IAPETUS2 Doctoral Training Partnership

UKRI Natural Environment Research Council

Research Experience Placement (REP) Scheme Project Form 2021

Project Supervisors:
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Host Organization and Department (if applicable):
Durham University Earth Sciences

Project Title:
How did the Ceara Rise aseismic ridge evolve and what role did it play in the evolution of the Amazon delta?

Project Description:
The Ceara Rise is an aseismic ridge located offshore Brazil, lying at the southern limit of the Amazon delta. It has been drilled by the International Ocean Drilling Programme, and yet its origin remains an enigma. Did it result from a large-scale magmatic event at the Mid-Atlantic Ridge? Or is it the result of major crustal faulting and uplift? Despite repeated marine geophysical surveying the answers to these questions remain elusive. Based on seismic reflection surveying, the Ceara Rise appears to act as a dam to sediment outflux from the Amazon and, thus, control the deposition of the Amazon delta, the largest sediment fan on Earth. The delta's load on the lithosphere is sufficient to bend it, with a bending pattern that does not match that expected from simple flexural modelling. This project will address these enigmas by analysing seismic refraction data acquired across the Ceara Rise, using state-of-the-art modelling techniques to invert the data into a full crustal model, that will be tested with gravity data. This analysis will reveal not only crustal structure and composition, but also likely mode of origin, and distinguish between crust formed at a mid-ocean ridge setting or fragmented from a continental margin setting. The placement holder will become conversant in marine refraction data analysis and modelling, fluent in the use of forefront modelling tools, and trained in research project execution. They will also become embedded within a world-leading marine geophysical group studying a variety of Earth system processes occurring within the oceanic lithosphere.

Skills and Career-Development Opportunities:
By completion the student should be able to undertake research in any marine geophysical topic, use data analysis and modelling software, image and visualise a variety of geophysical data, and present their results in written or verbal forms.

Wider context of research:
The UK's Ocean-Bottom Instrumentation Facility is embedded within the Department of Earth Sciences, and is aligned to the Marine Geophysics Research Group. The placement holder will, as part of this project, receive training and experience of use of the range of instrumentation held by the Facility, and discover what it takes to acquire geophysical data in deep ocean settings, and in the environmentally harsh conditions of the seafloor.

Project Timeframe:
Ideally an 8-week period between mid-July and mid-September.

Week 1 – undertake background familiarisation of subject literature and refraction dataset.
Week 2 – undertake analysis of dataset by phase identification and event travel-time picking, both P- and S-waves. Spend time in Facility to become familiar with the instrumentation that acquired the data and how its configuration might affect its characteristics.
Week 3 – set-up inversion modelling scheme for P-waves and test initial model starting points.
Week 4 – run inversion modelling scheme from selected starting point.
Week 5 – repeat inversion scheme for S-waves. Visit the Facility and investigate how the instrumentation records P- and S-waves and understand how the instrumentation and its coupling to the seabed affects signal characteristics.
Week 6 – combine both P- and S-wave models to form an overall model of crustal structure, composition and likely mode or origin and evolution.
Week 7 – test crustal model using gravity data.
Week 8 – draft a short report on results and conclusions.