Mineral potential mapping – it works!

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Department of Planning and Environment

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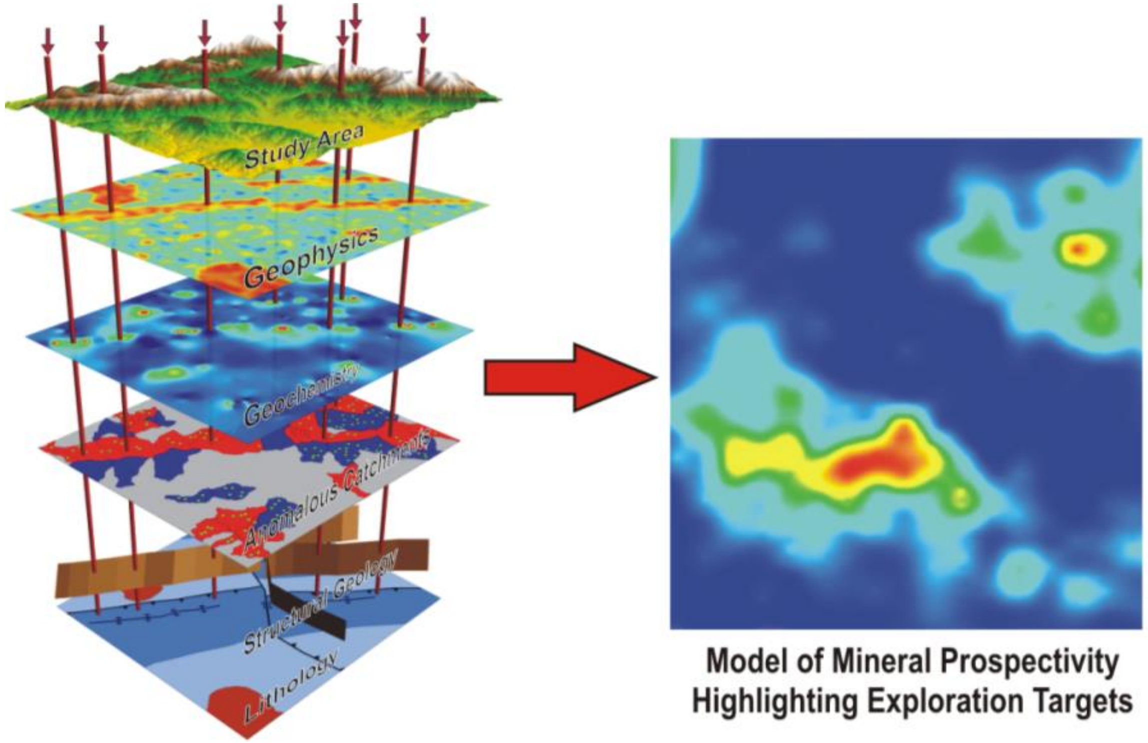
Why mineral potential studies?

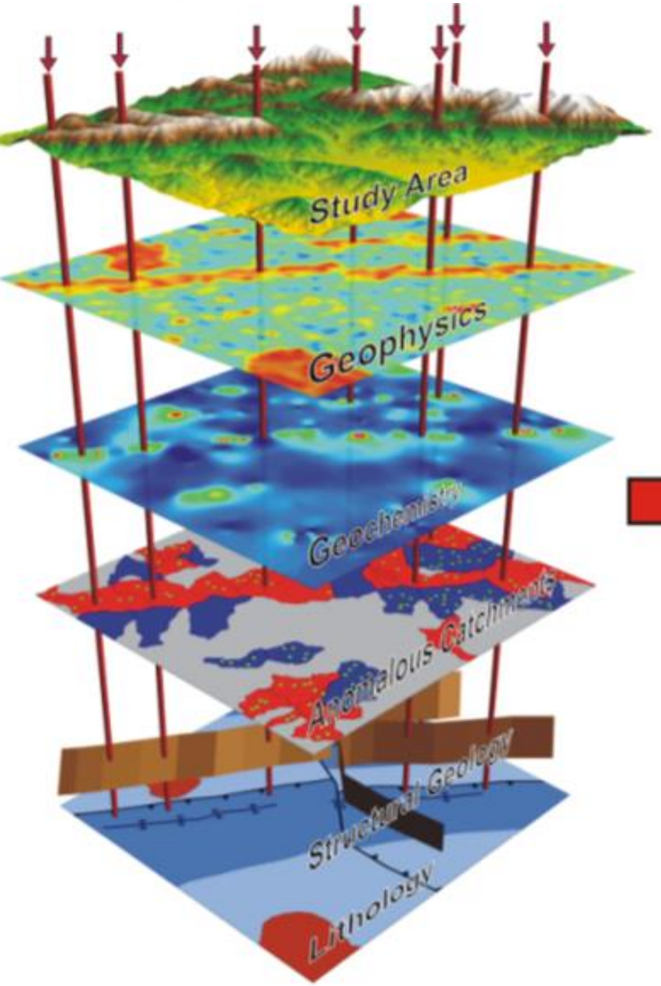
Introduction

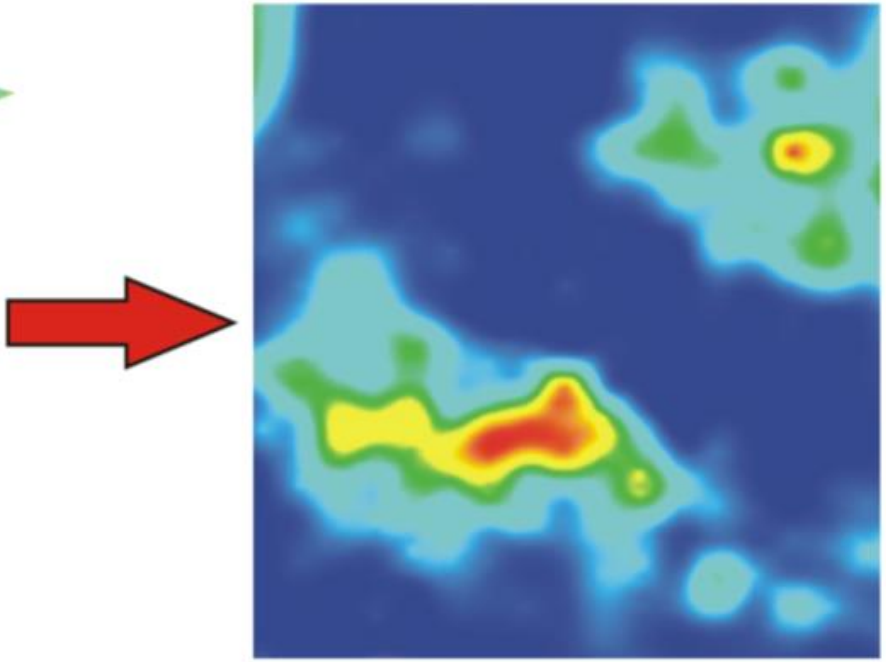
GSNSW is embarking on a statewide mineral potential mapping project that will:

- develop mineral system models and identify economic potential for key mineral systems
- replace the ‘potential’ layer in the current Mineral Resource Audit mapping
- have results which can trigger land-use referrals
- include Kenex spatial analysis
- identify land-use pressures
- result in availability of good metallogenic mapping, seamless geology and derivative maps.



Spatial analysis: weight of evidence





Model of Mineral Prospectivity
Highlighting Exploration Targets

- Create study area – 50 m x 50 m grid.
- Select **training points**.
- Select unit cell – **1 km^2 for all models** (~ extent of mineral system).
- Determine **prior probability** (odds of a training deposit in a unit cell).
- Create predictive maps and perform spatial analysis.
- Select predictive maps.
- Run mineral potential model.
- Test model success rate.

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Which mineral systems?

Mineral systems – NEO (Released)

1. **Intrusion-related tin-tungsten** (IR Sn-W)

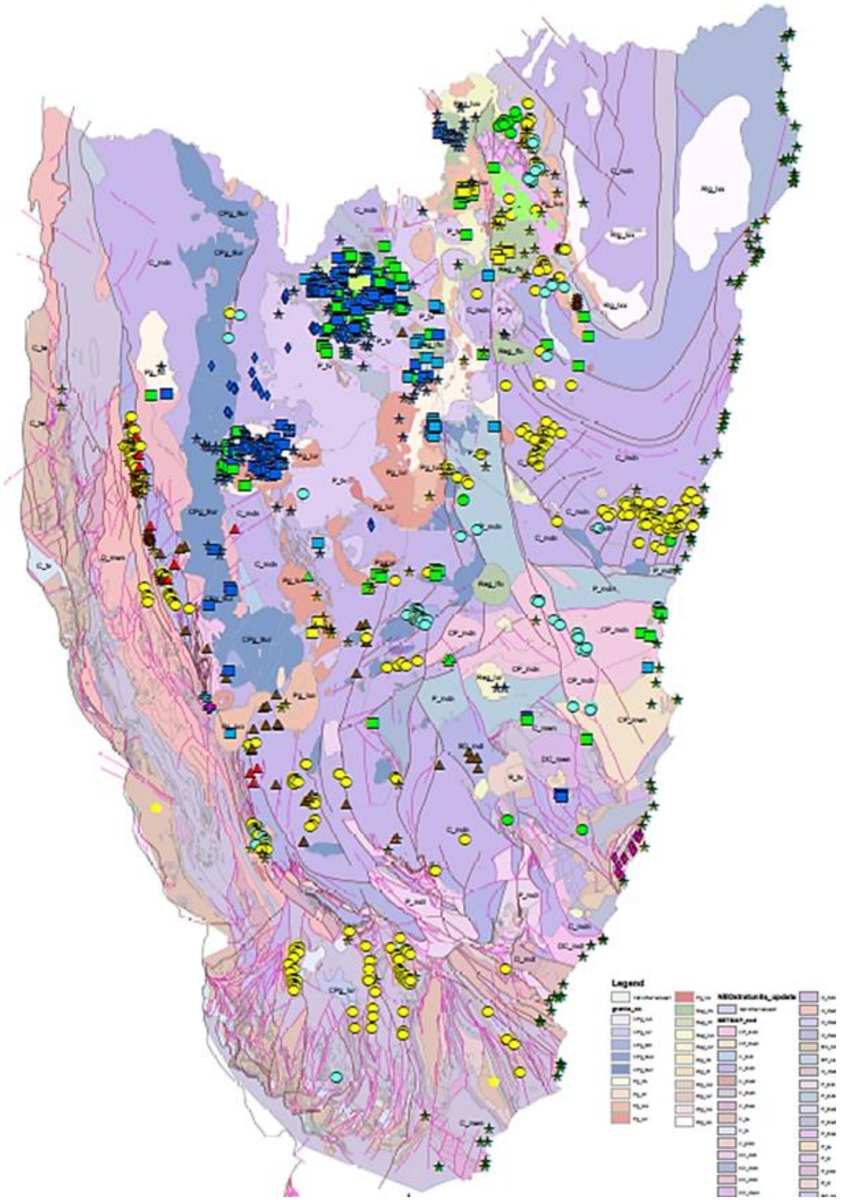
   [GS2017/0617]

2. **Intrusion-related gold** (IR Au)

   [GS2017/0618]

3. **Orogenic gold-antimony** (orogenic Au-Sb)

   [GS2017/0619]



Mineral systems – Zone 54 (Released)

