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Across the Pacific: Climate Evolution in the Middle Miocene

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We present the first high-resolution (3 kyr) astronomically-tuned record of δ18O and δ13C from planktonic foraminifera for the equatorial Pacific Ocean (16.5–13.5 Myr). Our data provides exciting new information on sea surface temperatures and primary productivity changes at the tropics during the middle Miocene at a resolution not achieved in any previous study, which sheds new light on the middle Miocene climatic transition (MMCT) and associated carbon-isotope excursion.

Reliable sea surface temperature estimates are crucial to any reconstruction and modelling of past ocean salinity and density, water column stratification, thermohaline circulation, and ice volume. Despite extensive studies of benthic foraminifera, existing planktonic foraminiferal records of this interval are extremely scarce and of low resolution, with samples representing time intervals of 2x105and 5x105 years. Previous studies have been hindered by the absence of biogenic carbonate (e.g., Leg 199). Consequently the impact of global warming and cooling on tropical surface waters and the propagation of orbital cycles in the Earth System are unknown.

In 2009 Integrated Ocean Drilling Program Expedition 320/321 recovered lower-middle Miocene sediments with high sedimentation rates (30m/myr), continuous recovery, and orbital cyclicity from the east equatorial Pacific Ocean. At Site U1338 planktonic foraminifera are abundant and diverse in the lower and middle Miocene sediments and exceptionally well preserved. Scanning electron microscope studies revealed open pore spaces, little evidence of calcitic overgrowth on the wall surface and in many cases preserved spines (Fox and Wade, 2013).

We compare our data from Site U1338 to Site 1146 in the western equatorial Pacific Ocean, to reconstruct bottom and surface water conditions and changes in ocean dynamics across the equatorial Pacific during this highly complex interval of climate history.