Chemical characteristics of ungrouped iron meteorites from Yamato Mountains

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Introduction

It was announced that Y-792345 (2.57 g), Y 000088 (4.25 g), Y 000090 (1.56 g) and Y 983934 (7.5 g) were classified into ungrouped iron meteorites [1]. According to the previous suggestion [2], it is likely that these ungrouped iron meteorites with less than 20 g of total mass are metal nodule of chondrites and achondrites. In this study, we determined elemental abundances for these iron meteorites as much as possible using LA-ICP-MS and EPMA, and the obtained results are compared with those of iron meteorites as well as those of metal fractions of chondrites and achondrites.

Experiments

Small metal fragments allocated from NIPR were mounted in epoxy and polished. LA-ICPMS analysis were carried out using a Thermo ElementXR coupled to CETAC LAS-213 at NIPR. Iron meteorites were ablated on line mode with spot size of 100 μm in diameter at a scan speedrate of 25-50 μm/s. All analyses were performed with 20Hz repetition rate and 100% power output. Under these conditions, ^{31}P, ^{53}Cr, ^{57}Fe, ^{59}Co, $^{60, 61, 62}$Ni, $^{63, 65}$Cu, $^{69, 71}$Ga, $^{73, 74}$Ge, ^{75}As, ^{95}Mo, $^{101, 102}$Ru, ^{103}Rh, $^{105, 106}$Pd, $^{182, 183, 184}$W, $^{185, 187}$Re, $^{189, 190}$Os, $^{191, 193}$Ir, $^{194, 195}$Pt and ^{197}Au were monitored in low resolution (R = 300). For quantification, North Chile (IIAB), Hoba (IVB) and NIST SRM663 are used as reference samples. EPMA, JEOL JXA-8200 at NIPR was used for the determination of Si, Fe, Co and Ni. The accelerating voltage was 15 keV and the operating beam current of 30 nA and defocused beam (100 μm in diameter) were used.

Results and Discussion

Y 983934, Y 000088 and Y 000090: The most noticeable chemical features of three ungrouped iron meteorites (Y 983934, Y 000088 and Y 000090) are significantly low Co abundances (3230 ppm for Y 983934, 2960 ppm for Y 000088, 2860 ppm for Y 000090) and higher Si abundances (2330 ppm for Y 983934, 1850 ppm for Y 000088, 1220 ppm for Y 000090). These chemical features are similar to those of metal fraction of enstatite chondrites and achondrites, and some ungrouped iron meteorites (Horse Creek and LEW 85368). CI-normalized elemental abundances for siderophile and chalcophile elements for Y 983934 are flat, and are similar to those of metal fractions of enstatite chondrites, indicating that Y 983934 is metal nodule of enstatite chondrite. Y 000088 and Y 000090 are significantly depleted in Re, Os, Ir, Mo, Ru and Pt compared with metal fractions of enstatite chondrite, while moderately and volatile siderophile elements are not fractionated among these elements. These chemical features can be seen in enstatite achondrites [3]. Fractionation of these refractory siderophile elements are explained by partial melting of enstatite chondrites. Thus, Y 000088 and Y 000090 are considered to be metal fraction of enstatite achondrites.
Silicon abundances of Y 000088 and Y 000090 are lower than that of Horse Creek, while these three iron meteorites have similar Ga and Ge abundances to each other, implying that these three iron meteorites are related. If so, fractionation trend seen in magmatic iron meteorites can be seen in these three iron meteorites. Although Y 000088 and Y 000090 have lower Ir, Re and W than those of those of Horse Creek, Au abundances for these three iron meteorites are almost similar to each other. Thus, it was excluded that Y 000088 and Y 000090, and Horse Creek are genetically related.

Y 792345: Compare with other iron meteorites, Y-792345 has a lower P abundance (11.1 ppm). Its abundance is similar to those for metal fractions of ordinary chondrites. Although CI-normalized elemental abundances for moderately and volatile siderophile elements of Y-792345 are similar to those of bulk metal of H ordinary chondrites, significant depletions of highly siderophile elements can be seen in Y 792345 compared with bulk metal of H ordinary chondrites. Chemical characteristics observed in Y 792345 can be seen in large metal nodule of ordinary chondrites and some iron meteorites such as ALH 84233 and LEW 88023 [2,4]. Slight difference can be seen in opposite fractionation of Re/Os and Ru/Pt ratios. In terms of its chemical composition, it is concluded that Y 792345 represent as metal fraction of H ordinary chondrite.

References

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