1. **Shear-hosted iron-oxide copper gold (Copper Blow type)**

   GS2018/0371

2. **Orogenic gold**

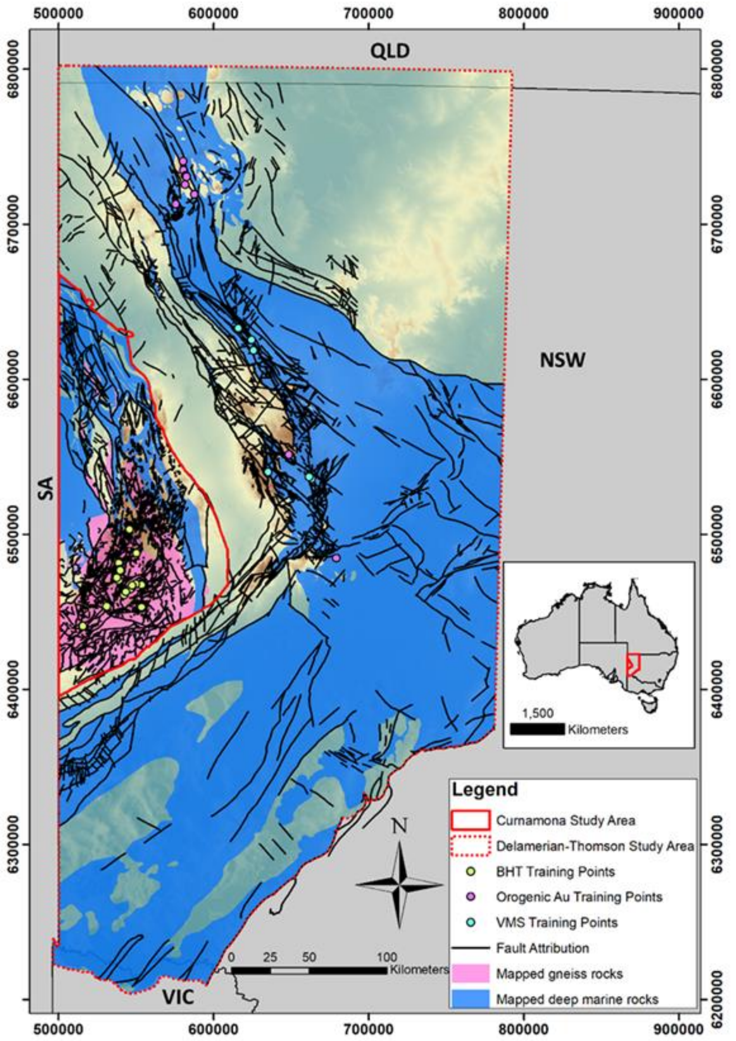
   GS2018/0372

3. **Volcanic-associated massive sulphide (Grasmere type)**

   GS2018/0370

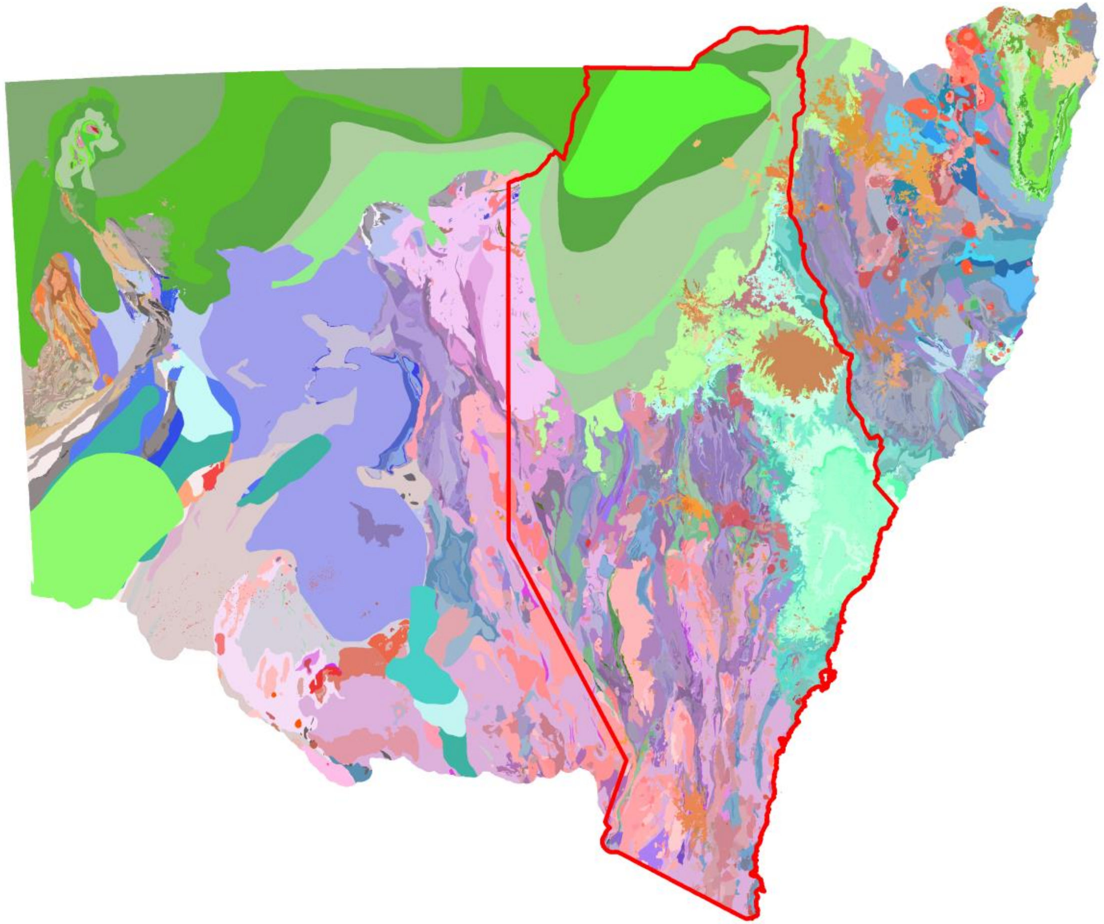
4. **Broken Hill type Pb-Zn-Ag**

   GS2018/0400



Mineral systems – Zone 55E (Release July 2019)

1. **Porphyry centred Cu-Au**
2. **Orogenic gold**
3. **Volcanic-associated massive sulphide**
4. **Post Ordovician magmatic hydrothermal skarn systems**



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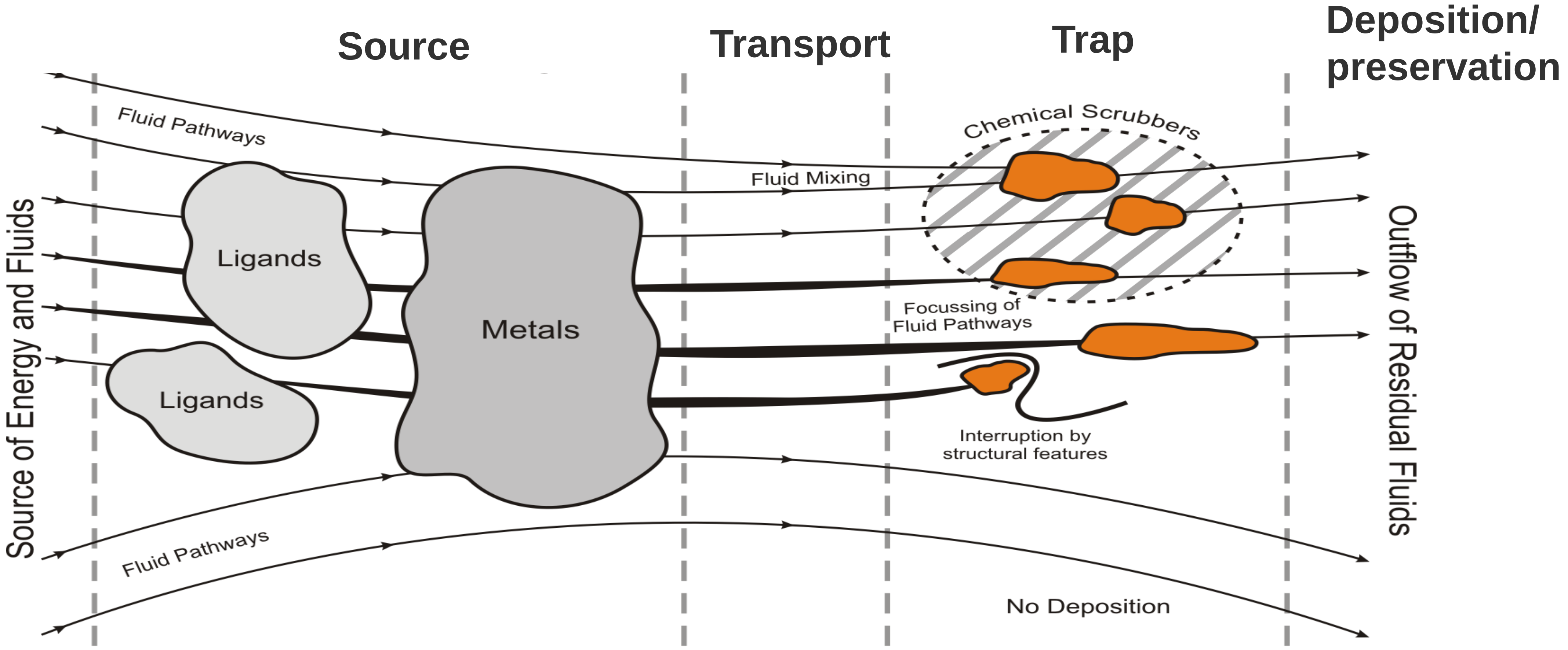
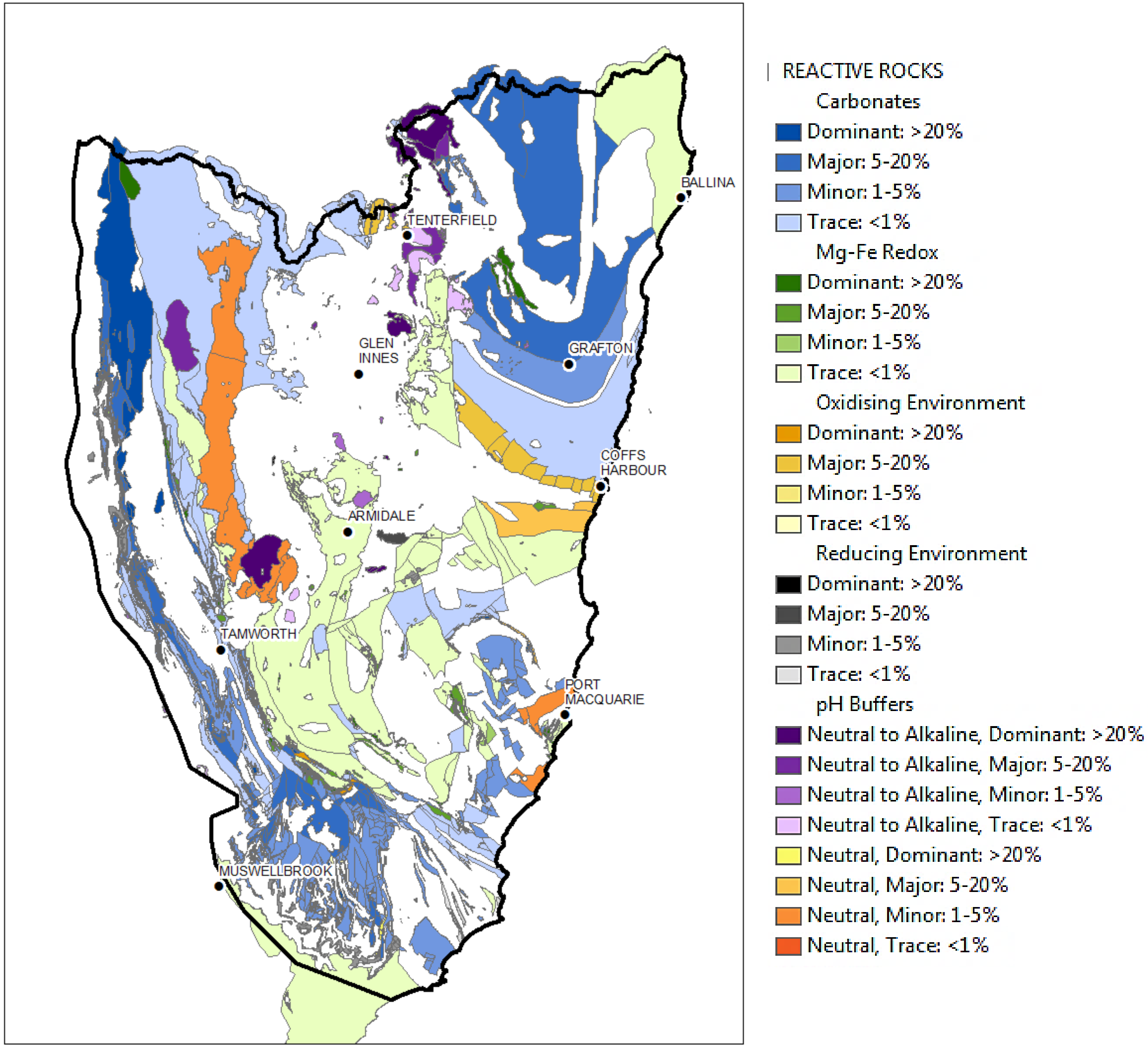
Methodology and outputs

