Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20249

Elemental compositions of ~3 mg Ryugu samples and CI chondrites compared

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The similar relative abundances of non-atmophile elements between the Sun and rare CI chondrites suggest that CI chondrites represent the most primordial meteorites available for laboratory analyses. Samples returned from asteroid Ryugu by the Japanese Hayabusa2 mission resemble CI chondrites, but were not altered on Earth [1-3].

ICP-MS data obtained from five ~3 mg Ryugu samples from chamber A (1st touchdown) and ~50 mg powder aliquots from the CI chondrites Ivuna (2 x), Orgueil (3 x) and Y-980115 are used to reassess their elemental composition and chemical variability. For quality control, Allende Smithsonian reference powder, JB-2, BHVO-2 and ~3 mg powder test samples from Allende, Ivuna and JB-2 were analyzed. Fifty-eight elements were quantified relative to Ivuna and by three point calibration using freshly prepared CI chondrite matched calibration solutions. Blank contributions for Ryugu were only relevant for Nb, Mo and W. Except for U in Ivuna, results for 3 mg test samples agreed with results from 5o mg samples to within better than 10% or within 10 to 20% for Se, Ag, Te (Ivuna), S, Ag, Ir, Pt (Allende) and As and Bi for JB-2 (HSE, Ag and S not quantified in basalts).

Ivuna and Mg normalized data reveal the following: Many elements in CI chondrites agree within ~2 %. Orgueil samples display enrichments in some refractory elements [4]. Y-980115 is depleted in Cd, In, Tl and Bi [5]. One Ryugu sample matches the CI chondrite REE pattern, the other four samples are enriched in light over heavy REE with variable REE/Mg. Two Ryugu samples are clearly enriched in Ca and Sr, one in Mn and Fe. Overall, the 3 mg Ryugu samples from chamber A display a clear CI chondrite affinity, but their chemical compositions are somewhat affected by aqueous alteration. The data allows to assess the heterogeneity of Ryugu samples from chamber A.

[1] Yokoyama et al. (2022) *Science* 379, [2] Nakamura et al. (2022) *Proc. J. Acad. B* 98, 227-282, [3] Ito et al. (2022) *Nat. Astron.*6, 1163–1171, [4] Barrat et al. (2012) *GCA* 83, 79-92, [5] Braukmüller et al. (2018) *GCA* 239, 17-48.