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# Sr-Nd-Hf-Pb isotope evidence from alkaline magmatism on the Labrador Sea margins for the temporal evolution of a rift in the North Atlantic cratonic mantle lithosphere

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Olivine lamproites (˜ 1400-1200 Ma), aillikites to carbonatites (˜ 606-550 Ma) and melilitites to basanites (˜ 160-100 Ma) erupted through the North Atlantic craton crust along the borders of the present-day Labrador Sea over a period of 1300 Myr, and so present a relatively continuous record of the fate of the rifting lithosphere. The Mesoproterozoic olivine lamproites from Labrador are characterized by unradiogenic Nd (Nd = -5.3 to -8.4), Hf (Hf = -7.8 to -10) and Pb (206Pb/204Pb = 14.2-14.8), but moderately radiogenic Sr isotope compositions (87Sr/86Sr $>$ 0.7047). Coupled with the occurrence of rare diamonds, these isotopic compositions indicate thick, ancient enriched continental lithospheric mantle at 1300Ma. In contrast, Late Neoproterozoic carbonate-rich aillikites and carbonatites have different Nd (Nd = 0.1-1.8), Hf (Hf = -0.9 to +2.6), Pb (206Pb/204Pb = 17.4-18.8) and Sr (87Sr/86Sr $<$ 0.7040) isotope compositions that are typical for convective upper mantle. Carbonate-poorer aillikites from the northernmost Labrador occurrences, however, appear to have isotope chracteristics transitional between the lamproites and the more southerly carbonate-rich aillikites. This implies a complex pattern of lithosphere-asthenosphere interaction at depths between ˜ 200 and 150 km during incipient rifting and lithospheric thinning since at least the

end of the Precambrian. The Mesozoic suite of sodic alkaline dyke rocks has slightly unradiogenic Nd (-3.9 to -1.3) and Hf (-4.6 to +1.3), but moderately radiogenic Sr (0.7043-0.7062) and Pb (206Pb/204Pb = 19.0-20.7) isotope compositions, compatible with melting at the newly adjusted lithosphere-asthenosphere boundary at a depth of about 120-90 km. These new age and isotopic data demonstrate that lithosphere destruction beneath the North Atlantic Craton commenced before the end of the Precambrian, associated with the break-up of Rodinia, and continued intermittently until the opening of the Labrador Sea at around 60 Ma. It is estimated that between 600 Ma, when a diamond-bearing lithospheric root up to 200 km thick was present, and 150 Ma, approximately 50 to 100 km of the cratonic lithosphere was eroded by the hotter underlying asthenosphere. This lithosphere destruction began beneath a stagnant supercontinental plate assembly resulting in enhanced passive rifting with associated alkaline magmatism.