

Exploration Implications from Geochemistry of Groundwaters from Bluebush Diamond Drill Holes.



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Summary

- Groundwaters from diamond drill holes provide similar information to that previously obtained from water bores. Closer spatial density of sample locations would seem more cost-effective for exploration at this stage, than deeper sources.
- Major constituent variation in diamond drill hole groundwaters indicates that groundwaters from GRW4,5 are different from those sampled out of the other two drill holes. Differences derive from higher concentrations of Mg and Ca, which implies a greater mafic rock input to water in this drill hole.
- Statistical clustering of all sampled locations (including the new diamond drill holes), on the basis of concentrations of a suite of major and trace constituents, delineated discrete zones that are reasonably coincident with local areas of high residual gravity. Locations of GRW1 and 2,6 fitted in this cluster, but GRW4.5 did not.
- The low NMg anomaly that was previously found to coincide with the general region of anomalous gravity, is confirmed by the samples from diamond drill hole GRW2/6 with a sharp southern boundary illustrated between GR6/GRW3 and GRW4 and 5. This anomaly implies a central zone of rocks that are more felsic/less mafic than those that surround them. Whereas a zone of low groundwater scandium supports this conclusion, partially coincident central zones of low groundwater molybdenum, rubidium, fluorine and uranium (indicators of felsic or potassic aquifer rocks) preclude a simple interpretation.
- Ore elements at locally elevated levels in groundwaters from diamond drill holes include zinc in GRW1 and GRW4 with copper and gold in GRW1 and 2,6. None of these were sufficiently high to indicate saturation of the groundwater with ore minerals. Minor coincidence among ore elements is evident in groundwaters from only a few sites.
- All groundwaters from diamond drill holes contained modest concentrations of arsenic that are too low to indicate proximity to sulphide minerals, but do not exclude possibly deep or further distant sources.
- Groundwaters from the diamond drilling plotted on the relevant mineral stability field diagram, fit the same trend as the bore waters from the first program.

Groundwater Analyses

Bluebush Diamond Drill Holes

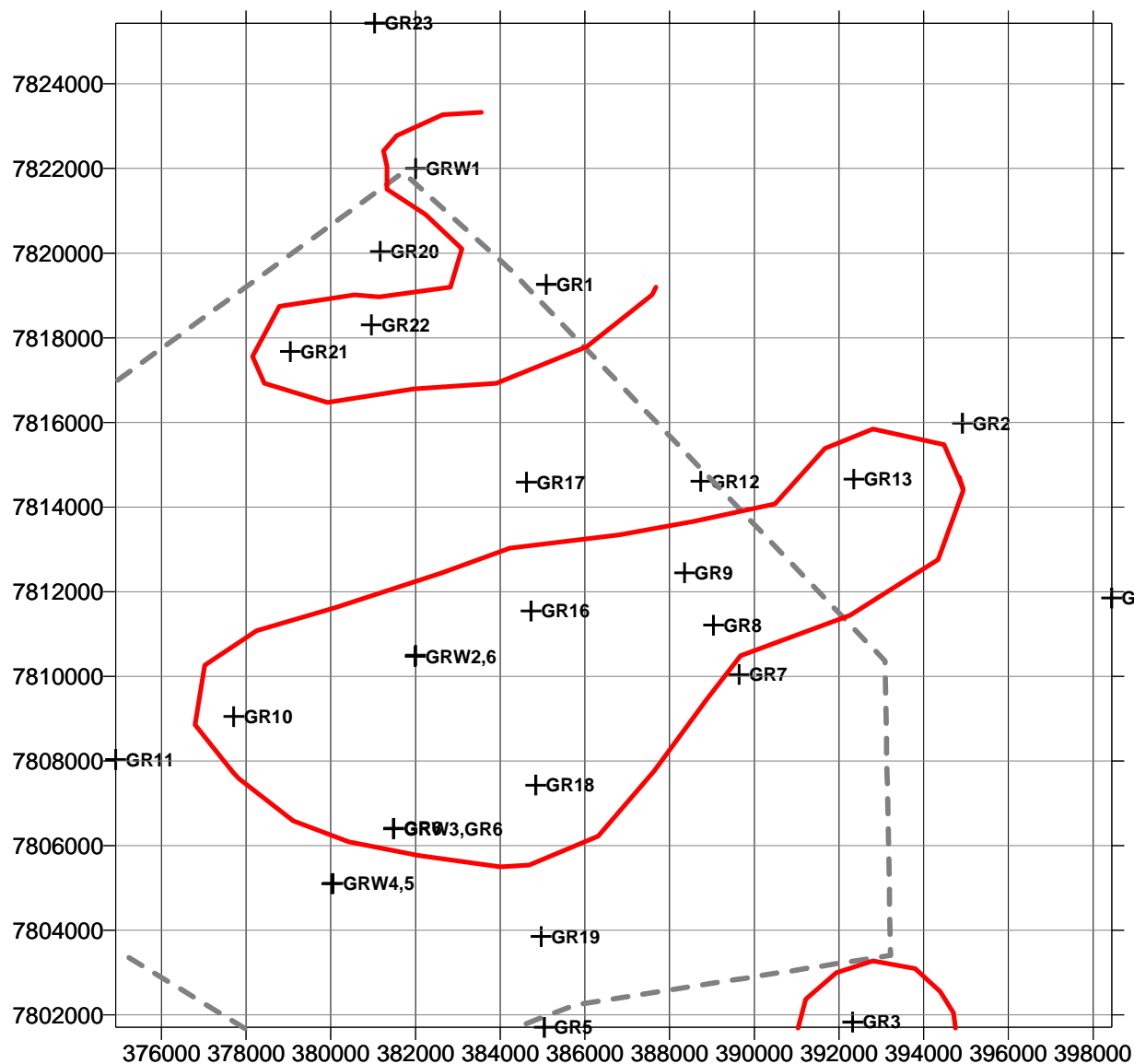
Bluebush Dimond Drill Hole Groundwater Data

DH/Bore Name	Type	Water Table	Sample Depth	AMG Zone	Grid East	Grid North	Temp (C)	pH	Eh mV	Ca mg/l	Mg mg/l
	DH	6	10	53	382000	7822000	31.8	6.35	170	1107	1887
	B	7	15	53	381992	7810475	33.4	7.1	360	32	87
	B			53	381484	7806398	33.5	6.45	150	47	45
	B	4.5	12	53	380050	7805110	33	5.88	360	48	19
	DH	4.5	12	53	380025	7805105	33.4	5.97	524	38	16
	DH?	6.5	15	53	382000	7810500	33.4	6.13	140	2.9	5.6
Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	HCO3 mg/l	Cu ug/l	Pb ug/l	Zn mg/l	F mg/l	U ug/l	Al mg/l	Fe mg/l
9568	690		6267	90	68.0	2.2	0.09	<0.1	106.0	0.172	0.147
1117	188	1700	393	445	8.1	2.2	-0.03	2.9	38.4	0.013	0.008
394	46	550	312	165	25.6	0.1	-0.03	0.9	9.6	-0.002	0.034
22	22	25	9	105	-0.1	1.2	2.7	0.7	1.7	0.005	-0.005
78	25	55	28.5	130	-0.1	-0.1	-0.03	1.1	3.5	0.099	0.044
147	24	150	51	90	4.3	0.5	-0.03	1.1	1.5	9.62	5.37
Ti mg/l	Mn mg/l	B mg/l	P mg/l	Ag ug/l	Ba mg/l	Be mg/l	Cd ug/l	Co ug/l	Cr ug/l	La ug/l	Mo ug/l
0.006	0.104	8.2	1.5	-1	-0.002	-0.002	0.7	0.7	11.4	0.3	38.1
-0.002	0.003	2.18	0.15	-1	0.024	-0.002	0.3	0.1	6.3	-0.1	4.9
-0.002	0.003	0.516	0.06	-1	0.049	-0.002	0.2	-0.1	6.3	-0.1	5.3
-0.002	0.003	0.125	-0.05	-1	0.285	-0.002	-0.1	-0.1	2.1	-0.1	0.4
0.004	-0.002	0.233	0.07	-1	0.186	-0.002	-0.1	-0.1	2.0	-0.1	7.8
0.308	0.056	0.349	0.29	-1	0.019	-0.002	-0.1	-0.1	2.8	0.3	17.0
Sc ug/l	Sr mg/l	Y ug/l	Ni ug/l	Yb ug/l	As ug/l	Li mg/l	Si mg/l	Au ng/l	V mg/l	Sb ug/l	Bi ug/l
12.3	20.7	0.4	12.3	0.33	0.8	0.21	11	5.8	0.009	0.9	0.6
11.0	1.41	-0.1	0.4	-0.1	1.4	-0.005	35	1	0.021	0.2	-0.1
8.1	0.94	-0.1	0.3	-0.1	0.7	-0.005	30	3.1	0.008	-0.1	-0.1
7.6	0.41	-0.1	0.6	-0.1	0.9	-0.005	45	1.5	0.027	0.1	-0.1
5.8	0.324	-0.1	0.9	-0.1	1.8	-0.005	39	2.3	0.03	0.1	-0.1
2.6	0.081	0.3	1.4	-0.1	2.7	0.012	28	7	0.014	0.2	-0.1
Th ug/l	Rb ug/l	Cs ug/l	Tl ug/l	Ga ug/l	Ge ug/l	Tb ug/l					
0.8	78.7	0.5	0.5	-0.1	2.4	0.1					
-0.1	92.6	0.2	0.1	-0.1	0.4	-0.5					
-0.1	12.8	0.3	-0.1	-0.1	0.2	-0.5					
-0.1	13.5	0.3	-0.1	-0.1	0.1	-0.5					
-0.1	15.3	0.3	-0.1	-0.1	0.2	-0.5					
-0.1	11.4	-0.1	-0.1	0.2	0.3	-0.5					



Statistical Clustering

Locations grouped by
groundwater chemical
components.



Groundwaters from locations within red lines fit into a statistical cluster calculated from concentrations of trace elements and normalised majors. Apart from GR3, and 13 clustered locations all coincide with discrete zones of high residual gravity. This clustering may constitute a groundwater geochemical signature for the source of the gravity anomaly in the Bluebush project region. Note that diamond drill holes represented by GRW1,2 and 6 fit in this cluster but that represented by GRW4 and 5 does not.

