

GEOMORPHIC RECORDS OF NEOTECTONICS AT THE IZMIT-SAPANCA CORRIDOR, NW TURKEY

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ABSTRACT *In this study, by the using of geomorphic approach, the spatial variation of deformation of the North Anatolian Fault Zone (NAFZ) on the geomorphology of Izmit - Sapanca Corridor and surrounding area is assessed. Results provide evidence for relative variations in tectonic activity and suggest a relatively high degree of activity along the southern segment of the northern strand of the NAFZ. In contrast, low degree of tectonic activity along northern segment of the northern strand. This pattern is in coherent with sedimentology of the basin-fill deposits and structural evidence that was studied in the scope of this research. This study suggests that the Izmit - Sapanca Corridor formed as an asymmetric pull-apart basin by the dextral strike - slip tectonics of the North Anatolian Fault Zone in the Late Pliocene and cut - across by a cross-basin fault in the Middle - Late Pleistocene.*

INTRODUCTION

The NAFZ is the most important feature controlling the recent tectonic and morphologic development of the northern part of Turkey. The Izmit - Sapanca Corridor is situated at a tectonically active region of Turkey that formed and controlled by the dextral strike-slip tectonics of the NAFZ. Just east of the study area, the NAFZ splays into two major strands; the northern and the southern strands. The corridor is located between 29°45'59" : 30°21'49" longitudes and 40°44'00" : 40°42'56" latitudes of the northern strand. According to GPS measurements this strand is the most active with approximate slip rates of 10-15 mm/yr (Straub et al., 1997), and includes the segment that slipped in the 17 August 1999 great Kocaeli earthquake (M=7.4). The surface rupture of this earthquake pass through the corridor and an extensive subsidence along the southern side of the corridor, liquefaction and lateral spreading occurred near the towns of Sapanca, Gölcük and Hersek in that shock (Lettis et al., 2000).

The analyses of this research endeavours to interpret the relative intensity of active tectonics through the study of morphological features and assess the spatial variations of Plio-Quaternary deformation and tectonic activity of the NAFZ in and around the Izmit - Sapanca Corridor.

TECTONIC SETTING

The geological evolution of the study area is divided into two major periods called the paleotectonic and neotectonic periods. The Lake Sapanca located in the eastern part of the Izmit - Sapanca Corridor. This depression lies on a paleotectonic suture zone (Intra-

Pontide Suture Zone; Şengör and Yılmaz, 1981) that formed due to collision of Laurasian derived continental fragment (Istanbul Zone) to the Gondwanan derived continental fragment (Sakarya Zone), as a result of the northward subduction of Neotethys oceanic plate during Early Eocene period (Okay et al., 1994); subsequently this region was exposed to post-collisional compressional forces during the Late Eocene-Early Miocene times (Sunal and Tüysüz, 2002). Late Miocene-Early Pliocene times defined as another N-S compressional period (Emre et al., 1998). The faultings related to this tectonic stage cannot be observed in the Kocaeli Peneplain to the north of the study area. All the structural elements related to this compressional regime were developed in the south of the Izmit-Sapanca Corridor. This period related with the deformation of the North Anatolian Shear Zone (Şengör et al., 2005) as defined as the early stage of the NAFZ in the study area.

The neotectonic period in Turkey started by the collision of Arabian and Anatolian plates along the Bitlis-Zagros Suture Zone to the southeastern Turkey and the westward escape of Anatolian plate in the Late Pliocene (Koçyiğit et al., 2001). The NAFZ extends from Karlıova in the east to Gulf of Saros in the west in an approximately E-W direction between the Eurasia and Anatolian plates and connecting the East Anatolian compressional regime to the Aegean extensional regime with about 1200 km in length and 100 km in width. The Adapazarı basin, Izmit-Sapanca Corridor and the Marmara Sea located on the northern strand of the NAFZ that the seismically most active strand. The present day morphotectonic framework of the study area was mainly set in the Late Pliocene-Quaternary period by the strike – slip tectonics of the NAFZ.

MORPHOTECTONICS

The Izmit – Sapanca Corridor is an about 12.5 km wide (maximum), 50 km long and E-W trending trough originated from strike – slip and oblique faulting pattern. The corridor is divided into three morphotectonic structure along its longitudinal profil. The western part of the Izmit – Sapanca Corridor is a 200 m deep depression that filled by Marmara Sea and called as Gulf of Izmit. The middle part of the corridor (Izmit plain) is a terrestrial environment with an average altitude of 30 m. The eastern part of the Izmit – Sapanca Corridor is a lake basin with a depth of 53 m (Lettis et al., 2000) that called as Lake Sapanca. The water surface elevation above sea level is 35 m.

