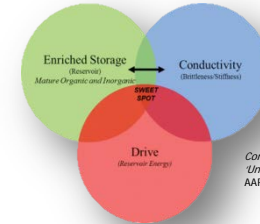
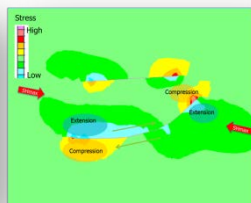
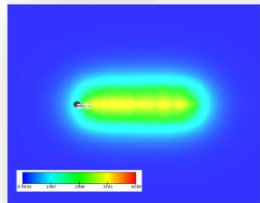
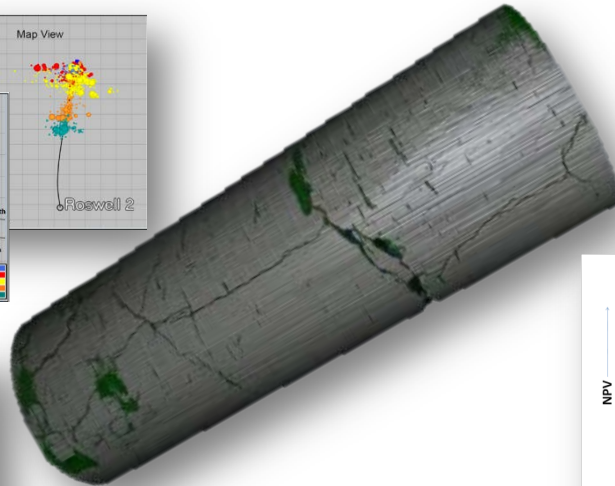
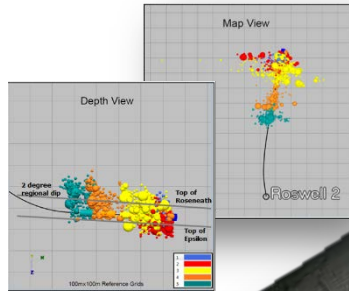
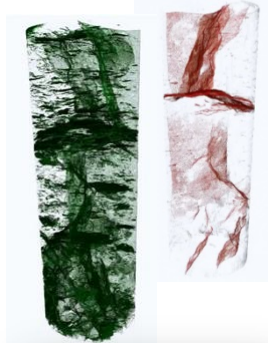


FROM PLAY TO PRODUCTION: THE COOPER UNCONVENTIONAL STORY - 20 YEARS IN THE MAKING

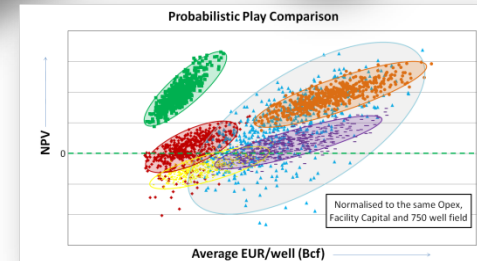
Carl Greenstreet, Santos Ltd

Concurrent Session 3: Unconventional Reservoir Breakthroughs, 2015 APPEA Conference & Exhibition

Santos
We have the energy.

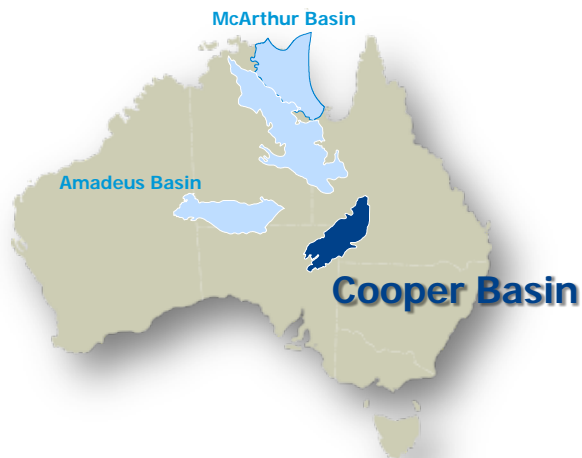


Conventional Reservoirs Hold Keys to the 'Un's by Jeff Ottmann and Kevin Bohacs, AAPG Explorer Article, February 2014



Santos
We have the energy.

