The Jurassic Cretaceous Boundary in West Central Alberta

An example of the use or misuse of drill cuttings mineralogy for delineating hiatal surfaces in the subsurface rock record!

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Introduction

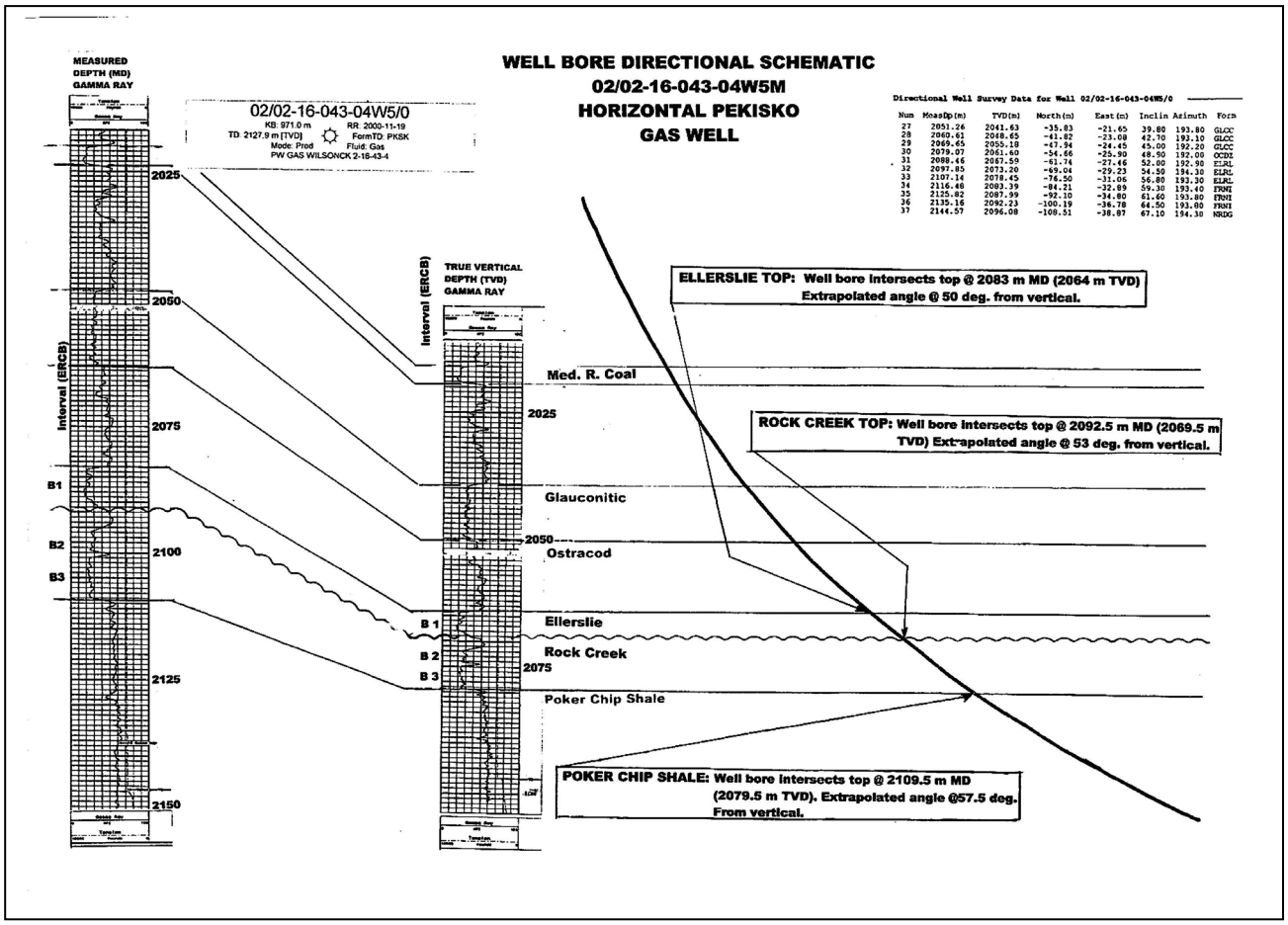
Historically, drill-cuttings samples have played a major role in delineating subsurface stratigraphy in the WCSB, especially by validating the correlation of stratigraphic units and reservoir intervals using well-log signatures. Drill cuttings are very important for identifying very thick lithostratigraphic units and the presence of reservoir zones. However, when it comes to detecting thin litho-units and significant breaks (hiatal surfaces, hardgrounds, etc.), in particular the stratigraphic position of such breaks, drill cuttings must be used with caution because of the interpreted resolution that 2.5 m and 5 m sampling intervals provide.

