

The simulation experiments on hydrothermal formation of organic globules in carbonaceous chondrites

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Organic globules were found in the Tagish Lake meteorite (carbonaceous chondrite fallen in 2000). Since then, divers characterizations of organic globules in meteorites have been reported. However, there are no experimental studies on the formation processes of organic globules. In order to simulate the globule formation processes, hydrothermal heating experiments of an OH-bearing amino acid (threonine: Thr) have been conducted in the presence of some rocks (rhyolite, basalt).

By heating 40 ml of Thr solution with a rock piece in a hydrothermal vessel at 160 C for 4 days, globules of 2 to 20 micrometers in size were observed under Scanning Electron Microscope (SEM) on the rock surface. Elemental analysis of the globules showed that they consist mainly of carbon. This result suggests that the organic globules found in Tagish Lake meteorite could be formed during aqueous alteration of carbonaceous chondrites by hydrothermal organic-inorganic interactions.

For the quantitative analysis of the globule formation process, hydrothermal heating experiments with a glass slide with a smooth surface have been conducted. SEM images of glass surfaces showed increasing grain size of organic globules for longer heating duration. Image analyses of the SEM images have been used to determine grain size distributions and mean diameters of globules. Growth rates of organic globules at different temperatures can be evaluated based on their mean diameters. These results can be used to estimate the temperature conditions and time scales of organic globule formation in the meteorite parent body.