The Unexpected Should not be Unexplained – Multi-Disciplinary Integration Including Anomalous Data

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Summary

Subsurface data in tectonically complex areas is commonly a challenge to interpret. That is particularly true in large fields where depletion and secondary pressure maintenance mechanisms are in place. Making use of all of the data available is often attempted but frequently some data is discarded for various reasons. A series of examples from the eastern Venezuela thrust belt will focus on how to deal with anomalous, rejected data of various kinds: rock data (porosity), fluid data (API gravity) and pressure data (RFT).

In the Santa Barbara field there was no porosity-depth trend when using averages per sand unit for all 150 wells (log derived porosity calibrated with numerous cores). The display on a map of porosity depth trend per well shows domains of similar patterns (Fig.1) that are related to large scale folding and bed parallel slip post hydrocarbon emplacement. Similarly, patterns of abnormally low RFT pressures helped identify inverted series later confirmed by stratigraphy and log analysis (Fig.2).

Combining many wells with anomalous fluid characteristics led to a better understanding of the compartmentalization in Santa Barbara; it also led to the recognition of large thrusts (post hydrocarbon emplacement) in the Carito field (Fig.3). Block tilting making TVT>TST is responsible for the change in gradient (API versus depth).

A major horizontal detachment was identified using previously discarded pressure data from many wells. Subsequent work led to the discovery of a large hydrocarbon-filled klippe that glided above the detachment outlined by reservoir engineering data (Fig.4)..