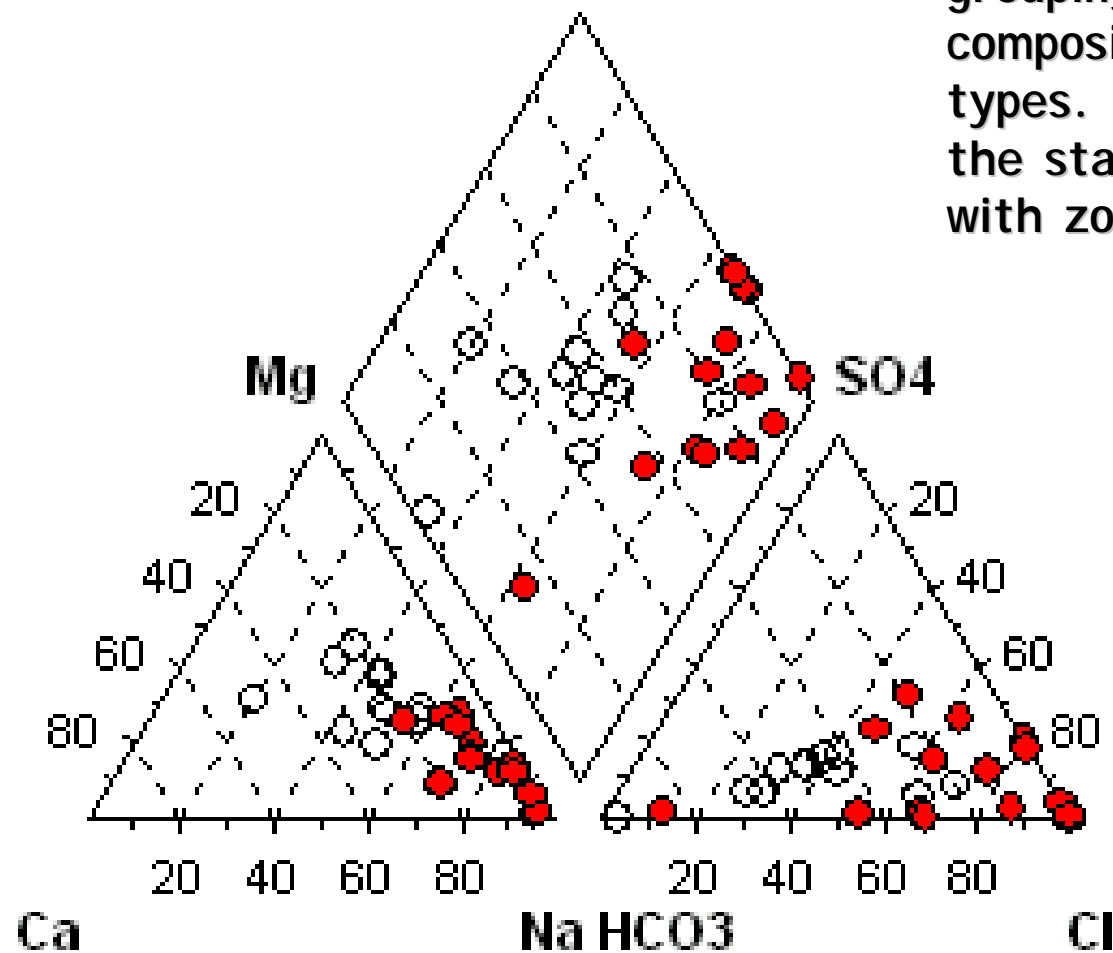
Analysed variables used for clustering - Cu, Pb, Zn, U, Al, Fe, Mn, Ba, Co, Sr, Ni, As, Li, Si, V, Rb, Cs, NCa, NMg, NK, NSO₄, Sc, F, Au, Mo and Ge.

Clustering procedure was k-means clustering of Principal Component scores 1,2,3 and 4.

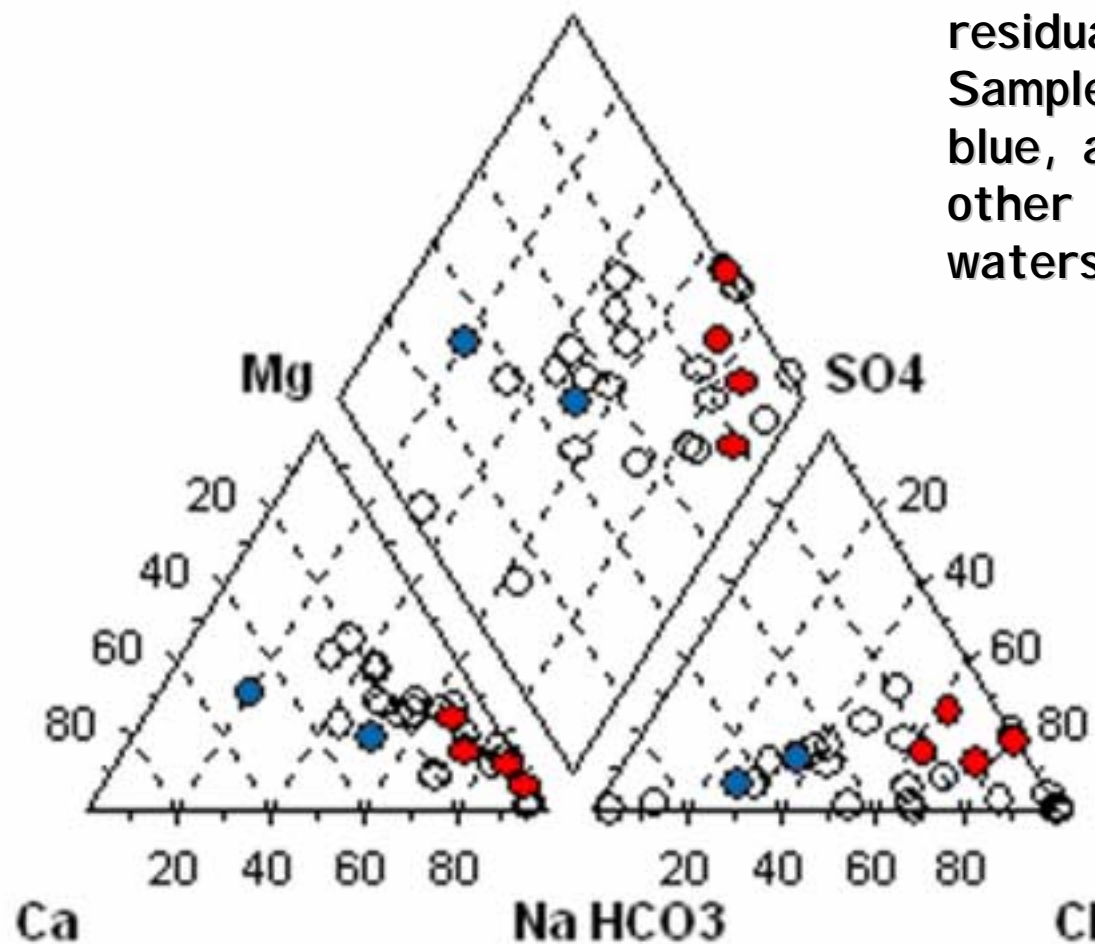
Properties of Aquifer Rocks

Identified from major
groundwater components – Ca,
Mg, Na, K, Cl, SO₄ and
carbonate

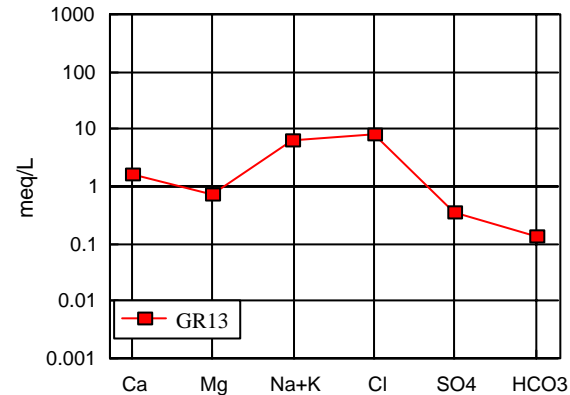
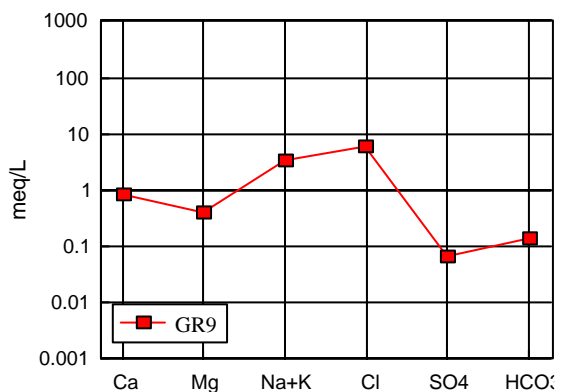
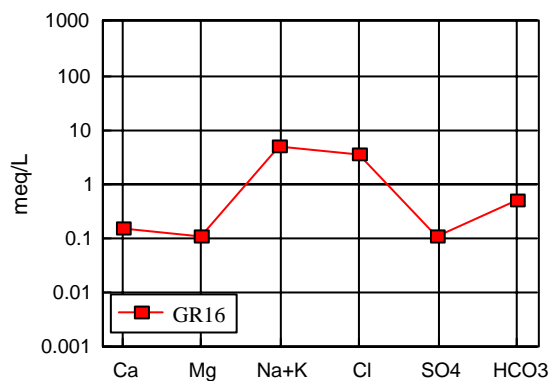
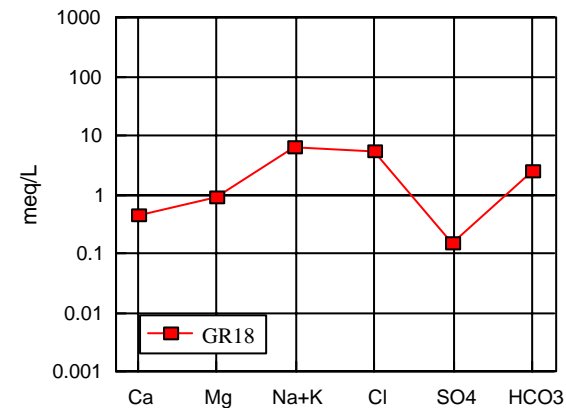
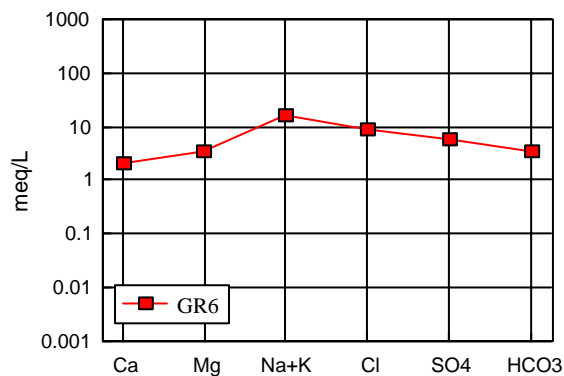
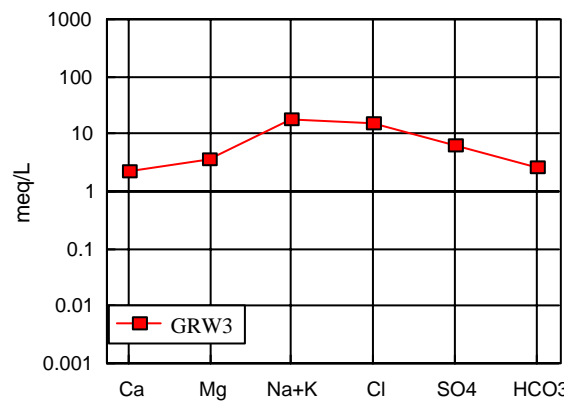
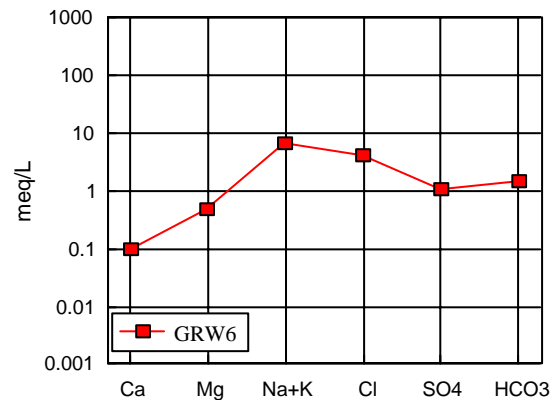
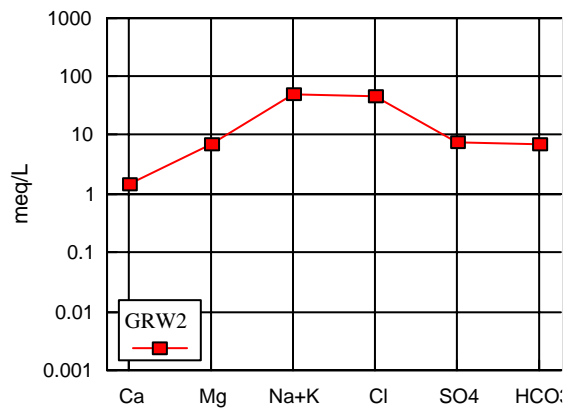
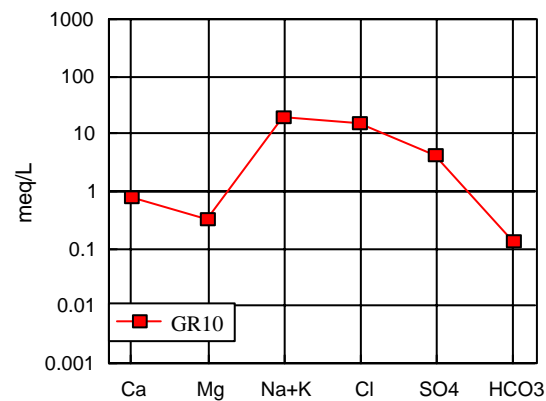
All groundwater samples from both collections plotted on a major element diagram that illustrates grouping in terms of major element composition, and hence aquifer rock types. Those shown in red are from the statistical cluster that coincides with zones of high residual gravity.