Agenda



Santos Unconventional Activity Areas

Agenda Items

- **#1** Cooper Basin Unconventional Targets

- #2** SCAB JV Commercialisation Approach

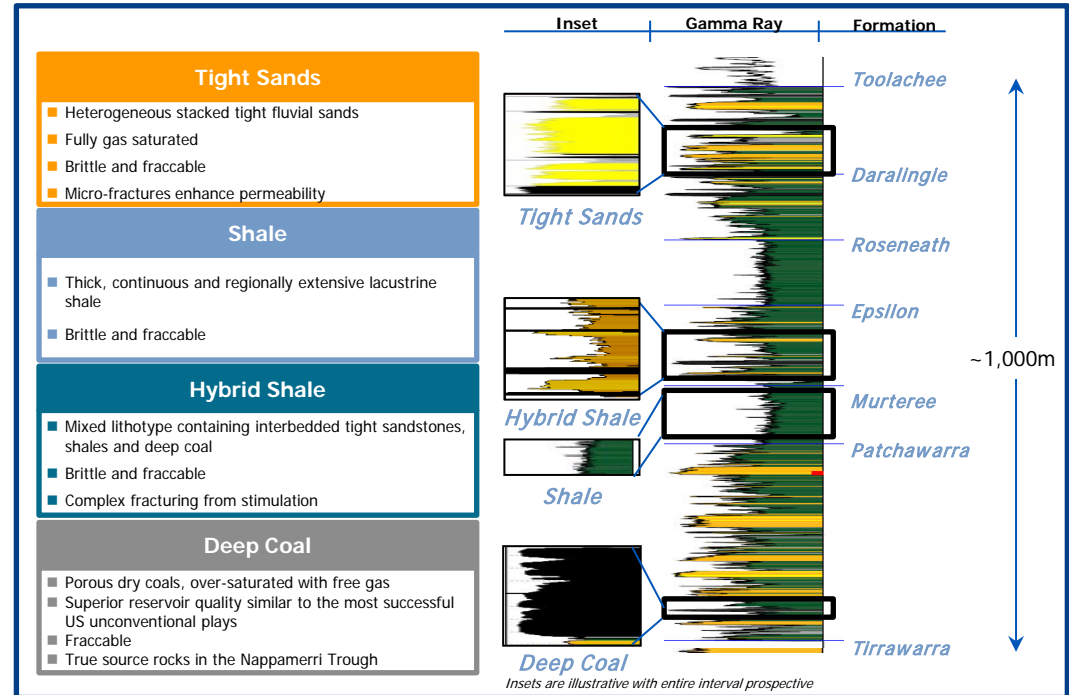
- #3** Results to-date

- #4** Next Steps

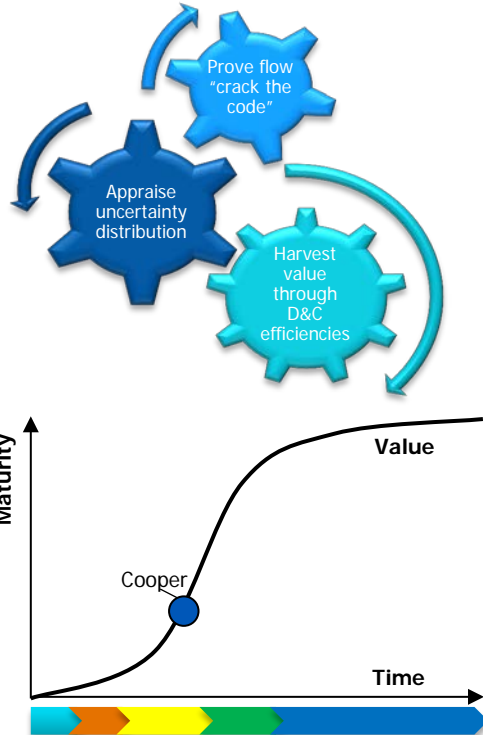
Unconventional Targets

- Permian age sequence contains four unconventional target lithotypes
- Regional distribution varies across the basin from single target to all four lithotypes stacked within a continuous gas column
- Each target has unique reservoir and productivity characteristics
- All four unconventional targets are prospective, each with proven gas content and demonstrated flow

