A Refined Approach to Subsurface Structural Mapping for the Alberta Basin Using Well Log Data, Trend Surface Analysis and Geostatistics

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Abstract

In general, the conventional approach for structure study in the WCSB uses aeromagnetic and gravity data for detecting the basement structures, and geophysical well log data (combined with seismic data when available) for interpreting the sedimentary cover structures. With respect to well log data, the main approach is to interpret faults from isopach and structure top contour maps. However, the conventional isopach and especially structure top contour maps are usually dominated by a regional trend, and this trend can mask local structure and faults that cause only minor offset (e.g., a few metres). Variations at such a metre-scale usually show as subtle irregularities in contour lines and, thus, are difficult to interpret. The present study has developed a refined approach to detecting faults with small offsets using formation picks data, based on one of the oldest mathematical techniques, known as trend surface analysis. It goes one step beyond the conventional approach by incorporating advanced geostatistics for modeling residuals and extracting formation top offset pattern information that could be caused by faults from modelled residual surfaces. A case study on structure mapping for the Peace River Arch region demonstrates that the refined approach is superior to the the conventional isopach and structure top contour interpretation, conventional seismic cross section and high resolution aeromagnetic approaches by a higher resolution and accuracy. The refined approach allows mining information on local subsurface structures that is hidden in the well log data, which have been accumulated through years of oil/gas exploration and geological study.