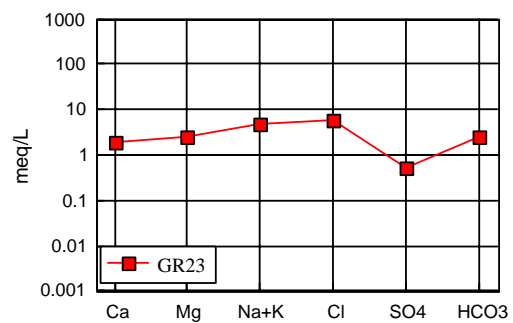
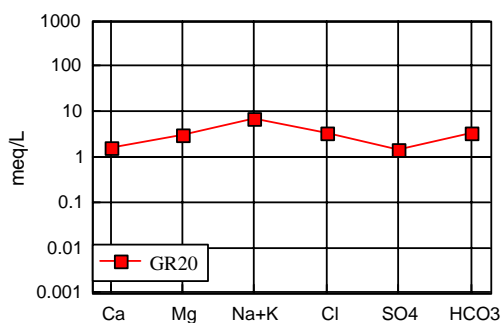
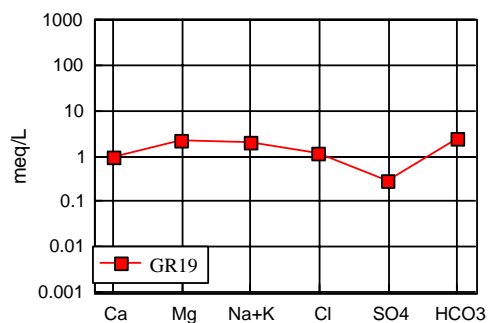
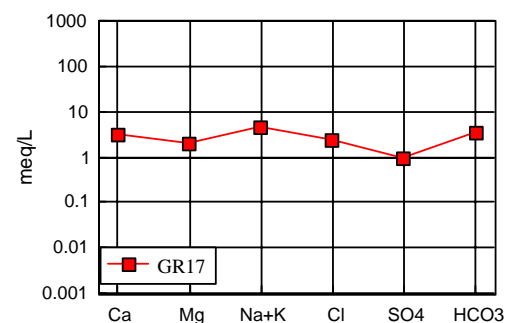
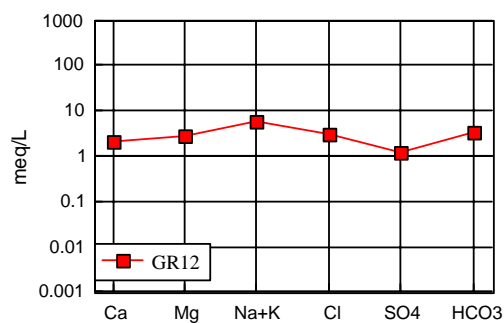
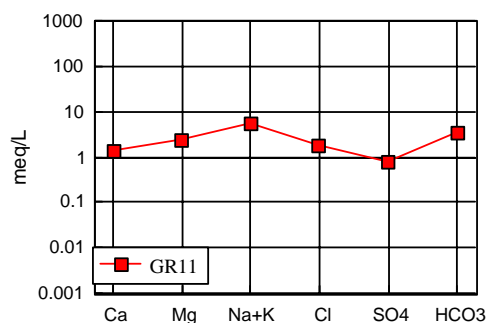
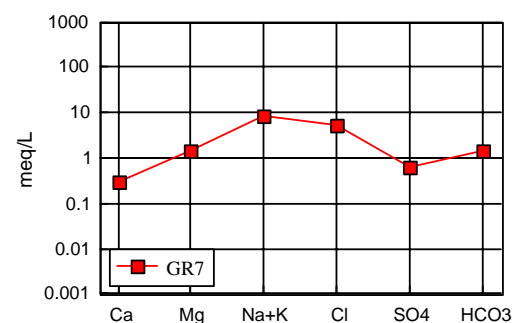
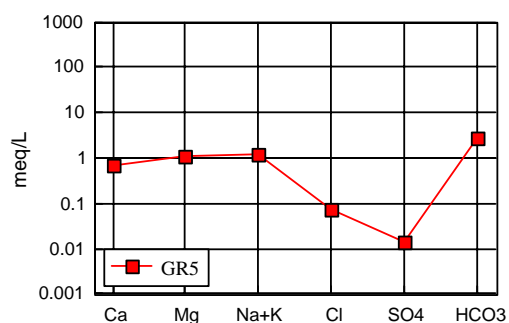
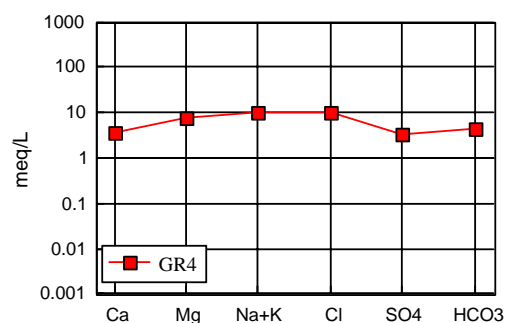
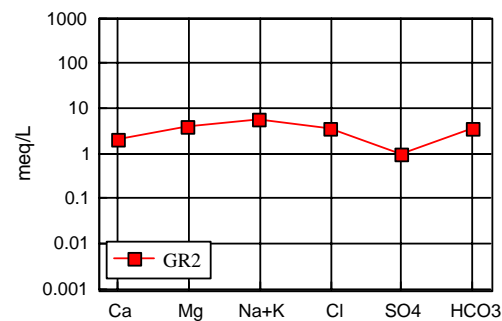
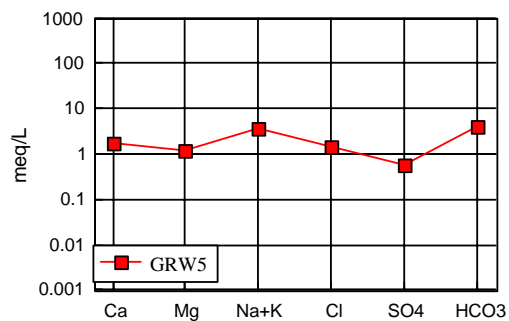
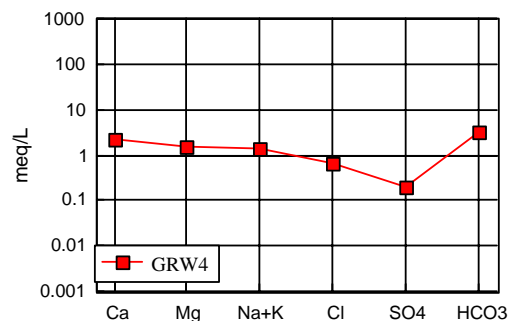


Major element composition of groundwaters from the diamond drilling are plotted with samples from the first program. Those that geochemically fit with samples from locations within zones of high residual gravity, are shown in red. Samples GRV4 and 5, shown in blue, are clearly different to the other two diamond drill hole waters.



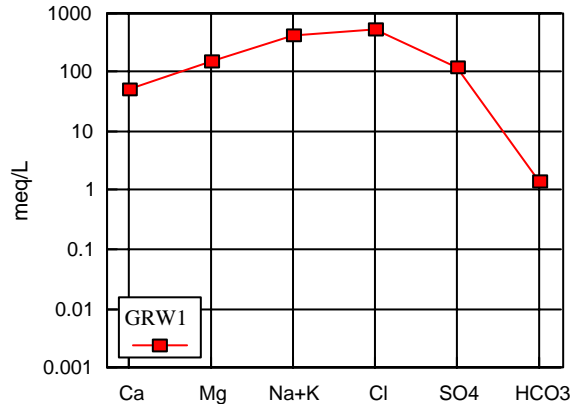
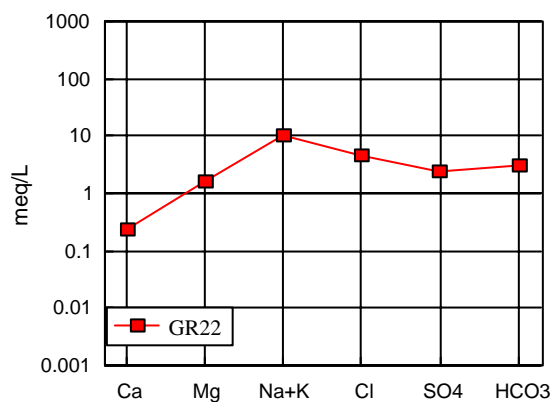
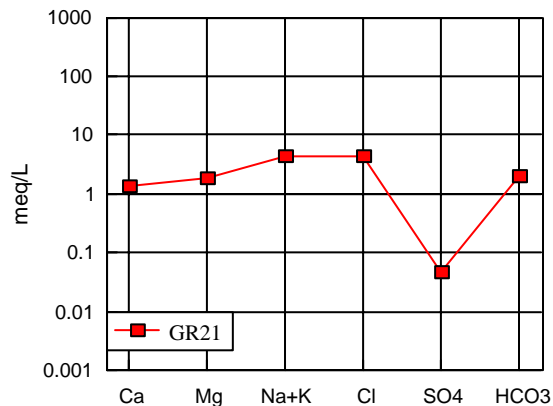
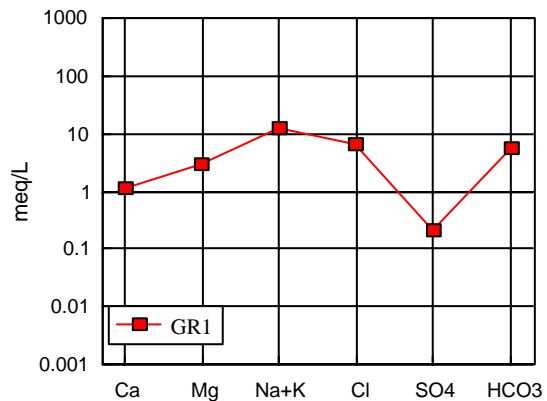
Some major element composition plots of samples that fit in the statistical cluster which coincides with zones of high residual gravity and are located within the central gravity anomaly



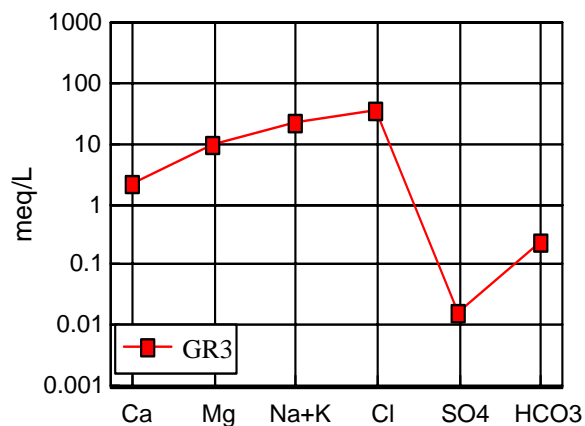


Major element composition plots of groundwaters that do NOT fit in the statistical cluster that coincides with zones of high residual gravity.

