



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

CREATE CHANGE



NORTHERN
TERRITORY
GOVERNMENT

Warramunga Province Deposit Atlas Program

An update

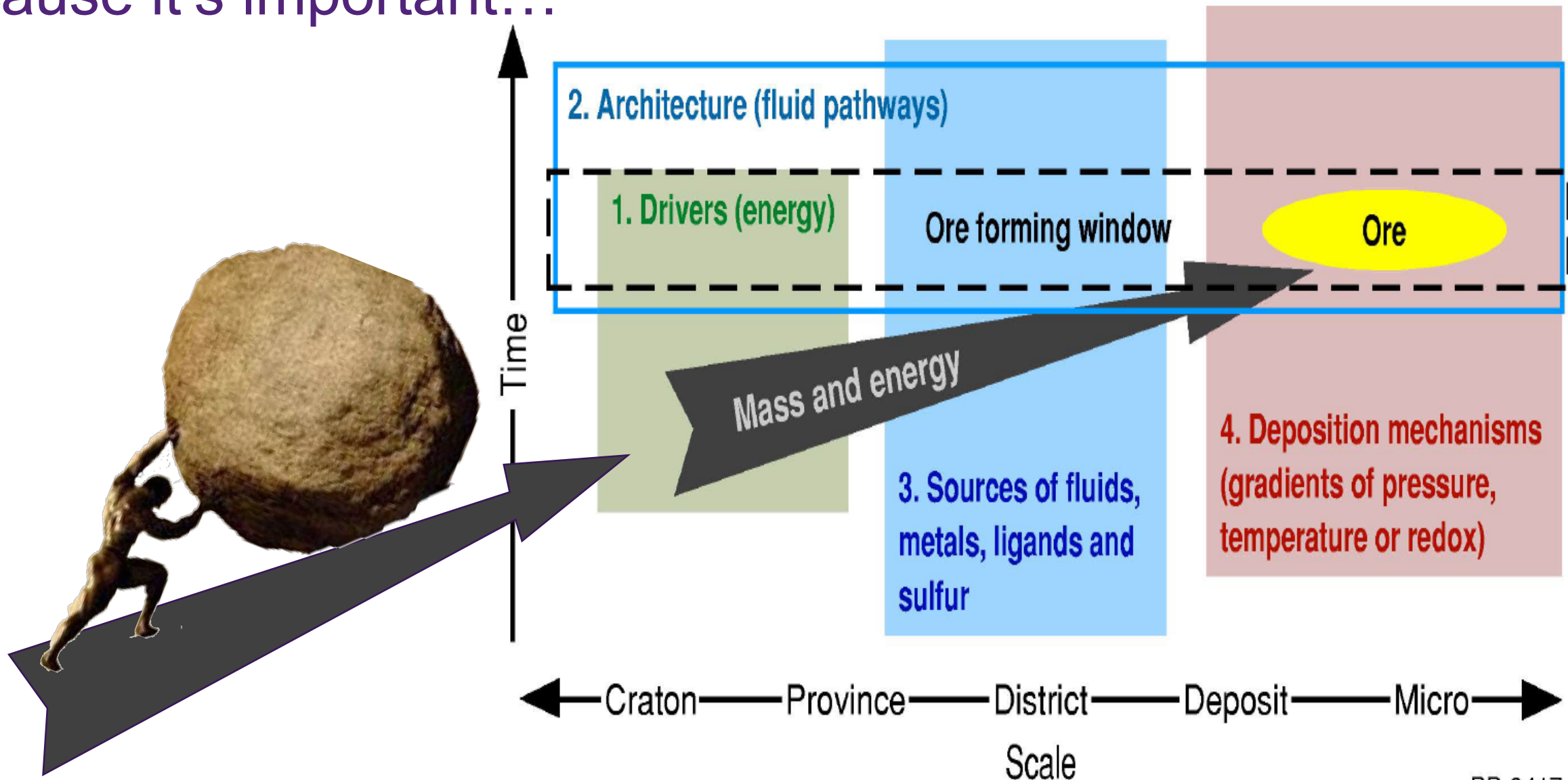
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Dave Esser
Karen Connors

W.H. Bryan Mining and Geology Research Centre,
Sustainable Minerals Institute

20 April 2021

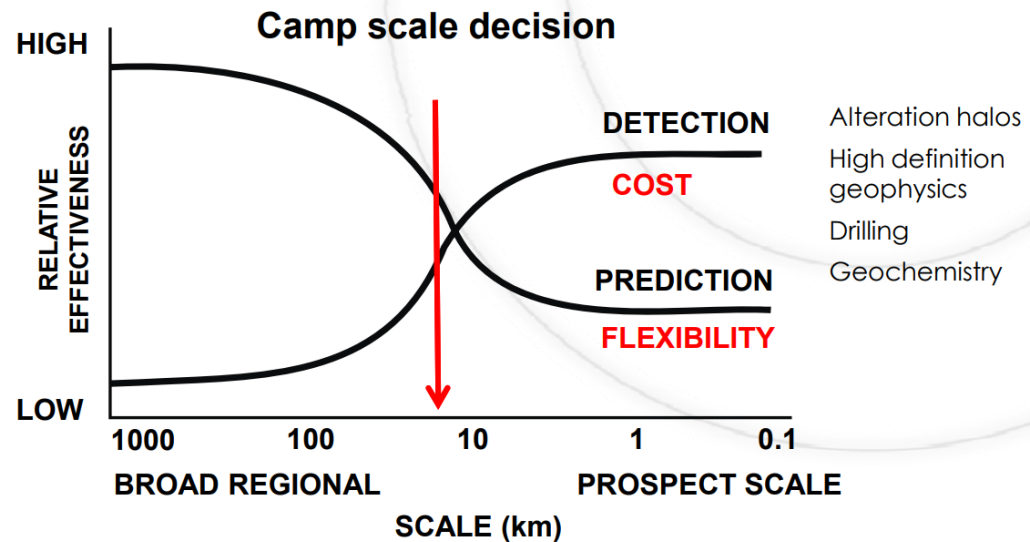
Why are we doing this?

Because it's important...



“Imitation is the sincerest form of flattery ...” (Oscar Wilde)

