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# GEOCHEMICAL AND SPATIAL CHARACTERISTICS OF REGOLITH AND GROUNDWATER AROUND THE GOLDEN DELICIOUS PROSPECT, WESTERN AUSTRALIA

*A.P.J. Bristow, D.J. Gray and C.R.M. Butt*

**CRC LEME OPEN FILE REPORT 106**

**June 2001**

(CRC LEME Restricted Report 15R/
CSIRO Division of Exploration and Mining Report 280R, 1996.
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CRC LEME is an unincorporated joint venture between The Australian National University,
University of Canberra, Australian Geological Survey Organisation and CSIRO Exploration and Mining
*Headquarters:* CRC LEME c/o CSIRO Exploration and Mining, Private Bag No 5, PO Wembley, Western Australia, 6913.

## RESEARCH ARISING FROM CSIRO/AMIRA YILGARN REGOLITH GEOCHEMISTRY PROJECTS 1987-1996

In 1987, CSIRO commenced a series of multi-client research projects in regolith geology and geochemistry which were sponsored by companies in the Australian mining industry, through the Australian Mineral Industries Research Association Limited (AMIRA). The initial research program, "Exploration for concealed gold deposits, Yilgarn Block, Western Australia" had the aim of developing improved geological, geochemical and geophysical methods for mineral exploration that would facilitate the location of blind, buried or deeply weathered gold deposits. The program commenced with the following projects:

**P240: Laterite geochemistry for detecting concealed mineral deposits (1987-1991).** Leader: Dr R.E. Smith.
Its scope was development of methods for sampling and interpretation of multi-element laterite geochemistry data and application of multi-element techniques to gold and polymetallic mineral exploration in weathered terrain. The project emphasised viewing laterite geochemical dispersion patterns in their regolith-landform context at local and district scales. It was supported by 30 companies.

**P241: Gold and associated elements in the regolith - dispersion processes and implications for exploration (1987-1991).** Leader: Dr C.R.M. Butt.
The project investigated the distribution of ore and indicator elements in the regolith. It included studies of the mineralogical and geochemical characteristics of weathered ore deposits and wall rocks, and the chemical controls on element dispersion and concentration during regolith evolution. This was to increase the effectiveness of geochemical exploration in weathered terrain through improved understanding of weathering processes. It was supported by 26 companies.

These projects represented 'an opportunity for the mineral industry to participate in a multi-disciplinary program of geoscience research aimed at developing new geological, geochemical and geophysical methods for exploration in deeply weathered Archaean terrains'. This initiative recognised the unique opportunities, created by exploration and open-cut mining, to conduct detailed studies of the weathered zone, with particular emphasis on the near-surface expression of gold mineralisation. The skills of existing and specially recruited research staff from the Floreat Park and North Ryde laboratories (of the then Divisions of Minerals and Geochemistry, and Mineral Physics and Mineralogy, subsequently Exploration Geoscience and later Exploration and Mining) were integrated to form a task force with expertise in geology, mineralogy, geochemistry and geophysics. Several staff participated in more than one project. Following completion of the original projects, two continuation projects were developed.

**P240A: Geochemical exploration in complex lateritic environments of the Yilgarn Craton, Western Australia (1991-1993).** Leaders: Drs R.E. Smith and R.R. Anand.
The approach of viewing geochemical dispersion within a well-controlled and well-understood regolith-landform and bedrock framework at detailed and district scales continued. In this extension, focus was particularly on areas of transported cover and on more complex lateritic environments typified by the Kalgoorlie regional study. This was supported by 17 companies.

**P241A: Gold and associated elements in the regolith - dispersion processes and implications for exploration (1991-1993).** Leader: Dr. C.R.M. Butt.
The significance of gold mobilisation under present-day conditions, particularly the important relationship with pedogenic carbonate, was investigated further. In addition, attention was focussed on the recognition of primary lithologies from their weathered equivalents. This project was supported by 14 companies.

Most reports related to the above research projects were published as CRC LEME Open File Reports Series (Nos 1-74), with an index (Report 75), by June 1999. Publication now continues with release of reports from further projects.

**P252: Geochemical exploration for platinum group elements in weathered terrain.** Leader: Dr C.R.M. Butt.
This project was designed to gather information on the geochemical behaviour of the platinum group elements under weathering conditions using both laboratory and field studies, to determine their dispersion in the regolith and to apply this to concepts for use in exploration. The research was commenced in 1988 by CSIRO Exploration Geoscience and the University of Wales (Cardiff). The Final Report was completed in December 1992. It was supported by 9 companies.

**P409: Geochemical exploration in areas of transported overburden, Yilgarn Craton and environs, WA.**
Leaders: Drs C.R.M. Butt and R.E. Smith.
About 50% or more of prospective terrain in the Yilgarn is obscured by substantial thicknesses of transported overburden that varies in age from Permian to Recent. Some of this cover has undergone substantial weathering. Exploration problems in these covered areas were the focus of Project 409. The research was commenced in June 1993 by CSIRO Exploration and Mining but was subsequently incorporated into the activities of CRC LEME in July 1995 and was concluded in July 1996. It was supported by 22 companies.

Although the confidentiality periods of Projects P252 and P409 expired in 1994 and 1998, respectively, the reports have not been released previously. CRC LEME acknowledges the Australian Mineral Industries Research Association and CSIRO Division of Exploration and Mining for authority to publish these reports. It is intended that publication of the reports will be a substantial additional factor in transferring technology to aid the Australian mineral industry.

This report (CRC LEME Open File Report 106) is a second impression (second printing) of CSIRO, Division of Exploration and Mining Restricted Report 280R, first issued in 1996, which formed part of the CSIRO/AMIRA Project P409.

**Copies of this publication can be obtained from:**
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# PREFACE

The principal objective of AMIRA Project 409 has been to develop geochemical methods for mineral exploration in areas of the Yilgarn Craton and its environs having substantial transported overburden, through investigations of the processes of geochemical dispersion from concealed mineralization. The Golden Delicious site was chosen for detailed investigation in the Project because it is a significant, new discovery totally concealed by up to 16 m of transported overburden. It has a partly truncated lateritic regolith, although substantial ferruginization remains in the upper few metres over parts of the deposit. Unusually for sites north of the Menzies Line, the groundwater is highly saline, due to the proximity of Lake Carey, and there are secondary carbonates present in the overburden. Results of detailed investigations of the transported overburden and upper residual regolith have shown that the exploration target can be enlarged by selecting some specific sample media. Anomalous concentrations of gold are present for over 400 m in the basal ferruginous gravels of the transported overburden, offset slightly downslope, and for over 300 m in the upper few metres of the residual regolith. Thus, collection of samples at or across the unconformity ("interface") would be successful in defining a broad anomaly that locates the underlying mineralization. An association between Au and ferruginous materials, particularly in the overburden, suggests that specific selection of ferruginous materials could be advantageous. Groundwaters are also anomalous for over 200 m in the vicinity of the deposit, indicating that hydrogeochemical surveys may have value and also demonstrating that Au dispersion is still active. This is reflected by the high solubility of Au in the basal gravels, which implies that the anomaly in these materials may be hydromorphic. Low concentrations of Au and W in the mottled zone immediately below the unconformity appear to be due to primary lithological variations rather than secondary depletion. Consequently, although the mineralization is enriched in W, neither the uppermost residual material nor the basal gravels have W anomalies. Neither As nor Sb are enriched in the mineralization. Sampling of units other than the basal gravels of the overburden does not indicate the presence of mineralization; sporadic samples with 10-20 ppb Au are background variations that simply reflect their provenance from a Au-bearing district. There is no Au enrichment associated with carbonates in the overburden, and specific sampling of these materials would be ineffective.

The results of the investigation, although having features specific to this site, are broadly applicable to equivalent sites in the northern Yilgarn and beyond. Thus, in common with other locations studied in this and previous projects, the principal findings are that the only the basal units of the cover sequence are likely to be useful as sample media, and that the ferruginous materials in these units and the uppermost residual regolith are preferred components that, if necessary, should be collected selectively.

C.R.M. Butt and R.E. Smith
Project Leaders
August 1996

# ABSTRACT

The dispersion and solubility of Au and other elements in the regolith, and the nature and distribution of regolith materials has been studied at and around the Golden Delicious deposit near Laverton, Western Australia. The deposit has a resource of 6.1 Mt @ 1.3 g/t Au hosted by a suite of Archaean granitoids that intrude mafic volcanic and volcaniclastic greenschist host rocks in the southern part of the Laverton tectonic zone. The mineralised and country rocks are deeply weathered, and subsequently partly eroded to the clay zone and upper saprolite. They are now covered by up to 20 m of colluvium - alluvium derived from eroding mafic regolith several km to the ESE. Late-stage haematite mega-mottling has overprinted the upper residual horizons. The entire regolith is saturated with saline, weakly alkaline groundwater below approximately 10 m. Much of the regolith, including the transported overburden, has been extensive modified during arid conditions. Samples of regolith and groundwater from a drill traverse across the deposit have been examined in detail to determine element distributions, their relationship to regolith evolution and their significance in exploration. Elements associated with Au mineralisation were W, Sb, K and REE, though none displayed a very direct correlation with Au. Only Au showed evidence of significant remobilisation, the other elements approximating their distribution in the Archaean prior to weathering.

The distribution, solubility and accessibility of Au in the regolith, its concentration in groundwater, and the chemistry and depth of groundwater, suggest that Au has been dissolved from mineralisation, and re-precipitated in the base of the transported overburden to give a Au anomaly (12-100 ppb), 500 m across strike, offset slightly down-slope of underlying mineralisation. No evidence, other than the Au contents of the groundwater and the slightly soluble nature of Au in the weathered Archaean, was found to suggest significant Au depletion or mobilization and it is suggested, based on the distribution and solubility of other elements associated with Au mineralisation, that the present Au distribution in the residual regolith is similar to that prior to weathering. Despite the lack of evidence for significant Au mobility, there is some enrichment (12-80 ppb) in the top few metres of the residuum for 300 m across strike, directly overlying mineralisation, that may be associated with late stage mottling or residual concentration. Gold in groundwater is anomalous, (0.046-0.18 µg/L), though slightly offset to the west, for 200 m across strike of mineralisation. Tungsten is anomalous (8->50 ppm) below the top few metres of the residuum for 400 m across strike, and indicates a broader primary halo than Au in the primary mineralisation. The distribution of Sb concentrations when normalised to Fe is similar to that of W. Neither Sb nor W are anomalous in the transported overburden overlying mineralisation and are relatively insoluble in the weathered Archaean.

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# 1. INTRODUCTION

## 1.1 LOCATION, CLIMATE AND VEGETATION

The Golden Delicious deposit is approximately 50 km south of Laverton (Figure 1). The present climate is semi-arid, with a highly variable rainfall throughout the year (average 200-250 mm) resulting from frontal systems from the W and SW in the winter months and from patchy convectional storms and cyclone related depressions in summer. Vegetation around the deposit comprises sparse to dense *Acacia* spp. woodland, with an understorey of smaller shrubs of *Acacia*, *Eremophila* and *Cassia* spp. (Hall *et al.*, 1994).

## 1.2 GEOLOGY AND MINERALISATION

The Golden Delicious deposit is situated in the Archaean Norseman - Wiluna greenstone belt of the Yilgarn Craton, in the southern part of the Laverton Tectonic Zone. This zone is characterised by major N and NNW trending shear zones and associated faults. The region comprises variously folded, faulted and metamorphosed greenstone sequences surrounded by granite (Figure 1). The major Archaean lithological units include ultramafic and mafic volcanics, felsic volcanics and volcaniclastics, banded iron formations, layered gabroic sills and intrusive sheets of granite (Keserue-Ponte, 1995).

The total resource is 6.1 million tonnes grading 1.3 g/t Au (0.6 g/t cut), including a higher grade northern zone of 2.4 Mt at 1.8 g/t Au (1 g/t cut) (Acacia Resources Ltd., 1995). Gold mineralisation is hosted by a suite of granitoids (Grove, 1996), that intrude intermediate to mafic volcanic and volcaniclastic greenschist host rocks (Figure 2), including intermediate trachy-andesitic to mafic volcanics, minor interbedded volcaniclastics and rare BIFs. Mineralisation in the greenstones is poor, being localised in narrow shears, and adjacent to the granitoid contacts.

The granitoids can be broadly subdivided into two intrusive suites:

1. A monzonite-syenite suite. The monzonite is the dominant lithology and is a fine to medium grained dark rock with a typical medium grained texture. Syenitic lithologies are typically medium to coarse grained, with perthitic feldspar phenocrysts up to 20 mm. Intrusive relationships and gradational contacts indicate the monzonite and syenite were co-magmatic. The monzonite-syenite suite shows extensive propylitic alteration.

2. Granite. This is typically fine to medium grained and, where relatively unaltered, is grey to pale pink. Most contacts between the monzonite-syenite suite and the granite are strongly sheared and the intrusive relationships are not understood. Studies by Acacia Resources Ltd. indicate that the granite and the monzonite-syenite suite lie on differing fractionation trends and, thus, are the product of separate intrusive events.

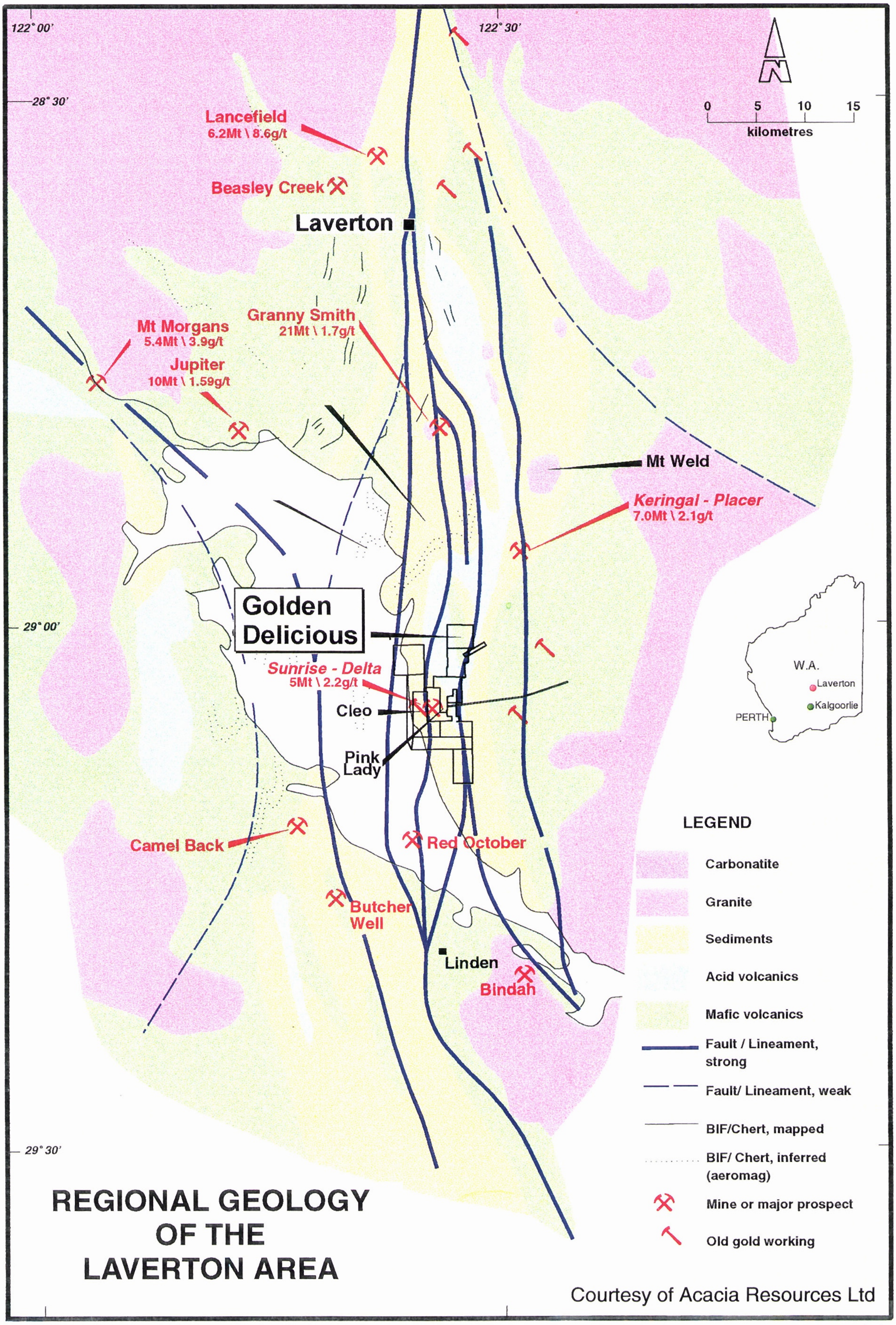


Figure 1: Regional geology of the Laverton area showing Golden Delicious and other gold occurrences in the area, (courtesy Acacia Resources Ltd.).

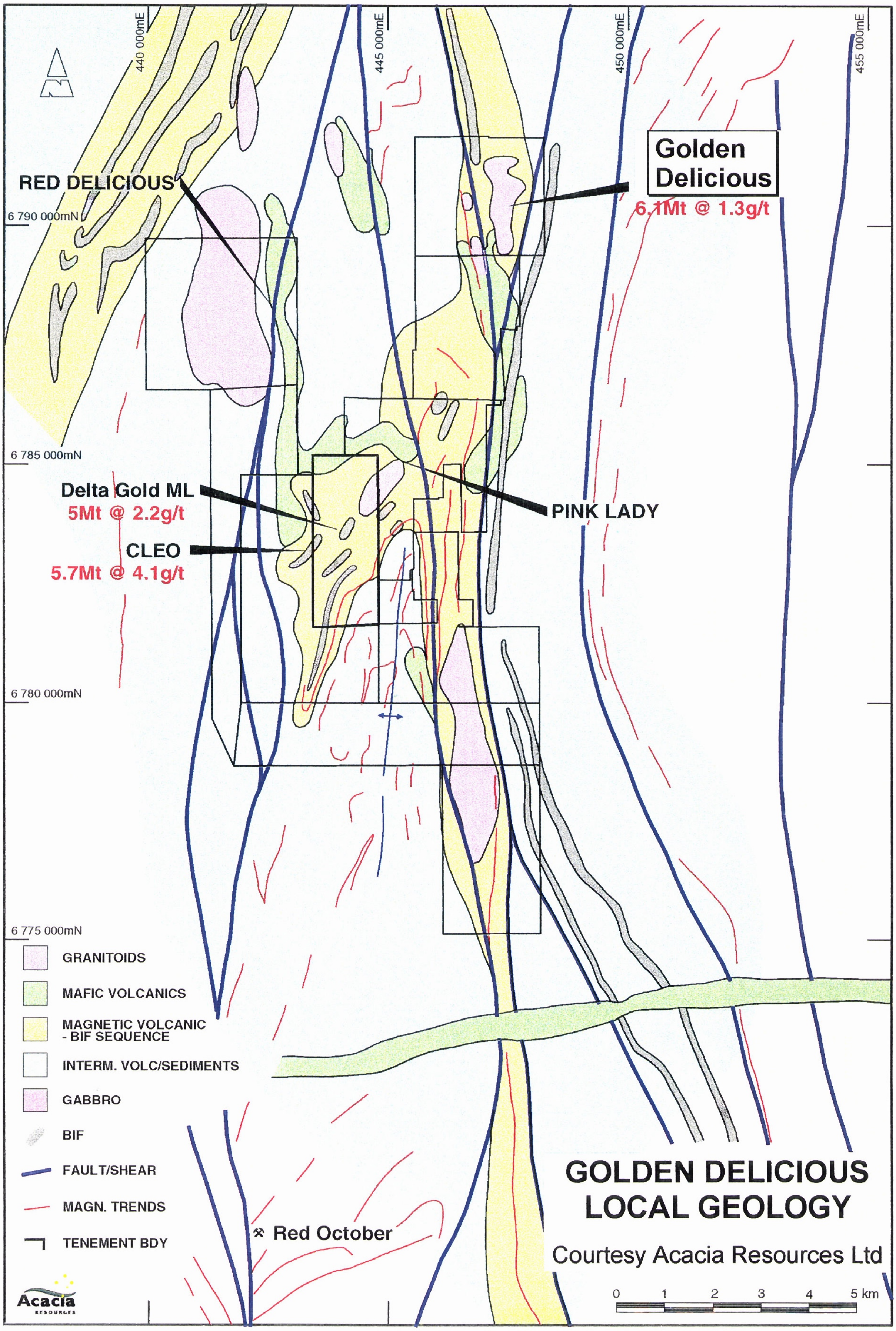


Figure 2: Local geology of the area surrounding Golden Delicious, (courtesy Acacia Resources Ltd.).

## 1.3 REGIONAL SURFACE REGOLITH RELATIONSHIPS

The Golden Delicious deposit is situated beneath a broad colluvial plain approximately 5 km east of the margin of Lake Carey and 5 km north east of the nearest exposed Archaean rocks.

Regional features of the surface regolith have been interpreted from Landsat Thematic Mapper colour composite imagery, using bands 7, 4 and 2 in red, green and blue (Figure 3) and band ratios $^5/_7$ $^4/_7$ $^4/_2$ (RGB) with limited field checking. Image processing methods are described in Section 2.5. The map subdivides the region into simple units, each warranting a different approach to regolith geochemistry. Drainage trends are highlighted to indicate the present direction of transport of eroded materials.

*Residual weathered Archaean materials*
This unit represents the surface expression of outcropping or subcropping saprolite or saprock, (with some truncated or incipient mottled zones), and soils developed from them. These may have been exposed by erosion of a pre-existing weathered profile, or may represent the most weathered form of the parent material.

*Post Archaean sedimentary materials*
These dominate the region and the surficial materials represent the uppermost part of a sedimentary sequence that may be highly variable in genesis, provenance, composition and thickness. They include alluvial, colluvial or aeolian sediments and may be less than one metre to many tens of metres thick. They were derived from erosion of fresh and weathered Archaean rocks or the reworking of younger sediments, either locally or from many kilometres away. The sediments themselves may have been subject to extensive post-depositional modification by chemical and physical weathering.

*Ferruginous materials*
These highly ferruginous materials may be developed in weathered Archaean bedrock, or younger sediments that have been extremely weathered and/or indurated by Fe oxides.

# 2. STUDY METHODS

## 2.1 DIAMOND DRILLING

### 2.1.1 Sampling

One diamond drill hole, cored from surface was made available by Acacia Resources for the purposes of the project (GD DDH 001). This core, where preserved, provided excellent samples of regolith materials from within the transported overburden and the underlying zone of mineralisation. Twenty seven samples were taken from this core and impregnated with Araldite resin under vacuum to preserve the materials for further examination. Impregnated samples of core were then sectioned with a diamond saw to provide two flat, near vertical sections of each sample for further work. Of the 27 samples impregnated, 14 were selected for detailed study. This was done on the basis of physical sample quality and representativness.

### 2.1.2 Petrography

One of the pieces of half core from each of the selected samples was face impregnated with Araldite and polished thin sections were prepared by staff of the CSIRO at the Floreat Park laboratories.

Figure 3: Landsat TM Bands 742(RGB) with regional interpretation of key regolith relationships

### 2.1.3 Chemical and mineralogical analysis

Offcuts from the polished thin section preparation were trimmed of excess Araldite resin and milled to <75 μm in a hardened carbon steel mill (K1045 - Robertson *et al.*, 1996).

A portion of each pulverised sample was examined by XRD using CuKα radiation, using a Philips PW1050 diffractometer, fitted with a graphite crystal diffracted beam monochromator (CSIRO). Each sample was scanned over a range 2-65° 2θ at a speed of 1° 2θ/min with data collected every 0.02° 2θ intervals. Peaks were selected manually using computer software to generate peak lists and plots at various scales for interpretation.

X-Ray fluorescence spectroscopy was performed on fused disks (0.7 g sample and 6.4 g lithium borate) using a Philips PW1480 instrument by the method of Norrish and Hutton (1969). Detection limits (in ppm) were as follows: Si, Al, Mg, Na (100); Fe (50); Ti (30); Mn, P (20); Ca, K (10); Ba (30); Ce, Cl (20); Cr, Co, Cu, La, Ni, S (10); Pb, Rb, Sr, V, Y, Zn, Zr (5); Nb (4); Ga (3) (CSIRO).

A 10 g aliquot of each pulverised sample was analysed by instrumental neutron activation analysis (INAA). Detection limits were as follows (ppm): K (2000); Fe (500); Na, Ba, Zn (100); Rb (20); Ag, Cr, Se, Mo (5); Br, Ce, U, W (2); As, Co, Cs, Ta (1); La, Eu, Yb, Hf, Th (0.5); Sb, Sm, Lu (0.2); Sc (0.1); Ir (0.02); Au (0.005) (Becquerel Laboratories).

## 2.2 BULK METRE DRILLING

### 2.2.1 Sampling

Twelve rotary air blast (RAB) holes were drilled by Acacia Resources specifically for this project. The holes were drilled vertically, to 20 metres depth, 1 m composites were sampled by riffle splitting to approximately 2-3 kg at the time of drilling. The holes were drilled in order from west to east but no deliberate cleaning of the drill rods or drilling apparatus was carried out between holes. Cross-hole contamination was not evident in the samples or geochemical data, possibly because of the flushing of the apparatus by groundwater, (approximately 11 metres below surface). Unconsolidated gravelly sediments below the water table were subject to the artificial concentration of coarse material in the drill samples; unconsolidated material collapses into the hole and the finer material is washed away by water, leaving an apparent concentration of the heavier, coarser gravels. This has affected the work carried out on these samples to varying degrees, and will be discussed later.

### 2.2.2 Sample preparation and bulk geochemical analysis

The single metre composites were air dried at 40-50 °C. Samples were then jaw crushed if necessary to <6 mm, riffle split to approximately 150 g and pulverised to <75 μm in a hardened carbon steel mill (K1045 - Robertson *et al.,* 1996).

A 10 g aliquot of the pulverised sample was analysed by INAA. Detection limits were as previously quoted.

A one gram aliqot of each pulverised sample was digested in cold 5M HCl, diluted to 1M after approximately 5 minutes. The digest was analysed by AAS for dissolved Ca and Mg. Detection limits (in the solid) were 0.0025% and 0.001% respectively.

### 2.2.3 Size fraction analysis

Three samples, selected to represent the sedimentary overburden, were subjected to size fraction analysis. A sub-sample was riffle split from the bulk and dry sieved for 20 minutes using a mechanical dry sieving apparatus (Ro-tap) to give plus 1000 μm, 250 μm-1000 μm, 63 μm-250 μm and minus 63 μm fractions. The coarser (plus 63 μm) fractions were then soaked in de-ionised water for approximately 72 hours, and wet sieved, thus yielding a further minus 63 μm fraction, washed from the coarser fractions. All fractions were pulverised (except plus 63 μm), and analysed for gross cyanide extractable Au. Comparable results were obtained for the wet and dry minus 63 μm fractions, so a total minus 63 μm fraction was calculated.

### 2.2.4 Material fraction analysis

Three samples were selected to represent the upper, middle and lower sections of the mottled zone developed in highly weathered and mineralised Archaean rocks. These were wet sieved and the plus 1 mm material hand separated into Fe-rich, Fe-poor and intermediate material (where present). The results are only qualitative because it was impossible to obtain a complete separation, but they are still valid for assessing the usefulness of selective sampling of Fe-rich materials from drill spoil. Each of the fractions were dried, pulverised and analysed for gross cyanide-extractable Au.

### 2.2.5 Selective extractions

*Water, iodide, cyanide partial extractions*

In-house partial extraction procedures were used to test the solubility of Au in a variety of regolith materials sampled by drilling. A 25 g portion of pulverised sample material was mixed with 50 mL of extractant in a screw-cap polyethylene bottle, and then gently agitated for one week, after which the total (or gross) extractable Au was determined. The three solutions were:

(i) deionised water: dissolves the most soluble Au.

(ii) iodide: a 0.1M KI, 1M $NaHCO_3$ solution is adjusted to pH 7.4 with HCl whilst $CO_2$ is bubbled through. This extraction dissolves more Au than water alone.

(iii) cyanide: 0.03M KCN, 0.2M NaOH solution dissolves all but the most refractory Au - this can include coarse pieces of Au and Au partly encapsulated within resistant material such as quartz.

A series of duplicate and triplicate extractions using these solutions was carried out on both pulverised and unpulverised samples. This extended experiment and its implications are described fully in Appendix 6.

*Citrate-dithionite, sodium hydroxide, hydrochloric/ascorbic, aqua regia sequential extractions*

Four extractant solutions were used to test the solubility of Au and other metals in a range of samples of weathered Archaean material. The extractions were performed sequentially on the same aliquot of sample and each extractant solution analysed for Au, As, Sb, La, Eu, Ce, Sm, Lu, Yb, Fe, Al, Mg, Cr, Sc, K, Rb, Co and W by ICPMS/OES. The residue remaining after the aqua regia phase was encapsulated and analysed for Au and 28 other elements by INAA (the 28 other elements are as previously listed, but their detection limits are higher due to low sample weight). The sequential extractions were undertaken in four main stages reflecting the four extractant solutions, designed to target Fe oxides (citrate-dithionate), clay minerals (NaOH), and progressively resistant mineral phases under reducing (HCl-ascorbic acid) and oxidising (aqua regia) conditions.

Part A

0.75 g of Na dithionite was added to 1.2 g sample, with 35 mL of 0.3M ammonium citrate (adjusted to pH 7 with concentrated ammonia solution). The mixture was heated to approximately 90°C for two hours and shaken occasionally. The solution was then centrifuged and the liquor decanted and collected for digest. The centrifuged pellet was suspended and rinsed with 15 mL ammonium citrate, re-centrifuged and the rinse decanted and collected for digest.

The procedure was repeated until all Fe oxides were removed (*i.e.*, the sample residue was pale grey). The pellet was rinsed finally with 0.1M ammonium chloride (pH 7 with HCl) solution and the rinse collected for digest. The combined decants and rinse were then digested with aqua regia and made up to 50 mL in 0.2M HCl for analysis.

Part B

The residue from Part A was boiled in 35 mL 5M NaOH for 1-2 hours using teflon containers in a sand bath on a hot plate. After cooling, the solution was centrifuged and the decanted liquor collected for digest. The centrifuged pellet was then suspended and rinsed with ≈15 mL 0.1M HCl, re-centrifuged and the rinse decanted and collected for digest.

This procedure was repeated and the two solutions of liquor + rinse were digested separately with aqua regia and made up to 50 mL in 0.2M HCl for separate analysis.

Part C

Thirty mL of 3M HCl, 0.3M ascorbic acid was added to the remaining sample from Part B. The solution was heated at 60°C for 2 hours in an ultrasonic water bath, and shaken occasionally. After cooling, the solution was centrifuged and the decant collected for digest. The centrifuged pellet was then suspended and rinsed with 15 mL 0.1M ammonium chloride, recentrifuged and the rinse decanted and collected for digest. The decant and rinse were then digested with aqua regia and made up to 50 mL with 0.2M HCl for analysis.

Part D

Thirty mL of aqua regia was added to the remaining sample from Part C and heated for 2 hours at 90°C in a water bath. After cooling, the solution was centrifuged and the decant collected. A further 30 mL of aqua regia was added to the sample and heated in a water bath for 2 hours at 90°C. After cooling, the solution was again centrifuged and the decants combined. The centrifuged pellet was then suspended and rinsed with 15 mL 1M HCl, 0.3M $HNO_3$, recentrifuged and the rinse decanted and combined with the other decants. The decant was boiled down to incipient dryness, concentrated HCl was added to drive off any remaining $HNO_3$, and made up to 50 mL in 0.2M HCl for analysis.

Metals extracted by the above procedures were considered "net" extractable, as re-adsorption of metals dissolved by the extractant back onto the sample was considered possible. To assess the significance of re-adsorption, a sachet of activated carbon was added to each extraction of a duplicate of one sample and analysed separately by INAA for the same suite of metals.

## 2.3 GROUNDWATER SAMPLING AND ANALYSIS

Twenty eight groundwater samples were collected at a variety of depths in late 1994 (Figure 4). Major emphasis was placed on the traverse at 6790200mN, so as to allow comparison with regolith sampling, with additional samples along the strike of the mineralization, 500 - 700 m S. Temperature, pH, conductivity and oxidation potential (Eh) were measured at the time of sampling. A 125 mL aliquot was collected in a polyethylene bottle (with overfilling to remove all air) for later $HCO_3^-$ analysis by alkalinity titration in the laboratory. About 1.5 L of water was filtered through a 0.2 µm membrane filter in the field. About 100 mL of the filtered solution was acidified [0.1 mL 15 moles/litre (M) nitric acid ($HNO_3$)], and analysed for:

1. Cu, Pb and Cd by Anodic Stripping Voltammetry;
2. Al, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P/I (the distinction between P and I is difficult due to spectral overlap), $SO_4$ (measured as S), Si, Sr, Ti, V, and Zn by inductively coupled plasma-atomic emission spectroscopy;
3. Ag, Bi, Cd, Ce, Dy, Er, Eu, Ga, Gd, Ge, Ho, La, Mo, Nd, Pb, Pr, Rb, Sb, Sc, Sm, Sn, Tb, Th Tl, Tm, U, W, Y, Yb and Zr by inductively coupled plasma - mass spectroscopy;
4. total phosphate (as P) by the molybdenum blue colormetric method (Murphy and Riley, 1962);
5. I by subtraction of P from P/I concentration.

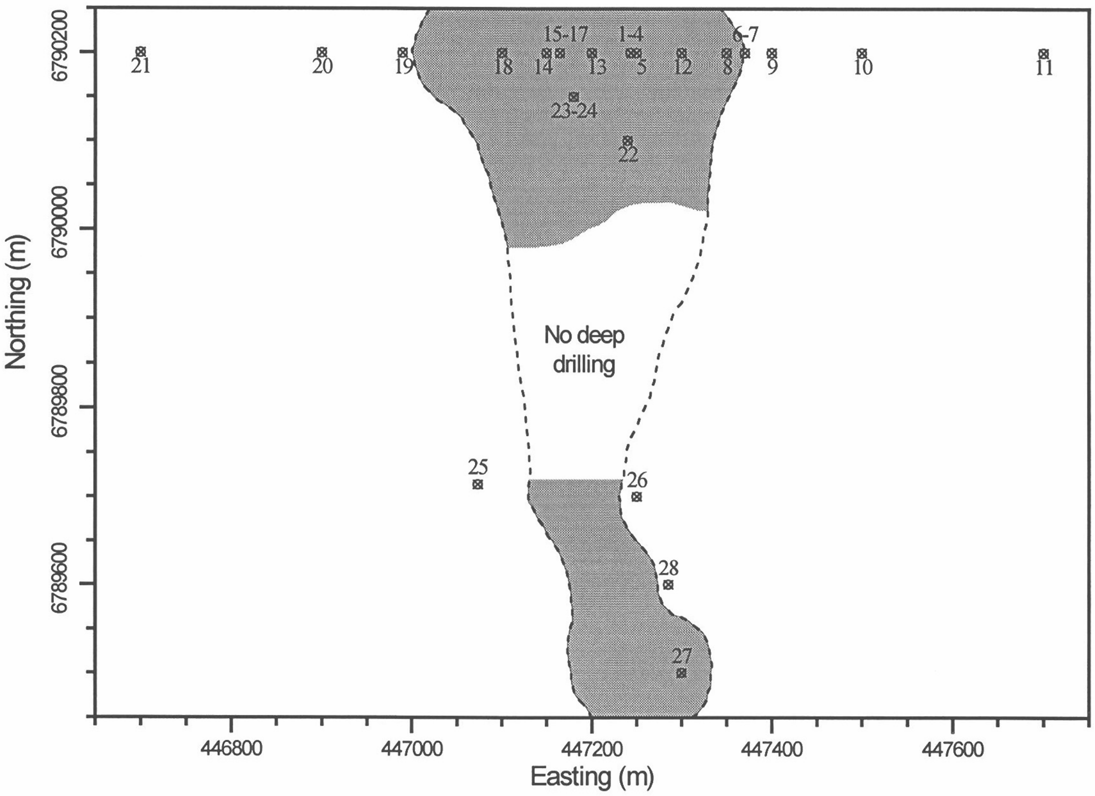


Figure 4: Location of water samples at Golden Delicious. The shaded area represents the interpreted projection of the mineralized zone (Acacia, 1994)

About 50 mL of the filtered water was collected separately, without acidification, and analysed for Cl by the Technicon Industrial method (Zall *et al.*, 1956).

A one litre sub-sample of the filtered water was acidified with 1 mL 15 M $HNO_3$ and one gram sachet of activated carbon added. The bottle was rolled for eight days in the laboratory and the water discarded. The carbon was then analysed for Au by INAA at Becquerel Laboratories, Lucas Heights. The method was tested by shaking Au standards of varying concentrations, and in varying salinities, with activated carbon (Gray, unpublished data).

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) for highly saline solutions, such as observed at this site, the specific ion interaction model known as the Pitzer equations was applied, using the program PHRQPITZ (courtesy USGS).

These programs are used to calculate the solubility indices (SI) for a number of mineral phases for each water sample. If the SI for a mineral equals zero (empirically from -0.2 to 0.2 for the major elements, and -1 to 1 for the minor elements that did not have Pitzer corrections), the water is in equilibrium with that particular solid phase, under the conditions specified. Where the SI is less than zero, the solution is under-saturated with respect to the phase, so that, if present, the phase may dissolve. If the SI is greater than zero, the solution is over-saturated with respect to this phase and the phase can precipitate. This analysis only specifies possible reactions, because 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.

## 2.4 REGOLITH DATA COLLECTION AND PROCESSING

One hundred and forty two RAB, RC, and air core drill holes were logged specifically for regolith-related features in the area surrounding Golden Delicious. Regolith information was predominantly in the form of descriptive logs of drill spoil, or diamond drill core. In the case of the RAB holes drilled for this project, the spoil was wet sieved at the time of logging. No wet sieving of the other holes was necessary, as the spoil had been washed thoroughly by rain. Surface RL for each drill hole was estimated from topographic plans provided by Acacia Resources and the RL of the palaeosurface (top of weathered Archaean) calculated from logging.

## 2.5 IMAGE PROCESSING

Landsat Thematic Mapper data were processed for the interpretation of regional surface regolith relationships (Section 1.3). ERMapper v4.2 to v5.2 and ENVI v1.1 were used at various stages of processing. A subset of the Laverton scene was rectified using ten ground control points taken from 1:250000 topographic maps. The data were corrected for atmospheric interference by dark subtraction. Hardcopy was produced of two different band combinations: 742 (RGB) and $^5/_7\ ^4/_7\ ^4/_2$ (RGB). Each band was enhanced manually to provide the most suitable local area contrast. Interpretation was based on contrasting spectral response and textural features highlighted in the imagery.

# 3. REGOLITH STRATIGRAPHY

## 3.1 TOPOGRAPHY AND PALAEOTOPOGRAPHY

The present land surface is very gently sloping (maximum 4 m across the study area) towards the north west (Figure 5); the palaeosurface also slopes to the north west, but the gradient is much steeper, (maximum 20 m) and more variable.

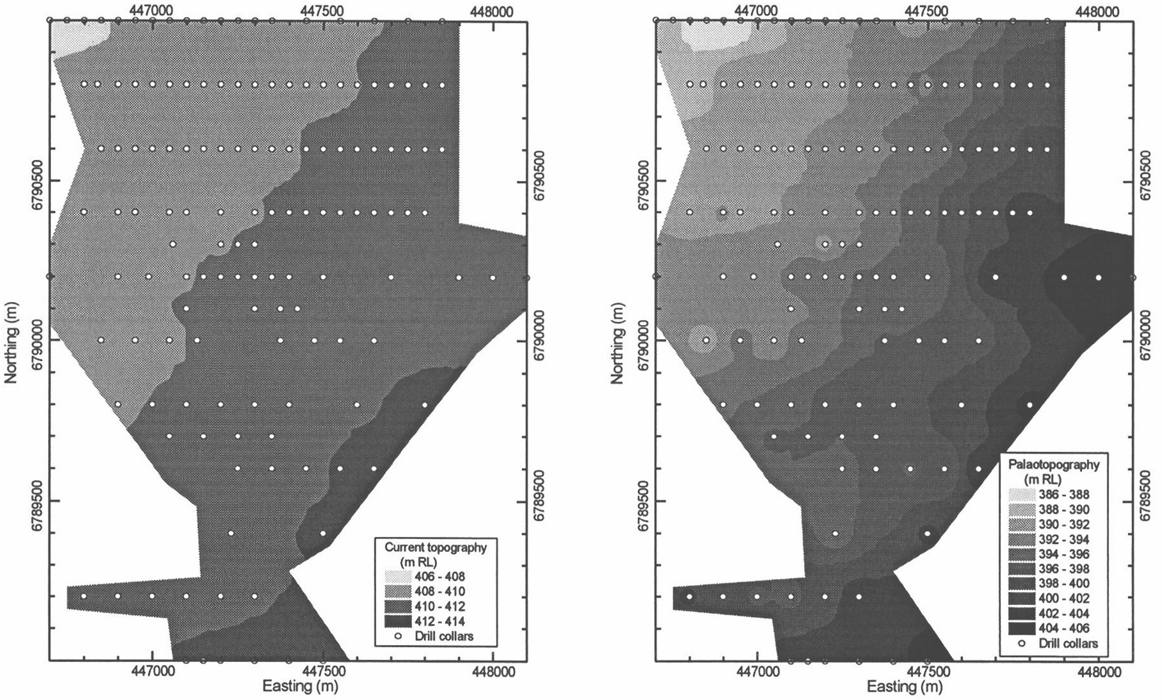


Figure 5: Surface topography and palaeotopography surrounding Golden Delicious.

The distribution of regolith materials at surface and in three dimensions is quite uniform throughout the area surrounding Golden Delicious (Figure 6). The materials that comprise the delineated units are generally continuous over the study area, although they vary in thickness. Full descriptions of the units represented on Figure 6 appear in Sections 3.2 and 3.3.

## 3.2 TRANSPORTED OVERBURDEN

The sediments overlying the weathered Archaean are a poorly sorted, polymictic colluvium-alluvium of clay, silt, sand and gravels that, in general, becomes coarser with depth. The sediments have been cemented in parts by various secondary minerals, including silica, carbonates and Fe oxides. Broken and abraded Fe-rich pisoliths, nodules and rock fragments dominate the coarser gravels. The relationship between present and palaeotopography and drainage suggests these gravels are derived from the greenstone uplands, 5 - 10 km ESE of the study area. Small pockets of ferruginous materials on these uplands (Figure 3) may represent remnants of pre-existing and more widely distributed ferruginous units. The general downward coarsening nature of the sediments mimics, in reverse order, the distribution of materials in lateritic profiles and so supports this hyposthesis.

Four units within the transported overburden have been identified on the basis of sedimentary features and post-depositional modifications. Where drill spoil had been severely degraded, the transported material was not able to be differentiated (Unit T0 in Figure 6).

*T1 - Calcareous, hardpanised, silty clays*

This is the uppermost unit of the transported overburden, characterised by fine sediments (< 1% gravel), which are strongly indurated with silica, carbonate and Fe oxides. Manganese oxides are common as dendritic coatings along partings and fractures. Carbonate occurs extensively as thin (up to 5 mm), laminar, sub-horizontal precipitations along partings and fractures, and as more massive, void-filling indurations of the fine sediments. The presence of this form of carbonate is diagnostic of the unit.

Figure 6: Stacked sections of drilling surrounding Golden Delicious showing the distribution of regolith materials in three dimensions.

*T2 - Silty clays with occasional carbonate mottles*

This is a variable unit dominated by fine sediments, although gravels are more common than in the upper unit. It is less strongly indurated by silica and Fe oxides than T1 and, as a result, appears more clay rich. Carbonate is present as irregular masses up to 40 mm in diameter, rather than the laminar structures seen in T1.

*T3 - Silty clays with abundant iron rich gravel*

This unit has abundant Fe-rich gravels that consist dominantly of broken and abraded Fe-rich pisoliths, nodules and ferruginous lithorelics. Maghemite is common in the pisoliths. Quartz and virtually unweathered rock fragments are minor constituents. The upper few metres of this unit, particularly in the NE of the study area, have minor amounts of concretionary goethite seemingly formed (or forming) *in situ.* These concretionary structures lack evidence of transport, have green-yellow cutans, and sometimes incorporate components of the sediment in their internal structure. Pale pink carbonate cementing the lower metre of this unit is common throughout the area.

The coarse, ferruginous materials are over-represented in drill spoil. Diamond core from this unit has up to 25% coarse material, whereas the drill spoil indicates up to 70%. This is probably because this unit is below the water-table and only weakly consolidated, so that the fine fraction is lost during wet, percussive drilling.

*T4 - Reworked mottled zone*

There was evidence on one section (Figure 6) of local re-working (possibly the result of bioturbation prior to deposition of the overlying sediements) of the mottled zone to give a thin layer of obviously transported material (polymictic sediments dominated by ferruginous silty clay) with abundant fragments of haematitic mottles very similar in appearance to those in the underlying mottled zone.

## 3.3 WEATHERED ARCHAEAN

*A1 - Mottled zone*

This unit is characterised by large (up to 200 mm diameter) haematite-rich mottles developed in clay-rich saprolite. Little coherent primary lithic fabric is preserved in the mottles or the clays except towards the base of the unit, where they are locally present (*e.g.,* as kaolinite pseudomorphs of feldspars in a ferruginous groundmass). Accretions or pseudo-mottles of dolomite in places permeate the Fe-poor, kaolinitic clays.

*A2 - Saprolite*

This unit comprises clay-rich saprolite merging to saprolite with good preservation of primary lithic fabrics. Saprolite is generally present at the base of drilling used in this study (approximately 50 m); the base of weathering, indicated from diamond drilling, is commonly at approximately 70-80 m below surface.

# 4. MINERALOGY OF REGOLITH MATERIALS

Core from diamond hole GD DDH 001 (drilled 60° E from 447225mE on section 6790200mN - in the main mineralised zone) was logged, photographed and sampled. The samples were subjected to geochemical and petrographic analysis as described in Section 2.1. Detailed petrography, mineralogy and geochemistry of the samples is included in a separate report "Atlas of Transported Overburden". This Section summarises the more significant features of the regolith revealed by this core; depths are measured down the inclined (60°) hole rather than from surface. Vertical depths are 86% of down hole depths.

The top 1.7 m consists of loosely consolidated sandy silty clays with no carbonate. From 1.7 to 8.4 m, the fine sediments are more consolidated; between 1.7-5.0 m, they are indurated by calcite (Figure 7).

The unit between 5 and 6.2 m (Table 1) consists of coarse, rounded alluvial gravels of relatively fresh rock - probably part of a narrow, local channel feature (see also Figure 7). This type of sediment was not observed elsewhere and is not considered representative of the regolith as a whole.

Calcite recurs as large (up to 40 mm) aggregates or mottles precipitated in an indurated clay-rich sediment, with minor ferruginous gravels, from 8.4 to 10.2 m. From 10.2-16.8 m it is a minor component of the poorly sorted and poorly consolidated, polymictic, gravelly silty clays. The clays associated with these units are under-represented in the RAB and RC drilling in the area, because of poor consolidation and flushing by groundwater during drilling (Section 3.2).

The transition from the transported overburden to the underlying mottled zone developed in the Archaean rocks is at 16.8 to 17.5 m. The unit is brecciated, with large (up to 20 mm) angular fragments of pale kaolinitic clays, (closely resembling those in the upper mottled zone), set in a matrix of ferruginous silts and clays characteristic of the overlying sediments. Minor amounts of ferruginous gravel are also present in the upper portions and pale pink dolomite cements the lower part. This dolomitic cement was observed elsewhere, where it was often associated with the unconformity between the transported overburden and the underlying Archaean.

These breccias are difficult to explain by sedimentary processes alone. A possible explanation is that they are a result of churning during soil formation when the transported overburden was thin (<1 m). The vertical mixing caused by these processes may explain the presence of quartz found in the upper few metres of the mottled zone, although a lithological change in the Archaean cannot be excluded (below and Section 7.2).

The mottled zone (17.5 to 29.9 m) lacks coherent lithic fabric at hand lens scale above 27.75 m, although here the original rock fabric was preserved in a ferruginous mottle. Haematite dominates the Fe oxides throughout the mottled zone; the appearance of goethite at 29.3 m may mark a redox front. Precipitations of dolomite within the pale clay of the mottled zone are common and form massive accretions up to 150 mm diameter, with a three dimensional dendritic form.

It is significant that albite and microcline persist higher in the mottled zone than muscovite (compare 09-2596 with 09-2595 in Figure 7). This is highly unlikely to be the result of weathering, because feldspars alter to kaolinite far more easily than micas. Accordingly, it is suggested that, despite significant alteration due to weathering, the absence of muscovite is related to changes in primary lithology or to an alteration halo. The appearance of quartz, co-incident with the disappearance of muscovite, is further evidence for such inherent variations, which appear crucial to the distribution of many elements throughout the regolith (Section 6).

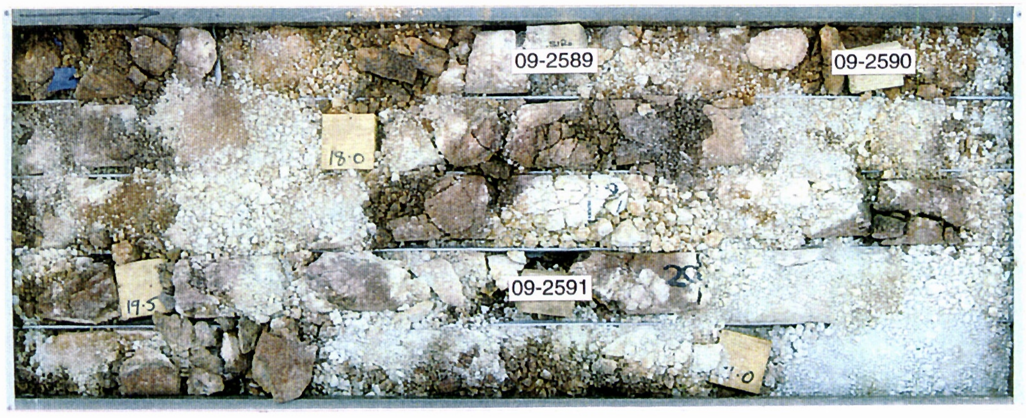
A large, massive dolomite precipitation at 29.9 m occurs at the base of mottling in the saprolite, with saprolite becoming less weathered with depth. There is no sharp transition between saprolite, saprock and fresh rock, and minor weathering along joints and fractures continues at depth.

Table 1: Descriptive log of DDH 001 (photographed in Figure 7), from and to depths are down hole; vertical depths in parentheses.

| From | To | Description |
|---|---|---|
| 0 | 1.7<br>(1.5) | Sandy silty ferruginous clay with minor quartz and maghemite gravel, indurated below 1.5m |
| 1.7 | 1.75<br>(1.5) | Fine ferruginous sediment, strongly indurated by carbonate |
| 1.75 | 2.3<br>(2.0) | Indurated fine ferruginous sediment, with minor polymictic gravel of quartz, ferruginous saprolite, saprolite, and maghemite pisoliths. |
| 2.3 | 5<br>(4.3) | Fine ferruginous sediment moderately indurated by carbonate, with minor polymictic gravel of quartz, ferruginous saprolite, saprolite, and maghemite pisoliths. |
| 5 | 6<br>(5.2) | Lost (few fragments of coarse alluvial gravel) |
| 6 | 6.2<br>(5.3) | Unconsolidated coarse gravel (up to 20 mm) of quartz, ferruginous nodules, pisoliths and other fragments. |
| 6.2 | 7.5<br>(6.5) | Weakly indurated fine sandy ferruginous sediment, with 30% polymictic gravel of quartz pisoliths and ferruginous saprolite. |
| 7.5 | 7.85<br>(6.8) | Unconsolidated fine clayey ferruginous sediment with minor angular polymictic gravel of quartz and ferruginous and relatively unweathered saprolite. |
| 7.85 | 8.15<br>(7) | Strongly indurated fine silty ferruginous sediment, with minor polymictic ferruginous gravel. |
| 8.15 | 8.4<br>(7.2) | Fine silty ferruginous sediment, with 40% polymictic gravel of quartz and ferruginous saprolite, nodules and pisoliths. |
| 8.4 | 10.2<br>(8.8) | Discrete irregular segregations of carbonate in an indurated ferruginous clay matrix with minor gravel of fresh and ferruginous lithic fragments. |
| 10.2 | 11.7<br>(10.1) | Fine clay-rich sediment, with 15% polymictic ferruginous gravel and minor carbonate |
| 11.7 | 16.8<br>(14.4) | Silty ferruginous (in places green) clay with approximately 10-20% (locally up to 60%) poorly sorted polymict gravel dominated by Fe-rich pisoliths with minor angular quartz, and other ferruginous fragments. Very minor carbonate in places. |
| 16.8 | 17.5<br>(15.1) | Silty ferruginous clay with minor polymictic ferruginous gravels and angular fragments of pale kaolinitic clay resembling the underlying mottled zone. Carbonate cements the lower portion. |
| 17.5 | 27.75<br>(23.9) | Mottled clay zone, plastic blue grey clays with large irregular haematitic mottles. Sharp pedoplasmation front at 27.75 |
| 27.8 | 29.9<br>(25.7) | Mottled saprolite, large haematitic mottles tending more goethitic at 29.3. |
| 29.9 | 30<br>(25.8) | Aggregate of carbonate precipitated in saprolite. |
| 30 | 38.1<br>(32.8) | Saprolite, grading through saprock to fresh rock at 56.5 (48.6). Minor weathering along joints continues at depth. |

Table 2: Basic descriptions of samples analysed from DDH 001, locations are marked on Figure 7.

| Sample | Down hole depth | Vertical depth | Description |
|---|---|---|---|
| ***09-2577*** | 2.5 | 2.2 | Fine sediment indurated by carbonate |
| ***09-2578*** | 3.55 | 3.1 | Fine ferruginous sediment strongly indurated by carbonate |
| ***09-2581*** | 6.95 | 6.0 | Indurated sandy ferruginous sediment with some fresh rock fragments |
| ***09-2584*** | 9.75 | 8.4 | Fine indurated clayey sediment with large carbonate accretion |
| ***09-2587*** | 16.25 | 14.1 | Fine indurated ferruginous sediment with 10-20% ferruginous gravels |
| ***09-2589*** | 17.3 | 15.0 | Fine sediment indurated by carbonate with angular fragments of pale kaolinitic clays |
| ***09-2590*** | 17.6 | 15.2 | Haematitic mottle with no primary textures observed with hand lens |
| ***09-2591*** | 19.95 | 17.3 | Haematitic mottle with no primary textures observed with hand lens |
| ***09-2592*** | 21.5 | 18.6 | Haematitic mottle with no primary textures observed with hand lens |
| ***09-2595*** | 25.55 | 22.1 | Pale grey clay from between haematitic mottles with massive precipitated carbonate |
| ***09-2596*** | 27.75 | 24.0 | Haematitic mottle with primary lithic fabric preserved |
| ***09-2598*** | 28.85 | 25.0 | Saprolite |
| ***09-2599*** | 29.95 | 25.9 | Free carbonate precipitating in saprolite |
| ***09-2601*** | 37.55 | 32.5 | Saprock |



| Sample | $SiO_2$% | $Al_2O_3$% | $Fe_2O_3$% | MnO% | MgO% | Ca0% | $Na_2O$% | $K_2O$% | $TiO_2$% | $P_2O_5$ % |
|---|---|---|---|---|---|---|---|---|---|---|
| ***09-2577*** | 43 | 12 | 6.5 | 0.03 | 1.3 | 12 | 0.85 | 0.68 | 0.41 | 0.027 |
| ***09-2578*** | 34 | 9 | 6.6 | 0.03 | 1.1 | 21 | 0.88 | 0.50 | 0.26 | 0.027 |
| ***09-2581*** | 55 | 12 | 14 | 0.08 | 1.1 | 0.57 | 1.5 | 0.53 | 0.56 | 0.032 |
| ***09-2584*** | 18 | 6 | 6.2 | 0.01 | 2.1 | 32 | 0.53 | 0.20 | 0.16 | 0.006 |
| ***09-2587*** | 33 | 14 | 35 | 0.07 | 0.6 | 0.11 | 0.77 | 0.35 | 1.2 | 0.031 |
| ***09-2589*** | 28 | 12 | 7.0 | 0.02 | 7.3 | 13 | 1.0 | 0.16 | 0.71 | 0.009 |
| ***09-2590*** | 39 | 15 | 29 | 0.02 | 0.6 | 0.11 | 1.0 | 0.14 | 0.97 | 0.011 |
| ***09-2591*** | 37 | 14 | 32 | 0.01 | 0.6 | 0.09 | 0.94 | 0.11 | 0.95 | 0.010 |
| ***09-2592*** | 39 | 14 | 29 | 0.03 | 0.7 | 0.10 | 1.2 | 0.11 | 1.1 | 0.015 |
| ***09-2595*** | 32 | 8 | 1.0 | 0.004 | 10 | 15 | 1.3 | 1.3 | 0.67 | 0.006 |
| ***09-2596*** | 45 | 19 | 13 | 0.04 | 1.1 | 0.07 | 2.0 | 5.5 | 0.63 | 0.044 |
| ***09-2598*** | 58 | 21 | 2.8 | 0.01 | 1.1 | 0.10 | 4.0 | 6.9 | 0.74 | 0.017 |
| ***09-2599*** | 13 | 5 | 1.0 | 0.01 | 16 | 24 | 0.70 | 1.5 | 0.12 | 0.013 |
| ***09-2601*** | 57 | 17 | 6.6 | 0.23 | 0.3 | 1.2 | 3.4 | 9.6 | 0.53 | 0.76 |

| Sample | Quartz | Calcite | Dolomite | Hematite | Goethite | Maghemite | Kaolinite | Albite | Orthoclase | Microcline | Muscovite |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *09-2577* | * * * * | * * * * |  | * |  |  | * * | * |  |  |  |
| *09-2578* | * * * | * * * * |  | * |  |  | * * |  |  | * * |  |
| *09-2581* | * * * * |  |  | * | * |  | * * | * * |  |  |  |
| *09-2584* | * * | * * * * |  |  | * |  | * |  |  |  | * |
| *09-2587* | * * * |  |  | * * * * |  | * * | * |  |  |  |  |
| *09-2589* | * * * |  | * * * * |  |  |  | * |  |  |  |  |
| *09-2590* | * * * |  |  | * * * |  |  | * |  |  |  |  |
| *09-2591* | * * * |  |  | * * * |  |  | * |  |  |  |  |
| *09-2592* | * * * |  |  | * |  |  | * |  |  |  |  |
| *09-2595* | * * |  | * * * * |  |  |  | * | * |  | * |  |
| *09-2596* |  |  |  | * |  |  |  | * * | * | * * * | * * |
| *09-2598* |  |  |  |  |  |  |  | * * * * |  | * * * * | * * * * |
| *09-2599* |  |  | * * * * |  |  |  |  |  |  |  | * * |
| *09-2601* |  |  |  |  |  |  |  | * * * * |  | * * * * | * |

* * * *  Predominant  * * *  Moderate to high concentration  * *  Slight to moderate concentration  *  Trace

Figure 7: Photographic record of diamond hole DDH 001 (drilled 60° towards E from 447225mE on the 6790200mN section) and XRD mineralogy and XRF major element analyses of samples as marked on the photographs. Sample descriptions are given in Table 2. Wooden blocks in trays are numbered with depth(m) down hole.

# 5. HYDROGEOCHEMISTRY

## 5.1 INTRODUCTION

Research in Australia and elsewhere (Morris, 1982; Hamilton *et al.*, 1983; Giblin and Snelling, 1984; Runnells, 1984; Dissanayake and Weerasooriya, 1986; Hall *et al.*, 1986; McHugh, 1988; Bergeron and Choinière, 1989; Dekkers *et al.*, 1989; Cidu and Edmunds, 1990) has suggested that hydrogeochemistry may be useful for exploration for Au and other metals. Although many such investigations have been undertaken in areas with a dominantly residual regolith, it is feasible that groundwater may also provide a useful exploration medium in areas of extensive transported overburden.

A primary justification given for the use of hydrogeochemistry in mineral exploration is that groundwater anomalies may be broader and more regular than the mineralization and secondary dispersion halo in the regolith, thus enhancing the exploration signature. In addition, areas of high reactivity (*e.g.*, faults and shear zones) may have distinct hydrogeochemical signatures even where they are unremarkable in terms of elemental abundances, and where petrographic study is difficult. However, such effects may also be counter-productive, as interpretation may become complicated by the various factors.

Hydrogeochemical studies also provide information on how various materials are weathering. This enhances understanding of active dispersion processes and assists in the development of weathering and geochemical models, which are essential for effective exploration in regolith-dominated terrain.

The aims of this hydrogeochemical study were, therefore:

1. to provide information on whether groundwater can be used successfully as an exploration medium in this area in particular and, in conjunction with other studies, in the northern Yilgarn and the adjoining Proterozoic belt in general;

2. to yield data on geochemical dispersion processes, and to assist in interpretation of geochemical data;

3. to contribute to a groundwater database on the characteristics of groundwaters at various sites, and to enhance our understanding of groundwater processes in mineralized zones.

The Golden Delicious Au deposit holds considerable interest for hydrogeochemical investigations for a number of reasons:

1. it lies north of the Menzies line, in the north eastern Yilgarn;

2. groundwater salinity is high to very high. This contrasts with the other sites north of the Menzies line investigated as part of AMIRA Project 409, namely Baxter and Lawlers, which have very low salinities, and Granny Smith, which has moderate to salinity, and permits comparison of the effect of salinity differences on the chemistry of Au and other elements;

3. results can be compared with Granny Smith, 25 km further N;

4. groundwater investigations are complementary to other studies reported here.

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 other Western Australian sites.

## 5.2 COMPILATION OF RESULTS AND COMPARISON WITH OTHER SITES

Groundwater analytical results are compiled in Appendix 1. The concentrations of various ions at Golden Delicious and at other sites are plotted versus TDS or pH in Appendix 2, Figures A2.1 - A2.60. The sea water data (Weast, 1983) are used to derive the line of possible values (denoted as the sea water line) if sea water were diluted with freshwater or concentrated by evaporation; the line is shown on each figure except when the concentration in sea water is too low, relative to the concentration of the element in groundwaters. Groundwater studied at 9 other gold deposits were used for comparison.

1. Northern groundwaters (Baxter and Lawlers: Gray, 1994, 1995): these occur in the northern part of the Yilgarn and margins, and are fresh and neutral, trending more saline in the valley floors.

2. Central groundwaters at, and north of, the Menzies line:
   Granny Smith: 25 km S of Laverton (Gray, 1993a);
   Mt Gibson: 100 km NE of Dalwallinu (Gray, 1991);
   Boags: at Bottle Creek, 210 km NNW of Kalgoorlie (Gray, 1992a);
   the Golden Delicious groundwaters discussed here.
   These groundwaters are neutral and brackish (commonly < 1% TDS) to saline (about 3% TDS), trending to hypersaline (10 - 30% TDS) close to the salt lakes (such as at the Golden Delicious site), with salinity commonly increasing with depth.

3. Kalgoorlie groundwaters:
   Golden Hope: near New Celebration mine, some 40 km SE of Kalgoorlie (Gray, 1993b);
   Wollubar: major palaeochannel system 40 km SE of Kalgoorlie (Gray, 1993b);
   Panglo: 30 km N of Kalgoorlie, with mineralization beneath 40 m of leached saprolite (Gray, 1990a);
   Baseline: 30 km N of Kalgoorlie, with 20m of transported material;
   Mulgarrie: minor palaeochannel about 40 km N of Kalgoorlie (Gray, 1992b);
   Argo: reducing palaeochannel system 25 km S of Kambalda (Gray and Lintern, 1995a);
   Steinway: a minor palaeochannel system 15 km W of New Celebration (Gray and Lintern, 1995b);
   These groundwaters are commonly acid (pH 3 - 5) and saline within the top part of the groundwater mass. Where buffered by extremely alkaline materials (*e.g.*, ultramafic rocks), they trend to more neutral (pH 5 - 7) and hypersaline at depth and when within a few km of various salt lakes in the region.

4. Mulga Rock is a palaeodrainage system in the Officer Basin, about 240 km NE of Kalgoorlie (Douglas *et al.*, 1993):
   Groundwaters are 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 is low, due to the presence of several metres of organic matter in the channel sediments.

Wollubar, Baseline, Panglo and Yalanbee are acid groundwater systems, whereas the other sites have dominantly neutral groundwater. Panglo, Yalanbee, Golden Hope, Mt Gibson and Boags are in dominantly relict or erosional landscapes, whereas the other sites have significant transported material. Comparisons with other sites may be useful in indicating the significance of any particular element anomaly, and whether the groundwater composition is affected by particular lithological interactions. Specific descriptions of the varying sites can be found in the referenced reports, with a generalized description of the hydrogeochemistry of the Yilgarn Craton given in Butt *et al*., (1993).

Solubility indicies (SI) for varying minerals (Section 2.3) are plotted in Figures A3.1 - A3.30. The equilibrium point is shown as the dashed line. Samples within one SI unit are at or near equilibrium with respect to that mineral; those above the line are oversaturated; and those below are undersaturated. In addition, the distributions of some elements in groundwater, as well as relevant SI data, are plotted in Appendix 4.

## 5.3 ACIDITY AND OXIDATION POTENTIAL

An Eh-pH plot of waters from Golden Delicious and other sites is shown in Figure 8. Data are combined into the various groundwater groups, as described in Section 5.2. The Golden Delicious groundwaters are neutral (pH 6.5 - 7.3) and have a similar Eh range to neutral waters from other sites. The more reducing groundwaters are those sampled from the deeper, and therefore oxygen-poor, bore holes.

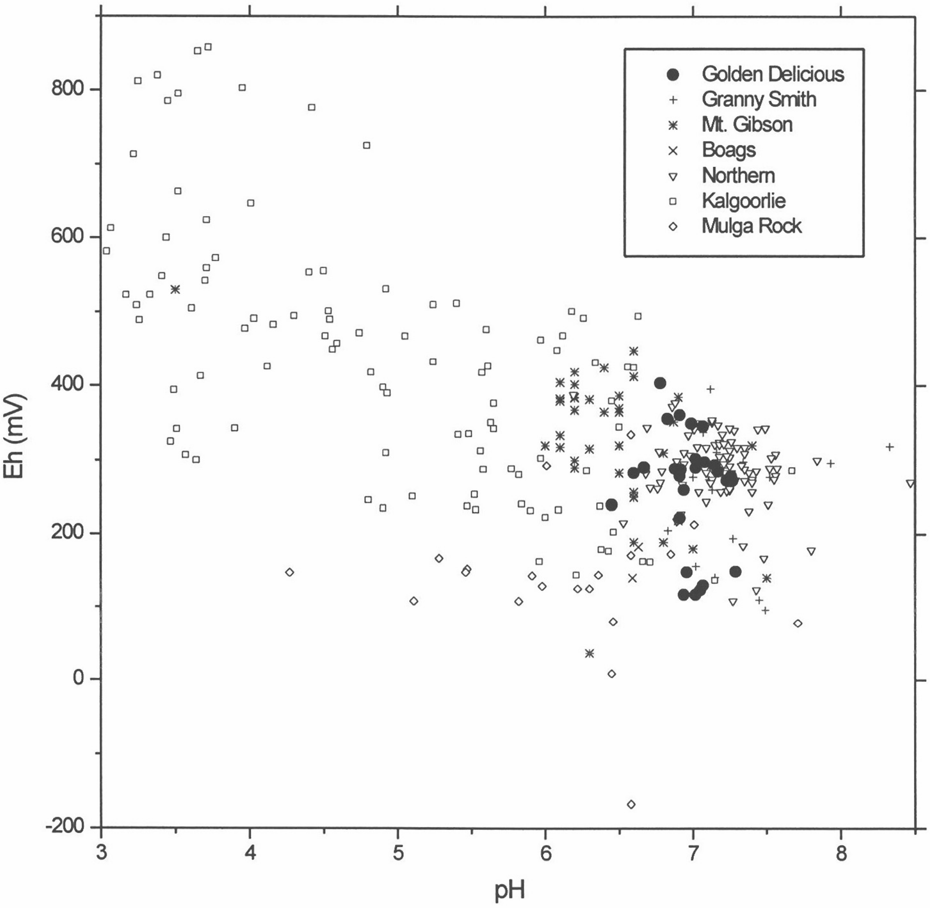


Figure 8: Eh vs. pH for groundwaters from Golden Delicious and other sites.

## 5.4 SALINITY EFFECTS AND MAJOR ELEMENT HYDROGEOCHEMISTRY

For the ions Na, Mg, Ca, K, Cl and $SO_4$, the ratio of the concentration divided by TDS (hereafter called the TDS ratio) is used in Table 3, rather than the concentration. This is because the chemistries of these ions are commonly controlled by salinization effects and therefore better understood by using the TDS ratio. Additional information may also be obtained from concentration vs. TDS plots (Figures A2.1 - A2.60). Golden Delicious is close to Lake Carey and groundwaters are therefore more saline (up to 16% TDS) than the other central Yilgarn sites. The southern Yilgarn groundwaters, and to a lesser degree, the central Yilgarn groundwaters, have very similar ion proportions to sea water, suggesting a marine origin, either from an earlier marine transgression, or due to oceanic salt originating from aerosols and being concentrated by evaporation. The northern groundwaters are markedly different from sea water. At Golden Delicious, some ion ratios differ from those in sea water: groundwaters are relatively enriched in Na and $SO_4$, and depleted in K, Mg and Cl. These major ion ratios match those at Granny Smith, suggesting that groundwaters in this region have some particular characteristics.

Table 3: Averaged pH, salinity and major element hydrogeochemistry at Golden Delicious and other Western Australian sites.

| | Golden Delicious | Granny Smith | Mt Gibson | Boags | Northern | Kalgoorlie | Mulga Rock | Sea Water |
|---|---|---|---|---|---|---|---|---|
| pH | 7.0 ± 0.2 | 7.3 | 6.5 | 6.6 | 7.1 | 4.9 | 6.1 | |
| Eh (mV) | 260 ± 80 | 250 | 310 | 160 | 280 | 440 | 130 | |
| TDS (%) | 6.4 ± 3.0 | 1.3 | 2.4 | 2.1 | 0.07 | 8.1 | 3.3 | 3.5 |
| Na/TDS | 0.352 ± 0.010 | 0.325 | 0.320 | 0.249 | 0.187 | 0.310 | 0.299 | 0.307 |
| Mg/TDS | 0.024 ± 0.001 | 0.024 | 0.033 | 0.052 | 0.065 | 0.040 | 0.033 | 0.037 |
| Ca/TDS | 0.011 ± 0.003 | 0.024 | 0.009 | 0.031 | 0.099 | 0.008 | 0.020 | 0.012 |
| K/TDS | 0.005 ± 0.001 | 0.010 | 0.011 | 0.009 | 0.038 | 0.002 | 0.009 | 0.011 |
| Cl/TDS | 0.520 ± 0.011 | 0.464 | 0.531 | 0.469 | 0.286 | 0.571 | 0.528 | 0.552 |
| $SO_4$/TDS | 0.085 ± 0.006 | 0.128 | 0.074 | 0.172 | 0.150 | 0.068 | 0.102 | 0.077 |
| $HCO_3$ | 140 ± 50 | 190 | 260 | 620 | 90 | 80 | 190 | 140 |
| Sr | 6.7 ± 1.4 | 1.8 | 2.4 | 5.9 | 0.3 | 7 | 6 | 7.9 |
| Ba | 0.03 ± 0.04 | 0.031 | 0.06 | 0.01 | 0.07 | 0.05 | 0.04 | 0.013 |
| Al | 0.009 ± 0.014 | 0.009 | 0.3 | <0.01 | 0.009 | 14 | 0.2 | 0.002 |
| Si | 22 ± 7 | 17 | 30 | 7 | 21 | 12 | 9 | 2.2 |
| Mn | 2 ± 4 | 0.4 | 1 | 0.03 | 0.2 | 5 | 0.8 | 0.0002 |
| Fe | 0.4 ± 1.0 | 0.4 | 3 | 0.07 | 0.04 | 4 | 12 | 0.002 |

All concentrations in mg/L unless otherwise stated

The specific characteristics of the Golden Delicious groundwaters are demonstrated by a plot of pH vs. TDS (Figure 9), which shows them to be both highly saline and of neutral pH. This strongly affects the concentration of various minor elements, including Au, as discussed below (Section 5.5).

The potential for dissolution or precipitation of minerals such as gypsum from the Golden Delicious groundwaters is tested by speciation analysis (Section 2.3). The range, mean and standard deviation of the SI values of the water samples for a number of relevant solid phases are given in Table 4, with SI values plotted in Appendix 3. As discussed in detail in Section 2.3, in general a SI of zero indicates the solution is saturated with respect to that mineral, a SI less than zero indicates under-saturation and a SI greater than zero indicates the solution is over-saturated.

The groundwaters at Golden Delicious have salinities up to half that required for halite saturation (Figure A3.1), but several major elements appear to be controlled by equilibration with other specific minerals in some or all of the groundwaters, namely:

Mg: sepiolite (Figure A3.11), dolomite and/or magnesite (Figures A3.6 and A3.7);
Ca: gypsum and/or calcite (Figures (A3.2 and A3.5);
Sr: celestine (Figure A3.3);
Ba: barite (Figure A3.4);
Si: amorphous silica (Figure A3.8) and/or sepiolite;
Fe: ferrihydrite (Figure A3.14);
Mn: rhodochrosite (Figure A3.15) (possibly).

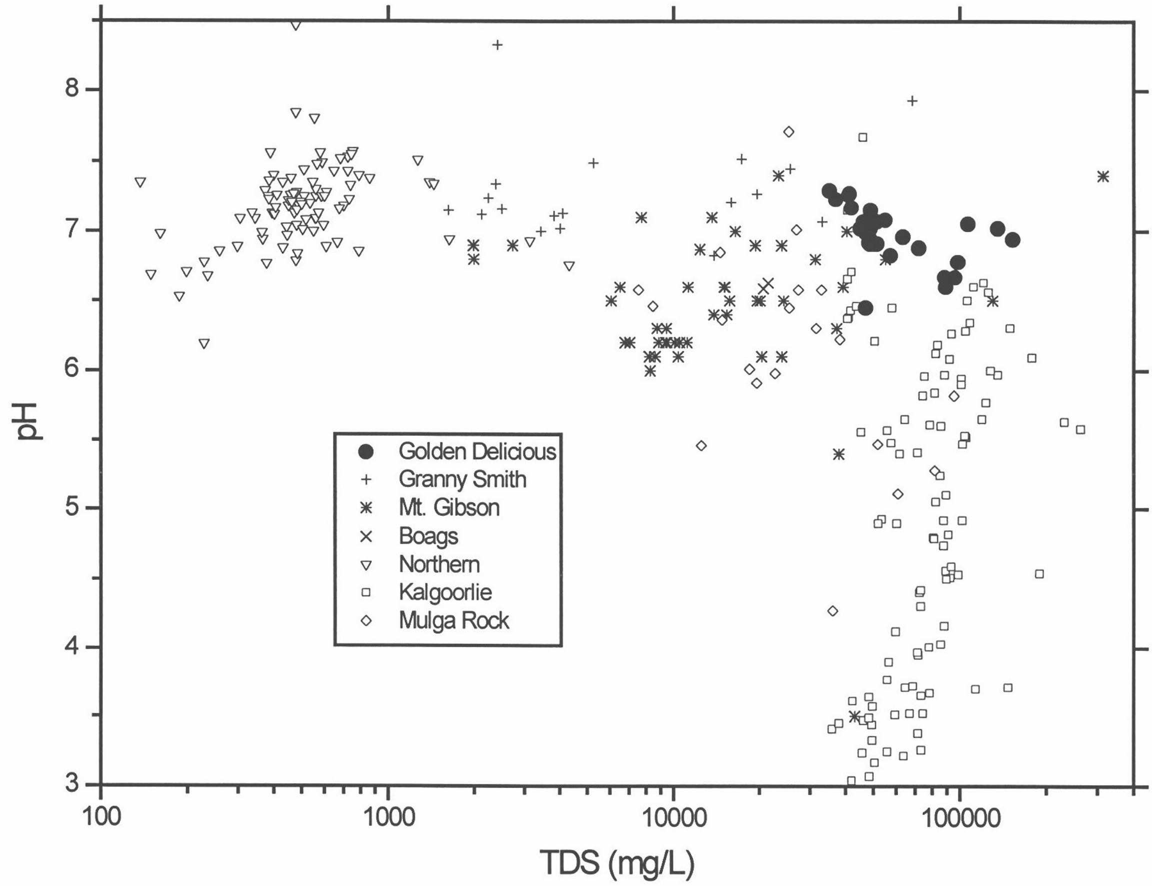


Figure 9: pH vs. TDS for groundwaters from Golden Delicious and other sites.

Concentrations for these elements (with the exception of Mn, for which groundwaters show a large SI range from highly unsaturated to saturated) are therefore fundamentally controlled by salinity and pH effects and are unlikely to show any effects from rock type or presence of mineralization.

Table 4: SI values for the Golden Delicious groundwaters for a number of relevant solid phases

| Mineral | Formula | Lower | Upper | Mean | Standard Deviation |
|---|---|---|---|---|---|
| Halite | $NaCl$ | -2.5 | -1.1 | -2.0 | 0.4 |
| Gypsum | $CaSO_4.2H_2O$ | -0.6 | -0.3 | -0.4 | 0.1 |
| Celestine | $SrSO_4$ | -1.1 | -0.6 | -0.8 | 0.1 |
| Barite | $BaSO_4$ | -0.9 | 0.6 | -0.4 | 0.4 |
| Calcite | $CaCO_3$ | -1.4 | -0.1 | -0.5 | 0.3 |
| Dolomite | $CaMg(CO_3)_2$ | -1.9 | 0.9 | 0.0 | 0.6 |
| Magnesite | $MgCO_3$ | -1.4 | 0.2 | -0.4 | 0.3 |
| Quartz | $SiO_2$ | 0.7 | 1.1 | 1.0 | 1.4 |
| Amorphous Silica | " | -0.6 | -0.2 | -0.3 | 0.1 |
| Gibbsite | $Al(OH)_3$ | 0.3 | 1.7 | 0.8 | 2.7 |
| Amorphous Alumina | " | -2.0 | -0.6 | -1.5 | 0.4 |
| Kaolinite | $Al_2Si_2O_5(OH)_4$ | 3.0 | 6.4 | 4.4 | 0.9 |
| Sepiolite | $Mg_2Si_3O_{7.5}(OH).3H_2O$ | -2.5 | 0.8 | -0.4 | 0.7 |
| Siderite | $FeCO_3$ | -3.2 | -0.6 | -1.4 | 1.0 |
| Goethite | $FeOOH$ | 4.9 | 6.3 | 5.8 | 5.5 |
| Ferrihydrite | $Fe_2O_3.nH_2O$ | -0.1 | 1.3 | 0.8 | 0.5 |
| Rhodochrosite | $MnCO_3$ | -3.3 | 0.4 | -1.5 | 1.0 |
| Tenorite | $Cu(OH)_2.H_2O$ | -7.0 | -2.5 | -4.1 | 1.9 |
| Smithsonite | $ZnCO_3$ | -4.3 | -3.0 | -3.9 | 0.4 |
| Cerussite | $PbCO_3$ | -4.0 | -1.6 | -2.4 | 0.6 |
| Sphaerocobaltite | $CoCO_3$ | -4.6 | -2.6 | -3.8 | 0.6 |
| Eskolaite | $Cr_2O_3$ | 6.2 | 6.9 | 6.5 | 0.3 |
| Au Metal | $Au$ | 1.9 | 5.9 | 3.5 | 1.0 |
| Iodyrite | $AgI$ | -1.8 | -1.2 | -1.4 | 0.2 |
| $Sb(OH)_3$ | $Sb(OH)_3$ | -1.2 | -0.1 | -0.8 | 0.5 |
| Bismoclite | $BiOCl$ | -1.0 | 0.8 | -0.3 | 0.6 |
| Sodium-autinite | $Na_2(UO_2)_2(PO_4)_2$ | -6.3 | -1.7 | -4.5 | 1.5 |
|  | $CaMoO_4$ | -2.7 | -0.2 | -1.9 | 0.7 |
|  | $FeWO_4$ | -3.8 | -2.3 | -2.9 | 0.7 |
| Monazite | $LaPO_4$ | -0.3 | 0.7 | 0.3 | 0.4 |
| " | $CePO_4$ | -0.4 | 0.3 | 0.0 | 0.3 |
| " | $NdPO_4$ | -0.5 | 0.2 | -0.2 | 0.2 |
| " | $GdPO_4$ | 0.2 | 0.3 | 0.2 | 0.0 |

## 5.5 MINOR ELEMENT HYDROGEOCHEMISTRY

In general, the concentrations of the minor elements (Table 5) are as expected for a saline/neutral environment. Elements such as B, which are commonly correlated with salinity, have relatively high concentrations, whereas base metals and REE have low dissolved concentrations, in comparison with the very high contents in the acidic Kalgoorlie groundwaters. This effect must be considered if comparing results for groundwaters from different regions.

Table 5: Averaged minor element compositions of groundwater at Golden Delicious and other Western Australian sites.

| | Golden Delicious | Granny Smith | Mt Gibson | Boags | Northern | Kalgoorlie | Mulga Rock | Sea Water |
|---|---|---|---|---|---|---|---|---|
| Li | 0.04 ± 0.08 | nd | 0.06 | nd | <0.005 | 1.0 | nd | 0.18 |
| Be | <0.005 | nd | nd | nd | <0.002 | 0.006 | nd | 0.0000056 |
| B | 4.3 ± 0.7 | nd | nd | nd | 0.6 | 5.1 | | 4.44 |
| P | 0.020 ± 0.013 | 0.013 | nd | nd | 0.03 | 0.016 | 0.8 | 0.06 |
| Sc | 0.017 ± 0.004 | <0.001 | 0.01 | <0.001 | 0.010 | 0.021 | <0.001 | 0.0000006 |
| Ti | 0.002 ± 0.001 | <0.002 | nd | nd | 0.001 | <0.005 | nd | 0.001 |
| V | <0.005 | nd | nd | <0.002 | 0.008 | <0.005 | <0.002 | 0.0025 |
| Cr | 0.005 ± 0.008 | <0.005 | 0.004 | 0.002 | 0.03 | <0.005 | 0.006 | 0.0003 |
| Co | 0.009 ± 0.012 | 0.02 | 0.01 | <0.002 | 0.01 | 0.21 | 0.007 | 0.00002 |
| Ni | <0.01 | 0.03 | 0.01 | <0.01 | 0.005 | 0.3 | 0.027 | 0.00056 |
| Cu | 0.006 ± 0.005 | 0.02 | 0.01 | 0.01 | 0.003 | 0.08 | 0.03 | 0.00025 |
| Zn | 0.012 ± 0.013 | 0.07 | 0.06 | 0.02 | 0.010 | 0 | 0.07 | 0.0049 |
| Ga | <0.005 | 0.0012 | nd | nd | 0.004 | 0.012 | nd | 0.00003 |
| Ge | <0.005 | nd | nd | nd | <0.0005 | 0.019 | nd | 0.00005 |
| As | 0.15 ± 0.08 | 0.04 | nd | 0.11 | 0.01 | <0.02 | <0.02 | 0.0037 |
| Rb | 0.055 ± 0.013 | nd | nd | nd | 0.03 | 0.038 | nd | 0.12 |
| Y | <0.001 | 0.0002 | nd | nd | <0.0002 | 0.25 | 0.004 | 0.000013 |
| Zr | 0.003 ± 0.008 | | nd | nd | <0.001 | <0.001 | nd | 0.00003 |
| Mo | 0.009 ± 0.010 | 0.027 | nd | nd | 0.0018 | <0.01 | nd | 0.01 |
| Ag | <0.001 | 0.0002 | nd | nd | <0.001 | 0.002 | nd | 0.00004 |
| Cd | <0.002 | 0.001 | nd | 0.009 | <0.002 | <0.003 | 0.001 | 0.00011 |
| Sn | 0.009 ± 0.031 | 0.0006 | nd | nd | <0.0002 | 0.003 | <0.0001 | 0.000004 |
| Sb | 0.001 ± 0.003 | 0.004 | nd | 0.2 | 0.0002 | <0.001 | 0.0004 | 0.00024 |
| I | 8.1 ± 2.9 | 2.5 | nd | nd | 0.32 | 6.5 | nd | 0.06 |
| Cs | 0.002 ± 0.003 | 0.003 | nd | nd | 0.0002 | 0.009 | 0.011 | 0.0003 |
| La | <0.001 | 0.0002 | nd | nd | <0.0002 | 0.3 | 0.0013 | 0.0000034 |
| Ce | <0.001 | 0.0008 | nd | nd | <0.0003 | 0.6 | 0.004 | 0.0000012 |
| Pr | <0.001 | 0.0002 | nd | nd | <0.0004 | 0.07 | 0.0005 | 0.0000006 |
| Nd | <0.001 | 0.0004 | nd | nd | <0.0005 | 0.2 | 0.0023 | 0.0000028 |
| Sm | <0.001 | 0.0001 | nd | nd | <0.0006 | 0.04 | 0.0010 | 0.0000005 |
| Eu | <0.001 | 0.0000 | nd | nd | <0.0007 | 0.011 | 0.0005 | 0.0000001 |
| Gd | <0.001 | 0.0001 | nd | nd | <0.0008 | 0.04 | 0.0010 | 0.0000007 |
| Tb | <0.001 | 0.0001 | nd | nd | <0.0009 | 0.006 | 0.0002 | 0.0000001 |
| Dy | <0.001 | 0.0001 | nd | nd | <0.0010 | 0.03 | 0.0006 | 0.0000009 |
| Ho | <0.001 | 0.0001 | nd | nd | <0.0011 | 0.005 | 0.0003 | 0.0000002 |
| Er | <0.001 | <0.0001 | nd | nd | <0.0012 | 0.014 | 0.0005 | 0.0000009 |
| Tm | <0.001 | <0.0001 | nd | nd | <0.0013 | 0.002 | 0.0002 | 0.0000002 |
| Yb | <0.001 | <0.0001 | nd | nd | <0.0014 | 0.010 | 0.0005 | 0.0000008 |
| W | 0.002 ± 0.003 | 0.0005 | nd | nd | 0.0006 | 0.015 | nd | 0.0001 |
| Au (μg/L) | 0.04 ± 0.05 | 0.015 | 0.13 | 0.5 | 0.006 | 0.2 | 0.004 | 0.004 |
| Hg | <0.001 | 0.0003 | nd | nd | 0.0001 | 0.005 | 0.0003 | 0.00003 |
| Tl | 0.005 ± 0.011 | 0.0002 | nd | nd | <0.0002 | <0.002 | 0.0004 | 0.000019 |
| Pb | 0.005 ± 0.007 | 0.009 | 0.13 | 0.008 | 0.001 | 0.2 | 0.014 | 0.00003 |
| Bi | 0.006 ± 0.008 | 0.0001 | nd | <0.002 | <0.0002 | <0.002 | <0.002 | 0.00002 |
| Th | <0.001 | 0.0001 | nd | nd | <0.0002 | <0.002 | 0.0004 | 0.000001 |
| U | 0.002 ± 0.001 | 0.009 | nd | <0.002 | 0.0007 | 0.02 | 0.008 | 0.0032 |

nd: not determined. All concentrations in mg/L unless otherwise stated.

Most of the minor elements are highly undersaturated with respect to their least soluble secondary mineral phase (Table 4), with the following exceptions:

REE: monazite (Figures A3.29 and A3.30);
Sb: $Sb(OH)_3$ (Figure A3.24);
Bi: bismoclite (Figure A3.25);
Mo: $CaMoO_4$ (Figure A3.27)

Therefore, observed variations in minor element concentrations in groundwater may well represent effects of release from weathering minerals, and groundwater distributions (Appendices 4 and 5) may well relate to lithological changes, or differing chemistry of mineralized zones.

## 5.6 GOLD HYDROGEOCHEMISTRY

Previous observations suggest that significant Au will dissolve either as the halide (chloride or iodide) complex, under acid, saline and oxidising conditions, or as the thiosulphate complex at the weathering interface, where sufficient carbonate is present to buffer sulphide oxidation (Gray, 1988). The Golden Delicious groundwater samples are shallow (commonly about 15 m below surface), saline (to highly saline at depth), and several tens of metres above the weathering front. The more likely mechanism is weak dissolution as Au halide. Compiled data for dissolved Au in groundwaters from the Yilgarn Craton (Figure 10) indicate that the concentrations at Golden Delicious are low to moderate (0.2 ppb). This range is similar to other groundwaters from the central Yilgarn, and contrasts with those in the north, which commonly have very low dissolved Au (< 0.04 ppb), and those in the Kalgoorlie region, which are highly variable, but can contain up to 4 ppb dissolved Au.

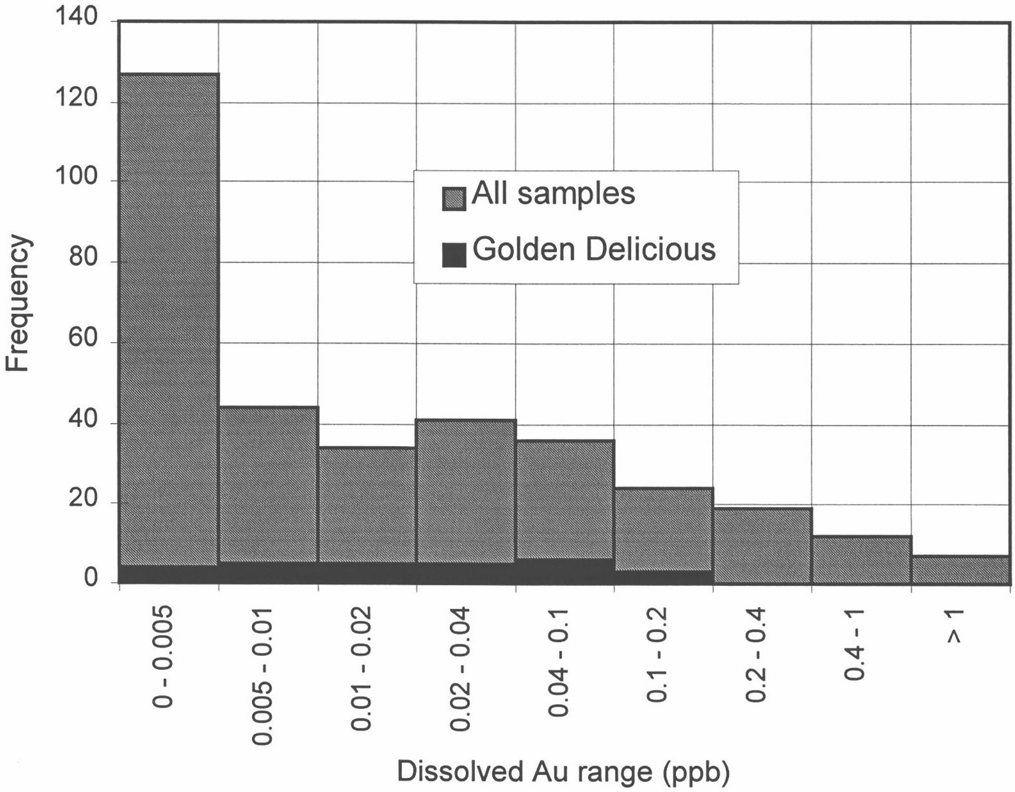


Figure 10: Distribution of dissolved Au concentrations at Golden Delicious, and throughout the Yilgarn and immediate margins.

This moderate dissolved Au content indicates that over the timescale of regolith modification under arid conditions, significant concentrations of Au could be redistributed in a more-or-less regular manner, leading to the patterns of depletion and supergene enrichment and secondary dispersion.

The distribution of Au in groundwaters strongly reflects the presence of mineralization at this site (Figure 11), even where only the shallow groundwaters are used, indicating that hydrogeochemistry could be an effective exploration procedure.

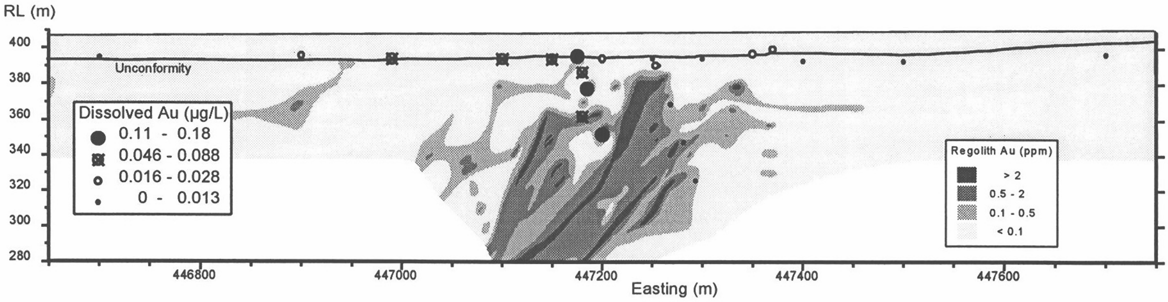


Figure 11: Dissolved Au distribution at Golden Delicious 6790200N (dots), superimposed on Au distribution in the regolith.

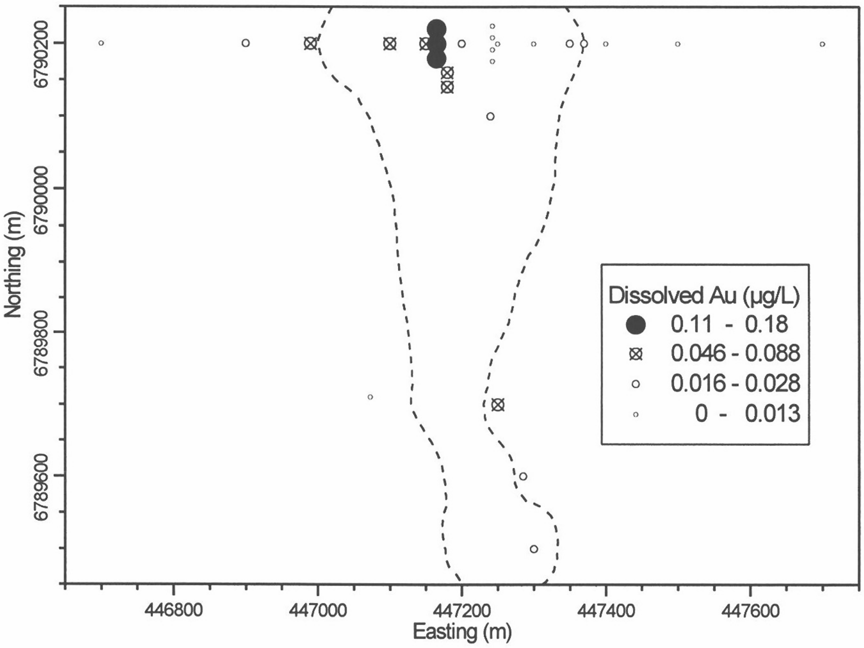


Figure 12: Dissolved Au distribution at Golden Delicious (dots), superimposed on the interpreted projection of the mineralized zone (Acacia, 1994).

## 5.7 INDICATOR ELEMENT HYDROGEOCHEMISTRY

Chalcophile elements that are enriched in *neutral* groundwaters in direct contact with weathering sulphides (*e.g.*, As, Mo, Ag, Sb, W, Tl and Bi: Figures A2.43, A2.46,A2.47, A2.50, A2.53, A2.56 and A2.58) have moderate to high concentrations in the Golden Delicious groundwaters, suggesting that *regional* groundwater sampling might well be effective at locating a deposit with similar characteristics. Iodine, which may also show chalcophile characteristics (Gray, 1990a and references given within), has a high concentration in these groundwaters (Figure A2.28), as also observed in other mineralized sites in the Yilgarn Craton. This may have particular significance for Au mobility, because thermodynamic calculations indicate that Au will be present as the iodide rather than the chloride complex. SI calculations, groundwater (Gray, 1994) and sorption studies (Gray, 1990b and Gray, work in progress ) suggest that Au iodide will have a higher mobility in the natural environment than other Au complexes commonly found in groundwaters.

As well as Au, dissolved elements that appear to correlate with mineralization at the *deposit* scale are I (Figures A4.15 and A4.62) and, possibly Mo (Figures A4.30 and A4.78), Tl (Figures A4.36 and A4.83), Pb (Figures A4.37 and A4.84), Bi (Figures A4.38 and A4.85) and U (Figures A4.40 and A4.86). This suite of elements is similar to multi-element responses observed in other, neutral, groundwaters in contact with Au-rich rock and regolith.

## 5.8 LITHOLOGICAL EFFECTS ON GROUNDWATER COMPOSITION

There appears to be a change in the concentration of Au in groundwater at about 447200E (Figure 11 and Figure 12), correlating with the western extent of the granite intrusion. This possible lithological change appears to be reflected in a number of the groundwater parameters: in particular, the eastern, granitic, part of this section shows a strong enrichment in Na (relative to salinity; Figure 13), moderate enrichments in P, Sc and Sn, and possible enrichments in Mn and Cu. In contrast, the western part of the section has higher Eh and dissolved As. Such lithological effects on groundwater compositions are common (Butt *et al.*, 1993).

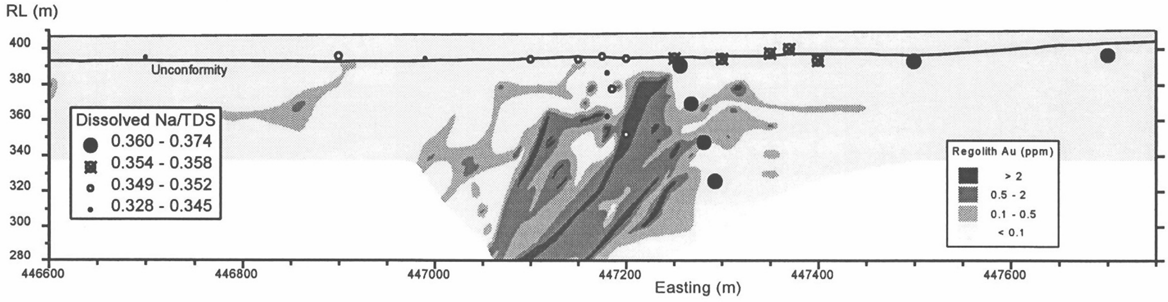


Figure 13 - Groundwater Na/TDS distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

Chromium is commonly enriched in groundwaters contacting ultramafic rocks, both in acidic (Gray, 1990a) and neutral (Gray, 1992b; Gray, 1995) environments. Two samples from the southern part of the study area have dissolved Cr concentrations above 0.02 mg/L (Figure 14), suggesting the presence of ultramafic rocks.

# 6. REGOLITH GEOCHEMISTRY

## 6.1 INTRODUCTION

The distribution of elements analysed in drill samples on section 6790200 mN are shown in Appendix 7, compared with Au distributions obtained from pre-existing drilling data. The intervals for the symbol plots were selected on the basis of the principal populations evident in the log probability distributions. The raw data are tabulated in Appendix 5. Summary statistics are given and significant associations with each element are represented by scatterplots, classified according to regolith units.

The solubilities of several elements in samples of weathered Archaean was determined to examine the possibility of depletion in these materials.

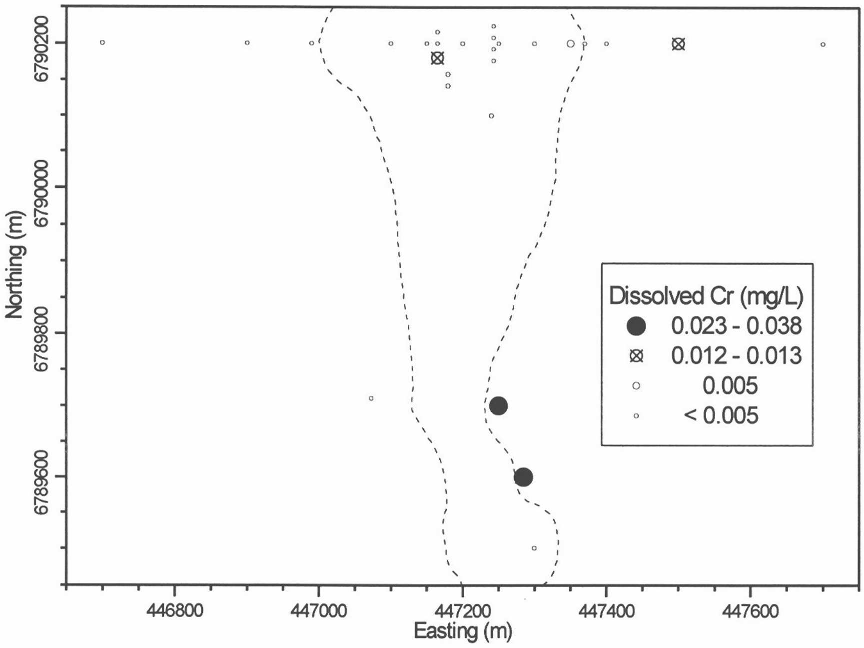


Figure 14: Dissolved Cr distribution at Golden Delicious (dots), superimposed on the interpreted projection of the mineralized zone (Acacia, 1994).

## 6.2 GOLD DISTRIBUTION

*Gold in transported overburden*

The most significant feature of the Au distribution in the transported material is the widespread anomaly in the basal ferruginous gravels (Figure 15). Concentrations up to 105 ppb are distributed 400 m across strike of the mineralisation, offset slightly downslope. Sampling from these few metres provides the greatest target enlargement of any sample medium tested at this site. Shallower sediments generally have much lower Au contents (<5 - 12 ppb) and sampling to the east of the displayed section (at 447800 mE, 447900 mE, 448000 mE) suggests this is the general background, indicating only that the sediments are derived from a Au-bearing province.

*Gold in weathered Archaean*

Gold occurs in fairly low (though anomalous) concentrations in the upper few metres of the ferruginous mottled zone. Concentrations of 12 - 80 ppb are distributed 300 m across strike of the mineralisation and appear not to be offset, at least within the plane of this section. Below the upper few metres, concentrations decline or remain constant, and increase towards the lower part of the mottled zone. This observation is supported by extensive drilling that indicates that the Au concentration throughout the mineralised zone decrease sharply above 25 - 30 m depth, which approximates to the basal section of the mottling within the mineralised zone. As will be described below, this apparent depletion may represent the primary Au distribution rather than weathering effects.

## 6.3 DISTRIBUTION OF OTHER ELEMENTS IN THE REGOLITH

### 6.3.1 Elements associated with Au mineralisation: W, Sb, (As)

*Tungsten*

The distribution of W in the saprolite is very similar to that of Au, but there is no detectable W in the transported overburden (Figure 16). Tungsten concentrations are high in the primary mineralisation (up to 125 ppm), and there is an extreme, though gradational, reduction in W concentration from lower to upper parts of the weathered Archaean, with the uppermost metre of the mottled zone in all but two samples having less than detection (2 ppm).

Tungsten concentrations in the mottled zone are significantly lower than those in the underlying saprolite. If this is due to W depletion, then the W would have had to have been almost completely dissolved and removed from the system. The known chemistry of W minerals and solubility experiments performed on samples of the saprolite and mottled zone (Section 6.5) suggest this is highly unlikely. Accordingly, it is concluded that the distribution of W reflects its original distribution in the primary mineralisation prior to weathering.

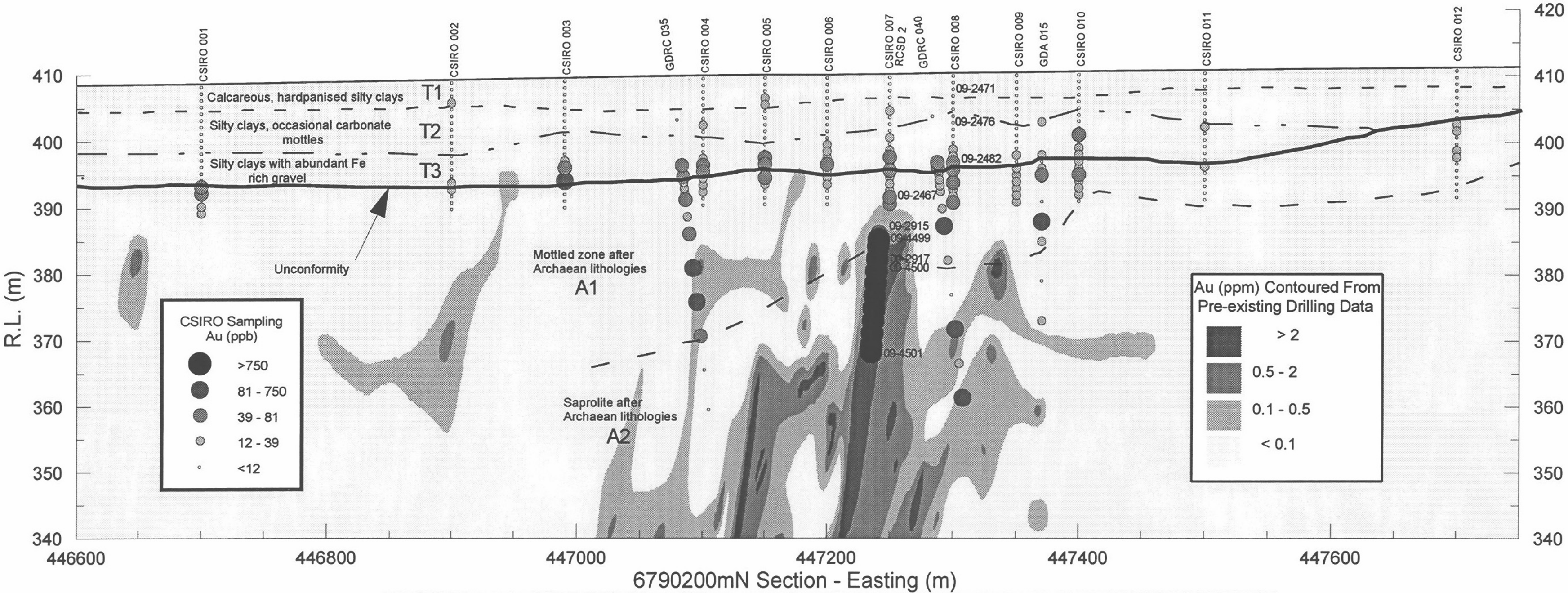
*Antimony and arsenic*

Antimony and As are commonly closely associated with each other, and this is generally the case at Golden Delicious. Both As and Sb have a strong relationship with Fe in the transported overburden, and give a broad anomaly in the basal gravels of the transported overburden (Sb, maximum 4.5 ppm; As, maximum 41 ppm), spatially associated with Au mineralisation at depth (Figure 17 and Figure 18). This is considered co-incidental and due to the strong association of both elements with Fe in the ferruginous gravels. When they normalised to Fe, they show no spatial association with mineralisation in the transported overburden (Figure A7.2 and Figure A7.23).

Concentrations of Sb in the mineralisation are low (maximum 7.8 ppm), and would not normally be considered anomalous (Figure 17). However, despite the association with Fe in the transported overburden, Sb is relatively enriched in the residual regolith, particularly the mineralisation, shown by a broad anomaly in the Fe normalised data, and a correlation between Sb/Fe and Au (Figure A7.23). In contrast, As does not show a similar trend, with no relative or actual enrichment in the mineralisation and only a very slight elevation in the As/Fe ratio associated with the mottled zone (Figure A7.2). The difference in the relationship between As and Sb is highlighted by the bimodal distribution in the Sb vs As scatterplot, and the spatial distribution of Sb/As values (Figure 19). The significance of this bimodal distribution will be discussed with other related issues in Section 7.

### 6.3.2 Major elements: Fe

Iron in the transported material is present principally as goethite, haematite and maghemite, (Section 4) and most variations reflect those in the distribution and occurrence of ferruginous lateritic gravels (Figure 20). Iron in the residual regolith is dominantly haematite in the mottled zone, but tends more goethitic at the base and into the saprolite (Section 4). The concentrations of Fe throughout the entire mottled zone are highly variable and can be attributed to the strong fractionation of Fe in this unit and the distribution and coarse nature of the individual mottles. The more consistent and elevated concentrations in the upper few metres probably reflect more pervasive and intense ferruginisation. The effect of local-scale variations in the Fe content on Au distribution within the mottled zone appears significant and is discussed later in Section 6.4.3. The concentration of Fe significantly affects the distribution of As and Sb (Section 6.3.1).



