

# Ultrafine soils – the technique, the advances, and the application to GSWA regional map products

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**MINERAL RESOURCES**  
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# Acknowledgements

- Ian Lau, Tenten Pinchand, Ravi Anand, Paul Morris





# One slide to rule them all

- Increase of 150–250% Au, Cu, Zn
- No “nugget effect”
- GSWA soils Au data 67% bdl → 10% bdl
- World-first, industry-ready workflow



# Use the best technique/size fraction for the job



ICP-AES

+

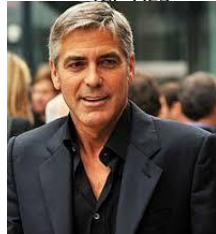


<250  $\mu\text{m}$  milled fraction

=



results



ICP-MS

+



<2 or 63  $\mu\text{m}$  fraction



results

Modified from Nick Oliver, HCOV Consulting



# Again, it's about picking the right course of action



ICP-AES

+



<2 or 63  $\mu\text{m}$  fraction

=



ICP-MS

+



<250  $\mu\text{m}$  milled fraction

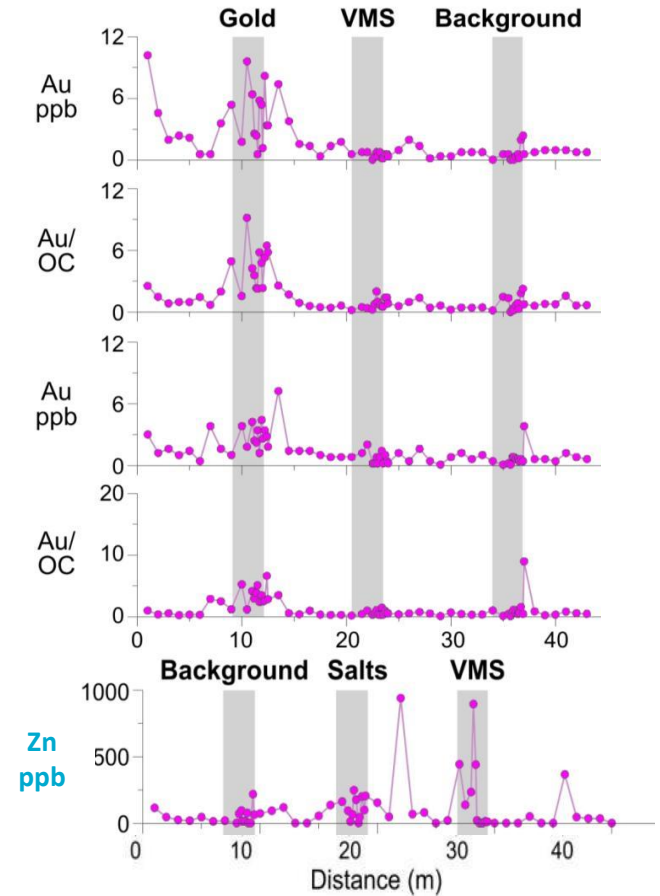


Modified from Nick Oliver, HCOV Consulting



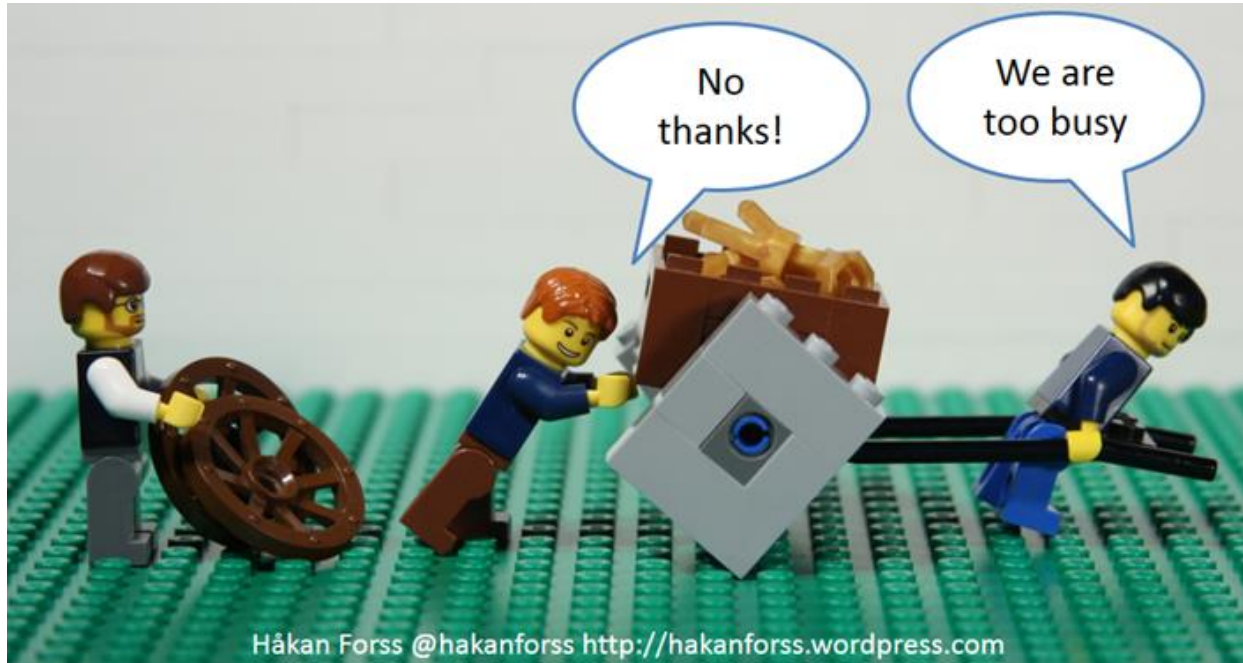
# Metal mobility

Anand et al. *Economic Geology* 2014





# Fine fractions = ALL the action



- We can't just keep doing the same thing... target element  $< 250 \mu\text{m}$  or 60 mesh...



# Approach

- Using bulk composite soils from >10 Au, Cu, Zn deposits in WA as references
- Test the method (sample/particle size, weight, extraction, dispersion)
- Site/orientation studies
- Regional map



# Delivered... in the report – free online from GSWA

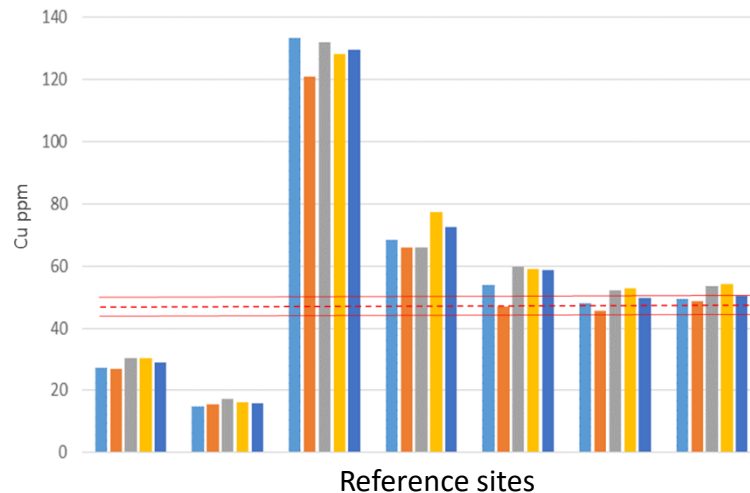
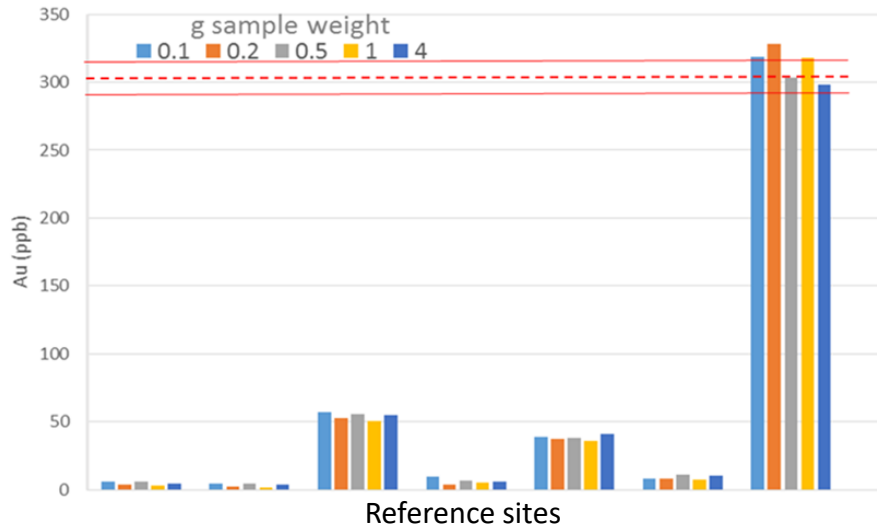
- Noble, et al., 2019 GSWA Report 190
- Data on GeoView or CSIRO Data Access Portal





