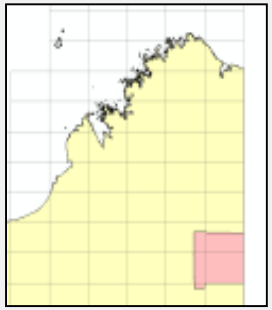
‘Beneath the sand of the Tanami Desert’

ARGA 2018, Wallaroo, SA

Nadir de Souza Kovacs

Ngururrpa program



The program area covers the traditional land of the Parna Ngururrpa People in a remote part of the Tanami Desert in WA

Parna Ngururrpa people invited GSWA to survey their country aiming to stimulate mineral exploration

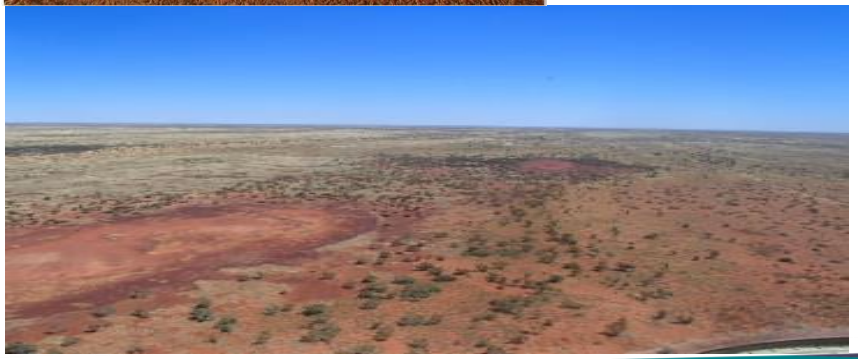
- gravity survey
- regolith landform map 1:250 000
- geochemical soil sampling

Geomorphology

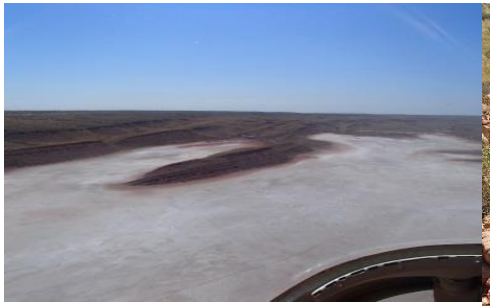
E-W longitudinal dunes and spinifex covered interdunes

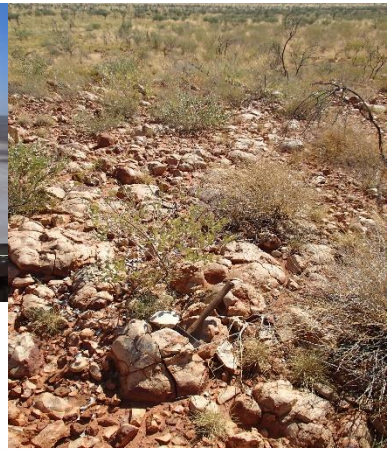
The landscape is flat, with variably weathered, low lying rock outcrops, and extensive eolian dune fields, sandplain and lacustrine - playa terrain.

Semi-arid, sandy soils, spinifex, sparse small shrubs and scattered small trees



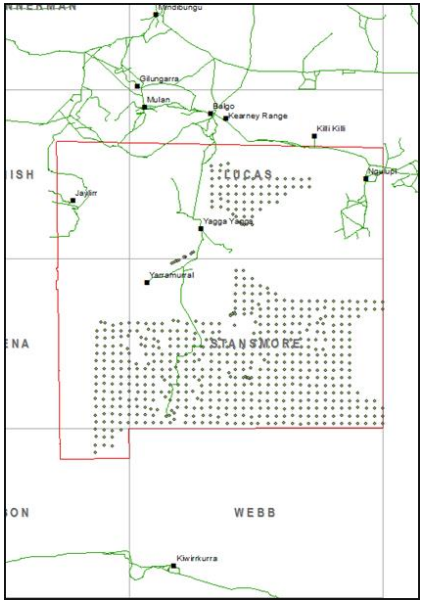
NW-SE Stansmore Range, max 510m asl – to the west lies the Canning Plain and the Great Sandy Dessert





Salt lakes and Neoproterozoic sandstone ridges covered by silcrete veneers are common to the East

Regolith sampling



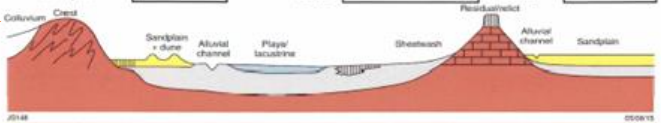
GSWA 2015 regional regolith geochemistry program collected 637 soil samples at 5 km grid, up to 90 cm depth.

