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**OPEN FILE  
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SERIES**

**LATERITE GEOCHEMISTRY  
IN THE CSIRO-AGE DATABASE  
FOR THE ALBANY-FRASER REGION**  
(Collie, Dumbleyung, Mt. Barker, Pemberton sheets)

**Volume I**

*E.C. Grunsky*

**CRC LEME OPEN FILE REPORT 28**

December 1998

(CSIRO Division of Exploration Geoscience Report 161R, 1991.  
Second impression 1998)

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## RESEARCH ARISING FROM CSIRO/AMIRA REGOLITH GEOCHEMISTRY PROJECTS 1987-1993

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" (1987-1993) 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 included 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.** 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.

Although the confidentiality periods of the research reports have expired, the last in December 1994, they have not been made public until now. Publishing the reports through the CRC LEME Report Series is seen as an appropriate means of doing this. By making available the results of the research and the authors' interpretations, it is hoped that the reports will provide source data for future research and be useful for teaching. CRC LEME acknowledges the Australian Mineral Industries Research Association and CSIRO Division of Exploration and Mining for authorisation 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 28) is a Second impression (second printing) of CSIRO, Division of Exploration Geoscience Restricted Report 161R, first issued in 1991, which formed part of the CSIRO/AMIRA Project P240.

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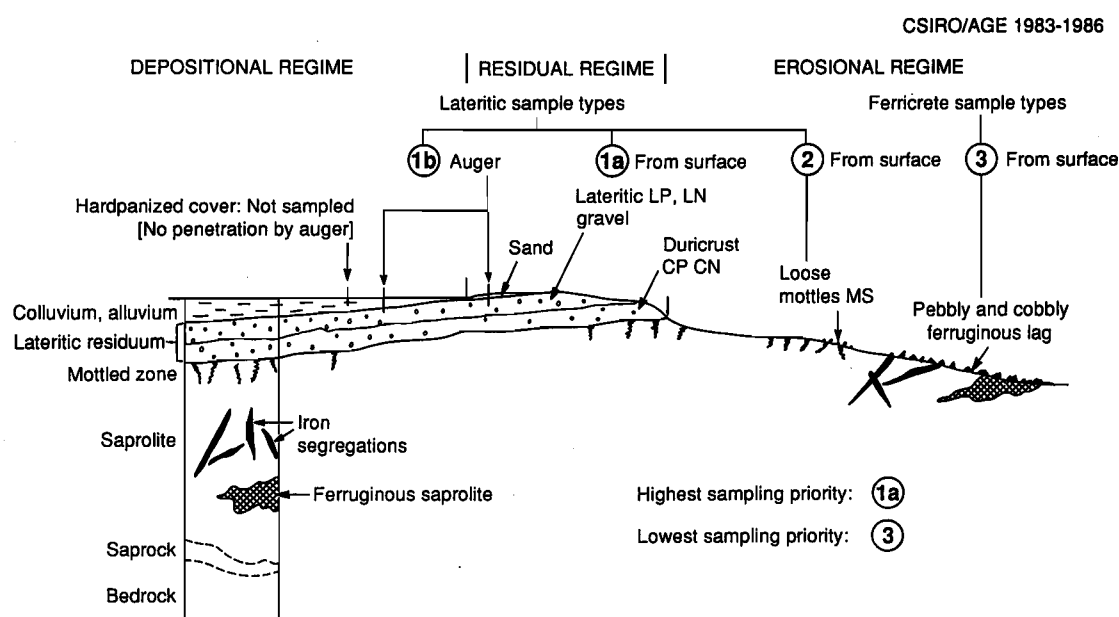
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## PROJECT LEADER'S PREFACE

R. E. Smith, March 1991

During the period 1980 to mid-1986 phases of testing the use of relatively wide-spaced sampling for laterite geochemistry in mineral exploration of the Yilgarn Block were carried out. These followed on from the CSIRO orientation studies on the Golden Grove (volcanogenic base metal sulphide) and Greenbushes (rare metal pegmatite) deposits. Sample coverage of the Yilgarn Block in these trials largely followed the strategy and tactics of the companies in the AGE joint venture with regard to ground availability, exploration potential, and the feasibility of follow up exploration. The CSIRO Laterite Geochemistry Group provided a research component for these trials, by guiding the scientific parameters including the fundamentals of sampling, data presentation, and data interpretation.

The priorities for sampling are shown in the figure below. These priorities initially were the most important factors in choosing terrain for sampling.



Terminology CSIRO/AGE 1983-1986		Equivalent Classification
Sample type	Code	CSIRO/AMIRA 1989 Codes
<b>Lateritic Types</b>		
Loose Pisoliths	LP	LT102
Loose Nodules	LN	LT104
Cemented Pisoliths	CP	LT202, LT212
Cemented Nodules	CN	LT204, LT214
Vermiform Laterite	VL	LT231
Plinthite	PN	
Mottled Zone Scree	MS	LG105
<b>Ferricrete Types</b>		
Massive Ferricrete	MF	IS101, IS102, IS103 IS201, IS301, Some LT229
Ferricrete Fragments	FF	LG201, LG203, LG206
Cemented Pebbly Ferricrete	PF	Some LT228
Ferricrete Pellets	PE	LG201
Re-cemented Fe-rich Colluvium	RC	
<b>Miscellaneous Types</b>		
Oolites Loose	OL	
Lateritized Rock	LR	
Gossan	GS	
Calcareous Nodules	CC	
Other	OT	

It should be noted, that in the AGE reconnaissance stage it was not generally feasible to sample through areas of hardpanized colluvium to reach buried laterite profiles. Hand augering was not successful in such areas, nor was drilling using a light trailer-mounted auger rig where access allowed. Thus there are large gaps within the AGE sampling that can now be effectively explored using to advantage the findings of the current Laterite Geochemistry Project.

Besides generating numerous geochemical anomalies, the testing of which will continue for years to come, the CSIRO/AGE database provides knowledge of backgrounds, regional variation, and element levels in laterite tied, where feasible, to gross bedrock type. Such information thus complements that arising from the Laterite Geochemistry Project's orientation areas and is of relevance both to research and exploration.

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### Diskette

5.25" Diskette (in back pocket)

Diskette: AFYILG.SDF & AFPROT.SDF Geochemical Data

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## ABSTRACT

A multi-element geochemical study has been carried out on laterite and associated ferruginous samples that cover parts of the granitoid/gneiss terrain of the COLLIE, DUMBLEYUNG, MOUNT BARKER, and PEMBERTON 1:250 000 map sheets. The report presents a summary of the data and a provisional interpretation of selected parts of the data. The data used in this study are contained in the accompanying diskette (in the back pocket).

The sampling arose as part of a combined research programme between CSIRO and an experimental exploration programme (the AGE Joint Venture Programme) during the period 1983 to 1986. The database which was used for the study is composed of laterite and associated ferruginous samples collected over predominantly gneissic and felsic intrusive rocks that span the Archaean Yilgarn Block and the Proterozoic Albany-Fraser Province. The data were split into two groups representing the distinctions between the two geological provinces. Laterite is the most abundant material. The laterites are predominantly composed of loose nodules and pisoliths and number 543 samples in the Yilgarn block, and 456 samples in the Proterozoic province.

A total of 1026 samples were analyzed for 30 elements. Summary statistics, histograms, and maps of the percentile classes are presented for selected elements in laterites. Several numerically-based procedures were applied for the purposes of outlining regional trends and detecting areas of relatively-high abundances of selected elements (anomalies). Numerical techniques included the use of principal components analysis, and ranking of individual elements, ranking of CHI-6\*X, PEG-4, and NUMCHI indices, and multivariate ranking of selected chalcophile elements ( $\chi^2$  plots).

The resulting ranked scores of these techniques have been plotted on maps and scatter plots. The most anomalous samples tend to occur as outliers when these methods are applied. The results of these applications confirm the presence of some broad regional geochemical trends that are most probably related to lithological variation within the granitoid/gneiss terrane.

There are significant geochemical distinctions between the laterites developed over the Archaean terrain (Yilgarn) and the laterites developed over the Albany-Fraser Orogenic belt based on the examination of histograms, order statistics, and a discriminant function analysis. Yilgarn laterite samples contain greater mean abundances for Ti, Mn, V, Zn, Sn, W, Ga, Nb, Zr, and Ba. Albany-Fraser laterite samples contain greater mean abundances for Cr, Ni, As, Sb, Bi, Mo, Se, and Au.

The essential geochemical features of the area are:

### Yilgarn laterites

- Gold occurs as individual Au anomalies as well as multi-element associations with Sb, W, Mo, Pb, and As in Whistlers, Darling Hill, Muradup, Boscabel, north of Trollup Hill, Peringillup, and Cranbrook areas.
- Areas with the greatest Sn, W, Nb, Ta potential occur in the Whistlers, Darling Hill Darkan, Quindanning, Boscabel, north of Trollup Hill, and Peringillup areas.
- Molybdenum occurs with Sn and As in the Whistlers, Darling Hill, Darkan, Boscabel and north of Trollup Hill areas.
- Tungsten is associated with As, Mo, Sb, Pb, and Au and as isolated anomalies. Tungsten anomalies occur in the Whistlers, Darling Hill Darkan, Quindanning, and Boscabel areas.
- Silver appears to have a very limited multi-element association with the exception of a slight association with Pb and Ga. Elevated Ag occurs in the Whistlers, Darling Hill, Darkan, and Boscabel areas.

### Albany-Fraser Laterites

- Elevated multi-element abundances of Au occur with Sn, Sb, W, and Sn. The areas which contain these multi-element associations include the Carbarup Hill, Mt. Barker, Denbarker, Lake Katherine, and Lake Muir areas.

- Tin and Nb occur as single and multi-element associations southeast and southwest of Denbarker, north of Mt. Barker, and the Lake Muir areas. Tin is also associated with Nb, Mn, Zr, Au, Mo, Sb, and Se in the Denbarker to Lake Katherine and Lake Muir areas.
- Molybdenum occurs as single and multi-element associations with As, Sb, Pb; As, Ni, Zn, and Cr; Ni, Sb, and Co in the Carbarup Hill, Denbarker to Lake Katherine, north of Lake Muir, and Mt. Barker areas,
- Tungsten occurs with little or no multi-element signature. Elevated abundances of W occur in the Denbarker and Lake Muir areas.
- Silver occurs with virtually no multi-element signature. Elevated abundances of Ag occur south of Denbarker, west of Lake Katherine, and the Lake Muir areas.

Other elements are difficult to assess individually. Since most economic commodities being sought have multi-element geochemical signatures, it makes sense to employ methods that make use of these multi-element characteristics. The results of the principal components analysis, the CHI-6\*X, PEG-4, and NUMCHI indices, and Mahalanobis distance methods all show zones that have multi-element enrichment and indicate that the areas mentioned above may warrant additional follow-up investigation. Exploration for Au and associated precious metal deposits may be assisted by the use of several of these multi-element methods.

The data and results presented in this report, plus additional geophysical, lithological, lithogeochemical, and structural data, may provide sufficient information for a selective and cost efficient exploration programme.

## 1.0 INTRODUCTION

The report summarizes the results of the progress of an on-going project to assess the geochemistry of laterites and associated ferruginous materials for the purposes of developing and improving exploration concepts, sampling strategies, and isolation of potentially-mineralized areas. The report presents the results of reconnaissance-scale laterite geochemistry on the COLLIE, DUMBLEYUNG, MOUNT BARKER and PEMBERTON 1:250 000 map sheets. The sampling was carried out in the 1983-1986 period as part of an application feasibility test of laterite geochemistry for mineral exploration. This work was collaborated between the AGE Joint Venture (Greenbushes Ltd., St. Joe Minerals, and later Sons of Gwalia, NL) and the Multi-element Geochemistry Group, CSIRO.

This report is produced in a format similar to that of the previous Exploration Geoscience Reports 2R, Southern Murchison region; 68R, Northern Murchison region, 121R, Central Yilgarn region; and the Wiluna region, 154R (Grunsky *et al.*, 1988, 1989; Grunsky, 1990a,b).

