Can Decompaction Increase the Predicting Accuracy for Depositional Facies in Geological Modelling?

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AN INTEGRATED GEOLOGICAL FRAMEWORK FOR CSG

INTRODUCTION

Well correlation and/or seismic interpretation based stratigraphic framework is basic for geological modelling. However, peat/coal compaction may change the sedimentary structure (Fig. 1). Also, there is big debate about the peat/coal compaction ratio as shown in Fig. 2. A local area, about 6×8 sq. km with 47 wells' wireline logs is selected for this study. The well spacing ranges from 0.8-1.5 km. Among those wells, 19 wells were used in modelling and 28 wells were used as monitors for prediction accuracy assessment. Two sets of models were generated, one with un-decompacted wireline logs and the other with de-compacted wireline logs. Fig. 3 shows the compaction ratio for different lithologies. A workflow was generated and used to optimise the variogram geometry.

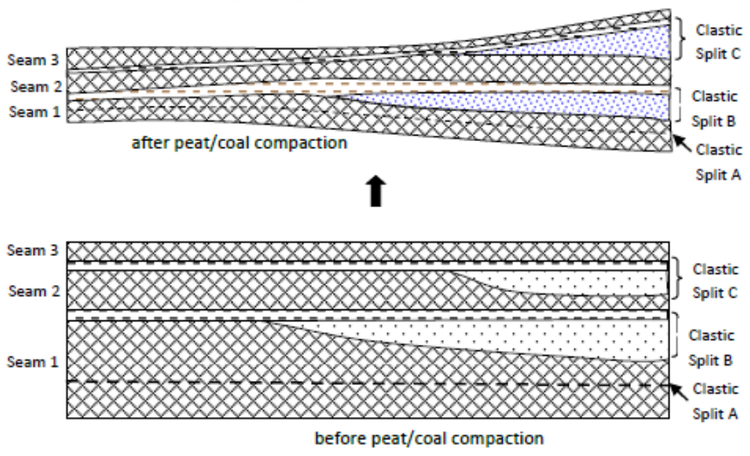


Fig. 1. Peat/coal compaction changes thickness hence structure (after Titheridge, 2016?)

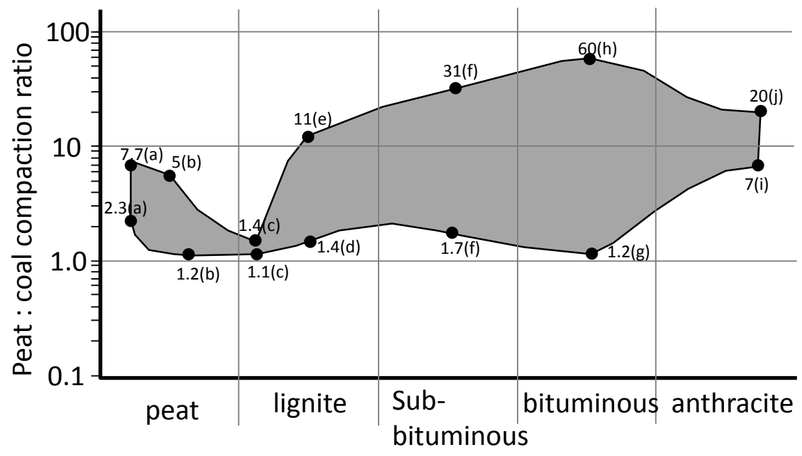


Fig. 2. Variations of peat:coal compaction ratio in the literature (after Widera, 2015). *a-Bloom (1964); b-Bird et al. (2004); c-Widera (2013a); d-Hurnik (1990); e-Smith and Clymo (1984); f-White (1986); Nadon (1998); h-Winston (1986); i-cited by Ryer and Langer (1980); j-Elliot (1985).*

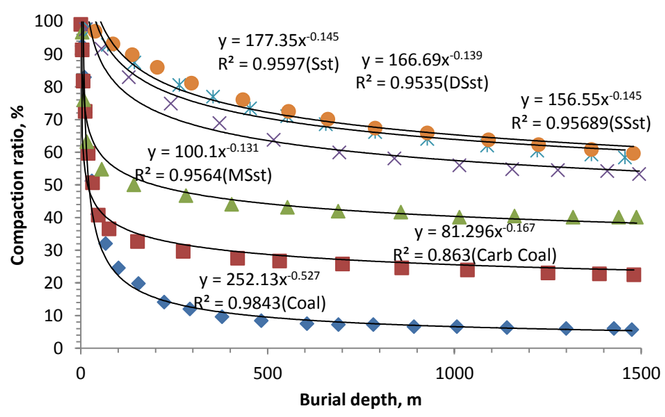


Fig. 3. Variation of compaction ratio of thickness for different facies with burial depth (after Buchanan, 2015).

