



Normal faulting in the northern Shanxi Grabens, China

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The Ordos Plateau forms a piece of non-deforming continental lithosphere in northeastern China. Despite being thousands of kilometres from the nearest plate boundary, numerous devastating earthquakes have been recorded around the margins of the plateau over the past 2000 years. Continental deformation in this part of Asia is believed to be caused by the ongoing collision of India with Eurasia; India is currently moving northwards at 40 mm/a. The rate of deformation around the Ordos Plateau, however, is significantly less; typical slip rates for faults bordering the plateau are of the order of 1 mm/a. This deformation is nonetheless important because the adjacent North China Plain is one of the most densely populated regions on Earth. The combined population of Beijing, Hebei and Shanxi Provinces is in excess of 125 million people—all potentially at risk from future earthquakes. Assessing the seismic hazard is clearly of vital societal importance.

The plateau is surrounded by extensional rift systems on all sides, except for the Liupanshan in the southwestern corner, where thrust faulting is dominant. The Hetao Graben lies to the north of the plateau, the Yinchuan Graben to the west, the Weihe Graben to the south and the Shanxi Grabens to the east, where they form an S-shaped series of en-echelon basins some 1200 km long. The northern portion of the Shanxi Grabens is characterised by east-northeast striking normal faults and asymmetric half-grabens with footwall blocks tilted to the south-southeast. GPS measurements in this region are sparse, but the existing data suggests a rate of extension across the northern Shanxi grabens of anywhere between 0 mm/a and 4 mm/a.

We have used optically stimulated luminescence dating of sedimentary quartz grains and Ar-Ar dating of basaltic lavas to determine ages for features which have been offset by the faulting. Combined with scarp heights and field measurements of fault dip, this data suggest a total extension rate across the northern Shanxi grabens that may be up to 3.6–6.5 mm/a. Qualitative observations of the tectonic geomorphology also provide evidence for fault growth and segment linkage in the region. Further work is needed to corroborate these slip rates, but the comparatively high rates obtained in this study may have implications for future seismic hazard.