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Application of the $\delta^{44/40}Ca$ – $\delta^{88/86}Sr$ multi-proxy to the Shuram Carbon Isotope Excursion

NILOUFAR LILLY SARVIAN[1], ANDREW D JACOBSON[1], MATTHEW HURTGEN[1], MAGDALENA OSBURN[1] AND KRISTIN BERGMANN[2]

[1]Northwestern University

[2]Massachusetts Institute of Technology

Presenting Author: nilou@earth.northwestern.edu

The Ediacaran-aged Shuram Excursion is the largest negative carbon isotope ($\delta^{13}C$) excursion in Earth's history. The origin of this excursion, however, remains enigmatic. Although negative shifts occur globally, some studies have posited a diagenetic origin, while others suggest a primary change in marine DIC reflecting major carbon cycle disruption. Here, we apply a new approach, the "$\delta^{44/40}Ca$ - $\delta^{88/86}Sr$ multi-proxy" to this problem, as it offers powerful resolution for differentiating between hypotheses.

Marine carbonate stable calcium and strontium isotope ratios ($\delta^{44/40}Ca$ and $\delta^{88/86}Sr$) are each sensitive to mass-dependent fractionation and reservoir mixing. Multiple explanations often arise when marine $\delta^{44/40}Ca$ and $\delta^{88/86}Sr$ values are interpreted separately, but applied together, the $\delta^{44/40}Ca$ - $\delta^{88/86}Sr$ multi-proxy can differentiate signals from mass-dependent fractionation versus those from various forms of end-member mixing, including seawater isotopic change and diagenetic overprinting. Analysis of $\delta^{88/86}Sr$ includes measurement of traditional radiogenic Sr isotope ratios ($^{87}Sr/^{86}Sr$), which provide additional constraints on mixing.

Using high-precision TIMS techniques, we apply this proxy to the Shuram Excursion recorded in carbonate rocks composing the Huqf Supergroup of Oman, which was deposited approx. 547 – 578 Ma[5]. We will present results from 20 carbonate rocks that span the Khufai, Shuram, and Buah formations. With our interpretive framework, we aim to understand the origin of $\delta^{44/40}Ca$ and $\delta^{88/86}Sr$ signals in Huqf Supergroup carbonates, and, by extension, test hypotheses surrounding the origin of the Shuram Excursion.

[1]Böhm et al. (2012) [2]Shao et al. (2021) [3]Wang et al. (2021) [4]Voigt et al. (2015) [5]Rooney et al. (2020)