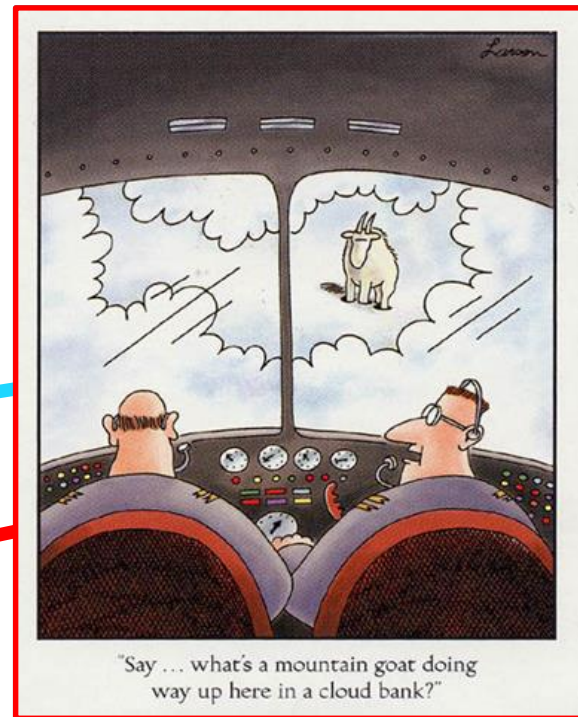
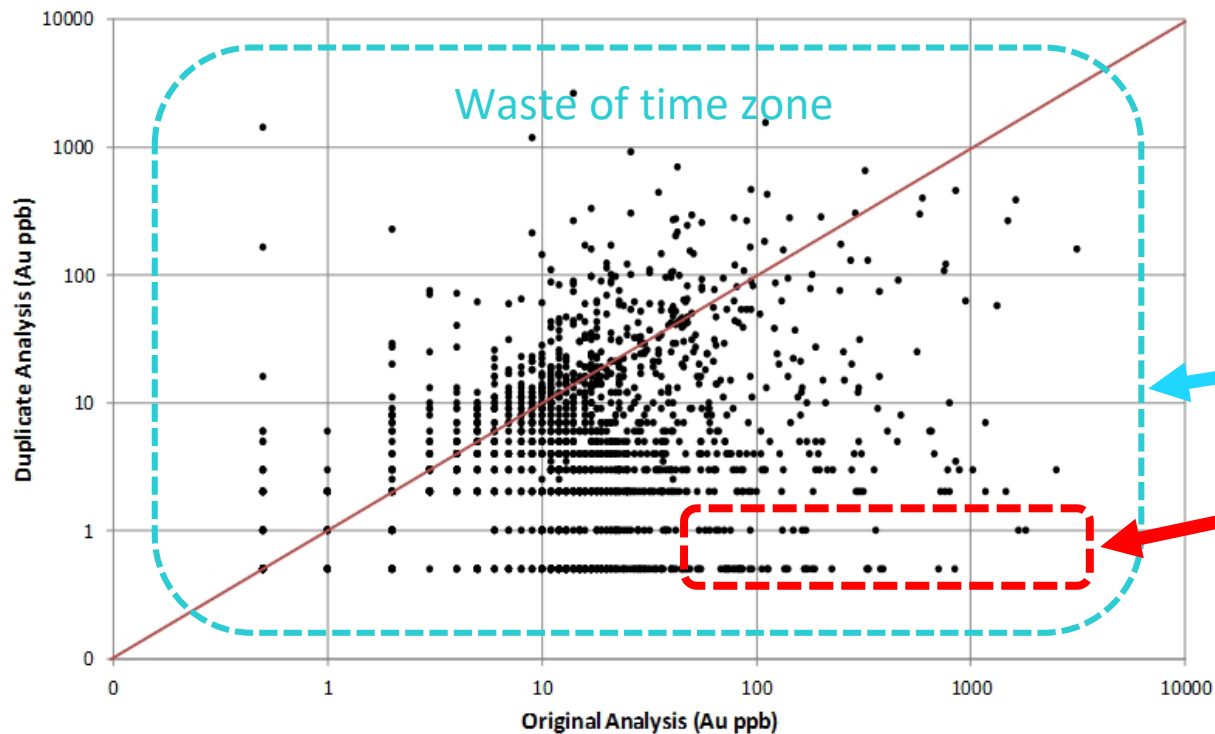
# Method development example

- Weight of sample for Au analysis
- No significant differences (4 g, 1 g, 0.5 g, 0.2 g and 0.1 g)
- Few differences e.g. Ag, Cu, Zn (org-rich/clay-poor)





