

“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 $\delta^{57}\text{Fe}$ values of the coeval magmatic suite comprising of the Curramulka Gabbro, 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 $\delta^{57}\text{Fe}$. 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 $\delta^{57}\text{Fe}$ of the melt to increase. This is followed by the crystallisation of magnetite which causes the $\delta^{57}\text{Fe}$ of the melt to decrease. Finally at the felsic end of the suite (>70% wt. % SiO_2) the $\delta^{57}\text{Fe}$ 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 $\delta^{57}\text{Fe} \approx +0.18$. 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 $\delta^{57}\text{Fe}$ average values of 0.48 and -0.32 respectively. With pyrite being isotopically heavier than chalcopyrite the predicted outcome. The postulated $\delta^{57}\text{Fe}$ value of the hydrothermal fluid ($\delta^{57}\text{Fe} \approx +0.18$) was used to predict what range of $\delta^{57}\text{Fe}$ that the ore minerals should fall within for the temperature range of 700-450°C. Only the pyrite mineralisation can be used to describe the $\delta^{57}\text{Fe}$ 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 $\approx 625^\circ\text{C}$.

KEYWORDS

Iron Isotope, Magmatic Suite, Open System

TABLE OF CONTENTS

Title	Error! Bookmark not defined.
Running title	1
Abstract.....	1
Keywords.....	1
List of Figures and Tables	3
Introduction	7
Background.....	9
Geological Setting	12
Ore Deposit.....	15
Ore mineral sampling	18
Methods	15
observations and Results	17
Geochemistry.....	17
Radiogenic Isotope Geochemistry	22
Hypothetical Evolving Magmatic Suite	4
Results of the Melts Modelling	9
Fe Isotope compositions of ore mineral separates.....	12
Hypothetical Ore Forming Fluid	13
Iron Isotope Fractionation within Fe bearing Ore Minerals	15
Conclusions	18
Acknowledgments	15
References	21

LIST OF FIGURES AND TABLES

- Figure 1 Modelled Wt% SiO₂ v $\delta^{57}\text{Fe}$ fractional crystallization trends using Melts-Rhyolite. Starting composition = crustally contaminated mantle melt. Data points are collected the felsic . intermediate and mafic igneous rocks from the Arthurton-Tickera-Curramulka suite. Indicating the isotopic composition of fluids derived from the modelled oxidized and reduced granites and the isotopic composition of magnetite, pyrite and chalcopyrite precipitated from these fluids between 700 and 450 degrees.(Poitrasson & Freyrier 2005, Heimann *et al.* 2008, Schuessler *et al.* 2009, Foden J. 2011, Sossi P. 2011)..... 8
- Figure 2 Regional map of the Yorke Peninsula, South Australia. Sample locations are shown. Samples of the Curramulka Gabbonorite were taken from drill core from previous exploration efforts within the region. The drill holes that they were taken from are listed with drill hole locations D2 – 6 referring to drill holes CUR D2 – 6. All samples recovered from the Hillside deposit come from the point labelled Hillside Project. Exact locations of drill holes are unable to be listed as it is restricted information. 16
- Figure 3 Photomicrograph of the Hillside deposit. This figure depicts sample HS003. The ore mineral separate samples HS003PY1 and HSCPY2 were recovered from this sample. A. and B. Brecciated pyrite with chalcopyrite over printing. C. And D. Late silica and carbonate veining and infill inbetween the fractured pyrite crystals..... 2
- Figure 4 Photomicrograph of the Hillside deposit. This figure depicts sample HS005. A. and C. Brecciated pyrite with chalcopyrite over printing. B.and D. large porphyroblastic garnet. G. and H. Late silica and carbonate veining and infill inbetween the fractured pyrite and garnet crystals..... 4
- Figure 5 Photomicrograph of the Hillside deposit. This figure depicts sample HS007. The ore mineral separate samples HS007PY1 and HS007CPY2 were recovered from this sample. A., B. and C. Brecciated pyrite with chalcopyrite over printing. B. partially reflected light and plane polarised light. large porphyroblastic garnet with alteration features in fractures.B Late silica and carbonate veining and infill inbetween the fractured pyrite and garnet crystals. 5
- Figure 6 Photomicrograph of the Hillside deposit. This image was taken using the SEM, depicting sample HS007. The ore mineral separate samples HS007PY1 and HS007CPY2 were recovered from this sample. A. Late silica and carbonate veining and infill inbetween the fractured chalcopyrite. B. late stage carbonate and silica infil in the chalcopyrite grain. C. Primary fractured magnetite with voids filled with chalcopyrite mineralisation. C. And D. Clinopyroxene alteration of host skarn with late silica and carbonate veining and infill in between the fractured pyrite, chalcopyrite and clinopyroxene crystals. 6
- Figure 7 Photomicrograph of the Hillside deposit. This figure depicts sample HS008. The ore mineral separate sample HS8CPY1 was recovered from this sample. A., B., C. and D. Brecciated pyrite with chalcopyrite over printing. E. and F. fractured magnetite

