Geochemical comparison of north Himalayan gneiss domes

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The Leo Pargil, and Renbu and Yalashangbo gneiss domes are among the western- and easternmost in the chain of north Himalayan gneiss domes, respectively (Figure 1). The processes of gneiss dome formation are still debated, but there is a growing consensus that they result from the diapiric rise of pooled melt from a mid-crustal, ductile channel (Beaumont and others, 2004; Whitney and others, 2004). In the channel-flow model, the ductile channel is exhumed towards the southern Himalayan range front and is exposed as the Greater Himalayan Sequence (GHS). Gneiss domes should be petrogenetically-related to the GHS if the channel flow theory is correct. Geochemical investigation of these granitic gneiss domes can therefore help to determine their origin and mode of development.

Leo Pargil is composed of amphibolite-facies schists, phyllites, metagraywacke, and subordinate quartzites, with numerous cm- to m-scale two-mica granite, tourmaline granite, and leucogranite dikes that constitute between 10% and 50% of the host rock (Thiede and others, 2006). The Renbu dome consists of an ~undeformed two-mica tourmaline granite intruded into upper amphibolite-facies schists, and lies on the west side of a north-south trending graben that is part of the Yadong-Gulu rift system (Leech, 2008). The Yalashangbo gneiss dome consists of a muscovite-biotite granite pluton, intruded into high-grade schists and gneisses (Zhang and others, 2007).

Leo Pargil contains relict U-Pb zircon core ages ranging from Late Archean to Middle Paleozoic (2.8 Ga to 400 Ma) and Middle Eocene to Middle Miocene ages (49 to 15 Ma) for zircon rims, with a weighted mean age of 24.4 Ma (Figure 2; Hassett and Leech, 2007). The Renbu dome has relict U-Pb zircon core ages ranging from Late Archean to Late Triassic (2.5 Ga to 200 Ma) and Late Eocene to Late Miocene ages (39 to 7 Ma) for zircon rims, with a weighted mean age of 9.4 Ma (Figure 2; Hassett and Leech, 2008). Yalashangbo has relict U-Pb zircon core ages ranging from Late Paleoproterozoic to Middle Cretaceous (1.8 Ga to 115 Ma), but zircon rims were too small for analysis and we therefore do not have a record of the timing of most recent magmatism. These results show that broadly, gneiss domes young towards the east, and support the idea that melts feeding gneiss-dome formation may have been truncated in the west by the Karakoram fault (Leech, 2009).

Statistical comparison of granitic zircon cores and country rock zircons for Leo Pargil show that 9 out of 10 REE are statistically indistinguishable, with only Pr showing significant variation in mean relative abundance (Figure 3). Similar results are found for analysis of host rock zircon from the Renbu gneiss dome, in which 8 out of 10 REE are statistically indistinguishable (Figure 3). There is little agreement between granitic zircon rims and cores, suggesting that fractionation occurred during the last magmatic event and zircon rims became enriched in HREE relative to zircon cores. These results indicate that the granitic and host rock zircon share a common protolith, that leucogranites within gneiss domes are most likely anatectic melts of the host rock, and that gneiss domes across the entire Himalayan orogen share a common origin.

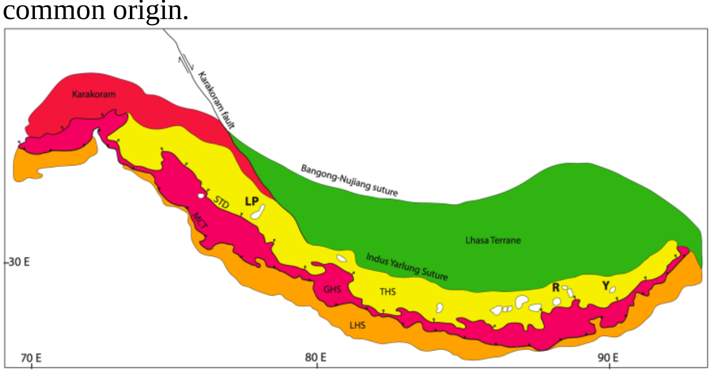

Fig. 1. Simplified geologic map of the Himalayas. Gneiss domes are shown in white, and occur within the THS, between the Indus Yarlung Suture Zone, and the South Tibetan Detachment zone. LHS, Lesser Himalayan Sequence; LP, Leo Pargil; MCT, Main Central thrust; R, Renbu; STD, South Tibetan Detachment; THS, Tethyan Himalaya Sequence; Y, Yalashangbo.

