

Fracture characterization of Devonian carbonates in northern AB, using image logs and core data

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Summary

This paper discusses fracture characterization and porosity estimates using data from multiple wells with image logs and cores, for water disposal in carbonates. Two main fracture intervals were identified within Keg River and Waterways Formations, dominated by partially open, non-systematic fractures. The borehole image and cores show that the Keg River Formation contains substantial porosity heterogeneity, due to the presence of natural fractures and vugs. Vugular porosity estimated from image logs is 2% within certain discrete depth intervals. In contrast, the Waterways Formation has an overall low fracture density and can act as confining unit for disposal in the Keg River carbonates.

Theory / Method / Workflow

Image logs and cores have been collected in 10 wells over the area of Imperial Oil (IOL) Aspen lease, in Athabasca region (AB). The aim of collecting the data was to characterize fractures and porosity systems in carbonate formations to assess suitable zones for future disposal and storage. Another aim of the study was to examine if fractures in the Waterways Formation, which has sealing properties for fluids disposal, exhibit regional systematic trends, or if fractures are localized and random.

The image processing and core description was performed by Schlumberger, Canada. The workflow employed for image processing, porosity computation and fracture characterization, is shown in Figure 1.

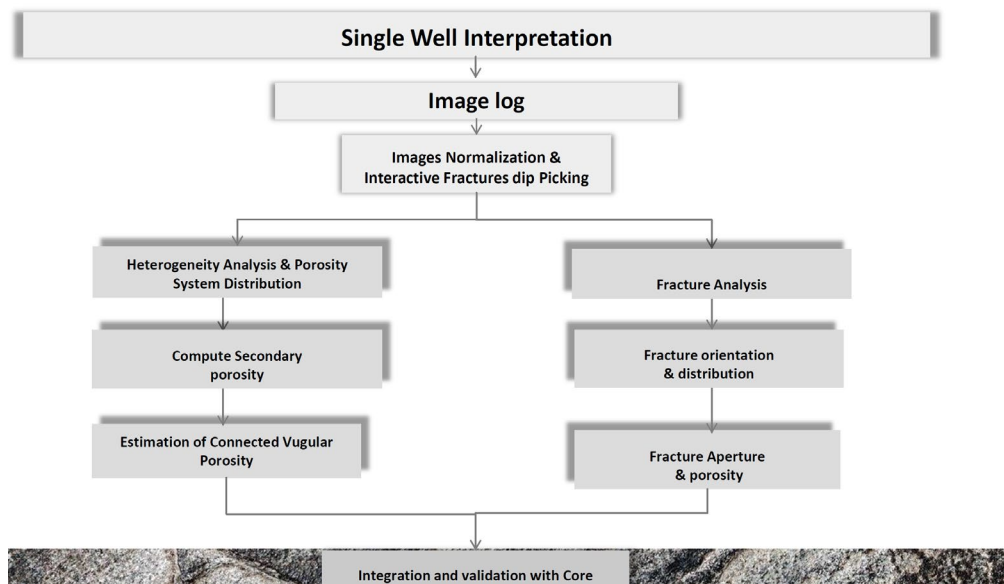


Figure 1 – Interpretation workflow for structural and sedimentological information extraction (From SLB workflow)

Results, Observations, Conclusions

The image logs acquired in the 10 wells are of high quality and display good correlation between the image logs interpretation and core characterization and description. Figure 2 and 3 show examples of high correlation between the image log and core data. Single well and multi-well image interpretation have shown that the fractures are mostly occurring in discrete intervals (clusters) with random strike distributions. Higher fracture apertures have been noted in zones with higher fracture densities. There has been observed the presence of vugular zones, both in the cores and image logs, which increase the formation porosity and storage capacity. The study did not reveal any correlation between vugular porosity and fracture density. In general, the upper intervals of each unit are more fractured than the rest of the unit, with the most fractured unit being the Keg River Formation. The fracture analysis shows that the Keg River is most suitable for disposal and storage in the study area. In addition, the present study shows that the overlying Waterways Formation has a low fracture density and lacks any vugs in the image logs or cores, hence being described as an excellent confining unit for fluid disposal.