NGURURRPA SAMPLING PROGRAM 2015

GSWA No | Site No M

EASTING | NORTHING

Sampler | Date | Time



REGOLITH-LANDFORM

Residual/relict | Sheetwash | Colluvium | Playa | Dunes | Sandplain | Outcrop

REGOLITH-COLOUR *Colour-other*

Red | Brown | Yellow | Orange | Grey

VEGETATION

Spinifex | Trees | Grass | Shrubs

SURFACE LAG YES NO | Mag. | Size (cm) | Sampled

SURFACE REGOLITH | Thickness (cm)

%	Fe %	Ca %	Si %	Lithic %	Quartz %	Other
Nod/grans >2mm						
Sand						
Silt/clay	N/A	N/A	N/A	N/A	N/A	

DOWNHOLE REGOLITH | Depth (cm)

%	Fe %	Ca %	Si %	Lithic %	Quartz %	Other
Nod/grans >2mm						
Sand						
Silt/clay	N/A	N/A	N/A	N/A	N/A	

LITHIC MATERIAL

%	Surface	Downhole	Outcrop	Dist (m)	Dirn (bearing)
Mafic volc					
Felsic volc					
Granitic					
Sedimentary					
Vein quartz					
Other					

Secondary coating Fe | Mn | Si | CO3 | Other

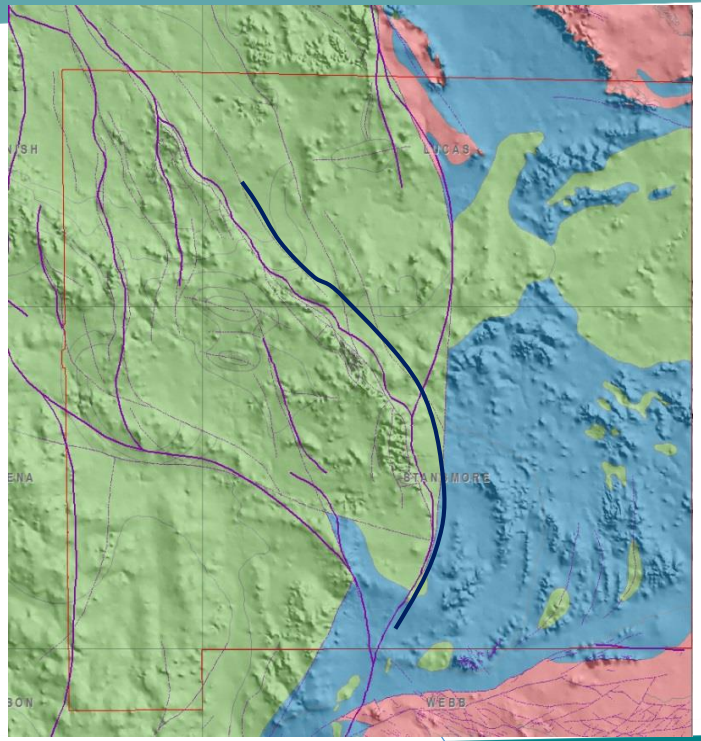
Units nearby Channel | Lake | Dune | Saprock | Saprolite | Other

Sample features Dry | Damp | Unconsolidated | Indurated | Cemented

Photo taken? YES NO

Comments

Geology



Phanerozoic Canning Basin - Eastern margin – sandstone, siltstone, minor conglomerate, coal, limestone

Proterozoic Centralia Murraba Basin – sandstone, wacke, conglomerate, siltstone, shale, limestone, dolomite, chert, and glauconitic sandstone

Proterozoic NAC - N border Granites-Tanami Orogen; granitic and S border Arunta Orogen; meta-igneous and meta-sedimentary

Regional faults and linear structures

Stansmore Fault

Minor linear structures

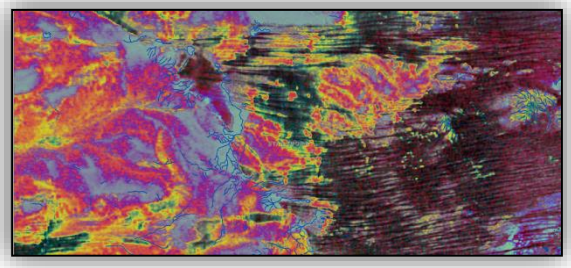
Beneath the sand…but how far beneath…

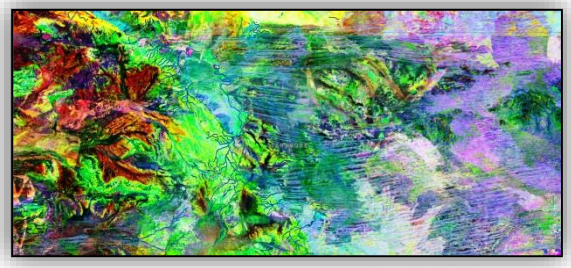
At the Surface

Orthophotos, Digital Elevation Models

Surface to 30 – 45 cm deep

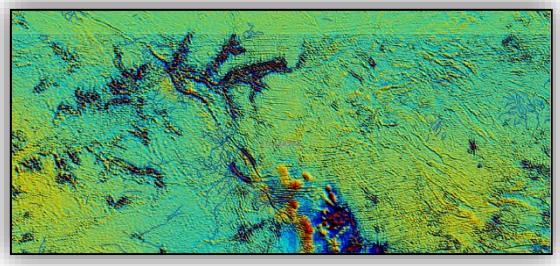
Radiometric KTU, LANDSAT AGSO ratios

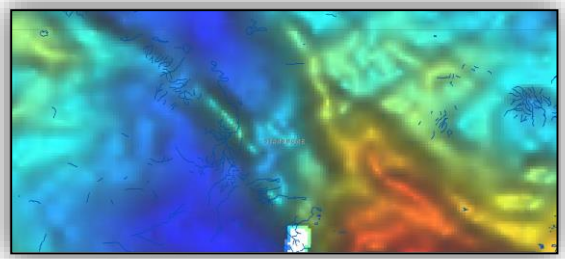




Near surface – deeper (?) (1 m to 90 m)

