

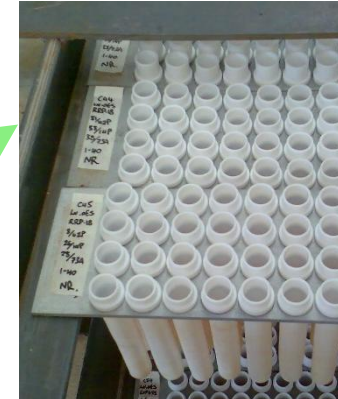
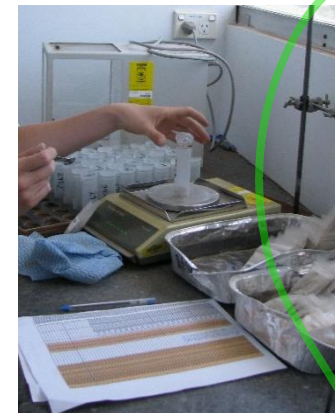
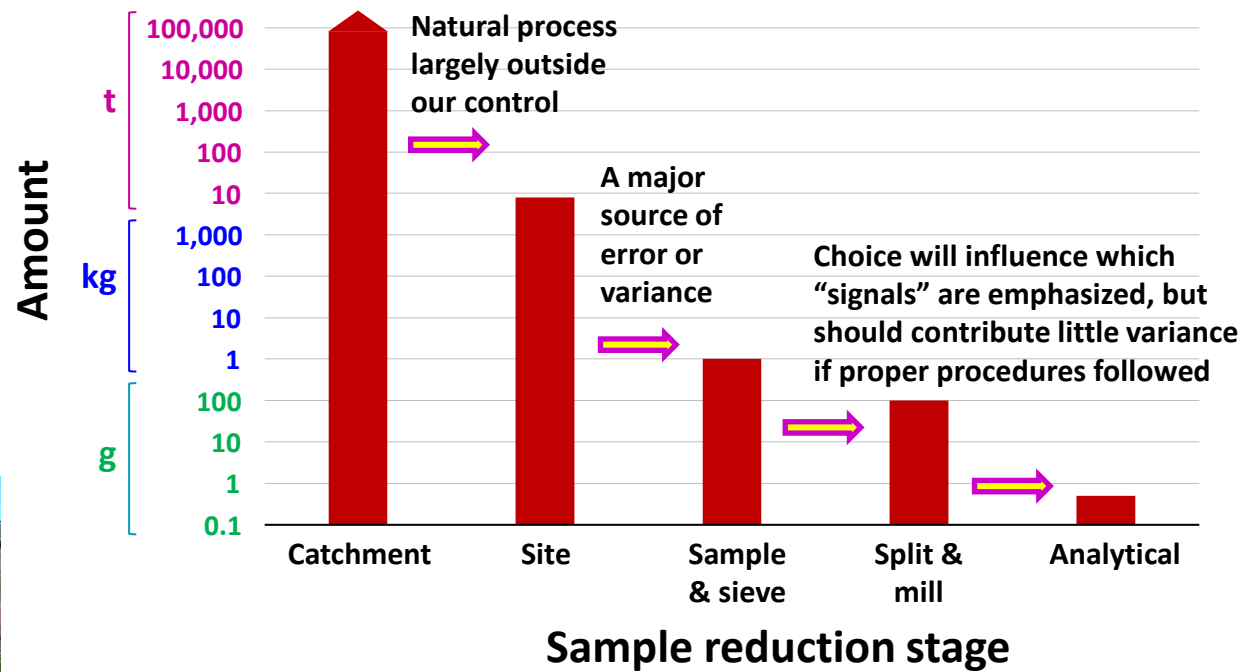
Regional geochemical mapping - how can analysis of just a few kilograms of samples from a large area generate such coherent maps?

David Cohen

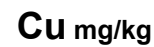


UNSW
Earth and Sustainability
Science Research Centre

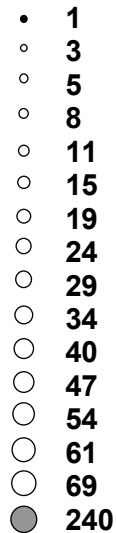
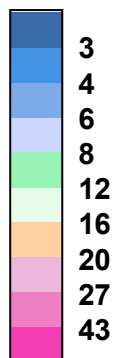




837 samples

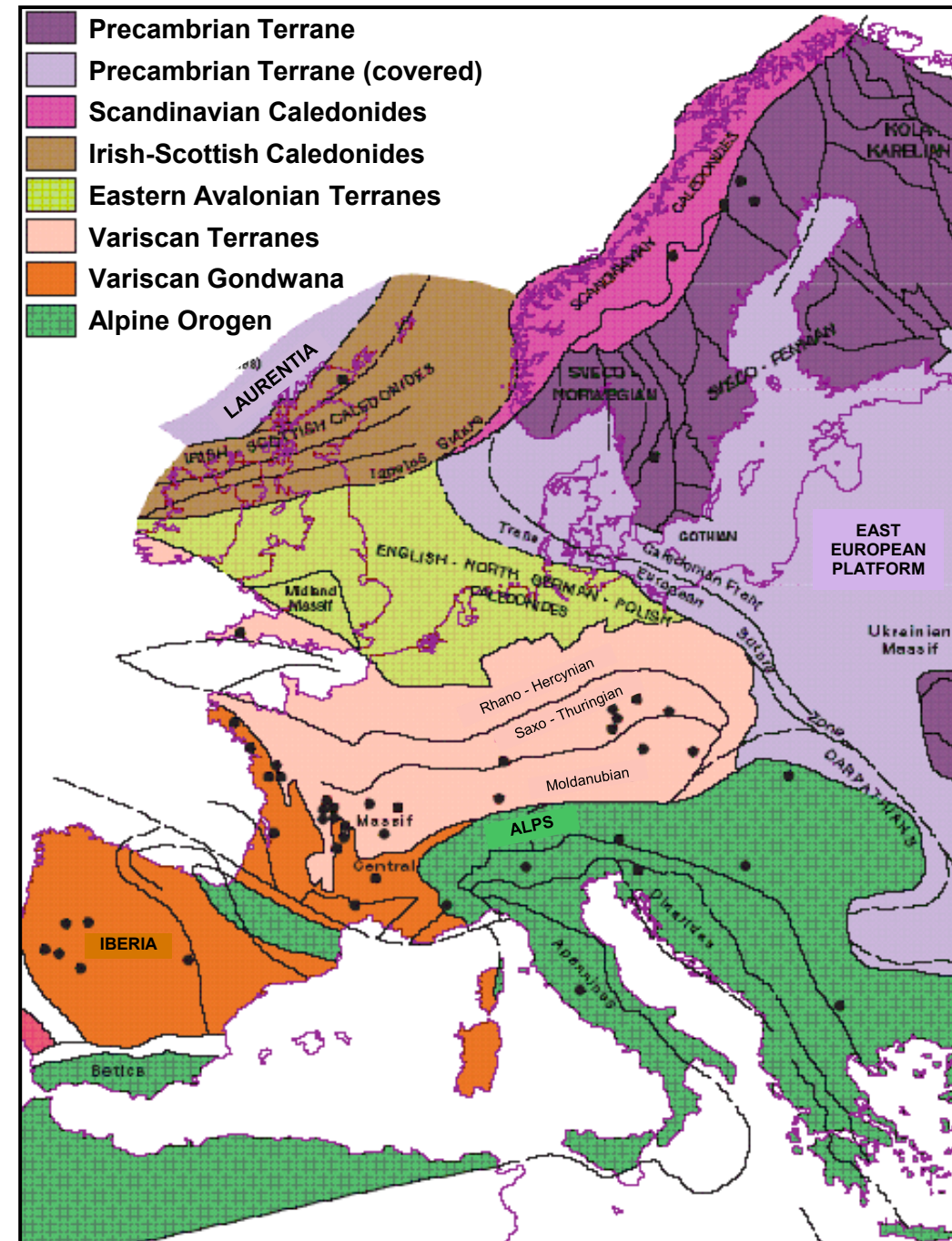


- Major Cu deposits



FOREGS Geochemical Baseline Mapping

Canary Islands



After Salminen et al. 2006, FOREGS/GTK

Element **Pb_top_<75um_ar** <- CLICK and select from pull-down list

Upper clip % **97** 28.048 ppm

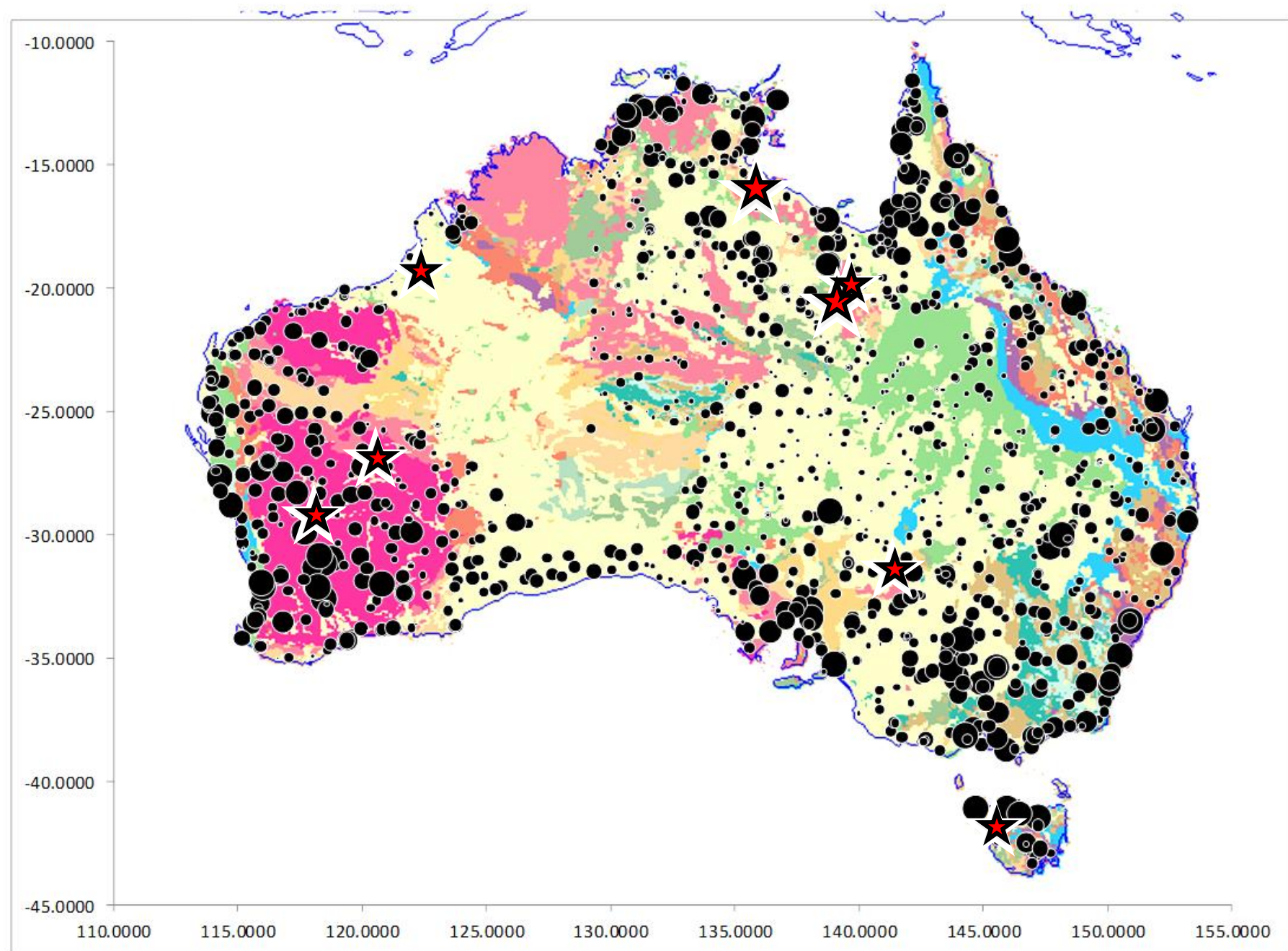
Pb_top_<75um_ar

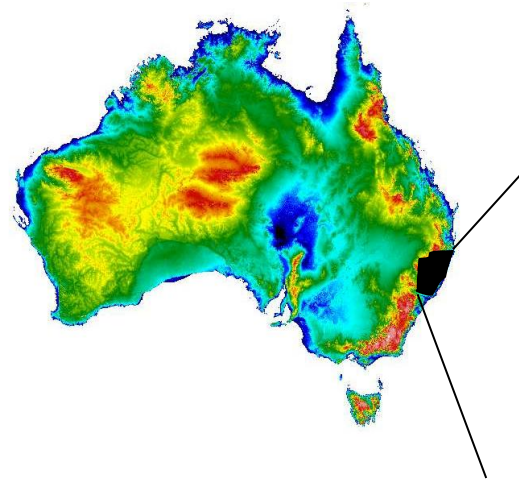
Min	0.000	ppm
Median	10.300	
Mean	13.186	
80th %ile	15.300	
90th %ile	19.420	
95th %ile	23.330	
Max	1520.000	

