Using Submerged Shorelines to Constrain Recent Rectonics on the Ganos Shelf, Western Marmara Sea

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Abstract

Following the devastating 1999 Izmit and Duzce earthquakes in northwestern Turkey, because of the impending seismic hazard facing Istanbul, the international community has initiated a series of expeditions to precisely map the fault system beneath the Marmara Sea, the only segment of the North Anatolian Fault that has not ruptured within the last century. Recent high resolution mapping of the sea floor has revealed sumberged shorelines on the shelf areas of the Marmara Sea and around the shallow basins. Uplifted marine terraces have served as tool for constraining tectonic activity in coastal areas because current orientations of these paleoshorelines record long-term tectonic influences by displaying the deformation of a previously horizontal surface. The same principle was applied to a pair of submerged paleoshorelines on the Ganos shelf at Gaziköy, south of the North Anatolian Fault, to constrain recent tectonic movement of that area.

The northeastern dip of the mapped shorelines, in contrast with the southeastern dip of the Gaziköy shelf and nearby uplifted terrace, illustrates a gentle anticline that plunges to the east. The eastward plunge of the anticline may be a response to far field stresses, such as uplift and compression of the Ganos Mountain to the west, while the N-S components of dip of the surfaces are related to the formation of the anticline. The normal component of the oblique slip along the Ganos segment of the North Anatolian Fault is responsible for the tectonic processes that have formed anticline. The southern block of the fault is backtilting due to isostatic rebound caused by unloading along the fault plane. This motion contributes to the tilt of the southern limb of the anticline. The entire southern block should be tilting to the south, but near field stresses, namely drag along the fault plane, are causing areas near the fault to dip toward the fault. This effect is seen in the northern dip of the submerged shorelines. The uplifted terrace does not reflect this near field stress because the terrace does not extend to the fault. If this terrace terminated at the fault the northern limb of the anticline would most likely be visible there as well. These dynamics show that the observed anticline is not a compressional feature, but rather is the result of near fault processes.