Regional geochemical databases have been developed for a variety of uses in several countries. One of their ultimate aims has been to define geochemical provinces in which the bedrock sequences contain anomalous populations of specific elements that can be related to zones of mineralization.

The results of this report are part of a reconnaissance-scale survey that resulted in a geochemical database. The database contains samples that cover wide areas of the Yilgarn Block of Western Australia and a portion of the Proterozoic Albany-Fraser Province, and forms part of the foundations for on-going research into the use of laterite geochemistry in mineral exploration. The project has focused on the sampling and analysis of the laterite cover and other residual materials that are extensively, but variably, developed throughout the Yilgarn Block. Sampling within this area covers mostly gneissic and granitoid terrane with some migmatite. This information provides a set of reference groups with which unknown samples may be compared. The sample materials referred to in this report adhere to the previous CSIRO/AGE terminology that was used primarily from 1983-1986. Eventually, the samples in the AGE database will be reclassified using the more recent terminology of Anand *et al.* (1989). Table 1 lists the sample types that have been used in this report.

### 1.1 Concept and scope

The research objectives of establishing a regional geochemical database were:

- to provide knowledge of regional variations in laterite geochemistry which may be due to regional changes in climate or landform characteristics;
- to establish the types of variation in laterite composition encountered in areas away from orientation studies about specific ore deposits;
- to relate laterite composition to both regional and local bedrock geological variation;
- to test and further develop the most efficient sampling strategies that will allow cost-effective exploration.

Further discussions on the philosophy and strategy of developing a multi-element geochemical database for the Yilgarn block have been discussed by Smith (1987).

### 1.2 Background to the study

Primary and secondary haloes can develop, persist, or be greatly enhanced in size through the development of laterite profiles as documented by Smith *et al.* (1979) who found kilometre-scale chalcophile element haloes in the pisolitic laterite cover associated with the Golden Grove Cu-Zn orebodies. These haloes can occur locally, as well as occurring in a consistent and contiguous manner within greenstone areas. Smith *et al.* (1989) have outlined a number of "chalcophile corridors" within the Yilgarn Block and propose that these areas have significantly-higher economic potential.

These observations, together with those of Mazzucchelli and James (1966) and Zeegers *et al.* (1981), provided the rationale for sampling various laterite materials and analyzing a suite of chalcophile and associated elements as well as additional indicator elements. By concisely defining the geochemical characteristics of the various laterite materials, it is expected that better control can be established on classifying the characteristics of unknown suites of samples with the ability to recognize geochemical anomalies that may be associated with mineralization.

A geological map of the area is shown in Figure 1, based upon reports by Chin and Brakel (1986), Wilde and Walker, 1982, 1984), Muhling and Brakel (1985), and the more recent Memoir 3 of the Geological Survey of Western Australia (1990). Some of the more significant localities are shown on the map for reference purposes with the subsequent maps of this report.

The area spans part of the Archaean Yilgarn Block and part of the Proterozoic Albany-Fraser Province. Both areas are dominated by large expanses of gneissic terrane which represent assimilated plutonic and supracrustal rocks.

The region was sampled using a 3-km triangular grid with selected follow-up sampling at spacings of 1 km and 300 m. A variety of laterite materials was sampled and classified as to the type of sample. Most samples belong to one of two groups consisting of either laterite or ferricrete materials. The most common forms of the laterites are nodular or pisolitic. The ferricrete material is typically Fe-rich, rubbly, or pebbly lag from partly truncated profiles. The sampling media are discussed below.

## **2.0 CLIMATE AND PHYSIOGRAPHY**

The region has a humid mesothermal climate with cool summers. Rainfall in this region is the highest in the state, ranging from approximately 600 mm per year in the northeast to over 1300 mm per year along the south coast.

The Pemberton area (Wilde and Walker, 1984) falls within the South West Physiographic Division of Jutson (1950). The most prominent feature is the Darling Scarp which demarcates the western edge of the Great Plateau (Jutson, 1950). East of the Darling Scarp, the plateau is subdivided into the Darling Plateau and the Ravensthorpe Ramp. The Darling Plateau averages 300 m above sea level and represents an exhumed lateritic peneplain that formed during the Tertiary. The Ravensthorpe Ramp represents the area that slopes gently south to the coast of the Southern Ocean. Broad Tertiary alluvial flats extend from the Darling Plateau to the north, on to the Ravensthorpe Ramp.

The Mount Barker area (Muhling and Brakel, 1985) is comprised of a gently southward-sloping ramp with a range of 280-320 m above sea level in the north to sea-level in the south. The area is typical of the Darling Plateau and covered with laterite. The Stirling Range rises as isolated peaks and divides the drainage pattern in the region.

The Collie area (Wilde and Walker, 1982) is almost entirely comprised of the Darling Plateau and is underlain primarily by metamorphic and intrusive rocks of the Yilgarn Block. The plateau is typically about 300 m above sea-level and forms a peneplained surface formed in the early Proterozoic. The area is strongly lateritized and is best preserved in the areas of higher rainfall.

The Dumbleyung area (Chin and Brakel, 1986), is primarily in the Darling Plateau ranging in elevation from 300 to 400 m above sea-level. It is extensively covered by laterite that formed in the Cretaceous to Tertiary period.

## **3.0 GEOLOGICAL SETTING AND MINERALIZATION**

### **3.1 Regional Geology**

#### **3.1.1 ARCHAEOAN GEOLOGY**

The regional geology and mineralization have been synthesized from reports of the Geological Survey of Western Australia by Chin and Brakel (1986), Wilde and Walker, 1982, 1984), and Muhling and Brakel (1985). The more recent Memoir 3 of the Geological Survey of Western Australia (1990) provides a regional perspective of the area. The general geology of the area is shown in Figure 1. A discussion of Phanerozoic rocks has not been included in this report as the objective of the sampling programme was to study the Proterozoic and Archaean rocks.

The northern part of the map area occurs within the Archaean Western Gneiss Terrane (Myers, 1990a) and is composed of a complex assemblage of repeatedly deformed and metamorphosed banded gneiss, which

includes quartz-rich metasedimentary rocks and banded iron formation. These rocks are generally of high metamorphic grade and metavolcanic rocks are notably scarce. The Western Gneiss Terrane in the area of this report can be subdivided into two complexes, an older heterogeneous complex of orthogneiss and paragneiss known as the Balingup gneiss complex in the western part of the area, and a younger batholithic terrane composed primarily of granitoid intrusions that occurs in the southern part of the Western Gneiss Terrane. The older rocks of the Balingup gneiss have been successively deformed with metamorphic grade ranging from amphibolite to granulite facies and are approximately 3.0 Ga in age (Myers, 1990a). The younger granitic rocks east of the Balingup complex form major plutons and batholiths that are subdivided into older deformed and metamorphosed granites and younger weakly deformed, which have been only slightly metamorphosed. The age of these rocks range from 2.7-2.6 Ga (Myers, 1990a).

### **Balingup Gneiss Complex**

This complex consists mainly of metasedimentary rocks with interlayered quartzite, quartz-mica schist, quartz-feldspar-biotite-garnet gneiss, and banded iron formation. Minor layers of quartz-feldspathic gneiss, amphibolite, calc-silicate gneiss, and ultramafic rock occur within the main assemblage. Roughly 30% of the complex is orthogneiss derived from porphyritic granite. The metamorphic grade is predominantly amphibolite facies; however, granulite facies rocks are found locally. The age of the complex by Sm-Nd has been given at 3.07-3.11 Ga and has been subsequently intruded by younger granitoids of 2.7-2.6 Ga (Wilde and Walker, 1984).

The Dumbleyung area is composed of Archaean granite and gneiss which contain small enclaves of metamorphosed mafic and ultramafic gneiss, banded iron formation, and some quartzite.

### **Greenstone Enclaves**

The greenstone enclaves have a complex history of deformation and metamorphism. The origin of these rocks is uncertain, most probably representing remnants of pre-Southern Cross supracrustal rocks, or remnants of layered intrusions emplaced into the granitoid rocks prior to the gneiss-forming events. The mafic rocks are typically amphibolite. Some pyroxene bearing mafic granulites have been noted in the Lake Dumbleyung area. Minor amounts of banded iron formation and quartzite occur within the granitoid gneiss.

### **Granitoid Gneiss**

The gneiss is most commonly tonalitic in composition. Felsic plutonic rocks that are chiefly composed of orthoclase-bearing tonalite that has been commonly referred to as adamellite. The IUGS subcommission on the Systematics of Igneous Rocks recommends that this term be avoided and the term "monzogranite" be substituted (LeMaitre, 1989:40).

The gneisses can be subdivided into phases with well-developed banding, feldspar augen, and homogeneous gneiss with discontinuous concentrations of platy minerals. Many gneisses are veined with fine- to medium-grained leucocratic monzogranite.

### **Younger Granitoid Intrusions**

The younger granitoid rocks are characterized by a lack of gneissic foliation and occur as distinct plutons that intrude the gneissic rocks. Compositionally, these rocks range from monzogranite, granodiorite, biotite granite, coarse-grained monzogranite, and porphyritic granite to monzogranite. Pegmatite dikes are commonly associated with the porphyritic and seriate monzogranites.

The Collie area is comprised of gneiss, migmatite, and granitoid rocks with a number of greenstone enclaves (Wilde and Walker, 1982). The western part of the area is composed of the Balingup gneiss complex. The eastern part of the area is comprised of isolated gneissic zones, and metavolcanics. The metavolcanics have been assigned to part of the Saddleback greenstone belt to the north. Migmatitic rocks occur in the Boyup Brook, Kulikup, and Nannup areas and are indicated by the presence of granitic neosome with a gneissic paleosome along the eastern margin of the Balingup complex.

## **3.1.2 PROTEROZOIC GEOLOGY**

The Manjimup Lineament marks the boundary between the Proterozoic and Archaean rocks. Archaean rocks that have been affected by Proterozoic deformation have been noted south of the Manjimup Lineament (Wilde and Walker, 1984). These rocks are approximately 1.3-1.1 Ga in age.



The Proterozoic rocks form two groups known as the Biranup and Nornalup complexes. The Biranup complex is composed of high-grade quartzo-feldspathic gneisses and layered-basic intrusions and appears to be sections of deep continental crust which were uplifted 1.2-1.1 Ga. The Nornalup complex is comprised of less intensely deformed orthogneiss and paragneiss and intruded by sheets of granite at about 1.1 Ga.

Large numbers of Proterozoic dikes, of quartz tholeiite composition, intrude the gneissic terrane of the Yilgarn Block. They occur as two prominent trends, a major group striking in an east-west direction, and a lesser group striking in a north-south direction. These two dike sets parallel the Darling Scarp and the southern coast. The east-west set are inferred to have intruded in the 1.0-1.2 Ga interval while the north-south swarm intruded in the interval of 1.2-1.4 Ga (Parker *et al.*, 1987). The intrusion of these dykes is associated with extensional regimes during the Proterozoic. The intrusion of these dykes predates the uplifting of the Stirling Range Formation as they are deformed and foliated within the sequence.

The northern margin of the Albany-Fraser orogen is marked by deformed psammitic and pelitic metasedimentary rocks which include the Stirling Range Formation and appear to have been tectonically transported into position. The Stirling Range Formation is more than 1.6 km thick, dips gently to the south and is fault bounded.

The Biranup complex is comprised of intensely-deformed, transposed rocks that are highly metamorphosed. The assemblages are sub-vertical and separated by zones of intense deformation and faulting. Tectonism occurred as dextral transcurrent and northward-directed thrust movements. The northeastern part of the complex contains a metagabbro (Fraser Complex) and consists of a number of subvertical tectonic slices 2-5 km thick. The sheets of the metagabbro are separated by narrow zones of intense deformation and interleaved with deformed metasedimentary rocks of quartzite, banded iron formation, pelites, and quartzo-feldspathic gneiss.