Scale Dependent Targeting



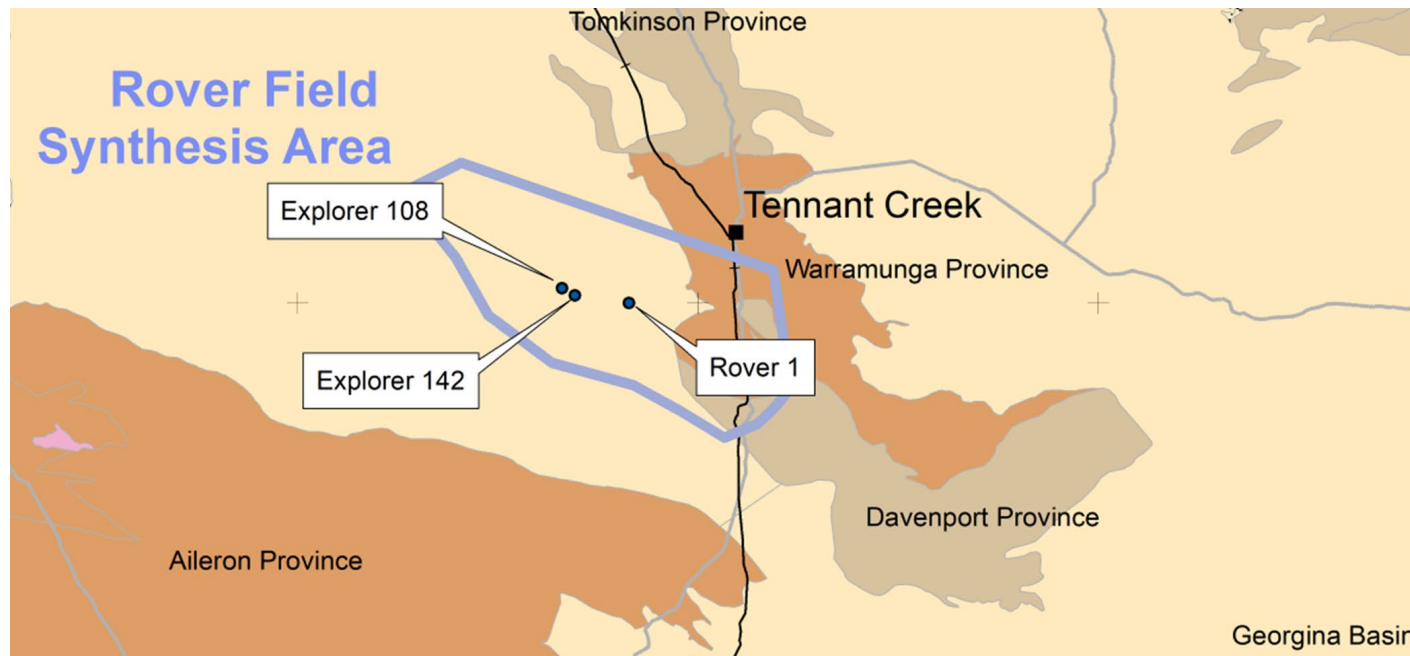
Where do we focus the more systematic, detailed and expensive detection technologies?

McCuaig et al. (2010)

