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Short communication

No major active backthrust bounds the Pir Panjal Range near Kashmir basin, NW Himalaya

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ABSTRACT

This research disputes the geomorphic data presented in Dar et al. (2014), and demonstrates that their data strongly conflicts with their own field evidence, and also with the previous geological observations. The authors have proposed a major ~SW dipping frontal fault that bounds the Pir Panjal Range near Kashmir basin of NW Himalaya. However, field photographs show a very steep ~86° dipping normal fault. This therefore, contradicts with all the morphometric indices, interpretations, and discussion presented because those are based on a major ~SE dipping thrust fault that bounds Pir Panjal Range in Kashmir basin. The proposed fault is a major ~SW dipping backthrust, which primarily conflicts with the previous geological observations in Kashmir basin because mostly ~NE dipping major thrusts are mapped in this region. And presently only three major ~NE dipping faults, the Main Frontal Thrust (MFT), the Raisi Fault (RF), and the Kashmir Basin Fault (KBF), are tectonically active. The new proposed major active thrust, as suggested by the triangular facets mapped by Dar et al. (2014), was mapped on the basis of geomorphic evidence as a ~SW dipping thrust fault, and field evidence shows a normal fault, which utterly questions the nature, and significance of the new research work.

1. Introduction

Kashmir basin is located on the NW portion of the Himalaya Mountains (Fig. 1). It is formed as a result of continent–continent collision between the Indian Plate and southern Tibet. The current tectonic convergence across the mountains occurs at a rate ~18 mm yr^{-1} (Bollinger et al., 2014; Bilham, 2015). The geomorphic expression of the ~NNE directed convergence is usually articulated in topography as major structures (e.g. folds, faults), which roughly form perpendicular to the direction of regional stress vector (Malik et al., 2010, 2014, 2015). Thus the regional strain energy is accommodated, largely, by these structures, however some faults release slip seismically because the strain builds up in the crust and is sporadically released in massive earthquakes along the Himalayan arc (Bilham, 2015; Grandin et al., 2015). Worryingly a significant portion of the active Main Frontal Thrust (MFT) zone, which is the active plate-boundary fault between India and the Himalayan range, over a 120 km-long by 50 km wide fault plane (e.g. Avouac et al., 2015; Galetzka et al., 2015; Grandin et al., 2015), is densely populated. And in the past it has hosted a number of great and major earthquakes (e.g. 1255, 1505, 1833, 1934, 1950, 2005), and latest destructive earthquake that hit Nepal on 25 of April 2015 (Hossler et al., 2015), clearly suggesting that a significant portion of tectonic strain is released by earthquakes on MFT. However, some portion of the regional convergence is also absorbed by active deformation in the interior of Himalaya (Thakur et al., 2010; Vassallo et al., 2015), and Kashmir basin is one such examples (Shabir and Bhat, 2012; Shah, 2013, 2015).

Presently three major ~SE dipping faults, the Main Frontal Thrust (Schiffman et al., 2013), Medlicott–Wadia/Raisi thrust (Thakur et al., 2010; Vassallo et al., 2015), and the Kashmir basin fault (Shah, 2013, 2015) are considered active in Jammu, and Kashmir region of NW Himalaya (Fig. 1). The recent work of Dar et al. (2014) however suggests another major active ~SW dipping backthrust that bounds the PirPanjal Range. And this work shows that such a structure conflicts with the current geomorphic, and geologic observations, and it is contrary to the field investigations shown in their own research work (Dar et al., 2014). Thus any seismic hazard mapping, and convergence budget along the NW Himalaya should not include such a structure.

2. Structural setup of Kashmir basin

The structural architecture of Kashmir basin is consistent with a classic piggyback model (Burbank and Johnson, 1982, 1983), and completely inconsistent with pull-apart model (Shah, 2016) and it contains Pliocene to Recent sediments that are mostly formed in lacustrine, fluvial and glacial conditions (Burbank and Johnson,

