Department of Earth, Environmental and Geographical Sciences

Tectono-structural framework of the Solu-Khumbu region, east-central Nepal Himalaya

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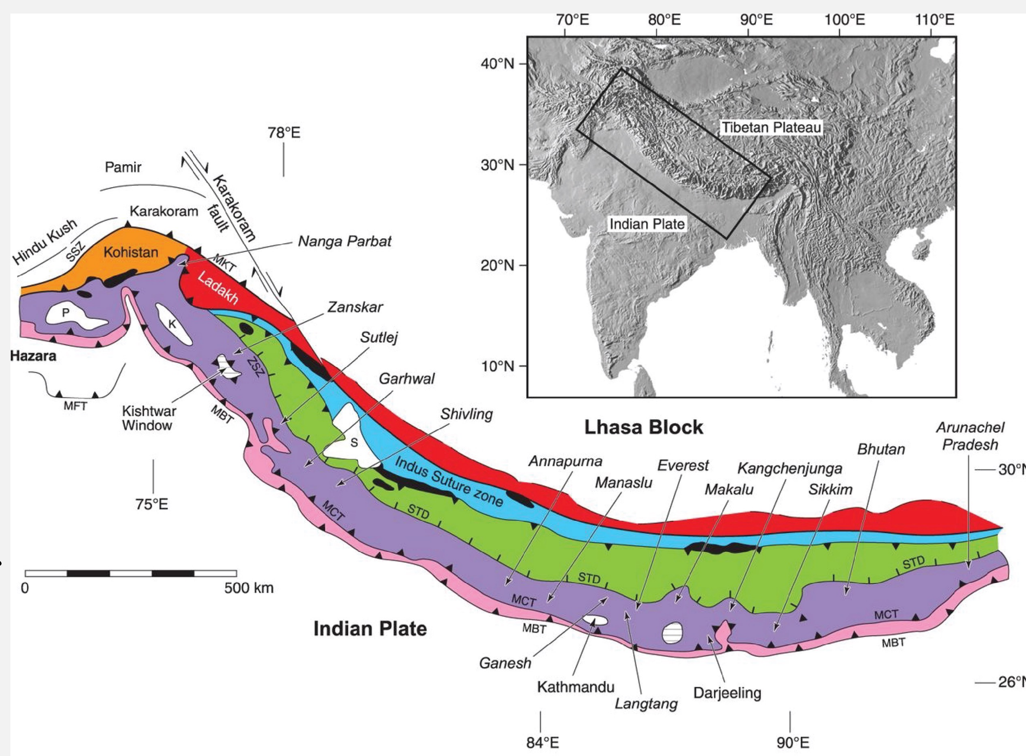
Introduction

Understanding the kinematic evolution of an active orogenic belt is crucial to elucidate the complexities of collisional tectonics.

The Himalaya is an active collisional margin that formed when Indian Plate collided with the Eurasian plate at around 55 million years ago. It is divided into four major lithotectonic units that are exposed at the surface today. Separating these units are a series of north-dipping shear zones that can be traced along the length of the orogen and that are each characterized by different structural and kinematic histories.



