Clearwater Formation Natural Fracture Characterization from Cores and Image Logs, Athabasca Oil Sands, Alberta

Queena Chou
Weatherford, Calgary, Alberta
queena.chou@ca.weatherford.com

This presentation details the procedure involved in the collection and processing of natural fracture data and the assessment of these fractures in the Clearwater Formation caprock.

Introduction

The caprock of interest is comprised of the Clearwater Formation, including the Wabiskaw member, overlying the productive McMurray Formation oil sands. The caprock predominantly consists of mudstones with interspersed silt and sand intervals, and averages a total package thickness of 50 meters. There are sedimentary and petrologic differences between the Clearwater units above and the underlying Wabiskaw units. Seventeen boreholes penetrating the caprock interval were available for study. Continuous coring into PVC sleeves was employed to capture this interval. In most wells, both resistivity-based and acoustic imaging logs were available over the same intervals as core. Core logging was performed on selected core intervals and analysis was performed on the accompanying borehole image logs. Observed natural fractures were documented and the results were analyzed statistically.

Procedure

The procedure for natural fracture data amalgamation was developed to ensure that redundant information from multiple sources within a single borehole were distilled down into a single dataset without duplication of the same fracture information observed from multiple data sources. This combination yielded a more reliable assessment of fracture origin and character. For example, both acoustic logs and core confirm that the majority of fractures which appear resistive (closed) on the resistivity-based image logs are in fact NOT mineralized.

Using identifiable markers, i.e., siltstone sections and sand lenses, natural fracture core depths were adjusted to log depths. During core logging, by using a natural fracture's characteristics, i.e., dip, relative orientation, trace length, etc., the observed natural fracture was matched to the same natural fracture observed in borehole image log.

Example

Figure 1 (below) shows the developed procedure for combining observed natural fractures in borehole image log and core of the same Clearwater Formation interval.

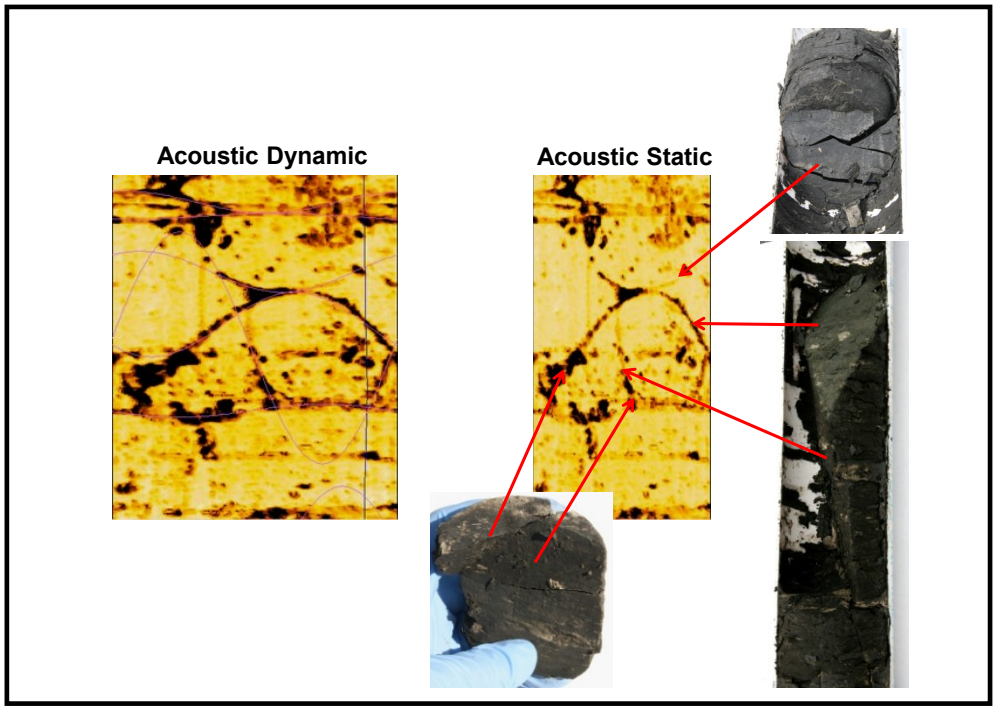

Figure 1: Matching up natural fractures observed in acoustic borehole image log and core, Clearwater Formation.

Conclusions

Documented natural fractures display preferential populations on a borehole scale. On a field scale, fracture populations are variable among the boreholes investigated. The combination of core and image log data results indicates that anything less than having both core and borehole image log is unlikely to yield a complete picture of natural fracture existence in the vicinity of a borehole. Core and at least one type of image log are necessary.

Acknowledgement

The authors wish to extend their appreciation to the management of the operating company and Weatherford Canada Partnership for the permission and for providing the means to submit this abstract.

Reference

Terzaghi, R. D., 1955, Sources of error in joint surveys: Geotechnique, **15**, 287-304.