Magnetic VD1, Gravity





….depends on the information provided by…

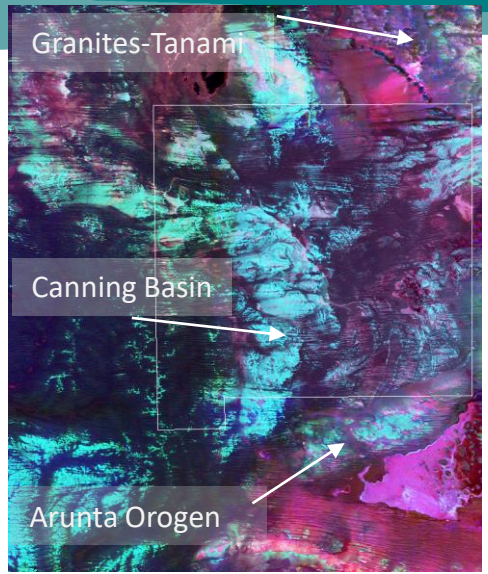
- ✓ Direct observation 2015 sampling – rock and residual regolith at less than 1 m deep
- ✓ Geophysical image - expression of regolith
- ✓ Inference from shallow stratigraphic holes in the neighbouring area (regolith thickness 1m to 90m)

Remote sensed imagery

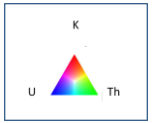
Radiometric - KTU

top 30-45 cm of the surface.
Outlines spatial distribution of materials and erosion.

Th ⟶ U ⟶ K
mobility



200 km



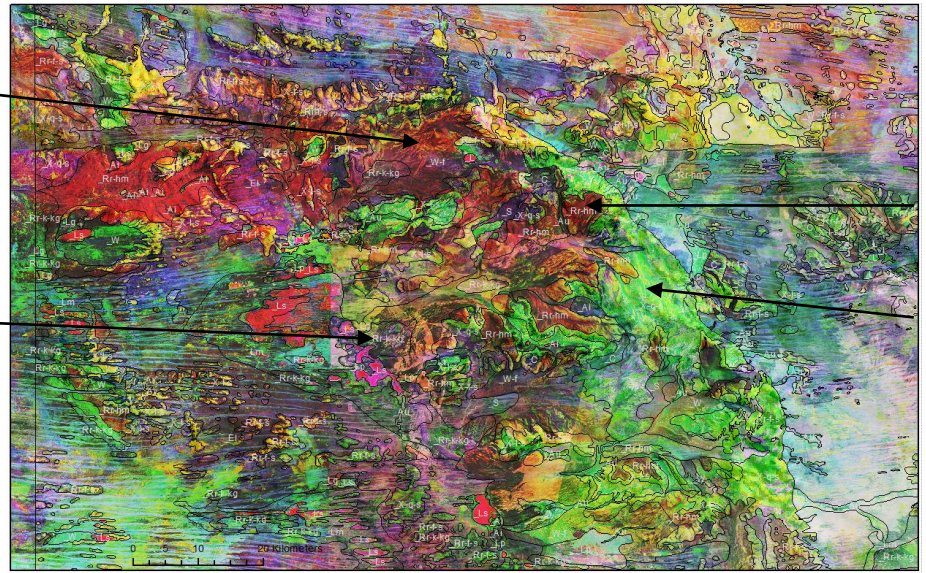
reddish-pink - quartzofelspatic and clay-rich sediments
greenish-blue - sediments, residual regolith and rocks lacking K-minerals, with relative amounts of U and Th
Eolian sand of local origin - some areas of sandplain form a thin veneer over weathered bedrock

Landsat AGSO* Ratio

top 30-45 cm of the surface.
Outlines spatial distribution of materials and erosion.

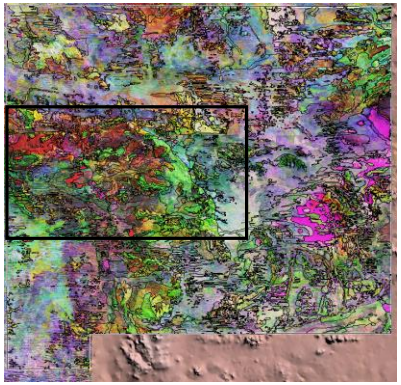
Fe- rich sheetwash (_W-f)

Calcrete (_Rr-k-kg)



Ferricrete (_Rr-hm)

Outcrop



* Ratios of bands 5/7,4/7 & 4/2 displayed as RGB respectively

Regolith

- ✓ Regolith-landform relationship with structures below
- ✓ Regolith cover will vary from > 1 m to >150 m

✓ <u>Transported regolith</u>

- ✓ Eolian sand of local origin - some areas of sandplain form a thin veneer over weathered bedrock
- ✓ Paleodrainage connecting to Lake Mackay
- ✓ Relict ferruginous magnetic palaeochannels containing magnetic minerals (magnetite/maghemite)

✓ <u>Residual regolith</u>

- Rock and residual regolith , < 1m deep at places
- Saprolite to 70 m thick under paleovalleys [1,2]
- Ferruginous duricrust on sandstone and monzogranite
- Calcrete in paleovalleys
- Silcrete veneer on Murraba basin rocks

