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Lateral and Vertical Geochemical Dispersion into Deep Cover: 4D Landscape Geochemistry and Biogeochemistry of the Barrier Ranges

Charlotte Mitchell

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Abstract

The aim of this thesis is to determine the relative contribution of lateral, as opposed to vertical, dispersion of the geochemical signals of basement-hosted mineralisation in prospective geological provinces that are mantled by transported cover. The study focuses on three areas within and on the margins of, the highly-mineralised Broken Hill Block and the Barrier Ranges in western New South Wales.

Fowlers Creek overlies low-grade metasedimentary bedrock with no known mineralisation on the eastern margins of the Barrier Ranges. Stream sediments show a downstream decreasing trend in concentrations in both Pb and Zn with values decreasing by 50% over 7 km of creek. Lead and Ag values were less important along Fowlers Creek in terms of biogeochemical results, with concentrations at background levels Pb 0.27 ppm and Ag 3.04 ppb. Rather, elements of interest along Fowlers Creek included; Cs, Y, U, Co and Ni. These elements peaked at 2 distinct points along the creek, by an order of magnitude above background, at points where the local geology interrupts the flow of the stream base aquifer (SBA).

Pine Creek cross-cuts the partially exposed Pinnacles Pb-Zn-Ag mine. Stream sediment samples contain elevated concentrations of Pb, Zn and Ag (Pb 4.5x and Ag 3.5x background values observed along Fowlers and Umberumberka Creeks) for at least 4.5 km downstream of mineralisation. River red gum (RRG) leaves from trees within the creek provided the clearest delineation of the underlying mineralisation. Lead and Ag concentrations steadily increase toward mineralisation and reach concentrations 2.5 orders of magnitude above background immediately above mineralisation. Leaf samples collected after a severe El Niño event where the previous year's rainfall was 188 mm, had Pb and Ag concentrations 5 -10 times greater than samples from the same trees collected after a La Niña event where the previous year's rainfall was 605 mm. These results demonstrate that changes in available water plays on the SBA and the significant role it plays in diluting the resulting metal concentration within the trees and the importance of temporal variation.

Umberumberka Creek is underlain by high-grade metamorphic rocks with numerous small mineral occurrences. Umberumberka Creek discharges at the western margin of the Broken Hill Block as an alluvial fan system which extends at least 10 km onto the Mundi Mundi Plain. This area is underlain by prospective bedrock but is buried by up to 150 m of transported sediments. On the plains, stream sediment results reflected a catchment average that was carried 10 km onto the plains before values decreased. Silver results on the plains had a mean value of 30 ppb and are comparable to soil survey results obtained by an exploration company over an area of Pb-Ag-Zn mineralisation identified beneath 150+ m of cover, situated on the fan floodout boundaries of Umberumberka Creek. The biogeochemical results for Umberumberka Creek fall within the same range of values as Fowlers creek, suggesting that these values are the natural background range for RRG. Results from both the stream sediments and the RRG suggest that the soil survey results obtained on the plains most likely reflect lateral dispersion from the Broken Hill Block rather than a vertical signal from below.

For the Broken Hill Block lateral dispersion is kilometric (at least 10 km) in creeks and distributive depositional systems. The signal is diluted due to catchment averaging but can still be elevated above background thus obscuring potential vertically transported signal from bedrock. The RRG provide a mechanism to see vertically down to the basement at depths of 10s of meters (Pine Creek and to an extent along Fowlers Creek) but don't give a signal when the depth to the source is 100s of meters. For the exploration industry to be successful in areas of thick transported cover it becomes ever more important to step back from there anomalies and see where they sit within the bigger landscape picture and temporally within the exploration program.

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Charlotte Mitchell

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To my family, without you none of this would have happened. I know you never really got why

I wanted to do this (sometimes I wonder why myself) but you have supported me through it all in your own ways and let me get on with it and for that I am forever grateful. Thank you for your love and support and nodding along when I tried to explain something I was working on. To Elliot and Frances – I know you both thought I just spent all day watching YouTube videos (there were a few watched I'll admit) but I hope this shows you that I was actually doing something and maybe one day you'll even read my thesis.

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Chapter 1: Introduction

Landscapes dominated by transported regolith materials are one of the major mineral exploration frontiers largely because the geochemical characteristics of these materials have been moved laterally and cannot be easily linked to underlying substrate. As such, for many geochemical exploration programs, finding samples with elevated metal and trace element contents is less of a challenge then actually being able to account for the lateral migration of these materials and being able to relate them to geological sources.

A number of models exist that can account for the distribution of chemical elements within the cover sequence of a basin. Vertical movement within the cover can be split into two groups: 1. movement that occurs within the phreatic (saturated) zone; and, 2. movement that occurs within the vadose (unsaturated) zone (Aspandiar *et al*., 1998). Phreatic zone processes include advective processes including; groundwater flow, dilatancy pumping (along faults), convection and through bubbles, and chemical and electrochemical processes (Aspandiar *et al*, 1998). Within the vadose zone, migration of elements includes; capillary action, gaseous processes - diffusion, atmospheric pumping and convection, plant uptake and bioturbation (Aspandiar *et al*, 1998). Extensive descriptions of many of the process can be found in Aspandiar *et al*. (1998). Four further factors that affect dispersion includes; relief, current climate, Neoformation or accumulation of minerals and the nature of the overburden (Butt, 2005). The degree of relief, the nature of the current climate and the nature of the overburden all determine if physical or chemical weathering is going to be more prevalent in a landform, and to what minerals can form or accumulate in the area (Butt, 2005). A large contributor to lateral dispersion into the cover are alluvial processes as demonstrated in figure 1.1.

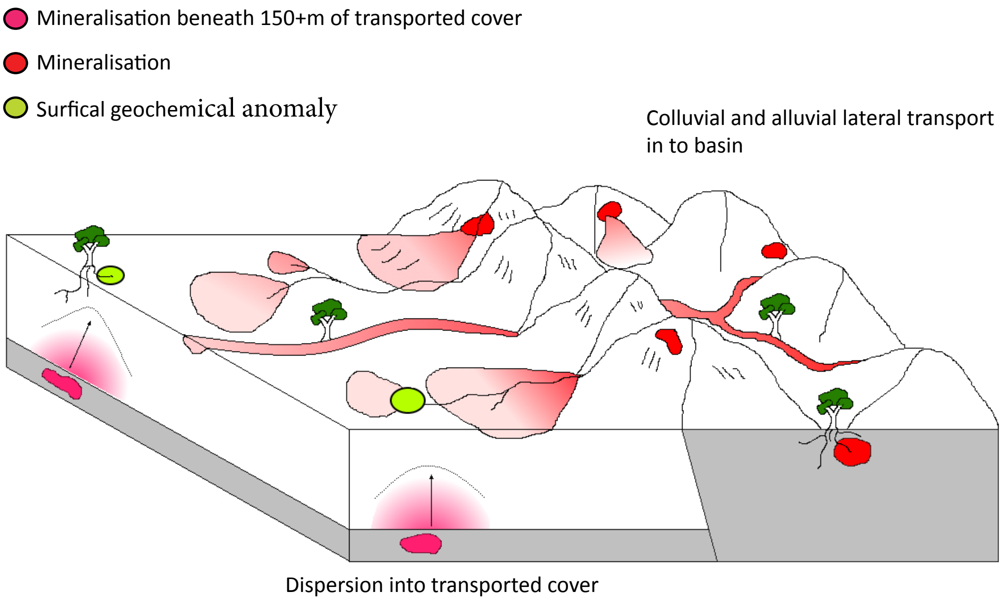

Figure 1.1: Schematic diagram demonstrating the different influences on the lateral transport of material in to cover sequences of a sedimentary basin and the interaction with underlying geology.

Much of Australia's prospective geology sits on the margins of basins with over 800+ metres of cover (Fig. 1.2), much of which is transported, with no reason as to why there should not be transport of mineralised materials into the basins. As such, as exploration moves into these regions of transported cover, we need to be able to reliably constrain and identify if the elements involved in the anomaly are a lateral representation of either a distal or proximal source or a vertical accumulation of a buried deposit. To understand this we need to look at a range of landscape settings, with differing spatial relationship to mineralisation and we need to sample as many of the potential sampling media as feasible.

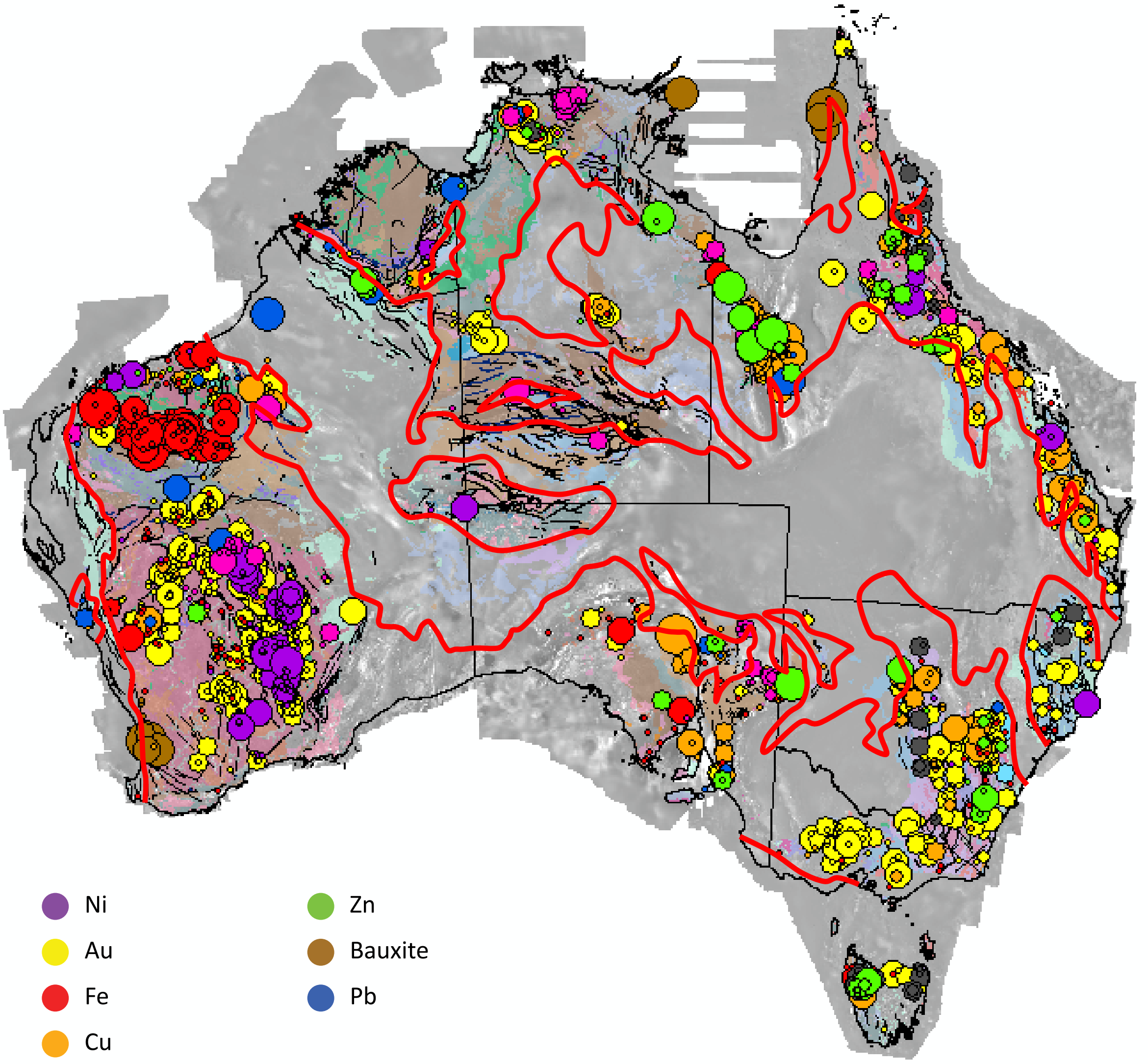

Figure 1.2: Many of Australia's mineralised and prospective regions sit on the margins of deep sedimentary basins with over 800 m depth to basement (red line). The varying dot size is representative of the varying deposit size. Image created in ArcMap by D. Giles, used with permission, not published.

The Barrier Ranges And The Broken Hill Region: A Case Study Of Elemental Dispersion

The Barrier Ranges and the Broken Hill region within provides a key example of the exploration frontier related to the tyranny of transport in the regolith geochemistry. Mineral exploration in Broken Hill has so far focused on areas of exposed or shallow buried bedrock, yet more than 90% of the prospective bedrock is covered by transported regolith. There have been few, or even arguably no, mineral exploration discoveries of discrete (i.e. not extensions of a previous discovery) buried Pb-Ag-Zn mineralisation from areas of transported regolith. As such if we wish to move mineral exploration into areas of transported cover we need to be able to reliably constrain the lateral dispersion pathways of the elements involved and be able to distinguish an anomaly that is proximal to its source from one that is a distal representation of a mineral system.

The geology of the Barrier Ranges can be split into 3 general groups; the Willyama Supergroup of the Broken Hill and Euriowie Blocks, the Adelaidean rocks that unconformably overlie the Willyama Supergroup, and the recent sedimentary basins. The Willyama Supergroup consists of a series of meta-sedimentary and meta-volcanic rocks that are Paleo-Mesoproterozoic, deposited in a back-arc environment as part of a rift zone on a thin crust (Stevens, 1988). Initial deformation was during the Olarian Orogeny (1600 – 1580Ma), followed by a hiatus in deposition until we reach the deposition of the Adelaidean sedimentary rocks (1100 Ma) which unconformably overlies the Willyama Supergroup (Stevens, 1988), both were later deformed during the Delamerian Orogeny (520-500 Ma). The Barrier Ranges and the Broken Hill Domain are flanked by depositional basins of Tertiary, some Mesozoic and Recent sedimentary transported cover.

The region is known for its numerous mineral occurrences, the most notable being that of the Broken Hill Pb-Ag-Zn deposit. As well as the main Line of Lode there are numerous locations across the Barrier Ranges where anomalous concentrations of Pb Zn Cu Au U and Ag are noted. The Broken Hill Domain consists of two main types of mineralisation; Broken Hill-type stratiform and Thackaringa-type vein deposits (Barnes, 1988). The Broken Hill-type Pb-Ag-Zn stratiform deposits are hosted within the Broken Hill Group metasediments, either psammite or psammopelite specifically within the quartz-gahnite and/or garnet-quartz-rich horizons. The mineralisation is hosted generally within galena, Fe-rich sphalerite and other minor sulfides (Barnes, 1988). Thackaringa-type Ag-Pb-Zn vein deposits are hosted by siderite-quartz+-calcite veins 0.1-1 m thick in fault or retrograde shear zones. Ore minerals include; argentiferous galena, sphalerite, chalcopyrite, pyrite, tetrahendrite and arsenopyrite. Little deformation to those outside the shear zones suggests that they developed late in the geological history of the Barrier Ranges (Barnes, 1988).

The Barrier Ranges and the Broken Hill Domain are an ideal location to develop and test the constraining of lateral dispersion, as the block has undergone an extensive erosive history with potentially mineralised bedrock eroded away, including the Broken Hill deposit, to be potentially redeposited within the surrounding basins (Plimer, 1982; Stevens, 1986).

Previous Work

Previous geochemical studies in the area (Fabris *et al*., 2009; Hedger and Dugmore, 2001; Tonui *et al*., 2003) around the Broken Hill region have identified areas of buried mineralisation beneath 150+m of transported cover using surface anomalies.

BHP Mineral Discovery, targeted Broken Hill style mineralisation beneath the Mundi Mundi Plains, through 150 m of transported cover at their “Polygonum” tenement, 40 km NW of Broken Hill (Hedger and Dugmore, 2001). Early drilling of a gravity survey response identified an area of mineralisation equivalent to that at Broken Hill. This was followed up with a series of soil geochemistry transects across the gravity response, with results showing relatively high Ag values (>44 ppb) directly over the gravity trend (Hedger and Dugmore, 2001). Follow up drilling of these sites identified further mineralisation but higher soil concentrations did not correspond with higher mineralisation grades (Hedger and Dugmore, 2001). Further soil work at the “Polygonum” tenement tested multiple analytical methods to determine the Ag concentration of soils overlying the previously identified mineralisation; variations within the results were interpreted to correspond with changes in the underlying lithology rather than changes in lateral source (Fabris *et al*., 2009).

PlatSearch NL’s “Thunderdome” prospect NW of Broken Hill, with Pb-Ag-Zn and Cu-Au mineralisation beneath 200 m of cover, was identified by drilling geophysical patterns (Tonui *et al*., 2003). Tonui *et al*., (2003) conducted a geochemical study of down-hole regolith samples from six drill holes, to examine the expression of mineralisation in the cover. Samples were analysed using XRD, Portable Infrared Mineral Analyser and XRF techniques. The sediment Pb-Ag-Zn and Cu-Au concentrations were interpreted to be linked to the underlying mineralisation.

What links these sites, other than the search for Broken Hill style mineralisation beneath 150+m of transported cover, is their position within the landscape. Both sites sit on the fringes of large fan systems and though researchers maintain that the anomalies are the result of vertical migration of metals through 150+m of cover, little consideration was given to the potential for laterally derived contributions. Previous geochemical exploration studies in the area have tended to downplay the potential of lateral dispersion from within the Broken Hill domain, yet significant evidence is available that suggest lateral transport plays a large role in the formation of such surface anomalies in the region (discussed in Chapter 4).

There are also a number of regional observations of high grade detrital minerals around Broken Hill, including garnets on the shoreline of Menindee Lakes 100 km south east of Broken Hill (Stevens, 1986). Charters (1982) identified several factors that suggested that the parent material of the Fowlers Gap (110 km north of Broken Hill) desert loam is largely transported. These factors included; similar morphologies across soils developed in different landscape setting and upon different lithologies, majority of the soil mineral suites are different from the local Fowlers Gap rocks and the area has only undergone low-grade metamorphism whereas the minerals present (amphiboles, epidote, garnet and biotite) are high-grade. This suggests that they were transported to the area from the south and the west from the high-grade Willyama Supergroup (Chartres, 1982a, b).

A number of existing studies have been conducted around the Broken Hill Block that have focused on the detection of shallowly buried mineralisation through transported cover using biogeochemical surveys. These are outlined below and highlighted in figure 1.3.

The Pinnacles mine is a Pb-Zn-Ag deposit 10 km south-west of Broken Hill and is the largest Broken Hill type deposit in the region outside the Broken Hill Line of Lode. The mine is within the catchment area of Pine Creek, a south flowing ephemeral creek system that flows along the eastern margin of the mine site, out into the Murray-Darling basin where it terminates in floodout fans and swamps (Hulme, 2008). Much of the catchment is dominated by depositional plains and erosional hills and rises, with the depositional plains being predominantly derived from transported material, in places up to 10 m thick (Hulme, 2008). River red gums (*Eucalyptus camaldulensis*) dominate the large drainage systems, while smaller tributaries are colonised by prickly wattle (*Acacia victorae*), with the depositional plains colonised by chenopod shrubland, dominantly Black Bluebush (*Maireana pyramidata*). In a pilot study conducted in 2001 (Hill, 2004) the leaves of *Eucalyptus camaldulensis* along Pine Creek, were sampled at 250 m spacing. Trees in close proximity to the mine had Pb concentrations 150x background level (background - BG - 2 ppm), Zn was 3x background (BG 33-57 ppm) and Ag 4.2x background values (BG 0.84 ppm)(Hulme, 2005). This was followed up by a more detailed study where all available trees along Pine Creek were sampled, as well as multiple organs from each tree. This was done to constrain the geochemical footprint. Hulme (2008), while sampling *Eucalyptus camaldulensis* along Pine Creek at the Pinnacles Pb-Zn mine, showed the extent of the metal dispersion plume downstream. High Pb concentrations (max: 411 ppm) were observed proximal to mineralisation with no downstream dispersion, while Zn exhibited high vales (max: 388 ppm) proximal to mineralisation as well as a distinct downstream pattern (Hulme, 2008). These results were expected due to the relative mobility of each metal, Pb low and Zn high. What was not expected was a secondary Zn high that was identified where Pine Creek joins a larger creek from the north-east, drilling of these anomalies failed to identify any underlying mineralisation, this was later believed to be the distal Zn footprint of the Broken Hill Line of Lode 10 km to the north-east (Hulme, 2008).

Another study along Pine Creek conducted by Dignam (2008) looked at using the Black bluebush (*Maireana pyramidata*) that grows around the mine site to develop an understanding of the geochemical expression of the buried mineralisation in the cover sequence. The study focused on the area east of the current mining activities, where there are numerous projections for mineralisation beneath the cover. Sampling was conducted along two transects (NE-SW and NW-SE) to include a previous survey in the area (Hill, 2004) with infill sampling to constrain any potential lateral dispersion (Dignam, 2008). Dignam noted high values of both Pb and Zn in the Black bluebush, Pb concentrations lay between 83-1279 ppm with a significant number of concentrations >400 ppm. While Zn ranged from 200-733 ppm with more than 10% of samples having a value greater than 300 ppm. Indium and Cd, accessory elements in sphalerite, where detected in all but 22 samples (of 121 samples). Indium ranged between 5-24 ppb and Cd 0.72-14.8 ppm. The In values are significant as they are not detected in the Eucalyptus camaldulensis, but are known indicator of Pb mineralisation (Dunn, 2007).

Stephens Creek is a major ephemeral drainage system that flows off of the ranges. With its headwaters north of Broken Hill within the Barrier Ranges, Stephens Creeks flows toward the south-east into the Murray-Darling Basin, where the creek terminates in the Menindee Lakes. The main sources of mineralisation in the catchment are the Broken Hill Line of Lode, the Yellowstone deposit (quartz – Fe sulfide) and the Flying Doctor deposit (Broken Hill type Pb-Zn-Ag), as well as many smaller mineral occurrences in the headwaters (e.g. Parnell deposit) (Dann, 2001). A River red gum and stream sediment geochemical survey along the length of Stephens Creek conducted by Dann (2001) sampled simultaneously at locations either proximal to known mineralisation or evenly distributed along the creek (approximately every 2 km upstream and every 5 km downstream) where possible at tributary junctions. The four elements selected for the purpose of the study, Pb Zn Cu and Ni, were selected on their relationship to the surrounding different types of mineralisation in the catchment. It was noted in river red gum leaves, all elements had elevated concentrations in the upper catchment above the Stephens Creek Reservoir (Dann , 2001). Both Pb and Cu concentrations were greater in river red gum samples in the upper catchment area with concentrations decreasing away from areas of known mineralisation, however, concentrations of Cu where also elevated in a tributary that flowed from an area of Pt-Cu-Ni occurrences. Zinc concentrations were more sporadic with high values in both the upper and lower sections of the creek. Nickel followed a similar pattern to Zn, with high concentrations recorded in the Murray-Darling Basin. Lead, Zn and Cu all exhibit similar trends in the stream sediments, with elevated concentrations above Stephens Creek Reservoir and downstream of the Parnell Pb-Zn-Ag deposit. Nickel concentrations are consistently higher around Mulga Springs Creek, likely reflecting the Mulga Springs-type Pt-Cu-Ni occurrence upstream (Dann, 2001).

The Flying Doctor prospect is 8 km NE of Broken Hill and is a part of the Northern Leases. The Broken Hill-type deposit is a part of the two main line of lodes (the upper and middle lodes) trending north-east. The Ag-Pb-Zn mineralisation is approximately 100 m below the surface. The area consists of saprock low hills and rises, alluvial channels and associated depositional plains and colluvial sheetflow deposits contributing to the 3 m of transported overburden (Hill *et al.*, 2005). River red gums grow along the major creek systems, with mainly open mulga (*Acacia aneura*) woodland on the hills and prickly wattle (*Acacia paradoxa*) in the valleys. The sheetflow deposits and plains are colonised by chenopod shrubland dominated by Black bluebush (*Maireana pyramidata)* and rock sida (*Sida petrofila*) (Hill *et al.*, 2005). Both plants and soils were sampled and analysed at this site by Hill *et al,* (2005). Two size fractions of the soil where analysed, 80-130 µm and <80 µm. As well as three plant species - black bluebush leaves, mulga phyllodes and prickly wattle phyllodes. Chemical analysis was conducted using X-ray fluorescence. Soil results where poor due to the dilution of samples (particularly the larger size fraction) by the addition of aeolian sediments (Hill *et al.*, 2005) . Lead however was an exception with high concentrations recognised in both size fractions directly over mineralisation (Hill *et al.*, 2005). More success was achieved with the biogeochemical survey. Lead was detected in all species with a marked increase directly over mineralisation. Copper and Zn both successfully identified areas of mineralisation using mulga and wattle. The mulga also picked up high Zn concentrations in the alluvium down slope from the mineralisation (Hill *et al.*, 2005).

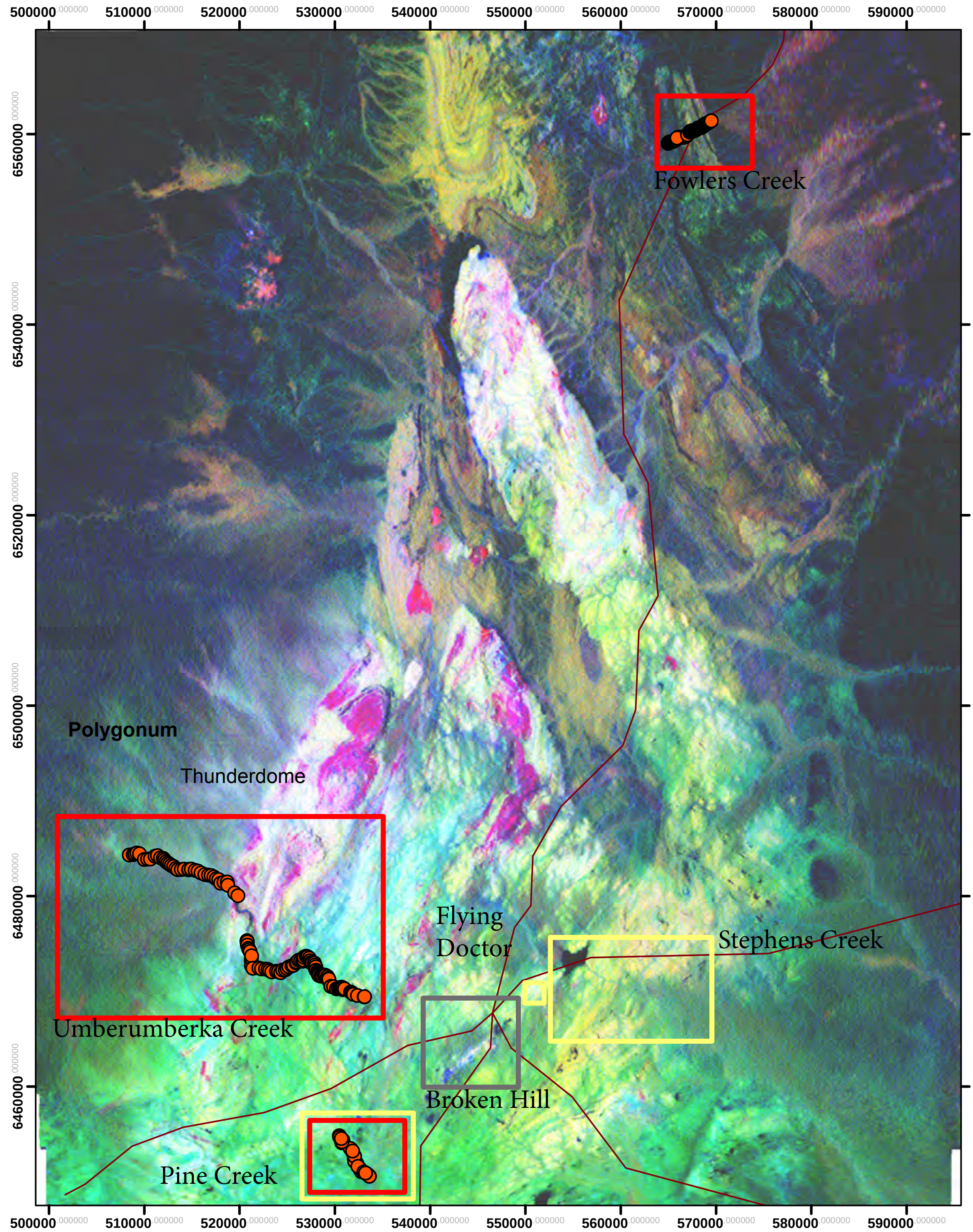

Figure 1.3: Radiometrics map for the Broken Hill region. Broken Hill is highlighted in grey, while previous works are highlighted in yellow. Case studies for this thesis are marked in red. Th = green, U = blue, K = red. Extensive lateral dispersion is shown away from the Broken Hill block into the surrounding basins. Base image from Minty *et al.*, 2009.

These studies showed that the river red gum (*Eucalyptus camaldulensis)* is an effective tool for mineral exploration within the Broken Hill region, being both able to take up the elements of interest but also in situations where the elements are either from a lateral source or are vertically derived. It also highlights the potential for further research into the capabilities of the trees for tools for exploration and constraining the lateral dispersion from the highly prospective Broken Hill block. Previous work locations are marked on figure 1.3.

Thesis Aims And Structure

The aim of this PhD study was to use the biogeochemistry and the geochemistry of the landscape and constrain the lateral and vertical dispersion in space and time – in 4 dimensions, from the Barrier Ranges and the Broken Hill Domain. This was done with a particular focus on the use of biogeochemistry, a means for mineral exploration that has been shown to effectively identify mineralisation within the Broken Hill Domain (referenced above) and other regions across Australia and around the globe (Cohen *et al*., 1998; Cohen *et al*., 1999; Dunn, 2007; Lintern, 2005; Reid *et al*., 2008; Stednick, 1987b, a). In addition to biogeochemical surveys, stream sediments surveys were conducted as a more "traditional" method for mineral exploration and to act as a baseline geochemistry in substitution to bedrock geochemistry and as a base to compare the biogeochemical surveys. Biogeochemical analysis of river red gum leaves (*Eucalyptus camaldulensis*) and stream sediments from 3 different ephemeral creek systems that drain 3 different terrain around the Barrier Ranges (Fig. 1.3) were conducted with the areas selected on a number of characteristics present in each location and outlined below. As such this thesis is split into 3 main chapters/case studies followed by a concluding chapter.

- Fowlers and Homestead Creek – A large catchment area over an area of low grade metasedimentary rocks with no know mineralisation underlying the majority of the creek system with only the very far reaches of Fowlers Creek overlapping the highly prospective northern Broken Hill Domain. It has an extensive fan system and drainage out into a large basin system. A large data set with bedrock geochemistry is available to develop a baseline/background for biogeochemistry and its ability of the trees to differentiate the subtle difference in the underlying bedrock from potentially transported anomalies. It allows us to further test the implication of landscape position on the biogeochemical response of the trees and the implication of pooling within the stream base aquifer. It also tests the influence of the proximal underlying bedrock on the geochemistry of the stream sediments.

- Pine Creek - A small catchment area with the substantial Pinnacles Pb-Ag-Zn mineralisation crossing the creek system. An existing data set that allows us to test the temporal variation on the biogeochemistry of a creek system and the effect of climatic phenomenon and temporal variation and the implications for mineral exploration programs

- Umberumberka Creek – A large catchment area covering high grade metamorphic rocks with substantial mineralisation and enriched geology within the catchment area and in the underlying geology of the Mundi Mundi Plains on to which the creek drains with an extensive fan system. It allows us to look at the influence of an enriched underlying geology, as well as numerous small occurrences of mineralisation, that sit within the catchment area of the creek and the numerous small tributaries that feed into Umberumberka Creek. There a re also a number of mineral exploration companies actively seeking and identifying mineral occurrences below 150+ m of transported cover at the end of the creek systems.

Chapter 2: Fowlers Creek - Implications Of Landscape Setting On The Biogeochemical Response Of *E. camaldulensis* And The Implications For Mineral Exploration

Foreword

The purpose of this chapter is to establish a baseline dataset for stream sediment geochemistry and *Eucalyptus camaldulensis* (river red gums) biogeochemistry in the Barrier Ranges. The catchment area is dominated by low-grade metasedimentary bedrock with no known mineral occurrences. Sampling in this catchment provides the opportunity to test the influence of underlying geology, landscape setting and stream morphology on the chemistry of stream sediments and *E. camaldulensis* leaves. A key outcome of this chapter is the importance of the role of the stream base aquifer and its interaction with the underlying geology in influencing the biogeochemistry of the *E. camaldulensis*. The background geochemistry and biogeochemistry established in this chapter provides context for Chapters 3 and 4, which deal with a mineralised catchment area and a catchment area of mineralisation distal to the creek and deep transported cover.

Bedrock samples and stream sediments were collected during the course of this PhD with the aid of fellow PhD students. The *E. camaldulensis* samples from along Fowlers and Homestead Creeks were collected by the author, Dr Steven Hill and undergraduate students during field camps run in the area in 2007 and 2008 and analysed within the following year. All subsequent treatment of the data including the sampling and analysis of the stream sediment and bedrock geochemistry was conducted by the author during PhD candidature.

Abstract

This study tests the effectiveness of a biogeochemical survey to delineate different bedrock lithologies that do not contain known mineralisation, and the impact that the landscape setting has on the biogeochemistry of *Eucalyptus camaldulensis* growing along ephemeral creek systems in far-western New South Wales, Australia.

We compared the biogeochemical results from *Eucalyptus camaldulensis* growing along creeks with differing catchment sizes with the geochemistry of stream sediments and the local bedrock occurrences. Elevated concentrations of U, Cs, Y Ni and Co with values between 1.5>2.5 standard deviations above their mean were measured in *E. camaldulensis* growing on quartzite bedrock. The biogeochemistry of the trees could be used to delineate quartzite sequences along the creeks. This, however, is interpreted to be mostly due to, the interplay of landscape setting and climate/rainfall influencing the biogeochemical response of the *E. camaldulensis* rather than the geochemistry of the underlying bedrock on which the trees grew. Climate, bedrock geochemistry and physical properties, landscape setting, and the physiological needs of the plant are all critical factors in this biogeochemical system.

In areas considered of little direct economic interest there is significant information that can be gained from a biogeochemical survey and the important influences of fundamental controls, such as landscape setting, on the results that can be further applied to surveys in a more focused mineral exploration setting, and shows value in regional baseline studies.

Introduction

Biogeochemistry and geobotany have been used throughout the world to map variations in elemental abundance and changes in the geology of the substrate (Dunn, 2007). Biogeochemical surveys have been most widely applied in agricultural settings but also for the purposes of mineral exploration. In these cases the aim is to identify zones of enrichment of a specific commodity or pathfinder elements within the substrate that may be many times greater than background concentrations. Relatively fewer, to no published, biogeochemical studies have been conducted in areas where there is no known mineralisation. These scenarios provide the opportunity to assess the biogeochemical response to 'background' chemical variations in the substrate, due to a combination of underlying geology and landscape setting changes. Such variations are important to understand for two reasons: 1) if our aim is to identify 'anomalies' for the purposes of mineral exploration, first we need to understand the nature of the background. How much variation is a result of geological or landscape factors that are not related to mineralisation? 2) The biogeochemistry may have the potential to map variations in the 'background' geology or landscape setting in their own right.

In this study we present a parallel assessment of riparian biogeochemistry of *Eucalyptus camaldulensis*, stream sediment and bedrock geochemistry from the Fowlers Creek drainage system at the eastern margin of the Broken Hill Block and Barrier Ranges in far western New South Wales, Australia. The Broken Hill Block contains numerous and diverse mineral occurrences, including the supergiant Broken Hill Pb-Zn-Ag deposit, hosted by Paleoproterozoic basement rocks. Elsewhere in the Broken Hill Block *E. camaldulensis* biogeochemistry has proven to be a useful sampling medium for mineral exploration, having been used to identify hitherto unknown extensions to mineralisation at the Pinnacles Pb-Zn-Ag deposit (Hulme, 2005; Hulme, 2008; Mitchell *et al*., 2015). In contrast to the Pinnacles case study, there is no known mineralisation within the Fowlers Creek catchment and the vast majority of the catchment is underlain by Neoproterozoic to Paleozoic sedimentary rocks that unconformably overlie the highly prospective Paleoproterozoic basement. The Fowlers Creek catchment therefore provides an opportunity to assess the relationship between *E. camaldulensis* biogeochemistry, its landscape setting, and the geochemistry of its bedrock and stream sediment substrates.

Background

Plants have been utilised by geologists as tools for mineral exploration in the related disciplines of geobotany and biogeochemistry. Both disciplines utilise the intimate relationship between plant physiology and the substrate on which the plants grow, in particular the different responses of individual plants and plant communities to variations in element concentrations within the substrate.

To survive and grow a tree must have access to water, light and the nutrients that are essential to its health. Elements are broadly classed as either essential nutrients or non-essential and can be passively or actively taken up by the plant as well as passively and actively excluded (Dunn, 2007). Elements such as Al, Cu and Zn are all essential to plant health and actively taken up by roots, while elements such as U, Pb and Ag are considered non-essential trace elements and are passively taken up by the plants (Dunn, 2007).

Geobotany is the processes of recognising communities or individual species of plants that are endemic to, or preferentially grown over, a certain substrate (Dunn, 2007). This may be because a particular rock type provides more essential nutrients than another, or because a particular plant is better able to tolerate varying concentrations of non-essential and potentially harmful elements. Plants that grow preferentially in areas where the substrate is enriched in specific metals are referred to as "indicator plants". Indicator plants are often associated with trace metals that are deleterious to plant life in elevated concentrations (e.g. Cu, Co & Ni).

These plants have a high tolerance for the trace metal of interest, typically having evolved a biological mechanism to either accumulate high levels of the metal within their tissue without harm or to actively exclude the metals at the root (Dunn, 2007).

Biogeochemistry involves the chemical analysis of carefully sampled plant material (specific species and organs), in a structured survey across an area of interest. There is no requirement for the chosen species to be an indicator plant. It is desirable that the plant is able to accumulate the element of interest in concentrations that reflect the chemistry of the substrate, rather than the biological requirements of the plant. Variations in the data, if interpreted in the proper context of plant physiology and interaction with the environment, have the potential to reflect changes in the underlying substrate and thus have potential for mineral exploration and geological mapping.

The aim of this study is to demonstrate the influence of the local bedrock geology on the biogeochemistry of *E. camaldulensis* growing along Fowlers Creek and Homestead Creek. More specifically it tests whether the geochemistry of the underlying low grade metasediment lithologies is reflected in the biogeochemistry of the trees, or instead, if the trees are more reflective of the changes related to the physical properties of the rocks and therefore their influence on the landscape. It aims to understand how geology influences the biogeochemistry of the *E. camaldulensis* by controlling the flow pathway of the stream base aquifer (that from which the trees dominantly obtain their water in arid zones) and the run-off into the creek. We collected bedrock and stream sediment samples from along Fowlers Creek and vegetation samples from along both Fowlers Creek and Homestead Creek (a tributary to Fowlers Creek). Bedrock samples were collected to provide a "baseline" geochemistry on which to compare the biogeochemical results, while the stream sediments are a strong representation of the physical component of lateral dispersion mechanisms within the creek system as well as chemical dispersion.

Study Area

Fowlers Gap is an arid-zone research station approximately 110 km north of Broken Hill in far western New South Wales, Australia (Fig. 2.1). The Fowlers Gap station, encompassing much of the Fowlers Creek and all of the Homestead Creek catchments, was used as pastoral land between 1864 and 1952. During that period the land was at times severely over grazed and much of the natural vegetation cover was reduced due to high stock numbers, feral rabbits and the resulting soil erosion (Mabbutt, 1973). Fowlers Gap was granted to the New South Wales Conservation Authority in 1952 and subsequently the lease was taken over by the University of New South Wales in 1966 for arid zone research. The area is still used for grazing sheep, with native vegetation slowly being restored.

The Fowlers Creek Catchment

Fowlers Creek hosts ephemeral flow from SW-NE, while its tributary, Homestead Creek, flows ephemerally from NW-SE, (Fig. 2.2). The Fowlers Creek catchment is a dendritic system covering 434 km^2 and draining toward the Lake Bancannia plains to the northeast. Homestead Creek is a tributary of the Fowlers Creek system with a catchment area of 30 km^2. Homestead Creek drains toward the southeast and meets the main channel of Fowlers Creek adjacent to the homestead and offices of the Fowlers Gap Arid Zone Research Station. The Caloola Syncline imparts a strong landscape control on the area (Fig. 2.2). The Neoproterozoic Faraway Hills Quartzite is folded by the syncline and defines a prominent ridge line around the station (Beavis, 1984; Sullivan, 1972). Fowlers Creek transects these two limbs of folded quartzite and associated topographic ridges, which thereby defines the 'gap' of Fowlers Gap. This 'gap' has long been exploited by transport routes, such as the Silver City Highway, for travellers northwards of Broken Hill.

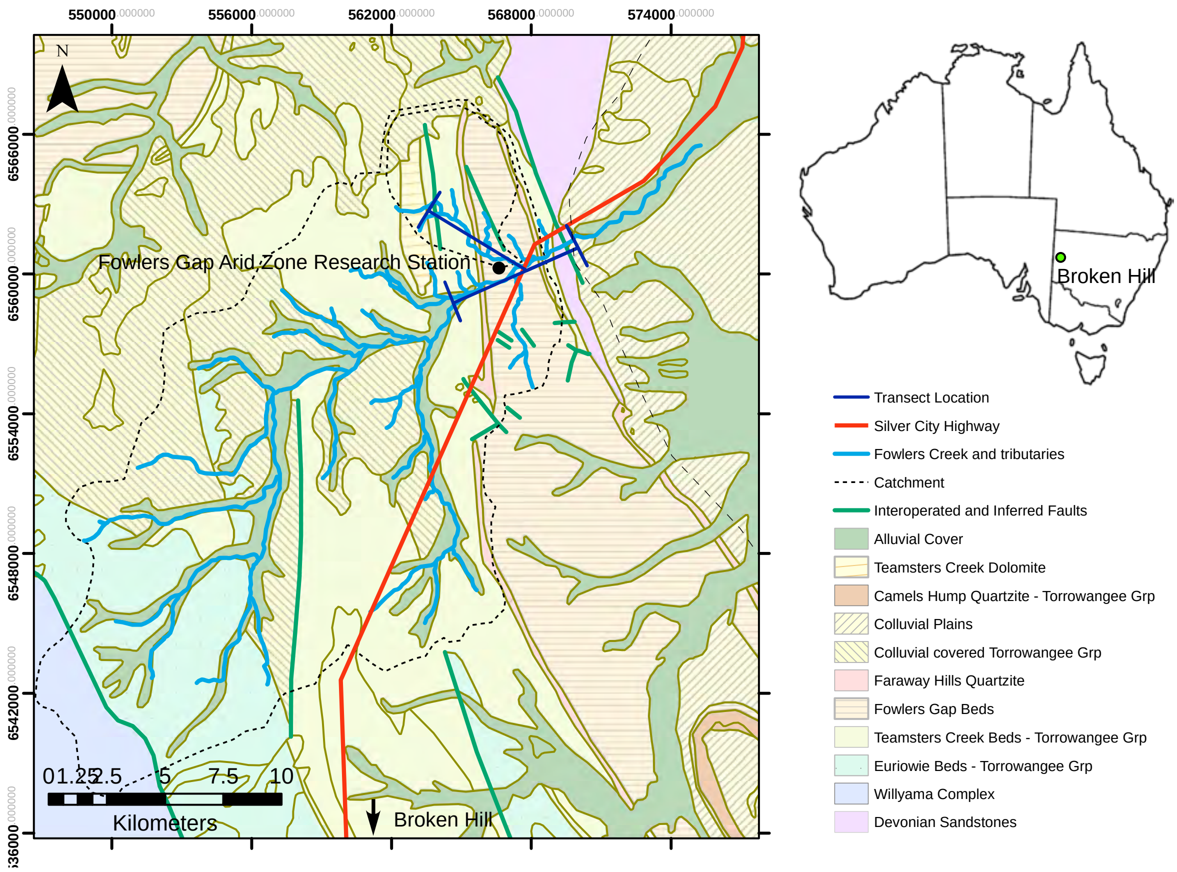

Figure 2.1: Fowlers Gap is situated approximately 110 km north of Broken Hill in far western NSW. Highlighted in the map is the main lithological and regolith changes in the area with Fowlers Creek and its tributaries. Map adapted from Cooper *et al.*, (1975).

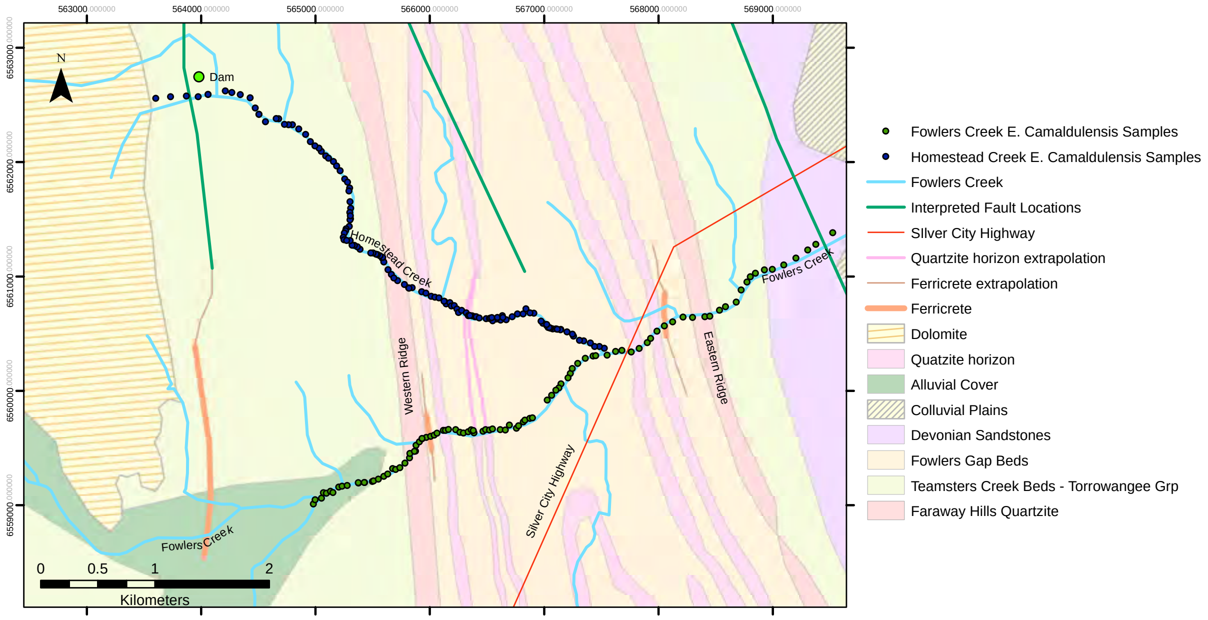

Figure 2.2: A closer view of the geology of the Caloola Syncline, Fowlers Gap. Ferricrete and quartzite horizons are extrapolated from single point occurrences, aerial images and adaptation from Mabbutt (1973).

The drainage system has three distinct sections within the study area; i) the headwater section to the west of the "Caloola Syncline", ii) the central "trunk" section enclosed between the two prominent quartzite ridges within the Caloola Syncline, and iii) the downstream section to the east of the Caloola Syncline (Wakelin-King, 2007) . The headwaters of Fowlers Creek have subdued relief of mostly sheetwash plains and low rises, where the channel is 20-50 m wide with a cobble- to sand-sized bedload (Dunkerley, 2014). Stream banks are colonised by chenopod shrubland (*Maireana spp., Atriplex spp., Sclerolaena spp. and Xanthium spp.*) (Hill and Roach, 2008a) and sparse riparian *E. camaldulensis* further back upstream into the catchment area (Wakelin-King 2007) . Run-off into the central part of the Fowlers Creek is mostly controlled by the quartzite ridge line that funnels water (and sediments) into the trunk of the creek within the Caloola Syncline. In this section the creek becomes narrower, anabranching and has scoured deeper in places forming flow chutes 4-11 m wide (Dunkerley, 2014). Additional input from Homestead Creek, which cuts through the same geology as Fowlers Creek, occurs in this section (Fig. 2.2). East of the Caloola Syncline, Fowlers Creek drains onto the Lake Bancannia Plains eventually becoming meandering and braided in floodouts before dissipating into the plains (Wakelin-King, 2007).

Homestead Creek is incised into reworked aeolian and sheetflow sediments and is typically incised to bedrock as it also transects the Caloola Syncline and the same bedrock lithologies as Fowlers Creek. It has a thin gravely bed in the upper catchment becoming deeper with thickening beds of dominantly coarse sands to the confluence with Homestead Creek (Dunkerley, 1999). Its upper section has been impeded by the construction of Freislich Dam, used as part of the water supply for Fowlers Gap Arid Zone Research Station.

Bedrock Geology

Regionally, the bedrock geology consists of folded, low-grade metamorphic Neoproterozoic sedimentary rocks, unconformably overlying Paleoproterozoic metamorphic rocks of the Broken Hill Block to the west. To the east the Neoproterozoic sedimentary rocks are unconformably overlain by Paleozoic (Devonian) sedimentary rocks.

The landscape of Fowlers Gap is strongly controlled by the Caloola Syncline (Fig. 2.2.) The Caloola Syncline is expressed by its eastern and western limbs that form the prominent ridge line around the station. The highest part of the ridge consists of the Neoproterozoic Faraway Hills Quartzite, a medium grained metamorphosed orthoquartzite (Beavis, 1984; Sullivan, 1972). Between the flanks of the ridges the geology is a repeated sequence of the Fowlers Gap Formation, an interbedded quartzite and shale sequence with limestone lenses (Beavis, 1984; Sullivan, 1972). To the west of the ridge line is the Teamsters Creek sub-group, a dominantly grey-green quartz vein shale with limestone lenses. Much of the Teamsters Creek sub-group is obscured by Quaternary cover. East of the syncline, the Teamsters Creek sub-group is repeated and is locally intruded by basalt sills and then unconformably overlain by Upper Devonian shales and quartzose sandstones. The Devonian sediments are unconformably overlain by Cretaceous sediments (Beavis, 1984; Gibson, 2003; Sullivan, 1972); of the Eromanga Basin that have been locally silicified and locally reworked and re-silicified in Tertiary fluvial sediments.

Regolith

The regolith-landforms of the Fowlers Gap area are strongly controlled by the resistant bedrock lithologies (e.g. quartzite) and the contemporary creeks that have incised across the area. The Faraway Hills Quartzite forms dominant ridge lines through the center of the field area while the lesser quartzite and limestone lenses form minor ridges and rises within the syncline and contribute significantly to the colluvial lag. Areas of greater erosion are generally underlain by shale and form a number of drainage depressions. To the east of the syncline, Fowlers Creek flows over Devonian sandstones and conglomerates and out onto the Lake Bancannia

Plains. Fowlers Creek has a large upland catchment area approximately 434 km^2 (Dunkerley, 1992) which covers an extensive range of underlying lithologies from the highly metamorphosed Mesoproterozoic Broken Hill Block/Willyama Supergroup in the far west and the Euriowie Block. Homestead Creek has a much smaller, more deeply incised, catchment area of approximately 30 km^2 (Dunkerley, 1999; Hill and Roach, 2007, 2008a, b).

Climate

Fowlers Gap is within the arid region of Australia (Bell, 1972). The climate is generally hot and dry during the summer with cool winters, and while there is no distinct rainfall pattern (Bell, 1972), summers tend to be wetter than winter, yet large but infrequent rainfall events can occur at any time of year (Dunkerley, 2013). The average annual rainfall for the area is 215 mm, with average summer temperatures being 34.6°C and winter temperatures being around 17.8°C (Bureau of Meteorology, 2014). Our study used data from biogeochemical sampling in mid-2007 (Fowlers Creek) and mid-2008 (Homestead Creek) and stream sediments and rock sampling were in late-2012. Rainfall in the year prior to the mid-2007 biogeochemical sampling was well below the area's annual average rainfall at 103 mm, while total rainfall to the mid-2008 biogeochemical sampling from the previous sampling was also below the average with 135.8 mm, while prior to the stream sediment sampling the area had experienced almost three years of higher-than-average rainfall (2010 – 522.8 mm, 2011 – 526.2 mm & 2012-Nov – 317 mm).

Field and Laboratory Methods

Bedrock Geochemistry

Bedrock samples were sampled opportunistically along Fowlers Creek and throughout the study area for whole-rock geochemical analysis. Samples were washed and sorted in the laboratory then sent to ACME Laboratories, Vancouver, Canada, where 1 kg of sample was crushed to 80% passing 10 mesh, from which a 250 g split was pulverised to 85% passing 200 mesh. Bedrock samples were analysed by using X-Ray Fluorescence (XRF) analysis (major elements) and Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) analysis (trace element) for a 45 element suite. Samples undergo $LiBO_2$ fusion prior to XRF analysis, while samples for ICP-MS analysis undergo a lithium metaborate/tetraborate fusion and a separate Aqua Regia HNO_3 digestion prior to analysis. Full suite of elements and their detection limits can be found in appendix 3.

Stream Sediment Geochemistry

Stream sediments were collected in late 2012 along Fowlers Creek. Samples were collected every 200-250 m adjacent to the *E. camaldulensis* samples to maintain spatial comparability between the two media. Approximately 2 kg of sediment was coarse sieved and collected in field focusing on the fine fraction, with samples stored in plastic sample bags. The samples were dried at 60°C for 12 hours (when needed) and sieved further in the laboratory to retain the <75µm fraction. Samples were sent to ACME Laboratories, Canada, where they were analysed using XRF analysis (major elements) and ICP-MS analysis (trace element) for a 45 element suite, samples undergo the same fusion and digestion procedures as the bedrock samples. Full suite of elements and their detection limits can be found in appendix 3.

Eucalyptus camaldulensis Biogeochemistry

Eucalyptus camaldulensis leaves were sampled and analysed for this study because they are available at all times of the year and previous studies have shown that they provide the best distinction between background and mineralised settings (Hill, 2009). Leaf samples were collected in mid-2007 (Fowlers Creek) and mid-2008 (Homestead Creek) by hand (wearing powder-free latex gloves, jewellery free and clean of chemicals such as sunscreen to systematically minimise contamination), selecting samples from a uniform canopy crown height of between one and two meters (Dunn, 2007) and from areas with minimal dust contamination (e.g. away from roads/tracks, mine/drill sites and livestock water and feed stations). Samples were taken from around the tree canopy circumference as much as possible (which varies for trees with irregular canopies) approximately 1-2 m above ground level. Once collected, the samples were stored in brown paper bags to dry out and to also prevent sweating and decomposition of samples. Bag openings were folded over, rather than stapled or pinned as this could be a potential source of metal contamination. Samples were dried within bags in an oven at 60° C for 48 hours. Samples were then ground/milled using an electric stainless-steel coffee grinder. The grinder was cleaned with ethanol, pre-contaminated with the next sample then cleaned again with ethanol between samples, at the University of Adelaide Mawson Laboratories to produce homogenised samples to be sent to a commercial laboratory for analysis.

All samples (2007 and 2008) were submitted to ACME Laboratories in Vancouver, Canada for processing and analysis. Preparation included further drying and milling to <100 mesh. The samples were not ashed. At ACME Laboratories, 0.5 g aliquots of sample were digested by HNO3 and modified aqua regia and analysed for a 53-element suite by ICP-MS.

QA/QC

Quality assurance and control (QA/QC) were monitored by submitting blind sample duplicates to the laboratory of milled samples (1 in 10 duplication). The laboratory also analysed internal reference materials STD V14 and V16 sample blanks and duplicates that we also used for QA/QC checks. The average pulp duplicates percentage error for Fowlers Creek were: Y 6.82%, Cs 2.47%, Co 4.82% and Ni 0.09%. The duplicate percentage error for the standard STD V14 was: Y 2.14%, Cs 6.45%, Co 3.04% and Ni 3.08%.

The average pulp duplicates percentage error for Homestead Creek were: Y 7.03%, Cs 0.63%, Co 18.3%and Ni 2.18%. The duplicate percentage error for the standard STD V14 for Homestead Creek was: Y 1.27%, Cs 2.15%, Co 3.88% and Ni 2.75%, and for standard STD V16: Y 3.1%, Cs 1.17%, Co 13.4% and Ni 16.9%.

In all sample duplicates and laboratory standards, U tested at or below detection limit (0.01 ppm) for ICP-MS at the time of testing making it difficult to calculate a pulp duplicate percentage error. As a result U values should be considered semi-quantitative, however, the difference between values are “large” and therefore this would not change our interpretation of the results. For Fowlers Creek all duplicate errors for the elements of interest are below 7% in samples and standards. For Homestead Creek the average duplicate percentage error in all samples plus standards was below 8% with the exception of Co in the sample duplicates and Co and Ni in standard STD V16.

Results

Of the elements analysed those that are of particular interest are those that are elevated within the biogeochemical samples, including U, Co, Cs, Y and Ni, plus Na and Au. Where results fall below detection limit they are reported at half-detection level (detection limits can be found in appendix 3.

Biogeochemistry - Fowlers Creek & Homestead Creek

Measures of dust contamination

In the nature of biogeochemical survey there lies the potential for wind-blown dust contamination. Hence, it is possible that if there is dust it may be influencing the results through diluting or contributing the sample chemistry. Samples were therefore tested for the potential for dust contamination by comparing the Zr content with Cs and Y (often found in dust) and Co (not expected to be strongly related to dust in the area) as well as the U and Ni. Strong

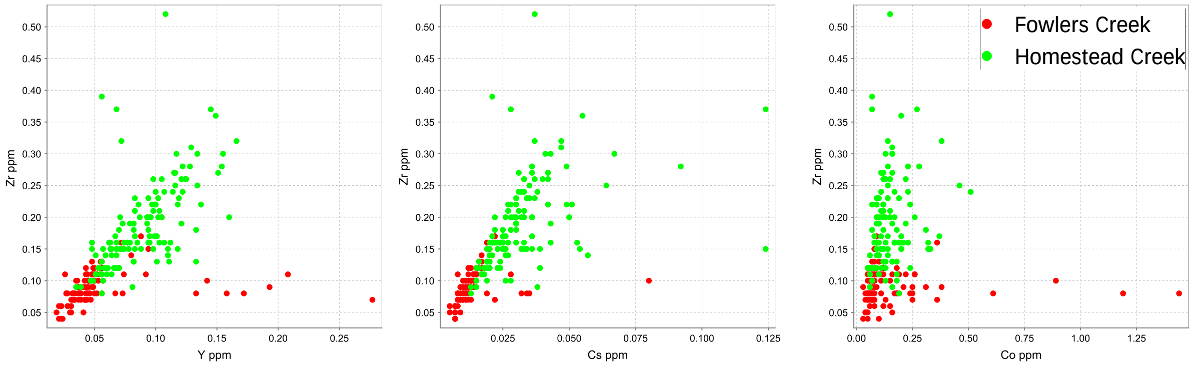

Figure 2.3: Dust contamination of the *E. camaldulensis* biogeochemical samples was determined by looking at the correlation between Cs, Y (both of which are often found in dust) and Co (not expected to be found in the dust at this location) vs Zr (a common comment of dust). To eliminate the influence of dust from the samples collected along Homestead Creek, samples were dust made a significant difference to the biogeochemistry, samples were normalised to Zr.

positive correlations were recorded in the Cs and Y with Zr (Fig. 2.3) while with Co there was only a slight correlation with Zr in the Homestead Creek samples. While the biogeochemical samples collected along Fowlers Creek showed little effect of dust contamination the samples from along Homestead Creek showed significant dust contamination. As such it was decided to normalise Cs, Co and Y to Zr to reduce the effect of dust. Zirconium was used as an indicator for dust contamination as its concentration in dust typically far exceeds that of biological material and was measured above analytical detection levels in the Homestead Creek samples.

Distribution of elements

The *E. camaldulensis* data along both Fowlers Creek and Homestead Creek is presented as log normalised of the combined data sets as shown in the histograms and split probability plots in figure 2.4. Combined summary statistics for Fowlers and Homestead Creeks are given in Table 2.1, with separate data for each creek found in table 2.2 (Fowlers Creek) and table 2.3 (Homestead Creek).

For the majority of elements in the analytical suite there is minimal variation between *E. camaldulensis* leaf samples collected along Fowlers Creek. The largest variation between samples occurs for U, Co, Cs, Y, Ni (Fig. 2.5 a-e) and Na (Fig. 2.6). Concentrations for U, Cs and Y do not fluctuate along the length of the creek except at two main points (~1-1.25 km and ~3.5-3.75 km along the creek) (Fig. 2.5 a-e). Nickel, Co and Na are also have higher concentrations at these locations but other samples also have fluctuation in concentrations between the two.

There is a larger variation in the biogeochemical results of the *E. camaldulensis* leaf samples along Homestead Creek than in the samples from Fowlers Creek. Some of this variation can be accounted for by dust contamination and results have been normalised to Zr to account for some of this. While a number of other elements are elevated along Homestead Creek, the interpretation of the biogeochemistry was restricted to the elements that recorded elevated values along Fowlers Creek. Similar spatial connected peaks in U, Co, Cs, Y and Ni also occur along Homestead Creek (Fig. 2.5 a-e). Gold within the *E. camaldulensis* samples from along both creek systems, are of interest in relation to identifying structural changes in the underlying geology (Fig. 2.7).

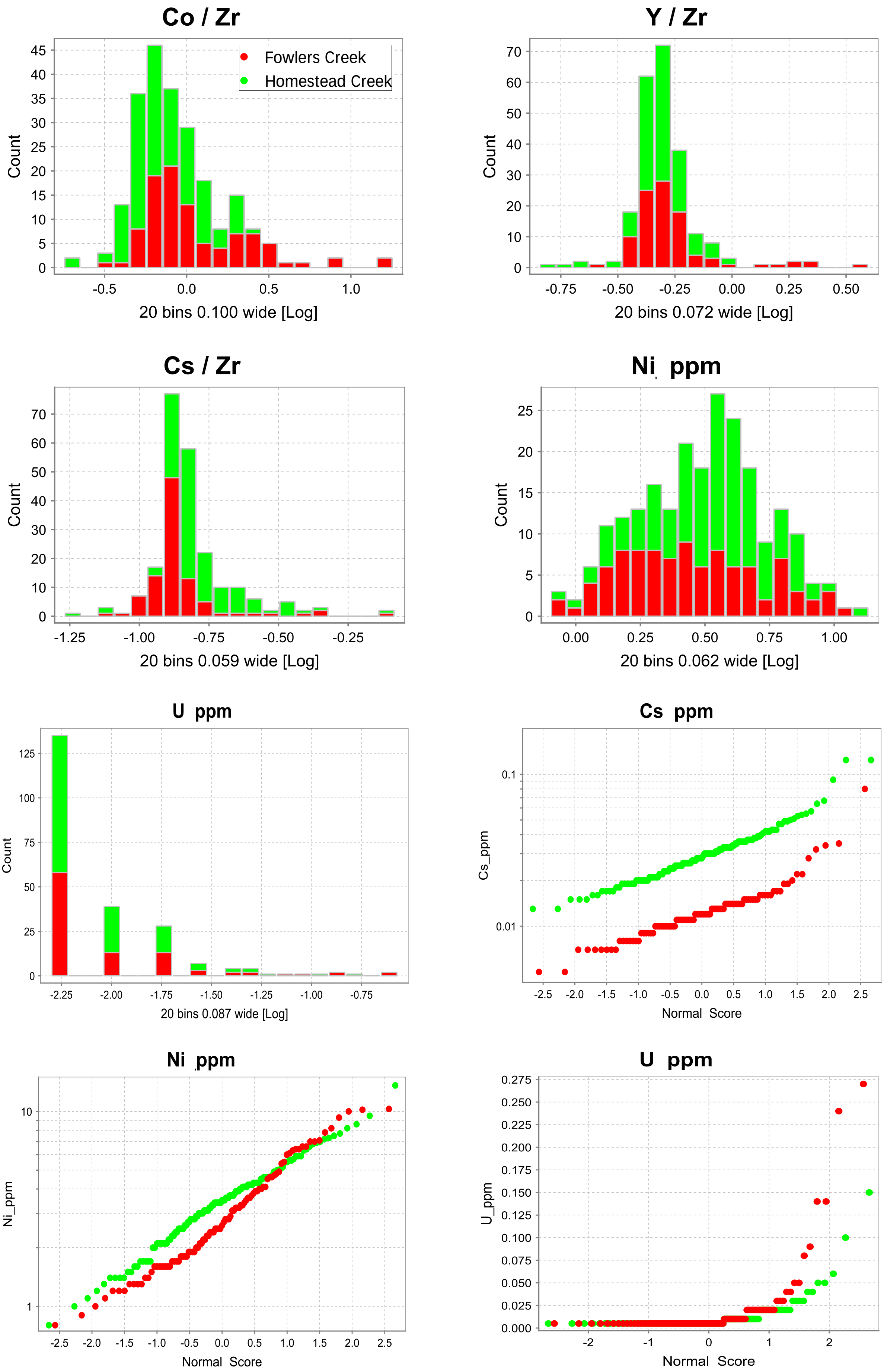

Figure 2.4: *Eucalyptus camaldulensis* logged histogram plots and split probability plots for Fowlers and Homestead Creeks, demonstrating the significant differences that occur with different elements along the two creek systems.

Table 2.1. Combined statistical data for *E. camaldulensis* growing along Fowlers and Homestead Creek.

E. camaldulensis	**Y / Zr**	**Cs / Zr**	**Co / Zr**	**U ppm**	**Ni ppm**	**Au ppb**	**Na pct**
Count Numeric	226	226	226	226	226	226	226
Minimum	0.144	0.054	0.179	0.005	0.800	0.100	0.002
Maximum	3.957	0.827	18.000	0.270	13.600	10.200	0.413
Mean	0.550	0.165	1.214	0.015	3.614	0.243	0.075
Median	0.480	0.144	0.750	0.005	3.200	0.100	0.043
Standard Deviation	0.343	0.086	1.755	0.030	2.077	0.789	0.087
Range	3.814	0.773	17.821	0.265	12.800	10.100	0.411

Table 2.2: Summary statistics for *E. camaldulensis* growing along Fowlers Creek.

E. camaldulensis Fowlers Creek	**Y / Zr**	**Cs / Zr**	**Co / Zr**	**U ppm**	**Ni ppm**	**Au ppb**	**Na pct**
Count Numeric	97	97	97	97	97	97	97
Minimum	0.236	0.073	0.333	0.005	0.800	0.100	0.005
Maximum	3.957	0.800	18.0	0.270	10.300	0.600	0.413
Mean	0.621	0.150	1.717	0.020	3.392	0.164	0.080
Median	0.486	0.130	0.875	0.005	2.600	0.100	0.044
Standard Deviation	0.495	0.089	2.547	0.042	2.234	0.098	0.091
Range	3.721	0.727	17.667	0.265	9.500	0.500	0.408

Table 2.3: Summary statistics for *E. camaldulensis* growing along Homestead Creek.

E. camaldulensis Homestead Creek	**Y / Zr**	**Cs / Zr**	**Co / Zr**	**U ppm**	**Ni ppm**	**Au ppb**	**Na pct**
Count Numeric	129	129	129	129	129	129	129
Minimum	0.144	0.054	0.179	0.005	0.800	0.100	0.002
Maximum	1.023	0.827	2.375	0.150	13.600	10.200	0.369
Mean	0.497	0.176	0.836	0.012	3.781	0.302	0.071
Median	0.480	0.155	0.667	0.005	3.500	0.100	0.040
Standard Deviation	0.129	0.083	0.459	0.018	1.943	1.039	0.083
Range	0.879	0.773	2.196	0.145	12.800	10.100	0.367

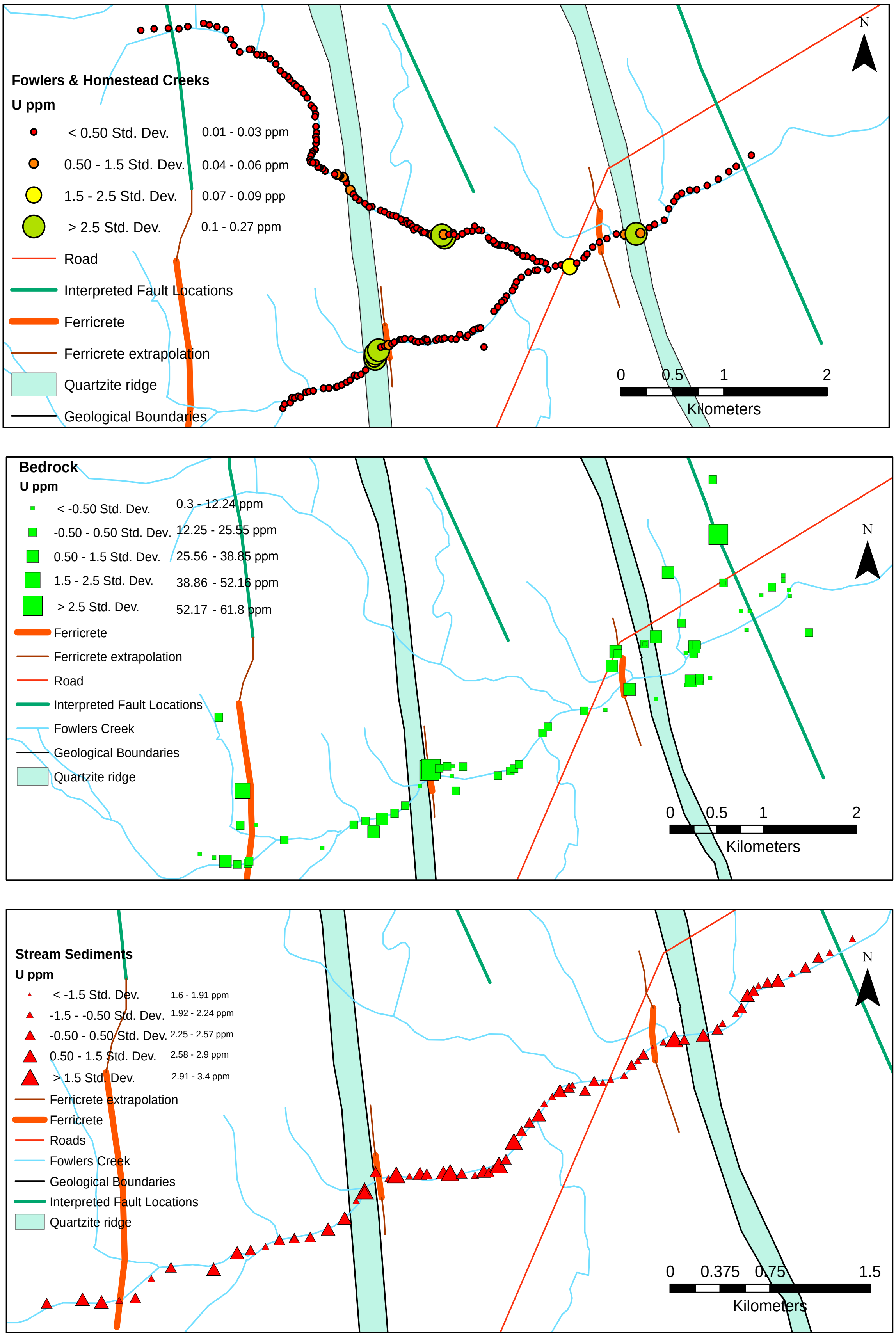

Figure 2.5a: *Eucalyptus camaldulensis* leaf samples collected along Fowlers Creek along with stream sediment and whole-rock geochemistry. Data is presented as standard deviations followed by the range in concentration for each division.

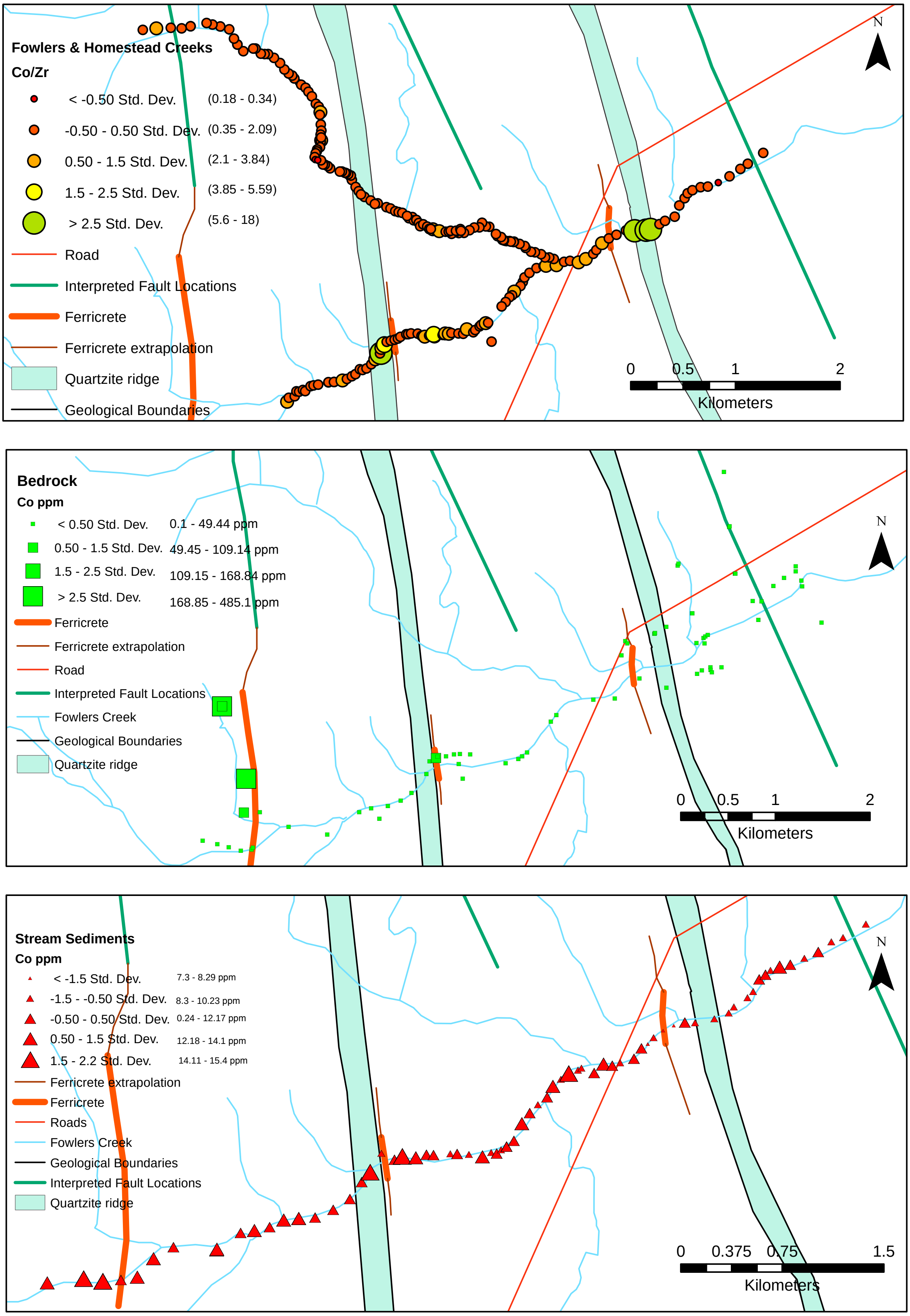

Figure 2.5b: *Eucalyptus camaldulensis* leaf samples collected along Fowlers Creek along with stream sediment and whole-rock geochemistry. Cobalt values have been normalised to Zr for biogeochemical samples. Data is presented as standard deviations followed by the range in concentration for each division.

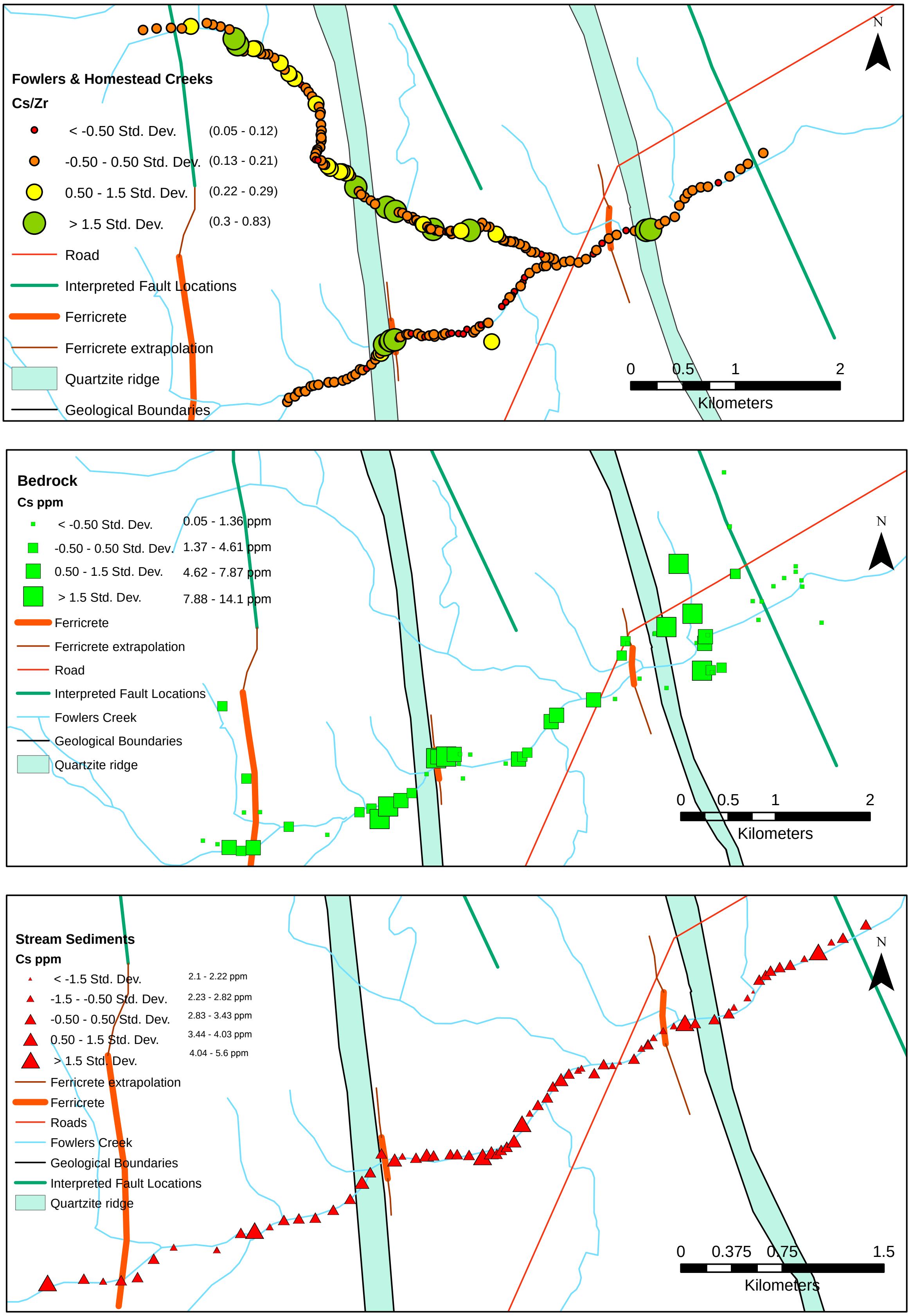

Figure 2.5c: *Eucalyptus camaldulensis* leaf samples collected along Fowlers Creek along with stream sediment and whole-rock geochemistry. Caesium values have been normalised to Zr for biogeochemical samples. Data is presented as standard deviations followed by the range in concentration for each division.

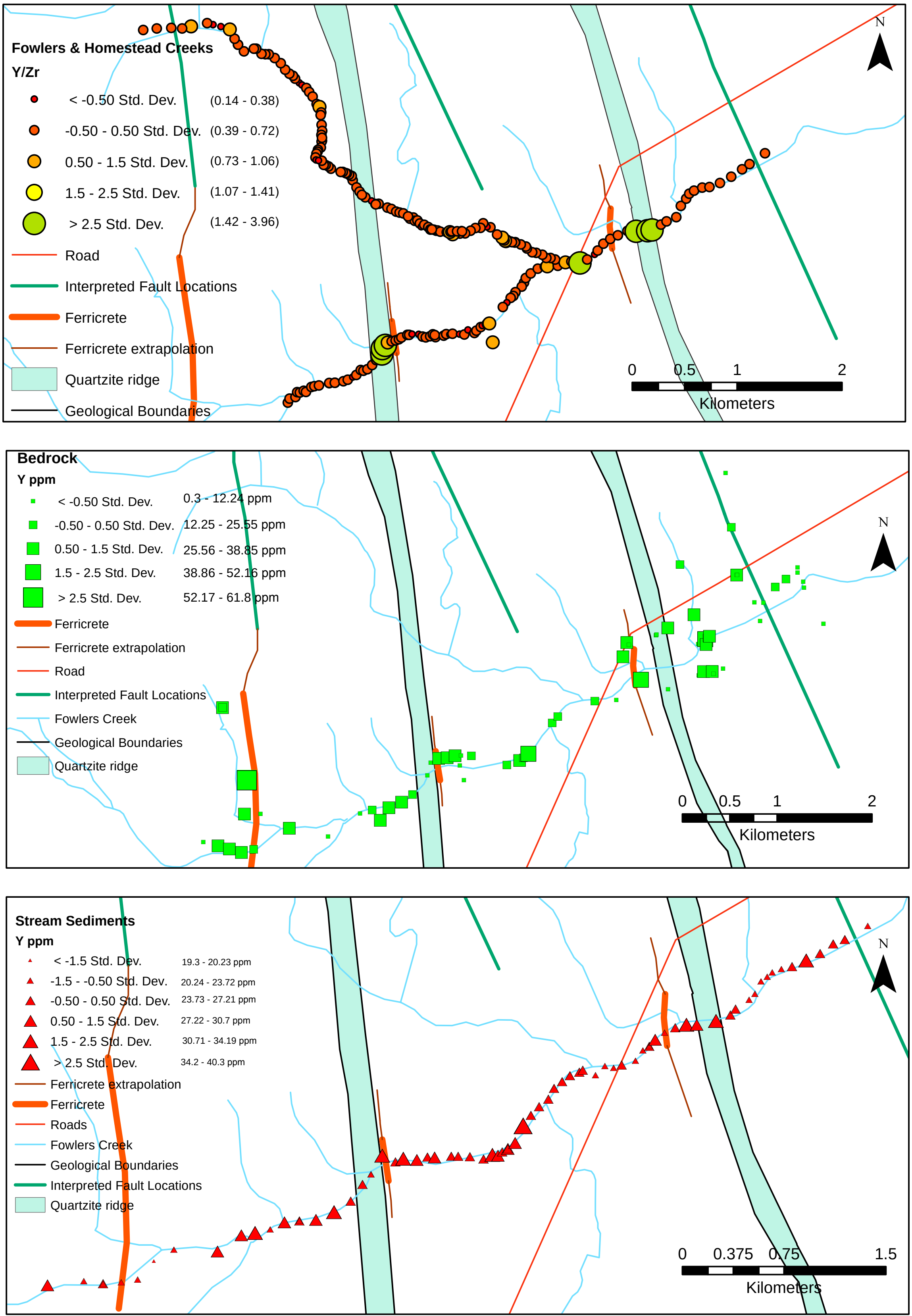

Figure 2.5d: *Eucalyptus camaldulensis* leaf samples collected along Fowlers Creek along with stream sediment and whole-rock geochemistry. Yttrium values have been normalised to Zr for biogeochemical samples. Data is presented as standard deviations followed by the range in concentration for each division.

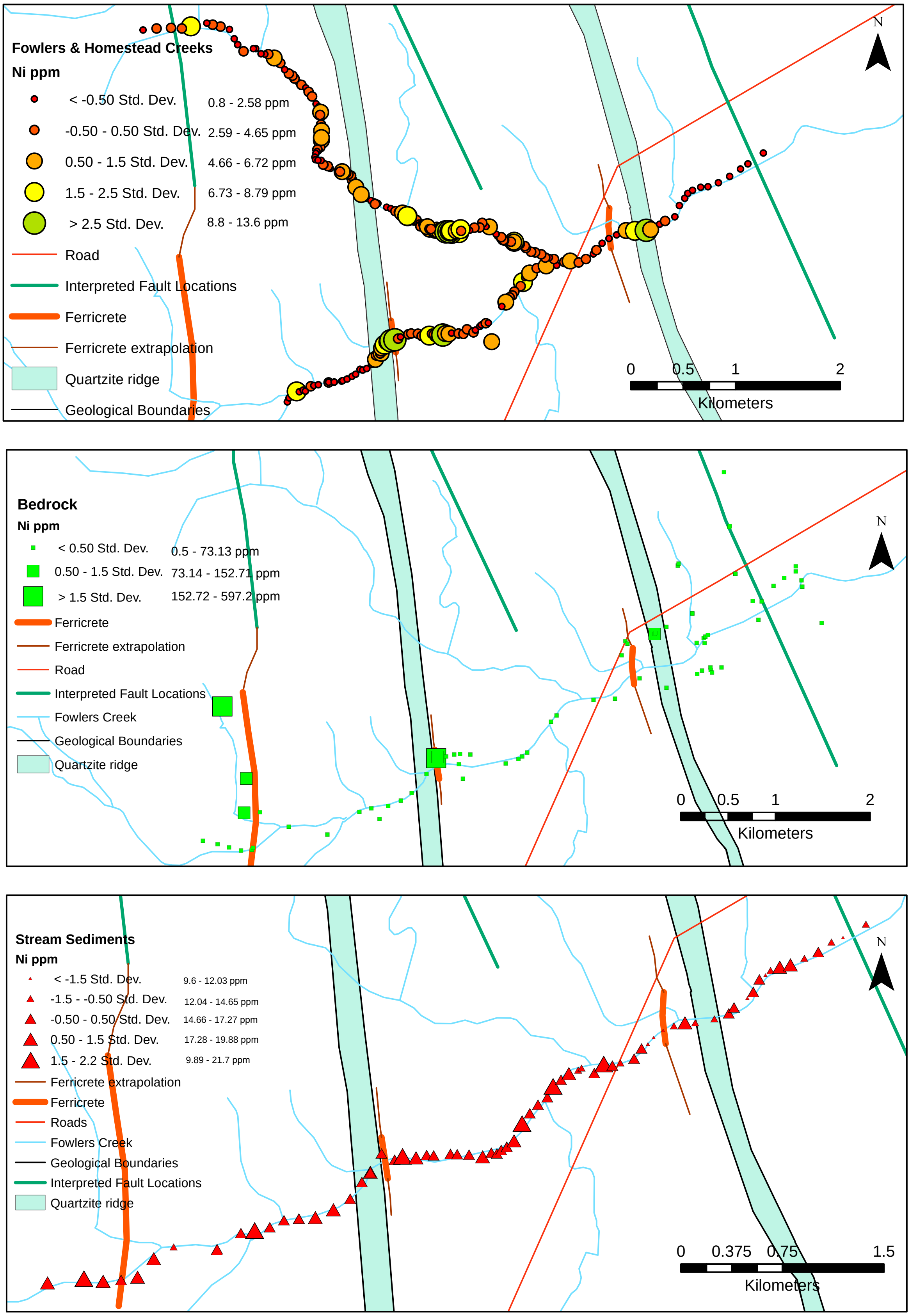

Figure 2.5e: *Eucalyptus camaldulensis* leaf samples collected along Fowlers Creek along with stream sediment and whole-rock geochemistry. Data is presented as standard deviations followed by the range in concentration for each division.

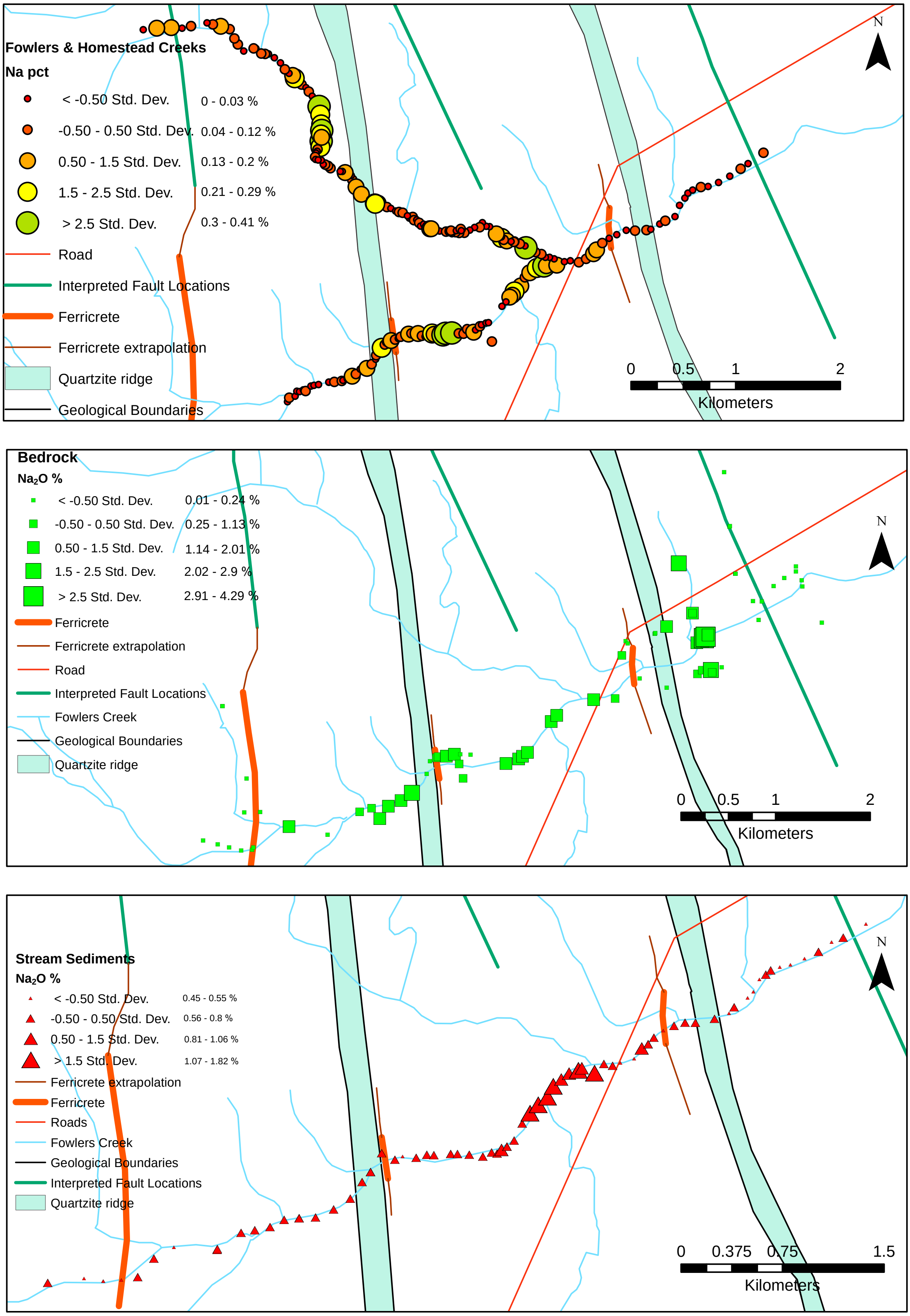

Figure 2.6: Sodium content of *E. camaldulensis*, stream sediments and whole-rock geochemistry from along Fowlers and Homestead Creeks. Data is presented as standard deviations followed by the range in concentration for each division.

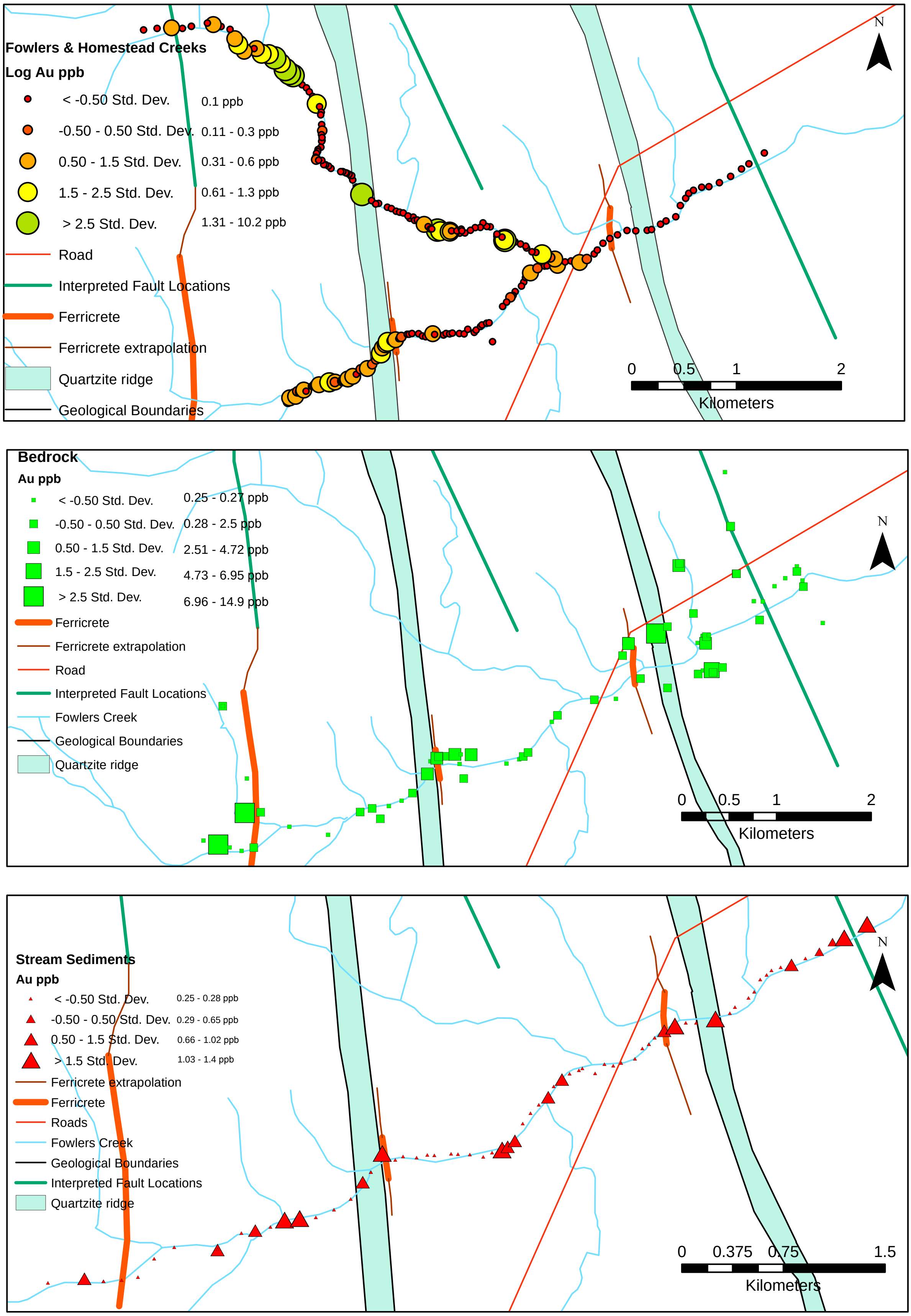

Figure 2.7: The Au content of the *E. camaldulensis* growing along Fowlers and Homestead Creeks potentially delineates the extension of fault structures that cut the creek systems at the far western end of the transects and between the two ridgelines highlighted as geological boundaries. Data is presented as standard deviations followed by the range in concentration for each division.

Bedrock geochemistry

Summary statistics for the whole-rock data set included in table 2.4 (summary statistics for each rock type can be found in the appendices - appendix 2).

The geology sampled proximal to Fowlers Creek can be classified into four groups based on their SiO_2 and Al_2O_3 content (Fig. 2.8).

•Group 1 has 85-100% SiO_2 and 0-6.5% Al_2O_3 and includes the sandstones (Devonian sandstones and conglomerates), quartzite, vein quartz and silcretes in the area.

•Group 2 has 45-80% SiO_2 and 9-20% Al_2O_3 and includes the shales and basalts.

•Group 3 has 15-65% SiO_2 and 0-4.5% Al_2O_3 and includes the limestone.

•Group 4 rocks have 15-65% SiO_2 and 5-7% Al_2O_3 which represents the limestone lens within the shales.

Both groups 3 and 4 contain veins where the original rock has been replaced by iron oxides. A number of samples at point locations along the creek have been classified as ferruginised material with Fe_2O_3 >25% (highlighted in Fig. 2.8).

Table 2.4: Summary statistics for all bedrock samples collected in and around Fowlers Creek.

All Rock Samples	**Co ppm**	**Pb ppm**	**Y ppm**	**Ni ppm**	**U ppm**	**Cs ppm**	**Fe_2O_3 pct**
Count Numeric	74	74	74	74	74	74	74
Minimum	0.1	0.7	0.3	0.5	0.05	0.05	0.23
Maximum	485.1	78	61.8	597.2	13.7	14.1	64.98
Mean	19.35	12.35	18.43	34.28	2.4	2.88	6.98
Median	4.7	7.05	14.05	10.05	1.8	1.2	2.34
Standard Deviation	61.27	13.6	13.32	81.57	2.24	3.23	13.03
Range	485	77.3	61.5	596.7	13.65	14.05	64.75

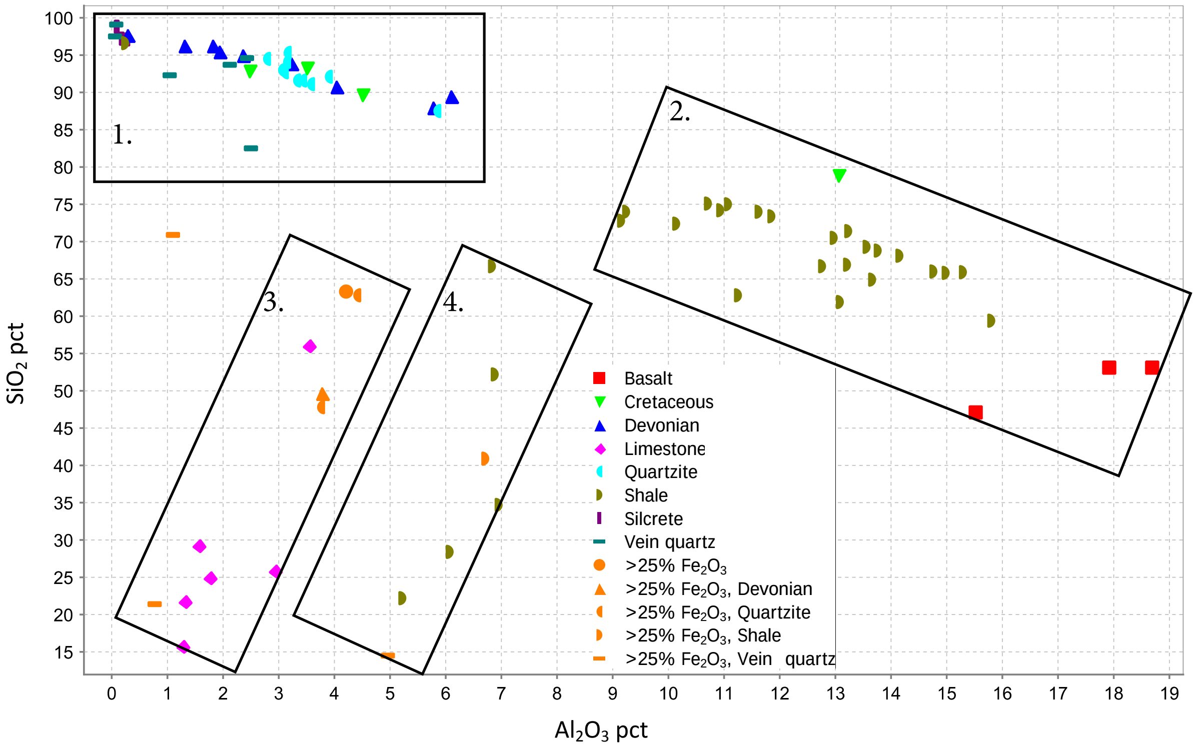

Figure 2.8: SiO_2 and Al_2O_3 content for bedrock/outcrop samples collected along Fowlers Creek. Bedrock data could be split into 4 groups based on their Al_2O_3 and SiO_2 content. Group 1: SiO_2 dominant bedrocks, group 2: 45-80% SiO_2, 9-20% Al_2O_3 - shales and basalts, group 3: 15-65% SiO_2, 0-4.5% Al_2O_3 - limestone, group 4: 15-65% SiO_2, 5-7% Al_2O_3 -represents the limestone lens within the shales.

These samples have elevated Co, U, Y and Ni in comparison to the surrounding geology. A subset of these samples collected at the western end of the creek transects were also enriched in Cu, Pb, Zn and As.

Stream sediment geochemistry

The stream sediments are clean fine quartz sand (SiO_2 dominant) stream sediments with minor clays (Al_2O_3) and iron oxides (Fe_2O_3) (Fig. 2.9). Elements that have concentrations in stream sediments that decrease downstream in Fowlers Creek are Cu, Co, Pb, Ni, Zn and As (Fig. 2.10 a-j). All of which have a very strong correlation with Fe_2O_3 (Table 2.5 and Fig. 2.11). Sodium content is relatively consistent along the length of Fowlers Creek with the exception of between distances 4-5 km where values peak to 1.8% (Fig. 2.6.).

There is minimal variation of Y in stream sediments along the creek with a concentration range between 20-33 ppm. Uranium has a very slight decreasing downstream trend (m=-0.02) (m is the slope of a line passing through the data points on X-Y plot of concentration vs. distance along creek), concentrations vary by 1-2 ppm. Caesium also has a slight downstream trend (m=-0.04) Cobalt and Ni have significantly decreasing downstream trends (m=-0.638, m=-0.6967 respectively).

For Ni, Co, and U (as well as Zn, Cu, As and Pb), beyond the general downstream decrease in concentration trend the data can be split into 3 smaller groups based on slope breaks in the distance vs. concentration plots (Fig. 10). The breaks in slope correspond with significant changes in the landscape setting of the creek within the wider landscape, the first break occurs with the intersection of the creek at the western quartzite ridge (the approximate transition from uplands/headwaters into the main trunk of the creek). The second break corresponds to the intersection of Fowlers Creek with the larger tributary Homestead Creek and with the highway and smaller station roadway.

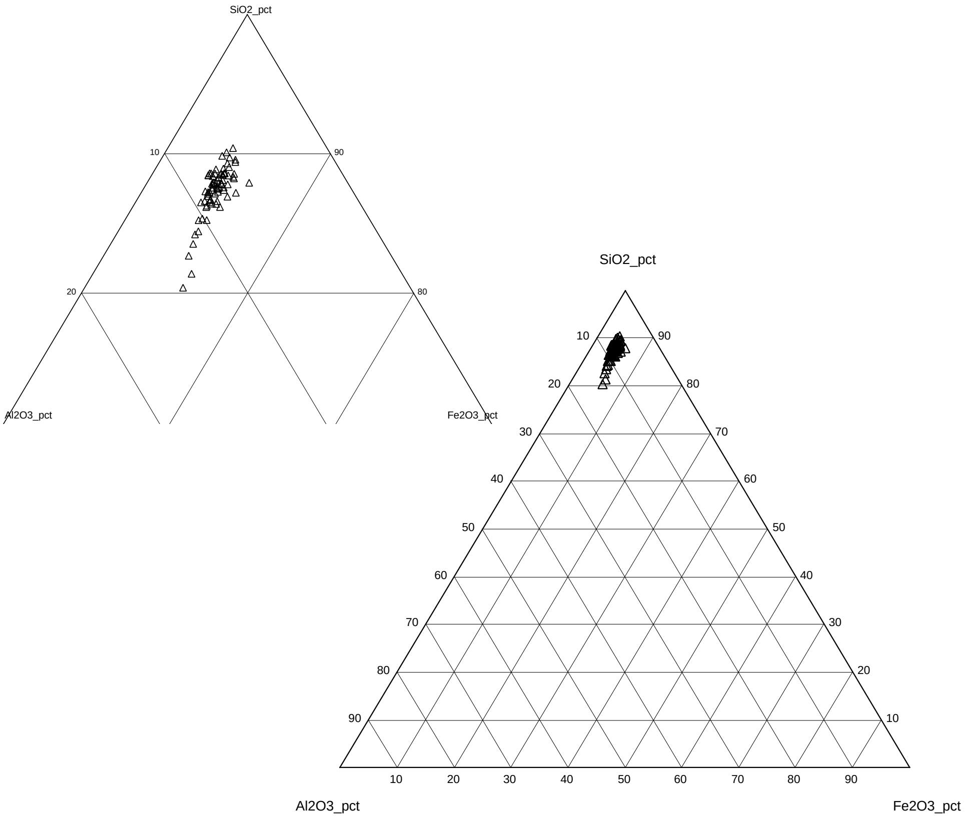

Figure 2.9: Ternary plot - clean fine quartz sand (SiO_2 dominant) stream sediments with minor clays (Al_2O_3) and iron oxides (Fe_2O_3).

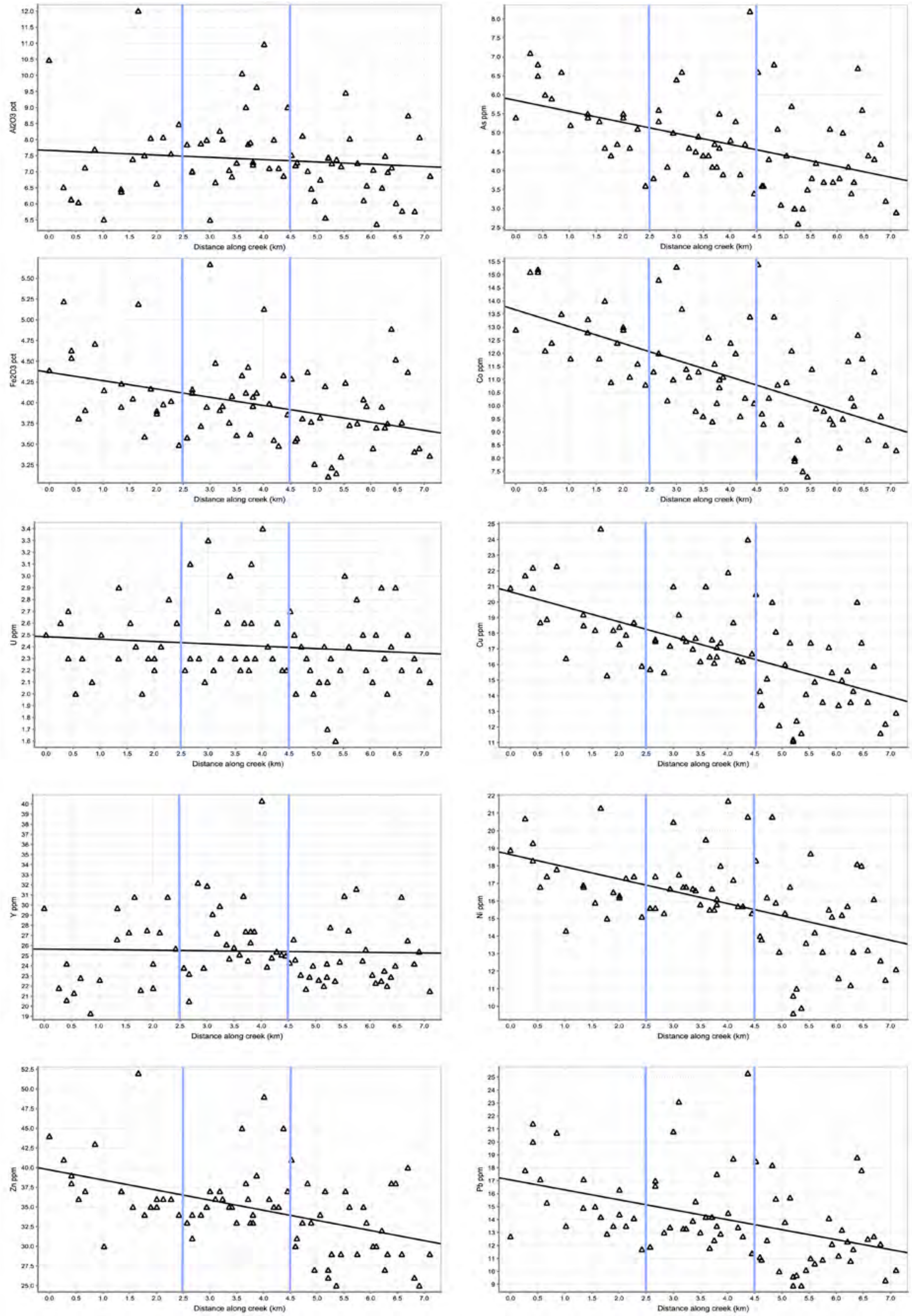

Figure 2.10: Stream sediment geochemistry vs. distance downstream along Fowlers Creek. The blue lines at 2.5 and 4.5 km represent the brakes in the geochemical trend at the western quartzite ridgeline and the confluence of Homestead Creek with Fowlers Creek, respectively. Black lines represent the downstream trend of the data (whole data linear regression).

