Deepwater exploration and production

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Abstract

Deepwater-reservoir elements are described in one of three ways: with sequence stratigraphic terms, process-accommodation terms, and/or architectural terms. A common terminology is developing with four main reservoir elements: Channel-fill, levee thin beds, sheets, and mass-transport deposits. Each of these have a series of sub-facies, which generally presents more complex internal architecture, and baffles/barriers in production.

When placed within a sequence stratigraphic framework, there is commonly a change in the reservoir elements from top to base, with higher net:gross elements at the base (sheets, amalgamated channels,) changing upward to lower net:gross channel-fill with levees.

One challenge in studying deepwater settings is in the different data sets used in their study. Geoscientists must routinely work at different scales, including seafloor images (from 3-D seismic and side-scan systems), shallow seismic, deeper seismic, wireline logs, outcrops, cores, and image logs. The best place where gaps in scale are addressed are through the use of shallow high frequency 3-D data.

Exploration in deepwater during the past 15 years has discovered more than 80 BBOE from 19 basins. An evaluation of some of the major themes for success includes the following.

(1) *Reservoir prediction*: reservoir architecture and the performance of different kinds of elements is critical. Understanding reservoir quality is becoming increasingly important in older, deeper reservoirs where diagenesis affects potential production. About ¾ of deepwater fields have a stratigraphic component to the trap, which is commonly critical to reserve size and performance. Stacking of reservoirs in mobile substrates has been critical to early success in several basins.

(2) *Trap imaging* has been critical in those basins where traps are completely imaged using pre-drill 3D PSDM Seismic.

(3) *Fluid prediction* includes notably DHIs and AVO. To date, approximately 75-80% of the reserves in deepwater have been found using DHIs, and with the effective use of AVO. In the future, this success rate may decrease when exploration focuses on older and deeper reservoirs where DHIs and AVO may not be effective.

(4) Understanding *fluid pressure* includes modeling entire basins for regional petroleum system, analyzing trap integrity, and understanding the effect on DHIs.

(5) Several potential *drilling problems* to avoid include: shallow water flow (locally overpressured sands), regional overpressure, allochthonous salt (safety, cost-efficient), and drilling in deeper sections (> 25,000 feet).

(6) *Economics* include containing drilling, speed in operations, and effective cash management. Companies are routinely drilling exploration/appraisal wells that can be reused for development wells, as well as having development teams participate in the exploration drilling to reduce costs. Cycle times are also important. FPSO's have been instrumental in successful development approaches in the early development of discoveries.

(7) *High-rate, high-ultimate wells* (HRHU) have been critical in the early development of deepwater reservoirs in many basins. HRHU reservoirs are dominantly located when vertically stacked reservoirs occur along mobile substrates. Without HRHU reservoirs, it is unlikely that these basins would reach development.

(8) *Properly trained geoscientists* working in integrated teams have been critical to the success in deepwater exploration, and will continue to be so in the future.