

ORGANIC GLOBULES IN CARBONACEOUS CHONDRITES: AN EXPERIMENTAL APPROACH.

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Introduction: Organic globules analysed in carbonaceous chondrites (CCs) are supposed to represent presolar material [1,2,3]. They consist of carbon, hydrogen, nitrogen and oxygen [1,2] and have either a hollow or solid structure [1,2,5,6,7]. Hydrocarbons [2,5,7], and in particular polycyclic aromatic hydrocarbons (PAHs) [2,7], have been considered as material composing these globules. Polycyclic aromatic hydrocarbons are aromatic rings of carbon atoms with peripheral hydrogen atoms fused together to form honeycomb structures. They are abundant in CCs [8] and could therefore be precursor material for organic globules. In order to test the PAH precursor hypothesis, we conducted hydrothermal as well as melting experiments with two different types of PAHs.

Experiment and Methods: Hydrothermal experiments were carried out polyfluorotetraethylene lined steel autoclaves with a total volume of 2 ml. We filled the reactors with either naphthalene (C₁₀H₈) or fluoranthene (C₁₆H₁₀) in the presence of an olivine slice (fo₉₀; San Carlos olivine) as an analogue for a reacting meteoritic matrix, and ultra pure water. Subsequently we heated the batch reactors to 150 °C for 70 days under anoxic condition. Additionally, we performed melting experiments (40-150 °C) in glass vials without olivine slices. The glass vials with a volume of 1.5 ml were filled with a PAH and ultra pure water or only a PAH in an anoxic atmosphere. The heating process started with all samples simultaneously at room temperature and was carried out in oven by increasing the temperature stepwise until the desired temperature was reached. The samples were exposed for minimum of 20 ±10 minutes at 40 °C and 120 ±60 minutes at 150 °C. After exposure the solid and the fluid samples were extracted and analysed by Raman spectroscopy. Solid sample material was also analysed using a focused ion beam scanning electron microscope.

Results: Our results show that naphthalene and fluoranthene alter solely as a result of melting and are not influenced by olivine. In the hydrothermal experiment and in the melting experiments with water naphthalene forms different sized globules depending on temperature. These globules are solid and vary from nanometer to millimeter size. Under equivalent experimental conditions fluoranthene also forms different sized globules. However, in the case of fluoranthene the globules do not vary in size with changes in temperature. In addition, the structure of the globules, produced with both PAHs, varies from hollow to semi-solid. In both cases in the experiments formed globules consist only of carbon.

Conclusion: Our experiments show that hydrothermal alteration and melting of PAHs leads to the formation of globules strikingly similar to those found in CCs. Furthermore, these experiments indicate that globule formation is host matrix independent, i.e. no aqueous mineral reaction or mineral surface is required to transform PAHs to organic globules. We suggest that melting of PAHs under aqueous conditions is potentially a major globule-forming process in parent bodies in the solar system.

References: [1] Garvie & Buseck, 2004. *Earth and Planetary Science Letter* 224:431-439. [2] Nakamura-Messenger et al., 2006. *Science* 314:1439-1442. [3] Hashiguchi et al., 2013. *Geochemica et Cosmochimica Acta* 122:316-323. [4] Rossignol-Strick & Barghoorn, 1971. *Space Life Science* 3:89-107. [5] Nakamura et al., 2002. *International Journal of Astrobiology* 1(3):179-189. [6] Garvie et al., 2008. *Meteoritics & Planetary Science* 43(5):1-5. [7] Gregorio et al., 2013. *Meteoritics & Planetary Science* 48(5):904-928. [8] Basile et al., 1984. *Organic Geochemistry* 5:211-216