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Sedimentary earthquake records in the Sea of Marmara

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The Sea of Marmara (SoM) is a tectonically very active marine basin located on the North Anatolian Fault Zone that is a major continental transform fault baundary between the Eurasian and Anatolian plates. The (SoM) consists of three transtentional major subbasins in excess of 1250 m depth and smaller basins with 100-200 m depth within the E-W elongated gulfs and bays. The major subbasins have steep slopes especially in the north with slope angles greater than 18ž.

The sedimentary infill sequence in the deep basins consists of about 75% turbidite-homogenite units and 25 % hemiplagic sediments, deposited at sedimentation rate of 1 to 3 m/ka. Deposition of most of the turbidite-homegenite units (THU) has been triggered by sesimo-tectonic activity that constitute 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.

We studied the sedimentological, physical and chemical characteristics of THUs in several cores recovered from different parts of basins, and identified the record of the devastating (Mw=7.4 1999) Izmit earthquake in the Izmit Gulf, using high resolution digital X-Ray Radiography and XRF Core Scanner, MSCL and grain-size analyses.

The units were dated using AMS C-14 and radionuclide methods. THUs are characterized by a relatively thin sand-silt unit at the base and thick homogeneous mud at the top. Digital X-ray radiography indicates that the THUs have multiple sand-silt laminae in the basal unit showing bidirectional foresets and a sharp and often erosional basal contact. The presence of the multi-laminae in the basal sub units with bidirectional cross-bedding indicates deposition by a single turbidity current reflecting or deflecting from the opposite slopes. The XRF Core Scanner analysis indicates that the basal units are usually enriched in Ca, and the whole of the THU unit is depleted in Mn. The high Ca is due to enrichement of biogenic calcite (e.g., benthic forams and bivalve shell fragments) that was originally deposited in upper slope regions and later transported to the deep basin by the turbidity flows. The Mn anomaly can be explained by high upward methane flux and associated anarobic methane oxidation at or near the seafloor during the crustal deformation and fault rupture, leading to suboxic-anoxic bottom water conditions. The sedimentary records of earthquakes identified in this way, and dated by the radiometric carbon and radionuclide methods, can be confidently matched with the historical earthquakes in the area.