Exploration of a sub-salt play in the Southern Amadeus Basin, Central Australia – searching for big gas in Proterozoic reservoirs

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Proterozoic Amadeus Basin, Northern Territory, Australia

Amadeus Basin – Neoproterozoic to Palaeozoic basin part of Centralian Superbasin

- Proterozoic – Palaeozoic sedimentary fill with several proven petroleum systems
- Targets are TCF-sized gas resource in conventional structures under Proterozoic evaporite seals
- Seismic program well advanced with drilling planned for 2019

Seapex 2017
Amadeus Basin; Wells, Seismic, and Infrastructure

Northern Amadeus Basin; Phanerozoic petroleum system, Mereenie and Palm Valley fields

Southern Amadeus Basin; Proterozoic petroleum system, under explored.
Thick, deformed Bitter Springs evaporite sequence

Thin, slightly deformed, Cambrian to Devonian series above the Petermann unconformity:

Some minor Alice Springs deformation

Thick, strongly folded, Cambrian to Devonian series above the Petermann unconformity:

Strong Alice Springs deformation
Amadeus Basin; Tectonic Elements

Three tectonic trends influenced basin development

1. Albany-Fraser
2. Petermann
3. Alice Springs
Wells in the south have penetrated a thick Proterozoic evaporite sequence and two wells Magee-1 and Mt Kitty-1 have tested gas from below the evaporites.
Neoproterozoic Sub-salt play

Gas flows from Magee-1 (1992) and Mt Kitty-1 (2014) have proven the sub-salt petroleum system.

- 2 wells have tested the sub-salt play, both flowed hydrocarbons → proven petroleum system
- Highly competent regional evaporite seal
- Material Helium, elemental H, valuable by-products
Heavitree Sandstone; Regional context

The Heavitree/Dean Quartzite ranges from 200m to 1000m thick North and South of the Amadeus Basin. Likely deposited as an extensive sheet sandstone in the Centralian Superbasin.
Amadeus Basin Exploration Program

1300 km planned 2D seismic program to mature opportunities for drilling in 2019

2013 2D Seismic Survey
- First regional 2D seismic
- 1586 line km over 43,000 sq km
- Line length up to 387km

Objectives
- Provide regional structural and stratigraphic framework
- Link isolated 2D grids
- Identify key leads for follow up

2016/7 2D Seismic Survey
- 1300km of seismic infill; 932km acquired, remainder later in year
- Acquisition and processing parameters modified
- Longer offsets, higher sampling, longer sweep length, infield and fast-track processing
Gradual shallowing of interpreted basement/near top Heavitree Fm; onlap and thinning of Neoproterozoic section towards the SE basin margin

- Significant seismic wash-out zones in areas of thick salt and/or intense halotectonics
- Imaging of very thick Mesoproterozoic pre-Amadeus unit – potential proto-Amadeus rift succession?
Southern Amadeus Basin; Lead B updip of Magee-1

Lead B - updip of Magee-1 (1991), wet gas flow from sub-salt play

- Thinning of Neoproterozoic unit onto the SE basin margin
- Mesoproterozoic pre-Amadeus unit is better imaged where basement is shallow and Gillen salt is thin and undeformed

Seapex 2017
Central arch a long term regional migration focus, speculative rift precursor basin remnants in western sector, stress regime more favourable

- Central High Lead part of regional sub-salt basement high and likely migration focus
- Difference in deformation style between south and north
  - South → Detached thrust faults related to early Petermann Orogeny & relatively undeformed Petermann U/C
  - North → Phanerozoic deformation as a result of Devonian Alice Springs Orogeny, does not extend south of central high
Evaporites – Highly competent seal traps H, He and hydrocarbons and protects from tectonic breaching

East Siberia

- Thick Cambrian evaporite seal has taken up tectonic deformation, protecting underlying hydrocarbon accumulations from tectonic breaching
- Effective top seal traps He (0.2% in Yurubcheno-Tokhomskoye Field)
- Multi-TCF gas fields and billion bbl oil fields

Amadeus

- Thick Neoproterozoic evaporite seal has taken up tectonic deformation, protecting underlying hydrocarbon accumulations from tectonic breaching
- Effective top seal traps H and He (Mt Kitty and Magee accumulations)
- Multi-TCF gas opportunities
Southern Amadeus Basin; Sub-salt Play - RESERVOIR

Gas flows from natural fractures in granite and pre-salt carbonates

Flowtests:
- Flow test #2
- Top Basement
- Image Log
- Basement Fractures

First significant gas below evaporite succession from fractured Lower Gillen dolomite

Seapex 2017
Southern Amadeus Basin; Raft Play

Rafts are made of (probable) Upper Gillen dolomite that sank into the Gillen halite in the core of anticlines.
Seismic Reprocessing – AMSAN 13b-04

Enhance imaging of sub-salt reflector and supra-salt section

Original Processing - 2013

Reprocessing - 2017
Southern Amadeus Raft Play; South Oman Analogue

Rafts within salt section of the Southern Amadeus Basin compare favourably with Dolomite stringers in Salt from South Oman.
Hydrocarbons have been generated and trapped below sealing Neoproterozoic evaporites in the Southern Amadeus Basin.

Large structural features are present that are currently being defined by a seismic acquisition program currently underway.

The Heavitree sandstone is the primary target; regional evidence points to a fluvio-marine sheet sand onlapping and to the east and thickening into the basin to the west.

Secondary targets are Gillen dolomites present as rafts within the evaporites. There are analogies with the South Oman late Phanerozoic to Palaeozoic dolomite ‘stringer’ play.

Seismic acquisition will be resumed in the 3rd quarter 2017 with the intention of further defining targets for drilling in 2019.
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