



METALLURGICAL DEVELOPMENT OF THE MULLAQUANA URANIUM PROJECT

The AusIMM International Uranium Conference 2011

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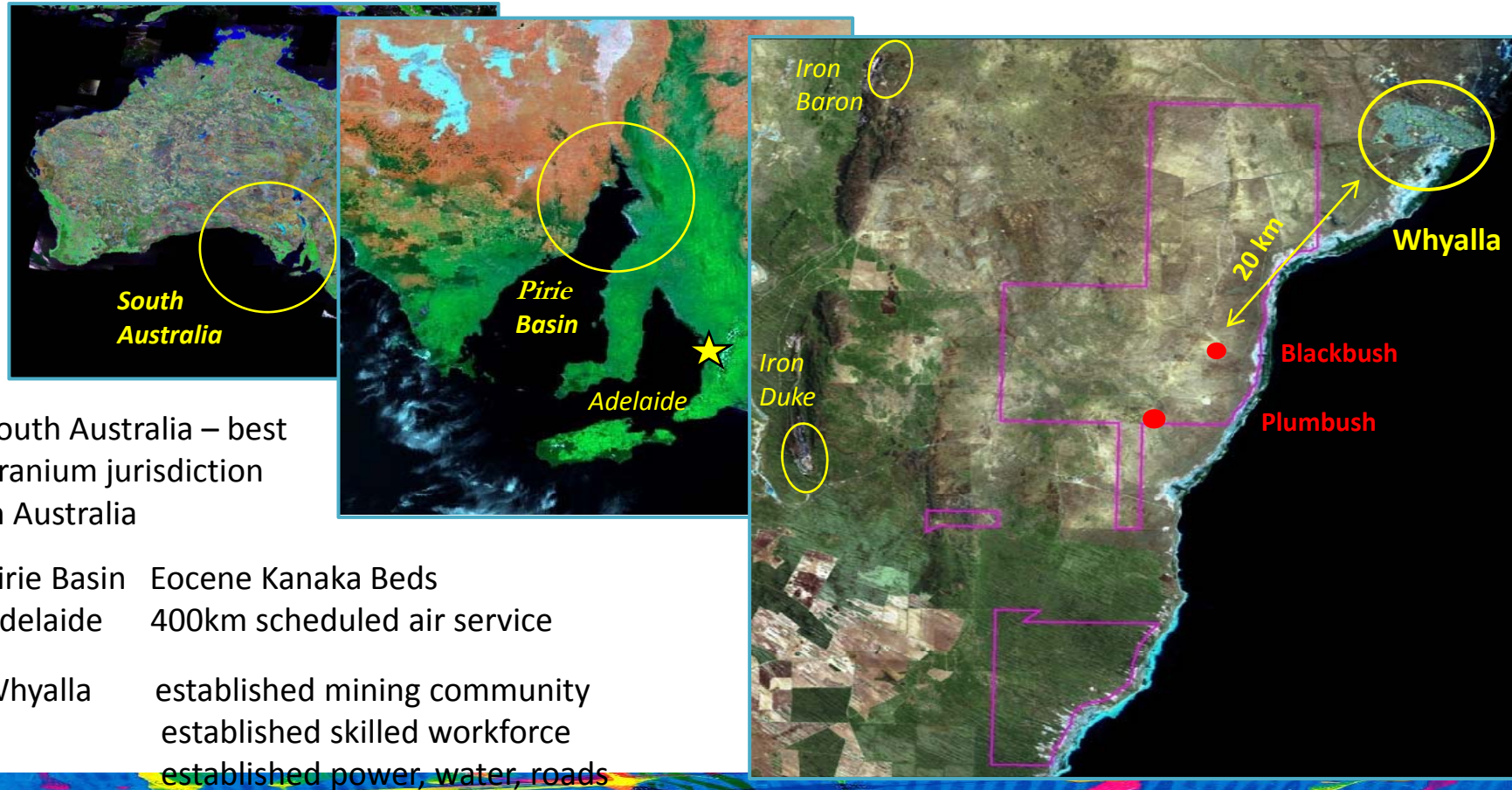
Presentation Outline