Table 2.5. Stream sediment geochemistry Pearsons correlation.

	Fe_2O_3 pct	**Co ppm**	**Cu ppm**	**Pb ppm**	**As ppm**	**Zn ppm**	**Ni ppm**
Fe_2O_3 pct	1	0.81	0.84	0.69	0.7	0.78	0.84
Co ppm	0.81	1	0.86	0.81	0.82	0.69	0.81
Cu ppm	0.84	0.86	1	0.79	0.79	0.9	0.93
Pb ppm	0.69	0.81	0.79	1	0.93	0.57	0.72
As ppm	0.7	0.82	0.79	0.93	1	0.58	0.74
Zn ppm	0.78	0.69	0.9	0.57	0.58	1	0.89
Ni ppm	0.84	0.81	0.93	0.72	0.74	0.89	1

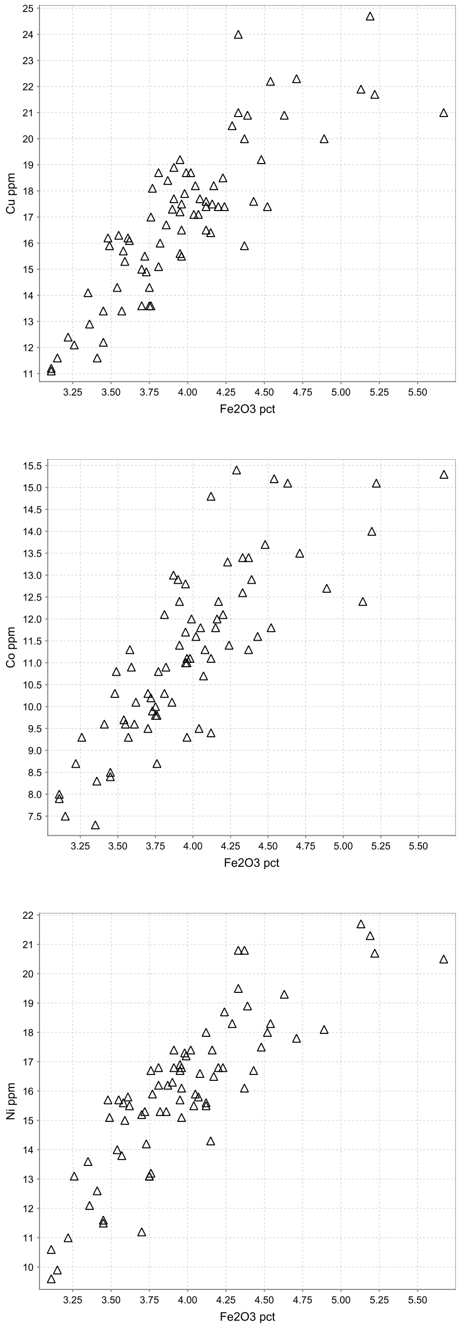

Figure 2.11: Select stream sediment geochemistry vs. Fe_2O_3 content demonstrating the strong correlation exhibited in the stream sediments.

Discussion

Bedrock and stream sediment geochemistry

The Fowlers Gap region consists of low grade metasedimentary rocks with no known significant mineralisation occurrences and overall could be considered as a 'background' setting. The catchment of Fowlers Creek barely overlaps basement rock of the Paleoproterozoic Broken Hill Block (Euriowie Block and Nardoo Inlier), which is characterised by widespread enrichment in Pb, Zn, Ag, and Cu, at the catchments far western extent. Whereas the Homestead Creak catchment does not include Broken Hill Block exposures. Locally there are occurrences of ferruginised bedrock units and quartz veins. The ferruginised zones and veins are enriched in Ni and Co (Fig. 2.4) and also in Cu, Pb, As and Zn compared with the adjacent bedrock.

The element enrichment measured in the ferruginised bedrock is also measured in the stream sediment geochemistry, where it is expressed as local highs followed by downstream decreases in metal content that would be expected from downstream dispersion and dilution from a localised point source (e.g. Fig. 2.2). Cobalt, Cu, Pb, As, Zn and Ni all have a strong correlation with Fe_2O_3 (Table 2.5 and Fig. 2.11) within the stream sediments suggesting that iron oxide is a major controlling factor in the distribution of the metals and is further evidence that the ferruginised lithology is the local source. The Fe_2O_3 content of the stream sediment also has a decreasing downstream trend (Fig. 2.10), further supporting the idea that the elevated elements are associated with the distribution of the Fe_2O_3. While the local ferruginised veins contribute locally to the stream sediment chemistry, which may be superimposed on a broader, more general downstream decreasing trend for the creek system with the highly enriched Broken Hill Domain in the upper reaches of the catchment and potentially further ferruginised horizons in the underlying low grade metasedimentary bedrock.

Landscape setting influence on stream sediment chemistry

Landscape setting within the 7 km of catchment in this study has a strong influence on the stream sediments geochemistry (Fig. 2.10). For Ni, Cu, and Zn and to a lesser extent As, Pb and Co, major changes occur in the distance vs. concentrations plots, corresponding to areas immediately downstream of significant changes in the landscape. The first break occurs at around 2-2.5 km, which is where the creek passes through the quartzite ridge line and changes from the braided channel to a single branch/trunk system. The second break in slope occurs approximately 4.5 km along the creek where Homestead Creek joins with Fowlers Creek. The strongest influence of the local geology on the stream sediment geochemistry is the addition of the sediments from Homestead Creek. The rapid decline in element concentrations in the first section, from the start of the sampling transect to the intersection with the first (western) ridge line over approximately 2 km, is a result of erosion and weathering of the ferruginised quartz veins immediately north of the creek, supplying trace metal enriched sediments to the system. The influence of the vein on the creek is localised and has a minimal impact on the larger creek system due to the ephemeral nature of the system and its low sediment transport. The distribution of the elements of interest from the ferruginised quartz vein is supported by the correlation between Ni (0.84), Co (0.81), Cu (0.84), Zn (0.78), Pb (0.69) and U (0.53) with Fe_2O_3. In the "trunk" of the creek, the element concentrations along Fowlers Creek stabilises, likely more representative of the regional background. The input of sediment into this section of the creek is restricted to sediments sourced from within the limbs of the syncline. The second break in trend (at the intersection of Homestead and Fowlers Creek) is likely the result of additional sediment from Homestead Creek and the re-disruption of sediment and settlement due to roadways and causeways.

As the sediments are sieved, the same size fraction of the bed surface sediments are sampled at all points along the creek, yet the implications of downstream bed surface changes that occur over a short distance (Dunkerley, 92) are still important in the distribution and gives a further understanding of what is happening. Dunkerley (1992) showed the downstream sorting of the surface bedload over a short distance is an important component of distribution of sediments from coarse to fine; with a higher frequency of coarse cobble-sized material closer to the headlands. This grading from coarse to fine material occurs at any location along the creek where erosion deposits material into the creek (e.g. locations where the underlying bedrock is exposed within the creek). The stream sediment geochemistry (and the radiometrics imagery (Fig. 2.12)) show a broad regional geochemical footprint, however, within these broad trends there are subtle small scale dispersion footprints.

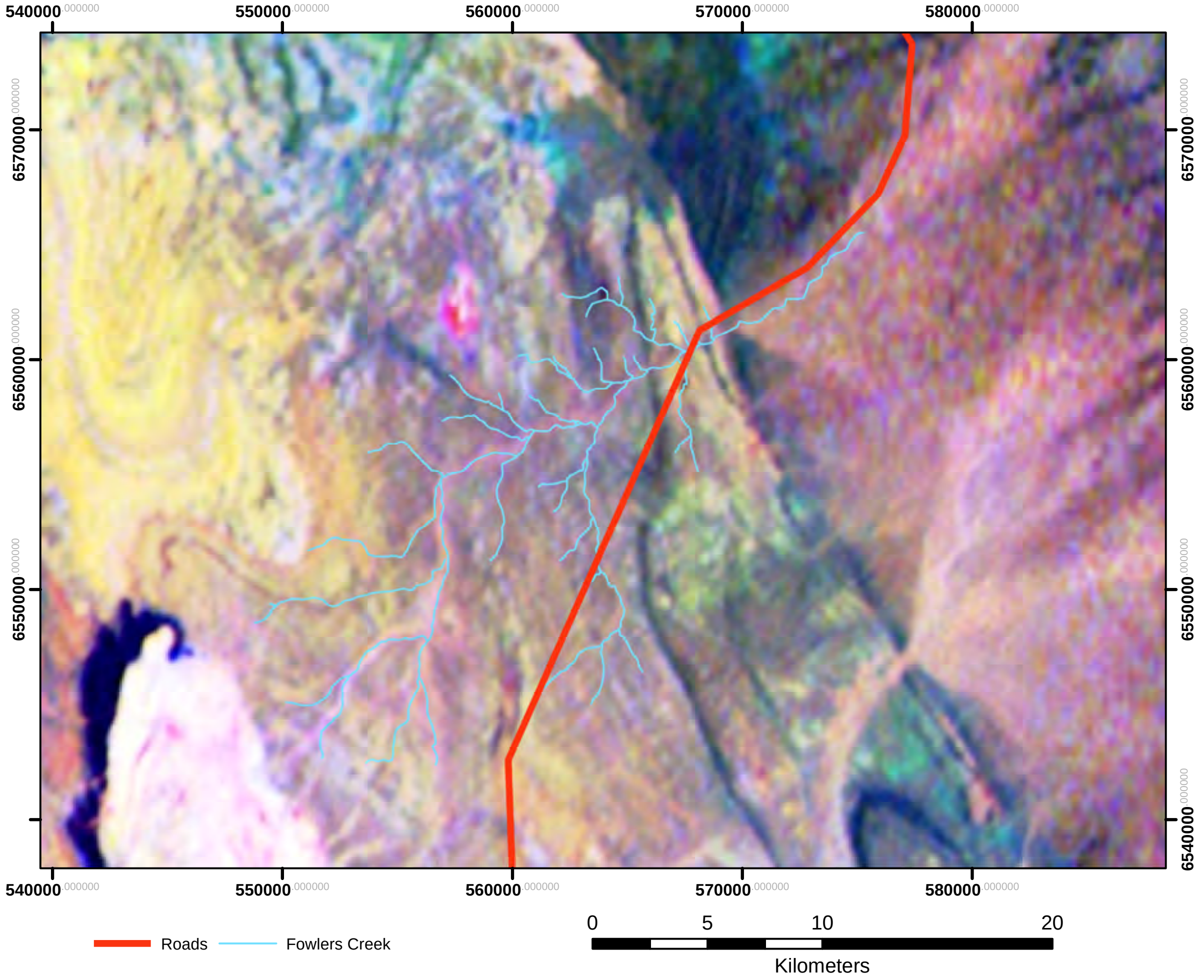

Figure 2.12: Radiometric imagery of the Fowlers Creek catchment and surrounds, showing the extensive lateral distribution along the ephemeral creek system. (Red = K, Blue = U, Green = Th). Base image from Minty *et al.*, 2009.

Stream sediments at the top of the profile (nearer the land surface) are transported faster and more frequently along the creek system than stream sediments buried at depth. Surface sediments would be shifted downstream during small rainfall events, large rainfall events (flash flooding), and windblown mechanical creep, whereas deeper sediments are transported less as they require more energy such as long sustained rainfall or flood/flow. This could theoretically lead to a difference in chemistry between the surface stream sediments and the deeper sediments (those that would be potentially permanently saturated and in contact with the root systems of the *E. camaldulensis*). Sediments at the surface of the creek are more likely to be dominated by a mechanical transport over chemical weathering/transport whereas the deeper sediments will be more strongly influenced by the stream base aquifer and chemical weathering. This may be a significant reason as for some of the difference between the stream sediment geochemistry and the biogeochemical results.

Biogeochemistry relationship to stream sediments

Spatially there are no observable correlations between the geochemistry of the stream sediments and the biogeochemical response of the *E. camaldulensis* (Fig. 2.5). The weak spatial correlation between the geochemistry of the stream sediments and the *E. camaldulensis* biogeochemistry suggests that the trees are accessing a deep water source (that has interacted with the deeper stream sediments) at the base of the creek, rather than "amalgamators" of the stream sediment chemistry. This may be further reflective of the differences brought about from the rate of sediment movement along the creek, particularly the difference between top- and bottom-of-creek sediments.

Compared to underlying geology

The physiological requirements of the *E. camaldulensis* are a fundamental control on what is uptaken by the roots of the tree. An exception is Ni and Co, which are considered to be trace elements and not essential, but do play small enzymatic roles (Dunn, 2007). Uranium, Y and Cs have no known role within the plants and are taken up passively from the substrate (Kabata-Pendias and Pendias, 2000; Dunn, 2007).

The biogeochemical data from along Fowlers Creek, were compared with the underlying geology (Fig. 2.5). The biogeochemistry broadly delineates the Faraway Hills Quartzite from the surrounding shales and limestone lens with U, Cs, Co, Y and Ni (Fig. 2.5). This suggests that spatially, the *E. camaldulensis* can biogeochemically express the large quartzite horizons.

The highest concentrations for the *E. camaldulensis* growing on both the western and eastern quartzite ridges have U concentrations between 0.5 - 2.5 standard deviation (SD) (increasing towards the ridgeline) above the mean (Table 2.2.) (0.04-0.27 ppm). Beyond and between the ridgelines there is minimal variation in the U concentration. Within the bedrock much of the U that could contribute to the *E. camaldulensis* concentration (i.e. upstream of the trees) is recorded in the ferricrete lens and ferruginised quartz veins, which may be local possible sources for the U. The distribution of U in the *E. camaldulensis* along Homestead Creek is much the same as along Fowlers Creek, with elevated values recorded at the western ridgeline. While it has not been mapped, it is possible that the ferricrete is laterally continuous and is also the source for the U along Homestead Creek. Further elevated U concentrations are recorded along Homestead Creek where smaller quartzite horizons have been mapped as crossing the creek by Mabbutt (1973) (see figure 2.2 for a closer geological interpretation).

Caesium is expressed similarly to U along Fowlers Creek, with the *E. camaldulensis* at the western ridgeline having concentrations between 1.5->2.5 SD above the mean (0.3-0.83) and a more abrupt increase at the eastern ridgeline (> 2.5 SD above the mean). There is some variation in Cs concentration in the *E. camaldulensis* between and beyond the ridgeline, with concentrations between -2.5 – 0.5 SD about the mean (0.05-0.21). The distribution of Cs within the bedrock is almost the reverse of the *E. camaldulensis* distribution (Fig. 2.5), with elevated concentrations in the shale and basalt samples and to a lesser extent within the ferricrete lens. Along Homestead Creek, however, the distribution of Cs is not quite as clear cut. While we still have a peak at the western quartzite ridge and at the smaller quartzite horizons that cut Homestead Creek, elevated concentrations are also recorded approximately 1.5 km upstream of the quartzite ridge as well as between the ridgeline and the smaller quartzite horizons. The western most elevated values are at a 90° bend in the creek where there is the potential for water to pool such as at the quartzite horizons.

The distribution of Co and Ni in the bedrock is much the same as the distribution of U, with the highest values recorded in the ferruginised quartz veins and ferricrete lens. The distribution within the *E. camaldulensis* of Co and Ni, is again much the same as the distribution of previous elements, with distinct peaks at the quartzite ridgelines along Fowlers Creek (5.6-18). There is, however, considerable variation in results in the area between the two ridgelines for Co (Fig. 5) and while this may be related to underlying quartzite horizons along Fowlers Creek, the same pattern is not repeated in any of the other elements. The Co concentrations of the *E. camaldulensis* along Homestead Creek are much the same as previous elements with concentrations 0.5->1.5 SD above the mean (2.1-3.84) at quartzite horizons. Nickel concentrations along Homestead Creek differ slightly from the pattern of the other elements by lacking a distinct peak at the western ridgeline but maintaining a peak at the smaller quartzite horizons. This may suggest that there is a further ferricrete horizon that may be contributing metals to the system closer to the smaller quartzite horizons.

Yttrium concentrations along both Fowlers Creek and Homestead Creek within the *E. camaldulensis* do not show as great a contrast between peak concentrations and background, as do the other elements. Along Fowlers Creek concentrations still increase towards a biogeochemical peak at the major quartzite ridgelines as well as increasing towards where the road cuts the creek (this is also repeated in U and Co data). Along Homestead Creek, however, Y values do not conform to the patterns in the other elements along this channel.

The ferricrete lens and ferruginised quartz veins appear to be the dominant source of the U, Co and Ni, while the shales appear to be the dominant source for the Cs and Y with *E. camaldulensis*. While some of the higher concentrations of these elements at the western quartzite ridge could be correlated spatially to the single ferricrete lens at the ridge, a majority of the *E. camaldulensis* that record elevated key elements concentrations are upstream of this single point. At the eastern quartzite ridge there is no underlying source to account for the concentrations of U, Ni and Co. Rather the *E. camaldulensis* are growing downstream of the ferricrete lens, ferruginised quartz veins and in the case of Cs and Y; downstream of the shales, and is possibly a laterally-offset signal of the stream base aquifer interaction with the underlying geology rather than a signal from the geology directly underlying the biogeochemical sample. Transport of the elements in the system is strongly controlled by the stream base aquifer and its interaction with the bedrock and therefore the landscape setting.

The shales along Fowlers Creek are moderately to highly weathered and fractured at the surface, this allows for rapid weathering, leading to the development of deeper, wider channels that allow for easier stream base aquifer flow. The more resistant quartzite typically has narrow and shallow channels and can form ridges at the stream base that can accumulate heavy minerals (e.g. alluvial gold) and allow the stream base aquifer to pool and evaporate. Elements transported from the source (e.g. ferricrete) can concentrate in these pools through changes in redox potential or from evaporation and are an element-rich water source for the trees to tap into.

Implications of landscape setting

Location effect on biogeochemistry

The high element concentrations in *E. camaldulensis* at the quartzite ridgelines appears to be a transported geochemical anomaly from upstream rather than from the directly underlying quartzite bedrock. The pooling of the stream base aquifer at the quartzite ridges allows for changes to the environmental conditions, altering the bioavailability of the different elements that elsewhere along the creek cannot be accessed by the trees.

Caesium has similar chemical properties and behaviour as Rb and K (Kiser *et al.*, 1979) and this is shown in the bedrock geochemistry with significant correlations – Cs-Rb (0.81), Cs-K_20 (0.87). Caesium is strongly absorbed on to clays/alumo-silicates (particularly illites) and is not easily removed from the clay, and therefore Rb and K, by the movement of groundwater (Lomenick, 1965). There is also a significant correlation between Al_2O_3 - Cs (0.78) in the bedrock geochemistry and within the stream sediments Al_2O_3-Cs (0.88), Al_2O_3-Rb (0.96). The addition of lime and peat to soils further inhibits the bioavailability of Cs to plants (increases the pH), while the availability of Rb to plants is greatly increased by soil acidity, this does not likewise stimulate the absorption of K (Kabata-Pendias and Pendias, 2000). As such, Cs is moved along the creek system by being strongly absorbed onto clays (Al_2O_3) and physically transported from either a distal source (e.g. Broken Hill Block) or from proximal shale bedrock along the creek. At the point where the creek cuts the quartzite ridges something (possibly the formation of carbonic acid from the breakdown of organic matter interacting with the stream base aquifer and/or ferrolysis) is potentially causing a decrease in the pH, releasing the Cs, Rb and Y from the clays making it bioavailable to the plants at these points. The movement of Y is also strongly controlled by its absorption onto alumo-silicates with the following correlations within the bedrock: Y-K_2O (0.62), Rb (0.62), Al_2O_3 (0.65).

In the bedrock, moderate correlations exist between Fe-Co (0.76), Fe-U (0.67), and Fe-Ni (0.75), suggesting that the ferricrete lens and ferruginised quartz veins are a probable source of these elements for the trees. The pH of the environment is also important in the mobility and the bioavailability of these elements (Kabata-Pendias and Pendias, 2000). For example, in soils, Co is mostly within Fe minerals and during weathering is relatively mobile in oxidising, acid environments (Kabata-Pendias and Pendias, 2000). Liming (increasing the pH) is a major factor in reducing the bioavailability of Ni, as the solubility of Ni in soil is inversely related to the soil pH (Kabata-Pendias and Pendias, 2000; Siebielec, 2007). The elements elevated at the peaks may be further concentrated through the evaporation of the pooled stream base aquifer and longer interaction with root systems of the *E. camaldulensis*.

The variations between the two ridgelines in both Co and Ni and in the Cs and Y, though small, is likely a further reflection of pooling behind smaller quartzite horizons, which have been observed but not mapped, within the shales along the creek (Beavis, 1984; Sullivan, 1972).

The distribution of Na within the landscape is reflected in the chemistry of both the vegetation and the stream sediments along Fowlers Creek (Fig. 2.6) and is strongly controlled by the position of the sample within the landscape. The highest concentrations of Na within biogeochemical samples and the stream sediments occur between the quartzite ridgelines, with the highest concentrations occurring upstream of the main highway that crosses Fowlers Creek (Fig. 2.1). The accumulation of Na along Fowlers Creek is marked by surface salt scalds and numerous dead trees within and around the creek and the main highway. The salt build up at the main highway and causeway into the station may be exaggerated in comparison to build-up of salt at other damming structures, due to an increase in run-off of water and salts from the road itself. If the implication is that the changes in the *E. camaldulensis* chemistry are caused by the pooling of the streambase aquifer at the quartzite ridges, then this is an implication of landscape setting. This in turn is associated with climate and the differences in the physical properties of the bedrock that makes up the landscape; resulting in a complex series of interactions that feed off of one another. The differential weathering of the different bedrock lithologies have shaped the morphology of the creek bed, with the shales being more susceptible to weathering than the quartzite, leading potentially to a broader deeper channel through which the stream base aquifer can flow. Whereas the far more resistant quartzite produces the ridges and the rock barriers within the creek that cause the stream base aquifer to pool, carrying with it the “enriched” waters that have interacted with the ferricrete further upstream. This has been schematically summarised in figure 2.13.

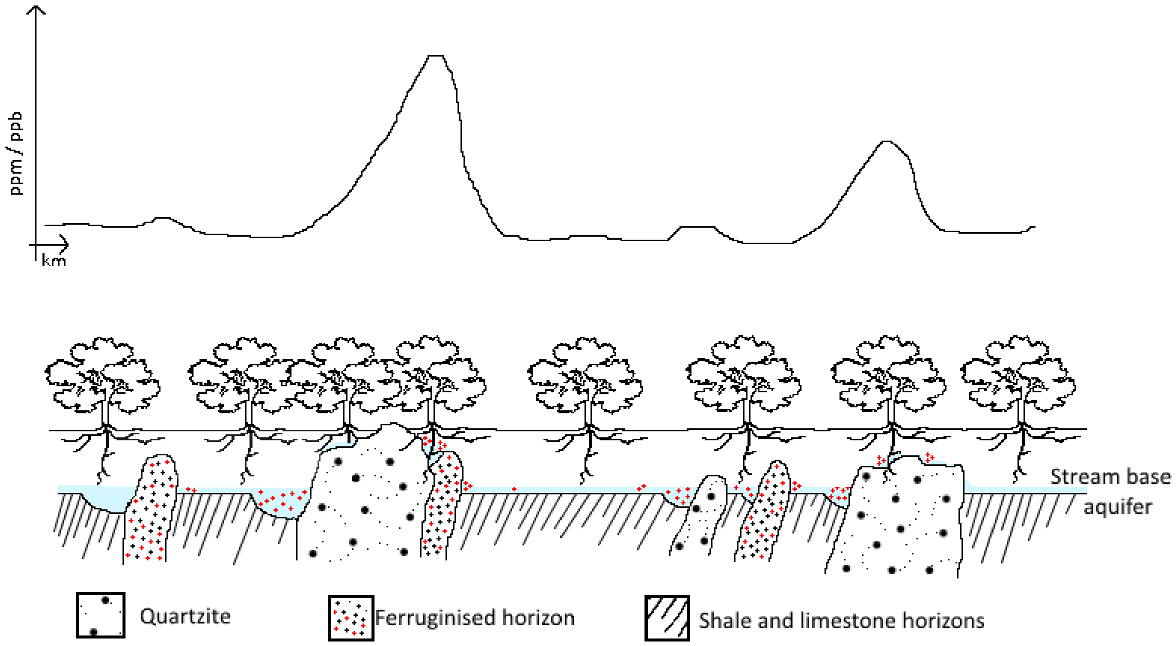

Figure 2.13: Schematic summary of the differing weathering of the different bedrocks along the creek and the implications this has on the geomorphology of the creek and the biogeochemical response of the *E. camaldulensis*.

Gold *in E. camaldulensis*

The importance of the location of the *E. camaldulensis* biogeochemistry in relation to position in the landscape is also highlighted when looking at the Au concentrations in the trees along Fowlers Creek and Homestead Creek (Fig. 2.7) and the proximity to the known fault systems in the area. Gold concentrations are elevated (in comparison to the rest of the creek) (0.6 ppb) at the far western end of Fowlers Creek and decrease downstream (0.2 ppb). The Au data population shows striping (or low resolution) as the levels are close to the lower analytical detection limit for ICP-MS (DL is 0.2 ppb), nevertheless the decreasing trend is still valid. The upstream source for the Au is possibly the north-south trend fault to the west of the western ridgeline. Although the known fault in the area is not mapped as crossing Fowlers Creek, it is possible to project the fault along the line of vein quartz samples. While there is a single point sample mapped as crossing the western fault along Homestead Creek (0.3 ppb), the elevated concentration (1.3 ppb) are shifted downstream from the potential source. A secondary increase in Au (0.3-0.4 ppb) at the intersection of Fowlers Creek and the road could suggest a placer style secondary deposit that is being detected by the trees. The increase in concentration of Au at the intersection of Fowlers Creek with Homestead Creek and the road is also reflected in the Homestead Creek data. A more likely explanation is that the Au may be within another interpreted fault that runs NW-SE within the syncline (Fig. 2.7). The biogeochemical results are not supported by the geochemistry of the stream sediments and only one bedrock sample at the far western projected fault location, nor do they follow the same peak trends for the other elements examined in this paper. The results, may be a reflection of the deeper interactions within the creeks with the stream sediments and the stream base aquifer. While the Au “anomalies” are more than single-point and therefore may be regarded as more than just a “nugget effect”. The biogeochemical results are interesting in that it may help identify fault structures, however significantly more research is required to test this.

Effects of Catchment size

While most of the patterns in the *E. camaldulensis* data along Fowlers Creek are repeated along Homestead Creek (Fig. 2.5), Homestead Creek as a whole is more biogeochemically variable than Fowlers Creek (Fig. 2.4 & 2.5). A number of possibilities exist that may account for the differences observed.

Initial investigations were to test for possible analysis and batch errors; this was done by comparing the duplicate percentage errors for samples and lab standard STDV14 between years. Sample duplicates and standards errors were considered to be acceptable (see results), so while analytical error cannot be completely eliminated, we are confident that it is not the key issue here. Once again it is likely a combination of factors that are having an effect of the deviation of patterns along Homestead Creek from Fowlers Creek; with climate, geology and catchment size all playing a role.

Some of the variation in the spatial distribution of the elevated values along Homestead Creek compared to Fowlers Creek may simply be a reflection in the underlying basement geology and the depth to bedrock. For example the distribution of Cs and Y anomalies along Homestead Creek, in the bedrock samples, values of both are elevated within the shale samples (Fig. 2.5). Yet, *E. camaldulensis* that are growing over the same stratigraphic level, but on different creeks, exhibit significantly different results. It is more likely therefore that variations are related to other phenomenon, either interactions of the trees with the sediment load or the stream base aquifer or may be down to the individual plant age and health.

All the stream sediment and biogeochemistry data from Fowlers Creek suggests that the trees are not interacting with the stream sediments at surface. It is, then, more likely a combination of deeper interactions with stream sediments and the stream base aquifer.

In order to compare the two biogeochemical surveys along Fowlers Creek and Homestead Creek directly, the catchment and temporal variations need to be considered. Fowlers Creek has a catchment size of 434 km², and Homestead Creek, a tributary of Fowlers Creek, has a catchment area of 30 km², and as such has an impact on the amount of water that makes it into the systems. Climate has a significant influence on the biogeochemical response of the *E. camaldulensis*; being the controlling factor on water supply to the area and therefore to the trees. Rainfall in the Fowlers Gap region is sporadic with large rainfall events that occur throughout the year (Dunkerley, 2013). The biogeochemical surveys for this study were conducted during a sampling period with below average rainfall (e.g. Dunkerley, 2013).

While flow records do not exist, the peak discharge rates close to the headwater/catchment – lowlands boundary has been estimated from geomorphic evidence to be around several hundred m³/s (Dunkerley, 2014; Dunkerley, 1992). Rainfall events, however large or small, will have an effect on the stream base aquifer within the creek by adding fresh water into the system. The fresh water can potentially dilute the chemistry of the stream base aquifer water, which is then influential on what is taken up by the vegetation dependent on it (i.e. the *E. camaldulensis* (Mitchell, 2015)). The recentness of the rainfall event in relation to the time at which the samples were collected is also influential on the biogeochemical response of the trees. It has been shown that Eucalyptus spp. will change their uptake/use of surface waters from recent rainfall/flood events via their lateral root systems in combination with the water from the deep groundwater/stream base aquifer (Cohen, 1997; Jolly, 1996; Mensforth, 1994; Thorburn, 1994). The surface waters would have a different chemistry to that of the stream base aquifer, having had no interaction with the underlying geology or having been effected by changes in chemical environment (i.e. pH changes at quartzite ridgelines).

The *E. camaldulensis* along Fowlers Creek were sampled in July 2007, where the wettest month of 67.7 mm in the May prior was the wettest month on record for 4 years. Although this rainfall would have fallen in the catchment and thus into Fowlers Creek, there is no record of flooding at the time. That such rainfall events greatly added to the inflow into the creek system it does not appear that the rainfall event significantly effected the streambase aquifer or that it necessarily all made it into the creek and is unlikely to have had enough impact as to flush the stream base aquifer thus unlikely to play a significant role in the biogeochemical response of the *E. camaldulensis*. The overall low rainfall prior to the sampling of *E. camaldulensis* along Fowlers Creek would suggest that the trees would have been more reliant on the deeper creek waters of the stream base aquifer and more reflective of this chemistry rather than the influence of more recent rainfall events (Mitchell, 2015). We consider this important for supporting the theory that the trees are uptaking water that has pooled behind the quartzite ridges (due to permeability and overall hardness difference between the quartzite and surrounding shales) and the potential that this creates for the chemistry of the water to change and thus allowing different elements to become soluble and therefore available for uptake that would otherwise be in a non-bioavaliable form for the trees to uptake.

Inflow into Homestead Creek, and the recharge and dilution/pooling of the stream base aquifer, would be further influenced by the building of Freislich Dam at the top of the creek further restricting the ephemeral flow into the already significantly smaller catchment area.

The effect of climate and rainfall on the transport of stream sediments is somewhat difficult to quantify. There have been few studies of sediment movement along Fowlers Creek, however a sediment trap on Homestead Creek with a capacity of 20 m^3 filled with sand and gravel in a single moderate event (Dunkerley, 2008). Further studies of flow behaviour and sediment load following a single isolated storm event on Homestead Creek showed that during low rainfall event the water was completely consumed within 7.6 km. The highest sediment load occurs at the flow front and decreases linearly with time and a peak flow discharge of 9 m^3/s (Dunkerley, 1999).

Implications of landscape setting and the differentiation of vertically and laterally derived anomalies on mineral exploration

The interaction between bedrock and tree and the implications of landscape setting is complex. Climate, bedrock geochemistry and its physical properties, landscape setting, and the physiological needs of the plant all interact in a complex system. The biogeochemical response of the *E. camaldulensis* growing along an ephemeral creek system is influenced by both the regional and distal geology as well as the proximal underlying geology on which they are growing.

When looking at the data in isolation (single creek vs. multiple creeks vs. landscape setting etc.) patterns are often lost. Due to the relative concentration difference between Homestead and Fowlers Creek, when looked at together the changes that occur along Fowlers Creek become obscured. This underlies the importance of how we deal with our data sets, even when using a single sample medium.

The biogeochemistry highlights the differences in the stream base aquifer chemistry caused by the underlying geology and the road construction disrupting the flow of water and sediments (e.g. locations where water pools along the creek).

The implications of the biogeochemical and stream sediment surveys on lateral and vertical anomaly differentiation in areas of transported cover are complicated. There are examples (e.g. western ridge) where there are elevated concentrations in within *E. camaldulensis* that can be attributed to both vertically and laterally derived sources, where the only way to tell them apart has been through examination of the local geology and landscape setting. Understanding the source of the dispersed material is aided by a description of the geology and bedrock geochemistry within the catchment area, and particularly underlying the creek. While there is a slight correlation between the geochemistry of the underlying geology (ferricrete) with the biogeochemical response of the tree growing directly on top of it, the laterally transported chemistry is the most strongly correlated.

By conducting parallel surveys along Fowlers Creek, with biogeochemistry, stream sediment geochemistry and the whole-rock geochemistry we were able to directly compare each sample medium. We found that the elements that are enriched in the ferruginised quartz vein, are being transported along the system and only Ni, Co and Zn are enriched in the biogeochemical samples at the quartzite ridgelines. Yet it has been shown that *E. camaldulensis* is capable of taking up and storing elements such as Pb to high concentrations both proximal and distal to its source (Mitchell, 2015) however the Pb (and other elements of interest) have not been transported, accumulated, or extracted by the roots at the quartzite ridgeline

Stream sediment chemistry is inherently a transported signal and is an amalgamation of the regolith and bedrock geology in the catchment. Some of the minor elevations in concentrations along the transects may be related to the smaller ferricrete occurrences. It is expected that these small outcrops do not contribute much volume of material to the creeks and is by the addition of material from smaller tributaries (i.e. Homestead Creek). As a result the lateral dispersion of elements is difficult to recognise in the stream sediment geochemistry and biogeochemistry due to the low element concentrations.

The thick transported cover, particularly in semi-arid Fowlers Gap, the influence of the sporadic rainfall, catchment size and position within the landscape become as important to vectors towards the source of any geochemical anomalies in mineral exploration programs. The sporadic rainfall distribution across a catchment is important to take into account when examining anomalies within stream sediment geochemistry and biogeochemical data sets. For example, rainfall may not erode and interact with the whole catchment and as such only part of the creek system will be engaged, and depending on the rainfall amount, either very little or vast amounts of bedload would be shifted. The differential shifting of sediments along the creek in a non-linear sequence of cause and effect, with the redepositing of sediments and additional input can make it difficult to work backwards unless a source is already pin-pointed.

Conclusions

A biogeochemical survey as well as a survey of bedrock and stream sediment geochemistry was conducted along an ephemeral creek system in semi-arid western New South Wales to test the influence of landscape setting on the biogeochemical response of *E. camaldulensis* and the potential implications for mineral exploration. Our results showed that *E. camaldulensis* biogeochemistry has some response to the differences between lithologies. The quartzite horizons could be distinguished by a suite of elements in the biogeochemistry, however, we think this is a result of chemical changes that occur in the stream base aquifer that pools behind "bars" of quartzite in Fowlers and Homestead Creeks.

Catchment size and the implications of rainfall distribution across a catchment means that differential inflow of water into the stream base aquifer could alter the standing time at these quartzite horizons and the implications that would have on the chemistry (i.e. heavy rainfall at the top of a smaller tributary may flush one area of pooling while another is unaffected). It has shown us that even in an area considered barren of mineralisation and of little economic interest there is significant information that can be gained from a biogeochemical survey and the interactions and importance of landscape setting that can be further applied to survey in the mineral exploration setting.

Chapter 3: El Niño–La Niña cycles and biogeochemical sampling: variability of element concentrations within *E. camaldulensis* leaves in semi-arid Australia

Foreword

The purpose of this chapter is to test the stream sediment and biogeochemical response in a catchment containing known mineralisation and to determine the potential influence of time-dependent climatic phenomena on the geochemical signal. Pine Creek, NSW, is situated within an area underlain with high-grade metamorphic bedrock containing known Pb-Zn-Ag mineralisation. The stream channel cross-cuts the Pinnacles Pb-Zn-Ag deposit with historic workings exposed in the catchment. Data from stream sediments and river red gums collected from 1.5 km upstream and 4.5 km downstream provides a measure of the extent of lateral dispersion from the known mineralisation.

Biogeochemical sampling over two field seasons (2005 and 2012) with vastly different rainfall brought about by the climatic phenomena of El Niño–La Niña cycles provides an opportunity to assess seasonal variations in the biogeochemical response of the *E. camaldulensis*. The results demonstrate the influence of the stream base aquifer on the biogeochemical response. This study utilises *E. camaldulensis* samples collected by Dr Karen Hulme in 2005 during her PhD. These samples have been reanalysed by the author with the same preparation and analytical procedures as samples collected in 2012. All 2012 *E. camaldulensis* samples and stream sediment samples were collected by the author with the aid of fellow PhD student Dr Ashlyn Johnson. All subsequent treatment of the data was conducted by the author as part of this PhD study.

This chapter has been published as a paper in Geochemistry: Exploration, Environments, Analysis:

Mitchell, C., Hill, S.M., Giles, D., Hulme, K. 2015. El Niño–La Niña cycles and biogeochemical sampling: variability of element concentrations within *E. camaldulensis* leaves in semi-arid Australia. Geochemistry: Exploration, Environment, Analysis. Vol. 15. 350-360.

This chapter differs from the published paper in that background concentrations of Pb and Ag (e.g. on page 55) refer to background concentrations established from the Fowlers Creek case study (Chapter 2), rather than from the lowest concentrations observed in the Pine Creek case study.

The original paper can be found within the appendices.
Following is a statement of authorship as required by The University of Adelaide policy.

Statement of Authorship

Title of Paper	El Niño–La Niña cycles and biogeochemical sampling: variability of element concentrations within *E. camaldulensis* leaves in semi-arid Australia
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Principal Author

Name of Principal Author (Candidate)	Charlotte Mitchell		
Contribution to the Paper	Collection and interpretation of data, development of idea, manuscript design and composition, and generation of figures and tables.		
Overall percentage (%)	85%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature	[redacted]	Date	1/8/2016.

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Prof David Giles		
Contribution to the Paper	Supervised development of work, helped in data interpretation and manuscript revision.		
Signature	[redacted]	Date	2/8/2016

Name of Co-Author	Dr Steven Hill		
Contribution to the Paper	Supervised development of work, helped in data interpretation and manuscript revision.		
Signature	[redacted]	Date	1/8/16

Name of Co-Author	Dr Karen Hulme		
Contribution to the Paper	Supplied samples from own 2005 study.		
Signature	[redacted]	Date	9/8/16

Abstract

We conducted the analysis of the chemistry of leaves from *Eucalyptus camaldulensis* (Australian river red gums) growing in a creek system that crosscuts known Pb-Zn mineralisation to assess the influence of cyclic El Niño and La Niña weather patterns on biogeochemical exploration. Samples were collected over two periods: in 2005 immediately after a severe El Niño event where the previous year's rainfall was 188 mm; and in 2012 after a La Niña event where the previous year's rainfall was 605 mm. During both periods, elemental components of the mineral system (Ag, Pb, Zn and Cu) were present within the samples at elevated concentrations. Following the El Niño years of low rainfall, the trees directly overlying mineralisation contained higher values of both Pb (up to 323 ppm) and Ag (up to 821 ppb) than in the wet La Niña year (Pb up to 69.2 ppm and Ag up to 165 ppb). The spatial distribution for Pb and Ag in both the 2005 and 2012 samples was nearly identical, but with consistently higher concentrations (averaging four times higher) in the 2005 samples. Zinc and Cu values in leaves are also elevated adjacent to mineralisation but show less contrast between the two sampling periods, presumably because the uptake of these trace nutrients is largely determined by biological factors. We interpret the large seasonal variations in Pb and Ag to reflect passive uptake of these non-nutrient elements, the concentrations of which in the plant tissues was controlled by the chemistry of the available stream base aquifer, which was comparatively diluted in the La Niña sampling period. These results demonstrate that changes in available water play a significant role in diluting the resulting metal concentration within the trees. These results have implications for mineral exploration sampling programs, particularly those that may take place over multiple field seasons. These implications include changes to anomaly/background cut-off for different years and changes to the dispersion halo.

Introduction

Biogeochemistry for mineral exploration is defined by Dunn (2007) as "The chemical analysis of plant tissues to assess the presence and nature of underlying mineralisation, bedrock composition, bedrock structure (faults, joints and folds), and the chemistry of the soil, surficial sediments, and associated groundwater". Biogeochemistry as a tool for mineral exploration has been used for many years to identify areas of potential mineralisation, with many successes (Stednick & Riese, 1987; Stednick *et al*., 1987; Hill *et al*., 2005; Lintern, 2005 & 2007; Dunn, 2007; Dignam *et al*., 2008; Fabris *et al*., 2008; Hulme, 2008). A number of biogeochemical studies have addressed seasonal variations of metal concentration in plants (Stednick & Riese, 1987; Stednick *et al*., 1987; Alfani *et al*., 2000). Most of these studies have taken place in the northern hemisphere where the seasons are more clearly defined than in the arid parts of Australia. Lodgepole Pine needle and twig analysis conducted by Stednick in the 1980s showed that while some elements (Cu and Zn) were relatively stable from season to season and year to year, elements such as Au changed significantly with the seasons (Stednick & Riese, 1987; Stednick *et al*., 1987). Studies addressing temporal changes in biogeochemistry in semi-arid and arid regions have been few (Hulme & Hill ,2004; Lintern, 2007; Hulme, 2008). Lintern (2007) found significant seasonal differences in the trace metal and major element concentrations of *Eucalyptus incrassata* and *Melaleuca uncinata* sampled two years apart in semi-arid South Australia. Hulme (2008) studied the seasonal variation of *Eucalyptus camaldulensis* (Australian river red gum) over a number of semi-arid regions in far-western NSW, Australia and noted that, whilst seasonal variation in most elements within *E. camaldulensis* occurred, it was not of sufficient magnitude to influence the interpretation of data for mineral exploration applications.

El Niño refers to the extensive warming of the central and eastern Pacific Ocean that leads to a major shift in weather patterns across the Pacific (Bureau of Meteorology, 2012b). El Niño years are much drier with winter rainfall far below the long term average and summer rainfall mostly near average in Australia. La Niña is the reverse, with extensive cooling of the central and eastern Pacific (Bureau of Meteorology, 2012b), La Niña years are associated with increased rainfall with both summer and winter rainfall above the long term average in Australia (Bureau of Meteorology, 2012b).

There have been several studies on the effect of El Niño on Australian rainfall patterns (Nicholls & Kariko, 1993; Cordery & Opoku-Ankomah, 1994) as well as studies into the effect of the El Niño–La Niña phenomenon on the vegetation of Australia (Nicholls, 1991). Nicholls noted that many of the attributes that make the Australian arid zone vegetation unique, in comparison to other arid and semi-arid zones around the world, are likely adaptations to the climatic changes brought on by El Niño-La Niña. These adaptations include drought tolerance, a dependence on extended wet periods to set seed, fire tolerance/dependence and tall trees with deep roots. A common theme of these adaptations is that the plant is tuned to two (or more) modes of operation in which its physiology and interactions with its environment may be quite different, such as different periods of uptake and storage of water and nutrients in response to the environment, which would influence the uptake of elements useful for biogeochemical exploration (Dawson & Pate, 1996; Dye, 1996; Cohen *et al.*, 1997).

There has been very little research that combines these themes to consider the influence of El Niño's dry winters and La Niña's flooding summer rains on the concentration of trace metals in plant tissues and the implications for biogeochemical exploration. Here, data are presented that demonstrate the temporal variation in trace metal concentrations within *E. camaldulensis* leaves growing along a creek system in a semi-arid region of Australia.

Study Area

The drainage system for this study is Pine Creek, 10 km SW of Broken Hill, in western New South Wales, Australia (Fig. 3.1). Pine Creek is a north-to-south flowing ephemeral alluvial channel flanked by depositional plains made up of transported material that is derived from dominantly alluvial sources, but also colluvial, sheetwash and aeolian processes (Fabris *et al*., 2008; Hulme, 2008). The lower half of the creek is bordered by alluvial depositional plains, while the headwaters of the creek are flanked by alluvial plains to the east while the west is more colluvial-dominated, with more exposed bedrock within the creek bed. *Eucalyptus camaldulensis* grow along the banks and on the sandbars within the creek with an understorey of chenopod shrub (black bluebush, bladder saltbush, pearl bluebush and sparse mulgas) colonizing depositional bars. Active channels between the sandbars are clear of vegetation.

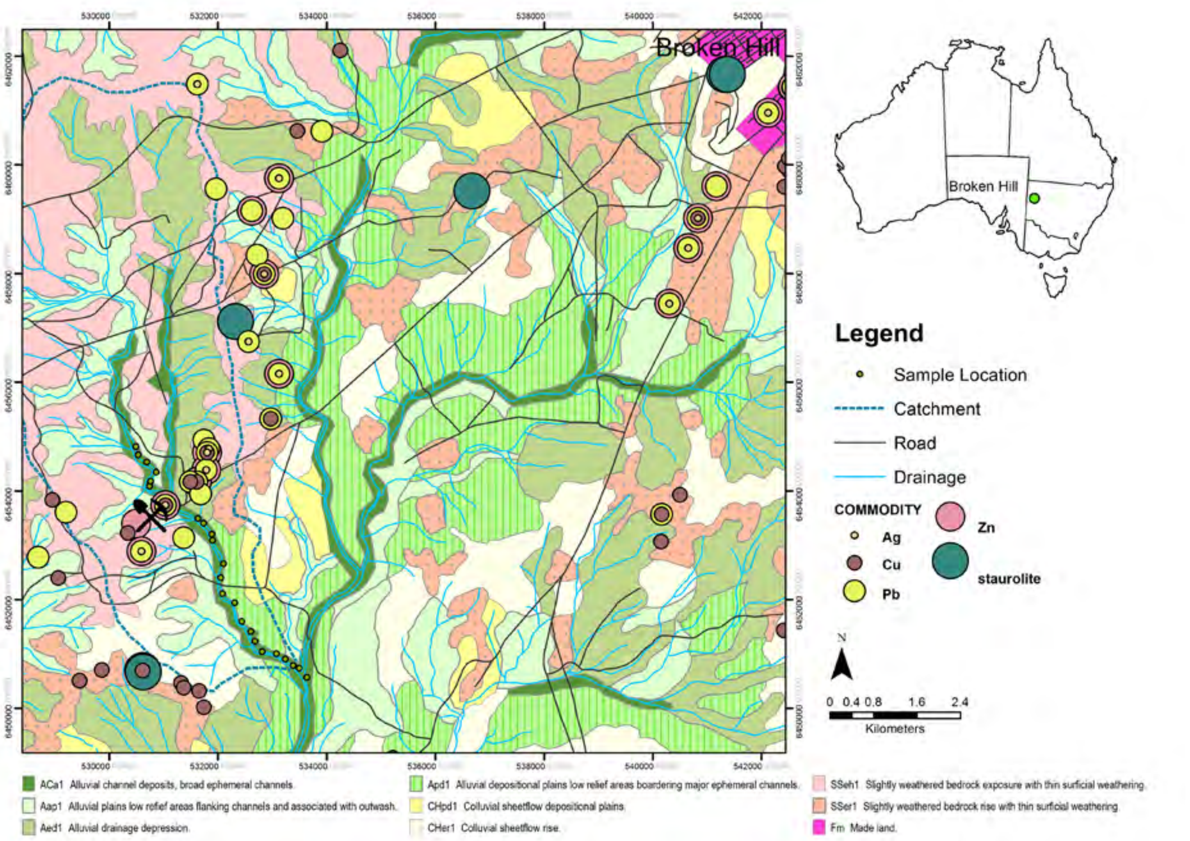

Figure 3.1: Regolith landform map and *Eucalyptus camaldulensis* sample locations along Pine Creek in relation to the Pinnacle-Barrier Pb-Zn Mine, mineral occurrences and Broken Hill (Regolith map adapted from Hill 2001).

Pine Creek bisects the Pinnacles-Barrier Pb-Zn mineralisation and crosses the Pinnacles-Thackaringa Shear Zone in this area. The Pinnacles-Barrier mineralisation has been worked sporadically since 1884 (Parr, 1994) with numerous small workings over a strike length of c. 2 km. The largest of these workings, the Pinnacles Mine, is located on the western flank of Pine Creek. Mineralisation is of the Broken Hill-type (Barnes, 1988) with ore grade accumulations of Ag, Pb, and Zn contained in sulfide minerals galena and sphalerite, with pyrite as a significant accessory phase mineral (Ayres, 1962). Broken Hill-type deposits are typically composed of stacked strata-bound lenses of varying metal content (typically Pb- and Ag-rich verses Zn-rich) hosted within quartzo-feldspathic to pelitic stratigraphy with prospective packages marked by thin quartz-gahnite and garnet-rich units (Walters, 1998). The Pb lode at the Pinnacles Mine contains grades of 6–11% Pb, 2.5% Zn and 300–500 g/t Ag, while the Zn lodes contain c. 1% Pb, 10–15% Zn and 30 g/t Ag (Parr, 1994). As of 2008, the mineral reserves at the Pinnacles included: 420 000 tonnes of contained Pb, 53 million oz. Ag, 14 000 tonnes Cu, 575 000 tonnes Zn and 219 000 oz. Au (Reid, 2009).

Several biogeochemical research programs have investigated the area surrounding the Pinnacles Pb- Zn mine (Hill, 2004; Hulme & Hill, 2005; Dignam *et al.*, 2008; Hulme, 2008). These focused on the downstream lateral dispersion of Pb and Zn from blind mineralisation along Pine Creek using the leaves of *E. camaldulensis* as well as using bluebush to identify and delineate the presence of mineralized zones under transported colluvial material. In a pilot study conducted in 2001 (Hill, 2004), the leaves of *E. camaldulensis* along Pine Creek were sampled at 250 m spacing. Trees in close proximity to the mine had Pb values of 150 times background level (for that survey) (background, BG, of 2 ppm) and Ag values of 4.2 times background values (BG 0.84 ppm) (Hulme & Hill, 2005). Hulme (2008) followed this up with a more detailed study where all available River Red gum trees along Pine Creek were sampled, focusing on the chemistry of the leaves.

Climate and rainfall patterns

The study area has a mean annual rainfall of 254 mm (Fig. 3.2), a mean maximum temperature of 24.3°C and a mean minimum temperature of 11.6°C (Bureau of Meteorology, 2012a).The Broken Hill region is classed as having an arid to semi-arid climate, with winters that are cool and wet. While the region experiences most of its rainfall during the summer as heavy storm events, the summers are typically hot and dry. Prior to the second (La Niña) sampling period, the Broken Hill region received twice its annual average rainfall (2010–540 mm and 2011–605 mm) for the two years previous to the sampling year (2012), with 2011 being the second wettest calendar year recorded for Broken Hill (Bureau of Meteorology, 2012b). Conversely, prior to the 2005 sampling period, Australia had experienced one of its most severe droughts, brought about by the 2002–2003 El Niño event which saw much of the country experience extreme dryness and high average temperatures (Bureau of Meteorology, 2012b) while the Broken Hill region experienced around four years of below average rainfall (Fig. 2). El Niño onset years for Australia include 1905, 1914, 1940, 1941, 1946, 1965, 1972, 1977, 1982, 1991, 1994, 1997, 2002, 2006, and 2009 (Bureau of Meteorology, 2012b) while La Nina onset years include 1906, 1910, 1916, 1917, 1950, 1955, 1956, 1971, 1973, 1975, 1988, 1998, 2007, 2008, and 2010 (highlighted in Fig. 2; Bureau of Meteorology, 2012b).

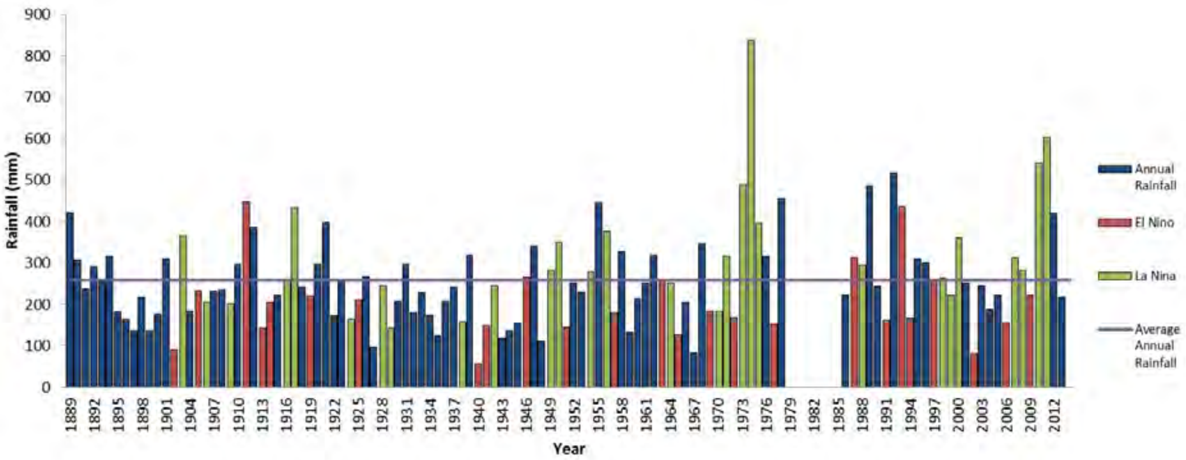

Figure 3.2: Annual rainfall amounts for Broken Hill, Australia. Coloured to the El Niño/La Niña phase onset years as observed across Australia. (Modified from Climate Data Online, Bureau of Meteorology, 2012a, b.)

Field and Laboratory Methods

In 2005, Hulme (2008) took a series of samples of *E. camaldulensis* leaves from trees along Pine Creek, extending from approximately 1.5 km upstream of the Pinnacles Mine to 4.5 km downstream. This sampling corresponds with below average rainfall for the area between two severe El Niño events. This area was re-sampled in 2012, a La Niña period, at the same time of year (late April to early May) using the same sampling method, materials and where possible, sampling the same individual trees. During the 2005 study, all mature trees along the creek were sampled; however, this was not possible during the 2012 sampling period because some trees have since been removed, while others were inaccessible due to mud and standing water along many parts of the alluvial channel. As such, the 2012 samples were collected every 200–250 m. In all, 23 samples were collected in 2012 versus 107 samples collected in the original survey, covering approximately 6 km of the creek system.

Studies of *E. camaldulensis* leaves have shown that they are effective at taking up metals and provide a good distinction between background and mineralized settings (Fabris et al., 2008). *Eucalyptus camaldulensis* are furthermore ideal trees for biogeochemistry surveys due to their morphology and distribution; the trees are generally single-trunked and are up to 30 m tall, have deep penetrating tap roots and lateral roots that can spread to tens of meters from the trunk, and can be found along most of Australia's waterways (Fabris *et al.*, 2008).

Sampling was conducted by hand (jewellery-free, and clean of chemicals such as sunscreen to systematically minimise any possible contamination), selecting samples that appeared of a uniform maturity (fully open mature leaves) free from any obvious disease and from a uniform canopy height (approximately 2 m above ground level) (Dunn, 2007) and from around the tree canopy circumference as much as possible (which varies for trees with irregular canopies). Samples were taken from areas with minimal dust contamination (e.g. away from roads/tracks, mine/drill sites and cattle feed stations).

Once collected, the samples were stored in brown paper bags (2005) or calico bags (2012) to dry out. Paper and calico bags allow water vapour to escape and prevent the sweating and decomposition of samples. The bag tops were folded over, rather than stapled or pinned as this is a potential source of metal contamination. Samples were dried in an oven at 60°C for 48 h at the University of Adelaide, in order to remove excess moisture and to prevent decomposition. The samples collected in mid-2012, once dried, were sorted and re-packaged with samples split for storage and analysis to increase randomization and to further reduce possible sampling bias. The samples from 2005 were milled in the University of Adelaide laboratories using a stainless-steel 'coffee' grinder mill and stored in plastic Ziploc® bags in a cool storage room following initial analysis. Biogeochemical samples can be kept for at least 10 years if properly dried and stored (Houba *et al*., 1995). The 2005 samples were repackaged and submitted to the laboratory for geochemical analysis. All samples (2005 and 2012) were submitted to ACME Laboratories in Vancouver, Canada for processing and analysis. Preparation included further drying and milling to <100 mesh. The samples were not ashed. At ACME Laboratories, 0.5 g aliquots of sample were digested by HNO3 and modified aqua regia and analysed for a 53-element suite by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS). Quality assurance and control (QA/QC) were monitored by including randomized pre-preparation sample duplicates (1 in 10 duplication). During the laboratory stage, standard laboratory vegetation reference materials (in this case vegetation standard STD V16) were inserted into the sequence plus laboratory sample blanks and duplicates. The average pulp duplicate percentage errors for the 2005 samples were: Pb 3.3%, Ag 2.7%, Zn 1.5%, and Cu 0.18%, and for 2012: Pb 7.3%, Ag 10.1%, Zn 10.4%, and Cu 2.4% (calculated on a much smaller population of values than 2005). The duplicate per cent error for the standard STD V16 was: Pb 0.94%, Ag 2.0%, Zn 0.41%, and Cu 4.5%. These variations in sample duplicates and standards are small compared to the observed seasonal variations and do not influence the interpretations and conclusions drawn from our study.

We conducted stream sediment sampling at the same time as the 2012 plant sampling program to establish a baseline geochemistry for Pine Creek. A total of 23 samples were collected proximal to the *E. camaldulensis* so as to maintain some spatial comparability between the two media. The stream sediments are a strong representation of the physical component of downstream dispersion mechanisms within the creek as well as chemical dispersion. Approximately 2 kg of sediment were collected in the field focusing on the fine fraction (actively trying to avoid collecting gravels and coarse sands), with samples collected and stored in plastic sample bags. The samples were (where required) dried overnight at 60°C and then sieved using at <200 mesh in the University of Adelaide laboratory to retain the <75 µm fraction. The samples were then submitted to ACME Laboratories, where they were digested with aqua regia and analysed for the standard 53-element suite plus rare earth elements using ICP-MS.

Results

Stream sediments

The Ag and Pb results (Table 3.1; Fig. 3.3a and b) for the stream sediments have very similar spatial distributions within Pine Creek, with a small increase towards the area of mineralisation. Values are elevated immediately downstream/proximal to the area of mineralisation. The values then decline to a 'constant' level, higher than those of samples taken upstream of mineralisation (i.e. above what would be considered background for the creek of c. 32–50 ppb Ag and 15–25 ppm Pb and c. 4.5x Pb and 3.5x Ag the values recored along Fowlers and Umberumberka Creeks). At c. 5 km downstream, the sample results become more variable, with values oscillating between the highest values and the average for the creek. Over mineralisation, values reach 90.3 ppm for Pb and 384 ppb for Ag, while the highest values recorded were 129 ppm for Pb and 576 ppb for Ag towards the end of the creek.

Zinc values (Table 3.1; Fig. 3.3c) for stream sediments follow a similar trend to that of Ag and Pb with background (for the creek) levels upstream of the mineralisation, peaking approximately 200 m downstream of the mineralisation and then returning to a constant level (c. 55 ppm) that is higher than the upstream background values (c. 25–40 ppm). Proximal to the mineralisation, Zn concentration peaks at 124 ppm. The spatial distribution of Cu (Table 3.1; Fig 3.3d) along Pine Creek within the stream sediments differs slightly to that of Pb, Ag and Zn. While it still records its highest value (31.5 ppm) proximal to mineralisation, values do not remain elevated downstream, rather, they remain close to background (c. 14 ppm).

Table 3.1: Summary statistics for the four main commodity elements studied within the <75 µm stream sediment fraction.

	Pb ppm	Ag ppb	Zn ppm	Cu ppm
Mean	47.7	170	59.5	16.6
Median	46.2	155	57	15.6
Max	129	576	124	31.5
Min	15.7	19	26.8	12.4
Range	113	557	97.4	19.1
SD	26.7	138	20.2	4.38
RSD	55.9	80.9	34	26.5

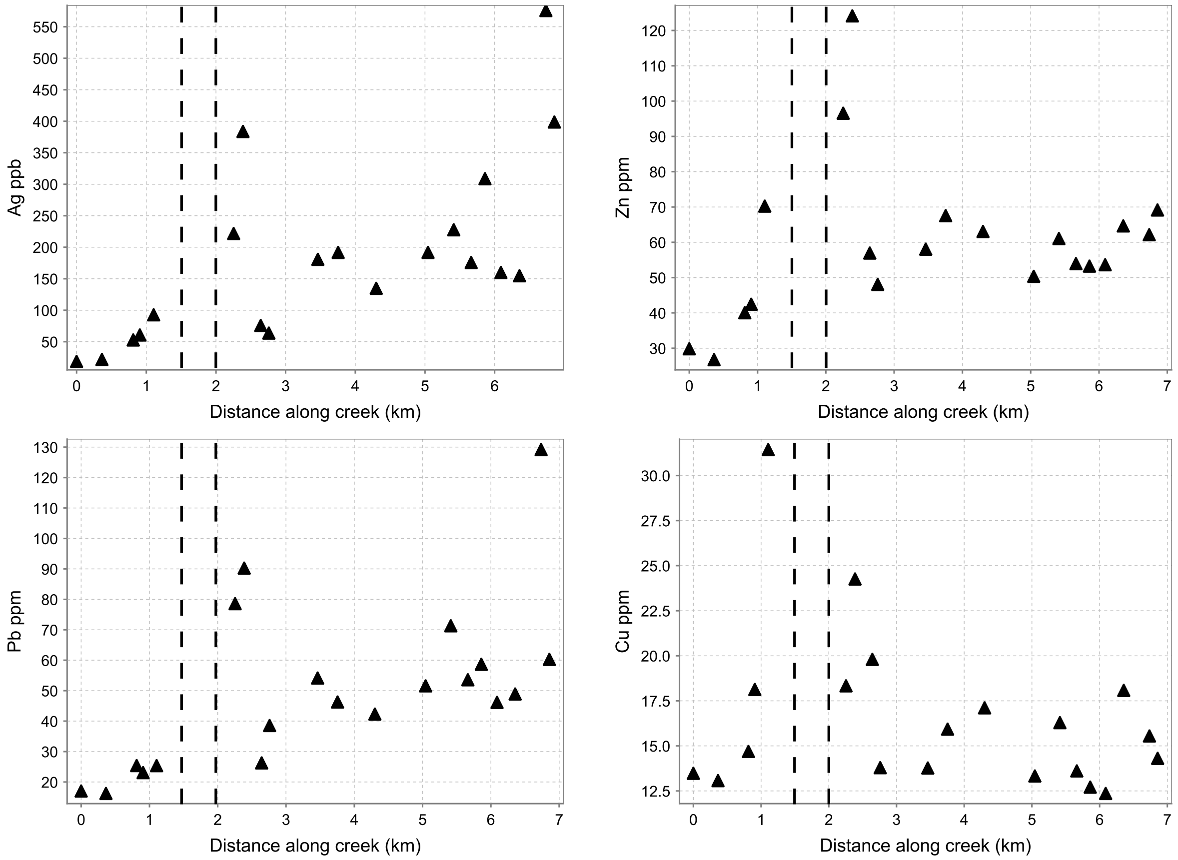

Figure 3.3: (a–d). Metal content of the <75 µm stream sediments collected in 2012 from Pine Creek (dashed lines indicate approximate location of mineralization).

Biogeochemistry

Measures of dust contamination

Wind-blown contaminants have the potential to contribute to leaf chemistry either by diluting the leaf chemistry or contributing to it and thus adversely influencing the findings of biogeochemical studies, particularly in areas around mine sites where there has been ground disturbance. Hulme (2008) prepared washed and unwashed samples of *E. camaldulensis* in her study and found dust contamination to have had little effect on the leaf chemistry. Hulme (2008) concluded that the vertically hanging and waxy cuticles of the *E. camaldulensis* leaves are well adapted to shed dust from their surface. Nevertheless, due to the close proximity of Pine Creek to the mine site and main road into the area, we took a conservative approach and corrected the data for the main commodity elements (Pb, Ag, Zn, and Cu) for detrital dust contamination by normalising to Zr. Zirconium was used as an indicator for potential detrital contamination because it is not a component of the Pinnacles mineralisation; its concentration within dust far exceeds that in biological materials and was measured at above detection limits in all of our samples. We did not use Al to measure contamination because it was at or below detection limit in a majority of samples.

Distribution of the commodity elements

The main commodity elements for the Pinnacles Mine of interest for biogeochemistry are Pb, Zn, Ag, and Cu. Non-commodity elements (those deemed essential in some part to plant health) within the Pine Creek system that are of interest for temporal variation include Al, Ca, Mg, Na, P, S, and Fe. The statistical data for the *E. camaldulensis* are summarized in Tables 3.2 and 3. The Pb and Zn data have been further split into an upstream and downstream fraction based on the two distinct populations observed within the sample population represented here in histogram form (Fig. 3.4).

Table 3.2: Summary statistics for *E. camaldulensis* Zr corrected biogeochemical data for the four main commodity elements studied. Lead and Ag data-sets are split between upstream (US) and downstream (DS) based on natural breaks in the data observed in the histogram plots.

	Pb (ppm)						**Ag (ppb)**						**Zn (ppm)**		**Cu (ppm)**	
Year	2005	US	DS	2012	US	DS	2005	US	DS	2012	US	DS	2005	2012	2005	2012
Count	107	26	81	23	5	18	107	26	81	23	5	18	107	23	107	23
Mean	44.9	150	11.2	12.2	40.3	4.42	121	393	34.1	329	92.7	16.2	48.8	59.7	7.73	9.38
Median	12.5	127	9.8	4.49	37.4	4.01	37.1	340	30	20	90	15.4	41	52.4	7.09	6.67
Max	323	323	41.8	69.2	69.2	9.77	821	821	111	165	165	32.5	111	139	24.8	26.5
Min	2.81	71.9	2.81	1.17	20.4	1.17	8.18	185	8.18	4	38	4	15.1	21.1	2.65	2.64
Range	320	251	39	68	48.8	8.6	812	636	103	161	127	28.5	95.9	118	22.2	23.9
SD	66.6	58.4	6.44	17.1	17.8	2.53	172	153	19.9	38.5	45.9	8.72	23.9	29.5	3.71	6.58
RSD	148	38.4	57.7	140	44.1	57.3	142	38.9	58.6	117	49.6	53.7	49.1	49.4	47.9	70.1

Table 3.3: Summary statistics for *E. camaldulensis* non-commodity elements but those considered essential to plant health; in %.

	Al (pct.)		**Ca (pct.)**		**Mg (pct.)**		**Na (pct.)**		**P (pct.)**		**S (pct.)**		**Fe (pct.)**	
Year	2005	2012	2005	2012	2005	2012	2005	2012	2005	2012	2005	2012	2005	2012
Mean	0.01	0.01	1.10	1.47	0.25	0.26	0.16	0.17	0.13	0.18	0.16	0.15	0.02	0.01
Median	0.01	0.01	1.03	1.38	0.24	0.24	0.15	0.17	0.13	0.18	0.14	0.14	0.02	0.01
Max	0.03	0.02	1.95	2.97	0.38	0.52	0.40	0.30	0.18	0.35	0.28	0.32	0.05	0.03
Min	0.01	0.01	0.57	0.75	0.16	0.15	0.01	0.02	0.09	0.08	0.03	0.08	0.01	0.01
Range	0.03	0.02	1.38	2.22	0.22	0.37	0.37	0.29	0.09	0.27	0.25	0.24	0.04	0.02
SD	0.01	0.01	0.32	0.58	0.04	0.08	0.11	0.09	0.02	0.05	0.05	0.05	0.01	0.01
RSD	51.5	51.7	28.9	39.5	17.4	31.9	65.8	52.3	16.9	33.5	33.1	33.5	31.9	36.6

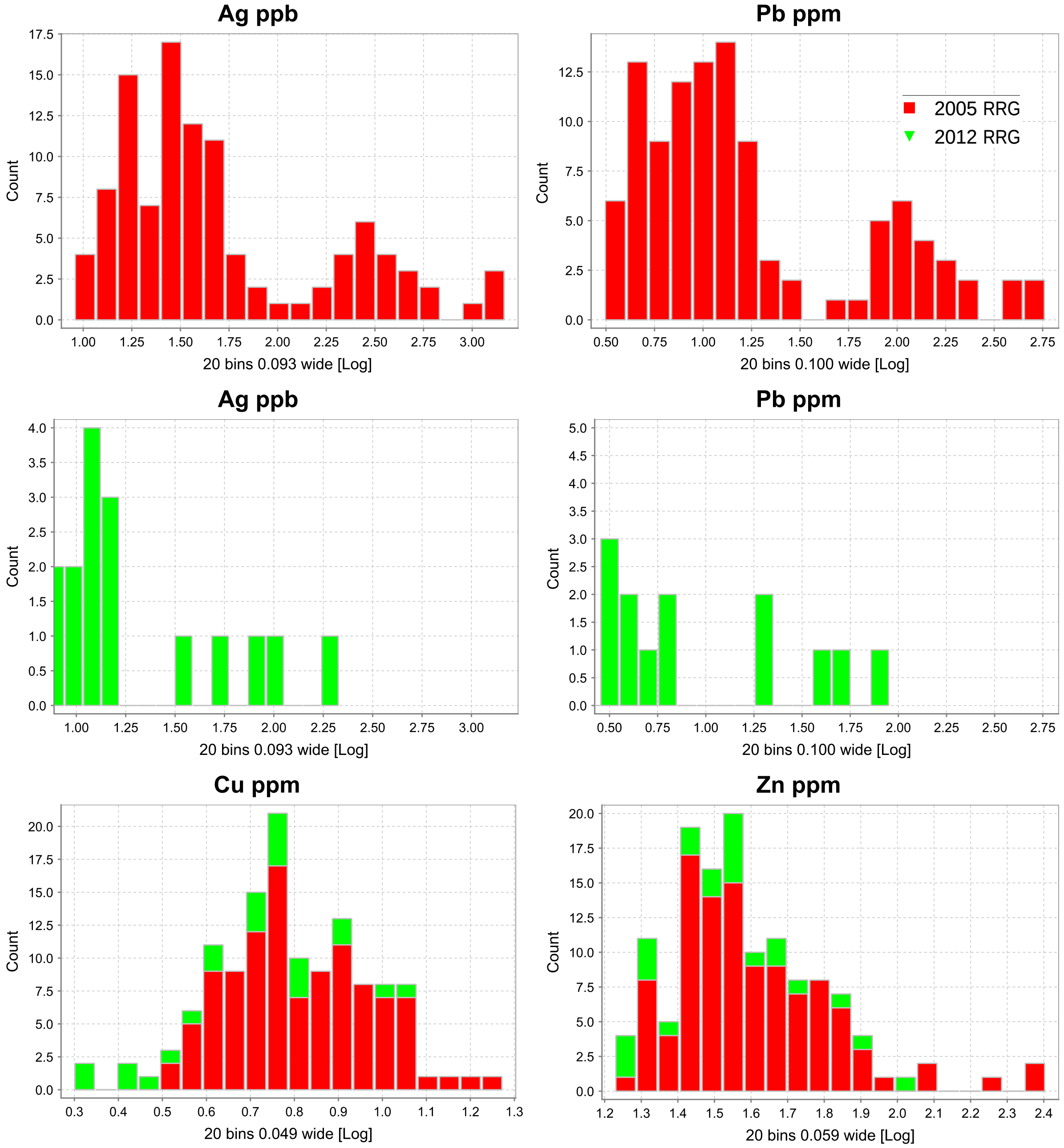

Figure 3.4: Histogram plots of the four main commodity elements for *E.camaldulensis* (non corrected). The plots for Ag and Pb clearly show the skewed distribution within the data-set and demonstrate the split populations. These split populations demonstrate the importance of anomaly cut-off values for same sample material that is sampled a number of years apart, with the 2005 values completely obscuring the 2012 results.

Values presented are concetration ratios of the raw data normalised to Zr followed by raw values presented.

Silver values (Fig. 3.5a) within the leaves of the *E. camaldulensis* from Pine Creek are almost an order of magnitude higher in the samples collected by Hulme in 2005 (Ag/Zr: 821, raw Ag: 1477 ppb) proximal to the Pinnacles mine than those collected in 2012 (Ag/Zr: 165, raw Ag: 214 ppb). Immediately south of the mine site, both the 2005 and 2012 values drop rapidly over a short distance (c. 750 m), they then level off before continuing to decrease. The 2005 samples have a greater range (Ag/Zr: 8.18–821, raw Ag: 9-1477 ppb) compared to 2012 (Ag/Zr: 4–165, raw Ag: 3-214 ppb).

The Pb content of the *E. camaldulensis* leaves (Fig. 3.5b) from along Pine Creek follow the same broad spatial trends in both 2005 and 2012, with maximum values occurring at the surface projection of the buried mineralisation, at which point values reach 580 ppm (Pb/Zr: 323) (2005) and 89 ppm (Pb/Zr: 69.2) (2012), followed by a drop of an order of magnitude in Pb levels beyond the mineralisation (south of the causeway). Values remain consistent along the creek for c. 2 km; they then gradually decrease by half an order of magnitude along the remainder of the creek transects.

The highest Pb and Ag values recorded along Pine Creek are 2.5 to 3 order of magnitudes higher than the background values established along Fowlers and Umberumberka Creeks for *E. camaldulensis.*

Zinc values (Fig. 3.5c) still maintain the same pattern as the other commodity elements along the creek, with higher values over and flanking mineralisation (maximum concentration of 254 ppm (Zn/Zr: 111) in 2005 and 98.7 ppm (Zn/Zr: 139) in 2012). While the values remain higher in the 2005 samples immediately upstream and overlying the mineralisation, beyond the mineralisation there is little difference between the two sampling periods with the concentrations being quite variable. At the southern (downstream) end of the creek transect, the 2012 samples begin to increase in Zn concentration in comparison to the 2005 samples.

Copper values (Fig. 3.5d) follow a similar pattern to that of Zn, with the values in samples upstream of the mineralisation being distinctly higher than for the 2005 samples. The difference between years is not as pronounced as with Pb and Ag values but corresponds with the maximum values at mineralisation. While the overall range of Cu is small (3.36–18.8 ppm in 2005 and 1.99–10.9 ppm in 2012), the values downstream are quite variable.

Overall, the box-and-whisker plots (Fig. 3.6) show that the most noteworthy difference between 2005 and 2012 occurs in the Pb and Ag values, both of which have greater mean values and a greater range of values in 2005. Zinc and Cu values have similar median values between the two sampling periods, with greater outliers in the 2005 samples. In contrast, box-and-whisker plots (Fig. 3.7) for those elements deemed essential for growth show that there is little to no difference between the two years. Phosphorus has a slightly higher average value in 2012 and a wider range of values. Calcium also has a slightly higher average value in 2012 in comparison to 2005 samples. There are only minor differences between sampling periods for Al, Mg and Na, and only minor differences in S contents. Box-and-whisker plots for the main commodity elements, for stream sediments and both the 2005 and 2012 *E. camaldulensis* samples, allow for comparison of the three sample media. While the stream sediments exhibit higher average values than both periods of biogeochemical sampling, the overall range of values is much more constrained (Fig. 3.8).

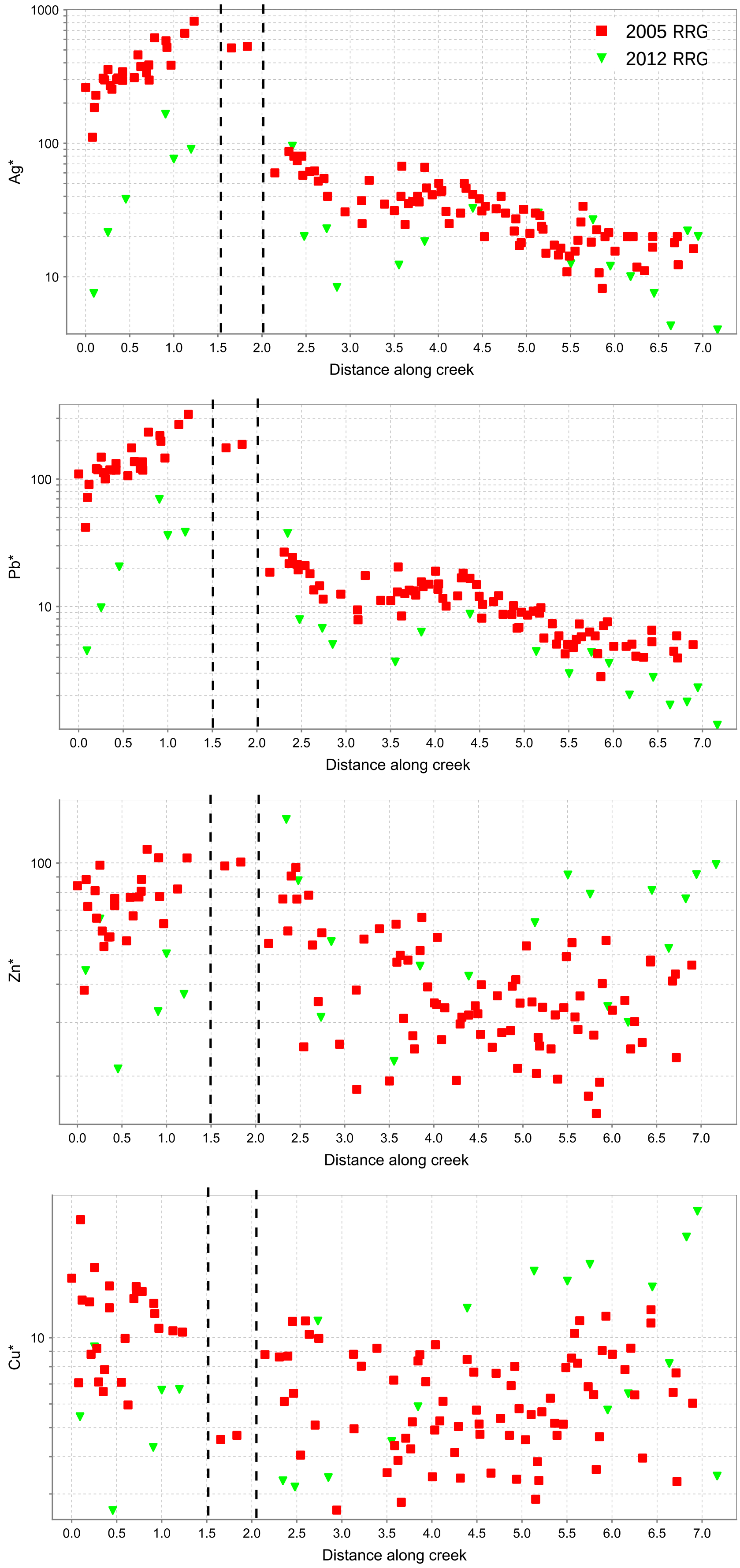

Figure 3.5: (a–d). Metal concentration in leaves of the *Eucalyptus camaldulensis* from along Pine Creek collected in 2005 and 2012. While values are highest in the 2005 samples proximal to mineralization (particularly for Pb, Ag & Zn), further downstream a larger dispersion footprint can be seen in the Zn and Cu in both years. (Dashed lines represent the known areas of mineralization and mineral occurrences.) *Data corrected to Zr (Ag in ppb, Pb Zn Cu in ppm).

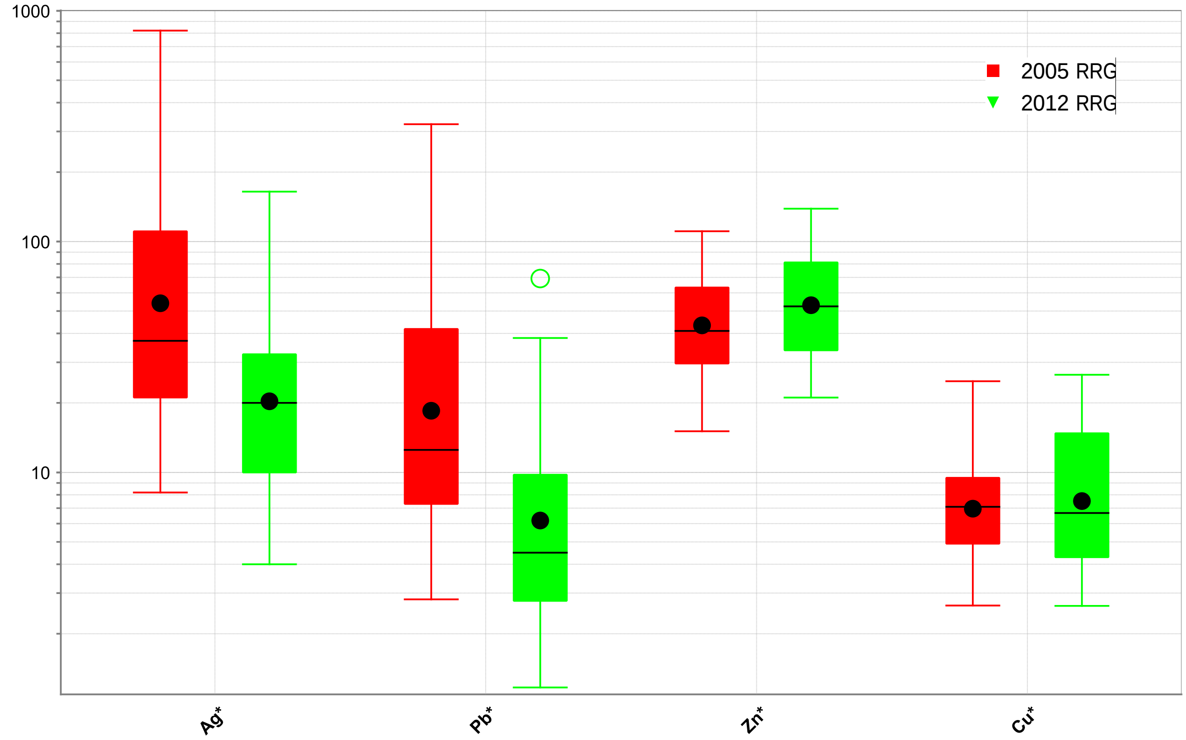

Figure 3.6: Box-and-whisker plots for Ag, Zn, Pb and Cu for *E. camaldulensis*. They show that there was a much larger range in values for Ag and Pb in the 2005 samples than in the 2012 samples, while the Zn and Cu values are comparable between years. Data corrected to Zr.

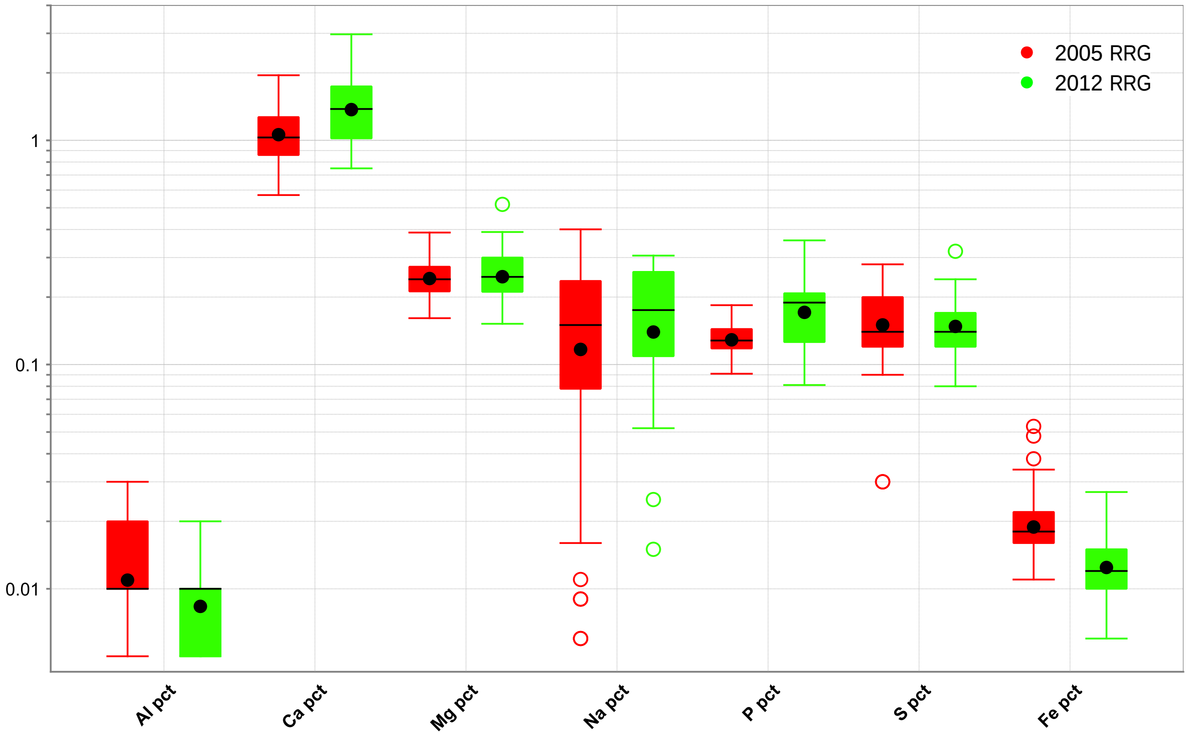

Figure 3.7: Box-and-whisker plots for non commodity elements (but essential for plant health) Al, Ca, Mg, Na, P, S and Fe within *E. camaldulensis*. There is very little difference between the years for those elements essential for plant health.

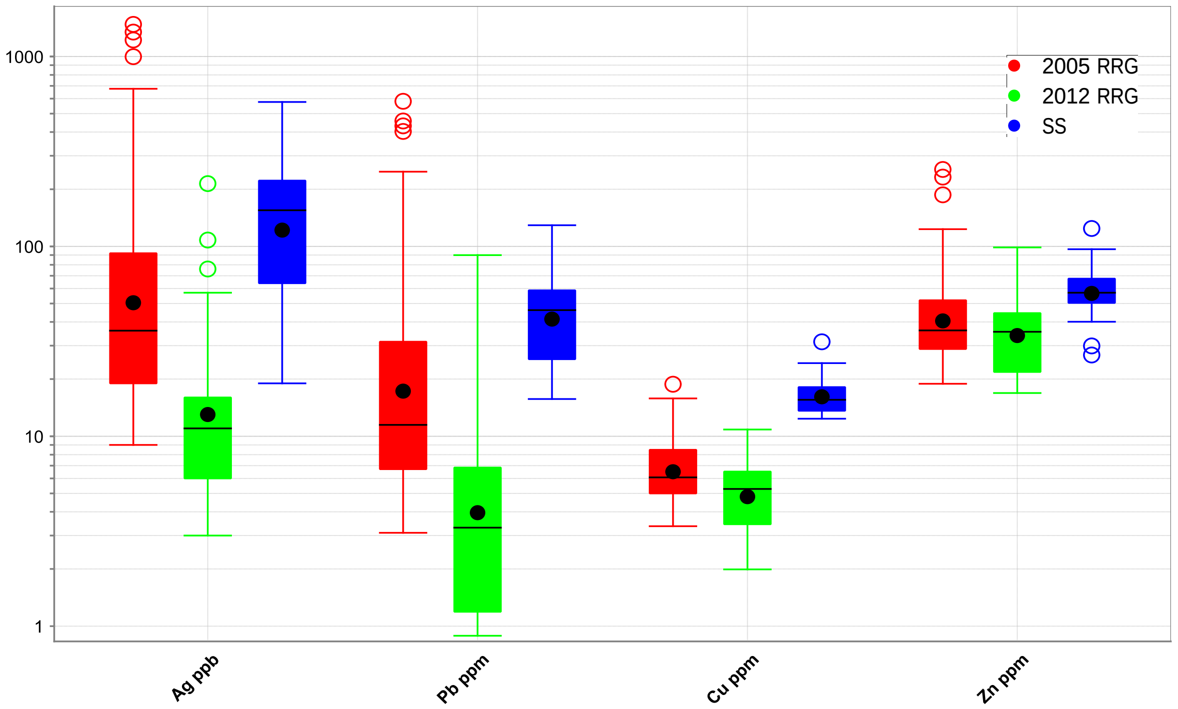

Figure 3.8: Box-and-whisker plots for Ag, Pb, Zn and Cu in stream sediments, both the 2005 and 2012 *Eucalyptus camaldulensis* samples. While the stream sediments have a higher average value, there is a much larger range of values recorded in both sampling periods for the *Eucalyptus camaldulensis.*

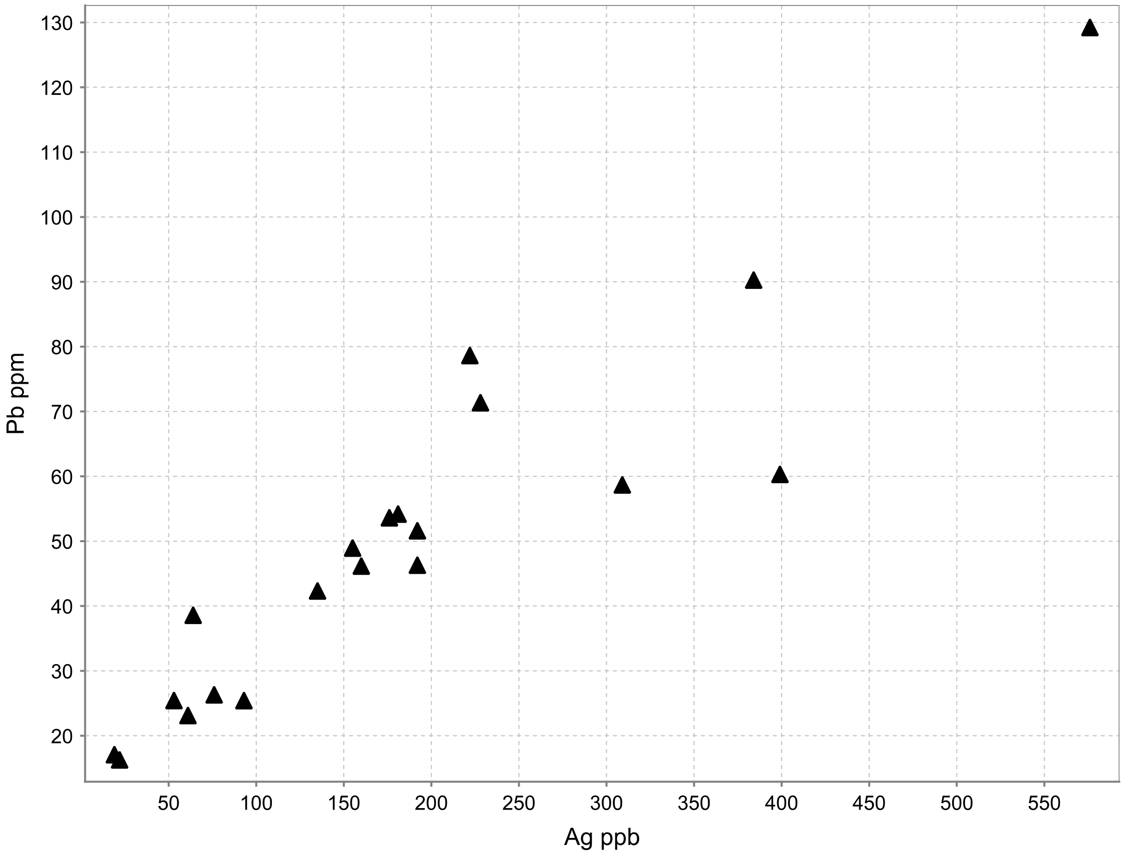

Figure 3.9: Scatter (X-Y) plot of the Ag and Pb content of the <75 µm stream sediment fraction. The strong correlation between Ag and Pb within the stream sediments is reflective of the strong association of Ag with galena and suggests that this relationship is maintained within the sediments.

Discussion

Downstream smearing of stream sediment chemistry

There is a general elevation in stream sediment concentrations for the commodity elements (Pb, Ag, Cu, and Zn) downstream of the mineralisation compared to samples upstream (Fig. 3.3). Although there are some high concentrations immediately adjacent to the mineralisation, these concentrations are close to or less than crustal averages and there is no systematic up-stream increase in concentration toward mineralisation. We interpret that this pattern is due to a combination of factors: (1) the point source of metal-rich sediment (the Pinnacles mineralisation) is only a small area of the catchment so that the amplitude of the stream sediment geochemical response is heavily diluted; and (2) Pine Creek is a low frequency, high intensity ephemeral creek. During high rainfall events, the creek acts as a ‘water-cannon’ moving a large amount of material very rapidly, and ‘smearing’ any possible anomaly along the system. Such ‘smearing’ produces a long dispersion train with relatively little contrast to background. In Pine Creek the dispersion train continues to the end of the sampling transect, c. 4 km beyond the area of known mineralisation, at which point Ag and Pb values rise again. This is likely a reflection of creek morphology and the redistribution of sediments caused by localized flooding and flood plain input from nearby creek systems, plus additional enriched sediment load from the creek flowing from the Broken Hill deposit, rather than sources underlying the creek (Fig. 3.1). The widespread aeolian cover, reworked by these stream systems, would also contribute to the dilution of stream sediment signatures of buried mineralisation. The strong correlation between Ag and Pb in stream sediments (Fig. 3.9) is reflective of the strong association of Ag with galena and suggests that this relationship is maintained within the sediments.

Essential vs. non-essential elements

Silver and Pb concentrations are highest in samples of those *E. camaldulensis* leaves from trees that are growing in the shallow cover directly overlying the area of blind mineralisation. These higher metal concentrations may be due to: direct interaction with buried mineralisation; interaction with the geochemical dispersion ’footprint’ of mineralisation; and/or run-off from the mine site. The 2012 biogeochemical results in particular show that the Ag and Pb concentrations decrease rapidly immediately downstream of mineralisation, with little downstream dispersion. Recent costean excavation in the creek bed near the tree with highest Ag, Pb and Zn concentrations in 2005 found previously unknown underlying mineralisation, now known as the Perseverance Zone (Reid, 2009). The close spatial relationship between Ag and Pb along Pine Creek in both years, as well as the strong geochemical relationship, is again reflective of the close association of Ag with the galena mineralisation. It suggests a similar means of uptake and behaviour by the plants in dealing with Ag and Pb, both of which are considered non-essential elements.

The remaining commodity elements (Zn, Cu) are only slightly elevated directly overlying the mineralisation and within the samples upstream of mineralisation; however, Cu and Zn concentrations are much more variable than those for Pb and Ag downstream with values recorded increasing towards the end of the transect. This may be due to a number of reasons, for example: the metals may be more widely abundant, they may be more mobile or are much more essential for plant growth and therefore better taken up to required levels. The distinction between areas of mineralisation and areas of background are less obvious when using Zn and Cu levels in *E. camaldulensis* samples. This is because these elements are essential to the health of the plants (Cu plays a significant role in photosynthesis and respiration while Zn is an integral part of a number of enzymes; (Kabata-Pendias & Pendias, 2000) and so the plants will take up the metals to the extent that they are needed while only slightly reflecting the increase in availability over mineralisation.

Other elements essential to plant growth (Fe, P, Ca, Al, Mg, S) plus Na are mostly comparable between sampling periods (Fig. 3.7). Any major differences would be likely to suggest that one of the year's samples may be a representation of physiological stress; however, this is not observed. This further suggests that the trees are performing selective uptake of elements that are essential for their health (such as Mg), while at the same time passively taking up elements that are not essential (such as Pb) and more directly linked to changes in shallow aquifer hydrogeochemistry between rainfall regimes (Fig. 3.10). The results here highlight how the biogeochemical responses of non-essential trace elements compared to essential elements can vary between different climatic events and associated hydrogeochemical regimes.

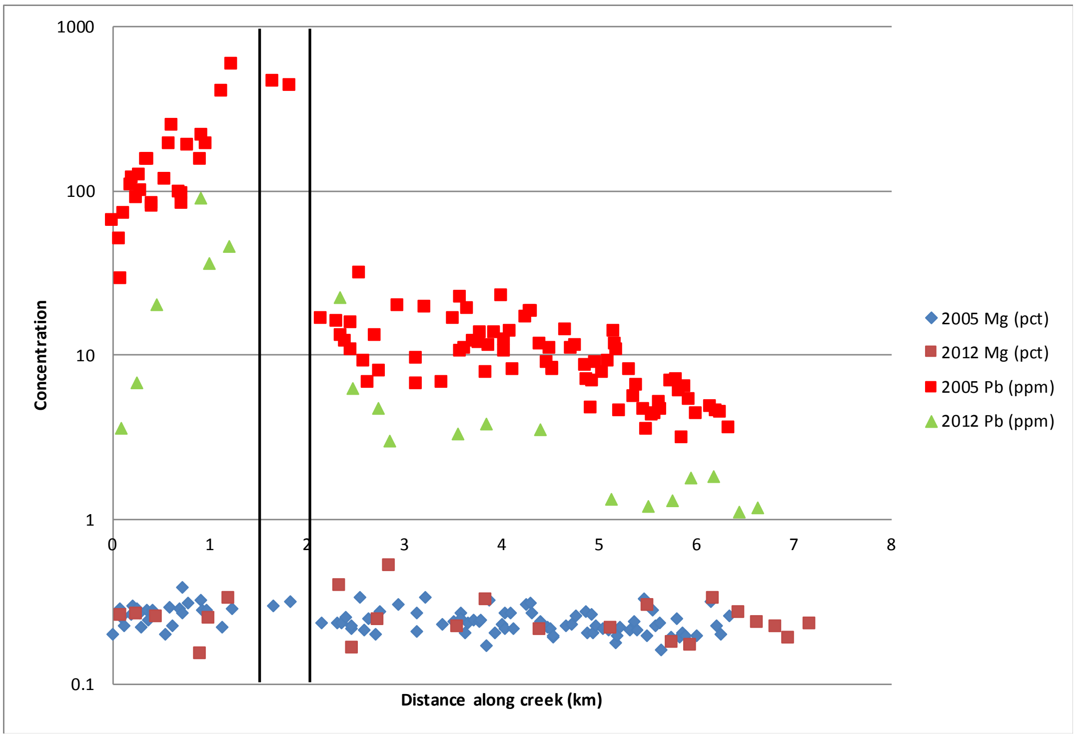

Figure 3.10: Comparison of Mg and Pb along the distance of the creek in *E. camaldulensis* using non normalised data. This demonstrates that while the dilution of the stream base aquifer between years significantly alters the levels at which non-essential elements such as Pb are taken up by the trees and alters with distance from source, it shows that essential elements such as Mg remain constant despite dilution and landscape setting.

Effect of rainfall

A number of studies have examined temporal variation from the seasonal to the year-to-year scale. Lintern (2007) found significant seasonal differences in the geochemistry of *Eucalyptus incrassata* and *Melaleuca uncinata* sampled two years apart, including changes in the major elements of Ca, K, Mg, and Na (Lintern, 2007). Lodgepole Pine needle analysis conducted by Stednick in the early 1980s showed that while the distributions of some trace elements (Cu and Zn) were relatively stable, both throughout the year and from year to year, rare elements such as Au changed significantly with the seasons (Stednick & Riese, 1987; Stednick *et al.*, 1987). However, the changes observable in the Pine Creek samples cannot be accounted for by annual seasonality changes as they were sampled at the same time of year. Sampling procedures for both periods of sampling and the analytical procedures used are equivalent which would signify that the changes observed are a result of external influences rather than the result of sampling and analytical procedures. The most significant difference between the two sampling periods is the rainfall regime as a result of the local cyclic rainfall patterns observed for arid Australia and which have then been exaggerated by the climatic changes associated with El Niño and La Niña.

Previous to the 2012 sampling period, Broken Hill received about twice the annual average rainfall for the two years prior and during the year of sampling. The 2010–2011 La Niña event has been one of the strongest on record with 2010 and 2011 being Australia's third and second wettest calendar years on record, respectively, with the average rainfall event in the Broken Hill area lasting four days (Bureau of Meteorology, 2012b). The extra rainfall caused extensive flooding in the region and with the changes in rainfall there is a change in the availability of water for trees. To understand the implications of this for the *E. camaldulensis* growing along Pine Creek, the nature and landscape setting of where the trees grow along the creek need to be considered. Pine Creek is an ephemeral system, only flowing after extensive rainfall events. Dawson & Pate (1996) showed that the shallow lateral roots and deep tap roots of the *Banksia prionotes* (a native tree to Western Australia) had access to different water sources and dominance changed with seasonal change. During the wet winter, water was predominantly taken up from the lateral roots that took advantage of the higher rainfall and greater water availability in the upper soil. In contrast, during the drier summer period, water was predominantly taken up via deeper (sinker) roots from deeper water sources. This same idea can be applied to Pine Creek, where, during periods of drought, the tree would take water preferentially from the deeper ground water/stream base aquifer, and during periods of rainfall the trees would make use of the available surface water.

During El Niño, when the rainfall is lower than average and temperatures generally higher, the water level of the stream base aquifer would be significantly lower and the elemental concentrations in the stream base aquifer would be expected to be higher. Factors contributing would include: lesser rainfall recharge, greater evaporation, longer interaction with the mineralisation and other bedrock lithologies at the base of the alluvial base aquifer, and slower through-flow in the system. With the changes in climatic regime during El Niño and La Niña, the resulting changes in rainfall with each event play a significant role in the hydrogeochemical concentrations of the underlying stream base aquifer underlying Pine Creek. During La Niña the greater rainfall would lead to a greater input of water into the system, meaning the chemistry of the shallow alluvial aquifer is typically diluted and flushed (greater volume of mixing of enriched water with 'clean water'; Fig. 3.11).

In normal conditions and during prolonged drought (such as during 2005 following the 2002/3 El Niño event), the deep penetrating roots of the trees would get most of their water from the underlying shallow alluvial aquifer. The chemistry of the aquifer would be in equilibrium with the chemistry of the sediments through which it passes and the underlying bedrock lithologies (which in this case is mineralised). During 2012, the La Niña high rainfall levels lead to greater input of water into the system, thus diluting the hydrogeochemistry of the shallow alluvial aquifer. With the shallow alluvial aquifer diluted and the additional uptake of water by the lateral root system of the tree from the surface water, lower metal levels within the tree would result as they become diluted in the greater volume of 'clean' water. With those samples derived from trees within a creek channel, it is important to consider the morphology of the drainage channel, as well as sediment transport and residence within the system. At the start of the sampling transect along the creek, the depth to the base of the creek (and therefore bedrock) through the cover is shallow, with extensive bedrock exposed in the creek bed (Fig. 3.11). At this point the rainfall input into the system appears to have a significant effect on the biogeochemistry of the *E. camaldulensis* growing in the area, as is reflected in the results (Fig. 3.5), with samples directly overlying and flanking the mineralisation showing significantly different values between sampling periods. The shallow depth to basement means that tree roots and the water source would always be in close proximity to the metal source, further supporting the theory of a diluted alluvial stream base aquifer. The high values recorded upstream of the mineralisation in the *E. camaldulensis* samples are opposite to what is observed in the stream sediments where values are much lower. This further supports the argument that the trees are taking up water that is more closely related to the bedrock underlying the stream sediments rather than to the stream sediments themselves. At the downstream section of the survey (Fig. 3.11), the depth to the bedrock is greatly increased. There is a greater amount of alluvium build-up due to a change in the creek morphology (sharp 90° bend) and the addition of tributary creek sediment loads. Here, during periods of drought, the deep sinker roots of the *E. camaldulensis* will take up water from a deeper source, interacting with both the stream sediments and underlying bedrock. However, during the periods of high rainfall and input to the creek during La Niña, the trees will take up the more accessible water in the surface sediments, as outlined earlier, with very little interaction with the bedrock. The chemistry of the trees is then much more a reflection of the recent rainfalls and its short interaction and an amalgamation of the stream sediment chemistry rather than a representation of what lies beneath.

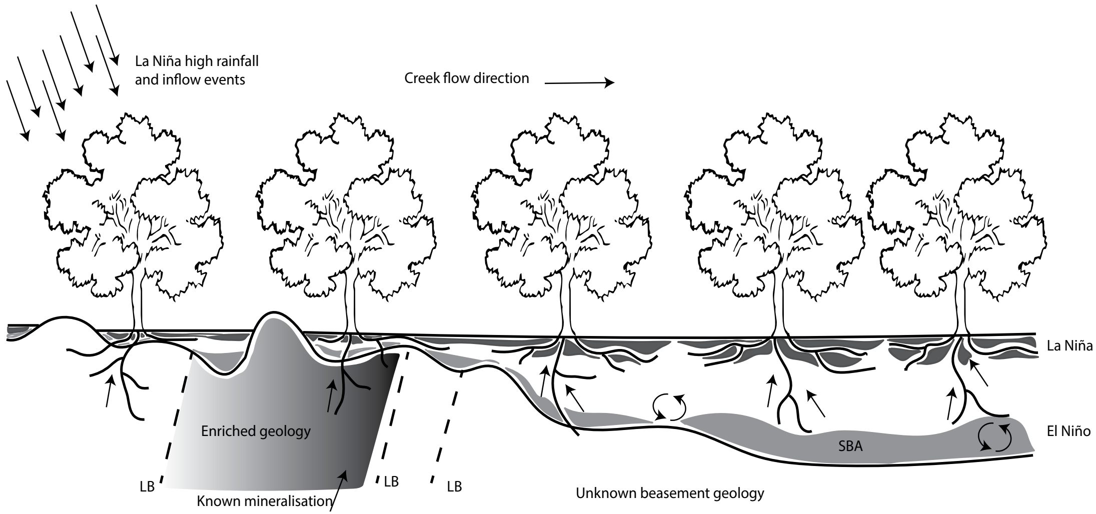

Figure 3.11: A schematic representation of the changes that occur with the stream base aquifer brought about by different climatic conditions. Additional rainfall and inflow during La Niña conditions flushes the stream base aquifer (SBA) and provides additional, easily accessible, surface water for the extensive lateral root systems of the *Eucalyptus camaldulensis*. It further represents the potential depth-to-bedrock along the creek and the interactions with the known underling geology, possible lithological boundaries (LB) and the interaction of the tree roots with crack in the shallow outcropping geology. The greater the depth to bedrock, the less representative the biogeochemistry is of the underlying lithologies.

Implications for mineral exploration

Knowledge of the climatic variations of an area is important for biogeochemical surveys, especially if plant biogeochemical sampling is conducted over several seasons or years or uses historical data-sets. The local climate variation and cyclic rainfall patterns as seen in the Broken Hill region could have a significant effect on the biogeochemical results of a survey and would be further enhanced by climatic changes brought on by climatic phenomena such as El Niño and La Niña. These fluctuating rainfall amounts could lead to the misinterpretation of geochemical data obscuring the contrast between background and anomaly, leading to potentially missed opportunities and mineralisation occurrences being overlooked. Sampling that does occur over several seasons or is affected by large climatic changes would still be possible, but should be considered with different anomaly cut-offs and re-sampling some of the existing data points (where applicable) to establish if there is, in fact, a change between sampling seasons. This can further be addressed by splitting the data into smaller populations based on data splits observed in histogram plots (Fig. 3.4a–f).

Splitting the data-set into smaller populations based on natural data breaks in this case was only necessary for some but not all of the elements observed in this study. Splitting the data allows for a more meaningful understanding of the values in relation to median values and ranges, without information being lost or obscured by outliers. An example of this is derived from the anomalous samples collected in the 2005 sampling period, where samples with Pb >31.4 ppm would be considered anomalous, whereas if that value is applied to the 2012 sample data, it would mask the biogeochemical response to the underlying mineralisation. Concentrations considered to be anomalous for the 2012 data would be Pb values greater than 4.7 ppm. Landscape setting is also important to consider during a biogeochemical survey. A survey that is focused along a drainage/alluvial channel, such as the one conducted along Pine Creek, would have a halo that is constrained and focused within the bounds of the creek system, with the biogeochemical footprint for Pb within Pine Creek restricted to approximately 1 km either side of the mineralisation. However, a survey over a colluvial plain could have very wide anomalies and multiple point sources and may be difficult to pin-point if they are either laterally or vertically transported.

This study has shown that biogeochemistry is a reliable means of exploration during both periods of drought and, to a lesser extent, after high rainfall and flooding. Ultimately the main implications which need to be considered are: changes in anomaly/ background thresholds due to differences in absolute values for trace metals, and the differing sizes of geochemical haloes, influencing the detection of footprints and ultimately the required sample spacing to detect the footprint.

