Thesis Summary

Deformation processes of crustal-scale faults depending on depth: Studies of paleo- and active orogenic belts from Indian continent

(深度に依存する地殻スケール断層の変形過程：インド大陸における古造山帯と活動的な造山帯の研究)

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The present research encompasses the study of deformation microstructures from fault rocks deformed at several depths to elucidate the variability of deformation mechanisms. Since, the study focusses on the exhumed fault rocks of Delhi-Aravalli orogeny (paleo-orogenic belt) and Himalayan orogeny (active orogenic belt), the results not only constrain deformation mechanisms from variable depths, but also provide important insights on tectonic scenario of the respective orogenies. Primarily, the studies were focused along the Rakhabdev lineament of Delhi-Aravalli orogeny, the Main Boundary Thrust (MBT) and the Nahan Thrust (NT) of Himalayan orogeny. Extensive fieldwork and detailed sampling were crucial for the initial stage of this research. Application of advanced techniques such as Scanning Electron Microscopy, Electron Backscatter Diffraction techniques and Transmission Electron Microscopy were necessary for characterization of deformation microstructures. Moreover, Raman Spectroscopic analysis and LA-ICP-MS were used for identification of serpentine minerals and U-Pb geochronology of samples, respectively. The present research indicates that the studied rocks deformed in ductile, brittle-ductile, and brittle regime as revealed from the study of microstructures within rocks of paleo- and active orogenic belt. The rocks of paleo-orogenic belt represent deformation experienced at ductile regime, specifically the microstructures and the crystallographic preferred orientation (CPO) indicate that the origin and deformation of the antigorite serpentinite occurred in upper mantle conditions, while the calcite veins cutting the serpentinites portray the deformation in shallow crustal conditions. Also, the tectonic setting of the Rakhabdev lineament as a paleo-subduction zone evolving to a crustal collisional setting has been inferred. The deformation in brittle-ductile to brittle regime is represented by the rocks studied from the active orogenic belt, indicating a sharp thrust contact for MBT (brittle-ductile regime), while a wider heterogenous damage zone for NT (brittle regime). Especially, the present study indicates the evidence of the seismicity from the NT. Additionally, the microstructures of the fault core of NT indicate lithology dependence of deformation mechanism, resulting in deformation either by cataclasis and frictional sliding, or by pressure solution creep. Also, the validity of the carbonate clumped isotope thermometry is tested to simplify temperature estimations techniques from shallow crustal fault rocks and the results indicate the potentiality of its application for estimating deformation temperatures of the fault rocks.