- Location
- Geology / Hydrogeology
- Ore Characterisation
- Leaching Testwork
- **Uranium Recovery from Hyper Saline Solutions**
- ANSTO Testwork Program
- In Situ Recovery Trial



Exploration location – South Australia – Pirie Basin

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Blackbush Prospect - Inferred Mineral Resource Estimate

45.5M tonnes

12,700t contained eU_3O_8
(28 million lbs)

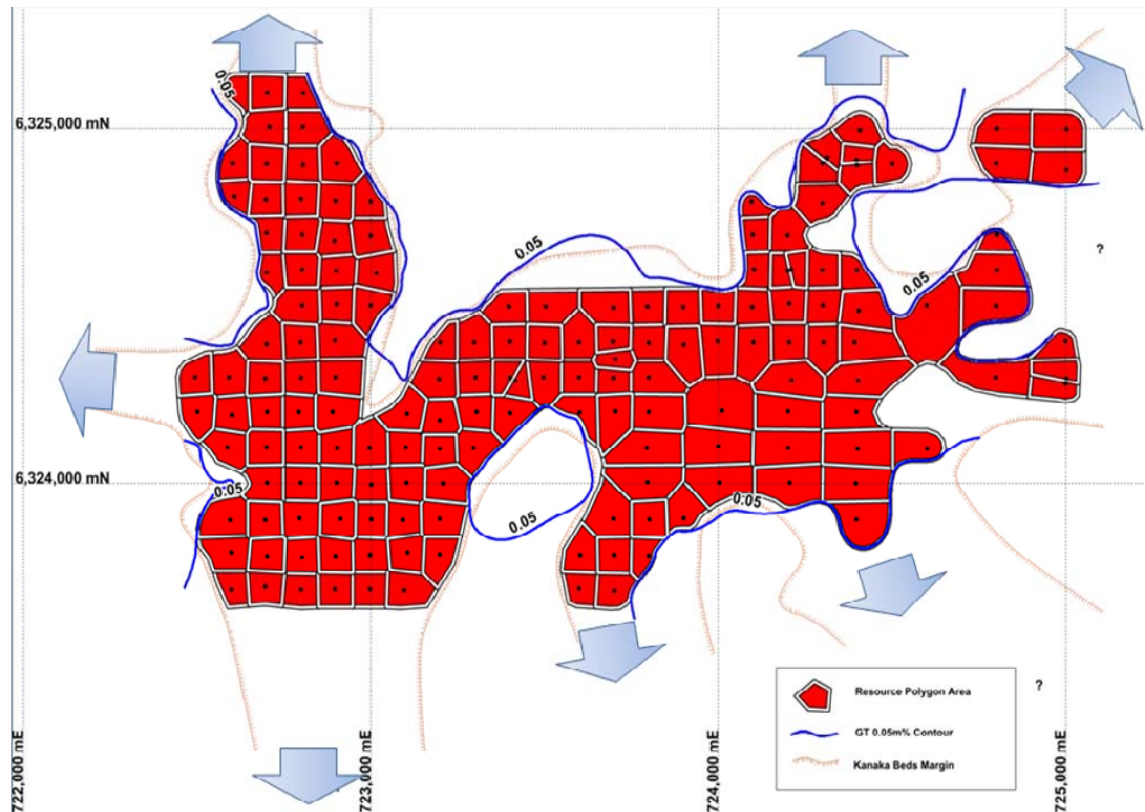
weighted average:

