Magmatism and Continental Breakup in the South Atlantic

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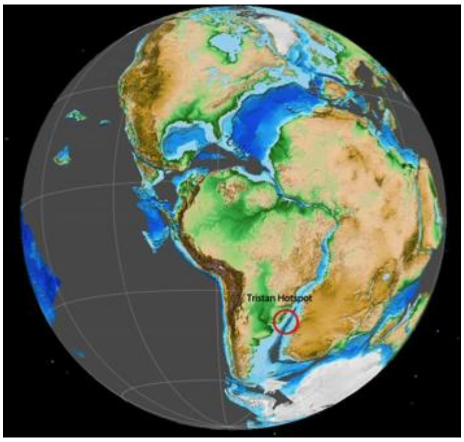
Importance of the area of research:



Rifting and magmatism are fundamental geological processes that shape the surface of our planet. A relationship between the two is observed at continental margins but its precise nature has eluded geoscientists and remained controversial. Two decades ago, largely based on detailed observations from the North Atlantic, a paradigm was established that identified mantle temperature in the form of mantle plumes as the primary controlling factor in determining volume of rift-related volcanism. This idea has since dominated understanding in the Earth science community. In this project we will test this idea using state-of-the-art industry data from the South Atlantic to determine the thermal structure along strike and over time.

What the student will do:

The project will focus on the southern South Atlantic where it has been previously suggested that continental breakup here was controlled by the Tristan hotspot (see plate reconstruction). The student will primarily use an existing deep seismic dataset from industry partner ION-GX. This seismic was collected using specifications beyond that typically available to academics (10-12 km offset streamers). The data contains enigmatic lower crustal reflectivity within the continent-ocean transition zone with contrasting patterns along strike. Previous interpretations suggest these features may have a magmatic (underplate) or tectonic (shear zone) origin. The student will test these alternatives by backstripping stratigraphy and inverting subsidence patterns for the best-fitting thicknesses and densities of lower crustal gabbroic intrusions. The results will be compared to the seismic observations and predictions of rift-generate magmatism for different thermal conditions from numerical models developed at Imperial. This will allow the spatial pattern of the thermal conditions at the time of breakup to be found. We will also examine the contribution of sub-plate support (e.g. dynamic topography) to observed subsidence patterns post-breakup. These results will be compared to established models of dynamic topography over time to test our current understanding of the process.

Training:

The student will join the 'Geodynamics: Core to Surface' research group with well-established strengths in geophysical acquisition, data interpretation and numerical modeling of rifted margins. Training will be given in seismic interpretation and subsidence modelling.

We are seeking a numerate geoscience or physics graduate.
PLEASE NOTE: CLOSING DATE FOR APPLICATIONS is 8 January 2018. If you would like further information please contact Jenny Collier (jenny.collier@imperial.ac.uk).

References:

- Lodhia, B. H**., Roberts G. G.,** et al. (in press). Continental margin subsidence from shallow mantle convection: Example from West Africa, Earth and Planetary Science Letters.
- **Collier, J. S**., C. McDermott, G. Warner, N. Gyori, M. Schnabel, K. McDermott and B. W. Horn (2017). New constraints on the age and style of continental breakup in the South Atlantic from magnetic anomaly data. Earth and Planetary Science Letters 477, 27-40.
- Stucky de Quay, G., **Roberts, G. G.**, et al. (2017). Incipient mantle plume evolution: Constraints from ancient landscapes buried beneath the North Sea, G-Cubed, doi:10. 10.1002/2016GC006769.
- Taposeea, C. A., J. J. Armitage and **J. S. Collier** (2016). Asthenosphere and lithosphere structure controls on early onset oceanic crust production in the southern South Atlantic. Tectonophysics, doi: 10.1016/j.tecto.2016.06.026.