Conclusion

A biogeochemical survey over an area of known mineralisation has shown that the changes in rainfall from year-to-year within the context of climatic phenomena such as El Niño and La Niña can play a significant role on the metal content of *E. camaldulensis*. While not every El Niño or La Niña event is identical in intensity and impact on the country, the long term cycles are clearly defined in yearly rainfall patterns. Our results indicate that the change in rainfall can result in concentrations in the leaves that are an order of magnitude different in trees that are growing over buried mineralisation. These differences are brought about by the diluting effect of the additional inflow of water into the creek's stream base aquifer during a La Niña event. The additional rainfall dilutes the signature of mineralisation while providing 'clean' water to the trees that has not interacted with the underlying mineralisation. The implications of this are important to the mineral exploration industry where sampling programs can be spread over several seasons and years and may result in a missed opportunity. To overcome the confounding effects of changing rainfall events, the surveys should include re-sampling a number of the same sample points, splitting data into smaller populations based on natural breaks and years and establishing different anomalous and background thresholds for each data-set.

Chapter 4: Umberumberka Creek – constraining lateral dispersion and the implications for mineral exploration

Foreword

The purpose of this chapter is to test the extent of lateral geochemical dispersion, as measured in stream sediment geochemistry and *E. camaldulensis* biogeochemistry, within an entire catchment from its erosional headwaters to its distributive alluvial fan.

This final case study aimed to pull together what was learnt from the studies along Fowlers and Pine Creeks. Umberumberka Creek has the highly mineralised Broken Hill Block, an area of high-grade highly metamorphosed highly prospective bedrock, within its catchment area and is dotted with numerous small mineral occurrences. The creek then flows onto the Mundi Mundi Plains - an area of thick transported cover around 150 m thick overlying the same prospective geology of the Broken Hill Block with mineralisation identified within it.

Umberumberka Creek and the Mundi Mundi Plains are an ideal area to establish a case study as a number of exploration companies have conducted geochemical surveys on the plains that have identified a geochemical response thought to be derived from underlying mineralisation. These survey were sat on the distal fringes of the large creek and fan systems that drain the Broken Hill Block and this was considered to be of little impact.

The study showed that the creeks could shift a geochemical signal at least 10 km out onto the plains with results that were comparable to the results obtained by the exploration companies. It showed that biogeochemical surveys were more successful at identifying mineralisation when it was situated directly beneath the tree where its roots have close and prolonged interactions with the stream base aquifer, otherwise values fell within the range established along Fowlers Creek. Out on the plains the tree chemistry showed no reflection of the deeply buried underlying geology, but did reflect a close to upper catchment average.

The samples were collected by the author and Dr Steve Hill and PhD student Verity Normington in 2011. All samples were prepared by the author and submitted for analyses. All treatment of the data was done by the author.

Abstract

The need to constrain lateral dispersion away from a mineralisation source becomes ever more important when it comes to identifying and defining a new mineral deposit. It becomes even more important as exploration moves from areas of exposed and shallowly covered bedrock to areas of ever increasing cover thickness. Umberumberka Creek straddles the highly mineralised Willyama Supergroup in the Barrier Ranges NSW, host to the famous Broken Hill Pb-Zn-Ag Line of Lode deposit, while continuing on to the Mundi Mundi Plains, an area of thick transported cover over prospective bedrock. Samples of *Eucalyptus camaldulensis* (river red gum) leaves and stream sediments were collected simultaneously along the length of Umberumberka Creek along with sediments samples from a small profile through fan sediment out on the Mundi Mundi Plains.

Biogeochemical analysis of the leaves showed that within the catchment area of the creek, *E. camaldulensis* were partially able to delineate some changes in the underlying geology, but without prior knowledge of the underlying geology and mineralisation would be of little use in identifying trends within the data related to changes in geology. The stream sediment geochemistry within the catchment area was likewise difficult to discern due to a strong correlation with the clay fraction and its distribution in the creek following floods and heavy rain. Beyond the headwaters both stream sediments and *E. camaldulensis* demonstrated a catchment average that was maintained to at least 12 km from the range front.

Both sample media demonstrated the creeks capability to transport material far out onto the plains with element values at concentration that could be considered anomalous. This becomes ever more important where exploration companies are drilling surface anomalies along the edges of large alluvial fans without taking into account the influence of lateral dispersion.

Introduction

Mineral exploration in Australia is moving from the areas of exposed and shallowly covered bedrock to areas of ever increasing cover thickness and the need to be able to readily understand and constrain where an anomaly originated from is ever more important. Exploration around the Broken Hill area, NSW, has been focused on finding another Broken Hill Type Pb-Zn-Ag deposit beneath the 150+ m of transported cover of the Mundi Mundi Plains. Previous geochemical studies in the area (Fabris *et al.*, 2009a; Hedger and Dugmore, 2001; Tonui *et al.*, 2003) have identified mineralisation within the buried bedrock. BHP Mineral Discovery, targeted Broken Hill style mineralisation beneath the Mundi Mundi Plains, through 150 m of transported cover at their “Polygonum” tenement, 40 km NW of Broken Hill (Hedger and Dugmore, 2001). Early drilling of a gravity survey response identified an area of mineralisation potentially equivalent to that of Broken Hill. This was followed up with a series of soil sample transects across the gravity response, with relatively high Ag concentrations directly over the gravity trend (30 ppb), follow up drilling of these sites identified further mineralisation but higher soil concentrations did not correspond with higher mineralisation grades (Hedger and Dugmore, 2001). Further soil work at the “Polygonum” tenement tested multiple analytical methods to determine the Ag content of soils overlying the previously identified mineralisation; variations within the results were interpreted to correspond with changes in the underlying lithology (Fabris *et al.*, 2009). PlatSearch NL’s “Thunderdome” prospect NW of Broken Hill, with Pb-Ag-Zn and Cu-Au mineralisation beneath 200 m of cover, was also identified by drilling geophysical patterns (Tonui *et al.*, 2003). Tonui *et al.*, (2003) conducted a geochemical study of down-hole regolith samples from six drill holes, to examine the expression of the mineralisation in the cover. The sediment Pb-Ag-Zn and Cu-Au contents were interpreted to be linked to the underlying mineralisation.

The link between these sites, other than the search for Broken Hill type mineralisation beneath 150+ m of transported cover, is their position within the landscape. Both sites are on the fringes of large fan systems with the soil anomalies of Polygonum sitting on the fringes of a very distinct fan as shown in the radiometrics (Fig. 4.1), which shows distinctive Th and U footprints within the fan systems 10-15 km out from the range front, and regolith landform map (Fig. 4.2), and though they all maintain that the anomalies where the result of vertical migration of metals through 150+ m of cover, none significantly tested for lateral transport. Previous geochemical exploration studies in the area have tended to downplay the potential of lateral dispersion from the catchment headwaters out onto the Mundi Mundi Plains.

We set out to test the possible influences of the ephemeral creeks draining off the nearby Broken Hill Block on the surficial geochemistry of the Mundi Mundi Plains and the possible implications this could have on mineral exploration into the future. This was to be tested by focusing on a single creek system from its erosional upper headwater/catchment area and following it onto the plains to its alluvial fan and floodout point where it becomes more depositional. Stream sediment samples, biogeochemical samples from *Eucalyptus camaldulensis* and sediment samples from a section through the alluvial fan, were collected to establish the extent of lateral dispersion and the influence of vertically accumulated materials.

There are a number of models that can account for the distribution of elements within the cover sequence of a basin. Vertical movement within the cover can be split into two groups, those that occur within the phreatic (saturated) zone and those that occur within the vadose (unsaturated) zone. Extensive descriptions of many of the processes can be found in Aspandiar *et al.*, (1998). Four further factors that effect dispersion includes; relief, current climate, Neoformation or accumulation of minerals and the nature of the overburden (Butt, 2005).

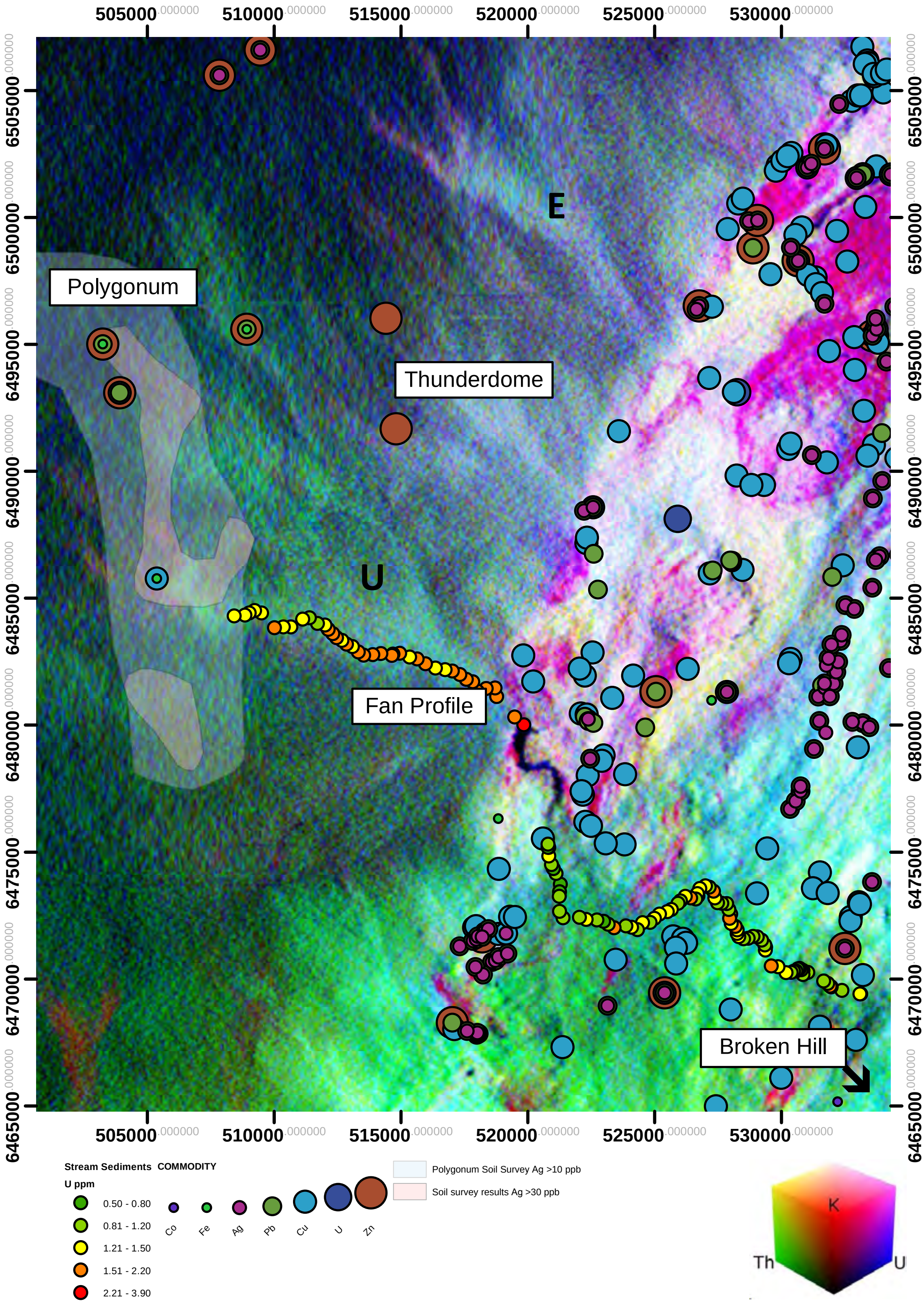

Figure 4.1: Radiometric image of part of the Barrier Ranges and Mundi Mundi Plains, NSW. The image shows the extensive dispersion of Th and U along the fan systems that drain the Barrier Ranges and its numerous mineral occurrences onto the plains. Highlighted (pale blue) is an area identified through an aeromagnetic survey as prospective for Broken Hill Type mineralisation and within that areas where a soil survey returned Ag >30 ppb and considered prospective. Uranium stream sediment data is based on natural breaks in the data. Eldee Fan = E, Umberumberka Fan = U. Base image from Minty *et al.*, 2009.

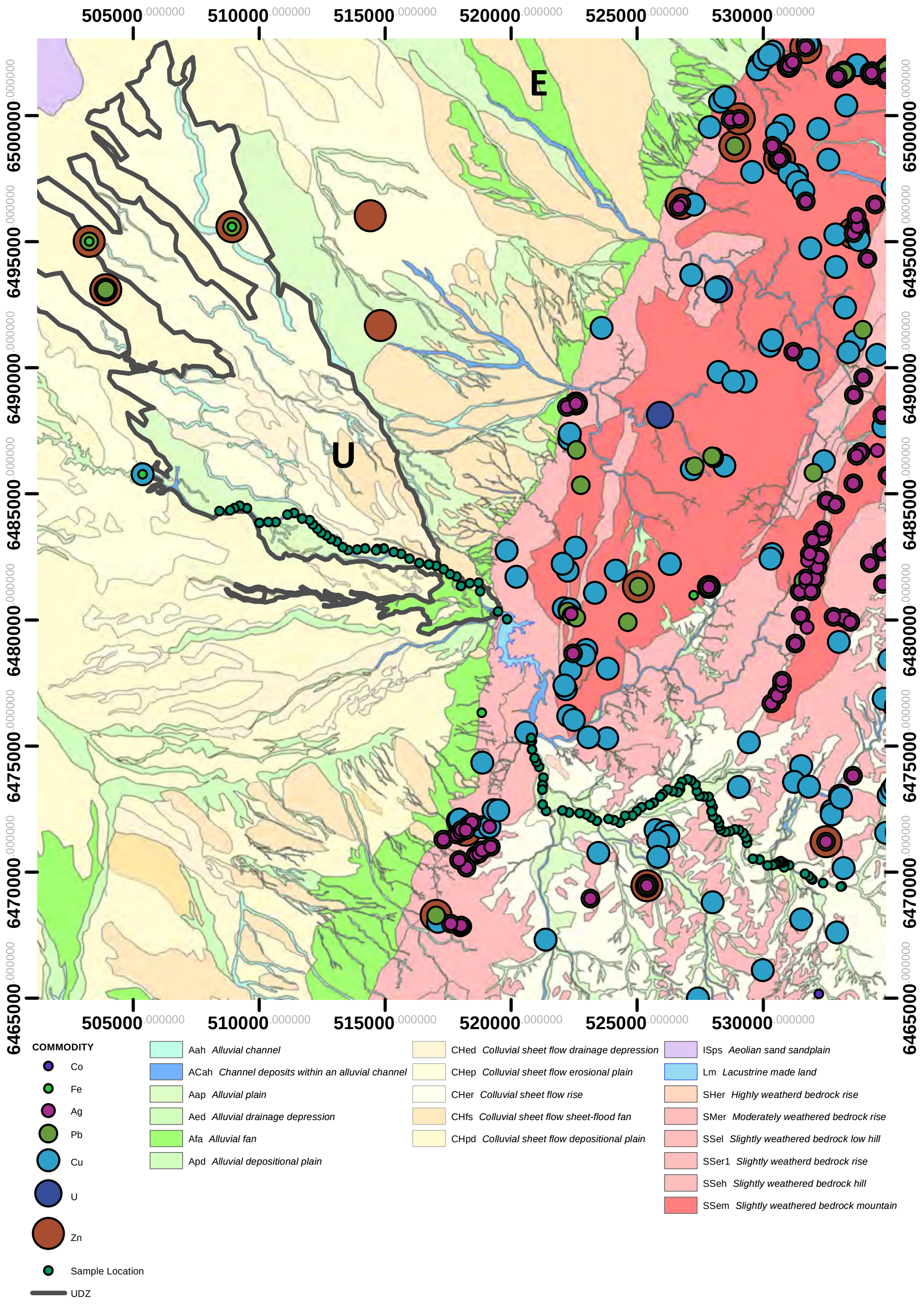

Figure 4.2: Regolith –Landform map of the Umberumberka Creek catchment area and flood out. The extent of lateral transport and multiple generations of fan deposits out onto the Mundi Mundi Plains are easily observable. Eldee Fan = E, Umberumberka Fan = U.

The degree of relief, the nature of the current climate and the nature of the overburden all determine if physical or chemical weathering is going to be more prevalent in a landform, and to what minerals can form or accumulate in the area (Butt, 2005).

Lateral transport has been shown by others (Hill *et al.*, 2005; Hulme, 2008; Mitchell *et al.*, 2015), particularly in the Broken Hill region, to play a major role in the distribution of surface anomalies. Hulme (2008), while sampling *E. camaldulensis* along Pine Creek at the Pinnacles Pb-Zn mine south-west of Broken Hill, showed the extent of metal movement along the creek. High Pb concentrations in the biogeochemical samples were proximal to mineralisation with minimal downstream dispersion, while Zn exhibited high concentrations proximal to mineralisation as well as a distinct downstream dispersion pattern (Hulme, 2008). These results were expected due to the relative mobility of each metal, Pb low and Zn high (Dunn, 2007). What was not expected was a secondary Zn high that was identified where Pine Creek joins a larger creek from the north-east, drilling of these anomalies failed to identify any underlying mineralisation, this was later believed to be the distal Zn footprint of the Broken Hill Line of Lode 10 km to the north-east (Hulme, 2008). Further studies at Pine Creek by Mitchell *et al*. (2015) looked further at the extent of lateral dispersion from mineralisation in biogeochemical samples in relation to climatic events and compared these results to the geochemistry of the stream sediments sampled proximal to the biogeochemical samples. It was found that while concentrations of elements within the biogeochemical samples changed with the changes in climatic events, the spatial distribution of an anomaly remained consistent. It further showed the extent of lateral dispersion within the stream sediments, with elevated concentrations of Pb, Ag and Zn recorded approximately 5 km downstream from the point of mineralisation.

Study Area

Climate and land use

The Broken Hill region experiences an arid- to semi-arid climate, with cold dry winter and summers generally hot and dry with summer storms bringing much of the rainfall into the region. Average temperatures range from 32.7°C in January to a low of 3.8°C in July, with the average yearly rainfall being 223.9 mm (over a 120 year period) (Bureau of Meteorology, 2012a). Much of the region is used for rangeland grazing of both cattle and sheep. A majority of the Broken Hill region has in the past undergone extensive mineral exploration, and small and large scale mining operations in the past 100 years, including the Broken Hill supergiant mine on the outskirts of the study area that is still being worked.

Geology and Mineralisation

The geology of the Broken Hill region can be split into 3 broad groups; the Willyama Supergroup of the Broken Hill and Euriowie Blocks, the Adelaidean rocks that unconformably overlie the Willyama Supergroup, and the recent sedimentary basins. The Willyama Supergroup consists of a series of meta-sedimentary and meta-volcanic rocks Paleo-Mesoproterozoic in age (1730-1640 Ma), deposited in a back-arc environment as part of a rift zone on a thin crust (Stevens *et al.,* 1988). Initial deformation of the group was during the Olarian Orogeny (1600 – 1580 Ma), followed by a hiatus in deposition till we reach the deposition of the Adelaidean sedimentary rocks (1100 Ma) which unconformably overlies the Willyama Supergroup (Stevens *et al*., 1988), both where later deformed during the Delamerian Orogeny (520-500 Ma). The Broken Hill Domain is flanked by depositional basins of Tertiary, some Mesozoic and Recent sedimentary transported cover (Fig. 4.3).

The region is known for its numerous mineral occurrences, the most notable being that of the Broken Hill Line of Lode Pb-Ag-Zn deposit. As well as the Line of Lode there are numerous locations across the Barrier Ranges where anomalous concentrations of Pb, Zn, Cu, Au, U and Ag noted (Fitzherbert *et al.*, 2015). The Broken Hill domain consists of two main types of Pb-Ag-Zn mineralisation, Broken Hill-type stratiform and Thackaringa-type vein deposits, and numerous small occurrences of other metals (Barnes, 1988). The Broken Hill-type Ag-Pb-Zn stratiform deposits are hosted within the Broken Hill Group metasediments, either psammite or psammopelite type specifically within the quartz-gahnite and/or garnet-quartz-rich horizons. The mineralisation is hosted generally within galena, Fe-rich sphalerite and other minor sulfides (Barnes, 1988). Thackaringa-type Ag-Pb-Zn vein deposits are hosted by siderite-quartz+-calcite veins 0.1-1 m thick in fault or retrograde shear zones. Ore minerals include; argentiferous galena, sphalerite, chalcopyrite, pyrite, tetrahedrite and arsenopyrite. Little deformation to those outside the shear zones suggests that they developed late in the geological history of the Barrier Ranges (Barnes, 1988).

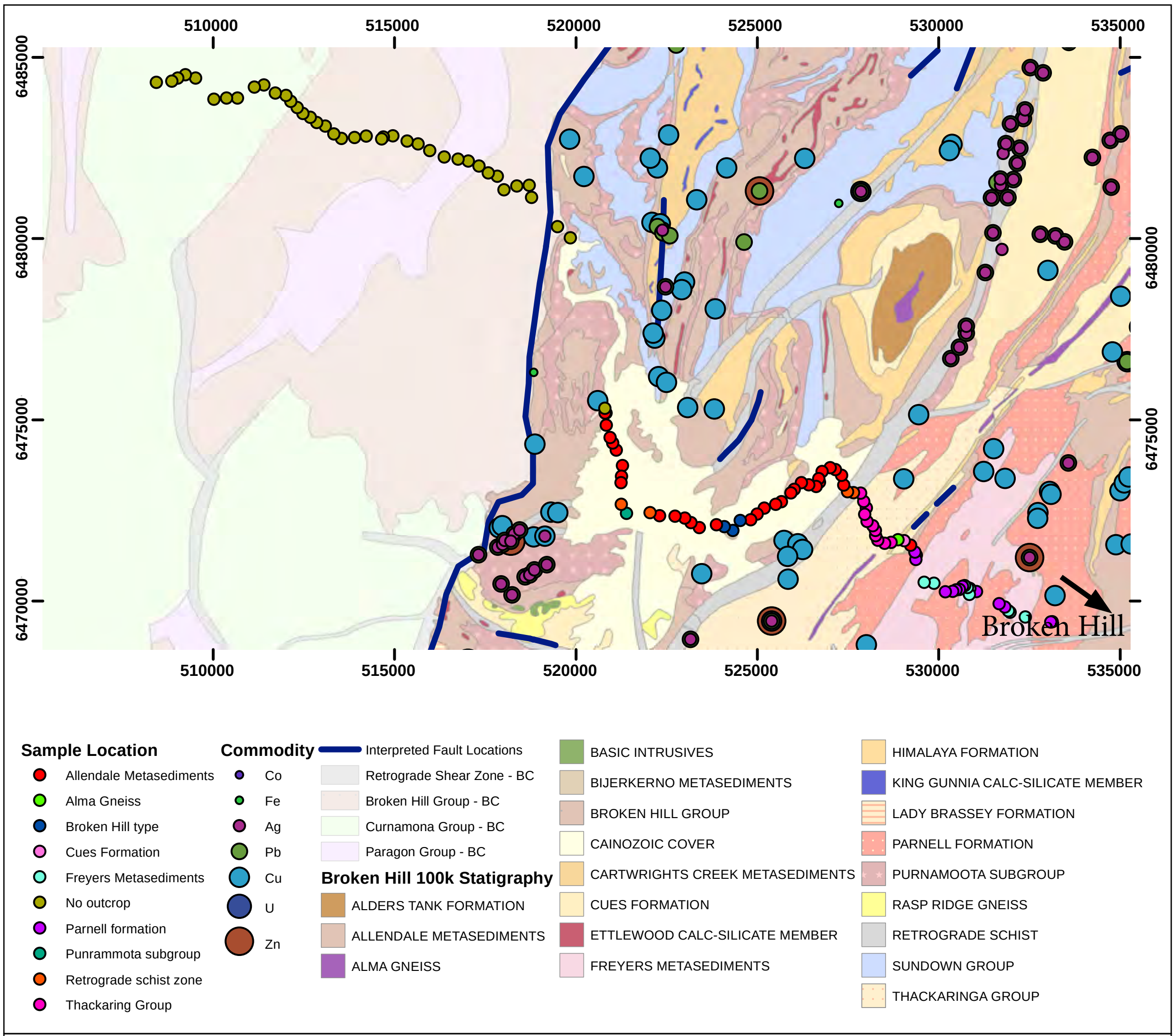

Figure 4.3: Geological map for the Umberumberka Creek catchment area and the interpreted underlying geology of the Mundi Mundi Plains. Mineralisation occurrences are mapped. Adapted from Willis, 1989 and Fitzherbert *et al.*, 2015. BC - Beneath Cover.

Regolith-Landforms

The regolith of the area can be split into two groups, *in-situ* regolith and transported regolith and is summarised from the Broken Hill Domain Regolith-Landforms 1:100 000 map (Hill, 2001) and regolith mapping at a 1:25,000 scale along Umberumberka Creek and surrounding landforms. The *in-situ* regolith in the region is dominantly saprock low hills and hills of the Barrier Range. The saprock is dominantly exposure of the Willyama Supergroup bedrock which has thin surficial weathering, ferruginous staining and prominent fracture features (Hill, 2001). The saprock is colonised by open woodlands of *Acacia aneura* and *Casuarina pauper* with a mixed understory including *Solanum ellipticum*, *Sida petrophila* and occasional chenopod shrubs (Hill, 2001).

The transported regolith can be split into two main groups, colluvial and alluvial, which make up 90% of the regolith in the area, the remaining 10% is made up of aeolian deposits, lacustrine and anthropogenic deposits. The Umberumberka creek headwaters are dominantly colluvial, with weathered Willyama Supergroup within colluvial depositional plains, sheetwash and rises, and with an aeolian component. The colluvial deposits are dominantly colonised by chenopod shrub land and open grass lands.

On the Mundi Mundi Plains, Umberumberka Creek and other creek systems greatly influence the regolith-landforms close to the range front (within 10 km) with alluvial channels, fans and depositional plains & swamps making up the majority of the transported regolith. These units consist of gravel to clay sized weathered particles eroded from the Willyama Supergroup. Large channels are colonised by *Eucalyptus camaldulensis*, while small channels are colonised by *Acacia victoriae* and *Myoporum montanum*, whereas plains, fans and drainage depressions are dominantly chenopod shrub land – *Atriplex vesicaria* and *Maireana spp*..

Field and Laboratory Methods

The main focus of this part of the study was to understand and constrain the lateral extent and migration of elements within the cover sequence both physically and chemically. This was done by choosing two readily available and accessible sampling media, stream sediments and the leaves of the *E. camaldulensis* growing along Umberumberka Creek as well as the geochemical analysis of a fan profile for a partial examination of vertical variation.

Stream Sediment Geochemistry

Stream sediment sampling was conducted simultaneously with the plant sampling to maintain spatial and temporal comparability between the two media. The stream sediments represent the physical/mechanical component of lateral dispersion mechanisms within the system. Approximately 2 kg of sediment was collected in the field focusing on the fine fraction (actively trying to avoid collecting gravels and coarse sands), with samples collected and stored in plastic sample bags. The samples were (where required) dried overnight at 60°C and then sieved to <200 mesh in the University of Adelaide laboratory to retain the <75 µm fraction. The samples were then submitted to ACME Laboratories, where they were digested with aqua regia and analysed for the standard 53-element suite plus rare earth elements using Inductively Coupled Plasma – Mass Spectrometry (ICP-MS). During the laboratory stage, standard laboratory reference materials (in this case standards NIST-981-1Y and DS8) were inserted into the sequence plus laboratory sample blanks and duplicates. Full element suite can be found in Appendix 3.

All stream sediment data was later corrected by normalising the data to the Al content to eliminate some of the landscape controls on the distribution of clays within the creek.

Biogeochemistry

Leaf samples were taken from 116 trees, sampled approximately every 250 m along the Umberumberka Creek in April 2011. Sampling was conducted by hand (jewellery-free, and clean of chemicals, such as sunscreen, to systematically minimise any possible contamination), selecting samples that appeared of a uniform maturity (fully open mature leaves) free from any obvious disease and from a uniform canopy height (c. 2 m above ground level) (Dunn 2007) and from around the tree canopy circumference as much as possible (which varies for trees with irregular canopies). Samples were taken from areas with minimal dust contamination (e.g. away from roads/tracks, mine/drill sites and cattle feed stations). Once collected, the samples were stored in calico bags to dry out. Calico bags allow water vapour to escape and prevent the sweating and decomposition of samples. Samples were dried in an oven at 60°C for 48 h at the University of Adelaide, in order to remove excess moisture and to prevent decomposition.

All samples were submitted to ACME Laboratories in Vancouver, Canada for processing and analysis. Preparation included further drying and milling to <100 mesh. The samples were not ashed. At ACME Laboratories, 0.5 g aliquots of sample were digested by HNO_3 and modified aqua regia and analysed for a 53-element suite by ICP-MS. Quality assurance and control (QA/QC) were monitored by including randomised pre-preparation sample duplicates (1 in 10 duplication). During the laboratory stage, standard laboratory vegetation reference materials (in this case vegetation standard STD V14) were inserted into the sequence plus laboratory sample blanks and duplicates. The duplicate percentage error for standard STD V14 was: Cu 0.63%, Zn 2.33%, Ag 3.52%, Pb 0.24% and U 0%.

Fan Profile Geochemistry

The Umberumberka fan profile was sampled every 10 cm in a cliff exposure along Umberumberka Creek, created by creek entrenchment, exposing a 4 m section through the upper section of the Umberumberka fan system. Samples were dried where necessary, and then sieved to obtain the <75 µm fine fraction. Both the retained coarse fraction and the sieved fine fraction were sent to ACME Laboratories, Canada, where the coarse fraction was pulverised to pass through the -100 mesh, they were then both digested using aqua regia and analysed for the standard 53-element suite plus rare earth elements using ICP-MS. During the laboratory stage, standard laboratory reference materials (standards NIST-981-1Y and DS8) were inserted into the sequence plus laboratory sample blanks and duplicates.

The fan profile was sampled to establish if there was any vertical changes with depth to the geochemistry within the first 2 m below the surface.

Results

The elements of primary interest within this study were Pb, Zn, Ag, Cu and U, being the primary minerals of the Broken Hill Type deposits being sought by the exploration industry and the most dominant mineral occurrences within the Umberumberka Creek catchment area. Where results fall below detection limit they are reported at half-detection level (detection limits can be found in appendix 3.

Stream Sediment Geochemistry

Within the stream sediment geochemistry Al show a very strong correlation with the following majors; Fe, K, Si and Mg (Fig. 4.4). The Si content was calculated by assuming a total 100% digestion and subtracting the other majors (Al, Fe, K, Mg, P, Na, Ca and Ti). The Broken Hill Type elements (Pb, Zn, Cu and Ag) (Fig. 4.5) also show a significant correlation with Fe. These correlations were examined to establish the dominant mineral phases present within the sediments and the potential controlling factor in the distribution of the commodity elements. What the correlations between Al and the other major tell us is that the sediments are mostly quartz with micas, clays and iron oxides in approximately equal proportions. The distribution of the Broken Hill Type elements, then, is controlled by the clays and iron oxides.

A table of summary statistics for stream sediments has been included (Table 4.1).

For the elements Pb, Zn and Cu the same pattern of distribution along the length of Umberumberka Creek is observed (Fig. 4.6 a-e). All three elements exhibit a general, if somewhat noisy, increasing trend downstream within the headwater catchment area, until 1 km from the end of the creek where there is a rapid decrease in values. Stream sediment values out on the Mundi Mundi Plains start elevated and remain somewhat consistent along the length of the creek with noise leveling out toward the end of the transect.

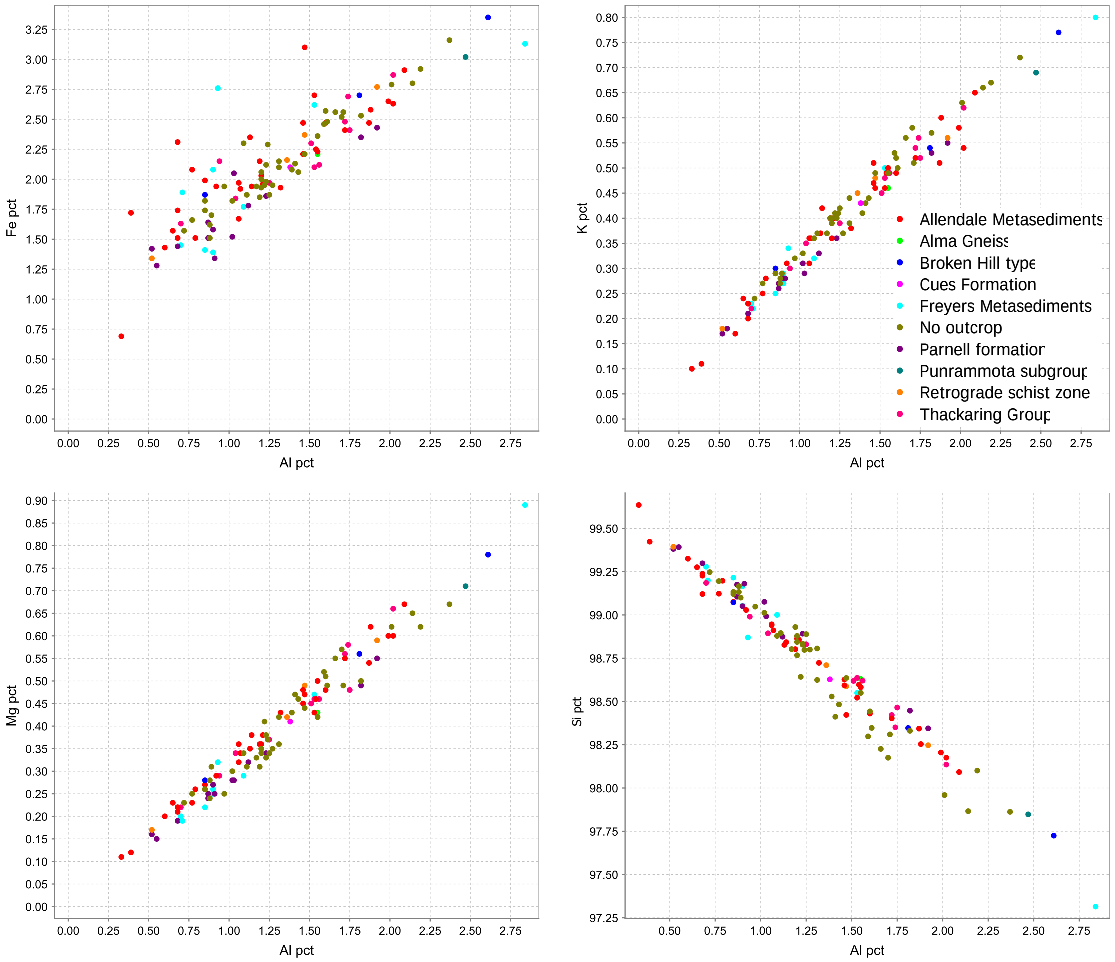

Figure 4.4: Aluminium show strong positive correlations with Fe, K and Mg within the <75µm stream sediment geochemistry, with a strong negative correlation with Si. It shows that the sediment is dominantly fine quartz with almost equal proportions of clay, sheet silicates and iron oxides.

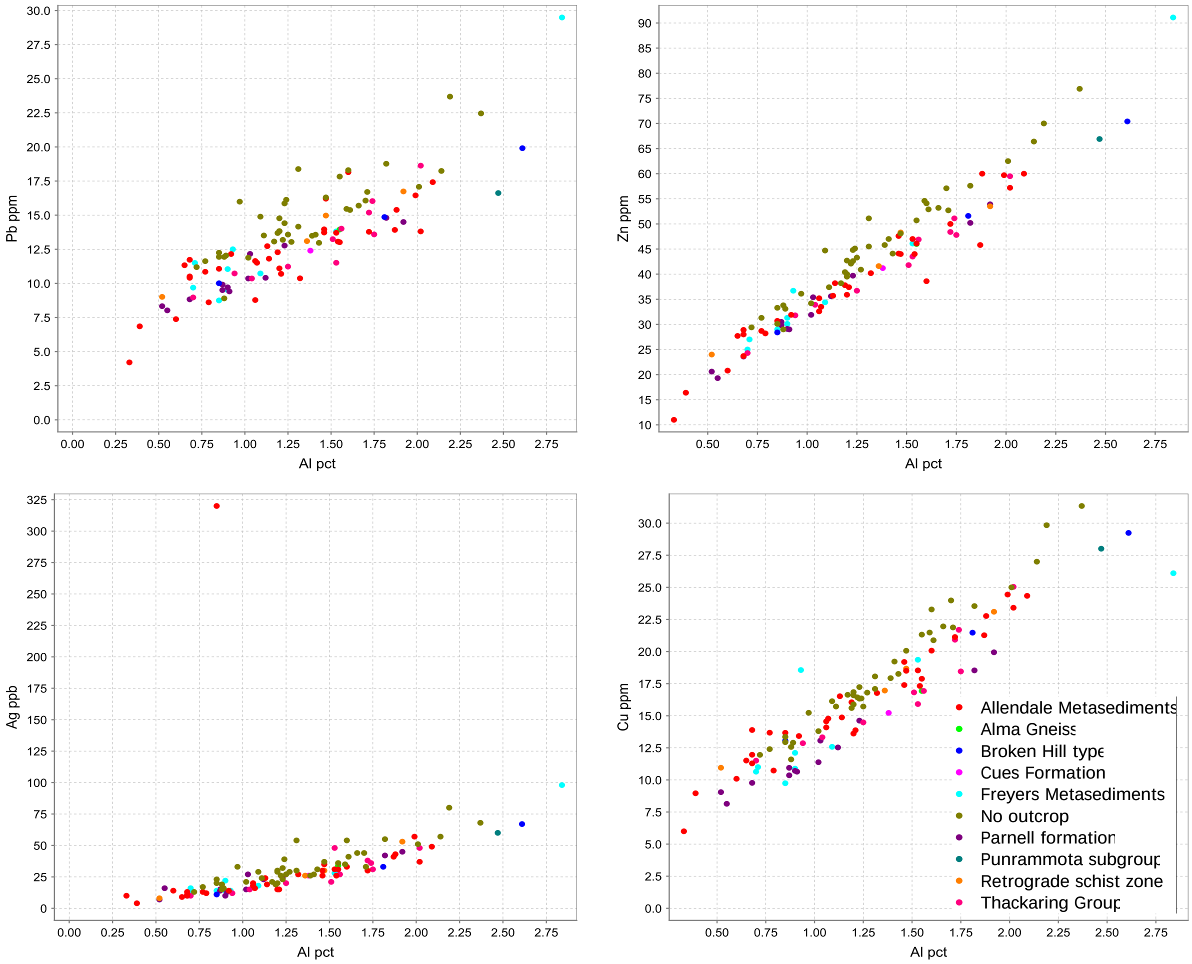

Figure 4.5: Strong correlations between Al and Pb, Zn, Ag & Cu also exist in the <75 µm stream sediment geochemistry. It shows and further supports that the Al (and likely clay) is the controlling factor on the distribution of metals within the Umberumberka Creek system.

Table 4.1: Statistical data for stream sediment samples collected along Umberumberka Creek.

Stream Sediments	**Pb ppm**	**Ag ppb**	**Zn ppm**	**Cu ppm**	**U ppm**
Count Numeric	116	116	116	116	116
Minimum	4.21	4	11	6	0.5
Maximum	29.49	320	91.1	31.34	2.2
Mean	13.237	30.621	41.257	16.636	1.333
Median	13.065	26	40.3	16.34	1.3
Standard Deviation	3.525	31.536	13.054	5.042	0.323
Range	25.28	316	80.1	25.34	1.7

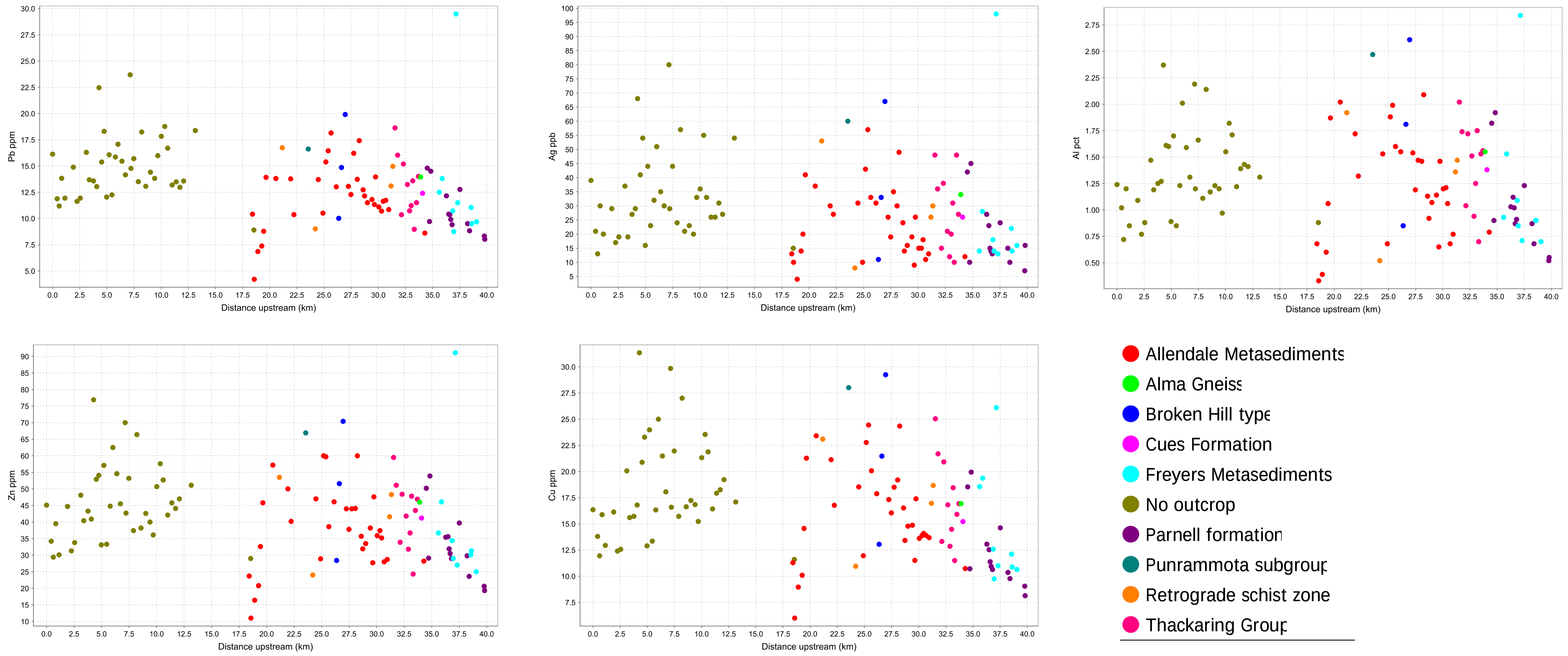

Figure 4.6 a-e: Raw stream sediment geochemistry along Umberumberka Creek coloured for proximal underlying geology.

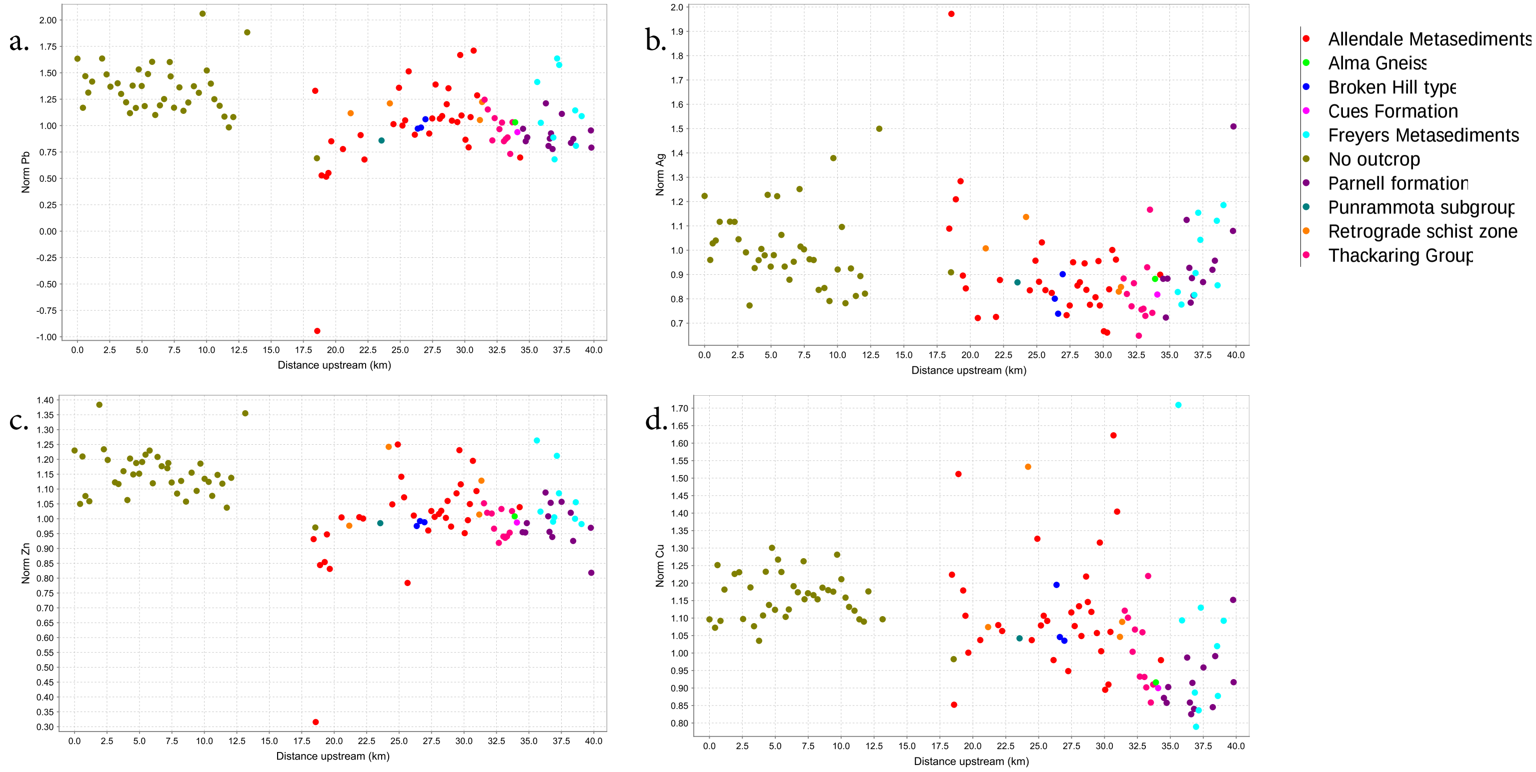

Figure 4.7: Stream sediment geochemistry for Pb, Zn, Ag and Cu normalised to Al. Much of the noise and variation within the data observed in the non-normalised data is removed.

Silver values along the creek, while showing a larger range than the other commodity elements, are consistent along the creek with little difference between samples collected within the headwater catchment area and that of samples collected on the plains.

Due to the strong correlation between Al and the Broken Hill Type elements both normalised-to-Al (Fig. 4.7) and non-normalised data has been used to assess the spatial validation of the stream sediment geochemistry.

Fan Profile Geochemistry

Summary statistics for combined coarse and fine fraction fan profile sediments for elements Pb, Ag, Cu and Zn can be found in Table 4.2.

The profile is divided into facies based on quick in-field observations which are summarised in figure 8, then backed up by the geochemistry of the sediments.

The same general trend exists within all elements with an increase in values towards a clay rich horizon identified as a palaeosol at 200 cm (Fig. 4.8 a-d). This increase towards the palaeosol is most prevalent in the Ag data (Fig. 4.8) a second peak, not observed in the Ag data but is in the Pb Zn and Cu data, is seen at approximately 85 cm and corresponds to a second less defined clay rich horizon as marked in Figure 4.8.

Strong correlations exist between Fe and Pb (0.7), Cu (0.95) and Zn (0.96) plus strong correlations also with Al. Silver did not exhibit the same correlations with Ag-Fe (0.44), a much stronger correlation, however, exists between Ag-S (0.86) and Ag-Hg (0.95).

Table 4.2: Fan profile statistics.

Fan Profile	**Pb ppm**	**Ag ppb**	**Zn ppm**	**Cu ppm**
Minimum	11.47	13	31.8	13.57
Maximum	21.13	429	73.2	32.04
Mean	14.918	62.778	51.083	22.391
Median	15.175	42	51.2	22.48
Standard Deviation	1.950	68.203	10.448	5.002
Range	9.66	416	41.4	18.47

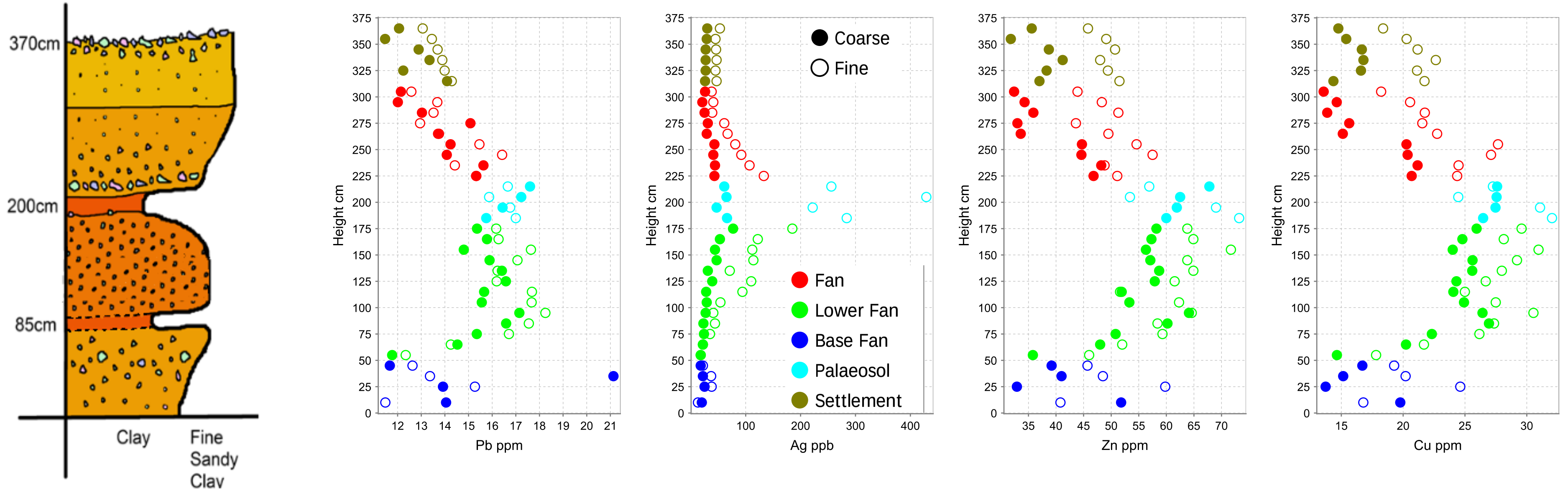

Figure 4.8: Schematic fan profile highlighting the main sedimentary features coupled with the geochemistry of the course (>75 µm) and fine (<75 µm) sediments.

Biogeochemistry

The elements of primary interest are those present in the Broken Hill Type deposits and surrounding mineral occurrences in the catchment area – Pb, Zn, Ag, Cu and U.

The biogeochemical results showed little to no correlation with Al, Fe or Zr and as such were considered free from significant detrital contamination and deemed fit for use without the need to normalise the data.

Lead: In the headwaters there is a distinct decreasing downstream trend in concentrations towards the reservoir. Concentrations in the headwaters range between 1.19 – 0.32 ppm with a single outlying point at 2.09 ppm. The range in concentrations narrows towards the end of the headwaters. On the plains the Pb concentrations remain fairly consistent ranging between 0.065 – 0.505 ppm with no discernible patterns (Fig. 4.9a).

Silver: Patterns are more difficult, if not almost impossible to discern from the *E. camaldulensis* data. This is because the data exhibits data striping and is plagued by data rounding – an artifact of concentrations being at or close to the detection limit. However, concentrations do range between 1.0 – 8.0 ppb. A defined peak anomaly occurs of 8.0 ppb occurs on the plains (Fig. 4.9b).

Zinc: While there is a slight downstream decrease in concentrations in the headwaters, such as seen in the Pb data, there is little distinction between the results from the headwaters and on the plains. In the headwaters the main body of concentrations range between 9.1 – 36.4 ppm with a number of outliers between 41.1 – 51.8 ppm and a single outlier at 91.1 ppm. On the plains the results range between 6.8 – 36.5 ppm (Fig. 4.9c).

Copper: Headwater concentrations range between 1.1 – 8.53 ppm with a peak at approximately 12 km along where concentrations go from 10.14 – 14.01 ppm where a smaller tributary enters Umberumberka Creek. There is little variation in the Cu content from the samples collected on the plains, 2.81 – 6.93 ppm (Fig. 4.9d).

Uranium: Concentrations exhibit a similar downstream trend as Pb but because values at or very close to the lower detection limit the data is striped. Concentrations range from 0.005 – 0.07 ppm (Fig. 4.9e). A table containing statistical data for Umberumberka Creek *E. camaldulensis* samples along with data from Fowlers Creek and Pine Creek has been included for comparison of the element uptake by the trees (Table 4.3).

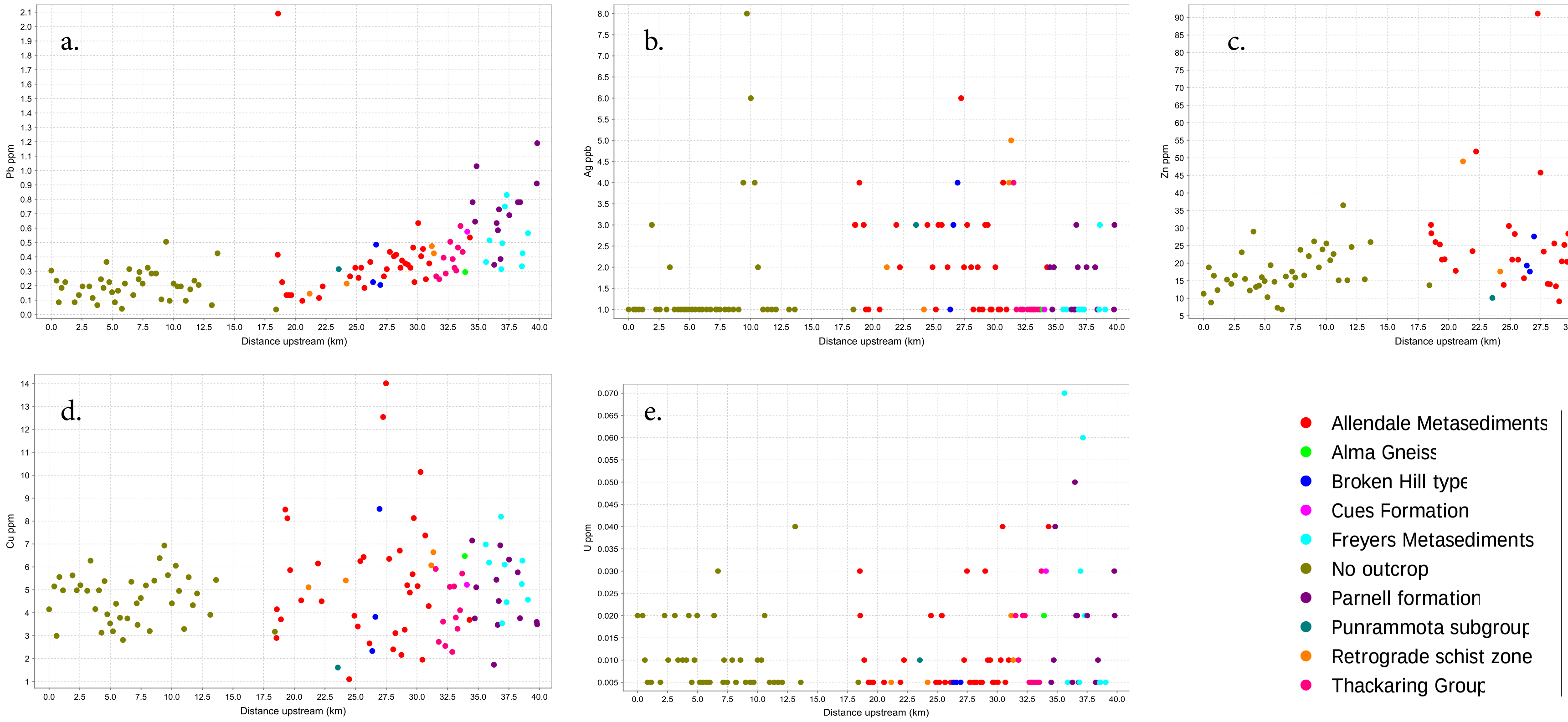

Figure 4.9: Biogeochemical results from leaf samples collected from *Eucalyptus camaldulensis* along Umberumberka Creek. Samples are coloured up for the proximal geology.

Table 4.3: Statistical data for *E. camaldulensis* from Umberumberka Creek as well as Fowlers and Pine Creek (2012 data) for quantitative comparison of uptake levels.

	Pb ppm	**Ag ppb**	**Zn ppm**	**Cu ppm**
Fowlers Creek : Count	98	98	98	98
Fowlers Creek : Minimum	0.05	1	11	2.1
Fowlers Creek : Maximum	0.86	9	56.2	10.92
Fowlers Creek : Mean	0.278	3.041	22.022	4.889
Fowlers Creek : Median	0.24	3	20.1	4.76
Fowlers Creek : Standard Deviation	0.153	1.686	8.267	1.572
Fowlers Creek : Range	0.81	8	45.2	8.82
Pine Creek : Count	23	23	23	23
Pine Creek : Minimum	0.89	3	16.9	1.99
Pine Creek : Maximum	89.94	214	98.7	10.85
Pine Creek : Mean	11.412	28.348	38.174	5.330
Pine Creek : Median	3.3	11	35.5	5.28
Pine Creek : Standard Deviation	20.895	48.224	20.933	2.431
Pine Creek : Range	89.05	211	81.8	8.86
Umberumberka Creek : Count	116	116	116	116
Umberumberka Creek : Minimum	0.035	1	6.8	1.1
Umberumberka Creek : Maximum	2.09	8	91.1	14.01
Umberumberka Creek : Mean	0.358	1.776	23.165	4.925
Umberumberka Creek : Median	0.31	1	21.1	4.915
Umberumberka Creek : Standard Deviation	0.268	1.279	11.067	1.964
Umberumberka Creek : Range	2.055	7	84.3	12.91

Discussion

Stream Sediments and Fan Profile Geochemistry

The overall increasing trend of the stream sediments geochemistry within the creek headwaters is contrary to what one would expect for stream sediments moving away from a mineralised source and enriched bedrock. In such a situation a downstream decreasing trend would be anticipated as the "enriched" sediments mixed with the clean sediments such as seen along Pine Creek (Mitchell, 2015, Chapter 3) and Fowlers Creek (Chapter 2). The geochemistry on these creeks is strongly controlled by the geology through which they travel, Umberumberka Creek on the other hand show little to no such correlation. What it does show however is a very strong correlation between the Broken Hill Type metals (Pb, Zn, Cu and U) with Al and the samples location within the overall landscape and catchment. The strong correlations with Al recognised within the stream sediments and the control it exhibits on the distribution pattern along the creek is partially an artifact of the sampling methods used. Aluminium content is a proxy for clay content and exhibits a strong affiliation for other metals which readily absorb onto the clay fraction of the sediments. During sampling and sample preparation for analysis, sampling was focused on the fine fraction (clay size fraction), once in the laboratory samples where not crushed to a uniform size, rather they were only sieved to the <75 µm further focusing and potentially biasing results rather than gaining an overall sediment analysis.

While that may account for the strong correlation with Al and the bias to the distribution of Broken Hill metals, the overall profile of the creek is controlled by the sample position within the landscape. As we move downstream, the catchment areas suppling sediment to the creek is ever increasing and shifts between bedrock dominated terrains to regolith/weathered bedrock dominated terrains. This ever increasing catchment area leads to an increased sediment load that would then obscure local patterns within Umberumberka Creek by carrying in it clay sediments "enriched" in metals from mineralised sources in the further reaches of the catchment area. The decline in Al at the end of the headwaters section of the creek immediately prior to the reservoir (Fig. 4.6), then, would be further representation of a change in flow regime that is brought about by a change in creek topography (the creek becomes significantly steeper into the lead up to the reservoir) and the water began to pool as the creek bed reached saturation point. The sandier/heavier fraction of the sediments then settles out while the finer silts and clay remained in suspension and were carried into the reservoir.

The sediments on the plains start at a concentration similar to that of the upper catchment (Fig. 4.6). The chemistry of the sediments consistently oscillates along the extent of the creek until a change in regolith landform unit is reached at the end of the creek (Fig. 4.2 & 4.6). The creek transitions from an alluvial channel to an alluvial depositional plain then into an alluvial swamp. This may result in changes in deposition rates or it may be that the sediments are greatly diluted by the addition of non-mineralised aeolian sediments from the west. The oscillations along the creek may also be the result of changes in depositional regime and the input of aeolian sediments.

Variation within the headwaters/catchment area are small, with the mineral occurrences having little effect on the overall average of the creek geochemistry and without prior knowledge of their whereabouts become extremely difficult to identify. The averaged concentrations for each of the Broken Hill Type metals are at close to the average crustal abundance (average crustal abundances (Ni 84 ppm, Zn 70 ppm, Cu 60 ppm, Co 25 ppm, U 2.7 ppm, Pb 14 ppm, Ag 0.075 ppm and Au 0.004 ppm). This is contrary to the results obtained by Mitchell et al (2015) along Pine Creek, where mineralisation caused a peak in stream sediment values immediately downstream from the mineral occurrence and an increased average for the remainder of the creek. Analytical and sampling method were identical in both creek systems, with the most significant differences being the catchment size and the size/proximity of the mineralisation to the creek/sample location. The catchment size of Umberumberka Creek is an order of magnitude greater than that of Pine Creek (~398 km^2 to Pine Creeks ~37 km^2), the mineralisation at Pine Creek is also large and crosses the creek at surface level, whereas the Umberumberka Creek catchment is dotted with small occurrences of low volume along its many tributaries.

However, once the data has been normalised to Al (Fig. 4.7 a-d) the large trends within the data all but disappear with the range of the data becoming fairly narrow. What we are left with appears to be a closer association between the stream sediment geochemistry and the proximal geology and mineralisation particularly with Ag, Cu and Zn and to a minor extent with Pb. The data exhibits a number of “kicks” which can be associated with tributary inflow into the main creek from terrains with extensive mineralisation. The concentrations recorded along the plains maintain an average concentrations representative of the catchment average.

Despite the extensive transported cover, mineralisation has been intersected further out on to the Mundi Mundi Plains based on geophysical targeting and follow up surficial geochemical sampling that revealed Ag enrichment in the soil (Fabris *et al*., 2009b; Hedger and Dugmore, 2001). The stream sediments on the alluvial fan (Fig. 4.6) had Ag concentrations that are comparable to the results reported by Hedger and Dugmore (2001) within their soil survey. The end of the creek and fan overlap into the area considered prospective for underlying Broken Hill Type mineralisation (Fig. 4.1) and was the basis of drilling program that identified the mineralisation.

Radiometrics

While the distribution of U with the stream sediment geochemistry is not significantly different to that of the other elements considered of interest in this study, used in conjunction with radiometrics (Fig. 4.1) (along with Th and K (Fig. 4.10)), it can add some clarity to understanding the distribution patterns.

The U (and K) content of the stream sediments exhibit a small range in concentrations yet still show a similar trend downstream with the drop in concentrations immediately prior to the reservoir and the higher average concentrations out onto the plains as with the main commodity elements. Thorium does not show the same distinct landscape control on it geochemistry as do the other elements. Yet, while sharing a similar distribution pattern as Pb and Zn, U does not exhibit the same strong correlations with Fe (0.34) and Al (0.14) as a whole system. However, when split into headwaters and plains, the correlations between U-Fe (0.61) and U-Al (0.47) on the plains become significantly stronger, while in the headwaters they are U-Fe (0.2) and U-Al (-0.13). Uranium (and Th) readily absorb onto clay during weathering and can account for the correlations observed between U with Al and Fe out on the plains.

What makes this data different is that we can bring in another data set, radiometrics, with which we can compare and add the additional quantitative stream sediment data to further our understanding of the lateral transport of materials and the resulting implications to mineral exploration. The radiometrics map covering the catchment and fan/floodouts of Umberumberka Creek and surroundings is shown in figure 4.1 and is overlain with the U content of the stream sediments from along Umberumberka Creek. In the radiometrics, K is shown as red, while Th is shown in green and U is shown in blue, areas high in all three elements are shown as white. The image shows the differential movement of the three elements away from their source regions, reflecting the different levels of regolith cover, exposed bedrocks and alluvial movement. Of particular interest is the movement of elements out onto the Mundi Mundi Plains where the radiometrics show extensive movement of both Th and U along current and past alluvial channels, along fans and in alluvial floodouts.

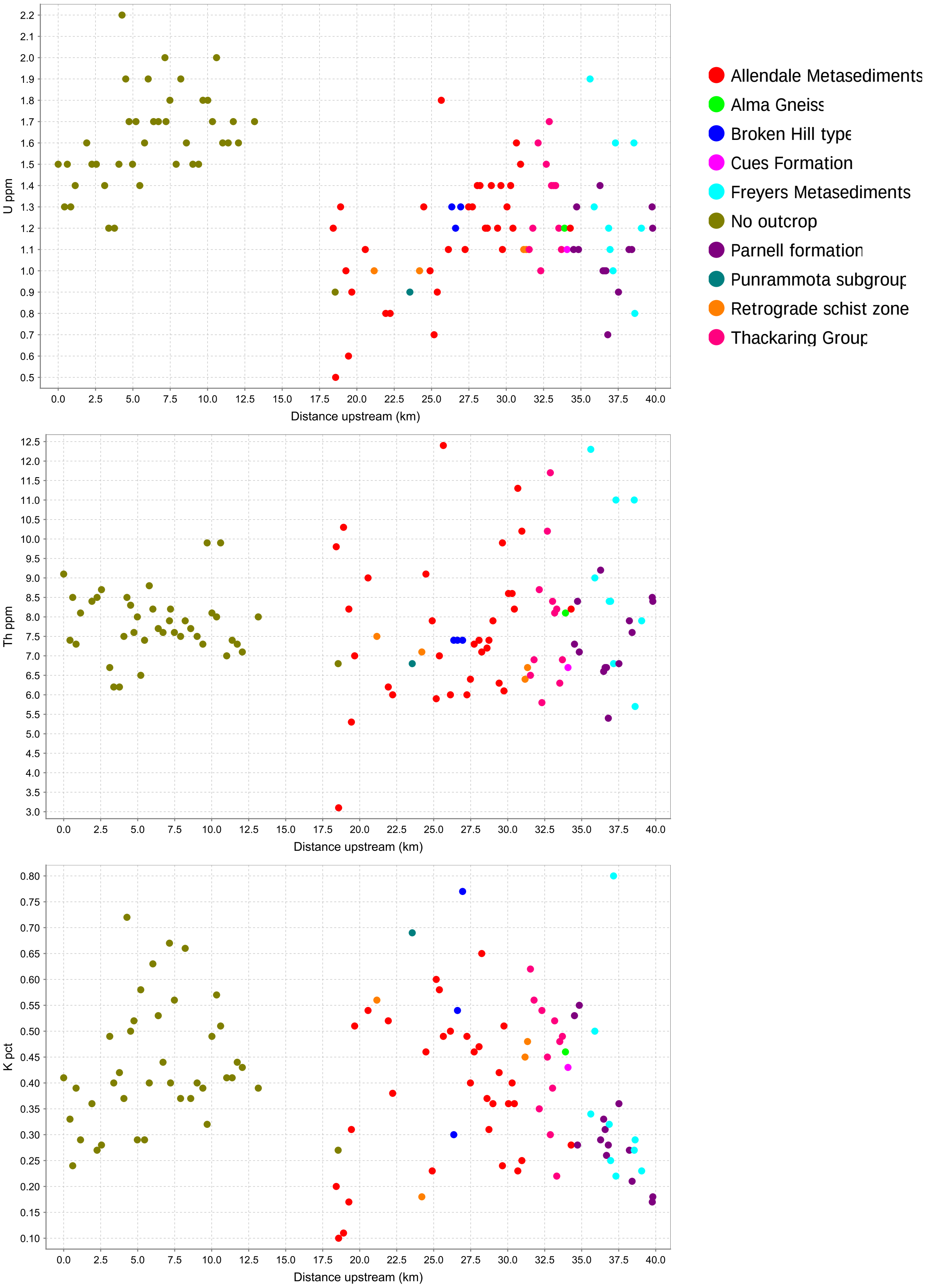

Figure 4.10: Stream sediment geochemistry for the radioelements U, Th and K. Uranium and K show a similar distribution pattern as the commodity elements along the creek. All 3 elements show a higher average concentrations on the Mundi Mundi Plains.

The largest measurable floodout is shown in the Th channel and is approximately 23 km in a straight line along the drainage from the range front. This floodout appears to be the northern boundary of the large Umberumberka Fan, with Umberumberka Creek forming the southern boundary, with Th measurable out to approximately 15 km and U measurable to around 8 km. The distribution of U along the creek in the radiometrics is somewhat supported by distribution of the U within the stream sediment geochemistry. While concentrations are not high in the stream sediments they do appear to follow a similar pattern, decreasing at the end of the creek following the "fade out" observable in the radiometrics in to a Th dominated floodout.

What the distribution of U along Umberumberka Creek in the stream sediment geochemistry, supported by the radiometrics, tells us is that there is significant amounts of movement along the creek systems out on to the fans, extending the influence of the ranges many tens of kilometers beyond the colluvial input. It can also be noted how the chemistry of the different fans differ off of the Broken Hill Block, with the Eldee fan to the north of Umberumberka (Fig. 4.1 and 4.2) significantly "hotter", reflective of its catchment area that is high in all 3 radioelements compared to Umberumberka, where the catchment area is dominantly Th rich.

If these other elements are being transported out onto plains, then the implications for constraining the lateral dispersion of a mineral deposit, or in this case the entire Broken Hill block, becomes more important in the context of mineral exploration, this will be discussed more in a later section.. The radiometrics shows that materials are spewed out onto the plain over distances of many kilometres and not just in the channels (consistent with migration of the channels within the fan and overbank deposits during floods and that the location of the lower creek is not static, but is in fact is changing and influences a vast area. Any "soil" signature from the fan will be heavily influenced by this signal.

Fan Profile

The different correlations that exist between Ag and Pb, Zn and Cu and their differing peaks (Fig. 4.8) within the fan profile represent different processes involved in pedogenesis and the formation of anomalies within a fan sequence.

The strong correlation of Pb, Zn and Cu with Al and Fe suggests that their distribution is strongly controlled by the presence of iron oxides, clays and micas as within the sediments. These, then, may be more representative of the change in flow pattern of sediments out onto the fan surface, i.e. increasing and decreasing flood rates and the resulting change in sediment load, rather than solely down to the pedogenic factors that lead to the accumulation of the clay rich horizons, though this will still be a contributing factor. As previously stated, the distribution of Al and therefore the clays exhibit a strong landscape control on their distribution along the creek systems rather than an underlying bedrock control. The distribution of Pb, Zn and Cu within the fan profile, then, may be linked to the shifting nature of the ephemeral creek, (much like an un-restrained hose), as shown in the radiometrics and regolith landform map by the wide and extensive fan systems (Fig. 4.1 and 4.2).

Of more interest is the distribution of the Ag within the profile which, while it spatially correlates with the upper clay horizon which is high in both Al and Fe. Geochemically it has little to no correlation with Al or Fe nor does it follow the same spatial trends of the other elements. Rather, Ag has a strong correlation with S and Hg, suggesting a different method of accumulation through pedogenesis and potentially a different source for Ag than the Pb, Zn and Cu. The fan profile (marked on Fig. 4.1) is proximal to the Ag anomaly recorded in the *E. camaldulensis* described later. It may be that Ag in the fan profile is the result of vertical turnover and accumulation from a source below the fan, such as the Paragon Group as suggested for the biogeochemical results, and is again further supported by the lack of corresponding anomaly in the stream sediments. Further possibilities to account for the high Ag concentrations such as pedogenic and sedimentary processes that have accumulated the Ag (and potentially mineralised grains) separately to the other elements. However, such ideas would require significantly more research to be able to be able to say that is for certain what is happening.

Eucalyptus camaldulensis

As was mentioned previously and as shown in figures 4.1-4.3, the headwaters of Umberumberka Creek are dotted with numerous mineralisation occurrences both proximal to the creek and upstream along the lines of many of the smaller tributaries. It has been documented by others (Hill, 2004; Hulme & Hill, 2005; Hulme, 2008; Mitchell, 2015) that *E. camaldulensis* is successful at uptaking and expressing a biogeochemical response in elements such as Pb, Ag and Zn within a similar terrain (Mitchell, 2015). Mitchell et al, examined *E. camaldulensis* growing along Pine Creek to the SW of the Broken Hill mine. Where the creek cross cuts the shallow Pb-Zn mineralisation the trees growing directly above and proximal to the mineralisation had Pb concentrations up to 150x and Ag to 800x above background (Mitchell, 2015). Yet when we look at the results from Umberumberka Creek, not only do we not get concentrations that are near the levels recorded in that study, but neither do we have the distinct peaks recorded. There is no systematic relationship between the trees and the mineralisation. The dominant mineral occurrence in the headwaters of Umberumberka Creek is Cu, with many occurrences situated on the smaller tributaries that flow into the larger creek. Some of the elevated Cu concentrations observed in *E. camaldulensis* can be accounted for from inflow from these smaller tributaries with their Cu mineralisation occurrences upstream (Fig. 4.9d). The only other element that appears to show any significant correlation spatially is Pb in the upper headwaters where there is a line of Pb, Ag and Zn occurrences crossing a series of small drainage channels at the edge of headwaters (Fig. 4.9a, b, and c). Yet while there is both Ag and Zn occurrences at the same locations as the Pb, the same patterns are not observed, i.e. spatial correlation to a mineral occurrence may occur with one metal within an occurrence but may disappear when looking at the other metals involved (Fig. 4.9). This is despite the considered relative mobility's of the different metal, with Pb having a lower mobility in the groundwater and soils that elements such as Zn.

When comparing the quantitative concentrations of metals recorded in *E. camaldulensis* of Umberumberka Creek with the data collected by Mitchell *et al.,* (2015) along Pine Creek (Chapter 3) and from a study conducted along Fowlers Creek (110 km N of Broken Hill) (Chapter 2), interesting observations can be drawn. All studies sampled the same species of eucalypt, were sampled and analysed using the same methods, while all growing along ephemeral creek systems in the semi-arid region around Broken Hill and the Barrier Ranges. In comparison to Pine Creek (Table 4.3), the biogeochemical results from along Umberumberka Creek fall well below the mean concentrations recorded for Pb, Zn, Ag and Cu, with the Pb and Ag concentrations for Umberumberka Creek only just breaking the minimum recorded along Pine Creek. Yet when compared to Fowlers Creek (Table 4.3), a creek that drains a terrain of low grade metasedimentary bedrock with no noted mineralisation, has a near identical range of concentrations as recorded along Umberumberka Creek. This might suggest that the Fowlers results are the natural range for the elements of interest in *E. camaldulensis* growing in a semi-arid terrain. Despite the presence of a number of mineral occurrences around Umberumberka Creek unless the enrichment of metals is in the trees immediate vicinity or the flow of the stream base aquifer is impeded (such as at the quartzite ridges at Fowlers Gap or exposed mineralisation/ and causeway along Pine Creek) the trees will only uptake what is needed with only a slight inflection in concentrations to reflect the presence of mineralisation.

In extreme cases, such as Pine Creek, the *E. camaldulensis* can take up incredible amounts of metal while still remaining healthy. It appears that for significant uptake to occur that is distinguishable from the surrounding natural variation, at least along an ephemeral creek system in a semi-arid environment, then the element source either needs to be very close to the tree for prolonged interaction of the roots and the enriched stream base aquifer (Pine Creek) or potentially where local infrastructure (causeways) and geology (impermeable quartzite horizons) imped the flow of the stream base aquifer either allowing; longer interaction, enrichment via evaporation, or differing chemical environment allowing different elements to become bioavailable for uptake.

What can we learn from the biogeochemical data from the *E. camaldulensis* collected along Umberumberka Creek out on the Mundi Mundi Plains?

The presence of Umberumberka Reservoir should isolate the lower half of the creek, and in a sense it does. The reservoir stops the flow of sediments out onto the plains through the creek system. The flow of water, however, is not completely stopped, as evidenced by the continued health of the riparian vegetation along the creek. It is reported that at the base of the reservoir wall groundwater seepage and leakage from the wall accounts to around 1ML/d into the stream base aquifer (Lewis, 2008). So while there is still stream base aquifer flow into the creek, being able to trace back any geochemical anomalies within *E. camaldulensis* on the plains to a lateral source becomes almost impossible.

The biggest challenge to interpreting the biogeochemical data is the depth to basement/cover thickness, which has been measured up to 200+ m. As such, direct interaction of the roots with underlying bedrock is unlikely. The results from the plains for the commodity elements, with the exception of Ag, show little variation with no observable patterns and sit within the lower half of the recorded concentrations for the samples. Silver concentrations (Fig. 4.9b) peak at 8 ppb while decreasing either side back to half-detection limit (1 ppb) for the remainder of the lower half of the creek with the exception of another slight “kick” in the data 7 km further downstream with concentrations reaching 3 ppb. While elevated Ag values on the plains may be just be noise, they may also be associated with a change in the underlying interpreted geology. The underlying geology changes from the Broken Hill Group into a narrow band of the Paragon Group, then back into the Broken Hill Group (Fig. 4.3) with the narrow band of the Paragon Group geology below the changes in the biogeochemical data. The geochronology of the Paragon Group is in part the same age as the Urquhart shale (Page, 2000) in the Mount Isa district and is host to the large Mount Isa Pb-Zn-Ag deposit. This, plus the presence of weakly mineralised rocks within the Paragon Group add to its prospectivity (Burton, 2006). While the slightly elevated Ag concentrations in the *E. camaldulensis* may be associated with the underlying change in geology, it is not directly indicative that it is therefore mineralised. However this would not account for the secondary peak in the Ag nor is there any similar systematic variation recorded for any of the other elements. Further research would be required to test this, potentially including drilling to basement to identify a potential source for the Ag.

Implications for mineral exploration

The use of biogeochemistry for mineral exploration in areas of thick transported cover appears to be very limited. In the catchment area of the creek, biogeochemistry has potential to be useful in differentiating some changes in the underlying geology, but appears to be of little use in identifying the many small mineral occurrences that dot the catchment area, possibly because they are too small and their geochemical signature getsth lost in the noise. Proximity and the size of a mineral occurrence, then, appears to be of some significance to the ability of the tree to uptake levels of the metals under investigation (Pine Creek - Chapter 3 - (Mitchell *et al*., 2015)) or some method to block and concentrate the steam base aquifer so that the trees roots are in prolonged contact with enriched waters (Fowlers Creek – Chapter 2). Beyond the headwaters/catchment area the *E. camaldulensis* data show what is expected to be a catchment average of the chemistry of the stream base aquifer. If a survey went beyond the confines of the alluvial system and into areas considered "background" with no prior knowledge of any mineralisation, then biogeochemistry would be a useful tool in directing exploration effort by measuring the potential extent of the lateral transport of an occurrence within the cover. As such biogeochemistry works well at measuring the vertical dispersion through shallow cover proximal to mineralisation but is ineffective where depth to basement/mineralisation far exceeds the reach of the root system.

Surficial geochemical sampling has shown that anomalies that form at the surface can be associated with underlying geology below 150+ m of cover (Fabris *et al*., 2009b; Hedger and Dugmore, 2001; Tonui *et al*., 2003) and this either suggests that the metal in the soils has accumulated through vertical turnover of material and that the metals are not in a form that is bioavailable for *E. camaldulensis.* On the other hand the surficial anomaly may be coincidental with underlying mineralisation in the bedrock and may then be more a representation of laterally transported material that has resulted in the formation of an anomaly.

The extent of lateral dispersion, then, is controlled strongly by the architecture of the creeks and fans that flank a mineral system, with creeks acting as a direct conduit for sediments out onto the plains beyond the reach of the colluvial fans. The stream acts as giant water cannon, shifting large amounts of water and sediments through the system. Along the plains the movement of elements has been super-efficient in both the stream sediments (movement of sediments physically along the creek) where concentrations increase (if somewhat noisily) downstream until a change in landform and in *E. camaldulensis* (shallow aquifer/ stream base aquifer) where concentrations are noisy yet consistent/level along the creek with no obvious tailing off or re-accumulation of elements in the washout fan at the end of the creek. This has significant implications for mineral exploration techniques applied in areas of transported cover, demonstrating the importance of lateral dispersion and the understanding of landscape setting and evolution. Stream sediments and their resultant chemistry show that even 12.5 km out from the range front there is little to no variation in the concentrations of the commodity elements. When it comes to mineral exploration then it is important to develop an understanding of the current landscape while developing a surficial sampling program as well as an understanding of the landscape evolution so when palaeochannels are encountered in drilling programs an understanding of the transported elements can be developed. During a drilling program in these terrains of deep transported sediments, the program needs to have a large spread of drilling locations and a detailed analysis of the cover sequence as to gain a more comprehensive understanding of the lateral dispersion.

The implications to the extent to this lateral dispersion are particularly important when exploration companies have been actively searching and drilling aeromagnetic anomalies at the end of the Umberumberka Creek alluvial fan and creek system (Hedger and Dugmore, 2001). Hedger and Dugmore noted past exploration methods at Polygonum which included a soil geochemical survey over an aeromagnetic anomaly in order to constrain Ag mineralisation encountered in drilling. Bulk cyanide leach of soil samples from the base of the soil evaporation zone had concentrations that ranged from <9 - >44 ppb Ag (Hedger and Dugmore, 2001), concentrations which are comparable to those recorded within the stream sediments along Umberumberka Creek. While Hedger and Dugmore acknowledge that there is a potential that lateral transport contributes to the soil survey result, there is little follow up as some of the major anomalies corresponded to underlying mineralisation identified in drilling.

Conclusions

While exploration is moving into terrains of transported cover, often 100s of metres thick, the need for a cheap and effective method to constrain the lateral dispersion of a mineral occurrence and to identify a probable source becomes ever more important. While both biogeochemical and stream sediment geochemical surveys lacked the clarity to pinpoint known mineralisation within the catchment area, both exhibited the ability to record an average concentrations for the system many kilometres from the source region into areas of transported cover. The Ag concentrations in the stream sediment geochemistry out onto the Mundi Mundi Plains raises questions as to the origin of the surface anomalies on which the Polygonum ore body was targeted. And while it is not possible to say that they are definitely either laterally or vertically derived, we have demonstrated the potential of the ephemeral creek systems to transport material significant distances that maintain a catchment average that is comparable to the results obtained at Polygonum. What this tells us is that we need to step back and look at the bigger picture to see where anomalies sit within the landscape, particularly in terrains dominated by transported materials. The biogeochemical survey was able to partially differentiate some of the underlying geology within the catchment, but could not be used reliably to pinpoint known mineral occurrences. However, it did show a transported average for the catchment area out on to the plains potentially reflecting the chemistry of the stream base aquifer. Values obtained in the biogeochemical survey are believed to represent what is considered background for *E. camaldulensis* along ephemeral creek systems in the Broken Hill region and need very specific conditions to accumulate metal at levels that are visible beyond the background noise.

Chapter 5: Conclusion

The constraining of lateral and vertical dispersion using the landscapes geochemistry and biogeochemistry in both space and time is a multifaceted one. The interaction between bedrock, stream sediments, groundwater and trees and the implications of landscape setting is complex. Landscape setting, climatic phenomena and weather, bedrock geochemistry and its physical properties and the physiological needs of the plant all interact in a complex system.

The work of this thesis has shown how all these factors influence the biogeochemistry *Eucalyptus camaldulensis* growing along ephemeral creek systems and the geochemistry of stream sediments. This provides information for constraining vertical and lateral dispersion in transported sediments and the implications for mineral exploration in such terrains.

The key outcomes for the use of *E. camaldulensis* as a tool for constraining lateral geochemical signals are as follows: they are able to map buried mineralisation in the areas of shallow cover, such as along Pine Creek, providing a more precise location of mineralisation and clearer contrast to background than the stream sediment chemistry. Biogeochemistry (and therefore its ability to map underlying geology) is strongly influenced by the hydrology of the stream base aquifer. Both the availability of water (e.g. volume and relative contribution of stream base aquifer and surface water in the case of Pine Creek) and geometry, residence time and chemistry of the stream base aquifer in the case of Fowlers Creek, play a significant role on the biogeochemical response of *E. camaldulensis*. In areas of deep cover (such as along Umberumberka Creek on the Mundi Mundi Plains) the biogeochemical results of *E. camaldulensis* are more reflective of where the stream base aquifer has come from, reflecting a laterally transported average signal from a catchment area, rather than from any interaction with the underlying geology or mineralisation.

Implications for explorers include collecting as much contextual information as possible (climate, landscape setting, geology, previous research etc.), taking into account season variations as they can be quite large – this means collecting data in one sampling session/season, or during comparable climatic conditions, preferably at dry times to concentrate signal from the stream base aquifer. The carefully assessment of the concentrations of commodity elements against biochemically inert elements such as Zr and Al to check for dust contamination on media which can significantly influence results. Avoid putting too much emphasis on results from essential nutrients e.g. Cu – these concentrations may be more controlled by the biological needs of the tree rather than the geology.

The key outcomes from the stream sediments is that they appear to provide an average signals of the upstream catchment, yet still produce elevated concentrations proximal and downstream of mineralisation that is proximal to the sample site. However, the signal can be complicated by complex stream patterns (e.g. at the tail end of Pine Creek and its junction with a larger creek system) and rapidly diluted by the larger volumes of material coming from non-mineralised rocks within the catchment area of the creek (e.g. downstream tapering of commodity elements in Fowlers Creek and the confluence of Homestead Creek with Fowlers Creek). In a buried environment you would need to try to reconstruct the alluvial system in order to understand the geochemical signal recorded.

In depositional settings (e.g. the alluvial fan of Umberumberka Creek on the Mundi Mundi Plains) the averaged concentrations of the upstream catchment can be distributed across a large area (over a distance of >10 km from the discharge point of Umberumberka Creek). Such a distribution of the upstream geochemistry can overwhelm the possible signature carried vertically from potentially buried mineralisation. This is considered important because a number of successful exploration programs that had been conducted on the distal edge of the fan associated with the creek system with soil survey results that were comparable to stream sediment results recorded along the creek.

For the Broken Hill Block and the Barrier Ranges, the lateral dispersion is kilometric (and up to at least 10km) in stream channels and distributive depositional systems. The signal is diluted due to catchment averaging but can still be elevated above background thus obscuring potential vertically transported signal from bedrock. *Eucalyptus camaldulensis* provides a mechanism to see vertically down to the basement at depths of 10's of metres (Pine Creek and to an extent along Fowlers Creek) and allow for differentiation between different bedrock and areas of mineralisation, but do not give a signal when the depth to the source is 100s of metres (e.g. no signal from Polygonum out on the Mundi Mundi Plains). For the exploration industry to be successful in its endeavors in areas of thick, transported cover it becomes ever more important to step back from anomalies and see where they sit within the bigger landscape picture and temporally within the exploration program.

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Appendices

Appendix 1
Published Paper - El Niño and La Niña cycles and biogeochemical sampling: variability of element concentrations within *E. camaldulensis* leaves in semi-arid Australia.

Research article
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El Niño–La Niña cycles and biogeochemical sampling: variability of element concentrations within *E. camaldulensis* leaves in semi-arid Australia

C. Mitchell[1]*, S. M. Hill[2], D. Giles[1] & K. Hulme[3]

[1] Deep Exploration Technologies Cooperative Research Centre, School of Earth & Environmental Sciences, University of Adelaide, North Terrace, Adelaide, SA, Australia, 5005
[2] Geological Survey of South Australia, GPO Box 320 Adelaide SA, Australia, 5001
[3] Kingsgate Consolidated, Suite 3/39 Clarke Street, Norwood, SA, Australia, 5067
* Correspondence: charlotte.mitchell@adelaide.edu.au

Abstract: We conducted the analysis of the chemistry of leaves from *Eucalyptus camaldulensis* (Australian River Red gums) growing in a creek system that crosscuts known Pb-Zn mineralization to assess the influence of cyclic El Niño and La Niña weather patterns on biogeochemical exploration. Samples were collected over two periods: in 2005 immediately after a severe El Niño event where the previous year's rainfall was 188 mm; and in 2012 after a La Niña event where the previous year's rainfall was 605 mm. During both periods, elemental components of the mineral system (Ag, Pb, Zn and Cu) were present within the samples at elevated concentrations. Following the El Niño years of low rainfall, the trees directly overlying mineralization contained higher values of both Pb (up to 323 ppm) and Ag (up to 821 ppb) than in the wet La Niña year (Pb up to 69.2 ppm and Ag up to 165 ppb). The spatial distribution for Pb and Ag in both the 2005 and 2012 samples was nearly identical, but with consistently higher concentrations (averaging four times higher) in the 2005 samples. Zinc and Cu values in leaves are also elevated adjacent to mineralization but show less contrast between the two sampling periods, presumably because the uptake of these trace nutrients is largely determined by biological factors. We interpret the large seasonal variations in Pb and Ag to reflect passive uptake of these non-nutrient elements, the concentrations of which in the plant tissues was controlled by the chemistry of the available stream base aquifer, which was comparatively diluted in the La Niña sampling period. These results demonstrate that changes in available water play a significant role in diluting the resulting metal concentration within the trees. These results have implications for mineral exploration sampling programs, particularly those that may take place over multiple field seasons. These implications include changes to anomaly/background cut-off for different years and changes to the dispersion halo.

Keywords: biogeochemistry; *Eucalyptus camaldulensis* leaves; River Red gum; rainfall; El Niño; La Niña; metals

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Biogeochemistry for mineral exploration is defined by Dunn (2007) as "The chemical analysis of plant tissues to assess the presence and nature of underlying mineralization, bedrock composition, bedrock structure (faults, joints and folds), and the chemistry of the soil, surficial sediments, and associated groundwater". Biogeochemistry as a tool for mineral exploration has been used for many years to identify areas of potential mineralization, with many successes (Stednick & Riese 1987; Stednick *et al.* 1987; Hill *et al.* 2005; Lintern 2005, 2007; Dunn 2007; Dignam *et al.* 2008; Fabris *et al.* 2008; Hulme 2008). A number of biogeochemical studies have addressed seasonal variations of metal concentration in plants (Stednick & Riese 1987; Stednick *et al.* 1987; Alfani *et al.* 2000). Most of these studies have taken place in the northern hemisphere where the seasons are more clearly defined than in the arid parts of Australia. Lodgepole Pine needle and twig analysis conducted by Stednick in the 1980s showed that while some elements (Cu and Zn) were relatively stable from season to season and year to year, elements such as Au changed significantly with the seasons (Stednick & Riese 1987; Stednick *et al.* 1987). Studies addressing temporal changes in biogeochemistry in semi-arid and arid regions have been few (Hulme & Hill 2004; Lintern 2007; Hulme 2008). Lintern (2007) found significant seasonal differences in the trace metal and major element concentrations of *Eucalyptus incrassata* and *Melaleuca uncinata* sampled two years apart in semi-arid South Australia. Hulme (2008) studied the seasonal variation of *Eucalyptus camaldulensis* (Australian River Red gum) over a number of semi-arid regions in far-western NSW, Australia and noted that, whilst seasonal variation in most elements within *E. camaldulensis* occurred, it was not of sufficient magnitude to influence the interpretation of data for mineral exploration applications.

El Niño refers to the extensive warming of the central and eastern Pacific Ocean that leads to a major shift in weather patterns across the Pacific (Bureau of Meteorology 2012*b*). El Niño years are much drier with winter rainfall far below the long term average and summer rainfall mostly near average in Australia. La Niña is the reverse, with extensive cooling of the central and eastern Pacific (Bureau of Meteorology 2012*b*), La Niña years are associated with increased rainfall with both summer and winter rainfall above the long term average in Australia (Bureau of Meteorology 2012*b*).

There have been several studies on the effect of El Niño on Australian rainfall patterns (Nicholls & Kariko 1993; Cordery & Opoku-Ankomah 1994) as well as studies into the effect of the El Niño–La Niña phenomenon on the vegetation of Australia (Nicholls 1991). Nicholls noted that many of the attributes that make the Australian arid zone vegetation unique, in comparison to other arid and semi-arid zones around the world, are likely adaptations to the climatic changes brought on by El Niño-La Niña. These adaptations include drought tolerance, a dependence on

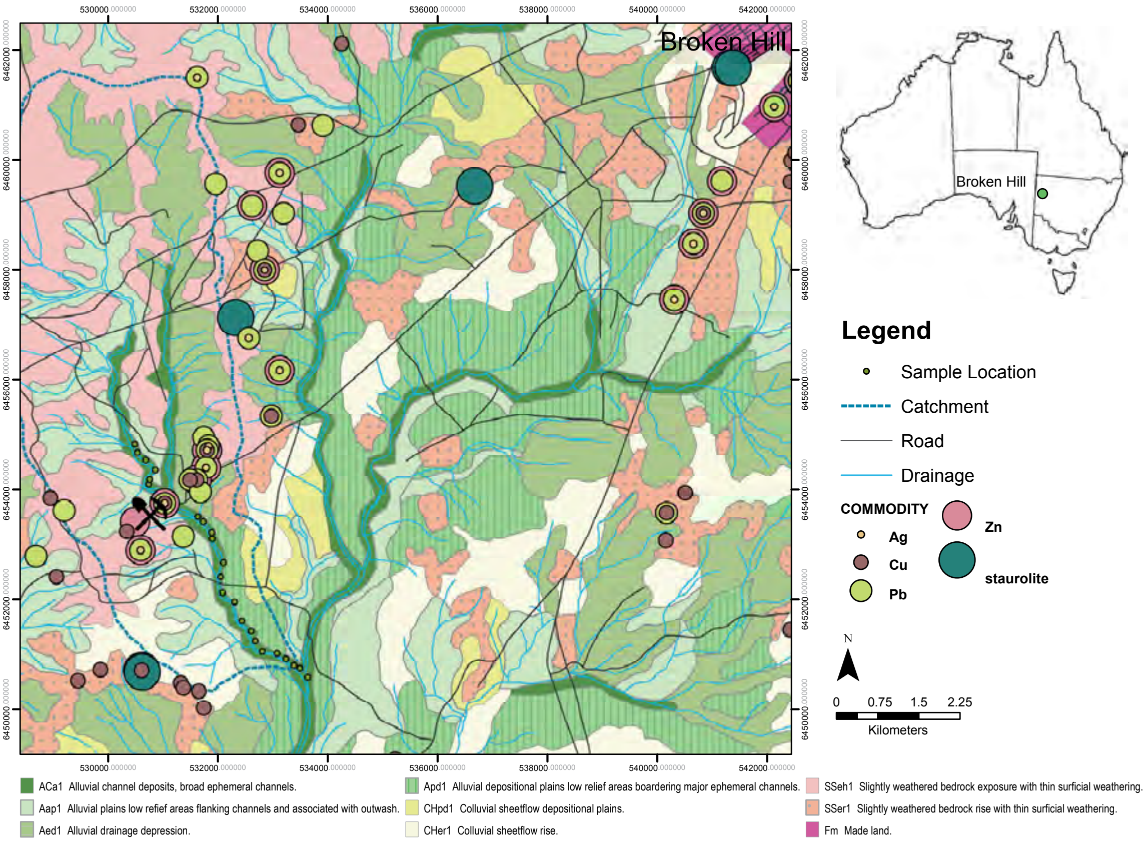

Fig. 1. Regolith landform map and *Eucalyptus camaldulensis* sample locations along Pine Creek in relation to the Pinnacle-Barrier Pb-Zn Mine, mineral occurrences and Broken Hill (Regolith map adapted from Hill 2001).

extended wet periods to set seed, fire tolerance/dependence and tall trees with deep roots. A common theme of these adaptations is that the plant is tuned to two (or more) modes of operation in which its physiology and interactions with its environment may be quite different, such as different periods of uptake and storage of water and nutrients in response to the environment, which would influence the uptake of elements useful for biogeochemical exploration (Dawson & Pate 1996; Dye 1996; Cohen *et al.* 1997).

There has been very little research that combines these themes to consider the influence of El Niño's dry winters and La Niña's flooding summer rains on the concentration of trace metals in plant tissues and the implications for biogeochemical exploration. Here, data are presented that demonstrate the temporal variation in trace metal concentrations within *E. camaldulensis* leaves growing along a creek system in a semi-arid region of Australia.

Study Area

The drainage system for this study is Pine Creek, 10 km SW of Broken Hill, in western New South Wales, Australia (Fig. 1). Pine Creek is a north-to-south flowing ephemeral alluvial channel flanked by depositional plains made up of transported material that is derived from dominantly alluvial sources, but also colluvial, sheetwash and aeolian processes (Fabris *et al.* 2008; Hulme 2008). The lower half of the creek is bordered by alluvial depositional plains, while the headwaters of the creek are flanked by alluvial plains to the east while the west is more colluvial-dominated, with more exposed bedrock within the creek bed. *Eucalyptus camaldulensis* grow along the banks and on the sandbars within the creek with an understorey of chenopod shrub (black bluebush, bladder saltbush, pearl bluebush and sparse mulgas) colonizing depositional bars. Active channels between the sandbars are clear of vegetation. Pine Creek bisects the Pinnacles-Barrier Pb-Zn mineralization and crosses the Pinnacles-Thackaringa Shear Zone in this area. The Pinnacles-Barrier mineralization has been worked sporadically since 1884 (Parr 1994) with numerous small workings over a strike length of *c.* 2 km. The largest of these workings, the Pinnacles Mine, is located on the western flank of Pine Creek. Mineralization is of the Broken Hill-type (Barnes 1988) with ore grade accumulations of Ag, Pb, and Zn contained in sulphide minerals galena and sphalerite, with pyrite as a significant accessory phase mineral (Ayres 1962). Broken Hill-type deposits are typically composed of stacked strata-bound lenses of varying metal content (typically Pb- and Ag-rich verses Zn-rich) hosted within quartzo-feldspathic to pelitic stratigraphy with prospective packages marked by thin quartz-gahnite and garnet-rich units (Walters 1998). The Pb lode at the Pinnacles Mine contains grades of 6–11% Pb, 2.5% Zn and 300–500 g/t Ag, while the Zn lodes contain *c.* 1% Pb, 10–15% Zn and 30 g/t Ag (Parr 1994). As of 2008, the mineral reserves at the Pinnacles included: 420 000 tonnes of contained Pb, 53 million oz. Ag, 14 000 tonnes Cu, 575 000 tonnes Zn and 219 000 oz. Au (Reid 2009).

Several biogeochemical research programs have investigated the area surrounding the Pinnacles Pb- Zn mine (Hill 2004; Hulme & Hill 2005; Dignam *et al.* 2008; Hulme 2008). These focused on the downstream lateral dispersion of Pb and Zn from blind mineralization along Pine Creek using the leaves of *E. camaldulensis* as

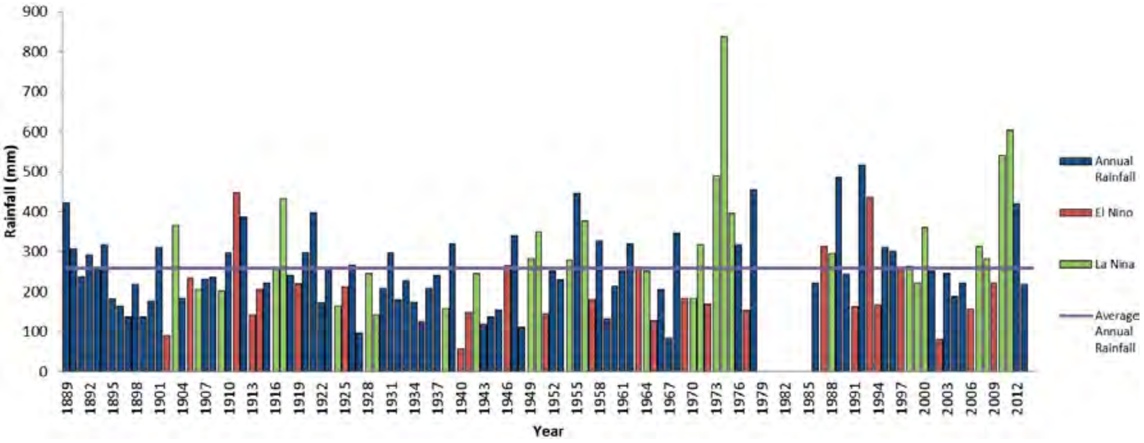

Fig. 2. Annual rainfall amounts for Broken Hill, Australia. Coloured to the El Niño/La Niña phase onset years as observed across Australia. (Modified from Climate Data Online, Bureau of Meteorology 2012*a*, *b*.)

well as using bluebush to identify and delineate the presence of mineralized zones under transported colluvial material. In a pilot study conducted in 2001 (Hill 2004), the leaves of *E. camaldulensis* along Pine Creek were sampled at 250 m spacing. Trees in close proximity to the mine had Pb values of 150 times background level (for that survey) (background, BG, of 2 ppm) and Ag values of 4.2 times background values (BG 0.84 ppm) (Hulme & Hill 2005). Hulme (2008) followed this up with a more detailed study where all available River Red gum trees along Pine Creek were sampled, focusing on the chemistry of the leaves.

Climate and rainfall patterns

The study area has a mean annual rainfall of 254 mm (Fig. 2), a mean maximum temperature of 24.3°C and a mean minimum temperature of 11.6°C (Bureau of Meteorology 2012*a*).The Broken Hill region is classed as having an arid to semi-arid climate, with winters that are cool and wet. While the region experiences most of its rainfall during the summer as heavy storm events, the summers are typically hot and dry. Prior to the second (La Niña) sampling period, the Broken Hill region received twice its annual average rainfall (2010–540 mm and 2011–605 mm) for the two years previous to the sampling year (2012), with 2011 being the second wettest calendar year recorded for Broken Hill (Bureau of Meteorology 2012*b*). Conversely, prior to the 2005 sampling period, Australia had experienced one of its most severe droughts, brought about by the 2002–2003 El Niño event which saw much of the country experience extreme dryness and high average temperatures (Bureau of Meteorology 2012*b*) while the Broken Hill region experienced around four years of below average rainfall (Fig. 2). El Nino onset years for Australia include 1905, 1914, 1940, 1941, 1946, 1965, 1972, 1977, 1982, 1991, 1994, 1997, 2002, 2006, and 2009 (Bureau of Meteorology 2012*b*) while La Nina onset years include 1906, 1910, 1916, 1917, 1950, 1955, 1956, 1971, 1973, 1975, 1988, 1998, 2007, 2008, and 2010 (highlighted in Fig. 2; Bureau of Meteorology 2012*b*).

Field and Laboratory Methods

In 2005, Hulme (2008) took a series of samples of *E. camaldulensis* leaves from trees along Pine Creek, extending from *c.* 1.5 km upstream of the Pinnacles Mine to 4.5 km downstream. This sampling corresponds with below average rainfall for the area between two severe El Niño events. This area was resampled in 2012, a La Niña period, at the same time of year (late April to early May) using the same sampling method, materials and where possible, sampling the same individual trees. During the 2005 study, all mature trees along the creek were sampled; however, this was not possible during the 2012 sampling period because some trees have since been removed, while others were inaccessible due to mud and standing water along many parts of the alluvial channel. As such, the 2012 samples were collected every 200–250 m. In all, 23 samples were collected in 2012 versus 107 samples collected in the original survey, covering *c.* 6 km of the creek system.

Studies of *E. camaldulensis* leaves have shown that they are effective at taking up metals and provide a good distinction between background and mineralized settings (Fabris *et al.* 2008). *Eucalyptus camaldulensis* are furthermore ideal trees for biogeochemistry surveys due to their morphology and distribution; the trees are generally single-trunked and are up to 30 m tall, have deep penetrating tap roots and lateral roots that can spread to tens of metres from the trunk, and can be found along most of Australia's waterways (Fabris *et al.* 2008).

Sampling was conducted by hand (jewellery-free, and clean of chemicals such as sunscreen to systematically minimise any possible contamination), selecting samples that appeared of a uniform maturity (fully open mature leaves) free from any obvious disease and from a uniform canopy height (*c.* 2 m above ground level) (Dunn 2007) and from around the tree canopy circumference as much as possible (which varies for trees with irregular canopies). Samples were taken from areas with minimal dust contamination (e.g. away from roads/tracks, mine/drill sites and cattle feed stations).

Once collected, the samples were stored in brown paper bags (2005) or calico bags (2012) to dry out. Paper and calico bags allow water vapour to escape and prevent the sweating and decomposition of samples. The bag tops were folded over, rather than stapled or pinned as this is a potential source of metal contamination. Samples were dried in an oven at 60°C for 48 h at the University of Adelaide, in order to remove excess moisture and to prevent decomposition. The samples collected in mid-2012, once dried, were sorted and re-packaged with samples split for storage and analysis to increase randomization and to further reduce possible sampling bias. The samples from 2005 were milled in the University of Adelaide laboratories using a stainless-steel 'coffee' grinder mill and stored in plastic Ziploc® bags in a cool storage room following initial analysis. Biogeochemical samples can be kept for at least 10 years if properly dried and stored (Houba *et al.* 1995). The 2005 samples were repackaged and submitted to the laboratory for geochemical analysis. All samples (2005 and 2012) were submitted to ACME Laboratories in Vancouver, Canada for processing and analysis. Preparation included further drying and milling to <100 mesh. The samples were not ashed. At ACME Laboratories, 0.5 g aliquots of sample were digested by HNO3 and modified aqua regia and analysed for a 53-element suite by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS). Quality assurance and control (QA/QC) were monitored by including randomized pre-preparation sample duplicates (1 in 10 duplication). During the laboratory stage, standard laboratory vegetation reference materials (in this case vegetation standard STD V16) were inserted into the sequence plus laboratory sample blanks and duplicates. The average pulp duplicate percentage errors for the 2005 samples were: Pb 3.3%, Ag 2.7%, Zn 1.5%, and Cu 0.18%, and for 2012: Pb 7.3%, Ag 10.1%, Zn 10.4%, and Cu 2.4% (calculated on a much smaller population of values than 2005). The duplicate per cent error for the standard STD V16 was: Pb 0.94%, Ag 2.0%, Zn 0.41%, and Cu 4.5%. These variations in sample duplicates and standards are small compared to the observed seasonal variations and do not influence the interpretations and conclusions drawn from our study.

We conducted stream sediment sampling at the same time as the 2012 plant sampling program to establish a baseline geochemistry for Pine Creek. A total of 23 samples were collected proximal to the *E. camaldulensis* so as to maintain some spatial comparability between the two media. The stream sediments are a strong representation of the physical component of downstream dispersion mechanisms within the creek as well as chemical dispersion. Approximately 2 kg of sediment were collected in the field focusing on the fine fraction (actively trying to avoid collecting gravels and coarse sands), with samples collected and stored in plastic sample bags. The samples were (where required) dried overnight at 60°C and then sieved using at <200 mesh in the University of Adelaide laboratory to retain the <75 µm fraction. The samples were then submitted to ACME Laboratories, where they were digested with aqua regia and analysed for the standard 53-element suite plus rare earth elements using ICP-MS.

Results

Stream sediments

The Ag and Pb results (Table 1; Fig. 3a and b) for the stream sediments have very similar spatial distributions within Pine Creek, with a small increase towards the area of mineralization. Values are elevated immediately downstream/proximal to the area of mineralization. The values then decline to a ’constant’ level, higher than those of samples taken upstream of mineralization (i.e. above what would be considered background for the creek of approximately 32–50 ppb Ag and 15–25 ppm Pb). At *c.* 5 km downstream, the sample results become more variable, with values oscillating between the highest values and the average for the creek. Over mineralization, values reach 90.3 ppm for Pb and 384 ppb for Ag, while the highest values recorded were 129 ppm for Pb and 576 ppb for Ag towards the end of the creek.

Zinc values (Table 1; Fig. 3c) for stream sediments follow a similar trend to that of Ag and Pb with background (for the creek) levels upstream of the mineralization, peaking approximately 200 m downstream of the mineralization and then returning to a constant level (*c.* 55 ppm) that is higher than the upstream background values (*c.* 25–40 ppm). Proximal to the mineralization, Zn concentration peaks at 124 ppm.

The spatial distribution of Cu (Table 1; Fig 3d) along Pine Creek within the stream sediments differs slightly to that of Pb, Ag and Zn. While it still records its highest value (31.5 ppm) proximal to mineralization, values do not remain elevated downstream, rather, they remain close to background (*c.* 14 ppm).