Symbols

Pb_top_<75um_ar

- 2.630 ppm
- 7.012
- 14.024
- 21.036
- 28.048





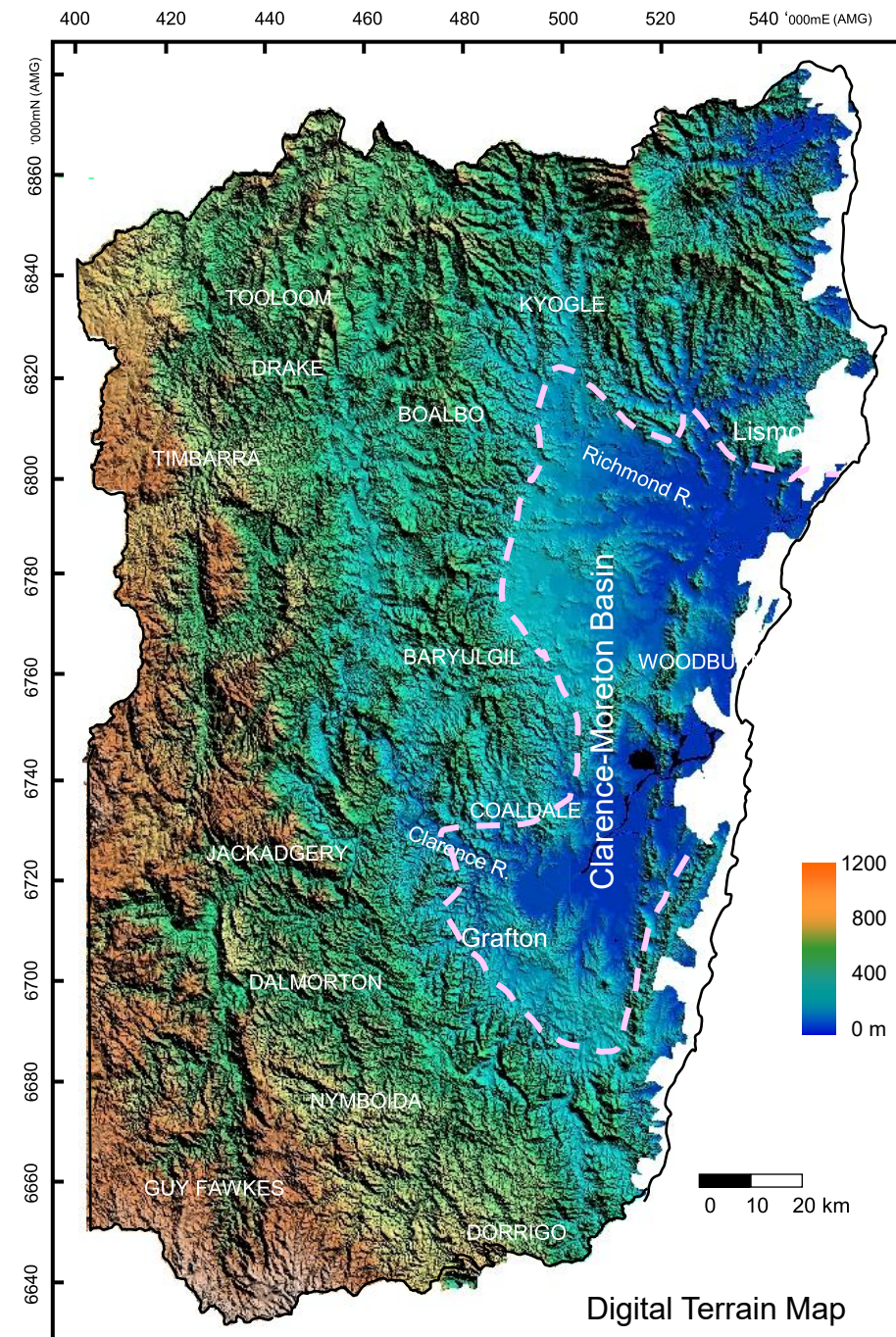
NRAC

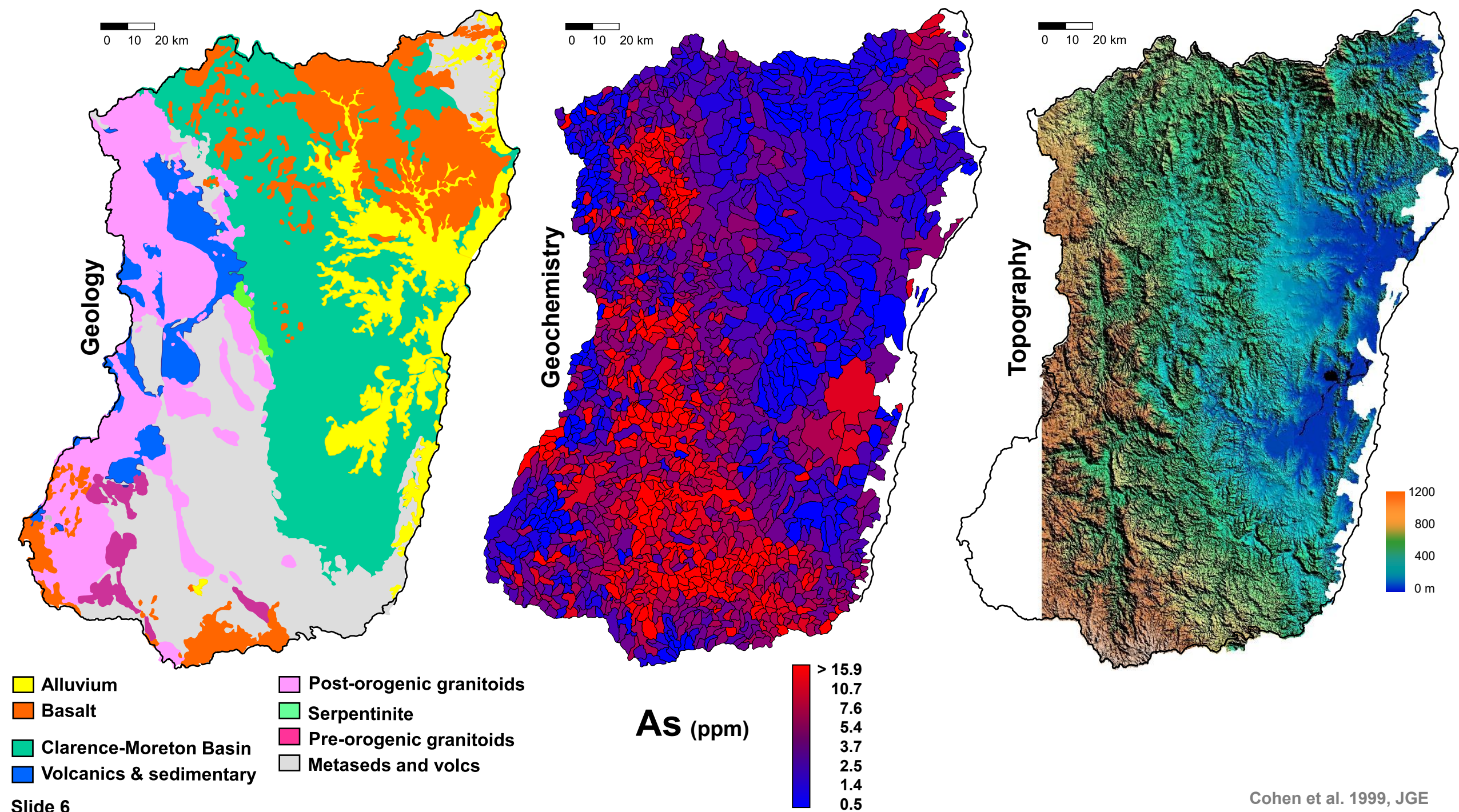
Geochemical Study - Northern New South Wales Australia

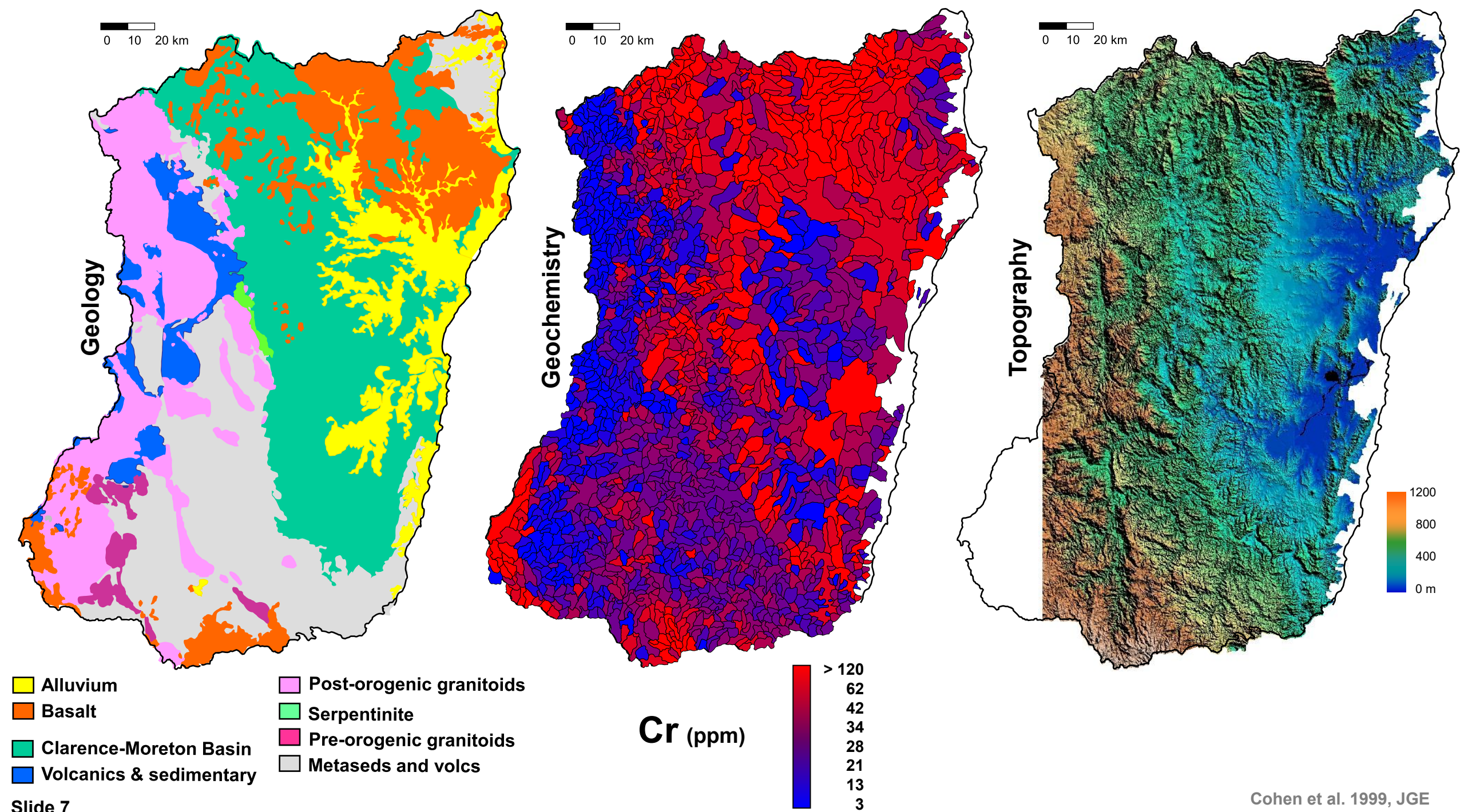
**Stream Sediment program using
15 km² catchments in hilly terrain and
50 km² catchments in plains**