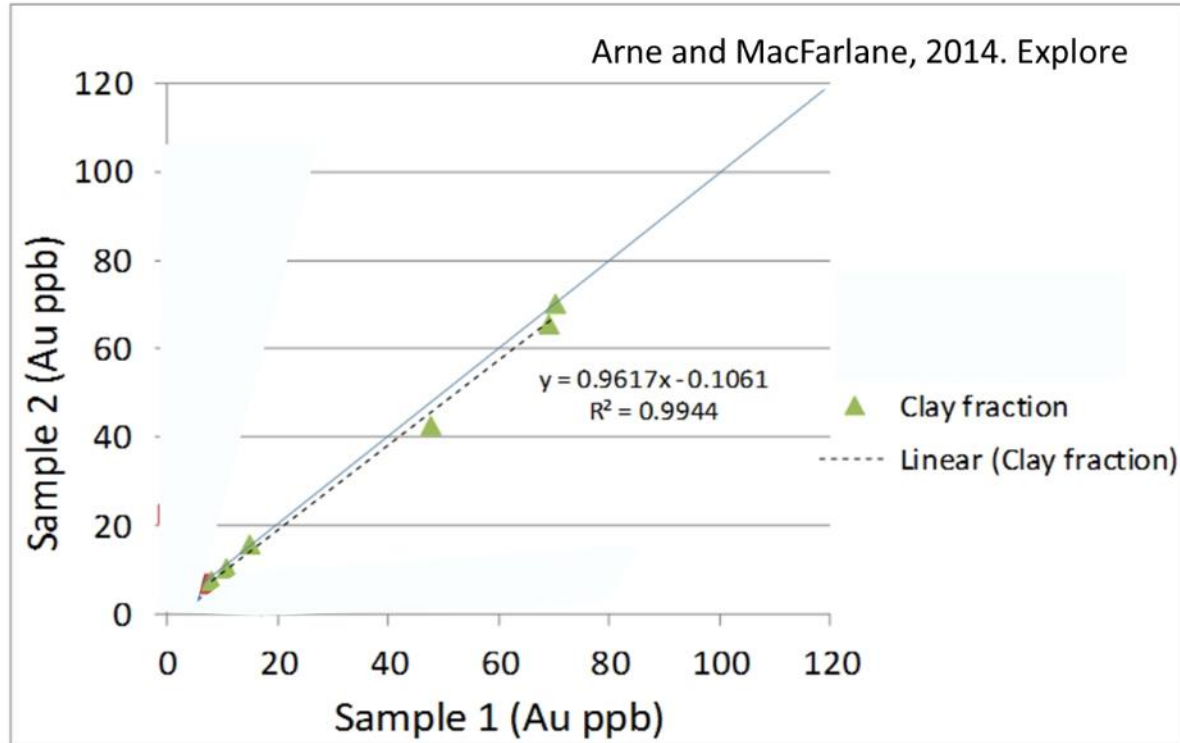
# Nuggets are not your friends



Heon, D (compiler) 2003. Yukon Regional Geochemical Database 2003

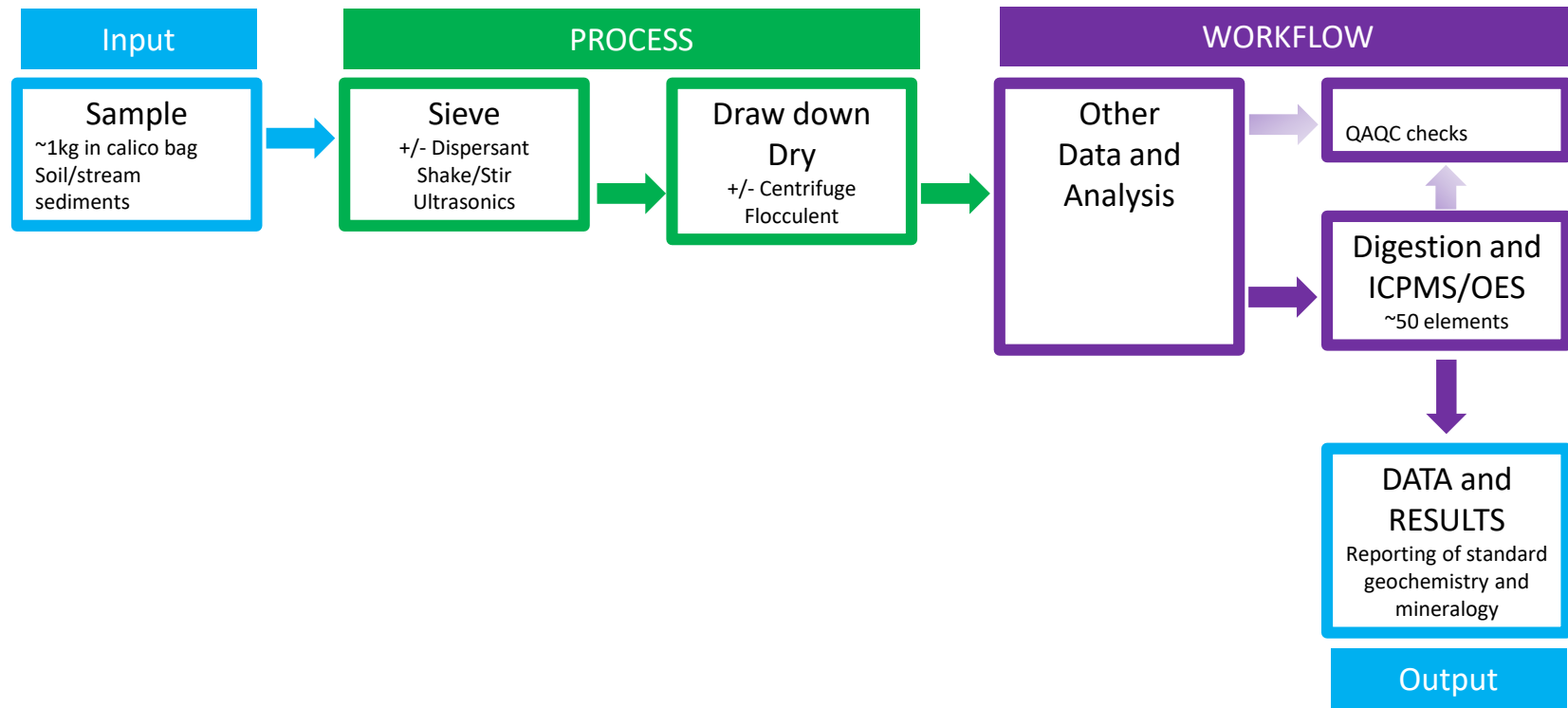


# Lost nuggets (and hype), but gained confidence





# Results: The UltraFine+ workflow





## Workflow benefit


**est” fine fraction offering for commercial laboratories**

[illegible]

Ta	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BP
			TI	TI	U	V	W		Y	Zn	Zr	Weight	pH	EC	Sequence	-0.2 μm	-2 μm	2-50 μm	50-125 μm	125-250 μm	Result in F	Result in A	Spec
<0.001	<0.2	14.8	706	0.6	1.02	139	0.4	14.3	57.9	25	39.93	6.91	25.75	23	37.37455	53.79097	36.29036	4.930748	0.907594	3.888241	0.153209	20	
<0.001	<0.2	13.8	696	0.5	0.98	138	0.4	13.6	49.3	22	40.08	7.08	52.02	25	35.94091	39.72478	45.84054	8.981279	2.538566	7.425034	0.117757	27	
<0.001	<0.2	13.4	619	0.5	0.93	134	0.4	11.6	39.6	21	39.77	6.97	24.53	236	32.12553	48.02374	40.72972	3.956541	1.026746	5.845989	0.375384	291	
<0.001	<0.2	13.7	578	0.5	0.92	134	0.4	10.9	35.2	21	40.16	6.89	23.6	237	38.23632	54.27139	35.42283	13.42889	7.65184	5.937452	0.384407	287	
<0.001	<0.2	12.5	565	0.4	0.85	122	0.4	9.9	38.5	20	40.08	6.85	24.1	238	35.91347	52.25459	42.72412	4.225678	0.772441	0.404015	0	336	
<0.001	<0.2	12.6	618	0.5	0.88	133	0.4	10.7	40.7	21	40.08	6.8	24.1	238	36.11513	51.35606	38.93853	6.10146	1.357467	1.189286	0.132923	263	

