Tectonometamorphic discontinuities within the Greater Himalayan Sequence in Western Nepal (Central Himalaya): Insights on the exhumation of crystalline rocks

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A B S T R A C T

The core of the Greater Himalayan Sequence in the Mugu-Karnali area (Western Nepal) is affected by a thick shear zone with development of nearly 4 km of mylonites (Mangri shear zone). It is a contractual shear zone showing a top-to-the-SW and WSW sense of shear. The shear zone developed during the decompression, in the sillimanite stability field, of rocks that previously underwent relatively high-pressure metamorphism deformed under the kyanite stability field. P–T conditions indicate that the footwall experienced higher pressure (1.0–0.9 GPa) than the hanging wall (0.7 GPa) and similar temperatures (675°–700 °C). U–Pb in-situ dating of monazites indicate a continuous activity of the shear zone between 25 and 18 Ma. Samples from the lower part of the Greater Himalayan Sequence underwent similar ductile shearing at ~17–13 Ma. These ages and the associated P–T paths revealed that peak metamorphic conditions were reached ~5–7 Ma later in the footwall of the shear zone with respect to the hanging-wall pointing to a diachronicity in the metamorphism triggered by the shear zone itself.

Mangri Shear Zone, with the other recently documented tectonic and metamorphic discontinuities within the Greater Himalayan Sequence, point to the occurrence of a regional tectonic feature, the High Himalayan Discontinuity, running for more than 500 km along the strike of the Central Himalayas. It was responsible of the exhumation of the upper part of the Greater Himalayan Sequence starting from 28 Ma, well before the activation of the Main Central Thrust and the South Tibetan Detachment. Our data point out that exhumation of the Greater Himalayan Sequence was partitioned in space and time and different slices were exhumaed in different times, starting from the older in the upper part to the younger in the lower one.

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1. Introduction

Plate tectonics well-accounts for the occurrence of high-pressure metamorphism in collisional settings. However, the mechanisms explaining the exhumation of deep seated metamorphic rocks are not well-explained by the paradigms of plate tectonics and are nowadays debated. One of the main problem to face is the occurrence of HP or UHP rocks exhumed in the same collisional cycle in which they formed in still contractual tectonics. This is the case in the Alps and in the Himalayas (Platt, 1993). Their occurrence ruled out two of the main mechanisms generally adopted for the exhumation of deep-seated rocks such as erosion and extensional tectonics. In the nineties the discovery of thrusts and normal faults active on the same vertical section, in a still active collisional belt, leads to the formulation of a new model of extrusion both by observation in the Himalayas (Hodges et al., 1992) and analogue modelling (Chemenda et al., 1995). This one was the first model able to explain rapid syn-convergence exhumation of deep seated rocks in the Himalayas.

The Himalayan belt, derived from the collision at ~55 Ma between India and Asia, is the most classical example of continent–continent collisional belt and it is a natural laboratory where several exhumation mechanisms were first described, so that it is the best place to test some of the generally accepted exhumation models. Several first-order tectonic discontinuities have been recognised in the Himalayas that from bottom to top are: Main Frontal Thrust, Main Boundary Thrust, Main Central Thrust (MCT) and South Tibetan...