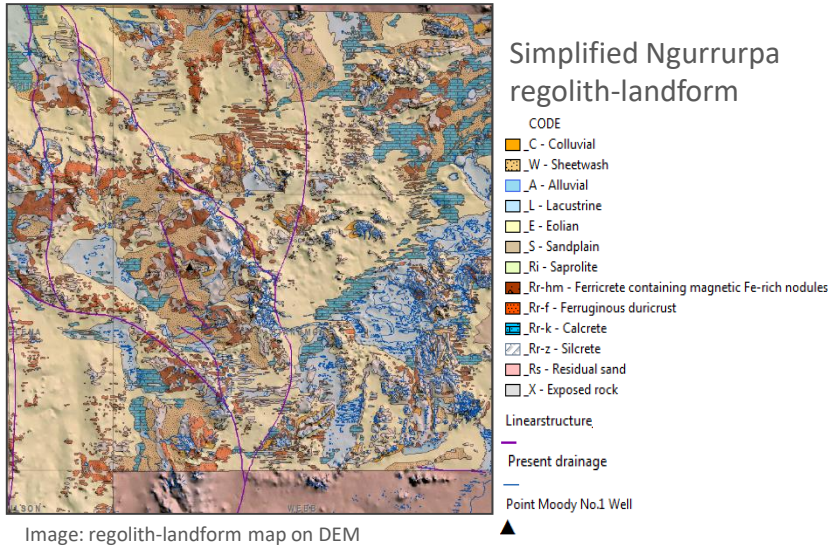


Image: regolith-landform map on DEM

[1] Blake, 1974 – Shallow stratigraphic drilling in the Granite-Tanami Region, BMR Record 1971-73
[2] Aquitaine Point Moody No.1 Well, Well Completion report 1966
[3] English, P. 2016. Ancient origins of some major Australian salt lakes: geomorphic and regional implications

Paleodrainage and paleochannels

Two paleodrainage systems

- Calcrete-filled paleovalley network up to 93 m deep
  - Four paleovalleys of a regional internal paleodrainage connecting to Lake Mackay
- Shallower paleochannel system showing a stronger magnetic response
  - Relict ferruginous magnetic palaeochannels containing magnetic minerals (magnetite/maghemite)

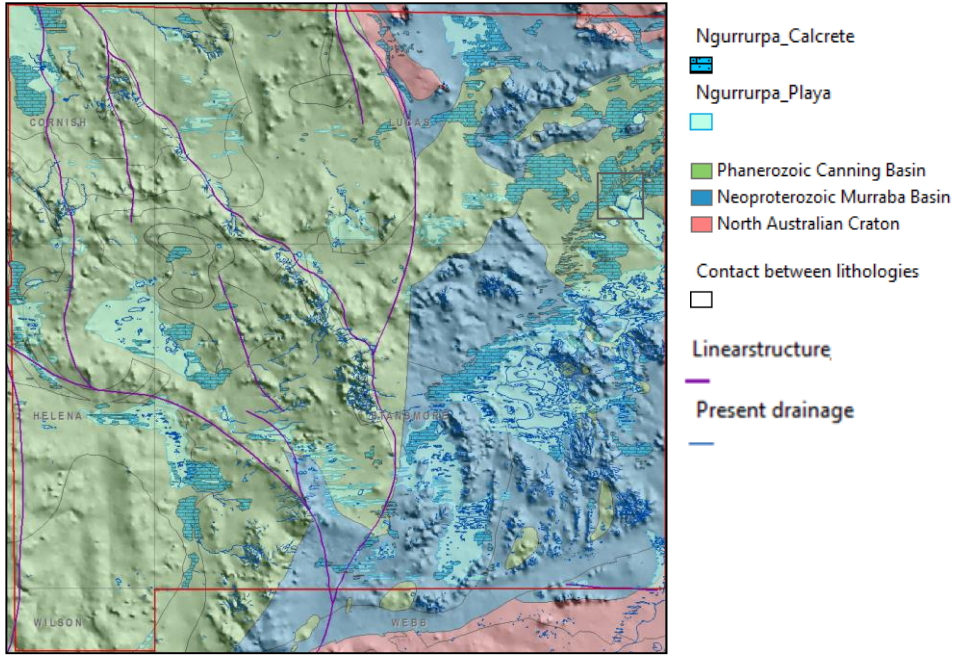
Calcrete fill paleovalleys

Regional-scale paleovalleys occupy topographic depressions, as part of an internal drainage network into Lake Mackay[3]

Palleovalleys are delineated by calcrete and lacustrine landforms

Paleovalleys run along linear structures as contact between lithology, faults and as fill in fault blocks

Distribution of calcrete and playa in relation to tectonic structures



[1] Blake, 1974 – Shallow stratigraphic drilling in the Granite-Tanami Region, BMR Record 1971-73
[3] English, P. 2016. Ancient origins of some major Australian salt lakes: geomorphic and regional implications

Calcrete fill paleovalleys

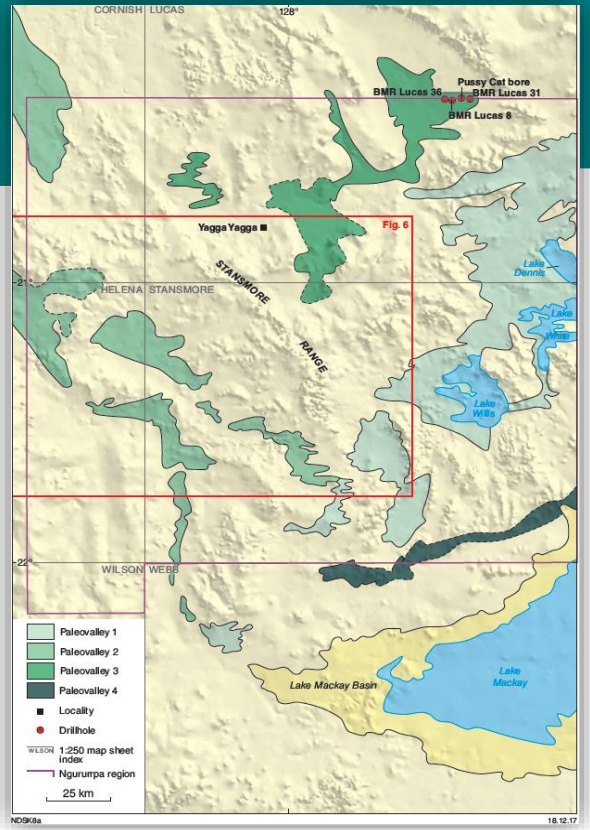
Four paleovalleys as part of an internal drainage network into Lake Mackay[2]

