

# The Taconic and Grampian orogenies: Ordovician arc-continent collision

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The Ordovician and Cretaceous were periods of dispersed continents, high sea-level, platform carbonates, oceanic black shales, blueschists, and fore-arc supra-subductionzone ophiolite complexes obducted, with their associated arcs, onto continental shelves, as giant thrust sheets up to 200 km normal to and 1000 km parallel with regional orogenic strike, during arc/rifted continental margin collision. The ophiolite sheets have associated regional subjacent polyphase-deformed Barrovian metamorphic complexes, transported high-temperature two-pyroxene granulite/ amphibolite basal soles, and blueschist assemblages. The metamorphic soles, which have MORB and OIB protoliths have ages roughly the same as the ophiolite above and are derived clearly from the subducting ocean, sliced off and attached to the base of the ophiolite before obduction. The soles are not metamorphic aureoles to the obducting hot ophiolite because they originated at pressures up to about 10 kb. The obducted sheets and their subjacent orogenies were short-lived continentward-vergent events and led, along the Laurentian margin of the Appalachian/Caledonian Orogen, to subduction polarity flip and vergence reversal. These short-lived collisional orogenies were accompanied by the development of flexural peripheral bulges, and foreland basins that received detritus from the rapidly eroding orogen.

The recent acquisition of a large amount of new stratigraphic, structural, geochronological, and heavy mineral data for the Ordovician Taconic/Grampian Zone of the Appalachian/Caledonian Orogen has resulted in a detailed understanding of the timing and relationships between ophiolite generation and obduction, deformation, metamorphism, magmatism and unroofing, which now permits fine-scale control of iterative numerical models of the obduction process and its geological consequences. A series of thermo-mechanical models have been developed for ophiolite obduction, resulting from arc/continent collision, based upon geological data from the Grampian Zone of the British Caledonides and the Taconic Zone of the Newfoundland Appalachians that accounts for their stratigraphy, structure, metamorphism, magmatism, geochemistry, and burial/exhumation history over a short orogenic episode of about twelve million years. Western Newfoundland preserves, superbly, most elements of the Taconic arc-Laurentian continental margin collision including continental edge facies changes, the obducted fore-arc Bay of Islands Ophiolite Complex, the Goose Tickle foreland basin, the arc, and the superposed polarity-flip arc. Western Ireland preserves the South Mayo Trough, some five kilometres of clastic and volcanic rocks and a major Barrovian metamorphic complex beneath the obducted arc. In western Newfoundland, there appear to have been two sub-parallel subduction surfaces; one shallow along which the arc and fore-arc were obducted, the other at a deeper level along which the Grenville basement was stripped from beneath the amphibolite-facies Fleur-de-Lys metamorphic complex and carried down into the eclogite facies before being obducted back against the Fleur-de-Lys.