The Nornalup complex occurs in the southern and southeastern part of the orogen and is composed chiefly of quartzo-feldspathic gneiss derived from granitoid rocks and metasedimentary rocks. Metasedimentary rocks are more prevalent in the southeast, whilst ortho- and paragneisses are more prevalent in the northwest, indicating a progressive increase in deformation and metamorphism to the northwest.

The boundary between the Archaean Yilgarn block and the Albany-Fraser Proterozoic orogen is marked by a shear zone that trends east-west in the western part of the area to north-westerly in the eastern part of the area (see Figure 1). The zone is commonly mylonitic in nature with breccia zones and fault bounded enclaves of metasedimentary rock.

### 3.2 Mineralization

#### Gold

The nature and distribution of Au deposits have been summarized by a number of researchers and agencies (Groves, 1988; Hickman and Watkins, 1988; Hickman and Keats, 1990).

The Western Gneiss Terrane contains one of Australia's largest gold deposits, at Boddington which is hosted within the Saddleback greenstone belt and has total reserves of 115.4 tonnes of Au, lying northwest of this study area.

Additional deposits within the area include Griffins Find, with total reserves of 2.4 tonnes of Au, and Jinkas Hill with reserves of 1.5 tonnes of Au. Griffins Find is situated in an enclave of mafic granulite which has been intruded by leucocratic monzogranite. The Jinkas Hill deposit is contained within a northwesterly-striking gossan zone concordant with layering in granitic, mafic granulite gneiss, quartz-magnetite rock (BIF?), and minor mica schist (Chin and Brakel, 1986).

Smaller deposits of Au occur south of Donnybrook (COLLIE), where 23.9 kg of Au were extracted from the Donnybrook Goldfield. No significant amounts of Au have been discovered in the PEMBERTON or MOUNT BARKER map areas.

## **Greenbushes Pegmatites**

### **Tin-Tantalum**

The Greenbushes rare metal deposit (COLLIE sheet) accounts for more than half of Western Australia's tin output (Witt, 1990). The deposit occurs within a pegmatite swarm hosted by the rocks of the Balingup Gneiss Complex. The main mineralized zone is approximately 5 km long and 600-800 m wide. The paragenesis of the mineralized zone is not clearly understood. The pegmatite itself is zoned with a Li-rich carapace, and zones of Na and K enrichment. Tin-tantalum mineralization is irregularly disseminated throughout the Na-rich zone but is also concentrated in quartz and greisen rich marginal zones. The chief minerals of economic importance are cassiterite, tantalite-columbite and spodumene. Total production figures for the Greenbushes area are 23606 t of cassiterite, 46320 t of spodumene, and 2556 t of tantalite-columbite.

Beryl has been mined from the Ferndale pegmatite for a total production of 10.91 t.

The Greenbushes pegmatites have also been mined for feldspar, muscovite, and in the weathered zone, kaolin.

Small Sn deposits occur between Willow Springs and Yornup, known as the Smithfield or Donovans Find in the PEMBERTON-IRVWIN INLET sheet. The Sn has been mined from overlying alluvium.

### **Heavy Mineral Sands**

Concentrations of heavy minerals (ilmenite, leucoxene, rutile, zircon, monazite, and xenotime) are located along Cainozoic strandlines in the Perth Basin in the COLLIE sheet, most notably in the Yoganup Formation near Yonanup and the Bassendean Sand near Capel (Wilde and Walker, 1982). Additional smaller deposits occur in the Lake Dumbleyung area (DUMBLEYUNG), the Hassell Beach Prospect (MOUNT BARKER), and the Callcup Hill and Northcliffe areas (PEMBERTON).

### **Other Commodities**

Isolated occurrences of ilmenite and magnetite have been reported in the Gnowangerup, Katanning, and Kojonup areas.

Small occurrences of Mo, Fe, V, bauxite, clay, kaolin, talc, asbestos, garnet, graphite, barite, gypsum, lime, quartz, nickel, and kyanite are found throughout the areas covered by this report. None of these occurrences is economic and current evidence indicates that the deposits are of minimal extent.

## **4.0 THE SAMPLING PROGRAMME**

### **4.1.1 SAMPLING**

A 3-km spaced triangular sampling grid was used over most of the sampled area, with limitations caused by the distribution of access roads and tracks, the extent of erosional dissection of the laterite cover, the extent of cover by younger alluvium/colluvium, and the extent of mining and other land tenements. Various follow-up and fill-in samples were also taken, usually closing the sample spacing to 1 km, in some cases to 330 m; the locations of follow-up sampling being obvious in the plots showing sample sites, for example at 1:250,000 scale or more detailed. Figure 2 shows the distribution of the samples collected throughout the area according to the three main sample groups, the laterite (Figure 2a), ferricrete materials (Figure 2b), and lateritized rock (Figure 2c). The lateritic samples are the most dominant sample. Sampling was limited to the eastern part of the COLLIE sheet, the southwestern part of the DUMBLEYUNG sheet, the central and western part of the MT. BARKER sheet, and the eastern central part of the PEMBERTON sheet.

The database is composed of samples collected from all three phases of the study. Samples that are labelled "R" in the description field (see Appendix 1) are those initially collected at the 3-km spacing regional scale. Samples labelled "F2" are those collected during follow-up work at the 1-km spacing interval, and samples labelled "F3" are those samples collected at less than 1 km spacing from additional follow-up work after the F2 samples were collected. The number of samples for each type is:

	Yilgarn			Albany-Fraser	
R	Regional Samples	450	R	Regional Samples	358
F2	Follow-up Phase 2	66	F2	Follow-up Phase 2	89
F3	Follow-up Phase 3	40	F3	Follow-up Phase 3	23
Total		556			470

Grand Total

1026

The strategy was to sample the cemented pisolitic laterite blanket and/or the loose laterite pisoliths which had been released from the duricrust by natural disaggregation. Lateritic nodules and pisoliths in the range of 1-cm to 2-cm diameter were sought in order to avoid the possibility of skewing the sample characteristics if very coarse material was collected and to aid sample preparation by providing suitable feed for the disk grinding stage (avoiding coarse crushing). Sampling was typically carried out over a 10 metre radius in order to suppress any unforeseen local variation. A 1-kg sample was collected for crushing, grinding and analysis of an aliquot. A separate 1-kg sample was collected for permanent reference. Other sample types were collected where the prime media were not available. A breakdown of the number of samples collected is given in Table 1. Where available, 1:50,000 photomosaics were used in selecting sample sites and for recording the locations. In some cases forestry maps at scales of 1:63 360 were also used for location. Each sample was assigned AMG coordinates.

The classification used in this report is the scheme adopted during the AGE study of 1983-1986. A more comprehensive and, in due course, genetic classification scheme is currently under development within the CSIRO/AMIRA Laterite Geochemistry Project. The most recent terminology and classification can be found in Anand *et al.* (1989) in which the terminology and classification of laterite and ferruginous materials have been expanded. The terms used in this report follow the older terms that are general enough to be considered useful for the purposes of a regional study. Correlation between the older and current schemes is also given in Table 1.

#### 4.1.2 SAMPLE TYPES

##### I LATERITE SAMPLE TYPES

Samples belonging to the laterite family often occurring geomorphically above breakaways (i.e., a relatively complete laterite profile):

Loose Pisoliths (LP) and Cemented Pisoliths (CP) - Ferruginous particles with high sphericity, 2 mm to 3 cm in diameter, and a concretionary Fe-rich or Fe-bearing coating. Internal concentric banding is common. This sample type commonly forms a blanket deposit, whether loose or cemented, up to a few metres in thickness. Also forms redistributed colluvium.

Loose Nodular Laterite (LN) Cemented Nodular Laterite (CN) - Ferruginous particles with low sphericity but with rounded edges. Commonly 1 to 4 cm across and a goethitic cutan (skin). Lateritic nodules and pisoliths form a continuous series and commonly occur together.

Vermiform or Vermicular Laterite (VL) - Iron-rich cemented mottled zone saprolite containing sinuous worm-like tunnels, holes, or clay zones. May contain spaced pisoliths, nodules, or sporadic rock fragments.

Plinthite (PN) - Grit cemented by goethite, with visible quartz grains. Plinthite fragments do not have a concretionary goethite cutan.

Mottled Zone Scree (MS) - Loose, locally-derived scree or float derived from Fe-rich mottles within the lateritic weathering profile.

## II FERRICRETE SAMPLE TYPES

Samples belonging to the ferricrete family typically occurring in situations where the nodular/pisolitic laterite has been removed by erosion, but stripping has not cut deeply into saprolite. These include:

Massive Ferricrete (MF) - Iron-rich material lacking pisolith- nodule texture, commonly has a botryoidal texture.

## III OTHER CATEGORIES

Lateritized Rock (LR) - Saprolite that is enriched in Fe-bearing weathering minerals, goethite, and hematite.

Figure 2a shows the distribution of the laterite sample materials (LN, LP, CN, CP, VL, MS, PN) and Figure 2b shows the distribution of the ferricrete materials (MF).

Given that there are only three ferricrete samples taken in the area, further analysis of these materials will not be considered. Similarly, only 24 samples of lateritized rock were collected over the area as shown in Figure 2c and will not be included in further analysis of the data.

### 4.1.3 SAMPLE PREPARATION

The samples were prepared using non-metallic sample preparation methods described by Smith *et al.* (1987: 256). Oversized material from 1 kg samples was reduced to minus 8 mm by crushing between zirconia plates in an automated hydraulic press. The crushed oversized material, together with the direct feed material, was then fed to an epoxy-resin lined disc grinder with alumina plates and further reduced to minus 1 mm. Final milling was done in an agate or alumina mill. Cleaning of the equipment was performed by a combination of air- and sand-blasting and the passage of a quartz blank.

### 4.2 Analytical Methods

A total of 1026 samples were analyzed by Amdel Ltd. (Adelaide) for 24 elements. An additional 7 elements were analyzed by the CSIRO analytical facilities on 40% of the samples. Gold was analyzed by Analabs (Perth). The methods of analysis are outlined in Table 2. Tin and Bi were analyzed by two methods because of their perceived importance in laterite geochemistry and to provide a consistent gauge of confidence in the results. The following elements have been analyzed by the methods outlined in Table 2: SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, MgO, CaO, TiO<sub>2</sub>, Au, Mn, Cr, V, Cu, Pb, Zn, Ni, Co, As, Sb, Bi1, Bi2, Mo, Ag, Sn1, Sn2, Ge, Ga, W, Ba, Zr, Nb, Ta, Se, and, Be. Additional elements may be analyzed later on. Only Bi2 and Sn2 have been used in this report. *All references to these two elements have been made with respect to Bi2 and Sn2.* The data on the accompanying diskette contain Bi1, Bi2, Sn1, and Sn2. Appendix 1 indicates the format of the data.

Samples analyzed by CSIRO were carried out on an Inductively Coupled Plasma Spectrometer (ICP) using a lithium metaborate fusion dissolved in nitric acid. Gold was analyzed by Analabs Laboratories using Atomic Absorption Spectroscopy (Graphite Furnace) after aqua-regia dissolution of 50 g of sample pulp.

#### 4.2.1 ANALYTICAL QUALITY CONTROL

Each batch of samples submitted for analysis contained three control samples that represent a spectrum of multi-element values. These control samples were submitted in a scrambled numerical sequence. The samples were also subjected to replicate analysis both by the CSIRO analytical facilities and by an independent laboratory. Problems of between-batch variation could usually be detected by examination of maps of the plotted data. If any clustering or unusual patterns were noted, the duplicated samples were submitted for assay.

Table 1. Sample Type, Abbreviation, and Number of Samples.

