

Demise of the Ordovician carbonate platform in the Canadian Arctic Islands.

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Summary

The Franklinian Margin along the (present day) northern edge of Laurentia was dominated by carbonate ramp or platform for about 60 million years, from early Cambrian to Late Ordovician time. Carbonate sedimentation ceased over much of the central and northeastern parts of the Arctic Islands in late Katian time, replaced by mudstone of the Irene Bay Formation.

The Late Ordovician history of the carbonate platform shows an overall deepening trend following a widespread late Middle Ordovician unconformity and associated normal faulting. Immediately overlying the unconformity are supratidal carbonate mudstones of the lower Thumb Mountain Formation, overlain by subtidal wackestones of the upper Thumb Mountain Formation. The upper Thumb Mountain Formation is increasingly bioturbated upsection, and the top of the formation has abundant macrofossils. Like most units deposited during the Ordovician in the Arctic Islands, the Thumb Mountain Formation is thickest in the centre of the platform and thins towards both the craton and platform margin, indicating a subtle intraplatformal basin.

The contact between the Thumb Mountain and overlying Irene Bay Formation is marked by an iron-stained hardground, or thin intraclast and bioclastic grainstone bed overlying a sharp contact with erosional relief. Clay content of the Irene Bay Formation is about 67% compared to about 15% in the uppermost Thumb Mountain Formation. Samples of Irene Bay Formation show a positive ϵNd shift to -9.1, compared to older units that have ϵNd about -18. The Irene Bay Formation extends from northwestern Greenland to southwestern Melville Island, but is absent northeast and southwest of these areas where it transitions into age-equivalent clean carbonate units. The Irene Bay Formation is thickest on northern Ellesmere Island (198 m), over 50 m thick from central Ellesmere Island to eastern Melville Island, then thins to the west before disappearing into a clean carbonate facies on western Melville Island. Units correlative to the Irene Bay Formation on northern Baffin Island contain a brachiopod with Siberian affinity. Following the late Katian, faunas with a Siberian affinity are commonly present in northern Laurentia.

Deposition of the Irene Bay Formation was synchronous with development of volcanic units in the deep-water basin to the north of the Franklinian Margin, as well as being synchronous with the development of an angular unconformity and volcanic units on Pearya terrane of northern Ellesmere Island. The tectonic interpretation is that thrust thickening of a craton-ward migrating orogenic wedge caused subsidence, as shown by accumulation of the deepening-upward Thumb Mountain Formation, followed by collision in late Katian time of a terrane with a probable volcanic arc character that introduced Siberian-affinity faunas. This collision is reflected on the platform by deposition of the Irene Bay Formation and influx of isotopically more juvenile clay.