Area approximately 24,000 km²

1,680 samples collected by 3 crews in 5 months

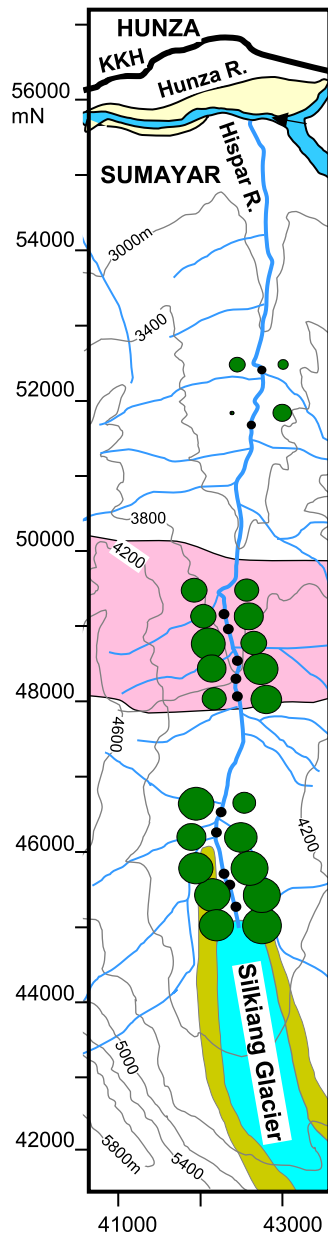




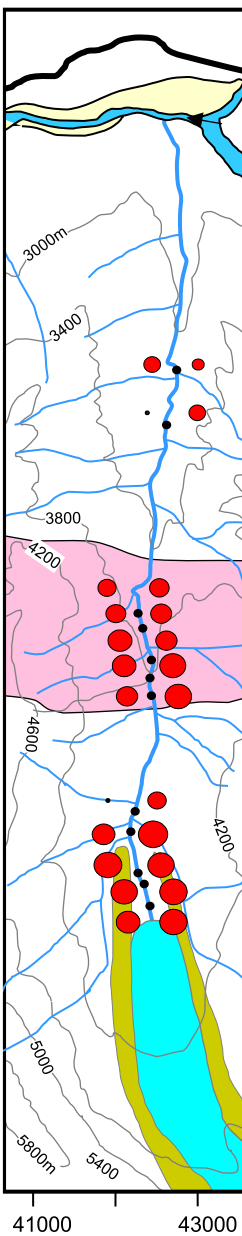




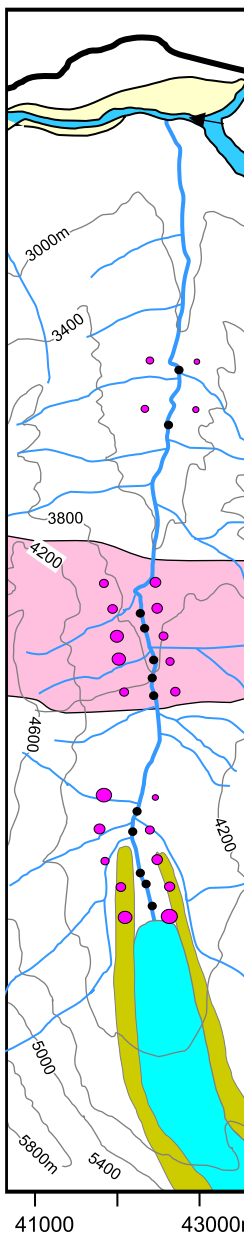
Ni



>125 μ m

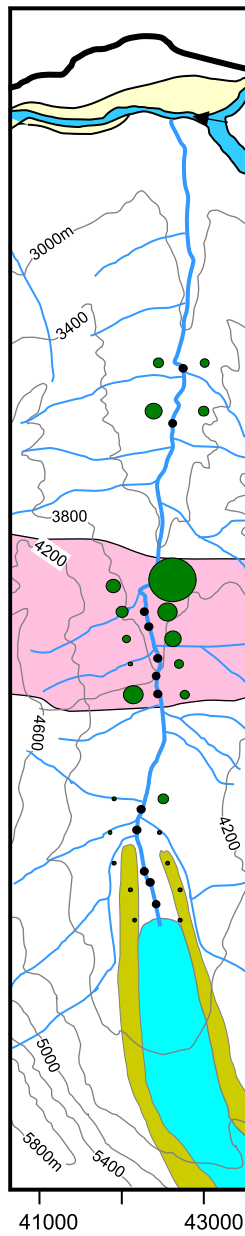


<125 μ m

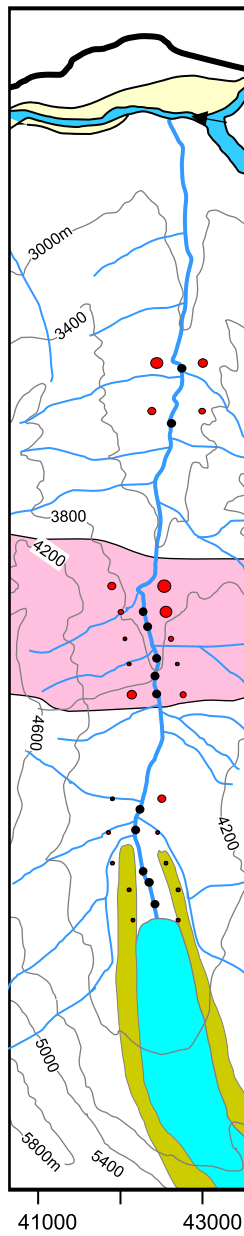


Pan Con.

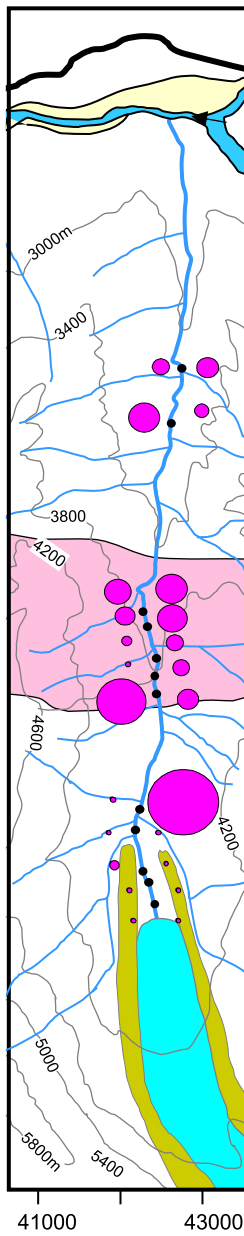
Sn



>125 μ m



<125 μ m



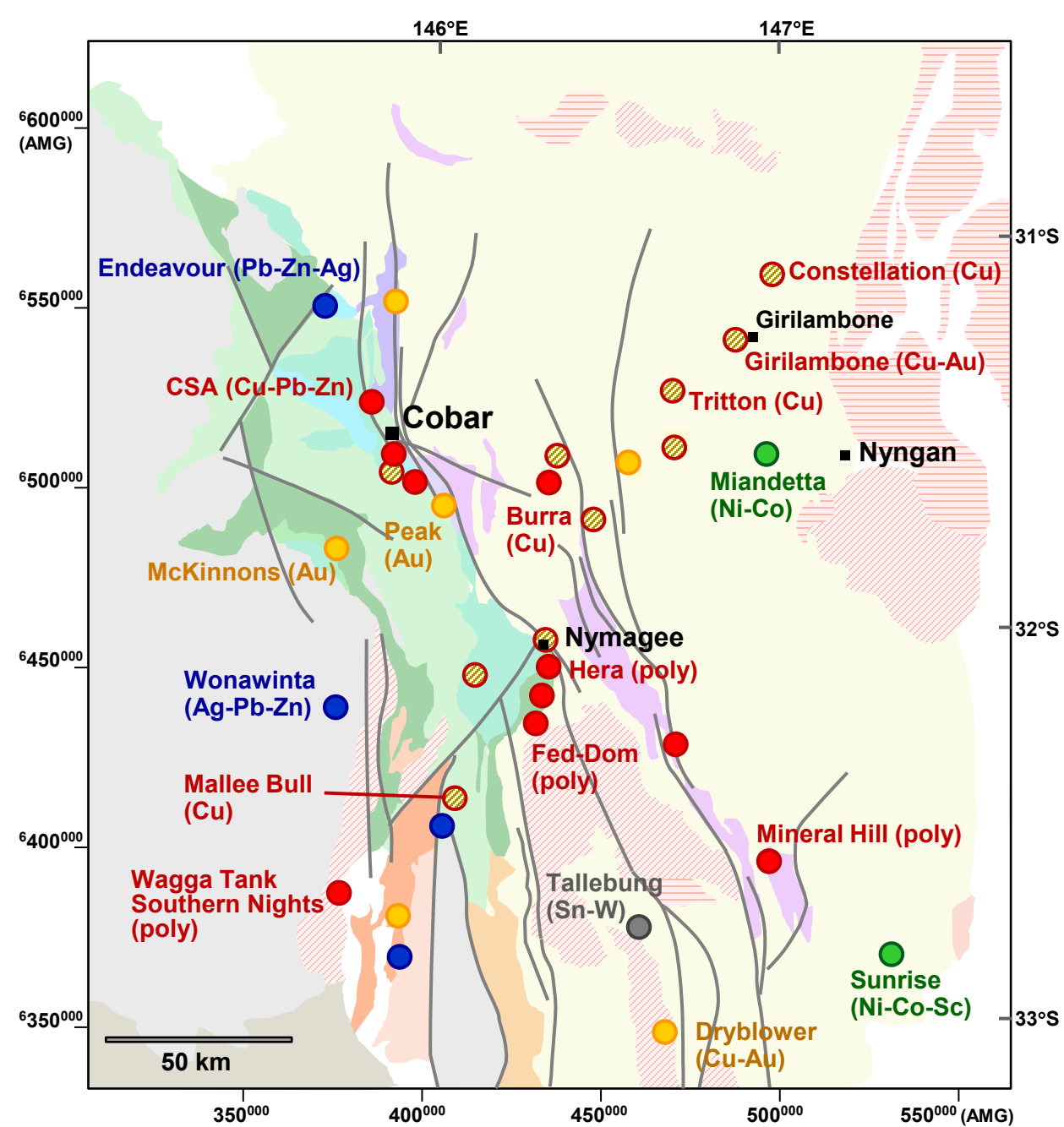
Pan Con.

Sumayar Pluton

Lateral Moraine

Site Energy

'High' 'Low'



Devonian

Shallow marine

- Winduck & Walters Ra Gps
- U. Amphitheatre Gp
- Biddabirra & Shume Fmns
- CSA Siltstone
- L. Amphitheatre Gp