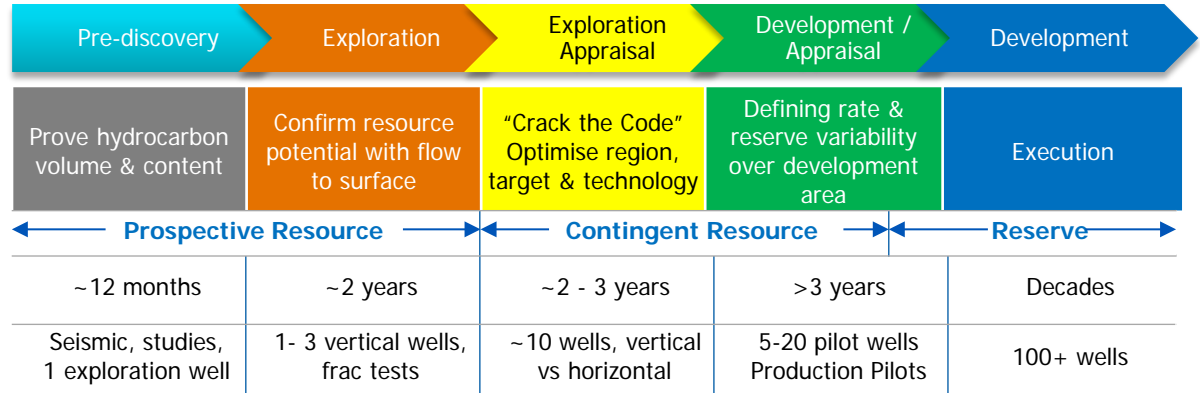
Thick sequence containing four unconventional targets, each with demonstrated flow



Commercialisation Approach



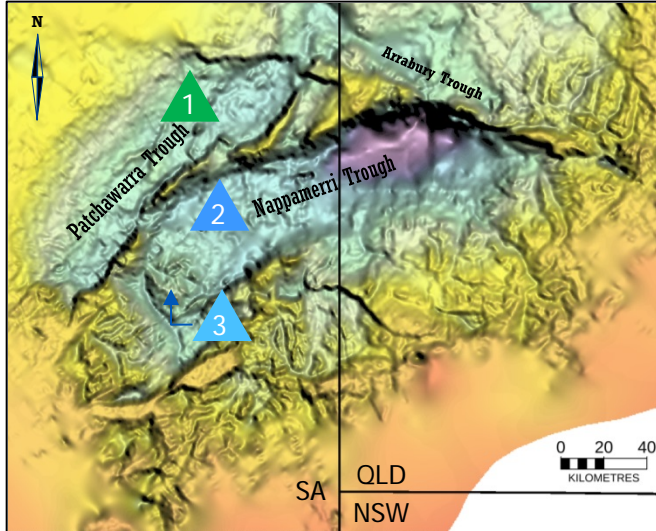
- › Involves long time frames and is capital and activity intense
- › Materiality & scale critical to underpin commerciality



Phase Gating Process



Cooper Basin Unconventional Appraisal



Basement Map

Unlocking the Cooper Basin's huge unconventional resource potential requires prioritisation, innovation and iterative learning

The economic success of unconventional resource plays depends upon the interplay between:

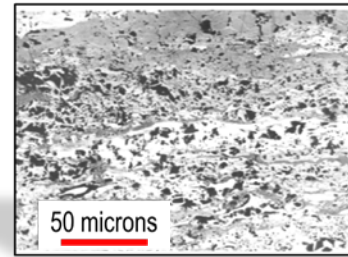
- › Reservoir Quality (RQ) "how good is the rock?"
- › Completions Quality (CQ) "what can we do to the rock to make it flow?"