DATA AND METHODOLOGY

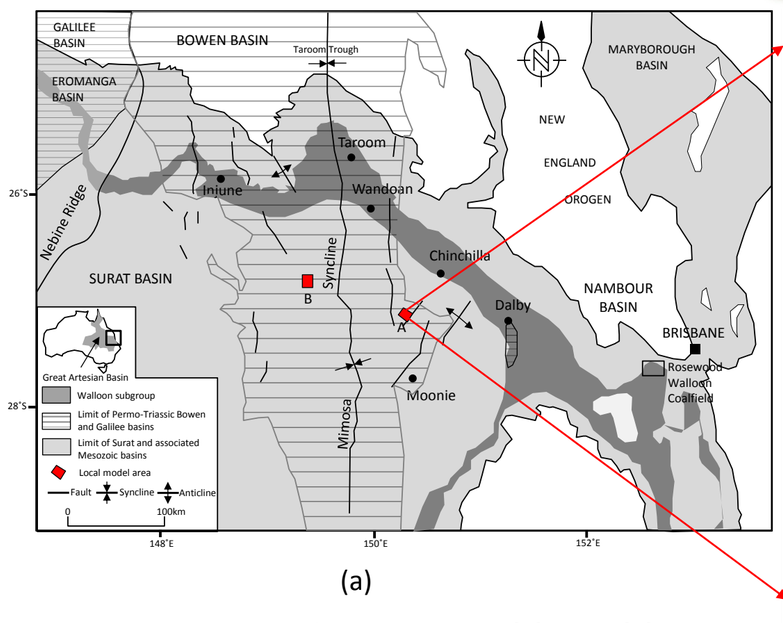
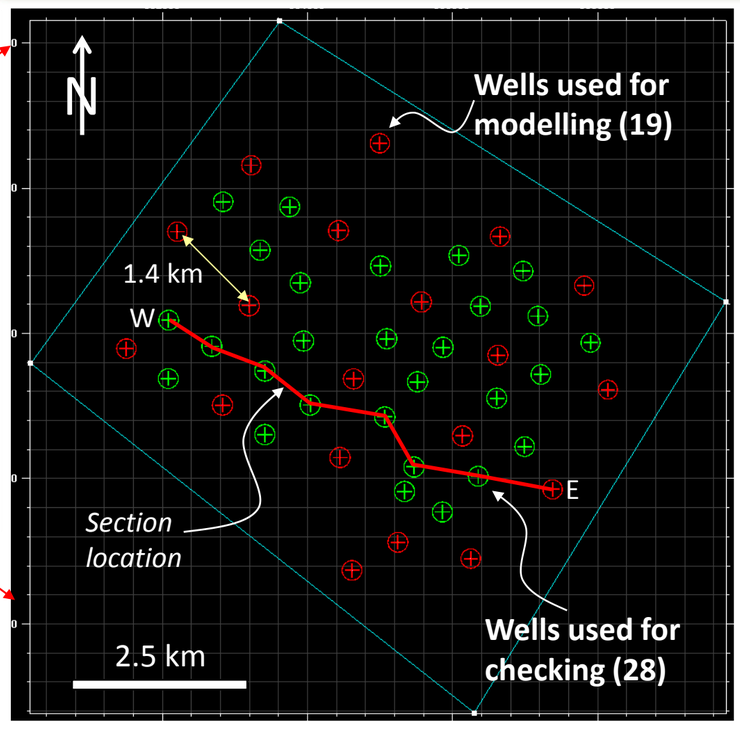


Fig. 4. Locations of the study area (a) wells (b).



