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Lower crustal rocks in the Norwegian Caledonides: field analogues for understanding the geodynamics of continental subduction and UHP exhumation

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The Scandinavian Caledonides and their counterparts in East-Greenland represent the best ancient example of a Himalayan-type continental collision orogen on the Earth. The mountain- and plateau areas that formed in response to the Scandian continental collision and the extensional tectonics in the Late Silurian to Devonian were comparable in size to the present-day Himalayas and the Tibetan plateau, with a strike length close to 2000 km and a width of more than 500 km. The collision also affected areas within the overriding continent far behind the collision zone, which gave rise to intra-continental mountains in Arctic Canada. The Iapetus ocean intervening Baltica-Avalonia and Laurentia was consumed by rapid subduction (>12 cm/yr) and closed by the Middle Silurian (∼430 Ma). The rapid convergence resulted in deep burial of continental lithosphere to (ultra) high-pressure [(U)HP] conditions. Syn-convergent thrust-stacking and upper crust-extension in the late Silurian to early Devonian was succeeded by buoyant eduction of the deeply buried, but still mostly coherent slab of continental rocks and some included lenses of mantle peridotite. These exhumed lower crustal rocks record a pressure-temperature gradient from amphibolite facies immediately below the Caledonian nappes via a wide belt of eclogite facies rocks (600C; 1.8-2 GPa) to coesite eclogites (700-800C; 2.7-2.8 GPa) across the ca 250 km wide Western Gneiss Region. Although the superstructure of the Scandian mountain belt is only rudimentarily preserved restoration of the SE-NW cross-sections can be used to constrain crustal thicknesses during the collision. These restored cross-sections allow explanation of burial and exhumation of coesite eclogite without direct conversion of pressure to burial. The exhumation of the very local and extreme UHP conditions recorded by micro-diamonds, majorite in peridotite garnet and ortho-pyroxene eclogite barometry cannot, however, be adequately explained by the available structures. The global importance of the Caledonides to understand collision geodynamics is primarily related to the structural and metamorphic evolution of the deep parts of orogenic belts, i.e. how UHP rocks are formed and exhumed.