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The Value of Integrated Analogues in Deepwater Systems: Examples From Slope Channels

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ABSTRACT

Deepwater depositional systems are inherently variable. This creates substantial difficulty in producing models for their architecture and thus for the distribution of reservoir facies in the subsurface. Often this means that the best that can be done is to assign broad probability distributions for the key parameters (e.g. shale baffle dimensions) that control reservoir behaviour. Typically these are based on outcrop data, from examples which may or may not be appropriate to the specific subsurface case. In fact no two deepwater systems are truly alike; every system is an analog only for itself. Nonetheless there are more similarities in some cases than in others, and the holy grail of subsurface prediction is to be able to generate a synthetic analog, based on a range of data from different sources. The problem lies in determining from seismic data, alone or with well data, what kind of analog we are looking for. The difference in horizontal scale between seismic and wells is 4 orders of magnitude, and the difference in scale of resolution is 2 orders of magnitude. This scale gap can be bridged by data from various sources, including outcrop data (where we have stratigraphic depth – effectively two-and-a-half D) but no timelines, and seafloor data from modern systems, where we have timelines and detail on depositional relationships, but typically little stratigraphic depth or knowledge of final architectures. Moreover, modern deepwater systems are by their very nature difficult to study. Nonetheless, we do see enough to know that they are complex and variable, and we should thus expect an equal degree of complexity in the subsurface. Outcrops also show this complexity and variability so that, for example, different examples of slope channel systems at outcrop show markedly different characteristics, even though they may have some features in common. A single model for all slope channels may have some value, but is no more likely to describe subsurface facies distribution than the Bouma sequence describes all turbidites. Common features, such as a hierarchy of incision surfaces within slope channel fills, may also be revealed in seismic data, and these have become an important part of published generic slope channel models. Shallow, high-resolution seismic data thus adds further to our analog arsenal. Lastly, physical and numerical models help us to understand flow process and deposit geometry, albeit beset with issues of scale.