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Investigation of the lithospheric structures and North Anatolian Fault Zone underneath the Marmara Sea by 3D Magnetotelluric modeling.

Tulay Kaya[1], Yasuo Ogawa[1], Takafumi Kasaya[2], S. Bülent Tank[1,3], M. Kemal Tunçer[4], Naoto Oshiman[5], Yoshimori Honkura[1], Masaki Matsushima[1], and Weerachai Siripunvaraporn[6]

[1]Tokyo Institute of Technology, Japan
[2]Jamstec, Japan
[3]Bogazici University, Turkey
[4]Istanbul University, Turkey
[5]Kyoto University, Japan
[6]Mahidol University, Thailand

SUMMARY

This study represents the application of 3D electromagnetic method in a nearly closed inland sea. In order to investigate lithospheric scale structures and extension of the North Anatolian Fault (NAF) zone underneath the Marmara Sea, where the next destructive earthquake is expected to occur in northwest Turkey, we deployed long period ocean bottom electromagnetic (OBEM) instruments in the Marmara Sea. The OBEM data were combined with wide-band magnetotelluric (MT) data acquired at land sites around the Marmara Sea. According to the 3D inversion results, a fluid related highly conductive anomaly in electrical resistivity models extends from the crustal to lithospheric depths and merges with the saline fluid and/or melted mantle material beneath the Cinarcik and Imrali Basins in eastern Marmara Sea and to the south of the Central Basin toward the west. These conductive anomalies are surrounded by relatively resistive anomalies. This system, observed previously in the Duzce region on the NAF in east but terminated to the west of the Izmit region, provides an additional constrain on the continuation of the segmentation of the NAF zone from land into the Marmara Sea. Branches of the NAF zone intersect with the resistive-conductive boundaries underneath the Marmara Sea as is on land. This shows segmented feature of the NAF zone on western Turkey. Another significant result of this study is that resistivity variation underneath the Marmara Sea is similar with the Marmara Region. With reference to this, we suggest extension of three tectonic zones from Marmara Region on land into the Marmara Sea.

Keywords: Ocean bottom electromagnetic (OBEM), Marmara Sea, North Anatolian Fault (NAF), 3d modeling, inversion.

INTRODUCTION

Our study area, Turkey is one of the seismically very active countries in the World. It hosts two main fault zones, North and East Anatolian Fault zones, formed due to the relative motions of four tectonic plates which are Eurasian, African, Arabian and Anatolian Plates.

The North Anatolian Fault (NAF) is the main transform fault zone of Turkey. It is located to the north of Turkey between the Eurasian and Anatolian plates. During the 20th century, westward movement of the Anatolian plate with respect to the Eurasian Plate caused devastating earthquakes which started from the east and migrated to the west along the NAF. The last two of these earthquakes occurred at the eastern edge of the Marmara Sea in 1999. In view of there is a seismic gap in the Marmara Sea (Toksöz *et al.*, 1979) and seismic energy accumulation increases day bay day at its eastern edge, due to the migration of the devastating earthquakes toward the west along the NAF and occurrence of the 1999 earthquakes in Izmit and Duzce which are the cities at the eastern edge of the Marmara Sea, occurrence of the next destructive earthquake in the Marmara Sea is inevitable.

Seismic tomography studies in the area are impossible because of lack of large earthquakes in the Marmara Sea since 1766. Like tomography studies, other disciplines have limited depth resolution in the Marmara Sea. On the other hands, Magnetotelluric (MT) method has a large depth resolution from a few meters to ten of kilometers. Electrical resistivity distribution underneath the Marmara Sea is crucial in terms of understanding