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3D Magnetotelluric imaging of the Marmara Sea and westward extension of the North Anatolian Fault

KAYA, Tulay[1*], OGAWA, Yasuo[1], TANK, Bulent[2], KASAYA, Takafumi[3], M. Kemal Tuncer[4], HONKURA, Yoshimori[1], OSHIMAN, Naoto[5], MATSUSHIMA, Masaki[1]

[1]Tokyo Institute of Technology, [2]Bogazici University, [3]JAMSTEC, [4]Istanbul University, [5]Kyoto University

Turkey is seismically very active country that has hosted large destructive earthquakes throughout the history. The sources of these devastating events are two main fault zones which are the North and East Anatolian Fault Zones. The last two demonstrative earthquakes on the North Anatolian Fault Zone (NAFZ) occurred at the eastern edge of the Marmara Sea, confirming migration of big events from east to west on this transform fault. In view of there is a seismic gap in the Marmara Sea and seismic energy accumulation increases day bay day at its eastern edge, occurrence of the next destructive earthquake in the Marmara is inevitable. Seismic, geodetic and other studies showed complexity of the structure suggesting various estimates about the extension of the NAFZ through the Marmara Sea. In this study, we benefit from the high depth resolution of the Magnetotelluric (MT) method to resolve the electrical resistivity structure beneath the Marmara Sea and disclose its relation with the geologic structure. In order to investigate extension of the NAFZ beneath the Marmara Sea we deployed long period ocean bottom electromagnetic data at 16 sites which form 4 profiles perpendicular to the possible traces of the NAFZ. Variation of the geoelectric strikes from east to west shows different oriented faults in the Marmara Sea and points out necessity of 3D modeling in this region. The highly conductive anomaly in electrical resistivity models extends from crustal depths to the lithosphere and merges with the melted mantle material at the eastern part of the Marmara Sea. This conductive anomaly is surrounded by relatively resistive anomalies which imply continuation of the fault structure from land to the Marmara Sea. Our results clear the location of the highly conductive and resistive anomalies that has crucial implications in two aspects; conductive anomaly may trigger the micro-seismic activity and resistive anomalies may act as asperity zones where stress accumulation results in large earthquakes.

Keywords: Ocean Bottom Electromagnetics (OBEM), North Anatolian Fault Zone (NAFZ), Magnetotellurics (MT), Marmara Sea, Resistivity / Conductivity, Fluid-controlled seismicity