Active fault, fault growth and segment linkage along the Janauri anticline (frontal foreland fold), NW Himalaya, India

Javed N. Malik a,⁎, Afroz A. Shah a,1, Ajit K. Sahoo a,2, B. Puhan a, Chiranjib Banerjee a, Dattatraya P. Shinde b, Navin Juyal b, Ashok K. Singhvi b, Shishir K. Rath a

a Department of Civil Engineering, Indian Institute of Technology Kanpur, Kanpur 208 016, UP, India
b Physical Research Laboratory, Ahmedabad 380 009, Gujarat, India

⁎ Corresponding author.
E-mail addresses: javed@iitk.ac.in (J.N. Malik), afroz.shah@jcu.edu.au (A.A. Shah), sahooajitkumar@gmail.com (A.K. Sahoo), shindedp@prl.res.in (D.P. Shinde), navin@prl.res.in (N. Juyal), singhvi@prl.res.in (A.K. Singhvi).
1 Now at School of Earth & Environmental Sciences, James Cook University, Townsville Queensland 4811, Australia.
2 Now at Reliance India Limited, Mumbai.

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A B S T R A C T

The 100 km long frontal foreland fold — the Janauri anticline in NW Himalayan foothills represents a single segment formed due to inter-linking of the southern (JS1) and the northern (JS2) Janauri segments. This anticline is a product of the fault related fold growth that facilitated lateral propagation by acquiring more length and linkage of smaller segments giving rise to a single large segment. The linked portion marked by flat-uplifted surface in the central portion represents the paleo-water gap of the Sutlej River. This area is comparatively more active in terms of tectonic activity, well justified by the occurrence of fault scarps along the forelimb and backlimb of the anticline. Occurrence of active fault scarps on either side of the anticline suggests that the slip accommodated in the frontal part is partitioned between the main frontal thrust i.e. the Himalayan Frontal Thrust (HFT) and associated back-thrust. The uplift in the piedmont zone along southern portion of Janauri anticline marked by dissected younger hill range suggests fore-landward propagation of tectonic activity along newly developed Frontal Piedmont Thrust (FPT), an imbricated emergent emergent thrust branching out from the HFT system. We suggest that this happened because the southern segment JS1 does not link-up with the northwestern end of Chandigarh anticline segment (CS). In the northwestern end of the Janauri anticline, due to no structural asperity the tectonic activity on HFT was taken-up by two (HF1 — in the frontal part and HF2 — towards the hinterland side) newly developed parallel active faults (Hajipur Fault) branched from the main JS2 segment. The lateral propagation and movements along HF1 and HF2 resulted in uplift of the floodplain as well as responsible for the northward shift of the Beas River. GPR and trench investigations suggest that earthquakes during the recent past were accompanied with surface rupture. OSL (optical stimulated luminescence) dates from the trench suggests occurrence of at least two events during the recent historic past, with the latest — Event II during 1500 AD (?).

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1. Introduction

The tectonic collision between Indian and Eurasian plates has made the Himalayan arc as one of the most seismically active regions of the world. Since collision (~50 Ma) along the Indus–Tsangpo Suture Zone, the successive zones of deformation have progressively advanced southward, resulting in faulting and folding along the prominent structural features of the Himalayan orogenic belt (Gansser, 1964; Seeber et al., 1981; Lyon-Caen and Molnar, 1983). From north to south these prominent structural features represent the principal intracrustal thrusts: the Main Central Thrust (MCT), Main Boundary Thrust (MBT), and Himalayan Frontal Thrust (HFT), with younger initiation ages towards the south (Thakur, et al., 2007). The strain accumulated across the Himalayan zone due to ongoing deformation has been episodically released in form of large to moderate magnitude earthquakes in the region. The recent 2005 (Mw 7.6) Muzaffarabad earthquake has again proved the capability of the Himalaya in producing large magnitude earthquakes. Field investigations revealed a rupture of about 65 km along an earlier identified “Tanda active fault” having lateral extend of about 16 km (Nakata et al., 1991; Kaneda et al., 2006; Yeats and Hussain, 2006). These earthquakes have raised concerns toward the seismic hazard assessment in Himalaya, especially in the foothill zones bordering the thickly populated Indo-Gangetic Plain. Apart from few large magnitude events in NW Himalaya with M≥ 7.6 viz. 1555 and 1885 Kashmir events; 1905 Kangra and recent 2005 Muzaffarabad, no historical records are available from this region. In seismically active regions of the