Thermal insights in the McArthur Basin based on bitumen reflectance and illite crystallinity

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Outline:

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• Geological setting
• Stratigraphy

Samples and Methodologies

Results
• Mineralogy
• Illite Crystallinity
• Solid Bitumen Reflectance
• Paleotemperatures

Conclusions
Geological setting

- Intracratonic basin
- Paleo- to Mesoproterozoic (1815 Ma to 1450 Ma)
- Unmetamorphosed sediments

Armour Energy has permits for exploration of conventional and unconventional reservoirs (oil and gas) in the Southern McArthur Basin, Batten Fault Zone.

In the Glyde 1 gas flowed at greater than 3 million standard cubic feet/day at 600m depth.
Glyde 1
(vertical Well)

Bukulara Sandstone
Ediacaran Period
580-540 Ma

Barney Creek Formation
1640 +/- 3 Ma

Stratigraphy

(Modified from Armour Energy, 2013; Munson, 2014)
Methodologies:

**X-Ray Diffraction** – whole rock and clay separates

- **General mineralogy** (semi quantitative)
- **Illite crystallinity** defined as the width of the first-order basal reflection (10Å peak) at half height – Kübler Index. Size fraction (2 μm).

**Organic Petrography**

- **Solid Bitumen Reflectance** – conversion to vitrinite reflectance using Landis and Castaño (1995) equation
- Determination of **paleotemperatures** using Barker and Pawlewicz (1986) equation
Samples:

Drill Cuttings

<table>
<thead>
<tr>
<th>Formation</th>
<th>Mineralogy Samples (N)</th>
<th>Optical Petrography Samples (N)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Glyde 1</td>
<td>Glyde ST1</td>
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<tr>
<td></td>
<td>13</td>
<td>13</td>
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<tr>
<td>Barney Creek Fm.</td>
<td></td>
<td></td>
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<tr>
<td>Teena Dolomite</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Emmerugga Dolomite</td>
<td>1</td>
<td>7</td>
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</tbody>
</table>
Erratic behaviour

Low diagenetic zone
(~150 to 200°C)
Lamalginate

Glyde ST1 - Sample C
Solid bitumen in the stratification

Glyde ST1 Sample C

Glyde ST1 Sample G
Solid bitumen surrounding crystals

Glyde 1
Sample E

Glyde 1
Sample K
Other Solid bitumens

Thucholite
Glyde 1
Sample E

Rounded Bit.
Glyde 1
Sample K
After conversion of the solid bitumen reflectance to vitrinite reflectance, 0.72% to 1.24% values were determined, indicating that the maturity of organic matter is the range of oil window passing to gas window.
Paleotemperature values determined from the solid bitumen reflectance after conversion to vitrinite reflectance
Conclusions:

- Evaluation of the thermal maturity achieved in the two wells in the McArthur Basin as based in the study of illite crystallinity and solid bitumen reflectance.
- Both illite crystallinity and solid bitumen reflectance show an erratic behaviour with depth.
- Hydrothermal fluid interaction is the main responsible for this erratic behaviour.
- The reflectance values and paleotemperatures placed the maturation of organic matter in the range of oil window passing to gas window.

- New data from a other drilled well (Lamont Pass 3) showed at least two different phases of hydrocarbon migration and reflectance values higher than the ones found for the Glyde wells.
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