

# Fe isotope fractionation between magnetite and silicate melt: insights from experiments

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Iron isotope systematics recorded in terrestrial and extraterrestrial specimens have been widely used to decipher the formation of Earth and its chemical evolution through geological time. In order to properly interpret the isotopic signature of ancient and modern rocks, a precise knowledge of the mechanisms controlling the high temperature fractionation of Fe stable isotopes during magmatic differentiation is required. However, our knowledge of the partitioning of Fe isotopes between minerals and melts currently relies primarily on theoretical calculations, for which modelling of the electronic and structural state of iron is complicated by its multiple redox and spin states, or on the study of natural specimens, for which equilibrium is difficult to demonstrate. Experiments, on the other hand, offer a valuable alternative, in that Fe isotope fractionation is determined in a controlled environment where the individual effects of intensive variables (e.g., P, T etc.) can be isolated. The challenges associated with experimental design and analysis of run products means that experimentally determined mineral-melt Fe isotope fractionation factors are scarce at present.

Here we present recent results from a series of experiments aimed at determining the Fe isotope fractionation factor between magnetite and silicate melt at high-pressure and high-temperature conditions. This system was chosen because of the important role magnetite plays in the evolution of magmas. Mineral and melt pairs were equilibrated at 1 GPa and 800 °C and different oxygen fugacities (between Co-CoO and Re-ReO<sub>2</sub> buffers) for several days using a piston cylinder apparatus. Experiments with different durations were performed in order to assess whether isotopic equilibrium was reached in the experiments. After the synthesis, the capsule was recovered at ambient pressure and temperature and mineral and melt separates were obtained, checked for purity, and analyzed for Fe isotopes by multi collector inductively coupled plasma mass spectrometry.

Importantly, the new results show that magnetite-melt fractionation factors covary with the different conditions investigated in the experiments. The effect of pressure, temperature and oxygen fugacity will be discussed in the context of interpreting Fe isotope systematics of natural magmatic systems.