Selecting predictive maps

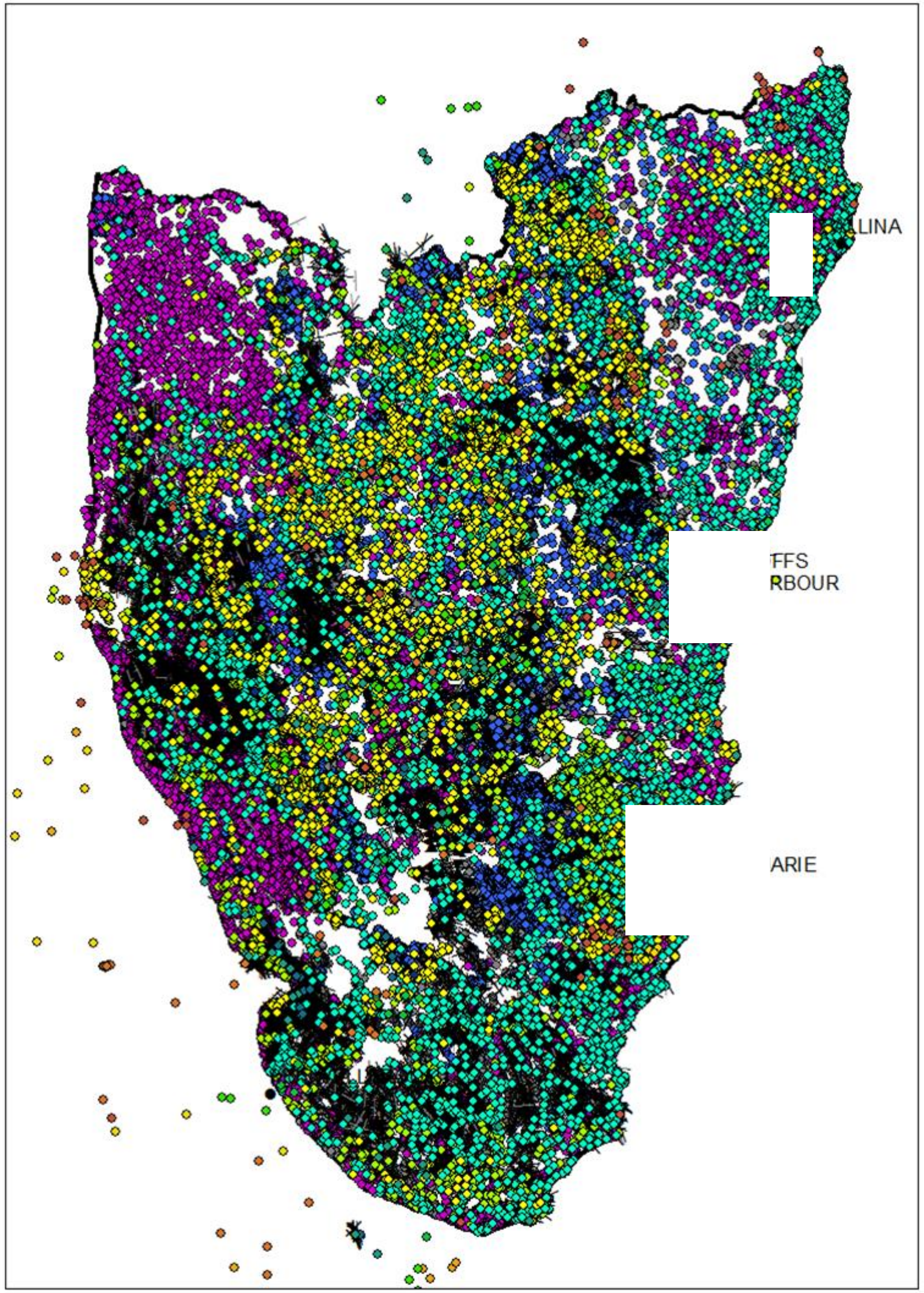


Source: Knox-Robinson & Wyborn 1997



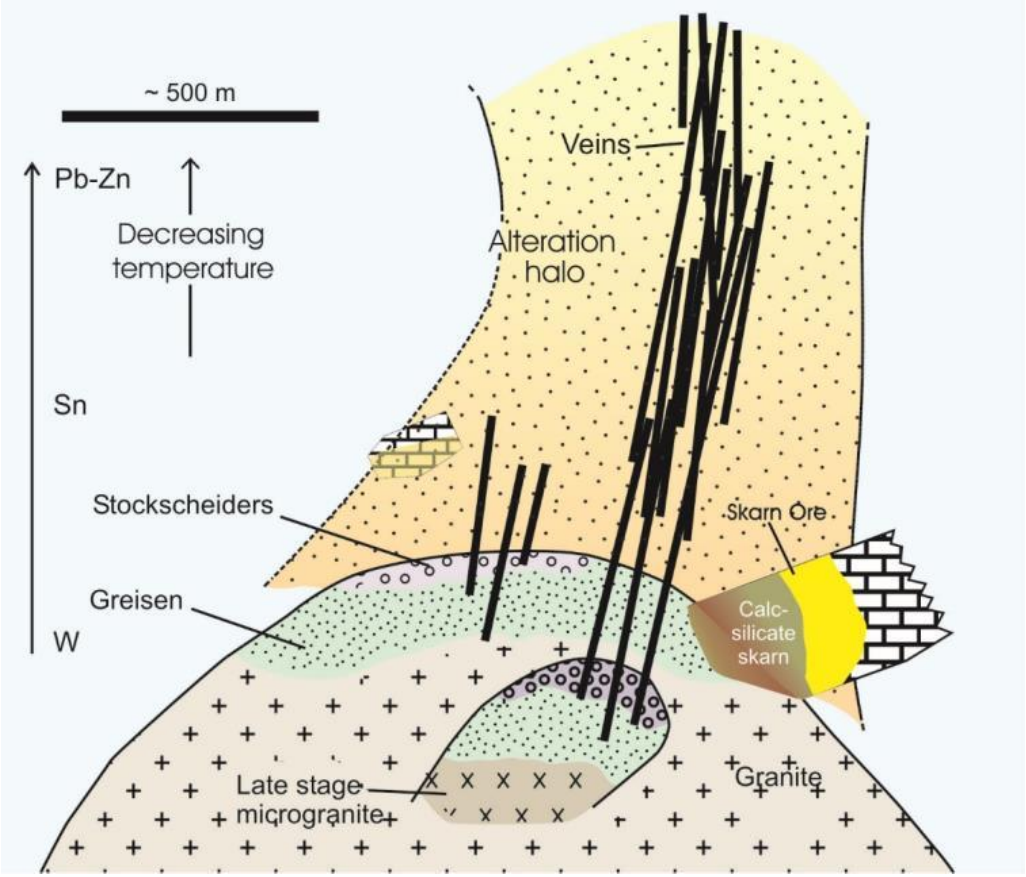
Data: map-based

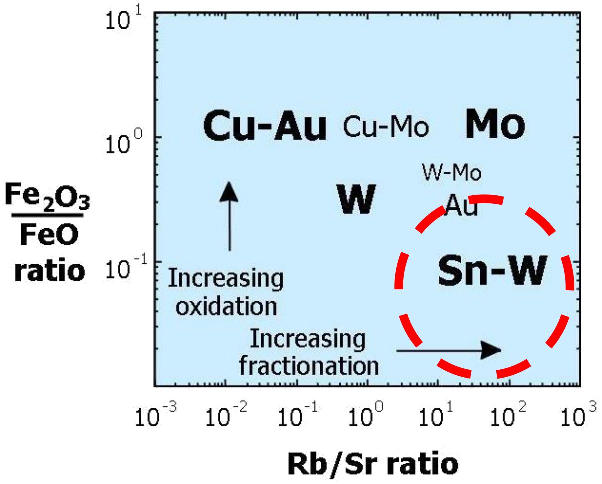
- Seamless
  - reactive rocks
  - igneous metal fertility
  - fault attribution
  - metamorphic map
  - geology.
- Geophysics
  - rad, gravity, mag + worms.



Data: point-based

- 783 radiometric ages.
- 6,788 whole-rock geochemistry.
- 11,160 mineral occurrences.
- 12,150 thin-section descriptions.
- 17,703 structural readings (including vein-sets).
- 28,719 drilling lithology logs.
- 42,633 field observations.
- 241,478 assays (drillhole, stream sediments, rock-chip, soil).



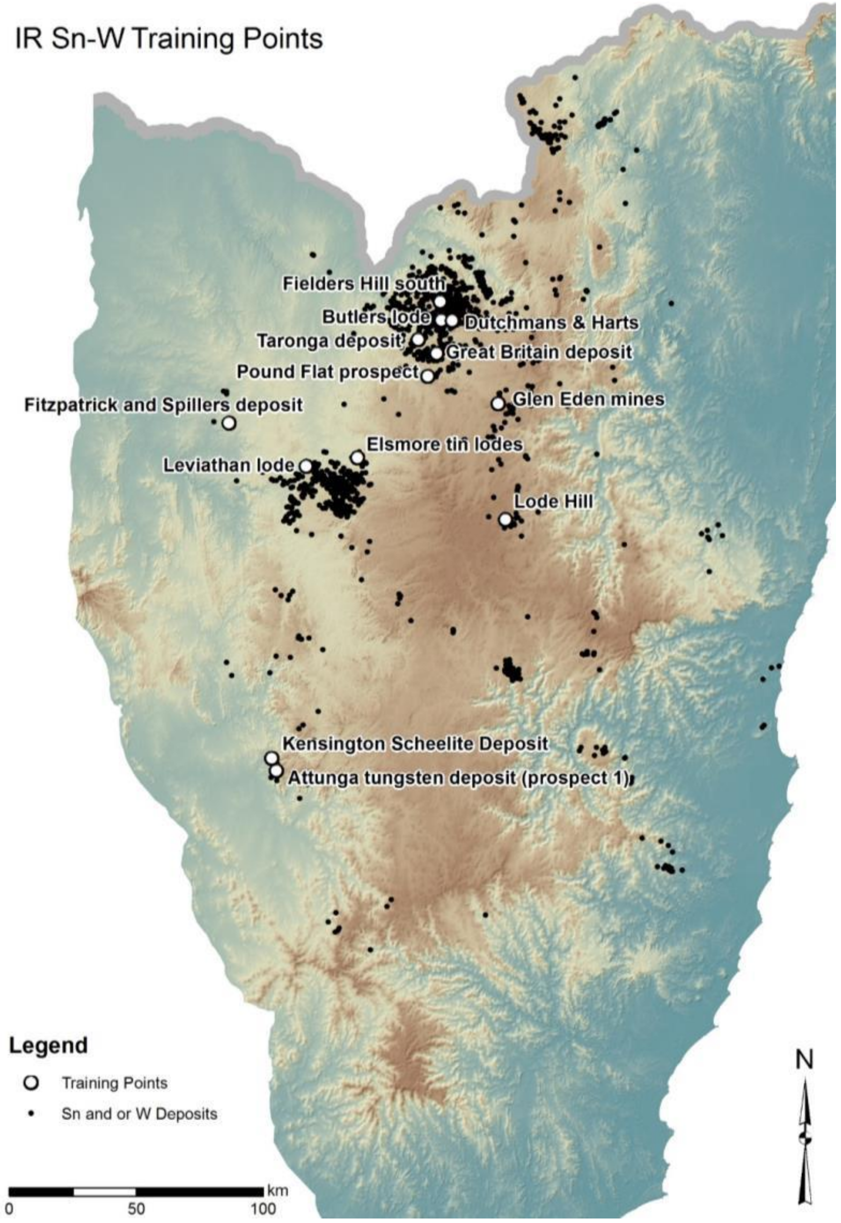


IR Sn-W: mineral system model

- Found in the apical regions of strongly fractionated, reduced I-type felsic granitoids of Permo-Triassic age (254–245 Ma).
- Stockwork/sheeted vein style – Torrington (e.g. Taronga, Great Britain), Pound Flat.
- Disseminated greisen – Fielders Hill.
- Breccia pipe – Glen Eden.
- Skarn/carbonate replacement – Attunga (Kensington W).

