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Fault kinematic investigations along the Panchkula-Morni region, NW Himalaya, India

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The Morni hills located in the north-western Himalaya in Panchkula district, Haryana has undergone poly-phase deformation owing to its complex tectonic history. In order to better understand the kinematic evolution of study area, detailed structural analyses of the fault system at regional-scale is carried out. We perform paleostress analyses on the collected fault-slip data to derive the paleostress tensors. The fault-slip data includes attitudes of fault planes and slickenside lineations, and the sense of slip along the fault plane determined by observing various kinematic indicators. The study area mainly exposes compacted, fine- to medium-grained calcareous sandstones belonging to the lower Siwalik formation in the Himalayan foreland basin. The exposed sandstones contain numerous striated slip planes of varying slip-sense. As the fault planes are intra-formational and exposed in uniform lithology, sense of slip cannot be determined through offset markers. In such cases, the sense of slip of the fault plane is determined solely by observing various slickenside kinematic indicators and fracture types developed on the faulted surface. The slickenside kinematic indicators e.g., calcite mineral steps were found useful in deciphering the sense of movement of each of the slip plane. The paleostress inversion of fault-slip data was carried out by applying the open source software T-Tecto studio X5 to obtain the reduced stress tensor. The Paleostress inversion algorithm called the Right Dihedral Method (RDM) is executed to estimate the principal stress axes orientations. Temporally, the slip planes may have reactivated multiple times preserving multiple slickenside orientations superimposing one another. Such fault-slip data are called heterogeneous and therefore, multiple stress states are deduced to explain the heterogeneous fault-slip data. The paleostress analysis results indicate stress regime index (R') range 1.25–2.25 and 0.20–1.00 suggesting pure strike-slip to transpressive and pure extensive to transtensive stress regime respectively prevailing in the study area.