

Interpretation of Gravity and Magnetic data with Fourier Spectral Analysis of Çanakkale Strait (Dardanelles)

Çanakkale Boğazı Gravite ve Manyetik Verilerinin Fourier Analizi ile Yorumlanması

Fatih Adatepe^{1*} Sinan Demirel¹ and Mümtaz Hisarlı²

¹ İstanbul University, Institute of Marine Sciences and Management, Müşküle Sok. 1, Vefa, İstanbul,

² İstanbul University, Engineering Faculty, Dept. of Geophysic, Avcılar, İstanbul, Turkey.

Abstract

The Dardanelles (Çanakkale Strait) is a water channel lying along southwest of the Marmara Sea, connecting the Aegean Sea with the Black Sea.

Gravity and magnetic data from the Strait of Çanakkale were analyzed one dimensional Fourier Spectral. That analysis along four profiles shows the presence of an anomalous mass at depths of 3.3 km and 3.5 km for the gravity and magnetic data, respectively.

The average dept values generated by the method similar to other studies conducted in the region.

Key words: Strait of Çanakkale, gravity, magnetic, Fourier Spectral Analysis

Introduction

The Dardanelles (Çanakkale Strait) is a water channel lying along southwest of the Marmara Sea, connecting the Aegean Sea with the Black Sea. It is approximately 60 km long, 1.2 km at the narrowest and 6.5 km at the widest part, with depts varying between 60 and 100 m.

Previos gravity and magnetic sudies

Dedehayır (1976) studies around the Çanakkale Strait made general assessments about the region using a natural magnetic vertical

* Corresponding author: E-mail: fatadatapa@istanbul.edu.tr

components map. According to these findings, the reason of closings with high value in the Biga Peninsula, Gallipoli and Dardanell is the beds with excalative formations in the Çanakkale Strait and Kaz Mountain.

The depth of the source causing gravity anomalies in the Gönen-Manyas Region Yörük (1983) and in the Marmara Sea Kale (1985) were calculated as approximately 3 - 3,5 km. The depths calculated as a consequence of the methods having been applied to the profiles generated from gravity and magnetic maps belonging to the Marmara Sea Adatepe (1988) were recorded to be between 2.5 and 4.7 km approximately.

Oral and Canitez (1987) in their researches investigated the Bouguer gravity anomalies in Western Anatolia from qualitative and quantitative perspectives. Finally, they investigated surface and deeper structures. Ergün and Özel (1995) concluded in that the magnetic anomalies with small wavelengths. Adatepe *et al.* (2000) in the southern shelf of the Marmara Sea had originated from granitic and volcanic stones located in the surroundings.

Regional geology

In the Gallipoli and Biga Peninsulas constituting the two sides of the Çanakkale Strait, four tectonic zones are located lying in the Northeast-Southwest direction dating back to the Tertiary age. (Figure 1). These are Gallipoli, Ezine, Ayvacık - Karabiga and Sakarya Zones starting from northwest.

The Gallipoli Zone among them; is a melange with a float as an accumulation prism comprising of Late Cretaceous-Palaeocene ancient pelagic limestone, radiolaria, serpentinite, gabbro and bluesiste rocks and is named as the Çetmi Ophiolit Melange. The Ayvacık-Karabiga Zone also comprises of Çetmi Melange and it is located along the Ezine and Sakarya Zone.

The Ayvacık-Karabiga Zone sets a model in two large areas divided with Miocene volcanic cover. A large portion of the Ezine Zone comprises of rocks with continental origin and is located in the southeast of the Gallipoli Zone. The located along these two zones is generally covered with Late Tertiary stones. The Sakarya Zone on the other hand is located between Pontid (inside) Zone in the north and İzmir- Ankara Zone in the south (Okay *et al.*, 1990). To summary, the surface of the basis around Dardanell comprises of metamorphic

rocks of the Istranca Massif in the north and Ophiolite Melange -like rocks- in the south, around Saros Gulf.

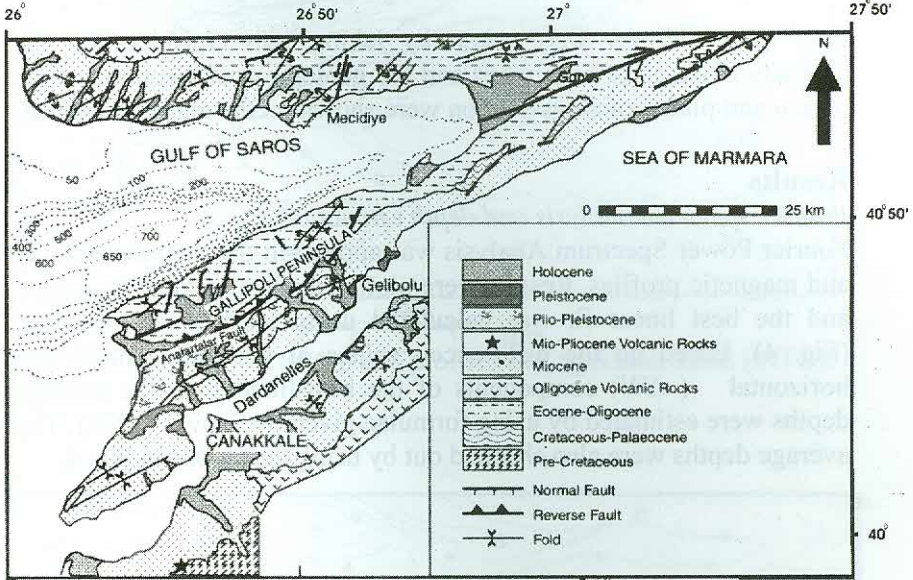


Figure 1. Geological map of Çanakkale Strait (Çağatay *et al.*, 1968)