In spite of this resolution problem, major age-determinative decisions (with significant economic consequences) have been rendered, primarily on the basis of mineralogical (petrography and XRD) analyses of 5 meter sample intervals. A prime example is the latest ERCB decision 2009-050 on placement of the Jurassic/Cretaceous boundary at Wilson Creek. In this decision the presence of a single phosphate grain in a 5 meter sample interval from the ‘build section’ of a deviated well bore (02/02-16-043-04W5), was considered to be diagnostic in positioning the Jurassic/ Cretaceous boundary in the adjacent twinned vertical well bore (00/02-16-043-04W5). Basing major decisions on this type of criterion is tenuous at best. Clearly, rock chips collected over an interval of several meters cannot be used to position a specific surface on a corresponding ‘vertical’ geophysical well log.

ERCB Decision 2009-050

Over the years, disputes between companies have arisen regarding determination of the Jurassic-Cretaceous boundary in productive gas pools in west central Alberta. ERCB decisions have been rendered based on a combination of disciplines including palynology, petrography, trace fossil interpretation, and sedimentological studies with geophysical log correlations. But the most important criterion for determining a Jurassic age has been the presence of phosphate grains in petrographically analysed core samples.

In the most recent ERCB decision (2009-050), Cretaceous-Jurassic zone designation hinged largely on the petrographic identification of a singular phosphate grain in drill-cuttings samples from the horizontal well, 02/02-16-043-04W5. The wireline gamma log (MD), of the horizontal well indicates two sandstone intervals occurring between ~2083 to 2091 meters (net 8 meters of sand) and ~2096 to 2100 meters (net 4 meters of sand). The wellbore schematic diagram illustrates that the wellbore trajectory in a horizontal well, when travelling from “heel” to “toe” is greater than the distance that would be travelled in comparison to a vertical well within the same stratigraphic interval thickness.

