RESERVES ESTIMATIONS WITHIN A RISK ANALYSIS FRAMEWORK OF A SET OF HYPOTHETICAL PROSPECTS IN THE VENEZUELA ATLANTIC MARGIN, ONE OF THE LAST EXPLORATION FRONTIERS ALONG NORTHEASTERN SOUTH AMERICA.

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Abstract

The Venezuela Atlantic Margin and the Orinoco Platform, the latest exploration frontier along northeastern South America, cover an area of approximately 73,000 km^2. As is typical of all frontier exploration situations, many uncertainties are associated with the subsurface geological and geochemical information necessary to constrain the hydrocarbon generation, migration, accumulation, and entrapment. Consequently, the reserves estimations for a set of hypothetical prospects were carried out within a risk analysis framework, where all input parameters were addressed probabilistically and all output results were considered probabilistic.

Two hypothetical prospects were evaluated in the study area in order to estimate the amount of oil available according to a set of different scenarios. Their locations were estimated according to the 2.5-modelling results (Figure 1). The first corresponds to a prospect located in the southern part of the Orinoco Platform, directly in the hydrocarbon migration pathway. The second corresponds to a prospect located at the base of the Cretaceous paleo-slope in the Venezuela Atlantic Margin. The prospects are hypothetical because no information on the size and properties of any traps are known. In essentially all of them, the Late Cretaceous sequence is considered to be the most probable and the most important source rock for the different systems proposed, as the 1-D and 2-D thermal modelling have proved (Bernardo, 2002). The reservoir input data set corresponds to traps representing a variety of sizes; their properties and ages vary according to their geographic locations.

The estimation of oil and gas available was made using a novel empirical approach for basin/prospect evaluation that combines aspects of basin modelling technology with risk analysis techniques. The overall computational process was carried out using SimGAME®. So the volumetric analysis of hydrocarbon charge from the Upper Cretaceous source into two hypothetical prospects, evoke the following interpretations:

Under the most favourable of assumptions (an infinite trap capacity and a 70% seal integrity), the maximum amounts of hydrocarbons available for entrapment within the hypothetical prospect in the southern part of the Orinoco Platform is estimated at 37 TCF of gas and 52 Billion bbls of oil (Figure 2), and within the hypothetical prospect in the Venezuela Atlantic Margin amounts are estimated at 190 TCF of gas and 94 Billion bbls of oil (Figure 3). The differences stem from differences in the quality, volume, and maturity of source rocks and in size and properties of the carrier systems within the two migration pathways.

Size and reservoir properties of the carrier systems impact the composition of the accumulating hydrocarbons more profoundly than do differences in source-rock quality. The larger the carrier system, and the more porous and permeable the reservoir rocks are, the greater the gas losses from the system are. This is manifested vividly in the gas enrichment of the Venezuela Atlantic Margin prospect relative to the Orinoco Platform prospect, in spite of the fact that the source rocks charging the Venezuela Atlantic Margin are assumed to be slightly more oil-prone than the source rocks charging the Orinoco Platform prospect.

A reduction in seal integrity of the system results not only in a reduction in the overall amount of oil and gas arriving at the trap, but also in a reduction in the gas/oil ratio within the trap as modelled in the prospect located south of the Orinoco Platform.

In a well-sealed petroleum system, trap area, as defined by the area of closure, appears to be very influential in determining the final gas/oil ratio within the trap. This is manifested in the increased gas vs. oil content of traps of successively decreasing size. Fluid stratification within a reservoir system into gas, oil, and water columns within the trap allows a trap with a small area of closure to retain gas to spill point, regardless of oil supply. This is illustrated by an example from the Venezuela Atlantic Margin where the computations indicate that any prospect smaller than 60 Km^2 would be essentially all gas (Figure 3).

References

Bernardo, Luis, 2002. Petroleum System Analysis of the Orinoco Platform, Offshore Eastern Venezuela. University of Houston, M.S. Thesis, 172 p.

