EFFECT OF CALCIUM CARBONATE SATURATION STATE ON Mg INCORPORATION IN FORAMINIFERAL CALCITE

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Incorporation of Mg in foraminiferal calcite has become one of the most commonly used proxies for the reconstruction of seawater temperatures and in combination with foraminiferal $\delta^{18}O$ it can potentially be used as a proxy for paleosalinity. The relation between Mg-partitioning and temperature in planktonic foraminifera has been analyzed in earlier studies using both field data and culturing experiments. Although temperature showed to be the most important parameter controlling the incorporation of Mg, variations in seawater CO_3^{2-} concentration and salinity also play an important role. These two parameters have a significant effect on the carbonate saturation state of the seawater (Ω). To quantify the effect of salinity on foraminiferal Mg incorporation independently from the seawater CO_3^{2-} concentration and vice versa, planktonic foraminifera *Globigerinoides sacculifer* were grown in the laboratory where calcification took place under three salinity values (30, 36 and 39 psu), controlled carbonate chemistry conditions, a constant temperature of 26°C and light intensity. Target Ω values were obtained by modifying the CO_3^{2-} concentration in the seawater. Results correspond to F-1 chambers.

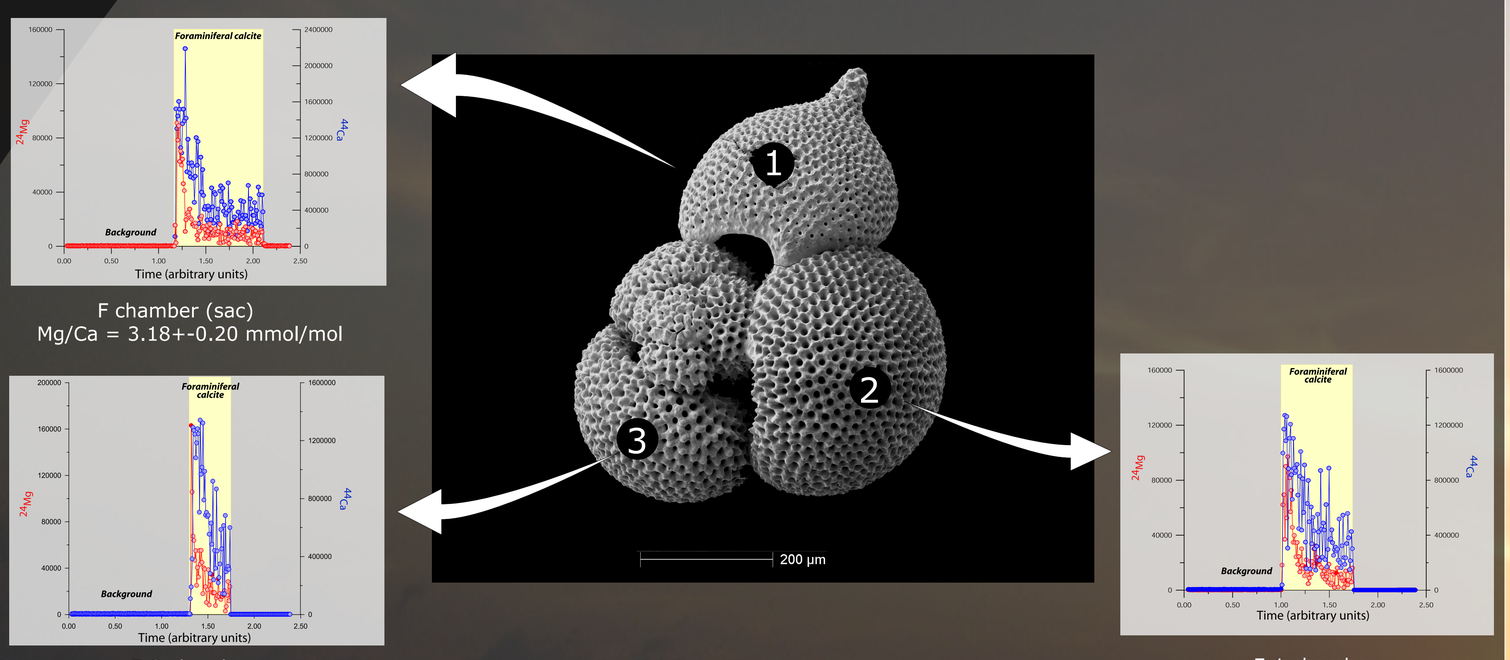

Figure 1. Planktonic foraminifer *Globigerinoides sacculifer* and three examples of laser ablation profiles. Specimens were collected off the Southwest coast of Puerto Rico (single chambers were analysed using Laser Ablation-ICP-MS;No. 1= F chamber (sac), No. 2= F-1 chamber, No. 3= F-2 chamber).