The rocks in the Biga and Gallipoli Peninsulas after the Tertiary Era have subsided in four different time zones having significant rising and abrasion periods between them. These are Maestrihtiyen-Early Eocene, Middle Eocene-Oligocene, Miocene and Plio-Quaternary Siyako *et al.* (1989). In parallel to the development process of the Çanakkale Strait, it has first become under the effect of tectonic activity and then fluvial processes. The current appearance of the Çanakkale Strait today comprises of sea water having risen during Late Pleistocene and Holocene (following Wurm ice age).

Material and Methods

MTA constitutes the database of gravity and magnetic maps. In these data with originals as map sections of scale 1/500.000 gridding methods were used and it was transformed into a numerical form by 2.5 km sampling range and these maps were used for the implementation of the research Genç *et al.* (1996). In order for the

deep effect coming to the maps to become more distinctive, filters with low transition were used.

According to this, filter values of $f_1=0.05$ and $f_2=0.10$ were applied to the Bouguer Gravity Anomaly map (Fig. 2) and filter values of $f_1=0.02$ and $f_2=0.03$ were applied to the Aeromagnetic map (Fig. 3) was generated.

Four cross-sections were taken by taking into consideration the anomaly closings of both maps and the geologic specifications of the region and places of cross-section were shown on the maps concerned.

Results

Fourier spectrum analysis and depth estimation

Fourier Power Spectrum Analysis was applied to the digitized gravity and magnetic profiles. Results were plotted against angular frequency and the best linear fit was calculated using least squares method (Fig. 4). Based on the difference values of vertical ($\Delta \ln G$) and horizontal (ΔW) components of the best-fitted line, the average depths were estimated by using formulae given by Sanver (1975). The average depths were also checked out by using the slopes in Fig. 4.

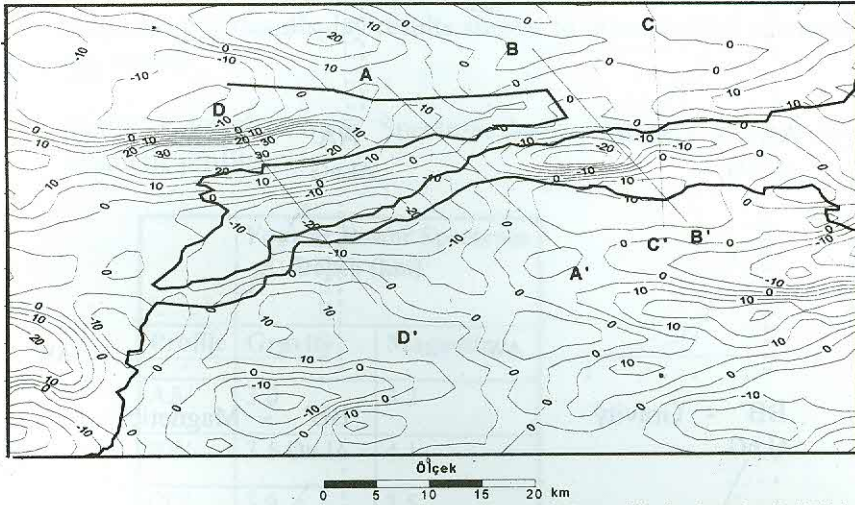


Fig. 2. Bouguer Gravity Map and profiles of Çanakkale Strait (MTA).

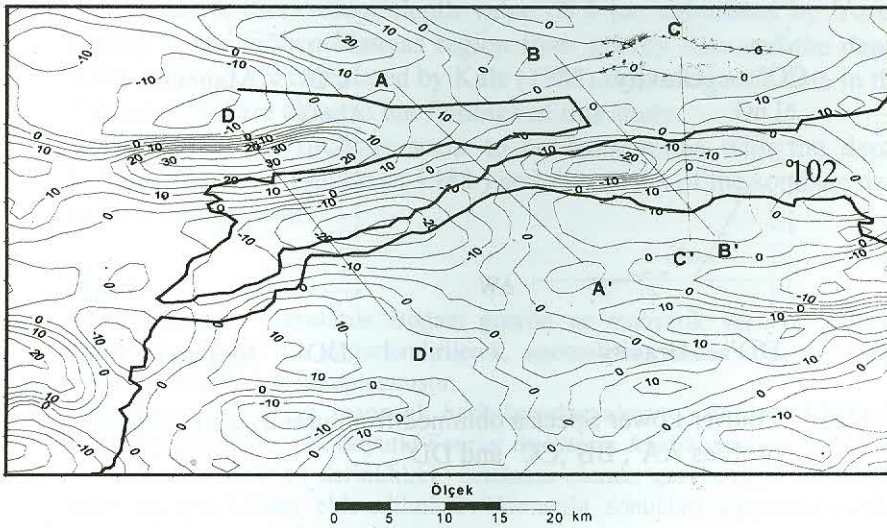


Fig. 3. Magnetic Map and profiles of Çanakkale Strait (MTA).