Deep marine

Volcanic / volcani-clastic

- Broken Ra Gp
- Rast Gp
- Mt Hope Gp

- Kopyje Gp
- Nurri Gp

Ordovician basement

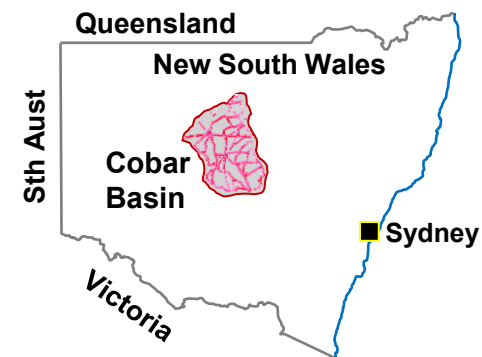
- Girilambone & Adaminaby Gps

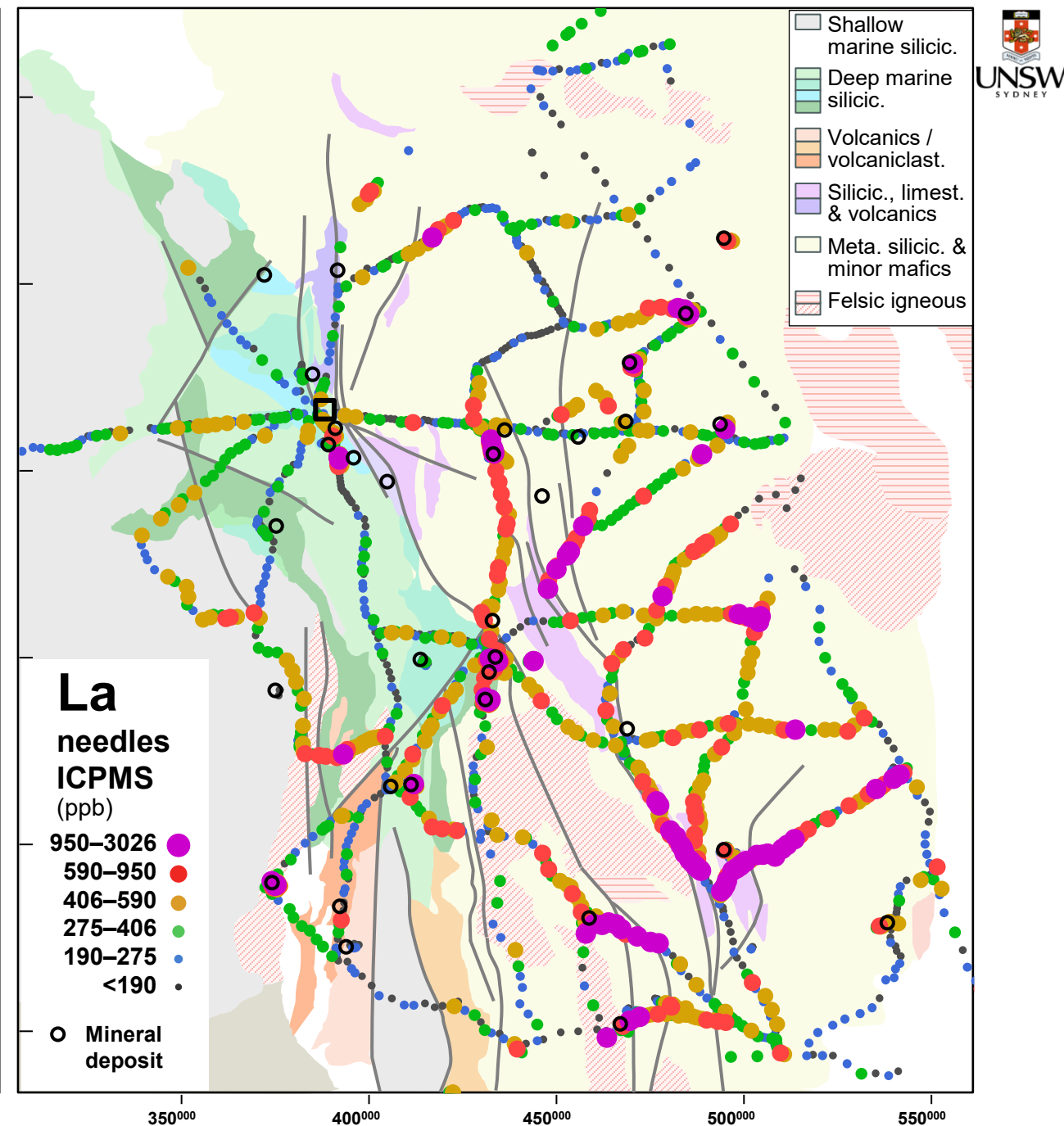
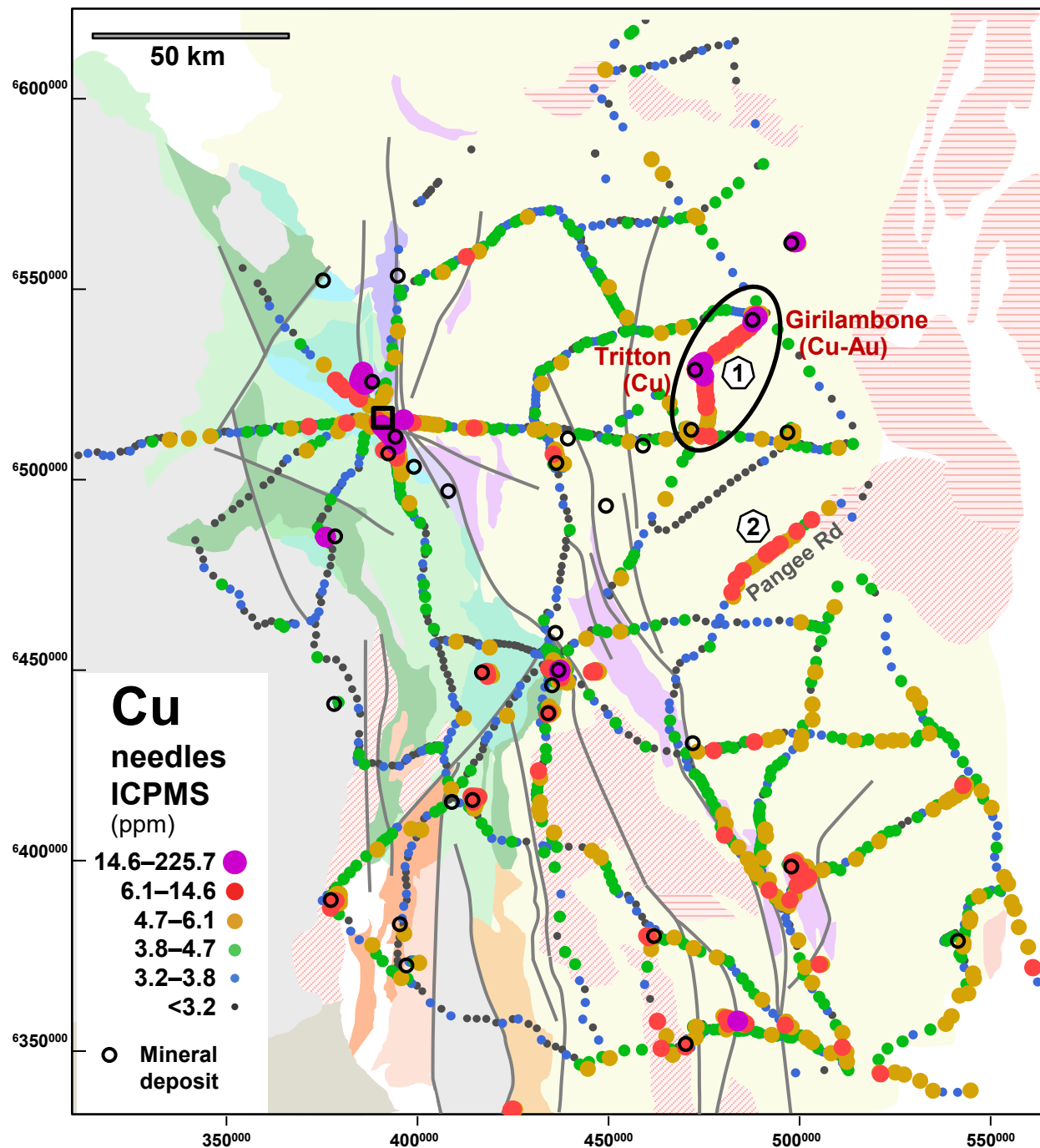
Igneous units

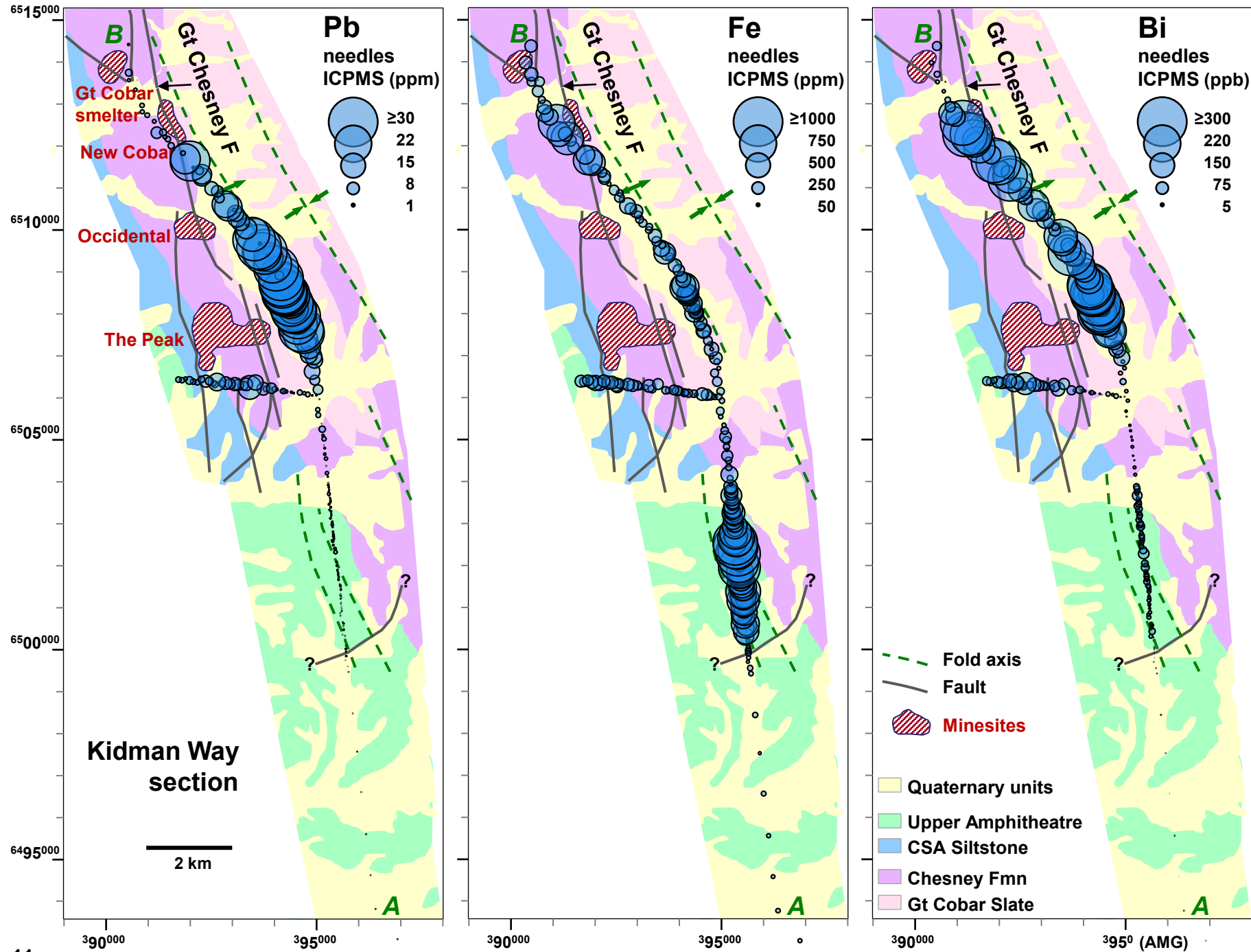
- Devonian magmatic rocks
- Silurian magmatic rocks

Mineral deposits

- Au
- Pb-Zn-Ag
- Ni-Co
- Cu
- Polymetallic
- Sn-W







McKinnons pit

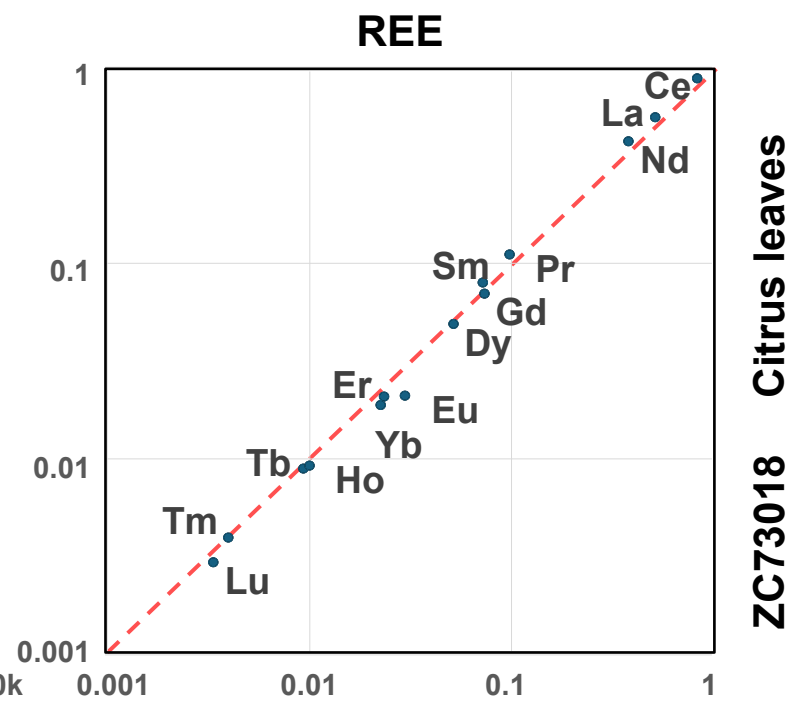
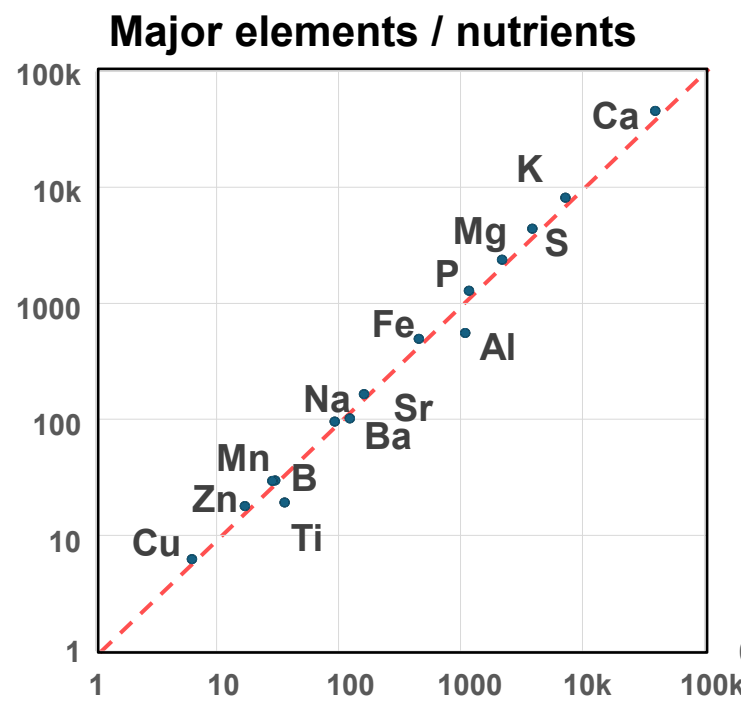
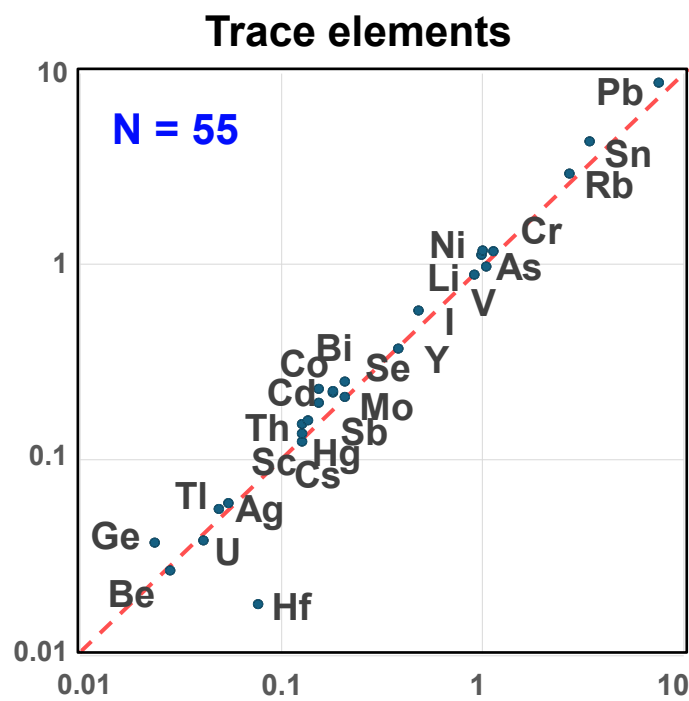


