Aluminous metapelites as a key to constraining the P-T evolution of the Upper Lesser Himalayan Sequence (Central Nepal)

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The Lesser Himalayan Sequence (LHS) of the Nepal Himalaya is a classic example of an inverted metamorphic sequence, which experienced Barrovian metamorphism during the Himalayan orogenic cycle. Although the LHS represents, in terms of volumes, the bulk of the Himalayan thrust-belt, its metamorphic evolution has been much less constrained than that of the overlying Greater Himalayan Sequence (GHS), the general belief being that it experienced a low-grade metamorphism (i.e., biotite and garnet zones). However, previous studies showed that the upper structural level of the LHS experienced peak temperatures up to 630-650°C, consistent with the sporadic occurrence of staurolite and/or kyanite -bearing lithologies. Moreover, the overall Upper-LHS metamorphic evolution is still poorly defined because the correspondent P-T paths have been rarely reconstructed in detail.

As a contribution to a better understanding of the LHS metamorphic evolution, this study aims at constraining the P-T path of the Upper-LHS in a key area of central Nepal (Ganesh Himal region). The study focuses on aluminous metapelites because these lithologies are more prone to developing low-variant assemblages than other lithologies. The detailed petrographic, microstructural and minerochemical investigation of six aluminous metapelites shows that, in most cases, the peak assemblage includes aluminous porphyroblastic phases (i.e., garnet, staurolite, kyanite, plagioclase) statically overgrowing over the main foliation. The isochemical phase diagram approach, based on the principles of equilibrium thermodynamics, is used to constrain the P-T evolution of the studied samples.

The P-T path constrained for the Upper-LHS is characterized by a prograde moderate increase in both P and T up to peak-P conditions of 8.5-11 kbar, 580-600°C, followed by heating decompression to the thermal peak of 620 ± 20°C, 8.5 ± 0.2 kbar. This "clockwise" path is significantly different from the typical "hairpin" path (i.e., prograde loading followed by cooling decompression) registered in the Lower-LHS and supports those thermo-mechanical models that predict a period of slowdown (or quiescence) of the thrust activity in the lowermost structural levels of the Himalayan thrust-belt.