GEOLOGICAL MODELLING TO CAPTURE RESERVOIR UNCERTAINTIES: A CASE STUDY FROM SIMIAN FIELD, OFFSHORE NILE DELTA, EGYPT

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Summary

Reservoir modeling of subsurface hydrocarbon reservoirs is usually an important added value for field data integration as Seismic and well data together in one three-dimensional model with the assistance of proper Geo-statistical methodologies. This integration opens a way to capture, analyze and test the possible uncertainties in subsurface fields, giving a useful tool on different scales for many decisions.
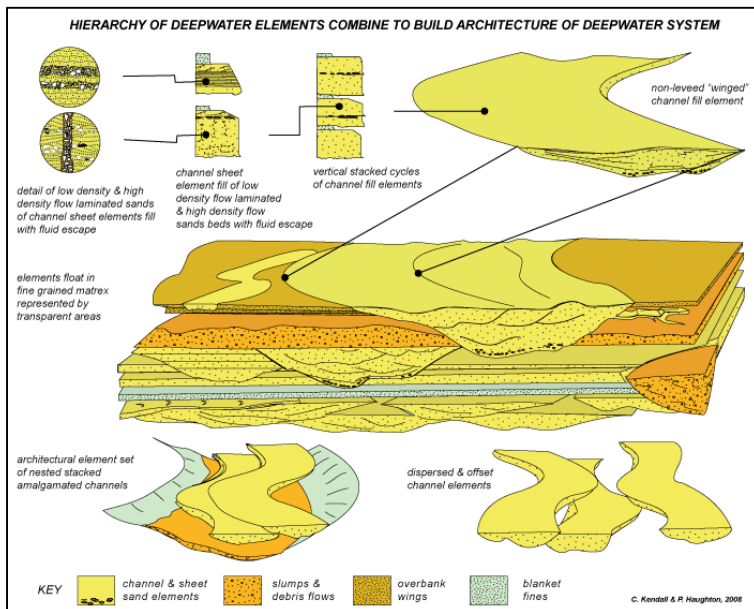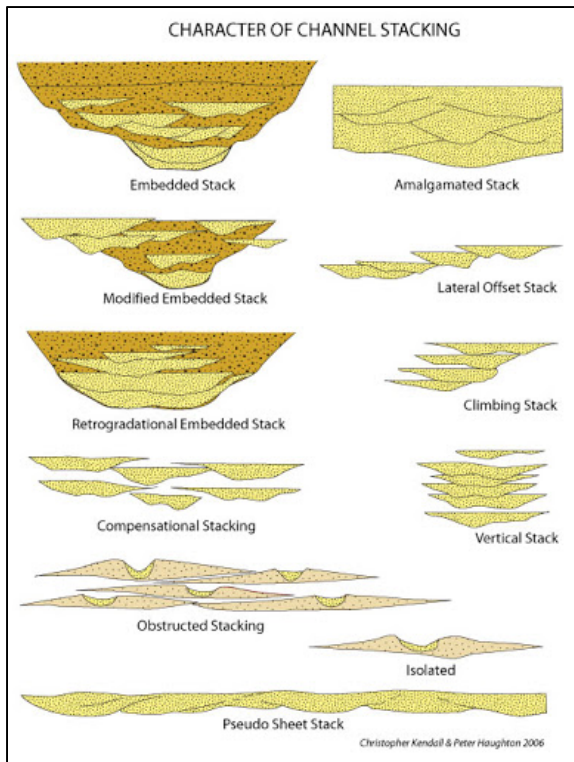
Multi-stacked channels in Simian field show a good example for having different uncertainties like reservoir heterogeneity, different contacts, connectivity between channels ...etc. That was dealt with by building a stochastic reservoir integrating different data available such as: Well logs, formation tops, pressure data, production data, Seismic acoustic impedance, Seismic inversion, spectral decomposition, and other data.

Overview

In Nile Delta, deposition of turbidite systems dominated in the Pliocene Epoch, forming complex deep marine reservoirs that led to many hydrocarbon discoveries to date.

