



Geochemistry of the Vøring Plateau lavas as an indicator of continent-mantle interaction processes during the early rifting in the NE Atlantic Ocean

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The Vøring volcanic rifted margin off Norway is a result of the continental break-up between Eurasia and Greenland, and is associated with the emplacement of one of the largest Large Igneous Provinces (LIP) in the world: the North Atlantic Igneous Province (NAIP). The ODP Leg 104 Hole 642E cores (Vøring Plateau, NE Atlantic), keep a record of the magmatic activity from the very early break-up phases. The bottom section of this hole (‘Lower Series’ or LS) is made up of a subaquatic succession of peraluminous glassy dacitic lavas (ca. 75m thick), cut by a 20m-thick tholeiitic dyke or sill, and underlain by a rhyolitic ignimbrite and basaltic andesitic flows. The LS is topped by a 15m thick succession of reddish volcanoclastic rocks, which separates the LS from the 750m thick ‘Upper Series’ (US) of transitional-type tholeiitic MORB.

While earlier studies emphasized the ‘bipolar’ nature of the tholeiitic US and of the ‘dacitic’ LS, a renewed geochemical study reveals more complexity in the chemical composition of the LS. The new isotopic and major/trace element analyses of the LS volcanic units and the US lava flows indicate that part of the LS are products of hybridisation of melts derived from a Proto-Icelandic mantle source and material derived from upper continental crust. An assimilation trend runs from high $^{87}\text{Sr}/^{86}\text{Sr}$ ratios (0.705 - 0.707) and slightly positive ϵNd values (+0.9 to +1.1) for the LS units to lower $^{87}\text{Sr}/^{86}\text{Sr}$ ratios (0.703 - 0.705) and clearly positive ϵNd values (+5.7 to +7.9) in the US. Indications of minor extent of mixing in lowest lava flows are preserved in e.g. enhanced Th/La ratios of the US.

The trace element Cesium is a potentially promising element to investigate the influence of the continental crust on initial continental break-up magmatism. Cs with its [Xe] 6s¹ electron configuration and large ionic radius (the largest cation) has a strong preference for ionic bonds. The Cs partition coefficients are exceedingly small for most rock forming minerals (<<1), except for biotite (>1). Hence, it is the most "lithophile" of all elements and shows the greatest relative increase during magmatic processes (protracted crystallisation or decreasing degree of melting). Cs concentrations in the Mantle and the Lower Continental Crust are very low, while the Upper Continental Crust contains nearly 5 ppm. As the natural abundances are often at the ppb level, it is only with the introduction of low blank sample dissolution methods and the ICP-MS that reliable Cs data become routinely available.

The available Cs data of the LS rocks are variable (1.25–0.14 ppm) but show a trend of increasing values with depth – hence relative age. It is intriguing that basaltic andesites have higher contents than the overlying dacites. As a possible explanation one could assume that Cs has been efficiently extracted from the crustal material in the very initial phases of melt-crust interaction. The US tholeiites generally have very low Cs contents (0.005 to 0.02 ppm); but some samples at the LS to US transition have higher Cs contents (up to 0.15 ppm). The Cs data of Hole 642E samples appear to define a trend of decreasing influence of mantle-crust interaction during the formation of the lava-pile. Additional data are collected to better define the relationships between the trace element and isotopic mantle-crust mixing trends.

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