IR Sn-W training points

	Name	Metal District	Commodity Major	Commodity Minor	Mineralisation Style
1	Attunga tungsten deposit (prospect 1)	Attunga	Au, W, Mo		W skarn
2	Butlers lode	Torrington	Sn, W	Pb, monazite, Ag, Zn	Sn-(W) vein
3	Dutchmans & Harts	Torrington	Sn		Sn-(W) vein
4	Elsmore tin lodes	Elsmore	Sn	Bi, W, Ag, Au	Sn-(W) vein/greisen
5	Fielders Hill south	Torrington	W, Bi, topaz - industrial	Sn, Cu, fluorite, cryolite, U, Au	topaz-W greisen
6	Fitzpatrick and Spillers deposit	Bingara extended	Sn		Sn-(W) vein
7	Glen Eden mines	not assigned	Mo, W	Sn, Bi, fluorite, cryolite, Cu, beryl - industrial	Mo porphyry
8	Great Britain deposit	Emmaville	Sn		Sn-(W) vein
9	Kensington Scheelite Deposit	Attunga	W		W skarn
10	Leviathan lode	Tingha	Sn	As, Cu, W	Sn-(W) vein
11	Lode Hill	not assigned	Sn		Sn-(W) vein
12	Pound Flat prospect	not assigned	Sn, As	Zn, Pb, W, Cu	Granite-related polymetallic veins
13	Taronga deposit	Emmaville	Sn	Cu, As, Ag, Zn, W, Pb, Mo, Bi	Sn-(W) vein



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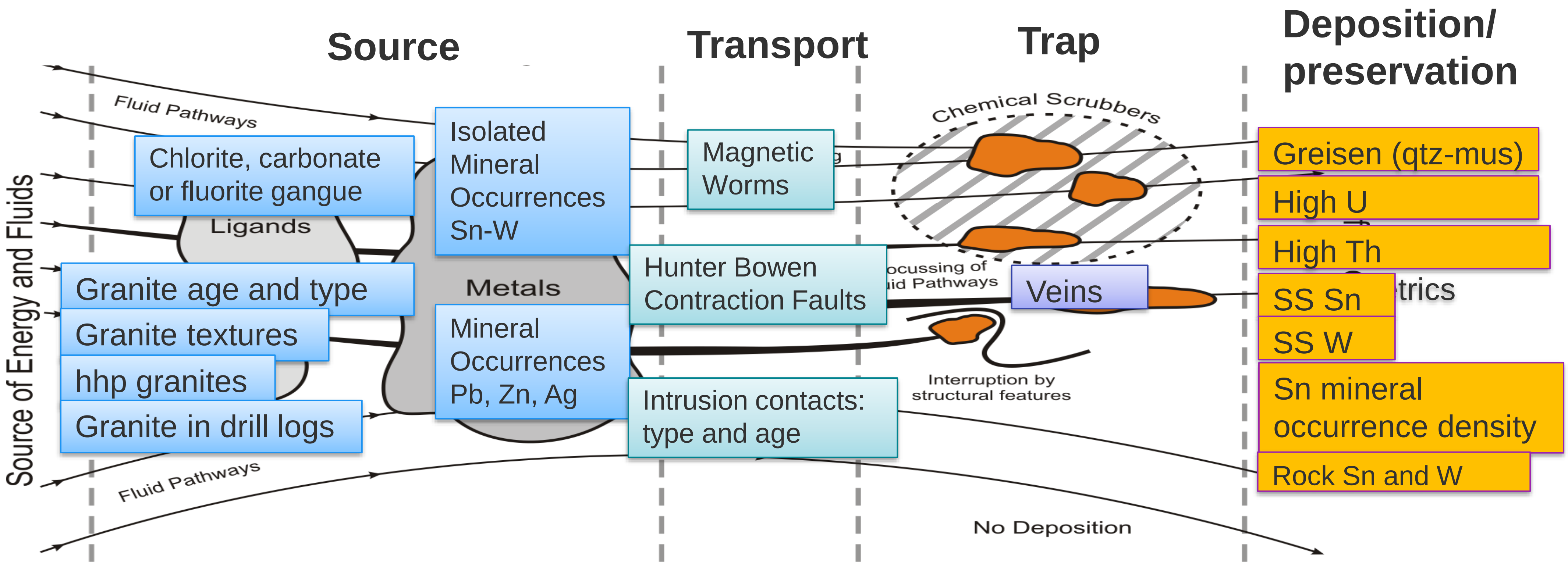
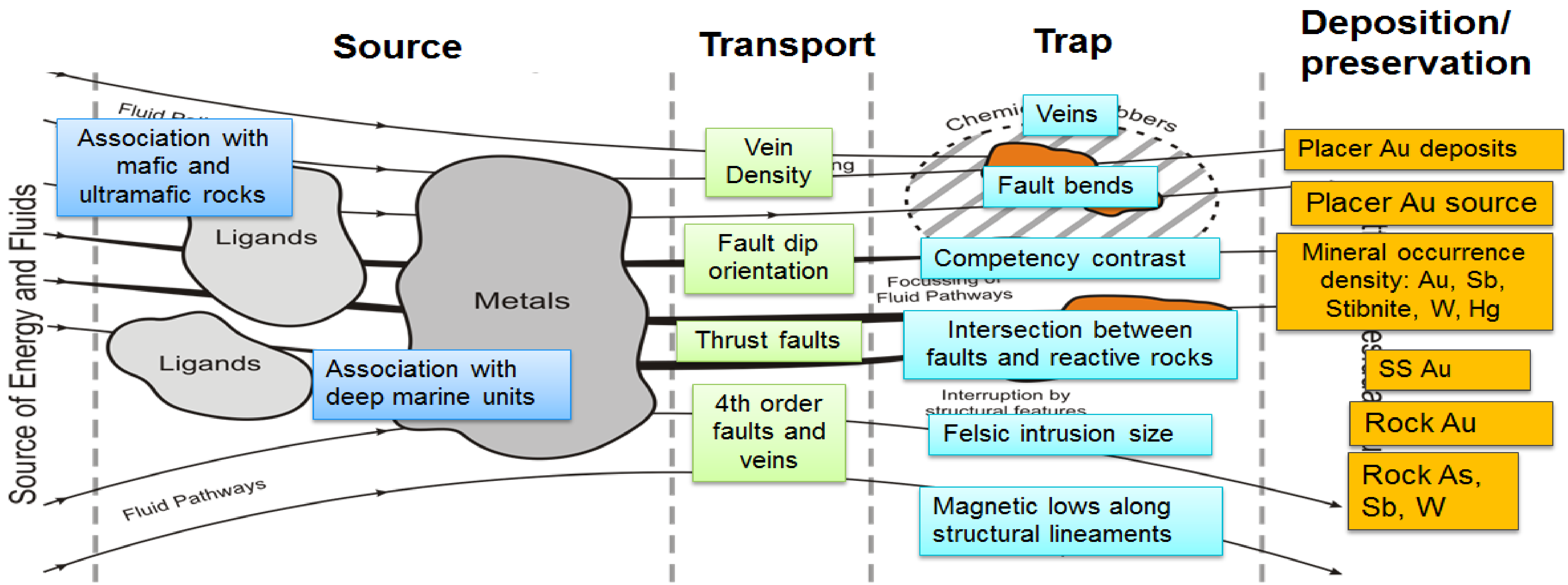
IR Sn-W: final predictive maps



Knox-Robinson & Wyborn 1997

Orogenic Au-Sb: final predictive maps



Knox-Robinson & Wyborn 1997

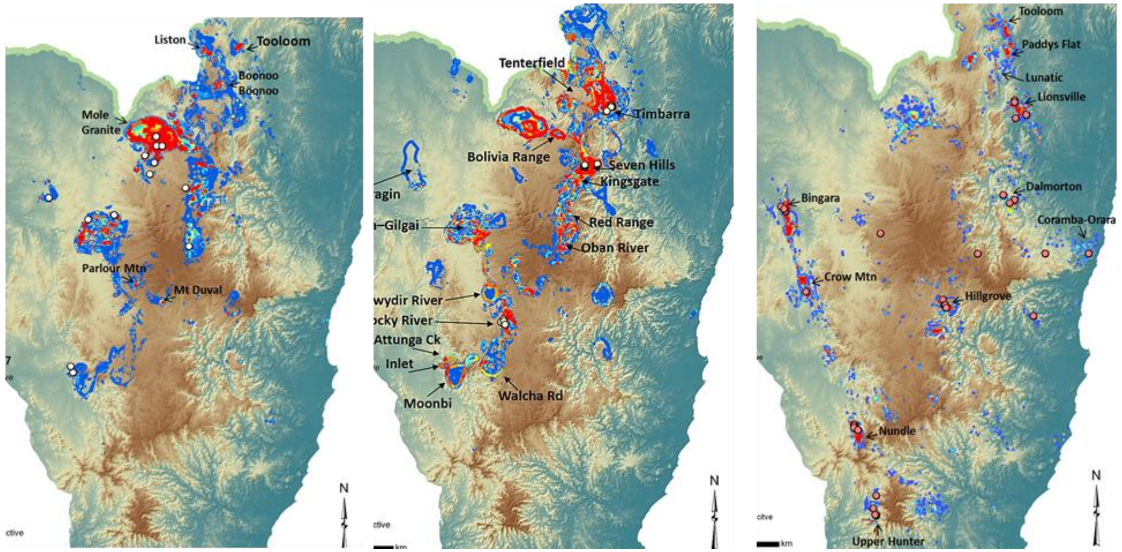
Final model results: what are the odds?

The odds of randomly finding a unit cell that contains the training site

The odds of finding the training sites using the model

How well the training sites are classified by the model

	IR Sn-W	IR Au	Orogenic Au-Sb
Prior Probability	0.0001	0.0001	0.0024
Post Probability (highly-prospective)	0.7366	0.9373	0.9412
Prospective area (highly-prospective)	6% (1.2%)	8% (1.4%)	4.5% (0.5%)
Efficiency	99.5%	99.5%	97.6%



Zone 54 – hot off the press

Table 3-2. Stream sediment sample anomaly thresholds for Curnamona study area.

