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Faunal analysis of mid-Piacenzian interval of ODP Site 1208 for Pliocene Model Intercomparison Project, Phase 2

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Abstract

In light of mounting empirical evidence that the Earth is warming, the climate research community looks to paleoclimate studies for a ground-truthing measure with which to test the accuracy of future climate simulations. The Pliocene Research, Interpretation and Synoptic Mapping Project (PRISM) produces data sets used for climate model – data comparisons. One component of the new PRISM4 work documents paleoclimate conditions within a narrow stratigraphic window centered on Marine Isotope Stage (MIS) KM5.3. This "time slice" represents two orders of magnitude increase in resolution and was chosen by the Pliocene Model Intercomparison Project (PlioMIP) for its Phase 2 experiments.

Here I report on a preliminary quantitative faunal analysis for a closely-spaced sequence of samples within core 16 of Site 1208, located in the Northwest Pacific Ocean below the modern day Kuroshio Current Extension, approximately 1400 kilometers east of Tokyo, Japan, in 3346 meters of water. The sequence includes four samples from MIS M2 and four from MIS KM5.3. I hope to ascertain whether there is a demonstrable difference in the faunal assemblages associated with these Pliocene climate extremes.

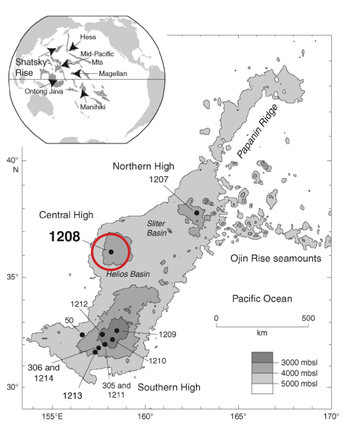


Figure 1. Location of ODP Site 1208.

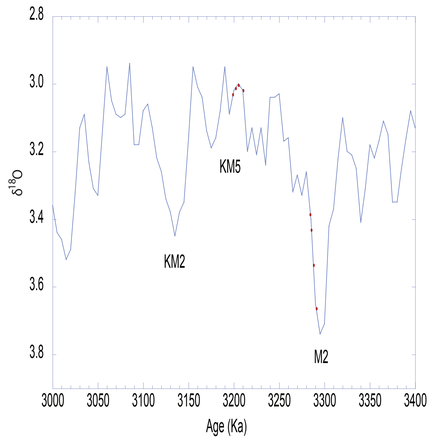


Figure 2. LR04 benthic δ18O stack, 3.4 Ma to 3.0 Ma (Lisiecki & Raymo, 2005).

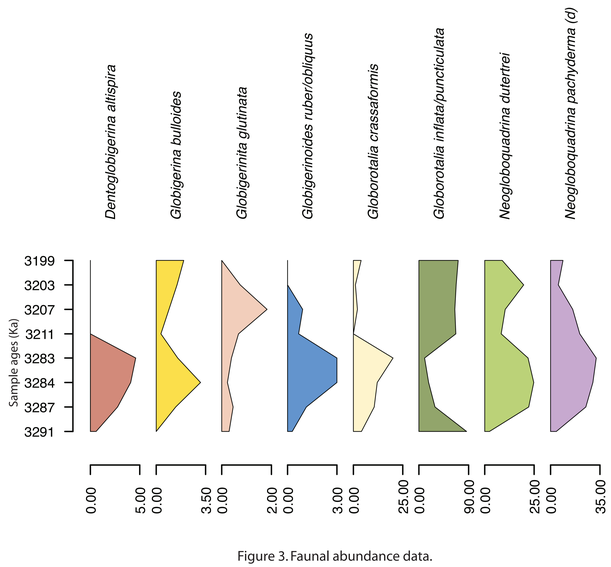


Figure 3. Faunal abundance data.

	Present Day	KM5.3	M2
Mean annual SST	19.6	19.8	18.3
Seasonality	10	5	10

Table 1. SST data.

