

Detailed mapping of the Chaman fault near Kabul, Afghanistan, using ALOS Images

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Afghanistan is part of the central Asia, which is located in a geologically active region of the world. The tectonic activity in Afghanistan and surrounding area is as a consequence of the collision between Eurasian and Indian plates. As contemporary deformation continues in the region, moderate to large magnitude earthquakes are common and will continue to occur, which may cause serious damage to infrastructures. A massive earthquake of 7.3 magnitude hit the Kabul city on July 5 or 6, 1505, produced 60 km of surface rupture with several meters of vertical offset (Quittmeyer and Jacob, 1979). The rupture broke the northern end of the Chaman fault, which called separately as the Paghman fault.

The strike of the Paghman fault ranges from N16°E to N35°E. It starts from Paghman district that run just to the west of Kabul city, and then northeastward across the right-lateral Herat fault, up to where it terminates near the northern margin of the Kabul Block. The fault trends north and northeast and is marked by continuous, linear and arcuate fault scarps on piedmont alluvium and at the mountain front contact. The fault is a major active geologic fault extending to ~80 km. The general relief of the area is consisted of mountainous uplifts and depressions. Kabul area is divided into northern and southern depressions.

To better understand the distribution and level of seismic hazard along the Paghman fault, we are going to produce a detail map of the fault including the Kabul city to provide valuable input into this assessment. For studying the fault ALOS satellite images were used. The images were imported into ArcMap for georeferencing into a global framework and then mapped individual features. Here, a topographical variation method was used for interpreting the 3-dimensional view and then the mapping of the active fault is attempted. Based on this, an attempt was made to measure offset of small-scale features, and identifies stream deposits and other landforms that were left-laterally displaced along the fault from Paghman to Charikar. The features were characterized based on their continuity and expression in geologic young deposits with horizontal displacement. The interpretation was based on the presence of apparently displaced young landforms and deposits which are generally located in valleys along the margins of the Paghman mountains ranges. In places where young deposits and landforms are scarce or absent, such as in steep mountainous terrain and urban areas, we focused on prominent and continuous escarpments.

The geomorphic expression of the fault system in Quaternary deposits varies along the fault trace. The faults typically offset late Pleistocene and Holocene deposits and landforms and are generally marked by continuous fault scarps. Pleistocene and Holocene ages of alluvium are surficial deposits which are differentiated by the levels of dissection and surface morphology. The oldest alluvium is preserved as deeply dissected remnants of thick fan deposits that are now isolated at the tops of low hills. Young alluvium is being actively deposited at stream level in the bottom of contemporary valleys. Alluvium deposits are mapped on the steep slopes along the fault. River alluvium is in the wider active floodplains of the Paghman, Qargha, Shakardara, Guldara, Farza, Istalif, Shinwari and Ghurband rivers. We were able to measure the left-lateral displacement on some fault strands of active streams and river channels. The old alluvial fans have been moved left-laterally >250 m from their original sources. These fans are now located nearby to small mountain drainages. As a result, the geomorphic evidence shows that movement has occurred on the fault throughout much of Quaternary time.

