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Sm-Nd Isotopic Mapping of the Western Himalayan Syntaxis: Tectono-stratigraphic Correlations and Insights

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The internal zones of mountain belts are in many cases a complex mosaic of polymetamorphic tectonic units, making conventional tectono-stratigraphic analysis difficult. Distinguishing major units on the basis of metamorphic grade or structural criteria alone becomes almost impossible in the deeper levels of orogenic edifices, because processes of burial, metamorphism and exhumation all vary in time and space during the construction of the mountain belt. This problem is exacerbated by the previous history of component units within the mountain belt, and the different degrees of overprinting they experience during the most recent orogenic cycle.

Such problems are particularly prevalent in the Western Syntaxis of the Himalayan orogenic belt (the Nanga Parbat massif), in contrast to the rest of the mountain range where major tectonic units can be correlated along most of the 2000 km arc. Until recently, the gneisses of the syntaxis were equated with the High Himalayan Crystalline Series (HHCS) on the basis of their high grade, but Whittington et al (2000) showed that their Nd isotopic signature was characteristic of another unit, the Lesser Himalaya (LH). In detail, Lesser Himalayan rocks are distinguished by older model ages (2.3-2.8 Ga), as opposed to model ages of 1.6-1.8 Ga for the HHCS. This reinterpretation, coupled with knowledge of extremely rapid Neogene exhumation (e.g. Zeitler et al 1982, 1993) in the region, demonstrated that the syntaxis represents a window through to deeper structural levels than are exposed elsewhere in the orogen, especially with regard to the Lesser Himalayan unit.

This study employs the Sm-Nd isotopic system primarily for Nd model age determination on a variety of samples through the crustal section in the syntaxis. Detailed structural and petrographic analysis of the eastern margin has been undertaken to focus the isotopic programme in the highly condensed crustal section. The eastern flank of the massif, being only weakly overprinted by Neogene exhumation, is an ideal section for studying early and pre-Himalayan processes, and thereby correlating the attenuated tectonic units with those recognized in the rest of the orogen. Expansion and refinement of the Whittington et al (2000) dataset is expected to identify further components of the Himalayan tectonic assembly, including magmatic bodies recognised along the arc, as well as delineating basement and cover slices within the HHCS and LH. The results contribute to a greater understanding both of processes of syntaxial formation, and to the collisional phase of Himalayan orogenesis.

In addition to model age studies, Sm-Nd dating of selected garnet samples in the different units is being undertaken to constrain their polymetamorphic evolution. This investigation is not only aimed at determining the timing of initial Himalayan collision in the different units, but also identifying 'relict' garnets from previous orogenies, as recognized by Argles et al (1999) in the Garhwal Himalaya. The combination of results has implications for terrane identification in the internal zones of both modern and ancient orogenic belts, and specifically for the lesser-known initial stages of Himalayan evolution immediately following initial collision. Further studies on the timing of prograde garnet growth in the eastern Himalaya are in progress to address the question of diachroneity of initial India-Asia collision.

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