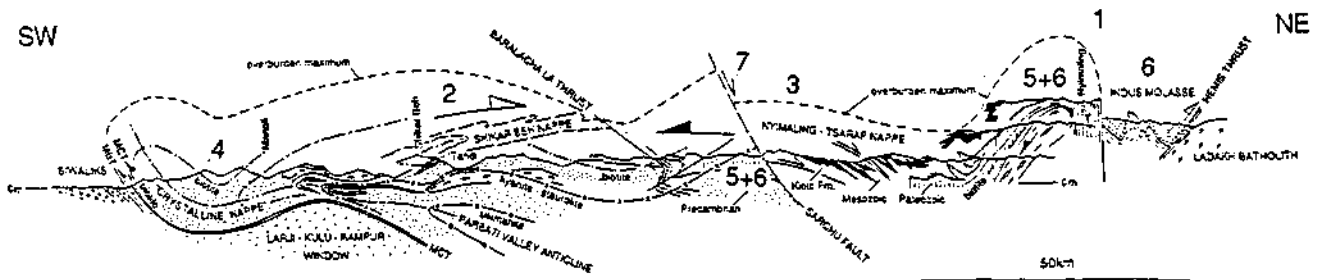


# Geological Transect Across the Northwestern Himalaya in Eastern Ladakh and Lahul – A Model for the Continental Collision of India and Asia

TALK

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## Chronology of the Tertiary Himalayan structures

- 1- Continental collision, underthrusting of India below Asia and initiation of the Nyimaling-Tsarap Nappe (Eocene)
- 2- NE vergent Shikar Beh Nappe (Eocene)
- 3- SW vergent Nyimaling-Tsarap Nappe (Eocene)
- 4- SW vergent "Crystalline Nappe" (MCT and MBT) (Oligocene-Miocene)
- 5- Dextral transpression (Oligocene)
- 6- NE vergent folding (Miocene)
- 7- Late extension (Miocene)

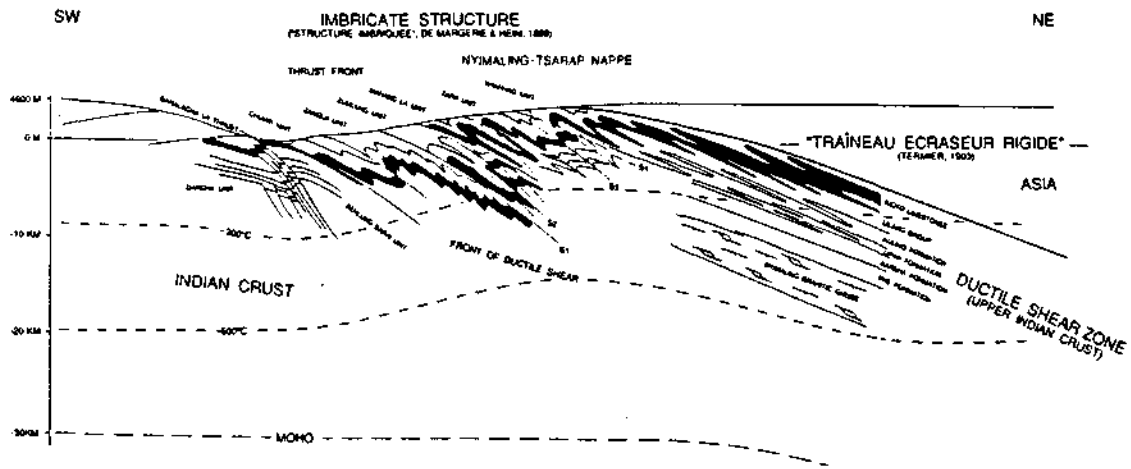
The detailed geological mapping and structural study of a complete transect across the northwestern Himalaya, allow to describe the tectonic evolution of the north Indian continental margin during the Tethys ocean opening and the Himalayan Orogeny.

The Late Paleozoic Tethys rifting is associated with several tectonomagmatic events. In Upper Lahul and SE Zaskar, this extensional phase is recorded by Lower Carboniferous synsedimentary transtensional faults, a Lower Permian stratigraphic unconformity, a Lower Permian granitic intrusion and middle Permian basaltic extrusions (Panjal Traps). In eastern Ladakh, a Permian listric normal fault is also related to this phase. The scarcity of synsedimentary faults and the gradual increase of the Permian syn-rift sediments thickness toward the NE, suggest a flexural type margin.

The collision of India and Asia is characterized by a succession of contrasting orogenic phases. South of the Suture Zone, the initiation of the SW vergent Nyimaling-Tsarap Nappe corresponds to an early phase of continental underthrusting. To the S, in Lahul, an opposite underthrusting within the Indian plate is recorded by the NE vergent Tandi Syncline. This structure is associated with the newly defined Shikar Beh Nappe, now partly eroded, which is responsible for the high grade (amphibolite facies) regional metamorphism of South Lahul.

The main thrusting of the Nyimaling-Tsarap Nappe followed the formation of the Shikar Beh Nappe. The Nyimaling-Tsarap Nappe developed by ductile shear of the upper part of the subducted Indian continental margin and is responsible for the progressive regional metamorphism of SE Zaskar, reaching amphibolite facies below the frontal part of the nappe, near Sarchu. In Upper Lahul, the frontal parts of the Nyimaling-Tsarap and Shikar Beh nappes are separated by a zone of

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The Nyimaling-Tsarap Nappe (situation before backfolding, extension, uplift and erosion).

low grade metamorphic rocks (pumpellyite-actinolite facies to lower greenschist facies). At high structural level, the Nyimaling-Tsarap Nappe is characterized by imbricate structures, which grades into a large ductile shear zone with depth. The related crustal shortening is about 87 km.

The root zone and the frontal part of this nappe have been subsequently affected by two zones of dextral transpression and underthrusting: the Nyimaling Shear Zone and the Sarchu Shear Zone. These shear zones are interpreted as consequences of the counterclockwise rotation of the continental underthrusting direction of India relative to Asia, which occurred some 45 Ma ago, according to plate tectonic models.

Later, a phase of NE vergent "backfolding" developed on these two zones of dextral transpression, creating isoclinal folds in SE Zaskar and more open folds in the Nyimaling Dome and in the Indus Molasse sediments.

During a late stage of the Himalayan Orogeny, the frontal part of the Nyimaling-Tsarap Nappe underwent an extension of about 15 km. This phase is represented by two type of structures, responsible for the tectonic unroofing of the amphibolite facies rocks of the Sarchu area: the Sarchu high angle Normal Fault, cutting a first set of low angle normal faults, which have been created by reactivation of older thrust planes related to the Nyimaling-Tsarap Nappe.

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