Slip rate and geomorphology of the Chaman Fault: Implications for earthquake hazard in West Pakistan

Shuhab D. Khan[1]; Wanda E. Crupa[1]; Jingqiu Huang[1]; Abdul S. Khan[2]; Din M. Kakar[3] and Aimal Kasi[2]

[1]Department of Earth & Atmospheric Sciences, University of Houston, Houston, Texas, USA

[2]Center of Excellence in Mineralogy, University of Balochistan, Pakistan

[3]Department of Geology, University of Balochistan, Pakistan

sdkhan@uh.edu

Abstract

The Chaman fault is one of the greatest strike-slip fault systems in Central Asia and defines the western margin of the Indian-Asian convergence zone, yet this is one of the least studied faults. The Chaman strike-slip fault system lies between the Indian and Afghan continental blocks that may have been active since around 25 Ma and has an estimated total displacement of 460 ± 10 km along its ~900 km length. We have undertaken tectonic geomorphic, geochronological and geodetic investigations along the Chaman fault in search for evidence of temporal and spatial variations in motion.

Four study areas were selected for detailed studies over the span of the Chaman Fault: 1) the Tarnak-Rud valley, 2) the Spinatizha Mountain Range, 3) the Nushki basin, and 4) area near Kharan. Remote sensing data allowed for in depth mapping of different components and faults. Wind and water gap pairs were identified that show displacement for the Nushiki and Spinatizha areas of 2.2 km and 0.8-1.2 km respectively. The mountain-front-sinuosity ratio, valley height-to-width-ratio, and the stream-length-gradient index are used to determine the relative tectonic activity of each area. These geomorphic indices suggest that the Kharan area is the most active and the Tarnak-Rud area is the least active. GPS data were collected and processed that yielded a ~7-10 mm/yr displacement rate along the Chaman Fault in the Spinatizha area. InSAR data were used to assess displacement rates. Our data support that ultra-slow earthquakes similar to those found along other major strike-slip faults, such as the San Andreas Fault system, are possible along the northern segments of Chaman Fault zone.