HYDROGEOCHEMISTRY OF THE TUNKILLIA GOLD PROSPECT, SOUTH AUSTRALIA

David J. Gray and Mark C. Pirlo

CRC LEME OPEN FILE REPORT 194 / CSIRO EM REPORT P2005/326

ISBN 1 921039 31 0

August 2005

CRC LEME
CSIRO Division of Exploration and Mining
Australian Resources Research Centre
P.O. Box 1130 Bentley, Western Australia, Australia 6102

The Tunkillia (Central Gawler) Project is providing a new knowledge base and developing methodologies for improved mineral exploration in areas of regolith cover in the central Gawler Craton, SA. This integrated project has a multidisciplinary team with skills in regolith geology, geomorphology, bedrock geology, geochemistry, hydrogeochemistry and soil science, working to understand the processes and controls on element dispersion in a variable regolith terrain. This report is specifically on groundwater investigations in the Tunkillia area.

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Cataloguing-in-Publication:
Gray, David J and Pirlo, Mark C.
Hydrogeochemistry of the Tunkillia Gold Prospect, South Australia
ISBN 1 921039 31 0
1. Regolith – South Australia
2. Hydrogeochemistry – South Australia
3. Exploration Geochemistry – South Australia
I. Gray, David J and Pirlo, Mark C.
II. Hydrogeochemistry of the Tunkillia Gold Prospect, South Australia
CRC LEME Open File Report 194.
ISSN 1329-4768

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ABSTRACT

The hydrogeochemistry of the Tunkillia gold prospect in the Gawler Craton of South Australia has been examined as part of a broader regolith and airborne electromagnetic study. Ninety four groundwater samples were collected from exploration drill holes using a bailer system. Field measurements included pH, Eh, EC and temperature. Separate, field preserved sub-samples were collected for cation, anion and alkalinity analyses. A 1 L sub-sample sample, filtered to 0.1 µm, was also collected for determination of Au content. Gold determination was based on pre-concentration onto a 1 g sachet of activated carbon, followed by Neutron Activation Analysis.

The hydrogeochemistry at Tunkillia is generally found to be comparable to that in the Kalgoorlie and Eastern regions of the Yilgarn Craton, with groundwaters dominantly saline and neutral to moderately acid. Groundwater salinity tends to be close to, or slightly below, that of seawater. However, in contrast to Yilgarn groundwaters, Tunkillia groundwaters exhibit a fairly homogeneous salinity. Another characteristic of Tunkillia groundwaters is their relatively high dissolved concentrations of base metals (Mn, Cu, Zn), REE and Y when compared with groundwaters from the Yilgarn.

A Ca enrichment and correlating K depletion is observed in Tunkillia groundwaters, and this may reflect the hydrolysis of Ca feldspars. The dominant lithologies in the area are thought to be felsic, an interpretation supported by minor element compositions (Li, Al, Si, U) when pH effects have been taken into account.

The main mineralised zone (Area 223), exhibits lower groundwater Au concentrations than observed in a secondary mineralised zone (Area 191 North). This might suggest that kinetic barriers are affecting Au dissolution in some parts of the study area. Low groundwater flow rates (ponding) could explain the low variation in groundwater salinity. Furthermore, the mineralisation at various zones in the study area may include different assemblages of sulphide and/or accessory minerals, resulting in differing availability for groundwater dissolution. For example, the Area 191 North mineralisation zone exhibits a clear enrichment in the SO_4/Cl ratio, interpreted as representing SO_4 release via sulphide oxidation. Dissolved Te, V and the saturation indices of Fe oxide minerals all show correlations with mineralised zones.

Interpretation and use of hydrogeochemical data for exploration programs must consider the role that groundwater flow rates are playing on groundwater residence time and in turn the contact time with fresh or weathered rocks.

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1. INTRODUCTION

A primary justification for the use of hydrogeochemistry in mineral exploration is that groundwater anomalies may be broader and more regular than the mineralisation and secondary dispersion halo in the regolith, thus enhancing the geochemical footprint. In addition, areas of high chemical permeability and reactivity, such as faults and shear zones, may have distinct hydrogeochemical signatures even where they are unremarkable in terms of elemental abundances, and where a petrographic study is difficult. However, such effects may also be counter-productive, as interpretation may become complicated.

Hydrogeochemical studies also provide information on how various materials are weathering. Understanding of active dispersion processes is enhanced, assisting in the development of weathering and geochemical models, considered essential for effective exploration in regolith-dominated terrain. The scope of this investigation includes the effect of underlying lithology on the observed water chemistry, thermodynamic modelling, mapping of the data and comparison with results from Western Australian sites.

2. SITE CHARACTERISTICS

The Tunkillia gold deposit is part of the Lake Everard Gold Project, 700 km NW of Adelaide in the Gawler Craton (Anon, 2003). Helix Resources acquired the Project in 1996 to explore for gold in Mesoproterozoic geological settings in the Gawler Craton. The Tunkillia discovery was announced in late 1996, and the 20 km^2 gold-in-calcrete anomaly remains the largest in the region.

Tunkillia is located within the central part of the Gawler Craton along the western margin of the Gawler Range Volcanic Province (Figure 1). Basement rocks within the Lake Everard tenement rarely outcrop; they have been intensely weathered and are overlain by a thin veneer of sediments (Anon, 2003). The main resource is located in Area 223 (Figure 2) within the western demagnetised zone, with Area 191 in the eastern demagnetised zone also identified as a prospective site (Anon, 2003). Mineralisation at Area 223 comprises a broad, flat lying supergene blanket at 50 metres depth overlying a series of up to six steeply dipping primary ore shoots trending sub-parallel to the regional shear trend (Figure 3). Mineralisation is contained within three main zones along strike for 1.6 kilometres, but has only been drilled in detail over the central 400-metre zone (Anon, 2003). Recent resource estimation indicates Area 223 to contain 10.5 Mt at 2.2 g/t Au (1.0 g/t cut-off) and 5.6 g/t Ag, for approximately 730,000 oz Au and 1,900,000 oz Ag (Anon, 2004).

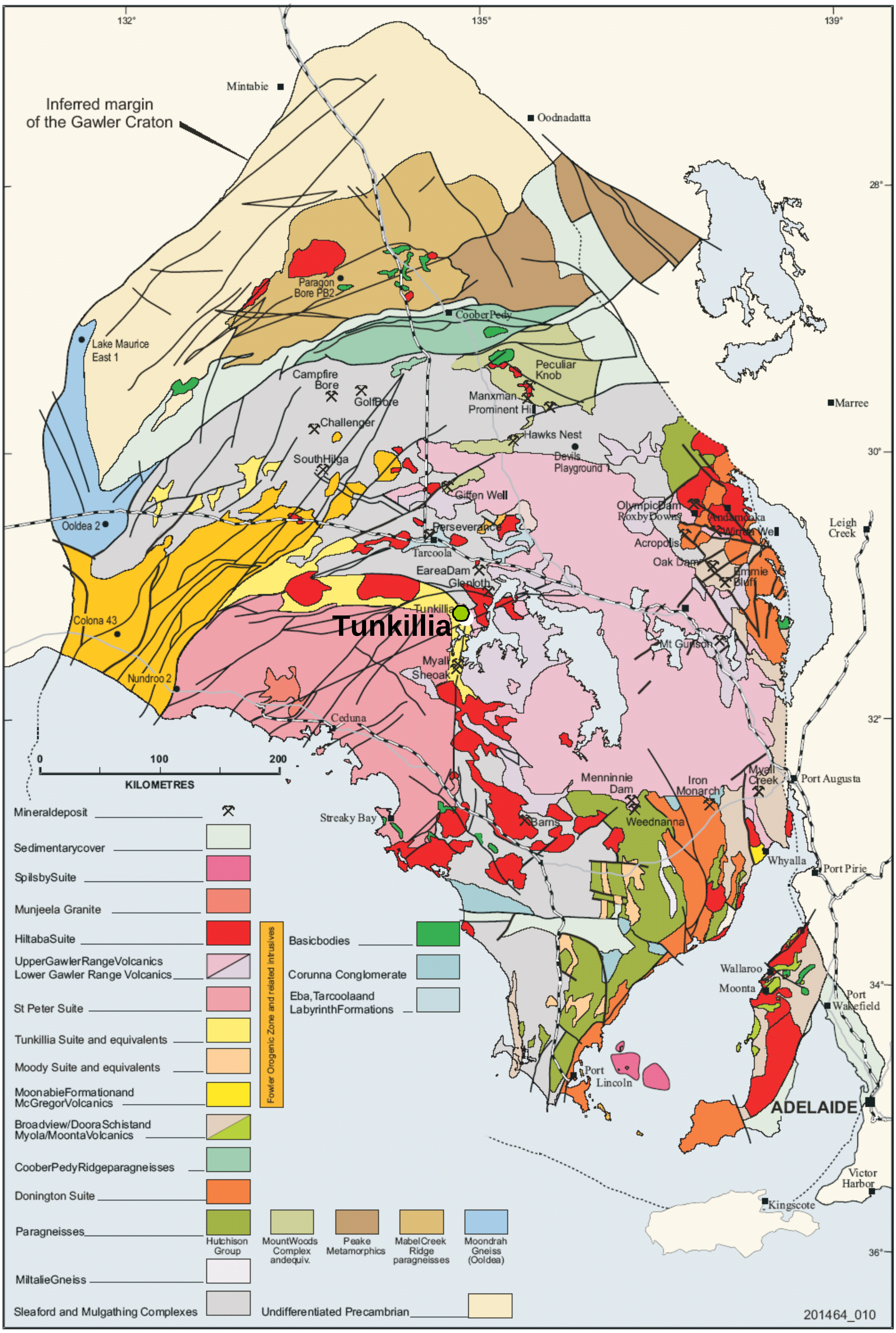

Figure 1: Geology of the Gawler Craton (courtesy PIRSA) with position of Tunkillia shown.

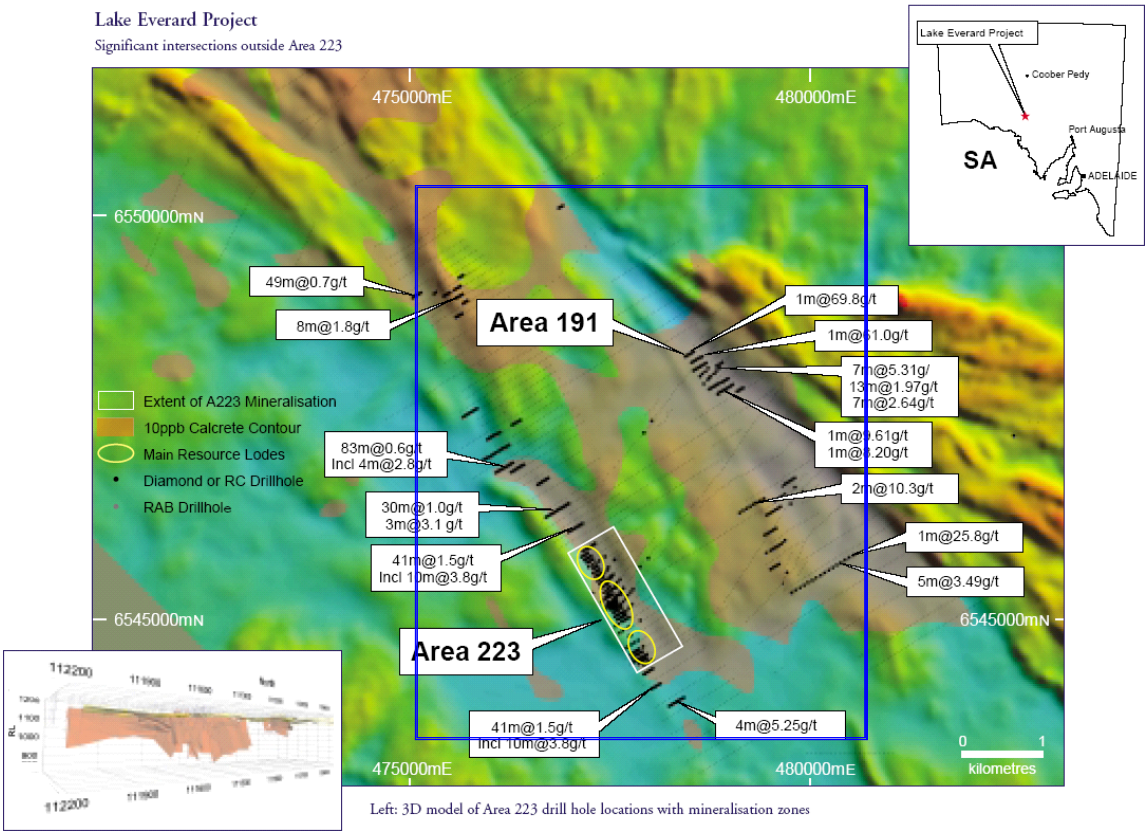

Figure 2: Drilling, calcrete Au and mineralisation for Area 223 (from Anon, 2003). The blue box represents the hydrogeochemical sampling area (Figure 4).

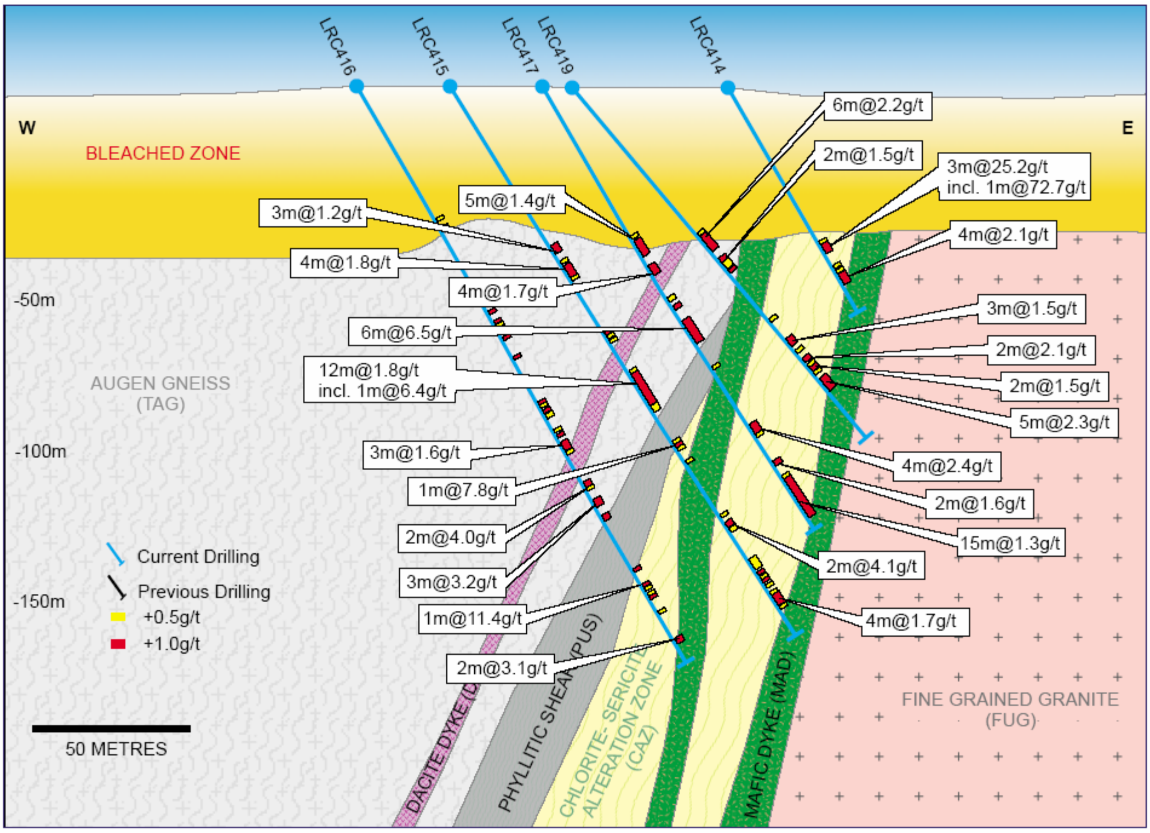

Figure 3: Cross section 111350mN, Area 223 (from Anon, 2003).

3. SAMPLING AND ANALYSIS

Groundwater sampling was conducted as part of a large Fieldwork Program (Worrall, 2003) conducted between the 4th and 22nd of May 2003. Drill holes were relocated and reopened by Helix Resources, and probed for groundwater by CSIRO staff. If groundwater was present and the holes not contaminated with diesel or other petroleum products such as drillers grease, the depth to water was recorded and water samples collected by bailer, and classified by the sampling area (Figure 4). Water samples were collected from 94 holes (Worrall, 2003), usually several metres below the water surface. Samples were analysed for pH and oxidation potential (Eh) on-site, with an aliquot collected for HCO_3^- analysis by alkalinity titration. About 1.5 L of water was filtered through a 0.1 µm membrane filter; about 200 mL then acidified [0.1 mL 15 moles/litre (M) nitric acid (HNO_3)], and analysed for:

(i) Al, B, Ba, Be, Ca, Cr, Cu, Fe, K, Li, Mg, Mn, Na, P, SO_4 (measured as S), Si, Sr, Ti, V and Zn by Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP-AES) at CSIRO Laboratories, Sydney;
(ii) Bi, Cd, Ce, Co, Cs, Dy, Eu, Er, Ga, Gd, Ge, Ho, In, La, Lu, Mo, Nd, Ni, Pb, Pr, Rb, Sb, Sm, Tb, Te, Th, Tl, Tm, U, Y and Yb by Inductively Coupled Plasma - Mass Spectroscopy (ICP-MS) at CSIRO Laboratories, Sydney.

Chloride, bromide, sulphate, nitrate, phosphate and iodide were analysed on an un-acidified, filtered sub-sample by suppressed ion chromatography on a Metrohm modular IC using an acid re-generated suppressor, MetroSep A Supp5 column, a carbonate/bicarbonate eluent (32 mM Na_2CO_3 and 10 mM $NaHCO_3$) and a conductivity detector.

A 1 L sub-sample of the filtered water was acidified with 1 mL 15 M HNO_3 and a 1 g sachet of activated carbon plus 30 g sodium chloride added. The bottle was rolled for eight days in the laboratory and the water discarded. The carbon was then analysed for Au by Instrumental Neutron Activation Analysis (INAA) at Becquerel Laboratories, Lucas Heights. The method has been previously tested by shaking Au standards of varying concentrations, and in varying salinities, with activated carbon (Gray, unpublished data).

Equilibrium activity diagrams were derived using The Geochemist's Workbench (GWB; Bethke, 1996). The solution species and degree of mineral saturation were computed from the solution compositions using the program PHREEQE (Parkhurst *et al*., 1980; described in detail in Gray, 1990 and Gray, 1991), which determines the chemical speciation of many of the major and trace elements. To obtain highly accurate speciation data on a limited suite of the major elements (Na, K, Mg, Ca, Cl, HCO_3, SO_4, Sr and Ba), the specific ion interaction model known as the Pitzer equations was applied, using the program PHRQPITZ (Plummer and Parkhurst, 1990). These programs calculate the saturation indices (SI) for each water sample for various minerals. If the SI for a mineral equals zero (empirically from -0.2 to 0.2 for the major element minerals, and -1 to 1 for the minor element minerals), the water is in equilibrium with that mineral, under the conditions specified. Where the SI is less than zero, the solution is under-saturated with respect to that mineral, so that, if present, the phase may dissolve. If the SI is greater than zero the solution is over-saturated with respect to this mineral, which can potentially precipitate from solution. Note that this analysis only specifies possible reactions, as kinetic constraints may rule out reactions that are thermodynamically allowed. Thus, for example, waters are commonly in equilibrium with calcite, but may become over-saturated with respect to dolomite, due to the slow rate of solution equilibration and precipitation of this mineral (Drever, 1982).

The determinations are important in understanding solution processes at a site. They have particular value in determining whether the spatial distribution of an element is correlated with geological phenomena such as lithology or mineralisation, or whether they are related to weathering or environmental effects. Thus, if Ca distribution is controlled by equilibrium with gypsum in all samples, then the spatial distribution of dissolved Ca will reflect SO_4 concentration alone and have no direct exploration significance.

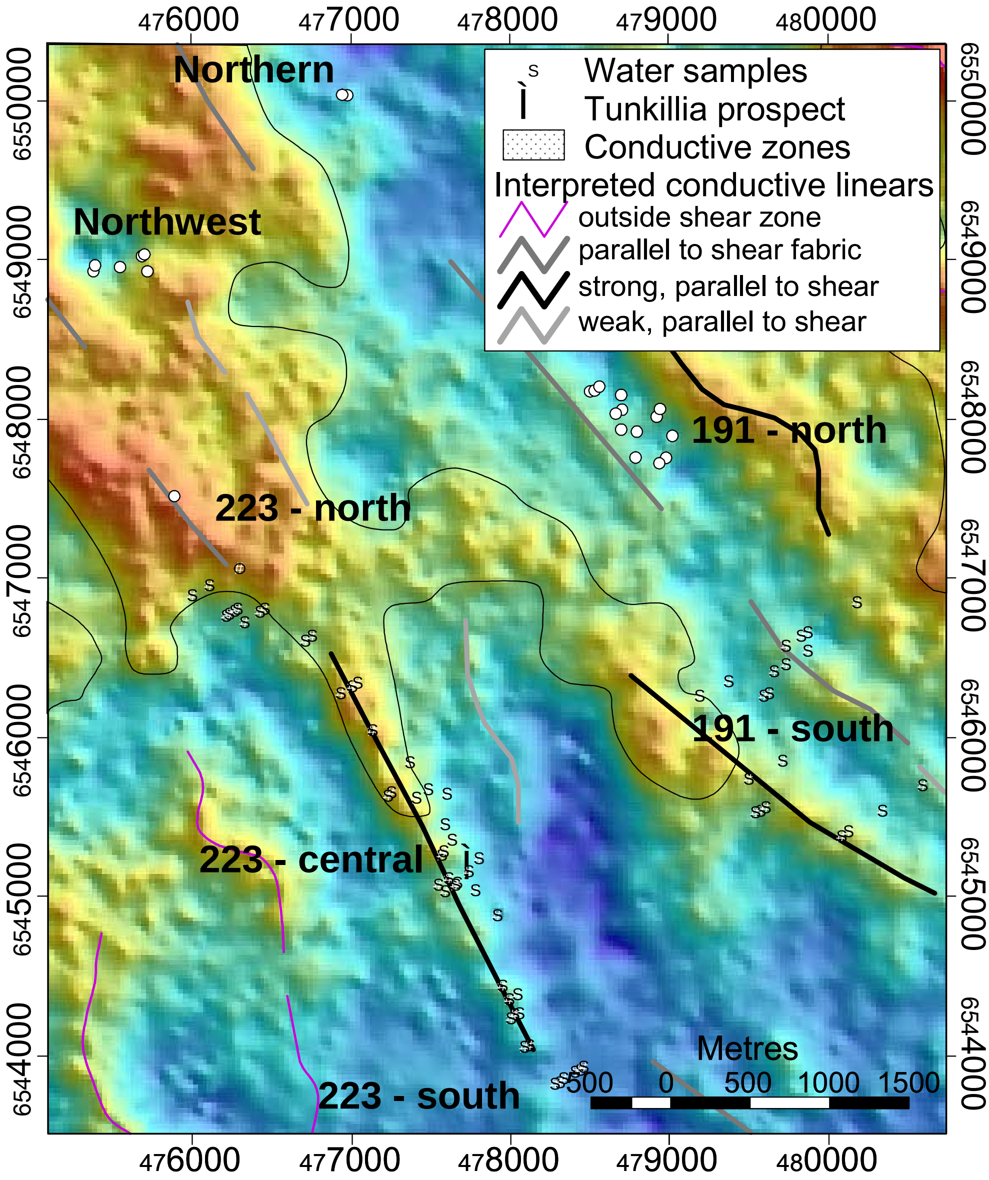

Figure 4: Location of water samples, overlain on conductance map (Lane and Worrall, 2002)

4. RESULTS

4.1 Compilation of results and comparison with other sites

Median concentrations of various ions at Tunkillia and at selected sites from Western Australia are given in Table 1 (Appendix 1), with comparative plots versus TDS, pH or Eh in Appendix 2, Figures A2.1-2.44. The sea water data (Weast, 1983) are used to derive the line of possible values if sea water were diluted with freshwater or concentrated by evaporation (denoted as the sea water line) in TDS plots. The sea water concentration is also shown in the pH plots. Where the line is not observed, this is because the concentration in sea water is very low, relative to the concentration of the element in groundwaters, and the line effectively lies on the x-axis. The results from Tunkillia can be compared with those from areas in WA, which are grouped as follows (Gray, 2001):

(i) *Northern groundwaters* (N Yilgarn and margins) -
Groundwaters are fresh and neutral, trending more saline in the valley floors.

(ii) *Central groundwaters* (close to and north of the Menzies line) -
Neutral and brackish (commonly < 1% TDS) to saline (about 3% TDS), trending to hypersaline (10 - 30% TDS) at the salt lakes, with common increases in salinity with depth.

(iii) *Kalgoorlie groundwaters* -
Commonly acid (pH 3 - 5), except where buffered by ultramafic rocks, and saline within the top part of the groundwater mass, trending to more neutral (pH 5 - 7) and hypersaline at depth and when within a few kilometres of various salt lakes in the region.

(iv) *Eastern groundwaters* (SE Yilgarn and margins) -
Saline to hypersaline and neutral to acid. The major ion chemistry is similar to that of the Kalgoorlie region, but the dissolved concentration of many other ions may be low, due to the common presence of lignites in the channel sediments

(v) *East Alford* (SE Gawler) -
Saline and neutral to moderately acid. Similar to Kalgoorlie and Eastern regions of the Yilgarn Craton, but the dissolved base metal concentration is commonly high, consistent with ubiquitous Cu / Zn mineralization in the Moonta and Walleroo areas.

Saturation index (SI; Section 3) values for varying minerals are plotted in Appendix 3, Figures A3.1 – A3.36. The equilibrium point is shown as the line at SI = 0. The two horizontal lines parallel to zero denotes the zone in which waters may be in equilibrium with that mineral. Note that where a mineral has a very broad zone, this indicates significant uncertainty in the thermodynamic data for this mineral or calculation problems - *i.e.*, samples within that zone are not necessarily at equilibrium, though samples above or below the zone are out of equilibrium.

4.2 Salinity effects and major element hydrogeochemistry

Most Tunkillia groundwaters have salinities (Figure 5) close to or slightly below sea water (salinity of 3.5%) and Na (Figure 5), Mg, Cl and SO_4 are correlated with total salinity and are close to the sea water dilution/evaporation line. With the exception of a few fresher samples (possibly representing fresher water from rainfall or perched aquifers), the variation in salinity is low relative to other sites (Figure 6). However, unlike other sites, there is a marked enrichment in Ca (Figure 7), which correlates with K depletion (Figure 8). This Ca enrichment / K depletion shows a weak trend with pH (being greater at higher pH), indicating that the common reason for K depletion in the southern Yilgarn, alunite precipitation in acid Al-rich waters (Gray, 2000) is unlikely to be the cause here. One possible cause is the hydrolysis of Ca feldspars to secondary clay minerals:

$$\underset{\text{(Anorthite)}}{4CaAl_2Si_2O_8} + \underset{\text{(Quartz)}}{2SiO_2} + 1\tfrac{1}{2}H_2O + 7H^+ + K^+ \rightarrow \underset{\text{(Illite)}}{2K_{0.5}Al_{2.5}Si_{3.5}O_{10}(OH)_2} + \underset{\text{(Kaolinite)}}{1\tfrac{1}{2}Al_2Si_2O_5(OH)_4} + 4Ca^{2+}$$

Table 1: Median compositions of Tunkillia and W.A. groundwaters.

	Tunkillia	Kalgoorlie	Eastern	Central	Northern	Sea water
pH	5.7 ± 1.1	5.6 ± 1.3	6.4 ± 1.1	6.9 ± 0.6	7.3 ± 0.3	-
Eh (mV)	436 ± 147	398 ± 152	288 ± 183	290 ± 94	303 ± 64	-
HCO_3	32 ± 84	36 ± 140	45 ± 181	170 ± 191	108 ± 44	142
TDS (%)	3.0 ± 0.5	5.6 ± 3.5	10.6 ± 10.5	2.0 ± 3.1	0.1 ± 0.5	3.5
Na*	0.312 ± 0.013	0.312±0.014	0.304±0.014	0.328±0.024	0.209±0.082	0.307
Mg*	0.030 ± 0.004	0.037±0.008	0.041±0.010	0.029±0.008	0.059±0.019	0.037
Ca*	0.027 ± 0.007	0.007±0.004	0.005±0.010	0.009±0.011	0.087±0.034	0.012
K*	0.009 ± 0.002	0.003±0.005	0.004±0.003	0.010±0.003	0.024±0.012	0.011
Cl*	0.525 ± 0.011	0.568±0.033	0.558±0.027	0.524±0.042	0.314±0.134	0.552
SO_4*	0.091 ± 0.008	0.070±0.023	0.085±0.027	0.083±0.032	0.168±0.052	0.077
Sr	3.2 ± 3.2	6.1 ± 4.8	8.2 ± 3.3	2.8 ± 2.8	0.4 ± 0.7	7.9
Br	52 ± 9	49 ± 26	23 ± 39	16 ± 26	1.1 ± 2.4	67
I	0.0 ± 1.1	2.9 ± 2.5	0.1 ± 3.6	5.1 ± 4.2	0.4 ± 0.6	0.06
F	3 ± 5	1.6 ± 2.2	nd	nd	nd	1.3
B	6.5 ± 1.3	6.9 ± 2.3	3.3 ± 1.4	4.3 ± 0.7	0.8 ± 0.5	4.44
Li	0.54 ± 0.18	0.17 ± 0.42	0.51 ± 0.21	0.00 ± 0.08	0.00 ± 0.02	0.18
Rb	0.067 ± 0.032	0.047±0.027	0.037±0.020	0.051±0.013	0.013±0.011	0.12
Cs	0.004 ± 0.008	0.004±0.013	0.001±0.004	0.001±0.003	0.000±0.001	0.0003
Ba	0.003 ± 0.024	0.028±0.039	0.032±0.029	0.020±0.093	0.038±0.032	0.013
Be	0.004 ± 0.034	0.001±0.005	0.003±0.884	0.003±0.000	0.001±0.000	0.000
Al	0.4 ± 31.4	0 ± 27	0 ± 20	0.0 ± 1.5	0.003 ± 0.021	0.002
Si	15 ± 13	18 ± 14	4 ± 10	27 ± 11	26 ± 10	2.2
V	<0.005	<0.005	<0.005	<0.005	0.008±0.010	<0.005
Mn	6.5 ± 6.0	2 ± 6	2 ± 3	0.1 ± 2.3	0.0 ± 0.4	0.0002
Fe	0.2 ± 2.7	0.2 ± 3.4	0.2 ± 31.0	0.0 ± 6.9	0.01 ± 0.08	0.002
Cr	0.003 ± 0.002	0.003±0.060	0.001±0.010	0.003±0.007	0.009±0.045	0.0003
Co	0.04 ± 0.09	0.10 ± 0.21	0.01 ± 0.04	0.00 ± 0.03	0.00 ± 0.04	0.00002
Ni	0.05 ± 0.08	0.14 ± 0.27	0.02 ± 0.11	0.00 ± 0.04	0.002 ± 0.008	0.0006
Cu	0.03 ± 0.13	0.04 ± 0.12	0.02 ± 0.18	0.00 ± 0.03	0.003 ± 0.002	0.0003
Zn	0.24 ± 0.48	0.05 ± 3.37	0.08 ± 0.16	0.00 ± 0.10	0.005 ± 0.010	0.005
Ga	0.001 ± 0.002	0.001±0.011	0.000±0.004	0.003±0.001	0.001±0.001	0.00003
Ge	0.001 ± 0.004	0.023±0.029	0.018±0.013	0.003±0.001	0.000±0.001	0.00005
Y	0.06 ± 0.28	0.008±0.173	0.001±0.058	0.0005±0.0002	0.0001±0.0003	0.00001
La	0.01 ± 0.08	0.003±0.252	0.001±0.080	0.0005±0.0008	0.0001±0.0002	0.000003
Ce	0.03 ± 0.22	0.006±0.477	0.001±0.137	0.0005±0.0003	0.0001±0.0002	0.000001
Mo	0.002 ± 0.015	0.005±0.007	0.001±0.003	0.009±0.020	0.003±0.031	0.01
Cd	0.002 ± 0.004	0.0025±0.0041	0.0010±0.0012	0.0010±0.0021	0.0005±0.0003	0.0001
Sb	0.0002 ± 0.0002	0.0005±0.0010	0.0005±0.0015	0.0005±0.0500	0.0001±0.0005	0.0002
Tl	0.0002 ± 0.0003	0.0014±0.0016	0.0007±0.0003	0.0005±0.0078	0.0001±0.0008	0.00002
Pb	0.005 ± 0.046	0.022±0.228	0.026±0.584	0.001±0.166	0.0005±0.0012	0.00003
Bi	0.0001 ± 0.0001	0.0005±0.0004	0.0003±0.0004	0.0005±0.0063	0.0001±0.0002	0.00002
Th	0.0001 ± 0.0008	0.0005±0.0004	0.0003±0.0004	0.0005±0.0006	0.0001±0.0002	0.000001
U	0.024 ± 0.036	0.0034±0.0528	0.0011±0.0107	0.0018±0.0023	0.0006±0.0089	0.0032
Au (ppb)	0.012 ± 0.308	0.040 ± 0.492	0.003 ± 0.047	0.030 ± 0.186	0.004 ± 4.724	0.004

± standard deviation; * ratio to total salinity; nd: not determined;

All parameters in mg/L unless otherwise noted

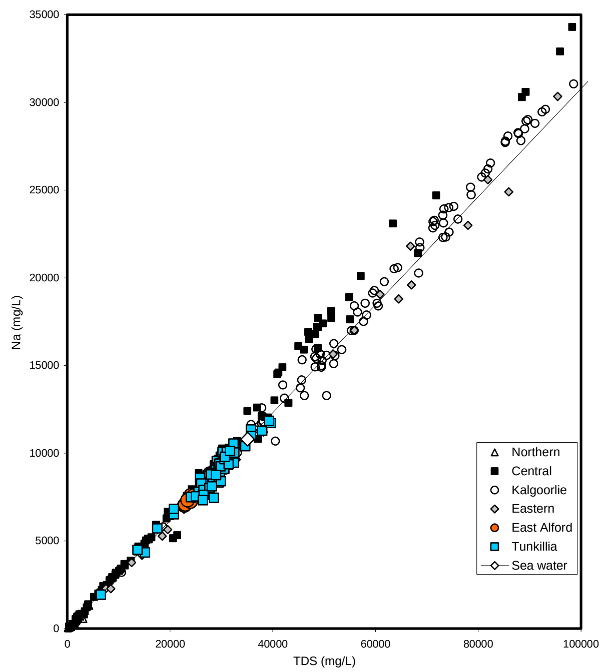

Figure 5: Dissolved Na vs TDS for groundwaters from Tunkillia and other sites.

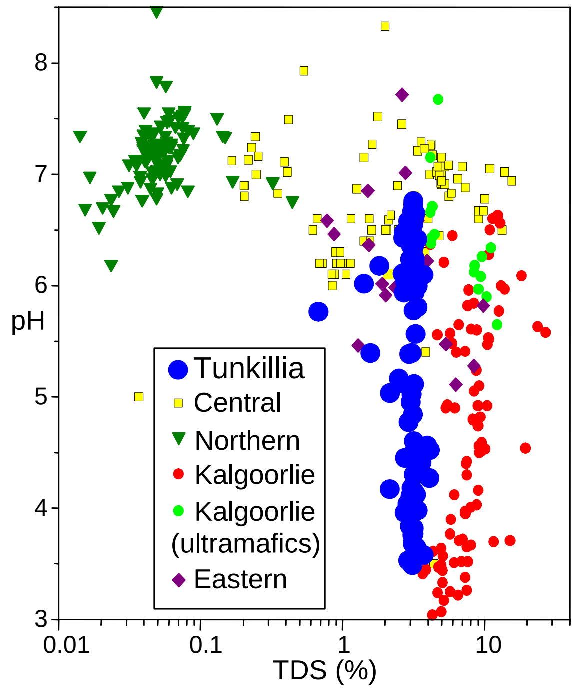

Figure 6: pH vs TDS for groundwaters from Tunkillia and other sites.

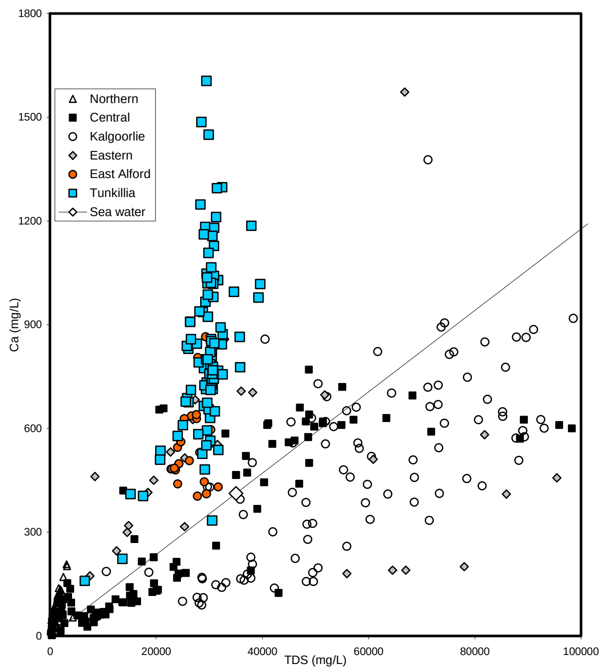

Figure 7: Dissolved Ca vs TDS for groundwaters from Tunkillia and other sites.

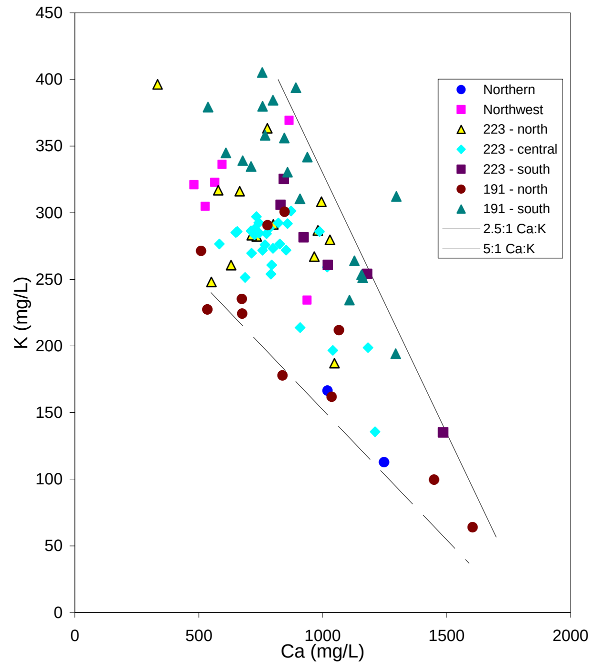

Figure 8: Dissolved K vs Ca at Tunkillia, differentiated by area (Figure 4). The four lowest and three highest salinity waters are removed for clarity.

4.3 Acidity and oxidation potential

An Eh-pH plot of Tunkillia groundwaters differentiated by area (Figure 4) is shown in Figure 9. Most Tunkillia groundwaters appear to be controlled by similar Eh/pH couples as other South and Western

Australian groundwaters (Gray, 2001). Some of these waters have been plotted in Figure 10 for reference. Those groundwaters within the "Fe" domain (Figure 9) generally have moderate to high concentrations of Fe, with soluble Fe possibly originating from the dissolution of Fe-containing minerals such as pyrite:

$$\underset{\text{(pyrite)}}{2FeS_2} + 7O_2 + 2H_2O \rightleftharpoons 2Fe^{2+} + 4SO_4^{2-} + 4H^+$$

The released acidity may well be involved in other weathering (such as feldspar dissolution; Section 4.2), leading to buffering at neutral pH. Closer to the surface, this Fe^{2+} may oxidise:

$$2Fe^{2+} + \tfrac{1}{2}O_2 + 5H_2O \rightleftharpoons \underset{\text{(ferrihydrite)}}{2Fe(OH)_3} + 4H^+$$

The resultant proton release may cause greater pH reduction, due to the lack of buffering minerals. This could result in higher Eh, lower pH groundwaters within this Fe controlled domain.

As pH is reduced, a limit is reached whereby pH is maintained above 3, by dissolution of aluminosilicates such as kaolinite, with dissolution of Al (the "Al" domain in Figure 9). The "HO" group represents near neutral groundwaters with low Fe concentrations and weak control of Eh. This group of waters has lower activity than other groundwaters, and commonly has lower trace element concentrations (Gray, 2001). These various controls result in a bimodal pH distribution (Figure 11), with 31% of groundwaters between pH 3.5 and 4.5 and 32% between pH 6 and 6.5.

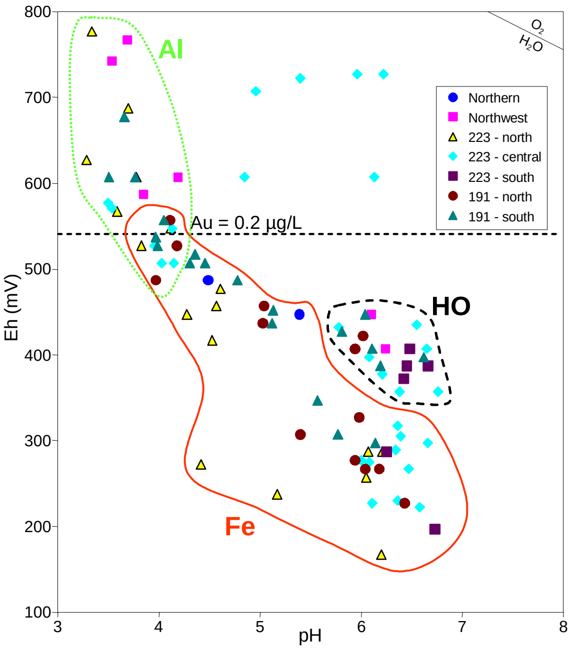

Figure 9: Eh vs pH for Tunkillia groundwaters, differentiated by area (Figure 4). The dashed line is the lower Eh limit at which Au has a solubility of 0.2 µg/L relative to Au metal. Eh/pH controls are discussed in the text.

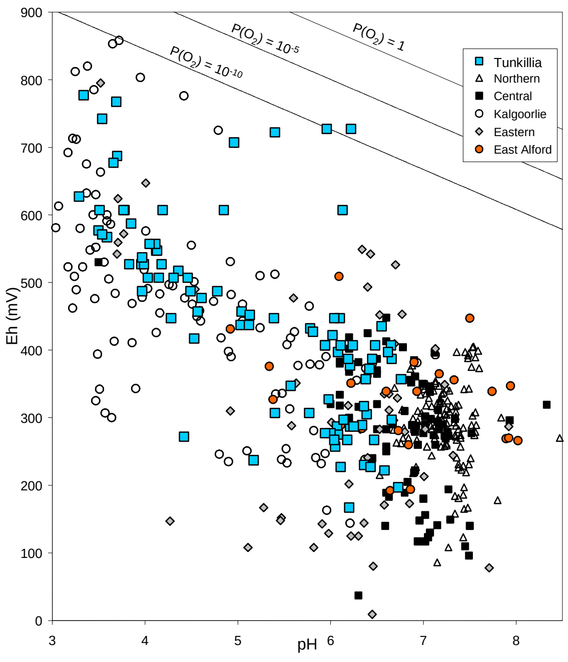

Figure 10: Eh vs pH for Tunkillia and other South and Western Australian groundwaters. In addition to the usual water stability line [$P(O_2)$=1], the lines for O_2 pressures of 10^{-5} and 10^{-10} atm are also shown.

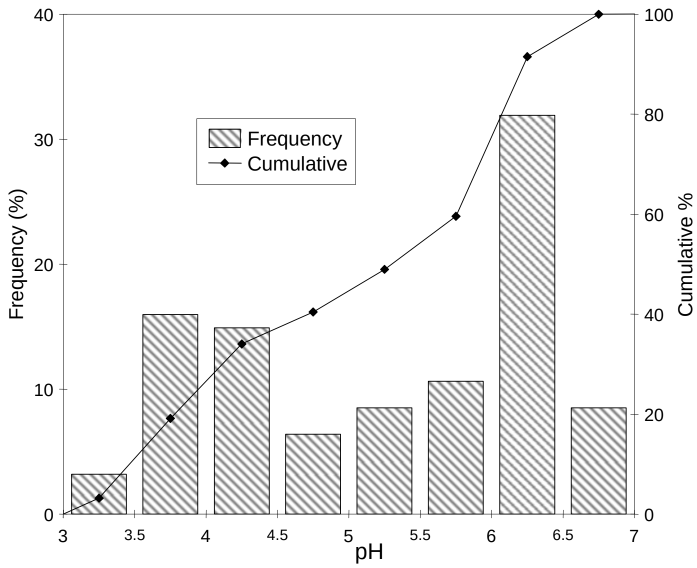

Figure 11: Distribution of groundwaters pH values, Tunkillia.

In contrast to these previously identified Eh/pH groupings (Gray, 2001), some of the groundwaters in the mineralised zone at Area 223 (*i.e.*, 223 central in Figure 9) appear to be different from other Tunkillia (and indeed other Western and South Australian; Figure 10) groundwaters. The high Eh even at neutral pH indicates a higher O_2 fugacity than usual, which has consequences for Au mobility.

Major elements such as Al and Si are strongly effected by pH (Figure 12 and Figure 13), indicating enhanced dissolution of feldspars or other Al and Si containing minerals under acid conditions. At pH values below 4, Tunkillia groundwaters are at kaolinite and amorphous silica saturation (Figure 14). This is consistent with either kaolinite itself being attacked under these very acid conditions, or being precipitated where other more soluble alumino-silicates are present. Amorphous silica acts as the sink for any excess released Si. Conversely, in near neutral conditions the high dissolved K and moderate Si means that feldspars are stable relative to kaolinite (Figure 15). Thus, in present day conditions feldspars are stable in the water saturated regolith where pH remains above 5.

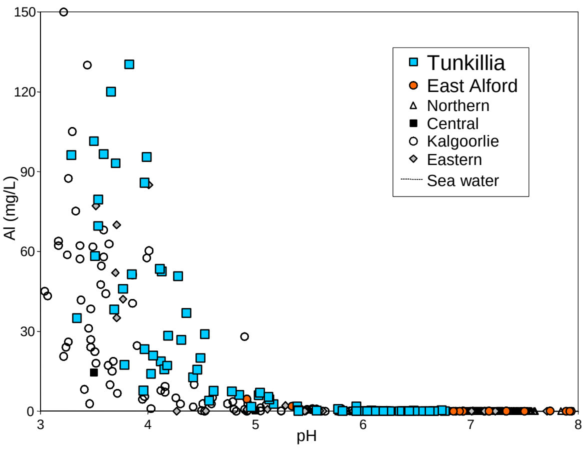

Figure 12: Dissolved Al vs. pH for groundwaters from Tunkillia and other sites.

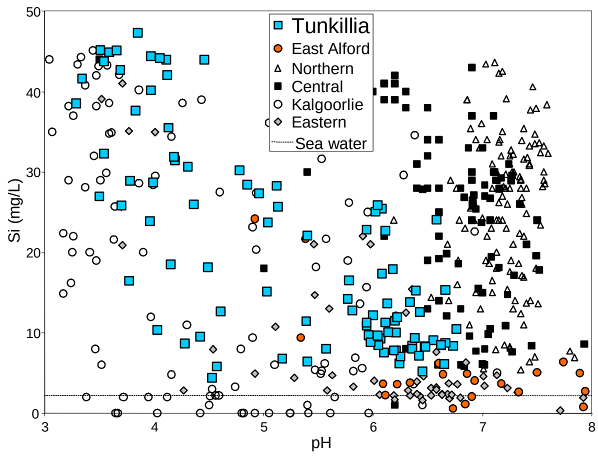

Figure 13: Dissolved Si vs. pH for groundwaters from Tunkillia and other sites.

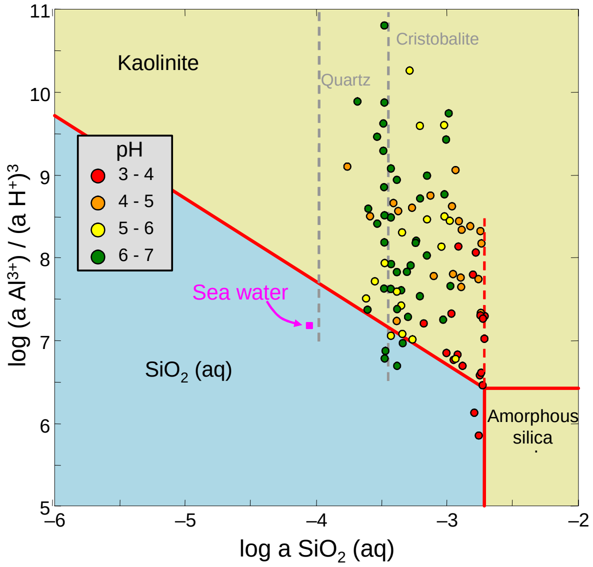

Figure 14: Tunkillia groundwater activity data (from PHREEQE), colour-coded by pH, overlain on a Al-Si-H_2O equilibrium activity diagram (GWB; 25°C / 1 atm). All SiO_2 phases except amorphous silica suppressed.

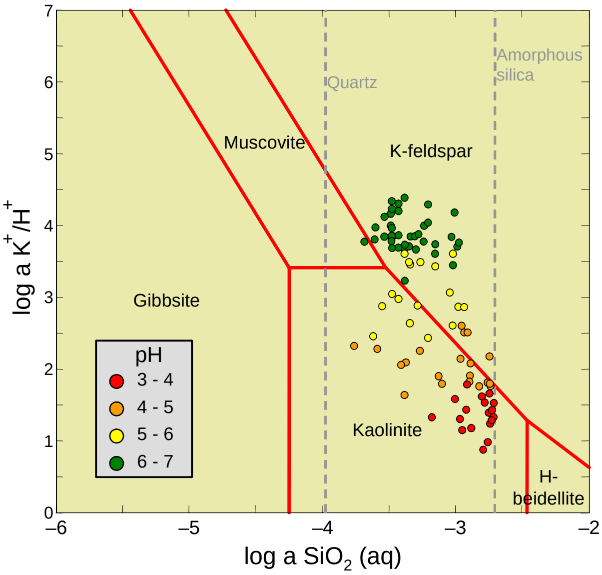

Figure 15: Tunkillia groundwater activity data (from PHREEQE), colour-coded by pH, overlain on a K-Al-Si-H_2O equilibrium activity diagram (GWB; 25°C / 1 atm). Pyrophyllite suppressed.

4.4 Gold chemistry

The relatively high salinity of the Tunkillia groundwaters means that the dominant mechanism for the mobilization of Au in the southern Yilgarn, namely as the chloride complex ($AuCl_2^-$) is expected to be significant for those groundwaters that are both acid and oxidising:

$$2Au_{(S)} + 4Cl^- + ½O_2 + 2H^+ \rightleftharpoons 2AuCl_2^- + H_2O$$

Thermodynamically, the neutral and oxidising groundwaters in the main mineralised zone at Area 223 should also be effective at dissolving Au. However, these groundwaters have surprisingly low Au concentrations (Figure 16), suggesting kinetic barriers to Au dissolution. Highest Au solubilities (up to 2.5 µg/L) were observed for the 191 north area (Figure 4), with only moderate Eh (Figure 16). These Au-rich groundwaters also had observable dissolved Fe (Figure 17), despite the fact that dissolved Fe will reduce $AuCl_2^-$ at these Eh levels:

$$AuCl_2^- + Fe^{2+} + 3H_2O \rightleftharpoons Au_{(S)} + Fe(OH)_3 + 2Cl^- + 3H^+$$

Possible Au complexes that would not be reduced by Fe are with thiosulfate [$Au(S_2O_3)_2^{3-}$], although this is unlikely to be stable at the pH values of these Au-rich groundwaters (pH < 4.2). The iodide complex (AuI_2^-), would be expected to be stable, although there is little evidence for high I concentrations in Area 191. Further research would be required to determine the form of the dissolved Au in these groundwaters.

Although not fully understood, the differing properties of these groundwaters appear to cause a subdued dissolved Au response around mineralisation in Area 223 and enhanced dissolved Au in Area 191.

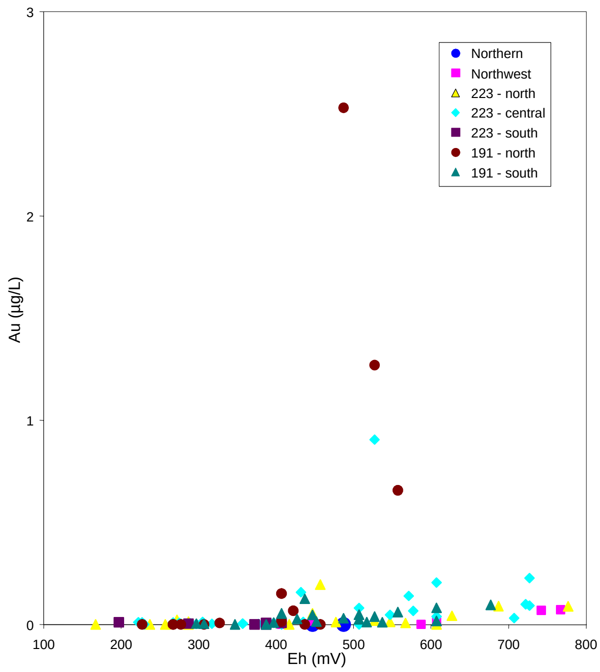

Figure 16: Dissolved Au vs Eh at Tunkillia, differentiated by area (Figure 4).

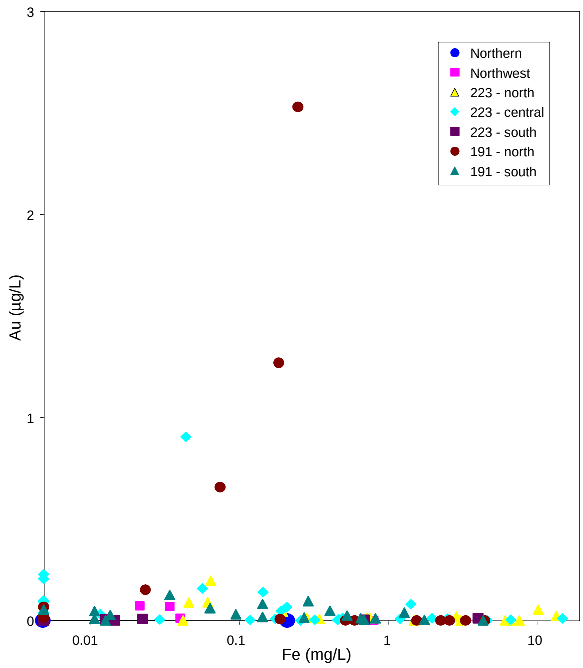

Figure 17: Dissolved Au vs Fe at Tunkillia, differentiated by area (Figure 4).

4.5 Minor element hydrogeochemistry

The concentrations of the minor elements (Table 1; Figure 18 - Figure 26) show some similarities to Kalgoorlie groundwaters, as expected for an acid/saline environment (Gray, 2001). In particular, base metals (Figure 19 - Figure 21) have higher dissolved concentrations than the neutral central and northern groundwaters. This effect is also strong for the REE (Figure 24 - Figure 26), particularly for heavy REE and Y (not plotted), indicating higher relative dissolution of heavy REE at Tunkillia. In contrast, anionic chalcophile elements such as Sb (Figure 23) have low concentrations, although Mo does have some very high dissolved concentrations (Figure 22). Comparison with other sites is enhanced by calculating median concentrations at half pH intervals (*e.g.*, Figure 27). On the basis of these comparisons (Table 2), groundwaters at Tunkillia appear to dominantly represent felsic lithologies.

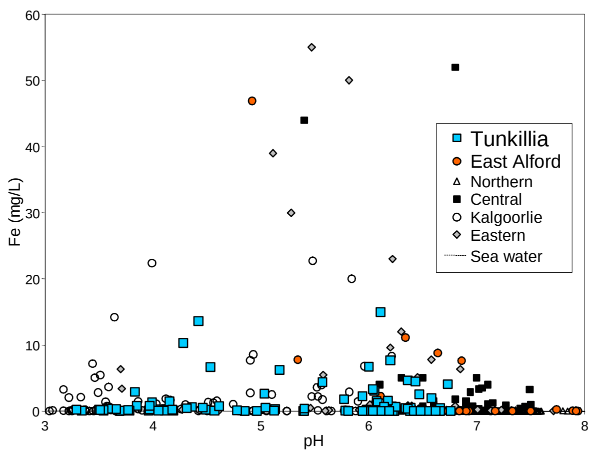

Figure 18: Dissolved Fe vs pH for groundwaters from Tunkillia and other sites.

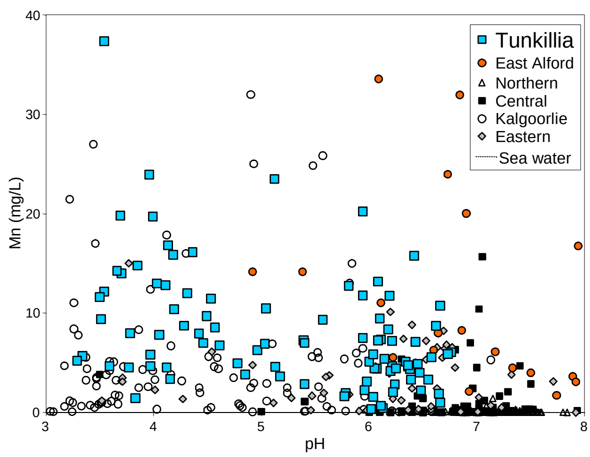

Figure 19: Dissolved Mn vs pH for groundwaters from Tunkillia and other sites.

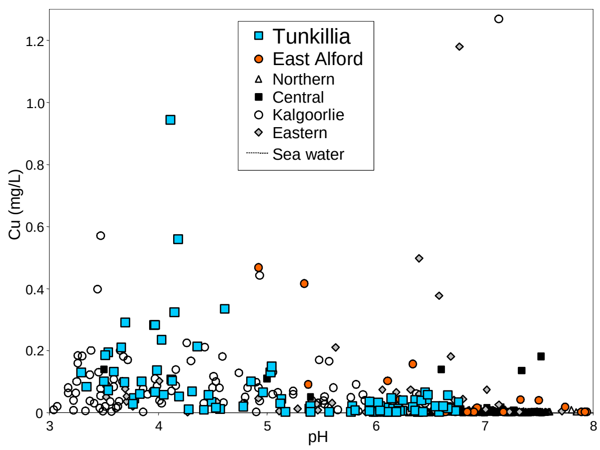

Figure 20: Dissolved Cu vs pH for groundwaters from Tunkillia and other sites.

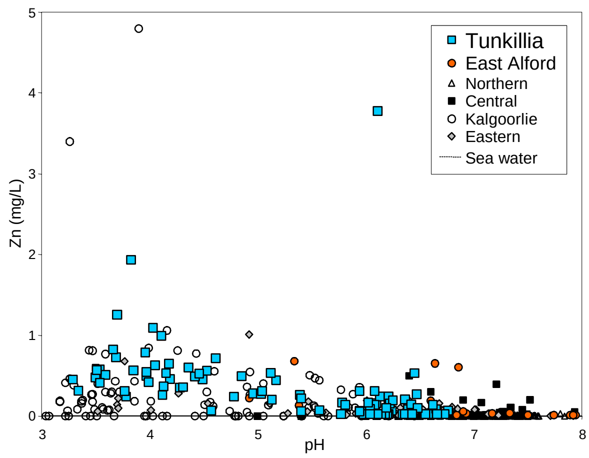

Figure 21: Dissolved Zn vs pH for groundwaters from Tunkillia and other sites.

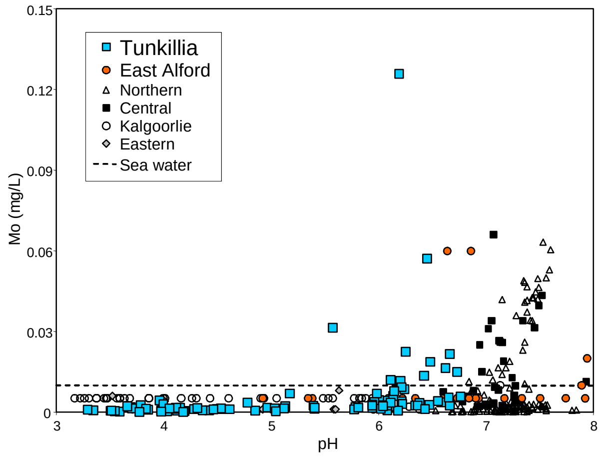

Figure 22: Dissolved Mo vs pH for groundwaters from Tunkillia and other sites.

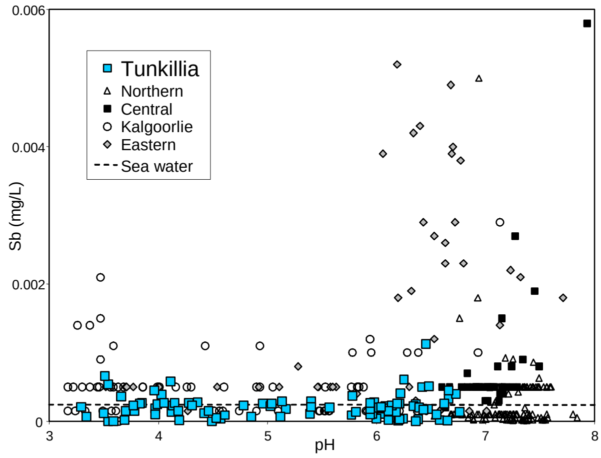

Figure 23: Dissolved Sb vs pH for groundwaters from Tunkillia and other sites.

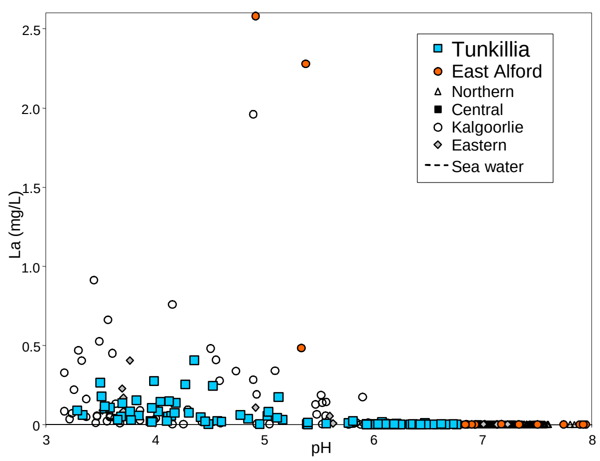

Figure 24: Dissolved La vs pH for groundwaters from Tunkillia and other sites.

