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Why Leaching in the Dark? Have a Look inside your Salt Dome by 3D Borehole Radar

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Abstract

The development of a storage site in a geologically unknown salt dome can usually be supported by geophysical investigations applying seismic and gravity methods at the Earth's surface. However, in most cases, no details of the inner structure can be extracted from these measurements.

Exploration boreholes give initial information about the inner architecture of the dome. Additional logging programmes deliver further details of the salt structure in the vicinity around a borehole.

One interesting geophysical method which can resolve salt structures in greater distances around a borehole is Ground Penetrating Radar (GPR). This is due to the electric and dielectric properties of pure salt, which are ideal for the propagation of radar waves. Thus, structures within the salt as well as salt boundaries can be detected in distances of several hundreds of metres around a borehole.

During the past decade a directional borehole GPR system has been developed which supplies geologists with structural information about the 3D space. This wireline service is performed together with the logging programme, usually applied in salt boreholes. The directional borehole GPR system is a development which has been optimised during the past decade by the experience of many services.

The principle of GPR is sending out electromagnetic pulses into the surrounding salt and recording the signals reflected at structures which show different electric properties compared to the salt medium, i.e. electric conductivity and dielectric permittivity. The presentation of recorded GPR data is comparable to images generated of seismic data showing special wiggle and colour codes for amplitudes and the incoming direction of each recorded signal.

The main goals of directional borehole radar measurements are to identify geological boundaries and to correlate them in the 3D space with different material properties like layers of potassium, anhydrite, etc. or with salt dome boundaries. With this information the geometry of a planned cavern can be adjusted. The development of a cavern field can be optimised by applying the radar survey in every new borehole.

In this presentation the directional borehole radar method and equipment are introduced. Outstanding field cases are presented to demonstrate the high improvement of the geological data base for the further exploration and development of cavern fields within salt domes.

Key words: Cavern design, GPR (Ground Penetrating Radar), Geophysics, Borehole, Exploration