

# Seismotectonic Analysis of Pabbi Blind-Thrust in the NW Himalayan Foreland: Evidence from the 2024 Kharian Earthquake

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## Abstract

Ongoing deformations within the northwestern Himalayan foreland were probed through integrated seismic and gravity analyses. Local broadband waveform data from CES and PMD seismic networks of a moderate size (Mw 5.0) earthquake on December 5, 2024, near Kharian (NW Punjab, Pakistan) were inverted for source parameters to understand the subsurface geological structure and its tectonic association. The epicentral region is 30 km away from Mangla dam, where wider-scale damages were previously caused by the 2019 Mw 5.8 Mirpur earthquake and its secondary effects. A recent shallow-depth (3 km) seismic event exhibited a thrust mechanism with a relatively steep dip angle ( $35^\circ$ ) on a ramp anticline. The optimized present-day stress regime, derived from four events, indicates a causative fault with maximum horizontal stress oriented NNW-SSE, reflecting oblique convergence of the Indo-Eurasian plate. Gravity data from TOPEX satellites validated the mapped features. The distinct anomalies imply that the Pabbi ramp anticline constitutes an active blind thrust, partitioned by sinistral faults acting as transfer structures. Although the Main Frontal Thrust accommodates the majority of regional tectonic stress, recent deformation suggests localized shortening along the ramp-related Pabbi anticline, emphasizing its potential seismic hazard.

**Keywords:** Fault plane solution; present-day stress status; seismo-tectonic analysis; Pabbi Anticline

## How to cite

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