U-Pb SHRIMP geochronology of leucogranites from the Greater Himalayan Sequence in Zanskar and from the Karakoram fault zone, NW India

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New U-Pb SHRIMP ages have been obtained along the westernmost limb of the South Tibetan Detachment in northwest India, locally known as the Zanskar Shear Zone (ZSZ), and from the dextral strike-slip Karakoram fault zone. This research investigates the extent of ductile mid-crustal exhumation and anatexis in the westernmost part of the Greater Himalaya Sequence (GHS), and explores a possible relationship between leucogranites in Zanskar and the Karakoram fault zone. All ages presented here are ^{204}Pb-corrected ^{238}U/^{206}Pb ages.

Leucogranite from the lowest structurally-exposed GHS near the Suru dome in the Zanskar region (Z45, 34°3.69' N, 75°56.07' E; Figure 1) yields an average monazite age of 19.2±0.4 Ma, which correlates with the previously-determined U-Pb TIMS age of 20.8±0.3 Ma for a leucogranite to the east (Noble and Searle, 1995); both leucogranite ages are appreciably younger than the 25.1±0.6 Ma monazite age of pelitic schist from the Nun-Kun valley (Z40, 34°3.09' N, 76°14.67' E). Approximately 100 km to the southeast in the Haptal valley, a migmatite yields an average monazite age of 20.7±0.4 Ma (Z1, 33°26.60' N, 76°46.59' E), while an adjacent late-stage pegmatite dike in a small leucogranite pluton yields monazite ages ranging from 25.9±1.3 to 19.0±0.9 Ma (Z5, 33°27.07' N, 76°46.11' E; Figure 2). Leucogranite samples Z23 and Z4 yielded inherited monazite ages of ~470 Ma and ~450 Ma, respectively, indicating that Cambro-Ordovician Pan-African granites were a partial source for Zanskar leucocratic melts.

Oligocene−Miocene ages suggest that units near the ZSZ reached monazite closure temperatures (~750–720^{0}C; Copeland and others, 1988) earlier than deeper GHS units. In the Haptal valley, ductile shear along the ZSZ juxtaposed Miocene migmatites, associated leucogranites and older metapelites while telescoping the metamorphic isograds (Searle and others, 1999). Haptal leucogranites can be traced in the field to migmatite zones, indicating that locally-generated melt ponded below the ZSZ; this is consistent with observations made by Dezes and others (1999) to the east near the Gumburanjun dome. In the Nun-Kun valley, less extensional offset occured along the ZSZ than in the Haptal valley (Inger, 1998) and leucogranites are hosted by schists and gneisses rather than migmatite, suggesting that leucogranite melts migrated further from their source in northwest Zanskar. Also, there is a significant structural transition near Pensi La, where extensional shear zones in the northwest, distributed among imbricated thrust sheets, converge into the compact ZSZ in the east (Kundig, 1989). These observations suggest that the Pensi La segment of the ZSZ may represent the northwesternmost limit of ductile, melt-facilitated exhumation of the GHS.

In the Nubra Valley, a leucogranite from the Karakoram fault zone yielded an average U-Pb zircon age of 15.0±0.2 Ma (KF19, 34°37.99' N, 77°38.18' E). In the Pangong range, leucogranite intruded into a psammite host from the northern end of Tangste gorge gave a zircon age range from 19.8±0.1 to 12.7±0.5 Ma (PT10, 34°03.65' N, 78°13.877' E). A two-mica leucogranite from the southern end of Tangste gorge yielded zircon core ages ranging from 69.0±0.3 to 35.7±0.2 Ma and zircon rim ages that cluster at ~20 Ma (PT22, 34°02.23' N, 78°12.70' E; Figure 2). Whereas Karakoram and Zanskar leucogranite crystallization ages appear coeval, the inherited Paleocene—Eocene cores from the Karakoram zircons indicate that fault zone leucogranites are at least partially related to Neo-Tethyan oceanic subduction. Anomalously low zircon εHf(t) values for leucogranites in the Pangong range reported by Ravikant and others (2009) suggest that Indian crust may have been an additional melt source. Hf isotope analysis of Zanskar and Karakoram zircon cores may determine whether Karakoram fault zone leucogranites are related to GHS units to the south.

