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Formation of the North Atlantic Igneous Province: what is the role of the Iceland mantle anomaly?

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Several studies have recently challenged the arrival of the Iceland mantle plume around breakup time as an explanation for North Atlantic Igneous Province formation, as some unexplained aspects remain. Alternative processes have been suggested for the wide-spread and excessive magmatism, including delamination, small-scale or edge driven convection, and chemical mantle heterogeneities. We review available datasets and compare them with predictions from the mantle plume and alternative models.

We find that none of the existing models provides a complete explanation of all aspects of North Atlantic breakup-related magmatism at this point. Additional most of the observed geochemical variations are ambiguous and can either be explained to reflect intrinsic variations of deep-mantle sources (mantle plume) or contaminations from the non-convective mantle and/or continental crust. Even the strongest radiogeninc isotopic mantle plume “fingerprint”, high He ratios, is currently being challenged, as a prove of a deep mantle source.

Based on this modelling (numerical and analogue), geophysical and geochemical available datasets we suggest a new model for the formation of the North Atlantic Igneous Province. In this model, dynamic processes related to rifting that are predicted now by many models play a dominant role in the model for volcanic margin formation. Small-scale convection can enhance melt production during rifting and may be responsible for widespread uplift, also post-break-up. We suggest that the onset of magmatism along the NAIP is first only due to dynamic rift processes which may have triggered the later phase. In the second phase of the hybrid model, which is not

related to the continental break-up. The Icelandic mantle anomaly dominates the NAIP formation.

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