Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.14755

Elemental and isotopic variability in pristine vs. terrestrially contaminated CM chondrites revealed using stepwise acid leaching: a comparative study of Aguas Zarcas and NWA 11346

LIAM S T MCGOVERN, BRUCE L A CHARLIER AND COLIN J N WILSON

Victoria University of Wellington

Presenting Author: liamcgovern@hotmail.co.nz

Pristine carbonaceous chondrite fall samples (those collected dry, within days of falling) available for laboratory investigation are exceedingly rare. Such samples retain elemental and isotopic information on primary materials and parent body processing, free of a terrestrial overprint. To gain insights into the elemental and isotopic variability preserved in such primitive samples, we performed stepwise acid leaching experiments on pristine material from the 2019 CM2 Aguas Zarcas fall, and compare them with the hot desert NWA 11346 CM-an find.

Trace- and rare-earth-elements (measured using ICP-MS) yield diverse leaching release patterns, likely reflecting differing parent body histories and the contrasting impacts of terrestrial contamination on our find versus fresh fall samples. Isotopic measurements (using TIMS) for Sr showed that while the bulk $\mu^{84}Sr$ values for both meteorites were indistinguishable from the terrestrial standard, the leach fractions revealed highly variable $\mu^{84}Sr$ values. Both Aguas Zarcas and NWA 11346 showed extreme negative $\mu^{84}Sr$ anomalies in the stronger-acid leachates; however, the variability of $\mu^{84}Sr$ among Aguas Zarcas leachates differed markedly from the same leaching steps for NWA 11346. For Ba isotopes, bulk meteorite data for Aguas Zarcas showed depletions in ^{130}Ba, ^{135}Ba, ^{137}Ba and ^{138}Ba, while NWA 11346 showed depletions in ^{135}Ba, ^{137}Ba and ^{138}Ba. Mild acid leachates of Aguas Zarcas yielded positive anomalies in ^{130}Ba, ^{132}Ba, ^{135}Ba, ^{137}Ba and ^{138}Ba, while the NWA 11346 leachates were mostly indistinguishable from the standard. In contrast, final leachates of both samples showed strong depletions for the same five nuclides, although the absolute values for Aguas Zarcas were more extreme.

The Sr and Ba isotopic variabilities between the two samples and their respective leachates suggests the presence of inputs from multiple nucleosynthetic sources, highlighting further the diversity among CM chondrites and the heterogenous distribution of materials with contrasting nucleosynthetic anomalies within the protoplanetary disk. Moreover, the more variable and extreme isotopic deviations found in Aguas Zarcas versus NWA 11346 demonstrates the impact of terrestrial contamination on the easily-disturbed signatures of nucleosynthetic isotopic anomalies in primitive meteorites.