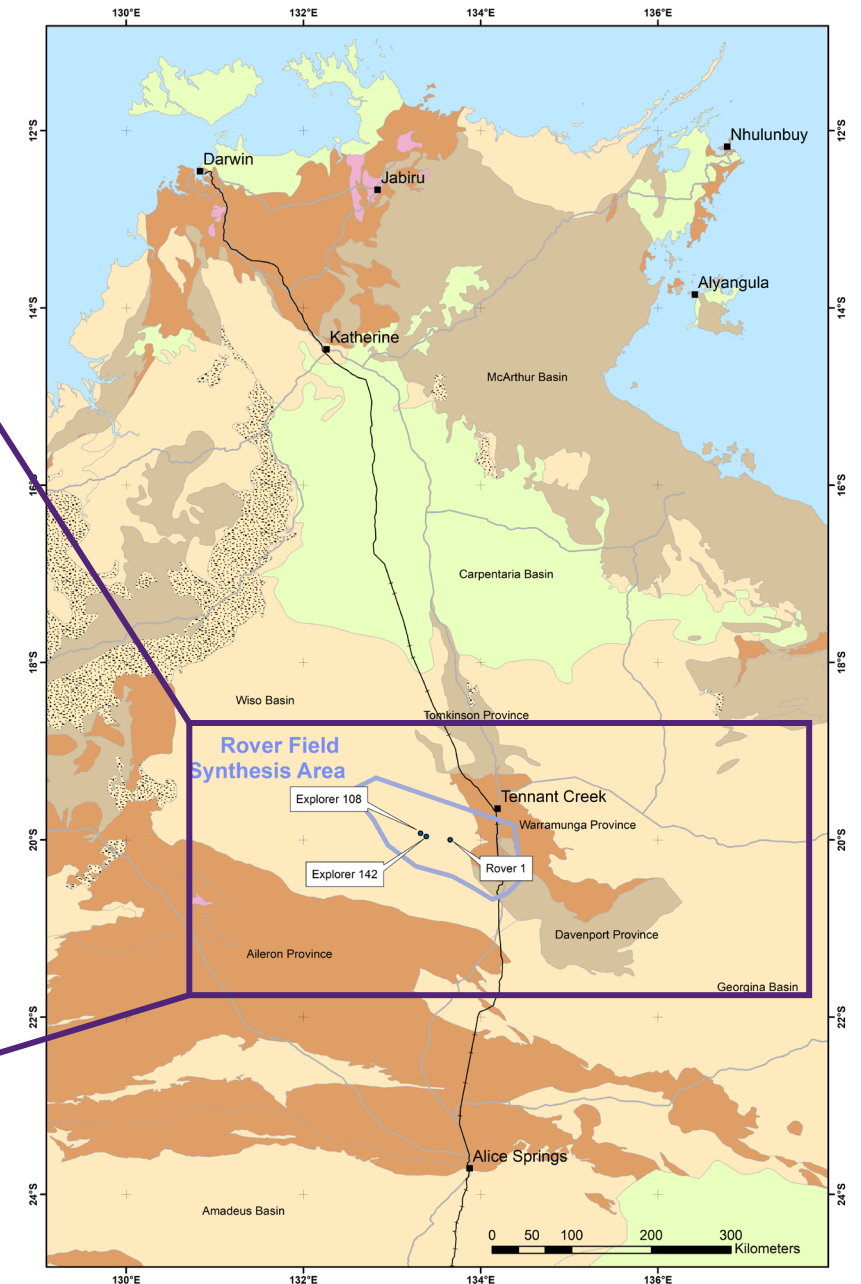


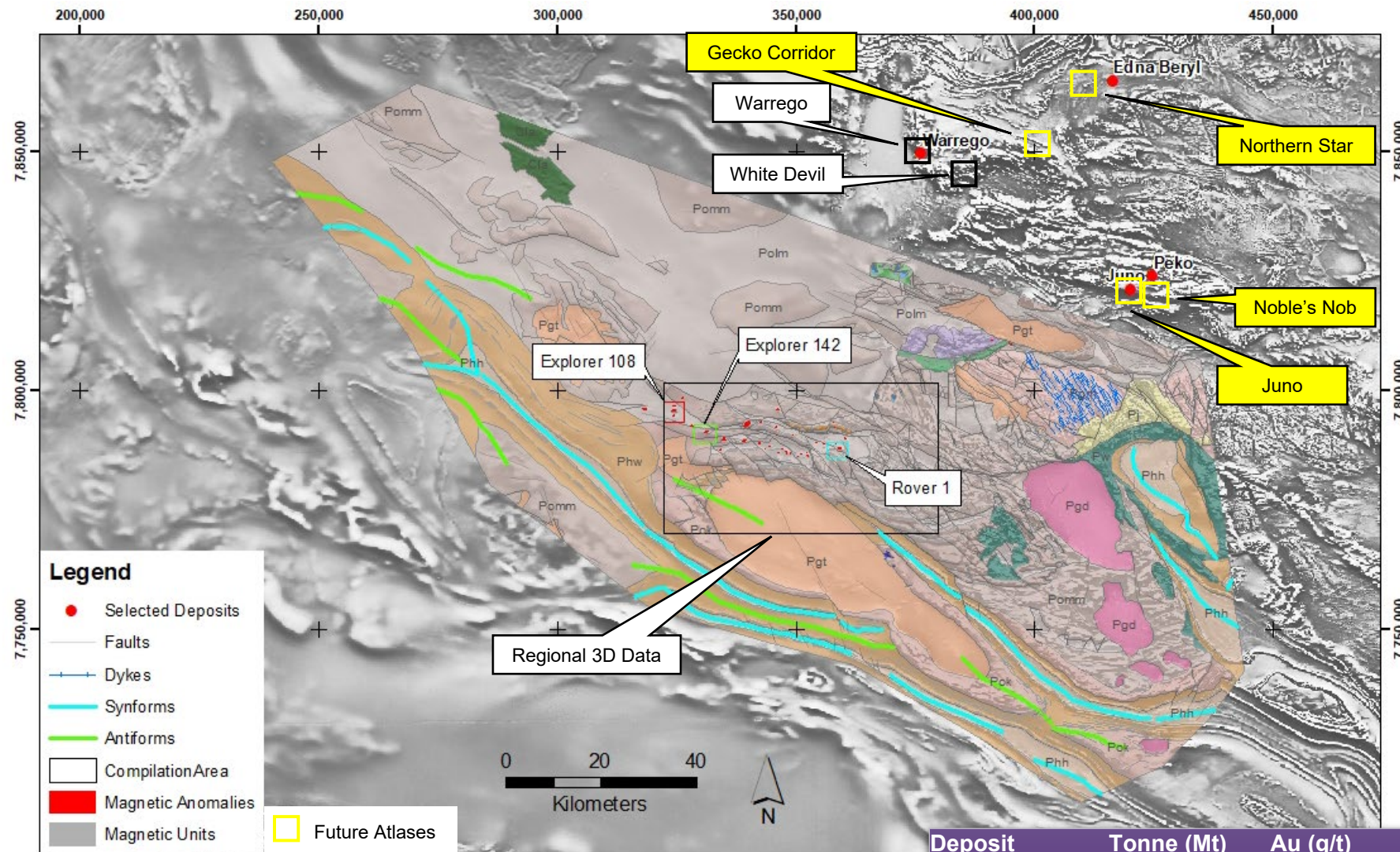
Warramunga Province

- Exposed Proterozoic rocks (+1850 – 1650 Ma) centred on the Tennant Creek mineral field
- Extension to the east and west under Neoproterozoic to Palaeozoic basin rocks (850 - 360 Ma)



LEGEND





- 1) Basement Solid Geology interpretation with accompanying drill compilation
- 2) 3D compilation of three key deposits

Deposit	Tonne (Mt)	Au (g/t)	Cu (%)	Bi (%)	Notes
Rover 1	6.9	1.74	1.2	0.14	Indicated and Inferred Resources (Leggo et al, 2019). Plus Ag, Co. Inferred Resource (Leggo et al, 2019)
Explorer 142	0.176	0.21	5.21	-	
		Tonne (Mt)	Zn (%)	Pb (%)	Ag (g/t)
Explorer 108- WCuriosity	11.87	3.24	2.00	3.32	Indicated and Inferred. Includes 5.69Mt @ 0.36% Cu. (Leggo et al, 2019)

<https://youtu.be/SnCQr-9KRrY>

Geoscience ANALYST

Objects

Search in tree... (Ctrl+F)

Name

- Workspace
 - DEM
 - Drilling
 - Geology
 - Geophysics
 - Rover 4 IP - MT Collaborative S...
 - RoverCentral_Magnetics_3D_in...
 - RoverRegional GRAV BA
 - RoverRegional TMI RTP 1VD
 - Google Earth
 - Hylogger
 - R2ARD17 Core Photos
 - R2ARD17 Downhole Data
 - R2ARD17
 - RVDD0001 Core Photos
 - RVDD0001 Downhole Data
 - RVDD0002 Core Photos
 - RVDD0002 Downhole Data
 - WGR3D001 Core Photos
 - WGR3D001 Downhole Data
 - WGR5D001 Core Photos
 - WGR5D001 Downhole Data
 - Mineralisation
 - E108 Ag 20ppm isosurface unc...
 - E108 Cu Blanket 500ppm isosur...
 - E108 Pb 1% isosurface unconstr...
 - E108 Zn 2.5 % isosurface uncon...
 - R1 - Au 2.5ppm isosurface unc...
 - R1 - Cu 0.5% isosurface uncon...

Controls

Key(s)/Button(s) Action

- Navigation
 - Left click Select / rota
 - Ctrl + Left click Multi-select
 - Shift + Left click (+ Ctrl t... Area-select
 - Middle click Pan (drag)
 - Right click Context me

Viewport

2D Profile Viewer

Workspace Object Cells Vertices

Project : Rover Regional.geoh5

Contributors : uqgunte
uqpgow

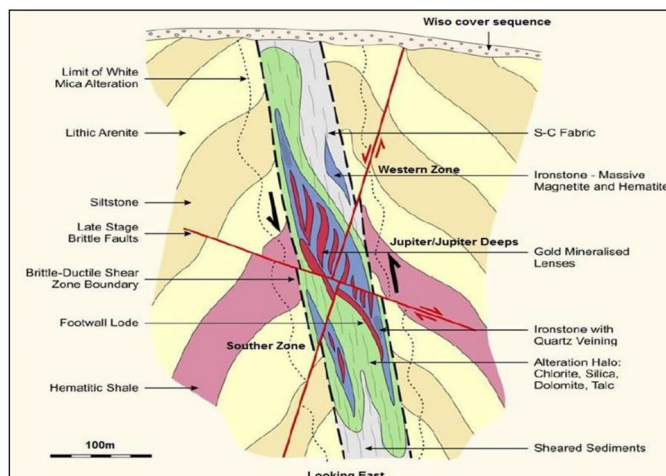
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Comments

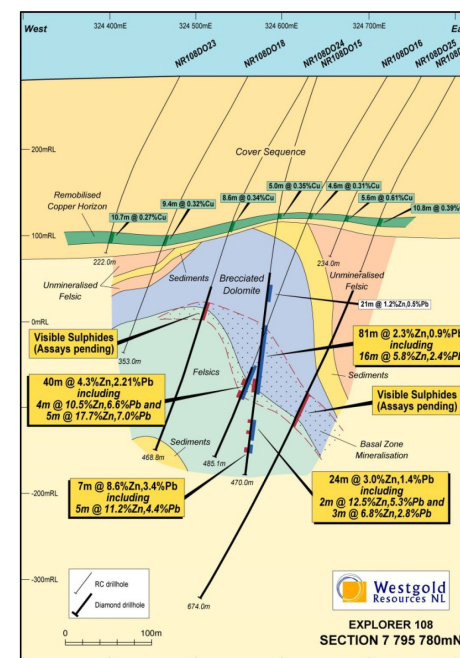
Files

Name	Size	Type
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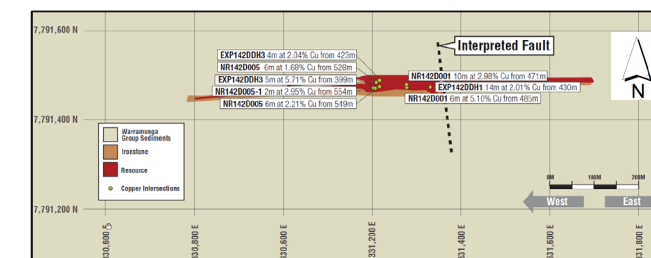
SECTION (looking east)



SECTION (looking north)