Sample type	Code	Number of Samples	Equivalent Classification CSIRO/AMIRA 1989 Codes (Anand <i>et al.</i> , 1989)
<b>YILGARN BLOCK</b>			
<u>Lateritic Types</u>			
Loose Pisoliths	LP	102	LT102
Cemented Pisoliths	CP	27	LT202, LT212
Loose Nodules	LN	334	LT104
Cemented Nodules	CN	20	LT204, LT214
Vermiform Laterite	VL	4	LT231
Plinthite	PN	33	
Mottled Zone Scree	MS	23	LG105
<b><u>TOTAL</u></b>		<b>543</b>	
<u>Ferricrete Types</u>			
Massive Ferricrete	MF	1	IS101, IS102, IS103, IS201,
<b><u>TOTAL</u></b>		<b>1</b>	
<u>Miscellaneous Types</u>			
Lateritized Rock	LR	12	
<b><u>TOTAL</u></b>		<b>12</b>	
<b><u>Y-B TOTAL</u></b>		<b>556</b>	
<b>ALBANY-FRASER</b>			
<u>Lateritic Types</u>			
Loose Pisoliths	LP	10	LT102
Cemented Pisoliths	CP	2	LT202, LT212
Loose Nodules	LN	363	LT104
Cemented Nodules	CN	49	LT204, LT214
Vermiform Laterite	VL	6	LT231
Plinthite	PN	4	
Mottled Zone Scree	MS	22	LG105
<b><u>TOTAL</u></b>		<b>456</b>	
<u>Ferricrete Types</u>			
Massive Ferricrete	MF	2	IS101, IS102, IS103, IS201,
<b><u>TOTAL</u></b>		<b>2</b>	
<u>Miscellaneous Types</u>			
Lateritized Rock	LR	12	
<b><u>TOTAL</u></b>		<b>12</b>	
<b><u>A-F TOTAL</u></b>		<b>470</b>	
<b><u>GRAND TOTAL</u></b>		<b>1086</b>	



## 5.0 DATA PRESENTATION AND ANALYSIS

The geochemical data that accompany this report are contained on a 5.25" floppy diskette which can be found in the back pocket of the report. Appendix 1 provides the details regarding the format of the data.

A summary of the multi-element geochemical data is listed in Tables 3 and 4. The Tables list the number of samples analyzed for each element, the 1, 5, 10, 25, 50, 75, 90, 95, and 99th percentiles, minimum, maximum, mode, mean values, and the standard deviation.

The Tables list the summary statistics for the following groups of data:

**Table 3a:** Summary Statistics for the Yilgarn Block, all Regional (R) samples for **Lateritic** materials (LN, LP, CN, CP, PN, VL, MS).

**Table 3b:** Summary Statistics for the Yilgarn Block region, all Follow-up (F2/F3) samples for **Lateritic** materials (LN, LP, CN, CP, PN, VL, MS).

**Table 4a:** Summary Statistics for the Albany-Fraser region, all Regional (R) samples for **Lateritic** materials (LN, LP, CN, CP, PN, VL, MS).

**Table 4b:** Summary Statistics for the Albany-Fraser region, all Follow-up (F2/F3) samples for **Lateritic** materials (LN, LP, CN, CP, PN, VL, MS).

Element	Reported as	Detection Limit	Laboratory	Analysis Method	Digestion Method
SiO <sub>2</sub>	WT%	0.5	CSIRO	ICP	FS
Al <sub>2</sub> O <sub>3</sub>	WT%	0.5	CSIRO	ICP	FS
Fe <sub>2</sub> O <sub>3</sub>	WT%	0.1	AMDEL	AAS	HF
MgO	WT%	0.05	CSIRO	ICP	FS
CaO	WT%	0.05	CSIRO	ICP	FS
TiO <sub>2</sub>	WT%	0.003	CSIRO	ICP	FS
Mn	PPM	5	AMDEL	AAS	HF
Cr	PPM	5	AMDEL	XRF	
V	PPM	10	AMDEL	XRF	
Cu	PPM	2	AMDEL	AAS	HF
Pb	PPM	4	AMDEL	XRF	
Zn	PPM	2	AMDEL	AAS	HF
Ni	PPM	5	AMDEL	AAS	HF
Co	PPM	5	AMDEL	AAS	HF
As	PPM	2	AMDEL	XRF	
Sb	PPM	2	AMDEL	XRF	
Bi1	PPM	1	AMDEL	OES	
Bi2	PPM	1	AMDEL	XRF	
Mo	PPM	2	AMDEL	XRF	
Ag	PPM	0.1	AMDEL	OES	
Sn1	PPM	1	AMDEL	OES	
Sn2	PPM	1	AMDEL	XRF	
Ge	PPM	1	AMDEL	OES	
Ga	PPM	1	AMDEL	OES	
W	PPM	10	AMDEL	XRF	
Ba	PPM	100	CSIRO	ICP	FS
Zr	PPM	50	CSIRO	ICP	FS
Nb	PPM	4	AMDEL	XRF	
Ta	PPM	3	AMDEL	XRF	
Se	PPM	2	AMDEL	XRF	
Be	PPM	1	AMDEL	OES	
Au	PPB	1	ANALABS	Carbon Rod Aqua Regia	

Legend:	AAS	Atomic Absorption Spectroscopy
	XRF	X-ray Fluorescence
	ICP FS	Inductively Coupled Plasma Fusion
	OES	Optical Emission Spectroscopy (semi-quantitative)

Materials which were classified as loose nodules (LN), loose pisoliths (LP), cemented nodules (CN), cemented pisoliths (CP), plinthite (PN), vermicular laterite (VL), and mottled zone scree (MS) are generally known to be compatible sample media and were therefore grouped together. These samples, placed in the laterite family, total 543 for the Yilgarn block and 456 for the Albany-Fraser belt, and their statistics are shown in Tables 3a,b, and 4a,b. Because of the abundance of the favoured laterite sampling medium, it was not necessary, generally, to seek alternative media. Hence only three ferricrete and 24 lateritized rock samples were collected. This contrasts with the distribution of the major sample media types found in other regions. Lateritic materials are more common in the southern part of Western Australia, while the abundance of ferricrete materials increases towards the north.

Many samples were analyzed for elements whose values were below the detection limit. In these cases, the value of the variable was set to one third of the detection limit as the default minimum value. Subsequent statistical and numerical procedures used this minimum value. As mentioned above, not all samples have been analysed for the full set of elements at this stage. In such cases, for calculations of statistics, the number of samples used to compute the statistic was reduced. The number of samples used for the calculations of the statistics of each element is indicated in the Tables.

Examination of the Tables is useful in making preliminary assessments about the data. The first part of each Table provides insight as to how the values of data are distributed over the range of the data. By scanning the values over the range of percentiles, the nature of the distribution of the data can be observed. Elements with highly skewed distributions (e.g. Au) tend to have similar concentrations over the range of percentiles, increasing rapidly at the 90, 95, and 99 percentile rankings. More normally-distributed elements (e.g.  $\text{TiO}_2$ ) show a more uniform change in abundance with increasing percentile levels. Samples that occur in the upper percentile range (>95th percentile) are usually of interest in an exploration programme. It is these "high" or "anomalous" values that may be indicative of a mineralized zone whose chemistry is unlike that of the regional geochemical patterns.

The 50th percentile gives the abundance value of the midpoint of the distribution of samples and can be quite different from the arithmetic mean of the sample population. This 50th percentile value is recommended for estimating the central value of a distribution. The tables also list minimum, maximum, median, mode, mean, and standard deviation for each element. Normally-distributed populations tend to have similar values for the median, mode, and mean. The standard deviation gives an estimate of the range of the data around the arithmetic mean.

Statistical tests involving the t-test (testing the similarities of the means) and the F-test (testing the similarities of variances) have not been carried out because many of the frequency distributions are non-normal and any statistical inferences may be misleading. Procedures exist for transforming the data into more normal-like distributions for subsequent statistical inferences (e.g., power transformations, see Smith *et al.*, 1984). In this study it was deemed important to test the distinction between samples from the Proterozoic Albany-Fraser Provinces and the Archaean Yilgarn Block. Subsequently, a selected suite of elements was transformed and the two groups were tested for their differences. The results of this are outlined below.

*Barium must be interpreted with caution as the method of sample preparation (from alumina disks) adds an average of about 100 ppm of Ba, because of an impurity in the alumina, depending on the hardness of the sample.*

### 5.1 Testing the differences between the two terranes

The laterite samples were initially separated into two groups representing samples from Archaean lithologies and samples from Proterozoic lithologies. In order to quantitatively test the appropriateness of separating samples from the two provinces, a discriminant function analysis was carried out.

Since the distributions of almost all of the elements are non-normally distributed, a procedure was carried out whereby an appropriate transformation was applied to bring about normality to the data. The procedure that was applied is outlined in Howarth and Earle (1979) by which three methods can be used to estimate values of  $\lambda$  for the Box-Cox power transformation.

The transformation is defined as:

$$z = (x\lambda - 1)/\lambda \quad (\lambda \neq 0)$$

$z = \ln(x) \quad (\lambda > 0)$  for all  $x > 0$  where  $x$  represents the abundance of the element in question.

Estimates of  $\lambda$  were computed for 20 elements ( $\text{Fe}_2\text{O}_3$ , Ag, Mn, Cr, V, Cu, Pb, Zn, Ni, Co, As, Sb, Mo, Sn, Ga, W, Zr, Nb, Se, Au) for the Yilgarn and Albany-Fraser laterites respectively. The values of  $\lambda$  were then averaged and both sample groups were subsequently transformed.

Two group discriminant function analysis were carried out as outlined by Davis (1986: 478). The results of the analysis indicated that the two laterite groups are sufficiently distinct to warrant keeping them as two separate groups. Elements that enhance the distinction between the two groups are As, Nb, Ni, Sn, Mo, Ga, Mn, and Au. Elements that showed minimal differences between the two groups include Ag, Cr, Cu, Pb and Co. Figure 32 shows a plot of the discriminant function scores of the two groups. The mean discriminant score for the Albany-Fraser laterites is -4.6 and the mean discriminant score for the Yilgarn laterites is -1.2. The figure shows a degree of overlap between the two groups; however, they are statistically distinct.

## 5.2 Histograms

Histograms of the data were plotted for selected elements of specific sample types. These plots are shown in Figures 3 - 31. The histograms were computed using 40 class divisions based on the minimum and maximum values of the variables. For presentation purposes, the minimum and maximum values were truncated at the mean  $\pm$  three standard deviations. Above each histogram is a box and whisker plot that shows the median (50th percentile), left hinge (25th percentile), right hinge (75th percentile) and range (minimum and maximum values) of the data. Each histogram also lists these values in a numerical form at the right-hand side of the figure.

This report also includes the use of quantile-quantile plots (Q-Q plots). Q-Q plots are useful for providing a graphical comparison of data with respect to an expected distribution, in this case, the normal distribution. When the distribution of an element is normal, then the Q-Q plot is a straight line. Q-Q plots also assist in detecting outliers at both the upper and lower tails of the distribution.

Each figure is comprised of two histograms. Figures 3a-31a show histograms of the lateritic materials from the Archaean age samples of the Yilgarn Block and Figures 3b-31b show histograms of the lateritic materials from the Proterozoic gneisses and granitoid rocks of the Albany-Fraser Province. Each pair of histograms is plotted with the same scale and data interval to assist in visualizing the similarities and differences between the two populations.

Some of the outliers are of such large values that to include them on the Q-Q plots or histograms would grossly distort the presentation of the data. Consequently, the extreme outliers were not plotted on these figures; however, these values can be observed as large atypical values on the element maps in Figures 33-54 and Tables 5 and 6.

A visual comparison of the histograms yields the following observations:

- **$\text{SiO}_2$ :** Abundances in the Yilgarn laterites have a greater range of abundances relative to the Albany-Fraser laterites (Figures 3a,b) and correspondingly lower mean/median values. This may reflect the presence of more mafic enclaves that occur in the gneiss terrane of Archaean age.
- **$\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{MgO}$ , and  $\text{CaO}$ :** Abundances and distribution between the two terranes show similar features as shown in Figures 4a,b, 5a,b, 6a,b, and 7a,b.
- **$\text{TiO}_2$ :** Figures 8a,b show  $\text{TiO}_2$  abundances which have a greater range of values in the Yilgarn laterites relative to the Albany-Fraser laterites. As suggested with  $\text{SiO}_2$ , the Yilgarn laterites may be host to a wider variety of lithologies that include mafic enclaves that are  $\text{TiO}_2$  rich.
- **Ag:** The range and median values (Figures 9a,b) are similar for both areas.

