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Peak metamorphic temperatures from Raman Spectroscopy on Carbonaceous Matter (RSCM) and δ^{18}O and δ^{13}C (carb) isotope composition of a major mélange zone in the South Norwegian Caledonides

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A mélange in southern Norway comprises a matrix of garnet, mica- and black carbonaceous schists and phyllites of abyssal origin, interlayered with originally coarser grained siliciclastic metasediments, serpentinite conglomerates and sandstones, solitary metaperidotites and thin slivers of gneisses. Several models for the formation of the mélange have been suggested, including formation as a) an ophiolitic mélange formed during ophiolite obduction, b) an unconformable post-obduction transgressive sequence or c) a mélange formed during hyperextension along the pre-Caledonian margin of Baltica. In the past, the mélange has therefore not been treated as one single tectonic unit, but has been assigned to various tectonic positions with both outboard Iapetus and inboard Baltican origins.

In this study we argue that the mélange occupies a tectonostratigraphic position below major Baltican basement nappe-complexes previously assigned to the Middle Allochthon. Furthermore, we present new consistent results on the peak metamorphic temperatures (T $\sim$500 °C), based on RSCM, and a characteristic $\delta^{18}O_{carb}$ isotope composition (11-15.5 ‰ SMOW), both consistent for more than 250 km along strike of the mélange. $\delta^{13}C_{carb}$ values fall within three clusters around 1, -2, and -7 ‰ (PDB), respectively.

The stable isotope investigation presented here was carried out in order to explore if pre-Caledonian isotope signatures in various generations of carbonate veins and the early Ordovician fossils at Otta, could have been preserved through a later Caledonian metamorphic overprint. The results presented here however, suggest that re-equilibration of the carbonates took place in the Silurian, most likely coeval with peak metamorphism of $\sim$500 °C at $\sim$420 Ma, and the main fabric development close to the base of the nappe-stack. Re-equilibration of the carbonates was assisted by the presence a pervasive static fluid, allowing for oxygen isotope exchange with the surrounding schists and resulting in an mélange-wide uniform $\delta^{18}O_{carb}$ signature. The carbon isotope composition was re-equilibrated only within each lithological body and notably not beyond lithological boundaries.