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Prebiotic chemistry inventory: New insights revealed from CV carbonaceous chondrites.

LIBBY D. TUNNEY[1], ALLYSON L. BRADY[2], KIMBERLY T. TAIT[3], VERONICA DI CECCO[3] AND GREG F. SLATER[1]

[1]McMaster University
[2]Carleton University
[3]Royal Ontario Museum

Presenting Author: tunneyl@mcmaster.ca

Given the scarcity of samples from sample return missions, meteorites represent an unparalleled opportunity to investigate the prebiotic chemistry of the interstellar medium and the early Earth. Earth's processes have erased our prebiotic history that preceded the origin of life; therefore, solvent extractable components of meteorites have become the best approach to inform origin of life discussions. Typically, carbonaceous chondrites, in particular CM2 chondrites, are often selected for studies due to their high organic carbon content compared to other carbonaceous chondrite classes. However, neglecting other carbonaceous chondrites, such as the rarer CB, CV, and CK classifications, may also overlook the detection of important organic compounds that may be absent in more frequently studied classes. Here, we investigate understudied meteorites belonging to the CV carbonaceous chondrite category to add to the inventory of soluble organic matter.

Dichloromethane (DCM) and aqueous extractions of 5 CV chondrites (Allende, NWA 4502, NWA 11554, NWA 10935, and NWA 4838) alongside the most readily studied CM2 carbonaceous chondrite, Murchison, were conducted. Each specimen was sampled at different levels, going from its core to the exterior. Analyses from gas chromatography – mass spectrometry (GC-MS) revealed a diverse spread of organic compounds across the samples. Of particular interest is the NWA 4502 specimen, which contained both elemental sulfur and organosulfur compounds. The DCM extraction of NWA 4502 included 1,2,4-trithiolane, cyclic octaatomic sulfur, hexathiane, and hexathiepane, and preliminary results from its aqueous extraction include an organosulfur acid, mercaptoacetic acid, in addition to both proteinogenic and non-proteinogenic amino acids. In addition, the sampling level (core versus exterior) shows no correlation to the total number of extraterrestrial compounds detected, demonstrating the heterogeneous nature of meteorites. NWA 4502 presents a unique suite of organics, demonstrating the need to investigate other types of carbonaceous chondrites that have otherwise been overlooked. Not only is sulfur a prerequisite for life (CHNOPS), but the bioavailability of sulfur as organosulfur compounds has numerous implications to the origin of life.