

PS The Impact of Velocity Uncertainties to Estimate GRV in Structural Complexity Scenarios*

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Abstract

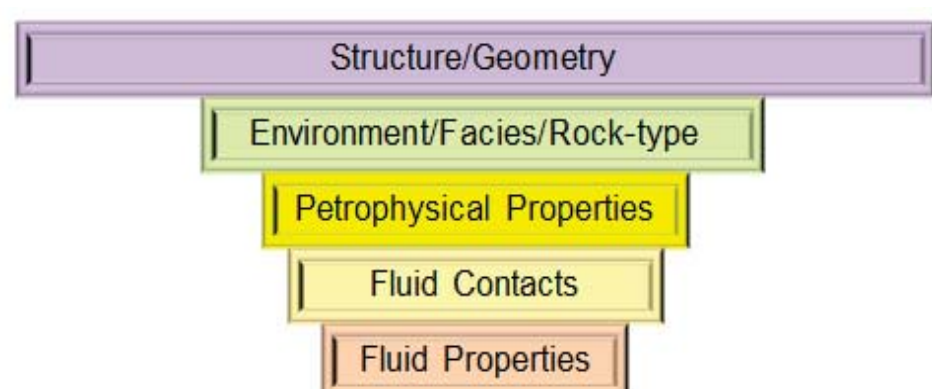
All exploration appraisal development project portfolios manage and evaluate several inherent uncertainties, analyzing risk elements with highest impact on the volumetric evaluation. Oil-in-Place (OIP) estimation is influenced by some well information, such as porosity, oil saturation, and Net to gross is usually predicted by deterministic and stochastic methods, as well as seismic surveys interpretation that generates framework, a key issue to assessment of gross rock volume. The TWT structural interpretation brings uncertainties related to seismic resolution, and time-depth conversion through velocity models constitutes a fast and precise evaluation method to improve GRV calculation with better time interpretation. Structural scenarios from different individual compartments types, such as stratigraphic, fluid, and fault blocks, allow assessment of velocity uncertainty and its impact on GRV distributions. Usually, when estimating OIP, there is a concern regarding the variation of internal properties within a GRV, such as porosity, NTG and saturation. However, the greatest impact is related to the velocity model, since higher or lower velocity can directly change the final portfolio volume. In compressional settings, the uncertainties associated with velocity models become even greater. The present study uses a methodology in which a depth-based framework is populated with time-domain inputs (horizons and faults) and dynamically converted on the fly to depth. Then it uses different models for conversion, creating different scenarios in which the results are compared and evaluated.

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Overview

All exploration-appraisal-development projects portfolio manages and evaluates several inherent uncertainties, analyzing risk elements with highest impact on the volumetric evaluation. Recoverable Oil in Place (OIP) estimation is influenced by intrinsic variables such as structural interpretation, time-depth conversion, rock and fluid properties, fluid contacts and it is usually predicted by deterministic and stochastic methods. Studies (Bu and Damsleth, 1996) have shown that structural uncertainty can account for 3/4 of the total reserves uncertainty.



Tornado Chart of relative uncertainties which have the greatest impact on hydrocarbon volumes.

