Geophysical Research Abstracts
Vol. 17, EGU2015-15070, 2015
EGU General Assembly 2015

Factors controlling structural style and magmatism in passive margins

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Comparing volcanic and non-volcanic passive margins, the distinct variability in geometry and subsidence history implies that the thermo-mechanical conditions vary at the time of rifting. Volcanic rifted margins (such as in the North Atlantic) show large magmatic activity and shallow water condition at the rift-drift transition, implying high geothermal gradients. For non-volcanic rifted margins where the initial thermal condition is potentially colder, it may develop in two end-member styles (Type I and Type II). Type-I margin with limited magmatism can be observed at Iberia-Newfoundland conjugate margins where the continental crustal thins across a narrow region and large tracts of continental mantle lithosphere are exposed at the seafloor. Type-II margin as observed in the ultra-wide central South Atlantic margins, in contrast, has normal magmatic activity and has a strongly thinned continental crust that span very wide regions (>250 km) below which the continental mantle lithosphere was removed. Here we perform thermo-mechanical finite element numerical experiments to investigate factors that are potentially important for the formation of volcanic and non-volcanic passive margins. Forward numerical models are used to predict the structural styles and characteristic magmatism associated with each of these end members. A number of parameters including different rheological stratifications and thermal gradients are tested and factors that control the degree of magmatism and structural style during rifting are focused.