Challenging the Paradigm "Missing Section - Normal Fault" - Implications for Hydrocarbon Exploration

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In structurally complex areas, seismic interpretation can be misled by wrongly interpreted well data. A common approach in the oil industry can be summarized by the Spanish sentence “pozo mata sismica” meaning that data from a well must prevail in a seismic interpretation. A major problem arises when well-based interpretation is taken as data; a missing section is the observation, calling it a normal fault is an interpretation. A series of examples will show, in various structural settings, numerous cases of missing sections that cannot be attributed to normal faulting. All field names in the text are from Venezuela if not otherwise specified.

The easiest recognizable misinterpretation occurs where wells have missing sections juxtaposed to wells with coeval massive sands; with enough well control additional support comes from recognizing the typical rhomboidal shaped blocks e.g. Dunlin Field - UK. Synsedimentary activity of horst blocks in the middle of major deposition centers (e.g. Brent delta) is responsible for such occurrences.

Many tools either alone or combined, can be used to diagnose problematic missing sections e.g. hydrocarbon column anomalies associated with fault plane mapping, abnormal RFT pressure trends, detailed fault throw map or perfectly identical TVDss depths of fault cuts in different stratigraphic units.

Unusual approaches can also be successful at recognizing misinterpreted normal faults as in the Lama Field: the TDs of every well that failed to reach their targeted depths were analyzed by plotting their coordinates in 3-D. This revealed the existence of three previously unrecognized steeply dipping reverse faults that only one third of the wells had been able to penetrate; each of the latter showed missing sections where crossing these faults.

While 3-D seismic is the norm, 2-D lines can be invaluable in better defining the tectonic style of very complex areas. Large amount of hydrocarbon can be present below faults which have been obliquely reactivated and which appear at first glance to have the geometry of normal faults (e.g. Western Canada Foothills).

Implications for the examples cited above range from redesign of water injection wells for pressure support (Lama Field), to major bypassed pay zone (Santa Barbara Field), change in reserve estimates (Dunlin) and finally to a new hydrocarbon discovery (near Bosque Field).