Three-dimensional sequence stratigraphy offshore Louisiana, Gulf of Mexico (West Cameron 3D seismic data)

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3D sequence stratigraphy is defined as the sequential analysis of chronostratigraphic maps interpreted on 3D seismic data. It results from the combination of three pre-existent methods of analysis of detritic sediments: sequence stratigraphy on 2D vertical seismic sections, well log sequence stratigraphy analysis and vertical and horizontal high resolution sequence stratigraphy interpretation of 3D seismic data sets. It aims at identifying the changes of relative sea level recorded in the fossil and constitutes a new potent exploration and development tool for subtle hydrocarbons stratigraphic traps discovery. Reservoir morphology, heterogeneity and subtle stratigraphic trapping mechanisms can be better understood through systematic horizontal identification of sedimentary facies of systems tracts provided by 3D attribute maps. On new prospects as well as on already producing fields the additional input of 3D sequence stratigraphy enables to locate and identify new productive zones.

In a clastic shelf environment such as offshore Louisiana (northern Gulf of Mexico), it becomes possible to directly infer the sedimentation facies from the lateral variations in seismic reflection along a time consistent reflector interpreted on the entire surface of a 3D survey. These amplitude anomalies observed along a flattened horizon enhance subtle and continuous geological objects (inferior to 20 m) invisible on the vertical seismic lines. Successive paleosurfaces of sedimentation can be reconstructed every 4 milliseconds (every 4 m in the sub-surface, 0-2500 m) and show the vertical evolution in the deposition conditions through time and space. The relationship between deformation (subsidence, salt tectonic) and sedimentation is deduced from these reconstructed paleosurfaces.

Offshore Louisiana, regular eustatic cycles of 0.1 Ma extend over the entire Gulf Coast Pleistocene (0 to 3.0 Ma) and 0.8 Ma cycles are identified from the upper Neogene to the present (0 to 10.5 Ma). 0.1 Ma cycles are correlated to the eccentricity period of the Earth orbit around the sun (96'000 years) and the 0.8 Ma cycles coincide with major inversions of the magnetic field around the Earth.