PLAN



	Rover1	Explorer 108 (-Curiosity)	Explorer 142
Metals	Au-Cu-Ag-Bi-Co	Zn-Pb-Ag-(Cu)	Cu-Au-(Bi)
Host Rock	Fine grained sedimentary sequence: hematitic shales, laminated ironstones, cherty siltstones	Sandy siltstones, felsic volcanic units	hematitic metasediments including greywackes, sandstones, siltstones, jaspilite, chert and ironstone,
Alteration Assemblage	magnetite-quartz-hematite-chlorite (carbonate)	dolomite-chlorite-talc-silica-magnetite- hematite	hematite
Mineralisation Assemblage	chalcopryite-bismuthinite-pyrite-gold	sphalerite-galena-pyrite-(chalcopryite)	
Mineralisation Style	veins, breccias, stringer zones	domains or veins of semi-massive sulfides, sub-vertical shear hosted	sub-vertical E-W high strain shear zone on southern limb of anticline
Structural Setting	brittle-ductile shear, steeply dipping	high strain zone in NNW-striking anticlinal asymmetric fold	
Cover Depth	130m	180m	220m

Mineralisation Style



Chalcopyrite mineralisation in massive ironstone - magnetite, Rover 1 (Beckwith 2010)



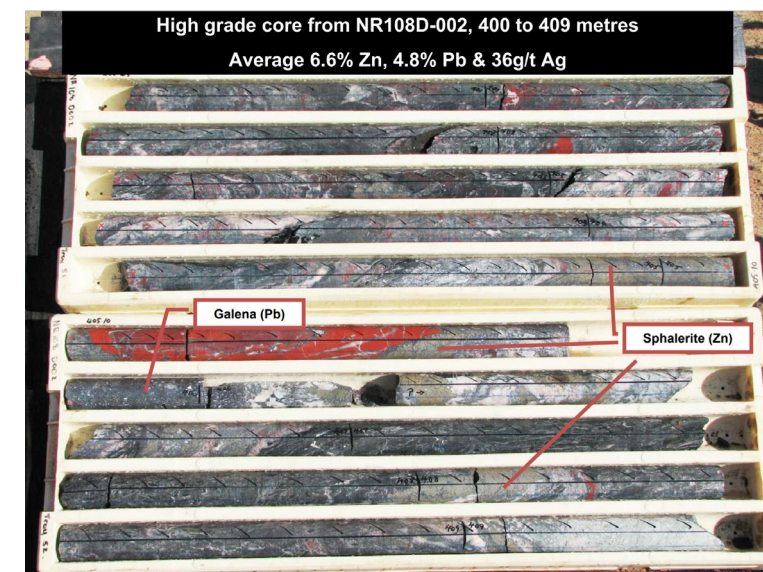
Chalcopyrite mineralisation in massive ironstone - hematite, Rover 1 (Beckwith 2010)

Copper-gold



Massive chalcopyrite mineralisation, Rover 1 (WGR1D011, Westgold Resources)

Zinc-lead-silver



Mineralised core from the lower contact with the brecciated and deformed dolomite, Explorer 108 (Beckwith 2010)

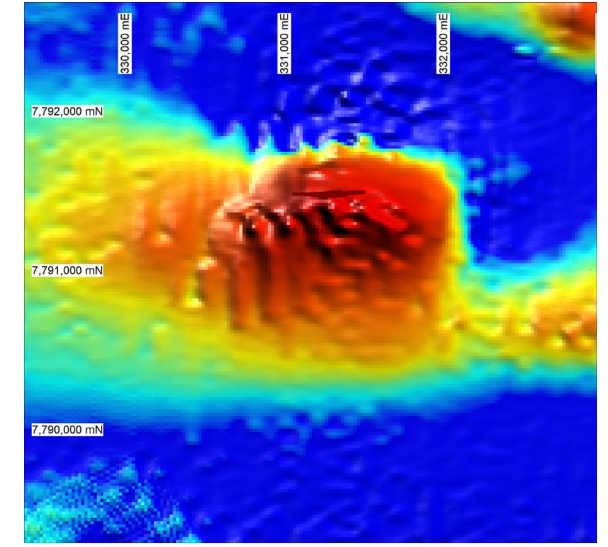
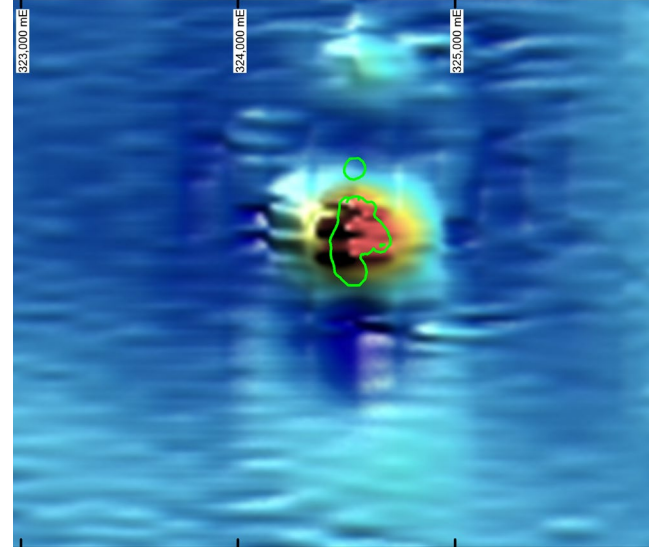
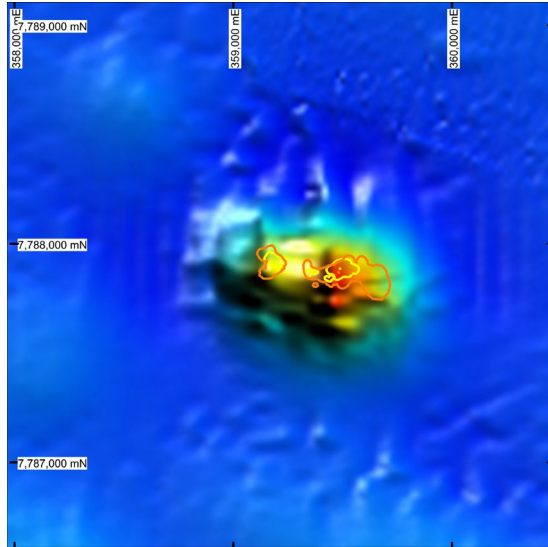
Geophysical Signatures

