

The Lomonosov Moscow State University experience in fiber optic sensors technology

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Over past two decades, significant number of papers have appeared on the using of fiber optic technologies in various geoscience applications. Geodynamical [1] and structural [2] monitoring, condition monitoring of dams [3] and wells [4], seismological [5] and seismic [6] surveys and other [7] measurements have become available using distributed acoustic, temperature and strain sensing (DAS, DTS, DSS). The technology has not yet been fully implemented in Russian Federation. Currently, there are no regulations for the use of fiber optic sensors. Some of the first mentions of the prospects and possibilities of applying DAS and DTS in publications, date back to the beginning of the last decade [8],[9]. Currently, large companies together with scientific institutes are working on introducing the technology into production. Scientific group of the Department of Seismometry and Geoacoustics of Lomonosov Moscow State University has been testing domestically produced DAS and DTS since 2021[10]. Currently, as part of pilot projects, various studies are being carried out in the zone of a extremely shallow waters, wells on a land and on the Arctic shelf. Surveying in the zone of extremely shallow water is designed to record surface and refracted waves. Using DAS data, dispersion images were constructed, which from a velocity model of S-waves in the medium was obtained. From times of arrives first breaks the model of P-waves velocities was obtained. To control the correctness of the recording, data from multicomponent bottom stations were used.

Well surveys are designed to collect vertical seismic profiling (VSP) data. Based on the moments of the first arrivals of downward waves, a model of P-waves near the well was calculated. Upward reflected waves are used to tie VSP data to very high resolution conventional midpoint seismic data. The resultant velocity model provides the best time to depth conversion for 2D seismic profiling data. The same cable was used to measure temperature in borehole with DTS.

Based on the experience gained, methodological recommendations are being developed for the using, development and processing of fiber-optic sensor data.

The purpose of the report is to highlight the operating principle of fiber-optic sensors, the main achievements in their applications in the world and the working group of Moscow State University.

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