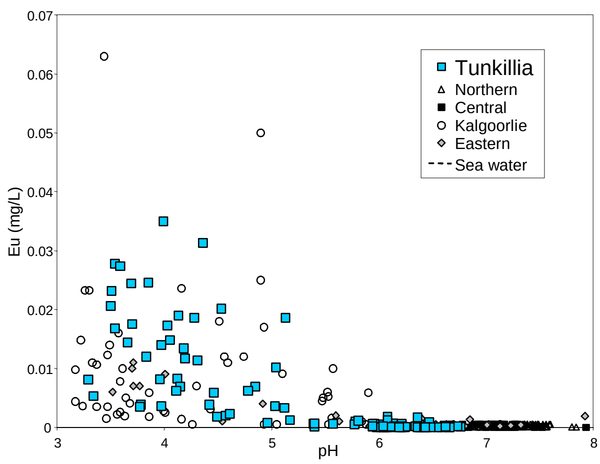

Figure 25: Dissolved Eu vs pH for groundwaters from Tunkillia and other sites.

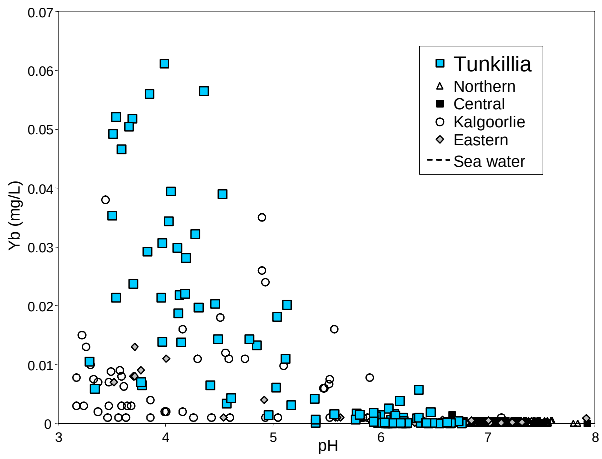

Figure 26: Dissolved Yb vs pH for groundwaters from Tunkillia and other sites.

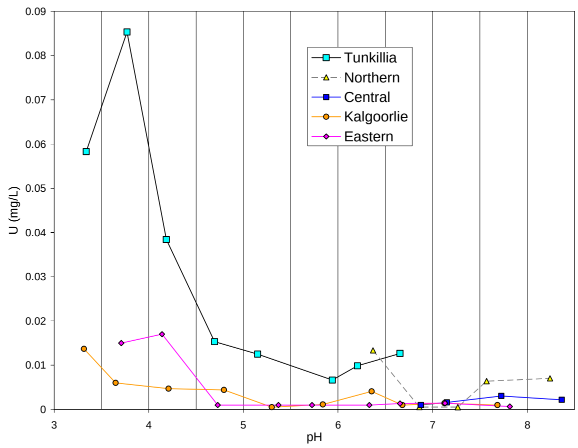

Figure 27: Distribution of median U concentration vs pH for Tunkillia and other sites.

Table 2: Relative concentration of selected elements and of acidity at Tunkillia (compared with primarily greenstone terrains, Western Australia and corrected for pH effects; e.g. Figure 27)

Low	Medium	High
		Acidity
Mg	Na	Ca
Cl		SO_4
Ba	B	F
		Li
Mo		Al
Sb		Si
Au	Cu	Be
	Fe	Mn
Ni	Co	Zn
Pb	Light REE	Y, heavy REE
		U

5. HYDROGEOCHEMICAL MAPPING

Data for all elements is in the Appendix, with selective plots given below. The spatial distribution of elemental concentrations further distinguishes the particular hydrogeochemical controls at Tunkillia. Additionally, various dissolved elements may be effective pathfinders for mineralization. This has been indicated for dissolved Au and chalcophiles such as As or Mo in Yilgarn Craton groundwaters (Gray, 2001). For Tunkillia groundwaters, some of the most significant spatial variations are in pH/Eh (Figure 28), as discussed in Section 4.3. In particular the "unusual" neutral and highly oxidised groundwaters (Purple circles) are uniquely located in the 223 central area. Conversely, high SO_4/Cl ratios are located in the 191 north area (Figure 29). Further work is required, but it is postulated that these effects are due to the weathering of specific sulphide assemblages. However, this is not reflected by especially high dissolved Fe concentrations (Figure 30), possibly because of the complex pH, Eh and ligand controls on Fe solubility. When the solution saturation with respect to secondary Fe minerals (*e.g.*, $Fe_3(OH)_8$; Figure 31) is used to "normalise" for these effects, there is a high correlation of $Fe_3(OH)_8$ saturation at 223 central, and possibly at 191 north.

As expected, dissolved Au is highly anomalous, with concentrations greater than 50 ng/L (0.05 µg/L) commonly observed (Figure 32). This suggests that Au mineralisation (though not necessarily economic) occurs throughout the Tunkillia area. Highest dissolved Au concentrations occur in the 223 Central zone (and upgradient / south), and particularly within the 191 North zone. Though both sites are clearly highly anomalous, it is not known whether the higher Au response in 191 North groundwaters is due to as yet undiscovered mineralisation or differing groundwater conditions (Sections 4.3 and 4.4). Dissolved V (Figure 33) is anomalous hundreds of metres around the main mineralised zone at 223 Central and possibly in the 191 North zone. This could be related to mica alteration. The dissolved Te anomaly (Figure 34) in the 223 Central zone is marked, with a 5 – 10 fold increase over background (Figure 36). In contrast, the Te anomaly at 191 North is subdued. Dissolved Sb values tend to be raised upgradient (Figure 35) of the 223 mineralisation, with only a 2:1 anomaly-to-background (Figure 37). No other elements showed any clear anomaly associated with known mineralisation.

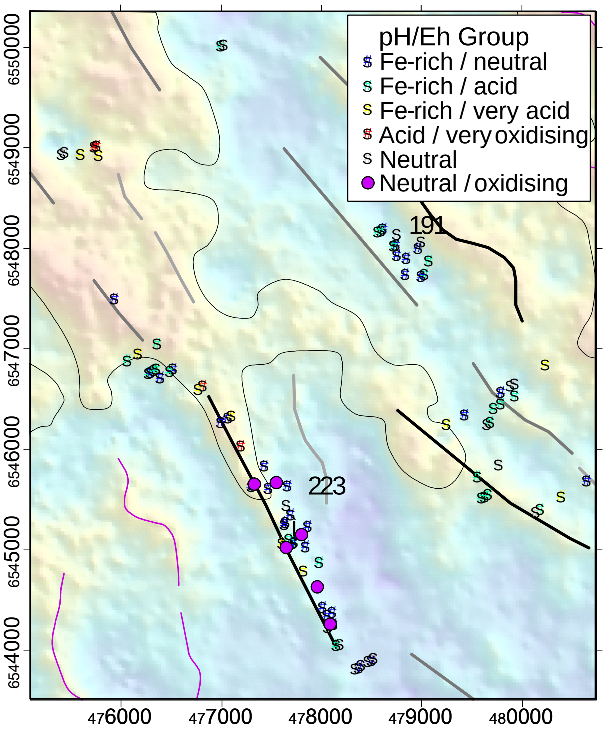

Figure 28: Distribution of pH/Eh groundwater groups at Tunkillia.

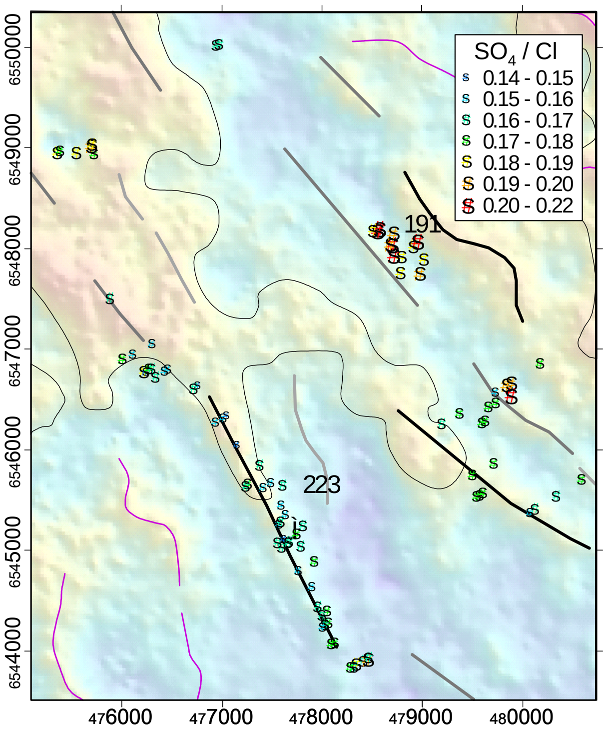

Figure 29: Distribution of the SO_4/Cl groundwater ratio at Tunkillia.

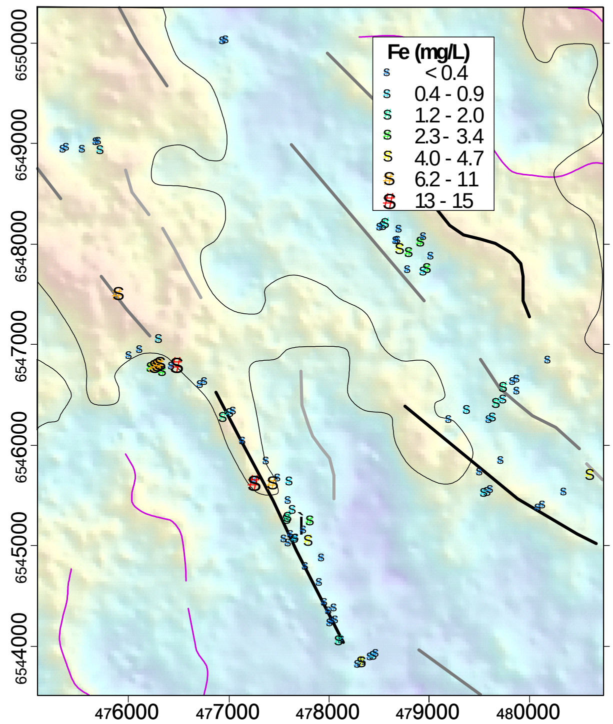

Figure 30: Distribution of dissolved Fe at Tunkillia.

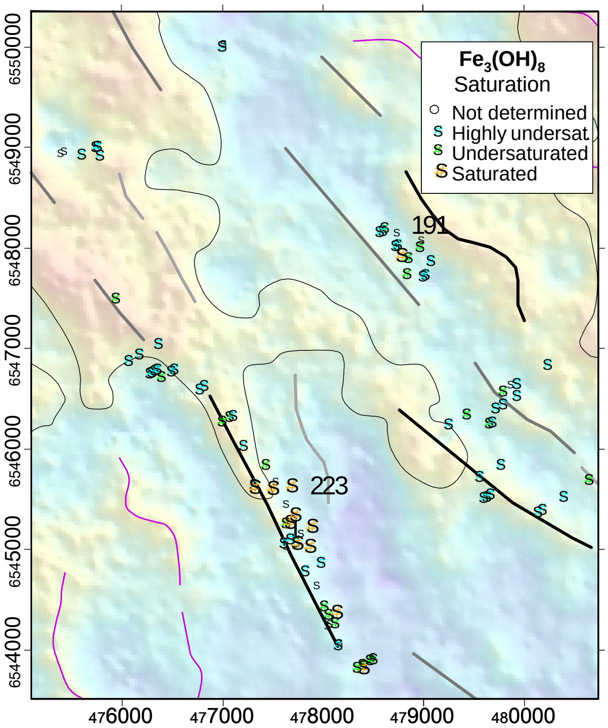

Figure 31: Distribution of SI values for $Fe_3(OH)_8$ at Tunkillia.

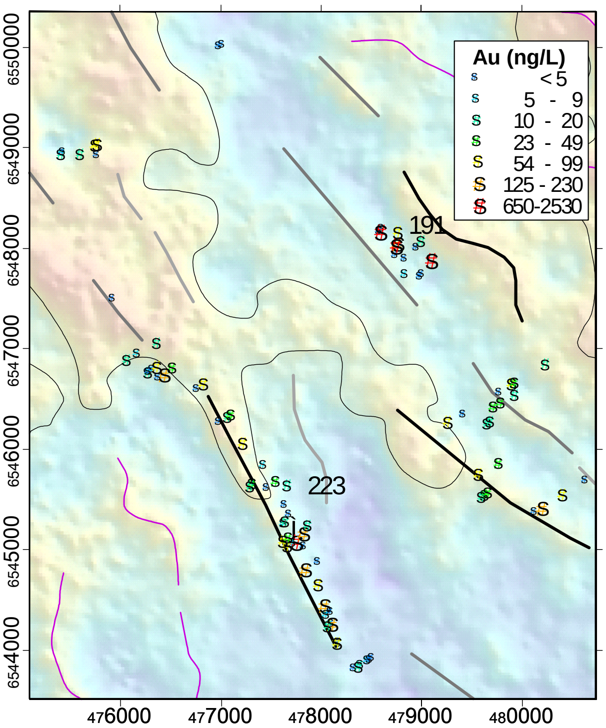

Figure 32: Distribution of dissolved Au at Tunkillia.

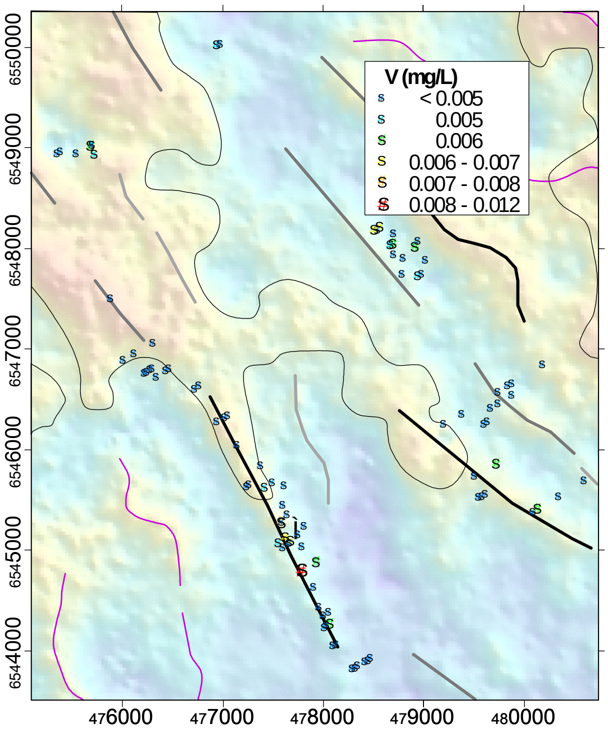

Figure 33: Distribution of dissolved V at Tunkillia.

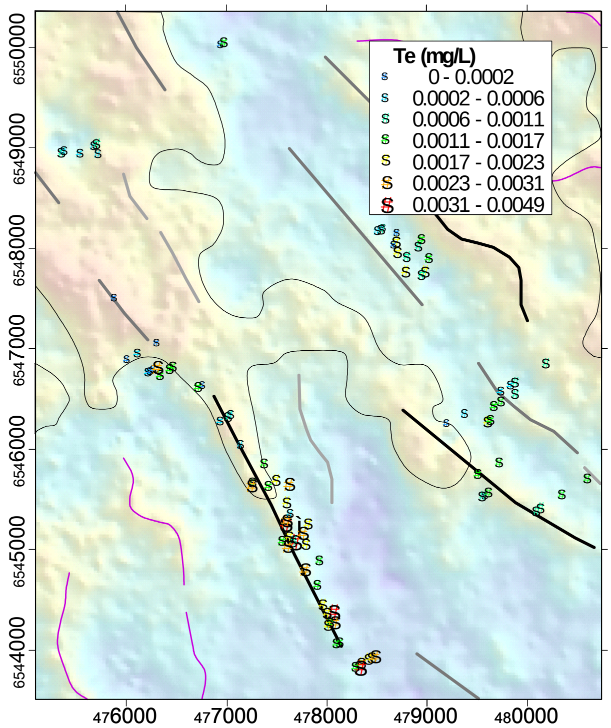

Figure 34: Distribution of dissolved Te at Tunkillia.

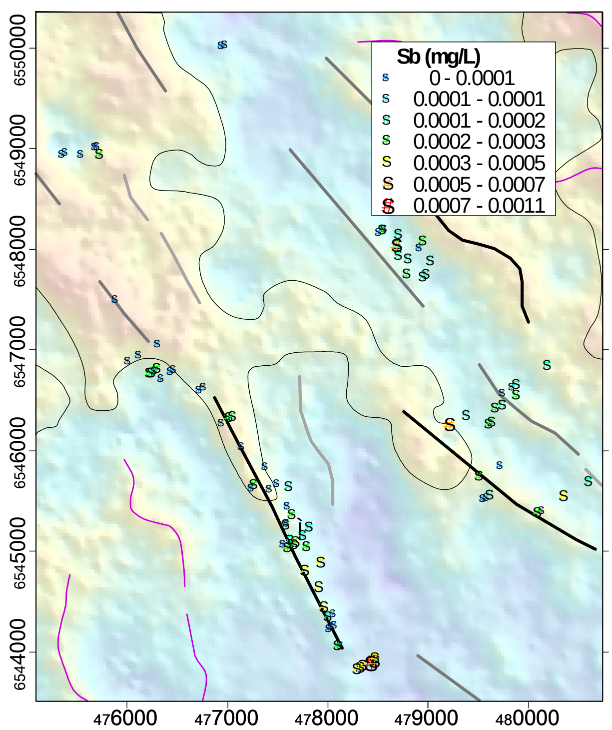

Figure 35: Distribution of dissolved Sb at Tunkillia.

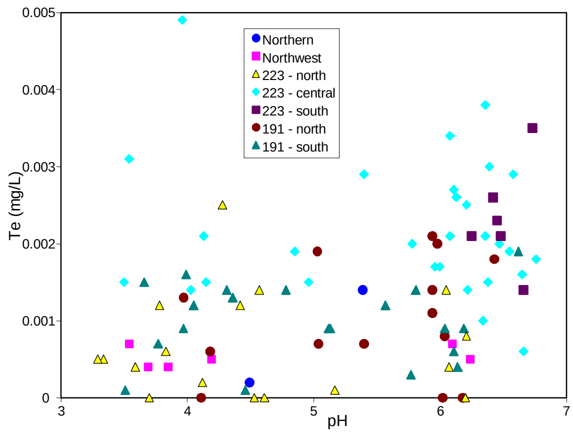

Figure 36: Dissolved Te vs pH at Tunkillia, differentiated by area (Figure 4).

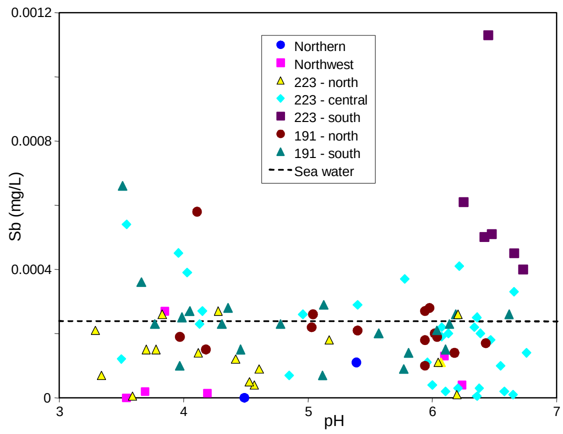

Figure 37: Dissolved Sb vs pH at Tunkillia, differentiated by area (Figure 4).

6. DISCUSSION AND CONCLUSIONS

The Tunkillia groundwater survey offered an extensive study of an entire Au exploration site within the Gawler Craton, with 94 samples analysed. Although the site shows many similarities to sites in the Yilgarn Craton, some distinct differences are observed. These findings have implications for the use of hydrogeochemistry for exploration, and possibly for the supergene dispersion patterns in this region. The homogeneous salinity of the area (Section 4.2) differs from the marked variation in salinity at most of the Yilgarn sites, suggesting differing flow patterns. At the Yilgarn, saline groundwater flow is commonly strongly affected by evaporative playas at the valley floors, through which groundwaters flow, albeit slowly, eastward to the Eucla Basin, and by density driven convection (Gray, 2001; Carey and McPhail, 2002). This results in major lateral and depth differences in salinity. In contrast, the uniformity of salinity at Tunkillia implies little directional flow, and a generally "ponded" situation. Such a lack of flow would imply that groundwater anomalies would spatially closely match results in the fresh or weathered rock.

Possibly, as a result of longer contact times, or because the uniformity of salinities enables variation from the sea water norm to be readily identified, specific major element enrichments and depletions are observed at Tunkillia. The common Ca enrichment / K depletion (Section 4.2) may be the result of Ca feldspar hydrolysis (Na and K feldspar commonly being stable in these groundwaters, except for pH below 5). This suggests groundwaters are interacting with fresh rock or weakly weathered regolith, again indicating that groundwater should mirror the geology at this site. Clear differentiations in the SO_4/Cl ratio, in particular the SO_4 enriched at 191 North (Figure 29), suggest S release via oxidation of sulfide minerals.

Groundwater pH values show a bimodal distribution, with highest numbers centred around pH 4 and pH 6 (Section 4.3). Interpretation of results should take this into account, as the more acid groundwaters are expected to have higher base metal, and low anion (including As, Sb, Mo and Te) contents. When pH effects are taken into account, Tunkillia groundwaters are enriched in a felsic suite of elements (*e.g.*, Li, Al, Si, U; Table 2), relative to Yilgarn greenstone sites.

Assessing Eh in conjunction with pH (Figure 9), indicates specific Eh/pH groups, considered to be controlled by dissolved Fe (Fe), Al dissolution (Al), and neutral and poorly poised (HO), which is very similar to the situation for Yilgarn groundwaters (Figure 10). In addition, a group of six groundwaters have high Eh ($\geq$ 600 mV), even though pH is greater than 5. These high O_2 fugacity groundwaters (Figure 10) differ from Yilgarn groundwaters, and are all found within the 223 central area, close to the identified mineralisation (Figure 28). Though the genesis of these specific Eh/pH conditions is not known, it may reflect subtleties in sulfide oxidation in this area. This effect may explain the only moderate dissolved Au content around the identified mineralisation at Area 223, in contrast with the major response at 191 North (Figure 32). Other elements with potential as groundwater pathfinders are V (Figure 33) and Te (Figure 34). Dissolved Fe (possibly related to sulfide dissolution) gives a patchy distribution (Figure 30), possibly due to the complex effect of pH and Eh on solubility. When this effect is "normalised" by calculating groundwater saturation to secondary Fe oxides such as $Fe_3(OH)_8$, a strong anomaly around the 223 mineralisation is observed (Figure 31).

The Tunkillia site demonstrates subtle but important differences from Yilgarn groundwaters, possibly related to a number of factors:

1. Tunkillia is primarily composed of felsic rocks;
2. Tunkillia groundwater appear to be more "ponded" than in the Yilgarn, potentially causing longer contact times;
3. Mineralisation at 223 Central and 191 North may include differing accessory and/or sulfide minerals, leading to differing releases to groundwater.

Various dissolved elements (Au, V, Te) have potential value for exploration. Dissolved Au is anomalous throughout most of the Tunkillia area, with particularly high dissolved concentrations around the mineralised area at Area 223 and at 191 North. Dissolved V and Te, Eh/pH classes and "normalised" Fe all appear to correlate with mineralised sites. The results discussed in this report demonstrate the capability for groundwater geochemistry to reflect flow characteristics, lithology and mineralisation in the Tunkillia region.

ACKNOWLEDGEMENTS

The authors would like to thank staff of Helix Resources Ltd for their assistance and support throughout the research. Dale Longman is acknowledged for field and laboratory technical support. Staff of Geoscience Australia, particularly Lisa Worrall, gave advice and field support. Financial support was supplied by the Co-operative Research Centre for Landscape Environment and Mineral Exploration (CRCLEME).

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Appendix 1: Analytical Results

1a: Sampling details

Drill Hole	Easting (AGD84)	Northing (AGD84)	RL (mASL)	Azi-muth	Dip	Depth (m)	CSIRO sample	To water	To base
LRC001	478648.64	6547854.03	1192.51	218.0	-60	180	TK90	31	36
LRC004	478758.66	6547955.66	1191.36	218.0	-60	180	TK89	29	34
LRC007	477496.34	6545297.14	1198.60	218.0	-60	180	TK18	36	41
LRC026	478548.26	6547885.79	1193.85	38.0	-60	171	TK91	33	38
LRC031	477659.39	6545176.23	1200.52	218.0	-60	228	TK15	39	44
LRC033	477599.27	6545096.83	1202.13	218.0	-60	228	TK14	40	45
LRC036	477448.38	6545394.23	1199.68	218.0	-60	228	TK19	37	42
LRC041	477639.62	6544980.37	1205.50	218.0	-60	228	TK8	42	52
LRC044	477461.15	6545579.50	1199.50	218.0	-60	228	TK20	38.5	43.5
LRC057	477268.82	6545564.67	1201.27	53.0	-60	204	TK22	38.5	43.5
LRC058	477342.23	6545619.97	1197.52	53.0	-60	204	TK21	35	40
LRC059	477089.67	6545574.50	1196.50	53.0	-60	204	TK24	32.5	37.5
LRC068	477620.54	6544733.06	1208.26	53.0	-60	204	TK6	46	56
LRC070	477780.45	6544824.47	1209.66	53.0	-60	204	TK7	49.5	59
LRC071	477755.84	6544577.42	1206.93	53.0	-60	204	TK5	53	63
LRC077	477430.09	6545206.87	1200.94	38.0	-60	150	TK16	38	43
LRC078	477439.53	6545219.42	1202.40	38.0	-60	120	TK17	42	47
LRC083	476894.74	6546278.58	1192.06	53.0	-60	162	TK62	36	36
LRC084	476868.76	6546263.78	1192.40	53.0	-60	162	TK61	36	41
LRC087	476791.71	6546217.51	1197.79	53.0	-60	156	TK63	38	43
LRC094	476616.82	6546580.00	1190.10	53.0	-60	162	TK64	28	33
LRC096	476566.71	6546549.08	1189.70	53.0	-60	150	TK65	28	33
LRC100	477108.12	6545588.80	1197.70	53.0	-60	159	TK23	34.5	39.5
LRC109	476313.19	6546748.07	1188.20	53.0	-60	162	TK66	27	32
LRC110	476287.33	6546732.31	1187.58	52.5	-60	162	TK67A	26	28
LRC113	476211.88	6546684.78	1185.96	53.0	-60	162	TK67	24	29
LRC114	476186.09	6546668.70	1185.74	53.0	-60	162	TK68	24	29
LRC116	475735.01	6547444.77	1185.77	53.0	-60	159	TK76	29	34
LRC123	476156.59	6547006.63	1187.61	53.0	-60	162	TK75	29	34
LRC130	475969.86	6546894.88	1184.81	53.0	-60	162	TK74	27	32
LRC134	475865.22	6546834.35	1184.70	53.0	-60	162	TK73	25	30
LRC138	476150.65	6546750.82	1186.86	53.0	-60	162	TK72	27	32
LRC139	476123.96	6546735.84	1186.02	53.0	-60	162	TK71	25	30
LRC140	476097.93	6546720.55	1185.22	53.0	-60	162	TK70	24	29
LRC141	476071.69	6546707.13	1184.74	53.0	-60	162	TK69	23	28
LRC147	477221.59	6545780.57	1197.74	53.0	-60	162	TK25	35.5	40.5
LRC166	476998.79	6545988.21	1197.71	53.0	-60	162	TK60	35	40
LRC176	480036.58	6546788.49	1190.16	53.0	-60	160	TK47	29	34
LRC179	477976.88	6544004.91	1213.71	53.0	-60	162	TK32	50	55
LRC180	477949.64	6543990.68	1214.12	55.0	-60	162	TK33	51	56
LRC183	477909.84	6544210.16	1211.13	53.0	-60	162	TK29	49	54
LRC184	477885.05	6544192.48	1210.65	53.0	-60	158	TK30	50	
LRC185	477859.15	6544176.93	1210.51	53.0	-60	162	TK31	49	55
LRC189	477811.25	6544372.20	1209.64	53.0	-60	162	TK26	46.5	
LRC192	478867.41	6547823.55	1191.18	53.0	-60	162	TK87	30	35
LRC201	478632.14	6547691.86	1194.46	53.0	-60	162	TK88	33	38
LRC204	478820.23	6547686.80	1193.49	53.0	-60	162	TK85	33	38
LRC205	478793.36	6547670.48	1193.82	53.0	-60	156	TK86	33	38

App. 1a: Sampling details (cont.)

Drill Hole	Easting (AGD84)	Northing (AGD84)	RL (mASL)	Azi-muth	Dip	Depth (m)	CSIRO sample	To water	To base
LRC215	478542.99	6547987.42	1193.05	53.0	-60	162	TK92	31	36
LRC216	478517.72	6547971.74	1192.25	53.0	-60	162	TK93	31	36
LRC223	478546.19	6548097.60	1189.63	53.0	-60	162	TK94	28	33
LRC227	478414.35	6548143.68	1189.56	53.0	-60	162	TK95	27	32
LRC228	478389.14	6548128.69	1189.65	53.0	-60	162	TK96	27	32
LRC229	478363.20	6548114.14	1190.58	53.0	-60	162	TK97	28	33
LRC235	477470.71	6545049.34	1199.82	53.0	-60	150	TK13	37	42
LRC238	477410.74	6545014.07	1200.14	53.0	-60	246	TK12	37	42
LRC254	480449.70	6545635.42	1197.37	53.0	-58	220	TK56	40	45
LRC259	480191.09	6545480.45	1198.78	53.0	-60	216	TK59	36	41
LRC263	479984.63	6545353.02	1200.31	48.0	-60	222	TK57	39	44
LRC264	479937.08	6545320.59	1200.47	53.0	-60	203	TK58	38	43
LRC270	476821.18	6549977.33	1189.45	53.0	-60	162	TK84	40	45
LRC271	476796.74	6549962.58	1189.00	53.0	-60	198	TK83	40	45
LRC277	477900.32	6544318.09	1212.46	53.0	-60	180	TK27	51.5	56.5
LRC279	477850.20	6544290.37	1216.69	52.0	-60	180	TK28	56	61
LRC281	478320.07	6543865.54	1218.61	53.0	-60	180	TK36	55	60
LRC282	478293.21	6543849.94	1218.17	53.0	-60	180	TK35	49	54
LRC283	478266.14	6543836.12	1219.92	55.0	-60	180	TK34	110	115
LRC286	478191.08	6543788.60	1219.68	53.0	-60	180	TK37	55	60
LRC287	478163.95	6543772.83	1219.32	53.0	-60	180	TK38	55	60
LRC288	478139.32	6543758.01	1219.70	53.0	-60	180	TK39	51	56
LRC291	479223.32	6546290.99	1195.67	52.0	-60	204	TK43	36	41
LRC295	479052.10	6546192.43	1200.32	53.0	-60	200	TK42		
LRC300	477522.12	6545018.40	1201.09	53.0	-60	96	TK9	40.5	45.5
LRC301	477507.13	6545010.05	1201.43	53.0	-61	138	TK10	38	43
LRC305	477447.52	6544966.37	1204.67	53.0	-60	240	TK11	42.5	47.5
LRC322	479722.01	6546598.20	1200.00	53.5	-60	148	TK46	29	34
LRC323	479687.84	6546577.37	1200.00	52.5	-60	148	TK45	29	34
LRC326	479585.34	6546514.87	1200.00	53.0	-60	148	TK44	30	35
LRC327	479586.18	6546398.21	1200.00	53.0	-60	148	TK49	30	35
LRC329	479517.85	6546356.54	1200.00	53.0	-60	148	TK48	32	37
LRC333	479484.51	6546219.05	1200.00	53.0	-60	136	TK41	31	36
LRC334	479450.35	6546198.22	1200.00	53.5	-60	148	TK40	32	37
LRC337	479564.72	6545799.27	1200.00	53.0	-60	148	TK51	34	39
LRC343	479359.73	6545674.28	1200.00	54.5	-60	190	TK52	38	43
LRC345	479463.89	6545503.45	1200.00	53.0	-60	148	TK55	37	42
LRC346	479429.73	6545482.62	1200.00	53.0	-60	148	TK53	39	44
LRC347	479395.56	6545461.78	1200.00	54.0	-60	154	TK54	40	45
LRC351	478793.91	6548024.20	1200.00	53.0	-60	148	TK98	27	32
LRC354	479722.85	6546481.54	1200.00	53.0	-60	118	TK50	28	33
LRC365	475527.36	6548961.66	1200.00	53.0	-60	150	TK78	26	31
LRC368	475552.98	6548977.29	1200.00	53.0	-60	150	TK79	25	30
LRC371	475399.23	6548883.54	1200.00	53.0	-60	150	TK80	27	32
LRC373	475206.22	6548883.02	1200.00	53.0	-60	150	TK81	27	32
LRC374	475240.39	6548903.85	1200.00	53.0	-60	150	TK82	27	32
LRC378	475579.44	6548876.25	1200.00	53.0	-60	132	TK77	24	29

Appendix 1b: Tabulated Geochemistry

No.	Location	Easting m	Northing m	pH	Eh mV	TDS mg/l	Fe mg/l	HCO3 mg/l	Br mg/l	Cl mg/l
TK7	223 - Central	477909	6544996	4.03	507	29418	0.26	0	51.7	15404
TK8	223 - Central	477768	6545152	6.36	230	29311	4.7	114	52.9	15409
TK9	223 - Central	477651	6545190	3.96	527	29530	0.05	0	51.6	15496
TK10	223 - Central	477636	6545182	6.34	289	30418	0.47	276	47.6	15815
TK11	223 - Central	477576	6545138	5.40	722	29605	<0.01	28	49.0	15405
TK12	223 - Central	477539	6545186	3.50	577	29947	0.21	0	50.1	15686
TK13	223 - Central	477599	6545221	4.13	547	31827	0.20	0	54.7	16945
TK14	223 - Central	477728	6545269	6.13	607	29081	<0.01	103	48.5	15122
TK15	223 - Central	477788	6545348	6.47	267	26460	2.5	148	43.9	13732
TK16	223 - Central	477559	6545379	6.08	275	30102	1.2	45	50.7	15833
TK17	223 - Central	477568	6545391	6.58	222	28052	2.0	112	46.8	14785
TK18	223 - Central	477625	6545469	6.66	297	30572	0.47	173	51.2	16071
TK19	223 - Central	477577	6545566	6.76	357	30437	<0.01	166	51.2	16011
TK20	223 - Central	477590	6545751	6.39	305	29809	0.50	192	50.4	15571
TK21	223 - Central	477471	6545792	4.85	607	30264	<0.01	4	49.2	16041
TK22	223 - Central	477397	6545736	6.00	277	32602	7	87	56.8	17126
TK23	223 - Central	477237	6545760	4.96	707	29186	0.01	7	53.2	15014
TK24	223 - Central	477218	6545746	6.11	227	25939	15	57	44.2	13186
TK25	223 - Central	477350	6545952	6.38	357	30978	0.03	163	53.6	16050
TK26	223 - Central	477940	6544544	5.78	432	30512	0.06	44	50.4	15623
TK27	223 - Central	478029	6544490	6.36	317	30797	0.33	252	51.5	15856
TK28	223 - Central	477979	6544462	6.08	397	30559	0.18	78	51.8	15759
TK29	223 - Central	478038	6544382	6.21	377	30929	0.12	160	52.6	16117
TK30	223 - Central	478014	6544364	5.96	727	30311	<0.01	98	51.0	15672
TK31	223 - Central	477988	6544349	6.55	435	30314	<0.01	166	50.7	15626
TK32	223 - Central	478106	6544177	6.65	407	31385	<0.01	158	53.4	16548
TK33	223 - Central	478078	6544162	4.15	507	31117	1.4	0	53.2	16238
TK34	223 - South	478395	6544008	6.45	387	28606	0.02	204	50.3	15303
TK35	223 - South	47842	654402	6.25	28	30975	0.70	299	51.5	15507

		2	2		7					
TK36	223 - South	478449	6544037	6.42	372	32454	<0.01	304	54.0	16730
TK37	223 - South	478320	6543960	6.48	407	26113	0.01	301	44.5	13278
TK38	223 - South	478293	6543945	6.73	197	30386	4.1	266	50.8	15707
TK39	223 - South	478268	6543930	6.66	387	29789	0.02	260	49.5	15211
TK40	191 - South	479579	6546370	6.62	397	30952	0.01	108	52.5	16018
TK41	191 - South	479613	6546391	4.36	517	32235	0.67	0	56.1	16912
TK42	191 - South	479181	6546364	3.51	607	29773	0.15	0	52.5	15800
TK43	191 - South	479352	6546463	6.14	297	30660	0.70	91	53.0	16180
TK44	191 - South	479714	6546687	5.77	307	6568	1.8	32	11.9	3629
TK45	191 - South	479816	6546749	6.11	407	25637	<0.01	51	43.8	13100
TK46	191 - South	479851	6546770	6.04	447	26597	0.01	33	45.6	13798
TK47	191 - South	480165	6546960	3.77	607	29929	0.15	0	51.6	15569
TK48	191 - South	479646	6546528	3.99	527	32661	1.3	0	51.9	17148
TK49	191 - South	479715	6546570	4.31	507	30682	0.41	0	56.0	15878
TK50	191 - South	479851	6546653	5.13	452	25147	0.28	10	44.9	12738
TK51	191 - South	479693	6545971	5.81	427	32522	0.01	64	53.3	17292
TK52	191 - South	479488	6545846	4.05	557	27775	0.07	0	51.8	14743
TK53	191 - South	479558	6545654	4.46	507	26639	0.54	0	48.9	14134

App. 1b: Tabulated Geochemistry (cont.)

No.	Location	Easting m	Northing m	pH	Eh mV	TDS mg/l	Fe mg/l	HCO_3 mg/l	Br mg/l	Cl mg/l
TK54	191 - South	479524	6545633	3.97	537	26478	0.84	0	44.1	14333
TK55	191 - South	479593	6545675	4.78	487	28234	0.10	0	52.1	14956
TK56	191 - South	480578	6545807	5.57	347	31519	4.4	32	55.9	16665
TK57	191 - South	480113	6545525	5.12	437	30782	0.04	25	54.7	16147
TK58	191 - South	480066	6545492	6.19	387	29027	0.01	112	52.0	15373
TK59	191 - South	480320	6545652	3.66	677	31901	0.30	0	57.3	16909
TK60	223 - North	477127	6546160	3.34	777	30441	0.05	0	57.3	16481
TK61	223 - North	476997	6546435	6.21	287	29592	0.74	141	54.2	15851
TK62	223 - North	477023	6546450	3.29	627	29566	0.20	0	49.6	16216
TK63	223 - North	476920	6546389	6.07	287	29381	1.5	106	54.9	15660
TK64	223 - North	476745	6546752	3.70	687	30257	0.06	0	50.4	16563
TK65	223 - North	476695	6546721	3.78	607	30536	0.04	0	56.2	16082
TK66	223 - North	476442	6546920	4.42	272	34754	14	0	65.7	18847
TK67	223 - North	476416	6546904	4.57	457	38048	0.07	4	70.5	20523
TK68	223 - North	476315	6546840	6.05	257	31766	3.1	153	58.5	17011
TK69	223 - North	476200	6546879	3.83	527	30711	2.9	0	54.6	16488
TK70	223 - North	476227	6546892	5.17	237	24113	6	79	46.0	13096
TK71	223 - North	476253	6546908	4.53	417	39735	7	0	74.1	21353
TK72	223 - North	476279	6546923	4.28	447	39344	10	0	72.7	21203
TK73	223 - North	475994	6547006	4.12	547	29053	0.29	0	54.2	15367
TK74	223 - North	476099	6547067	3.59	567	35885	0.35	0	67.6	19069
TK75	223 - North	476285	6547178	4.61	477	30719	0.77	0	56.5	16230
TK76	223 - North	475864	6547616	6.20	167	30841	8	99	56.1	16198
TK77	Northwest	475708	6549048	3.85	587	28786	0.81	0	52.8	14958
TK78	Northwest	475656	6549133	3.69	767	29268	0.02	0	53.8	15303
TK79	Northwest	475682	6549149	3.54	742	29239	0.04	0	47.1	15304
TK80	Northwest	475528	6549055	4.19	607	29660	0.04	0	48.7	15543
TK81	Northwest	475335	6549055	6.10	447	35812	<0.01	164	66.5	18507

TK82	Northwest	475369	6549076	6.24	407	28866	<0.01	97	52.5	15138
TK83	Northern	476925	6550134	4.49	487	29754	0.22	0	52.5	15669
TK84	Northern	476950	6550149	5.39	447	28412	<0.01	18	50.4	15042
TK85	191 - North	478949	6547858	5.03	437	29633	2.6	1	53.0	15443
TK86	191 - North	478922	6547842	5.40	307	8825	0.38	25	16.5	4618
TK87	191 - North	478996	6547995	3.97	487	29672	0.25	0	57.2	15458
TK88	191 - North	478761	6547864	5.98	327	29526	0.19	80	53.0	15535
TK89	191 - North	478887	6548127	5.94	277	30417	2.3	88	48.0	15864
TK90	191 - North	478777	6548026	6.04	267	29934	3.3	66	48.0	15846
TK91	191 - North	478677	6548057	6.43	227	25847	4.5	92	40.9	13321
TK92	191 - North	478672	6548159	5.94	407	31017	0.02	27	55.8	15993
TK93	191 - North	478646	6548143	4.11	557	30787	0.08	0	56.5	16116
TK94	191 - North	478675	6548269	6.02	422	13679	<0.01	66	22.4	6805
TK95	191 - North	478543	6548315	6.18	267	17553	1.6	109	30.7	8804
TK96	191 - North	478518	6548300	5.04	457	20877	0.53	0	37.1	10712
TK97	191 - North	478492	6548286	4.18	527	20810	0.19	0	36.8	10491
TK98	191 - North	478923	6548196	5.94	407	26140	<0.01	49	46.1	13317
TK101	223 - Central	477884	6544749	6.22	727	29483	<0.01	129	51.9	15665
TK102	223 - Central	477749	6544905	3.54	571	28008	0.15	0	51.0	15180

App. 1b: Tabulated Geochemistry (cont.)

No.	F mg/l	NO_3 mg/l	SO4 mg/l	Na mg/l	K mg/l	Mg mg/l	Ca mg/l	Au µg/L	Al mg/l	Si mg/l	B mg/l	Ba mg/l	Be mg/l
TK7	5.0	16.6	2844	9200	261	841	795	0.001	14	10	6.1	0.019	0.026
TK8	1.3	17.4	2670	8899	199	825	1183	0.001	0.041	8	5.1	<0.005	0.001
TK9	2.3	71.2	2587	9546	270	793	713	0.905	8	24	5.7	0.009	0.016
TK10	1.1	21.3	2637	9768	292	844	858	0.006	0.008	14	6.2	0.009	0.001
TK11	0.7	25.3	2679	9600	297	802	733	0.099	0.329	22	6.1	<0.005	0.061
TK12	4.5	17.0	2703	9785	286	761	655	0.067	101	27	6.2	<0.005	0.030
TK13	2.5	109.5	2604	10240	276	829	767	0.047	53	36	6.2	0.054	0.050
TK14	2.0	19.4	2652	9296	284	832	774	0.206	0.098	14	6.3	<0.005	0.005
TK15	2.1	11.4	2335	8334	214	806	909	0.011	0.240	8	5.2	<0.005	0.003
TK16	0.6	14.5	2534	9790	272	827	757	0.008	0.202	25	6.2	0.011	0.010
TK17	0.4	14.4	2451	8874	254	781	791	0.011	0.013	24	5.4	0.123	0.001
TK18	1.3	34.6	2646	9734	277	847	827	0.003	0.006	15	6.4	<0.005	0.001
TK19	1.4	23.2	2629	9676	272	839	852	0.004	0.008	10	6.2	<0.005	0.001
TK20	3.0	20.5	2643	9208	286	947	987	0.014	0.012	15	6.1	<0.005	0.006
TK21	3.5	19.7	2611	9481	292	943	821	0.039	6	28	6.1	<0.005	0.033
TK22	2.0	14.4	2693	10509	301	985	872	0.005	0.035	12	6.3	0.023	0.001
TK23	2.0	28.6	2648	9559	283	870	724	0.033	1.6	27	6.0	<0.005	0.037
TK24	1.8	46.9	2299	8598	251	797	687	0.011	0.027	11	5.5	0.021	0.002
TK25	2.4	38.9	2651	9955	197	910	1041	0.006	0.018	9	6.3	<0.005	0.001
TK26	1.3	76.6	2720	10193	288	811	726	0.158	0.342	17	6.6	<0.005	0.018
TK27	0.3	15.4	2900	9620	259	953	1018	0.004	0.045	8	6.6	<0.005	0.001
TK28	1.5	19.1	2721	10128	292	805	743	0.009	0.277	17	6.6	<0.005	0.016
TK29	1.4	29.2	2844	9910	285	867	744	0.003	0.029	8	7.0	<0.005	0.001
TK30	1.4	16.0	2706	9991	286	828	711	0.228	0.040	10	7.0	<0.005	0.002
TK31	1.3	37.0	2575	10070	288	799	785	0.014	0.006	9	6.8	<0.005	0.001
TK32	2.0	54.1	2977	9332	136	994	1211	0.001	0.010	6	5.4	<0.005	0.001
TK33	3.6	19.7	2854	10071	285	944	649	0.081	16	19	8.3	0.005	0.006
TK34	0.1	38.8	2670	7458	135	1365	1486	0.009	0.028	5	3.1	<0.005	0.001
TK35	0.1	19.6	3113	9535	254	1168	1180	0.004	0.013	7	4.6	<0.005	0.001

TK36	2.3	45.8	2778	10554	325	973	843	0.001	0.037	7	6.1	0.011	0.002
TK37	1.0	35.7	2477	8050	306	944	830	0.008	0.033	8	5.8	<0.005	0.001
TK38	0.8	35.8	2684	9435	261	1061	1021	0.012	0.363	8	5.5	0.093	0.001
TK39	0.8	20.3	2700	9435	282	1041	923	0.001	0.008	9	5.9	0.093	0.001
TK40	3.8	17.7	2812	9671	264	932	1128	0.010	0.042	8	7.6	<0.005	0.001
TK41	14.6	33.7	3028	9898	394	1006	892	0.013	37	26	7.7	0.020	0.068
TK42	10.4	26.9	2763	8952	384	985	800	0.082	58	45	7.2	<0.005	0.085
TK43	2.9	26.2	2916	9110	253	917	1157	0.005	0.041	10	7.5	<0.005	0.001
TK44	0.8	5.5	587	1930	70	159	159	0.004	0.808	14	1.5	0.071	0.003
TK45	1.4	78.8	2673	7798	339	901	677	0.054	0.007	23	7.2	0.011	0.001
TK46	0.9	67.5	2720	7904	335	999	711	0.047	0.011	26	7.2	0.007	0.001
TK47	4.1	26.5	2735	9249	234	950	1108	0.018	46	16	6.7	<0.005	0.017
TK48	16.3	89.5	3155	10033	405	1006	756	0.039	96	29	8.7	0.017	0.084
TK49	10.4	43.7	2910	9663	380	984	758	0.049	27	31	8.6	0.009	0.073
TK50	5.7	199.7	2830	7538	345	831	609	0.015	4.4	26	8.1	0.022	0.025
TK51	2.7	29.6	3032	9462	312	1010	1298	0.028	0.126	13	6.8	<0.005	0.002
TK52	10.3	43.6	2680	8002	356	1044	845	0.061	21	44	5.8	<0.005	0.096
TK53	9.3	43.1	2561	7619	330	1036	858	0.025	16	44	5.4	0.008	0.113

App. 1b: Tabulated Geochemistry (cont.)

No.	F mg/l	NO3 mg/l	SO4 mg/l	Na mg/l	K mg/l	Mg mg/l	Ca mg/l	Au µg/L	Al mg/l	Si mg/l	B mg/l	Ba mg/l	Be mg/l
TK54	7.4	52.3	2533	7316	310	973	908	0.012	23	44	5.1	<0.005	0.058
TK55	6.3	32.4	2746	8105	342	1055	938	0.032	7	30	5.8	<0.005	0.063
TK56	0.9	39.9	2945	9366	194	941	1295	0.001	0.228	8	6.6	<0.005	0.002
TK57	10.9	35.3	2750	9786	358	860	768	0.126	5.3	28	7.0	0.007	0.143
TK58	3.2	14.1	2529	8754	251	836	1161	0.001	0.064	8	6.0	<0.005	0.001
TK59	15.2	126.7	2955	10117	379	803	538	0.096	120	45	7.9	0.026	0.107
TK60	0.7	22.1	2466	9511	282	887	734	0.089	35	42	5.9	<0.005	0.008
TK61	2.2	35.6	2511	8949	187	886	1047	0.014	0.036	10	6.1	<0.005	0.001
TK62	3.1	48.5	2339	9282	248	829	551	0.043	96	39	6.0	0.009	0.017
TK63	2.4	37.4	2546	8902	267	892	966	0.001	0.069	9	5.9	<0.005	0.001
TK64	6.0	35.2	2388	9425	261	898	630	0.091	93	26	6.3	0.010	0.016
TK65	0.9	19.4	2689	9638	291	958	801	0.001	17	29	6.3	<0.005	0.005
TK66	2.2	41.5	3010	10398	308	1086	995	0.023	13	10	6.3	<0.005	0.004
TK67	0.7	50.0	3347	11277	338	1254	1186	0.196	3.9	6	6.3	<0.005	0.001
TK68	3.8	39.0	2810	9451	280	1009	1029	0.001	0.039	8	6.3	<0.005	0.001
TK69	16.4	89.0	3197	9102	396	1034	334	0.020	130	38	8.9	0.055	0.027
TK70	4.3	15.5	1797	7493	317	728	578	0.001	2.6	7	4.9	0.080	0.003
TK71	10.5	63.7	3792	11722	412	1291	1018	0.001	29	4	7.1	<0.005	0.012
TK72	15.8	10.9	3568	11838	399	1258	978	0.054	51	9	7.1	<0.005	0.015
TK73	4.6	11.3	2763	8807	316	1065	665	0.014	19	42	7.5	0.010	0.027
TK74	12.4	19.0	3105	10978	363	1494	777	0.008	97	45	7.5	0.091	0.032
TK75	3.0	14.1	2596	9884	283	938	714	0.012	7	13	6.7	0.024	0.004
TK76	4.2	7.2	2681	9526	287	1052	980	0.001	0.028	11	7.1	0.006	0.001
TK77	16.2	13.5	2749	9300	305	864	527	0.001	51	47	8.0	0.006	0.075
TK78	16.1	11.9	3024	9073	323	900	564	0.073	38	43	7.8	0.013	0.079
TK79	20.2	8.7	2926	9211	321	919	481	0.070	79	44	8.3	0.034	0.073
TK80	18.8	18.2	2917	9303	336	880	594	0.013	28	31	8.1	0.025	0.072
TK81	5.5	11.0	3522	11351	369	1034	865	0.017	0.089	8	8.8	0.014	0.001
TK82	2.6	14.7	274	8843	234	849	937	0.001	0.016	6	7.2	0.020	0.001

			7											
TK83	7.4	14.5	2719	9269	166	837	1019	0.001	20	18	7.4	<0.005	0.026
TK84	2.9	15.6	2507	8591	113	834	1248	0.001	1.7	11	6.7	<0.005	0.009
TK85	3.3	14.7	3046	8909	162	966	1036	0.001	6	15	8.1	0.010	0.021
TK86	0.6	2.6	872	2712	63	272	256	0.001	0.141	6	2.1	0.058	0.001
TK87	7.3	21.9	2997	9402	235	820	674	2.530	86	40	8.7	0.023	0.044
TK88	2.7	11.2	2905	8330	64	980	1605	0.008	0.049	9	6.8	<0.005	0.001
TK89	4.1	12.2	3064	9120	212	984	1065	0.001	0.172	11	7.4	0.006	0.003
TK90	2.8	5.8	3073	8397	100	979	1450	0.001	0.016	10	6.9	<0.005	0.001
TK91	2.6	8.3	2824	7844	178	745	838	0.001	0.015	13	6.6	<0.005	0.001
TK92	5.5	41.9	3355	9458	301	948	847	0.152	1.7	23	8.0	<0.005	0.125
TK93	11.6	30.9	3233	9329	291	942	778	0.657	53	44	8.2	<0.005	0.081
TK94	0.3	323.9	1339	4482	156	295	222	0.068	0.020	25	3.9	0.025	0.001
TK95	0.8	1.5	1974	5709	161	414	405	0.001	0.008	18	6.3	0.026	0.001
TK96	4.2	46.7	2242	6521	227	552	535	0.001	7	24	6.5	0.033	0.040
TK97	5.8	33.3	2042	6822	271	597	509	1.270	17	32	6.7	0.027	0.066
TK98	1.3	12.2	2762	8272	224	807	676	0.015	0.027	11	6.8	<0.005	0.001
TK101	1.2	8.2	2560	9229	273	832	800	0.093	0.009	12	6.2	<0.005	0.001
TK102	6.1	8.9	2354	8787	277	762	583	0.140	70	32	6.3	0.010	0.100

App. 1b: Tabulated Geochemistry (cont.)

No.	Cr mg/l	Cu mg/l	Li mg/l	Mn mg/l	Sr mg/l	Ti mg/l	V mg/l	Zn mg/l	Co mg/l	Ni mg/l	Ga mg/l	Ge mg/l
TK7	<0.005	0.236	0.45	12.95	4.6	<0.005	0.006	1.10	0.108	0.064	0.0033	0.0126
TK8	<0.005	0.042	0.80	4.62	12	<0.005	<0.005	0.21	0.032	0.053	0.0009	0.0048
TK9	<0.005	0.282	0.57	23.95	2.1	<0.005	0.007	0.79	0.232	0.158	0.0029	0.0057
TK10	0.005	0.019	0.61	5.11	2.8	<0.005	<0.005	<0.05	0.003	0.012	0.0003	0.0002
TK11	0.008	0.021	0.56	6.98	1.3	<0.005	<0.005	0.22	0.060	0.128	0.0006	0.0000
TK12	<0.005	0.101	0.54	11.61	2.0	<0.005	0.005	0.48	0.113	0.098	0.0062	0.0115
TK13	<0.005	0.102	0.64	16.83	3.1	<0.005	0.007	0.37	0.137	0.091	0.0048	0.0078
TK14	0.010	0.013	0.42	0.43	4.4	<0.005	<0.005	0.24	0.007	0.039	0.0001	0.0000
TK15	0.006	0.043	0.45	4.00	7.9	<0.005	<0.005	0.27	0.025	0.035	0.0006	0.0000
TK16	0.007	<0.005	0.55	13.17	2.0	<0.005	0.008	0.14	0.081	0.092	0.0013	0.0000
TK17	<0.005	<0.005	0.50	5.55	2.4	<0.005	<0.005	<0.05	0.012	0.021	0.0006	0.0000
TK18	<0.005	0.056	0.58	10.74	2.5	<0.005	<0.005	<0.05	0.018	0.021	0.0007	0.0000
TK19	0.006	0.035	0.60	6.05	3.4	<0.005	<0.005	0.07	0.006	0.013	0.0004	0.0000
TK20	0.005	<0.005	0.47	3.28	5.4	<0.005	<0.005	0.08	0.008	0.036	0.0006	0.0000
TK21	0.014	0.100	0.51	3.82	3.0	<0.005	<0.005	0.50	0.056	0.096	0.0010	0.0000
TK22	<0.005	<0.005	0.52	5.12	3.1	<0.005	0.005	<0.05	0.075	0.077	0.0000	0.0000
TK23	<0.005	0.066	0.61	6.27	1.3	<0.005	<0.005	0.28	0.076	0.144	0.0008	0.0000
TK24	<0.005	<0.005	0.68	7.33	1.5	<0.005	<0.005	3.78	0.058	0.097	0.0005	0.0000
TK25	<0.005	<0.005	0.57	4.36	5.7	<0.005	<0.005	<0.05	0.005	0.012	0.0001	0.0000
TK26	0.009	0.021	0.48	1.95	3.3	<0.005	<0.005	0.17	0.026	0.053	0.0004	0.0022
TK27	<0.005	0.007	0.48	4.74	8.2	<0.005	<0.005	<0.05	0.002	0.013	0.0005	0.0012
TK28	<0.005	0.017	0.51	7.22	2.5	<0.005	<0.005	0.31	0.089	0.110	0.0006	0.0013
TK29	<0.005	0.006	0.45	7.20	3.9	<0.005	0.006	0.24	0.076	0.076	0.0006	0.0000
TK30	<0.005	0.021	0.45	2.24	3.3	<0.005	<0.005	0.06	0.016	0.040	0.0003	0.0000
TK31	<0.005	0.021	0.59	3.29	4.0	<0.005	<0.005	<0.05	0.008	0.024	0.0003	0.0000
TK32	0.007	0.018	0.59	1.88	13	<0.005	<0.005	0.09	0.003	0.013	0.0001	0.0000
TK33	0.005	0.324	0.43	3.38	6.1	<0.005	<0.005	0.53	0.026	0.033	0.0013	0.0029
TK34	<0.005	0.066	0.64	4.87	15	<0.005	<0.005	0.53	0.007	0.019	0.0006	0.0013
TK35	<0.005	0.041	0.41	4.42	11	<0.005	<0.005	0.20	0.009	0.022	0.0005	0.0014

TK36	<0.005	0.040	0.38	15.76	4.3	<0.005	<0.005	0.15	0.012	0.016	0.0012	0.0017
TK37	<0.005	0.058	0.21	2.22	9.0	<0.005	<0.005	0.10	0.005	0.016	0.0002	0.0000
TK38	<0.005	0.006	0.46	5.88	11	<0.005	<0.005	<0.05	0.006	0.029	0.0009	0.0016
TK39	<0.005	0.014	0.30	0.98	9.5	<0.005	<0.005	<0.05	0.002	0.014	0.0003	0.0007
TK40	<0.005	0.021	0.61	8.70	7.0	<0.005	<0.005	0.14	0.015	0.017	0.0007	0.0012
TK41	<0.005	0.214	0.70	16.13	4.6	<0.005	<0.005	0.60	0.204	0.155	0.0072	0.0167
TK42	<0.005	0.186	0.75	9.38	2.9	<0.005	<0.005	0.57	0.218	0.205	0.0048	0.0121
TK43	<0.005	0.047	0.54	5.38	9.0	<0.005	<0.005	<0.05	0.013	0.024	0.0006	0.0013
TK44	<0.005	<0.005	0.11	1.63	0.8	<0.005	<0.005	<0.05	0.013	0.014	0.0003	0.0009
TK45	<0.005	<0.005	0.39	0.68	5.8	<0.005	<0.005	<0.05	0.006	0.027	0.0000	0.0000
TK46	<0.005	0.006	0.46	1.55	6.3	<0.005	<0.005	<0.05	0.050	0.031	0.0000	0.0000
TK47	<0.005	0.028	0.40	4.51	8.6	<0.005	<0.005	0.31	0.040	0.126	0.0013	0.0042
TK48	<0.005	0.137	0.67	19.72	4.3	<0.005	<0.005	0.42	0.298	0.214	0.0073	0.0155
TK49	<0.005	0.069	0.69	12.00	2.7	<0.005	<0.005	0.36	0.208	0.199	0.0032	0.0059
TK50	<0.005	0.045	0.52	4.58	3.5	<0.005	<0.005	0.20	0.112	0.097	0.0040	0.0107
TK51	<0.005	0.008	0.69	12.73	5.1	<0.005	0.006	0.14	0.085	0.076	0.0009	0.0000
TK52	<0.005	0.058	0.70	7.80	2.6	<0.005	<0.005	0.63	0.293	0.321	0.0033	0.0046
TK53	0.008	0.057	0.62	6.99	2.1	<0.005	<0.005	0.53	0.258	0.294	0.0010	0.0003

App. 1b: Tabulated Geochemistry (cont.)

