Relationship between Tectonics, Pressure Compartmentalization and Vertical Hydrocarbon Leakage in the Deep Offshore Niger Delta

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Several indicators of oil seeps and other fluid leakages including outlets from sinusoidal palaeochannels, giant pockmarks (± 700m wide, up to 50m deep), mud volcanoes (±2800m wide, several episodes), and gas hydrates (marked by BSR at ±300ms) have been observed on the seabed in the deep offshore Niger Delta. Their classified morphology and proximity to imbricate thrust structures relate to the NE-SW gravitational sliding.

High resolution 3D seismic and well data were used to link the leakage features to active and inactive gravity-tectonic processes from the lower Miocene to the present. Fluid chimneys, leaking turbiditic reservoirs and changing morphology of sedimentary fairways were then highlighted from map and section views and their distributions compared to pressure compartments and structural limits. The present day distribution of pressure is shown by Wireline Formation Tester (WFT) data. Analyses reveal that this is related not only to direct gravity loading, but also to the architecture resulting from horizontal displacement of structural and sedimentary units within the basin. Based on the differences in faulting and folding of each stratigraphic unit, a comprehensive layer-by-layer fluid-pressure dissipation model is suggested to explain the vertical and lateral compartmentalization of overpressure in the deep offshore context.