Rover 1

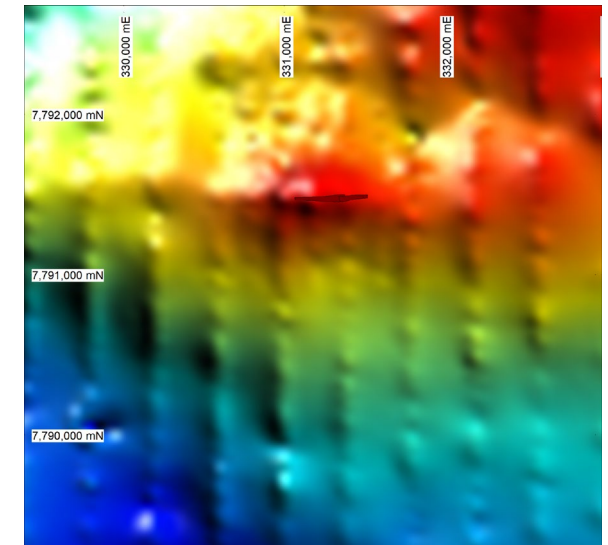
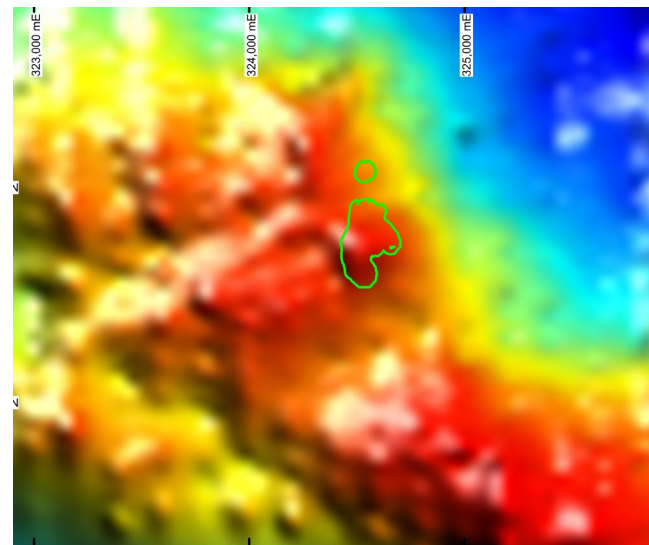
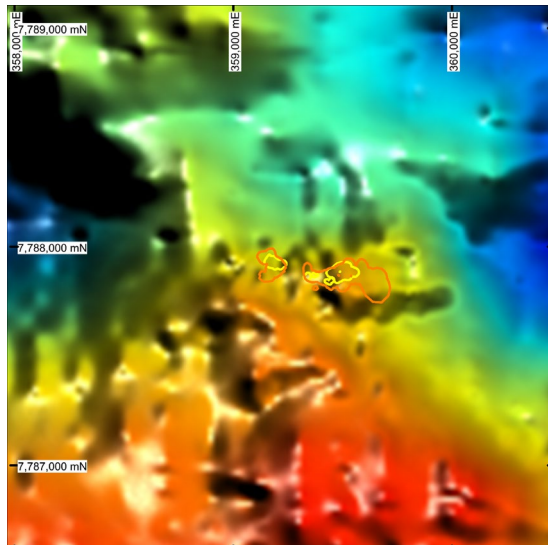
Explorer 108

Explorer 142

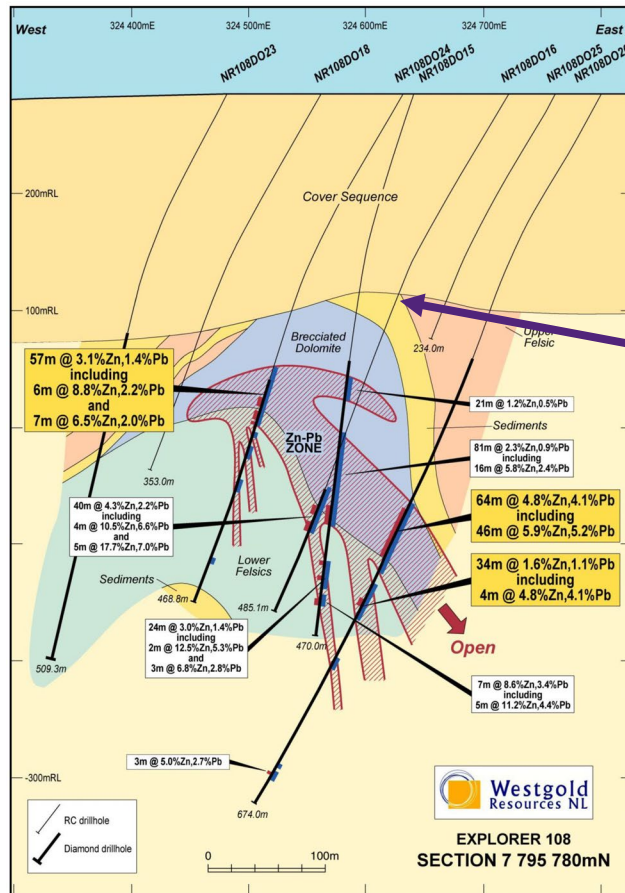
*Aeromagnetic
RTP-1VD*



*Residual
Bouguer
Gravity*



Top Proterozoic Geochemistry

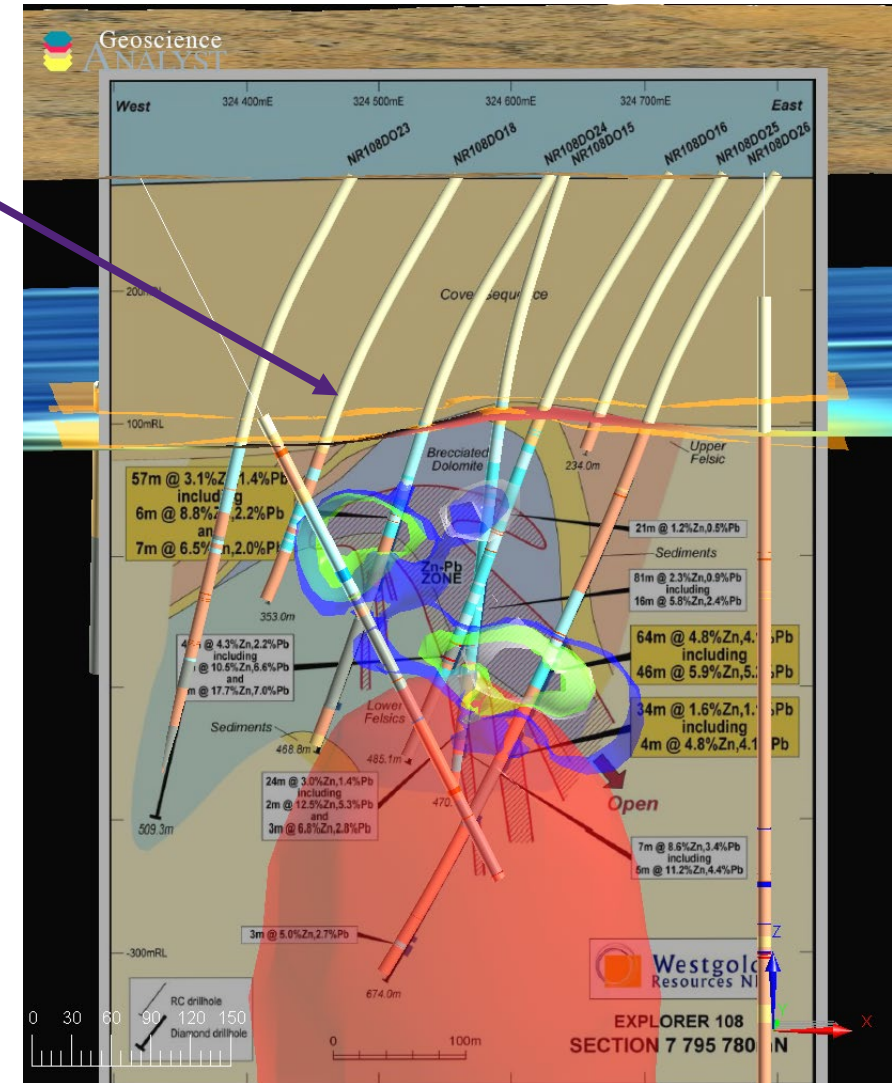
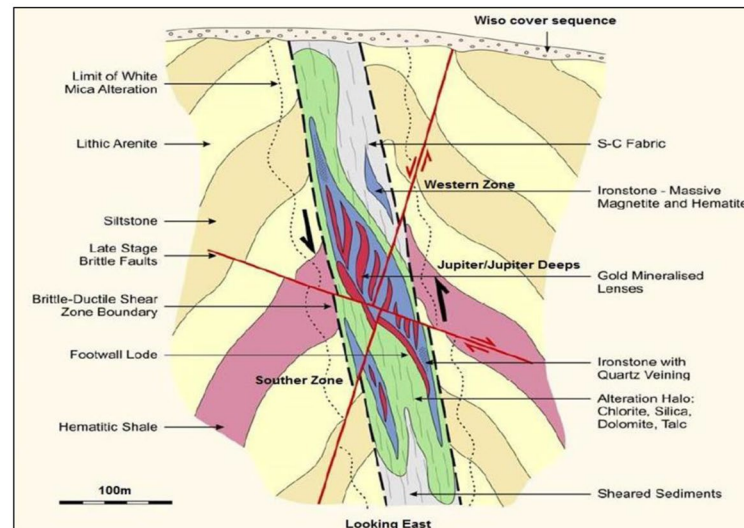