- grade 280ppm eU_3O_8
- thickness 11.71m

Resource envelope remains open in several directions

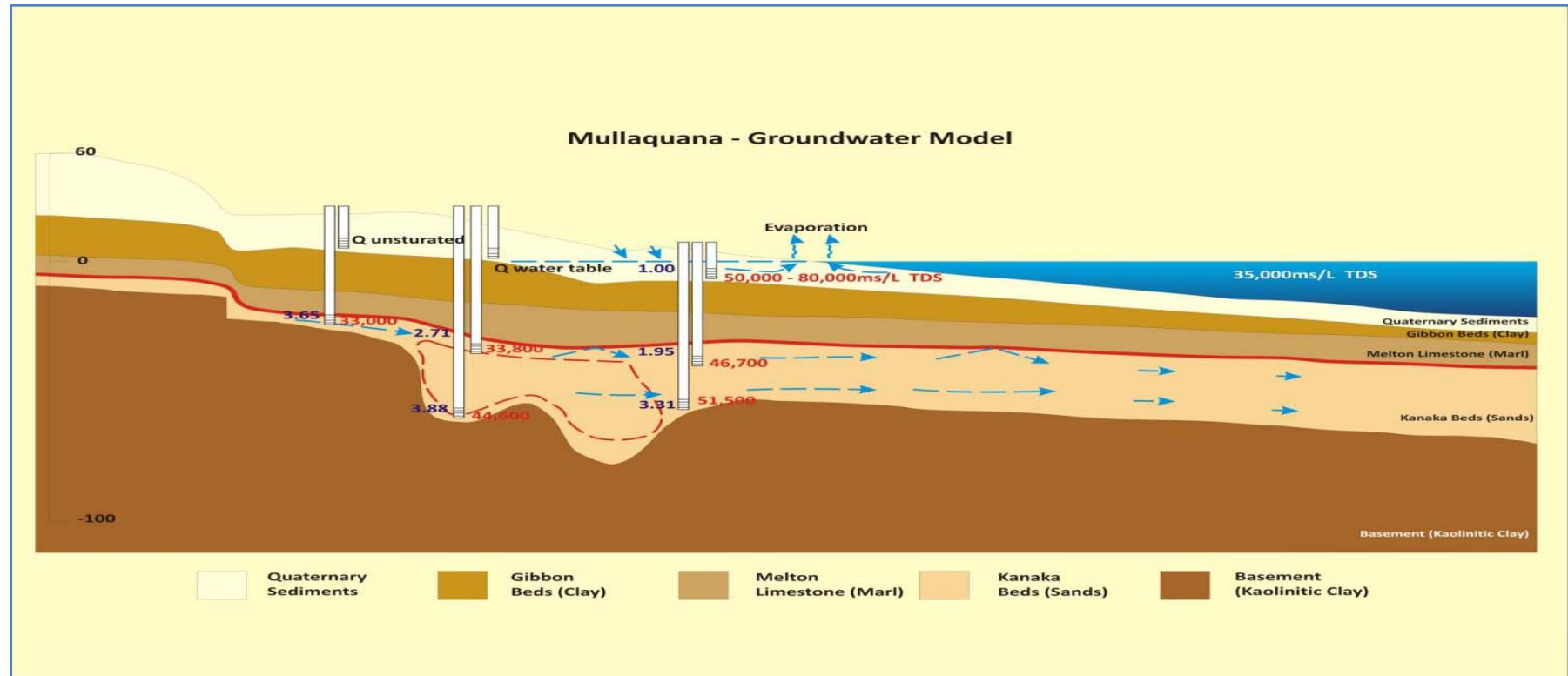
Higher grade/thickness
“starter zones” present

view north, 1 km graticules



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GROUNDWATER – SURFACE WATER - GULF



Groundwater

Analyte	Units	MRE001	MRE002
pH Value	pH Unit	7.1	7.2
Total Dissolved Solids @180°C	mg/L	33000	36000
Uranium	mg/L	0.1	0.2
Total Alkalinity as CaCO3	mg/L	180	190
Sulfate as SO4 2-	mg/L	3800	3900
Chloride	mg/L	20000	20000
Fluoride	mg/L	1.3	1.4
Calcium	mg/L	1800	1900
Magnesium	mg/L	1700	1800
Sodium	mg/L	9400	8200
Potassium	mg/L	100	110
Strontium	mg/L	24	23