	BQ	BR	BS	BT	BU	BV	STSA	EX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM		
1	Specific Si to Dn	(Dx)	(Dx)	(Dx)	0.90	Sample Ni:Mini1 STSA Wt1 STSA	Error BY STSA kaolin abn	14000	3p	2200AR	3	Water abn	ferric oxide hem/ go	colour pla	Albedo	Mini1 STSA Wt1 STSA Error	tStsa	(1000R)	1380D	wmAlsmi	wm				
2	27376.8	0.054406	1.016260	49.24355	F5FR.1829	Kaolinite	0.569	57.034	0.253	0.135	16.505	0.163	0.0897	893.39	SYR 4/4	0.284	NULL	NULL	NULL	0.836	0.00842	NULL	NULL		
3	33933.3	0.078692	4.972019	72.3388	F5FR.1829	Kaolinite	0.576	78.643	0.294	0.157	19.213	0.257	0.0961	895.28	SYR 3/2	0.181	NULL	NULL	NULL	0.807	0.0102	NULL	NULL		
4	29700.16	0.066311	2.487504	60.94927	F5FR.1829	Kaolinite	0.71	81.155	0.284	0.163	16.649	0.259	0.103	894.47	SYR 3/4	0.181	NULL	NULL	NULL	0.887	0.0113	NULL	NULL		
5	38177.68	0.054618	6.685788	54.94152	F5FR.1829	Kaolinite	0.592	44.691	0.207	0.116	13.827	0.183	0.0778	893.6	SYR 4/4	0.181	NULL	NULL	NULL	0.875	0.0623	NULL	NULL		
6	33820.93	0.054676	3.476667	54.5556	F5FR.1829	Kaolinite	0.603	81.31	0.236	0.127	14.738	0.175	0.116	895.63	SYR 3/2	0.181	WmAlsmi	0.536	145.68	0.878	0.016	NULL	NULL		
7	25538.63	0																							
8	25338.1	0																							
9	1	ferric oxide abundance						Estimate of the amount of iron oxides, based on absorption in the 800-1000nm region						H											
10	1	hem/ go						Estimate of the proportion of hematite to goethite, based on the wavelength of the Iron oxide absorption, lower is hematite, higher is goethite						K											
11	1	colour plain						Colour in Munsell values, estimated from the spectral values in the visible wavelengths						L											
12	1	Albedo						brightness of the spectrum. Can be related to grain size, mineralogy, organic content, sulphide and other opaque minerals etc.						M											
13	1	Mini1 stSAV						Visible-near infrared mineral automatic identification (hematite or goethite)						N											
14	1	Wt1 stSAV						weight of TSA identification (higher is better, 1 means only one mineral, lower values means that there are other minerals needed in the						O											
15	1	Error stSAV						TSA error (lower is better, higher may mean that it is a poor match)						P											
16	1	(((1000R))) / (((1000R)))						ratio of 1000nm to 1200nm. Helpful for picking out flat spectra, which could be bad measurements or unusual materials						Q											
17	1	1380D						Depth at 1380 nm, can be related to the abundance of kaolinite (particularly well crystalline)						R											
18	1	wmAlsmi_prof						White mica/Al-smectite abundance, based on the strength of the 2200nm absorption (excludes samples containing kaolinite)						S											
19	1	wmAlsmci_prof						White mica/Al-smectite composition, based on the wavelength at 2200nm (excludes samples containing kaolinite)						T											





# Impact to industry already (outside this project)

- ASX release Feb 19, 2019 -  
Encounter Resources

*“The application of Ultrafine+ at Nazare was successful in defining a high quality gold anomaly with significant contrast to background in an area where traditional geochemistry was ineffective. This coherent gold anomaly is coincident with major structural intersection at Nazare”*

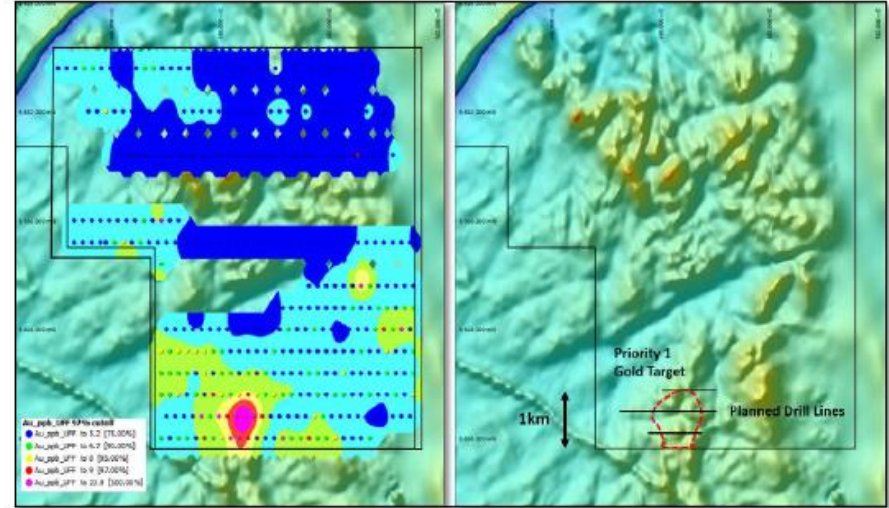
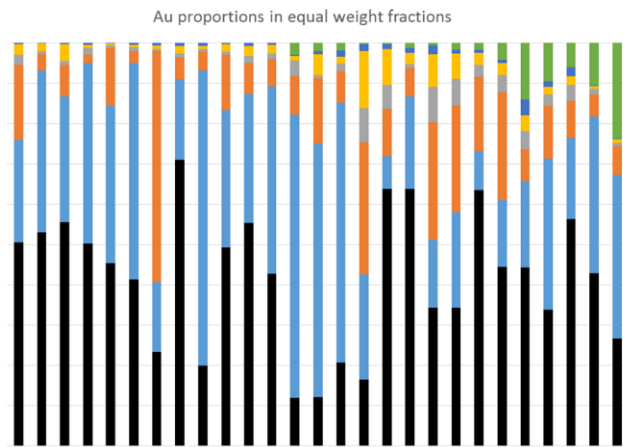
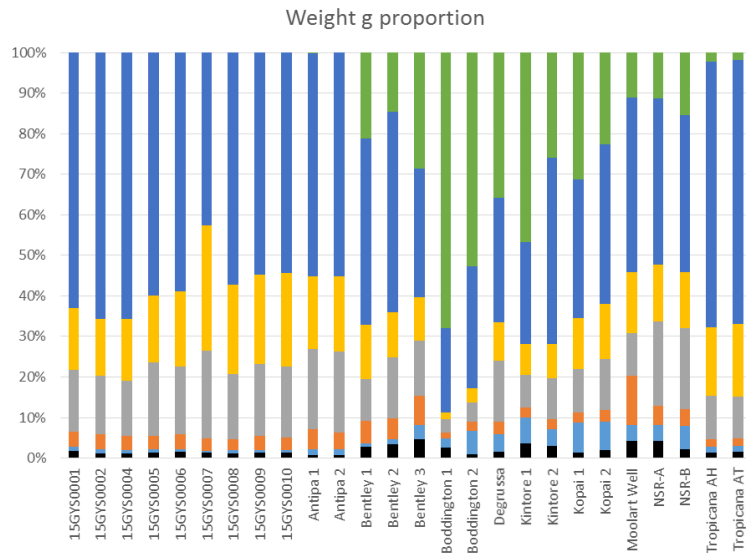


Figure 3 – CSIRO developed geochemical sampling technique trial results at Nazare over airborne TMI (magnetics)



