Experimental Study of Trace Element Coprecipitation in Marine Carbonate Minerals: reexamining current proxies and identifying new potential ones

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Carbonate minerals are ubiquitous in the ocean system. When they form, biotically or abiotically, they coprecipitate a variety of trace elements and their isotopes (TEIs) from seawater into their crystal structures. The quantities of TEIs in carbonate minerals are usually influenced in various degrees by a number of oceanographic variables (e.g., T, pH, TEI concentrations, S, mineral precipitation rate, Pco2, etc.). Consequently, information of various paleoceanographic variables may have been recorded in carbonate minerals by TEIs. For example, the fact that Mg coprecititation in calcite is strongly influenced by temperature makes Mg in marine calcite a proxy of paleo seawater temperature. It is also because of the fact that TEIs in carbonate minerals are usually influenced by more than one variable, however, that the effects of each and every variable on a certain TEI need to be separated before this TEI can be applied unambiguously as proxy of a particular paleoceanographic variable. Therefore, the effects of each and every variable on the coprecipitation of a certain TEI proxy have to be quantitatively defined and the usually complex “multi-factor” relationships may then be untangled using a multi-proxy approach. Well-controlled lab experimentation is currently the most viable way of identifying important variables and quantifying their effects on a particular TEI proxy. Data obtained in the lab may also lead to the discovery of new potential TEI proxies for the multi-proxy approach and for paleo variables that are presently difficult to reconstruct. In this presentation, we report our recent experimental work on the coprecipitation of a number of TEIs in calcite and aragonite (e.g., Mg, Sr, Cd, Cu, Co, Pb, REEs, U, Zn, etc.) under controlled conditions. Results of the partition coefficients of these TEIs and the effects of temperature, pH, carbonate ion concentration, mineral precipitation rate, TEI concentrations, and Pco2 on their partitioning are used to reexamine some of the current TEI proxies and to identify new ones.