Precise Iron Isotopic Ratios for Standard Reference Materials and Natural Fe-bearing Samples

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Recent studies have revealed that natural stable isotope fractionations of many elements heavier than S (e.g., Fe, Cu, Zn or Ge) are common on the Earth (Hirata, 1997; Beard and Johnson, 1999; Beard et al., 1999; Mandernack et al., 1999; Marechal et al., 1999; Anbar et al., 2000; Zhu et al., 2000; Anbar, 2001; Zhu et al., 2001). The study of natural isotopic variation for heavy elements has had a significant influence in many research fields such as biology, planetary, earth, and environmental sciences. Among the first row transition elements, because Fe has a relative mass difference that is likely to be sufficient to record biologically-induced isotopic fractionation. In this study, precise determination of Fe isotopes for several geochemical materials have been made by means of multiple collection-inductively coupled plasma-mass spectrometry (MC-ICPMS).

Precise and accurate isotopic analysis of Fe was severely limited by the serious mass spectrometric interferences, such as ArN+, ArO+ or ArOH+ polyatomic ions These unwanted interfering signals could be minimized by dry plasma condition achieved either by laser ablation sample introduction or by desolvating nebulizer technique. Moreover, Ni external correction technique was applied in this study to improve the precision and accuracy of the data. The resultant precisions (internal precision or repeatability) of the measurements for both the 54Fe/56Fe and 57Fe/56Fe ratios were better than 0.02% (2SD) for laser ablation technique and 0.005% (2SD) for solution samples at the 95% confidence level.

Using the present technique, the 54Fe/56Fe and 57Fe/56Fe ratios for three standard reference materials and several Fe-bearing minerals were measured. There are significant variations in Fe isotopic ratios (~0.02%) among the standard reference materials (JMC-943001, NIST-665 and IRMM-014), indicative of importance of isotopic standard to maintain the traceability of the isotopic data. In this presentation, Fe isotopic data on some geochemical materials and possible mechanism of isotopic fractionation of Fe will be discussed.