Palaeogeographic mapping of the basal Epsilon Formation, southern Cooper Basin, South Australia: What are the controls determining the organic enrichment of the uppermost part of the Murteree Shale?

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Abstract

To support the voracious worldwide demand for energy resources into the future, a significant focus by energy companies is likely to be on the exploration and development of unconventional resources. One such unconventional resource that has started to attract more attention in recent times is the extraction of ‘shale gas’ – natural gas that is trapped within fine-grained sedimentary lithologies. Of particular interest is the Munkarrie gas field, located in the southern Cooper Basin, South Australia. Within this field, the Munkarrie-2 and Munkarrie-4 wells contain a relatively high Total Organic Carbon (TOC) concentration from the top of the Murteree Shale. This project was charged with determining what were the controlling factors regarding the organic richness in the uppermost part of the Murteree Shale. Ironically, it is the overlying Epsilon Formation that may possibly determine what may be the cause of the ‘sweet spot’ for the Murteree Shale. Core logging was performed at Munkarrie-2 and Toolachee-17 to gain a better understanding of the core. This confirmed that part of the Munkarrie-2 cored interval was a barrier island complex that existed in a microtidal lacustrine environment – the Murteree Lake.

Using Schlumberger Petrel, both 2D and 3D models were created from a total of 420 wells within the study area. The large quantity of data helped construct an assortment of geocellular models, subsea depth maps, isopach and sandstone percentage maps, culminating in the construction of a palaeogeography map. The palaeogeography map is a palinspastic restoration for the basal segment of the Epsilon Formation, exposing the depositional environments and reconstructing the fluvio-deltaic processes that were operative at the time. As deltaic progradation occurred, it is hypothesised that fluvial run-off from nearby floodplains created prosperous conditions for bacteria and algal organisms. Thus, a semi-enclosed lagoon caused by the existence of the barrier islands may have become anoxic due to the prolific multiplication of the organisms. Nourished by a nutrient supply from nearby fluvial systems, a proliferation of algae may have led to a dramatic increase in organic carbon on the lake floor. This study is proposing that the presence of barrier island complexes, situated in the basal part of the Epsilon Formation, could be connected to a localised organic TOC enrichment zone that has been recognised in the upper Murteree Shale (just below the lithostratigraphic boundary of the Epsilon Formation).
# Table of Contents

1.0 Introduction ............................................................................1
   1.1 Introduction and Key Research Question ............................................1
   1.2 Aims .............................................................................2
   1.3 Deliverables .....................................................................2
   1.4 Geological Setting .................................................................2
   1.5 Structural Ridges and Troughs .....................................................3
   1.6 Previous Work ....................................................................7
      1.6.1 Prior Palaeogeographical Studies ..............................................7
      1.6.2 Environmental Conditions ....................................................9

2.0 Methodology ..........................................................................11
   2.1 Introduction ......................................................................11
   2.2 Data Preparation and Loading ....................................................11
   2.3 Well Correlation ................................................................12
   2.4 Time-Slice Partitioning ............................................................13
   2.5 Building a Subsurface Geological Model ......................................13
   2.6 Nautical Chart Colourisation Assigned to the Palaeogeographic map ........................................................................15
   2.7 Sedimentary Log Design .........................................................16

3.0 Electrofacies .........................................................................17
   3.1 Electrofacies Analysis and Classification ......................................17
      3.1.1 Fining Upwards Pattern .........................................................19
      3.1.2 Coarsening Upwards Pattern ..................................................20
      3.1.3 Cylinder ('blocky') Pattern ......................................................21
      3.1.4 Serrated Pattern .................................................................22

4.0 Lithofacies & Sedimentary Logs ..............................................24
   4.1 Lithofacies Analysis ...............................................................24
      4.1.1 Facies A: Light grey siltstone ..................................................28
      4.1.2 Facies B: Coal, carbonaceous siltstone and organic-rich mudrock ........................................................................28
      4.1.3 Facies C: Shale ................................................................29
      4.1.4 Facies D: Heterolithic bedding with ripples and soft-sediment deformation .................................................................30
      4.1.5 Facies E: Horizontally laminated sandstone with minor mud drapes .................................................................31
      4.1.6 Facies F: Horizontally laminated sandstone with ripples, low-angle cross-lamination and plant fragments ........................................................................32
      4.1.7 Facies G: Heterolithic bedding with vertical burrowing ..............32
      4.1.8 Facies H: Dark grey siltstone (Lacustrine mudrock) ..................33
4.1.9 Facies I: Fine-grained sandstone with burrows ................................................. 35
4.1.10 Facies J: Laminated siltstone with rippled cross-lamination .............. 35

5.0 Palaeogeography Maps and Other Data ......................................................... 37
5.1 Summary of Results ....................................................................................... 37
5.1.1 Base Map ........................................................................................................ 37
5.1.2 Subsea Depth Maps (top of Epsilon Formation & Murteree Shale surfaces) .. 37
5.1.3 Isopach Map (entire Epsilon Formation) ....................................................... 37
5.1.4 Sandstone Percentage Map (basal Epsilon Formation) .............................. 38
5.1.5 Palaeogeography Map - Unbiased ................................................................. 38
5.1.6 Palaeogeography Map - Interpreted ............................................................... 38
5.1.7 Fence Diagram & Correlation Window ........................................................ 38
5.1.8 3D Model ....................................................................................................... 38

6.0 Discussion ....................................................................................................... 48
6.1 Findings of the Palaeogeographic Map.......................................................... 48
6.1.1 Introductory Statements ............................................................................... 48
6.1.2 General Progradation Direction ..................................................................... 48
6.1.3 Fluvial Systems .............................................................................................. 48
6.1.4 Floodplains ................................................................................................... 50
6.1.5 Barrier-island complexes ............................................................................. 51
6.2 Controls on the Organic Richness of the top section of the Murteree Shale in the Munkarie field .................................................................................. 52
6.3 Limitations and Uncertainties ........................................................................ 55

7.0 Conclusion ...................................................................................................... 56

8.0 Bibliography .................................................................................................... 57

Appendix 1 – basal Epsilon Formation ‘Picks’ ...................................................... 62
Appendix 2 – TOC Data ....................................................................................... 71