# More “interesting results” are in the fine fraction

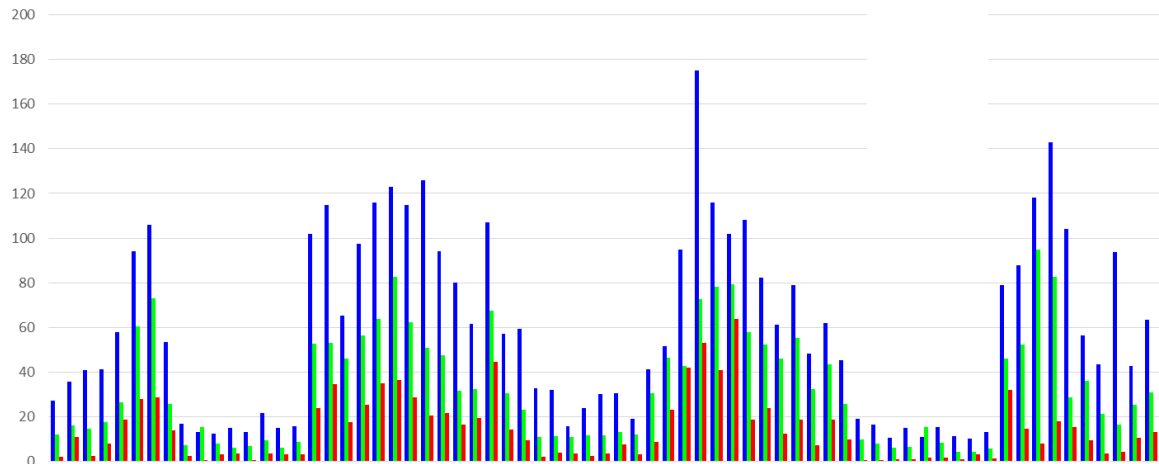
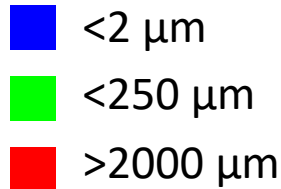


■ <2µm ■ 2-61µm ■ 61µm-125µm ■ 125µm-180µm ■ 180µm-250µm ■ 250µm-2000µm ■ >2000µm

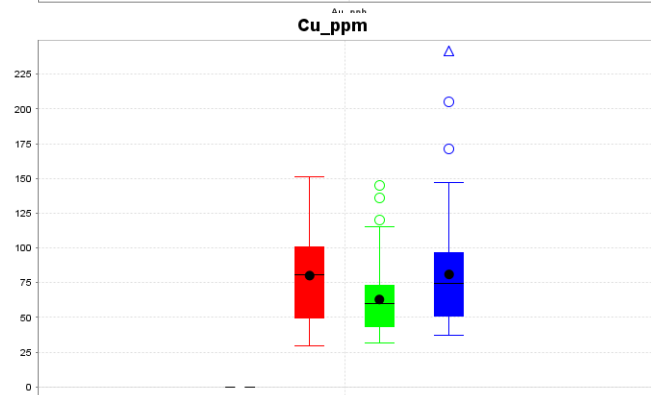
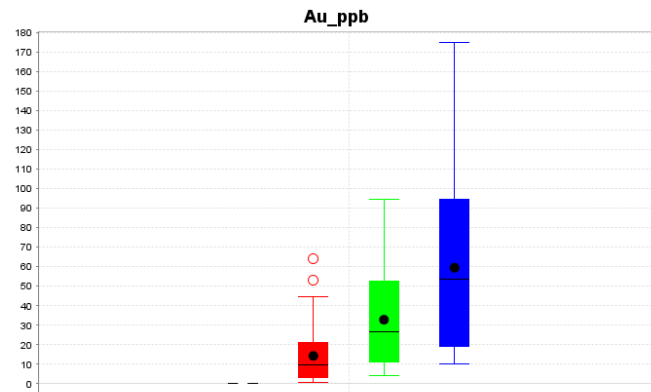


