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Wide-angle seismic imaging of the west Hatton margin (North Atlantic): Results of the HADES experiment

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North Atlantic continental margins are usually characterised by a combination of regional uplift, crustal extension and magmatism leading to the formation of seaward dipping reflectors (SDRs) during the breakup. The west Hatton margin (WHM) represents a Late Paleocene-Early Eocene volcanic margin as suggested SDR sequences observed and drilled near the breakup axis. The temporal and spatial relationships of these volcano-tectonic processes are interpreted as the response to a deep thermal mantle anomaly. Integration of new wide-angle seismic, 2D seismic and potential field data allows us to clarify the deep structure of the WHM. The HADES project was designed to investigate the structure of the Hatton margin and data along 3 new wide-angle seismic reflection/refraction lines have been acquired. Up to 100 Ocean Bottom Seismometers (OBSs), with very short spacing (2 to 3km), were deployed on each line and they recorded very closely spaced shots. This survey, characterised by a large number of OBS, permitted recording a wide-range of offsets with a very dense coverage. The HADES experiment represents an excellent example of a multi-fold wide-angle survey. With these kind of multi-fold wide-angle seismic data, it is now possible to use imaging techniques usually applied to multi-channel seismic reflection data such as depth migration or waveform inversion techniques. It is well established that these techniques require as an input a precise background velocity model, which can be easily derived from wide-angle seismic data by running first-arrival travel time tomography. Thus, in order to improve the resolution of the tomographic image across the Hatton margin, we applied a two-step tomographic approach specifically designed

for this type of dense acquisition geometry. The first-step consists of first-arrival tomography that defines the large-scale velocity structure of the medium. In the second step, this velocity model is used as a background model to apply a waveform inversion technique. On the profile located on the continental crust, the first step of this tomographic approach provided a well-defined seismic velocity model. This model is characterised by two high velocity bodies, located at the ocean-continent transition, between 10 and 12 km depth. They likely represent zones of underplated magma generated during the break-up and the emplacement of the SDRs. The derived model is in good agreement with gravity and magnetic data acquired in this area. This velocity model will be used as a starting model to initiate a full waveform inversion technique. Some preliminary results of full waveform inversion of these data will also be given in this presentation. This project is funded by the Geological Survey of Ireland and the Irish Petroleum Infrastructure Programme.