Deep seismic exploration of the Iberian Microplate

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The Iberian Peninsula and its margins have been extensively studied by multi-seismic data acquisition experiments since the early 70's. Relatively old seismic refraction (form the 70's to the late 80's) and more modern (early 90's to present day) spatially dense wide-angle seismic reflection transects have constrained the distribution of P and S wave velocity and the depth and geometry of the main crustal and lithospheric interfaces. Deep normal incidence high resolution seismic reflection surveys imaged: the crustal architecture; the distribution of deformation and help determine the evolution of the most relevant geologic features within Iberia and its margins. Deep seismic imaging started with the Spanish-French collaboration across the Pyrenees (ECORS-Pyrenees), and it was soon after followed by the ESCI program in the mid-80's. Similar to other Deep Continental Seismic Reflection Programs (ECORS, DEKORP, BIRPS in EU and LITHOPROBE, COCORP in Canada and USA), ESCI acquired a series of on-land and marine seismic transects that revealed the internal architecture of key orogenic belts within Iberia, namely the Betic Cordillera and the northern part of the Iberian Massif (Iberian part of the European Variscan orogen). Later, the EUROPROBE initiative fostered detailed studies of the central and southern part of the Iberian Massif. Two 300 km long transects (IBERSEIS and ALCUDIA) imaged this orogen in SW Iberia. The resulting seismic profiles sampled three major tectonic blocks which collided in the late Paleozoic: form south to north these are: the South Portuguese, the Ossa-Morena and, the Central Iberian blocks. These terranes and their sutures show characteristic seismic fabrics. These seismic signatures reveal a distribution of the deformation that gives valuable insights into the evolution of the orogen, e.g. thickening and thinning mechanisms, igenous activity and strike slip tectonics. The upper and lower crusts appear to be decoupled along an interface that runs through the entire seismic transects. Deformation seems to have been accommodated in different ways at upper and crustal levels in the three tectonic blocks. Furthermore, the northern part of the southernmost transect (the IBERSEIS transect) images a 1-2 s thick high amplitude reflective sill-like structure located at mid crustal levels. It has been interpreted as a mafic sill intrusion along a mid-crustal decollement. The Central Iberian Zone, imaged by the ALCUDIA transect, reveals thick and highly reflective lower crust, the reflection fabric consists of relatively continuous, sub-horizontal to arcuate events, suggesting that deformation is mostly associated with ductile deformation. The Moho features a laterally variable seismic signature (highly reflective beneath the Central Iberian Zone, discontinuous and diffuse below the Ossa-Morena Zone and, sharp and well defined to the south of the South Portuguese Zone). Along the entire transect, the Moho is sub-horizontal and located at an average depth of 31-35. (Research supports: CGL2014-56548-P, CGL2016-81964-REDE; SIT4ME EIT-KIC-RawMaterials; 2017-SGR-1022).