Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.36461

The Hunt for Presolar Graphite Grains in Polished Sections of the Orgueil and Murchison Meteorites with SEM

GAVIN FOWLER[1,2], ANDREW M. DAVIS[1,2,3], PHILIPP R. HECK[1,2], LIV MUMMA[2,4], ANDREW REGULA[1] AND THOMAS STEPHAN[1,2]

[1]Department of the Geophysical Sciences, University of Chicago
[2]Robert A. Pritzker Center for Meteoritics and Polar Studies, Negaunee Integrative Research Center, Field Museum of Natural History
[3]Enrico Fermi Institute, The University of Chicago
[4]Department of Chemistry, University of Chicago

Presolar graphite grains provide the unique opportunity to probe AGB star and supernova nucleosynthesis through their isotopic signatures. Neon measurements showed that the CI chondrite Orgueil contains ~10 ppm [1] (this corresponds to ~3 (>1 μm) presolar graphite grains per 1 mm^2), compared to only ~1 ppm in the CM chondrite Murchison [2]. Chemical separations of Murchison and Orgueil led to the extraction of hundreds of presolar graphite grains, which were analyzed for their nucleosynthetic signatures [2, 3]. However, chemical separation of presolar grains (burning down the haystack) is very time-consuming, results in the destruction of >99.9% of the bulk meteorite, and destroys the petrographic context. Developing nondestructive methods for presolar grain identification is an essential step towards gaining access to less abundant meteorite groups, such as CI chondrites. Using SEM and EDS, we have identified hundreds of carbon-rich objects and closely imaged over 100 in polished sections of the Orgueil and Murchison meteorites. After closer imaging, many of the identified objects appear to be epoxy-filled holes or organic matter. Some objects show textural features. The abundance of these objects is significantly higher in Orgueil than in Murchison. A handful of these objects appear to be similar to onion-type presolar graphite grains. We plan to analyze the Mo, Zr, Sr, and Ti isotopic signatures of these grains using resonance ionization mass spectrometry [4] to understand their nucleosynthetic signatures. Measuring these isotope systems in presolar graphite grains from CM and CI meteorites may provide information concerning the Solar System reservoirs from which the meteorites accreted [5].

[1] Huss and Lewis (1995) *Geochim. Cosmochim. Acta* 59, 115–160. [2] Amari et al. (2014) *Geochim. Cosmochim. Acta* 133, 479–522. [3] Jadhav et al. (2013) *Geochim. Cosmochim. Acta* 113, 192–224. [4] Stephan et al. (2016) *Int. J. Mass Spectrom*. 407, 1–15. [5] Hopp et al. (2022) *Sci. Adv.* 8, eadd8141.