“Controls on iron isotope variation in Granites and associated hydrothermal ore systems : The Hillside example”

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CONTROLS ON IRON ISOTOPE VARIATION IN GRANITES AND ASSOCIATED HYDROTHERMAL ORE SYSTEMS : THE HILLSIDE EXAMPLE

ABSTRACT

This study presents accurate and precise iron isotopic data for the Hillside ore body relating it back to modelled δ57Fe values of the coeval magmatic suite comprising of the Curramulka Gabbronorite, Arthurton Granite, Tickera Granite and altered granites associated with the Hillside ore deposit. Defining the possible link between the hydrothermal system that deposited the Hillside ore body and the magmatic evolution of the Hiltaba suite granites that host the ore in relation to its δ57Fe. Radiogenic isotope data suggests some open system behaviour with minor crustal contamination occurring within the magmatic suite. The iron enrichment trend is initially defined by the crystallisation of pyroxenes and olivine causing the δ57Fe of the melt to increase. This is followed by the crystallisation of magnetite which causes the δ57Fe of the melt to decrease. Finally at the felsic end of the suite (>70% wt. % SiO2) the δ57Fe of the melt increases again. It is during this latter stage that hydrothermal fluid is released and using the data from the melts model it is believed that it had a δ57Fe ≈ +0.18. Two fluids were involved in the precipitation of the ore body. The primary fluid precipitated the magnetite and pyrite. Whilst the secondary fluid altered the pyrite to chalcopyrite and magnetite to hematite. Ore mineral separates for pyrite and chalcopyrite gave δ57Fe average values of 0.48 and -0.32 respectively. With pyrite being isotopically heavier than chalcopyrite the predicted outcome. The postulated δ57Fe value of the hydrothermal fluid (δ57Fe ≈ +0.18) was used to predict what range of δ57Fe that the ore minerals should fall within for the temperature range of 700-450oC. Only the pyrite mineralisation can be used to describe the δ57Fe relationship between the suite and ore body as it precipitated from the primary fluid. The collected pyrite average value fell within the predicted range with a crystallisation temperature of ≈ 625oC.

KEYWORDS

Iron Isotope, Magmatic Suite, Open System

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