

Timing of Metamorphism and Extension in the Western Himalaya: Leo Pargil Dome, NW India

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Background

The Himalayan orogen is the product of significant crustal shortening and thickening that has occurred since the Eocene and has resulted in generally east-west trending major fault systems, such as the Main Central thrust zone and South Tibetan detachment system that accommodated displacement since the Eocene (e.g. Searle and others, 2003; Cottle and others, 2007). In contrast to these older structures, the Leo Pargil dome, NW India, is a 30-km-wide, northeast-southwest trending antiformal structure bound by normal faults (Thiede and others, 2006) that are interpreted to record the onset of orogen-parallel extension in this region.

The Leo Pargil dome is composed of amphibolite facies rocks intruded by multiple generations of deformed and undeformed leucogranite dikes and sills. In the deepest structural positions, the injection complex transitions into migmatitic gneiss. The northwest-dipping, ~300-m-thick Leo Pargil shear zone bounds the western limb of the dome and records top-to-the-northwest normal-sense shear and separates the footwall rocks on the western side of the dome from the low-grade Tethyan Sedimentary sequence (Thiede and others, 2006) and Upper Hiamanta sequence in the hanging wall.

Metamorphism

New pressure-temperature data from the Leo Pargil shear zone and the hanging wall were calculated using THERMOCALC. These data suggest that Barrovian-style metamorphism occurred at ~640 °C and 0.7 GPa in the staurolite-grade Upper Hiamanta sequence in the hanging wall of the Leo Pargil shear zone. Syn-kinematic staurolite growth during top-to-the-northwest shear on the Leo Pargil shear zone occurred at ~590 °C and 0.8 GPa. This data suggests that the rocks exposed within the Leo Pargil shear zone were exhumed from mid-crustal levels by significant displacement on the shear zone during orogen-parallel extension.

Geochronology

In situ U-Th-Pb dating of monazite from hanging wall rocks suggest that Barrovian-style metamorphism occurred during the late Eocene to early Oligocene, similar to other studies of the Upper Hiamanta group in the Sutlej valley (Chambers and others, 2008). Staurolite growth during top-to-the-northwest shear on the Leo Pargil shear zone occurred during the late Oligocene. This was followed by injection of multiple generations of leucogranite in the footwall during the early Miocene (Lederer and others, 2010). These data provide new constraints on the transition from crustal thickening to melting and extensional exhumation in the NW Himalaya.

References

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