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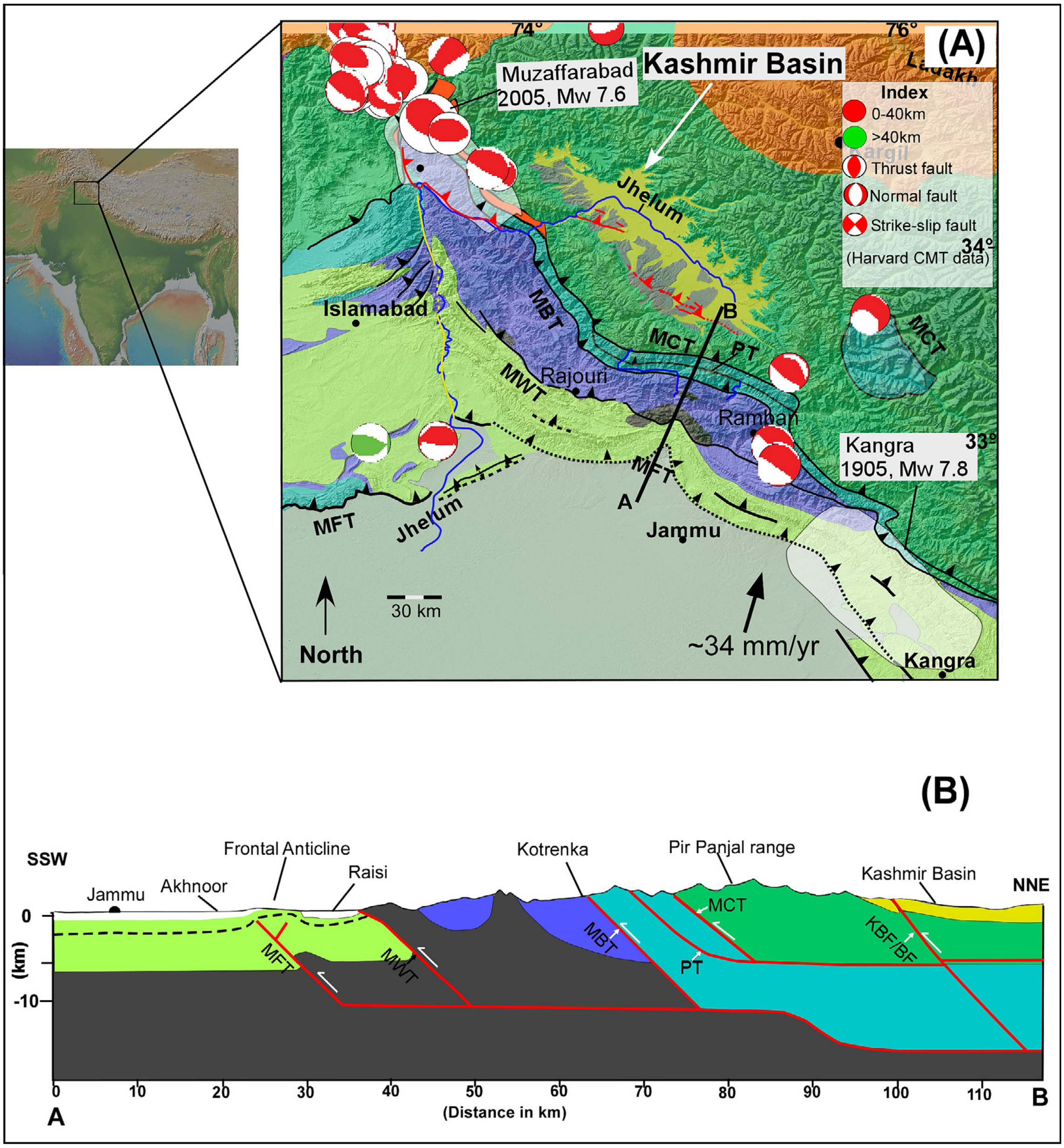

Fig. 1. (A) Tectonic setting of a portion of NW Himalaya, and the active tectonics of Kashmir basin (modified from Thakur et al., 2010; Shah, 2013, 2015; Vassallo et al., 2015). MCT = Main Central Thrust, MBT = Main Boundary Thrust, MWT = Medlicott–Wadia Thrust (MWT), and MFT = Main Frontal Thrust. (B) Simplified geological cross-section (after Shah, 2015).

1982, 1983). The active tectonic skeleton of the basin is clearly dominated by a major ~NE dipping thrust fault (Shah, 2013) that has modified the geomorphology of the basin (Fig. 1) wherein regions of the upper portion of the hanging wall are uplifted, and those of the lower portions are subsided (Shah, 2013). Since the basin is located ~100 km south of the active Himalayan frontal fault zone therefore the active nature of deformation in Kashmir basin is a classic example of an out-of-sequence thrusting in NW Himalaya (Shah, 2013, 2015; Mukherjee, 2015), and a crucial region to understand the earthquake hazard in the interior of NW Himalaya (Shah, 2015).

3. No major active backthrust bounds the PirPanjal Range

Dar et al. (2014) have studied the tectono-geomorphic evolution of the Karewa Basin, Jammu and Kashmir, NW Himalaya by using satellite data, topographic maps and digital elevation model (DEM). The geomorphic indices and various morphotectonic parameters are reported to be supported by the extensive field evidence. However, the field evidence strongly contradicts the geomorphic, and morphotectonic indices presented. The field photographs (Fig. 8 in Dar et al., 2014) show a very steep (~86°) normal fault (Fig. 8a and 8b in Dar et al., 2014) that is either dipping right, or left to the observer, the structural data (dip-amount, dip-direction and azimuth of the fault) are not provided (Fig. 2A–D). And importantly, this fault is not a thrust fault but a steep normal fault (Fig. 2), which goes against the crux of their paper. There are also variations in dip amount with depth of some of these mapped normal faults (Fig. 2), this poses structural problems as these variations are on outcrop scale. For example the dip amount of these outcrops varies from ~22° to ~86°, which is quite strange for the same fault, and at very shallow levels. The fault also show dip variation on a single photograph (Fig. 2E and F), which