Rank	Region	Targets	Reservoir Quality	Completion Quality	Comments
1	Patchawarra Trough	Deep Coal			<ul style="list-style-type: none"> › High RQ, "the source-rock" with high gas content and liquids in some areas › Add-on coal frac program in SACBJV development wells is de-risking CQ › Rates per frac stage encouraging
2	Nappamerri Trough	Tight Sand, Shale, Hybrid Shale, Deep Coal			<ul style="list-style-type: none"> › Multi-lithologies within large gas column provides multiple opportunities › Strong overpressure – positive for drive and volumes › Requires effective fracturing in high stress environment
3	Moomba Big Lake	Shale, Hybrid Shale			<ul style="list-style-type: none"> › Shale has low RQ (storage) & minor overpressure › Requires higher frac effectiveness (CQ) to compensate

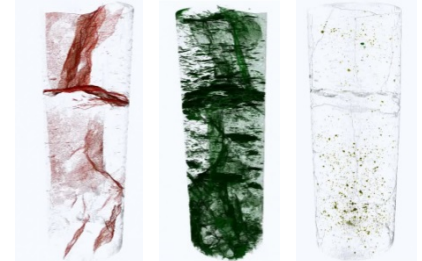
Permian Deep Coal Natural Gas Play

- › Pioneering play with no true analogues
- › Dry porous coals – no need to dewater (not CSG!)
- › Challenges prevailing belief that coals are incapable of production >2,500m depth
- › Moomba-77 (2007) play opener proved flow and achieved initial contingent resource bookings
- › Pursuing stand-alone Deep Coal opportunities in high graded regions
- › Potential to enhance base business economics by adding coal frac stages to future conventional wells

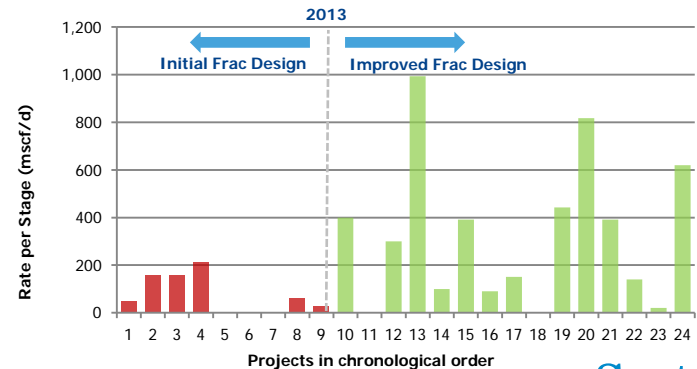
- › Step change in flow performance achieved: 0.4 mmscf/d and increasing flow rates over time
- › Material prospective resource with high liquids content (10-100 bbl/mmscf)



Polished block sample



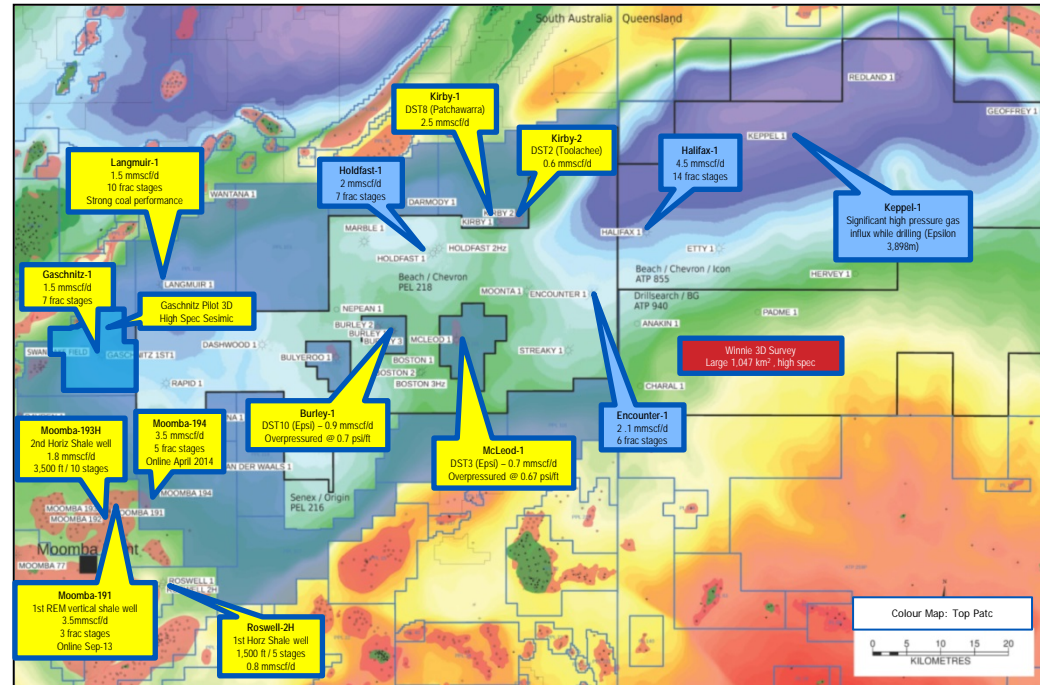
X-ray pore scale imaging (Lithicon)