Table 1. *Summary statistics for the four main commodity elements studied within the <75 µm stream sediment fraction*

	Pb (ppm)	Ag (ppb)	Zn (ppm)	Cu (ppm)
Mean	47.7	170	59.5	16.6
Median	46.2	155	57	15.6
Max	129	576	124	31.5
Min	15.7	19	26.8	12.4
Range	113	557	97.4	19.1
SD	26.7	138	20.2	4.38
RSD	55.9	80.9	34	26.5

Biogeochemistry

Measures of dust contamination

Wind-blown contaminants have the potential to contribute to leaf chemistry either by diluting the leaf chemistry or contributing to it and thus adversely influencing the findings of biogeochemical studies, particularly in areas around mine sites where there has been ground disturbance. Hulme (2008) prepared washed and unwashed samples of *E. camaldulensis* in her study and found dust contamination to have had little effect on the leaf chemistry. Hulme (2008) concluded that the vertically hanging and waxy cuticles of the *E. camaldulensis* leaves are well adapted to shed dust from their surface. Nevertheless, due to the close proximity of Pine Creek to the mine site and main road into the area, we took a conservative approach and corrected the data for the main commodity elements (Pb, Ag, Zn, and Cu) for detrital dust contamination by normalising to Zr. Zirconium was used as an indicator for potential detrital contamination because it is not a component of the Pinnacles mineralization; its concentration within dust far exceeds that in biological materials and was measured at above detection limits in all of our samples. We did not use Al to measure contamination because it was at or below detection limit in a majority of samples.

Distribution of the commodity elements

The main commodity elements for the Pinnacles Mine of interest for biogeochemistry are Pb, Zn, Ag, and Cu. Non-commodity elements (those deemed essential in some part to plant health) within the Pine Creek system that are of interest for temporal variation include Al, Ca, Mg, Na, P, S, and Fe.

The statistical data for the *E. camaldulensis* are summarized in Tables 2 and 3. The Pb and Zn data have been further split into an upstream and downstream fraction based on the two distinct populations observed within the sample population represented here in histogram form (Fig. 4).

Silver values (Fig. 5a) within the leaves of the *E. camaldulensis* from Pine Creek are almost an order of magnitude higher in the samples collected by Hulme in 2005 (max: 821 ppb) proximal to the Pinnacles mine than those collected in 2012 (max: 165 ppb). Immediately south of the mine site, both the 2005 and 2012 values drop rapidly over a short distance (*c.* 750 m), they then level off before continuing to decrease. The 2005 samples have a greater range (8.18–8.21 ppb) compared to 2012 (4–165 ppb).

The Pb content of the *E. camaldulensis* leaves (Fig. 5b) from along Pine Creek follow the same broad spatial trends in both 2005 and 2012, with maximum values occurring at the surface projection of the buried mineralization, at which point values reach 323 ppm (2005) and 69.2 ppm (2012), followed by a drop of an order of magnitude in Pb levels beyond the mineralization (south of the causeway). Values remain consistent along the creek for *c.* 2 km; they then gradually decrease by half an order of magnitude along the remainder of the creek transects.

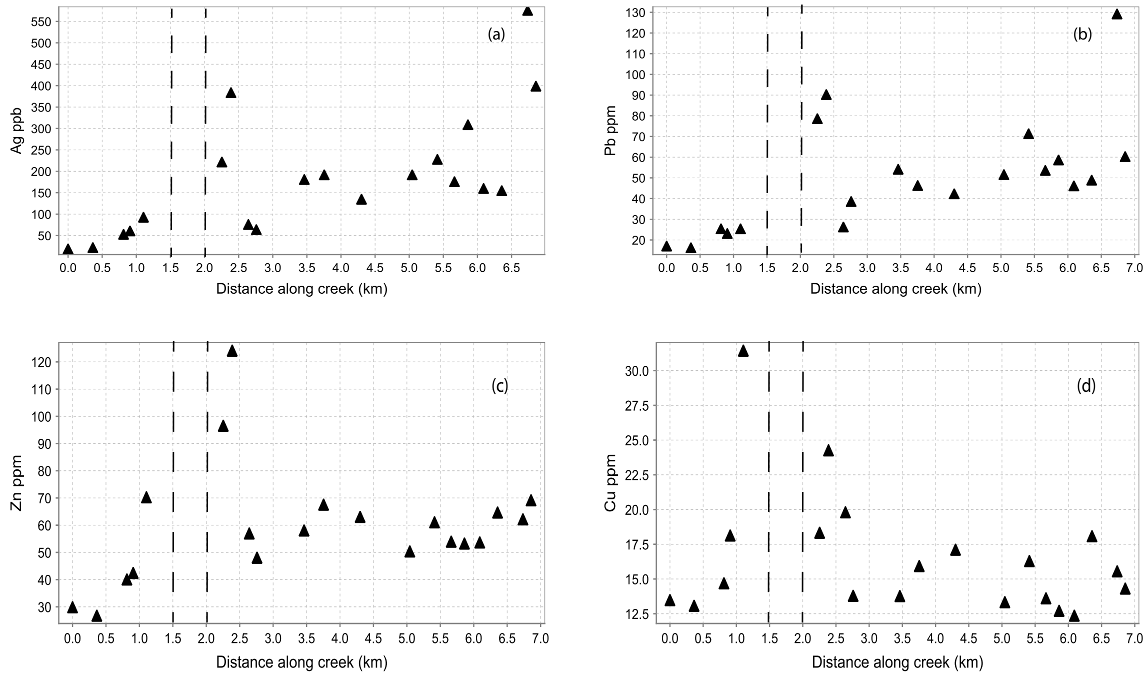

Fig. 3. (**a–d**). Metal content of the <75 µm stream sediments collected in 2012 from Pine Creek (dashed lines indicate approximate location of mineralization).

Table 2. *Summary statistics for River Red gum biogeochemical data for the four main commodity elements studied. Lead and Ag data-sets are split between upstream (US) and downstream (DS) based on natural breaks in the data observed in the histogram plots*

	Pb (ppm)						Ag (ppb)						Zn (ppm)		Cu (ppm)	
Year	2005	US	DS	2012	US	DS	2005	US	DS	2012	US	DS	2005	2012	2005	2012
Count	107	26	81	23	5	18	107	26	81	23	5	18	107	23	107	23
Mean	44.9	150	11.2	12.2	40.3	4.42	121	393	34.1	329	92.7	16.2	48.8	59.7	7.73	9.38
Median	12.5	127	9.8	4.49	37.4	4.01	37.1	340	30	20	90	15.4	41	52.4	7.09	6.67
Max	323	323	41.8	69.2	69.2	9.77	821	821	111	165	165	32.5	111	139	24.8	26.5
Min	2.81	71.9	2.81	1.17	20.4	1.17	8.18	185	8.18	4	38	4	15.1	21.1	2.65	2.64
Range	320	251	39	68	48.8	8.6	812	636	103	161	127	28.5	95.9	118	22.2	23.9
SD	66.6	58.4	6.44	17.1	17.8	2.53	172	153	19.9	38.5	45.9	8.72	23.9	29.5	3.71	6.58
RSD	148	38.4	57.7	140	44.1	57.3	142	38.9	58.6	117	49.6	53.7	49.1	49.4	47.9	70.1

Table 3. *Summary statistics for non-commodity elements but those considered essential to plant health; in %*

	Al		Ca		Mg		Na		P		S		Fe	
Year	2005	2012	2005	2012	2005	2012	2005	2012	2005	2012	2005	2012	2005	2012
Mean	0.012	0.009	1.1	1.47	0.25	0.26	0.16	0.17	0.13	0.18	0.16	0.15	0.02	0.013
Median	0.01	0.01	1.03	1.38	0.24	0.24	0.15	0.17	0.128	0.18	0.14	0.14	0.018	0.012
Max	0.03	0.02	1.95	2.97	0.38	0.52	0.4	0.3	0.18	0.35	0.28	0.32	0.053	0.027
Min	0.005	0.005	0.57	0.75	0.16	0.15	0.006	0.015	0.09	0.081	0.03	0.08	0.011	0.006
Range	0.025	0.015	1.38	2.22	0.22	0.37	0.369	0.29	0.09	0.266	0.25	0.24	0.042	0.021
SD	0.006	0.005	0.32	0.58	0.043	0.08	0.11	0.09	0.02	0.05	0.05	0.05	0.006	0.005
RSD	51.5	51.7	28.9	39.5	17.4	31.9	65.8	52.3	16.9	33.5	33.1	33.5	31.9	36.6

Zinc values (Fig. 5c) still maintain the same pattern as the other commodity elements along the creek, with higher values over and flanking mineralization (maximum concentration of 111 ppm in 2005 and 139 ppm in 2012). While the values remain higher in the 2005 samples immediately upstream and overlying the mineralization, beyond the mineralization there is little difference between the two sampling periods with the concentrations being quite variable. At the southern (downstream) end of the creek transect, the 2012 samples begin to increase in Zn concentration in comparison to the 2005 samples.

Copper values (Fig. 5d) follow a similar pattern to that of Zn, with the values in samples upstream of the mineralization being distinctly higher than for the 2005 samples. The difference between years is not as pronounced as with Pb and Ag values but

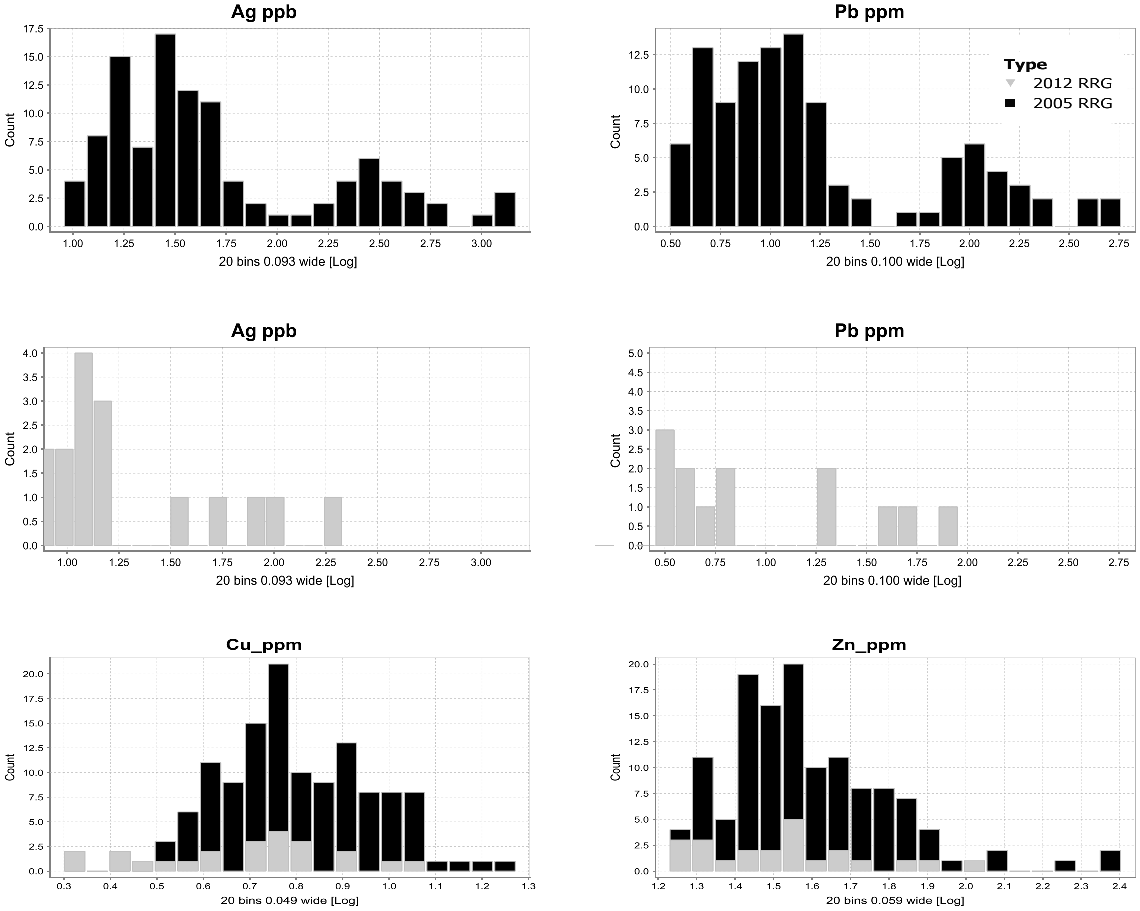

Fig. 4. Histogram plots of the four main commodity elements. The plots for Ag and Pb clearly show the skewed distribution within the data-set and demonstrate the spilt populations. These split populations demonstrate the importance of anomaly cut-off values for same sample material that is sampled a number of years apart, with the 2005 values completely obscuring the 2012 results.

corresponds with the maximum values at mineralization. While the overall range of Cu is small (3.36–18.8 ppm in 2005 and 1.99–10.9 ppm in 2012), the values downstream are quite variable.

Overall, the box-and-whisker plots (Fig. 6) show that the most noteworthy difference between 2005 and 2012 occurs in the Pb and Ag values, both of which have greater mean values and a greater range of values in 2005. Zinc and Cu values have similar median values between the two sampling periods, with greater outliers in the 2005 samples.

In contrast, box-and-whisker plots (Fig. 7) for those elements deemed essential for growth show that there is little to no difference between the two years. Phosphorus has a slightly higher average value in 2012 and a wider range of values. Calcium also has a slightly higher average value in 2012 in comparison to 2005 samples. There are only minor differences between sampling periods for Al, Mg and Na, and only minor differences in S contents.

Box-and-whisker plots for the main commodity elements, for stream sediments and both the 2005 and 2012 *E. camaldulensis* samples, allow for comparison of the three sample media. While the stream sediments exhibit higher average values than both periods of biogeochemical sampling, the overall range of values is much more constrained (Fig. 8).

Discussion

Downstream smearing of stream sediment chemistry

There is a general elevation in stream sediment concentrations for the commodity elements (Pb, Ag, Cu, Zn) downstream of the mineralization compared to samples upstream (Fig. 3). Although there are some high concentrations immediately adjacent to the mineralization, these concentrations are close to or less than crustal averages and there is no systematic upstream increase in concentration toward mineralization. We interpret that this pattern is due to a combination of factors: (1) the point source of metal-rich sediment (the Pinnacles mineralization) is only a small area of the catchment so that the amplitude of the stream sediment geochemical response is heavily diluted; and (2) Pine Creek is a low frequency, high intensity ephemeral creek. During high rainfall events, the creek acts as a ‘water-cannon’ moving a large amount of material very rapidly, and ‘smearing’ any possible anomaly along the system. Such ‘smearing’ produces a long dispersion train with relatively little contrast to background. In Pine Creek the dispersion train continues to the end of the sampling transect, *c.* 4 km beyond the area of known mineralization, at which point Ag and Pb values rise again. This is likely a reflection of creek morphology and the redistribution of sediments caused by localized flooding and flood plain input

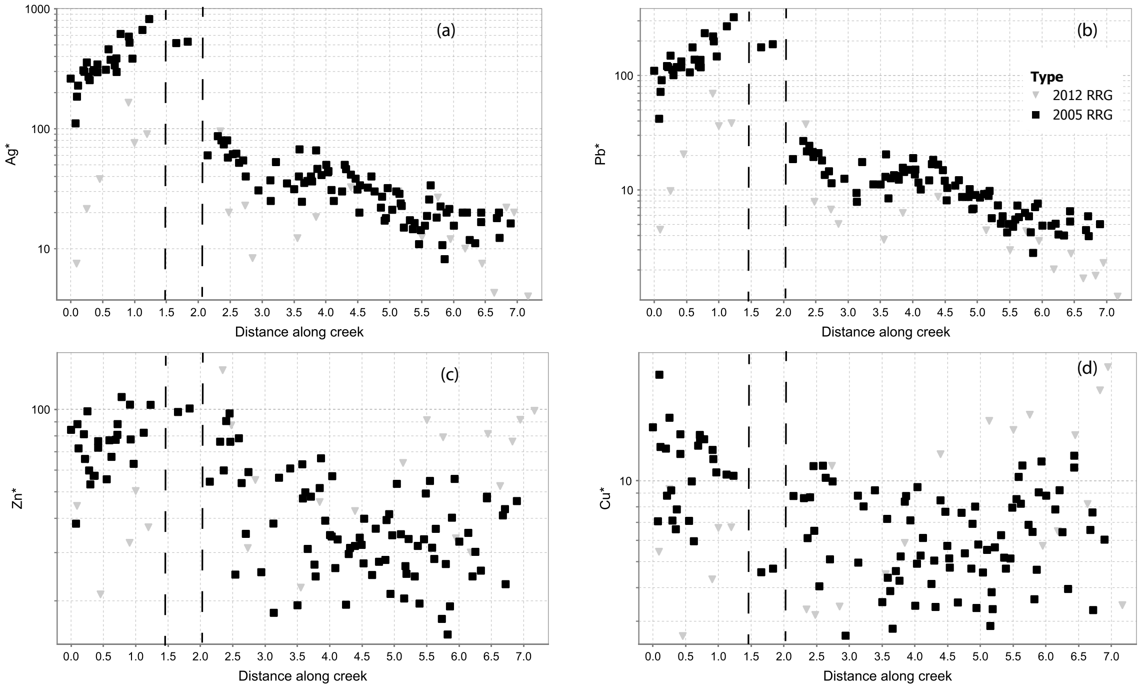

Fig. 5. (**a–d**). Metal concentration in leaves of the *Eucalyptus camaldulensis* from along Pine Creek collected in 2005 and 2012. While values are highest in the 2005 samples proximal to mineralization (particularly for Pb, Ag & Zn), further downstream a larger dispersion footprint can be seen in the Zn and Cu in both years. (Dashed lines represent the known areas of mineralization and mineral occurrences.) *Data corrected to Zr (Ag in ppb, Pb Zn Cu in ppm).

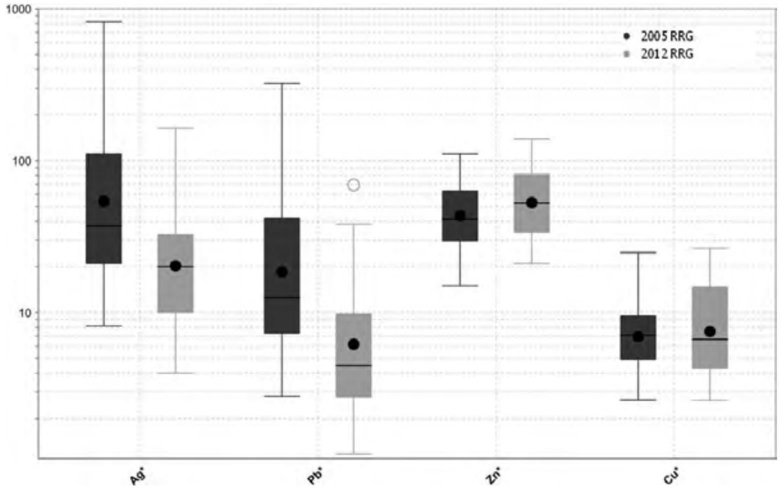

Fig. 6. Box-and-whisker plots for Ag, Zn, Pb and Cu. They show that there was a much larger range in values for Ag and Pb in the 2005 samples than in the 2012 samples, while the Zn and Cu values are comparable between years.

from nearby creek systems, plus additional enriched sediment load from the creek flowing from the Broken Hill deposit, rather than sources underlying the creek (Fig. 1). The widespread aeolian cover, reworked by these stream systems, would also contribute to the dilution of stream sediment signatures of buried mineralization. The strong correlation between Ag and Pb in stream sediments (Fig. 9) is reflective of the strong association of Ag with galena and suggests that this relationship is maintained within the sediments.

Essential vs non-essential elements

Silver and Pb concentrations are highest in samples of those *E. camaldulensis* leaves from trees that are growing in the shallow cover directly overlying the area of blind mineralization. These higher metal concentrations may be due to: direct interaction with buried mineralization; interaction with the geochemical dispersion ’footprint’ of mineralization; and/or run-off from the mine site. The 2012 biogeochemical results in particular show that the Ag and Pb concentrations decrease rapidly immediately downstream of mineralization, with little downstream dispersion. Recent costean excavation in the creek bed near the tree with highest Ag, Pb and Zn concentrations in 2005 found previously unknown underlying mineralization, now known as the Perseverance Zone (Reid 2009). The close spatial relationship between Ag and Pb along Pine Creek in both years, as well as the strong geochemical

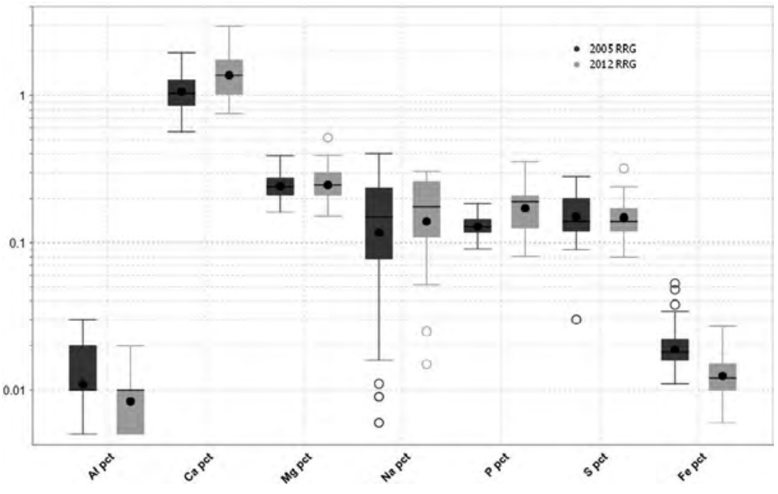

Fig. 7. Box-and-whisker plots for non-commodity elements (but essential for plant health) Al, Ca, Mg, Na, P, S and Fe. There is very little difference between the years for those elements essential for plant health.

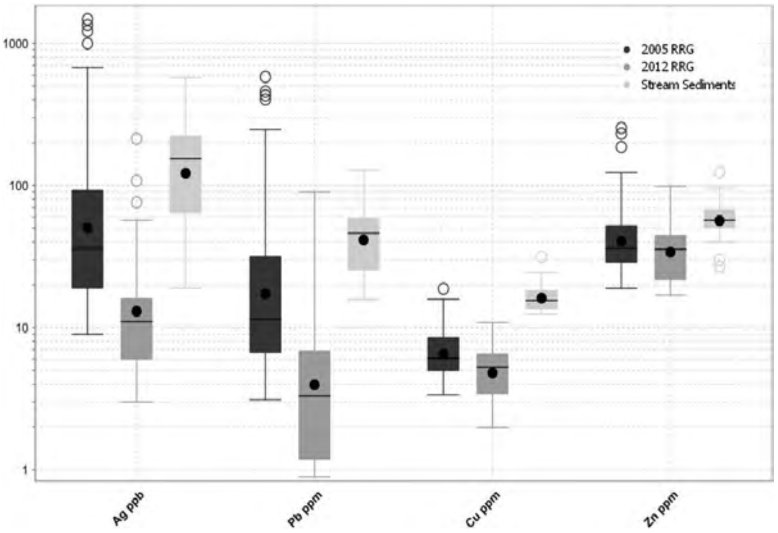

Fig. 8. Box-and-whisker plots for Ag, Pb, Zn and Cu in stream sediments, both the 2005 and 2012 *Eucalyptus camaldulensis* samples. While the stream sediments have a higher average value, there is a much larger range of values recorded in both sampling periods for the *Eucalyptus camaldulensis*.

relationship, is again reflective of the close association of Ag with the galena mineralization. It suggests a similar means of uptake and behaviour by the plants in dealing with Ag and Pb, both of which are considered non-essential elements.

The remaining commodity elements (Zn, Cu) are only slightly elevated directly overlying the mineralization and within the samples upstream of mineralization; however, Cu and Zn concentrations are much more variable than those for Pb and Ag downstream with values recorded increasing towards the end of the transect. This may be due to a number of reasons, for example: the metals may be more widely abundant, they may be more mobile or are much more essential for plant growth and therefore better taken up to required levels. The distinction between areas of mineralization and areas of background are less obvious when using Zn and Cu levels in *E. camaldulensis* samples. This is because these elements are essential to the health of the plants (Cu plays a significant role in photosynthesis and respiration while Zn is an integral part of a number of enzymes; (Kabata-Pendias & Pendias 2000) and so the plants will take up the metals to the extent that they are needed while only slightly reflecting the increase in availability over mineralization.

Other elements essential to plant growth (Fe, P, Ca, Al, Mg, S) plus Na are mostly comparable between sampling periods (Fig. 7). Any major differences would be likely to suggest that one of the year's samples may be a representation of physiological stress; however, this is not observed. This further suggests that the trees are performing selective uptake of elements that are essential for their health (such as Mg), while at the same time passively taking up elements that are not essential (such as Pb) and more directly linked to changes in shallow aquifer hydrogeochemistry between rainfall regimes (Fig. 10). The results here highlight how the biogeochemical responses of non-essential trace elements compared to essential elements can vary between different climatic events and associated hydrogeochemical regimes.

Effect of rainfall

A number of studies have examined temporal variation from the seasonal to the year-to-year scale. Lintern (2007) found significant seasonal differences in the geochemistry of *Eucalyptus incrassata* and *Melaleuca uncinata* sampled two years apart, including changes in the major elements of Ca, K, Mg, and Na (Lintern 2007). Lodgepole Pine needle analysis conducted by Stednick in the early 1980s showed that while the distributions of some trace elements (Cu and Zn) were relatively stable, both throughout the

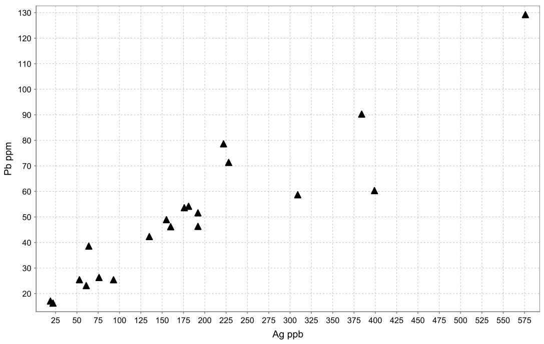

Fig. 9. Scatter (X-Y) plot of the Ag and Pb content of the <75 µm stream sediment fraction. The strong correlation between Ag and Pb within the stream sediments is reflective of the strong association of Ag with galena and suggests that this relationship is maintained within the sediments.

year and from year to year, rare elements such as Au changed significantly with the seasons (Stednick & Riese 1987; Stednick *et al.* 1987). However, the changes observable in the Pine Creek samples cannot be accounted for by annual seasonality changes as they were sampled at the same time of year.

Sampling procedures for both periods of sampling and the analytical procedures used are equivalent which would signify that the changes observed are a result of external influences rather than the result of sampling and analytical procedures. The most significant difference between the two sampling periods is the rainfall regime as a result of the local cyclic rainfall patterns observed for arid Australia and which have then been exaggerated by the climatic changes associated with El Niño and La Niña.

Previous to the 2012 sampling period, Broken Hill received about twice the annual average rainfall for the two years prior and during the year of sampling. The 2010–2011 La Niña event has been one of the strongest on record with 2010 and 2011 being Australia's third and second wettest calendar years on record, respectively, with the average rainfall event in the Broken Hill area lasting four days (Bureau of Meteorology 2012*b*). The extra rainfall caused extensive flooding in the region and with the changes in rainfall there is a change in the availability of water for trees. To understand the implications of this for the *E. camaldulensis* growing along Pine Creek, the nature and landscape setting of where the trees grow along the creek need to be considered. Pine Creek is an ephemeral system, only flowing after extensive rainfall events. Dawson & Pate (1996) showed that the shallow lateral roots and deep tap roots of the *Banksia prionotes* (a native tree to Western Australia) had access to different water sources and dominance changed with seasonal change. During the wet winter, water was predominantly taken up from the lateral roots that took advantage of the higher rainfall and greater water availability in the upper soil. In contrast, during the drier summer period, water was predominantly taken up via deeper (sinker) roots from deeper water sources. This same idea can be applied to Pine Creek, where, during periods of drought, the tree would take water preferentially from the deeper ground water/stream base aquifer, and during periods of rainfall the trees would make use of the available surface water.

During El Niño, when the rainfall is lower than average and temperatures generally higher, the water level of the stream base aquifer would be significantly lower and the elemental concentrations in the stream base aquifer would be expected to be higher. Factors contributing would include: lesser rainfall recharge, greater evaporation, longer interaction with the mineralization and other bedrock lithologies at the base of the alluvial base aquifer, and slower through-flow in the system. With the changes in climatic regime during El Niño and La Niña, the resulting changes in rainfall with each event play a significant role in the hydrogeochemical concentrations of the underlying stream base aquifer underlying Pine Creek. During La Niña the greater rainfall would lead to a greater input of water into the system, meaning the chemistry of the shallow alluvial aquifer is typically diluted and flushed (greater volume of mixing of enriched water with 'clean water'; Fig. 11).

In normal conditions and during prolonged drought (such as during 2005 following the 2002/3 El Niño event), the deep penetrating roots of the trees would get most of their water from the underlying shallow alluvial aquifer. The chemistry of the aquifer would be in equilibrium with the chemistry of the sediments through which it passes and the underlying bedrock lithologies (which in this case is mineralized). During 2012, the La Niña high

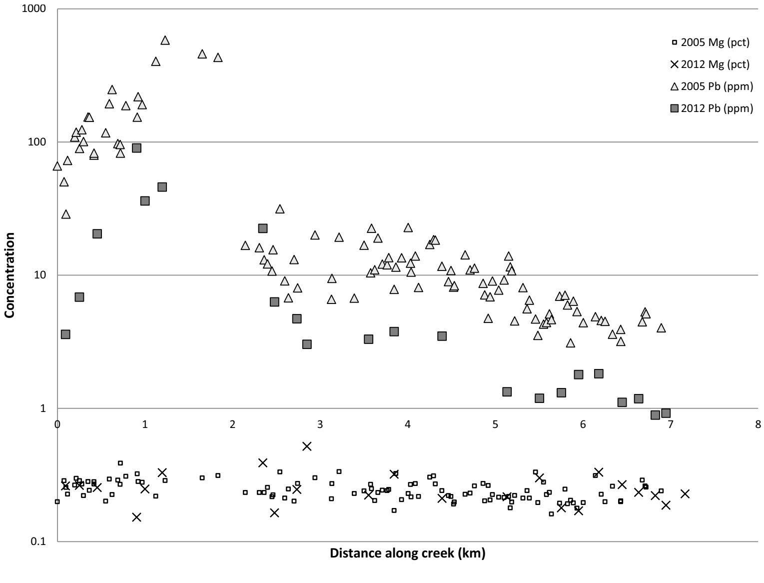

Fig. 10. Comparison of Mg and Pb along the distance of the creek. This demonstrates that while the dilution of the stream base aquifer between years significantly alters the levels at which non-essential elements such as Pb are taken up by the trees and alters with distance from source, it shows that essential elements such as Mg remain constant despite dilution and landscape setting.

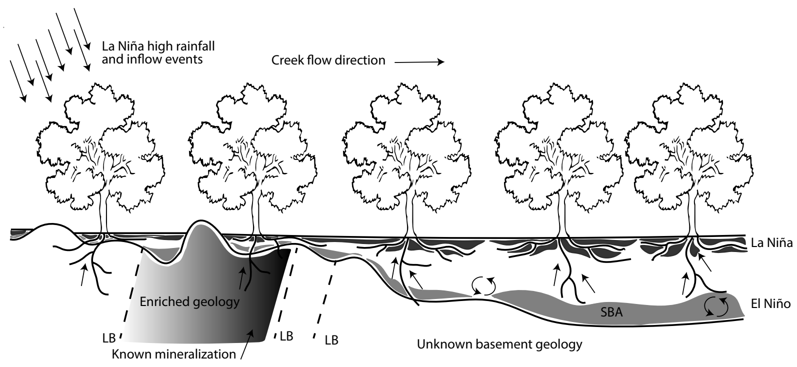

Fig. 11. A schematic representation of the changes that occur with the stream base aquifer brought about by different climatic conditions. Additional rainfall and inflow during La Niña conditions flushes the stream base aquifer (SBA) and provides additional, easily accessible, surface water for the extensive lateral root systems of the *Eucalyptus camaldulensis*. It further represents the potential depth-to-bedrock along the creek and the interactions with the known underling geology, possible lithological boundaries (LB) and the interaction of the tree roots with crack in the shallow outcropping geology. The greater the depth to bedrock, the less representative the biogeochemistry is of the underlying lithologies.

rainfall levels lead to greater input of water into the system, thus diluting the hydrogeochemistry of the shallow alluvial aquifer. With the shallow alluvial aquifer diluted and the additional uptake of water by the lateral root system of the tree from the surface water, lower metal levels within the tree would result as they become diluted in the greater volume of ‘clean’ water.

With those samples derived from trees within a creek channel, it is important to consider the morphology of the drainage channel, as well as sediment transport and residence within the system. At the start of the sampling transect along the creek, the depth to the base of the creek (and therefore bedrock) through the cover is shallow, with extensive bedrock exposed in the creek bed (Fig. 11). At this point the rainfall input into the system appears to have a significant effect on the biogeochemistry of the *E. camaldulensis* growing in the area, as is reflected in the results (Fig. 5), with samples directly overlying and flanking the mineralization showing significantly different values between sampling periods. The shallow depth to basement means that tree roots and the water source would always be in close proximity to the metal source, further supporting the theory of a diluted alluvial stream base aquifer. The high values recorded upstream of the mineralization in the *E. camaldulensis* samples are opposite to what is observed in the stream sediments where values are much lower. This further supports the argument that the trees are taking up water that is more closely related to the bedrock underlying the stream sediments rather than to the stream sediments themselves. At the downstream section of the survey (Fig. 11), the depth to the bedrock is greatly increased. There is a greater amount of alluvium build-up due to a change in the creek morphology (sharp *c.* 90° bend) and the addition of tributary creek sediment loads. Here, during periods of drought, the deep sinker roots of the *E. camaldulensis* will take up water from a deeper source, interacting with both the stream sediments and underlying bedrock. However, during the periods of high rainfall and input to the creek during La Niña, the trees will take up the more accessible water in the surface sediments, as outlined earlier, with very little interaction with the bedrock. The chemistry of the trees is then much more a reflection of the recent rainfalls and its short interaction and an amalgamation of the stream sediment chemistry rather than a representation of what lies beneath.

Implications for mineral exploration

Knowledge of the climatic variations of an area is important for biogeochemical surveys, especially if plant biogeochemical sampling is conducted over several seasons or years or uses historical data-sets. The local climate variation and cyclic rainfall patterns as seen in the Broken Hill region could have a significant effect on the biogeochemical results of a survey and would be further enhanced by climatic changes brought on by climatic phenomena such as El Niño and La Niña. These fluctuating rainfall amounts could lead to the misinterpretation of geochemical data obscuring the contrast between background and anomaly, leading to potentially missed opportunities and mineralization occurrences being overlooked. Sampling that does occur over several seasons or is affected by large climatic changes would still be possible, but should be considered with different anomaly cut-offs and resampling some of the existing data points (where applicable) to establish if there is, in fact, a change between sampling seasons. This can further be addressed by splitting the data into smaller populations based on data splits observed in histogram plots (Fig. 4a–f). Splitting the data-set into smaller populations based on natural data breaks in this case was only necessary for some but not all of the elements observed in this study. Splitting the data allows for a more meaningful understanding of the values in relation to median values and ranges, without information being lost or obscured by outliers. An example of this is derived from the anomalous samples collected in the 2005 sampling period, where samples with Pb >31.4 ppm would be considered anomalous, whereas if that value is applied to the 2012 sample data, it would mask the biogeochemical response to the underlying mineralization. Concentrations considered to be anomalous for the 2012 data would be Pb values greater than 4.7 ppm. Landscape setting is also important to consider during a biogeochemical survey. A survey that is focused along a drainage/alluvial channel, such as the one conducted along Pine Creek, would have a halo that is constrained and focused within the bounds of the creek system, with the biogeochemical footprint for Pb within Pine Creek restricted to *c.* 1 km either side of the mineralization. However, a survey over a colluvial plain could have very wide anomalies and multiple point sources and may be difficult to pin-point if they are either laterally and vertically transported.

This study has shown that biogeochemistry is a reliable means of exploration during both periods of drought and, to a lesser extent, after high rainfall and flooding. Ultimately the main implications which need to be considered are: changes in anomaly/background thresholds due to differences in absolute values for trace metals, and the differing sizes of geochemical haloes, influencing the detection of footprints and ultimately the required sample spacing to detect the footprint.

Conclusion

A biogeochemical survey over an area of known mineralization has shown that the changes in rainfall from year-to-year within the context of climatic phenomena such as El Niño and La Niña can play a significant role on the metal content of *E. camaldulensis*. While not every El Niño or La Niña event is identical in intensity and impact on the country, the long term cycles are clearly defined in yearly rainfall patterns. Our results indicate that the change in rainfall can result in concentrations in the leaves that are an order of magnitude different in trees that are growing over buried mineralization. These differences are brought about by the diluting effect of the additional inflow of water into the creek's stream base aquifer during a La Niña event. The additional rainfall dilutes the signature of mineralization while providing 'clean' water to the trees that has not interacted with the underlying mineralization. The implications of this are important to the mineral exploration industry where sampling programs can be spread over several seasons and years and may result in a missed opportunity. To overcome the confounding effects of changing rainfall events, the surveys should include resampling a number of the same sample points, splitting data into smaller populations based on natural breaks and years and establishing different anomalous and background thresholds for each data-set.

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Appendix 2

Fowlers Creek Bedrock Statistics Tables

Fowlers Creek Bedrock Statistics

Cretaceous	Co ppm	Pb ppm	Y ppm	Ni ppm	U ppm	Cs ppm	Fe2O3 pct
Count Numeric	4	4	4	4	4	4	4
Minimum	0.7	2.6	5.1	1.6	1	0.8	0.66
Maximum	4.2	3.2	21.9	3.9	1.5	2.2	1.1
Mean	2.33	2.85	11.98	2.5	1.2	1.33	0.86
Median	2.2	2.8	10.45	2.25	1.15	1.15	0.84
Standard Deviation	1.44	0.26	7.08	1.12	0.22	0.61	0.19
Interquartile Range	2.68	0.5	12.72	2.05	0.4	1.08	0.36
Range	3.5	0.6	16.8	2.3	0.5	1.4	0.44

Devonian	Co ppm	Pb ppm	Y ppm	Ni ppm	U ppm	Cs ppm	Fe2O3 pct
Count Numeric	10	10	10	10	10	10	10
Minimum	0.1	1.2	4.8	0.9	0.6	0.2	0.35
Maximum	8	5.2	29.9	20.2	13.7	4.6	39.27
Mean	2.66	2.95	12.34	4.8	2.46	1.46	4.62
Median	1.2	2.8	8	1.25	1.15	0.65	0.53
Standard Deviation	2.73	1.44	8.22	6.55	4.03	1.68	12.19
Interquartile Range	4.55	2.78	12.85	8.08	1.18	2	0.85
Range	7.9	4	25.1	19.3	13.1	4.4	38.92

Limestone	Co ppm	Pb ppm	Y ppm	Ni ppm	U ppm	Cs ppm	Fe2O3 pct
Count Numeric	6	6	6	6	6	6	6
Minimum	1.5	2.6	4.3	0.7	0.8	0.2	0.23
Maximum	4.2	18.5	8.1	3.9	2.3	1.2	3.39
Mean	2.42	6.12	6.18	2.23	1.42	0.55	1.13
Median	2.1	3.3	6.35	2.15	1.3	0.4	0.7
Standard Deviation	1.05	6.19	1.68	1.42	0.53	0.38	1.2
Interquartile Range	1.88	6.23	3.2	2.68	0.82	0.63	1.73
Range	2.7	15.9	3.8	3.2	1.5	1	3.16

Limestone Lens	Co ppm	Pb ppm	Y ppm	Ni ppm	U ppm	Cs ppm	Fe2O3 pct
Count Numeric	6	6	6	6	6	6	6
Minimum	1.2	5.4	10.5	2.9	1.9	1.2	0.68
Maximum	32.3	30.2	34.3	68.6	4.4	3.7	40.06
Mean	9.9	15.82	23.18	19.45	2.83	2.4	8.42
Median	6.6	11.85	24.75	11.5	2.7	2.4	2.37
Standard Deviation	11.23	10.88	10.45	24.35	0.9	1.19	15.52
Interquartile Range	10.4	21.95	20.95	19.73	1.45	2.35	10.19
Range	31.1	24.8	23.8	65.7	2.5	2.5	39.38

Basalt	Co ppm	Pb ppm	Y ppm	Ni ppm	U ppm	Cs ppm	Fe2O3 pct
Count Numeric	3	3	3	3	3	3	3
Minimum	16.3	3.6	23.2	5.6	1.7	1.3	7.96
Maximum	40	16.3	44	18.7	4.5	9.3	17.8
Mean	25.3	8.03	30.37	10.27	3.33	5.5	11.24
Median	19.6	4.2	23.9	6.5	3.8	5.9	7.97
Standard Deviation	12.84	7.17	11.81	7.32	1.46	4.01	5.68
Interquartile Range	23.7	12.7	20.8	13.1	2.8	8	9.84
Range	23.7	12.7	20.8	13.1	2.8	8	9.84

Silcrete	Co ppm	Pb ppm	Y ppm	Ni ppm	U ppm	Cs ppm	Fe2O3 pct
Count Numeric	3	3	3	3	3	3	3
Minimum	0.1	0.7	5.6	0.5	1	0.05	0.37
Maximum	0.5	6.6	7.3	0.9	1.5	0.05	0.41
Mean	0.3	2.83	6.2	0.67	1.2	0.05	0.39
Median	0.3	1.2	5.7	0.6	1.1	0.05	0.38
Standard Deviation	0.2	3.27	0.95	0.21	0.26	0	0.02
Interquartile Range	0.4	5.9	1.7	0.4	0.5	0	0.04
Range	0.4	5.9	1.7	0.4	0.5	0	0.04

Vein Quartz	Co ppm	Pb ppm	Y ppm	Ni ppm	U ppm	Cs ppm	Fe2O3 pct
Count Numeric	5	5	5	5	5	5	5
Minimum	0.9	0.7	0.3	1.1	0.05	0.05	0.37
Maximum	14.9	21.8	29.6	68.6	2.3	1	4.76
Mean	5.02	10.92	8.86	17.2	0.89	0.38	1.97
Median	2.6	12	4.3	3.7	0.5	0.3	1.39
Standard Deviation	5.85	8.97	12.17	28.9	0.89	0.39	1.69
Interquartile Range	9.35	17.5	19.1	36.85	1.53	0.7	2.73
Range	14	21.1	29.3	67.5	2.25	0.95	4.39

Ferricrete	Co ppm	Pb ppm	Y ppm	Ni ppm	U ppm	Cs ppm	Fe2O3 pct
Count Numeric	8	8	8	8	8	8	8
Minimum	25	4.7	15.2	66	2.5	0.3	9.02
Maximum	485.1	63.6	61.8	597.2	9.7	14.1	64.98
Mean	125.95	28.8	33.88	194.63	5.65	4.41	31.45
Median	64.45	30.35	29.95	116.25	4.95	2.05	24.36
Standard Deviation	155.4	18.82	14.75	181.24	2.73	4.88	22.43
Interquartile Range	139.35	26.7	19.68	198.27	5.13	6.95	45.62
Range	460.1	58.9	46.6	531.2	7.2	13.8	55.96

Quartzite	Co ppm	Pb ppm	Y ppm	Ni ppm	U ppm	Cs ppm	Fe2O3 pct
Count Numeric	10	10	10	10	10	10	10
Minimum	1.1	1	5.5	1	0.7	0.3	0.4
Maximum	12.9	78	12.9	111.5	3.1	2.5	25.88
Mean	3.47	12.29	7.6	16.03	1.16	0.85	3.45
Median	2.35	6.3	6.8	4.75	0.9	0.7	1.06
Standard Deviation	3.5	23.28	2.11	33.73	0.72	0.63	7.89
Interquartile Range	2.03	5.83	1.42	7.9	0.55	0.48	0.65
Range	11.8	77	7.4	110.5	2.4	2.2	25.48

Shale	Co ppm	Pb ppm	Y ppm	Ni ppm	U ppm	Cs ppm	Fe2O3 pct
Count Numeric	22	22	22	22	22	22	22
Minimum	1.4	3.2	1.5	2.5	0.3	0.2	1.24
Maximum	24.2	27.8	45.5	45.4	4.3	11.1	8.48
Mean	11.55	14.76	27.55	24.71	2.64	5.9	5.1
Median	9.65	16.35	29.45	27.2	2.45	5.85	5.32
Standard Deviation	6.7	6.48	9.94	11.55	1.09	2.92	1.88
Interquartile Range	9.52	9.28	14.27	13.15	1.47	4.17	2.36
Range	22.8	24.6	44	42.9	4	10.9	7.24

Appendix 3
Biogeochemical and Geochemical Data

Fowlers Creek *E. camaldulensis*

Sample No.	Eastings	Northings	Ag ppb	Al pct	As ppm	Au ppb	B ppm	Ba ppm	Be ppm	Bi ppm	Ca pct	Cd ppm
FC001	564982	6559009	2	0.01	0.2	0.2	79	34.4	0.05	0.01	1.84	0.03
FC002	564998	6559047	1	0.01	0.1	0.3	100	21.5	0.05	0.01	1.83	0.02
FC003	565053	6559061	4	0.02	0.2	0.3	124	26.4	0.05	0.01	1.06	0.02
FC004	565071	6559108	1	0.01	0.1	0.2	115	27.9	0.05	0.01	1.51	0.02
FC005	565096	6559104	4	0.01	0.2	0.2	87	30.6	0.05	0.01	1.18	0.02
FC006	565132	6559121	1	0.02	0.2	0.3	90	23.2	0.05	0.01	1.04	0.01
FC007	565153	6559110	2	0.01	0.2	0.1	109	25.9	0.05	0.01	1.37	0.02
FC008	565204	6559157	3	0.01	0.1	0.1	66	19.6	0.05	0.01	0.89	0.01
FC009	565233	6559165	3	0.02	0.1	0.2	97	30.5	0.05	0.01	1.24	0.01
FC010	565278	6559171	1	0.02	0.05	0.3	81	28.9	0.05	0.01	1.13	0.02
FC011	565376	6559193	3	0.02	0.3	0.6	74	27.6	0.05	0.01	1.18	0.01
FC012	565375	6559196	2	0.01	0.2	0.4	77	22	0.05	0.01	1.51	0.02
FC013	565430	6559197	3	0.01	0.2	0.3	48	26.2	0.05	0.01	1.08	0.01
FC014	565428	6559197	2	0.02	0.3	0.2	67	19.1	0.05	0.01	0.84	0.01
FC015	565499	6559207	2	0.02	0.4	0.2	62	14.7	0.05	0.01	1.12	0.01
FC016	565509	6559212	2	0.01	0.2	0.2	59	14.3	0.05	0.01	0.95	0.02
FC017	565551	6559227	2	0.02	0.2	0.3	61	25.2	0.05	0.01	1.07	0.02
FC018	565599	6559251	3	0.02	0.2	0.3	39	18.3	0.05	0.01	0.87	0.01
FC019	565633	6559271	3	0.01	0.3	0.1	87	14.9	0.05	0.01	1.23	0.01
FC020	565676	6559319	2	0.005	0.1	0.2	65	15.1	0.05	0.01	1.14	0.01
FC021	565701	6559311	2	0.01	0.1	0.1	115	26.9	0.05	0.01	1.91	0.03
FC022	565738	6559327	3	0.01	0.2	0.3	80	27.4	0.05	0.01	1.23	0.04
FC023	565784	6559367	3	0.02	0.3	0.2	66	30.1	0.05	0.01	1.42	0.01
FC024	565823	6559413	7	0.005	0.1	0.2	120	23.3	0.05	0.01	1.28	0.01
FC025	565827	6559451	5	0.01	0.3	0.2	168	33.5	0.05	0.01	1.47	0.02
FC026	565876	6559472	4	0.02	0.4	0.3	130	12.9	0.05	0.01	1.31	0.11
FG027	565867	6559470	3	0.02	0.05	0.4	122	12.2	0.05	0.01	1.03	0.01
FC028	565881	6559523	2	0.02	0.2	0.3	136	20.3	0.1	0.01	1.3	0.02
FC029	565910	6559553	2	0.02	0.2	0.3	165	13.7	0.1	0.01	1.15	0.04
FC030	565932	6559580	5	0.02	0.1	0.4	87	34.6	0.05	0.01	1.67	0.03
FC031	565969	6559592	5	0.02	0.3	0.2	134	27.2	0.05	0.01	1.54	0.02
FC032	566008	6559601	2	0.01	0.2	0.3	145	19.7	0.05	0.01	1.33	0.02
FC033	566039	6559611	2	0.01	0.05	0.1	72	15.1	0.05	0.01	1.04	0.01
FC034	566063	6559628	2	0.005	0.1	0.2	65	35.3	0.05	0.01	1.7	0.01
FC035	566119	6559654	2	0.005	0.05	0.1	69	20.8	0.05	0.01	0.95	0.01
FC036	566137	6559654	3	0.02	0.05	0.1	91	21.8	0.05	0.01	1.56	0.01
FC037	566164	6559661	4	0.01	0.05	0.1	50	15.2	0.05	0.01	0.89	0.01
FC038	566227	6559659	1	0.01	0.05	0.1	37	17.3	0.05	0.01	1.16	0.01
FC039	566264	6559637	3	0.01	0.2	0.1	158	86.4	0.05	0.01	3.23	0.02
FC040	566295	6559630	3	0.02	0.05	0.1	86	29.5	0.05	0.01	1.98	0.06
FC041	566337	6559641	4	0.02	0.05	0.1	163	34.2	0.05	0.01	1.84	0.01
FC042	566387	6559631	2	0.01	0.05	0.1	172	25.5	0.05	0.01	0.83	0.02
FC043	566362	6559658	8	0.01	0.05	0.3	129	14.1	0.05	0.01	1.17	0.01
FC044	566381	6559652	2	0.02	0.1	0.1	239	28.7	0.05	0.02	0.98	0.02
FC045	566465	6559646	3	0.01	0.05	0.1	157	36.1	0.05	0.01	1.61	0.02
FC046	566489	6559660	4	0.01	0.1	0.1	122	27	0.05	0.01	1.54	0.01
FC047	566523	6559656	4	0.01	0.05	0.1	74	22.4	0.05	0.01	1.33	0.03
FC048	566549	6559665	3	0.01	0.2	0.1	108	28	0.05	0.01	1.28	0.02
FC049	566616	6559660	2	0.01	0.05	0.1	51	10	0.05	0.01	0.6	0.005
FC050	566661	6559657	1	0.01	0.05	0.1	71	23.8	0.05	0.01	1.15	0.01
FC051	566697	6559700	1	0.005	0.2	0.1	172	17.5	0.05	0.01	0.8	0.01
FC052	566758	6559672	2	0.02	0.05	0.1	123	37	0.05	0.01	1.66	0.02
FC053	566776	6559693	2	0.005	0.05	0.1	90	29.9	0.05	0.01	1.83	0.01
FC054	566818	6559728	2	0.02	0.05	0.1	88	24	0.05	0.01	2.12	0.02
FC055	566832	6559743	4	0.02	0.05	0.1	103	24.2	0.05	0.01	1.63	0.02
FC056	566876	6559758	2	0.01	0.2	0.1	103	29.4	0.05	0.01	1.5	0.01
FC057	566899	6559763	3	0.005	0.05	0.1	81	26.5	0.05	0.01	1.36	0.01
FC058	565932	6559583	4	0.02	0.05	0.1	88	39.9	0.05	0.01	1.84	0.02
FC061	567230	6560151	2	0.005	0.05	0.1	49	11.5	0.05	0.01	1.37	0.03
FC062	567209	6560112	3	0.02	0.05	0.1	90	20.5	0.05	0.01	1.16	0.02
FC063	567148	6560060	1	0.005	0.1	0.1	66	10.7	0.05	0.01	1.12	0.1
FC064	567129	6560024	2	0.02	0.2	0.1	47	29.8	0.05	0.01	1.4	0.04
FC065	567104	6560005	7	0.005	0.2	0.2	44	9.2	0.05	0.01	1.05	0.01
FC066	567067	6559960	4	0.005	0.05	0.1	47	11.1	0.05	0.01	0.7	0.01
FC067	567028	6559919	3	0.01	0.05	0.1	32	13.3	0.05	0.01	0.69	0.02
FC068	567246	6560194	8	0.01	0.05	0.1	32	16.3	0.05	0.01	0.8	0.04
FC069	567294	6560239	9	0.02	0.05	0.3	53	6	0.05	0.01	0.93	0.02
FC070	567361	6560283	3	0.02	0.05	0.2	58	19.8	0.05	0.01	1	0.02

Sample No.	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Fe pct	Ga ppm	Ge ppm	Hf ppm	Hg ppb	In ppm	K pct
FC001	0.15	0.25	1.7	0.012	3.46	0.011	0.05	0.005	0.002	20	0.01	0.56
FC002	0.16	0.07	1.6	0.013	3.54	0.011	0.05	0.005	0.001	22	0.01	0.98
FC003	0.24	0.12	2	0.014	5.31	0.015	0.05	0.005	0.003	14	0.01	0.95
FC004	0.19	0.08	2	0.012	3.53	0.014	0.1	0.005	0.001	18	0.01	1.07
FC005	0.2	0.06	1.9	0.01	5.22	0.012	0.05	0.005	0.001	20	0.01	0.92
FC006	0.36	0.1	1.6	0.017	2.77	0.02	0.1	0.005	0.003	21	0.01	0.97
FC007	0.16	0.08	1.9	0.01	3.19	0.012	0.05	0.005	0.003	16	0.01	1.05
FC008	0.19	0.08	1.8	0.012	5.61	0.012	0.05	0.005	0.001	9	0.01	1.17
FC009	0.2	0.07	2	0.015	3.74	0.015	0.1	0.005	0.002	18	0.01	1.1
FC010	0.25	0.12	2	0.017	3.81	0.018	0.1	0.02	0.007	21	0.01	1.48
FC011	0.21	0.06	2.3	0.015	4.42	0.016	0.1	0.005	0.003	23	0.01	1.09
FC012	0.17	0.07	2	0.01	3.96	0.011	0.1	0.01	0.002	11	0.01	0.76
FC013	0.17	0.11	2	0.01	5.46	0.013	0.1	0.005	0.005	17	0.01	0.91
FC014	0.22	0.06	2.2	0.015	5.63	0.016	0.1	0.005	0.003	16	0.01	0.96
FC015	0.21	0.09	2.2	0.013	3.98	0.015	0.1	0.01	0.002	23	0.01	0.86
FC016	0.19	0.18	2.2	0.012	3.93	0.013	0.1	0.01	0.003	13	0.01	0.9
FC017	0.2	0.05	2	0.014	3.72	0.016	0.1	0.01	0.005	13	0.01	0.92
FC018	0.24	0.1	2.1	0.016	3.5	0.016	0.1	0.005	0.008	11	0.01	0.87
FC019	0.16	0.05	2	0.01	5.7	0.012	0.05	0.03	0.003	12	0.01	0.89
FC020	0.14	0.05	2	0.009	4.24	0.011	0.05	0.01	0.001	14	0.01	1.13
FC021	0.15	0.07	1.6	0.011	3.37	0.012	0.05	0.005	0.004	19	0.01	0.79
FC022	0.18	0.06	1.9	0.011	7.65	0.014	0.05	0.005	0.002	10	0.01	0.79
FC023	0.22	0.05	2.1	0.013	4.98	0.015	0.1	0.01	0.005	14	0.01	1.01
FC024	0.1	0.1	2	0.007	4.8	0.009	0.05	0.03	0.002	14	0.01	1.13
FC025	0.14	0.04	2.1	0.011	6.46	0.011	0.1	0.02	0.002	20	0.01	0.51
FC026	0.21	1.19	2	0.019	5.61	0.015	0.1	0.02	0.002	13	0.01	1.4
FG027	0.26	0.08	2.3	0.017	3.88	0.018	0.1	0.01	0.007	17	0.01	1.64
FC028	0.29	0.25	1.8	0.013	3.41	0.014	0.1	0.005	0.004	16	0.01	0.68
FC029	0.47	0.36	2	0.022	4.38	0.012	0.05	0.01	0.003	15	0.01	0.99
FC030	0.24	0.19	2	0.028	5.1	0.016	0.1	0.02	0.007	18	0.01	1.26
FC031	0.22	0.07	2.1	0.08	5.77	0.016	0.1	0.005	0.003	24	0.01	1.05
FC032	0.18	0.04	1.8	0.032	3.77	0.013	0.1	0.005	0.004	18	0.01	1.13
FC033	0.12	0.07	1.3	0.008	3.15	0.01	0.05	0.01	0.002	16	0.01	0.84
FC034	0.12	0.04	1.5	0.007	2.95	0.009	0.05	0.005	0.002	16	0.01	0.55
FC035	0.08	0.03	1.3	0.007	2.55	0.008	0.05	0.01	0.004	14	0.01	0.67
FC036	0.16	0.06	2.2	0.013	4.83	0.015	0.1	0.01	0.004	19	0.01	0.94
FC037	0.16	0.08	2.2	0.012	6.3	0.013	0.05	0.03	0.004	21	0.01	1.4
FC038	0.13	0.06	2.2	0.012	5.26	0.012	0.05	0.02	0.005	11	0.01	1.32
FC039	0.13	0.13	1.7	0.01	5.5	0.011	0.1	0.02	0.004	44	0.01	0.59
FC040	0.3	0.36	2.1	0.019	7.12	0.021	0.1	0.01	0.002	26	0.01	1.14
FC041	0.23	0.18	2.1	0.016	6.03	0.017	0.1	0.02	0.002	22	0.01	1.39
FC042	0.15	0.31	1.7	0.014	3.15	0.015	0.05	0.02	0.002	13	0.01	0.72
FC043	0.17	0.15	2.1	0.01	7.31	0.013	0.1	0.02	0.003	13	0.01	0.89
FC044	0.16	0.38	1.8	0.013	4.07	0.013	0.1	0.01	0.003	14	0.01	0.6
FC045	0.15	0.05	2	0.01	4.56	0.013	0.1	0.01	0.003	25	0.01	0.47
FC046	0.15	0.18	2	0.01	6.21	0.013	0.1	0.005	0.004	22	0.01	0.73
FC047	0.15	0.25	2.1	0.009	5.68	0.011	0.05	0.01	0.003	15	0.01	0.98
FC048	0.24	0.08	2	0.012	5.2	0.014	0.1	0.02	0.006	15	0.01	0.48
FC049	0.11	0.22	2.2	0.008	5.05	0.01	0.05	0.01	0.006	15	0.01	1.28
FC050	0.19	0.08	2.1	0.011	3.48	0.014	0.1	0.01	0.008	22	0.01	0.73
FC051	0.09	0.16	1.8	0.005	2.83	0.008	0.05	0.005	0.0005	16	0.01	0.53
FC052	0.22	0.11	2.2	0.014	2.81	0.015	0.1	0.02	0.003	21	0.01	0.43
FC053	0.09	0.05	1.5	0.007	2.68	0.01	0.05	0.005	0.003	24	0.01	0.56
FC054	0.2	0.08	2	0.014	3.28	0.017	0.1	0.01	0.004	16	0.01	0.56
FC055	0.17	0.06	2.2	0.011	2.91	0.014	0.1	0.005	0.004	22	0.01	1.42
FC056	0.17	0.21	2.2	0.011	3.77	0.013	0.1	0.005	0.002	25	0.01	1.29
FC057	0.11	0.05	2	0.007	3.4	0.009	0.05	0.005	0.002	16	0.01	0.92
FC058	0.28	0.23	2	0.032	5.21	0.016	0.1	0.01	0.004	17	0.01	1.26
FC061	0.11	0.08	1.9	0.007	4.67	0.009	0.05	0.03	0.004	10	0.01	0.97
FC062	0.23	0.07	2.4	0.015	4.45	0.017	0.05	0.01	0.003	9	0.01	0.79
FC063	0.11	0.15	2.1	0.007	3.71	0.01	0.1	0.005	0.004	11	0.01	0.56
FC064	0.22	0.12	2.1	0.012	6.64	0.016	0.1	0.01	0.006	6	0.01	0.95
FC065	0.13	0.06	2	0.008	8.44	0.011	0.1	0.005	0.006	12	0.01	1.43
FC066	0.1	0.12	2	0.005	6.04	0.008	0.05	0.02	0.002	6	0.01	1.25
FC067	0.19	0.07	1.9	0.01	5.14	0.013	0.05	0.03	0.004	11	0.01	1.6
FC068	0.19	0.07	1.7	0.008	6.89	0.013	0.05	0.02	0.001	10	0.01	0.69
FC069	0.2	0.08	1.8	0.013	6.93	0.016	0.05	0.01	0.005	15	0.01	0.91
FC070	0.24	0.05	2	0.015	4.63	0.017	0.1	0.02	0.001	19	0.01	0.74

Sample No.	La ppm	Li ppm	Mg pct	Mn ppm	Mo ppm	Na pct	Nb ppm	Ni ppm	P pct	Pb ppm	Pd ppb	Pt ppb
FC001	0.06	0.37	0.278	144	0.56	0.008	0.01	1	0.101	0.3	1	0.05
FC002	0.08	2.22	0.19	332	0.03	0.051	0.005	1.8	0.092	0.43	1	0.05
FC003	0.1	0.96	0.258	86	0.05	0.009	0.005	1.2	0.104	0.58	1	1
FC004	0.09	0.39	0.224	68	0.11	0.01	0.01	7	0.094	0.18	1	1
FC005	0.09	1.51	0.296	75	0.11	0.024	0.005	1.6	0.188	0.3	1	1
FC006	0.16	1.45	0.213	46	0.05	0.008	0.01	1.7	0.076	0.17	1	1
FC007	0.07	1.66	0.205	122	0.12	0.051	0.005	1.3	0.098	0.13	1	0.05
FC008	0.09	0.44	0.197	45	0.09	0.007	0.01	3.4	0.124	0.05	1	0.05
FC009	0.1	1.01	0.221	51	0.17	0.013	0.005	1.5	0.113	0.16	1	0.05
FC010	0.11	0.76	0.325	64	0.33	0.008	0.005	1.6	0.088	0.2	1	1
FC011	0.1	1.45	0.257	51	0.23	0.029	0.01	2.6	0.13	0.22	2	0.05
FC012	0.08	0.53	0.248	34	0.09	0.008	0.005	1.8	0.109	0.26	1	1
FC013	0.07	1.17	0.215	53	0.13	0.018	0.01	2.2	0.101	0.22	2	1
FC014	0.09	0.9	0.27	47	0.06	0.066	0.01	1.6	0.17	0.24	1	0.05
FC015	0.09	0.9	0.196	41	0.08	0.085	0.005	1.3	0.104	0.3	1	0.05
FC016	0.08	0.67	0.238	75	0.06	0.022	0.01	1.6	0.114	0.39	1	0.05
FC017	0.1	0.42	0.156	113	0.05	0.011	0.005	0.9	0.168	0.86	1	0.05
FC018	0.12	0.74	0.194	70	0.26	0.174	0.005	1.3	0.098	0.35	1	0.05
FC019	0.07	0.67	0.215	51	0.07	0.084	0.01	1.4	0.148	0.23	1	1
FC020	0.06	0.35	0.217	60	0.07	0.009	0.005	1.6	0.138	0.48	1	0.05
FC021	0.08	1.56	0.195	106	0.04	0.031	0.005	2	0.108	0.08	1	0.05
FC022	0.1	1.33	0.205	80	0.04	0.13	0.005	1.8	0.117	0.19	1	0.05
FC023	0.1	1.5	0.244	88	0.08	0.052	0.005	1.7	0.208	0.14	1	1
FC024	0.04	0.68	0.28	34	0.08	0.008	0.005	6.1	0.196	0.07	1	1
FC025	0.07	3.67	0.439	50	0.04	0.104	0.005	3.2	0.173	0.15	1	1
FC026	0.1	4.77	0.279	250	0.05	0.011	0.005	6.3	0.182	0.26	1	1
FG027	0.12	1.56	0.282	46	0.14	0.014	0.01	3.9	0.231	0.42	1	1
FC028	0.12	5.45	0.354	98	0.03	0.237	0.005	6.4	0.125	0.09	1	0.05
FC029	0.2	4.3	0.209	107	0.02	0.071	0.01	7	0.12	0.32	1	1
FC030	0.11	2.09	0.25	74	0.09	0.044	0.01	4.9	0.218	0.28	1	1
FC031	0.1	2.36	0.218	45	0.09	0.186	0.01	10.3	0.186	0.17	1	1
FC032	0.08	2.24	0.254	83	0.06	0.042	0.005	9.3	0.196	0.64	2	0.05
FC033	0.06	1.04	0.173	73	0.1	0.013	0.005	3.9	0.209	0.17	1	1
FC034	0.05	0.89	0.218	66	0.04	0.047	0.005	1.7	0.123	0.13	1	0.05
FC035	0.04	0.9	0.148	84	0.03	0.056	0.005	1.2	0.089	0.13	1	0.05
FC036	0.08	1.41	0.199	58	0.05	0.173	0.005	2.8	0.198	0.22	1	0.05
FC037	0.07	1.18	0.165	71	0.14	0.108	0.005	3.6	0.184	0.22	1	0.05
FC038	0.06	0.5	0.236	28	0.2	0.127	0.01	2.7	0.12	0.36	1	0.05
FC039	0.07	1.22	0.263	54	0.02	0.047	0.01	3.7	0.076	0.45	1	0.05
FC040	0.14	3.02	0.346	117	0.24	0.026	0.01	4	0.15	0.2	1	0.05
FC041	0.1	3.49	0.372	38	0.23	0.047	0.01	8.2	0.229	0.26	1	0.05
FC042	0.08	6.47	0.269	74	0.04	0.112	0.005	2.9	0.109	0.19	1	0.05
FC043	0.08	1.2	0.159	27	0.06	0.26	0.005	4.1	0.14	0.45	1	0.05
FC044	0.08	9.35	0.33	91	0.04	0.13	0.01	3.5	0.152	0.4	1	0.05
FC045	0.07	2.01	0.304	74	0.03	0.373	0.005	10	0.162	0.14	1	0.05
FC046	0.07	1.75	0.242	43	0.07	0.413	0.005	6.4	0.266	0.46	1	0.05
FC047	0.07	1.14	0.272	39	0.05	0.195	0.01	4.7	0.132	0.23	1	0.05
FC048	0.12	1.09	0.231	55	0.03	0.294	0.005	2.4	0.172	0.23	1	0.05
FC049	0.06	1.13	0.202	22	0.13	0.036	0.005	3.3	0.108	0.2	1	0.05
FC050	0.09	1.38	0.214	30	0.06	0.063	0.005	2.8	0.13	0.24	1	0.05
FC051	0.04	2.9	0.227	77	0.07	0.071	0.005	4.5	0.118	0.13	1	0.05
FC052	0.08	2.99	0.3	48	0.11	0.202	0.005	3.2	0.117	0.18	1	0.05
FC053	0.04	0.85	0.22	142	0.06	0.008	0.005	2.5	0.102	0.38	1	0.05
FC054	0.09	1.25	0.282	152	0.03	0.105	0.01	2.3	0.132	0.52	1	1
FC055	0.08	1.08	0.216	101	0.08	0.024	0.01	1.9	0.11	0.86	1	1
FC056	0.09	1.77	0.344	114	0.15	0.023	0.01	4.6	0.139	0.14	1	0.05
FC057	0.07	0.6	0.313	65	0.02	0.007	0.005	1.9	0.134	0.36	1	0.05
FC058	0.12	2.07	0.254	80	0.08	0.055	0.01	4.8	0.208	0.23	2	0.05
FC061	0.05	0.59	0.286	194	0.03	0.079	0.005	7.8	0.131	0.09	1	0.05
FC062	0.1	0.82	0.271	50	0.06	0.144	0.01	4.6	0.098	0.26	1	0.05
FC063	0.05	0.45	0.33	137	0.03	0.288	0.005	4.1	0.151	0.13	1	0.05
FC064	0.11	0.59	0.247	54	0.12	0.179	0.005	3.8	0.191	0.19	1	0.05
FC065	0.06	0.52	0.293	42	0.03	0.187	0.005	3.3	0.286	0.32	1	0.05
FC066	0.04	0.4	0.214	51	0.11	0.012	0.005	6.6	0.12	0.32	1	1
FC067	0.08	0.37	0.17	45	0.07	0.024	0.01	2.5	0.18	0.34	1	0.05
FC068	0.08	0.47	0.257	67	0.12	0.069	0.005	2.1	0.189	0.24	1	1
FC069	0.08	0.9	0.172	73	0.04	0.129	0.005	6.6	0.096	0.28	1	0.05
FC070	0.1	0.92	0.302	78	0.11	0.225	0.01	4	0.131	0.3	1	0.05

Sample No.	Rb ppm	Re ppb	S pct	Sb ppm	Sc ppm	Se ppm	Sn ppm	Sr ppm	Ta ppm	Te ppm	Th ppm	Ti ppm
FC001	1	7	0.12	0.01	0.2	0.3	0.02	96.5	0.0005	0.01	0.01	6
FC002	2.1	20	0.14	0.01	0.2	0.3	0.01	105.5	0.001	0.01	0.01	6
FC003	1.3	4	0.08	0.01	0.2	0.3	0.01	82.3	0.0005	0.01	0.02	7
FC004	1.5	9	0.09	0.01	0.2	0.3	0.01	74.8	0.0005	0.01	0.02	6
FC005	0.7	8	0.11	0.01	0.2	0.3	0.01	61.6	0.0005	0.01	0.02	10
FC006	1.4	8	0.08	0.01	0.2	0.4	0.01	51.2	0.0005	0.01	0.04	6
FC007	1.1	13	0.1	0.01	0.2	0.3	0.01	61.7	0.0005	0.01	0.01	6
FC008	2.5	3	0.09	0.01	0.3	0.3	0.01	44.6	0.0005	0.01	0.02	7
FC009	1.6	5	0.07	0.01	0.2	0.3	0.01	74.4	0.0005	0.01	0.02	7
FC010	1.5	10	0.13	0.01	0.2	0.4	0.01	51.7	0.0005	0.01	0.03	6
FC011	0.9	16	0.11	0.01	0.2	0.4	0.02	59.6	0.0005	0.01	0.03	8
FC012	0.7	4	0.07	0.01	0.3	0.2	0.01	70.7	0.0005	0.01	0.01	6
FC013	0.6	2	0.09	0.01	0.3	0.3	0.01	54.1	0.0005	0.01	0.01	6
FC014	1	4	0.11	0.01	0.2	0.4	0.01	38.6	0.0005	0.01	0.02	9
FC015	0.7	11	0.09	0.01	0.2	0.4	0.02	59.8	0.0005	0.01	0.02	7
FC016	0.7	2	0.1	0.01	0.2	0.4	0.01	49.5	0.0005	0.01	0.02	7
FC017	0.7	5	0.09	0.01	0.3	0.5	0.01	62.6	0.0005	0.01	0.02	9
FC018	1.1	6	0.06	0.01	0.3	0.3	0.01	46.8	0.0005	0.01	0.03	7
FC019	0.7	11	0.09	0.01	0.2	0.4	0.01	57.7	0.0005	0.01	0.02	8
FC020	1	6	0.1	0.01	0.2	0.3	0.01	48.6	0.0005	0.01	0.02	7
FC021	2	9	0.08	0.01	0.2	0.4	0.01	89.2	0.0005	0.01	0.01	6
FC022	0.5	9	0.11	0.01	0.2	0.4	0.01	65.2	0.0005	0.01	0.02	7
FC023	1.2	13	0.1	0.01	0.2	0.4	0.02	71.8	0.0005	0.01	0.02	11
FC024	1.3	17	0.11	0.01	0.2	0.8	0.01	56.1	0.0005	0.01	0.01	9
FC025	0.8	21	0.11	0.01	0.2	0.4	0.01	65.2	0.0005	0.01	0.01	8
FC026	3.2	13	0.14	0.01	0.3	0.4	0.01	44.9	0.0005	0.01	0.01	10
FG027	2.1	17	0.12	0.01	0.2	1.1	0.01	46.4	0.0005	0.01	0.02	12
FC028	1	35	0.17	0.01	0.2	0.4	0.02	50	0.0005	0.01	0.02	7
FC029	2.5	34	0.21	0.01	0.2	0.3	0.02	36	0.0005	0.01	0.01	7
FC030	2.7	11	0.13	0.01	0.2	0.4	0.02	67.3	0.0005	0.01	0.02	12
FC031	2.7	10	0.12	0.01	0.2	0.3	0.01	72.7	0.0005	0.01	0.02	10
FC032	5.4	17	0.12	0.01	0.3	0.4	0.02	63	0.0005	0.01	0.02	10
FC033	0.6	22	0.04	0.01	0.2	0.4	0.01	49.9	0.0005	0.01	0.01	10
FC034	0.5	18	0.07	0.01	0.2	0.4	0.01	80.5	0.0005	0.01	0.01	6
FC035	1.4	5	0.06	0.01	0.1	0.3	0.01	43.2	0.0005	0.01	0.01	5
FC036	1.6	8	0.09	0.01	0.3	0.4	0.01	80.7	0.0005	0.01	0.01	10
FC037	2.9	5	0.1	0.01	0.2	0.3	0.01	44.3	0.0005	0.01	0.02	9
FC038	2.7	2	0.1	0.01	0.2	0.4	0.01	49.7	0.0005	0.01	0.02	7
FC039	0.7	6	0.08	0.01	0.2	0.3	0.01	147.4	0.0005	0.01	0.01	5
FC040	1.2	7	0.1	0.01	0.2	0.7	0.01	99.5	0.0005	0.01	0.03	9
FC041	1.7	30	0.15	0.01	0.2	1.2	0.01	82.8	0.0005	0.02	0.02	12
FC042	0.4	25	0.11	0.01	0.2	0.2	0.01	34.9	0.0005	0.01	0.02	6
FC043	0.8	16	0.1	0.01	0.2	0.7	0.01	42.8	0.0005	0.01	0.02	8
FC044	0.4	29	0.11	0.01	0.2	0.4	0.01	40.4	0.0005	0.01	0.01	8
FC045	0.4	14	0.09	0.01	0.3	0.5	0.01	66.6	0.0005	0.01	0.01	8
FC046	0.8	4	0.08	0.01	0.2	0.4	0.01	70.1	0.0005	0.01	0.01	12
FC047	1	5	0.08	0.01	0.2	1.1	0.01	79.5	0.0005	0.01	0.01	7
FC048	0.4	5	0.09	0.01	0.2	0.7	0.01	62.9	0.0005	0.01	0.02	9
FC049	1.5	4	0.11	0.01	0.2	0.5	0.01	23.6	0.0005	0.01	0.01	6
FC050	0.7	8	0.08	0.01	0.2	0.4	0.01	53.5	0.0005	0.01	0.02	7
FC051	0.3	26	0.11	0.01	0.2	0.5	0.01	32.7	0.0005	0.01	0.01	6
FC052	0.3	14	0.07	0.01	0.2	0.5	0.01	81.4	0.0005	0.01	0.02	7
FC053	0.3	26	0.08	0.01	0.1	0.4	0.01	75.2	0.0005	0.01	0.01	5
FC054	0.4	25	0.13	0.01	0.2	0.7	0.01	99.5	0.0005	0.01	0.02	8
FC055	0.9	17	0.12	0.01	0.2	0.4	0.01	70.8	0.0005	0.01	0.01	7
FC056	1.3	24	0.13	0.01	0.2	0.4	0.01	60.9	0.0005	0.01	0.02	7
FC057	0.6	13	0.1	0.02	0.3	0.3	0.01	56	0.0005	0.01	0.01	7
FC058	2.8	13	0.13	0.01	0.3	0.4	0.01	72.7	0.0005	0.01	0.02	11
FC061	0.9	32	0.18	0.01	0.2	0.5	0.01	66.8	0.0005	0.02	0.01	7
FC062	1	11	0.17	0.01	0.2	0.4	0.01	49.9	0.0005	0.01	0.02	7
FC063	0.6	8	0.25	0.01	0.3	0.3	0.01	53.7	0.0005	0.01	0.01	8
FC064	1.2	3	0.14	0.01	0.3	0.2	0.01	69.5	0.0005	0.01	0.02	11
FC065	1.4	6	0.23	0.01	0.2	0.4	0.01	49.1	0.0005	0.01	0.01	14
FC066	1.4	3	0.18	0.01	0.2	0.3	0.01	36.1	0.0005	0.01	0.01	6
FC067	2	7	0.1	0.01	0.2	0.3	0.01	32.7	0.0005	0.01	0.02	8
FC068	0.8	2	0.08	0.01	0.2	0.2	0.01	43.2	0.0005	0.01	0.02	9
FC069	0.9	4	0.17	0.01	0.2	0.3	0.01	51.4	0.0005	0.01	0.02	5
FC070	0.9	6	0.11	0.01	0.2	0.3	0.01	49.7	0.0005	0.02	0.02	7

Sample No.	Tl ppm	U ppm	V ppm	W ppm	Y ppm	Zn ppm	Zr ppm
FC001	0.01	0.005	1	0.05	0.032	14.6	0.07
FC002	0.01	0.005	1	0.05	0.043	15.9	0.07
FC003	0.01	0.005	2	0.05	0.052	17	0.11
FC004	0.01	0.005	2	0.05	0.045	24.5	0.1
FC005	0.01	0.02	2	0.05	0.043	32	0.08
FC006	0.01	0.01	1	0.05	0.08	11	0.14
FC007	0.01	0.01	1	0.05	0.037	13.7	0.07
FC008	0.01	0.01	1	0.05	0.044	18.3	0.09
FC009	0.01	0.005	2	0.05	0.046	16.6	0.1
FC010	0.01	0.005	3	0.05	0.05	15.5	0.12
FC011	0.01	0.005	2	0.05	0.048	16.5	0.11
FC012	0.01	0.005	2	0.05	0.038	13.8	0.08
FC013	0.01	0.005	2	0.05	0.037	16	0.08
FC014	0.01	0.005	2	0.05	0.044	18.9	0.11
FC015	0.01	0.005	2	0.05	0.043	11.1	0.12
FC016	0.01	0.005	3	0.05	0.039	16	0.08
FC017	0.01	0.005	2	0.05	0.043	15.4	0.11
FC018	0.01	0.005	1	0.05	0.048	17.3	0.13
FC019	0.01	0.005	1	0.05	0.033	12.7	0.08
FC020	0.01	0.005	1	0.05	0.031	15.2	0.07
FC021	0.01	0.005	1	0.05	0.042	14.1	0.07
FC022	0.01	0.005	1	0.05	0.049	13.3	0.09
FC023	0.01	0.005	1	0.05	0.049	21.7	0.1
FC024	0.01	0.03	1	0.05	0.021	20.4	0.04
FC025	0.01	0.05	2	0.05	0.033	51.8	0.07
FC026	0.03	0.27	1	0.05	0.133	26.4	0.08
FG027	0.01	0.08	1	0.05	0.055	32.7	0.13
FC028	0.01	0.14	1	0.05	0.193	34.7	0.09
FC029	0.02	0.24	1	0.05	0.277	24.5	0.07
FC030	0.02	0.03	1	0.05	0.092	26.2	0.11
FC031	0.01	0.02	1	0.05	0.053	32	0.1
FC032	0.01	0.04	1	0.05	0.044	25	0.08
FC033	0.01	0.005	1	0.05	0.034	16.4	0.07
FC034	0.01	0.005	1	0.05	0.03	15.5	0.05
FC035	0.01	0.005	1	0.05	0.023	18.1	0.04
FC036	0.01	0.005	2	0.05	0.044	16.9	0.09
FC037	0.01	0.005	2	0.05	0.035	20.2	0.1
FC038	0.01	0.005	1	0.05	0.028	26.2	0.08
FC039	0.01	0.01	1	0.05	0.042	25	0.07
FC040	0.01	0.005	1	0.05	0.072	56.2	0.16
FC041	0.03	0.02	2	0.05	0.056	25	0.12
FC042	0.01	0.02	1	0.05	0.036	32.9	0.09
FC043	0.01	0.02	2	0.05	0.045	23.3	0.1
FC044	0.01	0.02	1	0.05	0.037	35.4	0.09
FC045	0.01	0.005	2	0.05	0.034	20.1	0.08
FC046	0.01	0.005	2	0.05	0.038	17.7	0.08
FC047	0.02	0.005	2	0.05	0.027	17.8	0.08
FC048	0.01	0.005	2	0.05	0.05	18.6	0.11
FC049	0.01	0.005	2	0.05	0.026	18.2	0.11
FC050	0.01	0.01	3	0.05	0.042	22	0.1
FC051	0.01	0.03	1	0.05	0.019	13.5	0.05
FC052	0.01	0.01	2	0.05	0.05	24.3	0.1
FC053	0.01	0.005	1	0.05	0.024	16.5	0.04
FC054	0.01	0.02	1	0.05	0.048	31.6	0.11
FC055	0.01	0.005	1	0.05	0.036	17.3	0.1
FC056	0.01	0.01	1	0.05	0.048	19.5	0.09
FC057	0.01	0.01	2	0.05	0.041	25.2	0.05
FC058	0.02	0.03	2	0.05	0.091	26.8	0.11
FC061	0.01	0.005	1	0.05	0.023	32	0.06
FC062	0.01	0.01	2	0.05	0.049	18.2	0.12
FC063	0.01	0.005	2	0.05	0.028	21.8	0.06
FC064	0.01	0.005	2	0.05	0.055	26	0.12
FC065	0.01	0.005	2	0.05	0.031	31.8	0.06
FC066	0.01	0.005	2	0.05	0.021	17.2	0.06
FC067	0.01	0.005	1	0.05	0.045	31.4	0.09
FC068	0.01	0.005	1	0.05	0.052	28.3	0.08
FC069	0.01	0.005	1	0.05	0.045	17	0.1
FC070	0.01	0.005	1	0.05	0.057	26.6	0.12

Sample No.	Eastings	Northings	Ag ppb	Al pct	As ppm	Au ppb	B ppm	Ba ppm	Be ppm	Bi ppm	Ca pct	Cd ppm
FC071	567428	6560304	3	0.01	0.05	0.1	55	7.4	0.05	0.01	0.63	0.01
FC072	567452	6560306	6	0.01	0.05	0.1	114	18.1	0.05	0.01	0.88	0.02
FC073	567551	6560311	2	0.01	0.05	0.3	52	8.6	0.05	0.01	0.5	0.01
FC074	567625	6560343	4	0.01	0.05	0.1	83	26.2	0.05	0.01	1.5	0.04
FC075	567681	6560352	4	0.01	0.05	0.1	111	15.2	0.05	0.01	0.88	0.03
FC076	567763	6560338	3	0.02	0.05	0.3	125	23.9	0.05	0.01	1.79	0.07
FC077	567832	6560370	2	0.02	0.05	0.2	56	13.7	0.05	0.01	1.3	0.02
FC078	567903	6560420	2	0.005	0.05	0.1	61	15.3	0.05	0.01	0.65	0.02
FC079	567932	6560457	3	0.02	0.1	0.1	79	27.7	0.05	0.01	1.46	0.05
FC080	567987	6560521	1	0.01	0.05	0.1	50	13.5	0.05	0.01	0.66	0.01
FC081	568052	6560567	3	0.01	0.05	0.1	92	16.5	0.05	0.01	0.83	0.01
FC082	568124	6560602	6	0.005	0.05	0.1	51	24.3	0.05	0.01	0.85	0.02
FC083	568215	6560643	4	0.005	0.05	0.1	44	14.5	0.05	0.01	0.67	0.01
FC084	568299	6560640	5	0.02	0.3	0.1	110	18.7	0.05	0.01	1.27	0.01
FC085	568407	6560646	3	0.02	0.5	0.1	135	14.5	0.05	0.01	1.21	0.06
FC086	568449	6560652	8	0.01	0.1	0.1	92	20.1	0.05	0.01	0.9	0.02
FC087	568534	6560703	2	0.01	0.05	0.1	89	15.8	0.05	0.01	0.71	0.03
FC088	568587	6560734	2	0.02	0.05	0.1	157	27.3	0.05	0.01	0.98	0.04
FC089	568680	6560775	2	0.01	0.05	0.1	151	36.3	0.05	0.01	1.84	0.04
FC090	568724	6560881	2	0.02	0.1	0.1	70	21.4	0.05	0.01	1.39	0.01
FC091	568774	6560950	1	0.02	0.05	0.1	74	24.9	0.05	0.01	1.01	0.01
FC092	568804	6560997	3	0.02	0.05	0.1	72	23.2	0.05	0.01	1.2	0.01
FC093	568849	6561027	3	0.02	0.05	0.1	82	9.1	0.05	0.01	0.58	0.02
FC094	568927	6561056	3	0.005	0.05	0.1	66	27.2	0.05	0.01	1.48	0.03
FC095	568996	6561061	2	0.02	0.05	0.1	49	26.9	0.05	0.01	1.37	0.01
FC096	569097	6561099	6	0.01	0.05	0.1	94	60.8	0.05	0.01	1.96	0.02
FC097	569203	6561160	3	0.02	0.05	0.1	119	36.7	0.05	0.01	1.34	0.01
FC098	569306	6561231	2	0.01	0.05	0.1	120	31.8	0.05	0.01	1.18	0.01
FC099	569377	6561280	3	0.02	0.3	0.1	84	50.7	0.05	0.01	1.88	0.03
FC100	569525	6561382	1	0.01	0.4	0.1	67	16.3	0.05	0.01	1.2	0.02

Sample No.	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Fe pct	Ga ppm	Ge ppm	Hf ppm	Hg ppb	In ppm	K pct
FC071	0.22	0.11	2.2	0.014	7.71	0.016	0.1	0.03	0.001	16	0.01	0.99
FC072	0.2	0.19	1.9	0.011	5.62	0.013	0.1	0.03	0.0005	23	0.01	0.94
FC073	0.25	0.24	2.1	0.012	6.51	0.016	0.1	0.01	0.001	10	0.01	1.1
FC074	0.23	0.08	1.8	0.011	7.13	0.014	0.1	0.02	0.003	17	0.01	1.18
FC075	0.2	0.08	1.9	0.011	4.18	0.014	0.1	0.03	0.0005	18	0.01	1.23
FC076	0.44	0.26	1.7	0.014	5.65	0.018	0.1	0.02	0.005	24	0.01	1.15
FC077	0.25	0.26	2.2	0.015	3.59	0.019	0.1	0.03	0.002	9	0.01	1.53
FC078	0.13	0.05	1.9	0.008	6.48	0.01	0.05	0.04	0.0005	14	0.01	0.9
FC079	0.22	0.09	2	0.015	4.34	0.018	0.1	0.01	0.001	21	0.01	1.01
FC080	0.14	0.17	1.9	0.008	4.78	0.011	0.1	0.01	0.002	17	0.01	0.82
FC081	0.18	0.07	1.9	0.011	5.08	0.015	0.1	0.02	0.003	19	0.01	1.1
FC082	0.12	0.04	1.7	0.009	3.88	0.01	0.05	0.02	0.001	18	0.01	0.96
FC083	0.17	0.05	2	0.008	7.46	0.012	0.05	0.03	0.002	9	0.01	1.81
FC084	0.24	0.89	2.1	0.014	8.51	0.016	0.1	0.01	0.002	19	0.01	1.18
FC085	0.54	1.44	1.8	0.034	6.65	0.014	0.1	0.005	0.004	15	0.01	0.87
FC086	0.3	0.61	1.5	0.035	10.92	0.013	0.1	0.01	0.002	16	0.01	1.5
FC087	0.16	0.08	1.8	0.009	4.69	0.011	0.05	0.01	0.001	21	0.01	1.33
FC088	0.23	0.07	1.9	0.016	3.85	0.017	0.1	0.005	0.004	23	0.01	1.04
FC089	0.17	0.06	2	0.01	3.06	0.014	0.1	0.01	0.007	14	0.01	0.82
FC090	0.23	0.16	2.1	0.014	5.39	0.017	0.1	0.01	0.002	16	0.01	1.01
FC091	0.24	0.07	1.9	0.014	3.83	0.016	0.1	0.02	0.006	21	0.01	1.27
FC092	0.2	0.06	2	0.013	5.23	0.016	0.1	0.01	0.006	15	0.01	1.42
FC093	0.37	0.09	2.2	0.022	5.26	0.023	0.1	0.02	0.003	11	0.01	1.39
FC094	0.14	0.06	1.4	0.009	6.57	0.011	0.05	0.005	0.003	15	0.01	1.3
FC095	0.28	0.07	1.9	0.016	5.58	0.017	0.1	0.005	0.004	21	0.01	1.43
FC096	0.13	0.03	1.8	0.009	7.19	0.012	0.1	0.005	0.003	19	0.01	0.81
FC097	0.22	0.08	1.9	0.016	4.74	0.02	0.1	0.005	0.005	18	0.01	0.69
FC098	0.14	0.09	1.7	0.012	3.87	0.012	0.1	0.005	0.003	19	0.01	1.49
FC099	0.31	0.08	2	0.02	2.1	0.02	0.1	0.005	0.009	22	0.01	0.87
FC100	0.15	0.05	2.3	0.011	2.52	0.012	0.05	0.005	0.003	15	0.01	1.03

Sample No.	La ppm	Li ppm	Mg pct	Mn ppm	Mo ppm	Na pct	Nb ppm	Ni ppm	P pct	Pb ppm	Pd ppb	Pt ppb
FC071	0.1	0.76	0.301	23	0.02	0.396	0.01	2.2	0.14	0.32	1	0.05
FC072	0.09	3.27	0.257	55	0.09	0.176	0.01	4.8	0.116	0.32	1	0.05
FC073	0.09	0.74	0.124	72	0.05	0.188	0.01	2.4	0.181	0.24	2	0.05
FC074	0.11	0.61	0.351	108	0.02	0.015	0.01	3.1	0.197	0.16	1	0.05
FC075	0.08	0.55	0.372	173	0.04	0.007	0.005	5.5	0.15	0.24	1	0.05
FC076	0.19	1.31	0.398	319	0.05	0.04	0.005	3.6	0.131	0.33	1	0.05
FC077	0.11	0.75	0.25	133	0.05	0.065	0.005	3.2	0.184	0.44	1	0.05
FC078	0.05	0.98	0.255	62	0.03	0.165	0.005	2.5	0.173	0.22	1	0.05
FC079	0.09	2.33	0.329	156	0.02	0.144	0.01	2.8	0.193	0.29	1	0.05
FC080	0.06	0.91	0.161	83	0.19	0.044	0.005	2.1	0.178	0.13	1	0.05
FC081	0.07	0.78	0.206	123	0.1	0.027	0.01	2.5	0.155	0.26	2	0.05
FC082	0.04	1.69	0.248	105	0.07	0.023	0.005	1.4	0.163	0.09	1	0.05
FC083	0.07	0.86	0.16	38	0.06	0.007	0.01	5.4	0.124	0.6	1	0.05
FC084	0.1	1.92	0.3	71	0.2	0.04	0.01	7.1	0.167	0.15	1	0.05
FC085	0.18	8.56	0.313	196	0.05	0.109	0.01	10.2	0.128	0.2	1	0.05
FC086	0.11	2.83	0.181	127	0.05	0.007	0.005	6	0.292	0.16	1	0.05
FC087	0.07	0.61	0.201	134	0.03	0.007	0.005	1.6	0.2	0.68	1	0.05
FC088	0.11	2	0.395	81	0.06	0.051	0.01	3.1	0.102	0.49	1	0.05
FC089	0.09	1.8	0.363	90	0.15	0.014	0.005	2	0.137	0.33	1	0.05
FC090	0.09	0.84	0.281	38	0.04	0.016	0.005	1.3	0.209	0.28	1	0.05
FC091	0.11	0.27	0.184	46	0.08	0.005	0.005	1.1	0.281	0.15	1	0.05
FC092	0.1	0.52	0.191	74	0.2	0.025	0.01	1.8	0.252	0.12	1	0.05
FC093	0.15	0.44	0.199	33	0.07	0.01	0.01	1.6	0.135	0.23	1	0.05
FC094	0.07	1.19	0.132	47	0.08	0.109	0.005	1.9	0.126	0.31	1	0.05
FC095	0.12	0.41	0.24	38	0.08	0.006	0.005	2.4	0.148	0.33	1	0.05
FC096	0.07	0.63	0.252	95	0.02	0.015	0.005	2.3	0.139	0.2	1	0.05
FC097	0.11	0.84	0.272	168	0.17	0.022	0.01	1.2	0.154	0.19	1	0.05
FC098	0.07	1.05	0.174	67	0.33	0.032	0.005	1.9	0.225	0.21	1	0.05
FC099	0.15	0.53	0.248	94	0.05	0.021	0.01	1.7	0.123	0.37	1	0.05
FC100	0.07	0.83	0.143	86	0.08	0.09	0.005	0.8	0.122	0.39	2	0.05

Sample No.	Rb ppm	Re ppb	S pct	Sb ppm	Sc ppm	Se ppm	Sn ppm	Sr ppm	Ta ppm	Te ppm	Th ppm	Ti ppm
FC071	1.2	8	0.19	0.01	0.2	0.2	0.01	37.8	0.0005	0.01	0.02	7
FC072	1	3	0.13	0.01	0.2	0.4	0.01	56.8	0.0005	0.01	0.02	6
FC073	1	2	0.12	0.02	0.2	0.5	0.01	19	0.0005	0.01	0.01	9
FC074	0.8	15	0.2	0.01	0.2	0.3	0.01	68	0.0005	0.01	0.02	9
FC075	0.5	38	0.2	0.01	0.3	0.4	0.01	34.7	0.0005	0.01	0.02	7
FC076	1	6	0.14	0.01	0.2	0.3	0.01	84.8	0.0005	0.01	0.02	7
FC077	1.2	4	0.26	0.01	0.3	0.2	0.01	59.9	0.0005	0.01	0.02	10
FC078	0.7	5	0.11	0.01	0.2	0.2	0.01	37.1	0.0005	0.01	0.01	8
FC079	1.5	7	0.1	0.01	0.2	0.2	0.01	98.2	0.0005	0.02	0.02	10
FC080	0.7	2	0.1	0.01	0.2	0.4	0.01	33.2	0.0005	0.01	0.01	8
FC081	1.9	1	0.13	0.01	0.2	0.4	0.01	43.3	0.0005	0.01	0.01	8
FC082	2.1	2	0.11	0.01	0.2	0.3	0.01	50.8	0.0005	0.01	0.01	7
FC083	1	5	0.13	0.01	0.2	0.4	0.01	29.5	0.0005	0.01	0.02	6
FC084	1.4	13	0.14	0.01	0.3	0.4	0.01	58.7	0.0005	0.01	0.02	9
FC085	1.8	6	0.11	0.01	0.2	0.2	0.01	35.2	0.0005	0.02	0.02	7
FC086	3.3	5	0.15	0.01	0.2	0.2	0.01	33.4	0.0005	0.01	0.02	14
FC087	0.6	19	0.22	0.01	0.2	0.2	0.01	30.2	0.0005	0.01	0.01	10
FC088	0.4	19	0.09	0.01	0.2	0.3	0.01	41.2	0.0005	0.01	0.02	7
FC089	0.4	35	0.12	0.01	0.2	0.3	0.01	79	0.0005	0.02	0.02	7
FC090	1	2	0.11	0.01	0.2	0.2	0.01	43.7	0.0005	0.01	0.02	10
FC091	0.8	5	0.15	0.01	0.2	0.3	0.01	32.2	0.0005	0.01	0.02	13
FC092	1.2	10	0.12	0.01	0.2	0.2	0.01	44.7	0.0005	0.01	0.02	12
FC093	2.7	3	0.17	0.01	0.2	0.2	0.01	17.7	0.0005	0.01	0.03	9
FC094	1.8	7	0.12	0.01	0.2	0.2	0.01	48.9	0.0005	0.01	0.01	6
FC095	1.7	1	0.09	0.01	0.2	0.2	0.01	45.8	0.0005	0.02	0.02	8
FC096	0.4	8	0.1	0.01	0.2	0.1	0.01	75.6	0.0005	0.02	0.02	7
FC097	0.4	13	0.11	0.01	0.2	0.2	0.01	46.3	0.0005	0.01	0.02	8
FC098	1.8	9	0.12	0.01	0.2	0.2	0.01	46.6	0.0005	0.01	0.02	10
FC099	1.4	6	0.09	0.01	0.2	0.3	0.01	77.3	0.0005	0.01	0.02	8
FC100	0.7	12	0.11	0.01	0.3	0.4	0.01	46.8	0.0005	0.01	0.02	7

Sample No.	Tl ppm	U ppm	V ppm	W ppm	Y ppm	Zn ppm	Zr ppm
FC071	0.01	0.01	1	0.05	0.055	18.8	0.11
FC072	0.01	0.02	1	0.05	0.067	14.8	0.08
FC073	0.01	0.005	1	0.05	0.05	15.6	0.08
FC074	0.01	0.02	1	0.05	0.073	25.3	0.08
FC075	0.01	0.02	1	0.05	0.056	27.6	0.08
FC076	0.01	0.09	1	0.05	0.208	23.1	0.11
FC077	0.01	0.005	2	0.05	0.074	19.6	0.11
FC078	0.01	0.005	1	0.05	0.027	13.6	0.08
FC079	0.01	0.005	1	0.05	0.049	20.8	0.11
FC080	0.01	0.005	1	0.05	0.032	17.2	0.08
FC081	0.01	0.005	1	0.05	0.046	16	0.08
FC082	0.01	0.005	1	0.05	0.031	17.5	0.05
FC083	0.01	0.02	1	0.05	0.044	21.5	0.07
FC084	0.06	0.05	1	0.05	0.142	23.9	0.1
FC085	0.04	0.14	1	0.05	0.158	20.1	0.08
FC086	0.01	0.04	1	0.05	0.172	43.3	0.08
FC087	0.01	0.02	1	0.05	0.047	49.1	0.07
FC088	0.01	0.01	2	0.05	0.056	21.5	0.13
FC089	0.01	0.02	1	0.05	0.046	22	0.08
FC090	0.01	0.005	1	0.05	0.044	21	0.11
FC091	0.01	0.005	1	0.05	0.055	19.6	0.11
FC092	0.01	0.005	1	0.05	0.057	30.4	0.1
FC093	0.01	0.005	2	0.05	0.088	17.6	0.17
FC094	0.01	0.005	1	0.05	0.039	25.2	0.07
FC095	0.01	0.01	1	0.05	0.07	17.9	0.12
FC096	0.01	0.005	1	0.05	0.042	22.7	0.09
FC097	0.01	0.01	1	0.05	0.057	21	0.12
FC098	0.01	0.005	1	0.05	0.04	21.1	0.09
FC099	0.01	0.005	1	0.05	0.094	12.4	0.15
FC100	0.01	0.005	1	0.05	0.037	12.7	0.08

Homestead Creek *E. camaldulensis*

Sample No.	Eastings	Northings	Ag ppb	Al pct	As ppm	Au ppb	B ppm	Ba ppm	Be ppm	Bi ppm	Ca pct	Cd ppm
HSCK 001	567527	6560371	2	0.02	0.05	0.3	22	41.5	0.05	0.01	1.28	0.005
HSCK 002	567483	6560386	1	0.02	0.05	0.2	39	12.5	0.05	0.01	1.43	0.01
HSCK 003	567442	6560386	4	0.01	0.05	0.2	49	41	0.05	0.01	2.29	0.06
HSCK 004	567405	6560417	3	0.02	0.05	0.4	154	30.2	0.05	0.01	1.82	0.02
HSCK 005	567346	6560435	3	0.02	0.05	0.1	45	9.8	0.05	0.01	0.62	0.005
HSCK 006	567309	6560440	1	0.01	0.05	0.1	34	26.7	0.05	0.01	1.15	0.01
HSCK 007	567257	6560477	1	0.02	0.05	0.1	48	36.4	0.05	0.01	1.17	0.005
HSCK 008	567248	6560495	1	0.02	0.2	0.1	44	58.2	0.05	0.01	1.44	0.02
HSCK 009	567200	6560514	1	0.02	0.2	0.1	57	45.4	0.05	0.01	1.64	0.03
HSCK 010	567146	6560536	2	0.02	0.05	0.1	161	28.7	0.05	0.01	1.3	0.005
HSCK 011	567023	6560570	20	0.02	0.05	0.1	24	20.9	0.05	0.01	0.7	0.02
HSCK 012	567036	6560553	2	0.03	0.05	0.1	54	72.7	0.05	0.01	1.97	0.02
HSCK 013	567105	6560541	2	0.02	0.1	0.1	125	35	0.05	0.01	1.49	0.005
HSCK 014	567075	6560541	1	0.02	0.1	0.2	52	31	0.05	0.01	0.97	0.01
HSCK 015	567057	6560546	3	0.02	0.1	0.1	39	46.7	0.05	0.01	2.17	0.01
HSCK 016	567144	6560533	2	0.03	0.05	0.1	128	31.7	0.05	0.01	1.21	0.005
HSCK 017	566989	6560589	1	0.02	0.05	0.2	63	33	0.05	0.01	0.94	0.005
HSCK 018	567116	6560537	2	0.02	0.05	0.1	52	21.7	0.05	0.01	1.18	0.02
HSCK 019	567051	6560548	4	0.01	0.1	0.8	27	30.5	0.05	0.01	0.84	0.01
HSCK 020	567045	6560553	7	0.03	0.2	0.5	33	28.2	0.05	0.01	1.05	0.005
HSCK 021	567023	6560579	1	0.03	0.2	0.1	37	39.4	0.05	0.01	1.7	0.01
HSCK 022	566974	6560608	1	0.02	0.1	0.1	35	36.1	0.05	0.01	0.95	0.005
HSCK 023	566911	6560677	3	0.03	0.05	0.1	46	46.6	0.05	0.01	1.1	0.01
HSCK 024	566877	6560681	1	0.02	0.05	0.1	27	18.3	0.05	0.01	0.49	0.005
HSCK 025	566841	6560716	1	0.02	0.1	0.1	52	44.9	0.05	0.01	1.25	0.005
HSCK 026	566817	6560672	3	0.02	0.2	0.1	45	28.2	0.05	0.01	0.84	0.01
HSCK 027	566767	6560671	5	0.04	0.1	0.1	32	18.6	0.05	0.01	0.49	0.005
HSCK 028	566722	6560646	1	0.02	0.05	0.1	15	25.9	0.05	0.01	0.67	0.01
HSCK 029	566669	6560620	1	0.02	0.1	0.1	35	32.7	0.05	0.01	1.4	0.01
HSCK 030	566620	6560617	2	0.03	0.1	0.1	47	25.7	0.05	0.01	0.99	0.005
HSCK 031	566585	6560626	5	0.03	0.1	0.1	45	28.7	0.05	0.01	1.31	0.005
HSCK 032	566550	6560611	2	0.02	0.05	0.1	72	16	0.05	0.01	0.99	0.03
HSCK 033	566338	6560656	1	0.02	0.1	0.1	69	22.4	0.05	0.01	1.21	0.005
HSCK 034	566372	6560654	2	0.02	0.05	0.1	37	22.6	0.05	0.01	0.91	0.01
HSCK 035	566395	6560646	1	0.01	0.1	0.1	36	21.9	0.05	0.01	1.17	0.005
HSCK 036	566407	6560647	1	0.03	0.05	0.8	22	28.9	0.05	0.03	1.5	0.01
HSCK 037	566433	6560636	1	0.03	0.05	0.4	49	37	0.05	0.01	1.39	0.01
HSCK 038	566494	6560630	7	0.03	0.1	0.2	59	22	0.05	0.01	1.22	0.02
HSCK 039	566523	6560632	1	0.03	0.05	0.4	52	17.8	0.05	0.01	1.03	0.05
HSCK 040	566529	6560634	6	0.03	0.2	0.3	78	23.8	0.05	0.01	1.6	0.005
HSCK 041	566542	6560639	6	0.04	0.2	0.1	53	38.5	0.05	0.01	1.64	0.005
HSCK 042	566592	6560640	2	0.02	0.05	0.1	45	28.4	0.05	0.01	0.82	0.01
HSCK 043	566635	6560656	1	0.02	0.05	0.1	87	32.5	0.05	0.01	0.91	0.005
HSCK 044	566639	6560640	1	0.01	0.05	0.1	39	30.8	0.05	0.01	1.29	0.01
HSCK 045	566130	6560780	1	0.03	0.05	0.1	23	60.1	0.05	0.01	2.01	0.04
HSCK 046	566144	6560759	1	0.03	0.1	0.1	40	35.7	0.05	0.01	1.18	0.01
HSCK 047	566176	6560770	1	0.02	0.05	0.1	23	31.5	0.05	0.01	0.91	0.04
HSCK 048	566190	6560740	1	0.03	0.05	0.1	41	48.1	0.05	0.01	1.42	0.01
HSCK 049	566215	6560744	1	0.03	0.1	0.1	44	47.2	0.05	0.01	1.06	0.01
HSCK 050	566238	6560715	1	0.02	0.05	0.1	31	42.3	0.05	0.01	1.4	0.01
HSCK 051	566252	6560684	2	0.02	0.05	0.1	23	25	0.05	0.01	0.9	0.005
HSCK 052	566280	6560702	4	0.02	0.05	0.3	24	29.7	0.05	0.01	1.22	0.005
HSCK 053	566319	6560680	7	0.01	0.2	0.1	33	41.8	0.05	0.01	1.6	0.01
HSCK 054	566339	6560658	1	0.02	0.05	0.1	45	32.1	0.05	0.01	1.37	0.01
HSCK 055	566352	6560658	1	0.01	0.2	0.1	22	31	0.05	0.01	1.24	0.03
HSCK 056	565815	6560900	1	0.02	0.05	0.1	39	21.8	0.05	0.01	0.95	0.01
HSCK 057	565846	6560901	2	0.02	0.05	0.1	20	23.6	0.05	0.01	0.68	0.005
HSCK 058	565930	6560865	1	0.02	0.05	0.1	30	49.9	0.05	0.01	1.98	0.01
HSCK 059	565967	6560853	1	0.04	0.05	0.1	24	49.9	0.05	0.01	1.31	0.02
HSCK 060	566013	6560826	2	0.04	0.05	0.1	57	35.5	0.05	0.01	0.96	0.01
HSCK 061	566045	6560818	3	0.03	0.2	0.1	78	47.9	0.05	0.01	1.91	0.005
HSCK 062	566080	6560811	1	0.02	0.05	0.1	61	36.1	0.05	0.01	1.56	0.02
HSCK 063	566125	6560782	3	0.02	0.1	0.1	22	46.2	0.05	0.01	1.71	0.03
HSCK 064	565585	6561159	5	0.02	0.05	0.1	37	20.3	0.05	0.01	0.83	0.005
HSCK 065	565599	6561125	3	0.02	0.1	0.1	33	38.5	0.05	0.01	1.32	0.02
HSCK 066	565635	6561058	1	0.04	0.2	0.1	33	21.1	0.05	0.01	1.14	0.06
HSCK 067	565664	6561017	1	0.01	0.05	0.1	23	23.7	0.05	0.01	1.36	0.01
HSCK 068	565718	6560963	1	0.02	0.2	0.1	54	24.5	0.05	0.01	1	0.01
HSCK 069	565687	6560986	2	0.04	0.1	10.2	102	31.1	0.05	0.01	1.08	0.02

