

Complex shear zone evolution revealed from garnets in Himachal Himalaya: Implications to Himalayan tectonics

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The Himalaya is a structurally complex and active orogenic system. To better understand Himalayan geodynamics, it is important to focus on studying the interaction between the footwall and the hanging wall. In this study, the garnets from the footwalls and hanging walls of two major shear zones, the Manali shear zone and the Rohtang shear zone from the Himachal Himalaya have been analyzed in detail to understand the footwall-hanging wall interaction and the evolutionary history of the area. In the Tethyan Himalayan Sequence, two distinct garnets (Grt1 and Grt2) growth events are observed, whereas the Greater Himalayan Crystalline (GHC) high-grade gneisses contain garnets with multiple growth zones (Grt3). Grt1 overprints an earlier folding and shearing event, as evidenced by the overprinting relationships and inclusion trails. Hence, Grt1 are unlikely to be a result of crustal thickening associated with folding as previously conceived. Further, the late idioblastic garnets, Grt2 are found in the Haimanta metasediments in conjunction with the Rohtang shear zone and overprints a mylonite fabric. As the euhedral garnets are in the hanging wall of the Rohtang shear zone, it is most likely a result of metamorphism in the hanging wall caused by high-temperature GHC rocks in the footwall. Garnet zoning profiles by microprobe analysis further corroborate this. This metamorphism is associated with Oligo-Miocene crustal expansion in the Rohtang shear zone. The results further indicate that the shear sense interpretation of inclusion trails in garnets might be misled by the overprinting of several fabrics and metamorphic events. The observations indicate that the sinusoidal inclusion trails seen in the study area are not indicative of a shearing event. Instead, they suggest that the trails are a result of garnet growth over a crenulation fabric, specifically related to the Phoajal folding event.