Mineralogy variations in the Mamadawerre Sandstone, Kombolgie Subgroup at Angularli Uranium Prospect: applications to exploration in other areas.

Belinda Smith
NTGS
Mamadawerre Sandstone – visual logging

WRD0085
“strongly bleached… fracture coated with white clay”

WRDD0136 “strongly weathered, highly fractured…” “patchy diagenetic hematite” “fractured zone has clay-filled gouges… leached”

Which hole overlies mineralisation??
Angularli prospect – geology and uranium

Inferred Resource 0.91Mt @ 1.3% U₃O₈ (~26Mlbs U₃O₈)

Vimy Resources ASX announcement 20 March 2018

Modified from Hollis and Glass, 2012. Howship and Oenpelli 1:100,000 Explanatory Notes p6
Angularli Prospect
Mamadawerre Sandstone at surface

Angularli fault zone

Oenpelli Dolerite to north

WRDD0134

WRD0117

Angularli fault zone

Bathurst Island Formation (cover)

8701450N

long section

Oenpelli Dolerite

WRD0117

Angularli fault zone

unconformity surface

(unscanned) ore zone

(distal to mineralisation drillhole)
Angularli Prospect

Mineralisation in hangingwall of structural zone (King, 2012)
Silica-sericite-clay-pyrite alteration (basement)
Sandstone mineralogy not described

Primary uranium mineralisation has developed in the hangingwall of the Angularli fault, within the SFB and the overlying sandstone.” Vimy Resources ASX

Announcement 20 March 2018
Measuring mineralogy variations

Reflectance spectroscopy: measuring absorption of radiation from molecular vibration

Proximal automatic / continuous drillcore / rock samples; Hyperspectral (mineral species including quartz, feldspars, pyroxenes) with imagery (HyLogger)

Proximal manual / point measurement (no imagery, less minerals detected than HyLogger)

15 drillholes scanned under agreement
Pyrophyllite ($\text{Al}_2\text{Si}_4\text{O}_{10}(\text{OH})_2$)
Usually in Al-rich metamorphic rocks
or from hydrothermal alteration
300-380°C temperatures at 2kBar pressures (Frey, 1987)
Can form from kaolinite

Dickite ($\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$) (kaolin polymorph)
Could be diagenetic or from hydrothermal alteration
90-130°C at 3-4.5km from diagenesis (Worden & Morad, 2003)

Tourmaline – minor; patchy matrix infill, or in breccias
well-documented in alteration around Athabasca U
Mamadawerre Sandstone; Angularli – tourmaline textures

WRD0089 with tourmaline in brecciated fracture zones at 40 m.

Tourmaline in matrix: WRD0085, 97.6 m

Image courtesy P.Sinclair, Cameco 2017
Mamadawerre Sandstone; Angularari – long section

Tourmaline near mineralisation
Diaspore (α-AlO(OH)) near faults
high temp; 275°C (Ervin and Osborn, 1951)
can form from kaolinite desilicification (Chesworth, 1994)

Orthogonal section
Looking 255° SW

Interpreted solid geology from ancillary data supplied by Cameco, 2017

unscanned intervals (mineralised)
Mamadawerre Sandstone; Angularli – diaspore textures

WRDD0137 237.1 m; diaspore > white mica close to the unconformity. Note the diaspore is in a darker zone with diffuse boundaries. Adjacent core has sulphides.