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Au (ppb) | 292 | 235 | 9 | <5 | 27900 | <5 | 24 | 1780 | 5 |

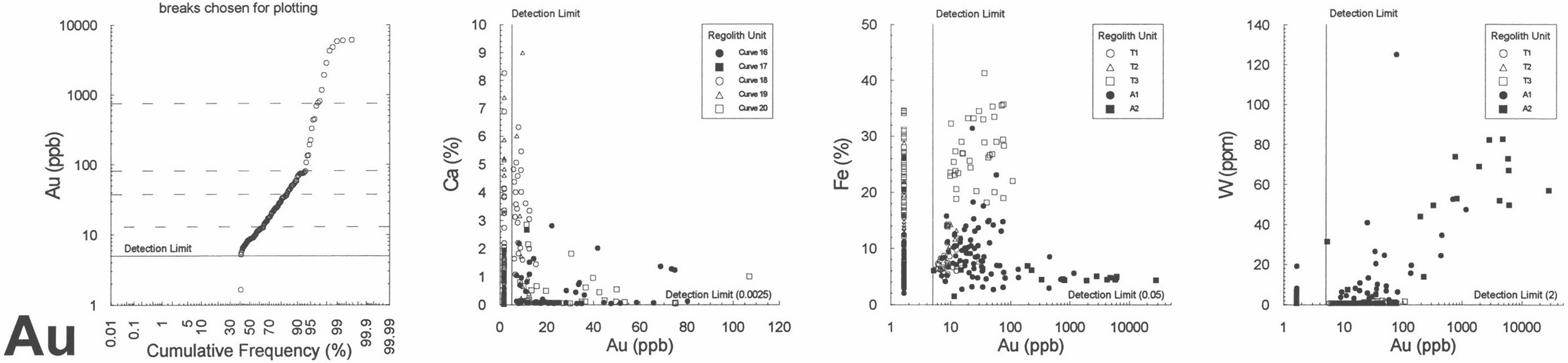
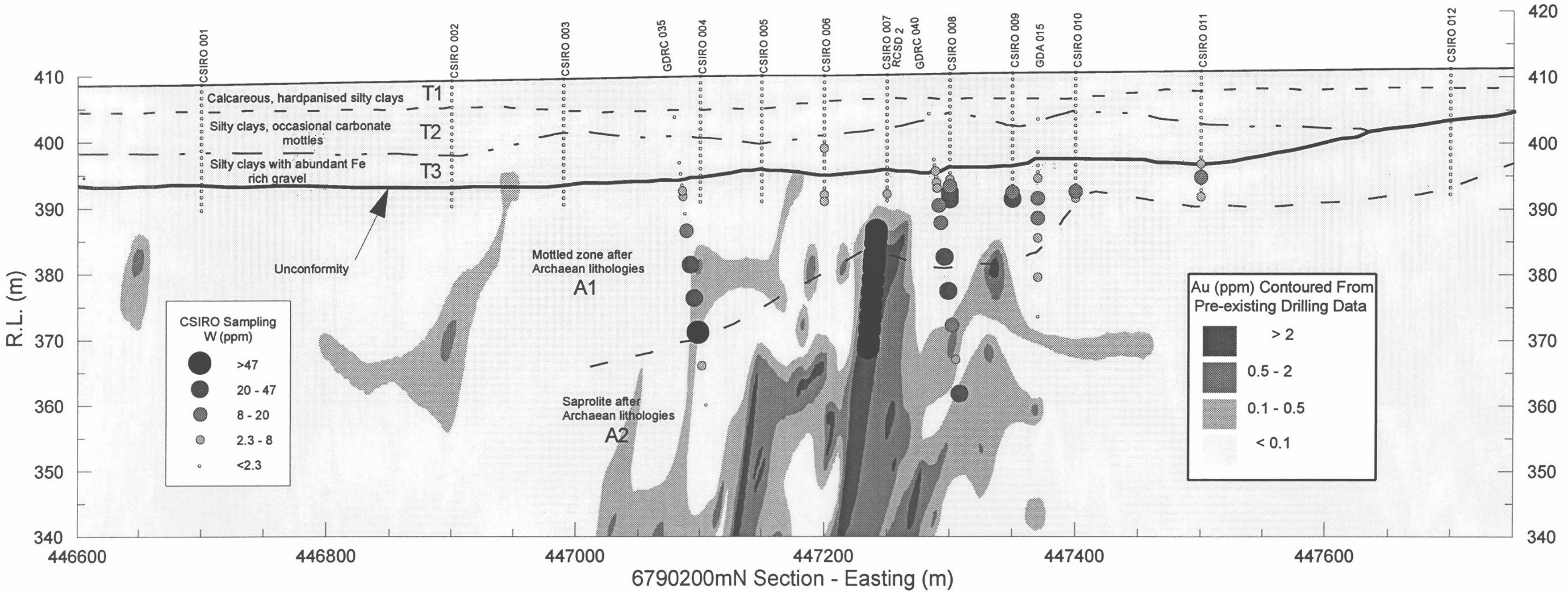
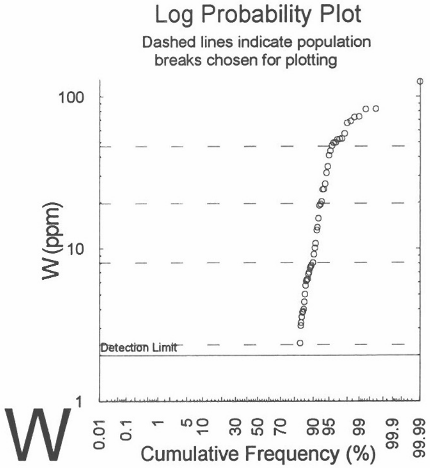


Figure 15: Distribution of Au in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| W (ppm) | 292 | 5.4 | <2 | <2 | 125 | <2 | <2 | 15 | 2 |



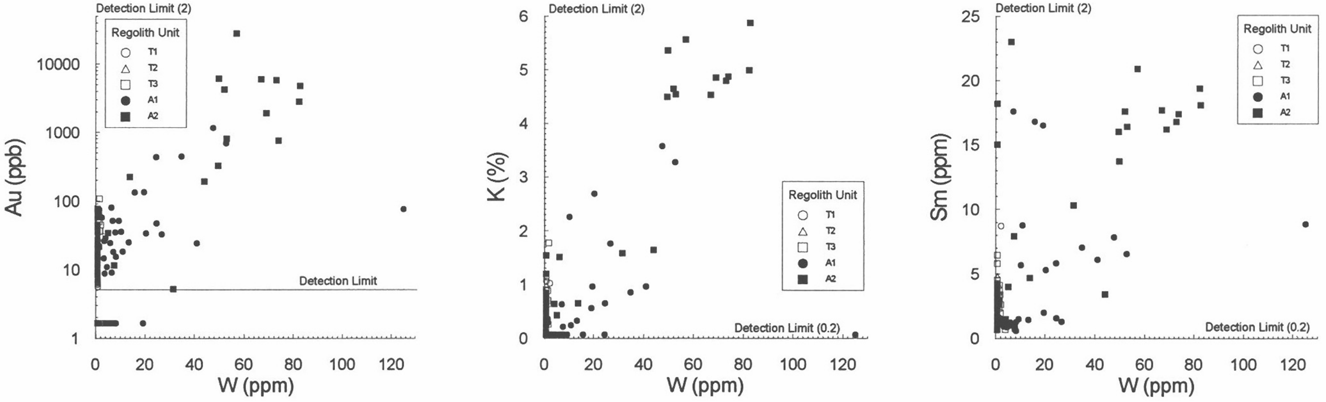
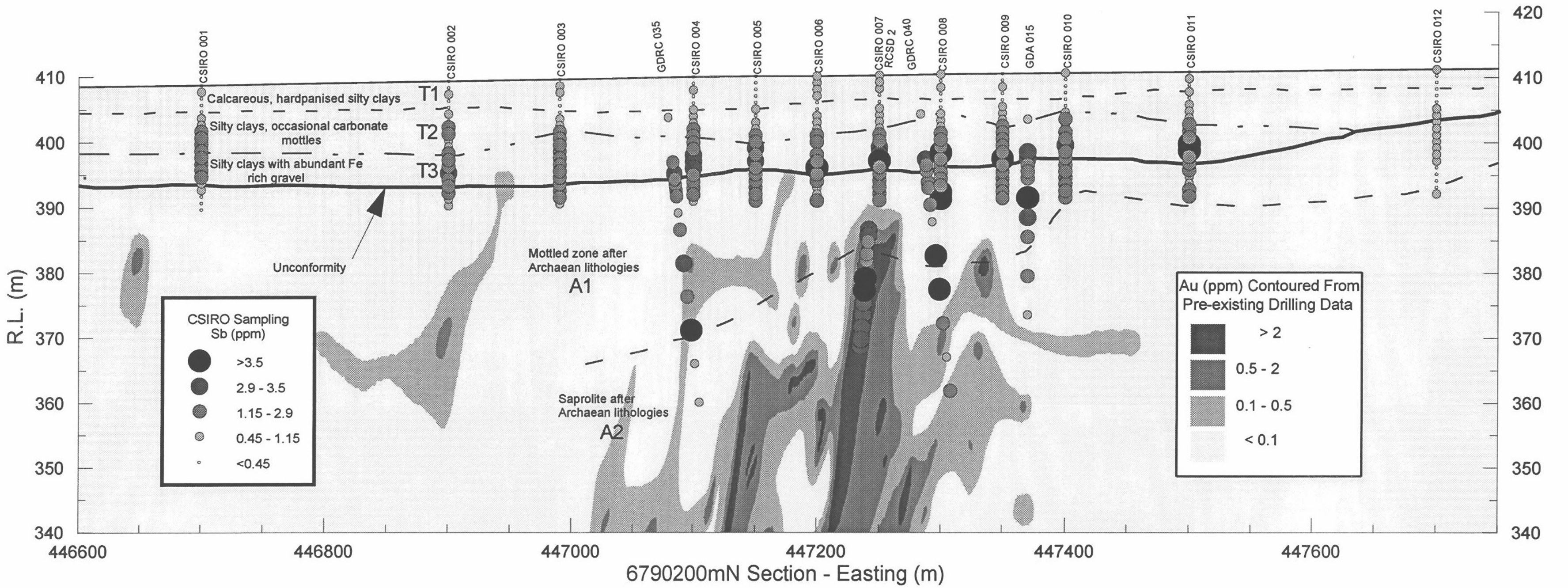
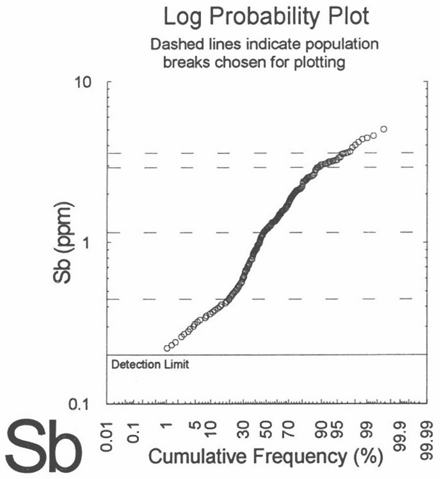


Figure 16: Distribution of W in the regolith and significant associations with other elements.





| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Sb (ppm) | 292 | 1.4 | 1.2 | <0.2 | 7.9 | 0.5 | 2.1 | 1.1 | 0.2 |

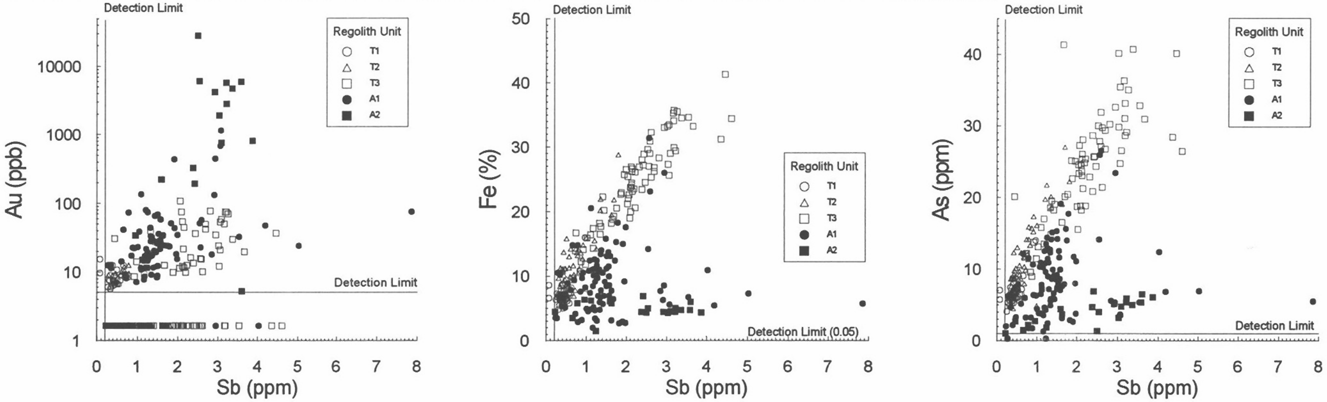
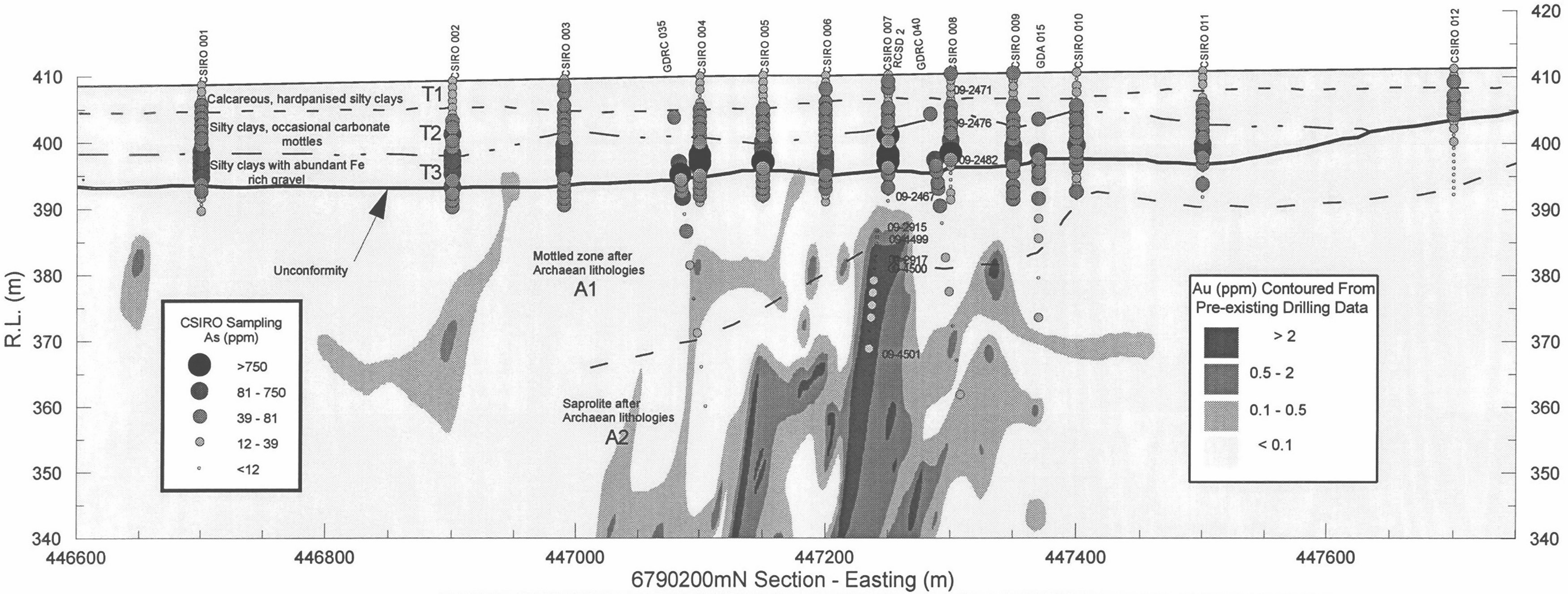
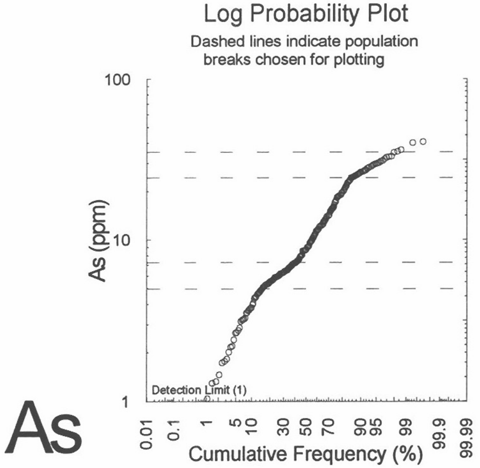


Figure 17: Distribution of Sb in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| As (ppm) | 292 | 12.4 | 9 | <1 | 41 | 6 | 18 | 9 | 1 |



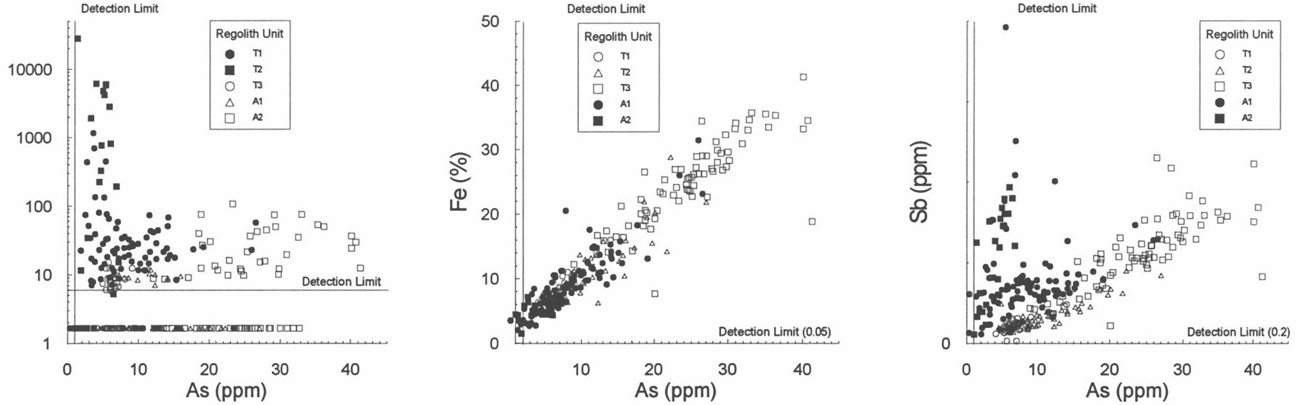


Figure 18: Distribution of As in the regolith and significant associations with other elements.

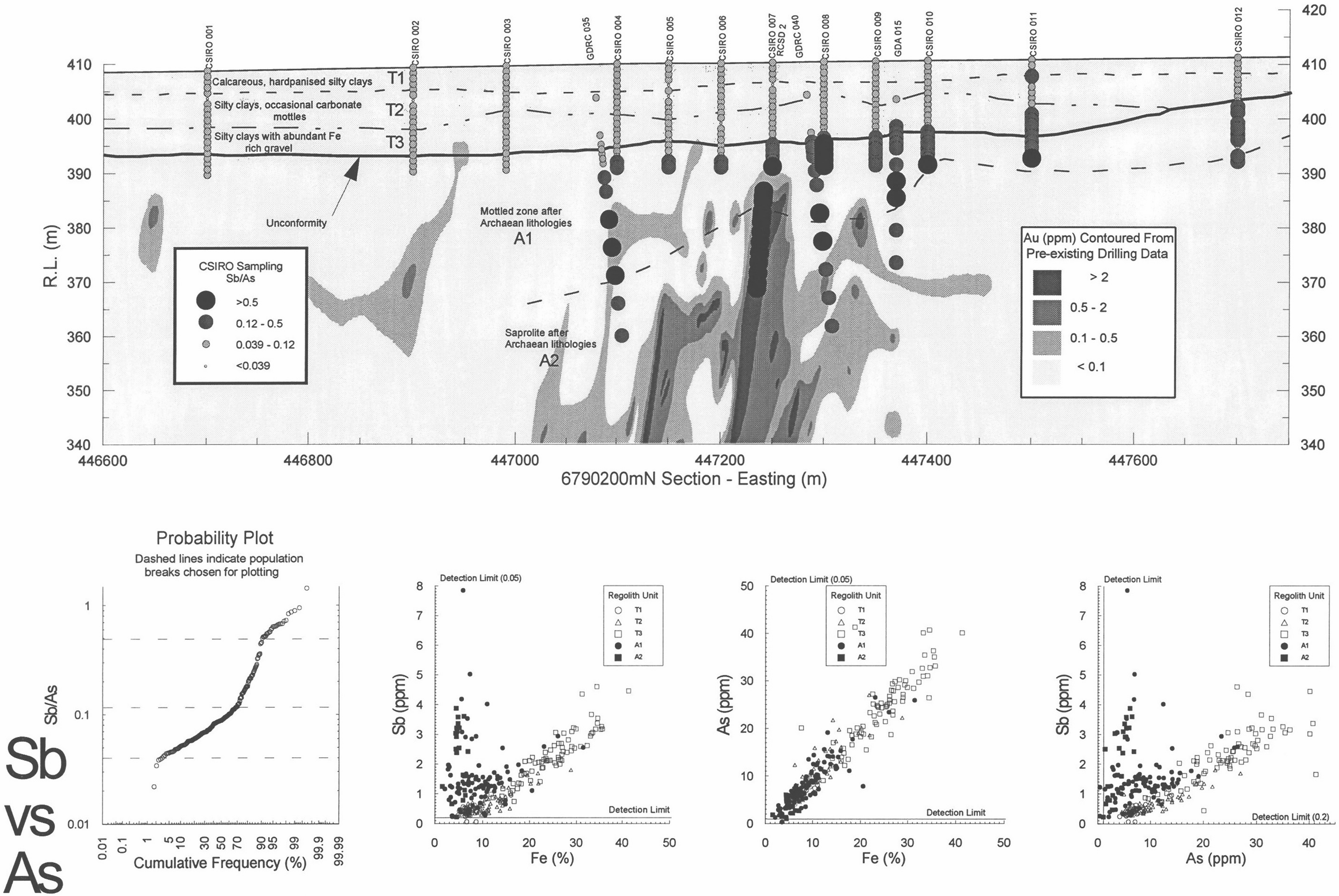
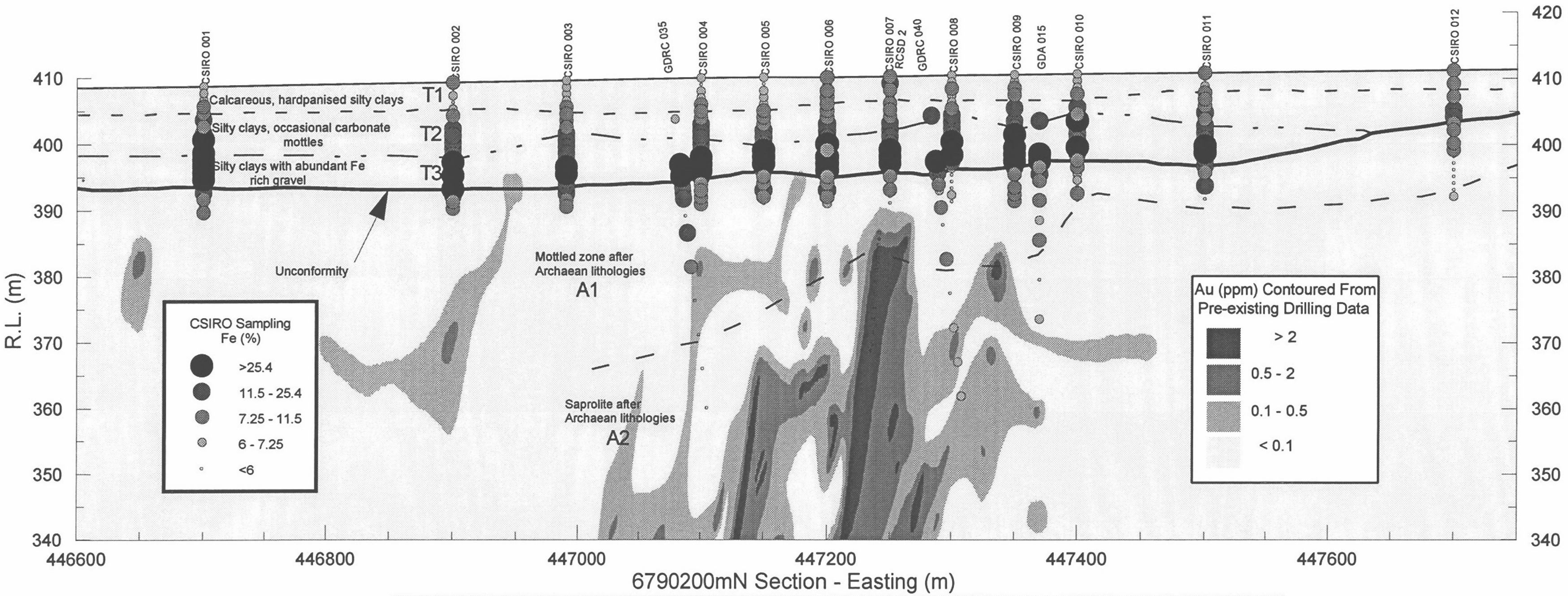
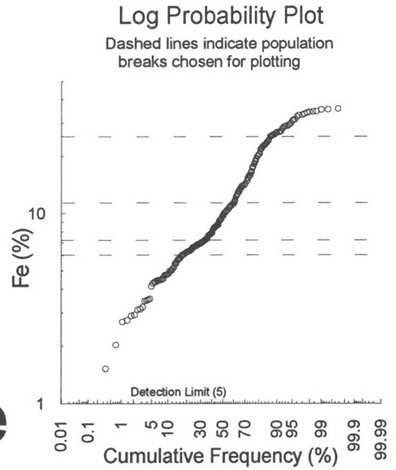


Figure 19: Distribution of Sb/As in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Fe (%) | 292 | 13 | 9.7 | 1.5 | 41.3 | 6.7 | 17.5 | 8.6 | 0.05 |



Fe

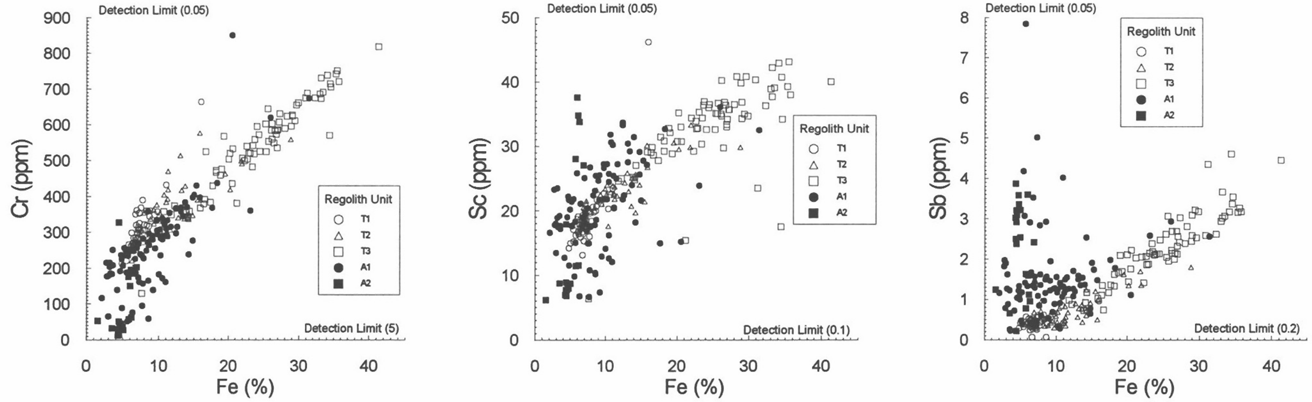


Figure 20: Distribution of Fe in the regolith and significant associations with other elements.

### 6.3.3 Alkaline earth elements: Ca, Mg, Ba

*Calcium and magnesium*

Acid soluble Ca and Mg (Section 2.2.2) mainly indicate the distribution of calcite and dolomite (Figure 21).

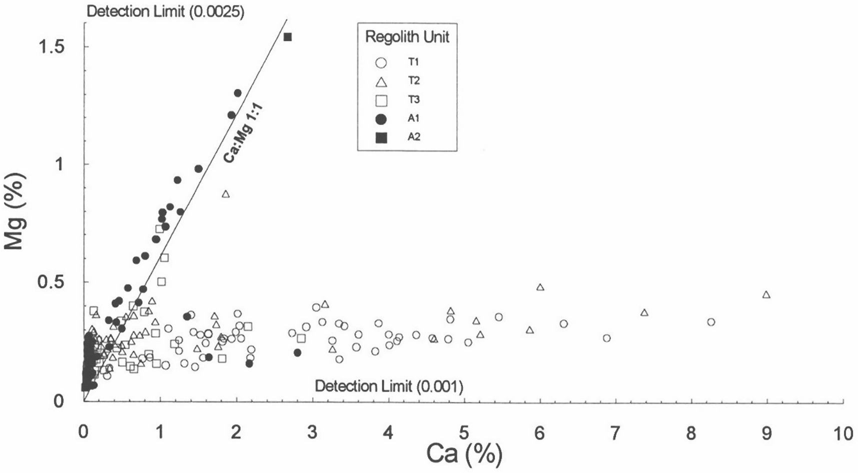


Figure 21: Scatterplot of Ca vs. Mg. The 1:1 molar ratio reflects the occurrence of dolomite.

Calcite is restricted to the upper sedimentary unit (T1) and occurs as laminar precipitations or aggregates associated with near-surface hardpanisation. Both calcite and dolomite are present in the carbonate mottling found in a few parts of unit T2. Carbonates in the mottled zone are largely dolomite (Figure A7.7 and Figure A7.18 show the distributions of Ca and Mg respectively).

In contrast with sites south of the Menzies line, the carbonate in the near-surface (unit T1) at Golden Delicious is not present in its powdery, pervasive form, but as laminar sub-horizontal veins, coatings and mottles. At the detection limits of INAA (5 ppb), there is no apparent association of Au with carbonate, although such a relationship may exist at lower abundance. If not, however, this may suggest the difference in carbonate morphology may assist in the selection of carbonate as a sampling medium for Au exploration. Factors, such as thickness of transported material and depth and chemistry of the groundwater, are probably significant in controlling the Au-carbonate association.

*Barium*

Barium displays a random distribution throughout the transported material (Figure A7.5). It is variably enriched (>1400 ppm) in the saprolite and lower mottled zone, but very low in the upper mottled zone. This possibly suggests depletion by dissolution of barite from this horizon or may reflect inherent primary bedrock variation.

### 6.3.4 Alkali metals: Na, K, Rb, Cs

*Potassium, rubidium and caesium*

The distribution of these elements in the transported overburden appears random, reflecting the poor sorting and diverse provenance of the sediments. They have similar distributions in the residual regolith, despite the imperfect correlation between them (Figure A7.15, Figure A7.20, and Figure A7.11). All have moderate abundances (K > 4%; Rb >135 ppm; Cs >5.7 ppm) in the lower part of the mottled zone and in the saprolite (due to relict microcline and muscovite in the weathered syenite), but decrease by up to an order of magnitude over a few metres into the upper mottled zone, (K <0.35%, Rb <20 ppm, Cs < 1.2 ppm). Potassium, Rb and, to a lesser extent, Cs show some correlation with Au and W in the weathered Archaean, probably due to the association of micas with alteration and Au mineralisation. There is also some association between these elements and the REEs, perhaps suggesting common host minerals (*i.e.* feldspar or mica).

The sharp reduction in concentration of K, Rb and Cs between the saprolite, lower mottled zone and upper mottled zone could be due to destruction of micas and feldspars by extreme weathering. However, for mica this is improbable; primary variation in lithology or alteration assemblage probably have a more significant control over the distribution of these element. This is supported by the persistance of feldspars higher in the profile than mica, co-incident with the appearance of quartz (Section 4).

*Sodium*

The main control on Na distribution in the transported overburden is the depth and salinity of the groundwater. Enrichments of Na (commonly 0.75-0.9%) to approximately 4 to 8 m depth are above the capillary fringe which itself may extend a metre or more above the piezometric head (8 - 11 m depth at the time of drilling). These enrichments obviously above the water-table are probably due to evaporative concentration of dissolved salts, including halite. Above 4 m depth, flushing by meteoric water prevents halite accumulation.

In the lower mottled zone and saprolite, the high Na content of the intrusive rocks (due to albite) has more control over Na distribution. The reduction in Na content in the upper mottled zone (> 2.4% in saprolite compared with < 0.9% in the upper mottled zone) probably results largely from destruction of feldspars, rather than primary variations in mineralogy. Furthermore, given the hypersaline nature of the groundwater, Na concentrations within the saturated zone are affected by the water content. Samples of the upper mottled zone are more clay-rich and would be expected to retain relatively more saline water than samples of the saprolite, thus boosting observed Na concentrations.

### 6.3.5 Halogens: Br

The distribution of Br in the regolith is a function of both water retention and mineralogy (Figure A7.6). The groundwater is shallow (≈8-11 m) and contains appreciable quantities of Br, but Br concentrations in the transported overburden appear random and probably reflect the distribution of Br-rich sediment rather than water content. If water retention was significant in controlling the Br concentration in the overburden, higher concentrations would be expected in samples from below the water-table.

Overall, the Br distribution appears to be a function of clay content and the highest concentrations are found in the most clay rich horizons of the residual regolith (>8 ppm). A similar feature was noted at Mt. Percy (Butt, 1991).

### 6.3.6 Lithophile transition elements: Cr, Sc

Chromium is strongly associated with Fe throughout the regolith whereas Sc only shows this association in the transported overburden (Figure A7.10 and Figure A7.24). The concentrations of Cr in the transported overburden (200-700 ppm) are similar to those found in weathered mafic rocks elsewhere in the Yilgarn (*e.g.* Reedy near Cue, Robertson *et al.*, 1990), supporting the suggested provenance from mafic rocks to the ESE. Both Cr and Sc are present in very low concentrations in the residual regolith except in the upper few metres of the mottled zone, perhaps indicating minor residual concentration.

### 6.3.7 Immobile elements: Hf, Th, Ta

*Hafnium*

Hafnium is commonly hosted in zircon and is residually concentrated by weathering. In the transported overburden the Hf distribution correlates with that of coarser ferruginous gravels (Figure A7.14). Hafnium is enriched approximately twofold in the upper few metres of the mottled zone, suggesting residual concentration.

*Thorium and tantalium*

In the transported overburden, these elements are enriched in the basal ferruginous gravels (Figure A7.27 and Figure A7.26), with good correlation between Hf and Th (Figure A7.14). The correlation between Hf and Ta is weaker, probably due to low concentrations of Ta. The distribution of these metals in the transported overburden may reflect their heavy minerals, deposited as placers; Ta in tantalite or microlite and Th in monazite. There appears to be minor concentration of Th and Ta in the upper few metres of the mottled zone, (possible due to residual concentration), but the distribution in the residual regolith probably dominantly reflects that prior to weathering.

### 6.3.8 Rare earth elements: La, Ce, Sm, Eu, Yb, Lu

*Light REE (La, Ce, Sm, Eu)*

These elements exhibit very similar distributions throughout the regolith (Figure A7.16, Figure A7.8, Figure A7.25 and Figure A7.12). All have a fairly constant and homogeneous distribution within the transported material and good contrast is seen between this and the top of the Archaean in most cases. Concentrations in the saprolite and lower mottled zone are high (La >100; Ce >200; Sm >16; Eu >3.5) and decrease by an order of magnitude over only 1-2 m in the upper mottled zone (La <5; Ce <11; Sm <1.3; Eu <0.7). Similar leaching from the clay and mottled zones occurs at Mt. Percy, though the decrease is smaller (Butt, 1991). The distribution of these elements at Golden Delicious thus reflects both leaching and the primary distribution. The close relationship between La and Ba at Golden Delicious is similar to that at Mt. Percy, probably reflecting the distribution of albite.

*Heavy REE (Yb, Lu)*

The distribution and chemical behaviour (see also Section 6.5) of Yb and Lu differ markedly from that of the light REE, (Figure A7.29 and Figure A7.17); they show more variation in concentration throughout the transported overburden (tending to increase with depth) and show less evidence of leaching in the residual regolith (with general enrichment around mineralisation). Ytterbium and Lu are strongly correlated despite their low abundances (0.8-4 ppm and <0.2-0.5 ppm respectively).

### 6.3.9 Other elements: Co, Zn

Cobalt and Zn concentrations in the saprolite at Golden Delicious are approximately 30 ppm and 150 ppm respectively, deceasing to <17 ppm and <100 ppm respectively in the mottled zone. This suggests leaching of the saprolite similar to that at Mt. Percy (Butt, 1991).

The abundance of Co and Zn are greater in the upper units (T1 and T2) of the transported overburden, (17-30 ppm and 120-150 ppm respectively), than in the lower ferruginous unit (T3), (<17 ppm and <120 ppm respectively). This may reflect the derivation of the lower unit from a lateritic ferruginous zone and the upper units from saprolite.

The relationship between Co and Sc (Figure 22) provides good discrimination between the regolith units discriminated at Golden Delicious, mainly a function of the opposite trends in the distributions of these elements throughout the regolith.

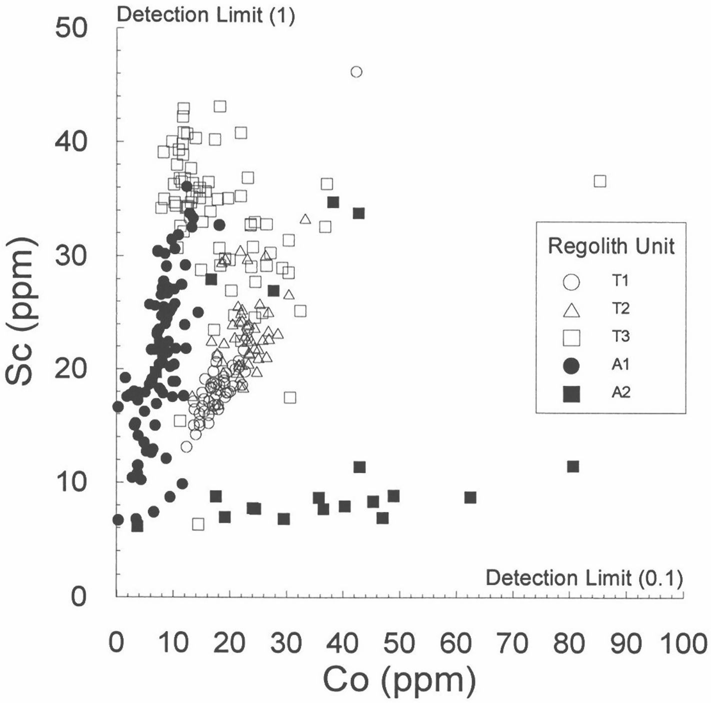


Figure 22: Scatterplot of Co vs. Sc showing good discrimination between three units of the transported overburden (T1, T2 and T3) and particularly between the mottled zone (A1) and saprolite (A2).

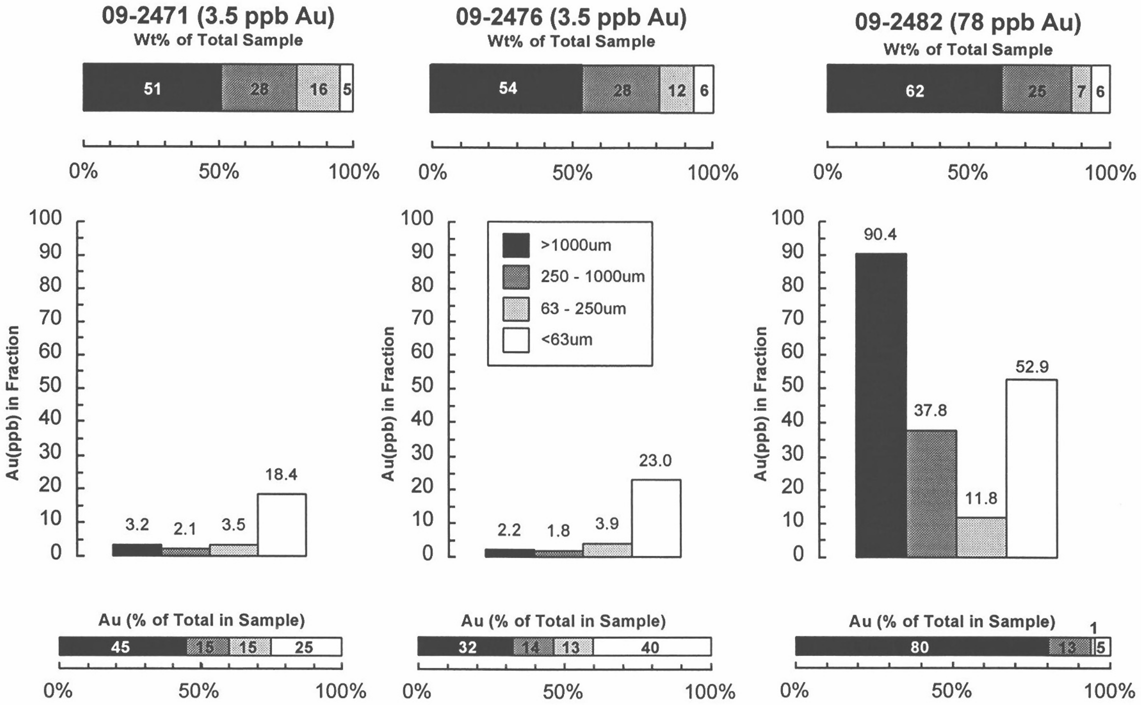


Figure 23: Size fraction analysis (by wet sieving) of transported material. Sample descriptions are given in Table 6 and their locations are marked on Figure 15.

## 6.4 OCCURRENCE OF GOLD IN THE REGOLITH

### 6.4.1 Introduction

The distribution and solubility of Au in the transported material, mottled zone and saprolite and their relationship to mineralisation, have been examined by size fractionation, separate analysis of Fe-rich and Fe-poor fractions, partial extractions using water, iodide and cyanide reagents and sequential extractions using various reagents. Locations of samples used in these experiments are shown in Figure 15.

### 6.4.2 Transported overburden

Samples of transported overburden were selected from the upper (T1), middle (T2), and lower (T3) units overlying primary mineralisation. Descriptions of the samples appear in Table 6, and the results of size fraction analysis are summarised in Figure 23.

Table 6: Descriptions of samples studied from the transported material.

| | |
|---|---|
| **09-2471** | Calcareous, hardpanised fine sediment, with minor Fe-rich gravel. Unit T1. |
| **09-2476** | Fine grained sediment, indurated by Fe oxides and silica, containing approximately 20% Fe-rich pisoliths in a polimictic gravel. Unit T2. |
| **09-2482** | Unconsolidated coarse sediment dominated by Fe rich pisoliths and minor amounts of indurated finer sediments. Unit T3. |

All the transported material is partly indurated, which compromises the interpretation of the size fraction analysis. Much of the coarser fraction consists of indurated masses of the finer fractions. The degree of induration decreases with depth:- 09-2471 > 09-2476 > 09-2482.

Samples 09-2471 and 09-2476 exhibit very similar characteristics in terms of physical Au fractionation. Relatively high concentrations of Au are present in the fine fraction, although this represents only a small percentage of the total sample weight. The remainder of the Au, in the coarser fractions, may be associated with indurated (though still porous) finer material. Gold is highly soluble in the bulk samples regardless of whether they were pulverised or not (Figure 24). This suggests that Au is mainly present in a complexed form, accessible to solution, rather than as metallic Au.

Sample 09-2482 represents the basal few metres of the transported overburden. Size fraction analysis shows that most of the Au in the sample is contained in the coarse fraction (Figure 23), which is dominated by ferruginous lateritic debris. Most of the Au in the bulk sample is dissolved by cyanide whether the sample is pulverised or not. This implies that the Au in the unpulverised sample is accessible to solution and is on surfaces, rather than occluded in the ferruginous gravel. The proportion of iodide-soluble Au increases from almost 25% to over 80% if the sample is pulverised (Figure 24). The cause is uncertain, but may be due to the presence of an insoluble coating, such as silica or alumino-silicates, that will dissolve in an alkaline cyanide solution but not in the neutral iodide reagent. Alternatively, a kinetic or surface area effect may be responsible.

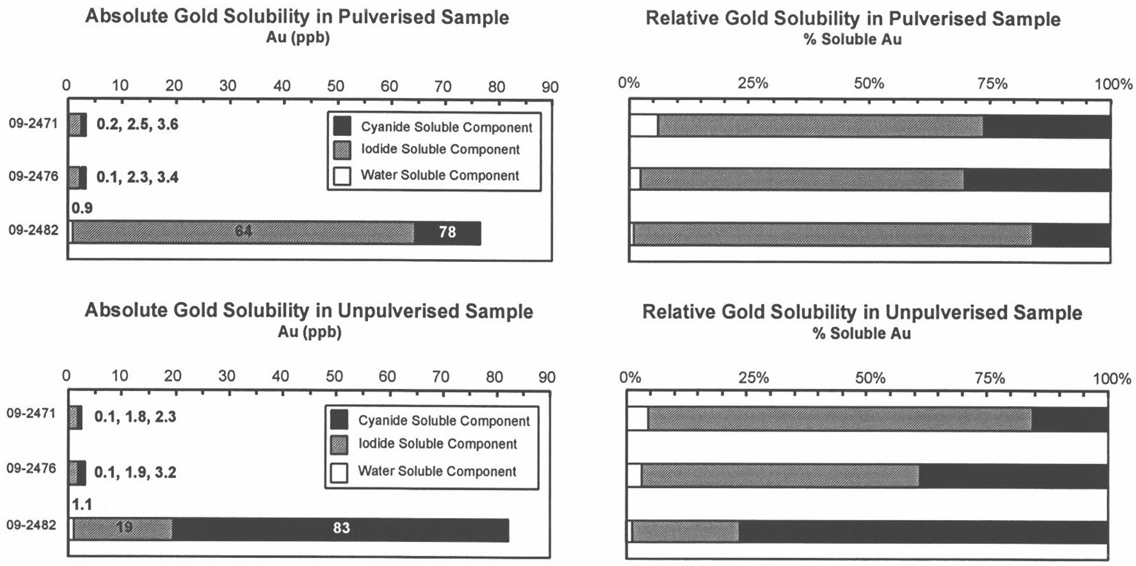


Figure 24: Absolute and relative Au solubility in pulverised and unpulverised samples of transported materials. Relative solubility is expressed with respect to the cyanide-soluble component in each case. Sample locations are marked on Figure 15.

### 6.4.3 Residual regolith

The distribution and solubility of Au from the upper and lower mottled zone and the saprolite have been investigated using the samples described in Table 7; locations are marked on Figure 15.

Table 7 - Descriptions of samples studied from the residual regolith.

| | |
|---|---|
| **09-2467** | Upper mottled zone, no primary lithic fabric, strong Fe fractionation. |
| **09-2915** | Middle mottled zone, no primary lithic fabric, strong Fe fractionation |
| **09-4499** | Middle - lower mottled zone, little primary lithic fabric, strong Fe fractionation. |
| **09-2917** | Lower mottled zone, some primary lithic fabric, moderate Fe fractionation |
| **09-4500** | Saprolite with incipient mottle development, minor gross Fe fractionation. |
| **09-4501** | Saprolite, no gross Fe fractionation. |

In the mottled zone, Au contents of ferruginous materials increases with depth (Figure 25). This could be due to depletion of Au from the ferruginous fraction of the upper mottled zone or variations in the primary mineralisation prior to weathering (see Section 6.3).

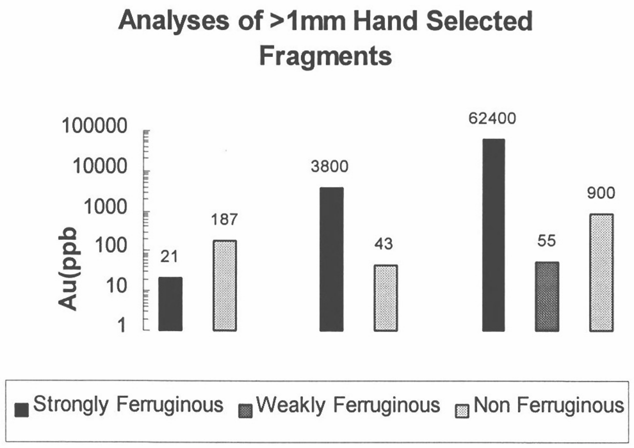


Figure 25: Gold fractionation between ferruginous and non-ferruginous materials from the mottled zone.

Dissolution of Au by water, iodide and cyanide reagents is difficult to interpret because of the difference in absolute Au concentrations in the samples studied (Figure 26). The solubility of Au is relatively constant and fairly low (though significant) compared with that in the transported material. Cyanide-soluble data for pulverised versus unpulverised samples indicate that most of the Au is accessible to solution. (Erroneous results, with water-soluble Au greater than iodide-soluble Au, were obtained for the unpulverised samples of 09-4501, possibly because of its coarseness and very high Au concentration - see Appendix 6).

A small proportion of the Au is water-soluble, consistent with the observation that groundwaters have anomalous Au contents (Section 5). These results also suggest that Au is mobile under present conditions and is available for dispersion into the transported overburden.

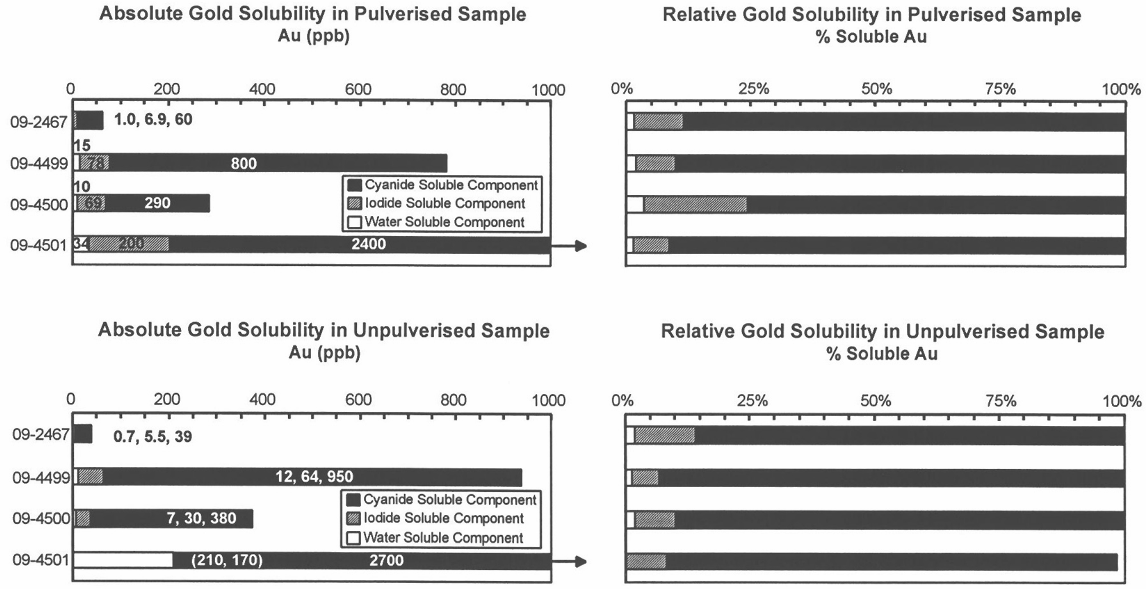


Figure 26: Absolute and relative Au solubility in pulverised and unpulverised samples of residual materials. Relative solubility is expressed with respect to the cyanide soluble component in each case. Sample locations are marked on Figure 6.

Further work investigating the solubility of gold in the residual regolith is described in Section 6.5, where the solubility of elements in the saprolite, lower mottled zone and upper mottled zone in various partial extraction solutions is considered.

## 6.5 SELECTIVE EXTRACTION OF METALS IN THE MOTTLED ZONE AND SAPROLITE

### 6.5.1 Introduction

The solubility of various metals in the saprolite, and lower and upper mottled zones has been determined, in order to establish weather the low abundances in the upper mottled zone are due to depletion. The procedure is described in detail in Section 2.2.5 and involves sequential extractions of an aliquot of sample by a number of solutions designed to dissolve various mineralogical phases (citrate-dithionite followed by NaOH, HCl-ascorbic acid and aqua regia extractions, the final residue also being analysed by INAA). Activated carbon was added to extractant solutions of a duplicate of one sample to assess the probability of re-adsorption of metal onto active sites. Except for Au, (described below), adsorption of metal on activated carbon was insignificant (Figure 27 to Figure 35). The sample descriptions are given in Table 7 and locations shown on Figure 15.

### 6.5.2 Elements associated with major mineral phases: Fe, Al, Mg, K, Rb.

A far greater proportion (84%) of the sample of the upper mottled zone was dissolved than the samples of lower mottled zone and saprolite (36% and 46% respectively). This suggests greater solubility of kaolinite and haematite than of feldspar and muscovite. This difference is reflected in the solubility of Al, K and Rb (Table 8).

Table 8: Total weight loss and concentrations of Al, K and Fe dissolved from each sample as a result of the sequential extraction procedure.

| Sample number | Description (Depth below unconformity) | Mineralogy | Weight loss (g) | Weight loss (%) | Al dissolved | K dissolved | Fe dissolved |
|---|---|---|---|---|---|---|---|
| ***09-2467*** | Upper mottled zone (4 m) | Kaolinite, haematite, quartz | 1.008 | 84 | 9 % | 1.4 % | 4.5 % |
| ***09-4499*** | Lower mottled zone (10 m) | Albite, microcline, muscovite, kaolinite, haematite | 0.554 | 46 | 2.5 % | 2 % | 4.5 % |
| ***09-4499c*** | Lower mottled zone (10 m) | Albite, microcline, muscovite, kaolinite, haematite | 0.494 | 41 | 2.5 % | 2.1 % | 4.5 % |
| ***09-4501*** | Saprolite (27 m) | Albite, microcline, muscovite | 0.436 | 36 | 1 % | 2.2 % | 4 % |

*Iron and magnesium*

The ammonium citrate - Na dithionite extraction dissolves Fe oxides by reduction of $Fe^{3+}$ to soluble $Fe^{2+}$ by dithionite at neutral pH. Between 40% and 60% of the Fe is citrate-dithionite soluble (Figure 27). Very little Fe is NaOH soluble; most remaining Fe is dissolved by the HCl-ascorbic acid, probably from feldspars and clays. A minor proportion (5-10%) of the Fe from the saprolite and lower mottled zone remained undissolved, even after the aqua regia treatment.

Interpretation of Mg solubility is also hindered by the lack of residual or total data for these samples. The extraction behaviour of Mg seems to closely reflect that of Fe, suggesting they have a common mineralogical association (Figure 27).

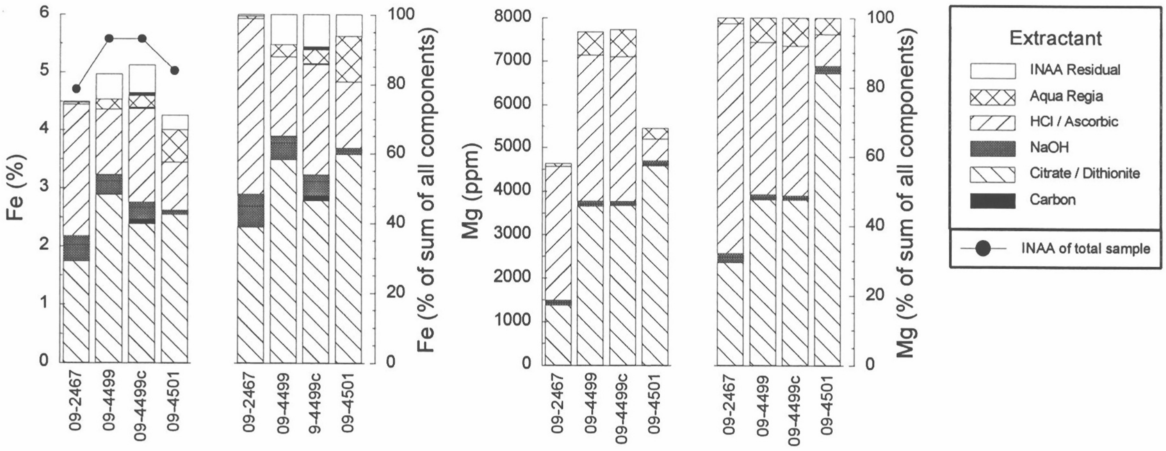


Figure 27: Solubility of Fe and Mg in various extractants, applied sequentially, and compared with the residual. Total Fe by INAA of a separate sub-sample is plotted for comparison. 09-4499c had an activated carbon sachet included with each extraction phase that was analysed separately to assess the potential for re-adsorption of dissolved metal.

*Aluminium*

The solubility of Al is difficult to interpret completely, due to the lack of data for the residues or original sample. Very little Al is dissolved by citrate-dithionite, consistent with the selective nature of this extraction for Fe oxides (Figure 28). This does, however, suggest that there is little Al substitution for Fe, haematite and goethite.

Significant quantities of Al (30-60% of total dissolved) are released by each NaOH extractant, probably from kaolinite. Further treatments with NaOH would probably dissolve more. The amount of Al dissolved by HCl-ascorbic acid was greatest in the most kaolinitic sample (09-2467, upper mottled zone).

The amount of Al dissolved by these extractants decreases with depth and, therefore, extent of weathering. If the dissolved Al represented total kaolinite ($Al_2Si_2O_5(OH)_4$) in samples 09-2467, 09-4499, 09-4499c and 09-4501, then they would contain 43%, 12%, 12% and 4.8% respectively. From results presented in Section 4, few primary minerals would be expected to remain in 09-2476 (upper mottled zone), compared with 09-4499 (lower mottled zone) and 09-4501 (saprolite) and this perhaps explains why so much Al is dissolved from this sample relative to the other two.

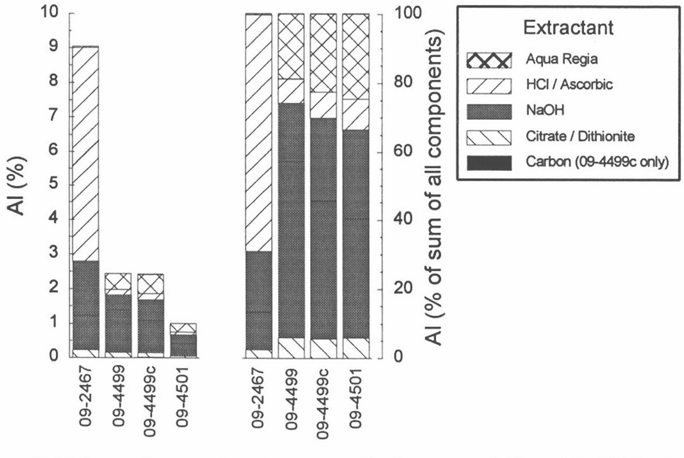


Figure 28: Solubility of Al in various extractants, applied sequentially. 09-4499c had an activated carbon sachet included with each extraction phase that was analysed separately to assess the potential for re-adsorption of dissolved metal.

*Potassium and rubidium*

Potassium and Rb have similar solubilities in these samples (Figure 29), reflecting their close mineralogical association. The discrepancy between total K analysed by INAA and total K calculated as the sum of each extractant is unexplained (<0.2% compared with 1.4%). However, it is possible that the NaOH used in the extraction contained sufficient K contamination to cause this discrepancy. The difference between K in the original sample and the total extraction results is almost constant, further suggesting contamination. If contamination has occurred, the concentration of dissolved K will be reduced by approximately 0.5-0.6% in each NaOH extraction, revealing that K dissolved by the NaOH extractant does increase slightly with depth, perhaps indicating that small amounts of K are being released from the deeper samples.

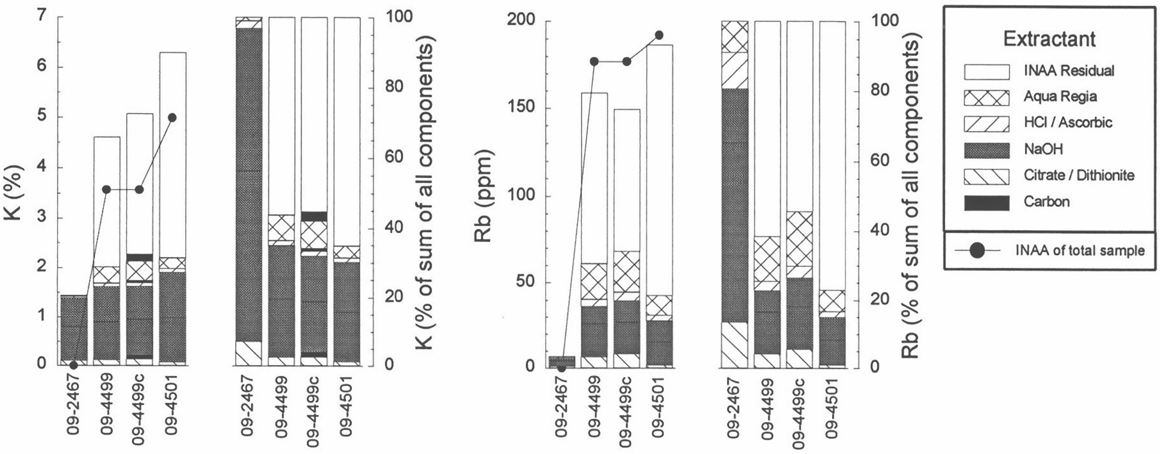


Figure 29: Solubility of K and Rb in various extractants, applied sequentially. 09-4499c had an activated carbon sachet included with each extraction phase that was analysed separately to assess the potential for re-adsorption of dissolved metal. Total K and Rb by INAA of a separate sub - sample are plotted for comparison

The small amounts of K and Rb in the upper mottled zone (09-2467) are dissolved more readily by all extractants relative to the deeper samples, in which they are mainly insoluble. As for Al, this suggests the K and Rb are dominantly hosted by secondary minerals (*e.g.* illite or an evaporite) in the mottled zone, rather than primary muscovite or feldspar.

Table 9: Net Au concentrations (ppb) dissolved by each extractant. Data in parentheses (sample 09-4499c) refer to gross Au concentration determined from absorption on activated carbon.

| Sample | Citrate-dithionite | NaOH-1 | NaOH-2 | 3M HCl, 0.3M ascorbic acid | Aqua regia | INAA (of residue) | Total (sum of all components) | INAA (of separate sub-sample) |
|---|---|---|---|---|---|---|---|---|
| 09-2467 | 9.5 | 2.1 | 3.7 | 11 | 32 | <1.1 | 58 | 80 |
| 09-4499 | 35 | 3.3 | 2.1 | 7 | 670 | <2.7 | 720 | 1200 |
| 09-4499c | 12 (99) | 7.9 (52) | 7.1 (68) | 2.9 (430) | 63 (400) | 12 | 1200 | 1200 |
| 09-4501 | 220 | <0.42 | <0.42 | 54 | 2000 | 5 | 2300 | 2800 |

### 6.5.3 Metals associated with Au mineralisation: Au W, Sb, (As)

*Gold*

Analysis of hand picked samples, (Figure 25; Section 6.4.3), suggested strong fractionation of Au with Fe oxides, particularly deeper in the mottled zone. However, citrate-dithionite solution only extracted 5 - 15% of the Au in the each of the 3 samples (Figure 30 and Table 9), suggesting that Au may be present as metallic Au rather than fine molecular Au. Even if re-adsorption is taken into consideration, the proportion of gross extractable Au is only doubled from 5 to 10% (09-4499c).

Nevertheless, re-adsorption is a significant factor (Figure 30) particularly for the HCl-ascorbic acid extractant.

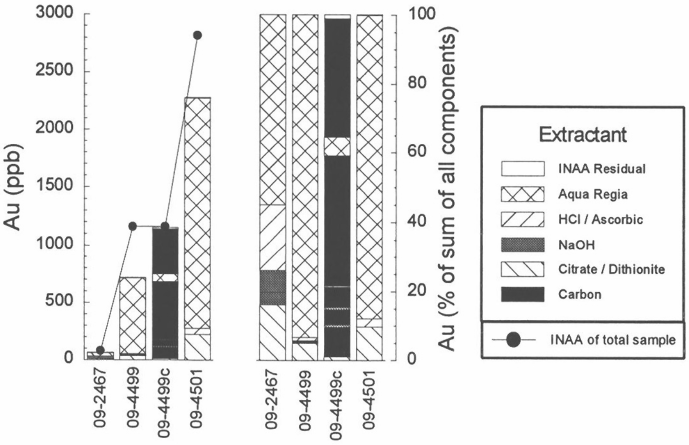


Figure 30: Solubility of Au in various extractants, applied sequentially, and compared with the residual. Total Au by INAA of a separate sub-sample is plotted for comparison. 09-4499c had an activated carbon sachet included with each extraction phase that was analysed separately to assess the potential for re-adsorption of dissolved metal.

*Arsenic*

Significant proportions (35-50%) of the contained As are associated with Fe oxides, as indicated by citrate-dithionite soluble As (Figure 31). This is consistent with the high correlation between Fe and As throughout the regolith (Section 6.3.1). Concentrations of As measured in NaOH, HCl-ascorbic acid and aqua regia are all at the detection limit. Relatively constant and low concentrations of As are present in the residue hosted by more resistant minerals.

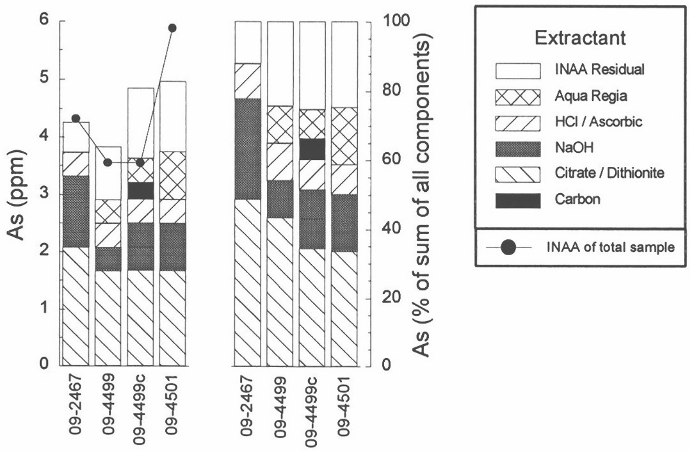


Figure 31: Solubility of As in various extractants, applied sequentially, and compared with the residual. Total As by INAA of a separate sub -sample is plotted for comparison. 09-4499c had an activated carbon sachet included with each extraction phase that was analysed separately to assess the potential for re-adsorption of dissolved metal.

*Antimony and tungsten*

Both these elements exhibit low solubility in the extractant solutions (Figure 32). The solubility of Sb seems greater, but concentrations in most extractant solutions are at, or very close to the detection limit.

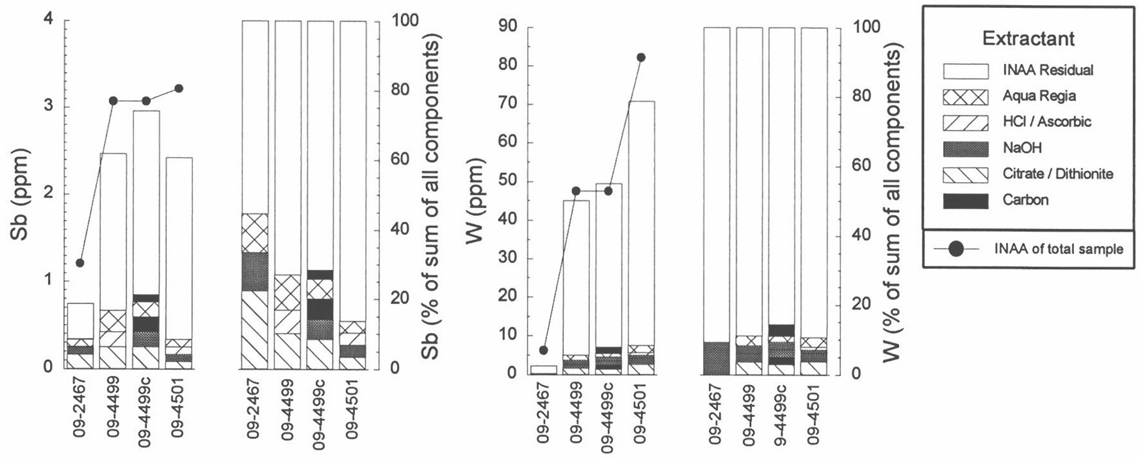


Figure 32: Solubility of Sb and W in various extractants, applied sequentially. 09-4499c had an activated carbon sachet included with each extraction phase that was analysed separately to assess the potential for re-adsorption of dissolved metal. Total Sb and W by INAA of a separate sub - sample are plotted for comparison.

### 6.5.4 Transition metals: Cr, Sc, Co

*Chromium*

In the samples from the mottled zone (09-2467 and 09-4499), approximately 15-20% of the contained Cr is extracted by citrate-dithionite (*i.e.* associated with Fe oxides) whereas, in the saprolite, Cr is below detection in citrate-dithionate (Figure 33). Between 15 and 25% of the contained Cr in all the samples in soluble in NaOH. In the upper mottled zone (09-2467), approximately 60% of the Cr is soluble in HCl-ascorbic acid, whereas in the deeper samples the proportion is only 25%. Aqua regia dissolves no detectable Cr from any of the samples and the proportion of Cr in the residues increases with depth.

Given the strong correlation between Cr and Fe throughout the regolith, the low proportion of Cr extracted by citrate-dithionite relative to HCl-ascorbic acid, particularly in the mottled zone, is unexpected. This may be because:

1. Chromium released in the saprolite is hosted by minerals other than Fe oxides (*e.g.* kaolinite) in the upper mottled zone.
2. Precipitation of the Fe oxides in the mottled zone post-dates the release of Cr in the saprolite.
3. Chromium solubility is a function of variations in primary mineralogy.

*Cobalt*

The total Co content and the proportions dissolved by citrate-dithionite and aqua regia are highest in the saprolite and decreases significantly through to the upper mottled zone. Conversely, the proportions of Co dissolved by NaOH and, particularly, HCl-ascorbic acid increases towards the surface. The concentration of Co not soluble in citrate-dithionite remains relatively constant from the saprolite to the upper mottled zone, perhaps indicating this small amount of cobalt is unaffected by further weathering. Possible explanations are:

1. Cobalt has been leached from the Fe oxides of the mottled zone and removed from the system

2. Cobalt was redistributed during lateritisation, (*i.e.,* leached in the clay and mottled zones and enriched in the lower saprolite and ferruginous duricrust), and following truncation has remained unchanged by late stage precipitation of Fe oxides as haematitic mega-mottles.

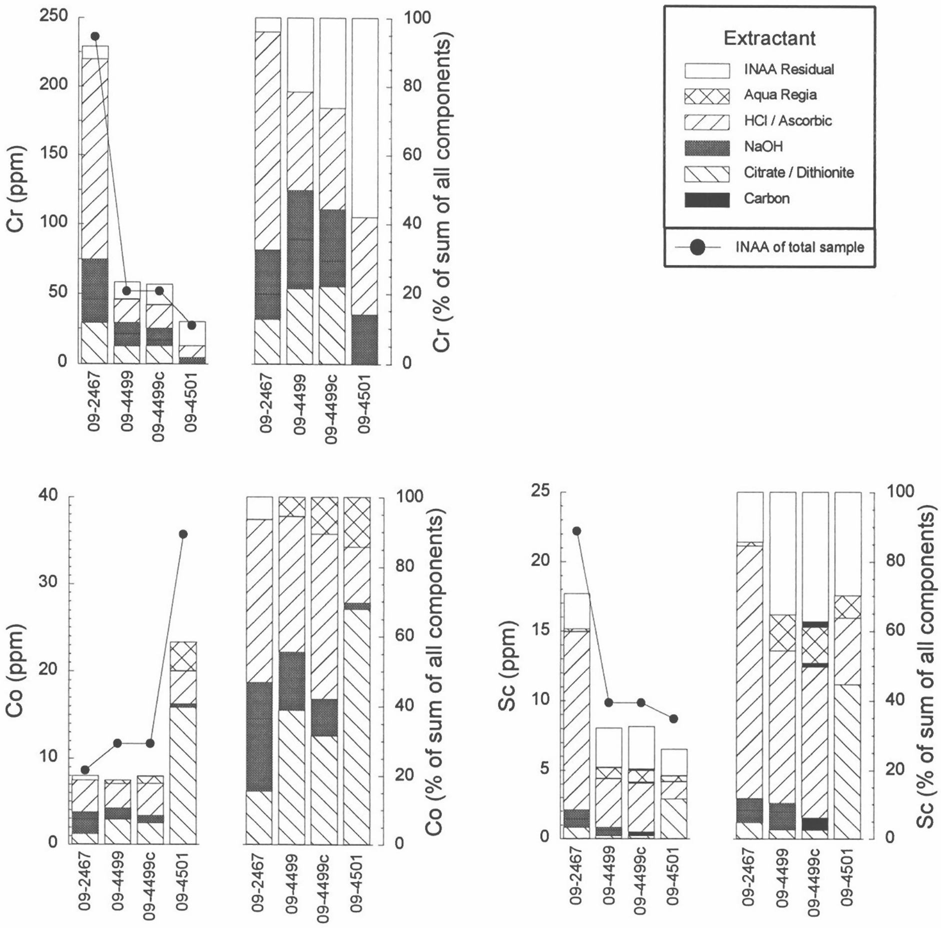


Figure 33: Solubility of Cr, Co and Sc in various extractants, applied sequentially. 09-4499c had an activated carbon sachet included with each extraction phase that was analysed separately to assess the potential for re-adsorption of dissolved metal. Total Cr, Co and Sc by INAA of a separate sub-sample are plotted for comparison.

*Scandium*

Similar to Cr, the Sc content is significantly greater in the upper mottled zone (23 ppm) than in the deeper samples (10 ppm). Nevertheless, 45% of Sc in the saprolite is citrate-ditionite soluble, whereas <10% is soluble in the mottled zone. In contrast, the proportion of NaOH and HCl-ascorbic acid soluble Sc decreases with depth. This extraction behaviour is similar to that of Co and may reflect either an association with Fe oxides that varies with weathering, or variations related to primary mineralogy.

### 6.5.5 Rare earth elements (REE): La, Ce, Sm, Eu, Yb, Lu

*Light REE (La, Ce, Sm, Eu)*

The behaviour of each of these elements is similar, though some of the solubility characteristics appear affected by atomic weight (Figure 34). The proportion of the light REE soluble in citrate-dithionite is very low, and association with Fe oxides is not considered significant.

No detectable concentrations of the light REE were dissolved by NaOH, but significant proportions were dissolved by HCl-ascorbic acid, particularly in the deeper samples. The concentrations of light REE dissolved by aqua regia are higher in the saprolite than the mottled zone, though only represent on average approximately 10% of the total concentration.

The proportion of light REE remaining in the residue increases upwards but the total contents decrease markedly, perhaps suggesting that the more soluble forms of each element have been leached from the mottled zone. The proportion of each element in the residue also increases with atomic weight.

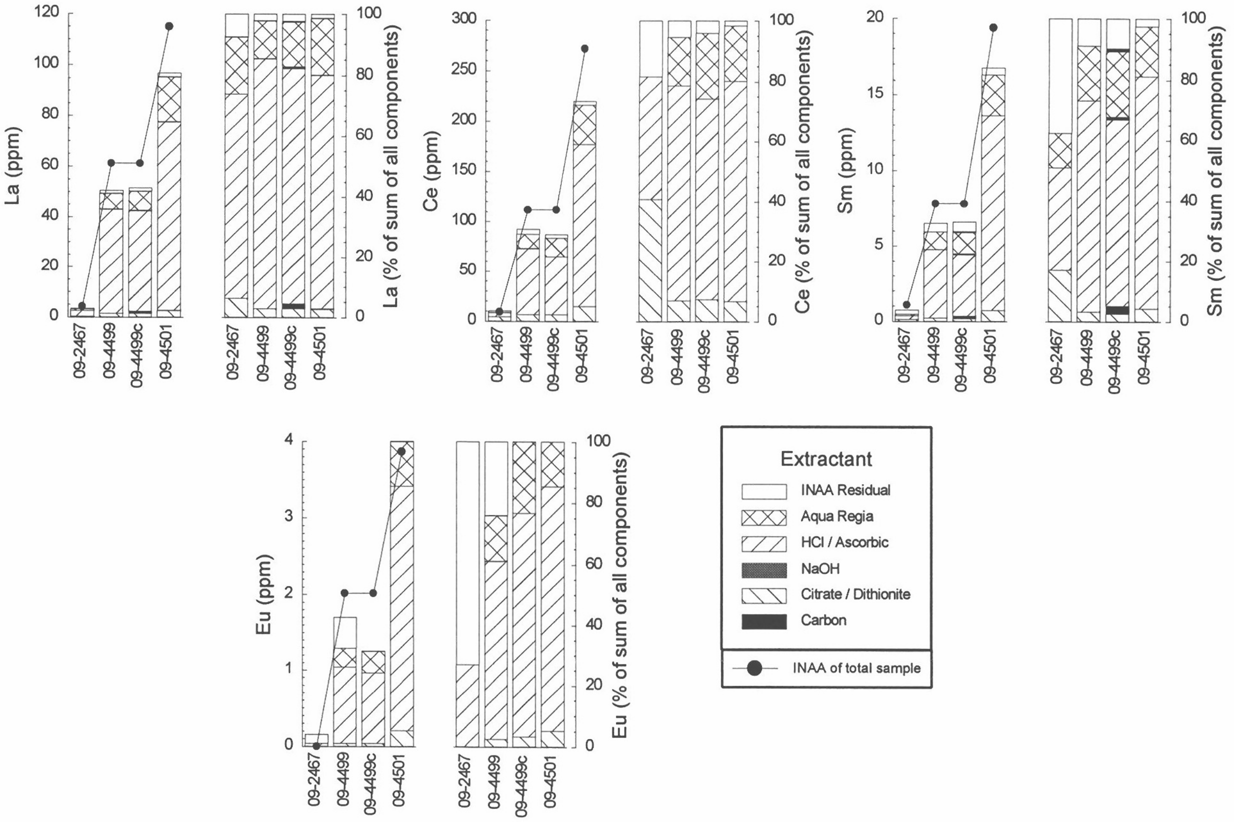


Figure 34: Solubility of some light REE (La, Ce, Sm and Eu) in various extractants, applied sequentially. 09-4499c had an activated carbon sachet included with each extraction phase that was analysed separately to assess the potential for re-adsorption of dissolved metal. Total concentration of each element by INAA of a separate sub-sample are plotted for comparison.

*Heavy REE*

The trend to increasing proportions of the heavier elements remaining in the residue is particularly observed for Yb and Lu (Figure 35). In the upper mottled zone (09-2467) more than 85% of the total heavy REE remains in the residue (compared with only just over 5% for La). The heavy REE in these samples have very low solubility in the citrate-dithionite phase.

The solubility of the heavy REE in the NaOH, HCl-ascorbic acid, and aqua regia phases, (≈40-50%, ≈10-20% and ≈5-10% respectively), is similar to that of Al in the two deeper samples, but unlike Al in the upper mottled zone, the heavy REE concentrations are close to or at detection. The low heavy REE concentrations are either due to leaching or a function of primary mineralogy.

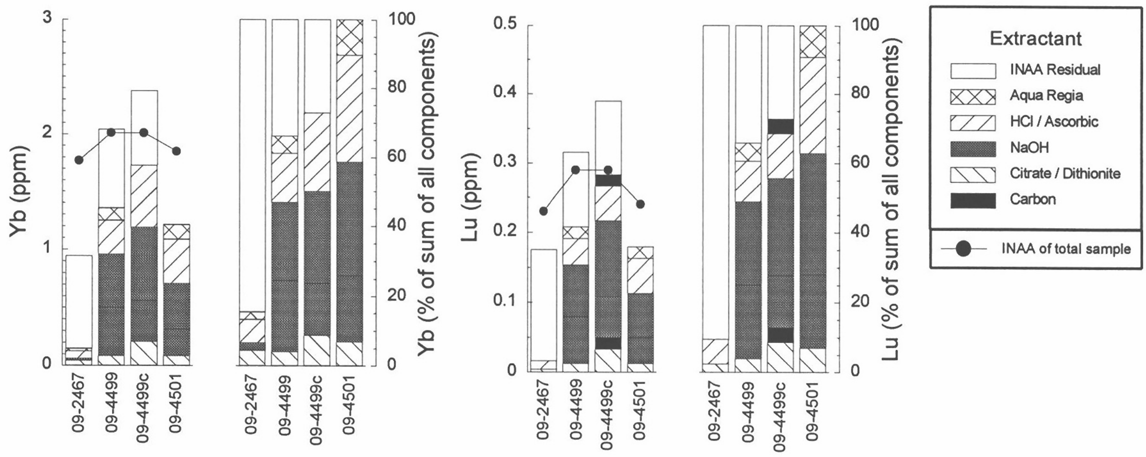


Figure 35: Solubility of the some heavy REE (Yb and Lu) in various extractants, applied sequentially. 09-4499c had an activated carbon sachet included with each extraction phase that was analysed separately to assess the potential for re-adsorption of dissolved metal. Total Yb and Lu by INAA of a separate sub-sample are plotted for comparison.

# 7. DISCUSSION AND CONCLUSIONS

## 7.1 REGOLITH EVOLUTION

The geochemical and other data presented in this study suggest that the regolith at Golden Delicious has had a complex history. Many features are consistent with established models of regolith evolution in the Yilgarn Craton, but others suggest site-specific variations.

Two dominant periods and climatic regimes were of particular importance in the development and evolution of the regolith of the Yilgarn Craton. These were, firstly, the humid, warm climates of the Cretaceous to mid-Miocene and secondly, the drier climates since the Miocene. The former humid climates gave rise to extensive deep lateritic weathering, whereas the later arid to semi-arid climates, which still prevail, have resulted in a general lowering of water tables and changes to the nature and rate of chemical weathering that have modified the pre-existing regolith (Butt, 1991).

Many regolith characteristics at Golden Delicious appear to reflect these two major weathering episodes. However, erosion of the upper horizons of the deeply weathered profile, deposition of colluvial sediments and subsequent modification of both residual and transported regolith components have occurred.

The interpretation of regolith development in terms of the weathering history is complicated by variations in the regolith that correspond to primary lithological differences. Despite this, the evolution of the regolith and landscape at Golden Delicious can be estimated as follows:

1. Lateritic weathering under warm, humid conditions gave rise to deeply weathered profiles throughout the region. This possibly included extensive development of a regolith having a ferruginous zone overlying a plasmic clay zone and saprolite, grading into fresh rock at depth. Evidence includes the weathering of sulphides to Fe oxides, feldspars and some muscovite to kaolinite and the associated leaching of alkalis and alkaline earths from the saprolite. In addition, lateritic debris is a significant component of the transported overburden.

2. Widespread erosion of the slopes flanking the Lake Carey palaeodrainage truncated the deeply weathered profile at Golden Delicious, largely removing any ferruginous horizons and leaving only a clay zone and saprolite. The erosion was probably triggered by climatic change, such as the onset of aridity, and/or by drainage rejuvenation following a marine transgression and/or by seismic activity on the shield margin. Significant deposition of sediments of the Lake Carey palaeodrainage probably occurred at this time.

3. Mixing occurred between the accumulating sediments and the underlying saprolite, possibly as the result of formation of a palaeosol.

4. Sediments were deposited over Golden Delicious, derived from slowly eroding landscapes upslope to the east. The sediments are comprised of a poorly-sorted mixture of ferruginous clays and coarse lateritic fragments that becomes progressively finer, and less ferruginous, upwards. This stratigraphy is the inverse of a "typical" lateritic regolith and suggests the sediments were derived from the erosion of such a regolith.

5. Lowering of the water-table left much of the saprolite and clay zone unsaturated, and local variations in redox conditions (possibly due to the presence of tree roots), caused Fe oxides to precipitate as haematitic mega-mottles in the clay zone and upper saprolite. Similar mottling is present at equivalent depths in the sediments of Lake Carey and their genesis may be related.

6. Salinisation of the groundwater associated with aridity led to precipitation of carbonates and halite throughout the regolith. Rise of the water-table to its present level saturated the residual profile. The high pH may have prevented re-hydration of haematite to goethite.

The mottling at Golden Delicious appears unrelated to many of the significant geochemical trends observed in the residual regolith in which it is found. As such, this mottling is unlike many mottled zones formed during lateritic weathering. It is suggested that it is a late stage overprinting of an already truncated (or non-ferruginous) deep regolith in which the element distributions reflect primary mineralogical and geochemical heterogeneity and the superimposed effects of lateritic weathering.

Mineralogical analysis of core samples show albite and microcline are present higher in the regolith than muscovite, the disappearance of which is coincident with the appearance of quartz. It is not uncommon for micas to persist throughout lateritic profiles, long after all feldspar has been destroyed, hence the reverse situation is extremely unlikely. Thus, it is suggested these variations in mineralogical variations are primary, associated with zonation in the altered intrusive, or a separate intrusive lithology. This hypothesis is difficult to confirm visually due to the extent of weathering.

The abundances of several elements (K, Rb, Cs, Na, light REE, W, Au) decrease by an order of magnitude over a few metres within the mottled zone. This trend does not correspond to any observed characteristics of the mottling, or other weathering features, (*e.g.*, pedoplasmation front). Furthermore, the low solubility of W, K and Rb, in particular, throughout the saprolite suggests that leaching is highly unlikely. This element suite closely resembles that commonly associated with primary alteration and mineralisation, hence it is concluded that the distribution reflects variations in primary composition, rather than being a function of weathering. In contrast, the concentrations of elements associated with resistant minerals display little, (Th, Ta) or no (Hf) variation across the mottled zone, with some residual concentration in the upper few metres.

There is inconsistent preservation of primary lithic fabrics in the mottled zone. In some places, fabrics are preserved by ferruginous mottles very close to or at the unconformity whereas, elsewhere, they have been destroyed. This might be due to differential weathering, but similarities in morphology, mineralogy and consistency suggest mottling is a later overprint of already variably weathered rocks.

## 7.2 DISPERSION FROM MINERALISATION

Although many features of element distributions in the residual regolith may reflect those present prior to weathering, there is evidence for secondary geochemical dispersion from mineralisation, particularly for Au. The close association between Au and K in the residuum probably mimics the primary distribution. However, evidence for secondary dispersion includes:

- Significant amounts (up to approximately 200 ppb), though not a high proportion (<10%), of the Au in the weathered Archaean are highly soluble, and moderate to high concentrations of Au are present in the groundwater.

- Enrichments of Au (40-80 ppb) in the top few metres of the Archaean, 300 m wide, are centred over the mineralisation. These enrichments may be the result of either residual accumulation or secondary chemical concentration.

- Enrichments of Au (12-105 ppb) in the basal few metres of the transported overburden, over 400 m wide, are offset slightly downslope of mineralisation. These enrichments are accessible to solution, (*i.e.,* Au can be dissolved without pulverising the samples), and up to 80% of it is iodide-soluble. This indicates that little of the Au is occluded in sedimentary clasts. Although this Au may have been reworked from detrital Au in the cover, the presence of auriferous groundwater and the close spatial relationship to mineralisation and to suggest dispersion from the latter is probable.

- Despite the small amounts of Au associated with Fe oxides soluble in citrate-dithionite extractant, hand selection of Fe oxides did show an association. This suggests that the Au in the Fe oxides is mainly coarse metallic Au, perhaps precipitated preferentially with haematite during late stage mottling.

There is no evidence for dispersion of W from mineralisation, and little for Sb. The Sb/Fe ratio gives a broader anomaly in the Archaean than Au; this may be primary, but the slight solubility of Sb suggests some secondary mobilisation. The Sb/Fe ratio shows no contrast in the transported overburden and the weak Sb anomaly is considered unrelated to mineralisation.

Arsenic concentrations in mineralisation are low (<7 ppm) and there is little evidence for secondary dispersion. There is a weak anomaly in the upper Archaean and the ferruginous, basal unit of the transported overburden, and a close association between As and Fe throughout the regolith. The As/Fe association is common, and the weak anomaly in the upper mottled zone may be due to re-mobilisation from the ferruginous gravels.

## 7.3 IMPLICATIONS FOR EXPLORATION

This research has shown that an understanding of the evolution of the regolith and landscape is vital to accurate interpretation of geochemical data and hence the design of effective sampling programs for exploration of complex environments. Although the findings of this research relate specifically to Golden Delicious, they have broader application.

(i) At Golden Delicious the exploration target can be enlarged by selecting favourable media, namely:

- Ferruginous gravels at the base of the transported overburden - 400 m.
- Top of the Archaean - 300 m.
- Groundwater - 200 m

(ii) Selection of a sample at the unconformity ("interface") would be successful in defining a broad anomaly, although the very different solubility of Au above and below the unconformity suggests different enrichment mechanisms (*i.e.*, residual accumulation in the uppermost residual regolith and hydromorphic dispersion into the basal gravels).

(iii) Tungsten and, when normalised to Fe, Sb are both anomalous for over 500 m across the strike of mineralisation, deep in the residual regolith. They are absent in the uppermost few metres, possibly reflecting primary compositional trends.

(iv) Late stage mottling of residual regolith is less significant in concentrating Au as that occurring during lateritic weathering. Although not necessary for the generation of broad anomalies over mineralisation at Golden Delicious, selective sampling of ferruginous materials may nevertheless be advantageous.

(v) Calcareous hardpan in the near-surface overlying mineralisation is not anomalous in Au using the detection limits of neutron activation analysis, and no association between Au and carbonate was detected.

Detailed investigations such as this are inappropriate as part of an exploration program, but the following general approach is recommended.

1. Determine the regional regolith-landform relationships of the area to be explored.

2. In areas of substantial transported overburden, drill broad-spaced reconnaissance holes (about 1-2 km spacing) to determine the:
   (a) major lithologies;
   (b) nature and stratigraphy of regolith materials in the potential host lithologies, including the depth, sedimentology, stratigraphy and weathering features of the transported overburden;
   (c) geochemical characteristics of the entire regolith, to give an insight into the possible dispersion mechanisms and potential pathfinder elements. At regional scales, the composition and provenance of the transported overburden may indicate the most prospective districts.
   (d) depth, basic chemistry (pH, Eh, conductivity) and Au content of the groundwater.

3. Subdivide the area into regions having different regolith and groundwater conditions that may dictate different sampling strategies. These areas should be dealt with separately, perhaps prioritised on the basis of likely cost of exploration, (*e.g.*, deep transported overburden requiring deeper drilling), and prospectivity.

4. Establish appropriate sample media, sample spacing and analytical suite, based on reconnaissance sampling and known dispersion models. For example, the Au anomaly in the basal gravels at Golden Delicious would be located by 200 m spaced sampling.

5. A specific hydrogeochemical survey may be appropriate if the water-table is shallow and groundwater chemistry favours high contrast Au anomalies. At Golden Delicious, Au-anomalous groundwater gives a significantly enlarged exploration target. The groundwater data will also aid the selection of sampling media, by providing information on the possibility of Au mobilisation throughout the regolith, and possibly to indicate the potential for significant Au depletion or supergene enrichment.

6. Interpret geochemical data from each sub-division separately, grouping like sample media for separate statistical analysis.

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# APPENDICES

# APPENDIX 1: TABULATED GROUNDWATER DATA

**Table A1: Tabulated Groundwater Data.**

| No. | | East (m) | North (m) | Sampling depth (m) | pH | Eh (mV) | TDS (%) | Na | Mg | Ca | K | Cl | $SO_4$ | $HCO_3$ | P | Li | Be | Rb | Sr | Cs | Ba | B | Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | GDDH01 | 447243 | 6790200 | 25 | 6.96 | 148 | 6.3 | 23100 | 1590 | 630 | 319 | 32244 | 5468 | 230 | 0.04 | <0.005 | <0.005 | 0.058 | 7.34 | 0.006 | 0.040 | 4.85 | 0.004 |
| 2 | GDDH01 | 447243 | 6790200 | 50 | 7.05 | 123 | 10.7 | 39900 | 2650 | 635 | 477 | 53969 | 8778 | 221 | 0.047 | 0.193 | <0.005 | 0.076 | 8.35 | 0.007 | 0.064 | 3.77 | 0.006 |
| 3 | GDDH01 | 447243 | 6790200 | 75 | 7.02 | 117 | 13.5 | 49800 | 3190 | 655 | 592 | 70804 | 10291 | 190 | 0.051 | 0.284 | <0.005 | nd | 9.49 | nd | 0.055 | 3.28 | 0.005 |
| 4 | GDDH01 | 447243 | 6790200 | 100 | 6.94 | 117 | 15.3 | 56100 | 3395 | 690 | 706 | 81356 | 10396 | 168 | 0.047 | 0.243 | <0.005 | 0.087 | 10.8 | 0.012 | 0.020 | 2.99 | 0.006 |
| 5 | CSIRO 7 | 447250 | 6790200 | 18 | 7.29 | 149 | 3.5 | 12400 | 845 | 465 | 189 | 17829 | 3221 | 169 | 0.025 | <0.005 | <0.005 | 0.039 | 4.51 | <0.001 | 0.190 | 3.38 | 0.006 |
| 6 | GDA 15 | 447370 | 6790200 | 12 | 7.27 | 273 | 4.1 | 14600 | 1010 | 615 | 261 | 21066 | 3490 | 89 | 0.018 | <0.005 | <0.005 | 0.057 | 6.15 | <0.001 | 0.019 | 4.42 | 0.044 |
| 7 | GDA 15 | 447370 | 6790200 | 12 | 7.26 | 279 | 4.1 | 14500 | 1000 | 610 | 257 | 21006 | 3446 | 90 | 0.036 | <0.005 | <0.005 | 0.058 | 6.08 | <0.001 | 0.019 | 4.39 | 0.004 |
| 8 | CSIRO 9 | 447350 | 6790200 | 15 | 7.17 | 285 | 4.2 | 14900 | 1040 | 555 | 255 | 21143 | 3866 | 195 | 0.018 | <0.005 | <0.005 | 0.052 | 5.67 | <0.001 | 0.018 | 4.90 | 0.005 |
| 9 | CSIRO 10 | 447400 | 6790200 | 18 | 7.02 | 290 | 4.5 | 16100 | 1090 | 560 | 267 | 22881 | 3970 | 177 | 0.022 | <0.005 | <0.005 | nd | 5.63 | nd | 0.021 | 4.52 | 0.004 |
| 10 | CSIRO 11 | 447500 | 6790200 | 18 | 7.15 | 294 | 4.9 | 17700 | 1155 | 500 | 271 | 25075 | 4015 | 160 | 0.02 | <0.005 | <0.005 | 0.053 | 5.18 | 0.001 | 0.018 | 3.64 | 0.003 |
| 11 | CSIRO 12 | 447700 | 6790200 | 15 | 6.45 | 240 | 4.7 | 16900 | 1000 | 440 | 278 | 24941 | 3311 | 64 | 0.017 | 0.042 | <0.005 | nd | 4.53 | nd | 0.151 | 2.20 | 0.004 |
| 12 | CSIRO 8 | 447300 | 6790200 | 18 | 6.91 | 222 | 4.9 | 17200 | 1200 | 575 | 274 | 25005 | 4269 | 170 | 0.012 | <0.005 | <0.005 | nd | 6.18 | nd | 0.018 | 4.96 | 0.003 |
| 13 | CSIRO 6 | 447200 | 6790200 | 18 | 6.91 | 279 | 5.0 | 17400 | 1235 | 605 | 274 | 25771 | 4374 | 173 | 0.011 | <0.005 | <0.005 | nd | 6.50 | nd | 0.018 | 5.05 | 0.002 |
| 14 | CSIRO 5 | 447150 | 6790200 | 18 | 6.92 | 288 | 4.8 | 16800 | 1190 | 620 | 272 | 24882 | 4329 | 138 | 0.01 | <0.005 | <0.005 | 0.043 | 6.54 | 0.001 | 0.013 | 5.16 | 0.002 |
| 15 | GDRC 21 | 447165 | 6790200 | 19 | 7.02 | 302 | 4.9 | 17200 | 1200 | 640 | 286 | 24886 | 4539 | 86 | 0.011 | <0.005 | <0.005 | 0.044 | 6.73 | <0.001 | 0.012 | 5.00 | 0.044 |
| 16 | GDRC 21 | 447165 | 6790200 | 40 | 6.83 | 356 | 5.7 | 20100 | 1415 | 625 | 310 | 29496 | 5138 | 84 | 0.013 | 0.023 | <0.005 | nd | 6.85 | nd | 0.010 | 4.68 | 0.015 |
| 17 | GDRC 21 | 447165 | 6790200 | 70 | 6.78 | 404 | 9.8 | 34300 | 2410 | 600 | 444 | 52519 | 7954 | 115 | 0.024 | 0.137 | <0.005 | 0.049 | 7.89 | 0.002 | <0.005 | 3.95 | 0.001 |
| 18 | CSIRO 4 | 447100 | 6790200 | 18 | 6.91 | 361 | 5.1 | 18100 | 1330 | 615 | 287 | 26415 | 4524 | 165 | 0.009 | <0.005 | <0.005 | nd | 6.56 | nd | 0.013 | 5.21 | 0.002 |
| 19 | CSIRO 3 | 446990 | 6790200 | 18 | 7.07 | 346 | 5.1 | 17700 | 1300 | 620 | 289 | 26916 | 4479 | 142 | 0.008 | <0.005 | <0.005 | 0.051 | 6.48 | 0.001 | 0.013 | 5.07 | 0.004 |
| 20 | CSIRO 2 | 446900 | 6790200 | 16 | 6.99 | 350 | 4.7 | 16500 | 1215 | 660 | 278 | 23974 | 4344 | 146 | 0.009 | <0.005 | <0.005 | nd | 6.57 | nd | 0.011 | 5.04 | 0.002 |
| 21 | CSIRO 1 | 446700 | 6790200 | 16 | 7.23 | 273 | 3.7 | 12600 | 915 | 520 | 211 | 19161 | 3400 | 160 | 0.015 | <0.005 | <0.005 | nd | 4.91 | nd | 0.106 | 4.03 | 0.003 |
| 22 | GDRC 38 | 447240 | 6790100 | 25 | 7.07 | 130 | 4.6 | 15900 | 1100 | 565 | 265 | 24324 | 3835 | 82 | 0.012 | <0.005 | <0.005 | 0.050 | 5.94 | 0.001 | 0.016 | 4.36 | 0.003 |
| 23 | GDA 14 | 447180 | 6790150 | 26 | 6.94 | 260 | 4.9 | 16000 | 1200 | 770 | 281 | 26045 | 4404 | 87 | 0.008 | <0.005 | <0.005 | 0.048 | 7.20 | 0.001 | 0.021 | 4.32 | 0.002 |
| 24 | GDA 14 | 447180 | 6790150 | 50 | 6.6 | 283 | 8.9 | 30600 | 2190 | 625 | 404 | 48099 | 7250 | 104 | 0.02 | 0.092 | <0.005 | 0.040 | 7.77 | 0.001 | 0.008 | 3.99 | 0.012 |
| 25 | GDA 26 | 447073 | 6789714 | 25 | 7.08 | 298 | 5.5 | 18900 | 1275 | 610 | 313 | 29497 | 4224 | 87 | 0.009 | <0.005 | <0.005 | 0.063 | 6.28 | 0.002 | 0.027 | 4.25 | 0.051 |
| 26 | GDA 22 | 447250 | 6789700 | 30 | 6.67 | 290 | 8.9 | 30300 | 2190 | 570 | 394 | 47328 | 7626 | 165 | 0.024 | 0.044 | <0.005 | 0.048 | 6.94 | 0.003 | <0.005 | 4.32 | 0.007 |
| 27 | GDA 31 | 447300 | 6789500 | 23 | 6.88 | 289 | 7.2 | 24700 | 1795 | 590 | 369 | 38327 | 5947 | 141 | 0.012 | <0.005 | <0.005 | 0.074 | 6.80 | 0.002 | 0.009 | 4.21 | 0.003 |
| 28 | GDA 19 | 447285 | 6789600 | 30 | 6.67 | 291 | 9.6 | 32900 | 2535 | 610 | 421 | 50648 | 8703 | 146 | 0.015 | <0.005 | <0.005 | 0.049 | 7.71 | 0.003 | <0.005 | 4.10 | 0.001 |

All concentrations in ppm (mg/L), unless otherwise noted

nd: not determined

**Table A1 (cont):**

| No. | Si | I | Sc | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Ga | Ge | As | Y | Zr | Mo | Ag | Cd | Sn | Sb | La |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 16 | 7.5 | 0.014 | <0.005 | <0.005 | 2.4 | 0.77 | 0.020 | <0.001 | <0.005 | 0.008 | <0.005 | 0.007 | 0.03 | <0.001 | <0.001 | 0.015 | <0.001 | <0.002 | 0.005 | <0.001 | 0.005 |
| 2 | 9.8 | 10.3 | 0.023 | <0.005 | <0.005 | 15.7 | 3.5 | 0.055 | <0.001 | 0.008 | <0.005 | <0.005 | <0.005 | 0.135 | <0.001 | 0.001 | 0.034 | <0.001 | <0.002 | 0.006 | <0.001 | 0.001 |
| 3 | 8.0 | 11.3 | nd | <0.005 | <0.005 | 10.4 | 3.4 | 0.030 | <0.01 | 0.014 | 0.010 | nd | nd | 0.153 | nd | 0.042 | 0.031 | <0.001 | <0.002 | 0.167 | <0.001 | nd |
| 4 | 7.7 | 12.7 | 0.017 | <0.005 | <0.005 | 7.0 | 2.9 | 0.031 | <0.001 | 0.014 | 0.008 | <0.005 | <0.005 | 0.178 | <0.001 | 0.001 | 0.025 | <0.001 | <0.002 | 0.008 | <0.001 | <0.001 |
| 5 | 17 | 4.2 | 0.010 | <0.005 | <0.005 | 2.1 | 0.03 | 0.012 | <0.001 | <0.005 | 0.006 | <0.005 | <0.005 | 0.056 | <0.001 | <0.001 | 0.004 | <0.001 | <0.002 | 0.003 | <0.001 | <0.001 |
| 6 | 30 | 4.6 | 0.018 | <0.005 | <0.005 | 0.17 | 0.03 | 0.008 | <0.001 | 0.007 | 0.054 | <0.005 | <0.005 | 0.081 | <0.001 | <0.001 | 0.004 | <0.001 | <0.002 | 0.003 | 0.011 | 0.001 |
| 7 | 29 | 4.6 | 0.021 | <0.005 | <0.005 | 0.17 | 0.03 | 0.006 | <0.001 | 0.007 | 0.052 | <0.005 | <0.005 | 0.094 | <0.001 | <0.001 | 0.006 | <0.001 | <0.002 | 0.003 | 0.012 | 0.001 |
| 8 | 29 | 6.5 | 0.020 | <0.005 | 0.005 | 0.01 | 0.03 | 0.003 | <0.001 | 0.007 | 0.002 | <0.005 | <0.005 | 0.111 | <0.001 | <0.001 | 0.002 | <0.001 | <0.002 | 0.005 | <0.001 | <0.001 |
| 9 | 27 | 5.0 | nd | <0.005 | <0.005 | 0.87 | 0.03 | <0.005 | <0.01 | 0.016 | 0.012 | nd | nd | 0.15 | nd | 0.011 | nd | <0.001 | <0.002 | 0.015 | <0.001 | nd |
| 10 | 28 | 5.6 | 0.022 | <0.005 | 0.012 | 0.05 | 0.03 | 0.003 | <0.001 | 0.018 | 0.002 | <0.005 | <0.005 | 0.088 | <0.001 | <0.001 | 0.002 | <0.001 | <0.002 | 0.003 | <0.001 | <0.001 |
| 11 | 28 | 3.9 | nd | <0.005 | <0.005 | 1.7 | 0.08 | 0.016 | <0.01 | <0.005 | 0.002 | nd | nd | 0.102 | nd | 0.004 | nd | <0.001 | <0.002 | 0.005 | <0.001 | nd |
| 12 | 27 | 5.3 | nd | <0.005 | <0.005 | 0.61 | 0.17 | <0.005 | <0.01 | <0.005 | 0.004 | nd | nd | 0.156 | nd | 0.004 | nd | <0.001 | <0.002 | 0.001 | <0.001 | nd |
| 13 | 26 | 15.1 | nd | <0.005 | <0.005 | 0.20 | 0.03 | <0.005 | <0.01 | <0.005 | 0.006 | nd | nd | 0.267 | nd | 0.002 | nd | <0.001 | <0.002 | <0.001 | <0.001 | nd |
| 14 | 27 | 8.7 | 0.019 | <0.005 | <0.005 | 0.11 | 0.03 | 0.003 | <0.001 | <0.005 | 0.005 | <0.005 | <0.005 | 0.068 | <0.001 | <0.001 | 0.002 | <0.001 | <0.002 | 0.002 | <0.001 | <0.001 |
| 15 | 28 | 6.8 | 0.016 | <0.005 | <0.005 | 0.01 | 0.03 | 0.002 | <0.001 | <0.005 | 0.006 | <0.005 | <0.005 | 0.069 | <0.001 | <0.001 | 0.002 | 0.002 | <0.002 | 0.003 | <0.001 | <0.001 |
| 16 | 27 | 7.7 | nd | <0.005 | <0.005 | 0.03 | 0.03 | <0.005 | <0.01 | <0.005 | 0.030 | nd | nd | 0.321 | nd | 0.002 | nd | 0.001 | <0.002 | 0.003 | <0.001 | nd |
| 17 | 19 | 9.0 | 0.019 | <0.005 | 0.013 | 0.06 | 0.03 | 0.004 | <0.001 | 0.012 | 0.010 | <0.005 | <0.005 | 0.154 | <0.001 | 0.001 | 0.004 | 0.003 | <0.002 | 0.003 | <0.001 | <0.001 |
| 18 | 26 | 9.9 | nd | <0.005 | <0.005 | 0.18 | 0.03 | <0.005 | <0.01 | <0.005 | 0.005 | nd | nd | 0.229 | nd | 0.001 | nd | <0.001 | <0.002 | <0.001 | <0.001 | nd |
| 19 | 24 | 7.1 | 0.017 | <0.005 | <0.005 | 0.11 | 0.03 | 0.007 | <0.001 | 0.006 | 0.012 | <0.005 | <0.005 | 0.086 | <0.001 | <0.001 | 0.003 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 |
| 20 | 24 | 11.7 | nd | <0.005 | <0.005 | 0.06 | 0.03 | <0.005 | <0.01 | <0.005 | 0.007 | nd | nd | 0.332 | nd | 0.001 | nd | <0.001 | <0.002 | <0.001 | <0.001 | nd |
| 21 | 15 | 5.2 | nd | <0.005 | <0.005 | 0.28 | 0.03 | <0.005 | <0.01 | <0.005 | 0.008 | nd | nd | 0.265 | nd | <0.001 | nd | <0.001 | <0.002 | <0.001 | <0.001 | nd |
| 22 | 27 | 9.8 | 0.021 | <0.005 | <0.005 | 0.04 | 0.03 | 0.004 | <0.001 | <0.005 | 0.005 | <0.005 | <0.005 | 0.107 | <0.001 | <0.001 | 0.003 | <0.001 | <0.002 | 0.004 | <0.001 | <0.001 |
| 23 | 25 | 8.0 | 0.013 | <0.005 | <0.005 | 0.02 | 0.03 | 0.002 | <0.001 | <0.005 | 0.014 | <0.005 | <0.005 | 0.111 | <0.001 | <0.001 | 0.002 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 |
| 24 | 19 | 11.4 | 0.011 | <0.005 | <0.005 | 0.13 | 0.03 | 0.007 | <0.001 | <0.005 | 0.018 | <0.005 | <0.005 | 0.171 | <0.001 | <0.001 | 0.008 | 0.003 | <0.002 | <0.001 | <0.001 | 0.002 |
| 25 | 19 | 7.7 | 0.017 | <0.005 | <0.005 | 0.13 | 0.03 | 0.006 | <0.001 | <0.005 | 0.013 | <0.005 | <0.005 | 0.148 | <0.001 | <0.001 | 0.009 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 |
| 26 | 20 | 10.2 | 0.017 | <0.005 | 0.023 | 0.04 | 0.03 | 0.005 | <0.001 | <0.005 | 0.012 | <0.005 | <0.005 | 0.18 | <0.001 | <0.001 | 0.004 | 0.003 | <0.002 | <0.001 | <0.001 | <0.001 |
| 27 | 9.6 | 7.4 | 0.008 | <0.005 | <0.005 | 0.63 | 0.03 | 0.012 | <0.001 | <0.005 | 0.017 | <0.005 | <0.005 | 0.236 | <0.001 | <0.001 | 0.008 | 0.001 | <0.002 | <0.001 | <0.001 | <0.001 |
| 28 | 12 | 10.8 | 0.010 | <0.005 | 0.038 | 0.005 | 0.03 | 0.003 | <0.001 | <0.005 | 0.011 | <0.005 | <0.005 | 0.163 | <0.001 | <0.001 | 0.003 | 0.003 | 0.002 | <0.001 | <0.001 | <0.001 |

All concentrations in ppm (mg/L), unless otherwise noted

nd: not determined

Table A1 (cont):

| No. | Ce | Pr | Nd | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | W | Au (ppb) | Hg | Tl | Pb | Bi | Th | U |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.008 | <0.005 | <0.001 | 0.046 | 0.003 | 0.011 | <0.001 | 0.003 |
| 2 | 0.001 | <0.001 | 0.001 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.005 | <0.005 | 0.002 | 0.014 | 0.015 | 0.005 | <0.001 | 0.004 |
| 3 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | 0.013 | <0.005 | <0.001 | nd | <0.002 | nd | nd | nd |
| 4 | <0.001 | <0.001 | 0.002 | 0.001 | <0.001 | 0.002 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.009 | <0.005 | <0.001 | 0.009 | 0.011 | 0.015 | <0.001 | 0.003 |
| 5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.010 | <0.001 | 0.004 | 0.008 | <0.001 | <0.001 | 0.003 |
| 6 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | 0.018 | <0.001 | 0.003 | 0.007 | <0.001 | <0.001 | <0.001 |
| 7 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.018 | <0.001 | 0.002 | <0.002 | 0.008 | <0.001 | <0.001 |
| 8 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.016 | <0.001 | 0.001 | <0.002 | 0.002 | <0.001 | 0.003 |
| 9 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | <0.001 | 0.013 | <0.001 | nd | <0.002 | nd | nd | nd |
| 10 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.005 | <0.001 | <0.001 | 0.015 | 0.002 | <0.001 | 0.002 |
| 11 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | <0.001 | 0.008 | <0.001 | nd | <0.002 | nd | nd | nd |
| 12 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | <0.001 | 0.012 | <0.001 | nd | <0.002 | nd | nd | nd |
| 13 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | <0.001 | 0.024 | <0.001 | nd | <0.002 | nd | nd | nd |
| 14 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.060 | <0.001 | <0.001 | 0.006 | <0.001 | 0.001 | 0.002 |
| 15 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.113 | <0.001 | 0.001 | <0.002 | 0.002 | <0.001 | <0.001 |
| 16 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | <0.001 | 0.173 | <0.001 | nd | 0.031 | nd | nd | nd |
| 17 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.181 | <0.001 | <0.001 | 0.020 | 0.022 | 0.004 | <0.001 |
| 18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | <0.001 | 0.082 | <0.001 | nd | <0.002 | nd | nd | nd |
| 19 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.046 | <0.001 | <0.001 | <0.002 | 0.002 | <0.001 | 0.002 |
| 20 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | <0.001 | 0.024 | <0.001 | nd | <0.002 | nd | nd | nd |
| 21 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | <0.001 | 0.009 | <0.001 | nd | <0.002 | nd | nd | nd |
| 22 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.028 | <0.001 | <0.001 | 0.007 | 0.020 | 0.001 | <0.001 |
| 23 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.088 | <0.001 | 0.003 | 0.007 | 0.022 | <0.001 | <0.001 |
| 24 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.086 | <0.001 | 0.001 | 0.005 | 0.006 | <0.001 | <0.001 |
| 25 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.008 | <0.001 | <0.001 | <0.002 | 0.001 | <0.001 | <0.001 |
| 26 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | 0.075 | <0.001 | 0.003 | 0.005 | <0.001 | <0.001 | 0.004 |
| 27 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | 0.020 | <0.001 | <0.001 | <0.002 | 0.002 | <0.001 | 0.003 |
| 28 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.029 | <0.001 | <0.001 | <0.002 | 0.001 | <0.001 | 0.002 |

All concentrations in ppm (mg/L), unless otherwise noted

nd: not determined

# APPENDIX 2: ELEMENT/ION CONCENTRATION FOR GROUNDWATERS - GRAPHED

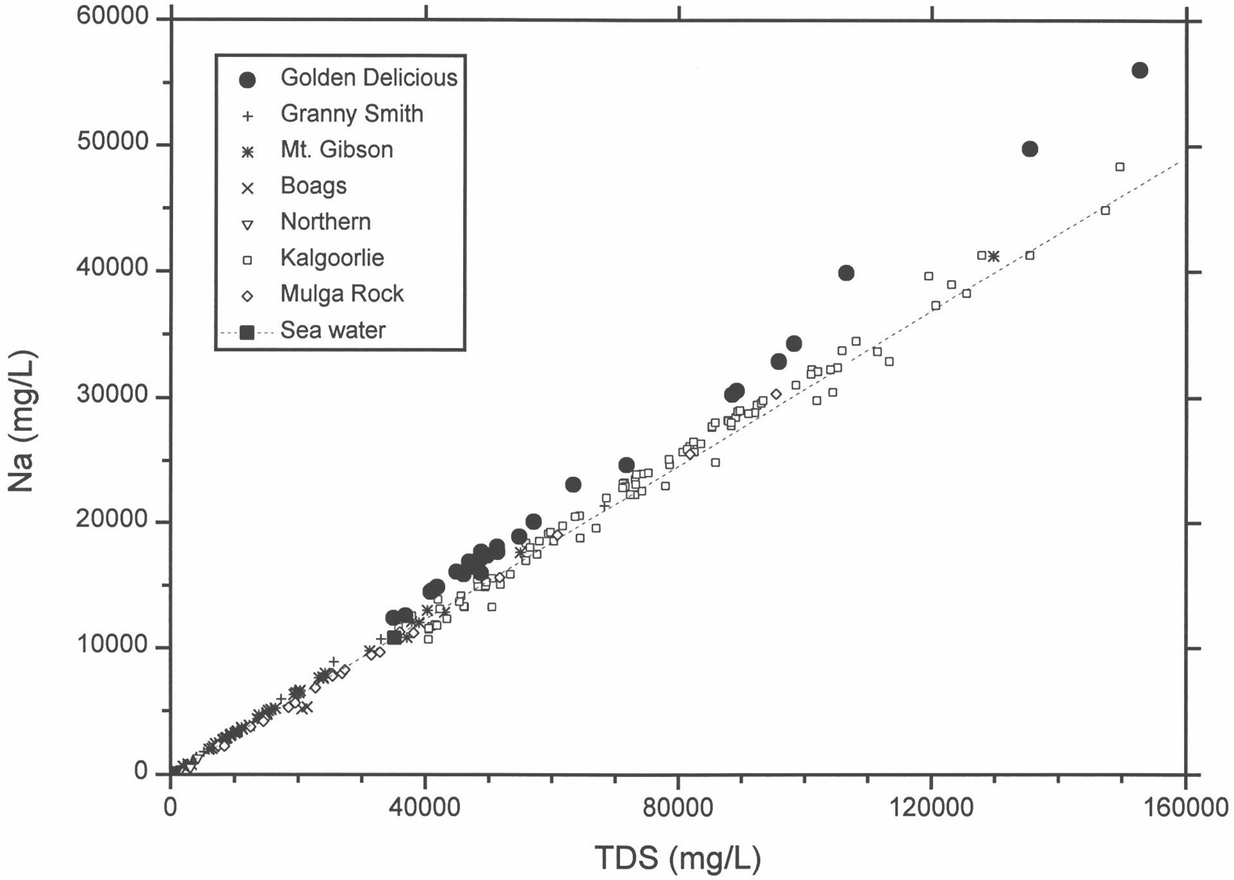

Figure A2.1: Na vs. TDS for groundwaters from Golden Delicious and other sites.

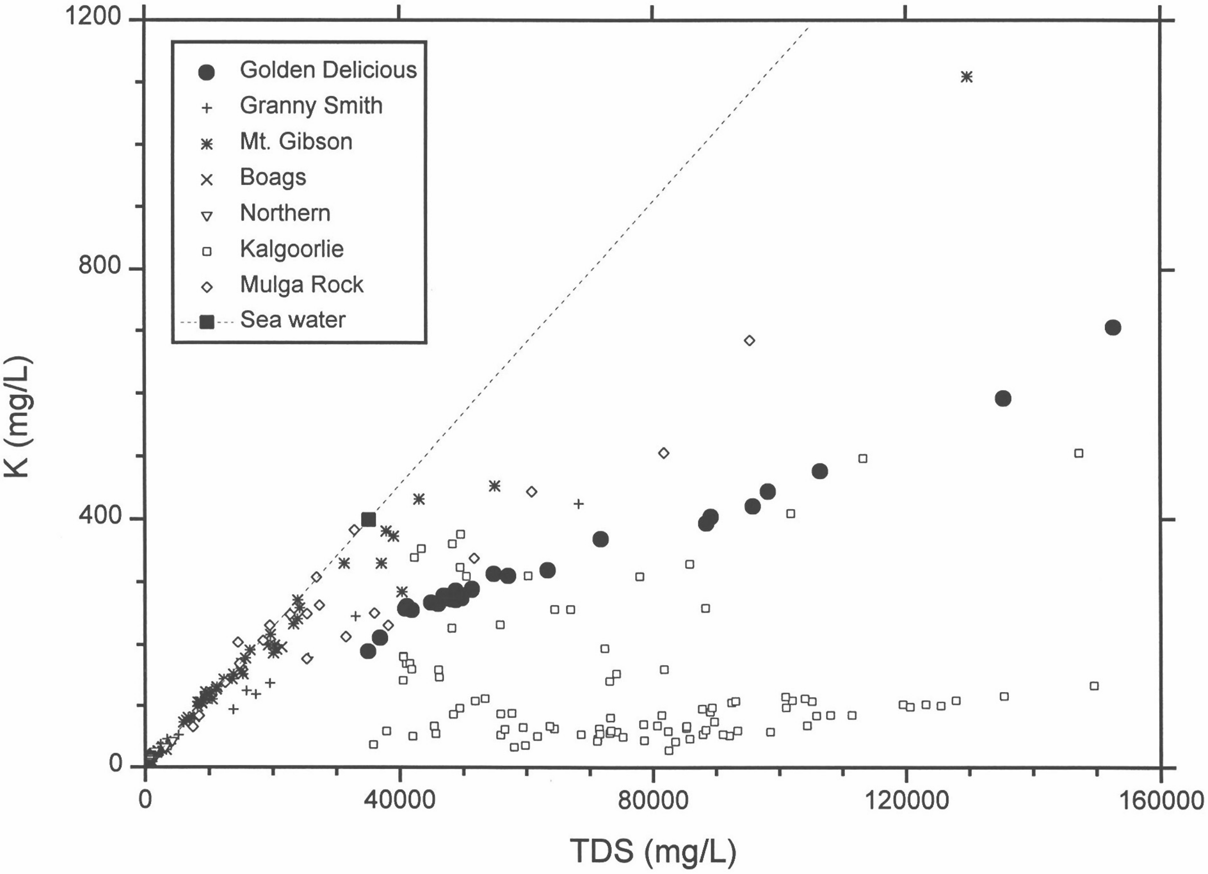

Figure A2.2: K vs. TDS for groundwaters from Golden Delicious and other sites.

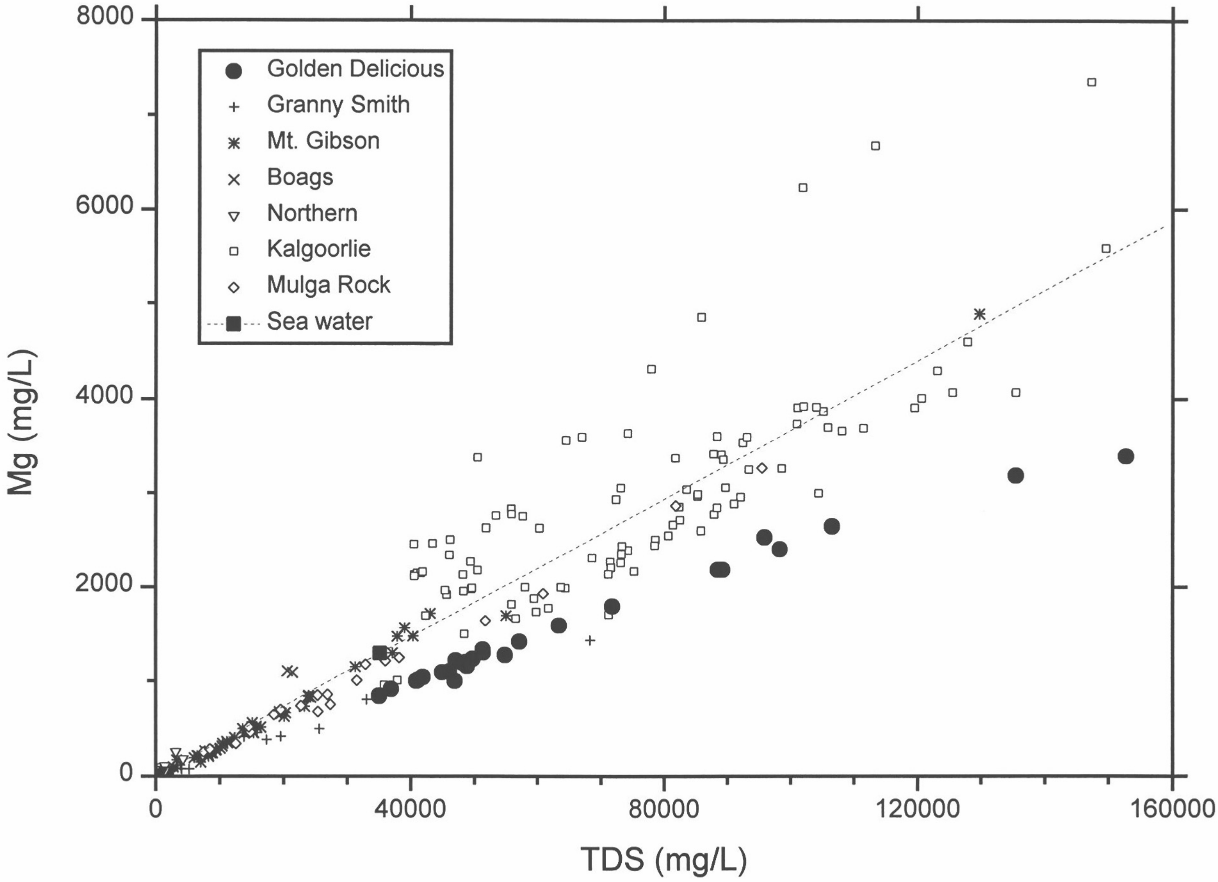

Figure A2.3: Mg vs. TDS for groundwaters from Golden Delicious and other sites.

