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3D P-Wave Velocity Structure of the Deep Galicia Rifted Margin

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The combined wide-angle reflection-refraction and multi-channel seismic (MCS) experiment, Galicia 3D, was carried out in 2013 at the Galicia rifted margin in the northeast Atlantic Ocean, west of Spain. The main geological features within the 64 by 20 km (1280 km^2) 3D box investigated by the survey are the peridotite ridge (PR), the fault bounded, rotated basement blocks and the S reflector, which has been interpreted to be a low angle detachment fault. 44 short period four-component ocean bottom seismometers and 28 ocean bottom hydrophones were deployed in the 3D box. 3D MCS profiles sampling the whole box were acquired with two airgun arrays of 3300 cu.in. fired alternately every 37.5 m.

We present the results from 3D first-arrival time tomography that constrains the P-wave velocity in the 3D box, for the entire depth sampled by reflection data. Results are validated by synthetic tests and by the comparison with Galicia 3D MCS lines. The main outcomes are as follows: 1- The 3.5 km/s iso-velocity contour mimics the top of the acoustic basement observed on MCS profiles. Block bounding faults are imaged as velocity contrasts and basement blocks exhibit 3D topographic variations. 2- On the southern profiles, the top of the PR rises up to 5.5 km depth whereas, 20 km northward, its basement expression (at 6.5 km depth) nearly disappears. 3- The 6.5 km/s iso-velocity contour matches the topography of the S reflector where the latter is visible on MCS profiles. Within a depth interval of 0.6 km (in average), velocities beneath the S reflector increase from 6.5 km/s to 7 km/s, which would correspond to a decrease in the degree of serpentinization from $\sim$45 % to $\sim$30 % if these velocity variations are caused solely by variations in hydration. At the intersections between the block bounding normal faults and the S reflector, this decrease happens over a larger depth interval (> 1 km), suggesting that faults act as conduit for the water flow in the upper mantle.