No.	Cr mg/l	Cu mg/l	Li mg/l	Mn mg/l	Sr mg/l	Ti mg/l	V mg/l	Zn mg/l	Co mg/l	Ni mg/l	Ga mg/l	Ge mg/l
TK54	0.007	0.068	0.57	4.66	1.0	<0.005	<0.005	0.55	0.177	0.216	0.0006	0.0001
TK55	<0.005	0.019	0.56	4.94	5.0	<0.005	<0.005	0.24	0.124	0.159	0.0013	0.0021
TK56	<0.005	<0.005	0.47	9.33	5.1	<0.005	<0.005	0.07	0.018	0.051	0.0007	0.0010
TK57	0.009	0.030	0.87	23.51	1.8	<0.005	0.006	0.54	0.355	0.505	0.0020	0.0015
TK58	<0.005	<0.005	0.67	11.72	5.9	<0.005	<0.005	0.10	0.007	0.025	0.0012	0.0001
TK59	0.011	0.210	0.78	14.25	0.4	<0.005	<0.005	0.83	0.298	0.274	0.0027	0.0027
TK60	<0.005	0.084	0.54	5.66	2.7	<0.005	<0.005	0.31	0.028	0.050	0.0019	0.0019
TK61	<0.005	0.007	0.52	4.67	5.8	<0.005	<0.005	<0.05	0.006	0.013	0.0001	0.0014
TK62	<0.005	0.129	0.52	5.20	3.0	<0.005	<0.005	0.45	0.081	0.110	0.0019	0.0029
TK63	<0.005	0.010	0.67	4.41	4.5	<0.005	<0.005	<0.05	0.003	0.015	0.0002	0.0000
TK64	<0.005	0.291	0.60	14.01	2.0	<0.005	<0.005	1.26	0.149	0.138	0.0033	0.0082
TK65	<0.005	0.046	0.63	7.97	1.4	<0.005	<0.005	0.24	0.047	0.065	0.0011	0.0031
TK66	<0.005	0.009	0.44	7.94	1.5	<0.005	<0.005	0.49	0.063	0.085	0.0011	0.0024
TK67	<0.005	0.012	0.28	8.53	1.8	<0.005	<0.005	0.07	0.035	0.035	0.0005	0.0014
TK68	<0.005	0.006	0.72	4.43	3.4	<0.005	<0.005	0.08	0.005	0.018	0.0001	0.0000
TK69	0.012	0.061	0.83	1.44	7.5	<0.005	<0.005	1.94	0.099	0.070	0.0025	0.0072
TK70	<0.005	<0.005	0.19	3.63	2.8	<0.005	<0.005	0.45	0.026	0.026	0.0004	0.0022
TK71	<0.005	0.017	0.55	11.46	3.6	<0.005	<0.005	0.56	0.136	0.130	0.0046	0.0140
TK72	<0.005	0.012	0.63	8.73	2.3	<0.005	<0.005	0.35	0.131	0.142	0.0040	0.0152
TK73	<0.005	0.106	0.94	4.53	3.8	<0.005	<0.005	0.26	0.082	0.075	0.0014	0.0053
TK74	<0.005	0.132	0.86	4.67	3.6	<0.005	<0.005	0.51	0.130	0.134	0.0039	0.0168
TK75	<0.005	0.335	0.66	6.73	0.7	<0.005	<0.005	0.72	0.039	0.055	0.0004	0.0005
TK76	<0.005	0.013	0.71	4.17	3.2	<0.005	<0.005	<0.05	0.005	0.019	0.0001	0.0007
TK77	<0.005	0.100	0.92	14.78	1.1	<0.005	0.005	0.57	0.273	0.199	0.0022	0.0075
TK78	<0.005	0.098	0.96	19.81	1.1	<0.005	0.006	0.73	0.278	0.207	0.0018	0.0060
TK79	<0.005	0.073	1.16	12.14	2.7	<0.005	<0.005	0.58	0.260	0.191	0.0037	0.0108
TK80	<0.005	0.052	1.00	10.40	0.9	<0.005	<0.005	0.46	0.218	0.179	0.0020	0.0057
TK81	<0.005	0.014	0.59	9.46	1.9	<0.005	<0.005	0.16	0.093	0.069	0.0003	0.0006
TK82	<0.005	0.006	0.56	2.80	4.2	<0.005	<0.005	0.07	0.002	0.008	0.0001	0.0003

TK83	<0.005	0.035	0.34	9.67	5.2	<0.005	0.005	0.46	0.066	0.071	0.0002	0.0006
TK84	<0.005	0.013	0.31	7.23	7.2	<0.005	<0.005	0.26	0.030	0.030	0.0001	0.0007
TK85	<0.005	0.129	0.46	6.92	7.9	<0.005	<0.005	0.27	0.039	0.044	0.0009	0.0023
TK86	<0.005	<0.005	0.14	2.84	2.1	<0.005	<0.005	0.06	0.019	0.022	0.0004	0.0012
TK87	<0.005	0.283	0.42	5.82	2.4	<0.005	<0.005	0.50	0.078	0.074	0.0021	0.0066
TK88	<0.005	<0.005	0.43	3.10	15	<0.005	<0.005	<0.05	0.002	0.008	0.0001	0.0004
TK89	<0.005	0.016	0.51	11.77	2.7	<0.005	0.006	0.07	0.015	0.024	0.0004	0.0008
TK90	<0.005	0.020	0.43	5.83	10	<0.005	<0.005	0.09	0.008	0.026	0.0002	0.0012
TK91	<0.005	<0.005	0.45	7.10	2.0	<0.005	<0.005	<0.05	0.015	0.019	0.0003	0.0017
TK92	<0.005	0.036	0.65	20.22	0.4	<0.005	0.006	0.31	0.201	0.132	0.0006	0.0018
TK93	<0.005	0.944	0.53	12.79	0.4	<0.005	0.005	1.00	0.168	0.108	0.0011	0.0040
TK94	<0.005	0.033	0.17	0.33	2.1	<0.005	<0.005	0.17	0.002	0.004	0.0001	0.0009
TK95	<0.005	<0.005	0.35	8.37	1.4	<0.005	0.007	<0.05	0.003	0.009	0.0003	0.0012
TK96	<0.005	0.149	0.46	10.44	2.1	<0.005	<0.005	0.31	0.150	0.060	0.0020	0.0063
TK97	<0.005	0.560	0.47	15.85	2.2	<0.005	0.007	0.65	0.292	0.074	0.0024	0.0059
TK98	<0.005	0.005	0.43	7.49	2.5	<0.005	<0.005	0.06	0.009	0.010	0.0004	0.0021
TK101	0.006	0.006	0.48	2.04	3.5	<0.005	<0.005	0.16	0.015	0.044	0.0006	0.0040
TK102	<0.005	0.195	0.69	37.37	2.2	<0.005	0.012	0.41	0.226	0.130	0.0044	0.0125

App. 1b: Tabulated Geochemistry (cont.)

No.	Rb mg/l	Mo mg/l	Cd mg/l	In mg/l	Sb mg/l	Te mg/l	Cs mg/l	Y mg/l	La mg/l	Ce mg/l	Pr mg/l
TK7	0.104	0.0003	0.0034	<0.00005	0.00039	0.0014	0.005	0.559	0.083	0.273	0.0435
TK8	0.107	0.0025	0.0023	<0.00005	0.00025	0.0021	0.024	0.185	0.001	0.006	0.0017
TK9	0.049	0.0043	0.0066	0.00014	0.00045	0.0049	0.000	0.347	0.023	0.102	0.0183
TK10	0.050	0.0025	0.0005	0.00011	0.00022	0.0010	0.006	0.008	0.000	0.001	0.0002
TK11	0.055	0.0013	0.0064	<0.00005	0.00029	0.0029	0.001	0.007	0.000	0.000	0.0001
TK12	0.072	0.0005	0.0049	0.00052	0.00012	0.0015	0.001	0.533	0.266	0.855	0.1137
TK13	0.088	0.0013	0.0083	0.00019	0.00023	0.0021	0.001	0.421	0.149	0.482	0.0753
TK14	0.063	0.0060	0.0151	0.00012	0.00020	0.0026	0.002	0.052	0.000	0.000	0.0001
TK15	0.110	0.0027	0.0026	0.00010	0.00018	0.0020	0.032	0.050	0.010	0.028	0.0038
TK16	0.056	0.0007	0.0006	<0.00005	0.00022	0.0034	0.002	0.094	0.010	0.035	0.0048
TK17	0.041	0.0036	0.0008	<0.00005	0.00002	0.0029	0.001	0.002	0.000	0.000	0.0000
TK18	0.054	0.0024	0.0006	<0.00005	0.00033	0.0006	0.011	0.001	0.000	0.000	0.0000
TK19	0.087	0.0058	0.0006	<0.00005	0.00014	0.0018	0.031	0.002	0.000	0.001	0.0001
TK20	0.071	0.0027	0.0019	0.00010	0.00020	0.0030	0.007	0.003	0.001	0.001	0.0002
TK21	0.062	0.0006	0.0089	<0.00005	0.00007	0.0019	0.001	0.213	0.037	0.125	0.0210
TK22	0.071	0.0045	0.0004	<0.00005	0.00004	0.0017	0.002	0.053	0.003	0.005	0.0008
TK23	0.043	0.0017	0.0042	<0.00005	0.00026	0.0015	0.001	0.033	0.002	0.008	0.0016
TK24	0.062	0.0120	0.0331	0.00005	0.00002	0.0027	0.005	0.001	0.000	0.000	0.0000
TK25	0.063	0.0034	0.0002	<0.00005	0.00003	0.0015	0.038	0.001	0.000	0.000	0.0000
TK26	0.066	0.0019	0.0097	0.00014	0.00037	0.0020	0.002	0.042	0.011	0.026	0.0038
TK27	0.110	0.0025	0.0002	0.00006	<0.00003	0.0038	0.012	0.007	0.002	0.004	0.0006
TK28	0.068	0.0024	0.0125	0.00008	0.00019	0.0021	0.003	0.085	0.016	0.036	0.0045
TK29	0.083	0.0093	0.0010	<0.00005	0.00003	0.0025	0.008	0.034	0.007	0.018	0.0022
TK30	0.060	0.0038	0.0138	<0.00005	0.00011	0.0017	0.004	0.034	0.003	0.008	0.0015
TK31	0.071	0.0041	0.0064	<0.00005	0.00010	0.0019	0.008	0.004	0.001	0.002	0.0002
TK32	0.107	0.0054	0.0032	<0.00005	0.00001	0.0016	0.028	0.002	0.001	0.001	0.0001
TK33	0.127	0.0017	0.0115	<0.00005	0.00027	0.0015	0.007	0.215	0.055	0.181	0.0277
TK34	0.180	0.0571	0.0125	0.00012	0.00113	0.0023	0.023	0.003	0.001	0.002	0.0002
TK35	0.188	0.0224	0.0053	0.00003	0.00061	0.0021	0.023	0.003	0.001	0.001	0.0001

TK36	0.166	0.0135	0.0031	0.00010	0.00050	0.0026	0.020	0.001	0.001	0.001	0.0001
TK37	0.118	0.0187	0.0029	<0.00005	0.00051	0.0021	0.015	0.002	0.001	0.001	0.0002
TK38	0.154	0.0149	0.0034	<0.00005	0.00040	0.0035	0.014	0.007	0.002	0.005	0.0009
TK39	0.155	0.0216	0.0020	<0.00005	0.00045	0.0014	0.022	0.001	0.001	0.001	0.0001
TK40	0.075	0.0164	0.0045	<0.00005	0.00026	0.0019	0.019	0.006	0.003	0.004	0.0004
TK41	0.078	0.0007	0.0016	0.00051	0.00028	0.0013	0.010	0.953	0.407	0.991	0.1354
TK42	0.053	0.0006	0.0023	0.00084	0.00066	0.0001	0.001	0.783	0.178	0.549	0.0855
TK43	0.061	0.0078	0.0000	0.00007	0.00023	0.0004	0.013	0.013	0.004	0.007	0.0010
TK44	0.024	0.0010	0.0002	<0.00005	0.00009	0.0003	0.001	0.014	0.011	0.027	0.0031
TK45	0.081	0.0035	0.0011	<0.00005	0.00015	0.0006	0.001	0.001	0.002	0.002	0.0003
TK46	0.075	0.0022	0.0017	<0.00005	0.00021	0.0009	0.001	0.016	0.002	0.003	0.0006
TK47	0.069	0.0001	0.0023	0.00012	0.00023	0.0007	0.015	0.107	0.084	0.184	0.0227
TK48	0.121	0.0029	0.0043	0.00072	0.00025	0.0016	0.005	1.166	0.276	0.778	0.1205
TK49	0.077	0.0015	0.0031	0.00014	0.00023	0.0014	0.006	0.437	0.076	0.243	0.0387
TK50	0.099	0.0021	0.0012	0.00012	0.00029	0.0009	0.001	0.433	0.174	0.555	0.0876
TK51	0.059	0.0017	0.0031	0.00006	0.00014	0.0014	0.005	0.061	0.022	0.042	0.0055
TK52	0.073	0.0014	0.0025	0.00026	0.00027	0.0012	0.001	0.873	0.145	0.351	0.0534
TK53	0.076	0.0010	0.0029	0.00018	0.00015	0.0001	0.001	0.423	0.020	0.068	0.0124

App. 1b: Tabulated Geochemistry (cont.)

No.	Rb mg/l	Mo mg/l	Cd mg/l	In mg/l	Sb mg/l	Te mg/l	Cs mg/l	Y mg/l	La mg/l	Ce mg/l	Pr mg/l
TK54	0.044	0.0002	0.0034	0.00017	0.00010	0.0009	0.000	0.264	0.017	0.056	0.0088
TK55	0.063	0.0035	0.0026	0.00014	0.00023	0.0014	0.004	0.243	0.061	0.162	0.0235
TK56	0.086	0.0314	0.0002	0.00005	0.00020	0.0012	0.013	0.027	0.008	0.017	0.0022
TK57	0.074	0.0014	0.0049	<0.00005	0.00007	0.0009	0.006	0.368	0.042	0.065	0.0084
TK58	0.077	0.1259	0.0003	<0.00005	0.00026	0.0009	0.008	0.004	0.001	0.002	0.0003
TK59	0.079	0.0021	0.0017	0.00082	0.00036	0.0015	0.001	0.776	0.031	0.117	0.0224
TK60	0.074	0.0007	0.0037	0.00008	0.00007	0.0005	0.002	0.097	0.061	0.181	0.0275
TK61	0.056	0.0040	0.0001	0.00005	0.00026	0.0008	0.032	0.003	0.001	0.001	0.0001
TK62	0.115	0.0009	0.0017	0.00012	0.00021	0.0005	0.002	0.150	0.090	0.266	0.0374
TK63	0.051	0.0042	0.0000	0.00003	0.00011	0.0004	0.008	0.001	0.000	0.001	0.0001
TK64	0.068	0.0014	0.0041	0.00032	0.00015	<0.0001	0.002	0.332	0.136	0.474	0.0721
TK65	0.042	0.0026	0.0051	0.00011	0.00015	0.0012	0.001	0.105	0.029	0.105	0.0184
TK66	0.070	0.0007	0.0017	0.00007	0.00012	0.0012	0.006	0.127	0.047	0.138	0.0196
TK67	0.053	0.0011	0.0025	0.00008	0.00004	0.0014	0.002	0.059	0.024	0.068	0.0102
TK68	0.056	0.0020	0.0000	<0.00005	0.00011	0.0014	0.007	0.001	0.000	0.001	0.0001
TK69	0.085	0.0013	0.0005	0.00032	0.00026	0.0006	0.002	0.408	0.154	0.444	0.0645
TK70	0.056	0.0069	0.0000	0.00005	0.00018	0.0001	0.001	0.066	0.030	0.068	0.0087
TK71	0.106	0.0014	0.0028	0.00014	0.00005	<0.0001	0.015	0.643	0.246	0.668	0.0974
TK72	0.099	0.0012	0.0056	0.00021	0.00027	0.0025	0.017	0.503	0.254	0.677	0.0956
TK73	0.071	0.0005	0.0020	0.00017	0.00014	0.0002	0.001	0.305	0.051	0.183	0.0310
TK74	0.087	0.0002	0.0032	0.00028	<0.00003	0.0004	0.002	0.744	0.107	0.490	0.0933
TK75	0.039	0.0011	0.0010	<0.00005	0.00009	<0.0001	0.003	0.080	0.020	0.053	0.0079
TK76	0.043	0.0116	0.0000	<0.00005	0.00001	<0.0001	0.009	0.000	0.000	0.000	0.0000
TK77	0.046	0.0009	0.0013	0.00056	0.00027	0.0004	0.001	0.824	0.057	0.258	0.0471
TK78	0.057	0.0019	0.0016	0.00035	<0.00003	0.0004	0.001	0.877	0.052	0.185	0.0322
TK79	0.063	0.0003	0.0009	0.00056	<0.00003	0.0007	0.001	0.747	0.101	0.422	0.0708
TK80	0.066	0.0004	0.0007	0.00016	<0.00003	0.0005	0.003	0.511	0.138	0.328	0.0411
TK81	0.092	0.0021	0.0005	<0.00005	0.00013	0.0007	0.006	0.020	0.007	0.012	0.0014
TK82	0.096	0.0085	0.0000	<0.00005	0.00004	0.0005	0.014	0.001	0.000	0.001	0.0001

TK83	0.048	0.0012	0.0006	0.00006	<0.00003	0.0002	0.004	0.220	0.003	0.007	0.0013
TK84	0.051	0.0024	0.0000	<0.00005	0.00011	0.0014	0.004	0.085	0.001	0.003	0.0004
TK85	0.057	0.0014	0.0013	0.00006	0.00022	0.0019	0.005	0.113	0.055	0.137	0.0184
TK86	0.027	0.0016	0.0002	<0.00005	0.00021	0.0007	0.001	0.019	0.014	0.035	0.0046
TK87	0.049	0.0007	0.0010	0.00026	0.00019	0.0013	0.001	0.449	0.106	0.325	0.0479
TK88	0.049	0.0069	0.0000	<0.00005	0.00028	0.0020	0.007	0.001	0.001	0.001	0.0002
TK89	0.050	0.0028	0.0005	<0.00005	0.00010	0.0011	0.012	0.009	0.001	0.003	0.0005
TK90	0.060	0.0026	0.0003	<0.00005	0.00019	0.0008	0.007	0.003	0.001	0.001	0.0002
TK91	0.043	0.0012	0.0007	<0.00005	0.00017	0.0018	0.003	0.001	0.000	0.001	0.0001
TK92	0.057	0.0016	0.0015	0.00005	0.00018	0.0021	0.004	0.056	0.005	0.011	0.0016
TK93	0.046	0.0016	0.0013	0.00027	0.00058	0.0000	0.001	0.588	0.022	0.095	0.0152
TK94	0.027	0.0013	0.0005	<0.00005	0.00020	0.0000	0.000	0.001	0.000	0.000	0.0000
TK95	0.028	0.0006	0.0005	<0.00005	0.00014	0.0000	0.000	0.026	0.001	0.001	0.0001
TK96	0.072	0.0003	0.0013	<0.00005	0.00026	0.0007	0.001	0.361	0.081	0.220	0.0343
TK97	0.077	0.0001	0.0015	0.00016	0.00015	0.0006	0.001	0.431	0.074	0.239	0.0397
TK98	0.039	0.0024	0.0008	0.00009	0.00027	0.0014	0.002	0.005	0.000	0.001	0.0002
TK101	0.053	0.0031	0.0061	0.00018	0.00041	0.0014	0.004	0.004	0.001	0.002	0.0003
TK102	0.065	0.0005	0.0037	0.00058	0.00054	0.0031	0.004	0.366	0.117	0.452	0.0679

App. 1b: Tabulated Geochemistry (cont.)

No.	Nd mg/l	Sm mg/l	Eu mg/l	Gd mg/l	Tb mg/l	Dy mg/l	Ho mg/l	Er mg/l	Tm mg/l	Yb mg/l	Lu mg/l
TK7	0.221	0.0606	0.0173	0.0832	0.0120	0.0710	0.0150	0.0417	0.0053	0.0344	0.0055
TK8	0.013	0.0063	0.0017	0.0116	0.0023	0.0163	0.0037	0.0092	0.0009	0.0057	0.0007
TK9	0.108	0.0350	0.0082	0.0482	0.0077	0.0474	0.0099	0.0264	0.0034	0.0214	0.0030
TK10	0.000	0.0002	0.0002	0.0007	0.0001	0.0008	0.0002	0.0010	0.0002	0.0009	0.0003
TK11	0.001	0.0008	0.0001	0.0005	0.0001	0.0004	0.0001	0.0004	0.0000	0.0001	0.0001
TK12	0.492	0.0964	0.0206	0.1151	0.0149	0.0795	0.0161	0.0460	0.0058	0.0353	0.0055
TK13	0.352	0.0837	0.0190	0.0952	0.0134	0.0717	0.0132	0.0323	0.0038	0.0218	0.0035
TK14	0.001	0.0011	0.0007	0.0038	0.0008	0.0050	0.0011	0.0032	0.0004	0.0016	0.0003
TK15	0.016	0.0029	0.0009	0.0052	0.0007	0.0045	0.0010	0.0031	0.0004	0.0019	0.0004
TK16	0.025	0.0065	0.0018	0.0115	0.0017	0.0099	0.0019	0.0049	0.0005	0.0026	0.0005
TK17	0.000	0.0000	0.0000	0.0002	0.0000	0.0003	0.0000	0.0004	0.0001	0.0001	0.0001
TK18	0.000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
TK19	0.001	0.0000	0.0001	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000
TK20	0.000	0.0000	0.0000	0.0003	0.0000	0.0002	0.0000	0.0003	0.0001	0.0002	0.0001
TK21	0.104	0.0267	0.0069	0.0349	0.0053	0.0313	0.0066	0.0170	0.0021	0.0133	0.0020
TK22	0.005	0.0009	0.0005	0.0032	0.0004	0.0034	0.0008	0.0023	0.0003	0.0014	0.0002
TK23	0.009	0.0028	0.0008	0.0052	0.0008	0.0050	0.0009	0.0021	0.0003	0.0014	0.0002
TK24	0.000	0.0000	0.0000	0.0001	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000
TK25	0.000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000
TK26	0.018	0.0036	0.0010	0.0058	0.0009	0.0050	0.0011	0.0027	0.0003	0.0017	0.0004
TK27	0.002	0.0012	0.0000	0.0010	0.0001	0.0008	0.0002	0.0008	0.0001	0.0010	0.0002
TK28	0.022	0.0043	0.0012	0.0090	0.0013	0.0082	0.0017	0.0046	0.0005	0.0025	0.0005
TK29	0.010	0.0027	0.0006	0.0042	0.0006	0.0029	0.0006	0.0015	0.0001	0.0010	0.0001
TK30	0.010	0.0029	0.0006	0.0045	0.0006	0.0035	0.0007	0.0018	0.0002	0.0012	0.0002
TK31	0.001	0.0004	0.0000	0.0003	0.0000	0.0002	0.0000	0.0001	0.0000	0.0000	0.0000
TK32	0.000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
TK33	0.126	0.0308	0.0069	0.0344	0.0052	0.0300	0.0061	0.0167	0.0022	0.0138	0.0022
TK34	0.001	0.0003	0.0000	0.0003	0.0001	0.0003	0.0001	0.0003	0.0001	0.0000	0.0001
TK35	0.001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0003	0.0000	0.0001	0.0001

TK36	0.001	0.0001	0.0000	0.0001	0.0000	0.0002	0.0000	0.0002	0.0000	0.0001	0.0001
TK37	0.001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0001	0.0003	0.0000	0.0001	0.0000
TK38	0.004	0.0009	0.0002	0.0010	0.0002	0.0011	0.0001	0.0005	0.0001	0.0004	0.0000
TK39	0.000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001
TK40	0.002	0.0007	0.0001	0.0005	0.0001	0.0004	0.0001	0.0004	0.0001	0.0002	0.0000
TK41	0.576	0.1174	0.0313	0.1590	0.0225	0.1365	0.0273	0.0750	0.0094	0.0565	0.0089
TK42	0.396	0.0916	0.0232	0.1259	0.0198	0.1169	0.0239	0.0620	0.0081	0.0492	0.0075
TK43	0.004	0.0008	0.0002	0.0013	0.0001	0.0010	0.0004	0.0011	0.0002	0.0013	0.0003
TK44	0.012	0.0021	0.0005	0.0026	0.0003	0.0018	0.0004	0.0009	0.0001	0.0007	0.0001
TK45	0.001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000
TK46	0.004	0.0009	0.0002	0.0016	0.0002	0.0009	0.0002	0.0003	0.0001	0.0002	0.0000
TK47	0.093	0.0193	0.0035	0.0208	0.0029	0.0164	0.0031	0.0088	0.0012	0.0070	0.0009
TK48	0.549	0.1340	0.0350	0.1787	0.0275	0.1633	0.0328	0.0881	0.0107	0.0611	0.0100
TK49	0.188	0.0441	0.0114	0.0616	0.0093	0.0541	0.0110	0.0289	0.0035	0.0197	0.0031
TK50	0.430	0.0857	0.0186	0.0994	0.0122	0.0624	0.0121	0.0309	0.0036	0.0201	0.0032
TK51	0.025	0.0042	0.0011	0.0070	0.0008	0.0054	0.0012	0.0027	0.0004	0.0015	0.0003
TK52	0.244	0.0531	0.0148	0.0993	0.0149	0.0933	0.0211	0.0601	0.0072	0.0394	0.0066
TK53	0.069	0.0185	0.0059	0.0357	0.0063	0.0430	0.0095	0.0278	0.0038	0.0203	0.0033

App. 1b: Tabulated Geochemistry (cont.)

No.	Nd mg/l	Sm mg/l	Eu mg/l	Gd mg/l	Tb mg/l	Dy mg/l	Ho mg/l	Er mg/l	Tm mg/l	Yb mg/l	Lu mg/l
TK54	0.045	0.0118	0.0036	0.0225	0.0036	0.0243	0.0060	0.0182	0.0023	0.0139	0.0024
TK55	0.104	0.0228	0.0062	0.0324	0.0050	0.0299	0.0067	0.0171	0.0024	0.0143	0.0021
TK56	0.010	0.0017	0.0006	0.0038	0.0005	0.0019	0.0007	0.0018	0.0003	0.0016	0.0004
TK57	0.040	0.0101	0.0033	0.0300	0.0051	0.0349	0.0082	0.0216	0.0025	0.0110	0.0018
TK58	0.001	0.0004	0.0000	0.0003	0.0001	0.0004	0.0001	0.0002	0.0001	0.0001	0.0001
TK59	0.133	0.0477	0.0144	0.0814	0.0141	0.0938	0.0205	0.0591	0.0078	0.0504	0.0075
TK60	0.124	0.0266	0.0053	0.0261	0.0034	0.0159	0.0031	0.0080	0.0010	0.0059	0.0010
TK61	0.000	0.0000	0.0000	0.0002	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001
TK62	0.158	0.0343	0.0081	0.0380	0.0053	0.0262	0.0052	0.0135	0.0018	0.0105	0.0016
TK63	0.000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0001
TK64	0.325	0.0727	0.0175	0.0746	0.0106	0.0587	0.0109	0.0297	0.0039	0.0237	0.0034
TK65	0.086	0.0202	0.0038	0.0214	0.0030	0.0166	0.0033	0.0083	0.0012	0.0065	0.0009
TK66	0.084	0.0184	0.0038	0.0231	0.0033	0.0185	0.0038	0.0092	0.0013	0.0065	0.0012
TK67	0.044	0.0099	0.0020	0.0119	0.0017	0.0085	0.0017	0.0049	0.0006	0.0034	0.0005
TK68	0.000	0.0000	0.0000	0.0001	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
TK69	0.281	0.0586	0.0120	0.0750	0.0104	0.0621	0.0128	0.0350	0.0044	0.0292	0.0043
TK70	0.036	0.0065	0.0012	0.0090	0.0012	0.0063	0.0016	0.0040	0.0005	0.0031	0.0006
TK71	0.429	0.0910	0.0201	0.1183	0.0172	0.0962	0.0200	0.0547	0.0065	0.0390	0.0061
TK72	0.417	0.0865	0.0186	0.1085	0.0149	0.0812	0.0165	0.0430	0.0053	0.0322	0.0052
TK73	0.149	0.0376	0.0083	0.0493	0.0075	0.0440	0.0091	0.0258	0.0030	0.0187	0.0029
TK74	0.475	0.1102	0.0274	0.1378	0.0200	0.1091	0.0224	0.0589	0.0079	0.0466	0.0068
TK75	0.037	0.0077	0.0023	0.0117	0.0017	0.0108	0.0023	0.0058	0.0007	0.0043	0.0006
TK76	0.000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TK77	0.276	0.0830	0.0246	0.1183	0.0193	0.1190	0.0244	0.0677	0.0089	0.0560	0.0087
TK78	0.189	0.0726	0.0244	0.1351	0.0208	0.1301	0.0254	0.0698	0.0088	0.0518	0.0080
TK79	0.379	0.1016	0.0278	0.1285	0.0194	0.1171	0.0230	0.0633	0.0084	0.0521	0.0080
TK80	0.186	0.0449	0.0117	0.0705	0.0104	0.0656	0.0137	0.0384	0.0049	0.0281	0.0045
TK81	0.006	0.0012	0.0003	0.0018	0.0002	0.0015	0.0004	0.0010	0.0001	0.0006	0.0001
TK82	0.000	0.0002	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000

TK83	0.010	0.0047	0.0018	0.0112	0.0023	0.0176	0.0046	0.0146	0.0022	0.0143	0.0026
TK84	0.003	0.0018	0.0006	0.0043	0.0007	0.0071	0.0018	0.0049	0.0007	0.0042	0.0007
TK85	0.078	0.0142	0.0036	0.0182	0.0026	0.0140	0.0030	0.0073	0.0011	0.0061	0.0010
TK86	0.019	0.0033	0.0007	0.0036	0.0004	0.0022	0.0005	0.0012	0.0002	0.0007	0.0001
TK87	0.214	0.0510	0.0140	0.0645	0.0104	0.0605	0.0126	0.0373	0.0050	0.0307	0.0049
TK88	0.001	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000
TK89	0.002	0.0005	0.0001	0.0008	0.0002	0.0009	0.0002	0.0005	0.0001	0.0006	0.0000
TK90	0.001	0.0001	0.0000	0.0002	0.0001	0.0003	0.0001	0.0003	0.0001	0.0001	0.0000
TK91	0.001	0.0002	0.0000	0.0003	0.0000	0.0001	0.0000	0.0002	0.0000	0.0001	0.0000
TK92	0.007	0.0015	0.0006	0.0048	0.0008	0.0053	0.0012	0.0031	0.0004	0.0018	0.0003
TK93	0.080	0.0222	0.0062	0.0462	0.0082	0.0556	0.0130	0.0372	0.0052	0.0298	0.0049
TK94	0.000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000
TK95	0.001	0.0002	0.0001	0.0007	0.0002	0.0022	0.0009	0.0034	0.0006	0.0038	0.0007
TK96	0.162	0.0394	0.0102	0.0553	0.0081	0.0467	0.0098	0.0260	0.0033	0.0181	0.0030
TK97	0.195	0.0501	0.0134	0.0682	0.0106	0.0605	0.0125	0.0310	0.0039	0.0220	0.0035
TK98	0.001	0.0005	0.0002	0.0004	0.0001	0.0006	0.0001	0.0005	0.0000	0.0003	0.0001
TK101	0.002	0.0011	0.0002	0.0007	0.0002	0.0006	0.0002	0.0004	0.0001	0.0004	0.0002
TK102	0.314	0.0754	0.0168	0.0842	0.0129	0.0672	0.0120	0.0299	0.0037	0.0214	0.0033

App. 1b: Tabulated Geochemistry (cont.)

No.	Tl mg/l	Pb mg/l	Bi mg/l	Th mg/l	U mg/l
TK7	0.0002	0.016	<0.00005	0.0002	0.033
TK8	<0.0001	0.004	<0.00005	<0.0001	0.006
TK9	0.0002	0.018	<0.00005	<0.0001	0.028
TK10	0.0002	0.001	0.00005	0.0007	0.042
TK11	0.0003	0.002	0.00005	0.0003	0.002
TK12	0.0001	0.007	<0.00005	0.0003	0.116
TK13	0.0004	0.016	0.00012	0.0029	0.076
TK14	0.0002	0.002	0.00007	<0.0001	0.040
TK15	0.0001	0.004	0.00015	<0.0001	0.013
TK16	0.0002	0.005	0.00005	<0.0001	0.023
TK17	0.0001	0.001	<0.00005	<0.0001	0.004
TK18	0.0001	0.002	0.00009	0.0008	0.006
TK19	<0.0001	0.006	0.00011	0.0003	0.007
TK20	<0.0001	0.003	0.00012	0.0002	0.029
TK21	0.0003	0.008	0.00007	0.0001	0.083
TK22	<0.0001	0.005	0.00014	0.0001	0.007
TK23	0.0001	0.019	0.00005	<0.0001	0.007
TK24	<0.0001	0.005	<0.00005	<0.0001	0.004
TK25	<0.0001	0.002	<0.00005	<0.0001	0.006
TK26	0.0003	0.004	0.00033	0.0009	0.035
TK27	0.0001	0.001	0.00009	0.0003	0.039
TK28	0.0006	0.012	0.00008	0.0001	0.060
TK29	0.0005	0.003	0.00005	0.0001	0.049
TK30	0.0001	0.005	0.00009	<0.0001	0.029
TK31	<0.0001	0.011	0.00007	<0.0001	0.047
TK32	<0.0001	0.003	0.00007	<0.0001	0.007
TK33	<0.0001	0.027	<0.00005	<0.0001	0.063
TK34	0.0007	0.081	0.00019	0.0012	0.069
TK35	0.0004	0.052	0.00012	0.0004	0.077
TK36	0.0002	0.011	0.00016	0.0003	0.036
TK37	0.000	0.008	0.0000	0.000	0.093

	2		7	1	
TK38	<0.0001	0.064	0.0001 1	0.000 2	0.029
TK39	0.000 1	0.002	0.0001 0	0.000 1	0.068
TK40	<0.0001	0.006	<0.00005	<0.0001	0.019
TK41	0.000 4	0.259	<0.00005	0.000 1	0.094
TK42	0.000 8	0.011	0.0002 3	0.002 6	0.140
TK43	0.000 1	0.003	0.0001 0	0.000 4	0.005
TK44	0.000 1	0.001	<0.00005	0.000 1	0.001
TK45	0.000 1	0.001	0.0000 5	0.000 1	0.001
TK46	0.000 1	0.003	0.0000 7	<0.0001	0.001
TK47	0.000 6	0.079	<0.00005	0.000 2	0.021
TK48	0.001 3	0.334	0.0002 8	0.000 6	0.129
TK49	0.001 9	0.077	0.0001 8	0.000 1	0.043
TK50	0.000 4	0.002	0.0002 5	0.001 0	0.025
TK51	0.000 3	0.005	0.0002 8	0.000 3	0.026
TK52	0.000 2	0.100	0.0001 6	0.000 4	0.037
TK53	0.000 5	0.011	0.0001 4	0.000 1	0.015

App. 1b: Tabulated Geochemistry (cont.)

No.	Tl mg/l	Pb mg/l	Bi mg/l	Th mg/l	U mg/l
TK54	0.0001	0.008	0.00007	<0.0001	0.009
TK55	0.0007	0.045	0.00010	0.0001	0.018
TK56	0.0001	0.003	0.00014	<0.0001	0.012
TK57	0.0014	0.005	0.00012	<0.0001	0.025
TK58	<0.0001	0.004	0.00007	<0.0001	0.021
TK59	0.0010	0.022	0.00006	0.0012	0.099
TK60	0.0001	0.013	0.00015	0.0002	0.031
TK61	0.0001	0.001	0.00032	0.0003	0.001
TK62	0.0002	0.009	0.00022	0.0046	0.058
TK63	<0.0001	0.001	0.00018	0.0001	0.002
TK64	0.0002	0.007	0.00012	0.0013	0.085
TK65	0.0002	0.006	0.00018	0.0003	0.025
TK66	0.0002	0.003	0.00013	<0.0001	0.007
TK67	0.0002	0.002	0.00014	0.0001	0.012
TK68	<0.0001	0.003	0.00021	<0.0001	0.003
TK69	0.0005	0.016	0.00009	0.0026	0.099
TK70	0.0001	<0.001	0.00012	0.0001	0.001
TK71	0.0012	0.033	0.00002	0.0001	0.038
TK72	0.0011	0.084	0.00016	0.0004	0.045
TK73	0.0004	0.008	0.00007	0.0003	0.054
TK74	0.0003	0.020	0.00006	0.0005	0.075
TK75	0.0001	0.060	<0.00005	<0.0001	0.008
TK76	<0.0001	<0.001	<0.00005	<0.0001	0.001
TK77	0.0005	0.010	0.00010	0.0006	0.126
TK78	0.0003	0.002	0.00013	0.0002	0.085
TK79	0.0002	0.002	0.00007	0.0004	0.127
TK80	0.0002	0.013	0.00009	0.0001	0.030
TK81	0.0002	0.001	0.00014	<0.0001	0.020
TK82	<0.0001	<0.001	0.00005	<0.0001	0.004

TK83	0.0001	0.017	0.00009	<0.0001	0.017
TK84	0.0001	0.005	<0.00005	<0.0001	0.009
TK85	0.0001	0.050	0.00019	0.0004	0.016
TK86	<0.0001	0.001	<0.00005	0.0002	0.002
TK87	0.0004	0.006	0.00014	0.0008	0.069
TK88	<0.0001	<0.001	<0.00005	<0.0001	0.006
TK89	0.0001	<0.001	0.00003	<0.0001	0.005
TK90	<0.0001	<0.001	0.00007	<0.0001	0.002
TK91	0.0001	<0.001	<0.00005	0.0001	0.002
TK92	0.0003	0.007	<0.00005	0.0001	0.004
TK93	0.0004	0.008	0.00023	0.0034	0.039
TK94	<0.0001	<0.001	0.00006	<0.0001	0.001
TK95	<0.0001	0.001	0.00009	<0.0001	0.000
TK96	0.0001	0.012	0.00007	0.0001	0.017
TK97	0.0002	0.012	0.00007	0.0001	0.036
TK98	0.0001	0.001	0.00017	<0.0001	0.002
TK101	0.0002	0.012	0.00021	0.0001	0.016
TK102	0.0005	0.027	0.00026	0.0027	0.127

Appendix 2: Element/ion concentrations for groundwaters

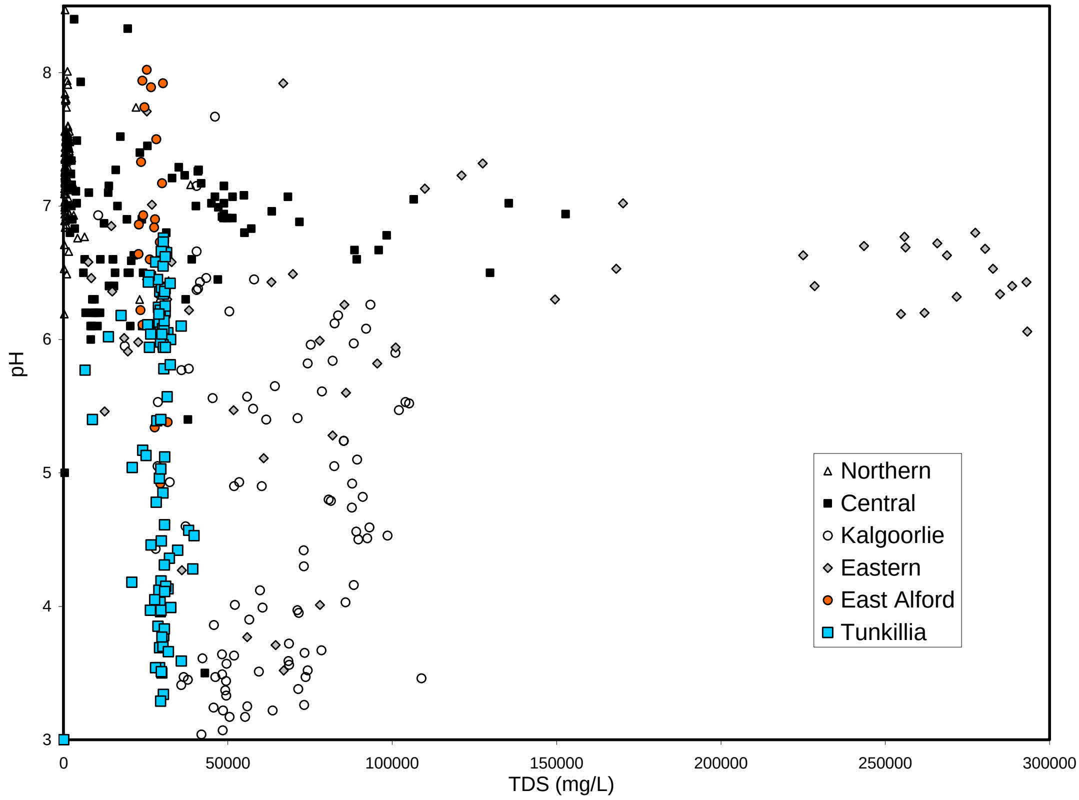

Figure A2.1: pH vs. TDS for groundwaters from Tunkillia and Western Australia.

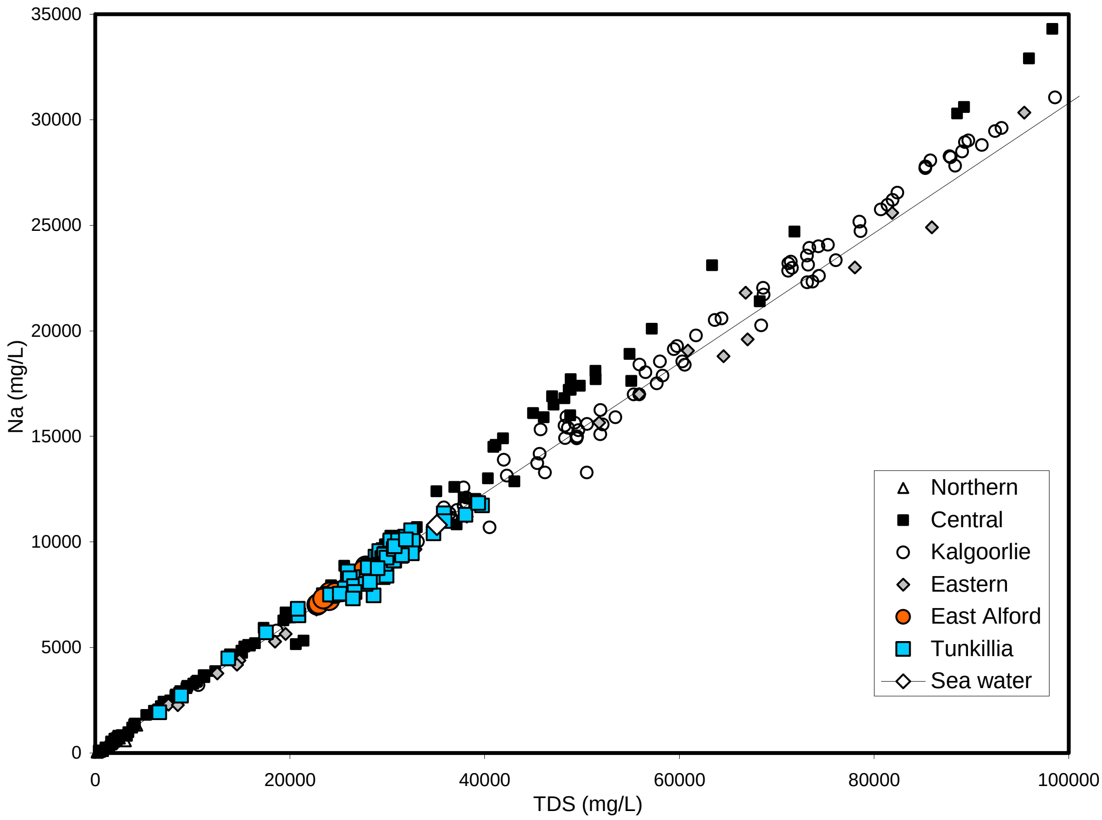

Figure A2.2: Na vs. TDS for groundwaters from Tunkillia and Western Australia.

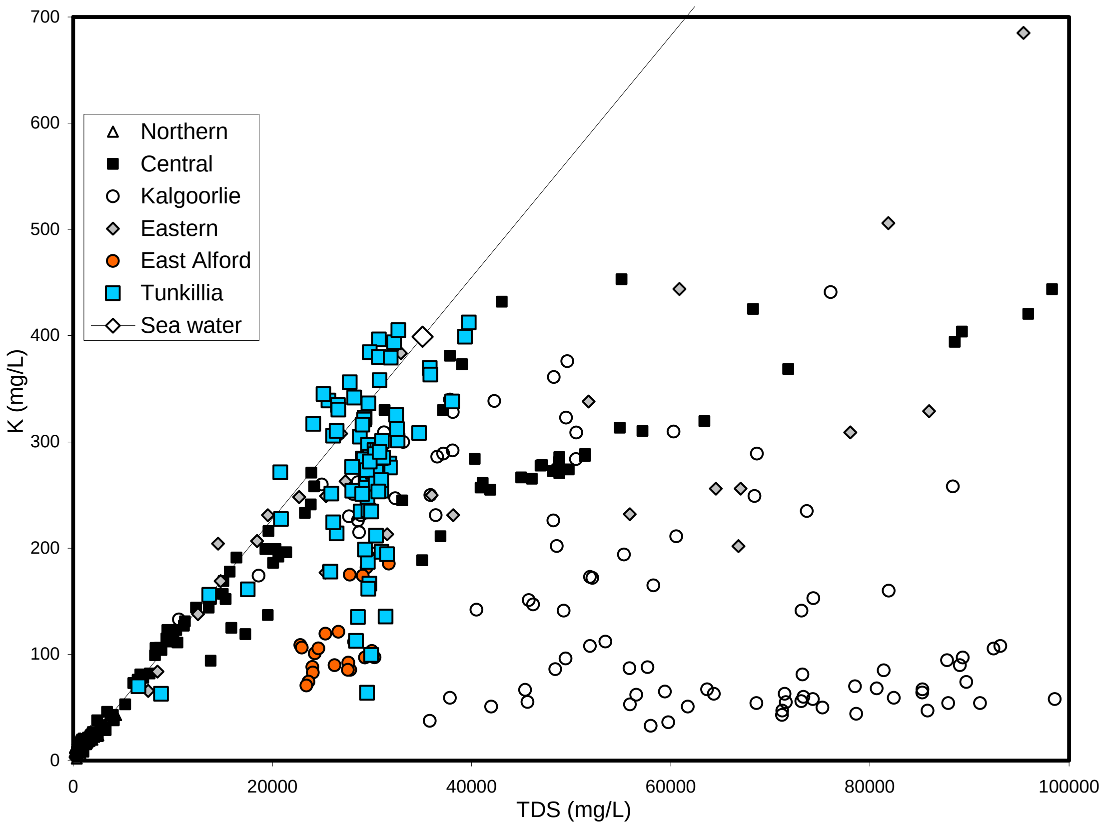

Figure A2.3: K vs. TDS for groundwaters from Tunkillia and Western Australia.

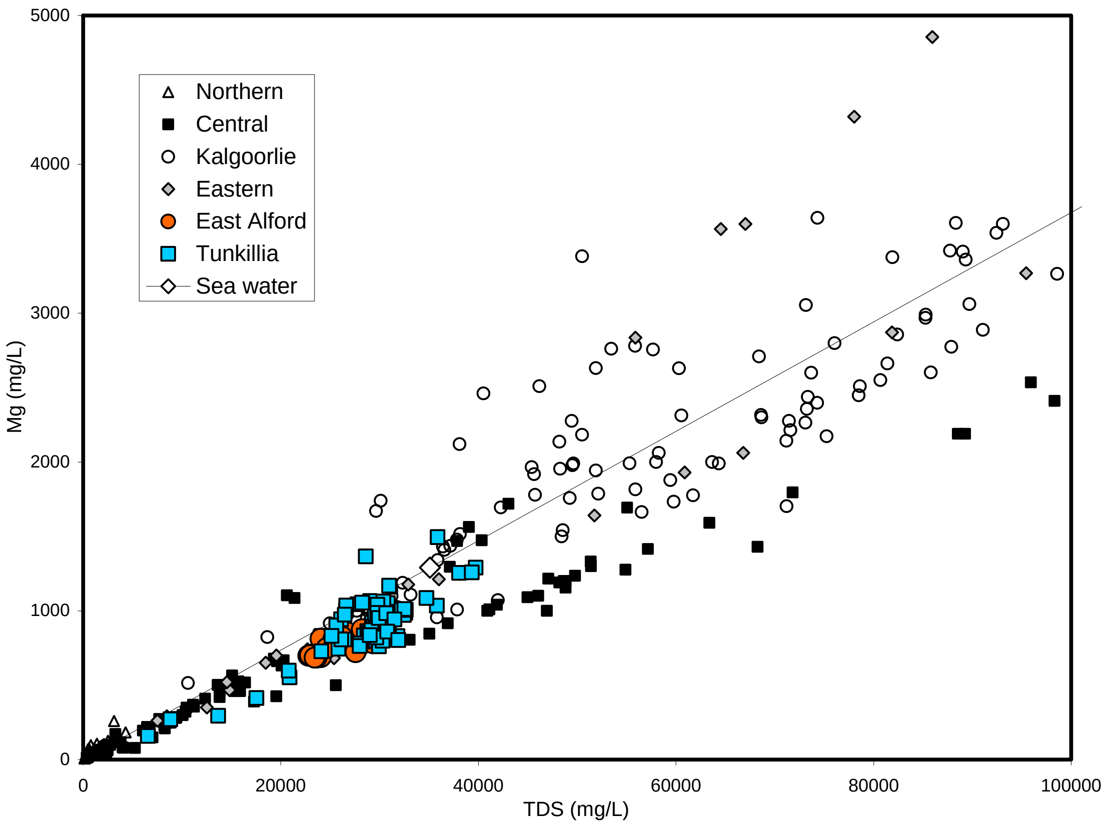

Figure A2.4: Mg vs. TDS for groundwaters from Tunkillia and Western Australia.

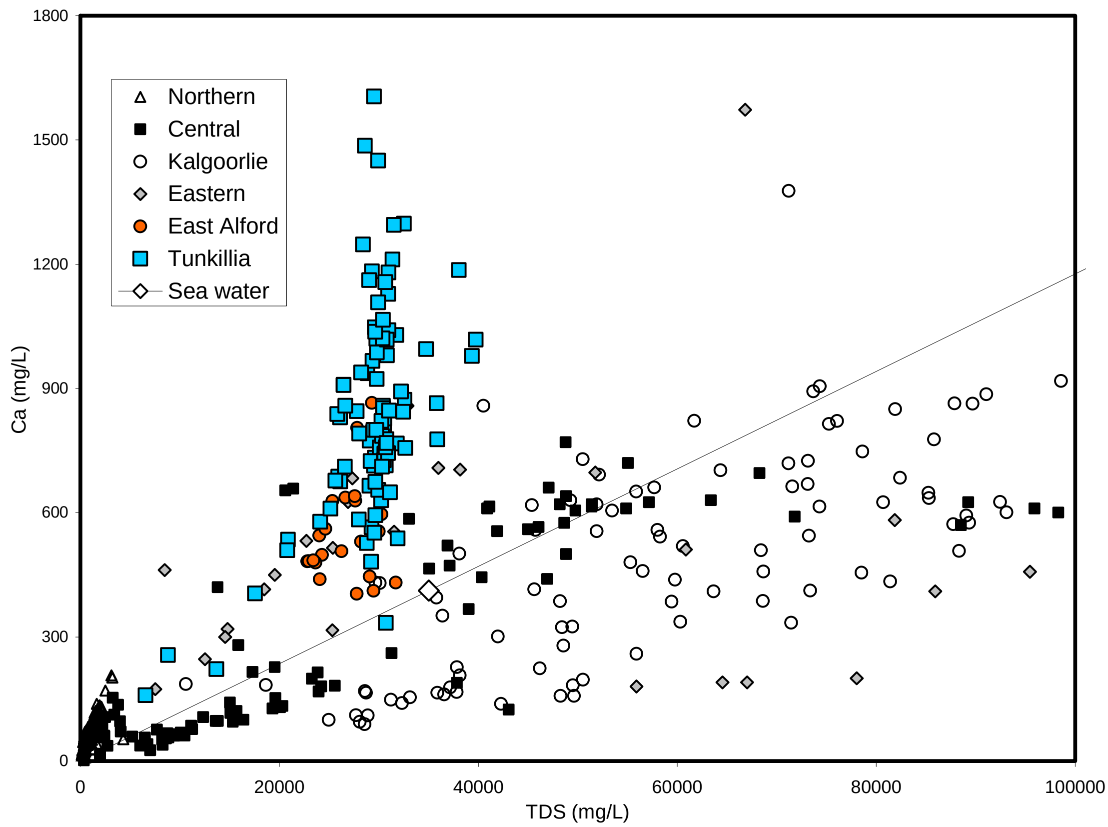

Figure A2.5: Ca vs. TDS for groundwaters from Tunkillia and Western Australia.

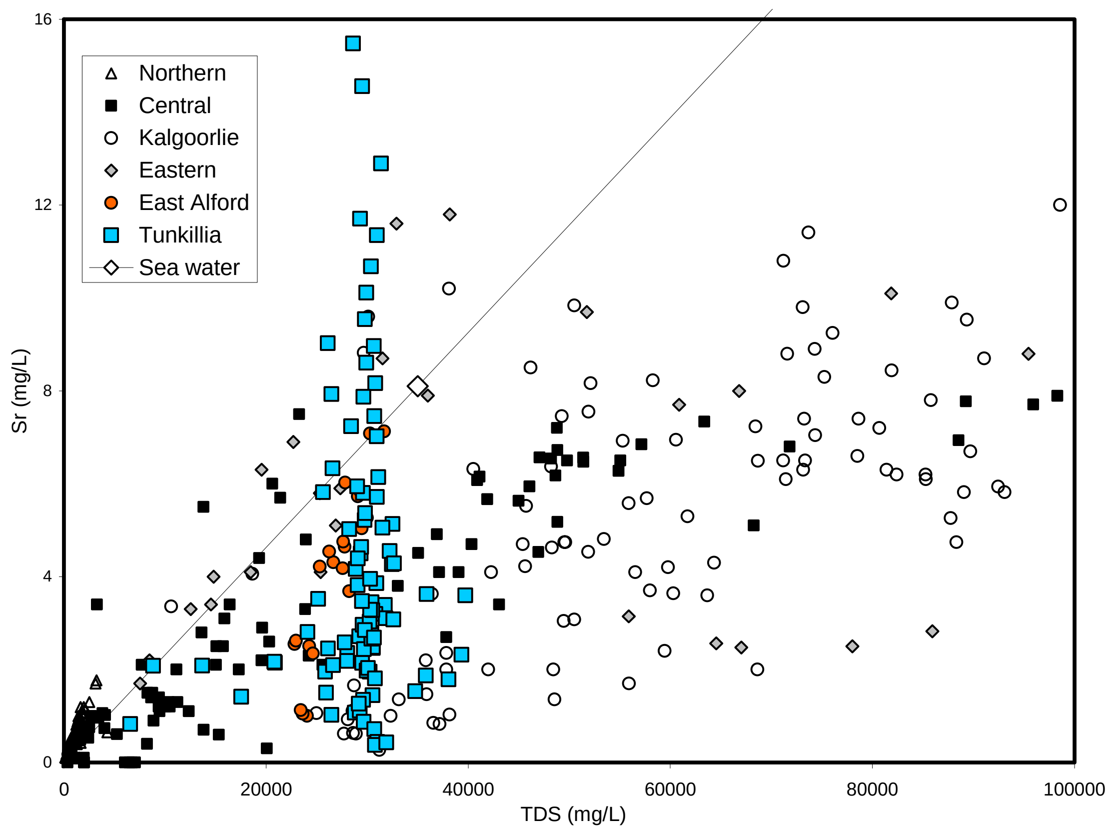

Figure A2.6: Sr vs. TDS for groundwaters from Tunkillia and Western Australia.

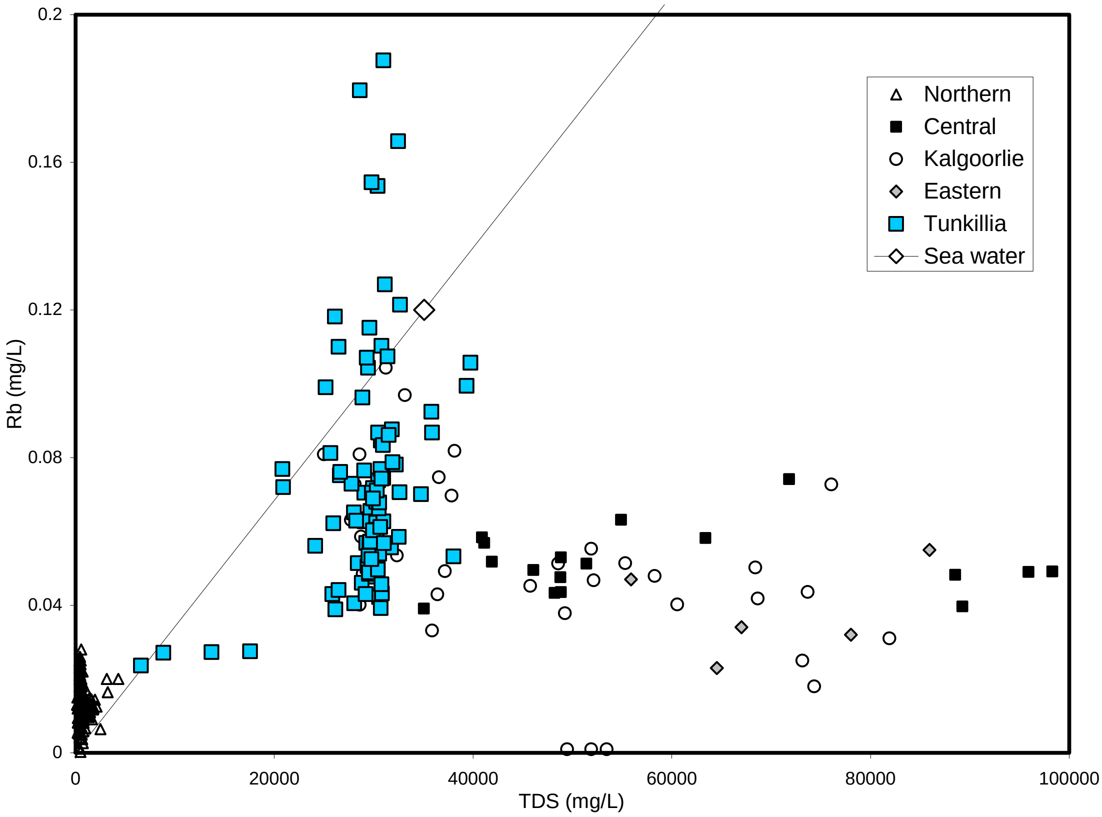

Figure A2.7: Rb vs. TDS for groundwaters from Tunkillia and Western Australia.

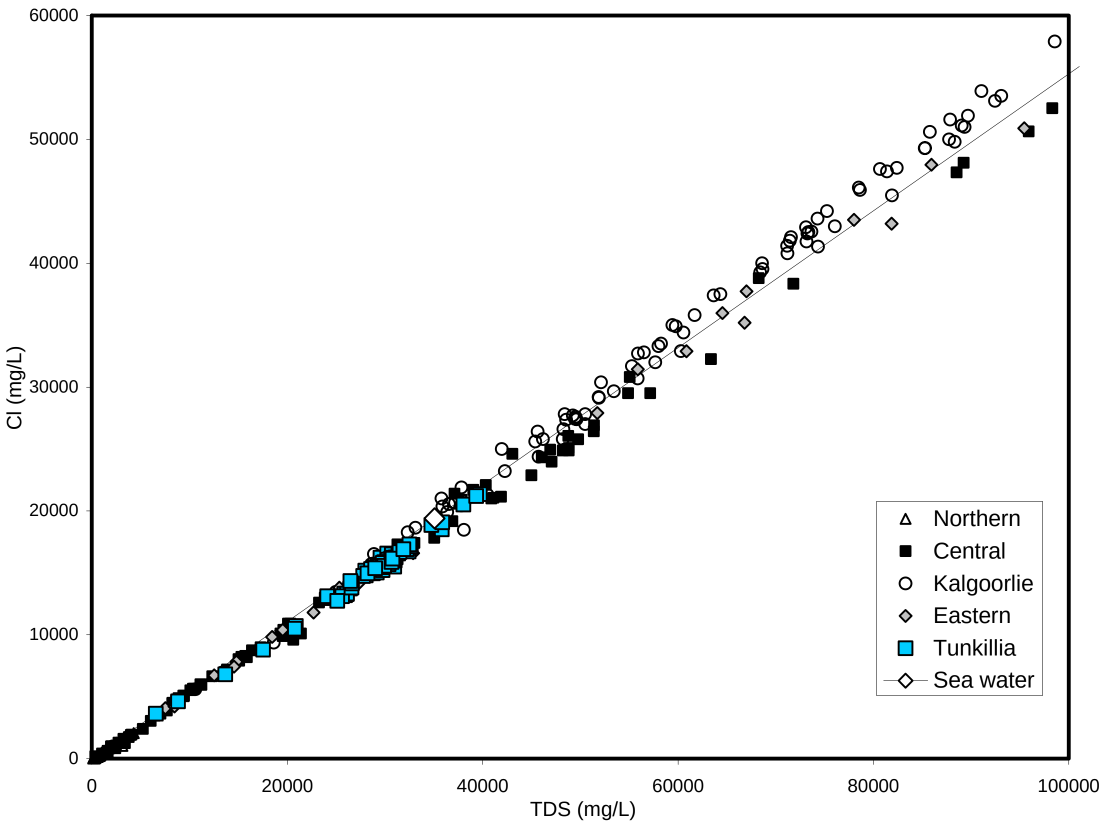

Figure A2.8: Cl vs. TDS for groundwaters from Tunkillia and Western Australia.

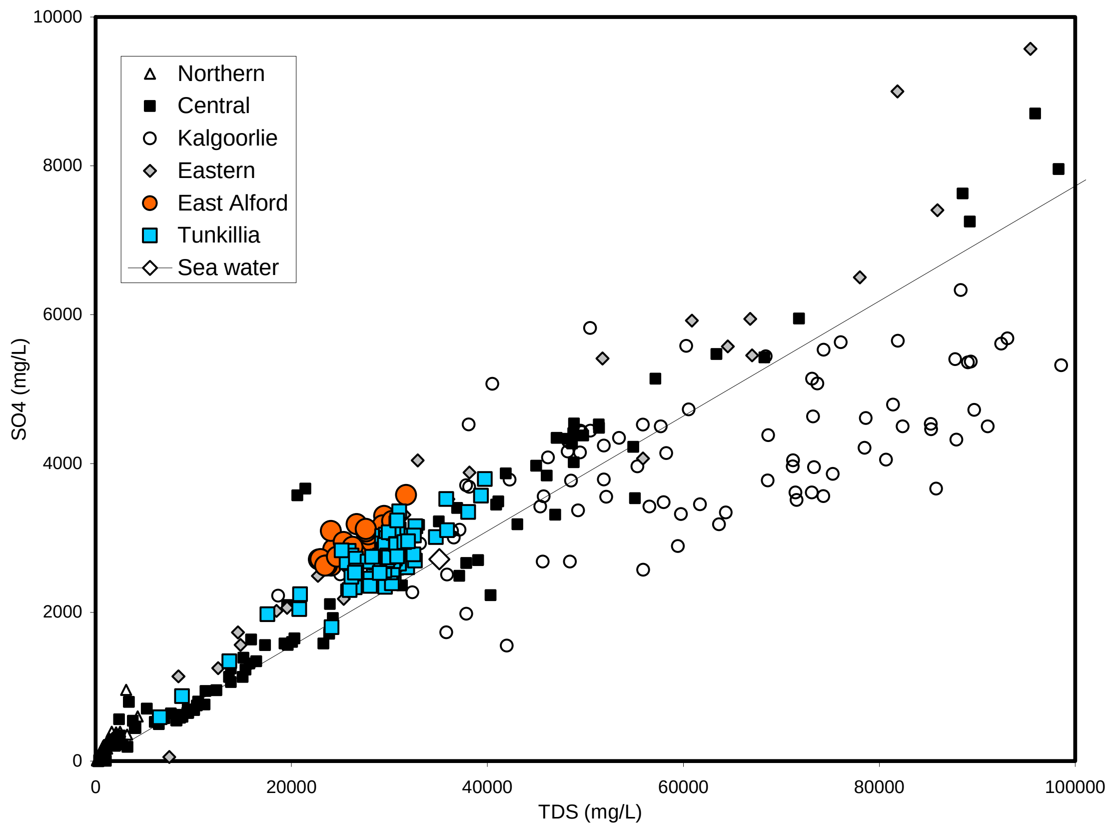

Figure A2.9: SO_4 vs. TDS for groundwaters from Tunkillia and Western Australia.