Explorer 108

Remobilised copper horizon

Outcropping at base of Wiso Basin

Rover 1



Explorer 108

Halo Expression

Prospect	Rover1	Explorer 108 (-Curiosity)	Explorer 142
Structural Setting	brittle-ductile shear, steeply dipping	high strain zone in NNW-striking anticlinal asymmetric fold	sub-vertical E-W high strain shear zone on southern limb of anticline
Structural Control	Nearly EW shear immediately to the N of (and synthetic to?) a 30km-long regional WNW shear which separates sediment-dominated package to N from metavolcanic package to S.	No obvious regional control. Local control appears to be a NNW-trending antiformal closure, with mineralisation in hinge and steep eastern limb.	The near vertical shear is interpreted to have formed along the southern limb of an anticline during a north-south shortening event.
Geophysical Expression	Coincident gravity and magnetic high. No clear helitem expression, though on boundary between conductive and non-conductive domain.	E108 - coincident magnetic and detailed gravity high. No clear helitem expression, though on boundary between conductive and non-conductive domain.; Curiosity - anomalous chargeability	Coincident gravity and magnetic high. No clear helitem expression, though on boundary between conductive and non-conductive domain.
Alteration Halo	<ul style="list-style-type: none"> zones of chlorite, silica, dolomite and talc extending up to 50m away from ironstone bodies. white mica alteration extending a further 50m outside of the shear zones hosting mineralisation. Halo zone with widespread anomalous copper (>1000ppm) up to 200m away from >0.5% Cu shell 	<ul style="list-style-type: none"> Widespread outer sericite and inner chlorite-talc alteration, dimensions not well specified but apparently extensive. Pb-Zn extensive and intense silica dolomite breccia. Extensive zones of anomalous copper (>1000ppm) in regional drilling. Zone of anomalous copper (>500ppm) immediately above basement contact 	Similar to Rover 1. Zones of strongly anomalous copper up to 1000ppm occur in 100m envelop around mineralised body

Correlations with the Tennant Creek mineral field

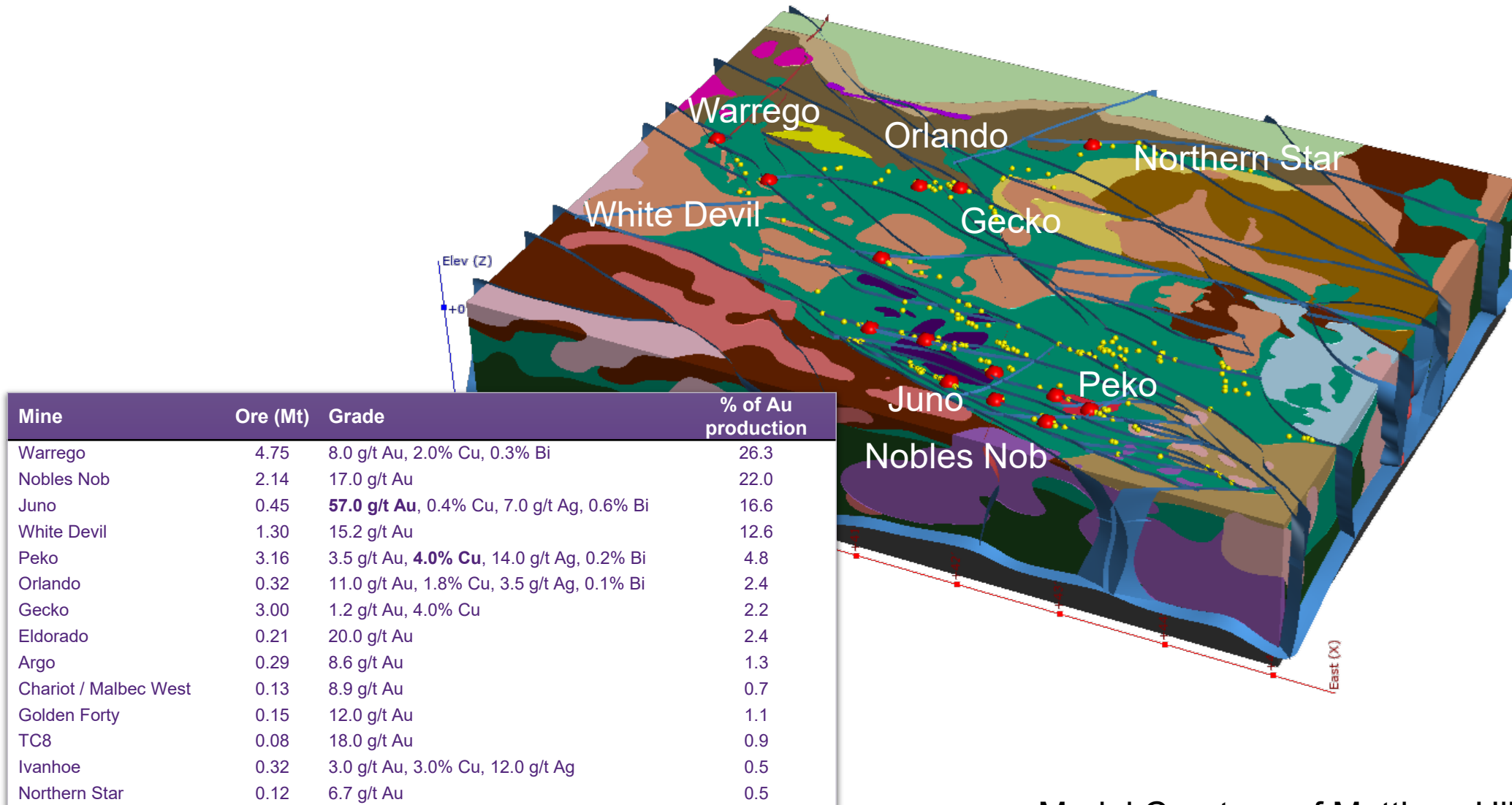
Similarities:

- Structurally-controlled mineralisation, locally high strain
- Fine-grained sedimentary rocks \pm volcanic/volcaniclastic host sequences (large granite bodies in broader area)
- Lower greenschist facies regional metamorphism
- Spatially coincident with ironstone bodies
- Metal association: Au-Cu-Bi (either Au or Cu may be dominant metal)
- Alteration assemblage: chlorite-dominant, quartz-magnetite-hematite

Differences:

- Ooradidgee Group host sequences (vs older Warramunga Formation) with felsic volcanic component
- Zn-Pb-Ag related mineralisation style at Explorer 108 - Curiosity

