Planktonic foraminiferal Mg/Ca paleothermometry and its application for reconstructing sea surface temperatures

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Mg/Ca measurements on mixed-layer planktonic foraminifera offer the ability to independently estimate past changes in sea surface temperatures (SST). Paired with isotopic measurements the method allows for reconstructing seawater $\delta^{18}O$ and by inference sea surface salinity as well as assessing the temporal relationship between SST changes and the growth and decay of continental ice-sheets. The accuracy of this method is confounded, however, by the need to correct Mg/Ca records for alteration by post-depositional dissolution. We have examined the possibility of using changes in the size-normalized weight of planktonic foraminiferal tests for correcting Mg/Ca-based SST reconstructions for varying degrees of shell preservation/dissolution. The method is based on the observation of a strong linear correlation between changes in shell weight, bulk shell Mg/Ca and the degree of calcite saturation of the bottom water. The concomitant decrease in shell weight and Mg/Ca reflects the preferential removal of Mg-rich foraminiferal shell calcite during post-depositional dissolution. Based on this observation we suggest that extrapolating the observed trends back to the initial size-normalized shell weight, which is the weight the shell presumably had when it sank to the seafloor, may provide the means for correcting SST reconstructions for alteration by dissolution. New observations suggest, however, that the initial shell's weight/size ratio may vary, possibly as a function of the CO_3 ion content of the surface water. In this talk we will discuss the implications of these effects on the accuracy Mg/Ca paleothermometry. Reconstructions of LGM SST in the equatorial Pacific from cores in different preservational environments suggest that the inaccuracy associated with these effects is typically less than 1°C. The uncertainty may be, however, greater when applied to older time intervals.

The amplitude and phasing of climate change during the last deglaciation in the Sulu Sea, western equatorial Pacific

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Records of climate change from different tropical regions produced apparently contrasting results. Particularly controversial are records from the equatorial Pacific. We present a high-resolution $\delta^{18}O$ and Mg/Ca records in the planktonic foraminifera *G. ruber* from the Sulu Sea, suggesting that SST in this site was 3.4±0.5°C colder than present during the LGM, similar with inferred cooling in other equatorial Pacific sites. The most conspicuous features of the record are: (1) the LGM-Holocene $\Delta\delta^{18}O$ amplitude in the Sulu Sea is comparable with the global ice effect (~1‰), similar with that observed in the western equatorial Pacific (WEP) (Lea et al., 2000), but significantly lower than observed in the South China Sea (SCS; ~1.7‰) (Kienast et al., 2001); (2) SST in the Sulu Sea increases gradually throughout the deglaciation and early Holocene showing no discernible evidence for abrupt warming at the Bølling-Alleröid transition or YD cooling. The warming trend in the Sulu Sea appears more similar to the warming pattern observed in Antarctica than Greenland; (3) SST warming in the Sulu Sea leads foraminiferal $\delta^{18}O$ largely because during the early phase of deglaciation (between 20 and 14.8 ky B.P.), Sulu Sea's surface water $\delta^{18}O_{seawater}$ became heavier by ~0.3‰ before starting to decrease to Holocene levels; (4) sub-orbital events seen in the Sulu Sea $\delta^{18}O$ record are coherent and coincide with events observed in the foraminiferal $\delta^{18}O$ records from the SCS, Hulu Cave (Wang et al., 2001) and Greenland $\delta^{18}O$ records.

Comparison between the WEP, Sulu Sea and SCS records supports the idea of different climate controls on the open-ocean equatorial regions vs. marginal seas. Because of its proximity to the continent and restricted circulation, the climate variability in the SCS is dominated by the mean state of the East Asian Monsoon (EAM) and thus tightly coupled with Northern Hemisphere climate. The Sulu Sea and open-ocean WEP show, however, a more complex climate response: its thermal evolution appears to be linked with the Southern Hemisphere whereas its hydrology is strongly influenced by the interactions between ENSO and EAM systems as well as its location between the SCS and the western Pacific warm pool.