PS The Evolution from Depositional Geometry to Trap Definition by Rapid Multi-Layer Mapping*

Michelle Allum[1]

Search and Discovery Article #41418 (2014)**
Posted August 18, 2014

*Adapted from poster presentation given at Geoscience Technology Workshop (GTW), Deep Horizon and Deep Water Frontier Exploration in Latin American and the Caribbean, Port of Spain, Trinidad, March 9-11, 2014
**AAPG©2014 Serial rights given by author. For all other rights contact author directly.

[1]PetroCom Technologies Ltd., Newton, Trinidad, West Indies (michelle.allum@petrocomtech.com)

Abstract

Cretaceous sandstone reservoirs off the west coast of Africa were deposited on a basin floor setting. These sandstones were historically identified by seismic attributes that contrasted with the surrounding rocks. The traps are stratigraphic and the terminations are upslope. The geometry of the lows in which the sands accumulated is different from the geometry of the traps, because through time the shape of the beds was modified by compaction or by fluid mobilisation in the underlying substratum. To successfully identify the optimal location for exploration and appraisal wells, the evolution from depositional geometry to the current trap geometry must be mapped to understand the fill history and where to place the critical pinch-out edge. This can best be done by mapping numerous layers in the overlying strata. While this process has traditionally been very time consuming, there are modern tools that can help significantly.

Case studies on the shelf in Trinidad show how the geometry of sandstones bodies transported by turbidites was controlled by the paleobathymetry. In these cases, the basin floor responded to fluid movement in the underling strata and so the changes in bathymetry were dynamic and served to highlight the topographic control on sandstone distribution. The change from depositional geometry to trap architecture is gradual and is caused by compaction and mud mobilisation. Layer by layer mapping illustrates how the sandstone bodies migrated in response to the changes in bathymetry and how the changes in the underlying strata concerted those bodies into potential traps.

The Evolution from Depositional Geometry to Trap Definition by Rapid Multi-layer Mapping

Michelle Allum, PetroCom Technologies Ltd., Trinidad

March 2014

AAPG Latin America Region — Geosciences Technology Workshops 2014

PetroCom — PetroCom Technologies Limited

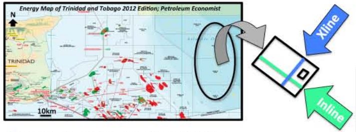
Abstract

Cretaceous sandstone reservoirs off the west coast of Africa were deposited on a basin floor setting. These sandstones were historically identified by seismic attributes that contrasted with the surrounding rocks. The traps are stratigraphic and the terminations are upslope. The geometry of the lows in which the sands accumulated is different from the geometry of the traps, because through time the shape of the beds was modified by compaction or by fluid mobilisation in the underlying substratum. To successfully identify the optimal location for exploration and appraisal wells, the evolution from depositional geometry to the current trap geometry must be mapped to understand the fill history and the location of the critical pinch-out edge. This can best be done by mapping numerous layers in the overlying strata. While this mapping process has traditionally been very time consuming, there are modern tools that can help significantly.

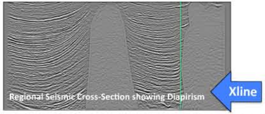
Case studies on the shelf in Trinidad show how the geometry of sandstones bodies transported by turbidites was controlled by the paleo-bathymetry. In these cases, the basin floor responded to fluid movement in the underling strata and so the changes in bathymetry were dynamic and served to highlight the topographic control on sandstone distribution. The change from depositional geometry to trap architecture is gradual and is caused by compaction and mud mobilisation. Layer by layer mapping using modern technology illustrates how the sandstone bodies have migrated in response to the changes in bathymetry, and how the changes in the underlying strata converted those bodies into potential traps.

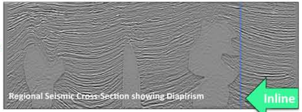
Success Criteria

Can identify lithology & change in geometry from depositional to trap using multiple reflectors, which allows us to determine which pinch-out edge to target and trap locations.



- Deepwater Block Offshore East Coast of Trinidad
- Diapiric environment; 800-1000m water depth
- 3D Seismic down to 6 secs, Variable quality
- No well data, well logs or stratigraphic control

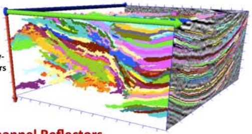




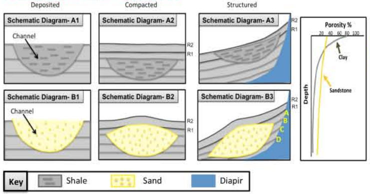
Method

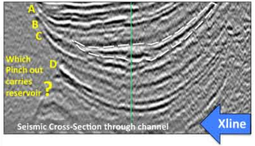
- Generated GeoPopulation time structure maps for all reflectors
- Identified and selected reflectors with distinctive geometries that indicated reservoir presence using compaction as the primary identifier
- Based on the interaction between overlying, underlying and internal reflectors, identified sand fairways vertically and laterally
- Using the structure of reflectors with the required trapping geometry, determined the location of prospective traps

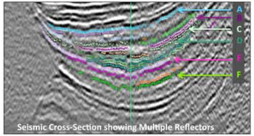
3D Cube of Multiple, Rapidly-mapped reflectors showing the structure of the area of interest

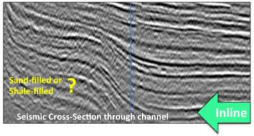


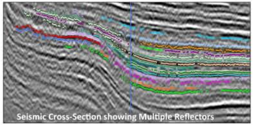
Schematic Diagrams of Transition from Depositional Geometry to Trap Geometry



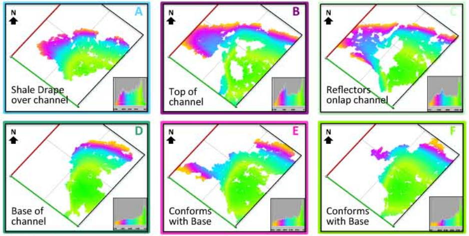








Time Structure Maps of Key Channel Reflectors



Acknowledgements

The author gratefully acknowledges Mr. Philip Farfan who made an invaluable contribution to this study and without whom this presentation would not have been possible. Acknowledgements are also due to the Ministry of Energy & Energy Affairs for the permission to display this seismic, and to Seisnetics LLC for the use of the proprietary pre-interpretation technology used for rapid multi-layer mapping.

Conclusion

Unravelling the compaction history proves to be very useful in prospecting in diapiric provinces where depositional geometries are usually greatly changed by compaction and structuring. Because structuring affects each pinch-out edge of each layer differently, it is important to have multiple layers mapped to identify the most sand-prone trapping areas.