SUBMARINE CANYONS OF THE SEA OF MARMARA

M. Namik Çagatay [1]*, Gülsen Uçarkus [1] and Kadir K. Eris [1]
[1] ITU, EMCOL and Geological Engineering Department, Faculty of Mining, Istanbul, Turkey - cagatay@itu.edu.tr

Abstract
Numerous canyons are distributed on the steep slopes (>10º) of the ~1250 m-deep transtensional Marmara basins, which are developed between the splays of the North Anatolian Fault. The canyons are commonly short (1-3 km), except for a few canyons which are up to 50 km long. The canyons started forming by tectonic and erosional processes mainly during the Plio-Quaternary, but their subsequent evolution was strongly influenced by climatically controlled Quaternary cyclic sea (lake) level changes.

Keywords: Marmara Sea, Canyons, North Anatolian Fault, Sea level

The Sea of Marmara, located on a continental transform-fault plate boundary between the Eurasian and Anatolian-Aegean plates, is a tectonically very active basin (figure 1). As in the case of all the active tectonic continental margins around the world, the Sea of Marmara margins are incised by a number of submarine canyons. East of the Sea of Marmara, the North Anatolian Fault (NAF) forming the transform plate boundary splays into branches and accommodates a total of ~2.5 cm/year dextral motion.

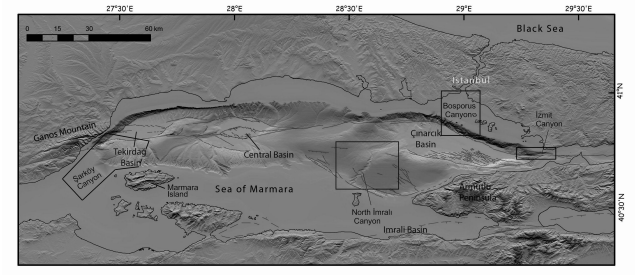

Fig. 1. Morphotectonic map of Sea of Marmara showing the submarine canyons and active faults (red lines). EM300 bathymetry from [1] and active faults modified after [2].

The Sea of Marmara continental margins are marked by numerous submarine canyons. Their length is mostly limited by the width of the continental slope, which varies from 1 to 3 km [3, 4], except for the Izmit, North Imrali Sarköy canyons which are 36, 33.5 and 50 km long (figure 1). The southern slopes of the Tekirdag and Central basins with low slope angles have the longest, widest (1-3 km) and deepest (up to 400 m) submarine canyons, whereas the northern continental slope of the Çinarcik Basin and northwestern slope of the Tekirdag Basin with steep slopes (up to 29º), are short (1-2 km long) and narrow (few hundred metres) [3].

Most of the Sea of Marmara canyons have a straight course, extending from the shelf edge to the base of the continental slope. The only exception is the North Imrali Canyon on the southern slope of the Çinarcik Basin, which is sinuous (figure 1). All the canyons are associated with erosional gullies. Some canyons show branching towards the shelf edge. Others are characterized by arcuate head scars near the upper slope-shelf edge area in the north and on southern slope of the Tekirdag Basin (figure 1). Some large canyons are located on the faults and are associated with submarine landslides near their junctions with the deep basins (e.g., Izmit and Sarköy Canyons) (figure 2). The Sarköy and the Istanbul (Bosporus) canyons are connected with the outlets of the Çanakkale (Dardanelles) and Bosporus straits on the shelf. They evidenced the passage of large water masses between the Mediterranean Sea and Black Sea and their morphology was strongly modified by erosional and *depositio*nal processes, especially during interstadials and melt water pulses, when one-way flow regime operated from the Black Sea through the straits and the Sea of Marmara.

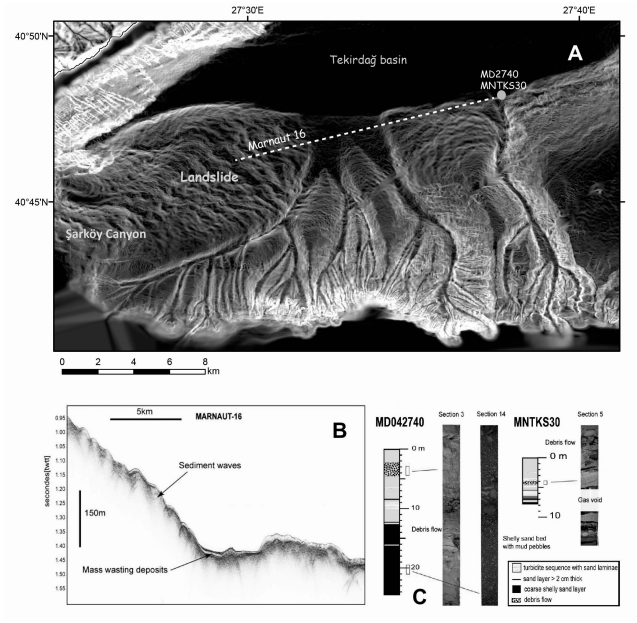

Fig. 2. (A) Slope gradient map of north of Marmara Island, southern slope of Tekirdag Basin, showing the canyons including the lower course of the Sarköy Canyon. The canyons appear to merge and open to Tekirdag Basin. Also seen is Ganos Landslide Complex to the west overlying strike slip Ganos Fault. (B) Chirp subbottom profile across the slope of the landslide and mouths of canyons, showing the transparent mass-wasting deposits. (C) Cores located at the mouth of canyons containing debris flow deposits (modified after [3]).

The sinuous North Imrali Canyon most probably developed at the shelf extension of the Kocasu River by erosive activity of the turbidity currents (figure 1). Mass wasting and turbidity current activity in the canyons were more frequent and effective during the periods of low sea level and transition from lacustrine to marine conditions in the Sea of Marmara.

References
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