Simplified geological map of the Himalaya from Searle & Treloar, 2019

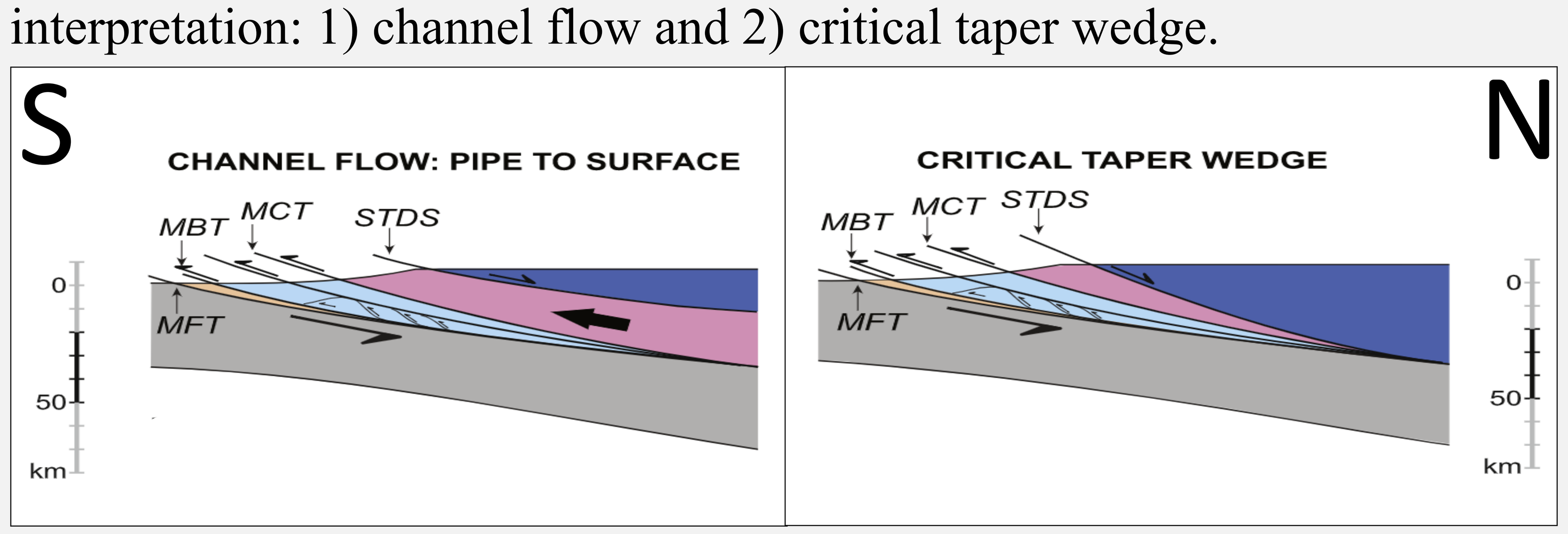
Here we present a quantitative study for identifying variation in the deformation characteristics of shear zones using the microstructures and crystallographic preferred orientation of quartz which combining with P-T-t data will provide a tectono-metamorphic evolution model, to better understand the exhumation process of the Greater Himalayan Sequence of Himalayan orogeny.

Field Photograph

a. Boudinage leucogranite sill from Greater Himalayan Sequence (GHS)
b. Isoclinal chevron fold from Lesser Himalayan Sequence (LHS)