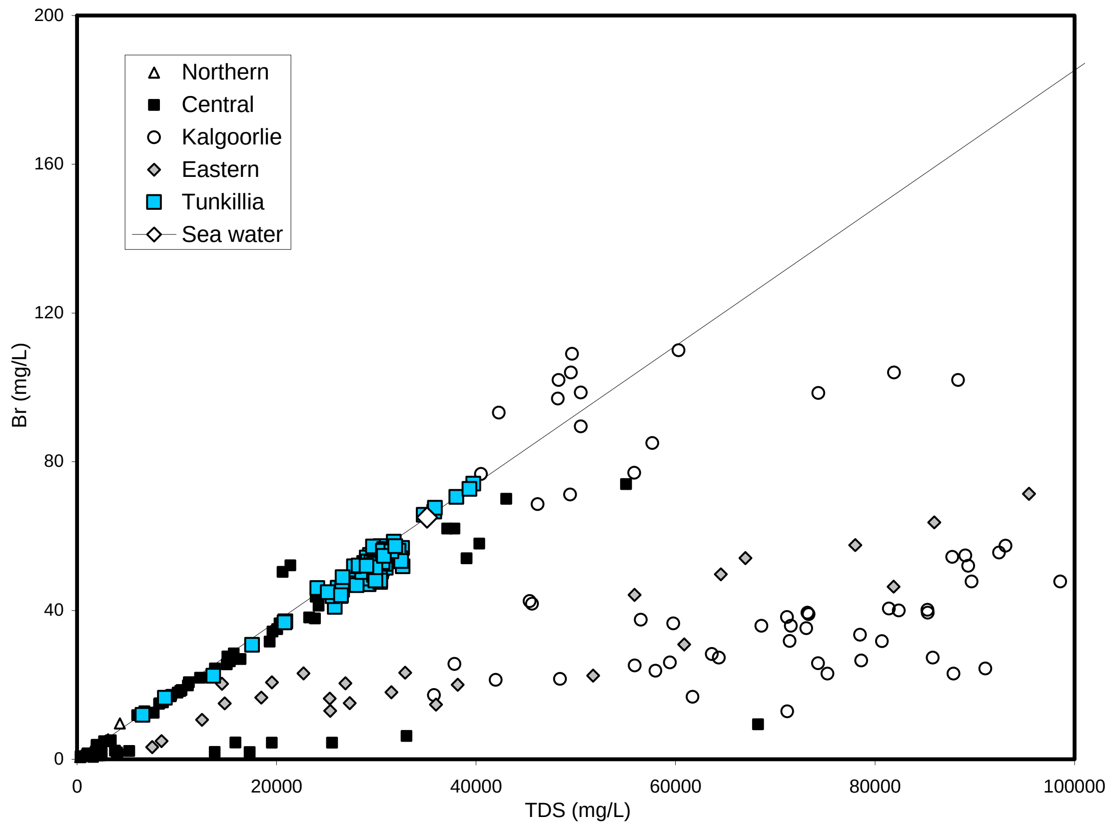

Figure A2.10: Br vs. TDS for groundwaters from Tunkillia and Western Australia.

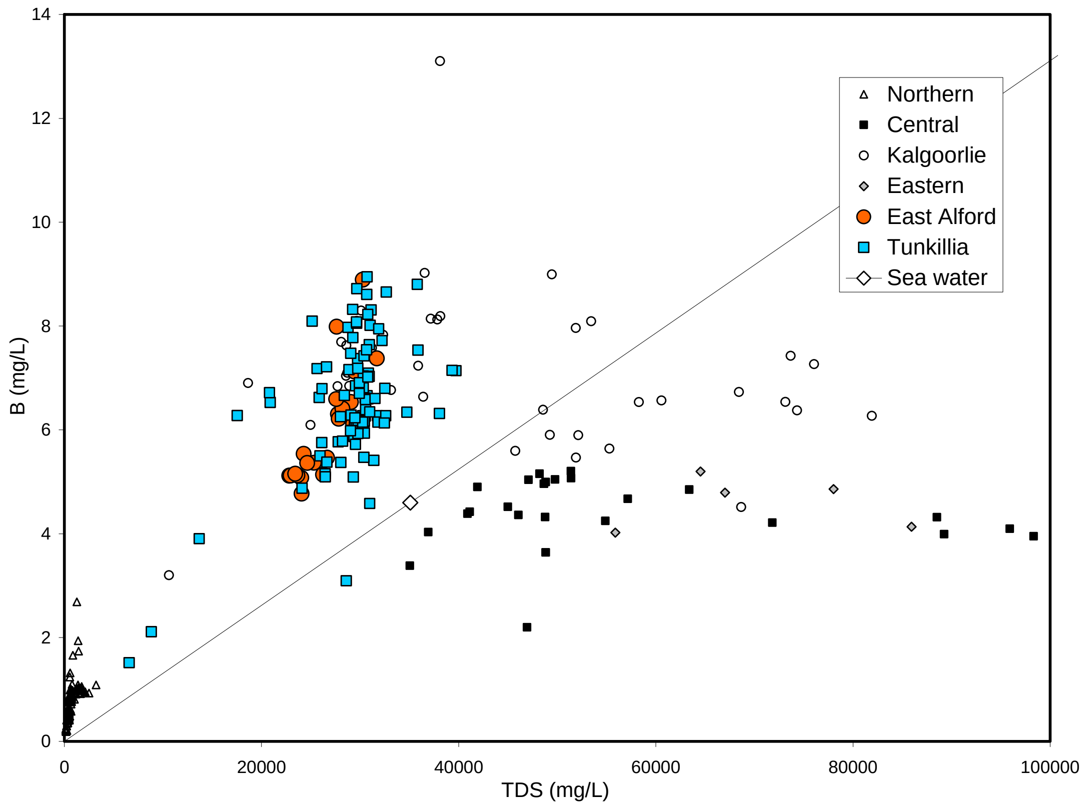

Figure A2.11: B vs. TDS for groundwaters from Tunkillia and Western Australia.

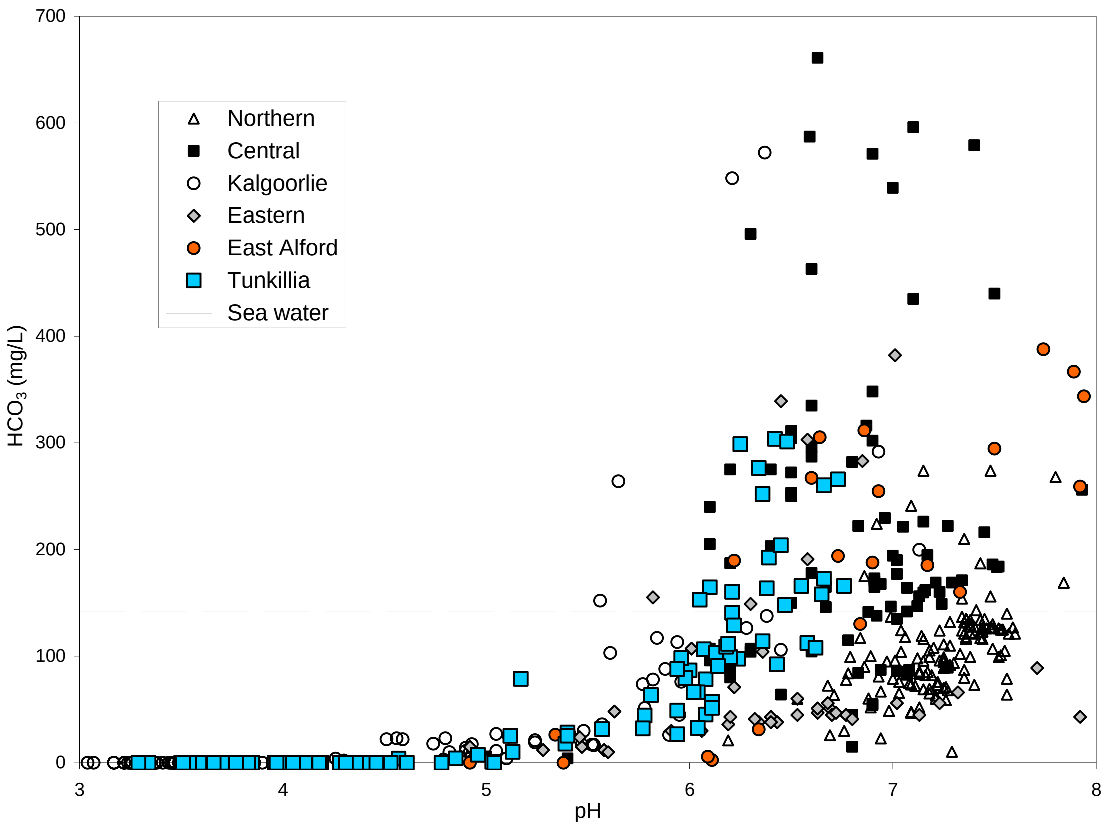

Figure A2.12: HCO_3 vs. TDS for groundwaters from Tunkillia and Western Australia.

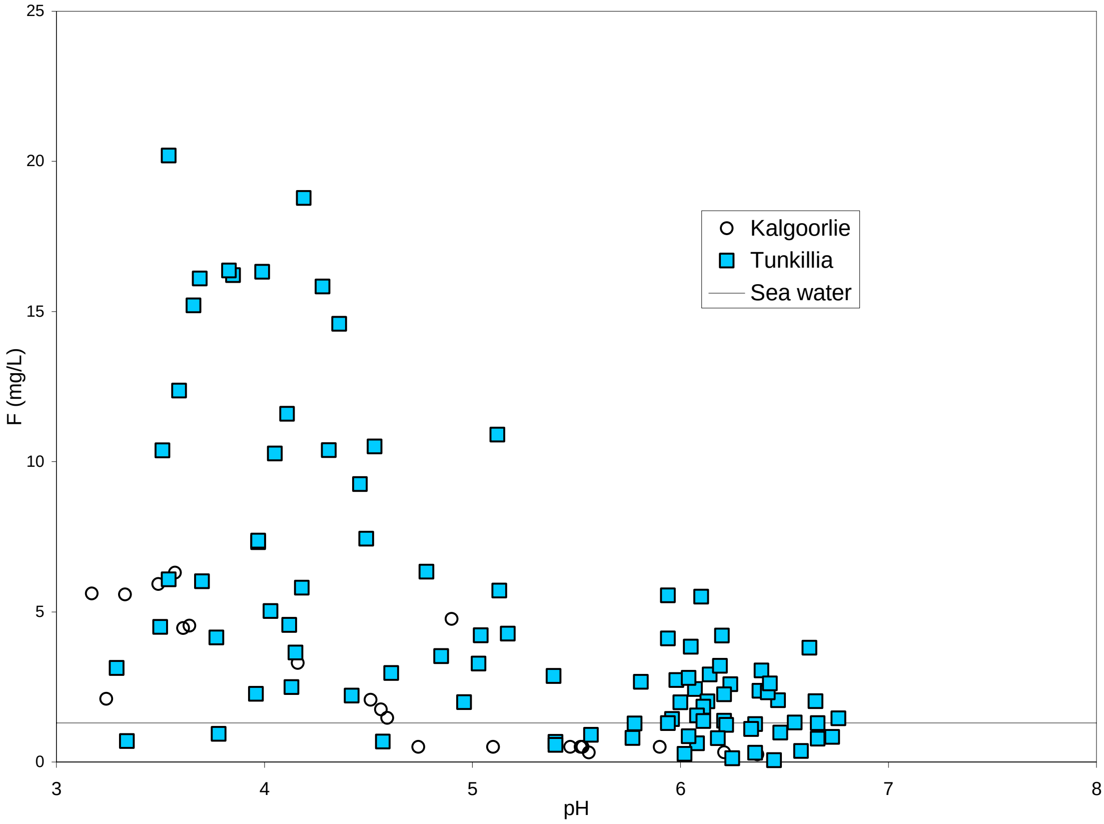

Figure A2.13: F vs. TDS for groundwaters from Tunkillia and Western Australia.

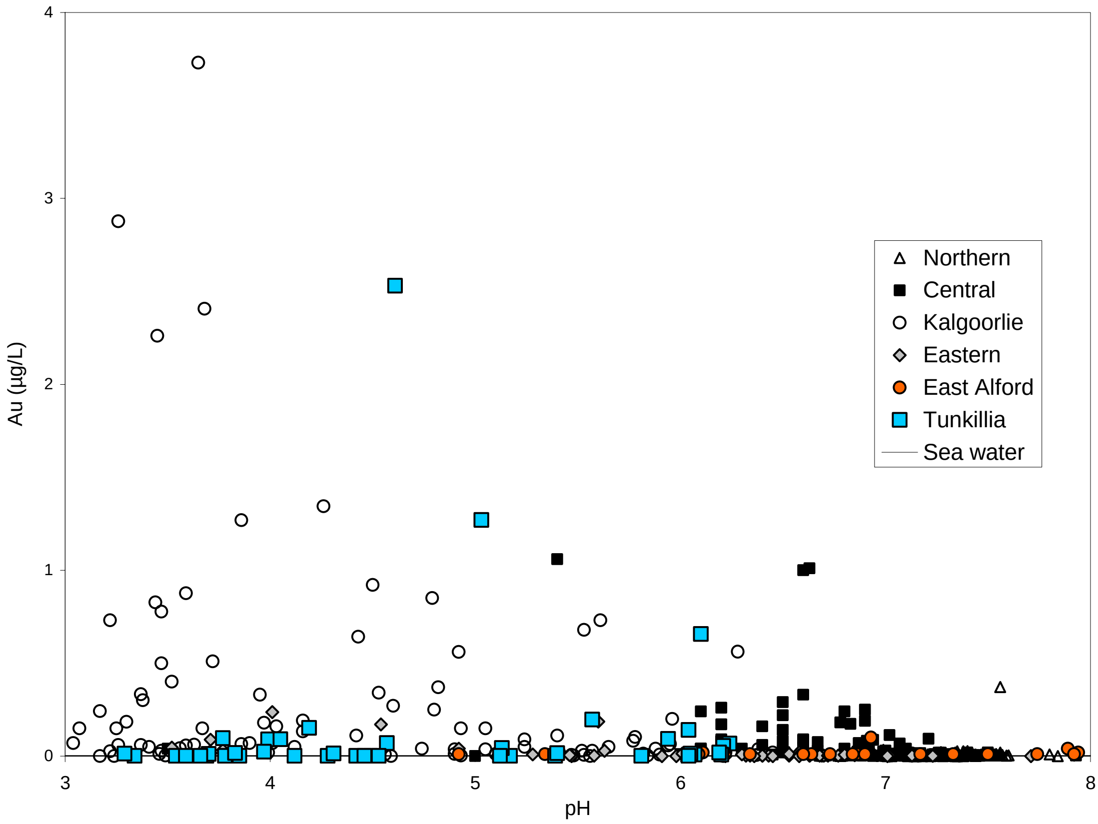

Figure A2.14: Au vs. TDS for groundwaters from Tunkillia and Western Australia.

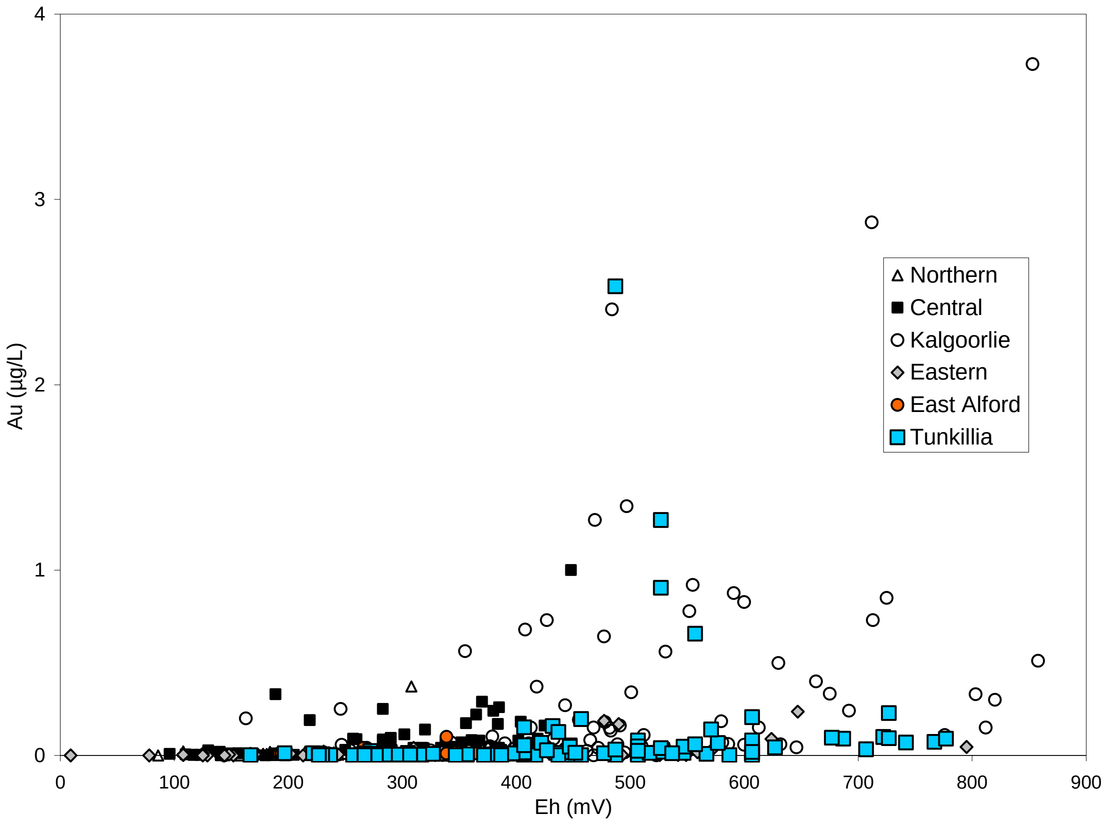

Figure A2.15: Au vs. Eh for groundwaters from Tunkillia and Western Australia.

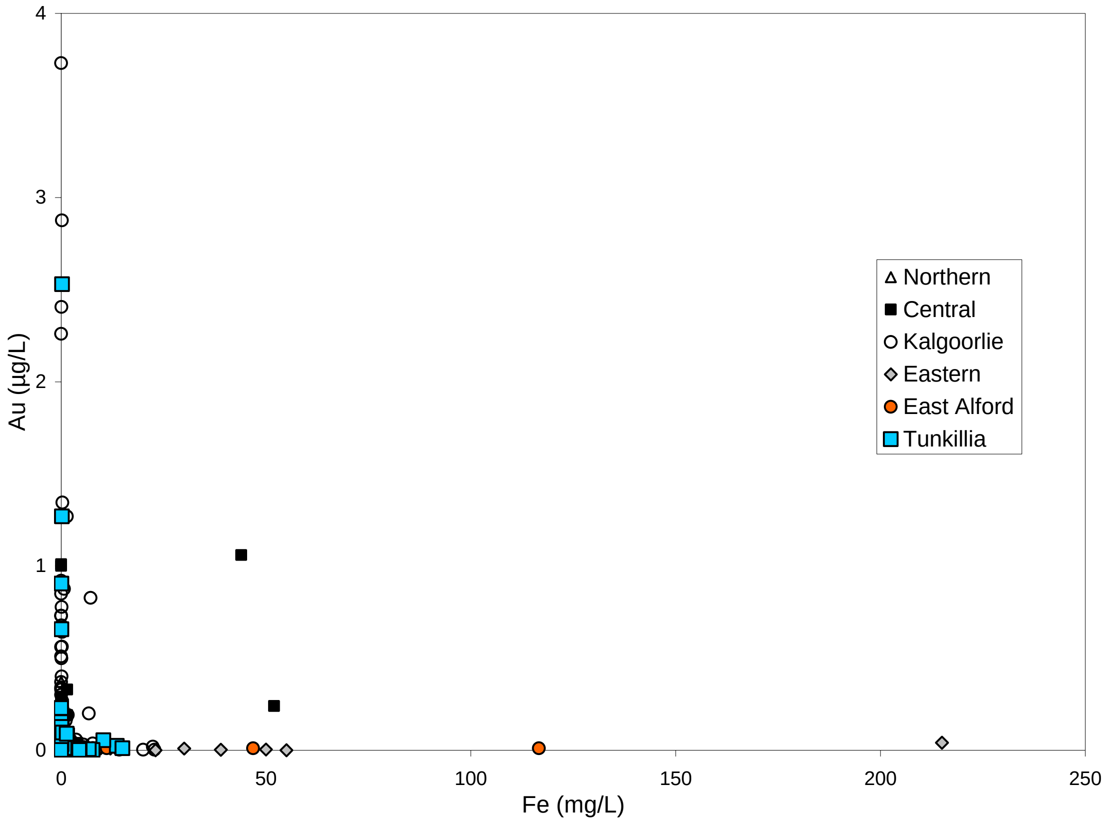

Figure A2.16: Au vs. Fe for groundwaters from Tunkillia and Western Australia.

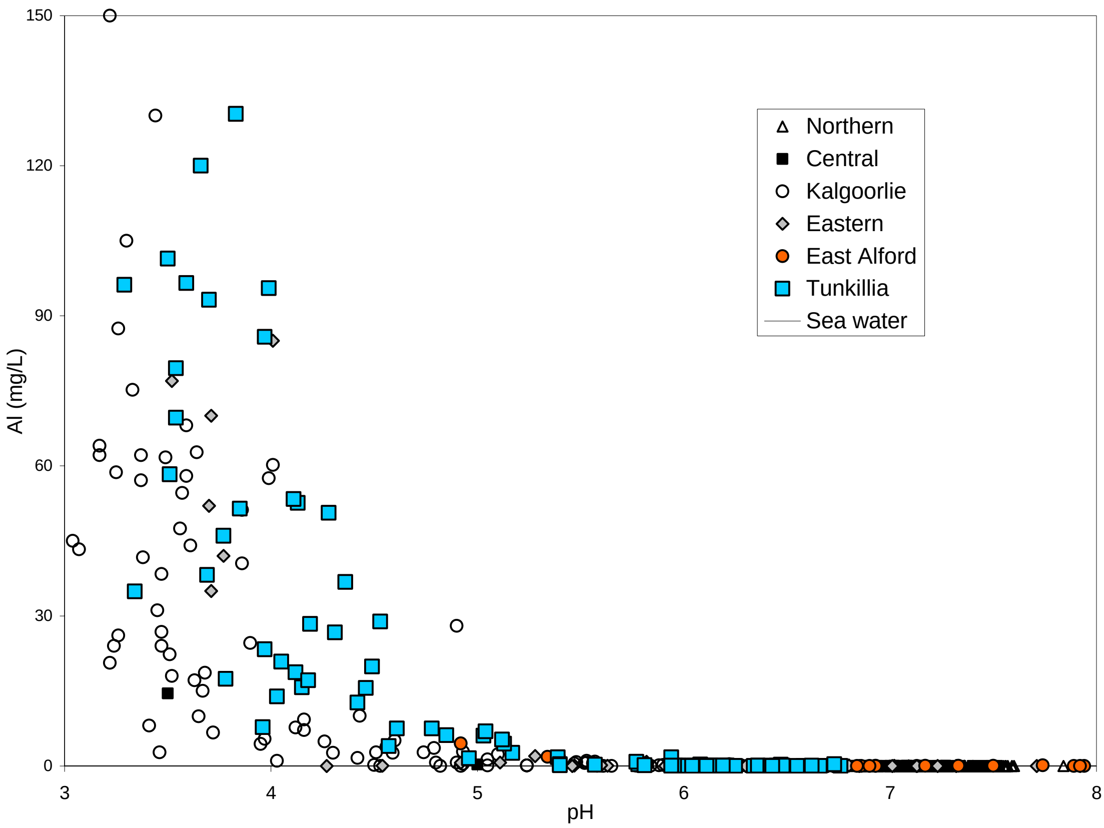

Figure A2.17: Al vs. pH for groundwaters from Tunkillia and Western Australia.

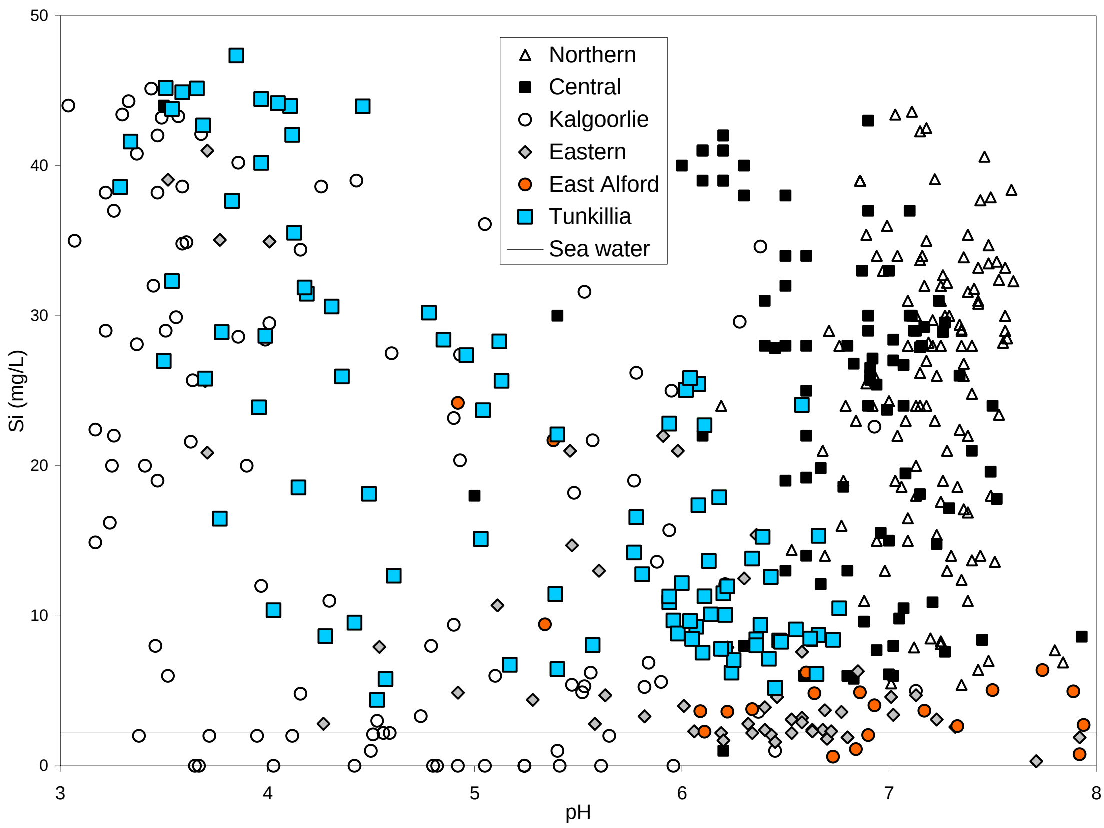

Figure A2.18: Si vs. pH for groundwaters from Tunkillia and Western Australia.

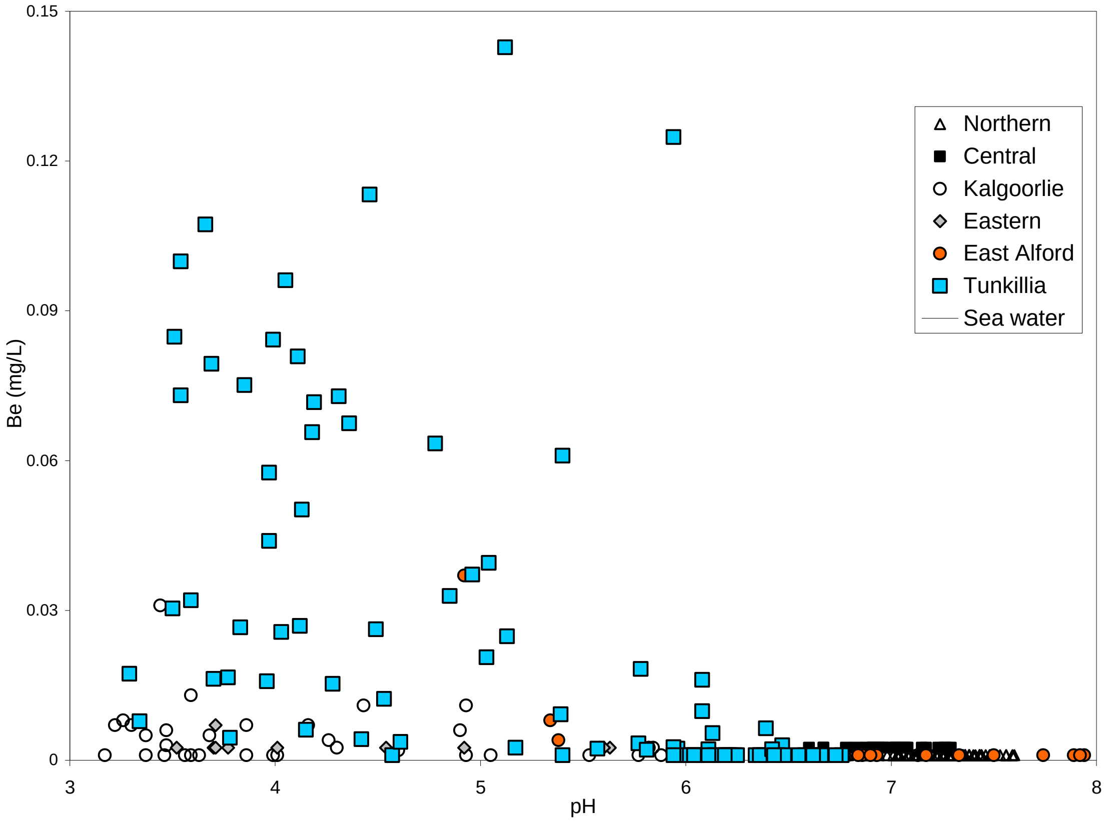

Figure A2.19: Be vs. pH for groundwaters from Tunkillia and Western Australia.

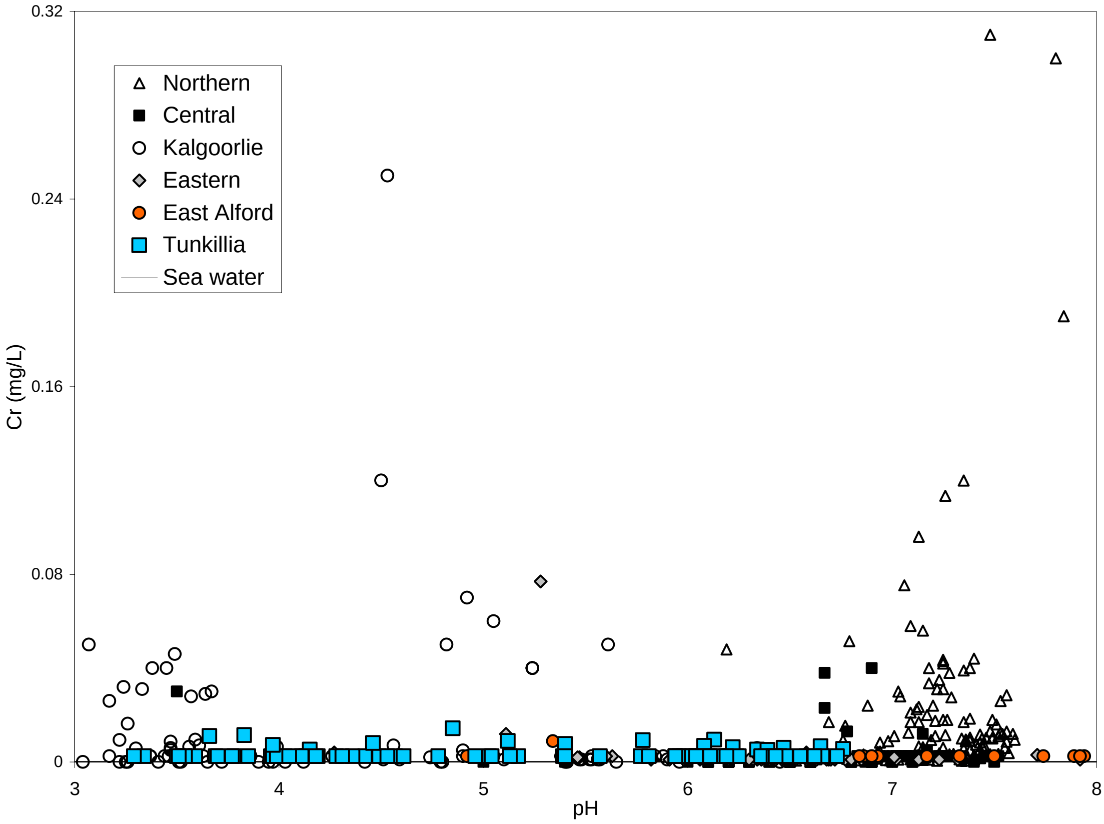

Figure A2.20: Cr vs. pH for groundwaters from Tunkillia and Western Australia.

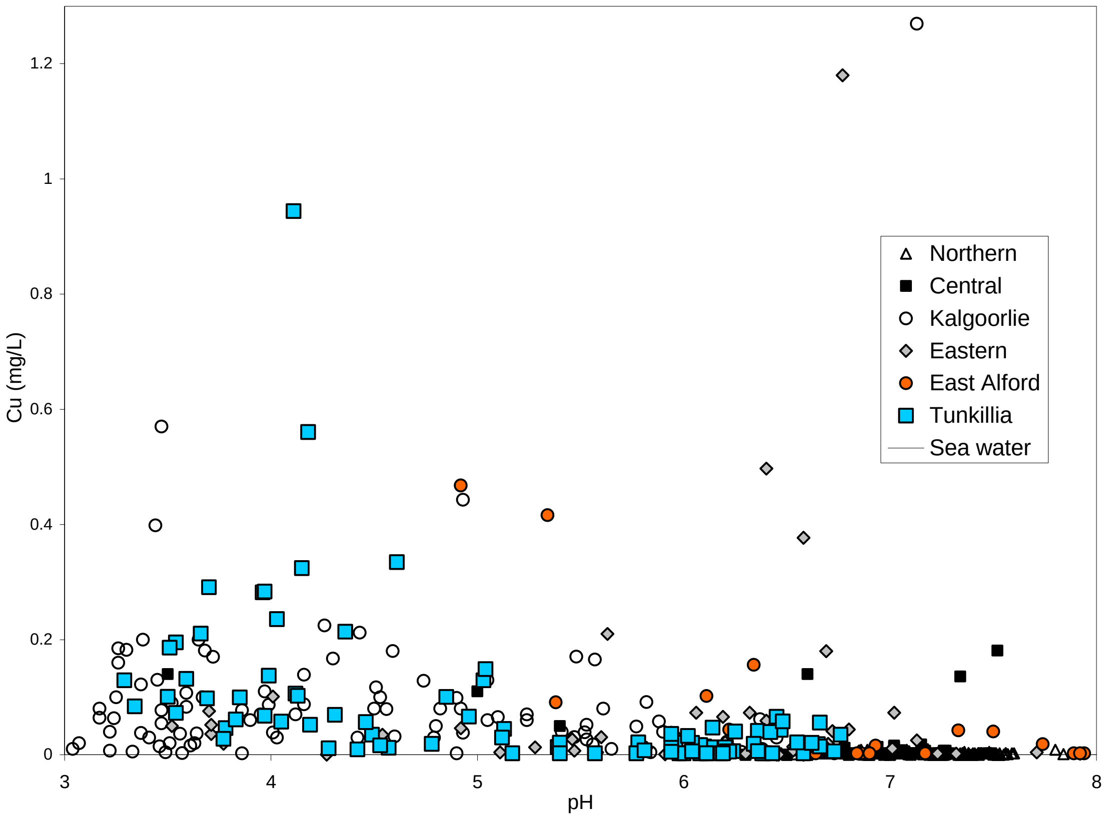

Figure A2.21: Cu vs. pH for groundwaters from Tunkillia and Western Australia.

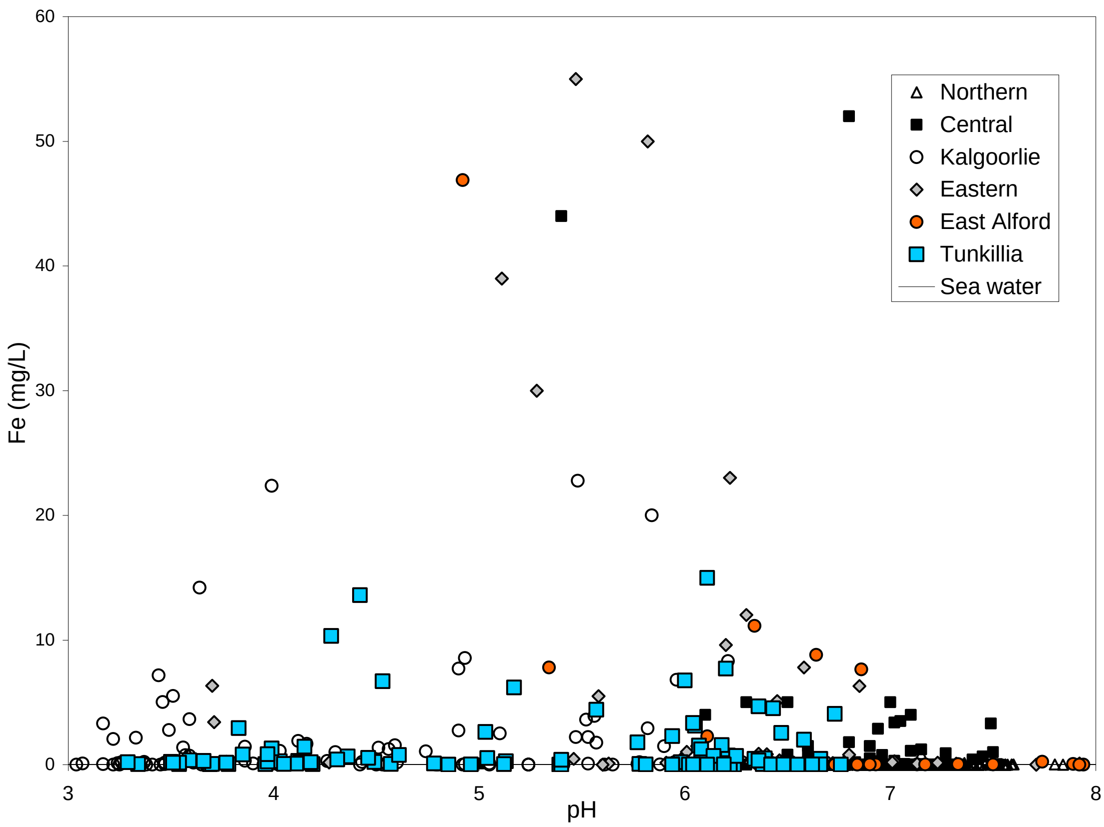

Figure A2.22: Fe vs. pH for groundwaters from Tunkillia and Western Australia.

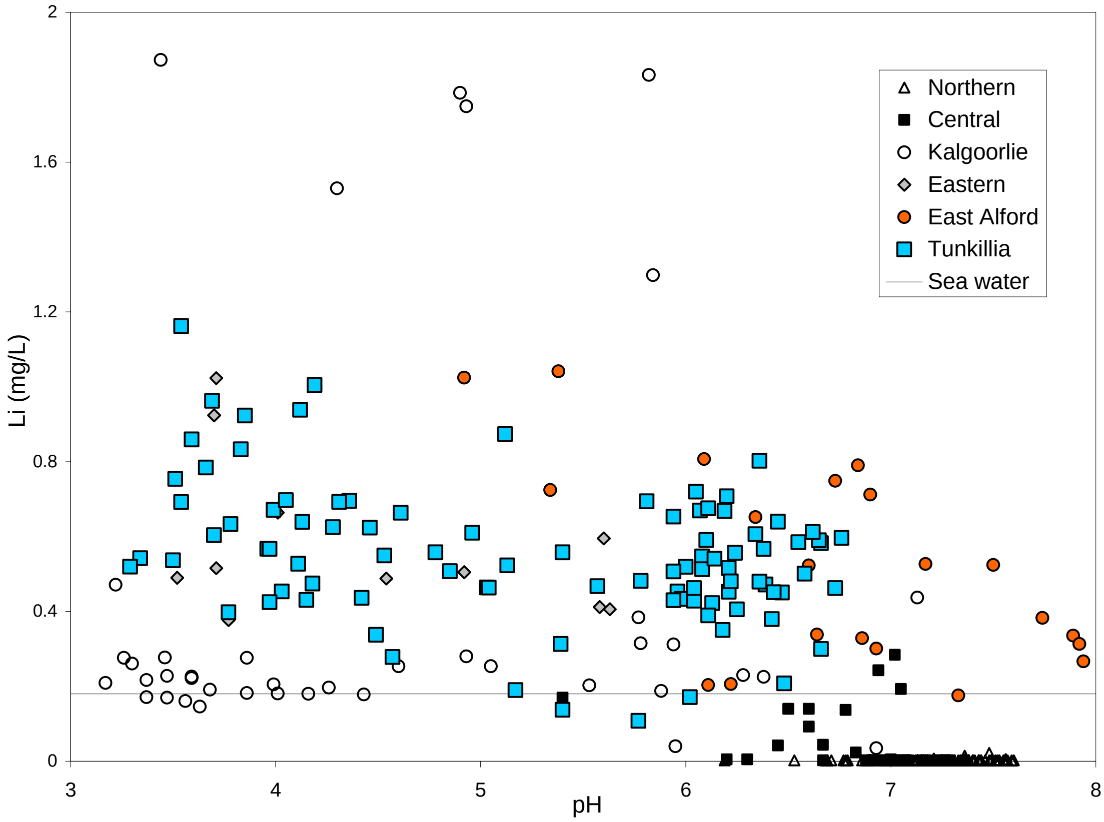

Figure A2.23: Li vs. pH for groundwaters from Tunkillia and Western Australia.

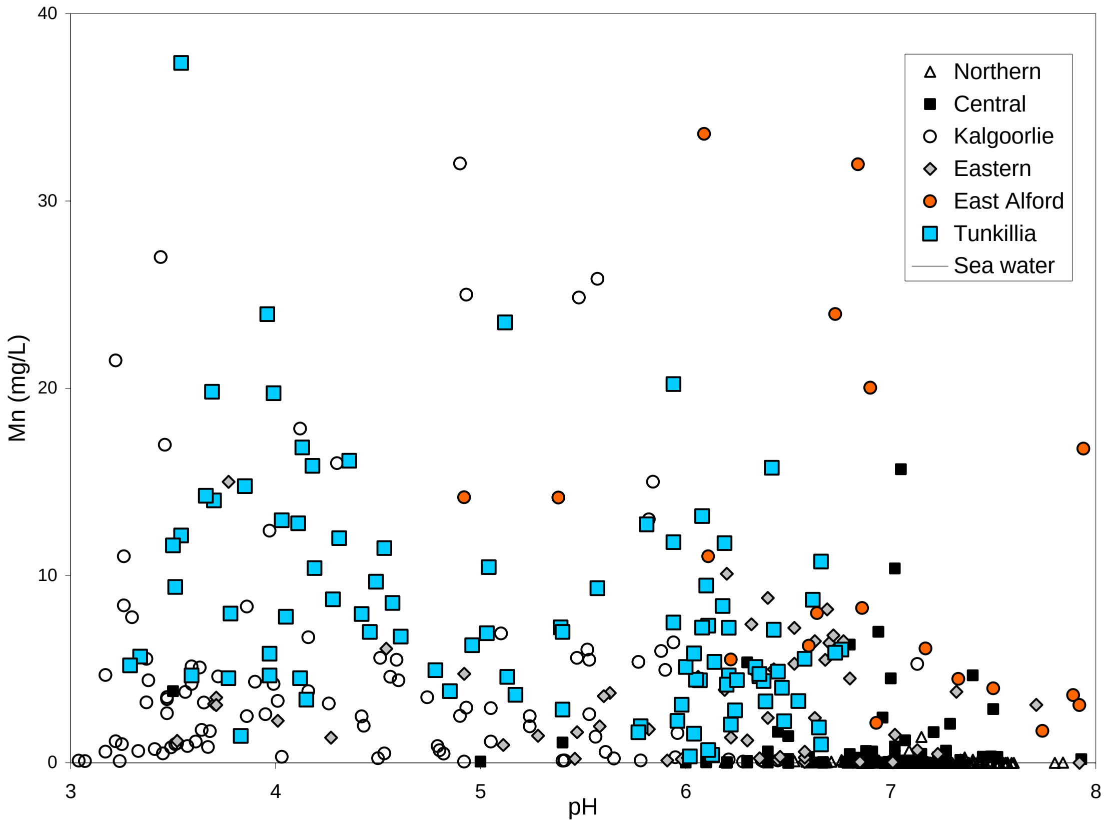

Figure A2.24: Mn vs. pH for groundwaters from Tunkillia and Western Australia.

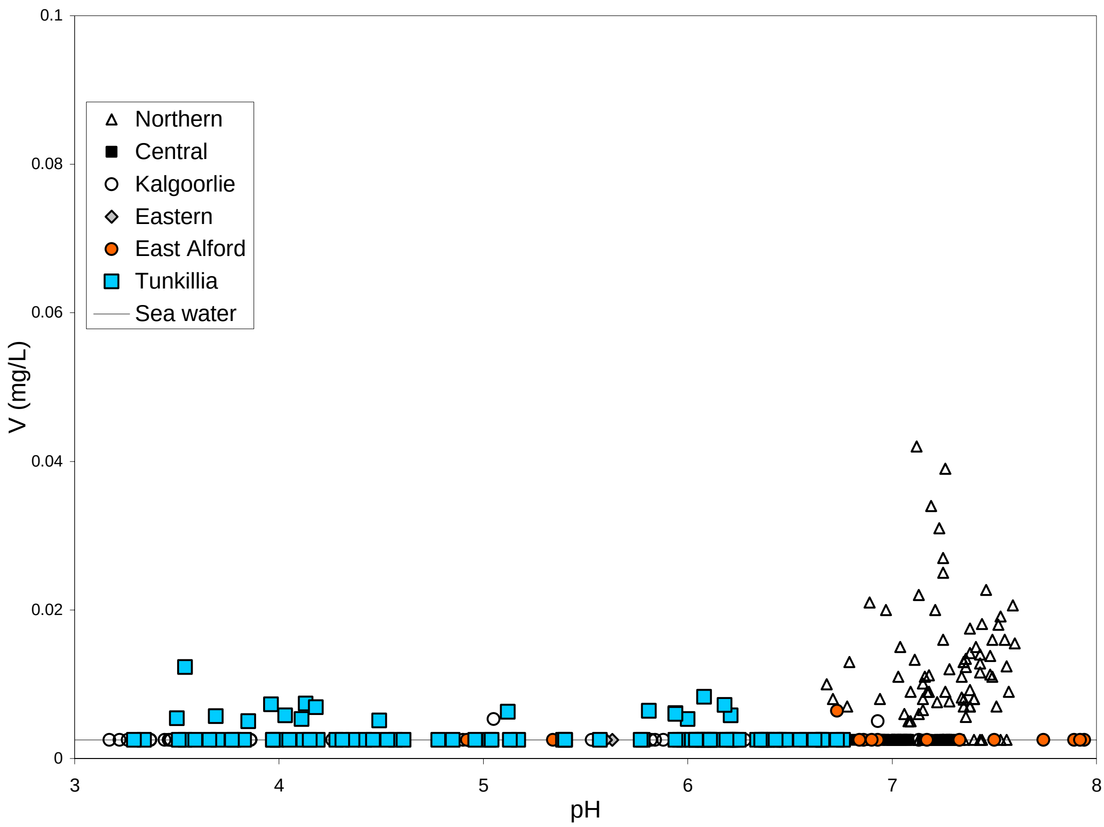

Figure A2.25: V vs. pH for groundwaters from Tunkillia and Western Australia.

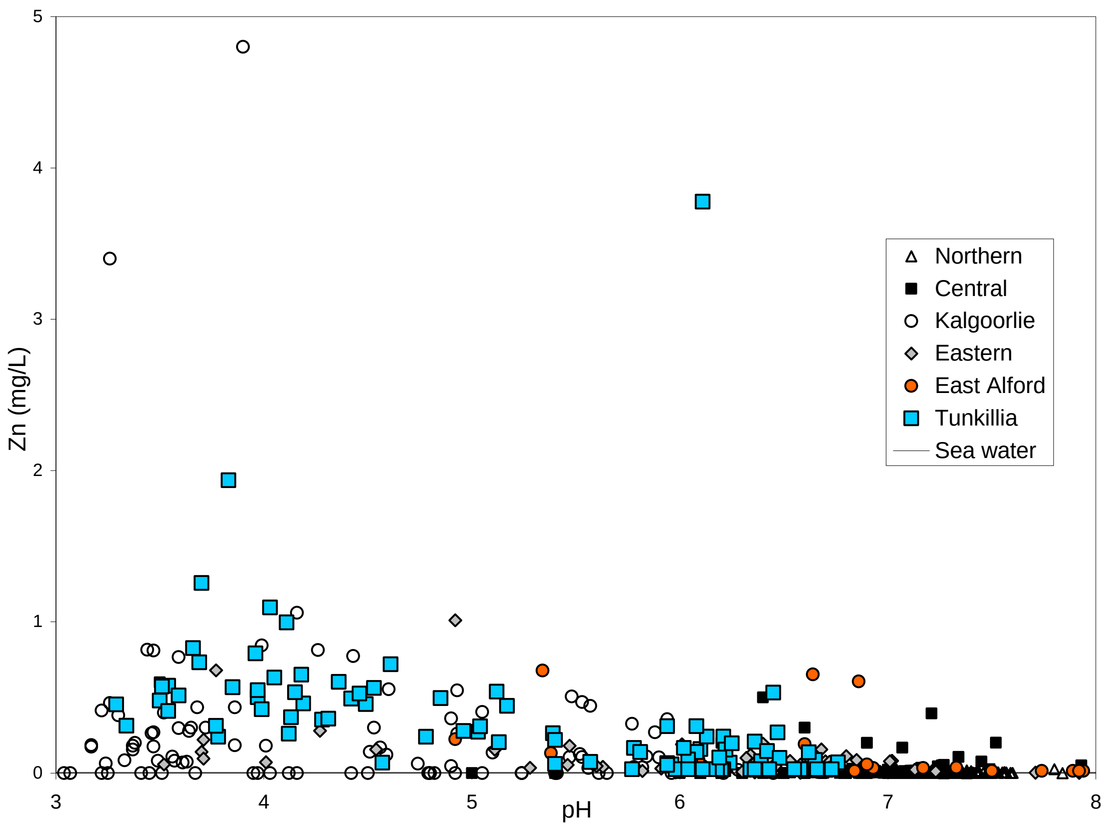

Figure A2.26: Zn vs. pH for groundwaters from Tunkillia and Western Australia.

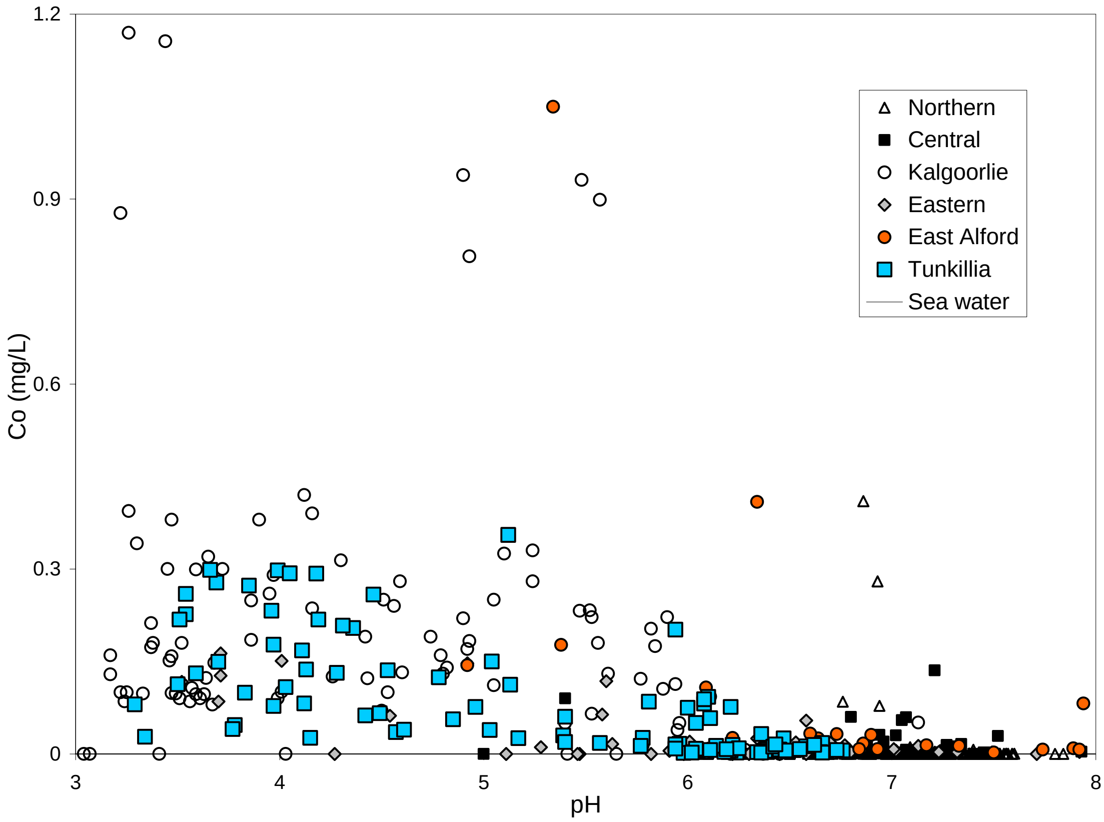

Figure A2.27: Co vs. pH for groundwaters from Tunkillia and Western Australia.

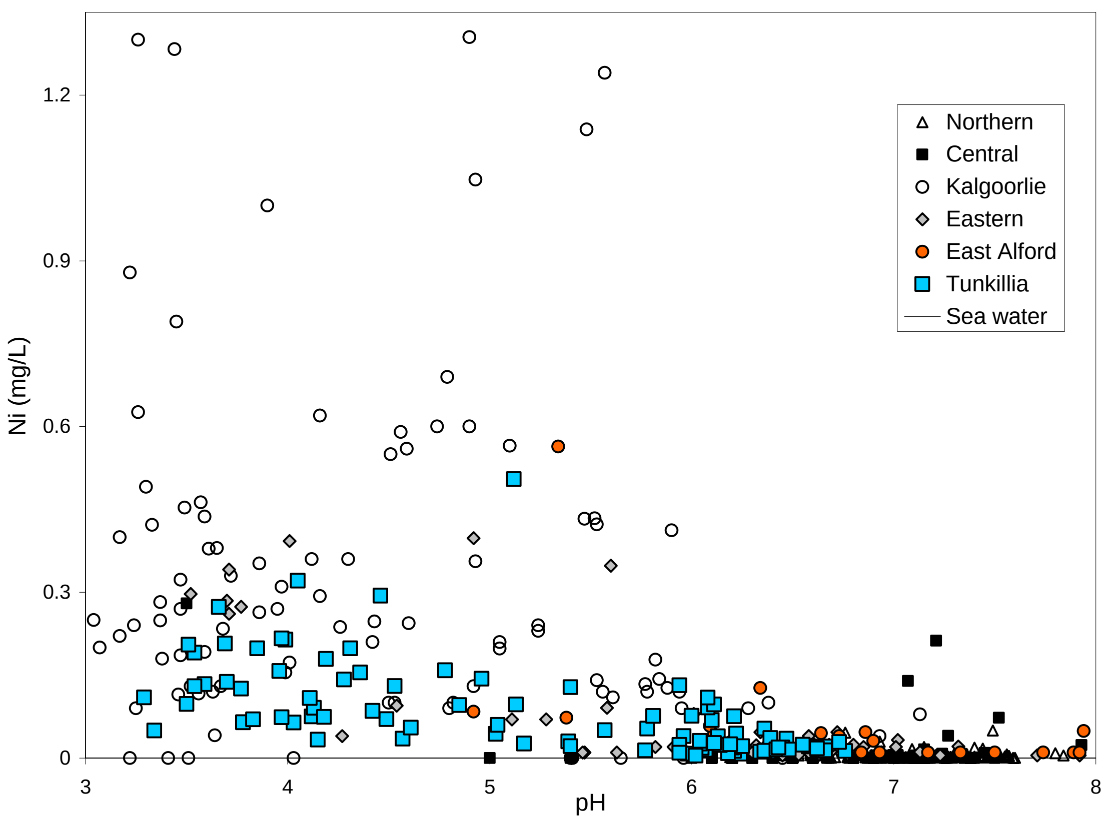

Figure A2.28: Ni vs. pH for groundwaters from Tunkillia and Western Australia.

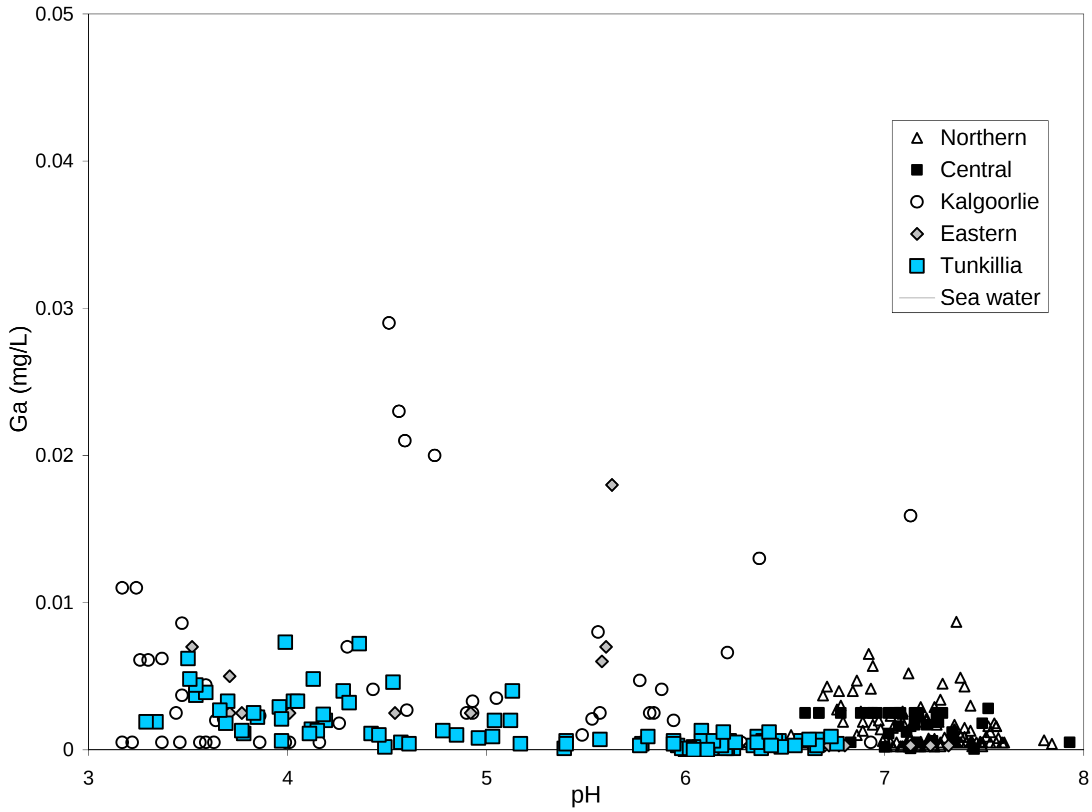

Figure A2.29: Ga vs. pH for groundwaters from Tunkillia and Western Australia.

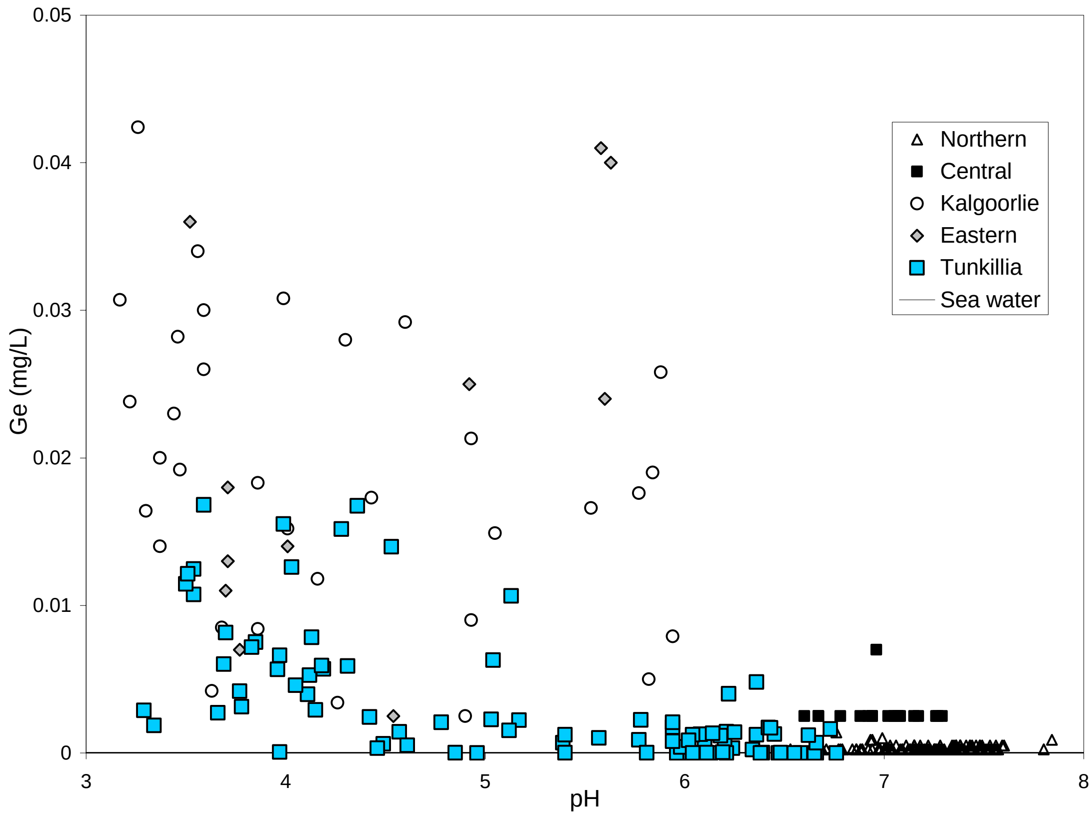

Figure A2.30: Ge vs. pH for groundwaters from Tunkillia and Western Australia.

