Complex geophysical survey on solving the problem of water loss in the karst terrain reservoir

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COMPLEX GEOPHYSICAL SURVEY ON SOLVING THE PROBLEM OF WATER LOSS IN THE KARST TERRAIN RESERVOIR

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ABSTRACT

Geophysical surveys in karst terrain are always a specific challenge. Each of them requires a careful consideration of the problem, specific conditions on the ground, the selection of adequate methods applicable in that specific and unique karst area. But they should have one thing in common: a complex approach and looking at the problem from wider to narrower, with a gradual narrowing of the investigation area, increasing the spatial precision and resolution of the obtained data.

On the example of a typical karst reservoir, on which we had the opportunity to perform geophysical research with the aim of detecting rupture structures and karst phenomena, that may be predisposed directions of water circulation and its loss from the reservoir, this paper presents the design of methodology, order of applied methods and the obtained results.

A cabinet analysis of the digital elevation model (DEM) was performed first, in the low-frequency and high-frequency content of the spectrum. The database of DEM points of the terrain surface is integrated with data on the topography of the reservoir lake bottom, obtained by hydrographic sonar surveys.

Based on the obtained positions of assumed ruptures, the design of standard geophysical methods was carried out: seismic and geoelectrical profiling. The comparative analysis of 2D models obtained by the parameter of propagation velocity of longitudinal (primary) seismic waves (V_p) and 2D models based on the parameter of specific electrical resistance (SEO) was supposed to confirm and define their positions and spatial orientation.

In order to obtain a better model and provide spatial position of ruptures in the horizontal plane, surface seismic tomography in the horizontal plane was performed. As a result, maps of V_p distribution were obtained.

Predisposed directions of water circulation in karst terrain are generally not along all existing ruptures, but only along those which are connected and open for circulation in the current stage of karstification. In order to quantify along which of the detected ruptures the circulation and the water loss from the reservoir is happening, the monitoring of tracer (saturated NaCl solution), poured into the existing and available piezometer wells, was conducted. Sequential electrometric monitoring was performed, with the aim of monitoring the movement of the low resistance solution. Also, as a test procedure, magnetometric sequential monitoring was performed, which attempted to quantify small changes in the value of the gradient of the Earth's magnetic field, caused by the circulation of the ionic solution.

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