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Evidences of Silurian dextral transpression in the Scandinavian Caledonides

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The Scandinavian Caledonides are classically interpreted as a fold and thrust belt resulting from the collision between Laurentia and Baltica during the Silurian, which involved the up-to-400 km ESE-wards translation of nappes onto the Baltoscandian platform. It has been suggested that the Caledonian fold and thrust belt formed through several distinct orogenic episodes, from early shortening in the Late Ordovician to orogenic collapse in the Devonian. The classic Caledonian, orogen-perpendicular ESE-ward nappe transport is constrained by abundant and consistently oriented stretching lineations across the entire orogen and unambiguous kinematic indicators. However, there is also a large number of NW–SE-trending and roughly orogen-parallel lineations, particularly in the upper ophiolite- and eclogite-bearing nappes, which are more challenging to interpret with the traditional orogeny evolution model. The analysis of the areal extent, spatial distribution and geometrical relationships of the Caledonian nappes in southern and central Norway, however, offers new insights and allows for new constraints on the bulk kinematic framework of the shortening history of the belt.

Here we present new, first-order geological observations that demonstrate a two-fold compressional history and associated strain partitioning during Caledonian convergence. More specifically, we propose that Late Ordovician NNW–SSE shortening caused early compression, followed by WNW–ESE Early Silurian shortening, which resulted in strain partitioning along the planar fabrics and discontinuities from the earlier event. In detail, orogen-parallel dextral wrench tectonics caused significant lateral displacement along at least three, orogen-scale NE–SW striking corridors, wherein the nappes appear to be consistently displaced in a dextral fashion. We propose that the Møre–Trøndelag Fault Complex, which accommodated significant sinistral displacements during the later Devonian orogenic collapse, localized on one of these early dextral shear corridor. This is expressed by the asymptotic dragging of the nappes along it and also the significant morphological asymmetry of the central Norwegian coast line, which is not compatible with sinistral shearing. Along a southern corridor, which extends from the Hardangerfjord to the east of Folldal, the Caledonian foliation is asymptotically bent into the ENE–WSW orientation of the shear corridor, also consistent with an overall dextral kinematics. This is also confirmed by the gradual reorientation and increased strain toward these shear corridors of Ordovician to Silurian intrusive bodies, indicating that the dextral displacement is of Silurian age. Similar dextral displacements along NE–SW faults have previously been interpreted from potential field data offshore southern Norway.

Large-scale dextral transpression in the Scandinavian Caledonides readily accounts for numerous geological features that are not as easily reconciled with the more classical model of only ESE-ward translation and/or sinistral transpression.