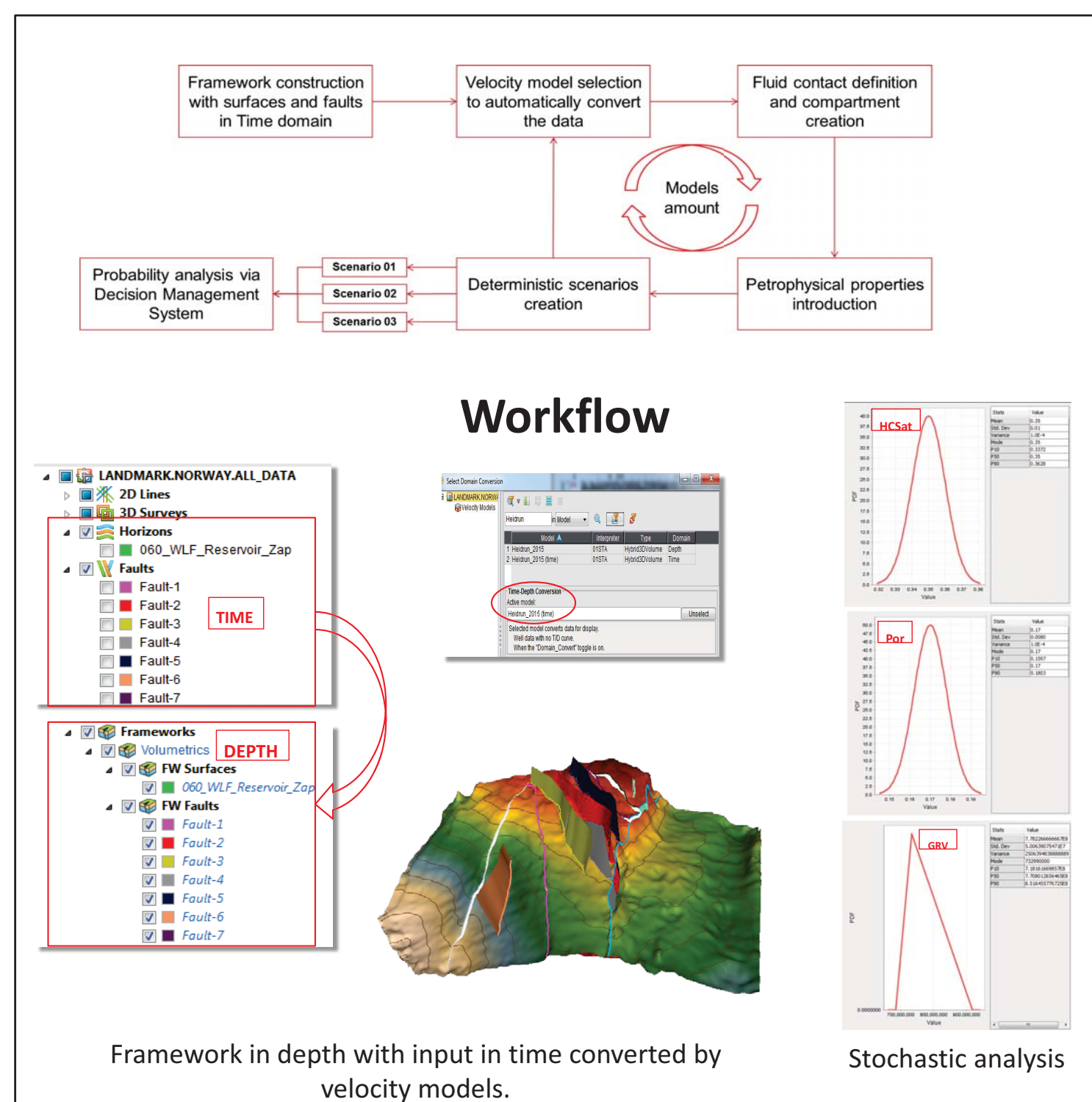
One of the main factors influencing structural uncertainty is time-depth conversion through velocity models, since it configure the geometry of the reservoir through the conversion of Time X Depth.

Methodologies

The present study uses a methodology in which a depth-based framework is created using time-domain inputs (horizons and faults) and dynamically to convert to depth. Then it uses three different velocities models for conversion, creating different scenarios in which the results are compared and evaluated.