# More Au in <2 $\mu\text{m}$

- East Kalgoorlie area

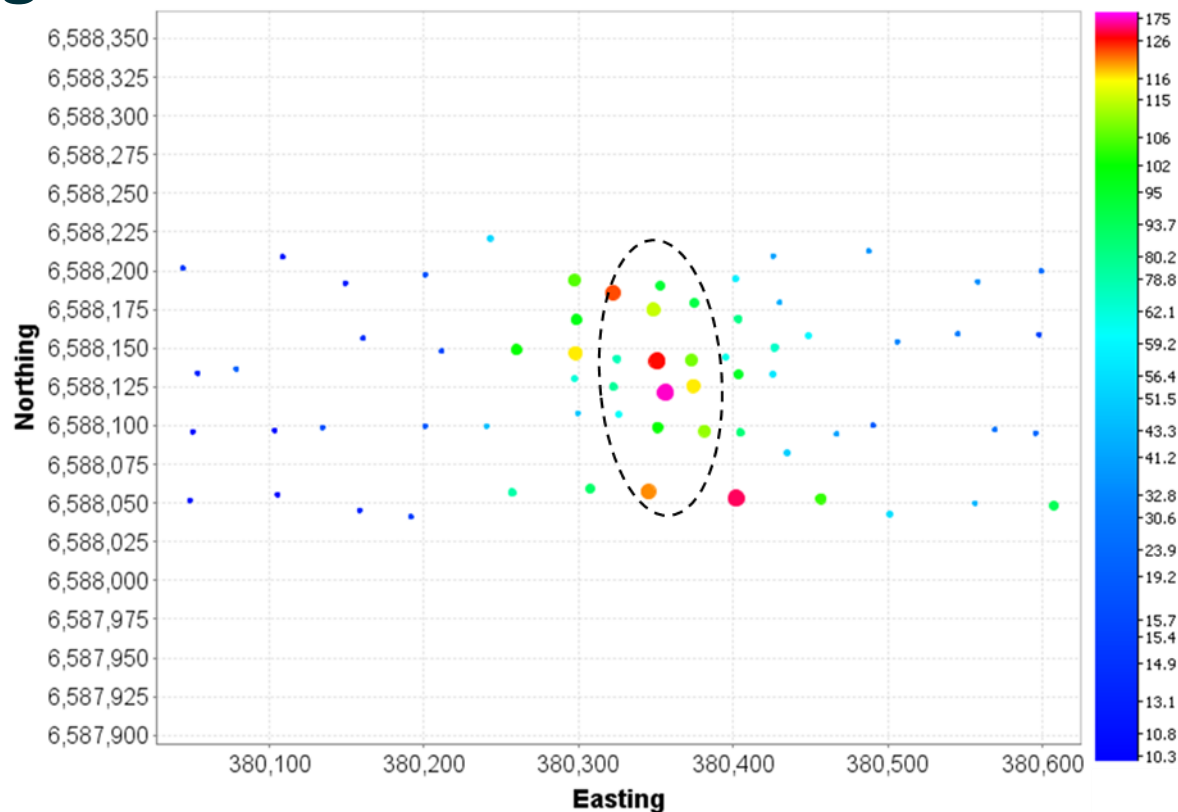


Individual sample sites with 3 particle size fractions



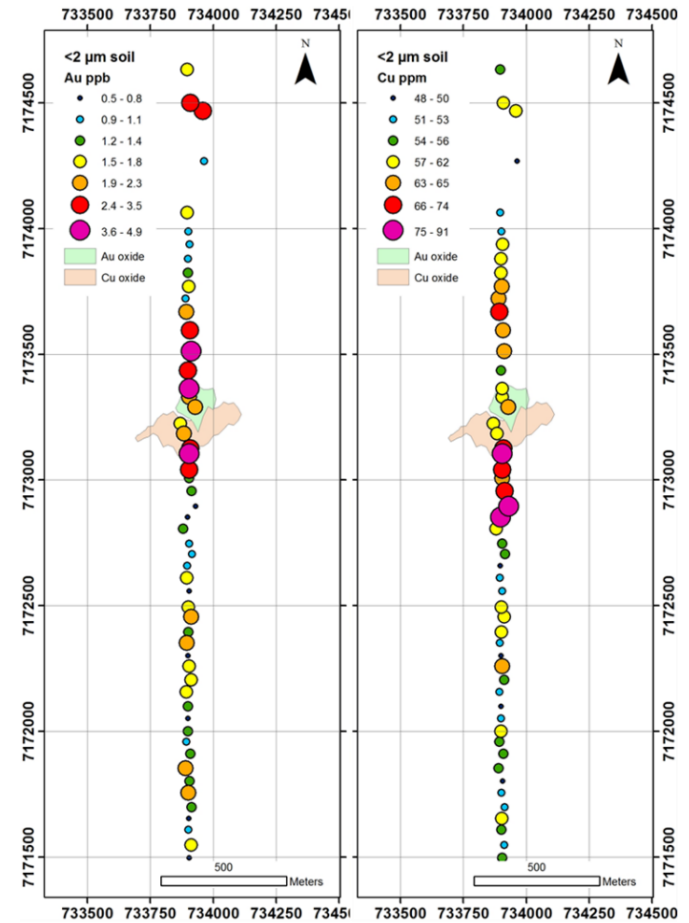
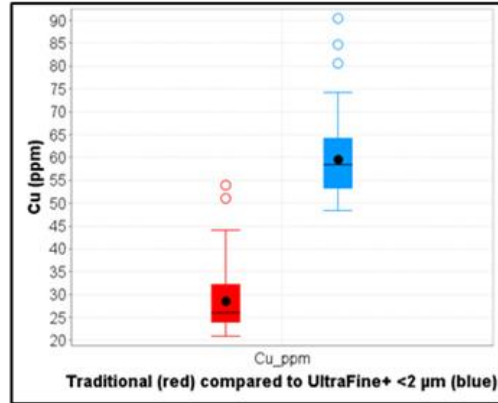
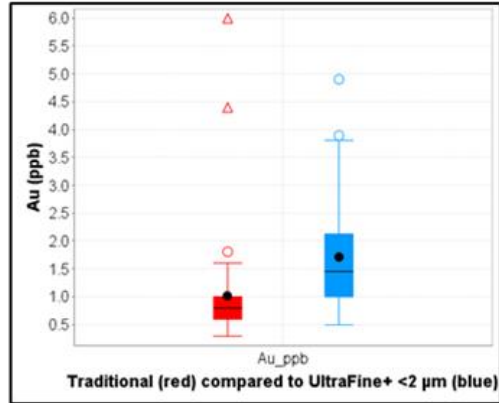


# East Kalgoorlie orientation





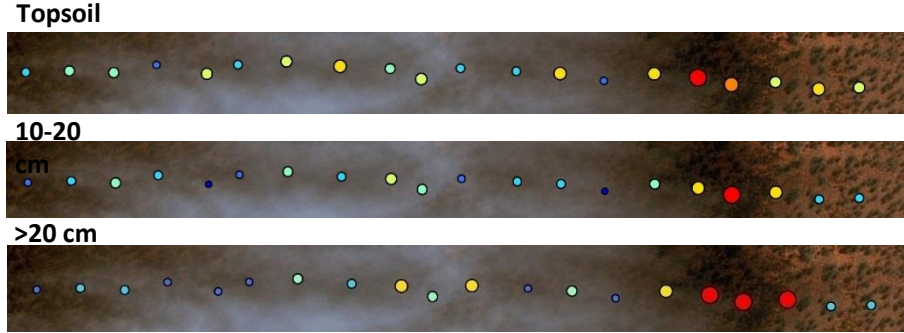
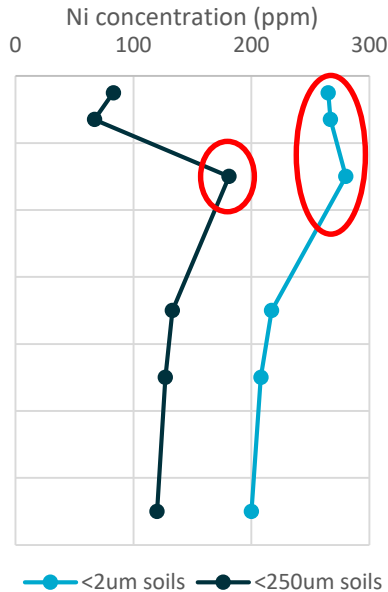
# DeGrussa orientation





# North Miitel and new sites in the Yilgarn

- Profile sampling is more about consistency, but initial tests are exceptional



Topsoil	10-20cm	>20 cm
Au ppb	Au ppb	Au ppb
● 3.4 - 4.9	● 4.1 - 7.0	● 4.6 - 7.5
● 2.7 - 3.3	● 3.4 - 4.0	● 4.1 - 4.5
● 2.3 - 2.6	● 2.9 - 3.3	● 3.5 - 4.0
● 2.1 - 2.2	● 2.5 - 2.8	● 3.0 - 3.4
● 1.8 - 2.0	● 2.1 - 2.4	● 2.5 - 2.9
● 1.3 - 1.7	● 1.5 - 2.0	● 1.9 - 2.4
● 1.1 - 1.2	● 1.2 - 1.4	● 1.4 - 1.8
● 0.8 - 1.0	● 0.7 - 1.1	● 0.9 - 1.3

