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High frequency array observations of December 2020 swarm at surface and borehole stations at ICDP Eger Rift site Landwüst (Vogtland)

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Within the ICDP project “Drilling the Eger Rift”, we focus on the German-Czech border region West Bohemia/ Vogtland which is known for its earthquake swarms. These swarms are clusters of small magnitude ($M_L < 4$) earthquakes which are supposed to be linked to the rise of fluids with mainly mantle origin. We aim to improve the seismological observation of these small magnitude earthquakes and related processes especially at frequencies above 100 Hz by installing three dense small aperture 3D arrays. Each single 3D array will consist of a 400 m deep vertical array borehole installation and a small aperture (400 m) surface array.

The drill site S1 in Landwüst and its surroundings serve as pilot site for the first installation. The borehole chain consists of eight 3-component 10 Hz geophones and the continuous recordings are sampled with 1000 Hz. In parallel, twelve surface stations are installed which are equipped with 4.5 Hz geophones. The data were recorded with 400 Hz sampling rate at most locations, but at some selected stations we additionally record data with 1000 Hz sampling rate being the desired sampling rate for the final array configuration. Due to the high sampling rates and the high frequency content of the recorded earthquake signals, local site conditions may lead to non-coherent recordings for different parts of the array which have a major influence on the overall array performance. However, preliminary results from broad band frequency wave number analysis (5-180 Hz) in a moving time window (0.2 s) with first test installation data also indicate that the coherency across the array site is still high enough to clearly identify P and S waves from local earthquakes.

In the period December 2020 – January 2021, an earthquake swarm took place with two activity clusters in Nový Kostel (Czech Republic) and Obertriebhel/ Oelsnitz (Vogtland, Germany) about 20

km apart. This swarm was recorded by both borehole stations and surface stations in Landwüst. Preliminary results show that more than 14000 events can be identified at the borehole stations and that about 70-80% of these events are also observed at the surface stations. For small earthquakes, mainly the S wave can be identified, but also impulsive P waves are clearly visible at the surface stations. These high frequency waves (up to 230 Hz at the surface) show a good coherency across the surface array. At the borehole stations, we observe an even higher frequency content up to 300 Hz and more. We present recordings from selected events to analyse frequency content and coherency across the 3D array.