Geophysical Research Abstracts
Vol. 13, EGU2011-4924, 2011
EGU General Assembly 2011
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Slab rollback and continental break-up in a convergent setting – seismic structure of passive continental margins in the Western Mediterranean

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The Western Mediterranean Sea is a natural laboratory to study the processes of continental extension and rifting in a convergent setting. Gravitational collapse due to tectonic thickening of continental lithosphere and the roll-back of a subducting oceanic slab during the latest phases of consumption of the Tethys ocean have led to rapid Neogene extension in an area characterized by a constant convergence of the African and European Plates since Cretaceous time, rifting Spain/Balearic Islands from Algeria, causing passive continental margins on both sides of the Western Mediterranean Basin. However, little is known about the crustal and upper mantle structure of much of the area, including the Algerian-Balearic Basin and the Spanish/Balearic margin. Here we present results from three onshore/offshore seismic refraction and wide-angle lines surveying the Spanish passive continental margin to the south of the town of Alicante and the southwest of the Balearic promontory to the south of Ibiza and Majorca. The data were acquired during the cruise M69/2 of the German research vessel METEOR in September of 2006. As seismic source we used two 32-litres BOLT airguns, providing seismic offsets of 30 to 80 km, including wide-angle reflections from the crust/mantle boundary zone (seismic Moho). Profile P03 approaching Alicante had 20 ocean bottom receivers (OBH/S) and 10 land stations; profile P04 had 6 land stations on Ibiza and 22 OBH/S; profile P05 had 24 OBH/S and 11 land stations on Majorca. All lines extend roughly 100 km into the Algerian-Balearic basin, yielding for the first time constraints on the nature of the crust covering the seafloor between Spain and Algeria. Crust in the Algerian-Balearic basin is roughly 6 km thick and the seismic velocity structure mimics normal oceanic crust. Seismic Moho in the Algerian basin occurs at $\sim$11 km below sea level, reaching >24 km under SE Spain and Ibiza. Profile p03 off Alicante reveals a narrow continent/ocean transition zone while the SW Balearic promontory at Ibiza and Majorca is characterized by a much wider transition zone. In the transition zones, however, we did not found any evidence for velocities intermediate between lower crustal and upper mantle rocks, representing magmatic under plating or lower crustal intrusions as typical for volcanic margins. Thus, margins in the Western Mediterranean Sea belong to the class of so call non-volcanic margins.