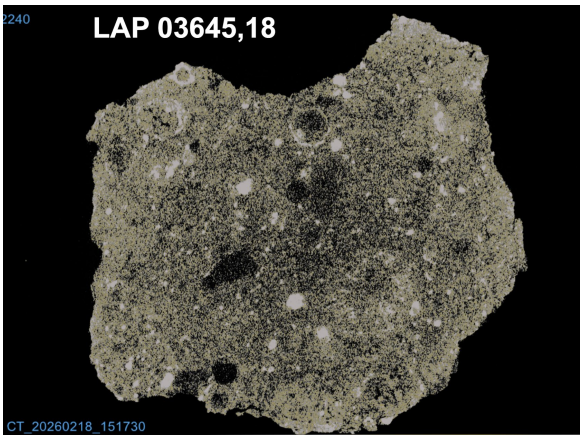
Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37748

S Isotope Constraints on Inner Solar System Nebular Chemistry: Insights from R Chondrite Sulfides

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The analysis of primitive meteorite materials can expand our understanding of solar system evolution. Meteorites are divided into classes based on their mineralogy, chemical abundances, and isotopic compositions. R (Rumuruti) chondrites are a group of meteorites that are distinguished by their high-oxidation state and mineralogy that links their origin to an oxygen-rich reservoir in the early solar nebula [1]. R-chondrites have very small amounts of metallic iron but are rich in Fe-Ni sulfides. Due to their alteration history and abundant sulfur (S) content, R-Chondrites are suspected to have sampled inner solar-system processed materials and offer a unique opportunity to use their S-isotope composition to evaluate solar nebula chemistry in its unusual environment of formation.

We will present data on the mineralogy, 3D structure, and in-situ triple S-isotope composition of six R-chondrites (PRE 95404, LAP 03645, LAP 03639, MIL 07440, LAP 04840, and PCA 91241). Preliminary petrographic analysis from CT scans and reflected light analysis reveal large (~300μm), roughly angular sulfides and rings of sulfide (~20μm) that enclose chondrules and percolate through nearby cracks (Figures 1 and 2). Therefore, there are at least two populations of S within the R-chondrites that will be targeted for S-isotope compositions. Using the triple S-isotope composition, we will constrain whether there are remnants of UV-photolysis preserved in the meteorites and whether the S chemical and isotopic compositions preserve signatures supporting existing evidence for a prominent oxidative history [2].

Figure 1: CT scan of LAP 03645. Brighter white and yellow areas indicate denser regions, while dark spots mark vesicles and cracks within the chondrite's structure.

Figure 2: Reflected light image of PRE 95404. The bright spots reveal two populations of sulfides: large, round, individual sulfides and smaller sulfides percolating around darker chondrules.

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