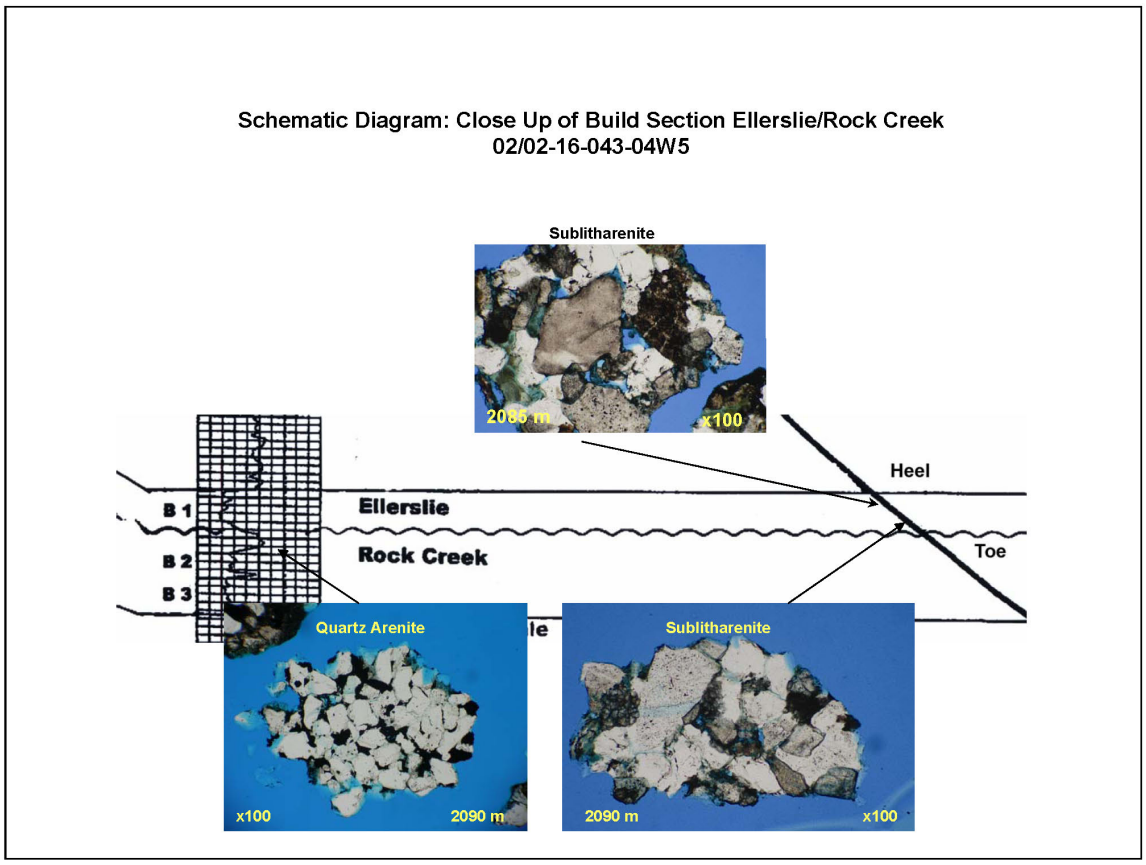


A greater number of drill chip sample vials would be collected simply reflecting the greater distance that the wellbore would be travelling through the units. The drill chip vials would be labeled at drilled depth which is assumed to correspond to measured depths (MD). The Kick Off Point (KOP) to start to build angle (Build Section) going through the Ellerslie/Rock Creek strata ranged from a 50 to 57 degree angle.

It is critical to keep this in mind when choosing representative samples from a horizontally drilled well (02/02-16-043-04W5). The lower Mannville would be represented in a greater number of drill chip vials. The schematic diagram illustrating a close up segment of the build section shows that porous sandstones (sublitharenites) are recognized from the heel of the wellbore trajectory to the toe.

Upon review of the drill chips and thin section analysis recovered from the horizontal well 02/02-16-043-04W5) at Vial Depth 2090 meters, two distinct sand lithologies are present. One is a porous good reservoir quality, fine grained, moderately sorted lithic sandstones and the other is a fine grained well sorted quartz arenite.

Since drill cutting vials represent five meter intervals drill-chip observation and thin-section analysis confirmed the prevailing presence of lithic sandstones in overlying Vial 2085 meters. Quartz arenites were absent in both Vials 2085 and 2080 meters. Binocular drill chip observation and thin section analysis confirmed the lithic sandstones (sublitharenites) present in Vial 2090 meters corresponded to the upper B1 sand “interval” with wireline gamma log signature at ~2083 to 2091 meters. Drill cuttings within 2090 meters represent the “toe” of the wellbore trajectory within the build section. Both the lower portion of the B1 sand unit and the upper portion of the B2 unit are represented in Vial 2090 meters. Cutting and petrographic analysis of drill chips recovered at 2095 meters confirmed the presence of quartz arenites. Therefore the quartz arenites, that contain one phosphate sand grain, that were present at 2090 meters correspond to the lower B2 “sand” kick with wireline gamma log sandstone interval ~2096 to 2100 meters. The fact that the quartz arenite lithology is significantly different from the overlying sublitharenites indicates a Jurassic sediment in the B2 interval.



Re-sampling of drill cuttings recovered in Vials labeled 2095 to 2110 meters from vertical well bore 00/06-21-043-04W5 illustrates sublitharenites were encountered in these intervals. They are compositionally and texturally similar to B1 sandstones recovered at 02/02-16-043-04W5. No phosphate grains were encountered in any of the thin-section grain mounts at 00/06-21-043-04W5.

Conclusions

There can be a high degree of confidence that drill cuttings can represent proper intervals when correctly correlated to the wireline logs. The high degree of confidence relies on the premise that representative drill chip selection was conducted. Choosing representative samples from the vials is critical, and one must remember that the lag time may be off and the depth indicated on the vials

should be adjusted to correspond to downhole (true vertical) depth. The petrographic analysis demonstrates that Cretaceous sands exist above and within the 2090 meter interval at 02/02-16-043-04W5.

Acknowledgements

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References

ERCB Decision 2009-050