

## **Enhanced ENSO variability during the Little Ice Age based on Mg/Ca in individual planktonic foraminifera**

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Traditional paleoceanographic measurements of planktonic foraminiferal shell chemistry combine multiple specimens to obtain a robust mean that typically averages over decades to centuries, depending on sedimentation rates. Yet because each individual foraminifer lives only a few weeks, measurements on individuals can provide temporal resolution similar to that of macroscopic archives like corals, but without equivalent stratigraphic context. Certain important paleoclimate questions can hypothetically be addressed using the individual-foram approach, including changes in seasonality and interannual variability.

We have developed a method to analyze individual-foram Mg/Ca following the traditional 'wet chemistry' protocol of crushing, oxidative cleaning, dissolution, and analysis by sector-field ICP-MS. This method is relatively fast and provides a more direct comparison to the many multi-specimen Mg/Ca studies that have been undertaken over the past 15 years. Measurements on liquid standards indicate that analytical precision is better than 1% down to sub-microgram post-cleaning sample sizes. Multi-spot laser ablation measurements made on the same individual specimens are in good agreement.

We demonstrate the utility of this method using an unbioturbated box core from Soledad Basin, located off Baja California Sur in the eastern subtropical Pacific, a site that is strongly teleconnected to ENSO today. We present Mg/Ca measured on individual specimens of *Globigerina bulloides* (upwelling season) over the past 250 years, with ~5-year resolution. For the 20th century population we use a Monte Carlo approach to simulate what water depths, months, and temperature fidelity these individuals are actually recording. Mg/Ca average values indicate that this site was warmer during the late Little Ice Age, consistent with an 'El Niño-like' mean state at that time. Quantile-quantile analysis of populations supports the idea that this warm state was accompanied by enhanced ENSO variance.