

Modeling Sr partitioning in foraminiferal calcite

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An in-depth understanding of strontium (Sr) partitioning in foraminiferal calcite is important for correctly reconstructing environmental conditions from which the foraminiferal calcite precipitates. Following an existing model framework for coral calcification [1], we developed a steady state model which can predict the composition in the calcifying fluid of foraminifera based on given seawater composition. This model accounts for three processes during foraminiferal calcification: transmembrane transport, active proton pumping and calcite precipitation, and is coupled with an ion-by-ion model [2, 3] of calcite precipitation that predicts Sr partitioning in inorganic calcite as a function of solution chemistry, temperature and pressure. The partitioning coefficient in foraminiferal calcite (K_{Sr}) measured at varying seawater depths in four oceans [4] were fit successfully with one set of parameters. Our results suggest that the partitioning of Sr in foraminiferal calcite is consistent with that in inorganic calcite, accounting for an elevation of pH in the calcifying fluid by proton pumping. The DIC, $[Ca^{2+}]$, and $[Sr^{2+}]$ in the calcifying fluid are not significantly different from those in seawater, but the pH of the calcifying fluid is elevated by more than one unit, in order to match the measured K_{Sr} data [4]. Our model shows that it is possible to use foraminiferal Sr as a proxy for seawater chemistry, but modification of the seawater pH and alkalinity needs to be accounted for.

[1] Chen, Gagnon & Adkins (2018), *Geochim. Cosmochim. Acta* 236, 179-197.

[2] Wolthers, Nehrke, Gustafsson & Van Cappellen (2011), *Geochim. Cosmochim. Acta* 77, 121-134.

[3] Nielsen, De Yoreo & DePaolo (2013), *Geochim. Cosmochim. Acta* 115, 100-114.

[4] Yu, Elderfield, Jin, Tomascak & Rohling (2014), *Quaternary Science Reviews* 98, 1-6.