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Eratosthenes Seamount : a mid-ocean dip-stick recording the late Tertiary and Quaternary marine geological history of the Eastern Mediterranean

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The Eratosthenes Seamount is second to the Mediterranean Ridge as the most prominent physiographic feature in the eastern Mediterranean. The seamount is separated from adjacent structures such as the Nile Cone, the Levant Basin and Cyprus by a deep moat along its circumference. It is a simply folded, pre-Messinian structure, and as such bears sedimentary and structural evidence to the geological events that affected the eastern Mediterranean during the last 7 million years. We presume that due to its unique structural position and history, a thin but complete late Tertiary and Quaternary sedimentary sequence can be obtained from the Eratosthenes. This obtainable sequence would probably record the marine depositional environments of the eastern Mediterranean during the desiccation and the subsequent rejuvenation of the sea in the Mio-Pliocene transition period and during the various glacial period and the associated deposition of sapropels. The Eratosthenes Seamount would also bear evidence for the tectonic collision events along the Cyprean Arc and their dating. The collision between Eratosthenes Seamount and Cyprus preceded the tectonic collision along the Hellenic Arc. Since the Eratosthenes collision was not affected by subsequent halokinetic processes, details of the Afro-European tectonic collision could be encountered and interpreted. Boreholes of the Ocean Drilling Program on the Eratosthenes seamount and its environment would illuminate the major geological problems of the eastern Mediterranean, namely,

- Plate tectonic regime in the eastern Mediterranean
- Early stages of convergence and collision processes
- Pre-Messinian sedimentary history and paleoceanography of the eastern Mediterranean
- Messinian and Plio-Quaternary sedimentology, geochemistry, paleoclimatology and paleoceanography

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The Mediterranean : a deep-sea archive for global changes in sea level

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Eustatic sea level fluctuations manifest themselves differently in different depostional environments. For example, late Miocene/early Pliocene fluctuations have been extensively documented in the Mediterranean by lithologic (and biostratigraphic) changes recorded in numerous land sections, as well as in deep sea cores from three drilling legs (DSDP Legs 13 & 42 and ODP Leg 107). These lithologic changes resulted from a drastic restriction of the inflow of sea water at the western Mediterranean's connection to the Atlantic Ocean.

Earlier in the Miocene, the Mediterranean had already lost its eastern connection to the Indian Ocean, which probably terminated global circum-equatorial tropical circulation. With this closure, the Mediterranean was now essentially located on the western side of a continent with a subsequent climate change towards increasing aridity. As the modern Mediterranean is an important source of dense water with its opening to the Atlantic, it is proposed that the onset of similar restricted oceanographic/climatic conditions in the Miocene had significant global effects. The exact correlation of paleoceanographic events in the Mediterranean with other records of Miocene sea level change, particularly those derived from oxygen isotope stratigraphy in the open oceans and sequence stratigraphy on the contintental margins, would allow for an evaluation of the causes and consequences of these proposed global effects. Therefore, future ocean drilling in the eastern Mediterranean is proposed to recover a complete Miocene to Oligocene sequence in order to evaluate the relationship between global sea level changes and Mediterranean paleoceanography.

Correlation of sea-level events, as recorded in the sedimentary record of different basins, often proves difficult when magneto- and biostratigraphies fail or are not applicable. Strontium isotope stratigraphy is potentially an excellent method for correlating the open ocean record with problematic sequences, such as those deposited in restricted marine basins. For example, strontium isotopes have been used successfully to correlate Pliocene/Pleistocene pelagic sediments from ODP cores and land sequences in the Mediterranean Sea with cored sediments from DSDP sites in the open ocean. [1,2] With these correlations, it was possible to evaluate the response of the restricted Mediterranean, as manifested by lithologic changes, to late Miocene/early Pliocene sea level fluctuations, which are recorded as variations in the oxygen isotope stratigraphy from the open ocean sites.[1] Although the theoretical stratigraphic resolution of the technique for the period 6-4 Ma is 0.23 m.y., the practical resolution was estimated to be 0.3-0.5 m.y. It is proposed that paleoceanographic events recorded in deep sea sediments of the eastern Mediterranean could be correlated with globally recorded Miocene sea level fluctuations with the aid of conventional magneto- and biostratigraphy, as well as strontium isotope stratigraphy. This proposed correlation could thus be used to evaluate the influence of major changes in ocean circulation patterns on climatically induced eustatic sea level changes.

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[1] McKenzie, J.A., Hodell, D.A., Mueller, P.A., and Mueller, D.W., 1988. Application of strontium isotopes to late Miocene-early Pliocene stratigraphy, Geology, submitted.

[2] McKenzie, J.A., Palmer, S.C. and Mueller, P.A., 1988. Strontium isotope stratigraphy of the Piocene-Pleistocene "deep-sea type section" at ODP Site 653, Proc. ODP, Sci. Results, 107: College Station, TX (Ocean Drilling Program), submitted.