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Inferred paleotectonic settings and paleogeography at 500-450 Ma based on geochemical evaluation of Ordovician volcanics and gabbros of the Upper Allochthon, Mid Norway

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Evaluation of major- and trace-element analyses of Ordovician volcanics and gabbros from the Støren Nappe of the Upper Allochthon, Mid Norway, including 87 new analyses, covers the Late Cambrian-earliest Ordovician ophiolite complexes and overlying Ordovician volcanics. The older rocks have mainly MORB-like compositions likely formed in a back-arc basin, plus less abundant oceanic-arc basalts and andesites. Compositions characteristic of fore-arc environments are absent.

The Upper Allochthon has three elements: A) The Gula Nappe of probable Cambrian and Tremadocian, epicontinental sedimentary rocks, B) The Støren and Meråker nappes with their basal suprasubduction-zone ophiolitic volcanics and intrusions plus younger Ordovician successions, C) In northwestern parts of the Støren Nappe, a complex of predominantly calc-alkaline arc intrusive rocks 482 to 441 Ma. The structural and stratigraphic history indicates obduction of ophiolites occurred at 480-475 Ma soon after formation, followed by uplift, erosion, and deposition of conglomerates incorporating ophiolite debris. The overlying sequence includes shelly Toquima-Table Head faunas of Laurentian affinity and younger strata into Upper Ordovician. Field relations suggest that the ophiolites were obducted onto rocks of the Gula Complex. A Tremadocian, graptolite-bearing black shale/phyllite in the eastern part of the Gula has close geochemical affinities with the reducing V- and U-enriched Alum shale of the Baltoscandian margin, black shales in the lower Köli nappes of the Upper Allochthon in Sweden, and similar shales in the Gander and Avalon zones of Maritime Canada. Such shales originated in high-latitude (40-50° south) cool-water environments, as existed in Late Cambrian-earliest Ordovician Baltica, Avalonia, and Ganderia, and have not been recorded in equatorial paleolatitudes, such as the earliest Ordovician margin of Laurentia.

Our paleotectonic account for these features is in three time slices: 1) A Late Cambrian to Tremadocian, oceanic-arc system, including subduction-initiation magmas, developed 500-480 Ma above a subduction zone dipping oceanward from a microcontinent that earlier rifted away from Baltica or Ganderia. 2) The ophiolitic and primitive arc rocks obducted 480-475 Ma upon epicontinental rocks flanking the microcontinent, which was then drifting rapidly across the Iapetus Ocean approaching Laurentia. In obduction, fore-arc igneous rocks were transported far onto the microcontinent and eroded. 3) A new arc and marginal basin developed 470-460 Ma, after a subduction polarity reversal, with sedimentary infill replete with Laurentian faunas, locally punctuated by calc-alkaline volcanics and dikes, with fringing reefal limestones. The highest clastic successions record continental sedimentary sources to southeast and volcanic sources to northwest, mainly before full development of the Taconian arc-continent collision 458-443 Ma as in New England. Lacking is evidence of Late Ordovician Taconian deformation/metamorphism, a hallmark of the Appalachians, perhaps explained by the postulated upper-plate location of the Støren Nappe, also lacking in corresponding upper-plate locations in the Appalachians. The entire volcano-sedimentary assemblage was later affected by Scandian, Silurian-Early Devonian emplacement of nappes onto the Baltoscandian margin.