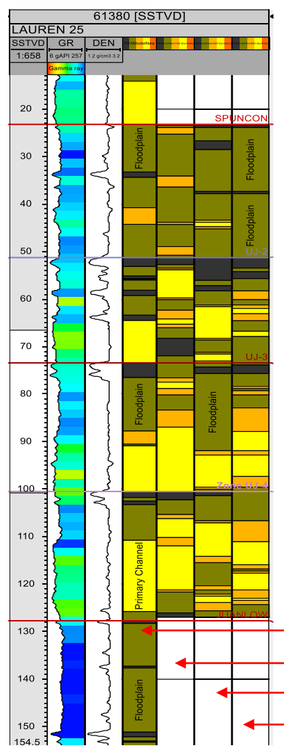


Fig. 5. An example showing depositional facies comparison between log and model predicted depositional facies at one borehole. A workflow in Petrel was used to automatically calculate the prediction accuracy by using different variogram ranges, major direction, and vertical range. Major range varies from 0 to 5 km; major-range/minor-range ratio varies from 1 to 2; vertical range varies from 1 to 5; major range direction varies from 0 to 180˚. Each case includes 200 realisations.

RESULTS

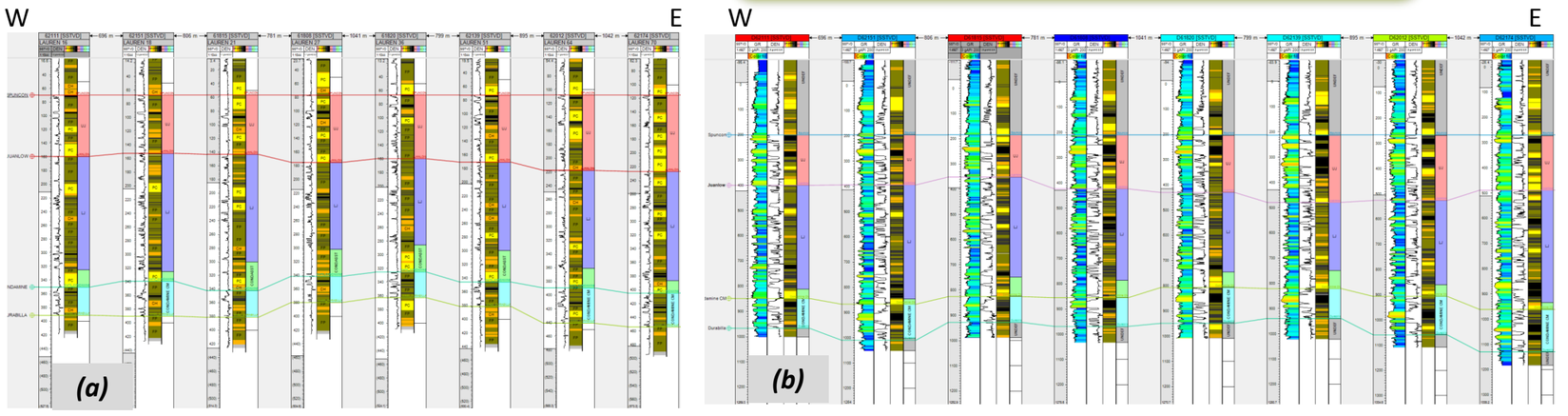


Fig. 6. Correlation based on un-decompacted (a) and decompacted (b) wire logs and depositional facies.

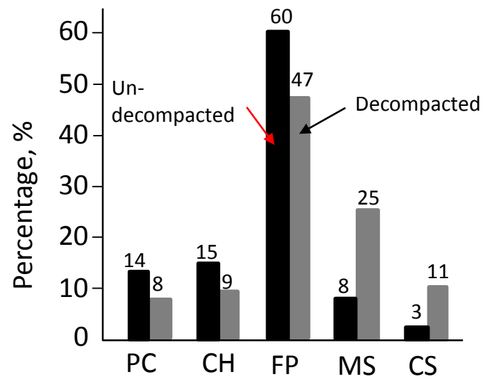
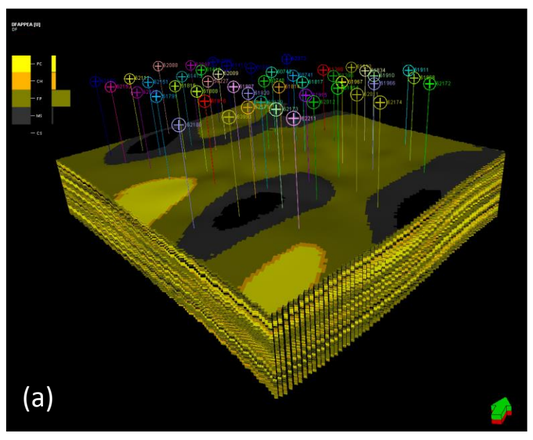


Fig. 7. Histogram of facies.



