The Eratosthenes Seamount : a fossil superstructure in the Eastern Mediterranean

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In the present study we interpret the structure of the Eratosthenes Seamount and nearby areas of the southeastern Mediterranean. We integrate available seismic reflection profiles with other geophysical data and with plate kinematic considerations. This allows to distinguish between structural elements of different ages and to relate them to the evolution of the Levant basin, especially in Mesozoic times.

It is found that the Eratosthenes Seamount, one of the most prominent features in the southeastern Mediterranean, forms the highest part of a much larger structural high. The latter is interpreted as a partly volcanic construction over a continental block which was stranded in the Levant basin following Early Mesozoic rifting. This structural high is defined by a prominent seismic reflector which rises several km towards the Eratosthenes Seamount. Mapping of this reflector defines a high (Eratosthenes Structural High, hereafter ESH) which approximately ovelaps the extent of a large magnetic anomaly. We find that the magnetization of the rocks causing this anomaly, deduced in a previous study, is similar to that expected of Early Mesozoic rocks on the African plate. Since at the time rifting-related volcanism was indeed widespread in the Eastern Mediterranean border of Africa, we infer that the ESH formed at that time, coevally with the rifting that formed the Levant basin. However, there was not much motion between this block and Africa since then.

Superimposed on the ESH is a quadrilateral graben delimited by steep fault scarps. As this graben encloses the Eratosthenes Seamount and its slopes, downfaulting of its central area produces a moat which surrounds the topographic high. Messinian evaporites pinch out and onlap the flanks of the ESH outside the graben and seem to be absent in the graben. This shows that the ESH was a well expressed physiographic feature in Messinian times, its peak (the present seamount) having been more than 1500 m higher than the top of evaporites. The steep foults delimiting the graben are interpreted as Miocene strike-slip foults, reactivated with a vertical motion in post-Messinian time. Strike-slip motions presently occur mostly on local structures around the Eratosthenes Seamount whereas the ESH, thicker and more buoyant than the surrounding eastern Mediterranean crust, interrupts the process of subduction along the central segment of the Cypriot Arc, thus causing the younger uplifting phases in Cyprus.

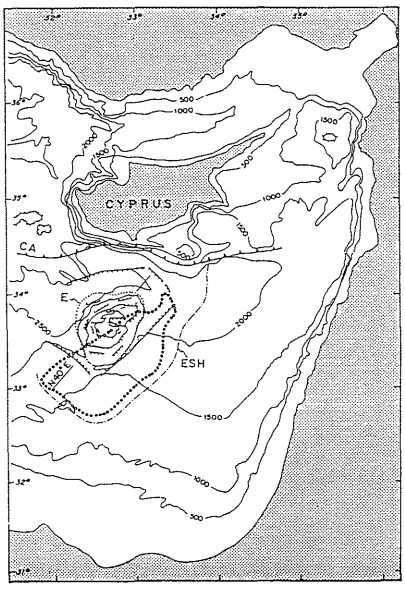

Fig. 1 - The Eratosthenes Seamount, E (dots) forms the central and highest part of the larger Eratosthenes Structural High, ESH (dots and dashes). Note the good correlation between ESH and the zero-contour of the magnetic anomaly (open circles). Steep faults delimit the moat around the seamount, forming a quadrilater graben whose axis strikes about N 40° E. The shape of Africa-Anatolia plate boundary, the Cypriot Arc (CA), is affected by the collision with the ESH which interrupts the process of subduction along this segment. Bathymetry simplified after Hall (1980, 1981). Contour interval is 500 m.

Eratosthenes Seamount : Mid-Ocean recorder of paleotectonics and paleo-oceanography of the Eastern Mediterranean Region

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Eratosthenes Seamount is the most prominent physiographic feature on the eastern Mediterranean seafloor. Located south of Cyprus, it is at the heart of the tectonic collision zone between Africa and Eurasia. Dredged samples recently recovered from the seamount suggest that it has been a high structural feature since the Cretaceous, in effect a dip-stick or recorder of tectonic and oceanographic changes especially those tied to eastern gateway closure, destruction of the Tethyan seaway, and evolution of the Cyprean arc.

Eratosthenes Seamount rises over 2 km above the regional seafloor; its summit is at a water depht of 690 m. The feature appears to be a folded structure of sedimentary and perhaps metamorphic rocks. Relief is not steep, and the slopes and summit are mantled with a thick accumulation of sediments. Today it is isolated from the surrounding Nile Cone, Levant Basin and Cyprus by a deep moat-like depression that widens to the west forming the Eratosthenes abyssal plain, thus this sedimentary mantle appears not to be formed so much of Quaternary debris but rather of geologically-older sediments. Seismic reflection profiles suggest the seamount has no evaporite deposits left by the Messinian dessication event, thus was isolated as a high structure at least back to the Miocene. Heat-flow measurements, gravity and magnetic anamoly patterns, and limited sampling programs suggest no volcanism associated with the seamount.

Recent dredging recovered chalk of middle Cretaceous age, covered with a dark-colored calcareous crust containing numerous shell molds of Miocene age. These geological ages remain tentative. Never the less, a Cretaceous age implies that Eratosthenes seamount could bear evidence of sedimentary and structural events that affected the eastern Mediterranean region since that time, such as the Senonian folding of the Syrian arc anticlines that affected much of the Levant. Miocene age crusts may imply uplift and that the seamount stood high above regional sea-levels, additional criteria that it offers a window through the Messinian evaporite into older sedimentary sequences.

We suggest that Eratosthenes seamount is likely a promontory of the African plate, protruding northwards and in collision with Cyprus, the latter a southward-protruding promontory from Anatolia. This collision preceded the Africa-Eurasia closure that resulted in the Hellenic arc. The transition of the collision zone westwards drastically reduced the rate of closure in the Cyprean arc. Since the seamount was unaffected by other eastern Mediterranean tectonic events, including halokinetic processes associated with Messinian evaporite deposits, the Cyprus-Eratosthenes collision zone may preserve the earlier closure events. Here collision events apparently were aborted, preserving for study by drilling the record of early stages of continent-continent collision.

Here then is a setting where a drilling program would illuminate the major geological and oceanographic history of the eastern Mediterranean region:

- plate tectonic history in connection with the early stages of continentcontinent convergence and collision,
- paleo-oceanographic consequences of this tectonic activity, including the destruction of the eastern oceanic gateway and the uplift of the Levant, all influencial on regional and global changes in oceanographic circulation,
- sedimentary history and paleo-oceanography preceeding, during and following the Messinian dessication event, one of the very few areas in the eastern Mediterranean Sea where such a window exists for safe drilling into and through these deposits or their time-equivalent deposits,
- late Pleistocene and Quaternary sedimentary history and paleo-oceanography connected with major glacial and interglacial periods, such as sapropel formation, sea-level variation, climatic modifications, major fluvial modifications, etc.

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