Geophysical Research Abstracts
Vol. 21, EGU2019-9484, 2019
EGU General Assembly 2019

Mechanisms of seafloor spreading at 13°N on the Mid-Atlantic Ridge

Murray Hoggett (1), Gael Lymer (1), Timothy J. Reston (1), Chisomaga Opara-Nestor (1), Christine Peirce (2), and Richard Hobbs (2)

(1) School of Geography, Earth and Environmental Science, University of Birmingham, Edgbaston, Birmingham, UK, (2) Department of Earth Sciences, Durham University, Science Labs, Durham, UK

Oceanic Core Complexes (OCCs) are domed corrugated surfaces interpreted as unroofed plutonic and partially serpentinized mantle footwalls of large off-set normal 'detachment' faults. These detachments cross-cut the entire crust and accommodate much of the plates separation at slow spreading mid-ocean ridges. OCCs have been widely studied from bathymetric and seabed sampling data, but many aspects of their structure below the seafloor, together with their mode of development, remain poorly understood and controversial.

A fundamental question concerns the inter-connectivity of detachments along ridge. Are they essentially continuous features with OCCs exposed at the seafloor while the rest of the detachment surface is covered in the intervening regions (Escartín et al., 2008; Reston and Ranero, 2011), or are they spatially restricted features linked by intervening magmatic zones (MacLeod et al., 2009)?

To investigate these hypotheses, 3D grids of refraction and reflection seismic profiles were acquired across and between two OCCs ('1320' and '1330') of the 13°N segment of the Mid-Atlantic Ridge (MAR), during the JC132 expedition on board the RRS James Cook in January and February 2016. These data constitute the first seismic images of evolving OCCs at the MAR and reveal the geometry and crustal structure of the 13°N segment in unprecedented detail.

Preliminary observations from newly processed seismic reflection data show that:
- at the seafloor, the exhumed corrugated sections of the detachments are gently domed and remarkably smooth compared to the structures of the surrounding environment;
- an ∼200-400 m thick seismic package of layers is observed beneath each of the detachment domes, which could represent an inherent component of the OCCs never observed so far;
- toward the ridge, the detachments seem to be faulted and offset by normal faults dipping away from the MAR. These faults could either be part of the rolling hinge exhumation process of OCCs, or be related to post-exhumation degradation once motion along the detachment has ceased;
- the toes of the OCCs appear to steepen toward the ridge, suggesting a significant footwall rotation of the detachment fault at depth, suggesting strong links between the shallow and relatively deeper portions;
- heading away from the ridge, the structure of the breakaway ridge (a blocky massif comprising a probable crustal section) is complex and includes inward- and outward-dipping normal faults bounding tilted blocks and horsts, possibly involving multiphase and 'flip-flop' faulting, potentially associated with magmatic processes.

Further work is required to address the along-strike geometry of the OCCs; yet we expect the JC132 data to bring a paradigm shift in our understanding of the mechanisms of seafloor formation at slow spreading mid-ocean ridges.