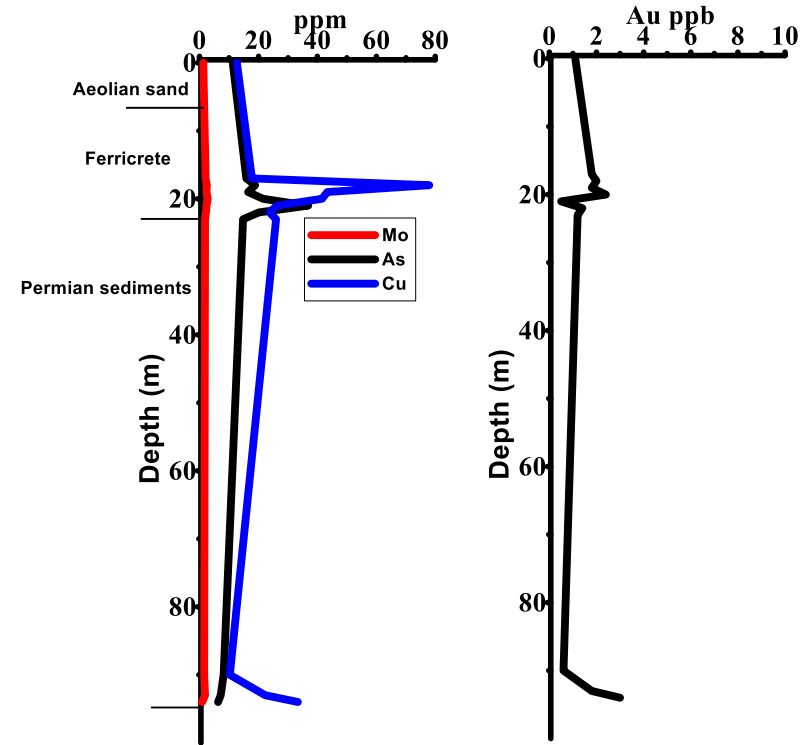




# Permian interface

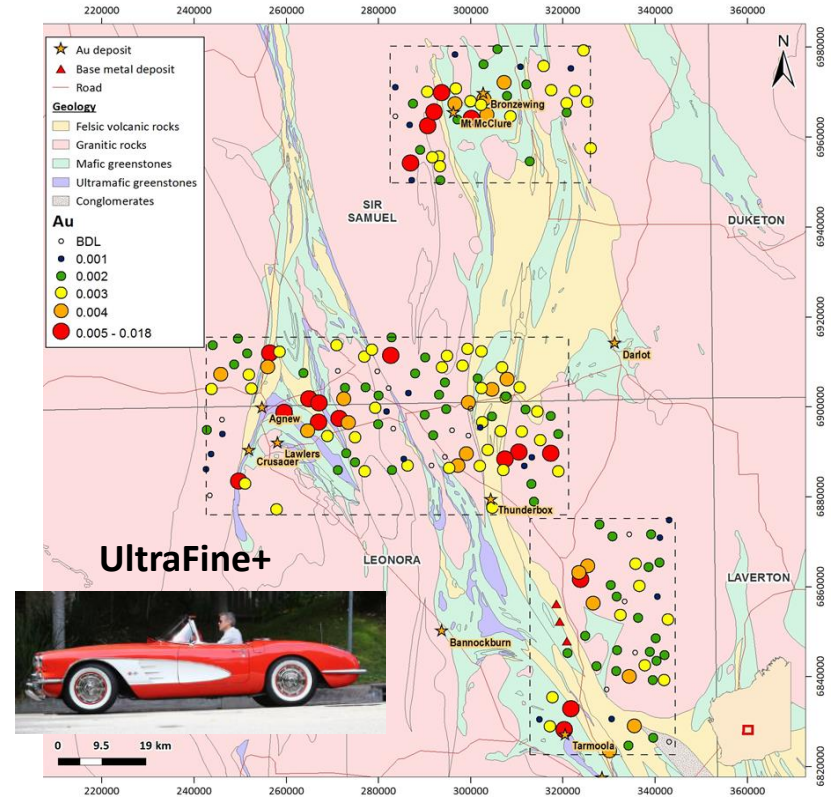
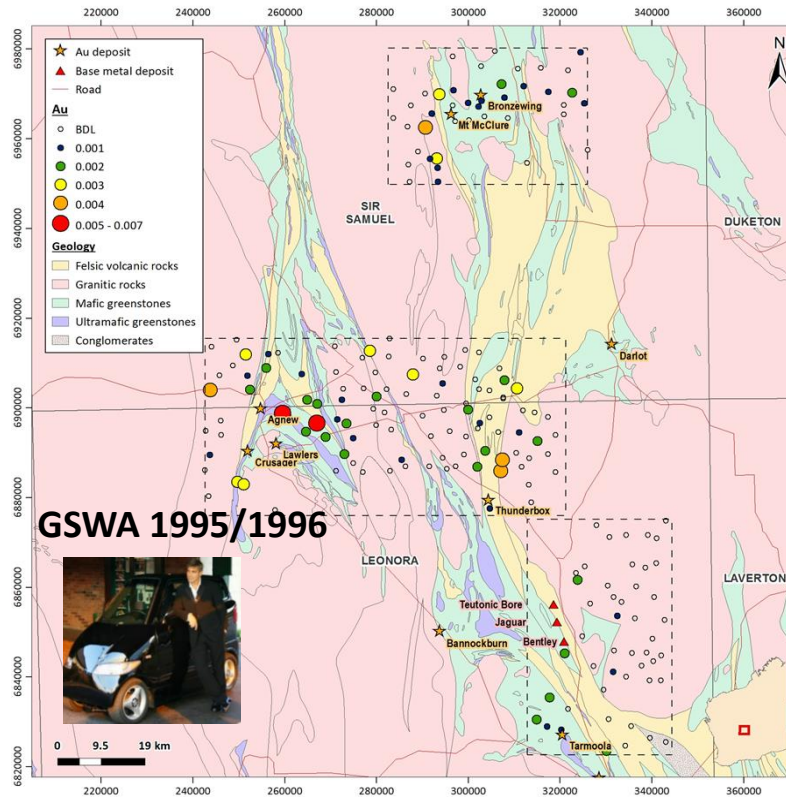
- CuAu deposit – deep transported cover
- Lateral extent?

Profile above mineralization





# Gold with results on the same scales





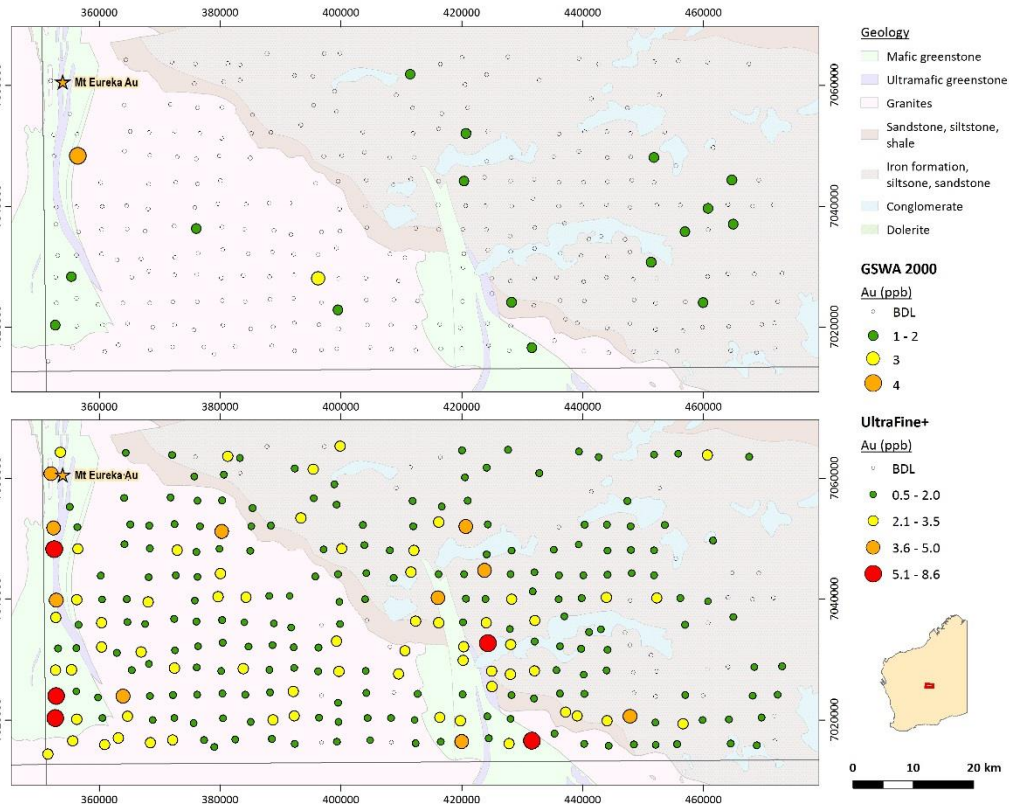
# GSWA historic soils reprocessed with



- Original sampling and analysis by GSWA (2000)

