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Seismic Modeling of the Subcrustal Reflectivity Beneath the Iberian Massif (Spain)

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Sub-Moho reflectors have been identified in seismic refraction and wide-angle reflection recordings in western Iberia since the late ‘80s. These control source seismic wide-angle shot records have energy large enough to illuminate the uppermost mantle showing strong sub-Moho arrivals at distant offsets (>180 km) with amplitudes significantly higher than the Pn and a relatively long coda. The kinematics and wavelet characteristics of these features are probably produced by an increase in P-wave velocity, and forward modeling indicates that these arrivals reflect off an interface in the 60-80 km depth range beneath the Iberian Massif. The waveform and time length of this arrival suggests that it can result from the interaction of the seismic energy with a ~10 km thick heterogeneous layer. To test this hypothesis, we used a 2D second-order finite-difference acoustic and elastic full wave-field scheme with a layer consisting of randomly distributed bodies smaller than ¼ of the wavelength of the seismic waves in thickness and $\Delta Vp=\pm 0.2$ km/s at the considered depth range. Resulting synthetic shot gathers reproduce well the observed amplitudes and codas as a result of the constructive interference caused by the tuning effect produced by this gradient heterogeneous zone. The contrast in physical properties and depth level of this feature are consistent with the top of the phase transition from spinel to garnet lherzolite, the so-called Hales discontinuity.

Some of the available gathers show a second and deeper reflection. Detailed analysis of the reflected wave-forms suggests that the reflected wavelet has reversed polarity, a feature suggesting. a velocity decrease with depth. Finite difference acoustic and elastic full wave-field modeling places this discontinuity around 90 km depth beneath the Ossa-Morena Zone (south Iberian Massif). A lateral change is observed beneath the Centro-Iberian Zone (central Iberian Massif) where it is imaged at 103-110 km depth on the southeast and shallows up to 80 km depth on the northeast. The indicated depth would be consistent with the depth location of the LAB, which is relatively well constrained for the target area by other geophysical observations.

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