Element	Threshold	75th Percentile	85th Percentile	95th Percentile
Ag ppm	0.114	0.065	0.114	1
Au ppm	0.015	0.00255	0.015	1.98
As ppm	12.9	7.58	12.9	100
Ba ppm	270	0.0001	270	410
Bi ppm	0.29	0.0003	0.29	0.7
Co ppm	15	12	15	21
Cu ppm	34.4	28.3	34	52
Ni ppm	24	20	24	32
Pb ppm	44.1	35.9	44.1	84
Sb ppm	0.49	0.41	0.49	0.65
U ppm	2.97	1.95	2.97	4
W ppm	3.8	1.9	3.8	15
Zn ppm	94.9	80.6	94.9	149

Table 3-3. Combined rock chip and drill hole anomaly thresholds for Delamerian-Thomson study area.

Element	Threshold	75th Percentile	85th Percentile	95th Percentile
Ag ppm	0.098	0.0492	0.098	1
Au ppm	0.097	0.00298	0.0099	0.097
As ppm	27.5	13.9	27.5	92
Ba ppm	805	218.9	360	805
Bi ppm	6	0.61	1.97	6
Ca ppm	3400	3400	14000	41100
Co ppm	48	32.3	48	119
Cu ppm	72.8	46	72.8	273
Eu ppm	1.2	0.6	1.2	2.7
F ppm	-	-	-	-
Fe ppm	5200	51400	88100	16900
K ppm	100	762	1300	2400
Mg ppm	2200	2200	5700	13800
Mn ppm	8132	1030	1762	8132
Na ppm	800	200	400	800
Ni ppm	98.4	60.4	98.4	850
P ppm	589	589	1130	2930
Pb ppm	82	24.8	37	82
PGE ppm	0.2537	0.252	0.252	0.2537
REE ppm	210.51	210.51	210.51	228.67
S ppm	1100	200	400	1100
Sb ppm	3.9	0.79	1.26	3.9
Si ppm	-	-	-	-
U ppm	1.53	1.53	2.99	8
W ppm	0.2	0.09	0.2	1.3
Zn ppm	270	80	109	270

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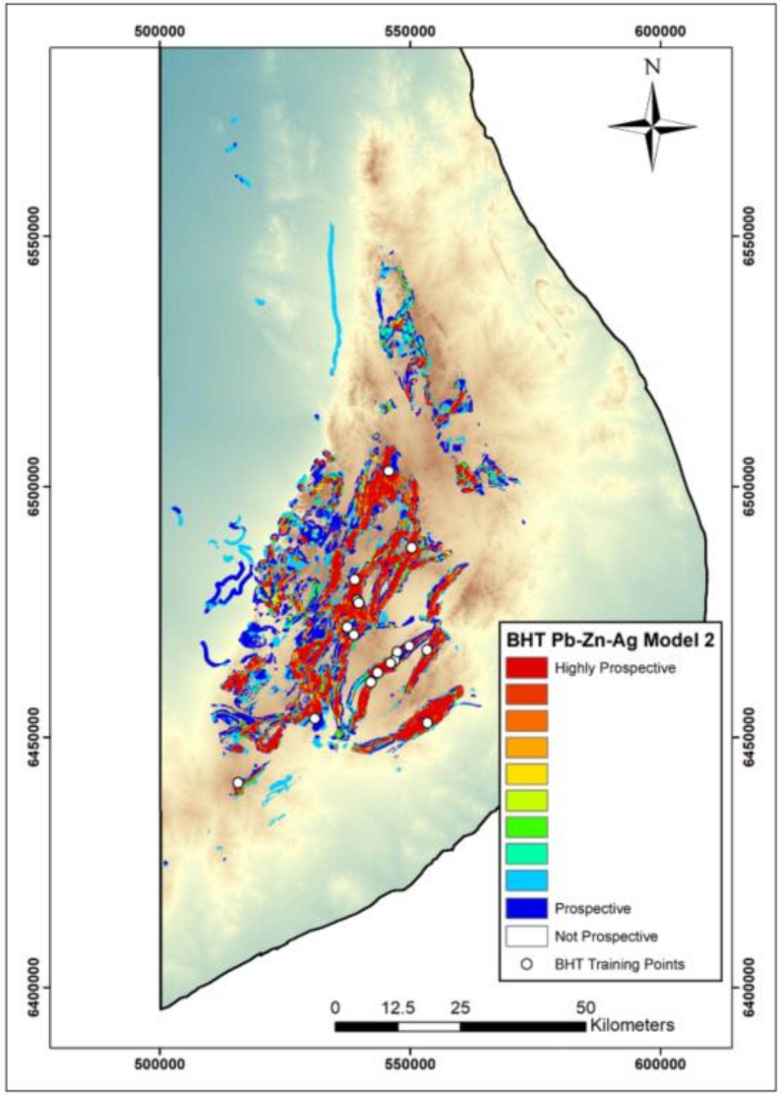
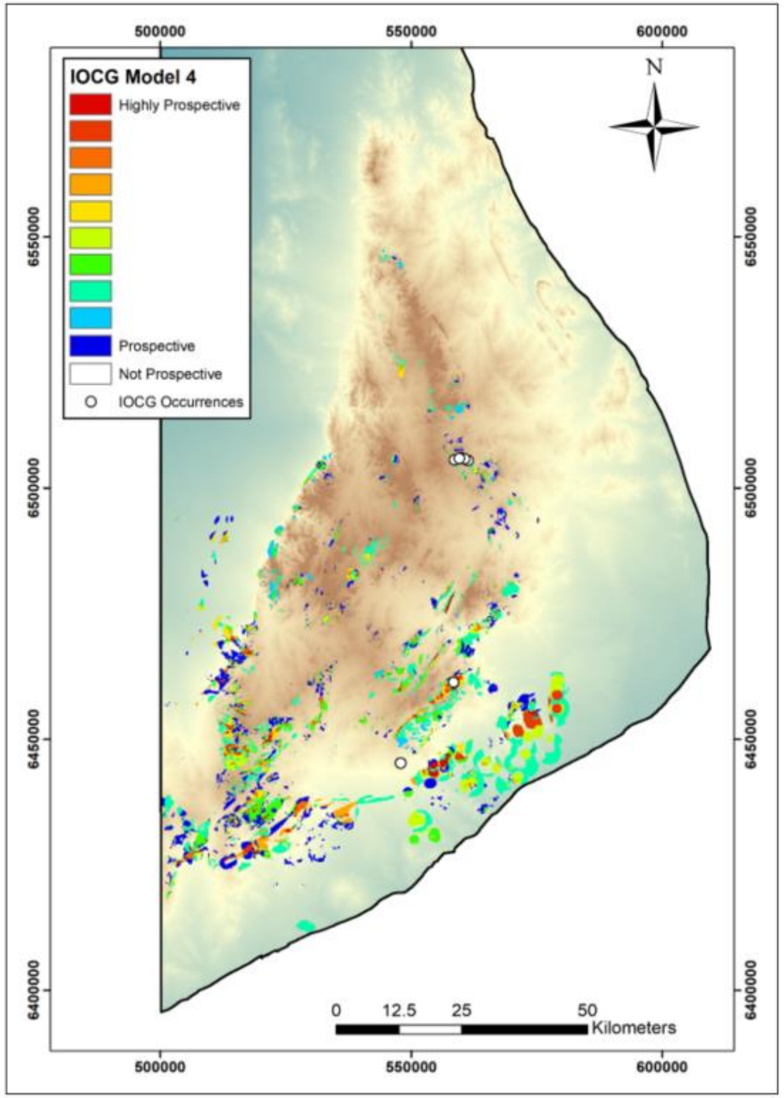
Curnamona modelling results





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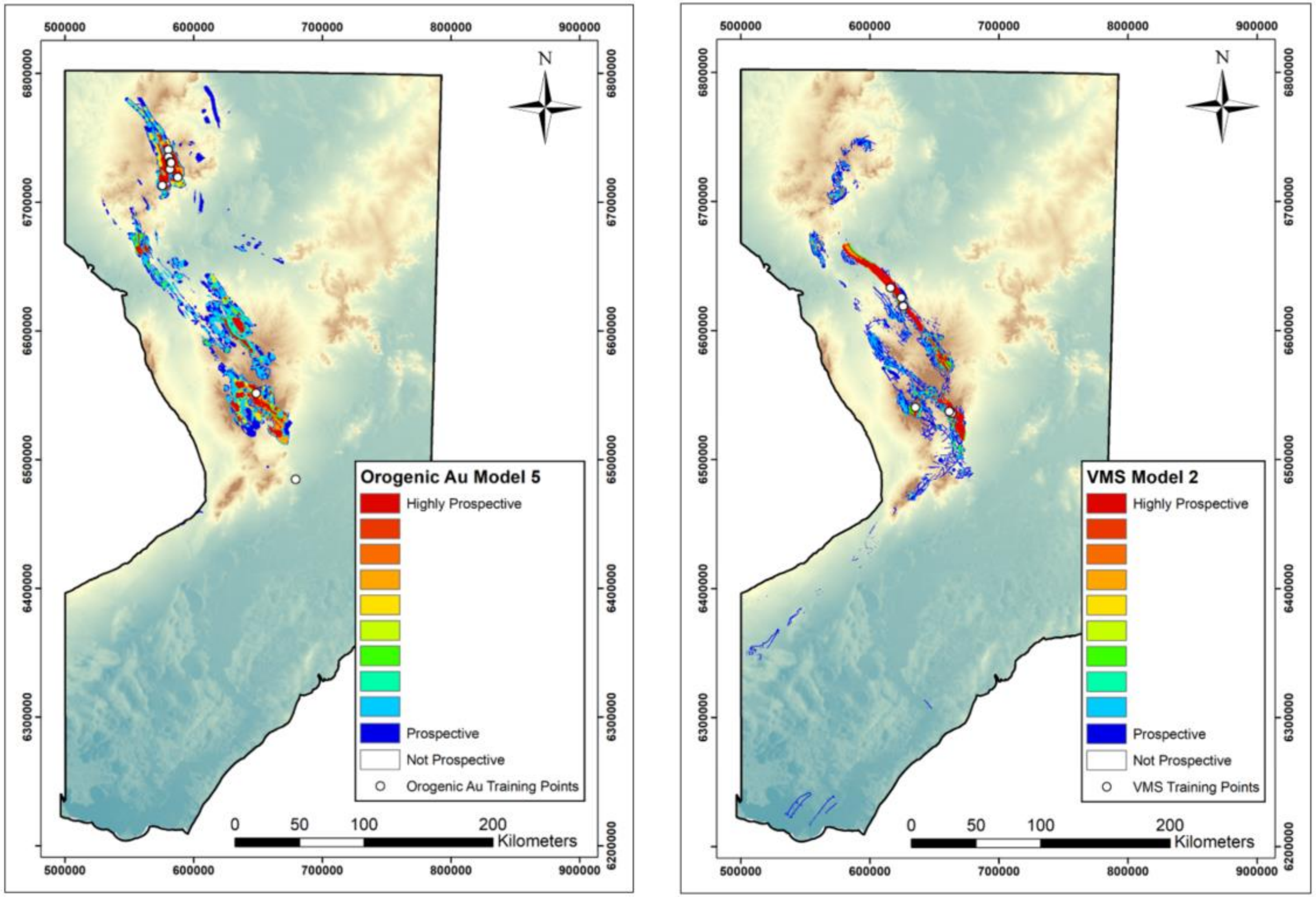
Koonenberry modelling results



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Predictive maps – diamonds in the rough

