Fe isotopic composition of inner solar system materials: Tthe fit of Martian basalts and minerals

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Currently, there is a debate about the Fe isotopic signature of inner solar system materials and whether Fe isotopes could be fractionated during planetary differentiation processes [1]. Large variations have been found among terrestrial mantle xenoliths, in sharp contrast to the homogeneous isotopic composition of terrestrial basalts. Previous Fe isotope work on lunar, Martian, HED and terrestrial basalts have shown that although the Fe isotopic compositions of these materials were relatively homogeneous for each planetary body, there were systematic interplanetary differences [2]. This has been interpreted as a signature of the accretion history experienced by each planetary body. Martian mantle-derived samples, directly accessible for lab-based studies, are only available as Martian meteorites. They represent a variety of lithological types ranging from melt rocks to basaltic cumulates that formed during different episodes of Martian magmatic history. We present the most comprehensive bulk (>10) and major silicate minerals (>5) Fe isotope data from Martian basaltic rocks using a high-resolution MC-ICP-MS and compare our results with previously published data. At the level of precision obtained in our preliminary study (± 0.05‰ for $\delta^{57/54}Fe_{IRMM-14}$), all Martian meteorites and their dominant silicate phases appear to have an indistinguishable Fe isotopic composition. In addition, our data agree remarkably well with previously published low-resolution Fe isotope data [3], confirming that Martian basalts do indeed have a lighter isotopic composition than basalts from the Earth and the Moon, as proposed by [2]. Martian igneous rocks display, along with those from Vesta, the most restricted Fe isotope variations compared to terrestrial and lunar igneous samples. This may simply be related to the limited sampling of Martian reservoirs, or more interestingly, it may be that the high-temperature geochemical processes on Mars are more straightforward compared to those on heavily impact-processed planetary bodies like the Moon, or a dynamic planet like the Earth with a plate tectonic regime still active today.

References

[1] Weyer, S., Anbar, A.D., Brey, G.P., Munker, C., Mezger, K. and Woodland, A.B. (2007) *EPSL* **256**, 638-646.

[2] Poitrasson, F., Halliday, A.N., Lee, D.C., Levasseur, S. and Teutsch, N. (2004) *EPSL* **223**, 253-266.

[3] Anand, M., Russell, S.S., Blackhurst, R.L. and Grady, M.M. (2006) *Phil. Trans. R. Soc. B* **361**, 1715-1720.

Rb-Sr and Sm-Nd isotope studies on the metabasalts of the Late Archean Hutti Greenstone Belt, Dharwar Craton, south India

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The Late Archean Hutti Greenstone Belt in the Eastern Dharwar Craton consists of predominantly tholeiites and felsic volcanic rocks and is surrounded by granitoid rocks. Based on distinctly different metamorphic mineral assemblages the belt can be divided into east-west and north-south trending arms.

Rb-Sr and Sm-Nd isotope studies were carried out on the metabasalts from both the arms of the Hutti Greenstone Belt. The samples of the N-S arm define a collinear array in the Rb-Sr isotope evolution diagram which corresponds to an age of 2674 ± 120 Ma (MSWD = 8). The samples of the E-W arm define a collinear array in the Sm-Nd isotope evolution diagram which corresponds to an age of 2664 ± 86 Ma (MSWD = 0.94). The above ages for the metabasalts are interpreted to represent time of metamorphism which occurred soon after formation of their igneous precursors. The granitoid intrusives and gneisses surrounding the belt with U-Pb titanite and zircon ages ranging from 2574 ± 8 Ma to 2531 ± 3 Ma are younger than the metabasalts.

Neither the E-W nor the N-S arm metabasalts show any correlation in ε_{Sr} vs. ε_{Nd} plot (Figure 1) and hence, it is inferred that their precursor magmas were not contaminated by continental crust. Based on the ε_{Sr} values it is suggested that the E-W arm metabasalts were derived from a source relatively more Rb-depleted than that for the N-S arm metabasalts. The sources for the magmas represented by both the E-W and N-S arm metabasalts were depleted in LREE > 600 Ma ago before melting as they all have positive ε_{Nd} values.

Two felsic volcanics from the Hutti Schist Belt have both negative ε_{Nd} and negative $f_{Sm/Nd}$ values and they could have been derived from LREE enriched sources. The felsic volcanic from the E-W arm of the Hutti Schist Belt has negative ε_{Sr} value indicating that its magma must have derived from Rb-depleted sources while the magma representing the felsic volcanic of N-S arm was either derived from sources or interacted with continetal crust having high Rb/Sr ratio.

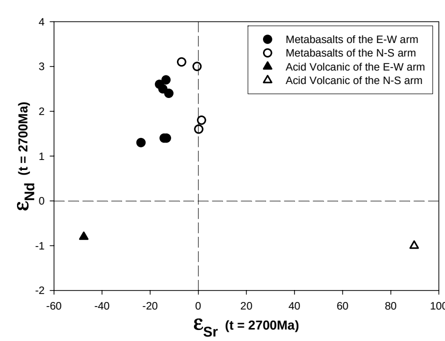

Figure 1: ε_{Sr} vs. ε_{Nd} plot for the Hutti metavolcanics calculated for an age of 2700 Ma