Tennant Creek mineral field

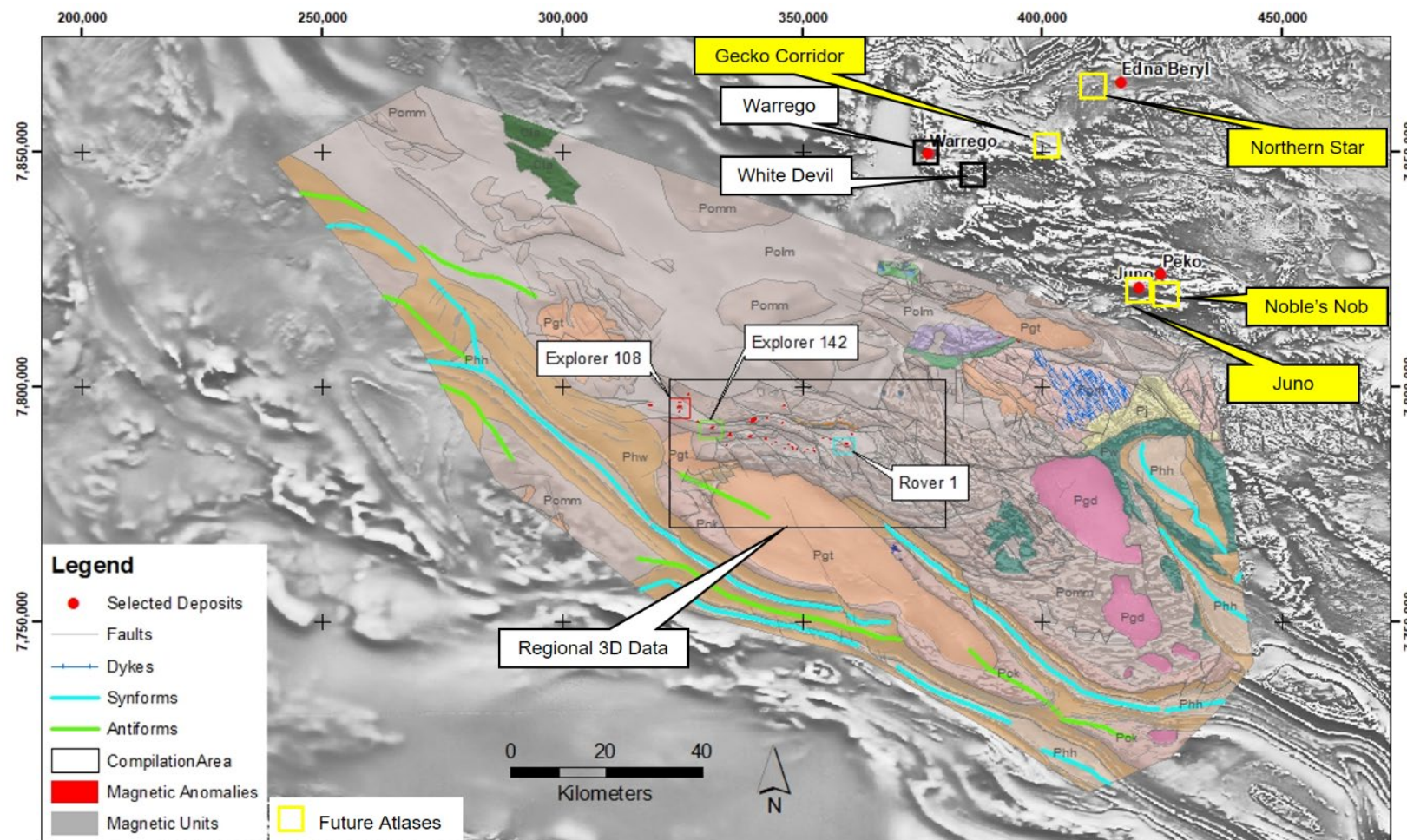


Mine production data from Donnellan (2013)

