geoconvention
Virtual Event
September 21-23
2020
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Multidisciplinary integration to reveal compartments and leaking zones in the Montney by combining gas chromatography coherency indexes and cuttings compositions

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Abstract

Reservoir compartments have been identified in Montney horizontal wells of the B.C. field using a 3-D visualization of reservoir pressures from DFIT analyses. A follow-up work showed that sudden jumps of the butane isomer ratio (iC4/nC4) helped corroborate the existence of some of these faults and localize them more precisely. Additionally, the presence or abnormally high concentration of specific minerals such as sphalerite, barite and ferroan dolomite in the cuttings further supports this interpretation and suggests hydrothermal activity associated with at least some of the faults.

As estimating the mineralogy of each cutting vial for every well would be too costly, the recent focus has been to look at fractionation of the gases reported by gas chromatography that can be done real-time. The new approach is based on quantifying the coherency of light alkanes C1 to C5 with respect to each other, by computing the Pearson correlation coefficient from Pixler ratio plots. Lower values of this newly defined coherency index called Coh_all indicate a deviation from a normal linear trend and thus molecular fractionation of the gas (Fig.1). This index is complemented by two additional indexes by filtering out respectively C2 (Coh_C2F) and C5 (Coh_C5F) from the regression. Visualizing the variations of these coherency indexes along laterals provide a powerful tool to identify gas molecular fractionations associated with discontinuities such as faults. Furthermore, comparing those different coherency indexes with each other helps interpreting the controls on fractionation, such as for instance the preferential past escape of light gas on only one side of the fault (in this case Coh_all < Coh_C2F).

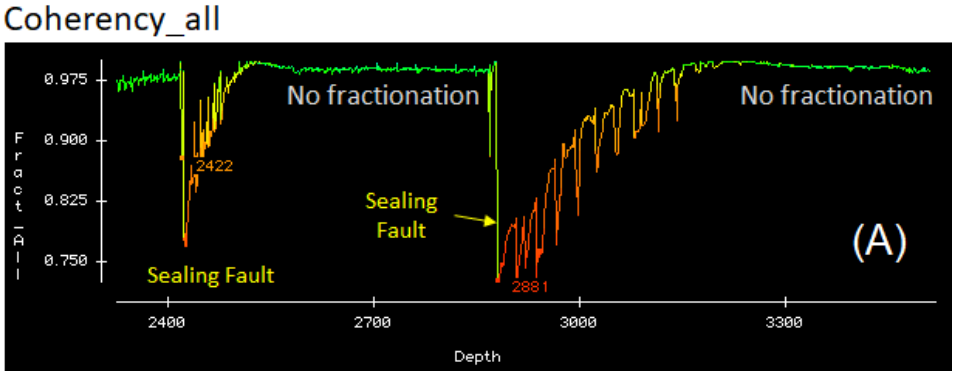

Fig. 1 Gas chromatography composition incoherency pattern indicating two sealing faults with leakage expression south of the faults in Well A, a NW-SE Hz well

Our results clearly confirm that the pressure compartments identified by DFIT are associated with faults. The integration of gas chromatography and cuttings analysis has corroborated the location and the azimuth of the faults proposed by the DFIT 3-D analysis (Fig.2). The next analytical step will be to integrate this interpretation with well stimulation data and identify the potential influence of these faults on individual hydraulic fracturing stages.

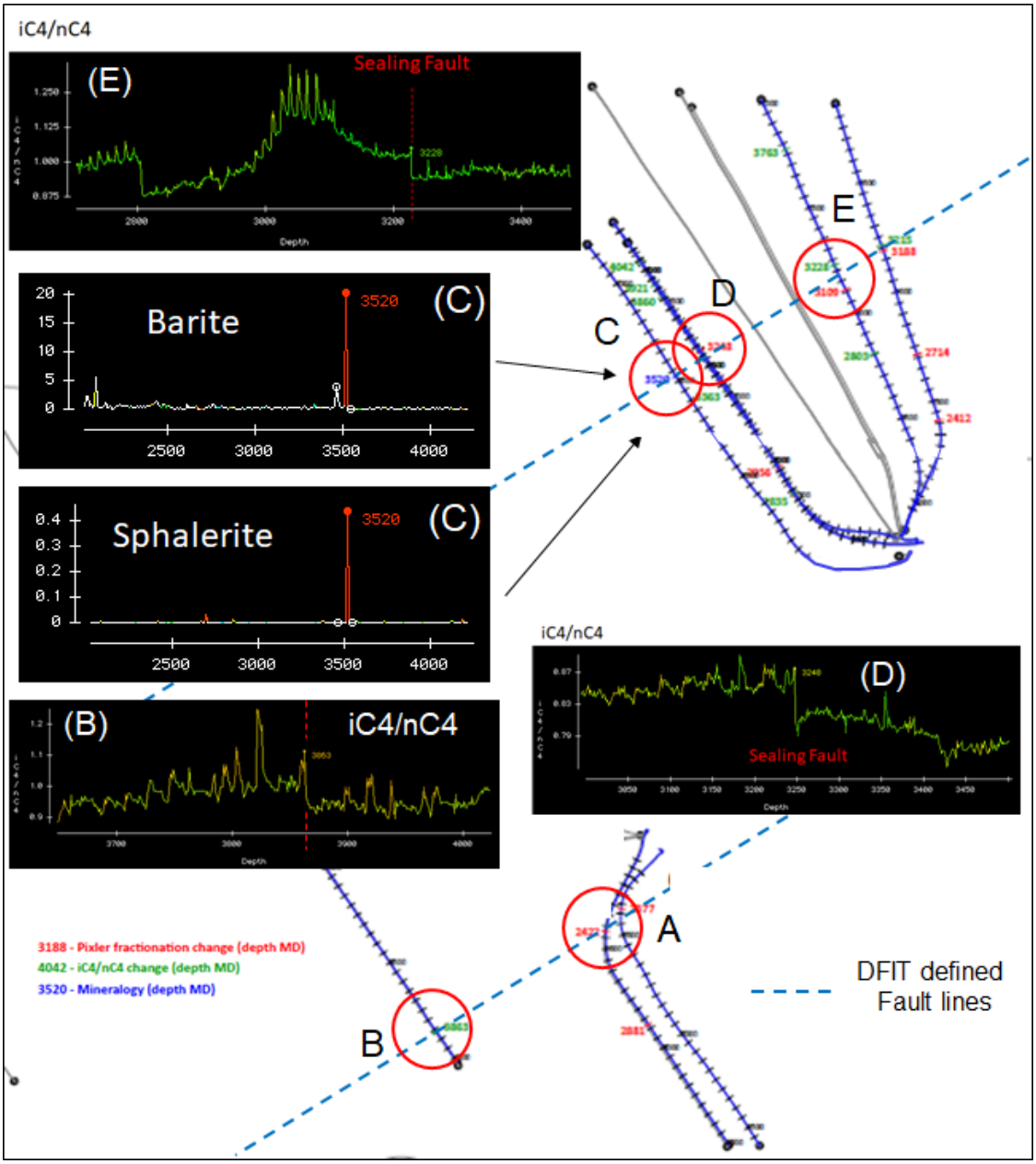

Fig.2 Confirmation of DFIT defined reservoir compartmentalization using gas chromatography and cuttings mineralogy