SULFUR ISOTOPIC ANOMALY IN A RYUGU SULFATE

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Carbonaceous chondrites (CCs) provide evidence for timing of water activity after planetesimal formation, episodic aqueous events, evolution of volatiles, and formation of secondary phases. Ryugu belonging to the CI class of CCs is a least terrestrially contaminated samples from an outer solar system asteroid. Prior to our study, Yoshimura et al. (2023) found that the salt extracts contain soluble sulfur-bearing species such as polythionic acids, alkylsulfonates, hydroxyalkylsulfonates as well as thiosulfate. Our team identified a lone sulfate grain in asteroid Ryugu particle A0070 using µXANES (Figure A) and performed sulfur isotopic analysis of the calcium sulfate grain with the NanoSIMS (Figure B). The anomalous sulfur signature is derived from irradiation of the solar system's parent molecular cloud by nearby massive stars (e.g., Vacher et al. 2021). Based on these data, we confirm that Ryugu formed much farther from the Sun, near where comets formed, and where the sun's UV light was too weak for photochemistry. I will present the published results (Bose et al. 2024) and discuss the consequences of aqueous alteration in Ryugu and the degree of lateral mixing in small bodies.

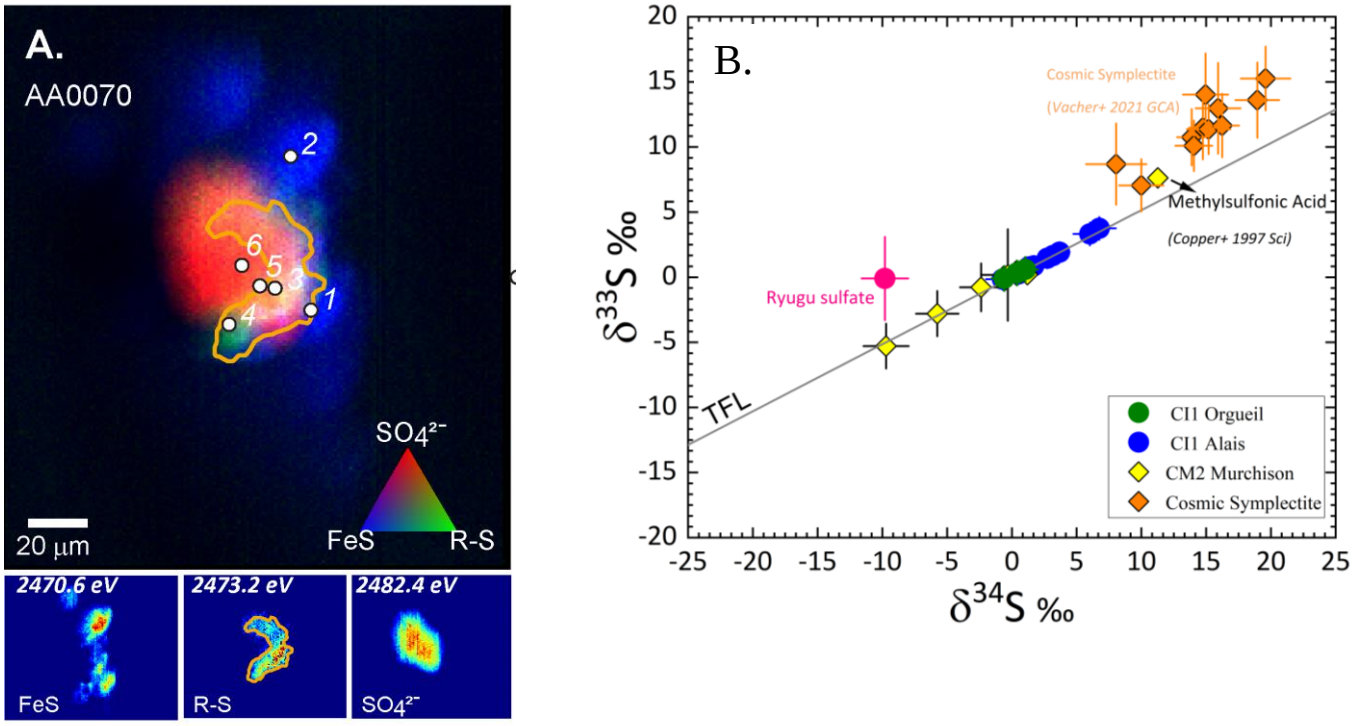

Figure (A) The thiol (in green) forms a partial rim, about 10 µm wide around a calcium sulfate grain (in red). The rim is surrounded by smaller monosulfide grains (in blue). **(B)** Three-sulfur isotope plot showing the sulfur isotopic composition of sulfides in several CC meteorites, cosmic symplecties (1), methylsulfonic acid (2), and the thiol-and sulfate-bearing composite grain identified in Ryugu particles A0070 with a $\Delta^{33}S = 5 \pm 2‰$ (1σ).

References

[1] T. Yoshimura et al. 2023. Nature Communications 14: 5284. [2] G. Vacher et al. 2021. Geochimica et Cosmochimica Acta 309: 135. [3] G. W. Cooper et al. 1997. Science 277: 1072. [4] Bose et al. 2024. Science Advances 10, eadp3037.