Present Deformation Field of Silent Strand of Western NAFZ

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SUMMARY

North Anatolian Fault Zone (NAFZ), where the Anatolian and Eurasian plates meet, is one of the largest active strike-slip fault zones in the world. The western part of NAFZ has a seismic past and many scientists have focused on this region. The study of monitoring horizontal crustal movements on the western part of NAFZ has started by Geodesy Department of KOERI, Bogazici University in 1990. Three geodetic control networks were established in Iznik, Sapanca, and Akyazi regions in order to monitor crustal displacements. The first period observations were performed by using terrestrial methods and these observations were repeated annually until 1993 by using total-station and electromagnetic distance-meter instruments. Since 1994 GPS measurements have been carried out at the temporary and permanent points in the area and the crustal movements are being monitored. In this study, the results obtained from these GPS observations performed at Iznik-Mektece segment are presented. A present-day deformation field is also investigated by GPS velocities. Iznik-Mektece segment of the NAF was identified as a seismic gap and the results of the study seem to be more confusing than clarifying. There has been no significant horizontal movements were detected by terrestrial methods but 14-year GPS data that evaluated gave us a significant idea about slip rate and deformation on that segment of NAFZ.
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1. IZNIK-MEKECE FAULT SEGMENT

The North Anatolian Fault (NAF), which is one of the most seismically active fault of the world, runs along the northern part of Turkey about 1500 km, from the Karliova to the North Aegean. NAFZ branches from 30.6° E westward into three active fault zones. The middle strand is called Iznik-Mekece fault zone (Figure 1-1). The middle branch extends westward via the southern coast of Lake Iznik to the Marmara Sea. Iznik-Mekece fault zone is known seismically low active than the other northern and southern fault zones. From the knowledge of historical events and trench studies, the recurrence interval of large earthquakes for middle strand is probably in the vicinity of 2000 years or more. Furthermore, there is only a micro-earthquake activity in the Gemlik area for the last 15 years (Barka, 1997). In spite of geologic evidence indicative of recent activity of the Iznik-Mekece fault, the middle and eastern part of the fault is virtually inactive seismically (Ucer et al., 1985; Tsukuda et al., 1988; Lio et al., 1989). Presence of seismic gaps in the area implies potential sites for future large earthquakes.

Figure 1-1: Iznik-Mekece fault segment of NAFZ.

The Iznik-Mekece Fault that is located around west of Geyve, goes along approximately 15 km up to Sakarya as an right lateral fault (Barka, 1997) and then bounds the Geyve basin and then leaps over to the right side continuous through Mekece and Iznik Lake in W-SW.
direction. Many researches were conducted along the fault for investigating seismic potential (Ambraseys and Finkel, 1991; Stein et al., 1997; Barka and Reilinger, 1997; Reilinger et al. 2000; Ayhan et al., 2002; Ergintav et al., 2002; Meade et al., 2002; Reilinger et al., 2006; Ergintav et al., 2007).

2. GEODETIC OBSERVATIONS

The study of monitoring horizontal crustal movements on the western part of NAFZ has started by Geodesy Department of Bogazici University in 1990. Iznik micro-geodetic network (10km² with 10 points) were constructed to investigate crustal deformation on the silent branch of the North Anatolian Fault Zone, then terrestrial methods were applied until 1994. After GPS observations started in 1994, space techniques have been applied (Gurkan et al., 1999; Ozener; 2000, Gurkan et al., 2001). The mean velocity of Iznik-Mekece segment was found 18mm/yr for the 1994-1998 periods (Ozener, 2000). The estimated GPS displacement during the first 298 post-seismic days after the Izmit Earthquake (17 August 1999, Mw 7.4) for IGAZ station around the fault (Ergintav et al., 2002) was approximately 85 mm in direction of southwest.

Another network in the region called the GCM-ITU (General Command of Mapping-Istanbul Technical University) network was originally implemented by GCM as constitution of nine pillars scattered around south and north of Iznik-Mekece fault and measured with conventional techniques in 1941, 1963 to 1981. In 1941 and 1963, the network observed with triangulation method by GCM. These observations actually conducted to connect the stations to the national triangulation network. In 1981, the network was re-observed by Geodesy Department of ITU applying angle and distance measurements. The slope distances were observed by tellurometer, and then reduced to sea level. Figure 2-1 shows the station points of two mentioned networks.
Figure 2-1: The constellation of Iznik network (stations shown by the circles) and GCM_ITU network (stations shown by the triangles).

After twenty years the network became part of the micro-geodetic networks of Geodesy Department of KOERI. It was designated to monitor crustal deformation around the western part of NAFZ. In 2004 and 2007 two GPS campaigns were performed on the network. The results are shown in Figure 2-2.
3. CONCLUSIONS

Geodetic observations have been performed for monitoring both local and regional crustal movements by establishing micro-geodetic networks along plate boundaries on the western part of NAFZ in Marmara region over three decades. Geodesy provides facilities to investigate the Earth’s crust movements if geodetic networks are established to be capable for detecting variations in time and crustal movements. The various sources of geodetic data can be used to observe crustal deformation. Crustal deformation studies are based on the analysis of repeated geodetic measurements. The Iznik network of Geodesy Department of Bogazici University has a long observation period. And a geodetic database has been created from the studies of monitoring crustal movements. For significant geometrical and geophysical analysis and interpretation of the deformation on the western part of NAFZ periodical geodetic observations need to be continued.

The overall results show that no significant horizontal displacements have been detected in the Iznik network and no significant movement between the northern and the southern part of the Iznik-Mekece fault has been detected. This leads us to suggest there will not be any possible tectonic activity in a short time. Therefore, this fault is still inactive as claimed in Barka’s earlier studies (such as Barka and Reilinger, 1997).
REFERENCES


BIOGRAPHICAL NOTES

Associate Professor Haluk Ozener was born in 1967. He received the B.S. degree (1988) in Geodesy and Photogrammetry Engineering from Istanbul Technical University, and the M.Sc. (1992) and Ph.D. (2000) degrees in Geodesy from the University of Bogazici. He is currently working in the Surveying Technique Division of the Department of Geodesy and Photogrammetry Engineering of ITU in Turkey.

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