Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.10436

# MORB Fe isotope variation as a consequence of mantle source heterogeneity and crustal level magma differentiation

**YAOLING NIU**[1], SHUO CHEN[2], PU SUN[2], YANHONG CHEN[1], PENGYUAN GUO[2], MENG DUAN[2], HONGMEI GONG[2], XIAOHONG WANG[2], SONG XUE[1] AND YUANYUAN XIAO[2]

[1]China University of Geosciences in Beijing
[2]Institute of Oceanology, Chinese Academy of Sciences
Presenting Author: yaoling.niu@durham.ac.uk

Early studies show uniform global MORB Fe isotope composition ($\delta^{56}$Fe = +0.105±0.006‰, $N = 43$) [**1**] that is heavier than MORB melting residues (abyssal peridotites; $\delta^{56}$Fe = +0.010±0.014‰, $N = 37$), which is indistinguishable from chondrites [**2**]. Recent analyses in our IOCAS laboratory on MORB glasses from the EPR, MAR and near-EPR seamounts show large $\delta^{56}$Fe variations (+0.028 to +0.360‰ with the mean of +0.1018±0.056‰, $N = 68$). The global MORB mean $\delta^{56}$Fe (+0.0997±0.0245‰, $N = 160$) remains similar, but the variability is revealing [**3-6**].

The $\delta^{56}$Fe increase with decreasing MgO for a MORB suite with uniform source composition demonstrates significant Fe isotope fractionation during MORB differentiation [**3**] as manifested by magma-chamber cumulates [**4**].

MORB sample suites showing source heterogeneity exhibit large $\delta^{56}$Fe variations that correlate positively with $[La/Sm]_N$, $^{87}$Sr/$^{86}$Sr and negatively with $^{143}$Nd/$^{144}$Nd, $^{176}$Hf/$^{177}$Hf [**5,6**], resulting from melting of a mantle with enriched lithologies of low-F melt metasomatic origin dispersed in depleted matrix developed at the LAB in Earth's history (>1 Ga) [**7**,**8**]. In this low-F process, heavy Fe ($^{56,57}$Fe) behaves more incompatibly than light Fe ($^{54}$Fe). The $^{56,57}$Fe-Fe$^{3+}$ affiliation (vs. $^{54}$Fe-Fe$^{2+}$) can be invoked as Fe$^{3+}$ is more incompatible than Fe$^{2+}$, but this may not be the sole/definite cause of heavy Fe enrichment. High-F melting may not produce detectable Fe isotope fractionation in the melts but can leave an Fe isotope fractionation signature in the melting residues as evidenced in the melts derived from previous residues [**9**].

All this assumes no core-mantle Fe isotope fractionation following the chondritic-Earth assumption. This needs testing through studying Fe isotope fractionation between silicate and sulphide/metal phases in sudbury-type-Fe-Ni-Cu deposits [**10**].

**[1]** Teng et al., 2013, GCA 107, 12-26; **[2]** Craddock et al., 2013, EPSL 365, 63-76; **[3]** Chen et al., 2019, GCA 267, 227-239; **[4]** Chen et al., 2021, Comm. Earth-&-Environ. 2, 65; **[5]** Sun et al., 2020, GCA 286, 269-288; **[6]** Guo et al., 2022; **[7]** Niu et al., 2002, EPSL 199, 327-345; [**8**] Niu & Green, 2018, ESR 185, 301-307; [**9**] Chen et al., 2021, EPSL 572, 117133; **[10]** Wang et al., 2021, Minerals 11, 464. NSFC (41630968) support.