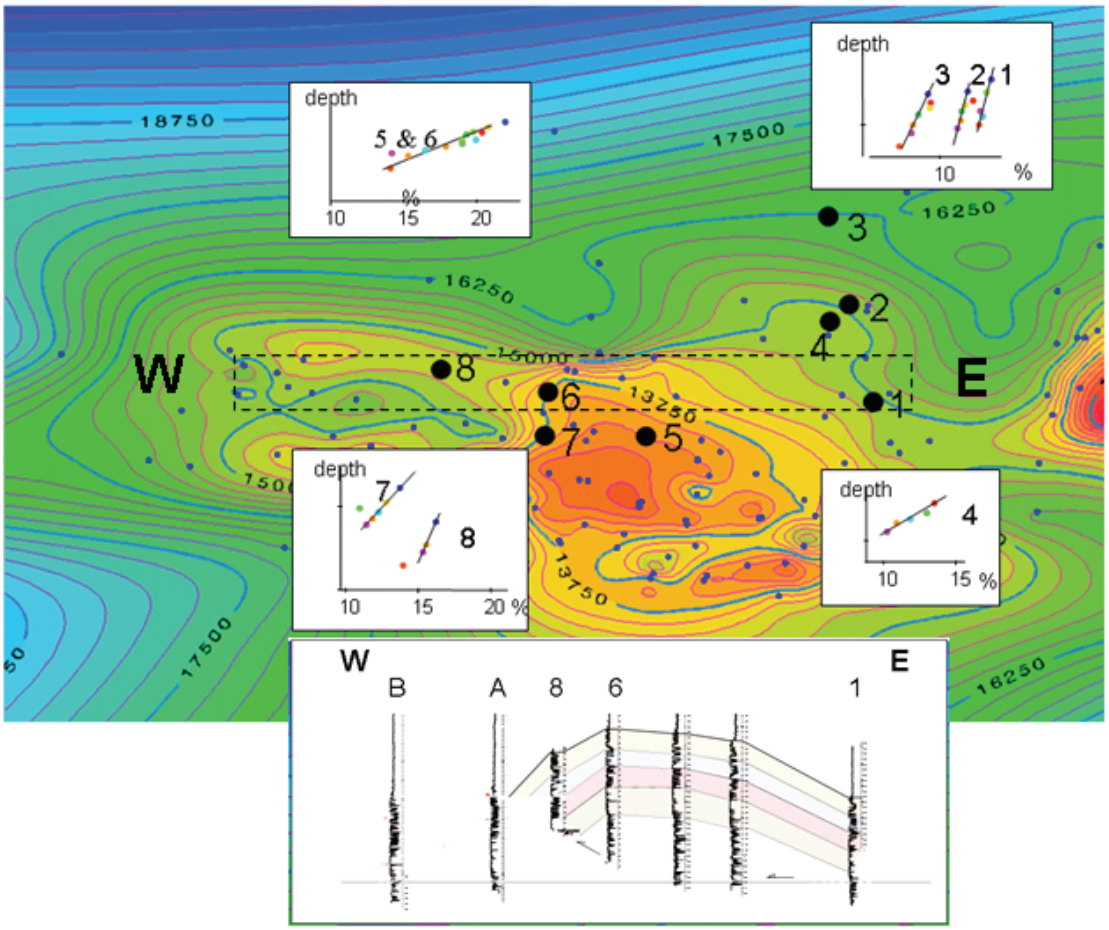


Figure 1: Various domains of porosity-depth trend in the Santa Barbara field

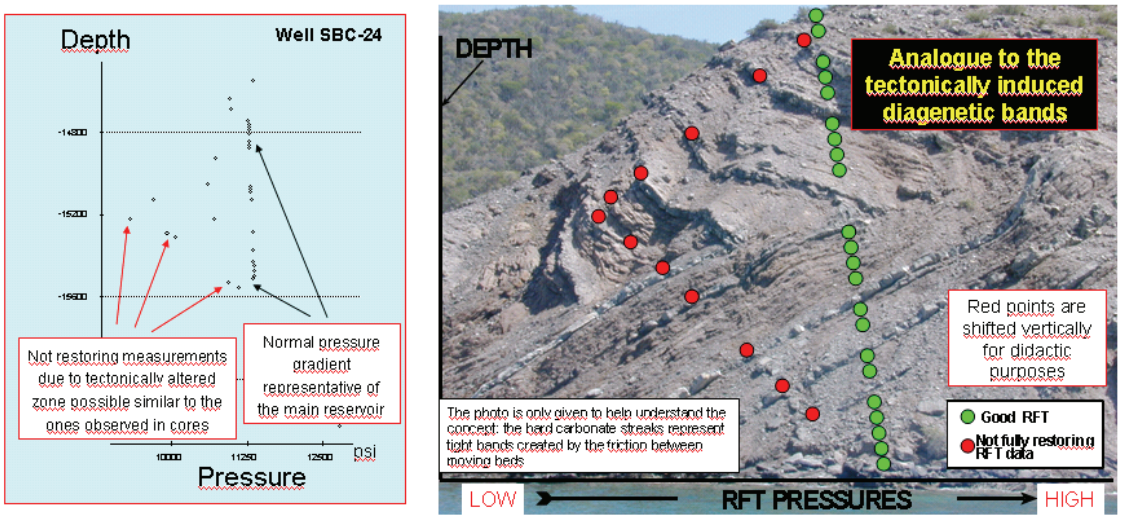


