The Eastern Marmara pull-apart junction (North Anatolian Fault) and its relation to the submarine end of the 1999 Izmit earthquake rupture

G. Uçarkuş (1,2), R. Armijo (2), N. Pondard (2), B. Meyer (3), Z.Çakır (4)

(1) ITU, Eurasia Institut of Earth Sciences (34469), Turkey (2) IPG Paris, (UMR 7578 CNRS), France (3) University Pierre et Marie Curie, Paris (UMR 7072), France (4) ITU, Faculty of Mines (34469), Turkey. (ucarkus1@itu.edu.tr)

The North Anatolian Fault makes a major transtensional stepover in the west which forms the lithospheric scale Sea of Marmara pull-apart and smaller pull-apart basins at a range of scales. The easternmost pull-apart basin (Çinarcik Basin) is located at the junction where the strike-slip tectonic regime of the NAF dramatically changes into the oblique extension. Faults with large normal component bound the Çinarcik basin. They are clearly identified in the submarine morphology as well as in the deep seismic reflection profiles (down to 6 km) and shallow 3.5 kHz profiles (down to 50 m). The sediment fill in the basin records the evolution of the activity of these normal faults. Sedimentation rates and vertical components of slip are estimated and discussed from these profiles. The historical and instrumental seismicity indicates that the rupture of these oblique faults are probably associated with significant normal faulting earthquakes (e.g., 1963 and 1894). The 1963 Ms 6.4 Çinarcik earthquake has clear normal faulting mechanism.

The 1999 Mw 7.4 Izmit earthquake ruptured with purely right-lateral strike-slip motion. Modelling of InSAR and GPS data suggests that the Izmit rupture extended offshore to the eastern entrance of Çinarcik Basin. We performed an ultra-high resolution bathymetric survey with the ROV Victor 6000 to explore the geometry of fault breaks. The micro-bathymetry data allows us to identify with confidence the submarine extension of the Mw 7.4 1999 Izmit earthquake rupture. It is clearly expressed as a series of fresh fault breaks across the bottom of a submarine canyon at 180 m depth, 10 km west of the Hersek peninsula. The flat floor of the canyon appears to result from leveling by significant sediment transport. So, on the average the sedimentation rate must be low. Under such conditions, only the last earthquake break can be preserved across the canyon floor. Microbathymetry suggests the 1999 fault scarp is there 0.5 m high. The break continues for some kilometers to the west and appears to end at the junction with Çinarcik basin normal faulting, suggesting that the fault complexity at the junction acts as a barrier to rupture propagation of large earthquakes. Our findings are consistent with the 1999 rupture deduced from SAR interferometry. The evolution of the sedimentation and faulting in Çinarcik basin appears critical for a better understanding of mechanical fault interactions at the junction.