Geophysical Research Abstracts
Vol. 20, EGU2018-12760, 2018
EGU General Assembly 2018

Birth of an oceanic spreading center at a magma-poor rift system

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Oceanic crust is continuously created at mid-oceanic ridges and seafloor spreading represents one of the main processes of plate tectonics. However, if oceanic crust architecture, composition and formation at present-day oceanic ridges are largely described, the processes governing the birth of a spreading center remain enigmatic. Understanding the transition between inherited continental and new oceanic domains is a prerequisite to constrain one of the last major unsolved problems of plate tectonics, namely the formation of a stable divergent plate boundary. In this study, we present newly released high-resolution seismic reflection profiles that image the complete transition from unambiguous continental to oceanic crusts in the Gulf of Guinea. Based on these high-resolution seismic sections we show that onset of oceanic seafloor spreading is associated with the formation of a hybrid crust in which thinned continental crust and/or exhumed mantle is sandwiched between magmatic intrusive and extrusive bodies. This crust results from a polyphase evolution showing a gradual transition from tectonic-driven to magmatic-driven processes. The results presented in this study provide a characterization of the domain in which lithospheric breakup occurs and enable to define the processes controlling the formation of a new plate boundary.