Sample No.	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Fe pct	Ga ppm	Ge ppm	Hf ppm	Hg ppb	In ppm	K pct
HSCK 001	0.26	0.13	2.3	0.02	6.7	0.018	0.05	0.04	0.005	15	0.01	1.34
HSCK 002	0.23	0.1	1.6	0.017	4.9	0.014	0.05	0.02	0.005	16	0.01	1.75
HSCK 003	0.16	0.06	1.7	0.013	8.54	0.01	0.05	0.02	0.005	18	0.01	1.4
HSCK 004	0.26	0.07	2.2	0.022	5.79	0.019	0.05	0.02	0.005	16	0.01	1.09
HSCK 005	0.24	0.07	2.1	0.019	6.57	0.018	0.05	0.01	0.004	17	0.01	1.28
HSCK 006	0.19	0.13	1.9	0.015	6.1	0.012	0.05	0.02	0.005	16	0.01	1.42
HSCK 007	0.22	0.06	1.7	0.019	7.2	0.018	0.05	0.005	0.004	20	0.01	0.92
HSCK 008	0.26	0.11	2.3	0.02	5.78	0.017	0.05	0.02	0.004	15	0.01	1.16
HSCK 009	0.32	0.11	2.4	0.025	8.05	0.022	0.05	0.02	0.008	17	0.01	1.41
HSCK 010	0.29	0.09	2	0.021	8.5	0.021	0.05	0.03	0.009	20	0.01	1.44
HSCK 011	0.21	0.08	2	0.016	6.78	0.017	0.05	0.02	0.007	15	0.01	0.55
HSCK 012	0.38	0.11	2.4	0.032	5.79	0.029	0.05	0.04	0.008	18	0.01	1.75
HSCK 013	0.26	0.14	1.9	0.021	8.4	0.019	0.05	0.005	0.004	16	0.01	0.87
HSCK 014	0.28	0.09	2.3	0.023	6.61	0.022	0.05	0.005	0.007	22	0.01	1.1
HSCK 015	0.36	0.18	1.9	0.019	7.1	0.018	0.05	0.005	0.008	17	0.01	1.32
HSCK 016	0.34	0.11	2.2	0.027	7.48	0.026	0.05	0.005	0.009	16	0.01	1.44
HSCK 017	0.22	0.11	2	0.019	5.29	0.018	0.05	0.01	0.003	23	0.01	1.77
HSCK 018	0.28	0.16	2	0.016	7.29	0.018	0.05	0.02	0.007	17	0.01	1.18
HSCK 019	0.23	0.16	3.2	0.015	6.21	0.013	0.05	0.02	0.005	12	0.01	1.46
HSCK 020	0.31	0.18	2.8	0.025	6.47	0.023	0.05	0.005	0.01	19	0.01	1.33
HSCK 021	0.46	0.12	2.5	0.03	6.83	0.027	0.05	0.005	0.011	20	0.01	1.62
HSCK 022	0.2	0.07	1.7	0.026	6.01	0.013	0.05	0.005	0.004	14	0.01	1.25
HSCK 023	0.41	0.23	2.6	0.038	9.11	0.03	0.05	0.04	0.009	23	0.01	1.74
HSCK 024	0.23	0.12	1.7	0.02	5.14	0.016	0.05	0.005	0.006	9	0.01	0.99
HSCK 025	0.31	0.17	2.7	0.022	4.86	0.022	0.05	0.005	0.011	17	0.01	1.09
HSCK 026	0.31	0.17	2	0.024	6.79	0.024	0.05	0.02	0.006	18	0.01	1.23
HSCK 027	0.51	0.16	2.7	0.047	6.6	0.04	0.1	0.01	0.014	13	0.01	2.95
HSCK 028	0.26	0.1	2	0.057	5.19	0.018	0.05	0.01	0.004	12	0.01	1.33
HSCK 029	0.24	0.11	1.9	0.023	5.42	0.018	0.05	0.005	0.008	12	0.01	1.43
HSCK 030	0.37	0.1	1.8	0.037	8.47	0.027	0.05	0.02	0.009	20	0.01	2.14
HSCK 031	0.4	0.1	2.3	0.028	6.36	0.025	0.05	0.03	0.007	18	0.01	1.27
HSCK 032	0.32	0.16	2.1	0.024	7.51	0.019	0.05	0.02	0.008	25	0.01	1.45
HSCK 033	0.26	0.12	2.1	0.02	7.03	0.017	0.05	0.005	0.004	23	0.01	1.22
HSCK 034	0.28	0.32	1.7	0.054	9.07	0.017	0.05	0.01	0.006	12	0.01	2.05
HSCK 035	0.2	0.06	1.7	0.017	6.95	0.012	0.05	0.01	0.004	17	0.01	1.06
HSCK 036	0.5	0.15	2.8	0.037	6.61	0.027	0.05	0.02	0.011	15	0.01	1.82
HSCK 037	0.38	0.51	2.8	0.031	5.82	0.025	0.05	0.02	0.01	22	0.01	1.54
HSCK 038	0.39	0.16	3	0.031	14.12	0.03	0.05	0.04	0.014	19	0.01	1.88
HSCK 039	0.38	0.26	2.4	0.022	6.57	0.021	0.05	0.01	0.007	27	0.01	1.57
HSCK 040	0.35	0.07	2.8	0.03	8.32	0.025	0.05	0.02	0.008	23	0.01	1.67
HSCK 041	0.52	0.11	2.8	0.036	8.47	0.03	0.1	0.03	0.01	35	0.01	1.87
HSCK 042	0.22	0.21	2.5	0.02	7.35	0.017	0.05	0.01	0.004	21	0.01	1.72
HSCK 043	0.3	0.13	2.5	0.026	5.5	0.022	0.05	0.02	0.006	19	0.01	1.26
HSCK 044	0.17	0.07	2.1	0.028	5.93	0.012	0.05	0.005	0.004	15	0.01	1.34
HSCK 045	0.41	0.12	2.8	0.042	6.02	0.027	0.05	0.02	0.012	21	0.01	1.56
HSCK 046	0.32	0.09	2.6	0.027	5.23	0.022	0.05	0.01	0.005	20	0.01	1.63
HSCK 047	0.3	0.31	2.8	0.028	7.26	0.022	0.05	0.03	0.008	24	0.01	1.67
HSCK 048	0.35	0.14	2.6	0.035	5.59	0.025	0.05	0.02	0.01	18	0.01	1.65
HSCK 049	0.43	0.22	3.1	0.033	5.32	0.031	0.05	0.03	0.008	23	0.01	1.94
HSCK 050	0.27	0.1	2.2	0.03	6.24	0.019	0.05	0.01	0.004	17	0.01	1.39
HSCK 051	0.18	0.06	2.3	0.02	4.07	0.016	0.05	0.02	0.006	12	0.01	1.54
HSCK 052	0.25	0.09	2.3	0.032	5.6	0.016	0.05	0.01	0.003	18	0.01	1.1
HSCK 053	0.2	0.09	2.2	0.015	8.32	0.012	0.05	0.005	0.005	20	0.01	1.13
HSCK 054	0.3	0.17	2.6	0.021	5.38	0.018	0.05	0.005	0.005	21	0.01	1.2
HSCK 055	0.18	0.1	2.5	0.017	7.76	0.012	0.05	0.01	0.004	16	0.01	0.74
HSCK 056	0.21	0.07	2.4	0.018	4.9	0.017	0.05	0.01	0.008	18	0.01	0.66
HSCK 057	0.25	0.08	2.3	0.024	6.66	0.018	0.05	0.02	0.001	15	0.01	0.71
HSCK 058	0.26	0.19	2.5	0.053	3.93	0.018	0.05	0.01	0.007	20	0.01	0.97
HSCK 059	0.62	0.2	3.1	0.055	2.53	0.045	0.1	0.04	0.016	29	0.01	1.09
HSCK 060	0.57	0.27	3.1	0.124	7.34	0.042	0.1	0.02	0.013	21	0.01	1.92
HSCK 061	0.34	0.12	2.9	0.028	3.84	0.024	0.05	0.03	0.007	18	0.01	1.36
HSCK 062	0.27	0.09	2.7	0.03	6.54	0.022	0.05	0.03	0.008	17	0.01	1.73
HSCK 063	0.34	0.1	2.9	0.033	5.1	0.019	0.05	0.05	0.009	16	0.01	1.32
HSCK 064	0.25	0.2	2.4	0.021	6.6	0.018	0.05	0.03	0.004	12	0.01	1.27
HSCK 065	0.24	0.2	2.7	0.025	4.19	0.017	0.05	0.01	0.008	14	0.01	1.19
HSCK 066	0.52	0.23	3.3	0.092	4.24	0.036	0.1	0.03	0.01	16	0.01	1.26
HSCK 067	0.19	0.18	2.4	0.019	3.41	0.014	0.05	0.02	0.005	13	0.01	1.26
HSCK 068	0.26	0.23	2.5	0.025	3.39	0.019	0.05	0.03	0.005	21	0.01	1.47
HSCK 069	0.49	0.14	3.1	0.036	5.81	0.035	0.1	0.03	0.009	26	0.01	1.87

Sample No.	Rb ppm	Re ppb	S pct	Sb ppm	Sc ppm	Se ppm	Sn ppm	Sr ppm	Ta ppm	Te ppm	Th ppm	Ti ppm
HSCK 001	2.2	0.5	0.15	0.03	0.2	0.2	0.04	68.1	0.0005	0.01	0.04	6
HSCK 002	1.8	1	0.24	0.02	0.1	0.3	0.02	79.9	0.0005	0.01	0.03	6
HSCK 003	1.7	5	0.19	0.03	0.2	0.3	0.02	111.8	0.0005	0.01	0.02	8
HSCK 004	1.6	6	0.3	0.03	0.2	0.6	0.05	86	0.0005	0.01	0.04	7
HSCK 005	1.1	3	0.19	0.04	0.2	0.2	0.06	31	0.0005	0.01	0.04	8
HSCK 006	2.2	5	0.17	0.02	0.1	0.3	0.04	53	0.0005	0.01	0.03	7
HSCK 007	0.9	4	0.17	0.04	0.2	0.3	0.06	52.2	0.0005	0.01	0.03	7
HSCK 008	3.8	3	0.19	0.02	0.2	0.5	0.04	53.1	0.0005	0.01	0.04	7
HSCK 009	2.8	5	0.17	0.04	0.2	0.3	0.04	73.6	0.0005	0.01	0.05	8
HSCK 010	2	3	0.21	0.03	0.2	0.4	0.05	54.3	0.0005	0.01	0.04	9
HSCK 011	0.7	2	0.13	0.03	0.1	0.3	0.04	27.4	0.0005	0.01	0.03	6
HSCK 012	3.4	5	0.15	0.01	0.2	0.2	0.03	84.6	0.0005	0.01	0.06	12
HSCK 013	1.2	2	0.17	0.04	0.2	0.4	0.06	68.9	0.0005	0.01	0.04	7
HSCK 014	2.2	4	0.23	0.05	0.2	0.3	0.06	35.9	0.0005	0.01	0.04	9
HSCK 015	2.4	1	0.14	0.04	0.2	0.4	0.04	77	0.0005	0.01	0.03	7
HSCK 016	2.2	3	0.18	0.03	0.2	0.3	0.03	47.6	0.0005	0.01	0.05	9
HSCK 017	1.7	3	0.17	0.02	0.2	0.3	0.04	39.6	0.0005	0.01	0.03	10
HSCK 018	2	3	0.13	0.03	0.2	0.3	0.03	46.6	0.0005	0.01	0.03	7
HSCK 019	2.3	3	0.12	0.06	0.2	0.3	0.04	32.1	0.0005	0.01	0.02	9
HSCK 020	2.3	4	0.2	0.04	0.2	0.3	0.07	41.3	0.0005	0.01	0.05	10
HSCK 021	2.7	6	0.19	0.02	0.2	0.4	0.03	66.2	0.0005	0.01	0.06	13
HSCK 022	2.8	3	0.18	0.03	0.2	0.4	0.04	34.9	0.0005	0.01	0.03	8
HSCK 023	10.1	2	0.21	0.03	0.3	0.2	0.03	37.6	0.0005	0.01	0.06	12
HSCK 024	2.5	4	0.1	0.05	0.2	0.2	0.03	20.2	0.0005	0.01	0.03	5
HSCK 025	1.5	6	0.19	0.01	0.2	0.3	0.03	54.4	0.0005	0.01	0.05	8
HSCK 026	1.6	6	0.13	0.03	0.1	0.3	0.05	33.4	0.0005	0.01	0.04	8
HSCK 027	10.1	3	0.18	0.03	0.2	0.4	0.04	17	0.0005	0.01	0.08	12
HSCK 028	13.2	4	0.07	0.03	0.3	0.2	0.04	25.5	0.0005	0.01	0.03	6
HSCK 029	4.6	5	0.11	0.01	0.2	0.2	0.04	60.6	0.0005	0.01	0.04	7
HSCK 030	7.7	6	0.21	0.03	0.1	0.3	0.04	38.2	0.0005	0.01	0.05	12
HSCK 031	2.5	7	0.12	0.05	0.2	0.2	0.05	57.4	0.0005	0.01	0.05	8
HSCK 032	3.8	12	0.15	0.03	0.2	0.3	0.05	29.8	0.0005	0.01	0.04	8
HSCK 033	3.9	6	0.16	0.03	0.2	0.3	0.04	48.2	0.0005	0.01	0.03	7
HSCK 034	15.8	1	0.18	0.03	0.2	0.4	0.02	35.5	0.0005	0.01	0.04	6
HSCK 035	5.1	3	0.12	0.04	0.2	0.3	0.04	45.6	0.0005	0.01	0.03	6
HSCK 036	8.1	5	0.13	0.02	0.2	0.3	0.05	53.3	0.0005	0.01	0.07	11
HSCK 037	3.1	8	0.14	0.04	0.2	0.3	0.05	65.4	0.0005	0.01	0.06	9
HSCK 038	2.1	15	0.14	0.01	0.05	0.2	0.03	41.1	0.0005	0.01	0.07	14
HSCK 039	4.1	13	0.12	0.03	0.2	0.2	0.07	33.9	0.0005	0.01	0.05	8
HSCK 040	3.5	12	0.11	0.01	0.05	0.2	0.02	66.8	0.0005	0.01	0.06	9
HSCK 041	4.1	9	0.14	0.01	0.3	0.2	0.03	67.6	0.0005	0.01	0.07	12
HSCK 042	3.2	0.5	0.11	0.01	0.3	0.2	0.03	27.6	0.0005	0.01	0.03	10
HSCK 043	1.7	11	0.13	0.01	0.2	0.2	0.02	36.6	0.0005	0.01	0.04	9
HSCK 044	4.6	10	0.08	0.01	0.2	0.2	0.03	49.4	0.0005	0.01	0.03	6
HSCK 045	6.5	2	0.17	0.01	0.1	0.2	0.02	63.2	0.0005	0.01	0.06	11
HSCK 046	3.4	3	0.17	0.01	0.2	0.2	0.03	30.7	0.0005	0.01	0.05	10
HSCK 047	7.3	5	0.1	0.03	0.2	0.2	0.03	34	0.0005	0.01	0.05	8
HSCK 048	7.4	5	0.09	0.01	0.3	0.3	0.05	44.9	0.0005	0.01	0.06	9
HSCK 049	4.7	5	0.2	0.01	0.2	0.3	0.02	33	0.0005	0.01	0.06	12
HSCK 050	4.6	4	0.14	0.01	0.3	0.2	0.03	59.9	0.0005	0.01	0.04	8
HSCK 051	4.9	4	0.12	0.01	0.3	0.2	0.01	27.5	0.0005	0.01	0.03	5
HSCK 052	7.8	4	0.08	0.02	0.2	0.2	0.03	44.3	0.0005	0.01	0.04	7
HSCK 053	1.4	9	0.17	0.01	0.05	0.3	0.03	71.6	0.0005	0.01	0.03	7
HSCK 054	2.8	6	0.2	0.01	0.2	0.2	0.01	60.7	0.0005	0.01	0.04	7
HSCK 055	2.9	6	0.17	0.01	0.2	0.2	0.01	50.6	0.0005	0.01	0.02	6
HSCK 056	1.4	15	0.17	0.01	0.2	0.4	0.01	31.4	0.0005	0.01	0.03	6
HSCK 057	2.2	2	0.12	0.01	0.3	0.2	0.01	19.9	0.0005	0.01	0.04	7
HSCK 058	4.1	4	0.11	0.01	0.2	0.3	0.04	85.5	0.0005	0.01	0.04	6
HSCK 059	5.8	9	0.19	0.01	0.2	0.5	0.04	45.6	0.0005	0.01	0.1	10
HSCK 060	12.6	6	0.17	0.01	0.3	0.3	0.03	28.1	0.0005	0.01	0.09	13
HSCK 061	2.2	13	0.09	0.01	0.3	0.3	0.04	83.9	0.0005	0.01	0.05	7
HSCK 062	3.2	15	0.18	0.01	0.1	0.7	0.01	60.2	0.0005	0.01	0.04	9
HSCK 063	5.1	1	0.16	0.01	0.3	0.3	0.02	52.4	0.0005	0.01	0.04	10
HSCK 064	3.2	3	0.07	0.01	0.2	0.3	0.04	35.4	0.0005	0.01	0.03	7
HSCK 065	2.7	7	0.09	0.01	0.2	0.3	0.04	53	0.0005	0.01	0.04	7
HSCK 066	5	8	0.13	0.01	0.3	0.6	0.05	35.2	0.0005	0.01	0.07	10
HSCK 067	2.6	3	0.13	0.01	0.3	0.2	0.02	57.8	0.0005	0.01	0.03	6
HSCK 068	2.7	3	0.14	0.01	0.4	0.2	0.02	33.9	0.0005	0.01	0.04	10
HSCK 069	2.8	11	0.24	0.01	0.2	0.3	0.03	32.4	0.0005	0.01	0.06	9

Sample No.	La ppm	Li ppm	Mg pct	Mn ppm	Mo ppm	Na pct	Nb ppm	Ni ppm	P pct	Pb ppm	Pd ppb	Pt ppb
HSCK 001	0.13	0.26	0.201	28	0.18	0.003	0.005	3.9	0.112	0.21	1	0.5
HSCK 002	0.11	0.45	0.163	176	0.09	0.007	0.01	2.4	0.108	0.14	1	0.5
HSCK 003	0.09	0.47	0.308	152	0.15	0.002	0.005	2.8	0.197	0.81	1	0.5
HSCK 004	0.14	1.08	0.29	42	0.06	0.074	0.01	2.9	0.142	0.28	1	0.5
HSCK 005	0.12	0.47	0.146	77	0.05	0.044	0.005	4.3	0.17	0.21	1	0.5
HSCK 006	0.08	0.58	0.254	67	0.11	0.031	0.005	4.3	0.149	0.18	1	0.5
HSCK 007	0.11	0.75	0.192	48	0.09	0.303	0.005	3.5	0.153	0.17	1	0.5
HSCK 008	0.12	0.71	0.336	148	0.2	0.027	0.005	3.1	0.122	0.19	1	0.5
HSCK 009	0.16	1.19	0.233	54	0.08	0.081	0.005	3.4	0.149	0.2	1	0.5
HSCK 010	0.13	0.8	0.208	67	0.19	0.076	0.01	7.7	0.18	0.22	1	0.5
HSCK 011	0.11	0.48	0.162	122	0.08	0.232	0.005	3	0.129	0.16	1	0.5
HSCK 012	0.2	0.8	0.307	87	0.09	0.039	0.02	3.6	0.227	0.25	1	0.5
HSCK 013	0.13	1.04	0.269	182	0.03	0.077	0.005	4.2	0.128	0.17	1	0.5
HSCK 014	0.13	0.56	0.172	71	0.1	0.201	0.005	2.5	0.161	0.22	1	0.5
HSCK 015	0.18	0.67	0.417	385	0.04	0.02	0.01	3	0.129	0.23	1	0.5
HSCK 016	0.17	0.52	0.226	87	0.19	0.049	0.01	6.4	0.171	0.25	1	0.5
HSCK 017	0.09	0.44	0.22	85	0.05	0.009	0.005	2.4	0.227	0.24	1	0.5
HSCK 018	0.12	1.05	0.163	147	0.06	0.031	0.01	4.2	0.156	0.17	1	0.5
HSCK 019	0.11	0.51	0.181	118	0.16	0.008	0.005	2.6	0.243	1.71	1	0.5
HSCK 020	0.16	0.55	0.263	184	0.11	0.056	0.01	2.7	0.184	0.25	7	0.5
HSCK 021	0.22	0.4	0.259	298	0.29	0.005	0.01	3.9	0.245	0.22	1	0.5
HSCK 022	0.09	0.45	0.184	81	0.1	0.166	0.005	2.3	0.166	0.1	1	0.5
HSCK 023	0.21	0.29	0.269	118	0.07	0.011	0.02	5.9	0.211	0.27	1	0.5
HSCK 024	0.1	0.29	0.186	59	0.05	0.01	0.005	2.2	0.107	0.47	1	0.5
HSCK 025	0.15	1.09	0.313	176	0.15	0.007	0.005	3.3	0.155	0.18	1	0.5
HSCK 026	0.16	0.8	0.181	87	0.1	0.05	0.02	3.7	0.154	0.15	1	0.5
HSCK 027	0.25	0.34	0.1	35	0.08	0.008	0.01	3.7	0.192	0.28	1	0.5
HSCK 028	0.12	0.52	0.195	49	0.15	0.018	0.005	2.1	0.116	0.2	1	0.5
HSCK 029	0.12	0.76	0.217	87	0.04	0.047	0.01	2.1	0.136	0.2	1	0.5
HSCK 030	0.18	1.7	0.172	86	0.19	0.043	0.01	7.2	0.238	0.22	1	0.5
HSCK 031	0.21	3	0.236	71	0.03	0.036	0.005	4.5	0.155	0.22	1	0.5
HSCK 032	0.15	7.05	0.264	299	0.02	0.011	0.01	8.6	0.162	0.3	1	0.5
HSCK 033	0.13	0.98	0.182	211	0.03	0.051	0.005	5.5	0.129	0.14	1	0.5
HSCK 034	0.14	0.61	0.138	86	0.06	0.005	0.005	3.5	0.127	0.2	1	0.5
HSCK 035	0.13	1.37	0.236	101	0.06	0.031	0.005	4.7	0.137	0.16	1	0.5
HSCK 036	0.31	0.79	0.199	69	0.17	0.027	0.01	6.3	0.193	0.23	1	0.5
HSCK 037	0.21	1.31	0.265	114	0.29	0.024	0.02	5.2	0.155	0.25	1	0.5
HSCK 038	0.21	8.46	0.221	198	0.09	0.093	0.02	13.6	0.286	0.22	1	0.5
HSCK 039	0.21	5.05	0.247	263	0.03	0.012	0.005	9.5	0.162	0.18	1	0.5
HSCK 040	0.18	6.09	0.339	83	0.03	0.039	0.01	6.9	0.16	0.37	1	0.5
HSCK 041	0.29	4.11	0.322	88	0.04	0.044	0.01	7.3	0.218	0.25	1	0.5
HSCK 042	0.13	0.49	0.213	71	0.04	0.007	0.005	5.1	0.223	0.11	1	0.5
HSCK 043	0.17	3.34	0.19	144	0.04	0.064	0.005	7	0.165	0.29	1	0.5
HSCK 044	0.1	0.48	0.213	140	0.03	0.01	0.005	4.6	0.144	0.06	1	0.5
HSCK 045	0.28	0.71	0.279	173	0.07	0.023	0.01	8.2	0.235	0.21	1	0.5
HSCK 046	0.16	0.38	0.245	56	0.04	0.019	0.005	3.8	0.21	0.17	1	0.5
HSCK 047	0.15	0.49	0.197	72	0.18	0.077	0.01	4.1	0.156	0.17	1	0.5
HSCK 048	0.19	0.59	0.25	40	0.12	0.036	0.01	2.9	0.152	0.21	1	0.5
HSCK 049	0.21	0.54	0.276	103	0.04	0.013	0.01	4.6	0.21	0.23	1	0.5
HSCK 050	0.13	0.56	0.232	39	0.15	0.056	0.005	2.5	0.153	0.13	1	0.5
HSCK 051	0.1	0.31	0.088	59	0.03	0.008	0.005	4.2	0.09	0.09	1	0.5
HSCK 052	0.12	0.49	0.162	41	0.03	0.009	0.005	2.6	0.12	0.11	1	0.5
HSCK 053	0.11	1.46	0.263	109	0.03	0.009	0.005	5.5	0.157	2.07	1	0.5
HSCK 054	0.15	1.57	0.368	302	0.06	0.134	0.005	3.4	0.14	0.14	1	0.5
HSCK 055	0.09	0.72	0.258	144	0.29	0.155	0.005	3.4	0.112	0.15	1	0.5
HSCK 056	0.11	0.99	0.189	76	0.21	0.215	0.005	4.2	0.118	0.09	1	0.5
HSCK 057	0.13	0.39	0.182	72	0.06	0.145	0.005	2.2	0.144	0.12	1	0.5
HSCK 058	0.15	1.56	0.289	194	0.11	0.076	0.005	1.4	0.102	0.16	1	0.5
HSCK 059	0.31	0.51	0.268	107	0.08	0.019	0.02	1.7	0.13	0.33	1	0.5
HSCK 060	0.29	0.47	0.241	59	0.11	0.013	0.02	4.3	0.196	0.35	1	0.5
HSCK 061	0.19	1.68	0.273	90	0.08	0.056	0.005	4	0.114	0.2	1	0.5
HSCK 062	0.15	0.79	0.227	77	0.37	0.039	0.01	5.9	0.178	0.16	1	0.5
HSCK 063	0.23	0.68	0.246	139	0.07	0.019	0.005	7.5	0.219	0.12	1	0.5
HSCK 064	0.13	0.65	0.167	120	0.15	0.004	0.005	3.5	0.13	0.14	1	0.5
HSCK 065	0.13	0.6	0.26	95	0.06	0.041	0.005	3.3	0.129	0.12	1	0.5
HSCK 066	0.25	0.53	0.248	46	0.28	0.152	0.005	5.9	0.126	0.19	1	0.5
HSCK 067	0.09	0.3	0.142	32	0.07	0.019	0.005	2.5	0.118	0.08	1	0.5
HSCK 068	0.13	1.68	0.151	150	0.34	0.047	0.005	4.5	0.21	0.14	1	0.5
HSCK 069	0.24	0.61	0.199	83	0.3	0.176	0.02	5	0.141	0.17	3	0.5

Sample No.	Tl ppm	U ppm	V ppm	W ppm	Y ppm	Zn ppm	Zr ppm
HSCK 001	0.01	0.005	1	0.05	0.056	21.7	0.13
HSCK 002	0.01	0.005	1	0.05	0.06	22	0.11
HSCK 003	0.01	0.005	1	0.05	0.039	34.2	0.09
HSCK 004	0.01	0.02	1	0.05	0.07	38	0.18
HSCK 005	0.01	0.01	1	0.05	0.058	20.5	0.12
HSCK 006	0.01	0.005	1	0.05	0.047	31.9	0.1
HSCK 007	0.01	0.01	1	0.05	0.06	39.2	0.12
HSCK 008	0.01	0.005	1	0.05	0.07	29.2	0.12
HSCK 009	0.01	0.005	1	0.05	0.083	34.9	0.17
HSCK 010	0.01	0.01	1	0.05	0.074	32.2	0.16
HSCK 011	0.01	0.005	1	0.05	0.053	36.9	0.12
HSCK 012	0.01	0.005	1	0.05	0.1	43.1	0.24
HSCK 013	0.01	0.02	1	0.05	0.068	27.5	0.14
HSCK 014	0.01	0.005	1	0.05	0.077	30.6	0.16
HSCK 015	0.01	0.005	1	0.05	0.101	39.9	0.13
HSCK 016	0.01	0.005	1	0.05	0.083	34.4	0.21
HSCK 017	0.01	0.005	1	0.05	0.057	22	0.15
HSCK 018	0.01	0.02	1	0.05	0.082	28.7	0.13
HSCK 019	0.01	0.005	1	0.05	0.081	25.2	0.09
HSCK 020	0.01	0.005	1	0.05	0.094	28.3	0.18
HSCK 021	0.01	0.005	1	0.05	0.133	55.5	0.18
HSCK 022	0.01	0.005	1	0.05	0.047	27.7	0.1
HSCK 023	0.01	0.005	1	0.05	0.107	52.6	0.24
HSCK 024	0.01	0.005	1	0.05	0.048	17.9	0.15
HSCK 025	0.01	0.01	1	0.05	0.085	33.7	0.16
HSCK 026	0.01	0.01	1	0.05	0.095	28.1	0.16
HSCK 027	0.01	0.005	1	0.05	0.129	38.4	0.31
HSCK 028	0.01	0.005	1	0.05	0.059	34.1	0.14
HSCK 029	0.01	0.005	1	0.05	0.073	25.6	0.15
HSCK 030	0.01	0.01	1	0.05	0.094	26.4	0.23
HSCK 031	0.01	0.03	1	0.05	0.102	19.1	0.2
HSCK 032	0.01	0.15	1	0.05	0.133	32.9	0.13
HSCK 033	0.01	0.005	1	0.05	0.082	19.3	0.13
HSCK 034	0.01	0.03	1	0.05	0.083	27.7	0.15
HSCK 035	0.01	0.02	1	0.05	0.051	31.5	0.11
HSCK 036	0.02	0.02	1	0.05	0.124	36.5	0.26
HSCK 037	0.01	0.04	1	0.05	0.114	30.2	0.24
HSCK 038	0.01	0.02	1	0.05	0.115	50.4	0.27
HSCK 039	0.01	0.1	1	0.05	0.16	36.8	0.2
HSCK 040	0.01	0.01	1	0.05	0.097	38.3	0.22
HSCK 041	0.01	0.05	1	0.05	0.151	25.6	0.27
HSCK 042	0.01	0.01	1	0.05	0.062	29.6	0.16
HSCK 043	0.01	0.03	1	0.05	0.071	24.1	0.2
HSCK 044	0.01	0.005	1	0.05	0.049	23.4	0.1
HSCK 045	0.01	0.005	1	0.05	0.137	40.9	0.22
HSCK 046	0.01	0.005	1	0.05	0.086	32.4	0.22
HSCK 047	0.01	0.005	1	0.05	0.082	40.5	0.18
HSCK 048	0.01	0.005	1	0.05	0.102	23.2	0.23
HSCK 049	0.01	0.005	1	0.05	0.105	27.7	0.26
HSCK 050	0.01	0.005	1	0.05	0.073	23.2	0.19
HSCK 051	0.01	0.005	1	0.05	0.051	24.6	0.14
HSCK 052	0.01	0.005	1	0.05	0.078	16.2	0.15
HSCK 053	0.01	0.005	1	0.05	0.058	57.8	0.12
HSCK 054	0.01	0.005	1	0.05	0.094	26.1	0.16
HSCK 055	0.01	0.005	1	0.05	0.055	34.1	0.11
HSCK 056	0.01	0.005	1	0.05	0.061	19.6	0.12
HSCK 057	0.01	0.005	1	0.05	0.063	26.6	0.16
HSCK 058	0.01	0.005	1	0.05	0.079	16.4	0.16
HSCK 059	0.01	0.005	1	0.05	0.149	22.1	0.36
HSCK 060	0.01	0.005	1	0.05	0.145	24.4	0.37
HSCK 061	0.01	0.01	1	0.05	0.099	15.5	0.22
HSCK 062	0.01	0.01	1	0.05	0.079	26.4	0.19
HSCK 063	0.01	0.005	1	0.05	0.112	37.6	0.16
HSCK 064	0.03	0.01	1	0.05	0.077	20.6	0.16
HSCK 065	0.01	0.005	1	0.05	0.068	33.4	0.15
HSCK 066	0.03	0.06	1	0.05	0.128	33.9	0.28
HSCK 067	0.03	0.005	1	0.05	0.057	18.1	0.1
HSCK 068	0.01	0.005	1	0.05	0.062	11.2	0.16
HSCK 069	0.01	0.01	1	0.05	0.122	38.7	0.28

Sample No.	Eastings	Northings	Ag ppb	Al pct	As ppm	Au ppb	B ppm	Ba ppm	Be ppm	Bi ppm	Ca pct	Cd ppm
HSCK 071	565819	6560896	13	0.02	0.3	0.1	41	19.9	0.05	0.02	0.8	0.005
HSCK 072	565589	6561166	4	0.02	0.05	0.1	36	24.5	0.05	0.01	0.69	0.01
HSCK 073	565565	6561180	3	0.04	0.1	0.1	47	19.8	0.05	0.01	0.73	0.02
HSCK 074	565543	6561191	1	0.02	0.05	0.1	33	30.5	0.05	0.01	1.26	0.01
HSCK 075	565531	6561193	1	0.03	0.05	0.1	55	35.3	0.05	0.01	1.8	0.02
HSCK 076	565505	6561204	1	0.02	0.05	0.1	44	25.8	0.05	0.01	1.12	0.02
HSCK 077	565484	6561205	2	0.02	0.05	0.1	83	45.4	0.05	0.01	1.32	0.05
HSCK 078	565391	6561236	1	0.04	0.2	0.1	57	36.7	0.05	0.01	1.65	0.02
HSCK 079	565368	6561258	1	0.03	0.05	0.1	43	30.9	0.05	0.01	1.35	0.02
HSCK 080	565341	6561270	1	0.02	0.2	0.1	59	38.8	0.05	0.01	1.59	0.01
HSCK 081	565322	6561272	4	0.03	0.2	0.1	47	14.6	0.05	0.01	0.91	0.01
HSCK 082	565305	6561312	1	0.03	0.05	0.1	28	36.1	0.05	0.01	1.36	0.005
HSCK 083	565307	6561503	1	0.02	0.1	0.1	57	11.7	0.05	0.01	0.91	0.02
HSCK 084	565303	6561494	1	0.03	0.05	0.1	31	22.3	0.05	0.01	0.77	0.02
HSCK 085	565296	6561437	1	0.02	0.2	0.1	50	20.3	0.05	0.01	0.94	0.02
HSCK 086	565269	6561416	1	0.03	0.05	0.1	61	66.5	0.05	0.01	2.15	0.04
HSCK 087	565265	6561398	4	0.02	0.05	0.1	50	41.4	0.05	0.01	1.06	0.02
HSCK 088	565254	6561379	1	0.02	0.05	0.1	39	32.9	0.05	0.01	1.1	0.02
HSCK 089	565244	6561342	1	0.04	0.05	0.1	46	40.4	0.05	0.01	2.11	0.03
HSCK 090	565251	6561320	1	0.02	0.1	0.2	30	14.9	0.05	0.06	0.63	0.005
HSCK 091	565273	6561313	1	0.03	0.2	0.1	27	14.2	0.05	0.03	0.5	0.005
HSCK 092	565090	6562053	1	0.02	0.3	0.1	28	29.3	0.05	0.01	1	0.01
HSCK 093	565115	6562033	1	0.02	0.2	0.1	48	21.2	0.05	0.01	0.5	0.005
HSCK 094	565158	6562004	3	0.03	0.2	0.1	36	35.3	0.05	0.01	0.95	0.005
HSCK 095	565185	6561965	3	0.03	0.1	0.1	79	27.9	0.05	0.01	1.35	0.01
HSCK 096	565217	6561923	3	0.04	0.2	0.1	86	29.7	0.05	0.01	0.99	0.01
HSCK 097	565256	6561851	1	0.03	0.05	0.5	108	39.1	0.05	0.01	1.3	0.02
HSCK 098	565282	6561824	1	0.02	0.05	0.1	69	16.1	0.05	0.01	1.14	0.03
HSCK 099	565300	6561772	4	0.02	0.05	0.1	176	34.1	0.05	0.01	1.84	0.02
HSCK 100	565294	6561746	4	0.03	0.05	0.1	58	56.9	0.05	0.01	2.52	0.04
HSCK 101	565303	6561653	1	0.03	0.05	0.1	47	80.5	0.05	0.01	2.53	0.02
HSCK 102	565309	6561595	1	0.03	0.1	0.2	78	19.6	0.05	0.01	0.85	0.01
HSCK 103	565301	6561558	1	0.03	0.05	0.1	51	22.8	0.05	0.01	0.86	0.02
HSCK 104	565306	6561529	1	0.03	0.05	0.1	52	30.4	0.05	0.01	1.17	0.03
HSCK 105	565051	6562093	2	0.03	0.05	0.1	51	35.7	0.05	0.01	1.47	0.02
HSCK 106	565031	6562121	2	0.03	0.05	1.3	36	29.8	0.05	0.05	1.49	0.03
HSCK 107	564996	6562141	1	0.02	0.05	0.9	37	33.6	0.05	0.03	1.28	0.02
HSCK 108	564956	6562178	1	0.04	0.2	6.1	117	28.8	0.05	0.02	0.88	0.01
HSCK 109	564914	6562241	1	0.02	0.05	0.4	32	18.6	0.05	0.01	0.45	0.01
HSCK 110	564855	6562289	5	0.04	0.05	1	56	22.7	0.05	0.01	1.06	0.02
HSCK 111	564799	6562326	1	0.02	0.05	0.5	85	44.4	0.05	0.01	1.41	0.02
HSCK 112	564766	6562326	1	0.03	0.05	0.2	88	16	0.05	0.01	0.76	0.02
HSCK 113	564730	6562329	1	0.02	0.2	0.5	48	19.4	0.05	0.01	1	0.01
HSCK 114	564679	6562378	1	0.04	0.2	0.3	73	31.6	0.05	0.01	1.26	0.02
HSCK 115	564657	6562379	1	0.02	0.05	0.1	62	31.4	0.05	0.01	1.71	0.03
HSCK 116	564564	6562352	1	0.04	0.2	0.3	43	35.4	0.05	0.01	1.43	0.03
HSCK 117	564507	6562417	1	0.02	0.05	0.3	57	52.4	0.05	0.01	1.69	0.02
HSCK 118	564507	6562417	1	0.01	0.1	0.4	45	42.1	0.05	0.01	1.25	0.02
HSCK 119	564474	6562472	1	0.02	0.05	0.3	40	22.2	0.05	0.01	1.15	0.02
HSCK 120	564429	6562561	1	0.02	0.05	0.1	73	29.8	0.05	0.01	1.97	0.02
HSCK 121	564344	6562589	16	0.03	0.05	0.1	46	10.9	0.05	0.01	1.24	0.03
HSCK 122	564269	6562607	1	0.02	0.1	0.3	96	10.5	0.05	0.01	1.26	0.01
HSCK 123	564213	6562621	1	0.02	0.2	0.1	88	9.9	0.05	0.01	1.11	0.005
HSCK 124	564061	6562591	1	0.02	0.05	0.1	63	3.6	0.05	0.01	1.43	0.02
HSCK 125	564061	6562591	1	0.02	0.05	0.1	57	3.8	0.05	0.01	1.46	0.02
HSCK 126	563975	6562570	1	0.01	0.6	0.1	47	26	0.05	0.01	1.36	0.2
HSCK 127	563872	6562576	1	0.02	0.05	0.3	34	38.4	0.05	0.01	0.66	0.05
HSCK 128	563734	6562570	1	0.01	0.05	0.1	57	69.2	0.05	0.01	1.33	0.06
HSCK 129	563604	6562557	1	0.01	0.2	0.1	40	29	0.05	0.01	0.53	0.02

Sample No.	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Fe pct	Ga ppm	Ge ppm	Hf ppm	Hg ppb	In ppm	K pct
HSCK 071	0.27	0.09	2.1	0.025	6.87	0.022	0.05	0.005	0.004	18	0.01	0.74
HSCK 072	0.21	0.24	1.9	0.02	4.93	0.017	0.05	0.005	0.004	15	0.01	1.23
HSCK 073	0.41	0.46	2.4	0.035	7.29	0.032	0.05	0.02	0.007	17	0.01	2.16
HSCK 074	0.24	0.12	2.1	0.036	9.55	0.02	0.05	0.005	0.005	19	0.01	1.69
HSCK 075	0.35	0.12	2.3	0.029	4.95	0.027	0.05	0.02	0.007	30	0.01	1.25
HSCK 076	0.37	0.2	2	0.036	8.29	0.024	0.05	0.02	0.006	17	0.01	2.44
HSCK 077	0.24	0.09	1.8	0.034	9.28	0.019	0.05	0.02	0.007	17	0.01	1.54
HSCK 078	0.41	0.14	2.7	0.064	6.51	0.035	0.1	0.02	0.014	16	0.01	2.28
HSCK 079	0.33	0.09	2.9	0.05	6.47	0.03	0.05	0.005	0.008	17	0.01	1.05
HSCK 080	0.28	0.11	2.1	0.026	5.03	0.022	0.05	0.02	0.007	18	0.01	1.07
HSCK 081	0.39	0.11	2.6	0.036	6.42	0.029	0.05	0.02	0.003	18	0.01	1.85
HSCK 082	0.35	0.17	2.2	0.036	6	0.03	0.05	0.01	0.006	20	0.01	1.53
HSCK 083	0.33	0.33	2.4	0.026	4.72	0.023	0.05	0.005	0.005	16	0.01	0.72
HSCK 084	0.32	0.14	1.9	0.026	7.47	0.025	0.05	0.01	0.006	15	0.01	0.64
HSCK 085	0.3	0.08	1.9	0.021	4.81	0.021	0.05	0.01	0.005	14	0.01	0.87
HSCK 086	0.33	0.12	2.2	0.032	6.48	0.027	0.05	0.005	0.007	17	0.01	0.9
HSCK 087	0.26	0.09	2.2	0.027	7.88	0.021	0.05	0.02	0.005	18	0.01	1.95
HSCK 088	0.32	0.13	2.2	0.024	4.9	0.022	0.05	0.01	0.006	18	0.01	1.32
HSCK 089	0.49	0.13	2.2	0.04	4.29	0.034	0.05	0.005	0.011	23	0.01	1.26
HSCK 090	0.26	0.07	1.7	0.021	2.54	0.019	0.05	0.01	0.014	13	0.01	1.09
HSCK 091	0.47	0.15	2.6	0.037	5.18	0.033	0.1	0.01	0.019	17	0.01	1.22
HSCK 092	0.23	0.07	1.8	0.028	4.87	0.018	0.05	0.01	0.011	17	0.01	0.77
HSCK 093	0.26	0.14	1.9	0.037	4.95	0.02	0.05	0.02	0.015	24	0.01	1.52
HSCK 094	0.41	0.13	2.3	0.043	8.41	0.027	0.05	0.01	0.014	18	0.01	1.48
HSCK 095	0.36	0.12	2.5	0.031	11.54	0.027	0.05	0.03	0.007	21	0.01	1.62
HSCK 096	0.51	0.16	3	0.041	6.9	0.039	0.1	0.02	0.012	23	0.01	1.87
HSCK 097	0.41	0.09	2.5	0.049	6.35	0.032	0.1	0.01	0.014	26	0.01	0.93
HSCK 098	0.36	0.2	2.4	0.023	5.05	0.021	0.05	0.01	0.007	17	0.01	0.67
HSCK 099	0.39	0.37	1.8	0.026	11.46	0.024	0.1	0.005	0.007	27	0.01	1.6
HSCK 100	0.46	0.16	2.5	0.03	6.34	0.027	0.05	0.02	0.009	15	0.01	0.95
HSCK 101	0.43	0.19	2.4	0.034	7.99	0.031	0.05	0.005	0.011	26	0.01	1.02
HSCK 102	0.34	0.15	2.5	0.033	5.73	0.03	0.05	0.01	0.008	16	0.01	0.86
HSCK 103	0.44	0.17	2.6	0.033	6.25	0.032	0.05	0.03	0.013	26	0.01	0.85
HSCK 104	0.4	0.15	2.4	0.03	4.65	0.028	0.05	0.02	0.011	19	0.01	0.59
HSCK 105	0.38	0.24	2.9	0.051	10.01	0.033	0.05	0.03	0.011	26	0.01	1.1
HSCK 106	0.44	0.13	3	0.042	6.56	0.033	0.05	0.03	0.009	13	0.01	0.86
HSCK 107	0.32	0.1	2	0.043	7.12	0.021	0.05	0.02	0.012	20	0.01	1.56
HSCK 108	0.45	0.12	2.1	0.042	5.58	0.034	0.1	0.02	0.011	27	0.01	1.07
HSCK 109	0.29	0.14	2.1	0.039	5.99	0.021	0.05	0.03	0.007	19	0.01	1
HSCK 110	0.58	0.28	3	0.049	10.76	0.038	0.05	0.04	0.016	24	0.01	1.12
HSCK 111	0.29	0.22	2.3	0.03	7.17	0.025	0.05	0.02	0.006	21	0.01	1.65
HSCK 112	0.41	0.12	2.2	0.033	4.68	0.027	0.05	0.04	0.007	27	0.01	0.69
HSCK 113	0.28	0.09	1.9	0.03	4.01	0.019	0.05	0.01	0.008	17	0.01	0.72
HSCK 114	0.65	0.16	2.1	0.067	5.26	0.042	0.1	0.06	0.012	19	0.01	1.2
HSCK 115	0.31	0.32	2	0.043	5.05	0.022	0.05	0.04	0.008	22	0.01	1.13
HSCK 116	0.46	0.38	2	0.047	4.7	0.038	0.1	0.02	0.012	33	0.01	0.88
HSCK 117	0.2	0.06	1.7	0.039	2.74	0.015	0.05	0.005	0.003	19	0.01	0.95
HSCK 118	0.16	0.06	1.8	0.038	3.19	0.011	0.05	0.05	0.002	13	0.01	0.99
HSCK 119	0.23	0.09	1.8	0.124	5.2	0.018	0.05	0.03	0.006	17	0.01	1.02
HSCK 120	0.23	0.12	1.5	0.019	2.6	0.016	0.05	0.005	0.006	26	0.01	0.4
HSCK 121	0.34	0.09	3.1	0.03	5.91	0.024	0.05	0.04	0.005	17	0.01	0.43
HSCK 122	0.23	0.13	1.5	0.025	7.39	0.019	0.05	0.02	0.006	14	0.01	0.61
HSCK 123	0.2	0.05	1.7	0.023	4.25	0.016	0.05	0.04	0.004	14	0.01	0.79
HSCK 124	0.4	0.09	1.6	0.026	6.72	0.015	0.05	0.02	0.003	19	0.01	1.1
HSCK 125	0.44	0.11	1.8	0.033	7.3	0.02	0.05	0.02	0.009	19	0.01	1.25
HSCK 126	0.23	0.18	1.9	0.018	7.41	0.016	0.05	0.02	0.004	34	0.01	1.35
HSCK 127	0.23	0.1	1.6	0.027	5.04	0.017	0.05	0.02	0.005	18	0.01	0.73
HSCK 128	0.18	0.19	1.3	0.013	7.32	0.011	0.05	0.03	0.004	21	0.01	0.62
HSCK 129	0.18	0.06	1.8	0.017	6.36	0.015	0.05	0.03	0.004	14	0.01	1.11

Sample No.	La ppm	Li ppm	Mg pct	Mn ppm	Mo ppm	Na pct	Nb ppm	Ni ppm	P pct	Pb ppm	Pd ppb	Pt ppb
HSCK 071	0.13	0.94	0.199	66	0.22	0.22	0.01	3	0.125	0.18	1	0.5
HSCK 072	0.11	0.79	0.137	106	0.04	0.018	0.005	4.1	0.086	0.13	1	0.5
HSCK 073	0.21	0.75	0.158	134	0.14	0.006	0.005	4.6	0.14	0.22	1	0.5
HSCK 074	0.12	0.69	0.227	77	0.07	0.008	0.005	4.3	0.236	0.31	1	0.5
HSCK 075	0.18	1.09	0.278	79	0.03	0.18	0.02	3.6	0.16	0.22	1	0.5
HSCK 076	0.23	0.66	0.215	264	0.07	0.008	0.01	4.9	0.184	0.15	1	0.5
HSCK 077	0.13	0.79	0.313	102	0.19	0.005	0.005	3.1	0.227	0.24	1	0.5
HSCK 078	0.22	0.95	0.21	156	0.1	0.067	0.01	1.7	0.21	0.24	1	0.5
HSCK 079	0.19	1.29	0.264	115	0.06	0.077	0.01	3.2	0.137	0.3	1	0.5
HSCK 080	0.15	0.96	0.368	121	0.06	0.071	0.02	1.4	0.147	0.17	1	0.5
HSCK 081	0.18	1.48	0.258	40	0.14	0.014	0.01	2.8	0.196	1.01	1	0.5
HSCK 082	0.18	0.56	0.252	75	0.24	0.011	0.005	1.2	0.175	0.19	1	0.5
HSCK 083	0.16	2.01	0.199	253	0.04	0.225	0.005	5	0.218	0.15	1	0.5
HSCK 084	0.16	1.11	0.274	92	0.13	0.36	0.01	2.8	0.13	0.19	1	0.5
HSCK 085	0.15	1.72	0.189	73	0.05	0.265	0.005	3.4	0.195	0.12	1	0.5
HSCK 086	0.2	1.64	0.293	95	0.07	0.112	0.01	4.3	0.229	0.14	1	0.5
HSCK 087	0.14	0.57	0.215	75	0.07	0.003	0.005	2	0.198	0.19	1	0.5
HSCK 088	0.18	0.74	0.215	77	0.08	0.01	0.005	1.6	0.173	0.19	1	0.5
HSCK 089	0.26	1.52	0.297	137	0.12	0.071	0.01	1.5	0.145	0.29	1	0.5
HSCK 090	0.12	0.64	0.149	68	0.08	0.025	0.01	0.8	0.106	0.1	1	0.5
HSCK 091	0.22	0.26	0.183	77	0.07	0.009	0.04	1.6	0.145	0.22	1	0.5
HSCK 092	0.12	0.58	0.218	62	0.07	0.005	0.005	1.3	0.107	0.08	1	0.5
HSCK 093	0.13	0.87	0.133	69	0.05	0.054	0.02	3	0.103	0.15	1	0.5
HSCK 094	0.22	0.33	0.194	106	0.11	0.004	0.01	2.1	0.12	0.15	1	0.5
HSCK 095	0.18	2.04	0.238	96	0.1	0.047	0.005	4.6	0.215	0.21	1	0.5
HSCK 096	0.24	1.06	0.182	145	0.1	0.006	0.02	3.4	0.164	0.29	1	0.5
HSCK 097	0.23	3.22	0.263	130	0.13	0.03	0.01	2.1	0.169	0.23	1	0.5
HSCK 098	0.28	3.17	0.224	319	0.05	0.333	0.005	2.1	0.1	0.15	1	0.5
HSCK 099	0.26	1.81	0.35	682	0.06	0.045	0.005	5.6	0.191	0.18	1	0.5
HSCK 100	0.38	2.1	0.383	238	0.09	0.208	0.02	3.7	0.131	0.43	1	0.5
HSCK 101	0.32	2.45	0.362	151	0.06	0.274	0.01	3.9	0.2	0.45	1	0.5
HSCK 102	0.17	2.45	0.221	73	0.08	0.369	0.005	5.7	0.213	0.17	1	0.5
HSCK 103	0.21	1.21	0.223	113	0.04	0.26	0.02	2.7	0.193	0.19	1	0.5
HSCK 104	0.21	2.75	0.222	117	0.03	0.197	0.005	4.9	0.177	0.32	1	0.5
HSCK 105	0.2	2.23	0.205	86	0.2	0.259	0.01	2.8	0.187	0.29	1	0.5
HSCK 106	0.24	1.24	0.237	104	0.16	0.172	0.02	3.2	0.131	0.75	1	0.5
HSCK 107	0.17	0.47	0.253	122	0.18	0.009	0.005	3.6	0.146	0.38	1	0.5
HSCK 108	0.23	1.44	0.278	108	0.11	0.04	0.01	1.7	0.159	0.28	1	0.5
HSCK 109	0.15	0.32	0.135	70	0.07	0.008	0.005	4	0.108	0.25	1	0.5
HSCK 110	0.3	0.86	0.19	160	0.33	0.009	0.01	5.6	0.14	0.38	1	0.5
HSCK 111	0.16	0.26	0.22	137	0.26	0.005	0.005	3.1	0.182	0.26	1	0.5
HSCK 112	0.19	1.61	0.214	82	0.03	0.117	0.005	1.4	0.139	0.32	1	0.5
HSCK 113	0.17	0.66	0.201	99	0.03	0.037	0.01	1.1	0.068	0.16	1	0.5
HSCK 114	0.32	1.12	0.239	84	0.08	0.022	0.02	2.3	0.166	0.43	1	0.5
HSCK 115	0.2	1.69	0.149	241	0.05	0.074	0.005	2.5	0.141	0.23	1	0.5
HSCK 116	0.33	1.49	0.128	212	0.07	0.021	0.02	3.4	0.128	0.34	1	0.5
HSCK 117	0.12	2.06	0.219	125	0.03	0.043	0.005	1.4	0.089	0.19	1	0.5
HSCK 118	0.08	1.52	0.218	96	0.04	0.045	0.005	1.5	0.084	0.13	1	0.5
HSCK 119	0.16	0.94	0.164	133	0.03	0.062	0.005	2.1	0.097	0.2	1	0.5
HSCK 120	0.21	1.54	0.285	116	0.03	0.095	0.005	1	0.06	0.13	1	0.5
HSCK 121	0.19	1.52	0.224	139	0.19	0.153	0.01	4.1	0.079	3.06	1	0.5
HSCK 122	0.11	1.11	0.338	171	0.05	0.051	0.005	4.6	0.105	0.21	1	0.5
HSCK 123	0.11	0.54	0.176	108	0.02	0.011	0.005	1.7	0.102	0.16	1	0.5
HSCK 124	0.19	1.28	0.211	525	0.03	0.059	0.005	6.6	0.075	0.22	1	0.5
HSCK 125	0.21	1.23	0.208	476	0.04	0.077	0.005	6.8	0.078	0.19	1	0.5
HSCK 126	0.1	1.03	0.206	307	0.07	0.016	0.005	4.1	0.125	0.16	1	0.5
HSCK 127	0.12	1.18	0.101	163	0.06	0.177	0.005	3.7	0.131	0.15	1	0.5
HSCK 128	0.09	1.27	0.128	262	0.09	0.161	0.005	3.1	0.119	0.13	1	0.5
HSCK 129	0.08	0.79	0.128	86	0.08	0.031	0.005	2	0.141	0.14	1	3

Sample No.	Rb ppm	Re ppb	S pct	Sb ppm	Sc ppm	Se ppm	Sn ppm	Sr ppm	Ta ppm	Te ppm	Th ppm	Ti ppm
HSCK 071	1.8	8	0.17	0.01	0.2	0.3	0.03	28.7	0.0005	0.01	0.04	9
HSCK 072	3.3	5	0.08	0.01	0.2	0.2	0.03	31	0.0005	0.01	0.03	6
HSCK 073	4.6	8	0.16	0.01	0.2	0.2	0.03	26.4	0.0005	0.01	0.07	12
HSCK 074	8.5	5	0.16	0.01	0.3	0.1	0.02	48.7	0.0005	0.01	0.04	15
HSCK 075	2.9	8	0.12	0.01	0.2	0.1	0.03	61.2	0.0005	0.01	0.05	11
HSCK 076	9.7	16	0.17	0.01	0.3	0.2	0.01	42.2	0.0005	0.01	0.04	12
HSCK 077	5.1	16	0.16	0.01	0.1	0.05	0.03	51.4	0.0005	0.01	0.03	14
HSCK 078	8.4	7	0.18	0.01	0.2	0.2	0.04	50.6	0.0005	0.01	0.06	15
HSCK 079	3.2	7	0.16	0.01	0.3	0.2	0.02	44	0.0005	0.01	0.05	10
HSCK 080	2.3	6	0.15	0.01	0.2	0.2	0.01	55.5	0.0005	0.01	0.04	10
HSCK 081	7.8	23	0.14	0.01	0.2	0.2	0.01	47.8	0.0005	0.01	0.06	14
HSCK 082	3.8	3	0.11	0.01	0.2	0.1	0.04	53	0.0005	0.01	0.05	12
HSCK 083	1.1	10	0.16	0.01	0.3	0.2	0.01	35.8	0.0005	0.01	0.04	14
HSCK 084	1	6	0.11	0.01	0.3	0.1	0.01	34.8	0.0005	0.01	0.05	9
HSCK 085	1	12	0.18	0.01	0.2	0.1	0.01	45.9	0.0005	0.01	0.04	12
HSCK 086	2.7	8	0.16	0.01	0.2	0.2	0.01	98.4	0.0005	0.01	0.05	15
HSCK 087	3.9	11	0.15	0.01	0.2	0.2	0.04	50.1	0.0005	0.01	0.04	13
HSCK 088	2.2	5	0.15	0.01	0.2	0.3	0.04	47.5	0.0005	0.01	0.03	11
HSCK 089	2.4	10	0.18	0.01	0.2	0.4	0.04	99.3	0.0005	0.01	0.08	12
HSCK 090	2.3	9	0.14	0.01	0.2	0.2	0.09	32.5	0.0005	0.01	0.06	6
HSCK 091	2.6	5	0.13	0.01	0.2	0.2	0.09	16.4	0.0005	0.01	0.07	9
HSCK 092	2.5	1	0.14	0.01	0.3	0.2	0.07	48.3	0.0005	0.01	0.06	6
HSCK 093	5.4	0.5	0.16	0.01	0.2	0.2	0.04	26	0.0005	0.01	0.05	5
HSCK 094	5.7	3	0.16	0.01	0.2	0.2	0.02	44.2	0.0005	0.01	0.04	7
HSCK 095	4.1	5	0.18	0.01	0.2	0.3	0.01	64.2	0.0005	0.01	0.05	14
HSCK 096	2.7	3	0.23	0.01	0.3	0.3	0.01	44.5	0.0005	0.01	0.08	13
HSCK 097	3.4	9	0.17	0.01	0.3	0.3	0.01	51.8	0.0005	0.01	0.06	12
HSCK 098	1.8	7	0.14	0.01	0.3	0.3	0.03	56.2	0.0005	0.01	0.04	8
HSCK 099	4.6	9	0.18	0.01	0.2	0.3	0.02	82	0.0005	0.01	0.05	13
HSCK 100	3.4	5	0.13	0.01	0.2	0.2	0.02	146.6	0.0005	0.01	0.05	10
HSCK 101	2.3	5	0.21	0.01	0.2	0.2	0.01	101.2	0.0005	0.01	0.06	15
HSCK 102	3.4	7	0.18	0.01	0.3	0.2	0.01	35.9	0.0005	0.01	0.06	14
HSCK 103	1.8	8	0.19	0.01	0.3	0.2	0.03	42.2	0.0005	0.01	0.06	14
HSCK 104	1.1	6	0.13	0.01	0.2	0.3	0.05	48.9	0.0005	0.01	0.06	13
HSCK 105	5.3	0.5	0.21	0.01	0.2	0.2	0.03	58	0.0005	0.01	0.06	14
HSCK 106	2.3	4	0.14	0.06	0.2	0.2	0.08	55.7	0.0005	0.01	0.07	10
HSCK 107	6	3	0.17	0.05	0.2	0.2	0.04	61.5	0.001	0.01	0.05	9
HSCK 108	1.7	8	0.15	0.04	0.2	0.2	0.04	52.2	0.0005	0.01	0.07	11
HSCK 109	3	2	0.14	0.07	0.2	0.2	0.09	18	0.0005	0.01	0.04	7
HSCK 110	3.3	2	0.2	0.05	0.2	0.2	0.06	44.5	0.0005	0.01	0.08	11
HSCK 111	3.6	8	0.19	0.04	0.2	0.2	0.05	78.8	0.0005	0.01	0.05	11
HSCK 112	1.2	7	0.22	0.04	0.3	0.3	0.04	27.5	0.0005	0.01	0.06	10
HSCK 113	1.6	4	0.18	0.05	0.2	0.2	0.05	29.7	0.0005	0.01	0.03	6
HSCK 114	3.1	5	0.21	0.01	0.2	0.2	0.03	43.2	0.0005	0.01	0.1	13
HSCK 115	3.1	6	0.18	0.04	0.2	0.2	0.05	62.4	0.0005	0.01	0.04	9
HSCK 116	1.6	6	0.19	0.04	0.1	0.2	0.05	49.2	0.0005	0.01	0.08	10
HSCK 117	4	4	0.13	0.01	0.2	0.2	0.03	58.7	0.0005	0.01	0.03	6
HSCK 118	4.6	2	0.12	0.02	0.1	0.1	0.04	40.5	0.0005	0.01	0.02	5
HSCK 119	4.7	4	0.13	0.05	0.3	0.1	0.04	34.4	0.0005	0.02	0.03	7
HSCK 120	0.6	4	0.17	0.02	0.2	0.2	0.04	85.2	0.0005	0.01	0.03	5
HSCK 121	0.8	3	0.16	0.05	0.2	0.1	0.08	49	0.0005	0.01	0.06	7
HSCK 122	1	7	0.23	0.04	0.2	0.2	0.06	62.1	0.0005	0.01	0.03	7
HSCK 123	1.5	9	0.19	0.05	0.2	0.1	0.04	51.9	0.0005	0.01	0.03	6
HSCK 124	2.3	3	0.18	0.04	0.2	0.2	0.05	87.3	0.0005	0.02	0.04	6
HSCK 125	2.7	5	0.19	0.04	0.2	0.2	0.05	81.1	0.0005	0.01	0.04	6
HSCK 126	1.6	2	0.2	0.05	0.1	0.3	0.04	78.7	0.001	0.01	0.03	7
HSCK 127	2.3	1	0.14	0.03	0.2	0.4	0.05	46.3	0.0005	0.01	0.03	7
HSCK 128	1.1	0.5	0.16	0.04	0.2	1.3	0.05	83.1	0.0005	0.02	0.02	7
HSCK 129	1	0.5	0.13	0.04	0.2	0.4	0.05	37.9	0.0005	0.01	0.03	8

Sample No.	Tl ppm	U ppm	V ppm	W ppm	Y ppm	Zn ppm	Zr ppm
HSCK 071	0.01	0.005	1	0.05	0.074	21.1	0.15
HSCK 072	0.01	0.02	1	0.05	0.068	13.5	0.12
HSCK 073	0.01	0.05	1	0.05	0.134	28.4	0.25
HSCK 074	0.01	0.005	1	0.05	0.064	20.1	0.15
HSCK 075	0.01	0.005	1	0.05	0.096	20.3	0.2
HSCK 076	0.01	0.04	1	0.05	0.101	22.1	0.17
HSCK 077	0.01	0.02	1	0.05	0.063	42	0.15
HSCK 078	0.01	0.005	1	0.05	0.116	24.7	0.25
HSCK 079	0.01	0.005	1	0.05	0.093	33	0.2
HSCK 080	0.01	0.005	1	0.05	0.071	26.5	0.15
HSCK 081	0.01	0.02	1	0.05	0.087	30.5	0.2
HSCK 082	0.01	0.005	1	0.05	0.093	35.3	0.2
HSCK 083	0.01	0.01	1	0.05	0.098	31.3	0.15
HSCK 084	0.01	0.005	1	0.05	0.099	38.4	0.17
HSCK 085	0.01	0.005	1	0.05	0.067	25.3	0.17
HSCK 086	0.01	0.005	1	0.05	0.105	33.3	0.2
HSCK 087	0.01	0.01	1	0.05	0.068	22.5	0.16
HSCK 088	0.01	0.005	1	0.05	0.066	29.9	0.12
HSCK 089	0.01	0.005	1	0.05	0.121	24.2	0.26
HSCK 090	0.01	0.005	1	0.05	0.056	18.2	0.39
HSCK 091	0.01	0.005	1	0.05	0.108	27.6	0.52
HSCK 092	0.01	0.005	1	0.05	0.068	11.5	0.37
HSCK 093	0.01	0.005	1	0.05	0.072	15.3	0.32
HSCK 094	0.01	0.005	1	0.05	0.117	15.9	0.3
HSCK 095	0.01	0.005	1	0.05	0.103	24.9	0.21
HSCK 096	0.01	0.01	1	0.05	0.134	19	0.3
HSCK 097	0.02	0.01	1	0.05	0.1	30.3	0.22
HSCK 098	0.01	0.005	1	0.05	0.118	16.6	0.15
HSCK 099	0.01	0.01	1	0.05	0.095	40.2	0.17
HSCK 100	0.01	0.01	1	0.05	0.121	36.5	0.19
HSCK 101	0.01	0.005	1	0.05	0.119	28.7	0.23
HSCK 102	0.01	0.01	1	0.05	0.098	29.3	0.21
HSCK 103	0.01	0.03	1	0.05	0.122	33.8	0.24
HSCK 104	0.01	0.02	1	0.05	0.105	34.7	0.2
HSCK 105	0.01	0.005	1	0.05	0.118	25.7	0.22
HSCK 106	0.01	0.005	1	0.05	0.125	38.8	0.26
HSCK 107	0.01	0.005	1	0.05	0.082	40.7	0.19
HSCK 108	0.01	0.01	1	0.05	0.116	25.1	0.27
HSCK 109	0.01	0.005	1	0.05	0.074	23.2	0.15
HSCK 110	0.01	0.01	1	0.05	0.154	31.5	0.28
HSCK 111	0.01	0.01	1	0.05	0.093	33.4	0.19
HSCK 112	0.01	0.01	1	0.05	0.095	19.6	0.2
HSCK 113	0.01	0.005	1	0.05	0.103	22	0.16
HSCK 114	0.01	0.01	1	0.05	0.155	28.7	0.3
HSCK 115	0.01	0.005	1	0.05	0.107	38.9	0.16
HSCK 116	0.01	0.005	1	0.05	0.166	29.2	0.32
HSCK 117	0.01	0.005	1	0.05	0.066	19.1	0.12
HSCK 118	0.01	0.005	1	0.05	0.035	24.1	0.09
HSCK 119	0.01	0.005	1	0.05	0.088	23.8	0.15
HSCK 120	0.01	0.02	1	0.05	0.111	13.9	0.13
HSCK 121	0.01	0.005	1	0.05	0.083	42.5	0.23
HSCK 122	0.01	0.005	1	0.05	0.048	21.7	0.16
HSCK 123	0.01	0.005	1	0.05	0.054	23.3	0.12
HSCK 124	0.01	0.02	1	0.05	0.11	33.8	0.14
HSCK 125	0.01	0.02	1	0.05	0.11	29.5	0.15
HSCK 126	0.01	0.02	1	0.05	0.064	24.6	0.11
HSCK 127	0.01	0.005	1	0.05	0.064	20.7	0.14
HSCK 128	0.01	0.01	1	0.05	0.056	21	0.08
HSCK 129	0.01	0.02	1	0.05	0.056	14.1	0.11

Fowlers Creek Stream Sediment

Sample No.	Eastings	Northings	Ag	Al2O3	As	Au	Ba	Ba2	Be	Bi	CaO	Cd	Ce
ss001	569548	6561361	0.050	6.870	2.900	1.100	321.000	0.030	4.000	0.200	0.720	0.050	52.000
ss002	569379	6561261	0.050	8.070	3.200	1.300	366.000	0.040	0.500	0.200	0.780	0.050	64.200
ss003	569294	6561228	0.050	5.770	4.700	0.600	290.000	0.030	0.500	0.300	0.480	0.050	56.300
ss004	569196	6561157	0.050	8.750	4.300	0.600	361.000	0.040	0.500	0.300	0.780	0.050	66.200
ss005	569094	6561108	0.050	5.780	4.400	0.250	308.000	0.030	0.500	0.300	0.650	0.050	60.300
ss006	568990	6561061	0.050	6.020	5.600	0.700	300.000	0.030	6.000	0.300	0.720	0.050	63.900
ss007	568911	6561044	0.050	7.130	6.700	0.250	319.000	0.040	0.500	0.400	0.680	0.050	60.500
ss008	568843	6561019	0.050	6.990	3.700	0.250	319.000	0.040	0.500	0.300	0.770	0.050	60.900
ss009	568807	6560986	0.050	7.490	3.400	0.250	342.000	0.030	0.500	0.200	1.110	0.050	61.100
ss010	568760	6560953	0.050	6.500	4.100	0.250	316.000	0.030	0.500	0.300	0.720	0.050	67.200
ss011	568716	6560861	0.050	5.370	5.000	0.250	273.000	0.030	0.500	0.300	0.530	0.100	61.800
ss012	568673	6560816	0.050	7.060	3.800	0.250	331.000	0.030	0.500	0.200	0.510	0.100	60.100
ss013	568573	6560747	0.050	6.570	3.700	0.250	311.000	0.040	0.500	0.300	0.680	0.050	60.600
ss014	568535	6560704	0.050	6.110	5.100	0.250	299.000	0.030	2.000	0.300	0.590	0.050	64.900
ss015	568428	6560662	0.050	7.270	3.700	1.100	341.000	0.040	0.500	0.200	0.720	0.050	64.000
ss016	568286	6560632	0.050	8.030	4.200	0.250	355.000	0.030	2.000	0.200	0.740	0.050	67.600
ss017	568210	6560634	0.050	9.460	3.800	0.250	374.000	0.040	2.000	0.300	0.890	0.050	75.600
ss018	568129	6560609	0.050	7.170	3.500	1.200	327.000	0.030	2.000	0.200	0.720	0.100	69.600
ss019	568050	6560575	0.050	7.380	3.000	1.000	296.000	0.030	0.500	0.200	0.470	0.050	59.300
ss020	567980	6560522	0.050	7.260	2.600	0.250	341.000	0.040	0.500	0.200	0.570	0.050	62.000
ss021	567938	6560475	0.050	7.430	3.000	0.250	345.000	0.040	0.500	0.200	0.550	0.050	63.900
ss022	567890	6560444	0.050	5.570	5.700	0.250	300.000	0.030	0.500	0.300	0.620	0.050	57.900
ss023	567835	6560368	0.050	6.750	4.400	0.250	345.000	0.030	2.000	0.300	0.550	0.050	55.500
ss024	567734	6560336	0.050	6.090	3.100	0.250	317.000	0.030	2.000	0.200	0.550	0.050	55.500
ss025	567675	6560316	0.050	6.470	5.100	0.250	316.000	0.030	0.500	0.400	0.760	0.050	61.000
ss026	567610	6560329	0.050	7.020	6.800	0.250	343.000	0.040	4.000	0.400	0.930	0.050	64.300
ss027	567541	6560261	0.050	8.120	4.300	0.250	334.000	0.040	0.500	0.200	1.210	0.050	57.500
ss028	567447	6560297	0.050	7.290	3.600	0.250	328.000	0.040	0.500	0.200	0.790	0.050	56.700
ss029	567422	6560282	0.050	7.200	3.600	0.250	300.000	0.030	4.000	0.200	0.850	0.050	73.200
ss030	567353	6560258	0.050	7.520	6.600	0.250	343.000	0.040	0.500	0.300	1.340	0.050	63.300
ss031	567295	6560214	0.050	9.010	3.400	1.000	352.000	0.040	0.500	0.200	1.250	0.050	58.900
ss032	567236	6560164	0.050	6.870	8.200	0.250	313.000	0.040	0.500	0.400	0.970	0.050	51.400
ss033	564753	6558961	0.050	6.380	5.400	0.250	312.000	0.040	0.500	0.300	0.730	0.050	69.500
ss034	564929	6559081	0.050	7.390	5.300	0.250	321.000	0.040	1.000	0.300	0.740	0.050	67.100
ss035	565030	6559099	0.050	12.010	4.600	0.700	432.000	0.040	1.000	0.300	0.500	0.050	67.100
ss036	565143	6559124	0.050	7.510	4.400	0.250	344.000	0.040	1.000	0.300	0.760	0.100	60.900
ss037	565247	6559176	0.050	8.050	4.700	1.400	331.000	0.040	0.500	0.300	0.800	0.100	65.000
ss038	565358	6559188	0.050	6.630	5.500	1.100	321.000	0.040	4.000	0.300	0.950	0.050	61.700
ss039	565479	6559194	0.050	8.070	4.600	0.250	324.000	0.030	1.000	0.300	0.680	0.100	66.800
ss040	565613	6559253	0.050	7.560	5.100	0.250	332.000	0.030	3.000	0.300	0.970	0.050	65.100
ss041	565736	6559333	0.050	8.480	3.600	0.250	345.000	0.030	2.000	0.200	1.030	0.050	57.700
ss042	565824	6559457	0.050	7.850	3.800	1.000	330.000	0.030	2.000	0.200	0.800	0.100	57.600
ss043	565886	6559530	0.050	7.020	5.600	0.250	314.000	0.030	4.000	0.300	0.900	0.050	76.700
ss044	565969	6559669	0.050	7.880	4.100	1.400	316.000	0.030	3.000	0.300	0.750	0.050	60.700
ss045	566821	6559667	0.050	7.860	4.700	0.250	332.000	0.040	2.000	0.300	1.000	0.050	61.200
ss046	566066	6559621	0.050	7.990	5.000	0.250	327.000	0.040	2.000	0.300	0.970	0.050	57.800
ss047	566123	6559646	0.050	5.500	6.400	0.250	277.000	0.030	2.000	0.400	0.630	0.050	83.100
ss048	566223	6559637	0.050	6.670	6.600	0.250	294.000	0.030	1.000	0.700	0.780	0.050	55.600
ss049	566302	6559657	0.050	8.270	3.900	0.250	343.000	0.030	6.000	0.300	0.990	0.050	67.100
ss050	566354	6559654	0.050	8.010	4.600	0.250	318.000	0.030	0.500	0.300	0.980	0.050	57.200
ss051	566477	6559665	0.050	7.050	4.500	0.250	297.000	0.040	6.000	0.300	0.800	0.050	50.600
ss052	566528	6559663	0.050	6.850	4.900	0.250	282.000	0.040	0.500	0.300	0.670	0.050	70.700
ss053	566616	6559659	0.050	7.280	4.400	0.250	304.000	0.030	1.000	0.300	0.820	0.050	58.500
ss054	566715	6559643	0.050	10.060	4.400	0.250	372.000	0.040	5.000	0.300	1.150	0.050	57.500
ss055	566780	6559675	0.050	9.010	4.100	0.250	345.000	0.040	8.000	0.200	0.960	0.050	69.000
ss056	566853	6559694	0.050	7.910	4.100	1.400	331.000	0.030	0.500	0.300	1.080	0.050	50.400
ss057	566894	6559718	0.050	7.220	4.600	0.250	324.000	0.030	1.000	0.300	0.930	0.050	63.800
ss058	566947	6559762	0.050	9.640	3.900	1.000	347.000	0.030	3.000	0.200	0.870	0.050	61.500
ss059	567007	6559888	0.050	10.970	4.800	0.250	390.000	0.040	3.000	0.300	0.920	0.050	90.600
ss060	567064	6559965	0.050	7.110	5.300	0.250	321.000	0.030	0.500	0.300	0.910	0.050	59.600
ss061	567124	6560027	0.050	8.000	3.900	0.250	325.000	0.040	6.000	0.300	1.180	0.050	52.200
ss062	567193	6560084	0.050	7.110	4.700	0.700	320.000	0.030	3.000	0.200	1.140	0.050	55.900
ss063	564045	6558734	0.050	6.050	6.000	0.250	324.000	0.030	3.000	0.400	0.860	0.050	59.900
ss064	563910	6558724	0.050	6.140	6.500	0.250	329.000	0.040	0.500	0.400	0.820	0.050	59.400
ss065	564165	6558754	0.050	7.130	5.900	0.250	338.000	0.040	1.000	0.300	1.000	0.050	56.800
ss066	564285	6558891	0.050	7.700	6.600	0.250	387.000	0.040	2.000	0.300	1.280	0.050	57.000
ss067	564433	6558975	0.050	5.510	5.200	0.250	296.000	0.030	1.000	0.300	0.670	0.050	75.900
ss068	564752	6558956	0.050	6.460	5.500	0.800	329.000	0.030	2.000	0.300	0.770	0.100	74.400
ss069	563500	6558712	0.050	10.480	5.400	0.250	396.000	0.030	5.000	0.200	0.880	0.050	61.800

Sample No.	Co	Cr2O3	Cs	Cu	Dy	Er	Eu	Fe2O3	Ga	Gd	Hf	Hg	Ho
ss001	8.300	0.010	3.100	12.900	3.930	2.100	0.940	3.360	8.000	4.190	10.600	0.020	0.640
ss002	8.500	0.005	3.400	12.200	5.020	2.700	1.080	3.450	10.000	4.750	12.400	0.020	0.880
ss003	9.600	0.004	2.300	11.600	4.200	2.540	0.910	3.410	7.200	4.500	15.600	0.020	0.810
ss004	11.300	0.007	4.400	15.900	4.680	2.860	1.130	4.370	10.800	5.390	10.400	0.020	0.850
ss005	8.700	0.015	2.700	13.600	4.940	3.320	1.040	3.760	6.700	5.350	9.100	0.020	0.990
ss006	11.800	0.013	2.900	17.400	5.020	2.560	1.060	4.520	7.000	4.710	11.000	0.005	0.780
ss007	12.700	0.012	2.900	20.000	4.490	2.490	1.030	4.890	8.400	4.900	8.300	0.020	0.730
ss008	10.000	0.007	2.900	14.300	3.770	2.300	0.970	3.750	7.800	4.440	9.200	0.020	0.820
ss009	10.300	0.005	3.100	13.600	4.470	2.410	1.070	3.700	8.500	4.820	9.200	0.005	0.790
ss010	11.700	0.005	2.900	15.600	4.480	2.290	0.990	3.950	8.500	5.060	13.100	0.005	0.770
ss011	9.500	0.002	2.100	15.000	4.290	2.390	0.880	3.700	6.300	4.800	9.700	0.010	0.770
ss012	8.400	0.002	2.600	13.400	4.450	2.530	1.040	3.450	8.300	4.440	12.700	0.010	0.890
ss013	9.300	0.004	2.500	15.500	4.450	2.750	0.970	3.960	7.600	4.760	15.900	0.005	0.870
ss014	9.500	0.005	3.200	17.100	4.420	2.370	0.930	4.040	7.700	4.870	9.000	0.005	0.770
ss015	9.800	0.005	3.100	13.600	5.510	2.980	1.010	3.750	9.000	5.410	13.500	0.005	1.100
ss016	9.900	0.006	3.400	14.900	4.750	2.790	2.880	3.730	9.800	5.470	10.300	0.005	0.800
ss017	11.400	0.009	4.200	17.400	6.280	3.220	1.290	4.240	11.200	6.090	13.600	0.030	1.070
ss018	7.300	0.007	2.800	14.100	4.200	2.670	0.990	3.350	8.700	5.380	9.800	0.005	1.020
ss019	7.500	0.005	2.500	11.600	3.990	2.720	0.920	3.150	10.000	4.290	11.300	0.020	0.960
ss020	8.700	0.007	2.700	12.400	4.930	2.840	1.020	3.220	8.400	5.280	11.700	0.005	0.940
ss021	8.000	0.006	3.100	11.100	4.270	2.580	1.080	3.110	8.300	4.660	9.800	0.005	0.790
ss022	12.100	0.012	2.400	17.400	4.360	2.390	1.010	4.200	7.100	4.890	9.600	0.005	0.820
ss023	10.900	0.005	2.900	16.000	3.900	2.440	0.960	3.820	8.100	4.580	9.600	0.005	0.780
ss024	9.300	0.006	2.200	12.100	4.170	2.540	1.030	3.260	7.200	4.680	10.000	0.005	0.830
ss025	10.800	0.006	2.600	18.100	4.140	2.580	1.040	3.770	7.100	4.850	9.200	0.005	0.720
ss026	13.400	0.004	3.300	20.000	4.010	2.200	1.030	4.370	8.900	4.810	7.200	0.010	0.760
ss027	10.300	0.004	3.200	15.100	3.990	2.500	1.110	3.810	8.600	4.720	9.100	0.005	0.800
ss028	9.300	0.005	2.700	13.400	4.650	2.780	1.000	3.570	8.200	4.620	9.800	0.005	0.900
ss029	9.700	0.008	2.800	14.300	5.110	2.990	1.220	3.540	9.000	5.340	11.800	0.005	0.940
ss030	15.400	0.019	3.400	20.500	3.890	2.520	1.060	4.290	9.800	4.630	6.100	0.005	0.740
ss031	10.100	0.008	4.000	16.700	4.930	2.610	1.100	3.860	11.000	5.150	8.300	0.005	0.890
ss032	13.400	0.020	3.200	24.000	4.570	2.340	1.000	4.330	8.200	4.610	6.400	0.005	0.790
ss033	13.300	0.003	2.100	18.500	5.320	2.900	1.070	4.230	8.100	5.700	14.800	0.005	0.930
ss034	11.800	0.008	2.900	18.200	5.070	2.800	1.110	4.050	8.500	5.460	12.900	0.005	0.910
ss035	14.000	0.007	5.600	24.700	5.480	2.940	1.240	5.190	14.000	5.740	8.700	0.020	0.970
ss036	10.900	0.004	2.800	15.300	4.460	2.520	0.950	3.590	9.100	4.730	11.100	0.010	0.630
ss037	12.400	0.006	3.200	18.200	4.730	2.900	1.130	4.170	9.900	5.430	10.800	0.005	0.920
ss038	12.900	0.004	2.800	17.300	4.410	2.610	1.000	3.900	7.200	5.060	13.000	0.005	0.770
ss039	11.100	0.005	3.300	17.900	4.730	3.000	1.230	3.980	9.800	5.180	11.900	0.005	0.950
ss040	11.600	0.007	3.300	18.700	4.860	3.020	1.130	4.020	8.900	5.520	9.300	0.005	1.010
ss041	10.800	0.008	3.100	15.900	5.170	2.900	0.980	3.490	9.800	5.090	10.000	0.005	0.880
ss042	11.300	0.007	3.900	15.700	4.260	2.410	1.090	3.580	10.100	4.740	11.600	0.005	0.810
ss043	12.000	0.005	3.300	17.500	4.700	2.510	1.060	4.160	8.400	5.430	10.000	0.005	0.830
ss044	10.200	0.011	3.300	15.500	5.740	3.530	1.000	3.720	9.000	5.240	11.000	0.005	1.030
ss045	11.600	0.006	3.100	17.600	5.340	2.830	1.110	4.430	9.400	4.660	10.600	0.005	0.930
ss046	11.000	0.005	3.500	17.200	4.740	2.560	1.080	3.950	9.200	4.730	10.500	0.005	0.820
ss047	15.300	0.005	2.600	21.000	5.650	3.130	1.130	5.670	7.400	6.430	14.100	0.005	1.070
ss048	13.700	0.003	3.000	19.200	5.270	3.020	1.010	4.480	8.200	5.030	8.800	0.005	0.980
ss049	11.400	0.009	3.800	17.700	5.070	2.710	1.140	3.910	10.300	5.690	12.700	0.005	0.880
ss050	11.100	0.004	3.000	17.500	5.160	3.080	1.060	3.960	8.700	4.990	8.800	0.005	1.010
ss051	9.800	0.007	3.000	17.000	4.670	2.720	0.950	3.760	8.200	4.740	10.600	0.005	0.840
ss052	11.300	0.006	2.900	17.700	4.810	2.780	1.080	4.080	8.100	5.100	13.700	0.005	1.000
ss053	9.600	0.004	3.300	16.200	4.570	2.870	1.080	3.610	8.100	4.900	11.600	0.005	0.960
ss054	12.600	0.008	4.600	21.000	5.050	2.800	1.060	4.330	11.800	4.870	7.600	0.005	0.850
ss055	9.400	0.006	3.800	16.500	5.690	2.910	1.230	4.120	10.700	5.940	11.700	0.005	1.060
ss056	10.100	0.006	3.300	16.100	4.480	2.700	1.010	3.620	9.800	4.550	9.100	0.005	0.770
ss057	10.700	0.003	3.000	17.100	5.180	2.980	1.160	4.070	7.800	5.220	10.300	0.005	0.980
ss058	11.100	0.005	4.000	17.400	4.720	3.050	1.100	4.120	11.000	5.370	8.800	0.005	1.000
ss059	12.400	0.007	4.600	21.900	7.030	4.310	1.530	5.130	11.600	7.350	20.700	0.010	1.310
ss060	12.000	0.007	2.600	18.700	4.380	2.730	1.000	3.990	8.700	4.770	9.300	0.005	0.870
ss061	9.600	0.010	3.300	16.300	4.270	2.540	1.000	3.550	9.500	4.310	9.700	0.005	0.900
ss062	10.300	0.012	2.900	16.200	4.560	3.050	1.010	3.480	8.400	4.650	7.500	0.005	0.960
ss063	12.100	0.012	2.900	18.700	4.550	2.360	0.960	3.810	7.000	4.350	10.000	0.005	0.700
ss064	15.100	0.006	2.600	20.900	4.600	2.480	1.000	4.630	7.100	4.740	10.900	0.005	0.780
ss065	12.400	0.006	3.000	18.900	4.190	2.590	1.020	3.910	7.800	4.480	9.800	0.005	0.850
ss066	13.500	0.005	3.300	22.300	3.640	2.190	0.920	4.710	8.900	4.330	7.100	0.005	0.700
ss067	11.800	0.005	2.500	16.400	4.350	2.480	1.060	4.150	6.500	5.360	16.400	0.005	0.800
ss068	12.800	0.013	2.500	19.200	5.000	2.820	1.160	3.950	8.000	5.360	12.800	0.005	0.960
ss069	12.900	0.010	4.300	20.900	5.450	3.160	1.230	4.390	12.500	5.070	8.600	0.005	1.010

Sample No.	K2O	La	Lu	MgO	MnO	Mo	Na2O	Nb	Nd	Ni	P2O5	Pb	Pr
ss001	1.280	26.700	0.360	0.770	0.050	0.200	0.530	10.400	24.300	12.100	0.060	10.100	6.550
ss002	1.580	33.800	0.410	0.930	0.050	0.200	0.580	11.700	27.600	11.500	0.070	9.300	7.820
ss003	1.090	28.900	0.380	0.620	0.060	0.200	0.480	12.100	24.900	12.600	0.060	12.100	6.990
ss004	1.640	34.500	0.420	1.170	0.070	0.200	0.570	11.300	29.200	16.100	0.080	12.700	8.010
ss005	1.110	32.900	0.470	0.690	0.070	0.400	0.470	8.700	26.300	13.200	0.060	12.500	7.560
ss006	1.240	32.600	0.390	0.700	0.070	0.400	0.450	10.000	28.300	18.000	0.070	17.800	7.660
ss007	1.340	31.100	0.350	0.850	0.080	0.400	0.540	11.400	27.600	18.100	0.080	18.800	7.500
ss008	1.360	30.200	0.360	0.820	0.070	0.300	0.590	8.400	28.600	13.100	0.070	11.700	7.370
ss009	1.450	28.900	0.380	0.970	0.070	0.300	0.780	9.700	27.800	11.200	0.070	10.800	7.260
ss010	1.260	33.500	0.370	0.780	0.070	0.400	0.520	12.700	29.700	15.700	0.070	12.300	7.930
ss011	1.070	32.000	0.320	0.580	0.070	0.400	0.480	9.000	28.700	15.200	0.060	13.200	7.400
ss012	1.360	31.700	0.390	0.700	0.050	0.300	0.510	9.600	29.500	11.600	0.060	11.200	7.520
ss013	1.240	28.900	0.400	0.750	0.070	0.200	0.570	12.500	26.100	15.100	0.070	12.100	6.870
ss014	1.170	31.800	0.330	0.700	0.080	0.300	0.490	9.500	30.100	15.500	0.070	14.100	7.750
ss015	1.400	32.500	0.460	0.830	0.070	0.200	0.600	11.400	27.700	13.100	0.070	10.900	7.810
ss016	1.530	35.900	0.390	0.920	0.060	0.300	0.610	11.500	33.500	14.200	0.070	10.600	8.370
ss017	1.700	42.500	0.480	1.220	0.070	0.100	0.710	11.200	36.200	18.700	0.080	11.000	9.300
ss018	1.380	34.700	0.400	0.800	0.060	0.200	0.570	10.300	29.700	13.600	0.060	10.100	7.640
ss019	1.430	29.900	0.410	0.690	0.040	0.100	0.540	10.600	23.900	9.900	0.060	8.900	7.000
ss020	1.380	32.400	0.430	0.730	0.050	0.200	0.570	10.600	26.300	11.000	0.060	9.700	7.650
ss021	1.440	33.400	0.350	0.720	0.040	0.200	0.560	8.300	32.300	9.600	0.060	9.600	7.790
ss022	1.120	31.300	0.350	0.670	0.090	0.400	0.820	11.500	26.400	16.800	0.060	15.700	7.360
ss023	1.280	29.100	0.340	0.680	0.060	0.200	0.510	10.400	26.100	15.300	0.060	13.800	6.810
ss024	1.170	30.100	0.360	0.610	0.050	0.100	0.460	8.900	29.800	13.100	0.060	10.000	7.180
ss025	1.230	30.700	0.320	0.780	0.090	0.400	0.620	10.100	26.000	15.900	0.070	15.600	7.660
ss026	1.370	31.900	0.320	0.900	0.100	0.600	0.630	8.900	28.500	20.800	0.070	18.200	7.730
ss027	1.520	30.000	0.380	1.290	0.080	0.100	1.280	9.900	25.700	16.200	0.070	12.400	7.100
ss028	1.390	29.800	0.380	0.900	0.070	0.200	0.960	9.800	26.900	13.800	0.060	10.900	6.940
ss029	1.410	35.900	0.400	1.140	0.080	0.200	1.130	11.700	31.700	14.000	0.070	11.100	9.240
ss030	1.470	29.700	0.330	1.140	0.120	0.600	0.940	8.400	25.300	18.300	0.070	18.500	7.300
ss031	1.630	31.400	0.380	1.280	0.080	0.400	0.870	8.600	30.200	15.300	0.070	11.400	7.640
ss032	1.390	26.400	0.320	1.220	0.120	0.700	1.580	8.000	26.300	20.800	0.070	25.300	6.470
ss033	1.260	36.500	0.490	0.760	0.090	0.400	0.560	11.400	32.700	16.800	0.070	17.100	8.700
ss034	1.370	35.500	0.440	0.890	0.080	0.400	0.560	11.500	29.600	15.900	0.070	15.000	8.340
ss035	2.250	35.600	0.410	1.550	0.090	0.300	0.550	11.000	33.400	21.300	0.100	14.200	8.380
ss036	1.400	32.300	0.370	0.920	0.080	0.200	0.620	9.200	26.600	15.000	0.060	12.900	7.680
ss037	1.460	33.300	0.420	1.040	0.080	0.300	0.600	12.300	30.700	16.500	0.070	13.500	7.790
ss038	1.270	32.300	0.390	0.830	0.090	0.300	0.560	11.300	29.000	16.300	0.060	14.400	7.600
ss039	1.490	35.700	0.420	1.020	0.080	0.300	0.620	11.900	28.100	17.300	0.080	13.500	8.280
ss040	1.420	35.700	0.460	0.970	0.090	0.200	0.640	10.900	32.200	17.400	0.070	14.100	8.270
ss041	1.580	31.200	0.420	1.100	0.070	0.200	0.720	9.500	27.100	15.100	0.070	11.700	7.210
ss042	1.440	31.400	0.380	0.980	0.080	0.200	0.640	10.500	28.400	15.600	0.070	11.900	7.170
ss043	1.310	40.000	0.380	0.870	0.100	0.400	0.640	11.300	35.200	17.400	0.070	17.000	9.240
ss044	1.450	32.900	0.500	0.970	0.070	0.300	0.650	11.800	29.500	15.300	0.070	13.000	7.440
ss045	1.430	33.400	0.410	1.110	0.090	0.300	0.630	12.700	28.700	16.700	0.070	14.200	8.430
ss046	1.450	29.400	0.350	1.040	0.090	0.300	0.650	12.000	28.000	16.700	0.070	13.400	7.200
ss047	1.030	43.000	0.470	0.670	0.130	0.600	0.520	15.400	42.700	20.500	0.070	20.800	10.310
ss048	1.240	29.000	0.420	0.830	0.100	0.400	0.610	12.000	26.000	17.500	0.070	23.100	7.060
ss049	1.540	37.000	0.390	1.080	0.080	0.300	0.640	11.300	33.600	16.800	0.080	13.300	8.560
ss050	1.440	29.300	0.450	1.050	0.080	0.200	0.630	10.100	25.500	16.800	0.070	13.300	7.000
ss051	1.300	26.800	0.430	0.890	0.080	0.200	0.620	9.100	21.900	16.700	0.070	13.900	6.620
ss052	1.270	36.000	0.420	0.840	0.080	0.300	0.630	10.300	35.000	16.600	0.070	15.400	8.700
ss053	1.330	30.900	0.400	0.900	0.070	0.300	0.640	10.200	25.900	15.800	0.070	13.000	7.530
ss054	1.810	31.100	0.390	1.370	0.080	0.300	0.690	9.500	28.200	19.500	0.090	14.200	7.470
ss055	1.580	37.100	0.520	1.200	0.080	0.200	0.710	11.300	32.900	15.500	0.080	11.800	8.650
ss056	1.440	26.300	0.400	1.100	0.080	0.200	0.830	9.200	22.500	15.500	0.070	12.400	6.370
ss057	1.340	34.300	0.440	0.940	0.090	0.300	0.660	11.300	32.600	15.800	0.070	13.500	8.070
ss058	1.700	32.100	0.420	1.250	0.070	0.200	0.620	10.500	28.500	18.000	0.080	12.900	7.480
ss059	1.920	49.400	0.630	1.520	0.100	0.300	0.740	14.100	40.500	21.700	0.100	14.500	11.430
ss060	1.360	30.100	0.360	1.270	0.090	0.400	1.380	9.600	25.700	17.200	0.080	18.700	7.240
ss061	1.500	28.400	0.400	1.220	0.070	0.200	1.460	9.900	25.300	15.700	0.070	13.400	6.950
ss062	1.390	29.400	0.380	1.370	0.080	0.300	1.820	9.500	26.400	15.700	0.060	12.700	6.910
ss063	1.150	31.200	0.380	0.740	0.090	0.500	0.520	10.000	25.400	16.800	0.060	17.100	7.210
ss064	1.170	30.300	0.380	0.740	0.100	0.400	0.510	10.000	28.200	19.300	0.060	21.400	7.350
ss065	1.320	30.900	0.380	0.890	0.090	0.300	0.560	11.000	29.200	17.400	0.070	15.300	7.140
ss066	1.420	30.000	0.330	1.050	0.110	0.400	0.560	10.100	24.100	17.800	0.070	20.700	6.870
ss067	1.070	40.200	0.380	0.630	0.090	0.300	0.520	14.700	34.000	14.300	0.060	13.500	9.470
ss068	1.250	39.000	0.440	0.770	0.090	0.400	0.550	12.200	33.200	16.900	0.070	14.900	9.230
ss069	1.850	33.400	0.480	1.370	0.080	0.300	0.610	9.600	29.000	18.900	0.070	12.700	7.600

Sample No.	Rb	Sb	Se	SiO2	Sm	Sn	Sr	SUM	Ta	Tb	Th	TiO2	Tl
ss001	57.000	0.200	0.250	81.700	4.600	2.000	76.900	100.320	1.100	0.610	11.100	0.710	0.050
ss002	69.500	0.200	0.250	79.100	5.470	3.000	88.600	100.170	0.700	0.680	13.100	0.720	0.100
ss003	47.000	0.200	0.250	83.500	4.990	1.000	57.700	99.630	2.000	0.670	12.700	0.880	0.050
ss004	73.100	0.200	0.250	75.700	6.040	2.000	87.000	99.800	1.000	0.750	13.000	0.760	0.100
ss005	49.600	0.200	0.250	83.300	5.740	1.000	61.500	99.840	1.000	0.810	13.000	0.710	0.100
ss006	54.800	0.300	0.250	81.500	5.720	2.000	68.900	99.740	0.800	0.680	13.300	0.880	0.100
ss007	59.300	0.400	0.250	79.800	5.790	1.000	74.300	100.350	1.100	0.690	12.900	0.790	0.100
ss008	57.300	0.100	0.250	81.200	5.260	1.000	80.000	100.290	0.900	0.770	11.600	0.750	0.050
ss009	60.900	0.200	0.250	77.600	5.330	1.000	89.400	99.600	0.900	0.680	11.200	0.730	0.100
ss010	54.600	0.200	0.250	81.100	6.230	2.000	71.500	99.690	1.400	0.720	17.700	0.790	0.100
ss011	45.200	0.300	0.250	85.400	5.250	2.000	54.100	100.960	0.800	0.670	13.500	0.790	0.050
ss012	58.800	0.200	0.250	81.400	5.470	2.000	72.900	100.080	0.900	0.660	12.800	0.760	0.100
ss013	52.400	0.100	0.250	81.800	5.150	1.000	71.100	100.440	1.100	0.680	11.700	0.880	0.100
ss014	50.800	0.200	0.250	82.400	5.360	1.000	62.900	99.840	0.900	0.650	12.500	0.850	0.100
ss015	59.200	0.100	0.250	80.000	5.600	1.000	74.900	99.960	1.100	0.830	13.400	0.850	0.050
ss016	67.000	0.100	0.250	78.400	6.060	1.000	87.200	99.830	1.100	0.760	13.500	0.840	0.050
ss017	73.500	0.050	0.250	74.200	6.840	2.000	96.600	100.030	1.000	0.870	15.600	0.850	0.200
ss018	55.800	0.200	0.250	80.100	5.500	2.000	77.500	99.330	0.700	0.760	12.000	0.790	0.100
ss019	54.300	0.200	0.250	81.700	4.600	3.000	67.800	100.660	1.000	0.720	10.700	0.660	0.100
ss020	59.600	0.100	0.250	81.300	5.750	1.000	78.800	100.300	0.800	0.750	13.000	0.710	0.100
ss021	61.700	0.100	0.250	80.600	5.630	5.000	77.900	99.830	0.900	0.680	12.500	0.680	0.050
ss022	50.200	0.300	0.250	82.400	5.280	0.500	62.800	99.880	1.200	0.660	12.200	0.850	0.050
ss023	57.700	0.200	0.250	81.800	5.220	0.500	73.300	99.920	0.900	0.660	12.000	0.650	0.100
ss024	50.200	0.200	0.250	82.700	4.970	0.500	65.300	99.900	1.000	0.630	11.200	0.680	0.050
ss025	55.600	0.300	0.250	82.200	5.430	2.000	71.900	100.360	1.000	0.710	12.200	0.820	0.100
ss026	60.700	0.300	0.250	80.300	5.690	2.000	75.000	100.350	0.900	0.660	11.100	0.800	0.200
ss027	63.800	0.200	0.250	74.300	5.320	2.000	98.800	99.980	0.900	0.650	10.600	0.710	0.200
ss028	58.500	0.200	0.250	79.200	5.010	1.000	77.100	99.890	0.900	0.680	11.800	0.780	0.050
ss029	57.900	0.200	0.250	77.100	6.480	3.000	83.500	99.360	1.000	0.750	13.600	0.840	0.100
ss030	69.200	0.300	0.250	76.200	5.360	1.000	100.600	100.180	0.800	0.670	10.900	0.660	0.200
ss031	70.100	0.200	0.250	74.200	5.960	2.000	102.000	100.130	0.800	0.710	12.600	0.720	0.200
ss032	58.700	0.400	0.250	77.600	4.870	1.000	78.300	100.680	0.800	0.700	9.700	0.680	0.200
ss033	52.300	0.200	0.250	81.100	6.000	1.000	65.000	99.920	0.900	0.810	15.000	0.980	0.050
ss034	57.200	0.200	0.250	79.900	5.830	0.500	71.000	100.390	0.900	0.750	14.000	0.920	0.100
ss035	93.900	0.200	0.250	70.400	6.400	3.000	92.200	100.790	0.900	0.810	14.200	0.790	0.200
ss036	59.400	0.100	0.250	80.200	5.400	1.000	74.500	100.520	0.800	0.690	13.200	0.740	0.100
ss037	64.100	0.100	0.250	77.700	5.550	1.000	81.900	99.890	1.100	0.740	14.100	0.840	0.100
ss038	54.400	0.100	0.250	80.800	5.460	1.000	69.500	100.090	0.900	0.720	12.000	0.930	0.100
ss039	63.300	0.100	0.250	77.400	5.960	2.000	77.600	99.450	1.000	0.800	12.400	0.920	0.100
ss040	62.000	0.100	0.250	78.400	5.930	1.000	78.300	99.650	1.000	0.840	12.600	0.960	0.100
ss041	67.900	0.050	0.250	76.700	5.420	1.000	91.100	99.330	0.900	0.740	13.600	0.770	0.100
ss042	63.100	0.050	0.250	78.100	5.140	1.000	80.700	99.320	0.700	0.680	11.600	0.850	0.100
ss043	60.000	0.200	0.250	80.700	6.560	1.000	78.000	100.460	1.100	0.750	14.600	0.860	0.100
ss044	60.400	0.050	0.250	79.300	6.410	1.000	77.700	100.470	0.900	0.850	12.600	0.850	0.100
ss045	63.300	0.100	0.250	78.000	5.650	1.000	87.000	100.220	1.000	0.760	11.900	0.870	0.100
ss046	63.700	0.100	0.250	78.000	5.160	1.000	87.400	99.660	0.900	0.700	10.400	0.770	0.100
ss047	49.300	0.300	0.250	81.200	7.510	1.000	53.600	99.520	1.500	1.000	18.500	1.270	0.100
ss048	57.200	0.200	0.250	80.200	5.020	0.500	70.500	99.590	1.000	0.750	10.800	0.980	0.100
ss049	67.500	0.100	0.250	76.500	6.170	2.000	87.400	99.390	1.000	0.900	14.000	0.890	0.100
ss050	60.100	0.050	0.250	77.800	5.170	1.000	81.900	99.730	0.900	0.780	11.800	0.790	0.200
ss051	54.900	0.100	0.250	79.900	4.770	1.000	69.600	99.660	0.800	0.710	11.300	0.880	0.100
ss052	54.700	0.200	0.250	80.900	6.180	1.000	66.200	100.250	1.000	0.780	14.500	0.980	0.100
ss053	58.100	0.050	0.250	79.300	5.450	0.500	72.700	99.380	0.900	0.730	12.700	0.930	0.100
ss054	76.300	0.050	0.250	72.900	6.010	2.000	99.000	99.540	0.800	0.740	11.500	0.830	0.200
ss055	67.100	0.100	0.250	76.400	6.320	1.000	92.800	100.530	1.100	0.830	15.100	0.850	0.100
ss056	61.700	0.050	0.250	78.000	4.830	2.000	91.600	100.060	0.800	0.670	10.600	0.730	0.100
ss057	57.200	0.100	0.700	79.400	5.800	1.000	76.100	99.980	0.900	0.780	12.300	0.870	0.100
ss058	72.100	0.050	0.250	73.300	5.380	2.000	91.800	99.520	1.000	0.760	12.400	0.810	0.200
ss059	79.700	0.050	0.250	70.300	7.950	2.000	93.700	100.160	1.200	1.160	19.500	1.120	0.200
ss060	57.600	0.100	0.250	76.000	5.010	1.000	77.000	98.830	0.900	0.700	11.400	0.880	0.100
ss061	63.100	0.050	0.250	74.600	5.060	2.000	96.300	99.030	0.800	0.700	10.900	0.790	0.100
ss062	58.400	0.100	0.250	74.500	5.200	0.500	97.400	98.740	1.000	0.690	12.000	0.760	0.100
ss063	49.700	0.200	0.250	82.300	5.000	1.000	63.400	100.060	0.900	0.660	12.200	0.890	0.100
ss064	52.500	0.200	0.250	80.700	5.180	0.500	65.000	99.510	1.100	0.680	11.300	1.030	0.100
ss065	56.800	0.100	0.250	79.800	4.840	2.000	75.500	99.990	0.900	0.640	11.100	0.810	0.100
ss066	62.500	0.100	0.250	77.300	4.850	1.000	82.100	99.780	0.900	0.640	10.800	0.790	0.100
ss067	45.000	0.200	0.250	82.900	6.400	0.500	60.100	99.630	1.400	0.700	14.700	1.080	0.050
ss068	52.400	0.100	0.250	80.800	6.670	2.000	64.700	99.570	1.100	0.810	14.400	1.000	0.100
ss069	79.600	0.050	0.250	70.900	5.550	2.000	93.300	99.360	0.800	0.750	12.200	0.820	0.100

Sample No.	Tm	TOTC	TOTS	U	V	W	Y	Yb	Zn	Zr
ss001	0.300	0.270	0.040	2.100	59.000	1.200	21.500	2.240	29.000	409.600
ss002	0.420	0.320	0.020	2.200	67.000	1.400	25.400	2.230	25.000	450.200
ss003	0.350	0.150	0.030	2.300	59.000	1.700	24.200	2.720	26.000	618.900
ss004	0.410	0.460	0.020	2.500	74.000	1.600	26.500	2.950	40.000	398.700
ss005	0.500	0.180	0.040	2.200	54.000	1.300	30.800	2.970	29.000	355.600
ss006	0.390	0.250	0.010	2.900	60.000	1.400	24.000	2.530	38.000	432.600
ss007	0.340	0.220	0.010	2.400	68.000	2.800	22.900	1.970	38.000	297.300
ss008	0.360	0.240	0.020	2.000	60.000	1.300	22.000	2.270	29.000	348.200
ss009	0.370	0.320	0.050	2.300	62.000	1.600	23.500	2.780	27.000	381.900
ss010	0.420	0.280	0.010	2.900	60.000	1.700	22.500	2.710	32.000	462.600
ss011	0.340	0.140	0.050	2.500	56.000	1.300	22.300	2.390	30.000	384.400
ss012	0.380	0.310	0.020	2.100	59.000	1.800	23.100	2.940	30.000	473.700
ss013	0.400	0.190	0.010	2.200	61.000	1.400	25.600	2.600	33.000	596.200
ss014	0.350	0.180	0.030	2.500	60.000	1.900	24.500	2.630	35.000	369.000
ss015	0.490	0.220	0.010	2.800	63.000	1.700	31.600	3.360	29.000	508.400
ss016	0.410	0.250	0.030	2.400	67.000	1.400	27.500	2.690	35.000	439.100
ss017	0.500	0.410	0.070	3.000	79.000	1.600	30.900	3.440	37.000	521.300
ss018	0.360	0.240	0.010	2.200	74.000	1.200	24.400	2.910	29.000	411.900
ss019	0.390	0.340	0.080	1.600	46.000	1.600	22.500	2.580	25.000	439.200
ss020	0.430	0.250	0.020	2.300	55.000	1.200	27.800	3.010	29.000	447.600
ss021	0.400	0.240	0.010	1.700	57.000	1.300	24.200	2.540	26.000	363.400
ss022	0.370	0.150	0.050	2.400	60.000	1.400	22.000	2.260	37.000	365.200
ss023	0.380	0.200	0.020	2.100	60.000	1.600	22.600	2.590	34.000	361.800
ss024	0.340	0.440	0.010	2.000	54.000	1.700	24.000	2.630	27.000	384.400
ss025	0.380	0.180	0.010	2.200	56.000	1.200	22.900	2.660	33.000	363.200
ss026	0.330	0.210	0.010	2.300	64.000	1.100	21.700	2.280	38.000	273.100
ss027	0.340	0.430	0.080	2.400	66.000	1.300	23.100	2.580	33.000	356.900
ss028	0.390	0.230	0.080	2.000	61.000	1.500	24.600	2.940	31.000	360.000
ss029	0.450	0.280	0.110	2.500	59.000	1.500	26.600	3.010	30.000	483.100
ss030	0.360	0.430	0.040	2.700	65.000	1.500	24.300	2.340	41.000	223.800
ss031	0.380	0.310	0.040	2.200	70.000	1.500	25.000	2.620	37.000	321.900
ss032	0.370	0.210	0.220	2.200	60.000	1.400	25.100	2.510	45.000	239.100
ss033	0.450	0.270	0.010	2.900	65.000	1.200	29.700	3.090	37.000	540.000
ss034	0.440	0.320	0.010	2.600	64.000	1.400	27.300	2.870	35.000	521.500
ss035	0.440	0.260	0.010	2.400	89.000	2.100	30.800	3.100	52.000	300.900
ss036	0.350	0.200	0.030	2.000	60.000	2.200	21.600	2.490	34.000	393.400
ss037	0.440	0.220	0.010	2.300	74.000	1.900	27.500	2.760	35.000	426.600
ss038	0.370	0.230	0.010	2.300	66.000	1.500	24.200	2.460	36.000	505.700
ss039	0.420	0.210	0.010	2.400	73.000	1.200	27.300	3.000	36.000	454.400
ss040	0.440	0.210	0.040	2.800	73.000	1.900	30.800	2.910	36.000	394.300
ss041	0.440	0.230	0.010	2.600	67.000	1.300	25.700	2.830	34.000	352.400
ss042	0.360	0.230	0.040	2.200	69.000	1.800	23.800	2.590	33.000	405.900
ss043	0.400	0.170	0.010	3.100	68.000	1.700	23.200	2.640	34.000	412.000
ss044	0.510	0.190	0.010	2.300	64.000	1.600	32.200	3.570	34.000	444.100
ss045	0.410	0.250	0.010	2.300	73.000	1.700	27.400	3.050	36.000	437.100
ss046	0.340	0.220	0.010	2.100	70.000	1.600	23.800	2.910	35.000	381.500
ss047	0.450	0.120	0.010	3.300	70.000	1.600	31.900	3.020	37.000	551.000
ss048	0.420	0.160	0.010	2.200	67.000	1.100	29.100	3.220	36.000	315.500
ss049	0.430	0.340	0.010	2.700	72.000	1.300	27.200	3.010	37.000	471.900
ss050	0.440	0.250	0.010	2.300	71.000	1.300	29.900	3.050	36.000	339.600
ss051	0.450	0.220	0.030	2.600	59.000	1.400	26.100	2.780	35.000	390.400
ss052	0.410	0.180	0.010	3.000	61.000	1.100	24.700	2.660	35.000	501.900
ss053	0.390	0.210	0.010	2.300	62.000	1.400	25.800	2.650	33.000	482.500
ss054	0.380	0.310	0.010	2.200	76.000	1.200	25.100	2.870	45.000	286.200
ss055	0.460	0.290	0.010	2.600	77.000	1.400	30.900	3.430	38.000	503.800
ss056	0.420	0.270	0.010	2.200	65.000	1.600	24.500	2.800	33.000	319.300
ss057	0.440	0.210	0.010	2.600	60.000	1.500	27.400	3.010	33.000	403.700
ss058	0.430	0.440	0.010	2.300	78.000	1.300	27.400	2.630	39.000	361.300
ss059	0.680	0.510	0.010	3.400	92.000	2.000	40.300	4.620	49.000	793.200
ss060	0.370	0.230	0.200	2.400	66.000	1.300	23.900	2.280	36.000	345.600
ss061	0.400	0.300	0.210	2.300	62.000	1.400	24.800	3.040	35.000	336.200
ss062	0.430	0.240	0.340	2.600	56.000	1.700	25.400	3.290	35.000	323.300
ss063	0.380	0.150	0.010	2.000	58.000	1.400	21.300	2.530	36.000	361.000
ss064	0.360	0.200	0.010	2.300	62.000	1.600	24.200	2.770	38.000	426.200
ss065	0.340	0.200	0.050	2.300	62.000	1.500	22.800	2.650	37.000	399.000
ss066	0.310	0.280	0.030	2.100	69.000	1.700	19.300	2.120	43.000	255.800
ss067	0.350	0.110	0.010	2.500	58.000	1.900	22.600	2.370	30.000	622.300
ss068	0.400	0.240	0.010	2.300	61.000	1.500	26.600	2.910	37.000	514.800
ss069	0.430	0.520	0.020	2.500	81.000	1.600	29.700	3.070	44.000	306.700

