

Adopting an Integrated Multidisciplinary Source-to-Sink Approach to Better Understand and Predict Clastic Reservoir Presence and Quality

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ABSTRACT

Integrated source-to-sink analysis encompasses a multitude of parameters (from hinterland character to drainage and sand composition) at scales from plate to pore and investigates the influence of exhumation and climate on the sedimentary system. By temporally coding the often-disparate data types using a proprietary global-sequence stratigraphic model, rapid interrogation and comparison of source-to-sink relationships are possible. The approach can mitigate subsurface risk by enabling more informed predictions of clastic-reservoir occurrence and quality, which is invaluable in frontier areas where data are limited. The analysis begins with a rapid assessment of reservoir intervals obtained from geological and gross depositional maps, regional depth frameworks, chronostratigraphic charts, and play cross-sections. Paleo-elevation models are then constructed from stratigraphic, hard-rock, and geodynamic data, enabling sedimentation pathways and hinterland relief to be visualized. The potential sediment source areas can then be categorized by combining lithological, mineral-deposit, and hard-rock geochronology datasets. Thermochronology data add timing and uplift constraint. The sediments, themselves, can then be compared to the hinterland “fingerprint” using lithological, compositional, and detrital geochronology data. In this way, paleo-drainage pathways interpretation can be critically assessed. Information on the nature of the sink is uncertain in frontier areas; however, the sediment source data can be used to make informed predictions of reservoir character. The final stage uses 1-D basin models to understand the impact of hinterland uplift, changing sedimentation rates and burial within the petroleum system. This paper will demonstrate the integrated source-to-sink approach using a case study from the Sub-Andean trend of northern South America. The trend encompasses a series of linked foreland basins that record the Late Cretaceous and Cenozoic collision of allochthonous Caribbean material with the northwest margin of the South American Plate. Key reservoir horizons were deposited in petroliferous basins from northern Peru to Trinidad as a direct result of inversion during the transition from passive to foreland-basin deposition. This provides constraint for South American–Caribbean plate interactions and allows for predictions to be made regarding reservoir quality, both spatially and temporally.