Quantifying Uncertainties around Net Rock Volume: Application of Analogue Informed Facies Models*

Alwin ten Hove¹, Sarah Cobain², Ben Meyer², Luca Colombera³, and Nigel P. Mountney³

Search and Discovery Article #70311 (2017)**
Posted December 26, 2017

*Adapted from poster presentation give at AAPG International Conference and Exhibition, London, England, October 15-18, 2017

**Datapages © 2017 Serial rights given by author. For all other rights contact author directly.

¹Petrotechnical Data Systems B.V., Rijswijk, Zuid Holland, Netherlands (alwin.ten-hove@pds.group)
²Petrotechnical Data Systems Ltd, London, United Kingdom
³Fluvial & Eolian Research Group, School of Earth & Environment, University of Leeds, Leeds, United Kingdom

Abstract

A key challenge for geomodellers is the identification and quantification of uncertainties, which become particularly difficult to handle when combining multiple geological concepts, data sources and modelling methods. In reservoirs with limited well control, it is important to incorporate appropriate analogue data to populate the inter-well volume. A novel approach is proposed here that allows for unbiased, analogue-informed modelling to directly control uncertainties in facies-modelling parameters, and to assess their impact on Net Rock Volume (NRV). A case study of a ‘braided’ fluvial reservoir succession, offshore NW Australia, penetrated by five wells, is used to demonstrate this novel approach. Data contained within the Fluvial Architectural Knowledge Transfer System (FAKTS) database, which stores data on fluvial sedimentary units from multiple analogues, is used to generate several scenarios that represent end-member depositional concepts. Raw data were converted from FAKTS into input parameters for direct application in facies modelling algorithms. The uncertainty range of each parameter was captured as part of the conversion, before being applied to uncertainty workflows. The relative impact of all parameters is shown through tornado plots. The impact when utilizing object- vs. pixel-based methods, including their influence on ranges of NRV, was also explored. Traditional random seed modelling on its own predicts little to no difference in NRV since the percentage of sand (Net-to-Gross) was fixed. Changing the size of the geobodies had similar results, as the desired sand percentage could be attained by altering the number of channel bodies. However, object dimensions do affect the reservoir architecture and therefore the potential connected hydrocarbon volume. By comparing the connected sand volume per well, the impact of the dimensional uncertainty on recovery was determined. To assess the impact of different depositional environments, different ranges of sand percentage were considered. To assess the impact of different algorithms, the percentage of sand was altered systematically for each algorithm. This allowed determination of noise level and quantification of the effect of algorithm choice. By combining different concepts and approaches, and linking them to analogue data, the full uncertainty space associated with facies modelling of the chosen field was assessed. The demonstrated methodology is repeatable in application to other reservoirs.


Quantifying uncertainties around Net Rock Volume: application of analogue-informed facies models
Alwin ten Hove*, Sarah Cobain, Matt Bowyer, Ben Meyer, Luca Colomba, Nigel P. Mountney

Introduction
A key challenge for geoscientists is the identification and quantification of uncertainties, which become particularly difficult to handle when combining multiple geological concepts, data sources and modelling methods.

1. The Database

2. Parameterisation of Depositional Concepts

3. Case Study: Crux Field

4. Methods for Connected NRV

5a. Object Based: Braided System

5b. Pixel Based: Braided System

5d. Pixel Based: Meandering System

6. Kept Sand Analysis

7. Impact of Well Location

8. Summary and References

9. Acknowledgements

*Corresponding author: Alwin.ten-Hove@pds.group

Summary
Quantifying uncertainty around NRV is a crucial aspect of reservoir characterisation. This process is essential to understand the variability in rock volumes and the potential uncertainties in reserves and production forecasts. This study demonstrates an approach that combines analogue and digital datasets to quantify uncertainties in NRV at the Crux field. The approach involved the selection of a suitable analogue dataset and the associated facies models, which were used to inform the input parameters needed for an object-based model run. The resulting FAKTS data were then used as input for the variogram range calculation, allowing us to compare the sensitivities between both geological concepts (braided vs. meandering).

Acknowledgements
This project was funded by the UK Oil & Gas Innovation Centre, which is supported by the Department for Business, Energy & Industrial Strategy. The authors would like to thank colleagues at pdm Group for their contributions and support during the project.

References