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Comparing high-sensitivity geophones to fiber-optic DAS technologies in a hard-rock VSP survey

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As part of the preparations for a microseismic network on the planned nuclear waste repository in Forsmark, Sweden, we carried out a suite of measurements for site characterisation and instrument testing using geophones and DAS fiber-optic technology. Three high-sensitivity 240 V/m/s geophones were grouted into a 200 m deep borehole together with a linear, a helical and a helical engineered fiber-optical cable. Two different interrogators were used for DAS acquisition. We performed a walk-away vertical seismic profile (VSP) survey with 10 m source spacing out to 1.1 km offset and compare the responses of the four different measurement systems. The complete transfer functions of the fiber-optic systems have not yet been determined, and depend on factors such as incidence angle, signal frequency content and the fiber gauge length. Preliminary results show that all systems record signals with high signal-to-noise ratio and that which system has highest performance depends on source-receiver distance, signal frequency content and wave incidence angle. Due to incomplete knowledge of the fiber transfer functions we cannot match the DAS velocity signal with the geophone signal. Investigation of the detection capabilities of the fiber and geophone systems is underway and will be presented together with a discussion of the relative merits of the various systems for microseismic monitoring.