Dispersion of a continental crust component by the Iceland plume

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A unique isotopic composition with elevated $^{87}Sr/^{86}Sr$, Δ7/4 and Δ8/4 in rocks from the Öræfajökull and Snæfell volcanoes in the Eastern Flank Zone (EFZ) has been ascribed to the presence of continental crust (CC) under SE Iceland [1]. We modeled a CC-contamination trend from Icelandic rift zone basalts in the Mid-Icelandic Belt, via Eastern Rift Zone (ERZ) tholeiites to EFZ basalts. The most enriched basalts of the ERZ, Öræfajökull and Snæfell suites correspond to 1-2%, 2-4% and 3-6% CC, respectively [1]. The unique Sr-Pb-Nd-O-isotope composition of Öræfajökull is common to the entire compositional range from basalt to rhyolite [2], indicating CC-contamination of primitive melts near the Moho, before fractional crystallization to generate evolved rocks [3] [4]. Plate reconstructions and crustal thickness variations indicate that CC-fragments belong to an extended Jan Mayen Microcontinent (JMM), separated from the outer Greenland shelf by spreading along the Kolbeinsey Ridge [1]. Due to northwestward shift of the plate boundary relative to the plume axis, the rift zones in Iceland relocated at 24, 15, 7 and 2 Ma [5]. This enabled the JMM to remain near the eastern margin of the rift zones and become deeply buried under a growing lava pile.

The dispersion of the CC component from Öræfajökull along the EFZ, and diagonally across the ERZ, supports a plume axis located 33 km west of the Öræfajökull summit [6]. Dilution of the CC component in ERZ lavas, erupted from the highly productive Grimsvötn and Bárðarbunga fissure swarms, is caused by extensive mantle melting under these volcanic systems. The positioning of the plume axis under the northwestern part of Vatnajökull by several previous studies (reviewed in [6]) can be explained by extensive rifting, asthenospheric upwelling and melt production in the northern part of the ERZ, near the confluence with the Northern RZ. The elevated crustal thickness on the east side of Bárðarbunga and Grimsvötn [1] may also result from the high volcanic production rate.

[1] Torsvik et al. (2015) *PNAS* 10.1073/pnas. 1423099112. [2] Prestvik et al. (2001) *EPSL* **190**, 211-220. [3] Martin & Sigmarsson (2010) *Lithos* **116**, 129-144. [4] Selbekk & Trønnes (2007) *JVGR* **160**, 45-57. [5] Harðarson et al. (2008) *Jökull* **58**, 161-178. [6] Shorttle et al. (2010) *GGG* **11**, Q0AC05.