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Imaging Core Points and Natural Fractures in Oil-Base Mud Guides Completion Design, Utica Shale

Quanta Geo service's photorealistic geological images accurately position 85 sidewall cores in a thinly laminated reservoir and describe the natural fracture system

CHALLENGE

Obtain representative geologic images in a well drilled with oil-base mud (OBM) to better understand the Utica Shale by mapping the position of 85 sidewall cores in the laminated reservoir and identifying natural fractures to guide completion design.

SOLUTION

Image the wellbore in high resolution using new Quanta Geo* photorealistic reservoir geology service, which is specifically designed for imaging in OBM.

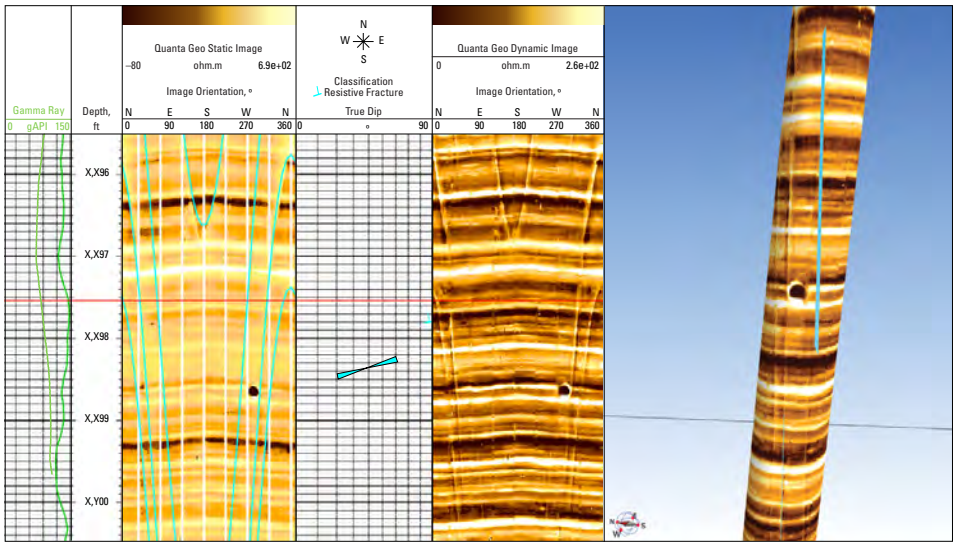
RESULTS

Accurately located the laminae in which all 85 sidewall core plugs were cut to precisely match the laboratory analysis with standard logs and clearly identified natural fractures to better understand the complexity of the hydraulic fracture network that would result from stimulation of the well.

Thinly laminated unconventional reservoir with high-angle fractures

An operator had collected 85 sidewall cores from the Utica Shale for laboratory analysis to support formation evaluation, stimulation design, and reserves estimation. However, if the core points could be accurately located, the laboratory measurements could also be matched to specific laminae. This would enable better understanding of the relation of core measurements to the log response and provide an overall indication of the representativeness of each core with respect to bulk reservoir properties.

The Utica Shale is naturally fractured, typically with subvertical, short fractures. If the fracture system could be imaged, that would provide precise orientation to enable calculation of the opening pressure required for interaction of the natural fracture system with hydraulic fracturing. However, in shales drilled with OBM, conventional microresistivity imagers usually do not perform well for this application.

