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The Lithosphere-Asthenosphere System Underneath Ireland

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The passive teleseismic experiment ISLE (Irish Seismological Lithospheric Experiment) was conducted in 2002/03 to explore the deep lithospheric and asthenospheric structure below Ireland. During the experiment we deployed 16 broadband and 8 short-period mobile stations and used 5 permanent stations (Landes et al., EOS, 2005). The recorded waveforms were analysed with the receiver-function, teleseismic-tomography and SKS-splitting methods. Here we present the main results from the ISLE research as well as a geodynamic interpretation.

The receiver function models show the topography of the main discontinuities at depth. The crust-mantle boundary (Moho) is relatively flat at 30 +/-2 km depth as determined with P-to-S and S-to-P converted waves. The lithosphere-asthenosphere boundary (LAB) is at about 85 +/-5 km depth in the south of Ireland and at 55 +/-5 km depth in the north (Landes et al., EPSL, 2007). In the region of thinner lithosphere we also find a low seismic P-wave velocity anomaly (about –2%) at about 60-120 km depth in the tomography model. This anomaly does not span across the entire east-west extension of northern Ireland but seems to be concentrated in the central part (Wawerzinek et al., in prep.). The receiver function models contain a low S-wave velocity anomaly at this depth. We interpret this low-velocity anomaly towards north as lithospheric thinning due to thermal erosion originating from the head of the proto-Iceland plume, because it also coincides with a region of Tertiary volcanism (Landes et al., EPSL, 2007).

The 410 km and 660 km seismic discontinuities appear to be flat in our receiver function model and coincide with predictions from the iasp91 earth model (Landes et al.,

GJI, 2006), thus the above mentioned velocity anomaly is confined to the upper mantle. SKS-splitting analysis yields up to 1.2 s delay between the fast and slow directions. However, due to different splitting pattern from events with different backazimuths, it is inferred that the origin of the shear-wave splitting is in the lower mantle (Do et al., GRL, 2006).