Abstract

Mid-ocean ridges are present in every ocean but Iceland is the only place where such a structure is exposed at the surface. The large basaltic plateau created over millions of years cannot only be explained by the presence of the ridge and a plume has often been advocated as a cause of the large magmatic production. Iceland provides a large petrological diversity especially in terms of basaltic composition: it shifts from tholeiitic in the centre of the island to alkali on the sides. A tholeiitic signature is associated with the formation of MORB while an alkaline one is related to the presence of intra-plate volcanism forming OIB.

This study focuses on the compositional evolution present in Iceland and links it to magmatic production on off-rift axis position. The occurrence of recent volcanic activity on the west part (Snaefellsnes peninsula) is not explained especially considering that the plume position is thought to be located on the east side. Different source mechanisms under MOR are tested here to explain compositional evolution and the location of volcanism in Iceland.

Geochemical interpretation was done according to three zones: (1) the Rift Zone (central rift), (2) the South Transition Zone (south-east + Vestmannaeyjar islands) and (3) the West Diverging Volcanism (Snaefellsnes peninsula). Compositions display a change from tholeiitic (RZ) to alkali (WDV) with in-between, intermediate signature (STZ).

Precise geochemical and petrological observations (whole rock and mineral phases) are carried out in order to constrain the crystallisation sequence of each zone. Sequences are corrected using the fractional crystallisation model developed by Tornare (2016) to determine primitive liquids composition. Source attribution shows that partial melting of a DMM cannot account for Iceland's off-axis lava compositions. Instead this study, proposes two source mixing models; (1) a pyroxenite mantle (recycled crust) with a DMM and (2) a lithospheric metasomatic cumulate with a E-DMM. Variations in depth and pressure are performed assuming changes in melting mode and mineral abundances with calculations starting at 1GPa (spinel field) to 3GPa (garnet field).

Off-rift axis magmatism is symmetric and produced by the percolation of melt through the lithosphere. Mixing processes as well as metasomatic reactions induced by lithospheric melt percolation are the suggested mechanisms generating large volcanic activity and alkali geochemical signature in the Snaefellsnes Peninsula.

Keywords: Iceland, alkali basalt, mid-ocean ridge, off-rift axis magmatism, mantle source, mantle heterogeneity, partial melting , pyroxenite, lithospheric metasomatism.