U-Pb SHRIMP age data from zircon cores indicate that the common source for anatectic granites cannot be the Lesser Himalayan Sequence as this unit contains no ages younger than 1.5 Ga (Richards and others, 2005), but ages are consistent with either the GHS or the Tethyan Himalayan Sequence. Future Pb and Nd isotopic analyses will identify the source of the gneiss-dome granites, and may strengthen arguments in favor of the channel flow model.

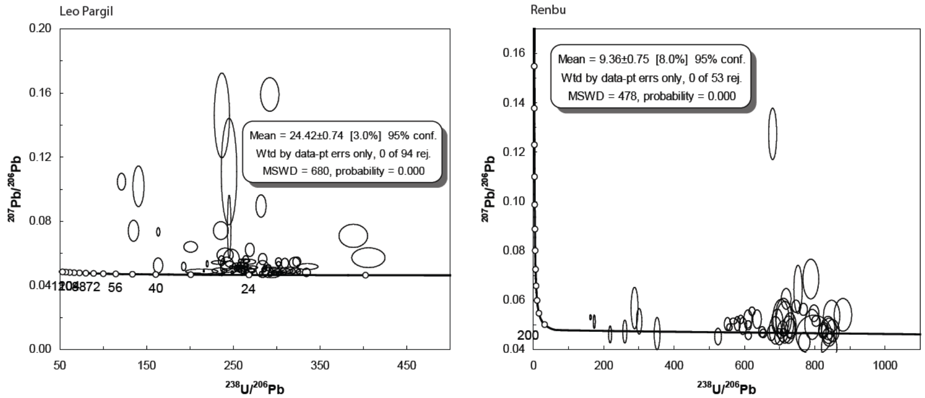

Fig. 2. Tera-Wasserberg Concordia diagrams for Leo Pargil and Renbu gneiss domes, showing ages of most recent magmatism.

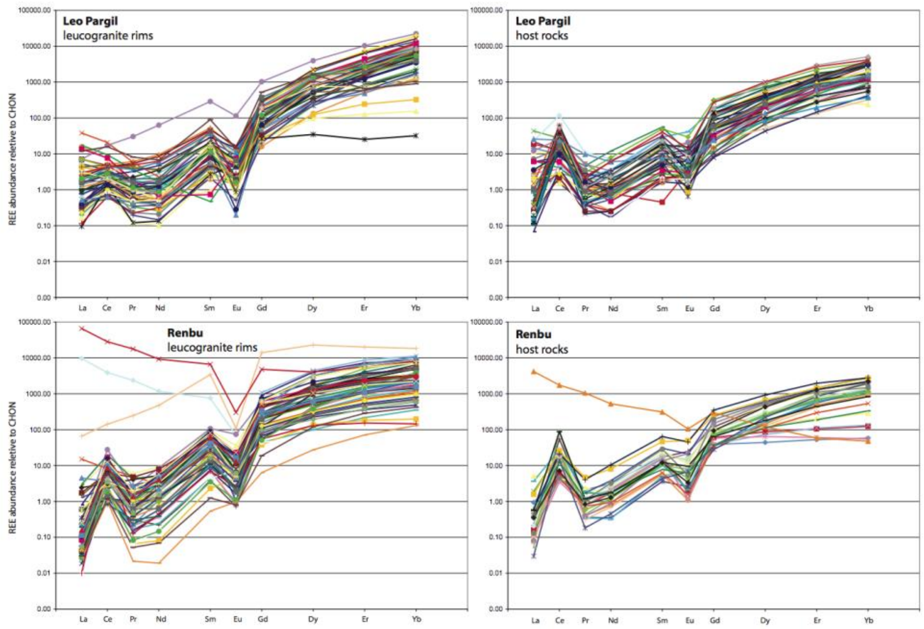

Fig. 3. REE spider plots for Leo Pargil and Renbu gneiss domes, showing HREE-enrichment for granitic zircon rims compared to country rock zircon.

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Cite as: Hassett, W.C., Sommerfeld, J.W., Horton, F.M. and Leech, M.L., 2010, Geochemical investigation of north Himalayan gneiss domes, *in* Leech, M.L., and others, eds., Proceedings for the 25th Himalaya-Karakoram-Tibet Workshop: U.S. Geological Survey, Open-File Report 2010-1099, 2 p. [http://pubs.usgs.gov/of/2010/1099/hassett/].