Geospeedometry as a tool for identifying different lithotectonic packages in Higher Himalayan Crystallines, Sikkim, India

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The Higher Himalayan Crystallines (HHC) in Sikkim, India is made up of an interlayered sequence of pelitic migmatites (Qtz-Kfs-Pl-Sil-Bt-Grt-Ilm-Rut-Crd-Spl, with Kfs > Pl), quartzofeldspathic gneisses (Qtz-Pl-Kfs-Grt-Ilm-Bt) and minor metabasites and calc-silicates. Unlike in the adjacent sections in Eastern Nepal (e.g. Goscombe *et al*., 2006), there is no obvious lithological contrast within the section of HHC studied by us in Sikkim. Thermobarometry indicates metamorphic pressures and temperatures of ~ 8 Kbar, 700 - 850 °C. Textural relations indicate an early decompressional path (documented by breakdown of garnet to cordierite, plagioclase or plagioclase + spinel), followed by cooling. This is similar to the path deduced by Ganguly *et al*. (2000) for other rocks from nearby regions. There is evidence of melts produced during the decompression (e.g. Harris *et al*., 2004), which presumably reacted with garnet during cooling to produce various symplectitic textures. While all of these features are found spread across the entire HHC sequence between the Main Central Thrust (MCT) and the South Tibetan Detachment System (STDS), compositional zoning in garnets are clearly different in different parts. We have modeled these compositional gradients using a code that allows multistage thermal histories with different boundary conditions to be handled. In the northernmost part of the HHC, just south of the STDS, compositional zoning indicates very rapid cooling.(e.g. from 800 - 600 °C within 100000 years). In contrast, in the southern part of the HHC just north of the MCT, there appear to be two groups of rocks: (i) initial rapid cooling for about 50000 years followed by slower cooling over the next 2 myrs., and (ii) single stage, relatively slow cooling between 800 - 600 °C over 0.5 myrs. These results show that it is possible to use geospeedometry to distinguish lithotectonic packages evolving with different P-T-t histories, even when petrographic criteria fail to reveal obvious distinctions. This may prove to be an easily applicable but useful tool for mapping in high grade terrains.

References

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Cenozoic topographic evolution of the Western North America Cordillera

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Stable isotopic studies of intermontane basins in the Rocky Mountains, Basin and Range and Sierra Nevada record the isotopic fingerprint of an evolving landscape during the Cenozoic. During the early Eocene the western edge of this orogen consisted of high proto-Sierra Nevada and to the east lay a broad plateau of the Sevier hinterland bordered on its east by intraforeland basins with local basement uplifts. Mean elevation was spatially and temporally transient with increased peak elevations and elevated relief migrating from north to south. This occurred at 50-47 Ma in SW Montana, at 40-35 Ma in N. Nevada, and by ~22 Ma in S. Nevada, as evidenced by large negative shifts in O isotopes that are diachronous in the Basin and Range. During this time the drainage basins in the Sevier foreland were reorganized which resulted in river capture events that caused rapid (<200 ka) and large O isotope shifts in these lakes. Sr isotopic studies of lacustrine rocks in the intraforeland basins and paleosols in the hinterland suggest that the drainage networks of these basins evolved from local networks draining adjacent basement uplifts to large catchments that extended deep into the Sevier hinterland. This drainage reorganization is diachronous first occurring in the north and sweeping south with time, as evidenced by the temporal variation in O isotope profiles in the intraforeland basins. North to south migration of a high rugged landscape is contemporaneous with the timing of core complex formation and volcanism. As such, our work is consistent with tectonic models calling for north to south removal of the Farallon slab or delamination of the mantle lithosphere, both of which would have caused a rise in surface elevations and triggered dissection of a pre-Cenozoic continental plateau.