Geophysical Research Abstracts
Vol. 20, EGU2018-323, 2018
EGU General Assembly 2018

Quantifying Ocean-Continent Transition Structure: A South-East Indian Example

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The structure of the ocean-continent transition and the volume of magmatism found there is frequently used as a basis for margin classification. However, such classifications based on seismic interpretations are often not quantitatively verified. The south-east Indian margin is often regarded as a type-example of a magma-poor margin with an ocean-continent transition displaying exhumed mantle that is separated from thin oceanic crust by ~9km thick transitional crust, interpreted as proto-oceanic crust (Haupert et al., 2016; Nemčok et al., 2013; Pindell et al., 2014; Sinha et al., 2015).

Using a profile from ION's SE IndiaSPAN regional long-offset transcrustal reflection seismic dataset, we apply a series of quantitative techniques to re-evaluate the structure of the ocean-continent transition. These techniques consist of; gravity anomaly inversion, residual depth anomaly analysis, subsidence analysis and joint gravity and seismic inversion.

Our quantitative analysis shows that the presence of exhumed mantle on this profile requires a deeper seismic interpretation of top basement than suggested in previous studies.

In addition, we test five alternative seismic interpretations for the margin structure using these quantitative analyses. Of these five possible interpretations for the ocean-continent transition, our quantitative analysis supports two interpretations. One geological interpretation that satisfies the quantitative results consists of (from proximal to distal) thinned continental crust adjacent to exhumed serpentinized mantle, followed by thick (~9km) magmatic crust that transitions into thin oceanic crust (~5km). An alternative plausible interpretation supported by our quantitative analysis consists of thinned continental crust adjacent to exhumed serpentinized mantle as before but followed by serpentinized mantle with sedimentary cover sandwiched by magmatic additions forming a ~9km thick hybrid crust. This then transitions into thin oceanic crust (~5km).

With these results we show that the inherent non-unique nature of seismic data interpretation is reduced by testing the interpretation using quantitative methods. Although we cannot provide a unique solution, the combination of seismic interpretation and quantitative analysis provides an improved constraint on the structure of the ocean-continent transition and its formation processes, therefore improving our ability to classify rifted margins.