Wonawinta pit



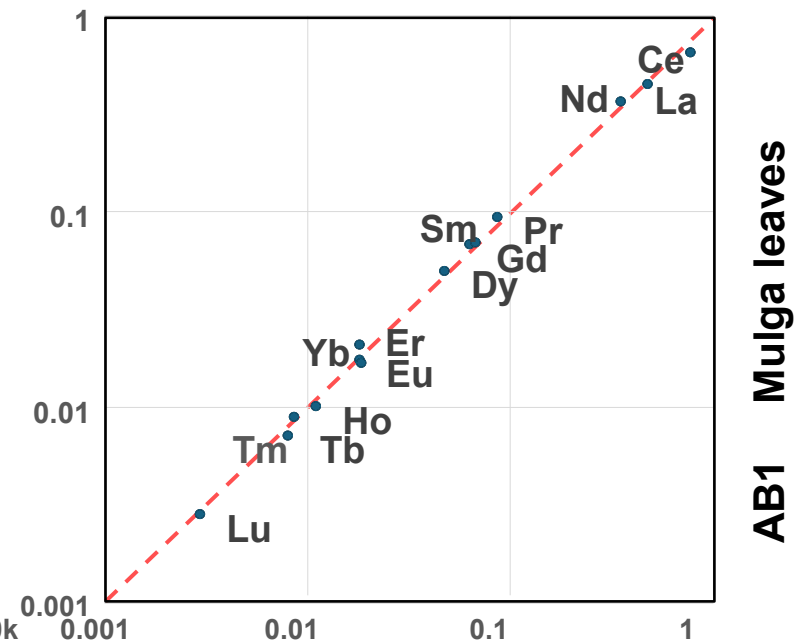
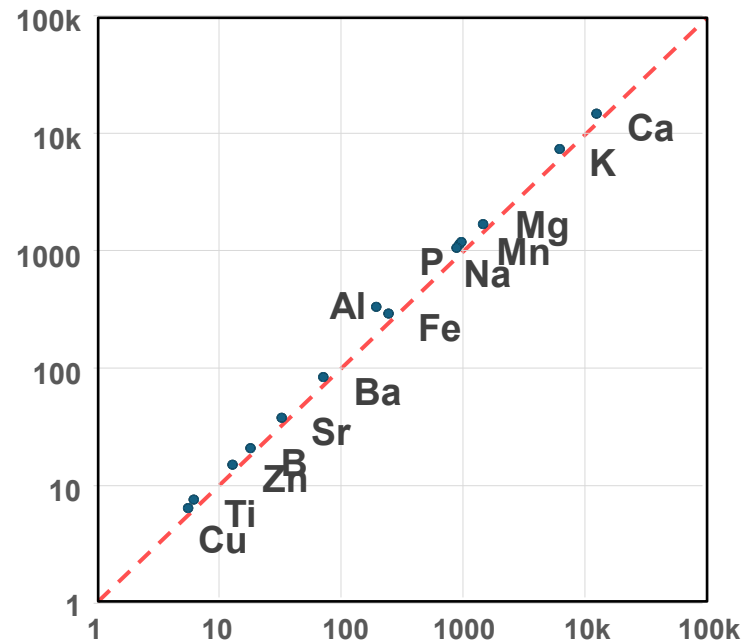
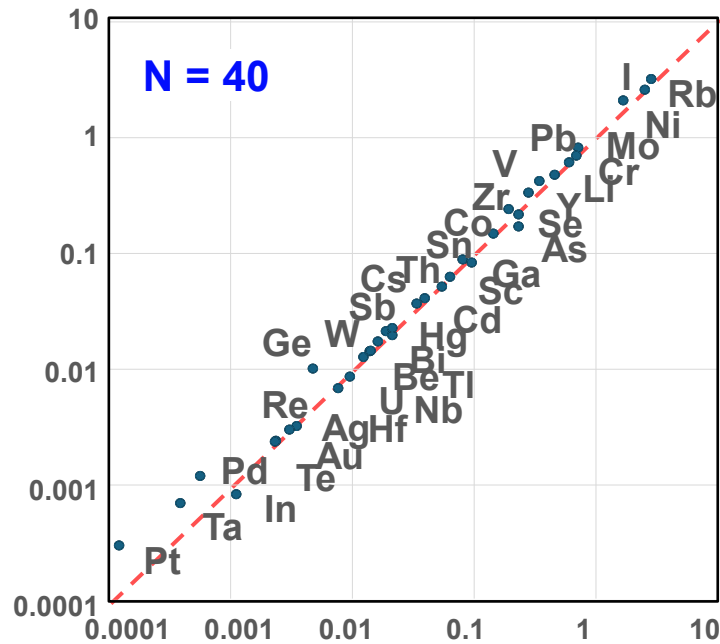
Schifano et al. 2025, JGE

Ave. for
samples
analysed in
Cobar study
(ppm)



Citrus leaves
ZC73018

Microwave
aqua regia
ICP-MS



Mulga leaves
AB1

Certified values (ppm)

Target Prediction Models

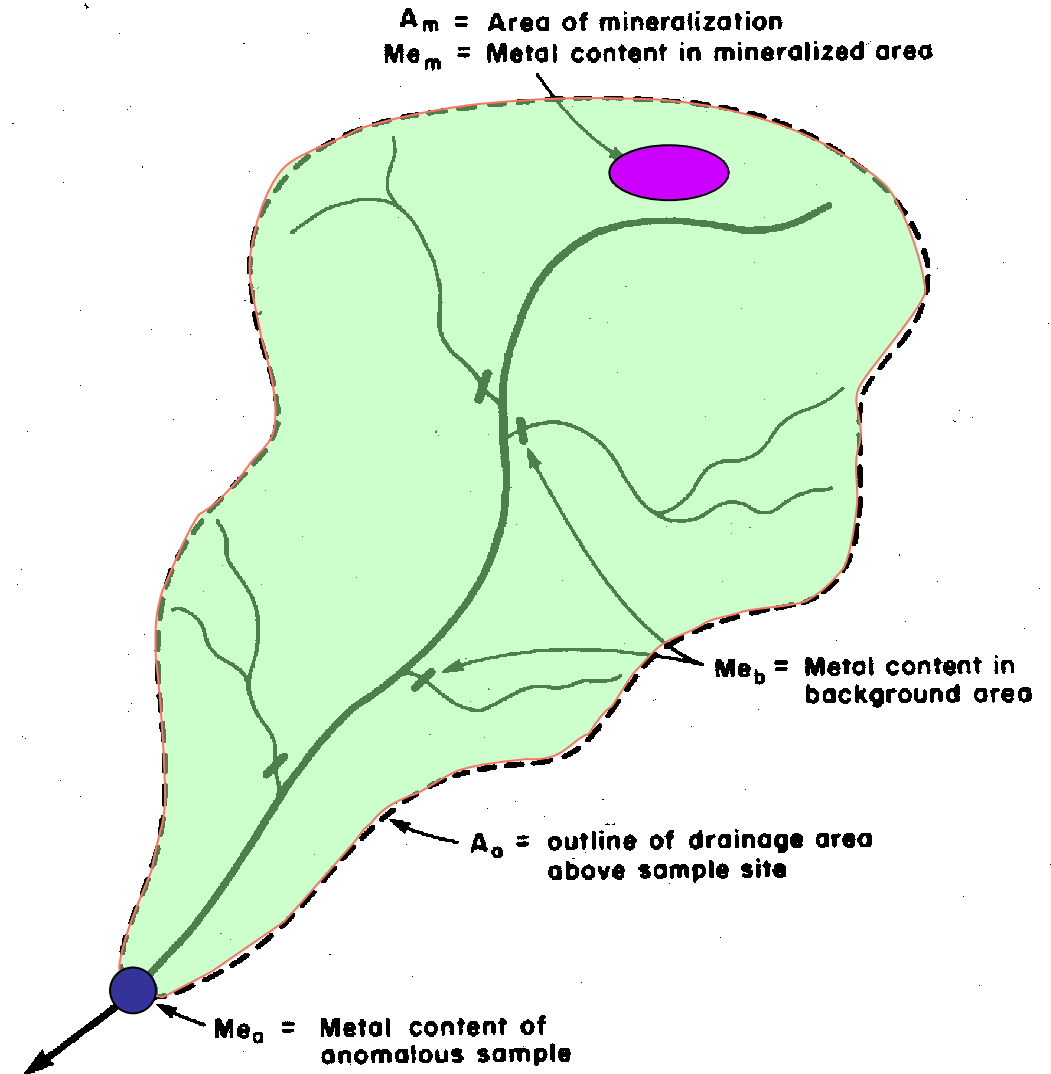
A theoretical model linking the expected metal contents of stream sediments near mineralization with the grade and areal extent of mineralization in the drainage basin has been developed by Hawkes (1976).

This is based on the relationship:

$$M_a = A_m / A_a \cdot (M_m - M_b) + M_b$$

where:

- M_m = grade of mineralization
- M_a = metal content of anomalous stream sediment
- M_b = background metal content of streams
- A_m = surface area of mineralization
- A_a = upstream drainage area



