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Reconstruction of the Himalayan Architecture: Insights from the Tethyan Himalayan Decollement and the Great Himalayan Thrust

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Bounded by the north-dipping Main Central Thrust (MCT) below and the South Tibet Detachment (STD) above, the Greater Himalayan Crystalline Complex (GHC) forms the metamorphic core of the Himalayan orogen and represents the subducted northern margin of the Indian continent. Predominant stretching structures in the GHC trend perpendicular to the belt and are linked to southward exhumation or emplacement of the GHC between the STD and the MCT in the Miocene. Based on new structural, metamorphic and magmatic records in the central Himalayan orogen, we recognized the Tethyan Himalayan Decollement (THD) and the Great Himalayan Thrust (GHT), which allow us to reconstruct the Himalayan architecture since the Eocene.

Exposed in the Cuona-Luoza region in southern Tibet, the THD is composed of 5-6 km thick mylonitic sillimanite-garnet-biotite gneisses, schists and orthogneisses at the base of the Tethyan Himalayan Sequence. The THD developed “A” type sub-recumbent folds, gently north-dipping foliation, N-S trending stretching lineation, and a top-to-the-south shear sense. It is associated with the listric structure in Triassic-Cretaceous sedimentary rocks in the upper part of the Tethyan Himalayan Sequence. Numerous syntectonic leucogranite veins intruded into the THD, and preserve subhorizontal foliation defined by sillimanite-garnet-biotite layers. U-Pb zircon geochronology yields the protolith ages of 474-594 Ma for the THD. The syntectonic leucogranite veins contain both magmatic zircons with age of 25-16 Ma, and metamorphic zircons (Th/U<0.1) with age of 49-39 Ma, suggesting the initiation of high-temperature metamorphism and deformation in the THD in the early Eocene, and subsequent partial melting and deformation in the early Miocene.

Located in the lower part of the GHC, the GHT was recognized in the Beni-Jomsom cross-section in the central Nepal Himalaya. It consists of several large-scale north-dipping thrust shear zones with a top-to-the-south shear sense. According to the c-slip fabric of quartz from mylonitic gneisses and syn-tectonic felsic veins, the GHT experienced ductile deformation at high temperature (>650 °C). U-Pb ages of metamorphic zircon rims indicate that thrusting began at 34 Ma at the top of GHT, and progressively migrated southward until 26 Ma near the MCT.

Combined with previous studies, we propose that the THD and GHT were activated during the early subduction of the Indian continental plate beneath the Lhasa terrane, and accompanied with partial melting of the thickened lower continental crust. During the early Eocene, southward thrusting of the GHC materials along the GHT and the Tethyan Himalayan Sequence over the GHC along the THD may have built the proto-Himalayan orogen with high elevation. This process triggered the parallel-orogen extensional since 28 Ma in the GHC, and subsequent coeval movement along the top-to-the-south MCT and top-to-the-north STD in 23-14 Ma.