Contributions of fault gouge mineralogy on aseismic creep of active faults: the East Anatolian Fault (Eastern Turkey) as a case study

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In the complex tectonic setting of the Eastern Mediterranean, the westward motion of the Anatolian Block is accommodated mainly along its boundary faults, the North Anatolian Shear Zone (NASZ) and the East Anatolian Shear Zone (EASZ). Although there are relatively limited studies on the active tectonics of the EASZ, horizontal slip rate is suggested to be of about 10 mm/yr, using geodetic data. In terms of instrumental and historical seismicity, this sinistral strike-slip fault generated surface rupturing earthquakes along almost its entire length except two segments, Palu in the northeast and Turkoglu in the southwest, creating two seismic gaps on the East Anatolian Fault (EAF), the most prominent member of the EASZ. In spite of the fact that there are some off-fault seismic activities such as the 2010 Kovancılar Earthquake (M 6.1) in the vicinity of Palu Seismic Gap, recent geodetic measurements show significant aseismic creep, almost retaining the full far plate velocity (~10 mm/yr) for about 100 km-long section of the fault. Hence, the region is continuously monitored by various types of techniques, such as GNSS, InSAR, creepmeter, seismology, and high-resolution photogrammetry.

In addition to monitoring, we investigated the mechanical signature of the creep in the fault zone using fault rocks along the Palu Segment. We collected several samples directly from the deformation zone of the EAF, which makes the boundary between limestones of the Kirkgecit Formation and the chaotic alternation of volcanics, mudstones, and limestones of the Maden Complex, at two locations. The Underground Railway Tunnel Section (39.9504°N, 38.6976°E) is cut by the fault zone where the creep signals are recorded by a creepmeter. The X-Ray Diffraction (XRD) analyses of collected samples of this locality suggest the presence of montmorillonite (smectite group) as the main clay mineral in addition to chlorite-kaolinite with a negligible amount of illite-mica minerals within the fault rocks. This preliminary result suggests a linkage between the creeping and petrophysical properties of fault rocks, which are made of the weak smectite mineral and show no-frictional healing as the expected characteristics of the creep. However, the preliminary analyses of fault gouge samples from the Murat River Section (39.9696°N, 38.7043°E) yield a small amount of smectite group clays. We are going to extend our study at different locations in order to increase the spatial resolution on the relation between the fault rocks and...
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