Figure 2: Abnormal RFT data indicating inverted series with outcrop analogue

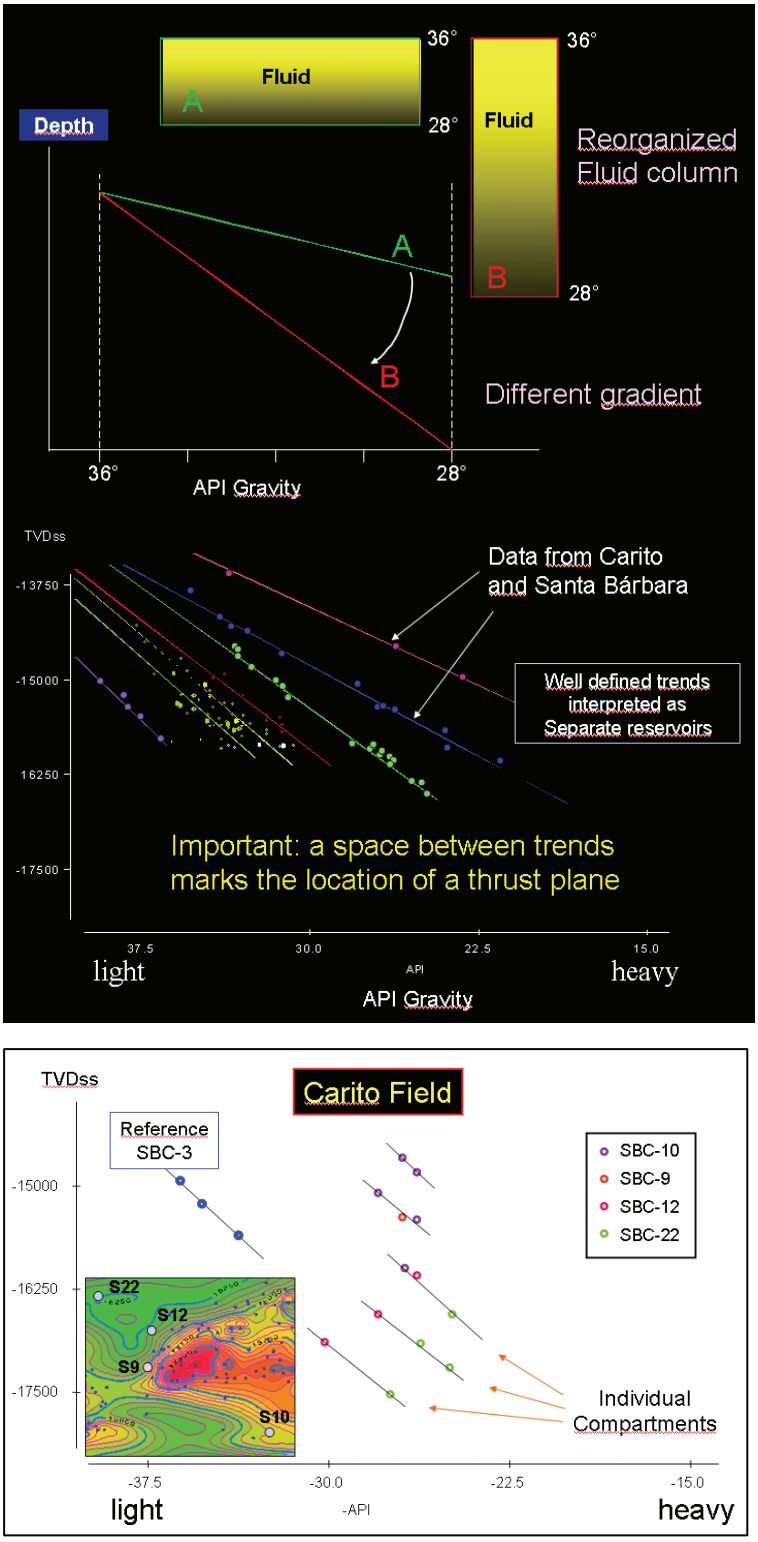
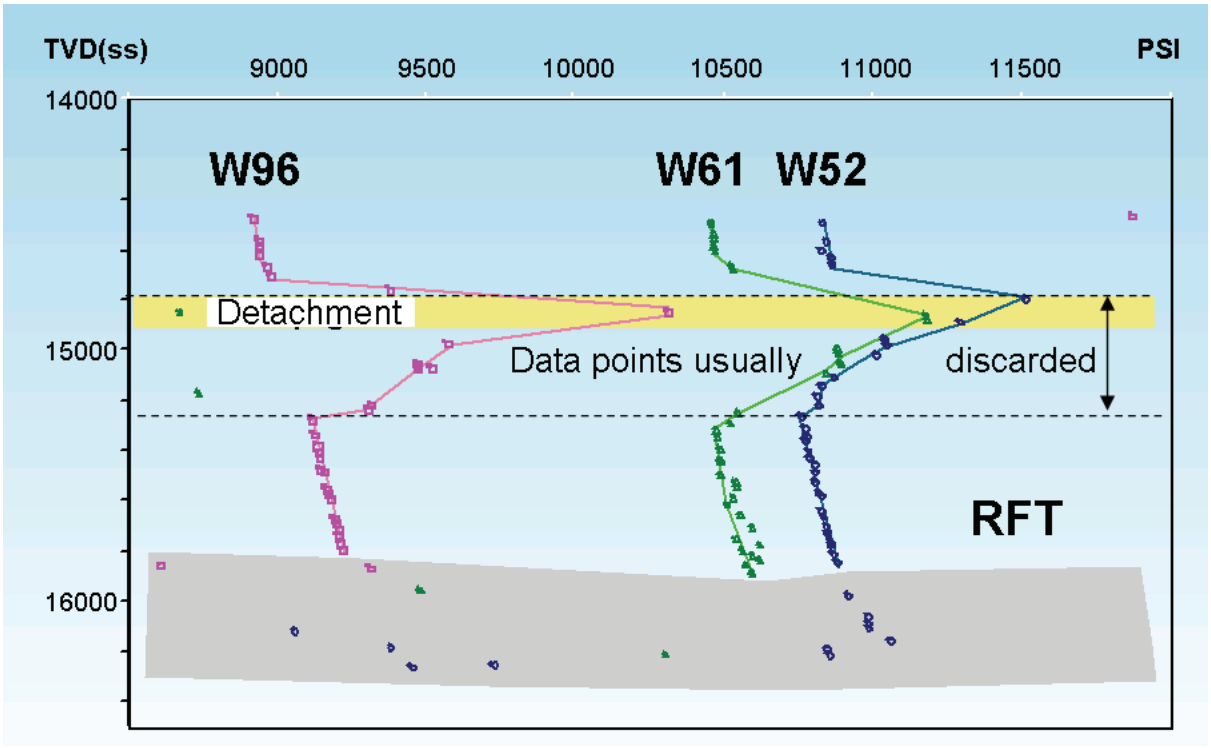