with a clinopyroxene believed to be pigeonite. F. Network replacement of pyrite by chalcopyrite.	7
Figure 8 Photomicrograph of the Hillside deposit. This figure depicts sample HS014. All images show fractured primary magnetite with silica infill. Late stage alteration of the host skarn to clinopyroxene and silica. The clinopyroxene have has altered the host mineral (believed to be garnet) and still retains remnant fracturing from an earlier deformation event.	10
Figure 9 Photomicrograph of the Hillside deposit. This figure depicts sample HS016. . A., B., E. and F. Brecciated pyrite with chalcopyrite over printing. All images show late stage alteration of the host skarn to clinopyroxene and orthoclase. F. shows clinopyroxenes having a spicule texture.	12
Figure 10 Photomicrograph of the Hillside deposit. This figure depicts sample HS017. All images show fractured primary magnetite with silica infill. Late stage alteration of the host skarn to clinopyroxene and silica. The clinopyroxene is believed to be diopside.	13
Figure 11 Is a Q-Pl-KSpar (normative) plot showing that most of the Tickera - Arthurton samples fall in the granite field, while the Curramulka samples are gabbros. The data displayed in the red circles are the collected Tickera-Arthurton-Curramulka samples. Sampled data (red circles) are from the tables; Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Table 11, Table 12, Table 13, Table 14 and Table 15 (Creaser & Cooper 1993, Wurst A. T. 1994).	19
Figure 12 Is a Q-Pl-KSpar (normative) plot showing that most of the Tickera - Arthurton samples fall in the granite field, while the Curramulka samples are gabbros. A. MALI (Na ₂ O+K ₂ O-CaO) v SiO ₂ and B. Fe # (FeO(T)/ FeO(T) + MgO) v SiO ₂ diagrams (Frost <i>et al.</i> 2001) the samples fall on the boundary between the “ferroan” and “magnesian” granite fields and between the “alkalic” and “alkali-calcic” fields , the felsic samples falling exactly the in the whole Gawler Craton Hiltaba granite data set plotted for reference. The data displayed in the red circles are the collected Tickera-Arthurton-Curramulka samples while the green circles are other Hiltaba aged plutons from the Gawler Craton.	20
Figure 13 Depicts relationship between the Curramulka and Hiltaba suites whole rock data explored by variation diagrams. Sampled data (red circles) are from the tables; Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Table 11, Table 12, Table 13, Table 14 and Table 15 (Creaser & Cooper 1993, Wurst A. T. 1994). A. MgO Vs CaO B. MgO vs TiO ₂ C. SiO ₂ TiO ₂ D. TiO ₂ vs Sc. Hypothetical magma suite data created by MELTS is plotted (blue crosses) showing that the created data follow similar trends (Gualda <i>et al.</i> 2012). Green circles are other Hiltaba aged plutons from the Gawler Craton.	20
Figure 14 Depicts relationship between the Curramulka and Hiltaba suites whole rock data explored by variation diagrams. Sampled data (red circles) are from the tables; Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Table 11, Table 12, Table 13, Table 14 and Table 15 (Creaser & Cooper 1993, Wurst A. T. 1994). A. SiO ₂ vs Zr, zircon content increases with SiO ₂ . B. Sc vs V. Green circles are other Hiltaba aged plutons from the Gawler Craton.	21

Figure 15 Strontium/Rubidium whole rock isochron a broad representative of magmatic samples. Where the equation for the linear function is $y=0.017821424x+0.712941723$. Data obtained from Table 2. 4

