

Alkaline and carbonatite intrusives help to unravel the temporal evolution of a cratonic rift in the North Atlantic region

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The Labrador Sea is a small ocean basin in the North Atlantic realm that cuts through the Archean cratonic lithosphere of Labrador and Greenland. While the onset of sea-floor spreading has been determined at ca. 60 Ma [1], the preceding rifting stages are poorly constrained mainly due to the inaccessibility of the offshore sedimentary basins and the strong uplift plus erosion of the rift flanks. However, diverse suites of alkaline and carbonatite magmas that erupted through the North Atlantic craton crust over a period of 1300 m.y. present a relatively continuous record of the fate of the rifting lithosphere [2].

Mesoproterozoic lamproites are characterized by unradiogenic Nd, Hf and Pb, but moderately radiogenic Sr isotope compositions. Coupled with the occurrence of diamonds, these isotopic compositions indicate thick, ancient enriched SCLM at 1400-1200 Ma. In contrast, Neoproterozoic carbonate-rich aillikites and carbonatites have different radiogenic isotope compositions that are typical for convective upper mantle. Carbonate-poorer aillikites from the northern Labrador occurrences, however, have isotope characteristics 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 since at least the end of the Precambrian. A Mesozoic suite of nephelinitic dyke rocks has slightly unradiogenic Nd and Hf, but moderately radiogenic Sr and Pb isotope compositions, compatible with melting at the newly adjusted lithosphere-asthenosphere boundary at a depth of 120-90 km. These new data demonstrate that between 550 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 [2].

[1] Chalmers & Laursen (1995) *Marine & Petroleum Geology* **12**, 205-217. [2] Tappe *et al.* (2007) *EPSL* **256**, 433-454.

Inverse carbon isotopic trend in hydrocarbons from hydrothermal fluids of Socorro Island, Mexico

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Socorro Island, the biggest of the Revillagigedo Archipelago, is a part of the Mathematician Ridge, a former EPR after a jump ~ 3Ma to its present location. Fumarolic steam (96°C) of Everman volcano at the island is enriched in H₂ and CH₄ (10 and 3.5 vol% in dry gas) with ³He/⁴He = 7.6Ra, H₂/H₂O ≈ 100, CO₂/H₂ ≈ 8; H₂/CH₄ ≈ 3 and 650 < C1/C2 < 900. Methane of Socorro is isotopically heavy (-13 > δ¹³C > -19 ‰) and δ¹³C1 > δ¹³C2 ≥ δ¹³C3. The chemical (on the CO₂ - free basis) and isotopic composition of gases are very similar to submarine and terrestrial gases produced by serpentinization of ultramafic rocks. The source of high H₂ and CH₄ in Socorro gases is thought to be serpentinization of Mg-rich gabbroid intrusive bodies beneath the volcano edifice by infiltrated seawater in presence of magmatic CO₂ [1]. However, the Socorro and other “ultra-mafic” gases have too high C1/C2+ (~1000) to be produced by the Fischer-Tropsch type synthesis (FTS) as suggested by many authors (see review in [2]). Methane in the case of Socorro can be a mixture of isotopically heavier abiogenic CH₄ and isotopically lighter thermogenic CH₄. The observed inverse isotopic trend can be thus provided with a mixture of abiogenic CH₄ and thermogenic hydrocarbons with a common CH₄/C2+ of ~100. Beside FTS and a simple mixing several other mechanisms responsible for high C1/C2+ and the “inverse” isotopic trend are suggested.

[1] Taran *et al.* (2002) *Chemical Geology* **188** 51-63.

[2] Taran *et al.* (2007) *Geochim. Cosmochim. Acta* **71** 4474-4487.