- **Mn:** The laterites of the Yilgarn block have a similar range of abundances to the Albany-Fraser laterites (Figures 10a,b). The median value of the Yilgarn laterites is higher than that of the Albany-Fraser laterites. This also suggests that the Yilgarn area may have a greater mafic component.
- **Cr:** Samples from both areas show a similar range of abundances and similar median/mean values (Figures 11a,b). The range of Cr values is puzzling since a relative increase of Cr is expected in the Archaean lithologies given the other increases in Ti and Mn. One possible explanation is given by Condie (1986). Condie has shown that Cr abundances are higher in post-Archaean basalts and that evolution of the crust has resulted in greater abundances of Cr in post-Archaean rocks.
- **V:** The laterites of the Yilgarn show a greater median value relative to the Albany-Fraser laterites (Figures 12a,b). This may be due, in part, to the presence of pegmatites in the Archaean Balingup gneiss complex.
- **Cu, Pb, Zn, Co:** The Yilgarn and Albany-Fraser laterites show similar median, mean, and dispersion characteristics for these three elements as shown in Figures 13a,b, 14a,b, and 15a,b, 17a,b. Zinc is slightly more abundant in the Yilgarn laterites.
- **Ni:** The Albany-Fraser laterites show a bimodal population of Ni abundances which is not indicated in the Yilgarn laterites (Figures 16a,b). The Albany-Fraser laterites show peak values of Ni at 30 and 70 ppm which may reflect differences between gneissic and intrusive lithologies. As in the case of Cr, Ni is relatively more abundant in the Proterozoic rocks.
- **As:** Arsenic abundances are higher and more positively skewed in the Albany-Fraser laterites relative to the Yilgarn laterites (Figures 18a,b).
- **Sb, Bi, Mo:** These elements show log-normal type distributions that are positively skewed (Figures 19a,b, 20a,b, 21a,b). The range of values for the Yilgarn and Albany-Fraser laterites is similar, but the Albany-Fraser laterites are consistently higher in the median/mean values.
- **Sn:** Figures 22a,b show the distribution of Sn which is consistently higher in the Yilgarn laterites in comparison to the Albany-Fraser laterites. This may be due to the presence of Sn-bearing pegmatites associated with the Greenbushes tin deposits.
- **Ge:** Germanium abundances between the two terranes are similar as shown in Figures 23a,b and reveal little diagnostic information.
- **Ga, Nb:** Mean/median Ga abundances are higher in the Yilgarn terrane relative to those of the Albany-Fraser terrane. The shape of the distributions between the two terranes is the same as shown in Figures 24a,b and 28a,b.
- **W:** Figures 25a,b show that the mean/median values and range of values between the two terranes are similar. The Yilgarn laterites have a higher maximum value relative to the Albany-Fraser laterites. The larger W values for the Yilgarn laterites are most probably due to the proximity of the Sn deposits in the northwest part of the area.
- **Ba, Zr:** Barium and Zr have similar median/mean values and ranges of abundances between the two terranes as shown in Figures 26a,b, and 27a,b. Both Ba and Zr have slightly higher median values in the Yilgarn laterites.
- **Ta:** Figures 29a,b display little variation in abundances. Almost all of the values are less than detection limit; however, where they are elevated they may reflect alteration/mineralization events.
- **Se:** Selenium (Figures 30a,b) displays a similar range of abundances between the two terranes; however, the mean/median value of Se is higher in the Albany-Fraser relative to that in the Yilgarn, possibly reflecting some trace element abundance changes between the Archaean and Proterozoic crust.
- **Au:** Figures 31a,b show a similar median and range of abundances for terranes.

Most of the elements have non-normal frequency distributions and for many of the histograms of these elements positively-skewed values can represent fractionated igneous environments or anomalous values that are potentially associated with various types of mineralization. Some elements, in particular the chalcophile suite (As, Sb, Bi, Se, Pb, Ge, Zn, Cu, Ag), are known to be good pathfinders for both base-metal sulphide mineralization and precious metal mineralization. These elements form the basis for the empirical chalcophile and pegmatophile functions as well as for use in multivariate statistical analysis that have been developed by Smith and Perdrix (1983) and Smith *et al.* (1984).

An analysis of the nature of the causes of the frequency distributions of the elements is beyond the scope of this report. The non-normal nature of the distributions may be due to a mixture of samples from different geological environments, some of which may represent rare occurrences due to mineralization (e.g. As, Sb, Bi, Ag, Au).

Geochemical anomalies can be defined by a number of techniques. Simple ranking and examination of the extremes of pathfinder and target elements is an effective means of defining anomalies for a first-pass interpretation. Tables 5 and 6 provide listings of samples that rank above the 95th percentile. Table 5 lists the samples for the Yilgarn laterites and Table 6 lists the samples for the Albany-Fraser laterites. These tables can be used to identify anomalous samples that may be associated with various types of mineralization.

## 5.2 Element maps

Maps of the ranked abundances of most of the elements listed in Tables 3 and 4 are shown in Figures 33a,b - 54a,b. The Yilgarn laterites are shown in Figures 33a-54a and the Albany-Fraser laterites are shown in Figures 33b-54b.

Since the sample sites are not distributed uniformly over the map area, methods of data presentation such as contour maps are not appropriate for describing the spatial variation of the data at the scale presented. However, the data can be conveniently presented by using symbols whose sizes are based upon the percentile ranking of the data relative to the *maximum* and *minimum* values of the data. A commonly-used method of expressing concentrations over irregularly-sampled areas is the expression of each concentration by a symbol whose size is proportional to its magnitude (Howarth, 1983:124). The use of such symbols can be employed to indicate areas that are enriched or depleted. However, caution is advised in the interpretation of these proportionally-sized symbols. Symbol size does not necessarily reflect anomalously low or high values, rather it reflects the maximum and minimum values of the data which may or may not be "anomalous" with respect to zones of mineralization.

The size of the symbols is not a linear function of concentration of the elements. For visual ease and assistance in the recognition of outlier data, the symbol sizes are defined as:

$$\text{Map Symbol Size} = \text{Minimum Symbol Size for Map} + \text{Constant Symbol Size} * (\text{Percentile}/100)^4,$$

where the percentile is the percentile ranking of the sample for the particular element being considered. This quartic function enhances the size of the symbols for samples in the upper percentile rankings whilst making the samples that fit in the rankings of less than 75 percentile range more equal in size. This non-linear distribution of symbol sizes assists in a faster visual assessment of anomalous values. Each sample is assigned a symbol size based on the interval between 9 selected percentile rankings (1, 5, 10, 25, 50, 75, 90, 95, 99 percentile levels).

## 5.3 Interpretation of the Geochemical Maps

Interpretation of the geochemical maps requires some knowledge of the geological processes that have acted upon, or are still acting within an area. Inference about the geological environment can be made from many of the geochemical maps and can assist in refining geological models. Hallberg (1984) has shown that within the saprolitic laterite profile, ratios of  $\text{TiO}_2$ , Cr, and Zr retain characteristics of the original lithologies. Titanium and Cr ratios commonly outline the mafic volcanic or mafic volcanically-derived sedimentary assemblages, whilst Zr is useful in outlining the Zr-enriched felsic volcanics. Maps of these elements must be interpreted with caution as the abundances may have been modified by several processes, particularly during weathering. Fractionated igneous rocks tend to show enrichment in Mo, Be, W, Ga, and Sn and laterite geochemistry on a regional scale could be expected to reflect such effects. Birrell and Smith (1984) have previously reviewed chalcophile distributions for selected portions of the Yilgarn block. They recommended that for selected chalcophile elements, samples which rank above the 90th percentile are significant and that the areas from which these samples were taken be considered for follow-up sampling.



Many of the elements reflect the compositions of the underlying lithologies. The elements that most commonly reflect the underlying supracrustal rocks of the greenstone belts include:  $\text{Fe}_2\text{O}_3$ ,  $\text{TiO}_2$ ,  $\text{SiO}_2$ , Cr, Mn, V, Ni, Co, Zr, Cu, and Zn. Elements such as  $\text{SiO}_2$ , Ga, Nb, Mo, Sn, Pb, Nb, and Se tend to reflect underlying lithologies associated with the felsic granitoid/gneissic terranes which are largely fractionated environments. The effects of weathering processes can be reflected by the abundances of  $\text{Fe}_2\text{O}_3$ ,  $\text{TiO}_2$ , Cr, Mn, V, Ni, and Zr. These elements tend to be residual even after the lateritic material weathers. Thus, the interpretation of some of these elements must be cautiously applied. Other elements such as Cu, Zn, Ga, and Nb can also reflect secondary processes, for example alteration, that are commonly associated with mineralization. Elements such as Ag, As, Sb, Bi, Mo, Sn, W, Se, Ga, and Nb can also reflect environments that are associated with alteration and mineralization. Any one element in itself is not necessarily a good pathfinder associated with an altered/mineralized zone. However, a combination of a selected group of elements may be a suitable means of isolating areas with more mineral potential.

Copper and Zn anomalies can be difficult to assess since their abundance levels are also a function of lithology. Besides being economic commodities, they are also ubiquitously associated with alteration zones within bedrock. Thus elevated values must be interpreted cautiously. Methods of anomaly detection for these elements can be assisted by using methods such as those advocated by Smith et al. (1984), Stanley and Sinclair (1987), and Garrett (1989).

Generally, the laterites are a better sample medium for distinguishing the characteristics of the various geological processes. Ferricretes are also useful, but the geochemical signals are more erratic. Nonetheless, the ferricretes may be the only material available in areas where laterites are missing, and can assist in assessing the geochemical characteristics in a sampling programme. The following descriptions of the elements includes both the laterites and ferricretes except where noted otherwise.

- Iron,  $\text{Fe}_2\text{O}_3$  (Figures 33a,b), tends to show a relative increase in abundance northwest and northeast of Mount Barker on the MT. BARKER sheet. Relative increases in Fe are also noted in the Whistlers, Mayanup, Muradup, Darkan, Cranbrook, and Peringillup areas on the COLLIE and DUMBLEYUNG sheets.
- Silver, Ag (Figures 34a,b), displays levels above 0.1 ppm in the Boscabel and Peringillup areas of the DUMBLEYUNG sheet, the Darling Hill, Darkan, Muradup areas of the COLLIE sheet, and north of Trollup Hill on the MT. BARKER sheet. Two occurrences of Ag greater than 0.1 ppm occur northeast and northwest of the Chitelup Hill area on the PEMBERTON sheet.
- Manganese, Mn (Figures 35,a,b), shows elevated abundances in the Whistlers, Mayanup, and Muradup areas on the COLLIE sheet. Elevated abundances also occur in the Denbarker and Carbarup Hill areas of the MT. BARKER sheet.
- Chromium, Cr (Figures 36a,b), V (Figures 37a,b), Ni (Figures 41a,b), and Co (Figure 42a,b) most probably outline mafic gneisses areas in the COLLIE and DUMBLEYUNG sheets within the Archaean rocks. Elevated abundances of these elements occur in the Whistlers, Darling Hill, Muradup, Capercup, and Quindanning areas in the COLLIE sheet, and north of Trollup Hill and the Boscabel area on the DUMBLEYUNG sheet. Elevated abundances of these elements in the Albany-Fraser laterites are found within the central part of the sampling zone in the Lake Katherine, Carbarup Hill and Denbarker areas on the MT. BARKER sheet and north of Chitelup Hill on the PEMBERTON sheet.
- Copper, Cu (Figures 38a,b), shows elevated abundances in the Whistlers, Capercup, and Darling Hill areas on the COLLIE sheet with some isolated elevated abundances occurring within the central part of the sampling area of the COLLIE sheet. Other isolated elevated abundances occur in the Cranbrook area of the MT. BARKER sheet. Elevated abundances associated with the Albany-Fraser laterites occur in the Lake Katherine area of the MT. BARKER sheet and north of the Chitelup Hill area on the PEMBERTON sheet.
- Lead, Pb (Figures 39a,b), is elevated in abundance in the Darling Hill, Quindanning, Darkan, Capercup, and Muradup areas of the COLLIE sheet and the Boscabel and Peringillup areas of the DUMBLEYUNG sheet. Elevated Pb values occur in the Carbarup Hill, Denbarker, Lake Katherine, and Lake Muir areas on the MT. BARKER and PEMBERTON sheets.