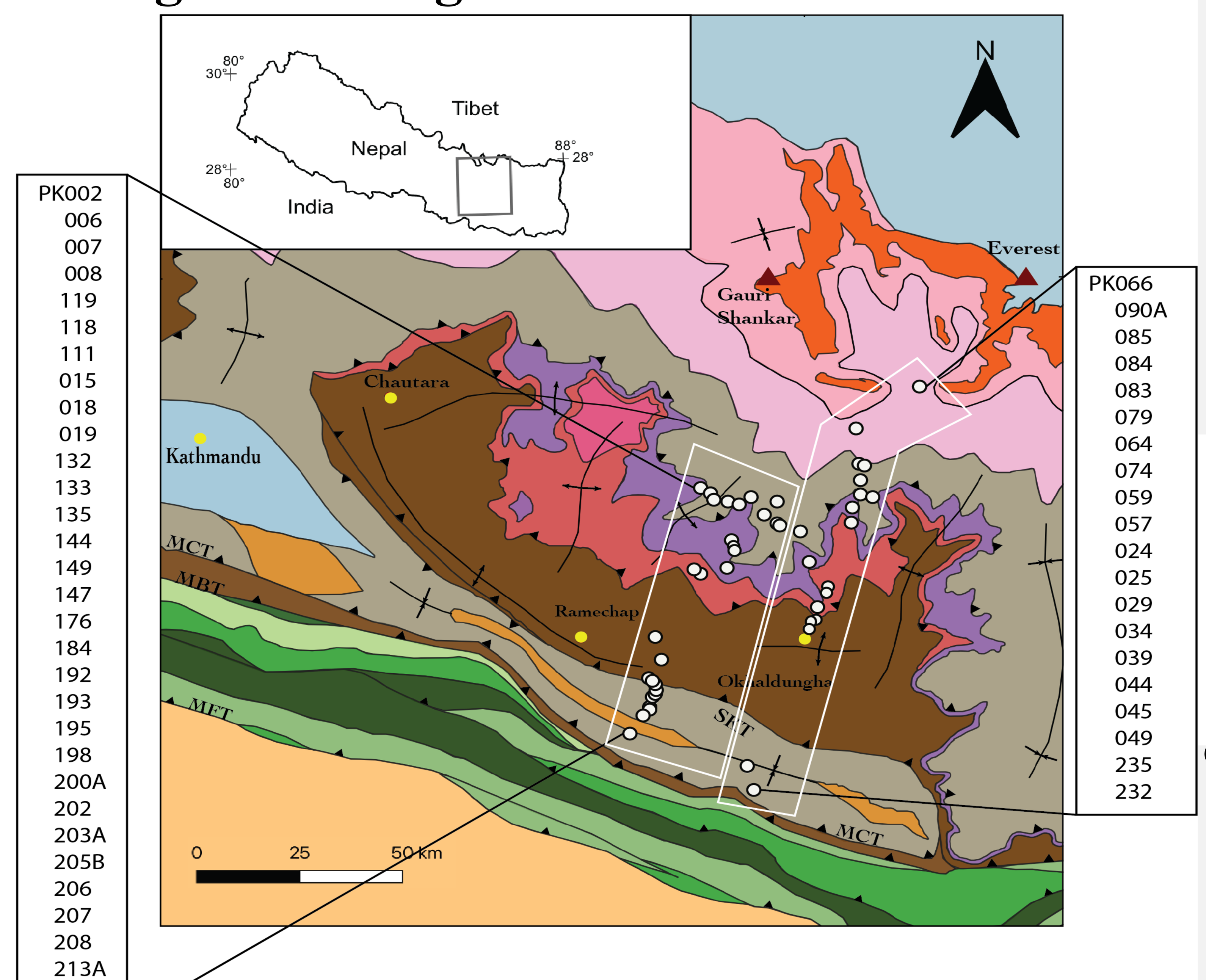
Orogenesis Hypotheses

Two end-member models dominate current Himalayan orogenic interpretation: 1) channel flow and 2) critical taper wedge.



Reference: J. M. Cottle et al, 2015

Geological Setting



Modified after Schelling (1992), Larson and Cottle (2014) and Larson et al.(2016)

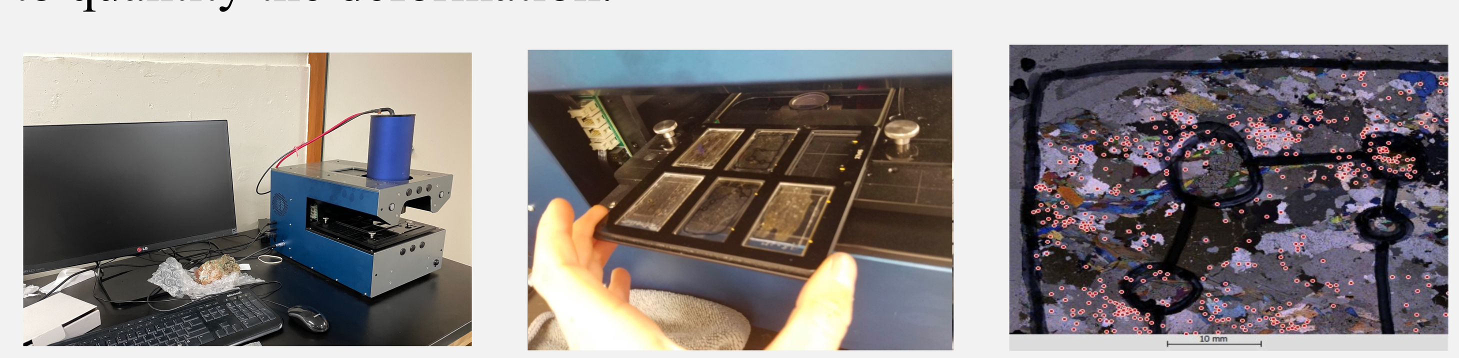
This study combines microstructural observations with quantitative analyses of fabrics from sheared rocks in the field area, we characterized the response of quartz to changes in deformation condition across the Ramechap window of the Greater Himalayan Sequence in the Solu-Khumbu region, east–central Nepal Himalaya.

Microstructure

From our observation, deformation at the proximity of the shear zone occurred at a high temperature with evidence of dynamic recrystallization whereas straight boundary condition with static recrystallization as recovery far from the shear zone.

