'Water' content as a tool to estimate rheological differences in the lithosphere of young extensional basins

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Nominally anhydrous minerals in the lithospheric mantle, such as olivine and pyroxenes can host a small amount (tens to hundreds of ppm) of structurally bound hydroxyl ('water'). Numerous studies pointed out that water has a strong effect on the rheological properties of the lithospheric mantle, such as melting temperature, electrical conductivity, viscosity and seismic wave propagation speed. Water content of mantle xenoliths can thus be used to estimate such rheological properties which can then be compared with geophysical observations.

In this study we present effective viscosities and electrical resistivities calculated with the use of 'water' contents of upper mantle xenoliths from the Carpathian-Pannonian region (CPR). The CPR is a young extensional basin in Central Europe, where intraplate alkali basalts sampled the lithosphere in five areas, including locations from both the central and marginal regions. 'Water' contents are generally higher in xenoliths from the marginal areas compared with those from the central areas of the CPR, due to significant hydrogen loss during the extension in the Miocene (Patkó et al., 2019). It is demonstrated that due to the different 'water' contents, the lithospheric mantle in the central areas can be characterized with higher effective viscosity and electrical resistivity, and thus can be considered as more rigid than the marginal areas. This relative rigidity induced by lithospheric thinning may be a general feature of extensional basin systems worldwide, and can be regarded as a 'self-healing' mechanism of the extending lithosphere.

References:
