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**SGS USES QEMSCAN TO ANALYSE DRILL CUTTINGS FOR A
DOIG SANDSTONE WELL EVALUATION**

A COMPLEX WELL EVALUATION ACHIEVED WITH TECHNOLOGICALLY ADVANCED QEMSCAN ANALYSIS

The evaluation of a well can be complex and difficult.

Running wireline logs and cutting core in a horizontal well is cost prohibitive and operationally difficult, so therefore not often done. This means there is a limited amount of geological data available to aid in the evaluation of a well.

QEMSCAN offers a technique to extract much of the same information from drill cuttings that would be gathered from core studies. At SGS, we use QEMSCAN, it is the newest, most powerful and flexible analytical tool available for the study of rock samples, which is currently available in the minerals industry. The system is capable of analysing a variety of samples, including drill cuttings, thin-sections and core.

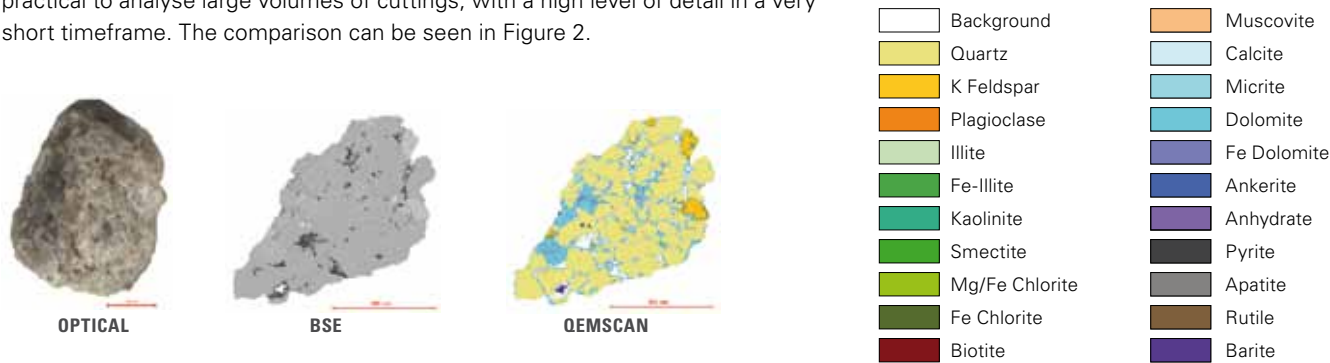
PROJECT BACKGROUND

The Doig Sandstone Well has a 1,250m horizontal section of reservoir, so for evaluation, coring was not a practical solution. The existing strip log for the well-site, was limited in the level of detail due to very fine cuttings. Advanced analysis of drill cuttings has been difficult and even impossible due to sample size, damage from the drilling process and sample contamination. SGS utilised QEMSCAN for this project to increase the accuracy, reliability and to provide a detailed automated analysis.

QEMSCAN is a rapid, automated SEM/EDX system. SGS uses QEMSCAN to analyse over a thousand points in a sample every second, providing statistically robust results unmatched by any other analytic technique. Once the data is captured by QEMSCAN it can then be manipulated digitally allowing advanced interpretation to be performed with ease.

FIGURE 1

Traditionally only optical analysis was available for drill cuttings. Special SEM studies could be undertaken but it was impractical for a large-scale study, as it was a very time intensive manual process. At SGS, we use QEMSCAN as it now makes it practical to analyse large volumes of cuttings, with a high level of detail in a very short timeframe. The comparison can be seen in Figure 2.



An example showing the analysis of a sandstone drill cutting

FIGURE 2

A) SEM Image of quartz overgrowths on detrital quartz grains (Q) and apatite grains (Ap).
B) QEMSCAN false color mineral map showing euhedral quartz grains, dolomite grains, apatite coated quartz grains and a calcite cement.

