Loading the Laurentian margin: correlating foreland basin subsidence with eclogite metamorphism

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Paleozoic loading of the former Laurentian continental margin is recorded both in the subsidence history of the Appalachian foreland basin and in metamorphic rocks now exhumed in internal parts of the Newfoundland Humber zone.

The Cambrian-Ordovician passive margin of Laurentia underwent a transition to a foreland basin setting beginning in Early Ordovician time. Middle Ordovician ('Taconian') foreland basin sediments (Table Head and Goose Tickle groups), in part derived from the Humber Arm Allochthon, are relatively thin (ca. 250 m in offshore industry seismic data, thinning to the west). The overlying Late Ordovician Long Point Group is preserved in outcrop only on the west coast of Port au Port Peninsula, but can be traced on seismic data offshore beneath the Gulf of St. Lawrence. Limestone at the base of the Long Point Group (Lourdes Limestone) is overlain by a 1.25 km thick succession of siliciclastic sediments (Winterhouse and Misty Point formations) representing marginal marine and deltaic environments. In sharp contrast to the thin "Taconian" succession, this significant thickness of Late Ordovician clastics indicates rapid subsidence of the foreland basin, with corresponding rapid sediment supply from the orogen to the east.

In the internal Humber zone, metamorphic equivalents of the Cambrian-Ordovician passive margin succession (Fleur de Lys Supergroup) are exposed in the Baie Verte Peninsula and elsewhere. These units record Barrovian metamorphism with peak temperatures around 700 to 750°C at 7 to 9 kbar; isotopic data indicate that peak temperatures were reached in Early Silurian time ('Salinian orogeny'), followed by rapid exhumation. Amphibolite facies metamorphism overprints an earlier eclogite facies assemblage, for which minimum pressures of 1.2 GPa at 500°C require burial of the Laurentian margin beneath at least 40 km of overburden, which may have included thrust sheets of continental margin rocks and allochthonous arc terranes of the Dunnage zone. The eclogite facies metamorphism has not been dated directly, but by analogy with thermal models for Barrovian metamorphism involving overthrusting, peak pressures probably preceded peak temperatures by at least 10 My.

We suggest that Dunnage zone arc terranes were tectonically emplaced above the Laurentian margin on a crustal scale in a previously undocumented episode of major Late Ordovician tectonism, resulting in both high-pressure metamorphism of the Fleur de Lys Supergroup, and in rapid subsidence and sediment supply to the foreland basin now largely hidden beneath the Gulf of St. Lawrence.