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Isotope analysis of tungsten in IIIAB iron meteorites and main group pallasites

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Iron meteorites and stony-iron meteorites are fragments of differentiated asteroids, of which the cosmological data can provide key informations regarding the formation of the metallic core of differentiated asteroids and the terrestrial planets. Because tungsten is a moderately siderophile element, the behavior is comparatively variable that depends on the physical parameters such as oxygen fugacity. Therefore, the abundance and stable isotopic compositions of W have useful informations about the formation processes of differentiated planets or planetesimals.
W isotopes in some iron meteorites have been investigated, but the numbers of samples analyzed were is still limited. Therefore, no detailed discussions on the isotopic variation of W among the chemical groups have been made. In this study, we have determined a series of W isotopic compositions in IIIAB iron meteorites in order to evaluate the extent of the variation of W stable isotopes within a single chemical group. IIIAB iron meteorites are the best available samples that derived from a crystallized metal core of a differentiated body. It is widely accepted that the features of the IIIAB irons are strongly related with those for the main group pallasites (PMG), and these meteorite groups are considered to be originating from the same parent body, based on the chemical composition and the oxygen isotope signature. We also investigated possible relationship between IIIAB irons and PMG on W isotopic compositions.
In this thesis, W isotopic compositions in four IIIAB iron meteorites and four PMG were analyzed by MC-ICPMS. The 184W/183W and 186W/183W values for IIIAB iron meteorites varied significantly which ranged from -0.29 to +0.53, and from -0.48 to +1.43 in epsilon unit, respectively. The resulting W isotopic data for metal phase of PMG varied from +0.41 to +1.12 for 184W/183W and from +0.88 to +3.14 for 186W/183W in epsilon unit, respectively. All samples have no nucleosynthetic anomaries, but they would have experienced mass-dependent fractionation from a condritic reservoir. The W concentrations in IIIAB irons and PMG were determined by isotope dilution method. The relationship between the W isotope ratios and W concentrations suggests that the W isotopes have been fractionated during fractional crystallization and diffusion between metal and silicate phases in the parent body of IIIAB irons and PMG.