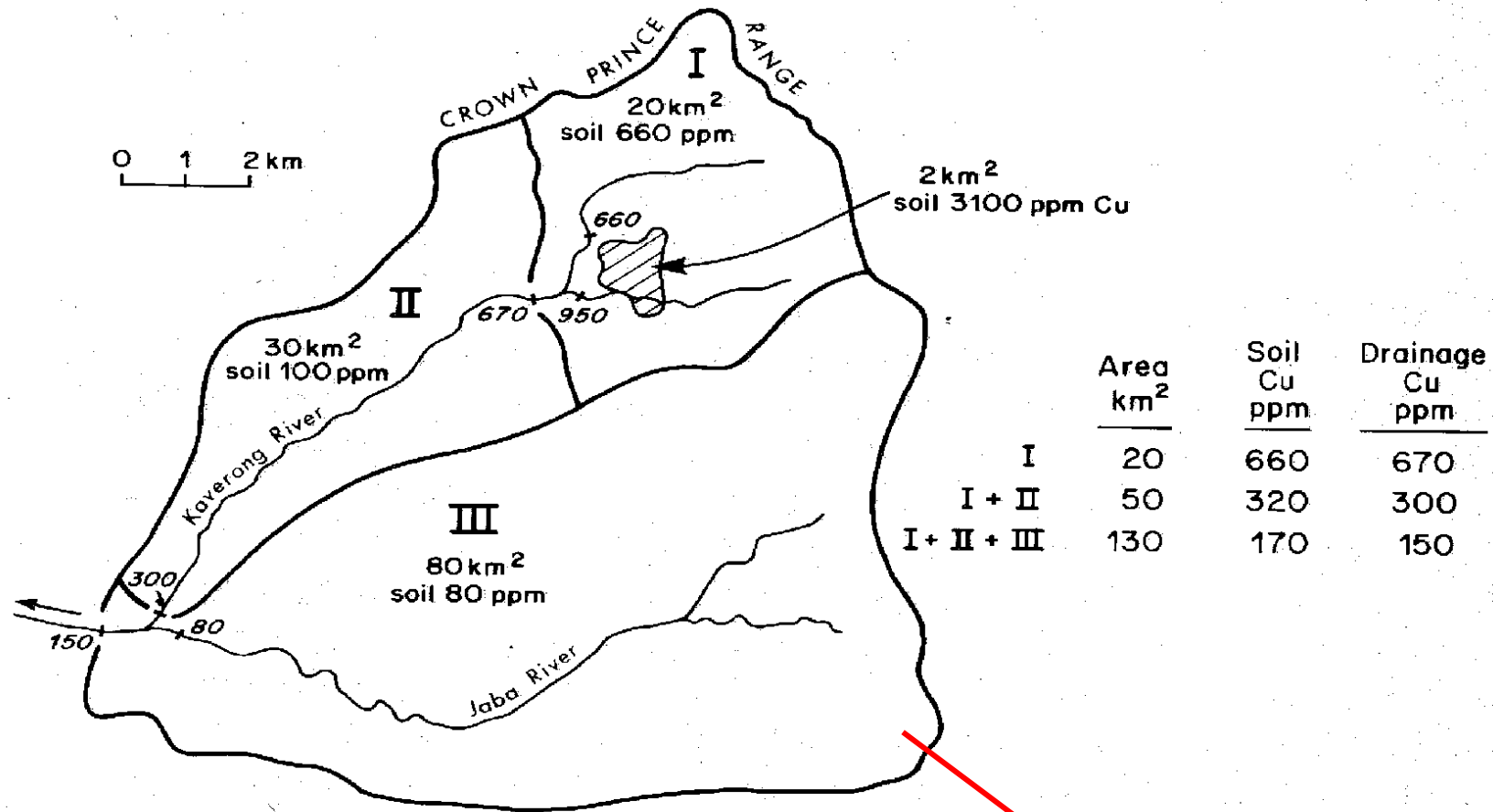
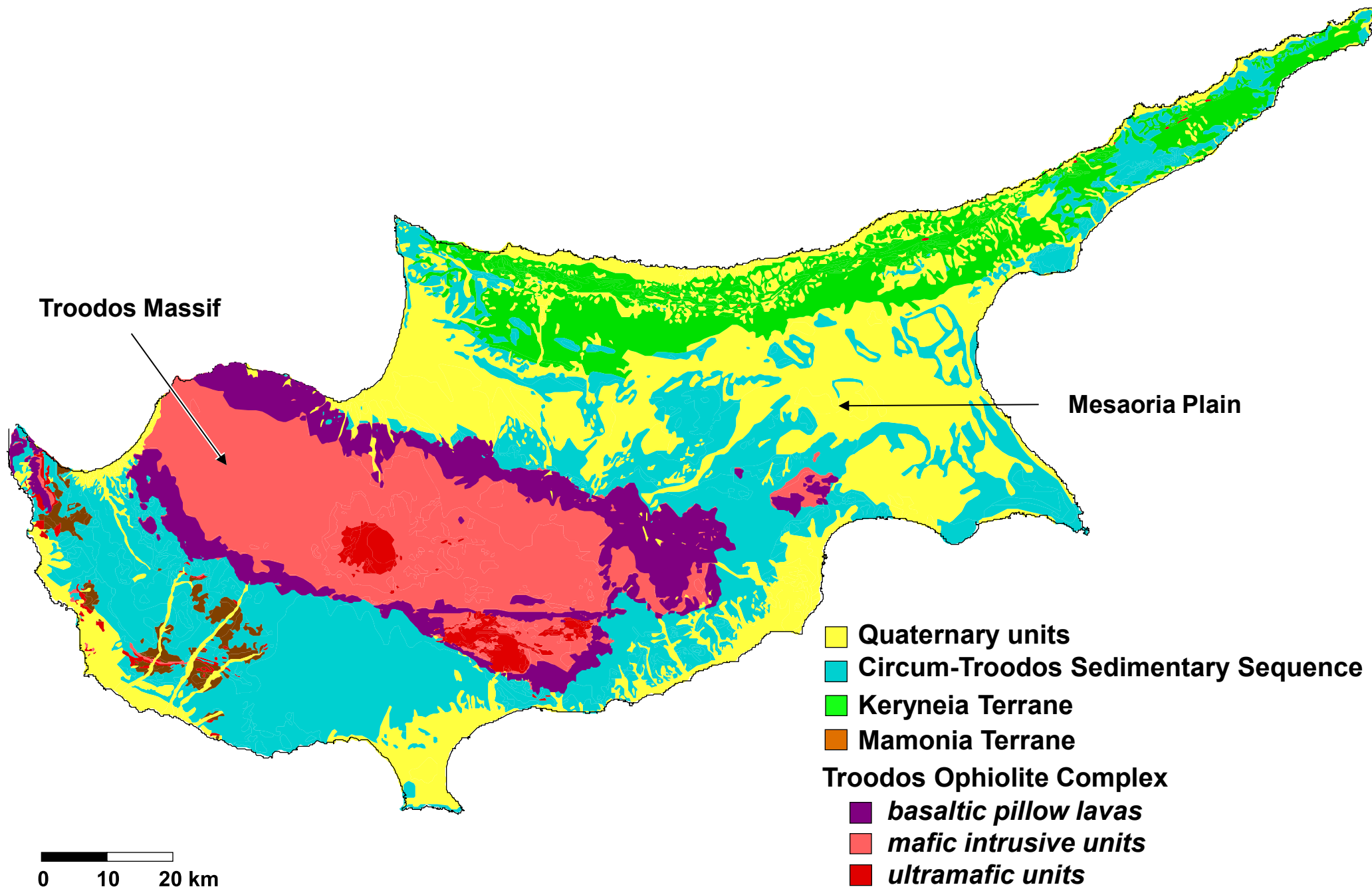
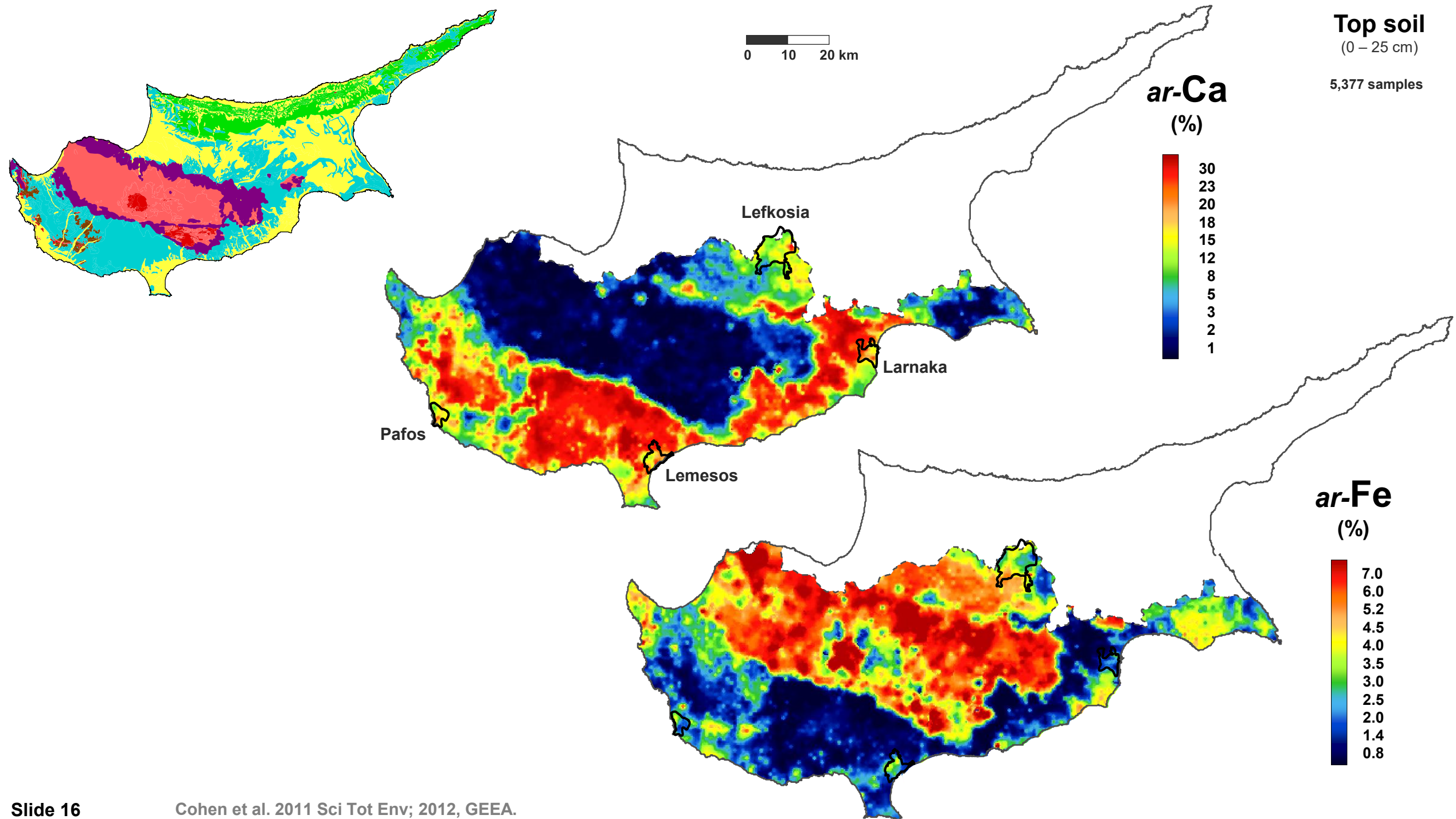
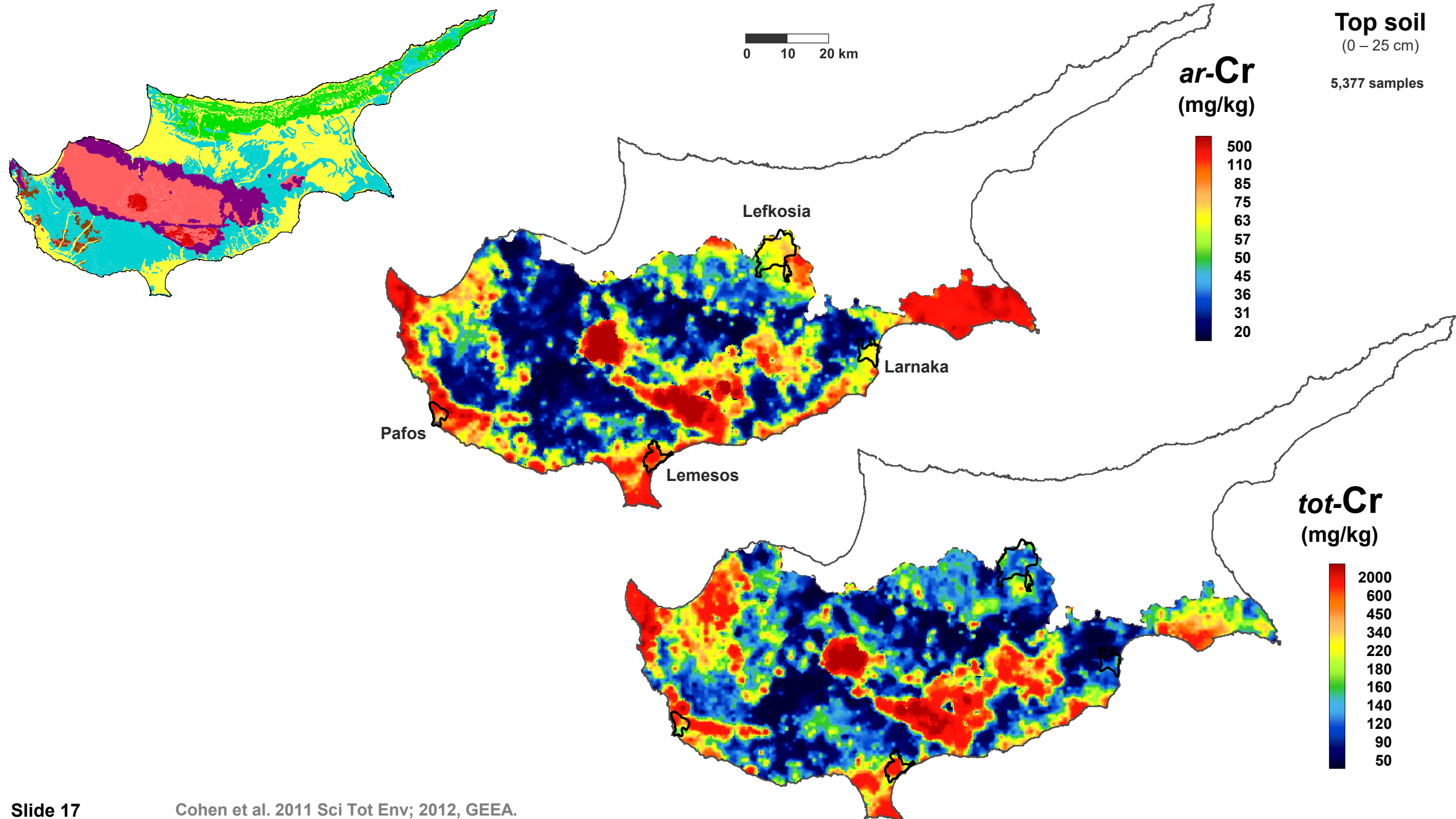


