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Geophysical Studies in the Marmara Sea; Their Contribution to the Regional Geology

Marmara Denizi Jeofizik Çalışmaları; Bölge Jeolojisine Katkıları

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Abstract

Marmara Sea region is a relatively small inland marine realm of active plate tectonics and crustal movements. In recent years, exploration of the oceans using geophysical methods has had a profound effect on the way we view the structure of the Earth and its behaviour through geological time. Under the light of new geophysical data, various studies have been devoted to the Marmara Sea. The most important studies known by the author will be cited, their relevant results to the regional geology (structural models and palaeogeographic evolution of the Marmara Sea) will be given.

Keywords: Marmara Sea, geology, geophysics, active faulting, tectonic models

Introduction

The Marmara Sea is a 278-km long and 75-km wide intracontinental sea on the waterway between the Mediterranean and the Black Sea. The total coastline length is about 1025 km including 23 islands. Asian coasts (663 km) are 2.5 times longer than the European coasts (264 km). It has a surface area of approximately 11,350 km^2 and a volume of 3,380 km^3.

Beyond the important bays (İzmit, Gemlik, Bandırma and Erdek) placed at both sides of two big peninsulas (Armutlu and Kapıdağ), this inland sea is characterized by deep troughs (1150-1280m) to the north and broad (~32 km) shelf to the south. The northern shelf is narrow (2-13 km) and there is literally no shelf area in front of the Ganos Mountain, where very

steep slopes at the shoreline continue down to deep trough. Continental slope along the northern margin of the Marmara Sea is very steep. The wide southern shelf, on the other hand, is locally interrupted by large and small islands.

These shelves are separated by an E-W deep trough which is segmented by the splays of the North Anatolian fault (NAF) (Ketin, 1948) into three rhomboidal or wedge-shaped transtentional basins. The seafloor morphology of the Marmara Sea was not so evident until the depth measurements using high resolution multibeam acoustic methods. Andrusov was the first researcher who gave the first bathymetric information for the Marmara Sea together with some detailed oceanographic data in 1890. Following studies, based on the clasical and single channel acoustical methods, show three central basins lying at depths between 1152 and 1276 m (Ardel and Kurter, 1970, 1973). The total shelf area occupies 57% of the hypsographic curve. In recent years, new and modern bathymetric data has a profound effect on the way we view the seafloor morphology.

The Marmara Sea is connected to the low salinity Black Sea and the fully marine Mediterranean via two narrow, long and elongated straits. The width of the Strait of İstanbul ranges between 0.7 and 3.5 km with an average of 1.6 km. Its average depth is 36 m with a maximum of 110 m. It has a sill depth of ~35 m. At the southern end of the Strait of İstanbul 7-km-long Golden Horn estuary, as named in antiquity because of its shape, is located. The width of the Strait of Çanakkale, on the other hand, ranges between 1.2 and 7 km with an average of 4.0 km. The narrowest part of the Strait of Çanakkale is about 25 km east of its junction with the Aegean Sea. Its average depth is 55 m, with a maximum of 105 m. Whereas the Strait of Çanakkale is connected to the Tekirdağ depression, westernmost of the deep basins aligned in the Marmara Sea, by a gradually widening junction region, it is terminated at the Aegean Sea by an abrupt opening, where a sill is placed between 60 and 65 m contour lines (Alpar et al., 1998). This indicates that the connection between the Marmara Sea and the Aegean Sea would be interrupted if the sea level were dropped about 65 m. It is known that the palaeoshorelines during the Wurm glaciation were located at about (115-120), (90-100) and 150 m in the Aegean, Marmara and Black Seas, respectively (Aksu and Piper, 1983; van Andel and Lianos, 1984; Smith et al., 1995; Ryan, 1997). The sills in the Turkish straits are well above than the fossil shores of the neighbouring seas. Therefore, late Quaternary sea level changes have been in effect on the depositional, stratigraphic and palaeogeographic features of the Marmara Sea.