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How anisotropic is the Irish crust? Results from wide-angle shear-wave data

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Travel-time analysis of shear-wave (S-wave) data recorded in southwest Ireland during a controlled-source seismic experiment has been used to investigate the magnitude of crustal anisotropy. The data used were recorded from 20 in-line shots on up to 170 three-component short-period stations deployed at approximately 1-km spacing along two parallel profiles. Analysis of the travel-time differences between vertically and horizontally polarised S-waves recorded on vertical, radial and transverse seismometer components was undertaken using seismic phases travelling near the Earth's surface (Sg) and reflected from the Moho (SmS). Travel-time differences between the components for both phases scatter largely within about the uncertainty in the measurements (around ± 0.2 s) with no observed coherent variation with shot-receiver offset. Synthetic S-wave seismograms were computed from 1-D S-wave velocity models with varying degrees of anisotropy in the upper and in the lower crusts. Travel-time differences of Sg and SmS phases picked from these synthetic seismograms confirm that for anisotropies with probable symmetries of magnitude 1 - 2%, in either the upper or lower crust, should result in an observable variation with offset of the travel-time differences between the transverse and radial, and transverse and vertical components. The study shows that crustal anisotropy does not contribute significantly to the marked anisotropy recently deduced from SKS measurements in Ireland, which is therefore confirmed to mainly reside at sub-crustal and deeper mantle levels.