Geophysical Research Abstracts
Vol. 13, EGU2011-10971, 2011
EGU General Assembly 2011

Detailed Stratigraphy and Correlation of Miocene to Recent Records at Drill Sites Along the Pacific Equator (315, 573, 851 and U1338)

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Large zonal and meridional variations in sea surface properties (e.g., temperature, salinity, primary productivity) characterize the modern tropical Pacific Ocean. The variance has a complex origin reflecting multiple influences; it also changes significantly on inter-annual time scales. There is considerable interest in reconstructing past sea surface properties within this region, especially during warm intervals of the late Miocene and early Pliocene. A basic issue confronts such studies, particularly from a modeling perspective: given the extreme spatial and temporal complexities of surface water across the modern tropical Pacific, compelling arguments for regionally meaningful changes in the past require high-resolution, time-correlative, and lengthy records from multiple locations. Notably, most studies to date have avoided sites from the climatically sensitive region where wind-driven upwelling dominates (the Equator between 100°W and 175°W), and available sites along the Equator contain sediment records dated using different time scales.

Deep Sea Drilling Project Sites 315 and 573, Integrated Ocean Drilling Program Site U1338, and Ocean Drilling Program Site 851 form a transect along the Equator with approximate longitudes of 159°, 133°, 118° and 111°, respectively. Here, we align the sedimentary sequences at these sites over the last 9 million years as follows. First, depths of certain calcareous and diatom datums are refined at these sites. Second, these and polarity chron datums at each site are migrated to a common time scale. Third, bulk carbonate content, and bulk carbonate carbon and strontium isotope records are generated at the sites. Fourth, these and physical property records are placed in the time domain, assuming linear changes between key datums. Even without further stratigraphic adjustment or tuning, there is remarkable coherency between records at Sites 573, U1338 and 851, such that variations in physical properties, carbonate content and carbon isotopes align at the decimeter scale. This coherency may extend to the discontinuous spot cores at Site 315, but is less obvious in sites away from this Equatorial zone. The detailed, aligned records contain time intervals where various changes have different baseline characteristics, amplitudes and frequencies. We suggest that, along this portion of the Equator, surface water properties have changed significantly but systematically with a time resolution <10,000 years. We speculate that the variance relates to major short-term changes in wind-driven upwelling, that this has occurred for at least 9 million years, but under different boundary conditions. Models for this region may need revision as additional and increasingly detailed records from these sites begin to accumulate.