Genesis and emplacement of Higher Himalayan Leucogranite in the Arunachal Himalaya, Northeast India: constrains from deformation microstructures and geochemical data

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The Higher Himalayan Leucogranites (HHLG) intruded into the high grade rocks of the Higher Himalayan Crystallines (HHC) in western Arunachal Pradesh, eastern Himalaya, yield distinctive field data, petrography, microstructures, geochemical and mineral chemistry data. The HHC comprise a structurally lower kyanite zone and a structurally higher sillimanite zone. The HHLG mostly occur as sill-like bodies of limited thickness and lateral extent within the HHC and are also observed as disturbed dykes. The HHLG are medium to coarse grained and composed of quartz, K-feldspar, plagioclase, muscovite and biotite with accessory monazite, apatite and zircon. Tourmaline and garnet are also observed in some of the samples.

The HHLG are characterized by the presence of two micas; normative corundum; high contents of SiO_2 (67 - 78 wt.%), Al_2O_3 (13 - 18 wt.%), A/CNK (0.98 - 1.44) and Rb (154 - 412 ppm); low contents of CaO (0.33 - 1.91 wt.%) and Sr (19 - 171 ppm), and a high ratio of $FeO_{(tot)}$/MgO in biotite (2.54 - 4.82). These distinctive features, along with their strong depletion in high field strength elements (HFSE), suggest their affinity to peraluminous S-type granite generated by the partial melting of crustal material. Since the HHLG are closely associated with the sillimanite gneisses/schists of HHC, it is suggested that the sillimanite gneisses/schists might represent the melt source and even represent a zone of in-situ melting. Their common occurrence within the high-grade regional metamorphic terrains, the lack of spatial and temporal association with basaltic magmatism strongly suggests that the HHLG are the product of pure crustal melt and uncontaminated by mantle material. On the basis of field setting and geochemical characteristics, it is suggested that the sources for the HHLG are more likely the kyanite pelitic schists at the lower part of the HHC and sillimanite gneisses/schists in the middle part of the HHC, from which the leucogranite are generated by fluid absent melting of muscovite.

Geothermobarometric estimations and mineral assemblages of the HHC metapelites suggest that the HHLG was generated at the middle crust (~20 km) and the produced melt of HHLG was intruded in the high grade rocks of HHC.

The emplacement of the HHLG at the depth of middle crust is also supported by the occurrences of high temperature deformation microstructures like quartz amoeboid, chessboard extinction in quartz and cuspate/lobate boundaries between quartz and feldspars. As the HHLG extruded towards shallow structural levels, the initial high deformation temperature microstructures are overprinted by low deformation temperature features like tapering deformation twins, deformation bands in feldspars followed by fractures.

The deformational microstructures present in the HHLG indicate that the early high temperature ductile deformation conditions at deeper level were superimposed by brittle deformation conditions with lowering temperature during extrusion of the HHLG with the mid crustal rocks towards the shallow structural levels during the Himalayan orogeny.

Key words: leucogranite; microstructure; geochemistry; granite emplacement; eastern Himalaya