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Upper mantle structure beneath the Alps and the Variscides from waveform analysis of north African earthquakes recorded at European seismic stations

B. Nita (1), E. Perchuc (1), P. Maguire (2), H. Thybo (3)

(1) Polish Academy of Sciences, Institute of Geophysics, Warsaw, Poland, (2) University of Leicester, Department of Geology, Leicester, UK, (3) University of Copenhagen, Geological Institute, Copenhagen, Denmark (blankan@igf.edu.pl / Phone: 48 022 6915801)

We have examined upper mantle seismic velocity structure in the depth range 250-450 km around the 410 km discontinuity beneath the Alps and Variscides, using recordings from five selected events (mb $>$5.5) with epicenters in northern Algeria, and occurring between 1995 and 2005. The data used has included that from both regional and global databases as well as original waveform recordings. The dense coverage of stations in Germany (GRSN and GRF networks) and in the UK is particularly suitable for our study owing to the fact that the epicentral distance range of 1600-2400 km provides ideal coverage of imaged structures situated at depths of 250-450 km.

We have compared the P-coda waveforms for recordings from two azimuth spans (referring to the stations in the UK and in Germany) and from different offset ranges (1600-1800 km and 1800-2400 km). The UK recordings at distances between 1600–1800 km from recordings crossing the tectonically 'cold' Variscide region, are characterized by distinctive reflections from beneath the 410-km discontinuity, appearing about 8s after the refracted wave. Such reflections are not present on recordings resulting from waves traversing the tectonically young, 'hot' upper mantle region beneath the Alps.

For the GRF array broadband recordings we separated out signals propagating with different apparent horizontal velocities by applying the VESPA (Velocity Spectrum Analysis) process which visualizes time domain variation in beam energy.

Traveltime curve branches resulting from different refracted/reflected seismic waves

from beneath upper mantle discontinuities, have been used as input parameters for our study of ray propagation. Preliminary models of seismic discontinuities in the upper mantle beneath the Alps and the Variscides are proposed. The upper mantle beneath the ’hot’ Alpine region seems to be characterized by a shallower ‘410-km’ boundary than the upper mantle below the ‘cold’ Variscan orogen.