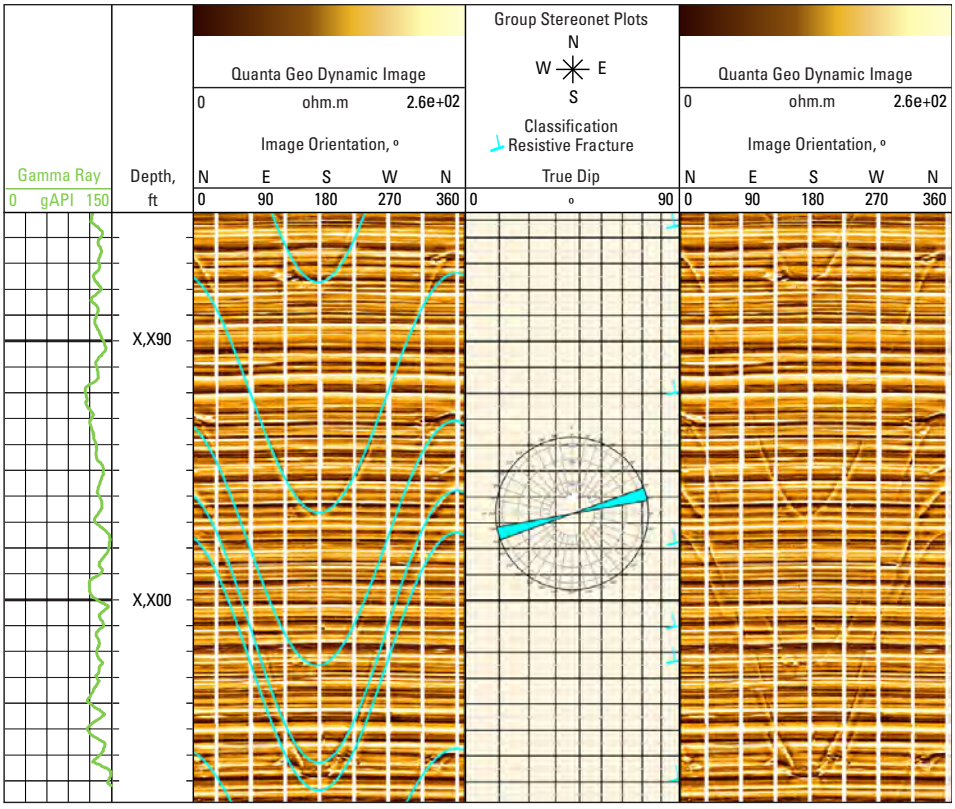


Although only a few small fractures in the Utica Shale were intersected by the vertical wellbore, they were imaged in high resolution by Quanta Geo photorealistic reservoir geology service, with their orientation perfectly matching that of fractures in the overburden, as shown here. From these excellent-quality images and the 3D visualization created by the Techlog wellbore software platform, it could be clearly determined for this slightly deviated hole section that the bedding is flat and the fracture system subvertical, with precise measurement of the strike. The circular features on both the static and dynamic images are evidence that a sidewall core was cut at X,X98.6 ft.*

High-resolution imaging in oil-base mud

Quanta Geo service's photorealistic images provide full-coverage microresistivity images and dip data in OBM that faithfully represent the formation geology. This newly engineered imager features an innovative sonde design with 192 pad-mounted microelectrodes for 98% circumferential coverage in an 8-in borehole. The microelectrodes are smaller than those used on conventional imagers to provide excellent spatial resolution of 0.24 in × 0.13 in [6 mm × 3 mm] in the vertical and horizontal dimensions, respectively. Tool-specific processing routines render highly representative images with photographic quality. Visualization and interpretation are fully powered by customized apps and workflows in the Techlog wellbore software program.

Quanta Geo service avoids the problem of inconsistent imager pad application in the highly deviated and horizontal wells typically drilled in unconventional reservoirs by independently applying each pad to the borehole wall to significantly reduce the risk that a pad is not in contact.



The abundant subvertical natural fractures imaged by Quanta Geo service in the overburden have the same orientation as the fractures in the targeted shale.

Clearly imaged core points and natural fractures

All 85 core points and the natural fracture system were well imaged by Quanta Geo service in the Utica Shale. With the position of the sidewall cores accurately known, the representativeness of the sample analysis could be evaluated for designing the stimulation treatment and reserve estimation for the unconventional reservoir. The core measurements were also used to accurately calibrate the log interpretation with the Techlog platform.

Although only a few small fractures were intersected by the vertical wellbore in the target interval, Quanta Geo service captured them in clear detail. In addition, intense fracturing in the overburden was imaged with the same orientation as the fractures in the target zone. For the first time in the Utica Shale, it was easy to confirm from the images that the dominant fracture system is subvertical and striking NNE–SSW at 80°–260°.

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