AGU FALL MEETING
San Francisco | 12–16 December 2016

S13B-2569: Crustal Imaging of the Faroe Islands and North Sea Using Ambient Seismic Noise

Monday, 12 December 2016
13:40 - 18:00
Moscone South - Poster Hall

The recent development of ambient seismic noise imaging offers the potential for obtaining detailed seismic models of the crust. Cross-correlation of long-term recordings from station pairs reveals an empirical “Green’s function” which is related to the impulse response of the medium between the two stations. Here, we present new results using two different broadband datasets: one that spans the Faroe Islands and another that spans the North Sea. The smaller scale Faroe Islands study was tackled first, because with only 12 stations, it was well suited for the development and testing of a new data processing and inversion workflow. In the Faroe Islands study cross-correlations with high signal-to-noise ratios were obtained by applying phase weighted stacking, which is shown to be a significant improvement over convectional linear stacking. For example, coherent noise concentrated near the zero time lag of the linearly stacked cross correlations appears to have an influence on the dispersion characteristics beyond 10 s period, but we have managed to minimize these effects with phase weighted stacking. We obtain group velocity maps from 0.5s to 15s period by inverting inter-station travel times using an iterative non-linear inversion scheme. It reveals the presence of significant lateral heterogeneity in the mid-upper crust, including evidence of a low velocity zone in the upper crust, which may mark the base of the basalt layer. This is most clearly revealed by taking the average group velocity dispersion curve for all station pairs and inverting for 1-D shear wave velocity. The computation of a 3-D shear wave speed model both verifies and adds further detail to these results. Application to the North Sea dataset was challenging due to the highly attenuative nature of the crust in this region, which has previously been observed to dramatically reduce the signal-to-noise ratio of short period surface waves. However, with the help of phase-weighted stacking good quality empirical Green’s functions can be retrieved for this large dataset. Both group and phase velocity dispersion information are extracted from the cross-correlations, which are then inverted to produce period-dependent velocity maps. The next stage is to invert these maps for 3-D shear wave velocity structure beneath the North Sea region.

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