BUCHS Nicolas (2019) : Geology of the Nidar - Tso Morari area (Indian Himalayas, Ladakh). From intra-oceanic subduction to nappe exhumation

Abstract

The Himalaya is the highest and largest mountain belt around the world formed after the collision between the Indian and Eurasian plates during the Eocene.

The Nidar - Tso Morari area, in NW India, illustrates the transition between the Indian and Eurasian plates including remnants of the Neotethys oceanic crust preserved as ophiolites in the Indus suture zone. This area is characterized by the ultra-high pressure (UHP) metamorphic Tso Morari nappe made up of Ordovician granites intruded in Precambrian to Cambrian sediments (Phe and Karsha Fms) and eclogite boudins. The rocks of the Tso Morari nappe characterize the leading edge of the northern Indian passive continental margin and are overlaid by the sediments of the Tetraogal nappe. The Tso Morari nappe records UHP metamorphism dated at ~53 m.y. ago during the north dipping subduction of the Indian continent beneath the Eurasian plate.

The subduction of the Neotethys oceanic crust started during the Lower Cretaceous in an intra-oceanic setting involving magmatism in the upper Eurasian plate and generated the rocks of the Nidar Ophiolite. The Nidar Ophiolite is an almost complete ophiolitic sequence that records at least two magmatic events in a suprasubduction zone context close to the Eurasian continental margin. The first magmatic phase generated a fore-arc oceanic crust and the second magmatic phase is characterized by arc-related intrusive complexes and dikes intruded into the preexisting fore-arc crust. The subduction-related magmatic activity migrated northward to form the Ladakh Batholith between the Lower Cretaceous and the Middle Eocene. The progressive subduction of the Neotethys oceanic crust produces an accretionary wedge that records evidence of seamount accretion before the collision between the Indian and the Eurasian plates. These seamounts are partly preserved in the Drakkarpo and the Karzok-Ribil nappes. The Drakkarpo nappe is also characterized by the Changlung Mélange formed in “Piggy Back” basin developed on the accretionary wedge. This basin was fed by the erosion of the wedge and the southern Eurasian plate. A shelf was present in the northern part of the basin between the Early Ypresian and the Early Lutetian. It represents the youngest marine occurrence in the Indus suture zone.

Based on field work and samples collected in the Nidar - Tso Morari area, we present new lithostratigraphic, geochronologic, biostratigraphic structural and geochemical data which allow to constrain: (1) the geology of the Eastern part of the Tso Morari nappe through a new detailed map; (2) the age of the magmatic records and the geodynamic context of the formation of the Nidar Ophiolite; (3) the geometry and the composition of the accretionary wedge (Drakkarpo and the Karzok-Ribil nappes); (4) the age of the last marine occurrence in the Neotethys Ocean; (5) the global geodynamic significance and the formation of the North Himalayan nappes (The Tso Morari, Tetraogal and Karzok-Ribil nappes); and (6) the timing of the India-Asia collision.

We propose a kinematic reconstruction of the paleogeography between the Indian and Eurasian plates from the initiation of the intra-oceanic subduction zone to the nappe exhumation during the collision from Lower Cretaceous to Upper Eocene. The new data on the geometry of the north Indian margin and the accretionary wedge, and the structure of the North Himalayan nappe stack could be integrated in exhumation models of the ultra-high pressure Tso Morari nappe.