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Inter-relationship between the Tectonic and Magmatic Evolution of Hyper-extended Margins and Break-up

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High-quality, long-offset seismic reflection and refraction data, coupled with new well data on hyper-extended passive continental margins show a margin architecture and evolution in which the volume and distribution of syn-rift magmatism and fault structures vary considerably. These observations led to an oversimplified classification of rifted margins as either volcanic or non-volcanic. Available data show that rifted margins are more complex and cannot be characterized based on the volume of observed magma alone. Indeed, so called "non-volcanic" margins are not necessarily amagmatic, as shown by ODP drilling along the Iberia-Newfoundland rifted margins and the fact that these margins eventually result in the production of oceanic crust. On the other hand, magma-rich margins, such as the Norwegian, Northwest Australian and Brazilian rifted margins, show evidence for earlier episodes of hyper-extension, suggesting that there is significantly more deformation before magma emplacement than has previously been proposed. Rather than break-up occurring as an end-result of hyper-extension, break-up occurs significantly later if and when excess magma intrudes the extended margin. This leads to the question about how magmatic and tectonic processes are interacting before, during and after continental breakup. In particular, we hypothesize that a fundamental trigger for continental break-up is the arrival or injection of excess magma into an extensional system; the relative timing between extension, degree of extension, and excess magma arrival is a major factor in margin architecture variability.

In our presentation, we will review results from the South and North Atlantic and discuss the structural and magmatic evolution of so called magma-rich and magma-poor rifted margins. Further, we will show that the commonly proposed end-member type margins, i.e. "non-magmatic" and "non-tectonic" margins, do not exist, per se, and that rifted margins show a more complex poly-phase tectonic and magmatic evolution than previously suggested. However, it remains unclear whether decompression melting is the driving force for the magma generation that aides break-up, or simply the passive consequence of extension. In our presentation, we will discuss the inter-relationship between extension, hyper-extension and magma input in controlling both the evolution and timing of continental break-up and the architecture of passive continental margins.