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Aspen Geolog™ Multimin Helps De-risk a Suitable Disposal Site for Radioactive Waste, On Time and Within Budget

“With Geolog, we are able to efficiently perform accurate QC, which is important for minimizing uncertainties within an optimized budget.”

- Rodney Garrard, Project Manager, Nagra

CHALLENGE

Find a suitable site for the deep geological disposal of radioactive waste in Northern Switzerland, requiring a detailed characterization of the host rock in terms of mineralogy and porosity.

SOLUTION

Use Aspen Geolog Multimin shortly after logging acquisition to evaluate the validity and accuracy of the data through the creation and analysis of multiple models.

VALUE CREATED

- Using Aspen Geolog Multimin, it was possible to perform detailed QC within a multi-mineral interpretation easily, efficiently, and with high accuracy, while dealing with a highly detailed acquisition.
- Detailed and accurate information about the formations provided accurate rock characterization relative to budget.

Overview

Subsurface exploration is not only an essential component in the search for energy sources such as oil, gas or water. It can also be used to solve the problem of long-term storage or disposal of waste, such as CO₂ or radioactive waste.

Nagra is a Swiss technical competence center tasked with responsibility for deep geological disposal of radioactive waste. For this project, the company's focus was on the clay-rich, mid-Jurassic Opalinus Clay formation as a potential host rock in Northern Switzerland. The goal of the project was to find a suitable disposal site for the waste. This required a detailed characterization of the host rock in terms of mineralogy and porosity, based on excellent log quality. This project was performed by GPCI, an independent petroleum consulting firm, and the QA/QC provider for Nagra.

In an exploration project such as this, it is critical to have very accurate and detailed rock characterization of the targeted formations relative to the budget. The Opalinus Clay formation will be an integral part of the disposal concept. The composition of the rock, especially the clay mineralogy, determines its barrier performance. It is therefore necessary to acquire high-quality petrophysical data that can provide a detailed compositional breakdown of the potential host lithologies.

For the most recent boreholes in the exploration project, clay inhibitors (potassium, K-silicate) have been added to the mud system to prevent washouts in the shaly formation and allow robust data acquisition. This makes it imperative to accurately correct for the presence of potassium in the drilling fluid, as this impacts the measurements from

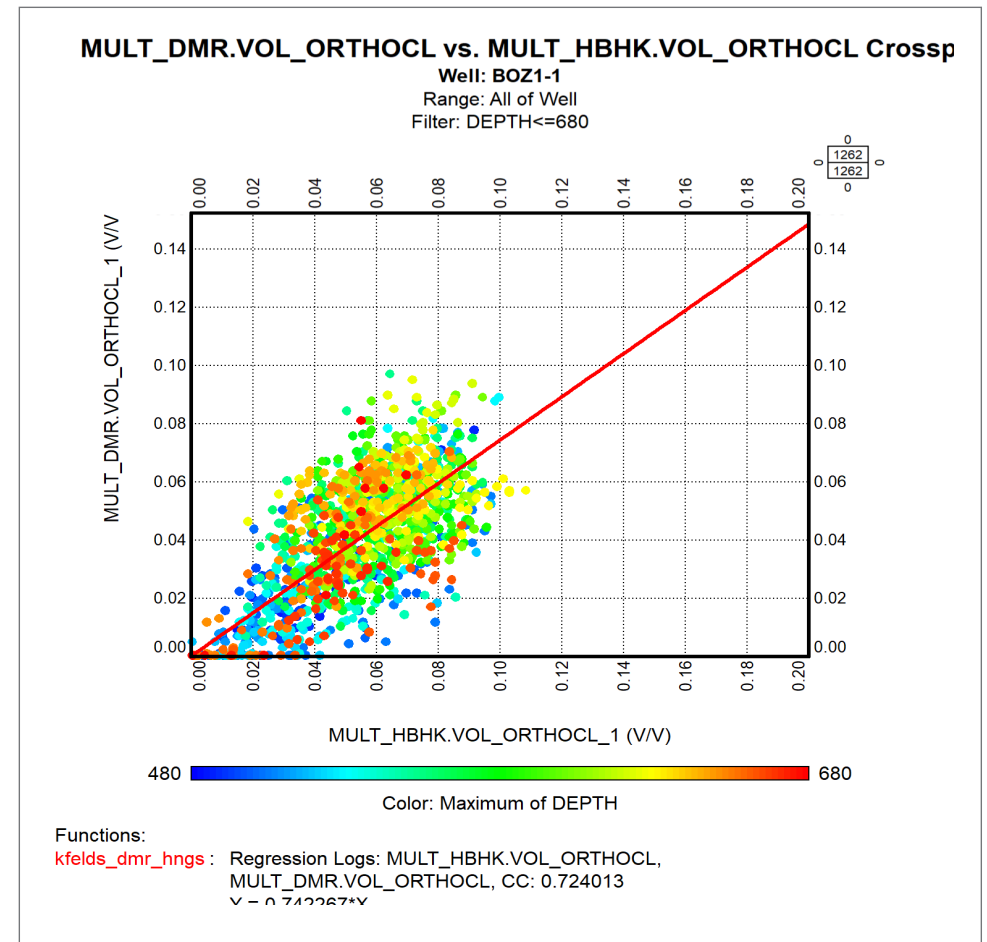


Figure 1. A plot showing impact of the potassium correction on the Multimin-computed orthoclase volume, X-axis with HNGS-measured, Y-axis with DMR mud potassium concentration. The difference in mud potassium correction has a drastic impact on the orthoclase volume, consequently low impact on the accurate quantification of the clay content.