Basin-centred Gas (BCG) Play

- Early Nappamerri Trough exploration from 1971 onwards focused on anticlinal gas discoveries
- In 2011, Beach Energy proved the Nappamerri Trough BCG play with the drilling of out-of-closure Holdfast-1
- 29 contemporary wells drilled into the Nappamerri Trough BCG play to-date (22 fracture stimulated); all drilled out of closure and all encountering gas
- Early results encouraging
 - Regionally extensive out-of-closure gas resource established
 - Thick >1,000m overpressured succession
 - Multiple stacked unconventional lithotypes, all with demonstrated flow
- Milestone Moomba-194 result proved ability to obtain flow from all unconventional lithotypes in a single well; well brought online at 45 e3m3 (1.6 MMscf/d)

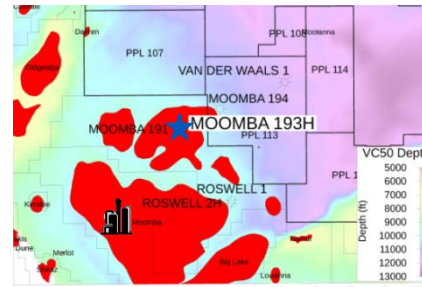
Huge Nappamerri Trough BCG play proven;



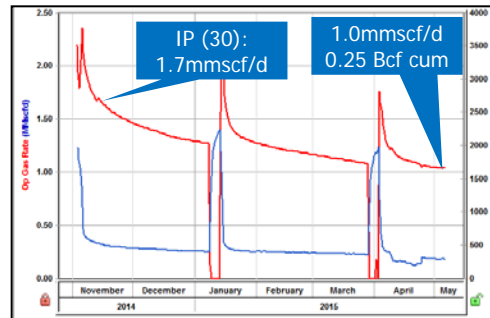
REM (Roseneath / Epsilon / Murteree) Shale Play

- Extraordinary Moomba-191 play opener quickly tied into producing infrastructure (453 Mm³ / 1.6 Bcf produced to-date)
- Further reservoir characterisation and testing appraisal work completed
- Successfully drilled two fracture stimulated horizontal – both appraisal prototypes with modest lateral lengths and frac stages
- Moomba-193H horizontal (900m lateral / 10 frac stages) on line for long term performance characterisation
- Commercial-scale wells might require 3km lateral lengths and ~30 frac stages

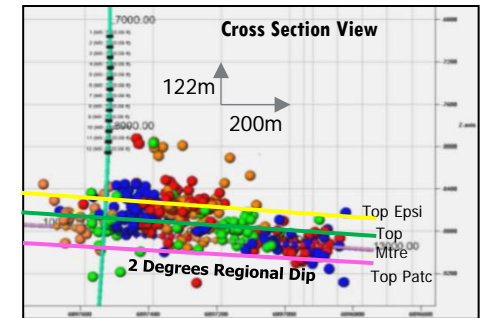
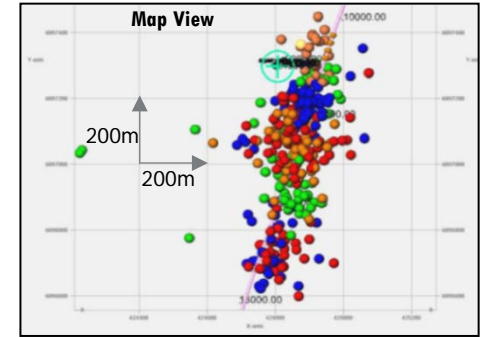
Appraised early success at Moomba-191 with two horizontal wells; interpretation ongoing