The northern and southern margins of the Izmit – Sapanca Corridor are defined by series of mountain ranges. The Samanlı mountains in the south of the corridor was heaved as a pressure ridge structure. The northern margin defined as Kocaeli Peneplain in nomenclature. The surrounding topography of the Izmit-Sapanca Corridor is asymmetric and being steeper along the southern side of the corridor where Samanlı mountains rises steeply to over 1500 m from the depression floor, which is 35 m above sea level. At the northern side, the topography of the Kocaeli Peneplain that bounds the depression is more subdued and tilted northward.

The mountain ranges are composed of Paleozoic to Early Tertiary metamorphic and sedimentary rocks which form the basement geology for the region. In the southern side of the Kocaeli Peneplain to the north of the study area, Paleozoic - Early Tertiary rocks crop out as uplifted basement against the basin-fill deposits of the corridor and consist of sandstone, clayey limestone, marl and interbedded sandstone and shale. In the northern front of the Samanlı Mountains that situated to the south of the Izmit – Sapanca

Corridor, lithology mainly consist of Paleozoic - Mesozoic rocks that includes metamorphic rocks.

The faults along the northern and southern sides of the depression, indicate mainly oblique normal faulting as mountain front faults. The northern side of the Izmit-Sapanca Corridor is fault bounded, but as a result of subdued topography the faults are morphologically less marked whereas the faults along the southern side of the depression deep steeply to the north side of the corridor.

CONCLUSIONS

The geomorphic approach, carried out in field studies of the faulted mountain fronts around the Izmit – Sapanca Corridor showed that the southern side is relatively active from the northern side due to a series of geomorphic evidence of tectonic activity such as, alluvial fans, facets, steep fault scarps and elongated ridges.

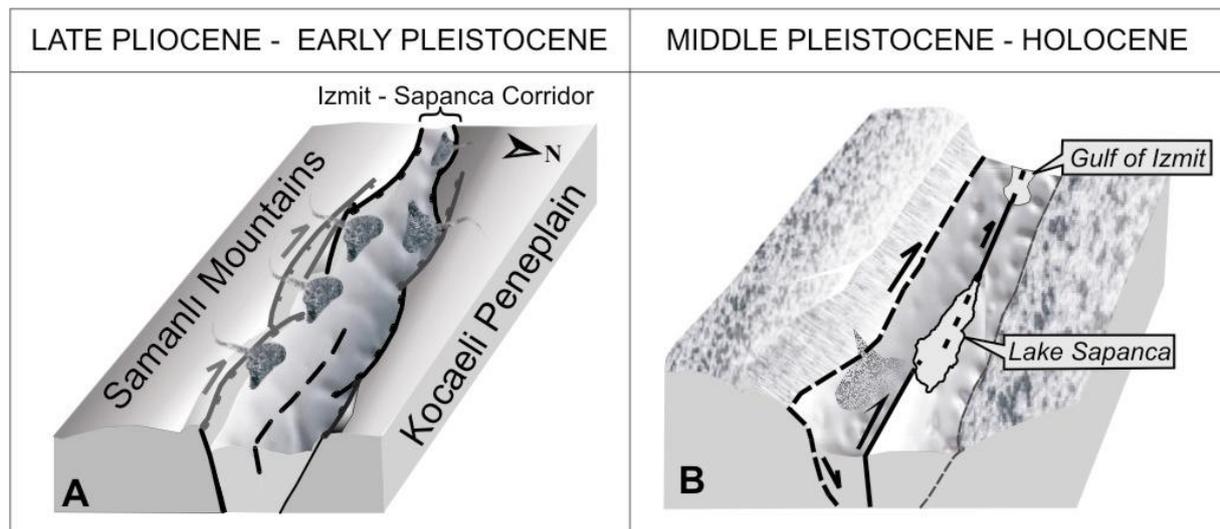


Figure-1. Schematic block diagrams showing the consecutive stages of morphotectonic evolution of the study area from Late Pliocene (A) to present (B).

The fault geometry in the Izmit-Sapanca Corridor characterized by mountain front faults on both sides. Results of the geomorphic research of this study proved that the southern mountain front boundary is dominantly active relatively to the northern one and showed characteristics of a master fault.

Along the northern strand of the NAFZ (like the other portions of the NAFZ) pull-apart basins and other strike-slip fault related morphological features developed. The Izmit-Sapanca Corridor is an asymmetric pull-apart basin that developed in the Late Pliocene along this strand. And this corridor cut-across by cross-basin fault in Middle - Late Pleistocene.

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