Defining the Beetaloo Sub-basin

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Introduction

This presentation was given as part of the AGES2018 Workshops, held in Alice Springs on 20–21 March 2018.

The workshop presented findings from the ‘Definition of the Beetaloo Sub-basin boundary’ project and the update of the ‘greater McArthur Basin SEEBASE® surface’. Participants were introduced to the geological, geophysical and modelling workflows used and had the opportunity to discuss the results of these projects with the principal authors from both NTGS and Frogtech Geoscience.
Previous Boundaries
Previous Boundaries
Previous Boundaries
Aims

• Determine what problems exist with previous sub-basin definitions

• Investigate suitable criteria for defining the Beetaloo Sub-basin

• Create more scientifically meaningful sub-basin boundaries
Definition

• NTGS defined the boundary of the Beetaloo Sub-basin using the top of the Kyalla Formation at a depth of 400 m
Why the Kyalla Formation
Why the Kyalla Formation

• The boundary needed to include as much of the Roper Group stratigraphy as possible

• We wanted the most amount of geological constrains as possible

  − Kyalla Formation intersected in 19 of the 26 petroleum wells across the sub-basin, the most frequently intersected unit
Why at 400 metres

- Cambrian unconformity between 200–370 metres depth below the surface
Methodology

• Collate and QAQC well data

• Standardise stratigraphic units and depth-time convert all formation tops

• Import well data into Kingdom and interpret
Statistical Analysis – Well data

• Time/depth relationships for each well were modelled and condition tested (non-random variables, normal sample distribution, etc.)

• Simple regression models then used to test linear relationships and predict depth of formation tops in TWT (seconds)
Statistical Analysis – Well data

Burdo Two Way Time/Depth Linear Regression

Tanumbirini Two Way Time/Depth Linear Regression
Statistical Analysis – Regional Time/Depth Model

- Well data from all wells in the sub-basin combined and averaged to calculate a regional time/depth relationship

- Individual well time/depth data compared to one another using hypothesis testing to analyse population means and variance
Boundary Constraints

• 19 geological controls (intersections) of the Kyalla Formation in well data

• The top of the Kyalla Formation interpreted along 96 seismic lines

• The intersection of the formation top with either faults, younger unconformities or the 400 m depth constraint resulted in 84 geophysically interpreted control points
Constraints
Regional Geological Interpretation

- Base Roper Gp, base Nathan Gp, base McArthur Gp, top Kyalla and top Velkerri formations recently interpreted across the sub-basin

- Results used to inform the updated SEEBASE depth to economic basement product
Interpretations - PB13-20
Interpretations - PB13-20

West

East

8 km
Daly Waters Fault Zone Longitudinal Section
Daly Waters Fault Zone Longitudinal Section
Sills and Synsedimentary Faulting
Regional Cross-sections (PB13-20, HAL2012-L122 & L229)
Regional Cross-sections (PB13-20, HAL2012-L122 & L229)
Basin Evolution

Deposition of McArthur Group

West Beetaloo Sub-basin  Daly Waters Structural High  East Beetaloo Sub-basin  Arnold High

Hatches Creek Group/Tomkinson Creek Group/Birrindudu Group

Cambrian units  Mc Arthur Gp  Roper Gp  Tawallah Gp  Nathan Gp  Bedrock
Basin Evolution

Deposition of Nathan Group
Basin Evolution

Tilting of McArthur and Nathan groups
Basin Evolution

Basin inversion/eustasy? and erosion

West Beetaloo Sub-basin

Daly Waters Structural High

East Beetaloo Sub-basin

Arnold High

West

East

Hatches Creek Group/Tomkinson Creek Group/Birrindudu Group
Basin Evolution

Deposition of Roper Group
Basin Evolution

Basin inversion/eustasy? and erosion followed by Cambrian deposition

West Beetaloo Sub-basin  Daly Waters Structural High  East Beetaloo Sub-basin  Arnold High

Hatches Creek Group/Tomkinson Creek Group/Birrindudu Group

Cambrin units  Mc Arthur Gp  Roper Gp  Tawallah Gp  Nathan Gp  Bedrock
Thank You