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Towards safer Planning: 3D-Borehole Radar Surveys for a detailed Imaging of the Mogilno Salt Structure in Poland - A Case Study

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Abstract

The provision of reliable geological models for salt structures is vital for their optimized and safe industrial utilization. With respect to the Mogilno salt structure in Poland precise geometry information were required for planning the brine production and the safe operation of the resulting caverns. The detailed geological imaging of the flat-topped Mogilno salt structure is of high importance because this salt dome is rather narrow with approximately 2 km (1.25 mi) in length and only 0,4 (0.25) to 1,4 km (0.87 mi) in width.

In 2007 2D-seismic data had been recorded, processed and interpreted for the structural delineation of the salt formation. Several verification drillings along the interpreted edges of the salt structure, though, did not confirm the lateral extent of the salt deposit at many drill-hole positions as indicated by the interpretation of the 2D-seismic data. In fact, 2 drill-holes even penetrated strata flanking the salt structure and 4 drill-holes encountered rock salt at considerably greater depths than expected.

The interpretation of structural data from drill-holes tagging the salt helped targeting further drillings into the rock salt. Additional surveys have been carried out within these drill-holes using a direction sensitive 3D-borehole radar system. The results of these surveys significantly facilitated the imaging of the lateral boundary of the Mogilno salt structure and allowed a much better planning of the safety pillar widths for the cavern constructions. The results of this case study indicate, that the Mogilno salt structure is narrower than expected from the sole interpretation of the 2D seismic data. The geological interpretation of radar-wave reflections in context of the drilling results in the 3D-space showed that in some areas the lateral salt dome boundary is located 150 m (490 ft) closer to the central axis of the Mogilno structure than assumed.

At the Mogilno site the 3D-borehole radar method evolved to an integral compound of the standard investigation program for new cavern development projects. In total, eight additional exploration drill-holes and seven 3D-borehole radar surveys provided a sound base to optimize the salt resource evaluation and production planning. The results significantly reduced uncertainties by verifying sufficient lateral salt pillar widths and will provide robust subsurface data for the planning of future cavern locations.

Key words: Geophysics, Geology, GPR (Ground Penetrating Radar), 3D-Borehole Radar, Poland, Rock Salt, Salt Caverns