Turbidite paleoseismology in the Sea of Marmara Sea

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The Sea of Marmara (SoM), being located on the North Anatolian Fault (NAF), is a tectonically very active basin. It consists of three transtensional major basins (Çınarcık, Central and Tekirdağ Basins) in excess of -1250 m and smaller ones forming -100 to -200 m deep E-W elongated gulfs and bays, such as the İzmit and Gemlik Gulfs in eastern Sea of Marmara. The basins have steep slopes, especially in the north, with slope angles up to 29º.

The sedimentary infill sequence in the basins consists of about 75% turbidite-homogenite units (THU) and 25 % hemipelagic sediments and is deposited at sedimentation rates of 1 to 3 m/ka. Deposition of most of the THUs has been triggered by sesimo-tectonic activity that constitutes a serious geohazard in the densely populated coastal areas of the Marmara region. Identification and dating of these units are therefore important in determination of the repeat-time of earthquakes on different fault segments, and thus, for the probabilistic earthquake risk assessment in the area.

A systematic study of the sedimentological, physical and chemical characteristics of THUs in several cores recovered from the different Marmara basins characterizing different segments of the NAF was carried out, using high resolution digital X-Ray Radiography and XRF Core Scanner, MSCL and grain-size analyses. The units were dated using AMS 14C and radionuclide methods.

Using the physical and geochemical propeties, THUs can be correlated in different cores located along depth transects in the basins. THUs are commonly characterized by multiple sand-silt laminae at the base and a homogeneous mud at the top. The basal unit has a sharp and often erosional basal contact and occasional bidirectional cross-bedding. These multiple sand-silt laminae of some THUs show upward decreasing thickness and grain-size that are indicative of deposition by a single turbidity current reflecting or deflecting from the opposite slopes. Others are of different thickness and composition showing characteristics of amalgamated turbidites, sourced from different slope regions. Fluid escape structures such as sand lenses and balls in a mud matrix are also common features.

Radionuclide and AMS14C dated THU in the different basins of the SoM can be confidently correlated with historical records and provide recurrence time of 300 to 350 years for the last 5000 years, which is compatible with the slip rates from GPS measurements. However, the intervals between two consequtive events vary widely between 150 to 650 years.