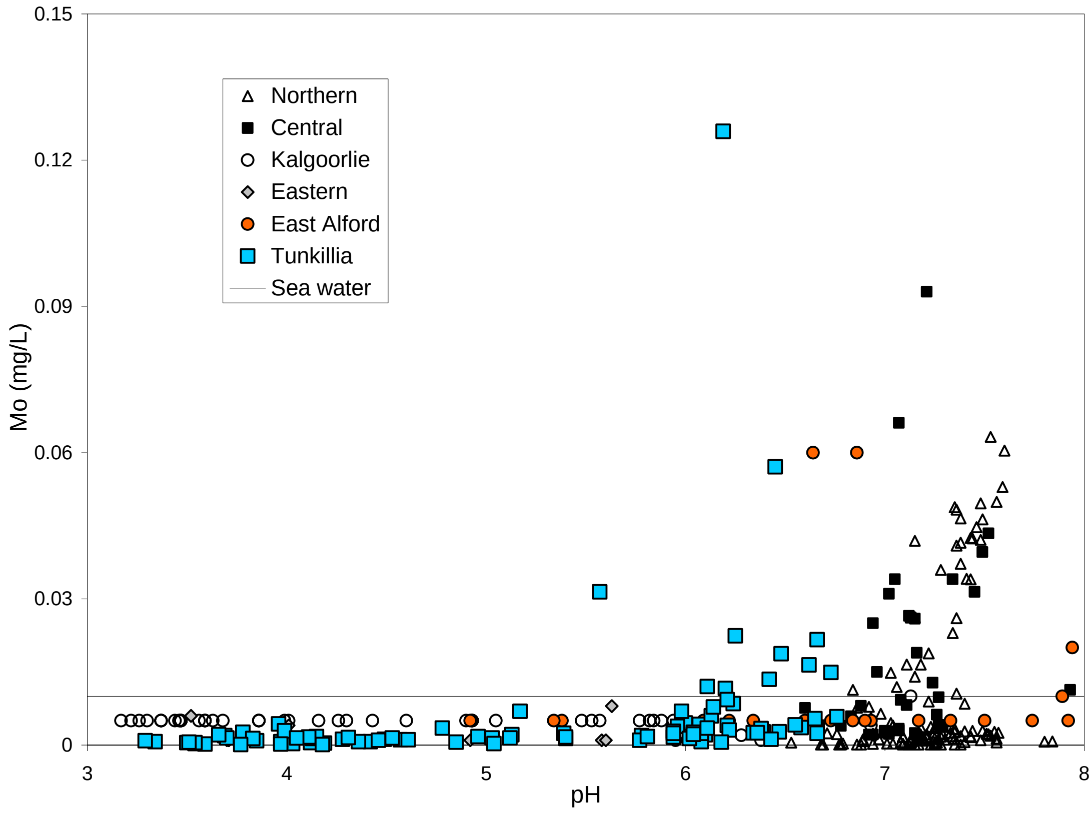

Figure A2.31: Mo vs. pH for groundwaters from Tunkillia and Western Australia.

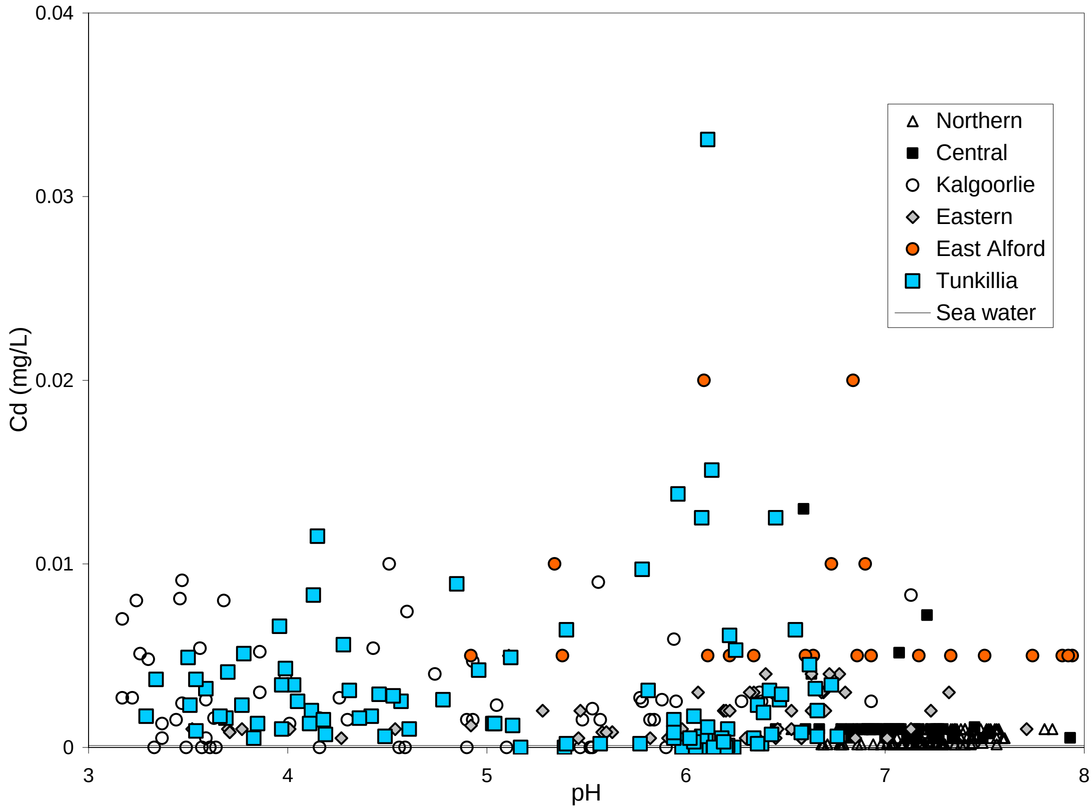

Figure A2.32: Cd vs. pH for groundwaters from Tunkillia and Western Australia.

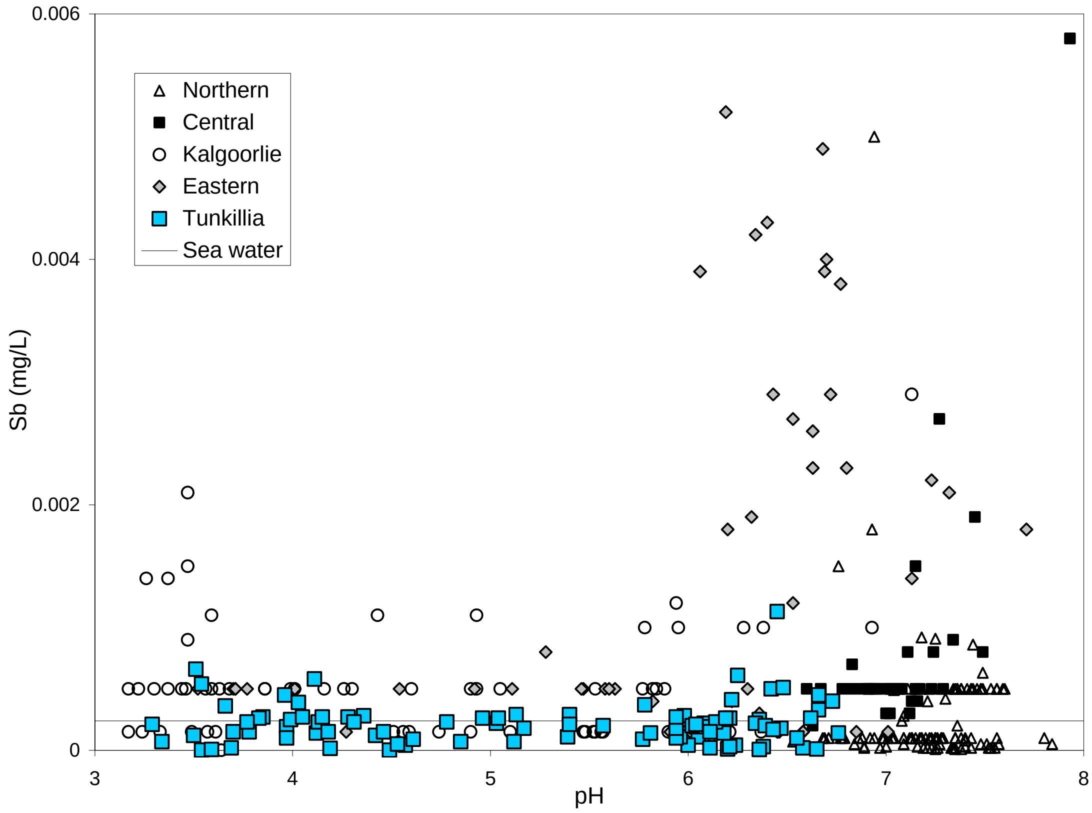

Figure A2.33: Sb vs. pH for groundwaters from Tunkillia and Western Australia.

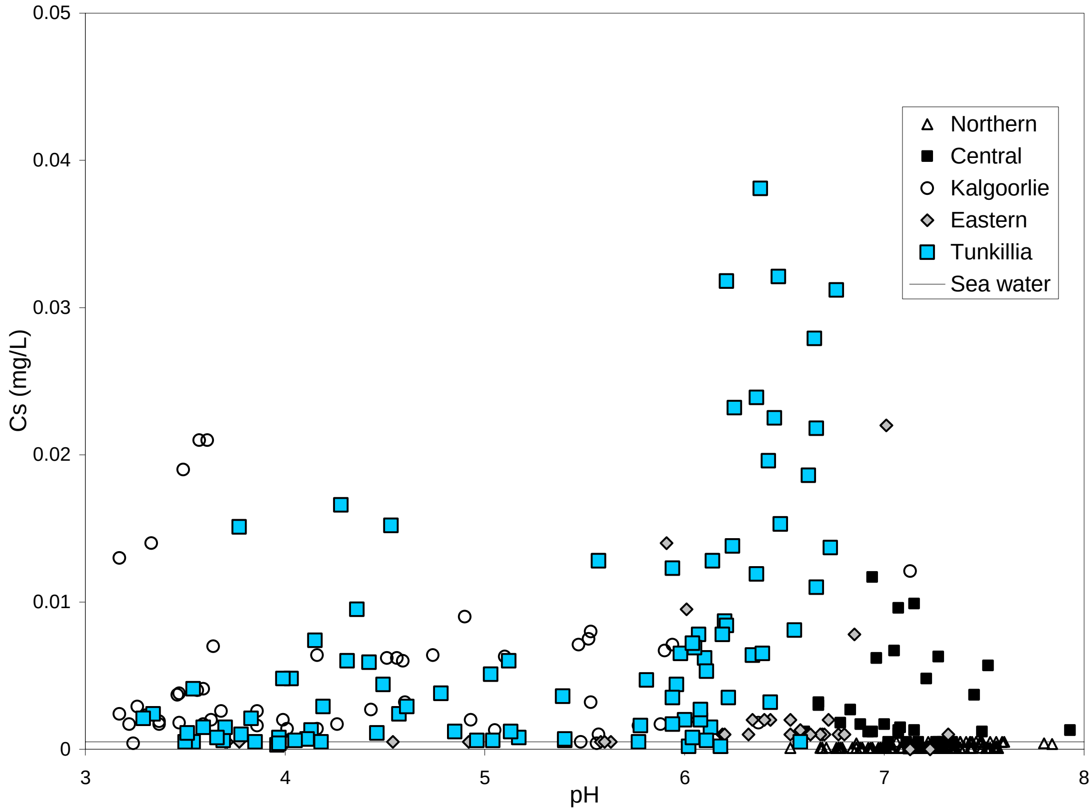

Figure A2.34: Cs vs. pH for groundwaters from Tunkillia and Western Australia.

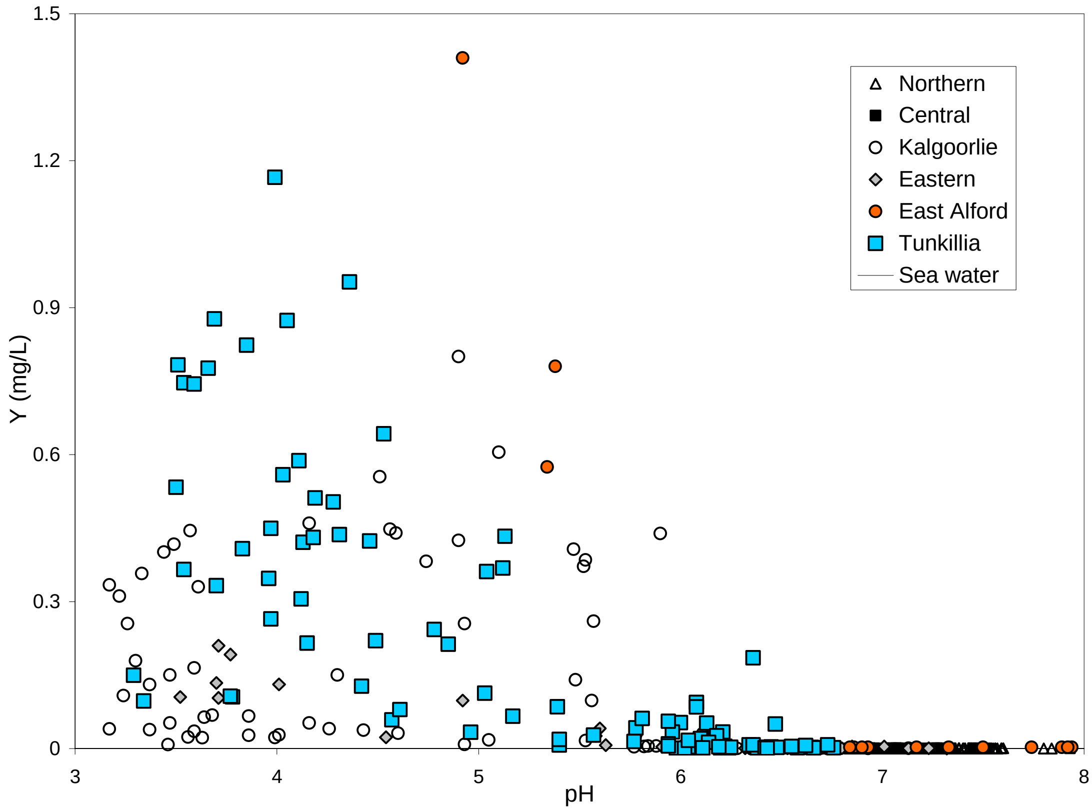

Figure A2.35: Y vs. pH for groundwaters from Tunkillia and Western Australia.

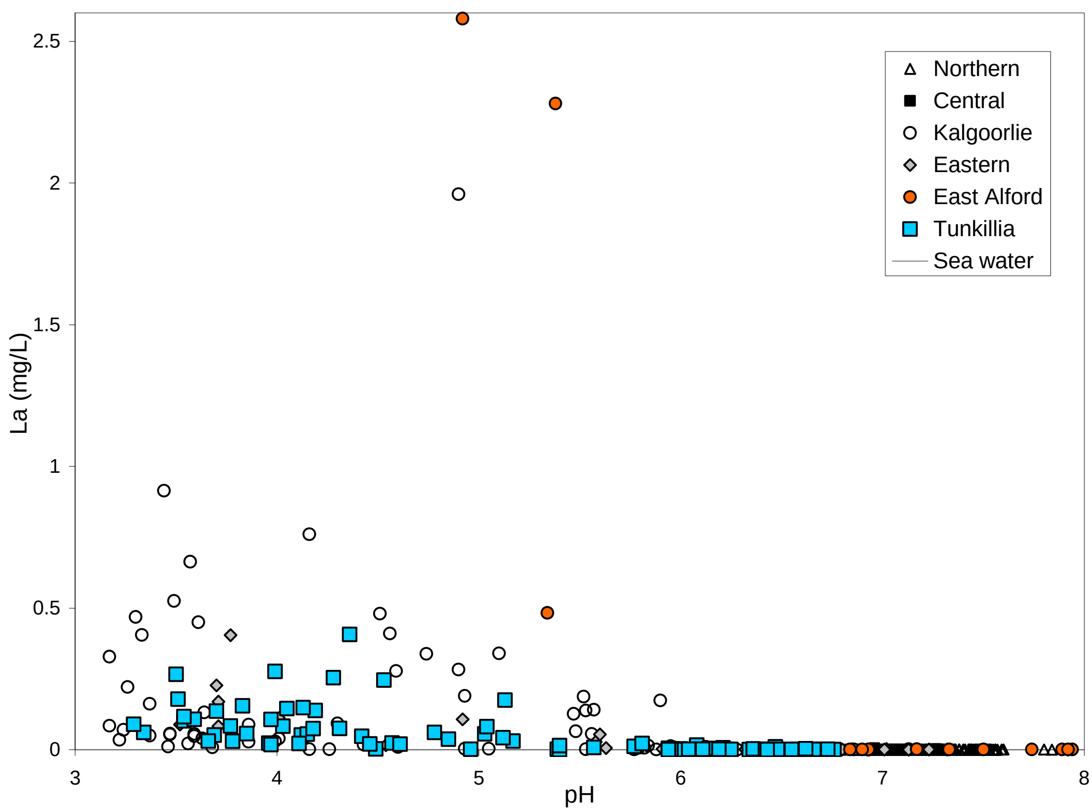

Figure A2.36: La vs. pH for groundwaters from Tunkillia and Western Australia.

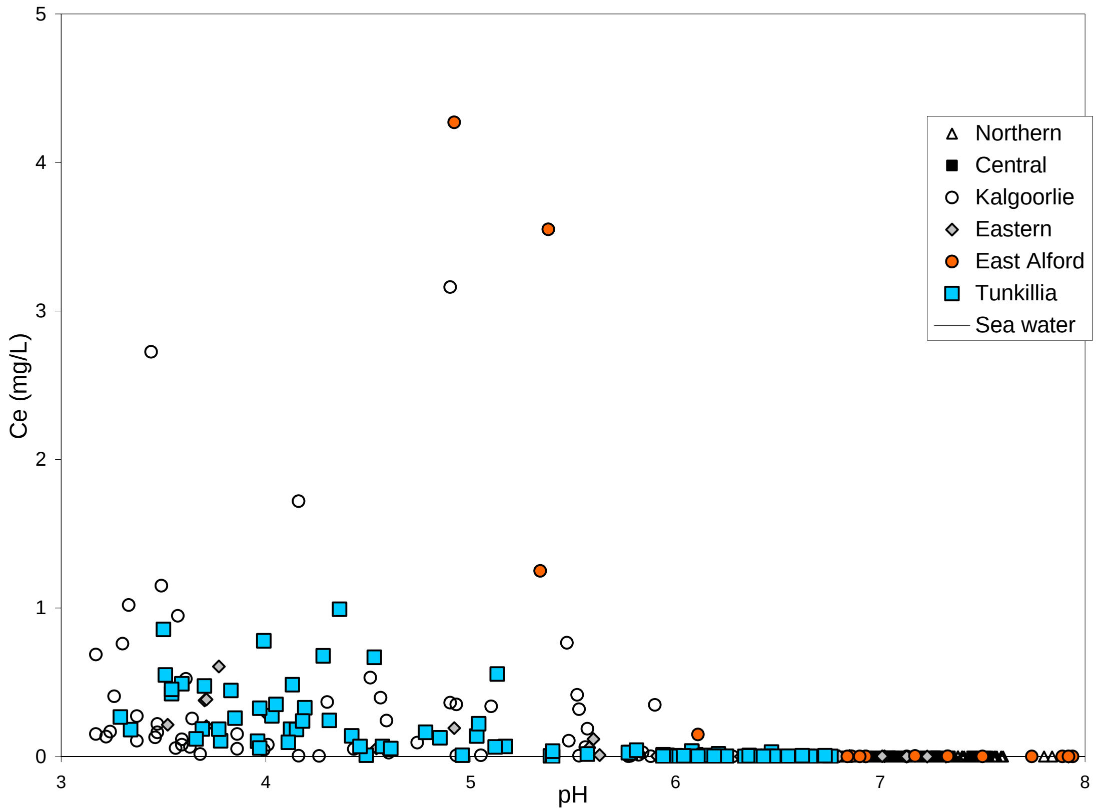

Figure A2.37: Ce vs. pH for groundwaters from Tunkillia and Western Australia.

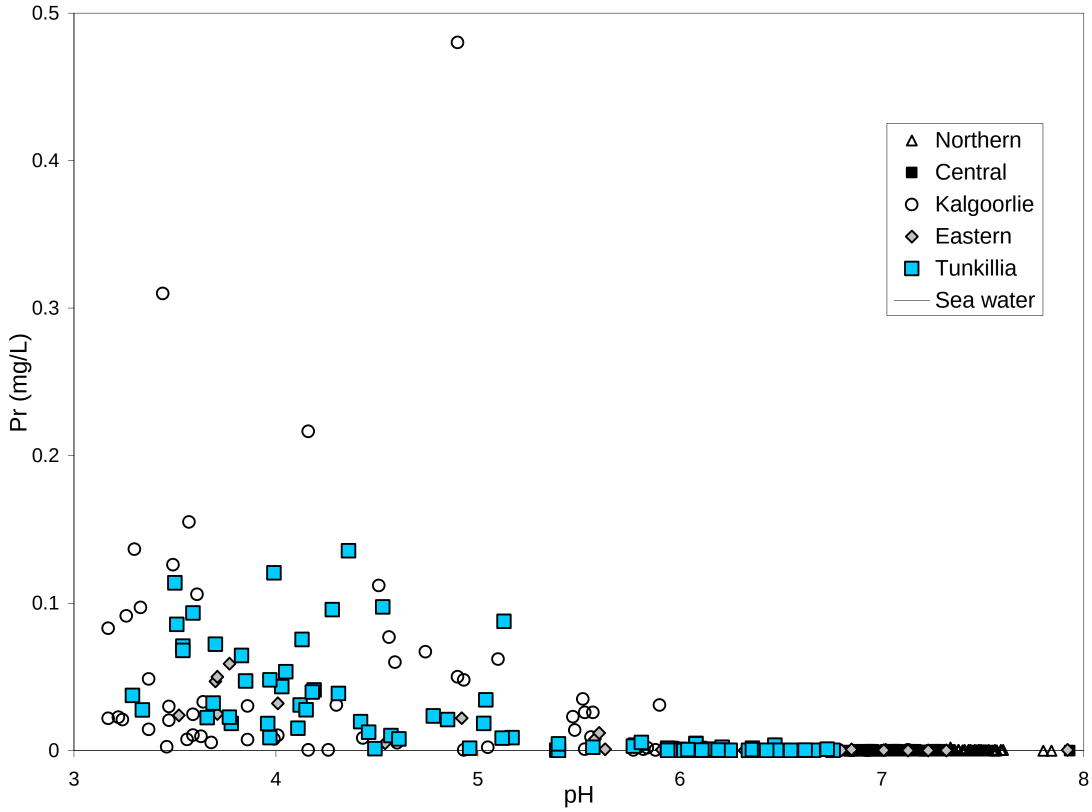

Figure A2.38: Pr vs. pH for groundwaters from Tunkillia and Western Australia.

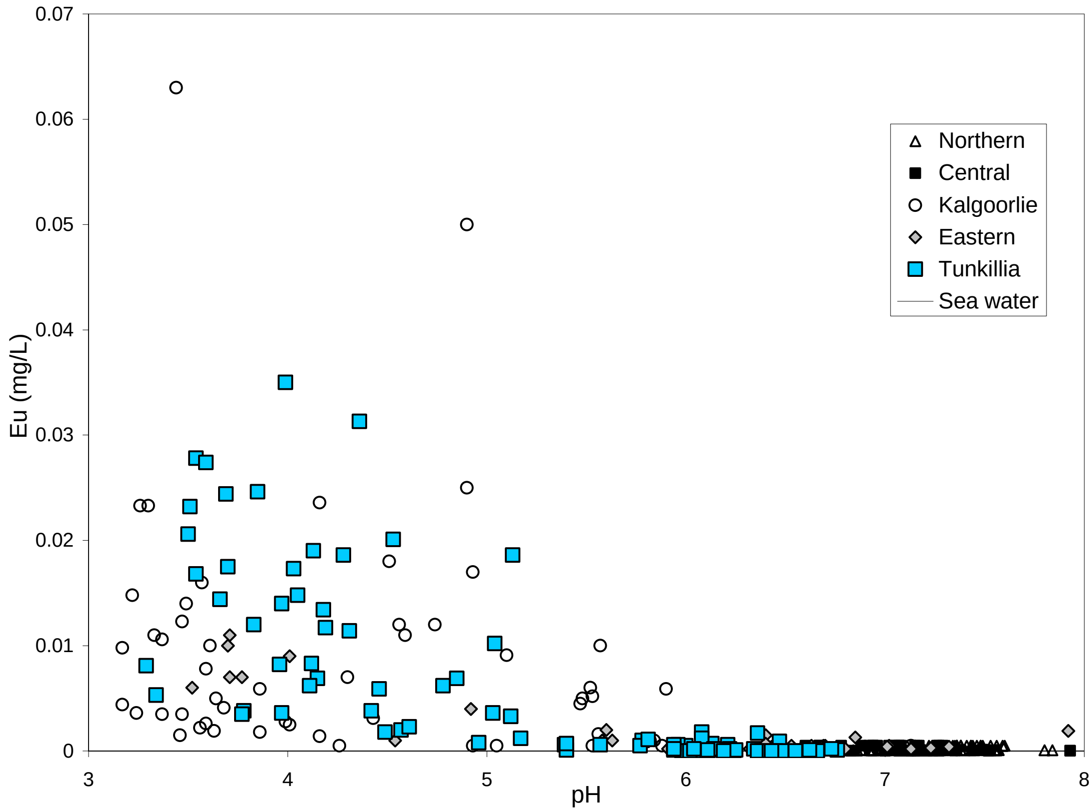

Figure A2.39: Eu vs. pH for groundwaters from Tunkillia and Western Australia.

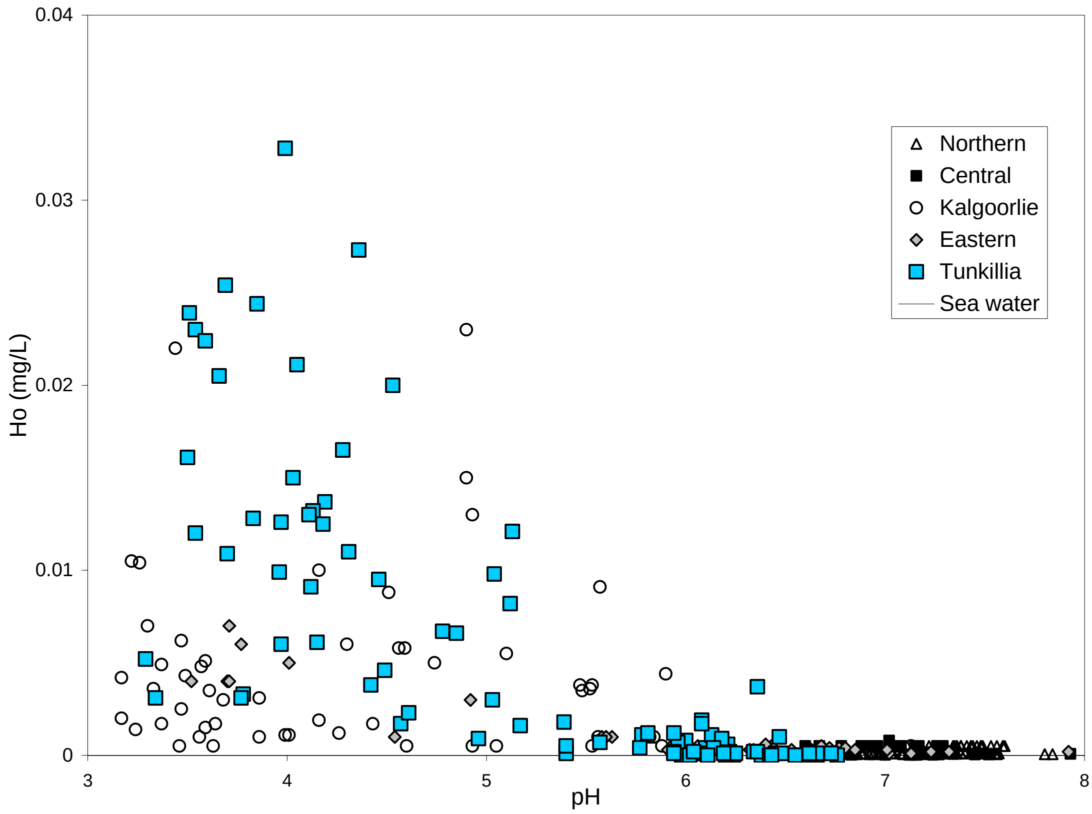

Figure A2.40: Ho vs. pH for groundwaters from Tunkillia and Western Australia.

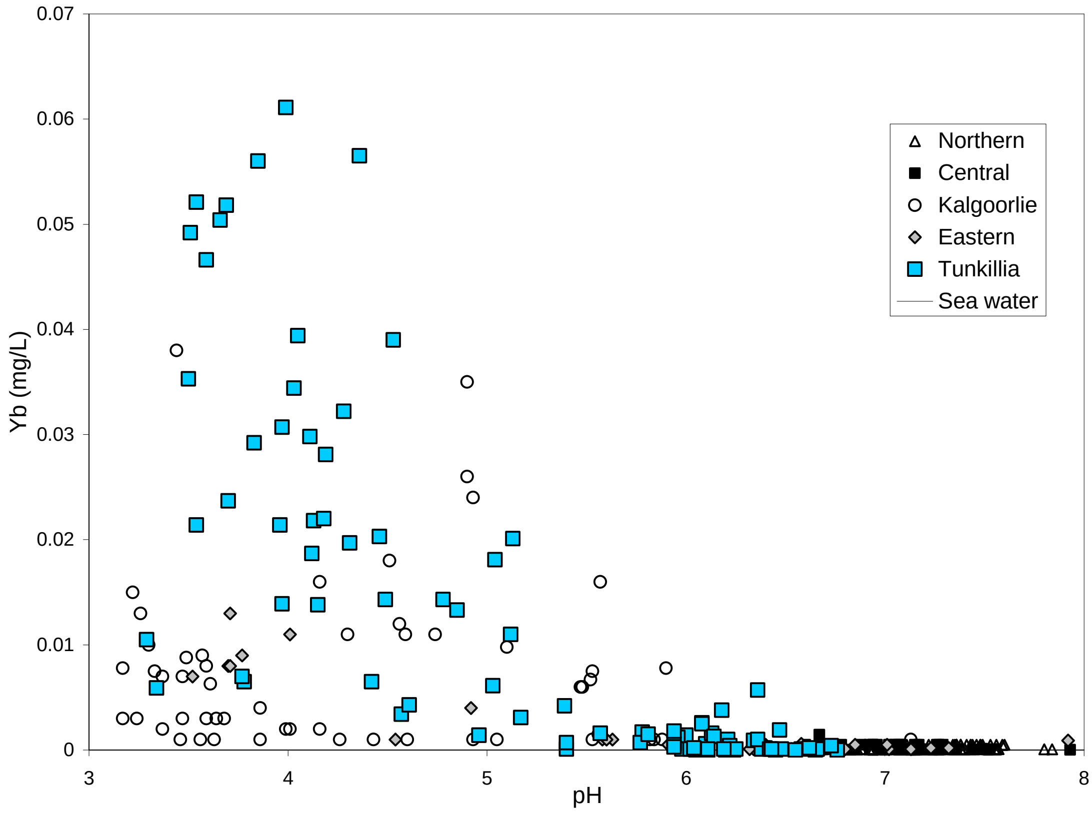

Figure A2.41: Yb vs. pH for groundwaters from Tunkillia and Western Australia.

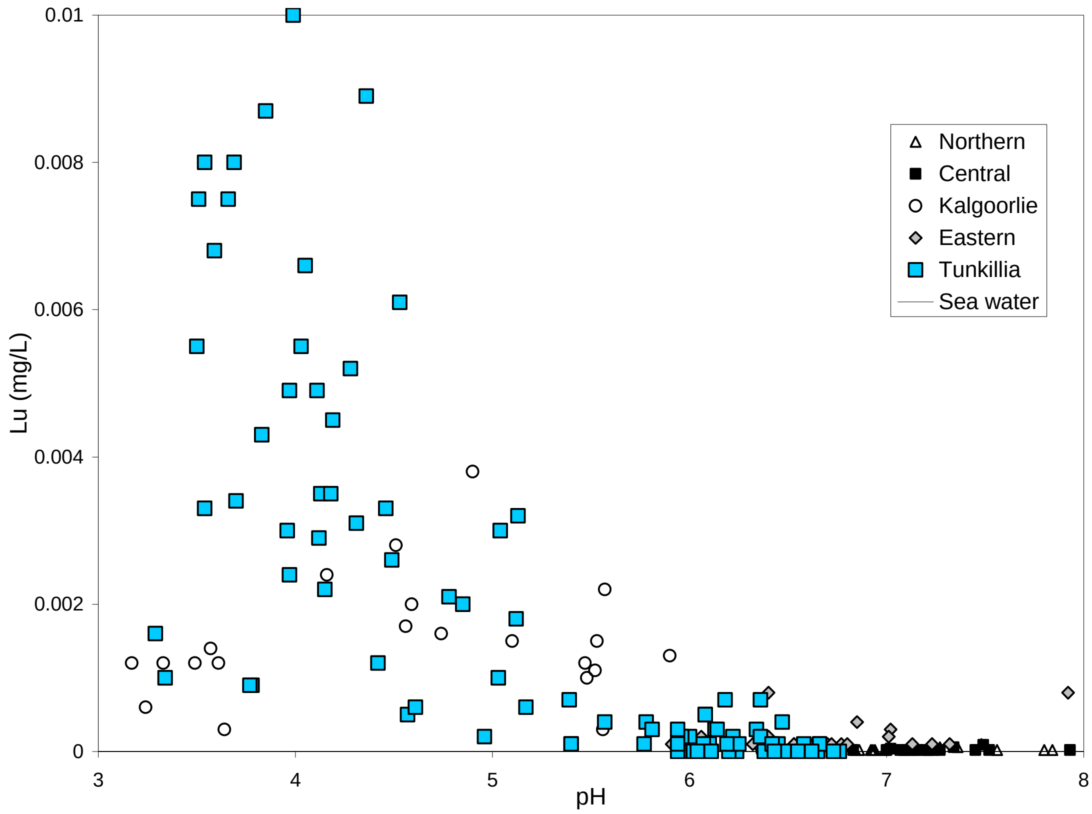

Figure A2.42: Lu vs. pH for groundwaters from Tunkillia and Western Australia.

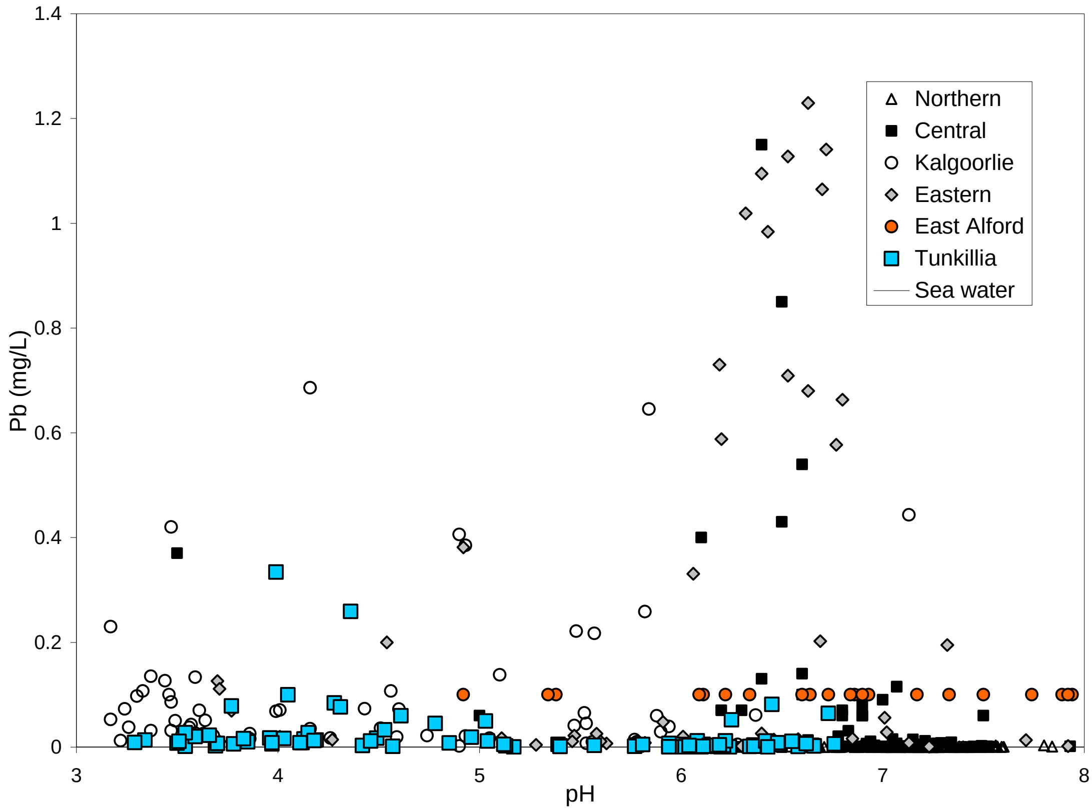

Figure A2.43: Pb vs. pH for groundwaters from Tunkillia and Western Australia.

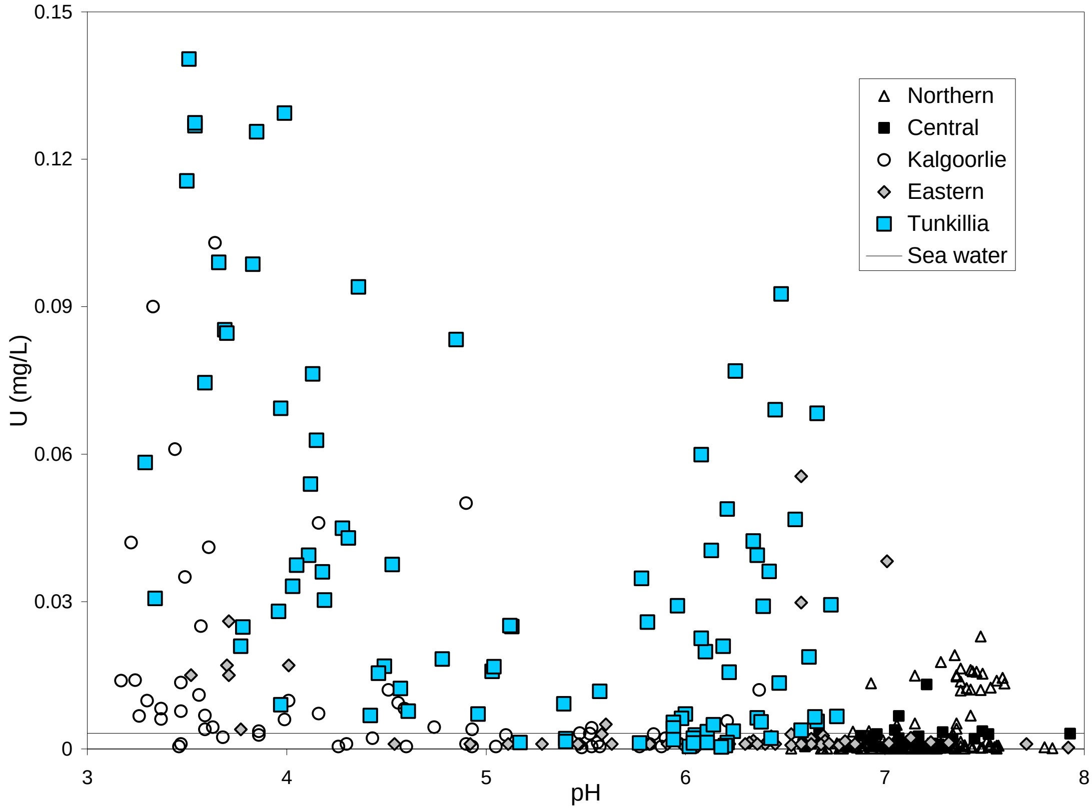

Figure A2.44: U vs. pH for groundwaters from Tunkillia and Western Australia.

Appendix 3: Saturation indices for groundwaters

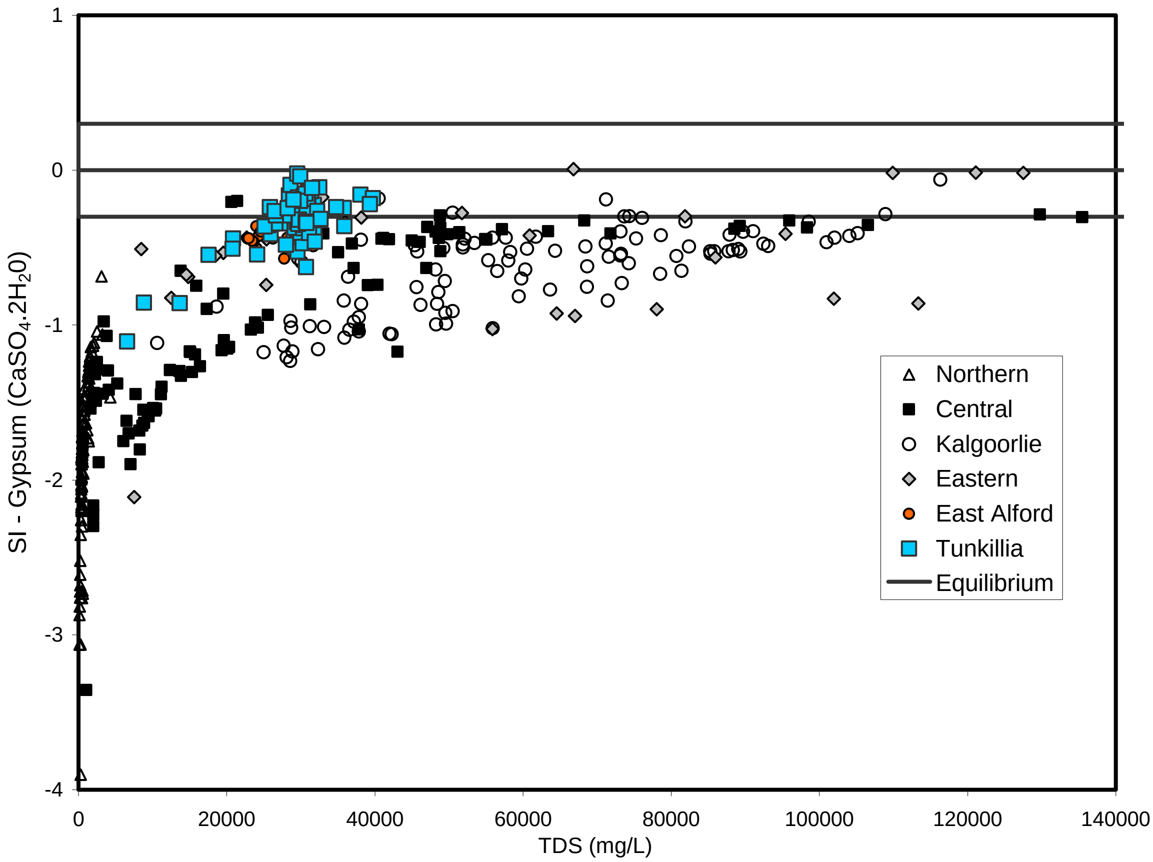

Figure A3.1: SI for gypsum for groundwaters from Tunkillia and Western Australia.

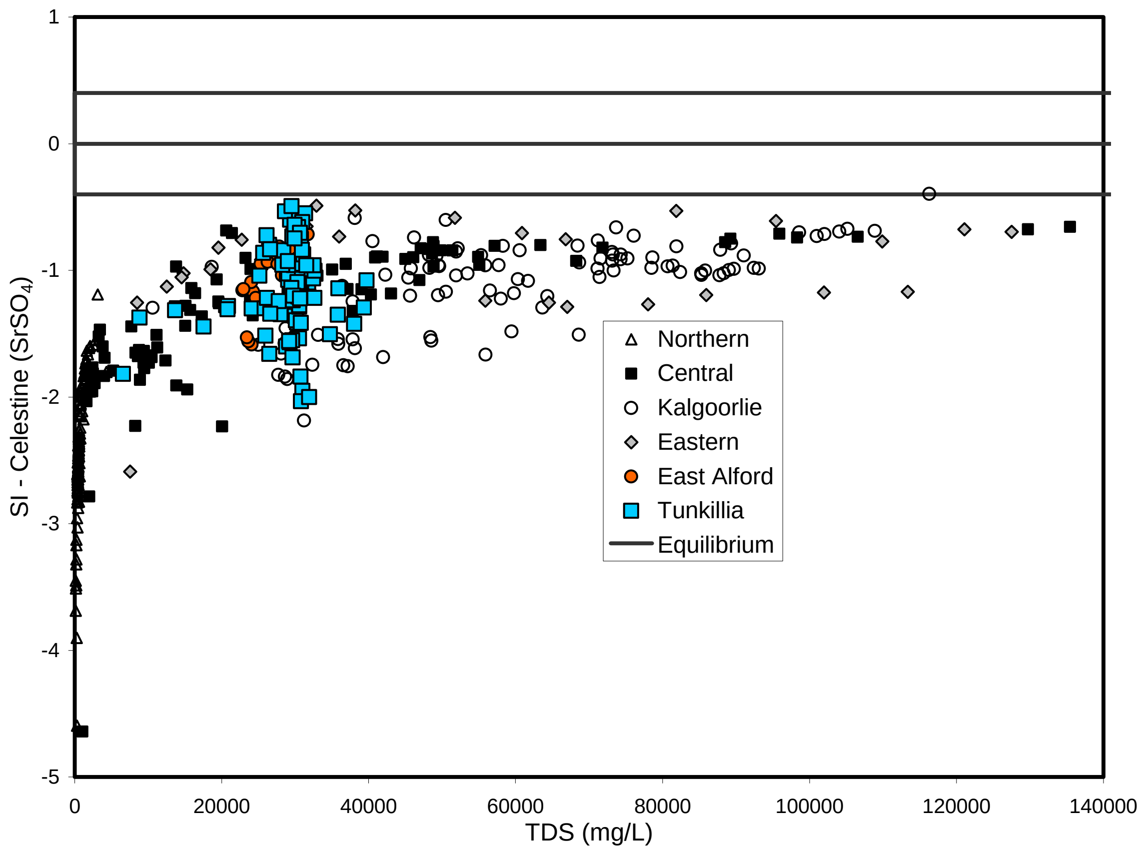

Figure A3.2: SI for celestine for groundwaters from Tunkillia and Western Australia.

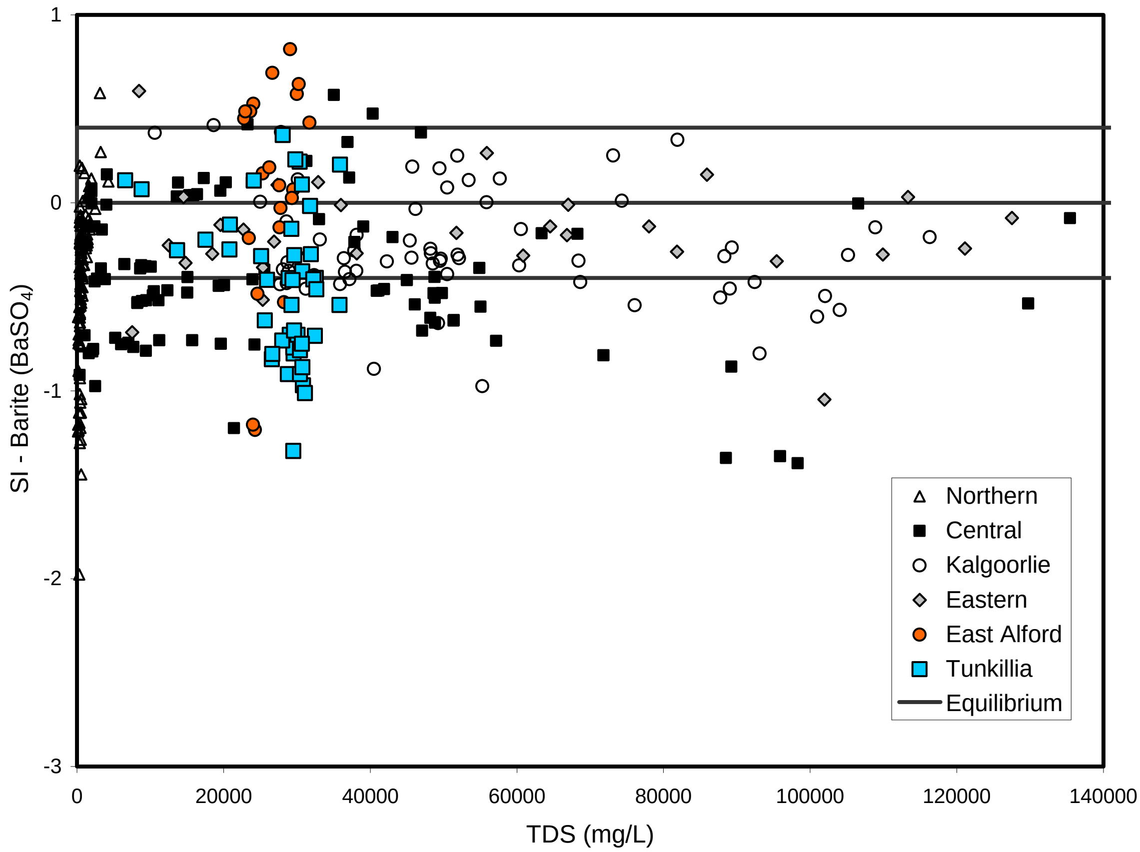

Figure A3.3: SI for barite for groundwaters from Tunkillia and Western Australia.

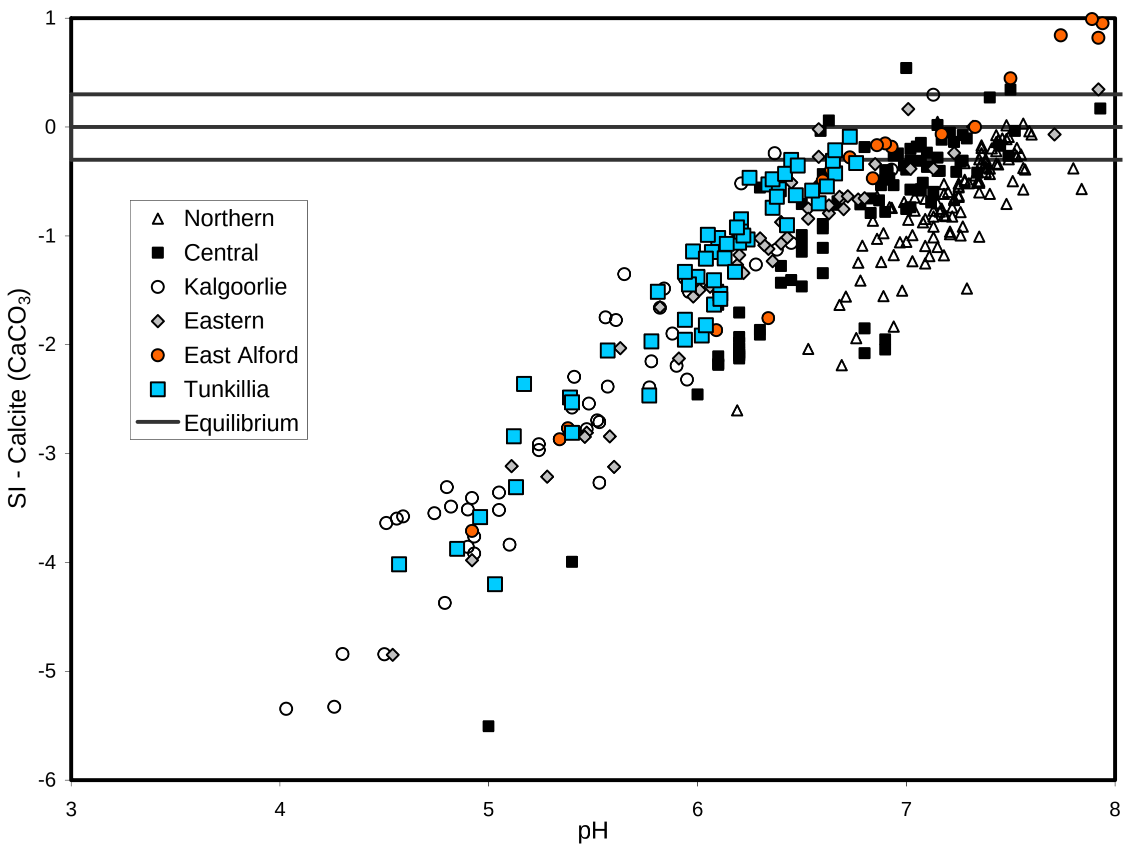

Figure A3.4: SI for calcite for groundwaters from Tunkillia and Western Australia.

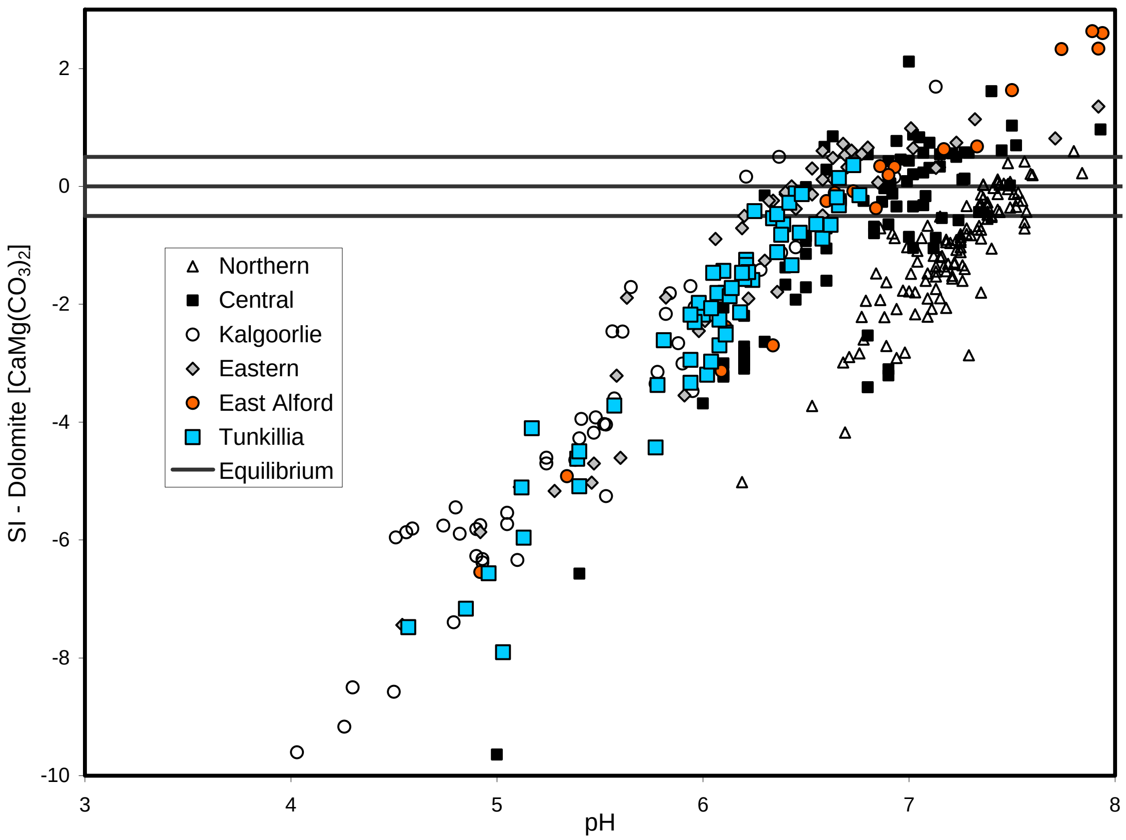

Figure A3.5: SI for dolomite for groundwaters from Tunkillia and Western Australia.

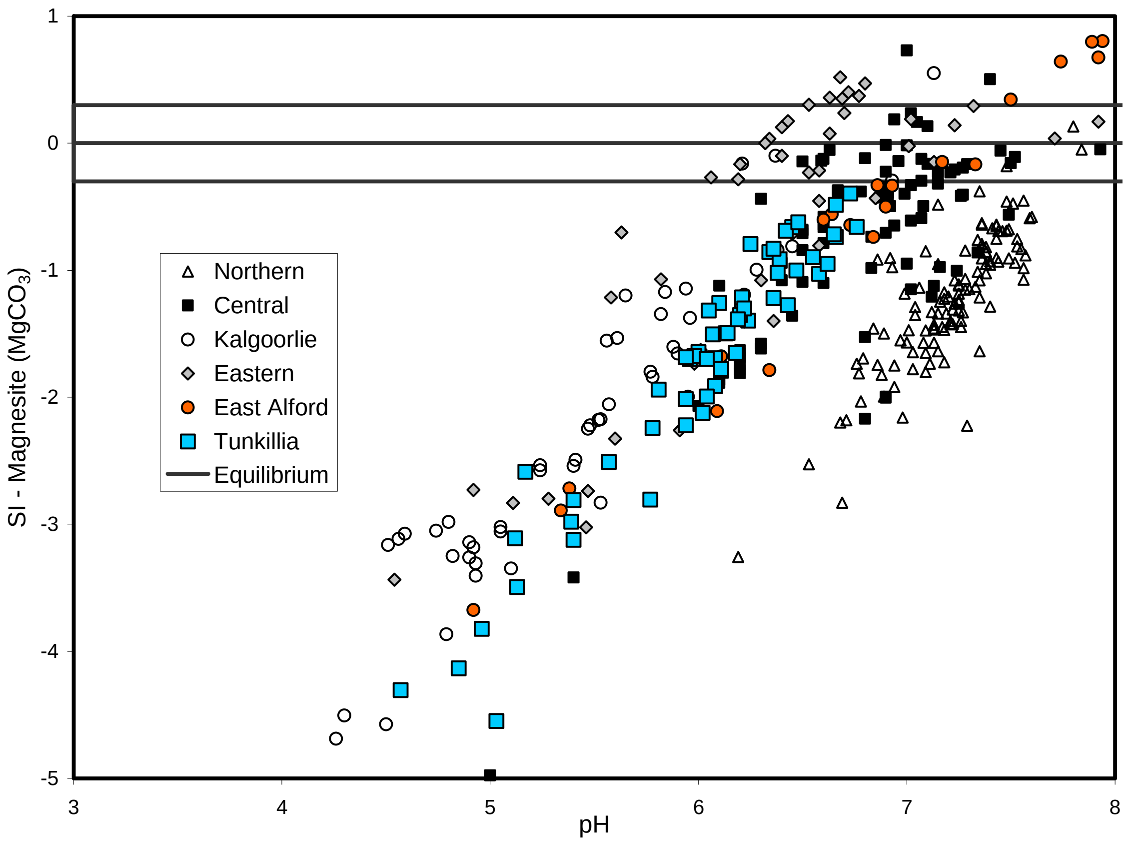

Figure A3.6: SI for magnesite for groundwaters from Tunkillia and Western Australia.

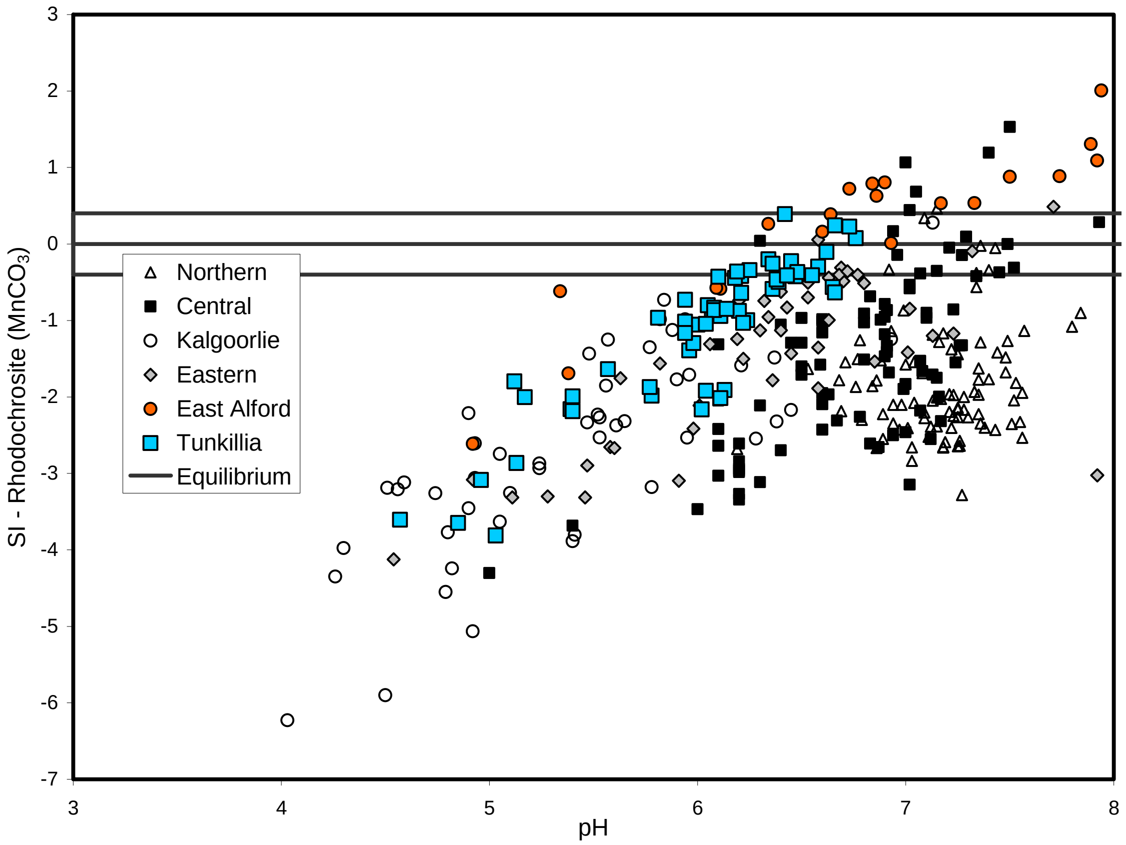

Figure A3.7: SI for rhodochrosite for groundwaters from Tunkillia and Western Australia.