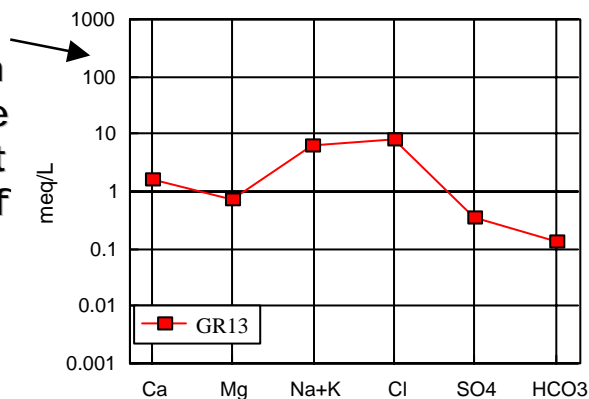
Apart from GR7, the common pattern for this group is that of typically mafic rocks.

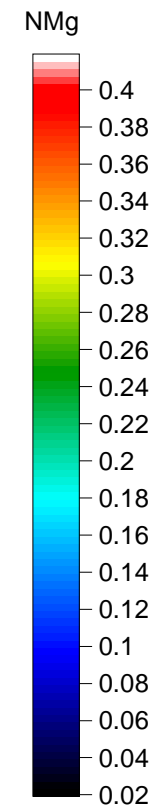
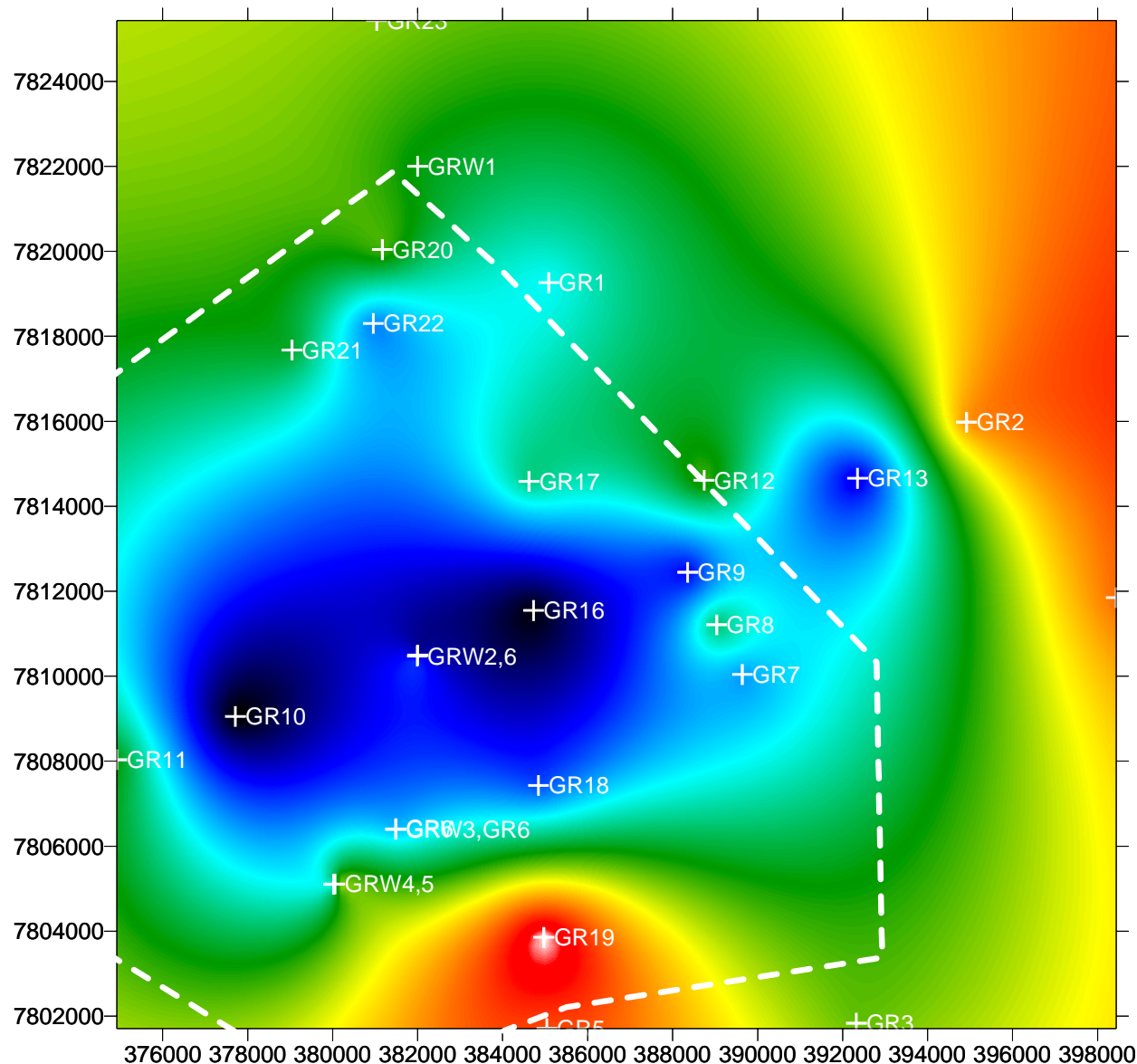


Major element composition plots from samples that fit in the statistical cluster that coincides with zones of high residual gravity, and that are located in a northern zone of high residual gravity.



Major element composition plots from samples that fit in the statistical cluster that coincides with zones of high residual gravity, but which are located outside geophysically identified zones.

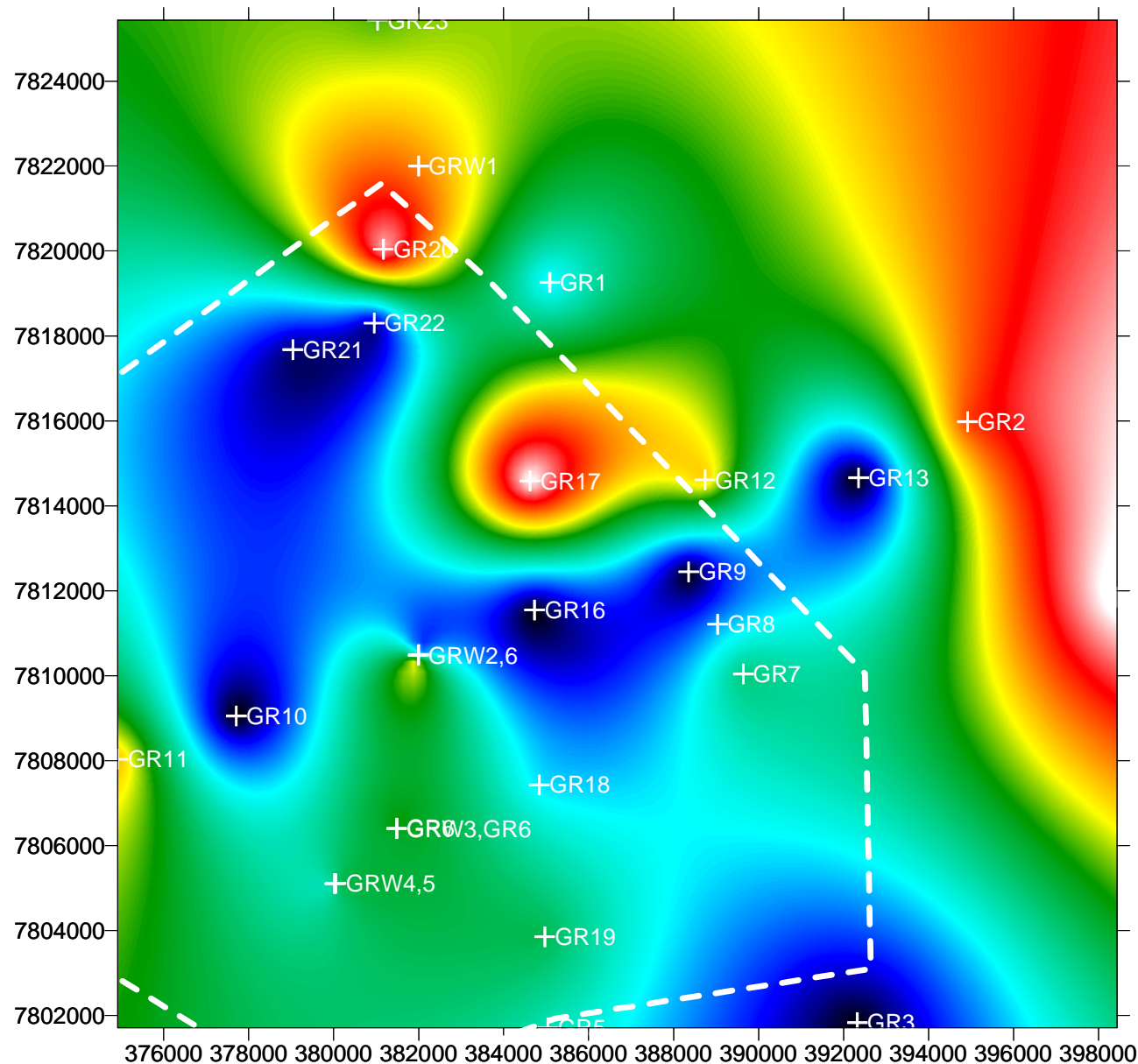




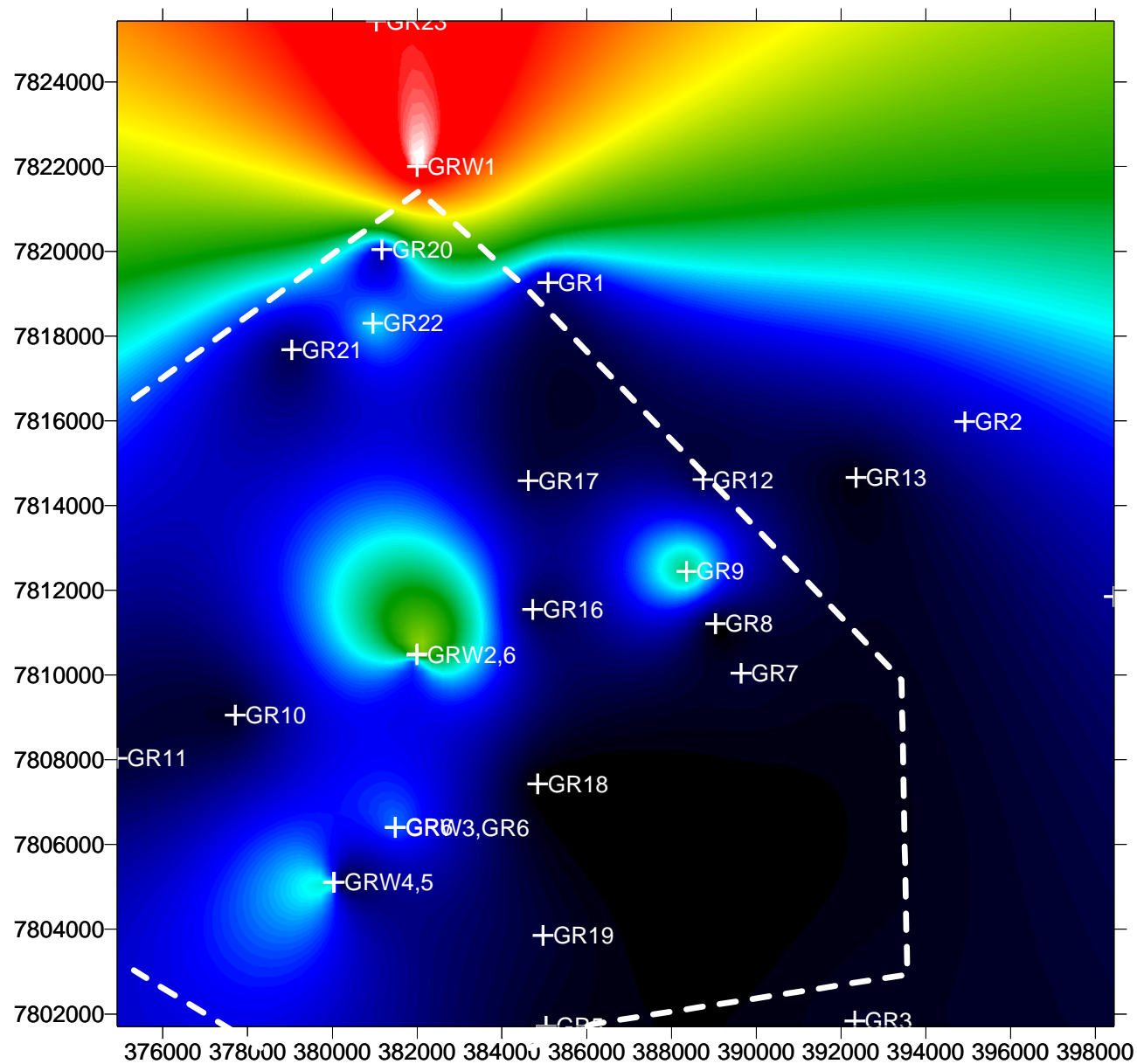
The low NMg anomaly that was previously found to coincide with the general region of anomalous gravity, is confirmed by the samples from diamond drill hole GRW2/6. Of particular interest is the sharp boundary in NMg illustrated between GR6/GRW3 and GRW4 and 5. This supports the southern increase in NMg evident in the original bore water data. In general this anomaly implies a central zone of rocks that are more felsic/less mafic than those that surround them.