- Zinc, **Zn** (Figures 40a,b), shows elevated abundances in the Mayanup - Whistler - Darling Hill area on the COLLIE sheet and in a northwesterly striking zone from the Trollup Hill area to Capercup. Elevated abundances also occur north of Lake Muir, Denbarker, Lake Katherine, and Carbarup Hill areas. The presence of elevated zinc abundances most probably reflects the presence of mafic gneisses.
- Arsenic, **As** (Figures 43a,b), displays significant abundances in the Mayanup - Whistlers - Darling Hill-Darling Hill area on the COLLIE sheet. Elevated abundances occur throughout the Albany-Fraser laterites, but there tends to be increased abundances in the Carbarup and Denbarker to Lake Katherine areas on the MT. BARKER sheet.
- Antimony, **Sb** (Figures 44a,b), displays isolated elevated abundances west of the Quindanning area and sporadically along a northwesterly trending zone through the centre of the sampling area on the COLLIE sheet. Other significant abundances occur in the Peringillup area on the DUMBLEYUNG sheet, and the Cranbrook area on the MT. BARKER sheet. A zone of elevated Sb values occurs in a north-south trending zone in the Denbarker to Lake Katherine area.
- Bismuth, **Bi** (Figures 45a,b), shows slight increases above 1 ppm in the Darling Hill, Darkan, Peringillup, north of Trollup Hill, and Cranbrook areas. Two isolated areas of elevated Bi values occur in the Albany-Fraser laterites southeast of Chitelup Hill and along a northwesterly trend from Denbarker to Lake Katherine.
- Molybdenum, **Mo** (Figures 46a,b), and **Sn** (Figure 47a,b) and show elevated abundances in the Whistlers - Darling Hills area, west of Capercup and the Quindanning to Darkan area on the COLLIE sheet. These elements also occur in increased abundances north of the Trollup Hill area, the Cranbrook area on the MT. BARKER sheet, and the Peringillup area on the DUMBLEYUNG sheet. In the Albany-Fraser laterites, elevated abundances of the elements occur in the Carbarup Hill area and in a northwest trending zone from Denbarker to Lake Katherine.
- Tungsten, **W** (Figures 49a,b), shows elevated abundances in the Quindanning, Capercup, Darling Hill, Mayanup, Trollup Hill, Peringillup, and Cranbrook areas within the Yilgarn terrane. Within the Albany-Fraser laterites elevated W values occur in the Carbarup Hill, Denbarker to Lake Katherine zone, Rocky Gully, and the Chitelup Hill areas.
- Gallium, **Ga** (Figures 48a,b), shows elevated abundances in the Darling Hill area and south of Mayanup on the COLLIE sheet. A broad zone of increased Ga abundances also occurs in the Darkan area. Elevated abundances of Ga are also noted in the Denbarker to Lake Katherine area on the MT. BARKER sheet.
- Zirconium, **Zr** (Figures 50a,b), tends to outline areas of fractionated material. Thus, the elevated abundances of Zr in the Whistlers, Darkan, Quindanning areas on the COLLIE sheet, and Peringillup area on the DUMBLEYUNG sheet indicate the presence of felsic intrusive rocks. This effect can also be seen in the Albany-Fraser laterites where elevated Zr occurs associated with the Nornalup complex in the Denbarker, Mt. Barker, and Carbarup Hill areas.
- Niobium, **Nb** (Figures 51a,b), tends to reflect the presence of fractionated felsic plutonic rocks and displays a pattern similar to that of Zr.
- Tantalum, **Ta** (Figures 52a,b), shows elevated values in the Darling Hill, Darkan, and Quindanning areas on the COLLIE sheet. Elevated abundances also occur in the Boscabel and Peringillup areas on the DUMBLEYUNG sheet, and the Trollup Hill and Cranbrook areas on the MT. BARKER sheet. The elevated values for Ta may serve as indicators for rare metal pegmatites similar to the Greenbushes Sn-Ta deposit. Elevated abundances of Ta also occur within the Albany-Fraser laterites, most notably in Lake Muir area of the PEMBERTON sheet and the Lake Katherine to Denbarker area on the MT. BARKER sheet.
- Selenium, **Se** (Figures 53a,b), shows elevated abundances in the Darling Hill, Muradup, Quindanning, Darkan, Boscabel, Peringillup, and Cranbrook areas. Elevated values in the Albany-Fraser laterites occur in the Carbarup Hill, Denbarker to Lake Katherine zone, Rocky Gully, and Chitelup Hill areas.

- Gold, Au (Figures 54a,b), occurs in elevated abundances in the Whistlers, Darling Hill, and Muradup areas on the COLLIE sheet, and the Boscabel and Peringillup areas on the DUMBLEYUNG sheet. Elevated abundances also occur in the Trollup Hill and the Cranbrook areas on the MT. BARKER sheet. In the Proterzoic rocks, elevated values of Au occur along the northern and western edges of the sampling area, in the Lake Katherine to northeast of Mt. Barker on the MT. BARKER sheet, and the Lake Muir area on the PEMBERTON sheet.

#### 5.4 Multivariate data analysis

The usefulness of multivariate data analysis methods applied to geochemical data has been well documented (Howarth and Sinding-Larsen, 1983, Chapter 6). The most commonly used multivariate methods include, principal components, cluster, factor, regression, and canonical analyses. Multivariate techniques have been specifically applied to Yilgarn volcanic terranes from which a number of geological processes can be inferred, ranging from primary compositional variation to alteration and associated mineralization (Grunsky, 1986). Multivariate techniques also include empirical techniques such as the chalcophile and pegmatophile indices developed by Smith and Perdrix (1983). Multivariate techniques were applied in previous studies (Grunsky *et al.*, 1988, 1989) and quite clearly outlined multi-element geochemical signatures that warrant further investigation.

There are some fundamental problems that commonly occur in geochemical databases such as the regional geochemical database that is being compiled for the Yilgarn block.

- 1) Most elements have a "censored" distribution, meaning that values at less than the detection limit can only be reported as being less than that limit.
- 2) The data do not occur as normally-distributed abundances.
- 3) The data have missing values. That is, not every sample has been analysed for the same number of elements.
- 4) Not every element has been analysed by the same method or the limits of detection of the method have changed over time.

These problems create difficulties when applying mathematical or statistical procedures to the data. Statistical procedures have been devised to deal with all except the last problem. To overcome the problems of censored distributions, procedures have been developed by applying transformations to estimate replacement values for the purposes of statistical calculations by the CSIRO Division of Mathematics and Statistics. Non-normally distributed data can be transformed using standard procedures as outlined by Smith *et al.* (1984). When the data have missing values, several procedures can be applied to estimate replacement values. Most procedures use a multiple regression procedure which estimates the replacement value based on a regression with samples that have complete analyses.

It is beyond the scope of this study to apply and report on all of these procedures. However, one of the more basic procedures can be applied to the data in order to enhance zones of increased abundances, or anomalies. This involves the use of robust estimates of means, correlations and covariances of the data. Because the nature of most of the element distributions is non-normal and positively skewed, the arithmetic means of these distributions tend to be higher than the medians or "true" means of the populations (cf. Histograms, Figures 3-31). Robust statistical procedures determine mean values and subsequent correlations and covariances between the elements based on finding a value of the mean closer to the median of the sample population. Robust procedures were subsequently applied to two procedures used in this report. Principal components analysis has been carried out using robust estimates of the means and correlations for the multivariate populations examined. The use of the Mahalanobis distance as an estimate of whether an unknown sample is anomalous or not is based on a robust estimate of the mean. These procedures are discussed below.

##### 5.4.1 PRINCIPAL COMPONENTS ANALYSIS

Many of the geochemical patterns that were described above can be determined by the use of systematic and statistical means of data analysis. A fundamental objective in the analysis of data is the extraction of meaningful information from which a geological interpretation can be made. As the number of variables increases, the more

detail is provided; however, this is at the expense of simplicity of interpretation. There are several good reviews that discuss the basics of multivariate data analysis techniques (e.g. Jöreskog *et al.*, 1976; Davis, 1986; Howarth and Sinding-Larsen, 1983).

In geological applications, and particularly within the study of igneous rocks, the foundation of petrology is based upon the systematic variation of the elements involved in magmatic fractionation. It is already known that the lithogeochemistry of igneous rocks contains a number of chemical variables that will correlate with one another. Because of this, it would be easier to examine just a few critical elements to extract a meaningful interpretation. However, it is not always known which elements are involved in the magmatic process during fractionation of igneous rocks nor is it always known what subsequent alteration or metamorphism has occurred. Thus, there is uncertainty in choosing, a priori, which variables to include in a subsequent data analysis. A way to overcome this uncertainty is to apply some technique of data analysis that will assist in reducing the number of variables based on correlations or covariances of the variables. Techniques such as factor analysis, principal components analysis, and cluster analysis, can be applied in response to these problems.

The objective of principal components analysis is to reduce the number of variables necessary to describe the observed variation within a set of data. This is done by forming linear combinations of the variables (components) that describe the distribution of the data. Ideally, to the geologist, each component might be interpreted as describing a geological process such as differentiation (partial melting, crystal fractionation, etc.), alteration/mineralization (carbonatization, silicification, alkali depletion, metal associations and enrichments, etc.), and weathering processes (bedrock-saprolite-laterite).

A method of principal components analysis known as Simultaneous RQ-Mode Principal Components Analysis (Zhou *et al.*, 1983) was carried out on the correlation matrix of the combined regional ("R") laterite and ("F2/F3") laterite data groups. This is in contrast to separation of the "R" samples from the "F2/F3" samples analyzed in a previous report (Grunsky, 1990a). In the earlier study, principal components analysis was carried out separately for the "R" samples and for the "F2/F3" samples. The results of each analysis were essentially the same with similar element relationships expressed in each group. Thus it was decided to include both groups together for further analysis.

The correlation matrix used to compute the principal components has been derived by robust estimation methods. Robust estimation gives a better estimate of the means and correlations of the variables by down-weighting the influence of anomalous samples. The complete set of oxides/elements was not used in the analysis. A subset of 20 oxides/elements was chosen for the laterite materials as listed in Tables 7 and 8. Two factors influence the choice of a subset of variables. Firstly, not all of the samples were analysed for all of the elements (e.g. SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>, MgO, CaO, Ba, Zr, etc.) or the elements were of such low abundance levels that it was not considered useful to include them in the analysis (e.g. Bi, Ge, Ta, Be). Secondly, only those samples with non-zero values for all elements were included in the analysis. Samples with values less than the detection limit were set to one third of the detection limit value.

Tables 7 and 8 list the element correlations, eigenvalues, the component loadings of the elements, and the contribution (relative significance) that each element makes to each component of the reduced variable space.

The correlation coefficients can be useful in assessing pairs of significant relationships between elements. Correlation coefficients can be tested for their significance by statistical procedures (Student's t-test). In the case of the Yilgarn laterites of 435 samples and the Albany-Fraser laterites of 355 samples, significant correlation coefficients are defined by absolute correlation coefficient values greater than 0.0790 and 0.0874 at the 95% confidence level respectively. A description of the correlations between the elements would be awkward. The relationships can be expressed best by the examination of the principal component scores in Tables 7 and 8. As well, the relationships can be visually assessed by projecting the principal component scores of the elements and samples on to the principal component axes.

