Geoscience Australia’s Activities in the Georgina Basin

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APPLYING GEOSCIENCE TO AUSTRALIA’S MOST IMPORTANT CHALLENGES
Southern Georgina Basin

**Petroleum System Elements**

- Middle Cambrian marine source rocks
- Arthur Creek Fm
- Type II kerogen
- Paleozoic oil and gas generation
- Preservation since Devonian Alice Springs Orogeny
Southern Georgina Basin

Statoil’s Oz-Alpha-1

Central Petroleum’s Enerdrill Rig 2

AGES Conference 17-18 March 2015
Georgina Basin Project Overview

Aim: Reduce exploration risk by improving the understanding of conventional and unconventional hydrocarbon prospectivity

Activities:

• Compile and release regional geoscience datasets (2014-2015)
  ➢ GIS data package, Well Composites
  ➢ HyLogging data package; reprocessing and interpretation

• Australian Source Rock Study (2015-2016)
  ➢ Characterise and map effective source rocks (oil & gas)
  ➢ Map limit of petroleum systems i.e. correlation of hydrocarbon fluids generated by source rocks either in-place or migrated
Georgina Basin GIS Geoscience Data Package

Includes datasets on:
- Landsat
- Map sheets & cross sections
- Potential field data
- Seismic lines locations and jpegs
- Wells
- Formation tops
- Biostratigraphy
- Shows
- Geochemistry
  - TOC, Rock-Eval
  - XRD, ICPMS, XRF
Georgina Basin Well Composites

Includes datasets
• Logs (calliper, gamma, sonic)
• Porosity, Permeability
• Lithology
• Hylogger SWIR Albedo, Mineralogy
• Formation tops
• Biostratigraphy
• Geochemistry
Georgina Basin Stratigraphy

Smith et al., APPEA 2013
Lower Arthur Creek Formation Source Rock

Arthur Creek Fm

Thorntonia Lst
Source Rock Characterisation

Arthur Creek Fm ‘shales’
- HI >300 to 750 mg/gTOC
- Type II kerogen, excellent oil & gas source potential

Thorntonia/Hay River ‘carbonates’
- HI >300 to 700 mg/gTOC
- Type II kerogen, excellent oil & gas source potential
HyLogging data package: released Sept 2014

25 wells (NT and QLD)
Reprocessed data by Rocksearch

Request it here:
Hunt 1 Dulcie Syncline

- Arthur Cr
- Thorntonia
- Red Heart
- Mt Baldwin

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Hunt 1 Mineralogy

Arthur Ck Fm
Thorntonia
RHD
Mt Baldwin

Gp1 TIR Minerals
Calcite
Dolomite
Quartz
White micas
Feldspars
Hunt 1: observed relationships

Gamma

SWIR albedo

TOC

Total recovery rate

Arthur Creek Formation
Characterising the Arthur Creek Fm

- Mapping the base of the Arthur Creek Fm across the Dulcie Syncline on the basis of spectral response.
- Note lack of response – aspectral behaviour due to the dark core
Isotope Stratigraphy

Dulcie Syncline

Microbial alteration
Lindsay et al, 2005

Toko Syncline

Undilla Sub-basin

Calcite  Ankerite  Dolomite  Siderite  Whole carbonate

NTGS 99/1 (Crevelling et al, 2013)

BMR Mt Isa 1

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Isotope Stratigraphy

Arthur Creek Fm

Microbial alteration
Lindsay et al, 2005

unconformity

Thorontonia Lst/
Hay River Fm

Baldwin 1

\[ \delta^{13}C_{org} (\%) \]

-34 -32 -30 -28 -26 -24

Macintyre 1

\[ \delta^{13}C_{org} (\%) \]

-34 -32 -30 -28 -26 -24

503.5 504.5 505.5 506.5 507.5 508.5 509.5 510.5

AGE (Ma)
Shale Gas Targets

max. 2,500 units (1 unit = 200 ppm methane equiv.)

PetroFrontier Press Release May 2012
Shale (mud) gas: Carbon Isotopes

Mud Gas:
MacIntyre-2H 20–423 units meq
Owen-3H 9–23 units meq
(1 unit meq = 200 ppm)

- Methane
- Ethane
- Propane
- i-Butane
- n-Butane
- i-Pentane
- n-Pentane

Carbon isotopes (%)

Error ±0.6‰ (2σ)

Units:
- Up to 423 units
- 20 units
- 15 units
- 23 units

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Carbon Isotopes; $C_1$ to $C_3$ Gases

MacIntyre-2H
$T_{max}$ 462°C; $V_{Rc^*}$ 1.14%

Owen-3H
$T_{max}$ 436°C; $V_{Rc^*}$ 0.71%

*Jarvie et al., 1991
$R_c = 0.018T_{max} - 7.16$
MacIntyre-2H: Arthur Creek Fm TOC & Rock-Eval

- **Total organic carbon (%):**
  - Drilled depth (m) vs. total organic carbon.

- **Rock Eval T$_{max}$ (°C):**
  - Drilled depth (m) vs. Rock Eval T$_{max}$.

- **Hydrogen Index (HI, mg hc/gTOC):**
  - Drilled depth (m) vs. Hydrogen Index.

- **Oil staining:**
  - Decrease in HI as HC generation progresses.

- **T$_{max}$ representative of maturity:**

Data from PetroFrontier
Source Rock Characterisation and Oil Staining

Arthur Creek Fm ‘shales’
- HI >300 to 750 mg/gTOC
- Type II kerogen, excellent oil & gas source potential

Tmax Values
- Tmax 460-470 °C kerogen
- Tmax < 440 °C oil staining
Thank you

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