Challenges in Fluvial Reservoir Geology

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ABSTRACT

The petrophysical characterization of subsurface fluvial reservoir successions is challenging because accumulated deposits comprise a complex mosaic of lithofacies assemblages and architectural elements, the arrangement of which is dictated by multiple interacting autogenic and allogenic processes that operate over a wide range of spatial and temporal scales. The international research community has amassed large datasets from studies of both modern rivers and ancient preserved successions to characterize the geology of many types of fluvial system; such data have the potential to provide analogue constraint to subsurface models. However, an overarching challenge is how to collate these disparate datasets to enable meaningful comparison and thereby constrain and inform models to improve reservoir prediction. To address this issue a relational-database, which collates published data in a standardized form, has been used to compile sets of quantitative information on proportions, geometries, spatial relationships and petrophysical properties of fluvial facies units, architectural elements and depositional elements from >200 case studies. Principal applications include: (i) compilation of quantitative facies models describing the sedimentary characteristics exhibited by specific types of fluvial systems (e.g. braided, coastal plain) and genetic units (e.g. channel-complexes, deltaic distributary channels), with the scope to guide interpretations and predictions, and constrain uncertainty associated with architectural variability; (ii) investigation of the relative roles of climate, tectonics and eustasy in controlling the sedimentary architecture of fluvial systems at multiple spatial and temporal scales, through comparison of different continental successions, whereby observation-based quantitative data are used to critically evaluate deeply entrenched paradigms in fluvial sedimentology and sequence stratigraphy; (iii) quantification of connectivity metrics associated with types of fluvial systems (e.g. meandering, distal fluvial fan) by consideration of the arrangement of reservoir-quality genetic units; (iv) constraint of forward stratigraphic modelling algorithms for modelling fluvial stratigraphy; (v) use of the database to guide and constrain stochastic simulations of fluvial architecture, whereby results can be used to characterize reservoir connectivity for different types of fluvial depositional systems in different tectonic and climatic settings.