AEGC2019 Data to Discovery
Australasian Exploration Geoscience Conference
2-5 September 2019 • Perth, Western Australia
Incorporating the AIG, ASEG, PESA, and WABS

Extending the envelope of LWD acoustic measurements; Reliable LWD acoustic data acquisition in shallow, unconsolidated formations and large borehole sections

Jitesh Vij
Schlumberger
Mumbai, India
jvij@slb.com

J. Dolan
Schlumberger
Perth, Australia
JDolan2@slb.com

Y. Wang
Schlumberger
Perth, Australia
YWang4@slb.com

SUMMARY

Logging-while-drilling (LWD) is the preferred logging method in large boreholes and shallow unconsolidated formations, as the borehole condition in such formations deteriorates soon after drilling, and wireline data is thus adversely affected. This paper demonstrates the high-quality results of the latest generation of LWD sonic tool, in shallow, unconsolidated formations and large borehole size. The results enabled accurate wellbore analysis computation and prevented drilling problems while also delivering high quality data at high rates of penetration (ROP). Comparison with wireline results further clarifies the situation.

Key words: LWD, Sonic, Wireline, Drilling, ROP

INTRODUCTION

Acquiring quality shear measurement is important, especially in the shallow unconsolidated formations, to do proper geomechanics study and ensure that hole condition is good. However, in such formation, wireline measurements are difficult to acquire as the borehole is already washed out. LWD is the alternative, and in fact it helps to do geomechanics in real time, thereby adjusting mud weights and taking corrective decisions while drilling.

At the same time, acquiring LWD quality shear in such boreholes is not easy and this paper demonstrates what made it possible for the latest generation tool to do this and also presents the results.

METHOD AND RESULTS

The major challenge with acquiring robust LWD quadrupole shear in unconsolidated formations and larger boreholes is the poor signal to noise ratio (SNR) owing to a weakly excited formation quadrupole mode, attenuation and high noise. By utilizing a strong quadrupole source, modifying the tool design and incorporating smart noise reduction methods it is now possible to enhance the SNR. This enables capturing high-quality shear in large boreholes.

In a field in the Northern Australian basin, the upper formations consisted of soft, unconsolidated sediments, while deeper zones pose drilling challenges due to reactive shale, circulation losses, and stick/slip. In previous wells, these attributes led to a high risk of wellbore instability, bottom hole assembly damage, stuck pipe, and more. To improve drilling operations, further explore the field's development potential, and aid key decision making, an operator planned to drill and evaluate an appraisal well. With limited evaluation data from the formations in the upper sections, the operator wanted high-quality LWD acoustic measurements that would reduce uncertainty and mitigate operational risk.

Despite drilling challenges, the operator achieved an ROP of up to 245 m/h while drilling the 16-in section and acquired accurate, reliable compressional and shear acoustic data – even in the unconsolidated upper section where severe washouts prevented quality logging data acquisition from wireline-conveyed measurement tools.

In this well a high-quality robust shear slowness was acquired in these unconsolidated formations and with the very high ROP. A strong formation flexural quadrupole mode was recorded with minimal noise, yielding a strong signal-to-noise ratio, which enabled accurate determination of the shear slowness. This enabled continuous shear slowness through the section.

CONCLUSIONS

Both LWD acoustic measurements provided a robust comparison with wireline-conveyed data and were superior in zones of damaged wellbore. The operator used these numbers to understand the limitations of the borehole geomechanics, ensuring optimal well path designs for future development wells and improving the project economics. This paper will present the results of this case study and demonstrate the value that LWD can deliver in these conditions