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The Hølonda and Ilfjellet volcano-sedimentary basins of the central Norwegian Caledonides: Early/Middle Ordovician response to ophiolite obduction, subduction initiation and continental-arc establishment

Tor Grenne (1), Deta Gasser (2), Fernando Corfu (3), Lars Eivind Augland (3), Reidulv Bøe (4), and Trond Slagstad (4)

(1) Geological Survey of Norway (NGU), Trondheim, Norway (tor.grenne@ngu.no), (2) Western Norway University of Applied Sciences (HVL), Sogndal, Norway (Deta.Gasser@hvl.no), (3) University of Oslo, Department of Geosciences and CEED, Oslo, Norway, (4) Geological Survey of Norway (NGU), Trondheim, Norway

The Hølonda area of the central Norwegian Caledonides is well known for its Middle Ordovician fossiliferous limestones with Laurentian faunas, which led Tuzo Wilson to postulate the presence of an oceanic suture running through the Scandinavian Caledonides, separating Baltica- from Laurentia-derived nappes. The limestones are associated with continental-arc volcanic rocks and overlie obducted SSZ ophiolites, indicating an active tectonic setting of the Laurentian margin (or an associated microcontinent) prior to the closure of the Iapetus Ocean during the Caledonian orogeny.

Despite its importance for the understanding of the closure history of the Iapetus Ocean, the volcano-sedimentary stratigraphy of the Hølonda area is far from resolved. Existing stratigraphic schemes differ widely, and the absolute ages of several crucial units are not resolved. In this contribution, we present a new interpretation of the volcano-sedimentary evolution of the Hølonda and adjacent areas, based on extensive fieldwork and new geochemical and geochronological data. Our results indicate that the region hosts two different but connected Early/Middle Ordovician basins, representing shallow- and deep-water responses to ophiolite obduction, subduction initiation and continental-arc establishment.

(1) The Hølonda basin to the northwest unconformably overlies the obducted Late Cambrian/Early Ordovician ophiolites. The stratigraphy in this basin starts with fluvial(?), typically red, Gaustabakk conglomerates and sandstones with detritus from weathered ophiolite and its continental substratum. These are overlain by sandstones and graptolitic shales (Bogo and Lo formations) and, locally, contemporaneous basaltic rocks, passing upwards into presumably shallow marine to subaerial andesites (Nonsåsen Fm) of continental margin affinity. The latter has yielded a U-Pb TIMS zircon age of 467±1 Ma, providing the first absolute age for this succession. Further up, Hølonda limestones and associated subvolcanic/volcanic, shoshonitic Hølonda Porphyrites, also of continental margin affinity, formed in shallow water on a shelf, prior to deposition of a thick turbidite succession (Nyplassen Fm).

(2) The Ilfjellet basin to the southeast also unconformably overlies the eroded ophiolites but shows a different volcano-sedimentary evolution. It starts with the Klæbu Fm, which comprises deep-marine turbidites with continental and ophiolitic sources. The overlying Støren Fm (traditionally termed Støren Group and considered correlatives of the ophiolites) is dominated by N- to E-MORB basalts, followed by another thick sequence of turbidites (Fjellvollen Fm). Extremely enriched mafic to felsic volcanic rocks occur locally within the Støren and Fjellvollen formations and yield zircon ages of ca. 474-468 Ma. Notably, the uppermost part of the Fjellvollen Fm comprises submarine mass-flow deposits with coarse detritus from Hølonda Porphyrites and limestones, prior to turbidites equivalent to the Nyplassen Fm.

Our revised stratigraphic model has the Ilfjellet basin as an equivalent but deeper marine facies southeast of the contemporaneous Hølonda basin, reflecting a hitherto unknown phase of subsidence and related volcanism. Tentative models invoke formation in a transient period of slab steepening and eventual breakoff after Early Ordovician arc-continent collision and ophiolite obduction, followed by polarity flip and westward subduction initiation along the Laurentian margin.