



Microanalysis by Ion Microprobe of Oxygen Isotopic Compositions in Foraminifera

C. Rollion-Bard

CRPG-CNRS, Nancy, France (rollion@crpg.cnrs-nancy.fr / Fax : 33-3-83-51-17-98)

Foraminifera are widely used in paleoceanographic reconstructions. Their oxygen isotopic composition reflects the oxygen isotopic composition of seawater (so variation in temperature and/or ice volume). But, their mineralization is controlled by biological processes and would not simply obey to thermodynamical laws involved in inorganic precipitation of carbonate. Indeed, the carbonate deposited by some foraminifera and scleractinian corals is depleted in $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ relative to isotopic equilibrium with ambient seawater. This deviation of the biogenic carbonate - water fractionation from the inorganic fractionation is called the "vital" effect (Urey et al., 1951). This "vital effect" complicates the interpretation of proxies. For example, the so-called "Carbonate Ion Effect" (CIE) by Spero et al. (1997) demonstrates the limitations inherent to empirical proxy relationships. Thus it is important to better constrain the paleoenvironmental proxies by a better comprehension of the biomineralization of the organisms. Indeed, the measurements at micrometer scale of oxygen, carbon and boron isotopic compositions in scleractinian corals *Porites lutea* have shown a great variability which seems to be linked to kinetic effects and pH variation of the calcifying fluid (Rollion-Bard et al., 2003).

This study reports the same kind of demarche. Preliminary results of oxygen isotopic composition in 8 foraminifera (*Globigerines*) show an intratest variability of about 0.6 ‰. This value represents a 1σ error given by 4 to 10 measurements performed for each foraminifera. This range could represent the variability of $\delta^{18}\text{O}$ in seawater vacuoles isolated by the forams during their growth. Indeed, Grinstein et al. (2004) have shown that the seawater composition within these vacuoles can evolve in order to increase the pH (up to 9). On the other hand, the average value obtained for each single foraminifera is very reproducible and the mean value for 8 foraminifera is -1.3‰ ($\pm 0.22\text{‰}$ (2σ)). Boron isotopic measurements will be measured in the same spots

by ion microprobe in order to check the pH values found by direct microelectrodes measurements at the calcification sites. It should be possible to test the Grinstein et al., (2004) assumption that "the pH dynamics in intact organisms may be different (probably with higher amplitude" than 1 log unit). $\delta^{13}\text{C}$ will also be measured in order to constrain its intratest variability.

References:

Grinstein, M., Bentov, S., Koller-Rink, S., De Beer, D., and Erez, J., 2004, Direct microelectrodes measurements at the calcification site of foraminifera. Proceedings of AGU Fall Meeting, San Francisco.

Rollion-Bard, C., Chaussidon, M., and France-Lanord, C., 2003. pH control of oxygen isotopic composition of symbiotic corals. *Earth And Planetary Science Letters*, 215[1-2], 275-288.

Spero, H.J., Bijma, J., Lea, D.W. and Bemis, B.E., 1997. Effect of seawater carbonate concentration of foraminiferal carbon and oxygen isotopes. *Nature*, 390, 497-500.

Urey, H.C., Lowenstam, H.A., Epstein, S., and McKinney, C.R., 1951, Measurements of paleotemperatures and temperatures of the Upper Cretaceous of England, Denmark, and the southeastern United States. *Bulletin of Geologic Society of America*, 62, 399-416.