Properties of Aquifer Rocks

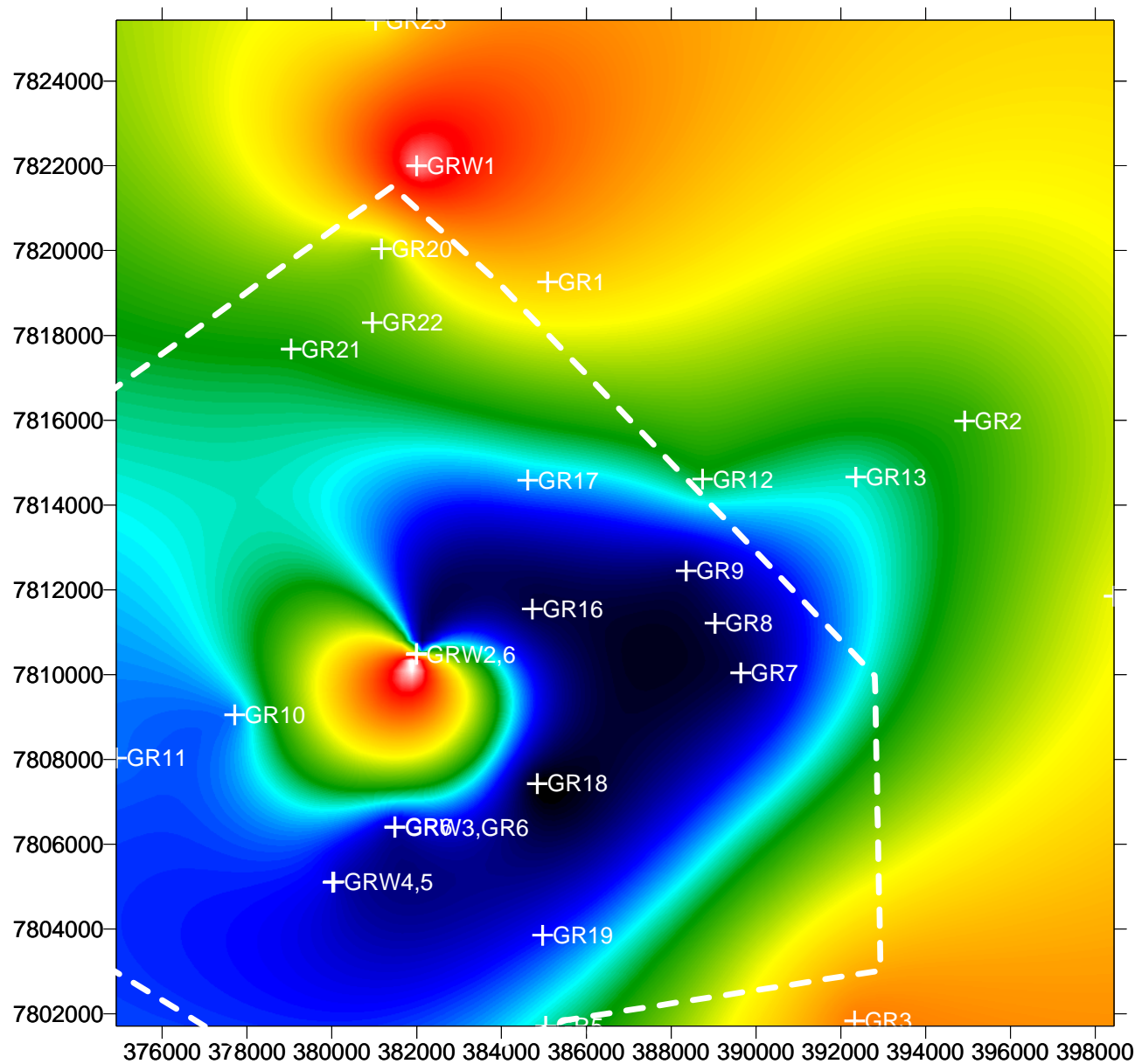
Indications from trace
components.



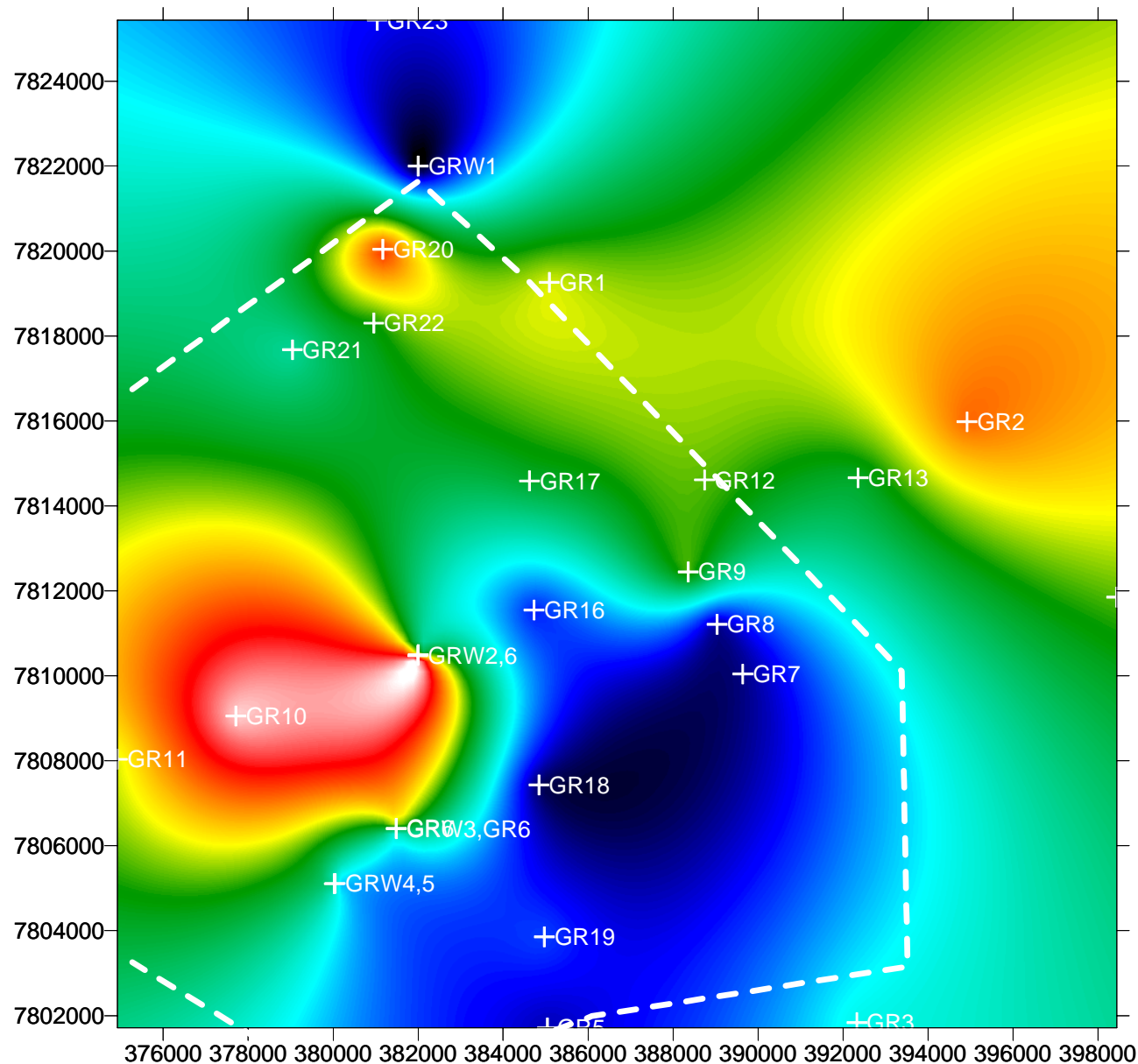
Scandium in groundwaters is usually a good indicator to ferromagnesian minerals in aquifer rocks. Indeed in this data set it correlates at 95% confidence with NMg. However, in this data set it also correlates with uranium, an uncommon constituent of ferromagnesian minerals. This suggests more than one rock type contributing to specific groundwaters, particularly in the vicinity of GRW1.



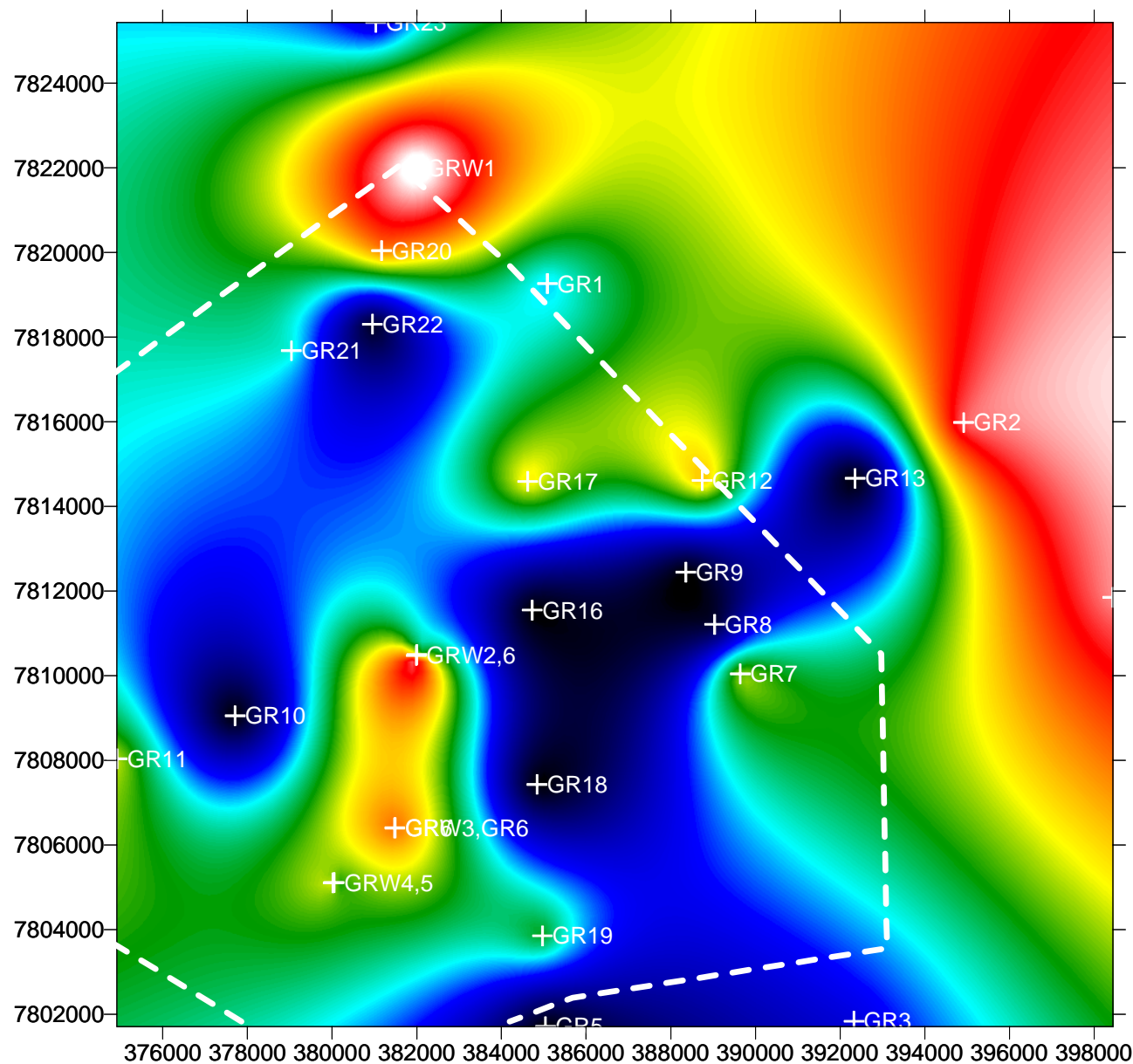
Because the three main locations of higher molybdenum values occur in diamond drill hole waters, the possibility has to be considered that molybdenum drilling grease may be the source.