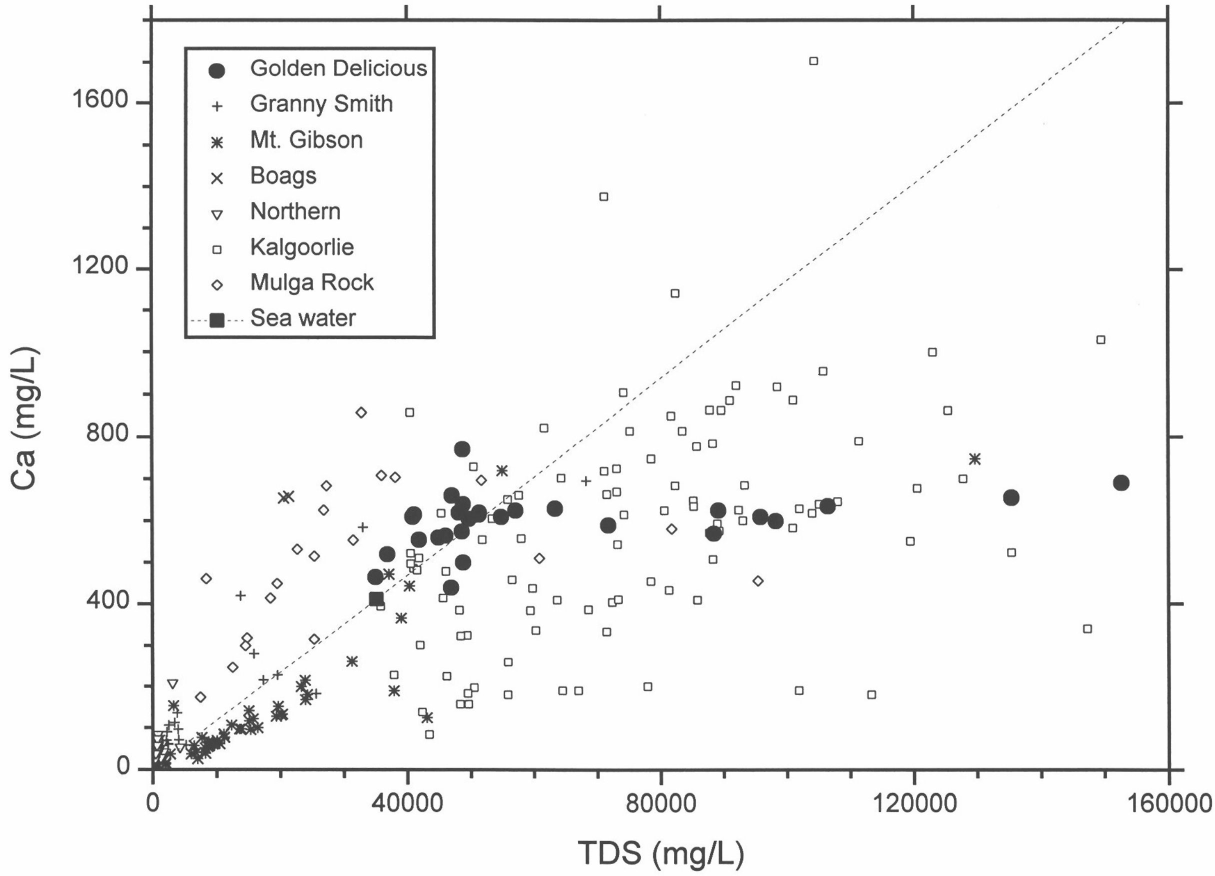

Figure A2.4: Ca vs. TDS for groundwaters from Golden Delicious and other sites.

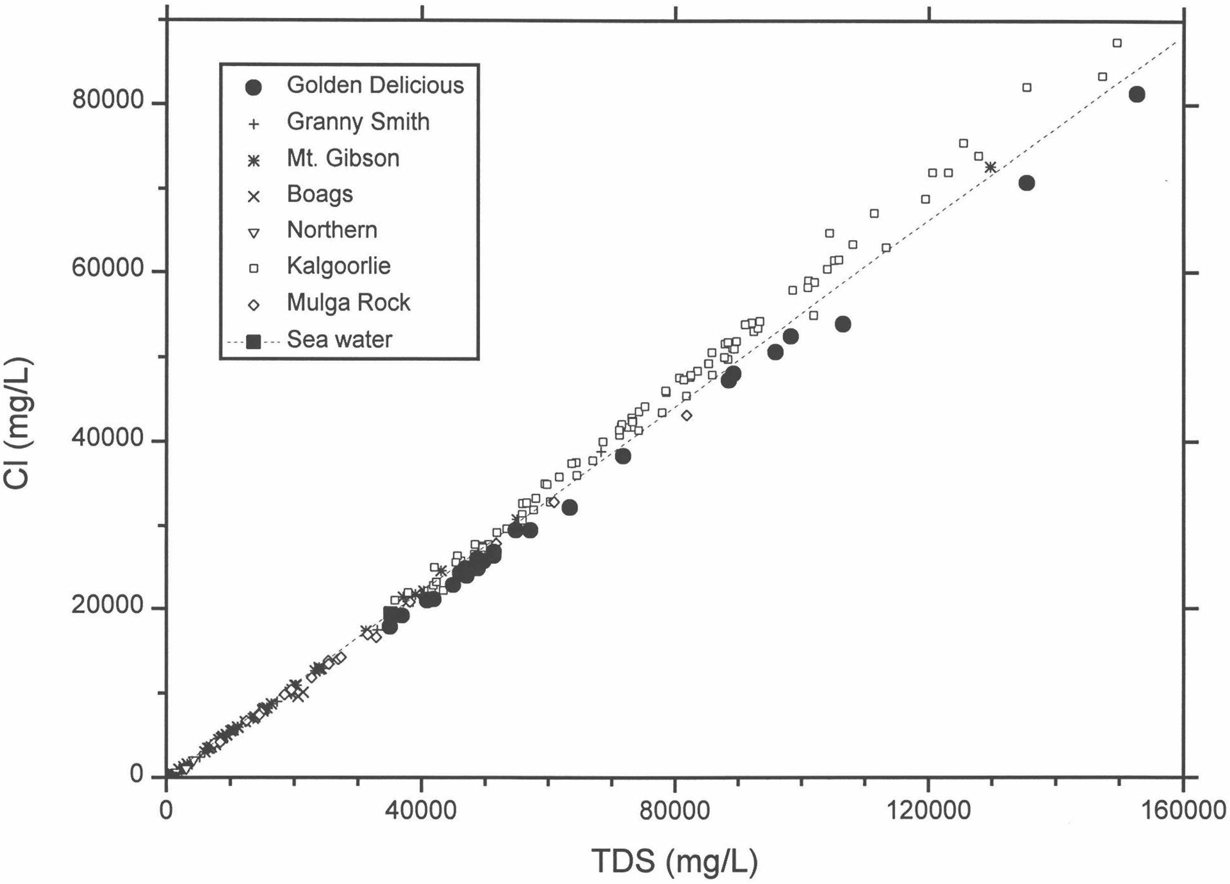

Figure A2.5: Cl vs. TDS for groundwaters from Golden Delicious and other sites.

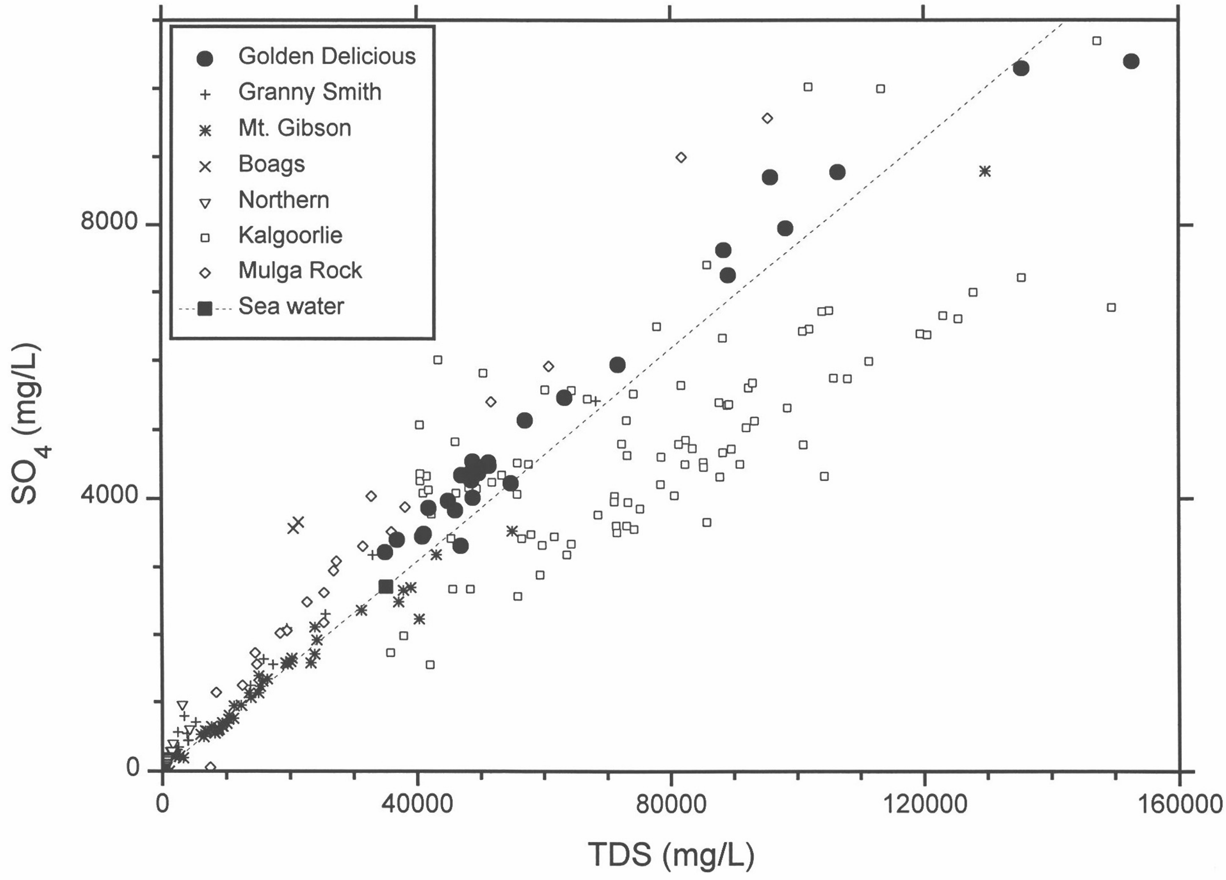

Figure A2.6 $SO_4$ vs. TDS for groundwaters from Golden Delicious and other sites.

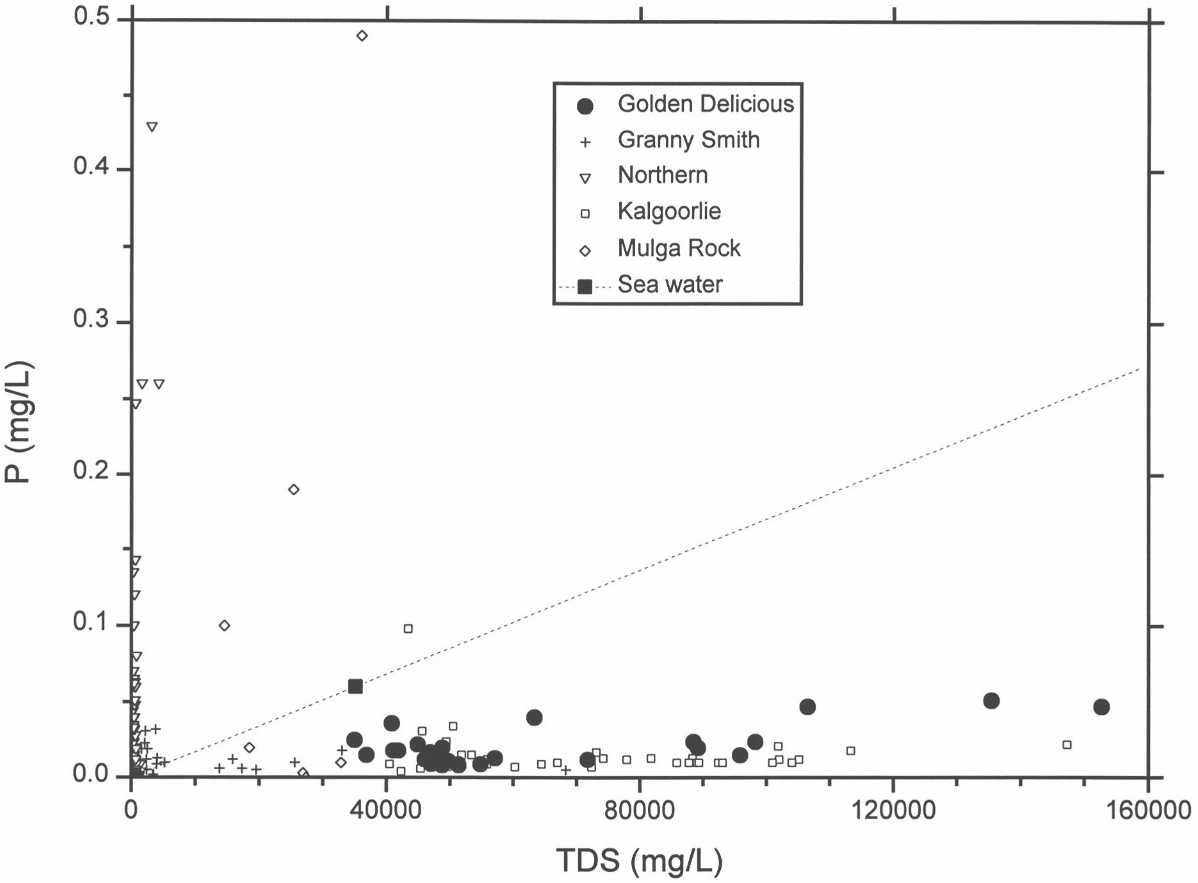

Figure A2.7: P vs. TDS for groundwaters from Golden Delicious and other sites.

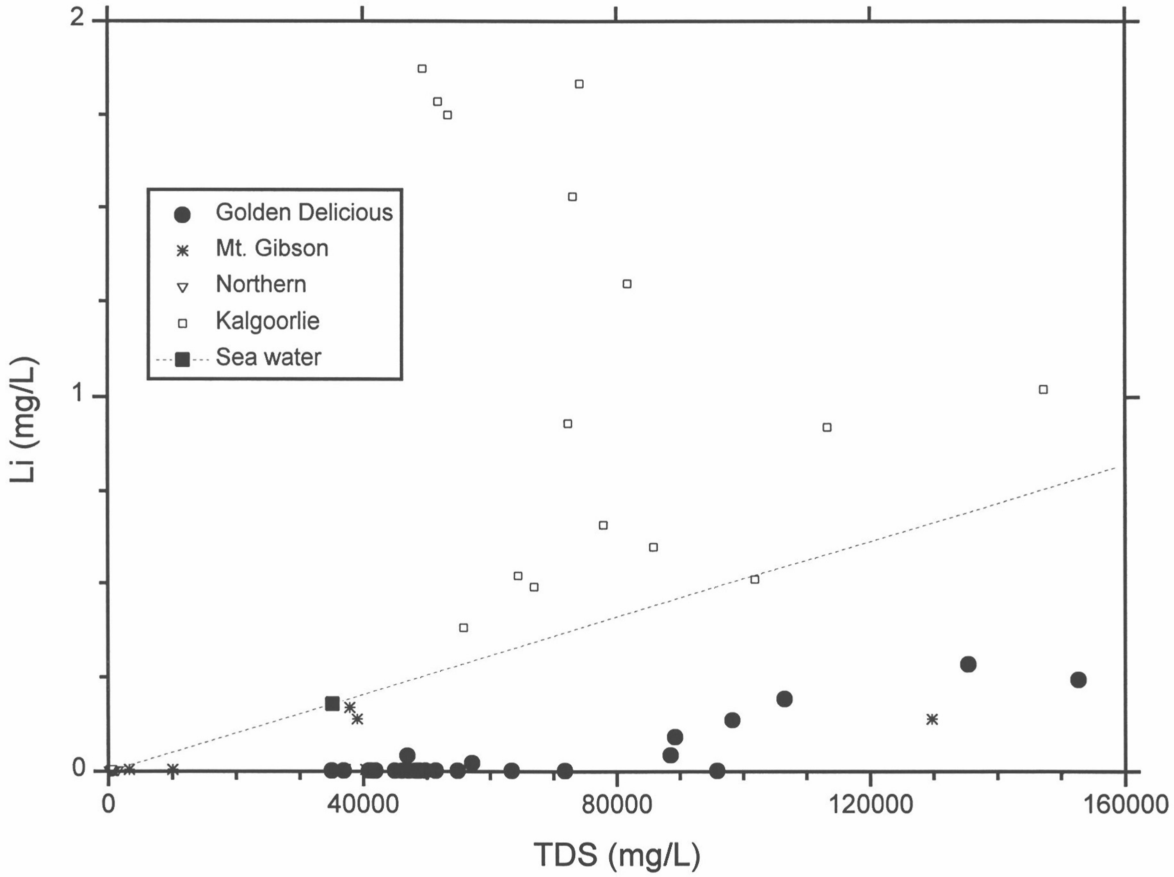

Figure A2.8: Li vs. TDS for groundwaters from Golden Delicious and other sites.

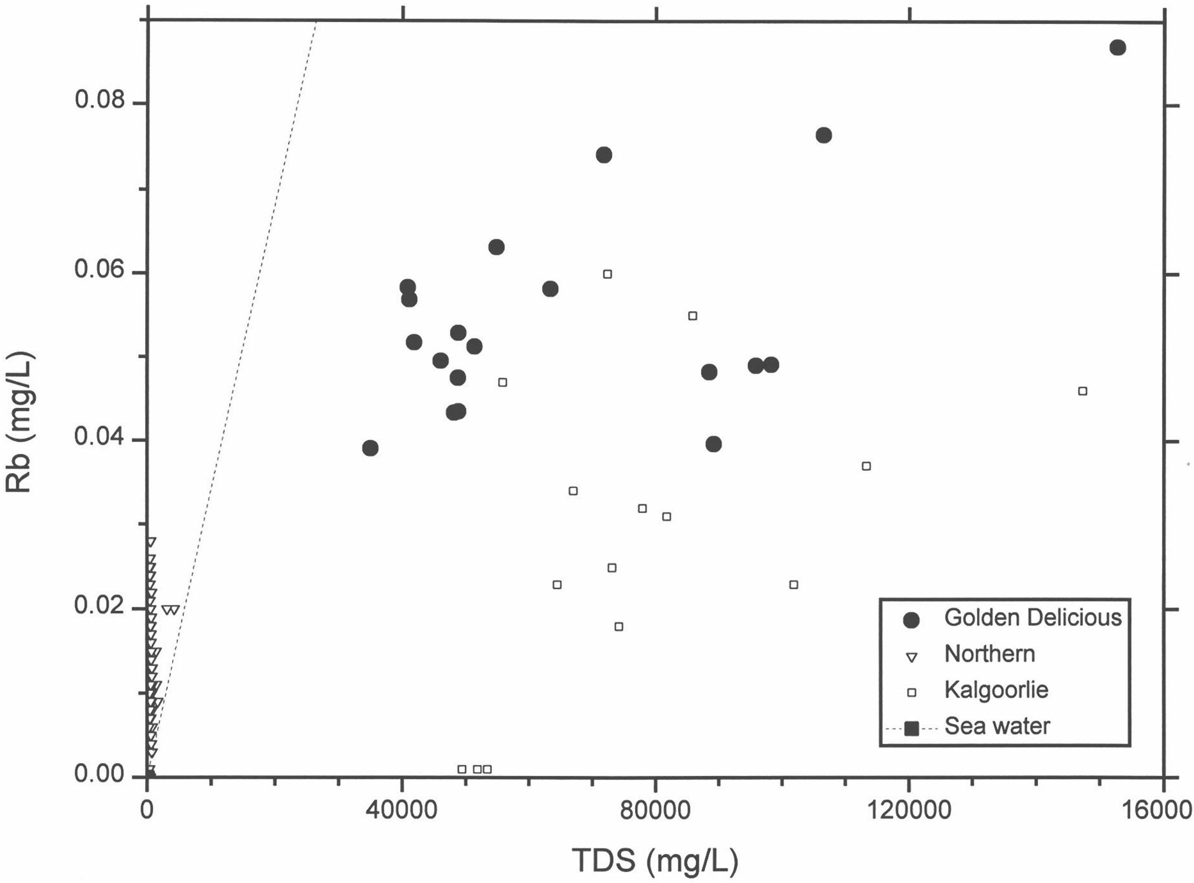

Figure A2.9: Rb vs. TDS for groundwaters from Golden Delicious and other sites.

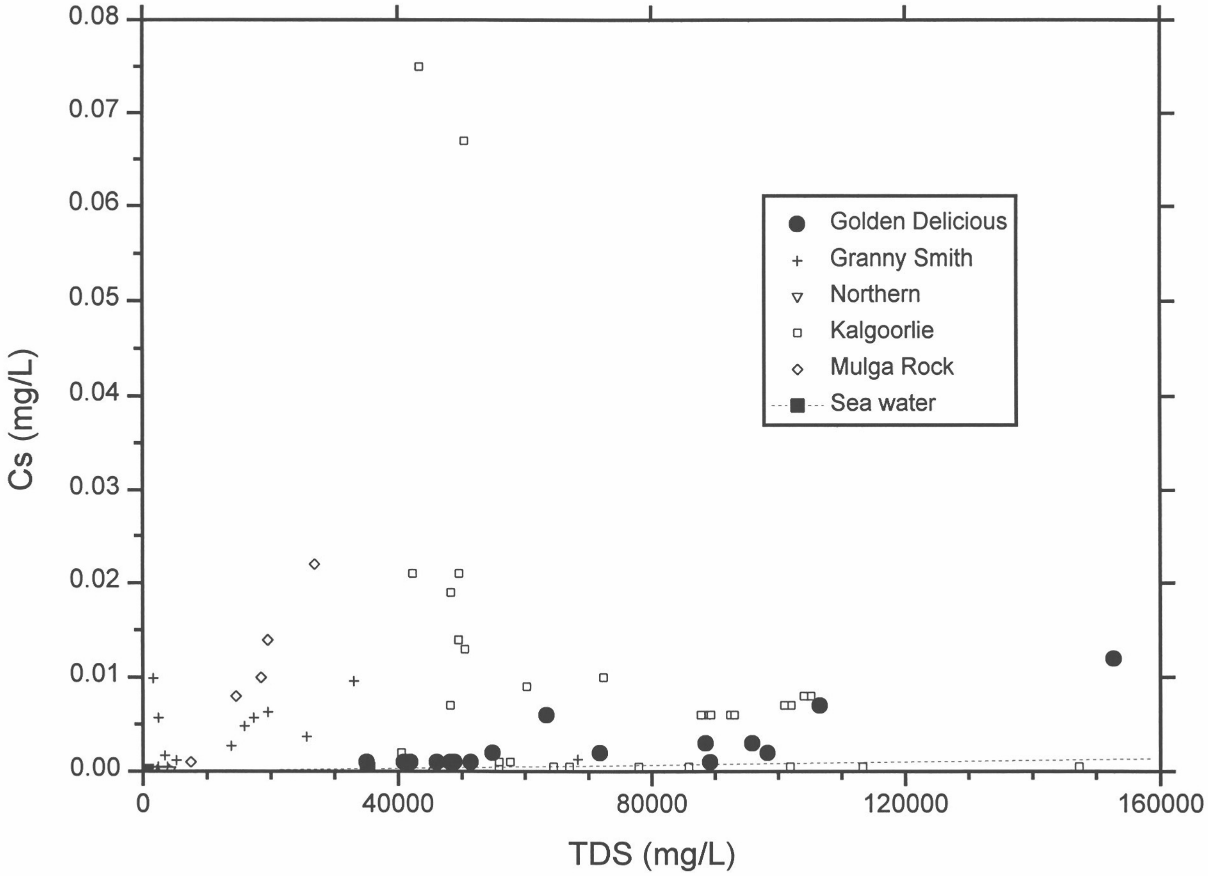

Figure A2.10: Cs vs. TDS for groundwaters from Golden Delicious and other sites.

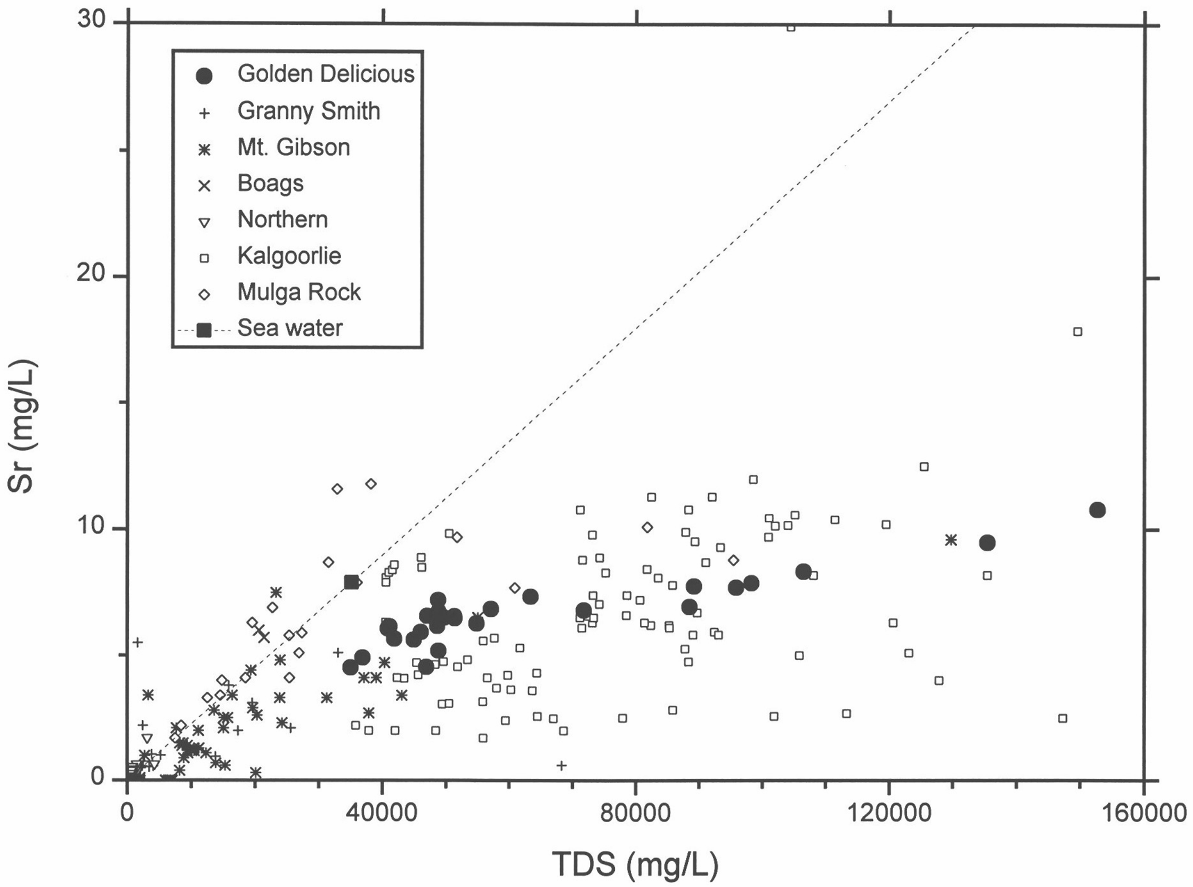

Figure A2.11: Sr vs. TDS for groundwaters from Golden Delicious and other sites.

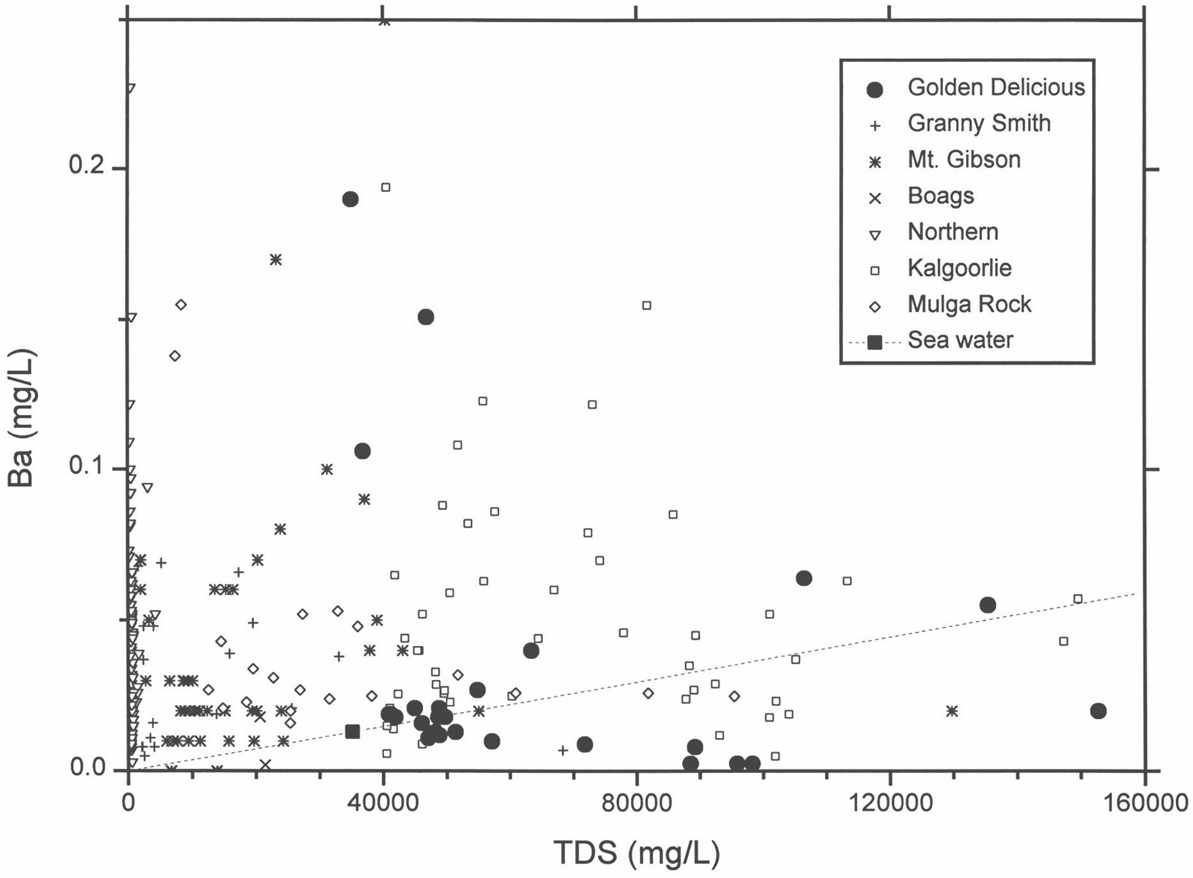

Figure A2.12: Ba vs. TDS for groundwaters from Golden Delicious and other sites.

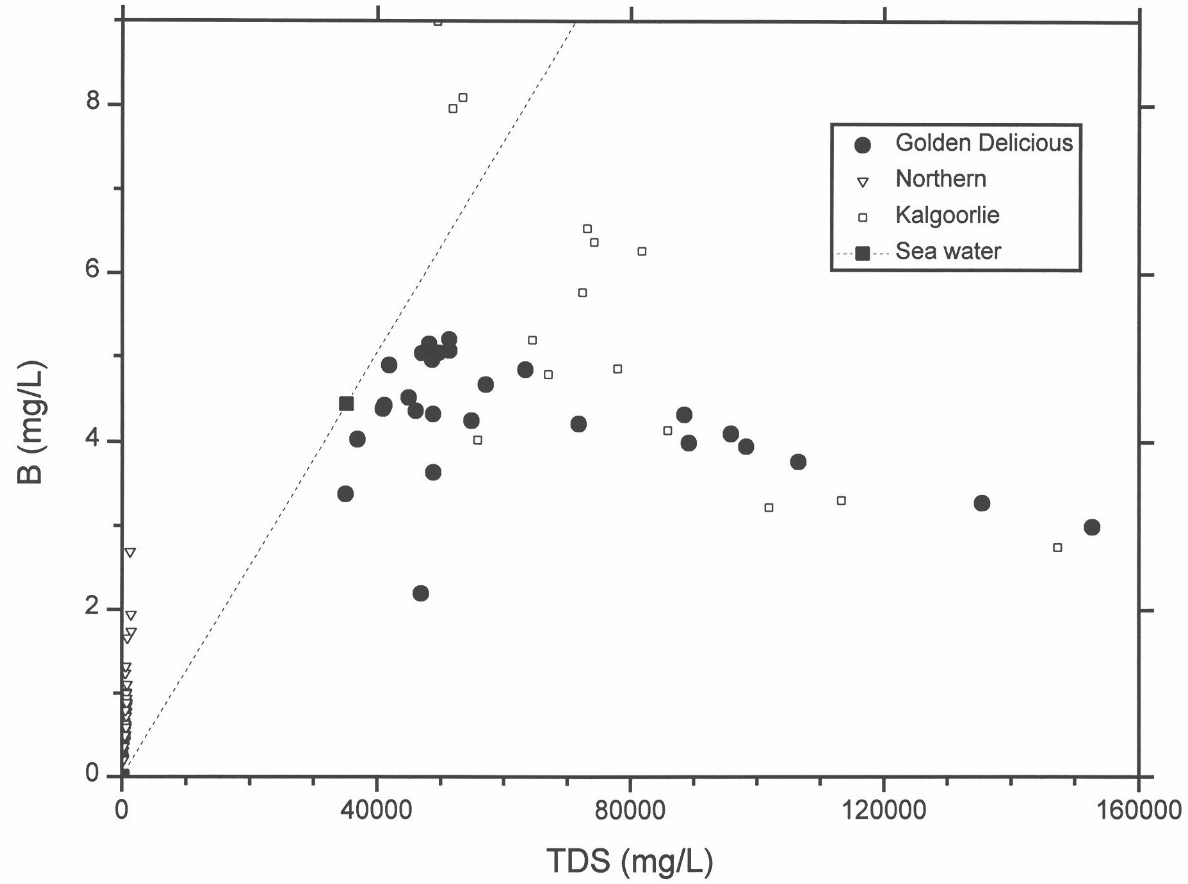

Figure A2.13: B vs. TDS for groundwaters from Golden Delicious and other sites.

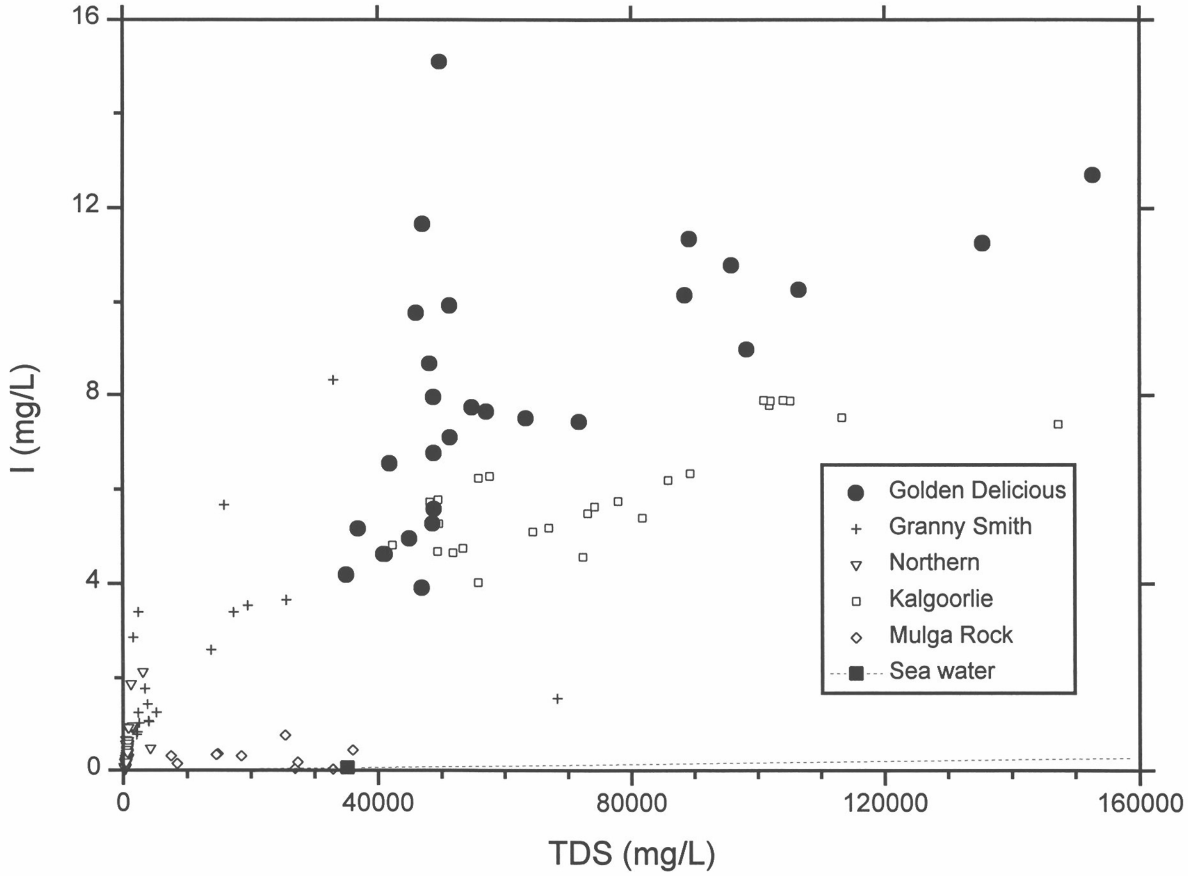

Figure A2.14: I vs. TDS for groundwaters from Golden Delicious and other sites.

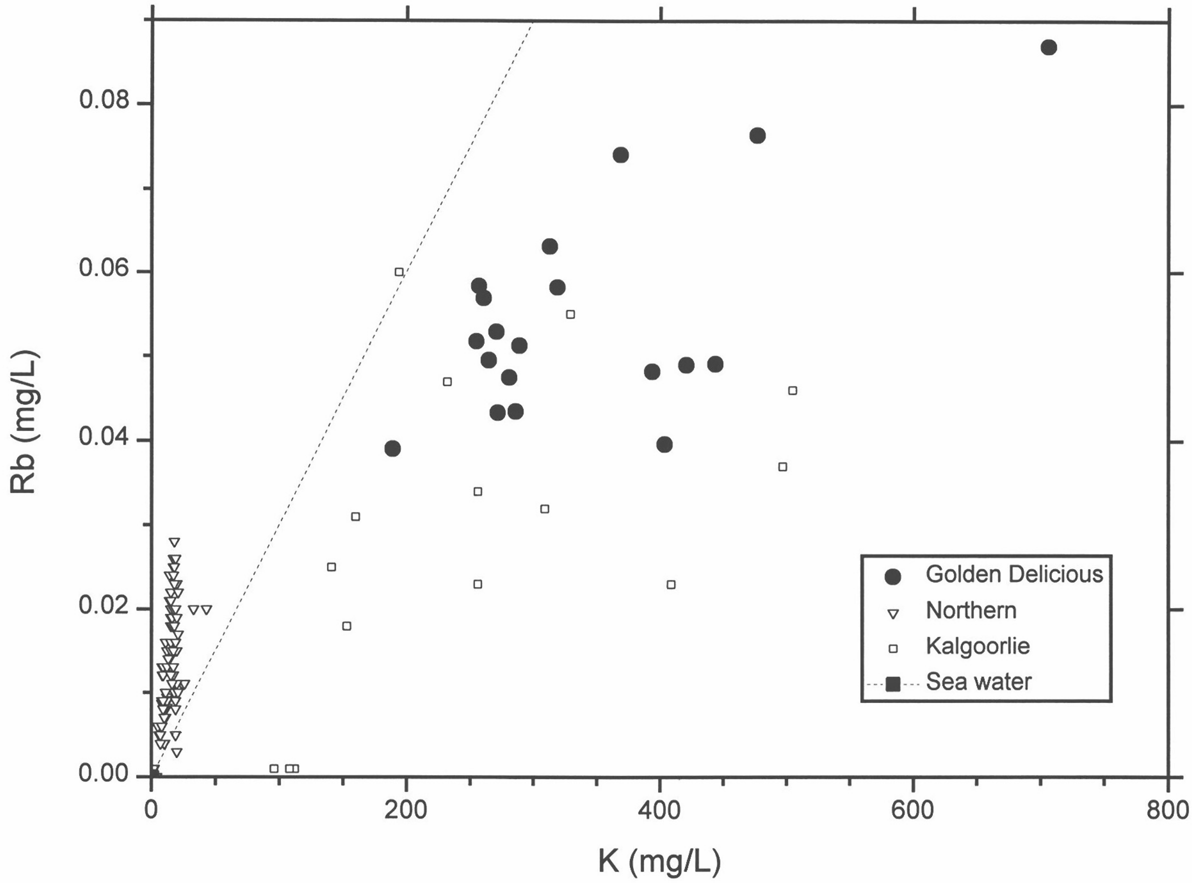

Figure A2.15: Rb vs. K for groundwaters from Golden Delicious and other sites.

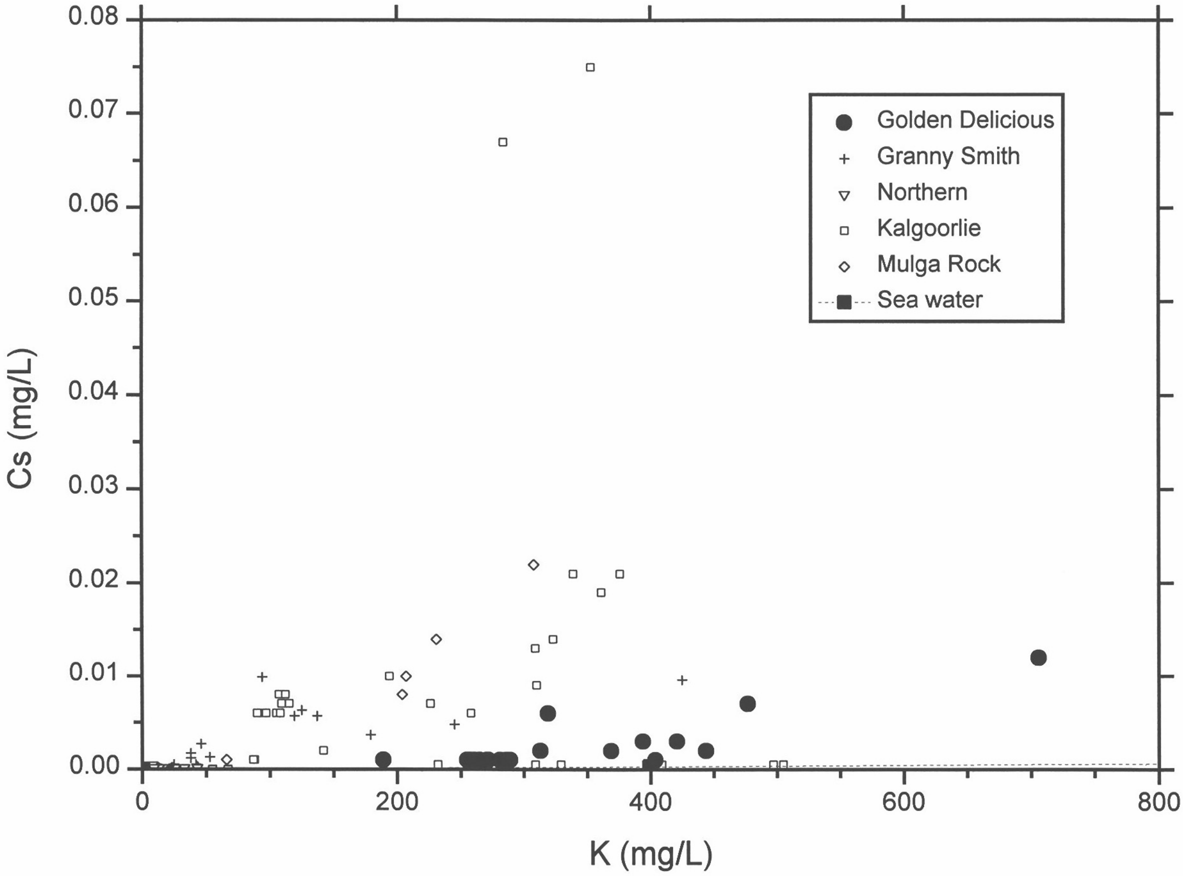

Figure A2.16: Cs vs. K for groundwaters from Golden Delicious and other sites.

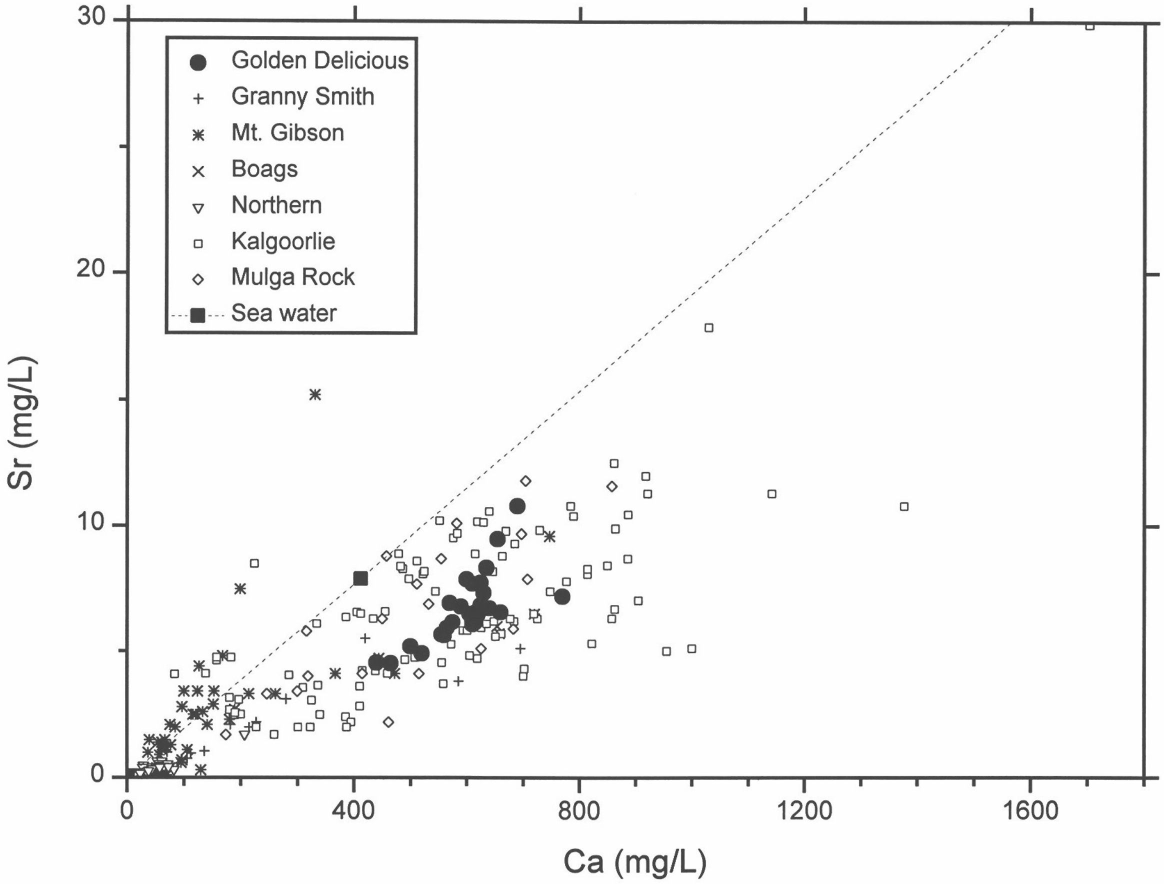

Figure A2.17: Sr vs. Ca for groundwaters from Golden Delicious and other sites.

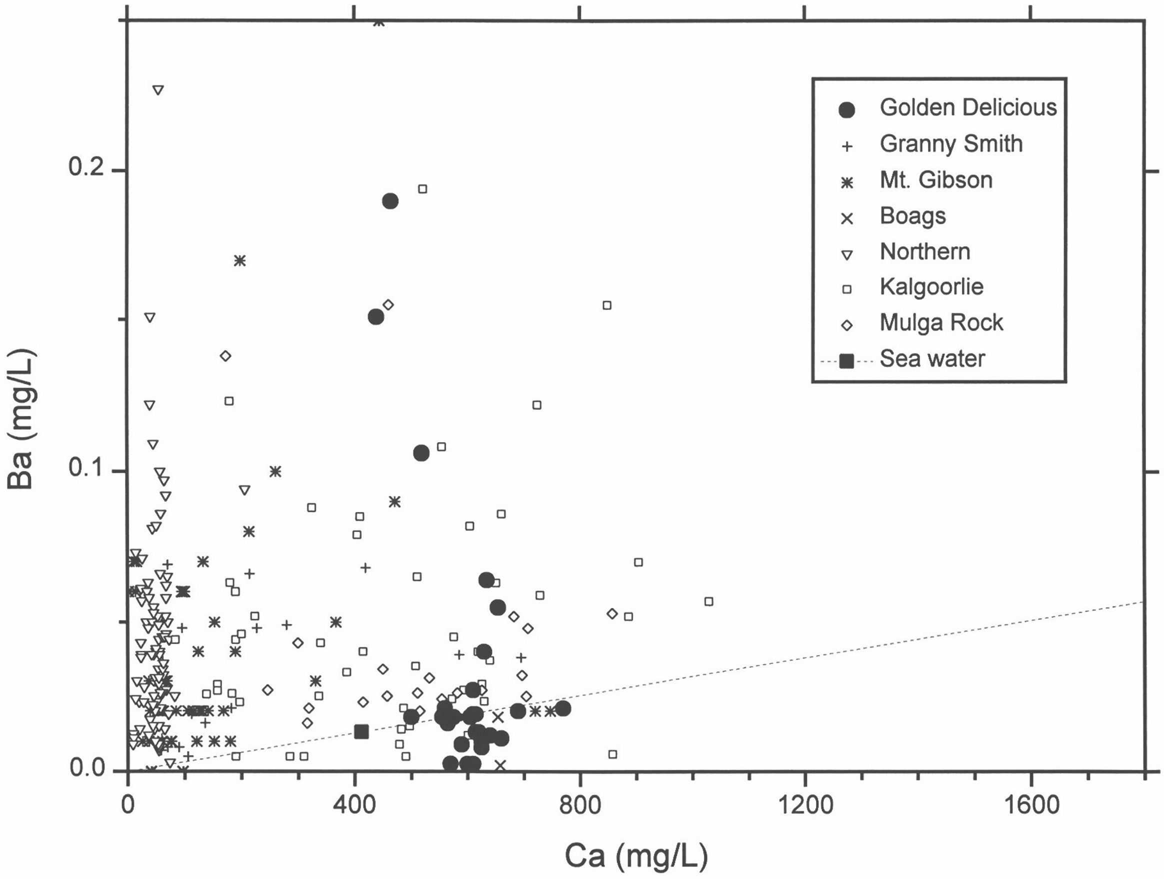

Figure A2.18: Ba vs. Ca for groundwaters from Golden Delicious and other sites.

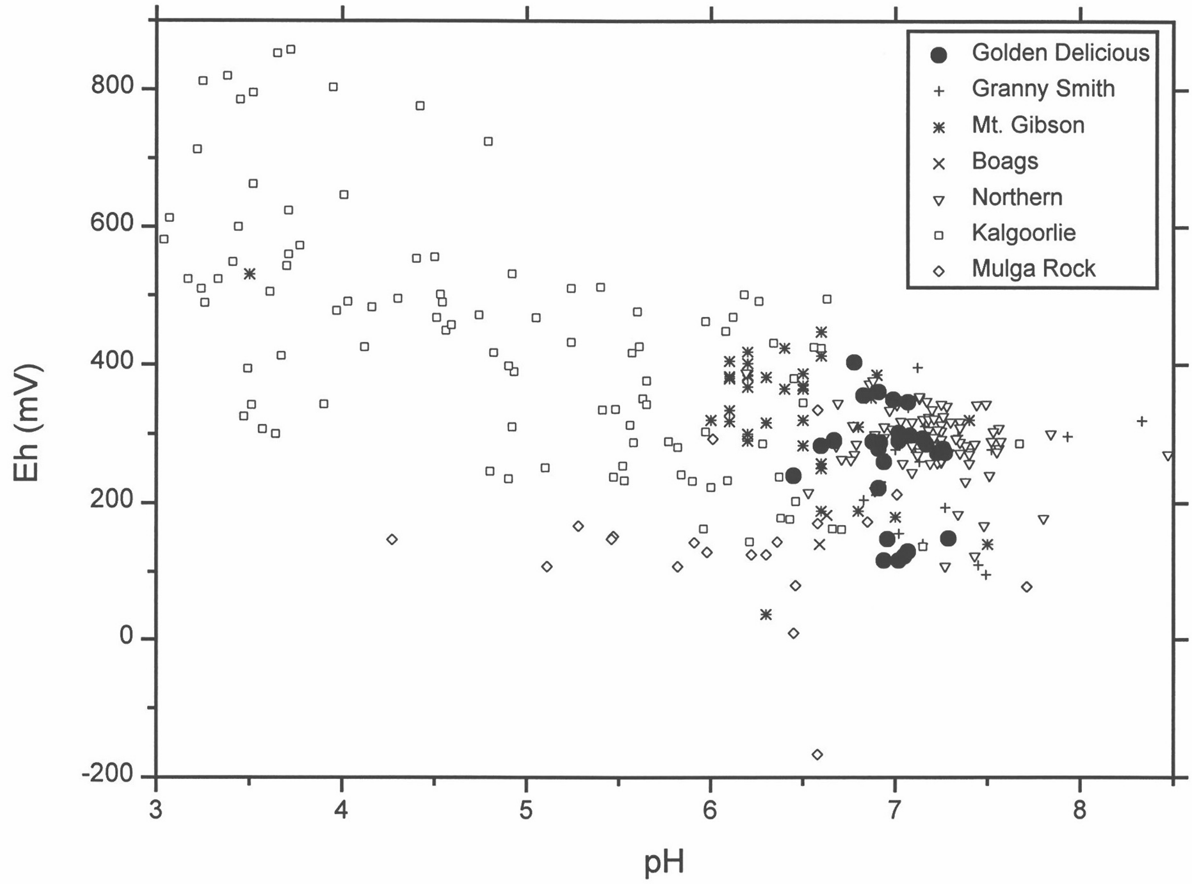

Figure A2.19: Eh vs. pH for groundwaters from Golden Delicious and other sites.

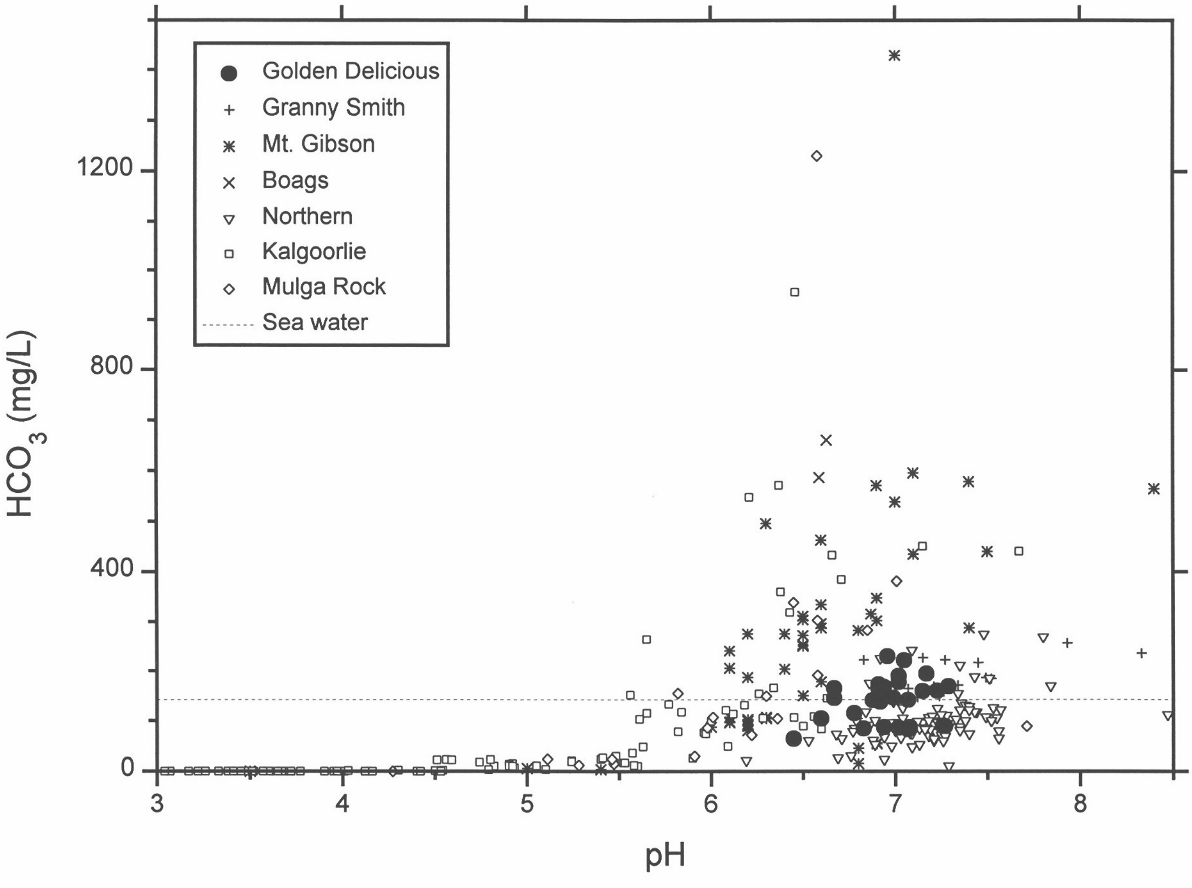

Figure A2.20: $HCO_3$ vs. pH for groundwaters from Golden Delicious and other sites.

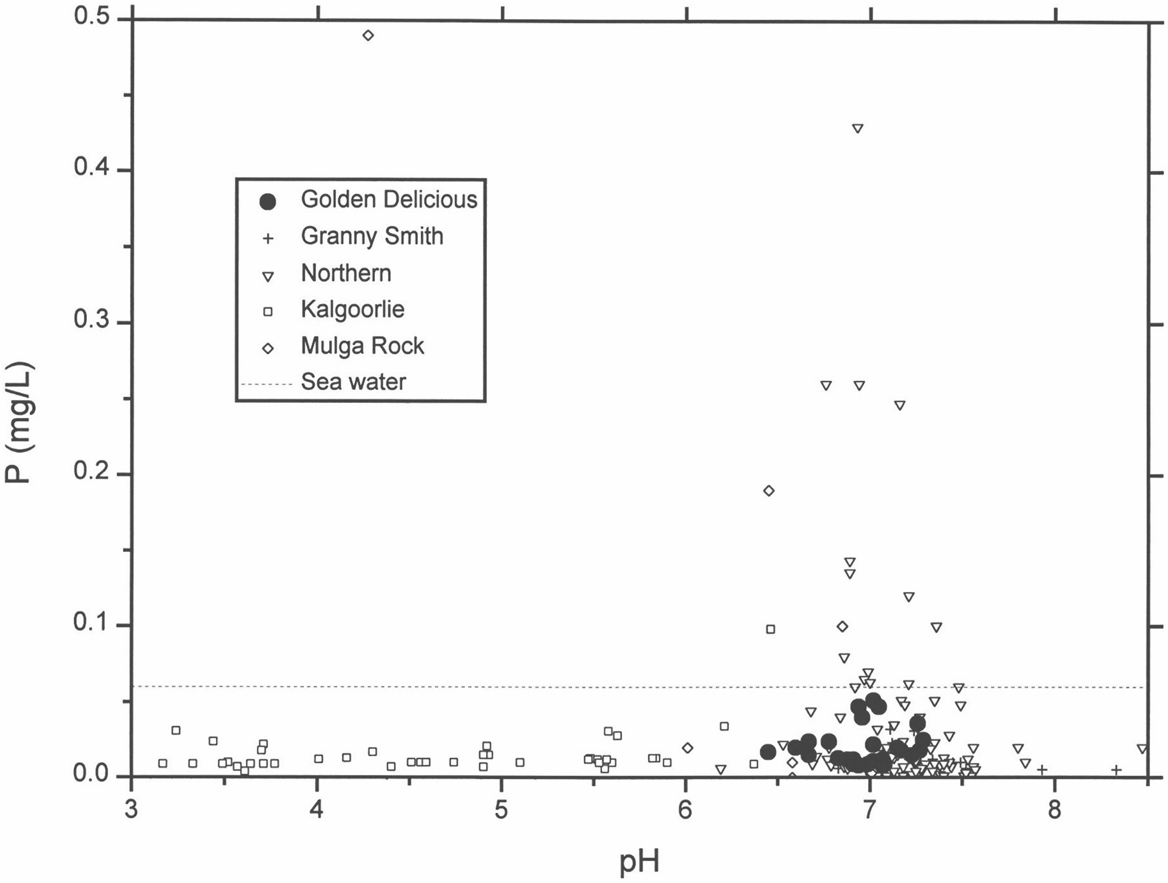

Figure A2.21: P vs. pH for groundwaters from Golden Delicious and other sites.

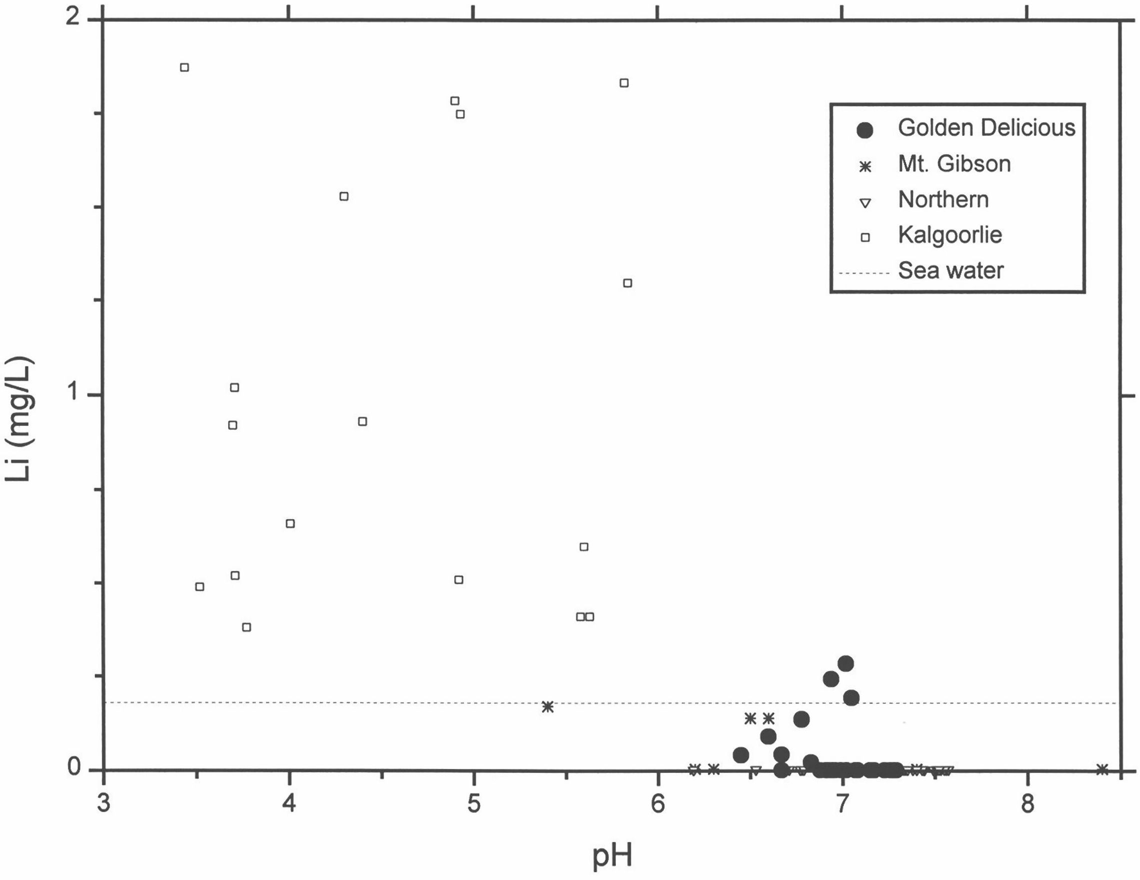

Figure A2.22: Li vs. pH for groundwaters from Golden Delicious and other sites.

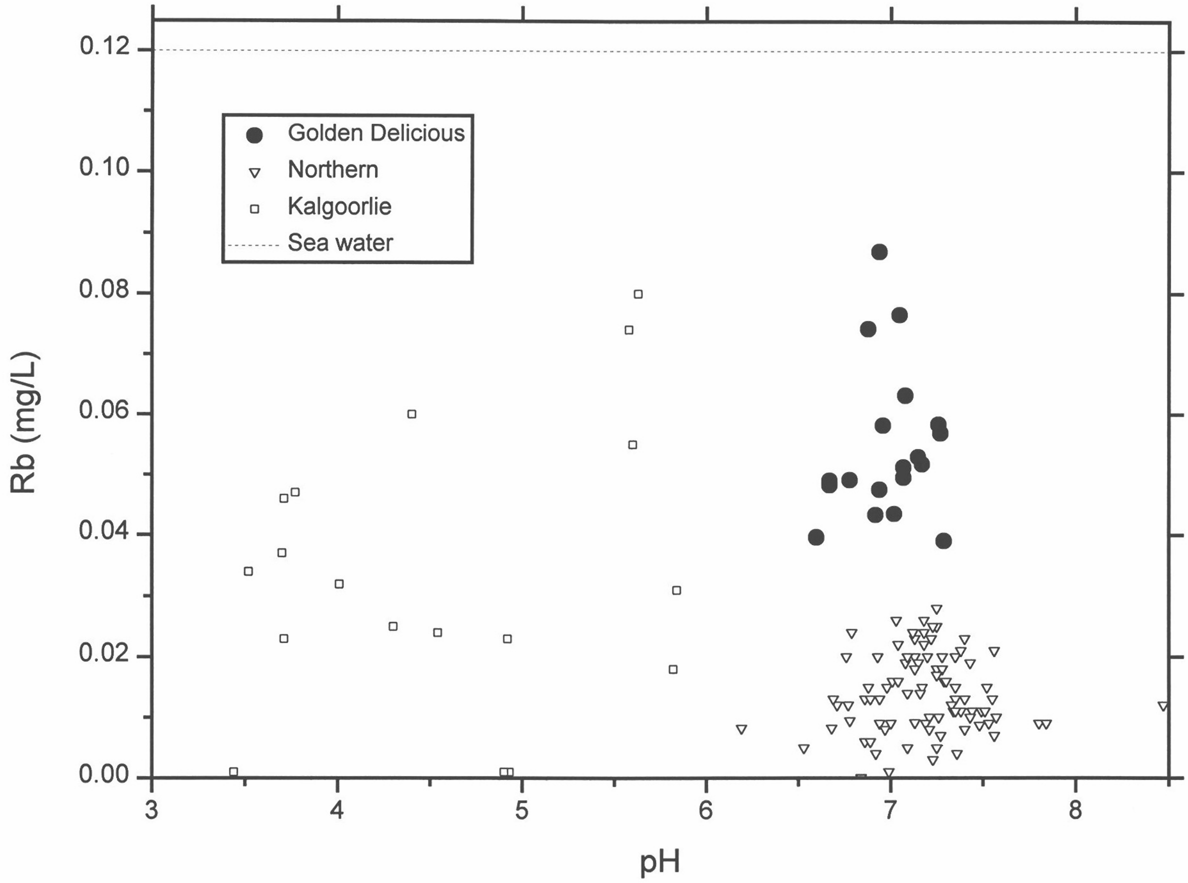

Figure A2.23: Rb vs. pH for groundwaters from Golden Delicious and other sites.

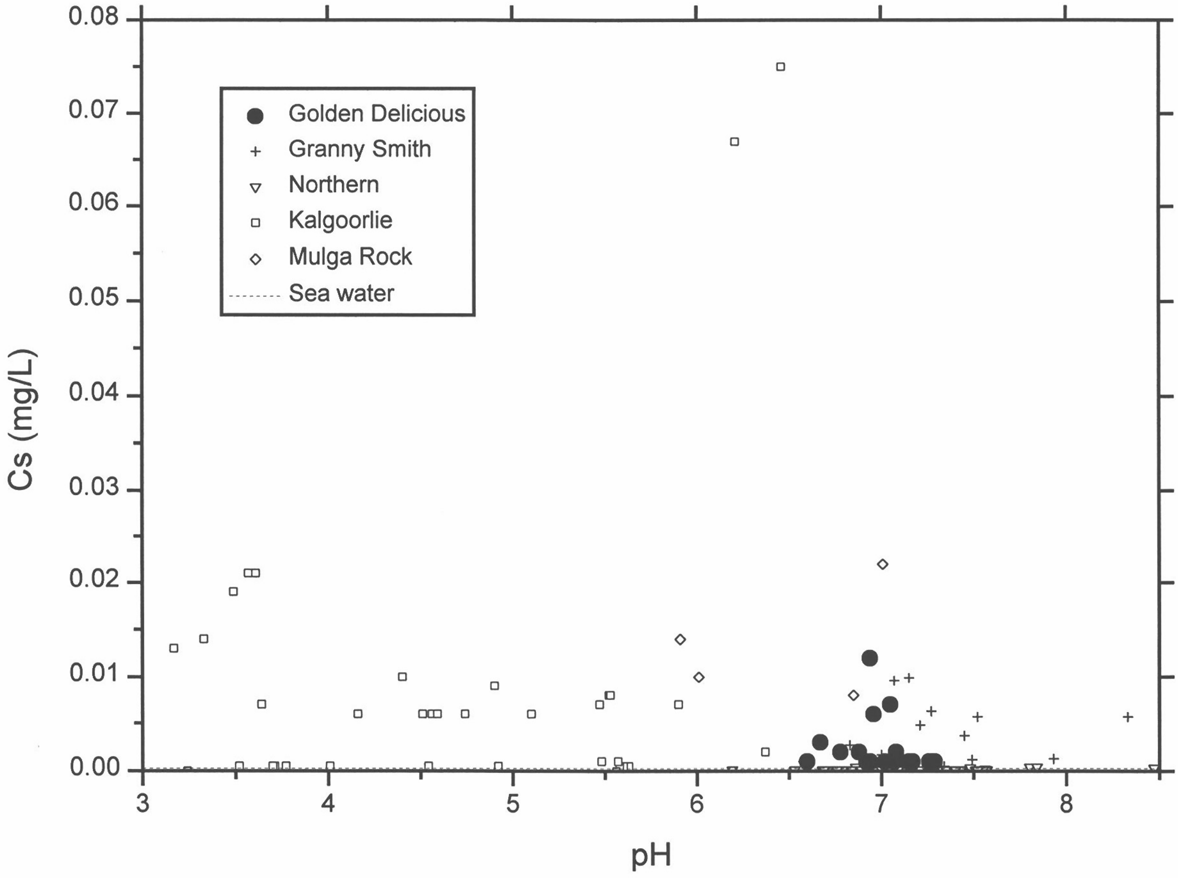

Figure A2.24: Cs vs. pH for groundwaters from Golden Delicious and other sites.

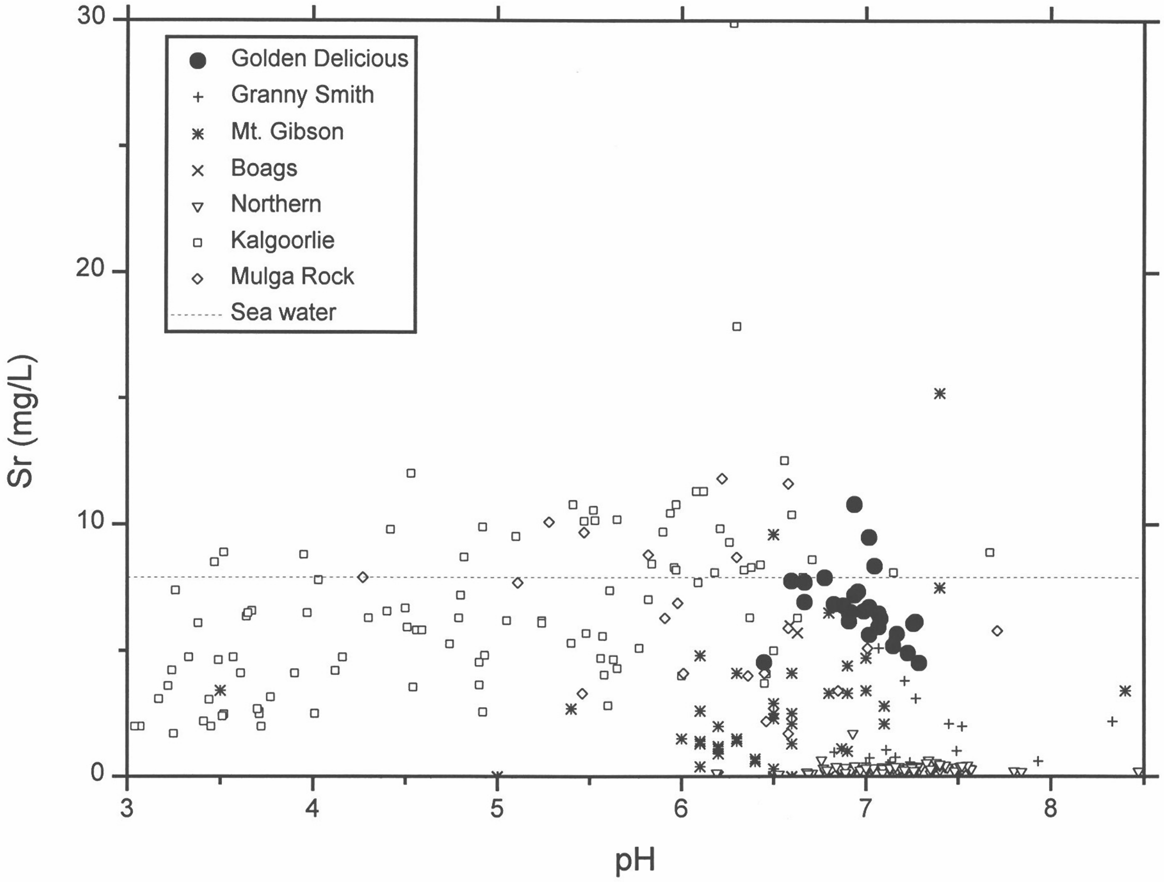

Figure A2.25: Sr vs. pH for groundwaters from Golden Delicious and other sites.

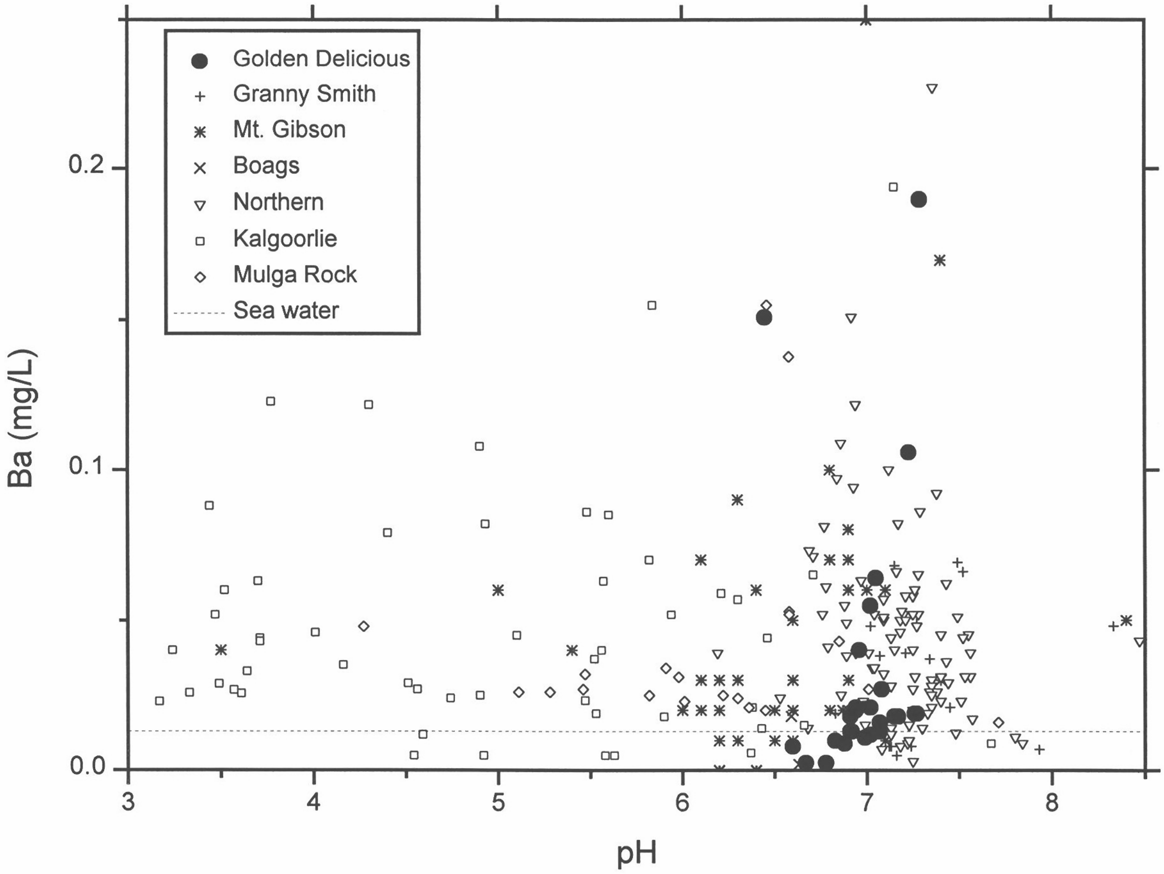

Figure A2.26: Ba vs. pH for groundwaters from Golden Delicious and other sites.

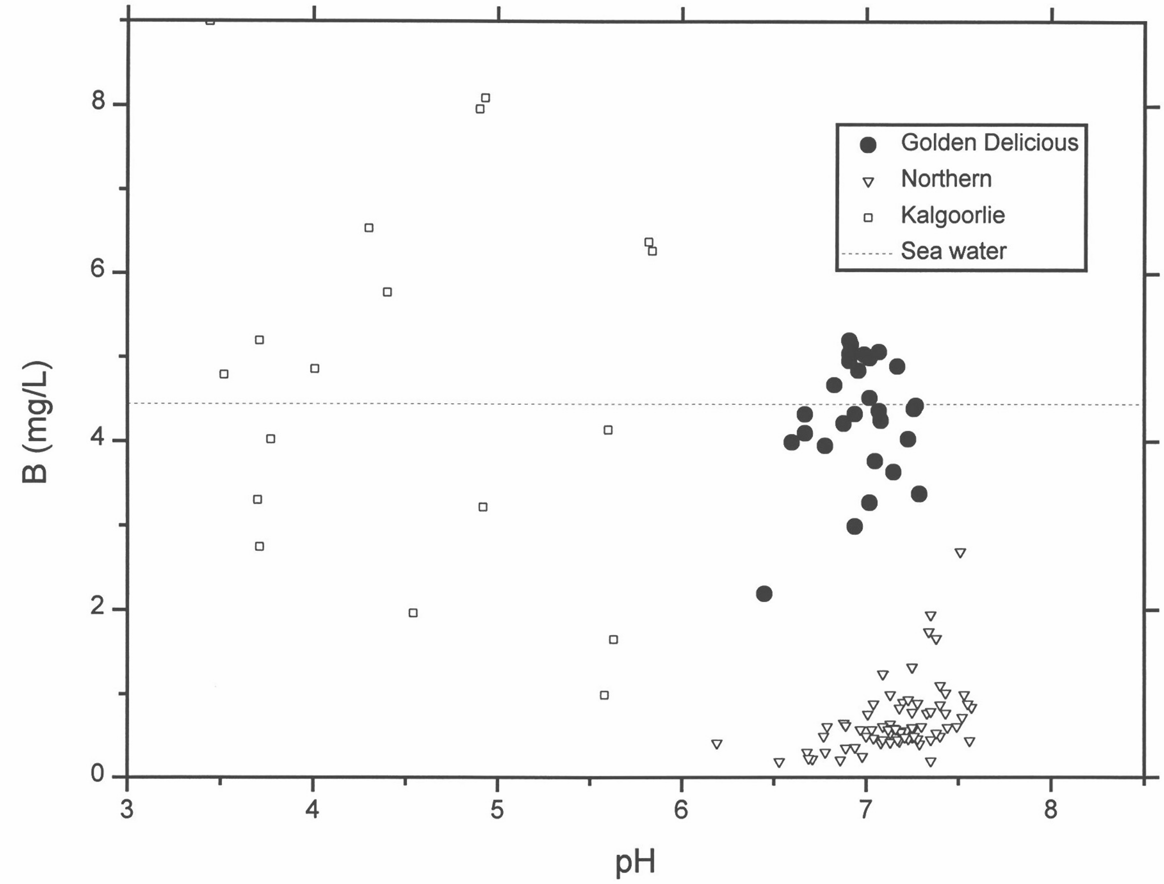

Figure A2.27: B vs. pH for groundwaters from Golden Delicious and other sites.

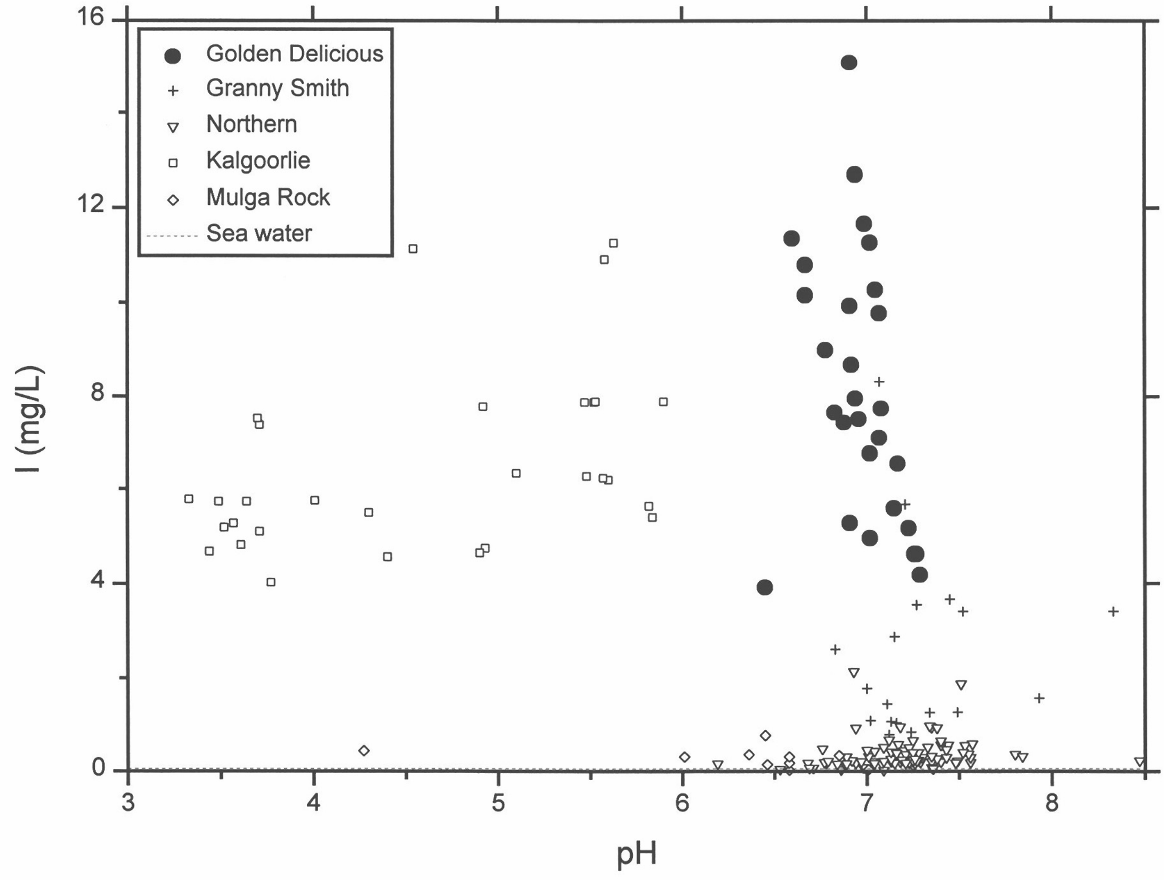

Figure A2.28: I vs. pH for groundwaters from Golden Delicious and other sites.

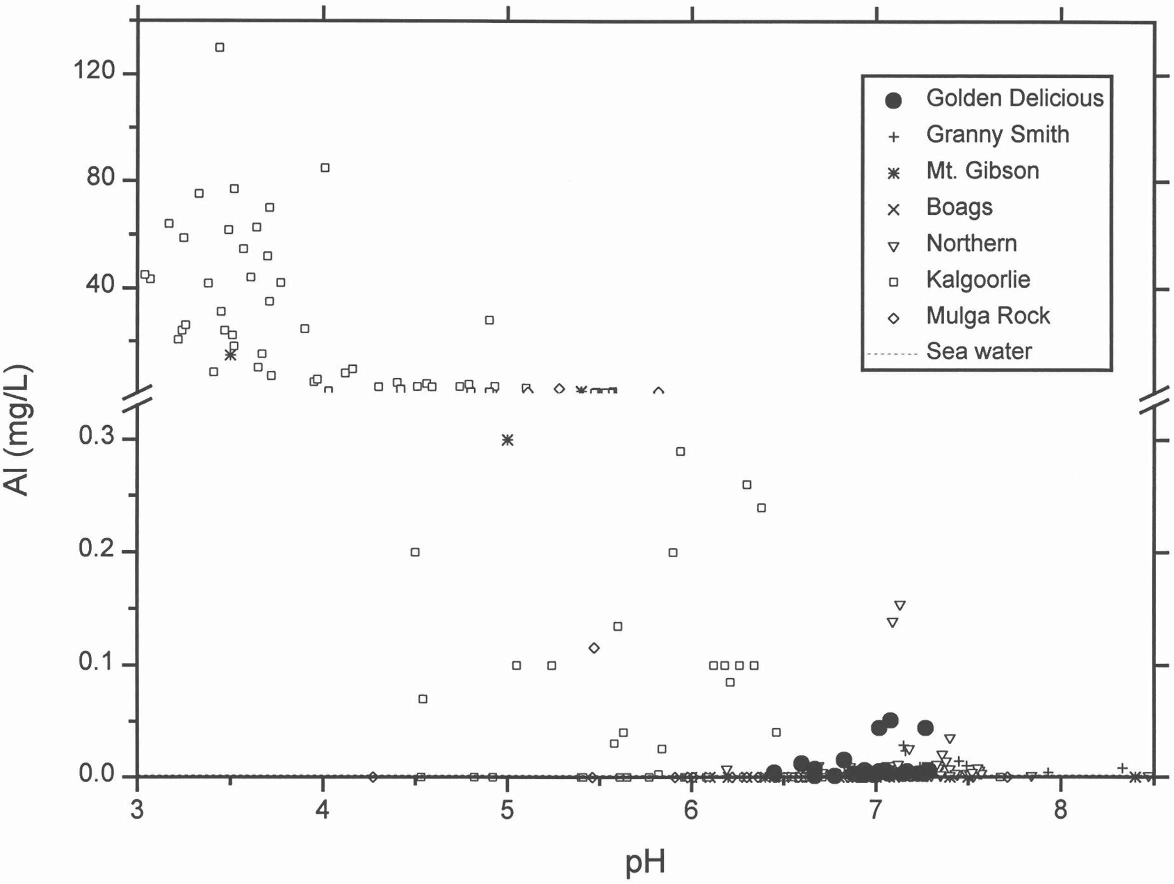

Figure A2.29: Al vs. pH for groundwaters from Golden Delicious and other sites.

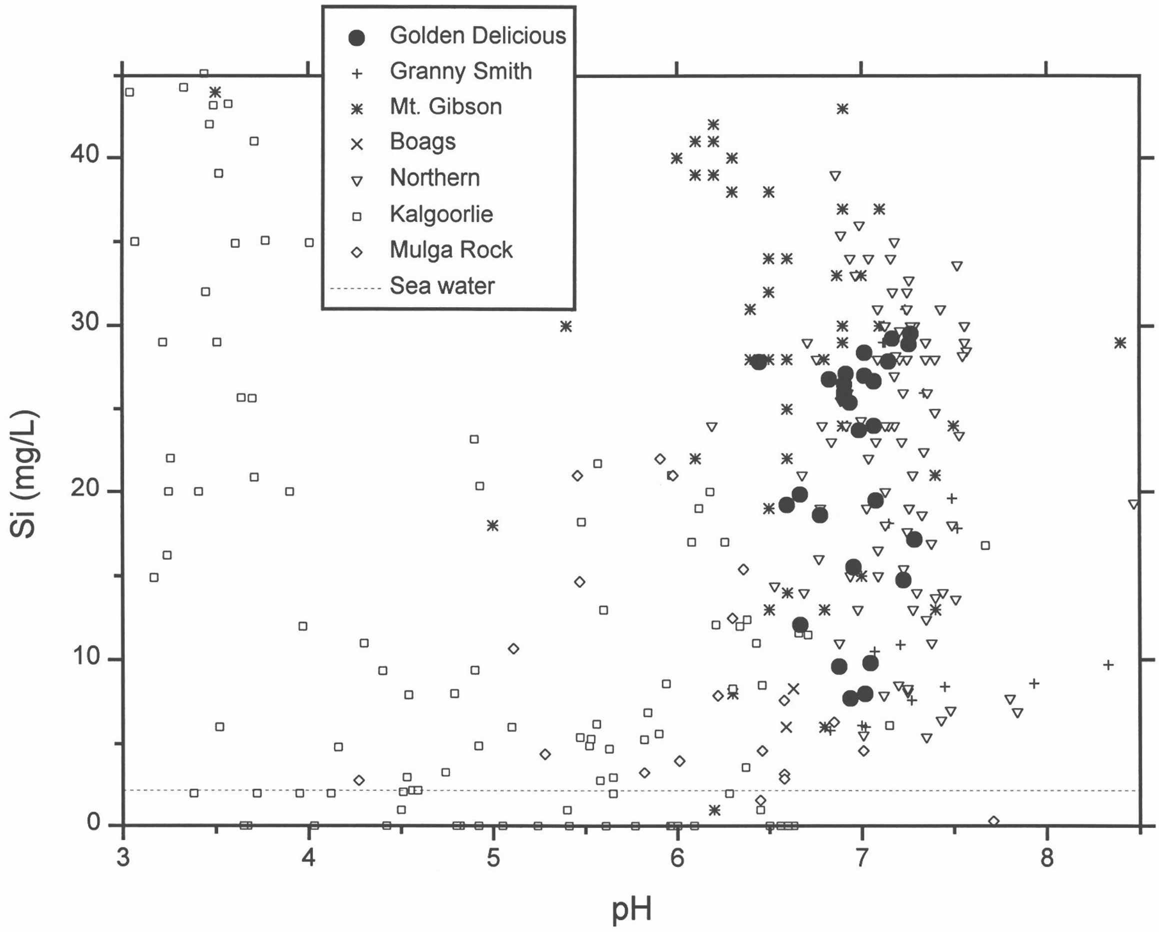

Figure A2.30: Si vs. pH for groundwaters from Golden Delicious and other sites.

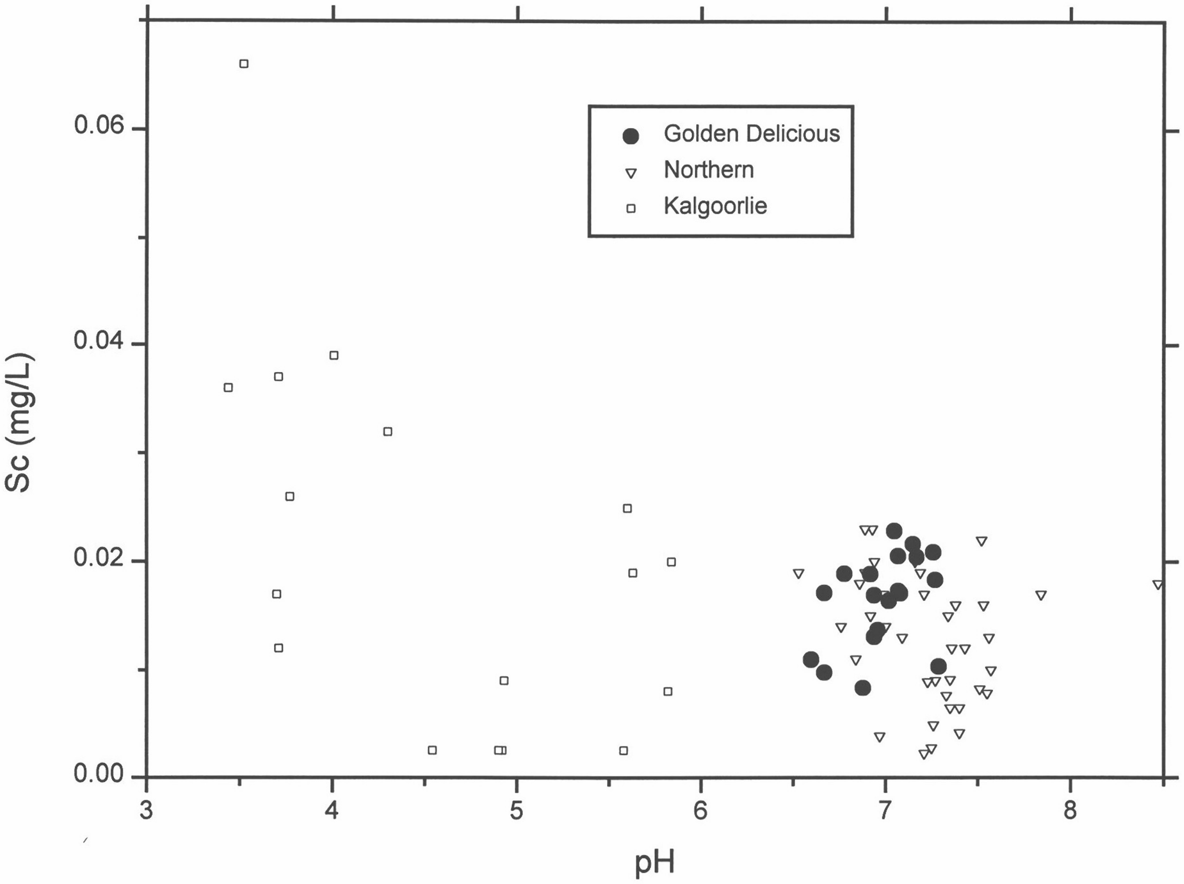

Figure A2.31: Sc vs. pH for groundwaters from Golden Delicious and other sites.

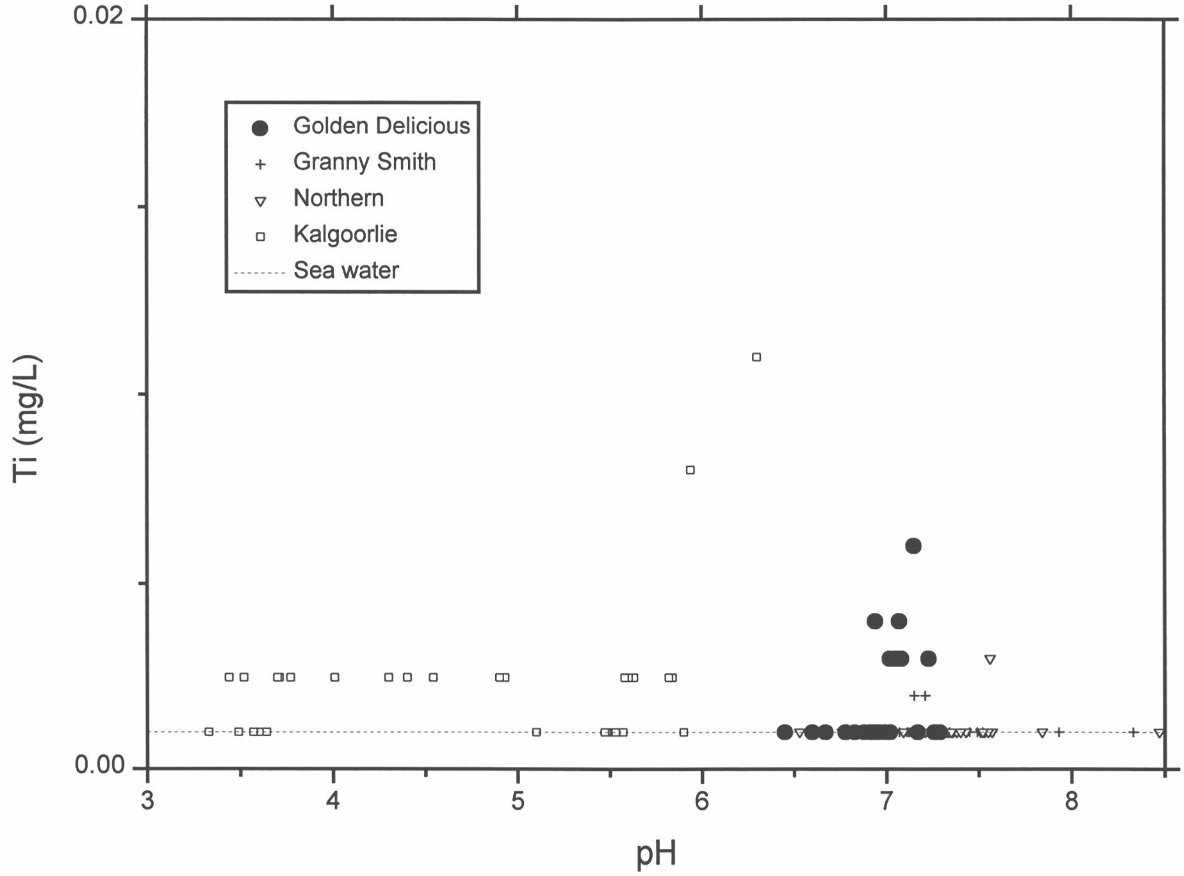

Figure A2.32: Ti vs. pH for groundwaters from Golden Delicious and other sites.

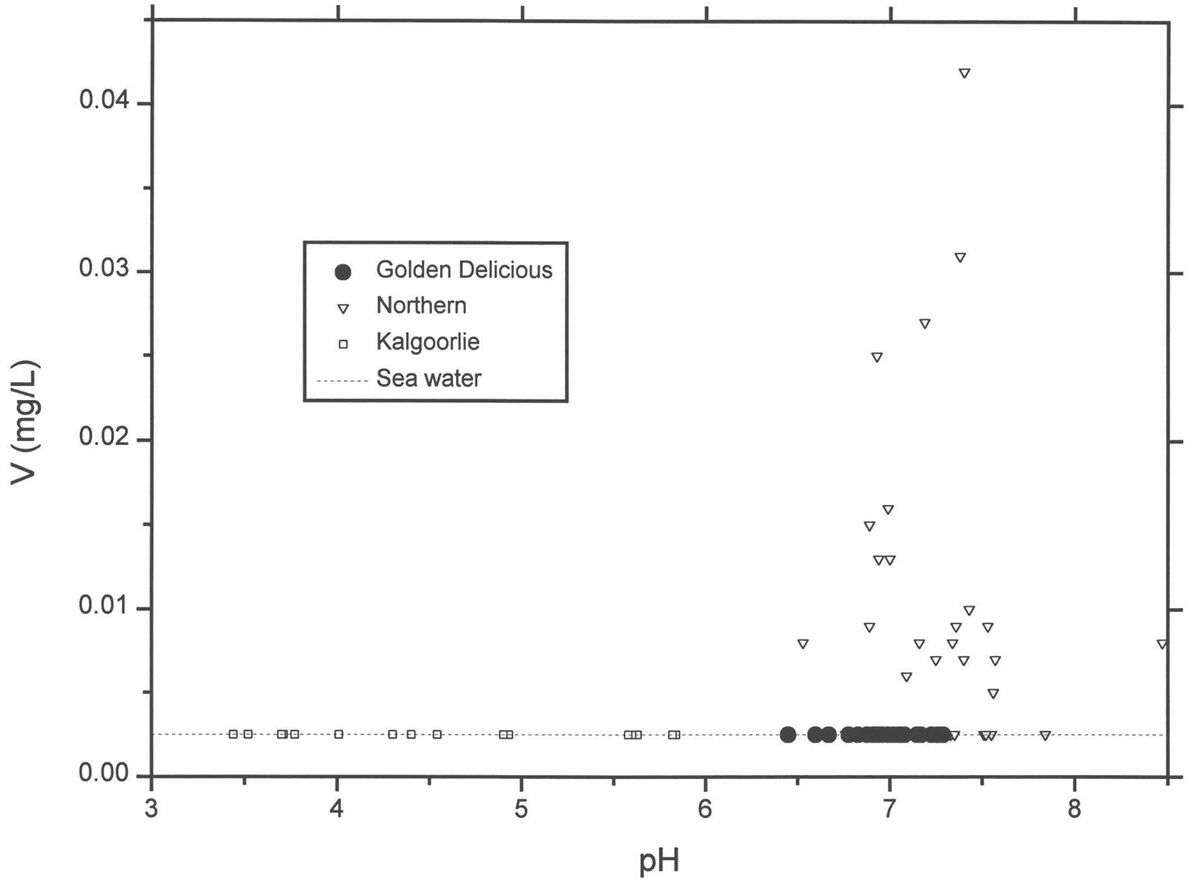

Figure A2.33: V vs. pH for groundwaters from Golden Delicious and other sites.

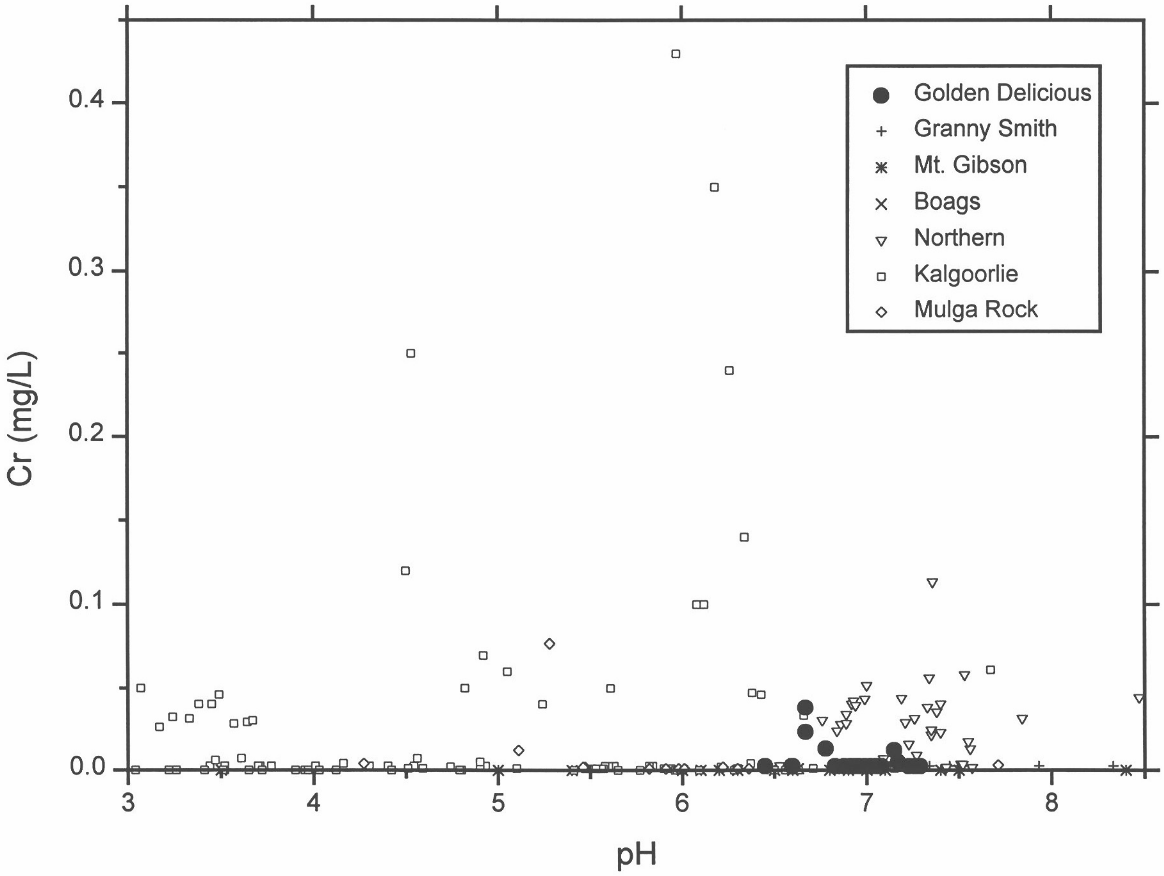

Figure A2.34: Cr vs. pH for groundwaters from Golden Delicious and other sites.

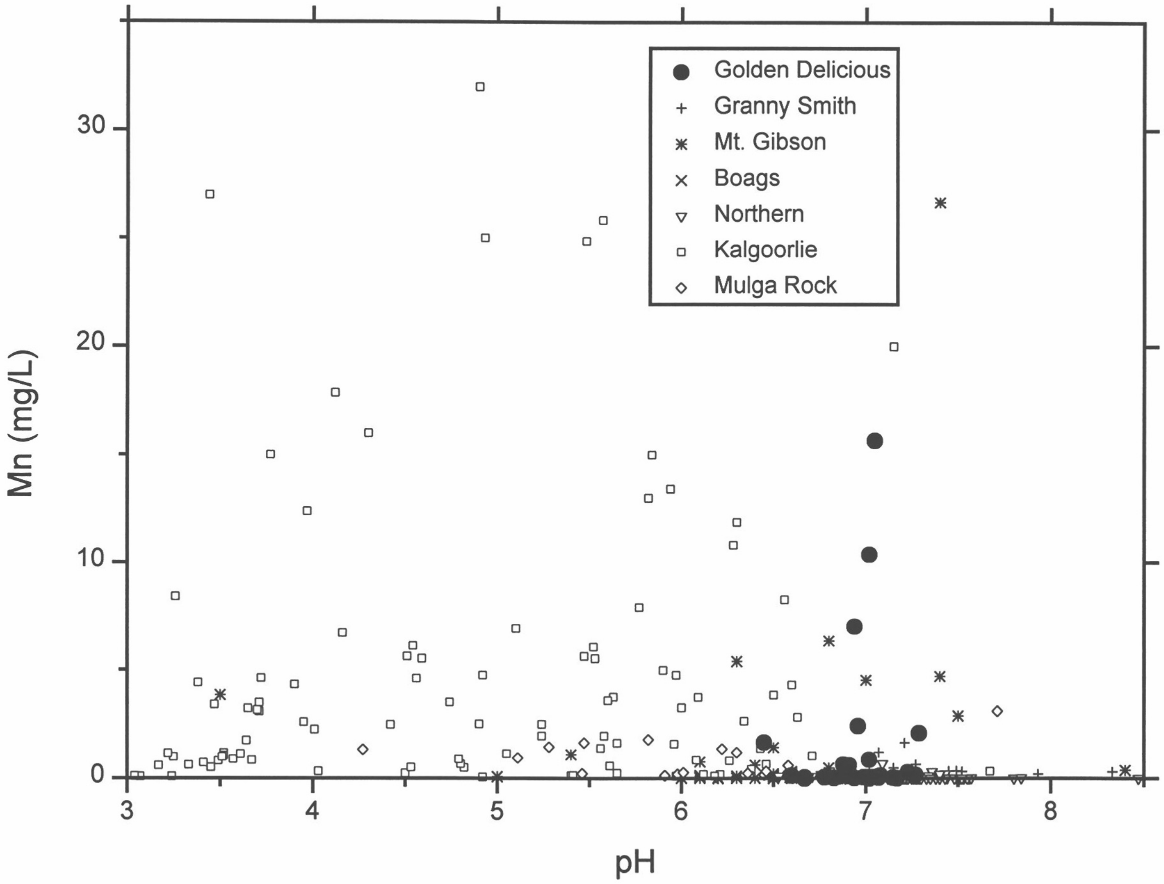

Figure A2.35: Mn vs. pH for groundwaters from Golden Delicious and other sites.

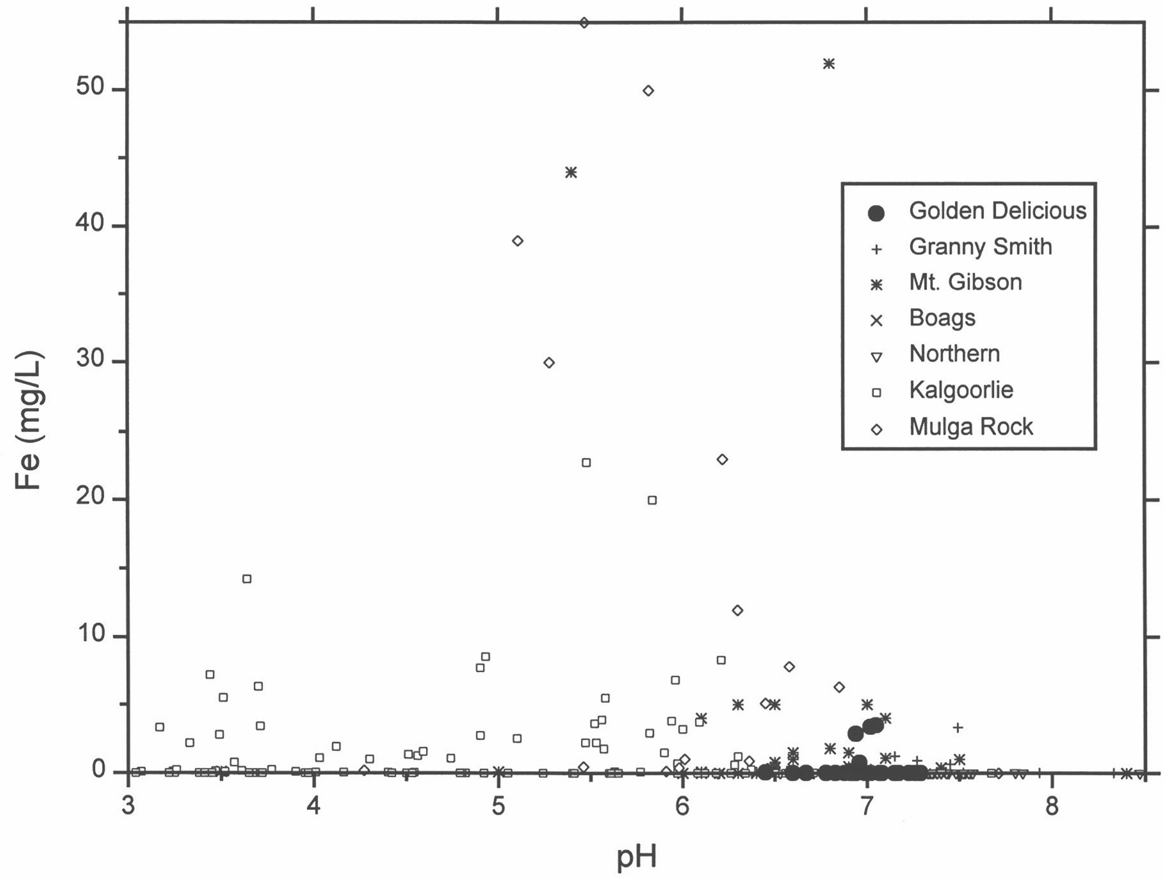

Figure A2.36: Fe vs. pH for groundwaters from Golden Delicious and other sites.

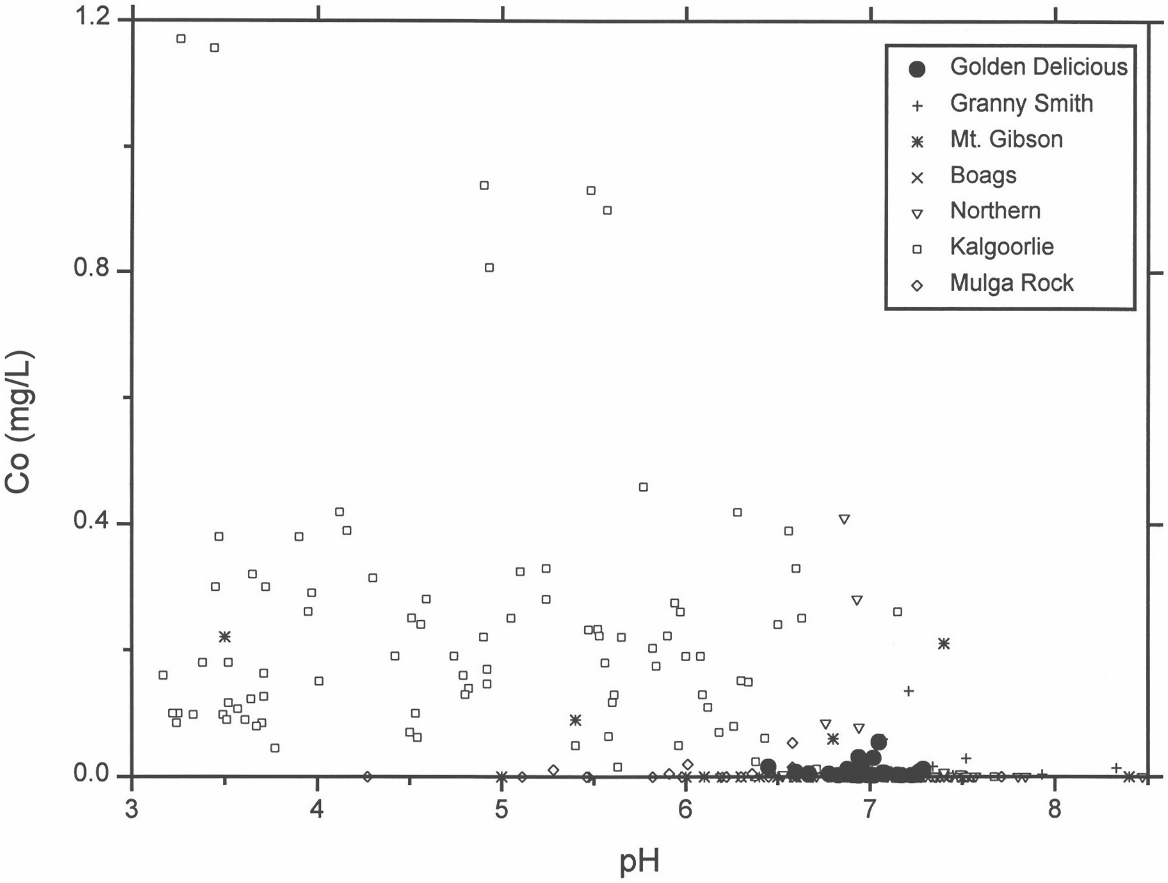

Figure A2.37: Co vs. pH for groundwaters from Golden Delicious and other sites.