Ore Characterisation

4" diameter core from 3 locations sorted into low medium and high grade composites;

- Head Assays
- Mineralogy – XRD, Qemscan
- SGs / Bulk Density
- Particle Size Distribution, Assay by Size
- Moisture
- Porosity / Void Ratio
- QA / QC (duplicates)

MRC001



High grade hole, mineralisation ~60-67m, sand / silt / lignite, gamma peak grade ~8,000 ppm eU₃O₈, average grade ~1,000 ppm eU₃O₈ at ~63m

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Ore Characterisation – Core Composite Samples

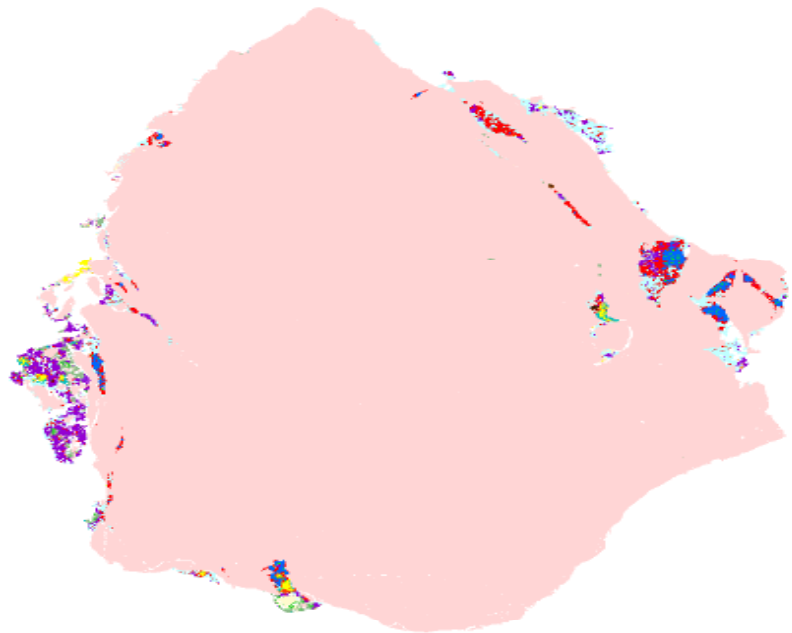
Head Assays

	U ₃ O ₈ ppm	Fe %	Ca %	CO ₃ ²⁻ %	C (org) %	Th, V ppm	Mo ppm
11 Composite average	950	0.63	0.34	1.49	4.80	~20	~30
Low	132	0.2	0.12	0.1	1.5	~ 5	~7
High	3904	2.0	1.00	7.0	14.0	~100	~150

Ore Characterisation – Core Composite Samples

Mineralogy – ~ 1.0 mm particle

Mineralisation is predominantly uraninite/coffinite localised on grain boundaries and fractures



Mineral Name	
Background	
Uraninite	
Coffinite	
Uranium - Si intergrowths coarse	
Uranium - Si intergrowths fine	
Uranium - Pyrite intergrowths	
Uranium - Clay intergrowths	
Uranium - Ti oxide intergrowths	
Quartz	
Pyrite	
Other sulphides	
Sulphide - Silicates intergrowths	
Ti-oxides and Ti-rich intergrowths	
Kaolinite or similar Al Silicate	
Chlorite and similar	
Muscovite and similar	
Feldspar	
Zircon	
Carbonates	
REE	
Other silicates	
Others	



Ore Characterisation – Core Composite Samples

➤ Particle Size

$D_{50} \sim 0.5$ mm

> 60% uranium in sub 0.5 mm fraction

➤ Bulk Density

Wet bulk density ~ 1.9 kg/L (in situ, i.e. including water)

Dry bulk density ~ 1.5 kg/L (~ 26 % moisture)