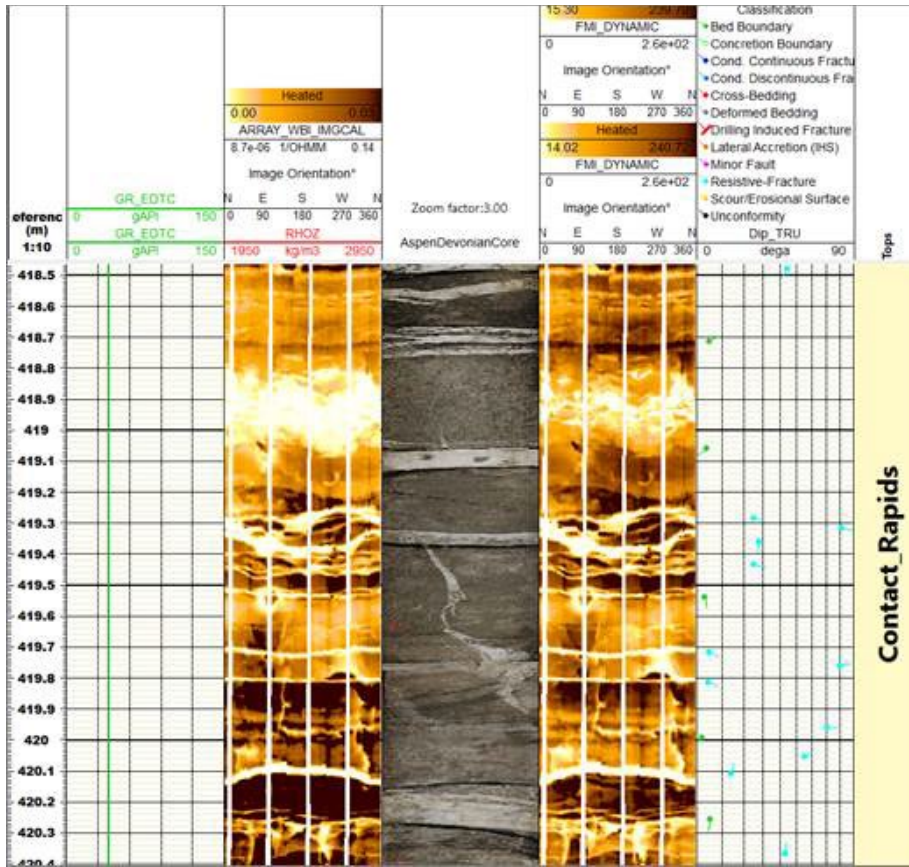


Figure 2 – Healed fractures from image logs and cores in Contact Rapids Formation

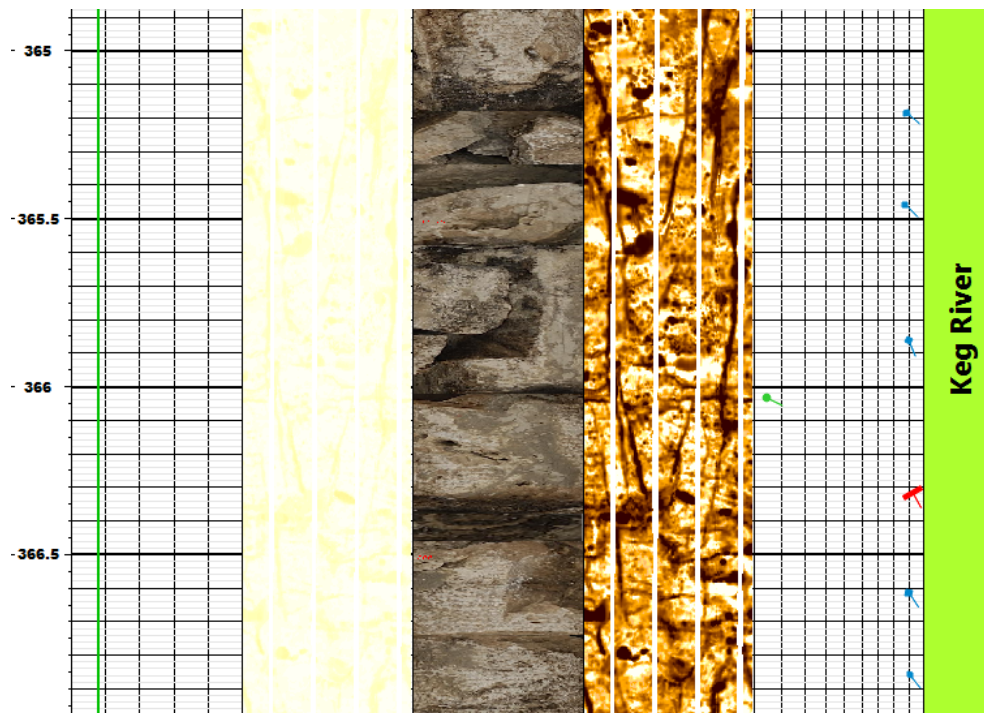


Figure 3 – Vuggy facies from image logs and cores in Keg River Formation

Novel/Additive Information

This paper presents results from borehole image logs calibrated with core descriptions, which demonstrate that the Keg River Formation is a suitable unit for fluids disposal, due to high fracture density and high porosity. In addition, the present study shows low fracture density in the overlying Waterways Formation. The results of this work can be used for future reservoir and geomechanical models as the image logs interpretation is correlated with the core descriptions for consistency. This methodology can also be used for CO₂ disposal reservoir assessment in deeper carbonate formations.

Acknowledgements

References

Andjelkovic et al., Geoconvention 2018, Evaluating storage and flow capacity on Devonian carbonates using image logs secondary porosity assessments.