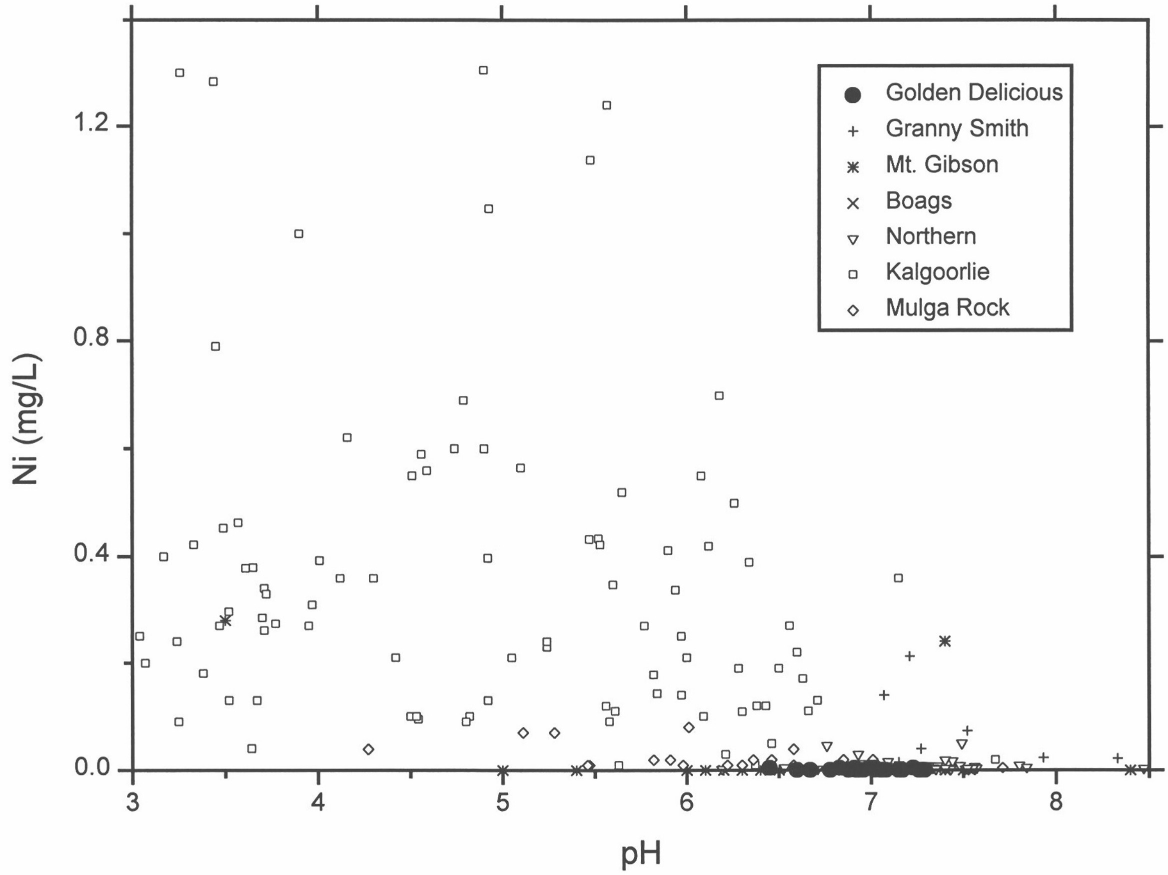

Figure A2.38: Ni vs. pH for groundwaters from Golden Delicious and other sites.

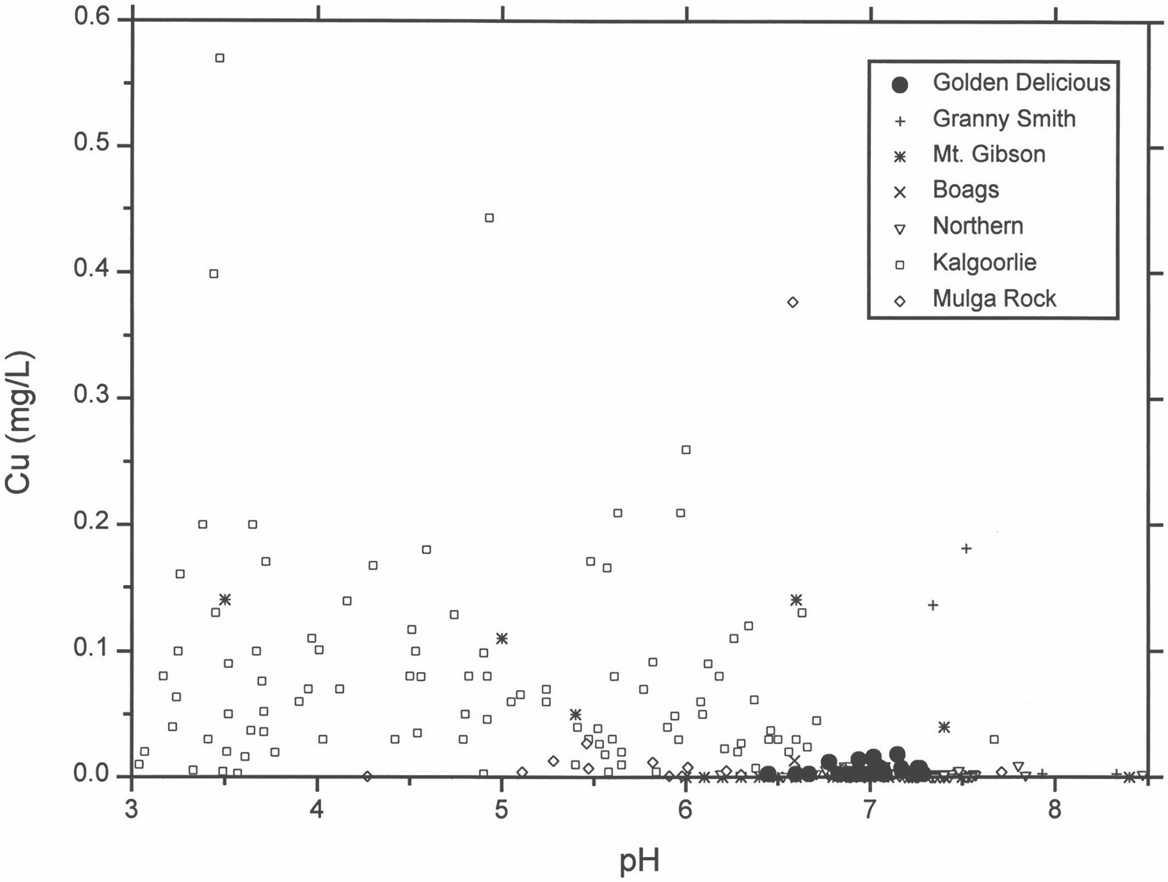

Figure A2.39: Cu vs. pH for groundwaters from Golden Delicious and other sites.

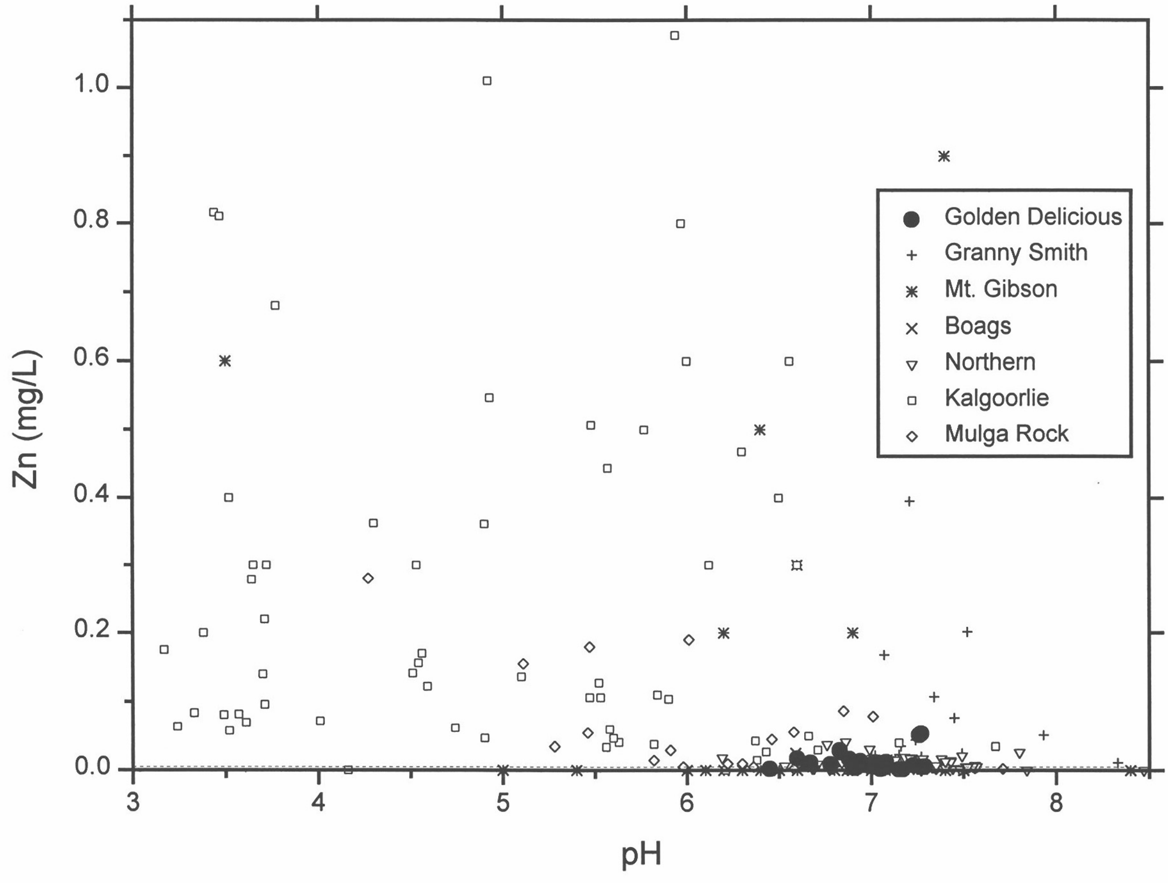

Figure A2.40: Zn vs. pH for groundwaters from Golden Delicious and other sites.

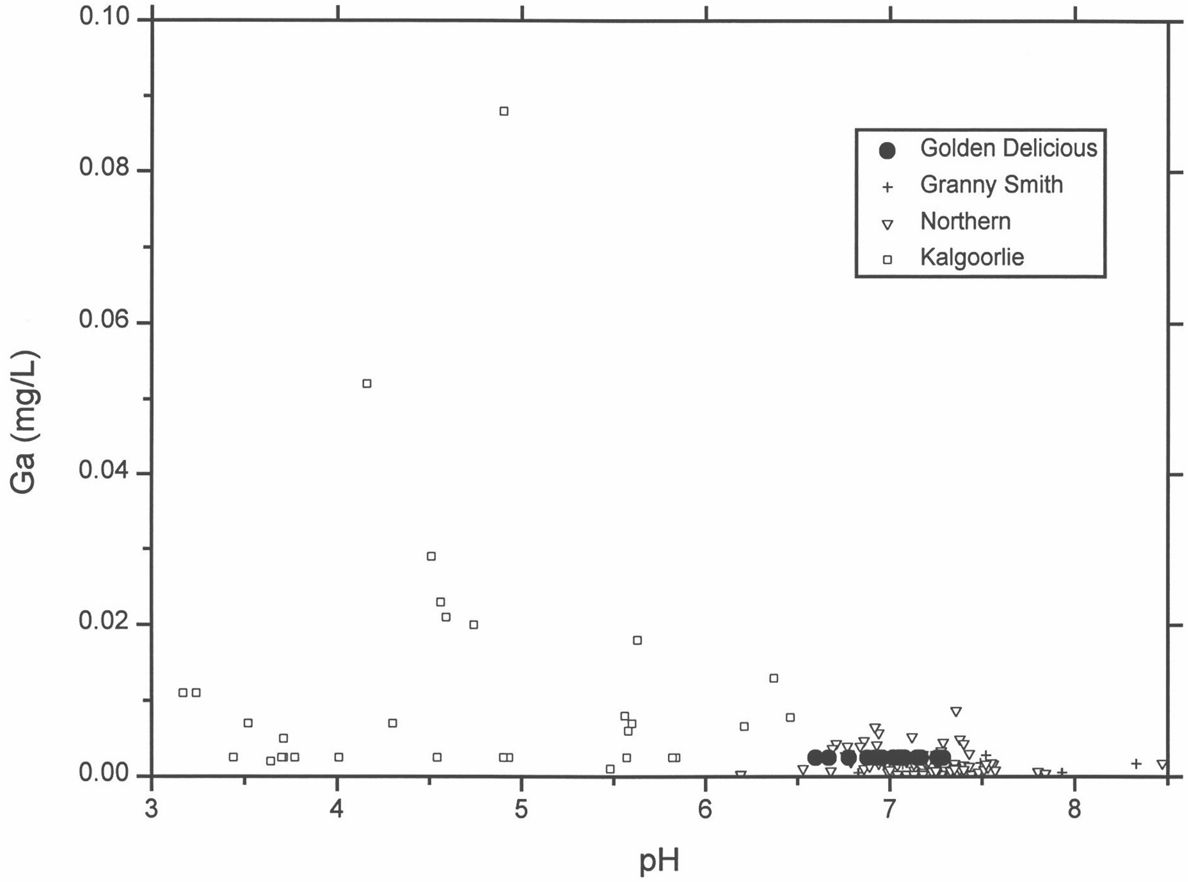

Figure A2.41: Ga vs. pH for groundwaters from Golden Delicious and other sites.

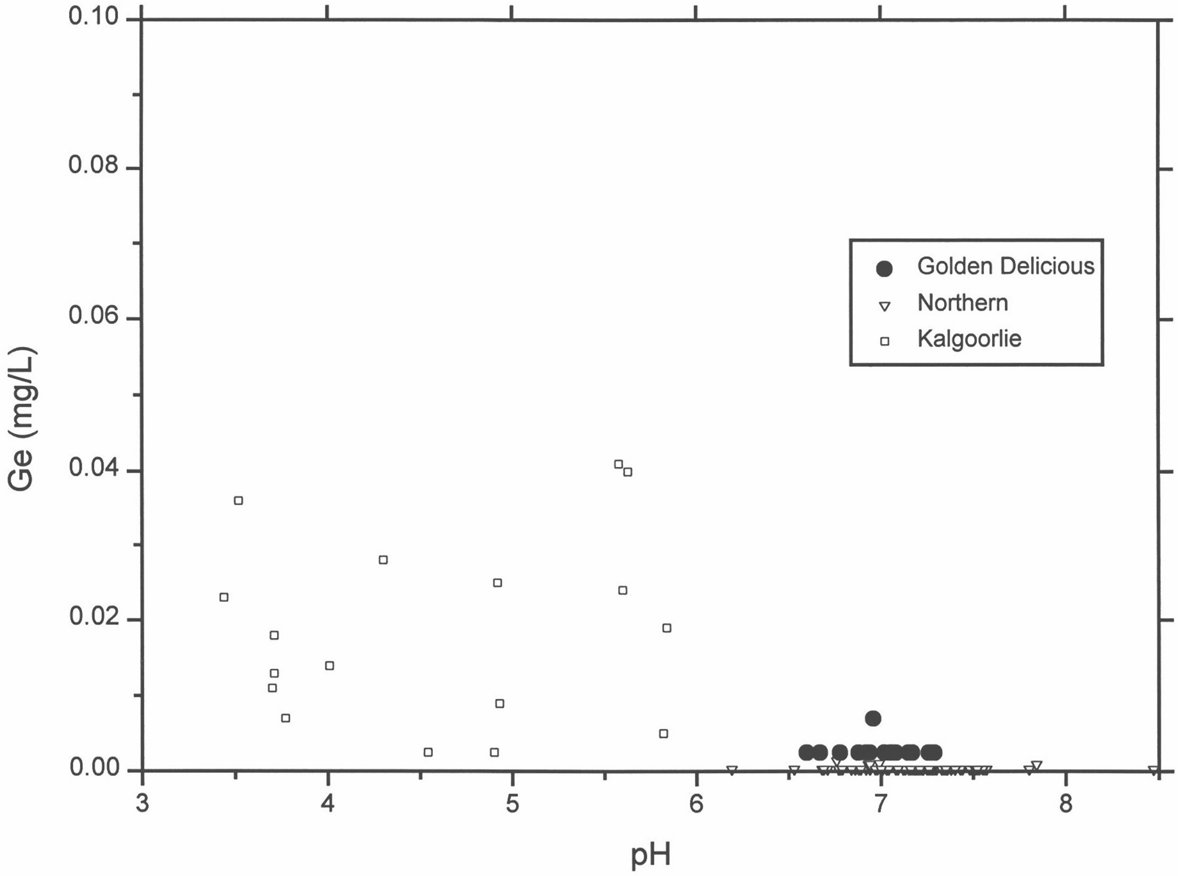

Figure A2.42: Ge vs. pH for groundwaters from Golden Delicious and other sites.

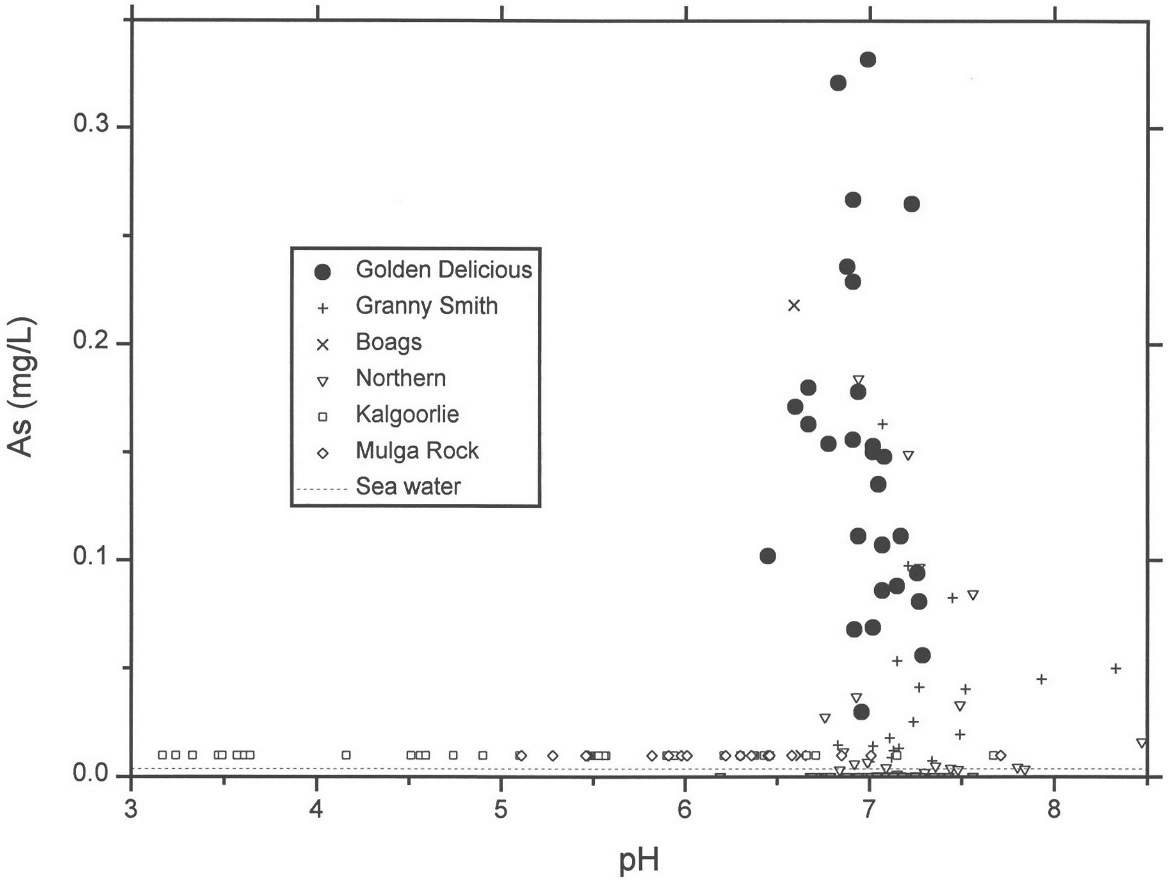

Figure A2.43: As vs. pH for groundwaters from Golden Delicious and other sites.

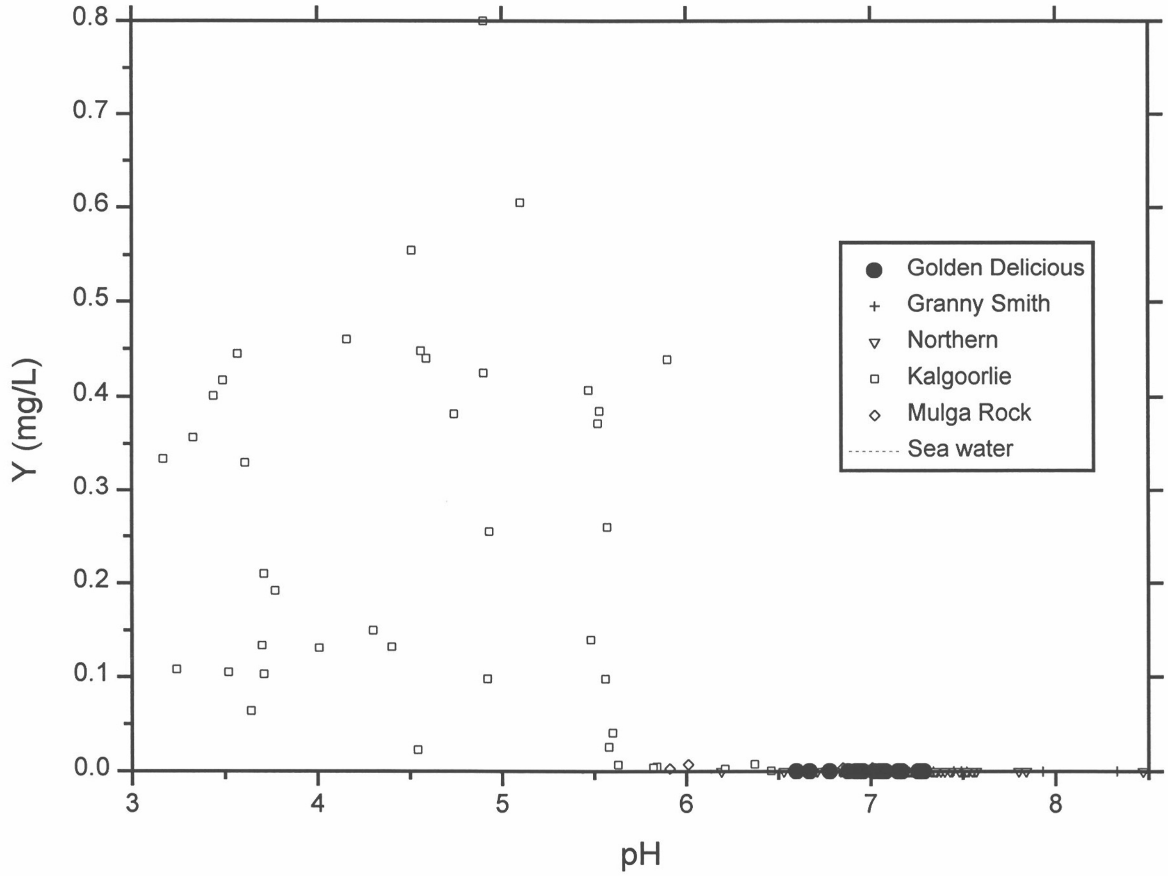

Figure A2.44: Y vs. pH for groundwaters from Golden Delicious and other sites.

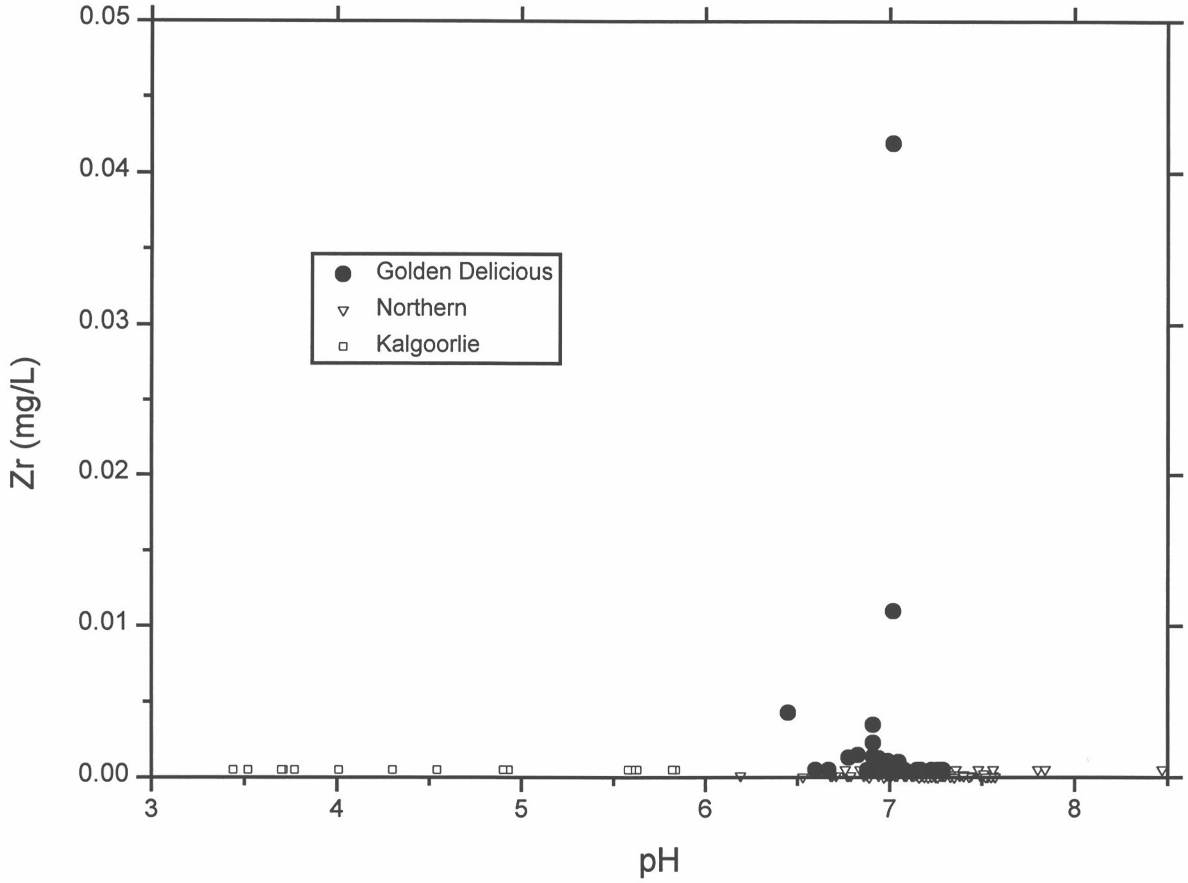

Figure A2.45: Zr vs. pH for groundwaters from Golden Delicious and other sites.

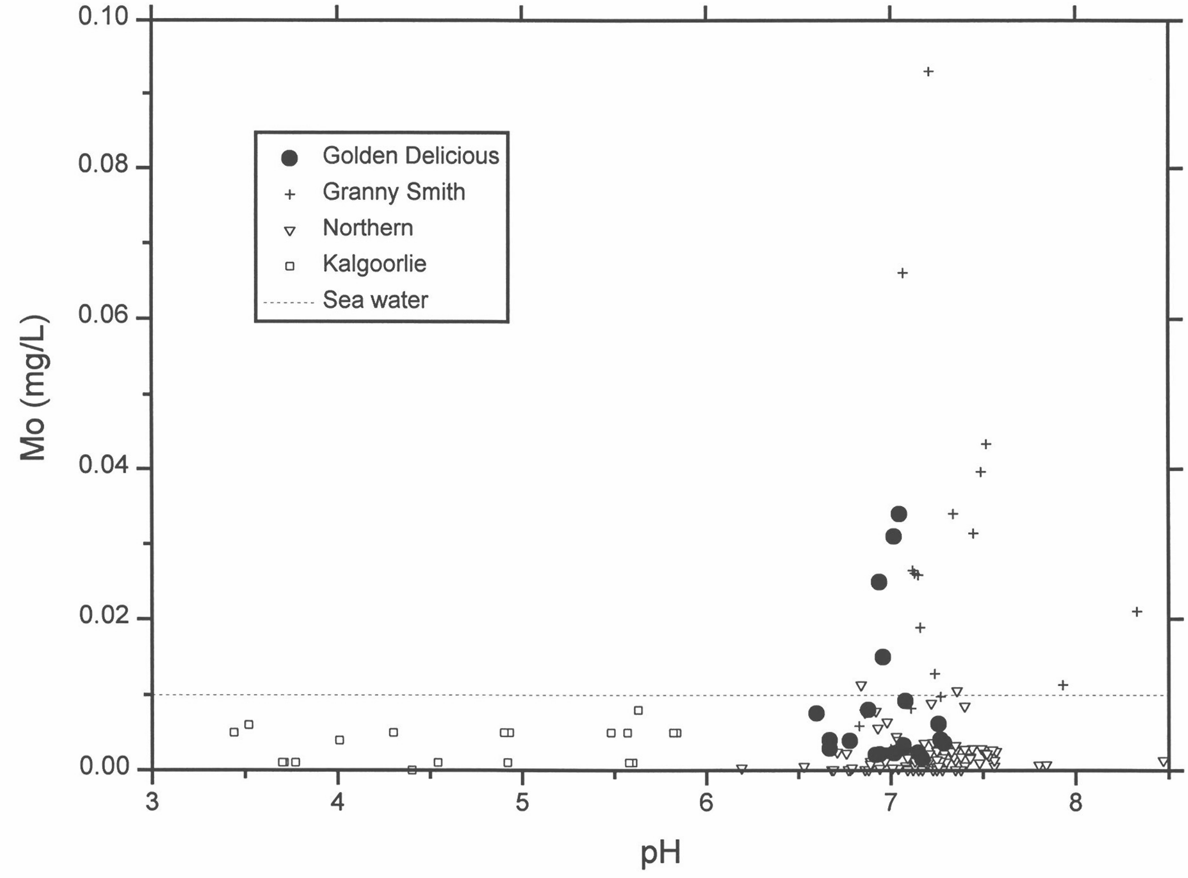

Figure A2.46: Mo vs. pH for groundwaters from Golden Delicious and other sites.

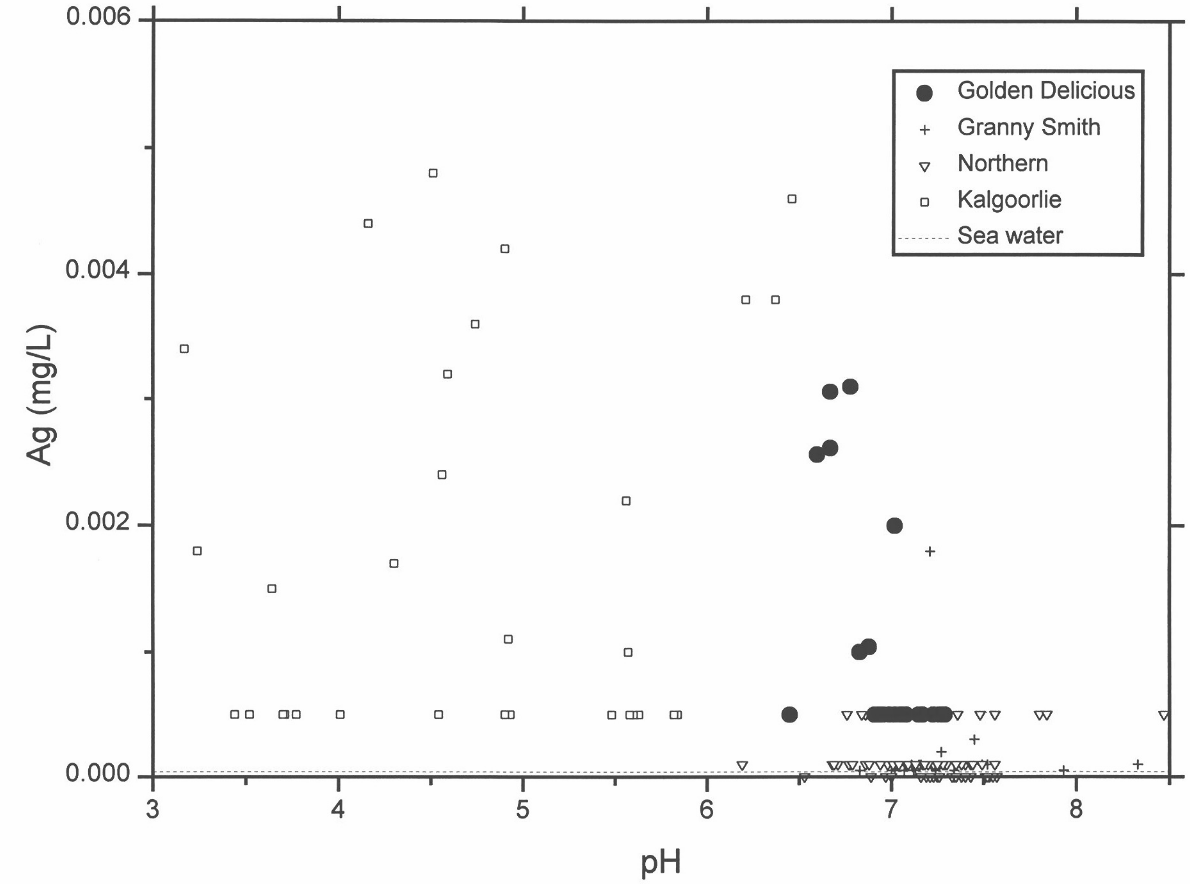

Figure A2.47: Ag vs. pH for groundwaters from Golden Delicious and other sites.

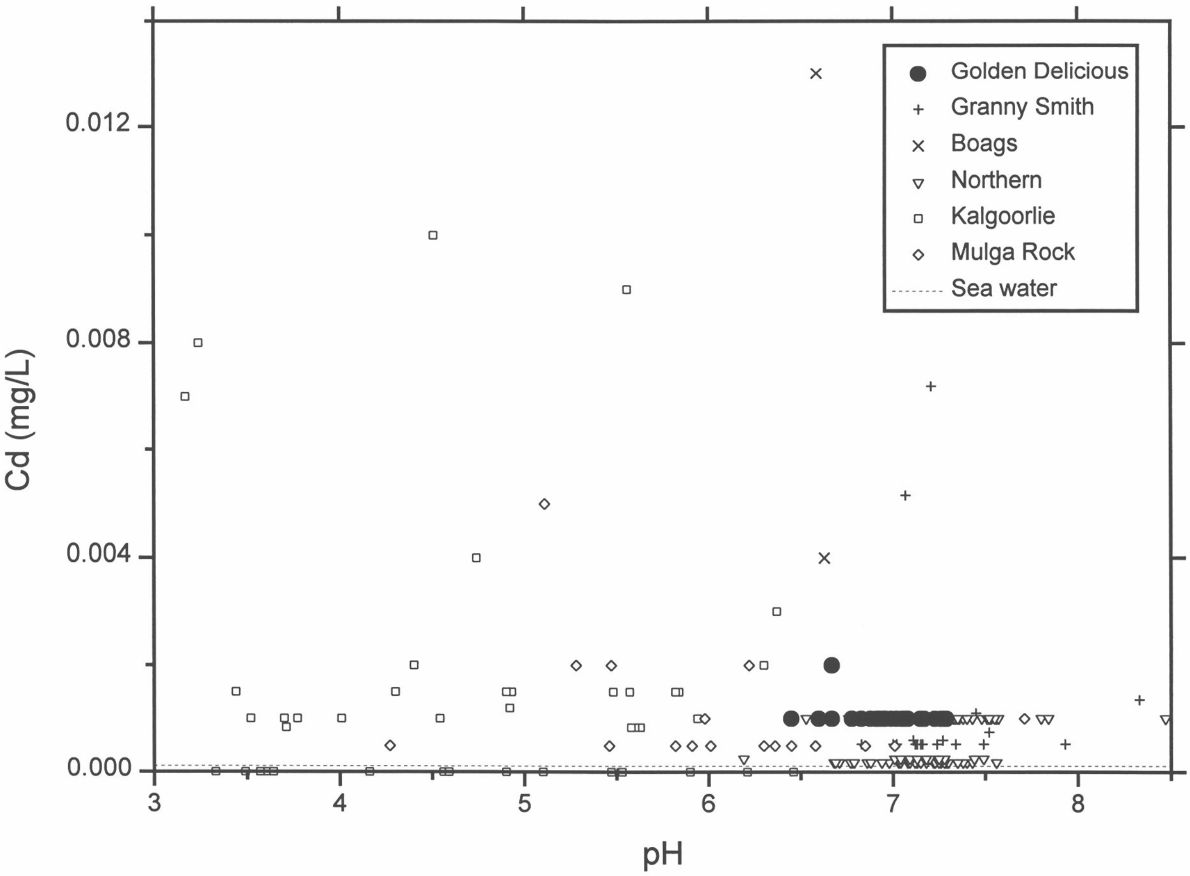

Figure A2.48: Cd vs. pH for groundwaters from Golden Delicious and other sites.

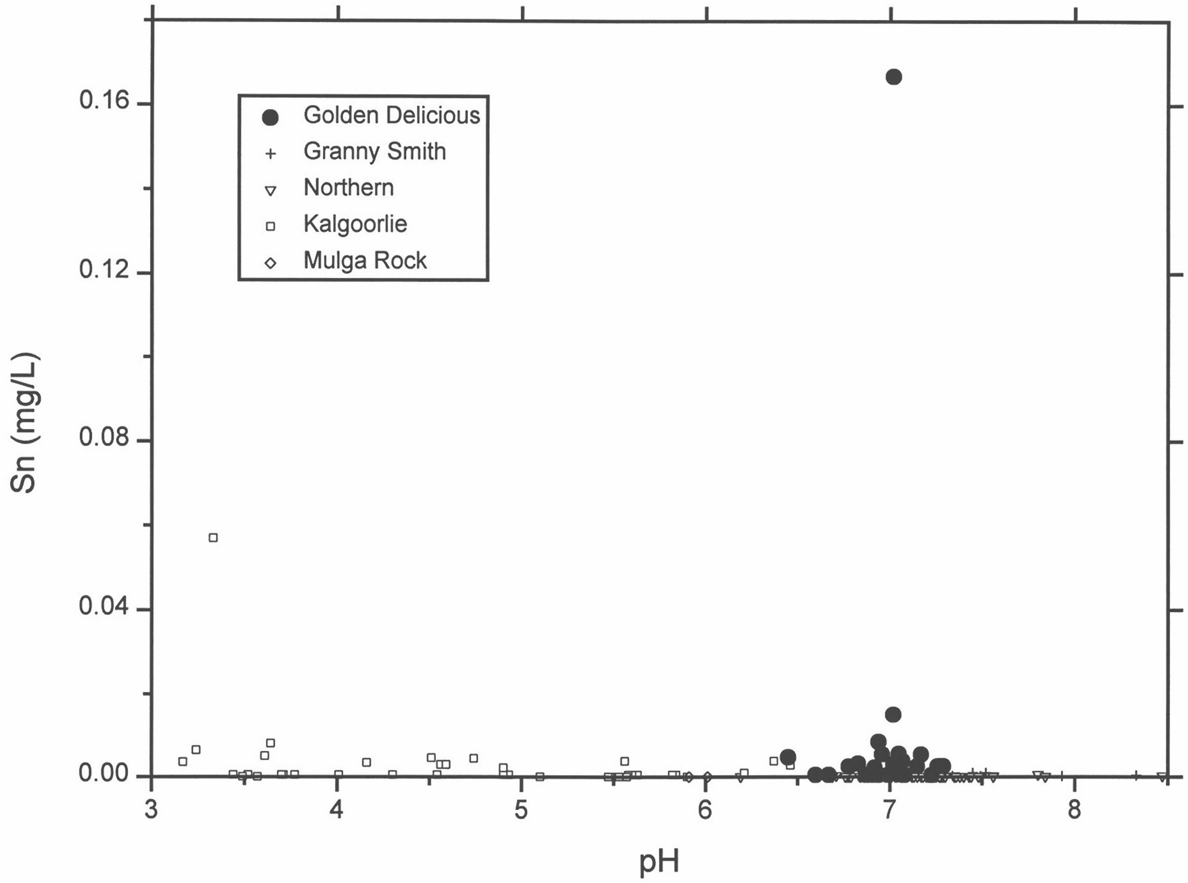

Figure A2.49: Sn vs. pH for groundwaters from Golden Delicious and other sites.

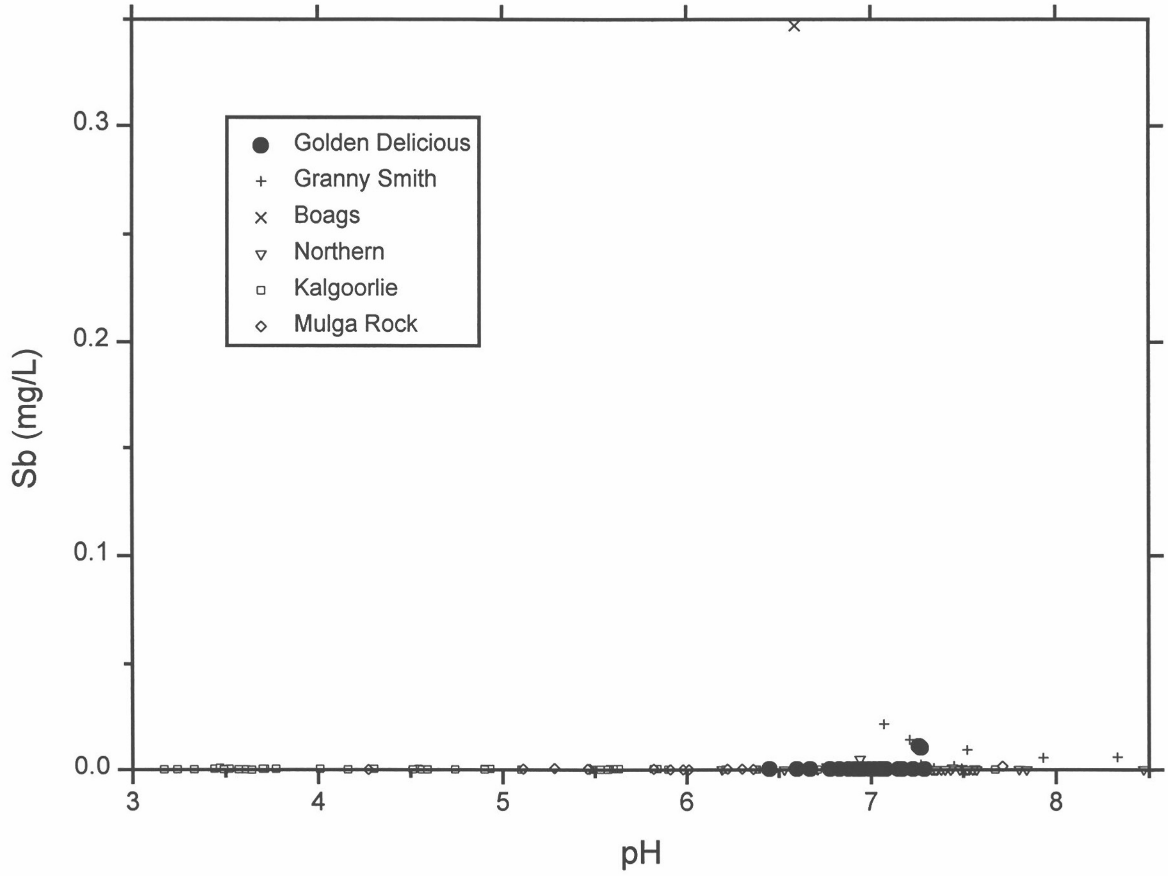

Figure A2.50: Sb vs. pH for groundwaters from Golden Delicious and other sites.

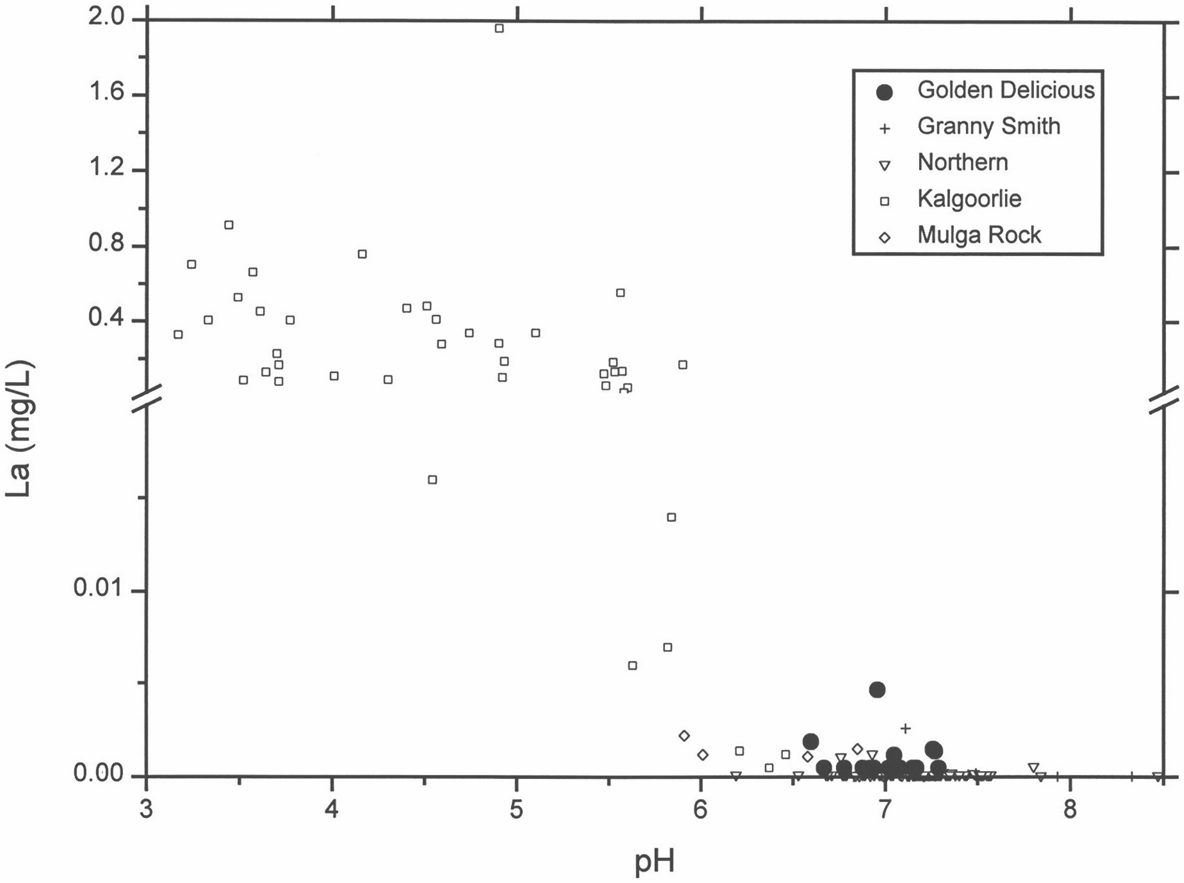

Figure A2.51: La vs. pH for groundwaters from Golden Delicious and other sites.

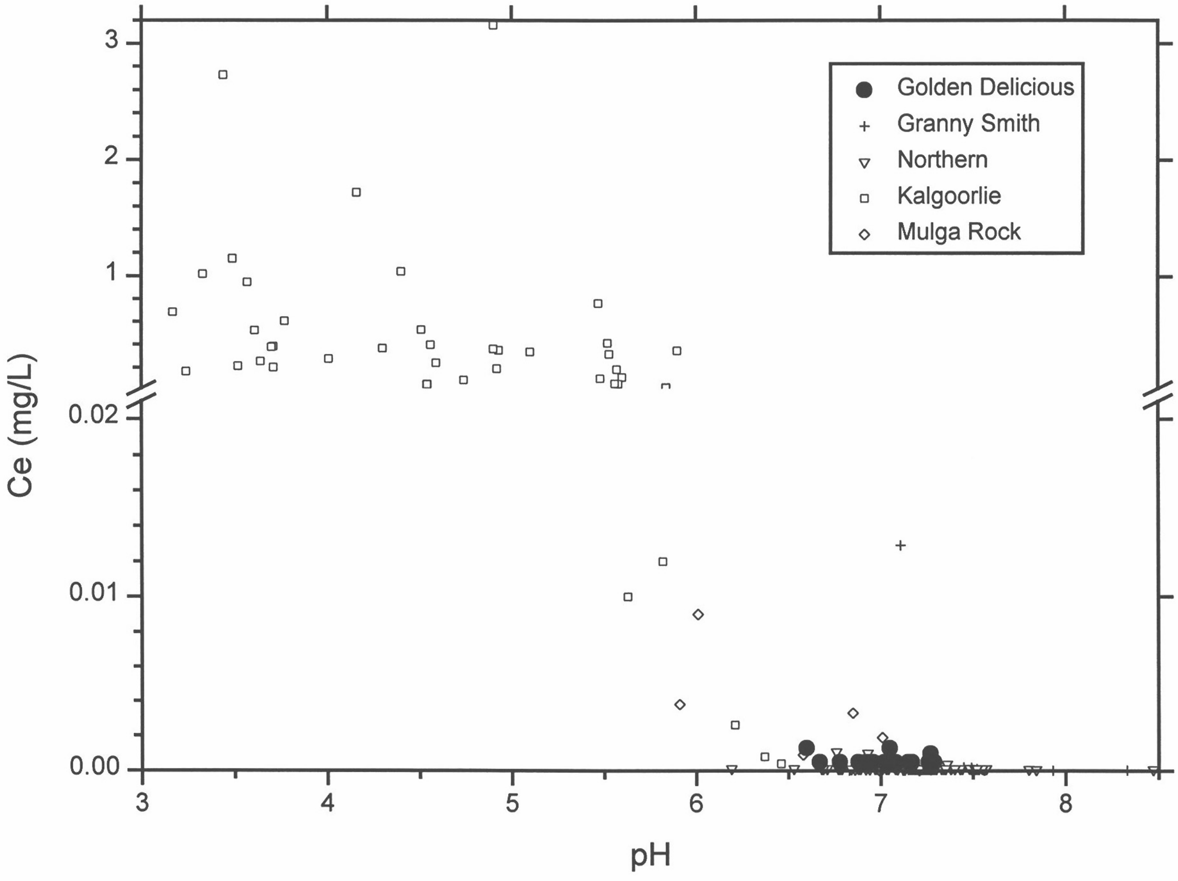

Figure A2.52: Ce vs. pH for groundwaters from Golden Delicious and other sites.

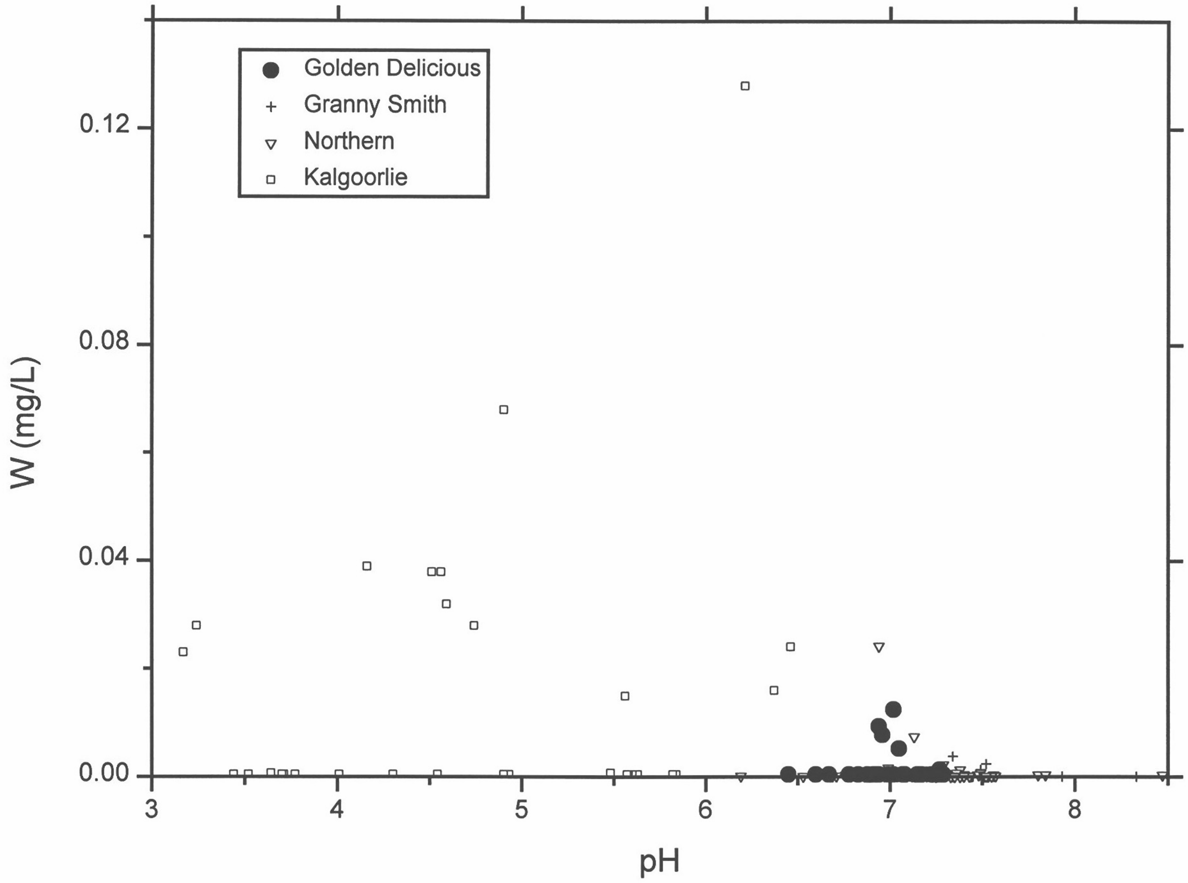

Figure A2.53: W vs. pH for groundwaters from Golden Delicious and other sites.

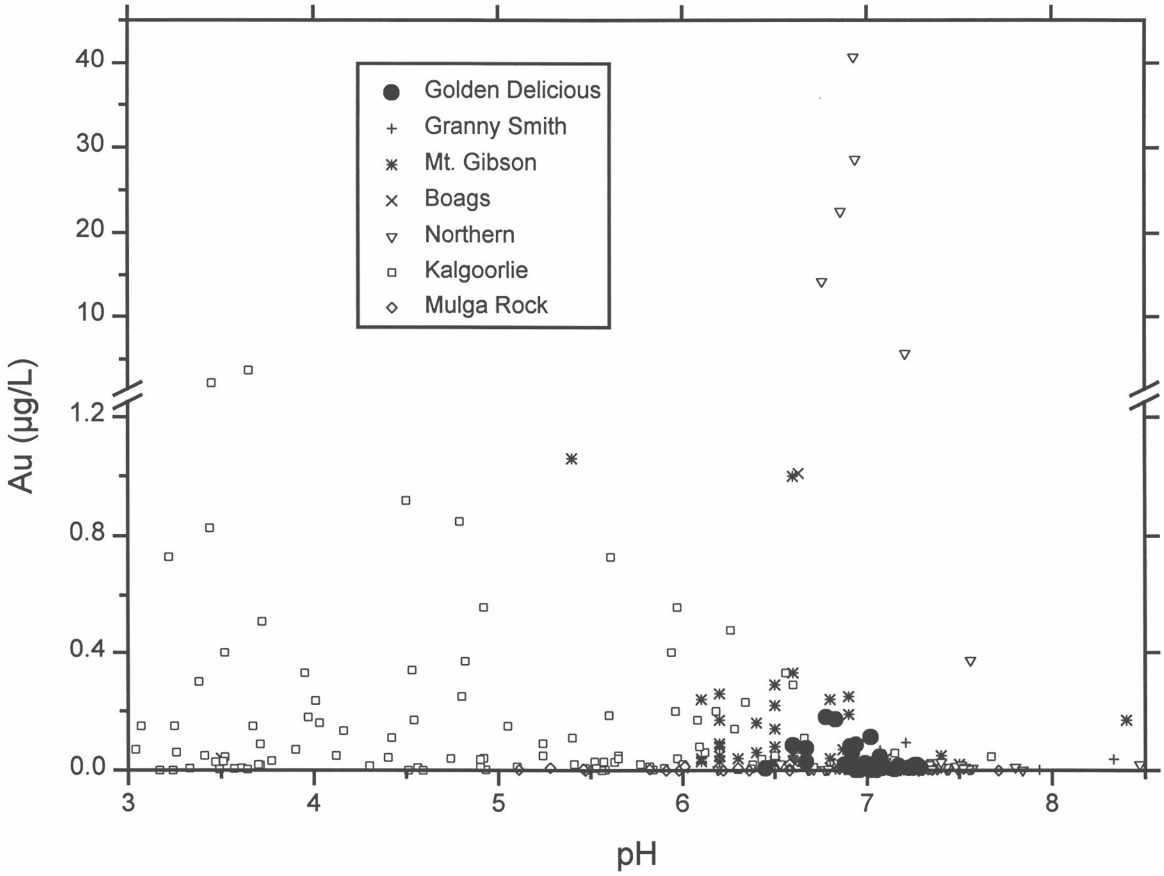

Figure A2.54: Au vs. pH for groundwaters from Golden Delicious and other sites.

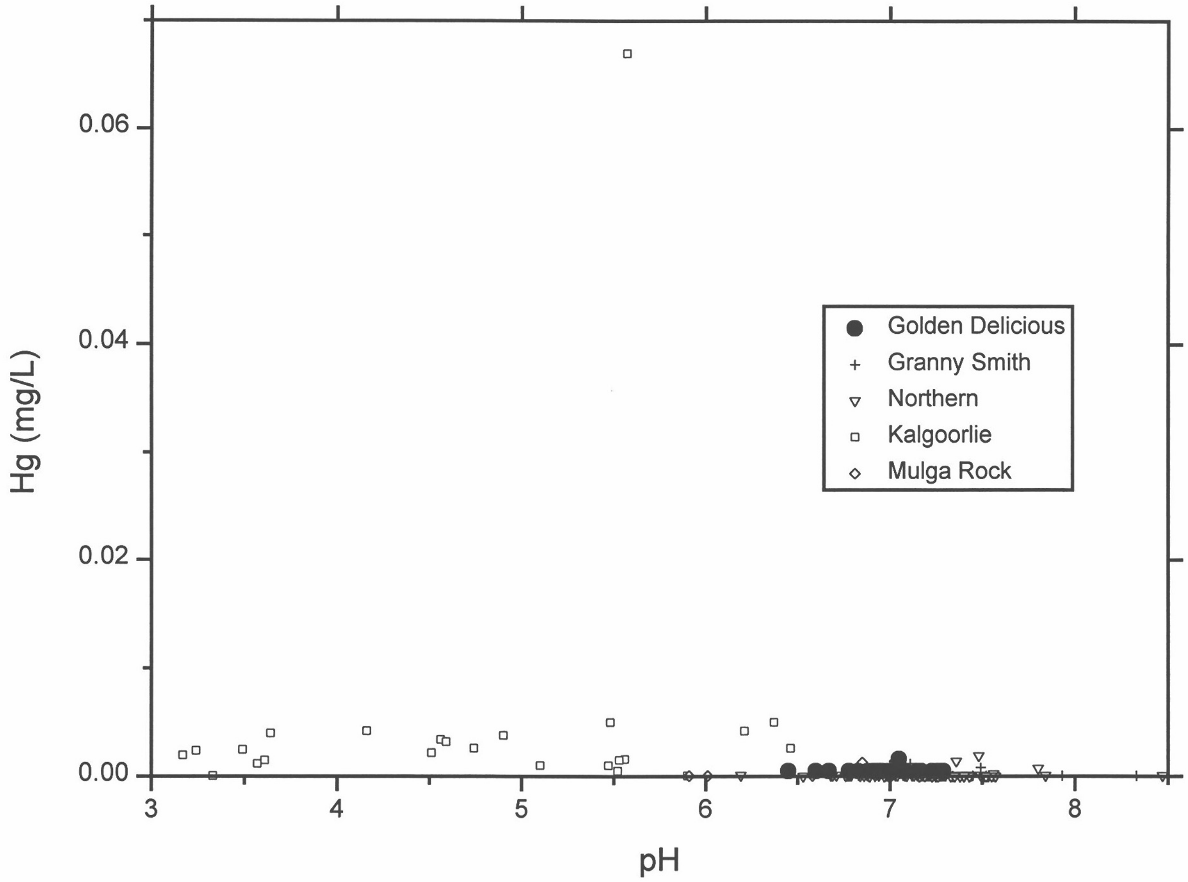

Figure A2.55: Hg vs. pH for groundwaters from Golden Delicious and other sites.

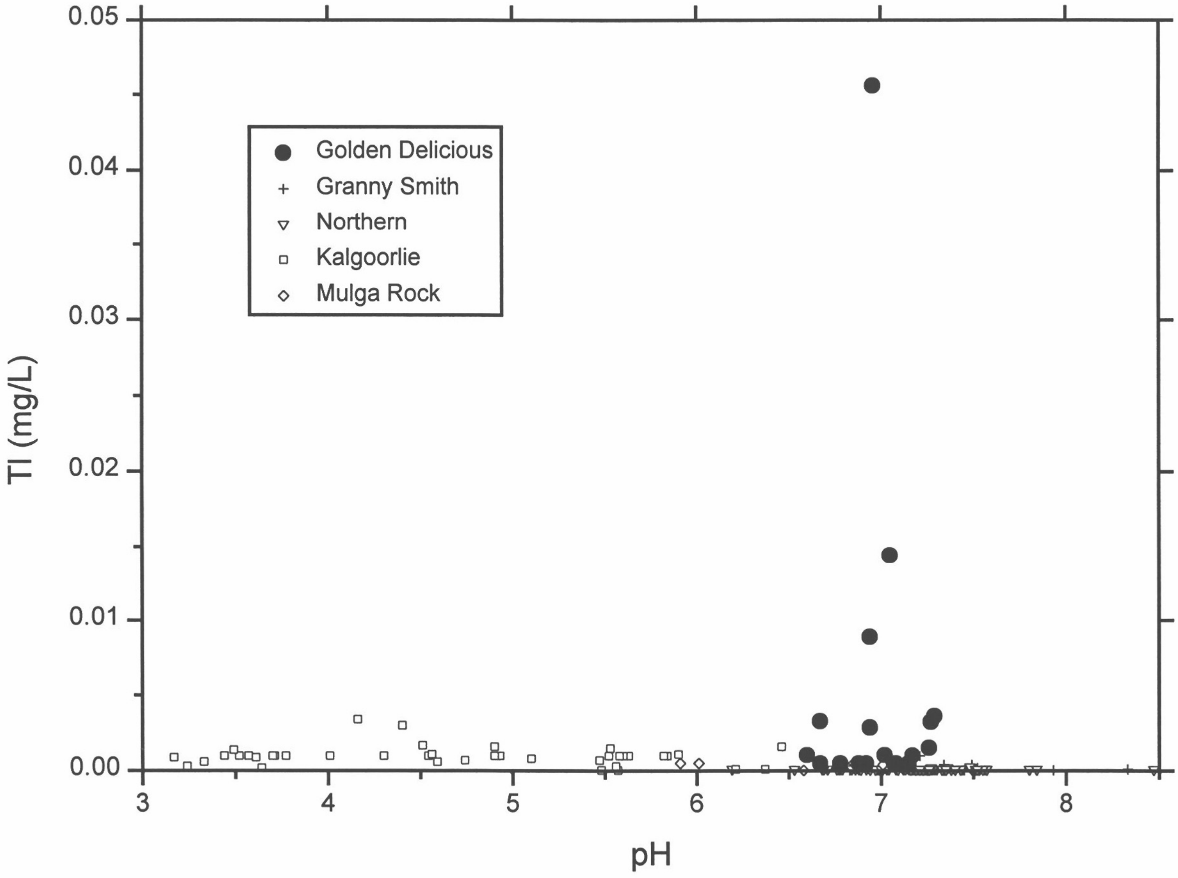

Figure A2.56: Tl vs. pH for groundwaters from Golden Delicious and other sites.

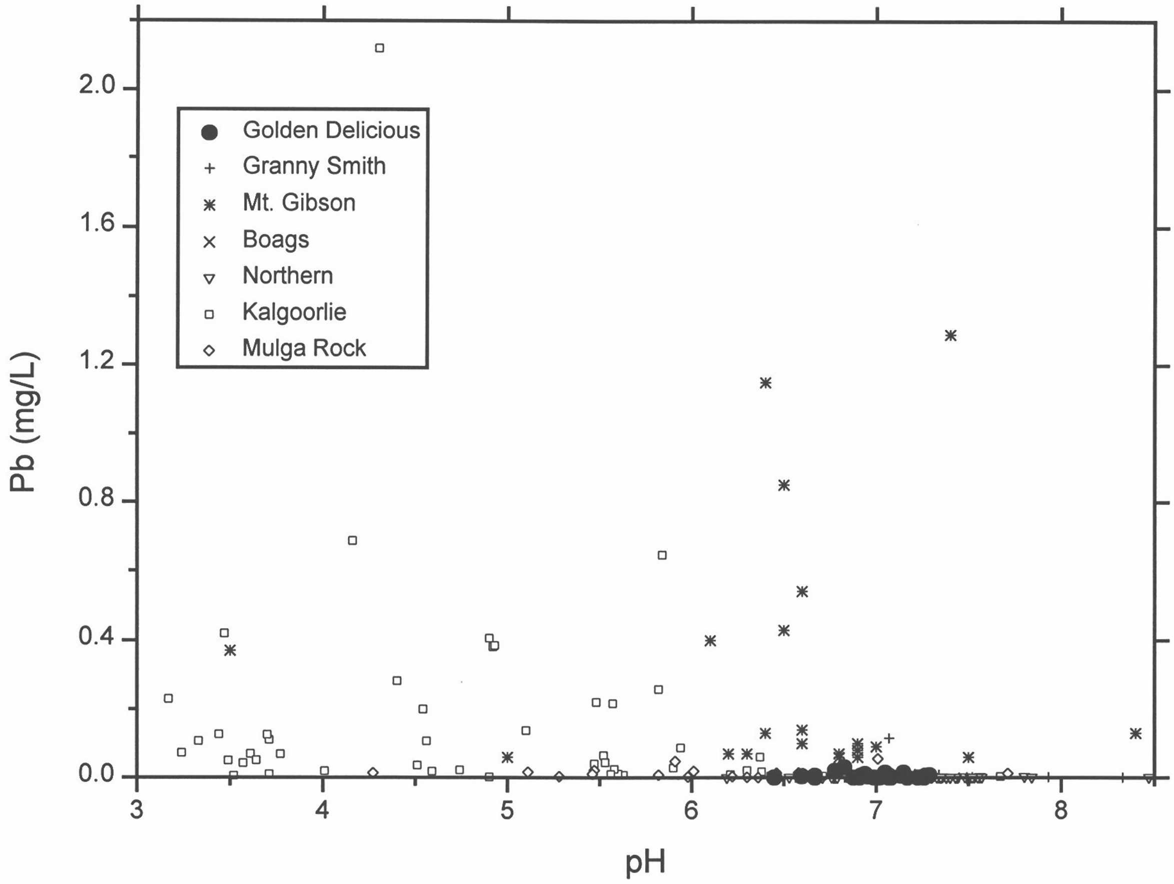

Figure A2.57: Pb vs. pH for groundwaters from Golden Delicious and other sites.

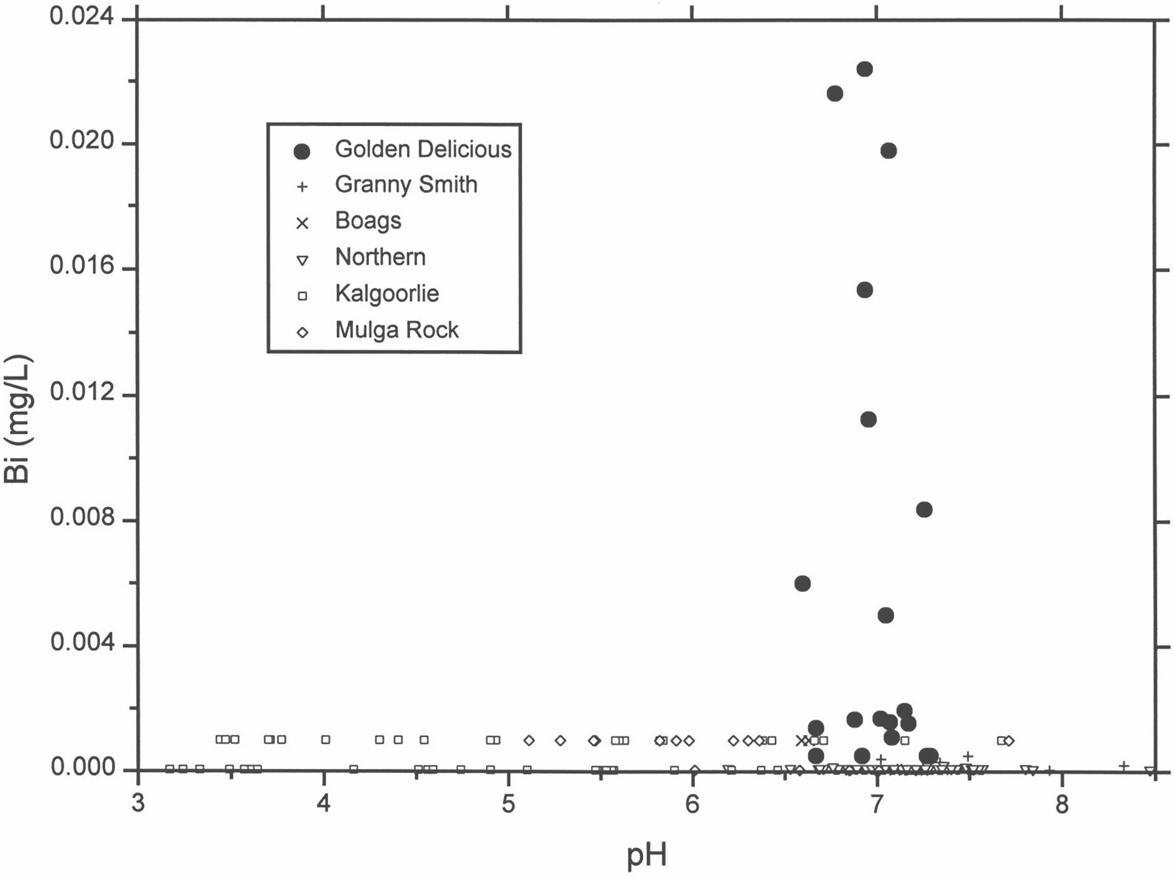

Figure A2.58: Bi vs. pH for groundwaters from Golden Delicious and other sites.

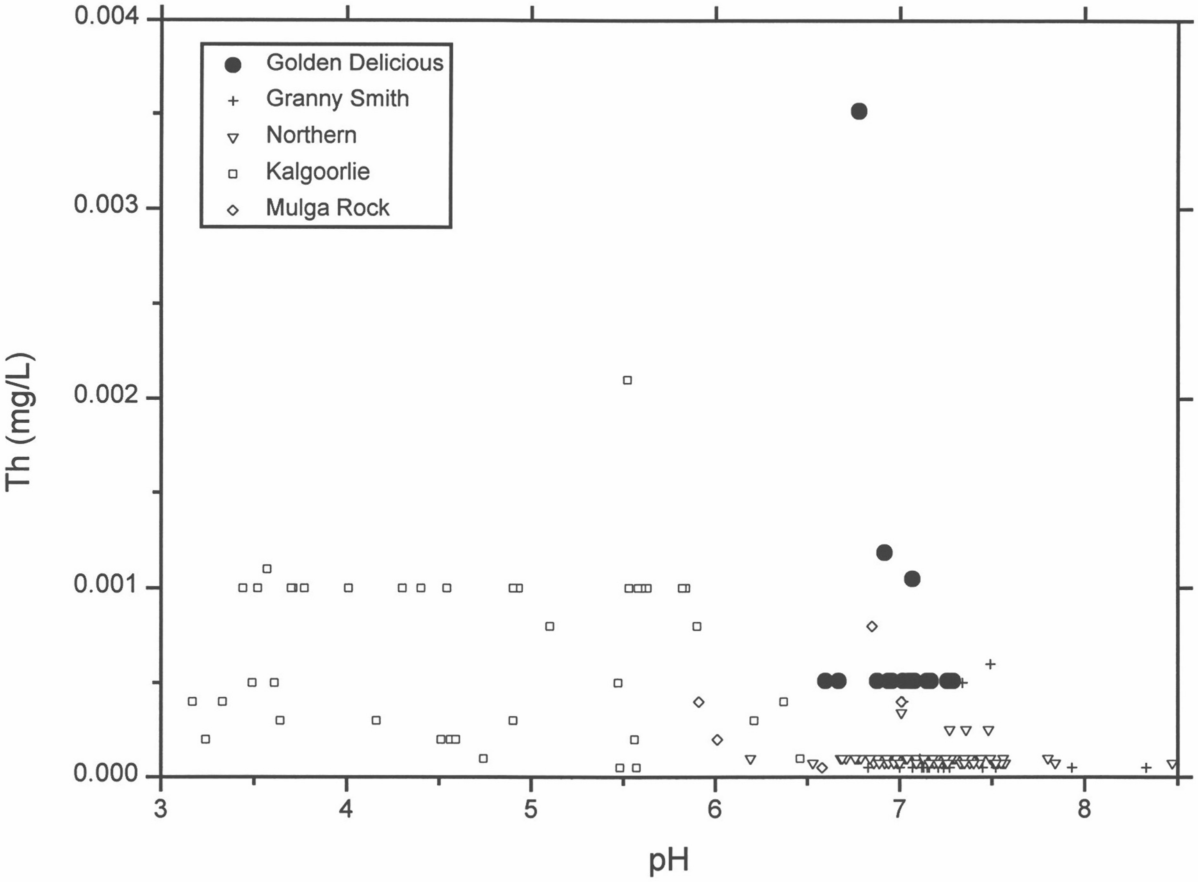

Figure A2.59: Th vs. pH for groundwaters from Golden Delicious and other sites.

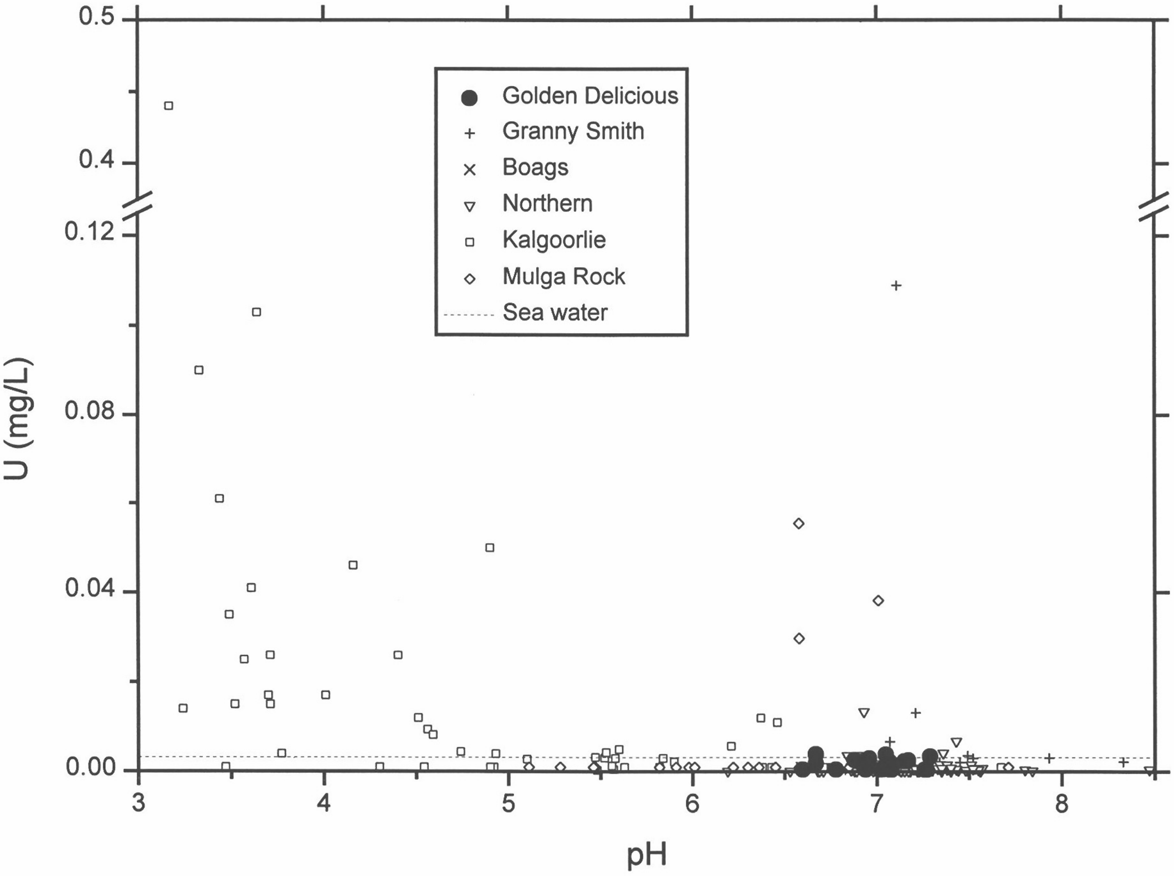

Figure A2.60: U vs. pH for groundwaters from Golden Delicious and other sites.

# APPENDIX 3: SATURATION INDICES - GROUNDWATERS

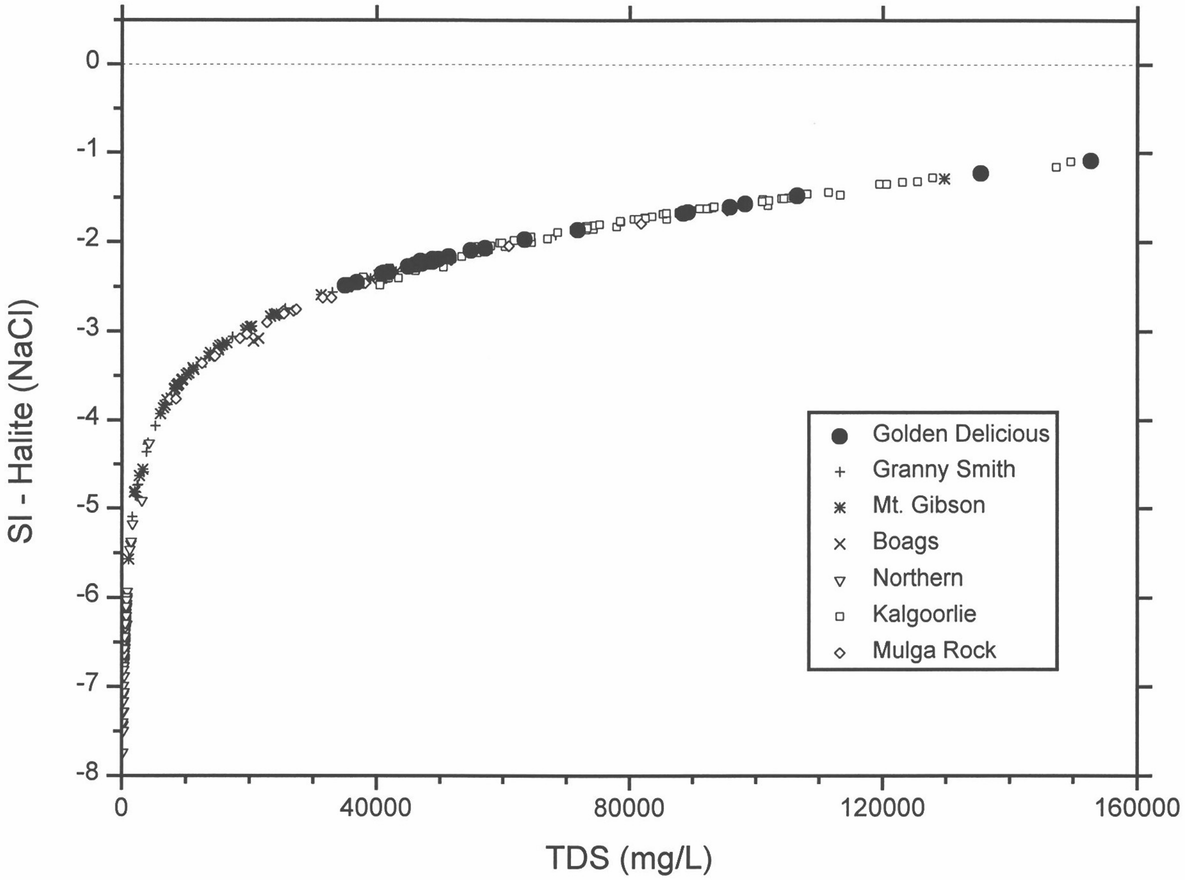

Figure A3.1: SI for halite vs. TDS for groundwaters from Golden Delicious and other sites.

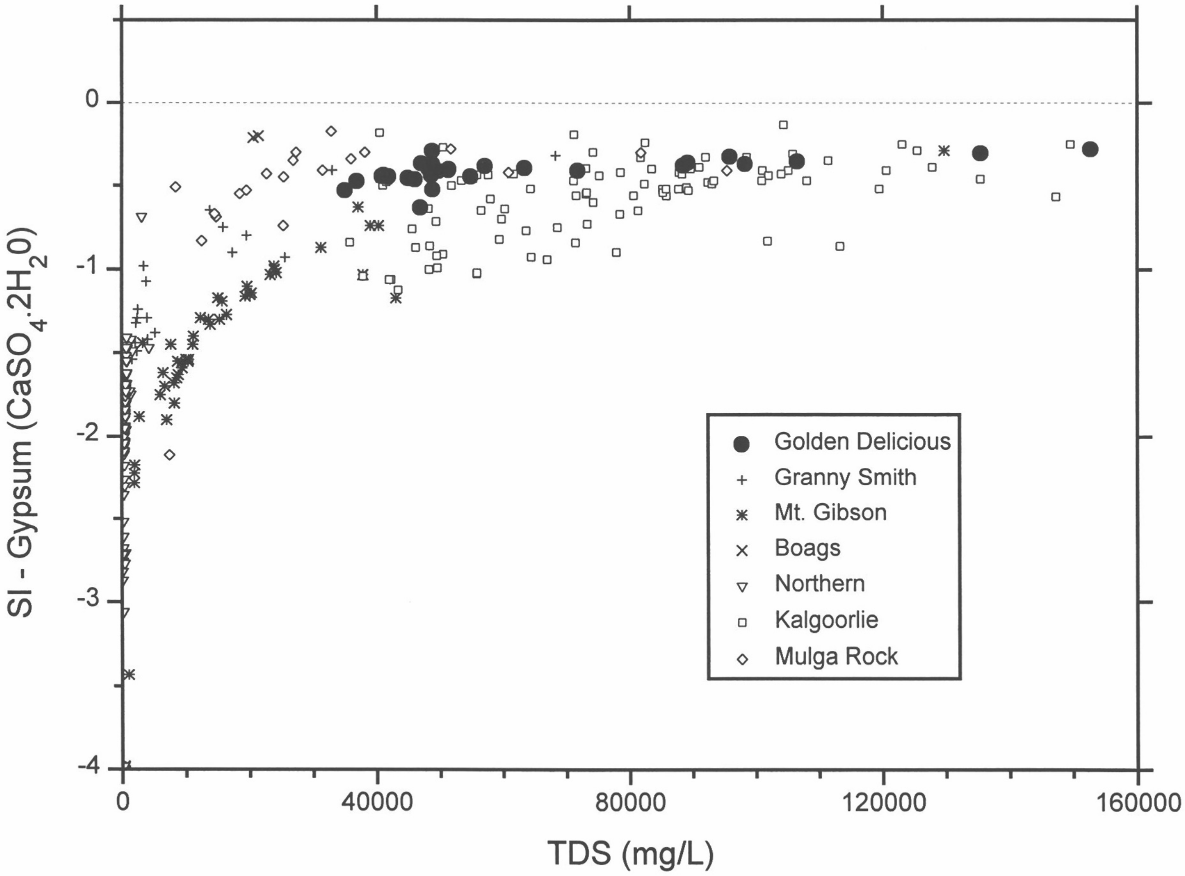

Figure A3.2: SI for gypsum vs. TDS for groundwaters from Golden Delicious and other sites.

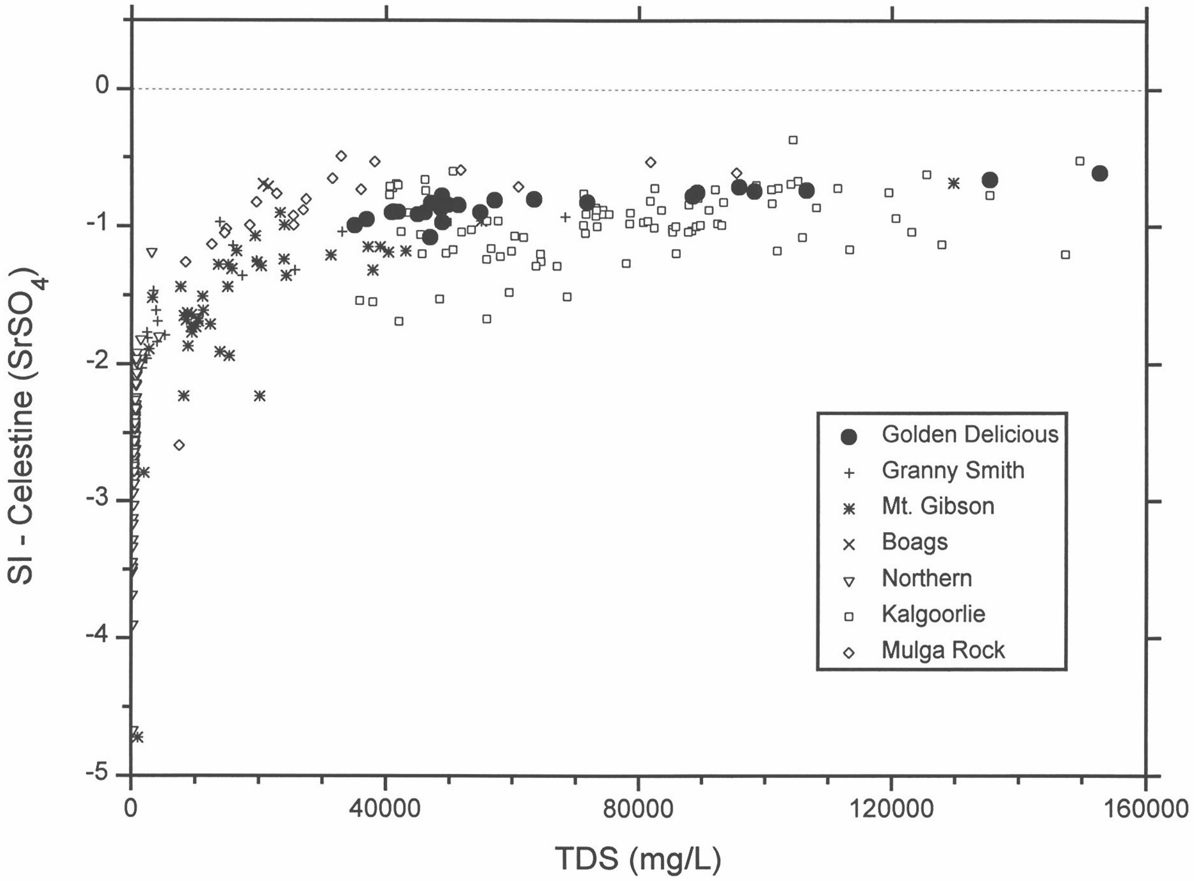

Figure A3.3: SI for celestine vs. TDS for groundwaters from Golden Delicious and other sites.

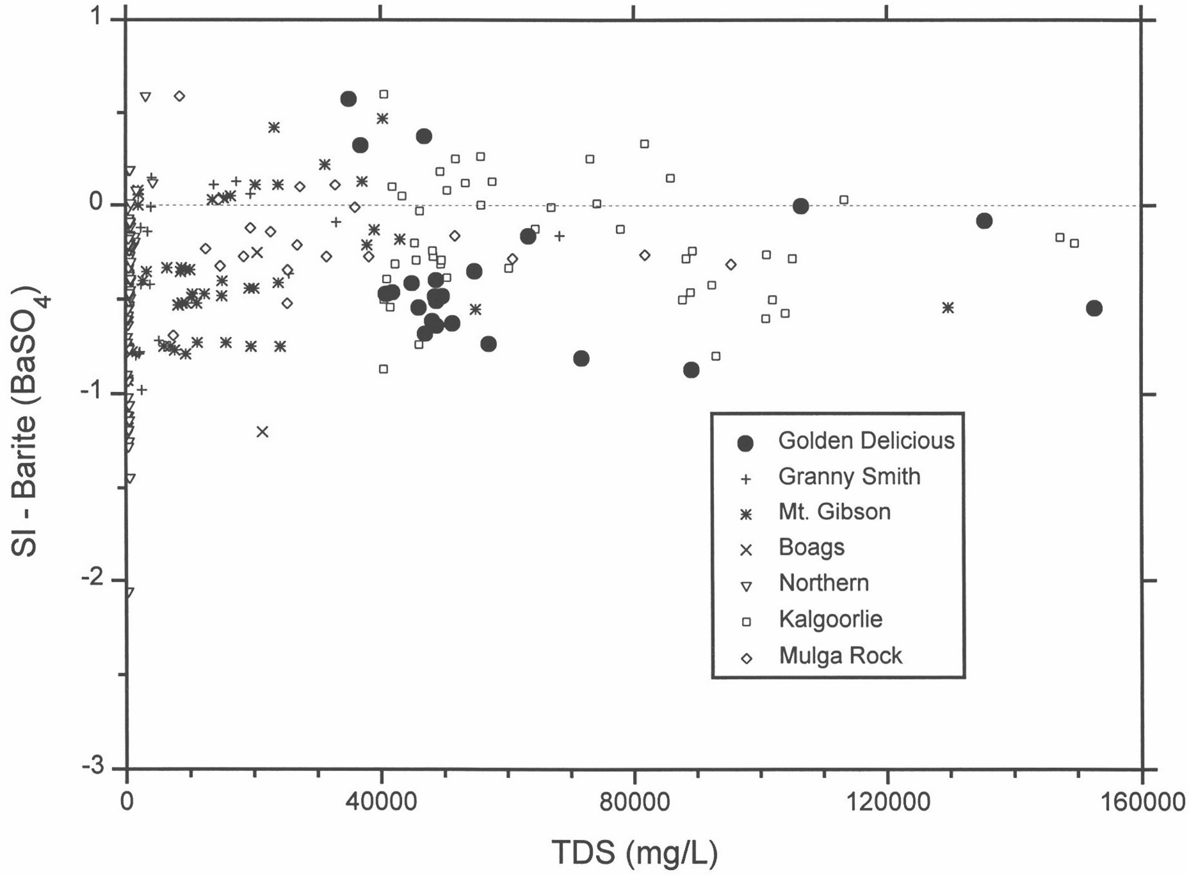

Figure A3.4: SI for barite vs. TDS for groundwaters from Golden Delicious and other sites.

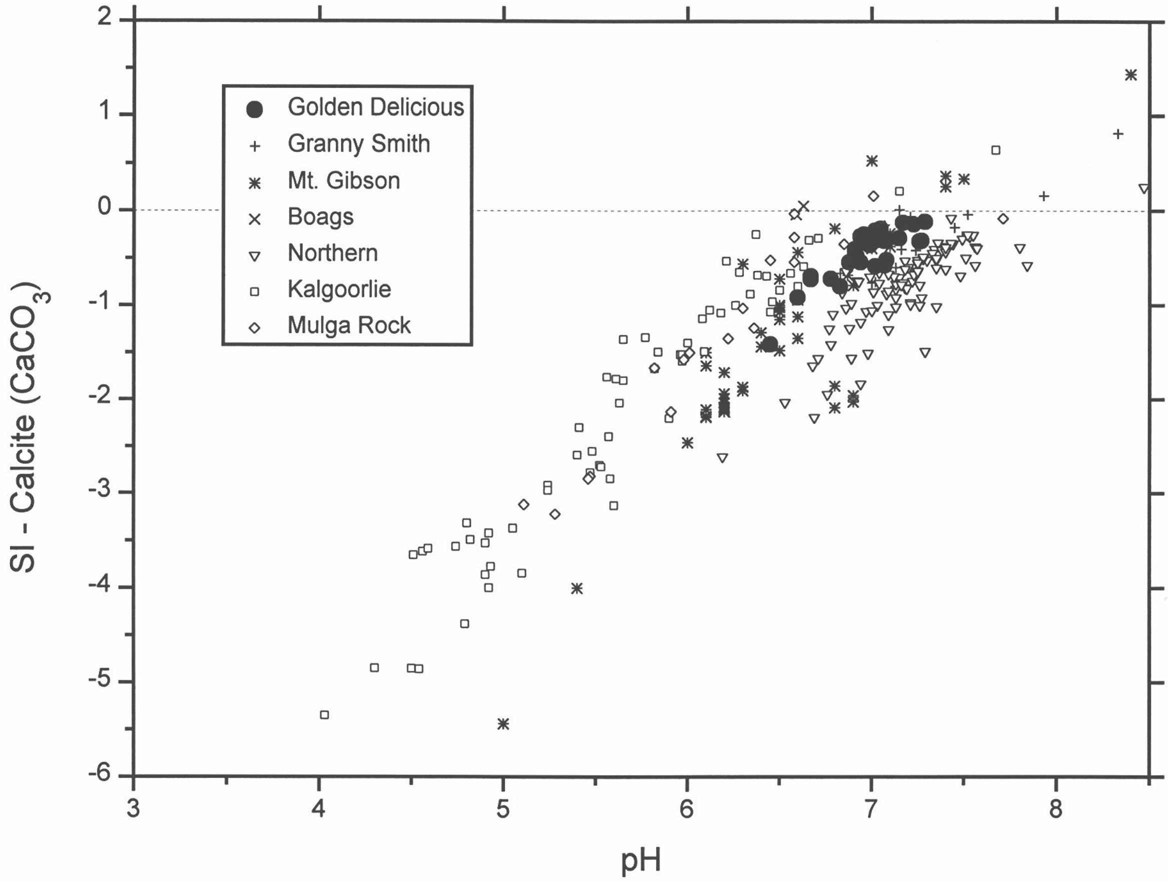

Figure A3.5: SI for calcite vs. pH for groundwaters from Golden Delicious and other sites.

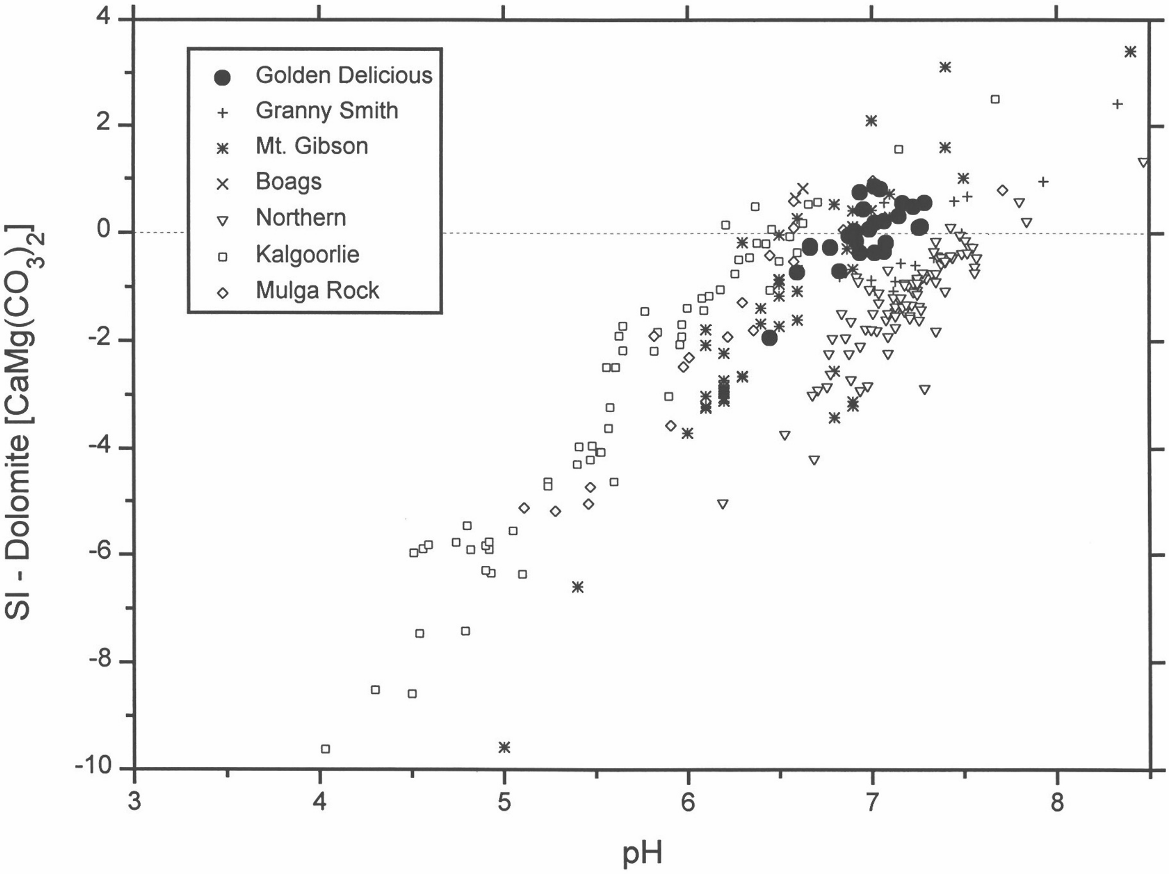

Figure A3.6: SI for dolomite vs. pH for groundwaters from Golden Delicious and other sites.

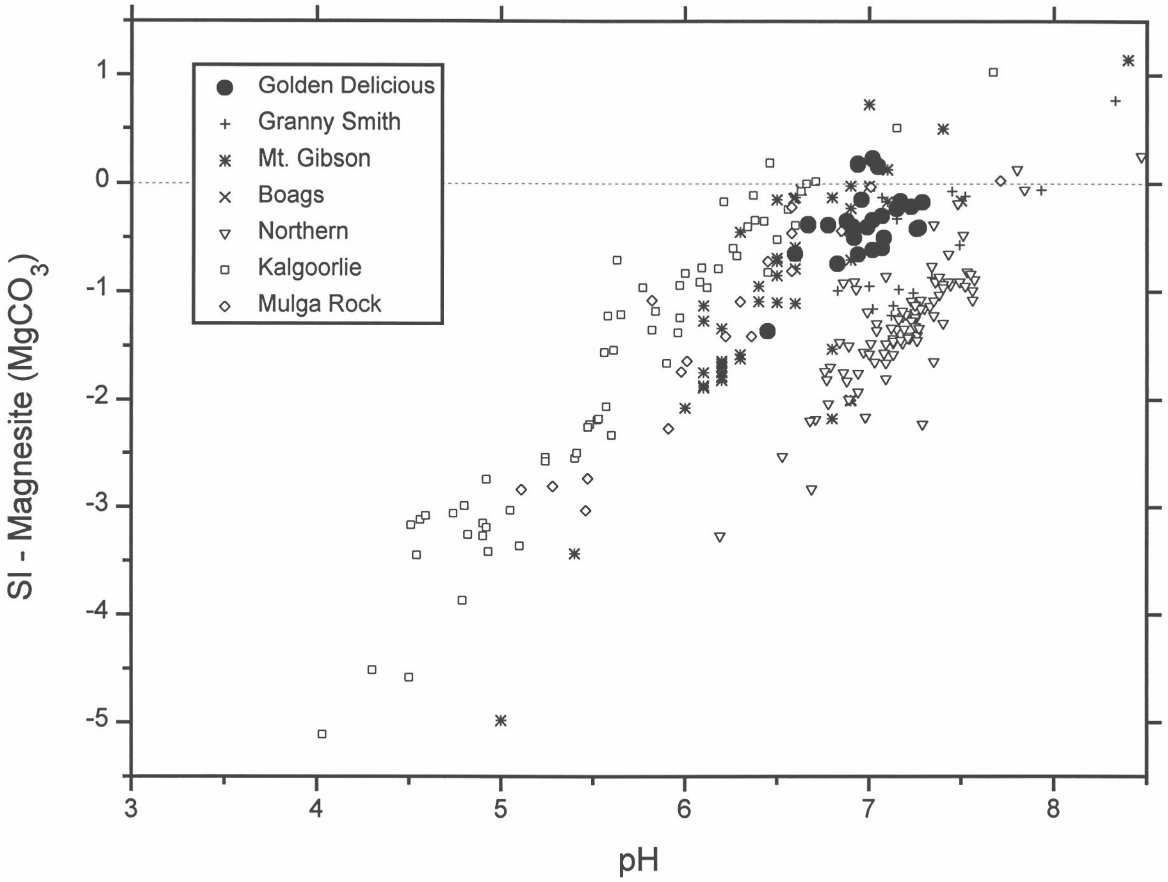

Figure A3.7 SI for magnesite vs. pH for groundwaters from Golden Delicious and other sites.

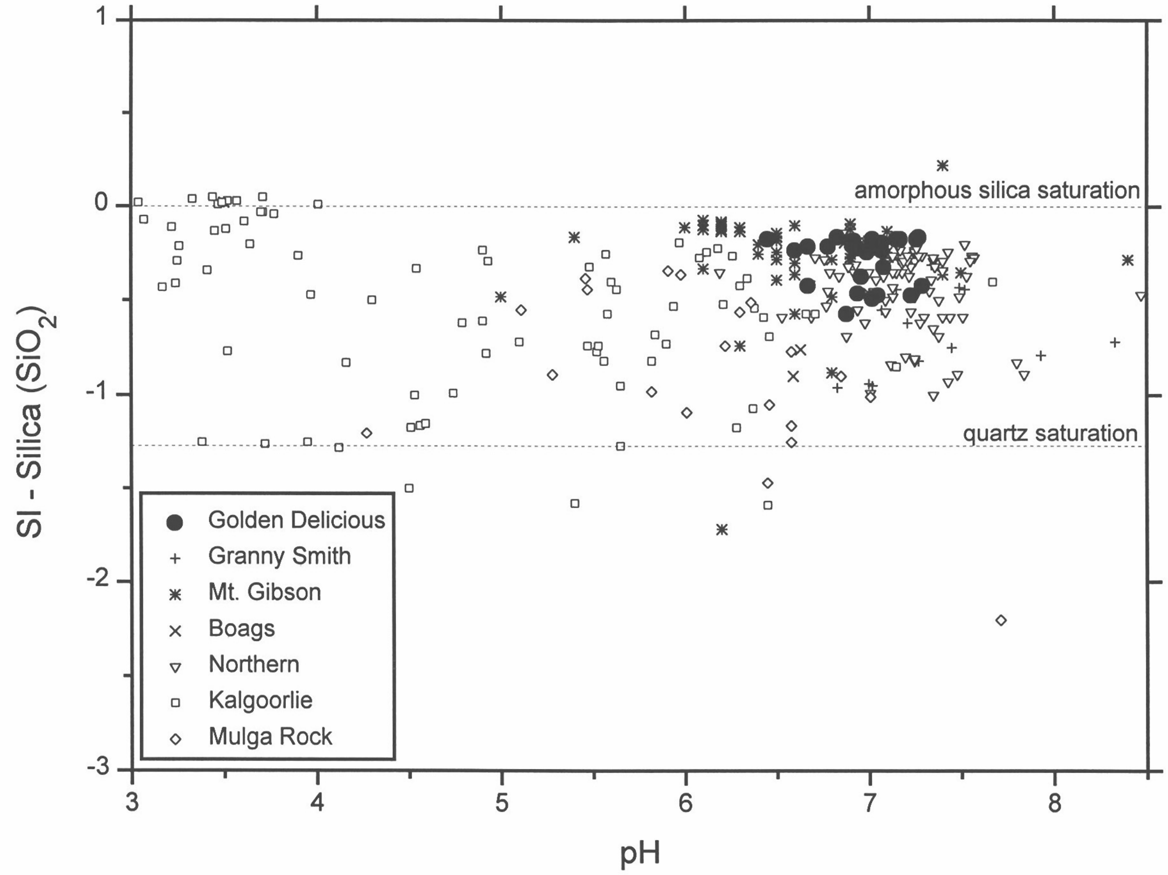

Figure A3.8: SI for silica vs. pH for groundwaters from Golden Delicious and other sites.

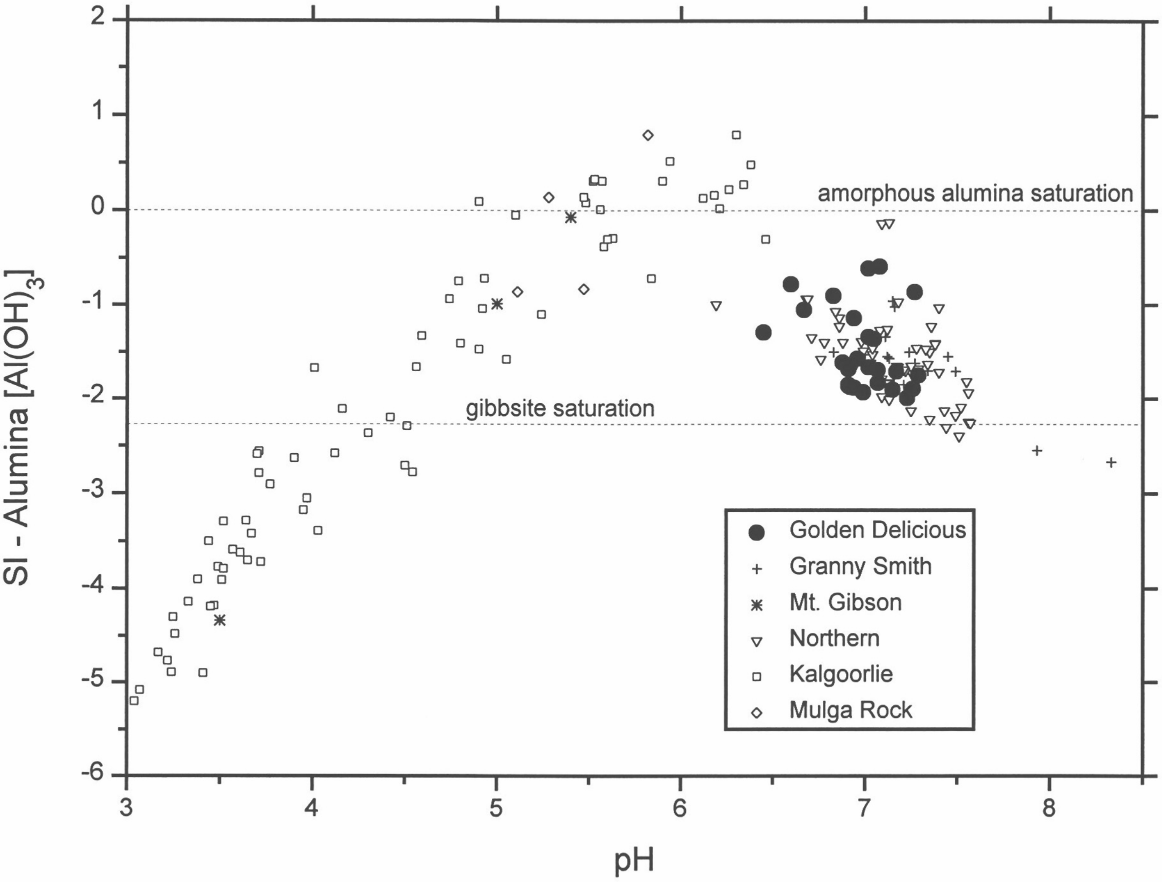

Figure A3.9: SI for alumina vs. pH for groundwaters from Golden Delicious and other sites.

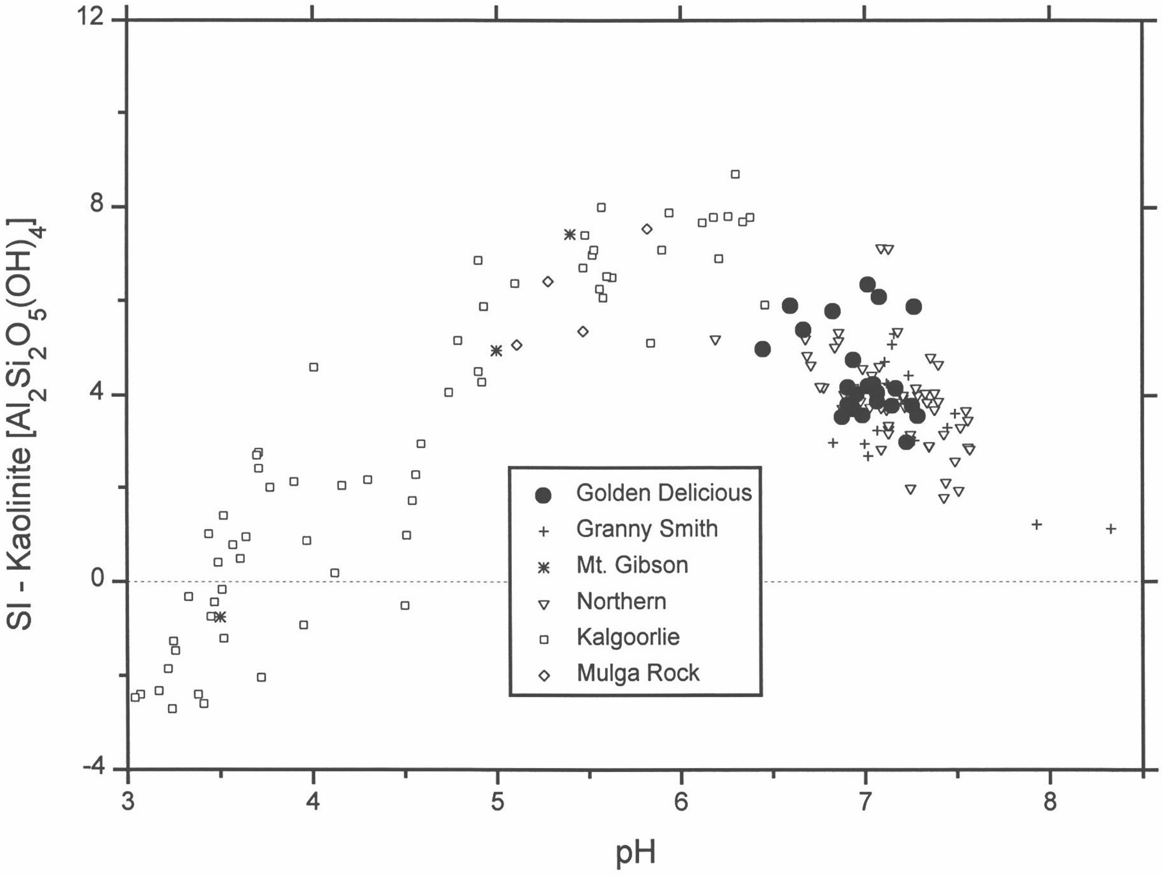

Figure A3.10: SI for kaolinite vs. pH for groundwaters from Golden Delicious and other sites.

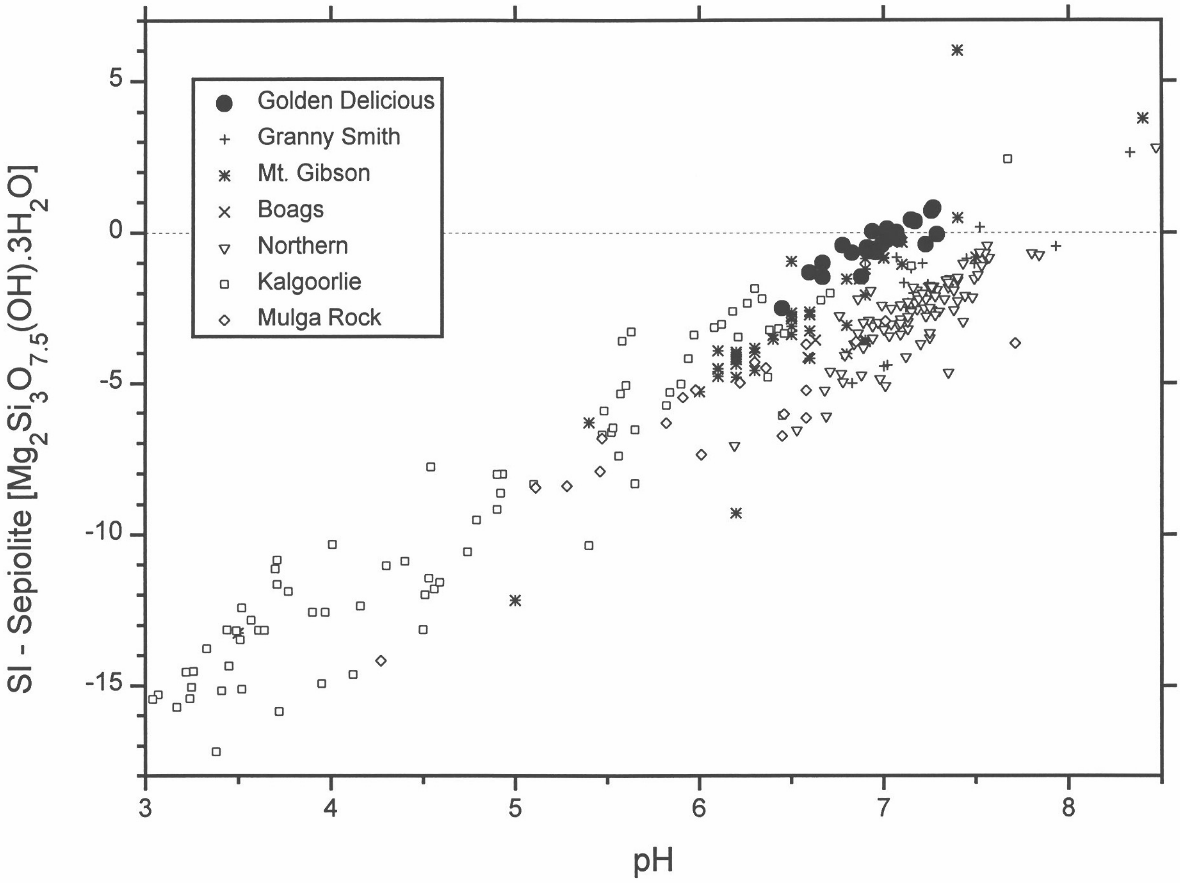

Figure A3.11: SI for sepiolite vs. pH for groundwaters from Golden Delicious and other sites.