Location Map



Moomba-193H production history

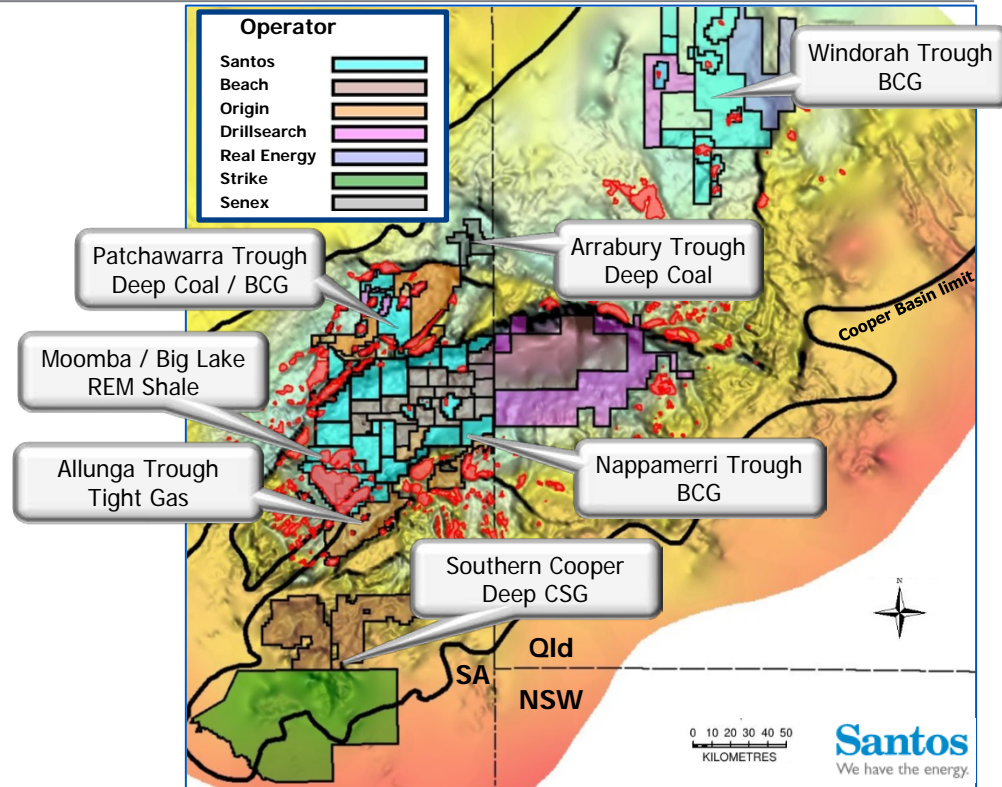


Moomba-193H microseismic monitoring

Next Steps

- Cooper Basin well positioned for further unconventional success
 - prospective geology,
 - existing infrastructure and
 - market access / demand growth
- Each resource play unique; must adapt established technologies & workflows to local conditions
- Current activities focus on defining play fairways, prioritising reservoir targets and matching appropriate D&C technologies
- Recent oil price drop may slow investment but contribution from unconventional resources will progressively grow over time

Attractive Cooper Unconventional prospectivity generating significant investment into multiple plays



Acknowledgements

Thanks to Santos and SACB Joint Venture partners Beach Energy and Origin Energy, for their ongoing support and permission to present. It is important to recognise the huge technical contribution from staff, both present and past, who have worked hard to realise the Cooper Basin's unconventional potential.

Van der Waals-1 Stimulation – Nappamerri Trough Basin Centred Gas Play



South Australia Cooper Basin JV Partners