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Structural inheritance during Caledonian nappe stacking (Kalak Nappe Complex, Finnmark)

Alberto Ceccato (1,4), Luca Menegon (1), Alison Halton (2), and Clare Warren (3)

(1) School of Geography, Earth and Environmental Sciences, University of Plymouth, Plymouth, United Kingdom (alberto.ceccato.90@gmail.com), (2) School of Physical Sciences, Open University, Milton Keynes, United Kingdom, (3) School of Environment, Earth & Ecosystem Sciences, Open University, Milton Keynes, United Kingdom, (4) Dipartimento di Scienze Biologiche, Geologiche ed Ambientali, University of Bologna, Bologna, Italy

During the Caledonian orogeny, the poly-metamorphosed and poly-deformed Sørøy and Sværholt terranes of the Kalak Nappe Complex (KNC, northern Norway) have been involved in the development of fold nappes at lower crustal conditions. The occurrence of multiple fabrics, with different age and P-T conditions of formation, makes the untangling of the KNC amalgamation and Caledonian history very difficult. On the other hand, this makes the KNC the ideal locality to analyse the role of structural inheritance during crustal shortening within orogenic cores. We have investigated a NW-SE cross section of the KNC exposed on Kvaløya Island (Finnmark, Norway), in order to provide more compelling and detailed identification of pre-Caledonian and Caledonian deformation and to analyse the strain patterns and structural inheritance during Caledonian top-to-SE thrusting.
Results from structural analysis indicate that, in places, the granulite-facies sub-horizontal pre-Caledonian fabric of the Sørøy Terrane has localized Caledonian deformation during top-to-SE-directed thrusting at P-T conditions of 550-675°C and 0.8-1.0 GPa. In-situ 40Ar/39Ar ages of syn-kinematic micas from the Sørøy Terrane fabrics are not directly ascribable to known tectonometamorphic events in the KNC. Rather, they yield a range of dates that most likely reflect the complex microstructure and deformation history of the analysed fabrics. The pre-Caledonian upright folds in banded orthogneisses and amphibolites of the Sværholt Terrane display different orientation, NE-SW and NW-SE respectively, in the northern and southern part of Kvaløya. Top-to-SE tilting of upright folds in northern Kvaløya suggests only weak Caledonian overprint. In southern Kvaløya, the upright folds are sheared parallel to their hinges during top-to-SE tectonic transport. With increasing strain, upright folds are progressively and vertically flattened to become tight recumbent folds, and a new, mylonitic foliation develops parallel to fold axial planes at amphibolite-facies (650-700°C and 0.9-1.0 GPa), showing a top-to-SE kinematic consistent with Caledonian nappe stacking.
The structural evolution observed in Kvaløya highlights the influence of the different orientation of pre-collisional fabrics on the style of collisional shortening of lower crustal sections. Different orientations of similar Caledonian structures, such as folds in the Sværholt terrane, does not necessarily imply different deformation stages, but may be related to the orientation of inherited pre-collisional structures. The orientation of pre-collisional structures may control strain partitioning and localization during orogenic deformation: the Sørøy pre-Caledonian fabric localized simple shear being optimally oriented for top-to-SE thrusting. The Sværholt terrane, instead, accommodated mainly a strong flattening component before the development of a pervasive foliation suitably oriented for top-to-SE thrusting. 40Ar/39Ar age of micas appear to be unreliable for dating poly-deformed fabrics; further investigation using other geochronometers may provide a better method for discerning between deformation events.