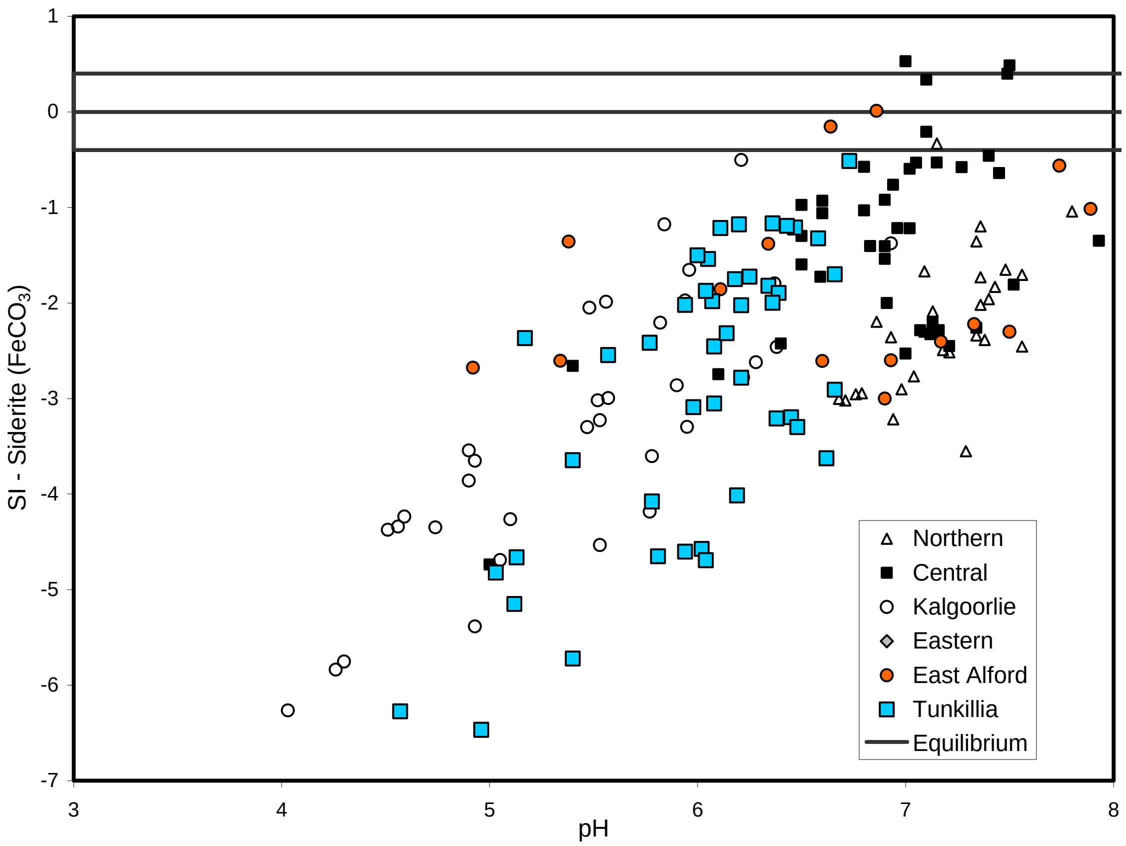

Figure A3. 8: SI for siderite for groundwaters from Tunkillia and Western Australia.

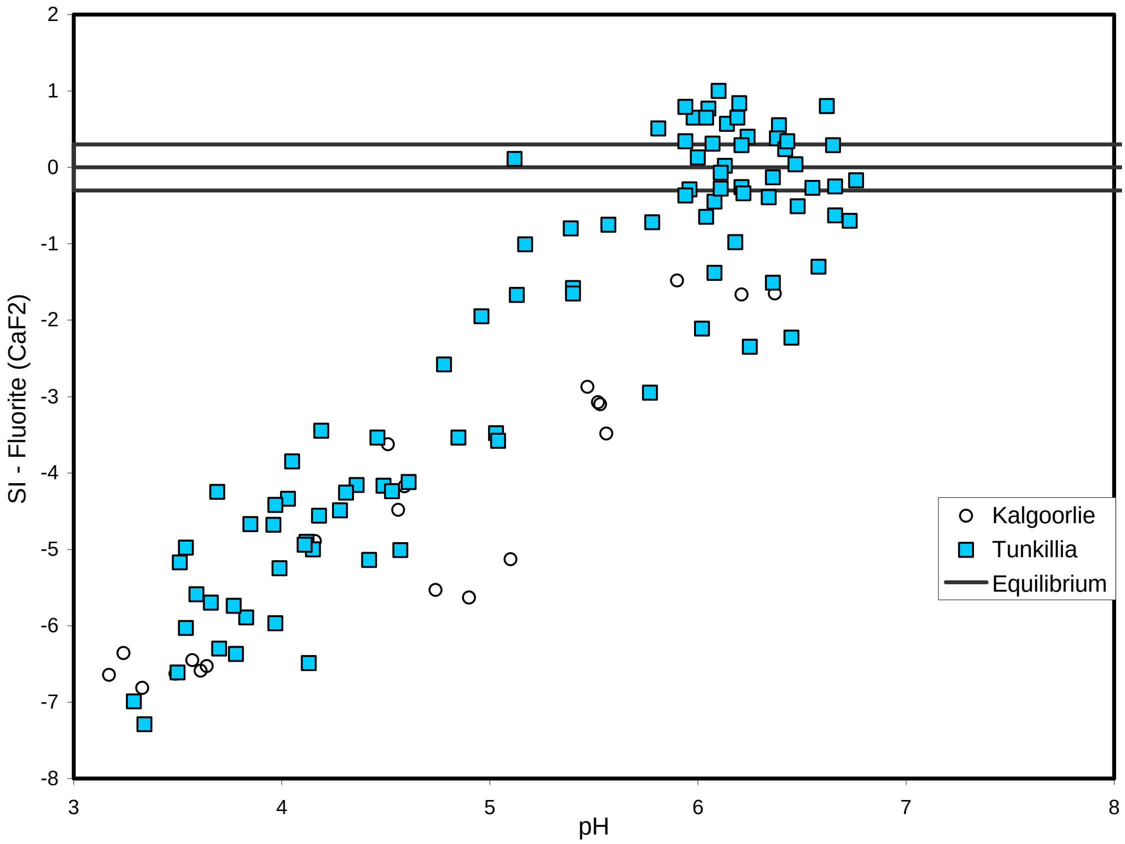

Figure A3.9: SI for fluorite for groundwaters from Tunkillia and Western Australia.

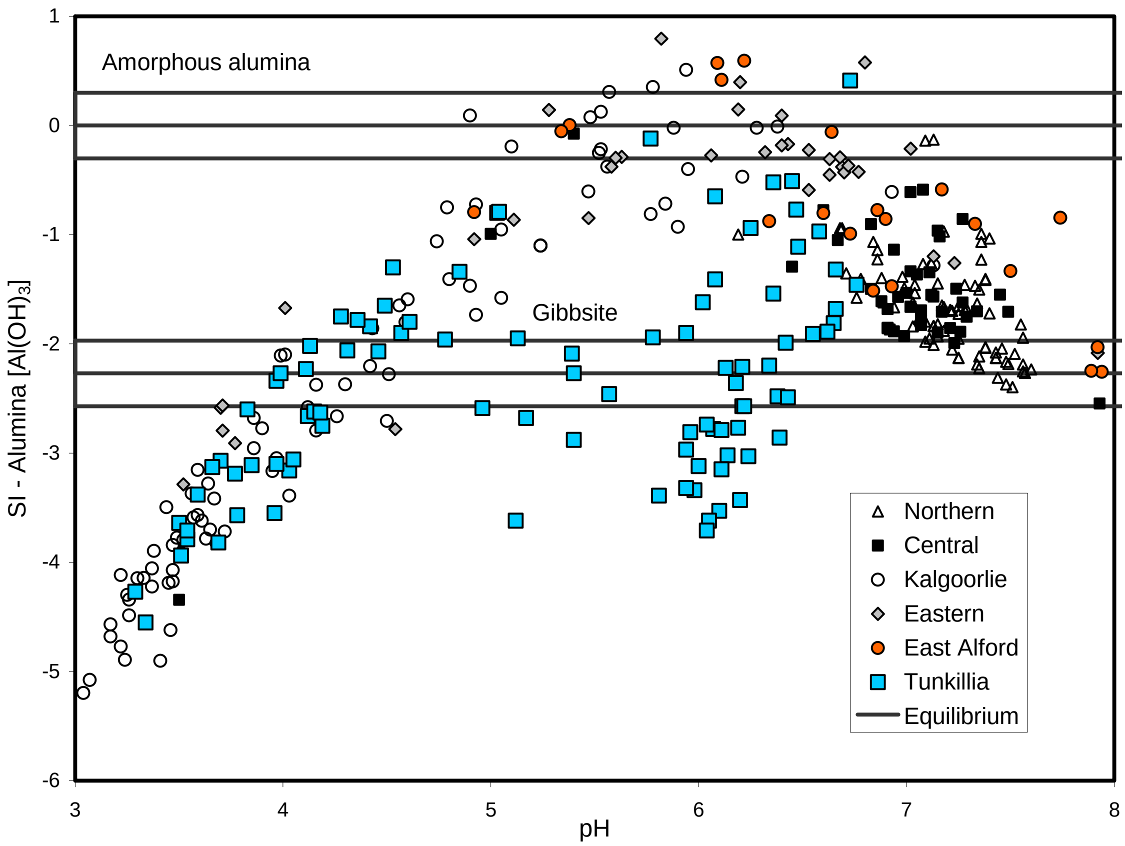

Figure A3.10: SI for alumina for groundwaters from Tunkillia and Western Australia.

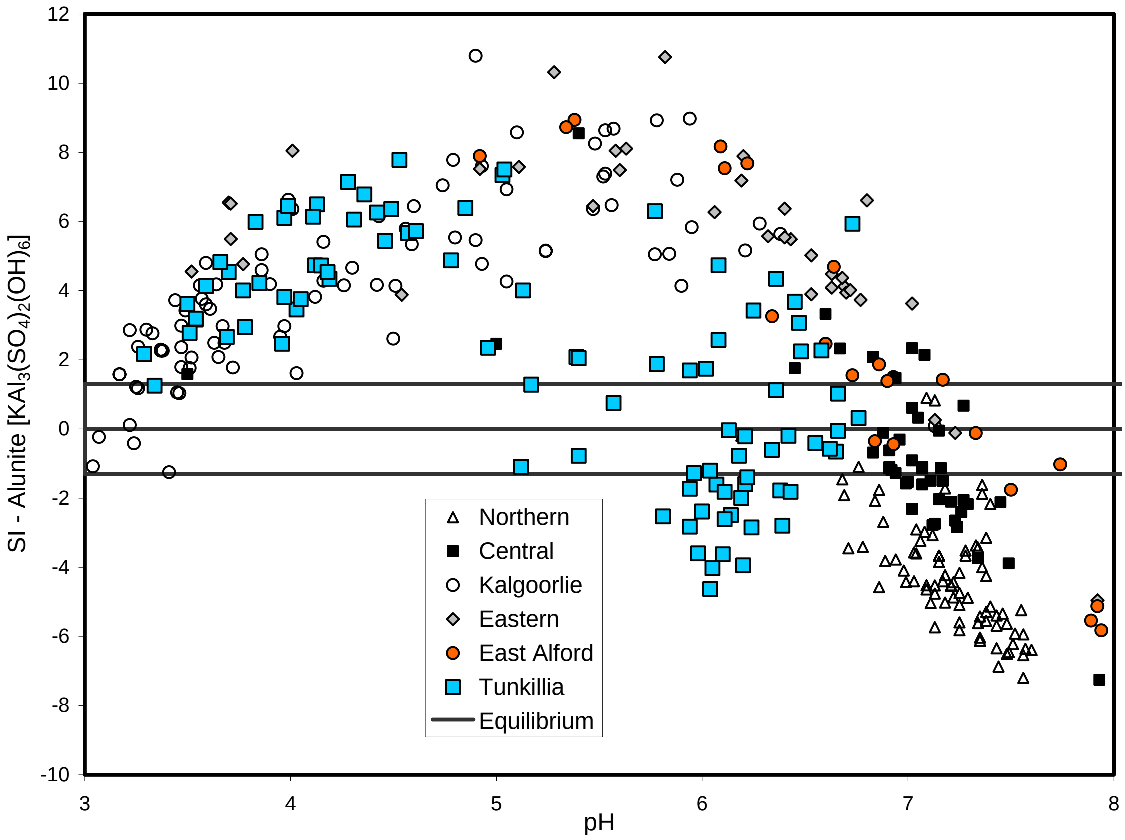

Figure A3.11: SI for alunite for groundwaters from Tunkillia and Western Australia.

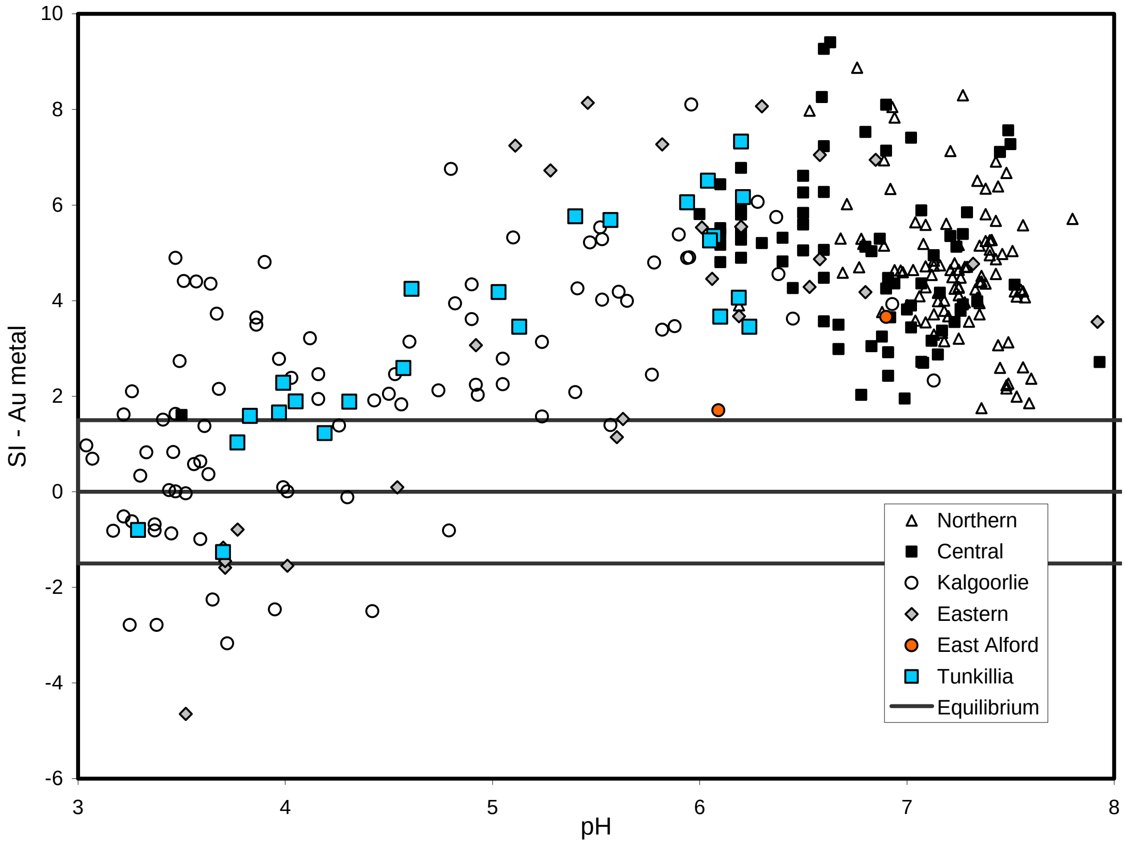

Figure A3.12: SI for Au metal for groundwaters from Tunkillia and Western Australia.

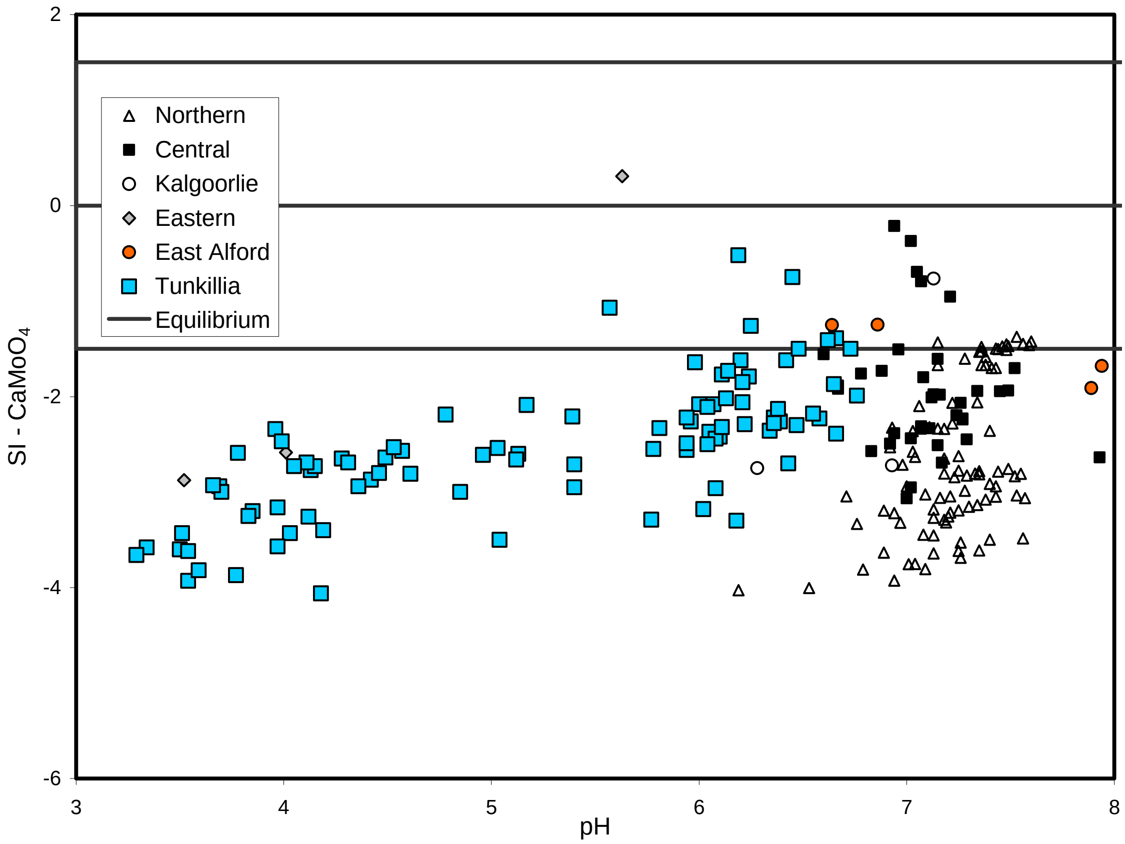

Figure A3.13: SI for $CaMoO_4$ for groundwaters from Tunkillia and Western Australia.

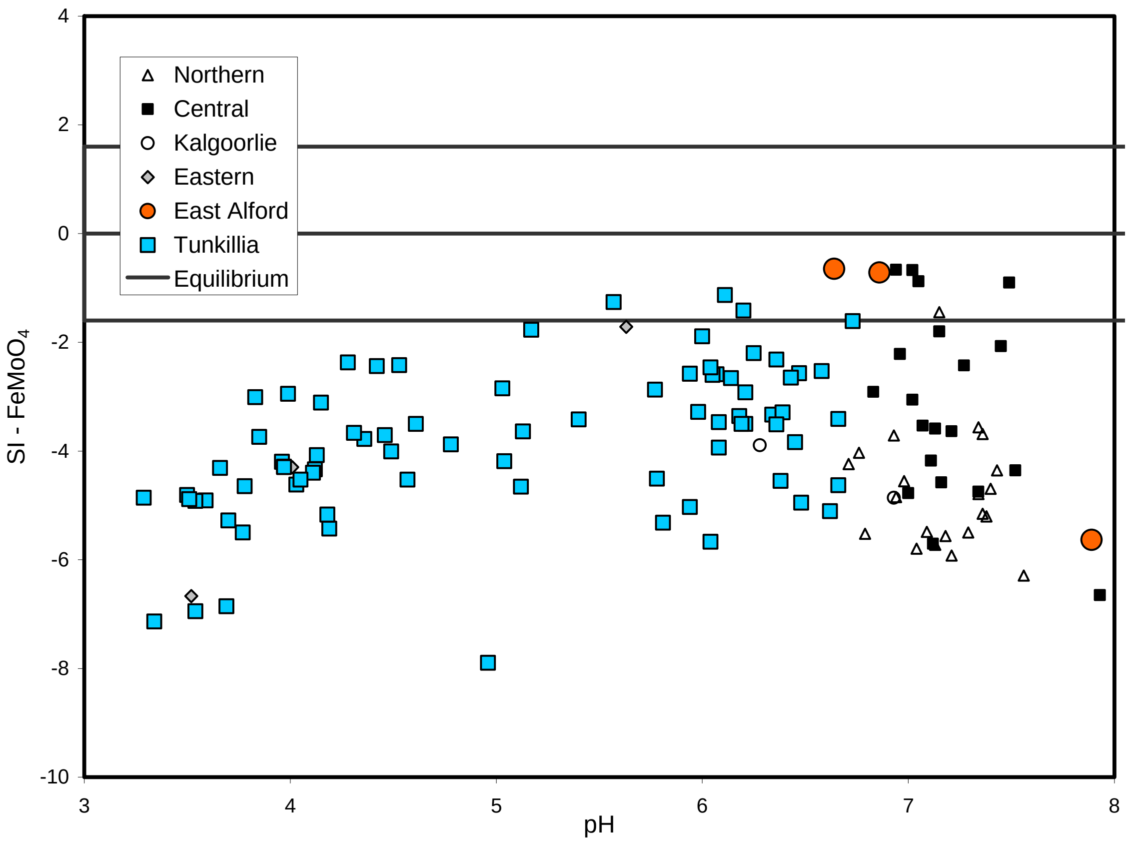

Figure A3.14: SI for $FeMoO_4$ for groundwaters from Tunkillia and Western Australia.

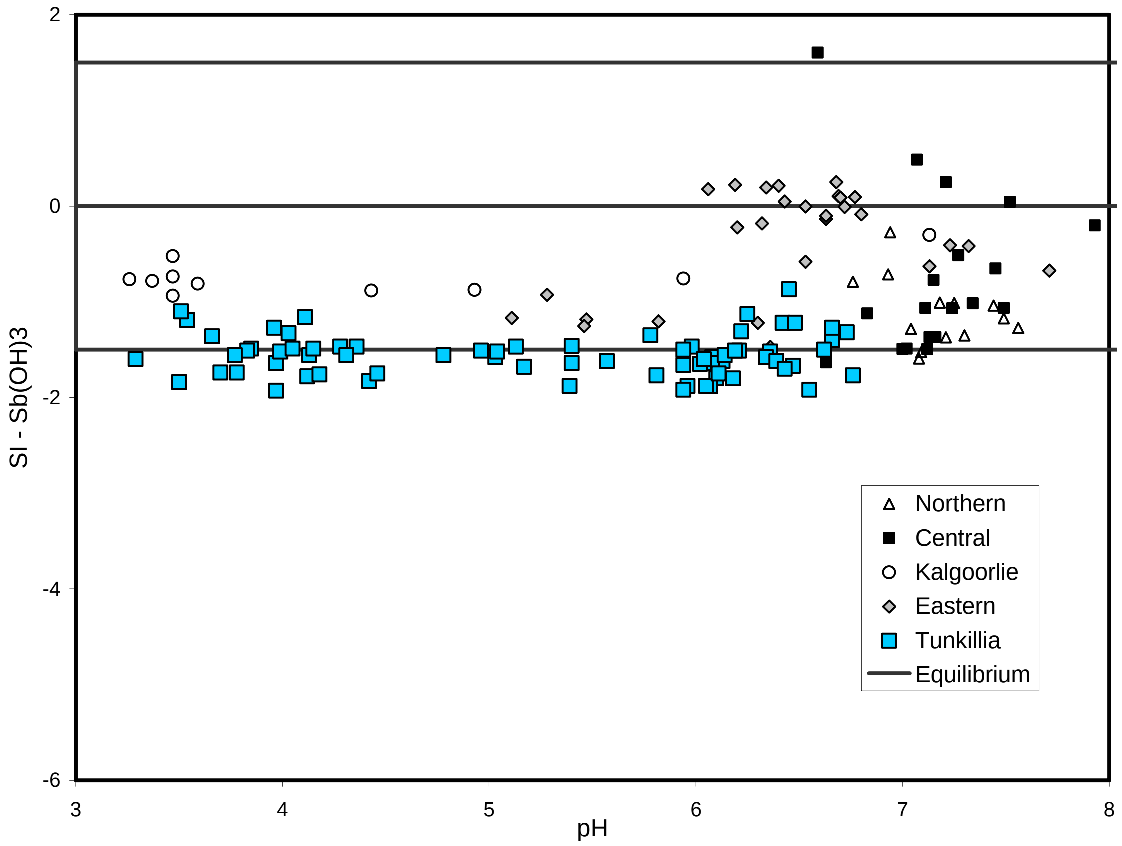

Figure A3.15: SI for $Sb(OH)_3$ for groundwaters from Tunkillia and Western Australia.

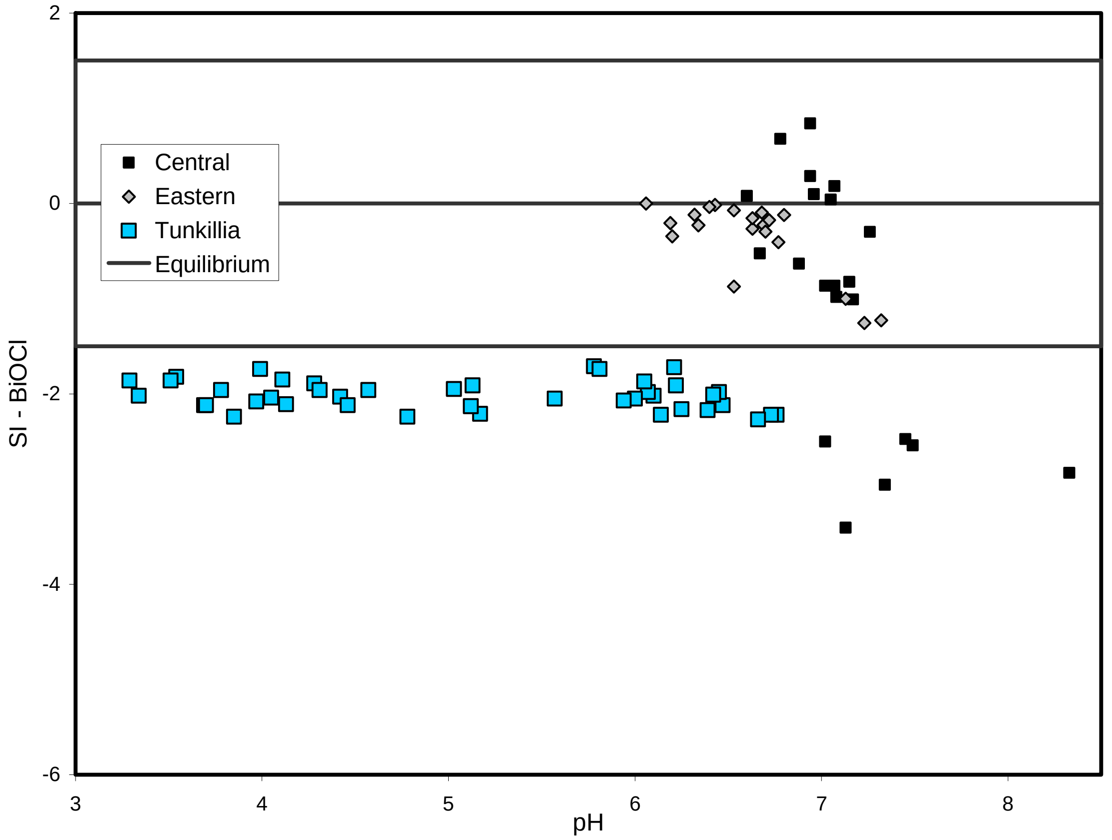

Figure A3.16: SI for BiOCl for groundwaters from Tunkillia and Western Australia.

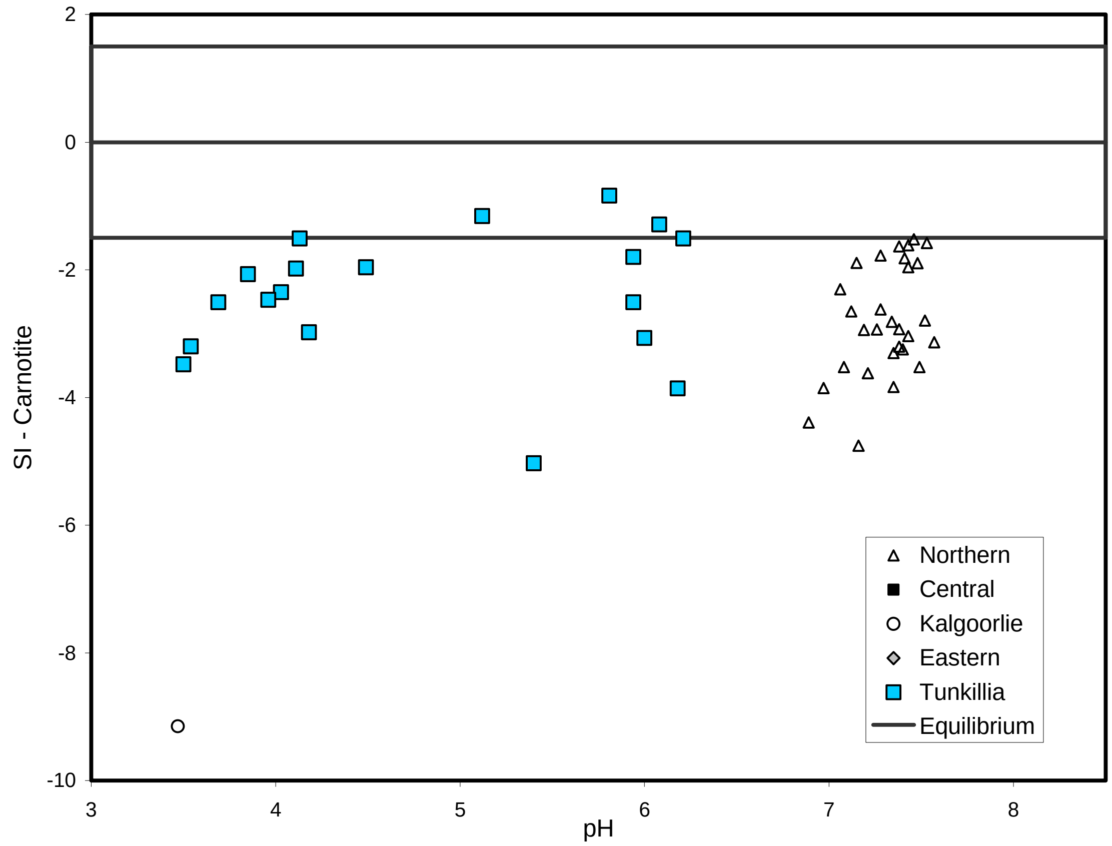

Figure A3.17: SI for carnotite for groundwaters from Tunkillia and Western Australia.

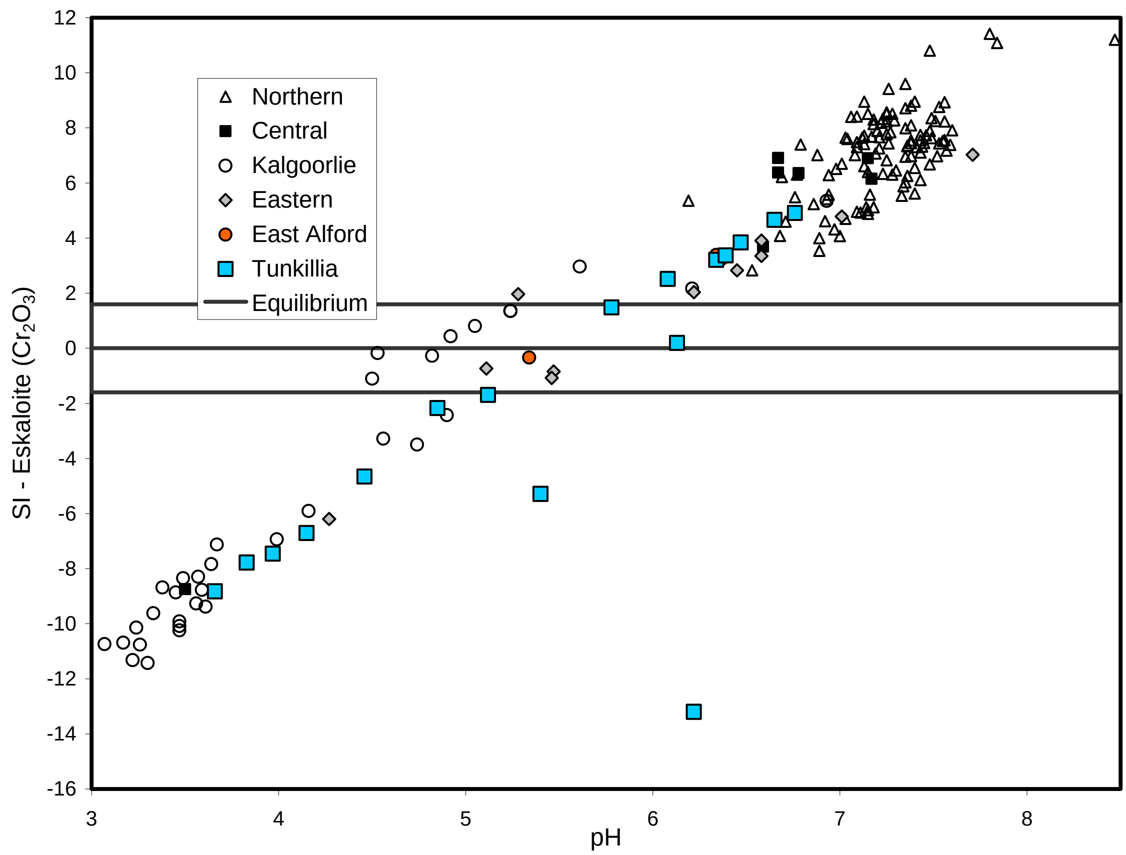

Figure A3.18: SI for eskaloite for groundwaters from Tunkillia and Western Australia.

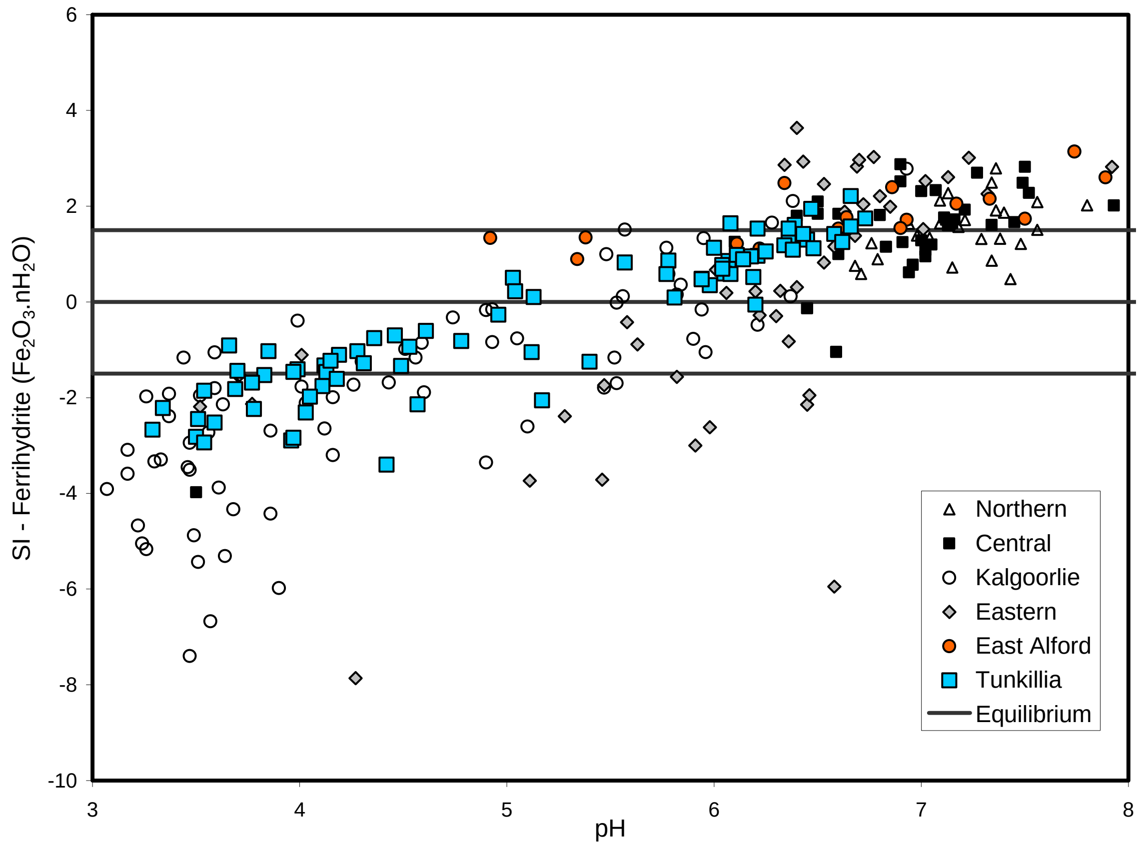

Figure A3.19: SI for ferrihydrite for groundwaters from Tunkillia and Western Australia.

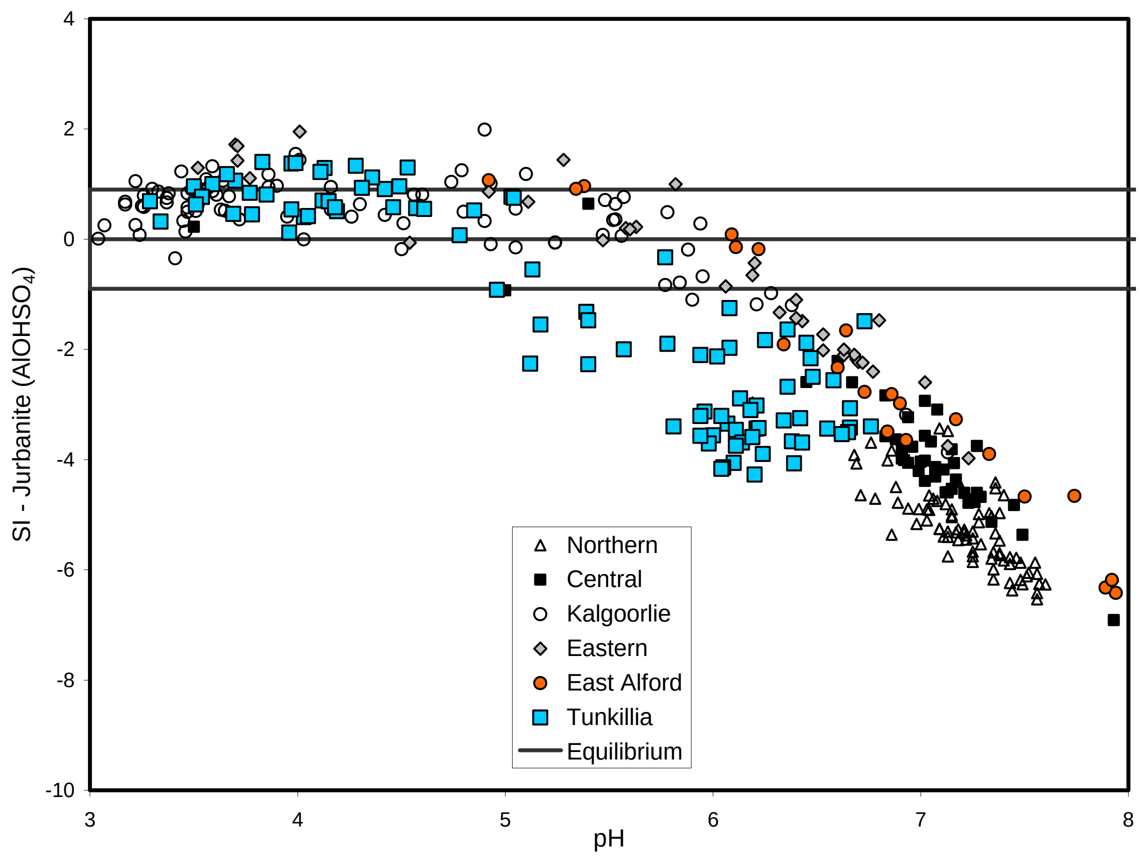

Figure A3.20: SI for jurbanite for groundwaters from Tunkillia and Western Australia.

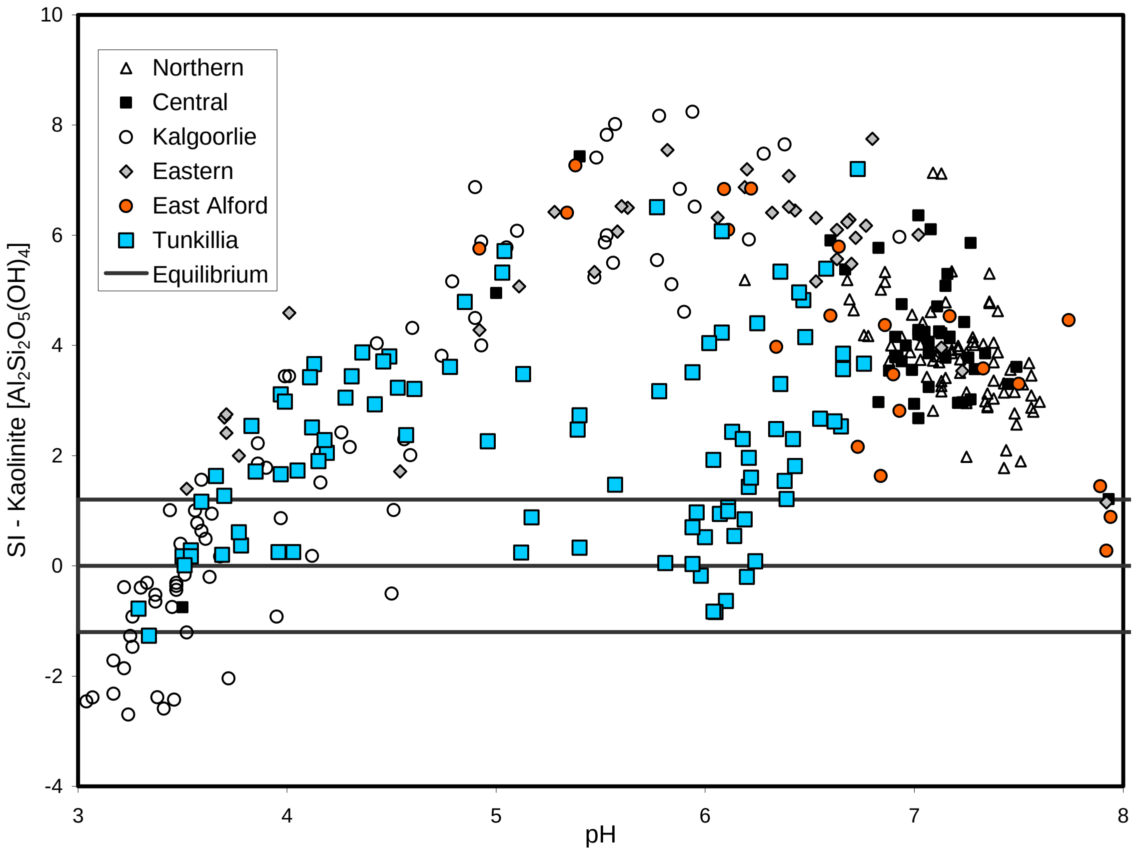

Figure A3.21: SI for kaolinite for groundwaters from Tunkillia and Western Australia.

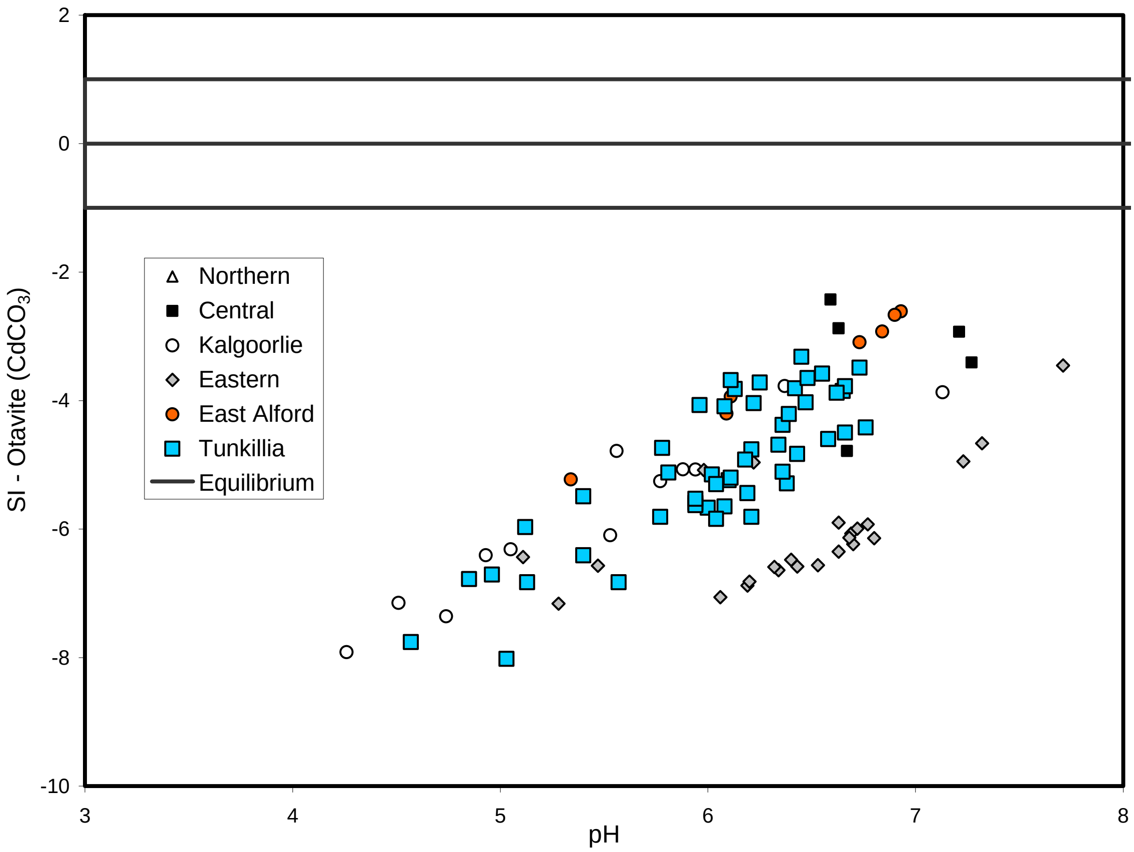

Figure A3.22: SI for otavite for groundwaters from Tunkillia and Western Australia.

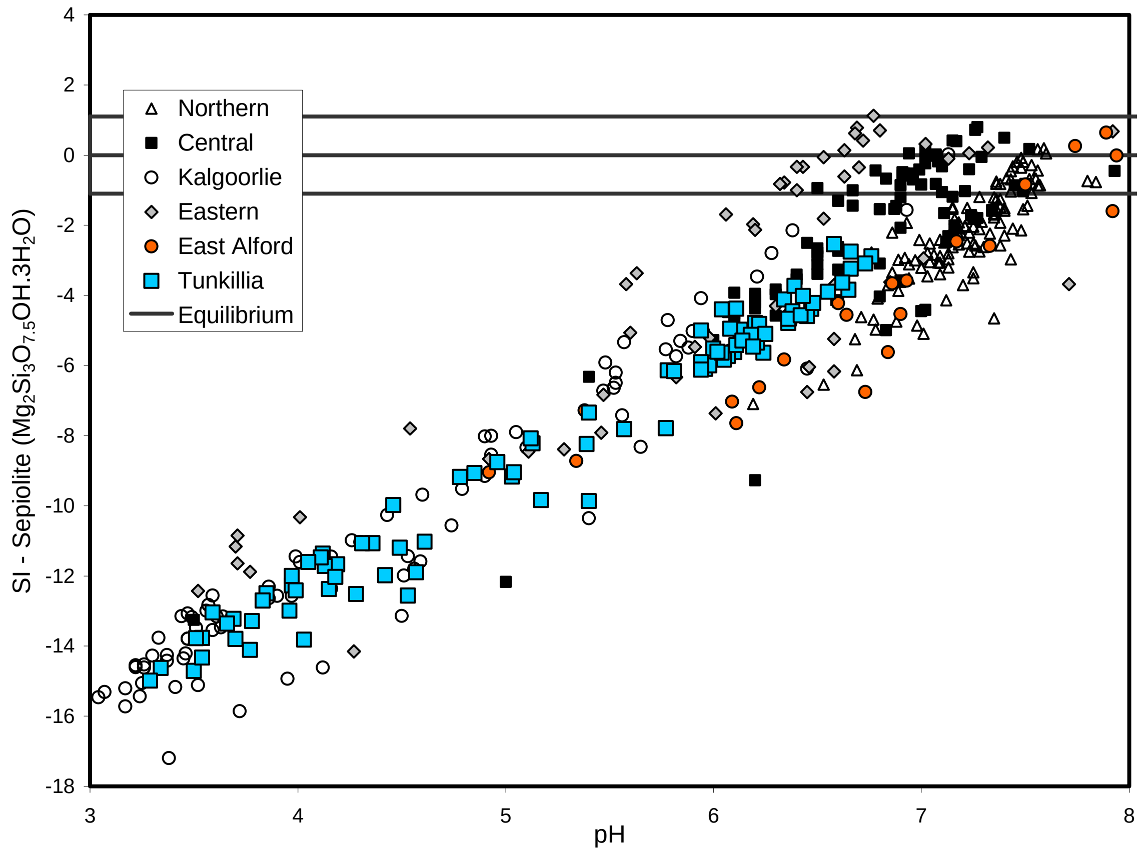

Figure A3.23: SI for sepiolite for groundwaters from Tunkillia and Western Australia.

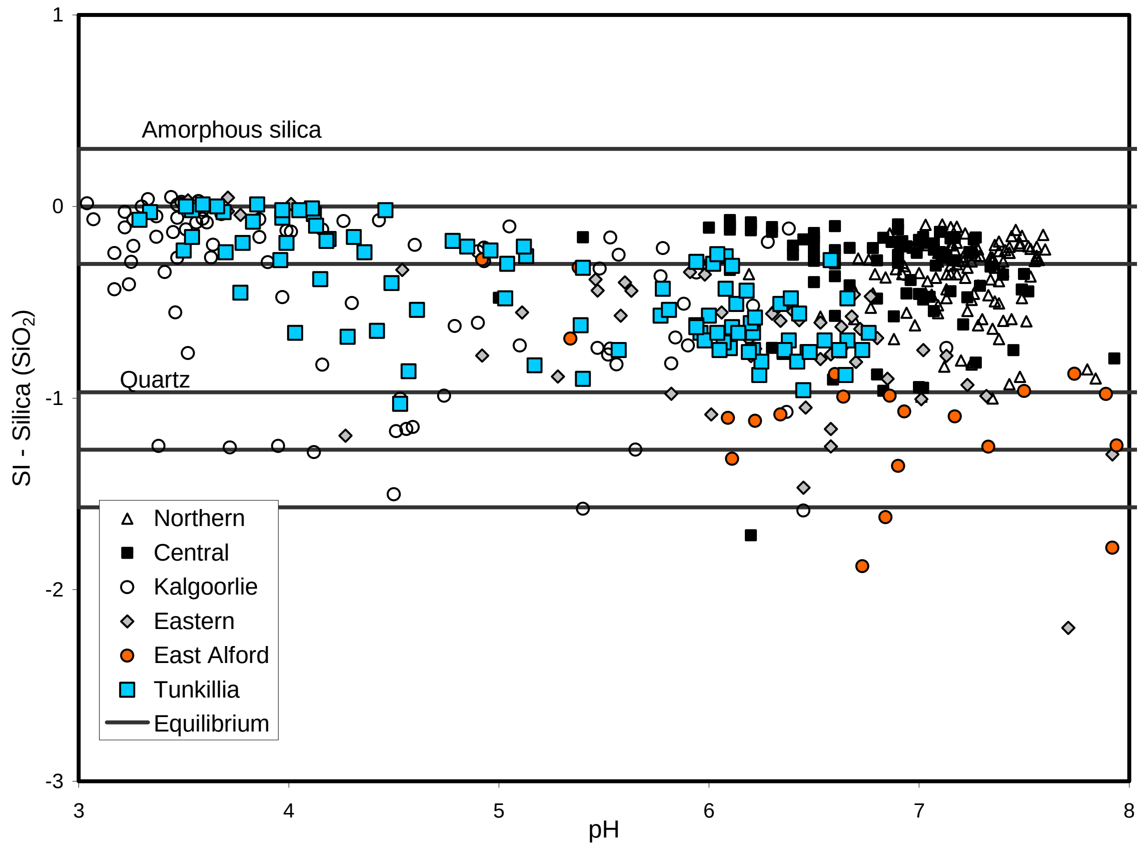

Figure A3.24: SI for silica for groundwaters from Tunkillia and Western Australia.

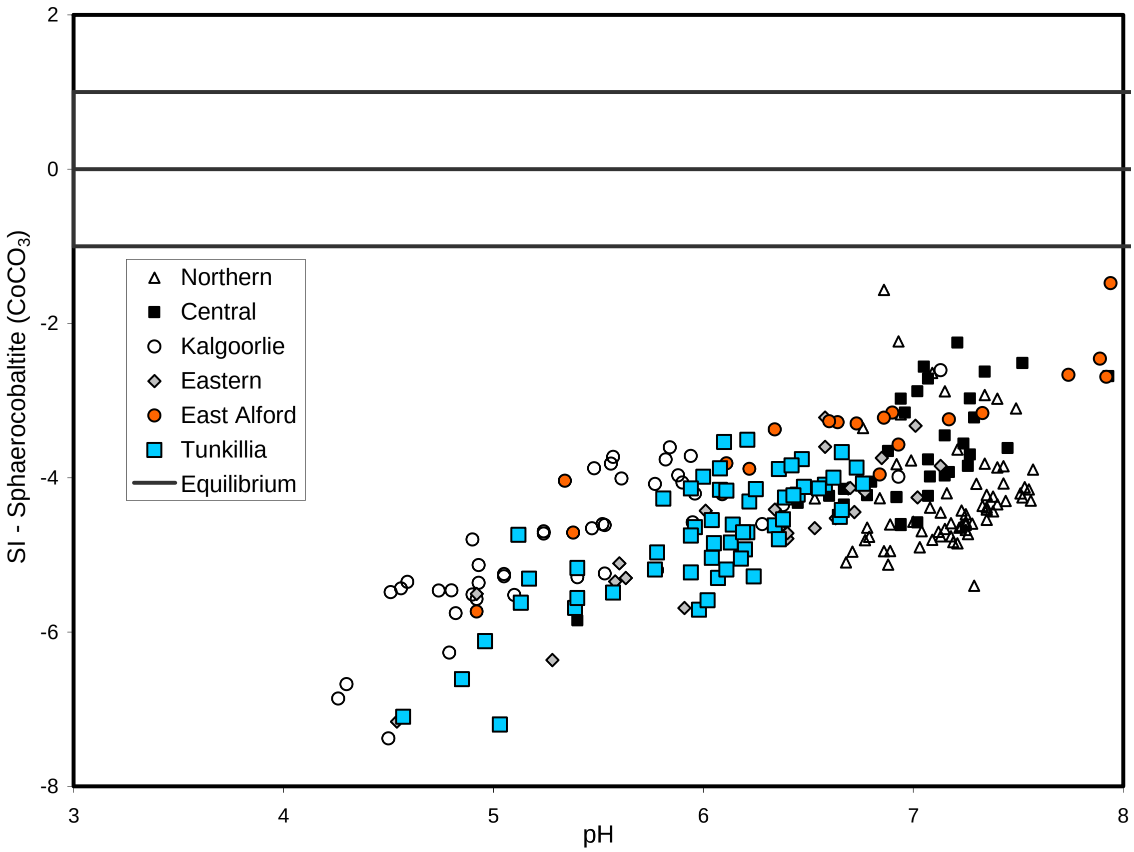

Figure A3.25: SI for sphaerocobatite for groundwaters from Tunkillia and Western Australia.

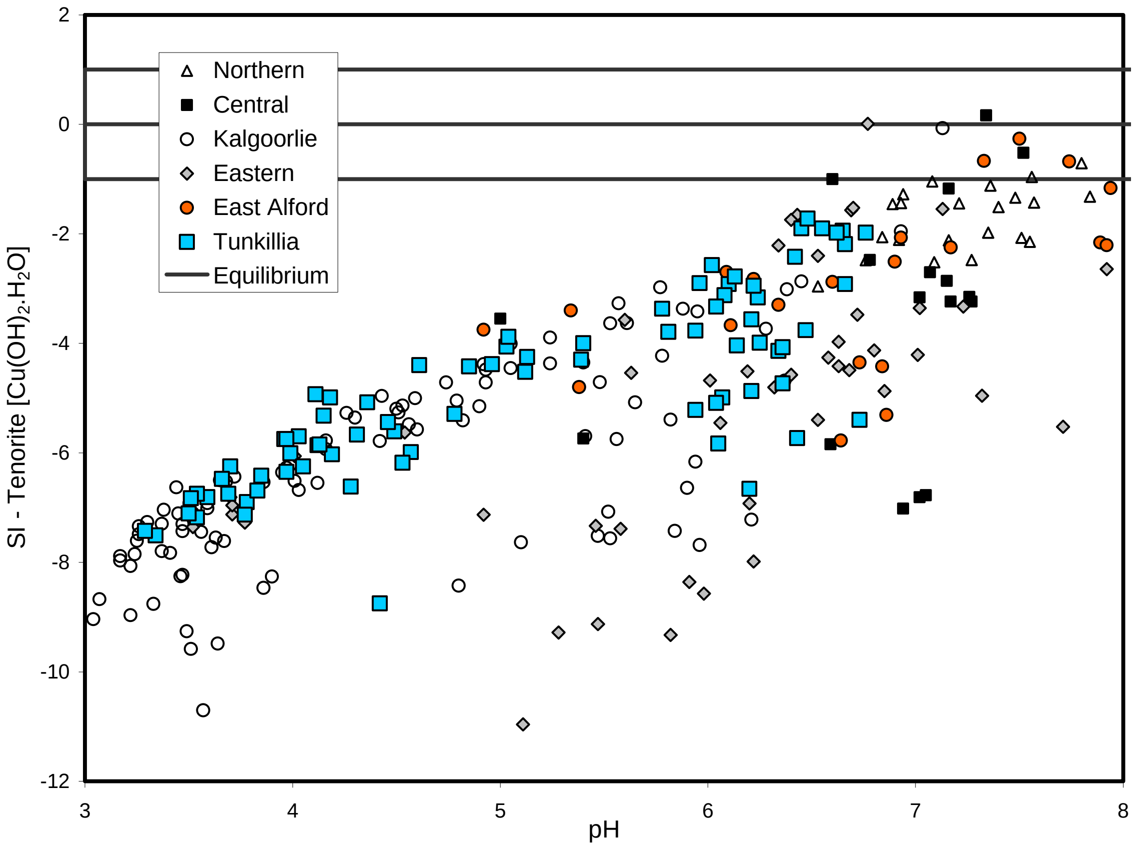

Figure A3.26: SI for tenorite for groundwaters from Tunkillia and Western Australia.

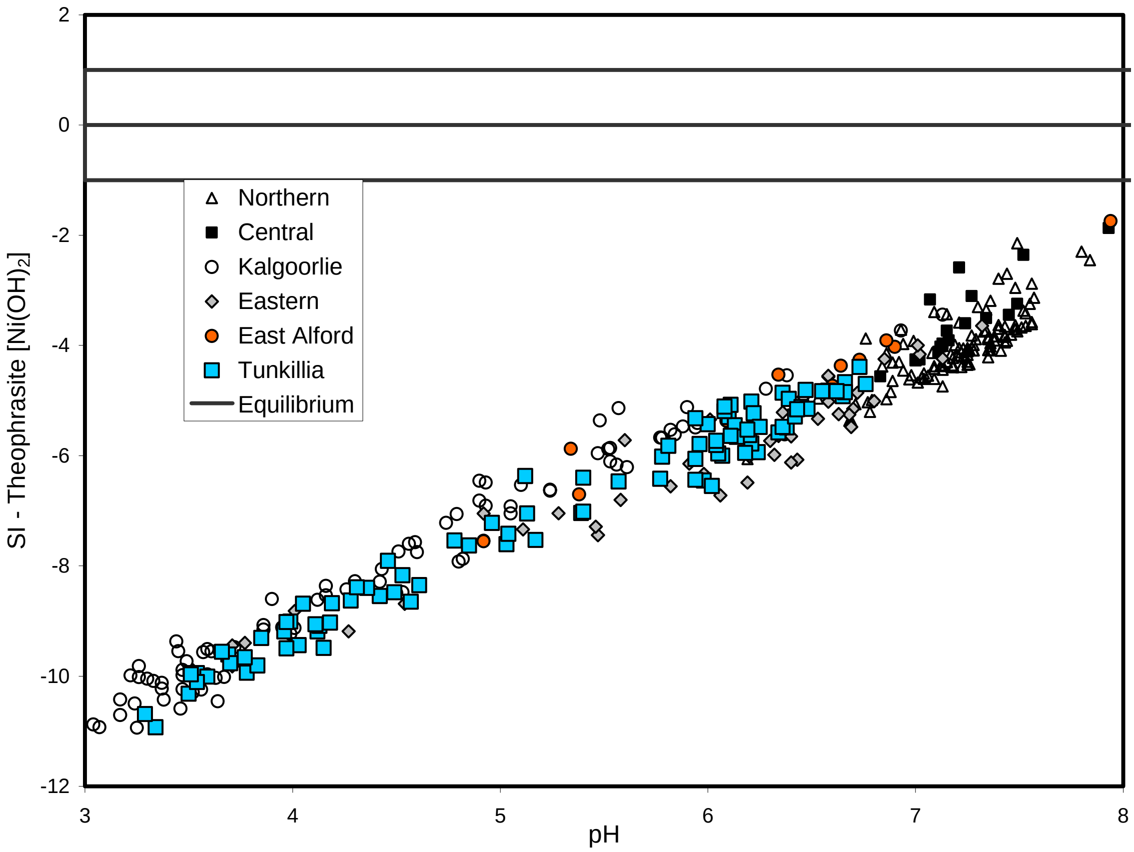

Figure A3.27: SI for theophrasite for groundwaters from Tunkillia and Western Australia.