Figure 3: Identification of thrust sheets using a multi-well approach and API gravity



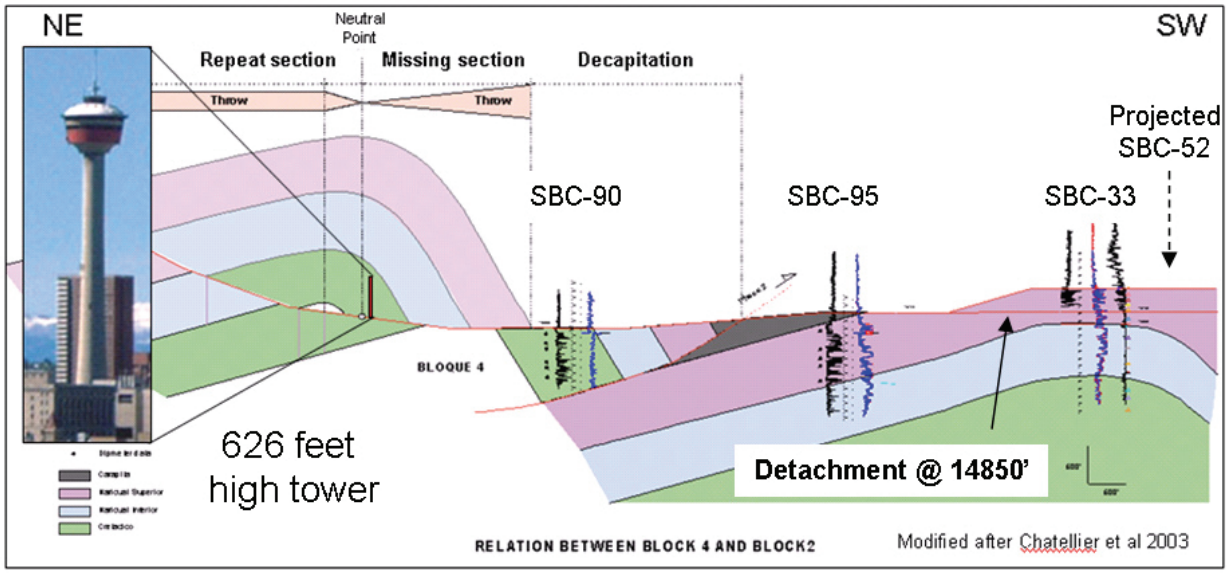


Figure 4: Detachment plane outlined by abnormally high RFT pressures and associated large structure displaced along that plane