

Permeability trends within sandstones, conglomerates, and mud laminated sandstones of the Viking Formation, Joffre Field, Central Alberta

Blair Cann, Department of Geoscience, University of Calgary, 2500 University Drive, Calgary, AB T2N 1N4

b_cann21@yahoo.com

and

Rudi Meyer, Department of Geoscience, University of Calgary, 2500 University Drive, Calgary, AB T2N 1N4

Summary

Extensive measurements of horizontal (kh) and vertical (kv) permeability on subsurface cores in the Western Canada Sedimentary Basin make-up an ideal database to address the influence of a variety of depositional and/or diagenetic parameters on permeability anisotropy of given rock units.

Introduction

This study aims to define, describe and compare permeability trends within the shallow marine successions of the Viking sandstone in the area of Joffre Field. Seventeen(17) wells with kh and kv data were selected in this area based on the availability of broadly different lithologies (e.g. conglomerate, sandstone, and mud-laminated sandstone) that are thought to reflect the relative influence of bedding, lamination and bioturbation on trends in kv and kh and the resulting anisotropy represented by the kv/kh ratio.

Theory and/or Method

The core samples studied come from depths of 1406 to 1616 metres MD, range in length from 6 to ~35 cm and display permeabilities between 0.01 and 5790 mD. Values of kh, kv and kv/kh are classified with respect to three(3) lithologies, defined simply as sandstone with mud laminae, sandstone, and conglomerate. Further distinction is made between bioturbated and non-bioturbated samples, and an attempt is made to test permeability magnitudes versus relative intensity of bioturbation. Although overlapping characteristics among the resulting group of lithofacies is apparent, a relatively simple subdivision is deemed necessary to highlight 1st order trends in the permeability data. Histograms are the main graphic tool used to analyze lithofacies-specific trends in kh, kv and kv/kh.

Conclusions

The following results are highlighted: *i)* A significant proportion of cross-bedded/laminated, unbioturbated sandstones and conglomerates have kv/kh ratios >1, 3% and 13%, respectively; *ii)* The effect of bioturbation on the kv/kh of all three lithologies is drastic with 46% and 48% of kv/kh >1 in bioturbated sandstones and conglomerates, respectively, and; *iii)* Average kv/kh is increased by bioturbation as is the homogeneity of given permeability distributions. The results are very important for the consideration of horizontal wells and method of fracturing; and, similar to previously reported

effects of bioturbation, they do not support the common use of low kv/kh ratios in reservoir modelling studies. As a corollary, considering the nearly syndepositional origin of bioturbation, kv/kh ratios observed at depth may be minima, and any burial models of similar sediments should take into account the rates of kv and kh reduction with depth as a function of diagenetic processes. Extension of these results to samples at different burial depths is in-progress.

Acknowledgements

Many thanks to geoLOGIC systems ltd. for the many free training courses on their geoScout program, and thanks to the ERCB Core Research Centre for donating the hours spent on the core tables in their core lab in North West Calgary.