

Evolution of the Arctic Ocean

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ABSTRACT

Tectonic events determined in the Canadian Arctic suggest a new model for the evolution of the Arctic Ocean.

The Canadian Arctic Islands formed during two long phases. The constructional phase extended from Precambrian to Late Devonian time, ending with the Ellesmerian Orogeny. Basins were formed successively and welded to the continental lithosphere. At the end of this phase, this entire region may have been an emergent continent.

The fragmentation phase occurred by a plate tectonic event that extended from mid-Mississippian to mid-Tertiary time. Extension faults were propagated southeastward from the Canada Basin, fragmenting the Canadian Arctic into sub-plates that now form islands. This event ended rather suddenly, probably when the faults became connected with similar faults in the Baffin Bay region. The Canadian Arctic has been dormant tectonically since mid-Tertiary time.

The wider circum-arctic region appears to have had similar phases. The constructional phase ended in about Late Devonian time, after orogenic events. At the end of this phase, the continent of Pangaea extended across the present Arctic Ocean and surrounding lands.

The fragmentation phase may have begun in mid-Mississippian time, when the Boreal Rifting Episode produced divergence of plates away from a spreading center occupying the Alpha Ridge. The Canadian Arctic Islands were fragmented as a marginal side effect, with the Sverdrup Basin forming above the fragmented continental crust. Fragmentation ended in the western Arctic in mid-Tertiary time, when spread on the Alpha Ridge ceased. The ridge remains high today, probably because of a submerged continental remnant beneath it.

In mid-Tertiary time, the Nansen-Gakkel Ridge separated a fragment of continental material from the Eurasian Plate to form the Lomonosov Ridge. This fragment is now isolated between an active and a dormant spreading center. Because it is rather narrow to begin with, marginal thinning from the two sides caused the ridge to subside below sea level.