WRD0105
Mamadawerre Sandstone – long section: kaolinite

- Kaolinite thins to south
- Mixed with white mica, dickite, some pyrophyllite
Mamadawerre Sandstone – long section: dickite

- Dickite increases to south
- Higher proportion of dickite in southern holes
- Overlaps with kaolinite in southern holes but not northern holes
- Found along fractures (not interstitially) in northern holes
Mamadawerre Sandstone – long section: pyrophyllite

- Pyrophyllite increases to the south.
- Higher proportion of pyrophyllite in southern holes.
- Overlaps with dickite in southern holes but not kaolinite.
- Found along fractures (not interstitially) in northern holes.
Mamadawerre Sandstone – pyrophyllite mineralogy textures

pyrophyllite after kaolinite, WRD0063

pyrophyllite and quartz sandstone WRD0105, 179.8 m
Mamadawerre Sandstone – long section: white mica

- White mica near top of holes
- Lower crystallinity white mica near Oenpelli Dolerite to north
- Thinner, higher crystallinity white mica to the south
- White mica around dolerite intrusive in WRDD0137
Mamadawerre Sandstone – long section: chlorite

chlorite around dolerite in WRDD0137
chlorite in holes adjacent to Oenpelli Dolerite
Mamadawerre Sandstone – cross-cutting mineralogy textures

- wx kaolinite, minor possible dickite (along deformation bands?) white mica
- White mica after kaolinite

WRD0085 129.5 m: dickite along open fracture (sub-parallel to core axis) in sharp contact with well-crystalline kaolinite quartzose sandstone.
Mamadawerre Sandstone, Angularli prospect – long section: all

- Pyrophyllite and dickite more common to the south
- Tourmaline proximal to uranium mineralisation
- Diaspore in or adjacent to fault zones
- Minerals both zoned and mixed; cross-cutting
- Mixed mineralogy with local scale variation downhole
Angularli – distal hole
WRDD0136

Drilled under NTGS Geophysics and Drilling Collaborations; Round 9, 2016-2017
12km from Angularli
Background mineralisation

Bathurst Island Group
Dickite in faulted Mamadawerre Sst
Cahill Formation

Cross-section geology simplified after Sinclair, 2017

WRDD0136

(distal to mineralisation drillhole)
Comparison of Mamadawerre Sandstone white mica variations; Angularly proximal vs distal

WRDD0136: not mineralised

Logged as faulted sandstone

Mamadawerre Sandstone

Cahill Fm Metaseds and mafic amphibolites

WRD0097: mineralised

Variable white mica composition and crystallinity. Mixed mineralogy

Not Scanned

UNCONFORMITY

diagenetic

Uniform white mica composition and crystallinity

FAULT CONTACT

Faulted Mamadawerre Sandstone

Not Scanned

Uniform white mica composition and crystallinity

Not Scanned

Mamadawerre Sandstone

Cahill Fm Metaseds

Mamadawerre Sandstone

Not Scanned

AUSTRALIA NORTH TERRITORY

GES2018
Applications to exploration – using reflectance spectroscopy

Proximal manual / point measurement (no imagery, less minerals detected than HyLogger)

Proximal automatic / continuous drillcore / rock samples; Hyperspectral (mineral species including quartz, feldspars, pyroxenes) with imagery (HyLogger)
HyLogger – 26,750 spectra (~125 spectra per metre)

PIMA / ASD – 295 spectra (~1 spectrum per metre)
HyLogger vs ASD: WRD0084 white mica variations

Mamadawerre Sandstone

Moderate crystallinity white mica
Variable white mica composition (wavelength)

not scanned; (mineralised)

Lower crystallinity white mica
More phengitic than sandstone white mica

HyLogger

ASD
Summary

• Primary uranium mineralisation in the Mamadawerre Sandstone at Angularli prospect
• Mineral zonation both with depth and along strike at Angularli
• Pyrophyllite, diaspore and tourmaline at Angularli prospect
• Non-mineralised WRDD0136 (distal to Angularli prospect):
  • uniform white mica composition and crystallinity
  • no tourmaline, no diaspore, trace to no pyrophyllite
• Handheld reflectance spectroscopy tools (‘Terraspec, PIMA’) can emulate HyLogger SWIR data, especially when combined with photos (textural context) and other ancillary data (assays, petrography)
Acknowledgements

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- HyLogging and TSG are trademarked by CSIRO.
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