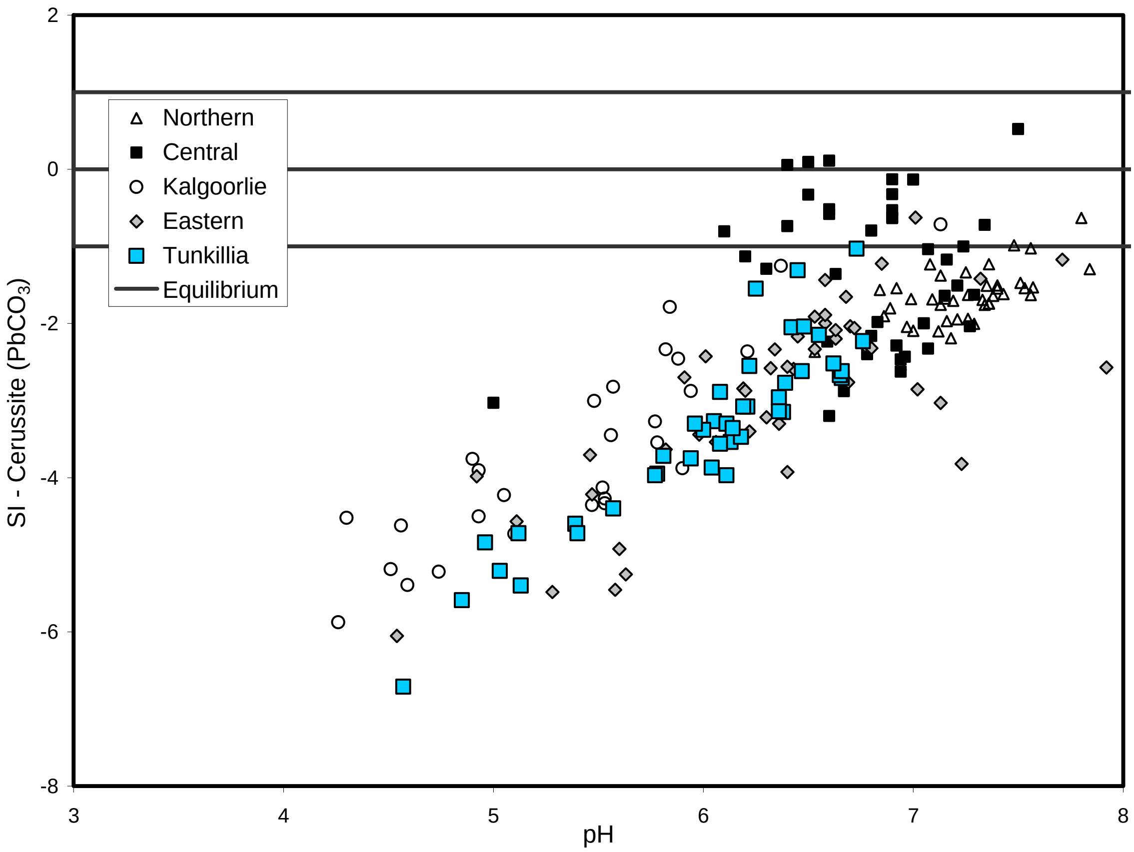

Figure A3.28: SI for cerusssite for groundwaters from Tunkillia and Western Australia.

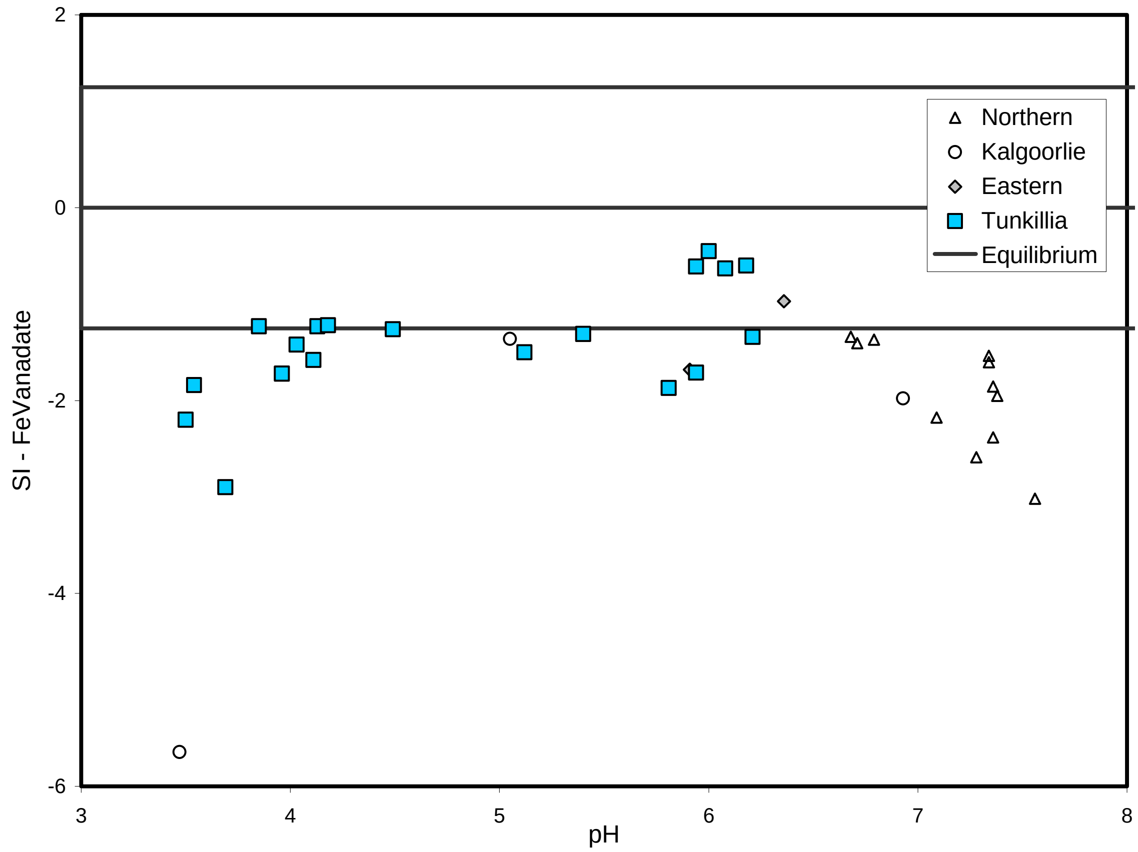

Figure A3.29: SI for Fe vanadate for groundwaters from Tunkillia and Western Australia.

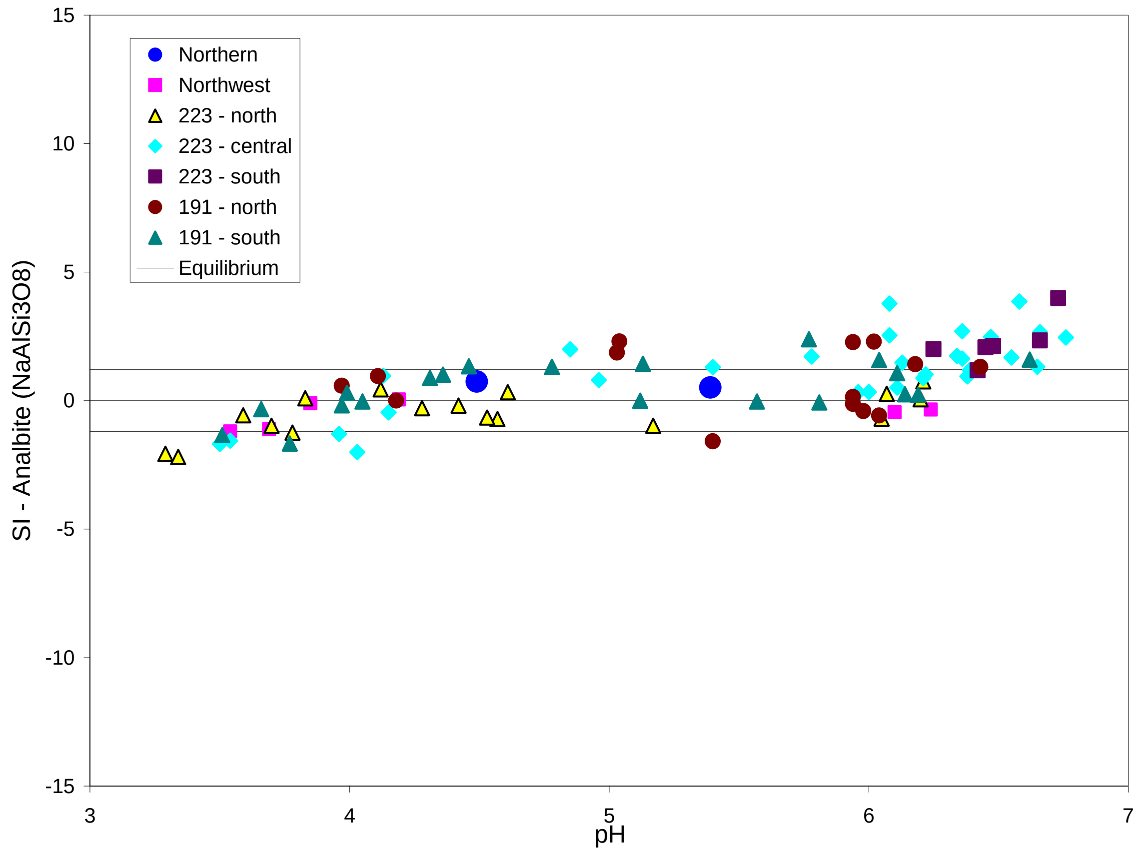

Figure A3.30: SI for analbite for groundwaters from various areas at Tunkillia.

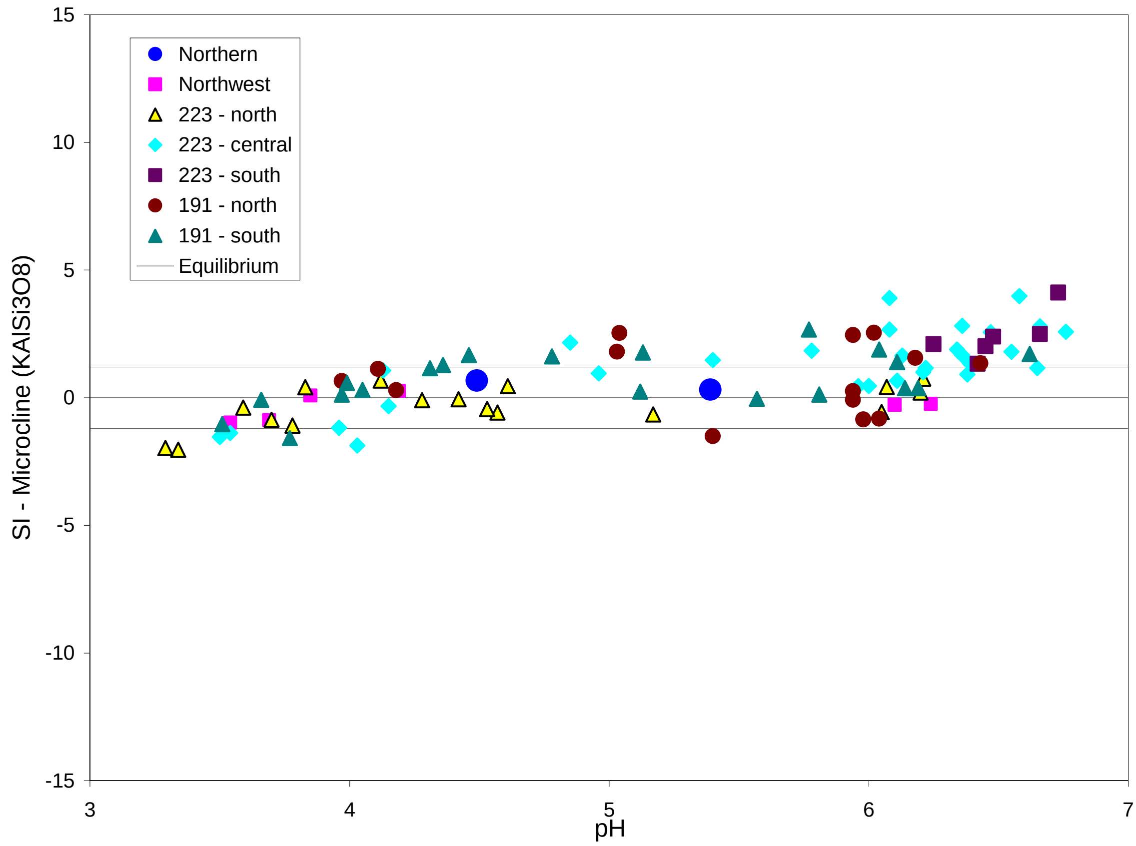

Figure A3.31: SI for microcline for groundwaters from various areas at Tunkillia.

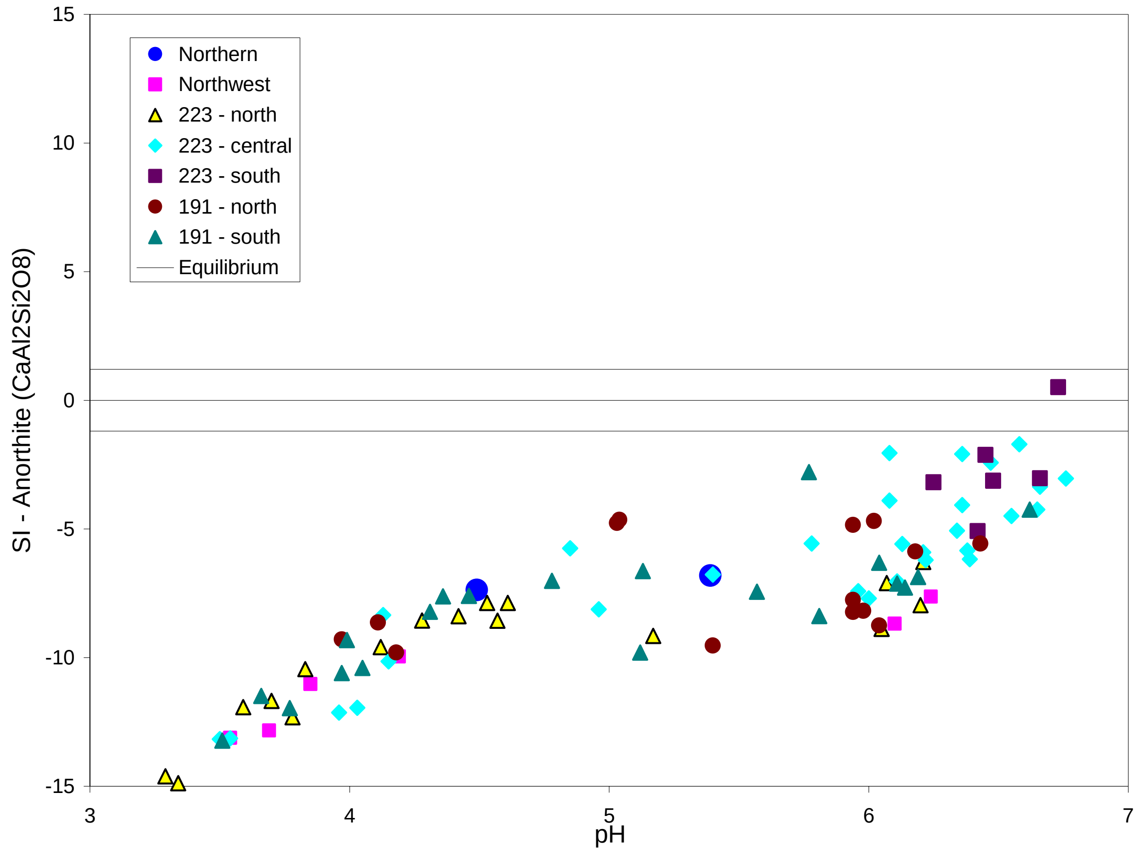

Figure A3.32: SI for anorthite for groundwaters from various areas at Tunkillia.

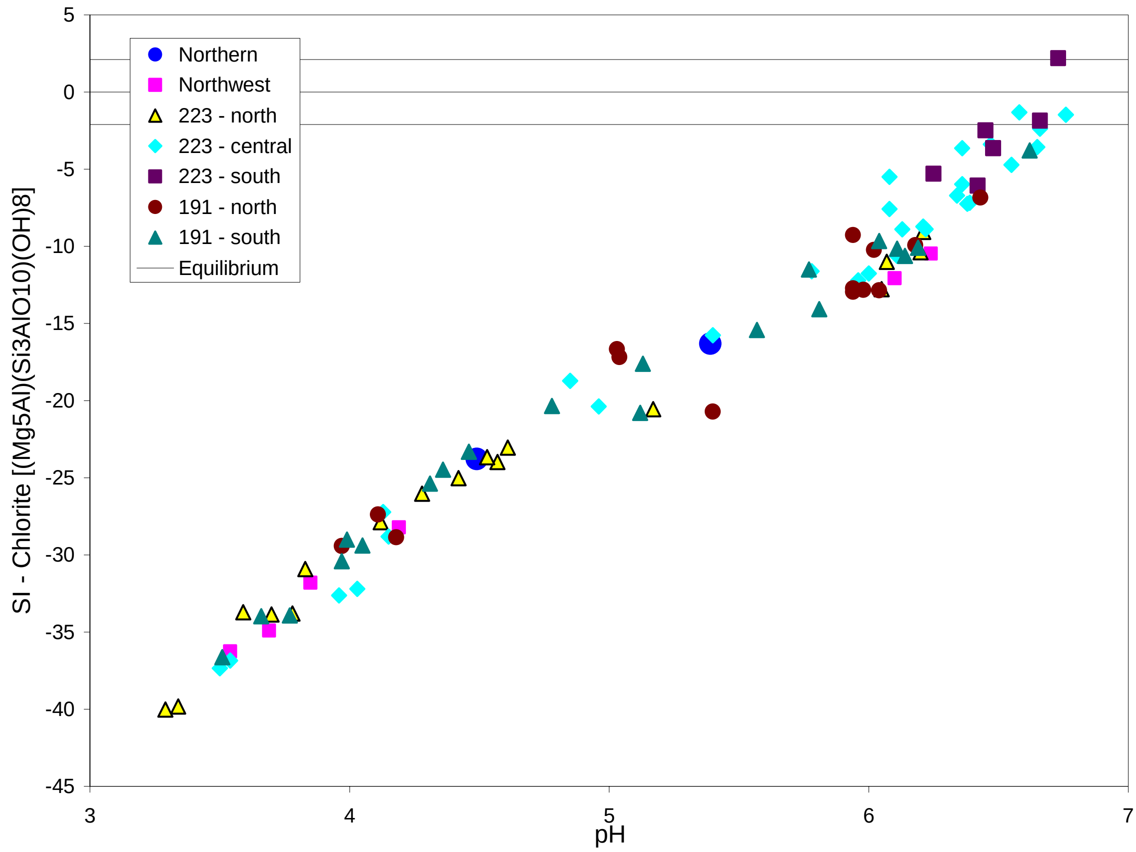

Figure A3.33: SI for chlorite for groundwaters from various areas at Tunkillia.

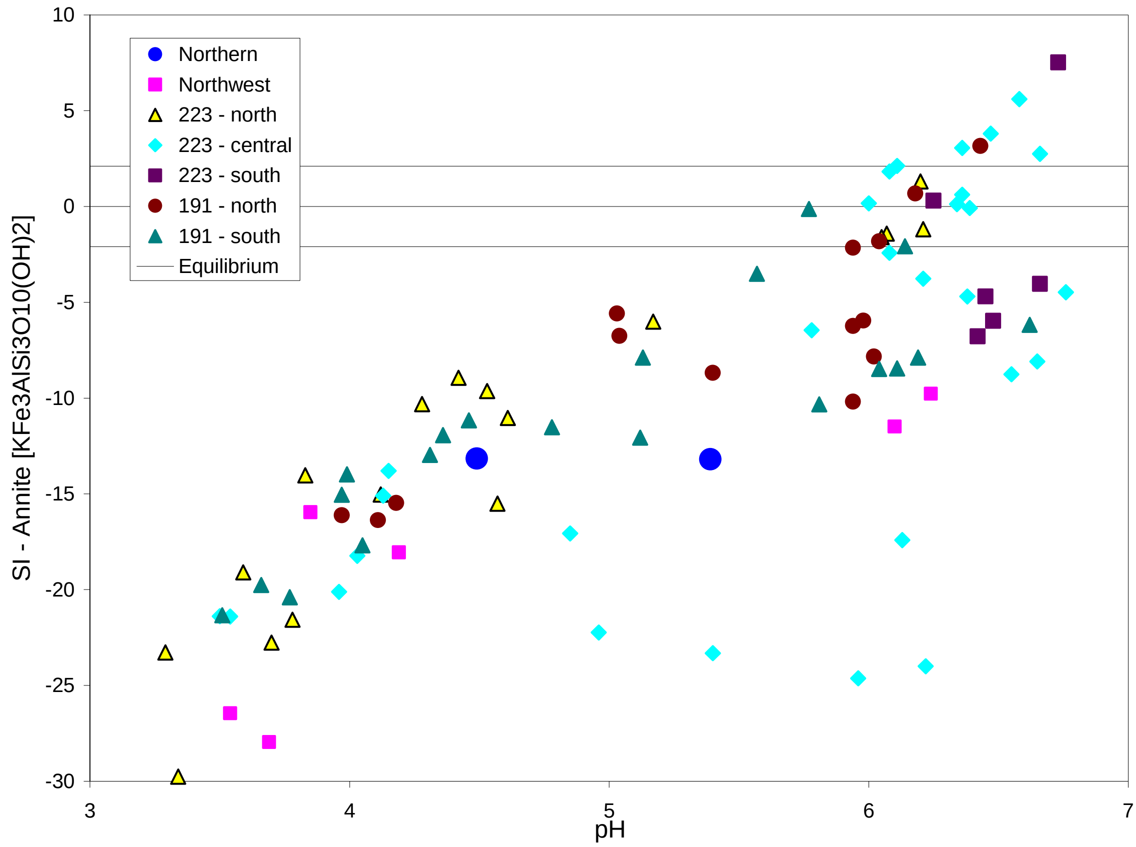

Figure A3.34: SI for annite for groundwaters from various areas at Tunkillia.

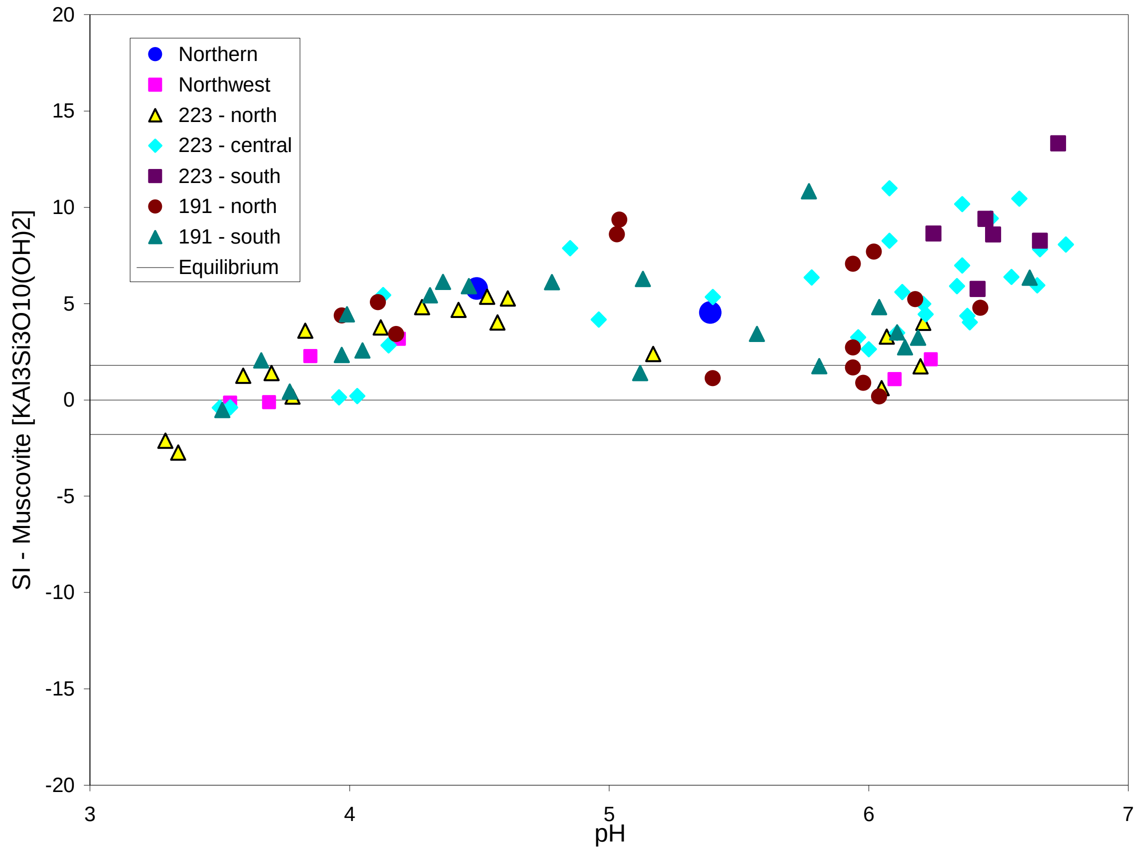

Figure A3.35: SI for muscovite for groundwaters from various areas at Tunkillia.

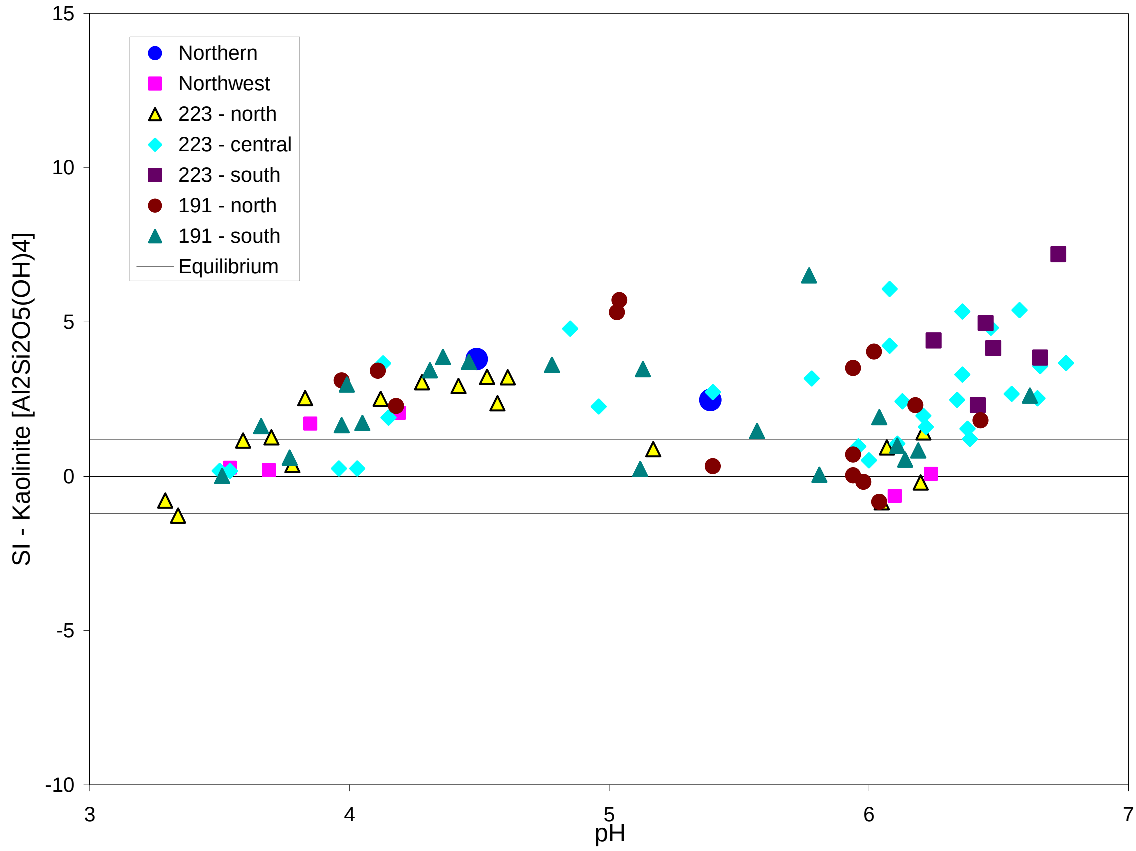

Figure A3.36: SI for kaolinite for groundwaters from various areas at Tunkillia.

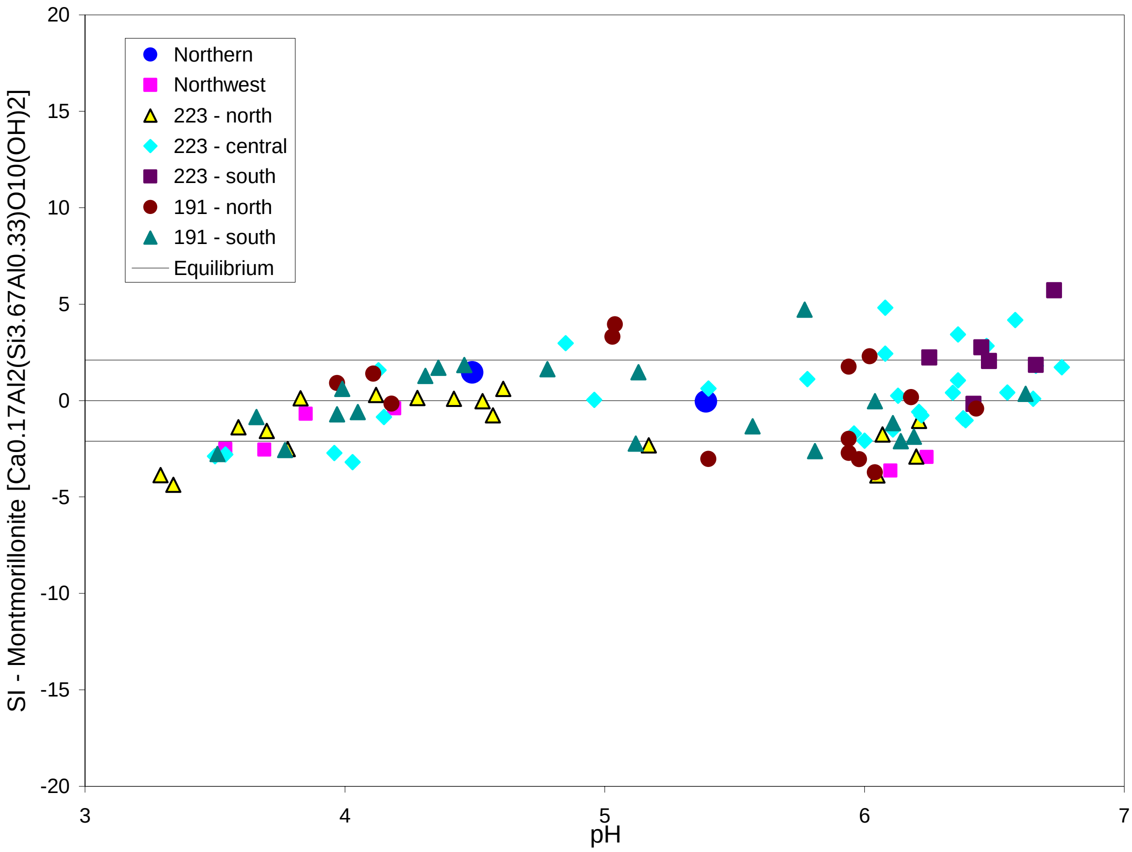

Figure A3.37: SI for montmorillonite for groundwaters from various areas at Tunkillia.

Appendix 4: Element/ion distribution maps for groundwaters.