Paleovalleys 1 and 4 are extensions of the Wilkinkarra Paleovalley[5] in NT

Cenozoic sedimentary basin at northern end of Paleovalley 3 is 91 m deep in drillhole BMR Lucas 36[1]

Depressions are filled with calcrete (up 15 m) and unconsolidated alluvial sandy-clay and clay (up to 90m)1

Potable water between 14 – 16.5 m, below 4 m of calcrete and 10 m of sand.

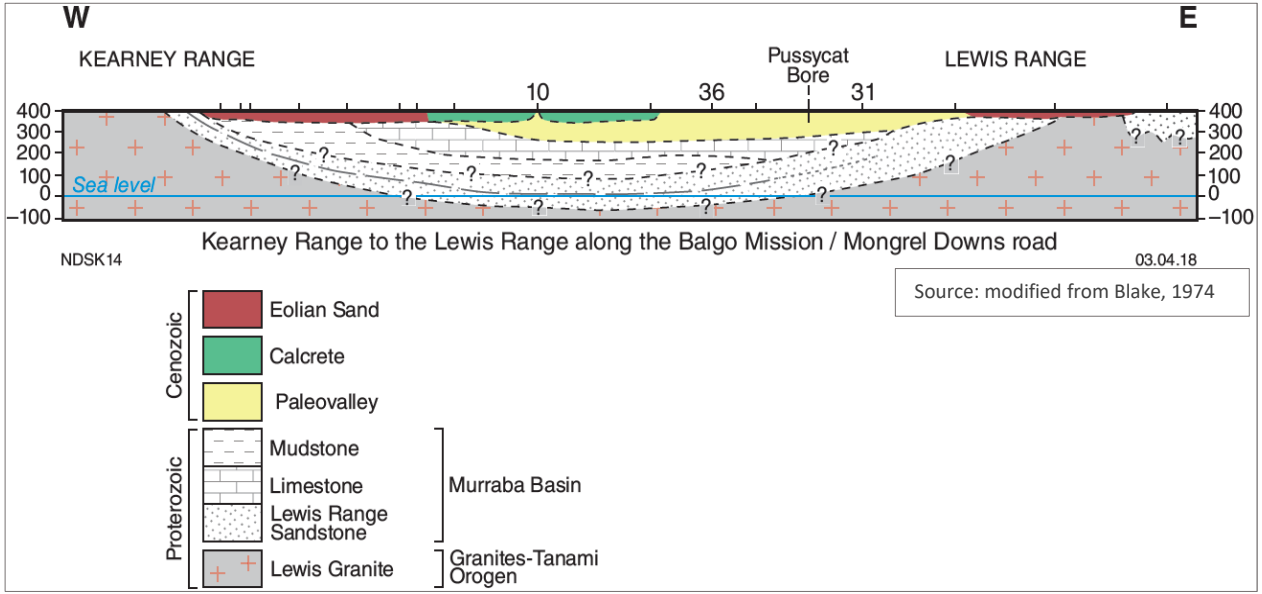


Paleodrainage network. Figure drapped on DEM.
Source: GSWA record 2018/3

[1] Blake, 1974 – Shallow stratigraphic drilling in the Granite-Tanami Region, BMR Record 1971-73
[3] English, P. 2016. Ancient origins of some major Australian salt lakes: geomorphic and regional implications
[5] Woodgate et al, 2012, Hydrological investigation of Paleovalley Aquifers in the Wilkinkarra Region, Northern Territory. Record 2012/09. Geoscience Australia

Paleovalley sequences

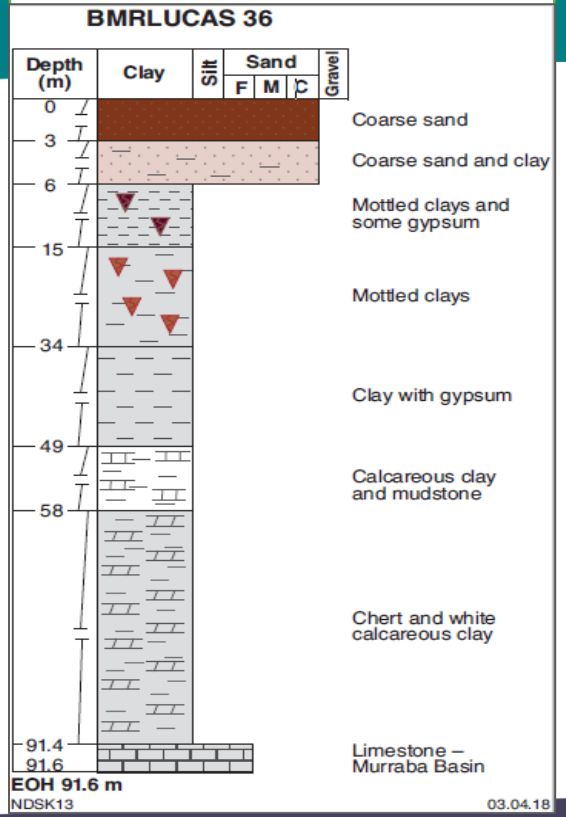
At the northern end of Paleovalley 3 is a broad Cenozoic basin reaching up to 91 m in depth [1], below 6 m of eolian sand



Source: modified from Blake, 1974

[1] Blake, 1974 – Shallow stratigraphic drilling in the Granite-Tanami Region, BMR Record 1971-73

Fining upwards channel sequences.



