Tracking Northward Migration of the ITCZ in the equatorial Atlantic from the LGM through the Early Holocene Using Mg/Ca as a SST Proxy

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Introduction

- The Intertropical Convergence Zone (ITCZ) is an atmospheric band of low pressure that circles the earth near the equator.
- The position of the ITCZ is identified by the patterns of convection and precipitation, which coincide with the ascending limb of the Hadley Circulation Cell.
- The mean current position of the ITCZ is ~20°N of the equator, but migrates with the seasons.
- The ITCZ is the portion of the tropics over the ocean and has low of a latitudinal range than the ITCZ over land masses, thus making it efficient for tracking mean northward migration.

Method

- This study constrained SST estimates using Mg/Ca ratios for G. ruber u.c. (77/103) because of their prevalence in the upper 50 m of the water column, which allows G. ruber u.c. (77/103) to serve as a faithful proxy for near-surface SST (Spence, 1998).
- All samples were cleaned for trace metal analysis using procedures from Marchetti (2002), which involved crush, dry removal with methanol, oxide removal, and Mg/Fe matrix removal.
- SST was derived from Mg/Ca using an equation from Delaney et al. (2002), which was expressed specifically for G. ruber, Atlantic:
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  \text{Mg/Ca} = 0.38 - 0.99(77/103 - 0.6) \text{(core depth)}
  \]

Motivation/Scope

- Movements of the ITCZ affect patterns of wind and rain causing the wet and dry seasons in the tropics and the regulating the strength of monsoonal weather.
- Past studies have documented shifts in the ITCZ using diverse proxies at near shore sediment cores, terrestrial core deposits, lake sediments and dust categories.
- This investigation used 6 sediment cores (Fig. 2) from the northern equatorial Atlantic to track shifts in the marine ITCZ by looking at changes in SST across a meridional range from 25°N to 40°N.

Results

- Data from all 6 sediment cores depict increase in SST (as indicated by elevated Mg/Ca in Figure 4).
- Where available, δ¹⁸O data corroborates an inferred increase in SST as indicated by and increase in Mg/Ca from the Last Glacial Maximum (LGM) (green line) to the Early Holocene (EH) (red line).
- The documented increase in SST after the LGM (as indicated by increased Mg/Ca in Figure 4) is supported by the proxy measurements of salinity and/or aridity/humidity represented in Figure 5.

Conclusions

- Results from this investigation confirm the findings of previous studies (Fig. 3), while strengthening the evidence of ITCZ migrations by adding an additional proxy (Mg/Ca from deep ocean sediment cores) to the corroborative record.
- Migration of the maritime ITCZ, as evidenced by this study, are strongly coupled with high latitude Atlantic climate forcing (e.g., the last glacial maximum).
- Thought the significance of the modern ITCZ is well known, it is difficult to infer the amount of forcing the ITCZ movements have had on global scale climate change through the Holocene into the Last Glacial Maximum and beyond.
- The current understanding of these presented data will be augmented by a full record of δ¹⁸O data to be available at the end of the summer.

References

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