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Episodic Tectonic Control of the Petroleum System of La Concepcion Field, Maracaibo Basin, Venezuela

Post-Cretaceous Caribbean-South America plate interactions have profoundly influenced petroleum systems along this boundary in a complex variety of ways: reservoir-source geometries and litho- and organic facie types, time variant heat flows, strain partitioning, times of maturation, etc. An integrated borehole basin modeling 3D reflection seismic fault mechanical stratigraphic analysis of the Cretaceous-Tertiary rocks of La Concepcion Field of Northwest Maracaibo Basin, provides one window into the cumulative effects of these interactions

Four distinct episodes of subsidence and accompanying fault populations are observed: Phase-One 95-64Ma: post rift thermal subsidence of basement (North American-South-American rifting), Phase-Two 66-56Ma: tectonic subsidence, Phase-Three 58-42Ma: tectonic uplift owing to crustal shortening (collision between Caribbean and South American plates), and Phase-Four 44-32Ma: tectonic subsidence. Strain in the basement and indurated Lower to Middle Cretaceous clastic and carbonate sediments is principally accommodated by brittle deformation (highly fractured faults) whereas in the overlying Tertiary clastics, deformation is both brittle and ductile (positive flower structures). Paleostrain analysis reveals that the latest event, Phase Four, produces the Northeast trending "La Concepcion Fault Zone", a dextral transpressional reactivation of earlier Phases.

The crustal events perturbed the thermal state of the La Luna Formation of 96-83Ma and accelerated its oil maturation to commence at 40Ma. Consequently, those faults which are pre-Phase-Four are principally reservoir creators (fractured carbonates) but seals to lateral migration, whereas Phase Four faults allow significant vertical petroleum migration conduits to overlying clastics reservoir enhancement in the underlying carbonates. Cumulative production from reservoirs within these two principal lithofacies since 1924 is 151MMBbl.