



Submarine Paleoearthquake Records and Seismic Risk Assessment in the Sea of Marmara, Turkey

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Long-term paleoearthquake history of faults is important for probabilistic earthquake risk assessment. Such records can be obtained from the study of mass-transport units triggered by seismic activity in marine and lake basins. The Sea of Marmara (SoM), located on the North Anatolian Fault (NAF), is an important laboratory for the study of paleoearthquake records, mainly because it has: a) more than 2000 years of historical earthquake records with which radiometrically dated sedimentary earthquake records can be correlated, b) high sedimentation rates ($\leq 3\text{m/kyrs}$) so that individual events can be distinguished, and c) cold fluid and hydrocarbon seeps along active faults, leaving sedimentary and geochemical signatures of earthquake activity. After the destructive 1912 Mw 7.4 Mürefte and 1999 Mw 7.4 Izmit and Mw 7.2 Duzce earthquakes, the SoM represent a seismic gap. It is therefore crucial to obtain information on the long-term earthquake history of the NAF in the SoM.

We have carried out a systematic study of the 24 cores recovered from the various Marmara basins and high characterizing the different segments of the NAF, using high resolution digital X-Ray Radiography and μ -XRF Core Scanner, MSCL physical properties and grain-size analyses. The chronology was determined using AMS radiocarbon and radionuclide methods. Turbidite-homogenite deposits (TH) triggered by earthquakes are commonly characterized by multiple sand-silt laminae above a sharp and often erosional base and a homogeneous mud at the top. However, in shallow basins (<110 m) such as Gölcük and Gemlik, the TH units consists of red brown coarse to medium silt units having a sharp basal boundary. The basal TH parts have high gamma density and magnetic susceptibility, and are often enriched in one or more of elements, such as Si, Zr, Ca, Ti, K and Fe, indicative of coarse detrital silicate and carbonate shell input.

Radionuclide and radiocarbon dated TH units in different basins of the SoM can be confidently correlated with historical earthquake records. The sedimentary records measured over more than 5000 yrs provide average earthquake recurrence time between 220 and 300 yrs for the various segments of northern branch, and 1000 yrs for the middle NAF branch in the Gemlik Gulf. These results are compatible with GPS velocities and geological slip rates. However, the intervals between two consecutive events vary widely between 90 to 1500 years for the different northern NAF segments.

The last earthquake event recorded in the Golcuk and Karamursel basins is the 1999; on Prince Islands segment in the Çınarcık Basin the 1894; in the Central High and Central Basin the 1963; in the Tekirdağ Basin and Western High the 1912; and in the Gemlik Gulf the 1855 earthquakes. The western High and Central Basin records suggest that the 1912 earthquake rupture is unlikely to have reached beyond Western High into the Central Basin. The only earthquake recorded on the sediment covered Central High segment for the last 15 ka is a faint, far-field expression of the 1963 event having an assigned epicentre in the southern Çınarcık Basin. This suggests that the Central High segment SW of Istanbul has been creeping, and that the rupture of the 1963 earthquake may have extended from the southern Cınarcık Basin to the Central High.