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Formation, obduction and provenance of the Støren–Bymarka–Løkken ophiolite, Central Norwegian Caledonides; constraints from geochronology, geochemistry, Sm–Nd and Lu–Hf data

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Suprasubduction-zone ophiolites are a characteristic feature of the Palaeozoic Caledonian–Appalachian orogenic belt, and mark the onset of convergence and closure of one or more oceans separating the Baltican, Laurentian and Avalonian continents, ending with continent-continent collision in the Mid Palaeozoic. The Bymarka–Løkken ophiolite in the Central Norwegian Caledonides is a variably tectonised ophiolite fragment, locally with an incomplete, but nevertheless well-preserved ophiolite pseudostratigraphy. Previous work has concluded that the ophiolite formed in an Early Ordovician suprasubduction-zone environment, most likely in an oceanic arc/back-arc basin system, but little is know about the evolution of the ophiolitic crust. There has also been some debate as to the whether obduction of the ophiolite upon the subjacent Gula Complex was onto Laurentia, Baltica, or a microcontinent of Baltican affinity. Here we present new, high-precision TIMS and SHRIMP zircon analyses from felsic rocks in the ophiolite. Combined with geochemical and Sm–Nd whole-rock and Lu–Hf zircon analyses from the same rocks, these data allow us to elucidate the timing of various stages in the evolution of the ophiolite. Plagiogranite bodies range in age from 493 to 480 Ma and have relatively juvenile isotopic compositions. Geochemical data suggest subduction-zone influence and we interpret this stage to represent formation of the ophiolite in an oceanic back-arc setting. At 480 Ma, a large granitoid body with an unradiogenic isotopic composition and strong subduction-zone geochemical signature intruded the ophiolite. We interpret this stage to reflect convergence in the back-arc basin and formation or migration of an oceanic arc. The unradiogenic isotopic composition probably reflects subduction of back-arc basin crust with sediments derived from the nearby continent or microcontinent. At 480–470 Ma, a greenstone-dominated conglomerate and an overlying volcaniclastic sequence was deposited unconformably on the eroded, metamorphosed ophiolite, indicating obduction between 480 and 470 Ma, either onto a microcontinent close to Baltica at intermediate to high latitudes or directly onto Laurentia. By Late Arenig (Dapingian) time, the sediments were hosting Laurentian faunas, and detrital zircon data from these rocks reveal a significant Archaean component, unlike tectonostratigraphically lower allochthonous, parautochthonous and autochthonous sedimentary rocks that generally lack Archaean input. This suggests that the volcaniclastic succession and its ophiolite base had reached the equatorial latitudes of Laurentia by this stage. At 469–467 Ma, the ophiolite and its sedimentary cover was intruded by trondhjemite dykes and calc-alkaline volcanic rocks with intermediate isotopic compositions. We interpret this magmatism to reflect the establishment of a magmatic arc close to the continental margin of Laurentia at this time. Data from other parts of the Central Norwegian Caledonides suggest this arc might have been active until Late Silurian collision between Laurentia and Baltica.