Geophysical Research Abstracts
Vol. 16, EGU2014-3325, 2014
EGU General Assembly 2014

Latest stages of deformation leading to breakup of the Australian-Antarctic rifted margins: new constraints from deep seismic observations and potential data.

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The discovery of large domains of hyper-extended continental crust and exhumed mantle along many present-day magma-poor rifted margins questions the existing models proposed to explain lithospheric breakup and 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 in the most distal parts of rifted margins where the latest stage of rifting occurred and the first steady state oceanic crust was emplaced. In this aim, 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.

Our seismic observations allow the recognition of different tectono-sedimentary units and magmatic additions. The relation between the sedimentary units, magmatic additions and the tectonic structures enable to define a complex interaction between these processes indicating a clear polyphase evolution of rifting and migration of the deformation towards the area of future breakup. The migration of deformation is well imaged by the fact that each tectono-sedimentary unit "downlaps" oceanwards onto "new" basement, which enables to define basement units that become younger oceanwards. This observation suggests that final rifting is associated with the creation of new "basement" under conditions that are not yet those of a steady state oceanic crust. We propose that two major detachment systems are responsible for mantle exhumation forming this new basement. In particular, they can explain the different deformation phases observed in the tectono-sedimentary sequences and related magmatic additions. It appears that the sedimentary structures linked to these two detachment systems can be followed along the margins over several hundreds of kilometres, indicating that they represent a large scale asymmetric extension. The identification on potential field maps of different domains corresponding to the different basement units allows us to propose an oceanward and gradual variation in the basement composition. It is likely that the amount of magma gradually increases until the emplacement of the first steady state oceanic crust and that magma underplating may have occurred along most of the distal margin.

One main question resulting from our model is related to the interpretation of the magnetic anomalies in such an asymmetric context. Answering to this question can help to solve the paleogeographic reconstructions and to better define the age of the lithospheric breakup in these margins.