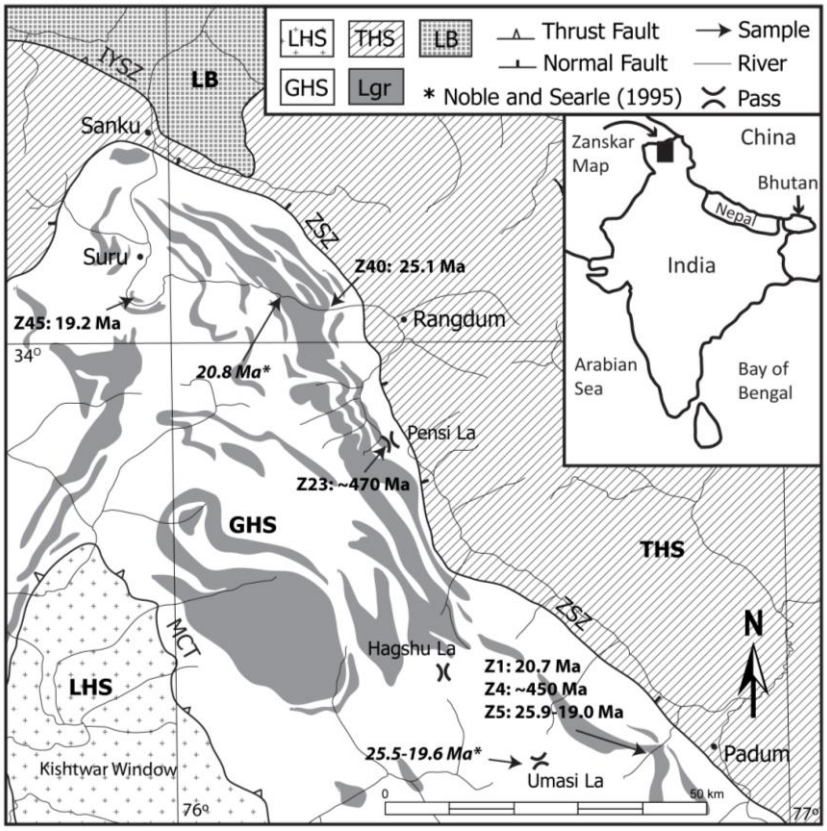

Figure 1. Simplified geological map of the Zanskar region delineating major lithotectonic units and showing sample locations. LHS, Lesser Himalaya Sequence; GHS, Greater Himalaya Sequence; THS, Tethyan Himalaya Sequence; IYSZ, Indus Yarlung Suture Zone; ZSZ, Zanskar Shear Zone; MCT, Main Central Thrust; LB, Ladakh Batholith. Modified from Steck (2003).

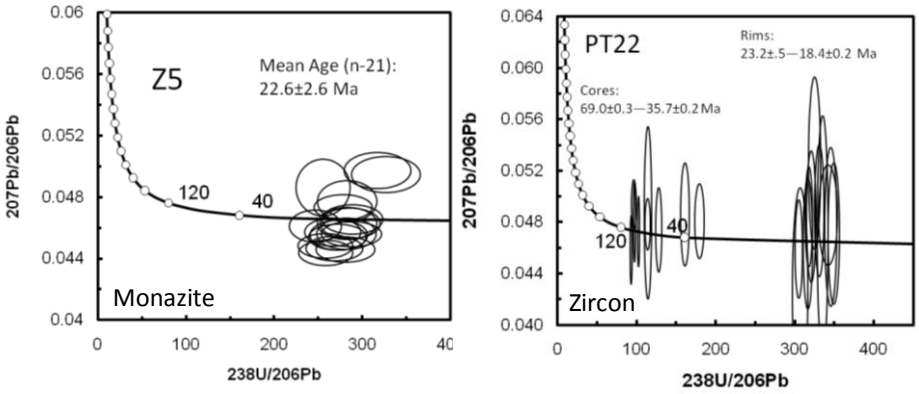

Figure 2. Tera-Wasserburg concordia diagrams for A) sample Z5, leucogranite from the Haptal Valley in Zanskar, and B) sample PT22, a 2-mica leucogranite from Tangste Gorge in the Karakoram fault zone. Data-point error ellipses are 2σ.

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