Geophysical Research Abstracts
Vol. 14, EGU2012-7974, 2012
EGU General Assembly 2012

The ocean-continent transition along the NW Moroccan margin – A new insight

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In a joint effort a marine geoscientific survey off Morocco was conducted by BGR and Ifremer onboard the French R/V L'ATALANTE (MIRROR cruise in 2011) providing two grids of seismic profiles. In this paper we refer to the multi-channel seismic (MCS) reflection data of leg 2 (southern grid) between the latitudes of 30.5° and 33° N with a total length of 1,391 km. Basic objectives included to image the structure of the crust and to test rifting models in order to understand the nature of the continental margin of Morocco as well as the opening process of the Atlantic Ocean between NW Africa and Canada.

Already an initial interpretation of the MCS data enabled the identification of major seismic unconformities and sequences, and their correlation with the two existing DSDP wells 415 and 416 revealing more details about the continent-ocean transition and its function in the plate tectonic history.
Two main MCS profiles of the southern grid, which are spanning 300 km each, are running perpendicular to the slope, and traverse the shelf edge/break, the slope, the Essaouira Rise, and the Agadir Canyon, ending just over the abyssal plain. They are crossing three different structural units, a zone of rifted continental margin (Zone 1), a zone of initial seafloor spreading (Zone 2), and a zone of regular seafloor spreading as well as post-Cretaceous igneous activity (Zone 3). Zone 1 is composed (i) of huge rotated basement blocks located under the shelf and the uppermost slope, and (ii) of striking salt domes at the lowermost slope. Zone 2 is characterized by a sub-basement reflector with overlying tilted basement blocks. The sub-basement reflector trends generally horizontal and appears to be a detachment fault. At the seaward end of the profiles a Zone 3 can be distinguished. Its basement is imaged by reflectors typical for oceanic crust though they are only locally recognizable. In this zone volcanic remnants dominate the sedimentary record expressed by seismic images of Tertiary sills and dykes.

At this position, Zone 2 might provide a clue regarding the location of the transition between volcanic and non-volcanic passive rifted margins. It exhibits crustal structures including tilted basement blocks overlying a bright sub-basement reflector that are similar to those at the Galicia margin (S reflector), the Porcupine Basin (P reflector), and the Iberia Abyssal Plain margin (H reflector) to the north of our study area. It is commonly accepted that the S reflector as well as the P reflector are the seismic expression of detachment faults controlling the extension of the margin during the transition from rifting to drifting. In analogy, we favour this view for the corresponding structural elements in our study area.