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An Ultra-high Resolution Record of Miocene Climate Change: The Organic-rich Mudrock Successions of the Monterey Formation, California

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The Miocene was a time of global change which marked the transition from the 'greenhouse' conditions of the Mesozoic and early Cenozoic, to the 'icehouse' conditions which now dominate the Earth's climate. The causes of these global climate changes are much debated, and one may involve complex CO_2 draw-down mechanisms centred on elevated levels of silicate weathering in the rising Alpine-Himalayan mountain chain. Another means of removing atmospheric CO_2 is through the enhanced production of marine organic matter together with its preservation in organic-rich sediments. Abundant organic- and siliceous-rich sediments collected off the Pacific coast of North America during the Miocene and are preserved in the Monterey Formation of California. These deposits are the focus of the 'Monterey hypothesis' which links polar cooling to thermocline development; the resulting coastal upwelling and deposition of organic carbon in turn caused a negative greenhouse effect thereby strengthening the thermocline-upwelling-carbon deposition chain (Vincent & Berger, 1985).

The purpose of the present study is to understand the high-resolution record of geochemical and sedimentary changes which are preserved in the rocks of the Monterey Formation, and to relate this record to the processes driving mid- to late-Miocene climate change. The most complete and undeformed succession of the Monterey Formation is at Naples Beach (ca. 15 km to the W. of Santa Barbara) where ca. 350m of laminated mudrocks, together with siliceous sediments, phosphates, carbonates and numerous volcanic ashes, were deposited between ca. 18-6 Ma ago. The section at Naples Beach is thermally immature wrt hydrocarbon development, having been heated to only ca. 50°C. Our new high-resolution graphic log (at 1:100) and sedimentary facies analysis of the Naples section formed the basis for detailed sampling of the mudrocks and ashes, and for ca. 2000 magnetic susceptibility (m.s.) measurements taken at 10cm intervals. Length-series Fourier analysis of the m.s. data has identified the 38ka obliquity cycle in the interval from 15-14Ma ago, and the 20ka precession and 95ka eccentricity cycles in the interval from 11-9Ma ago. The 400ka eccentricity cycle is probably also present. In principle, the absolute timing of these astronomically-driven variations in sediment composition (as reflected in the m.s. data) may be identified from high-precision Ar-Ar dating of the interlayered ashes. Also, where sedimentation rates are fairly high, the 38ka obliquity cycle is represented by as much as 4-5m mudrock, thus permitting samples of known absolute age to be collected at a resolution of a few hundred years.

Preliminary Re-Os analyses of organic-rich mudrock samples (following the approach developed by Cohen et al. 1999 for Jurassic mudrocks) suggest that the Naples Beach record of Miocene seawater Os isotope variations is broadly similar to that preserved in metalliferous sediments (Reusch et al. 1998) and Mn crusts (Burton K.W. pers. comm.) from the deep ocean. Ar-Ar dating of ca. 10-12 key ash layers, together with calculated astronomical ages, will be used to determine the exact timing of Os isotope variations and of other geochemical parameters which are expressions of this important cooling event in Earth history.

Vincent E, & Berger WH, *Natural Variations in Carbon Dioxide and the Carbon Cycle, AGU*, 455-468, (1985).

Cohen AS, Coe AL, Bartlett JM & Hawkesworth CJ, *Earth Planet. Sci. Lett.*, **167**, 159-173, (1999).

Reusch DN, Ravizza G, Maasch KA & Wright JD, *Earth Planet. Sci. Lett.*, **160**, 163-178, (1998).