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Seismic monitoring with a shallow borehole-geophone array at the COSC-1 drilling site

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An array of borehole geophones was installed at the COSC-1 drilling site with the aim to continuously monitor seismic signals originating from controlled source experiments, ambient and drill-bit noise as well as natural seismicity. These seismic data can provide detailed information on the structure of the elastic parameter distribution around the COSC-1 borehole at the 10's to 100's of meter scale. For this monitoring experiment, nine three-component seismic sensors were deployed in the depth interval from 20 to 100 m below the surface in two shallow boreholes next to the COSC-1 main borehole and the output signals were continuously recorded over five months from late April to late September 2014. This time period includes a short 'quiet' time interval just before the start of the drilling in May, the entire drilling activities until August, and the subsequent vertical-seismic profiling (VSP) experiment in September. In total, around 2.6 terabytes of seismic data were recorded and will be jointly analyzed with other seismic data and supporting geological information.

The seismic-data analysis of the five-month records will focus on several aspects. For example, we will explore, what information on the geological structure along the main borehole can be extracted by continuously listening to the drill-bit noise. The data acquired with the shallow monitoring array during the VSP experiments complements the VSP recordings with a geophone chain located at greater depths in the main borehole. The VSP data recorded with the monitoring array can aid in, for example, the seismic-reflection and seismic-refraction processing to image the shallow structure around the borehole (top most few 100's of meters). In addition, recordings of ambient noise from the borehole array may provide information on the shallow subsurface structure at the COSC-1 drilling site. Finally, signals from local earthquakes may be identified, providing information on the natural seismicity of the area.