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Post-orogenic exhumation of metamorphic core complexes in the SW Scandinavian Caledonides – A comparison of structures and processes

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Post-orogenic extension exhumed large terranes of deeply subducted continental crust in the southern Scandinavian Caledonides and overprinted large parts of the orogen. Hence, this last stage of the orogenic evolution is particularly important to understand in order to unravel earlier phases of the Wilson cycle. We compare two basement windows in SW Norway: The Øygarden Complex and the Gulen culmination of the Western Gneiss Region display large variations in metamorphic conditions and exhumation-related structures.

The Gulen area represents the southernmost culmination of the Western Gneiss Region in the footwall of the Nordfjord-Sogn detachment zone. The area hosts the southernmost occurrence of eclogites in the autochthonous basement, marking the extent of Caledonian high-pressure metamorphism. Shear zones formed preferentially in felsic lithologies during exhumation while eclogites were retrogressed. The area shows two distinct deformation domains: Subvertical coaxial amphibolite-facies shear zones developed in the core of the culmination and indicate N-S shortening and E-W extension. Detachment mylonites formed on the flanks of the culmination and show non-coaxial fabrics, low-grade retrogression and vertical shortening.

The Øygarden Complex is a hotter basement window as witnessed by the occurrence of Caledonian migmatites and sillimanite-bearing gneisses. This window is characterized by very strong pervasive deformation and shallow dips. Most rocks show common properties of detachment mylonites, such as non-coaxial fabrics, fluid-assisted retrogression and vertical shortening. Decoupled structural levels display variations in folding, localized vs. distributed deformation and distinct kinematics of the shear deformation.

The described structures can be well understood in the light of recent models of core-complex formation. The Gulen culmination demonstrates that bulk constriction in the footwall of a transtensional detachment system can be partitioned into vertical shortening and horizontal shortening in shallow and deep levels of the ductile crust, respectively. The Øygarden Complex, in contrast, displays a sequence of isostasy-driven extension-perpendicular lower crustal flow followed by buoyancy-dominated flow at shallower levels, similar to other migmatite-cored metamorphic core complexes (e.g. Naxos).