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# Rocks & Redox: Isotopic and Geochemical Insights into Life at the Edge - *Shen-Su Sun Award Lecture*

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Searching for extraterrestrial life requires a thorough understanding of how life survives or thrives in astrobiological analogue environments, and of how to detect biosignatures in such settings. Both questions are intimately linked to rocks and redox chemistry: rocks provide not only the environmental habitat and chemical resources that sustain microbial life but also a record of past biological activity, while redox reactions driven both by abiotic rock-associated processes and by microbial metabolism are essential for energy flow and life's persistence. In this presentation, I will show how multiple oxygen and sulfur isotope measurements of gypsum samples from the Qaidam Basin, a Mars-analogue environment, reveal variability in sulfur biogeochemical redox cycling under extreme conditions limited in water and nutrient availability. I will further discuss how sulfur metabolism may occur in the dark subsurface, based on recent experimental findings demonstrating that crustal faulting can generate diverse redox pairs and drive biological redox cycling.