

Inter-Mineral Equilibrium Iron Isotopic Fractionation Factors from a Special Metamorphic Rock

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Determining inter-mineral equilibrium Fe isotopic fractionations is of great significance due to the ubiquity of Fe and the wide range of Fe isotopic variations documented in nature [1]. This can be done experimentally by juxtaposing two phases at high temperature to allow isotopic exchange, followed by isotopic analyses of the separated phases [2]. The main difficulty, however, is that diffusion in solids can be slow even at high temperature so equilibration is difficult to achieve. In the worst-case scenario, kinetic isotopic fractionation can overprint and mask the subtle equilibrium isotopic fractionation. An alternative way is to measure naturally coexisting minerals, which involve much longer timescale, but sample selection is critical, since the temperature condition has to be known and the minerals must be in equilibrium. We have studied the Fe isotopic compositions of minerals in a pelitic schist from Mt. Moosilauke, New Hampshire, where the metamorphic temperature and pressure conditions have been constrained to be at the Al₂SiO₅ triple point [3]. Minerals were handpicked from the rock under a binocular microscope, and then measured for their Fe isotopes using MC-ICPMS following [4]. The bulk rock has an Fe isotopic composition of +0.1 ‰ in δ⁵⁶Fe. The δ⁵⁶Fe values of minerals vary significantly, from -0.2 ‰ to +0.4 ‰. Biotite has a very similar δ⁵⁶Fe value to the bulk. Garnet and ilmenite have lighter Fe isotopic compositions than the bulk, while muscovite and plagioclase have heavier isotopic compositions. These Fe isotopic compositions most likely reflect equilibrium fractionations among minerals, and thus provide an excellent tool to calibrate mineral fractionation factors. Applications of these calibrations to interpretations of natural iron isotopic variations in rocks will be presented.

[1] Dauphas et al. (2017) *Rev. Mineral. Geochem.*, 415-510. [2] Shahar et al. (2017) *Rev. Mineral. Geochem.*, 65-83. [3] Hodges and Spear (1982) *Am. Mineral.* 67, 1118-1134. [4] Dauphas et al. (2009) *Chem. Geol.* 267, 175-184.