the spectral gamma-ray (HNGS tool) of potassium and uranium levels (Figure 1). Different levels of correction have been applied in real time by the wireline engineers. In addition, an elemental spectroscopy (ECS tool) closure model was tested to provide a magnesium (Mg) content

measurement, which is key for dolomite quantification (Figure 2). Thus, it was crucial to quality control the measure and corrections applied almost in real time; and ensure such wireline data could be used with confidence to characterize the Opalinus Clay and bounding formations.

Accurate and Detailed Multiminereral Interpretation

Aspen Geolog Multiminer was used shortly after logging acquisition to evaluate the validity and accuracy of these data through the creation and

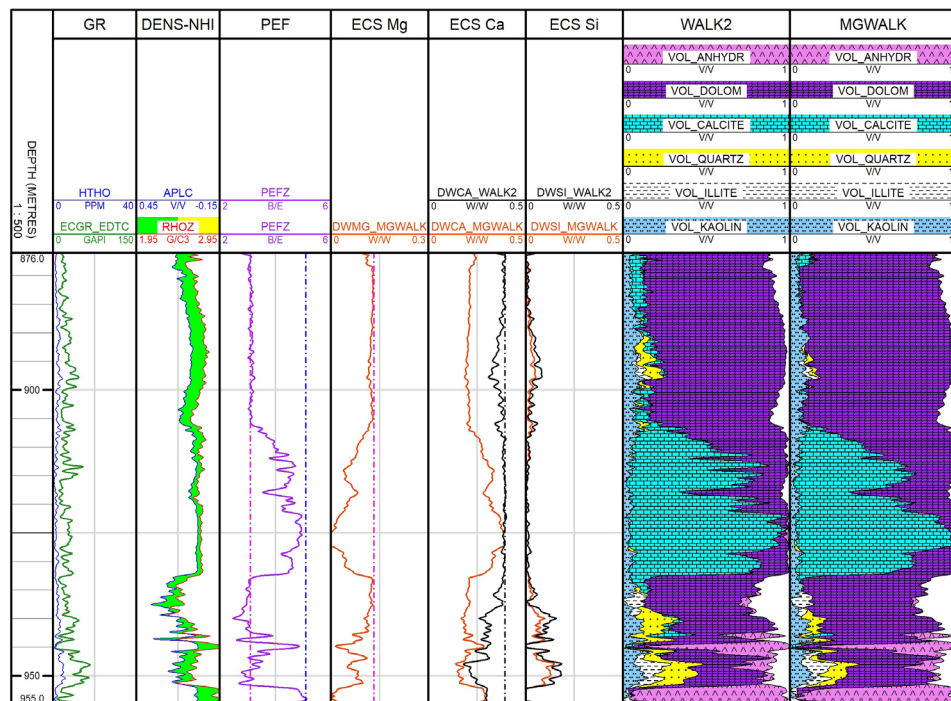


Figure 2. An alternative processing method (MGWALK) was evaluated and used with ECS standard processing (WALK2). Expert, “almost real-time” QA/QC of the wireline data in Geolog and good communication between the teams were critical for assessing logging speed and performing processing at optimum quality.

analysis of multiple models (Figure 3). Multiminer was able to solve the following technical challenges:

- Process and QC a very detailed acquisition in a short turnaround time.
- Obtain an extremely accurate and detailed multiminereral interpretation of the clay formation and check the impact of the new mud formula, to meet the strict requirements for detailed rock characterization.
- Evaluate the potential added value of the Mg measurement in the carbonate series.

