# Application and Integration of Modern Depositional Analogues into Reservoir Modelling Workflows

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## Abstract

Recent detailed studies of modern terrestrial, coastal and deep-water depositional environments have revealed complexities that existing 20th Century classification systems are unable to capture and describe. Furthermore, concurrent advances in 3D modelling software capabilities have enabled these complexities and details to be captured in reservoir models.

In order to harness these developments, new and improved methods of description and classification of these depositional systems are required. Any new classification must be able to describe the natural hierarchies that exist in the depositional system and that can be mimicked by most 3D reservoir modelling packages. Hence, an architectural classification of depositional bodies built around a natural hierarchy is a first step in any new classification. Once the classification is generated, the most meaningful way of incorporating the modern depositional analogue data at the appropriate vertical and horizontal scale must be established.

Many modern analogues across all environments are captured as two dimensional plan view images (e.g. aerial photographs, satellite imagery, high-resolution 3D seismic attribute maps, multibeam swath bathymetry data). Hence, geometrical data on horizontal extents of geobodies are the principal outputs of these datasets. Vertical thickness information can be gleaned from shallow core data. In rare examples, neotectonics or cut-banks on rivers have exposed modern to recent systems hence thickness data and 2D cross-sections can sometimes be observed. Additionally, thickness data can also be interpreted from shallow geophysical techniques such as ground penetrating radar. With the high-resolution marine 3D seismic datasets, exquisite detail can also sometimes be gleaned of geobodies in 3-dimensions. With advanced modern absolute age dating techniques, relative ages of geobodies, and hence detailed depositional histories can also be established. All these types of modern analogue data can be utilised in various ways in 3D reservoir modeling studies.

Three types of data derived from modern analogues are generally used in 3D modelling workflows. 1) Qualitative or soft data is derived from a general understanding of a type of depositional system. Things such as correlation concepts and typical lateral and vertical facies juxtaposition relationships enable a user to build conceptual models of depositional systems. 2) Quantitative or hard data are measurements taken from modern systems that describe geometries and architectures of geobodies. Typically statistical or attribute data can be used to condition 3D models. 3) The hard and soft data can be combined to describe shapes and lateral relationships between geobodies or facies in a volume, which can then be used to generate training images for multi-point statistical methods of populating models.

The perfect modern analogue for a subsurface field is the Holy Grail for reservoir modelling! However, most practitioners realise that given the inherent complexities of depositional systems, at best, a modern depositional environment can only represent a partial analogue for any other

system. The generation of multiple scenario model suites based on different modern depositional analogues that honour all subsurface data is an approach that cab be used to better manage these uncertainties.