Seismic profiling by the TRANSALP working group: Receiver functions image and Upper Mantle anisotropy

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A passive seismic experiment was carried out along the TRANSALP line in 1998 and 1999. A stationary network of short-period and broad-band stations has been used to record teleseismic events within time periods of 9 months in 1998/1999 and 2 months again in 1999. An additional broad-band network of seven stations was started in February 2002 to complement the previous campaigns at the southern end of the profile. Fig. 1 shows the distribution of the complete station network. Small average station spacing (~5 km) and high number of recorded teleseismic events are the basis for a relatively high-resolution study of the crustal and upper mantle structure beneath the Eastern Alps. Results of two distinct methods, the receiver-functions method and the polarisation analysis of shear waves, are presented. They provide independent information on main discontinuities and seismic anisotropy.

We use the receiver-function technique to investigate the crustal and upper-mantle structure beneath the Eastern Alps. P-waves from far-distance earthquakes impinging on crustal and upper-mantle discontinuities from below convert to S-waves and are shown as receiver functions after component rotation, deconvolution (to remove source effects), filtering for different frequency bands, stacking within pre-defined bins and further processing. A north-south cross section of receiver functions along the TRANSALP traverse confirms the asymmetry of the Moho geometry (Fig. 2). Moho depth is 36 km below the Molasse at the northern end of the section and reaches a maximum of some 55 km beneath and south of the Tauern Window. The transition from European to Adriatic crust is rather steep. The Adriatic Moho is subhorizontal in ~40 km depth. In combination with the reflection seismic image (TRANSALP Working Group, 2002), large-scale intra-crustal discontinuities can be mapped also. We find a north dipping interface at the southern end of the TRANSALP profile above the Adriatic Moho in the middle and lower crust. We suggest that it represents a major shear zone in the retrowedge of the Alpine orogen.

Measurements of shear-wave splitting of teleseismic 'SKS' phases (travelling most of their path as S-waves, but within the earth core as converted P-waves) yield information on the mantle anisotropy beneath the Eastern Alps. Our data show a preferred orientation of WSW-ENE of the fast S-wave phase and can be explained approximately by a single anisotropic layer with a fast polarisation direction subparallel to the ENE strike of the orogen (~65-70°). According to the model of Meissner *et al.* (2002), the preferred orientation may be a consequence of mantle (and lower crustal) creep towards the Pannonian in the East.

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REFERENCES

MEISSNER R., MOONEY W.D. and ARTEMIEVA I., 2002 – *Seismic anisotropy and mantle creep in young orogens.* Geophys. J. Int., v.149, pp. 1-14.

TRANSALP WORKING GROUP, 2002 – *First deep seismic images of the Eastern Alps reveal giant crustal wedges and transcrustal ramps.* Geophys. Res. Lett., v. 29, 10.1029/2002GL014911.

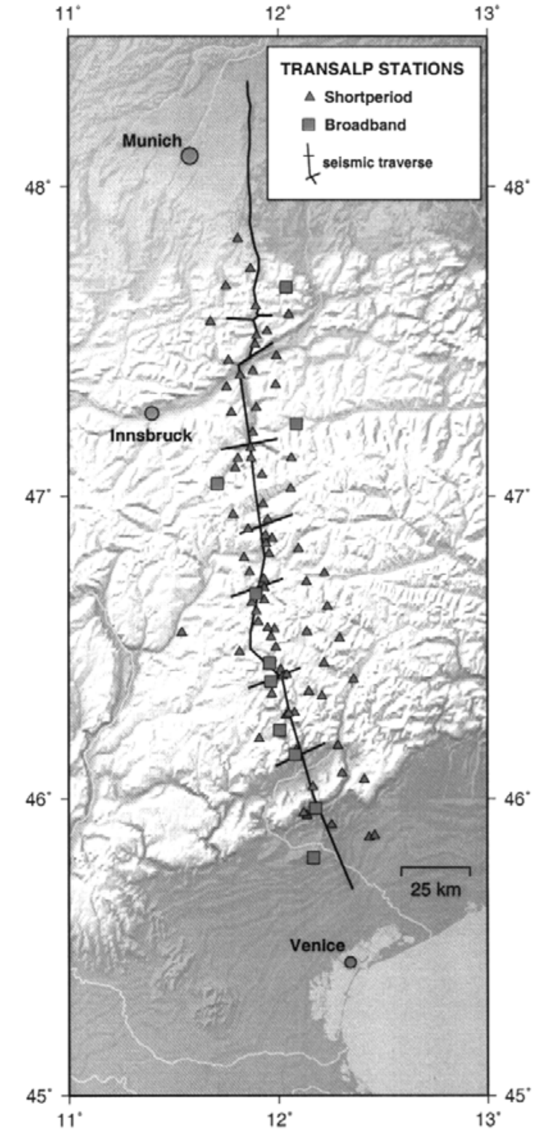

Fig. 1 – Stationary network of short-period and broad-band seismometer stations recording continuously for 9 months in 1998/1999 and 2 months in 1999 again, complemented by seven broad-band stations running since February 2002.

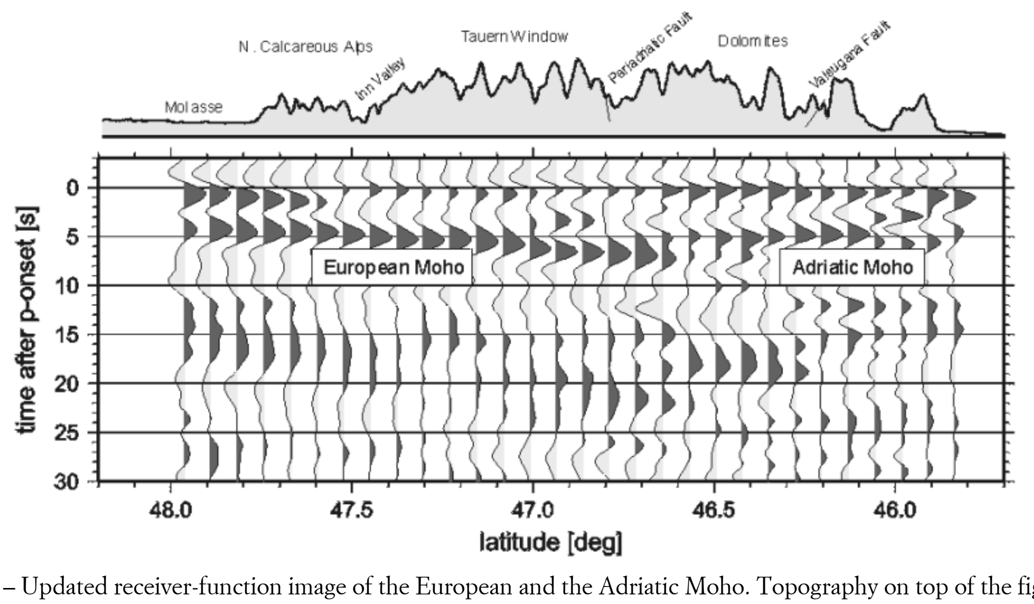

Fig. 2 – Updated receiver-function image of the European and the Adriatic Moho. Topography on top of the figure. Vertical scale is the difference in traveltime between the first P-wave arrival (on vertical component) and P-to-S-converted arrivals on the horizontal components. The signals were filtered for a period range of 2-12