Geophysical Research Abstracts
Vol. 21, EGU2019-5407-1, 2019
EGU General Assembly 2019

Linking timing of deformation across multiple exposures of an orogen-scale shear-zone: the case of the Himalayan Main Central thrust

Zoe Braden (1,2), Laurent Godin (3), Dawn Kellett (4), Chris Yakymchuck (5), and John Cottle (6)

(1) Geological Sciences & Geological Engineering, Queen's University, Kingston, Canada (zoe.braden@gmail.com), (2) Geological Institute, Eidgenössische Technische Hochschule Zürich, Zürich, Switzerland, (3) Geological Sciences & Geological Engineering, Queen's University, Kingston, Canada (godinl@queensu.ca), (4) Geological Survey of Canada, Dartmouth, Canada (dawn.kellett@canada.ca), (5) Earth and Environmental Sciences, University of Waterloo, Waterloo, Canada (chris.yakymchuk@uwaterloo.ca), (6) Department of Earth Science, University of California, Santa Barbara, USA (cottle@geol.ucsb.edu)

The spatial extent and dynamic evolution of orogen-scale shear zones renders the determination of the timing and duration of ductile deformation and displacement challenging. The Himalayan Main Central thrust (MCT) is one of the most intensively studied thrust-sense shear zones in the world, particularly regarding its timing and duration of displacement. Yet, available timing constraints vary greatly along the length of orogen such that 'when was the MCT active' remains unresolved. From the Himalayan hinterland to the Karnali klippe, the MCT is exposed multiple times in western Nepal along its transport direction. Pressure-temperature-deformation-time (P-T-d-t) data from three comparable structural sections of the MCT, which together represent > 100 km in the direction of tectonic transport illuminate how spatio-temporal variations in recorded shear complicate attempts to decipher the timing of deformation.

Metamorphic P-T data, quartz microstructures and quartz crystallographic preferred orientation data suggest that all three segments of the MCT underwent similar shear conditions and kinematic behaviour. However, each segment reached peak T conditions during different windows of time. Based on U-Th/Pb monazite petrochronology, U/Pb zircon geochronology, 40Ar/39Ar thermochronology, P-T, and quartz microstructure data, the hinterland-most MCT segment reached peak metamorphic conditions of $\sim$650C and 0.8 GPa from 14 to 12 Ma and records a minimum temperature of deformation of 500C $\pm$ 50C; this MCT segment cooled below 450C by 6 Ma. The MCT segment on the north flank of the Karnali klippe records peak metamorphic conditions of $\sim$700C and 1.0 GPa at ca. 30 Ma and deformation temperatures of at least 500C $\pm$ 50C; this segment cooled below 415C by 14 Ma. The foreland-most MCT segment, exposed on the south flank of the Karnali klippe, records deformation prior to 17 Ma, possibly beginning as early as 33–30 Ma with peak temperatures of 500–600C and deformation temperatures of at least 425C $\pm$ 50C; this MCT segment cooled below 315C by ca. 17 Ma.

Our data indicate that the apparent record of ductile deformation on the MCT is diachronous in the transport direction. In western Nepal, a single shear zone segment does not record the full timing and duration of deformation on the MCT, even for relatively continuous down-dip structural sections. These results point to the need to study the temporal evolution of orogen-scale shear zones over significant distances in the direction of tectonic transport, acknowledge potential gaps in the petrochronological record, and incorporate P-T-d data with the variable timing of shearing when developing regional geodynamic models.