Late Quaternary stratigraphy and sedimentology of the Marmara Sea: Implications for tectonic studies

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High resolution sub-bottom profiles on the shelf edge in various parts of the Marmara Sea generally includes a sediment wedge that within the seismic penetration depth of the subbottom profiles, appears to extend back to at least marine isotope stage (MIS) 11 (~360 kyr). The seismic units in the sediment wedge are separated by shelf crossing unconformities that can be clearly correlated with sea-level lowstands in the global sea-level curves based on the oxygen isotope data. The most conspicuous unconformities occur at the base of Units 1 and 5 deposited broadly during the Marine Isotope Stage 5 (MIS-5, ~80-127 kyr BP) and MIS-1 (mainly Holocene), respectively. These units are represented by mainly seismically transparent transgressive muds (high stand systems tract, HST) that have a maximum thickness of about 2.5 and 12 m, respectively on most parts of the northern shelf. The intervening Units 2, 3, and 4 were deposited during MIS-2, MIS-3, and MIS-4, respectively and represent relatively low stands in the Marmara basin. Unit 2 has been largely eroded in most parts of the shelf. They are generally represented by parallel to prograding reflections, having internal reflection characteristics indicative of relatively coarse-grained sediments.

The cores recovered from the shelf edge and pressure ridges reach up to MIS-5 and, together with seismic and bathymetric data, give important information on the late Quaternary evolution of the Marmara Sea. According to the core data, the Marmara Basin was marine during MIS-5 and 4, but mainly fresh to brackish, disconnected from the Mediterranean during the deposition of MIS 3 and 2. The basin was last inundated by Mediterranean waters at ~12 kyr BP ($^{14}C_{uncalib.}$). The shoreline of the Marmara "lake" prior to the transgression was at –85 m, controlled by the bedrock sill depth of the Çanakkale (Dardanelles) Strait. Another shoreline is located at -64 m, probably formed during Younger Dryas still stand. These shorelines, together with a sapropel unit dated 10.6 - 6.4 kyr BP and two ash layers originated from the Santorini Cape Riva and Campanian eruptions (dated 22 ka BP and 39.3 ka BP cal. year respectively) provide important time lines for studying tectonic events and rates.
The geometry of sediment fill in the ~1250 m-deep basins with steep slopes (>15-28º) shows the changing rates or styles of tectonic activity and sedimentation rates in the basin. The rates of thickening and the dipping of the strata in the basins have been determined by the interplay of the rates of subsidence, sedimentation and sea-level change. The basinal sediments are characterized by alternation of normal hemipelagic sedimentation and turbidite-homogenite (T-H) units that are mostly deposited during seismic events. As such, they are important archives of past earthquakes. The T-H units commonly consists of a thin (<5 cm) sand layer with erosional lower contact at the base and a relatively thick, homogeneous mud layer at the top. They thicken towards the deepest, subsiding part of the basins close to the active Main Marmara Fault. The relatively coarse turbiditic units correspond to different units in a discontinuous Bauma sequence. Some demonstrate "amalgamated" features, typical of deposition from

reflected or deflected single turbidity currents. As a result of mass flow sedimentation, the deep basins are characterized by very high (>1 m/kyr), but variable sedimentation rates that are controlled by the morphotectonics and glacio-eustatic water-level changes (i.e., lacustrine vs. marine periods). The rates are the highest in the deepest, tectonically subsiding parts of the basins, and 2-3 times higher for the latest low-stand lacustrine period than those for the latest high-stand marine period.