

Synchrotron Light Illuminates the Origin of the Solar System

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Samples of the carbonaceous asteroid Ryugu were brought to Earth by the Hayabusa2 spacecraft. Mineralogical, petrological, and physical properties of seventeen Ryugu particles measuring 1–8 mm indicate that they are most similar to CI chondrites. The presence of CO₂-bearing water in pyrrhotite indicates that the original parent asteroid formed beyond the H₂O and CO₂ snow lines in the solar nebula, where, based on Ryugu mineralogy, very limited amounts of high-temperature objects including small chondrules and Ca, Al-rich inclusions were present. Fluid-rock reactions occurred at low-temperature, high pH, and reducing conditions at water/rock mass ratios smaller than 1 and changed an olivine-pyroxene rich lithology, remaining as the least-altered fragments in Ryugu samples, into phyllosilicate-carbonate rich lithologies, the predominant material of Ryugu samples. The solar nebula might have been still present when magnetite crystallized from the fluid in Ryugu's parent body.

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