How to Interpret Turbidites: The Role of Relative Confinement in Understanding Reservoir Architectures

David Stanbrook[1], Mark Bentley[2], Ed Stephens[3]
[1]Murphy Oil; [2]Heriot-Watt University; [3]TRACS International

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Abstract

Reservoir architecture is key in determining reservoir performance and hydrocarbon productivity but varies greatly in deep-water clastic reservoir systems. The ability to predict reservoir architecture from limited log and core data is therefore of considerable value when architectures are sub-seismic. Predictive architectural interpretations can be made by understanding the relative confinement of turbidity currents from which the reservoir is built. These predictions are made by observing patterns at the core and log scale and correlated through a relative confinement matrix to seismic scale architecture. Variations in relative confinement are expressed through lateral bed continuity; vertical connectivity; amalgamation ratio; net:gross; hemi-pelagics distribution; facies association distribution and uniformity; bed thickness frequency distribution; bioturbation style, diversity and intensity; distribution of sedimentary structures; mineralogical content, variability & textural maturity; grain size and grain size variability etc. A turbidity current is a combination of sediment and water kept in suspension through turbulence that flows down slope. The flow behavior is a combination of the original volume of sediment, density of the flow, gradient of the slope, interaction with substrate and, critically, the ability for flows to expand (sensu Kneller, 1995) - i.e. the degree of confinement to which the flow is subjected by the container through which it is passing. There is a relationship between relative flow confinement of a turbidity current and the depositional style and preserved expression of the flow deposits. The degree of relative confinement is a result of the size of the flow and the size of the

container into which it is flowing and / or depositing. Conceptually we can compare within a matrix a qualitative size of flow with a qualitative container size (Stanbrook et al, 2015). For example the scale of the container may range from small sours to large basins. Similarly, the size of the flows may be vary considerably. The purpose of this matrix is to derive a dimensionless comparison of flows and their container to express a degree of relative confinement. For example, in terms of relative confinement there is much architectural similarity between a low volume flow in a small container and a large volume flow in a large container as each flow will be experiencing a similar degree of confinement. Notionally the expression of the interaction of these two dimensions is described for individual turbidity current deposits, however this can also be translated to the bed-set scale (or larger) in genetically similar units. The careful analysis of the parameters described above allows the prediction of depositional architectures through the understanding of relative confinement, making the often-opaque interpretation of deep-water clastics transparent to the lay-geologist.