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Reservoir-Fairway Distribution and Variability within Evolving Seafloor Topography along Deep-Water Margins with Mobile Substrates

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Deep-water passive margins with mobile substrates (e.g. mobile salt or mud) tend to undergo significant gravity-driven deformation through time. Such deformation, typically expressed as up-dip extension to down-dip contraction is particularly evident in regions where long term sediment delivery to slope and basin takes place. Evolving paleo-seafloor topography (gradients) along margins of this category is modified by several gravity-driven processes:

i) mobile substrate-related, extensional to contractional deformation,
ii) mass transport erosion and deposition (mass transport complexes),
iii) gravity-flow erosion and deposition, and
iv) long-term passive margin outbuilding.

The combined impact of these four variable terrain-modifying mechanisms controls the evolution of seafloor topography and impacts any subsequently arriving gravity flow's development and distribution. Thus, given sand-rich sediment delivery / sandy gravity flows, these four mechanisms control positioning, style and orientation of reservoir units at all scales.

Comparative analysis of evolving lobe-channel-levee complexes within a tectono-stratigraphic framework from the West-African margin shows systematic, and consequently predictable, reservoir distribution and organization. Both regional seafloor gradient (linked to flow run-out distance) and local seafloor topography/gradient control reservoir fairway positioning, architectural style and orientation. However, local fault- and fold-related topography and gradients not only influence the location of major sediment fairways, but detailed reservoir thickness- and facies-distribution varies both spatially and temporally as fault and fold arrays on the slope develop.