One of the most complicated systems in the Nile Delta offshore is stacked channels that are challenging in different aspects, such as: the relations and connectivity between various stacked channels, the effect of each sub-channel on the heterogeneity inside the reservoirs, identification of the aquifer and its extension, whether different contacts would be found for the same canyon or not and what the possible reason would be … etc.

Each of these challenges is considered as an uncertainty that needs to be studied using the proper tools, capturing as much of the field's uncertainties as possible helps a lot in several decisions in oil and gas before and during production such as well optimization, remaining hydrocarbon volume, further maturation possibilities, and after field maturation for production forecasting.

CHARACTER OF CHANNEL STACKING

Embedded Stack

Amalgamated Stack

Modified Embedded Stack

Lateral Offset Stack

Retrogradational Embedded Stack

Climbing Stack

Compensational Stacking

Vertical Stack

Obstructed Stacking

Isolated

Pseudo Sheet Stack

Christopher Kendall & Peter Haughton 2006

HIERARCHY OF DEEPWATER ELEMENTS COMBINE TO BUILD ARCHITECTURE OF DEEPWATER SYSTEM

non-leveed "winged" channel fill element

channel sheet element fill of low density flow laminated & high density flow sands beds with fluid escape

vertical stacked cycles of channel fill elements

detail of low density & high density flow laminated sands of channel sheet elements fill with fluid escape

elements float in fine grained matrex represented by transparent areas

architectural element set of nested stacked amalgamated channels

dispersed & offset channel elements

KEY — channel & sheet sand elements — slumps & debris flows — overbank wings — blanket fines

C. Kendall & P. Haughton, 2008

Reservoir modeling is a helpful approach that is proved to be effective on different scales, integrating almost all available data, analyzing most of data and their interrelations together, giving the opportunity to test the validity of different static and dynamic scenarios for various fluids movement and their impact on further fields' development.

In this study we will discuss reservoir modeling approaches of Simian field, a large field in West Delta Deep Marine concession, to capture most of the previously mentioned uncertainties, starting from data set, data analysis, defining uncertainties, conceptual model estimation, structure modeling, merging deterministic and stochastic modeling of various petrophysical Properties, and finally the outcome and results.
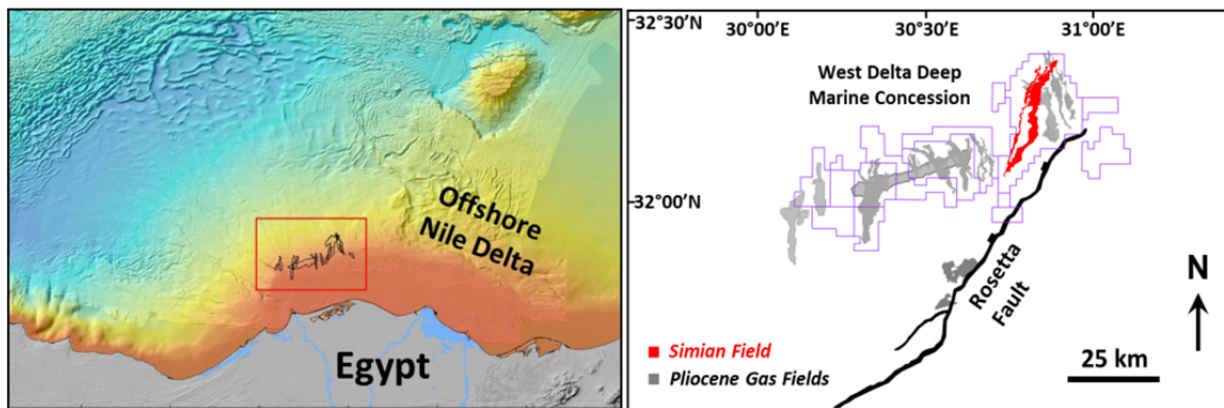
Wael Salah et. al. Modified from Samuel et. al.

Acknowledgements

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Figure from: http://www.sepmstrata.org/page.aspx?&pageid=40&3