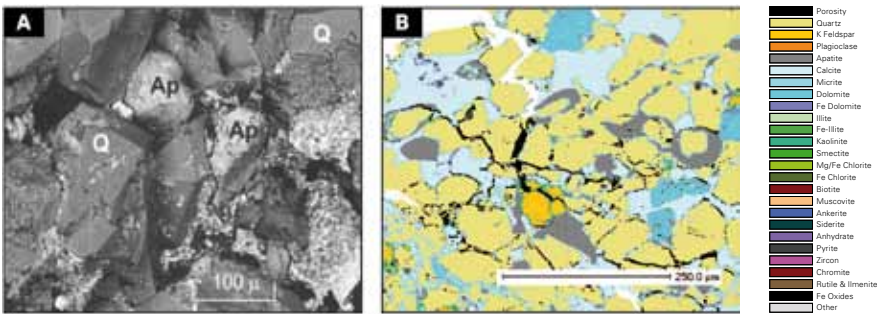
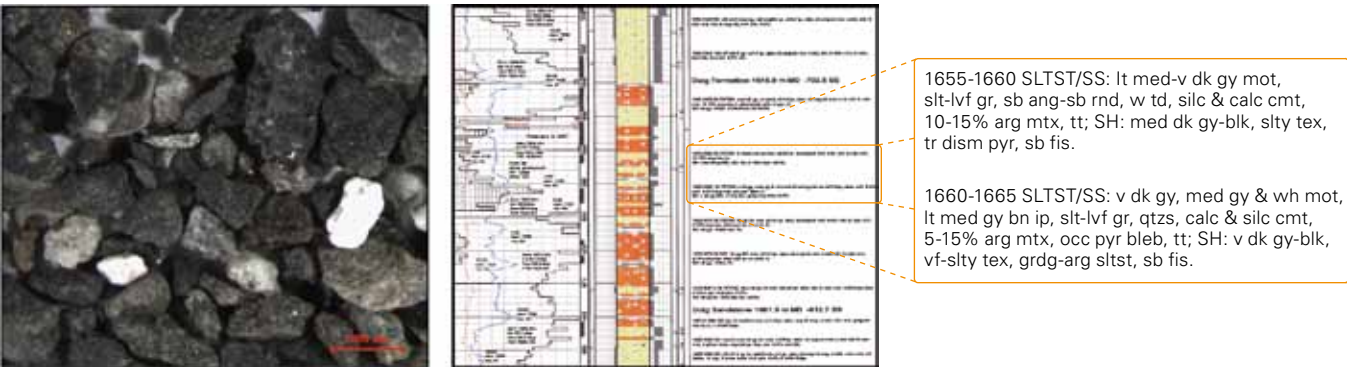


FIGURE 3

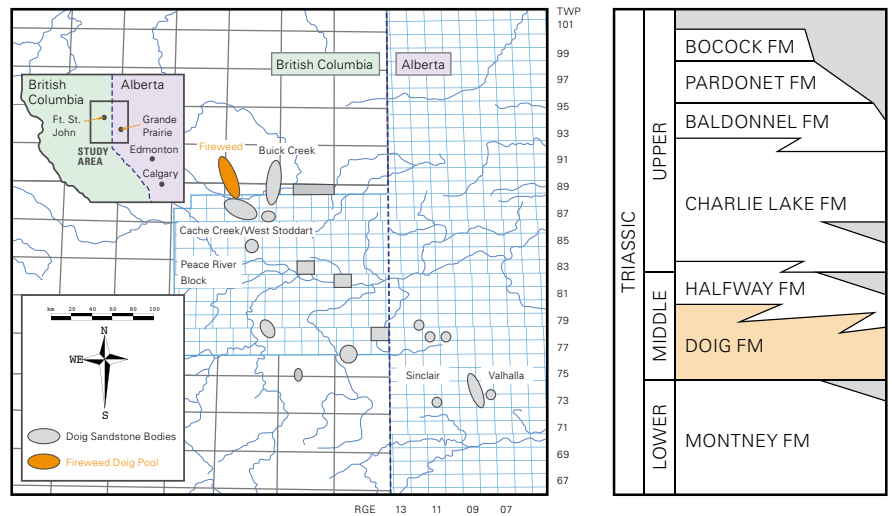


Optical microscope view of cuttings and the accompanying strip-log and well-site geologist's description of the cuttings from the interval at 1,665m.

CASE STUDY

SGS used QEMSCAN to analyse drill cuttings in the evaluation of the horizontal Doig Sandstone Well. In this study, the operator wanted to use drill cuttings to determine the subtle horizontal variations in the well. The well-site strip log provided some information but subtle variations could not be quantified optically. By mapping variations in the reservoir, it was thought that the completion and future drilling locations could be optimized. SGS used QEMSCAN for an automated analysis of the drill cuttings to determine mineralogy, porosity, grain size and other textural properties to measure variations in the reservoir.

