Isotopic Anomalies of Molybdenum in Iron Meteorites

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A number of conflicting observations on specific Mo isotope anomalies in iron meteorites have been reported. Lu and Masuda [1], using P-TIMS, report the existence of small isotopic anomalies in 92,94,96,97,100Mo in 8 iron meteorites. Yin et al. [2] used N-TIMS to measure the isotopic composition of 5 irons, but found no evidence of isotopic anomalies. Dauphas et al.[3], using MC-ICP-MS, reported the presence of small isotopic anomalies in bulk iron meteorites. These anomalies are characterized by either a coupled excess in p-and r-process material, or a corresponding deficit in s-process nuclides.

Isotopes of Mo are synthesized by p-process (92,94Mo), s-only process (96Mo), r-only process (100Mo) and a combination of s- and r-process (95,97,98Mo). Furthermore 97Mo is the end-product of the now-extinct radionuclide 97Tc with a mean half-life of 3.6 Ma. Unfortunately 92, 94, 96Zr and 96,98,100Ru are isobaric with the corresponding Mo isotopes, which requires a chemical separation process to eliminate Zr and Ru, and produce a Mo extract suitable for mass spectrometric analysis. This presentation will report on an experiment where replicate extracts of iron meteorites were analyzed by P-TIMS after undergoing an ion exchange procedure of high efficiency and low blank.

Duplicate analysis of a laboratory standard processed through the same ion exchange separation procedure as the meteorites provided isotope abundance data with high external reproducibility. Replicate analysis of samples of Mt. Magnet and Sikhote Alin revealed variable isotope compositions. In particular, the isotope abundance of 97Mo was enriched by as much as +2‰ compared to the laboratory standard. Other isotopes of Mo showed much less variability. The data support significant Mo isotope heterogeneity in iron meteorites.

References

[1] Lu, Q. and Masuda, A. (2000) .Origin of Elements in the Solar System, Kluwer Academic, 385-400.
[2] Yin Q., Jacobsen, S.B., and Yamashita, K. (2002) Nature, **415**, 881-883.
[3] Dauphas (2002) Ap. J. **565**, 640-644.