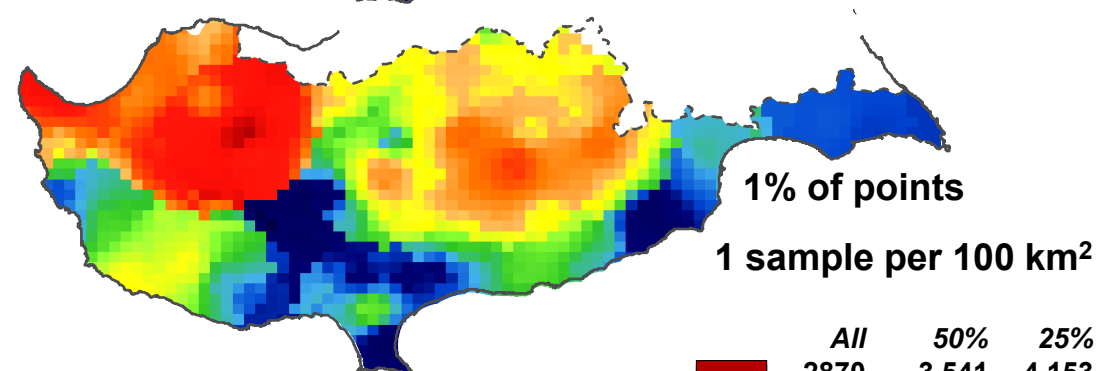
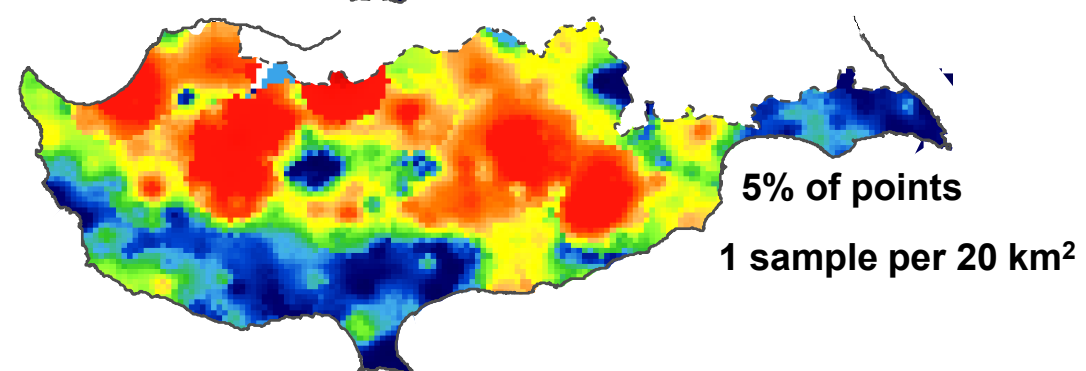
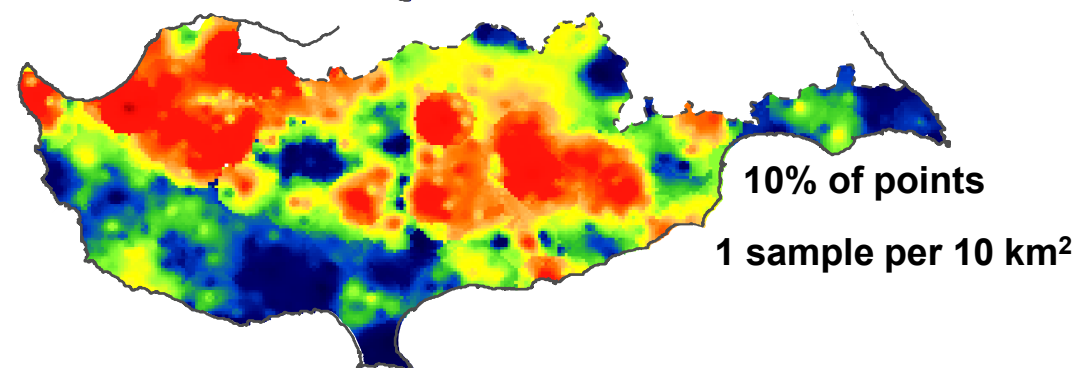
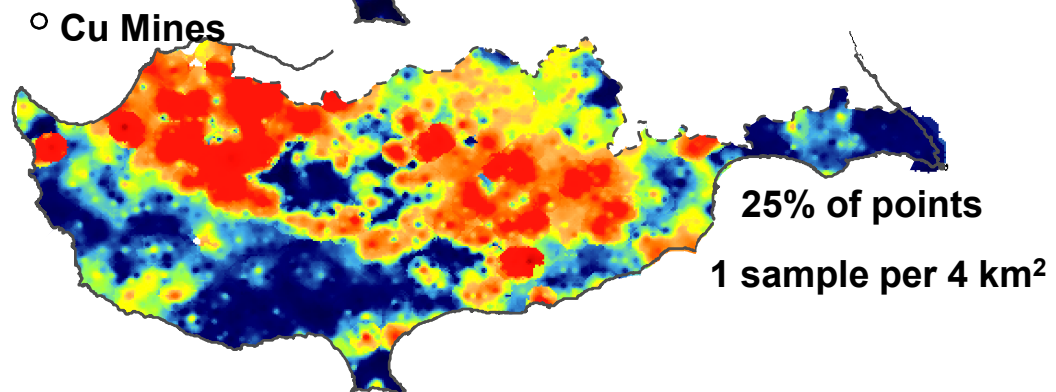
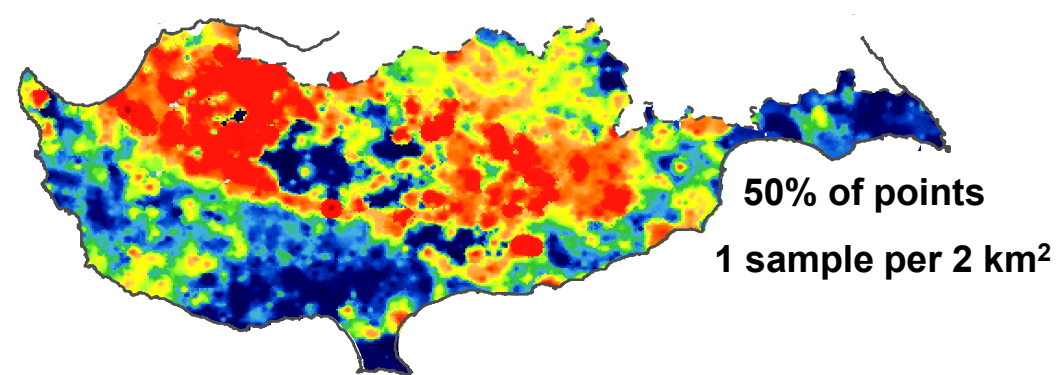
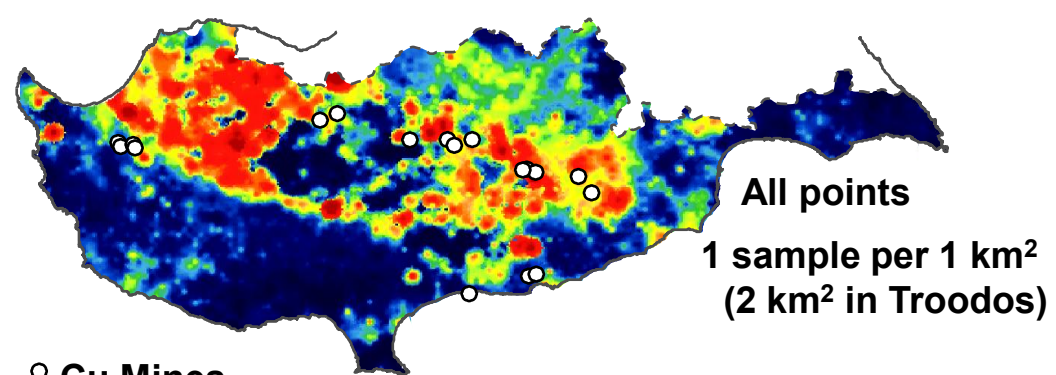
Fig. 8A-2. The catchment areas, and the copper contents of the soils and stream sediments within the catchment areas, in the vicinity of the Panguna porphyry copper deposit, Bougainville, Papua New Guinea. After Mackenzie (1977).

Catchment	A_m	A_a	M_m	M_b	M_a	Obs M_a
I	2	20	3100	660	904	670
I + II	2	50	3100	250	364	300
III	0	80	0	80	80	80
I + II + III	2	200	3100	150	180	150



