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Initiation of crustal-scale thrusts triggered by metamorphic reactions at depth: insight from a comparison between Himalaya and Norwegian Caledonides.

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The Norwegian portion of Caledonides is a 1000 km long mountain chain that compares in size and structure with the Tertiary Himalayas. Both result from the collision of a cold and thick shield (India for Himalaya and Baltica for the Caledonides) with a continent (Eurasia and Laurentia, respectively) after the subduction of a wide ocean (Tethys and Iapetus, respectively). In both ranges, tectonic units, from the front to the internal zone, represent slices of the passive margin progressively implicated in subduction then collision.

In both ranges, High-Pressure and Ultrahigh-Pressure metamorphic rocks are observed in structurally high-level tectonic units (Tso-Morari eclogites close to the Himalayan Yarlung Tsangpo Suture Zone or Jamtland eclogites in the Caledonian Uppermost Allochthon). Those rocks are interpreted as markers of the subduction stages before collision. The recently described granulitized eclogites in Ama Drime range and Sikkim region represent a younger high-pressure metamorphic event affecting units with continental affinities. They compare with the Bergen eclogitized granulites, that belong to the Middle Allochthon unit of the Caledonides.

A detailed age review on both orogenies show striking analogies. In both cases, the initiation of the major crustal-scale thrust system is synchronous with eclogitization of continental units at depth. In Himalaya, the initiation of the MCT is dated between 20 and 23 Ma, while the eclogitic stage of the Ama Drime metamorphics is estimated between 24 and 21 Ma; in the Caledonides the ca 430 Ma age for the Bergen eclogites compares with the ages of the remnants of the foreland basins infill coeval with the thrust of Lower and Middle Allochthons onto Baltica. To go further in the comparison of timings, the Himalayan equivalents of the 410-400 Ma old UHP eclogites present in the Western Gneiss Region of the Caledonides are to be searched at depth in present time.

Structural studies in the Bergen area show a network of eclogitic veins and shear-bands affecting and dislocating the metastable granulites. Eclogitization appears as a clear softening mechanism for the granulitic crust. The overall strain pattern is compatible with crustal-scale simple shear in the eclogite facies conditions. In Nepalese Himalaya, modelling of thermal structure at depth shows that density changes due to eclogitization processes must be active with a delay to explain the regional gravity anomaly data. Furthermore, crustal structure deduced from receiver function analysis at depth, suggests oblique structures compatible with simple shear at lower crustal levels.

Similarities between field observations in the Caledonides and crustal structure at depth in the Himalayas lead to the conclusion that eclogitization can act as a decoupling mechanism in the lower crust that allows the counterflow exhumation of the crustal slab and the initiation of thrusts at the front of the orogen.