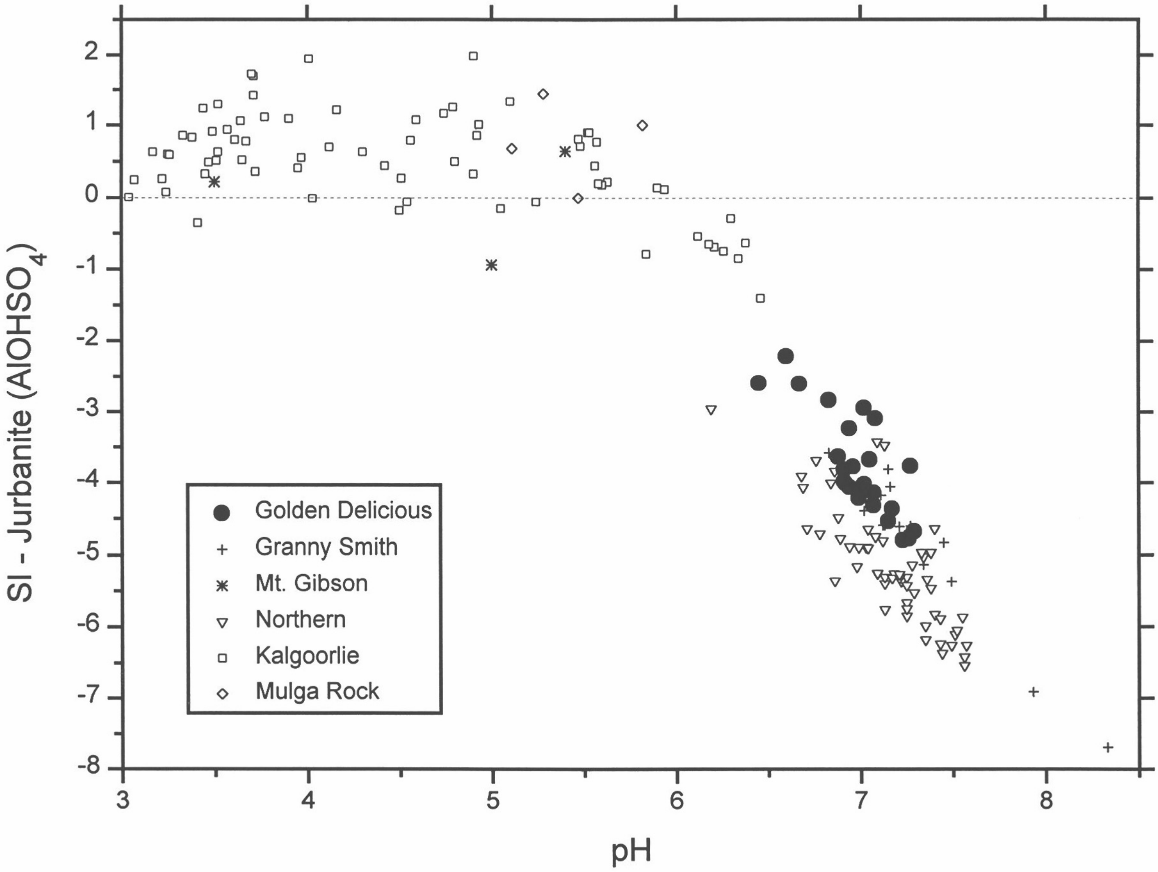

Figure A3.12: SI for jurbanite vs. pH for groundwaters from Golden Delicious and other sites.

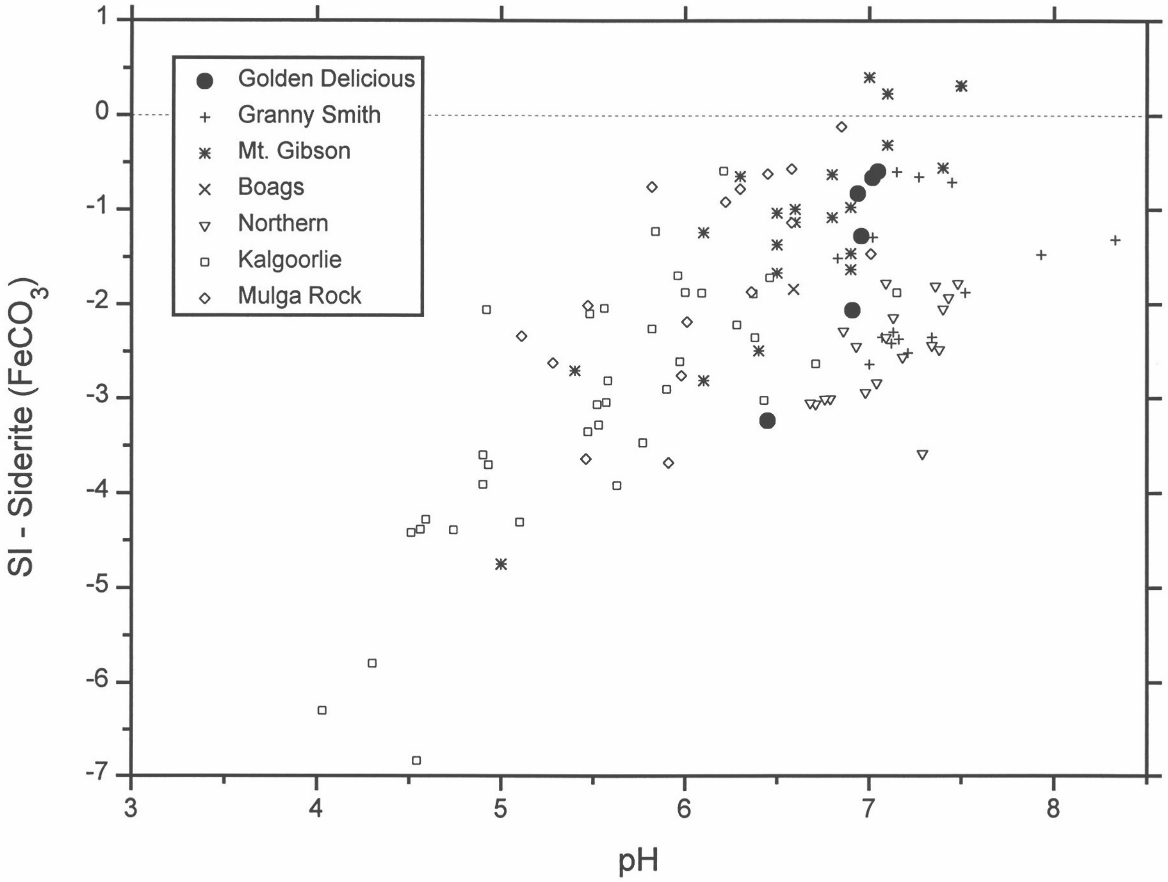

Figure A3.13: SI for siderite vs. pH for groundwaters from Golden Delicious and other sites.

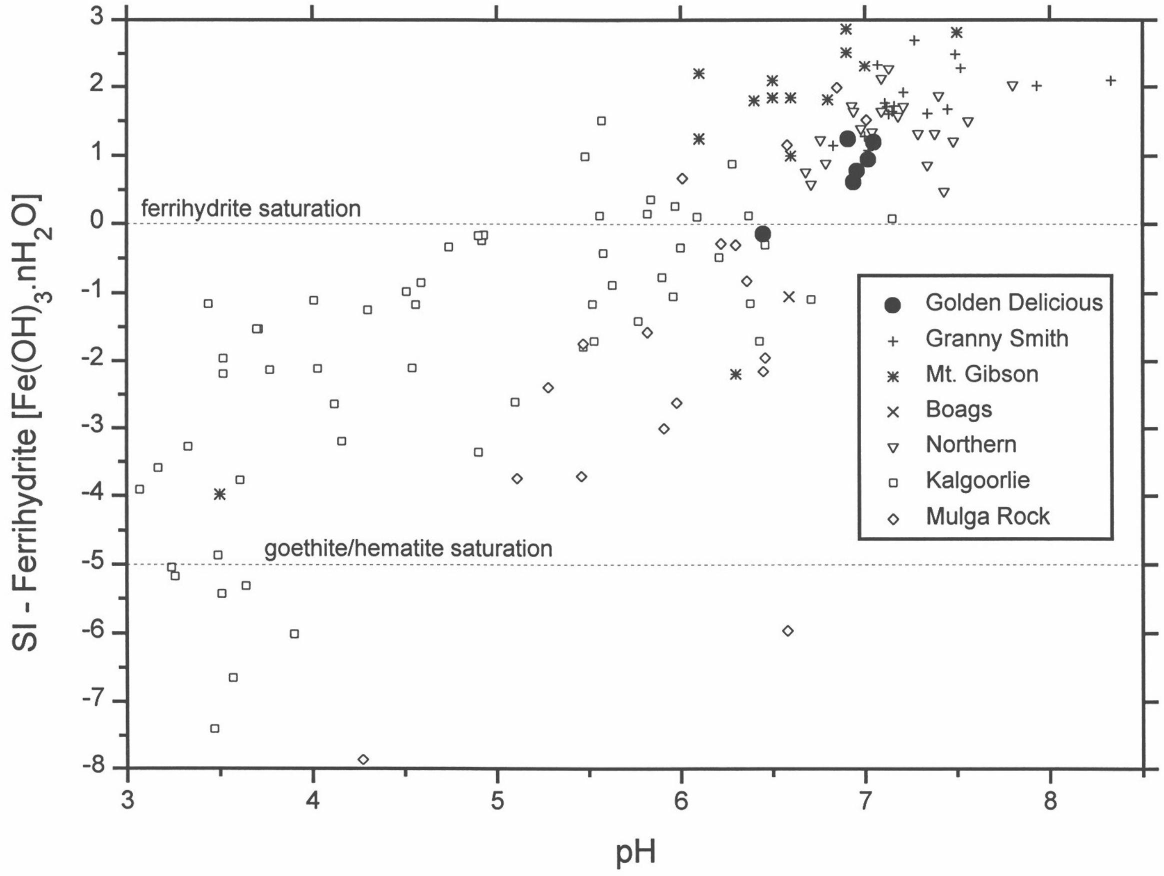

Figure A3.14: SI for ferrihydrite vs. pH for groundwaters from Golden Delicious and other sites.

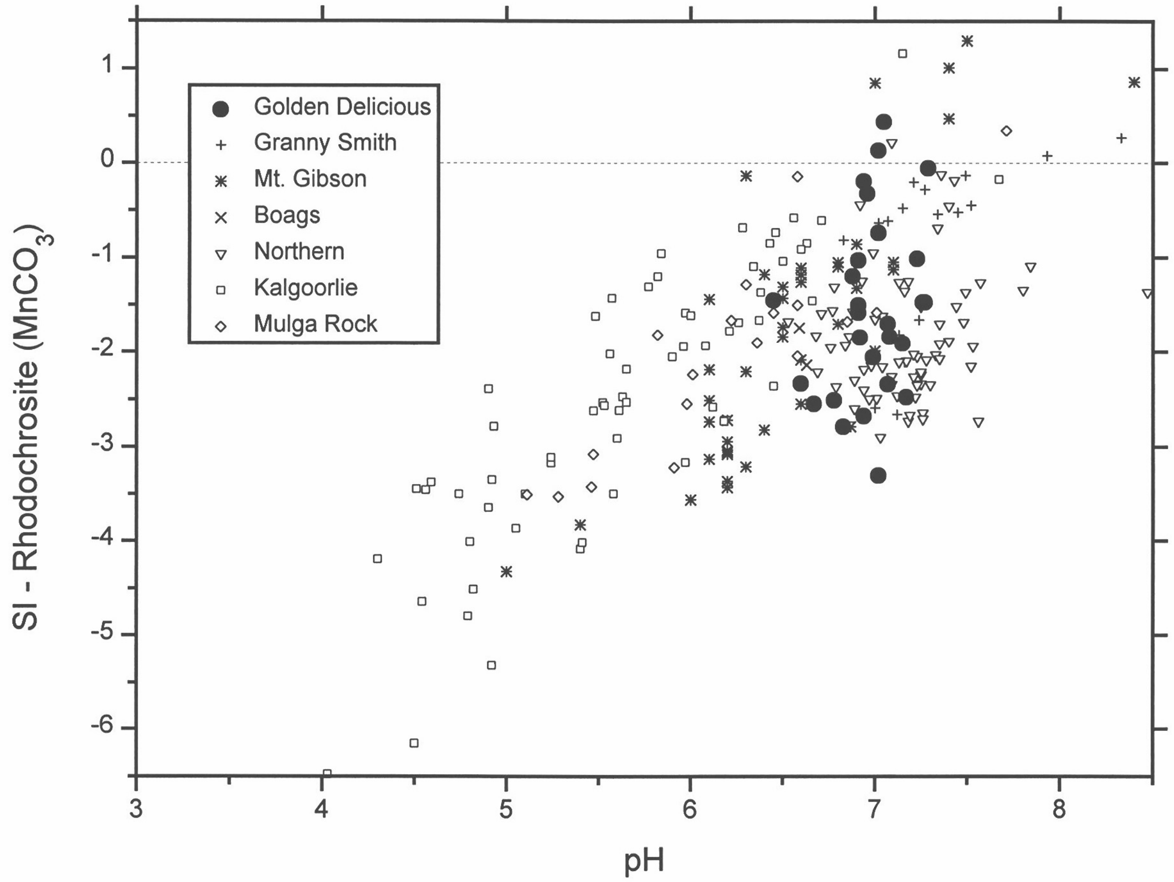

Figure A3.15: SI for rhodochrosite vs. pH for groundwaters from Golden Delicious and other sites

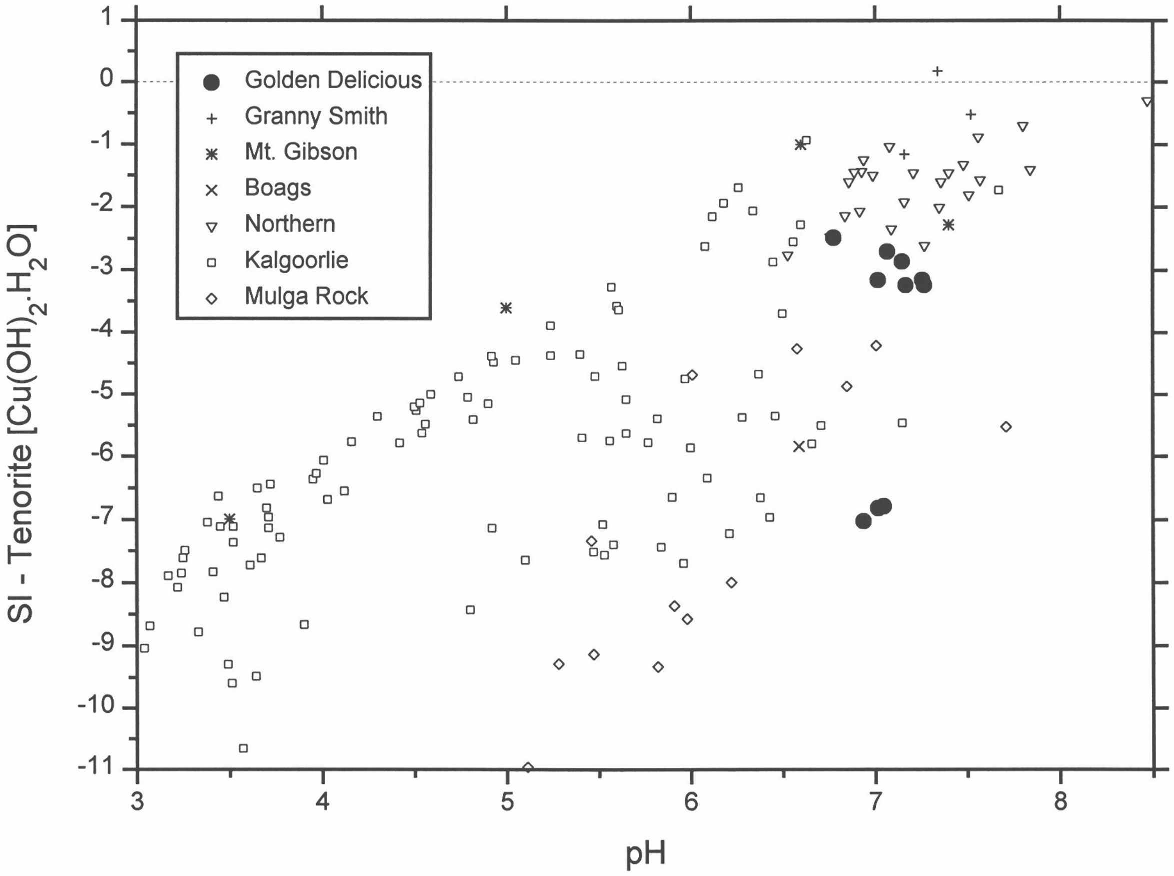

Figure A3.16: SI for tenorite vs. pH for groundwaters from Golden Delicious and other sites.

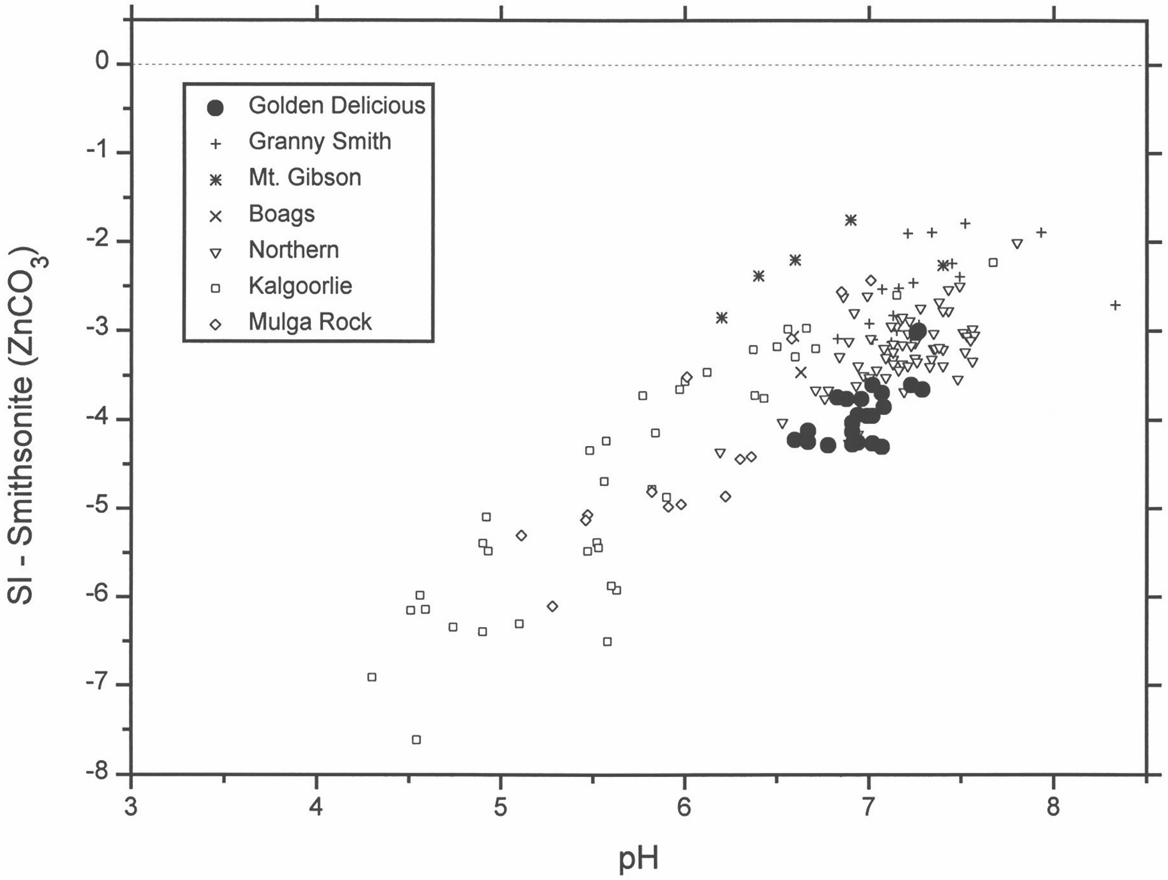

Figure A3.17: SI for smithsonite vs. pH for groundwaters from Golden Delicious and other sites.

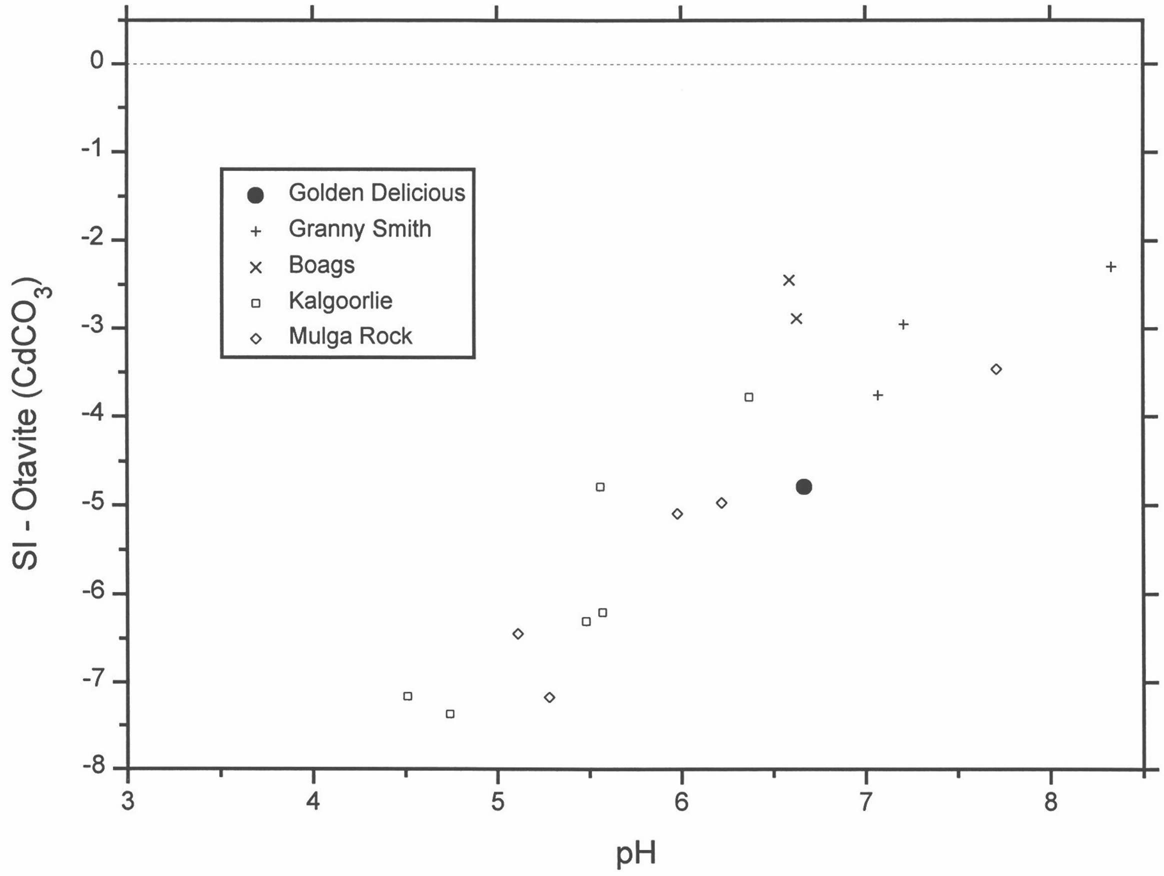

Figure A3.18: SI for otavite vs. pH for groundwaters from Golden Delicious and other sites.

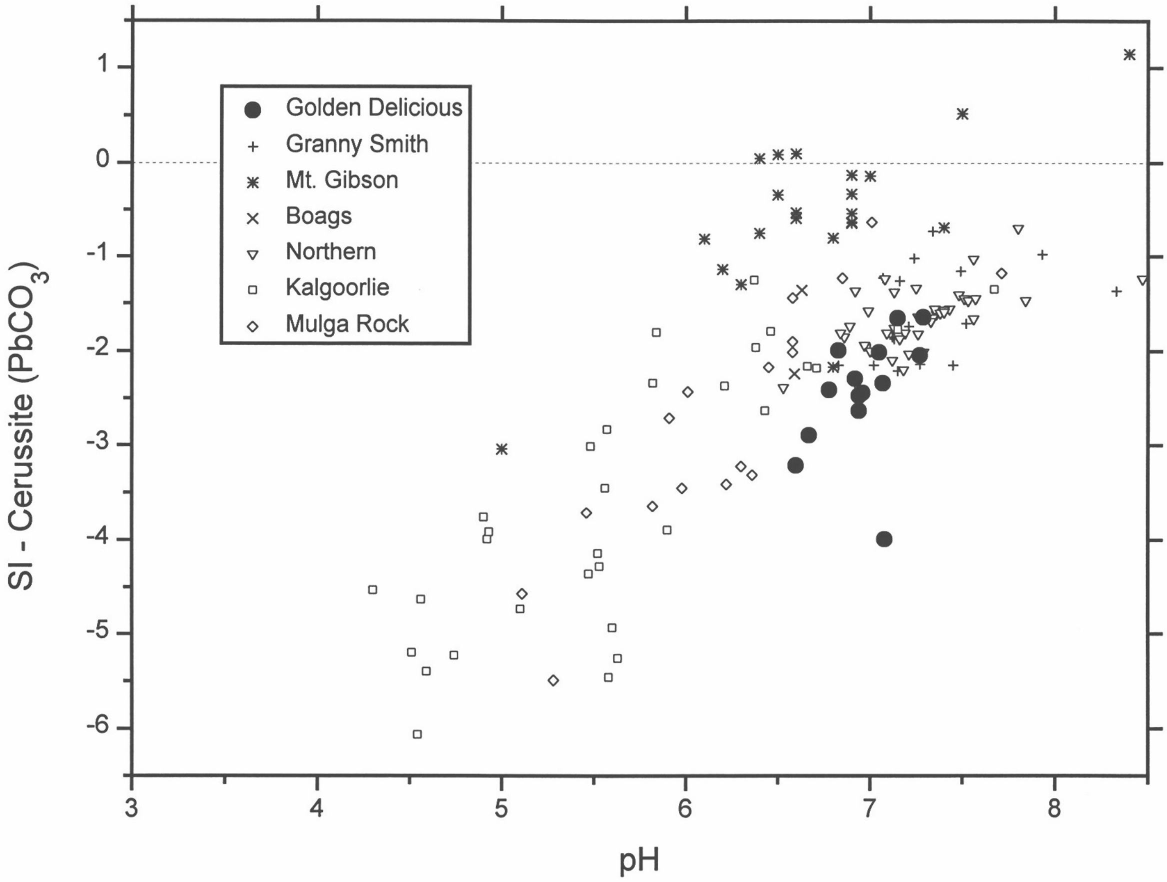

Figure A3.19: SI for cerussite vs. pH for groundwaters from Golden Delicious and other sites.

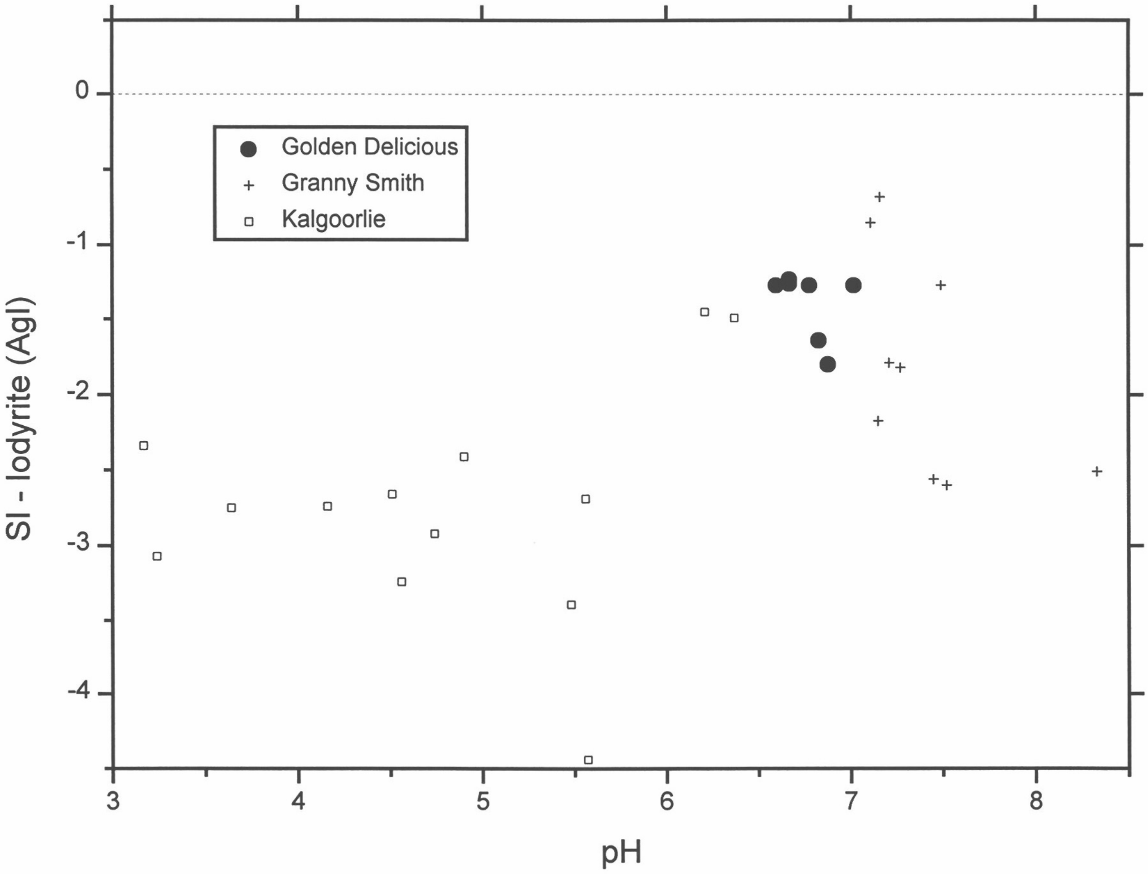

Figure A3.20: SI for iodyrite vs. pH for groundwaters from Golden Delicious and other sites.

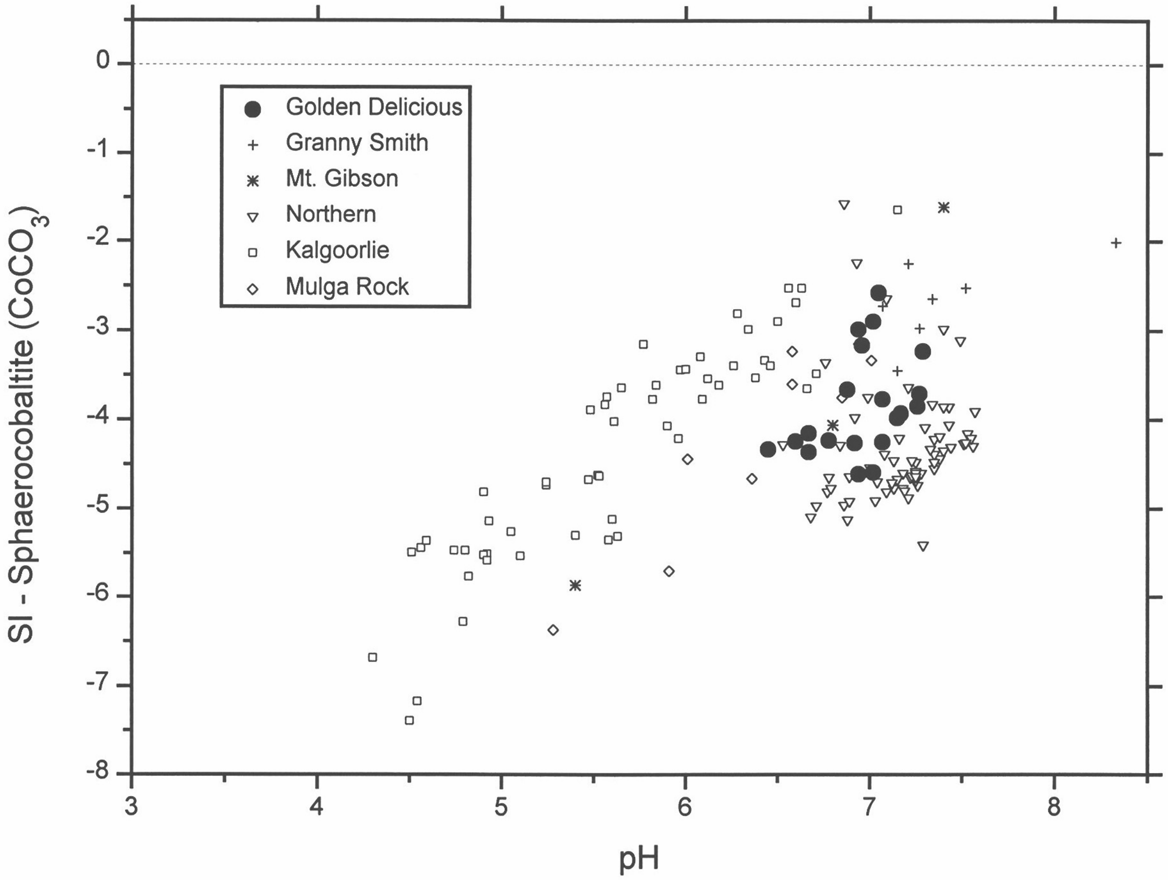

Figure A3.21: SI for sphaerocobaltite vs. pH for groundwaters from Golden Delicious and other sit

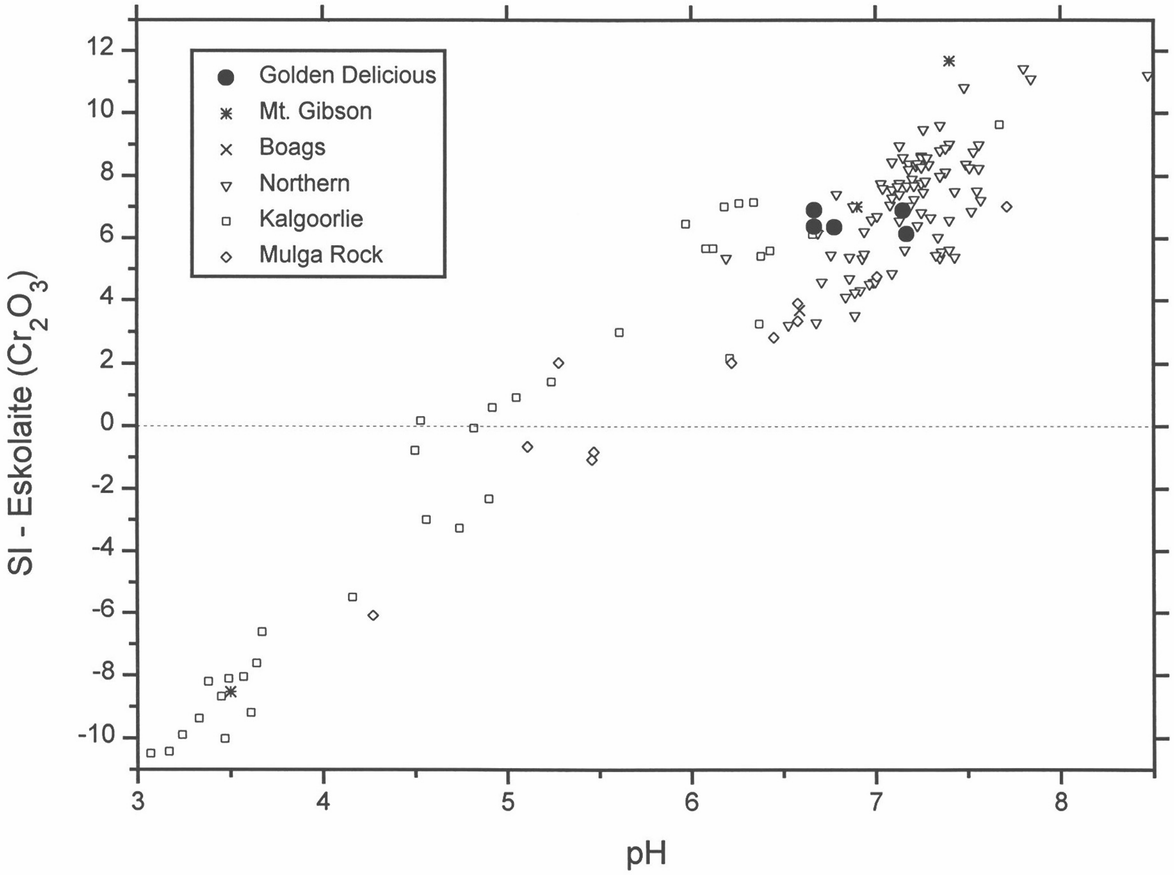

Figure A3.22: SI for eskolaite vs. pH for groundwaters from Golden Delicious and other sites.

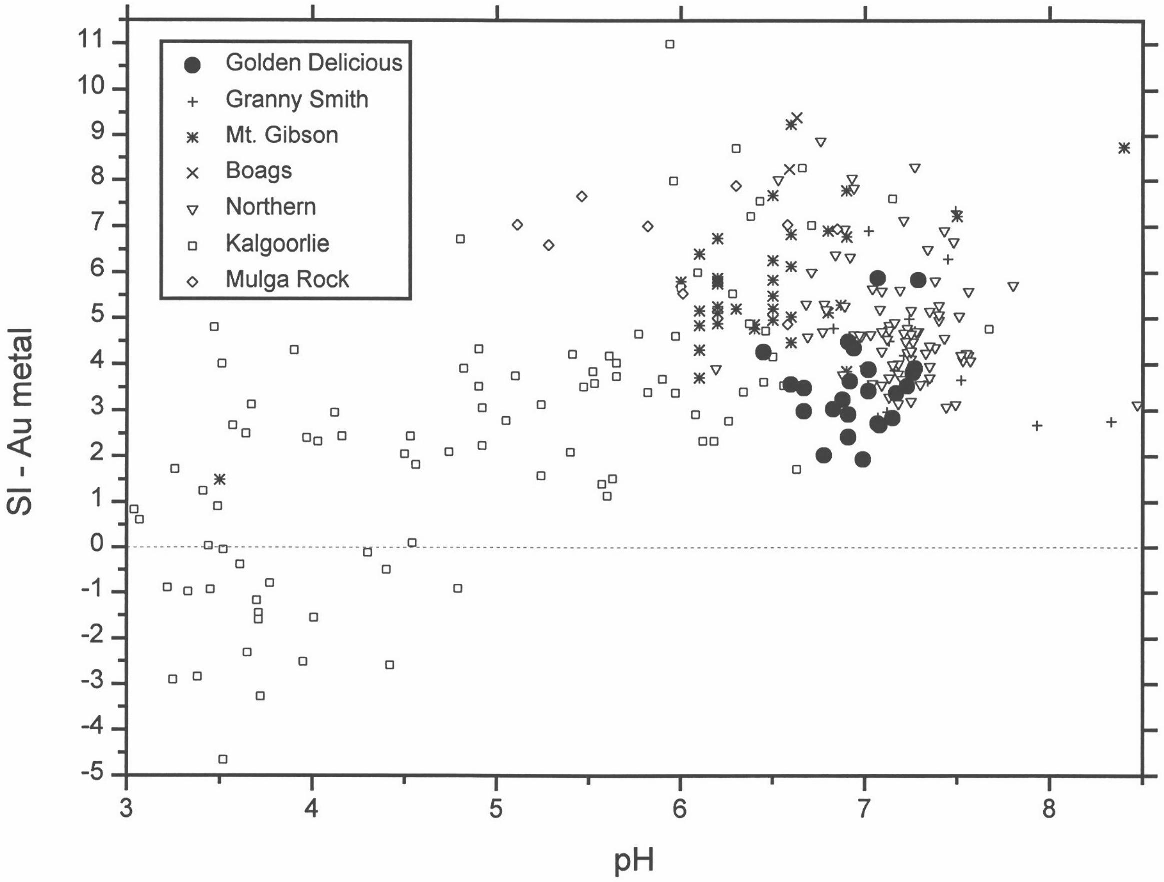

Figure A3.23: SI for Au metal vs. pH for groundwaters from Golden Delicious and other sites.

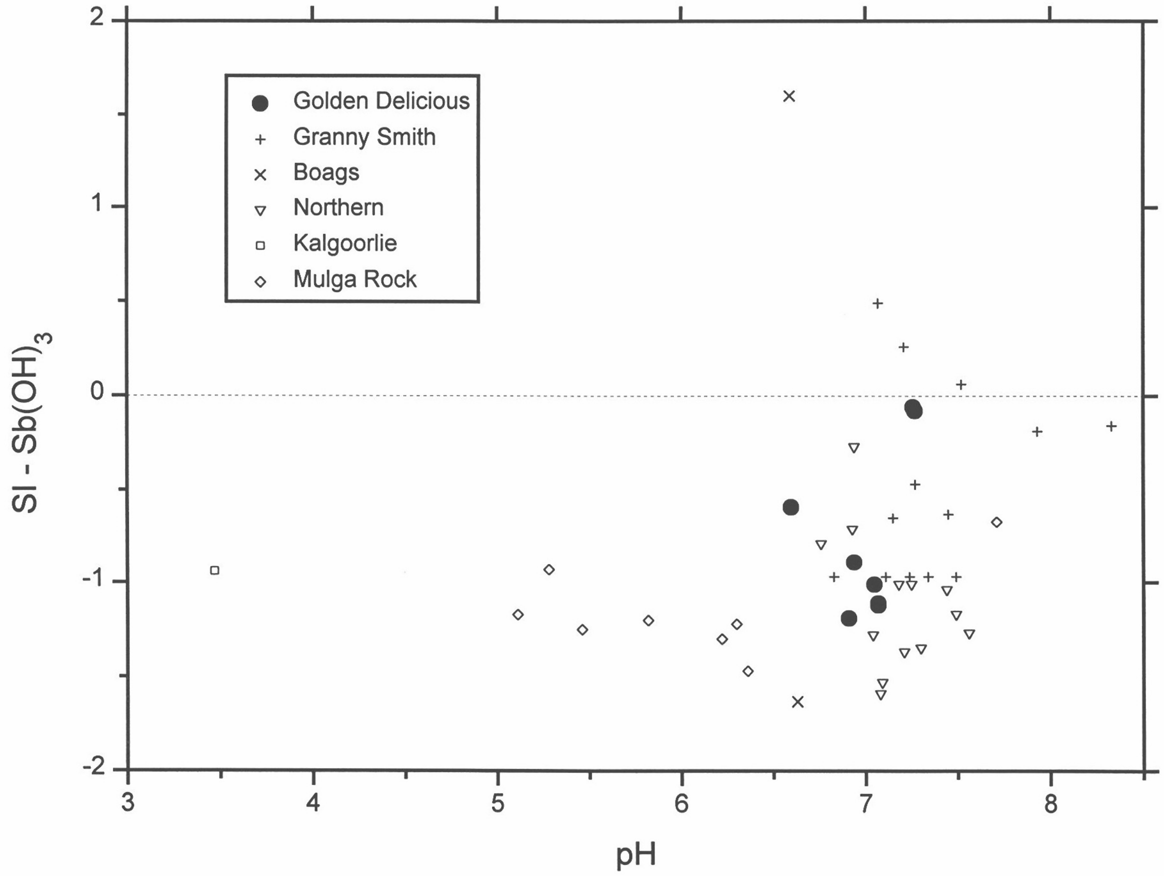

Figure A3.24: SI for $Sb(OH)_3$ vs. pH for groundwaters from Golden Delicious and other sites.

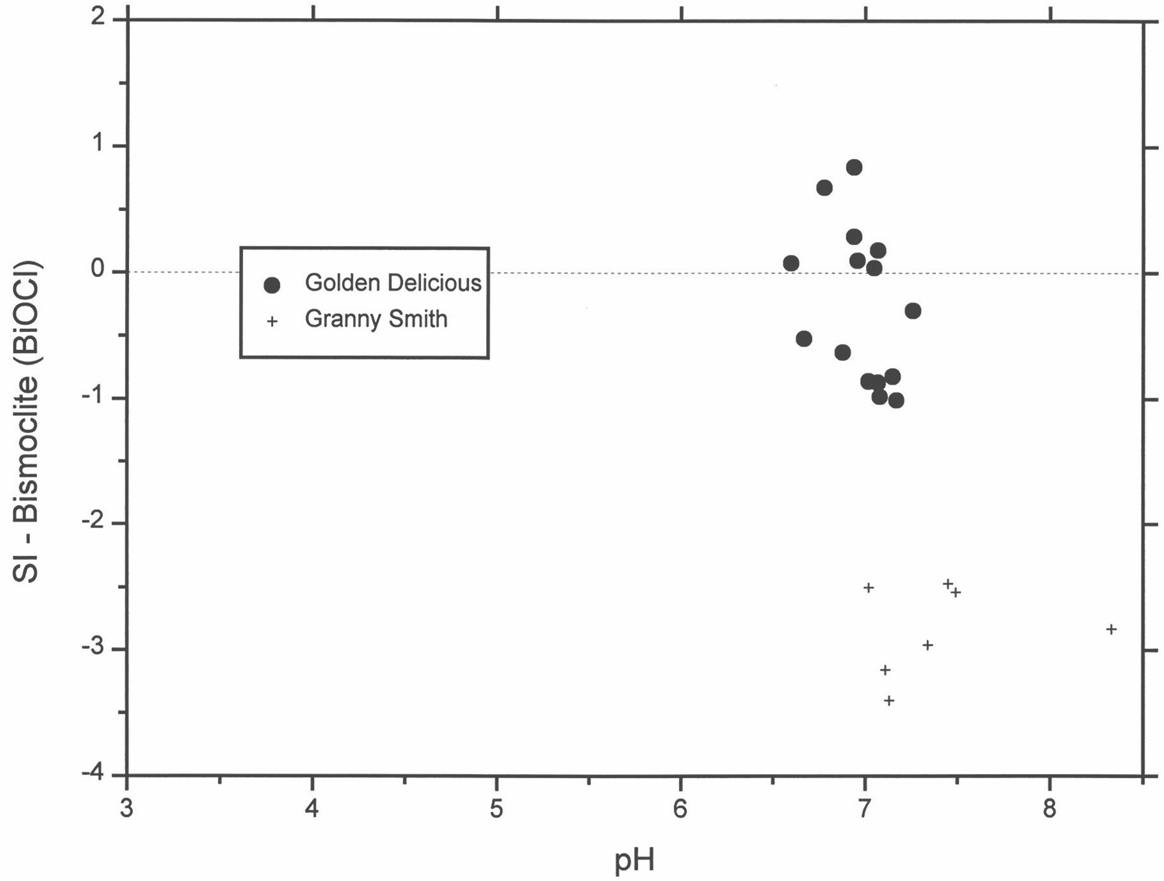

Figure A3.25: SI for bismoclite vs. pH for groundwaters from Golden Delicious and other sites.

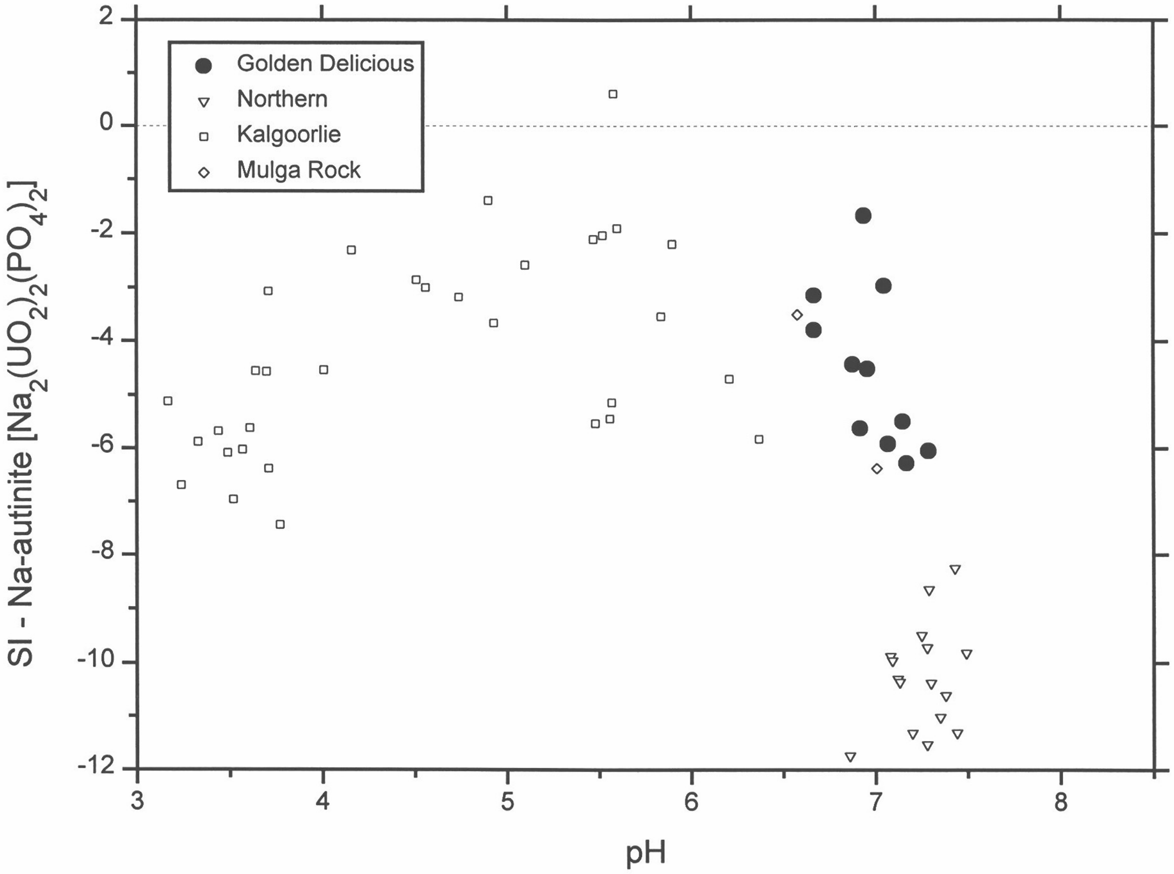

Figure A3.26: SI for Na-autinite vs. pH for groundwaters from Golden Delicious and other sites.

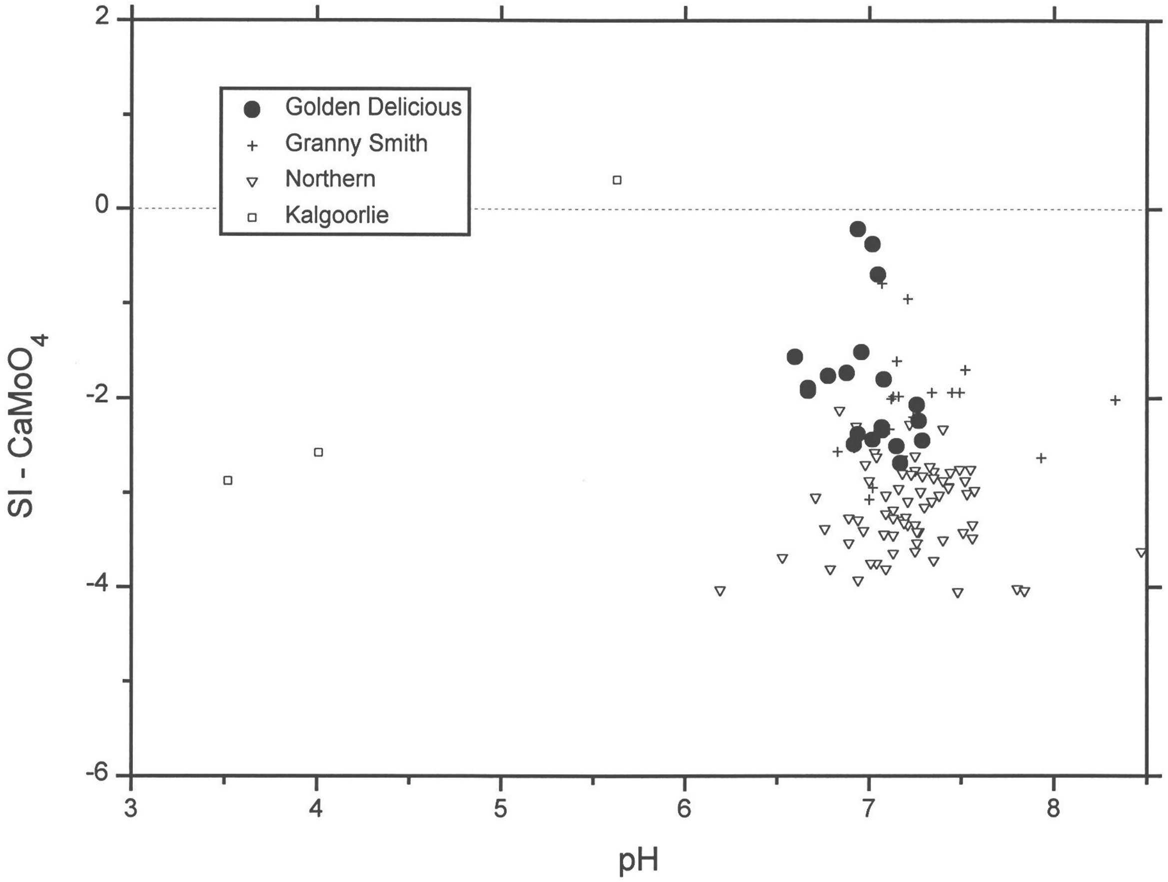

Figure A3.27: SI for $CaMoO_4$ vs. pH for groundwaters from Golden Delicious and other sites.

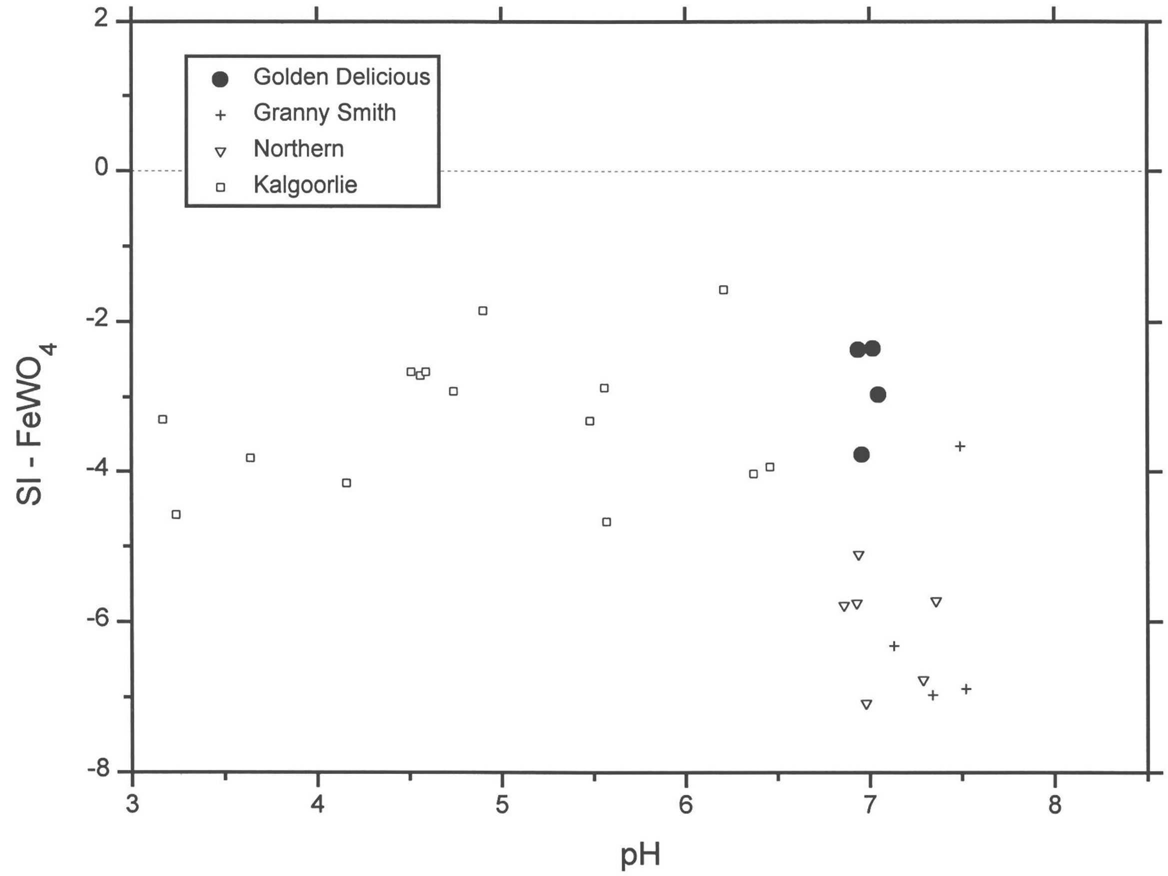

Figure A3.28: SI for $FeWO_4$ vs. pH for groundwaters from Golden Delicious and other sites.

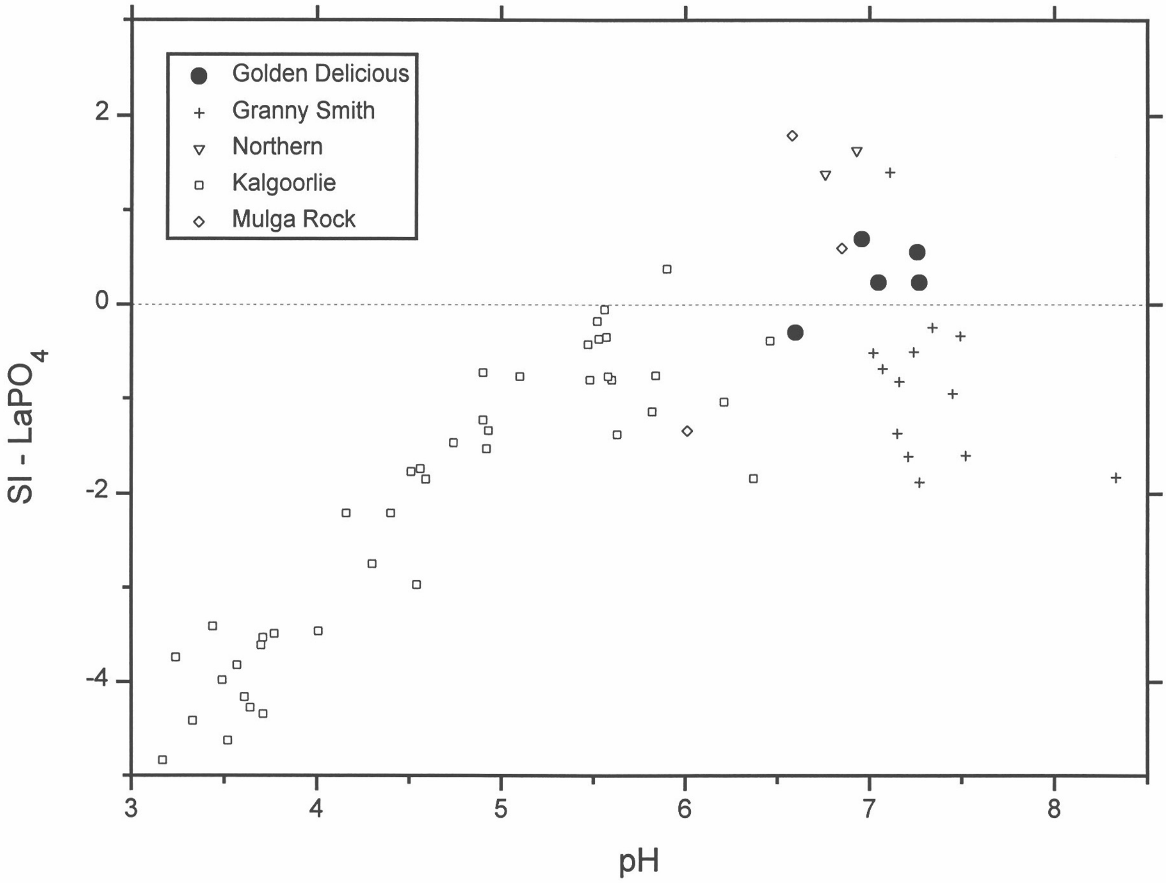

Figure A3.29: SI for $LaPO_4$ vs. pH for groundwaters from Golden Delicious and other sites.

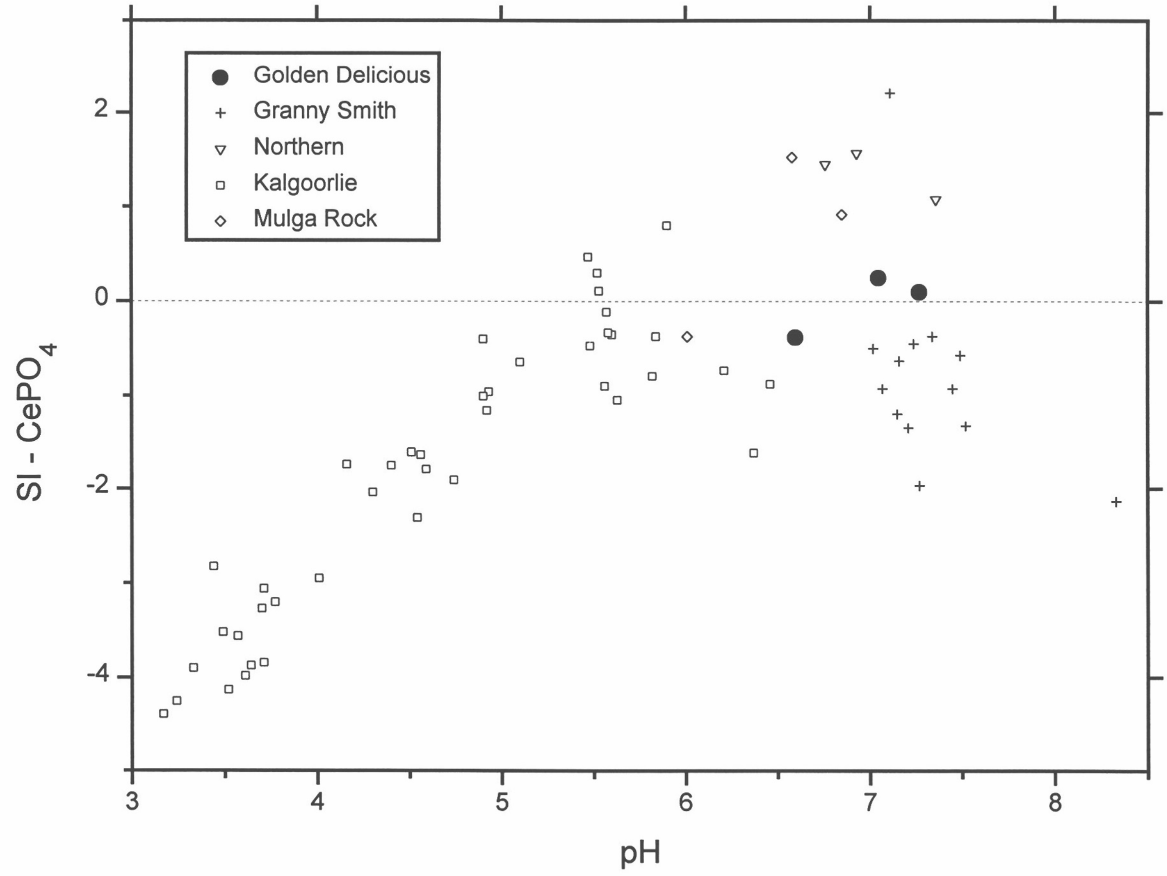

Figure A3.30: SI for $CePO_4$ vs. pH for groundwaters from Golden Delicious and other sites.

# APPENDIX 4: ELEMENT/ION DISTRIBUTION MAPS - GROUNDWATERS

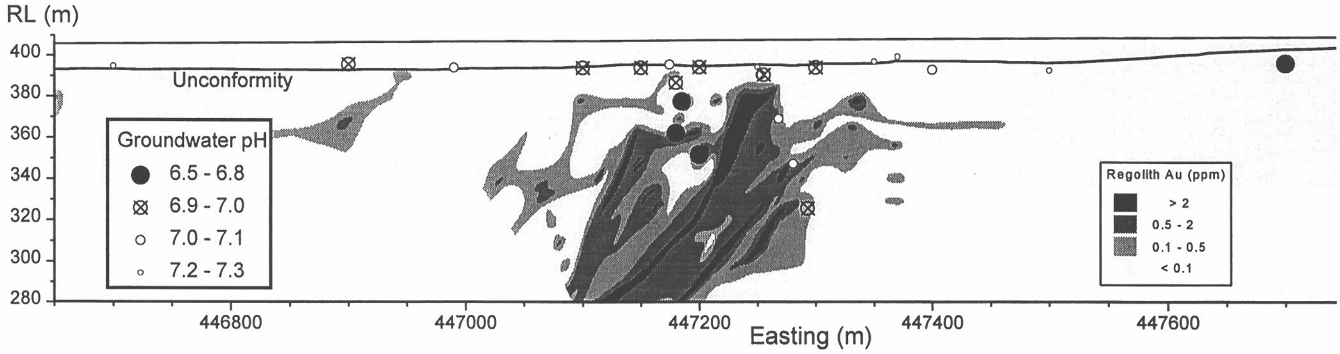

Figure A4.1: Groundwater pH distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

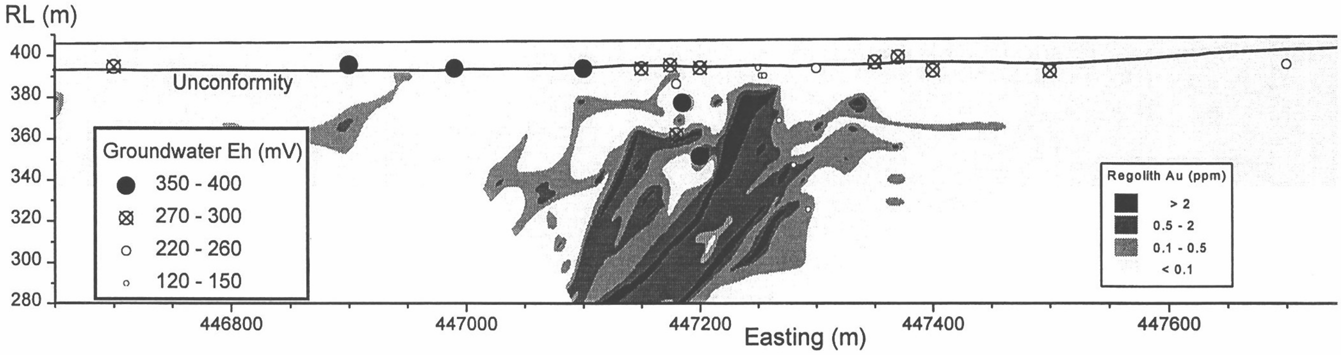

Figure A4.2: Groundwater Eh distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

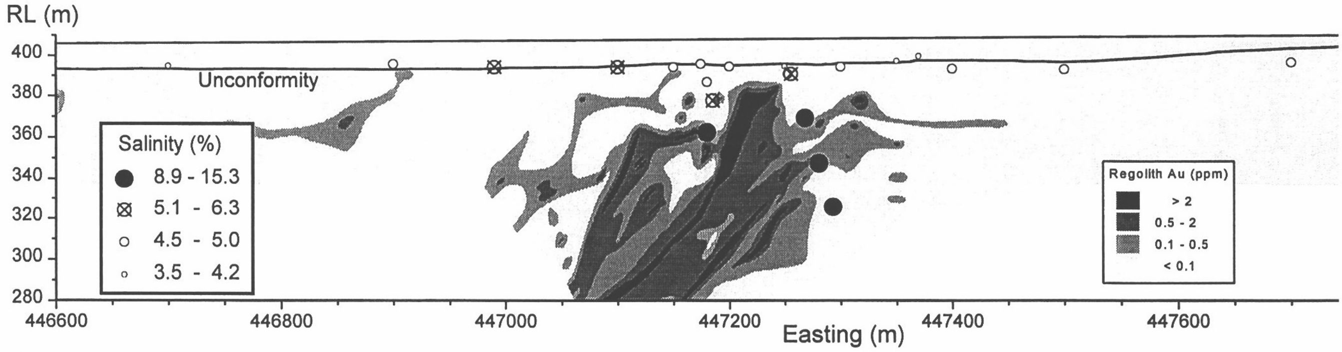

Figure A4.3: Groundwater salinity distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contour

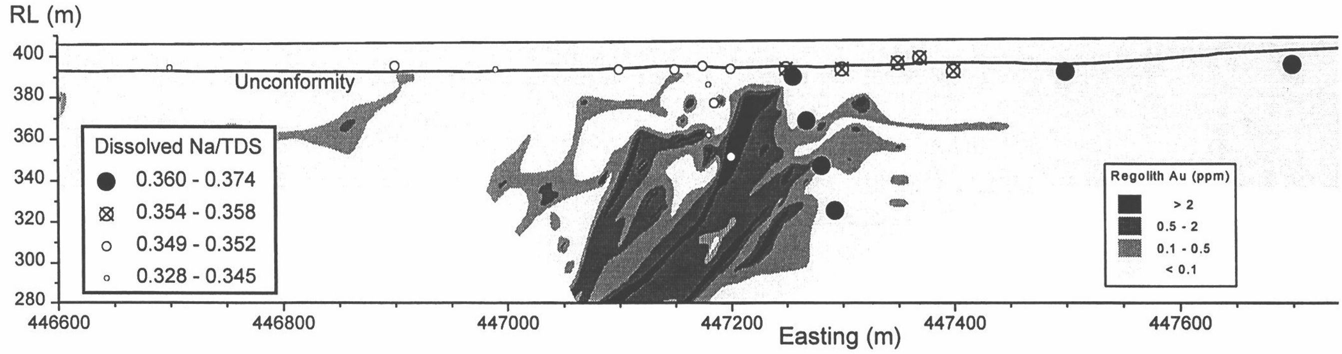

Figure A4.4: Groundwater Na/TDS distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contou

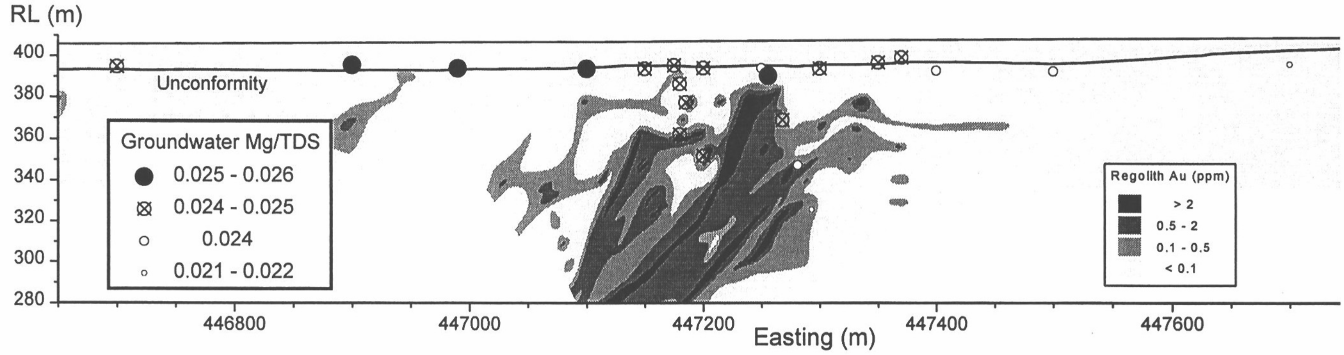

Figure A4.5: Groundwater Mg/TDS distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contou

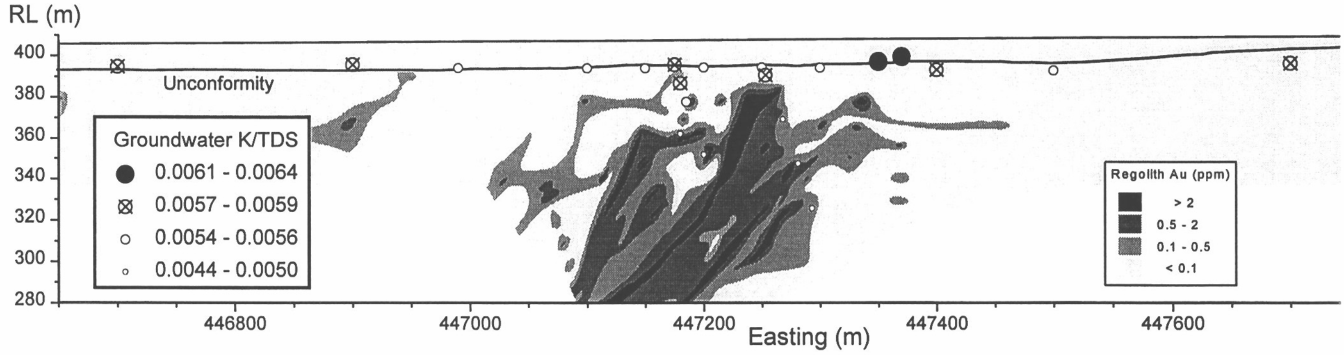

Figure A4.6: Groundwater K/TDS distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contou

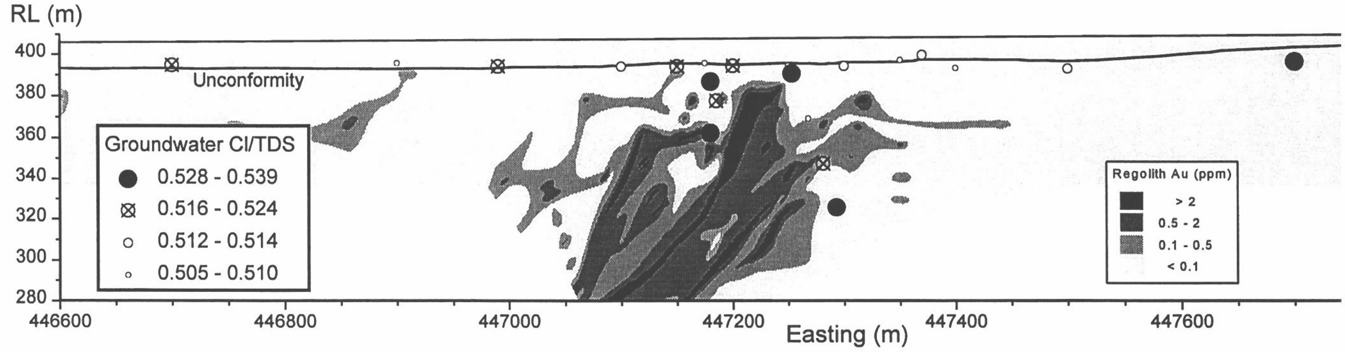

Figure A4.7: Groundwater Cl/TDS distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contou

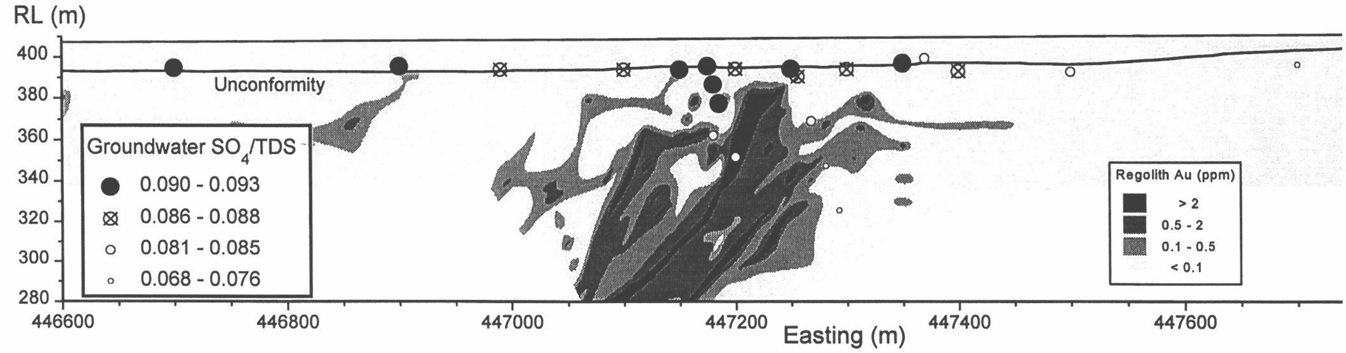

Figure A4.8: Groundwater $SO_4$/TDS distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au conto

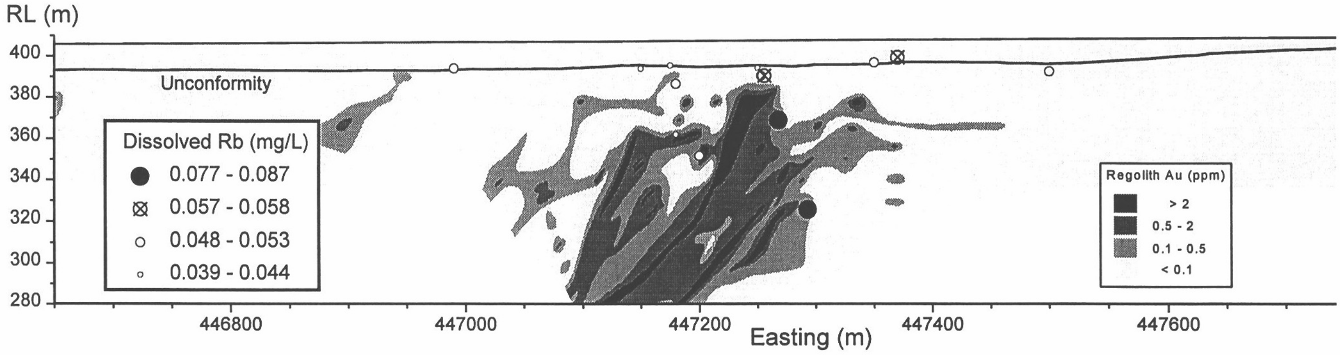

Figure A4.9: Dissolved Rb distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

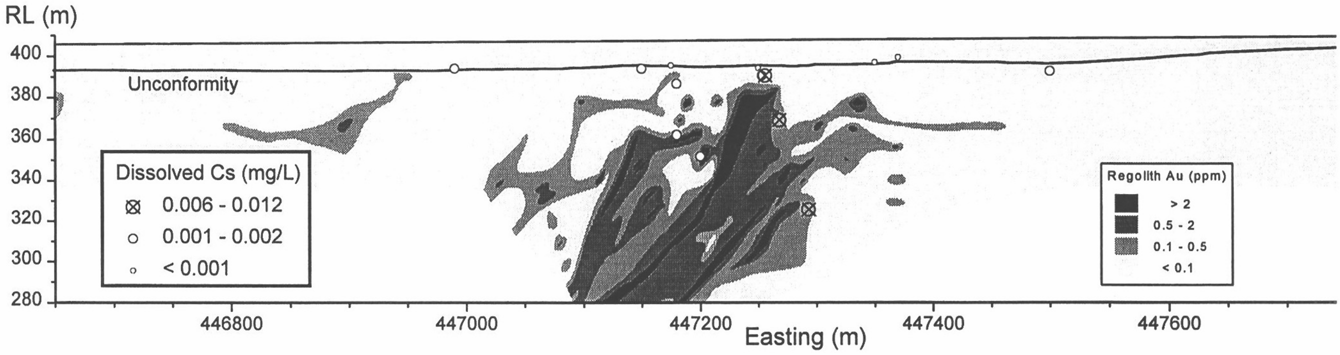

Figure A4.10: Dissolved Cs distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

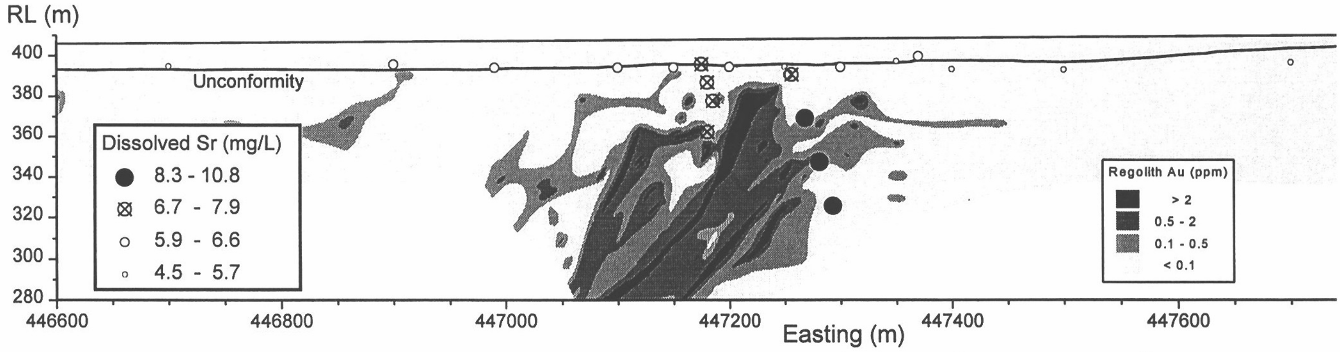

Figure A4.11: Dissolved Sr distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

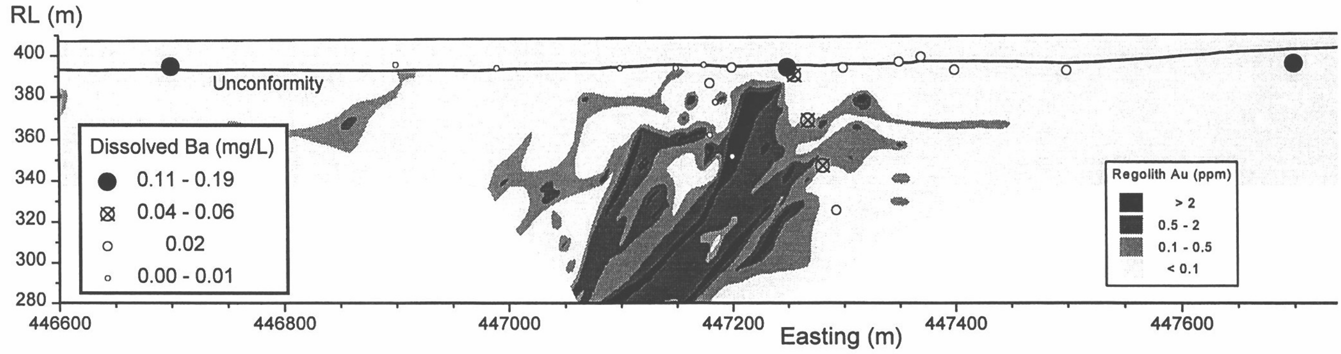

Figure A4.12: Dissolved Ba distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

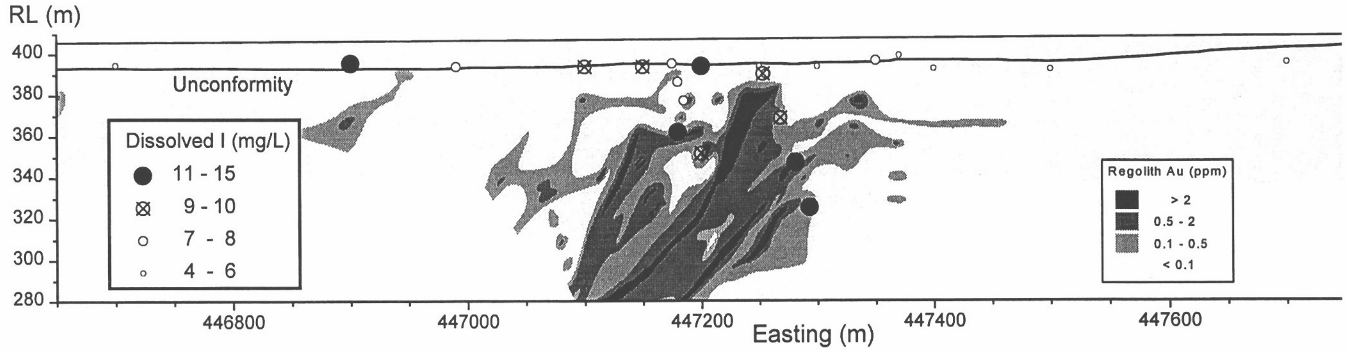

Figure A4.13: Dissolved I distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

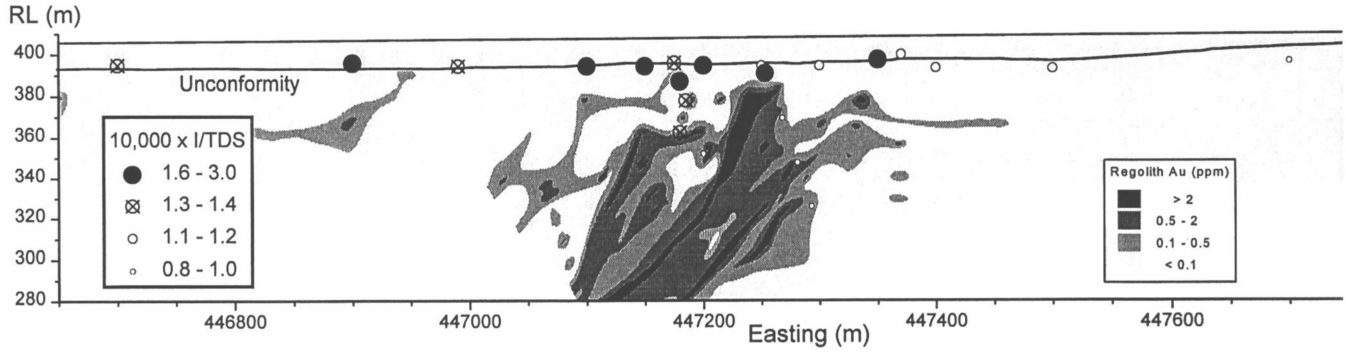

Figure A4.14: Groundwater I/TDS distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contour

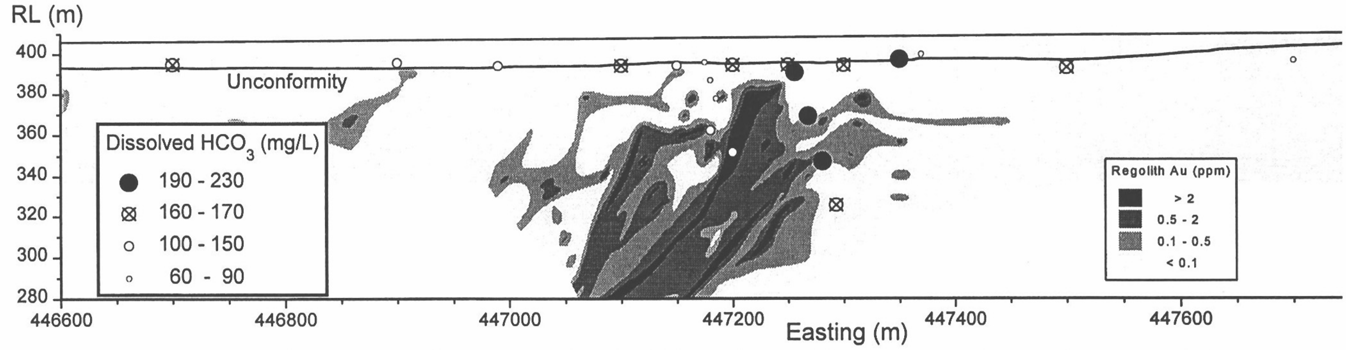

Figure A4.15: Dissolved $HCO_3$ distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

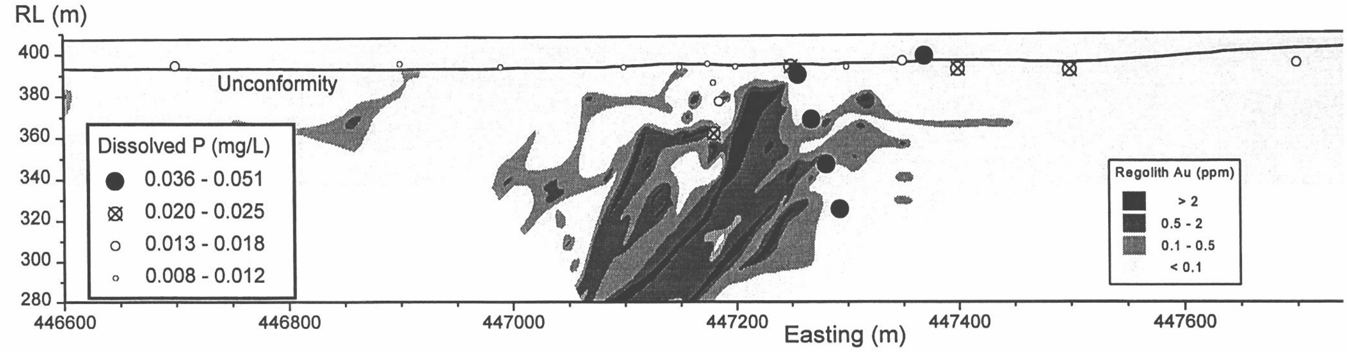

Figure A4.16: Dissolved P distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

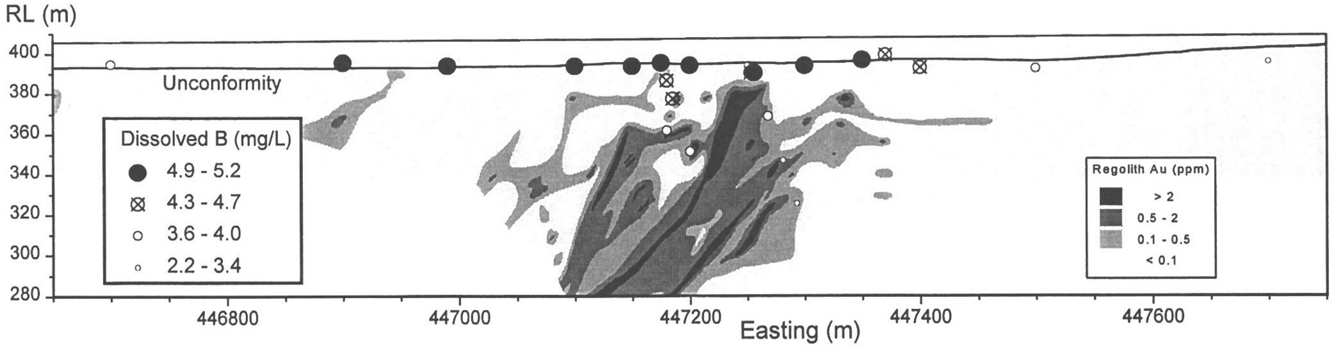

Figure A4.17: Dissolved B distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

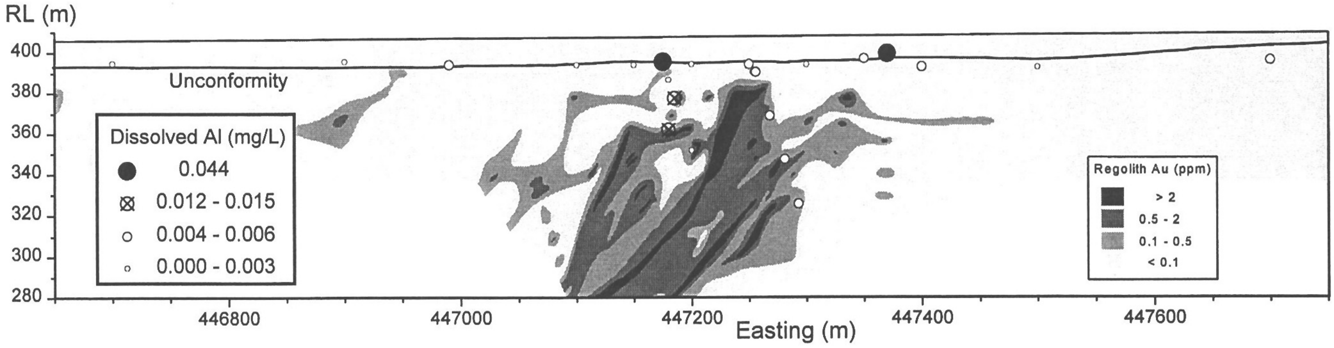

Figure A4.18: Dissolved Al distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

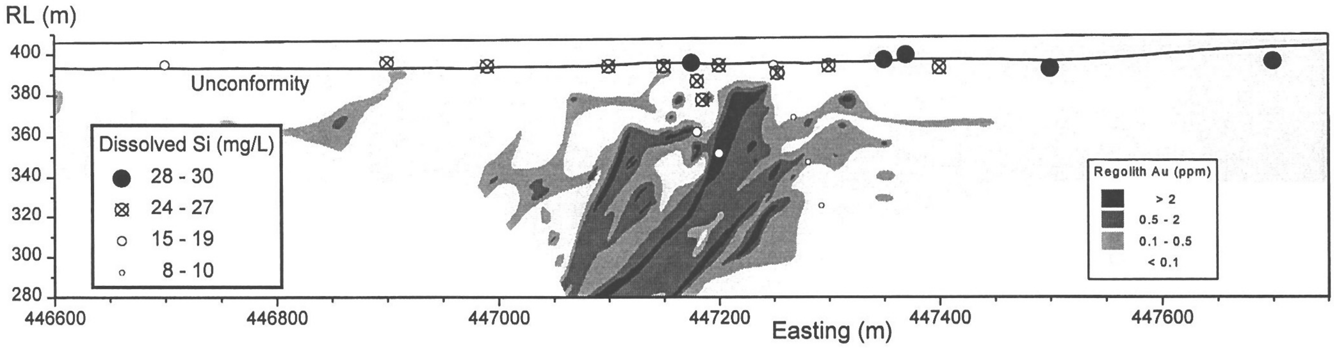

Figure A4.19: Dissolved Si distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

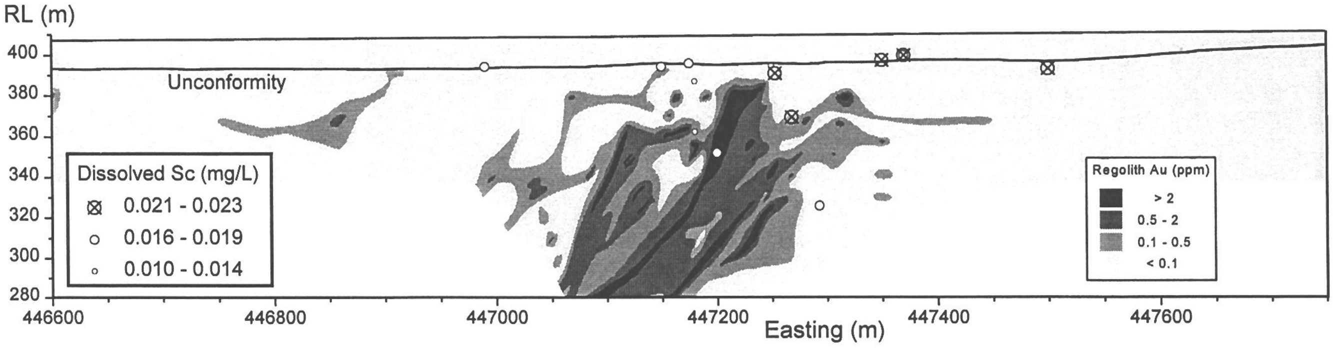

Figure A4.20: Dissolved Sc distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

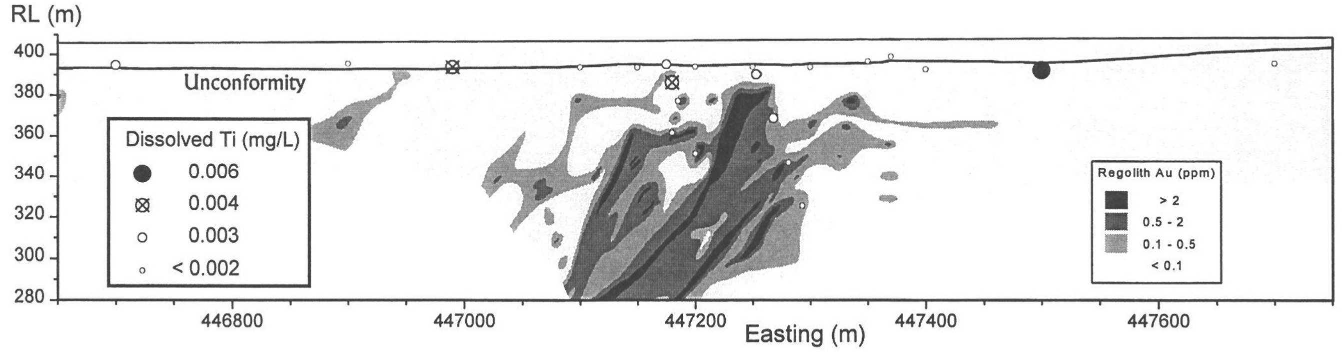

Figure A4.21: Dissolved Ti distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

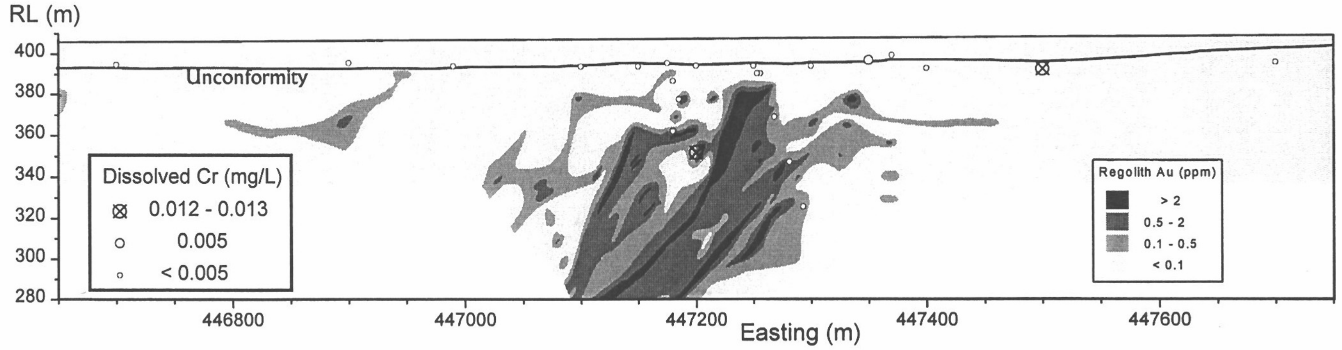

Figure A4.22: Dissolved Cr distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

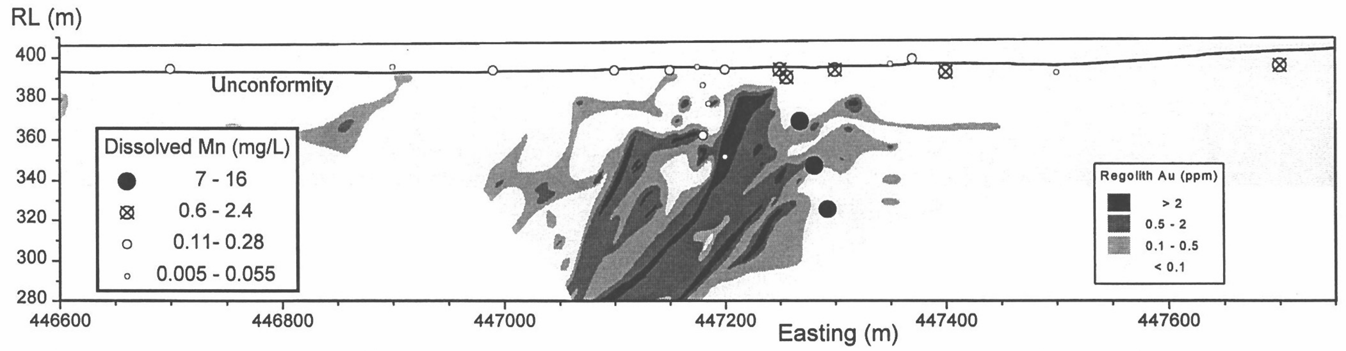

Figure A4.23: Dissolved Mn distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

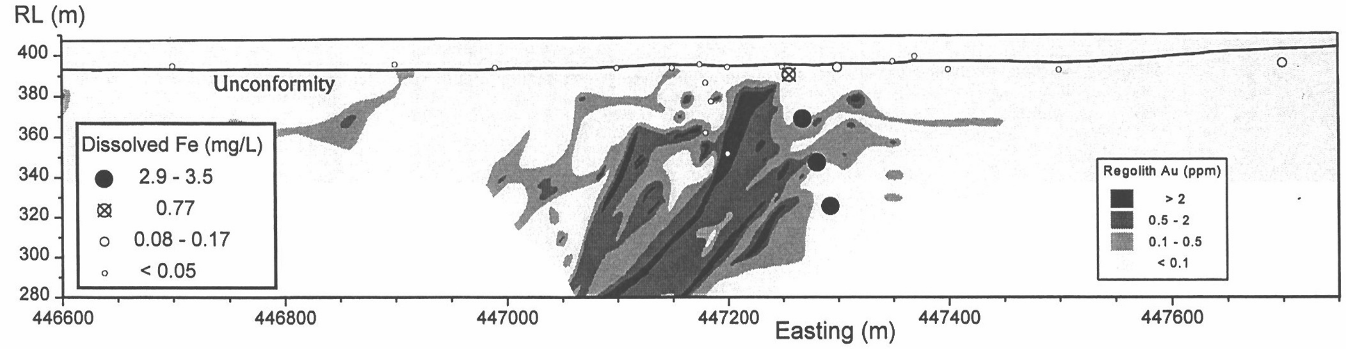

Figure A4.24: Dissolved Fe distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

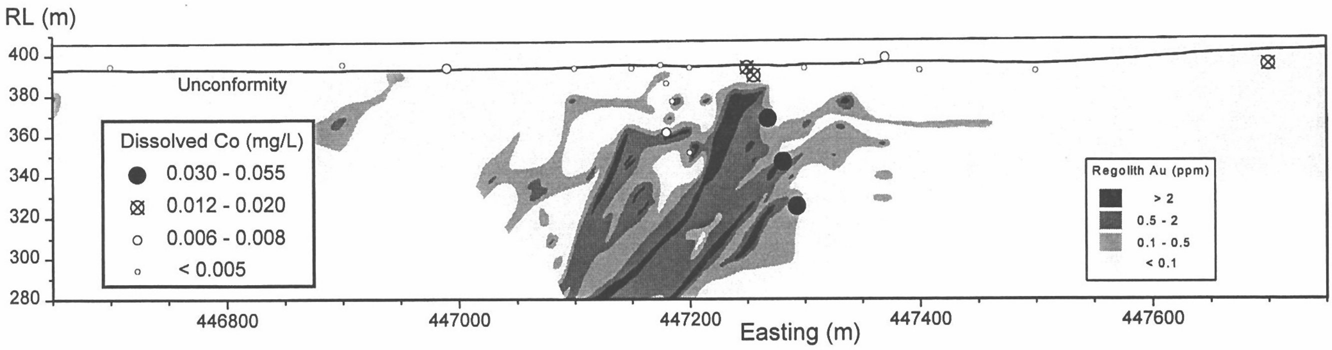

Figure A4.25: Dissolved Co distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

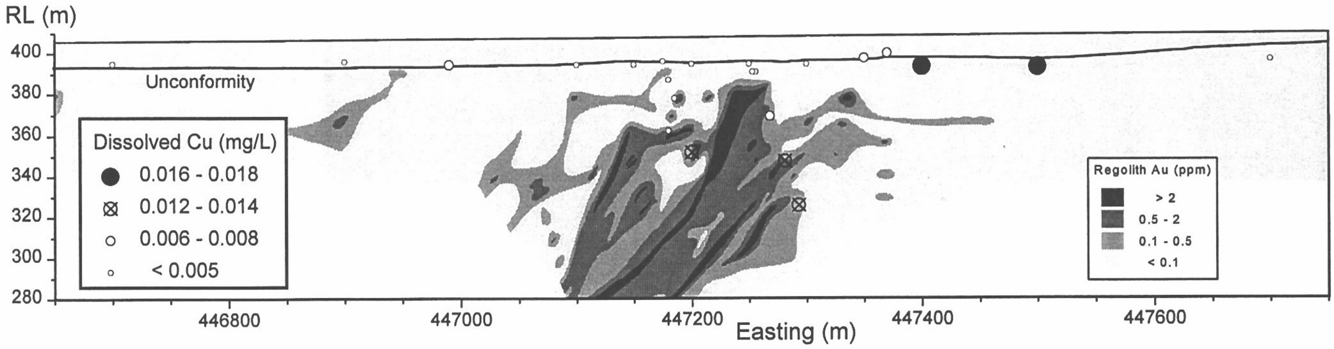

Figure A4.26: Dissolved Cu distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

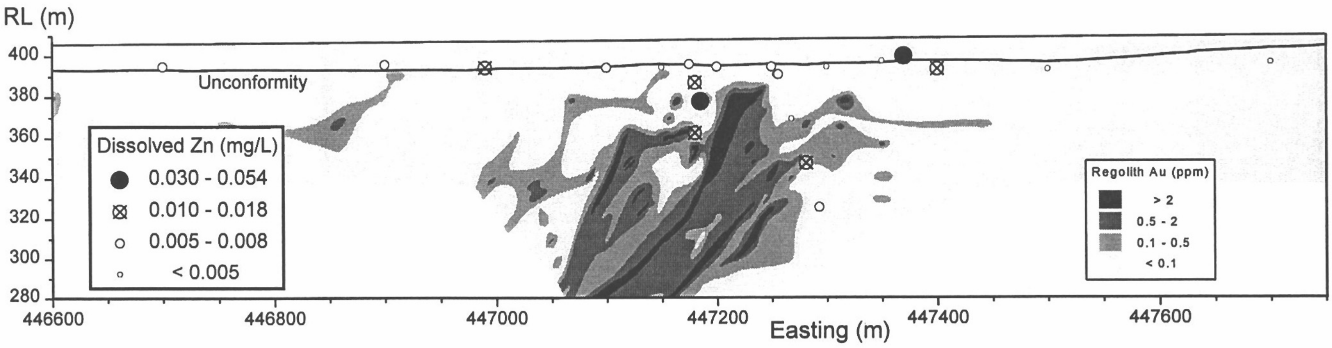

Figure A4.27: Dissolved Zn distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

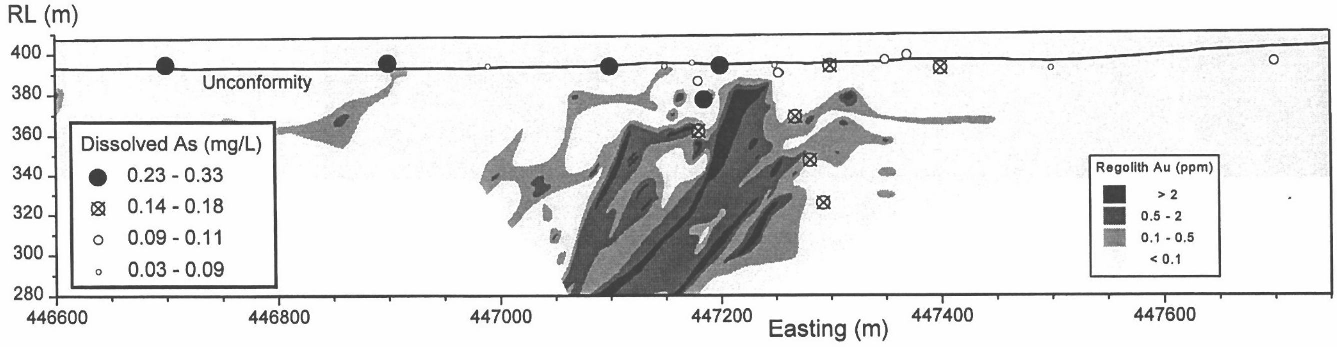

Figure A4.28: Dissolved As distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

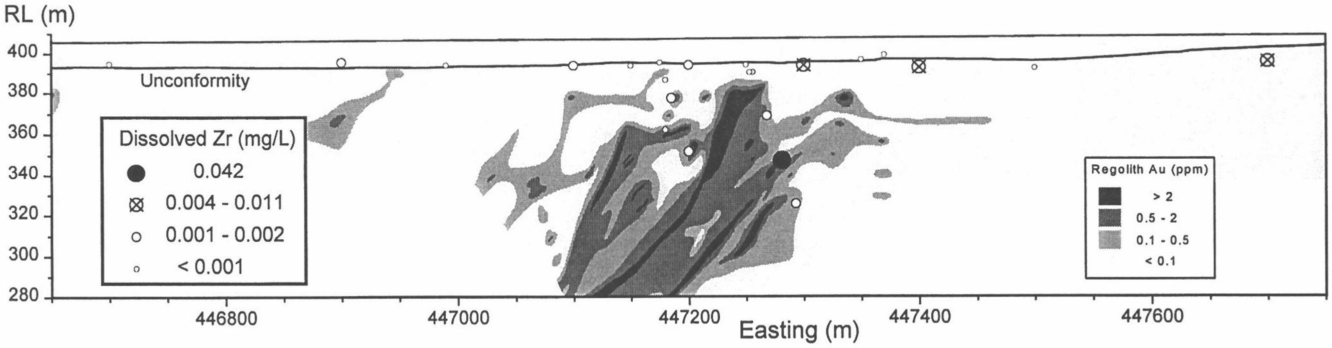

Figure A4.29: Dissolved Zr distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

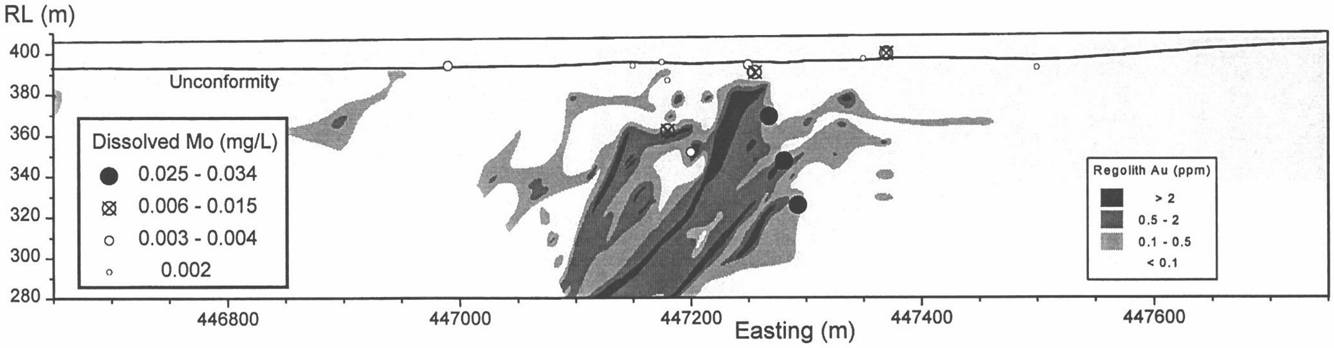

Figure A4.30: Dissolved Mo distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

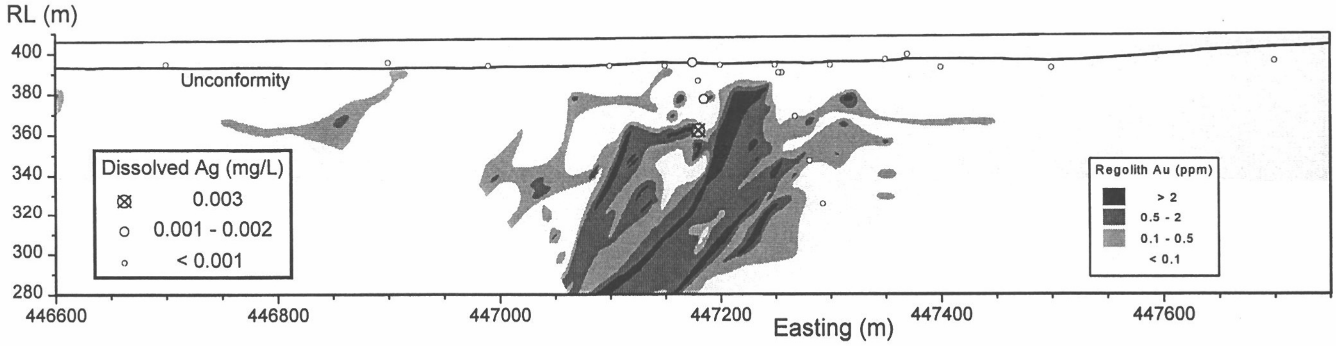

Figure A4.31: Dissolved Ag distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

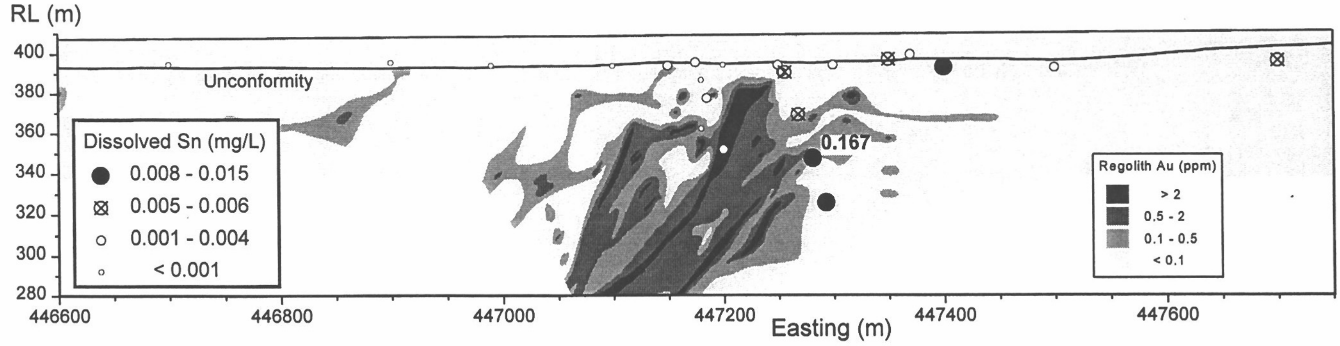

Figure A4.32: Dissolved Sn distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

