

Imaging fluid channels within the NW Bohemia/Vogtland region using ambient seismic noise and MFP analysis

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Presently ongoing geodynamic processes within the intracontinental lithospheric mantle give rise to different natural phenomena in the NW Bohemia/Vogtland region, among others: earthquake swarms, mineral springs and degassing zones of mantle-derived fluids (mofettes). Their interaction mechanisms and relations are not yet fully understood, therefore they are intensively studied using geophysical, geological and biological approaches.

We focus on the investigation of near-surface channels that conduct mantle-originating fluids as well as CO₂ near the Earth's surface. We aim at the detection, imaging and characterization of the fluid channel structure as well as the observation of their temporal and spatial variability.

The Hartoušov Mofette Field within the Cheb Basin (NW Bohemia/Vogtland region) is a key site to study fluid flow as it is characterized by strong surface degassing of CO₂. On this field, we applied the noise source localization method Matched Field Processing (MFP) considering the fluid flow as seismic noise source. Within multiple campaigns, we measured ambient seismic noise in continuous mode during the night to avoid cultural noise generated by human activity. We used arrays of about 30 randomly distributed stations with 1 to 4 ha extent.

We compared the surface position of the MFP output with punctual CO₂ flux measurements performed by Nickschick et al. (2015) and observed a strong relation between high CO₂ flux values and the position of the MFP maxima. Additionally, we observed surface indicators for CO₂ degassing on the same positions of the MFP predicted noise sources: wet and dry mofettes accompanied by bog cotton, bug traps and brown to yellow coloured grass.

The MFP maxima can be followed into the subsoil to image the fluid channel structure down to 50 m depth. We analyzed the influence of the array size on the vertical and horizontal MFP resolution as well as the temporal and spatial variability of the flow activity.