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Insoluble organic matter (IOM) in primitive carbonaceous chondrites

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Insoluble organic matter (IOM) extracted from several primitive carbonaceous chondrites, e.g., Oued Chebeika 002 (CI), Murchison (CM), NWA-16301 (CM), NWA-16097 (CM), and Hassi Knebi 001 (C3 Ungrouped), have been studied in order to understand the stellar sources and the thermal processes these IOMs had experienced, and to shed lights on the earliest evolution history of the solar system. Whole rock powders were treated with HF/HCl to remove soluble organics, carbonates, metal complexes, and silicates, while IOMs and minute refractory oxides, e.g., spinel and corundum, remained. Raman spectroscopic results showed that, despite varied in metamorphic grades, the peak metamorphic temperatures are similar, within uncertainties, among these IOMs. In addition, the H, C, N, and O isotopic compositions of the extracted IOMs have been studied via the AS NanoSIMS with three analytical routines, C and N, then H, followed by O isotopes. While the preliminary C, N, and H results of this study are comparable to that of the published data [1-2], there are clear offsets of our data and that of [1-2]. For example, $d^{15}N$ (~ -20‰) and dD (~ +485‰) of OC-002 (CI) are quite distinct from the other CI chondrites. The NWA-16097 (CM) showed slightly enriched $d^{13}C$ (~ +9‰) and depleted $d^{15}N$ (-15‰) relative to Murchison (this study and [1]), while the NWA-16301 (CM) also exhibited slightly depleted$d^{15}N$ (-13‰) and dD (+128‰) relative to Murchison (this study and [1]). The C3 ungrouped HK-001 showed distinct H, C, and N results relative to CI and CMs at -5‰, -22‰, and +24‰ for $d^{13}C$, $d^{15}N$, and dD, respectively. Furthermore, many grains with pre-solar C, N, and H signatures are also found among these samples, and most of these grains are organic compounds with some SiC and graphite. The grains with anomalous C and N isotopes are overlapping with other primitive samples [3-4], while a few grains showed positive correlated N and H signatures. More studies, e.g., O isotopes and non-acid-treated samples, are needed to verify if the IOMs were indeed mixtures between chondrite precursors and volatile-rich dusts [5].