#### 5.4.1.1 Principal components analysis: Yilgarn laterite samples from the Yilgarn Block

A general rule is that eigenvalues (see Table 7) which are greater than 1.0 are considered to be significant components. Thus in Table 7, the first 7 components would be considered worth examining. An exception to this is those components which contribute only a small amount of the overall data variation but contain

contributions by economically-significant elements. In this case, W, Sn, and Au are significant in the 9th through to the 13th, components and are thus considered as well. The cumulative contribution of the first seven eigenvalues for 63% of the data variation.

The relationships between the elements are expressed in Table 7. The principal component scores for the elements indicate the relative associations of the variables. Positive and negative associations between the variables can be observed in the first two columns of the principal component scores in Table 7. The relative contributions of the variables are also shown in Table 7 and indicate the relative amount that each variable contributes to each component. This assists in determining which component is the most significant for each element. For example, much of the  $\text{Fe}_2\text{O}_3$  variation is accounted for in the first component (>89.3%) while the variation of Au is distributed over two components (F3 and F4). A discussion of all of the principal components is not practical for the purpose of this report. Only those components which are considered to be useful for assistance in exploration are discussed here.

Table 7 shows that the first two components account for 32% of the total variation of the data and the first 10 components account for 76.7% of the total variation.

The relationships between the elements can be seen by examining the principal component scores and the relative contributions of the variables. The first group consists of positively associated  $\text{Fe}_2\text{O}_3$ , Mn, V, Cu, Zn, and Cr, and the second group consists of samples associated with Ga (Sn, Zr, and Nb). The two groups, however, are inversely associated. These two groups most likely represent the differences between the gneissic and granitoid lithologies. The mafic gneisses are most likely associated with  $\text{Fe}_2\text{O}_3$ , Mn, V, Cu, Zn, and Cr while the felsic gneisses, pegmatites, and granitic rocks are associated with increased abundances of Ga, Zr, Sn, and Nb.

The relationships between these two groups are best shown graphically. Figure 55a shows the samples and elements plotted on to the first two principal component axes. The relationships of the elements noted above can be clearly seen in the diagram. *Each sample is plotted as a small cross and each element is also projected onto the C1-C2 plane. In this way the relationship between the samples and the elements can be graphically displayed.* The figure illustrates the relationships between the mafic gneisses and the felsic gneisses, pegmatites, and granitoid rocks. The mafic gneisses are associated with the relative increases in  $\text{Fe}_2\text{O}_3$ , V, Mn, Zn, Cr, and Cu. The felsic gneisses and associated rocks show a relative increase in Ga, Sn, Zr, and Nb along the negative side of the C2 axis. Nickel and Co plot along the positive side of the F2 axis. Although these elements are typically associated with mafic rocks, the scores of the elements indicate that they show a weak association with the elements associated with the mafic gneisses and an inverse relationship with elements associated with the fractionated felsic granitoid rocks.

Figure 56a shows a map of the sample scores for the first principal component. Large positive scores (circles) are associated with the Fe, V, Mn, Zn, Cr, Cu enriched (mafic) areas, while large negative scores (stars) are associated with the rocks that are relatively depleted in these elements. Thus the map provides a crude outline of the relative mafic to felsic compositional variation within the gneisses and granitoid rocks. This suggests that mafic rocks occur in the Whistlers, Mayanup, Muradup, Darkan, and Cranbrook areas.

Figure 56b shows a map of the sample scores for the second principal component. The large positive scores are associated with Ni, Co, and Cu enrichment with a slight contribution by Se and Au, while the large negative scores are associated with Nb, Sn, Zr, and Ga with a small contribution by Mo. As indicated previously, this component distinguishes the fractionated felsic granitoid rocks from the more mafic gneisses. The strong association of Sn with these rocks may suggest that the more fractionated rocks with the greater negative C2 score are possibly associated Sn mineralized pegmatites. These sites, most notably in the Whistlers area, south of Muradup, the Cranbrook area, and around the Darkan area, may be suitable targets for further follow-up. Table 9 lists sample numbers and coordinates for positive component scores greater than the 95th percentile (Ni, Co, Cu) and negative component scores less than the 5th percentile (Nb, Sn, Zr, Ga). Samples with scores that are less than -0.15 may have potential for Sn-Nb mineralization.

The third component (7.5% of the total variation) is comprised of significant contributions from Ni, As, Mo, Cr, Au, and Mn (Table 7). Arsenic, Mo, and Ni are positively associated, but inversely associated with Sb and Au. Seventeen percent of the Au variation is accounted for by this component and should be considered as significant for outlining areas with potential Au. These associations can also be seen in Figure 55b which shows



the plot of the samples and elements plotted onto the C1-C3 plane. Figure 56c shows the scores of the samples plotted over the area. The large positive scores are associated with increases of Ni, As, and Mo and the large negative scores are associated with Au and Sb. Large positive scores occur in west of the Whistlers area, Boscabel, and the Darkan areas. Large negative scores occur in the Darling Hill, Darkan, Quindanning, Peringillup, and Cranbrook areas. These areas warrant further follow-up for their Au potential. Table 9 lists the sample numbers and coordinates for positive scores less than the 5th percentile (Au, Sb), and negative component scores greater than the 95th percentile (As, Mo, Ni). Sample scores that are less than -0.10 may have Au potential and scores that are greater than .20 may have potential for Mo and Sn.

The fourth component (6.7% of the total variation) is accounted for primarily by Au, Sb, Pb, W, As, and Mo as indicated by Table 7. More than 58% of the total Au variation is accounted for by this component, making it a significant component to use for mapping out Au potential. Figure 55c shows the samples and element scores projected onto the C1-C4 plane. Table 9 lists the sample numbers and component scores greater than the 95th percentile (Au, Sb, Pb, W, Mo, As) for the fourth component. Sample scores greater than 0.20 may be worth additional follow-up. Figure 56d shows the scores of the samples plotted onto the map area. Large positive scores with the Au associations listed above occur in the Whistlers, Mayanup, Darling Hill, Darkan, Quindanning, Boscabel, north of Trollup Hill, and Cranbrook areas. These areas have some of the best potential for additional Au mineralization.

The eleventh component is dominated by an inverse association between W-Sb-Se and Au-As. Table 7 indicates that these five elements account for most of the variation within the component. Figure 55d shows the sample and element scores plotted onto the C1-C11 plane. The inverse relationship between W and Au is clearly seen. Negative scores are associated with Au and As, while positive scores are associated with W, Sb, and Se. Table 9 indicates that values of C12 that are greater than 0.10 are associated with the W-Sb-Se enrichment while scores of less than -0.10 are associated with Au-As enrichment. Figure 56e shows these samples plotted onto the map area. Large positive scores associated with increased W abundances occur in the Darling Hill, Darkan, Quindanning, Boscabel, and Cranbrook areas. Large negative scores associated with increased Au abundance occur in the Mayanup, Whistlers, Darling Hill, Darkan, Boscabel, Peringillup and Cranbrook areas.

The twelfth component is dominated by an inverse association of Au-Ga with Pb (Table 7). Figure 55e shows the sample and element scores projected onto the C1-C12 plane where the association of Au and Ga is inversely associated with the presence of Pb. Figure 56f shows the sample scores plotted onto the map area. Large positive scores associated with increased Au abundances occur in the Mayanup, Darling Hill, Quindanning, Darkan, Muradup, Boscabel and north of Trollup Hill areas. Large negative scores indicating elevated Pb abundances occur in the Darling Hill, Muradup, Darkan, Boscabel, Peringillup, and Cranbrook areas. Table 9 indicates that scores greater than 0.10 are associated with increased abundances of Au-Ga and scores that are less than -0.10 are associated with increased Pb abundances.

#### 5.4.1.2 Principal components analysis: Albany-Fraser laterite samples

The results of the principal components analysis applied to the Albany-Fraser laterites is shown in Table 8. In this analysis the first 10 components account for 75% of the data variation. The components that account for significant amounts of Au variation are the fifth, sixth, ninth and tenth components respectively.

The first component accounts for 18% of the total data variation and appears to reflect the major compositional differences between the lithologies in the Proterozoic rocks. Table 8 shows that the component is dominated by contributions from Fe, V, Zn, Pb, Cu, Mn, Cr, Co, As, Sb, Ga, Zr, Nb, and Se. The second component accounts for 9.5% of the data variation and is dominated by Nb, Zr, Mn, Ni, Co, and Sn. The scores of the samples are plotted onto the C1-C2 axes in Figure 57a and displays the basic compositional relationships between the samples. Positive C1 scores indicate association with the more mafic materials which may represent mafic gneisses, xenoliths or enclaves within the Proterozoic belt. These samples are not as abundant as the more fractionated granitoid rocks that occur near the origin of the plot. These more felsic samples have a relative increase in Zr, Nb, and Ga abundances. The second component outlines samples that have mafic components associated along the negative part of the C2 axis while samples that plot along the positive part of the C2 axis are associated with more felsic materials. Table 10 lists sample scores that show that negative C2 scores less than 0.15 are associated with more mafic rocks as evidenced by the association with Ni and Co while positive C2 scores greater than 0.10 are associated with more fractionated felsic rocks as indicated by the association of Nb, Zr, Ga, and Sn. Figure 58a shows the sample scores for the first component plotted onto the map area. The map indicates that areas that contain relatively more mafic components occur in the Carbarup

Hill area, northwest of Mt. Barker, west of Lake Katherine, and the Chitelup Hill area. The second component shows felsic rocks as positive scores in the Denbarker and Lake Muir areas.

The fifth component is significant as it accounts for 20% of the variation of Au. Table 8 indicates that increases in Au abundance are positively associated with Ga and Cr increases. Positive C5 scores are associated with Mo, Ni, Sb, and Co. Figure 57b shows the sample and element scores plotted onto the C1-C5 plane. Samples with negative scores are associated with Au increases, while positive scores are associated with Mo increases. Table 10 indicates that samples with scores less than -0.15 are associated with Au increases and samples with scores greater than 0.15 are associated with Mo increases. Figure 58c shows the sample scores plotted onto the map area. Large positive scores associated with Mo increases occur in the Denbarker, Mt. Barker, Lake Katherine, and Lake Muir areas. Large negative scores associated with Au increases occur in the Carbarup Hill, north of Denbarker, Rocky Gully, and Lake Muir areas. These areas have potential for further investigation.

The sixth component accounts for 22% of the variation of Au. Table 8 and Figure 57c indicate that Ga and Sb are associated with increases with Au, whilst Sn is inversely associated with these elements. Table 10 shows that samples with scores less than -0.15 have an association of Au increase and samples with scores greater than 0.15 are associated with Sn increases. Figure 58d shows a map of the sample scores. Large positive scores associated with Sn occur west of Denbarker and the Lake Muir areas. Areas with large negative scores associated with Au occur in the Mt. Barker, Denbarker, Lake Katherine, and Lake Muir areas.

Table 8 shows that the ninth component is dominated by Au, Cr, Se, and Co and to a lesser extent, W and Sb. Figure 57d shows the samples and elements projected onto the C1-C9 axes. Positive scores are associated with Au, Co, and W while negative scores are associated with Cr, Se, and Sb. Only the positive scores associated with Au are of interest. Table 10 indicates that scores above 0.15 have potential Au association. Figure 58e shows a map of the scores in which Au associated positive scores occur in the Denbarker, Carbarup Hill, Lake Katherine, and Lake Muir areas. This component accounts for the most variation of Au (28%) and scores associated with this component may be significant follow-up targets.

The tenth component is dominated by Sn, Sb, Au, W, Mo, Pb, Zn, and Se. Table 8 and Figure 57e show that Sn, Au, Mo, Sb, and Se are positively associated while W, Pb, and Zn are inversely associated to the former group. Table 10 indicates that positive scores greater than 0.15 have elevated abundances in Sn, Au, Mo, Sb, and Se while scores that are less than -0.10 have an association with W, Pb, and Zn. Figure 58f shows the sample scores plotted on to the map area. Positive scores associated with Au occur in the Denbarker, Lake Katherine, Rocky Gully, and Lake Muir areas, while negative scores associated with W occur in the Carbarup Hill, Denbarker, and Lake Muir areas. More than 13% of the Au variation is accounted for by this component and is thus a significant component for potential Au exploration targets.