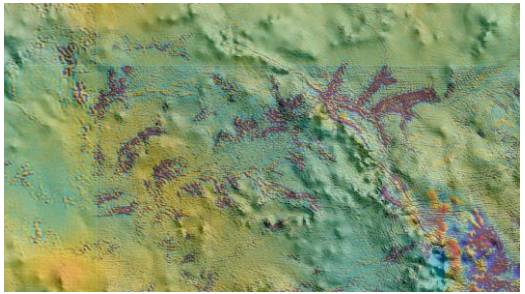
Magnetic-fill paleochannels

Up to 4.5 m deep

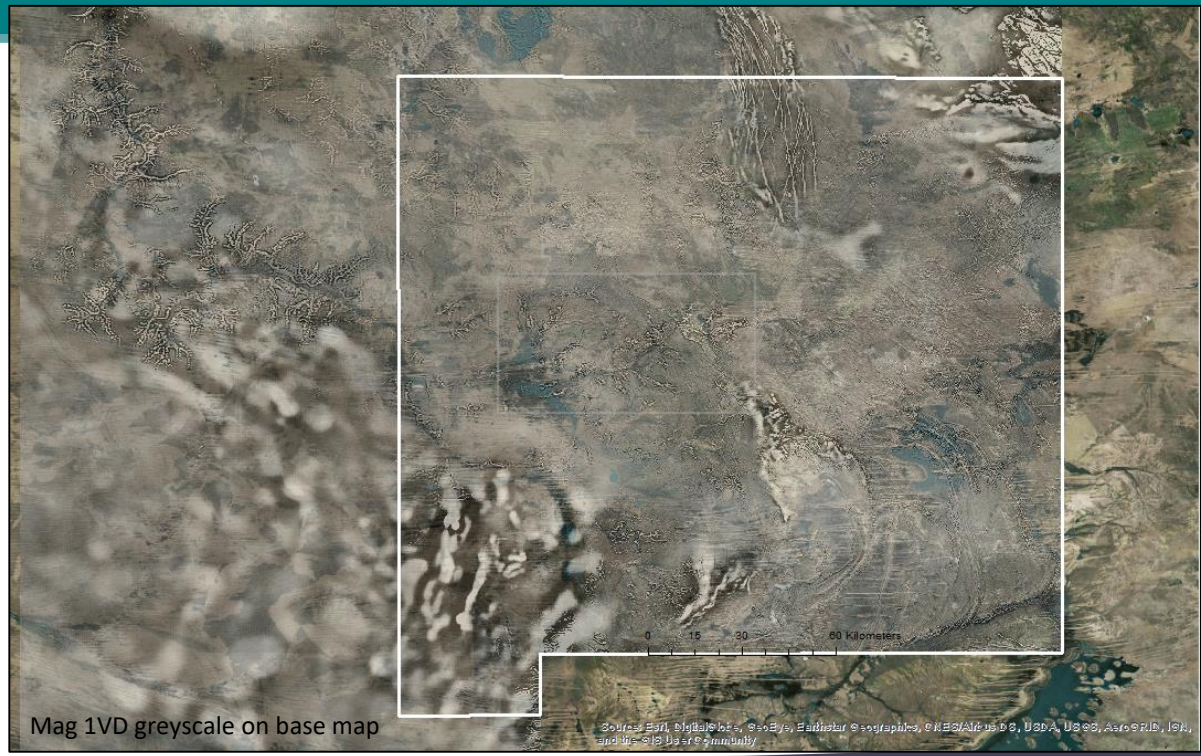
Network of dendritic buried palaeochannels filled with ferruginous magnetic material (maghemite gravel[4]) , visible on mag RTV 1VD images.

To be visible in mag image maghemite-gravel lenses have to be 0.4 m - 1 m thick at 1.5 m – 4.5 m deep[4]

'Eroded upper channels' surface expression – ferricrete, Fe-rich sheetwash



Mag 1VD colour on DEM – Stansmore Range



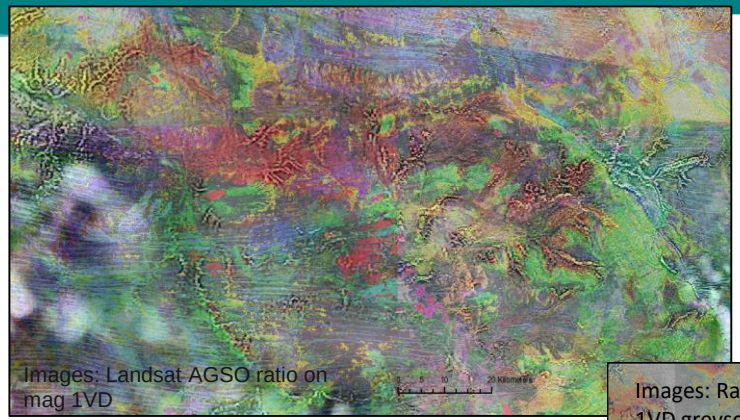
Mag 1VD greyscale on base map

[4] Mackey, T.2000. Palaeochannels near West Wyalong, New South Wales: a case study in delineation and modelling using aeromagnetics

