



Middle Miocene environmental change: the sedimentary record of the Monterey Formation (California, U.S.A.)

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In outcrops west of Santa Barbara (CA, USA), the middle part of the Miocene Monterey Formation is predominantly composed of organic-rich mudstone interstratified with phosphatic laminae. The presence of erosional surfaces, angular unconformities, and reworked clasts and nodules suggests that bottom-current activity and gravity-flow deposition have been instrumental in sediment accumulation. The phosphatic laminae were precipitated at a very early stage of diagenesis, during periods of non-sedimentation. They formed less permeable sedimentary lids and may as such have contributed to enhanced OC preservation. Between 13 and 10.6 Ma, the thus formed phosphatic laminae were frequently subjected to subsequent sediment winnowing and reworking, resulting in the formation of condensed phosphatic beds. In spite of good preservation conditions and correspondingly high TOC contents (up to approximately 25w%), the overall OC accumulation rates (maximal 1130 mg/cm²/ky) are moderate in comparison to those of actual high productivity areas, which is mainly due to the episodic character of depositional processes and the intervening long periods of non-deposition and sediment reworking. They preclude the sections studied here, and – by extrapolation - the Monterey Formation in general from being an important OC sink during the middle Miocene. Alternatively, large OC sinks were probably created on the continent (lignite deposits) and in sedimentary depo-centers, which received increasing amounts of detrital sediments due to a combination of climate change, spreading of grasslands, and the increasing importance of mountain chains such as the Himalaya. The associated high nutrient fluxes may have been involved in the back-stepping and drowning of carbonate platforms and in the generation of widespread phosphate-rich deposits during the late early and early middle Miocene.