Geophysical Research Abstracts
Vol. 17, EGU2015-12617, 2015
EGU General Assembly 2015

Configuration of geological domains and geodynamic evolution of the Africa-Eurasia plate boundary off SW Iberia revisited based on seismic velocity and density models

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We present a new classification of geological (basement) domains at the Africa-Eurasia plate boundary offshore SW Iberia, together with a regional geodynamic reconstruction spanning from the Mesozoic extension to the Neogene-to-present-day convergence. It is based on seismic velocity and density models along two regional wide-angle seismic transects, one running NW-SE from the Tagus to the Seine abyssal plains, and the other running N-S from S Portugal to the Seine Abyssal Plain, combined with previously available information. The seismic velocity and density structure at the Seine Abyssal Plain and the internal Gulf of Cadiz indicates the presence of a highly heterogeneous oceanic crust, similar to that described in ultra-slow spreading centers, whereas in the Horseshoe and Tagus abyssal plains, the basement structure resembles that of exhumed mantle sections identified in the Northern Atlantic margin. The integration of all this new information allows defining the presence of three oceanic domains off SW Iberia: (1) the Seine Abyssal Plain domain, generated during the first stages of slow seafloor spreading in the NE segment of the Central Atlantic (Early Jurassic); (2) the Gulf of Cadiz domain, made of oceanic crust generated in the Alpine-Tethys spreading system between Iberia and Africa, which was coeval with the formation of the Seine Abyssal Plain domain and lasted up to the North Atlantic continental break-up (Late Jurassic); and (3) the Gorringe Bank domain, mainly made of rocks exhumed from the mantle with little synchronous magmatism, which formed during the first stages of North Atlantic opening (Early Cretaceous). Our models suggest that the Seine Abyssal Plain and Gulf of Cadiz domains are separated by the Lineament South strike-slip fault, whereas the Gulf of Cadiz and Gorringe Bank domains appear to be limited by a deep thrust fault located at the center of the Horseshoe Abyssal Plain, which coincides with the seismicity cluster nucleated in the middle of the plain that shows moment tensor solutions of reverse faulting at depths of 40–60 km. The formation and evolution of these three domains during the Mesozoic is key to understand the sequence of events that occurred during the first stages of opening of the Northern Atlantic and its connection and interplay with the Western Mediterranean basin.