Stable strontium isotope ($\delta^{88/86}$Sr) record of pre-Sturtian carbonate rocks spanning a large δ^{13}C anomaly

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The carbon isotope record of marine carbonates (δ^{13}C) tracks Neoproterozoic glacial events in the form of large negative anomalies (~-8‰) that interrupt sustained intervals of relatively high values. The mechanisms responsible for the δ^{13}C variations during this time remain enigmatic. To evaluate the relationship between Neoproterozoic carbon isotopes and global-scale glaciation, we used a high-precision TIMS method[1] to measure the radiogenic (^{87}Sr/^{86}Sr) and stable ($\delta^{88/86}$Sr) strontium isotope composition of marine carbonate rocks in the Copper Cap Formation (Mackenzie Mountains, Canada), which were deposited before the Sturtian snowball Earth event.

The combination of ^{87}Sr/^{86}Sr and $\delta^{88/86}$Sr measurements holds promise for better resolving the balance between global weathering and carbonate burial rates, and their relationship to the massive environmental changes that occurred during this time. The ^{87}Sr/^{86}Sr ratio of seawater represents a balance between radiogenic inputs from continental weathering and non-radiogenic inputs derived from hydrothermal alteration of the oceanic crust[2]. While ^{87}Sr/^{86}Sr ratios can constrain Sr input fluxes, they cannot asses the Sr output flux, which primarily occurs via marine carbonate burial. Recent work has shown that modern marine carbonates (both biotic and abiotic) preferentially incorporate lighter Sr isotopes relative to seawater[3]. Therefore, unlike ^{87}Sr/^{86}Sr ratios, the $\delta^{88/86}$Sr value of seawater is sensitive to global carbonate burial rates. In this context, we measured the first $\delta^{88/86}$Sr record for the time period prior to the Sturtian snowball Earth event.

Preliminary data show that ^{87}Sr/^{86}Sr ratios (0.706-0.714) weakly correlate to δ^{13}C values, and inversely with $\delta^{88/86}$Sr values (0.30‰-0.51‰). The interpretation of these results will consider both primary and secondary drivers of isotopic variation in the rock record in the context of the ~25 myr lead up to the first snowball Earth[4].

[1]Andrews et al. (2016) [2]Palmer and Edmond (1992) [3]Pearce et al. (2015) [4]Rooney et al. (2014)