Model Courtesy of Matthew Hill

Plunge +34
Azimuth 335



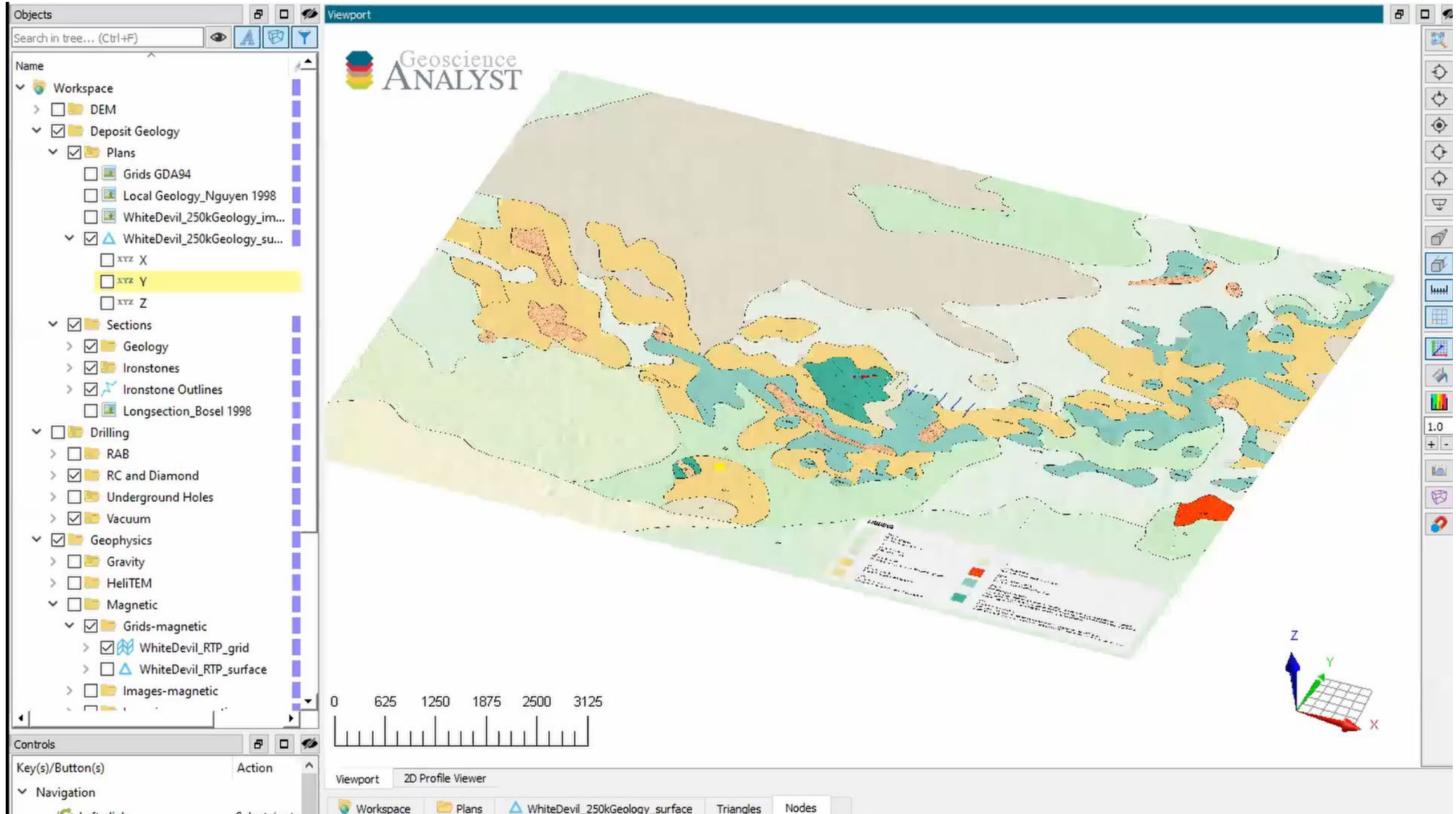


Interpreted Stratigraphic Unit

Cla	Antrim Plateau Volcanics	Pog	Edmirringee Volcanics	Pp	Porphyry (Tennant Creek Supersuite?)
Pirm	Mafic Intrusive	Povhm	Ooradidgee Group undiff. (v. high mag.)	Pgm	Mumbilla Granodiorite (felsic)
Pgd	Devils Marbles Granite	Pohm	Ooradidgee Group undiff. (high mag.)	Pgmd	Mumbilla Granodiorite (interm.)
Phh	Hanlon Subgroup	Pomm	Ooradidgee Group undiff. (moderate mag.)	Pgt	Tennant Creek Granite
Phw	Wauchope Subgroup	Polm	Ooradidgee Group undiff. (low mag.)	Pj	Junalki Formation
Pok	Kurinelli Sandstone	Porm	Ooradidgee Group undiff. (remanent mag.)	Pw	Warramunga (sedim.)

White Devil

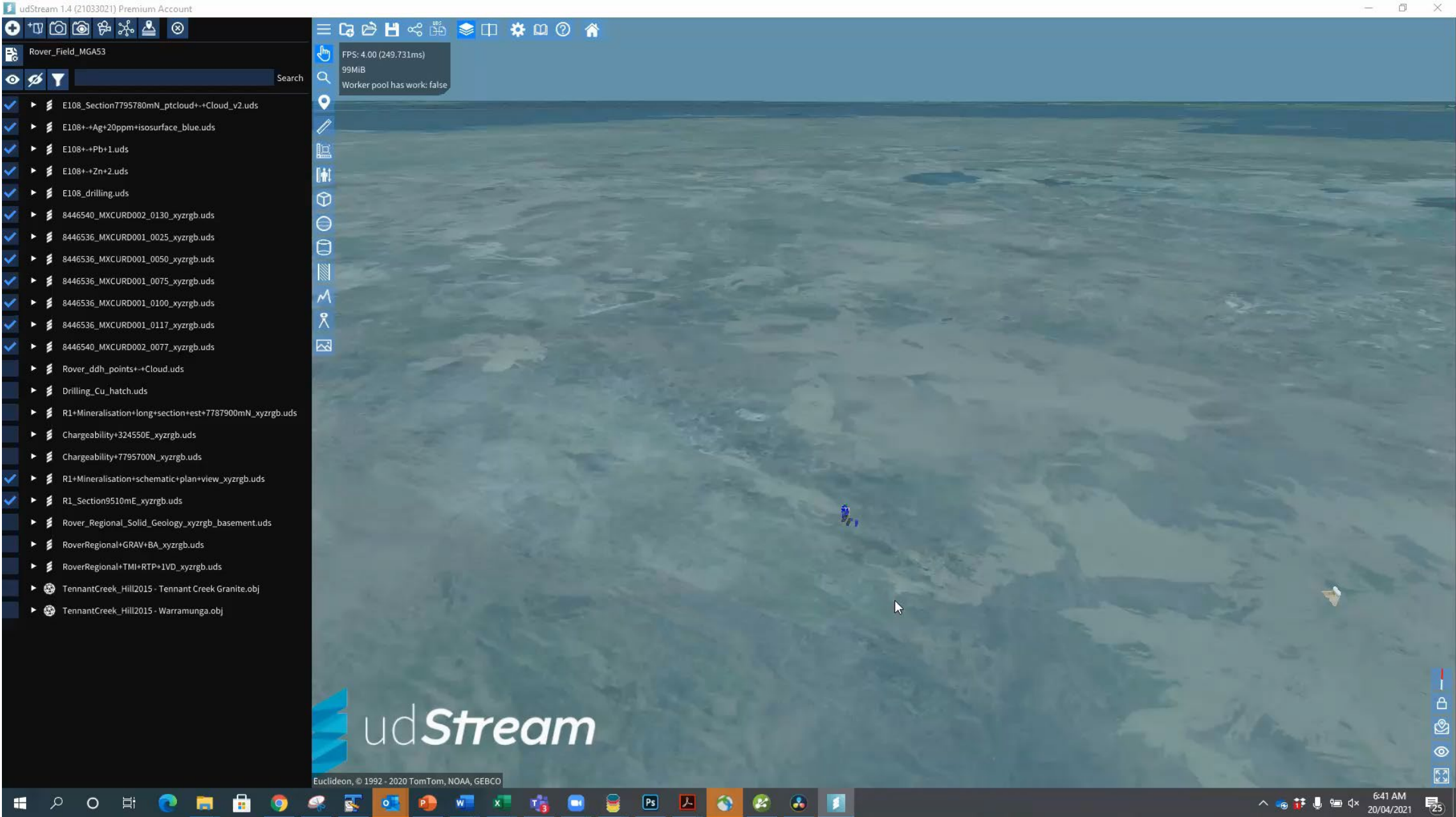
<https://youtu.be/C0RrF6KjFMc>



Mineral Prospectivity & Exploration Strategy

Exploration Approach

- Potential high-grade gold (or copper) deposits allow underground development
- Strongly structurally-controlled mineralisation style requires detailed interpretation of magnetic data to seek high-strain zones (east-west with interaction with fold hinges?)
- Ironstone association provides strong magnetic susceptibility or density contrasts (magnetic and gravity datasets)
- Potential high-grade copper systems (5% Cu at Explorer 142) suggests high sulphide content may yield electromagnetic response. No apparent severe conductive overburden issues in Wiso Basin Cambrian rocks.
- Western extent of the Warramunga Province style rocks (Ooradidgee Group) not yet closed off.
- Cover depth mapping required. Magnetic depth to basement modelling?



Data Release - GEMIS

- All data has been released as part of the NTGS Digital Information Package (DIP) series:
 - **DIP 23:** Solid Geology interpretation GIS and PDF document, regional data compilation, regional Geoscience Analyst 3D compilation.
 - **DIP 24-26:** PDF summary document, data compilation and Geoscience Analyst 3D compilation for the three deposits (Rover 1, Explorer 108-Curiosity, Explorer 142)
 - **DIP 27-28:** PDF Geoscience Analyst 3D compilation for Warrego and White Devil

Link to data:

<https://geoscience.nt.gov.au/gemis/ntgsjspui/simple-search?query=%22Gow%22&location=1/81425>

<https://geoscience.nt.gov.au/gemis/ntgsjspui/handle/1/91084>

<https://geoscience.nt.gov.au/gemis/ntgsjspui/handle/1/91085>



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Thank you

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<https://www.linkedin.com/in/rick-valenta-60356319/>

CRICOS code 00025B

Data Release Article:

<https://resourcingtheterritory.nt.gov.au/about/news/2020/undercover-western-warramunga-province-the-rover-field-revealed>

Data Package Link:

<https://geoscience.nt.gov.au/gemis/ntgsjspui/simple-search?query=%22Gow%22&location=1/81425>

Youtube videos

AGES21reg_model: <https://youtu.be/SnCQr-9KRrY>

AGES21_udstream: <https://youtu.be/Zl0hr-17W14>

AGES21_white_devil: <https://youtu.be/C0RrF6KjFMc>