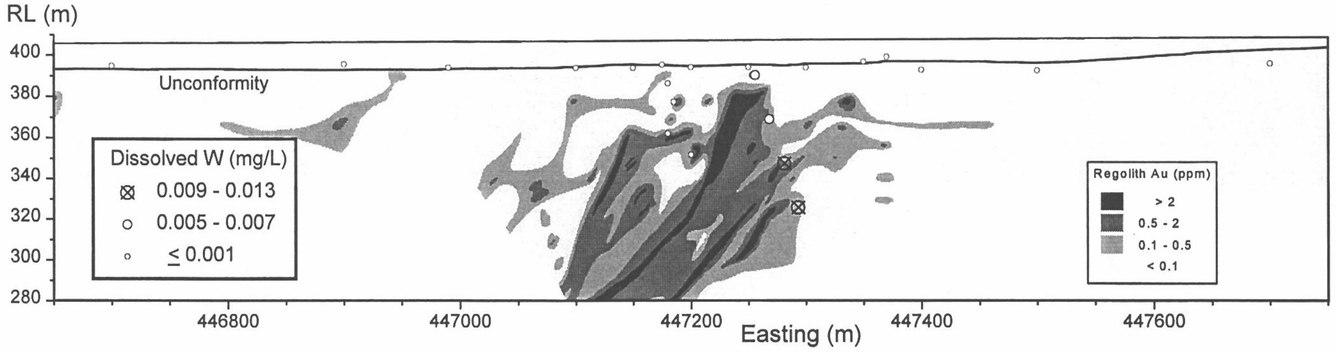

Figure A4.33: Dissolved W distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

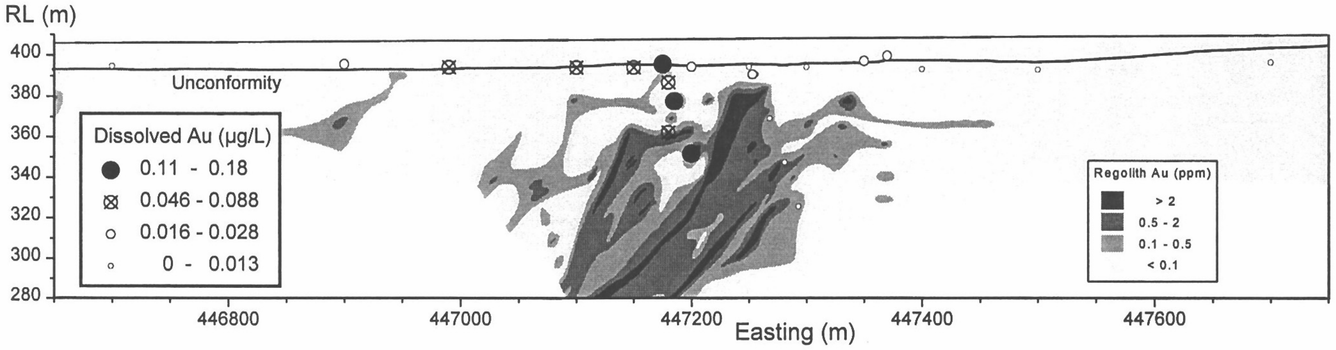

Figure A4.34: Dissolved Au distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

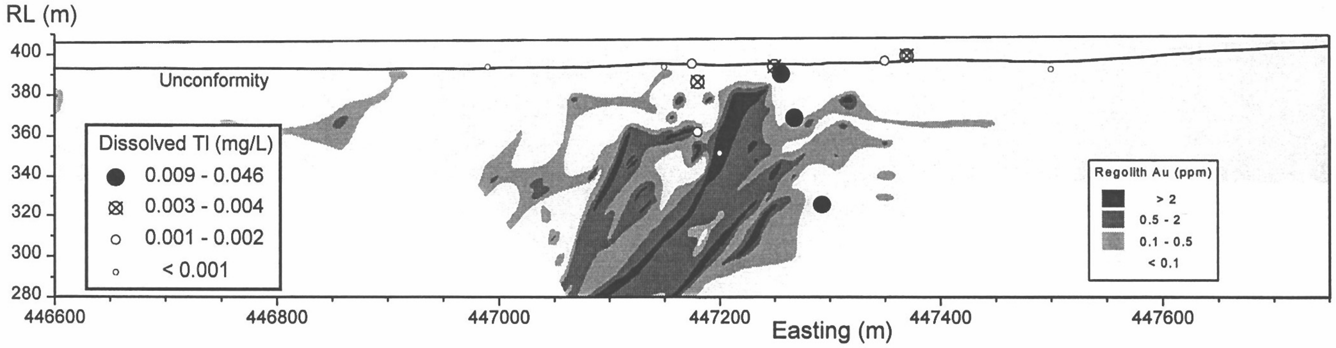

Figure A4.35: Dissolved Tl distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

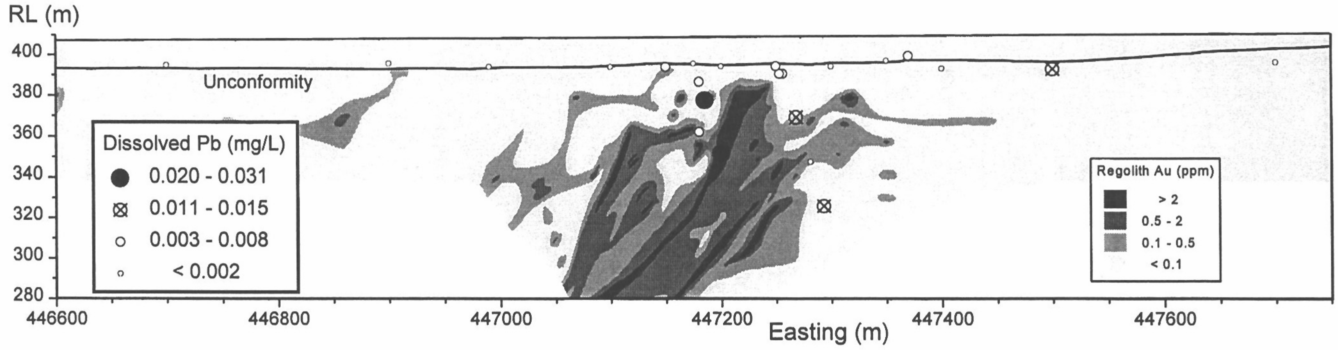

Figure A4.36: Dissolved Pb distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

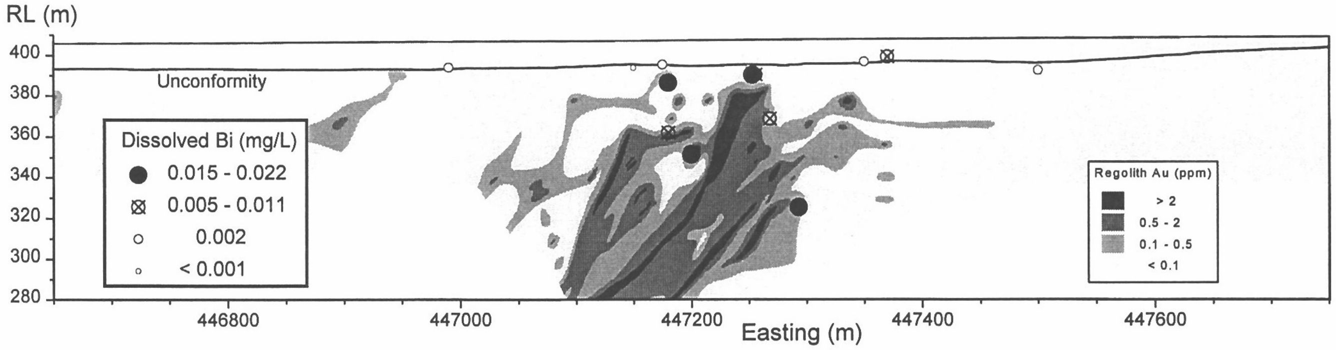

Figure A4.37: Dissolved Bi distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

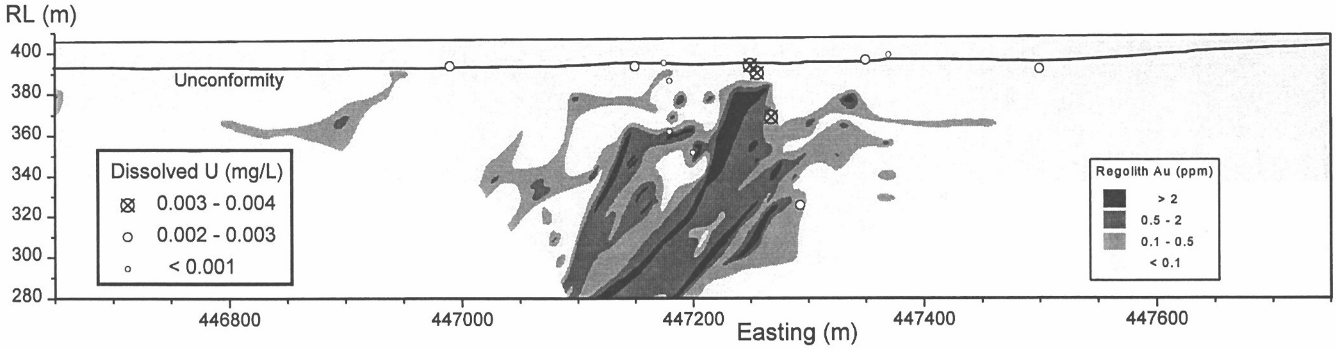

Figure A4.38: Dissolved U distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

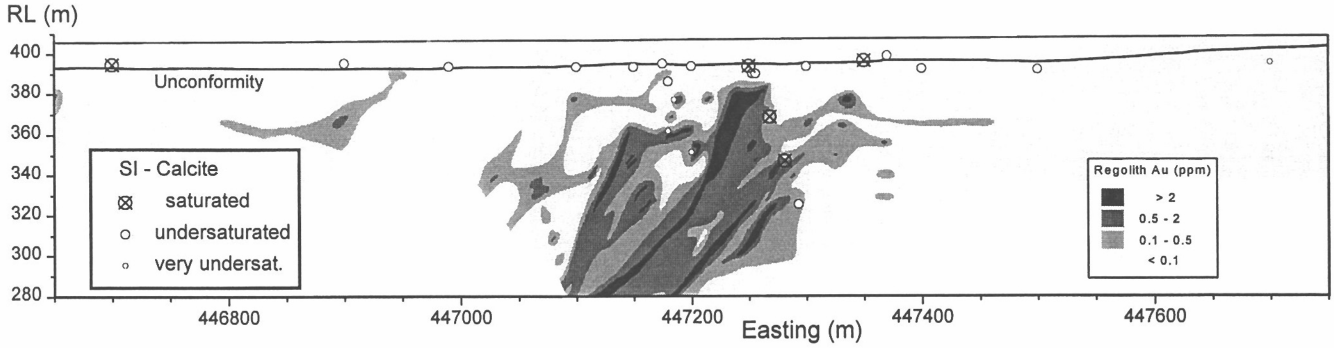

Figure A4.39: Calcite SI distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

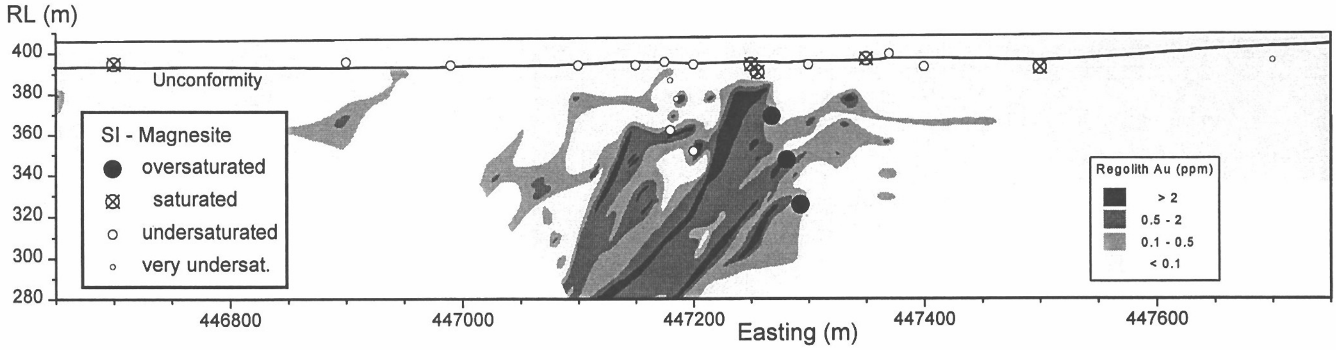

Figure A4.40: Magnesite SI distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

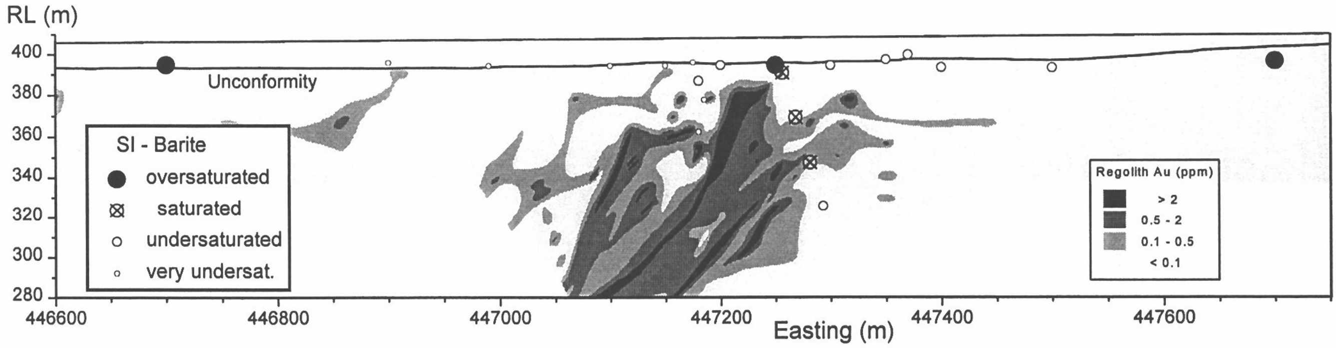

Figure A4.41: Barite SI distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

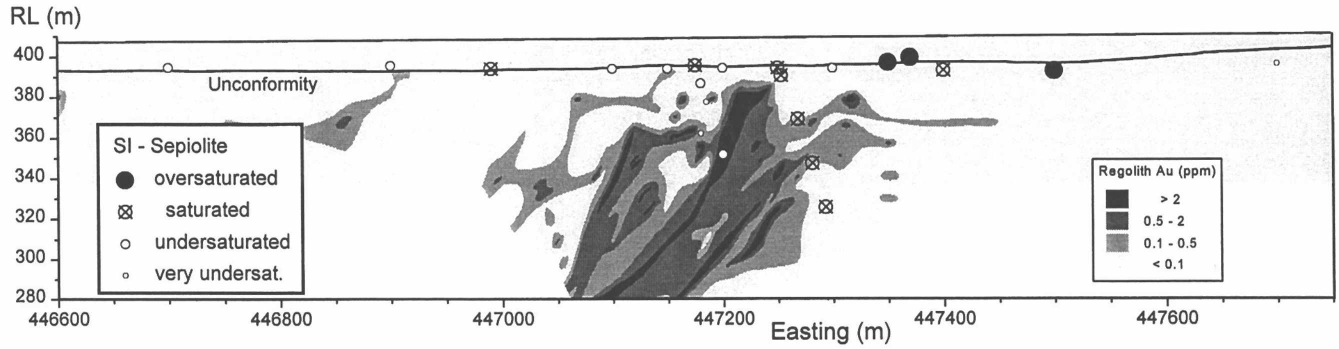

Figure A4.42: Sepiolite SI distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

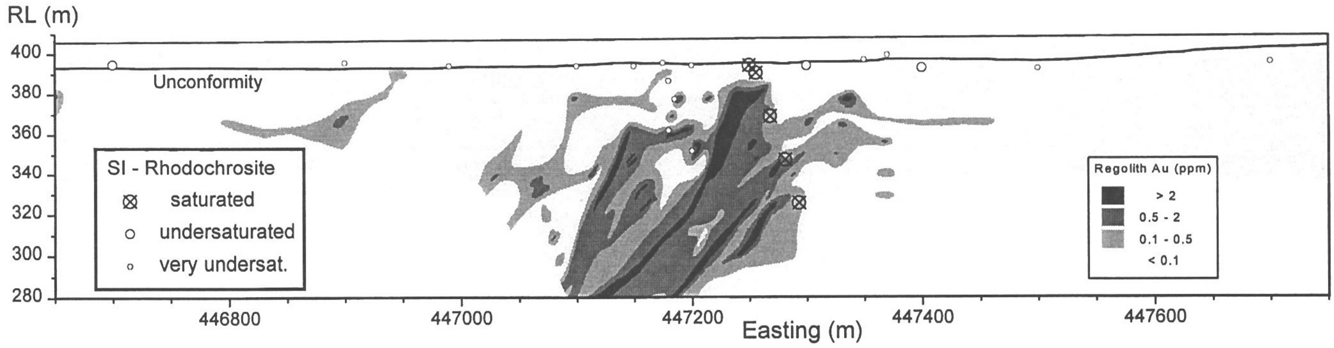

Figure A4.43: Rhodochrosite SI distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

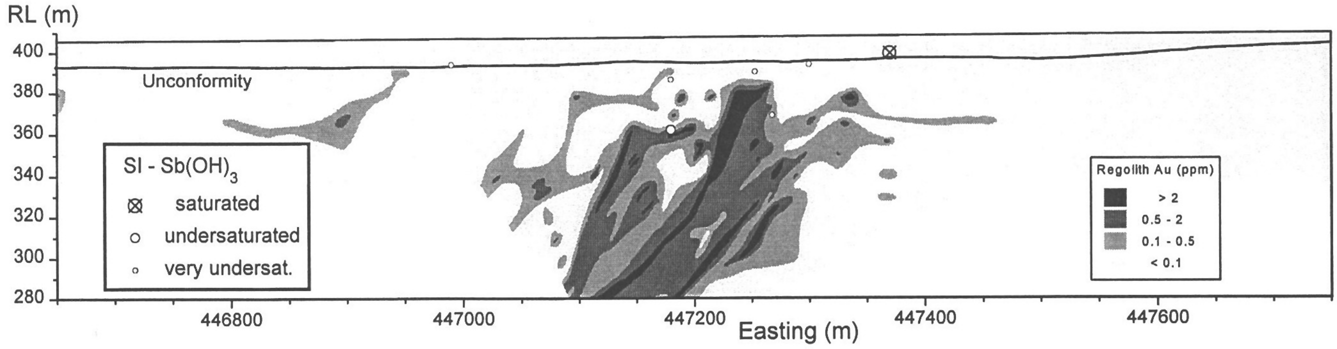

Figure A4.44: $Sb(OH)_3$ SI distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

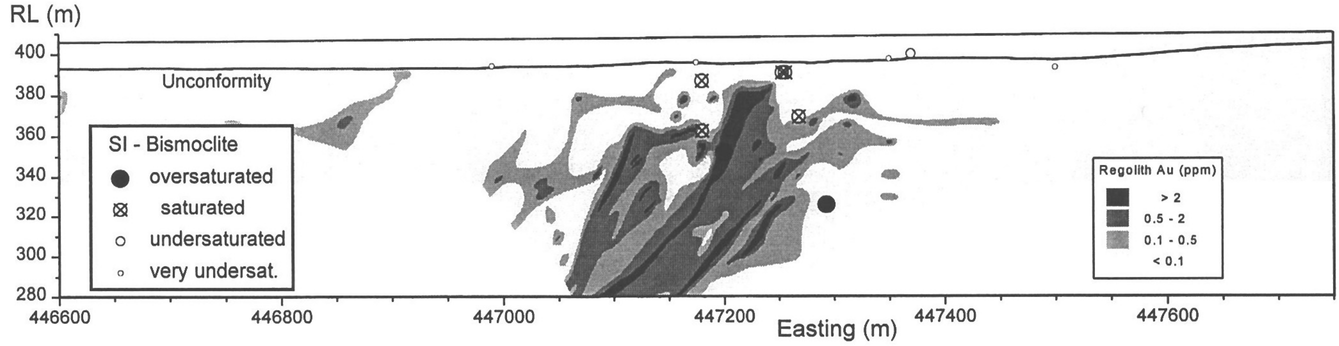

Figure A4.45: Bismoclite SI distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

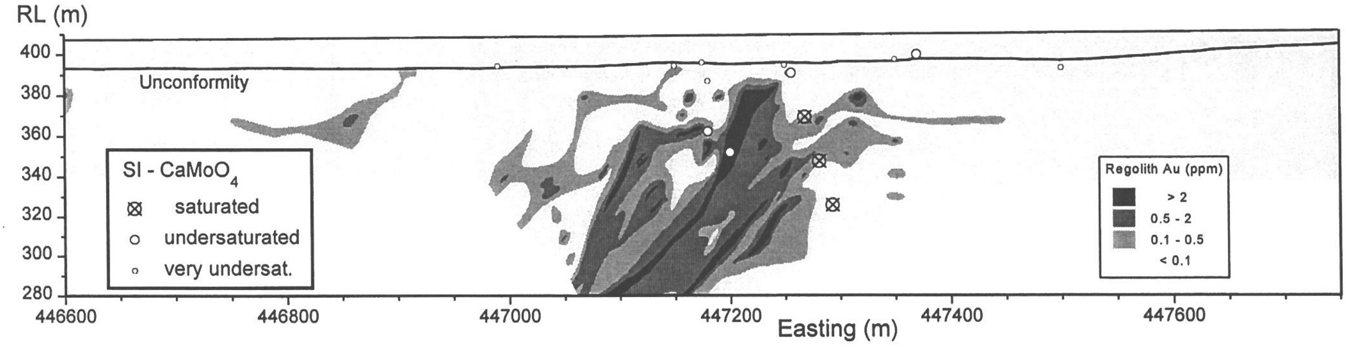

Figure A4.46: $CaMoO_4$ SI distribution at Golden Delicious 6790200N (dots), superimposed on regolith Au contours.

# APPENDIX 5: RAW GEOCHEMICAL DATA FROM DRILLING ON 6790200MN

| Hole Number | From | To | Regolith Unit | As | Au | Ba | Br | Ca | Ce | Co | Cr | Cs | Eu | Fe | Hf | K | La | Lu | Mg | Na | Rb | Sb | Sc | Sm | Ta | Th | W | Yb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | m | m | | ppm | ppb | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | % | ppm | % | ppm | ppm | % | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| CSIRO001 | 0 | 1 | T1 | 6 | 8 | 368 | 6.9 | 1.8 | 30 | 16 | 284 | 1.6 | 0.7 | 6.4 | 3.5 | 0.4 | 18 | <0.2 | 0.25 | 0.41 | 35 | 0.4 | 16 | 2.8 | <1 | 7.5 | <2 | 1.4 | 124 |
| CSIRO001 | 1 | 2 | T1 | 6 | <5 | 186 | 4.7 | 2.0 | 29 | 15 | 285 | 1.1 | 0.6 | 6.7 | 3.1 | 0.3 | 18 | <0.2 | 0.32 | 0.58 | 22 | 0.5 | 17 | 2.8 | 1.1 | 7.1 | <2 | 1.5 | 122 |
| CSIRO001 | 2 | 3 | T1 | 6 | 6 | 340 | 4.8 | 4.8 | 35 | 19 | 258 | 2.2 | 0.9 | 6.4 | 2.9 | <0.2 | 21 | <0.2 | 0.35 | 0.61 | 34 | 0.3 | 18 | 3.5 | <1 | 7.2 | <2 | 1.6 | 115 |
| CSIRO001 | 3 | 4 | T1 | 8 | 9 | 389 | 4.4 | 2.0 | 29 | 23 | 432 | 1.3 | 0.7 | 11 | 3.0 | 0.3 | 17 | <0.2 | 0.37 | 0.75 | 23 | 0.4 | 24 | 3.2 | <1 | 7.6 | <2 | 1.6 | 118 |
| CSIRO001 | 4 | 5 | T2 | 9 | <5 | 304 | 3.9 | 1.7 | 32 | 21 | 404 | <1 | 1.2 | 11 | 2.6 | 0.5 | 19 | 0.2 | 0.32 | 0.78 | <20 | 0.4 | 23 | 3.5 | <1 | 7.1 | <2 | 1.8 | 128 |
| CSIRO001 | 5 | 6 | T2 | 13 | <5 | 457 | 3.8 | 0.62 | 31 | 26 | 576 | <1 | 1.0 | 16 | 3.3 | 0.6 | 18 | 0.2 | 0.25 | 0.79 | 35 | 0.5 | 30 | 3.7 | <1 | 7.5 | <2 | 2.0 | 148 |
| CSIRO001 | 6 | 7 | T2 | 16 | 10 | 1250 | 6.5 | 9.0 | 24 | 13 | 294 | <1 | 0.9 | 10 | 2.1 | <0.2 | 14 | <0.2 | 0.46 | 0.54 | <20 | 0.8 | 18 | 2.8 | <1 | 5.4 | <2 | 1.6 | 105 |
| CSIRO001 | 7 | 8 | T2 | 22 | <5 | 262 | 5.4 | 7.4 | 26 | 19 | 353 | 1.1 | 0.9 | 14 | 2.4 | <0.2 | 15 | 0.2 | 0.38 | 0.46 | <20 | 1.2 | 20 | 3.2 | <1 | 5.7 | <2 | 1.8 | 103 |
| CSIRO001 | 8 | 9 | T2 | 22 | <5 | 499 | 4.4 | 1.8 | 27 | 19 | 558 | <1 | 0.9 | 29 | 3.5 | <0.2 | 17 | 0.3 | 0.27 | 0.46 | 32 | 1.8 | 30 | 3.5 | <1 | 7.7 | <2 | 2.1 | <100 |
| CSIRO001 | 9 | 10 | T2 | 19 | <5 | 748 | 5.7 | 1.9 | 33 | 22 | 462 | 2.8 | 1.3 | 20 | 3.4 | <0.2 | 22 | 0.3 | 0.88 | 0.65 | <20 | 1.6 | 31 | 4.3 | <1 | 6.3 | <2 | 2.9 | 139 |
| CSIRO001 | 10 | 11 | T3 | 25 | <5 | 790 | 6.2 | 0.18 | 27 | 85 | 553 | 1.9 | 1.2 | 26 | 3.6 | <0.2 | 17 | 0.4 | 0.23 | 0.58 | <20 | 2.0 | 37 | 3.8 | <1 | 6.4 | <2 | 2.9 | 105 |
| CSIRO001 | 11 | 12 | T3 | 30 | <5 | 378 | 3.1 | 0.85 | 31 | 22 | 655 | 2.1 | 1.0 | 30 | 4.2 | <0.2 | 18 | 0.4 | 0.20 | 0.49 | <20 | 2.5 | 41 | 3.6 | <1 | 8.0 | <2 | 2.5 | 107 |
| CSIRO001 | 12 | 13 | T3 | 26 | <5 | 438 | 2.3 | 1.0 | 29 | 17 | 603 | <1 | 0.7 | 26 | 4.0 | <0.2 | 17 | 0.3 | 0.50 | 0.46 | 33 | 2.1 | 40 | 3.6 | <1 | 8.2 | <2 | 2.5 | 111 |
| CSIRO001 | 13 | 14 | T3 | 26 | <5 | 426 | 2.3 | 1.1 | 24 | 16 | 607 | <1 | 0.8 | 27 | 4.1 | <0.2 | 14 | 0.3 | 0.60 | 0.44 | 20 | 2.4 | 36 | 2.9 | <1 | 10 | <2 | 2.1 | 108 |
| CSIRO001 | 14 | 15 | T3 | 30 | 10 | 281 | 2.1 | 0.65 | 26 | 10 | 675 | 1.2 | 0.9 | 32 | 4.8 | <0.2 | 14 | 0.2 | 0.40 | 0.39 | 21 | 2.6 | 36 | 2.8 | 1.6 | 12 | <2 | 2.0 | <100 |
| CSIRO001 | 15 | 16 | A1 | 12 | 73 | 190 | 4.8 | 1.3 | 11 | 8.8 | 397 | <1 | <0.5 | 15 | 5.6 | <0.2 | 6.5 | <0.2 | 0.80 | 0.71 | <20 | 0.8 | 29 | 1.4 | 1.5 | 8.4 | <2 | 1.4 | <100 |
| CSIRO001 | 16 | 17 | A1 | 12 | 42 | 271 | 6.4 | 2.0 | 9.2 | 6.8 | 276 | <1 | <0.5 | 15 | 4.0 | <0.2 | 4.9 | <0.2 | 1.3 | 0.62 | <20 | 0.7 | 26 | 1.1 | <1 | 7.4 | <2 | 1.1 | <100 |
| CSIRO001 | 17 | 18 | A1 | 6 | 11 | 250 | 7.1 | 0.81 | 7.1 | 8.2 | 235 | <1 | <0.5 | 10 | 4.1 | <0.2 | 4.0 | <0.2 | 0.61 | 0.89 | 22 | 0.3 | 22 | 0.9 | 1.1 | 5.8 | <2 | 1.1 | <100 |
| CSIRO001 | 18 | 19 | A1 | 5 | 13 | 202 | 4.6 | 1.5 | 4.8 | 5.1 | 174 | <1 | <0.5 | 7.1 | 4.5 | <0.2 | 3.6 | <0.2 | 0.98 | 0.67 | <20 | 0.3 | 18 | 0.7 | <1 | 5.5 | <2 | 1.1 | <100 |
| CSIRO001 | 19 | 20 | A1 | 6 | 13 | <100 | 4.2 | 1.1 | 5.4 | 5.0 | 172 | <1 | <0.5 | 11 | 4.3 | <0.2 | 3.5 | <0.2 | 0.73 | 0.64 | <20 | 0.3 | 16 | 0.7 | 1.3 | 5.5 | <2 | 1.1 | <100 |
| CSIRO002 | 0 | 1 | T1 | 5 | 6 | 320 | 7.4 | 1.6 | 32 | 17 | 325 | 2.4 | 0.8 | 7.3 | 3.0 | 0.4 | 19 | <0.2 | 0.29 | 0.38 | 47 | 0.3 | 19 | 2.9 | 1.0 | 8.3 | <2 | 1.5 | 131 |
| CSIRO002 | 1 | 2 | T1 | 6 | 8 | 346 | 9.7 | 6.3 | 29 | 14 | 212 | 1.6 | 0.7 | 4.8 | 2.7 | 0.5 | 17 | <0.2 | 0.33 | 0.61 | 33 | 0.3 | 14 | 2.9 | <1 | 5.9 | <2 | 1.3 | <100 |
| CSIRO002 | 2 | 3 | T1 | 7 | 11 | 397 | 6.8 | 3.6 | 35 | 20 | 270 | 2.2 | 0.8 | 6.6 | 3.3 | 0.7 | 21 | 0.2 | 0.28 | 0.65 | 28 | 0.5 | 18 | 3.3 | <1 | 8.0 | <2 | 1.7 | 139 |
| CSIRO002 | 3 | 4 | T1 | 6 | 12 | 398 | 4.0 | 3.1 | 33 | 18 | 249 | 1.5 | 0.8 | 6.0 | 2.7 | 0.6 | 20 | <0.2 | 0.39 | 0.75 | 30 | 0.4 | 19 | 3.3 | 1.2 | 6.7 | <2 | 1.6 | 130 |
| CSIRO002 | 4 | 5 | T2 | 7 | 9 | 225 | 4.7 | 0.81 | 33 | 22 | 275 | 2.1 | 1.0 | 7.1 | 3.3 | 0.7 | 19 | 0.3 | 0.29 | 0.89 | 31 | 0.3 | 20 | 3.3 | 1.3 | 7.3 | <2 | 1.7 | 149 |
| CSIRO002 | 5 | 6 | T2 | 7 | 10 | 193 | 3.0 | 0.66 | 28 | 21 | 295 | 1.3 | 0.7 | 7.4 | 3.0 | <0.2 | 19 | 0.2 | 0.28 | 0.89 | 26 | 0.5 | 20 | 3.2 | <1 | 6.4 | <2 | 1.6 | 131 |
| CSIRO002 | 6 | 7 | T2 | 12 | 7 | 234 | 6.9 | 6.0 | 24 | 17 | 220 | 1.3 | 0.8 | 6.2 | 2.2 | <0.2 | 14 | 0.2 | 0.49 | 0.75 | <20 | 0.4 | 16 | 2.7 | <1 | 5.2 | <2 | 1.5 | <100 |
| CSIRO002 | 7 | 8 | T2 | 20 | <5 | 168 | 5.1 | 5.2 | 28 | 18 | 389 | 2.1 | 1.0 | 16 | 2.9 | <0.2 | 17 | 0.3 | 0.34 | 0.56 | 31 | 1.2 | 21 | 3.7 | <1 | 6.6 | <2 | 1.9 | <100 |
| CSIRO002 | 8 | 9 | T2 | 27 | <5 | 343 | 4.6 | 0.35 | 26 | 23 | 499 | <1 | 1.0 | 22 | 3.3 | <0.2 | 15 | 0.3 | 0.26 | 0.51 | <20 | 1.7 | 30 | 3.3 | <1 | 7.1 | <2 | 2.0 | 122 |
| CSIRO002 | 9 | 10 | T2 | 16 | <5 | 946 | 7.2 | 0.85 | 34 | 22 | 338 | 1.5 | 1.0 | 14 | 3.0 | <0.41 | 21 | 0.3 | 0.38 | 0.78 | 30 | 0.9 | 24 | 3.7 | <1 | 7.2 | <2 | 2.0 | 125 |
| CSIRO002 | 10 | 11 | T2 | 15 | <5 | 483 | 8.4 | 0.65 | 33 | 22 | 340 | 2.3 | 1.1 | 13 | 3.0 | 0.6 | 19 | 0.3 | 0.36 | 0.79 | <20 | 0.9 | 24 | 3.4 | <1 | 7.8 | <2 | 2.0 | 100 |
| CSIRO002 | 11 | 12 | T3 | 25 | <5 | 422 | 5.7 | 0.085 | 23 | 24 | 503 | 1.8 | 0.9 | 23 | 3.6 | 0.7 | 14 | 0.3 | 0.25 | 0.76 | 34 | 1.9 | 33 | 2.9 | <1 | 6.2 | <2 | 2.2 | 121 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSIRO002 | 12 | 13 | T3 | 32 | <5 | 549 | 3.2 | 0.043 | 25 | 14 | 675 | 1.2 | 1.1 | 31 | 4.5 | 0.8 | 20 | 0.3 | 0.15 | 0.46 | <20 | 2.6 | 40 | 3.9 | <1 | 9.8 | <2 | 2.7 | 107 |
| CSIRO002 | 13 | 14 | T3 | 24 | <5 | 180 | 3.7 | 0.044 | 32 | 16 | 525 | <1 | 0.9 | 25 | 5.1 | 0.8 | 16 | 0.3 | 0.15 | 0.48 | 36 | 2.5 | 37 | 3.1 | <1 | 9.2 | <2 | 2.2 | 111 |
| CSIRO002 | 14 | 15 | T3 | 31 | <5 | 194 | 3.3 | 0.031 | 28 | 12 | 738 | 1.4 | 0.7 | 34 | 5.4 | 0.9 | 14 | 0.3 | 0.10 | 0.39 | <20 | 3.2 | 43 | 2.9 | <1 | 11 | <2 | 2.1 | <100 |
| CSIRO002 | 15 | 16 | T3 | 19 | 27 | 2360 | 3.5 | 0.054 | 34 | 13 | 520 | 1.1 | 0.9 | 20 | 5.2 | 0.8 | 19 | 0.3 | 0.22 | 0.68 | 22 | 1.4 | 35 | 3.3 | 1.3 | 12 | <2 | 2.1 | 107 |
| CSIRO002 | 16 | 17 | A1 | 26 | 23 | 555 | 4.1 | 0.038 | 22 | 13 | 674 | 1.1 | 0.8 | 31 | 4.9 | 0.8 | 15 | <0.2 | 0.12 | 0.47 | <20 | 2.6 | 33 | 3.2 | 1.1 | 16 | <2 | 1.7 | <100 |
| CSIRO002 | 17 | 18 | A1 | 15 | 8 | 185 | 5.8 | 0.057 | 14 | 10 | 397 | <1 | <0.5 | 16 | 5.5 | 0.8 | 5.4 | <0.2 | 0.21 | 0.79 | <20 | 1.5 | 27 | 1.3 | 1.0 | 10 | <2 | 1.6 | <100 |
| CSIRO002 | 18 | 19 | A1 | 11 | <5 | 169 | 4.3 | 1.0 | 6.0 | 8.1 | 305 | <1 | <0.5 | 9.7 | 6.6 | 0.7 | 2.9 | 0.2 | 0.77 | 0.84 | <20 | 0.9 | 27 | 0.8 | 1.2 | 7.8 | <2 | 1.6 | 102 |
| CSIRO002 | 19 | 20 | A1 | 8 | <5 | <100 | 3.8 | 1.1 | 4.8 | 8.0 | 279 | 1.3 | <0.5 | 8.9 | 6.2 | 0.7 | 2.1 | 0.2 | 0.82 | 0.86 | <20 | 0.5 | 25 | 0.7 | <1 | 7.3 | <2 | 1.5 | <100 |
| CSIRO003 | 0 | 1 | T1 | 6 | <5 | 341 | 5.8 | 1.5 | 30 | 14 | 319 | 2.1 | 0.6 | 6.8 | 3.3 | 0.6 | 17 | <0.2 | 0.28 | 0.28 | 26 | 0.4 | 16 | 2.6 | <1 | 7.4 | <2 | 1.3 | 118 |
| CSIRO003 | 1 | 2 | T1 | 7 | <5 | 284 | 8.1 | 3.9 | 30 | 16 | 264 | 1.9 | 0.7 | 6.5 | 2.9 | 0.9 | 20 | <0.2 | 0.33 | 0.51 | 24 | 0.5 | 17 | 3.2 | <1 | 7.7 | <2 | 1.4 | 110 |
| CSIRO003 | 2 | 3 | T1 | 7 | <5 | 292 | 6.8 | 4.1 | 32 | 17 | 262 | 1.7 | 0.8 | 6.1 | 3.1 | 0.7 | 18 | <0.2 | 0.27 | 0.56 | 35 | 0.5 | 17 | 3.1 | <1 | 7.1 | <2 | 1.6 | 120 |
| CSIRO003 | 3 | 4 | T1 | 6 | 7 | 316 | 6.3 | 3.4 | 32 | 18 | 269 | 1.0 | 0.8 | 6.4 | 2.9 | 1.1 | 20 | <0.2 | 0.32 | 0.78 | 33 | 0.4 | 19 | 3.2 | <1 | 7.0 | <2 | 1.6 | 128 |
| CSIRO003 | 4 | 5 | T1 | 9 | <5 | 513 | 4.9 | 2.1 | 32 | 23 | 360 | 1.6 | 0.8 | 8.7 | 2.6 | 0.8 | 19 | 0.2 | 0.27 | 0.81 | 33 | 0.4 | 22 | 3.4 | <1 | 7.0 | <2 | 1.8 | 133 |
| CSIRO003 | 5 | 6 | T2 | 9 | <5 | 192 | 3.4 | 0.31 | 33 | 24 | 337 | 1.9 | 1.1 | 8.8 | 3.1 | 0.7 | 19 | 0.2 | 0.22 | 0.84 | 24 | 0.4 | 21 | 3.6 | <1 | 7.2 | <2 | 1.9 | 123 |
| CSIRO003 | 6 | 7 | T2 | 9 | <5 | 278 | 2.6 | 0.21 | 34 | 29 | 302 | <1 | 1.0 | 8.7 | 3.6 | 0.8 | 19 | 0.3 | 0.26 | 0.80 | 38 | 0.6 | 23 | 3.8 | <1 | 7.3 | <2 | 2.1 | 145 |
| CSIRO003 | 7 | 8 | T2 | 12 | 10 | 370 | 3.8 | 0.16 | 31 | 23 | 307 | 2.5 | 1.0 | 10 | 3.2 | 0.8 | 18 | 0.3 | 0.36 | 0.76 | 42 | 0.7 | 24 | 3.6 | <1 | 7.3 | <2 | 2.0 | 130 |
| CSIRO003 | 8 | 9 | T3 | 17 | 9 | 1460 | 6.0 | 0.13 | 34 | 20 | 358 | 1.4 | 1.1 | 14 | 3.0 | <0.2 | 21 | 0.3 | 0.38 | 0.69 | <20 | 1.2 | 27 | 4.1 | <1 | 6.7 | <2 | 1.9 | 106 |
| CSIRO003 | 9 | 10 | T3 | 20 | <5 | 566 | 5.3 | 0.94 | 30 | 30 | 429 | 1.4 | 1.3 | 18 | 2.9 | <0.2 | 20 | 0.3 | 0.29 | 0.63 | <20 | 1.4 | 31 | 4.3 | <1 | 5.7 | <2 | 2.5 | 130 |
| CSIRO003 | 10 | 11 | T3 | 25 | <5 | 453 | 4.9 | 0.12 | 29 | 37 | 518 | <1 | 1.1 | 24 | 3.7 | <0.2 | 15 | 0.3 | 0.19 | 0.62 | <20 | 2.1 | 36 | 3.6 | <1 | 6.5 | <2 | 2.6 | 111 |
| CSIRO003 | 11 | 12 | T3 | 25 | 11 | 438 | 3.0 | 2.9 | 33 | 20 | 524 | <1 | 1.1 | 25 | 3.8 | 0.6 | 20 | 0.3 | 0.27 | 0.48 | 53 | 2.0 | 35 | 3.7 | 1.5 | 7.3 | <2 | 2.6 | 110 |
| CSIRO003 | 12 | 13 | T3 | 24 | 12 | 442 | 4.0 | 2.1 | 35 | 23 | 558 | 1.2 | 0.9 | 24 | 4.3 | <0.2 | 17 | 0.3 | 0.32 | 0.49 | <20 | 2.1 | 37 | 3.6 | <1 | 8.2 | <2 | 2.6 | 119 |
| CSIRO003 | 13 | 14 | T3 | 28 | 45 | 298 | 5.6 | 0.15 | 25 | 11 | 582 | <1 | 0.7 | 27 | 4.8 | <0.2 | 13 | 0.3 | 0.13 | 0.42 | <20 | 2.2 | 37 | 2.6 | <1 | 9.5 | <6 | 2.1 | 150 |
| CSIRO003 | 14 | 15 | T3 | 26 | 36 | 289 | 3.8 | 0.11 | 37 | 12 | 596 | 1.6 | 0.8 | 29 | 5.1 | 1.8 | 18 | 0.3 | 0.20 | 0.59 | <20 | 2.4 | 40 | 3.4 | 1.4 | 11 | <5.2 | 2.1 | 138 |
| CSIRO003 | 15 | 16 | T3 | 23 | 107 | 171 | 4.2 | 0.99 | 39 | 13 | 506 | 1.3 | 1.0 | 22 | 4.7 | <0.2 | 18 | 0.2 | 0.72 | 0.68 | <20 | 2.1 | 34 | 3.7 | <1 | 13 | <4.6 | 2.1 | 129 |
| CSIRO003 | 16 | 17 | A1 | 16 | <5 | <100 | 5.0 | 1.9 | 24 | 13 | 365 | <1 | 0.8 | 12 | 5.7 | 0.4 | 13 | 0.2 | 1.2 | 0.78 | 32 | 1.7 | 34 | 2.6 | 1.8 | 12 | <4.2 | 1.8 | <100 |
| CSIRO003 | 17 | 18 | A1 | 13 | <5 | 132 | 6.6 | 0.95 | 27 | 14 | 367 | 1.7 | <0.5 | 12 | 6.2 | <0.2 | 8.2 | <0.2 | 0.68 | 0.83 | <20 | 1.3 | 33 | 1.6 | 1.1 | 12 | <4.2 | 1.7 | 112 |
| CSIRO003 | 18 | 19 | A1 | 12 | <5 | 120 | 4.0 | 0.58 | 14 | 11 | 326 | <1 | <0.5 | 11 | 6.0 | 0.5 | 6.1 | 0.2 | 0.47 | 0.70 | 26 | 1.3 | 32 | 1.2 | 1.2 | 12 | <2 | 1.6 | <100 |
| CSIRO003 | 19 | 20 | A1 | 10 | <5 | <100 | 6.8 | 0.33 | 11 | 10 | 320 | 2.3 | <0.5 | 11 | 6.3 | <0.2 | 5.2 | 0.2 | 0.34 | 0.76 | <20 | 1.1 | 31 | 1.1 | 1.2 | 11 | <2 | 1.7 | 104 |
| CSIRO004 | 0 | 1 | T1 | 5 | <5 | 291 | 5.5 | 1.6 | 37 | 17 | 306 | 2.0 | 0.9 | 7.1 | 2.9 | 0.5 | 22 | 0.2 | 0.28 | 0.25 | 30 | 0.4 | 19 | 3.2 | <1 | 8.4 | <2 | 1.6 | 137 |
| CSIRO004 | 1 | 2 | T1 | 6 | 9 | 262 | 7.2 | 5.5 | 29 | 14 | 220 | 1.7 | 0.5 | 5.4 | 3.0 | 0.3 | 17 | <0.2 | 0.36 | 0.53 | 29 | 0.3 | 17 | 2.9 | <1 | 7.2 | <2 | 1.2 | 116 |
| CSIRO004 | 2 | 3 | T1 | 6 | 7 | 411 | 4.3 | 4.0 | 32 | 18 | 298 | 1.5 | 0.8 | 6.2 | 2.9 | 0.4 | 19 | <0.2 | 0.28 | 0.59 | 26 | 0.5 | 17 | 3.1 | <1 | 7.3 | <2 | 1.5 | 123 |
| CSIRO004 | 3 | 4 | T1 | 5 | 7 | 301 | 3.4 | 2.9 | 34 | 21 | 266 | 1.2 | 1.1 | 6.7 | 3.1 | 0.8 | 21 | <0.2 | 0.31 | 0.73 | 39 | 0.3 | 19 | 3.3 | <1 | 7.2 | <2 | 1.6 | 136 |
| CSIRO004 | 4 | 5 | T1 | 7 | <5 | 251 | 3.2 | 1.2 | 34 | 19 | 305 | <1 | 0.8 | 7.8 | 2.8 | 0.6 | 19 | 0.2 | 0.26 | 0.79 | 30 | 0.4 | 20 | 3.3 | <1 | 6.8 | <2 | 1.7 | 135 |
| CSIRO004 | 5 | 6 | T2 | 9 | <5 | 314 | 3.1 | 1.5 | 33 | 27 | 392 | 1.2 | 0.9 | 11 | 2.9 | <0.2 | 19 | 0.2 | 0.22 | 0.72 | <20 | 0.5 | 23 | 3.8 | <1 | 6.8 | <2 | 1.9 | 147 |
| CSIRO004 | 6 | 7 | T2 | 10 | <5 | 220 | 3.9 | 0.36 | 33 | 25 | 330 | 1.1 | 0.8 | 9.4 | 3.8 | <0.2 | 19 | 0.3 | 0.27 | 0.80 | <20 | 0.5 | 21 | 3.5 | 1.1 | 7.4 | <2 | 2.0 | 128 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSIRO004 | 7 | 8 | T2 | 11 | 12 | 280 | 3.9 | 0.39 | 25 | 23 | 416 | 2.1 | 0.9 | 13 | 3.9 | <0.2 | 16 | 0.3 | 0.32 | 0.74 | <20 | 0.8 | 23 | 3.2 | <1 | 7.2 | <2 | 1.9 | 115 |
| CSIRO004 | 8 | 9 | T2 | 20 | <5 | 381 | 5.5 | 0.55 | 27 | 19 | 418 | <1 | 1.0 | 20 | 2.7 | <0.2 | 16 | 0.3 | 0.36 | 0.59 | 24 | 1.3 | 30 | 3.4 | <1 | 6.3 | <2 | 2.1 | 107 |
| CSIRO004 | 9 | 10 | T3 | 18 | <5 | 796 | 5.6 | 0.14 | 27 | 18 | 499 | 1.7 | 1.0 | 22 | 3.3 | <0.2 | 15 | 0.3 | 0.23 | 0.50 | <20 | 1.4 | 29 | 3.2 | <1 | 6.8 | <2 | 2.2 | 116 |
| CSIRO004 | 10 | 11 | T3 | 20 | <5 | 838 | 5.0 | 0.090 | 19 | 15 | 435 | 1.1 | 0.8 | 21 | 3.3 | <0.2 | 12 | 0.3 | 0.16 | 0.54 | <20 | 1.8 | 33 | 2.5 | 1.1 | 6.4 | <2 | 2.0 | 129 |
| CSIRO004 | 11 | 12 | T3 | 25 | 10 | 402 | 4.6 | 0.063 | 19 | 10 | 541 | <1 | <0.5 | 24 | 4.1 | 0.5 | 11 | 0.3 | 0.15 | 0.49 | 35 | 2.2 | 34 | 2.2 | <1 | 8.8 | <2 | 1.9 | 114 |
| CSIRO004 | 12 | 13 | T3 | 40 | 24 | 404 | 3.7 | 0.062 | 21 | 12 | 730 | <1 | 0.7 | 33 | 4.5 | <0.2 | 12 | 0.3 | 0.11 | 0.42 | 27 | 3.0 | 42 | 2.6 | 1.1 | 9.3 | <2 | 2.1 | 116 |
| CSIRO004 | 13 | 14 | T3 | 35 | 53 | 316 | 2.3 | 0.089 | 24 | 8.2 | 691 | <1 | 0.7 | 34 | 4.9 | <0.2 | 13 | 0.3 | 0.094 | 0.37 | 30 | 3.1 | 39 | 3.0 | <1 | 13 | <2 | 2.1 | <100 |
| CSIRO004 | 14 | 15 | T3 | 29 | 75 | 148 | 4.7 | 0.052 | 24 | 8.3 | 611 | <1 | 0.7 | 29 | 5.3 | 0.5 | 15 | 0.2 | 0.17 | 0.59 | 35 | 3.2 | 35 | 3.0 | 1.1 | 15 | <2 | 1.8 | 104 |
| CSIRO004 | 15 | 16 | A1 | 19 | 25 | 110 | 5.1 | 0.068 | 12 | 7.4 | 357 | <1 | <0.5 | 13 | 5.5 | 0.4 | 7.9 | 0.2 | 0.26 | 0.87 | 22 | 1.6 | 30 | 1.4 | 1.6 | 12 | <2 | 1.6 | 100 |
| CSIRO004 | 16 | 17 | A1 | 13 | 17 | <100 | 3.7 | 0.061 | 11 | 8.4 | 308 | <1 | <0.5 | 10 | 6.0 | <0.2 | 5.4 | 0.2 | 0.23 | 0.82 | <20 | 1.2 | 27 | 1.4 | <1 | 9.8 | <2 | 1.8 | <100 |
| CSIRO004 | 17 | 18 | A1 | 10 | 15 | <100 | 6.2 | 0.063 | 9.2 | 9.8 | 294 | 1.0 | <0.5 | 11 | 6.4 | 0.6 | 4.3 | 0.2 | 0.27 | 0.94 | <20 | 1.2 | 25 | 1.2 | <1 | 9.8 | <2 | 1.6 | <100 |
| CSIRO004 | 18 | 19 | A1 | 10 | 12 | <100 | 4.7 | 0.057 | 7.8 | 9.0 | 290 | <1 | <0.5 | 11 | 6.8 | <0.2 | 3.2 | 0.2 | 0.25 | 0.82 | <20 | 1.4 | 25 | 1.0 | 1.6 | 9.4 | <2 | 1.8 | <100 |
| CSIRO004 | 19 | 20 | A1 | 6 | 7 | <100 | 4.2 | 1.0 | 5.9 | 7.6 | 249 | 1.1 | <0.5 | 8.2 | 6.8 | <0.2 | 2.8 | 0.2 | 0.80 | 0.79 | <20 | 1.0 | 22 | 1.0 | 1.3 | 8.6 | <2 | 1.8 | <100 |
| CSIRO005 | 0 | 1 | T1 | 5 | <5 | 313 | 7.8 | 1.4 | 38 | 19 | 277 | 2.1 | 0.7 | 6.7 | 3.3 | 0.3 | 23 | 0.2 | 0.36 | 0.41 | 40 | 0.4 | 19 | 3.4 | <1 | 8.8 | <2 | 1.7 | 130 |
| CSIRO005 | 1 | 2 | T1 | 6 | <5 | 408 | 7.7 | 8.3 | 30 | 14 | 206 | 1.9 | 0.8 | 5.0 | 2.6 | 0.4 | 21 | 0.2 | 0.34 | 0.43 | 38 | 0.4 | 15 | 3.3 | <1 | 6.6 | <2 | 1.4 | 109 |
| CSIRO005 | 2 | 3 | T1 | 7 | 9 | 472 | 4.7 | 4.8 | 31 | 19 | 283 | 1.6 | 0.8 | 7.0 | 2.9 | 0.5 | 19 | <0.2 | 0.27 | 0.59 | 30 | 0.4 | 18 | 3.2 | <1 | 7.3 | <2 | 1.6 | 124 |
| CSIRO005 | 3 | 4 | T1 | 5 | 13 | 192 | 4.6 | 3.4 | 32 | 19 | 256 | 1.8 | 1.0 | 6.7 | 2.7 | 0.6 | 21 | 0.2 | 0.33 | 0.82 | 39 | 0.3 | 19 | 3.5 | <1 | 7.1 | <2 | 1.5 | 131 |
| CSIRO005 | 4 | 5 | T1 | 6 | 15 | 248 | 3.6 | 1.4 | 32 | 22 | 273 | 1.2 | 0.8 | 6.6 | 3.8 | <0.2 | 20 | 0.2 | 0.29 | 1.0 | 24 | <0.2 | 19 | 3.4 | 1.4 | 6.8 | <2 | 1.7 | 127 |
| CSIRO005 | 5 | 6 | T2 | 10 | <5 | 252 | 4.0 | 0.14 | 33 | 24 | 418 | <1 | 0.9 | 11 | 3.1 | <0.2 | 19 | 0.2 | 0.22 | 0.79 | <20 | 0.6 | 24 | 3.6 | 1.0 | 7.9 | <2 | 1.8 | 147 |
| CSIRO005 | 6 | 7 | T2 | 9 | <5 | 157 | 4.1 | 0.13 | 30 | 22 | 283 | 2.0 | 1.0 | 8.4 | 3.1 | 0.5 | 18 | 0.2 | 0.29 | 0.83 | 28 | 0.3 | 20 | 3.4 | <1 | 6.8 | <2 | 1.8 | 127 |
| CSIRO005 | 7 | 8 | T2 | 10 | 8 | 230 | 4.5 | 3.2 | 32 | 22 | 271 | <1 | 0.9 | 7.8 | 3.5 | 0.5 | 20 | 0.2 | 0.41 | 0.79 | <20 | 0.7 | 20 | 3.7 | <1 | 6.9 | <2 | 2.1 | 128 |
| CSIRO005 | 8 | 9 | T2 | 16 | <5 | 176 | 4.9 | 0.89 | 35 | 30 | 389 | 1.2 | 1.3 | 16 | 3.1 | 0.4 | 26 | 0.3 | 0.42 | 0.66 | 20 | 1.0 | 27 | 4.9 | <1 | 7.0 | <2 | 2.7 | 102 |
| CSIRO005 | 9 | 10 | T2 | 19 | <5 | 615 | 5.8 | 0.15 | 39 | 33 | 491 | <1 | 1.0 | 22 | 3.5 | <0.2 | 16 | 0.3 | 0.27 | 0.58 | 38 | 1.4 | 33 | 3.6 | 1.5 | 7.0 | <2 | 2.6 | 134 |
| CSIRO005 | 10 | 11 | T3 | 27 | <5 | 664 | 5.1 | 0.086 | 16 | 17 | 539 | <1 | 0.7 | 23 | 3.8 | <0.2 | 11 | 0.2 | 0.21 | 0.60 | <20 | 2.1 | 34 | 2.2 | 1.2 | 7.8 | <2 | 2.0 | 107 |
| CSIRO005 | 11 | 12 | T3 | 29 | <5 | 323 | 3.4 | 0.11 | 21 | 10 | 661 | <1 | 0.5 | 30 | 4.6 | <0.2 | 13 | 0.2 | 0.20 | 0.63 | 21 | 3.2 | 35 | 2.5 | <1 | 10 | <2 | 2.0 | <100 |
| CSIRO005 | 12 | 13 | T3 | 29 | 50 | 203 | 3.3 | 0.11 | 37 | 13 | 572 | <1 | 0.6 | 27 | 3.8 | <0.41 | 15 | 0.2 | 0.18 | 0.62 | 27 | 2.7 | 36 | 3.0 | 1.3 | 11 | <2 | 1.9 | <100 |
| CSIRO005 | 13 | 14 | T3 | 33 | 75 | 1410 | 4.9 | 0.040 | 34 | 11 | 720 | 2.0 | 0.9 | 36 | 4.9 | <0.2 | 19 | 0.2 | 0.13 | 0.43 | 26 | 3.2 | 38 | 3.7 | <1 | 15 | <2 | 2.0 | <100 |
| CSIRO005 | 14 | 15 | A1 | 15 | 18 | 156 | 5.2 | 0.074 | 16 | 9.8 | 370 | <1 | <0.5 | 14 | 5.9 | 0.4 | 7.5 | 0.3 | 0.27 | 0.89 | 24 | 1.4 | 31 | 1.7 | 1.4 | 12 | <2 | 1.8 | 114 |
| CSIRO005 | 15 | 16 | A1 | 13 | 44 | <100 | 4.9 | 0.071 | 11 | 8.6 | 310 | <1 | <0.5 | 11 | 6.7 | <0.2 | 5.7 | 0.2 | 0.28 | 0.92 | <20 | 1.3 | 30 | 1.3 | <1 | 11 | <2 | 1.8 | <100 |
| CSIRO005 | 16 | 17 | A1 | 11 | 18 | <100 | 4.2 | 0.060 | 6.6 | 7.9 | 295 | <1 | <0.5 | 9.8 | 7.0 | <0.2 | 3.6 | 0.2 | 0.21 | 0.82 | <20 | 1.3 | 27 | 1.0 | 1.2 | 10 | <2 | 1.7 | <100 |
| CSIRO005 | 17 | 18 | A1 | 11 | 12 | 130 | 2.7 | 0.058 | 11 | 9.2 | 315 | <1 | <0.5 | 13 | 6.4 | <0.2 | 4.3 | 0.2 | 0.20 | 0.78 | <20 | 1.2 | 22 | 1.3 | 1.3 | 9.9 | <2 | 1.7 | <100 |
| CSIRO005 | 18 | 19 | A1 | 10 | <5 | <100 | 5.6 | 0.42 | 6.1 | 8.2 | 289 | <1 | <0.5 | 11 | 6.4 | <0.2 | 3.3 | 0.3 | 0.41 | 0.76 | <20 | 1.2 | 21 | 1.1 | <1 | 9.3 | <2 | 1.7 | <100 |
| CSIRO005 | 19 | 20 | A1 | 5 | 9 | <100 | 4.5 | 0.69 | 6.9 | 9.1 | 235 | 1.3 | <0.5 | 5.2 | 7.6 | <0.2 | 3.3 | 0.2 | 0.59 | 0.86 | <20 | 1.2 | 21 | 1.0 | 1.0 | 8.4 | <2 | 1.8 | <100 |
| CSIRO006 | 0 | 1 | T1 | 6 | <5 | 261 | <2 | 0.34 | 37 | 17 | 354 | 1.8 | 0.9 | 7.3 | 3.4 | 0.7 | 21 | 0.2 | 0.14 | 0.20 | 35 | 0.6 | 18 | 3.3 | 1.0 | 8.7 | <2 | 1.7 | 123 |
| CSIRO006 | 1 | 2 | T1 | 6 | <5 | 310 | 2.7 | 3.3 | 36 | 15 | 252 | 2.0 | 0.9 | 6.3 | 3.1 | <0.2 | 23 | 0.2 | 0.26 | 0.29 | 47 | 0.5 | 18 | 3.7 | <1 | 8.2 | <2 | 1.5 | 117 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSIRO006 | 2 | 3 | T1 | 8 | <5 | 352 | 3.6 | 3.8 | 32 | 18 | 348 | 1.8 | 0.6 | 9.4 | 3.4 | 0.6 | 19 | <0.2 | 0.21 | 0.44 | 32 | 0.5 | 21 | 3.3 | <1 | 8.2 | <2 | 1.6 | 111 |
| CSIRO006 | 3 | 4 | T1 | 7 | <5 | 443 | <2 | 2.2 | 29 | 17 | 306 | 1.9 | 0.7 | 8.0 | 3.2 | 0.6 | 17 | <0.2 | 0.18 | 0.59 | 21 | 0.5 | 18 | 2.9 | 1.1 | 6.9 | <2 | 1.5 | 126 |
| CSIRO006 | 4 | 5 | T2 | 8 | <5 | 426 | 2.8 | 0.34 | 26 | 25 | 469 | <1 | 0.7 | 11 | 2.7 | <0.2 | 16 | 0.2 | 0.14 | 0.84 | 21 | 0.4 | 22 | 3.1 | <1 | 7.2 | <2 | 1.6 | 122 |
| CSIRO006 | 5 | 6 | T2 | 9 | <5 | 346 | 2.8 | 0.65 | 29 | 23 | 383 | 1.2 | 0.9 | 11 | 2.9 | <0.2 | 19 | 0.3 | 0.20 | 0.76 | 40 | 0.4 | 24 | 3.4 | 1.4 | 7.4 | <2 | 1.9 | 141 |
| CSIRO006 | 6 | 7 | T2 | 9 | 9 | 319 | 3.9 | 0.23 | 32 | 27 | 330 | <1 | 1.1 | 9.9 | 3.2 | 0.8 | 18 | 0.3 | 0.23 | 0.79 | <20 | 0.6 | 23 | 3.5 | <1 | 7.4 | <2 | 1.9 | 126 |
| CSIRO006 | 7 | 8 | T2 | 12 | 10 | 350 | 5.2 | 0.13 | 30 | 22 | 347 | 2.0 | 0.8 | 14 | 3.4 | <0.4 | 17 | 0.2 | 0.29 | 0.64 | 35 | 0.6 | 26 | 3.3 | 1.0 | 7.2 | <2 | 1.8 | 131 |
| CSIRO006 | 8 | 9 | T2 | 14 | 8 | 710 | 4.9 | 0.11 | 36 | 22 | 341 | 2.1 | 1.3 | 14 | 2.7 | <0.41 | 25 | 0.3 | 0.30 | 0.60 | <20 | 0.8 | 25 | 4.0 | <1 | 6.5 | <2 | 2.3 | <100 |
| CSIRO006 | 9 | 10 | T3 | 23 | 10 | 3400 | 5.7 | 0.079 | 36 | 24 | 520 | 1.2 | 1.2 | 23 | 4.1 | 0.5 | 17 | 0.3 | 0.25 | 0.56 | 21 | 1.9 | 33 | 3.7 | <1 | 8.1 | <2 | 2.5 | 126 |
| CSIRO006 | 10 | 11 | T3 | 23 | 16 | 821 | 2.9 | 0.067 | 28 | 13 | 583 | 2.0 | 0.9 | 27 | 4.8 | <0.2 | 17 | 0.4 | 0.16 | 0.52 | <20 | 2.3 | 33 | 3.4 | <1 | 11 | <2 | 2.5 | 113 |
| CSIRO006 | 11 | 12 | T3 | 20 | 30 | 386 | 10.4 | 1.8 | 6.0 | 14 | 129 | <1 | <0.5 | 7.6 | 5.2 | <0.2 | 3.0 | <0.2 | 0.18 | 0.13 | <20 | 0.4 | 6 | 0.7 | <1 | 4.5 | 4 | 0.9 | <100 |
| CSIRO006 | 12 | 13 | T3 | 28 | 16 | 148 | 3.9 | 0.66 | 28 | 12 | 586 | 1.5 | 0.9 | 27 | 4.7 | <0.2 | 15 | 0.3 | 0.14 | 0.45 | <20 | 2.6 | 34 | 3.1 | 1.5 | 13 | <2 | 1.9 | 105 |
| CSIRO006 | 13 | 14 | T3 | 27 | 42 | 134 | 4.0 | 0.43 | 35 | 13 | 559 | 3.3 | 0.8 | 26 | 5.0 | <0.49 | 19 | 0.3 | 0.22 | 0.51 | 29 | 2.7 | 35 | 3.7 | <1 | 14 | <2 | 2.3 | <100 |
| CSIRO006 | 14 | 15 | T3 | 31 | 20 | 504 | 4.1 | 0.49 | 36 | 13 | 673 | <1 | 1.2 | 33 | 5.6 | 0.7 | 20 | 0.3 | 0.34 | 0.44 | 28 | 3.7 | 38 | 3.9 | 1.8 | 16 | <2 | 2.2 | <100 |
| CSIRO006 | 15 | 16 | A1 | 14 | 19 | <100 | 4.7 | 0.092 | 8.3 | 8.6 | 284 | 1.2 | <0.5 | 10 | 5.5 | <0.4 | 5.3 | <0.2 | 0.23 | 0.83 | <20 | 1.3 | 27 | 1.1 | <1 | 11 | <2 | 1.5 | <100 |
| CSIRO006 | 16 | 17 | A1 | 14 | 22 | 173 | 4.7 | 0.066 | 7.0 | 8.4 | 279 | <1 | <0.5 | 9.1 | 6.4 | <0.4 | 2.9 | <0.2 | 0.20 | 0.81 | <20 | 1.2 | 26 | 0.9 | 1.4 | 10 | <2 | 1.6 | <100 |
| CSIRO006 | 17 | 18 | A1 | 11 | 12 | <100 | 3.9 | 0.067 | 11 | 11 | 297 | 1.4 | <0.5 | 12 | 6.1 | <0.2 | 3.5 | 0.2 | 0.19 | 0.82 | <20 | 1.1 | 22 | 1.2 | 1.4 | 10 | <2 | 1.6 | <100 |
| CSIRO006 | 18 | 19 | A1 | 7 | 11 | <100 | 3.9 | 0.47 | 6.6 | 10 | 239 | <1 | <0.5 | 7.4 | 7.0 | <0.2 | 2.8 | <0.2 | 0.42 | 0.78 | <20 | 1.1 | 20 | 0.9 | <1 | 8.3 | 4 | 1.6 | <100 |
| CSIRO006 | 19 | 20 | A1 | 6 | 9 | 157 | 5.2 | 0.95 | 7.9 | 12 | 226 | <1 | <0.5 | 6.7 | 6.5 | <0.2 | 3.5 | 0.2 | 0.68 | 0.89 | <20 | 1.3 | 18 | 1.0 | 1.3 | 7.8 | 6 | 1.5 | <100 |
| CSIRO007 | 0 | 1 | T1 | 7 | <5 | 310 | 4.0 | 0.77 | 36 | 18 | 360 | 2.2 | 0.9 | 8.2 | 3.7 | 0.5 | 25 | 0.2 | 0.18 | 0.50 | 47 | 0.6 | 21 | 3.8 | <1 | 9.2 | <2 | 1.7 | 137 |
| CSIRO007 | 1 | 2 | T1 | 14 | <5 | 955 | 14.0 | 1.9 | 84 | 42 | 664 | 7.2 | 2.1 | 16 | 6.5 | 1.0 | 55 | 0.5 | 0.26 | 1.1 | 110 | 1.0 | 46 | 8.7 | <1 | 20 | <6.3 | 4.1 | 335 |
| CSIRO007 | 2 | 3 | T1 | 7 | <5 | 262 | 5.0 | 4.1 | 31 | 18 | 321 | 2.4 | 0.8 | 7.9 | 2.9 | <0.2 | 18 | <0.2 | 0.26 | 0.52 | 34 | 0.5 | 18 | 3.1 | <1 | 7.0 | <2 | 1.6 | 121 |
| CSIRO007 | 3 | 4 | T1 | 6 | 6 | 271 | 6.5 | 4.4 | 29 | 17 | 270 | 1.6 | 0.8 | 6.3 | 3.0 | <0.2 | 19 | <0.2 | 0.28 | 0.67 | 38 | 0.3 | 17 | 3.1 | <1 | 6.9 | <2 | 1.5 | 117 |
| CSIRO007 | 4 | 5 | T1 | 7 | 10 | 236 | 4.8 | 1.6 | 29 | 21 | 317 | 1.4 | 0.8 | 8.6 | 2.8 | 0.6 | 18 | <0.2 | 0.25 | 0.76 | 25 | <0.2 | 20 | 3.3 | <1 | 6.6 | <2 | 1.5 | 121 |
| CSIRO007 | 5 | 6 | T1 | 9 | 12 | 349 | 3.9 | 2.0 | 33 | 23 | 357 | 2.3 | 0.7 | 9.7 | 2.9 | 0.5 | 19 | 0.2 | 0.29 | 0.72 | 33 | 0.7 | 23 | 3.6 | <1 | 6.5 | <2 | 1.7 | 149 |
| CSIRO007 | 6 | 7 | T2 | 9 | <5 | 178 | 5.8 | 4.8 | 25 | 18 | 265 | 1.7 | 0.8 | 8.4 | 2.5 | <0.2 | 15 | <0.2 | 0.38 | 0.65 | 23 | 0.5 | 18 | 2.7 | <1 | 5.8 | <2 | 1.5 | <100 |
| CSIRO007 | 7 | 8 | T2 | 14 | 9 | 964 | 3.9 | 1.7 | 28 | 22 | 336 | 1.4 | 0.7 | 14 | 3.3 | 0.5 | 15 | <0.2 | 0.36 | 0.60 | 20 | 0.7 | 25 | 2.7 | 1.1 | 6.2 | <2 | 1.5 | 114 |
| CSIRO007 | 8 | 9 | T3 | 14 | 9 | 336 | 5.7 | 0.79 | 29 | 21 | 340 | <1 | 0.9 | 14 | 3.0 | 0.5 | 19 | 0.2 | 0.38 | 0.61 | 26 | 0.9 | 25 | 3.4 | <1 | 6.7 | <2 | 1.9 | 113 |
| CSIRO007 | 9 | 10 | T3 | 41 | 13 | 703 | 4.5 | 0.18 | 28 | 26 | 458 | 1.6 | 1.0 | 19 | 3.5 | <0.2 | 18 | 0.3 | 0.26 | 0.63 | <20 | 1.7 | 33 | 3.6 | <1 | 7.3 | <2 | 2.4 | 133 |
| CSIRO007 | 10 | 11 | T3 | 21 | 12 | 276 | 6.8 | 0.13 | 31 | 22 | 521 | 1.7 | 1.1 | 23 | 3.9 | <0.2 | 19 | 0.3 | 0.19 | 0.66 | <20 | 2.2 | 35 | 3.8 | 1.6 | 8.4 | <2 | 2.7 | 101 |
| CSIRO007 | 11 | 12 | T3 | 33 | 35 | 659 | 4.5 | 0.11 | 26 | 12 | 685 | <1 | 0.9 | 33 | 4.2 | 0.6 | 15 | 0.2 | 0.11 | 0.46 | 32 | 2.9 | 39 | 3.1 | 1.5 | 11 | <2 | 2.2 | <100 |
| CSIRO007 | 12 | 13 | T3 | 36 | 50 | 673 | 2.1 | 0.54 | 28 | 11 | 742 | 1.7 | 0.8 | 35 | 5.0 | 0.6 | 16 | 0.3 | 0.24 | 0.36 | 35 | 3.2 | 39 | 3.3 | <1 | 13 | <4.1 | 2.0 | <100 |
| CSIRO007 | 13 | 14 | T3 | 40 | 37 | 329 | 4.1 | 0.61 | 35 | 9.8 | 818 | 2.2 | 1.2 | 41 | 6.2 | 0.7 | 21 | 0.3 | 0.15 | 0.35 | 32 | 4.5 | 40 | 4.1 | 1.8 | 19 | <4.4 | 2.2 | <100 |
| CSIRO007 | 14 | 15 | A1 | 14 | 69 | 597 | 6.3 | 1.4 | 17 | 12 | 369 | 1.7 | <0.5 | 13 | 5.5 | <0.2 | 11 | 0.2 | 0.36 | 0.77 | <20 | 1.5 | 28 | 2.2 | 1.3 | 11 | <2 | 1.8 | <100 |
| CSIRO007 | 15 | 16 | A1 | 9 | 32 | <100 | 7.4 | 0.43 | 9.4 | 9.0 | 282 | <1 | <0.5 | 7.8 | 7.1 | <0.2 | 5.3 | 0.3 | 0.33 | 0.82 | <20 | 1.4 | 27 | 1.2 | 1.8 | 10 | <2 | 1.9 | 102 |
| CSIRO007 | 16 | 17 | A1 | 6 | 34 | 169 | 6.3 | 0.72 | 11 | 10 | 252 | <1 | <0.5 | 6.0 | 7.4 | <0.2 | 5.4 | 0.2 | 0.41 | 0.87 | <20 | 1.3 | 26 | 1.3 | <1 | 10 | <2 | 2.0 | <100 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSIRO007 | 17 | 18 | A1 | 10 | 28 | 233 | 6.0 | 0.50 | 10 | 9.8 | 296 | 1.3 | <0.5 | 8.6 | 7.0 | <0.2 | 6.1 | 0.3 | 0.30 | 0.84 | <20 | 1.6 | 25 | 1.4 | 1.7 | 10 | <2 | 1.9 | <100 |
| CSIRO007 | 18 | 19 | A1 | 4 | 80 | 281 | 7.8 | 0.12 | 9.4 | 8.6 | 236 | 1.0 | <0.5 | 4.7 | 7.5 | <0.2 | 4.2 | 0.2 | 0.25 | 0.95 | <20 | 1.2 | 22 | 1.1 | 1.1 | 9.0 | 6 | 1.8 | <100 |
| CSIRO007 | 19 | 20 | A1 | 2 | 74 | 723 | 7.4 | 1.2 | 13 | 10 | 203 | 2.0 | <0.5 | 3.1 | 7.6 | <0.2 | 6.3 | 0.3 | 0.93 | 1.1 | <20 | 1.3 | 19 | 1.3 | 1.0 | 9.0 | <4.1 | 1.8 | <100 |
| CSIRO008 | 0 | 1 | T1 | 7 | <5 | 202 | 5.4 | 2.7 | 30 | 15 | 361 | 2.2 | 0.7 | 6.9 | 3.1 | 1.1 | 19 | <0.2 | 0.29 | 0.18 | 31 | 0.5 | 15 | 3.0 | <1 | 7.1 | <2 | 1.4 | 113 |
| CSIRO008 | 1 | 2 | T1 | 7 | 6 | 585 | 6.9 | 3.1 | 35 | 19 | 314 | 2.2 | 0.8 | 7.1 | 2.9 | 0.8 | 20 | 0.2 | 0.33 | 0.51 | 35 | 0.4 | 19 | 3.3 | 1.0 | 7.2 | <2 | 1.6 | 115 |
| CSIRO008 | 2 | 3 | T1 | 6 | 9 | 360 | 6.3 | 4.0 | 29 | 17 | 305 | 1.4 | 0.9 | 7.4 | 3.0 | 0.5 | 17 | <0.2 | 0.24 | 0.63 | 22 | 0.6 | 17 | 2.9 | <1 | 6.4 | <2 | 1.5 | 119 |
| CSIRO008 | 3 | 4 | T1 | 6 | <5 | 343 | 5.2 | 1.1 | 34 | 22 | 297 | 1.6 | 1.0 | 7.0 | 3.4 | 0.6 | 21 | 0.2 | 0.31 | 0.79 | 40 | 0.4 | 20 | 3.4 | <1 | 7.6 | <2 | 1.8 | 131 |
| CSIRO008 | 4 | 5 | T2 | 6 | <5 | 211 | 3.4 | 0.40 | 37 | 23 | 300 | 2.2 | 1.0 | 7.2 | 3.7 | 0.7 | 21 | 0.2 | 0.24 | 0.86 | 37 | 0.4 | 22 | 3.6 | <1 | 7.9 | <2 | 1.9 | 140 |
| CSIRO008 | 5 | 6 | T2 | 9 | <5 | 308 | 4.8 | 0.27 | 33 | 24 | 363 | 1.2 | 1.1 | 9.2 | 3.0 | 0.6 | 18 | 0.2 | 0.20 | 0.82 | 26 | 0.4 | 23 | 3.4 | 1.2 | 6.9 | <2 | 1.6 | 130 |
| CSIRO008 | 6 | 7 | T3 | 12 | <5 | 499 | 3.4 | 0.21 | 33 | 30 | 524 | 1.3 | 1.4 | 17 | 3.2 | 0.8 | 22 | 0.3 | 0.16 | 0.67 | 28 | 0.7 | 29 | 4.2 | 1.3 | 8.5 | <2 | 2.2 | 135 |
| CSIRO008 | 7 | 8 | T3 | 12 | 9 | 401 | 4.0 | 0.079 | 37 | 32 | 358 | 1.3 | 1.4 | 14 | 3.0 | 0.6 | 23 | 0.3 | 0.18 | 0.76 | 53 | 0.7 | 25 | 4.5 | <1 | 7.6 | <2 | 2.4 | 116 |
| CSIRO008 | 8 | 9 | T3 | 13 | <5 | 262 | 4.4 | 0.076 | 23 | 24 | 367 | 1.1 | 0.6 | 16 | 3.6 | 0.6 | 14 | 0.3 | 0.18 | 0.63 | 33 | 1.0 | 29 | 2.8 | <1 | 6.5 | <2 | 1.9 | 112 |
| CSIRO008 | 9 | 10 | T3 | 15 | <5 | 340 | 5.2 | 0.076 | 20 | 19 | 391 | 1.2 | 0.6 | 17 | 3.3 | 0.7 | 12 | 0.3 | 0.12 | 0.54 | 39 | 1.3 | 30 | 2.3 | <1 | 7.3 | <4.1 | 1.7 | 123 |
| CSIRO008 | 10 | 11 | T3 | 29 | <5 | 533 | 4.2 | 0.063 | 16 | 11 | 590 | 1.5 | 0.8 | 28 | 4.4 | 0.9 | 12 | 0.2 | 0.091 | 0.43 | <20 | 2.4 | 37 | 2.5 | 1.3 | 7.4 | <4.1 | 1.9 | 117 |
| CSIRO008 | 11 | 12 | T3 | 25 | 22 | 379 | 5.2 | 0.072 | 24 | 15 | 571 | 2.0 | 0.7 | 24 | 4.3 | 0.3 | 13 | 0.2 | 0.11 | 0.50 | 25 | 2.1 | 36 | 2.7 | <1 | 8.9 | <4.1 | 2.2 | <100 |
| CSIRO008 | 12 | 13 | T3 | 41 | 30 | 130 | 2.8 | 0.038 | 23 | 12 | 714 | <1 | 0.8 | 35 | 4.9 | 0.3 | 13 | 0.2 | 0.077 | 0.36 | 24 | 3.4 | 41 | 2.9 | <1 | 12 | <4.7 | 2.0 | 103 |
| CSIRO008 | 13 | 14 | T3 | 19 | 75 | 149 | 4.1 | 0.059 | 19 | 12 | 476 | 1.2 | 0.7 | 19 | 6.2 | 0.3 | 13 | 0.3 | 0.18 | 0.61 | 27 | 2.1 | 32 | 2.7 | <1 | 12 | <2 | 2.0 | <100 |
| CSIRO008 | 14 | 15 | A1 | 7 | 58 | <100 | 4.7 | 0.068 | 9.8 | 9.4 | 265 | 1.2 | <0.5 | 7.0 | 7.2 | <0.2 | 5.5 | 0.3 | 0.23 | 0.82 | <20 | 1.6 | 25 | 1.3 | 1.3 | 10 | <2 | 1.9 | <100 |
| CSIRO008 | 15 | 16 | A1 | 3 | 34 | <100 | 4.8 | 0.052 | 9.1 | 7.6 | 215 | <1 | <0.5 | 3.1 | 8.0 | <0.2 | 3.9 | 0.3 | 0.24 | 0.81 | <20 | 1.6 | 24 | 1.0 | <1 | 9.3 | <2 | 2.0 | <100 |
| CSIRO008 | 16 | 17 | A1 | 3 | 51 | <100 | 4.3 | 0.050 | 8.7 | 7.2 | 215 | <1 | <0.5 | 2.7 | 8.1 | <0.2 | 4.1 | 0.3 | 0.21 | 0.82 | <20 | 1.8 | 23 | 1.0 | 1.5 | 9.4 | 7 | 1.9 | <100 |
| CSIRO008 | 17 | 18 | A1 | 4 | 15 | 109 | 6.5 | 0.100 | 12 | 8.2 | 177 | 2.1 | <0.5 | 2.7 | 6.5 | <0.2 | 6.8 | 0.2 | 0.20 | 1.3 | 22 | 2.0 | 18 | 1.3 | 1.8 | 7.2 | 8 | 1.7 | <100 |
| CSIRO008 | 18 | 19 | A1 | 5 | 33 | 377 | 2.8 | 0.042 | 16 | 10 | 187 | 4.7 | <0.5 | 6.7 | 4.0 | 1.8 | 7.2 | <0.2 | 0.13 | 2.4 | 59 | 3.5 | 19 | 1.3 | <1 | 4.1 | 27 | 1.3 | 104 |
| CSIRO008 | 19 | 20 | A1 | 7 | 47 | 180 | 5.8 | 0.039 | 19 | 12 | 188 | 6.7 | <0.5 | 5.5 | 3.3 | 0.7 | 9.6 | <0.2 | 0.12 | 3.2 | 74 | 4.2 | 22 | 1.6 | 1.3 | 3.4 | 25 | 1.1 | 106 |
| CSIRO009 | 0 | 1 | T1 | 7 | <5 | 308 | 4.7 | 1.6 | 31 | 16 | 353 | 1.5 | 0.6 | 7.2 | 3.4 | 0.7 | 18 | <0.2 | 0.18 | 0.25 | 39 | 0.4 | 17 | 2.9 | <1 | 8.3 | <2 | 1.5 | 116 |
| CSIRO009 | 1 | 2 | T1 | 5 | <5 | 273 | 7.1 | 1.8 | 32 | 16 | 259 | 2.5 | 0.8 | 6.1 | 2.9 | 0.8 | 20 | 0.2 | 0.27 | 0.59 | 43 | 0.4 | 19 | 3.2 | <1 | 7.0 | <2 | 1.6 | 126 |
| CSIRO009 | 2 | 3 | T1 | 7 | 7 | 834 | 6.9 | 3.6 | 30 | 17 | 319 | 1.8 | 0.6 | 8.3 | 2.9 | 0.6 | 17 | <0.2 | 0.23 | 0.54 | 33 | 0.5 | 20 | 3.0 | <1 | 6.7 | <2 | 1.4 | 116 |
| CSIRO009 | 3 | 4 | T1 | 7 | 8 | 281 | 4.8 | 2.2 | 35 | 22 | 344 | 1.5 | 0.8 | 8.7 | 3.0 | <0.2 | 21 | 0.2 | 0.22 | 0.68 | 22 | 0.4 | 21 | 3.6 | <1 | 7.7 | <2 | 1.7 | 133 |
| CSIRO009 | 4 | 5 | T2 | 6 | <5 | 316 | 4.3 | 0.50 | 40 | 23 | 269 | 2.2 | 0.8 | 6.9 | 3.4 | 0.7 | 21 | 0.2 | 0.24 | 0.80 | 34 | 0.3 | 21 | 3.5 | <1 | 7.4 | <2 | 1.9 | 137 |
| CSIRO009 | 5 | 6 | T2 | 11 | <5 | 357 | 3.5 | 0.27 | 36 | 25 | 513 | <1 | 1.0 | 13 | 3.4 | <0.2 | 19 | 0.3 | 0.20 | 0.69 | 21 | 0.6 | 26 | 3.6 | <1 | 7.6 | <2 | 1.8 | 155 |
| CSIRO009 | 6 | 7 | T2 | 6 | 8 | 119 | 3.8 | 0.73 | 31 | 22 | 254 | <1 | 0.7 | 6.9 | 3.4 | 0.8 | 16 | <0.2 | 0.28 | 0.81 | 25 | 0.5 | 19 | 3.0 | <1 | 6.6 | <2 | 1.6 | 127 |
| CSIRO009 | 7 | 8 | T2 | 12 | 12 | 357 | 6.1 | 0.94 | 28 | 19 | 306 | <1 | 0.8 | 12 | 2.9 | <0.2 | 16 | 0.2 | 0.33 | 0.66 | 30 | 0.7 | 22 | 3.0 | <1 | 6.7 | <2 | 1.7 | 128 |
| CSIRO009 | 8 | 9 | T3 | 14 | <5 | 501 | 3.8 | 0.14 | 25 | 25 | 383 | 1.2 | 0.9 | 17 | 2.8 | <0.2 | 16 | 0.3 | 0.24 | 0.51 | 20 | 1.2 | 28 | 3.4 | <1 | 5.9 | <2 | 2.3 | 120 |
| CSIRO009 | 9 | 10 | T3 | 24 | <5 | 647 | 3.6 | 0.096 | 29 | 24 | 535 | <1 | 1.1 | 27 | 3.8 | 0.5 | 18 | 0.3 | 0.12 | 0.36 | 21 | 2.1 | 33 | 4.1 | 1.6 | 7.2 | <2 | 2.8 | 119 |
| CSIRO009 | 10 | 11 | T3 | 23 | <5 | 602 | 3.4 | 0.083 | 62 | 37 | 595 | <1 | 1.7 | 24 | 4.5 | 0.5 | 35 | 0.4 | 0.11 | 0.50 | 23 | 2.1 | 33 | 6.5 | 1.2 | 9.8 | <2 | 3.3 | 131 |
| CSIRO009 | 11 | 12 | T3 | 25 | <5 | 280 | 2.5 | 0.069 | 35 | 18 | 584 | 1.9 | 0.9 | 26 | 4.3 | 0.4 | 19 | 0.3 | 0.13 | 0.48 | <20 | 2.2 | 35 | 3.5 | <1 | 9.3 | <2 | 2.3 | <100 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSIRO009 | 12 | 13 | T3 | 27 | 15 | 163 | 2.3 | 0.058 | 30 | 12 | 623 | <1 | 0.8 | 29 | 4.8 | <0.2 | 14 | 0.3 | 0.11 | 0.40 | 26 | 2.6 | 34 | 3.0 | <1 | 12 | <2 | 2.0 | 127 |
| CSIRO009 | 13 | 14 | T3 | 33 | <5 | 476 | 4.6 | 0.042 | 37 | 7.8 | 705 | 2.0 | 1.2 | 35 | 5.5 | <0.2 | 19 | 0.3 | 0.11 | 0.38 | 21 | 3.5 | 34 | 4.1 | 1.1 | 19 | <2 | 2.4 | 103 |
| CSIRO009 | 14 | 15 | A1 | 14 | 24 | 138 | 4.5 | 0.074 | 19 | 8.4 | 430 | <1 | 0.6 | 15 | 6.3 | 0.4 | 11 | 0.2 | 0.19 | 0.70 | <20 | 1.7 | 28 | 2.3 | 1.8 | 12 | <2 | 1.8 | 108 |
| CSIRO009 | 15 | 16 | A1 | 9 | 19 | 246 | 4.8 | 0.094 | 11 | 6.2 | 290 | 1.1 | <0.5 | 9.1 | 6.3 | <0.2 | 5.7 | 0.2 | 0.19 | 0.74 | 22 | 1.5 | 22 | 1.4 | <1 | 9.5 | <2 | 1.6 | <100 |
| CSIRO009 | 16 | 17 | A1 | 5 | 28 | 182 | 6.1 | 0.073 | 10 | 6.7 | 225 | <1 | <0.5 | 4.8 | 7.0 | <0.2 | 4.4 | 0.2 | 0.19 | 0.88 | <20 | 1.3 | 22 | 1.0 | 1.5 | 8.5 | <2 | 1.7 | 102 |
| CSIRO009 | 17 | 18 | A1 | 7 | 12 | 374 | 6.2 | 0.064 | 31 | 5.8 | 264 | <1 | 0.8 | 8.6 | 6.2 | <0.2 | 17 | 0.2 | 0.17 | 1.5 | <20 | 1.5 | 19 | 2.4 | <1 | 9.3 | <2 | 1.6 | <100 |
| CSIRO009 | 18 | 19 | A1 | 8 | 36 | 883 | 4.3 | 0.34 | 88 | 2.8 | 164 | 2.0 | 1.2 | 8.5 | 4.8 | 2.3 | 48 | <0.2 | 0.23 | 3.5 | 44 | 1.5 | 10 | 5.7 | 2.6 | 12 | 10 | 1.5 | <100 |
| CSIRO009 | 19 | 20 | A1 | 8 | 34 | 932 | 4.4 | 0.78 | 74 | 3.7 | 157 | <1 | 1.4 | 7.7 | 4.3 | 2.7 | 38 | <0.2 | 0.47 | 3.5 | 49 | 1.6 | 11 | 5.3 | 1.7 | 11 | 20 | 1.3 | <100 |
| CSIRO010 | 0 | 1 | T1 | 7 | <5 | 330 | 4.5 | 1.3 | 23 | 12 | 350 | 1.3 | <0.5 | 6.7 | 3.1 | <0.2 | 15 | <0.2 | 0.16 | 0.19 | 26 | 0.5 | 13 | 2.3 | <1 | 6.8 | <2 | 1.3 | 107 |
| CSIRO010 | 1 | 2 | T1 | 4 | <5 | 267 | 4.6 | 1.2 | 34 | 17 | 262 | 2.4 | 0.8 | 6.3 | 3.1 | 0.3 | 22 | 0.2 | 0.21 | 0.54 | 40 | 0.2 | 18 | 3.3 | <1 | 8.2 | <2 | 1.7 | 127 |
| CSIRO010 | 2 | 3 | T1 | 6 | <5 | 371 | 3.3 | 3.4 | 34 | 20 | 309 | 1.7 | 0.7 | 7.2 | 2.8 | 0.3 | 19 | <0.2 | 0.18 | 0.57 | 34 | 0.3 | 18 | 3.2 | <1 | 7.1 | <2 | 1.6 | 116 |
| CSIRO010 | 3 | 4 | T1 | 6 | <5 | 312 | 3.3 | 0.87 | 35 | 23 | 296 | 1.8 | 0.8 | 7.7 | 2.9 | 0.3 | 21 | 0.2 | 0.18 | 0.69 | 32 | 0.4 | 20 | 3.6 | <1 | 7.4 | <2 | 1.7 | 120 |
| CSIRO010 | 4 | 5 | T2 | 4 | <5 | 132 | 2.5 | 0.22 | 42 | 27 | 282 | 1.9 | 1.0 | 7.3 | 3.6 | <0.2 | 23 | 0.3 | 0.19 | 0.77 | <20 | 0.4 | 21 | 4.1 | 1.1 | 7.7 | <4.1 | 2.0 | 146 |
| CSIRO010 | 5 | 6 | T2 | 10 | <5 | 451 | <2 | 0.75 | 33 | 27 | 428 | 2.2 | 1.1 | 14 | 3.1 | <0.2 | 19 | 0.2 | 0.16 | 0.65 | <20 | 0.4 | 25 | 3.8 | <1 | 7.4 | <2 | 1.9 | 139 |
| CSIRO010 | 6 | 7 | T3 | 10 | <5 | 257 | 4.0 | 0.17 | 33 | 22 | 357 | <1 | 0.9 | 11 | 3.6 | <0.26 | 19 | 0.2 | 0.18 | 0.74 | 30 | 0.8 | 23 | 3.6 | 1.0 | 7.4 | <2 | 1.9 | 133 |
| CSIRO010 | 7 | 8 | T3 | 19 | <5 | 532 | 2.1 | 0.072 | 31 | 20 | 548 | <1 | 0.9 | 27 | 4.4 | 0.2 | 20 | 0.3 | 0.14 | 0.42 | 26 | 2.0 | 30 | 4.0 | 1.1 | 7.4 | <2 | 2.7 | 106 |
| CSIRO010 | 8 | 9 | T3 | 16 | <5 | 390 | 3.5 | 1.2 | 40 | 29 | 379 | 1.1 | 1.1 | 16 | 3.0 | 0.5 | 20 | 0.3 | 0.24 | 0.48 | <20 | 1.1 | 29 | 3.7 | <1 | 6.1 | <2 | 2.2 | 116 |
| CSIRO010 | 9 | 10 | T3 | 19 | 40 | 734 | <2 | 0.95 | 47 | 24 | 467 | 1.4 | 1.2 | 18 | 3.9 | 0.2 | 21 | 0.3 | 0.16 | 0.47 | 22 | 1.3 | 31 | 4.0 | 1.2 | 8.6 | <2 | 2.6 | 121 |
| CSIRO010 | 10 | 11 | T3 | 17 | <5 | 985 | 5.3 | 0.27 | 64 | 26 | 472 | 1.5 | 1.6 | 18 | 4.6 | 0.3 | 30 | 0.4 | 0.13 | 0.55 | 22 | 1.6 | 29 | 5.8 | 1.4 | 11 | <2 | 3.2 | 113 |
| CSIRO010 | 11 | 12 | T3 | 30 | 12 | 308 | 3.7 | 0.14 | 32 | 14 | 631 | 1.4 | 0.9 | 27 | 4.9 | 0.2 | 21 | 0.2 | 0.11 | 0.43 | 26 | 3.0 | 36 | 3.6 | <1 | 13 | <2 | 2.3 | <100 |
| CSIRO010 | 12 | 13 | T3 | 19 | 13 | 834 | 3.1 | 0.068 | 47 | 18 | 532 | 2.4 | 0.9 | 21 | 5.2 | 0.2 | 25 | 0.3 | 0.14 | 0.55 | 27 | 2.2 | 31 | 4.1 | <1 | 15 | <2 | 2.1 | <100 |
| CSIRO010 | 13 | 14 | A1 | 12 | 22 | 316 | 6.0 | 0.074 | 26 | 14 | 354 | 1.6 | 0.8 | 12 | 5.2 | 0.3 | 16 | 0.2 | 0.18 | 0.72 | 24 | 1.6 | 25 | 3.0 | 1.1 | 11 | <4 | 1.9 | <100 |
| CSIRO010 | 14 | 15 | A1 | 9 | 16 | 390 | 4.7 | 0.065 | 12 | 8.2 | 334 | 1.0 | <0.5 | 9.7 | 6.5 | <0.2 | 7.5 | <0.2 | 0.15 | 0.75 | <20 | 1.3 | 22 | 1.5 | 1.2 | 10 | <2 | 1.7 | <100 |
| CSIRO010 | 15 | 16 | A1 | 6 | 66 | 156 | 5.4 | 0.061 | 8.7 | 6.3 | 260 | 1.3 | <0.5 | 7.0 | 6.4 | <0.2 | 4.8 | 0.2 | 0.17 | 0.74 | <20 | 1.4 | 19 | 1.1 | 1.3 | 8.5 | <4.1 | 1.6 | <100 |
| CSIRO010 | 16 | 17 | A1 | 7 | 17 | <100 | 5.1 | 0.054 | 10 | 6.1 | 257 | 1.8 | <0.5 | 7.0 | 6.6 | <0.2 | 5.9 | 0.2 | 0.19 | 0.85 | <20 | 1.3 | 19 | 1.2 | 1.2 | 8.4 | <2 | 1.6 | <100 |
| CSIRO010 | 17 | 18 | A1 | 7 | 21 | 363 | 6.9 | 0.056 | 20 | 7.6 | 233 | 1.6 | 0.5 | 5.7 | 6.6 | <0.2 | 11 | 0.2 | 0.19 | 0.88 | <20 | 1.4 | 18 | 1.8 | 1.4 | 8.4 | <2 | 1.7 | <100 |
| CSIRO010 | 18 | 19 | A1 | 8 | 18 | 1490 | 4.9 | 0.18 | 124 | 6.6 | 138 | 2.2 | 2.3 | 9.2 | 4.0 | 0.2 | 80 | <0.2 | 0.19 | 0.58 | 27 | 2.0 | 7 | 8.8 | <1 | 6.9 | 11 | 1.3 | <100 |
| CSIRO010 | 19 | 20 | A2 | 2 | 12 | 655 | 4.8 | 2.7 | 113 | 3.7 | 52 | 1.2 | 1.8 | 1.5 | 3.7 | <0.2 | 96 | <0.2 | 1.5 | 0.71 | <20 | 1.2 | 6 | 7.9 | <1 | 5.8 | 7 | 1.1 | <100 |
| CSIRO011 | 0 | 1 | T1 | 6 | 7 | 243 | 8.0 | 1.1 | 28 | 15 | 389 | <1 | 0.6 | 7.7 | 3.5 | 0.4 | 17 | <0.2 | 0.15 | 0.17 | 34 | 0.4 | 16 | 2.9 | <1 | 7.8 | <2 | 1.4 | 117 |
| CSIRO011 | 1 | 2 | T1 | 6 | 7 | 338 | 7.3 | 4.6 | 35 | 16 | 266 | 2.6 | 0.8 | 5.8 | 2.9 | 0.4 | 21 | 0.2 | 0.27 | 0.38 | 40 | 0.6 | 16 | 3.3 | <1 | 7.4 | <2 | 1.6 | 118 |
| CSIRO011 | 2 | 3 | T1 | 7 | 7 | 379 | 4.2 | 5.1 | 32 | 18 | 252 | 1.2 | 0.7 | 6.1 | 2.9 | 0.3 | 19 | 0.2 | 0.25 | 0.59 | 30 | 0.4 | 16 | 3.1 | <1 | 6.8 | <2 | 1.5 | 113 |
| CSIRO011 | 3 | 4 | T2 | 5 | <5 | 273 | 2.6 | 0.30 | 36 | 25 | 354 | 1.4 | 0.9 | 7.9 | 3.0 | 0.3 | 20 | 0.2 | 0.26 | 0.88 | 35 | 1.0 | 20 | 3.4 | <1 | 7.2 | <2 | 1.7 | 121 |
| CSIRO011 | 4 | 5 | T2 | 6 | <5 | 267 | 3.6 | 0.12 | 35 | 24 | 376 | 1.4 | 0.9 | 9.7 | 2.8 | 0.3 | 20 | 0.2 | 0.19 | 0.77 | 31 | 0.3 | 22 | 3.6 | <1 | 7.3 | <2 | 1.8 | 131 |
| CSIRO011 | 5 | 6 | T2 | 10 | <5 | 291 | 4.7 | 0.11 | 34 | 23 | 323 | 1.3 | 1.0 | 9.3 | 3.1 | <0.2 | 19 | 0.3 | 0.19 | 0.77 | <20 | 0.7 | 23 | 3.5 | <1 | 6.8 | <4 | 1.9 | 137 |
| CSIRO011 | 6 | 7 | T2 | 12 | <5 | 379 | 3.6 | 3.3 | 26 | 19 | 358 | 1.4 | 0.8 | 14 | 2.7 | <0.2 | 15 | 0.3 | 0.22 | 0.54 | 27 | 0.8 | 21 | 3.1 | <1 | 6.3 | <4.1 | 1.8 | 100 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSIRO011 | 7 | 8 | T2 | 13 | <5 | 674 | 4.2 | 5.2 | 27 | 17 | 288 | <1 | 0.9 | 11 | 2.7 | <0.2 | 15 | 0.2 | 0.29 | 0.44 | <20 | 0.8 | 23 | 3.1 | 1 | 5.4 | <4.2 | 1.9 | 108 |
| CSIRO011 | 8 | 9 | T3 | 21 | 13 | 454 | 2.0 | 0.51 | 44 | 27 | 482 | <1 | 1.0 | 23 | 3.9 | 0.3 | 20 | 0.4 | 0.17 | 0.38 | 28 | 2.4 | 30 | 4.0 | <1 | 9.4 | <2 | 2.6 | 116 |
| CSIRO011 | 9 | 10 | T3 | 20 | <5 | 444 | 7.4 | 0.062 | 20 | 15 | 567 | 2.4 | 0.8 | 19 | 5.1 | 0.3 | 12 | 0.3 | 0.11 | 0.47 | 29 | 1.7 | 29 | 2.3 | <1 | 12 | <2 | 2.1 | 114 |
| CSIRO011 | 10 | 11 | T3 | 21 | <5 | 366 | 4.4 | 0.044 | 16 | 11 | 602 | 1.1 | 0.6 | 25 | 5.2 | <0.2 | 9.9 | 0.2 | 0.078 | 0.39 | <20 | 2.6 | 33 | 2.0 | 1.1 | 13 | <5.7 | 1.7 | <100 |
| CSIRO011 | 11 | 12 | T3 | 28 | <5 | 803 | 4.6 | 0.047 | 27 | 17 | 688 | 2.8 | 0.9 | 31 | 4.5 | 0.4 | 17 | 0.2 | 0.086 | 0.37 | 43 | 4.4 | 24 | 3.3 | <1 | 14 | <2 | 1.7 | <100 |
| CSIRO011 | 12 | 13 | T3 | 26 | <5 | 674 | 5.2 | 0.040 | 34 | 31 | 570 | 2.0 | 1.1 | 34 | 4.4 | 0.3 | 21 | 0.3 | 0.11 | 0.42 | 43 | 4.6 | 18 | 4.2 | 1.0 | 12 | <2 | 2.2 | <100 |
| CSIRO011 | 13 | 14 | T3 | 16 | <5 | 393 | 5.8 | 0.13 | 12 | 11 | 381 | 1.6 | <0.5 | 21 | 4.8 | 0.3 | 7.4 | <0.2 | 0.17 | 0.65 | 33 | 2.0 | 15 | 1.7 | <1 | 8.9 | <2 | 1.4 | <100 |
| CSIRO011 | 14 | 15 | A1 | 11 | 35 | 539 | 4.3 | 0.037 | 6.9 | 3.3 | 368 | <1 | <0.5 | 18 | 6.4 | <0.2 | 3.2 | <0.2 | 0.080 | 0.39 | <20 | 2.0 | 15 | 0.9 | <1 | 14 | 8 | 1.7 | <100 |
| CSIRO011 | 15 | 16 | A1 | 4 | 8 | 146 | 5.3 | 0.046 | 8.5 | 3.6 | 358 | 1.4 | <0.5 | 8.4 | 5.7 | <0.2 | 20 | <0.2 | 0.11 | 0.62 | <20 | 1.2 | 18 | 0.9 | <1 | 7.1 | <2 | 1.0 | <100 |
| CSIRO011 | 16 | 17 | A1 | 2 | <5 | <100 | 5.2 | 0.11 | 5.3 | 3.2 | 178 | 1.6 | <0.5 | 2.9 | 5.5 | <0.2 | 5.4 | <0.2 | 0.16 | 0.63 | <20 | 0.8 | 18 | 0.6 | <1 | 5.3 | 8 | 1.0 | <100 |
| CSIRO011 | 17 | 18 | A1 | 8 | <5 | 155 | 5.4 | 0.053 | 4.9 | 3.4 | 850 | 1.2 | <0.5 | 21 | 4.6 | 0.2 | 10 | <0.2 | 0.10 | 0.55 | <20 | 1.1 | 15 | 0.7 | <1 | 6.9 | <2 | 0.8 | <100 |
| CSIRO011 | 18 | 19 | A1 | 1 | <5 | 243 | 6.4 | 0.032 | 5.7 | <1 | 116 | 1.8 | <0.5 | 2.0 | 6.4 | <0.2 | 4.3 | <0.2 | 0.12 | 0.88 | <20 | 1.2 | 17 | 0.8 | 1.0 | 5.7 | <2 | 1.2 | <100 |
| CSIRO011 | 19 | 20 | A1 | <1 | <5 | 500 | 5.7 | 0.033 | 6.3 | 1.6 | 183 | 3.6 | <0.5 | 3.5 | 6.0 | 0.2 | 3.9 | <0.2 | 0.12 | 1.0 | 30 | 1.2 | 19 | 0.7 | 1.1 | 5.5 | 8 | 1.2 | <100 |
| CSIRO012 | 0 | 1 | T1 | 6 | <5 | 194 | 8.4 | 0.31 | 29 | 15 | 368 | 2.0 | <0.5 | 7.5 | 3.4 | <0.2 | 16 | <0.2 | 0.11 | 0.15 | 26 | 0.6 | 15 | 2.7 | <1 | 7.7 | <2 | 1.4 | 106 |
| CSIRO012 | 1 | 2 | T1 | 6 | <5 | 364 | 8.6 | 6.9 | 31 | 16 | 237 | 1.9 | 0.6 | 5.4 | 2.7 | <0.2 | 18 | <0.2 | 0.27 | 0.47 | 33 | 0.4 | 15 | 3.0 | <1 | 7.0 | <2 | 1.4 | 119 |
| CSIRO012 | 2 | 3 | T1 | 7 | <5 | 291 | 3.4 | 1.5 | 27 | 21 | 336 | 1.2 | 0.8 | 10 | 3.1 | <0.2 | 16 | <0.2 | 0.15 | 0.78 | <20 | 0.3 | 20 | 3.0 | <1 | 6.2 | <2 | 1.5 | 120 |
| CSIRO012 | 3 | 4 | T2 | 5 | <5 | 223 | 3.4 | 1.8 | 35 | 22 | 274 | 1.8 | 0.9 | 6.6 | 2.8 | <0.2 | 22 | 0.2 | 0.23 | 0.81 | 28 | 0.3 | 18 | 3.7 | <1 | 6.5 | <2 | 1.6 | 128 |
| CSIRO012 | 4 | 5 | T2 | 9 | <5 | 1980 | 4.8 | 0.50 | 34 | 26 | 354 | 1.6 | 0.8 | 10 | 2.9 | <0.2 | 20 | 0.2 | 0.21 | 0.78 | 28 | 0.4 | 23 | 3.6 | 1.1 | 7.5 | <2 | 1.9 | 144 |
| CSIRO012 | 5 | 6 | T2 | 8 | <5 | 123 | 6.7 | 5.9 | 28 | 18 | 202 | <1 | 0.7 | 6.3 | 2.3 | <0.2 | 16 | <0.2 | 0.31 | 0.61 | 28 | 0.4 | 17 | 3.0 | <1 | 5.7 | <2 | 1.5 | 118 |
| CSIRO012 | 6 | 7 | T2 | 17 | <5 | 868 | 6.6 | 4.6 | 25 | 21 | 346 | <1 | 1.0 | 15 | 2.9 | <0.2 | 18 | 0.2 | 0.27 | 0.48 | <20 | 0.9 | 24 | 3.5 | <1 | 5.4 | <2 | 1.8 | 100 |
| CSIRO012 | 7 | 8 | T2 | 17 | <5 | 868 | 6.6 | 0.38 | 25 | 21 | 346 | <1 | 1.0 | 15 | 2.9 | <0.2 | 18 | 0.2 | 0.19 | 0.48 | <20 | 0.9 | 24 | 3.5 | <1 | 5.4 | <2 | 1.8 | 100 |
| CSIRO012 | 8 | 9 | A1 | 5 | 14 | 750 | 8.0 | 1.6 | 14 | 9.9 | 227 | 1.8 | <0.5 | 7.8 | 3.3 | <0.2 | 9.3 | <0.2 | 0.19 | 0.70 | 25 | 0.6 | 18 | 1.7 | <1 | 6.0 | <2 | 1.0 | <100 |
| CSIRO012 | 9 | 10 | A1 | 6 | 22 | 302 | 4.8 | 2.8 | 12 | 6.1 | 280 | <1 | <0.5 | 11 | 3.6 | <0.2 | 6.4 | <0.2 | 0.21 | 0.57 | <20 | 0.9 | 13 | 1.6 | <1 | 4.9 | <2 | 1.0 | <100 |
| CSIRO012 | 10 | 11 | A1 | 3 | 8 | 321 | 3.8 | 2.2 | 12 | 5.3 | 138 | <1 | <0.5 | 4.1 | 3.6 | <0.2 | 5.9 | <0.2 | 0.16 | 0.71 | <20 | 0.7 | 13 | 1.4 | <1 | 4.8 | <2 | 1.0 | <100 |
| CSIRO012 | 11 | 12 | A1 | 6 | 9 | 262 | 3.9 | 0.14 | 7.2 | 6.4 | 255 | 1.8 | <0.5 | 9.4 | 4.4 | <0.2 | 2.8 | <0.2 | 0.068 | 0.66 | <20 | 0.7 | 13 | 1.0 | <1 | 4.5 | <2 | 0.8 | <100 |
| CSIRO012 | 12 | 13 | A1 | 3 | 17 | 107 | 4.8 | 0.046 | 8.7 | 6.8 | 235 | 1.5 | <0.5 | 7.6 | 5.3 | <0.2 | 2.8 | <0.2 | 0.090 | 0.74 | <20 | 0.9 | 15 | 0.9 | <1 | 5.5 | <2 | 1.2 | <100 |
| CSIRO012 | 13 | 14 | A1 | 2 | 23 | <100 | 4.7 | 0.060 | 6.2 | 1.9 | 185 | 1.7 | <0.5 | 3.2 | 5.3 | <0.2 | 2.6 | <0.2 | 0.12 | 0.75 | <20 | 0.9 | 18 | 0.8 | <1 | 5.6 | <2 | 1.3 | <100 |
| CSIRO012 | 14 | 15 | A1 | 3 | 7 | <100 | 5.7 | 0.12 | 8.2 | 2.9 | 256 | 1.4 | <0.5 | 5.1 | 4.8 | <0.2 | 4.1 | <0.2 | 0.12 | 0.72 | <20 | 0.5 | 18 | 1.0 | <1 | 5.8 | <2 | 1.2 | <100 |
| CSIRO012 | 15 | 16 | A1 | 2 | <5 | 194 | 5.1 | 0.078 | 6.4 | 3.0 | 251 | 1.4 | <0.5 | 5.3 | 4.8 | <0.2 | 3.7 | <0.2 | 0.10 | 0.62 | <20 | 0.4 | 18 | 0.8 | <1 | 6.2 | <2 | 1.2 | <100 |
| CSIRO012 | 16 | 17 | A1 | 2 | <5 | 267 | 5.3 | 0.065 | 8.1 | 3.8 | 207 | <1 | <0.5 | 3.6 | 4.4 | <0.2 | 4.6 | <0.2 | 0.10 | 0.62 | <20 | 0.2 | 17 | 1.0 | <1 | 5.8 | <2 | 1.0 | <100 |
| CSIRO012 | 17 | 18 | A1 | <1 | <5 | 128 | 4.7 | 0.040 | 7.1 | 2.4 | 250 | <1 | <0.5 | 3.5 | 4.1 | <0.2 | 3.4 | <0.2 | 0.080 | 0.64 | <20 | 0.3 | 18 | 0.8 | <1 | 5.7 | <2 | 1.1 | <100 |
| CSIRO012 | 18 | 19 | A2 | 1 | <5 | 153 | 3.8 | 0.072 | 5.8 | 3.4 | 327 | <1 | <0.5 | 4.4 | 4.1 | <0.2 | 2.9 | <0.2 | 0.066 | 0.62 | <20 | 0.2 | 18 | 0.7 | <1 | 5.4 | <2 | 1.0 | <100 |
| CSIRO012 | 19 | 20 | A2 | 3 | <5 | <100 | 3.7 | 0.020 | 7.9 | 6.9 | 270 | <1 | <0.5 | 7.1 | 4.2 | <0.2 | 2.2 | <0.2 | 0.059 | 0.61 | <20 | 0.5 | 20 | 0.7 | <1 | 6.0 | <2 | 0.9 | <100 |
| GDA015 | 7 | 8 | T3 | 11 | 14 | 195 | 5.4 | nd | 36 | 24 | 348 | 1.1 | 1.3 | 12 | 3.6 | 0.6 | 23 | 0.3 | nd | 0.82 | 37 | 1.0 | 25 | 4.2 | <1 | 7.8 | <2 | 2.3 | 115 |
| GDA015 | 12 | 13 | T3 | 25 | 21 | 335 | 4.1 | nd | 35 | 15 | 644 | 2.7 | 0.8 | 26 | 6.3 | <0.2 | 20 | 0.3 | nd | 0.55 | <20 | 3.1 | 35 | 3.8 | <1 | 16 | <2 | 2.2 | 107 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GDA015 | 13 | 14 | A1 | 23 | <5 | 293 | 4.4 | nd | 29 | 12 | 620 | 2.4 | 1.1 | 26 | 6.2 | 0.5 | 19 | 0.3 | nd | 0.66 | 28 | 2.9 | 36 | 3.9 | 2.5 | 17 | <2 | 2.5 | 109 |
| GDA015 | 14 | 15 | A1 | 9 | 28 | 149 | 6.6 | nd | 15 | 5.9 | 339 | 1.2 | <0.5 | 11 | 6.8 | <0.2 | 9.9 | 0.2 | nd | 0.90 | <20 | 1.4 | 26 | 1.8 | 1.1 | 12 | <2 | 1.7 | 102 |
| GDA015 | 15 | 16 | A1 | 12 | 44 | <100 | 6.2 | nd | 13 | 8.0 | 404 | 1.2 | <0.5 | 15 | 7.0 | <0.2 | 6.5 | <0.2 | nd | 0.78 | <20 | 1.9 | 22 | 1.3 | 1.2 | 10 | <2 | 1.5 | <100 |
| GDA015 | 16 | 17 | A1 | 7 | 9 | 103 | 6.1 | nd | 10 | 7.6 | 333 | <1 | <0.5 | 11 | 6.7 | <0.2 | 5.2 | 0.3 | nd | 0.83 | <20 | 1.5 | 20 | 1.3 | 2.1 | 9.4 | 4 | 2.1 | <100 |
| GDA015 | 19 | 20 | A1 | 12 | <5 | 1460 | 8.1 | nd | 242 | 8.8 | 161 | 2.7 | 3.6 | 11 | 7.0 | 0.6 | 132 | 0.3 | nd | 1.0 | <20 | 4.0 | 12 | 17 | <1 | 11 | 19 | 2.1 | <100 |
| GDA015 | 22 | 23 | A1 | 5 | 133 | 2740 | 6.3 | nd | 257 | 3.5 | 76 | 1.2 | 3.5 | 6.3 | 5.4 | <0.2 | 136 | 0.3 | nd | 0.79 | 32 | 2.9 | 7 | 17 | <1 | 11 | 16 | 2.2 | <100 |
| GDA015 | 25 | 26 | A1 | 6 | 18 | 1820 | 7.1 | nd | 260 | <1 | 94 | <1 | 3.6 | 7.7 | 5.3 | 0.6 | 140 | 0.5 | nd | 2.5 | <20 | 2.8 | 7 | 18 | 1.9 | 12 | 7 | 3.3 | <100 |
| GDA015 | 31 | 32 | A2 | 4 | <5 | 1050 | 2.3 | nd | 247 | 43 | 57 | 8.0 | 5.6 | 5.8 | 4.9 | 1.5 | 103 | 0.4 | nd | 4.6 | 147 | 1.6 | 11 | 23 | 3.0 | 17 | 6 | 3.2 | 270 |
| GDA015 | 37 | 38 | A2 | 7 | 15 | 918 | 2.3 | nd | 233 | 81 | 62 | 7.1 | 4.3 | 6.2 | 4.1 | 1.5 | 99 | 0.4 | nd | 4.7 | 142 | 1.1 | 12 | 18 | 3.5 | 12 | <2 | 2.6 | 254 |
| GDRC035 | 7 | 8 | T2 | 8 | 9 | 164 | 4.3 | nd | 31 | 22 | 249 | 1.4 | 0.9 | 6.9 | 3.0 | <0.2 | 20 | 0.2 | nd | 0.92 | 25 | 0.7 | 19 | 3.5 | 1.1 | 6.6 | <2 | 2.0 | 106 |
| GDRC035 | 15 | 16 | T3 | 30 | 77 | 284 | 5.0 | nd | 16 | 12 | 623 | 1.7 | 0.5 | 28 | 5.2 | 0.4 | 12 | 0.3 | nd | 0.70 | 29 | 2.8 | 41 | 2.6 | 1.1 | 9.9 | <2 | 2.1 | 136 |
| GDRC035 | 17 | 18 | T3 | 35 | 70 | 273 | 4.3 | nd | 35 | 18 | 751 | <1 | 0.6 | 36 | 5.4 | <0.2 | 19 | 0.3 | nd | 0.53 | <20 | 3.3 | 43 | 4.1 | 1.3 | 16 | <2 | 2.7 | <100 |
| GDRC035 | 18 | 19 | A1 | 18 | 24 | 234 | 5.2 | nd | 20 | 18 | 437 | 2.4 | 0.8 | 18 | 5.8 | <0.2 | 12 | 0.3 | nd | 0.90 | 25 | 1.8 | 33 | 2.7 | 1.5 | 14 | <2 | 2.0 | 103 |
| GDRC035 | 19 | 20 | A1 | 14 | 17 | <100 | 6.1 | nd | 8.7 | 12 | 345 | <1 | <0.5 | 13 | 7.1 | <0.2 | 6.3 | 0.2 | nd | 0.79 | <20 | 1.4 | 29 | 1.4 | 1.0 | 11 | <2 | 1.6 | <100 |
| GDRC035 | 20 | 21 | A1 | 11 | 15 | 125 | 10.4 | nd | 5.0 | 9.2 | 315 | 1.2 | <0.5 | 12 | 7.2 | <0.2 | 4.3 | 0.2 | nd | 1.1 | <20 | 1.3 | 27 | 1.0 | 1.5 | 10 | 3 | 2.0 | 119 |
| GDRC035 | 21 | 22 | A1 | 27 | 57 | 129 | 6.4 | nd | 10 | 12 | 360 | 1.1 | <0.5 | 23 | 5.4 | <0.2 | 5.1 | 0.3 | nd | 0.82 | 24 | 2.6 | 24 | 1.5 | 1.6 | 11 | 2 | 1.8 | <100 |
| GDRC035 | 24 | 25 | A1 | 4 | 23 | <100 | 5.0 | nd | 5.0 | 9.5 | 207 | <1 | <0.5 | 5.0 | 7.8 | <0.2 | 2.2 | 0.3 | nd | 0.95 | <20 | 1.0 | 20 | 0.8 | 1.1 | 7.8 | <2 | 1.8 | <100 |
| GDRC035 | 27 | 28 | A1 | 14 | 51 | 165 | 4.0 | nd | 11 | 7.8 | 238 | <1 | <0.5 | 14 | 7.7 | <0.2 | 6.1 | 0.3 | nd | 0.86 | <20 | 2.5 | 18 | 1.5 | 1.7 | 10 | 9 | 1.7 | <100 |
| GDRC035 | 33 | 34 | A1 | 5 | 446 | 718 | 4.1 | nd | 99 | 4.4 | 59 | 2.0 | 2.0 | 8.5 | 10.1 | 0.9 | 52 | 0.4 | nd | 1.3 | 75 | 2.9 | 10 | 7.0 | 5.0 | 26 | 35 | 2.4 | <100 |
| GDRC035 | 39 | 40 | A1 | 3 | 435 | 1950 | 5.3 | nd | 83 | 4.9 | 66 | 2.1 | 1.2 | 2.9 | 7.7 | <0.2 | 48 | 0.2 | nd | 1.7 | 36 | 1.9 | 14 | 5.8 | 2.4 | 19 | 24 | 1.8 | <100 |
| GDRC035 | 45 | 46 | A1 | 5 | 76 | 237 | 4.3 | nd | 117 | 3.3 | 239 | 1.2 | 2.1 | 5.7 | 13.4 | <0.2 | 60 | 0.4 | nd | 0.76 | <20 | 7.9 | 15 | 8.9 | 4.2 | 20 | 125 | 2.8 | <100 |
| GDRC035 | 51 | 52 | A2 | 2 | <5 | 227 | 4.0 | nd | 20 | 17 | 175 | 3.7 | <0.5 | 5.8 | 3.4 | 0.6 | 6.7 | <0.2 | nd | 1.2 | 39 | 0.8 | 28 | 1.5 | <1 | 4.2 | 4 | 1.4 | 233 |
| GDRC035 | 58 | 59 | A2 | 1 | <5 | 1310 | 6.7 | nd | 90 | 63 | 32 | 10.5 | 3.2 | 3.5 | 3.7 | 1.2 | 110 | 0.5 | nd | 1.7 | 84 | 0.7 | 9 | 15 | <1 | 3.7 | <2 | 3.7 | 169 |
| GDRC040 | 7 | 8 | T3 | 9 | <5 | 261 | 2.5 | nd | 31 | 26 | 373 | 1.2 | 1.1 | 12 | 3.2 | 0.5 | 21 | 0.3 | nd | 0.81 | 29 | 0.9 | 25 | 4.0 | 1.3 | 7.8 | <2 | 2.0 | 140 |
| GDRC040 | 15 | 16 | T3 | 27 | 58 | 203 | 3.6 | nd | 31 | 12 | 627 | 1.5 | 1.0 | 29 | 5.8 | <0.2 | 19 | 0.3 | nd | 0.53 | 24 | 3.1 | 37 | 3.8 | 1.1 | 16 | <2 | 2.3 | 119 |
| GDRC040 | 16 | 17 | T3 | 18 | 54 | 184 | 5.6 | nd | 18 | 11 | 503 | 1.7 | 0.7 | 20 | 6.4 | <0.2 | 13 | 0.3 | nd | 0.68 | 36 | 2.1 | 31 | 2.6 | <1 | 13 | <2 | 2.0 | 104 |
| GDRC040 | 17 | 18 | A1 | 13 | 29 | 198 | 2.5 | nd | 9.2 | 8.7 | 383 | <1 | <0.5 | 14 | 7.0 | <0.2 | 6.4 | 0.3 | nd | 0.67 | <20 | 1.5 | 24 | 1.5 | 1.2 | 11 | 4 | 1.9 | 110 |
| GDRC040 | 18 | 19 | A1 | 4 | 39 | <100 | 3.3 | nd | 6.2 | 6.3 | 191 | 1.1 | <0.5 | 4.6 | 5.9 | <0.2 | 2.8 | 0.3 | nd | 0.71 | <20 | 1.0 | 19 | 0.9 | 1.9 | 8.2 | <2 | 1.8 | <100 |
| GDRC040 | 19 | 20 | A1 | 9 | 26 | 127 | 4.2 | nd | 5.7 | 7.2 | 272 | <1 | <0.5 | 8.4 | 7.6 | <0.2 | 3.2 | 0.3 | nd | 0.92 | 34 | 1.5 | 23 | 0.9 | 1.6 | 9.8 | 3 | 1.6 | <100 |
| GDRC040 | 20 | 21 | A1 | 8 | 24 | 154 | 9.9 | nd | 11 | 8.1 | 247 | 1.1 | <0.5 | 6.4 | 6.9 | <0.2 | 5.1 | 0.3 | nd | 1.3 | <20 | 1.7 | 21 | 1.2 | 1.3 | 9.2 | 6 | 2.0 | <100 |
| GDRC040 | 23 | 24 | A1 | 9 | 25 | 530 | 3.9 | nd | 20 | 3.9 | 182 | 2.4 | 0.7 | 10 | 4.3 | 0.3 | 16 | <0.2 | nd | 0.70 | 34 | 1.6 | 14 | 1.4 | 1.0 | 4.6 | 13 | 0.9 | 110 |
| GDRC040 | 26 | 27 | A1 | 4 | 135 | 416 | 5.7 | nd | 38 | 3.8 | 88 | 4.7 | <0.5 | 4.9 | 2.3 | 1.0 | 24 | <0.2 | nd | 0.71 | 46 | 1.1 | 12 | 2.0 | 1.0 | 3.6 | 20 | 0.9 | <100 |
| GDRC040 | 32 | 33 | A1 | 7 | 24 | 992 | 9.3 | nd | 119 | 7.0 | 161 | 3.6 | 1.5 | 7.3 | 3.4 | 1.0 | 41 | 0.2 | nd | 1.5 | 57 | 5.0 | 17 | 6.1 | 1.2 | 5.3 | 41 | 1.7 | 107 |
| GDRC040 | 38 | 39 | A2 | 6 | 5 | 407 | 4.6 | nd | 170 | 863 | 149 | 5.9 | 2.4 | 6.0 | 3.8 | 1.6 | 60 | 0.4 | nd | 3.4 | 154 | 3.6 | 38 | 10 | <1 | 4.0 | 31 | 3.0 | 109 |
| GDRC040 | 44 | 45 | A3 | 4 | 223 | 340 | 3.1 | nd | 47 | 38 | 195 | 2.7 | 1.5 | 6.1 | 2.5 | 0.7 | 25 | 0.3 | nd | 3.1 | 32 | 1.6 | 35 | 4.7 | <1 | 2.8 | 14 | 2.1 | 200 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GDRC040 | 50 | 51 | A4 | 3 | 34 | 174 | 2.6 | nd | 38 | 43 | 184 | 2.4 | 1.0 | 6.3 | 2.2 | 0.4 | 20 | 0.3 | nd | 3.0 | 33 | 1.0 | 34 | 4.0 | <1 | 2.8 | 5 | 2.1 | 195 |
| GDRC040 | 56 | 57 | A4 | 7 | 193 | 332 | 4.0 | nd | 35 | 28 | 202 | 2.8 | <0.5 | 6.9 | 2.5 | 1.6 | 18 | 0.3 | nd | 3.0 | 100 | 2.4 | 27 | 3.4 | 1.9 | 4.2 | 44 | 1.8 | 158 |
| RCSD2 | 25 | 27 | A1 | 4 | 689 | 1240 | <2 | nd | 89 | 9.5 | 50 | 5.3 | 1.9 | 4.5 | 4.3 | 3.3 | 49 | 0.2 | nd | 2.4 | 136 | 3.1 | 9 | 6.5 | 2.6 | 11 | 53 | 1.7 | 102 |
| RCSD2 | 26 | 27 | A1 | 4 | 1160 | 1160 | 2.7 | nd | 112 | 12 | 52 | 5.7 | 2.0 | 5.6 | 5.4 | 3.6 | 61 | 0.3 | nd | 3.0 | 177 | 3.1 | 10 | 7.8 | 1.5 | 13 | 48 | 2.0 | <100 |
| RCSD2 | 29 | 31 | A2 | 1 | 27900 | 1520 | <2 | nd | 256 | 19 | 19 | 3.1 | 4.6 | 4.4 | 4.6 | 5.6 | 131 | 0.3 | nd | 2.6 | 204 | 2.5 | 7 | 21 | 1.8 | 17 | 57 | 2.4 | 134 |
| RCSD2 | 30 | 31 | A2 | 5 | 326 | 1400 | 3.0 | nd | 235 | 30 | 14 | 4.3 | 3.4 | 4.5 | 4.8 | 4.5 | 104 | 0.4 | nd | 2.8 | 251 | 2.4 | 7 | 16 | 2.8 | 18 | 50 | 2.5 | 177 |
| RCSD2 | 31 | 33 | A2 | 3 | 1910 | 1440 | <2 | nd | 217 | 47 | 12 | 3.1 | 3.8 | 4.3 | 5.1 | 4.9 | 108 | 0.3 | nd | 2.6 | 175 | 3.0 | 7 | 16 | 2.5 | 17 | 69 | 2.1 | 157 |
| RCSD2 | 33 | 35 | A2 | 6 | 804 | 1140 | <2 | nd | 213 | 25 | 30 | 3.2 | 4.0 | 4.4 | 4.4 | 4.5 | 100 | 0.2 | nd | 2.0 | 170 | 3.9 | 8 | 16 | <1 | 15 | 53 | 1.7 | 165 |
| RCSD2 | 35 | 37 | A2 | 5 | 5950 | 1400 | <2 | nd | 225 | 45 | 44 | 2.2 | 4.5 | 4.7 | 4.3 | 4.5 | 105 | 0.2 | nd | 3.1 | 149 | 3.6 | 8 | 18 | 3.2 | 15 | 67 | 1.8 | 178 |
| RCSD2 | 37 | 39 | A2 | 5 | 5780 | 1180 | <2 | nd | 219 | 24 | 29 | 4.0 | 3.6 | 4.5 | 4.4 | 4.8 | 102 | 0.2 | nd | 2.4 | 142 | 3.2 | 8 | 17 | 2.5 | 16 | 73 | 1.7 | 171 |
| RCSD2 | 39 | 41 | A2 | 5 | 4200 | 1260 | <2 | nd | 229 | 49 | 51 | 4.3 | 4.4 | 4.4 | 4.9 | 4.6 | 107 | 0.2 | nd | 2.8 | 219 | 2.9 | 9 | 18 | <1 | 18 | 52 | 1.6 | 183 |
| RCSD2 | 41 | 43 | A2 | 5 | 759 | 1130 | <2 | nd | 226 | 37 | 33 | 2.8 | 4.1 | 4.5 | 4.2 | 4.9 | 104 | 0.2 | nd | 2.5 | 196 | 3.1 | 8 | 17 | 2.5 | 15 | 74 | 1.8 | 174 |
| RCSD2 | 43 | 45 | A2 | 5 | 4750 | 1610 | <2 | nd | 232 | 40 | 36 | 3.4 | 3.9 | 4.8 | 4.6 | 5.9 | 109 | 0.2 | nd | 2.2 | 182 | 3.4 | 8 | 18 | 2.0 | 15 | 83 | 1.7 | 156 |
| RCSD2 | 44 | 45 | A2 | 6 | 2820 | 1680 | 2.1 | nd | 272 | 36 | 27 | 2.8 | 3.9 | 5.0 | 4.9 | 5.0 | 115 | 0.2 | nd | 2.6 | 192 | 3.2 | 9 | 19 | <1 | 16 | 82 | 1.9 | 148 |

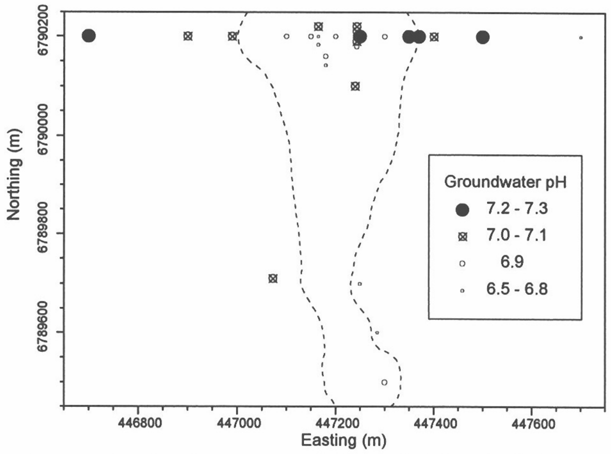


Figure A5.1: Groundwater pH at Golden Delicious.

