A Long-Term Slip-Rate Study Along The North Anatolian Fault, Eksik, Turkey Using Cosmogenic ^{36}Cl

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"Are fault loading and strain release rates constant in time and space?" This is a fundamental but as-yet unanswered question in active tectonics. In order to assess the constancy of fault loading rates, it is necessary to determine slip rates at a variety of locations along the fault and at a variety of time scales. GPS (global positioning system) is a common tool for obtaining a snapshot of the recent slip history of a fault. Herein we describe our determination of the slip rate on a millennial scale from the North Anatolian fault near the village of Eksik, Turkey, where, during the summer of 2004, we mapped a series of dextrally-offset fluvial terraces.

The Eksik site is an ideal location at which to determine a long-term fault slip-rate because of (1) the relative simplicity of the fault system at this location; and (2) the availability of datable materials at the site. At Eksik, the surface trace of the North Anatolian fault trends east-west, and is crossed by near-perpendicular, south-flowing drainages. At present, these drainages are actively incising a sequence of fill terraces comprising predominantly limestone cobbles. We mapped a total of three terrace surfaces (T1–T3), differentiated by elevation, surface morphology, and lithology. Detailed geomorphologic mapping and aerial photo analysis of the offset terraces along the fault, as well as a highly detailed total-station topographic survey, allow us to constrain the minimum offset of terrace T3 to 43 ± 3 m. In order to date these terrace surfaces, we collected limestone samples for ^{36}Cl cosmogenic nuclide analysis. We collected both surface samples and a profile of sub-surface samples to a depth of 1 m. We have dated 10 of the surface samples from terrace T3, both north and south of the fault. Terrace T3 is removed from sources of fluvial and colluvial sediment input, and therefore surface samples should accurately characterize the deposition age. Nine out of the ten samples returned remarkably consistent ages of 1,700–2,400 years before present. Combination of these age determinations with our estimate of total offset yields a fault slip-rate of ~22 mm/yr. This value is in close agreement with recent GPS rates and with the few other geomorphic slip-rate determinations on the North Anatolian fault, suggesting that during the past 2,000 years there have been no major changes in the strain release rate along this major strike slip fault system.