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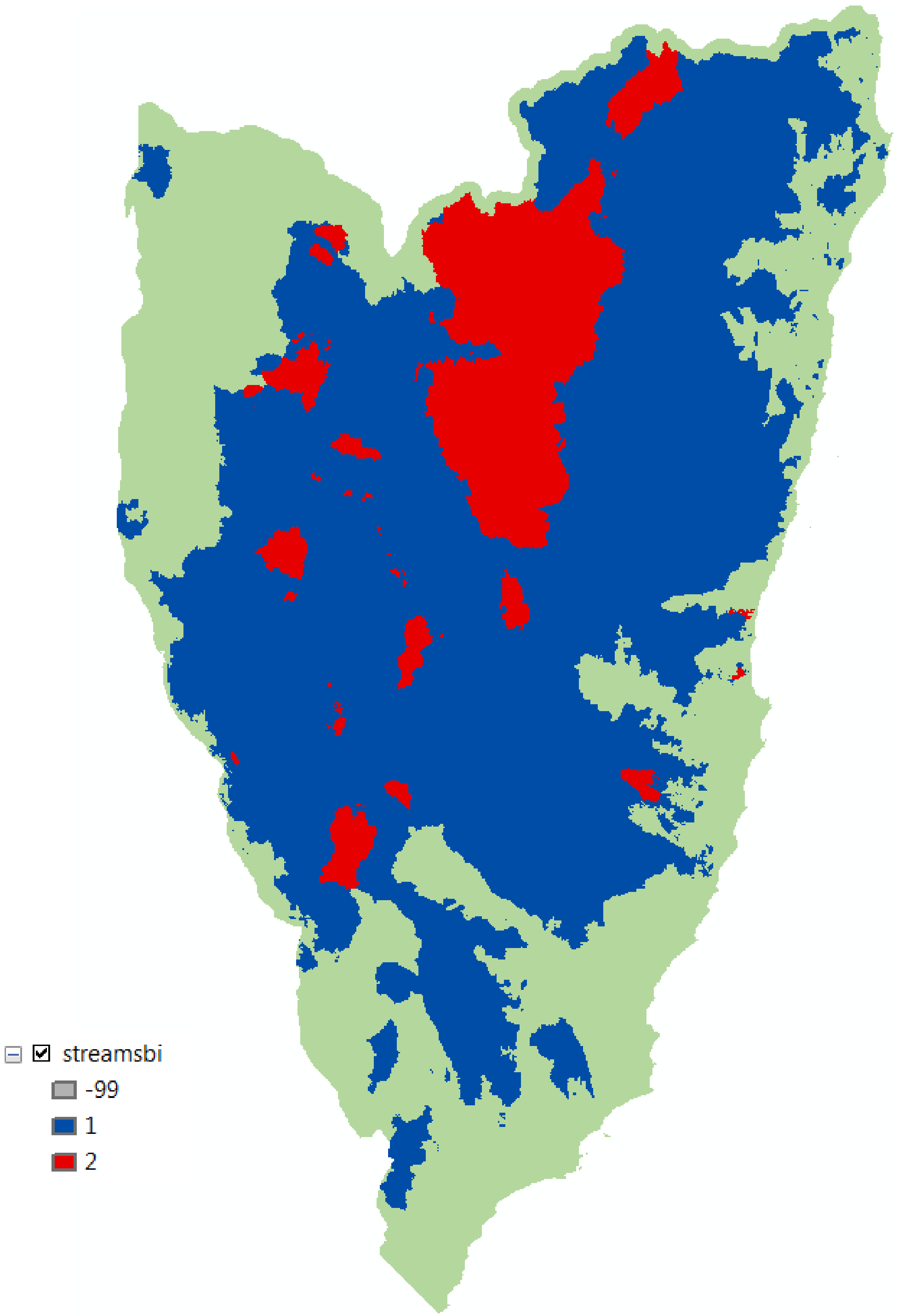
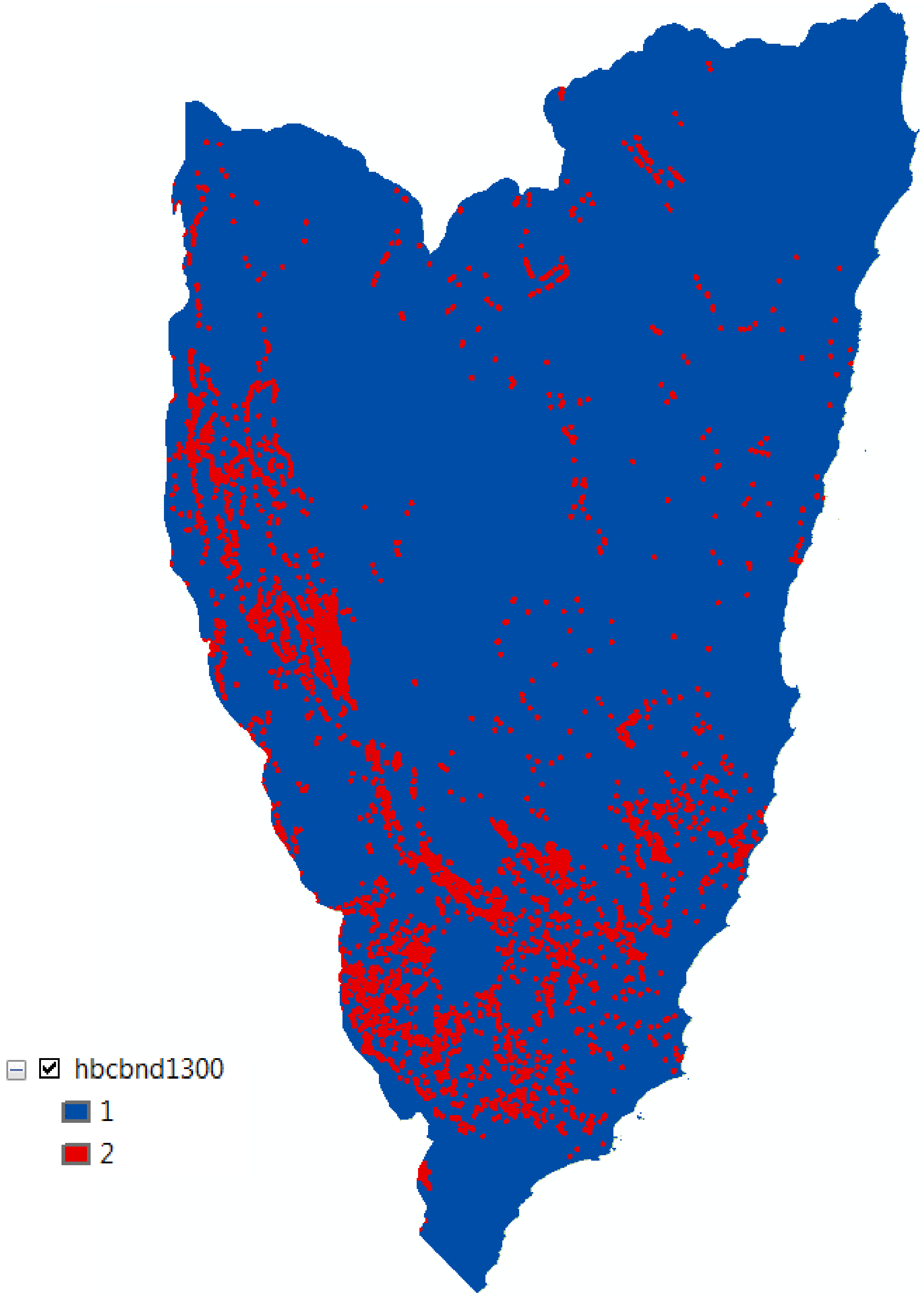


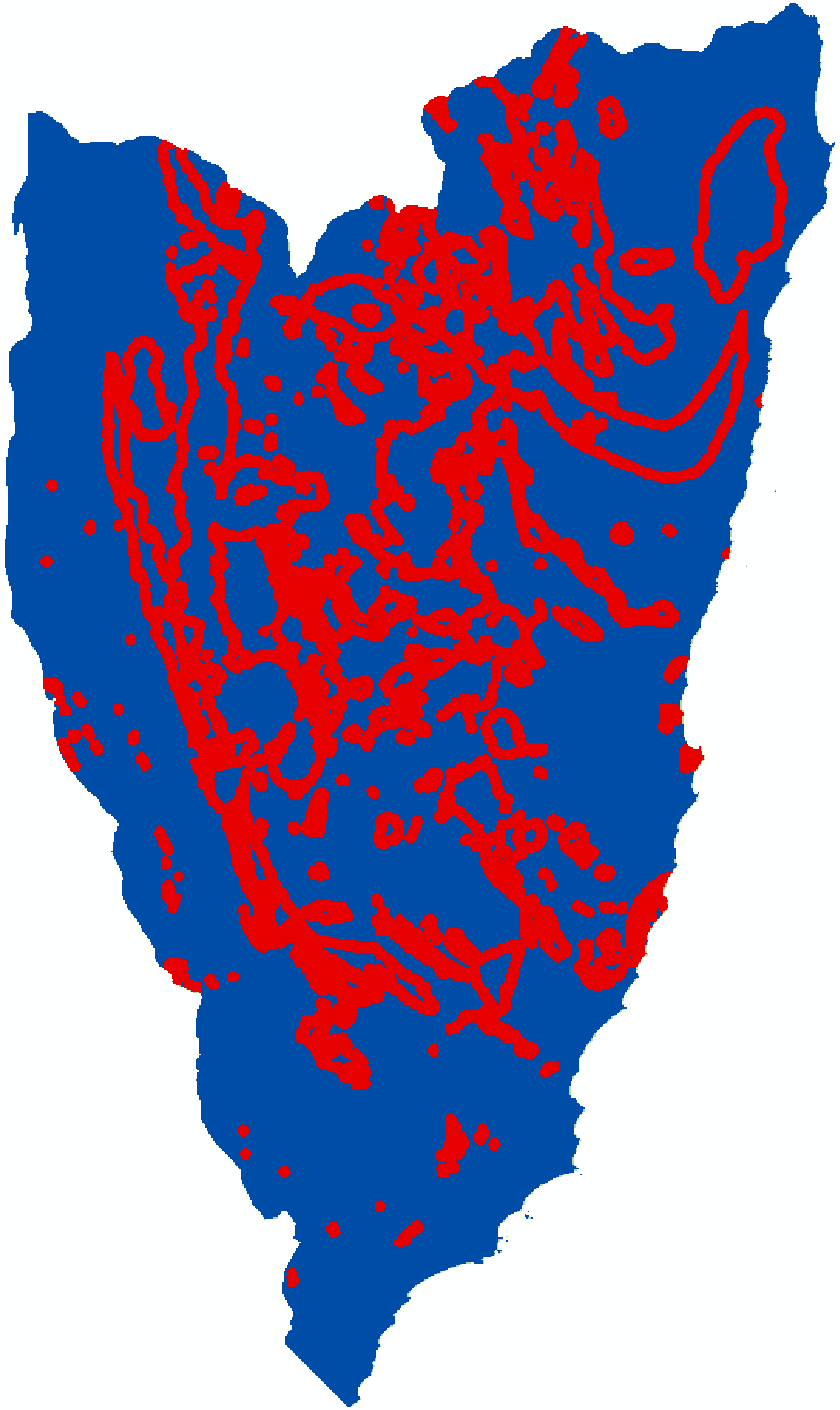
Geochemical maps

- Use stream seds, rock chips and whole rocks analyses.
- Cleaned and levelled stream sed data (a first for NEO).
- Each layer is a useful synthesis of data, often tens of thousands of data points.
- Example: stream sed Bi.



