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Caledonian shortening by combined folding and thrusting in the immediate footwall of the Caledonian sole thrust: The example of the Repparfjord Tectonic Window, northern Norway.

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The Repparfjord Tectonic Window (RTW) is a window through the Caledonian nappes in northern Norway that exposes a package of greenschist facies metasedimentary and metavolcanic rocks of Paleoproterozoic age. These were deformed and metamorphosed during the Svecofennian orogeny producing km-wavelength upright NE-SW folds. Pervasive effects of a later Caledonian overprint, caused by the emplacement of the Kalak Nappe Complex during the Silurian, are limited and confined to the northwestern edge of the window, where NW-SE-shortening caused the development of a compressional imbricate stack. Individual imbricates exploit preexisting, progressively tightening upright to overturned folds and are bound by generally very steep to sub-vertical discrete faults. One of these structures, the Skinnfjellet Fault Zone (SFZ), truncates the large doloarenite-hosted Nussir Cu deposit and has a present-day orientation that makes reverse displacement mechanically difficult. This study aims at a better understanding of the mechanical and temporal evolution of these steep thrusts.

The SFZ strikes roughly NS, is sub-vertical and bears dip-slip lineations. It separates greenstones in the west from arcosic sandstones, conglomerates and the Nussir Cu deposit in the east. Kinematic indicators give east block up. Faulting occurred mostly under brittle conditions producing an approximately eight meter thick damage zone and a 40 cm thick fault gouge core.

A second prominent fault is the Nussirjavrri Fault Zone (NFZ). The main fault plane dips moderately toward the NNE, bears a NW plunging lineation and a number of kinematic indicators indicate top-to-the-SSE thrusting. The fault trace is mappable for c. one km, but high-resolution geophysics indicates an ENE-WSW continuation. Mapping shows that the fault zone is folded openly with a fold axis trending NNE/SSW, consistent with the geometry of a subregional folding phase of inferred Caledonian age. The fault affects greenstones, graphitic slates and dolomites. The mylonitic thrust core thickness varies from 10 to 40 cm and is composed by alternating dark and light bands of chlorite, muscovite and graphite, together with quartz and carbonates. Interspersed within the foliation are interstitial euhedral pyrite and cm to dm scale dolomite clasts. Dolomite decarbonation is locally observed. Synkinematic quartz veins occur subparallel to the tectonic foliation. Quartz is dynamically recrystallized by SGRR and has an average grain size of c. 35μm. Thin sections show two distinct and strong LPO's. One is preserved within the core grains whereas the other is found within arrays of the recrystallized subgrains, whose distribution appears to be controlled by healed brittle fractures.

Mapping indicates that the NFZ is cut by the SFZ and its overall transport direction to the SSE, in addition to its structural location at the front of the imbricate, strengthen its interpretation as a Caledonian structure (also consistent with dated and similarly oriented faults from the RTW).

We suggest that the SFZ formed as an antithetic back thrust within the Caledonian imbricate stack, possibly exploiting the limbs of a preexisting large-scale antiform. During Caledonian shortening this Paleoproterozoic megafold was tightened, leading to a progressive steepening of the fold limbs and of the SFZ, while NFZ was progressively folded around the fold hinge.