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Constraints on the seismic properties of the mantle beneath the Nógrád-Gömör Volcanic Field (Northern Pannonian Basin)

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In the Carpathian Pannonian Region (CPR) Plio-Pleistocene alkali basalts have sampled the upper mantle at five known occurrences, bringing upper mantle xenoliths to the surface. One of these is the Nógrád-Gömör Volcanic Field (NGVF), which is located in the northern part of the Pannonian Basin.

For this study, 25 representative lherzolite and wehrlite xenoliths were selected from the central and southern parts of the NGVF. These xenoliths sample a small volume (∼4000 km3) of the upper mantle from a depth of about 35-50 km. Xenoliths collected from the southern part of NGVF originate from shallower depth (35-40 km) than those from the central part (40-50 km) [1]. Crystal preferred orientations (CPO) of the minerals were measured by electron backscatter diffraction (EBSD). Two distinct orientation types (A-Type, D-Type) based on the distribution and alignment of crystallographic axes were recognized, which show some correlation not only with the macroscopic texture, but also with olivine J-factors that indicate the strength of the xenolith fabric [2]. The seismic properties, i.e. seismic anisotropy and velocities, of these 25 mantle xenoliths were calculated based on the CPO and volume fractions of olivine, ortho- and clinopyroxene. It was found that P wave and fast split shear wave polarization direction is always close to the density maximum of the a-axis of olivine. Seismic anisotropy is higher for stronger CPO. Maximum P wave azimuthal anisotropy ranges are 4.5%-6.9% and 5.3%-11.9%, for the southern and the central area respectively. Maximum S wave polarization anisotropy ranges are 2.92%-5.31% and 3.97%-7.46%for the southern area and the central area respectively.

The anisotropy that would be measured by SKS, Rayleigh and Love waves for end-member orientations of the lineation and foliation could be predicted based on the already calculated seismic properties of the xenoliths [3]. The calculated anisotropy is compared to the results of S receiver function analysis based on data recorded at 3 nearby permanent seismological stations. The goal of this study is the development of a petrophysical and seismological model for the lithospheric mantle in order to obtain a better interpretation of the measured seismological data, and hence determine the current and – if possible – the fossil lithosphere asthenosphere boundary beneath the studied area.

References:
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