Magnetic-fill paleochannels – Surface expression

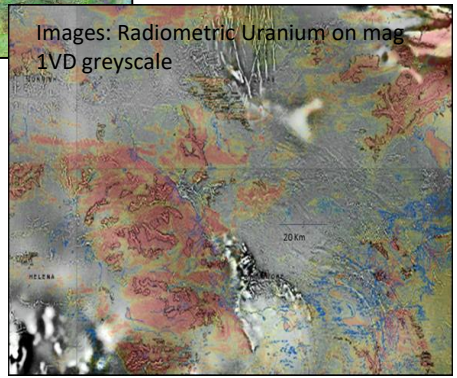
Sheetwash, playa or interdunes containing veneer of magnetic ferruginous lag (0.1-1.0 cm)

Abundant magnetic lag in sheetwash deposits west of Stansmore Fault, Stansmore Range.

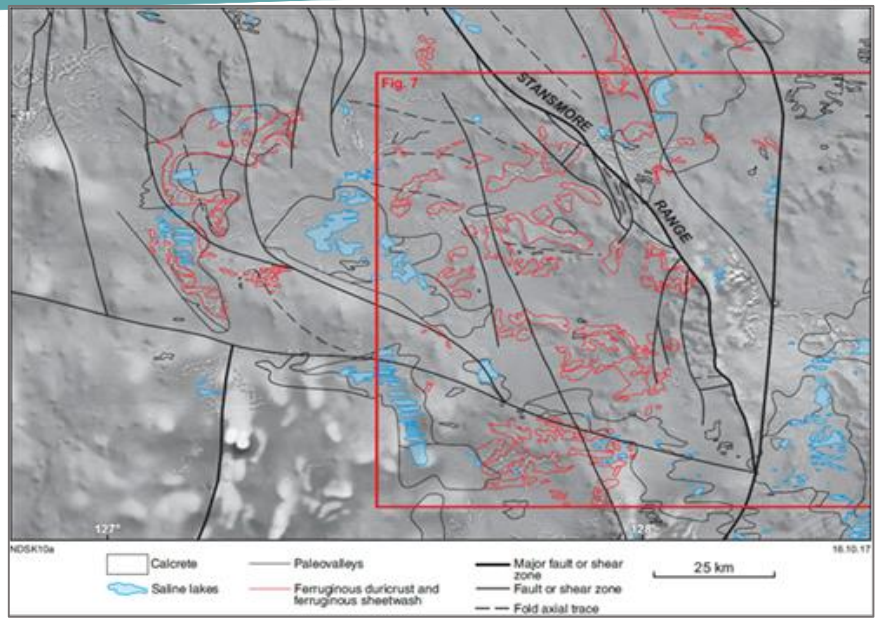


Landsat AGSO ratio (30–45 cm deep) – outcropping or weathering materials derived from paleochannels appear in shades of red and yellow - concentrations of clay and Fe-rich minerals

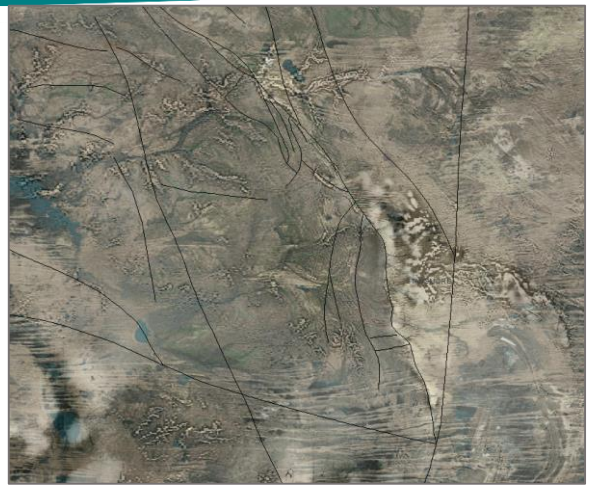
High U- Th radiometric residual minerals



Magnetic-fill paleochannels appear as tributaries of calcrete-fill paleovalley



Source: GSWA record 2018/3



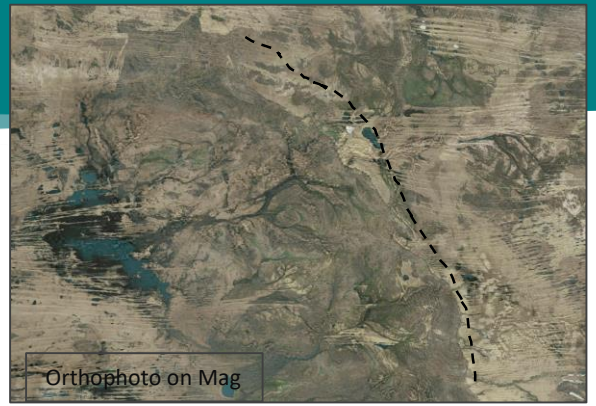
Similar maghemite-rich paleochannels in the Yilgarn are tributaries of main trunks of paleodrainages. These contain basal fluvial sand overlain by ferruginous gravel, and fragments of ferruginous duricrust[5]