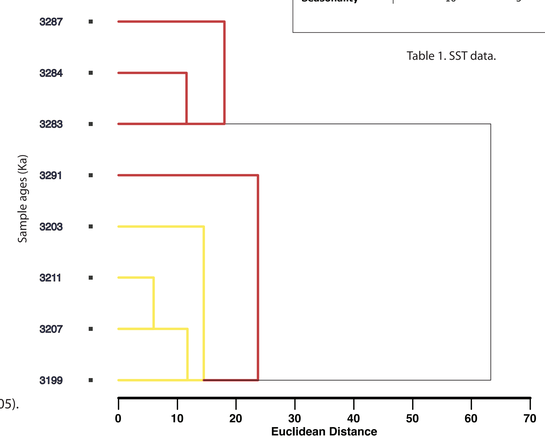


Figure 4. Cluster analysis.

Data and Analysis

I used the oxygen isotope stratigraphy of Venti and Billups (2012) to obtain samples from MIS M2 and MIS KM5.3. The Pliocene planktonic foraminiferal assemblage is dominated by *Globorotalia inflata, Globorotalia crassaformis, Neogloboquadrina dutertrei* and *Neogloboquadrina pachyderma* (dextral). Secondary taxa include *Globigerina bulloides, Globigerinita glutinata, Globigerinoides ruber* and *Dentoglobigerina altispira*.

Figure 3 shows the relative abundance of those taxa that make significant contributions to the assemblages in Core 16. Figure 4 is a hierarchical cluster analysis based upon these taxa and shows the KM5.3 samples form one group while the M2 samples a different cluster, except for the sample at 3291 Ka. This lowest sample is closest to peak M2 but shows qualitative and quantitative similarity to the KM5 samples.

Quantitative analysis of these faunal data using the modern analog technique shows little change in mean annual temperature between KM5.3 and present day (Table 1). However, there is a significant difference in seasonality, suggesting a minor northward displacement of the paleo Kuroshio Current relative to its modern position. A similar phenomenon has been documented in the North Atlantic where the Pliocene Gulf Stream diverted from eastern North America further north than where it does today, near Cape Hatteras.

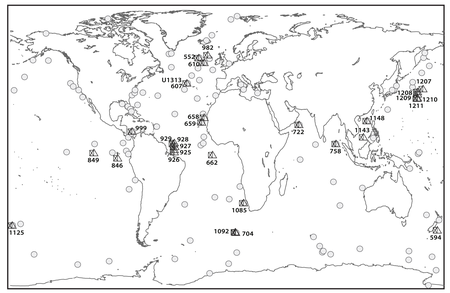
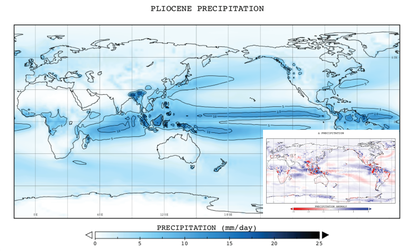


Figure 5. Potential sites for PlioMIP Phase 2

Conclusions

This preliminary test of the nature of the planktonic foraminiferal fauna from two climate extremes within the mid-Piacenzian of ODP Site 1208 shows that there are discernable differences which may yield SST and paleoceanographic information which can be used in the PlioMIP Phase 2 data model comparison. Site 1208 is one of 30 sites that will be used in the PRISM4 multiproxy paleoenvironmental analysis (Figure 5). Those data will be used to compare to an ensemble of climate models like the GISS ModelE2-R Pliocene simulation shown in Figure 6.



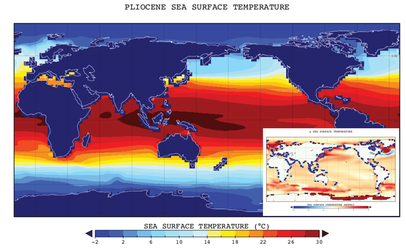


Figure 6. GISS Model E2-R PlioMIP simulation (Chandler et al., 2012).

Acknowledgements

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