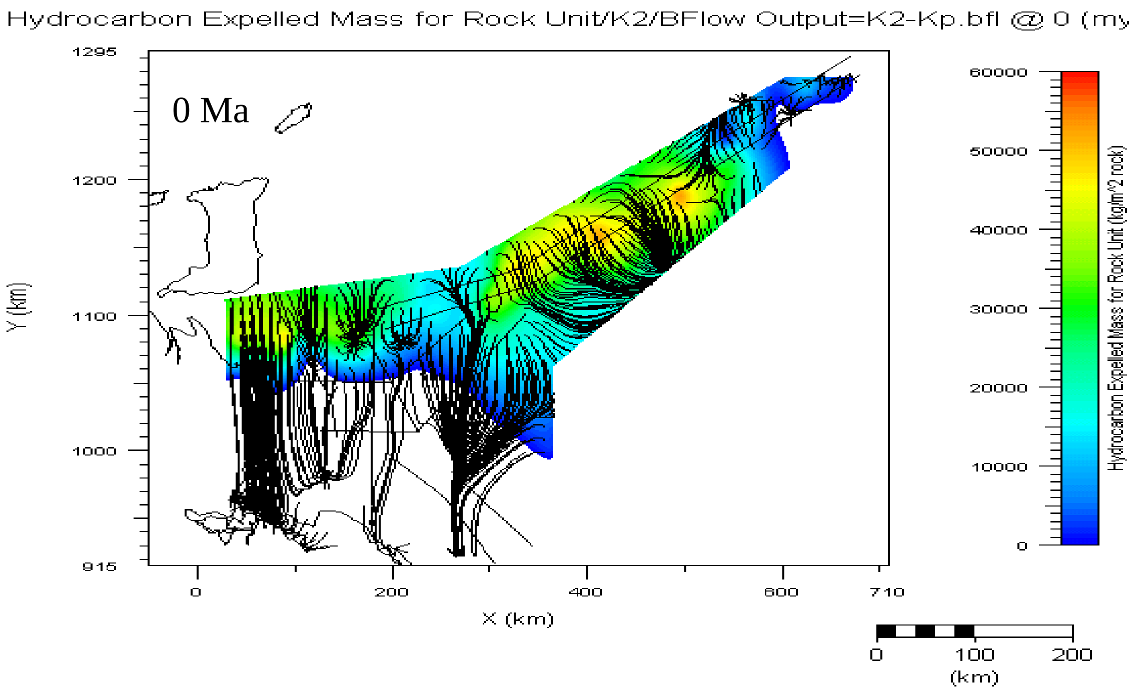

Figure 1. Expelled hydrocarbons and migration pathways for seismic unit K2 at present.

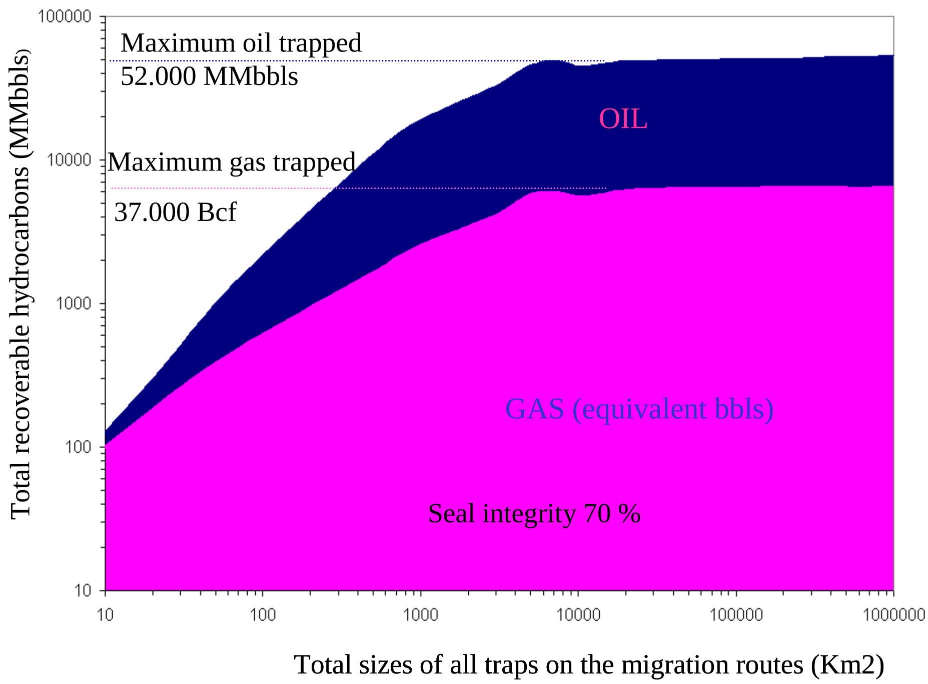

Figure 2. Relationship of product type of trapped hydrocarbons to total size of all traps on the migration routes for the Orinoco Platform prospect.

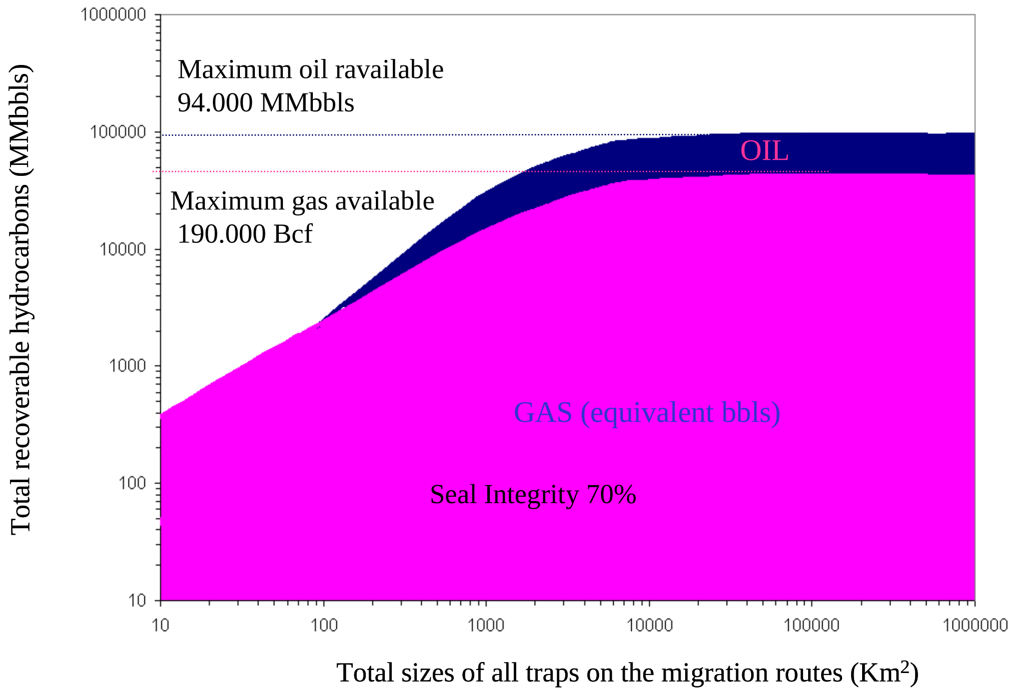

Figure 3. Relationship of product type of trapped hydrocarbons to total size of all traps on the migration routes for the Venezuela Atlantic Margin prospect.