Mg/Ca values from F chambers (sac) were significantly lower than Mg/Ca from older chambers (F-1, F-2) (significance level of 5%, p=0.001) (Figure 2). These results show that the internal primary calcite and the external gametogenic calcite of *G. sacculifer* are both depleted in Mg, data which is not in agreement with previous studies on the same species of planktonic foraminifera (Nürnberg et at. 1996; Eggins et al. 2003).

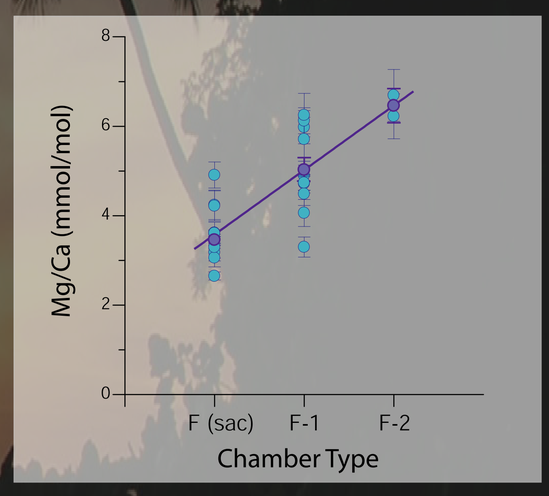

Figure 2. Foraminiferal Mg/Ca ratio of three different types of chambers. Data correspond to chambers that were built in the laboratory at a constant temperature of 26°C and salinity values ranging from 30 to 39 psu.

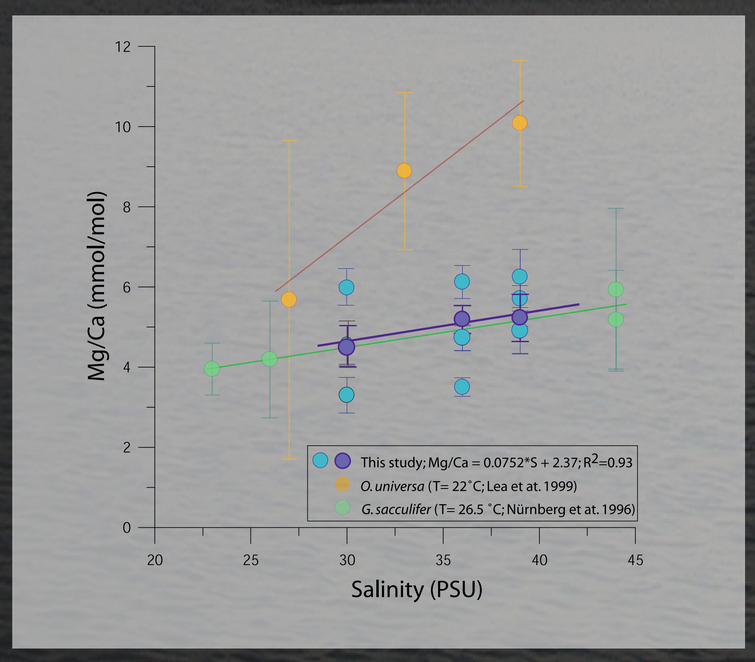

Figure 3. Foraminiferal Mg/Ca ratio at three different salinity values (Ωs were not modified).

Planktonic foraminiferal Mg/Ca showed an increase with salinity, results which are in line with previous studies (Figure 3). It is also clear that the variability between individuals is large. Still, shown averages have a significant relation with salinity. The relation between salinity and Mg/Ca values can be explained by either a direct effect, or by the associated change in the carbonate saturation state. Seawater Ω is related to the salinity through both Ca^{2+} and CO_3^{2-} concentration. Experiments were set up to deconvolve these two parameters (seawater Ω and salinity).

No clear relationship was found between foraminiferal Mg/Ca and CO_3^{2-} values (different seawater Ω values) used in these culture experiments (Figure 4). This is due probably to the fact that CO_3^{2-} (Ω) values chosen for this study were rather close to each other. However, for a salinity of 36 in which we had a wider range of CO_3^{2-} (Ω) values we could observe a weak negative correlation between Mg/Ca ratios and carbonate ion concentrations (Figure 4).

