

# **Géologie du Rupshu : comment cette partie de l'Himalaya indien c'est mise en place au cours du temps**

**GIRARD Mathieu**; January 12, 2001

*Supervisor: Prof. Albrecht Steck, Institut de Minéralogie et Géo chimie*

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The Rupshu area, in NW India, illustrates the transition between the Tethyan Himalaya, made of very low grade metasediments, and the North Himalayan Crystalline Zone (NHCZ). The Tethyan Himalaya contains a sedimentary series that spans from Precambrian to Cretaceous, with an important gap between Ordovician and Permian. The Lower and Middle Triassic formations are very monotonous and reflect a distal environment along the north Indian margin. From Upper Triassic, the formations begin to look like those of the Spiti-Zaskar sedimentary basin. However, because of the more distal situation of Rupshu, the detritic component is generally less important. The SW-vergent Kum Tso Thrust overthrusts distal Middle Triassic series over more proximal Upper Triassic to Liassic sediments. The very low grade metamorphism of the Tethyan Himalaya has been studied with "illite crystallinity". This allows us to estimate to about 16 km, the offset of an extensional shear zone observed along two parallel profiles, distant by about 70 km. This extensional shear zone is interpreted as a superficial equivalent of the Zaskar Shear Zone.

The NHCZ is formed by metamorphic equivalents of Paleozoic sediments. A description of the probably Permian lithologies of the Karzok Formation shows important lateral variations. The transition between the Tethyan Himalaya and the NHCZ is perfectly gradual and is marked by an increase of the metamorphic grade from diagenesis to the sillimanite zone. This Barrovian metamorphism, triggered by the SW-vergent emplacement of the Tso Moriri and Mata nappes, overprints a High Pressure - Low Temperature eclogitic metamorphism, linked to the subduction of the Indian plate below Asia. Only the Tso Moriri nappe has been affected by this first Himalayan metamorphic event. The Barrovian metamorphism, present in both of the nappes, has been studied with several quantitative thermobarometric methods. The thermodynamic data set of Holland and Powell (1998) and of Berman (1988), the isotopic quartz-garnet or quartz-kyanite geothermometers, and the geothermometers based on the Ti content of amphibole, quantified the metamorphic grade differences observed along the profile between Pang and the Tso kar. These methods showed that there are no metamorphic jumps between either the Tethyan Himalaya and the NHCZ or between the Tso Moriri and Mata nappes.

In the SE area, in Spiti, NE-vergent tectonic creates a lateral equivalent of the Shikar Beh nappe, defined westward by Steck et al. (1993). In spiti this nappe creates the Lagudarsi La Thrust. Interference structures with the frontal part of the Mata nappe show that the NE-vergent movements precede the SW-vergent ones.

A Cambro-Ordovician tectono-metamorphic event is highly suspected in Himalaya. The peraluminous Tso Moriri granite and the alkaline Rupshu granite, dated respectively at  $479 \pm 2$  Ma and  $482.5 \pm 1$  Ma by U/Pb on zircons, seem to have set up in a post-orogenic extensional setting. Even so both of them are generally highly

deformed, they preserved well differentiated signatures, particularly concerning their zircon typologies.

Field observations, as well as several analytical results, have shown that the Polokongka La granite is nothing other than the undeformed protolith of the Tso Morari gneiss. On the other hand, the Rupshu granite is very different not only from the Tso Morari gneiss, but also from its lateral equivalent, the Nyimaling granite, situated north-westward.