Healing-Phase, Top-Trapped Fills associated with Mass Transport Complexes: Controls on Turbidite deposition in Chaotic Margin Settings

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ABSTRACT

Mass transport processes and deposits play important roles in the formation and fill of deepwater basins, including, but not limited to, 1. erosion and destruction of older reservoirs, 2. deformation of younger reservoirs and seals through compaction and fluid ejection, 3. creation of extensive, sometimes overpressured, seals for adjacent or underlying reservoirs, and 4. creation of accommodation for healing-phase gravity flow sediment accumulations. These later deposits, here termed healing-phase, top-trapped fills (HPTT) can form significant reservoir volumes in traps whose basal and lateral seals are formed by the underlying mass transport material and whose topseal is formed by the overlying pelagic shales which drape these deposits. Accommodation and fill nature vary within the four deformational domains of the MTC; the extensional, translational, compressional and shearing domains. The extensional domains show commonly strike -elongate distribution of accommodation, and deposition of HPTT fills with high probability of sand, and lower risk of charge with extensional faults intersecting the decollement and, often the associated underlying source rocks. HPTT within the compressional domain are contained in similar strike elongate accommodation sinks. In addition, thrust faults here also rooted in the decollement provide charge pathways, but the often distal nature of compressional-domain accommodation, presents a higher risk to reservoir quality. Translational domains provide the most expansive zone of underfilled accommodation to host post-MTD emplacement turbidites, however the HPTT basal surface rugosity can present several problems in production. HPTT fills within translational regions lack the decollement-attached faulting to charge HPTT reservoirs, presenting an increased risk of migration into these regions. Zones of shearing can occur throughout the zone of MTD development and recent field studies show that large blocks increase internal fracturing in MTDs. Timing of MTD and HPTT deposits must be taken into account, as dewatering processes can increase the risk of topseal breach. Some examples of successful exploration in these settings include the North Slope Alaska Cretaceous, industry documented traps in the Gulf of Mexico and in some areas of the North Sea. However, the extensive nature of mass transport deposits in basins throughout the world suggest much potential exists for future identification of HPTT reservoirs and traps.