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Tectonic Inversion of the Algerian Continental Margin off Great Kabylia (North Algeria) - Insights from new MCS data (SPIRAL cruise)

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Index Terms
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Sub-marine active faulting threatens the coastline of Algeria, as shown by the major Mw 6.9 May 21, 2003 earthquake that occurred in Great Kabylia close to Boumerdes. We present here the structures associated to the Plio-Quaternary (P-Q) tectonic inversion of the central part of the Algerian margin offshore Great Kabylia using new deep multichannel seismic (MCS) lines. The large-scale structure of the margin deduced from wide-angle seismic (WAS) data modeling is presented in a companion abstract. Five MCS lines were acquired in the study area during the Algerian-French SPIRAL cruise (September 2009, R/V Atalante). Four lines were acquired using a 3040 cu. in. air-gun array and a 4.5 km 360 channel digital streamer and a 8350 cu. in. source favoring deep penetration was used for one coincident WAS profile and the fifth MCS line. All profiles are pre-stack time migrated and additional pre-stack depth migration was performed in key areas. The MCS lines crosscut the margin from the upper slope to the deep Algero-Provençal Basin either in a N-S direction sub-perpendicular to the structural trend of the margin, or in a NW-SE direction parallel to the actual convergence between Africa and Eurasia plates. Tectonic inversion is expressed on all profiles at the deep margin. The eastern line displays a flat-ramp compressive system in the deep sedimentary series, which emerges at the foot of the continental slope and marks the seaward limit of a P-Q basin perched at mid-slope. The south-dipping ramps are neo-formed structures, whereas the flats use inherited lithologic discontinuities (base of the Messinian evaporitic series, top of the acoustic basement). Westward in the Boumerdes area, the compressive deformation is expressed deeper in the acoustic basement where a southward dipping reflector is interpreted as a blind thrust on top of which all the sedimentary series (Miocene to P-Q) are bent in an antiform that uplifts the base of the Messinian series. A second antiform prolongates this uplift 20 km northward although no clear reverse structure is imaged underneath. These antiforms delimit two asymmetric sub-basins filled with a southward thickening P-Q wedge. As a whole, the geometry of the reverse structures supports fault-propagation or fault-bent fold models, as previously inferred from HR seismic interpretation. They are likely to participate to large uplifts such as the coastal one related to the Boumerdes earthquake. Reverse structures in the thinned continental crust co-exist with transtensional deformation at the transition with the oceanic domain 50 km northward of the margin toe, where a narrow asymmetric basin shows a downward offset of the base of the Messinian series and a southward thickening P-Q wedge. A transcurrent component on crustal faults playing since the P-Q may explain both basin geometry and lateral variations in width and depth.

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