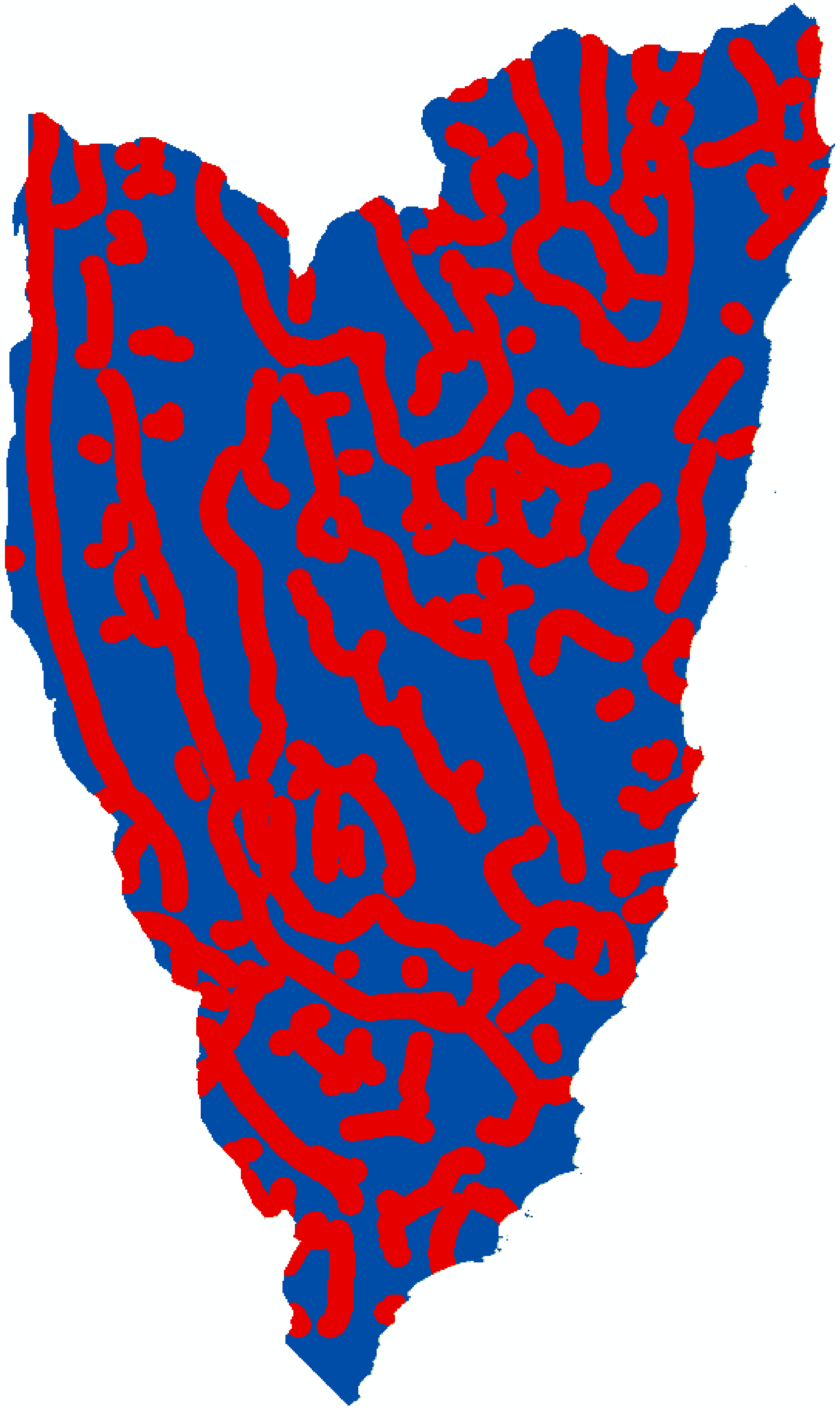
Fault bends

- Interpretation of seamless fault attribution map.
- Example: fault bends.
- Correlation with IR training points poor as most fault beds are in terranes away from contemporaneous granite formation.



Competency contrast

- Around granite contacts, adjacent faults, major rock boundaries.
- Sent to IR Au model.
- Can be modified or used for other models.



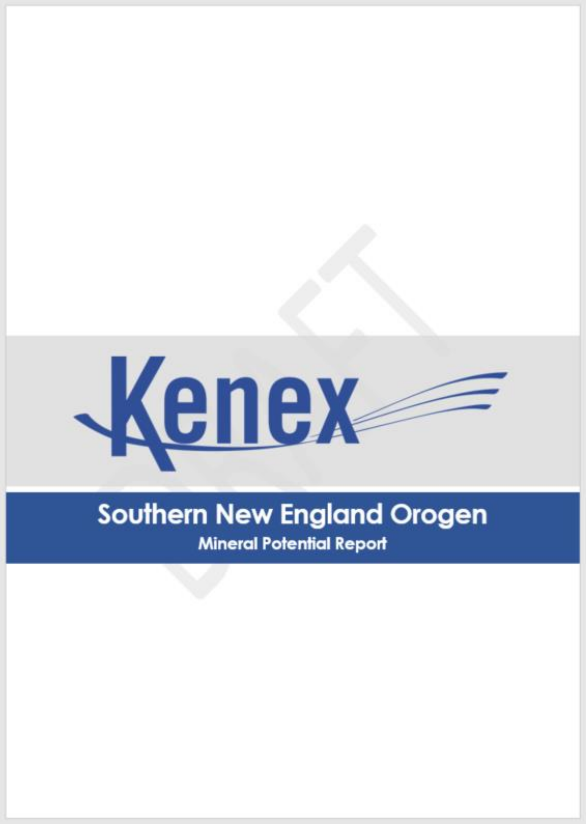
Gravity worms

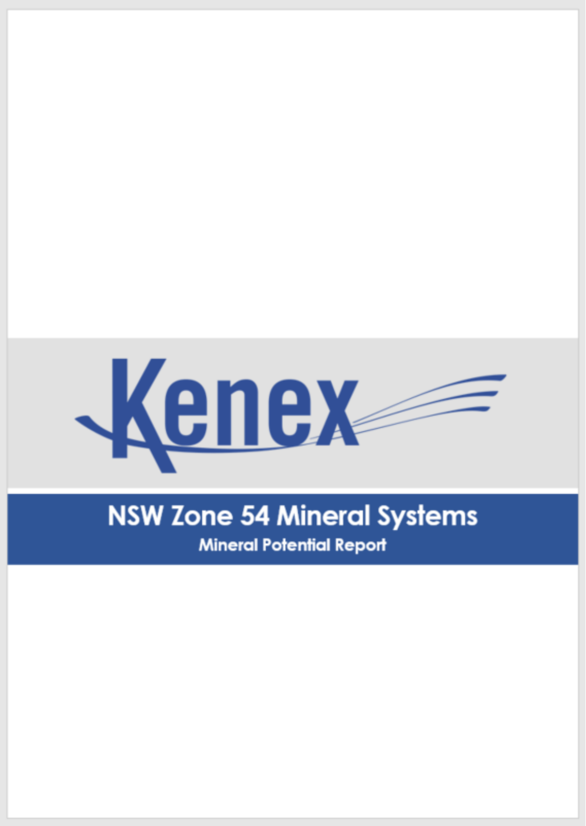
- Magnetic worms map geological contacts that could represent faults or granite boundaries.
- Select worms with Cont_ht = 11 944.
- Buffer 10 km at 100 m intervals around worms using Spatial Analyst distance buffer tool.
- Tested with training data – included in IR Sn-W model (migration to trap).

5

Data delivery & going undercover

Data Delivery –
reports, shape files, spatial data tables





NSW Geological Survey

- Provide simple yet robust predictive maps to inform land use planning.
- Distil mineral system knowledge, expressed spatially.
- Improve data quality - shows data gaps (quality and coverage).

Explorers

- New to the province.
- Want to test new ideas.

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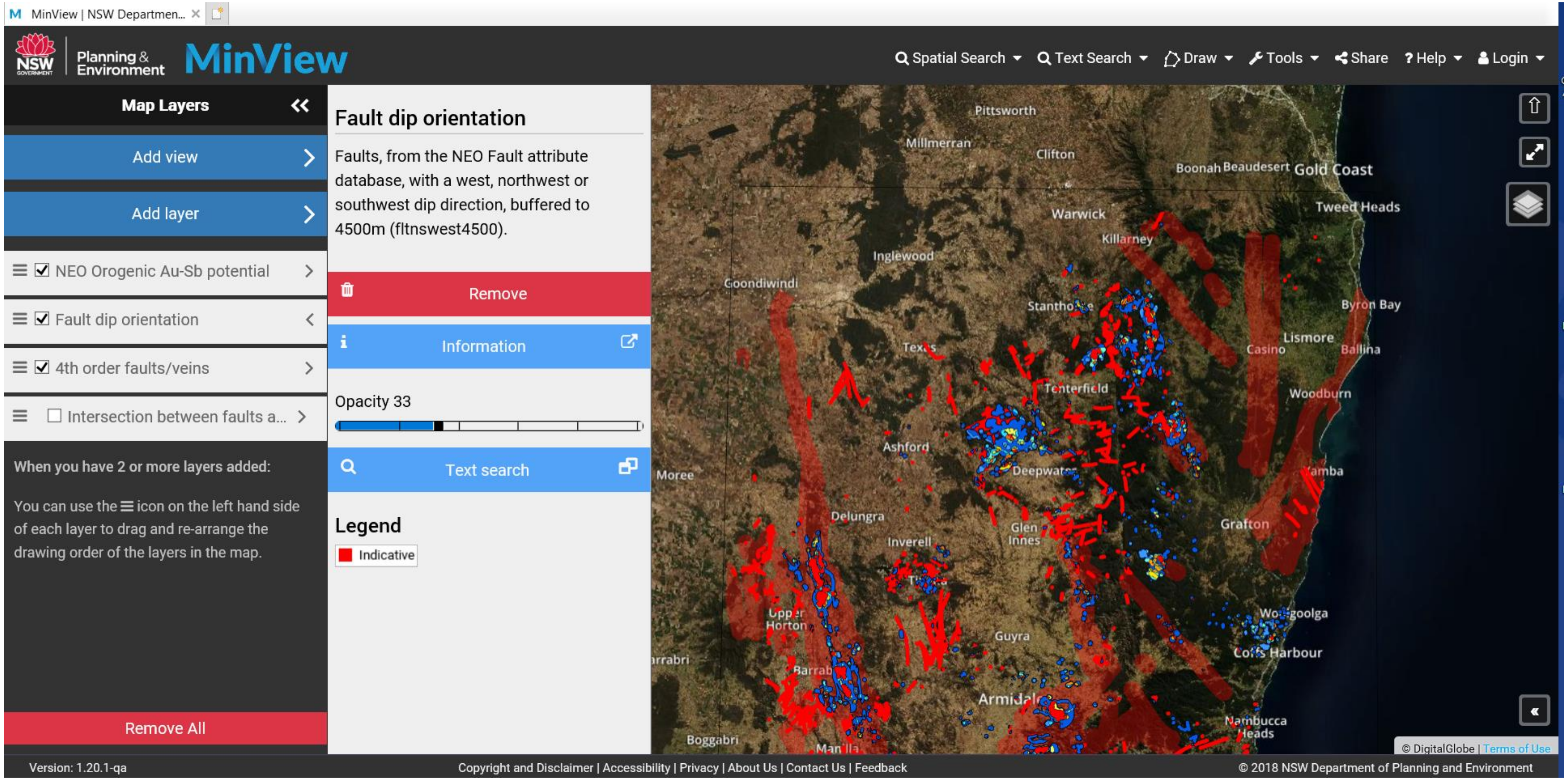
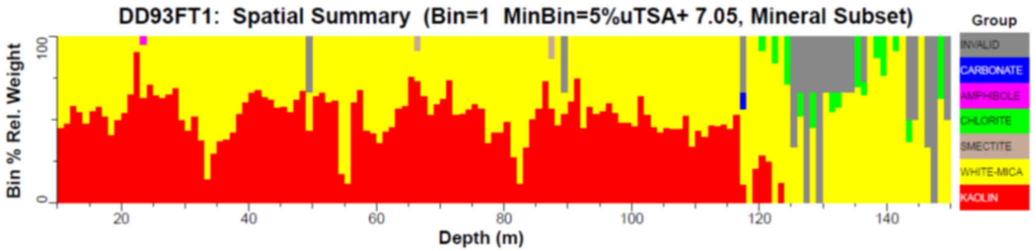
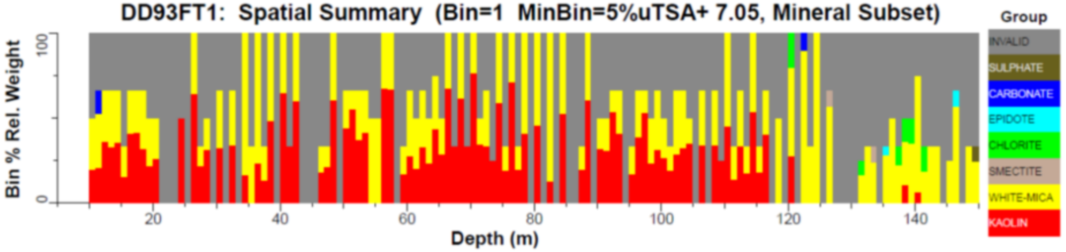
Check out MinView!



