Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.6489

Ca and Sr isotope constraints on the origin of the late Cambrian SPICE excursion: Insights from the sedimentary record of the Amadeus Basin, Central Australia

JURAJ FARKAS[1], CHRIS HOLMDEN[2], QUDSIYA AL-BUSAIDI[3], SUSANNE SCHMID[4], CHRISTINE EDGOOSE[5] AND ALAN COLLINS[3]

[1]University of Adelaide - Metal Isotope Group (MIG)
[2]University of Saskatchewan
[3]University of Adelaide
[4]CSIRO Mineral Resources
[5]NTGS - Northern Territory Geological Survey

Presenting Author: juraj.farkas@adelaide.edu.au

The late Cambrian Steptoean Positive Carbon Isotope Excursion (SPICE), which reaches a typical magnitude of +4 to +5 ‰, has been documented globally in marine carbonate records from North America, Australia, China and Russia (Saltzman et al., 2000). A number of models and hypotheses have been proposed to explain the origin and causes of this global positive C isotope excursion in the late Cambrian oceans, but thus far, no consensus has been reached on the main driving mechanisms, thus requiring further investigation and application of novel marine isotope proxies.

Here we present stable calcium ($\delta^{44/40}$Ca) and radiogenic strontium ($^{87}Sr/^{86}Sr$) isotope records from two correlative drill cores (Alice 1 and Dingo 2) in the Amadeus Basin, central Australia, which both intersect the SPICE excursion (Schmid et al., 2018). The acquired $\delta^{44/40}$Ca, δ^{13}C and $^{87}Sr/^{86}Sr$ data across the SPICE are complemented by major and trace element concentrations (Sr/Ca, Mn/Sr, S/Ca etc) as well as bulk mineralogy data (wt% calcite, dolomite, anhydrite), which thus allows to assess the impact of diagenesis and mineralogy on Ca, C and Sr isotope variations. Importantly, results show that the SPICE excursion recorded in dolomite-rich carbonates is associated with a negative $\delta^{44/40}$Ca excursion of 0.2 to 0.3 ‰, and a parallel increase in $^{87}Sr/^{86}Sr$ to more radiogenic and non-marine values, and these isotope trends are recorded in both drill cores suggesting a basin-wide signal. The latter could be thus linked to either (i) increased continental weathering flux, and/or (ii) diagenetic effects controlled by eustasy. Also, carbonate sections predating the SPICE and recording ROECE excursion show evidence of more evaporitic settings (presence of anhydrite and celestine, Schmid 2017) with parallel increase in Sr and S concentrations, and higher abundance of sulphate minerals ($CaSO_4$ and $SrSO_4$). Such mineralogical control is reflected also in $\delta^{44/40}$Ca data of bulk carbonates, as the latter show a strong correlation with the abundance of anhydrite (wt% of $CaSO_4$), but interestingly $^{87}Sr/^{86}Sr$ of these carbonates show values that overlap with expected Sr isotope composition of late Cambrian seawater (0.7090 to 0.7092), thus suggesting a possible ‘evaporitic seaway’ depositional setting for the Amadeus Basin during this time.