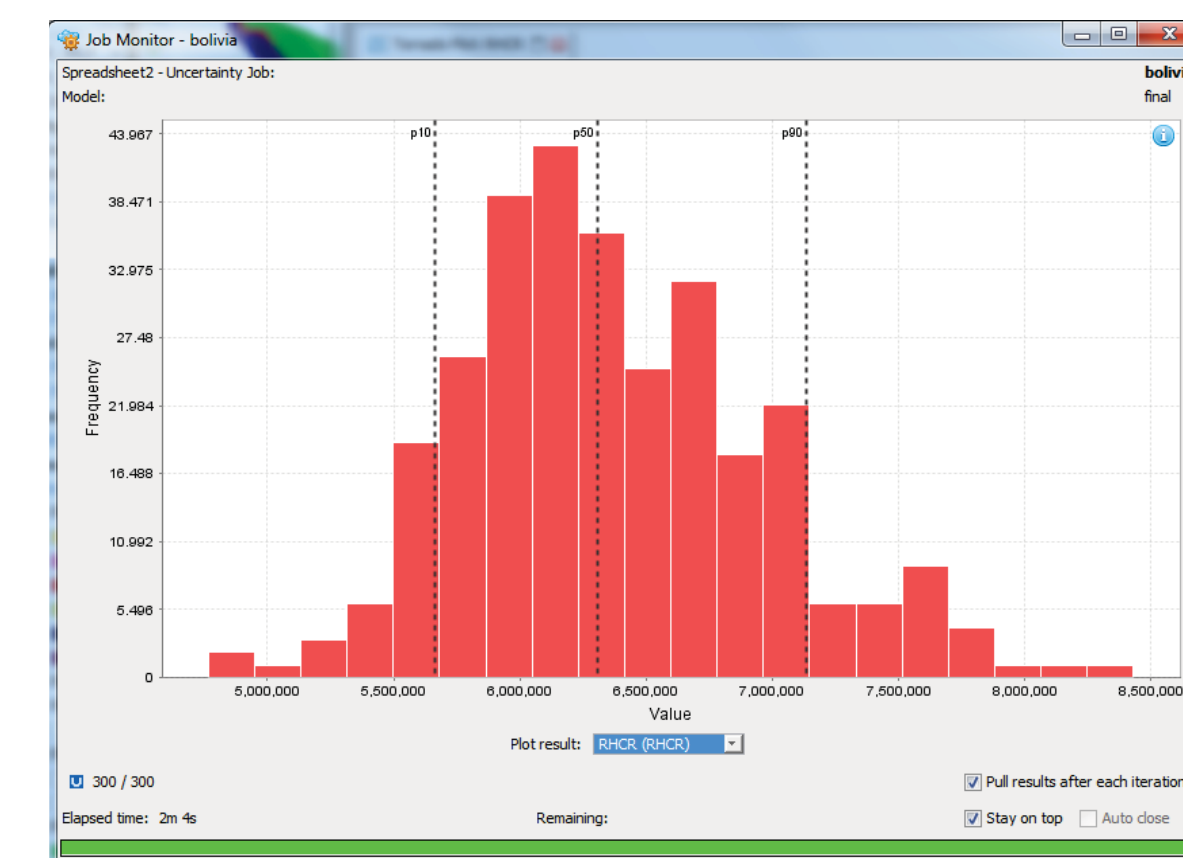
The volumetric estimation, based on GRV, is a deterministic methods based directly in the structural interpretation through Compartments.

After this preliminary estimation the stochastic scenarios are evaluated through the Monte Carlo algorithm (random sampling).

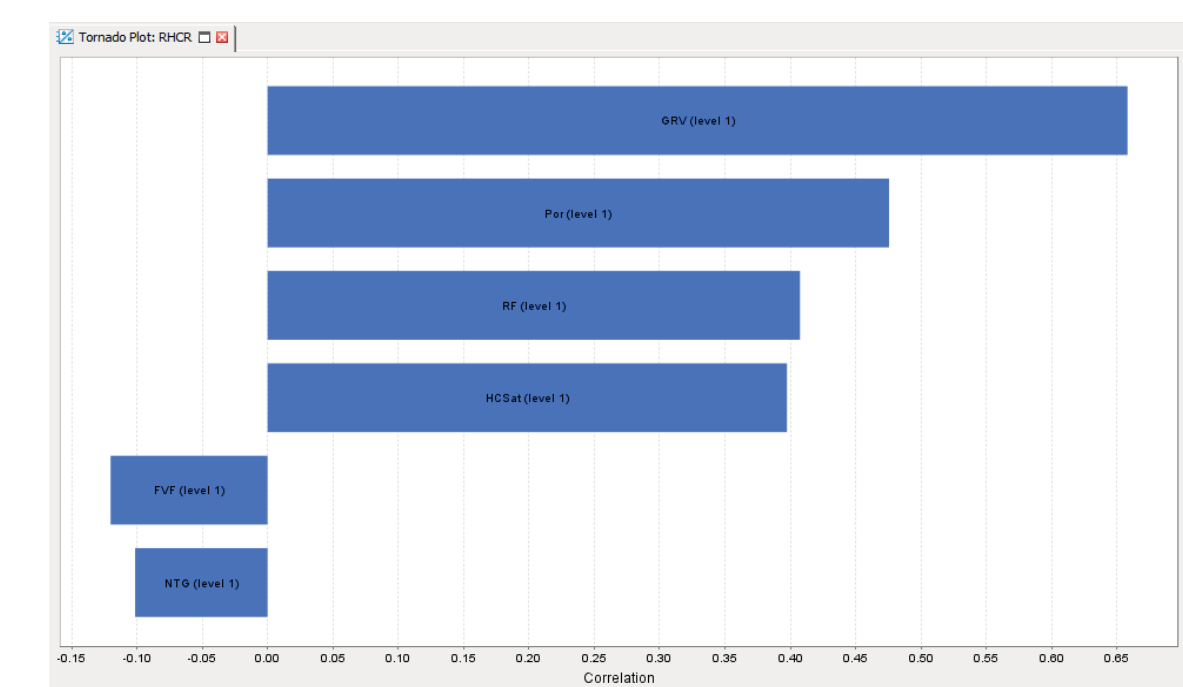


Framework in depth with input in time converted by velocity models.

