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Highly siderophile elements and Os isotope compositions of Ryugu samples

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JAXA's Hayabusa2 mission returned 5.4 g of samples from the Cb-type asteroid Ryugu. Initial analyses of Ryugu samples revealed the mineralogical, chemical, and isotopic similarities with CI (Ivuna-like) carbonaceous chondrites [e.g., 1-2]. Here we present the Os isotope ratios and abundances of highly siderophile elements (HSE: Ru, Rh, Pd, Re, Os, Ir, Pt, and Au) and volatile siderophile elements (VSE: S, As, Se, Sn, Sb and Te) to further investigate the origin of the materials that accreted to form Ryugu, and the chemical processes that affected these materials after accretion.

We processed eleven powder aliquots of bulk Ryugu aggregates from two sampling sites (TD1: A0106-A0107; TD2: C0108) together with six carbonaceous chondrites (Orgueil, Alais, Tarda, Tagish Lake, Murchison, and Allende). The Os isotopes were analyzed using N-TIMS (Triton Plus), and the sample solutions after Os extraction were used to determine HSE and VSE abundances using ICP-MS (iCAP-TQ) [3].

The bulk Ryugu samples have uniform ^{187}Os/^{188}Os ratios (0.1264±0.0005), consistent with the bulk CI value (0.1265±0.0001, [4]), corresponding to the limited variation in ^{187}Re/^{188}Os ratios observed (0.373-0.402). Given the small sample size for each measurement (<1.1 mg), the HSE abundances are somewhat variable (0.6-1.2xCI [5-6]) while the HSE/Ir ratios are highly uniform within the range of CIs. The most striking feature is that all HSE abundances for Ryugu show strong positive correlations with VSE abundances, such that the HSE/S ratios are consistent with the CI value and are systematically lower than those of the other carbonaceous chondrites. Our data suggest that Ryugu is mainly composed of CI-like materials, while further research is needed to fully understand the causes that produced the relatively uniform ^{187}Os/^{188}Os ratios and elemental HSE/S ratios.

This research was conducted in collaboration with the Hayabusa2 initial analysis chemistry team and the Hayabusa2 initial analysis core.

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