WS15-A02

Fiber Optic Vector Sensors

B.N.P. Paulsson* (Paulsson, Inc.), J.L. Toko (Paulsson, Inc.), J.A. Thornburg (Paulsson, Inc.) & R. He (Paulsson, Inc.)

SUMMARY

Seismic techniques dominate the characterization of subsurface structures, stratigraphy and reservoirs. They also dominate production monitoring processes. Borehole seismology, of all the seismic techniques, despite its current shortcomings, has been shown to provide the highest resolution characterization and most precise monitoring results because it generates higher signal to noise ratio and higher frequency data than surface seismic techniques.

To address the critical site characterization and monitoring needs for EGS, CCUS and deep offshore reservoir programs Paulsson, Inc. has developed a fiber-optic based ultra-large bandwidth clamped borehole seismic vector array capable of deploying up to one thousand 3C sensor pods suitable for deployment into ultra-high temperature and high pressure boreholes.

Tests of the new vector sensors have shown that the developed borehole fiber optic seismic sensor technology is capable of generating outstanding high vector fidelity data with extremely large bandwidth: 0.01 – 6,000 Hz. Field tests have shown that the system can record events at magnitudes much smaller than M-2.6 at frequencies up to 2,000 Hz. The sensors have also proved to be much more sensitive than regular coil geophones used in borehole seismic systems today. The fiber optic seismic sensors have furthermore been qualified to operate at temperatures over 300°C

Seismic techniques dominate the characterization of subsurface structures, stratigraphy and reservoirs. They also dominate production monitoring processes. Borehole seismology, of all the seismic techniques, despite its current shortcomings, has been shown to provide the highest resolution characterization and most precise monitoring results because it generates higher signal to noise ratio and higher frequency data than surface seismic techniques.

To address the critical site characterization and monitoring needs for EGS, CCUS and deep offshore reservoir programs Paulsson, Inc. has developed a fiber-optic based ultra-large bandwidth clamped borehole seismic vector array capable of deploying up to one thousand 3C sensor pods suitable for deployment into ultra-high temperature and high pressure boreholes.

Tests of the new vector sensors have shown that the developed borehole fiber optic seismic sensor technology is capable of generating outstanding high vector fidelity data with extremely large bandwidth: 0.01 – 6,000 Hz. Field tests have shown that the system can record events at magnitudes much smaller than M-2.6 at frequencies up to 2,000 Hz. The sensors have also proved to be much more sensitive than regular coil geophones used in borehole seismic systems today. The fiber optic seismic sensors have furthermore been qualified to operate at temperatures over 300°C.