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Stress-field orientation and crustal deformation in the Vienna Basin region (Alpine-Pannonian-Carpathian junction)

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Gaining insight into the regional stress field and deformation in the crust is challenging. As we cannot measure these directly, we rely on proxy measurements and numerical modelling to infer their orientation. For the Alpine-Pannonian-Carpathian junction, only a limited number of studies exist that provide such insights. They are based on either the interpretation of sparse and point-wise measurements of local stress-field orientations or on numerical modelling that aims to satisfy tectonic and geological constraints.

We infer seismic azimuthal anisotropy that relates to the orientation of the regional stress-field and crustal deformation from ambient-noise-derived Rayleigh waves in the region. This approach provides a spatially broad and independent measurement that complements previous studies. We use Rayleigh-wave group-velocity residuals after isotropic inversion at 5s and 20s center period, which are sensitive to crustal structure at different depths. They allow us to gain insight into two distinct mechanisms that result in fast orientations. At shallow crustal depths (5s), fast orientations in the region are N/S to NNE/SSW, roughly normal to the Alps. This effect is most likely due to the formation of cracks aligned with the present-day stress field. At greater depths (20s), fast orientations rotate towards NE, almost parallel to the major fault systems that accommodated the lateral extrusion of blocks in the Miocene. This is coherent with the expected direction of aligned crystal grains during crustal deformation occurring along the fault systems and the lateral extrusion of the central part of the Eastern Alps.