Chemical & Physical Sciences
UNIVERSITY OF TORONTO
MISSISSAUGA

COLLOQUIUM

TUESDAY, MARCH 27TH, 2012
12:00 P.M. (SHARP) – 1:00 P.M.
CCT 2150

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"A HIMALAYAM TOP-DOWN PERSPECTIVE INTO MID-CRUSTAL FLOW PROCESSES"

The Nepal Himalaya offers an excellent view of an active thermo-mechanical continental collision orogen. This presentation offers a synthesis of key observations and interpretations made over 15 years that contribute to our understanding of continental collisional orogenic systems, from a top-down perspective.

The Himalayan orogenic core in central Nepal exposes two lithotectonic elements, separated by crustal-scale faults. The uppermost orogenic superstructure package, the Tethyan sedimentary sequence (TSS), is a Paleozoic-Mesozoic weakly-metamorphosed sedimentary sequence originally deposited on the northern margin of the Indian craton. The subjacent Greater Himalayan sequence (GHS), representing the infrastructure, comprises amphibolite to granulite metamorphic facies rocks and extensive granitic melts and migmatites. The TSS/GHS interface, the South Tibetan detachment system, acted as a Miocene normal-sense décollement zone during southward extrusion of the GHS, coeval with slip along the Main Central thrust at the base of the GHS.

Our research documents significant thickening (>150%) of the TSS early in the orogenic evolution, which is interpreted to have instigated burial and metamorphism of the GHS in Eocene-Oligocene. This first orogenic phase was then followed by extensive Miocene melt-weakening and southward extrusion of the infrastructure, and decoupling of the superstructure along the South Tibetan detachment system.

Based on microstructural, geochronological, and thermobarometry studies, the GHS can be divided in two domains. The lower domain contains peak metamorphic assemblages yielding a metamorphic field pressure gradient that increases up structural section from 8 to 11 kbar, whereas the upper portion of the GHS records a metamorphic pressure gradient that decreases up structural section from 10 to 5 kbar. During the extrusion phase, the GHS underwent almost equal coaxial and noncoaxial strain at temperatures ranging between ~450 °C to >700°C, similar to peak metamorphic temperatures determined by thermometry. This flow style was diachronous, occurring earlier in the upper part of the GHS, and propagated structurally downward and toward the foreland. The extrusion strain accommodated significant vertical thinning and horizontal stretching in the hinterland part of the orogen, which was counterbalanced by vertical thickening and horizontal shortening in the foreland. This hinterland-foreland transition, coinciding with the boundary between the upper and lower portions of the Greater Himalayan sequence, highlights the complementarity of deformation processes between orogenic cores and forelands.