

Magnetic Fabrics, Microstructures and U-Pb Geochronology of the Kinnaur Kailash Granite and Associated leucogranites, Himachal Himalaya: Implications for Extensional Tectonics in the South Tibetan Detachment Zone

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The South Tibetan Detachment (STD) is a system of low-angle normal faults that separates the High Himalayan Crystallines from metasedimentary rocks of the Tethyan Group. In the Himachal High Himalaya, the STD is characterized by presence of S-type per-aluminous Palaeozoic (~ 500 Ma) granite, called the Kinnaur Kailash Granite (KKG), in its hanging wall. This granite is also intruded by leucogranites in the vicinity of the STD zone. In the present work, an integrated magnetic-fabric analysis, microfabric analysis and U-Pb geochronology of zircons were carried out on the KKG and associated leucogranites in the Satluj and Baspa valleys of the Kinnaur region to understand the tectono-magmatic evolution of these granites with respect to the deformation history of the STD.

The magnetic susceptibility and thermal de-magnetization properties indicate that almost all the granite samples taken from this area are paramagnetic in nature with little or no magnetite. The degree of magnetic anisotropy (P'), which is an indicator of intensity of deformation, is higher for samples that lie in the vicinity of the STD as compared to samples away from the STD. The P' value of granites varies from 1.025 (CS9/1) to 1.393 (CS11/5) and their corresponding K_m value ranges from $18.2(10^{-6}$ SI) to $721(10^{-6}$ SI). The KKG and the leucogranites show no linear correlation between P' and K_m values suggesting that the magnetic anisotropy is controlled by intensity of deformation.

Strike of magnetic foliation of the granites in both the valleys shows a large variation, i.e. NW-SE close to the STD and E-W in the central part and then NW-SE again near the contact with the Tethyan rocks (Fig.1). Strike of magnetic foliation of leucogranites is sub-parallel to the STD with steep dips. The strike of magnetic foliation of the KKG develops a sigmoidal pattern on a regional scale indicating trans-tensional shearing related to deformation along the STD.

Microstructures in the KKG indicate superposition of a solid-state deformation fabric over a pre-existing magmatic fabric. Microstructures in granite near the STD show the signature of intense solid-state deformation. The intensity decreases away from the STD. The leucogranites show low temperature solid-state deformation fabrics. Shear criteria in the mylonites of the KKG and leucogranites suggest shearing related to eastward extension along the STD.

U-Pb geochronology of zircons of two samples of KKG yield crystallization age of ~475 Ma (CS11/2: 477 ± 3.4 Ma; MA4/5a: 472 ± 4 Ma). The leucogranite gives a crystallization age of ~20 Ma (MA4/6B: 18.5 ± 0.6 Ma). The zircons of MA4/5A also show the signature of a hydrothermal event (~20 Ma) at its rim.

From the present study, the following conclusions are made:

- 1) The regional sigmoidal pattern in the magnetic fabric of the KKG is caused by transtension due to eastward extension along the STD.
- 2) The microfabric indicates superposition of deformation features at various temperatures, indicating repeated activity along the STD.
- 3) Since the timing of the hydrothermal event in the KKG and the crystallization of the leucogranites are similar, it is proposed that the deformation in the KKG and crystallization of the leucogranites are synchronous and they are triggered by deformation along the STD.
- 4) Microstructures in the leucogranites suggest that deformation in the STD zone continued even after the crystallization of the leucogranites.

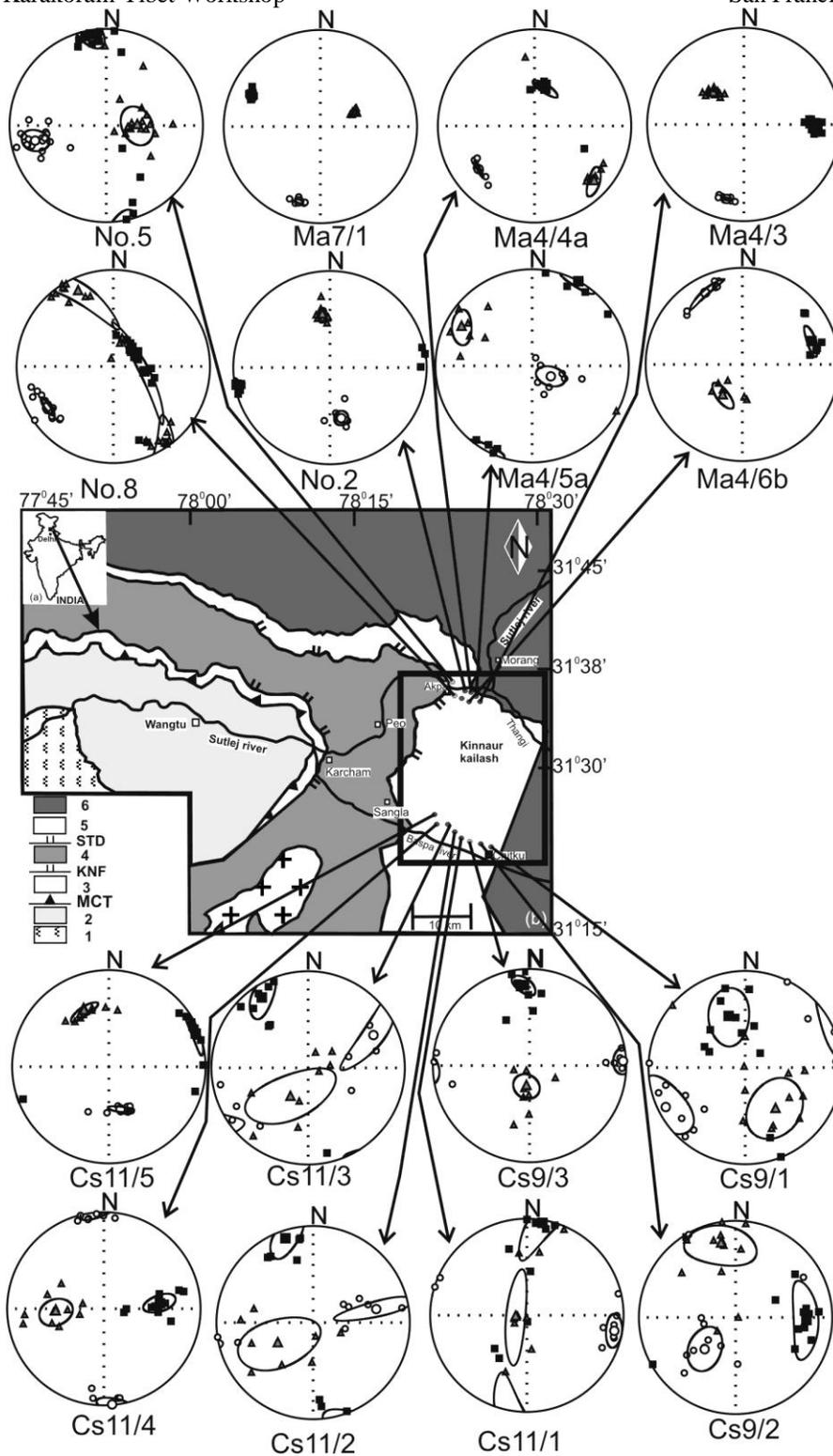


Figure 1. (a) Inset shows location of the area; (b) Geological map of the study area along with sample locations. Lower-hemisphere equal-area projections of AMS data of samples showing distribution of K1 (magnetic lineation; black squares), K2 (grey triangles), K3 (pole to magnetic foliation; open circles).