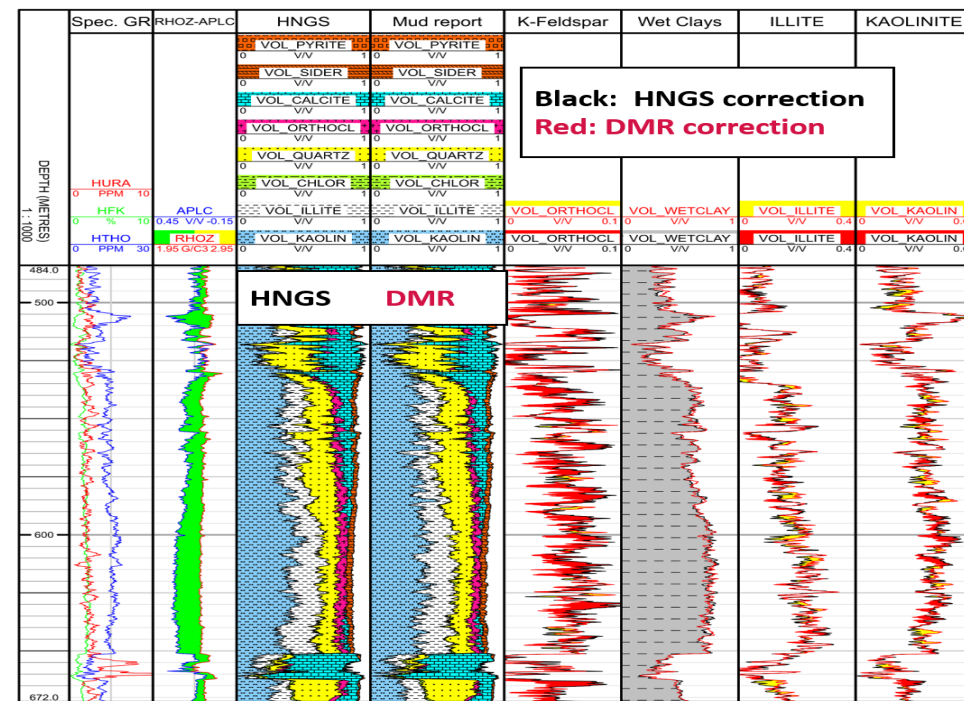


Figure 3. Comparison of multi-mineral interpretations generated with Geolog Multiminer from spectral gamma-ray indirect measurement (HNGS) and daily mud report (DMR).

The next step in characterizing a potential geological disposal facility was 3D characterization of the site structure. Borehole data, including the lab results from the continuously cored wells, were integrated with seismic in Aspen GOCAD™ and a 3D geomodel was generated (Figure 4). This helped to understand the geometry of the rock layers. In future studies, the variability of the rock types at the proposed disposal site can also be analyzed.

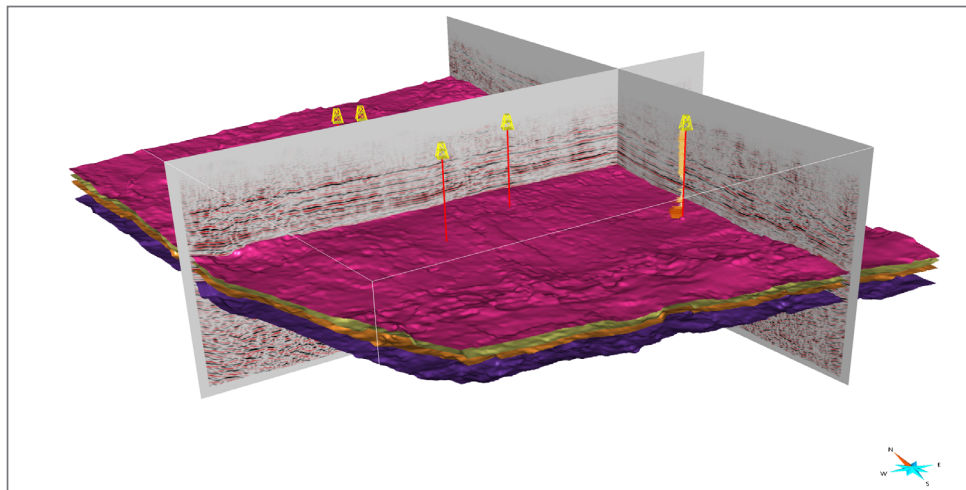


Figure 4. Structural model: horizons, seismic and drilled wells visualized in Aspen GOCAD.

Results

Nagra was able to successfully characterize the Opalinus Clay and bounding formations. The use of Multimin models proved the negligible impact of potassium mud corrections on the clay content, and also improved the dolomite volume quantification. The result was a very detailed and accurate characterization of the formation performed at minimal cost relative to budget, which could support the proposal for a radioactive waste disposal site.

Benefits

Geolog Multimin was used to QC and process the validity and accuracy of the new log data within 24 hours. This enabled a quick and detailed assessment of the impact of changes in log acquisition and processing on the required detailed formation characterization. The changes were validated and applied to the most recent boreholes.

Due to the flexibility, ease of use and efficient data integration of Multimin (i.e. the ability to integrate HNGS and ECS data), it was possible to perform detailed QC within a multi-mineral interpretation easily, efficiently, and with high accuracy, while dealing with a highly detailed acquisition.



About AspenTech

Aspen Technology, Inc. (NASDAQ: AZPN) is a global software leader helping industries at the forefront of the world's dual challenge meet the increasing demand for resources from a rapidly growing population in a profitable and sustainable manner. AspenTech solutions address complex environments where it is critical to optimize the asset design, operation and maintenance lifecycle. Through our unique combination of deep domain expertise and innovation, customers in capital-intensive industries can run their assets safer, greener, longer and faster to improve their operational excellence.

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