FIGURE 4



Doig Sandstone pool map and generalized Triassic stratigraphy for NW Alberta and NE British Columbia, Canada

Method

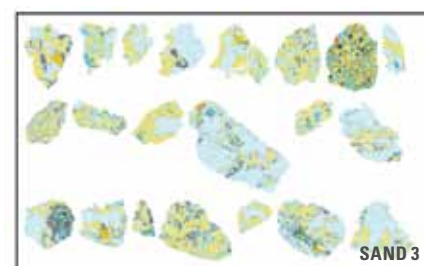
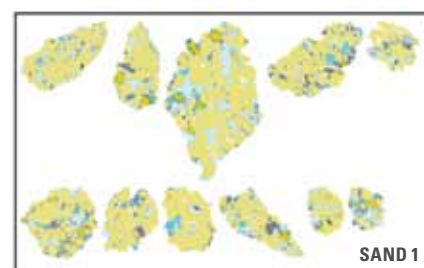
A junior exploration company sent cuttings samples from a well in the Fireweed Doig pool for analysis. The horizontal well had been drilled with a PDC bit, which combined with the fine-grained rock, limited the quality of the conventional optical analysis of the cuttings. Samples of the cuttings were collected at five-meter intervals to yield 254 samples over the approximately 1,250m horizontal leg. A section was prepared for each interval, two hours of QEMSCAN instrument analysis time was given to map each section.

QEMSCAN is a fully automated system that utilises Backscattered Electrons Imaging and (BSE) and Energy Dispersive X-ray Spectroscopy (EDX). Together these provide a system capable of rapid, accurate and high resolution mapping of rock samples. The system is capable of analysing over 1 million points per hour at a maximum resolution of 2 μm . The iDiscover software allows a large variety of data to be extracted from the results very quickly and easily.

Results

The QEMSCAN data analysis identified 3 sandstone units based on provenance, porosity and grain size. The well-site cutting analysis and LWD gamma ray had identified two shale breaks, which were interpreted as drilling out of the top of the main sandstone reservoir. However, it became evident in the QEMSCAN data that these were depositional breaks separating 3 different sands. Information obtained from this interpretation was integrated into the completion program to pick intervals for the stage frac completion and the geological model aiding in the placement of future development wells.

	SAND 1 (1940-2045 M)	SAND 2 (2205-2325 M)	SAND 3 (2630-2840 M)
QUARTZ	66.9%	66.1%	51.8%
AVG. QTZ. GRAIN SIZE	41.6 µm	36.5 µm	50.1 µm
AVG. QEMSCAN POROSITY	3.85%	3.99%	3.04%
POTASSIUM FELDSPAR	1.45%	0.13%	1.53%
PLAGIOCLASE	0.17%	1.35%	0.26%
FE/TI OXIDES	1.25%	0.43%	0.88%
PYRITE	0.59%	0.59%	0.78%
PHOSPHATE	6.76%	8.15%	7.36%
CALCITE	19.6%	20.5%	32.1%
DOLOMITE	1.65%	1.76%	2.52%
SMECTITE CLAYS	0.13%	0.06%	0.24%
KAOLINITE	0.63%	0.49%	1.37%
CHLORITE	0.05%	0.04%	0.10%
MICAS	0.40%	0.31%	0.70%



The large robust data set from this study revealed a correlation between quartz grain size and porosity. Zones with the larger quartz grains had lower porosity and upon further examination, it was noted that these zones also had significantly more calcite and less quartz. The cuttings images were examined to see if they could provide some explanation for this change. Once the images were reviewed it became apparent there was much more diagenetic replacement of quartz by calcite within the zones with larger quartz grains, likely due to there being a higher permeability during diagenesis. This indicated that quartz grain size could be used as a proxy for porosity when evaluating future wells.

The ability of QEMSCAN to measure these properties with a high degree of precision and accuracy allowed SGS to find small lateral variations in the reservoir. Trace mineralogy, grain size and porosity variations identified by the QEMSCAN analysis, indicated the presence of three unique sands separated by non-porous/permeable shales within the horizontal section. By recognising this variation, the geological model was adjusted. The operator can now better define the reservoir and better determine the placement of future wells.

Summary

The QEMSCAN analysis was able to provide unique insights into rock texture, type and mineralogical content. Subtle variations in grain size, cementation and trace mineralogy could be seen at a level of precision not offered by any other single method. By completing this case study, SGS successfully demonstrated the potential of QEMSCAN as a tool for the analysis of drill cuttings. The operator was pleased with the results and has already found new potential applications for this new technology.

SGS gratefully acknowledges the support of Breaker Energy Ltd. during this study.

WHY SGS?

SGS is the world's leading inspection, verification, testing and certification company. Recognised as the global benchmark for quality and integrity, we employ over 64 000 people and operate a network of more than 1 250 offices and laboratories around the world. We are constantly looking beyond customers' and society's expectations in order to deliver market leading services wherever they are needed.

