HYDRODYNAMIC ANALYSIS IN FAULTED STRATA - IMPLICATIONS TO FAULT SEAL.

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The discontinuities in hydraulic parameters presented by faults in the subsurface can be both due to the juxtaposition of variable lithologies and the rock properties of the fault zone itself. While the overall tectonic regime and host rock rheology sets the stage for predominant structural styles, variations in fault geometry allows for a complete range of stress conditions at various positions along any fault. In the fourth dimension of time, stress conditions are transient and mass transport can alter rock properties through diagenetic modification of both the host rocks and fault zone itself.

Hydrodynamic techniques supported by pressure, geochemical, and geothermal data can be used to estimate the capacity of faults and fault zones to trap hydrocarbons and evaluate present day transmissivity. Numerous case studies serve as analogies to various tectonostratigraphic settings and define what the hydrodynamic signatures are that represent those parameters. We present some examples of these from various sedimentary basins in the world representing foreland, passive margin and rift scenarios from Western Canada, Australia and France.

When the hydraulic behavior of faults is important at the time either of hydrocarbon migration or during a post trapping reactivation event, the prospect of defining the hydraulic characteristics of faults and their impact on the fluid flow and hydrocarbon migration requires more sophisticated approaches as the uncertainty in interpretation increases. This can be mitigated through the incorporation of other key parameters to restrict the domain of possible solutions. Techniques that can fill this role include reconstructing the basin thermal history through fluid inclusion and thermal indicator approaches, defining paleo oil columns through techniques such as GOI™, reconstructing structural geometry and defining the paleo-stress characteristics along a fault trace.

This paper will discuss the status of on-going research in these areas concentrating on how paleo-hydrodynamics can contribute to a holistic characterization of fault zone attributes and how better predictions of fault zone hydraulic parameters can be incorporated into numerical flow and mass transport models.