Geophysical Research Abstracts
Vol. 21, EGU2019-10085, 2019
EGU General Assembly 2019

Asymmetric emplacement of seaward dipping reflectors during rifting: where; when; how and why?

James Norcliffe (1), Douglas Paton (1), Estelle Mortimer (1), Andrew McCaig (1), and Karyna Rodriguez (2)

(1) University of Leeds, Institute of Applied Geoscience, School of Earth and Environment, Leeds, United Kingdom (ee13jrn@leeds.ac.uk), (2) Spectrum, Dukes Court, Woking, GU21 5BH, United Kingdom

Seaward Dipping Reflectors (SDRs) are a diagnostic feature of rifted-margins that were characterised by large amounts of magmatism during breakup. Drilling and geophysical studies from margins worldwide reveal that SDRs consist predominantly of basic volcanics that were emplaced during the rift-drift transition. SDRs provide a record of the interaction between tectonic and magmatic processes during lithospheric extension, hence their emplacement and rotation have received much recent attention. The majority of SDR sequences on conjugate rifted-margins have been shown to be highly asymmetric, with one margin containing a greater volume of volcanics than its conjugate. The global occurrence of this asymmetry indicates that it should be accounted for in generic models of magma-rich rifting, however, few studies have attempted to do so. In this study, we utilise high quality 2D seismic reflection data from the conjugate South Africa-Argentina and Namibia-Uruguay margins to investigate the mechanisms and causes of asymmetric SDR emplacement.

Three conjugate pairs of seismic lines were selected using flowlines from established plate models. The exact location of each of these conjugate profiles was also based on data availability and variations in regional structure. Firstly, the total asymmetry of each conjugate pair was assessed, and it is shown that between two and five times more extrusive material is present on the African margin than is on the South American conjugate. Secondly, the high-quality of these data enable us to track asymmetric magmatic accretion through time: from the emplacement of the earliest SDRs; to the emplacement of 'normal' thickness oceanic crust. It is evident from this analysis that asymmetry was present throughout SDR emplacement, but was relatively minor during the subsequent emplacement of normal oceanic crust, suggesting that the asymmetry was intrinsic to the process of SDR emplacement.

Through comparing observations with forward models, we demonstrate that asymmetric SDR emplacement was accommodated by two mechanisms, specifically: rift-jumps and asymmetric magmatic spreading. Previous studies have explained asymmetry through either one of these mechanisms, while we show that both can act in tandem. Furthermore, it is likely that both mechanisms were responding to the same geodynamic process. Given that the observed asymmetry is present within the SDRs but not within the normal thickness oceanic crust, we interpret it to have resulted from either rifting above a waning thermal anomaly in the mantle, or to variations in pre-rift lithospheric structure.