Stochastic analysis

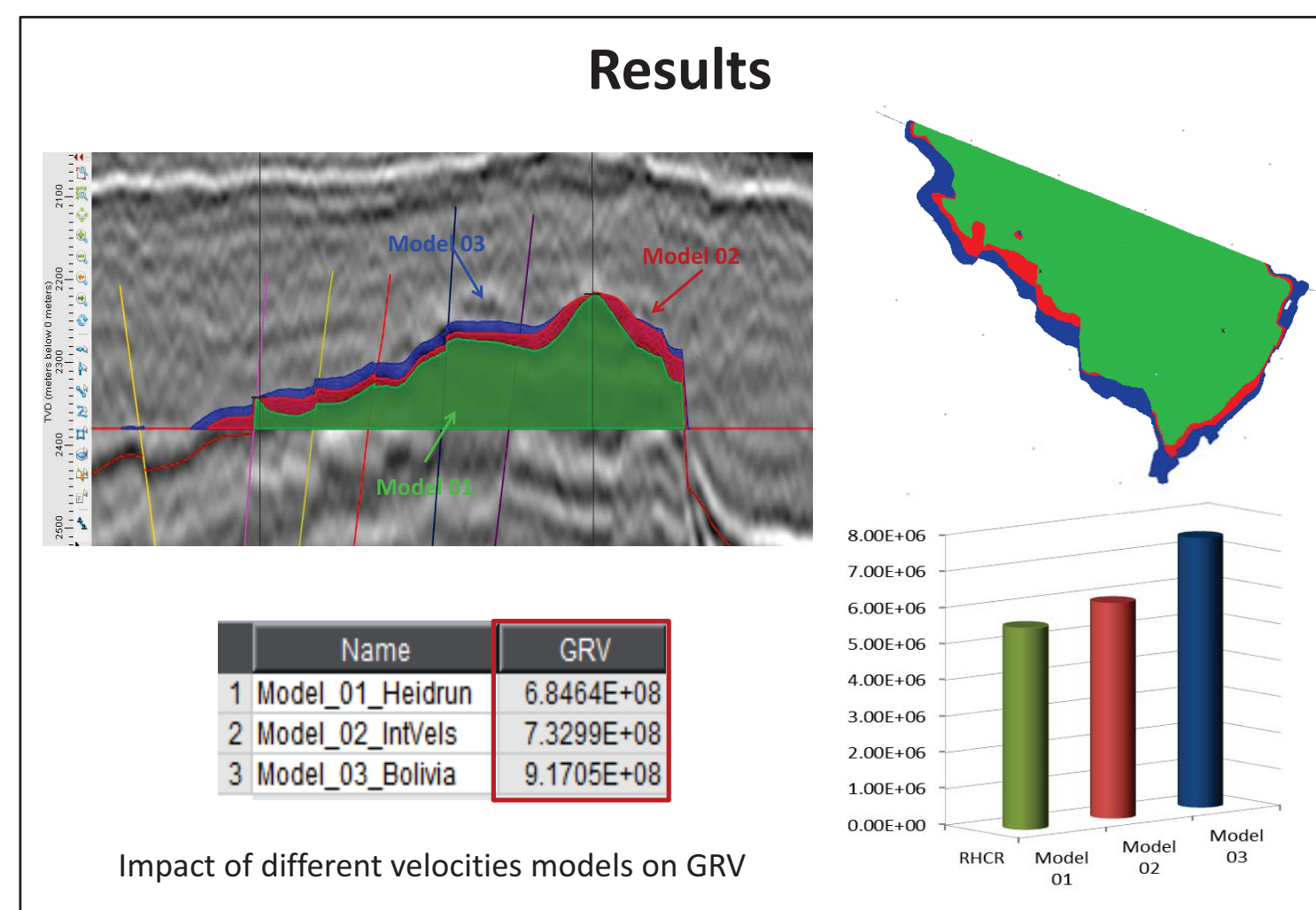


Probability distribution of recoverable volumes



Sensitivity analysis based on Tornado Chart

Results



Impact of different velocities models on GRV

Conclusions

- Reserves calculation require a more quantitative evaluation of all uncertainties implicit in volumetric estimation as structural framework and petrophysical parameters
- Changes in time-depth conversion significantly impact the value of Recoverable HC (RHCR)
- Fast decisions based in quantified uncertainties constrained by available data improve the ranking analysis of the portfolio of exploratory prospects