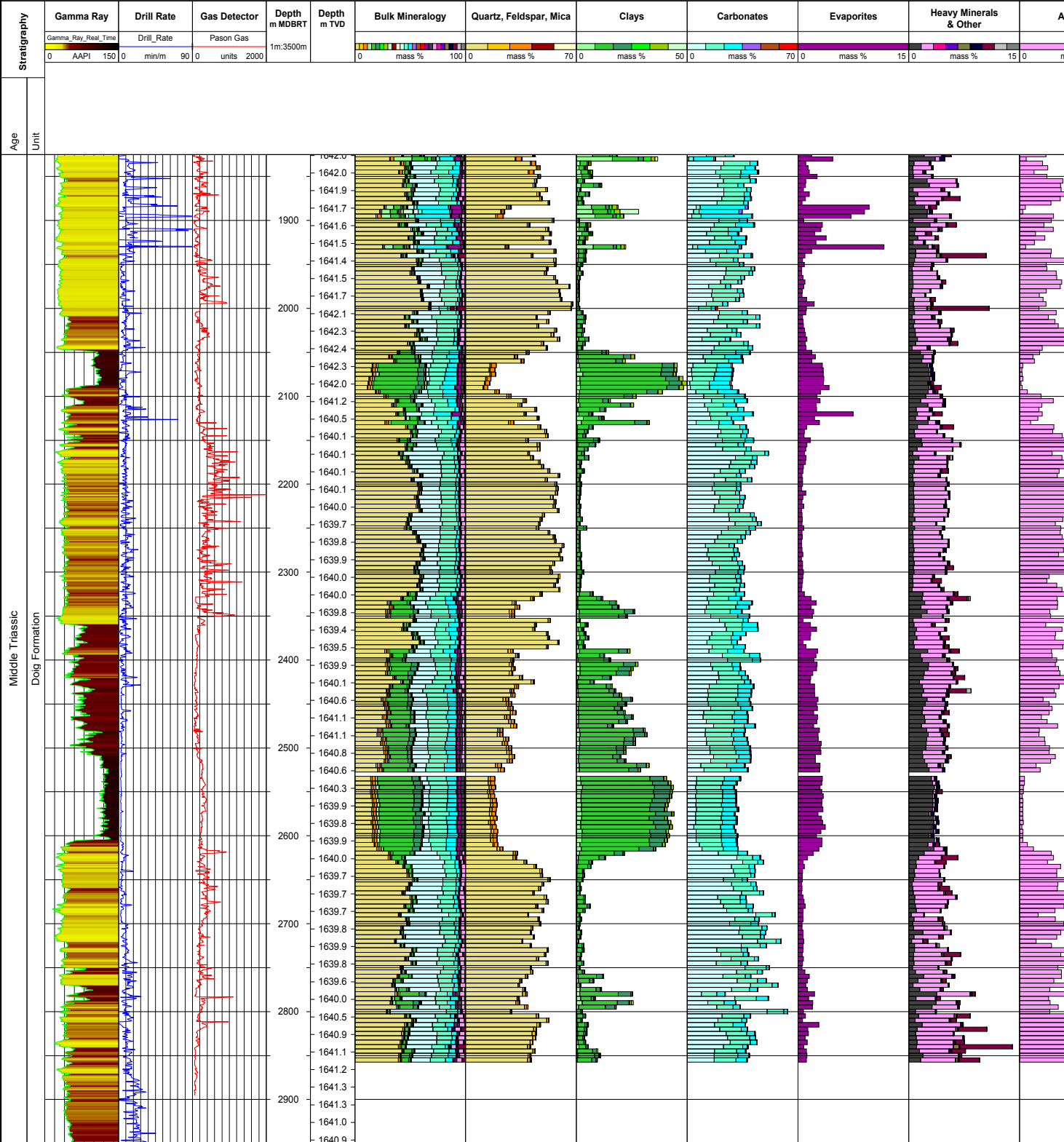
We have a history of undertaking and successfully executing large-scale, complex international projects. With a presence in every single region around the globe, our people speak the language and understand the culture of the local market and operate globally in a consistent, reliable and effective manner.

We provide innovative services and solutions for every part of the oil, gas and chemicals industry. Our global network of offices and laboratories, alongside our dedicated team, allows us to respond to your needs, when and where they occur. Our reputation for independence, excellence and innovation has established us as the market leader in providing services that improve efficiency, reduce risk and deliver competitive advantage for you.

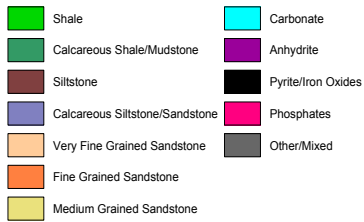
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