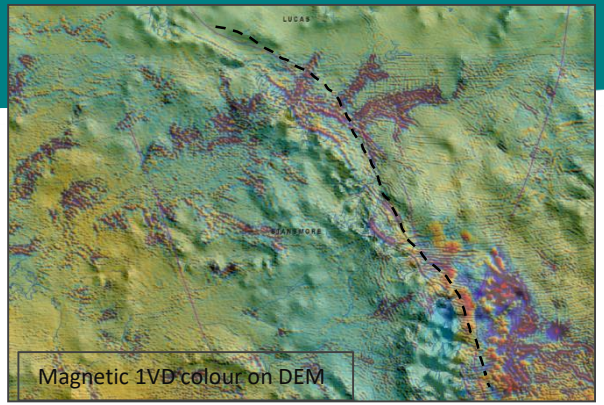
[5] Anand, RR and de Broekert, P, 2005, Regolith landscape evolution across Australia: CRC LEME, Perth, Western Australia, 345p

Neotectonism

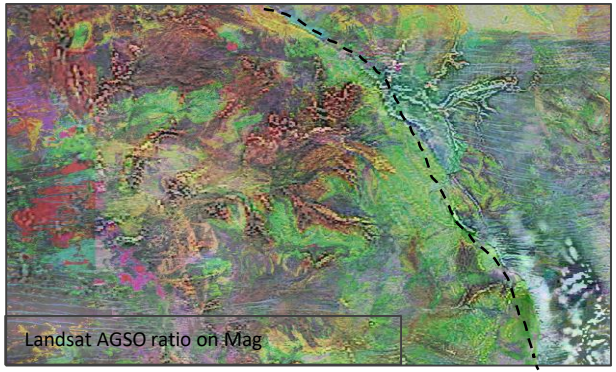
Stansmore Fault – Devonian (?) fault active since Devonian? active in the Cenozoic?

Is this paleochannel crossing the fault? Is it the same channel or 2 networks flowing at different directions?





Sheetwash with magnetic lag at west of the fault. Palaeochannel buried under eolian sand dunes to the east of the fault

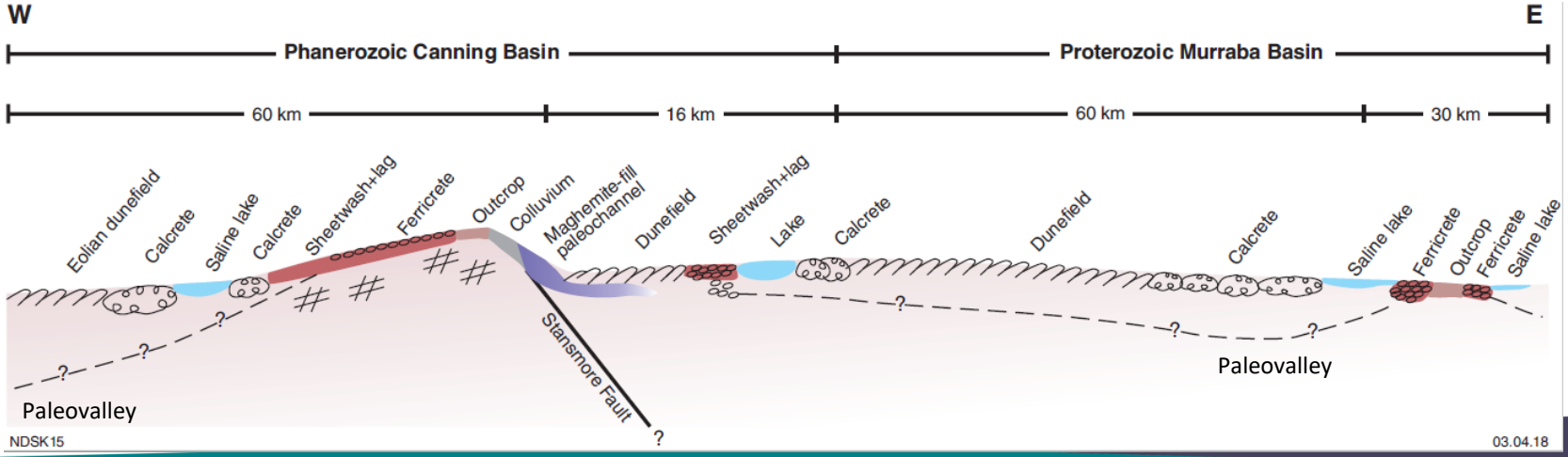


Palaeochannel in heritage area; not sampled

What's beneath the sand?

Transported regolith - few metres to 93 m thick [1, 2]
- eolian sand cover - 5m to 20m
- regolith infill in paleovalleys are up to 90 m thick

Two networks buried paleodrainages
- Calcrete filled paleovalleys – up to 93 m deep
- Magnetic palaeochannels – up to 4.5 m deep



What's beneath the sand?

Transported regolith - few metres to 93 m thick [1, 2]

- eolian sand cover - 5m to 20m
- regolith infill in paleovalleys are up to 90 m thick
- Two networks buried paleodrainages
- Calcrete filled paleovalleys – up to 93 m deep
- Magnetic palaeochannels – up 4.5 m deep

Insitu weathered bedrock

- Rock and insitu weathered rock - shallow depths < 1 meter to near 70m thick below paleovalleys

Neotectonism – Vertical displacement of paleochannels at Stansmore Fault

[1] Lucas 250k, Billilluna 250k – Shallow stratigraphic drilling in the Granite-Tanami Region, BMR Record 1971-73
[2] Aquitaine Point Moody No.1 Well, Well Completion report 1966