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Revised interpretation of magnetic anomalies in magma-poor rifted margins: case study of the Australia-Antarctica Basin

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The most commonly used method to determine the age of the oceanic crust consists in a qualitative study of magnetic anomalies. The aim of this work is to apply quantitative methods to interpret marine magnetic anomalies, and more specifically to identify in an objective way the locations of Earth's magnetic field reversals, and so their ages. This point is particularly interesting in order to understand magma-poor rifted margins, where the interpretation of magnetic anomalies is debated. Indeed, several anomalies may be linked to other processes related to lithospheric breakup. This process is characterized by tectonic, magmatic and hydrothermal events which can lead to magnetic lineations without link to the Earth's magnetic field reversals.
This work focuses on the Australia-Antarctica conjugate margins. The first step is the application of several potential field transforms to the regional magnetic anomaly map, which is derived from the ADMAP2 project (Golynsky et al., 2018) and data provided by Geosciences Australia. The mainly used potential field transforms are reduction to the pole, vertical derivative, analytic signal and upward continuation. The most significant results allow us to observe new magnetic lineations of very large scale (thousands of kilometres) and high amplitude (500 nT) on the Antarctic side of the conjugate margins. A joint comparison of the magnetic anomaly map with the free-air gravity anomaly map (Sandwell et al., 2014) and seismic profiles on a regional scale is then realized. This comparison allows us to correlate the regional magnetic and gravity anomalies with structural limits. Therefore, a magnetization contrast between different structural domains could explain this magnetic anomaly and this one would not necessarily be linked to a magnetic field reversal.
On the Australian part of the conjugate margins, the same comparison between the several geophysical data leads up to the same conclusions for the oldest magnetic anomalies, due to strong correlations of magnetic and gravimetric lineations with structural limits and tectonic events such as detachment faults. In consequences, these observations lead us to question the dating of tectonic events and kinematic models available for this region.

Keywords: magma-poor rifted margins; rifting; oceanization; mantle exhumation; magnetic anomalies; potential field methods