Sample No.	Eastings	Northings	Ag	Al2O3	As	Au	Ba	Ba2	Be	Bi	CaO	Cd	Ce
ss070	563768	6558743	0.050	6.520	7.100	0.800	319.000	0.030	3.000	0.400	0.570	0.100	64.600
ss071	566894	6559718	0.050	7.300	5.500	0.900	318.000	0.030	2.000	0.300	0.920	0.050	73.100
ss072	567938	6560475	0.050	7.450	3.000	0.250	350.000	0.030	0.500	0.200	0.550	0.050	57.700
ss073	565358	6559188	0.050	6.630	5.400	1.400	345.000	0.040	2.000	0.300	0.950	0.050	65.700
ss074	565886	6559530	0.050	7.000	5.300	0.250	329.000	0.030	0.500	0.400	0.920	0.050	54.200
ss075	563910	6558724	0.050	6.130	6.800	0.250	319.000	0.030	0.500	0.400	0.870	0.100	73.300

Sample No.	Co	Cr2O3	Cs	Cu	Dy	Er	Eu	Fe2O3	Ga	Gd	Hf	Hg	Ho
ss070	15.100	0.013	3.300	21.700	3.840	2.560	0.940	5.220	7.600	4.930	10.900	0.005	0.770
ss071	11.000	0.006	3.100	16.500	5.290	2.760	1.100	3.960	8.300	5.480	9.700	0.005	0.950
ss072	7.900	0.015	2.600	11.200	4.050	2.260	0.910	3.110	7.900	4.240	10.800	0.005	0.780
ss073	13.000	0.002	3.000	18.400	4.100	2.380	0.890	3.870	7.900	4.770	10.000	0.005	0.750
ss074	14.800	0.005	3.100	17.600	3.460	2.490	0.890	4.120	8.200	4.370	10.900	0.005	0.800
ss075	15.200	0.006	2.800	22.200	3.860	2.280	1.080	4.540	7.400	5.100	13.100	0.005	0.830

Sample No.	K2O	La	Lu	MgO	MnO	Mo	Na2O	Nb	Nd	Ni	P2O5	Pb	Pr
ss070	1.230	32.200	0.350	0.780	0.100	0.400	0.510	10.200	27.700	20.700	0.070	17.800	7.750
ss071	1.360	39.800	0.420	0.930	0.090	0.400	0.660	10.500	32.300	16.100	0.070	17.500	9.260
ss072	1.450	30.200	0.360	0.730	0.040	0.100	0.590	10.500	25.400	10.600	0.060	8.900	6.980
ss073	1.220	33.800	0.370	0.860	0.090	0.400	0.560	13.700	30.000	16.200	0.060	16.300	7.780
ss074	1.310	26.400	0.380	0.900	0.100	0.400	0.640	13.000	24.400	15.600	0.070	16.600	6.390
ss075	1.140	38.600	0.390	0.760	0.110	0.500	0.510	11.600	33.000	18.300	0.060	20.000	8.800

Sample No.	Rb	Sb	Se	SiO2	Sm	Sn	Sr	SUM	Ta	Tb	Th	TiO2	Tl
ss070	54.500	0.200	0.250	79.900	5.450	6.000	61.400	99.930	1.100	0.680	12.200	1.090	0.100
ss071	57.600	0.100	0.600	79.200	6.300	0.500	76.800	99.670	0.900	0.830	15.900	0.870	0.100
ss072	61.700	0.050	0.250	80.900	4.860	1.000	78.700	100.030	0.800	0.680	11.700	0.680	0.100
ss073	55.700	0.200	0.250	80.700	5.520	2.000	69.400	99.880	1.100	0.730	12.900	0.850	0.100
ss074	59.700	0.200	0.250	80.000	4.810	3.000	73.700	99.730	1.100	0.680	11.600	0.810	0.100
ss075	52.300	0.200	0.250	80.800	6.270	0.500	63.300	99.570	0.900	0.790	13.300	1.000	0.100

Sample No.	Tm	TOTC	TOTS	U	V	W	Y	Yb	Zn	Zr
ss070	0.360	0.250	0.010	2.600	69.000	1.600	21.800	2.470	41.000	437.100
ss071	0.430	0.210	0.010	3.100	62.000	1.400	26.300	2.790	34.000	373.600
ss072	0.350	0.250	0.010	2.100	56.000	1.100	22.900	2.480	27.000	415.800
ss073	0.340	0.260	0.010	2.200	73.000	1.900	21.800	2.280	35.000	413.200
ss074	0.340	0.200	0.010	2.300	70.000	0.900	20.500	2.460	31.000	436.800
ss075	0.330	0.190	0.010	2.700	66.000	1.800	20.600	2.230	39.000	506.300

Fowlers Creek Bedrock

Sample No.	Eastings	Northings	Ag	Al2O3	As	Au	Ba	Ba2	Be	Bi	CaO	Cd	Ce	Co	Cr2O3
br076	563527	6558830	0.1	0.08	1.2	0.3	24	0.01	1	0.1	0.08	0.1	1.1	1.0	0.003
br075	563683	6558792	0.1	1.04	64.1	8.2	613	0.06	1	0.1	0.39	0.1	28.3	14.9	0.007
br067	563731	6560246	0.2	0.77	135.9	1.1	273	0.03	1	0.1	2.21	4.1	7.0	197.3	0.003
br068	563732	6560247	0.1	2.50	116.9	0.3	406	0.04	1	0.1	0.14	0.3	29.2	101.4	0.003
br077	563802	6558758	0.1	11.25	58.1	0.3	545	0.06	1	0.3	0.35	0.1	72.2	36.9	0.011
br073	563929	6558724	0.1	10.14	5.5	0.3	315	0.03	1	0.5	0.19	0.1	41.2	24.2	0.006
br070	563960	6559125	0.1	1.10	317.8	14.9	748	0.07	1	0.1	0.21	0.1	27.3	59.6	0.007
br069	563985	6559484	0.3	4.96	76.7	0.3	1241	0.13	9	0.2	0.34	0.5	64.1	485.1	0.015
br071	564043	6558734	0.1	2.12	1.4	0.3	176	0.02	1	0.4	0.26	0.1	23.6	5.7	0.006
br072	564058	6558757	0.1	11.07	2.3	0.6	1124	0.12	1	0.4	0.21	0.1	56.9	14.2	0.011
br042	564130	6559129	0.1	0.24	13.1	0.6	25	0.01	1	0.1	0.03	0.1	4.2	2.5	0.004
br074	564432	6558977	0.1	6.95	26.9	0.3	993	0.10	1	0.3	28.48	1.0	71.1	6.6	0.007
br012	564838	6558894	0.2	0.06	5.0	0.3	24	0.01	1	0.1	0.09	0.1	0.6	0.9	0.006
br013	565175	6559132	0.1	5.22	4.3	1.1	221	0.03	2	0.1	35.79	0.1	31.0	6.6	0.002
br014	565303	6559170	0.1	6.07	2.5	0.6	255	0.03	1	0.1	31.01	0.2	43.5	4.6	0.006
br041	565389	6559062	0.1	14.76	5.9	1.1	589	0.07	1	0.3	0.54	0.1	80.9	16.1	0.011
br015	565479	6559194	0.1	14.98	3.0	0.3	659	0.07	3	0.3	0.65	0.1	112.4	11.5	0.013
br016	565612	6559251	0.1	9.15	0.7	0.3	274	0.03	1	0.3	2.76	0.1	61.2	9.5	0.006
br017	565728	6559333	0.1	9.24	2.2	1.1	393	0.04	2	0.1	3.87	0.1	70.1	5.7	0.007
br018	565884	6559532	0.1	3.15	0.3	3.3	397	0.04	2	0.1	0.07	0.1	18.8	1.6	0.004
br059	565917	6559667	0.1	3.06	1.8	0.3	381	0.04	1	0.1	0.06	0.1	18.4	1.7	0.003
br058	565984	6559700	1.6	3.76	55.4	4.5	358	0.04	1	0.1	0.68	0.8	17.5	69.3	0.005
br057	566002	6559712	0.1	12.76	6.8	0.7	558	0.06	1	0.4	0.27	0.1	57.3	25.0	0.015
br056	566090	6559719	0.1	13.56	2.2	2.0	563	0.06	4	0.3	0.27	0.1	106.5	6.9	0.017
br055	566174	6559740	0.1	13.23	1.0	2.7	633	0.07	5	0.5	0.62	0.1	104.6	2.8	0.015
br060	566225	6559637	0.1	1.56	0.7	0.3	207	0.02	1	0.1	38.15	0.1	8.8	2.2	0.001
br054	566237	6559742	0.1	1.31	0.3	0.3	161	0.01	1	0.1	41.84	0.1	8.7	1.5	0.001
br019	566267	6559485	0.1	1.76	2.3	1.8	226	0.02	1	0.1	40.22	0.1	13.4	2.0	0.002
br053	566345	6559737	0.1	6.83	1.9	2.5	326	0.04	1	0.1	12.20	0.1	56.2	1.2	0.008
br061	566717	6559643	0.1	5.85	1.1	0.3	726	0.07	1	0.1	0.34	0.1	37.2	1.8	0.006
br062	566852	6559689	0.1	12.97	3.8	0.3	625	0.07	4	0.4	0.43	0.1	108.1	8.4	0.013
br063	566892	6559717	0.1	11.85	1.0	1.0	555	0.07	1	0.4	0.20	0.2	84.1	4.0	0.014
br064	566945	6559760	0.1	10.71	2.5	0.7	451	0.05	2	0.4	0.58	0.1	83.4	9.2	0.011
br065	567195	6560084	0.1	13.76	6.6	0.3	724	0.08	4	0.2	0.37	0.1	52.0	8.6	0.013
br066	567253	6560151	0.1	14.15	1.4	1.0	720	0.08	1	0.3	0.33	0.2	65.1	9.7	0.018
br020	567641	6560313	0.1	10.93	2.5	1.3	570	0.06	7	0.3	0.45	0.1	62.1	13.7	0.006
br052	567869	6560325	0.1	3.90	1.0	0.3	785	0.08	1	0.1	0.06	0.1	21.4	1.4	0.003
br043	567939	6560780	0.1	11.62	8.2	1.9	428	0.05	5	0.2	0.63	0.1	90.3	24.0	0.010
br044	567978	6560930	0.1	6.71	48.8	2.3	342	0.04	6	0.1	0.38	0.1	44.7	32.3	0.005
br045	568000	6560905	0.1	3.54	1.3	2.9	178	0.02	1	0.1	20.28	0.1	11.9	1.5	0.002
br051	568127	6560536	0.1	4.21	32.0	1.0	410	0.04	12	0.1	0.14	0.1	20.0	33.0	0.003
br047	568286	6561006	0.1	4.41	402.1	0.3	181	0.02	1	0.1	0.42	0.1	21.7	12.9	0.002
br046	568288	6561006	0.1	2.79	10.1	0.5	190	0.02	2	0.1	0.09	0.1	22.5	1.5	0.001
br048	568291	6561015	0.1	3.58	6.0	9.0	296	0.03	2	0.1	0.09	0.1	26.5	2.9	0.001
br049	568409	6561082	0.1	15.29	10.8	1.1	753	0.08	2	0.3	0.45	0.1	93.5	9.6	0.013
br040	568411	6560439	0.1	3.16	4.1	1.1	254	0.03	3	0.1	0.10	0.1	16.8	1.1	0.003
br021	568529	6561726	0.1	3.44	2.7	2.9	191	0.02	2	0.1	0.28	0.1	15.7	4.8	0.003
br050	568538	6561748	0.1	17.92	1.9	1.0	1043	0.11	4	0.1	3.29	0.1	99.7	19.6	0.001
br010	568682	6561224	0.1	3.33	1.4	0.3	1161	0.12	1	0.1	0.11	0.1	14.6	3.2	0.003
br011	568684	6561222	0.1	13.66	1.1	0.7	551	0.06	2	0.1	0.35	0.1	78.6	16.2	0.013
br033	568728	6560911	0.1	3.11	0.7	0.3	92	0.01	3	0.1	0.13	0.1	15.7	3.2	0.003
br039	568735	6560586	0.1	2.93	4.8	0.9	229	0.02	1	0.1	22.27	0.1	16.3	3.1	0.002
br038	568784	6560624	0.1	15.80	0.3	0.3	674	0.07	5	0.4	3.04	0.1	85.6	21.4	0.085
br034	568803	6560964	0.1	15.52	5.5	1.9	359	0.04	1	0.1	3.24	0.1	41.0	40.0	0.007
br035	568813	6560908	0.1	13.08	7.1	3.1	449	0.05	3	0.2	4.32	0.1	72.4	15.9	0.012
br036	568821	6560978	0.1	18.69	2.5	0.8	873	0.10	6	0.1	2.74	0.1	98.4	16.3	0.002
br037	568846	6560994	0.1	6.88	4.0	0.3	186	0.02	1	0.1	17.48	0.3	50.4	8.1	0.005
br030	568875	6560654	0.1	1.27	7.8	0.3	145	0.02	1	0.1	29.51	0.2	9.6	4.2	0.002
br031	568877	6560625	0.1	13.21	3.7	5.9	249	0.03	1	0.1	0.47	0.1	70.0	18.5	0.011
br032	568891	6560602	0.1	2.43	1.1	0.8	20	0.01	1	0.1	0.10	0.1	10.6	2.6	0.005
br029	568991	6560654	0.1	4.04	3.5	0.9	399	0.04	1	0.1	0.23	0.1	28.5	5.5	0.002
br027	569017	6562710	0.1	0.29	0.8	0.3	341	0.03	1	0.1	0.07	0.1	6.7	1.2	0.040
br025	569074	6562132	0.1	1.94	0.3	1.2	265	0.02	2	0.1	0.23	0.1	28.6	1.1	0.015
br026	569077	6562141	0.1	3.78	82.4	2.2	322	0.03	6	0.1	0.31	0.1	42.0	5.9	0.023
br024	569134	6561639	0.1	5.78	5.6	1.0	256	0.03	7	0.2	0.13	0.1	51.4	8.0	0.012
br023	569136	6561639	0.1	2.36	0.3	0.9	126	0.01	1	0.1	0.11	0.1	17.8	1.1	0.003
br022	569138	6561639	0.1	3.51	0.3	1.4	350	0.04	3	0.1	0.18	0.1	21.8	4.2	0.002
br006	569320	6561350	0.1	1.31	0.7	0.3	250	0.03	1	0.1	0.05	0.1	23.1	1.2	0.001
br028	569380	6561155	0.1	1.82	0.3	0.9	166	0.01	2	0.1	0.04	0.1	22.9	1.6	0.002

Sample No.	Cs	Cu	Dy	Er	Eu	Fe2O3	Ga	Gd	Hf	Hg	Ho	K2O	La	Lu	MgO	MnO
br076	0.1	1.5	0.08	0.06	0.01	0.37	0.3	0.05	0.1	0.01	0.01	0.02	0.7	0.01	0.01	0.01
br075	0.5	10.5	3.36	1.99	0.61	4.76	1.3	3.98	0.4	0.01	0.64	0.30	18.7	0.15	0.12	0.01
br067	0.3	197.5	5.40	2.97	0.75	64.01	1.2	6.26	0.3	0.11	1.04	0.17	2.8	0.27	0.33	0.42
br068	1.4	43.8	3.88	1.94	0.79	10.96	2.9	4.15	1.2	0.05	0.74	0.66	12.2	0.21	0.29	0.06
br077	7.2	58.3	6.34	3.29	1.14	15.27	14.2	5.86	6.4	0.02	1.19	3.21	35.4	0.48	0.86	0.26
br073	3.0	62.2	4.99	2.51	0.84	7.87	13.5	4.79	5.2	0.01	0.85	1.27	22.4	0.35	2.86	0.13
br070	0.5	34.9	5.04	2.85	1.12	23.69	1.4	5.13	1.0	0.04	0.92	0.23	49.1	0.41	0.15	0.05
br069	2.7	107.8	16.49	9.34	2.35	64.98	7.2	13.46	2.2	0.02	3.11	1.54	24.7	1.34	0.53	1.35
br071	1.0	28.1	2.19	1.19	0.49	1.39	2.8	2.68	1.5	0.01	0.34	0.46	13.6	0.15	0.60	0.02
br072	7.1	136.9	3.60	2.20	0.78	4.13	15.2	4.25	3.5	0.01	0.70	3.74	31.7	0.24	1.94	0.07
br042	0.2	3.7	0.32	0.17	0.13	2.43	0.9	0.77	0.4	0.01	0.06	0.04	2.0	0.03	0.03	0.01
br074	1.6	22.9	5.33	3.25	1.12	2.36	8.4	6.18	4.9	0.01	1.10	1.34	41.2	0.41	0.66	0.13
br012	0.1	2.5	0.08	0.08	0.01	2.21	0.3	0.06	0.1	0.08	0.01	0.02	0.5	0.01	0.02	0.01
br013	3.2	12.6	1.64	1.08	0.44	2.38	6.4	2.23	1.6	0.01	0.43	1.18	16.2	0.13	2.46	0.03
br014	3.7	6.9	3.04	1.95	0.67	2.30	7.7	3.86	2.7	0.01	0.67	1.38	24.8	0.26	2.67	0.03
br041	9.9	24.8	6.05	3.30	1.27	6.19	20.2	6.72	5.9	0.01	1.06	3.56	47.4	0.46	3.01	0.12
br015	8.5	32.7	7.45	4.34	1.44	5.85	19.2	7.54	6.7	0.01	1.41	4.23	45.3	0.58	2.27	0.08
br016	5.9	33.0	4.43	2.98	0.95	4.48	8.8	4.82	7.7	0.01	1.03	1.85	30.8	0.43	2.22	0.07
br017	2.8	14.5	3.66	2.25	0.97	2.46	9.4	5.05	7.4	0.02	0.73	1.74	33.0	0.33	0.95	0.07
br018	0.7	1.7	1.41	0.77	0.48	0.40	4.0	2.03	4.1	0.01	0.31	1.57	12.4	0.11	0.05	0.01
br059	0.6	2.4	1.05	0.63	0.33	0.93	2.6	1.33	4.8	0.01	0.20	1.47	12.4	0.09	0.07	0.01
br058	14.1	36.2	2.49	1.19	0.60	38.61	3.6	2.82	6.5	0.02	0.40	0.76	8.4	0.15	0.37	0.10
br057	7.8	66.8	5.22	2.80	0.96	9.02	16.4	5.33	5.8	0.01	0.97	3.31	31.7	0.37	1.14	0.07
br056	8.2	33.3	6.24	3.46	1.67	5.75	18.2	7.71	6.8	0.01	1.17	3.28	57.6	0.42	2.25	0.06
br055	6.1	15.8	6.45	3.95	1.45	3.13	17.1	6.91	6.8	0.01	1.24	3.26	53.8	0.47	1.88	0.02
br060	0.2	2.8	0.65	0.50	0.17	0.23	1.1	0.64	0.8	0.01	0.13	0.74	5.2	0.04	0.38	0.01
br054	0.3	1.7	0.85	0.47	0.22	0.26	1.3	0.56	1.2	0.01	0.09	0.54	5.3	0.04	0.27	0.01
br019	0.5	5.2	1.37	0.64	0.48	0.52	2.9	1.64	0.9	0.01	0.25	0.61	8.5	0.08	0.41	0.04
br053	1.2	2.0	2.59	1.18	0.73	0.68	8.1	3.17	6.2	0.01	0.45	1.46	30.5	0.18	0.44	0.01
br061	0.8	4.0	2.31	1.23	0.67	0.73	4.9	2.82	8.0	0.01	0.49	2.18	20.0	0.19	0.13	0.01
br062	5.8	30.3	7.27	3.58	1.66	5.37	15.9	8.65	7.1	0.03	1.67	3.11	56.2	0.46	1.70	0.09
br063	4.5	17.6	5.05	2.96	1.23	4.53	15.5	5.84	7.1	0.01	1.01	3.15	46.5	0.36	1.38	0.05
br064	4.3	18.5	8.60	4.25	1.73	4.42	13.3	9.89	6.2	0.04	1.65	2.62	40.7	0.45	1.47	0.04
br065	5.1	25.9	3.66	2.23	0.84	6.00	17.7	3.43	5.9	0.01	0.61	3.24	29.5	0.28	2.53	0.07
br066	6.4	33.2	4.58	1.96	1.12	5.84	18.7	4.91	4.4	0.01	0.68	3.23	35.2	0.31	2.56	0.06
br020	7.1	18.5	4.31	2.70	1.14	4.90	16.6	5.57	5.4	0.01	0.91	2.78	33.8	0.38	1.19	0.08
br052	0.9	3.8	1.86	0.86	0.49	1.24	3.7	2.12	3.5	0.02	0.34	1.56	11.8	0.13	0.02	0.01
br043	3.5	22.3	5.75	3.27	1.44	2.87	13.5	6.75	7.2	0.01	1.00	2.20	40.3	0.47	0.75	0.09
br044	3.5	112.1	5.19	3.23	1.14	40.06	9.5	5.57	2.9	0.02	1.07	1.34	25.1	0.49	0.51	0.07
br045	1.2	12.2	1.05	0.60	0.27	0.87	5.1	1.30	2.3	0.02	0.18	0.49	6.5	0.13	0.70	0.01
br051	1.3	124.4	6.99	4.28	1.11	25.02	4.5	6.06	1.9	0.01	1.52	1.73	11.9	0.65	0.12	0.04
br047	0.9	12.4	1.34	0.75	0.45	25.88	4.5	1.94	2.1	0.02	0.25	0.06	12.9	0.11	0.31	0.02
br046	0.4	2.6	1.59	0.70	0.51	1.05	3.1	2.35	2.8	0.01	0.21	0.65	16.3	0.10	0.03	0.01
br048	0.7	3.7	1.67	0.86	0.49	1.06	3.9	2.39	4.2	0.11	0.33	1.25	15.7	0.14	0.19	0.01
br049	11.1	23.4	5.68	3.58	1.49	5.27	20.0	7.88	6.8	0.01	1.21	3.94	52.3	0.50	3.05	0.02
br040	0.3	3.8	1.21	0.63	0.36	0.42	4.0	1.74	3.3	0.04	0.24	0.07	12.9	0.10	0.04	0.01
br021	2.5	8.3	1.22	0.76	0.37	1.14	4.6	1.64	3.3	0.01	0.26	0.88	9.0	0.14	0.36	0.01
br050	9.3	36.8	5.32	2.47	1.96	7.96	21.6	7.09	4.6	0.01	0.90	4.89	54.2	0.35	2.85	0.09
br010	1.1	17.3	1.19	0.64	0.28	1.69	2.4	1.40	2.5	0.01	0.20	0.06	7.8	0.08	0.63	0.06
br011	8.6	3.5	6.11	3.55	1.32	7.45	17.9	6.20	5.8	0.01	1.24	3.73	37.4	0.50	3.97	0.13
br033	0.5	4.6	1.48	0.88	0.34	1.17	3.2	1.59	1.9	0.01	0.25	0.12	8.0	0.13	0.52	0.02
br039	0.8	1.6	1.48	0.90	0.70	3.39	3.7	2.00	1.6	0.01	0.30	0.54	9.5	0.14	12.19	0.11
br038	10.8	19.5	6.25	3.63	1.50	7.22	21.3	7.50	5.4	0.01	1.32	4.29	43.3	0.51	2.86	0.15
br034	1.3	48.9	7.92	4.92	2.53	17.80	23.3	8.36	5.0	0.01	1.68	1.04	18.8	0.69	2.63	0.25
br035	5.7	26.0	6.10	3.52	1.22	6.40	17.8	6.28	5.4	0.02	1.01	3.09	36.6	0.44	2.82	0.08
br036	5.9	43.6	4.78	2.61	1.58	7.97	24.0	6.79	5.8	0.01	0.82	4.70	52.3	0.31	2.79	0.08
br037	1.2	9.8	6.10	3.44	1.24	2.76	7.9	6.37	7.4	0.03	1.22	0.94	26.2	0.46	2.48	0.23
br030	0.3	12.4	1.20	0.62	0.36	1.51	2.9	1.83	0.4	0.01	0.25	0.17	5.2	0.08	13.84	0.67
br031	4.3	26.4	6.93	3.99	1.45	8.48	17.0	7.70	7.0	0.01	1.42	1.28	35.2	0.55	2.75	0.11
br032	0.3	1.3	0.85	0.47	0.21	1.14	2.9	1.18	1.3	0.01	0.14	0.05	5.4	0.08	0.51	0.01
br029	4.6	3.6	2.69	1.23	0.65	0.89	5.4	3.09	6.0	0.01	0.46	1.79	14.5	0.21	0.29	0.01
br027	0.2	1.0	1.37	1.19	0.18	0.93	2.0	1.14	6.9	0.01	0.29	0.02	3.7	0.21	0.01	0.01
br025	0.4	2.3	1.61	0.75	0.45	0.43	2.5	2.34	3.3	0.01	0.27	0.13	14.6	0.10	0.10	0.01
br026	1.0	10.5	4.55	2.66	0.96	39.27	5.6	4.63	5.9	0.02	0.91	0.22	20.9	0.38	0.19	0.02
br024	4.5	9.9	4.95	3.27	1.06	2.33	8.0	5.44	10.9	0.01	1.05	1.62	22.1	0.51	0.25	0.04
br023	1.7	2.1	1.41	0.83	0.24	0.59	3.5	1.65	5.3	0.01	0.30	0.40	9.9	0.15	0.30	0.01
br022	2.2	2.5	1.50	0.97	0.37	0.78	4.6	2.48	5.5	0.01	0.30	0.59	10.3	0.19	0.50	0.01
br006	0.5	3.4	0.89	0.52	0.17	0.48	0.8	0.94	1.3	0.01	0.16	0.20	9.0	0.08	0.04	0.01
br028	0.4	2.8	1.50	0.76	0.32	0.43	2.8	1.69	4.0	0.01	0.27	0.17	12.2	0.16	0.05	0.01

Sample No.	Mo	Na2O	Nb	Nd	Ni	P2O5	Pb	Pr	Rb	Sb	Se	SiO2	Sm	Sn	Sr	SUM	Ta
br076	0.1	0.01	0.4	0.3	1.1	0.01	17.0	0.12	0.6	0.1	0.3	99.1	0.08	1	2.2	99.75	0.1
br075	0.6	0.02	0.7	17.2	68.6	0.09	21.8	4.03	10.7	2.2	0.3	92.3	3.21	1	26.8	100.37	0.1
br067	0.8	0.02	1.0	7.0	597.2	0.48	4.7	1.02	6.6	0.5	0.3	21.4	2.56	1	24.9	100.25	0.1
br068	0.5	0.04	2.3	19.2	235.2	0.21	63.6	4.23	24.9	8.2	0.8	82.5	4.31	1	93.3	99.99	0.1
br077	0.8	0.06	14.2	29.3	66.0	0.04	18.9	8.30	168.1	0.4	0.3	62.8	5.91	3	75.0	100.26	1.1
br073	0.2	0.05	11.3	19.2	40.2	0.09	20.2	5.15	44.3	0.2	0.3	72.4	4.47	3	26.8	99.74	1.0
br070	0.6	0.01	0.9	47.3	103.2	0.27	33.9	12.30	8.3	1.4	1.1	70.9	6.39	1	43.6	100.54	0.2
br069	0.7	0.08	4.9	35.3	129.3	0.77	36.0	7.75	49.0	0.9	0.3	14.5	10.25	1	99.3	99.80	0.5
br071	3.2	0.02	4.2	11.6	9.4	0.18	12.0	2.98	19.6	0.1	0.3	93.7	2.60	1	25.9	99.81	0.3
br072	1.3	0.08	11.7	23.2	31.0	0.10	24.8	6.52	145.7	0.1	0.3	75.0	4.80	4	52.7	99.77	1.0
br042	0.4	0.02	0.3	2.1	2.5	0.01	6.1	0.52	2.5	0.1	0.3	96.6	0.45	1	6.4	99.91	0.1
br074	1.3	1.59	8.9	35.4	8.9	0.15	14.7	8.68	46.9	0.2	0.3	34.7	6.42	3	153.0	100.46	0.8
br012	1.9	0.01	0.1	0.5	3.7	0.01	3.1	0.08	0.4	0.1	2.1	97.5	0.08	1	12.7	100.32	0.1
br013	0.2	0.51	5.4	15.9	11.8	0.09	9.0	3.64	58.7	0.1	0.3	22.2	2.68	1	522.2	100.21	0.3
br014	0.2	0.48	5.1	19.8	11.2	0.10	7.3	5.16	65.6	0.1	0.3	28.4	3.57	2	375.0	100.04	0.5
br041	0.1	1.45	14.3	37.8	26.6	0.18	12.9	10.13	170.3	0.1	0.3	66.0	7.23	5	74.5	100.46	1.3
br015	0.9	1.26	14.2	42.8	28.6	0.36	18.3	11.32	173.2	0.3	0.3	65.8	8.43	5	71.2	99.61	1.3
br016	0.3	1.85	8.6	25.4	19.0	0.17	17.2	6.99	96.5	0.1	0.3	72.8	5.47	1	102.1	99.62	0.8
br017	0.4	2.59	9.8	29.7	10.8	0.14	7.8	7.74	85.5	0.1	0.3	74.0	5.85	3	162.5	99.76	0.8
br018	0.2	0.06	4.1	10.4	1.5	0.01	5.9	2.90	44.6	0.1	0.3	94.1	1.94	1	37.9	100.16	0.3
br059	0.1	0.04	2.1	9.1	4.3	0.03	6.7	2.57	43.2	0.1	0.3	93.0	1.66	1	56.6	99.51	0.2
br058	2.7	0.33	3.2	9.8	280.4	0.75	38.2	2.15	50.2	0.4	2.1	47.8	1.78	1	65.0	100.26	0.3
br057	1.5	1.00	12.6	25.8	76.9	0.24	26.8	6.92	160.0	0.3	0.6	66.7	5.15	4	89.3	99.94	1.2
br056	0.3	1.47	14.6	49.5	20.7	0.11	16.0	12.62	160.3	0.1	0.3	69.3	9.17	4	127.6	100.22	1.0
br055	0.3	1.58	13.6	45.1	9.7	0.17	18.8	12.45	131.5	0.1	0.3	71.4	8.56	4	104.8	99.60	1.1
br060	0.1	0.26	1.4	3.5	1.0	0.13	3.0	1.10	27.3	0.1	0.3	29.3	0.79	1	893.1	100.64	0.1
br054	0.1	0.22	2.2	3.6	0.7	0.27	3.3	1.07	17.8	0.1	0.3	21.8	0.74	1	666.2	99.81	0.1
br019	0.1	0.34	2.5	6.2	1.2	0.13	6.0	1.64	23.9	0.1	0.3	25.0	1.44	1	845.6	100.83	0.2
br053	0.2	0.09	10.9	22.7	2.9	0.03	5.4	6.40	50.1	0.1	0.3	66.7	4.47	3	60.1	100.30	0.7
br061	0.2	1.61	5.8	16.3	5.2	0.04	10.3	4.54	48.5	0.1	0.3	87.5	3.40	1	62.0	99.50	0.5
br062	0.4	1.61	14.1	49.3	27.3	0.22	16.7	13.41	136.0	0.1	0.3	70.5	10.14	3	74.7	100.06	1.0
br063	0.4	1.19	13.1	38.4	11.4	0.09	27.8	10.44	138.3	0.1	0.3	73.4	6.93	4	127.2	99.63	1.0
br064	0.2	1.23	10.3	43.1	21.5	0.38	18.9	10.83	117.2	0.1	0.3	75.1	9.62	3	78.4	99.55	1.0
br065	0.2	1.70	15.0	20.4	26.8	0.15	13.3	6.03	128.9	0.1	0.3	68.8	4.02	4	107.8	100.92	1.3
br066	0.4	1.76	12.2	31.6	27.3	0.14	18.4	8.30	130.5	0.1	0.3	68.1	6.11	4	106.2	100.11	0.9
br020	0.4	1.31	10.6	27.7	29.1	0.24	15.2	7.66	138.0	0.1	0.3	74.2	5.43	3	81.7	99.43	1.0
br052	0.1	0.98	2.0	10.9	4.3	0.04	7.1	2.77	35.5	0.1	0.3	92.1	2.43	1	39.2	100.65	0.2
br043	0.4	0.63	11.0	39.3	30.0	0.02	18.4	9.54	92.0	0.1	0.3	74.0	7.33	4	39.2	100.24	1.0
br044	1.0	0.21	5.8	20.1	68.6	0.86	30.2	5.25	59.8	0.6	0.3	40.9	4.58	2	41.1	99.76	0.6
br045	0.1	0.12	3.2	5.7	3.5	0.04	3.3	1.47	31.6	0.1	0.3	56.1	1.13	1	80.1	99.79	0.4
br051	0.8	0.10	2.3	14.4	68.8	0.70	8.3	2.77	58.9	0.7	0.3	63.3	3.24	1	42.2	99.86	0.2
br047	2.3	0.07	1.4	12.1	111.5	0.14	78.0	3.03	4.2	0.9	7.9	62.8	2.21	1	53.1	99.67	0.1
br046	0.1	0.03	1.0	12.1	3.8	0.01	3.5	3.59	18.2	0.1	0.3	94.5	2.43	1	25.2	100.30	0.1
br048	0.1	0.21	3.0	12.2	7.1	0.02	6.9	3.34	36.0	0.1	0.3	91.1	2.49	1	34.3	99.66	0.2
br049	0.2	1.29	13.3	47.0	27.1	0.16	18.2	11.22	186.3	0.3	0.3	65.9	8.09	5	125.1	100.45	1.5
br040	0.1	0.01	1.9	9.7	1.0	0.01	7.0	2.63	4.2	0.4	0.3	95.3	1.62	1	23.0	100.55	0.2
br021	0.3	0.82	2.9	8.3	12.1	0.03	2.2	2.12	36.7	0.1	0.3	91.6	1.67	1	29.7	99.83	0.2
br050	0.8	2.65	21.8	48.7	6.5	0.45	4.2	12.01	172.9	0.1	0.3	53.1	8.03	4	470.9	99.76	1.5
br010	0.4	1.30	2.2	7.1	10.4	0.02	1.0	1.79	1.6	0.1	0.3	91.6	1.45	1	65.6	100.23	0.1
br011	0.8	0.73	15.2	36.2	45.4	0.18	3.2	9.25	176.5	0.3	0.3	64.9	7.07	3	60.6	100.00	1.2
br033	0.2	1.22	2.0	7.4	3.4	0.05	1.4	2.00	4.5	0.1	0.3	92.7	1.56	1	28.1	100.04	0.2
br039	0.2	0.79	3.0	8.7	3.9	0.13	18.5	2.16	24.7	0.1	0.3	25.9	1.71	1	561.2	100.25	0.2
br038	0.4	0.59	13.5	42.2	44.0	0.19	3.2	10.06	203.7	0.2	0.3	59.4	7.64	5	64.3	100.53	1.4
br034	0.5	4.29	7.3	28.9	18.7	0.42	3.6	6.21	38.8	0.3	0.3	47.1	7.00	3	497.8	101.02	0.5
br035	0.3	1.04	11.8	31.6	27.9	0.18	12.6	8.85	137.0	0.2	0.3	61.9	6.89	4	80.8	100.35	1.1
br036	0.5	3.39	23.4	46.2	5.6	0.49	16.3	11.70	155.7	0.2	0.3	53.1	7.86	3	396.3	99.91	1.5
br037	0.1	1.75	7.3	25.6	13.3	0.13	28.3	6.50	34.3	0.1	0.3	52.2	5.76	2	310.4	100.77	0.8
br030	1.8	0.38	1.3	4.4	3.1	0.08	2.6	1.25	8.7	0.1	0.3	15.8	1.32	1	322.4	101.12	0.2
br031	0.2	2.61	12.4	32.3	32.4	0.22	9.7	8.95	61.7	0.1	0.3	66.9	7.72	3	72.2	100.73	1.3
br032	0.1	1.01	1.7	4.8	3.2	0.06	0.7	1.29	1.8	0.1	0.3	94.6	0.88	1	23.8	100.64	0.2
br029	0.1	0.07	4.1	14.3	20.2	0.08	5.2	3.95	69.2	0.1	0.6	90.8	3.04	1	66.7	100.08	0.4
br027	0.2	0.01	17.0	3.5	0.9	0.02	1.6	0.71	1.4	0.1	0.3	97.7	0.60	4	20.8	100.34	1.9
br025	0.1	0.01	1.7	13.1	1.0	0.03	1.2	3.49	6.6	0.1	0.3	95.5	2.51	1	47.1	99.60	0.3
br026	0.6	0.02	3.3	22.9	11.4	0.56	4.4	5.64	11.5	0.7	2.0	49.7	5.26	1	61.6	100.60	0.3
br024	0.2	0.09	6.6	22.1	8.3	0.05	4.3	5.98	84.8	0.1	0.3	88.0	5.40	1	31.0	100.04	0.8
br023	0.1	0.02	3.1	7.9	1.2	0.01	1.8	2.06	19.0	0.1	0.3	95.0	2.21	1	25.8	100.26	0.3
br022	0.1	0.03	3.7	8.4	3.9	0.01	2.9	2.25	29.0	0.1	0.3	93.3	1.69	2	44.3	101.07	0.2
br006	0.1	0.01	1.6	7.0	1.3	0.02	1.4	1.99	7.3	0.1	0.3	96.3	1.16	1	41.7	99.21	0.2
br028	0.1	0.01	2.5	10.1	1.1	0.03	2.9	2.58	8.0	0.1	0.3	96.3	1.72	1	25.5	100.00	0.3

Sample No.	Tb	Th	TiO2	Tl	Tm	TOTC	TOTS	U	V	W	Y	Yb	Zn	Zr
br076	0.01	0.2	0.01	0.1	0.01	0.03	0.01	0.1	4	0.3	0.3	0.05	2	1.2
br075	0.50	6.9	0.03	0.1	0.23	0.10	0.01	1.2	40	0.5	29.6	1.21	198	19.5
br067	0.90	2.4	0.01	1.2	0.37	0.59	0.01	3.5	66	0.3	35.1	2.25	809	14.7
br068	0.60	4.8	0.11	0.2	0.27	0.08	0.01	2.5	42	1.3	24.9	1.40	855	52.9
br077	0.94	16.1	0.95	0.2	0.47	0.10	0.06	4.3	115	2.5	32.9	3.39	222	254.4
br073	0.72	9.1	0.79	0.1	0.35	0.03	0.02	1.6	90	1.0	26.0	2.26	121	168.7
br070	0.75	1.3	0.01	0.1	0.45	0.12	0.01	3.2	64	0.3	27.0	2.90	471	37.3
br069	2.38	9.1	0.29	0.3	1.49	0.30	0.01	7.8	122	2.0	61.8	9.78	394	87.2
br071	0.40	5.4	0.19	0.1	0.17	0.01	0.03	2.3	15	0.9	9.5	1.20	25	48.3
br072	0.56	12.7	0.59	0.2	0.27	0.01	0.01	1.5	103	2.2	19.6	2.42	54	123.7
br042	0.06	0.5	0.01	0.1	0.02	0.01	0.01	0.3	4	0.3	1.5	0.18	8	21.9
br074	0.87	16.2	0.46	0.1	0.42	6.41	0.01	2.7	72	2.3	32.4	2.77	16	175.2
br012	0.02	0.1	0.01	0.1	0.01	0.03	0.01	0.5	4	0.3	0.6	0.08	5	1.9
br013	0.33	6.1	0.24	0.2	0.15	8.56	0.09	3.2	51	1.3	10.5	1.20	27	59.2
br014	0.51	8.4	0.33	0.2	0.27	7.59	0.06	2.7	57	1.4	19.5	1.82	31	98.9
br041	0.97	20.9	0.82	0.4	0.49	0.08	0.01	4.2	114	5.4	31.0	3.17	71	233.4
br015	1.17	19.8	0.81	0.4	0.59	0.07	0.01	4.2	139	4.3	38.6	3.97	64	248.0
br016	0.82	13.6	0.52	0.4	0.44	0.60	0.01	2.2	61	1.5	28.4	2.73	51	287.4
br017	0.64	13.7	0.51	0.2	0.34	0.84	0.01	2.4	59	2.3	20.1	2.45	17	247.2
br018	0.25	3.7	0.04	0.1	0.13	0.01	0.01	0.7	4	0.3	7.6	0.87	9	155.9
br059	0.16	3.4	0.07	0.1	0.08	0.01	0.03	1.0	12	0.3	5.5	0.62	9	178.1
br058	0.40	4.0	0.14	0.4	0.16	0.11	0.12	9.7	18	0.7	15.2	0.92	768	240.5
br057	0.79	19.9	0.66	0.6	0.41	0.05	0.15	8.6	100	2.0	26.0	2.76	258	201.7
br056	0.97	18.4	0.72	0.4	0.47	0.07	0.04	2.5	114	2.6	30.5	3.27	51	243.0
br055	0.97	20.3	0.72	0.3	0.51	0.16	0.01	3.1	84	1.6	34.1	3.08	30	279.3
br060	0.12	1.6	0.02	0.1	0.04	8.42	0.01	1.1	4	0.3	4.3	0.25	2	28.8
br054	0.11	1.7	0.03	0.1	0.04	9.29	0.01	0.8	4	0.3	4.5	0.56	5	36.4
br019	0.19	2.3	0.05	0.1	0.10	9.28	0.01	1.7	16	0.3	7.5	0.56	5	29.4
br053	0.41	9.2	0.36	0.1	0.17	2.64	0.02	1.9	36	1.3	12.4	1.24	7	245.2
br061	0.38	7.9	0.24	0.1	0.18	0.09	0.09	1.4	17	0.3	12.9	1.32	12	277.7
br062	1.22	19.1	0.70	0.3	0.53	0.13	0.01	3.2	83	1.7	34.9	3.50	42	276.0
br063	0.82	18.7	0.64	0.3	0.40	0.11	0.05	2.2	74	2.2	25.4	2.67	34	246.2
br064	1.47	14.4	0.54	0.2	0.53	0.05	0.01	2.0	63	1.7	45.5	3.24	47	220.0
br065	0.51	15.8	0.66	0.3	0.32	0.11	0.01	1.9	84	1.6	20.5	2.27	64	212.8
br066	0.69	16.9	0.68	0.3	0.29	0.07	0.01	2.6	92	2.0	17.6	1.95	65	173.2
br020	0.78	14.2	0.52	0.4	0.38	0.09	0.01	2.4	64	1.8	25.4	2.55	44	211.2
br052	0.29	4.5	0.09	0.1	0.14	0.05	0.01	0.9	4	1.2	9.2	0.96	10	134.9
br043	1.00	16.2	0.60	0.2	0.45	0.03	0.45	4.2	97	1.7	29.8	3.20	38	262.9
br044	1.53	9.3	0.28	0.1	0.51	0.12	0.17	4.4	65	1.4	30.0	3.23	238	119.2
br045	0.14	4.5	0.13	0.1	0.10	4.92	0.07	1.4	23	0.6	5.3	0.60	5	70.4
br051	0.98	4.7	0.07	0.1	0.65	0.06	0.01	5.6	40	0.3	48.1	4.41	401	73.7
br047	0.24	21.5	0.04	0.3	0.11	0.08	0.04	3.1	205	1.1	6.2	0.73	252	87.0
br046	0.36	3.7	0.07	0.1	0.09	0.01	0.01	0.8	12	0.3	6.7	0.78	10	105.6
br048	0.30	5.1	0.11	0.1	0.14	0.04	0.11	1.3	11	1.2	9.2	0.68	29	164.1
br049	1.05	22.4	0.86	0.5	0.53	0.05	0.06	4.3	118	2.3	33.8	3.55	74	232.0
br040	0.23	3.3	0.05	0.1	0.10	0.03	0.01	0.8	4	0.6	6.7	0.75	1	139.5
br021	0.20	3.5	0.15	0.1	0.13	0.04	0.01	0.9	12	1.0	6.8	0.85	28	107.8
br050	0.82	17.0	1.14	0.1	0.36	0.56	0.01	4.5	210	2.8	23.9	2.23	77	211.6
br010	0.20	3.0	0.10	0.1	0.11	0.02	0.03	0.7	15	0.8	6.8	0.65	13	87.6
br011	1.10	14.5	0.80	0.2	0.53	0.03	0.01	2.3	115	3.0	34.6	3.45	93	219.4
br033	0.22	3.3	0.10	0.1	0.12	0.03	0.01	0.9	11	1.1	7.6	0.83	13	79.1
br039	0.27	3.9	0.17	0.1	0.11	9.56	0.01	1.2	29	0.8	8.1	0.70	18	53.7
br038	1.03	19.3	0.92	0.1	0.57	0.65	0.01	3.9	147	3.4	35.0	3.96	85	182.2
br034	1.35	2.8	2.99	0.1	0.69	0.08	0.01	1.7	430	1.0	44.0	4.57	53	224.2
br035	0.89	16.7	0.82	0.1	0.46	0.98	0.01	3.3	115	2.8	29.1	2.93	67	201.1
br036	0.84	17.1	1.15	0.1	0.35	0.46	0.01	3.8	209	1.8	23.2	2.59	64	207.2
br037	0.98	10.3	0.48	0.1	0.49	4.23	0.01	2.1	44	1.4	34.3	3.01	42	259.5
br030	0.22	1.2	0.05	0.1	0.08	11.24	0.01	2.3	51	0.3	7.4	0.51	12	14.6
br031	1.12	15.6	1.12	0.1	0.56	0.06	0.01	2.8	107	2.8	35.6	3.93	98	286.9
br032	0.14	2.3	0.10	0.1	0.08	0.02	0.01	0.4	10	0.8	4.3	0.55	12	58.3
br029	0.41	6.3	0.21	0.1	0.21	0.08	0.01	1.1	22	2.1	12.2	1.32	22	230.9
br027	0.17	2.8	0.87	0.1	0.16	0.01	0.01	1.4	29	3.4	7.7	1.38	2	261.5
br025	0.30	4.4	0.09	0.1	0.12	0.08	0.01	0.7	11	0.5	5.8	0.75	2	140.9
br026	0.74	42.6	0.13	0.1	0.40	0.22	0.01	13.7	103	0.9	20.0	2.82	42	211.4
br024	0.82	14.6	0.32	0.1	0.51	0.01	0.01	3.3	75	3.1	29.9	3.77	26	396.7
br023	0.23	3.5	0.10	0.1	0.15	0.18	0.01	1.2	11	0.8	8.3	0.87	5	199.7
br022	0.24	3.6	0.10	0.1	0.17	0.01	0.01	1.2	18	0.7	10.2	1.08	10	217.0
br006	0.14	3.2	0.09	0.1	0.07	0.05	0.01	0.7	10	0.9	4.8	0.53	3	45.9
br028	0.23	6.3	0.17	0.1	0.12	0.03	0.01	1.2	9	0.7	7.4	0.84	2	139.1

Sample No.	Eastings	Northings	Ag	Al2O3	As	Au	Ba	Ba2	Be	Bi	CaO	Cd	Ce	Co	Cr2O3
br005	569414	6561347	0.1	3.23	0.3	0.3	142	0.02	1	0.1	0.07	0.1	22.0	0.9	0.005
br004	569539	6561511	0.1	6.10	0.3	0.3	815	0.09	1	0.1	0.08	0.1	132.2	0.1	0.002
br003	569650	6561595	0.1	13.06	0.3	0.3	235	0.02	1	0.1	0.47	0.1	71.8	2.3	0.006
br001	569772	6561717	0.1	4.51	0.6	0.3	238	0.03	1	0.1	0.54	0.1	15.4	0.7	0.005
br002	569773	6561663	0.1	2.48	2.8	0.7	232	0.02	1	0.1	0.30	0.1	9.9	2.1	0.004
br009	569833	6561570	0.1	0.09	0.3	0.3	855	0.08	1	0.1	0.03	0.1	2.2	0.1	0.004
br008	569842	6561506	0.1	0.18	0.3	1.1	720	0.06	1	0.1	0.08	0.1	3.5	0.3	0.002
br007	570045	6561124	0.1	0.28	0.3	0.3	288	0.02	1	0.1	0.07	0.1	8.2	0.5	0.003

Sample No.	Cs	Cu	Dy	Er	Eu	Fe2O3	Ga	Gd	Hf	Hg	Ho	K2O	La	Lu	MgO	MnO
br005	0.7	2.0	1.52	0.84	0.31	0.48	3.1	1.44	3.8	0.01	0.27	0.20	11.9	0.13	0.13	0.02
br004	0.6	1.6	7.02	1.85	3.22	0.35	3.5	14.65	3.8	0.01	0.88	0.25	59.9	0.14	0.12	0.01
br003	1.1	1.8	3.68	2.23	0.62	0.66	11.1	4.47	5.1	0.01	0.78	0.89	36.9	0.36	0.23	0.02
br001	1.2	2.5	1.70	1.21	0.22	0.90	5.0	1.18	5.6	0.01	0.33	0.48	8.4	0.17	0.31	0.01
br002	0.8	9.0	0.83	0.77	0.12	1.10	3.1	0.54	9.7	0.01	0.19	0.20	6.7	0.14	0.24	0.09
br009	0.1	0.9	0.81	0.70	0.04	0.37	0.3	0.39	12.2	0.01	0.21	0.02	1.1	0.15	0.01	0.01
br008	0.1	1.3	0.80	0.96	0.07	0.41	0.3	0.50	12.2	0.02	0.20	0.02	1.7	0.18	0.01	0.01
br007	0.1	2.8	1.31	1.04	0.14	0.38	0.3	1.01	10.8	0.01	0.26	0.03	5.5	0.22	0.01	0.01

Sample No.	Mo	Na2O	Nb	Nd	Ni	P2O5	Pb	Pr	Rb	Sb	Se	SiO2	Sm	Sn	Sr	SUM	Ta
br005	0.1	0.02	3.3	8.0	1.6	0.01	2.7	2.36	9.7	0.1	0.3	93.9	1.64	1	21.8	99.87	0.3
br004	0.1	0.03	2.6	67.7	1.0	0.15	4.0	17.20	11.6	0.1	0.3	89.5	14.77	1	131.1	99.48	0.3
br003	0.1	0.12	12.7	27.5	1.6	0.02	2.6	7.99	42.3	0.1	0.3	78.9	4.89	3	40.8	100.23	1.3
br001	0.1	0.07	8.0	5.7	1.6	0.01	2.7	1.57	25.6	0.1	0.3	89.7	1.33	2	29.8	99.73	0.9
br002	0.2	0.01	6.9	4.5	2.9	0.01	3.2	1.23	11.3	0.1	0.3	92.9	0.58	1	40.7	99.81	0.7
br009	0.1	0.01	13.6	0.5	0.5	0.01	0.7	0.22	0.2	0.1	0.3	98.8	0.21	1	24.0	100.07	1.4
br008	0.2	0.01	11.3	1.9	0.9	0.02	1.2	0.33	0.4	0.1	0.3	97.2	0.42	1	24.2	98.81	1.0
br007	0.1	0.01	15.1	1.2	0.6	0.12	6.6	0.81	0.1	0.1	0.3	97.1	0.67	2	98.6	99.41	1.5

Sample No.	Tb	Th	TiO2	Tl	Tm	TOTC	TOTS	U	V	W	Y	Yb	Zn	Zr
br005	0.21	3.8	0.17	0.1	0.13	0.06	0.01	0.7	11	0.9	7.5	0.79	2	163.8
br004	1.65	6.6	0.15	0.1	0.22	0.07	0.01	0.6	11	1.0	19.8	1.25	2	143.2
br003	0.63	15.4	0.60	0.1	0.35	0.11	0.01	1.5	48	2.2	21.9	2.37	2	178.6
br001	0.22	6.0	0.53	0.1	0.18	0.11	0.01	1.1	33	2.0	10.7	1.12	3	242.0
br002	0.11	3.1	0.30	0.1	0.11	0.09	0.04	1.0	25	1.7	5.1	0.84	4	400.3
br009	0.09	1.6	0.56	0.1	0.12	0.02	0.02	1.0	4	2.0	5.6	1.00	1	502.4
br008	0.12	1.9	0.49	0.1	0.14	0.04	0.03	1.1	4	2.1	5.7	1.13	2	443.9
br007	0.16	4.2	0.96	0.1	0.14	0.02	0.03	1.5	24	2.2	7.3	1.17	2	436.0

Pine Creek 2005 *E. camaldulensis*

Sample	Eastings	Northings	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co
PCH001	530401	6455030	67	0.005	0.3	0.1	21	21.6	0.05	0.04	0.98	0.15	0.15	0.1
PCH002	530796	6454813	100	0.01	0.6	0.1	30	27.1	0.05	0.01	1.13	0.16	0.18	0.11
PCH003	530513	6454800	132	0.02	0.8	0.3	71	28	0.05	0.01	1.83	0.27	0.29	0.22
PCH004	530462	6454740	157	0.005	1	0.1	29	18.8	0.05	0.01	1.13	0.26	0.19	0.11
PCH005	530536	6454720	133	0.02	0.9	0.2	40	36.6	0.05	0.01	1.73	0.25	0.32	0.19
PCH006	530535	6454698	74	0.005	0.6	0.3	31	20.7	0.05	0.01	1.02	0.16	0.12	0.1
PCH007	530521	6454688	183	0.005	0.9	0.1	32	20.9	0.05	0.01	1.27	0.3	0.23	0.11
PCH008	530571	6454622	276	0.01	1.7	0.4	31	39.8	0.05	0.01	1.74	0.48	0.25	0.12
PCH009	530557	6454613	298	0.01	1.3	0.1	40	28.7	0.05	0.01	1.62	0.55	0.32	0.19
PCH010	530593	6454601	214	0.005	1.3	0.1	26	23	0.05	0.01	1.34	0.46	0.21	0.16
PCH011	530611	6454582	298	0.01	1.7	0.2	32	24.2	0.05	0.01	1.53	0.58	0.37	0.16
PCH012	530621	6454566	254	0.01	1.5	0.2	29	24.7	0.05	0.01	1.29	0.42	0.26	0.25
PCH013	530667	6454542	389	0.02	2.2	0.5	54	26.4	0.05	0.01	1.36	0.71	0.4	0.14
PCH014	530682	6454541	401	0.02	1.6	0.5	37	22.8	0.05	0.01	1.07	0.68	0.38	0.21
PCH015	530628	6454539	206	0.005	0.8	0.3	35	34.5	0.05	0.01	1.9	0.4	0.2	0.07
PCH016	530628	6454539	207	0.005	0.9	0.1	34	34.3	0.05	0.01	1.95	0.4	0.16	0.06
PCH017	530758	6454514	341	0.01	1.6	0.3	62	13.3	0.05	0.01	1	0.51	0.36	0.2
PCH018	530798	6454502	505	0.01	2.1	0.5	26	10.7	0.05	0.01	0.96	1.04	0.36	0.16
PCH019	530822	6454481	676	0.02	3	0.1	28	12.2	0.05	0.01	1.12	1.29	0.58	0.22
PCH020	530808	6454417	270	0.01	1.2	0.5	33	18.8	0.05	0.01	0.89	0.46	0.22	0.13
PCH021	530830	6454404	270	0.01	1	0.1	32	31.7	0.05	0.01	1.24	0.52	0.2	0.12
PCH022	530827	6454402	208	0.005	0.8	0.1	39	28.1	0.05	0.01	1.93	0.49	0.2	0.12
PCH023	530867	6454354	493	0.005	2.5	0.5	40	18.3	0.05	0.01	1.2	0.95	0.32	0.15
PCH024	530783	6454256	410	0.005	1.8	0.2	39	17.5	0.05	0.01	1.34	0.79	0.32	0.25
PCH025	530774	6454250	574	0.01	2.9	0.8	53	14.6	0.05	0.01	0.84	1	0.39	0.18
PCH026	530761	6454206	499	0.01	2.8	0.5	72	7.8	0.05	0.01	0.8	0.79	0.41	0.4
PCH027	530701	6454062	998	0.02	5.9	1.3	61	17.3	0.05	0.01	0.74	1.36	0.67	0.21
PCH028	530803	6454032	1477	0.02	7.9	3	68	24.8	0.05	0.02	1.06	2.38	0.91	0.43
PCH029	531198	6453879	1345	0.03	7.1	1.4	78	3.9	0.05	0.02	0.66	5.23	0.96	0.33
PCH030	531203	6453699	1222	0.03	6.9	1.2	75	3.9	0.05	0.01	0.65	5.27	0.85	0.32
PCH031	531497	6453595	54	0.01	0.5	0.1	33	6.2	0.05	0.01	0.67	0.77	0.18	0.12
PCH032	531633	6453511	52	0.01	0.5	0.1	44	7.3	0.05	0.01	0.72	1.25	0.17	0.12
PCH033	531673	6453472	48	0.01	0.4	0.1	31	8.2	0.05	0.01	0.86	0.75	0.15	0.15
PCH034	531709	6453461	37	0.005	0.4	0.1	36	10	0.05	0.01	0.93	1.34	0.15	0.09
PCH035	531750	6453428	40	0.01	0.3	0.1	30	8.3	0.05	0.01	0.85	0.51	0.18	0.25
PCH036	531745	6453418	46	0.005	0.3	0.1	35	11.2	0.05	0.04	1.11	0.83	0.19	0.23
PCH037	531821	6453401	92	0.03	0.4	0.2	42	16.2	0.05	0.01	1.08	0.74	0.41	0.26
PCH038	531780	6453365	31	0.005	0.05	0.1	27	13.8	0.05	0.01	0.89	0.65	0.14	0.12
PCH039	531822	6453357	26	0.005	0.1	0.1	22	13.8	0.05	0.01	0.94	0.36	0.13	0.08
PCH040	531832	6453293	49	0.01	0.3	0.1	37	10.7	0.05	0.01	0.95	0.35	0.21	0.1
PCH041	531861	6453265	28	0.005	0.05	0.1	33	14.5	0.05	0.01	0.93	0.39	0.14	0.09
PCH042	532059	6453252	49	0.02	0.3	0.1	56	19.8	0.05	0.01	1.06	0.25	0.36	0.11
PCH043	531875	6453216	26	0.01	0.1	0.1	23	7	0.05	0.01	0.82	0.32	0.16	0.16
PCH044	531880	6453213	30	0.02	0.2	0.1	28	8.3	0.05	0.01	0.72	0.22	0.23	0.1
PCH045	531876	6453132	58	0.02	0.3	0.1	48	11.1	0.05	0.01	1.05	1.12	0.24	0.16
PCH046	531969	6452986	21	0.01	0.2	0.1	28	14.3	0.05	0.01	0.67	0.49	0.12	0.17
PCH047	532044	6452902	47	0.02	0.4	0.1	30	14.7	0.05	0.01	0.8	0.44	0.29	0.11
PCH048	532048	6452828	32	0.01	0.3	0.1	41	23.1	0.05	0.01	1.17	1.39	0.22	0.19
PCH049	532057	6452824	74	0.02	0.4	0.1	49	36	0.05	0.01	1.56	0.87	0.31	0.12
PCH050	532078	6452793	32	0.02	0.4	0.1	28	15.1	0.05	0.01	0.92	0.65	0.26	0.12
PCH051	532102	6452765	53	0.02	0.6	0.1	51	23.2	0.05	0.01	1.27	0.37	0.33	0.11
PCH052	532072	6452726	33	0.01	0.3	0.1	21	21.7	0.05	0.01	1.17	0.82	0.18	0.1
PCH053	532108	6452684	36	0.02	0.2	0.1	34	17.9	0.05	0.01	0.93	0.18	0.23	0.07
PCH054	532110	6452666	40	0.02	0.4	0.1	35	18.2	0.05	0.01	1.19	0.17	0.29	0.07
PCH055	532064	6452623	33	0.005	0.05	0.1	56	11.3	0.05	0.01	0.57	0.19	0.1	0.07
PCH056	532077	6452608	37	0.005	0.3	0.1	110	22.9	0.05	0.01	1.51	0.54	0.18	0.1
PCH057	532074	6452543	37	0.01	0.3	0.1	56	19.9	0.05	0.01	1.13	0.22	0.19	0.06
PCH058	532018	6452494	60	0.01	0.7	0.1	46	14.3	0.05	0.01	1.12	0.37	0.37	0.09
PCH059	532022	6452468	39	0.01	0.4	0.1	34	29.6	0.05	0.01	1.28	0.23	0.2	0.08
PCH060	532017	6452462	31	0.01	0.3	0.1	36	19.5	0.05	0.01	1.17	0.43	0.17	0.08
PCH061	532033	6452417	37	0.02	0.6	0.1	39	13.2	0.05	0.01	0.86	0.17	0.28	0.08
PCH062	532063	6452397	20	0.01	0.4	0.1	28	12.2	0.05	0.01	1.02	0.25	0.19	0.07
PCH063	532101	6452273	42	0.02	0.2	0.1	46	6.4	0.05	0.01	0.81	0.29	0.7	0.15
PCH064	532064	6452253	55	0.02	0.5	0.1	113	24.3	0.05	0.01	0.96	0.21	0.23	0.08
PCH065	532082	6452244	46	0.01	0.3	0.1	59	9.7	0.05	0.01	1.35	0.33	0.32	0.11
PCH066	532082	6452168	29	0.005	0.5	0.1	26	14.2	0.05	0.01	0.76	0.15	0.16	0.06
PCH067	532094	6452095	23	0.01	0.3	0.1	21	13.6	0.05	0.01	0.8	0.1	0.25	0.07
PCH068	532098	6452066	28	0.01	0.3	0.1	25	17.1	0.05	0.01	1.27	0.11	0.24	0.09
PCH069	532125	6452054	20	0.01	0.1	0.1	33	11.6	0.05	0.01	0.84	0.21	0.23	0.13

Sample	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo
PCH001	1.9	0.008	9.3	0.013	0.05	0.005	0.001	26	0.01	1.13	0.06	0.22	0.248	110	0.15
PCH002	2.6	0.01	8.43	0.016	0.05	0.02	0.0005	25	0.01	1.18	0.07	0.32	0.269	59	0.06
PCH003	2.4	0.014	8.09	0.025	0.05	0.03	0.008	66	0.01	0.83	0.11	0.8	0.279	173	0.11
PCH004	2.6	0.009	9.49	0.015	0.05	0.03	0.002	38	0.01	1.38	0.08	0.21	0.199	89	0.15
PCH005	2.7	0.014	8.48	0.025	0.05	0.03	0.008	45	0.01	0.74	0.15	0.62	0.286	201	0.13
PCH006	2.4	0.007	9.93	0.012	0.05	0.03	0.0005	38	0.01	1.2	0.05	0.22	0.255	78	0.15
PCH007	2.4	0.009	10.69	0.018	0.05	0.02	0.003	27	0.01	1.31	0.09	0.26	0.227	84	0.13
PCH008	2.5	0.01	11.86	0.022	0.05	0.02	0.003	36	0.01	1.27	0.11	0.36	0.265	84	0.17
PCH009	2.7	0.011	8.8	0.023	0.05	0.02	0.003	51	0.01	0.89	0.14	0.4	0.298	113	0.08
PCH010	2.6	0.008	10.3	0.018	0.05	0.005	0.006	45	0.01	1.3	0.1	0.22	0.286	99	0.09
PCH011	2.7	0.012	10.13	0.021	0.05	0.03	0.002	31	0.01	1.05	0.18	0.32	0.27	163	0.16
PCH012	2.6	0.011	7.11	0.019	0.05	0.02	0.002	21	0.01	0.96	0.12	0.24	0.221	135	0.15
PCH013	2.8	0.014	8.58	0.026	0.05	0.02	0.009	62	0.01	0.91	0.18	0.41	0.282	159	0.12
PCH014	2.5	0.015	10.17	0.024	0.05	0.02	0.006	38	0.01	1.02	0.13	0.3	0.242	54	0.14
PCH015	2.7	0.008	8.94	0.018	0.05	0.02	0.0005	20	0.01	0.94	0.08	0.26	0.281	53	0.15
PCH016	2.5	0.007	8.81	0.018	0.05	0.03	0.002	22	0.01	0.92	0.08	0.25	0.27	53	0.13
PCH017	2.7	0.012	7.8	0.023	0.05	0.03	0.005	31	0.01	0.73	0.17	0.4	0.201	123	0.18
PCH018	2.6	0.013	10.94	0.023	0.05	0.04	0.005	65	0.01	0.87	0.17	0.25	0.294	147	0.17
PCH019	2.9	0.02	10.72	0.034	0.05	0.02	0.006	46	0.01	0.79	0.24	0.61	0.225	409	0.1
PCH020	2.9	0.01	10.81	0.018	0.05	0.03	0.004	37	0.01	0.99	0.1	0.29	0.289	96	0.1
PCH021	2.6	0.009	10.37	0.017	0.05	0.02	0.002	27	0.01	1.07	0.09	0.25	0.269	87	0.11
PCH022	2.4	0.007	10.06	0.02	0.05	0.03	0.003	31	0.01	0.96	0.09	0.38	0.388	107	0.2
PCH023	2.7	0.008	11.42	0.02	0.05	0.03	0.0005	41	0.01	0.99	0.13	0.26	0.309	104	0.31
PCH024	2.7	0.008	9.12	0.018	0.05	0.03	0.0005	32	0.01	1.21	0.14	0.75	0.322	209	0.19
PCH025	2.7	0.011	13.25	0.022	0.05	0.02	0.006	44	0.01	0.7	0.18	0.55	0.282	77	0.14
PCH026	2.8	0.012	13.97	0.022	0.05	0.03	0.006	55	0.01	0.79	0.18	0.57	0.278	106	0.09
PCH027	3	0.012	15.82	0.029	0.05	0.03	0.002	102	0.01	0.64	0.29	0.46	0.219	128	0.18
PCH028	2.7	0.018	18.79	0.038	0.05	0.02	0.004	67	0.01	0.74	0.4	0.46	0.287	173	0.29
PCH029	3.2	0.033	11.87	0.053	0.1	0.005	0.006	90	0.01	0.97	0.38	0.82	0.3	100	0.12
PCH030	2.9	0.026	10.83	0.048	0.1	0.005	0.008	58	0.01	1.02	0.38	0.88	0.313	95	0.12
PCH031	2.7	0.011	7.9	0.017	0.05	0.02	0.003	29	0.01	1.47	0.08	0.19	0.233	62	0.17
PCH032	2.6	0.008	5.17	0.014	0.05	0.005	0.002	20	0.01	0.76	0.07	0.29	0.233	83	0.1
PCH033	2.3	0.009	3.67	0.013	0.05	0.03	0.0005	29	0.01	0.87	0.06	0.24	0.233	98	0.14
PCH034	1.9	0.008	4.34	0.013	0.05	0.005	0.005	16	0.01	0.83	0.06	0.28	0.255	81	0.15
PCH035	2.1	0.008	5.67	0.014	0.05	0.02	0.003	35	0.01	1.26	0.07	0.24	0.217	110	0.16
PCH036	2	0.009	5.21	0.016	0.05	0.02	0.004	33	0.01	1.2	0.08	0.33	0.224	106	0.06
PCH037	2.5	0.018	6.07	0.028	0.05	0.01	0.007	41	0.01	0.76	0.16	0.5	0.333	257	0.12
PCH038	2.4	0.006	5.69	0.012	0.05	0.02	0.001	23	0.01	1.11	0.06	0.18	0.212	89	0.05
PCH039	2.4	0.005	5.13	0.012	0.05	0.03	0.0005	25	0.01	1.23	0.06	0.15	0.248	118	0.07
PCH040	2.4	0.01	4.59	0.017	0.05	0.02	0.006	29	0.01	0.91	0.08	0.27	0.201	104	0.13
PCH041	2.5	0.007	6.96	0.014	0.05	0.02	0.002	20	0.01	1.13	0.06	0.26	0.273	34	0.56
PCH042	2.9	0.018	4.24	0.028	0.05	0.03	0.004	41	0.01	0.95	0.17	0.56	0.301	64	0.11
PCH043	2.5	0.01	6.16	0.014	0.05	0.01	0.002	25	0.01	1.16	0.06	0.32	0.209	258	0.04
PCH044	2.4	0.013	5.95	0.019	0.05	0.02	0.006	33	0.01	1.03	0.09	0.32	0.272	91	0.12
PCH045	2.6	0.012	8.83	0.019	0.05	0.02	0.003	24	0.01	0.97	0.09	0.45	0.335	107	0.34
PCH046	2	0.008	5.53	0.012	0.05	0.005	0.003	28	0.01	1.06	0.06	0.25	0.229	81	0.2
PCH047	2.5	0.015	5.3	0.023	0.05	0.005	0.007	47	0.01	0.68	0.12	0.39	0.24	157	0.1
PCH048	2.3	0.01	5.77	0.018	0.05	0.02	0.0005	30	0.01	1.19	0.1	0.39	0.269	256	0.16
PCH049	2.2	0.013	4.79	0.023	0.05	0.03	0.007	41	0.01	0.81	0.13	0.56	0.249	667	0.11
PCH050	2.5	0.015	5.05	0.021	0.05	0.03	0.006	27	0.01	1.05	0.11	0.39	0.203	184	0.18
PCH051	2.4	0.017	4.22	0.026	0.05	0.02	0.006	41	0.01	0.77	0.14	0.53	0.233	409	0.12
PCH052	2.3	0.012	4.15	0.018	0.05	0.04	0.004	19	0.01	1.23	0.09	0.32	0.243	116	0.12
PCH053	2.4	0.012	3.82	0.018	0.05	0.02	0.003	30	0.01	0.86	0.11	0.35	0.241	142	0.08
PCH054	2.5	0.014	5.75	0.02	0.05	0.02	0.003	22	0.01	0.92	0.14	0.39	0.246	118	0.07
PCH055	2.5	0.007	4.18	0.011	0.05	0.005	0.002	13	0.01	0.92	0.04	0.19	0.171	66	0.12
PCH056	2.3	0.01	7.02	0.018	0.05	0.02	0.0005	22	0.01	1.07	0.07	0.61	0.324	207	0.09
PCH057	2.6	0.011	6.41	0.019	0.05	0.03	0.005	29	0.01	0.83	0.08	0.39	0.206	98	0.14
PCH058	2.5	0.013	4.11	0.02	0.05	0.06	0.001	28	0.01	1.05	0.26	0.52	0.229	128	0.07
PCH059	2.6	0.012	4.42	0.018	0.05	0.04	0.005	25	0.01	0.91	0.08	0.26	0.268	85	0.13
PCH060	2.5	0.011	6.63	0.017	0.05	0.03	0.001	25	0.01	0.93	0.07	0.36	0.216	166	0.09
PCH061	2.4	0.014	6.32	0.02	0.05	0.03	0.0005	23	0.01	1.02	0.13	0.46	0.272	181	0.08
PCH062	2.4	0.009	4.9	0.017	0.05	0.03	0.003	14	0.01	0.9	0.08	0.25	0.218	157	0.07
PCH063	2.5	0.02	5.78	0.023	0.05	0.04	0.004	36	0.01	1.13	0.32	0.79	0.304	289	0.19
PCH064	2.6	0.013	5.55	0.02	0.05	0.04	0.003	30	0.01	0.9	0.1	0.94	0.311	160	0.12
PCH065	2.4	0.012	3.39	0.019	0.05	0.03	0.002	26	0.01	1.12	0.14	0.62	0.271	222	0.13
PCH066	2.4	0.009	5.92	0.014	0.05	0.03	0.001	15	0.01	1.14	0.06	0.33	0.241	113	0.1
PCH067	2.6	0.008	4.6	0.014	0.05	0.06	0.002	19	0.01	0.97	0.13	0.37	0.221	100	0.1
PCH068	2.2	0.012	5.15	0.019	0.05	0.03	0.003	22	0.01	1.03	0.11	0.44	0.218	200	0.19
PCH069	2.4	0.011	5.14	0.018	0.05	0.005	0.001	27	0.01	1.01	0.11	0.54	0.191	290	0.15

Sample	Na	Nb	Ni	P	Pb	Pd	Pt	Rb	Re	S	Sb	Sc	Se	Sn	Sr
PCH001	0.006	0.005	1.3	0.129	31.04	1	0.5	3.3	0.5	0.15	0.1	0.2	0.1	0.05	51.5
PCH002	0.144	0.005	2	0.155	39.93	1	0.5	3.1	0.5	0.19	0.13	0.2	0.1	0.02	70.3
PCH003	0.132	0.005	1.6	0.131	56.49	1	0.5	1.5	3	0.21	0.18	0.3	0.3	0.03	107.2
PCH004	0.131	0.005	2.2	0.165	65.89	1	0.5	3.1	0.5	0.23	0.21	0.3	0.2	0.03	59.5
PCH005	0.126	0.01	1.7	0.149	50.19	1	0.5	1.4	0.5	0.22	0.18	0.3	0.1	0.02	93.2
PCH006	0.323	0.005	2.8	0.146	28.74	1	0.5	2.9	1	0.2	0.09	0.3	0.1	0.01	56.9
PCH007	0.103	0.005	2.2	0.18	72.66	1	0.5	2.6	0.5	0.2	0.24	0.2	0.2	0.03	74.5
PCH008	0.019	0.005	1.4	0.18	108.66	1	0.5	1.9	0.5	0.21	0.35	0.3	0.1	0.03	117
PCH009	0.188	0.005	1.6	0.138	118.26	1	0.5	1.6	4	0.23	0.39	0.2	0.2	0.04	95.1
PCH010	0.055	0.005	1.5	0.122	89.28	1	0.5	3.3	2	0.22	0.28	0.2	0.05	0.03	73
PCH011	0.123	0.005	3.5	0.111	123.58	1	0.5	4.9	3	0.22	0.38	0.2	0.05	0.03	91.6
PCH012	0.15	0.005	3.4	0.091	100.49	2	0.5	3.1	0.5	0.21	0.31	0.4	0.1	0.03	65.5
PCH013	0.178	0.005	2.4	0.136	153.75	1	0.5	1.4	1	0.22	0.51	0.3	0.1	0.04	78.4
PCH014	0.201	0.01	2.6	0.126	153.12	1	0.5	3.2	0.5	0.2	0.51	0.3	0.05	0.03	69.2
PCH015	0.222	0.005	1.2	0.127	79.54	1	0.5	1	0.5	0.23	0.25	0.3	0.1	0.03	139.5
PCH016	0.213	0.005	1.3	0.127	82.4	1	0.5	1	0.5	0.2	0.28	0.3	0.2	0.03	136.3
PCH017	0.372	0.005	2.4	0.135	117.03	1	0.5	1.5	1	0.2	0.43	0.3	0.1	0.03	61.3
PCH018	0.389	0.005	3.9	0.12	193.36	1	0.5	1.9	3	0.22	0.62	0.3	0.05	0.04	44.4
PCH019	0.386	0.01	3.1	0.14	247.27	1	0.5	1.6	3	0.21	0.85	0.3	0.1	0.06	49.2
PCH020	0.391	0.005	2.3	0.164	97.2	1	0.5	1.9	0.5	0.23	0.34	0.3	0.05	0.04	52.7
PCH021	0.122	0.005	2	0.131	95.73	1	0.5	2.1	3	0.25	0.32	0.3	0.1	0.02	78.3
PCH022	0.142	0.005	2.8	0.135	82.43	1	0.5	1.6	2	0.26	0.27	0.3	0.2	0.03	110.2
PCH023	0.135	0.005	2.9	0.122	187.14	1	0.5	2.8	2	0.25	0.58	0.2	0.2	0.05	63.8
PCH024	0.182	0.005	1.8	0.116	153.43	1	0.5	2.3	7	0.25	0.49	0.2	0.2	0.02	86
PCH025	0.315	0.005	2.5	0.12	218.29	1	0.5	1.1	4	0.23	0.73	0.3	0.3	0.06	58.6
PCH026	0.383	0.005	3.4	0.129	190.43	1	0.5	1.1	11	0.25	0.65	0.3	0.3	0.06	41.3
PCH027	0.272	0.005	2.9	0.118	402.95	1	0.5	1.3	8	0.23	1.33	0.3	0.5	0.09	46.3
PCH028	0.401	0.01	2	0.11	580.68	1	1	3	6	0.25	2.08	0.2	0.8	0.09	65.8
PCH029	0.346	0.03	0.9	0.096	457.65	1	0.5	2.4	5	0.28	1.97	0.3	0.1	0.14	29.6
PCH030	0.353	0.03	0.8	0.1	430.96	1	0.5	2.3	5	0.28	1.82	0.3	0.05	0.1	28.9
PCH031	0.388	0.005	0.7	0.162	16.74	1	0.5	5.2	1	0.27	0.1	0.3	0.2	0.01	29.5
PCH032	0.268	0.005	0.6	0.118	16.06	1	0.5	1.4	6	0.25	0.09	0.3	0.05	0.01	40.2
PCH033	0.24	0.005	0.4	0.128	13.04	1	0.5	2.4	9	0.23	0.07	0.3	0.05	0.01	48.6
PCH034	0.162	0.005	0.6	0.111	12.15	1	0.5	1.5	10	0.1	0.05	0.2	0.05	0.01	55.3
PCH035	0.225	0.005	0.9	0.129	10.73	1	0.5	2.4	6	0.18	0.06	0.2	0.2	0.01	44.1
PCH036	0.138	0.005	0.9	0.126	15.52	1	0.5	2.1	15	0.11	0.08	0.3	0.05	0.03	54.1
PCH037	0.195	0.01	1	0.174	31.47	1	0.5	1	10	0.15	0.14	0.3	0.05	0.03	64.3
PCH038	0.022	0.005	1.4	0.132	9.05	1	0.5	1.9	8	0.14	0.05	0.4	0.1	0.01	53.5
PCH039	0.024	0.005	0.5	0.124	6.76	1	0.5	3	2	0.17	0.04	0.3	0.1	0.01	58.8
PCH040	0.2	0.005	0.9	0.099	13.1	1	0.5	1.6	2	0.17	0.07	0.3	0.05	0.01	55.1
PCH041	0.011	0.005	0.4	0.184	8.01	1	0.5	3	0.5	0.2	0.05	0.3	0.1	0.01	57.7
PCH042	0.048	0.005	1.2	0.158	20.03	1	0.5	1.1	4	0.16	0.07	0.4	0.05	0.01	60.9
PCH043	0.164	0.005	1.7	0.126	6.59	1	0.5	2.5	7	0.14	0.04	0.3	0.1	0.01	45.9
PCH044	0.232	0.005	0.9	0.144	9.45	1	0.5	1.7	3	0.16	0.05	0.3	0.05	0.02	47.2
PCH045	0.04	0.005	1.4	0.117	19.27	1	0.5	1.4	10	0.17	0.08	0.3	0.1	0.01	57.9
PCH046	0.029	0.005	0.8	0.133	6.71	1	0.5	2.1	2	0.03	0.04	0.2	0.05	0.01	42.9
PCH047	0.273	0.005	1.5	0.157	16.75	1	0.5	1	6	0.12	0.07	0.3	0.1	0.01	46.2
PCH048	0.024	0.005	1.4	0.162	10.41	1	0.5	2.1	5	0.16	0.05	0.3	0.2	0.01	69.6
PCH049	0.031	0.005	1.4	0.125	22.48	1	0.5	1	6	0.15	0.1	0.3	0.2	0.01	79.8
PCH050	0.037	0.005	0.8	0.142	10.97	1	0.5	2.1	2	0.14	0.05	0.3	0.1	0.01	49.4
PCH051	0.097	0.005	1.2	0.144	18.96	1	0.5	1.1	4	0.14	0.09	0.3	0.1	0.01	62.8
PCH052	0.091	0.005	0.7	0.138	12.11	1	0.5	2.3	2	0.14	0.05	0.3	0.1	0.01	57.7
PCH053	0.245	0.005	1.1	0.126	11.94	1	0.5	1.5	2	0.12	0.06	0.3	0.05	0.01	47.9
PCH054	0.197	0.005	2.2	0.131	13.52	1	0.5	2.5	1	0.13	0.07	0.3	0.05	0.04	62.4
PCH055	0.163	0.005	0.4	0.099	7.81	1	0.5	1.7	0.5	0.11	0.04	0.3	0.05	0.01	38.8
PCH056	0.029	0.005	0.7	0.132	11.48	1	0.5	2	2	0.13	0.05	0.3	0.1	0.01	97.2
PCH057	0.126	0.005	1	0.11	13.49	1	0.5	1.1	3	0.14	0.06	0.3	0.1	0.01	100.6
PCH058	0.176	0.005	1.1	0.118	22.75	1	0.5	1.4	5	0.16	0.09	0.2	0.05	0.01	51.1
PCH059	0.024	0.005	0.4	0.103	12.3	1	0.5	2	1	0.12	0.06	0.3	0.05	0.01	76.3
PCH060	0.197	0.005	0.8	0.135	10.54	1	0.5	1.8	4	0.14	0.05	0.3	0.05	0.01	63.2
PCH061	0.134	0.005	1.2	0.097	13.92	1	0.5	1.4	3	0.12	0.06	0.3	0.1	0.01	36.8
PCH062	0.033	0.005	0.9	0.099	8.07	1	0.5	1.5	5	0.12	0.03	0.3	0.05	0.01	56.4
PCH063	0.308	0.005	2	0.164	16.98	1	0.5	2.5	5	0.15	0.06	0.3	0.1	0.01	34.2
PCH064	0.347	0.005	1	0.177	18.47	1	0.5	1	7	0.14	0.08	0.3	0.1	0.01	49.2
PCH065	0.056	0.005	1	0.125	18.31	1	0.5	2.5	10	0.11	0.07	0.3	0.1	0.01	74
PCH066	0.078	0.005	1	0.097	11.66	1	0.5	2.5	2	0.1	0.05	0.2	0.1	0.01	37.8
PCH067	0.299	0.005	0.7	0.098	8.93	1	1	2.3	3	0.11	0.03	0.2	0.05	0.01	34.9
PCH068	0.199	0.005	1.2	0.117	10.83	1	0.5	2.3	3	0.13	0.05	0.3	0.05	0.01	64.6
PCH069	0.193	0.005	1.5	0.12	8.11	1	0.5	2.5	3	0.1	0.04	0.2	0.05	0.01	42

Sample	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
PCH001	0.0005	0.01	0.005	2	0.01	0.005	1	0.05	0.043	32.9	0.05
PCH002	0.0005	0.01	0.01	2	0.01	0.005	6	0.05	0.048	49.7	0.07
PCH003	0.0005	0.01	0.02	3	0.01	0.02	8	0.05	0.081	52.9	0.12
PCH004	0.0005	0.01	0.01	2	0.01	0.005	11	0.05	0.048	50.5	0.06
PCH005	0.0005	0.01	0.02	4	0.01	0.005	10	0.05	0.099	45.9	0.12
PCH006	0.0005	0.01	0.005	2	0.01	0.005	11	0.05	0.035	35.3	0.04
PCH007	0.0005	0.01	0.01	3	0.01	0.005	13	0.05	0.064	57.6	0.08
PCH008	0.0005	0.01	0.02	3	0.01	0.01	12	0.05	0.069	73	0.09
PCH009	0.0005	0.01	0.03	3	0.01	0.01	13	0.05	0.089	65.9	0.1
PCH010	0.0005	0.01	0.02	2	0.01	0.01	14	0.05	0.066	59	0.06
PCH011	0.0005	0.01	0.02	3	0.01	0.01	14	0.05	0.115	65.8	0.11
PCH012	0.0005	0.01	0.02	3	0.01	0.01	14	0.05	0.08	53.2	0.1
PCH013	0.0005	0.01	0.04	4	0.01	0.02	13	0.05	0.111	74.3	0.13
PCH014	0.0005	0.01	0.04	4	0.01	0.02	14	0.05	0.099	74.4	0.13
PCH015	0.0005	0.01	0.02	2	0.01	0.01	14	0.05	0.05	45.9	0.06
PCH016	0.0005	0.01	0.02	3	0.01	0.01	13	0.05	0.055	50.7	0.07
PCH017	0.0005	0.01	0.02	3	0.01	0.02	16	0.05	0.089	61.1	0.11
PCH018	0.0005	0.01	0.02	3	0.01	0.03	18	0.05	0.097	84.8	0.11
PCH019	0.0005	0.01	0.04	6	0.01	0.02	15	0.05	0.151	120.7	0.18
PCH020	0.0005	0.01	0.02	3	0.01	0.02	16	0.05	0.066	61.9	0.08
PCH021	0.0005	0.01	0.01	3	0.01	0.005	18	0.05	0.055	56.5	0.07
PCH022	0.0005	0.01	0.01	2	0.01	0.01	16	0.05	0.058	61.8	0.07
PCH023	0.0005	0.01	0.02	3	0.01	0.02	19	0.05	0.072	88.7	0.08
PCH024	0.0005	0.01	0.02	2	0.01	0.02	20	0.05	0.083	72.8	0.07
PCH025	0.0005	0.01	0.03	3	0.01	0.02	20	0.05	0.106	85.4	0.11
PCH026	0.0005	0.01	0.03	3	0.01	0.02	22	0.05	0.1	82.2	0.13
PCH027	0.0005	0.01	0.06	4	0.01	0.05	24	0.05	0.168	123.2	0.15
PCH028	0.0005	0.01	0.07	5	0.01	0.07	17	0.05	0.201	186.9	0.18
PCH029	0.001	0.01	0.09	8	0.01	0.05	20	0.05	0.211	254.2	0.26
PCH030	0.0005	0.01	0.1	7	0.01	0.05	19	0.05	0.194	231.6	0.23
PCH031	0.0005	0.01	0.005	3	0.01	0.005	20	0.05	0.048	49	0.09
PCH032	0.0005	0.01	0.005	2	0.01	0.005	19	0.05	0.053	45.7	0.06
PCH033	0.0005	0.01	0.01	2	0.01	0.005	19	0.05	0.039	35.9	0.06
PCH034	0.0005	0.01	0.01	2	0.01	0.005	1	0.05	0.05	45.3	0.05
PCH035	0.0005	0.01	0.01	2	0.01	0.005	4	0.05	0.05	48.3	0.05
PCH036	0.0005	0.01	0.02	3	0.01	0.005	1	0.05	0.058	60.9	0.08
PCH037	0.0005	0.01	0.03	4	0.01	0.01	7	0.05	0.113	37.4	0.15
PCH038	0.0005	0.01	0.005	2	0.01	0.005	10	0.05	0.039	39.2	0.05
PCH039	0.0005	0.01	0.005	2	0.01	0.005	11	0.05	0.034	26.9	0.05
PCH040	0.0005	0.01	0.02	2	0.01	0.005	12	0.05	0.069	31.6	0.09
PCH041	0.0005	0.01	0.01	2	0.01	0.005	14	0.05	0.038	41.3	0.07
PCH042	0.0005	0.01	0.03	4	0.01	0.005	18	0.05	0.116	40.7	0.16
PCH043	0.0005	0.01	0.01	2	0.01	0.005	16	0.05	0.044	26.8	0.07
PCH044	0.002	0.01	0.02	3	0.01	0.005	16	0.05	0.052	21.7	0.12
PCH045	0.0005	0.01	0.02	3	0.01	0.005	15	0.05	0.066	61.9	0.11
PCH046	0.0005	0.01	0.005	2	0.01	0.005	1	0.05	0.043	36.5	0.06
PCH047	0.0005	0.01	0.02	3	0.01	0.005	5	0.05	0.082	28.9	0.15
PCH048	0.0005	0.01	0.02	2	0.01	0.005	6	0.05	0.08	50.4	0.08
PCH049	0.0005	0.01	0.02	3	0.01	0.01	4	0.05	0.09	52	0.11
PCH050	0.0005	0.01	0.02	3	0.01	0.005	5	0.05	0.08	64.7	0.13
PCH051	0.0005	0.01	0.03	4	0.01	0.005	5	0.05	0.094	46.4	0.15
PCH052	0.0005	0.01	0.02	3	0.01	0.005	6	0.05	0.074	43.2	0.09
PCH053	0.0005	0.01	0.02	3	0.01	0.005	10	0.05	0.118	24.4	0.09
PCH054	0.0005	0.01	0.02	3	0.01	0.005	11	0.05	0.114	27	0.11
PCH055	0.0005	0.01	0.01	2	0.01	0.005	13	0.05	0.032	25.8	0.05
PCH056	0.0005	0.01	0.02	2	0.01	0.01	11	0.05	0.064	53	0.08
PCH057	0.0005	0.01	0.01	3	0.01	0.01	14	0.05	0.054	35.3	0.09
PCH058	0.0005	0.01	0.03	3	0.01	0.01	14	0.05	0.198	41.7	0.12
PCH059	0.0005	0.01	0.02	3	0.01	0.005	15	0.05	0.068	30.9	0.09
PCH060	0.0005	0.01	0.005	2	0.01	0.005	14	0.05	0.072	39.9	0.07
PCH061	0.0005	0.01	0.02	3	0.01	0.005	16	0.05	0.125	31.6	0.12
PCH062	0.0005	0.01	0.02	3	0.01	0.005	15	0.05	0.085	26.8	0.08
PCH063	0.0005	0.01	0.03	4	0.01	0.01	15	0.05	0.385	27.1	0.14
PCH064	0.0005	0.01	0.02	3	0.01	0.01	18	0.05	0.083	32.6	0.11
PCH065	0.0005	0.01	0.02	3	0.01	0.01	14	0.05	0.161	31.2	0.1
PCH066	0.0005	0.01	0.005	2	0.01	0.005	18	0.05	0.091	22.2	0.07
PCH067	0.0005	0.01	0.01	2	0.01	0.005	18	0.05	0.212	20.4	0.06
PCH068	0.0005	0.01	0.02	3	0.01	0.005	14	0.05	0.138	28.8	0.09
PCH069	0.0005	0.01	0.02	3	0.01	0.005	13	0.05	0.143	27.4	0.1

Sample	**Eastings**	**Northings**	**Ag**	**Al**	**As**	**Au**	**B**	**Ba**	**Be**	**Bi**	**Ca**	**Cd**	**Ce**	**Co**
PCH070	532132	6452048	27	0.02	0.5	0.1	39	15.5	0.05	0.01	1.52	0.13	0.28	0.1
PCH071	532255	6452044	42	0.01	0.4	0.4	89	29.6	0.05	0.04	1.86	0.18	0.24	0.11
PCH072	532205	6452018	36	0.005	0.5	0.3	40	23.6	0.05	0.01	1.23	0.25	0.17	0.09
PCH073	532255	6452014	39	0.02	0.3	0.1	79	35.2	0.05	0.01	1.68	0.29	0.25	0.11
PCH074	532310	6451932	22	0.01	0.4	0.1	58	17	0.05	0.01	1.08	0.21	0.16	0.08
PCH075	532326	6451923	19	0.01	0.05	0.5	47	14.9	0.05	0.01	0.92	0.18	0.15	0.05
PCH076	532339	6451885	12	0.01	0.3	0.4	61	21.1	0.05	0.01	1.11	0.25	0.15	0.07
PCH077	532342	6451865	18	0.01	0.3	0.1	48	12.9	0.05	0.01	1.03	0.11	0.22	0.06
PCH078	532337	6451838	32	0.02	0.2	0.1	31	14.8	0.05	0.01	0.99	0.3	0.22	0.12
PCH079	532364	6451772	19	0.01	0.4	0.1	71	23.8	0.05	0.01	1.95	0.19	0.16	0.09
PCH080	532374	6451710	30	0.01	0.6	0.1	45	21.1	0.05	0.01	1.63	0.11	0.19	0.11
PCH081	532378	6451660	43	0.02	0.4	0.3	71	20.9	0.05	0.01	1.25	0.15	0.31	0.09
PCH082	532397	6451655	31	0.02	0.3	0.3	40	14	0.05	0.01	0.81	0.1	0.26	0.09
PCH083	532396	6451639	25	0.02	0.2	0.1	82	11.2	0.05	0.01	1.11	0.18	0.24	0.07
PCH084	532425	6451623	12	0.01	0.2	0.1	69	15	0.05	0.01	0.91	0.15	0.15	0.09
PCH085	532517	6451599	19	0.02	0.4	0.1	58	14.5	0.05	0.01	0.97	0.1	0.23	0.09
PCH086	532470	6451598	16	0.02	0.4	0.1	94	17.3	0.05	0.01	1.02	0.14	0.2	0.09
PCH087	532496	6451592	18	0.01	0.2	0.1	73	12	0.05	0.01	0.84	0.11	0.23	0.08
PCH088	532559	6451563	12	0.02	0.4	0.1	74	16.9	0.05	0.01	1.33	0.4	0.24	0.1
PCH089	532572	6451538	10	0.005	0.3	0.1	76	12.7	0.05	0.01	0.7	0.18	0.14	0.08
PCH090	532573	6451474	14	0.01	0.4	0.1	62	24.1	0.05	0.01	1.18	0.44	0.21	0.13
PCH091	532591	6451446	15	0.01	0.1	0.1	74	13.2	0.05	0.01	0.95	0.12	0.16	0.11
PCH092	532609	6451418	18	0.01	0.2	0.1	38	13.9	0.05	0.01	0.81	0.12	0.14	0.07
PCH093	532628	6451404	27	0.005	0.05	0.1	46	24.9	0.05	0.01	1	0.08	0.15	0.08
PCH094	532655	6451314	20	0.02	0.2	0.1	35	15.7	0.05	0.01	1.19	0.07	0.19	0.09
PCH095	532687	6451262	27	0.02	0.1	0.1	46	26.4	0.05	0.01	1.2	0.18	0.25	0.06
PCH096	532683	6451234	15	0.02	0.4	0.1	39	17	0.05	0.01	1.08	0.2	0.26	0.11
PCH097	532683	6451198	9	0.02	0.2	0.1	33	12.8	0.05	0.01	0.78	0.17	0.19	0.07
PCH098	532688	6451168	18	0.01	0.05	0.1	71	7.1	0.05	0.01	0.93	0.1	0.16	0.09
PCH099	532696	6451127	15	0.01	0.05	0.1	78	13.2	0.05	0.01	0.86	0.1	0.14	0.07
PCH100	532763	6451101	14	0.01	0.05	0.1	49	12.4	0.05	0.01	0.81	0.11	0.16	0.08
PCH101	532902	6451098	20	0.01	0.05	0.1	64	17.4	0.05	0.01	0.89	0.39	0.21	0.13
PCH102	532838	6451083	18	0.01	0.4	0.1	57	10.9	0.05	0.01	0.81	0.16	0.17	0.07
PCH103	532795	6451075	13	0.02	0.2	0.1	48	11.8	0.05	0.01	1.33	0.25	0.21	0.11
PCH104	532880	6451064	10	0.01	0.3	0.1	81	22.6	0.05	0.01	0.93	0.24	0.16	0.08
PCH105	532973	6451061	10	0.005	0.05	0.1	54	24.9	0.05	0.01	0.83	0.25	0.12	0.09
PCH106	532974	6451061	12	0.005	0.1	0.1	25	16.3	0.05	0.03	0.91	0.17	0.1	0.12
PCH107	532728	6451056	18	0.005	0.3	0.1	36	27.1	0.05	0.01	1.37	0.16	0.18	0.08
PCH108	532760	6451053	18	0.01	0.1	0.1	33	20.1	0.05	0.01	1.28	0.17	0.18	0.14
PCH109	532770	6451051	16	0.02	0.2	0.1	45	10.6	0.05	0.01	1.02	0.3	0.26	0.13
PCH110	532944	6451051	13	0.005	0.05	0.1	61	23.3	0.05	0.01	1.41	0.2	0.19	0.12
PCH111	532977	6451047	18	0.01	0.2	0.1	50	39	0.05	0.01	1.22	0.19	0.2	0.15
PCH112	532951	6451045	18	0.01	0.05	0.1	63	19.7	0.05	0.01	0.98	0.58	0.23	0.08
PCH113	533076	6451012	19	0.02	0.1	0.1	79	42.2	0.05	0.01	2.08	0.26	0.27	0.17
PCH114	533136	6451001	13	0.01	0.05	0.1	37	33.5	0.05	0.01	0.99	0.54	0.22	0.09
PCH115	533114	6450993	9	0.005	0.05	0.1	27	18.7	0.05	0.01	0.96	0.1	0.16	0.1
PCH116	533140	6450984	15	0.01	0.05	0.1	41	18.4	0.05	0.01	0.82	0.13	0.16	0.07
PCH117	533241	6450924	11	0.02	0.05	0.1	36	19.2	0.05	0.01	1.19	0.2	0.24	0.1
PCH118	533255	6450919	11	0.02	0.05	0.1	36	26.7	0.05	0.01	1.03	0.13	0.23	0.1
PCH119	533009	6450859	8	0.005	0.05	0.1	20	21.6	0.05	0.01	1.09	0.07	0.14	0.06
PCH120	533341	6450820	6	0.01	0.05	0.1	27	12.7	0.05	0.01	0.72	0.08	0.15	0.08
PCH121	533377	6450794	11	0.005	0.05	0.1	45	18.9	0.05	0.01	0.8	0.19	0.13	0.1
PCH122	533466	6450750	9	0.02	0.05	0.1	52	16.4	0.05	0.01	0.78	0.16	0.22	0.08
PCH123	533498	6450741	12	0.02	0.2	0.1	40	23.9	0.05	0.01	1.01	0.23	0.29	0.09
PCH124	533549	6450685	7	0.02	0.05	0.1	53	19.3	0.05	0.01	0.92	0.13	0.24	0.19
PCH125	533554	6450682	4	0.005	0.05	0.1	29	16	0.05	0.01	0.79	0.16	0.13	0.13
PCH126	533610	6450637	5	0.005	0.05	0.2	30	13.4	0.05	0.01	1.07	0.19	0.12	0.11
PCH127	533624	6450599	8	0.005	0.05	0.1	35	15.6	0.05	0.01	0.96	0.31	0.12	0.11
PCH128	533626	6450574	5	0.005	0.05	0.1	34	8.9	0.05	0.01	1	0.74	0.12	0.1
PCH129	533636	6450547	6	0.01	0.2	0.1	37	4.8	0.05	0.01	0.62	0.14	0.15	0.09

Sample	**Cr**	**Cs**	**Cu**	**Fe**	**Ga**	**Ge**	**Hf**	**Hg**	**In**	**K**	**La**	**Li**	**Mg**	**Mn**	**Mo**
PCH070	2.2	0.011	3.8	0.021	0.05	0.02	0.0005	19	0.01	0.88	0.14	0.48	0.198	327	0.07
PCH071	2.1	0.013	4.58	0.023	0.05	0.01	0.002	29	0.01	0.98	0.1	0.49	0.226	111	0.07
PCH072	2.3	0.011	6.84	0.018	0.05	0.04	0.004	18	0.01	1.21	0.07	0.36	0.231	143	0.09
PCH073	2.6	0.015	6.98	0.024	0.05	0.02	0.007	21	0.01	1.13	0.13	0.44	0.261	74	0.21
PCH074	2.6	0.01	4.71	0.018	0.05	0.03	0.003	13	0.01	0.91	0.07	0.39	0.273	62	0.07
PCH075	2.9	0.007	4.84	0.014	0.05	0.01	0.002	10	0.01	1.06	0.06	0.4	0.202	49	0.05
PCH076	2.4	0.009	5.61	0.015	0.05	0.03	0.005	22	0.01	1.38	0.06	0.31	0.263	123	0.13
PCH077	2	0.012	3.36	0.018	0.05	0.01	0.006	18	0.01	1.01	0.1	0.38	0.205	73	0.1
PCH078	2.4	0.012	5.79	0.017	0.05	0.03	0.002	28	0.01	1.45	0.11	0.33	0.225	174	0.11
PCH079	2.5	0.013	4.1	0.021	0.05	0.04	0.003	21	0.01	1.09	0.08	0.48	0.215	77	0.22
PCH080	2.4	0.011	5.53	0.021	0.05	0.03	0.004	21	0.01	1.04	0.08	0.57	0.214	118	0.08
PCH081	2.6	0.017	4.32	0.025	0.05	0.02	0.004	37	0.01	0.86	0.13	0.7	0.218	127	0.15
PCH082	2.7	0.016	5	0.023	0.05	0.04	0.009	16	0.01	1.16	0.12	0.49	0.179	81	0.08
PCH083	2.6	0.014	3.66	0.019	0.05	0.02	0.005	36	0.01	0.87	0.12	1.02	0.198	157	0.07
PCH084	2.6	0.009	4.52	0.016	0.05	0.01	0.0005	19	0.01	1.17	0.06	0.5	0.222	132	0.09
PCH085	2.7	0.012	6.9	0.021	0.05	0.02	0.001	26	0.01	1.46	0.09	0.36	0.212	59	0.13
PCH086	2.9	0.013	5.69	0.021	0.05	0.05	0.004	23	0.01	0.91	0.09	0.74	0.241	78	0.14
PCH087	2.8	0.015	5.18	0.022	0.05	0.03	0.001	24	0.01	1.14	0.09	0.48	0.212	76	0.15
PCH088	2.7	0.013	5.65	0.022	0.05	0.03	0.007	28	0.01	0.94	0.1	0.67	0.332	135	0.07
PCH089	2.6	0.008	5.56	0.013	0.05	0.03	0.0005	10	0.01	1.07	0.05	0.21	0.196	58	0.1
PCH090	2.7	0.011	7.69	0.018	0.05	0.05	0.004	21	0.01	1.12	0.08	0.59	0.279	481	0.06
PCH091	2.4	0.01	8.27	0.015	0.05	0.04	0.0005	23	0.01	0.96	0.07	0.53	0.225	73	0.07
PCH092	2.7	0.009	5.75	0.015	0.05	0.02	0.0005	16	0.01	0.9	0.07	0.33	0.234	75	0.06
PCH093	2.5	0.01	9.12	0.016	0.05	0.03	0.0005	20	0.01	1.09	0.06	0.49	0.161	52	0.1
PCH094	2.7	0.013	7.54	0.019	0.05	0.05	0.008	17	0.01	0.81	0.09	0.27	0.194	44	0.06
PCH095	2.6	0.014	7.74	0.022	0.05	0.02	0.003	22	0.01	0.74	0.09	0.36	0.247	156	0.15
PCH096	2.6	0.018	5.07	0.024	0.05	0.03	0.007	15	0.01	1.32	0.13	0.27	0.192	214	0.17
PCH097	3.2	0.013	5.13	0.018	0.05	0.02	0.004	15	0.01	1.16	0.08	0.23	0.204	73	0.18
PCH098	2.7	0.011	8.15	0.015	0.05	0.03	0.003	30	0.01	1.36	0.06	0.29	0.195	65	0.16
PCH099	2.8	0.009	8.26	0.014	0.05	0.04	0.003	29	0.01	1.22	0.06	0.28	0.178	73	0.32
PCH100	2.8	0.01	7.92	0.016	0.05	0.03	0.003	29	0.01	1.38	0.07	0.22	0.196	61	0.13
PCH101	2.9	0.013	7.82	0.021	0.05	0.03	0.008	31	0.01	1.22	0.09	0.37	0.313	117	0.13
PCH102	2.8	0.01	8.3	0.017	0.05	0.01	0.003	17	0.01	0.84	0.07	0.28	0.226	72	0.06
PCH103	2.7	0.013	7.08	0.021	0.05	0.02	0.003	40	0.01	1.29	0.09	0.4	0.199	95	0.07
PCH104	2.7	0.01	3.56	0.018	0.05	0.03	0.003	25	0.01	0.71	0.06	0.47	0.26	142	0.1
PCH105	2.8	0.008	6.72	0.014	0.05	0.04	0.003	20	0.01	1.36	0.05	0.27	0.199	103	0.14
PCH106	1.9	0.009	7.44	0.011	0.05	0.01	0.001	19	0.01	1.03	0.05	0.22	0.202	99	0.16
PCH107	2.2	0.011	6.56	0.019	0.05	0.03	0.005	27	0.01	1.06	0.08	0.33	0.289	42	0.07
PCH108	2.3	0.009	6.86	0.018	0.05	0.04	0.001	36	0.01	1.2	0.08	0.24	0.261	136	0.14
PCH109	2.5	0.014	4.29	0.023	0.05	0.03	0.001	44	0.01	0.79	0.1	0.31	0.256	238	0.11
PCH110	2.5	0.01	4.83	0.016	0.05	0.03	0.007	31	0.01	0.9	0.08	0.3	0.24	116	0.1
PCH111	2.4	0.012	5.97	0.02	0.05	0.03	0.007	35	0.01	1.29	0.08	0.41	0.226	99	0.13
PCH112	2.7	0.011	6.73	0.018	0.05	0.02	0.005	20	0.01	0.74	0.08	0.38	0.337	142	0.12
PCH113	2.3	0.014	5.09	0.025	0.05	0.03	0.006	28	0.01	0.91	0.15	0.83	0.338	419	0.07
PCH114	2.3	0.011	6.21	0.019	0.05	0.02	0.002	28	0.01	0.72	0.1	0.53	0.318	498	0.1
PCH115	2.3	0.011	3.78	0.014	0.05	0.02	0.007	24	0.01	1.02	0.07	0.2	0.231	41	0.13
PCH116	2.6	0.008	9.94	0.015	0.05	0.03	0.004	38	0.01	0.83	0.07	0.3	0.226	116	0.11
PCH117	2.5	0.016	5.21	0.023	0.05	0.04	0.004	17	0.01	1.17	0.11	0.24	0.238	80	0.07
PCH118	2.5	0.013	5.78	0.021	0.05	0.02	0.001	29	0.01	1.26	0.11	0.33	0.265	115	0.15
PCH119	2.5	0.014	5.04	0.016	0.05	0.05	0.003	40	0.01	1.2	0.06	0.2	0.244	69	0.07
PCH120	2.4	0.009	5.52	0.014	0.05	0.03	0.004	14	0.01	1.02	0.06	0.22	0.198	189	0.13
PCH121	2.3	0.008	6.42	0.014	0.05	0.02	0.005	23	0.01	0.89	0.05	0.28	0.214	122	0.12
PCH122	2.7	0.013	5.49	0.018	0.05	0.04	0.001	21	0.01	1.05	0.09	0.2	0.212	81	0.16
PCH123	2.4	0.015	5.07	0.021	0.05	0.02	0.005	24	0.01	1.15	0.11	0.34	0.197	142	0.11
PCH124	2.4	0.012	6.26	0.022	0.05	0.04	0.008	27	0.01	0.92	0.1	0.51	0.245	230	0.09
PCH125	2.6	0.008	4.98	0.014	0.05	0.04	0.002	23	0.01	1.14	0.06	0.23	0.191	82	0.08
PCH126	2.8	0.007	6.13	0.015	0.05	0.04	0.002	23	0.01	1.39	0.05	0.43	0.177	94	0.1
PCH127	2.2	0.007	8.99	0.013	0.05	0.03	0.004	27	0.01	1.42	0.05	0.47	0.212	142	0.14
PCH128	2.3	0.007	5.81	0.015	0.05	0.05	0.004	31	0.01	1.22	0.05	0.47	0.22	97	0.08
PCH129	2.6	0.009	5.45	0.012	0.05	0.04	0.0005	45	0.01	1.39	0.05	0.33	0.198	162	0.08