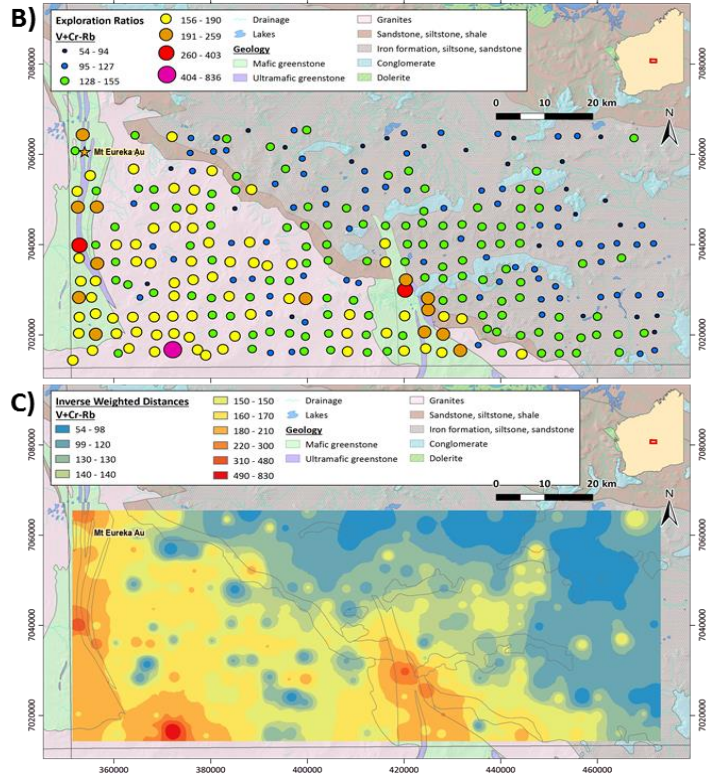
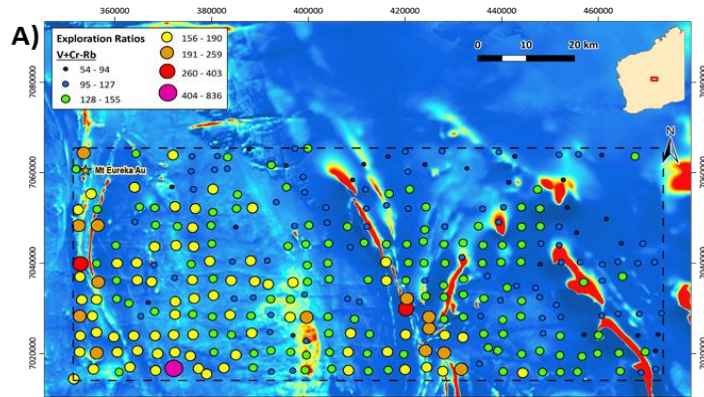


- Same samples using UltraFine+
- 5–9 ppb Au shows Bronzewing
- Not including:



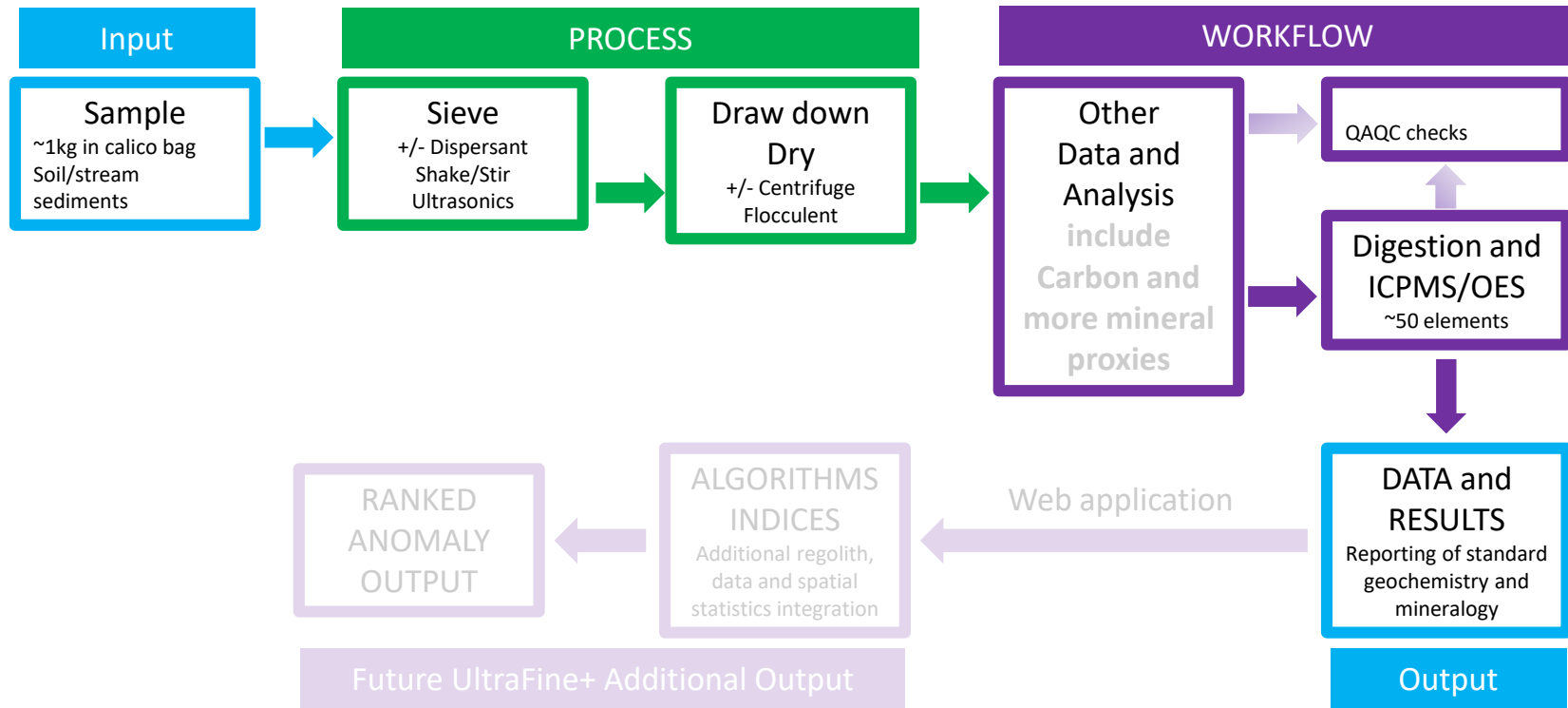


## Other map products and more to come





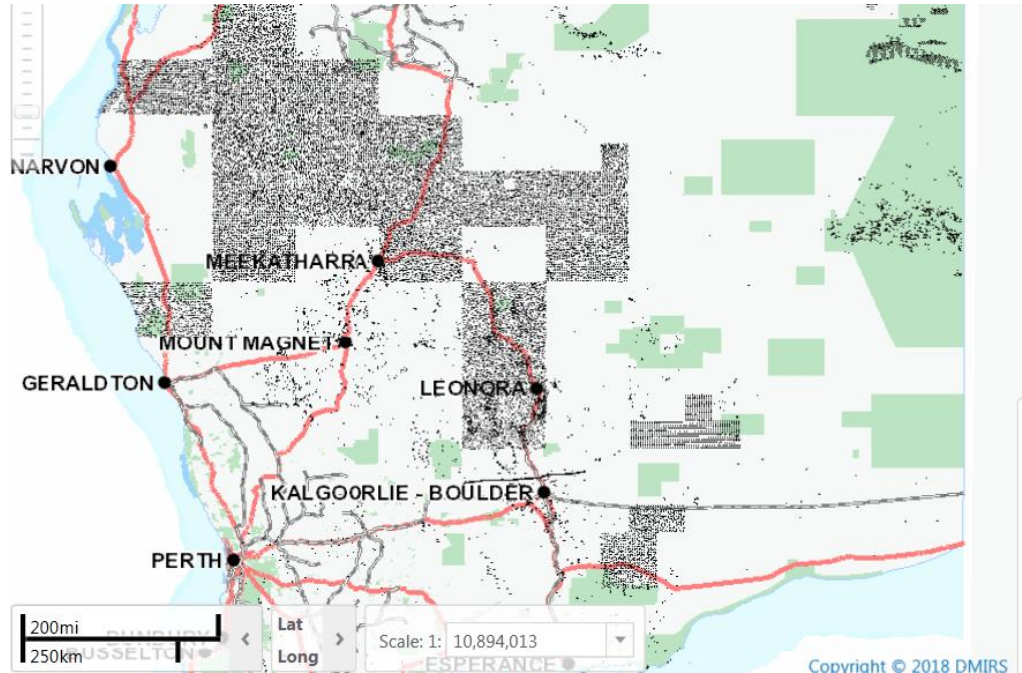
# and future development/project





# Opportunity: reprocess, evaluate and generate

*10,000,000 open data (samples), just a fraction of many, many more samples*







# Thank you

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