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The Organics in Sutter's Mill Meteorite

Early analyses of the Sutter's Mill carbonaceous chondrite [April 22, 2012 fall, ***Data link*** from the Meteoritical Bulletin] found that the soluble organics varied between individual fragments, perhaps not surprising for a ***breccia***, but were far lower in abundance and diversity (e.g. amino acids, hydrocarbons) compared to other meteorites of similar ***CM*** classification.

In spite of that, new work on the meteorite reveals that its insoluble organic material (IOM), when subjected to hydrothermal (hot water) decomposition in the laboratory, released water- and solvent-soluble organic compounds not previously detected in this or any other meteorite.

A team from Arizona State University headed by Sandra Pizzarello analyzed the compounds released from the Sutter's Mill IOM under experimental conditions —300 °C and 100 MPa (about 1000 times atmospheric pressure) for 6 days— chosen to mimic plausible hydrothermal environments on an asteroidal parent body or the early Earth. Using gas chromatography-mass spectrometry analyses, Pizzarello and colleagues found the hydrothermally released compounds from two Sutter's Mill fragments include oxygen-containing species such as polyethers and polyether esters that are unique compared to results from other carbonaceous chondrites.

Based on the laboratory results, Pizzarello and coauthors consider that the fragments of Sutter's Mill they analyzed had likely been altered by hot oxidizing conditions on the parent asteroid and that the organic content of the IOM may be both primary (e.g. compounds unaffected by alteration) and secondary compositions (e.g. molecules formed as alteration products). In relation to prebiotic organic synthesis on the early Earth, this work on Sutter's Mill meteorite raises the question could hydrothermal environments on the early Earth trigger the release or even the new formation of additional soluble organic compounds (e.g. polyethers) from the insoluble organic material in impacting carbonaceous chondrites? With an answer yet unknown, laboratory studies will continue on the large assortment of soluble and insoluble organics contained within the fascinating carbonaceous chondrite meteorites.

See Reference:

· Pizzarello, S., Davidowski, S. K., Holland, G. P., and Williams, L. B. (2013) Processing of Meteoritic Organic Materials as a Possible Analog of Early Molecular Evolution in Planetary Environments, *Proceedings of the National Academy of Sciences,* doi:10.1073/pnas.1309113110 [***abstract***].

See also:

· Jenniskens, P. and 69 others (2012) Radar-Enabled Recovery of the Sutter's Mill Meteorite, a Carbonaceous Chondrite Regolith Breccia, *Science,* v. 338, p. 1583-1587,

doi:10.1126/science.1227163 [***abstract***].
- ***NASA Researchers Strike Scientific Gold with Meteorite***, NASA News Release, Dec. 20, 2012.

Related **PSRD** reports:
- ***Soluble Organics of the Bells Meteorite***.
- ***Water, Carbonaceous Chondrites, and Earth***.
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