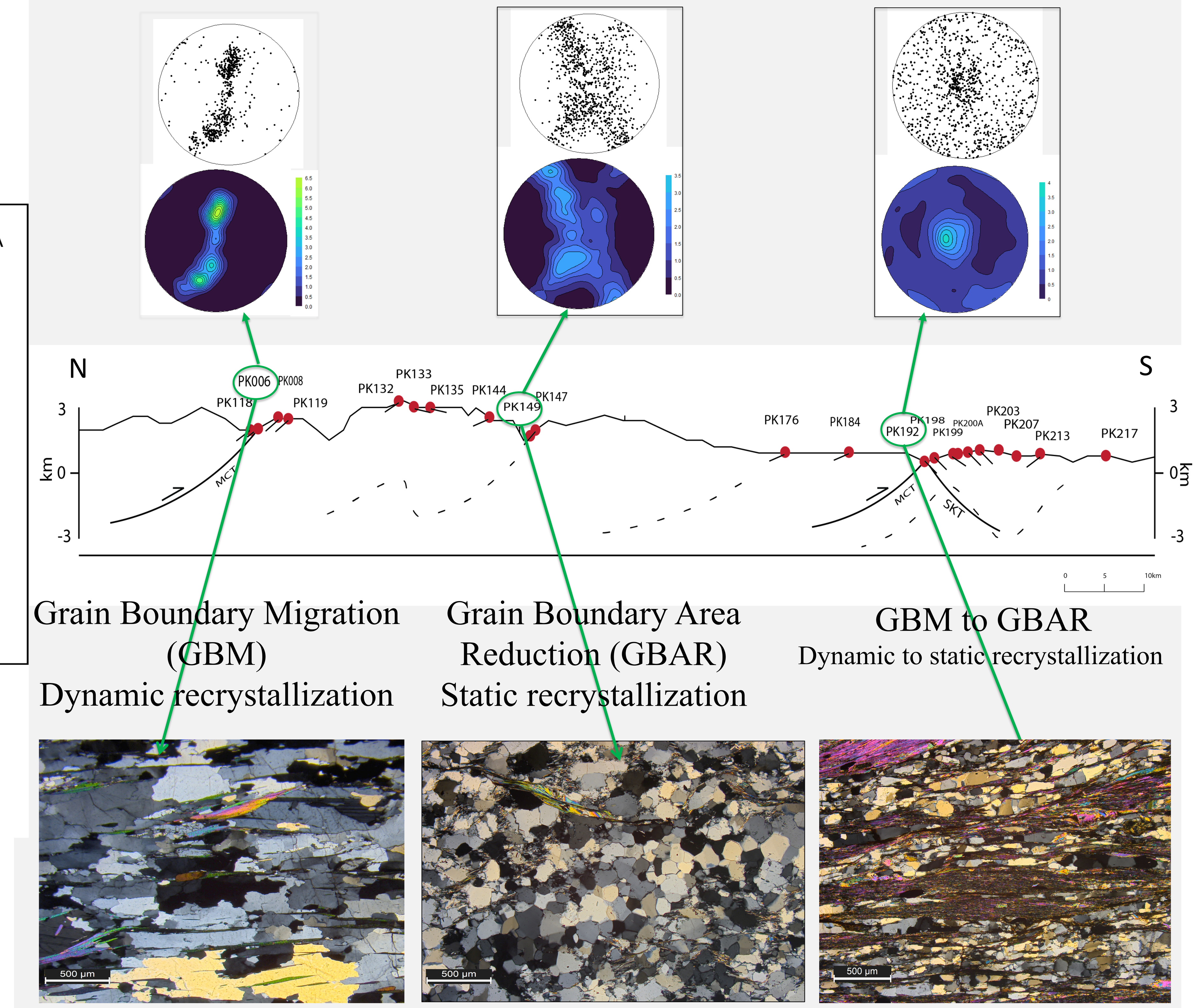
Crystallographic Preferred Orientation (CPO)

The c-axis of quartz crystals is an important component of CPO analysis because the strength of patterns it produces can be used to quantity the deformation.



The strengths of quartz c-axis patterns in the study area are consistent with microstructural observations: samples near the shear zone recording stronger fabric, and are therefore more strongly recrystallized, than those measured far from the shear zone.

Conclusion



From the microstructure and CPO data analysis we conclude that strain localization occurred near the shear zone. This confirms that fabric strength analysis is an effective method for deciphering strain localization in highly deformed rocks.

What's next?

Recrystallized grain-size piezometry of quartz will be used to constrain the stress conditions of rocks during deformation. We will then constrain the timing of deformation using in-situ geochronology (Rb-Sr in mica). Combining these methods with a pressure-temperature modeling will enable us to construct a P-T-t-d path for the rocks of the field area, which can be compared to the tectonic models for the orogen.

References

1. Cottle, J, Larson, K., Kellet, D., 2015, How does the mid-crust accommodate deformation in large-hot collisional orogens? A review of recent research in Himalayan orogen.
2. Schelling, D.,1992, The tectonostratigraphy and structure of the Eastern-Nepal Himalaya.

Acknowledgement

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