Predictive mapping – moving mineral potential under cover

- How much and what type of data is needed to inform meaningful potential mapping under cover?
- What proxies can be used undercover?
- Training of systems using legacy drill coverage in combination with new geophysics in Cobar.





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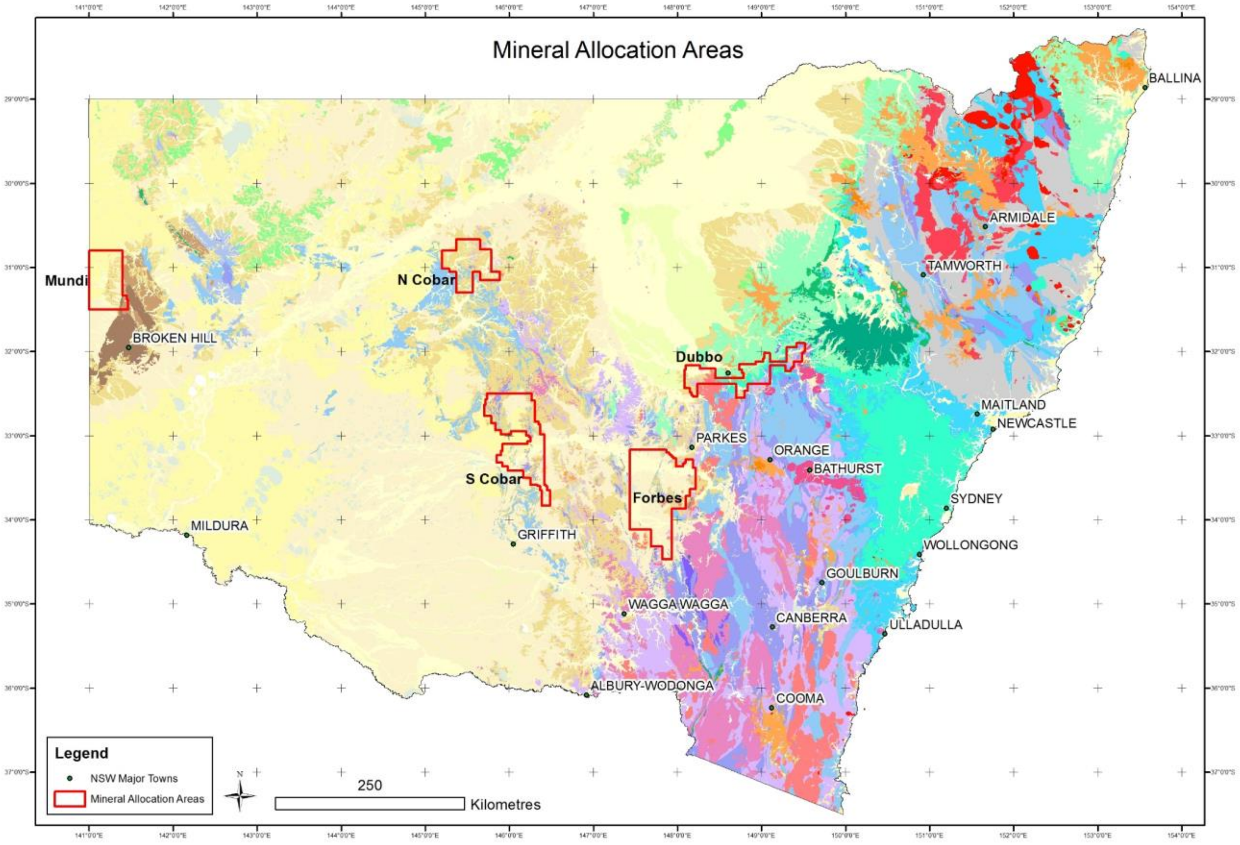
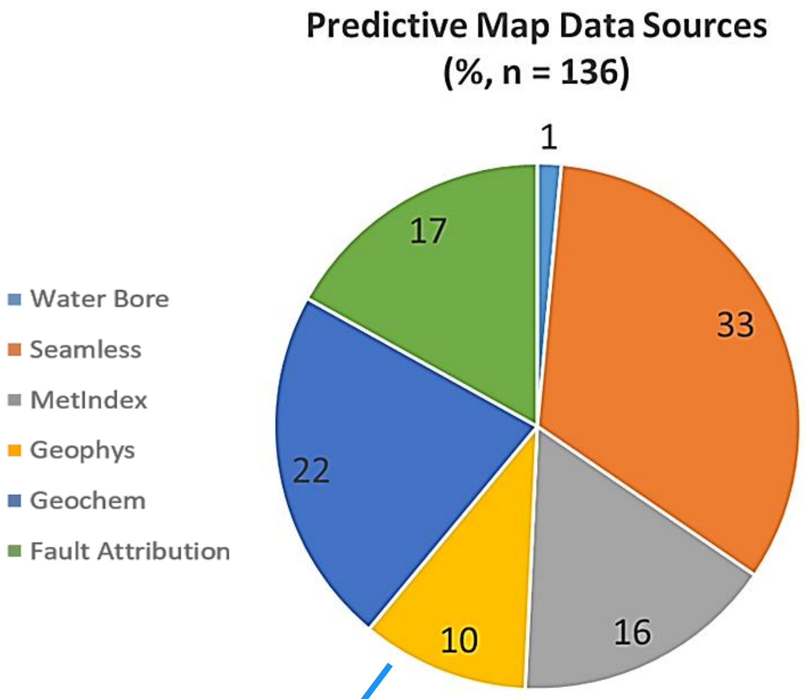
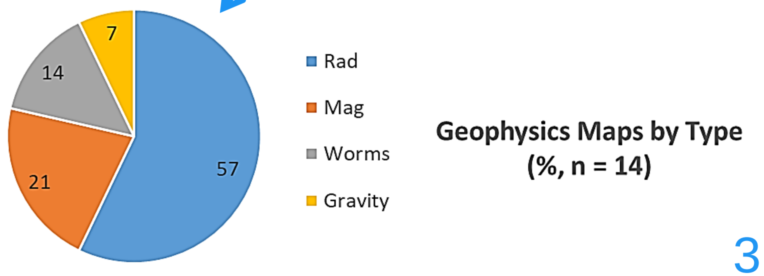
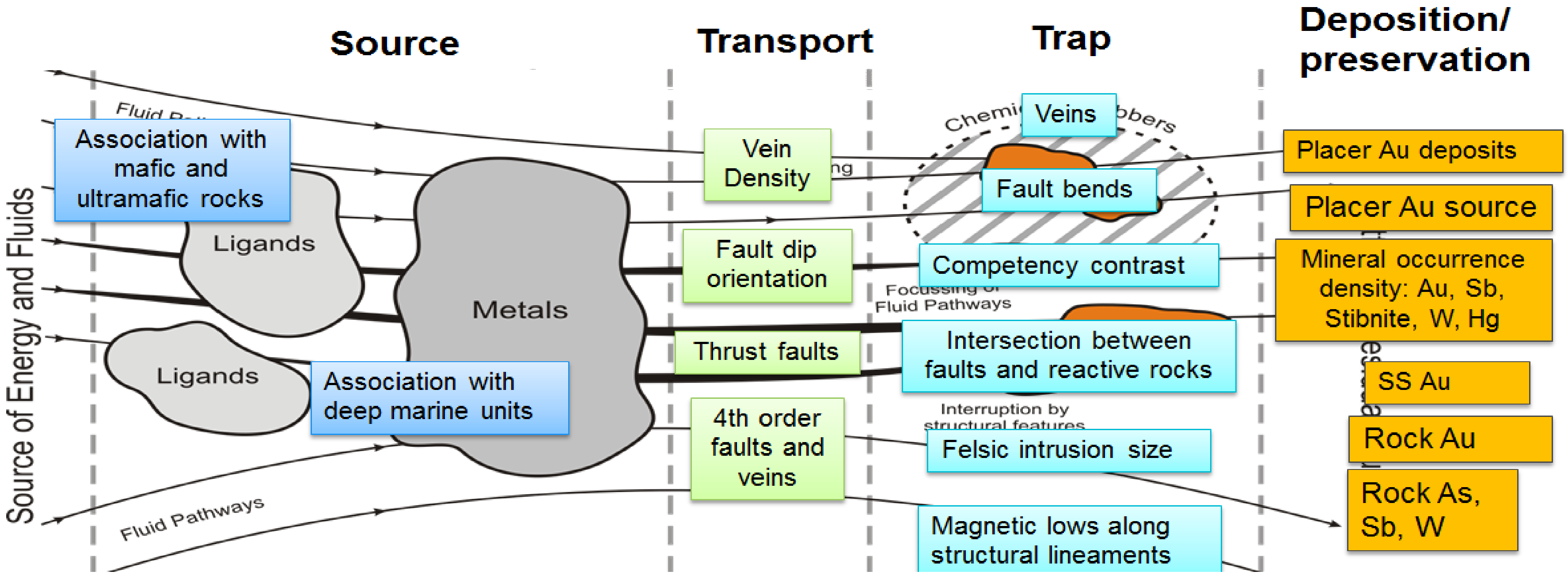
Predictive mapping – moving mineral potential under cover

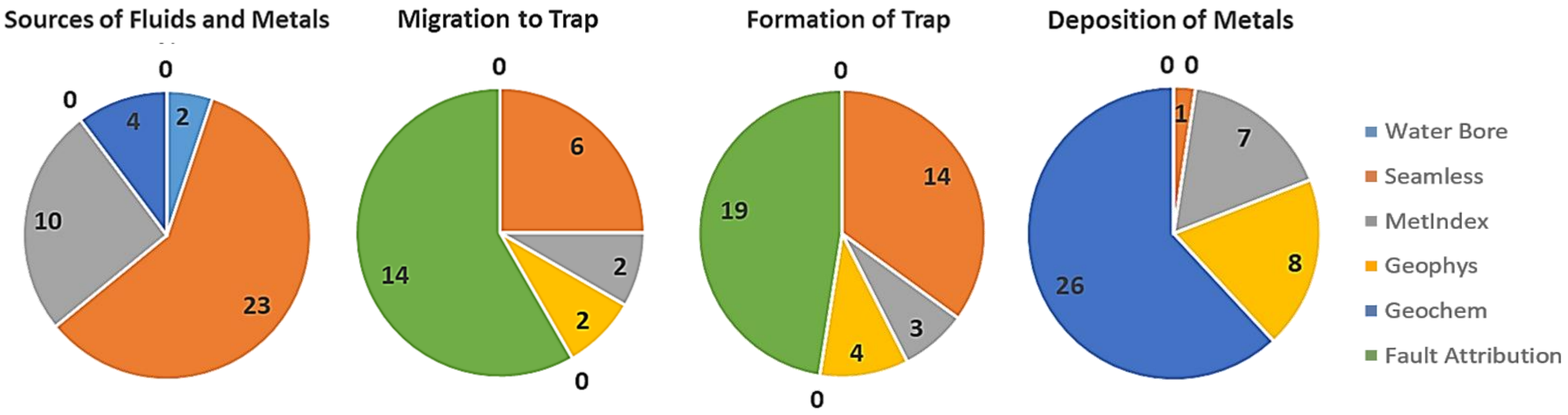






Predictive mapping – moving mineral potential under cover





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