REPORT ON THE
WATERFALL GULLY - BROOK GULLY FIELD AREA.

by D. E. Ayres, October, 1959

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R E P O R T O N T H E

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I. INTRODUCTION

The area selected for mapping is in the Mount Lofty Ranges approximately 10 miles south-east of Adelaide. It extends 2 miles east, and approximately $1\frac{1}{2}$ miles south, from the Devil's Elbow. The main Adelaide-Melbourne highway and several minor roads afford access to the area. 10 days were spent in the mapping of the area.

The survey was conducted as part of the 1959 Economic Geology Honours course. The main objectives were -

(a) to map recent road cuttings in the area in detail (scale 1" = 40').

(b) to map for 1 mile on either side of the road at a larger scale (1" = 400').

Mapping Technique.

1959 aerial photographs of the area are available from the Land's Department. These are at a scale of 1" = 20 chains. Enlargement of the photos by three times gives a scale of 1" = 400'. Geological data was plotted onto Kodatrace overlays on enlargements of two photos which covered the area.

A topographic map of the area was enlarged by three times enabling it to be used as a topographic base map. Geology was then finally plotted on linen which could be superimposed over the topographic map. By this means the final map was made as accurate as possible.

Bedding and cleavage attitudes of the strata were carefully noted. Where possible bedding cleavage relationships were obtained. Because of the lack of continuous outcrop individual beds could not be traced with reasonable accuracy. Systematic traversing in the area is essential to gain an accurate geological map but time did not permit such a method.

Topography

The area is characterised by steep hills and deep gullies. The streams flow to the west and the ridges decrease in elevation in this direction. Thick vegetation covers much of the area making outcrop location

difficult. Outcrops are more sparse in the southern and western portions of the area which are free of thick vegetation.

II. GEOLOGY

The rocks in this area form part of the Adelaidean Series (Late Proterozoic). This has been determined in previous regional investigations.

Rock Types

Two distinct rock units can be recognised in the area. These placed in their stratigraphic order are -

2. Upper Phyllite - slates, siltstones, sandstones, minor dolomite and phyllite.

1. Thick Quartzite - quartzite with sandstone and ferruginous sandstone bands. > 1000' thick.

1. Quartzite - specimens, D, E, L, N, R.

The typical quartzite is a massive white medium grained rock. Felspar or its alteration product is present in many specimens. At least four separate bands of macroscopically different quartzite or sandstone can be recognised in the sequence. Tracing of these bands along strike is difficult.

Normally in this quartzite no bedding can be seen. Bands of sandstone and ferruginous sandstone show bedding well. Cross-bedding relationships indicate in all cases that the beds are right way up. The dip is generally to the south-west at less than 20°.

2. Upper Phyllite.

Siltstone - specimens A, B.

This is a light brown well laminated rock with particles of siltstone size. Bedding is made apparent by the alternating lighter and darker laminations. The rock outcrops in the extreme southern and eastern portions of the area mapped. Medium dips to the south have been recorded near the contact of this siltstone and the Thick Quartzite. The siltstone

therefore overlies the quartzite and cannot belong to the Lower Phyllite as determined by geologists of the Department of Mines. It is obviously very near the base of the Upper Phyllite sequence.

Slate - Siltstone Series

This group, outcropping in the north-western and western portions of the area, consists of well cleaved slates, siltstones and sandstones. The actual relationship between these rock types is obscure as mapping has not yet been extended far enough to the north to clarify this.

Slate - specimen H

A dark grey rock with slaty cleavage commonly obscuring the bedding.

Siltstone - specimens I, F.

A light brown silty rock. Cross bedding is well shown in some specimens by the differential weathering of hard and soft bands and indicates that the beds are right way up. Cleavage is also apparent.

Sandstone -

A medium to coarse grained sandstone. Quartzite bands are also present. Cross bedding is often shown in the coarse bands.

Dolomite -

This is a dark-blue massive dolomite rock. Dip readings indicate that it is interbedded with the slates. Its presence can be detected in places by the occurrence of kunkar on the surface. The two outcrops found had both been exposed by quarrying operations.

Metamorphism -

There is no evidence of a degree of metamorphism higher than perhaps the greenschist facies in the area. The formation of slate, siltstone and quartzite is what is expected when muds, silts, and sandstones are subjected to diagenetic processes and then tectonic movements. Open folding in the slates has produced a prominent cleavage.

Faulting.

No direct evidence of major fault movements was observed. However the criteria used for postulating the two major faults in the area mapped are

1) truncation of structural trends in the slate-siltstone series.
2) a difference in lithology between areas on either side of the fault.
3) the ~~reversal~~ dip of the cleavage changes direction ~~along~~ across the line of the Beaumont fault.

Russell (1957) gives evidence of introduction of milky quartz with chloritisation along bedding planes locally along the Montacute fault in the Third Ck. - Fourth Ck. area. Milky quartz with chlorite and limonite pseudomorphs of pyrite were found scattered as float over the general area of a fault zone mapped by the Department of Mines. No direct evidence of this fault zone was seen.

