Analytical study of body waves in orthorhombic media and comparison with SKS-phase observations

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Anisotropic effects of wave propagation, observed in the Earth, provide interesting applications in basic research and practice, e.g., in reservoir geophysics and other fields.
Teleseismic waves often evidence upper mantle anisotropy, as created by aligned olivine grains. While each grain is associated with orthorhombic symmetry, the preferred alignment may lead to a transversely isotropic characteristic.
Considering body waves passing through an anisotropic medium, a splitting of shear waves can usually be observed, since their transverse polarization leads to a separation of the two quasi-shear waves. The associated splitting-delay is generated if the related fast and slow seismic velocities differ.
Most of the previous shear-wave splitting investigations were based on the common assumption of vertical incidence. However, the influence of increasing incidence angles, which may lead to angular dependent splitting-delay and fast polarization orientation, has been pointed out by Davis (2003).
Our study investigates the occurrence of these postulated dependences on azimuth and incidence angle (distance) for b-up and c-up olivine, which might be associated with the simple asthenospheric flow model and the vertical coherent deformation model, respectively.
Therefore the analytical solution of the splitting parameter variation of both cases (Fig. 1) is investigated first. Moreover splitting observations in SKS-recordings are examined at a selected broadband stations in the Afar Depression.

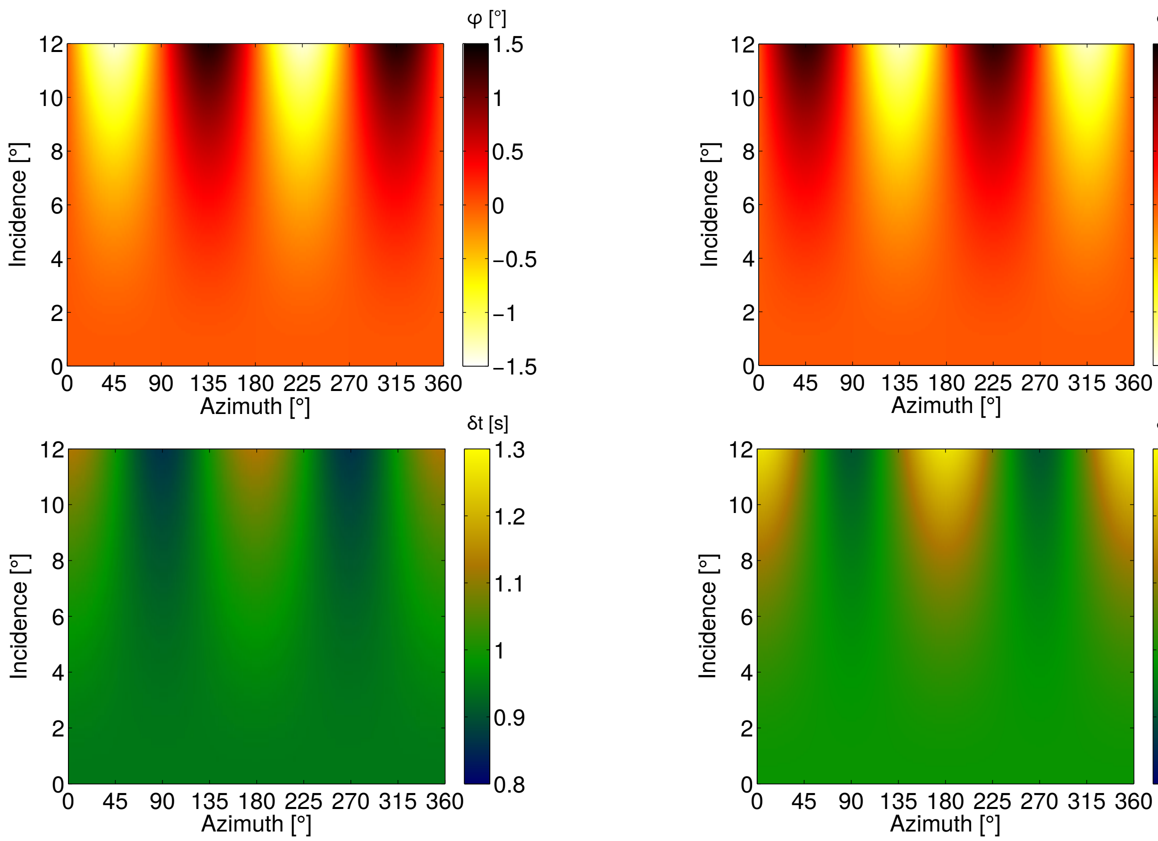

Fig. 1: Angular dependence of ϕ (top) and δt (bottom) in a b-up (left) and c-up (right) olivine case