Past and present slip rate analysis along the middle branch of the North Anatolian Fault

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Résumé

The North Anatolian Fault represents the main boundary between the Anatolian and Eurasian tectonic plates, which slip at about 26 mm/yr. In its western portion, it slips into three branches: northern, middle, and southern. Although on the middle branch (MNAF), the slip rate is ten times slower, historical earthquakes have ruptured it in 2000 years. This study focuses on the eastern part of the MNAF, in the Doğantepe–Geyve region, where it crosses a serpentinite massif, near its junction with the northern branch. This particular lithology has a strong influence on the fault behavior as it seems much more distributed.
We aim to characterize both long-term and short-term slip rates, as well as the seismic history of this segment, using a multidisciplinary approach combining geomorphological, paleoseismological, and INSAR analyses. Long-term slip was estimated through OSL dating of an offset alluvial terrace, and analysis of 10Be cosmogenic nuclides on three geomorphic markers: a shutter ridge, a wind gap, and the terrace. A paleoseismic trench, opened to identify past earthquakes, revealed at least one colluvial wedge structure related to one paleoearthquake that we aim to date using 14C on macrorests.
InSAR analysis (2014–2021) indicates low current slip rates on this segment (1.15 to 3.50 mm/yr), significantly lower than the 15.23–21.3 mm/yr observed on the northern branch. Some models suggest a locked fault between 4.10 and 10.56 km depth, which is surprising as the basement is made of serpentinites. Preliminary results indicate strike-slip strain accumulation for nearly 800 years without a confirmed seismic rupture, pointing to a high seismic potential. These results highlight the need for increased monitoring of this still poorly studied branch, located near densely populated areas.

Mots-Clés: North Anatolian Fault, Slip rate, Paleoseismology, InSAR, Geomorphology, Serpentinite, Seismic potential

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