Seismic anisotropy and subduction in Southern Italy

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In the current work we present a large collection of shear wave splitting measurements in the Calabrian Arc-Tyrrhenian basin subduction system. For our analysis we used earthquakes recorded from 2003 to 2005 at the CAT/SCAN temporary network and at the INGV national network. The dataset consists of SKS teleseismic phases (earthquakes with delta 87° - 112° and magnitude greater than 6.0) and of local S phases (events deeper than 150 km). We used the method of Silver and Chan to obtain the splitting parameters: fast direction (φ) and delay time (δt). Shear wave splitting results reveal the presence of a strong seismic anisotropy with a complex pattern of fast directions in the subduction system below the region. The SKS fast polarization directions define three anisotropic domains which correspond to the three different geological and geodynamic regions: the Calabrian Arc domain with fast directions oriented NNE-SSW; the Southern Apennines domain with fast directions oriented NNW-SSE and the Apulian Platform domain with fast directions oriented almost N-S in the northern part and ENE-WSW in the southern. The large number of splitting parameters evaluated for events coming from different back-azimuth allow us to hypothesize the presence of a depth-dependence anisotropic structure in each of the identified domains and to constrain at 50 km depth the upper limit of the anisotropic layer. We interpret the trench-parallel φ observed in Calabrian Arc and in Southern Apennines as a mantle flow below the slab, likely due to the pressure induced by the retrograde motion of the slab itself. The pattern of trench-perpendicular φ in the Apulian Platform seems to be not a direct result of the roll-back motion of the slab and may be explained as frozen-in lithospheric anisotropy or as asthenospheric flow deflected by the complicated structure of the Adriatic microplate. Results obtained with S phases show an extremely complex pattern of fast directions and delay times. These last measures are mainly located in the south-eastern sector of the Tyrrhenian Sea in correspondence of the high velocity body imaged at 150 km depth by the tomography. We related this strong fast directions variability inside the slab to the complex structure of the slab itself. The variable pattern of SKS and S splitting measurements suggest the presence of a local scale mantle flow strongly controlled by the geometry and motion of the anisotropic slab.