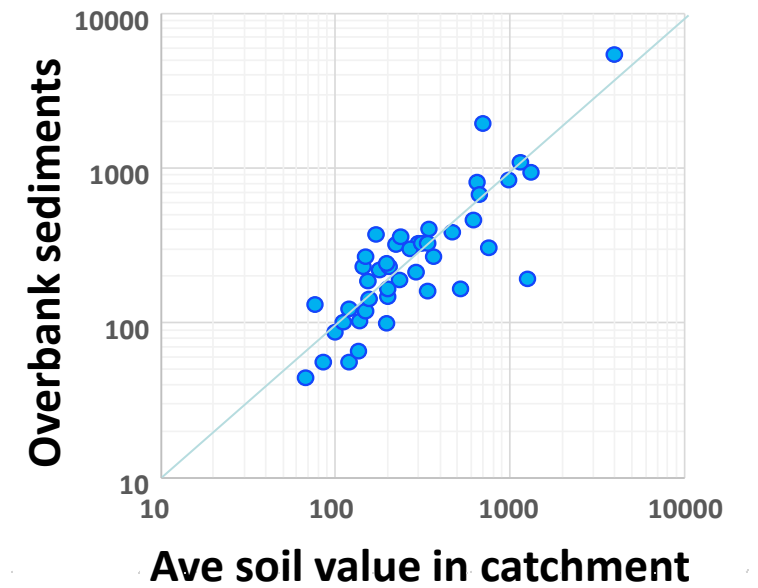
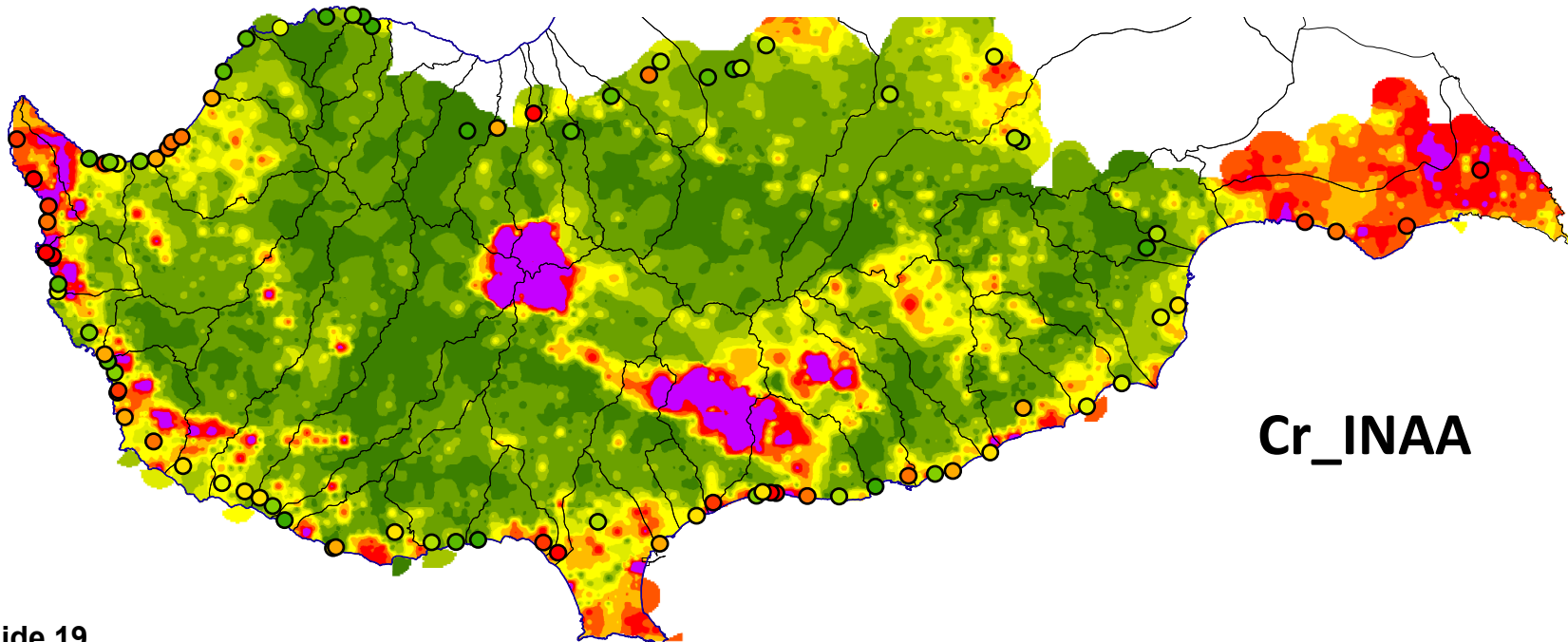
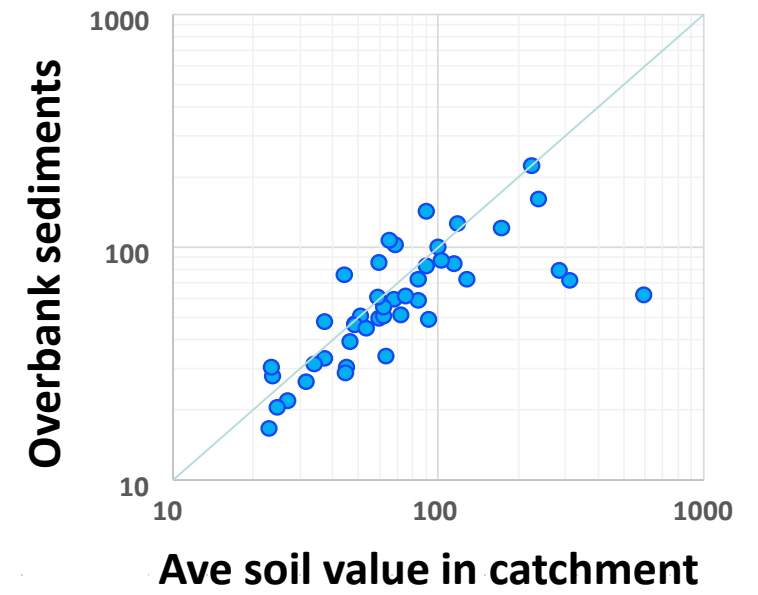
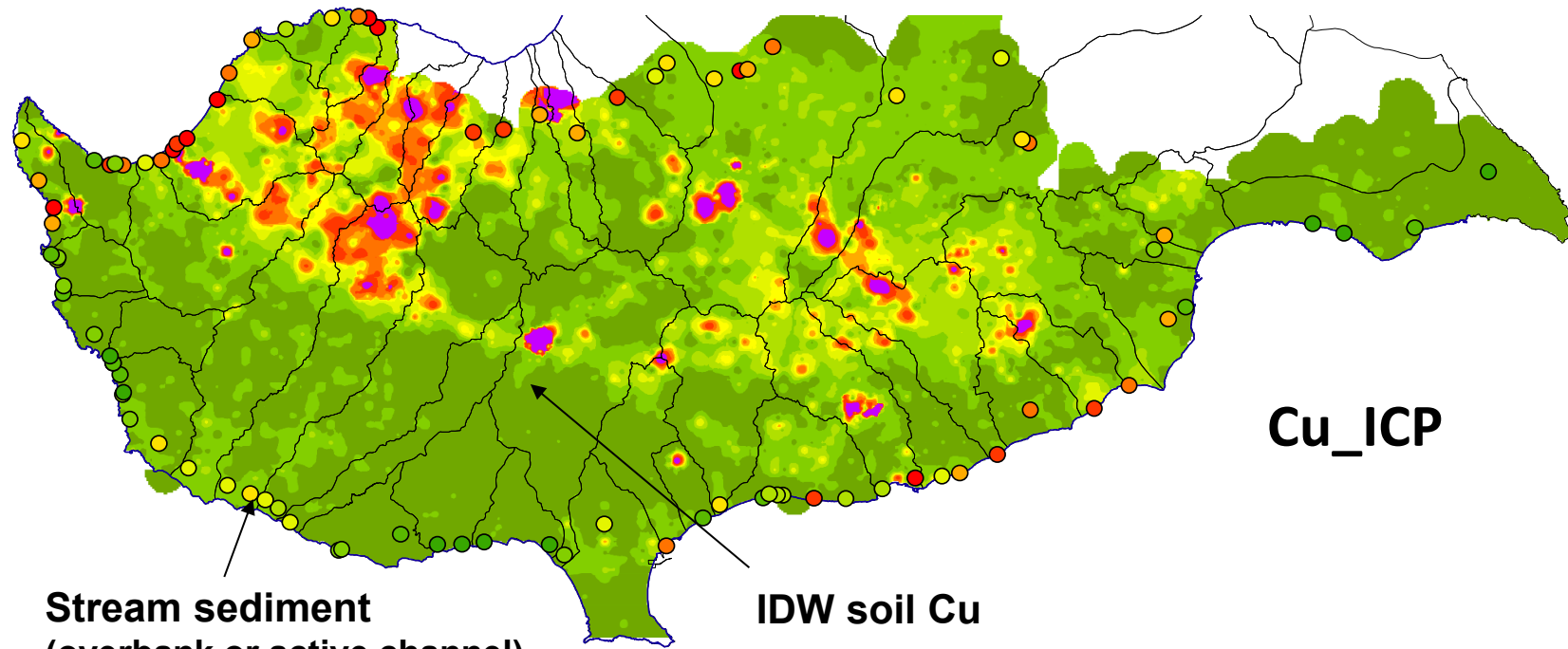






Cu in <2mm fraction soils
ar-ICPMS
(ppm)

	<i>All</i>	<i>50%</i>	<i>25%</i>	<i>10%</i>	<i>5%</i>	<i>1%</i>
	2870	3,541	4,153	2,774	3,183	962
	220	155	171	163	138	234
	135	102	110	110	90	125
	85	75	74	83	71	76
	75	62	62	63	59	58
	65	49	50	50	49	43
	55	42	38	36	40	34
	45	35	36	32	33	29
	35	29	28	30	30	25
	15	22	24	23	24	23
	1	2	2	3	2	2



Cyprus
catchments

Overbank

Predicted FT
(mass balance)

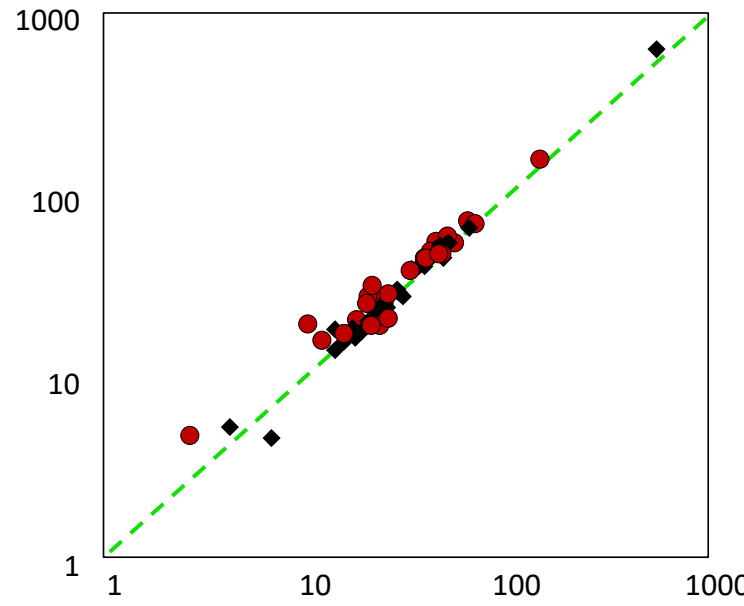
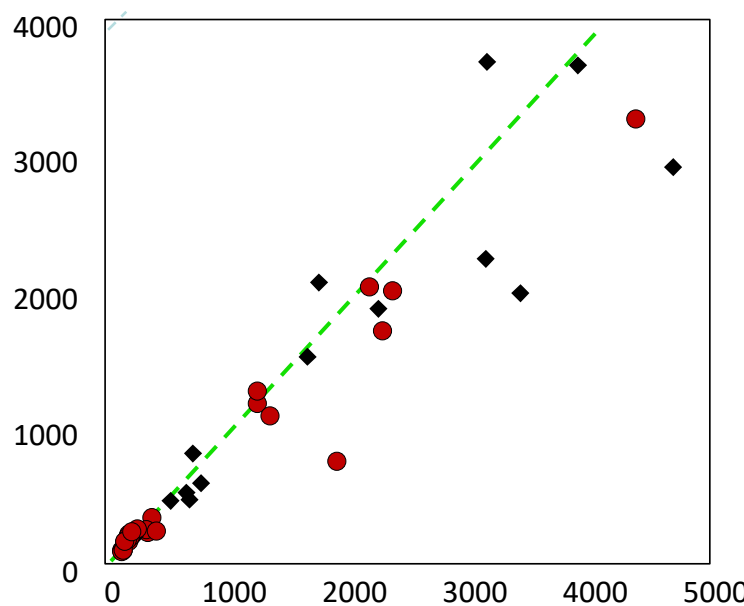
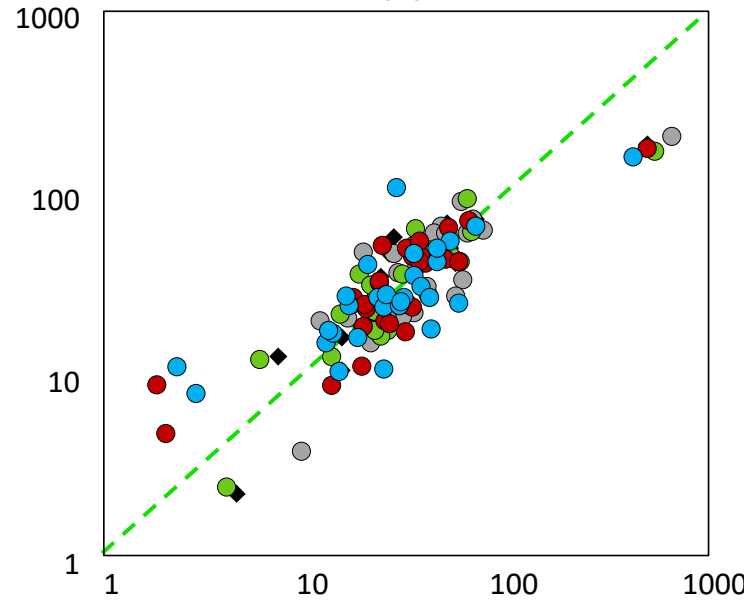
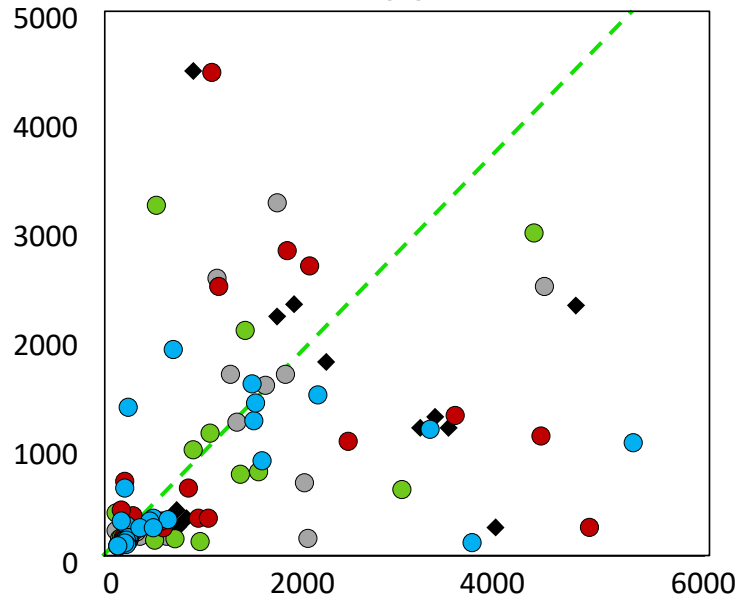
Cr (ppm)

Zn (ppm)

- ◆ FT < 2000 μm
- F4 < 125 μm
- F3 125 - 250 μm
- F2 250 - 500 μm
- F1 500 - 2000 μm

$$\text{Pred FT} = \frac{\sum_{i=1}^{i=4} W_i \cdot [M]_i}{\sum_{i=1}^{i=4} W_i}$$

- ◆ Active channel
- Overbank



Key points

Regional geochemical mapping using a variety of sampling media (stream sediments, soils or vegetation) display coherent patterns that can be related to the dominant controls at the scale of sampling selected.

Parent lithology is typically the major control on sample geochemistry (and mineralogy).

Soils and vegetation tend to reflect local factors, whereas stream sediments and related materials tend to represent an averaging of the materials within the catchment.

Providing sampling and analytical procedures have proper quality control, the main source of variance or error in such surveys is the selection of sampling location.

Site variability tends to be higher for elements contained in resistate minerals (the particle scarcity effect) compared with elements that are dominantly hydromorphically dispersed or associated with the fine fraction of regolith materials.

Despite the statistical crazy concept that a few kg of samples and grams of sample material actually analysed should be able to deliver geochemical data that is representative of entire catchments – experience shows it works. This is demonstrated by mapping at scales up to continental levels and the large number of mineral deposits discovered using regolith materials.