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Plio-Pleistocene stratigraphy and relative sea level estimates: an emerging global perspective

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The historical rise of atmospheric CO_2 to over 400 ppmv amplifies the need to better understand natural systems during past warmer interglacials. This change over the past 150 years approximates the CO_2 range of full glacial-interglacial cycles. Resulting future global impacts are likely, and accurate geological field data would help us better understand the past behavior of sea level (SL) and ice sheets. The middle Pliocene warm period (MPWP) offers an approximate analogue for a 400-ppmv world. Before PLIOMAX (www.pliomax.org), only a handful of estimates of relative sea levels (RSL) along with considerable uncertainties were available for the MPWP.

Precise elevations of Plio-Pleistocene RSL indicators were measured with decimeter accuracy using an OmniStar dGPS at sites in Australia, South Africa, Argentina, and other seemingly stable locations. High-resolution SL indicators include wave abrasion surfaces, sub- and intertidal sedimentary structures, and in situ marine invertebrates such as shallow water oysters and barnacles. In addition, thousands of km of terraced coastline was surveyed with dGPS between study sites.

The coastal geomorphic expression of Pliocene SL is profound. From $\sim$5 to 3 Ma, high frequency orbitally-paced, low amplitude SL oscillations acted as a shoreline "buzz saw" on hard bedrock, forming extensive high terraces. In high sediment environments such as that of the southeast US Atlantic Coastal Plain, relatively stable Pliocene ocean levels trapped huge volumes of fluvial sediments in the coastal zone, resulting in broad sandy terraces and extensive dune fields. However, glacio-isostatic adjustment (GIA), dynamic topography (DT), and other post-depositional processes have warped these marine terraces by tens of meters since the Pliocene (Raymo et al. 2011, Rovere et al 2014).

The PLIOMAX team has documented precise RSLs from numerous global sites that clearly indicate that global ice volume was significantly reduced during intervals of the Pliocene. Modeling of tectonic, GIA, and DT effects, combined with a renewed Sr dating effort will greatly clarify the SL history evident from the geology of these sites.

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