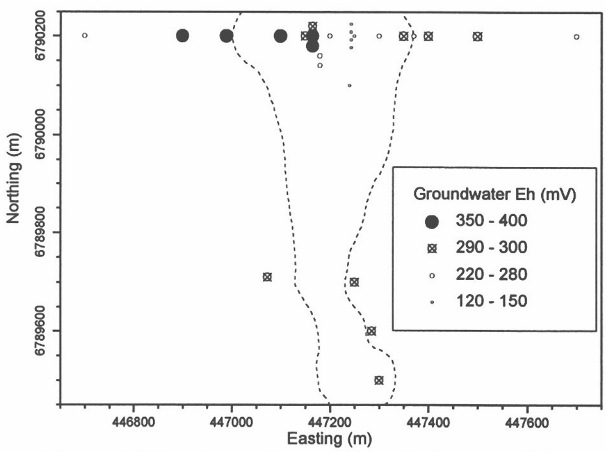


Figure A5.2: Groundwater Eh at Golden Delicious.

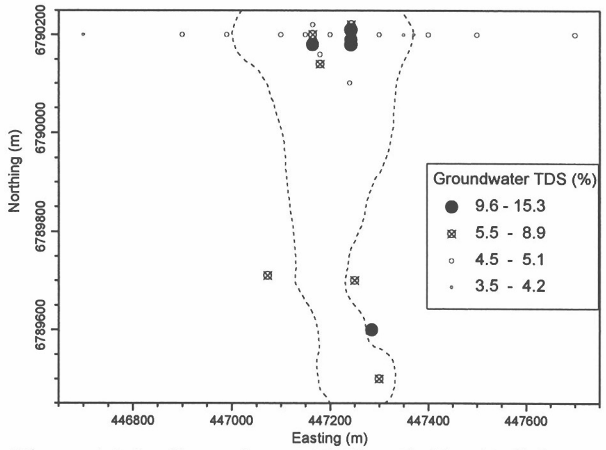


Figure A5.3: Groundwater TDS at Golden Delicious.

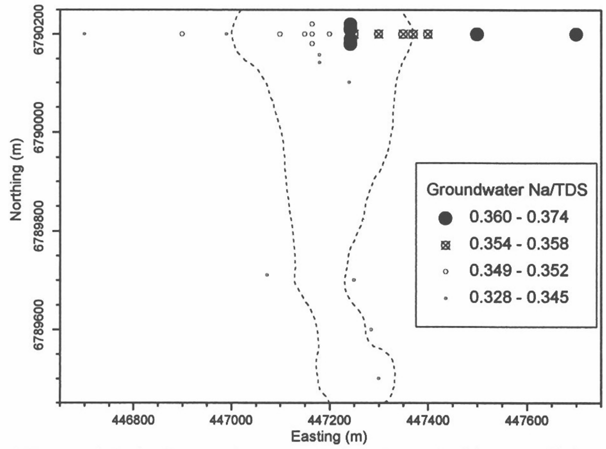


Figure A5.4: Groundwater Na/TDS at Golden Delicious.

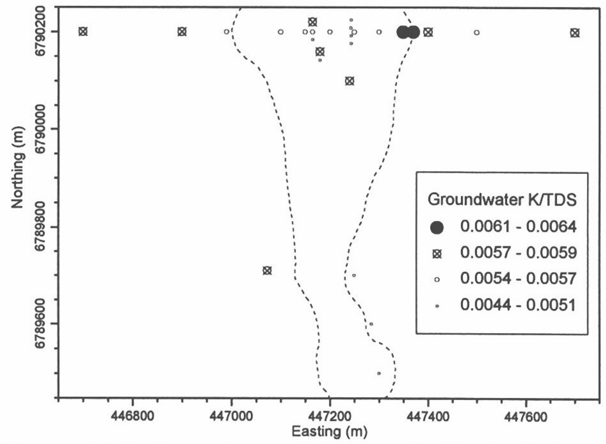


Figure A5.5: Groundwater K/TDS at Golden Delicious.

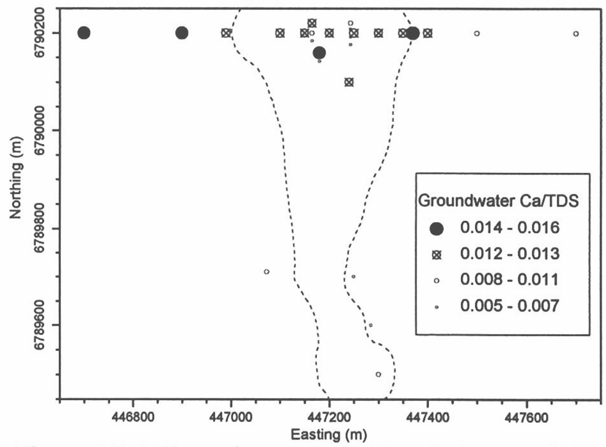


Figure A5.6: Groundwater Ca/TDS at Golden Delicious.

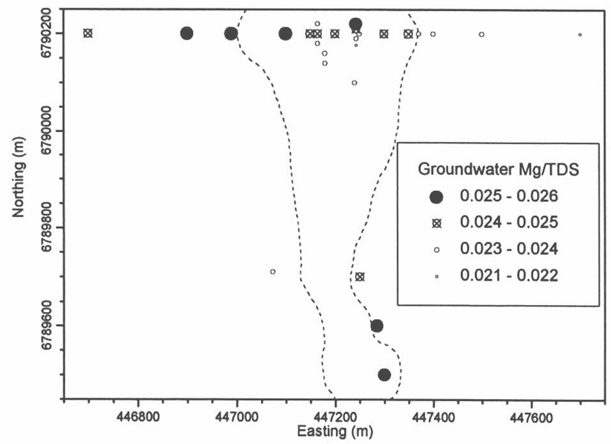


Figure A5.7: Groundwater Mg/TDS at Golden Delicious.

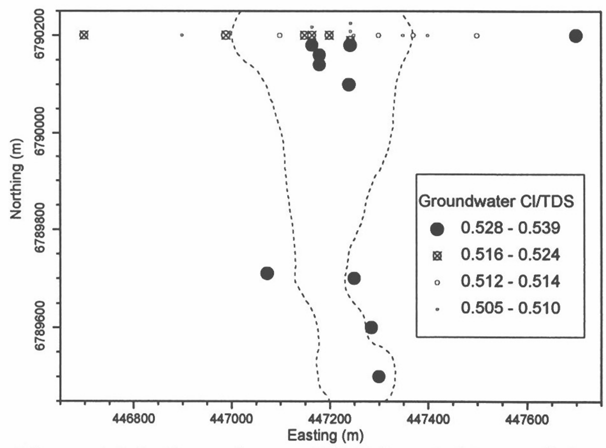


Figure A5.8: Groundwater Cl/TDS at Golden Delicious.

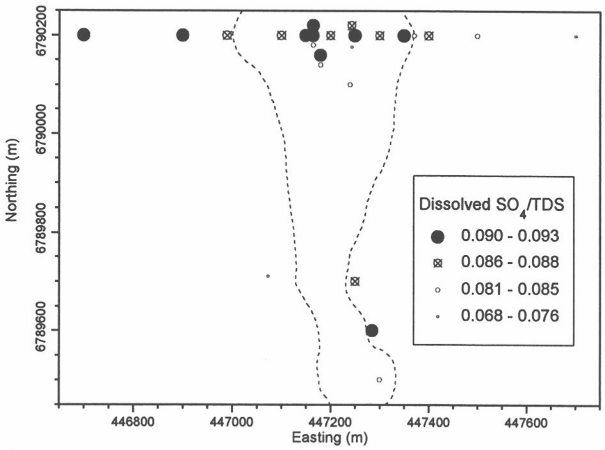


Figure A5.9: Groundwater SO$_4$/TDS at Golden Delicious.

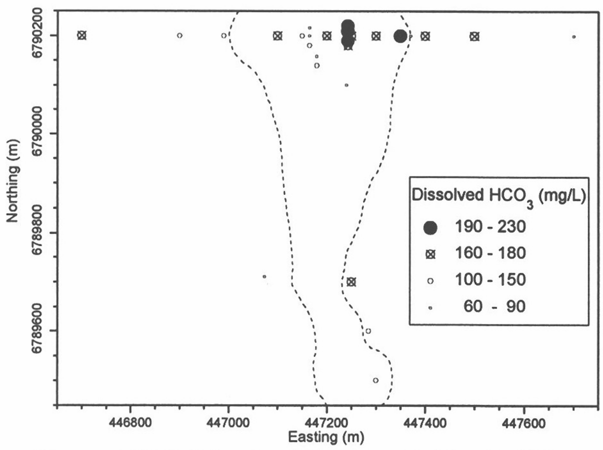


Figure A5.10: Dissolved HCO$_3$ at Golden Delicious.

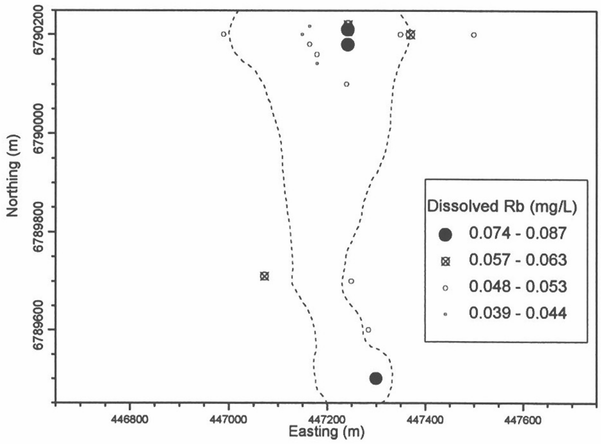


Figure A5.11: Dissolved Rb at Golden Delicious.

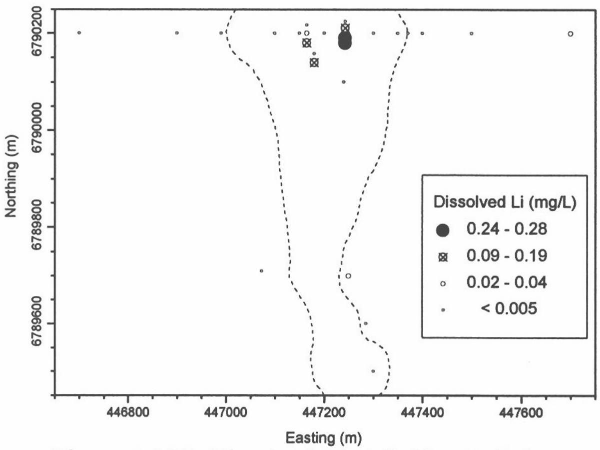


Figure A5.12: Dissolved Li at Golden Delicious.

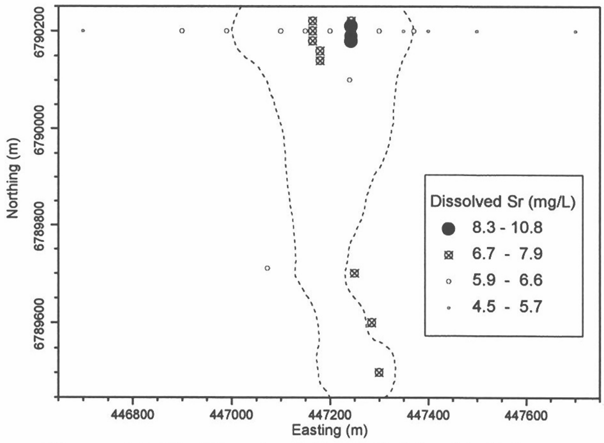


Figure A5.13: Dissolved Sr at Golden Delicious.

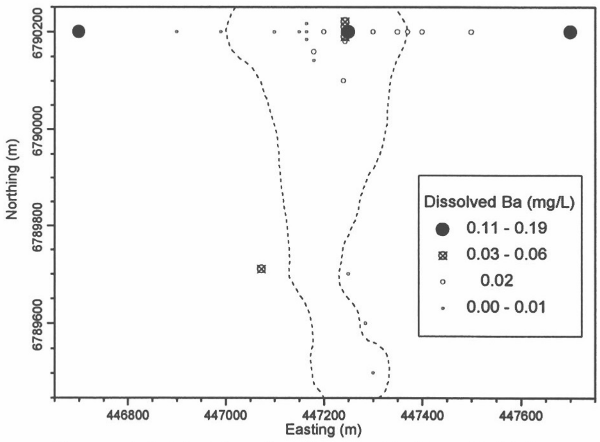


Figure A5.14: Dissolved Ba at Golden Delicious.

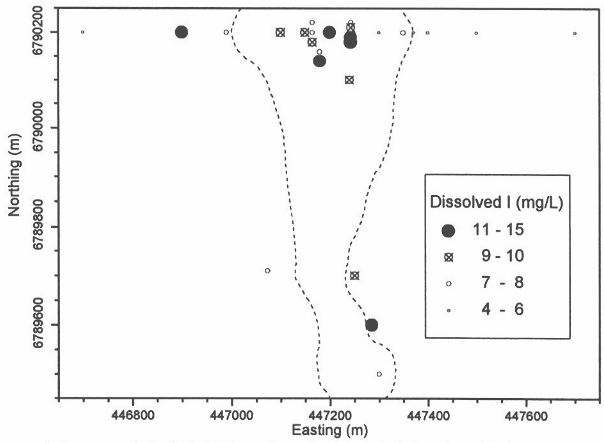


Figure A5.15: Dissolved I at Golden Delicious.

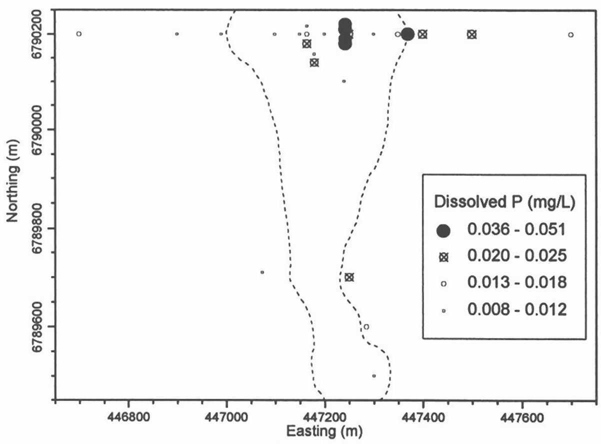


Figure A5.16: Dissolved P at Golden Delicious.

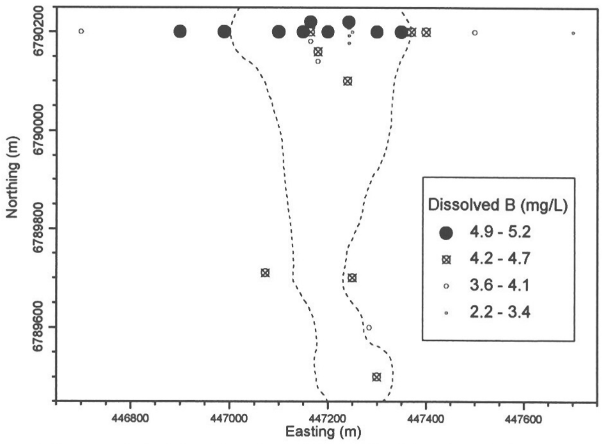


Figure A5.17: Dissolved B at Golden Delicious.

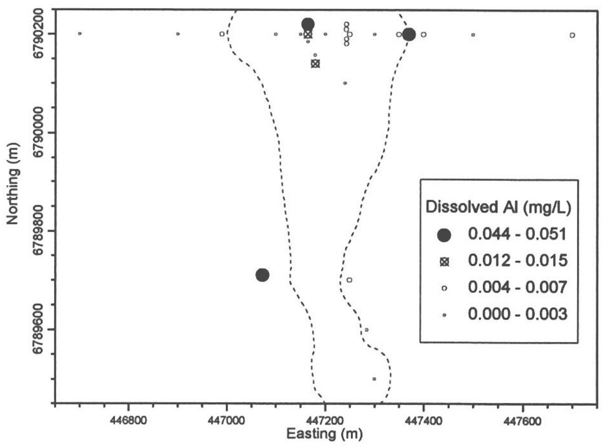


Figure A5.18: Dissolved Al at Golden Delicious.

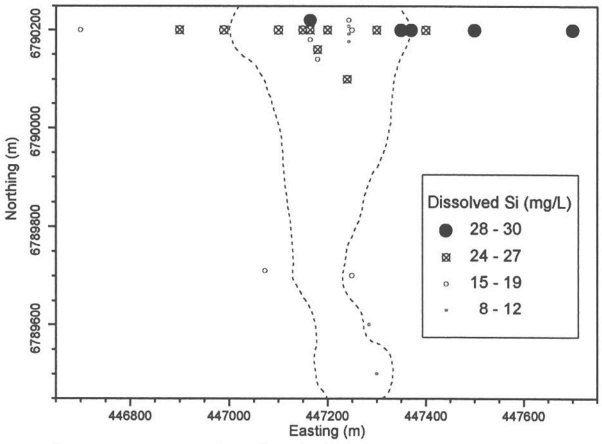


Figure A5.19: Dissolved Si at Golden Delicious.

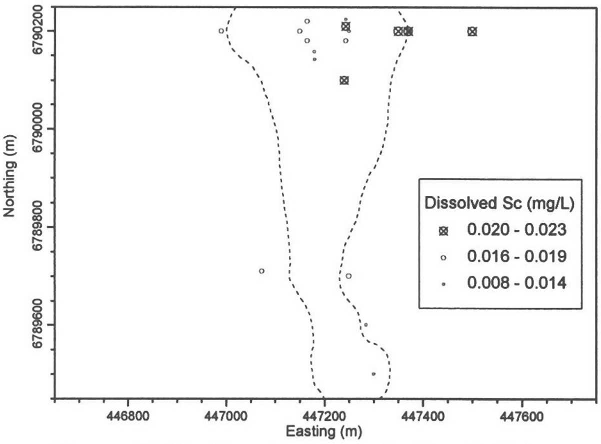


Figure A5.20: Dissolved Sc at Golden Delicious.

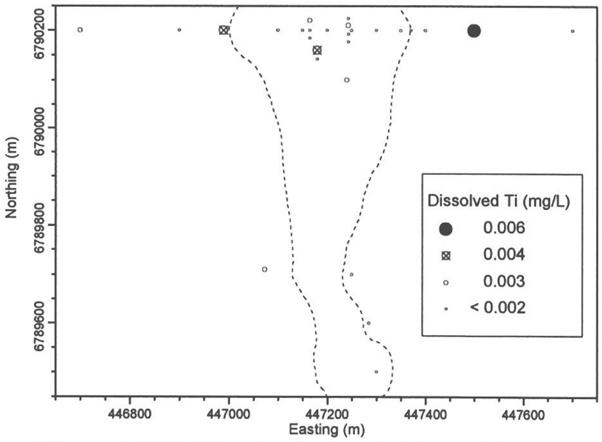


Figure A5.21: Dissolved Ti at Golden Delicious.

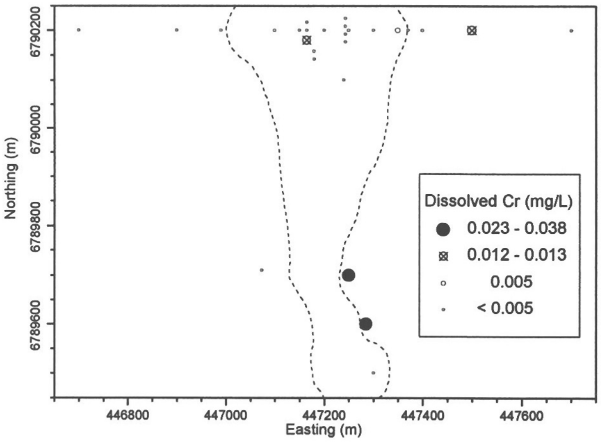


Figure A5.22: Dissolved Cr at Golden Delicious.

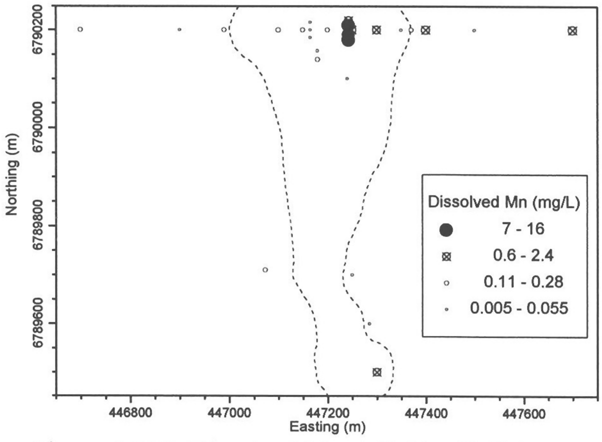


Figure A5.23: Dissolved Mn at Golden Delicious.

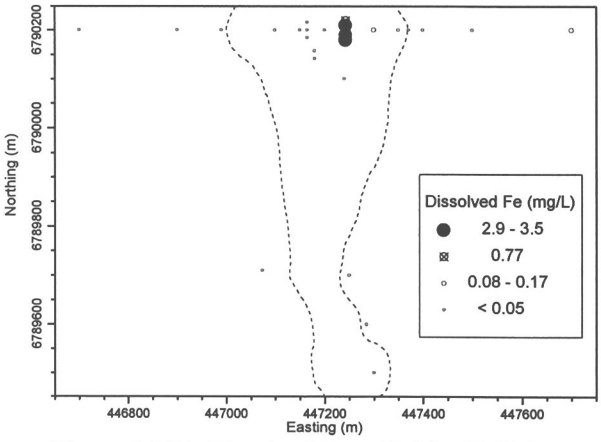


Figure A5.24: Dissolved Fe at Golden Delicious.

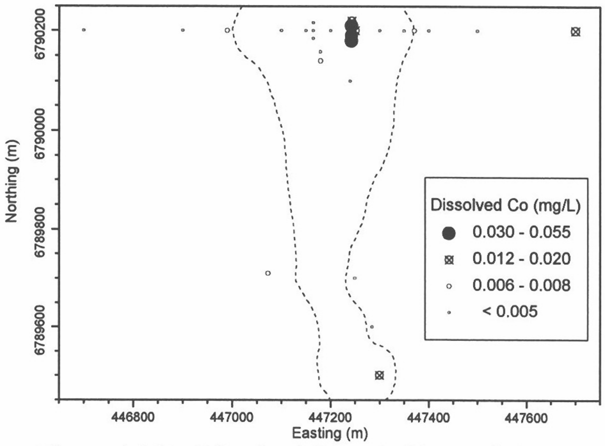


Figure A5.25: Dissolved Co at Golden Delicious.

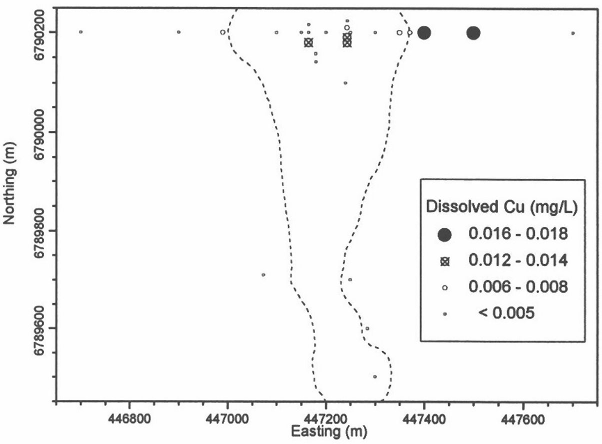


Figure A5.26: Dissolved Cu at Golden Delicious.

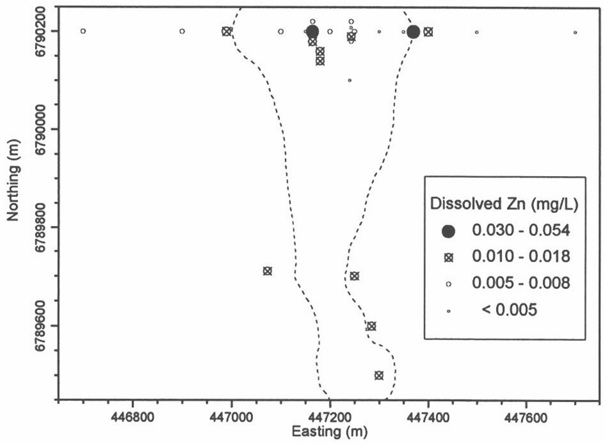


Figure A5.27: Dissolved Zn at Golden Delicious.

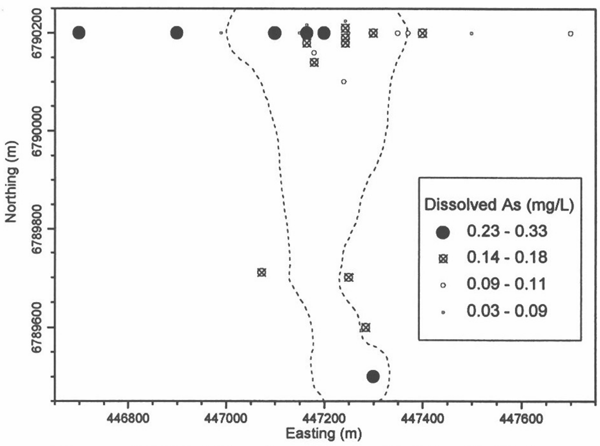


Figure A5.28: Dissolved As at Golden Delicious.

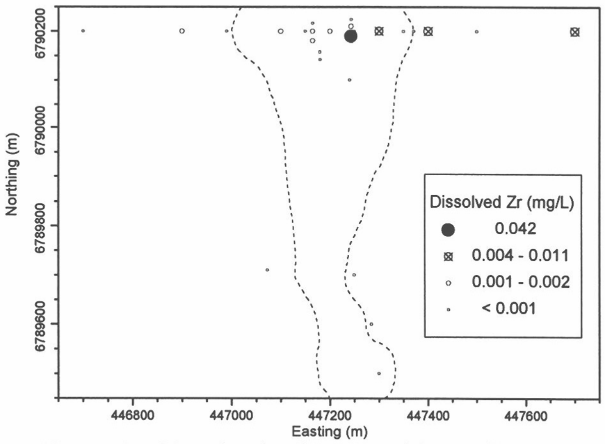


Figure A5.29: Dissolved Zr at Golden Delicious.

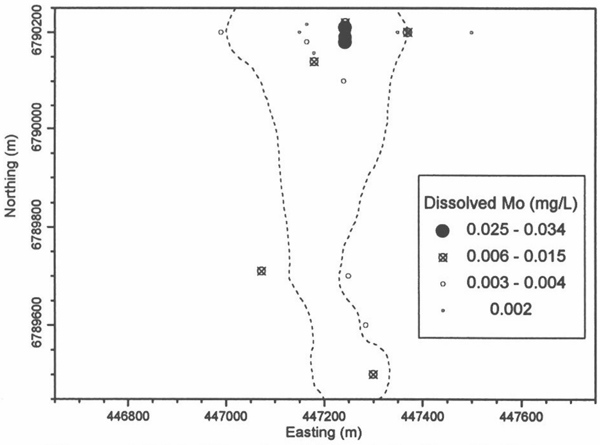


Figure A5.30: Dissolved Mo at Golden Delicious.

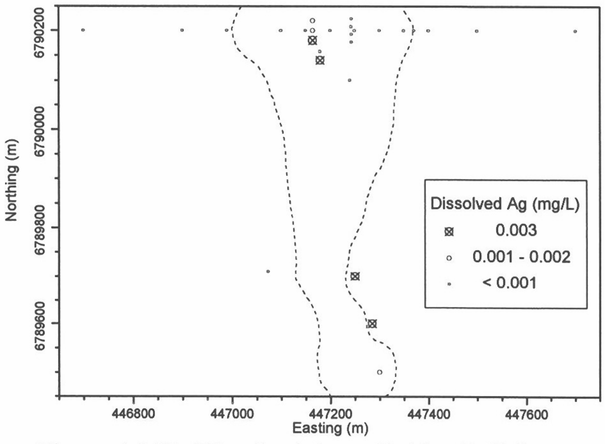


Figure A5.31: Dissolved Ag at Golden Delicious.

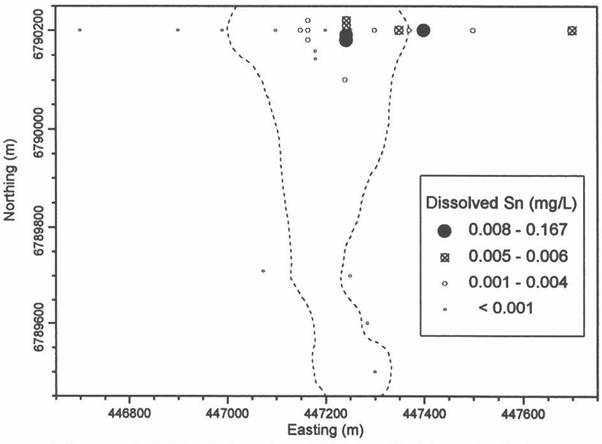


Figure A5.32: Dissolved Sn at Golden Delicious.

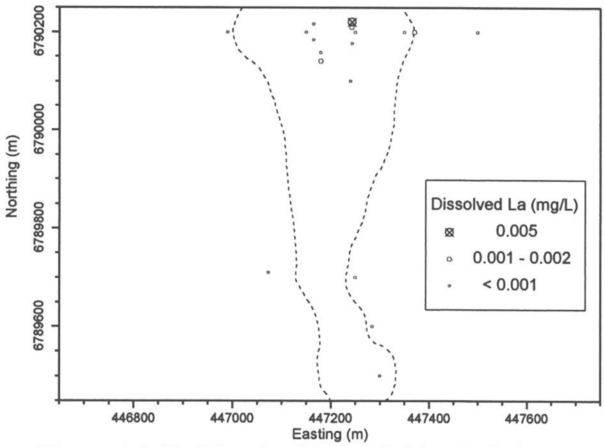


Figure A5.33: Dissolved La at Golden Delicious.

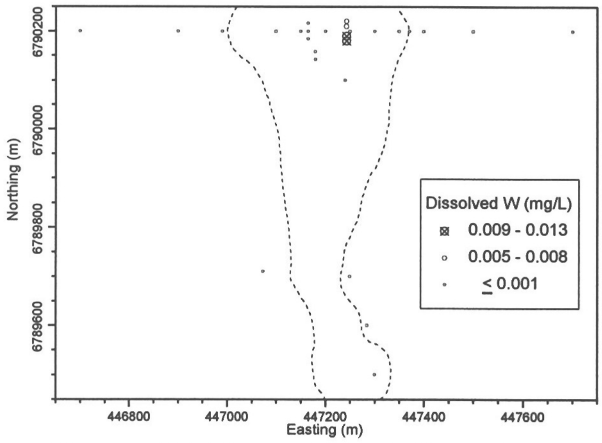


Figure A5.34: Dissolved W at Golden Delicious.

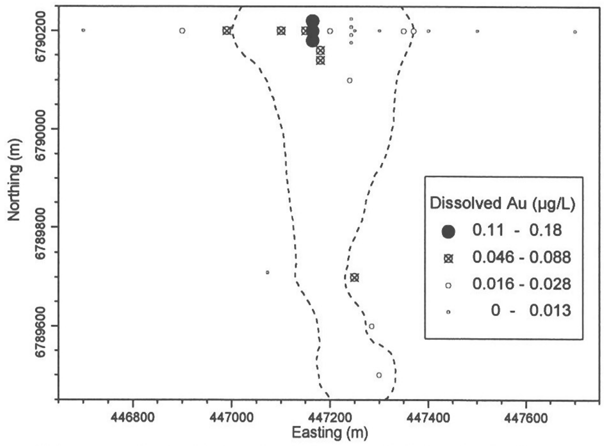


Figure A5.35: Dissolved Au at Golden Delicious.

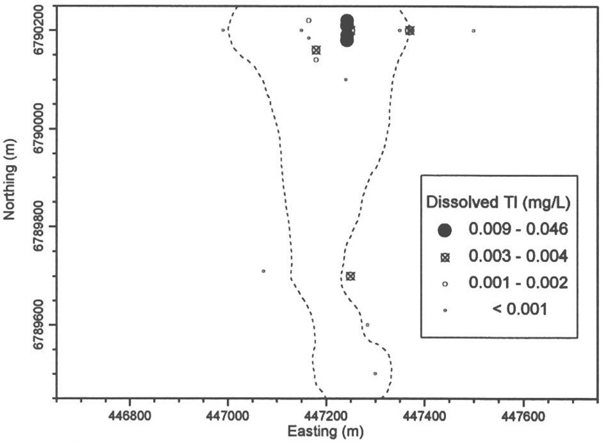


Figure A5.36: Dissolved Tl at Golden Delicious.

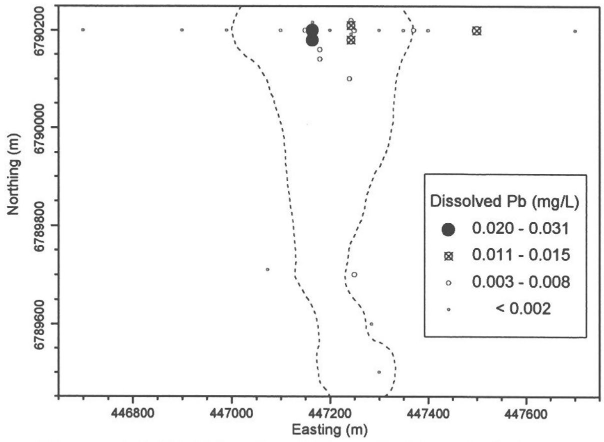


Figure A5.37: Dissolved Pb at Golden Delicious.

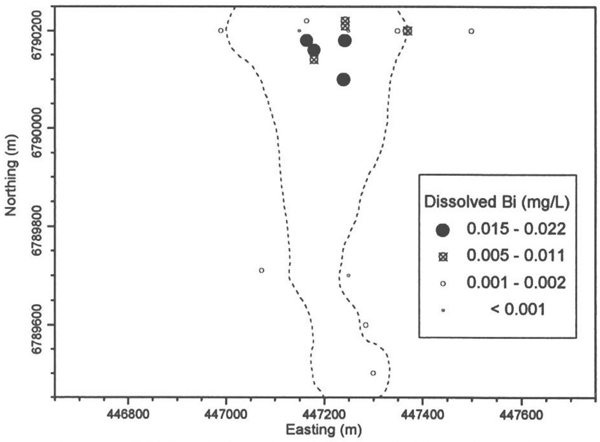


Figure A5.38: Dissolved Bi at Golden Delicious.

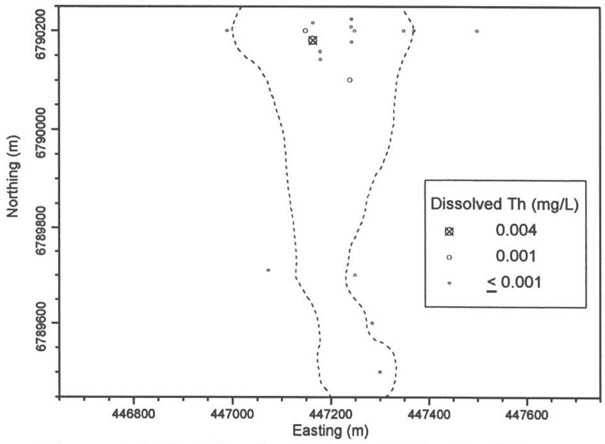


Figure A5.39: Dissolved Th at Golden Delicious.

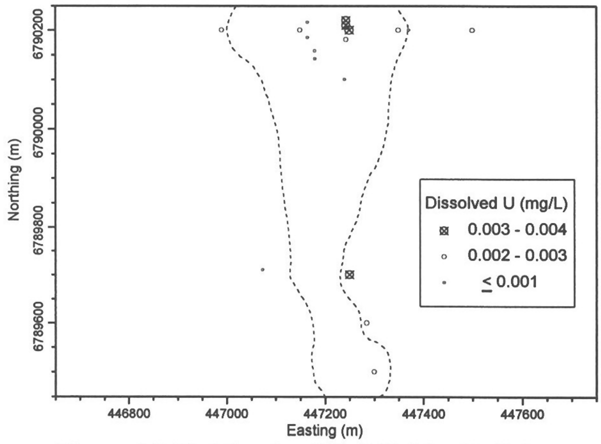


Figure A5.40: Dissolved U at Golden Delicious.

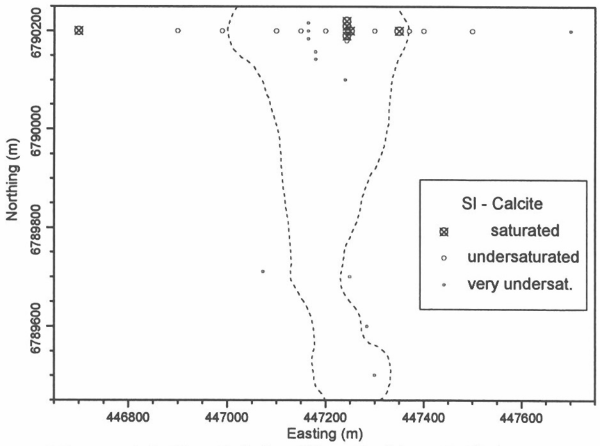


Figure A5.41: Calcite SI at Golden Delicious.

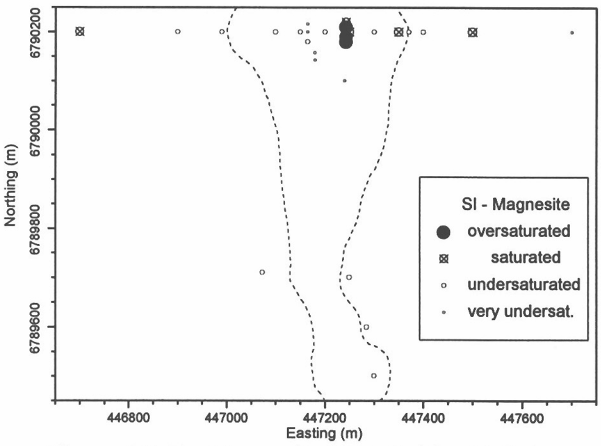


Figure A5.42: Magnesite SI at Golden Delicious.

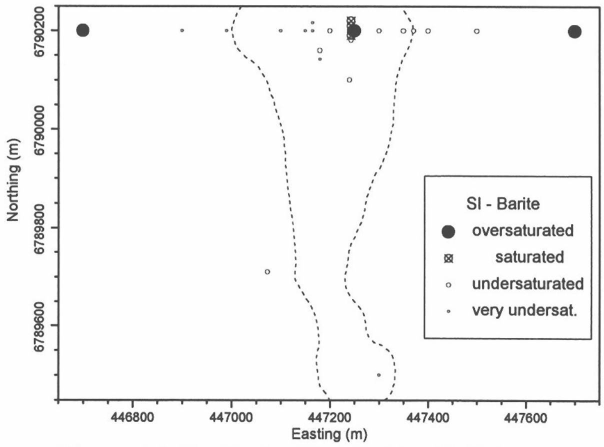


Figure A5.43: Barite SI at Golden Delicious.

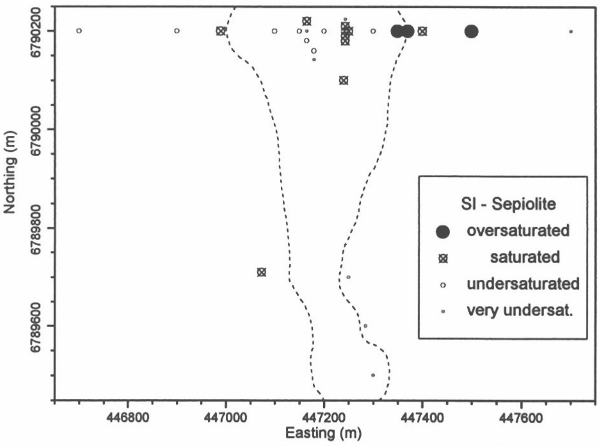


Figure A5.44: Sepiolite SI at Golden Delicious.

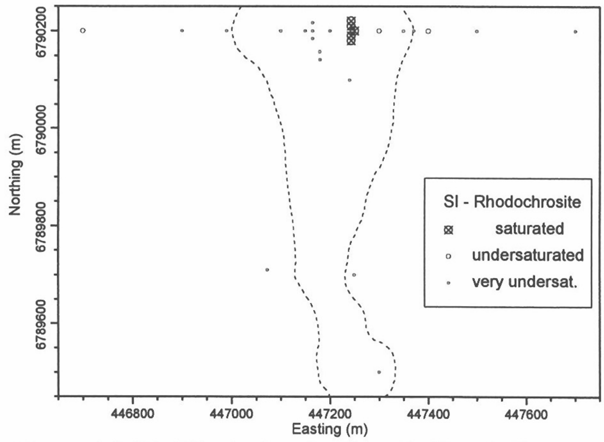


Figure A5.45: Rhodochrosite SI at Golden Delicious.

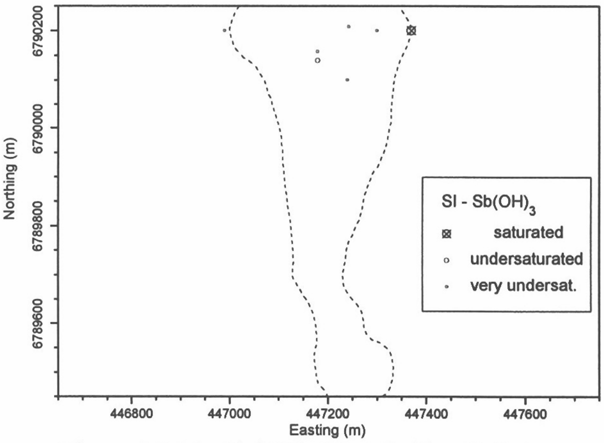


Figure A5.46: $Sb(OH)_3$ SI at Golden Delicious.

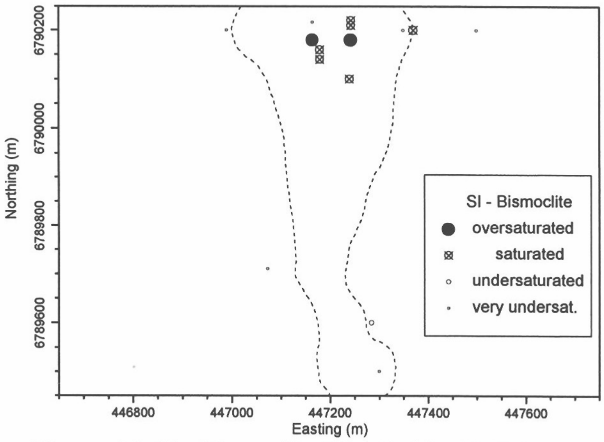


Figure A5.47: Bismoclite SI at Golden Delicious.

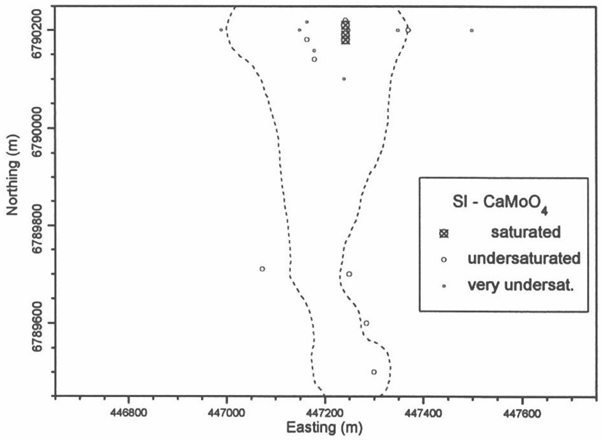


Figure A5.48: $CaMoO_4$ SI at Golden Delicious.

# APPENDIX 6: PARTIAL EXTRACTIONS OF AU IN REGOLITH MATERIALS AT GOLDEN DELICIOUS.

# PARTIAL EXTRACTIONS OF AU IN REGOLITH MATERIALS AT GOLDEN DELICIOUS

## 1. INTRODUCTION

The solubility of Au in regolith materials can be a useful indicator of the chemical form and mobility of Au under current conditions. The principal aim of this experiment was to determine the solubility of gold in various sub-surface regolith materials over mineralisation from the Golden Delicious Au deposit, 50km south of Laverton, Western Australia. The difference in Au solubility between fine pulverised and coarse unpulverised or "as drilled" samples and the variability of Au solubility within samples of unpulverised material were also examined. Variability of Au solubility in pulverised samples was not examined by this experiment. Variability in Au solubility between pulverised samples of sub surface regolith materials has been shown to be very low (Bristow *et al.*, 1996).

## 2. METHODS

### 2.1 SAMPLING

Samples used in this experiment were selected from rotary air blast (RAB) drilling undertaken along a 1 km section across mineralised and unmineralised lithologies at the Golden Delicious deposit.

The RAB drilled material was riffle split at the time of drilling, providing approximately 2.5 kg samples, each representing a 1 m depth interval. These were air dried at <40°C. Seven samples overlying mineralisation were selected: 09-2471, 09-2476, 09-2482 representing the transported overburden; 09-2467, 09-4499, 09-4500, 09-4501 representing the weathered Archaean rocks:

| | |
|---|---|
| **09-2471** | Calcareous, hardpanised fine sediment, with minor Fe-rich gravel. |
| **09-2476** | Fine grained sediment, indurated by Fe oxides and silica, containing approximately 20% Fe-rich pisoliths in a polimictic gravel. |
| **09-2482** | Unconsolidated coarse sediment dominated by Fe rich pisoliths and minor amounts of indurated finer sediments. |
| **09-2467** | Upper mottled zone, no primary lithic fabric, strong Fe fractionation. |
| **09-4499** | Middle - lower mottled zone, little primary lithic fabric, strong Fe fractionation. |
| **09-4500** | Saprolite with incipient mottle development, minor gross Fe fractionation. |
| **09-4501** | Saprolite, no gross Fe fractionation. |

These were sub-sampled as follows:

Approximately 200 g was riffle split from the total samples and pulverised to <75 μm in a hardened carbon steel mill (K1045, Robertson *et.al.*, 1996). This material is hereafter referred to as "pulverised sample".

Seven aliquots of approximately 30 g were riffle split from each of the original samples and are hereafter referred to as "unpulverised sample".

## 2.2 PARTIAL EXTRACTIONS

Three in house partial extraction solutions were used to test Au solubility in the above samples. The extractant solutions were as follows:

1. deionised water: dissolves the most soluble Au.

2. iodide: a 0.1M KI solution is adjusted to pH 7.4 with HCl whilst $CO_2$ is bubbled through. This extraction dissolves more Au than water alone.

3. cyanide: 0.03M KCN, 0.2M NaOH solution dissolves all but the most refractory Au - this can include coarser pieces of Au and Au partly encapsulated within resistant material such as quartz.

Using a constant solid solution ratio of 2:1, 25 g of the pulverised samples were subject to separate water, iodide and cyanide extractions. Separate aliquots of unpulverised samples were subject to duplicate water and iodide extractions and triplicate cyanide extractions. The sample and extractant were placed in a screw-cap polyethylene plastic bottle, with a plastic mesh sachet containing 1 g of activated carbon and gently agitated for one week, after which the carbon sachet was removed, washed in deionised water, and analysed for Au by INAA. Analysis of Au in carbon by INAA gives a detection limit of 1 ppb, thus providing a detection limit for the extraction of (1 ppb/1 g)/sample wt g (ie. 0.04 ppb for a 25 g sample).

# 3. RESULTS

Results of the partial extractions from unpulverised and pulverised samples are listed in Table A6.1 and Table A6.2 respectively and are combined graphically in Figure A6.1. The variability of Au solubility in unpulverised samples and differences between unpulverised and pulverised samples can be summarised as follows:

- Water- and iodide-soluble Au is repeatable for all samples of unpulverised material.

- Cyanide-soluble Au in unpulverised samples is variable, particularly in those with high total Au content ie. 09-2482, 09-4499, 09-4500 and 09-4501.

- There is a tendancy for Au solubility in any extractant to be higher (in most cases only slightly) in pulverised samples compared to unpulverised samples. This is true in all cases regardless of extractant, with a few notable exceptions, namely, water-soluble Au in 09-2476, 09-2482 and 09-4501, and cyanide-soluble Au in 09-2482, 09-4499, 09-4500 and 09-4501. Solubility is comparable or reduces slightly between unpulverised and pulverised samples in these cases.

- Iodide-soluble Au is lower than water-soluble Au in unpulverised samples of 09-4501.

Table A6.1: Results of partial extractions of Au on unpulverised aliquots of seven samples.

| Sample Number | Water Extractable Au (ppb) (1) | Water Extractable Au (ppb) (2) | Iodide Extractable Au (ppb) (1) | Iodide Extractable Au (ppb) (2) | Cyanide Extractable Au (ppb) (1) | Cyanide Extractable Au (ppb) (2) | Cyanide Extractable Au (ppb) (3) |
|---|---|---|---|---|---|---|---|
| **09-2471** | 0.11 | 0.09 | 2.1 | 1.6 | 2.2 | 2.3 | 2.2 |
| **09-2476** | 0.08 | 0.12 | 1.7 | 2.1 | 2.9 | 3.4 | 3.4 |
| **09-2482** | 0.89 | 1.3 | 21 | 18 | 82 | 60 | 110 |
| **09-2467** | 0.79 | 0.7 | 5.7 | 5.3 | 31 | 56 | 31 |
| **09-4499** | 12 | 12 | 67 | 60 | 840 | 1100 | 930 |
| **09-4500** | 7.4 | 7.4 | 42 | 33 | 350 | 430 | 360 |
| **09-4501** | 230 | 190 | 170 | 170 | 2600 | 3100 | 2300 |

Table A6.2: Results of partial extractions of Au on pulverised aliquots of seven samples.

| Sample Number | Water Extractable Au (ppb) | Iodide Extractable Au (ppb) | Cyanide Extractable Au (ppb) |
|---|---|---|---|
| **09-2471** | 0.2 | 2.47 | 3.55 |
| **09-2476** | 0.08 | 2.34 | 3.43 |
| **09-2482** | 0.92 | 64.4 | 77.6 |
| **09-2467** | 0.99 | 6.88 | 60.4 |
| **09-4499** | 15.4 | 77.6 | 796 |
| **09-4500** | 10.16 | 69.2 | 293.6 |
| **09-4501** | 34.04 | 202.8 | 2396 |

Duplicate and triplicate analyses from the unpulverised samples were averaged for comparison with the single analyses of pulverised material. The data were plotted cumulatively to show both absolute concentrations of Au extracted by each solution and the proportions of Au extracted by each solution relative to the total cyanide-soluble component (Figure A6. 2).

The solubility of Au in various regolith materials can be summarised as follows:

- Gold in the transported overburden overlying mineralisation though low, is highly soluble, approximately 75 % being dissolved from pulverised samples by iodide reagent (Figure A6. 2).

- The proportion of water-soluble Au in unpulverised and pulverised samples of transported overburden decreases with depth from the surface, from approximately 5 % at 3 m to just over 1 % at 14 m.

- Although less than 10% of Au is iodide-soluble, absolute concentrations of Au dissolved from high Au samples are significant (93, 79, and 234 ppb iodide-soluble from pulverised samples of 09-4499, 09-4500 and 09-4501 respectively).

- There is a marked difference in iodide-soluble Au between unpulverised (25%) and pulverised (80%) samples of 09-2482.

- Water-soluble Au (7.7%) is greater than iodide-soluble Au (6.3%) in unpulverised samples of 09-4501.

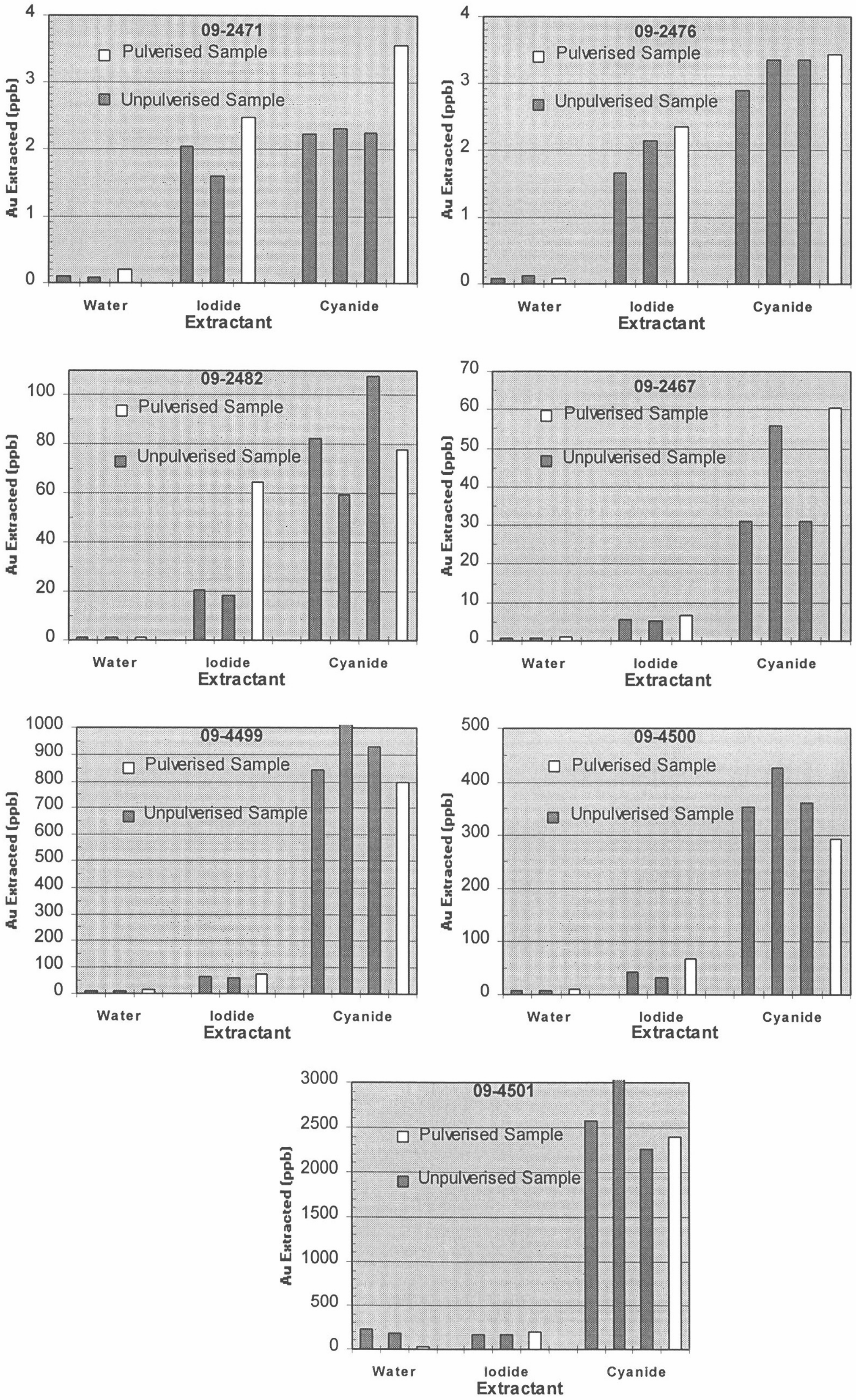


Figure A6.1: Gold extracted by water, iodide and cyanide for seven samples of regolith from Golden Delicious.

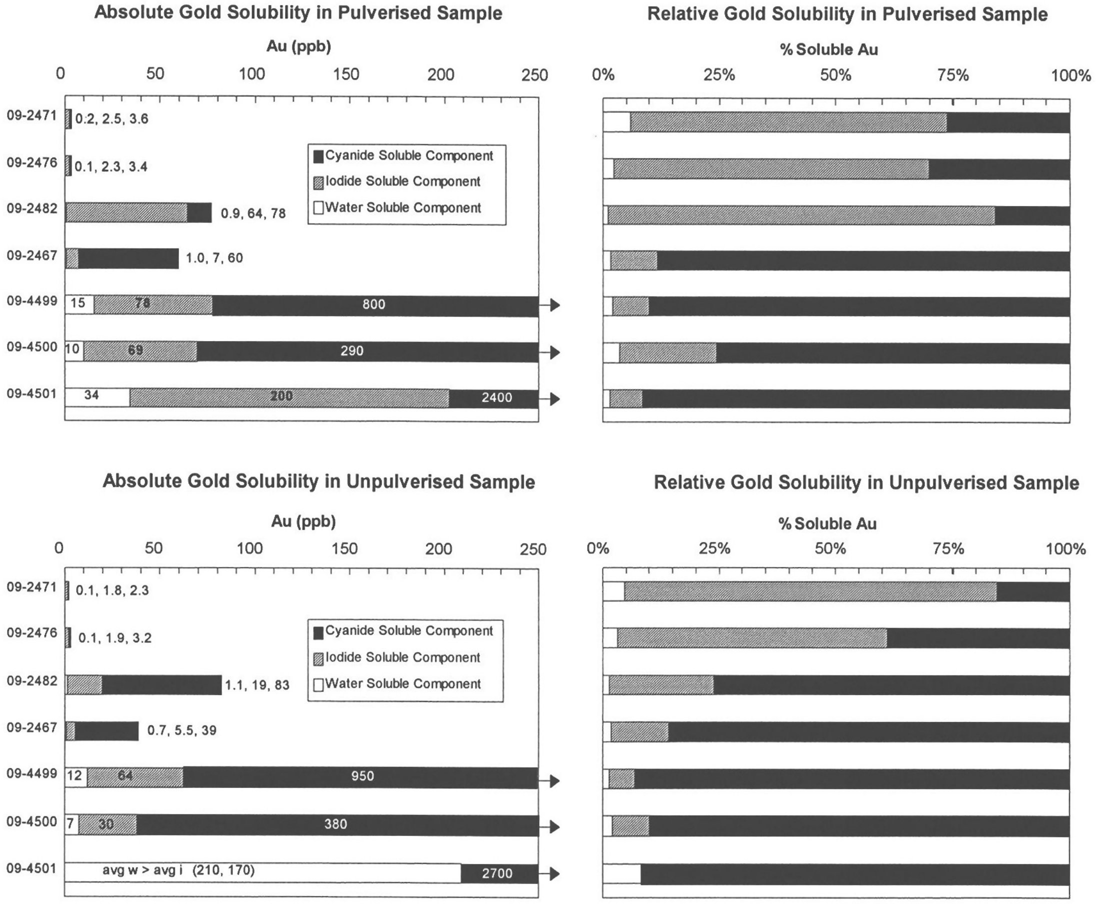


Figure A6.2: Absolute and relative Au solubility in pulverised and unpulverised samples. Data for unpulverised samples were averaged from duplicate and triplicate analyses.

# 4. DISCUSSION

## 4.1 EXPERIMENTAL PROCEDURES

Erroneous results for water- and iodide-soluble Au in 09-4501 are probably due to contamination of the carbon sachet. Washing after extraction may not have removed some coarse, Au-rich material trapped by the sachet, a problem compounded by the extremely high Au content of this sample.

Variability of total cyanide-soluble Au in the unpulverised samples is probably due to a nugget effect, with relatively coarse, metallic particles of Au having a heterogeneous distribution in the bulk samples. The water- and iodide-soluble Au components in these are relatively constant, indicating a uniform concentration of chemically precipitated, non-metallic Au. Despite the robustness of water- and iodide-soluble Au extraction, the ambiguity created by variability in total cyanide-soluble Au is significant enough to warrant the use of a sequential extraction technique that measures water-, iodide- and cyanide-soluble Au in a single aliquot of sample.

## 4.2 GOLD SOLUBILITY IN THE REGOLITH

The equivalence of cyanide- (total) soluble Au in both pulverised and unpulverised samples indicates that most Au is accessible to solutions in the regolith. Thus, even in sample 09-2482 in which 80 % of contained Au is associated with the coarse fraction, all Au in the sample is dissolved by cyanide without pulverising. This implies that little of the Au is occluded within ferruginous gravels that make up the coarse fraction.

Occlusion by silica cement may account for the higher water- and cyanide-soluble Au from pulverised hardpan (09-2471). Silica or alumino-silicate coatings in basal ferruginous gravel (09-2482) may account for the increase in iodide-soluble Au from 25 to 80% on pulverising. Such coatings may dissolve in an alkaline cyanide solution but not in the neutral iodide reagent, but are disrupted by pulverising. Alternatively, a kinetic or surface area effect may be responsible.

# 5. CONCLUSIONS

The following observations support the conclusion that Au has been, and is highly mobile in the regolith at the Golden Delicious deposit:

- A high proportion (up to 80 %) of Au in transported material is soluble and accessible to solutions in the regolith. This implies the Au is non-metallic or very finely divided.

- Significant concentrations of Au, (though low as a percentage of total Au), are dissolved by iodide in weathered Archaean materials.

- Sequential extractions measuring water-, iodide- and cyanide-soluble Au components of a single aliquot of sample should be used in favour of separate extractions of multiple aliquots. The principal reason for this being variability between samples (particularly in Au-rich, unpulverised samples).

- Extreme care must be exercised to avoid contamination of the carbon by coarse, Au rich particles, particularly when samples contain high concentrations of Au.

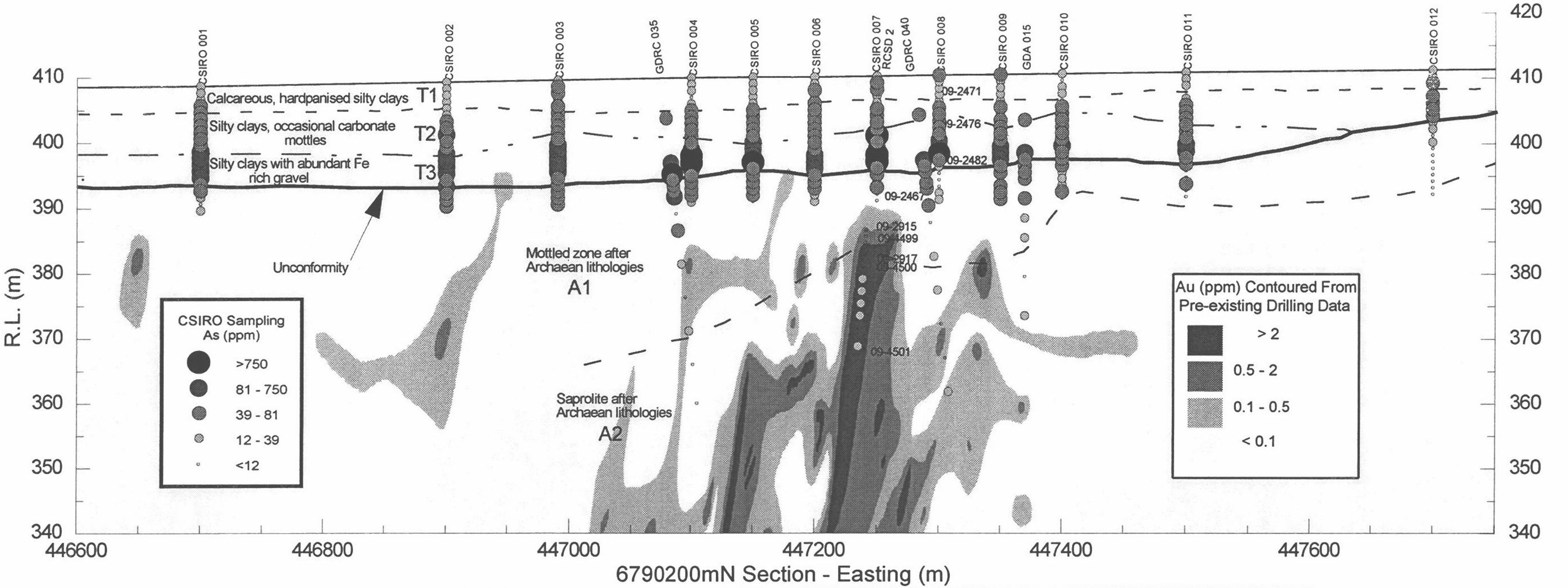
- Differences in Au solubility between pulverised and unpulverised samples of regolith provide evidence for availability or occlusion of Au.

# REFERENCES

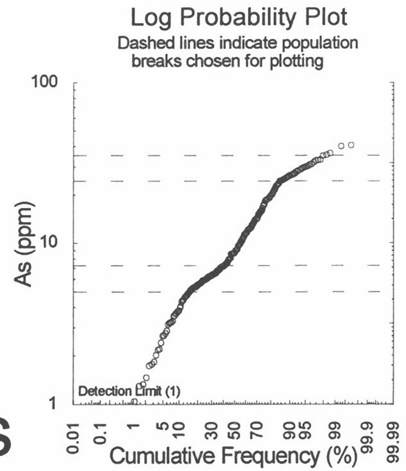
Bristow, A.P.J., Lintern, M.J. and Butt, C.R.M., 1996. Geochemical and spatial characteristics of regolith around the Safari prospect, Western Australia. AMIRA/CSIRO Project 409: Yilgarn Transported Overburden, Restricted Report 281R.

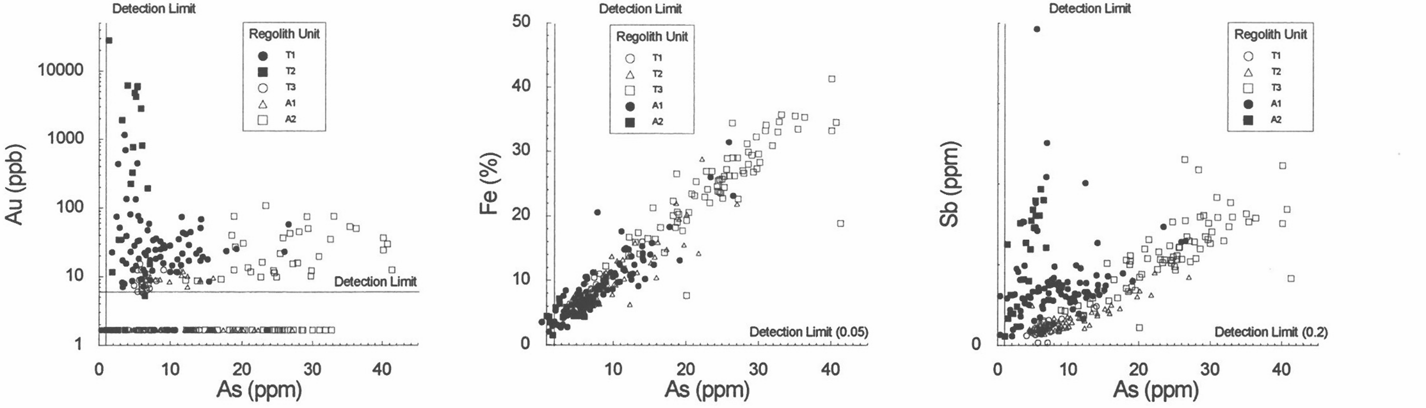
Robertson, I.D.M., Dyson, M., Hudson, E.G., Crabb, J.F., Willing, M.J. and Hart, M.K.W., 1996. A case hardened, low contamination ring mill for multi-element geochemistry. Journal of Geochemical Exploration, in press.

# APPENDIX 7: PLOTS OF ELEMENT (AND ELEMENT RATIO) DISTRIBUTION IN THE REGOLITH ON 6790200MN.



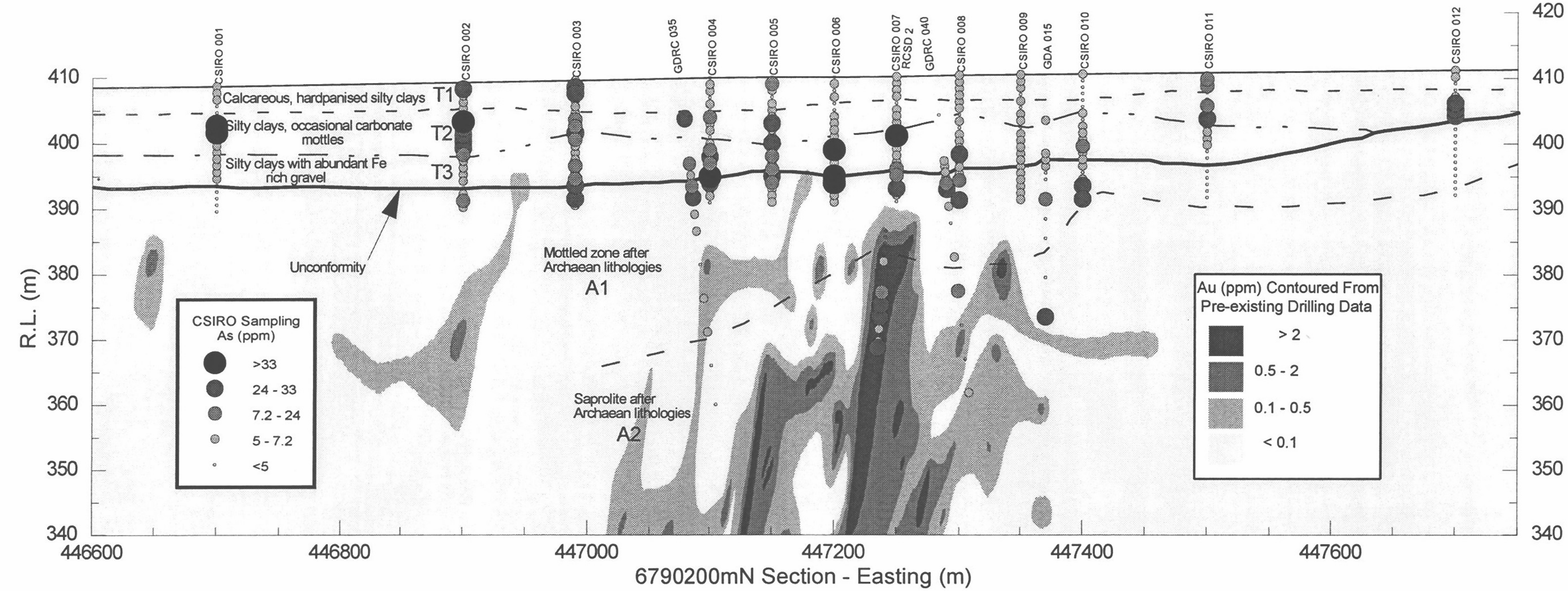
| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| As (ppm) | 292 | 12.4 | 9 | <1 | 41 | 6 | 18 | 9 | 1 |





As

Figure A7.1: Distribution of As in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| As (ppm) | 292 | 12.4 | 9 | <1 | 41 | 6 | 18 | 9 | 1 |

**As vs Fe**

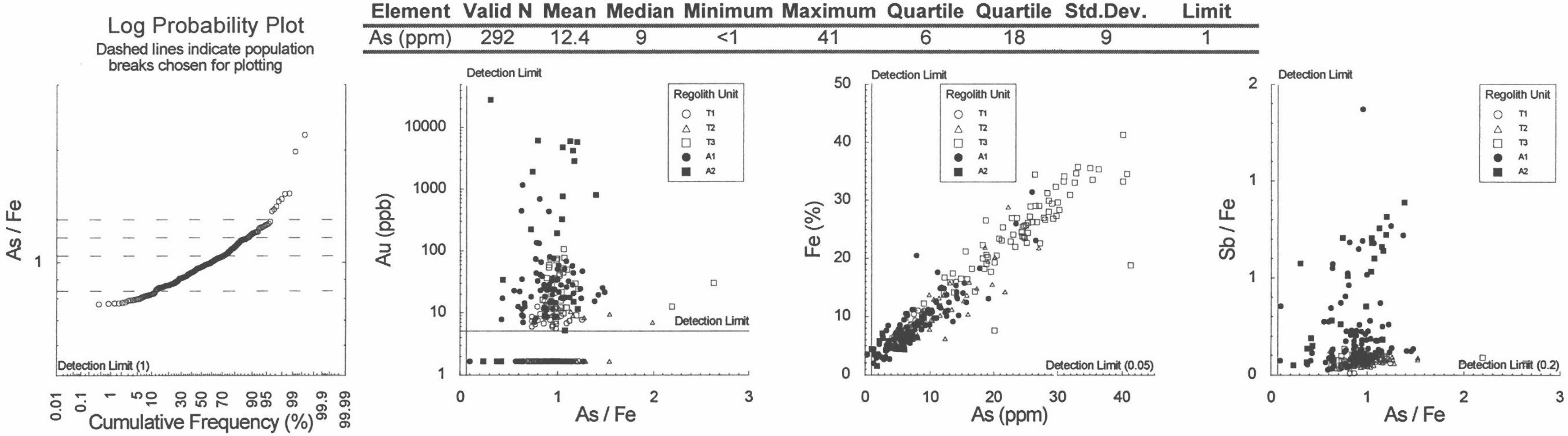
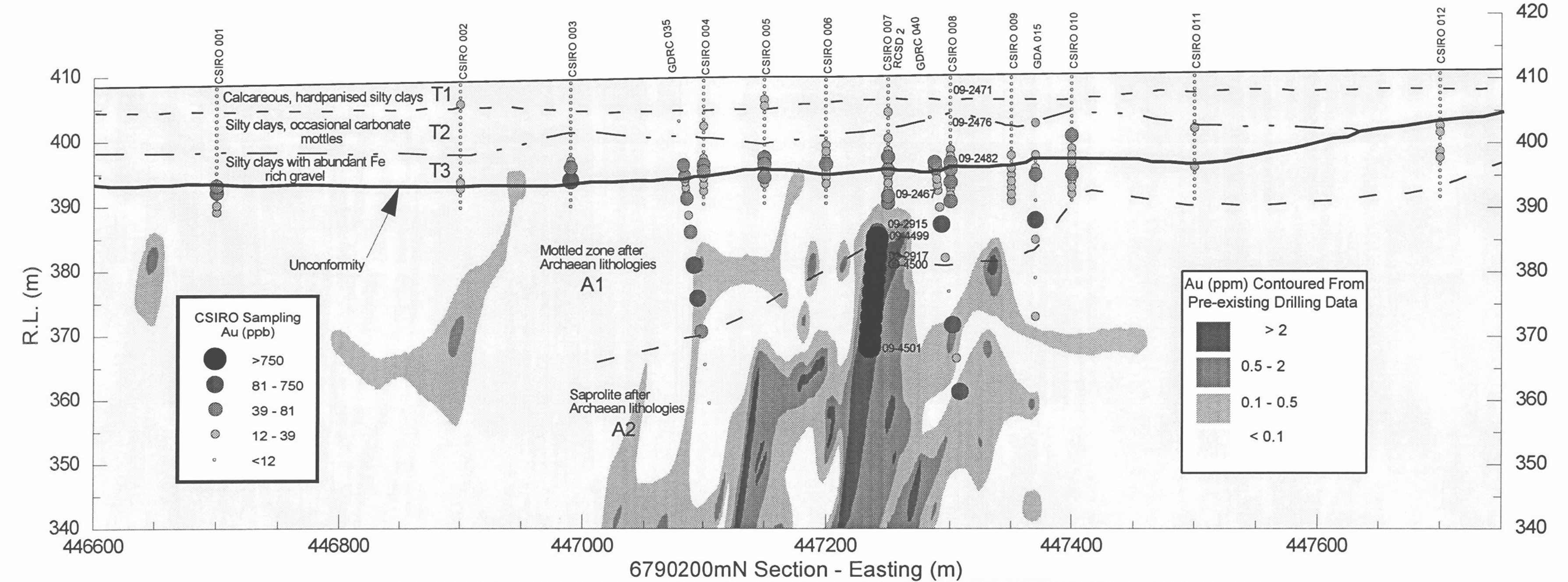
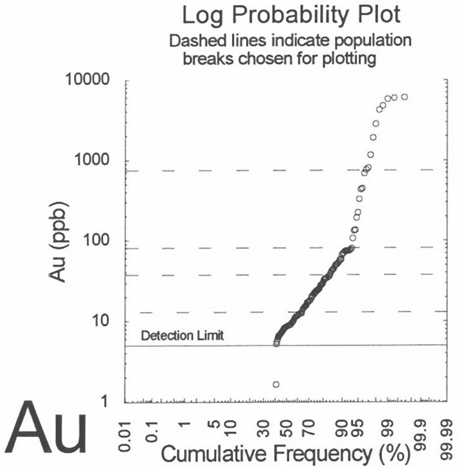


Figure A7.2: Distribution of As/Fe in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Au (ppb) | 292 | 235 | 9 | <5 | 27900 | <5 | 24 | 1780 | 5 |



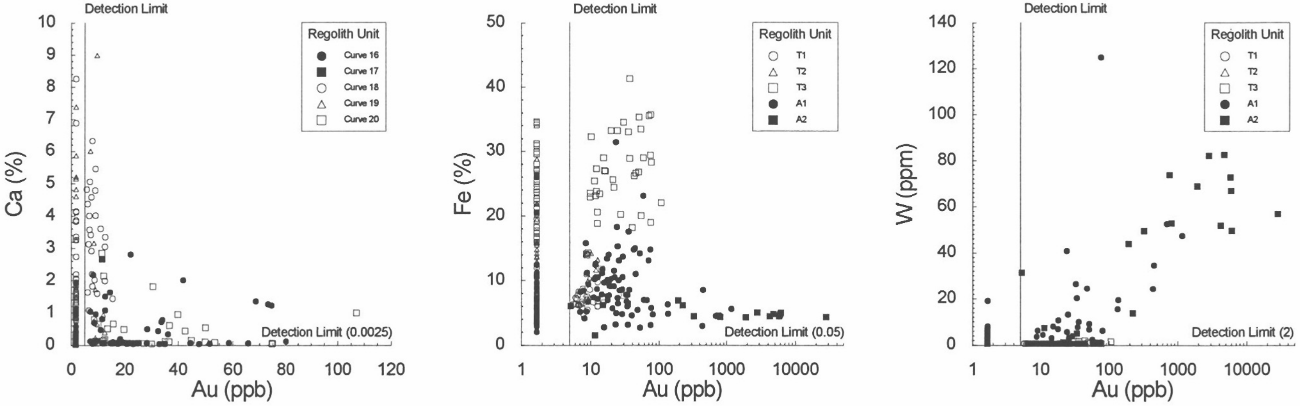


Figure A7.3: Distribution of Au in the regolith and significant associations with other elements.

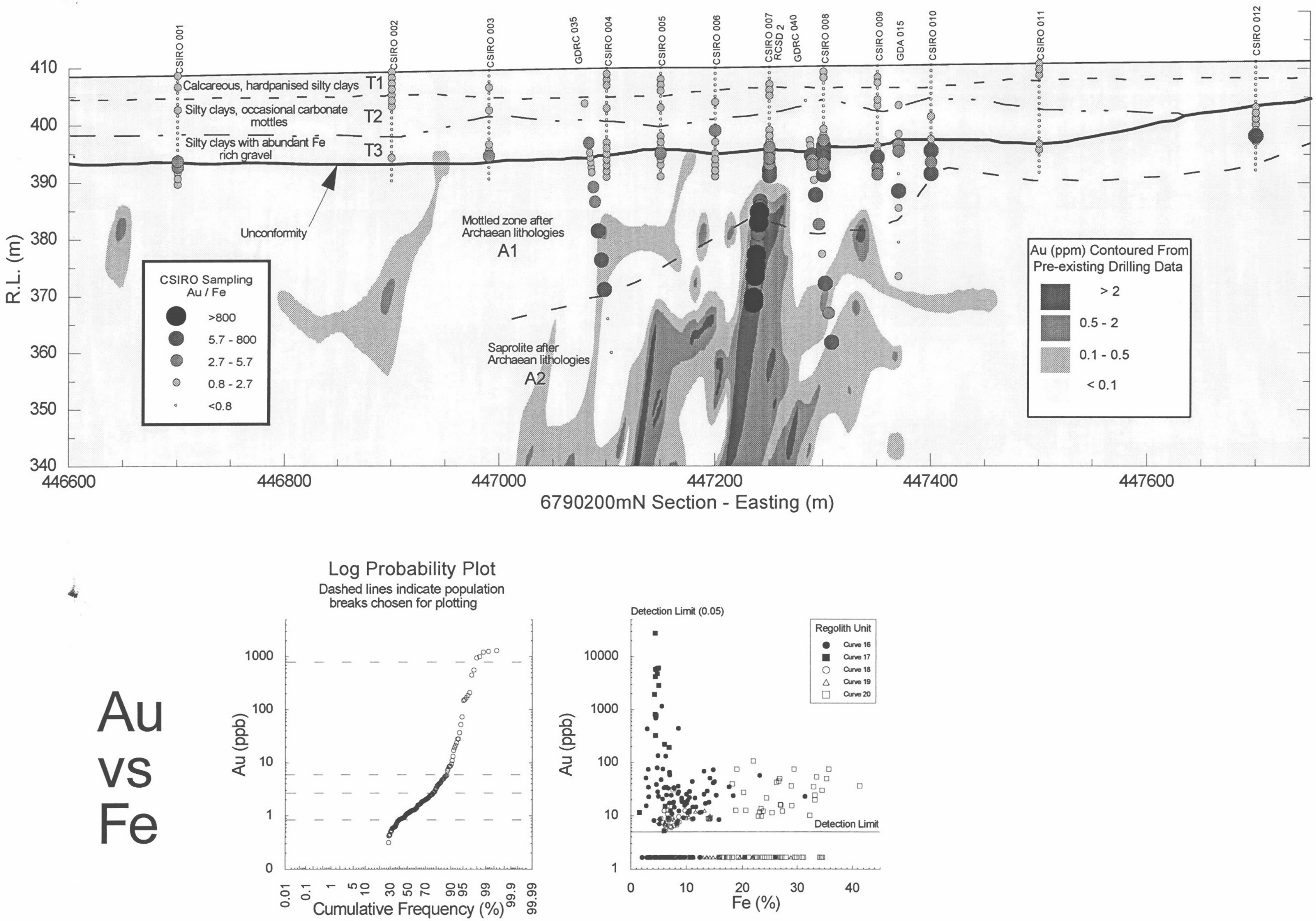
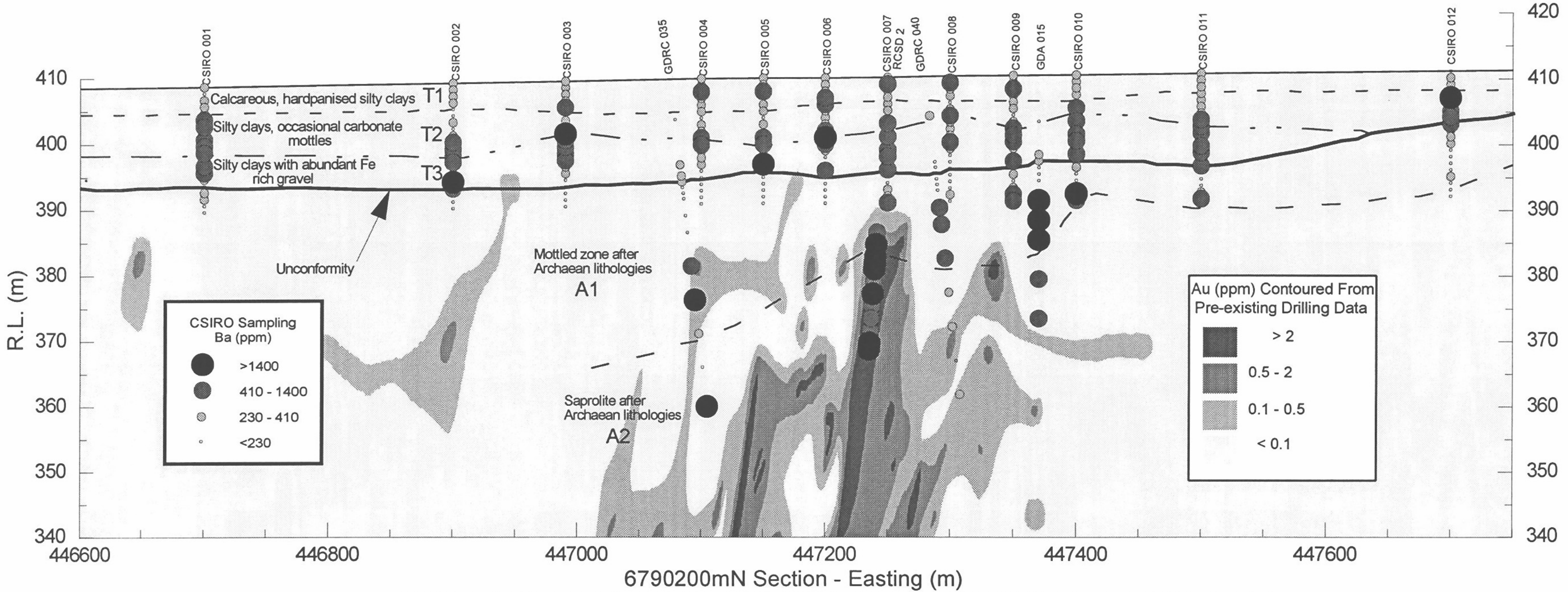
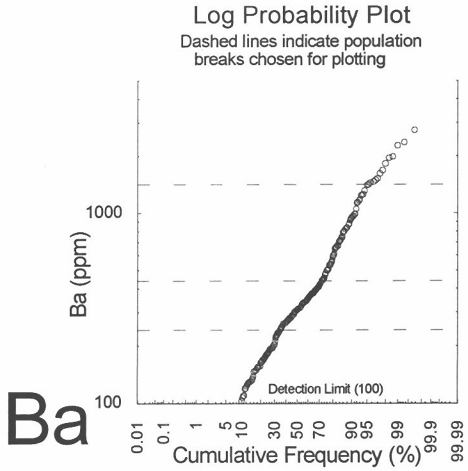


Figure A7.4: Distribution of Au/Fe in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Ba (ppm) | 292 | 443 | 313 | <100 | 3400 | 186 | 500 | 454 | 100 |



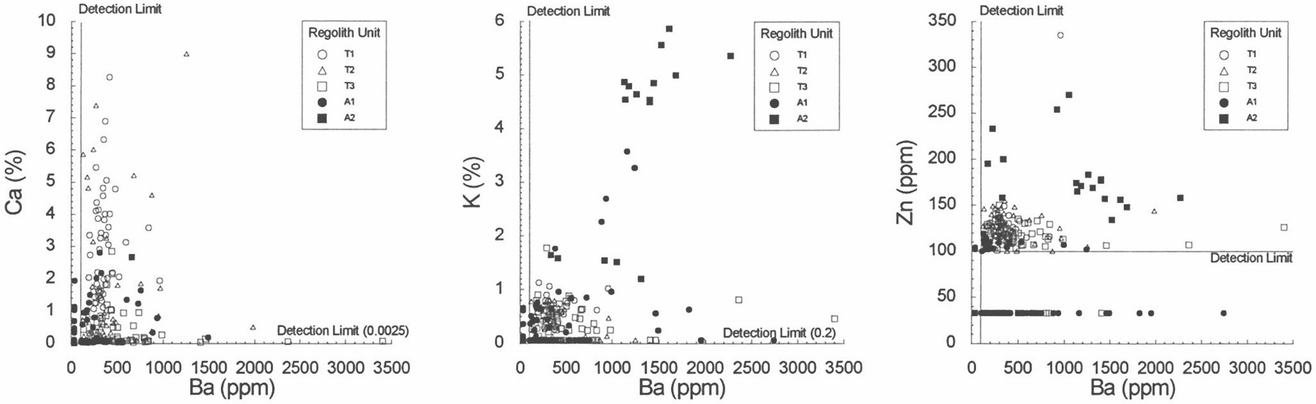
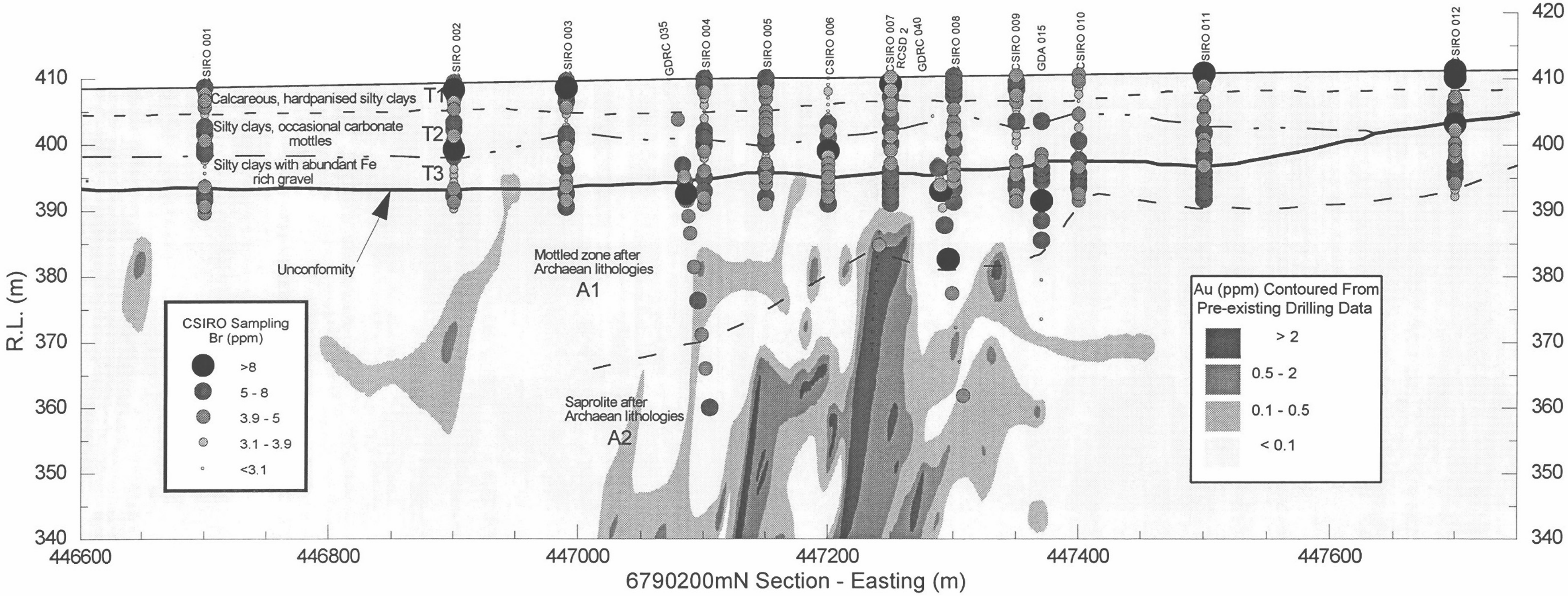
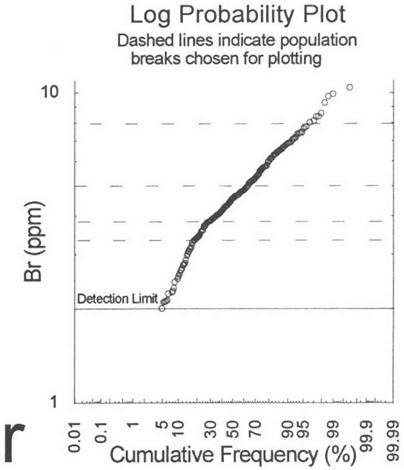
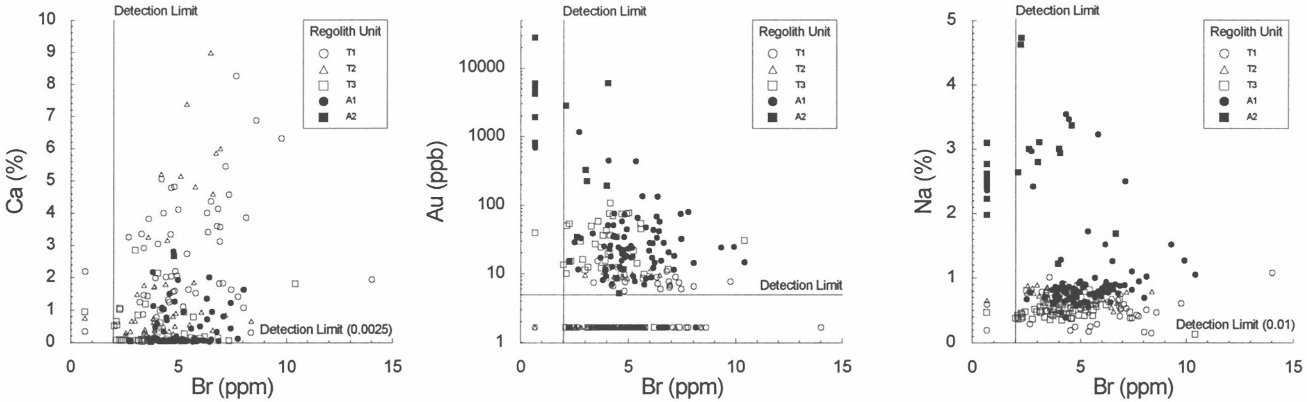


Figure A7.5: Distribution of Ba in the regolith and significant associations with other elements.



