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Resolving the Western Black Sea Fault Using Microtremor Measurements? -Preliminary Results-

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Two terrain-bounding major fault zones occur in the Marmara Sea and the northern onshore areas. The first of these is the dextral, E-W trending, North Anatolian Fault Zone which cuts through the deep basins within the Marmara Sea and is known to be one of the most seismically active fault zones on the Earth. The second is the inferred West Black Sea Fault Zone (WBFZ), a NNW-SSE trending, dextral boundary fault which separates the Istranca Massif to the west and the Istanbul Terrane to the east. The WBFZ is thought to have accommodated the opening of the east Black Sea basin (Okay et al., 1994). This fault zone and the two adjacent continental blocks are covered by Middle to Upper Eocene sediments and therefore the WBFZ is considered to be an inactive fault. Nevertheless, it forms a major crustal zone of weakness in the vicinity of Istanbul.

Scientists and researchers are confident that there will be in the comparatively near future a major earthquake in the Marmara Sea in the vicinity of Istanbul. Therefore, a major concern is to estimate possible damages to the heavily populated living areas due to such an event. Many studies have been conducted, accordingly, focusing on the offshore (Marmara Sea) and onshore areas (i.e., the City of Istanbul). We have initiated a new project with the aim of constraining the West Black Sea Fault and its local site effects by using geophysical methods. This fault is especially important for the determination of the possible damage area, whereas evidence of some basins which cut through this fault is considered to be potential risk of a site effect problem during a possible earthquake. Within the framework of our project, a series of geophysical methods, such as microtremor single station measurements, the Spatial Autocorrelation Method (SPAC), gravity, Vertical Electrical Sounding (VES), Multi-channel analysis of Surface Wave Data (MASW), and Magnetotellurics (MT) are planned in the area between the Büyükçekmece and Küçükçekmece Lakes.

The first phase of the project collected 3- component single station microtremor measurements at 278 points in the study area between 18 and 24 December 2013. The grid space chosen was 600x600 meters. The duration of measurements at each point were between 20 minutes to 60 minutes using a Guralp CMG 6TD short period seismometer, with a sampling rate of 100 Hz. As a result of the evaluation of these observations, we obtained soil fundamental frequencies and amplifications, as well as bedrock depth from the peak frequency of the microtremors records. According to the resulting soil thickness maps, possible lineament structures were identified. Our results indicate two different frequency distribution in the studied area. The soil fundamental frequency is obtained below 1 Hz along the western and eastern section, while a gradual decrease is shown towards the west and then once again a increase. In the north however, soil transfer peaks of 1 Hz and above are remarkable. Three different types of basins are derived by mapping the thickness of the sediments. The evolution of these basins are still under discussion whether they arise from a tectonic origin or formed as a result of the alteration of the Eocene limestones which distributed in an wide area.

In the next phase of the project, we will continue to collect other geophysical data such as gravity and electrical tomography etc. The results of this project will play an important role in the determination of the impact of the Western Black Sea Fault on an earthquake occurring in the Sea of Marmara and therefore serve as input to urban planning.

Key words: West Black Sea Fault, Microtremor, Site Effect, Istanbul University, Büyükçekmece Lake, Küçükçekmece Lake, North Anatolian Fault Zone, Damage, Karabulut (2012)

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(It is considered to pass among the Büyükçekmece and Küçükçekmece Lakes according to the results of work obtained by Karabulut, (2012)). This project was funded by Istanbul University Scientific Research Project.