

# **Coupling Stratigraphic and Petroleum Systems Modeling: Implications For Hydrocarbon Exploration\***

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Search and Discovery Article #120121 (2013)

Posted March 13, 2013

\*Adapted from extended abstract prepared in conjunction with poster presentation at AAPG Hedberg Conference, Petroleum Systems: Modeling The Past, Planning The Future, Nice, France, 1-5 October 2012, AAPG©2012

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## **Abstract**

The three-dimensional numerical simulation of sedimentary processes based on sequence stratigraphy concepts (i.e. stratigraphic modeling) has been used in sedimentary basin analysis to understand and represent the interplay between space accommodation generation and filling, along with the action of sedimentary processes that control facies distribution. Two of the main products of stratigraphic modeling are (1) the breaking of the basin-filling packages into stratigraphic sequences of different orders and (2) the detailed representation of lithofacies distribution within each sequence.

## **Discussion**

Petroleum systems modeling allows the reproduction of the geological history of the basins including the processes of compaction, heat flow and fluid flow, along with generation, migration and accumulation of petroleum. The technique involves the dynamic calculation of essential parameters such as porosity, pore pressure, temperature and maturation of source rocks. The method is based on the mass conservation of components, and solves numerically the governing equations for mass balance, and the equations for energy and momentum conservation. Even though the petroleum systems models are highly sophisticated, their representation of the stratigraphic framework and lithofacies distribution is commonly poor. Consequently, one can say that although the independent application of these techniques by the oil industry and the scientific community is quite widespread their integration, assessing the potential impact of incorporating detailed stratigraphic framework and lithofacies distribution into the modeling of petroleum migration and accumulation, remains not fully explored.

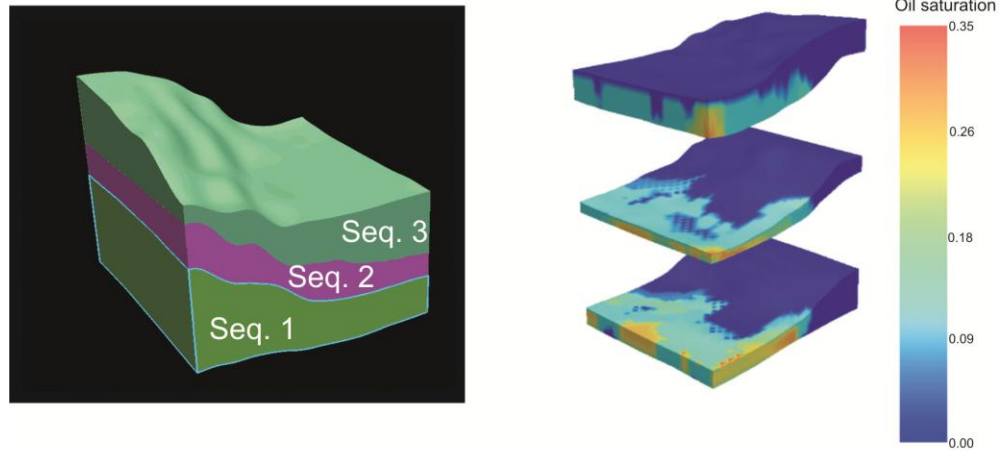
## **Goals**

The goal of this work is to establish a method to integrate stratigraphic and petroleum systems modeling using Petrobras proprietary software in order to apply such workflow in frontier areas of exploration. As a first approach two synthetic (although based on common real situations) petroleum systems models were constructed, in which the regional permeability structures based on low- and high-resolution sequences obtained by previous stratigraphic simulations were compared. The more detailed sequence and lithologic representation at the third-order scale allowed a better definition of carrier beds and regional seals, which significantly changed the patterns of petroleum secondary migration, favoring the identification of plays not currently represented in models with lower resolution ([Figure 1](#)).

## **Summary**

The next step, which is under way and will be presented at the Conference, is the application of this methodology to an exploratory area of Petrobras in order to highlight the significance of integrating the two techniques, aiming to achieve a better definition of new potential petroleum plays.

## A) Low-resolution model



## B) High-resolution model

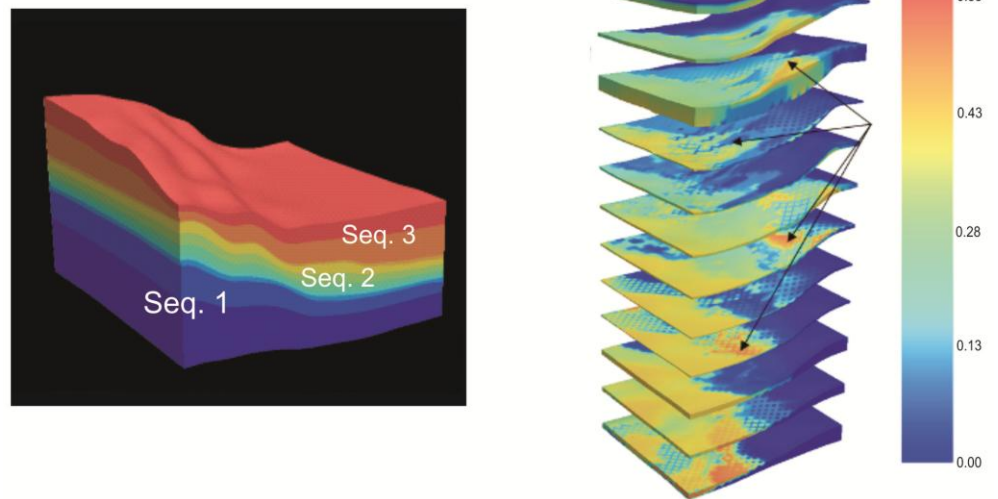


Figure 1. Comparison between the low and high-resolution petroleum system models. The arrows in Figure 1B represent the main potential plays identified by the introduction of refined stratigraphic framework and lithofacies distribution.