

Shale Tectonics and its Importance in Hydrocarbon Basin Evolution: A Rather Muddy Subject

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What role does shale tectonics play in forming basins? How and why do subsurface shales move? Can they push strata, or do they simply move as they are squeezed? Can shale diapirs act as traps, similar to salt diapirs?

Shale mobilization (argillokinesis) appears to play an important role in the ongoing evolution of several major hydrocarbon basins in the world and may even be critical to their prospectivity. The southern Gulf of Mexico, Niger offshore, the Caspian Sea, northeastern Venezuela and Trinidad, Indonesia, offshore India, and the Mackenzie Delta of northern Canada are all excellent locations to examine the effects and prospects associated with mobile shale systems. Unlike salt, which will initiate movement and then maintain it under limited impulses, shale requires overpressure to become ductile and may move from ductile to plastic to fluidized and back to ductile several times throughout its active life. Overpressure is typically caused by some combination of burial compaction, diagenesis of clays, kerogen maturation, and compressive tectonics. Shale's tendency toward pulses of inflation and deflation results in dynamic states of erosion, accumulation, and eruption associated with mobile shale features. The active fluid migration necessary to maintain these episodes forms vents for hydrocarbon migration from sometimes deeply buried source rocks to shallower reservoirs and traps, setting up the perfect prospective scenario. Oddly enough, however, numerous cases exist where these conduits have no damaging effect on overlying reservoir seals. Traps associated with shale diapirs include detachment folding, diapir toplap, diapir top drape or rollover rims, radial faults and tilted fault blocks, erosional truncation and associated unconformity traps, lateral mini-anticlines, and downbuilt anticlinal flank trap. We have examined various shale structures and processes of argillokinesis in several basins in the world, and we will discuss their implications for the enormous proliferation of hydrocarbon opportunities in argillokinetic basins of the world.