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Lower crustal anisotropy in Central Europe deduced from dispersion analysis of Love and Rayleigh waves

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Fundamental modes of surface waves are well suited for structural investigation: the dispersion curves of fundamental Love and Rayleigh modes can be inverted for S-velocity models from the lower crust down to the asthenosphere to depth of 300 km. Azimuthal variations of the Love and Rayleigh phase velocities point to azimuthal anisotropy of the underlying structure. Furthermore the depth of the anisotropic structure may be determined.

Love-Rayleigh discrepancy denotes the observation that fundamental Love and Rayleigh modes cannot be explained by the same isotropic one-dimensional model. It can be caused by radial anisotropy, that means by different SH and SV velocities. Alternatively, thin isotropic layers with alternating velocities, or the different influence of lateral heterogeneity on the measurments of the phase velocities of Love and Rayleigh waves might affect the observations as well.

We present a study of dispersion analysis of fundamental modes for Central Europe. Phase velocities are determined using a two-station method for paths between broadband stations in Germany and adjacent areas. The azimuths of the paths vary from 20°to 120 °. The lengths are about 400 km. Phase velocities were determined for frequencies between 5 mHz and 0.1 Hz which results in S-velocity profiles from lower crustal level down to 300 km depth. The results show a continental crust with Moho depth between 27 km and 30 km and a pronounced low-velocity zone between 80 km and 250 km depth: the asthenosphere.

Love-Rayleigh discrepancy was detected in the asthenosphere between 80 km and 250 km depth as well as in the lower crust. At lower crustal levels, the Love-Rayleigh discrepancy is dependant on the direction of the path. This observation might be explained by azimuthal anisotropy. While the Rayleigh phase velocities differ by 4% for distinct directions, Love waves do not show differences with varying azimuth. The direction in which the Rayleigh waves propagate fastest is the direction of the fast axis of the anisotropic structure. Here it is oriented NE similar to that deduced from Pn-studies. A laminated lower crust can explain the observed radial anisotropy.