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Why Small is Important: Nanogram Scale Determination of Non-traditional Stable Isotope Ratio

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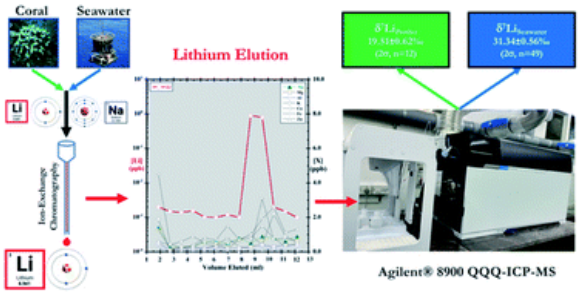

Advancement in our analytical ability to probe the marine carbonate archive at a progressively smaller scale allows us to investigate hitherto unresolvable changes in seawater chemistry. The chemical composition of marine biogenic carbonates is widely utilized for high fidelity paleoclimate reconstruction. Major climatic events are usually characterized by drastic drop in the abundance of marine calcifers due to significant fluctuations in seawater temperature and/or pH. Thus, high resolution reconstruction of past climate change, especially during the high magnitude events of the past, is limited by sample availability. For example, the Paleocene Eocene Thermal Maxima, the warmest period in earth's history in the last ~80 million years, is characterized by extremely poor abundance of calcifers in marine sediments. Limiting our ability to probe the timing of the event, the major causative forces, and the mechanism & timescale of recovery.

Development of accurate and precise isotope ratio determination techniques with low mass requirement holds the key to multi-proxy investigation of rapid, high amplitude climatic events. Non-traditional stable isotope systems like lithium, boron, magnesium, and potassium, can be utilized perturbations in the global carbon cycle. However, the abundance of these metals in the marine biogenic calcifers is low, ranging from few µmol/mol to tens of mmol/mol. Thus, any improvement in their determination technique(s), especially a reduction in the mass requirement without compromising precision or accuracy, allows for better paleoclimate reconstruction. I will focus on recent advances in the isotopic determination of lithium, boron, and potassium to elaborate on how a combination of improvements in ion chromatography and mass spectrometry has rendered minuscule masses of archive available to high fidelity geochemical probing.

