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New insights on the Gibraltar Arc geodynamics from SKS splitting: first contribution from the IberArray broad-band seismic network

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The Rif-Betic region, comprising the Gibraltar Arc and the extensional Alboran basin and including the diffuse limit between the Eurasia and African plates, is complex and there is still not a commonly accepted hypothesis about the mechanism responsible for its formation, as models including lithospheric delamination, convective removal or subduction have been proposed. In this context, the knowledge about the presence and properties of upper mantle anisotropy from SKS splitting measurements can provide valuable information to constrain the different geodynamical models. The installation of new permanent and semi-permanent broadband stations in the region has allowed obtaining a first insight into the anisotropic properties (Buontempo et al, 2008) and evidenced the presence of geographical variations in the anisotropic parameters, even if the lack of data in the Northern part of Morocco did not allow to obtain a detailed image. We present here the first analysis of the data provided by the IberArray broad-band seismic network that will allow a significant improvement the coverage of this area. The IberArray broad-band seismic network was deployed over this region for about 18 months, beginning in summer/fall 2007 in the framework of the large-scale Topo-Iberia project. This portable array, formed by up to 55 new generation dataloggers equipped with broad-band seismometers, has covered the southern part of Iberia (35 stations) and northern Morocco (20 stations) in an approximately regular grid, with a nominal spacing of 60 km. Data from more than 35 permanent broadband stations maintained by different institutions operating in the region has also been integrated into the IberArray database.

Events with epicentral distances between 85 and 120 degrees and magnitude greater than 6.0 are systematically extracted from the continuous dataset and SKS and SKKS phases are inspected for anisotropy using the SplitLab software. Processing of the whole dataset is still ongoing, but the available results, including those for the entire year 2008, significantly improve the spatial resolution of SKS measurements in this region. The inferred fast velocity directions (FVD) clearly show a spectacular rotation along the Gibraltar arc, following the curvature of the Rif-Betic chain, from roughly N65E beneath the Betics to close to N65W beneath the Rif chain. Stations located in the South and South-east edges of the array, show a distinct pattern, with FVD oriented NE-SW to E-W. The results for some sites suggest the presence of complex anisotropy features, probably including two anisotropic layers. The obtained FVD results are compatible with rollback / subduction models, while convective-removal and delamination models seem unlikely to be compatible with our results. The FVD variations along the Gibraltar arc could be explained by fossil anisotropy acquired during the Eocene Western Mediterranean subduction, while the change in FVD observed to the South and South-East of the Rif-Betic chain can be related to the imprint of a flow episode around the Alboran high velocity slab during its Miocene fragmentation from the Algerian slab.