Schlumberger

Borehole Seismic Surveys Using Optical Fiber Slash 3½-Hour Acquisition Time to 3½ Minutes

hDVS distributed acoustic sensing system transparently acquires checkshots with only 20 shots over four logging runs

CHALLENGE

Efficiently acquire a borehole seismic survey along with a full suite of logs to characterize clay layers.

SOLUTION

Connect the heterodyne distributed vibration sensing (hDVS) distributed acoustic sensing (DAS) system to the optical fibers incorporated in the hybrid cable to efficiently record data during conventional logging runs.

RESULTS

Acquired good-quality checkshot data in 3½ minutes per well logging run instead of 3½ hours to conduct a dedicated conventional borehole seismic survey requiring 200 shots.

Seismic survey needed for characterizing clay layers

In drilling a new well for the geological disposal of high-level, long-lived waste, the Belgian Agency for Radioactive Waste and Enriched Fissile Materials (NIRAS) needed to thoroughly characterize the various clay layers. The required data included a checkshot seismic survey for velocity model calibration.

Every logging run an opportunity for seismic acquisition on hybrid cable

The hDVS DAS system brings new efficiencies to borehole seismic applications. The system's optical interrogator unit at surface is connected to any optical-fiber cable deployed in a well, from hybrid wireline logging cable to production tubing with fiber installed or optical fiber permanently cemented behind casing.

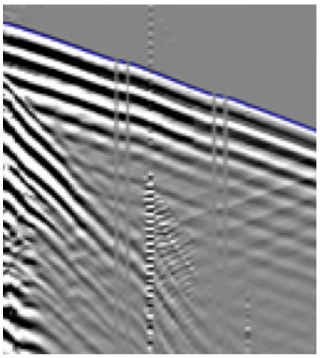
Because the hDVS DAS system makes every logging run or fiber installation an opportunity for seismic data acquisition, it significantly improves the efficiency of borehole seismic operations while lowering the cost. No longer is time required for rigging up and down and deployment of conventional borehole seismic tools because the system is simply connected to the fiber at surface and records seismic data in conjunction with other stationary logging services or on its own. A full well profile is recorded for each shot. The full-aperture measurements acquired are suitable for checkshots for seismic calibration or time-lapse imaging over the life of the field.

Seismic data acquisition in only 3½ minutes

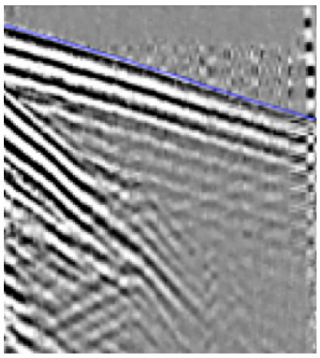
The NIRAS well was the first commercial deployment of the hDVS DAS system on 7-49 hybrid cable, which is a seven-conductor heptacable with two added single-mode optical fibers. The hybrid cable performed well with maximum tension during the logging runs recorded at 3,000 lbf.

The hDVS DAS system recorded seismic data on each of the four runs while the logging tools were near the bottom of the well. The seismic surveys were recorded transparently along with data acquisition by the FMI* fullbore formation microimager, Platform Express* integrated wireline logging tool, CMR-Plus* combinable magnetic resonance tool, ECS* elemental capture spectroscopy sonde, and a borehole seismic imager tool. Comparison shows that the main characteristics of the seismic waves on the imager's survey are matched by the hDVS DAS system's survey, making it highly usable as checkshot data for time picking.

Borehole seismic imager



hDVS DAS



The hDVS DAS system acquired highly usable checkshot data that matches the conventional borehole seismic survey but with only 10% of the shots required and at a 98% reduction in acquisition time.

More importantly, while the borehole imager required 200 shots to conduct the survey, the hDVS DAS system acquired seismic data with only 20 shots over the four runs. Similar efficiencies were achieved timewise: The conventional survey took about 6 hours 30 minutes for entire operation including rig-up, running to stations, 3½ hours for recording data, pulling out, and rig-down whereas the good-quality hDVS DAS survey took 3½ minutes, without needing a separate dedicated run.

slb.com/das

Schlumberger