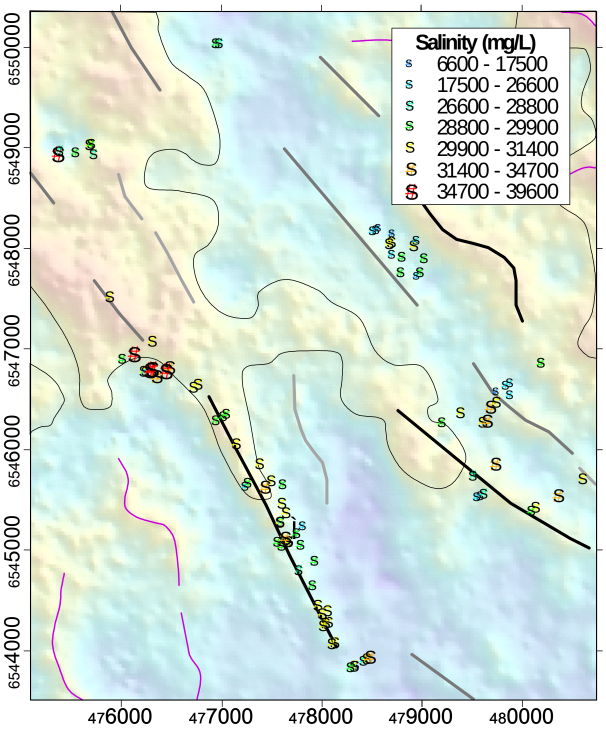

Figure A4.1: Salinity distribution at Tunkillia

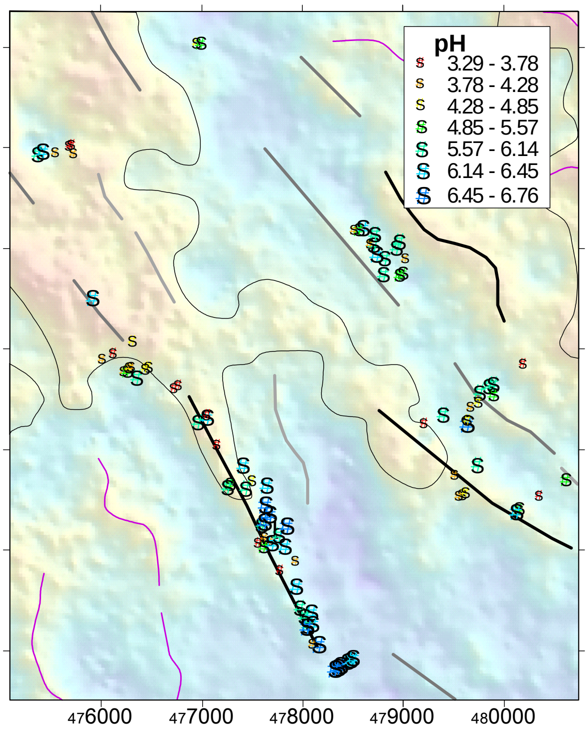

Figure A4.2: pH distribution at Tunkillia

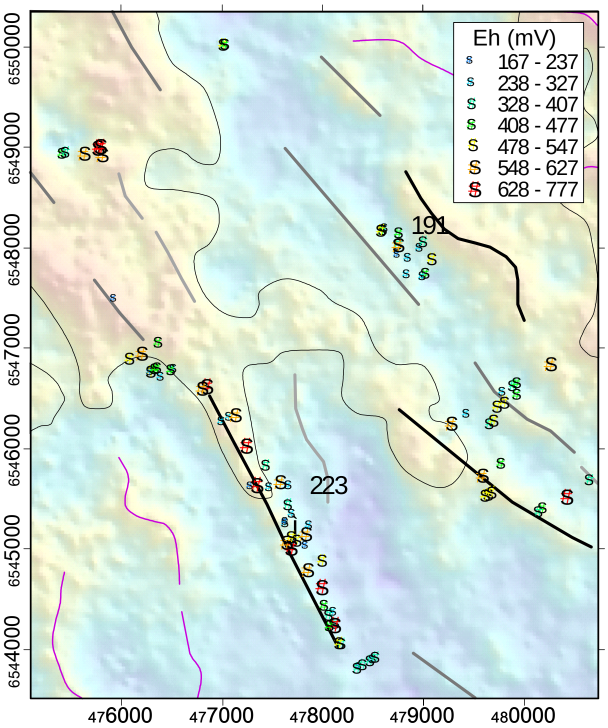

Figure A4.3: Oxidation potential distribution at Tunkillia

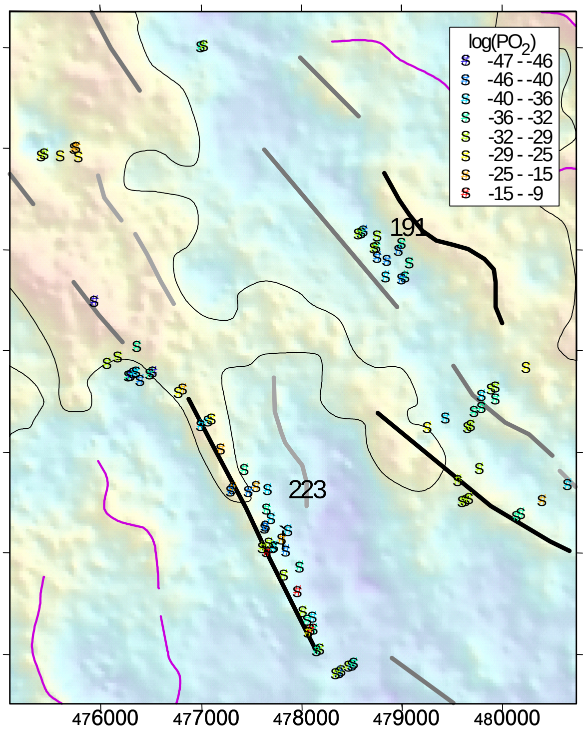

Figure A4.4: O_2 partial pressure distribution at Tunkillia

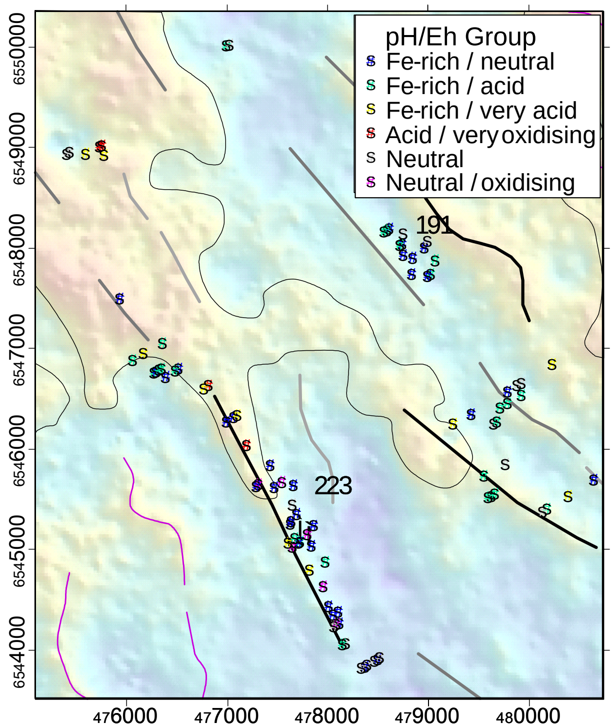

Figure A4.5: pH/Eh groups at Tunkillia

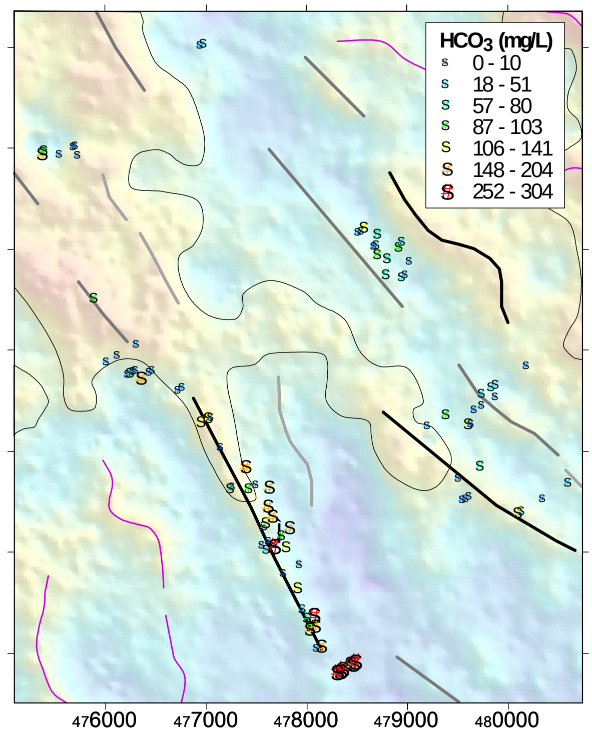

Figure A4.6: HCO_3 distribution at Tunkillia

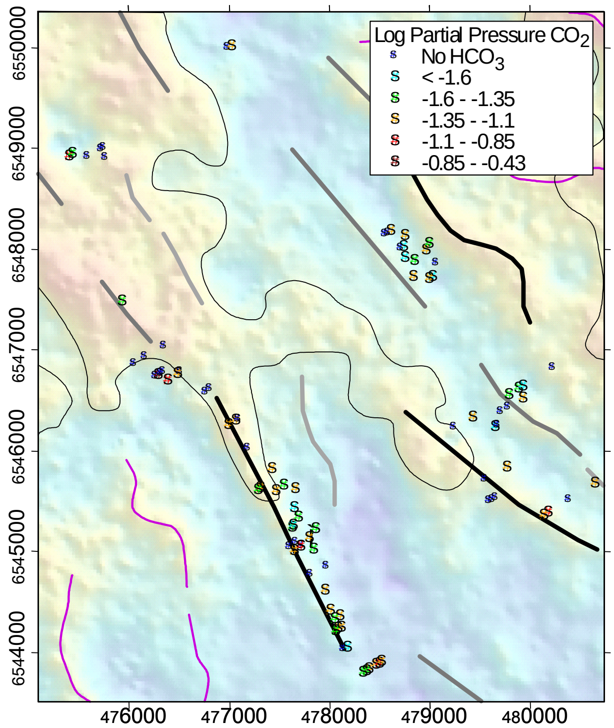

Figure A4.7: CO_2 partial pressure distribution at Tunkillia

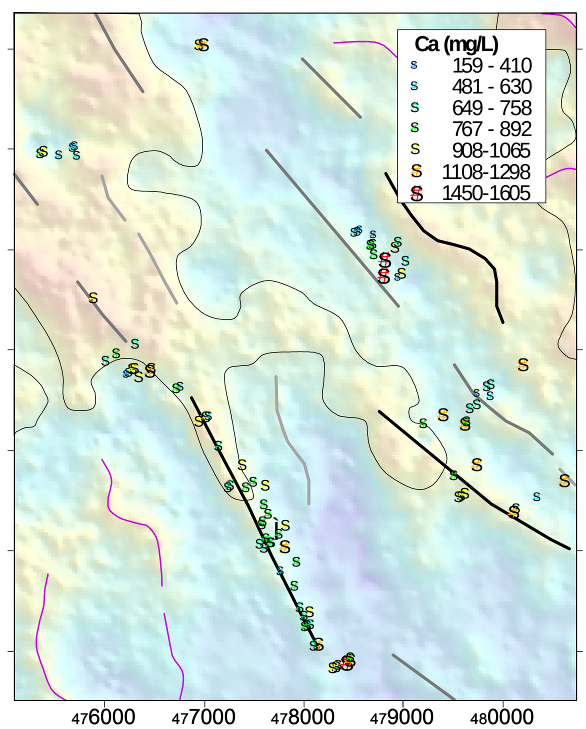

Figure A4.8: Ca distribution at Tunkillia

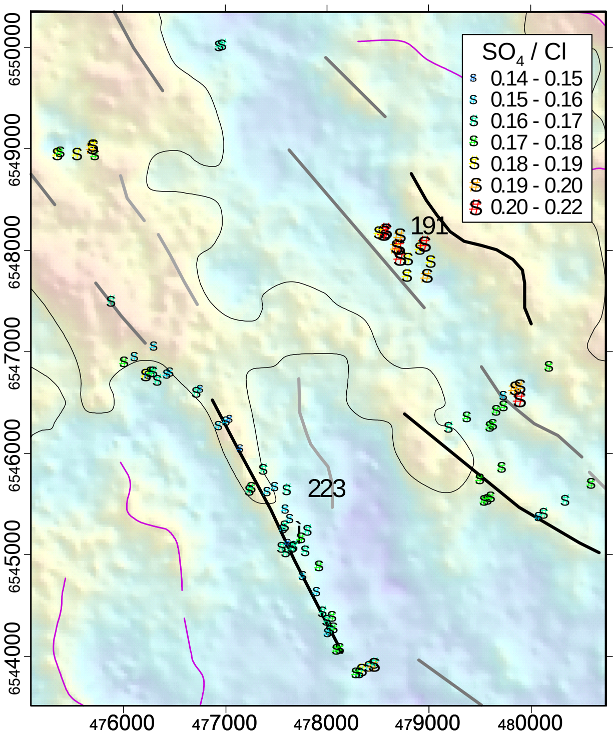

Figure A4.9: SO_4/Cl distribution at Tunkillia

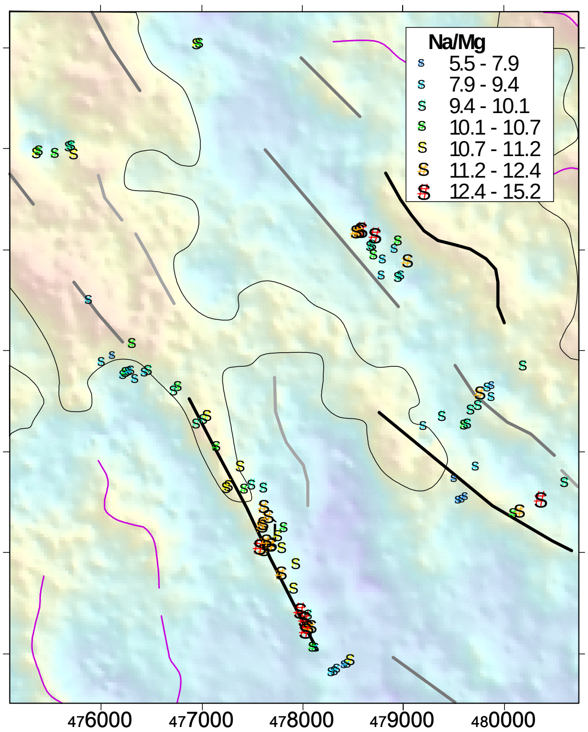

Figure A4.10: Na/Mg distribution at Tunkillia

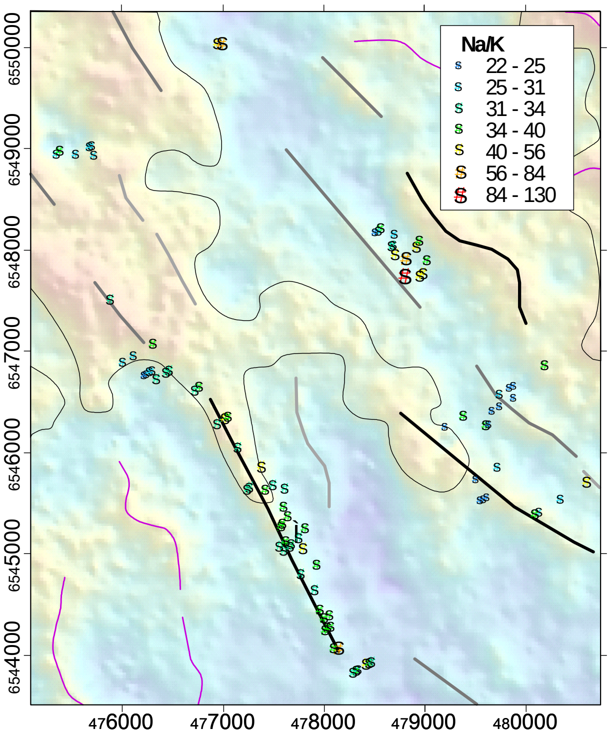

Figure A4.11: Na/K distribution at Tunkillia

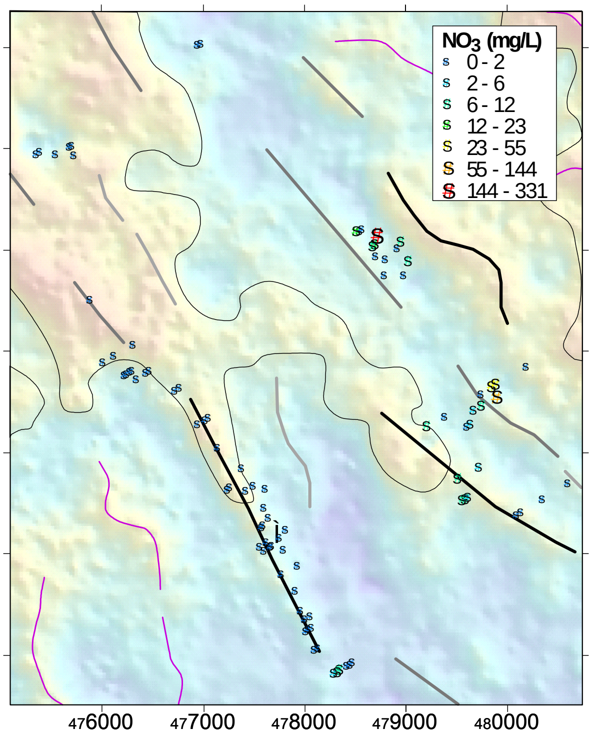

Figure A4.12: NO_3 distribution at Tunkillia

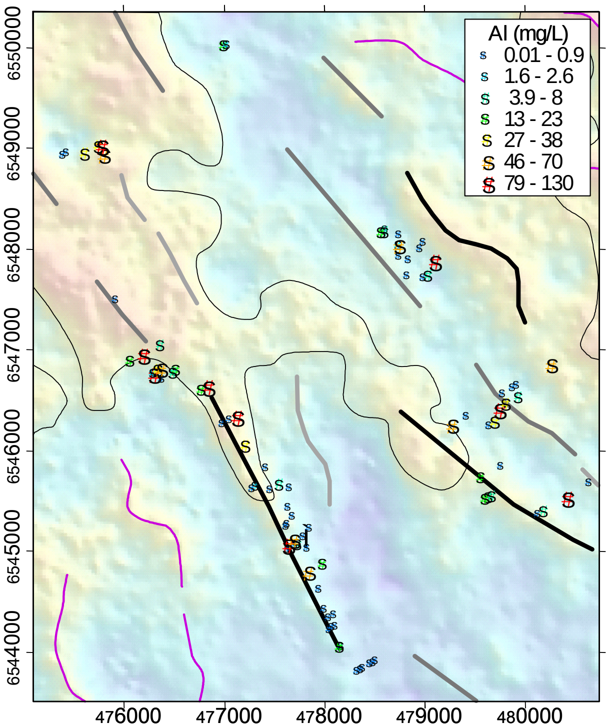

Figure A4.13: Al distribution at Tunkillia

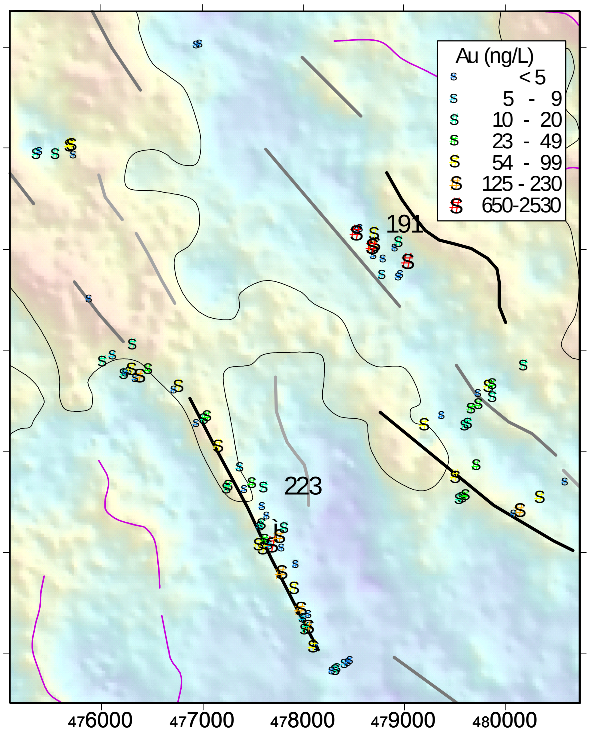

Figure A4.14: Au distribution at Tunkillia

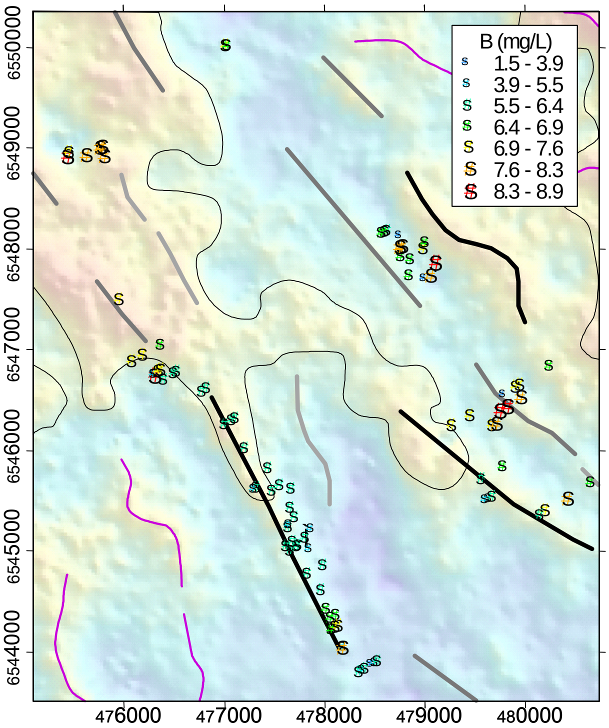

Figure A4.15: B distribution at Tunkillia

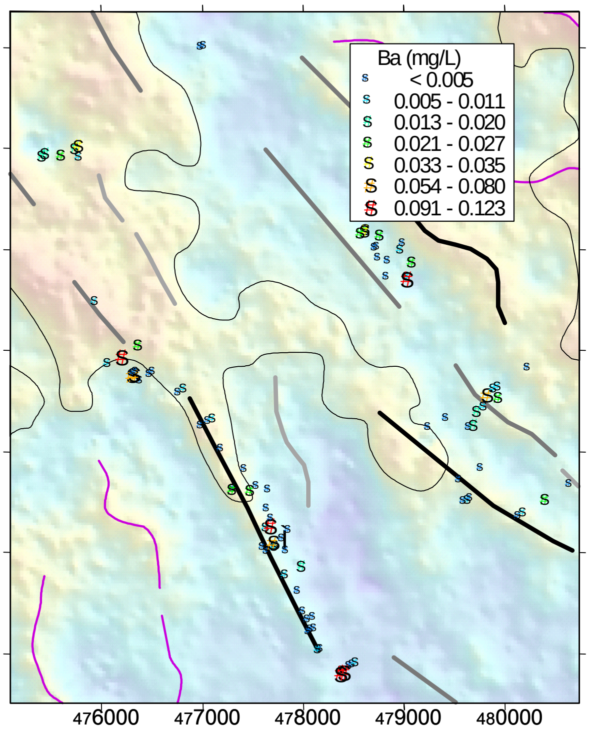

Figure A4.16: Ba distribution at Tunkillia

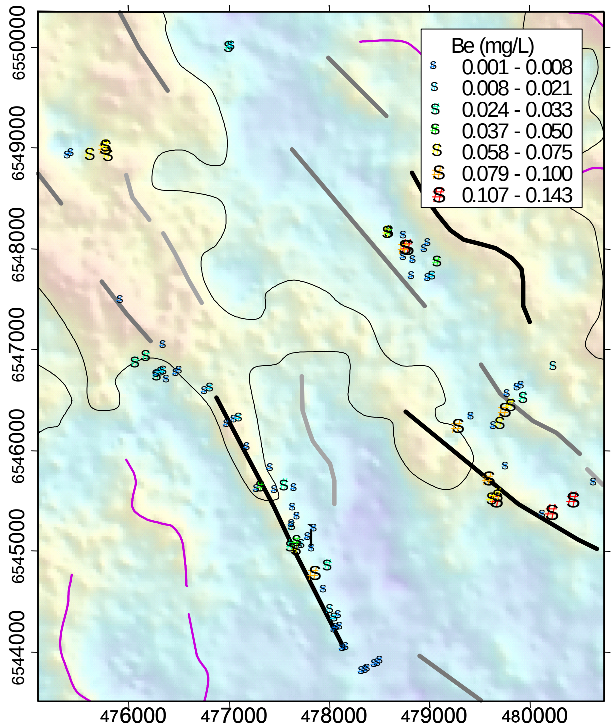

Figure A4.17: Be distribution at Tunkillia

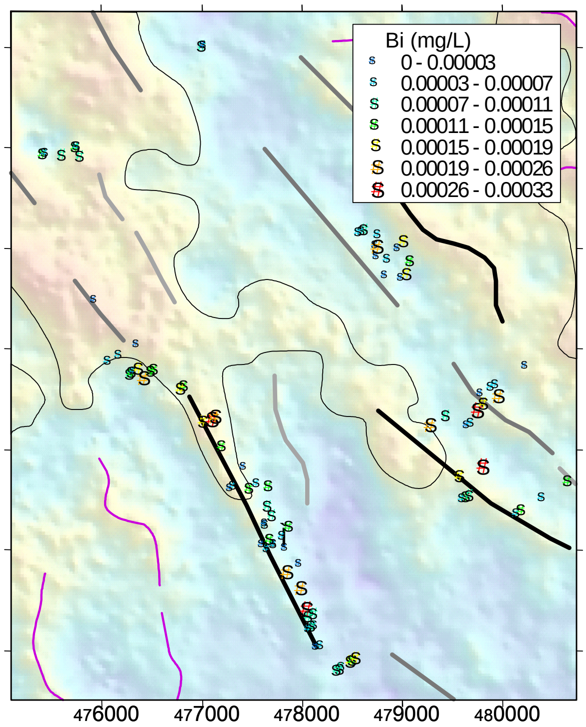

Figure A4.18: Bi distribution at Tunkillia

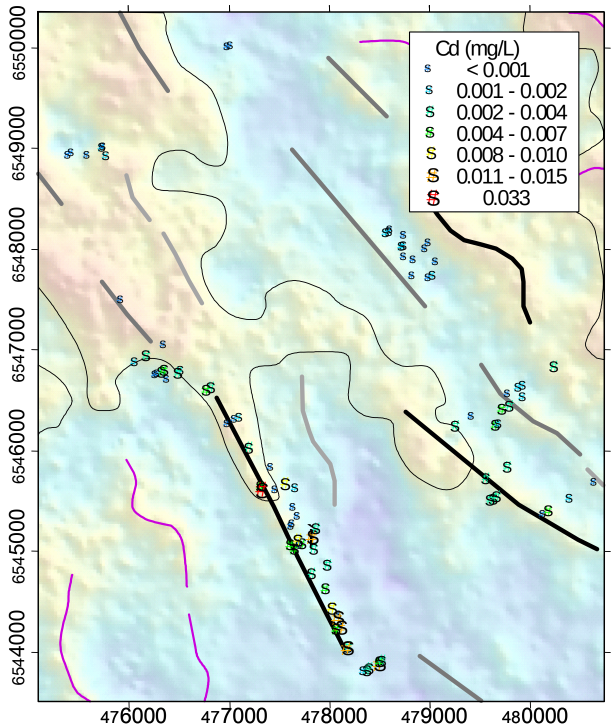

Figure A4.19: Cd distribution at Tunkillia

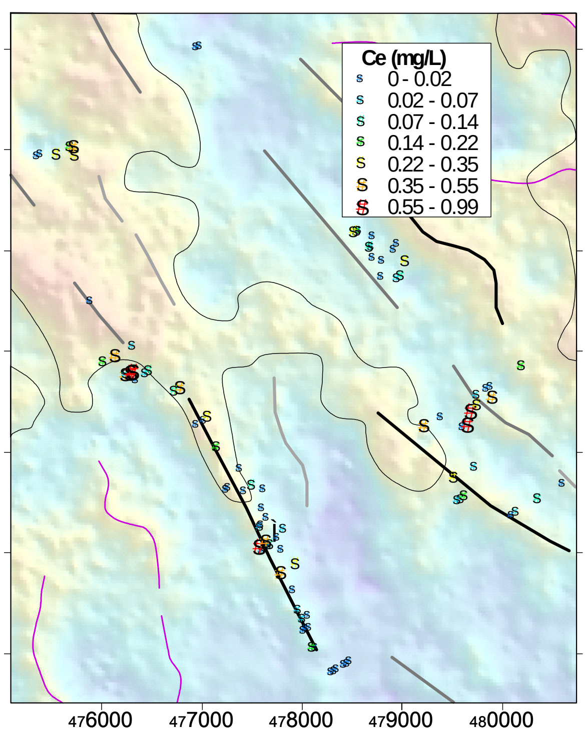

Figure A4.20: Ce distribution at Tunkillia

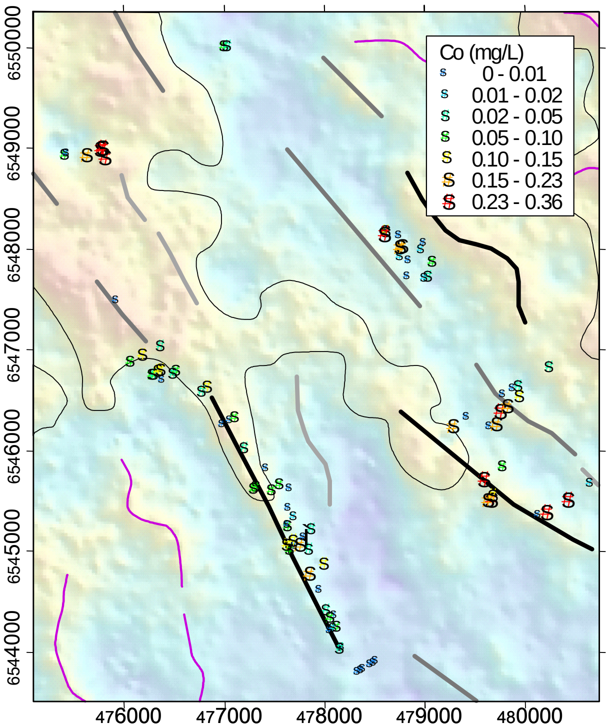

Figure A4.21: Co distribution at Tunkillia

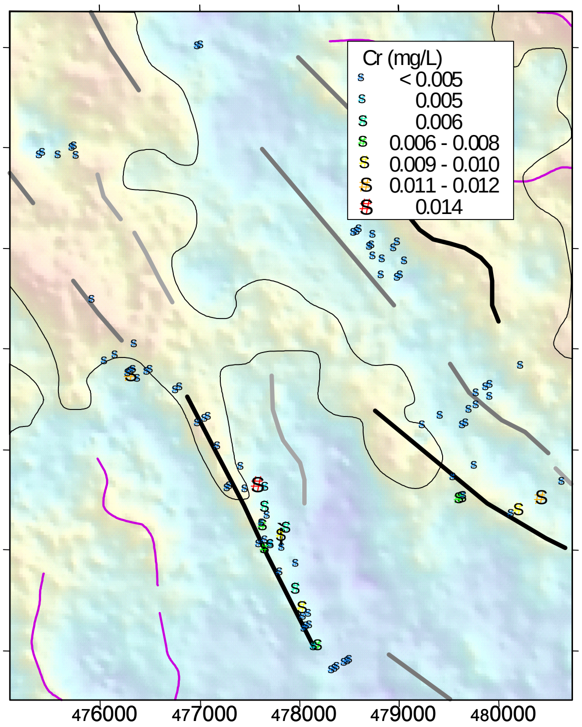

Figure A4.22: Cr distribution at Tunkillia

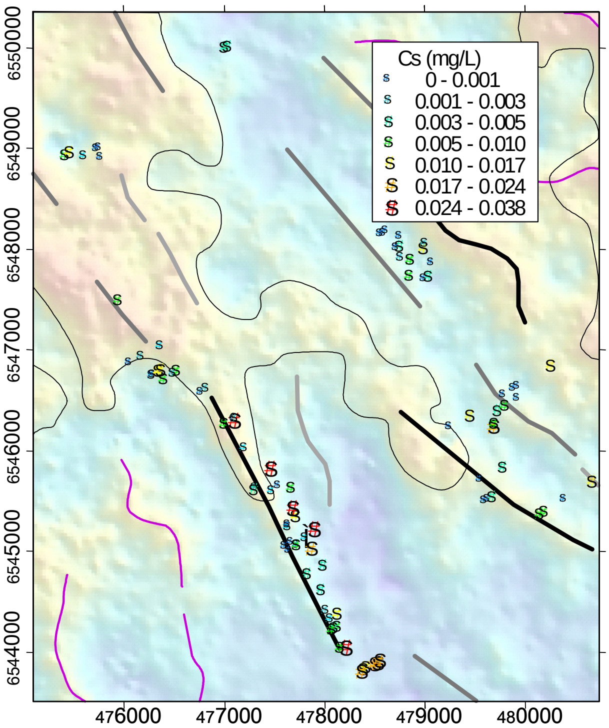

Figure A4.23: Cs distribution at Tunkillia

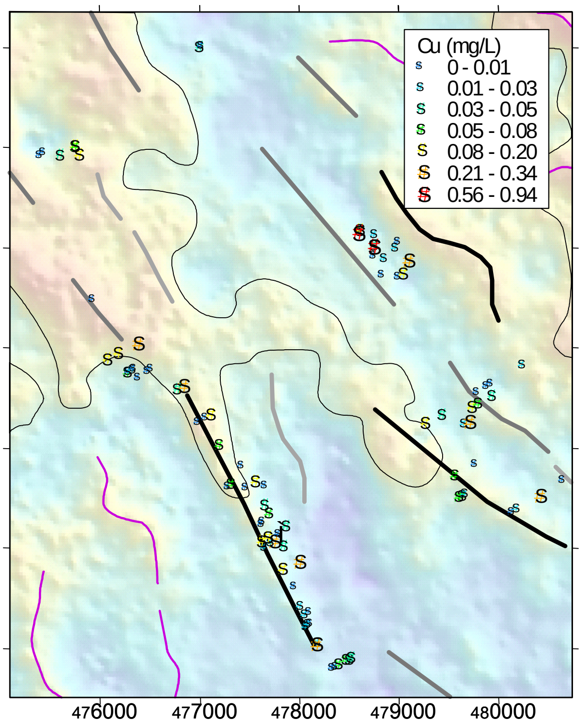

Figure A4.24: Cu distribution at Tunkillia

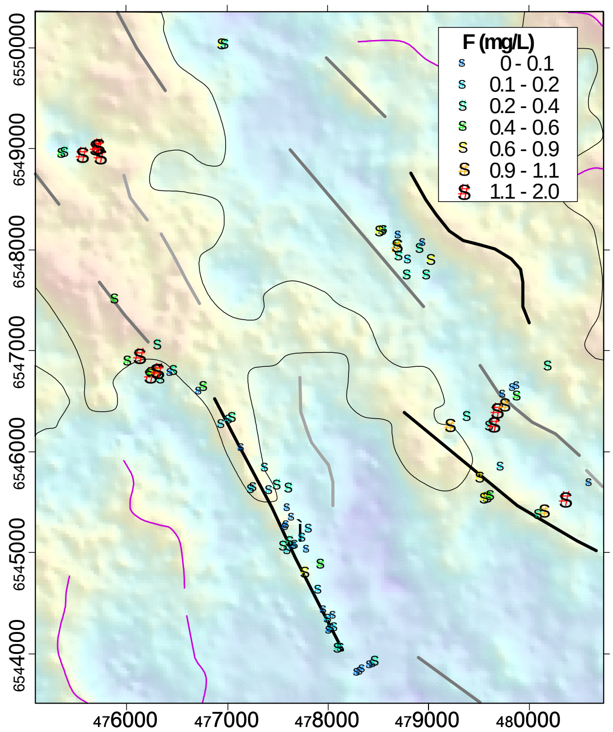

Figure A4.25: F distribution at Tunkillia

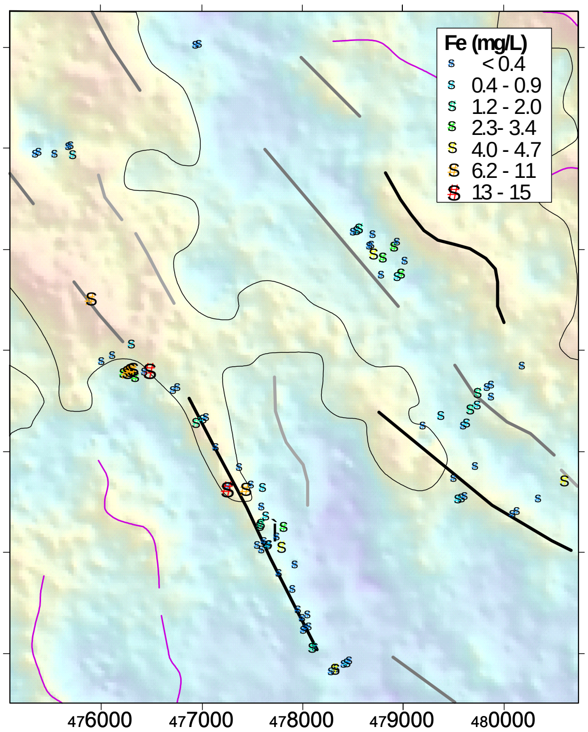

Figure A4.26: Fe distribution at Tunkillia

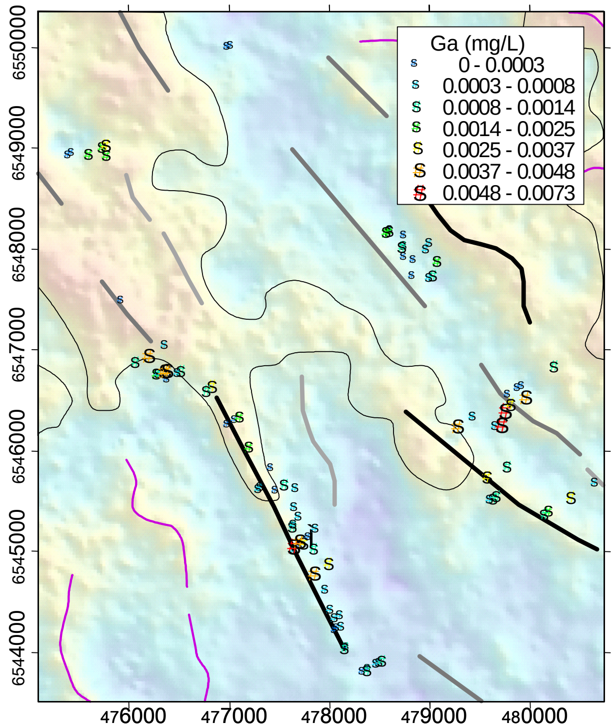

Figure A4.27: Ga distribution at Tunkillia

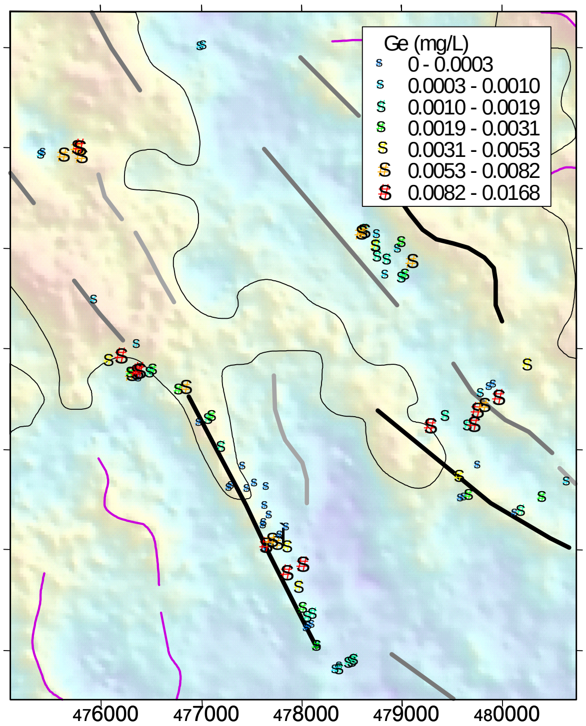

Figure A4.28: Ge distribution at Tunkillia

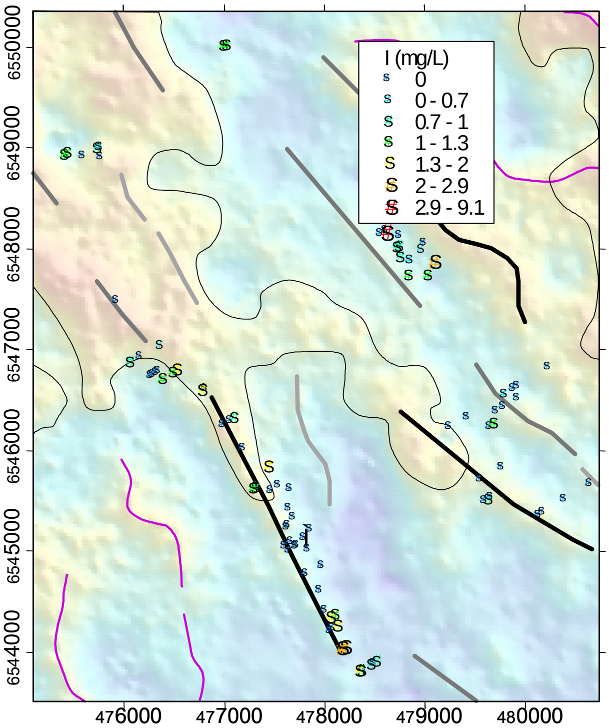

Figure A4.29: I distribution at Tunkillia

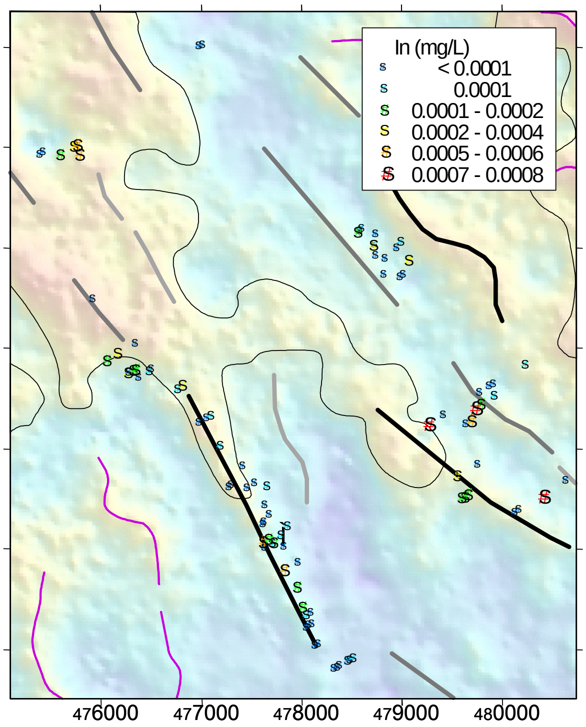

Figure A4.30: In distribution at Tunkillia

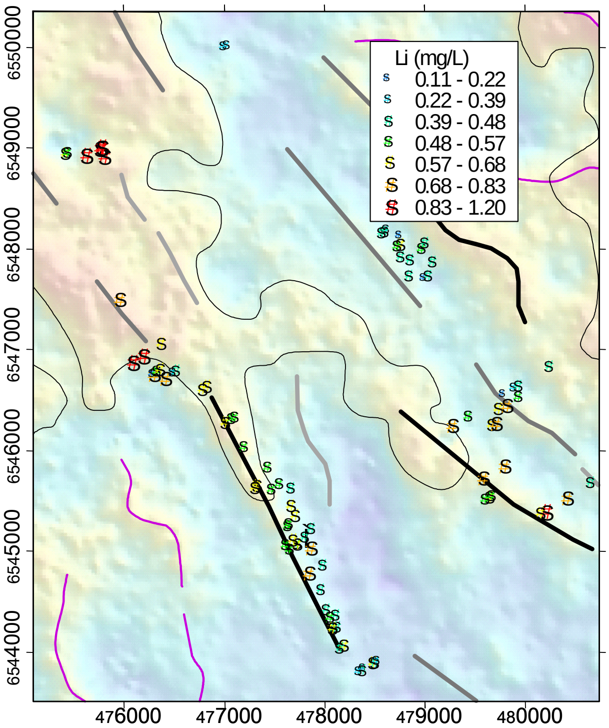

Figure A4.31: Li distribution at Tunkillia

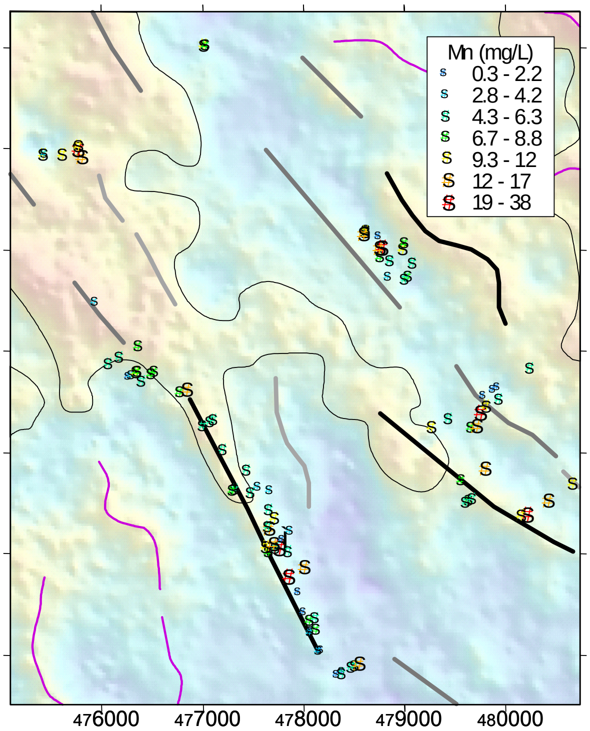

Figure A4.32: Mn distribution at Tunkillia

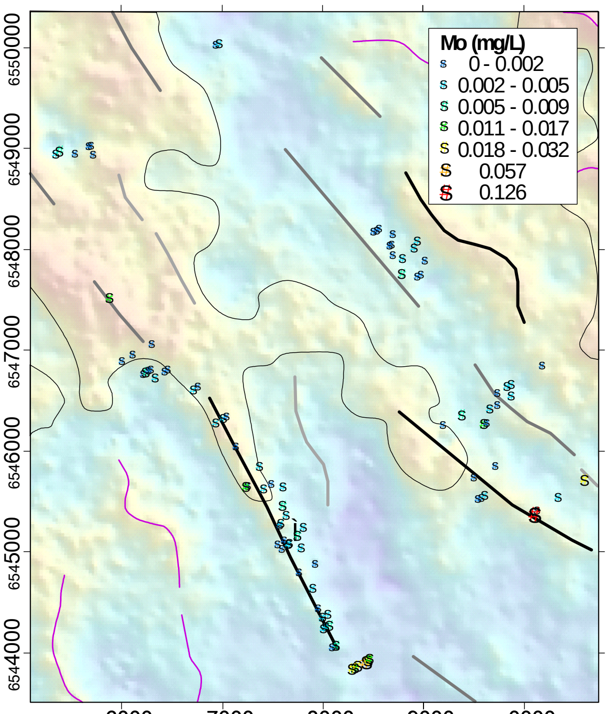

Figure A4.33: Mo distribution at Tunkillia

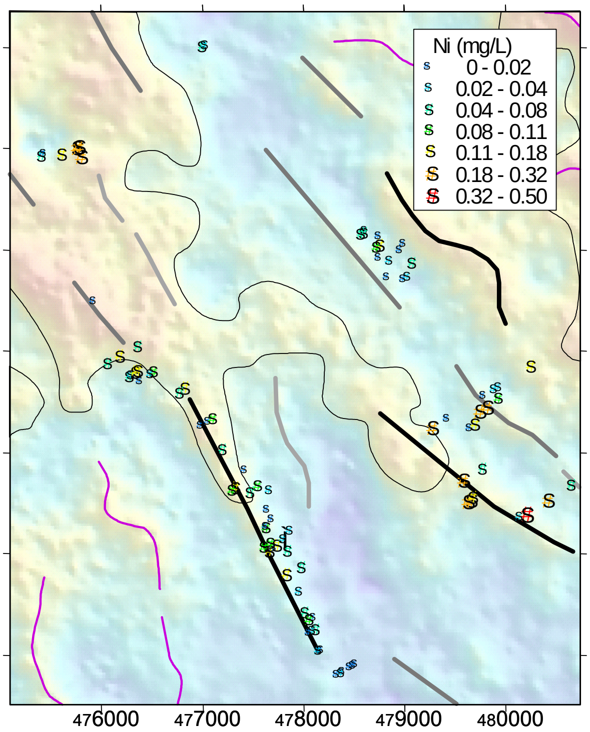

Figure A4.34: Ni distribution at Tunkillia

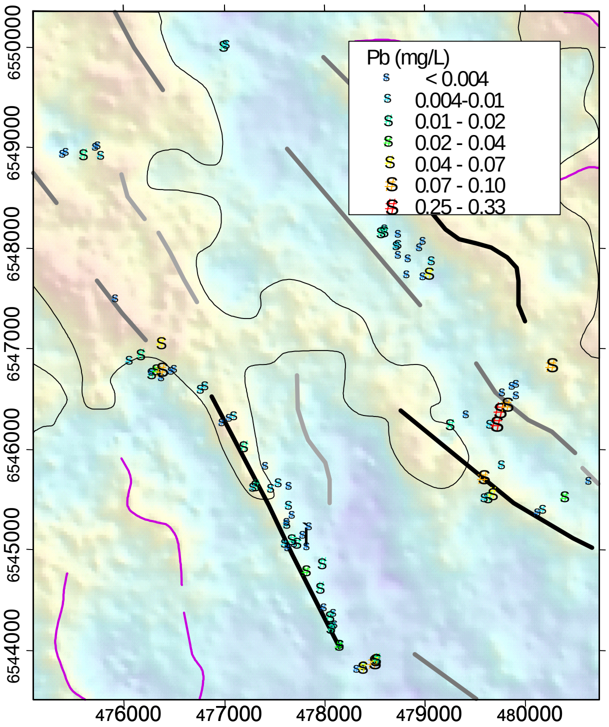

Figure A4.35: Pb distribution at Tunkillia

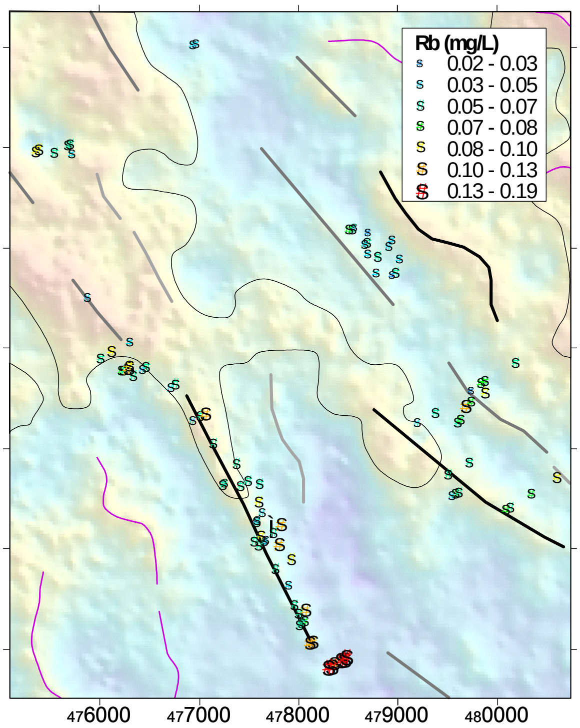

Figure A4.36: Rb distribution at Tunkillia

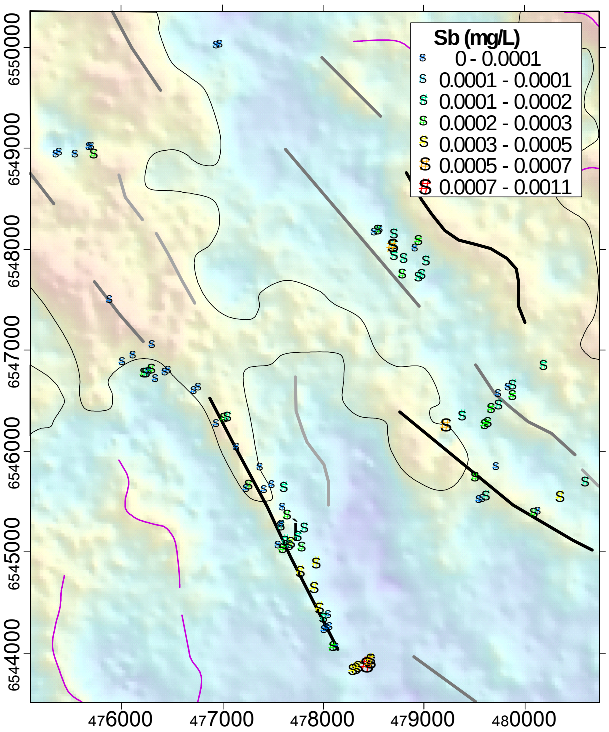

Figure A4.37: Sb distribution at Tunkillia

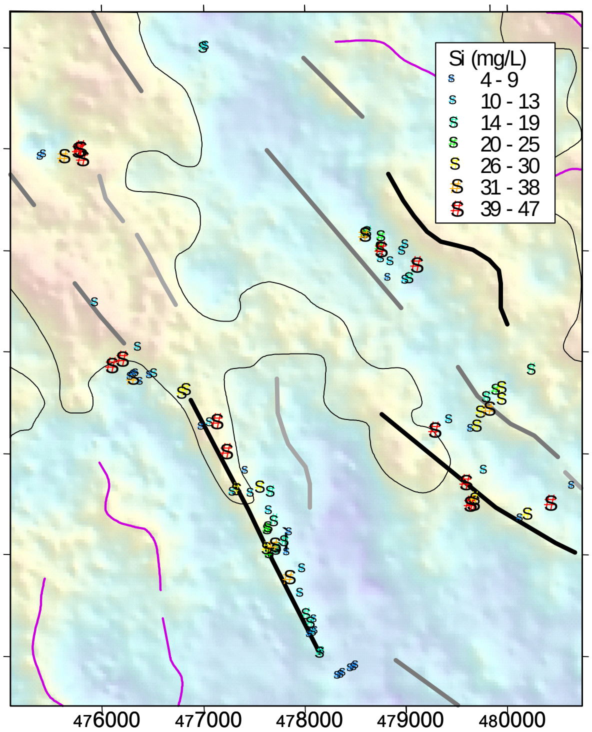

Figure A4.38: Si distribution at Tunkillia

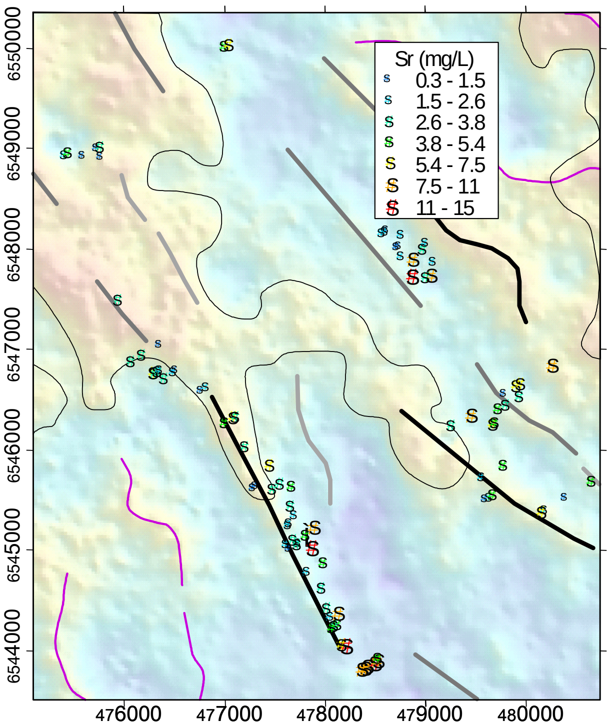

Figure A4.39: Sr distribution at Tunkillia

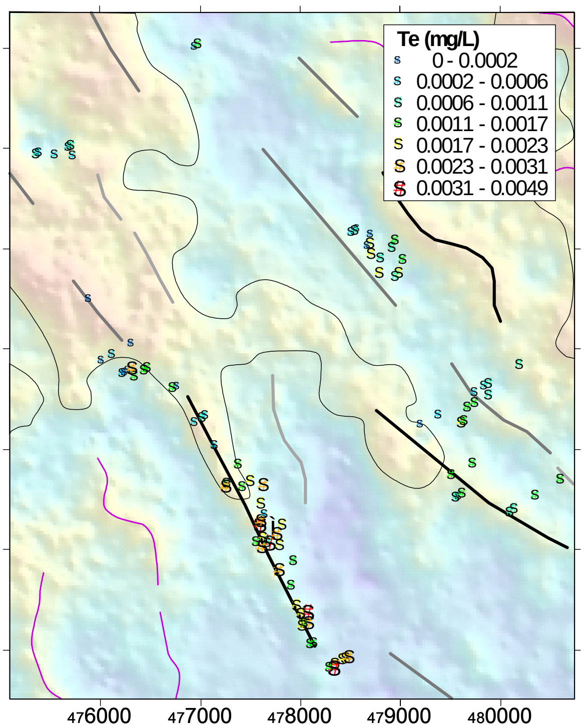

Figure A4.40: Te distribution at Tunkillia

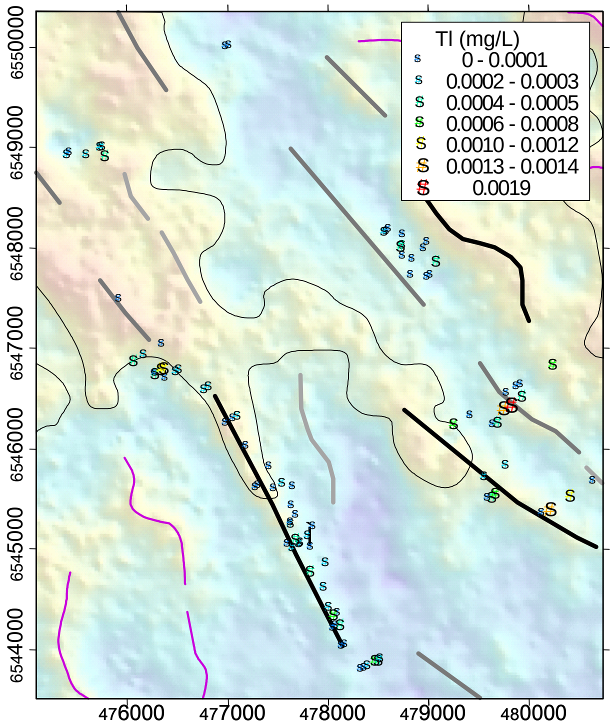

Figure A4.41: Tl distribution at Tunkillia

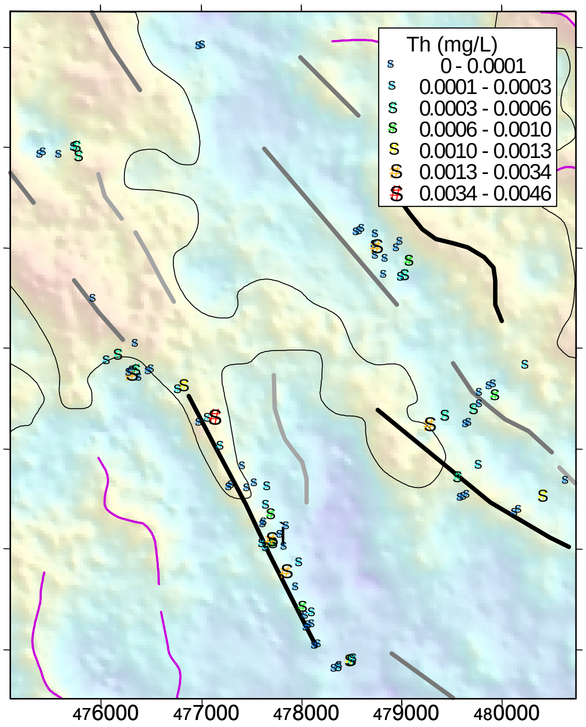

Figure A4.42: Th distribution at Tunkillia

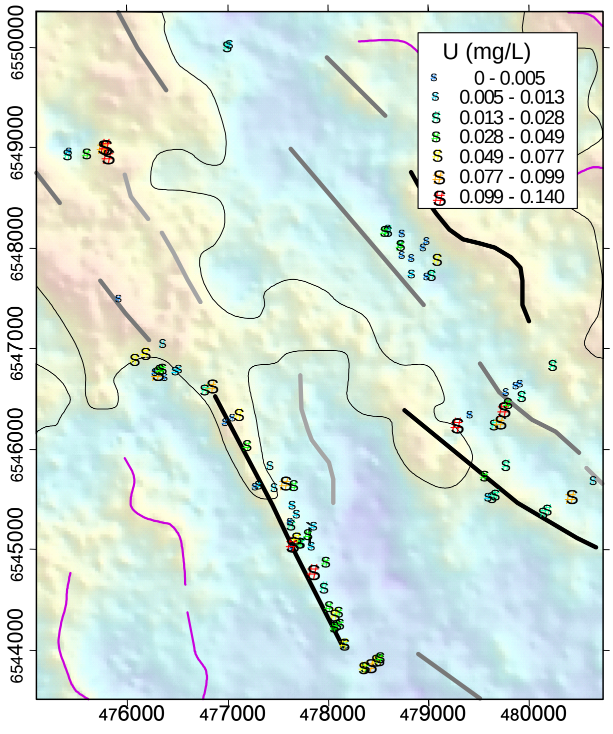

Figure A4.43: U distribution at Tunkillia

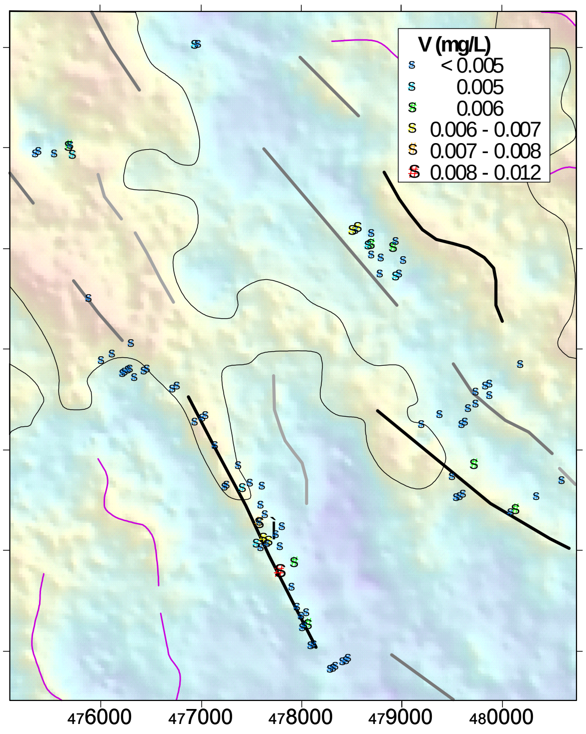

Figure A4.44: V distribution at Tunkillia

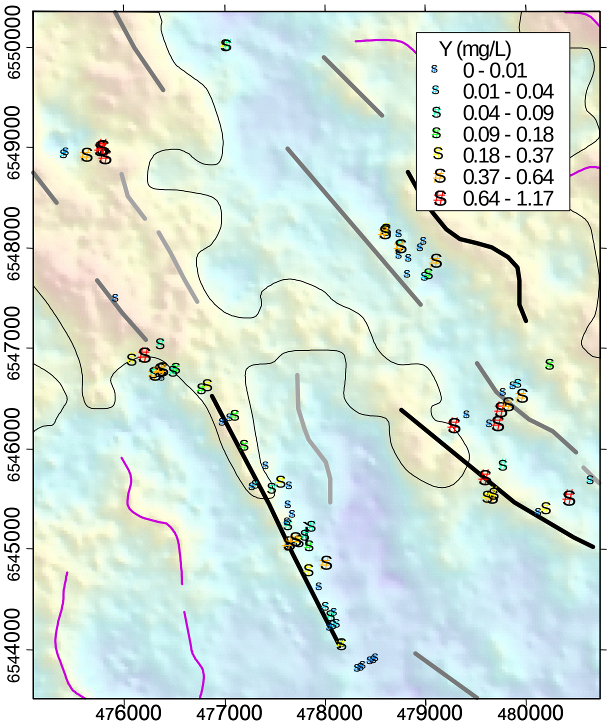

Figure A4.45: Y distribution at Tunkillia

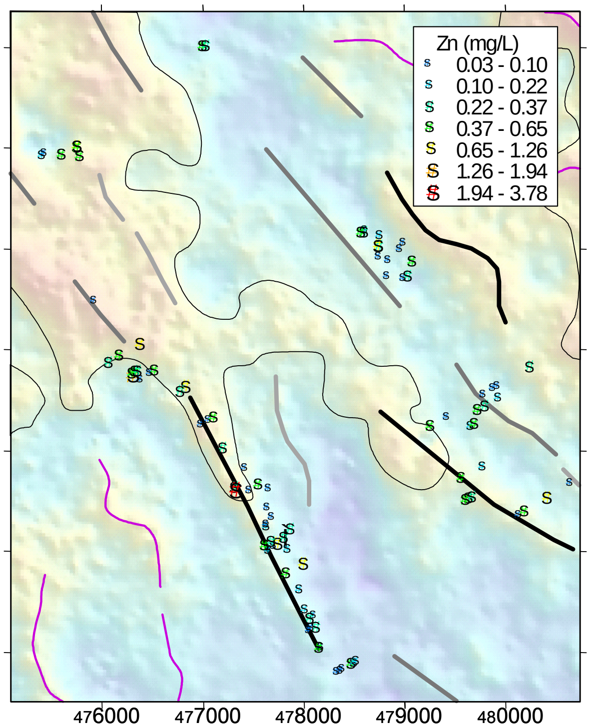

Figure A4.46: Zn distribution at Tunkillia

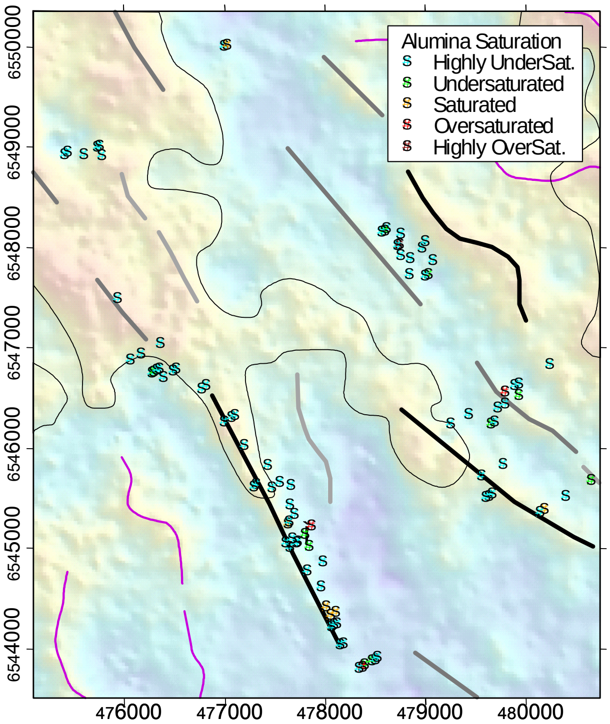

Figure A4.47: Alumina SI distribution at Tunkillia

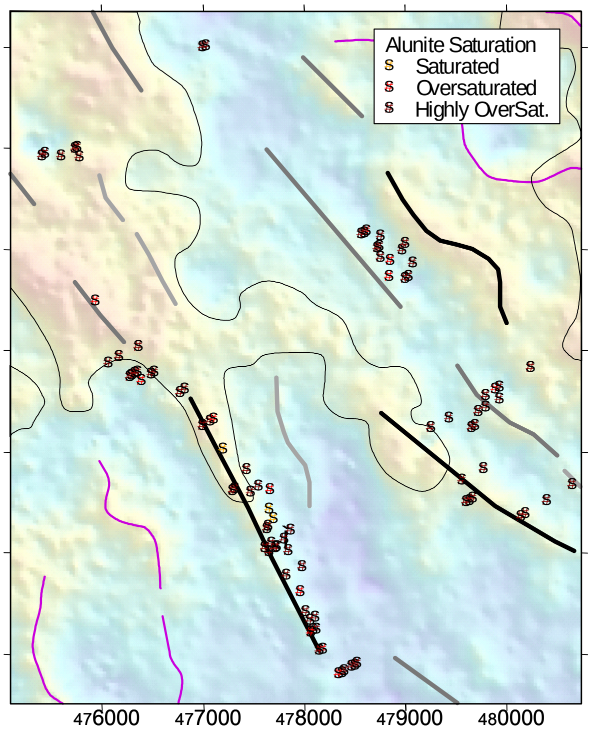

Figure A4.48: Alunite SI distribution at Tunkillia

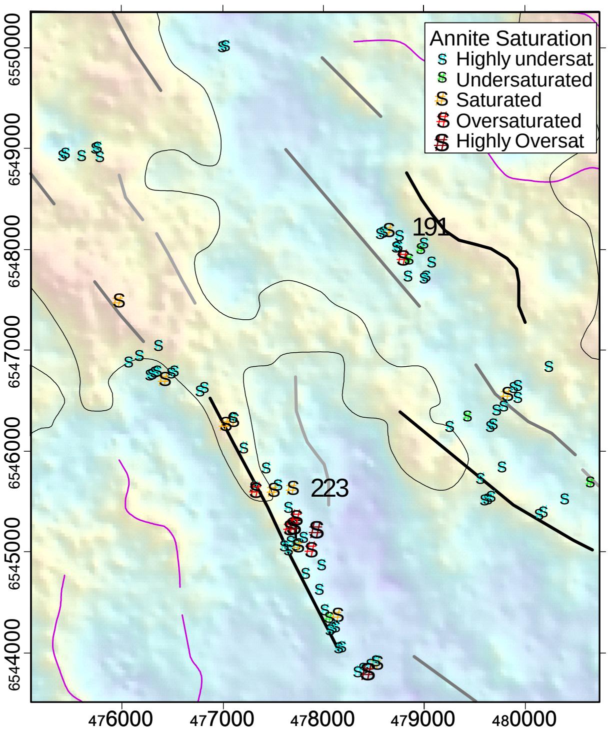

Figure A4.49: Annite SI distribution at Tunkillia

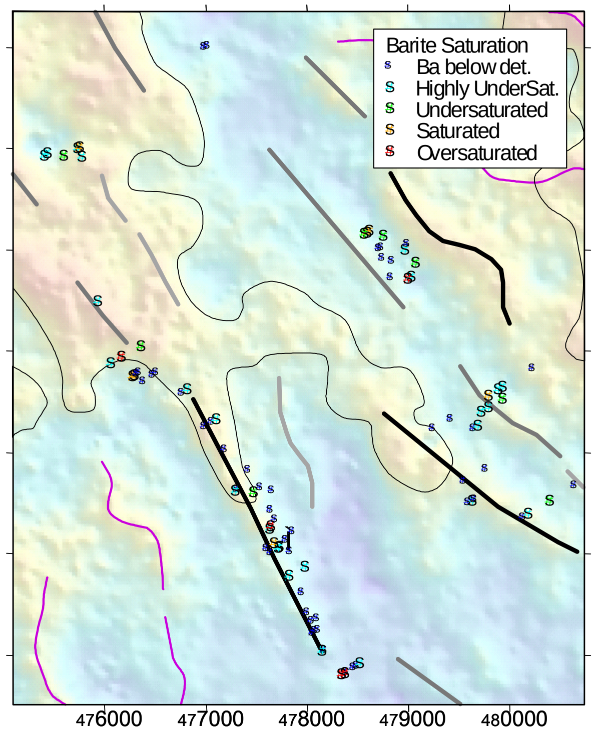

Figure A4.50: Barite SI distribution at Tunkillia

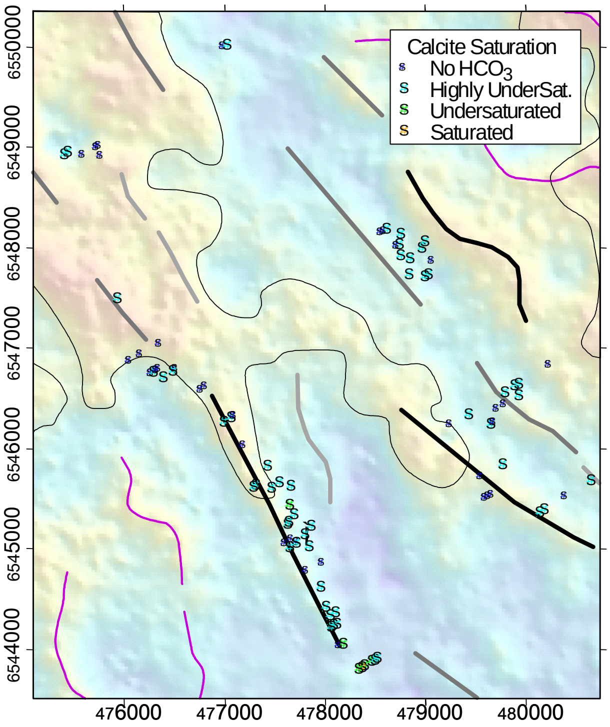

Figure A4.51: Calcite SI distribution at Tunkillia

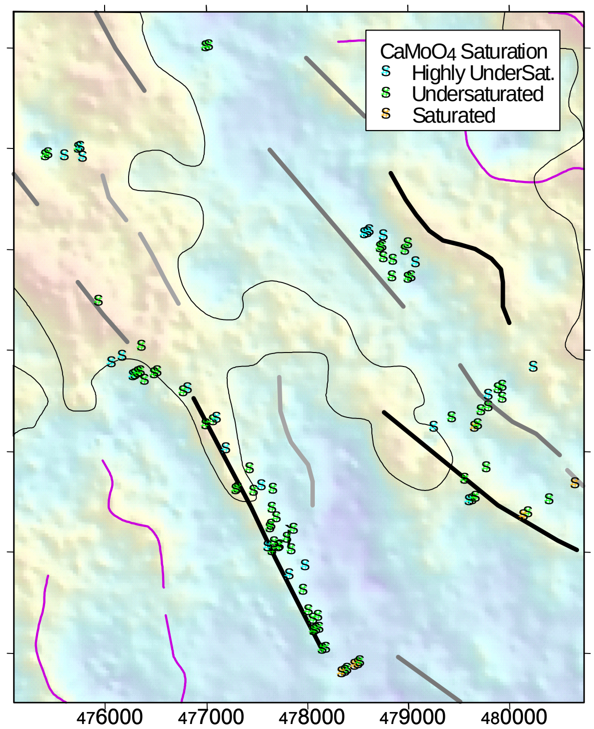

Figure A4.52: $CaMoO_4$ SI distribution at Tunkillia

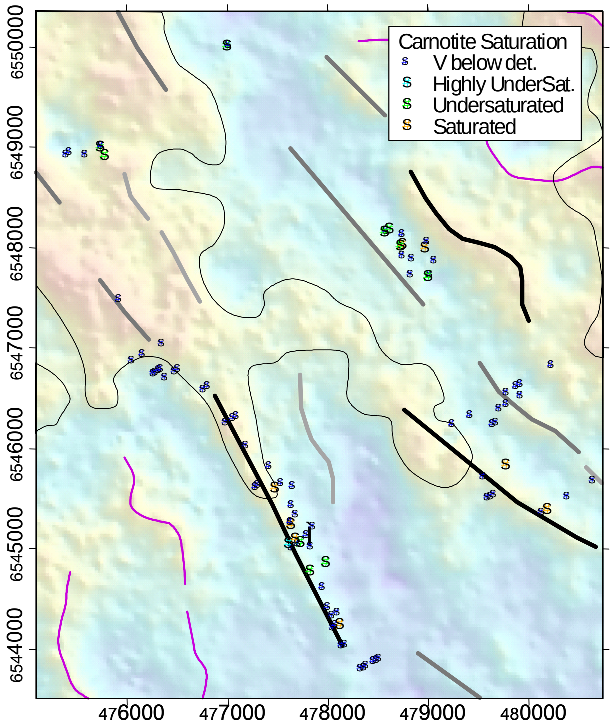

Figure A4.53: Carnotite SI distribution at Tunkillia

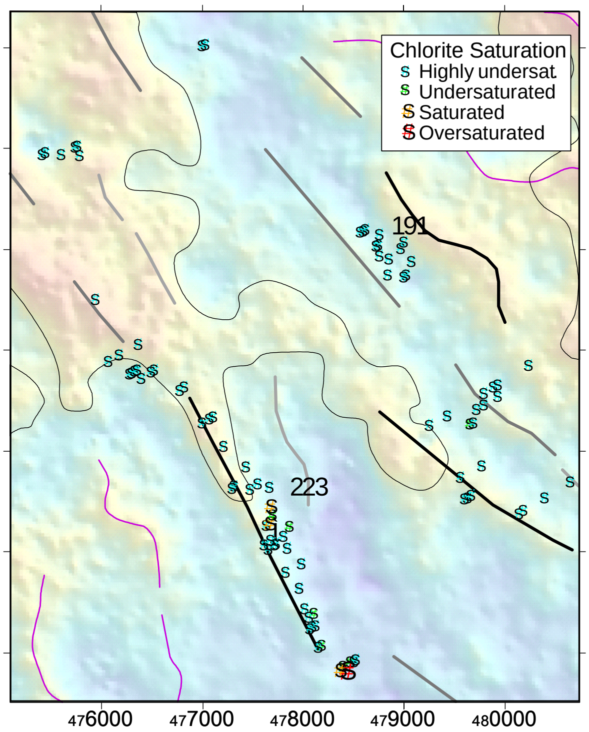

Figure A4.54: Chlorite SI distribution at Tunkillia

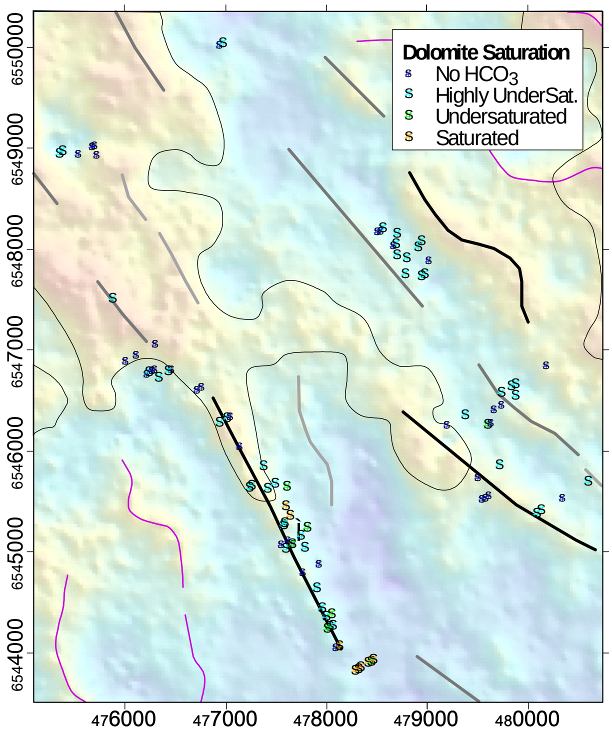

Figure A4.55: Dolomite SI distribution at Tunkillia

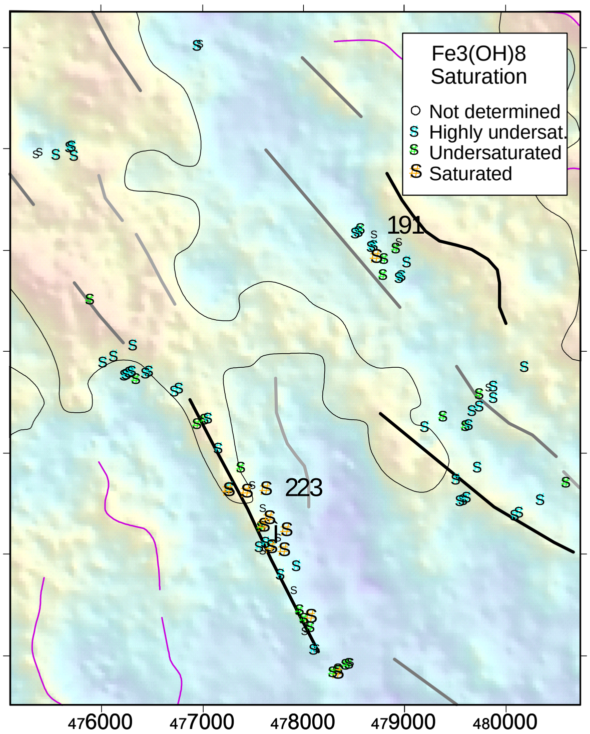

Figure A4.56: $Fe_3(OH)_8$ SI distribution at Tunkillia

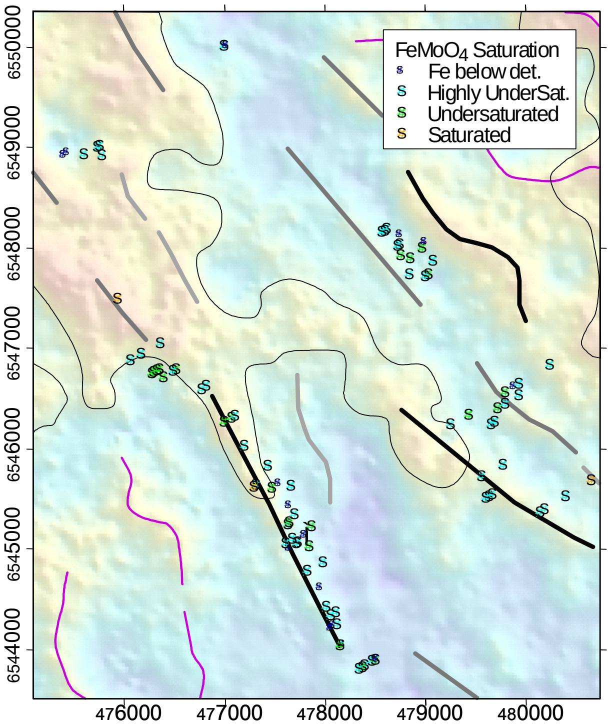

Figure A4.57: $FeMoO_4$ SI distribution at Tunkillia

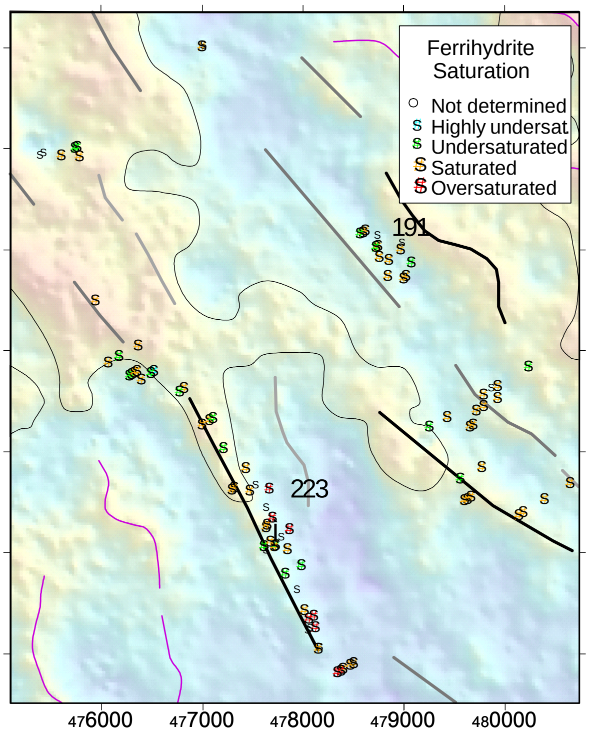

Figure A4.58: Ferrihydrite SI distribution at Tunkillia

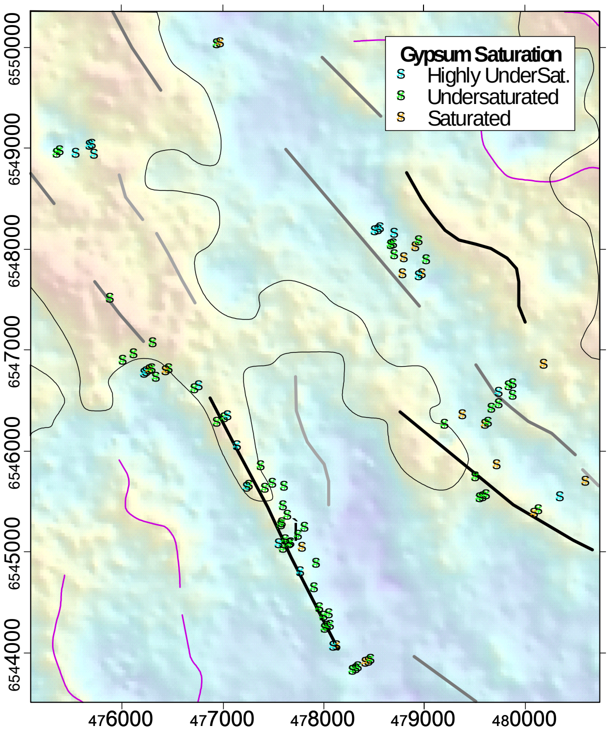

Figure A4.59: Gypsum SI distribution at Tunkillia

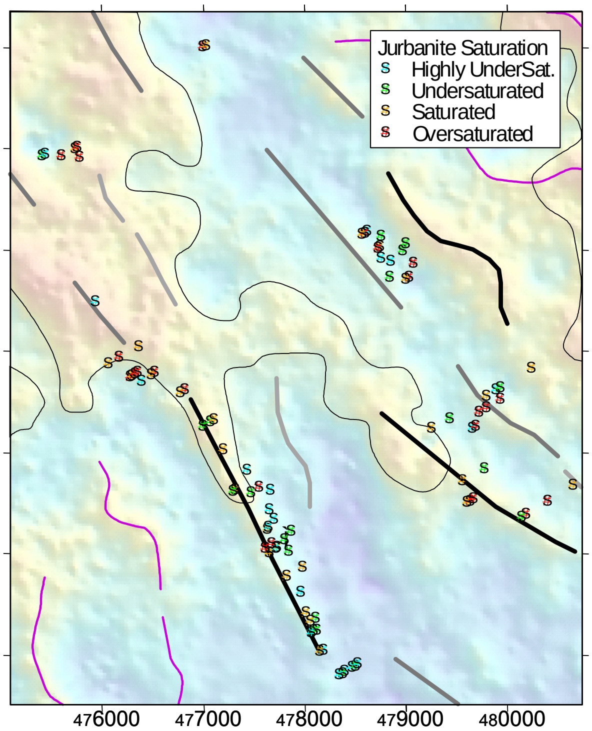

Figure A4.60: Jurbanite SI distribution at Tunkillia

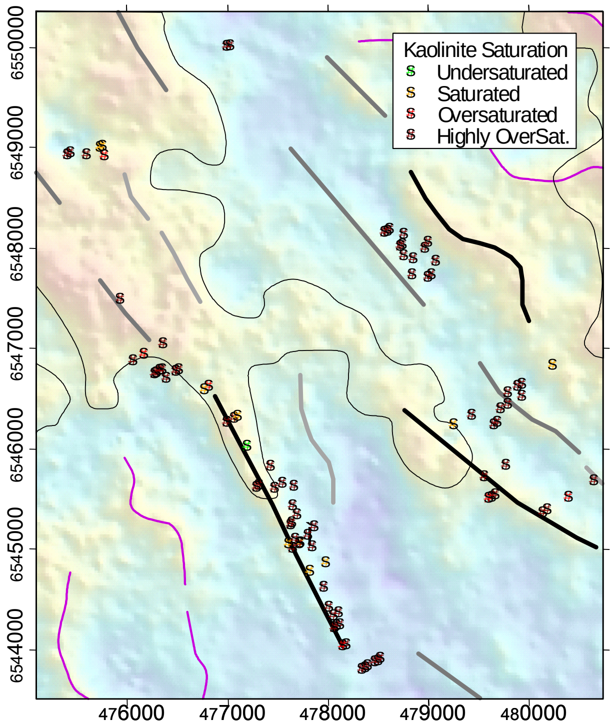

Figure A4.61: Kaolinite SI distribution at Tunkillia

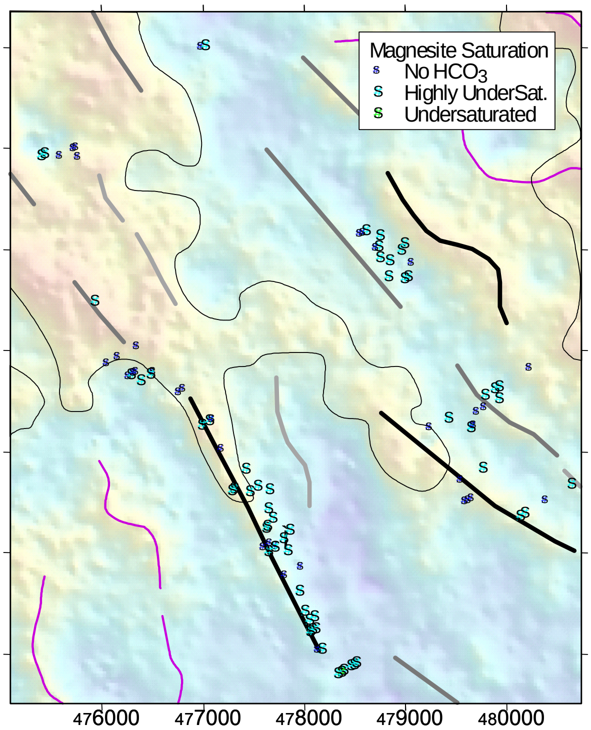

Figure A4.62: Magnesite SI distribution at Tunkillia

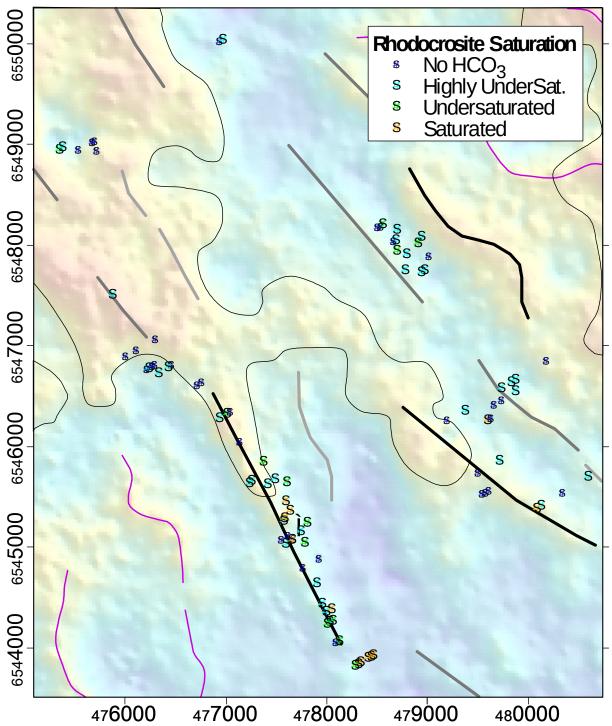

Figure A4.63: Rhodocrosite SI distribution at Tunkillia

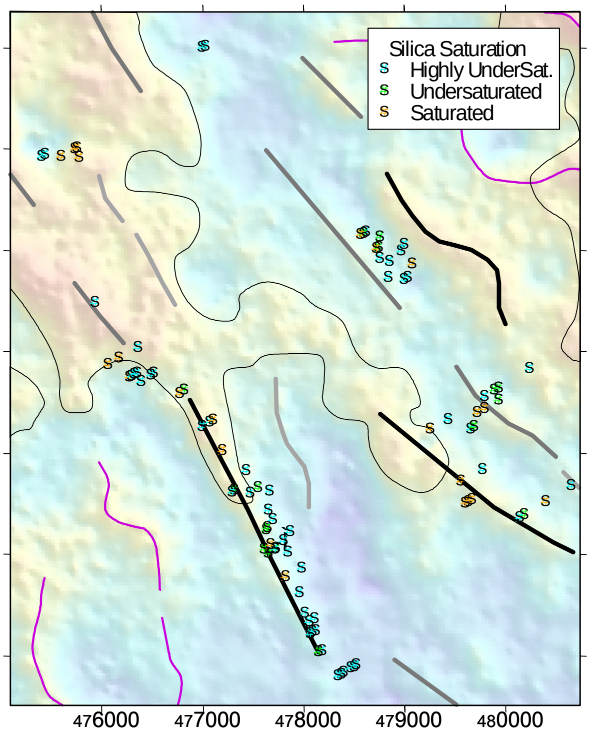

Figure A4.64: Silica SI distribution at Tunkillia