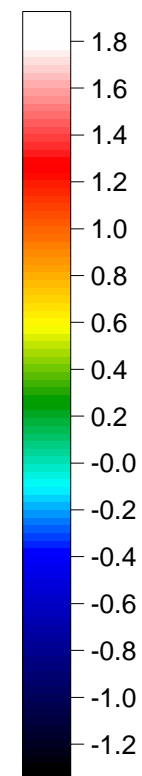
Apart from GRW2 the distribution of rubidium in Bluebush groundwaters implies that potassic rocks occur outside the general region of anomalous gravity.



The new data do not change the previous conclusion that concentrations of fluorine in groundwaters accord with locations of mapped sediments such as sandstones. However if igneous rocks are contributing to deeper groundwaters, fluorine in GRW1 and 2,6 could indicate felsic units, but not in GRW4 and 5.



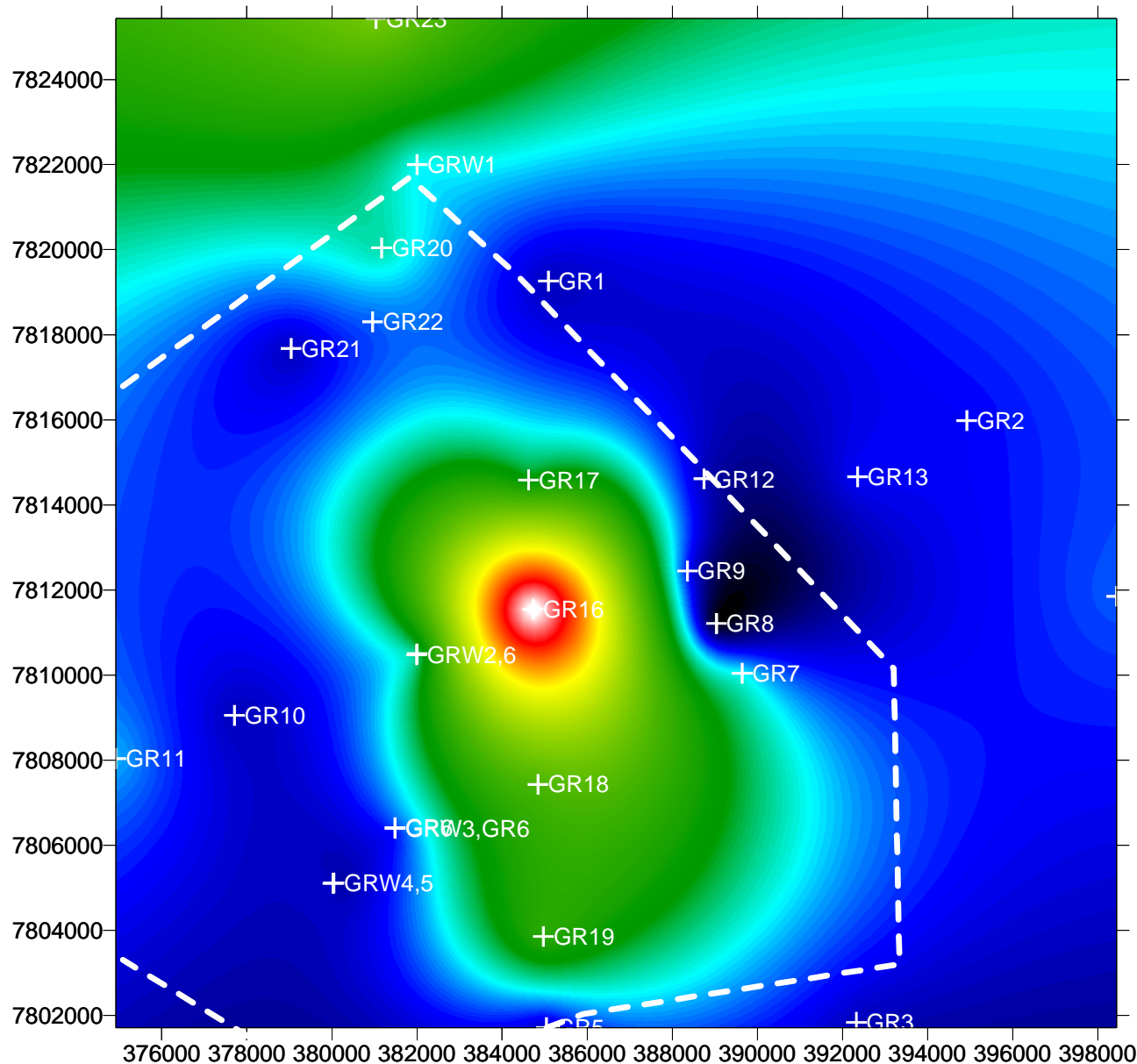
log U ug/L



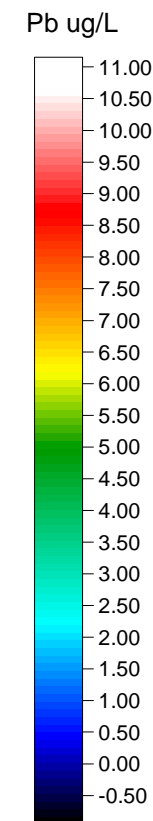
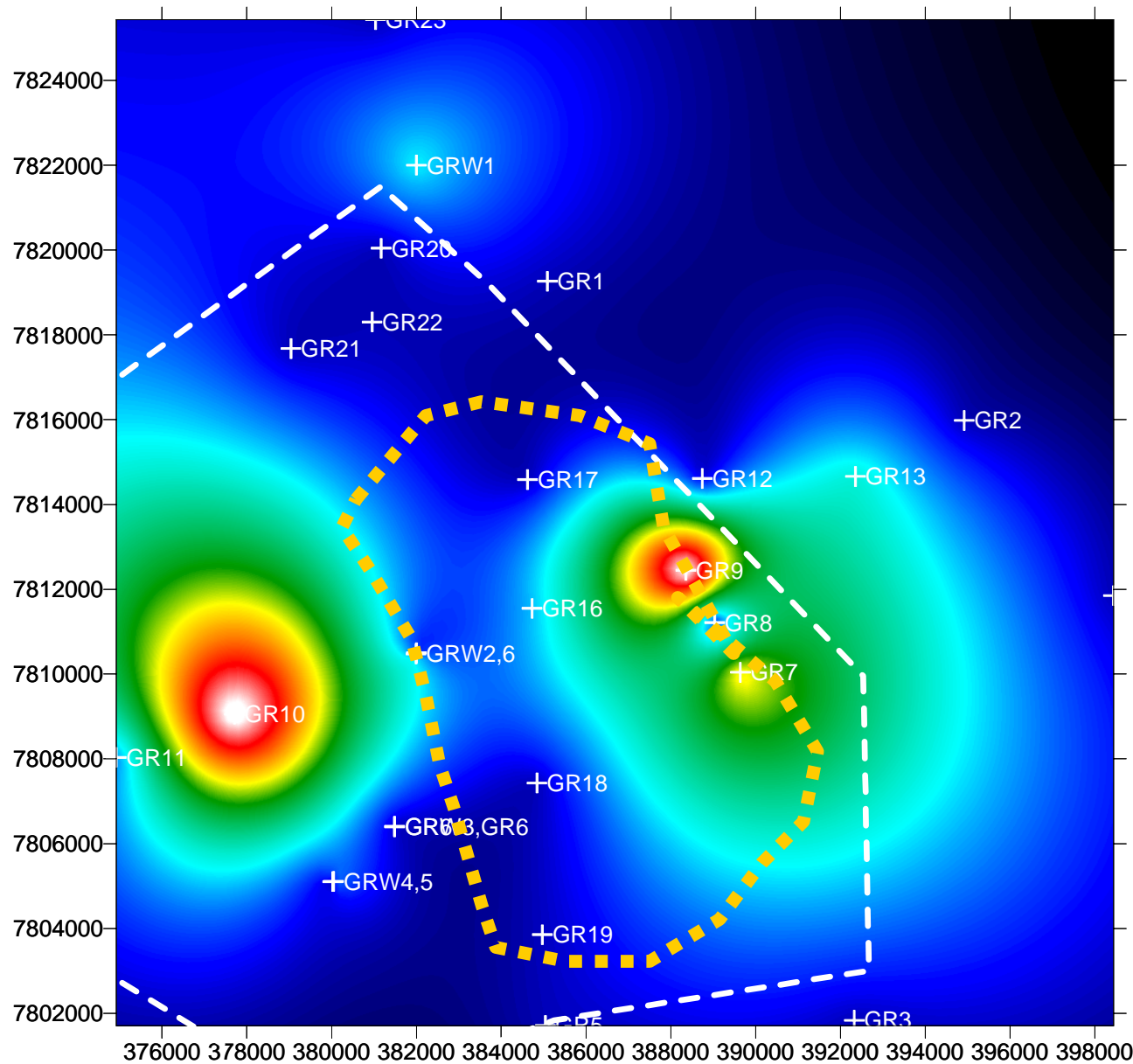
Very low values of uranium in Bluebush groundwaters identify a specific zone that includes part of the overall area of anomalous residual gravity. Elevated uranium concentrations, such as in GRW1, usually indicate groundwater leaching of felsic igneous rocks, with co-leached fluorine. The absence of fluorine in groundwater from GRW1 is similar to that observed in uranium enriched groundwaters in the Short Range region north of Warrego.