Figure 16 Bivariate plot of MgO against $\epsilon Nd_{(1585)}$. Samples plotted are the same samples listed in Error! Reference source not found. Data obtained from Table 2. 5

Figure 17 Bivariate plot of Sm/Nd against $\epsilon Nd_{(1585)}$. The red circles are the samples listed in Table 2. The open circles are other Hiltaba suite intrusions on the Gawler Craton. The squares indicate the Pre-Hiltaba Gawler basement. 6

Figure 18 % of melt remaining vs Temperature showing melt evolution path (red crosses) and the complimentary solid cumulate path (black dashes) created from the results of MELTS (Ghiorso & Sack 1995) modelling on the specific chosen starting gabbro norite, from the Curramulka. This was chosen as it most likely represent the true starting composition of the evolving system. The most favourable run made at pressure 1.2 kbar, 0.5 H₂O and oxygen fugacity of QFM + 1 as seen in the MELTS list. Minerals crystallised clinopyroxene (CPX), spinel (Sp), Ilmenite, Pionite, Orthoclase (KSp), Olivine (Ol) and plagioclase (Plag) 11

Figure 19 Variation of $\delta^{57}Fe_{melt}$ values from the hypothetical magmatic suite developed in the MELTS program plotted against other composition variations obtained from the output; A. SiO₂ (wt. %) and B. MgO (wt. %). 12

Figure 20 Bivariate plot of $\delta^{57}Fe$ in the melt against Temperature. Postulated $\delta^{57}Fe$ values of chalcopyrite (squares), magnetite (triangles) and pyrite (diamonds) from Table 4. Hypothetical $\delta^{57}Fe$ of the fluid and melt. Marked coloured crosses indicate average collected sample $\delta^{57}Fe$ value (Table 3). Note pyrite value falls with the predicted range. Using previous knowledge, the most likely composition of the ore forming fluid would have a $\delta^{57}Fe$ of 0.18. Arrows indicate most likely direction of change for the fluid with the shaded implying the new $\delta^{57}Fe$ of the fluid precipitating the as before mentioned minerals. 15

TABLES

Table 1 Collected mineral separates of the Fe bearing mineral from samples collected from Rex Minerals Hillside deposit..... 1

Table 2 Summary of Strontium - Rubidium and Neodymium - Samarium isotopic data from Mass Spectrometry results for the listed samples from the Curramulka Gabbro norites and associated felsic intrusions..... 3

Table 3 Summary of heavy iron isotope results on ore minerals and their accessory minerals from the Hillside deposit..... 14

Table 4 Model of predicted concentrations of $\delta^{57}Fe$ in Pyrite, Chalcopyrite and Magnetite precipitating from a fluid with $\delta^{57}Fe=0.18$ at varying temperature..... 14

Table 5 Geochemical data from the Curramulka Gabbro-norite. Samples recovered from previous exploration drill holes.	22
Table 6 Geochemical data from the Curramulka Gabbro-norite. Samples recovered from previous exploration drill holes.	23
Table 7 Geochemical data from the Curramulka Gabbro-norite. Samples recovered from previous exploration drill holes.	24
Table 8 Geochemical data from the Curramulka Gabbro-norite. Samples recovered from previous exploration drill holes.	25
Table 9 Geochemical data from the Curramulka Gabbro-norite and Granitic samples from the Hillside deposit. Samples for the Curramulka Gabbro-norite were recovered from previous exploration drill holes. Hillside granitic samples were recovered from drill holes drilled by Rex Minerals at their Hillside deposit.....	26
Table 10 Geochemical data from Granitic samples recovered from the Hillside deposit and Granitic samples associated with the Tickera Granite. Hillside granitic samples were recovered from drill holes drilled by Rex Minerals at their Hillside deposit. Tickera Granite samples were recovered from outcrop at Point	27
Table 11 Geochemical data recovered from previous studies by Wurst (1994).	28
Table 12 Geochemical data recovered from previous studies by Wurst (1994).	29
Table 13 Geochemical data recovered from previous studies by Wurst (1994).	30
Table 14 Geochemical data recovered from previous studies by Creaser (1993).	31
Table 15 Geochemical data recovered from previous studies by Creaser (1993).	32