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Synthesis of Prebiotic Organic Compounds within the Tagish Lake Meteorite

R.W. Hilts, C.D.K Herd, D.N. Simkus and G. Slater

The Tagish Lake meteorite stones are composites of several different lithologies that exhibit varying degrees of parent body hydrothermal alteration. Through leeching regimens with polar and weakly polar solvents , and by employing GC-MS techniques, we found within the extracts several different classes of soluble organic compounds, ranging from highly polar monocarboxylic acids, amino acids and phenols, to essentially non-polar aliphatic and aromatic hydrocarbons. The differences in both the concentrations and the classes of soluble polar organic species across the four lithologies studied are likely the result of varying degrees of oxidative hydrothermal alteration of primordial insoluble organic matter (IOM).The amino acids found in the water extracts, by contrast, are probably derived from small precursor molecules ,such as aldehydes and ketones, via aqueous-based reactions within the parent body.

Our findings support other studies which have shown that soluble prebiotic organic compounds present within carbonaceous chondrites are likely produced by hydrothermal oxidative processing of IOM. Monocarboxylic acids, which are present in relatively high abundances in our Tagish Lake stones, could have served as the construction material for pre-cellular membranes on the early earth, while amino acids via polymerization, could have produced the essential proteins needed to generate primitive cellular machinery.

As part of our future work on our Tagish lake specimens, we will attempt to uncover the locations of the organics within the solid matrices of the stones using in situ methods, such as TOF-SIMS, and look for relationships between the types of organic species and the interior minerals upon which they are absorbed. This may allow us to elucidate the precise, surface-based processes by which these prebiotic species were synthesized.