Signal or Noise? Significance of Variability in the Himalaya-Tibet System

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Over the past several decades, numerous research projects have used the Himalaya and Tibet as a natural laboratory to investigate the process of continental collision. Much has been learned about the orogen, including the remarkable along-strike continuity of many features, such as the orogen's basic geology and zonation, structures such as the MFT, MBT, MCT, and STD, the morphology and drainages of the Himalayan arc and adjacent regions, and the apparent symmetry of the syntaxes that cap the orogen. At the same time, and not surprising for an orogen as large as the Himalaya-Tibet system, studies have also identified considerable spatial variability in such elements as the divergent GPS field, the apparent presence of eclogite in the lower crust at locations in southern Tibet, variations in Moho depth, possible differences in inferred lower-crustal and mantle lithosphere strain, significant lateral variations in the magnitude and timing of exhumation in southern Tibet and the Himalaya, and localized exposure of both high-pressure and anatectic metamorphic terranes. To first order and better, synthesis of these observations has led to general geodynamical models that do well at linking solid-Earth and surface processes, for example the aneurysm model at local scales and the channel-flow model at broader scales.

However, significant questions about the Himalaya and Tibet remain. In particular, the early history of the orogen, the nature of initial boundary conditions, and the importance of these features in controlling the evolution of the orogen are not well understood. This includes such factors and phenomena as the diversity in arc terranes that faced incoming India before collision, the prehistory of Gondwanan blocks that make up Tibet, the rheology of the deeper lithosphere in southern Tibet, and the intact nature and persistence of the Lhasa Block. An interesting question is whether this lateral variability represents minor geological noise, or whether these features are telling us something about initial conditions, their impact on the current and future dynamics of the orogen, and which orogenic records ultimately will have preservation potential.

The Lhasa Block is an interesting case to consider in this context. Little deformed, the terrane sits in the midst of the actively deforming Himalayan-Tibet system, and shows little evidence of the intense deformation that took place not far to its south: the lithosphere of incoming India, often presumed to be old-and cold, was intensely shortened during collision, whereas in comparison, the presumed warm-and-soft crustal portions of the Lhasa Block have remained enigmatically unscathed. Elevations throughout much of the central and eastern block are high and fairly uniform although in contrast to the remarkably small degrees of exhumation evident in the central and western Lhasa Block, the block's eastern portions have been significantly exhumed. This exhumation has occurred over the region where crustal thicknesses decrease. At depth, the Lhasa Block currently appears to be underlain in places by eclogitized lower crust, and the timing and modification of this eclogite formation or retrogression could have significant geodynamic consequences. The widespread granites in the block contain a petrologic and isotopic record that spans the transition from Andean-margin convergence to collision. This record of transition from convergence to collision should also exist in many of the structures, rocks and landscapes of the Lhasa Block, and integrated work on this terrane could provide important constraints on the dynamics of the Himalaya-Tibet system.

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