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W isotopic composition of IVB iron meteorites

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Introduction

The investigation of W isotope anomalies in meteorites is of interest because of the former presence of the short-lived isotope ^{182}Hf, which decays to ^{182}W. Thus, variations in ^{182}W can be used to infer timescales of early solar system processes [$e.g.$, 1] However, the application of Hf-W chronometry relies on the assumption that W isotopes were homogeneously distributed in the solar nebula. This assumption appears to be valid for most meteoritic samples, but small deficits in s-process W isotopes have been observed in group IVB irons [2] and CAIs [3]. More recently, excesses in ^{180}W have been measured in several magmatic iron groups [4]. These data seem to imply heterogeneity of W isotopes in the early nebula, but these results have been questioned [5]. We report new isotopic measurements for several IVB irons to examine the extent of nucleosynthetic W isotope anomalies in this group.

Samples and Analytical Methods

We analyzed six IVB irons and the ungrouped iron Chinga. In addition, we processed two aliquots of the NIST W solution standard (SRM 3163) and six aliquots of a NIST Fe-Ni steel (SRM 129c) using our chemical separation protocol for W. Isotopic measurements were made with a ThermoScientific Neptune *Plus* MC-ICPMS in low resolution mode. Signal intensities for both ^{180}W and ^{178}Hf were measured using 10^{12} Ohm resistors. The accuracy of the interference correction on ^{180}W from ^{180}Hf was tested by analyzing several aliquots of SRM 3163 doped with Hf.

Results and Discussion

Both of the aliquots of SRM 3163 and the six replicates of the NIST steel have ε^{180}W values within uncertainty of zero. These results demonstrate the accuracy of the method and do not suggest the presence of analytical artefacts on the W masses in low-resolution mode, which was recently suggested [5] to explain a previous report [4] of ^{180}W excesses in magmatic iron meteorites. Moreover, the results for SRM 3163 doped with Hf show that the interference correction on ^{180}W is accurate for the range of Hf/W ratios of the samples. The ε^{180}W values for the IVB irons show excesses, although these are not umabigously resolvable for all samples at at the current level of precision. A small excess is also present in the ungrouped iron Chinga. All six IVBs exhibit small ε^{184}W deficits, consistent with previous results [2] and indicate the presence of a small deficit in s-process W isotopes in the IVB irons relative to terrestrial W. Also, the ε^{182}W values of all six IVBs are below the CAI initial [3], indicating neutron-capture induced shifts in the W isotope abundances caused by cosmic rays. This process may also affect the ε^{180}W values, but the magnitude of the effect is currently unknown. Analyses of additional samples with varying exposure histories may help to constrain the potential effect of cosmic rays on ε^{180}W.

References

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