Strontium isotope fractionation in scleractinian corals

N. FRUCHTER*, 1, F. BOHM1, A. EISENHAUER1, M. DIETZEL2, A. KRABBENHÖFT1, A. NIEDERMAYR2, S. REYNAUD3, B. LAZAR4 AND M. STEIN5

1Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany. (*nfruchter@ifm-geomar.de)
2Institute of Applied Geosciences, Graz University of Technology, Graz, Austria.
3Centre Scientifique de Monaco, Principality of Monaco.
4Institute of Earth Sciences The Hebrew University of Jerusalem, Israel.
5Geological Survey of Israel, Jerusalem, Israel.

Preferentially lighter strontium isotopes ($\delta^{88/86}$Sr$_{seawater}$) ~0.15 to 0.25 ‰) are taken up from seawater ($\delta^{88/86}$Sr$_{coral}$, ~0.39 ‰) by marine calcifiers during calcium carbonate precipitation. A temperature sensitivity of Sr isotope fractionation has been reported [1,2,3]. However the published results are discrepant and enigmatic.

In order to shed light into the temperature dependency of strontium isotope fractionation, we conducted inorganic precipitation experiments of aragonite, and investigated the applicability of $\delta^{88/86}$Sr as a temperature proxy. Strontium isotope fractionation mechanisms for biocalcification of corals and for the enhancement of strontium isotope fractionation were translated in modeling hypothesis which are part of a model called GRAAL [1,2].

GRAAL model is implemented within a geochemistry and transport code called HYTEC [3]. Therefore, it can account for the complexity of the amorphous layer whatever the time and position in space of a glass under alteration. Chemical description within GRAAL has been recently improved thanks to 24 experiments relative to six simple glasses containing Si, B, Na, Ca, Al and Zr, altered for months at four different neutral to alkaline pH [4]. Ten new modeling hypothesis were done for describing these six elements chemical interactions in the amorphous layer. One example: orthosilicic acid activity in solution is significantly lower than amorphous silica solubility only if enough aluminum is also available. Therefore a silica-aluminum rich end-member is taken into account to model the amorphous layer whereas Ca, Na, B and even Zr interactions with Si can be neglected to account for Si activity in solutions (in our experimental conditions at least).

We aim here at sharing both the success and limits of GRAAL model fundamental hypothesis and we will try to demonstrate the usefulness of the approach.


Modeling glass alteration layers

P. FRUGIER*, S. GIN, N. RAJMOHAN AND M DEBURE

CEA Marcoule, DTCD/SECM/LCLT, BP 17171, 30207 Bagnols-sur-Cèze Cedex, France.
(*correspondence: pierre.frugier@cea.fr, stephane.gin@cea.fr, nrmohan_2000@yahoo.com, mathieu.debure@cea.fr)

Glasses major constituents interact chemically within the amorphous layers resulting from glass alteration in water. These interactions determine the composition, the dissolution kinetic and the apparent solubility of the amorphous layers as well as their potential passivating properties with respect to the underlying glass. The knowledge of these interactions is required to predict concentrations in solution, pH and eventually glass alteration rates. However, these amorphous layers are complex solids resulting both from initial glass structure and recondensation processes, constantly reorganizing as solution composition changes. Identifying the main phenomenologies is required for modeling the amorphous layers with a number of parameters consistent with experimental accessible data and geochemical modeling tools. These phenomenologies were translated in modeling hypothesis which are part of a model called GRAAL [1,2].