Minor faults were observed in road cuttings. These were shown mainly by zones of intense shearing or local discordance of strata.

A gouge zone, possibly indicative of thrust faulting, was observed in a cutting 800 yards east of Eagle on the Hill Hotel. A more incompetent silty band between two competent sandstone bands had apparently taken up the movement, with development of a prominent cleavage.

Folding.

The Thick Quartzite appears to have acted as a competent block in this area and has been relatively unaffected by any folding movements. It dips gently to the south-west with minor undulations.

Minor folding is observable in the younger slates and siltstones. Actual plunge readings favour a south pitching anticline - syncline development in the Eagle on the Hill - Waterfall Gully area. The western limb of the anticline is cut off by the Beaumont fault. The structure further west is not known in detail but is generally west dipping. The eastern limb of the syncline is similarly cut off by the Clarendon - Ochre Cove fault.

Cleavage.

This is a more prominent feature of the slate-siltstone sequence than the bedding. It appears to be a true axial plane cleavage generally dipping at 55° - 60° to the east and striking 170° - 200° / i.e. the axial plane is overturned slightly to the west.

Calculated bedding-cleavage relationships indicate a south pitch of the folding. This agrees with lineations determined in the field.

A number of the cleavage attitude readings indicated a dip of the cleavage to the west. This variation could have been brought about by movement along the Beaumont fault.

The development of cleavage in the more incompetent siltstone

bands and not in the competent sandstone bands in the siltstone-sandstone sequence is of interest.

Drag Folds.

On only three drag folds found in the area were measurements of plunge direction and magnitude able to be made. The plunge was fairly constant at 20-25° to the south.

Cross Bedding.

Some sandstone beds in the Thick Quartzite showed well defined cross-bedding. This revealed that the beds were not overturned. Similarly some siltstone horizons in the Upper Phyllite show cross-bedding excellently because of differential weathering of hard and softer bands.

III. CONCLUSIONS.

The mapping which has been undertaken has not been in sufficient concentration to enable a complete structural and stratigraphic interpretation to be made, i,e. although outcrops have been mapped in detail there are "gaps" in various parts of the area in which no information has yet been recorded. This is partly due to lack of outcrop and partly because some of these areas have not yet been traversed owing to dense vegetation and rugged topography.

Consequently the interpretation in this report is not final and would be at least modified when further data is available.

IV. RECOMMENDATIONS

Further field mapping employing a traverse system should be undertaken in the area. Special attention should be paid to

1) Evidence for faulting along the proposed major faults in the area - especially along the contact between the Thick Quartzite and the slates to the west.
2) The stratigraphic relationship of the western slates to the Thick Quartzite.
3) Following the boundary between the Thick Quartzite and the Upper Phyllite.
4) The nature of the folding in the slate series and the stratigraphic relationships of the various rock types (slate, siltstone, sandstone).

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APPENDIX A

ROCK SLIDE DESCRIPTIONS

Specimen E. (Thick Quartzite).

This is a sedimentary quartzite consisting predominantly of rounded grains of quartz and felspar. The average grain size is .3 mm x .2 mm with grains up to .8 mm x .4 mm. The rock has a ferruginous cement which contains some magnetite grains.

Quartz. The grains show clear outlines with no indication of recrystallisation. Undulose extinction can be observed and some grains are fractured. The rock has been subjected to some stress. Inclusions of rutile and zircon can be seen.

Felspar. The presence of both plagioclase and microcline is indicated by the twinning. The grains usually have many small inclusions and alteration to sericite is noticeable along cleavages and grain boundaries.

The specimen is a ferruginous quartzite.

Specimen N. (Thick Quartzite).

This is a sedimentary quartzite consisting of angular grains of quartz and felspar. The corroded outlines of the grains show that recrystallisation has taken place. Undulose extinction indicates stress.

Quartz. The grains are fractured in places and contain numerous small inclusions. Undulose extinction is noticeable.

Felspar. Cross-hatched twinning indicates the presence of microcline. A small amount of plagioclase is shown by multiple twinning.

Sericite. A minor amount occurs, some as the alteration product of the felspars.

Specimen R. (Upper Phyllite)

This rock consists predominantly of recrystallised grains of quartz and felspar. The average grain size is .4 mm. The texture is granoblastic.

Quartz. Occurs as clear grains, some showing undulose extinction.

Inclusions of apatite can be seen in the quartz.

Felspar. Plagioclase of varying composition (Oligoclase, Andesine) is present. Some orthoclase and microcline are also present.

Muscovite. This occurs as fibrous grains showing high polarisation colours. These are probably remnants of the matrix.

Monazite, apatite and haematite occur as accessory minerals.

The specimen is an arkosic quartzite.

Specimen F. (Upper Phyllite).

This rock has a fine grained texture. Average grain size is .04 mm. The predominant minerals are quartz, felspar and fibrous grains of muscovite. Irregular grains of haematite and masses of limonite are present.

Accessory minerals are tourmaline (pleochroic blue prisms) apatite and zircon.

In hand specimen the rock is slightly altered and shows cross-bedding.

The specimen is a siltstone.