EGU22-9199
https://doi.org/10.5194/egusphere-egu22-9199
EGU General Assembly 2022


# Plume-Fracture Zone interactions in the NE Atlantic

**Lea Beloša**[1], Carmen Gaina[1,2], Sara Callegaro[1], Adriano Mazzini[1], Christine Meyzen[3], Stephane Polteau[4], and Michael Bizimis[5]

[1]Centre for Earth Evolution and Dynamics, University of Oslo, Norway
[2]School of Earth and Atmospheric Sciences, QUT, Australia
[3]Department of Geosciences, University of Padova, Italy
[4]Institute for Energy Technology, Kjeller, Norway
[5]School of Earth, Ocean and Environment, University of South Carolina, Columbia, SC 1629208, USA

Typically, the change in lithospheric thickness associated with fracture zones relates directly to the vigor of secondary convection or mantle flow patterns. Therefore, one might expect that mantle flow considerably boosted by the presence of a mantle plume would easily overcome the lithospheric steps created at fracture zone locations. However, to date, there are no studies to verify this assumption**.** Numerical models based on an example from the SW Indian Ridge suggest that the axial flow driven by a plume (the Marion plume) is indeed likely to be curtailed by the long-offset fracture zones[1].

We have investigated the interactions between the Jan Mayen fracture zone and Iceland mantle plume in the NE Atlantic by considering (a) the lithospheric and asthenospheric regional configuration and (b) the geochemistry of rocks produced by submarine volcanism.

Several global lithospheric models indicate a thinning of the lithosphere on both sides of the Jan Mayen Fracture transform, despite the difference in age of the two adjacent oceanic basins. However, the tomographic models indicate a gap in the asthenospheric flow at the lithosphere-asthenosphere depth under Jan Mayen transform fault, and only a narrow northward channel of this flow is visible under the westernmost part of the fracture zone.

Vesteris seamount is an alkaline seamount placed in the central part of the Greenland Basin, located ca. 480 km west from slow-spreading Mohn's ridge and ca. 250 km north from the Jan Mayen Fracture Zone. Vesteris is a solitary volcanic center far away from an active ridge regime with an eruptive age ranging from 650 – 10 ka [2]. Here we report new results from geochemical analysis of several samples dredged during the East Greenland Sampling campaign EGS-2012 from the flanks of Vesteris. Whole-rock major and trace elements, together with isotopes and olivine phenocryst mineral data, are used to decipher the source of volcanism at Vesteris Seamount.

The Sr-Nd-Pb isotopic signatures indicate that Vesteris volcanism is unrelated to the Iceland mantle plume. Low NiO concentrations in highly forsteritic olivines from Vesteris alkali basalt suggest that the source was dominantly peridotitic. Rare Earth Elements profiles indicate very low degrees of partial melting of a deep mantle source in the presence of residual garnet.

Vesteris seamount was formed in a location of a relatively steep gradient of the lithospheric-asthenospheric boundary and close to the northward mantle flow that is carving the Greenland thick lithosphere. The results suggest that the Iceland mantle flow may not have crossed the Jan Mayen Transform Fault; instead, the seamount tapped into a mantle reservoir in the Greenland Basin that preserved the complex history of the Greenland craton and adjacent terranes.

REFS. (1) Georgen and Lin, 2003, Plume-transform interactions at ultra-slow spreading ridges: Implications for the SW Indian Ridge, G-cubed, doi:10.1029/2003GC000542; (2) Mertz & Renne, 1995, Quaternary multi-stage alkaline volcanism at Vesteris Seamount (Norwegian—Greenland Sea): evidence from laser step heating 40Ar/39Ar experiments, Journal of Geodynamics, doi:10.1016/0264-3707(94)E0001-B.