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Contrasting seismogenic behaviors on the North Anatolian Fault in the Sea of Marmara

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Since the 1999 Izmit-Kocaeli earthquake, the Main Marmara Fault (MMF) of the North Anatolian Fault system in the Sea of Marmara has been considered at an imminent risk for a large earthquake. Land geodesy has difficulties characterizing the distribution of interseismic loading, and hence of slip deficit, on the offshore faults, and notably on the Istanbul-Silivri segment of the NAF. The need to clarify the status of offshore fault segments has motivated seafloor monitoring experiments and marine geophysical and sedimentological studies, notably in the framework of EMSO consortium and MARSITE and MAREGAMI projects. Results from cross-disciplinary projects have shown that aseismic creep, spatially correlated to active gas venting at the seafloor, occurs on the Western segment of the MMF. This segment is also capable to large earthquake ruptures such as the 1912 event. On the eastern part of the Sea of Marmara, the Istanbul-Silivri and Prince Island segments appear essentially locked. Moreover, the base of the seismogenic zone and locking depth appears to shallow (from 15-20 to 10-15 km) from west to east.

On one hand, we propose to further evaluate fault slip rates and distribution of locking ratio on individual fault segments using an elastic block model constrained by land geodesy data and marine observations (long-term fault slip rate estimates, local acoustic ranging results). On the other hand, we evaluate the temperature at the seismogenic depths by basin modelling. Results suggest that spatial variations of fault behavior in the Sea of Marmara may result from a combination of factors. First, thermogenic gas generation within the > 6 km thick sedimentary cover in the Western Sea of Marmara may contribute to unlock the shallow part of the fault by generating overpressures. Second, heterogeneity of the crust composition could be a factor as the North Anatolian Fault system follows the intra-pontide ophiolitic suture. For instance, long term post-seismic creep onland at Ismet Paşa has been related to the presence of serpentinite in the

fault zone. Moreover, high-density magnetic bodies have been identified along the MMF. Third, varying thermal regimes between the Western and Eastern parts of the Sea of Marmara may account for variations in the seismogenic depths. Seafloor heat flow in the Sea of Marmara is strongly affected by sediment blanketing and basin modeling considering this process suggests that the crustal heat flow is about 20 mW/m^2 higher in the eastern part than in western part of the Sea of Marmara. This difference may be explained by a more spread out crustal extension in the western Sea of Marmara.