Economic Mineral Indicators

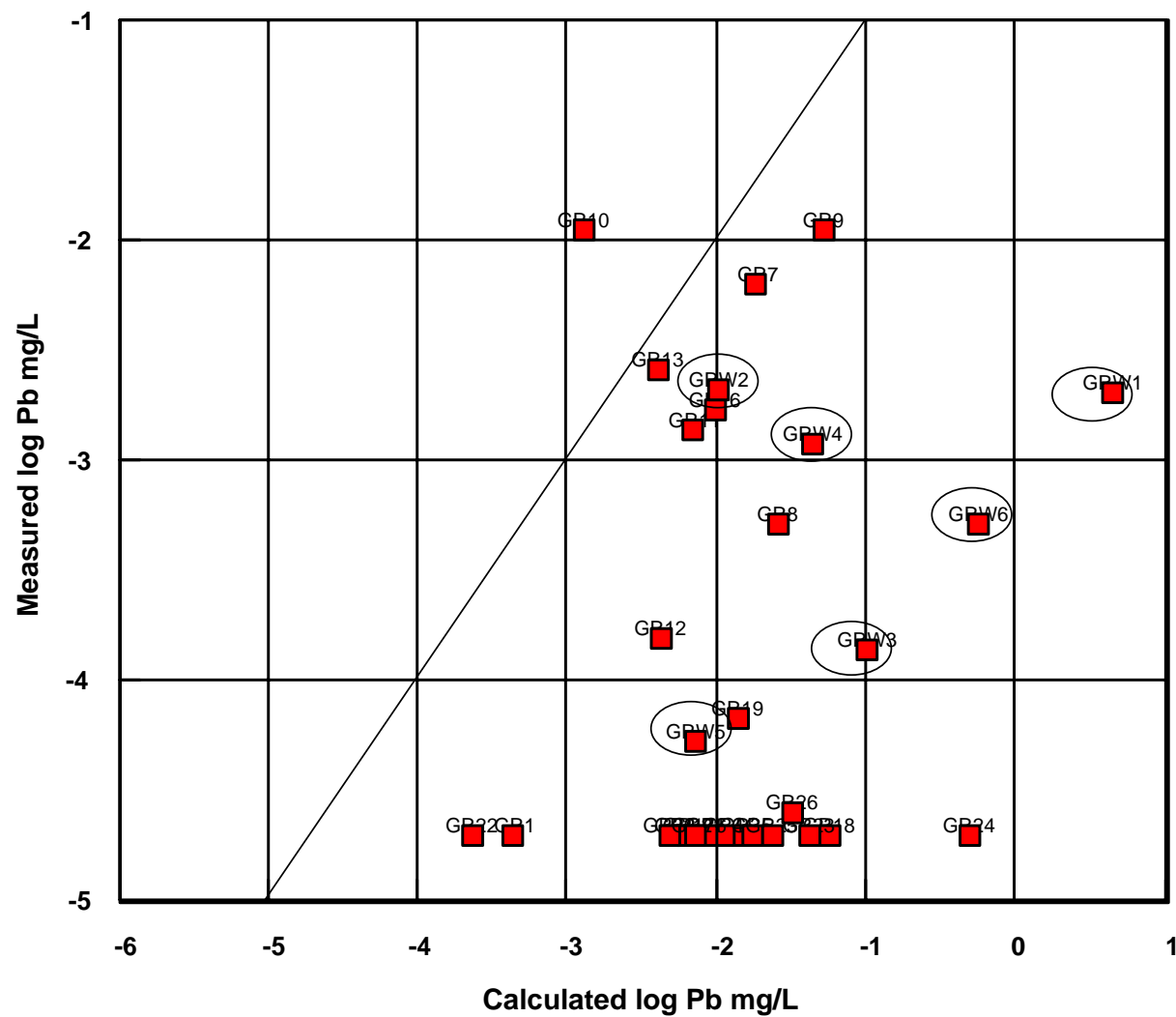
Gold, Lead, Zinc, Copper,
Arsenic



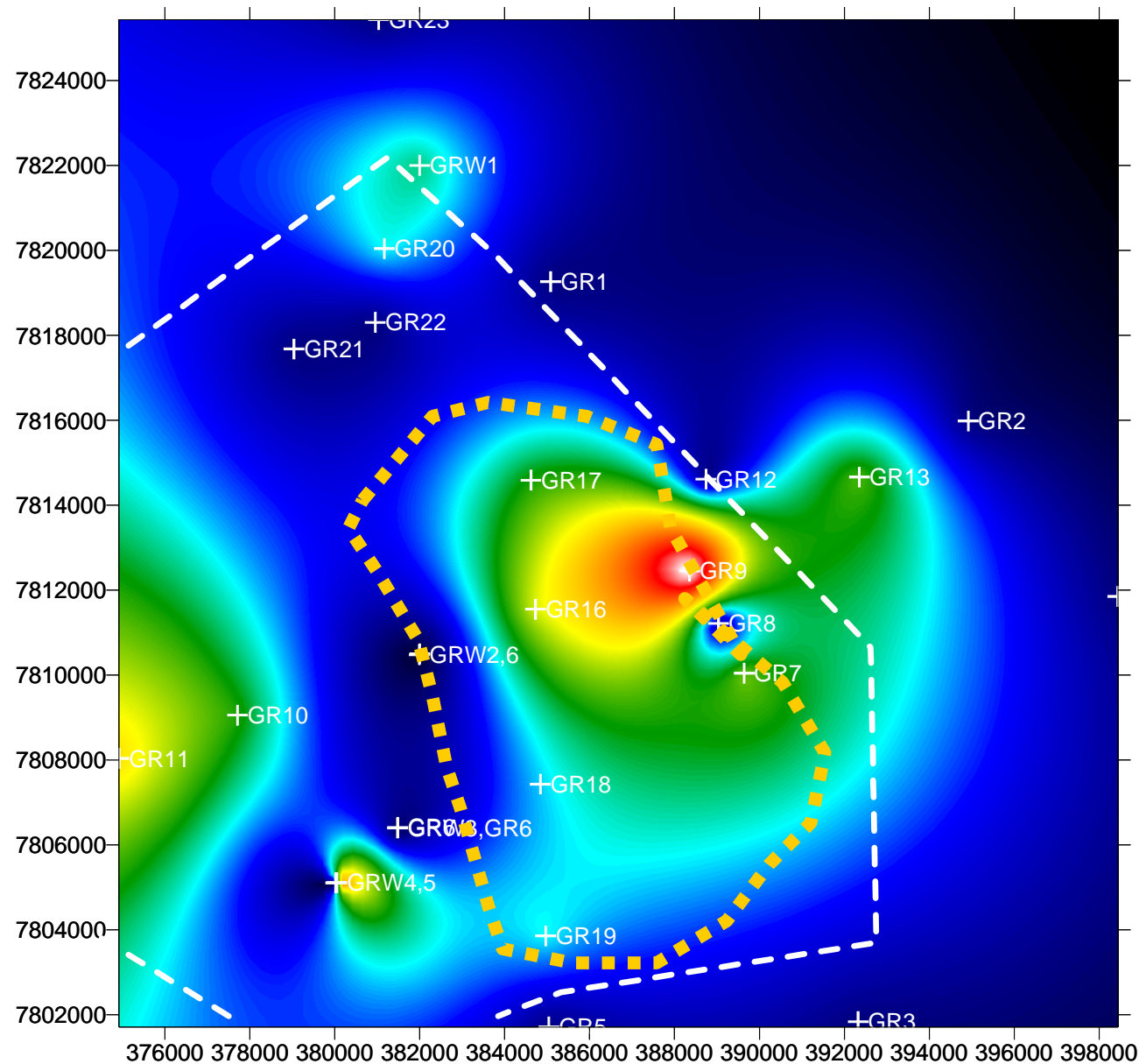
Gold values in groundwaters from diamond drill holes confirm the western boundary of the groundwater gold anomaly, evident from the previous study. Modest gold content in GRW6 and GRW1 support previous observations, as do the lower gold values in GRW4 and 5. Apart from GR16, gold values accord with sulphide sources rather than gold as a separate commodity.



Groundwaters in diamond drill holes did not contain elevated concentrations of lead. Within the overall data set, although only groundwater from GR10 contained lead at concentrations indicative of oxidised lead ore minerals, at two other sites (GR7 and 9) lead content of groundwaters is elevated above regional values. Only minor coincidence with the zone of anomalous gold (dashed gold line) is evident.



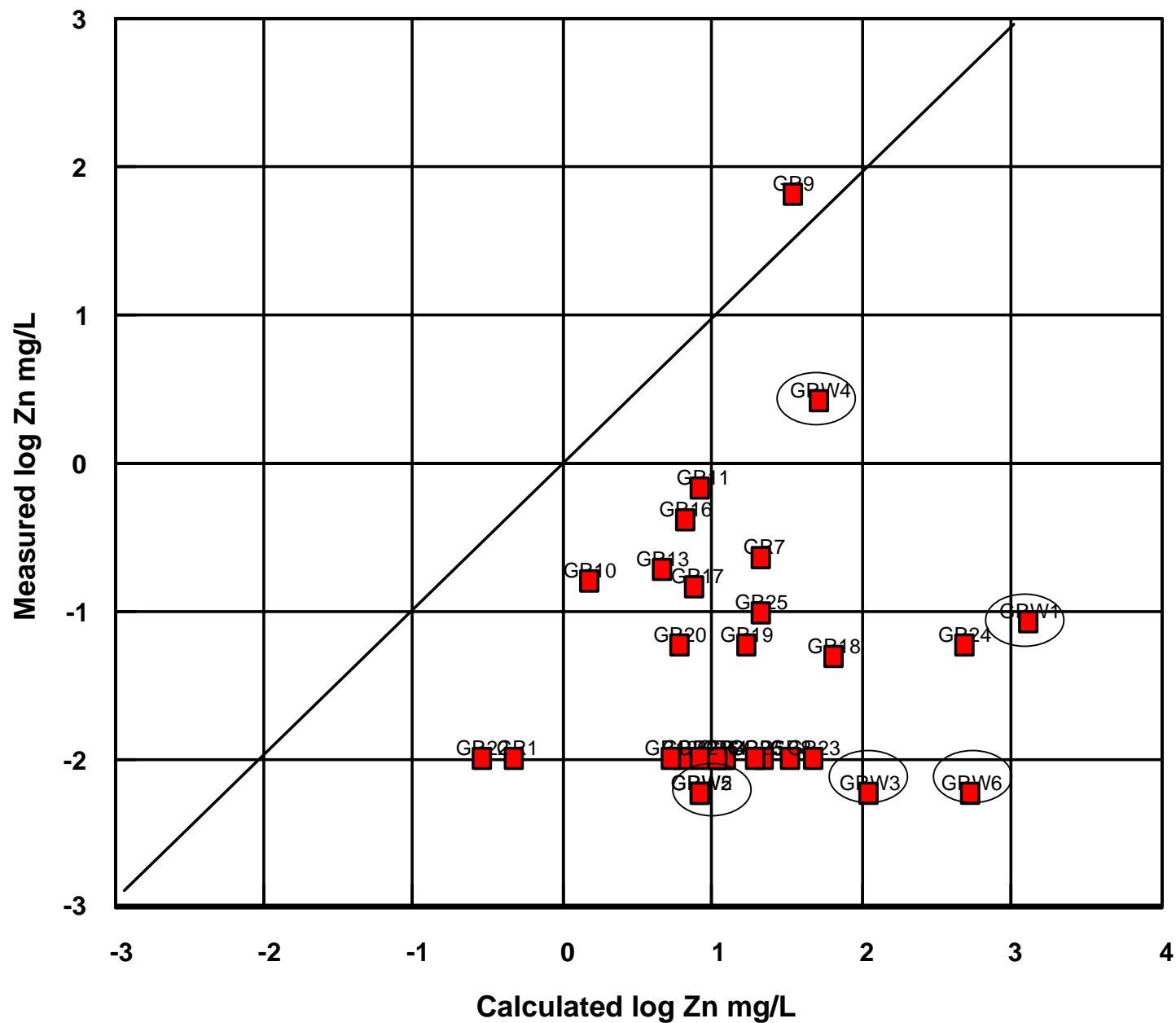
No groundwater from the diamond drilling contained sufficient lead to imply the presence of oxidised lead ore minerals.