➤ Ore SG

Average ~ 2.61 with clay samples averaging ~ 2.29

➤ Porosity

Via volume, density and PSD, ranged 27 to 50%, 30% used for preliminary calculations

Indicates good permeability and suitability for ISR



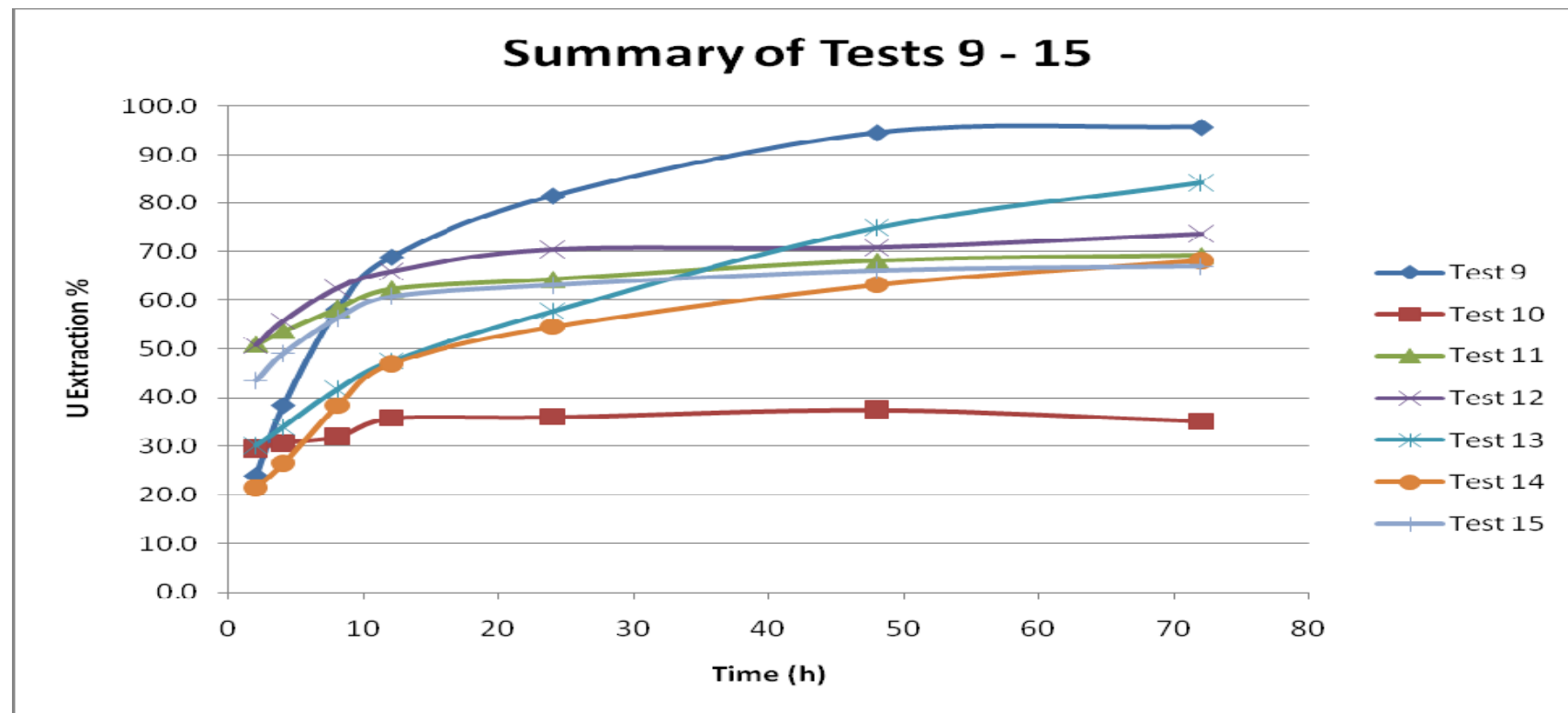
Leaching Testwork – Sea Water Bottle Rolls

