

## **Hydraulic Top Seal Failure - The Relationship Between High Pore Pressure and Hydrocarbon Preservation in Highly Overpressured Regions**

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In the deep-water block OPL 324, one of a series of anticlines above thrust faults was penetrated by the Petrobras Erinmi-1X well, hydrostatic fluid pressures were found throughout the majority of the Agbada Formation, followed by a sharp pressure transition zone into high overpressures of the Akata pro-delta shales. In the same area, within hanging-wall anticlines, vertical fluid escape structures are reported, sourced from the Akata Formation. In other deep-water areas of the delta, high overpressures and low integrity top seals are believed to be responsible for the formation of mud volcanoes. These observations suggest that hydraulic top-seal failure and fluid leakage may be a key issue for future exploration in the deep-water Niger Delta and that un-drilled reservoirs have a potential to be highly overpressured in the stratigraphically deeper sections of the basin.

Part of any risking strategy for prospects is an assessment of seal breach risk at top reservoir, i.e. when the seal may be breached by high pore fluid pressures causing hydraulic fractures in the top-seal. In this paper, we highlight a methodology that has been developed to analyze hydraulic failure, using data from regional overpressure mapping (in particular water-leg overpressures) in basins around the world. Vital to this methodology is the accurate derivation of fracture pressures, incorporating a pore pressure/stress coupling ratio term (which relates pore fluid pressure to horizontal stress magnitude through poroelastic fluid-stress interaction). In basins such as the Central North Sea and Scotian Shelf, offshore Canada, a relationship can be demonstrated between seal capacity and hydrocarbon preservation. In other areas such as Mid-Norway, Halten Terrace there is no clear relationship between seal capacity and hydrocarbon preservation, either at top reservoir or at shallower levels in the seal. We review the workflows to define seal breach and offer in-sights to de-risk traps.