The Mantle under Betics and Gibraltar Arc from Seismic Anisotropy and Body-Wave Dispersion

Götz Bokelmann[1], Emeline Maufroy[2], Luisa Buontempo[3], Jose Morales[3], and Guilhem Barruol[1]
[1] Géosciences Montpellier, CNRS, Université Montpellier II, 34095 Montpellier, France
[2] Géosciences Azur, Sophia Antipolis, 06560 Valbonne, France
[3] Instituto Andaluz de Geofísica, Universidad de Granada, 18071 Granada, Spain

We study the geodynamic situation of the Gibraltar arc region, for which there does not appear to exist a consensus yet. Indeed, a variety of tectonic models have been proposed for the region, including subduction, continental delamination, and convective removal, and we will try to distinguish between these models. For this purpose we study seismic anisotropy in the region, and also the dispersion of body waves.

Since seismic anisotropy can constrain deformation in the mantle, and thus flow, we are studying the splitting of teleseismic SKS phases in Southern Spain. Interestingly, fast axes of anisotropy that result from this analysis seem to show a smooth rotation of fast directions following more or less a trend parallel to the coastline, that is SW-NE in the Betics and North-South near the Gibraltar strait. A similar rotation is apparent in measures of Pn anisotropy suggesting tentatively that the deformation is vertically coherent through the upper mantle of Betics and Gibraltar arc.

The second technique that we address here uses the dispersion of body waves that traverse the upper mantle in the Alboran Sea. These show a characteristic dispersion behavior that is consistent with propagation through a subducted lithosphere that still contains its low-velocity crustal waveguide. Similar waveform behavior has been shown previously for wellestablished subduction zones around the Pacific. More importantly, it appears difficult to explain this kind of dispersion under the Alboran Sea by mechanisms that do not include subduction. The observation thus imposes a strong constraint on the structure of the upper mantle under the Alboran Sea and its nature. This is especially useful since the region is not well-illuminated by seismic rays for tomography.

Key words: Seismology, Anisotropy, Subduction, Delamination