Sample	Na	Nb	Ni	P	Pb	Pd	Pt	Rb	Re	S	Sb	Sc	Se	Sn	Sr
PCH070	0.149	0.005	0.9	0.102	8.33	1	0.5	1.8	5	0.11	0.04	0.2	0.1	0.02	71.4
PCH071	0.018	0.005	1.7	0.131	14.2	1	0.5	2.1	3	0.11	0.08	0.2	0.05	0.03	119.9
PCH072	0.009	0.005	0.9	0.124	10.95	1	0.5	2.9	2	0.14	0.05	0.2	0.05	0.01	78.7
PCH073	0.016	0.01	1.4	0.148	11.29	1	0.5	3.3	4	0.17	0.06	0.3	0.1	0.01	98.8
PCH074	0.105	0.005	1.1	0.109	8.68	1	0.5	2.5	1	0.14	0.05	0.3	0.2	0.01	59.7
PCH075	0.084	0.005	1	0.109	7.11	1	0.5	1.8	1	0.15	0.03	0.3	0.1	0.01	49.6
PCH076	0.062	0.005	0.8	0.16	4.74	1	0.5	3.5	6	0.16	0.03	0.3	0.05	0.01	58.9
PCH077	0.057	0.005	1.8	0.1	6.87	1	1	2.5	10	0.03	0.04	0.3	0.05	0.01	54.2
PCH078	0.067	0.005	2	0.121	9.03	1	0.5	4.5	3	0.13	0.04	0.2	0.1	0.01	53.7
PCH079	0.082	0.005	1.3	0.098	7.72	1	0.5	5.4	5	0.12	0.05	0.2	0.05	0.01	126.1
PCH080	0.187	0.005	1.4	0.098	9.2	1	0.5	3.6	6	0.14	0.06	0.3	0.1	0.01	74.4
PCH081	0.236	0.005	1.2	0.104	13.91	1	0.5	2.4	7	0.14	0.06	0.3	0.05	0.01	59.5
PCH082	0.045	0.005	0.9	0.143	11.54	1	0.5	2.7	2	0.12	0.04	0.3	0.05	0.01	40.5
PCH083	0.313	0.005	1.8	0.128	10.78	1	0.5	1.3	5	0.13	0.05	0.4	0.05	0.01	50.8
PCH084	0.098	0.005	1.8	0.14	4.53	1	0.5	1.6	2	0.1	0.03	0.3	0.05	0.01	57.2
PCH085	0.099	0.005	2	0.158	8.06	1	0.5	3.3	2	0.15	0.04	0.3	0.2	0.01	52.4
PCH086	0.204	0.005	2.7	0.132	5.58	1	0.5	1.2	3	0.12	0.04	0.4	0.05	0.01	57.9
PCH087	0.245	0.005	1	0.144	6.48	1	0.5	1.6	2	0.12	0.03	0.2	0.05	0.01	46.8
PCH088	0.048	0.005	1.5	0.109	4.68	1	0.5	1.2	4	0.13	0.03	0.4	0.05	0.02	68.9
PCH089	0.106	0.005	1.4	0.094	3.53	1	0.5	2.3	0.5	0.11	0.01	0.3	0.1	0.01	49.7
PCH090	0.239	0.005	1.5	0.179	4.29	1	0.5	2.5	4	0.13	0.03	0.2	0.1	0.02	58.4
PCH091	0.176	0.005	1.7	0.16	4.41	1	1	1.4	4	0.09	0.03	0.3	0.1	0.01	56.1
PCH092	0.145	0.005	1.2	0.152	5.11	1	0.5	2.3	2	0.1	0.03	0.3	0.05	0.01	40.6
PCH093	0.169	0.005	1.4	0.162	4.63	1	0.5	3.2	0.5	0.14	0.01	0.3	0.05	0.01	54.9
PCH094	0.127	0.005	1.8	0.126	6.94	1	0.5	2.6	2	0.12	0.03	0.3	0.1	0.01	47.1
PCH095	0.286	0.005	0.8	0.123	7.06	1	0.5	2.1	2	0.14	0.04	0.2	0.05	0.01	51.4
PCH096	0.009	0.01	1	0.12	5.97	1	0.5	7.1	1	0.1	0.04	0.3	0.2	0.01	48.7
PCH097	0.229	0.005	1.1	0.135	3.1	1	0.5	3.8	0.5	0.12	0.01	0.4	0.05	0.02	39.3
PCH098	0.309	0.005	2.2	0.13	6.37	1	0.5	4.3	3	0.14	0.02	0.3	0.05	0.01	37.5
PCH099	0.238	0.005	1.3	0.139	5.32	1	0.5	2.4	5	0.15	0.03	0.2	0.05	0.01	55
PCH100	0.124	0.005	2	0.159	4.39	1	0.5	2.2	2	0.14	0.03	0.3	0.05	0.02	41.5
PCH101	0.15	0.005	1.9	0.17	4.87	1	0.5	1.7	2	0.15	0.02	0.5	0.05	0.01	38.7
PCH102	0.309	0.005	2.3	0.125	4.56	1	0.5	3.1	2	0.13	0.03	0.3	0.2	0.01	34.5
PCH103	0.139	0.005	2.4	0.129	4.49	1	0.5	1.8	4	0.1	0.02	0.3	0.1	0.01	58.4
PCH104	0.231	0.005	0.8	0.122	3.6	1	0.5	1	1	0.1	0.02	0.3	0.05	0.01	64.4
PCH105	0.006	0.005	0.7	0.122	3.91	1	0.5	2.5	0.5	0.11	0.02	0.3	0.1	0.01	46.5
PCH106	0.157	0.005	1.4	0.122	3.18	1	0.5	5.4	3	0.1	0.03	0.2	0.05	0.04	38.6
PCH107	0.13	0.005	1.9	0.131	4.46	1	0.5	2.2	1	0.15	0.03	0.3	0.05	0.04	78.9
PCH108	0.1	0.005	2	0.152	5.3	1	0.5	2.9	3	0.19	0.04	0.3	0.1	0.03	73
PCH109	0.194	0.005	1.4	0.12	5.13	1	0.5	1.2	6	0.18	0.05	0.4	0.1	0.03	53.1
PCH110	0.258	0.005	0.9	0.118	4.02	1	0.5	2.5	0.5	0.16	0.03	0.3	0.1	0.01	64.8
PCH111	0.028	0.005	1.1	0.151	5.55	2	0.5	3.1	1	0.18	0.04	0.3	0.1	0.01	65.5
PCH112	0.193	0.005	1.3	0.222	5.29	1	0.5	0.9	3	0.16	0.04	0.2	0.1	0.02	54.3
PCH113	0.045	0.005	1.4	0.144	5.94	1	0.5	2.3	3	0.17	0.05	0.2	0.1	0.02	94.9
PCH114	0.192	0.005	0.8	0.177	4.26	3	0.5	1.6	4	0.18	0.04	0.3	0.2	0.03	49.2
PCH115	0.143	0.005	0.7	0.1	2.82	1	0.5	3.8	0.5	0.16	0.03	0.3	0.1	0.02	54.2
PCH116	0.25	0.005	1.4	0.143	2.84	1	0.5	1.7	2	0.18	0.03	0.3	0.1	0.01	39.3
PCH117	0.13	0.005	1.1	0.127	3.26	1	0.5	3	4	0.15	0.01	0.3	0.1	0.01	55.5
PCH118	0.137	0.005	1.6	0.145	1.94	1	0.5	2.9	4	0.19	0.03	0.3	0.1	0.01	42.8
PCH119	0.026	0.005	1.6	0.1	1.59	1	0.5	8.2	0.5	0.15	0.03	0.3	0.1	0.03	45.9
PCH120	0.202	0.005	0.8	0.133	1.75	1	0.5	3	0.5	0.15	0.02	0.2	0.1	0.01	31.3
PCH121	0.277	0.005	0.8	0.103	1.68	1	0.5	1.4	0.5	0.16	0.02	0.3	0.1	0.01	43.8
PCH122	0.21	0.005	1.2	0.108	2.42	1	0.5	2	0.5	0.14	0.03	0.2	0.2	0.01	45.7
PCH123	0.06	0.005	1	0.132	3.51	1	0.5	2.6	3	0.13	0.04	0.3	0.05	0.01	52.9
PCH124	0.205	0.005	2.6	0.153	1.96	1	0.5	2	3	0.16	0.01	0.5	0.1	0.01	45.2
PCH125	0.134	0.005	1.6	0.11	1.13	1	0.5	2.2	2	0.13	0.01	0.3	0.1	0.01	37.1
PCH126	0.203	0.005	1.4	0.121	1.28	1	0.5	2	6	0.17	0.01	0.3	0.2	0.01	52.5
PCH127	0.175	0.005	1.4	0.123	1.1	1	0.5	2.6	2	0.15	0.02	0.3	0.1	0.01	46.6
PCH128	0.199	0.005	1.2	0.113	1.42	1	0.5	3.8	6	0.11	0.03	0.3	0.1	0.01	49.6
PCH129	0.276	0.005	2.9	0.127	1.68	1	0.5	2.2	6	0.13	0.02	0.3	0.05	0.01	24.7

Sample	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
PCH070	0.0005	0.01	0.02	3	0.01	0.005	10	0.05	0.178	31.9	0.08
PCH071	0.0005	0.01	0.02	4	0.01	0.01	1	0.05	0.077	32.3	0.13
PCH072	0.0005	0.01	0.01	3	0.01	0.005	6	0.05	0.056	33	0.09
PCH073	0.0005	0.01	0.02	3	0.01	0.005	9	0.05	0.084	36.1	0.13
PCH074	0.0005	0.01	0.01	3	0.01	0.005	12	0.05	0.055	28.2	0.1
PCH075	0.0005	0.01	0.005	2	0.01	0.005	16	0.05	0.035	27.6	0.07
PCH076	0.0005	0.01	0.01	2	0.01	0.01	15	0.05	0.043	29	0.07
PCH077	0.0005	0.01	0.02	2	0.01	0.005	1	0.05	0.083	21.2	0.1
PCH078	0.0005	0.01	0.02	3	0.01	0.005	4	0.05	0.086	34.7	0.1
PCH079	0.0005	0.01	0.02	3	0.01	0.005	5	0.05	0.052	48.1	0.09
PCH080	0.0005	0.01	0.01	3	0.01	0.005	6	0.05	0.058	35	0.1
PCH081	0.0005	0.01	0.03	4	0.01	0.005	8	0.05	0.097	30.6	0.15
PCH082	0.0005	0.01	0.02	4	0.01	0.005	11	0.05	0.085	34.8	0.13
PCH083	0.0005	0.01	0.02	3	0.01	0.02	12	0.05	0.103	27.6	0.11
PCH084	0.0005	0.01	0.005	2	0.01	0.02	12	0.05	0.043	26.9	0.08
PCH085	0.0005	0.01	0.02	3	0.01	0.005	15	0.05	0.063	27	0.11
PCH086	0.0005	0.01	0.02	3	0.01	0.02	18	0.05	0.055	34.9	0.11
PCH087	0.0005	0.01	0.02	3	0.01	0.005	18	0.05	0.062	21.5	0.11
PCH088	0.001	0.01	0.02	3	0.01	0.01	17	0.05	0.073	36.9	0.11
PCH089	0.0005	0.01	0.01	2	0.01	0.005	20	0.05	0.038	34.5	0.07
PCH090	0.0005	0.01	0.02	3	0.01	0.005	15	0.05	0.051	49.3	0.09
PCH091	0.0005	0.01	0.01	3	0.01	0.01	13	0.05	0.046	25	0.08
PCH092	0.0005	0.01	0.01	2	0.01	0.005	18	0.05	0.047	19.9	0.07
PCH093	0.0005	0.01	0.02	2	0.01	0.005	17	0.05	0.044	29.3	0.08
PCH094	0.001	0.01	0.02	3	0.01	0.005	16	0.05	0.054	18.9	0.11
PCH095	0.0005	0.01	0.02	3	0.01	0.005	16	0.05	0.064	32.7	0.12
PCH096	0.0005	0.01	0.03	4	0.01	0.01	14	0.05	0.078	21.1	0.14
PCH097	0.0005	0.01	0.02	3	0.01	0.01	16	0.05	0.058	21	0.11
PCH098	0.0005	0.01	0.01	3	0.01	0.02	17	0.05	0.039	36.2	0.09
PCH099	0.0005	0.01	0.01	2	0.01	0.005	18	0.05	0.037	39	0.07
PCH100	0.0005	0.01	0.01	3	0.01	0.005	19	0.05	0.043	29.6	0.09
PCH101	0.0005	0.01	0.02	4	0.01	0.005	21	0.05	0.066	35.4	0.1
PCH102	0.0005	0.01	0.01	3	0.01	0.01	23	0.05	0.054	22.1	0.09
PCH103	0.0005	0.01	0.02	3	0.01	0.005	18	0.05	0.064	33.2	0.11
PCH104	0.0005	0.01	0.01	3	0.01	0.005	19	0.05	0.054	23.2	0.09
PCH105	0.0005	0.01	0.005	2	0.01	0.005	19	0.05	0.036	28.4	0.06
PCH106	0.0005	0.01	0.005	2	0.01	0.005	1	0.05	0.035	28.8	0.06
PCH107	0.0005	0.01	0.01	3	0.01	0.01	6	0.05	0.06	41	0.1
PCH108	0.0005	0.01	0.02	3	0.01	0.005	10	0.05	0.052	38.9	0.09
PCH109	0.0005	0.01	0.02	3	0.01	0.02	11	0.05	0.075	29.9	0.13
PCH110	0.0005	0.01	0.01	2	0.01	0.005	10	0.05	0.06	37	0.08
PCH111	0.0005	0.01	0.01	3	0.01	0.005	12	0.05	0.068	35.8	0.1
PCH112	0.0005	0.01	0.005	3	0.01	0.005	16	0.05	0.076	32.1	0.1
PCH113	0.0005	0.01	0.02	3	0.01	0.005	10	0.05	0.111	42.3	0.13
PCH114	0.0005	0.01	0.02	3	0.01	0.02	10	0.05	0.071	27.2	0.11
PCH115	0.0005	0.01	0.02	2	0.01	0.005	12	0.05	0.043	17	0.08
PCH116	0.0005	0.01	0.005	3	0.01	0.005	16	0.05	0.053	30.3	0.08
PCH117	0.0005	0.01	0.02	4	0.01	0.005	16	0.05	0.088	31.7	0.12
PCH118	0.0005	0.01	0.02	4	0.01	0.005	17	0.05	0.075	25.3	0.11
PCH119	0.0005	0.01	0.005	2	0.01	0.005	18	0.05	0.045	19.1	0.09
PCH120	0.0005	0.01	0.01	3	0.01	0.005	19	0.05	0.048	16.7	0.07
PCH121	0.0005	0.01	0.005	2	0.01	0.01	18	0.05	0.044	24.8	0.07
PCH122	0.0005	0.01	0.02	3	0.01	0.01	20	0.05	0.061	23.7	0.12
PCH123	0.0005	0.01	0.03	4	0.01	0.005	17	0.05	0.079	33.9	0.13
PCH124	0.0005	0.01	0.02	3	0.01	0.005	17	0.05	0.075	26.2	0.1
PCH125	0.0005	0.01	0.01	3	0.01	0.005	20	0.05	0.044	21.6	0.07
PCH126	0.0005	0.01	0.01	2	0.01	0.005	19	0.05	0.033	55.7	0.06
PCH127	0.0005	0.01	0.005	2	0.01	0.005	16	0.05	0.04	62.7	0.06
PCH128	0.0005	0.01	0.01	2	0.01	0.005	16	0.05	0.04	52.2	0.07
PCH129	0.0005	0.01	0.005	3	0.01	0.005	17	0.05	0.039	29.5	0.06

Pine Creek 2012 *E. camaldulensis*

Sample	Eastings	Northings	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co
PC001	530488	6454829	6	0.01	0.05	0.1	49	37	0.05	0.01	1.38	0.05	0.2	0.03
PC002	530534	6454676	15	0.005	0.4	0.7	31	34.8	0.05	0.01	1.84	0.1	0.33	0.08
PC003	530688	6454543	38	0.02	1.6	0.3	63	47.2	0.05	0.01	1.68	0.16	0.33	0.05
PC004	530738	6454096	214	0.02	4.9	0.1	82	25.3	0.05	0.03	0.75	0.56	0.45	0.07
PC005	530758	6454188	76	0.01	2.4	0.4	92	28.1	0.05	0.01	0.82	0.33	0.28	0.09
PC006	530861	6454357	108	0.02	3	0.8	73	47.3	0.05	0.01	2.24	0.39	0.33	0.11
PC007	531633	6453506	57	0.01	1.7	0.1	44	36.3	0.05	0.01	2.97	1.72	0.36	0.03
PC008	531732	6453416	16	0.01	0.6	0.4	54	18.1	0.05	0.02	1.02	0.9	0.17	0.09
PC009	531889	6453215	16	0.01	0.6	0.1	128	43.8	0.05	0.01	1.28	0.23	0.17	0.03
PC010	531896	6453099	5	0.005	0.5	0.3	90	32.6	0.05	0.01	2.69	0.47	0.24	0.09
PC011	532051	6452413	11	0.01	0.5	0.1	56	15.1	0.05	0.01	0.84	0.1	0.21	0.06
PC012	532084	6452123	11	0.01	0.6	0.1	40	44.4	0.05	0.01	1.74	0.25	0.26	0.08
PC013	532102	6452669	13	0.005	0.4	0.1	35	22.2	0.05	0.01	1.32	0.11	0.18	0.04
PC014	532305	6451954	9	0.005	0.1	0.1	37	16.2	0.05	0.01	0.78	0.18	0.05	0.02
PC015	532437	6451609	5	0.005	0.2	0.2	89	40	0.05	0.01	1.22	0.15	0.12	0.11
PC016	532605	6451424	8	0.005	0.05	0.1	75	34.6	0.05	0.01	1.11	0.14	0.09	0.05
PC017	532682	6451242	6	0.005	0.05	0.1	65	30	0.05	0.03	1.2	0.12	0.15	0.06
PC018	532810	6451052	9	0.01	0.1	0.1	112	54.9	0.05	0.01	1.75	0.27	0.2	0.16
PC019	533074	6451016	3	0.005	0.1	0.1	54	55.6	0.05	0.01	1.53	0.17	0.15	0.07
PC020	533237	6450920	3	0.01	0.3	0.2	60	51.7	0.05	0.01	1.58	0.18	0.18	0.07
PC021	533382	6450797	11	0.01	0.2	0.1	95	50.9	0.05	0.01	1.54	0.38	0.14	0.25
PC022	533493	6450748	8	0.005	0.05	0.2	24	36.6	0.05	0.01	0.88	0.4	0.12	0.31
PC023	533634	6450580	4	0.01	0.1	0.5	70	35.4	0.05	0.01	1.64	0.89	0.18	0.05

Sample	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo
PC001	0.8	0.007	4.35	0.013	0.05	0.01	0.002	19	0.01	0.62	0.07	0.52	0.261	86	0.05
PC002	0.9	0.006	6.52	0.009	0.05	0.005	0.002	26	0.01	0.55	0.11	0.42	0.264	181	0.04
PC003	1	0.016	2.64	0.021	0.05	0.04	0.003	37	0.01	0.42	0.15	0.72	0.254	211	0.08
PC004	1.2	0.014	5.58	0.027	0.05	0.04	0.007	40	0.01	0.47	0.18	0.64	0.152	77	0.08
PC005	0.8	0.011	6.67	0.017	0.05	0.04	0.002	35	0.01	0.48	0.11	0.76	0.248	94	0.02
PC006	1	0.013	8.05	0.024	0.05	0.04	0.004	29	0.01	0.63	0.16	0.58	0.329	174	0.31
PC007	0.8	0.006	1.99	0.015	0.05	0.04	0.003	13	0.01	0.44	0.14	0.45	0.39	205	0.05
PC008	0.9	0.008	2.53	0.013	0.05	0.04	0.003	25	0.01	0.76	0.08	0.33	0.164	82	0.02
PC009	0.8	0.011	7.95	0.015	0.05	0.005	0.0005	25	0.01	0.64	0.06	0.82	0.246	123	0.07
PC010	0.8	0.007	2.04	0.01	0.05	0.02	0.002	18	0.01	0.34	0.15	1.21	0.518	193	0.05
PC011	0.9	0.008	4.04	0.014	0.05	0.06	0.002	35	0.01	0.53	0.11	0.68	0.223	116	0.03
PC012	0.8	0.008	3.52	0.012	0.05	0.02	0.0005	29	0.01	0.67	0.13	0.58	0.32	204	0.01
PC013	0.9	0.007	5.02	0.01	0.05	0.02	0.002	15	0.01	0.69	0.09	0.48	0.211	85	0.02
PC014	0.7	0.0025	5.01	0.006	0.05	0.03	0.0005	11	0.01	0.98	0.03	0.19	0.217	53	0.03
PC015	0.9	0.0025	6.18	0.009	0.05	0.01	0.0005	27	0.01	0.75	0.06	0.91	0.3	262	0.06
PC016	1.9	0.005	5.28	0.008	0.05	0.005	0.0005	25	0.01	0.52	0.04	0.55	0.179	77	0.04
PC017	0.9	0.007	2.86	0.011	0.05	0.04	0.002	22	0.01	0.66	0.06	0.56	0.17	113	0.09
PC018	0.9	0.01	5.84	0.016	0.05	0.04	0.005	33	0.01	0.54	0.08	0.99	0.331	346	0.25
PC019	0.7	0.006	5.91	0.009	0.05	0.04	0.002	21	0.01	0.93	0.11	0.65	0.267	208	0.04
PC020	0.9	0.011	5.73	0.014	0.05	0.005	0.001	50	0.01	0.58	0.08	0.59	0.234	107	0.05
PC021	1.1	0.007	10.85	0.01	0.05	0.005	0.007	29	0.01	0.63	0.06	0.66	0.221	266	0.06
PC022	1	0.006	10.59	0.01	0.1	0.005	0.0005	18	0.01	1.22	0.05	0.31	0.187	598	0.04
PC023	0.9	0.008	3.44	0.012	0.05	0.005	0.006	20	0.01	0.55	0.08	1.22	0.228	127	0.02

Sample	Na	Nb	Ni	P	Pb	Pd	Pt	Rb	Re	S	Sb	Sc	Se	Sn	Sr
PC001	0.23	0.01	0.9	0.161	3.59	1	0.5	0.8	3	0.12	0.05	0.2	0.2	0.03	89.3
PC002	0.122	0.01	1.5	0.202	6.84	1	0.5	0.4	3	0.1	0.07	0.3	0.05	0.01	99
PC003	0.22	0.005	2	0.189	20.44	1	0.5	0.5	5	0.14	0.23	0.2	0.3	0.01	108.9
PC004	0.271	0.005	1.6	0.116	89.94	1	0.5	0.5	2	0.16	0.89	0.2	0.1	0.01	50.2
PC005	0.305	0.005	1.3	0.195	36.06	1	0.5	0.4	4	0.17	0.33	0.3	0.3	0.02	52
PC006	0.155	0.005	1.7	0.192	45.87	3	0.5	1.1	0.5	0.15	0.49	0.2	0.3	0.04	125.4
PC007	0.069	0.005	0.3	0.132	22.45	1	1	0.7	6	0.24	0.27	0.2	0.05	0.01	163
PC008	0.112	0.005	0.5	0.114	6.29	1	0.5	0.6	3	0.14	0.1	0.2	0.05	0.03	49.2
PC009	0.194	0.005	0.7	0.224	4.71	1	1	0.4	0.5	0.2	0.08	0.2	0.2	0.01	86
PC010	0.052	0.005	0.7	0.081	3.02	1	0.5	0.3	6	0.32	0.06	0.2	0.05	0.01	153.3
PC011	0.306	0.005	1.2	0.18	3.3	1	0.5	0.6	8	0.23	0.06	0.3	0.05	0.01	39.1
PC012	0.015	0.005	0.7	0.174	3.77	1	0.5	1	4	0.14	0.06	0.2	0.05	0.01	75.2
PC013	0.259	0.005	1.7	0.136	3.48	1	0.5	1.2	4	0.15	0.08	0.2	0.05	0.01	71.3
PC014	0.181	0.005	0.8	0.12	1.33	1	0.5	2.5	2	0.11	0.04	0.3	0.05	0.01	42.4
PC015	0.141	0.005	2	0.217	1.19	1	0.5	0.7	6	0.13	0.03	0.2	0.1	0.01	79.3
PC016	0.299	0.005	1.5	0.202	1.31	1	0.5	0.7	6	0.12	0.03	0.2	0.2	0.01	59.8
PC017	0.175	0.005	0.7	0.208	1.79	1	0.5	1.9	8	0.15	0.04	0.2	0.05	0.02	60.9
PC018	0.109	0.005	2	0.358	1.82	1	0.5	0.5	7	0.08	0.03	0.2	0.05	0.01	118.8
PC019	0.025	0.005	0.7	0.112	1.11	2	0.5	1.5	4	0.14	0.03	0.2	0.05	0.02	73
PC020	0.194	0.005	1.3	0.301	1.18	1	0.5	0.8	7	0.12	0.02	0.3	0.05	0.01	86.9
PC021	0.293	0.005	1	0.216	0.89	1	0.5	0.7	1	0.15	0.04	0.2	0.05	0.02	95.1
PC022	0.086	0.005	1.4	0.202	0.92	1	1	1.9	0.5	0.13	0.04	0.2	0.3	0.03	51.1
PC023	0.167	0.005	0.6	0.126	1.17	1	0.5	0.9	7	0.17	0.04	0.2	0.1	0.01	82.4

Sample	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
PC001	0.0005	0.03	0.02	11	0.01	0.01	1	0.05	0.05	35.5	0.08
PC002	0.0005	0.01	0.02	13	0.01	0.005	1	0.05	0.064	45.8	0.07
PC003	0.0005	0.01	0.03	13	0.01	0.01	1	0.05	0.088	21.1	0.1
PC004	0.0005	0.01	0.03	11	0.01	0.03	1	0.05	0.088	42.3	0.13
PC005	0.0005	0.01	0.04	13	0.01	0.01	1	0.05	0.066	50.3	0.1
PC006	0.0005	0.01	0.02	14	0.01	0.02	1	0.05	0.109	44.5	0.12
PC007	0.002	0.03	0.02	10	0.01	0.005	1	0.05	0.129	83.3	0.06
PC008	0.002	0.01	0.01	8	0.01	0.005	1	0.05	0.053	69.9	0.08
PC009	0.0005	0.01	0.02	15	0.01	0.02	1	0.05	0.048	21.8	0.07
PC010	0.0005	0.01	0.01	6	0.01	0.005	1	0.05	0.122	33.1	0.06
PC011	0.002	0.01	0.02	12	0.01	0.005	1	0.05	0.1	20.1	0.09
PC012	0.0005	0.01	0.005	11	0.01	0.005	1	0.05	0.149	27.5	0.06
PC013	0.0005	0.01	0.005	9	0.01	0.005	1	0.05	0.093	17	0.04
PC014	0.0005	0.01	0.005	8	0.01	0.005	1	0.05	0.013	19.1	0.03
PC015	0.001	0.01	0.005	14	0.01	0.03	1	0.05	0.06	36.5	0.04
PC016	0.0005	0.01	0.01	13	0.01	0.005	1	0.05	0.047	23.7	0.03
PC017	0.001	0.01	0.01	14	0.01	0.005	1	0.05	0.052	16.9	0.05
PC018	0.0005	0.01	0.02	23	0.01	0.01	1	0.05	0.052	27	0.09
PC019	0.0005	0.01	0.005	7	0.01	0.005	1	0.05	0.078	32.5	0.04
PC020	0.0005	0.01	0.02	20	0.01	0.005	1	0.05	0.083	36.7	0.07
PC021	0.001	0.01	0.01	14	0.01	0.02	1	0.05	0.074	38.1	0.05
PC022	0.0005	0.01	0.005	13	0.01	0.005	1	0.05	0.032	36.6	0.04
PC023	0.0005	0.01	0.02	9	0.01	0.005	1	0.05	0.042	98.7	0.1

Pine Creek Stream Sediment

Sample No.	Eastings	Northings	Ag ppb	Al pct	As ppm	Au ppb	B ppm	Ba ppm	Be ppm	Bi ppm	Ca pct	Cd ppm
1	532682	6451242	309	0.42	7.5	3.4	2	36.8	0.3	0.29	0.14	0.32
2	531732	6453416	384	1.66	8.4	2.1	6	122.0	0.7	0.32	0.49	0.53
4	533382	6450797	576	0.85	22.1	1.4	5	69.2	0.3	0.43	0.26	0.30
5	532810	6451052	160	0.60	8.7	1.0	3	50.0	0.2	0.22	0.23	0.26
6	532605	6451424	176	0.70	8.8	0.9	3	61.7	0.3	0.24	0.24	0.28
8	530488	6454829	19	0.74	4.1	1.1	5	63.6	0.3	0.26	0.34	0.06
9	530738	6454096	53	0.95	4.1	0.5	4	80.5	0.4	0.22	0.33	0.12
10	533634	6450580	89	1.15	4.9	0.8	5	94.6	0.6	0.22	0.33	0.23
11	530861	6454357	93	2.47	6.5	1.6	8	153.9	0.9	0.39	0.67	0.12
13	531633	6453506	222	1.26	7.7	0.6	6	96.2	0.5	0.27	0.37	0.48
15	530534	6454676	32	1.56	4.9	1.2	8	115.0	0.6	0.28	0.42	0.04
16	532051	6452413	181	0.70	8.3	0.6	3	56.9	0.3	0.23	0.25	0.29
17	532305	6451954	192	0.53	5.7	0.5	2	50.7	0.2	0.23	0.15	0.25
18	532084	6452123	192	0.94	7.1	0.3	4	67.2	0.3	0.23	0.25	0.32
19	531896	6453099	64	0.81	4.2	0.6	3	74.5	0.4	0.22	0.27	0.17
21	532102	6452669	135	1.06	5.7	0.8	6	83.1	0.5	0.24	0.42	0.26
22	533493	6450748	399	0.52	6.7	0.2	2	46.5	0.2	0.27	0.13	0.29
23	532437	6451609	228	1.03	9.3	0.1	5	81.5	0.3	0.26	0.31	0.23
24	533074	6451016	155	0.97	5.7	0.8	6	53.7	0.4	0.28	0.21	0.34
28	530758	6454188	61	1.23	4.7	0.9	7	88.4	0.5	0.24	0.57	0.08
29	530688	6454543	22	0.58	3.9	0.2	3	57.4	0.2	0.22	0.23	0.03
30	533237	6450920	98	0.73	6.3	0.2	4	59.8	0.4	0.24	0.22	0.23
31	531889	6453215	76	1.68	6.5	1.0	20	86.1	0.6	0.23	0.71	0.14

Sample No.	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Fe pct	Ga ppm	Gd ppm	Ge ppm
1	33.8	4.4	13.9	0.43	12.72	0.24	2.96	15.53	1.61	1.9	4.05	0.1
2	36.4	11.0	24.3	1.91	24.27	0.31	3.27	15.88	2.24	5.3	4.23	0.1
4	72.2	7.6	27.0	1.04	15.56	0.30	6.48	32.01	2.93	4.1	8.49	0.1
5	26.3	5.0	14.4	0.74	12.37	0.19	2.44	11.80	1.54	2.4	3.18	0.1
6	34.6	5.4	15.6	0.91	13.62	0.23	3.32	15.48	1.57	2.6	4.08	0.1
8	28.1	5.4	15.6	0.92	13.49	0.22	2.44	12.53	1.62	2.9	3.25	0.1
9	33.3	6.8	15.8	1.23	14.70	0.22	2.85	14.45	1.55	3.1	3.90	0.1
10	33.8	7.7	18.2	1.48	15.95	0.25	3.16	15.18	1.69	3.4	3.92	0.1
11	42.5	14.5	31.6	2.46	31.45	0.44	4.04	19.50	3.03	7.8	4.99	0.1
13	35.5	8.6	20.5	1.52	18.34	0.28	3.09	16.24	1.98	4.1	4.00	0.1
15	34.7	10.1	23.7	1.91	20.79	0.31	3.27	15.52	2.15	5.0	4.09	0.1
16	35.3	5.5	16.4	0.80	13.78	0.24	3.10	15.28	1.65	2.4	4.06	0.1
17	46.0	4.9	15.4	0.65	13.34	0.24	4.02	20.62	1.53	1.9	5.48	0.1
18	37.5	6.2	16.9	1.05	15.94	0.27	3.44	16.89	1.65	3.1	4.48	0.1
19	35.9	5.9	16.3	0.95	13.80	0.22	3.15	15.74	1.58	2.6	4.19	0.1
21	29.1	7.7	19.4	1.28	17.12	0.25	2.78	13.66	1.82	3.4	3.42	0.1
22	46.6	4.8	14.6	0.62	14.32	0.25	3.91	19.82	1.46	2.0	5.75	0.1
23	38.0	7.3	20.4	1.26	16.30	0.27	3.53	17.18	1.96	3.4	4.48	0.1
24	28.4	6.2	14.7	0.92	18.09	0.29	2.72	12.68	1.76	3.3	3.50	0.1
28	25.8	7.8	19.1	1.43	18.14	0.23	2.38	11.93	1.80	3.8	3.11	0.1
29	46.8	4.4	14.8	0.73	13.08	0.23	4.15	19.92	1.32	2.0	5.63	0.1
30	37.0	5.4	16.1	0.87	14.16	0.24	3.30	16.39	1.48	2.3	4.29	0.1
31	22.9	8.9	21.4	1.56	19.81	0.30	2.37	10.10	2.07	4.9	2.72	0.1

Sample No.	Hf ppm	Hg ppb	Ho ppm	In ppm	K pct	La ppm	Li ppm	Lu ppm	Mg pct	Mn ppm	Mo ppm	Na pct
1	0.13	3	0.57	0.03	0.10	18.5	2.4	2.08	0.12	164	0.25	0.049
2	0.23	12	0.83	0.03	0.51	18.3	11.0	2.66	0.50	323	0.28	0.013
4	0.14	3	0.72	<0.02	0.25	38.5	5.3	4.11	0.26	212	0.25	0.015
5	0.10	6	0.54	<0.02	0.19	14.4	3.7	1.90	0.21	146	0.22	0.194
6	0.13	3	0.59	<0.02	0.22	19.3	4.7	2.37	0.23	165	0.23	0.091
8	0.15	3	0.55	<0.02	0.22	15.2	5.3	1.91	0.26	164	0.26	0.233
9	0.15	6	0.49	<0.02	0.31	17.4	6.7	2.00	0.28	197	0.22	0.047
10	0.17	7	0.61	<0.02	0.37	17.6	7.4	2.29	0.35	221	0.24	0.016
11	0.27	12	1.12	0.03	0.69	21.2	14.8	3.16	0.71	444	0.26	0.017
13	0.19	10	0.72	0.02	0.38	18.4	8.7	2.35	0.37	256	0.25	0.016
15	0.27	12	0.75	0.03	0.48	17.8	10.4	2.30	0.48	312	0.29	0.080
16	0.14	5	0.66	<0.02	0.20	19.0	4.0	2.34	0.22	173	0.24	0.167
17	0.12	3	0.51	<0.02	0.15	26.1	3.1	2.91	0.15	148	0.22	0.005
18	0.15	3	0.68	0.02	0.26	20.8	5.4	2.40	0.25	195	0.23	0.011
19	0.15	3	0.63	<0.02	0.22	19.8	4.8	2.18	0.24	179	0.23	0.076
21	0.17	3	0.68	<0.02	0.32	15.7	6.5	1.94	0.38	230	0.25	0.292
22	0.08	5	0.64	<0.02	0.14	26.6	3.1	2.96	0.14	167	0.25	0.005
23	0.19	3	0.67	<0.02	0.31	21.0	6.9	2.33	0.33	217	0.24	0.050
24	0.18	3	0.76	<0.02	0.25	15.3	5.5	2.20	0.27	240	0.29	0.032
28	0.19	3	0.63	<0.02	0.37	13.6	7.8	1.71	0.40	232	0.26	0.236
29	0.15	3	0.56	<0.02	0.17	26.4	4.0	2.74	0.19	139	0.28	0.090
30	0.13	3	0.61	<0.02	0.20	20.9	4.6	2.26	0.22	172	0.24	0.053
31	0.24	6	0.77	0.02	0.43	12.0	9.6	1.99	0.83	295	0.42	1.539

Sample No.	Nb ppm	Nd ppm	Ni ppm	P pct	Pb ppm	Pd ppb	Pr ppm	Pt ppb	Rb ppm	Re ppb	S pct	Sb ppm
1	0.11	1	6.9	0.020	58.71	0.57	05	0.08	10.2	1	0.02	0.80
2	0.20	1	17.5	0.019	90.30	0.70	05	0.11	47.3	1	0.01	0.66
4	0.11	1	12.6	0.019	129.25	0.66	05	0.10	23.7	1	0.01	2.60
5	0.12	1	8.8	0.016	46.19	0.47	05	0.08	18.5	1	0.04	0.51
6	0.13	1	9.8	0.017	53.64	0.52	05	0.07	22.3	1	0.01	2.18
8	0.16	1	9.4	0.016	17.10	0.52	05	0.08	23.1	2	0.09	0.11
9	0.15	1	11.4	0.016	25.45	0.51	05	0.07	32.3	1	0.01	0.15
10	0.14	1	13.5	0.017	34.02	0.56	05	0.08	33.8	1	0.01	0.26
11	0.17	1	23.7	0.022	25.44	1.05	05	0.17	60.2	1	0.01	0.07
13	0.15	1	14.3	0.017	78.65	0.63	05	0.09	36.9	1	0.01	0.52
15	0.19	1	17.2	0.019	15.70	0.72	05	0.11	47.0	1	0.01	0.06
16	0.13	1	9.4	0.020	54.21	0.55	05	0.08	20.0	1	0.05	0.52
17	0.13	1	8.2	0.019	51.63	0.51	05	0.07	15.7	1	0.01	0.47
18	0.10	1	11.7	0.020	46.33	0.55	05	0.09	24.7	1	0.01	0.67
19	0.10	1	10.1	0.018	38.61	0.57	05	0.08	22.2	1	0.01	0.24
21	0.14	1	12.6	0.019	42.35	0.61	05	0.10	31.5	1	0.10	0.25
22	0.15	1	8.5	0.023	60.33	0.54	05	0.08	14.8	1	0.01	1.30
23	0.14	1	12.2	0.019	71.38	0.56	05	0.09	29.8	1	0.01	0.37
24	0.08	1	10.7	0.025	48.96	0.73	05	0.10	20.1	1	0.01	0.36
28	0.22	1	13.3	0.018	23.14	0.58	05	0.09	33.9	1	0.13	0.11
29	0.15	1	8.1	0.019	16.29	0.49	05	0.07	18.7	1	0.03	0.08
30	0.13	1	9.8	0.020	44.52	0.56	05	0.09	20.5	1	0.01	0.53
31	0.08	1	15.9	0.020	26.33	0.70	05	0.11	31.0	3	0.22	0.14

Sample No.	Sc ppm	Se ppm	Sm ppm	Sn ppm	Sr ppm	Ta ppm	Tb ppm	Te ppm	Th ppm	Ti pct	Tl ppm	Tm ppm
1	2.1	0.1	1.47	0.3	12.3	0.03	0.28	0.01	9.7	0.024	0.07	0.35
2	4.8	0.1	1.72	0.7	41.5	0.03	0.32	0.02	7.4	0.048	0.34	0.65
4	3.0	0.1	1.84	0.5	21.5	0.03	0.48	0.02	19.3	0.031	0.17	0.69
5	2.2	0.1	1.12	0.3	18.7	0.03	0.23	0.04	7.4	0.026	0.13	0.36
6	2.4	0.1	1.25	0.3	19.2	0.03	0.29	0.01	8.5	0.031	0.16	0.48
8	2.5	0.1	1.21	0.3	32.6	0.03	0.27	0.03	7.5	0.033	0.16	0.42
9	2.8	0.1	1.31	0.4	27.0	0.03	0.26	0.01	7.8	0.041	0.22	0.40
10	3.2	0.1	1.26	0.5	26.2	0.03	0.30	0.01	7.2	0.041	0.26	0.54
11	6.9	0.1	2.28	1.0	57.4	0.03	0.44	0.01	8.6	0.047	0.44	0.88
13	3.7	0.1	1.47	0.6	31.2	0.03	0.29	0.01	8.1	0.042	0.27	0.56
15	4.3	0.1	1.64	0.6	39.0	0.03	0.31	0.01	7.9	0.054	0.34	0.59
16	2.6	0.1	1.23	0.3	21.9	0.03	0.30	0.02	9.1	0.031	0.14	0.44
17	2.2	0.1	1.52	0.3	11.6	0.03	0.33	0.01	12.2	0.028	0.12	0.48
18	2.9	0.1	1.44	0.5	20.5	0.03	0.30	0.05	9.0	0.032	0.18	0.51
19	2.4	0.1	1.38	0.3	23.0	0.03	0.28	0.04	8.8	0.031	0.17	0.46
21	3.2	0.1	1.52	0.5	38.3	0.03	0.28	0.01	7.0	0.038	0.22	0.49
22	2.2	0.1	1.42	0.3	10.3	0.03	0.33	0.03	12.7	0.029	0.11	0.55
23	3.2	0.1	1.46	0.4	26.3	0.03	0.32	0.01	9.4	0.040	0.22	0.52
24	3.5	0.1	1.58	0.4	20.8	0.03	0.30	0.01	7.1	0.026	0.14	0.43
28	3.6	0.1	1.19	0.5	48.0	0.03	0.25	0.01	5.8	0.046	0.25	0.43
29	2.2	0.1	1.50	0.3	22.2	0.03	0.32	0.04	11.8	0.032	0.14	0.50
30	2.7	0.1	1.33	0.3	18.8	0.03	0.30	0.01	9.6	0.032	0.14	0.44
31	5.0	0.1	1.37	0.6	126.6	0.03	0.30	0.01	4.9	0.035	0.22	0.52

Sample No.	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm	Zr ppm
1	1.1	39	<0.1	6.36	0.08	53.3	4.9
2	0.8	40	<0.1	8.12	0.11	124.2	8.6
4	2.3	87	<0.1	8.02	0.10	62.2	6.2
5	0.8	36	<0.1	5.23	0.08	53.7	5.0
6	1.0	34	<0.1	5.78	0.07	54.0	5.8
8	0.9	40	<0.1	5.44	0.07	29.9	6.0
9	0.8	30	<0.1	5.75	0.08	40.1	6.2
10	0.8	31	<0.1	6.27	0.09	69.2	6.9
11	0.9	52	<0.1	11.20	0.16	70.3	10.7
13	1.0	38	<0.1	6.98	0.10	96.6	7.1
15	0.9	41	<0.1	7.76	0.11	52.4	9.0
16	1.1	36	<0.1	6.08	0.09	58.1	5.6
17	1.4	34	<0.1	5.97	0.08	50.4	5.3
18	1.0	33	<0.1	6.40	0.09	67.6	6.1
19	1.0	32	<0.1	5.89	0.08	48.1	5.6
21	0.8	37	<0.1	6.69	0.09	63.1	7.2
22	1.3	32	<0.1	6.55	0.09	69.2	4.7
23	1.1	43	<0.1	6.61	0.10	61.1	6.7
24	0.9	35	<0.1	7.08	0.11	64.7	6.8
28	0.8	35	<0.1	6.00	0.09	42.5	7.3
29	1.4	28	<0.1	6.11	0.08	26.8	5.6
30	1.1	30	<0.1	6.28	0.09	53.6	5.6
31	1.3	38	<0.1	6.97	0.10	57.0	8.2

Umberumberka Creek *E. camaldulensis*

Sample No.	Eastings	Northings	Ag ppb	Al pct	As ppm	Au ppb	B ppm	Ba ppm	Be ppm	Bi ppm	Ca pct
UMB RRG 001	533132	6469421	3	0.01	0.4	0.1	48	105	0.05	0.01	4.25
UMB RRG 002	533095	6469417	1	0.01	0.05	0.3	51	84.4	0.05	0.01	2.26
UMB RRG 003	532391	6469552	1	0.005	0.2	0.3	30	58.6	0.05	0.01	1.78
UMB RRG 004	531970	6469688	3	0.005	0.05	0.1	37	69.1	0.05	0.01	1.23
UMB RRG 005	531924	6469722	1	0.005	0.4	0.3	29	67.7	0.05	0.01	1.72
UMB RRG 006	531827	6469830	1	0.02	0.1	0.1	99	147.2	0.05	0.01	3.66
UMB RRG 007	531667	6469923	2	0.005	0.3	0.1	28	51.9	0.05	0.01	1.69
UMB RRG 008	530850	6470177	1	0.005	0.1	0.1	103	40.9	0.05	0.01	1.42
UMB RRG 009	531046	6470258	2	0.005	0.2	0.1	66	120.4	0.05	0.01	4.18
UMB RRG 010	530860	6470338	1	0.01	0.3	0.1	74	88.2	0.05	0.03	2.28
UMB RRG 011	530795	6470370	1	0.005	0.1	0.1	66	56.6	0.05	0.01	0.97
UMB RRG 012	530718	6470420	1	0.005	0.3	0.1	51	29.1	0.05	0.01	0.84
UMB RRG 013	530659	6470403	2	0.005	0.1	0.1	39	35.6	0.05	0.01	1.13
UMB RRG 014	530576	6470313	3	0.01	0.05	0.1	105	41.2	0.05	0.01	1.29
UMB RRG 015	530485	6470301	1	0.01	0.05	0.1	156	32.5	0.05	0.01	1.11
UMB RRG 016	530392	6470265	1	0.02	0.05	0.1	100	55.4	0.05	0.01	1.78
UMB RRG 017	530187	6470251	1	0.005	0.05	0.1	43	22.7	0.05	0.01	0.92
UMB RRG 018	529875	6470488	1	0.005	0.05	0.1	39	30.5	0.05	0.01	0.95
UMB RRG 019	529601	6470515	1	0.005	0.05	0.1	95	16	0.05	0.02	0.65
UMB RRG 020	529374	6471140	1	0.005	0.05	0.1	54	22.8	0.05	0.01	0.63
UMB RRG 021	529387	6471259	2	0.02	0.05	0.1	155	48.7	0.05	0.01	1.69
UMB RRG 022	529346	6471344	2	0.005	0.05	0.1	31	23.7	0.05	0.01	1.04
UMB RRG 023	529227	6471534	2	0.005	0.2	0.1	67	20.3	0.05	0.01	1.14
UMB RRG 024	529054	6471660	1	0.01	0.5	0.1	93	16.2	0.05	0.01	0.71
UMB RRG 025	528885	6471684	1	0.005	0.1	0.1	104	15.9	0.05	0.01	1.01
UMB RRG 026	528691	6471611	1	0.005	0.2	0.1	90	40.7	0.05	0.01	1.29
UMB RRG 027	528516	6471588	1	0.005	0.05	0.1	53	13.3	0.05	0.01	0.63
UMB RRG 028	528327	6471675	1	0.01	0.05	0.1	102	36.4	0.05	0.01	1.01
UMB RRG 029	528265	6471798	1	0.005	0.2	0.1	110	32.4	0.05	0.03	0.97
UMB RRG 030	528262	6471939	1	0.005	0.05	0.1	50	58.6	0.05	0.01	1.79
UMB RRG 031	528190	6472072	1	0.01	0.1	0.1	72	23.4	0.05	0.01	0.66
UMB RRG 032	528031	6472194	1	0.005	0.05	0.3	57	34.2	0.05	0.02	1.17
UMB RRG 033	527964	6472389	1	0.005	0.05	0.1	71	38.1	0.05	0.01	1.69
UMB RRG 034	527012	6473672	1	0.01	0.3	0.1	61	40.3	0.05	0.01	1.12
UMB RRG 035	526789	6473570	2	0.01	0.1	0.1	39	24.6	0.05	0.01	1
UMB RRG 036	526696	6473371	1	0.005	0.05	0.1	65	18.3	0.05	0.01	0.86
UMB RRG 037	526717	6473272	1	0.005	0.2	0.1	48	23.7	0.05	0.01	1.16
UMB RRG 038	526629	6473158	3	0.005	0.05	0.1	74	13.7	0.05	0.01	0.7
UMB RRG 039	526424	6473199	3	0.005	0.2	0.1	48	26.2	0.05	0.01	1
UMB RRG 040	526222	6473257	1	0.02	0.2	0.1	112	23.2	0.05	0.01	1.28
UMB RRG 041	527155	6473621	1	0.02	0.3	0.1	77	51.3	0.05	0.01	1.58
UMB RRG 042	527330	6473465	4	0.005	0.05	0.1	58	24.7	0.05	0.01	0.82
UMB RRG 043	527386	6473196	1	0.01	0.2	0.1	93	38.4	0.05	0.01	1.02
UMB RRG 044	527492	6473010	4	0.01	0.2	0.1	72	55.8	0.05	0.01	1.77
UMB RRG 045	527657	6472985	5	0.005	0.1	0.1	61	32.3	0.05	0.01	1.17
UMB RRG 046	527852	6472971	4	0.005	0.3	0.1	74	34	0.05	0.01	0.98
UMB RRG 047	527936	6472741	1	0.005	0.5	0.1	110	31.7	0.05	0.01	1.07
UMB RRG 048	528009	6472562	1	0.005	0.1	0.1	99	22.1	0.05	0.01	0.94
UMB RRG 049	526024	6473076	1	0.005	0.2	0.1	55	25.1	0.05	0.01	0.89
UMB RRG 050	525932	6472981	2	0.01	0.05	0.1	83	20	0.05	0.01	0.7
UMB RRG 051	525671	6472738	1	0.01	0.1	0.1	134	21.1	0.05	0.01	0.93
UMB RGG 052	525508	6472661	2	0.005	0.3	0.1	72	26.3	0.05	0.01	0.83
UMB RRG 053	525195	6472558	3	0.01	0.3	0.1	125	42.2	0.05	0.01	1.68
UMB RRG 054	524998	6472397	2	0.005	0.2	0.1	80	28	0.05	0.01	0.95
UMB RRG 055	524825	6472236	6	0.005	0.4	0.1	49	39	0.05	0.01	1.36
UMB RRG 056	524533	6472219	4	0.005	0.2	0.1	28	17.1	0.05	0.01	0.68
UMB RRG 057	524329	6471943	3	0.01	0.05	0.1	73	19.4	0.05	0.01	0.95
UMB RRG 058	524097	6472044	1	0.005	0.4	0.1	22	10.3	0.05	0.01	0.66
UMB RRG 059	523877	6472097	2	0.01	0.2	0.1	58	21.5	0.05	0.01	1.73
UMB RRG 061	523406	6472020	3	0.005	0.2	0.1	29	15.8	0.05	0.01	0.63
UMB RRG 062	523175	6472159	3	0.02	0.4	0.1	89	30.9	0.05	0.01	1.58
UMB RRG 063	523002	6472280	1	0.005	0.4	0.1	81	26	0.05	0.01	0.94
UMB RRG 064	522737	6472333	2	0.01	0.2	0.1	35	52.8	0.05	0.01	1.95
UMB RRG 065	522312	6472348	3	0.01	0.05	0.6	93	61.9	0.05	0.01	1.87
UMB RRG 066	522047	6472436	1	0.005	0.05	0.1	42	26.3	0.05	0.01	1.32
UMB RRG 067	521401	6472413	3	0.02	0.05	0.1	42	23	0.05	0.01	0.84
UMB RRG 068	521256	6472666	2	0.005	0.05	0.5	21	25.2	0.05	0.01	1.04
UMB RRG 069	521249	6473261	1	0.005	0.05	0.1	38	25.3	0.05	0.01	0.65
UMB RRG 070	521260	6473439	3	0.01	0.05	0.4	109	34.3	0.05	0.01	0.91

Sample No.	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Fe pct	Ga ppm
UMB RRG 001	0.2	0.21	0.12	1.2	0.008	3.49	0	0	0	0.01	0.05
UMB RRG 002	0.08	0.16	0.11	1.3	0.01	3.6	0	0	0	0.012	0.05
UMB RRG 003	0.02	0.07	0.06	1.4	0.005	4.57	0	0	0	0.005	0.05
UMB RRG 004	0.01	0.05	0.04	1.3	0.0025	6.27	0	0	0	0.004	0.05
UMB RRG 005	0.14	0.1	0.06	1.1	0.006	5.25	0	0	0	0.006	0.05
UMB RRG 006	0.04	0.15	0.08	1.4	0.011	3.76	0	0	0	0.01	0.05
UMB RRG 007	0.09	0.06	0.07	1.3	0.0025	5.76	0	0	0	0.004	0.05
UMB RRG 008	0.07	0.05	0.1	1.3	0.0025	6.1	0	0	0	0.004	0.05
UMB RRG 009	0.08	0.16	0.08	1.4	0.008	6.32	0	0	0	0.006	0.05
UMB RRG 010	0.06	0.12	0.21	1.4	0.009	4.46	0	0	0	0.01	0.05
UMB RRG 011	0.03	0.1	0.11	1.3	0.007	3.54	0	0	0	0.007	0.05
UMB RRG 012	0.005	0.04	0.08	1.1	0.0025	8.19	0	0	0	0.004	0.05
UMB RRG 013	0.03	0.06	0.06	1.3	0.0025	6.94	0	0	0	0.004	0.05
UMB RRG 014	0.04	0.13	0.08	1.4	0.012	4.51	0	0	0	0.012	0.05
UMB RRG 015	0.04	0.12	0.1	1.3	0.009	3.47	0	0	0	0.01	0.05
UMB RRG 016	0.04	0.21	0.1	1.3	0.016	5.44	0	0	0	0.015	0.05
UMB RRG 017	0.03	0.07	0.06	2.6	0.007	1.73	0	0	0	0.008	0.05
UMB RRG 018	0.04	0.09	0.08	1.3	0.008	6.19	0	0	0	0.007	0.05
UMB RRG 019	0.04	0.08	0.1	1.2	0.0025	6.98	0	0	0	0.005	0.05
UMB RRG 020	0.005	0.1	0.04	1.3	0.006	3.75	0	0	0	0.008	0.05
UMB RRG 021	0.15	0.24	0.14	1.3	0.014	5.11	0	0	0	0.014	0.05
UMB RRG 022	0.02	0.08	0.07	1.4	0.005	7.15	0	0	0	0.006	0.05
UMB RRG 023	0.03	0.11	0.06	1.3	0.007	3.69	0	0	0	0.007	0.05
UMB RRG 024	0.04	0.14	0.06	1.2	0.007	5.22	0	0	0	0.01	0.05
UMB RRG 025	0.05	0.09	0.06	1.3	0.007	6.47	0	0	0	0.007	0.05
UMB RRG 026	0.02	0.11	0.07	1.3	0.008	5.71	0	0	0	0.008	0.05
UMB RRG 027	0.01	0.07	0.12	1.4	0.0025	4.11	0	0	0	0.005	0.05
UMB RRG 028	0.03	0.11	0.07	1.4	0.011	3.3	0	0	0	0.012	0.05
UMB RRG 029	0.005	0.04	0.05	1.4	0.0025	3.79	0	0	0	0.004	0.05
UMB RRG 030	0.03	0.08	0.07	1.3	0.007	5.15	0	0	0	0.007	0.05
UMB RRG 031	0.01	0.12	0.06	1.4	0.011	2.29	0	0	0	0.011	0.05
UMB RRG 032	0.03	0.09	0.08	1.4	0.007	5.13	0	0	0	0.006	0.05
UMB RRG 033	0.02	0.09	0.07	1.4	0.008	3.61	0	0	0	0.007	0.05
UMB RRG 034	0.05	0.13	0.09	1.5	0.011	10.14	0	0	0	0.01	0.05
UMB RRG 035	0.03	0.13	0.12	1.7	0.01	5.16	0	0	0	0.011	0.05
UMB RRG 036	0.02	0.04	0.05	1.7	0.0025	5.68	0	0	0	0.003	0.05
UMB RRG 037	0.02	0.04	0.03	1.3	0.0025	8.13	0	0	0	0.004	0.05
UMB RRG 038	0.03	0.05	0.05	1.5	0.0025	4.88	0	0	0	0.005	0.05
UMB RRG 039	0.03	0.11	0.11	1.4	0.0025	5.2	0	0	0	0.006	0.05
UMB RRG 040	0.03	0.21	0.05	1.6	0.013	3.26	0	0	0	0.014	0.05
UMB RRG 041	0.03	0.21	0.07	1.4	0.017	1.95	0	0	0	0.02	0.05
UMB RRG 042	0.02	0.08	0.04	1.4	0.005	7.37	0	0	0	0.006	0.05
UMB RRG 043	0.01	0.13	0.05	1.5	0.008	4.29	0	0	0	0.009	0.05
UMB RRG 044	0.13	0.15	0.1	1.4	0.01	6.07	0	0	0	0.009	0.05
UMB RRG 045	0.04	0.15	0.05	1.4	0.007	6.64	0	0	0	0.008	0.05
UMB RRG 046	0.01	0.05	0.04	1.5	0.0025	5.91	0	0	0	0.005	0.05
UMB RRG 047	0.005	0.06	0.05	1.4	0.005	2.73	0	0	0	0.006	0.05
UMB RRG 048	0.01	0.1	0.04	1.5	0.007	2.55	0	0	0	0.007	0.05
UMB RRG 049	0.03	0.07	0.05	1.6	0.007	2.16	0	0	0	0.007	0.05
UMB RRG 050	0.02	0.12	0.07	1.5	0.009	6.71	0	0	0	0.009	0.05
UMB RRG 051	0.005	0.14	0.05	1.5	0.009	3.11	0	0	0	0.01	0.05
UMB RGG 052	0.005	0.05	0.06	1.7	0.0025	2.4	0	0	0	0.005	0.05
UMB RRG 053	0.02	0.12	0.1	1.4	0.009	6.35	0	0	0	0.008	0.05
UMB RRG 054	0.04	0.09	0.07	1.5	0.006	14.01	0	0	0	0.007	0.05
UMB RRG 055	0.14	0.08	0.14	1.5	0.0025	12.54	0	0	0	0.006	0.05
UMB RRG 056	0.02	0.03	0.06	1.5	0.0025	8.53	0	0	0	0.003	0.05
UMB RRG 057	0.005	0.17	0.22	1.3	0.01	3.82	0	0	0	0.012	0.05
UMB RRG 058	0.04	0.06	0.06	1.4	0.0025	2.33	0	0	0	0.004	0.05
UMB RRG 059	0.03	0.18	0.14	1.5	0.008	2.66	0	0	0	0.009	0.05
UMB RRG 061	0.03	0.06	0.22	1.4	0.0025	6.43	0	0	0	0.005	0.05
UMB RRG 062	0.05	0.22	0.09	1.4	0.014	6.25	0	0	0	0.015	0.05
UMB RRG 063	0.05	0.13	0.05	1.4	0.006	3.4	0	0	0	0.008	0.05
UMB RRG 064	0.2	0.15	0.09	1.6	0.008	3.87	0	0	0	0.012	0.05
UMB RRG 065	0.08	0.12	0.15	1.3	0.011	1.1	0	0	0	0.01	0.05
UMB RRG 066	0.03	0.1	0.06	1.1	0.006	5.41	0	0	0	0.007	0.05
UMB RRG 067	0.005	0.22	0.17	1.4	0.015	1.61	0	0	0	0.018	0.05
UMB RRG 068	0.09	0.09	0.09	1.1	0.0025	5.11	0	0	0	0.005	0.05
UMB RRG 069	0.02	0.08	0.07	1.2	0.007	4.54	0	0	0	0.008	0.05
UMB RRG 070	0.01	0.14	0.15	1.3	0.01	6.15	0	0	0	0.011	0.05

Sample No.	Gd ppm	Ge ppm	Hf ppm	Hg ppb	Ho ppm	In ppm	K pct	La ppm	Li ppm	Lu ppm	Mg pct
UMB RRG 001	0	0.005	0.003	31	0	0.01	0.49	0.11	0.97	0	0.565
UMB RRG 002	0	0.02	0.005	36	0	0.01	0.46	0.08	0.92	0	0.478
UMB RRG 003	0	0.02	0.003	11	0	0.01	0.6	0.03	0.38	0	0.301
UMB RRG 004	0	0.005	0.0005	11	0	0.01	0.92	0.03	0.38	0	0.227
UMB RRG 005	0	0.005	0.0005	14	0	0.01	0.8	0.05	0.61	0	0.249
UMB RRG 006	0	0.005	0.004	27	0	0.01	0.47	0.07	1.01	0	0.391
UMB RRG 007	0	0.005	0.0005	13	0	0.01	1.11	0.03	0.41	0	0.311
UMB RRG 008	0	0.005	0.0005	27	0	0.01	0.96	0.02	1.19	0	0.349
UMB RRG 009	0	0.02	0.004	19	0	0.01	0.86	0.07	0.99	0	0.499
UMB RRG 010	0	0.005	0.004	38	0	0.01	0.64	0.07	1.23	0	0.378
UMB RRG 011	0	0.005	0.004	21	0	0.01	0.85	0.04	1.1	0	0.236
UMB RRG 012	0	0.005	0.0005	13	0	0.01	1.11	0.02	0.27	0	0.165
UMB RRG 013	0	0.005	0.002	14	0	0.01	0.89	0.02	0.28	0	0.266
UMB RRG 014	0	0.005	0.002	29	0	0.01	0.82	0.05	0.84	0	0.325
UMB RRG 015	0	0.005	0.002	31	0	0.01	0.69	0.07	0.86	0	0.327
UMB RRG 016	0	0.005	0.004	37	0	0.01	0.65	0.11	1.24	0	0.385
UMB RRG 017	0	0.005	0.002	19	0	0.01	0.69	0.04	0.5	0	0.252
UMB RRG 018	0	0.005	0.0005	8	0	0.01	0.95	0.05	0.32	0	0.389
UMB RRG 019	0	0.02	0.001	12	0	0.01	0.86	0.04	0.43	0	0.221
UMB RRG 020	0	0.005	0.001	12	0	0.01	0.63	0.05	0.46	0	0.299
UMB RRG 021	0	0.005	0.004	37	0	0.01	0.81	0.11	1.13	0	0.419
UMB RRG 022	0	0.005	0.0005	16	0	0.01	0.93	0.04	0.25	0	0.26
UMB RRG 023	0	0.005	0.003	19	0	0.01	0.52	0.05	0.92	0	0.259
UMB RRG 024	0	0.005	0.005	20	0	0.01	0.77	0.06	0.62	0	0.309
UMB RRG 025	0	0.005	0.006	24	0	0.01	0.7	0.05	0.71	0	0.402
UMB RRG 026	0	0.005	0.003	21	0	0.01	0.87	0.05	0.55	0	0.33
UMB RRG 027	0	0.005	0.001	16	0	0.01	0.96	0.02	0.29	0	0.221
UMB RRG 028	0	0.005	0.005	27	0	0.01	0.84	0.06	0.69	0	0.291
UMB RRG 029	0	0.005	0.0005	21	0	0.01	0.78	0.02	0.49	0	0.307
UMB RRG 030	0	0.02	0.001	23	0	0.01	1	0.05	0.63	0	0.336
UMB RRG 031	0	0.005	0.005	23	0	0.01	0.52	0.06	0.48	0	0.191
UMB RRG 032	0	0.01	0.0005	20	0	0.01	0.69	0.05	0.44	0	0.333
UMB RRG 033	0	0.02	0.003	23	0	0.01	0.59	0.05	0.71	0	0.283
UMB RRG 034	0	0.005	0.003	33	0	0.01	1.21	0.06	0.88	0	0.338
UMB RRG 035	0	0.02	0.005	31	0	0.01	0.87	0.05	0.36	0	0.166
UMB RRG 036	0	0.02	0.002	13	0	0.01	0.79	0.02	0.55	0	0.21
UMB RRG 037	0	0.03	0.001	20	0	0.01	1.19	0.02	0.34	0	0.214
UMB RRG 038	0	0.03	0.002	20	0	0.01	0.7	0.03	0.66	0	0.341
UMB RRG 039	0	0.04	0.001	20	0	0.01	0.63	0.05	0.68	0	0.339
UMB RRG 040	0	0.04	0.007	40	0	0.01	0.58	0.09	1.69	0	0.206
UMB RRG 041	0	0.02	0.007	30	0	0.01	0.52	0.11	1	0	0.372
UMB RRG 042	0	0.03	0.001	26	0	0.01	0.71	0.03	0.51	0	0.291
UMB RRG 043	0	0.04	0.003	29	0	0.01	0.67	0.07	0.68	0	0.327
UMB RRG 044	0	0.05	0.005	31	0	0.01	0.85	0.07	1	0	0.413
UMB RRG 045	0	0.02	0.001	30	0	0.01	0.89	0.08	0.65	0	0.324
UMB RRG 046	0	0.03	0.004	18	0	0.01	0.85	0.03	0.39	0	0.327
UMB RRG 047	0	0.03	0.001	27	0	0.01	1.01	0.03	0.61	0	0.205
UMB RRG 048	0	0.005	0.005	17	0	0.01	0.78	0.03	0.7	0	0.222
UMB RRG 049	0	0.06	0.002	16	0	0.01	0.69	0.03	0.48	0	0.229
UMB RRG 050	0	0.05	0.0005	18	0	0.01	0.95	0.05	0.66	0	0.213
UMB RRG 051	0	0.04	0.005	19	0	0.01	0.47	0.07	0.64	0	0.184
UMB RGG 052	0	0.01	0.0005	12	0	0.01	0.67	0.02	0.49	0	0.294
UMB RRG 053	0	0.03	0.003	36	0	0.01	0.97	0.05	0.91	0	0.343
UMB RRG 054	0	0.03	0.001	26	0	0.01	0.75	0.04	0.81	0	0.384
UMB RRG 055	0	0.02	0.005	24	0	0.01	0.69	0.04	0.56	0	0.396
UMB RRG 056	0	0.06	0.0005	7	0	0.01	0.98	0.01	0.18	0	0.183
UMB RRG 057	0	0.03	0.005	21	0	0.01	0.75	0.07	0.54	0	0.309
UMB RRG 058	0	0.04	0.0005	11	0	0.01	1.03	0.03	0.58	0	0.187
UMB RRG 059	0	0.04	0.003	23	0	0.01	0.6	0.09	0.47	0	0.315
UMB RRG 061	0	0.05	0.002	13	0	0.01	1.35	0.02	0.27	0	0.181
UMB RRG 062	0	0.03	0.005	40	0	0.01	0.73	0.1	0.87	0	0.217
UMB RRG 063	0	0.03	0.001	29	0	0.01	0.75	0.06	0.76	0	0.243
UMB RRG 064	0	0.04	0.003	25	0	0.01	0.95	0.07	0.75	0	0.375
UMB RRG 065	0	0.04	0.002	32	0	0.01	0.5	0.08	0.91	0	0.361
UMB RRG 066	0	0.02	0.0005	18	0	0.01	1.2	0.06	0.33	0	0.224
UMB RRG 067	0	0.005	0.006	45	0	0.01	0.48	0.11	0.53	0	0.129
UMB RRG 068	0	0.03	0.0005	16	0	0.01	0.89	0.06	0.24	0	0.339
UMB RRG 069	0	0.02	0.0005	14	0	0.01	1.06	0.04	0.24	0	0.187
UMB RRG 070	0	0.02	0.005	13	0	0.01	0.95	0.07	0.41	0	0.195

Sample No.	Mn ppm	Mo ppm	Na pct	Nb ppm	Nd ppm	Ni ppm	P pct	Pb ppm	Pd ppb	Pr ppm	Pt ppb
UMB RRG 001	356	0.25	0.216	0.01	0	1.7	0.179	1.19	5	0	0.5
UMB RRG 002	162	0.15	0.321	0.005	0	1.2	0.075	0.91	3	0	0.5
UMB RRG 003	66	0.07	0.238	0.005	0	0.9	0.125	0.565	4	0	0.5
UMB RRG 004	48	0.12	0.171	0.005	0	1.4	0.16	0.425	6	0	0.5
UMB RRG 005	168	0.23	0.088	0.005	0	0.7	0.116	0.335	5	0	0.5
UMB RRG 006	133	0.06	0.165	0.005	0	1.8	0.11	0.78	4	0	0.5
UMB RRG 007	65	0.12	0.133	0.005	0	0.7	0.176	0.78	7	0	0.5
UMB RRG 008	137	0.17	0.449	0.005	0	1.7	0.215	0.75	7	0	0.5
UMB RRG 009	170	0.15	0.109	0.005	0	1.2	0.168	0.69	7	0	0.5
UMB RRG 010	115	0.12	0.299	0.005	0	1.2	0.12	0.83	4	0	0.5
UMB RRG 011	132	0.06	0.38	0.005	0	1.3	0.166	0.495	3	0	0.5
UMB RRG 012	58	0.14	0.349	0.005	0	0.7	0.155	0.315	4	0	0.5
UMB RRG 013	70	0.22	0.317	0.005	0	0.8	0.157	0.385	4	0	0.5
UMB RRG 014	102	0.14	0.367	0.005	0	1.4	0.212	0.73	6	0	0.5
UMB RRG 015	131	0.03	0.459	0.005	0	1.1	0.249	0.585	4	0	0.5
UMB RRG 016	123	0.05	0.53	0.005	0	1.6	0.203	0.635	5	0	0.5
UMB RRG 017	70	0.11	0.136	0.005	0	0.8	0.147	0.345	2	0	0.5
UMB RRG 018	144	0.05	0.107	0.005	0	0.6	0.198	0.515	4	0	0.5
UMB RRG 019	85	0.37	0.38	0.005	0	1	0.223	0.365	4	0	0.5
UMB RRG 020	62	0.09	0.917	0.005	0	0.6	0.147	0.645	3	0	0.5
UMB RRG 021	329	0.06	0.422	0.005	0	1.8	0.293	1.03	8	0	0.5
UMB RRG 022	71	0.17	0.303	0.005	0	0.6	0.169	0.78	5	0	0.5
UMB RRG 023	128	0.08	0.435	0.005	0	0.8	0.166	0.535	2	0	0.5
UMB RRG 024	166	0.07	0.431	0.005	0	0.9	0.166	0.575	6	0	0.5
UMB RRG 025	221	0.35	0.432	0.005	0	1.2	0.194	0.295	5	0	0.5
UMB RRG 026	97	0.05	0.164	0.005	0	1.1	0.274	0.435	4	0	0.5
UMB RRG 027	66	0.1	0.561	0.005	0	0.7	0.14	0.615	2	0	0.5
UMB RRG 028	78	0.06	0.137	0.005	0	2.7	0.279	0.465	3	0	0.5
UMB RRG 029	56	0.35	0.641	0.005	0	0.8	0.195	0.305	4	0	0.5
UMB RRG 030	92	0.06	0.168	0.005	0	2	0.226	0.325	2	0	0.5
UMB RRG 031	37	0.08	0.377	0.005	0	0.7	0.11	0.385	3	0	0.5
UMB RRG 032	61	0.12	0.433	0.005	0	2	0.201	0.505	4	0	0.5
UMB RRG 033	131	0.06	0.243	0.005	0	1.6	0.157	0.395	3	0	0.5
UMB RRG 034	89	0.19	0.304	0.005	0	2.6	0.431	0.405	7	0	0.5
UMB RRG 035	108	0.21	0.367	0.005	0	1.2	0.24	0.635	4	0	0.5
UMB RRG 036	84	0.09	0.344	0.005	0	1	0.164	0.465	4	0	0.5
UMB RRG 037	38	0.13	0.118	0.005	0	1.1	0.127	0.225	4	0	0.5
UMB RRG 038	81	0.03	0.367	0.005	0	1.5	0.171	0.325	4	0	0.5
UMB RRG 039	115	0.05	0.281	0.005	0	1.6	0.129	0.345	4	0	0.5
UMB RRG 040	79	0.3	0.314	0.005	0	3.3	0.144	0.355	1	0	0.5
UMB RRG 041	100	0.08	0.352	0.005	0	1.2	0.094	0.455	4	0	0.5
UMB RRG 042	48	0.15	0.355	0.005	0	1.9	0.167	0.245	5	0	0.5
UMB RRG 043	67	0.06	0.39	0.005	0	0.9	0.184	0.355	6	0	0.5
UMB RRG 044	111	0.11	0.26	0.005	0	3.5	0.26	0.475	3	0	0.5
UMB RRG 045	69	0.1	0.313	0.005	0	1.9	0.21	0.425	5	0	0.5
UMB RRG 046	69	0.07	0.295	0.005	0	1.2	0.175	0.265	4	0	0.5
UMB RRG 047	57	0.06	0.308	0.005	0	1.3	0.185	0.245	3	0	0.5
UMB RRG 048	48	0.19	0.225	0.005	0	2.1	0.171	0.285	3	0	0.5
UMB RRG 049	69	0.12	0.152	0.005	0	0.8	0.13	0.375	1	0	0.5
UMB RRG 050	53	0.12	0.388	0.005	0	1.5	0.194	0.325	4	0	0.5
UMB RRG 051	23	0.03	0.607	0.005	0	0.9	0.086	0.415	2	0	0.5
UMB RGG 052	39	0.35	0.65	0.005	0	0.6	0.148	0.405	2	0	0.5
UMB RRG 053	97	0.08	0.064	0.005	0	2.7	0.431	0.435	4	0	0.5
UMB RRG 054	85	0.18	0.414	0.005	0	1.6	0.234	0.315	8	0	0.5
UMB RRG 055	113	0.25	0.356	0.005	0	3	0.295	0.265	15	0	0.5
UMB RRG 056	43	0.15	0.22	0.005	0	0.8	0.174	0.205	4	0	0.5
UMB RRG 057	128	0.41	0.391	0.005	0	1.7	0.2	0.485	3	0	0.5
UMB RRG 058	260	0.03	0.278	0.005	0	0.5	0.165	0.225	4	0	1
UMB RRG 059	129	0.2	0.411	0.005	0	0.8	0.163	0.365	2	0	0.5
UMB RRG 061	100	0.13	0.401	0.005	0	0.8	0.211	0.185	4	0	0.5
UMB RRG 062	171	0.07	0.421	0.005	0	1	0.288	0.325	4	0	0.5
UMB RRG 063	152	0.03	0.222	0.005	0	1.4	0.236	0.255	3	0	0.5
UMB RRG 064	195	0.19	0.096	0.005	0	1.1	0.282	0.325	5	0	0.5
UMB RRG 065	66	0.12	0.124	0.005	0	2	0.162	0.265	1	0	0.5
UMB RRG 066	67	0.06	0.225	0.005	0	0.9	0.188	0.215	3	0	0.5
UMB RRG 067	17	0.04	0.231	0.01	0	1.3	0.084	0.315	1	0	0.5
UMB RRG 068	131	0.02	0.222	0.005	0	1.4	0.136	0.145	8	0	0.5
UMB RRG 069	41	0.06	0.323	0.005	0	0.5	0.112	0.095	3	0	0.5
UMB RRG 070	90	0.02	0.346	0.005	0	1	0.2	0.115	3	0	0.5

Sample No.	Rb ppm	Re ppb	S pct	Sb ppm	Sc ppm	Se ppm	Sm ppm	Sn ppm	Sr ppm	Ta ppm	Tb ppm
UMB RRG 001	0.7	2	0.16	0.06	0.1	0.2	0	0.03	234.4	0.0005	0
UMB RRG 002	0.5	2	0.21	0.1	0.2	0.4	0	0.01	152.1	0.0005	0
UMB RRG 003	0.7	2	0.18	0.26	0.2	0.2	0	0.01	103.1	0.0005	0
UMB RRG 004	1	2	0.19	0.26	0.2	0.2	0	0.01	59.9	0.0005	0
UMB RRG 005	0.9	2	0.14	0.08	0.1	0.2	0	0.01	91.8	0.0005	0
UMB RRG 006	0.7	2	0.16	0.21	0.2	0.2	0	0.01	239.1	0.0005	0
UMB RRG 007	1.2	2	0.19	0.53	0.1	0.3	0	0.01	90.2	0.0005	0
UMB RRG 008	0.8	2	0.2	0.15	0.2	0.8	0	0.01	122.3	0.0005	0
UMB RRG 009	0.9	2	0.17	0.03	0.2	0.3	0	0.03	281.7	0.001	0
UMB RRG 010	0.7	2	0.21	0.14	0.2	0.5	0	0.03	163.9	0.0005	0
UMB RRG 011	0.8	2	0.16	0.11	0.2	0.3	0	0.01	54.4	0.0005	0
UMB RRG 012	1.7	2	0.17	0.41	0.2	0.2	0	0.01	55.4	0.0005	0
UMB RRG 013	0.9	2	0.21	0.44	0.1	0.4	0	0.01	73.1	0.0005	0
UMB RRG 014	1	2	0.18	0.05	0.2	0.6	0	0.02	94.3	0.0005	0
UMB RRG 015	0.6	2	0.19	0.12	0.2	0.4	0	0.02	85.2	0.0005	0
UMB RRG 016	0.8	2	0.18	0.26	0.2	0.9	0	0.03	154.1	0.0005	0
UMB RRG 017	0.7	2	0.13	0.01	0.1	0.4	0	0.01	48.7	0.0005	0
UMB RRG 018	1.6	2	0.2	0.24	0.2	1.6	0	0.01	70.3	0.0005	0
UMB RRG 019	0.9	2	0.25	0.49	0.1	1.2	0	0.01	63.2	0.0005	0
UMB RRG 020	0.7	2	0.28	1.14	0.2	0.5	0	0.01	45.9	0.0005	0
UMB RRG 021	0.8	2	0.21	0.73	0.2	0.5	0	0.01	126.1	0.0005	0
UMB RRG 022	0.9	2	0.22	0.13	0.2	0.3	0	0.01	76	0.0005	0
UMB RRG 023	0.5	2	0.28	0.17	0.2	0.4	0	0.01	86.5	0.0005	0
UMB RRG 024	0.5	2	0.19	0.27	0.2	0.3	0	0.01	40	0.0005	0
UMB RRG 025	0.6	2	0.24	0.09	0.2	0.2	0	0.01	70.6	0.0005	0
UMB RRG 026	0.9	2	0.19	0.25	0.2	0.4	0	0.01	90.8	0.0005	0
UMB RRG 027	1.2	2	0.17	0.13	0.2	0.3	0	0.01	40.8	0.0005	0
UMB RRG 028	0.6	2	0.16	0.11	0.2	0.4	0	0.03	75.6	0.0005	0
UMB RRG 029	0.7	2	0.19	0.1	0.1	0.4	0	0.03	58.9	0.0005	0
UMB RRG 030	1.3	2	0.18	0.31	0.1	0.4	0	0.02	95.1	0.0005	0
UMB RRG 031	0.7	2	0.16	0.17	0.3	0.3	0	0.01	43.1	0.0005	0
UMB RRG 032	0.9	2	0.14	0.4	0.1	0.5	0	0.03	83.7	0.0005	0
UMB RRG 033	0.6	2	0.14	0.32	0.1	0.4	0	0.01	126.6	0.0005	0
UMB RRG 034	1.3	2	0.18	0.09	0.2	0.4	0	0.01	72.4	0.0005	0
UMB RRG 035	1	2	0.17	0.01	0.2	0.6	0	0.01	59.8	0.0005	0
UMB RRG 036	0.8	2	0.17	0.01	0.2	0.4	0	0.01	48.4	0.0005	0
UMB RRG 037	2.1	2	0.17	0.01	0.1	0.2	0	0.01	66.7	0.0005	0
UMB RRG 038	0.4	2	0.2	0.01	0.1	0.4	0	0.01	35.1	0.0005	0
UMB RRG 039	0.5	2	0.16	0.01	0.2	0.4	0	0.01	52.5	0.0005	0
UMB RRG 040	0.5	2	0.16	0.01	0.2	0.3	0	0.01	61.6	0.0005	0
UMB RRG 041	0.5	2	0.19	0.01	0.2	0.3	0	0.01	107.2	0.0005	0
UMB RRG 042	0.7	2	0.16	0.01	0.2	0.2	0	0.01	54.1	0.0005	0
UMB RRG 043	0.6	2	0.15	0.01	0.1	0.4	0	0.01	65.2	0.0005	0
UMB RRG 044	0.8	2	0.18	0.01	0.2	0.4	0	0.01	136.6	0.0005	0
UMB RRG 045	0.9	2	0.15	0.01	0.2	0.2	0	0.01	81.3	0.0005	0
UMB RRG 046	0.7	2	0.18	0.01	0.1	0.3	0	0.01	57.8	0.0005	0
UMB RRG 047	0.8	2	0.15	0.01	0.2	0.4	0	0.01	68.6	0.0005	0
UMB RRG 048	0.5	2	0.14	0.01	0.2	0.5	0	0.01	61	0.0005	0
UMB RRG 049	0.7	2	0.15	0.01	0.2	0.4	0	0.01	54.4	0.0005	0
UMB RRG 050	0.8	2	0.17	0.01	0.2	0.3	0	0.01	32.7	0.0005	0
UMB RRG 051	0.6	2	0.16	0.01	0.2	0.4	0	0.01	54.6	0.0005	0
UMB RGG 052	0.7	2	0.22	0.01	0.1	0.5	0	0.01	50.9	0.0005	0
UMB RRG 053	1	2	0.17	0.01	0.1	0.3	0	0.01	91	0.0005	0
UMB RRG 054	0.6	2	0.19	0.01	0.1	0.3	0	0.01	57.8	0.0005	0
UMB RRG 055	0.5	2	0.24	0.01	0.1	0.3	0	0.01	83.1	0.0005	0
UMB RRG 056	1.2	2	0.18	0.01	0.2	0.3	0	0.01	40.4	0.0005	0
UMB RRG 057	0.9	2	0.17	0.01	0.2	0.3	0	0.01	61.1	0.0005	0
UMB RRG 058	1.7	2	0.12	0.01	0.2	0.3	0	0.01	36.3	0.0005	0
UMB RRG 059	0.7	2	0.17	0.01	0.2	0.4	0	0.01	105.4	0.0005	0
UMB RRG 061	1.4	2	0.17	0.01	0.1	0.3	0	0.01	39.9	0.0005	0
UMB RRG 062	0.6	2	0.16	0.01	0.2	0.4	0	0.01	99.6	0.0005	0
UMB RRG 063	0.5	2	0.15	0.01	0.2	0.3	0	0.01	53.1	0.0005	0
UMB RRG 064	1	2	0.16	0.01	0.2	0.4	0	0.01	137.2	0.0005	0
UMB RRG 065	0.5	2	0.14	0.01	0.05	0.2	0	0.01	110.6	0.0005	0
UMB RRG 066	1.5	2	0.12	0.01	0.05	0.2	0	0.01	74.8	0.001	0
UMB RRG 067	0.5	2	0.13	0.01	0.05	0.3	0	0.01	43.2	0.0005	0
UMB RRG 068	1	2	0.13	0.01	0.05	0.2	0	0.01	45.4	0.0005	0
UMB RRG 069	1.2	2	0.16	0.01	0.05	0.1	0	0.01	39.9	0.0005	0
UMB RRG 070	0.9	2	0.12	0.01	0.05	0.2	0	0.01	72.2	0.0005	0

Sample No.	Te ppm	Th ppm	Ti pct	Tl ppm	Tm ppm	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm
UMB RRG 001	0.02	0.01	10	0.01	0	0.02	1	0.05	0.081	0	34
UMB RRG 002	0.02	0.01	5	0.01	0	0.03	1	0.05	0.052	0	23.9
UMB RRG 003	0.01	0.005	6	0.01	0	0.005	1	0.05	0.021	0	25.2
UMB RRG 004	0.01	0.005	8	0.01	0	0.005	1	0.05	0.01	0	33.7
UMB RRG 005	0.04	0.005	6	0.01	0	0.005	1	0.05	0.032	0	31.2
UMB RRG 006	0.01	0.02	7	0.01	0	0.01	1	0.05	0.054	0	24.7
UMB RRG 007	0.01	0.005	9	0.01	0	0.005	1	0.05	0.016	0	41.1
UMB RRG 008	0.01	0.005	10	0.01	0	0.06	1	0.05	0.023	0	36.4
UMB RRG 009	0.01	0.01	10	0.01	0	0.02	1	0.05	0.062	0	43.7
UMB RRG 010	0.01	0.01	8	0.01	0	0.02	1	0.05	0.037	0	28.7
UMB RRG 011	0.01	0.01	9	0.01	0	0.03	1	0.05	0.034	0	20.5
UMB RRG 012	0.01	0.005	8	0.01	0	0.005	1	0.05	0.013	0	22.1
UMB RRG 013	0.01	0.005	8	0.01	0	0.005	1	0.05	0.022	0	26.5
UMB RRG 014	0.01	0.02	12	0.01	0	0.02	2	0.05	0.061	0	34.4
UMB RRG 015	0.01	0.01	13	0.01	0	0.02	2	0.05	0.072	0	24.3
UMB RRG 016	0.01	0.02	12	0.01	0	0.05	1	0.05	0.066	0	33
UMB RRG 017	0.01	0.005	5	0.01	0	0.005	1	0.05	0.025	0	11.2
UMB RRG 018	0.01	0.01	10	0.01	0	0.005	1	0.05	0.028	0	23.3
UMB RRG 019	0.01	0.005	10	0.01	0	0.07	1	0.05	0.03	0	24.2
UMB RRG 020	0.01	0.005	8	0.01	0	0.01	3	0.05	0.028	0	17.4
UMB RRG 021	0.02	0.02	16	0.01	0	0.04	1	0.05	0.095	0	46.2
UMB RRG 022	0.01	0.005	9	0.01	0	0.005	1	0.05	0.032	0	29.7
UMB RRG 023	0.01	0.005	9	0.01	0	0.04	1	0.05	0.049	0	13.8
UMB RRG 024	0.01	0.01	9	0.01	0	0.03	1	0.05	0.037	0	33.3
UMB RRG 025	0.01	0.005	10	0.01	0	0.02	1	0.05	0.048	0	35
UMB RRG 026	0.01	0.005	14	0.01	0	0.03	2	0.05	0.044	0	21.1
UMB RRG 027	0.01	0.005	8	0.01	0	0.005	3	0.05	0.029	0	16.7
UMB RRG 028	0.01	0.02	15	0.01	0	0.005	3	0.05	0.042	0	22.3
UMB RRG 029	0.01	0.005	9	0.01	0	0.005	3	0.05	0.017	0	26.6
UMB RRG 030	0.01	0.005	12	0.01	0	0.005	2	0.05	0.024	0	17.9
UMB RRG 031	0.01	0.005	7	0.01	0	0.005	3	0.05	0.037	0	16.5
UMB RRG 032	0.01	0.005	11	0.01	0	0.005	1	0.05	0.04	0	28.5
UMB RRG 033	0.01	0.005	9	0.01	0	0.02	1	0.05	0.037	0	18.2
UMB RRG 034	0.01	0.02	21	0.01	0	0.01	1	0.05	0.029	0	45.4
UMB RRG 035	0.01	0.01	13	0.01	0	0.005	1	0.05	0.025	0	24.8
UMB RRG 036	0.01	0.005	8	0.01	0	0.005	1	0.05	0.016	0	20.4
UMB RRG 037	0.01	0.005	6	0.01	0	0.005	1	0.05	0.013	0	28.4
UMB RRG 038	0.01	0.005	9	0.01	0	0.01	2	0.05	0.023	0	25.2
UMB RRG 039	0.01	0.005	7	0.01	0	0.01	3	0.05	0.043	0	20.5
UMB RRG 040	0.01	0.02	9	0.01	0	0.03	2	0.05	0.044	0	9.1
UMB RRG 041	0.01	0.02	7	0.01	0	0.04	2	0.05	0.061	0	23.9
UMB RRG 042	0.01	0.005	9	0.01	0	0.005	3	0.05	0.024	0	30.1
UMB RRG 043	0.01	0.01	10	0.01	0	0.01	3	0.05	0.037	0	29.4
UMB RRG 044	0.01	0.01	14	0.01	0	0.02	3	0.05	0.046	0	23.8
UMB RRG 045	0.01	0.01	12	0.01	0	0.01	3	0.05	0.049	0	30.8
UMB RRG 046	0.01	0.005	9	0.01	0	0.02	3	0.05	0.018	0	20.8
UMB RRG 047	0.01	0.005	10	0.01	0	0.01	2	0.05	0.018	0	18
UMB RRG 048	0.01	0.005	9	0.01	0	0.02	3	0.05	0.031	0	13
UMB RRG 049	0.01	0.005	7	0.01	0	0.005	3	0.05	0.021	0	13.4
UMB RRG 050	0.01	0.01	10	0.01	0	0.005	3	0.05	0.039	0	25.6
UMB RRG 051	0.01	0.01	6	0.01	0	0.005	3	0.05	0.038	0	14
UMB RGG 052	0.01	0.005	8	0.01	0	0.005	4	0.05	0.018	0	14.1
UMB RRG 053	0.01	0.01	21	0.01	0	0.005	3	0.05	0.045	0	23.3
UMB RRG 054	0.01	0.005	12	0.01	0	0.03	3	0.05	0.032	0	45.8
UMB RRG 055	0.01	0.005	14	0.01	0	0.01	3	0.05	0.024	0	91.1
UMB RRG 056	0.01	0.005	9	0.01	0	0.005	5	0.05	0.008	0	27.6
UMB RRG 057	0.01	0.02	11	0.01	0	0.005	4	0.05	0.048	0	17.6
UMB RRG 058	0.01	0.005	8	0.01	0	0.005	3	0.05	0.02	0	19.3
UMB RRG 059	0.01	0.01	9	0.01	0	0.005	4	0.05	0.079	0	15.7
UMB RRG 061	0.01	0.005	11	0.01	0	0.005	3	0.05	0.015	0	21
UMB RRG 062	0.01	0.02	16	0.01	0	0.02	4	0.05	0.072	0	28.3
UMB RRG 063	0.01	0.01	12	0.01	0	0.005	4	0.05	0.061	0	21
UMB RRG 064	0.02	0.005	14	0.01	0	0.005	3	0.05	0.046	0	30.6
UMB RRG 065	0.02	0.02	9	0.01	0	0.02	1	0.05	0.047	0	13.8
UMB RRG 066	0.01	0.01	8	0.01	0	0.005	1	0.05	0.047	0	17.6
UMB RRG 067	0.01	0.04	6	0.01	0	0.01	1	0.05	0.083	0	10.1
UMB RRG 068	0.01	0.005	6	0.01	0	0.005	1	0.05	0.024	0	49
UMB RRG 069	0.01	0.005	6	0.01	0	0.005	1	0.05	0.026	0	17.8
UMB RRG 070	0.01	0.02	11	0.01	0	0.005	1	0.05	0.044	0	23.4

Sample No.	Zr ppm
UMB RRG 001	0.07
UMB RRG 002	0.09
UMB RRG 003	0.03
UMB RRG 004	0.02
UMB RRG 005	0.05
UMB RRG 006	0.09
UMB RRG 007	0.03
UMB RRG 008	0.02
UMB RRG 009	0.06
UMB RRG 010	0.08
UMB RRG 011	0.06
UMB RRG 012	0.03
UMB RRG 013	0.03
UMB RRG 014	0.08
UMB RRG 015	0.08
UMB RRG 016	0.11
UMB RRG 017	0.06
UMB RRG 018	0.05
UMB RRG 019	0.03
UMB RRG 020	0.06
UMB RRG 021	0.1
UMB RRG 022	0.04
UMB RRG 023	0.05
UMB RRG 024	0.07
UMB RRG 025	0.05
UMB RRG 026	0.07
UMB RRG 027	0.03
UMB RRG 028	0.11
UMB RRG 029	0.02
UMB RRG 030	0.06
UMB RRG 031	0.07
UMB RRG 032	0.05
UMB RRG 033	0.06
UMB RRG 034	0.08
UMB RRG 035	0.06
UMB RRG 036	0.02
UMB RRG 037	0.04
UMB RRG 038	0.05
UMB RRG 039	0.04
UMB RRG 040	0.12
UMB RRG 041	0.13
UMB RRG 042	0.04
UMB RRG 043	0.08
UMB RRG 044	0.08
UMB RRG 045	0.07
UMB RRG 046	0.03
UMB RRG 047	0.04
UMB RRG 048	0.05
UMB RRG 049	0.06
UMB RRG 050	0.08
UMB RRG 051	0.08
UMB RGG 052	0.03
UMB RRG 053	0.07
UMB RRG 054	0.06
UMB RRG 055	0.06
UMB RRG 056	0.02
UMB RRG 057	0.1
UMB RRG 058	0.03
UMB RRG 059	0.08
UMB RRG 061	0.04
UMB RRG 062	0.12
UMB RRG 063	0.05
UMB RRG 064	0.08
UMB RRG 065	0.09
UMB RRG 066	0.05
UMB RRG 067	0.14
UMB RRG 068	0.03
UMB RRG 069	0.06
UMB RRG 070	0.1

Sample No.	Eastings	Northings	Ag ppb	Al pct	As ppm	Au ppb	B ppm	Ba ppm	Be ppm	Bi ppm	Ca pct
UMB RRG 071	521289	6473732	2	0.005	0.05	0.6	55	84	0.05	0.01	1.82
UMB RRG 072	521118	6474157	1	0.01	0.05	0.3	25	40.4	0.05	0.01	0.89
UMB RRG 073	521020	6474354	1	0.005	0.05	0.1	53	64.8	0.05	0.01	1.85
UMB RRG 074	520946	6474509	3	0.005	0.05	0.5	80	45.7	0.05	0.01	1.23
UMB RRG 075	520838	6474849	4	0.02	0.05	0.4	66	25.2	0.05	0.01	0.97
UMB RRG 076	520834	6475184	3	0.03	0.05	0.1	43	30	0.05	0.01	1.45
UMB RRG 077	520805	6475184	3	0.04	0.1	0.3	107	30.6	0.05	0.01	1.34
UMB RRG 078	518018	6481343	1	0.005	0.05	0.5	37	64.7	0.05	0.01	1.42
UMB RRG 079	518374	6481447	1	0.005	0.05	0.3	37	86.3	0.05	0.02	1.87
UMB RRG 080	518715	6481467	1	0.01	0.05	0.1	37	47.5	0.05	0.01	1.23
UMB RRG 081	518780	6481129	1	0.005	0.05	0.1	55	16.7	0.05	0.01	1.38
UMB RRG 082	519497	6480323	1	0.005	0.05	0.1	57	6.3	0.05	0.02	0.61
UMB RRG 083	519852	6480019	1	0.005	0.3	0.5	54	27.2	0.05	0.01	1.09
UMB RRG 084	520804	6475315	1	0.005	0.1	0.1	68	39.4	0.05	0.02	0.83
UMB RRG 086	512012	6483942	1	0.01	0.05	0.1	86	114.9	0.05	0.01	2.86
UMB RRG 087	512140	6483778	1	0.02	0.05	0.1	67	42.6	0.05	0.01	1.45
UMB RRG 088	512321	6483610	1	0.005	0.05	0.3	39	41.2	0.05	0.01	1.27
UMB RRG 089	512476	6483447	1	0.02	0.1	0.2	61	42.4	0.05	0.01	1.12
UMB RRG 090	512680	6483341	1	0.01	0.1	0.1	57	36	0.05	0.01	1.18
UMB RRG 091	512860	6483196	1	0.005	0.05	0.1	68	38	0.05	0.01	1.4
UMB RRG 092	513095	6483096	1	0.005	0.05	0.1	59	52.2	0.05	0.01	1.23
UMB RRG 093	513331	6482881	1	0.005	0.05	0.1	41	37.7	0.05	0.01	1.27
UMB RRG 094	508439	6484304	1	0.02	0.1	0.1	98	64.2	0.05	0.01	1.44
UMB RRG 095	508861	6484341	1	0.02	0.2	0.1	94	99.2	0.05	0.01	1.95
UMB RRG 096	509030	6484423	1	0.005	0.05	0.1	84	40.4	0.05	0.01	1.09
UMB RRG 097	509237	6484515	1	0.005	0.1	0.2	74	46.2	0.05	0.02	0.96
UMB RRG 098	509522	6484424	1	0.005	0.05	0.1	45	47	0.05	0.03	1.27
UMB RRG 099	510027	6483840	3	0.005	0.05	0.3	34	39.6	0.05	0.02	0.78
UMB RRG 100	510371	6483874	1	0.005	0.05	0.2	53	86.3	0.05	0.02	1.17
UMB RRG 101	513541	6482758	1	0.005	0.05	0.1	45	27.9	0.05	0.02	1.26
UMB RRG 102	513902	6482785	1	0.02	0.05	0.1	126	91.7	0.05	0.02	3.1
UMB RRG 103	514222	6482822	1	0.005	0.05	0.1	85	68.1	0.05	0.01	1.98
UMB RRG 104	514958	6482828	1	0.005	0.05	0.3	46	51.5	0.05	0.02	1.41
UMB RRG 105	514697	6482799	1	0.005	0.05	0.1	51	41.1	0.05	0.01	1.52
UMB RRG 106	514652	6482745	1	0.005	0.05	0.1	34	52.8	0.05	0.01	1.59
UMB RRG 107	515349	6482684	1	0.005	0.05	0.2	73	51.9	0.05	0.01	1.31
UMB RRG 108	515652	6482608	1	0.005	0.05	0.1	56	22.7	0.05	0.01	1.17
UMB RRG 109	515977	6482420	1	0.005	0.05	0.2	41	54.3	0.05	0.01	1.46
UMB RRG 110	516372	6482246	1	0.005	0.05	0.5	38	54.8	0.05	0.01	1.13
UMB RRG 111	516753	6482189	4	0.005	0.05	0.3	45	54.3	0.05	0.01	1.26
UMB RRG 112	517039	6482133	8	0.005	0.05	1.5	36	55.2	0.05	0.01	1.67
UMB RRG 113	517330	6481994	6	0.01	0.05	0.7	54	56.4	0.05	0.01	1.85
UMB RRG 114	517586	6481809	4	0.005	0.05	0.4	33	58.6	0.05	0.01	1.31
UMB RRG 115	517838	6481713	2	0.005	0.05	0.6	53	97.5	0.05	0.01	2.56
UMB RRG 116	510671	6483874	1	0.005	0.05	0.4	54	40.8	0.05	0.01	1.33
UMB RRG 117	511141	6484173	1	0.01	0.05	0.5	90	142.1	0.05	0.01	2.76
UMB RRG 118	511405	6484231	2	0.005	0.05	0.1	48	66.7	0.05	0.01	1.07
UMB RRG 119	511720	6484008	1	0.005	0.05	0.3	72	40	0.05	0.01	1.16

Sample No.	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Fe pct	Ga ppm
UMB RRG 071	0.13	0.04	0.1	1.3	0.0025	4.5	0	0	0	0.003	0.05
UMB RRG 072	0.02	0.11	0.08	1.3	0.007	5.86	0	0	0	0.01	0.05
UMB RRG 073	0.02	0.06	0.24	1.1	0.0025	8.12	0	0	0	0.004	0.05
UMB RRG 074	0.005	0.04	0.04	1.2	0.0025	8.5	0	0	0	0.004	0.05
UMB RRG 075	0.04	0.31	0.13	1.5	0.019	3.71	0	0	0	0.021	0.05
UMB RRG 076	0.06	0.41	0.15	1.3	0.019	4.15	0	0	0	0.028	0.05
UMB RRG 077	0.005	0.67	0.11	1.5	0.031	2.9	0	0	0	0.039	0.1
UMB RRG 078	0.02	0.05	0.09	1	0.005	3.29	0	0	0	0.004	0.05
UMB RRG 079	0.03	0.08	0.05	1.2	0.005	5.55	0	0	0	0.003	0.05
UMB RRG 080	0.005	0.19	0.14	1.2	0.016	4.33	0	0	0	0.013	0.05
UMB RRG 081	0.005	0.13	0.05	1.1	0.007	4.84	0	0	0	0.008	0.05
UMB RRG 082	0.03	0.04	0.03	1.3	0.0025	3.91	0	0	0	0.003	0.05
UMB RRG 083	0.08	0.05	0.21	1.1	0.0025	5.43	0	0	0	0.006	0.05
UMB RRG 084	0.005	0.03	0.05	1.1	0.0025	3.17	0	0	0	0.003	0.05
UMB RRG 086	0.04	0.27	0.11	1.2	0.008	4.98	0	0	0	0.009	0.05
UMB RRG 087	0.005	0.22	0.05	1.3	0.017	3.13	0	0	0	0.015	0.05
UMB RRG 088	0.005	0.06	0.06	1.1	0.006	5.38	0	0	0	0.004	0.05
UMB RRG 089	0.03	0.29	0.13	1.2	0.022	3.93	0	0	0	0.018	0.05
UMB RRG 090	0.005	0.15	0.29	1.1	0.012	3.53	0	0	0	0.012	0.05
UMB RRG 091	0.01	0.14	0.11	1.2	0.01	3.19	0	0	0	0.008	0.05
UMB RRG 092	0.01	0.09	0.08	1.2	0.007	4.39	0	0	0	0.008	0.05
UMB RRG 093	0.005	0.04	0.06	1.1	0.0025	3.78	0	0	0	0.004	0.05
UMB RRG 094	0.005	0.21	0.16	1.5	0.024	4.15	0	0	0	0.02	0.05
UMB RRG 095	0.03	0.18	0.08	1.2	0.016	5.15	0	0	0	0.015	0.05
UMB RRG 096	0.005	0.07	0.1	1.1	0.006	2.99	0	0	0	0.006	0.05
UMB RRG 097	0.005	0.07	0.1	1.1	0.007	5.56	0	0	0	0.006	0.05
UMB RRG 098	0.005	0.1	0.08	1.5	0.009	4.98	0	0	0	0.008	0.05
UMB RRG 099	0.005	0.02	0.1	1.4	0.0025	5.63	0	0	0	0.002	0.05
UMB RRG 100	0.02	0.05	0.07	1.6	0.0025	4.98	0	0	0	0.004	0.05
UMB RRG 101	0.005	0.12	0.05	1.7	0.009	2.81	0	0	0	0.008	0.05
UMB RRG 102	0.02	0.5	0.08	1.5	0.026	3.75	0	0	0	0.022	0.05
UMB RRG 103	0.01	0.08	0.11	1.5	0.005	5.35	0	0	0	0.006	0.05
UMB RRG 104	0.005	0.1	0.08	1.7	0.006	4.64	0	0	0	0.007	0.05
UMB RRG 105	0.03	0.13	0.15	1.7	0.007	3.47	0	0	0	0.007	0.05
UMB RRG 106	0.01	0.15	0.1	1.6	0.009	4.41	0	0	0	0.009	0.05
UMB RRG 107	0.02	0.1	0.14	1.7	0.0025	5.19	0	0	0	0.007	0.05
UMB RRG 108	0.01	0.09	0.12	1.5	0.008	3.2	0	0	0	0.007	0.05
UMB RRG 109	0.01	0.12	0.09	1.6	0.009	5.4	0	0	0	0.009	0.05
UMB RRG 110	0.02	0.04	0.12	1.6	0.0025	6.38	0	0	0	0.004	0.05
UMB RRG 111	0.005	0.12	0.13	1.7	0.007	6.93	0	0	0	0.008	0.05
UMB RRG 112	0.02	0.05	0.08	1.6	0.0025	5.64	0	0	0	0.004	0.05
UMB RRG 113	0.03	0.14	0.08	1.8	0.01	4.41	0	0	0	0.01	0.05
UMB RRG 114	0.03	0.1	0.08	1.8	0.006	6.05	0	0	0	0.008	0.05
UMB RRG 115	0.01	0.12	0.18	1.6	0.006	4.95	0	0	0	0.006	0.05
UMB RRG 116	0.01	0.07	0.06	1.7	0.006	5.2	0	0	0	0.005	0.05
UMB RRG 117	0.03	0.19	0.15	1.7	0.008	4.96	0	0	0	0.009	0.05
UMB RRG 118	0.005	0.06	0.19	1.7	0.0025	6.27	0	0	0	0.004	0.05
UMB RRG 119	0.005	0.04	0.08	1.6	0.0025	4.16	0	0	0	0.003	0.05

Sample No.	Gd ppm	Ge ppm	Hf ppm	Hg ppb	Ho ppm	In ppm	K pct	La ppm	Li ppm	Lu ppm	Mg pct
UMB RRG 071	0	0.005	0.0005	25	0	0.01	0.81	0.02	0.45	0	0.376
UMB RRG 072	0	0.04	0.0005	12	0	0.01	0.67	0.05	0.24	0	0.235
UMB RRG 073	0	0.01	0.002	18	0	0.01	1.27	0.03	0.5	0	0.306
UMB RRG 074	0	0.02	0.005	26	0	0.01	0.86	0.02	0.38	0	0.173
UMB RRG 075	0	0.02	0.004	27	0	0.01	0.6	0.14	0.51	0	0.265
UMB RRG 076	0	0.03	0.01	22	0	0.01	1	0.17	0.74	0	0.212
UMB RRG 077	0	0.02	0.008	47	0	0.01	0.47	0.33	0.98	0	0.218
UMB RRG 078	0	0.005	0.0005	19	0	0.01	0.74	0.03	0.29	0	0.232
UMB RRG 079	0	0.02	0.0005	26	0	0.01	0.73	0.04	0.54	0	0.2
UMB RRG 080	0	0.01	0.007	24	0	0.01	1.04	0.11	0.38	0	0.296
UMB RRG 081	0	0.02	0.002	23	0	0.01	0.8	0.06	0.57	0	0.215
UMB RRG 082	0	0.005	0.0005	16	0	0.01	0.67	0.02	0.58	0	0.192
UMB RRG 083	0	0.005	0.002	24	0	0.01	1.05	0.03	0.83	0	0.31
UMB RRG 084	0	0.005	0.0005	25	0	0.01	0.56	0.01	0.22	0	0.302
UMB RRG 086	0	0.03	0.006	29	0	0.01	0.64	0.18	0.87	0	0.542
UMB RRG 087	0	0.02	0.008	30	0	0.01	0.74	0.11	0.81	0	0.128
UMB RRG 088	0	0.02	0.003	21	0	0.01	1.26	0.03	0.2	0	0.309
UMB RRG 089	0	0.02	0.003	41	0	0.01	0.64	0.16	0.85	0	0.215
UMB RRG 090	0	0.005	0.004	28	0	0.01	1.47	0.07	0.44	0	0.173
UMB RRG 091	0	0.01	0.002	25	0	0.01	0.94	0.06	0.51	0	0.276
UMB RRG 092	0	0.02	0.004	28	0	0.01	1.04	0.05	0.4	0	0.196
UMB RRG 093	0	0.005	0.003	17	0	0.01	1.06	0.03	0.27	0	0.242
UMB RRG 094	0	0.05	0.005	34	0	0.01	0.89	0.1	0.69	0	0.193
UMB RRG 095	0	0.005	0.004	38	0	0.01	0.74	0.09	0.78	0	0.177
UMB RRG 096	0	0.03	0.005	21	0	0.01	0.55	0.03	0.53	0	0.203
UMB RRG 097	0	0.005	0.0005	26	0	0.01	2.28	0.03	0.37	0	0.208
UMB RRG 098	0	0.02	0.007	29	0	0.01	0.59	0.04	0.19	0	0.222
UMB RRG 099	0	0.005	0.003	14	0	0.01	0.88	0.005	0.1	0	0.234
UMB RRG 100	0	0.005	0.003	16	0	0.01	1.02	0.03	0.26	0	0.189
UMB RRG 101	0	0.005	0.006	34	0	0.01	0.63	0.06	0.42	0	0.171
UMB RRG 102	0	0.005	0.004	47	0	0.01	0.38	0.26	1.75	0	0.506
UMB RRG 103	0	0.005	0.0005	37	0	0.01	0.66	0.05	0.72	0	0.271
UMB RRG 104	0	0.005	0.005	29	0	0.01	1.28	0.05	0.31	0	0.297
UMB RRG 105	0	0.005	0.001	23	0	0.01	0.58	0.09	0.45	0	0.257
UMB RRG 106	0	0.03	0.005	22	0	0.01	0.75	0.07	0.37	0	0.31
UMB RRG 107	0	0.005	0.003	30	0	0.01	0.65	0.03	0.93	0	0.346
UMB RRG 108	0	0.005	0.008	20	0	0.01	0.91	0.05	0.38	0	0.234
UMB RRG 109	0	0.02	0.003	27	0	0.01	1.05	0.06	0.6	0	0.283
UMB RRG 110	0	0.005	0.003	18	0	0.01	1.25	0.02	0.3	0	0.389
UMB RRG 111	0	0.005	0.0005	37	0	0.01	1.53	0.05	0.61	0	0.218
UMB RRG 112	0	0.005	0.0005	18	0	0.01	0.91	0.02	0.33	0	0.409
UMB RRG 113	0	0.02	0.004	33	0	0.01	0.9	0.07	0.62	0	0.331
UMB RRG 114	0	0.005	0.0005	31	0	0.01	1.07	0.05	0.65	0	0.248
UMB RRG 115	0	0.005	0.004	35	0	0.01	0.8	0.06	1.29	0	0.602
UMB RRG 116	0	0.005	0.0005	26	0	0.01	0.81	0.04	0.27	0	0.199
UMB RRG 117	0	0.04	0.001	33	0	0.01	0.88	0.1	0.65	0	0.428
UMB RRG 118	0	0.005	0.0005	22	0	0.01	1.06	0.03	0.27	0	0.337
UMB RRG 119	0	0.005	0.0005	21	0	0.01	0.85	0.02	0.52	0	0.244