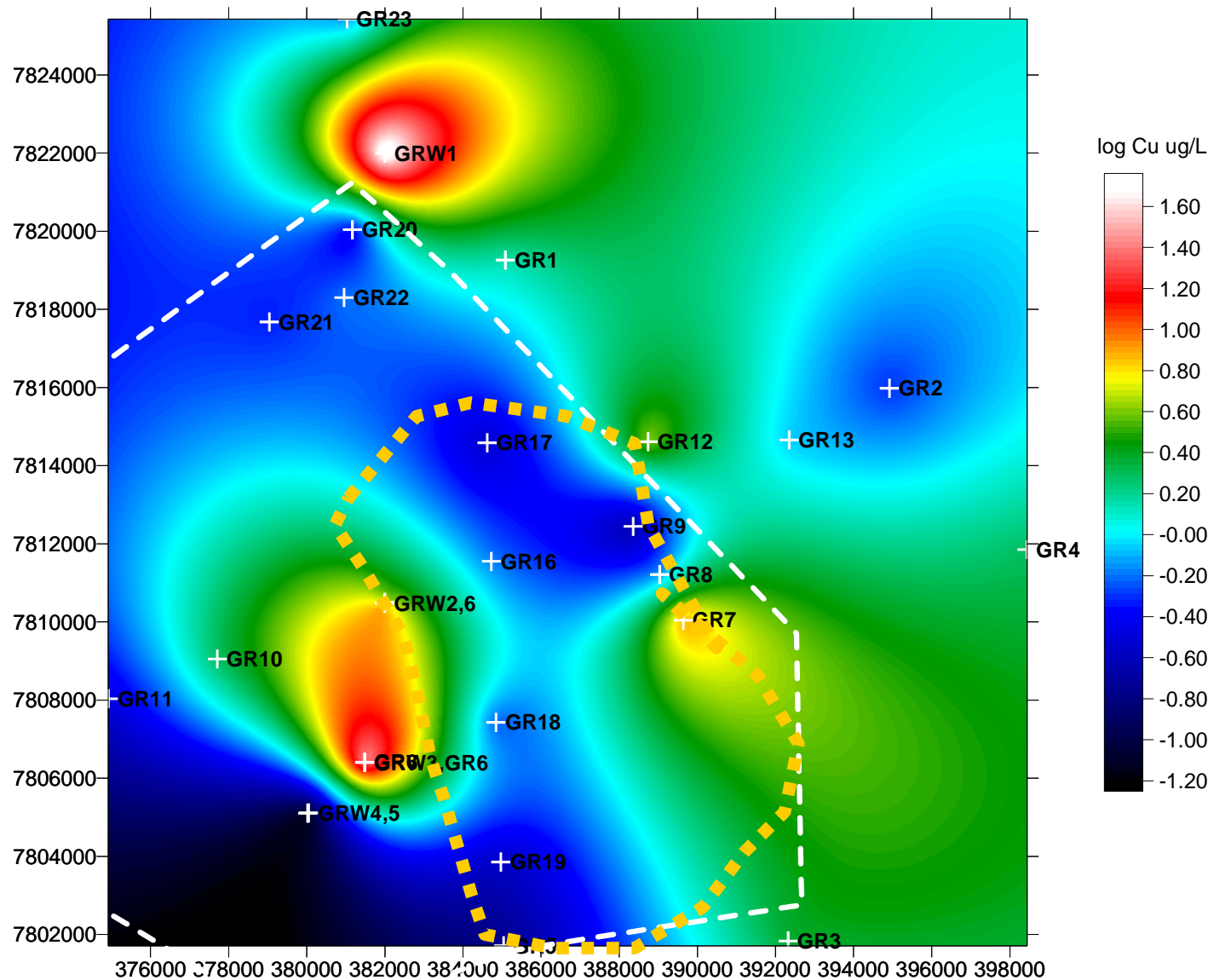
Groundwaters from diamond drill holes at GRW4 and GRW1 contained zinc at concentrations elevated above regional values established by the previous data.

Although only groundwater from GR9 contained zinc at a concentration indicative of oxidised zinc ore minerals, a degree of coincidence between sites where groundwaters have locally elevated zinc and the zone of anomalous gold (dashed gold line) is evident.

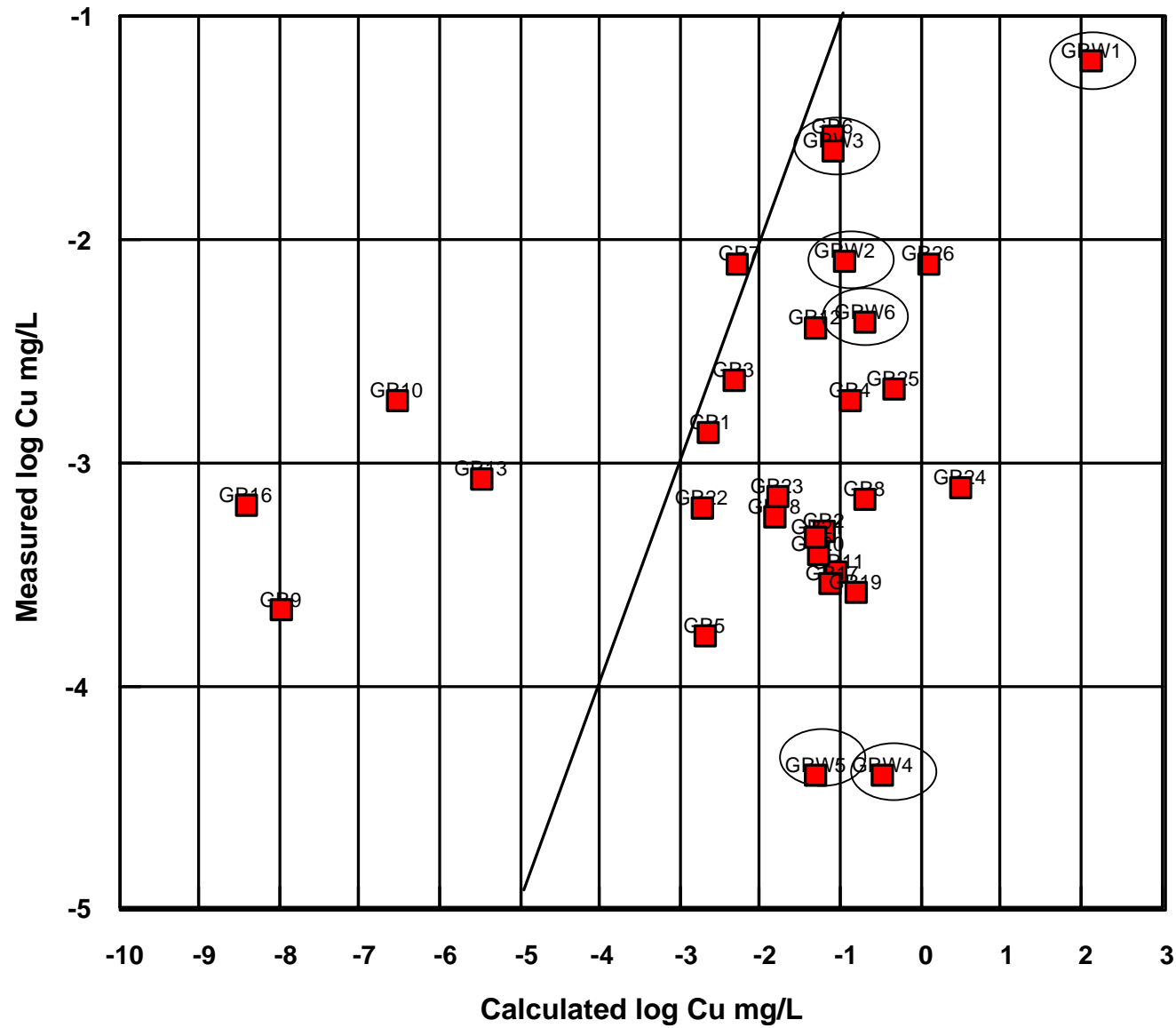




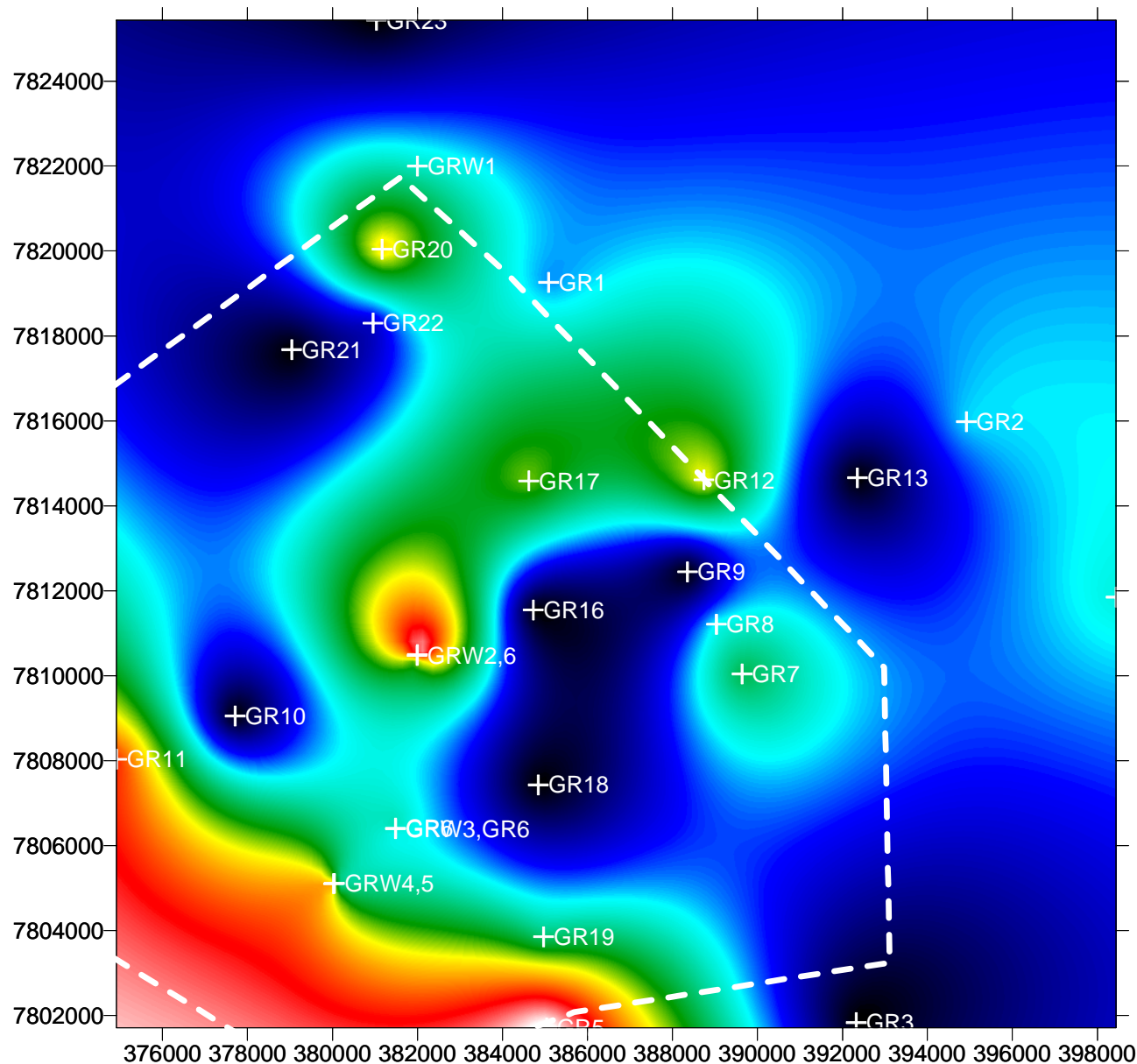
No groundwater from the diamond drilling contained sufficient zinc to imply the presence of oxidised zinc ore minerals.



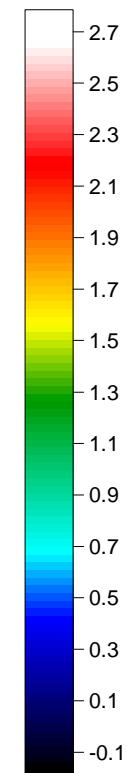
Copper values in groundwaters from diamond drill holes suggested the possibility of a copper source centered within the area bounded by GR10, GR6 and GRW2,6. Weight is added to this suggestion by the very modest value in GR10 being actually higher than that predicted if it were in contact with oxidised copper minerals. Groundwater from GRW1 also contained elevated copper. Only minor coincidence with the zone of anomalous gold (dashed gold line) is evident



No groundwater from the diamond drilling contained sufficient copper to imply the presence of oxidised copper ore minerals.



As ug/L



All groundwaters from diamond drill holes contained modest concentrations of arsenic that contributes to a regional pattern. However the values are too low to conclude their source to be significant quantities of nearby sulphide minerals. They might however be indicating deep sources

Silicate Mineral Stabilities

Indicated by compositions of
groundwaters in diamond drill
holes.

