What we learned from asteroid Ryugu samples

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The Hayabusa2 mission aimed at bringing back samples from C-type near-Earth asteroid (162173) Ryugu to understand what the C-type asteroid is made of and to investigate the formation and evolution of Ryugu [1]. The mission successfully returned ~5 g of samples collected from two locations on Ryugu [2, 3], delivering them to Earth in December 2020. Six percent of these samples were analyzed by the Hayabusa2 initial analysis team during a one-year priority period.

The Ryugu samples show close relations with CI chondrites in terms of their chemical, isotopic, mineralogical, and petrological properties [e.g., 4-8]. Considering that CI chondrites have undergone terrestrial weathering post-fall [e.g., 4, 5], the Ryugu samples are one of the freshest CI-like materials available for further study [4].

The presence of CO_2-bearing fluid inclusion in pyrrhotite indicates that Ryugu's parent planetesimal formed in the outer region of the Sun's protoplanetary disk [5]. Given the prevalence of C-type asteroids in the main belt, it is plausible that planetesimals similar to Ryugu migrated from these outer regions into the inner Solar System. Therefore, Ryugu's sibling bodies may have played a role in delivering water and organics to early Earth [7, 8].

Several percent of Ryugu grains exhibit signs of space weathering, such as solar wind implantation and micrometeoroid bombardment [9]. Noble gases from the solar wind, released from the returned grains, were detected in the sample container [10]. The space-weathered surfaces are dehydrated, potentially explaining the shallow OH vibration feature observed on Ryugu by the spacecraft [11].

This presentation will discuss the analysis results of the Ryugu samples in the context of Solar System evolution and will compare these findings with those from the Bennu samples [12].

References

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