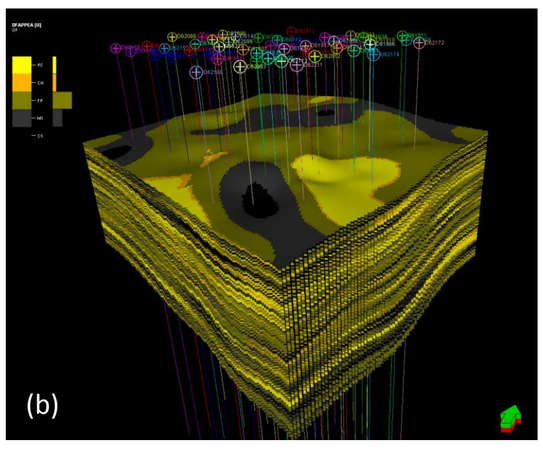


Fig. 7. One each realisation of depositional facies by truncated Gaussian method with (a) un-decompacted wireline logs and (b) decompacted wireline logs (decompaction ratios of Sandstone, Dirty Sst, Siltstone, mudstone, carb coal, and coal are 1.7, 1.7, 1.9, 2.5, 4.5, and 18, respectively).

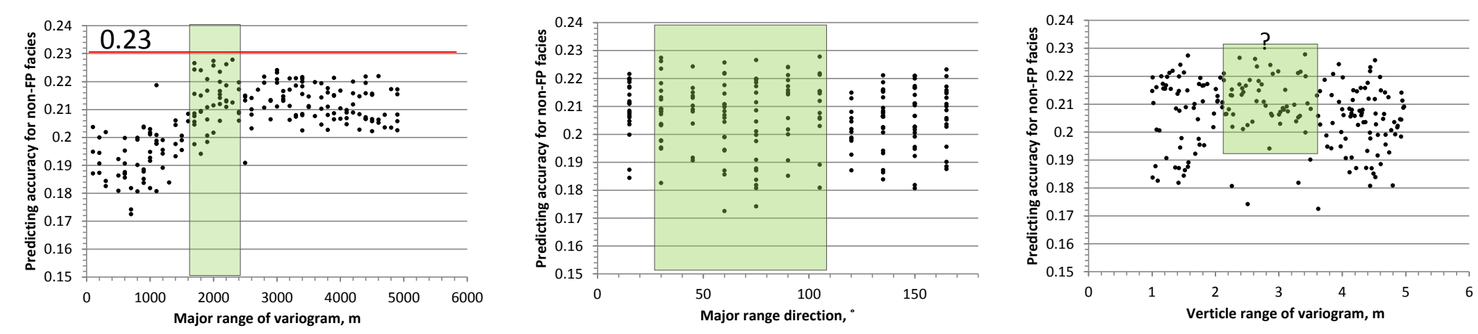


Fig. 8. Predicting accuracy against (a) major range of variogram; (b) major range direction; (c) vertical range of variogram for coal with un-decompacted wireline logs. *Major range at about 2 km yields highest predicting accuracy of about 23 %. Major range direction and vertical range have less impact on predicting accuracy for coal.*

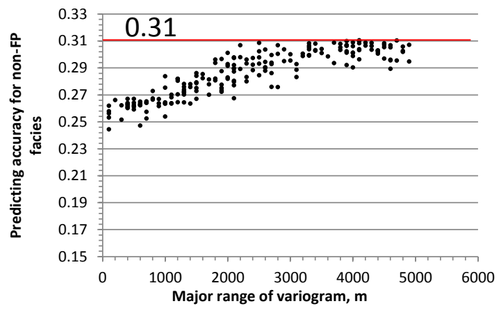


Fig. 9. Predicting accuracy against major range of variogram with decompacted wireline logs. *Major range at about 3 km yields highest predicting accuracy of about 0.31 %. Note that the different decompaction ratio will affect the grid numbers for different facies.*

CONCLUSIONS

- A workflow has been generated in Petrel to compare the predicting accuracy for depositional facies with different variogram geometry.
- Major range has a strong relationship with predicting accuracy compared with variogram direction and vertical variogram range.
- The incremental predicting accuracy is about 8% with decompacted logs.
- More decompaction ratios will be assessed in future.

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