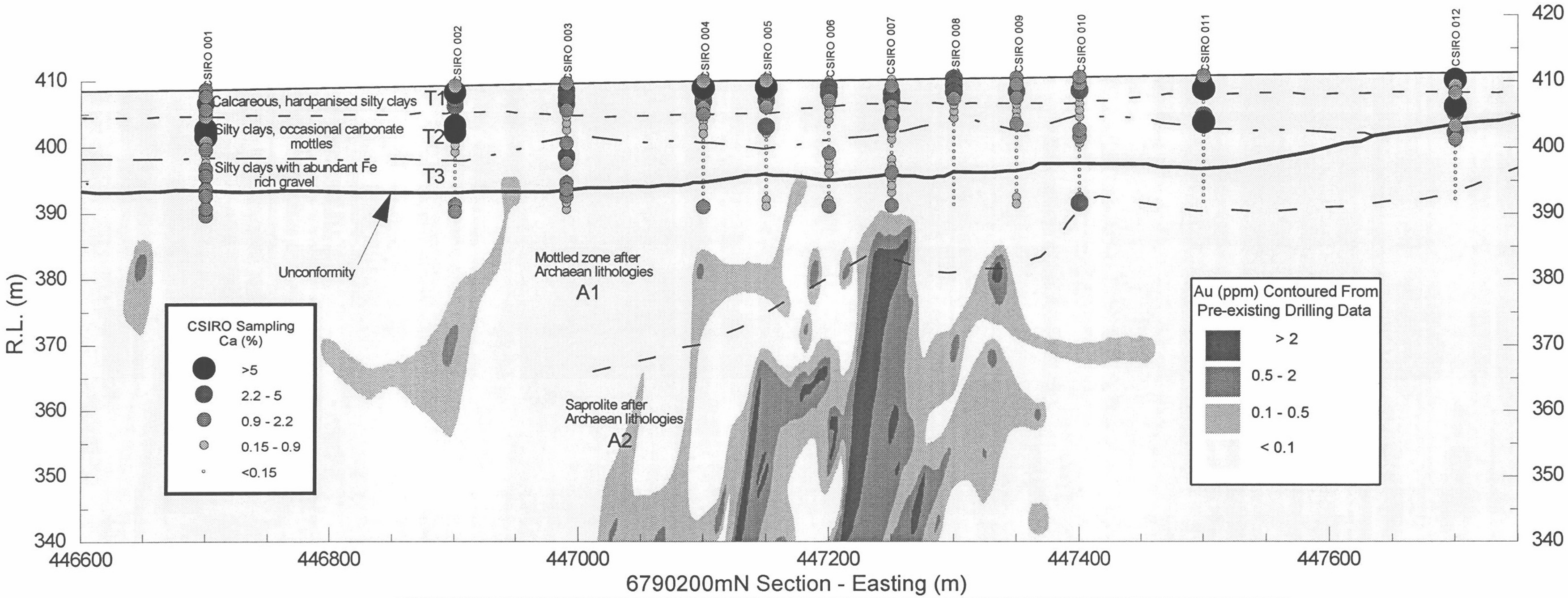
| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Br (ppm) | 292 | 5 | 5 | <2 | 14 | 4 | 6 | 2 | 2 |



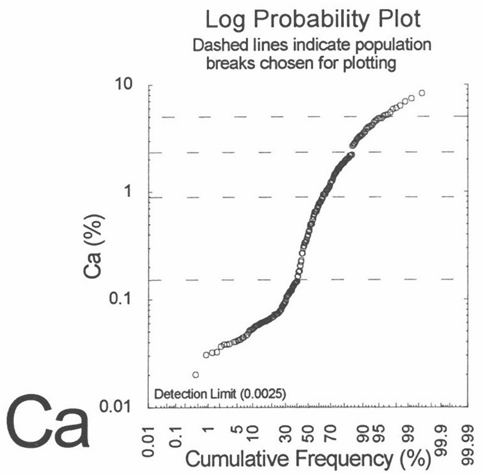


**Br**

Figure A7.6: Distribution of Br in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Ca (%) | 240 | 1.17 | 0.43 | 0.02 | 8.99 | 0.08 | 1.62 | 1.66 | 0.0025 |



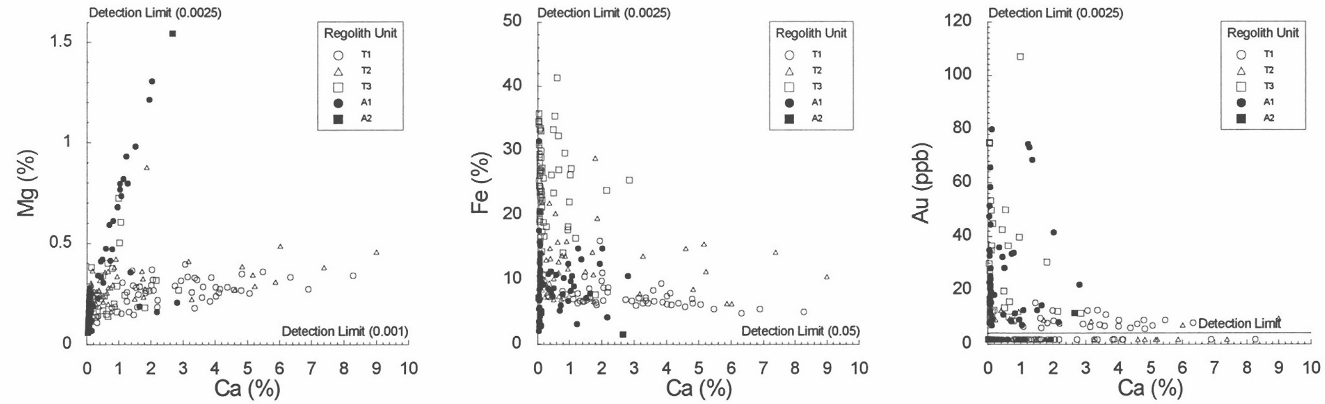
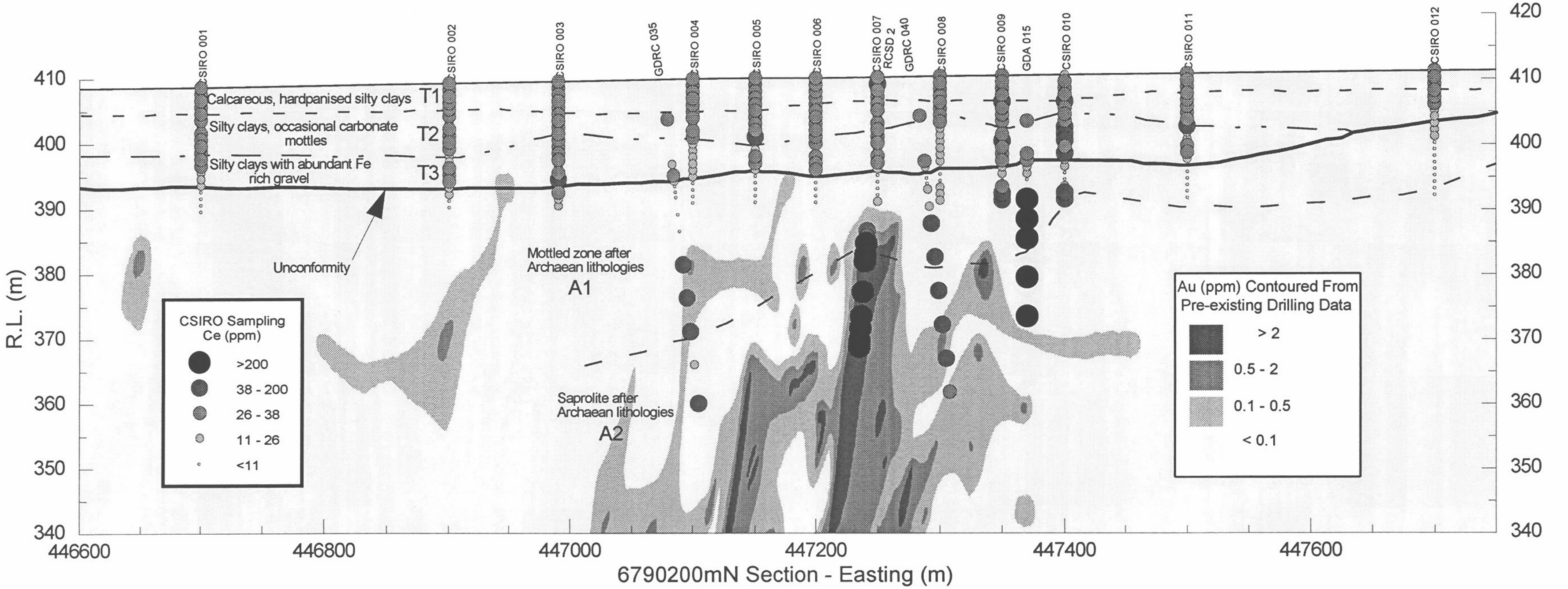
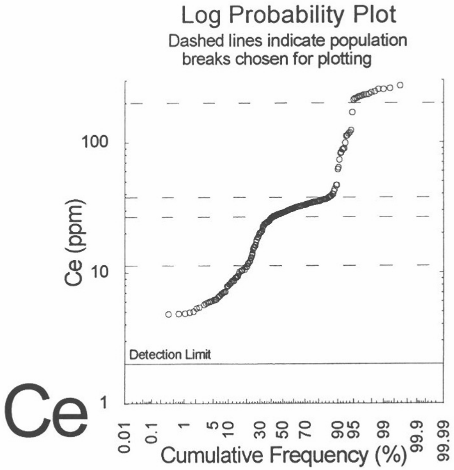


Figure A7.7: Distribution of Ca in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Ce (ppm | 292 | 40 | 29 | 5 | 297 | 16 | 35 | 53 | 2 |



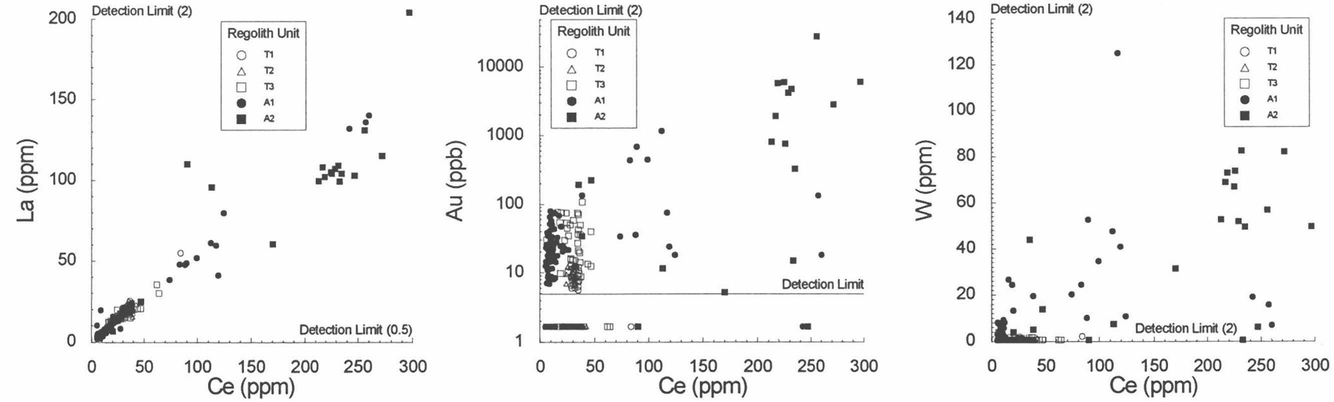
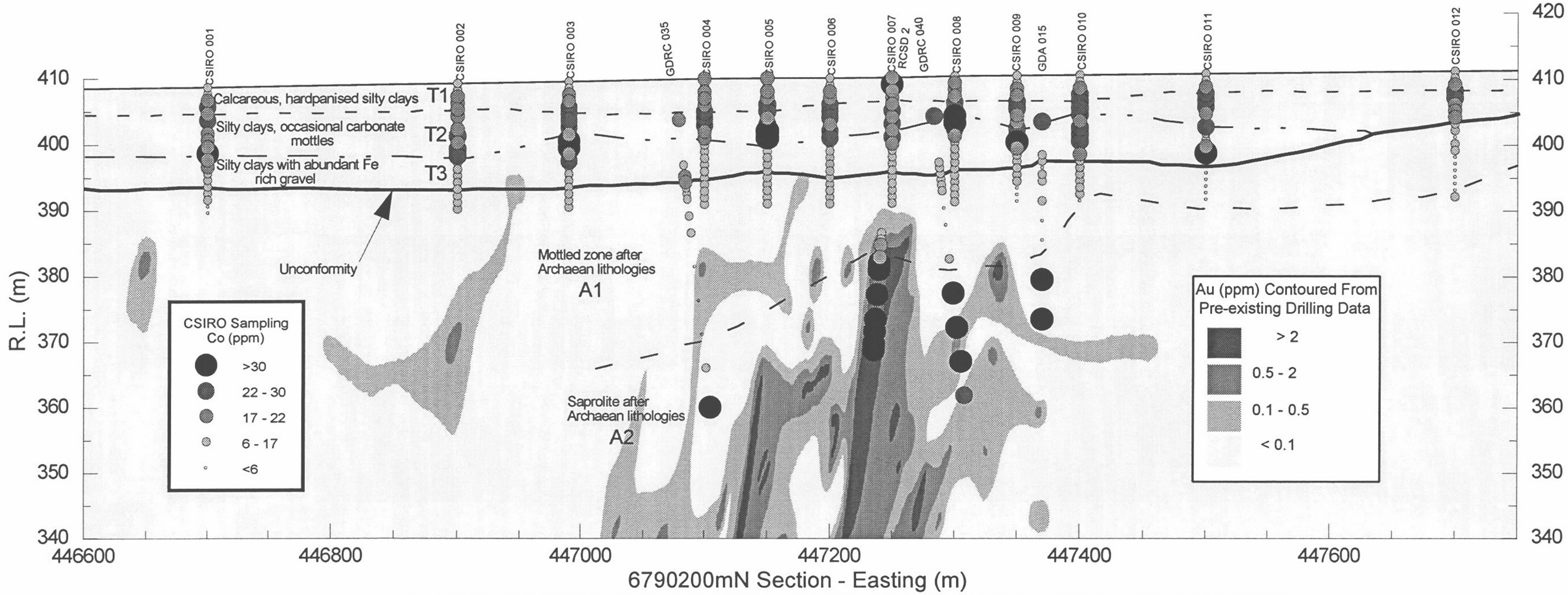


Figure A7.8: Distribution of Ce in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Co (ppm) | 292 | 20 | 16 | <1 | 863 | 9 | 22 | 51 | 1 |

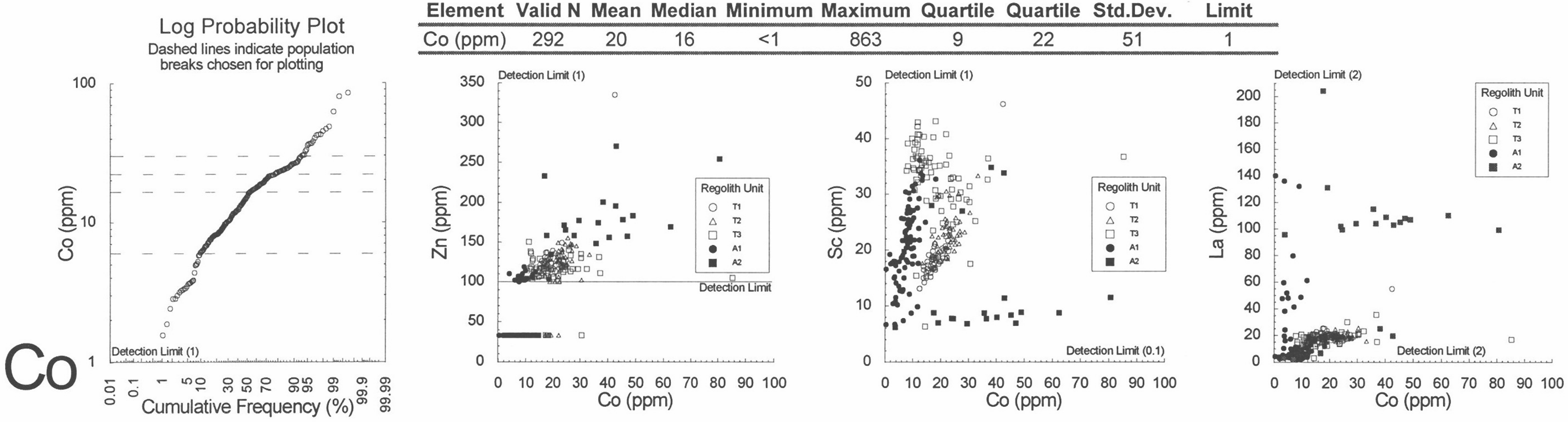
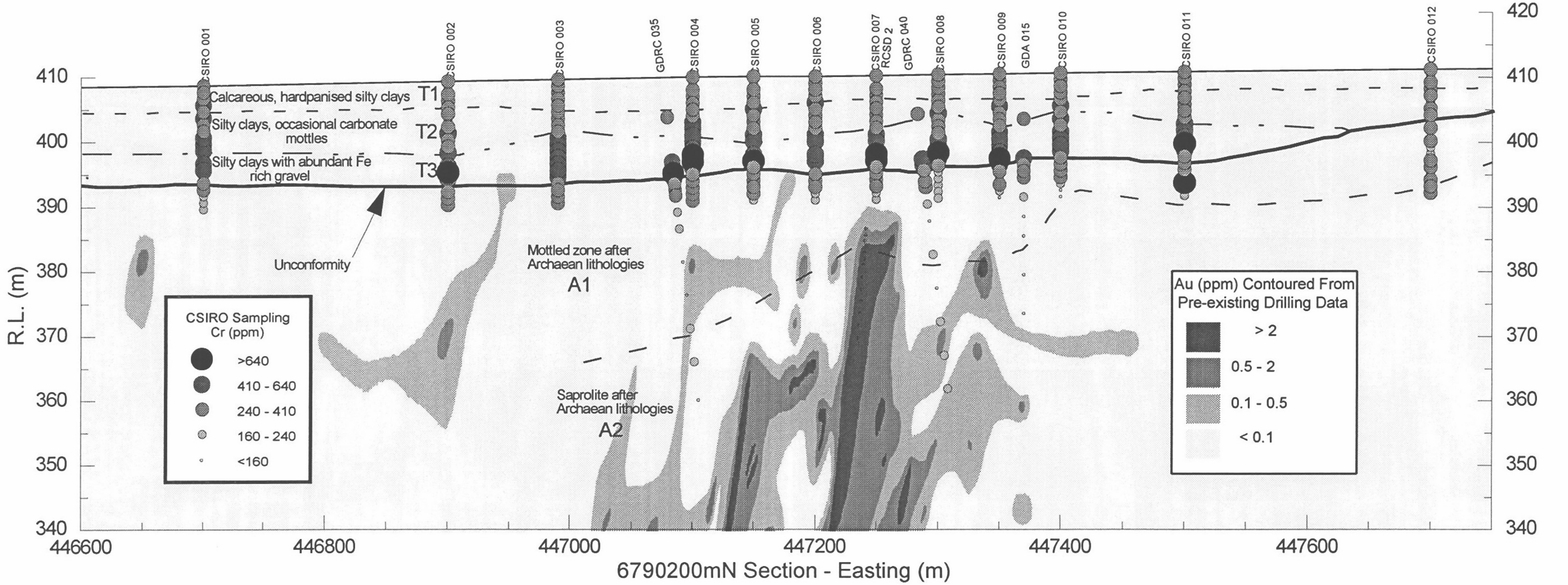


Figure A7.9: Distribution of Co in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Cr (ppm) | 292 | 348 | 321 | 12 | 850 | 252 | 434 | 170 | 5 |

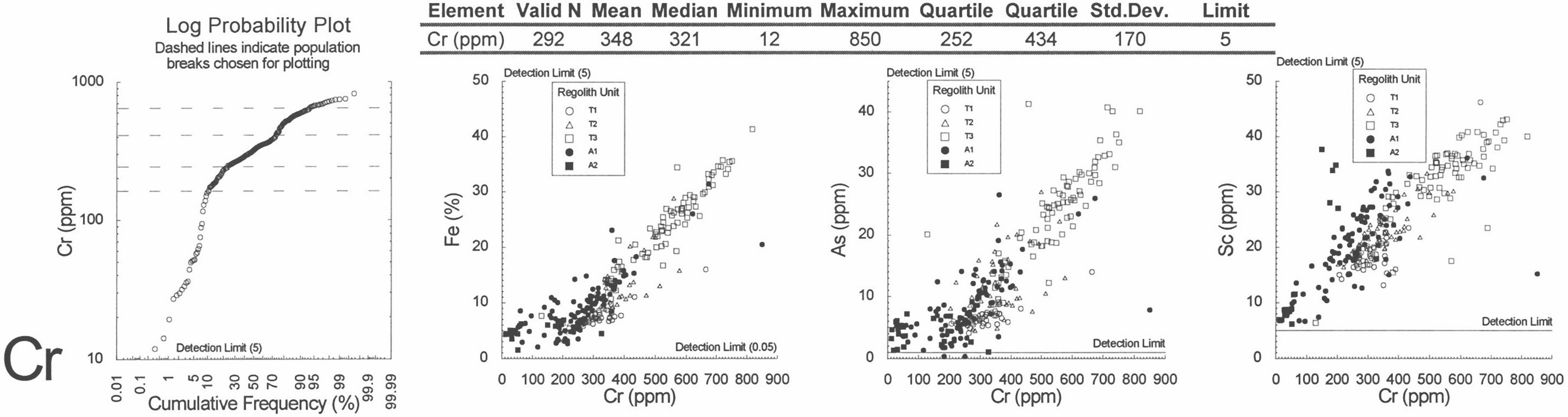
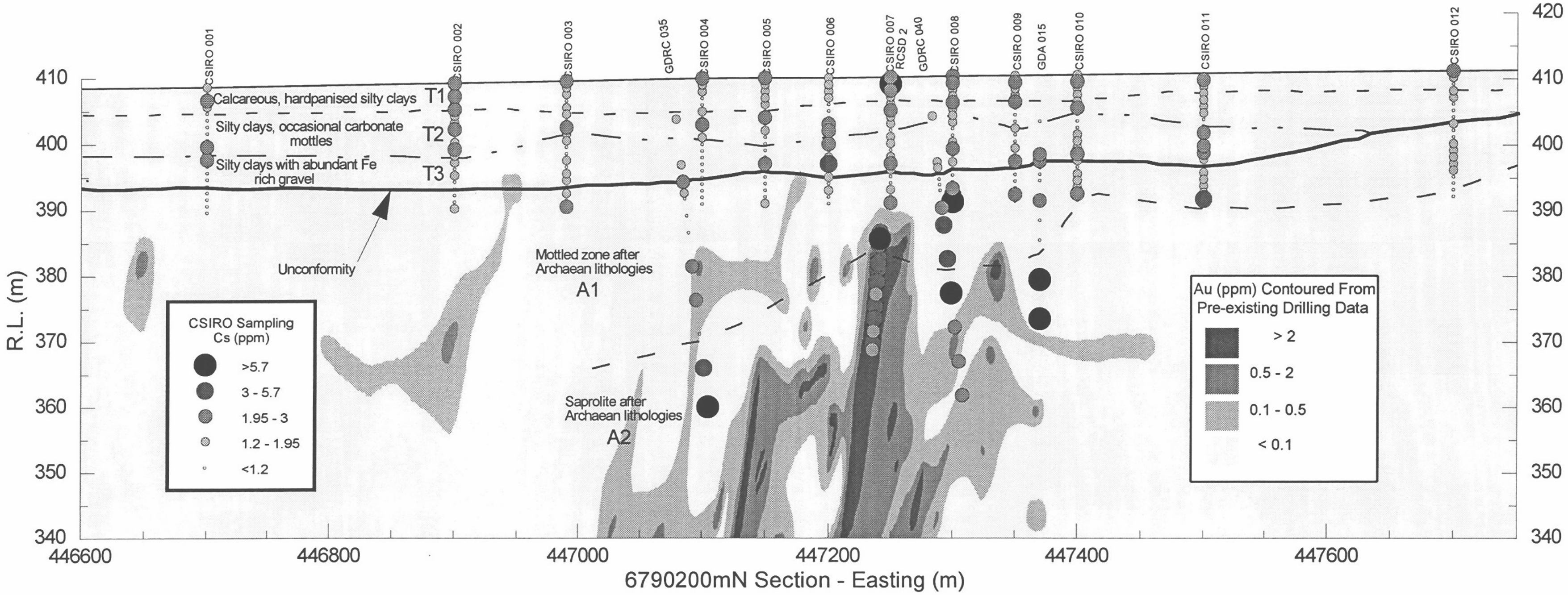
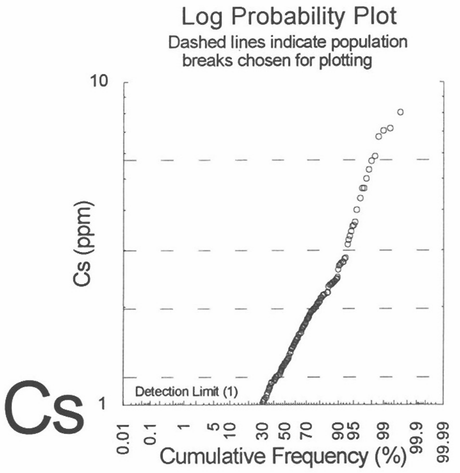


Figure A7.10: Distribution of Cr in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Cs (ppm) | 292 | 1.5 | 1.4 | <1 | 10.5 | <1 | 2 | 1.3 | 1 |



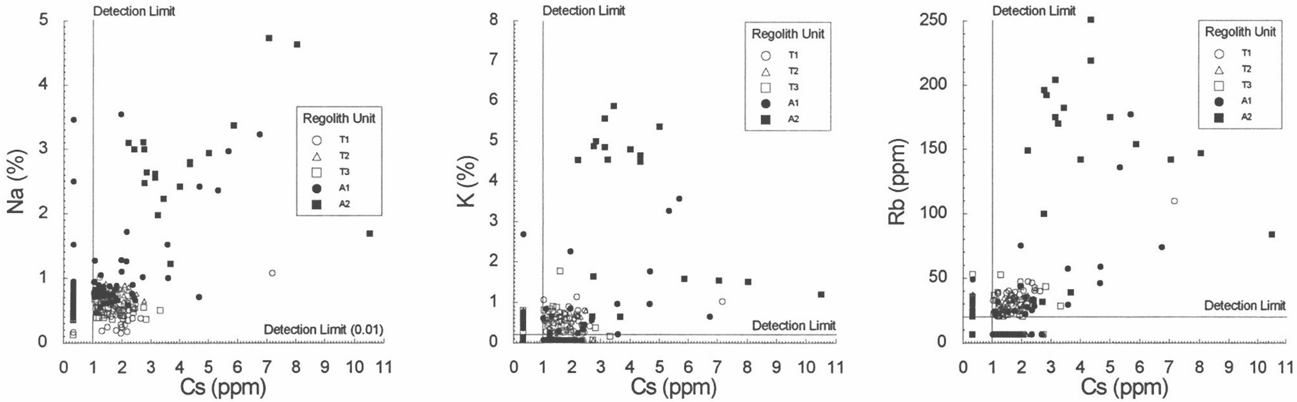
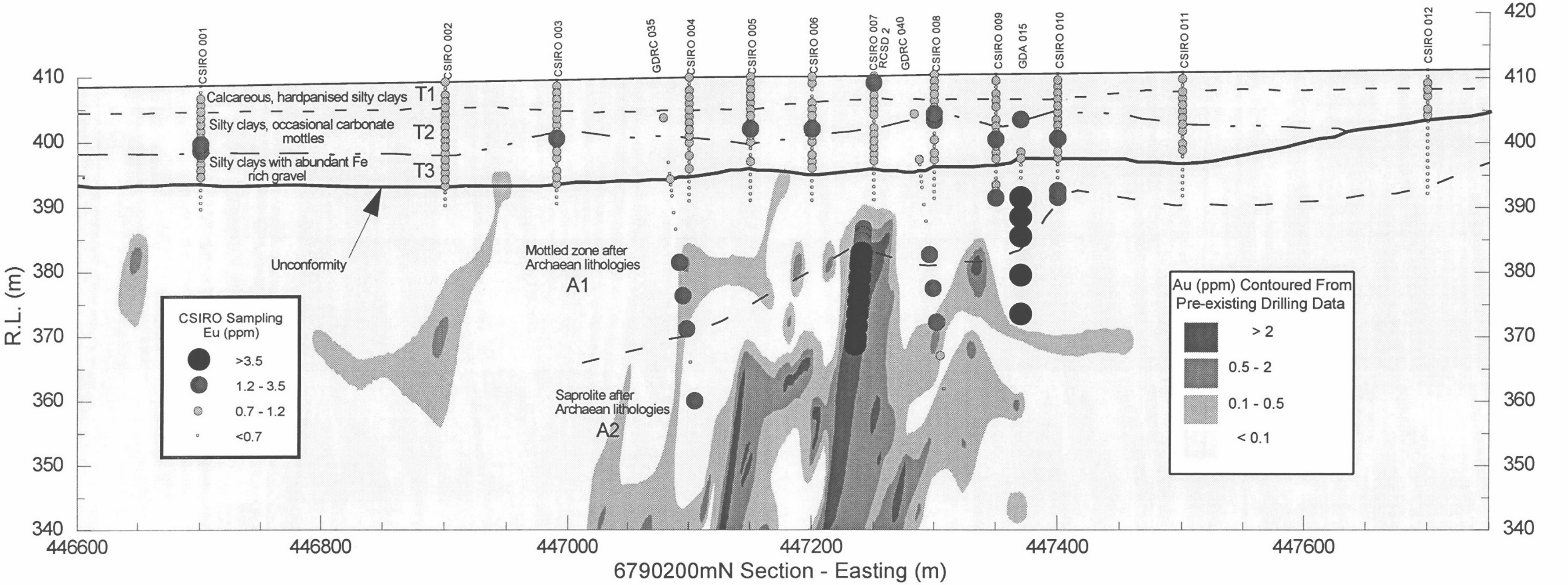
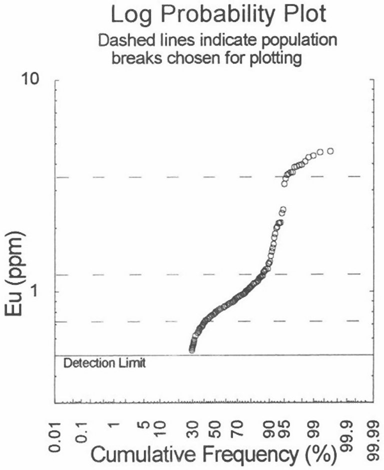
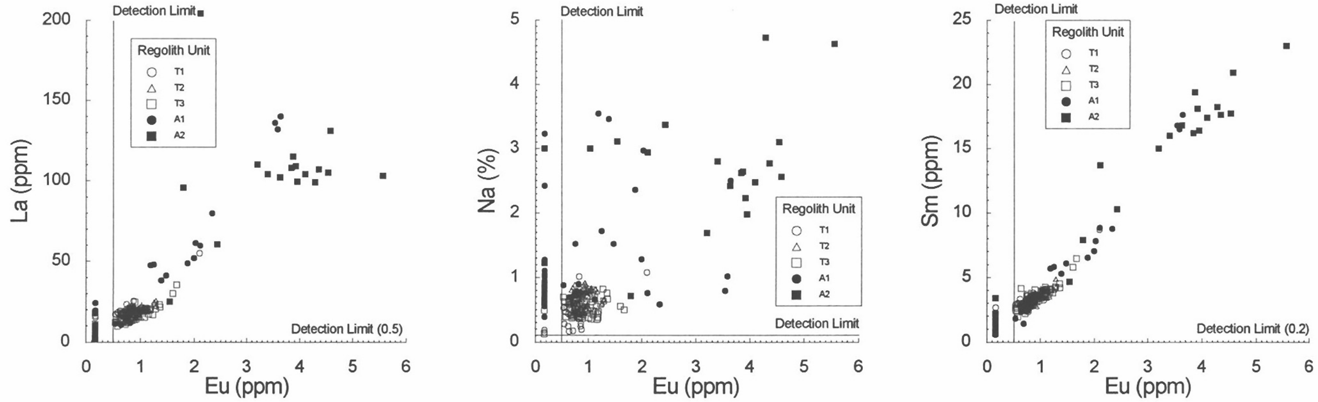


Figure A7.11: Distribution of Cs in the regolith and significant associations with other elements.



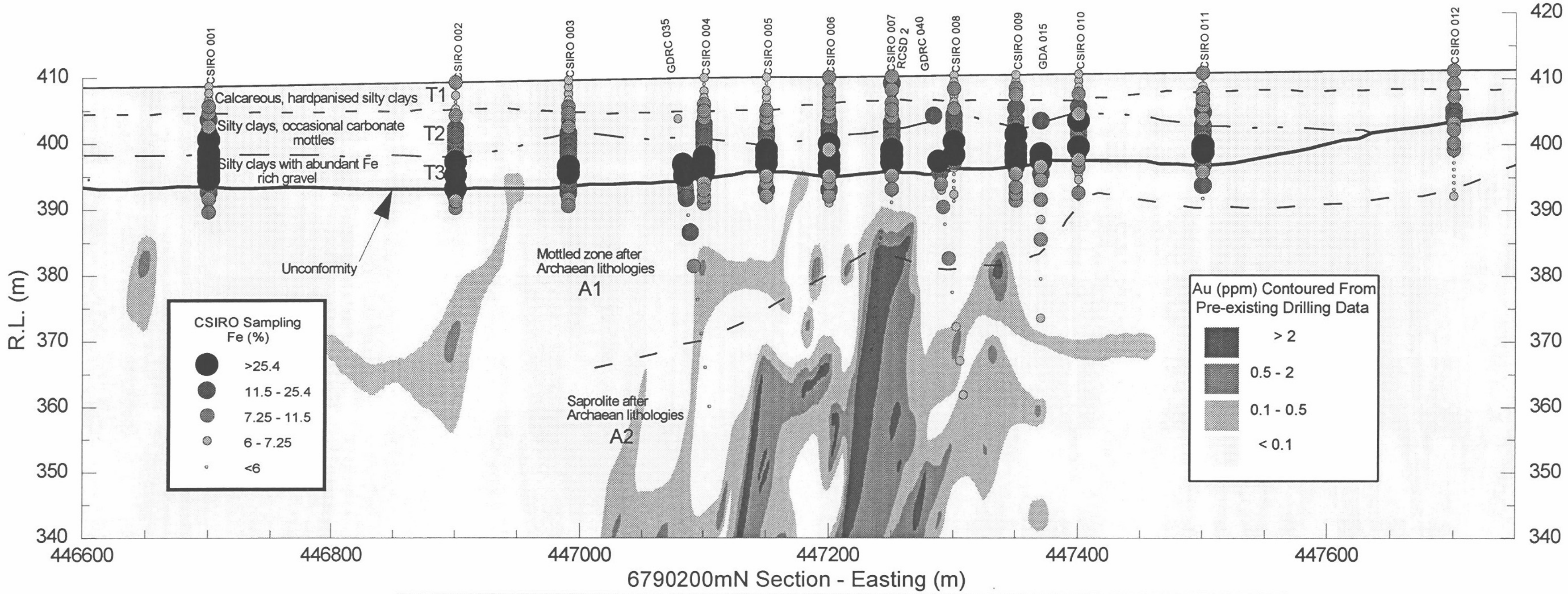
| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Eu (ppm) | 292 | 0.9 | 0.8 | <0.5 | 5.6 | <0.5 | 1 | 0.9 | 0.5 |



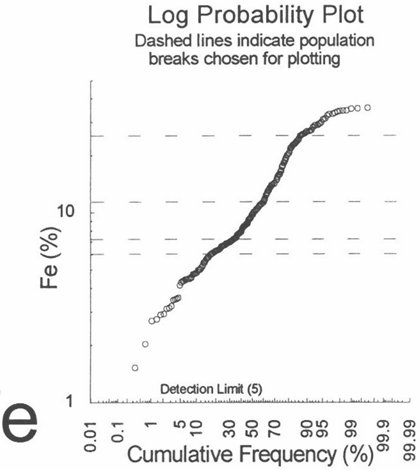


Eu

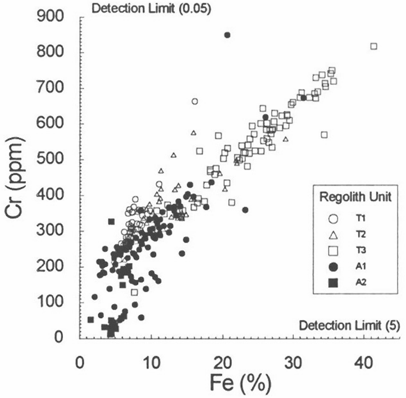
Figure A7.12: Distribution of Eu in the regolith and significant associations with other elements.

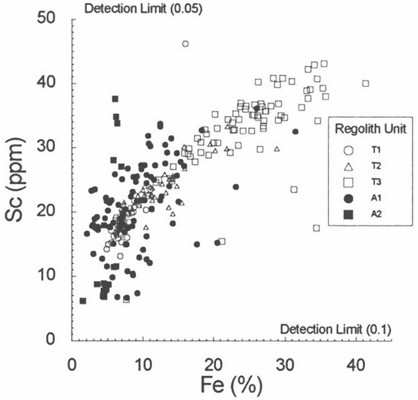


| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Fe (%) | 292 | 13 | 9.7 | 1.5 | 41.3 | 6.7 | 17.5 | 8.6 | 0.05 |



Fe





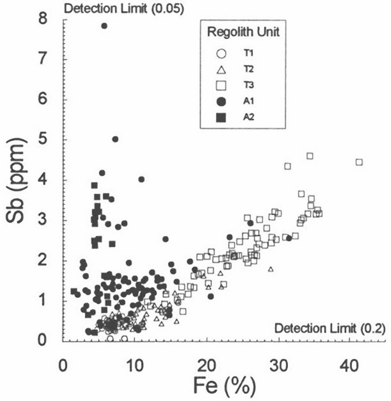
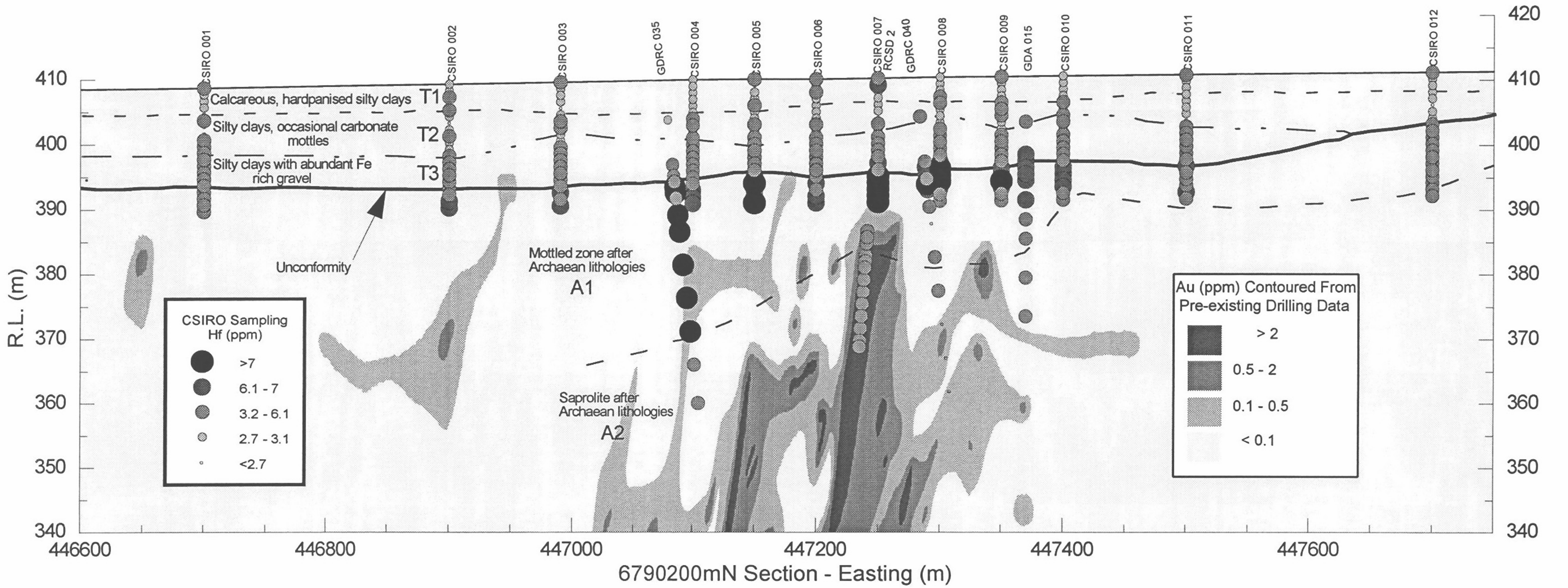
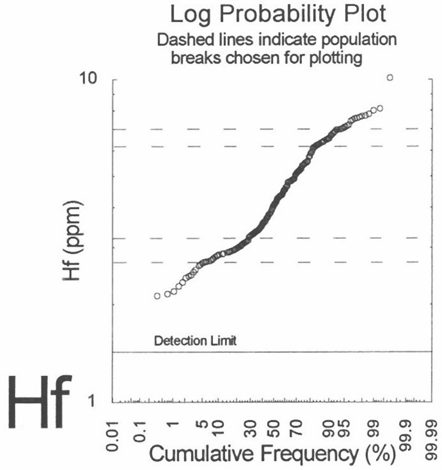


Figure A7.13: Distribution of Fe in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Hf (ppm) | 292 | 4.4 | 4.1 | 2.1 | 13.4 | 3.1 | 5.4 | 1.6 | 0.5 |



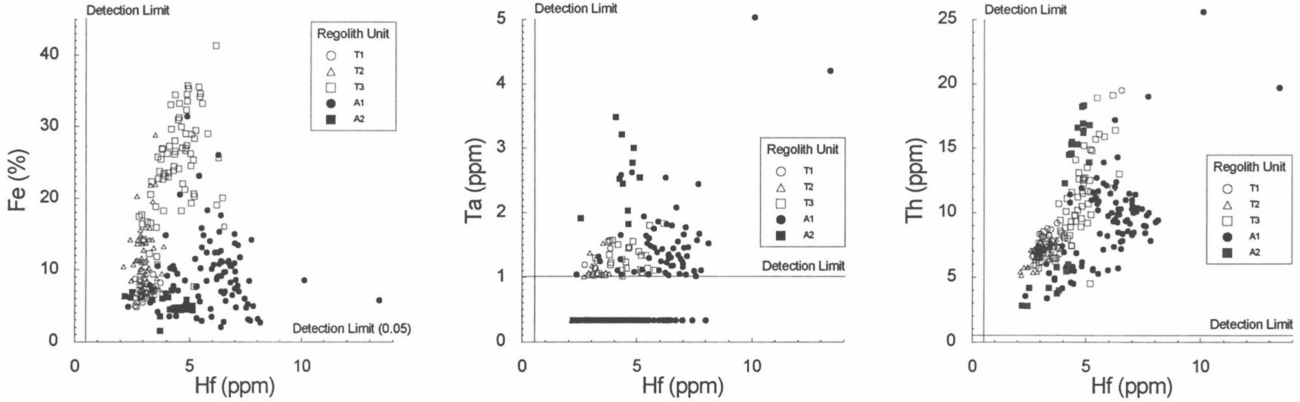
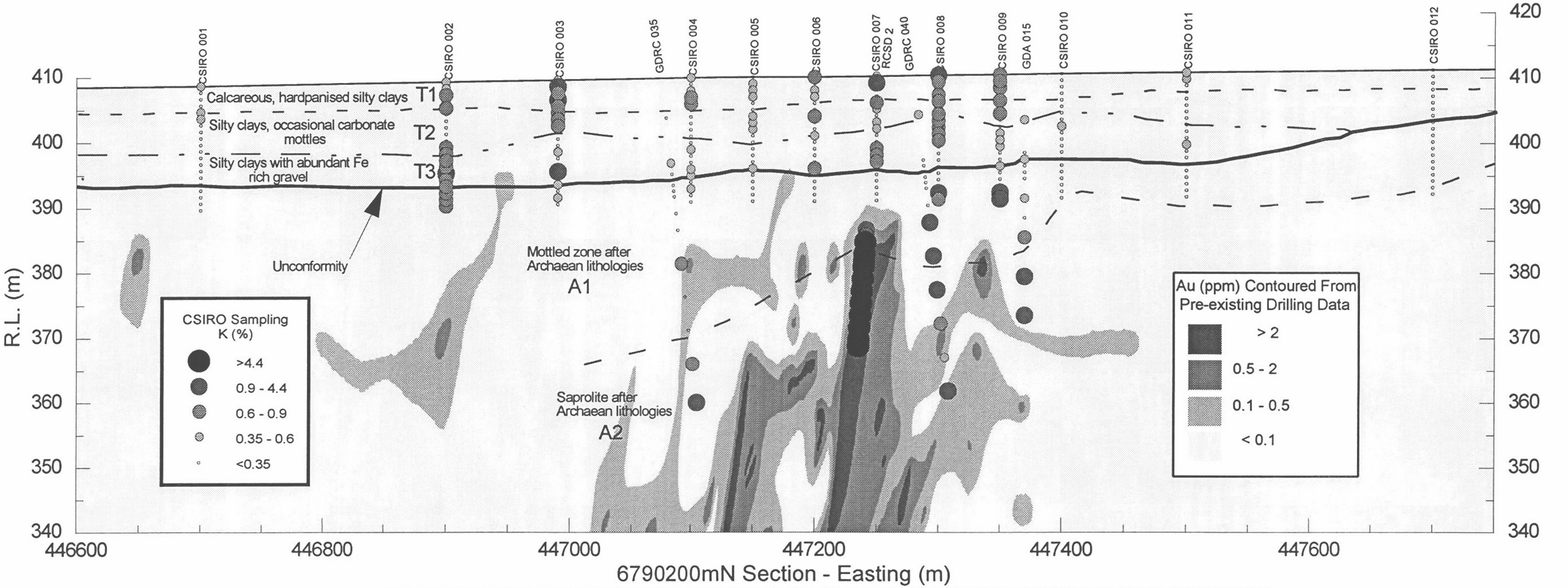
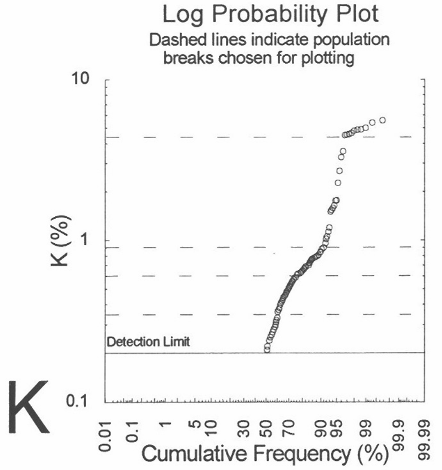


Figure A7.14: Distribution of Hf in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| K (%) | 292 | 0.5 | <0.2 | <0.2 | 5.9 | <0.2 | 0.6 | 1 | 0.2 |



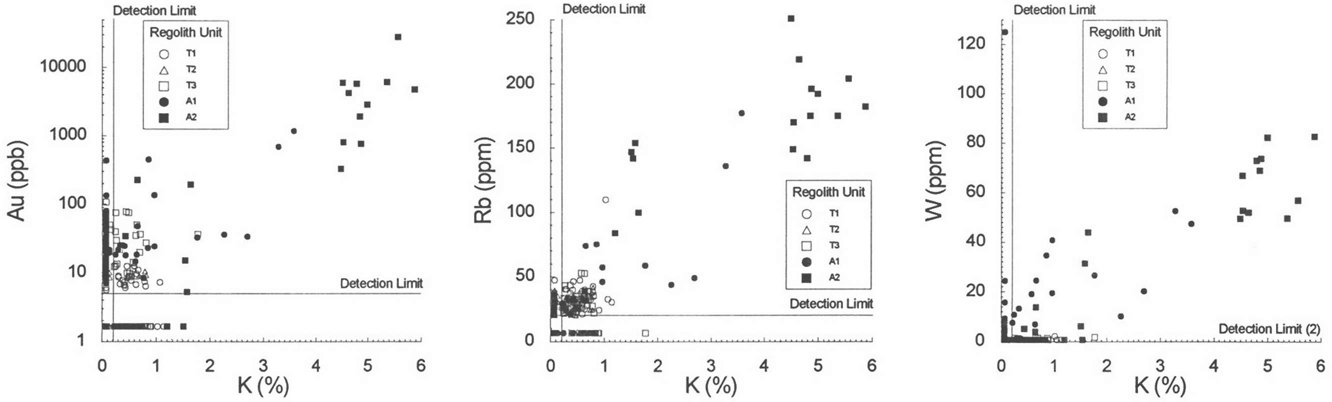
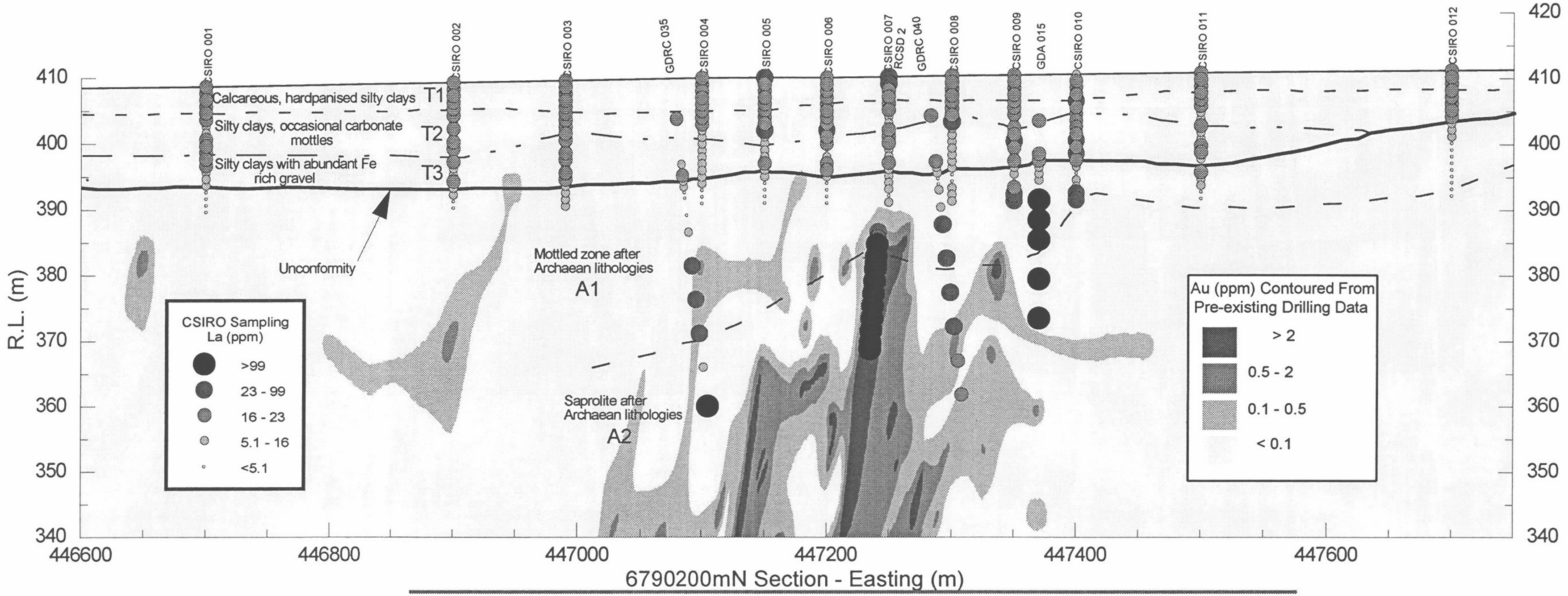


Figure A7.15: Distribution of K in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| La (ppm) | 292 | 22.1 | 17.2 | 2.1 | 204 | 9.7 | 20.2 | 27 | 0.5 |

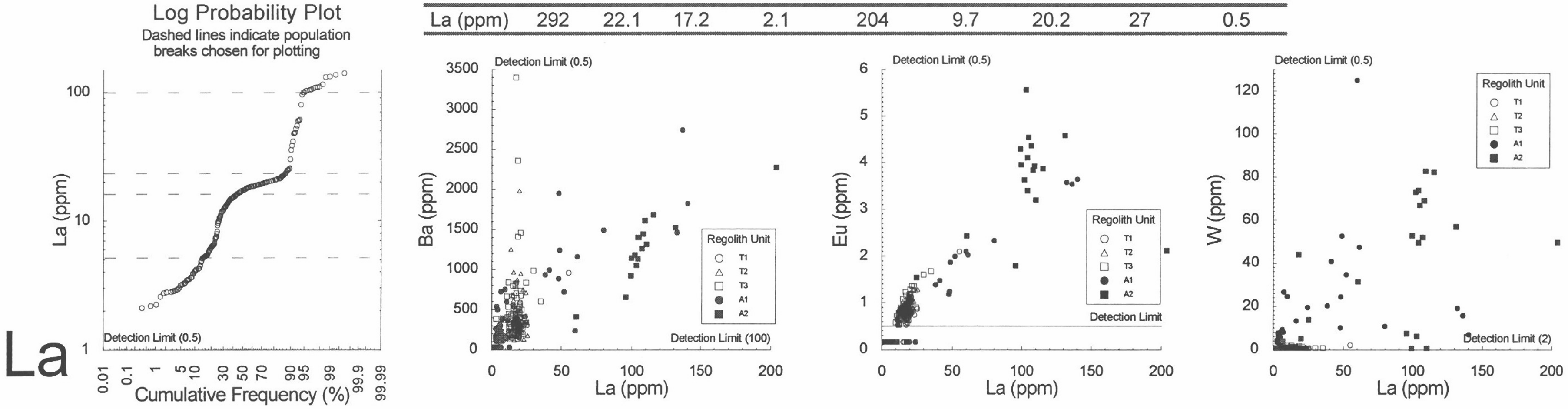


Figure A7.16: Distribution of La in the regolith and significant associations with other elements.

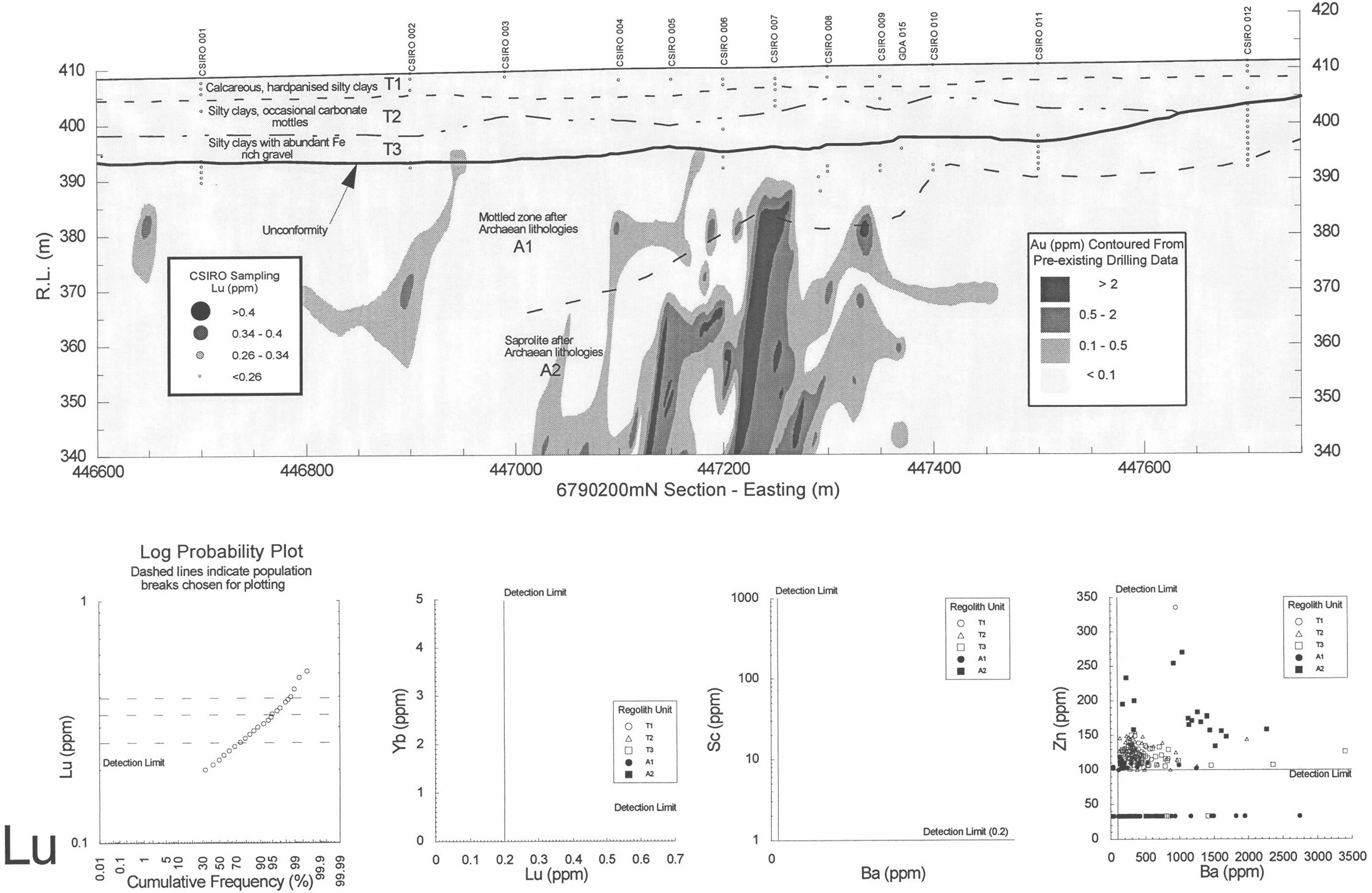
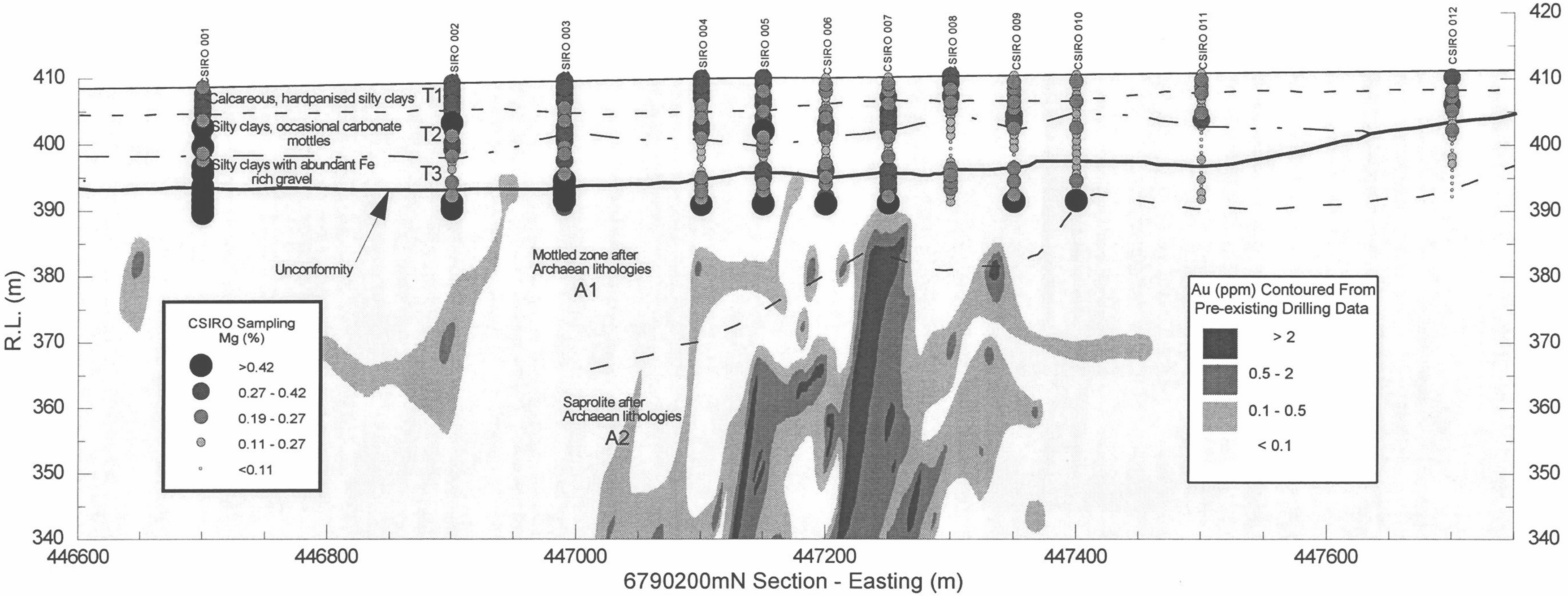
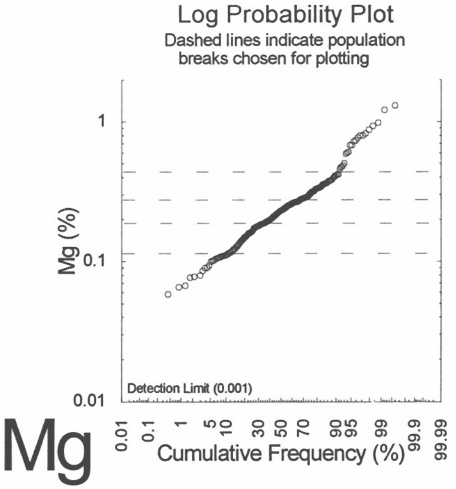
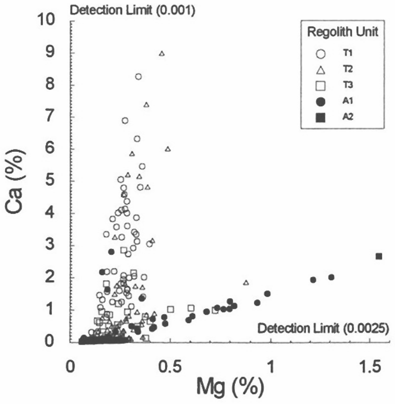


Figure A7.17: Distribution of Lu in the regolith and significant associations with other elements.



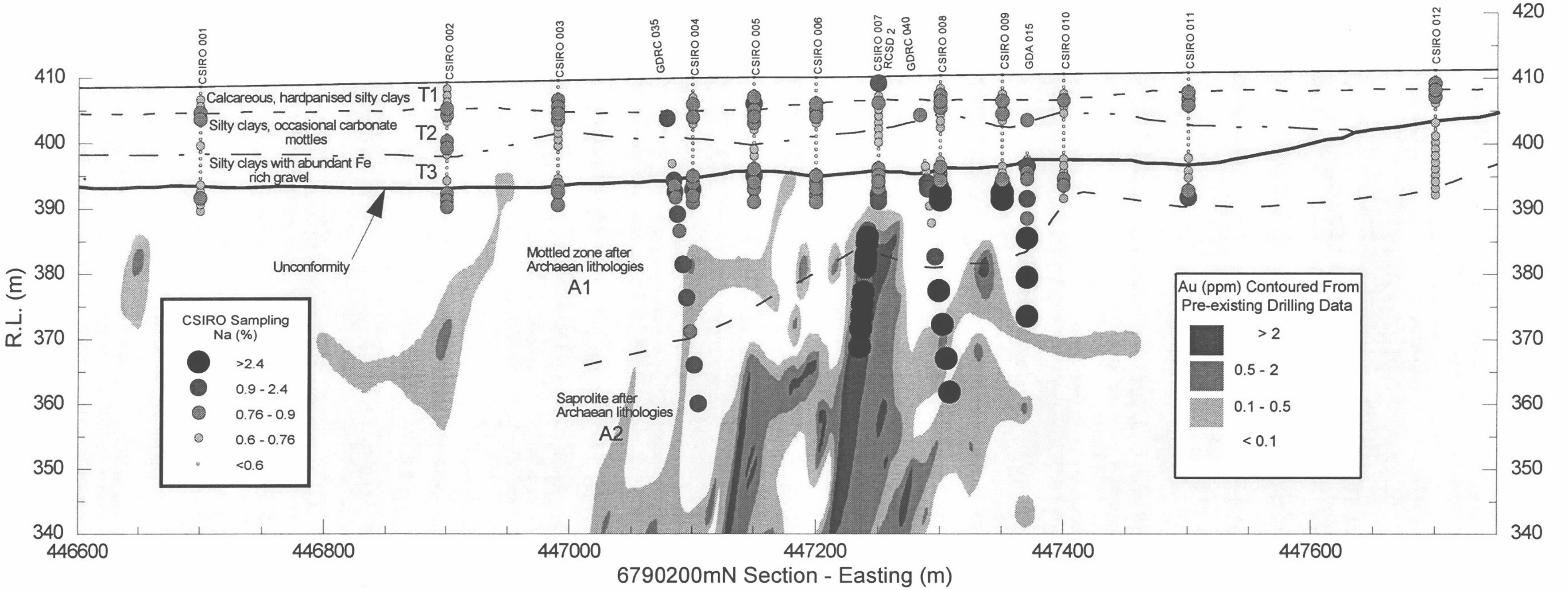
| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Mg (%) | 240 | 0.27 | 0.23 | 0.059 | 1.54 | 0.17 | 0.31 | 0.2 | 0.001 |





**Mg**

Figure A7.18: Distribution of Mg in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Na (%) | 292 | 0.86 | 0.7 | 0.13 | 4.7 | 0.54 | 0.82 | 0.7 | 0.01 |

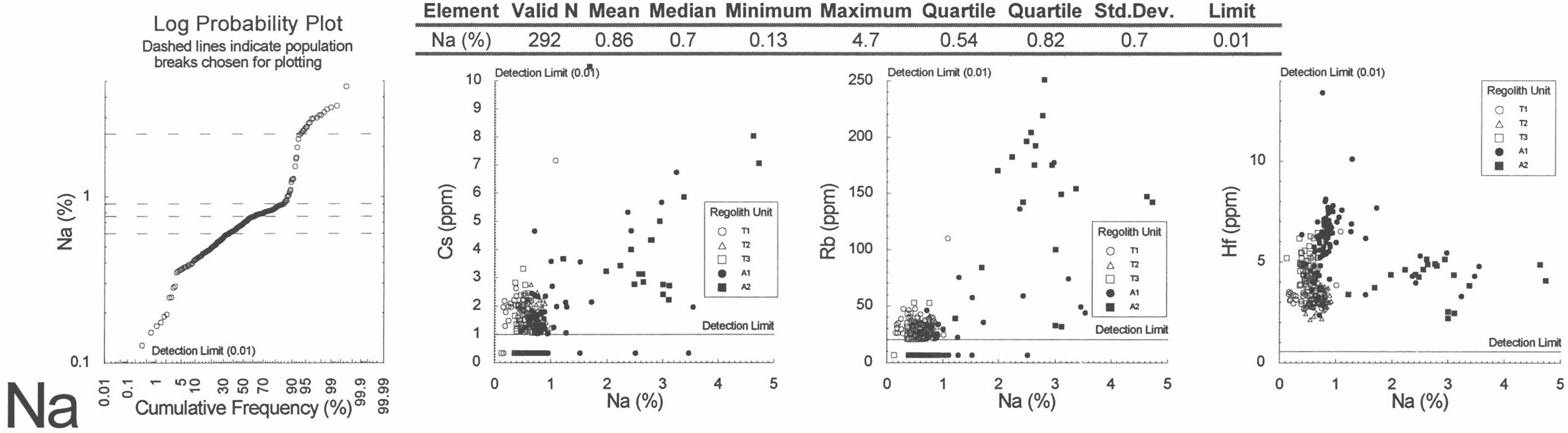
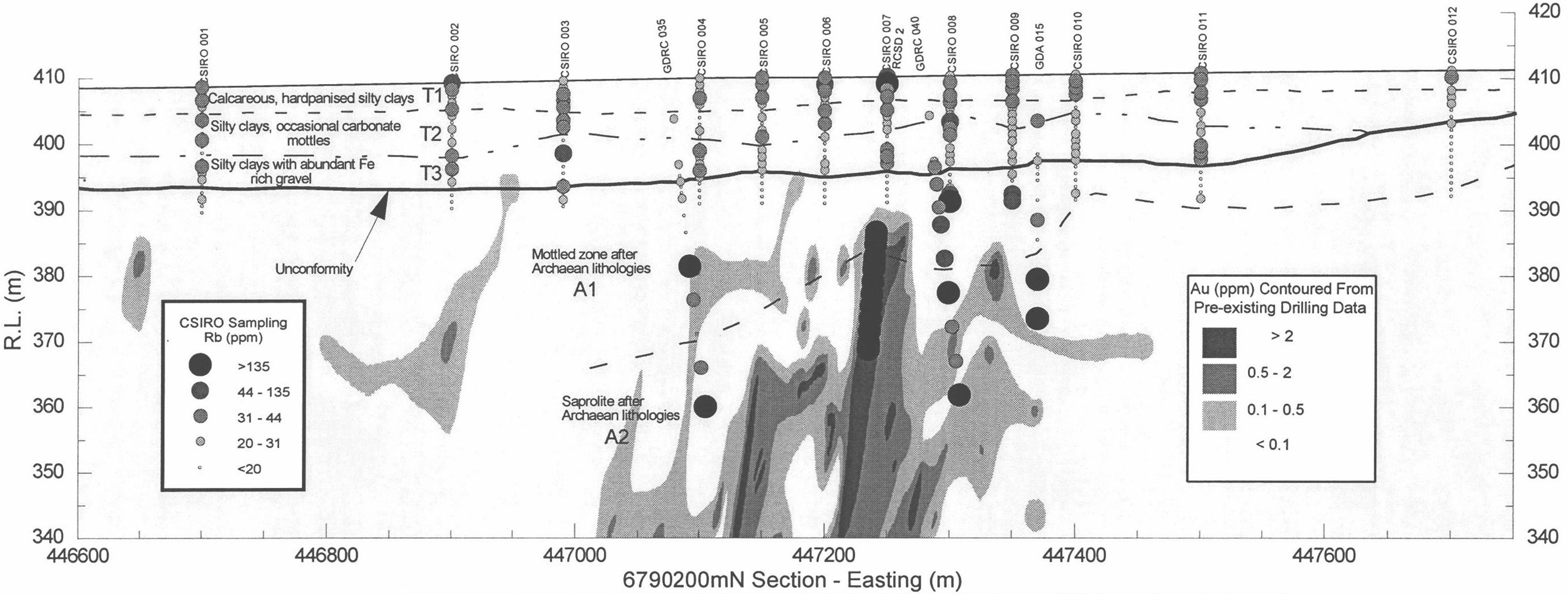


Figure A7.19: Distribution of Na in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Rb (ppm) | 292 | 30 | 24 | <20 | 251 | <20 | 33 | 39 | 20 |

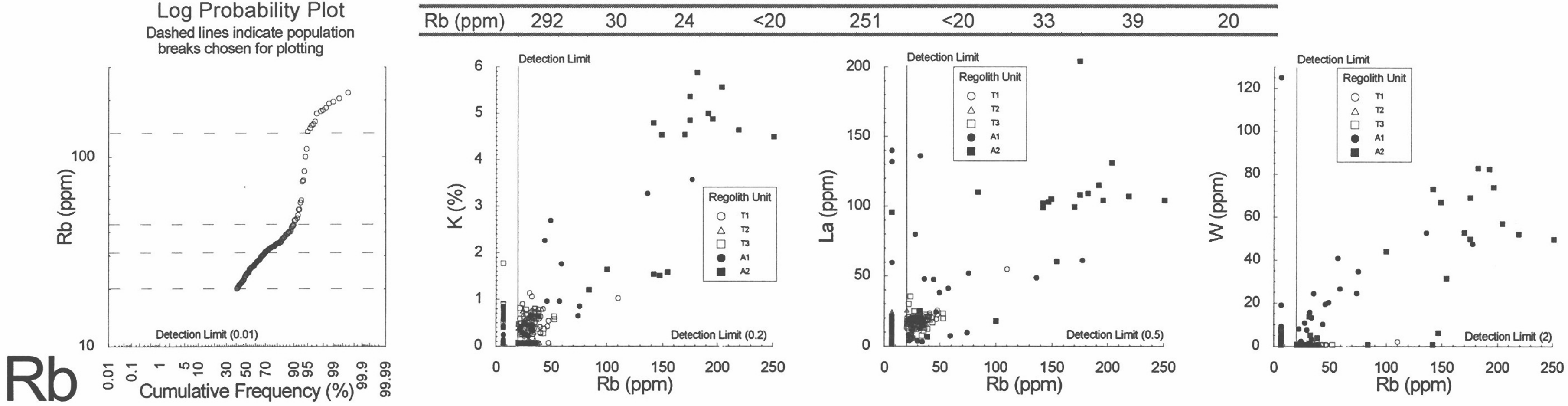
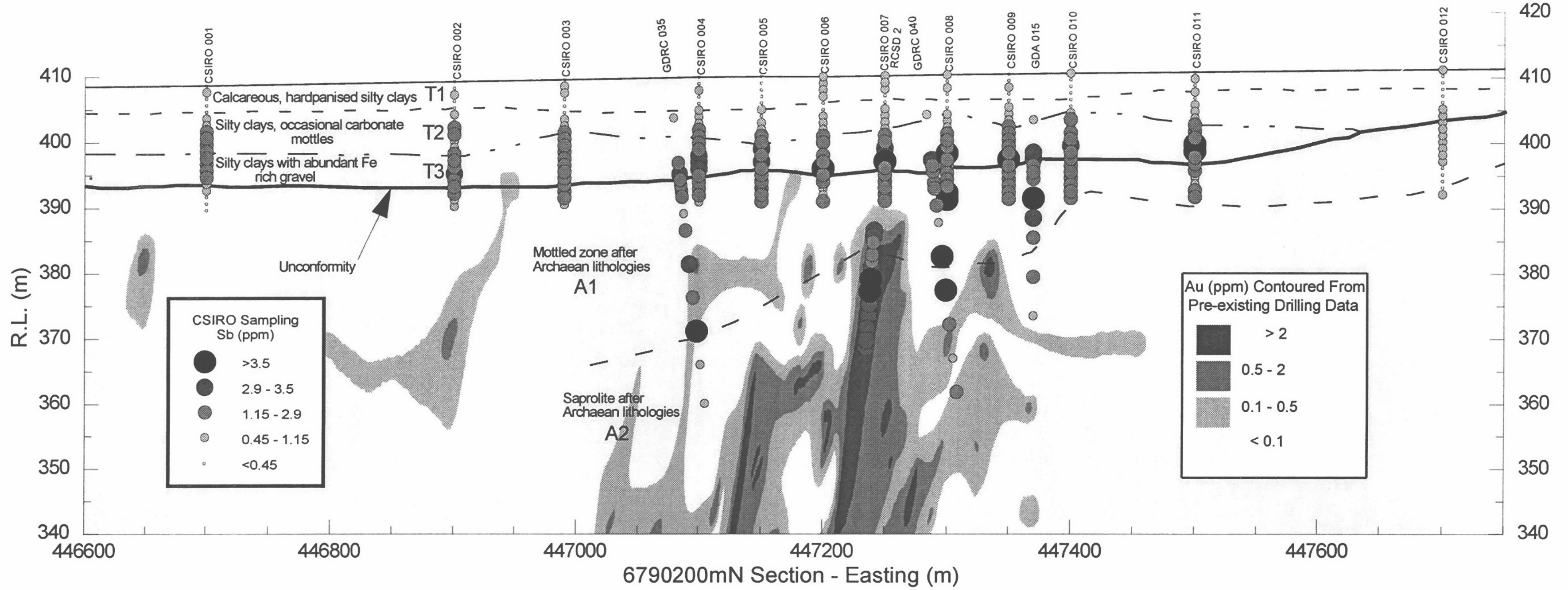
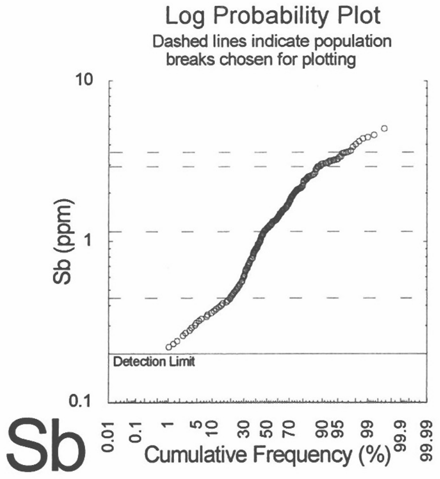


Figure A7.20: Distribution of Rb in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Sb (ppm) | 292 | 1.4 | 1.2 | <0.2 | 7.9 | 0.5 | 2.1 | 1.1 | 0.2 |



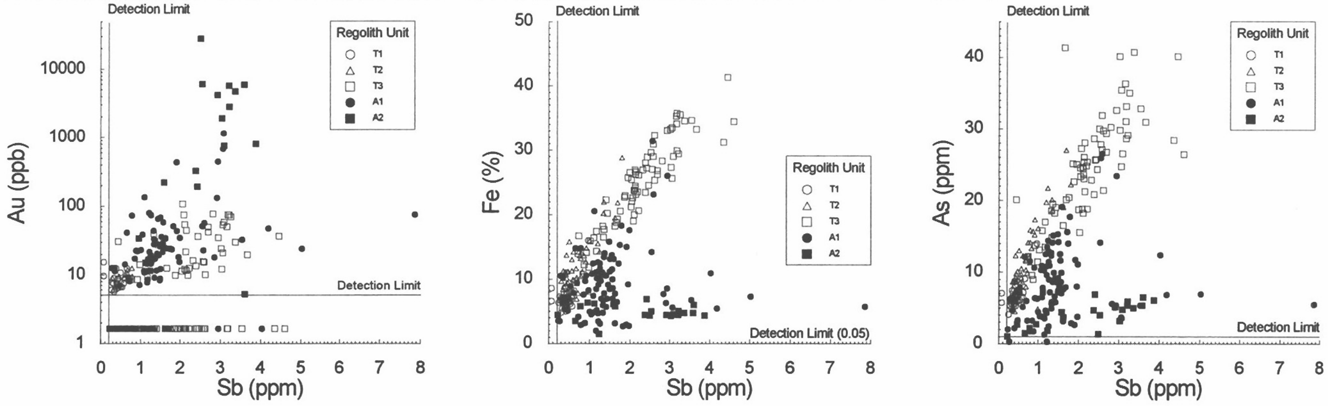


Figure A7.21: Distribution of Sb in the regolith and significant associations with other elements.

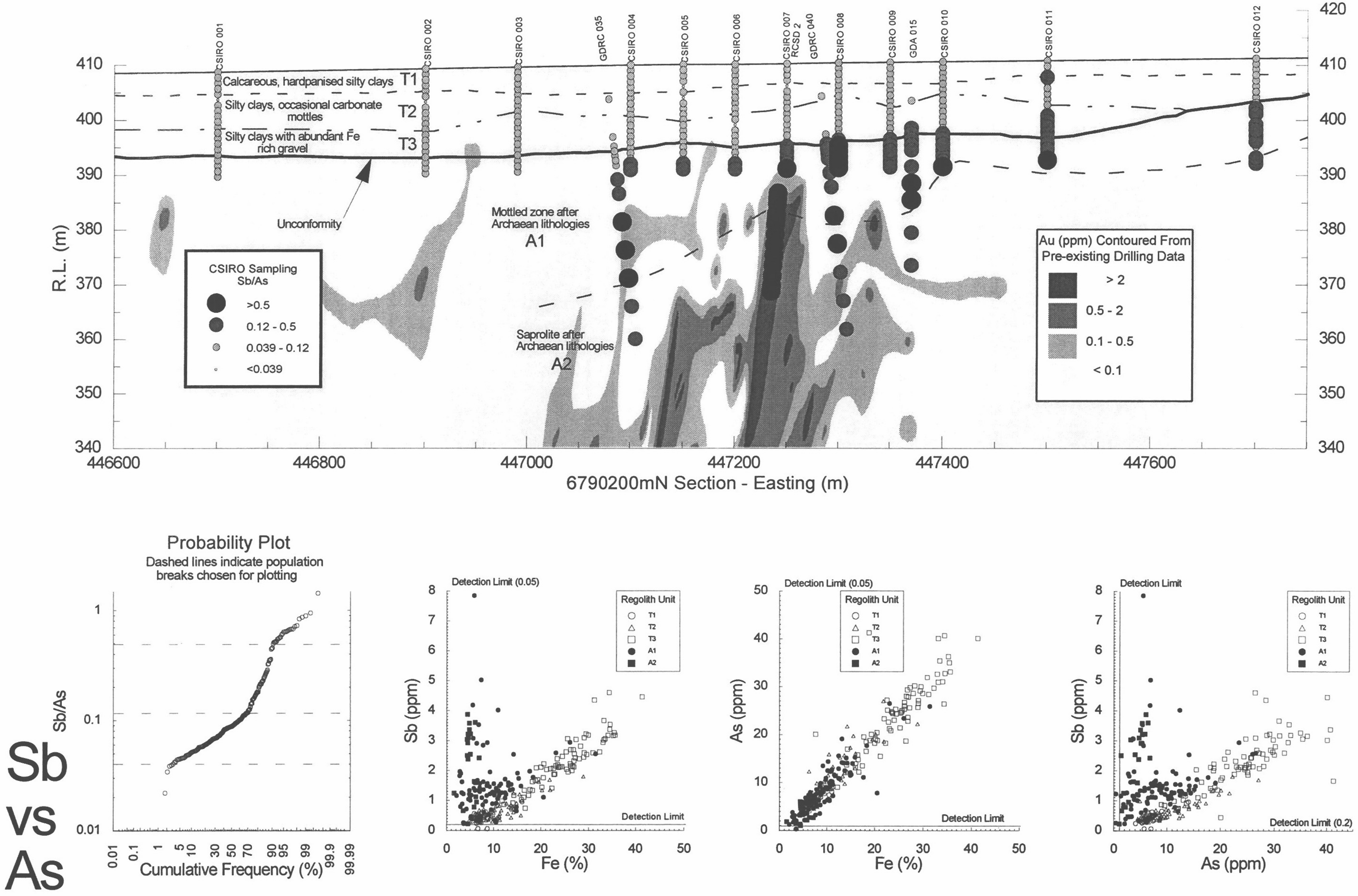
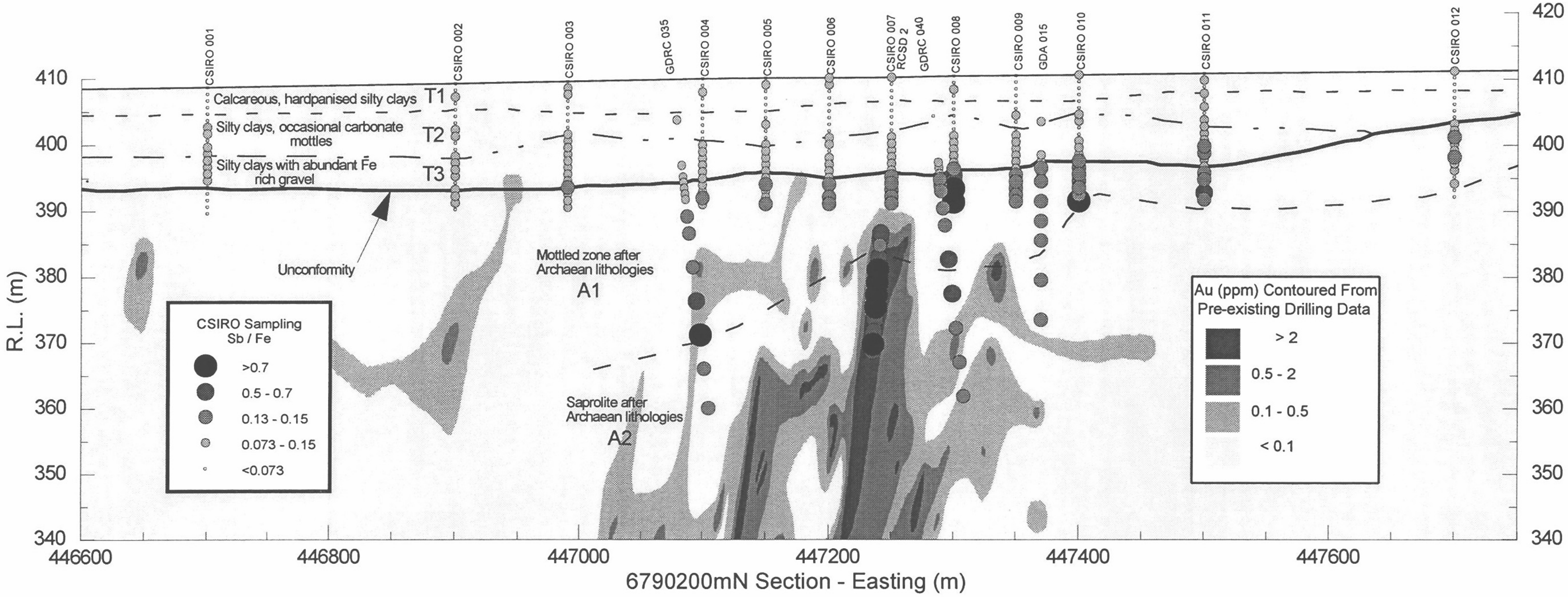
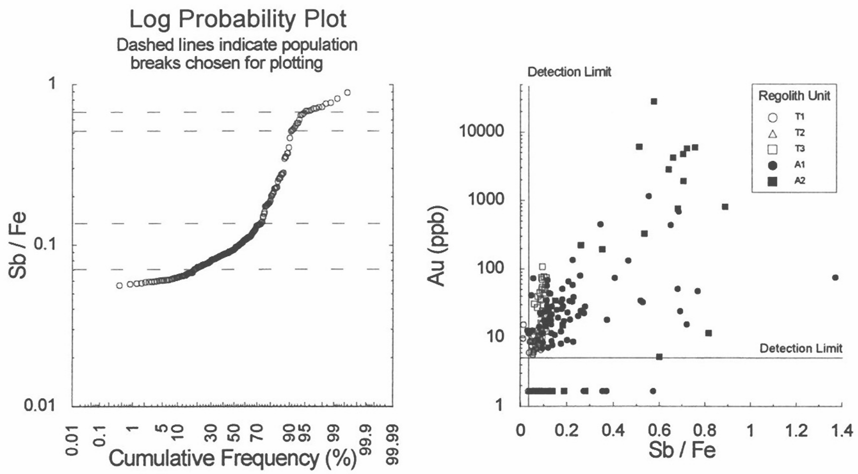


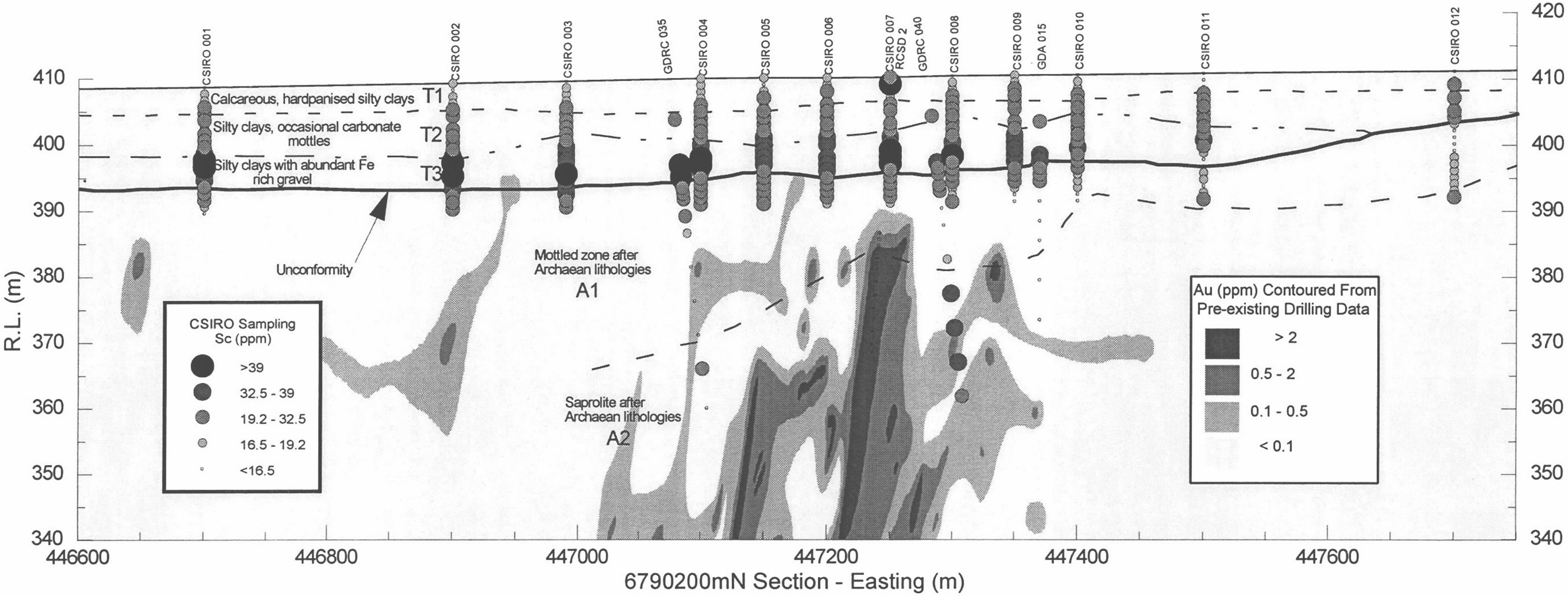
Figure A7.22: Distribution of Sb/As in the regolith and significant associations with other elements.



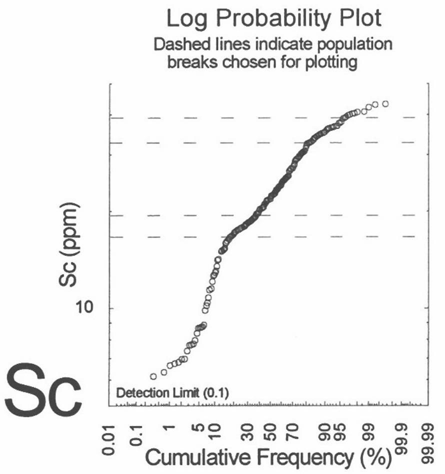


Sb / Fe

Figure A7.23: Distribution of Sb/Fe in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Sc (ppm) | 292 | 23.5 | 22.3 | 6.2 | 46.2 | 17.9 | 29.8 | 8.6 | 0.1 |



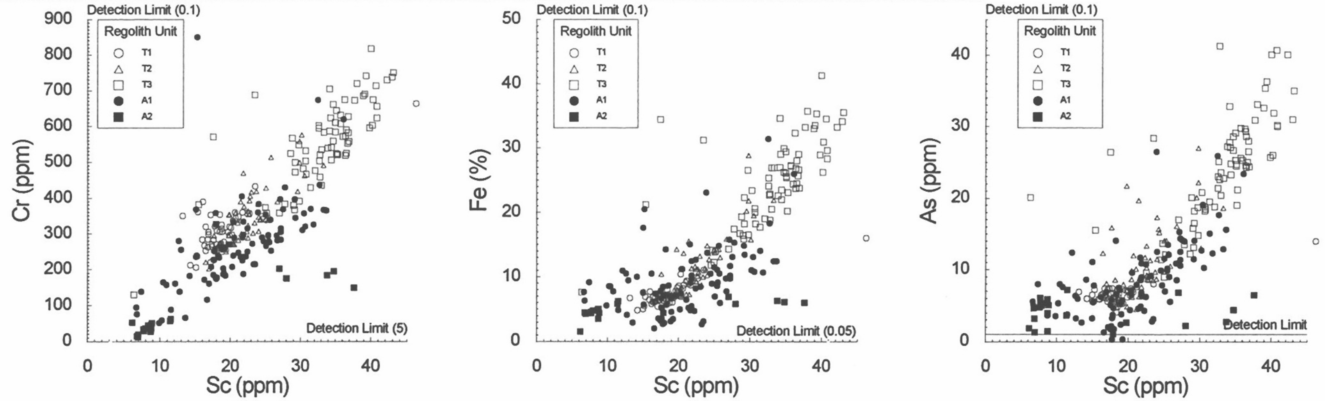
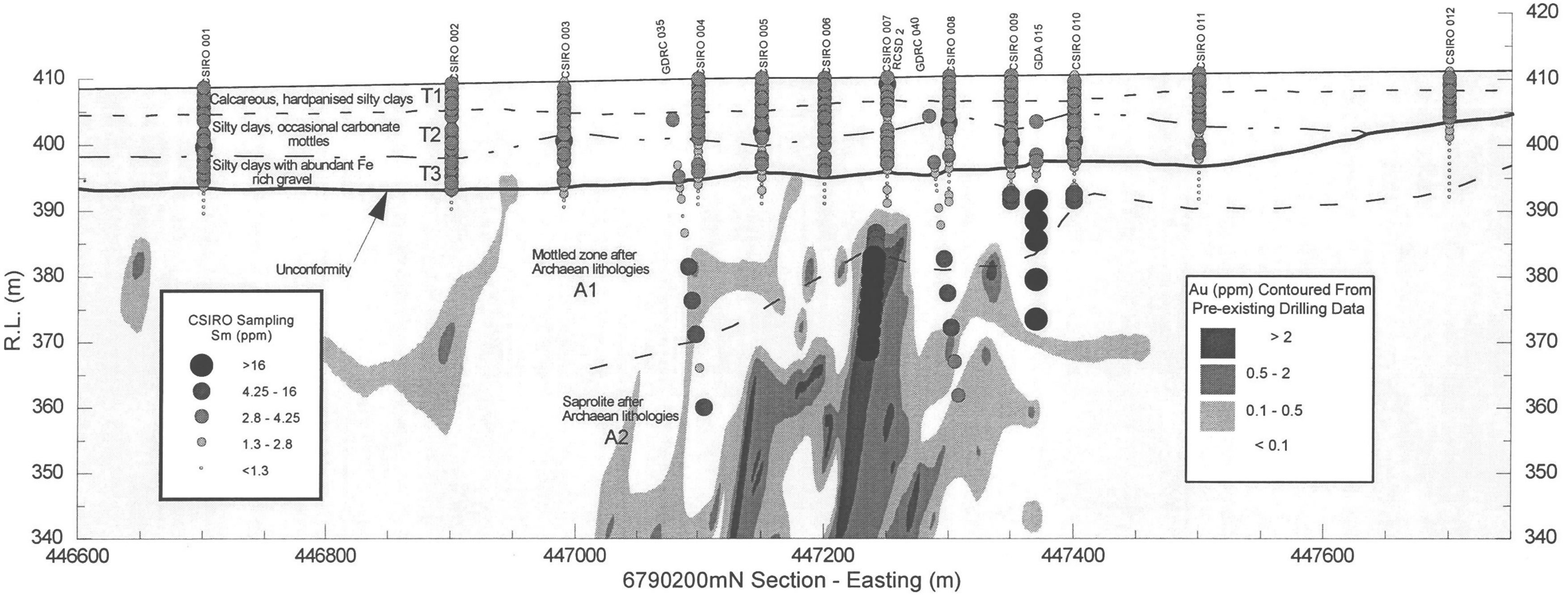
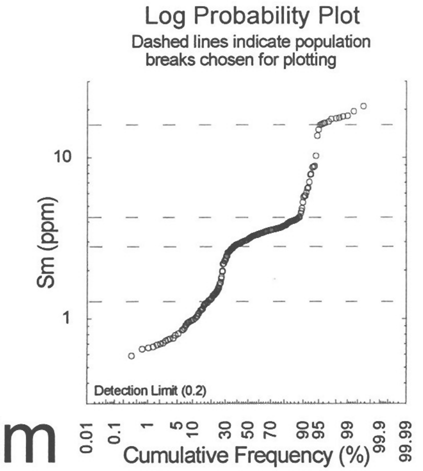


Figure A7.24: Distribution of Sc in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Sm (ppm) | 292 | 3.7 | 3.2 | 0.6 | 23 | 1.6 | 3.7 | 3.8 | 0.2 |



Sm

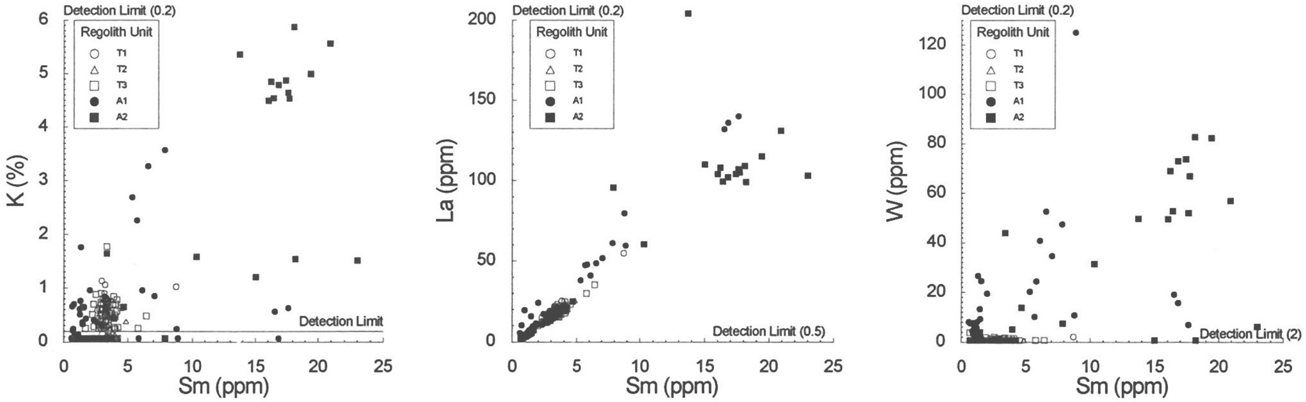
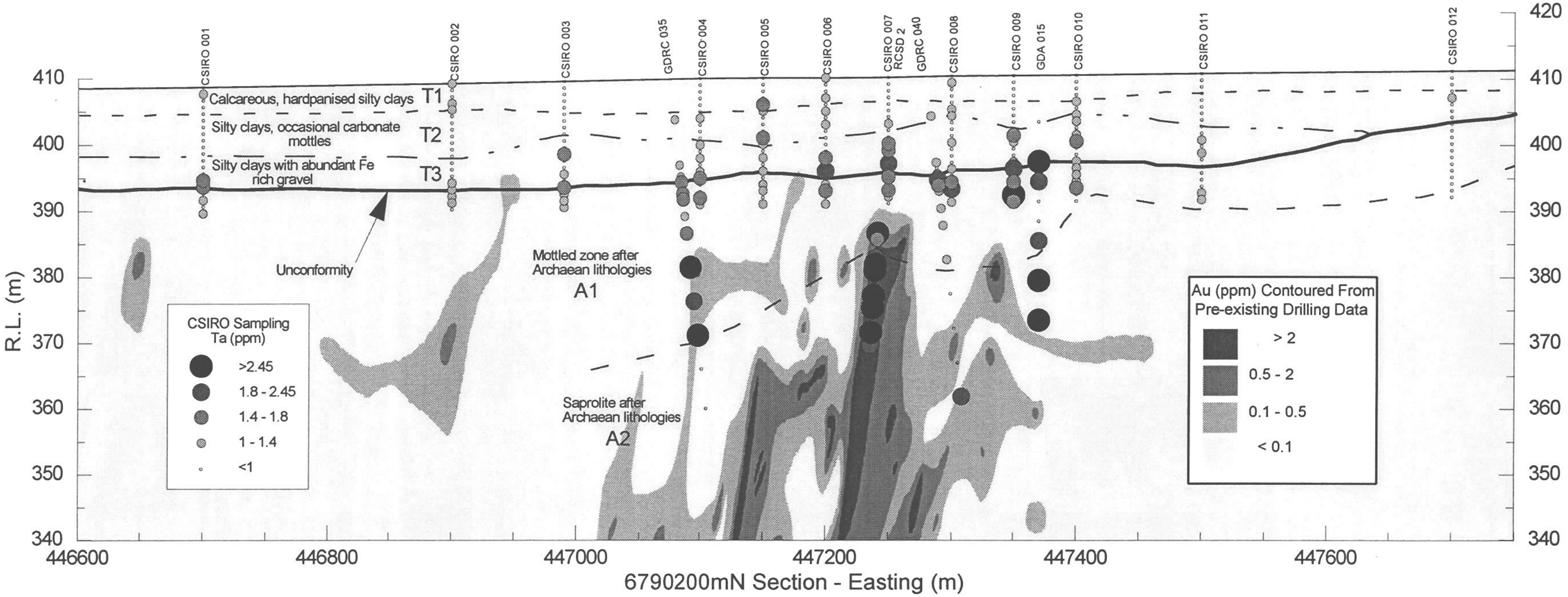
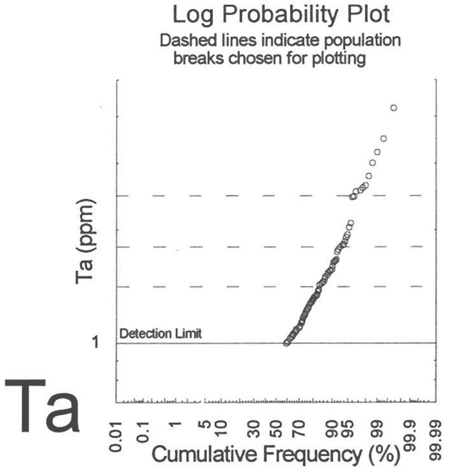


Figure A7.25: Distribution of Sm in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Ta (ppm) | 292 | <1 | <1 | <1 | 5 | <1 | 1.2 | <1 | 1 |



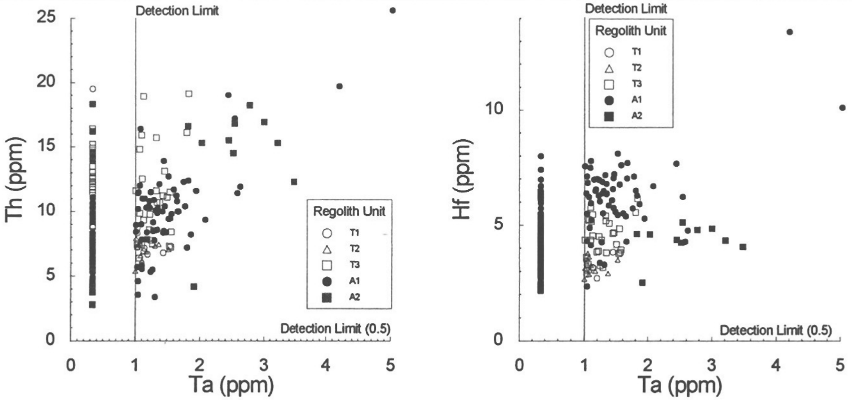
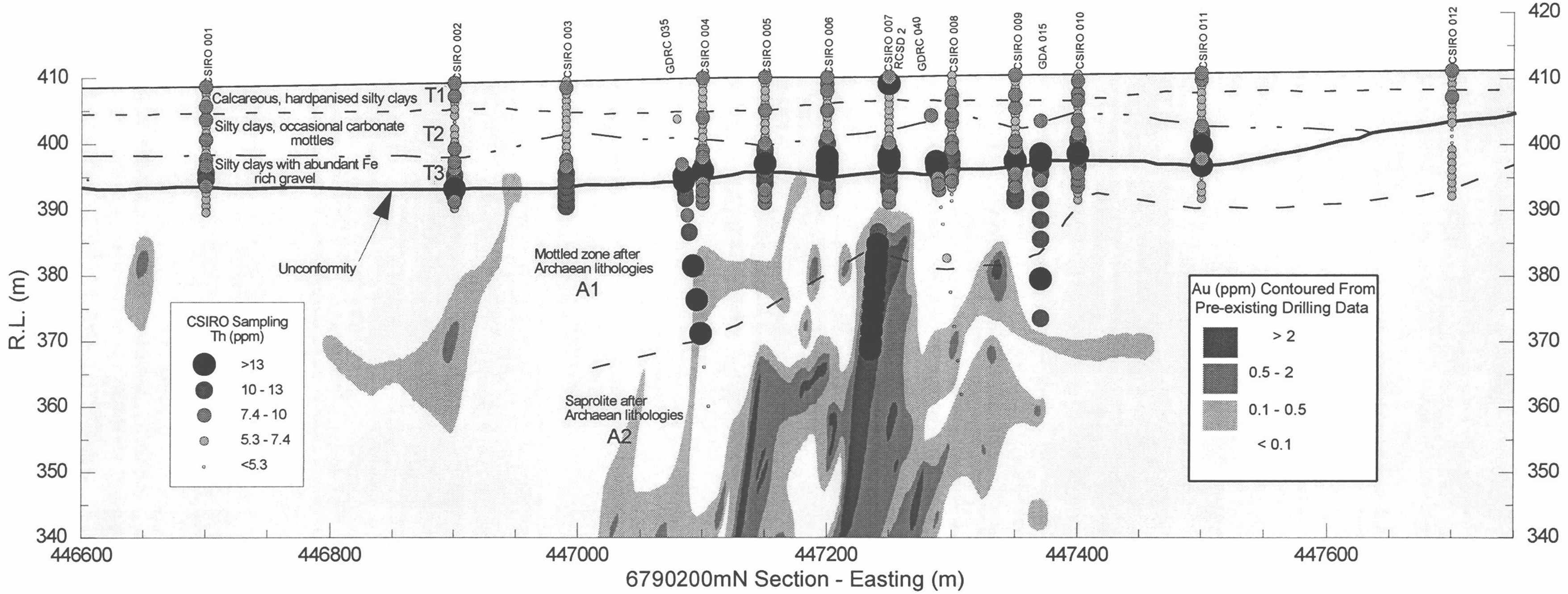
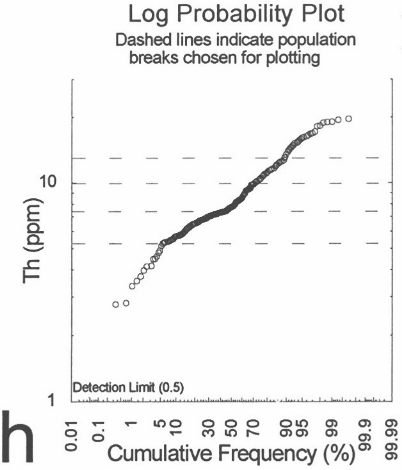
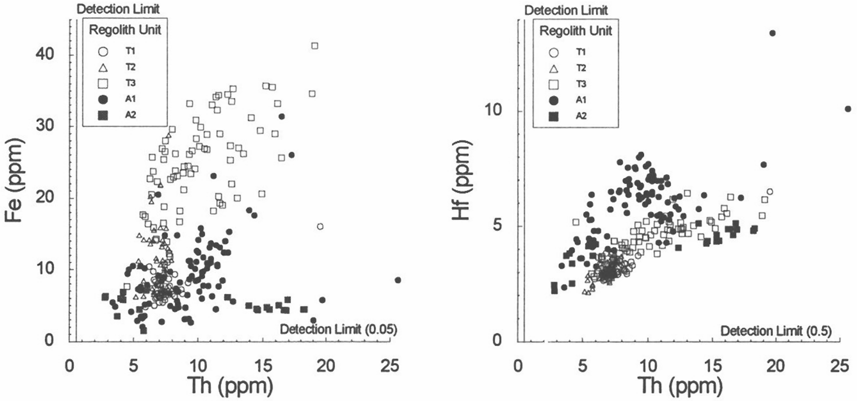


Figure A7.26: Distribution of Ta in the regolith and significant associations with other elements.



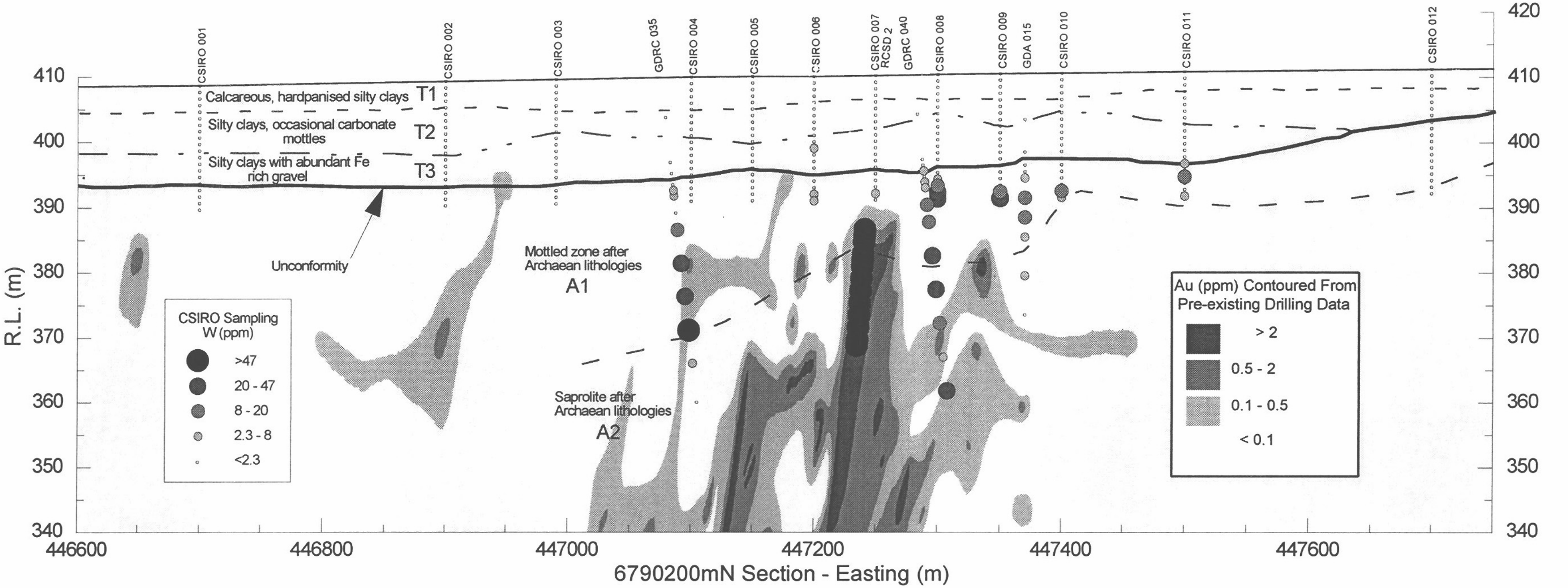
| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Th (ppm) | 292 | 8.9 | 7.8 | 2.8 | 25.6 | 6.8 | 10.6 | 3.4 | 0.5 |



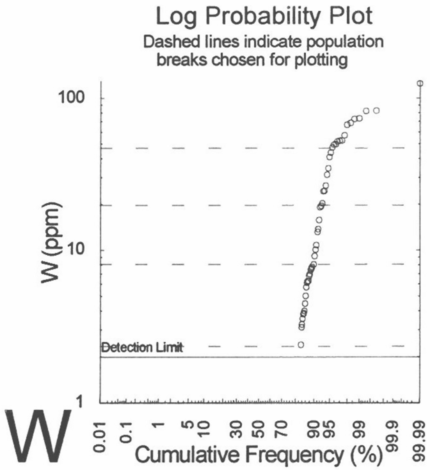


Th

Figure A7.27: Distribution of Th in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| W (ppm) | 292 | 5.4 | <2 | <2 | 125 | <2 | <2 | 15 | 2 |



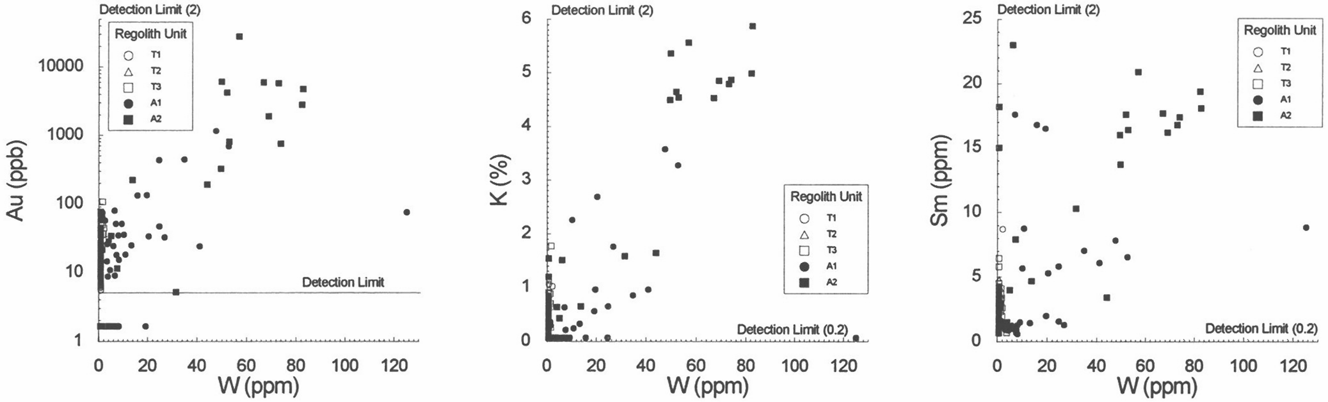
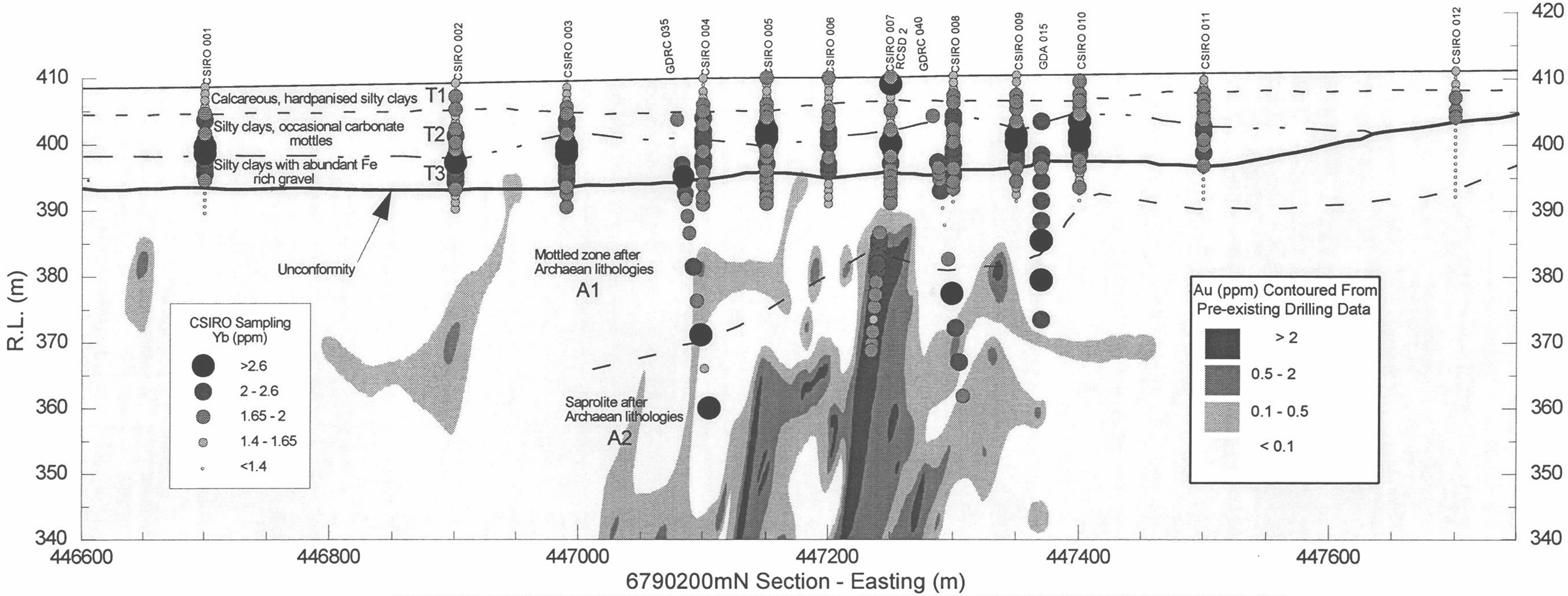
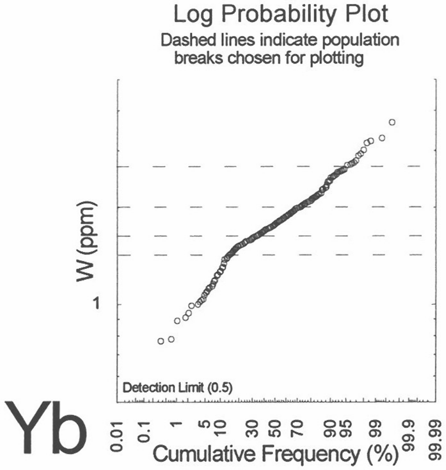


Figure A7.28: Distribution of W in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Yb (ppm) | 292 | 1.8 | 1.8 | 0.8 | 4 | 1.6 | 2 | 0.5 | 0.5 |



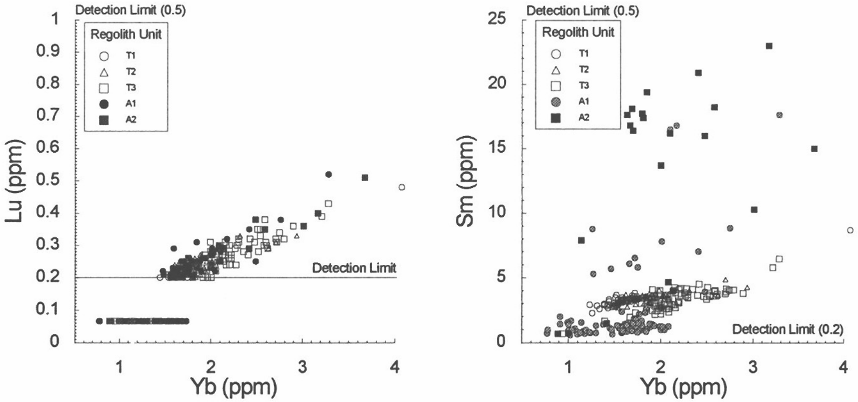
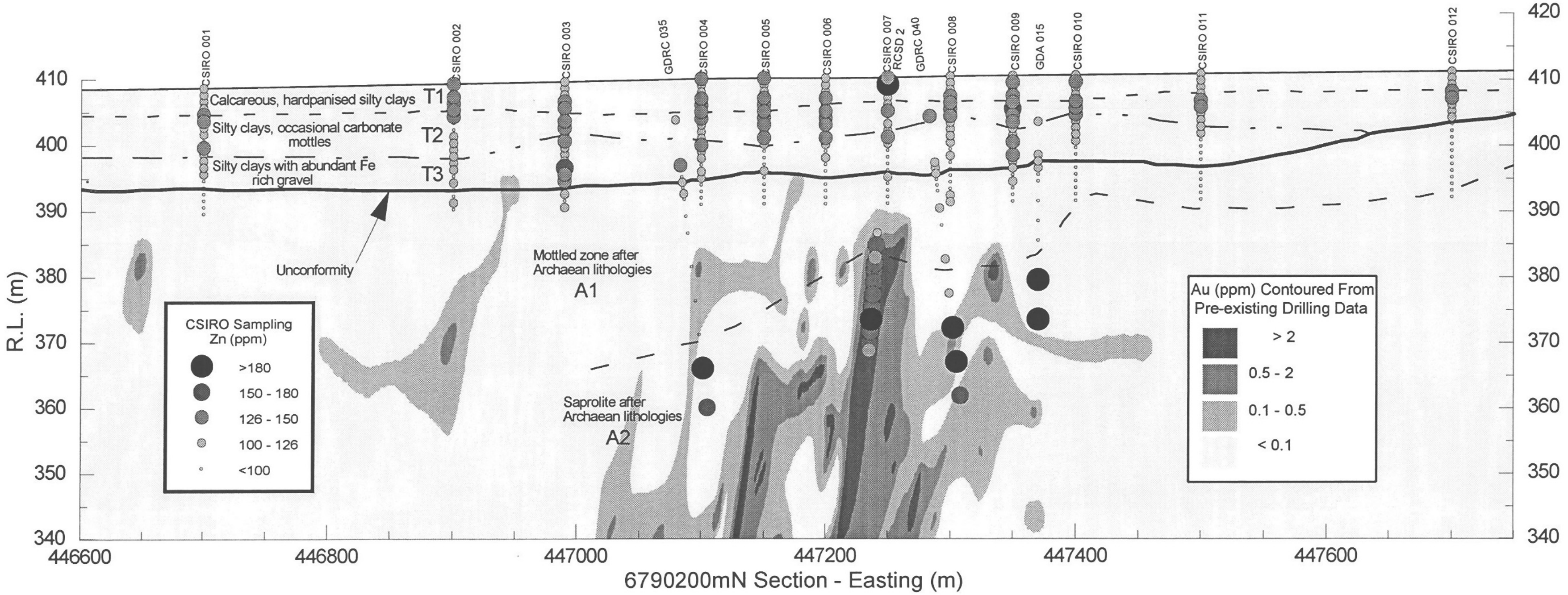
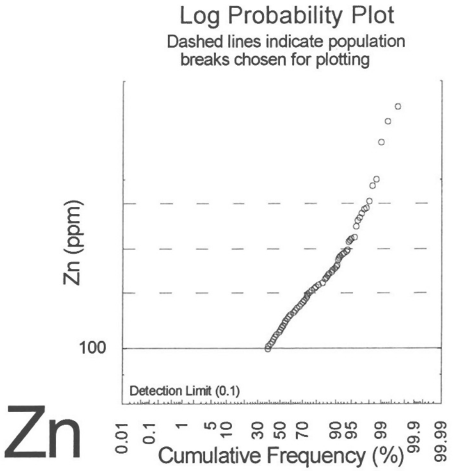


Figure A7.29: Distribution of Yb in the regolith and significant associations with other elements.



| Element | Valid N | Mean | Median | Minimum | Maximum | Lower Quartile | Upper Quartile | Std.Dev. | Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| Zn (ppm) | 292 | <100 | 0.9 | <100 | 335 | <100 | 127 | <100 | 100 |



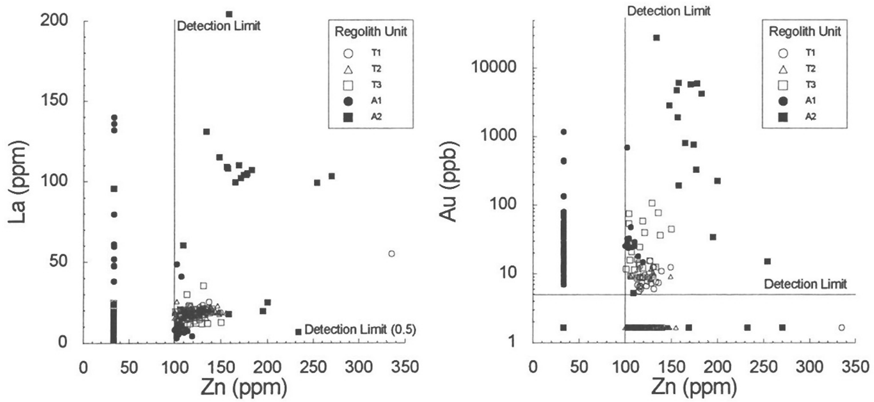


Figure A7.30: Distribution of Zn in the regolith and significant associations with other elements.