Geophysical Research Abstracts, Vol. 9, 03396, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03396

Crustal and uppermost mantle structure beneath Azores Islands from ambient seismic noise correlations.

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We used correlations of ambient seismic noise to study the structure of the crust and the uppermost mantle beneath the Azores archipelago. The data were selected from continuous records of 7 broadband seismic stations operated during 16 months of the Coordinated seismic experiment in the Azores Islands (2001 and may to august 2002).

The method is based on the extraction of Rayleigh and Love waves from correlations of seismic noise records between pairs of receivers. We applied a frequency-time analysis to the extracted surface wave signals to measure group velocities in the period range between 7 and 25 s for Rayleigh waves and between 7 and 16 s for Love waves. We then inverted the dispersion curves measured for different inter-station paths with a Monte-Carlo method to infer shear-velocity profiles down to a 40 km depth. During the inversion, we fixed depths of the water column to values inferred from the bathymetry and the deep mantle seismic structure to values typical for a young (4 Ma) oceanic lithosphere.

Our results indicate a thick crust and a low velocity anomaly in the first kilometers of the mantle beneath the southeastern part of the Azores Archipelago. We interpret these observations as a mantle thermal anomaly and a crustal underplating resulting from the presence a mantle plume beneath this part of the archipelago. To validate our method, we also applied a similar processing to the seismic noise recorded by the HOTSPOT seismic experiment in Iceland. We found a good agreement between our noise based estimations of the crustal thickness and the uppermost mantle S-wave velocity and the results obtained with traditional earthquake-based methods.