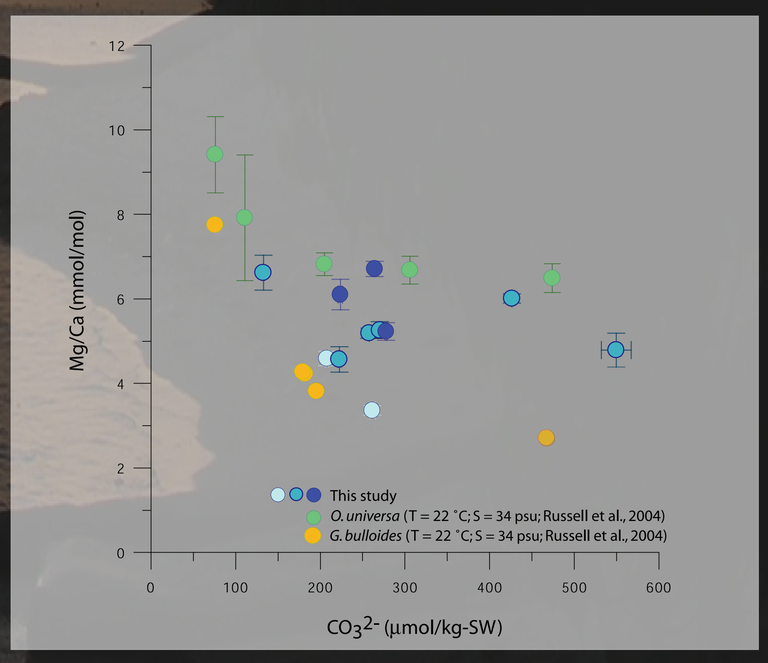

Figure 4.Foraminiferal Mg/Ca ratio at different CO_3^{2-} (Ω) values (constant temperature of 26 °C). Blue circles (light to dark) correspond to salinity values of 30, 36 and 39 respectively.

A similar relationship as the one shown in Figure 3, was found when Ω was kept constant at three different salinity values (Figure 5 A, B and C), showing salinity as the overriding control for these set of experiments.

The effect of $[Ca^{2+}]/[CO_3^{2-}]$ ratios will be tested in future culture experiments in order to deconvolve the effect of Ω on foraminiferal Mg/Ca independent from the rest of the carbonate parameters.

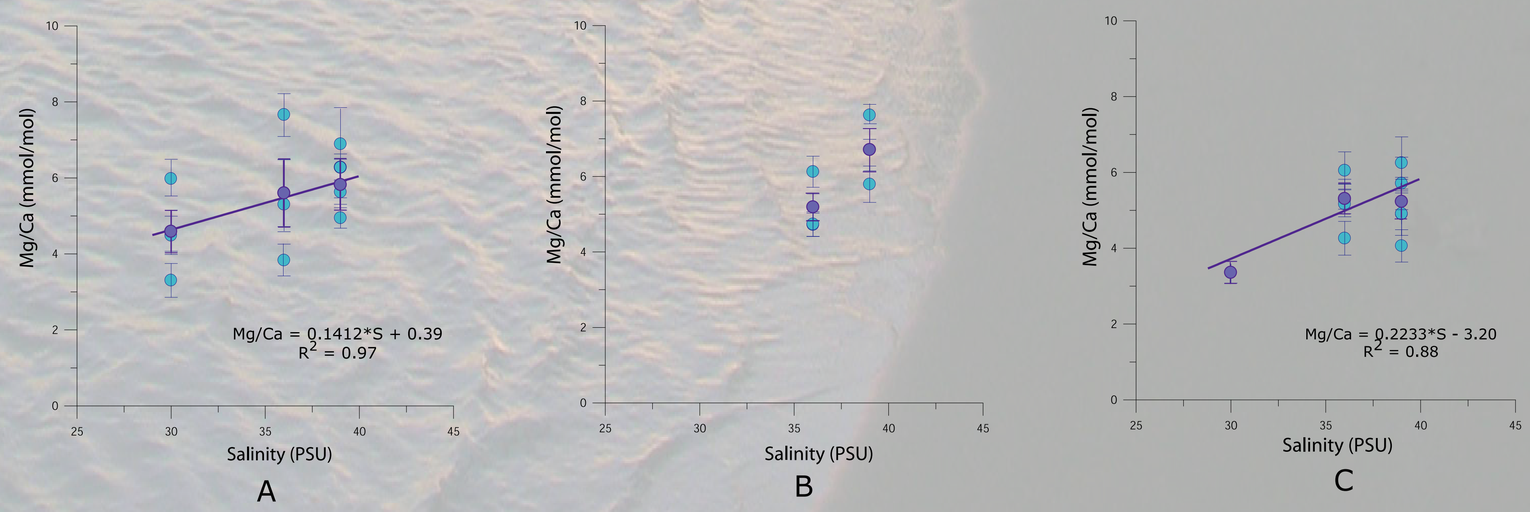

Figure 5. Foraminiferal Mg/Ca ratio at three different salinity values and constant **Ω**.
A. **Ω** = 5.25; B. **Ω** = 6.16; C. **Ω** = 6.50.