DAS Microseismic and Strain Monitoring During Hydraulic Fracturing

Hydraulic fracturing operations in unconventional subsurface reservoirs are typically monitored using geophones located either at the surface or in adjacent wellbores. A novel approach to record hydraulic stimulations utilizes fiber-optic Distributed Acoustic Sensing (DAS). A fiber-optic cable was installed in a treatment well in a subsurface reservoir (Meramec formation). DAS data were recorded during fluid injection of same fibered well and also during injection into a nearby treatment well at a distance of 350m. For both scenarios the DAS sensing array consisted of approximately 1000 channels at a fine spatial and temporal sampling and with a large sensing aperture. Thus, the full strain wave field is measured along the borehole over its entire length. A variety of physical effects, such as temperature, low-frequency strain and microseismicity were measured and correlated with the treatment program during hydraulic fracturing of the wells. These physical effects occur at various frequency scales and produce complementary measurements. Microseismic events in the magnitude range of -0.5 and -2.0 at a maximum distance of 500m were observed and analyzed for recordings from the fiber-equipped treatment well and also neighboring treatment well. The analysis of this DAS data set demonstrates that current fiber-optic sensing technology can provide enough sensitivity to detect a significant number of microseismic events and that these events can be integrated with temperature and strain measurements for an improved subsurface reservoir description.

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