Sample No.	Mn ppm	Mo ppm	Na pct	Nb ppm	Nd ppm	Ni ppm	P pct	Pb ppm	Pd ppb	Pr ppm	Pt ppb
UMB RRG 071	147	0.08	0.306	0.005	0	1.5	0.131	0.195	9	0	0.5
UMB RRG 072	59	0.16	0.274	0.005	0	1.2	0.13	0.135	3	0	0.5
UMB RRG 073	123	0.11	0.012	0.005	0	2	0.211	0.135	3	0	0.5
UMB RRG 074	50	0.15	0.278	0.005	0	2	0.19	0.135	4	0	0.5
UMB RRG 075	42	0.08	0.354	0.01	0	0.9	0.161	0.225	4	0	0.5
UMB RRG 076	66	0.12	0.484	0.02	0	1.1	0.153	2.09	4	0	0.5
UMB RRG 077	102	0.14	0.403	0.02	0	2.2	0.103	0.415	4	0	0.5
UMB RRG 078	112	0.07	0.156	0.005	0	1	0.137	0.095	1	0	0.5
UMB RRG 079	113	0.08	0.175	0.005	0	2	0.203	0.175	6	0	0.5
UMB RRG 080	77	0.09	0.015	0.005	0	2.2	0.18	0.235	3	0	1
UMB RRG 081	70	0.06	0.366	0.005	0	3.2	0.213	0.205	4	0	0.5
UMB RRG 082	77	0.19	0.614	0.005	0	0.6	0.128	0.065	1	0	0.5
UMB RRG 083	385	0.33	0.403	0.005	0	0.4	0.142	0.425	5	0	0.5
UMB RRG 084	46	0.05	0.289	0.005	0	0.8	0.106	0.035	2	0	0.5
UMB RRG 086	444	0.04	0.207	0.005	0	1.1	0.163	0.245	4	0	0.5
UMB RRG 087	123	0.1	0.252	0.005	0	0.8	0.164	0.185	2	0	0.5
UMB RRG 088	91	0.28	0.114	0.005	0	0.8	0.154	0.365	1	0	0.5
UMB RRG 089	261	0.19	0.282	0.02	0	0.9	0.193	0.225	1	0	0.5
UMB RRG 090	120	0.15	0.022	0.005	0	0.9	0.137	0.155	1	0	0.5
UMB RRG 091	136	0.22	0.01	0.005	0	1.2	0.122	0.085	1	0	0.5
UMB RRG 092	82	0.08	0.282	0.005	0	1.5	0.162	0.165	3	0	0.5
UMB RRG 093	99	0.12	0.285	0.005	0	0.9	0.182	0.04	2	0	0.5
UMB RRG 094	195	0.04	0.263	0.005	0	2.2	0.113	0.305	1	0	0.5
UMB RRG 095	248	0.26	0.186	0.005	0	2.6	0.213	0.235	3	0	2
UMB RRG 096	68	0.04	0.265	0.005	0	1	0.13	0.085	1	0	0.5
UMB RRG 097	162	0.27	0.04	0.005	0	2.2	0.16	0.185	2	0	0.5
UMB RRG 098	66	0.16	0.236	0.005	0	0.8	0.14	0.225	1	0	0.5
UMB RRG 099	85	0.09	0.178	0.005	0	1.2	0.12	0.085	1	0	0.5
UMB RRG 100	78	0.09	0.184	0.005	0	1	0.126	0.135	2	0	0.5
UMB RRG 101	125	0.07	0.296	0.005	0	0.9	0.105	0.215	1	0	0.5
UMB RRG 102	430	0.13	0.097	0.005	0	1.9	0.089	0.315	1	0	0.5
UMB RRG 103	190	0.06	0.299	0.005	0	1.6	0.155	0.135	2	0	0.5
UMB RRG 104	88	0.16	0.197	0.005	0	0.9	0.182	0.215	3	0	0.5
UMB RRG 105	155	0.03	0.224	0.005	0	1.1	0.122	0.295	3	0	0.5
UMB RRG 106	123	0.11	0.214	0.005	0	1.1	0.124	0.245	1	0	0.5
UMB RRG 107	107	0.19	0.173	0.005	0	1.6	0.144	0.325	4	0	0.5
UMB RRG 108	90	0.11	0.376	0.005	0	1.2	0.149	0.285	2	0	0.5
UMB RRG 109	110	0.15	0.216	0.005	0	1.3	0.168	0.285	3	0	0.5
UMB RRG 110	98	0.19	0.073	0.005	0	1	0.201	0.105	4	0	0.5
UMB RRG 111	125	0.11	0.023	0.005	0	2.5	0.161	0.505	2	0	0.5
UMB RRG 112	88	0.29	0.114	0.005	0	2	0.139	0.095	3	0	0.5
UMB RRG 113	215	0.09	0.083	0.005	0	1.1	0.181	0.215	4	0	0.5
UMB RRG 114	69	0.12	0.17	0.005	0	2	0.171	0.195	3	0	4
UMB RRG 115	166	0.17	0.217	0.005	0	2.2	0.141	0.195	3	0	0.5
UMB RRG 116	90	0.13	0.158	0.005	0	1.1	0.175	0.195	3	0	0.5
UMB RRG 117	319	0.06	0.121	0.005	0	2.1	0.218	0.195	4	0	0.5
UMB RRG 118	106	0.07	0.187	0.005	0	1.3	0.137	0.115	1	0	0.5
UMB RRG 119	101	0.11	0.306	0.005	0	1.4	0.136	0.065	1	0	0.5

Sample No.	Rb ppm	Re ppb	S pct	Sb ppm	Sc ppm	Se ppm	Sm ppm	Sn ppm	Sr ppm	Ta ppm	Tb ppm
UMB RRG 071	1	2	0.2	0.01	0.05	0.2	0	0.01	107.1	0.0005	0
UMB RRG 072	0.8	2	0.15	0.01	0.05	0.1	0	0.01	45.3	0.0005	0
UMB RRG 073	1.3	2	0.16	0.01	0.05	0.1	0	0.01	123.7	0.0005	0
UMB RRG 074	1.1	2	0.19	0.01	0.05	0.1	0	0.01	67	0.0005	0
UMB RRG 075	0.7	2	0.14	0.01	0.05	0.2	0	0.01	60.1	0.0005	0
UMB RRG 076	1.5	2	0.2	0.01	0.05	0.05	0	0.01	73.5	0.0005	0
UMB RRG 077	1	2	0.16	0.01	0.05	0.1	0	0.01	74.1	0.0005	0
UMB RRG 078	0.7	2	0.16	0.01	0.05	0.1	0	0.01	68.7	0.0005	0
UMB RRG 079	0.6	2	0.15	0.01	0.05	0.05	0	0.01	88	0.0005	0
UMB RRG 080	0.9	2	0.16	0.01	0.05	0.3	0	0.01	63.1	0.0005	0
UMB RRG 081	0.4	2	0.17	0.01	0.05	0.1	0	0.01	67.6	0.0005	0
UMB RRG 082	0.7	2	0.16	0.01	0.05	0.2	0	0.01	38.3	0.0005	0
UMB RRG 083	0.9	2	0.14	0.01	0.05	0.3	0	0.01	47.2	0.0005	0
UMB RRG 084	0.4	2	0.15	0.01	0.05	0.2	0	0.01	46.8	0.0005	0
UMB RRG 086	1	2	0.13	0.01	0.05	0.2	0	0.01	141.2	0.0005	0
UMB RRG 087	1.1	2	0.14	0.01	0.05	0.2	0	0.01	98.3	0.0005	0
UMB RRG 088	2.7	2	0.17	0.01	0.05	0.2	0	0.01	77.5	0.0005	0
UMB RRG 089	1	2	0.18	0.01	0.05	0.3	0	0.01	60.8	0.0005	0
UMB RRG 090	2.4	2	0.15	0.01	0.05	0.2	0	0.01	78.2	0.0005	0
UMB RRG 091	1.2	2	0.16	0.01	0.05	0.2	0	0.01	88.5	0.0005	0
UMB RRG 092	1.4	2	0.17	0.01	0.05	0.2	0	0.01	69.2	0.0005	0
UMB RRG 093	1.4	2	0.17	0.01	0.05	0.1	0	0.01	78.6	0.0005	0
UMB RRG 094	1.9	2	0.15	0.01	0.05	0.2	0	0.01	84.4	0.0005	0
UMB RRG 095	1.1	2	0.15	0.01	0.05	0.2	0	0.01	150	0.0005	0
UMB RRG 096	1	2	0.19	0.01	0.05	0.4	0	0.01	89.5	0.0005	0
UMB RRG 097	5.9	2	0.17	0.01	0.05	0.1	0	0.01	65.6	0.0005	0
UMB RRG 098	1.2	2	0.18	0.01	0.1	0.2	0	0.03	77.1	0.0005	0
UMB RRG 099	2.2	2	0.2	0.01	0.05	0.2	0	0.01	43.2	0.001	0
UMB RRG 100	1.6	2	0.19	0.01	0.05	0.2	0	0.01	70.1	0.0005	0
UMB RRG 101	0.7	2	0.22	0.01	0.05	0.2	0	0.01	76	0.0005	0
UMB RRG 102	0.7	2	0.2	0.01	0.05	0.3	0	0.02	146.1	0.0005	0
UMB RRG 103	1	2	0.21	0.01	0.05	0.1	0	0.01	124.5	0.0005	0
UMB RRG 104	2.4	2	0.23	0.01	0.05	0.3	0	0.01	65.2	0.0005	0
UMB RRG 105	0.7	2	0.25	0.01	0.05	0.3	0	0.01	72.6	0.0005	0
UMB RRG 106	1.7	2	0.24	0.01	0.1	0.3	0	0.01	67.4	0.0005	0
UMB RRG 107	0.8	2	0.2	0.41	0.05	0.2	0	0.03	85.6	0.0005	0
UMB RRG 108	1.7	2	0.21	0.28	0.05	0.1	0	0.01	65.3	0.0005	0
UMB RRG 109	1.6	2	0.2	0.21	0.05	0.2	0	0.02	75.1	0.0005	0
UMB RRG 110	1.4	2	0.19	0.14	0.05	0.05	0	0.01	65.3	0.0005	0
UMB RRG 111	2.1	2	0.23	0.22	0.1	0.05	0	0.03	61	0.0005	0
UMB RRG 112	1.2	2	0.27	0.17	0.05	0.05	0	0.01	86.9	0.0005	0
UMB RRG 113	1.1	2	0.23	0.08	0.2	0.2	0	0.03	108.6	0.0005	0
UMB RRG 114	0.9	2	0.23	0.1	0.05	0.05	0	0.01	68.5	0.0005	0
UMB RRG 115	0.7	2	0.27	0.1	0.05	0.2	0	0.03	155.6	0.0005	0
UMB RRG 116	1.6	2	0.23	0.18	0.05	0.1	0	0.01	89.7	0.0005	0
UMB RRG 117	1.3	2	0.2	0.23	0.05	0.05	0	0.02	170.6	0.0005	0
UMB RRG 118	2.2	2	0.2	0.22	0.1	0.2	0	0.01	66	0.0005	0
UMB RRG 119	0.8	2	0.23	0.18	0.05	0.2	0	0.02	69.8	0.0005	0

Sample No.	Te ppm	Th ppm	Ti pct	Tl ppm	Tm ppm	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm
UMB RRG 071	0.01	0.005	6	0.01	0	0.01	1	0.05	0.018	0	51.8
UMB RRG 072	0.01	0.02	7	0.01	0	0.005	1	0.05	0.033	0	21.1
UMB RRG 073	0.01	0.005	10	0.01	0	0.005	1	0.05	0.018	0	21
UMB RRG 074	0.01	0.01	9	0.01	0	0.005	1	0.05	0.013	0	25.3
UMB RRG 075	0.01	0.06	10	0.01	0	0.01	2	0.05	0.087	0	26
UMB RRG 076	0.01	0.06	11	0.01	0	0.02	1	0.05	0.137	0	28.5
UMB RRG 077	0.01	0.11	11	0.01	0	0.03	1	0.05	0.252	0	30.9
UMB RRG 078	0.01	0.005	7	0.01	0	0.005	1	0.05	0.013	0	15.1
UMB RRG 079	0.01	0.005	9	0.01	0	0.005	1	0.05	0.03	0	36.5
UMB RRG 080	0.01	0.03	9	0.01	0	0.005	1	0.05	0.056	0	15.1
UMB RRG 081	0.01	0.02	10	0.01	0	0.005	1	0.05	0.044	0	24.6
UMB RRG 082	0.01	0.005	6	0.01	0	0.04	1	0.05	0.011	0	15.4
UMB RRG 083	0.01	0.005	7	0.01	0	0.005	1	0.05	0.016	0	26
UMB RRG 084	0.01	0.005	5	0.01	0	0.005	1	0.05	0.012	0	13.7
UMB RRG 086	0.01	0.02	9	0.01	0	0.01	1	0.05	0.1	0	29
UMB RRG 087	0.01	0.03	10	0.01	0	0.02	1	0.05	0.064	0	13.2
UMB RRG 088	0.01	0.005	7	0.01	0	0.005	1	0.05	0.014	0	13.6
UMB RRG 089	0.01	0.03	11	0.01	0	0.01	1	0.05	0.086	0	16
UMB RRG 090	0.01	0.02	8	0.01	0	0.02	1	0.05	0.046	0	14.9
UMB RRG 091	0.01	0.01	6	0.01	0	0.005	1	0.05	0.046	0	10.3
UMB RRG 092	0.01	0.02	8	0.01	0	0.005	1	0.05	0.029	0	19.4
UMB RRG 093	0.01	0.005	9	0.01	0	0.005	1	0.05	0.016	0	14.7
UMB RRG 094	0.01	0.04	8	0.01	0	0.02	1	0.05	0.061	0	11.3
UMB RRG 095	0.01	0.02	12	0.01	0	0.02	1	0.05	0.067	0	18.8
UMB RRG 096	0.01	0.01	7	0.01	0	0.01	1	0.05	0.029	0	8.8
UMB RRG 097	0.01	0.005	8	0.01	0	0.005	1	0.05	0.019	0	16.4
UMB RRG 098	0.01	0.01	7	0.01	0	0.005	1	0.05	0.027	0	12.3
UMB RRG 099	0.01	0.005	5	0.01	0	0.005	1	0.05	0.004	0	15.3
UMB RRG 100	0.01	0.005	6	0.01	0	0.02	1	0.05	0.02	0	14.1
UMB RRG 101	0.01	0.02	6	0.01	0	0.005	1	0.05	0.039	0	7.3
UMB RRG 102	0.01	0.04	8	0.01	0	0.02	1	0.05	0.145	0	6.8
UMB RRG 103	0.01	0.005	8	0.01	0	0.03	1	0.05	0.027	0	16.2
UMB RRG 104	0.01	0.005	9	0.01	0	0.005	1	0.05	0.021	0	15.9
UMB RRG 105	0.01	0.01	6	0.01	0	0.01	1	0.05	0.048	0	17.6
UMB RRG 106	0.01	0.02	7	0.01	0	0.005	1	0.05	0.03	0	13.7
UMB RRG 107	0.01	0.02	7	0.01	0	0.01	1	0.05	0.025	0	23.8
UMB RRG 108	0.01	0.005	8	0.01	0	0.005	1	0.05	0.022	0	16.5
UMB RRG 109	0.01	0.02	9	0.01	0	0.01	1	0.05	0.037	0	22
UMB RRG 110	0.01	0.005	9	0.01	0	0.005	1	0.05	0.007	0	26.2
UMB RRG 111	0.01	0.01	8	0.01	0	0.005	1	0.05	0.052	0	18.8
UMB RRG 112	0.01	0.005	7	0.01	0	0.005	1	0.05	0.012	0	23.9
UMB RRG 113	0.01	0.02	10	0.01	0	0.01	1	0.05	0.039	0	25.6
UMB RRG 114	0.01	0.01	8	0.01	0	0.01	1	0.05	0.03	0	20.8
UMB RRG 115	0.01	0.01	7	0.01	0	0.02	1	0.05	0.047	0	22.6
UMB RRG 116	0.01	0.005	8	0.01	0	0.01	1	0.05	0.019	0	16.5
UMB RRG 117	0.01	0.02	11	0.01	0	0.02	1	0.05	0.06	0	23.1
UMB RRG 118	0.01	0.01	6	0.01	0	0.01	1	0.05	0.015	0	15.5
UMB RRG 119	0.01	0.005	6	0.01	0	0.01	1	0.05	0.018	0	12.2

Sample No.	Zr ppm
UMB RRG 071	0.03
UMB RRG 072	0.07
UMB RRG 073	0.03
UMB RRG 074	0.05
UMB RRG 075	0.17
UMB RRG 076	0.2
UMB RRG 077	0.29
UMB RRG 078	0.03
UMB RRG 079	0.03
UMB RRG 080	0.1
UMB RRG 081	0.05
UMB RRG 082	0.02
UMB RRG 083	0.03
UMB RRG 084	0.01
UMB RRG 086	0.08
UMB RRG 087	0.12
UMB RRG 088	0.03
UMB RRG 089	0.14
UMB RRG 090	0.1
UMB RRG 091	0.06
UMB RRG 092	0.06
UMB RRG 093	0.02
UMB RRG 094	0.16
UMB RRG 095	0.12
UMB RRG 096	0.04
UMB RRG 097	0.04
UMB RRG 098	0.05
UMB RRG 099	0.01
UMB RRG 100	0.02
UMB RRG 101	0.05
UMB RRG 102	0.17
UMB RRG 103	0.03
UMB RRG 104	0.05
UMB RRG 105	0.04
UMB RRG 106	0.06
UMB RRG 107	0.06
UMB RRG 108	0.06
UMB RRG 109	0.06
UMB RRG 110	0.03
UMB RRG 111	0.06
UMB RRG 112	0.03
UMB RRG 113	0.08
UMB RRG 114	0.05
UMB RRG 115	0.04
UMB RRG 116	0.03
UMB RRG 117	0.06
UMB RRG 118	0.02
UMB RRG 119	0.02

Umberumberka Creek Stream Sediments

Sample No.	Eastings	Northings	Ag ppb	Al pct	As ppm	Au ppb	B ppm	Ba ppm	Be ppm	Bi ppm	Ca pct
UMB SS 001	533132	6469421	16	0.55	1.6	0.5	2	46.1	0.2	0.26	0.14
UMB SS 002	533095	6469417	7	0.52	1.6	0.5	1	43.7	0.3	0.31	0.15
UMB SS 003	532391	6469552	16	0.7	2.1	0.1	3	56	0.5	0.33	0.16
UMB SS 004	531970	6469688	14	0.9	2.2	0.4	3	67.1	0.4	0.27	0.2
UMB SS 005	531924	6469722	22	0.9	2.7	0.1	3	59.6	0.5	0.36	0.19
UMB SS 006	531827	6469830	10	0.68	2	0.1	0.5	46.1	0.5	0.28	0.15
UMB SS 007	531667	6469923	15	0.87	2	0.3	4	64.2	0.6	0.27	0.18
UMB SS 009	531046	6470258	24	1.23	3.1	0.6	3	83.5	0.7	0.36	0.27
UMB SS 010	530860	6470338	13	0.71	1.9	0.5	1	51	0.3	0.34	0.17
UMB SS 008	530850	6470177	98	2.84	5.2	1.9	8	170.2	1.2	0.43	1.87
UMB SS 011	530795	6470370	14	0.85	1.9	0.5	4	54.5	0.3	0.24	0.18
UMB SS 012	530718	6470420	18	1.09	2.6	0.1	3	73.6	0.4	0.29	0.23
UMB SS 013	530659	6470403	13	0.91	2.2	0.3	4	63.9	0.3	0.25	0.2
UMB SS 014	530576	6470313	14	0.87	2.2	0.4	4	57.9	0.3	0.28	0.27
UMB SS 015	530485	6470301	15	1.02	2.3	0.3	2	71.4	0.3	0.27	0.23
UMB SS 016	530392	6470265	23	1.12	2.3	0.1	6	69.7	0.6	0.28	0.31
UMB SS 017	530187	6470251	27	1.03	2.4	0.4	2	65.1	0.3	0.32	0.21
UMB SS 018	529875	6470488	28	1.53	3	1.1	3	98.2	0.6	0.41	0.29
UMB SS 019	529601	6470515	14	0.93	3	0.1	3	79.4	0.5	0.58	0.17
UMB SS 021	529387	6471259	45	1.92	3.6	0.8	6	117.7	0.8	0.38	0.47
UMB SS 020	529374	6471140	10	0.9	1.9	0.2	7	64.9	0.6	0.26	0.24
UMB SS 022	529346	6471344	42	1.82	3.1	0.9	6	110.9	0.9	0.36	0.4
UMB SS 023	529227	6471534	12	0.79	2.1	0.3	3	58.3	0.4	0.29	0.15
UMB SS 024	529054	6471660	26	1.38	2.9	0.3	4	90.8	0.6	0.34	0.32
UMB SS 025	528885	6471684	34	1.55	2.8	0.3	4	95.9	0.5	0.38	0.35
UMB SS 026	528691	6471611	27	1.56	2.8	0.3	6	92.5	0.6	0.33	0.34
UMB SS 027	528516	6471588	48	1.53	2.7	0.4	5	101.2	0.6	0.33	0.32
UMB SS 028	528327	6471675	10	0.7	2.2	0.3	4	55.3	0.6	0.33	0.21
UMB SS 029	528265	6471798	31	1.75	3.5	0.5	7	107.7	0.5	0.5	0.37
UMB SS 030	528262	6471939	20	1.25	2.4	0.6	5	79.2	0.5	0.35	0.24
UMB SS 031	528190	6472072	12	0.94	2	0.1	3	71.2	0.5	0.37	0.18
UMB SS 032	528031	6472194	21	1.51	3.1	0.1	5	95.4	0.9	0.37	0.33
UMB SS 048	528009	6472562	38	1.72	3.6	0.6	4	114.8	0.8	0.38	0.42
UMB SS 033	527964	6472389	15	1.04	2.4	0.1	6	75.6	0.6	0.33	0.25
UMB SS 047	527936	6472741	36	1.74	3.5	0.4	4	117.7	1.1	0.41	0.46
UMB SS 046	527852	6472971	48	2.02	4.7	1.4	3	132.2	0.7	0.47	0.58
UMB SS 045	527657	6472985	30	1.47	3.5	0.5	4	105.2	0.7	0.41	0.35
UMB SS 044	527492	6473010	26	1.36	3.3	0.1	4	91.5	0.6	0.34	0.29
UMB SS 043	527386	6473196	13	0.77	2.6	0.4	3	55.9	0.5	0.36	0.16
UMB SS 042	527330	6473465	11	0.68	2.5	0.5	2	58.7	0.5	0.51	0.15
UMB SS 041	527155	6473621	18	1.06	2.4	0.3	3	74	0.6	0.33	0.22
UMB SS 034	527012	6473672	15	1.21	2.3	0.4	4	81.4	0.3	0.38	0.22
UMB SS 035	526789	6473570	15	1.2	2.5	0.6	3	76.3	0.5	0.33	0.24
UMB SS 037	526717	6473272	26	1.46	2.8	3	4	97.8	0.9	0.34	0.32
UMB SS 036	526696	6473371	9	0.65	2.1	0.8	1	54.5	0.3	0.37	0.12
UMB SS 038	526629	6473158	19	1.14	2.3	0.1	5	77.5	0.7	0.3	0.23
UMB SS 039	526424	6473199	320	0.85	2.6	0.1	2	62.3	0.4	0.46	0.18
UMB SS 040	526222	6473257	16	1.07	2.5	0.1	3	74.8	0.4	0.36	0.23
UMB SS 049	526024	6473076	14	0.92	2.3	0.1	3	69.4	0.6	0.3	0.22
UMB SS 050	525932	6472981	24	1.13	2.6	0.5	4	81.2	0.4	0.35	0.26
UMB SS 051	525671	6472738	49	2.09	4.1	0.9	7	132.1	1	0.41	0.55
UMB SS 052	525508	6472661	30	1.46	3	0.1	4	95.4	0.8	0.35	0.38
UMB SS 053	525195	6472558	35	1.47	3	0.3	3	100.1	0.6	0.37	0.41
UMB SS 054	524998	6472397	19	1.19	2.5	0.7	4	91.1	0.7	0.32	0.34
UMB SS 055	524825	6472236	26	1.54	2.6	0.7	3	98.1	0.7	0.34	0.36
UMB SS 056	524533	6472219	67	2.61	4.7	1.4	7	151.7	1.2	0.47	0.65
UMB SS 057	524329	6471943	33	1.81	3.3	0.5	7	104.4	0.6	0.45	0.41
UMB SS 058	524097	6472044	11	0.85	1.9	0.1	3	60.3	0.3	0.34	0.2
UMB SS 059	523877	6472097	31	1.55	2.6	0.5	3	98	0.7	0.35	0.34
UMB SS 061	523406	6472020	33	1.6	3.5	1.2	5	106.4	0.5	0.41	0.69
UMB SS 062	523175	6472159	57	1.99	3.8	0.7	6	139.8	0.5	0.49	0.57
UMB SS 063	523002	6472280	43	1.88	3.8	1.3	7	133.2	0.7	0.42	0.55
UMB SS 064	522737	6472333	10	0.68	1.9	0.1	1	56.8	0.2	0.3	0.2
UMB SS 065	522312	6472348	31	1.53	2.8	0.9	5	96	0.5	0.39	0.39
UMB SS 066	522047	6472436	8	0.52	2	0.1	1	42.8	0.4	0.28	0.14
UMB SS 067	521401	6472413	60	2.47	4.6	1.6	7	150.7	1.1	0.47	0.76
UMB SS 071	521289	6473732	27	1.32	2.8	2.6	3	100	0.8	0.35	0.55
UMB SS 070	521260	6473439	30	1.72	3.2	0.6	4	117	0.8	0.37	0.56
UMB SS 068	521256	6472666	53	1.92	3.8	0.6	5	119.2	0.8	0.4	0.52

Sample No.	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Fe pct	Ga ppm	Gd ppm
UMB SS 001	0.03	30.3	3.8	14.2	1.08	8.14	1.21	0.46	0.36	1.28	2	1.69
UMB SS 002	0.04	29.9	3.8	16.1	1.12	9.05	1.24	0.48	0.33	1.42	1.9	1.98
UMB SS 003	0.05	30.5	4.2	14.9	1.36	10.64	1.34	0.56	0.36	1.45	2.2	2.12
UMB SS 004	0.06	25.5	5.9	14.7	1.72	10.88	1.14	0.49	0.38	1.39	2.6	1.44
UMB SS 005	0.05	40.5	5.8	23.6	1.46	12.11	1.64	0.58	0.47	2.08	3.1	2.58
UMB SS 006	0.03	28.3	4.1	15.3	1.26	9.77	1.21	0.48	0.32	1.44	2.4	2.01
UMB SS 007	0.05	31.4	5.4	16.5	1.64	10.36	1.34	0.5	0.39	1.51	2.6	2.02
UMB SS 009	0.05	28.9	7.1	20.3	2.04	14.62	1.56	0.58	0.43	1.86	4	2.02
UMB SS 010	0.05	38.5	5	21.6	1.26	11	1.48	0.57	0.43	1.89	2.7	2.35
UMB SS 008	0.21	35.9	12.4	30.6	2.27	26.1	2.23	1.1	0.76	3.13	7.8	2.88
UMB SS 011	0.03	33.5	4.8	14.5	1.36	9.74	1.2	0.47	0.34	1.41	2.6	2.02
UMB SS 012	0.07	34.4	6.4	18.3	1.72	12.58	1.41	0.57	0.47	1.77	3.4	2.02
UMB SS 013	0.04	23.5	5.3	13.8	1.6	10.64	1.04	0.46	0.35	1.34	2.7	1.59
UMB SS 014	0.06	24.4	5.1	17.1	1.39	10.94	1.29	0.5	0.35	1.64	2.8	1.72
UMB SS 015	0.08	29.1	6.2	16.2	1.73	11.38	1.23	0.48	0.44	1.52	2.9	1.83
UMB SS 016	0.06	27.5	6.2	18.9	1.66	12.53	1.36	0.47	0.42	1.78	3.5	1.94
UMB SS 017	0.06	35.4	6.1	22	1.57	13.06	1.44	0.62	0.41	2.05	3.5	2.22
UMB SS 018	0.06	33.2	8.8	27.1	2.15	19.36	1.46	0.61	0.5	2.62	4.7	2.09
UMB SS 019	0.07	34.4	6.5	28	1.54	18.56	1.56	0.65	0.49	2.76	3.5	2.18
UMB SS 021	0.08	32.5	10.4	23.8	2.52	19.94	1.82	0.83	0.56	2.43	5.5	2.3
UMB SS 020	0.04	31.7	5	17.3	1.36	10.71	1.1	0.52	0.42	1.58	2.8	2.04
UMB SS 022	0.05	31.5	9.6	24.1	2.3	18.53	1.46	0.75	0.55	2.35	5.1	2.1
UMB SS 023	0.04	27.4	4.2	15.7	1.34	10.73	1.1	0.38	0.35	1.51	2.5	1.59
UMB SS 024	0.06	27.7	8	21.3	2.07	15.22	1.41	0.6	0.42	2.1	3.9	1.7
UMB SS 025	0.07	32.3	8.2	22.3	2.01	16.93	1.5	0.75	0.48	2.21	4.4	2.33
UMB SS 026	0.06	28	7.9	21.6	2.11	16.93	1.22	0.6	0.44	2.12	4.5	1.94
UMB SS 027	0.05	26.9	7.9	20.4	2.23	15.91	1.37	0.64	0.44	2.1	4.3	1.94
UMB SS 028	0.06	26	4.3	16.8	1.07	11.5	1.05	0.5	0.29	1.63	2.5	1.6
UMB SS 029	0.09	33.1	8.9	25.2	2.26	18.45	1.56	0.79	0.57	2.41	4.9	2.28
UMB SS 030	0.04	30.7	6.8	19.3	1.8	14.48	1.38	0.59	0.43	1.97	3.7	2.1
UMB SS 031	0.04	38	5.8	23.2	1.55	12.86	1.49	0.56	0.41	2.15	3.5	2.31
UMB SS 032	0.04	35.6	7.8	24.5	2.07	16.82	1.65	0.77	0.52	2.3	4.4	2.55
UMB SS 048	0.08	26.8	10.8	24.7	2.31	20.92	1.53	0.72	0.51	2.48	5	2.1
UMB SS 033	0.04	30.4	6	19.3	1.69	13.32	1.24	0.49	0.46	1.84	3.4	1.93
UMB SS 047	0.1	29.2	10.9	26.9	2.43	21.69	1.57	0.78	0.49	2.69	5.1	2.34
UMB SS 046	0.09	30.7	13.2	27.9	2.46	25.04	2.08	1	0.64	2.87	5.6	2.61
UMB SS 045	0.07	27.6	10.2	25.3	2.28	18.67	1.5	0.76	0.48	2.37	4.6	2.11
UMB SS 044	0.07	26.2	8.5	23.1	2.19	16.96	1.41	0.57	0.44	2.16	4.1	1.99
UMB SS 043	0.06	33.1	5.4	21.4	1.22	13.68	1.36	0.59	0.36	2.08	2.6	2.04
UMB SS 042	0.07	34	5.1	24.4	1.17	13.89	1.51	0.53	0.41	2.31	2.9	2.13
UMB SS 041	0.06	28.7	6.1	20.5	1.6	14.09	1.25	0.58	0.43	1.97	3.1	1.95
UMB SS 034	0.06	32.5	6.5	19.6	1.9	13.87	1.31	0.58	0.41	1.96	3.5	2.07
UMB SS 035	0.04	30.9	6.6	20.8	1.75	13.61	1.49	0.53	0.43	2.03	3.7	2.1
UMB SS 037	0.09	24.5	8.4	22.9	2.22	17.39	1.33	0.58	0.42	2.21	4.3	1.85
UMB SS 036	0.08	33.9	4.3	16.9	1.17	11.51	1.34	0.46	0.44	1.57	2.3	1.99
UMB SS 038	0.07	22.8	6.7	20.1	2	14.87	1.24	0.46	0.4	1.94	3.5	1.72
UMB SS 039	0.05	33.8	5.3	20.7	1.45	13.67	1.4	0.49	0.38	1.99	2.9	2.38
UMB SS 040	0.07	27.8	6.3	20.4	1.73	14.78	1.37	0.55	0.4	1.92	3.3	1.94
UMB SS 049	0.05	26.4	5.7	19.9	1.55	13.42	1.19	0.5	0.35	1.94	3	1.78
UMB SS 050	0.07	26.2	7.6	22.8	1.71	16.52	1.34	0.7	0.42	2.35	3.5	1.94
UMB SS 051	0.09	32	12.6	28.2	2.8	24.34	1.8	0.83	0.59	2.91	6.2	2.39
UMB SS 052	0.07	28.9	8.8	25.2	2	19.19	1.52	0.74	0.44	2.47	4.4	2.01
UMB SS 053	0.08	27.5	9.6	31.5	2.07	18.5	1.58	0.8	0.45	3.1	5.2	2.07
UMB SS 054	0.06	25.5	7.2	22.2	1.78	16.05	1.36	0.55	0.42	2.15	3.7	1.81
UMB SS 055	0.06	25.8	8.7	23.3	2.27	17.32	1.48	0.68	0.43	2.25	4.4	2.03
UMB SS 056	0.07	36.2	14.5	34.1	3.34	29.24	2.09	1.08	0.68	3.35	7.2	2.97
UMB SS 057	0.08	30.7	10.1	26.4	2.43	21.47	1.65	0.71	0.51	2.7	5.6	2.17
UMB SS 058	0.02	25	5.4	18.5	1.42	13.05	1.05	0.47	0.33	1.87	2.9	1.78
UMB SS 059	0.06	26	8.9	21.7	2.31	17.88	1.35	0.63	0.44	2.23	4.5	1.8
UMB SS 061	0.03	50.7	8.8	28.2	2.15	20.07	1.89	0.8	0.59	2.47	4.9	3.06
UMB SS 062	0.1	33.6	11.2	29	2.29	24.44	1.9	0.91	0.58	2.65	6.1	2.49
UMB SS 063	0.07	29.7	11.9	27.5	2.35	22.77	1.59	0.72	0.54	2.58	5.5	2.01
UMB SS 064	0.07	28.3	4.8	17.5	0.99	11.96	1.12	0.47	0.36	1.51	2.3	1.74
UMB SS 065	0.07	34.6	9.2	28.5	1.88	18.53	1.66	0.74	0.53	2.7	4.7	2.42
UMB SS 066	0.05	23.4	3.9	13.4	0.85	10.95	0.98	0.34	0.32	1.34	1.9	1.33
UMB SS 067	0.1	34.8	12.5	31.3	2.55	28.01	2.12	1.02	0.64	3.02	7	2.79
UMB SS 071	0.12	26.1	8	19.7	1.4	16.77	1.44	0.62	0.52	1.93	4	1.86
UMB SS 070	0.06	29.3	10.1	24.9	2	21.13	1.61	0.75	0.5	2.41	4.9	2.39
UMB SS 068	0.08	33.3	11	28.4	2.18	23.1	1.9	0.81	0.54	2.77	5.6	2.88

Sample No.	Ge ppm	Hf ppm	Hg ppb	Ho ppm	In ppm	K pct	La ppm	Li ppm	Lu ppm	Mg pct	Mn ppm	Mo ppm	Na pct
UMB SS 001	0.05	0.09	2.5	0.21	0.01	0.18	17	3.8	0.06	0.15	144	0.17	0.048
UMB SS 002	0.05	0.09	2.5	0.22	0.01	0.17	16.7	4.1	0.06	0.16	147	0.19	0.028
UMB SS 003	0.05	0.1	2.5	0.21	0.01	0.23	16.3	4.6	0.06	0.2	183	0.21	0.019
UMB SS 004	0.05	0.11	2.5	0.19	0.01	0.29	13.1	6.4	0.06	0.26	223	0.19	0.022
UMB SS 005	0.05	0.11	2.5	0.3	0.01	0.27	21.9	5.7	0.08	0.25	228	0.23	0.019
UMB SS 006	0.05	0.07	2.5	0.22	0.01	0.21	15.3	4.7	0.06	0.19	163	0.16	0.022
UMB SS 007	0.05	0.09	2.5	0.22	0.01	0.27	17	6	0.05	0.24	214	0.18	0.016
UMB SS 009	0.05	0.13	2.5	0.27	0.01	0.36	15.1	7.6	0.08	0.34	283	0.25	0.016
UMB SS 010	0.05	0.13	2.5	0.22	0.01	0.22	21	4.8	0.07	0.19	191	0.2	0.022
UMB SS 008	0.05	0.2	10	0.48	0.03	0.8	17.3	15.4	0.15	0.89	478	0.27	0.038
UMB SS 011	0.05	0.12	2.5	0.23	0.01	0.25	18.4	5.4	0.06	0.22	175	0.16	0.013
UMB SS 012	0.05	0.16	2.5	0.25	0.01	0.32	18.6	6.3	0.08	0.29	237	0.2	0.017
UMB SS 013	0.05	0.09	2.5	0.17	0.01	0.28	12.5	6.2	0.05	0.25	207	0.14	0.013
UMB SS 014	0.05	0.1	2.5	0.22	0.01	0.26	13.5	5.6	0.07	0.25	198	0.18	0.06
UMB SS 015	0.05	0.13	2.5	0.22	0.01	0.31	14.7	6.3	0.08	0.28	231	0.19	0.021
UMB SS 016	0.05	0.12	2.5	0.26	0.01	0.33	14.3	7.1	0.07	0.32	240	0.21	0.173
UMB SS 017	0.05	0.13	2.5	0.26	0.01	0.29	19.1	6.7	0.08	0.28	249	0.19	0.01
UMB SS 018	0.05	0.15	5	0.27	0.01	0.5	17.4	10	0.08	0.47	278	0.29	0.012
UMB SS 019	0.05	0.13	2.5	0.25	0.01	0.34	19.2	7	0.08	0.32	172	0.45	0.03
UMB SS 021	0.05	0.15	8	0.33	0.03	0.55	16.1	12.3	0.12	0.55	372	0.24	0.023
UMB SS 020	0.05	0.13	2.5	0.21	0.01	0.28	17.6	5.5	0.05	0.27	178	0.19	0.166
UMB SS 022	0.05	0.16	5	0.32	0.03	0.53	15.9	10.9	0.1	0.49	318	0.22	0.014
UMB SS 023	0.05	0.11	2.5	0.2	0.01	0.28	15	5.6	0.05	0.26	142	0.2	0.022
UMB SS 024	0.05	0.14	2.5	0.24	0.01	0.43	14.2	8.3	0.08	0.41	276	0.23	0.228
UMB SS 025	0.05	0.15	2.5	0.29	0.01	0.46	17.1	9.1	0.08	0.43	284	0.26	0.009
UMB SS 026	0.05	0.19	2.5	0.24	0.01	0.49	14.7	9.1	0.08	0.46	249	0.24	0.015
UMB SS 027	0.05	0.15	2.5	0.23	0.01	0.48	14.2	9.2	0.09	0.46	266	0.27	0.032
UMB SS 028	0.1	0.12	2.5	0.19	0.01	0.22	14.4	4.3	0.06	0.22	145	0.29	0.085
UMB SS 029	0.05	0.18	2.5	0.27	0.02	0.52	17.5	10.4	0.09	0.48	307	0.28	0.035
UMB SS 030	0.05	0.14	2.5	0.25	0.01	0.39	16.6	7.5	0.08	0.37	215	0.25	0.059
UMB SS 031	0.05	0.11	2.5	0.25	0.01	0.3	21.1	6.3	0.08	0.29	196	0.29	0.046
UMB SS 032	0.05	0.16	2.5	0.3	0.01	0.45	19.7	8.7	0.09	0.45	278	0.3	0.025
UMB SS 048	0.05	0.17	21	0.28	0.01	0.54	12.6	10.4	0.08	0.56	365	0.33	0.027
UMB SS 033	0.05	0.11	2.5	0.19	0.01	0.35	16.6	7.1	0.06	0.34	193	0.28	0.192
UMB SS 047	0.05	0.17	9	0.35	0.03	0.56	14.5	11.3	0.11	0.58	349	0.33	0.03
UMB SS 046	0.05	0.17	20	0.41	0.03	0.62	15	12.3	0.13	0.66	417	0.28	0.034
UMB SS 045	0.05	0.14	6	0.27	0.01	0.48	14.1	9.4	0.08	0.49	300	0.25	0.044
UMB SS 044	0.05	0.18	7	0.24	0.01	0.45	13.5	9.3	0.08	0.42	250	0.27	0.057
UMB SS 043	0.05	0.11	2.5	0.21	0.01	0.25	18.4	5.3	0.08	0.23	155	0.32	0.014
UMB SS 042	0.05	0.09	2.5	0.24	0.01	0.23	18.1	5.1	0.06	0.22	155	0.38	0.025
UMB SS 041	0.05	0.11	2.5	0.2	0.01	0.36	15.6	6.7	0.06	0.32	172	0.27	0.038
UMB SS 034	0.05	0.15	2.5	0.21	0.01	0.4	18	7.3	0.07	0.38	205	0.25	0.032
UMB SS 035	0.05	0.16	2.5	0.26	0.01	0.36	16.7	7.8	0.09	0.36	210	0.24	0.03
UMB SS 037	0.05	0.15	7	0.23	0.01	0.51	12.9	10.5	0.07	0.48	239	0.32	0.031
UMB SS 036	0.05	0.08	2.5	0.2	0.01	0.24	19.4	5.1	0.07	0.23	109	0.31	0.005
UMB SS 038	0.05	0.11	2.5	0.2	0.03	0.42	12.4	8.1	0.07	0.38	189	0.28	0.116
UMB SS 039	0.05	0.12	2.5	0.23	0.01	0.29	18.6	5.8	0.06	0.27	145	0.3	0.019
UMB SS 040	0.05	0.14	2.5	0.2	0.01	0.36	14.9	7.3	0.07	0.34	179	0.27	0.102
UMB SS 049	0.05	0.11	2.5	0.22	0.01	0.31	14	6.1	0.06	0.29	169	0.27	0.039
UMB SS 050	0.05	0.1	11	0.26	0.01	0.37	13.9	6.8	0.07	0.35	230	0.32	0.039
UMB SS 051	0.05	0.18	14	0.32	0.02	0.65	15.6	12.6	0.1	0.67	408	0.32	0.044
UMB SS 052	0.05	0.16	8	0.27	0.01	0.47	14.8	8.5	0.08	0.45	267	0.31	0.022
UMB SS 053	0.05	0.12	13	0.3	0.01	0.46	14.4	8.7	0.09	0.47	297	0.25	0.112
UMB SS 054	0.05	0.1	2.5	0.24	0.02	0.4	13.9	7.2	0.08	0.36	221	0.32	0.054
UMB SS 055	0.05	0.17	6	0.26	0.02	0.49	13	9.3	0.07	0.46	274	0.33	0.028
UMB SS 056	0.05	0.22	24	0.37	0.02	0.77	17.6	15.3	0.13	0.78	474	0.32	0.028
UMB SS 057	0.05	0.15	14	0.29	0.01	0.54	15.7	10.3	0.09	0.56	317	0.3	0.033
UMB SS 058	0.05	0.09	2.5	0.18	0.01	0.3	13.8	5.4	0.04	0.28	150	0.28	0.051
UMB SS 059	0.05	0.13	11	0.25	0.01	0.5	13.3	9.3	0.07	0.5	259	0.25	0.026
UMB SS 061	0.1	0.15	17	0.36	0.01	0.49	27.2	9.2	0.1	0.48	246	0.34	0.048
UMB SS 062	0.05	0.2	28	0.37	0.01	0.58	17.2	10.7	0.12	0.6	325	0.29	0.063
UMB SS 063	0.05	0.2	14	0.31	0.01	0.6	14.6	11.5	0.1	0.62	345	0.27	0.058
UMB SS 064	0.05	0.11	2.5	0.17	0.01	0.23	15.8	4	0.07	0.22	132	0.24	0.062
UMB SS 065	0.05	0.13	8	0.29	0.01	0.46	18.5	8.9	0.08	0.43	265	0.27	0.049
UMB SS 066	0.05	0.1	2.5	0.15	0.01	0.18	12.8	3.4	0.05	0.17	96	0.27	0.022
UMB SS 067	0.05	0.2	30	0.37	0.03	0.69	17.2	13.2	0.14	0.71	361	0.32	0.05
UMB SS 071	0.05	0.11	14	0.27	0.04	0.38	13.2	7.8	0.08	0.43	293	0.23	0.043
UMB SS 070	0.05	0.16	18	0.29	0.01	0.52	14.3	9.3	0.1	0.55	335	0.27	0.037
UMB SS 068	0.05	0.18	13	0.32	0.02	0.56	16.6	10.8	0.11	0.59	337	0.27	0.033

Sample No.	Nb ppm	Nd ppm	Ni ppm	P pct	Pb ppm	Pd ppb	Pr ppm	Pt ppb	Rb ppm	Re ppb	S pct	Sb ppm
UMB SS 001	0.11	14.06	6.4	0.015	8.02	5	3.72	1	17.9	0.5	0.01	0.08
UMB SS 002	0.12	12.92	7.3	0.017	8.33	5	3.8	1	18.5	0.5	0.01	0.07
UMB SS 003	0.1	13.2	7.8	0.018	9.69	5	3.6	1	23	0.5	0.01	0.07
UMB SS 004	0.13	10.99	9.5	0.013	9.51	5	3.01	1	29.3	0.5	0.01	0.08
UMB SS 005	0.09	17.94	9.9	0.017	11.05	5	4.95	1	24.9	0.5	0.01	0.07
UMB SS 006	0.11	11.88	6.9	0.017	8.83	5	3.49	1	20.8	0.5	0.01	0.06
UMB SS 007	0.12	13.54	8.9	0.015	9.51	5	3.87	1	27	0.5	0.01	0.07
UMB SS 009	0.1	12.53	11.4	0.017	12.77	5	3.51	1	34	0.5	0.01	0.07
UMB SS 010	0.11	17.26	8.5	0.017	11.5	5	4.67	1	22.3	0.5	0.01	0.07
UMB SS 008	0.24	16.36	19.5	0.038	29.49	5	4.21	1	46.7	0.5	0.01	0.1
UMB SS 011	0.09	14.4	8.7	0.013	8.75	5	3.83	1	24.2	0.5	0.01	0.06
UMB SS 012	0.11	14.83	10.4	0.016	10.73	5	4.11	1	29	1	0.01	0.09
UMB SS 013	0.13	10.26	8.9	0.014	9.41	5	2.84	1	28.4	0.5	0.01	0.07
UMB SS 014	0.1	10.44	9	0.015	9.91	5	2.88	1	23.4	0.5	0.02	0.06
UMB SS 015	0.12	12.59	10	0.015	10.36	5	3.41	1	29.9	0.5	0.01	0.07
UMB SS 016	0.14	12.38	10.2	0.017	10.41	5	3.25	1	28.7	0.5	0.04	0.08
UMB SS 017	0.1	15.57	11.2	0.017	12.16	5	4.27	1	26	0.5	0.01	0.07
UMB SS 018	0.14	15.22	16.4	0.02	13.81	5	4.05	1	49.2	0.5	0.01	0.07
UMB SS 019	0.15	15.89	14.3	0.026	12.5	5	4.39	1	37	0.5	0.01	0.06
UMB SS 021	0.14	14.27	16.8	0.021	14.5	5	3.79	1	45.9	0.5	0.01	0.1
UMB SS 020	0.16	14.46	9.1	0.014	9.71	5	3.95	1	27.4	0.5	0.03	0.08
UMB SS 022	0.14	15.44	14.7	0.022	14.8	5	3.83	1	43.4	0.5	0.01	0.09
UMB SS 023	0.16	12.04	9.9	0.015	8.61	5	3.4	1	30.2	0.5	0.01	0.07
UMB SS 024	0.16	12.49	13.3	0.018	12.4	5	3.4	1	38.4	0.5	0.05	0.07
UMB SS 025	0.11	15.06	14.3	0.02	13.95	5	3.94	1	41.2	0.5	0.01	0.09
UMB SS 026	0.18	12.46	14.4	0.019	14.01	5	3.44	1	47	0.5	0.01	0.1
UMB SS 027	0.13	12.23	14.4	0.019	11.51	5	3.37	1	45.9	0.5	0.01	0.08
UMB SS 028	0.19	11.31	9	0.02	8.97	5	3.23	1	22.2	0.5	0.05	0.05
UMB SS 029	0.19	15.28	16.2	0.025	13.59	5	3.91	1	45.4	0.5	0.01	0.1
UMB SS 030	0.14	14.27	12.2	0.022	11.23	5	3.63	1	38	0.5	0.01	0.05
UMB SS 031	0.15	16.75	11.8	0.02	10.73	5	4.52	1	31.7	0.5	0.01	0.08
UMB SS 032	0.12	16.43	14.6	0.023	13.24	5	4.36	1	42.4	0.5	0.01	0.09
UMB SS 048	0.09	12	17.9	0.018	15.19	5	3.02	1	47.7	0.5	0.01	0.1
UMB SS 033	0.17	13.62	12.1	0.02	10.36	5	3.72	1	34.8	0.5	0.01	0.09
UMB SS 047	0.14	12.96	18.5	0.02	16.03	5	3.5	1	49.9	0.5	0.01	0.1
UMB SS 046	0.12	13.91	20.2	0.021	18.63	5	3.61	2	49.5	0.5	0.01	0.09
UMB SS 045	0.12	12.69	16.6	0.018	14.97	5	3.25	1	45.5	0.5	0.01	0.09
UMB SS 044	0.15	11.33	15.1	0.018	13.1	5	3.15	1	45.3	0.5	0.01	0.09
UMB SS 043	0.13	13.96	10.5	0.021	10.85	5	4.04	1	26.4	0.5	0.01	0.06
UMB SS 042	0.15	14.44	12	0.024	11.73	5	4.03	1	25	0.5	0.01	0.07
UMB SS 041	0.13	13	11.4	0.016	11.64	5	3.44	2	35.6	0.5	0.01	0.08
UMB SS 034	0.16	14.87	13.1	0.019	10.7	5	3.92	1	40.8	0.5	0.01	0.08
UMB SS 035	0.11	14.08	11.7	0.02	11.1	5	3.67	1	35.6	0.5	0.01	0.08
UMB SS 037	0.2	11.39	16.2	0.02	13.96	5	2.79	1	51.3	0.5	0.01	0.1
UMB SS 036	0.18	15.2	8.9	0.018	11.33	5	4.12	1	26.8	0.5	0.01	0.07
UMB SS 038	0.18	10.31	13.6	0.018	11.81	5	2.81	1	43.4	0.5	0.01	0.08
UMB SS 039	0.16	14.34	10.9	0.018	11.07	5	3.91	1	30.9	0.5	0.01	0.07
UMB SS 040	0.16	12.78	11.9	0.018	11.51	5	3.27	1	37.4	0.5	0.01	0.1
UMB SS 049	0.13	11.5	11.1	0.017	12.15	5	3.1	1	32.8	1	0.01	0.07
UMB SS 050	0.11	11.96	14	0.019	12.73	5	3.04	1	35.1	0.5	0.01	0.08
UMB SS 051	0.11	14.59	20.4	0.022	17.42	5	3.73	1	57.3	0.5	0.01	0.1
UMB SS 052	0.12	12.21	16.2	0.021	13.73	5	3.5	1	42.5	0.5	0.01	0.09
UMB SS 053	0.13	12.21	16.3	0.019	16.21	5	3.28	1	40.6	0.5	0.02	0.1
UMB SS 054	0.13	11.9	13.8	0.019	12.28	5	3.22	1	38.6	1	0.01	0.08
UMB SS 055	0.15	11.39	15	0.017	13.06	5	2.93	1	45.6	0.5	0.01	0.08
UMB SS 056	0.19	16	24.1	0.025	19.91	5	4.22	1	62.9	1	0.01	0.11
UMB SS 057	0.12	14.14	17.7	0.021	14.86	5	3.55	1	46.5	0.5	0.01	0.08
UMB SS 058	0.14	11.29	10.5	0.018	10.01	5	2.92	1	30.5	0.5	0.01	0.07
UMB SS 059	0.13	11.29	15.2	0.018	13.02	5	3.02	4	47.1	0.5	0.01	0.09
UMB SS 061	0.33	20.29	16.2	0.023	18.15	5	5.68	1	44.8	0.5	0.01	0.09
UMB SS 062	0.34	15.23	19	0.024	16.45	12	3.92	1	48.8	1	0.01	0.14
UMB SS 063	0.23	13.21	19.8	0.019	15.39	5	3.41	1	52.6	0.5	0.01	0.09
UMB SS 064	0.16	12.59	10.1	0.016	10.51	5	3.25	1	22	0.5	0.01	0.08
UMB SS 065	0.14	15.51	15.6	0.019	13.71	5	4.06	1	38.9	0.5	0.01	0.09
UMB SS 066	0.14	10.63	7.8	0.017	9.01	5	2.89	1	19.7	0.5	0.01	0.05
UMB SS 067	0.21	15.9	20.5	0.023	16.62	5	4.09	2	54	0.5	0.01	0.1
UMB SS 071	0.1	12.32	13.5	0.017	10.37	5	3.15	1	29.5	0.5	0.01	0.14
UMB SS 070	0.15	12.98	15.9	0.018	13.78	5	3.33	1	43.3	0.5	0.01	0.08
UMB SS 068	0.21	15.45	18.7	0.022	16.74	5	3.73	1	46.5	0.5	0.01	0.08

Sample No.	Sc ppm	Se ppm	Sm ppm	Sn ppm	Sr ppm	Ta ppm	Tb ppm	Te ppm	Th ppm	Ti pct	Tl ppm	Tm ppm
UMB SS 001	1.2	0.05	2.72	0.3	14.4	0.025	0.28	0.03	8.4	0.016	0.13	0.07
UMB SS 002	1.3	0.05	2.52	0.3	14.4	0.025	0.26	0.04	8.5	0.019	0.13	0.06
UMB SS 003	1.5	0.05	2.68	0.3	16.1	0.025	0.3	0.04	7.9	0.02	0.16	0.07
UMB SS 004	1.8	0.05	2.25	0.4	20	0.025	0.21	0.03	5.7	0.02	0.21	0.05
UMB SS 005	2.1	0.2	3.36	0.5	20	0.025	0.34	0.07	11	0.018	0.18	0.09
UMB SS 006	1.5	0.2	2.58	0.4	14.2	0.025	0.27	0.02	7.6	0.019	0.15	0.06
UMB SS 007	2	0.05	2.7	0.5	18.7	0.025	0.28	0.04	7.9	0.022	0.19	0.06
UMB SS 009	2.7	0.2	2.84	0.6	28.9	0.025	0.29	0.08	6.8	0.021	0.25	0.09
UMB SS 010	1.8	0.05	3.38	0.4	16.3	0.025	0.34	0.03	11	0.021	0.16	0.08
UMB SS 008	5.8	0.05	3.35	1.1	96.3	0.025	0.42	0.07	6.8	0.014	0.33	0.17
UMB SS 011	1.9	0.1	2.86	0.5	17.4	0.025	0.28	0.04	8.4	0.022	0.16	0.07
UMB SS 012	2.3	0.2	2.93	0.6	24.1	0.025	0.33	0.04	8.4	0.022	0.2	0.08
UMB SS 013	1.8	0.1	2.02	0.3	19.5	0.025	0.21	0.03	5.4	0.021	0.2	0.06
UMB SS 014	2	0.4	2.3	0.4	25.5	0.025	0.26	0.09	6.7	0.021	0.16	0.06
UMB SS 015	2	0.05	2.56	0.5	22.3	0.025	0.26	0.03	6.7	0.023	0.22	0.08
UMB SS 016	2.3	0.1	2.44	0.5	29.9	0.025	0.27	0.01	6.6	0.025	0.19	0.08
UMB SS 017	2.3	0.3	2.94	0.5	22.7	0.025	0.32	0.01	9.2	0.019	0.18	0.09
UMB SS 018	3	0.1	2.91	0.6	31.6	0.025	0.34	0.03	9	0.027	0.35	0.09
UMB SS 019	2.2	0.4	2.87	0.3	19	0.025	0.31	0.04	12.3	0.027	0.25	0.09
UMB SS 021	3.9	0.4	2.99	0.9	48	0.025	0.34	0.01	7.1	0.022	0.32	0.1
UMB SS 020	1.9	0.1	2.61	0.5	25.2	0.025	0.3	0.01	8.4	0.021	0.19	0.06
UMB SS 022	3.5	0.1	2.92	0.7	39.9	0.025	0.3	0.03	7.3	0.022	0.31	0.11
UMB SS 023	1.5	0.2	2.56	0.3	16.6	0.025	0.24	0.01	8.2	0.026	0.22	0.06
UMB SS 024	2.8	0.4	2.42	0.6	37.4	0.025	0.29	0.06	6.7	0.025	0.28	0.08
UMB SS 025	3.1	0.2	2.89	0.7	35.3	0.025	0.35	0.02	8.1	0.022	0.28	0.09
UMB SS 026	2.9	0.4	2.39	0.6	34.4	0.025	0.28	0.01	6.9	0.031	0.33	0.08
UMB SS 027	2.8	0.05	2.5	0.7	36.2	0.025	0.28	0.02	6.3	0.027	0.33	0.08
UMB SS 028	1.7	0.05	2.41	0.3	22.1	0.025	0.26	0.03	8.2	0.025	0.14	0.07
UMB SS 029	3.4	0.2	3.07	0.7	42.2	0.025	0.34	0.06	8.1	0.026	0.32	0.1
UMB SS 030	2.4	0.2	2.68	0.4	28	0.025	0.3	0.02	8.4	0.028	0.27	0.08
UMB SS 031	2.1	0.05	3.56	0.4	20.7	0.025	0.34	0.01	11.7	0.028	0.22	0.08
UMB SS 032	3	0.2	3.13	0.6	35.8	0.025	0.36	0.01	10.2	0.028	0.3	0.1
UMB SS 048	3.6	0.05	2.68	0.7	44.9	0.025	0.3	0.01	5.8	0.014	0.34	0.11
UMB SS 033	2.1	0.3	2.57	0.4	28.7	0.025	0.28	0.01	8.7	0.03	0.25	0.08
UMB SS 047	3.6	0.3	2.8	0.7	44	0.025	0.34	0.01	6.9	0.017	0.37	0.11
UMB SS 046	4.3	0.1	3.07	1	57.6	0.025	0.35	0.01	6.5	0.011	0.39	0.13
UMB SS 045	3	0.2	2.69	0.7	36.7	0.025	0.26	0.01	6.7	0.016	0.33	0.09
UMB SS 044	2.8	0.5	2.36	0.7	30.2	0.025	0.26	0.01	6.4	0.026	0.31	0.08
UMB SS 043	1.9	0.05	2.89	0.3	15.6	0.025	0.29	0.03	10.2	0.022	0.18	0.07
UMB SS 042	1.6	0.05	2.91	0.3	15.6	0.025	0.29	0.01	11.3	0.023	0.17	0.08
UMB SS 041	2	0.05	2.5	0.4	21.9	0.025	0.26	0.03	8.2	0.023	0.24	0.07
UMB SS 034	2.3	0.2	2.59	0.4	24	0.025	0.28	0.04	8.6	0.033	0.29	0.08
UMB SS 035	2.5	0.1	2.65	0.5	25.7	0.025	0.3	0.05	8.6	0.027	0.25	0.08
UMB SS 037	2.7	0.05	2.24	0.6	30.8	0.025	0.24	0.03	6.1	0.027	0.36	0.09
UMB SS 036	1.3	0.1	2.84	0.3	12.4	0.025	0.3	0.05	9.9	0.023	0.18	0.06
UMB SS 038	2	0.05	2.31	0.5	22.9	0.025	0.24	0.04	6.3	0.032	0.33	0.06
UMB SS 039	1.8	0.05	3.04	0.3	17.2	0.025	0.32	0.04	10	0.027	0.22	0.08
UMB SS 040	2	0.1	2.4	0.5	23.7	0.025	0.27	0.01	7.9	0.028	0.27	0.07
UMB SS 049	1.8	0.2	2.33	0.4	21.3	0.025	0.24	0.01	7.4	0.019	0.22	0.07
UMB SS 050	2.4	0.3	2.38	0.5	26.8	0.025	0.27	0.01	7.2	0.016	0.26	0.09
UMB SS 051	4.1	0.1	3.13	0.9	55.4	0.025	0.39	0.03	7.1	0.018	0.43	0.11
UMB SS 052	3.1	0.05	2.7	0.6	36.6	0.025	0.26	0.01	7.4	0.019	0.3	0.1
UMB SS 053	3	0.3	2.59	0.8	39.5	0.025	0.28	0.03	7.3	0.016	0.29	0.1
UMB SS 054	2.5	0.4	2.5	0.5	31.3	0.025	0.27	0.01	6.4	0.018	0.27	0.07
UMB SS 055	3.1	0.3	2.34	0.7	35.4	0.025	0.29	0.01	6	0.02	0.33	0.09
UMB SS 056	5.2	0.05	3.53	1.1	61.5	0.025	0.41	0.01	7.4	0.022	0.46	0.15
UMB SS 057	3.6	0.1	2.92	0.7	41.4	0.025	0.31	0.01	7.4	0.02	0.33	0.12
UMB SS 058	1.8	0.3	2.32	0.5	19	0.025	0.24	0.01	7.4	0.022	0.22	0.07
UMB SS 059	2.8	0.05	2.31	0.6	33.3	0.025	0.26	0.01	6	0.025	0.35	0.08
UMB SS 061	3.5	0.8	4.32	0.6	57.6	0.025	0.43	0.01	12.4	0.038	0.31	0.13
UMB SS 062	4.6	0.3	3.27	0.9	52.8	0.025	0.35	0.01	7	0.034	0.33	0.14
UMB SS 063	4	0.05	2.66	0.8	48	0.025	0.32	0.01	5.9	0.035	0.39	0.1
UMB SS 064	1.6	0.05	2.48	0.3	17.9	0.025	0.23	0.01	7.9	0.025	0.16	0.07
UMB SS 065	3.2	0.2	3.03	0.6	37.2	0.025	0.32	0.01	9.1	0.025	0.28	0.11
UMB SS 066	1.2	0.05	1.93	0.2	12.6	0.025	0.19	0.01	7.1	0.02	0.13	0.06
UMB SS 067	5	0.1	3.32	0.9	61.8	0.025	0.35	0.01	6.8	0.027	0.36	0.16
UMB SS 071	2.7	0.5	2.53	0.6	42.7	0.025	0.28	0.01	6	0.016	0.21	0.09
UMB SS 070	3.6	0.2	2.8	0.7	45.8	0.025	0.28	0.01	6.2	0.022	0.31	0.12
UMB SS 068	4.1	0.4	3.33	0.9	46.1	0.025	0.34	0.01	7.5	0.024	0.32	0.12

Sample No.	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm	Zr ppm
UMB SS 001	1.2	25	0.05	5.19	0.42	19.3	4.1
UMB SS 002	1.3	28	0.05	5.29	0.34	20.6	4.7
UMB SS 003	1.2	28	0.05	5.85	0.47	25	5.1
UMB SS 004	0.8	25	0.05	5.15	0.41	31.3	4.9
UMB SS 005	1.6	40	0.05	7.34	0.59	30.1	5
UMB SS 006	1.1	27	0.05	5.34	0.42	23.6	4.4
UMB SS 007	1.1	28	0.05	5.73	0.47	29.8	5
UMB SS 009	0.9	33	0.05	7.23	0.58	39.7	6.2
UMB SS 010	1.6	36	0.05	6.75	0.5	27	4.8
UMB SS 008	1	61	0.05	11.78	1.04	91.1	7.5
UMB SS 011	1.1	27	0.05	5.76	0.46	29	4.9
UMB SS 012	1.2	33	0.05	6.86	0.5	34.4	5.5
UMB SS 013	0.7	25	0.05	5.02	0.32	29	5.1
UMB SS 014	1	31	0.05	5.56	0.47	30.5	4.9
UMB SS 015	1	29	0.05	5.8	0.4	31.9	5.3
UMB SS 016	1	33	0.05	6.3	0.46	35.6	5.4
UMB SS 017	1.4	38	0.05	7.01	0.55	35.4	5.3
UMB SS 018	1.3	42	0.05	7.42	0.56	46.1	6.7
UMB SS 019	1.9	43	0.05	6.66	0.48	36.7	5
UMB SS 021	1.1	41	0.05	9.06	0.75	53.9	7.7
UMB SS 020	1.3	29	0.05	5.91	0.42	29.1	5
UMB SS 022	1.1	40	0.05	8.09	0.67	50.2	7
UMB SS 023	1.2	26	0.05	4.83	0.31	28.2	4.5
UMB SS 024	1.1	36	0.05	6.82	0.51	41.2	5.9
UMB SS 025	1.2	38	0.05	7.72	0.61	46	6.7
UMB SS 026	1.1	35	0.05	6.44	0.49	46.9	6.4
UMB SS 027	1.2	35	0.05	6.73	0.51	43.5	6.3
UMB SS 028	1.4	29	0.05	5.48	0.37	24.3	4.9
UMB SS 029	1.4	41	0.05	8.03	0.6	47.8	7
UMB SS 030	1.4	34	0.05	6.53	0.44	36.7	5.6
UMB SS 031	1.7	37	0.05	6.54	0.48	31.8	5.1
UMB SS 032	1.5	39	0.05	7.6	0.57	41.8	6.5
UMB SS 048	1	39	0.05	8.05	0.66	48.4	6.1
UMB SS 033	1.6	31	0.05	5.96	0.45	33.9	5.4
UMB SS 047	1.2	43	0.05	8.18	0.67	51.1	6.1
UMB SS 046	1.1	47	0.05	10.07	0.8	59.5	6.6
UMB SS 045	1.1	38	0.05	7.45	0.61	48.3	6
UMB SS 044	1.1	35	0.05	6.26	0.47	41.6	6.2
UMB SS 043	1.5	35	0.05	5.86	0.44	28.7	4.4
UMB SS 042	1.6	39	0.05	6.32	0.5	28	4.6
UMB SS 041	1.2	33	0.05	5.53	0.41	35.2	4.8
UMB SS 034	1.4	33	0.05	6.06	0.41	37.4	5.6
UMB SS 035	1.3	35	0.05	6.13	0.48	35.9	5.8
UMB SS 037	1.1	34	0.05	6.13	0.51	47.6	5.6
UMB SS 036	1.4	27	0.05	5.15	0.35	27.7	4.1
UMB SS 038	1.2	31	0.05	5.09	0.38	38.2	5
UMB SS 039	1.6	33	0.05	5.83	0.39	30.7	4.9
UMB SS 040	1.4	31	0.05	5.75	0.42	33.5	5.6
UMB SS 049	1.2	33	0.05	5.46	0.36	31.9	4.6
UMB SS 050	1.2	39	0.05	6.33	0.49	35.7	5
UMB SS 051	1.4	46	0.05	9.47	0.78	60	7.1
UMB SS 052	1.4	40	0.05	7.24	0.57	44.1	6.1
UMB SS 053	1.3	51	0.05	7.34	0.59	44	5.1
UMB SS 054	1.3	36	0.05	6.14	0.45	37.8	4.9
UMB SS 055	1.1	37	0.05	6.56	0.56	44	5.9
UMB SS 056	1.3	55	0.05	11.09	0.86	70.4	8.2
UMB SS 057	1.2	44	0.05	7.98	0.61	51.6	6.5
UMB SS 058	1.3	32	0.05	4.99	0.38	28.4	4.5
UMB SS 059	1.1	36	0.05	6.49	0.48	46.1	6
UMB SS 061	1.8	44	0.05	8.98	0.62	38.6	7
UMB SS 062	0.9	48	0.05	8.95	0.77	59.7	7.7
UMB SS 063	0.7	44	0.05	8.26	0.71	60	7
UMB SS 064	1	28	0.05	4.96	0.34	28.9	4.4
UMB SS 065	1.3	48	0.05	7.64	0.59	47	6.1
UMB SS 066	1	24	0.05	4.23	0.33	24	4
UMB SS 067	0.9	55	0.05	10.33	0.79	66.9	8
UMB SS 071	0.8	36	0.05	7.29	0.59	40.2	4.8
UMB SS 070	0.8	42	0.05	7.92	0.68	50	6.3
UMB SS 068	1	49	0.05	8.95	0.71	53.5	6.9

Sample No.	Eastings	Northings	Ag ppb	Al pct	As ppm	Au ppb	B ppm	Ba ppm	Be ppm	Bi ppm	Ca pct
UMB SS 069	521249	6473261	37	2.02	4.1	1.8	7	134	1.2	0.36	0.71
UMB SS 072	521118	6474157	41	1.87	4	2.7	4	110	0.9	0.5	0.57
UMB SS 073	521020	6474354	20	1.06	2.5	0.7	3	85.4	0.5	0.26	0.49
UMB SS 074	520946	6474509	14	0.6	1.8	0.1	2	47.8	0.5	0.23	0.23
UMB SS 075	520838	6474849	4	0.39	1.5	0.1	0.5	29.6	0.3	0.22	0.13
UMB SS 076	520834	6475184	13	0.68	1.9	0.1	4	53.8	0.6	0.27	0.22
UMB SS 077	520805	6475184	10	0.33	0.9	0.1	0.5	27.3	0.3	0.2	0.13
UMB SS 084	520804	6475315	15	0.88	1.9	0.1	3	64.9	0.3	0.23	0.28
UMB SS 083	519852	6480019	99	1.62	3.9	1.7	9	98	1.5	0.71	0.67
UMB SS 082	519497	6480323	54	1.31	3.2	0.7	6	83.1	0.6	0.31	0.25
UMB SS 081	518780	6481129	27	1.41	3.4	0.7	5	135.6	0.5	0.29	1.44
UMB SS 080	518715	6481467	31	1.43	3.2	0.4	5	127.5	0.8	0.32	1.18
UMB SS 079	518374	6481447	26	1.39	3.5	0.7	6	119.5	1	0.32	1.13
UMB SS 078	518018	6481343	26	1.22	3.2	0.6	5	120.8	0.5	0.31	1.03
UMB SS 115	517838	6481713	33	1.71	3.7	0.5	5	116.5	0.8	0.37	0.98
UMB SS 114	517586	6481809	55	1.82	4	2	5	112.1	0.9	0.36	0.63
UMB SS 113	517330	6481994	36	1.55	3.7	1.3	3	105.2	0.8	0.48	0.54
UMB SS 112	517039	6482133	33	0.97	2.6	0.3	3	58.7	0.5	0.29	0.17
UMB SS 111	516753	6482189	20	1.2	2.9	0.7	4	96.3	0.5	0.3	0.72
UMB SS 110	516372	6482246	23	1.23	2.7	0.5	3	80.6	0.8	0.3	0.42
UMB SS 109	515977	6482420	21	1.17	2.7	1.4	4	90.6	0.6	0.3	0.66
UMB SS 108	515652	6482608	57	2.14	4.6	2.4	7	150.7	1	0.38	1.49
UMB SS 107	515349	6482684	24	1.11	2.7	2.2	4	78.8	0.7	0.29	0.46
UMB SS 104	514958	6482828	44	1.66	3.7	0.5	5	139.1	0.8	0.35	1.22
UMB SS 105	514697	6482799	29	1.2	2.5	0.1	3	80.4	0.8	0.3	0.3
UMB SS 106	514652	6482745	80	2.19	4.4	2.4	4	129	1.1	0.44	0.46
UMB SS 103	514222	6482822	30	1.31	2.8	0.3	2	109.6	0.5	0.31	0.79
UMB SS 102	513902	6482785	35	1.59	3.7	0.7	6	139.6	0.7	0.33	1.19
UMB SS 101	513541	6482758	51	2.01	4.3	1.1	7	147.6	1.3	0.38	1.42
UMB SS 093	513331	6482881	32	1.23	2.6	0.1	1	75	0.7	0.33	0.2
UMB SS 092	513095	6483096	23	0.85	2.3	0.1	3	58.5	0.6	0.28	0.17
UMB SS 091	512860	6483196	44	1.7	4.2	0.7	5	149	0.8	0.36	1.35
UMB SS 090	512680	6483341	16	0.89	2.2	0.3	3	65.3	0.4	0.27	0.18
UMB SS 089	512476	6483447	54	1.6	3.6	0.3	5	123.9	0.7	0.39	0.56
UMB SS 088	512321	6483610	41	1.61	3.5	0.5	6	120.1	0.7	0.34	1.02
UMB SS 087	512140	6483778	68	2.37	4.4	1.3	7	153.9	1.2	0.44	0.82
UMB SS 086	512012	6483942	29	1.27	2.8	0.1	6	79.1	1	0.3	0.49
UMB SS 119	511720	6484008	27	1.25	2.8	0.6	2	70.3	0.8	0.28	0.19
UMB SS 118	511405	6484231	19	1.19	2.7	0.7	2	68.1	0.6	0.26	0.2
UMB SS 117	511141	6484173	37	1.47	2.9	1.1	3	91.6	0.7	0.32	0.38
UMB SS 116	510671	6483874	19	0.88	2.6	0.4	1	50.6	0.4	0.28	0.12
UMB SS 100	510371	6483874	17	0.77	2.3	0.6	2	54.2	0.3	0.27	0.13
UMB SS 099	510027	6483840	29	1.09	2.7	0.6	3	74.3	0.6	0.31	0.22
UMB SS 098	509522	6484424	20	0.85	2.2	0.1	2	55	0.7	0.31	0.16
UMB SS 097	509237	6484515	30	1.2	2.6	0.1	3	78.3	0.6	0.3	0.24
UMB SS 096	509030	6484423	13	0.72	2.6	0.1	2	49.9	0.5	0.27	0.13
UMB SS 095	508861	6484341	21	1.02	2.4	0.1	2	67.3	0.5	0.29	0.23
UMB SS 094	508439	6484304	39	1.24	2.8	0.9	2	87.8	1	0.34	0.22

Sample No.	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Fe pct	Ga ppm	Gd ppm
UMB SS 069	0.07	39.8	10.3	27.3	2.14	23.41	1.96	0.85	0.65	2.63	6	2.65
UMB SS 072	0.13	31.3	10.3	23.6	1.93	21.27	1.75	0.86	0.6	2.47	5	2.51
UMB SS 073	0.08	22.8	6.6	17.3	1.21	14.56	1.13	0.56	0.44	1.67	3.3	1.92
UMB SS 074	0.04	30.1	4.5	15	0.76	10.09	1.18	0.44	0.37	1.43	2	1.75
UMB SS 075	0.02	32.6	3.9	17.8	0.49	8.96	1.14	0.38	0.35	1.72	2.1	1.96
UMB SS 076	0.05	34.9	4.8	18.5	0.88	11.29	1.22	0.48	0.46	1.74	2.5	2.25
UMB SS 077	0.02	11.7	2.1	6.9	0.51	6	0.62	0.27	0.22	0.69	1.1	0.9
UMB SS 084	0.04	26.2	5.2	15.7	1.24	11.6	1.13	0.44	0.41	1.51	2.8	1.66
UMB SS 083	0.36	54.5	10.3	24	4.87	37.3	2.08	0.75	0.61	2.76	5.7	3.36
UMB SS 082	0.09	34.3	7.2	17.9	1.87	17.09	1.7	0.67	0.47	2.1	3.7	2.21
UMB SS 081	0.06	34.2	8.8	18.7	2.08	19.22	1.77	0.76	0.57	2.13	4.4	2.43
UMB SS 080	0.1	31.8	8.4	17.5	2.19	18.26	1.74	0.69	0.5	2.06	4.1	2.24
UMB SS 079	0.09	33.5	8.5	18.1	2.11	17.93	1.56	0.71	0.51	2.08	4.2	2.33
UMB SS 078	0.1	31.2	7.7	17.7	2.06	16.43	1.55	0.74	0.49	1.95	3.7	2.32
UMB SS 115	0.1	42.3	9	22.7	2.42	21.88	1.94	0.8	0.62	2.56	4.9	2.66
UMB SS 114	0.14	38.8	9.6	22.9	2.33	23.54	1.88	0.93	0.67	2.53	5.2	3
UMB SS 113	0.09	37.4	9.1	21.4	2.45	21.32	1.94	0.78	0.59	2.36	4.4	2.62
UMB SS 112	0.08	36.6	5.9	16	1.72	15.23	1.51	0.64	0.46	1.94	3	2.47
UMB SS 111	0.07	32.1	7	18.2	1.98	16.84	1.44	0.66	0.43	1.93	3.7	2.18
UMB SS 110	0.08	32.1	6.9	17.3	1.95	17.23	1.37	0.64	0.47	1.98	3.5	2.05
UMB SS 109	0.09	31.6	7	17	1.91	16.63	1.53	0.58	0.48	1.94	3.5	2.09
UMB SS 108	0.13	38.4	11.8	25.3	3.02	27	2.1	1.01	0.68	2.8	6.4	2.7
UMB SS 107	0.08	31.4	6.4	16	1.91	15.72	1.52	0.6	0.48	1.87	3.3	1.95
UMB SS 104	0.09	37.6	9.5	22.2	2.8	21.96	2.09	0.85	0.68	2.56	5.4	2.72
UMB SS 105	0.08	35.5	6.6	17.8	2.14	16.59	1.72	0.73	0.52	2.06	3.7	2.38
UMB SS 106	0.23	41.8	11.1	25.3	2.77	29.84	2.36	1.04	0.66	2.92	6.2	3.2
UMB SS 103	0.09	32.8	8	18	2.19	18.06	1.78	0.72	0.59	2.15	4	2.15
UMB SS 102	0.1	37.1	9.4	21.7	2.67	21.48	1.98	0.86	0.66	2.46	4.9	2.69
UMB SS 101	0.12	38.5	10.9	24.5	2.89	25	2.17	1.03	0.68	2.79	6	3.04
UMB SS 093	0.08	36.1	7.4	19.3	1.77	16.33	1.9	0.7	0.59	2.12	3.6	2.67
UMB SS 092	0.07	29.3	5	14.6	1.62	13.35	1.39	0.52	0.45	1.74	2.7	1.89
UMB SS 091	0.12	33.3	10.9	22.6	2.64	23.98	1.96	0.83	0.61	2.52	5.6	2.76
UMB SS 090	0.06	32.1	5.1	14.7	1.66	12.9	1.52	0.57	0.45	1.7	2.8	1.93
UMB SS 089	0.11	37.3	10	23	2.29	23.28	2.16	0.89	0.68	2.57	4.9	2.75
UMB SS 088	0.09	37.8	8.8	22.3	2.51	20.88	1.77	0.91	0.66	2.48	5	2.55
UMB SS 087	0.17	44.5	12.6	28	3.31	31.34	2.4	1.13	0.78	3.16	7.4	3.45
UMB SS 086	0.08	32.2	6.7	16.8	1.99	16.8	1.67	0.61	0.47	1.95	3.9	2.2
UMB SS 119	0.08	26.4	6.6	17.2	2.18	15.72	1.37	0.57	0.49	1.87	3.4	2.02
UMB SS 118	0.08	28.3	6.6	16.8	1.96	15.6	1.24	0.61	0.46	1.85	3.3	1.95
UMB SS 117	0.07	30.5	8.5	20.5	2.29	20.06	1.54	0.71	0.56	2.21	4.1	2.17
UMB SS 116	0.06	33.2	4.8	14.8	1.64	12.57	1.55	0.49	0.45	1.62	2.7	2.11
UMB SS 100	0.06	34	4.7	14.3	1.58	12.4	1.39	0.53	0.45	1.66	2.6	2.16
UMB SS 099	0.09	33.3	6.4	20.2	1.76	16.13	1.58	0.71	0.55	2.3	3.8	2.4
UMB SS 098	0.06	32.2	5.2	15.8	1.36	12.94	1.59	0.61	0.48	1.82	2.7	2.13
UMB SS 097	0.05	32.3	6.4	17.3	1.8	15.88	1.43	0.67	0.54	2	3.6	2.04
UMB SS 096	0.05	32.9	4.3	13.7	1.47	11.95	1.38	0.52	0.44	1.57	2.6	2.13
UMB SS 095	0.07	32.1	5.3	15.7	1.65	13.8	1.47	0.61	0.48	1.82	3.1	2
UMB SS 094	0.12	38.9	6.9	19.8	1.72	16.35	1.65	0.74	0.6	2.29	3.9	2.59

Sample No.	Ge ppm	Hf ppm	Hg ppb	Ho ppm	In ppm	K pct	La ppm	Li ppm	Lu ppm	Mg pct	Mn ppm	Mo ppm	Na pct
UMB SS 069	0.1	0.19	9	0.34	0.02	0.54	21	9.4	0.14	0.6	360	0.3	0.059
UMB SS 072	0.05	0.17	11	0.37	0.03	0.51	16	11.5	0.11	0.54	372	0.26	0.026
UMB SS 073	0.05	0.12	2.5	0.22	0.01	0.31	12.1	6.8	0.08	0.36	246	0.21	0.013
UMB SS 074	0.05	0.1	2.5	0.16	0.01	0.17	16.5	4.2	0.06	0.2	141	0.18	0.006
UMB SS 075	0.05	0.05	2.5	0.2	0.01	0.11	18.5	2.3	0.07	0.12	91	0.2	0.007
UMB SS 076	0.05	0.08	2.5	0.2	0.01	0.2	19.3	5.1	0.06	0.21	141	0.21	0.011
UMB SS 077	0.05	0.08	2.5	0.09	0.01	0.1	7.2	2.6	0.01	0.11	56	0.1	0.013
UMB SS 084	0.05	0.13	2.5	0.18	0.01	0.27	14.8	5.6	0.05	0.28	169	0.2	0.009
UMB SS 083	0.05	0.1	16	0.33	0.04	0.59	29.9	13.7	0.09	0.51	403	0.6	0.013
UMB SS 082	0.05	0.08	8	0.27	0.01	0.39	18.1	8.5	0.08	0.36	255	0.35	0.007
UMB SS 081	0.05	0.18	9	0.33	0.01	0.43	17.6	9.2	0.09	0.47	322	0.33	0.015
UMB SS 080	0.05	0.16	8	0.31	0.01	0.44	17.1	10.3	0.11	0.46	304	0.3	0.011
UMB SS 079	0.05	0.13	2.5	0.3	0.01	0.41	17.2	9.2	0.1	0.43	314	0.33	0.011
UMB SS 078	0.05	0.1	2.5	0.31	0.01	0.41	16.7	8.3	0.08	0.41	285	0.32	0.021
UMB SS 115	0.05	0.15	2.5	0.36	0.03	0.51	22.2	10.5	0.11	0.49	313	0.4	0.011
UMB SS 114	0.05	0.16	9	0.34	0.03	0.57	20.2	10.7	0.1	0.5	362	0.42	0.034
UMB SS 113	0.1	0.14	9	0.33	0.01	0.49	19.9	9.5	0.11	0.42	288	0.38	0.008
UMB SS 112	0.05	0.08	2.5	0.26	0.02	0.32	20.3	6.8	0.07	0.25	193	0.37	0.005
UMB SS 111	0.05	0.12	2.5	0.25	0.01	0.39	16.6	8.1	0.08	0.35	246	0.33	0.011
UMB SS 110	0.05	0.13	5	0.26	0.02	0.4	17.3	7.7	0.08	0.33	231	0.34	0.009
UMB SS 109	0.05	0.1	2.5	0.25	0.02	0.37	16.9	7.7	0.07	0.33	230	0.31	0.014
UMB SS 108	0.05	0.16	18	0.37	0.02	0.66	19.6	13.9	0.12	0.65	394	0.38	0.02
UMB SS 107	0.05	0.16	5	0.23	0.01	0.37	17	7.5	0.07	0.31	219	0.29	0.013
UMB SS 104	0.05	0.13	8	0.32	0.02	0.56	19.7	10.5	0.1	0.55	358	0.36	0.016
UMB SS 105	0.05	0.12	2.5	0.27	0.01	0.4	19.4	7.7	0.08	0.35	246	0.3	0.008
UMB SS 106	0.05	0.13	20	0.41	0.03	0.67	21.4	12.8	0.12	0.62	390	0.44	0.008
UMB SS 103	0.05	0.12	2.5	0.29	0.01	0.44	17.8	7.9	0.1	0.42	290	0.29	0.013
UMB SS 102	0.05	0.16	2.5	0.39	0.03	0.53	19.2	10.4	0.11	0.52	348	0.31	0.014
UMB SS 101	0.05	0.16	8	0.39	0.02	0.63	20	11.4	0.12	0.62	414	0.31	0.014
UMB SS 093	0.05	0.14	2.5	0.32	0.01	0.4	19.1	7.8	0.09	0.38	301	0.27	0.017
UMB SS 092	0.05	0.09	2.5	0.24	0.01	0.29	16.1	6.1	0.06	0.26	185	0.28	0.005
UMB SS 091	0.05	0.16	16	0.41	0.02	0.58	17.1	11.2	0.12	0.57	389	0.32	0.013
UMB SS 090	0.05	0.09	2.5	0.27	0.01	0.29	17.7	6	0.08	0.31	200	0.29	0.012
UMB SS 089	0.05	0.13	7	0.35	0.03	0.52	19.4	10.3	0.11	0.51	358	0.3	0.009
UMB SS 088	0.05	0.16	8	0.33	0.03	0.5	19.6	10.6	0.11	0.49	328	0.36	0.022
UMB SS 087	0.05	0.2	17	0.44	0.03	0.72	22.6	15.6	0.11	0.67	453	0.39	0.015
UMB SS 086	0.05	0.14	2.5	0.27	0.01	0.37	17.1	7.7	0.08	0.35	233	0.29	0.008
UMB SS 119	0.05	0.11	2.5	0.24	0.01	0.42	15.1	8.1	0.07	0.34	219	0.3	0.007
UMB SS 118	0.05	0.1	2.5	0.2	0.01	0.4	15	7.5	0.06	0.31	214	0.28	0.007
UMB SS 117	0.05	0.15	6	0.28	0.01	0.49	16.4	9.6	0.09	0.44	276	0.31	0.016
UMB SS 116	0.05	0.11	2.5	0.2	0.01	0.28	18.8	6.5	0.06	0.24	152	0.3	0.005
UMB SS 100	0.05	0.1	2.5	0.21	0.01	0.27	19	5.8	0.06	0.25	160	0.28	0.005
UMB SS 099	0.05	0.12	2.5	0.31	0.01	0.36	18.2	7.1	0.08	0.34	233	0.29	0.005
UMB SS 098	0.05	0.08	2.5	0.23	0.01	0.29	18.2	5.2	0.06	0.26	181	0.26	0.004
UMB SS 097	0.05	0.12	6	0.26	0.03	0.39	16.9	7.2	0.06	0.34	227	0.28	0.008
UMB SS 096	0.05	0.11	2.5	0.24	0.01	0.24	18.7	5.3	0.05	0.23	145	0.23	0.004
UMB SS 095	0.05	0.09	5	0.24	0.01	0.33	17.3	6.2	0.07	0.3	197	0.28	0.006
UMB SS 094	0.05	0.11	7	0.3	0.01	0.41	20.6	7.5	0.09	0.37	263	0.24	0.007

Sample No.	Nb ppm	Nd ppm	Ni ppm	P pct	Pb ppm	Pd ppb	Pr ppm	Pt ppb	Rb ppm	Re ppb	S pct	Sb ppm
UMB SS 069	0.18	18.03	16.7	0.026	13.81	5	4.77	1	40.7	0.5	0.01	0.11
UMB SS 072	0.16	14.71	15	0.023	13.92	5	3.63	1	39.5	1	0.01	0.14
UMB SS 073	0.12	11.23	11.3	0.017	8.78	5	2.81	1	26.1	0.5	0.01	0.08
UMB SS 074	0.08	12.94	7.5	0.013	7.38	5	3.6	1	16.2	0.5	0.01	0.07
UMB SS 075	0.08	15.16	6.5	0.016	6.85	5	4.15	1	10.2	1	0.01	0.05
UMB SS 076	0.1	15.85	9	0.017	10.41	5	4.32	1	18.4	0.5	0.01	0.06
UMB SS 077	0.13	6.02	3.7	0.012	4.21	5	1.67	2	10	0.5	0.01	0.02
UMB SS 084	0.18	11.98	9.7	0.015	8.9	5	3.27	1	27	0.5	0.01	0.08
UMB SS 083	1.56	23.85	17	0.047	52.55	11	6.49	1	54.2	1	0.03	0.27
UMB SS 082	0.37	15.65	12	0.038	18.38	5	4.03	1	31.8	0.5	0.01	0.12
UMB SS 081	0.12	15.01	13.7	0.028	13.57	5	4.09	1	33.7	0.5	0.01	0.08
UMB SS 080	0.14	15.54	13.8	0.033	12.97	5	3.89	1	36	0.5	0.01	0.07
UMB SS 079	0.1	15.34	13.2	0.028	13.49	5	3.9	1	34.5	0.5	0.01	0.08
UMB SS 078	0.15	14.5	12.8	0.032	13.19	5	3.64	1	34.6	0.5	0.01	0.09
UMB SS 115	0.14	18.94	15.9	0.032	16.7	5	5.02	1	39	1	0.01	0.09
UMB SS 114	0.25	16.86	15.5	0.04	18.77	5	4.5	1	40.3	0.5	0.01	0.11
UMB SS 113	0.2	16.64	14.4	0.033	17.83	5	4.27	1	40.3	0.5	0.01	0.11
UMB SS 112	0.18	15.75	10	0.03	15.99	5	4.37	1	26.6	0.5	0.01	0.1
UMB SS 111	0.14	13.74	12.1	0.027	13.82	5	3.53	1	31.3	0.5	0.01	0.1
UMB SS 110	0.17	14.31	12.1	0.028	14.41	5	3.84	1	32.6	0.5	0.01	0.09
UMB SS 109	0.14	14.38	11.2	0.028	13.07	5	3.7	1	31	0.5	0.01	0.09
UMB SS 108	0.21	17.46	18.9	0.04	18.24	5	4.57	1	49.7	0.5	0.02	0.11
UMB SS 107	0.18	14.38	11.2	0.029	13.51	5	3.74	1	30.1	0.5	0.01	0.11
UMB SS 104	0.18	17.7	16.1	0.039	15.7	5	4.53	1	45.5	0.5	0.01	0.08
UMB SS 105	0.19	16.63	12	0.033	14.77	5	4.37	1	33.6	0.5	0.01	0.09
UMB SS 106	0.59	17.53	18.3	0.043	23.69	5	4.78	4	47	0.5	0.01	0.17
UMB SS 103	0.16	15.91	13.3	0.033	14.16	5	4.1	1	37.6	0.5	0.01	0.07
UMB SS 102	0.19	17.73	16.1	0.039	15.46	5	4.77	1	44	0.5	0.01	0.08
UMB SS 101	0.17	18.03	17.4	0.039	17.08	5	4.77	1	47.6	0.5	0.01	0.09
UMB SS 093	0.1	16.33	12.3	0.026	15.86	5	4.49	1	32.3	0.5	0.01	0.08
UMB SS 092	0.18	13.72	9.4	0.028	12.25	5	3.75	1	26.8	0.5	0.01	0.09
UMB SS 091	0.18	16.38	16.9	0.038	16.07	5	4	1	47.6	0.5	0.01	0.07
UMB SS 090	0.13	15.57	10.2	0.025	12.04	5	3.86	1	27.1	1	0.01	0.09
UMB SS 089	0.17	17.87	16.8	0.037	18.3	5	4.47	1	41.2	0.5	0.01	0.09
UMB SS 088	0.15	17.75	15.6	0.036	15.38	5	4.63	1	41.4	0.5	0.01	0.08
UMB SS 087	0.28	19.86	19.8	0.047	22.46	5	5.24	1	55.9	0.5	0.01	0.1
UMB SS 086	0.14	15	11.6	0.028	13.04	5	4.18	1	31	0.5	0.01	0.07
UMB SS 119	0.22	12.36	11.9	0.026	13.58	5	3.42	1	36.9	0.5	0.01	0.08
UMB SS 118	0.2	12.78	11.4	0.026	13.69	5	3.26	2	34.9	0.5	0.01	0.09
UMB SS 117	0.27	14.92	14.6	0.03	16.3	5	3.6	1	41.2	0.5	0.01	0.1
UMB SS 116	0.21	15.06	9.1	0.025	11.94	5	4.12	1	27.1	0.5	0.01	0.08
UMB SS 100	0.19	16.21	8.9	0.027	11.63	5	4.15	1	26.7	0.5	0.01	0.08
UMB SS 099	0.19	15.6	11.6	0.032	14.89	5	4.21	1	29.8	0.5	0.01	0.08
UMB SS 098	0.23	14.94	9.4	0.03	11.94	5	4.12	1	23.8	0.5	0.01	0.1
UMB SS 097	0.24	15.67	11.2	0.029	13.83	5	4.11	1	30.5	0.5	0.01	0.08
UMB SS 096	0.15	15.15	8	0.025	11.19	5	4.27	1	23.8	0.5	0.01	0.09
UMB SS 095	0.24	14.96	10.3	0.029	11.88	5	3.85	1	27.3	0.5	0.01	0.08
UMB SS 094	0.14	18.01	11.7	0.036	16.13	5	4.83	1	29.4	0.5	0.01	0.08

Sample No.	Sc ppm	Se ppm	Sm ppm	Sn ppm	Sr ppm	Ta ppm	Tb ppm	Te ppm	Th ppm	Ti pct	Tl ppm	Tm ppm
UMB SS 069	4.5	0.05	3.75	0.8	56.6	0.025	0.38	0.01	9	0.027	0.3	0.13
UMB SS 072	4	0.4	2.99	0.9	50.3	0.025	0.32	0.01	7	0.023	0.29	0.13
UMB SS 073	2.5	0.05	2.43	0.6	34	0.025	0.25	0.01	5.3	0.018	0.19	0.08
UMB SS 074	1.4	0.05	2.63	0.4	17.5	0.025	0.26	0.01	8.2	0.016	0.12	0.06
UMB SS 075	1	0.05	2.94	0.2	10	0.025	0.26	0.01	10.3	0.013	0.07	0.06
UMB SS 076	1.5	0.4	2.86	0.4	17.4	0.025	0.26	0.01	9.8	0.017	0.13	0.08
UMB SS 077	0.5	0.05	1.33	0.2	9.1	0.025	0.12	0.01	3.1	0.013	0.06	0.03
UMB SS 084	1.7	0.4	2.32	0.4	20.6	0.025	0.24	0.01	6.8	0.023	0.18	0.07
UMB SS 083	3.3	0.5	4.22	1.1	37.2	0.025	0.46	0.01	11	0.042	0.45	0.09
UMB SS 082	2.3	0.3	3.04	0.6	25.5	0.025	0.33	0.01	8	0.016	0.24	0.09
UMB SS 081	2.9	0.5	3.29	0.7	65.9	0.025	0.36	0.01	7.1	0.014	0.26	0.1
UMB SS 080	2.9	0.4	3.02	0.7	60.4	0.025	0.34	0.05	7.3	0.016	0.27	0.09
UMB SS 079	2.8	0.4	3.07	0.7	56.4	0.025	0.33	0.01	7.4	0.014	0.25	0.11
UMB SS 078	2.6	0.2	2.73	0.7	55.3	0.025	0.36	0.05	7	0.015	0.26	0.09
UMB SS 115	3.3	0.05	3.7	0.7	49.5	0.025	0.38	0.05	9.9	0.015	0.28	0.11
UMB SS 114	3.6	0.05	3.45	0.8	44.5	0.025	0.38	0.01	8	0.012	0.3	0.12
UMB SS 113	3	0.05	2.93	0.7	35.1	0.025	0.37	0.03	8.1	0.015	0.3	0.11
UMB SS 112	1.8	0.05	3.38	0.4	16.7	0.025	0.32	0.06	9.9	0.014	0.21	0.08
UMB SS 111	2.4	0.05	2.76	0.6	37.6	0.025	0.31	0.01	7.3	0.012	0.23	0.09
UMB SS 110	2.3	0.05	2.94	0.5	27.9	0.025	0.31	0.01	7.5	0.012	0.25	0.08
UMB SS 109	2.3	0.05	2.57	0.5	34.7	0.025	0.28	0.03	7.7	0.014	0.23	0.08
UMB SS 108	4.1	0.05	3.61	0.9	73.3	0.025	0.39	0.01	7.9	0.017	0.38	0.14
UMB SS 107	2	0.05	2.87	0.5	27.9	0.025	0.27	0.01	7.5	0.015	0.23	0.09
UMB SS 104	3.6	0.2	3.63	0.7	63.7	0.025	0.41	0.01	7.6	0.019	0.34	0.12
UMB SS 105	2.5	0.3	2.98	0.6	26.4	0.025	0.33	0.04	8.2	0.019	0.27	0.1
UMB SS 106	3.9	0.05	3.65	1	44.1	0.025	0.43	0.01	7.9	0.015	0.38	0.14
UMB SS 103	2.9	0.3	3.1	0.7	46.7	0.025	0.31	0.03	7.6	0.015	0.28	0.09
UMB SS 102	3.5	0.1	3.68	0.8	63.6	0.025	0.4	0.01	7.7	0.018	0.32	0.13
UMB SS 101	4	0.3	3.57	1	73	0.025	0.4	0.02	8.2	0.018	0.37	0.14
UMB SS 093	2.5	0.3	3.41	0.6	25.4	0.025	0.36	0.02	8.8	0.012	0.26	0.1
UMB SS 092	1.6	0.4	2.75	0.5	16.9	0.025	0.29	0.03	7.4	0.013	0.21	0.08
UMB SS 091	3.5	0.2	3.42	0.9	67.7	0.025	0.39	0.01	6.5	0.015	0.37	0.13
UMB SS 090	1.8	0.5	2.96	0.6	22.8	0.025	0.28	0.01	8	0.012	0.22	0.08
UMB SS 089	3.3	0.3	3.65	0.9	46.8	0.025	0.4	0.03	7.6	0.011	0.34	0.13
UMB SS 088	3.3	0.1	3.68	0.7	55.9	0.025	0.39	0.01	8.3	0.018	0.3	0.1
UMB SS 087	4.6	0.4	3.96	1	61.1	0.025	0.44	0.01	8.5	0.021	0.42	0.17
UMB SS 086	2.5	0.2	3.14	0.5	32.5	0.025	0.31	0.01	7.5	0.018	0.24	0.1
UMB SS 119	2.1	0.2	2.68	0.5	21	0.025	0.26	0.03	6.2	0.017	0.29	0.08
UMB SS 118	2.2	0.05	2.51	0.5	20.2	0.025	0.27	0.01	6.2	0.015	0.26	0.08
UMB SS 117	3	0.2	2.88	0.8	31.3	0.025	0.32	0.03	6.7	0.013	0.31	0.1
UMB SS 116	1.7	0.1	2.88	0.3	13.7	0.025	0.3	0.02	8.7	0.02	0.21	0.06
UMB SS 100	1.7	0.3	3.02	0.4	15.6	0.025	0.33	0.02	8.5	0.016	0.2	0.07
UMB SS 099	2.4	0.4	3.16	0.5	22.6	0.025	0.34	0.05	8.4	0.014	0.24	0.11
UMB SS 098	1.8	0.6	3.03	0.4	17.7	0.025	0.32	0.02	8.1	0.012	0.17	0.09
UMB SS 097	2.4	0.4	3.14	0.5	24.4	0.025	0.3	0.04	7.3	0.013	0.25	0.09
UMB SS 096	1.7	0.6	3.01	0.4	14.2	0.025	0.31	0.03	8.5	0.015	0.18	0.07
UMB SS 095	2	0.3	2.95	0.5	22.1	0.025	0.3	0.01	7.4	0.013	0.22	0.08
UMB SS 094	2.5	0.3	3.44	0.6	24.7	0.025	0.38	0.01	9.1	0.013	0.24	0.09

Sample No.	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm	Zr ppm
UMB SS 069	1.1	51	0.05	10.09	0.88	57.2	7.9
UMB SS 072	0.9	45	0.05	8.91	0.61	45.8	7.6
UMB SS 073	0.6	32	0.05	6.64	0.55	32.6	4.5
UMB SS 074	1	29	0.05	5.27	0.38	20.8	3.9
UMB SS 075	1.3	38	0.05	5.07	0.38	16.4	3.1
UMB SS 076	1.2	35	0.05	5.48	0.39	23.7	4
UMB SS 077	0.5	12	0.05	2.76	0.22	11	2.9
UMB SS 084	0.9	27	0.05	5.31	0.43	29	4.4
UMB SS 083	3.9	37	0.1	9.45	0.57	140.3	5.1
UMB SS 082	1.7	37	0.05	7.56	0.59	51.1	4
UMB SS 081	1.6	38	0.05	8.5	0.61	47	5.3
UMB SS 080	1.7	36	0.05	8.01	0.58	44.1	5.4
UMB SS 079	1.6	37	0.05	8.13	0.63	45.8	5.3
UMB SS 078	1.6	33	0.05	7.55	0.55	42.1	5.4
UMB SS 115	2	44	0.05	9.01	0.66	52.7	7.2
UMB SS 114	1.7	43	0.05	9.2	0.66	57.6	6.4
UMB SS 113	1.8	39	0.05	8.32	0.66	50.7	6.2
UMB SS 112	1.8	33	0.05	7.03	0.47	36.1	4.6
UMB SS 111	1.5	32	0.05	6.99	0.55	40	5.5
UMB SS 110	1.5	33	0.05	6.97	0.53	42.6	4.9
UMB SS 109	1.6	33	0.05	6.89	0.58	38.2	5.8
UMB SS 108	1.9	48	0.05	10.42	0.85	66.4	7.8
UMB SS 107	1.5	32	0.05	6.46	0.5	37.4	4.9
UMB SS 104	1.8	41	0.05	10.01	0.76	53.2	6
UMB SS 105	1.7	33	0.05	7.83	0.59	42.7	5.4
UMB SS 106	2	47	0.05	11.1	0.87	70	6.1
UMB SS 103	1.7	35	0.05	8.43	0.65	45.5	6.1
UMB SS 102	1.7	40	0.05	9.6	0.75	54.6	6.4
UMB SS 101	1.9	46	0.05	10.81	0.76	62.5	7.4
UMB SS 093	1.6	33	0.05	8.3	0.65	44.8	5.3
UMB SS 092	1.4	27	0.05	6.28	0.43	33.3	4
UMB SS 091	1.7	43	0.05	10.13	0.88	57.1	6.4
UMB SS 090	1.5	28	0.05	6.88	0.48	33.1	4.7
UMB SS 089	1.7	42	0.05	10.42	0.78	54.1	5.7
UMB SS 088	1.9	42	0.05	9.32	0.66	52.9	6.3
UMB SS 087	2.2	52	0.05	11.71	0.89	76.9	7.7
UMB SS 086	1.5	33	0.05	7.22	0.51	40.9	5.4
UMB SS 119	1.2	30	0.05	6.56	0.49	43.3	5.7
UMB SS 118	1.2	29	0.05	6.33	0.47	40.4	5.1
UMB SS 117	1.4	35	0.05	7.71	0.61	48.1	6
UMB SS 116	1.5	26	0.05	6.08	0.36	33.8	4.7
UMB SS 100	1.5	26	0.05	6.64	0.46	31.3	4.3
UMB SS 099	1.6	38	0.05	7.72	0.57	44.7	4.7
UMB SS 098	1.4	31	0.05	6.74	0.48	30.1	3.4
UMB SS 097	1.3	32	0.05	7.6	0.54	39.5	4.5
UMB SS 096	1.5	25	0.05	6.38	0.44	29.4	4.3
UMB SS 095	1.3	30	0.05	6.81	0.45	34.2	3.6
UMB SS 094	1.5	37	0.05	8.26	0.59	45.1	5.1

Ultratrace Aqua Regia Digestion - ICPMS - Biogeochemical Detection limits

Analyte	Mo	Cu	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb
DL	0.01 ppm	0.01 ppm	0.01 ppm	2 ppb	0.1 ppm	0.01 ppm	1 ppm	0.00%	0.1 ppm	0.01 ppm	0.2 ppb	0.01 ppm	0.5 ppm	0.01 ppm	0.02 ppm
Analyte	Bi	V	Ca	P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc
DL	0.02 ppm	2 ppm	0.01%	0.001%	0.01 ppm	0.1 ppm	0.00%	0.1 ppm	1 ppm	1 ppm	0.01%	0.001%	0.01%	0.1 ppm	0.1 ppm
Analyte	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf	Nb	Rb	Sn	Ta	Zr	Y
DL	0.02 ppm	0.01%	1 ppb	0.1 ppm	0.02 ppm	0.1 ppm	0.005 ppm	0.01 ppm	0.001 ppm	0.01 ppm	0.1 ppm	0.02 ppm	0.001 ppm	0.01 ppm	0.001 ppm
Analyte	Ce	In	Re	Be	Li	Pd	Pt	Pb							
DL	0.01 ppm	0.02 ppm	1 ppb	0.1 ppm	0.01 ppm	2 ppb	1 ppb	0.01 ppm							

Ultratrace Aqua Regia Digestion - ICPMS - Stream Sediments (Umberumberka and Pine Creek)

Analyte	Mo	Cu	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb
DL	0.01 ppm	0.01 ppm	0.01 ppm	2 ppb	0.1 ppm	0.01 ppm	1 ppm	0.00%	0.1 ppm	0.01 ppm	0.2 ppb	0.01 ppm	0.5 ppm	0.01 ppm	0.02 ppm
Analyte	Bi	V	Ca	P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc
DL	0.02 ppm	2 ppm	0.01%	0.001%	0.01 ppm	0.1 ppm	0.00%	0.1 ppm	1 ppm	1 ppm	0.01%	0.001%	0.01%	0.1 ppm	0.1 ppm
Analyte	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf	Nb	Rb	Sn	Ta	Zr	Y
DL	0.02 ppm	0.02%	5 ppb	0.1 ppm	0.02 ppm	0.1 ppm	0.02 ppm	0.01 ppm	0.02 ppm	0.02 ppm	0.1 ppm	0.1 ppm	0.05 ppm	0.1 ppm	0.01 ppm
Analyte	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm
DL	0.1 ppm	0.02 ppm	1 ppb	0.1 ppm	0.1 ppm	0.02 ppm	0.02 ppm	0.02 ppm	0.02 ppm	0.02 ppm	0.02 ppm	0.02 ppm	0.02 ppm	0.02 ppm	0.02 ppm
Analyte	Yb	Lu	Pd	Pt	Pb										
DL	0.02 ppm	0.02 ppm	10 ppb	2 ppb	0.01 ppm										

Whole Rock by XRF and Total Trace Elements by ICP-MS Detection Limits (Fowlers Creek bedrock and stream sediments)

Analyte	SiO2	Al2O3	Fe2O3	CaO	MgO	Na2O	K2O	MnO	TiO2	P2O5	Cr2O3	Ba	SUM	TOT/C	TOT/S
DL	0.10%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%	0.01%	0.01%	0.02%	0.02%
Analyte	Ba	Be	Co	Cs	Ga	Hf	Nb	Rb	Sn	Sr	Ta	Th	U	V	W
DL	1 ppm	1 ppm	0.2 ppm	0.1 ppm	0.5 ppm	0.1 ppm	0.1 ppm	0.1 ppm	1 ppm	0.5 ppm	0.1 ppm	0.2 ppm	0.1 ppm	8 ppm	0.5 ppm
Analyte	Zr	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
DL	0.1 ppm	0.1 ppm	0.1 ppm	0.1 ppm	0.02 ppm	0.3 ppm	0.05 ppm	0.02 ppm	0.05 ppm	0.01 ppm	0.05 ppm	0.02 ppm	0.03 ppm	0.01 ppm	0.05 ppm
Analyte	Lu	Mo	Cu	Pb	Zn	Ag	Ni	As	Au	Cd	Sb	Bi	Hg	Tl	Se
DL	0.01 ppm	0.1 pmm	0.1 ppm	0.1 ppm	1 ppm	0.1 ppm	0.1 ppm	0.5 ppm	0.5 ppb	0.1 ppm	0.1 ppm	0.1 ppm	0.01 ppm	0.1 ppm	0.5 ppm