

Transverse fluvial sedimentation in forelands: a numerical modelling approach for characterising petroleum reservoirs

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Abstract

Valley fills are important fluvial reservoir elements in producing foreland basins. The architecture, sizes and orientations of these fluvial sandbodies, however, present strong subsurface uncertainties to reservoir geologists. The well-exposed thick-bedded sandy channels and shale wedges of the Pennsylvanian Upper Breathitt Group, Central Appalachian Basin, Kentucky, provides an opportunity to construct a 3D model of the forcing factors for valley fill sedimentation styles in foreland basins. A numerical code and a geophysical software, Petrel, were used in a series of experiments to simulate the major forcing factors (sediment supply, rate of sea-level changes and rate of subsidence) of fluvial sedimentation in forelands. The subsidence rate was empirically calculated from a single-layer decompaction procedure at 40% pre-compaction porosity and 23% average subsurface porosity. Results showed that thicker sediment accumulated toward the orogen, and that sediment bodies thin down progressively away from it as a result of progradation. Varying the subsidence rates requires a simultaneous change in sediment influx from the hinterland for sedimentation style to have any significant preserved impact. Subsidence effectively forced an asymmetrical sedimentation that is tilted toward the orogen. Changes in eustasy revealed a complex environmental conditions where fluvial streams were restricted in advances and in competences to reveal any impact on sedimentation, while an increase in sediment influx resulted in aggradation and progradation farther into the basin. Overall, the impacts of sediment supply and subsidence rates show

predictable fluvial styles whereas varying sea-level changes is less-predictable. These findings provide useful insights into the management of subsurface uncertainties in foreland reservoirs.

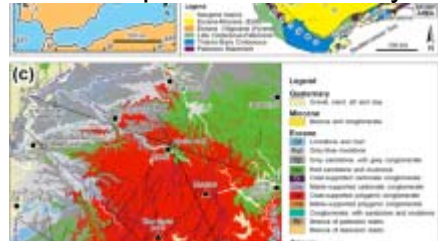
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Conflict of interest

The authors declare that they have no competing interests.

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