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Two great historical earthquake ruptures revealed in Nepal

Earthquakes along the Himalayan arc happen because of continent–continent collision, where the Indian plate is colliding with the Eurasian plate at geologic and geodetic convergence rates of 30–50 mm/yr (refs 1 and 2). About 20 mm/yr of this convergence is mainly absorbed by the Main Himalayan Thrust[3], which thus accounts for about half of the total convergence rate between the Indian and Eurasian plates[2]. It is therefore an active tectonic boundary along which accumulated stress is primarily released through earthquakes. It reaches the surface at the Main Frontal Thrust fault[4], that marks the southern margin of the Himalayan range[5]. Thus, it is not surprising that the ongoing collision has resulted[6–9] in more than six major earthquakes along the Himalayan arc in the past ~100 years.

None of the historical earthquakes is reported to have produced primary surface rupture[10] and it has generally been assumed on the basis of isoseismals and location, that the earthquakes are the result of slip on the Himalayan Frontal Thrust[10]. However, the consensus that no primary surface rupture is associated with historical earthquakes was questioned after the 2005 Kashmir earthquake, which, although was relatively small (M_w 7.6), did produce co-seismic surface faulting[9,11] for a distance of ~80 km. This was subsequently confirmed by the field evidence, which found extensive thrust surface rupture[12].

Therefore, the 2005 earthquake was a wake-up call to scientists to rethink and re-evaluate the accepted consensus by using modern techniques to collect the pieces of evidence left by historical ruptures along the Himalayan front. Thus, the long-standing consensus was finally challenged by Sapkota *et al.*[13], by providing strong evidences that the M_w 8.2 Bihar–Nepal earthquake on 15 January 1934 did break the surface.

Using the extensive geomorphological mapping of fluvial deposits, palaeoseismological logging of river-cut cliffs and trench walls, together with modelling of calibrated ^{14}C ages, their study demonstrated that the M_w 8.2 event has left clear traces of rupture along at least 150 km of the Main Frontal Thrust fault in Nepal[13]. This is the minimum rupture length, which means that the total length of the rupture could be larger. Furthermore, they found an earlier earthquake of 7 June AD 1255, which has also ruptured the surface along this stretch of the mega-thrust[13]. This earthquake is believed to have destroyed one-third of the population in the Kathmandu valley[13].

The significance of this work lies in the fact that the surface ruptures of other reportedly blind great Himalayan events might exist and thus, evidences need to be recollected. This will be useful to understand the historical earthquakes and to re-evaluate the seismic risk along the Himalayan front.

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