- Reagent consumption tests
- Acid and Alkaline leaching tests in sea water (~21 gpl Cl)

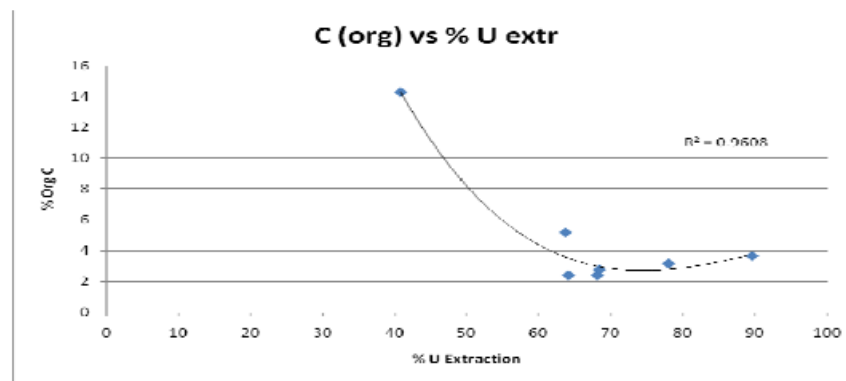
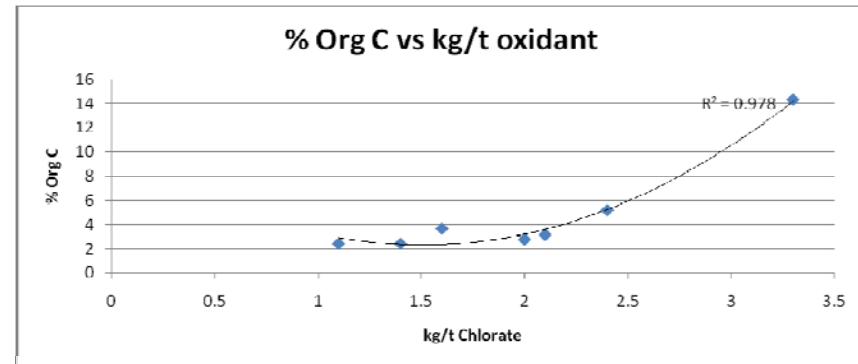
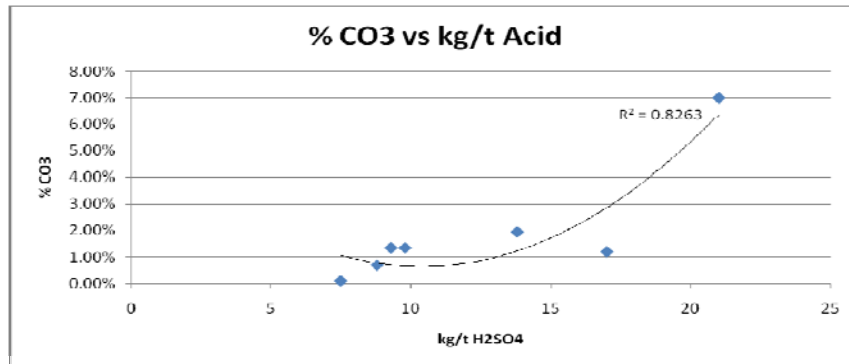
- ✓ Optimum;
 - ✓ pH 1.5 – 2.0 (sulphuric acid)
 - ✓ ORP ~500 mV, iron added + oxidant
 - ✓ 72 hrs

- Ore variability leach tests under optimum conditions

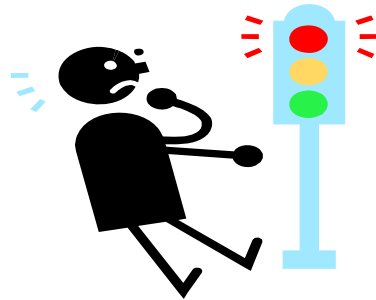
Bottle Rolls – pH 1.5 – 2.0, Ore type variation



