



Episodic magmatism resulting from intermittent rifting of the proto-North Atlantic: Insights from new geochronological constraints in Newfoundland, Canada

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The non-volcanic Newfoundland margin offshore eastern Canada formed after a period of lithospheric stretching and rifting which began in the Late Triassic to Early Cretaceous. This was followed by continental breakup resulting in separation of the Grand Banks and Iberia, and northern Newfoundland and Ireland in the Aptian-Albian. Despite the Newfoundland margin being considered as a non-volcanic, or magma-poor, passive margin, a sequence of Mesozoic-Cenozoic magmatic rocks have been documented on- and offshore Newfoundland that have been proposed to be contemporaneous with rifting and breakup. These include Mesozoic alkaline intrusive rocks in northern-central Newfoundland, referred to in previous work as the Notre Dame Bay Magmatic Province (NDBMP), that comprise multiple kilometre-scale gabbroic intrusions in addition to widespread, genetically-related, metre-scale lamprophyre dykes. Here, we describe the results of a comprehensive study into the petrology, geochemistry and geochronology of these intrusive bodies. Specifically, we conducted U-Pb dating on zircon and $^{40}\text{Ar}/^{39}\text{Ar}$ dating on phlogopite from several of the intrusive bodies. Our analyses confirm that a substantial, and geodynamically significant, magmatic event occurred on the Newfoundland margin at ca. 147.9 Ma (Late Jurassic, Tithonian), contemporaneous with significant rifting, and the formation of the offshore petroliferous rift basins. Comparison of this new Late Jurassic age with geochronological determinations from adjacent Mesozoic-Cenozoic rift-related magmatic rocks (e.g., the North Atlantic Igneous Province and the Central Atlantic Magmatic Province) reveals a picture of intermittent, episodic, rifting dominating the embryonic rift environment. This is contrary to the classic continuous, 'unzipping' of the proto-North Atlantic previously interpreted. Instead, a progressive and intermittent 'unsnapping' of the proto-North Atlantic is favoured.