Geophysical Research Abstracts
Vol. 17, EGU2015-3491, 2015
EGU General Assembly 2015

Tectono-magmatic evolution at distal magma-poor rifted margins: insights of the lithospheric breakup at the Australia-Antarctica margins.

Morgane Gillard, Julia Autin, and Gianreto Manatschal
Institut de Physique du Globe de Strasbourg; UMR7516, Université de Strasbourg/EOST, CNRS; Strasbourg, France (mgillard@unistra.fr)

The discovery of large domains of hyper-extended continental crust and exhumed mantle along many present-day magma-poor rifted margins questions the processes that play during the lithospheric breakup and the onset of seafloor spreading. In particular, the amount of magma and its relation to tectonic structures is yet little understood. Trying to find answers to these questions asks to work at the most distal parts of rifted margins where the transition from rifting to steady state seafloor spreading occurred. The Australian-Antarctic conjugated margins provide an excellent study area. Indeed, the central sector of the Great Australian Bight/Wilkes Land developed in a magma-poor probably ultra-slow setting and displays a complex and not yet well understood Ocean-Continent Transition (OCT). This distal area is well imaged by numerous high quality seismic lines covering the whole OCT and the steady-state oceanic crust.

The deformation recorded in the sedimentary units along these margins highlights a migration of the deformation toward the ocean and a clear polyphase evolution. In particular, the observation that each tectono-sedimentary unit downlaps oceanwards onto the basement suggests that final rifting is associated with the creation of new depositional ground under conditions that are not yet those of a steady state oceanic crust. These observations lead to a model of evolution for these distal margins implying the development of multiple detachment systems organizing out-of-sequence, each new detachment fault developing into the previously exhumed basement. This spatial and temporal organization of fault systems leads to a final symmetry of exhumed domains at both conjugated margins. Magma appears to gradually increase during the margin development and is particularly present in the more distal domain where we can observe clear magma/fault interactions. We propose that the evolution of such rifted margins is linked to cycles of delocalisation/re-localisation of the deformation which could be mainly influenced by magma and by the decoupling between the upper brittle deformation and the asthenospheric uplift. In this context, the lithospheric breakup appears to be triggered by progressive syn-extensional thermal and magmatic weakening. However, the observation of continentward dipping reflectors interpreted as flip-flop detachment systems suggests that the localisation of the spreading centre and the onset of the steady state oceanic spreading will not be necessarily associated with a clear magmatic oceanic crust. In case of a low magmatic budget we can rather observe the onset of steady state amagmatic oceanic spreading, similar to what is expected at ultra-slow spreading ridges.

This model of evolution (Gillard, 2014, PhD thesis) could well explain the fact that most magma-poor margins display symmetric exhumed domains on conjugate margins. However it raises the question of the nature of magnetic anomalies in ocean-continent transitions and their value for the interpretation of the kinematic evolution of conjugate rifted margins.