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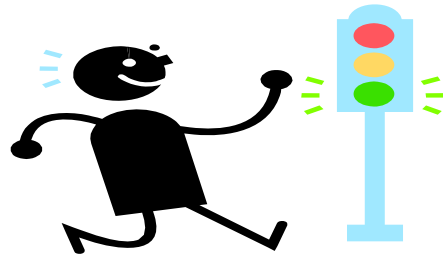


Uranium Recovery from Hyper Saline Leach Liquors



- 2008 Consulting Chemist – chelating resin for IX?
- 2010 Desktop Study
- 2010 / 2011 Vendor and Independent Testing

Uranium Recovery from Hyper Saline Leach Liquors



- ✓ 2011 Vendor and Independent Resin Testing
- 2011 ANSTO Testwork Program
- 2012 In Situ recovery trial

Uranium Recovery from Hyper Saline Leach Liquors

2011 Vendor and Independent Resin Testing – acidified sea water at 100 ppm uranium

Company / Resin	U Loading (g/l resin)	U Elution	Impurity Transfer	ANSTO Program
Dow 940U	> 30 confirmed	Na ₂ CO ₃ vendor	OK vendor	Yes
Clean Teq R603 B&C	> 30 confirmed	Na ₂ CO ₃ confirmed	?	Yes
IBC Superlig171	>10 Vendor	NaCl vendor	Iron Wash required	Yes
Clariant	>20	?	?	Yes
Iminodiacetic acid	< 10	?	High iron loading	Yes
Purolite and Others	Testing	?	?	Yes



Uranium Recovery from Hyper Saline Leach Liquors

– ANSTO Testwork Program

- Bulk ore sample ~70 kg's
- Ore characterisation (PSD, Mineralogy, dilute leach)
- Resin loading tests with leach liquors generated from 10kg bottle rolls (acidic sea water leach)
- Resins with loading > 10 g U / l resin → Elution testwork
- “Best” resins then tested with leach liquors generated from column leach tests



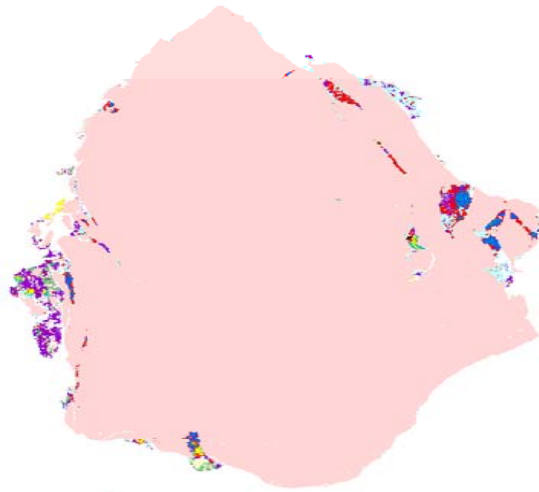
In situ Recovery Trial

- 1st Quarter 2012 commence
- Up to five patterns tested
- Sulphuric acid leach
- Ion exchange with 2 resins on trial
- Calcium control via pore volume flush and raffinate bleed

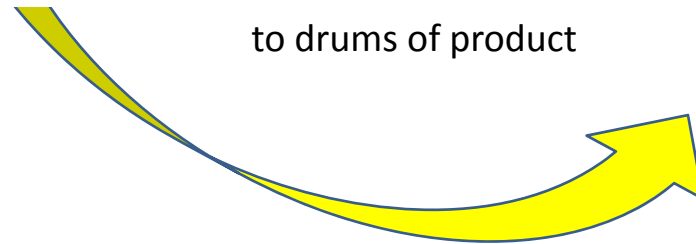
The challenge

is to move as quickly and as cost-effectively as practicable from

positive
laboratory
results



to drums of product



Acknowledgements

Questions ?



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