

Institut für Geophysik
Geophysikalisches Kolloquium
Wintersemester 2024/2025

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Strain localization across the scales

The ICDP Project “Drilling the Eger rift” investigates the geodynamic processes in the Czech-German border region in Westbohemia and the Vogtland. It especially focuses on the relationship between the frequently occurring earthquake swarms and the CO₂ degassing in the region. For this purpose, several boreholes were drilled to install seismic sensors and gas probing devices to gain new knowledge of this relation. One aim is to improve the high-frequency observations of the frequently occurring earthquake swarms by using 3D arrays as novel observational instruments recording at high sampling frequencies (1000 Hz). One of the sub-projects focuses on the analysis and localization of the continuous wave field trying to image the hypothesized fluid movements in the area. The pilot 3D array in the West of the swarm area at the ICDP site 1.5 km south of Landwüst (Vogtland, Germany) is recording since December 2020. The installation consists of a 12 surface three component (3C) station array and a 10 level almost vertical 3C borehole array. This new instrument recorded several earthquake swarms since its installation in December 2020. Furthermore, we used differential power spectral density (dPSD) levels at stations in the area to scan for time periods before the main phase of the swarm in which we could observe an increase in the continuous wave field energy levels. There has been speculations whether this observations could be interpreted as an indication for fluid movements within the crust. In order to confirm or reject this hypothesis we used the 3D-3C array to separate body and surface wave components in the continuous wave field both for this special time period of enhanced energy levels as well as for the period of the swarm itself. Our analysis reveals that the 3D-3C array is capable of clearly identifying the distinct arrivals of body waves from the swarm earthquakes even for very low SNR ratios. However, in the pre-swarm period which showed increased dPSD levels we rather observe a

diffuse mixture of surface waves originating from different directions without any clear body wave content. Moreover, the horizontal components show a loss of waveform coherence within the period of the elevated dPSD levels by a drop in the semblance of about 50% underlining the diffuse nature of the recorded wave field. Therefore it seems unlikely that the elevated dPSD levels are caused by deeper crustal sources such as the suspected fluid migration paths which are expected to be located in spatial proximity to the swarm earthquakes. This example illustrates the capability of the 3D-3C array to give new insights into the nature of the seismic wavefield which will help to better understand the underlying geodynamic processes.

Das Kolloquium findet um 16:00 Uhr im Seminarraum GEO 315, Corrensstr. 24, 48149 Münster statt. Alle an dem Thema Interessierten sind hierzu herzlich eingeladen.

Die Dozenten des Instituts für Geophysik