### 5.5 Anomaly Recognition by Principal Components Analysis

As discussed above, the results of the principal components analysis can be used as a means for ranking anomalies. Because the method determines factors based on the variance of the data, extreme values of the factors represent samples that are enriched in the linear combinations of elements that comprise that factor.

Tables 9 and 10 list the ranked scores for the components for both the Yilgarn and the Albany-Fraser laterites.

Robust principal component scores assist in verifying the atypical nature of some of these "outlier" samples. The areas of highest score ranking have already been discussed in the sections 5.4.1 and 5.4.2. Many of these scores are coincident with high ranking (>90 percentile) abundances of individual elements (Tables 5 and 6) and the CHI-6\*X, PEG-4, and NUMCHI indices (to be discussed next).

### 5.6 Anomaly Recognition by the CHI-6\*X, PEG-4, and NUMCHI Indices

CHI-6\*X, PEG-4, and NUMCHI indices were determined for the two laterite groups as outlined by Smith and Perdrix (1983). These indices are based on the empirical selection of pathfinder elements, from orientation studies, that are combined to produce a "score". The magnitude of the score is directly proportional to the significance of the exploration target. The indices are calculated according to the following formulae:

$$\text{CHI-6}^*\text{X} = \text{As} + 3.56\text{xSb} + 10\text{xBi} + 3\text{xMo} + 30\text{xAg} + 30\text{xSn} + 10\text{xW} + 3.5\text{xSe}$$

$$\text{PEG-4} = .09\text{xAs} + 1.33\text{xSb} + \text{Sn} + 0.14\text{xGa} + 0.4\text{xW} + 0.6\text{xNb} + \text{Ta}.$$

CHI-6\*X and PEG-4 indices must be interpreted cautiously as these indices can be very large, but the value can be the result of only one anomalous element. A useful adjunct to these indices is the NUMCHI index.

The NUMCHI index is based on an integer accumulation of the presence of a number of elements that exceed a given threshold and is thus a measure of the *number* of anomalous elements that are present.

The following elements and thresholds were used for the NUMCHI index:

#### Yilgarn laterites

Element:	Cu	Pb	Zn	As	Sb	Bi	Mo	Ag	Sn	W	Se
Threshold:	105	74	28	110	5	3	12	0.2	7	20	6

(ppm)

#### Albany-Fraser Laterites

Element:	Cu	Pb	Zn	As	Sb	Bi	Mo	Ag	Sn	W	Se
Threshold:	82	79	25	227	5	6	13	0.1	3	12	4

(ppm)

For a given sample, a cumulative score is obtained by adding 1 for each element that exceeds the threshold. Thus, for this NUMCHI index, a maximum possible score would be 11. The threshold values were chosen as the 90 percentile value for the distributions of the elements. These values were taken from Table 3a (Yilgarn laterites) and Table 4a (Albany-Fraser laterites) which provide background values for the "R" (regional) samples that were collected over the area.

These indices are subject to modification which is largely dependent upon the regional background values for which the indices are calculated. These formulae should not be applied without careful consideration of the materials being used, preferably from an orientation study, over the area. Depending upon the commodities being sought, the NUMCHI index can be varied by adding or deleting elements and varying the threshold coefficients.

#### Yilgarn laterites

Areas most worthy of further follow-up contain samples that rank in the upper percentile range of any individual index. However, the index must be above the regional background total for the index used. Tables 11a,b list the CHI-6\*X and PEG-4 indices for the samples that scored greater than the 90 percentile level for the laterite samples. Table 11c lists the samples for which NUMCHI is greater than 2 (more than 2 anomalous elements). Maps of the anomalous samples are shown in Figures 59a,b,c.

Figure 59a shows the CHI-6\*X indices plotted onto the map. Notably large indices occur in the Whistlers, Darling Hill, west of Capercup, Darkan, Quindanning, and Cranbrook areas.

Figure 59b shows the PEG-4 indices plotted onto the map area. Large PEG-4 indices occur in the Muradup, Whistlers, Darling Hill, Darkan, Quindanning, Cranbrook, and Peringillup areas.

The NUMCHI indices are plotted on the map in Figure 59c. The indices with values greater than 3 occur in the Darling Hill, Muradup, and Cranbrook areas.

#### Albany-Fraser Laterites

Tables 12a,b list the CHI-6\*X and PEG-4 indices for the samples that scored greater than the 90 percentile level for the Albany-Fraser laterite samples. Table 12c lists the samples for which NUMCHI is greater than 2 (more than 2 anomalous elements). Figures 60a,b,c show the three indices plotted on to the map.

Figures 60a,b show that the significant CHI-6\*X and PEG-4 indices occur in the Carbarup Hill, Mt. Barker, Denbarker, and Lake Katherine area. Figure 60c displays samples with scores greater than 3. Significant NUMCHI scores occur in the Carbarup Hill, the Denbarker to Lake Katherine area, and north of the Lake Muir area.

### 5.7 Anomaly Recognition by the use of $\chi^2$ [Chi-Square] Plots

Most anomaly recognition procedures are based upon determining the threshold that distinguishes background from anomalous values. However, the use of multivariate procedures can be useful in determining background from anomalous samples for a set of desired elements.

Garrett (1989, 1990) describes the use of the covariance matrix as a tool for distinguishing background from anomalous sample populations. The covariance matrix contains information on the variability of the elements as well as their inter-relationships. The multi-element data define a hyper-ellipsoid in multidimensional space. The mean value of each element defines the centroid of this hyper-ellipsoid and the distance from each sample point to the centroid is known as the Mahalanobis distance. In a multivariate normal sample population, most samples lie within an expected radius of the centroid and by definition the background group of samples. However, if outliers are included in the data, the shape of the hyper-ellipsoid that is defined by the covariance matrix changes. This resulting distortion affects the location of the centroid and thus affects the Mahalanobis distance for all of the samples.

Outliers can be distinguished from the main background population by determining the Mahalanobis distance of each sample to the group centroid. The distances can be compared to the "expected" distances of a multivariate normal population (cumulative probability with the number of degrees of freedom defined as the number of variables) by the use of chi-square ( $\chi^2$ ) values. This procedure *should not be confused* with the CHI-6\*X index which uses a suite of chalcophile elements for the calculation of a chalcophile index.

A graphical procedure of plotting the observed Mahalanobis distances against the quantiles of the  $\chi^2$  distribution assists in the detection of outliers. If the sample population is multivariate normal, then the Chi-square plot is a straight line. If the population contains outliers, then the observed Mahalanobis distances are greater than the expected chi-square values and the plot becomes non-linear. The procedure was carried out on a selected group of elements, most of which are of chalcophile affinity, namely: Cu, Zn, Pb, As, Sb, Bi, Mo, Ag, Sn, W, Se, Ga, Nb, and Ta.

#### Yilgarn and Albany-Fraser Laterites

Tables 13a,b and Figures 61a,b, 62a,b, and 63a,b show the results of the Chi-square/Mahalanobis Distance procedure.

The Mahalanobis distances were based on the ordinary sample mean calculated for each of the chalcophile elements. The figures show that samples with large Mahalanobis distances depart significantly from the expected Chi-square values. This results in upper samples breaking away from the trend of the main group of data.

The procedure was then repeated using re-ordered data (based on the initial Mahalanobis distances). The sample means were recalculated without the upper 15% of the ranked data (15% trimming of the data). This is a more robust estimate of the element means. Figures 61a,b shows a plot of the Mahalanobis distances vs. theoretical Chi-square distances for 542 Yilgarn laterite and 456 Albany-Fraser laterite samples respectively based on the 15% trim. Anomalous values are even further enhanced by the 15% trim of the data for the estimate of the group mean as seen in Figures 61a,b.

Figures 62a,b shows the Mahalanobis distances of the 521 Yilgarn laterite samples and 434 Albany-Fraser laterite samples plotted against the Chi-square distribution after the outliers were removed from the data set. Twenty one outliers were removed from the Yilgarn laterite data, and 22 outliers were removed from the Albany-Fraser laterite data. The sample points lie on a smooth continuous curve. Ideally, the points should define a straight line. This is based on the assumption that the data are multivariate normally distributed. This is not the case for most of the elements which have a skewed distribution. Thus the curved line results from non-normal distributions. The important feature is the *continuity* of the curve. If the curve is continuous then the samples can be assumed to be from a uniform population. Thus, the samples identified as departing from the main trend in Figures 61a,b can be targeted as anomalous samples and their locations require follow-up. These upper samples are identified in Tables 13a,b.

Figure 63a shows a map of the Mahalanobis distances from the Yilgarn laterite samples based on the 15% trimming of the data with 21 outliers removed. These samples form the bulk of the background population. Although 21 outliers have been removed, the upper percentile samples may also represent atypical samples that were previously masked. Thus, samples above the 95th percentile also warrant investigation for potential exploration targets. The samples with the large Mahalanobis distances can be interpreted as being anomalous. Anomalous Yilgarn samples are observed in the Whistlers, Darling Hill, Boscabel, Darkan, Quindanning, north of Trollup Hill, Peringillup, and Cranbrook areas. Samples that are above the 95th percentile are potential sites for additional follow-up exploration. Figure 63b shows the 21 deleted outliers which can be considered as very atypical and should also be considered to be areas for additional follow-up work. These atypical samples occur in the Darling Hill, Boscabel, Darkan, north of Trollup Hill, and Cranbrook areas.

Figure 64a shows a map of the Mahalanobis distances of the Albany-Fraser laterite samples based on the 15% trimming of the data and the elimination 22 outliers. Samples that rank above the 95th percentile should be considered atypical and may warrant further exploration. These sites are located in the Carbarup Hill, Denbarker to Lake Katherine area, and the Lake Muir area. Figure 64b displays a map of the 22 outliers that were previously deleted. These samples may warrant further exploration and highlight atypical abundances in the Denbarker to Lake Katherine area and north of the Lake Muir area.

It is important to keep in mind that these anomalies are based on a selected suite of elements (Cu, Zn, Pb, As, Sb, Bi, Mo, Ag, Sn, W, Se, Ga, Nb, Ta) that best reflect chalcophile enrichment and thus, may not reflect other processes that might be investigated.

## 6.0 DISCUSSION AND CONCLUSIONS

An interpretation with respect to the underlying lithologies has not been possible due to the limited distinctions between the lithologies that cover the area. Thus the interpretation of "mafic" gneisses has been used as a relative term indicating that the area is more mafic than the other materials in the area.

Gold mineralization is commonly associated with an increase in the abundance of a variety of elements, most commonly, As, Sb, W, Mo, B, Ag, Li, Ba, Rb, and Cr in the unweathered profile. As well, Cu, Pb, and Zn can be present in some Au deposits (Groves, 1988; Colvine *et al.*, 1988). However, not all of these elements are present for all types of deposits. Pegmatite associated rare metal deposits can be indicated by enrichment of Bi, As, Sb, Mo, Sn, Ge, W, Nb, and Au. Any one or combination of these elements can be considered as possible pathfinders to a variety of ore deposits.

The tables of summary statistics and histograms are a useful means for determining the range and distribution of elemental abundances within the area being investigated. In this particular study, the histograms clearly reflect the bimodal nature of the materials associated with the greenstone and the granitoid areas. The histograms in this study may assist as a basis of comparison between terranes in which the underlying lithologies are uncertain. Statistical procedures, such as those outlined by Smith *et al.* (1984), could be applied to unknown samples which could characterize their affinity with either greenstone or granitoid lithologies. This approach is currently being investigated.

There are significant geochemical distinctions between the Yilgarn laterites and the Albany-Fraser laterites based on the examination of histograms, order statistics, and a discriminant function analysis. Yilgarn laterite samples contain greater mean abundances for Ti, Mn, V, Zn, Sn, W, Ga, Nb, Zr, and Ba. Albany-Fraser laterite samples contain greater mean abundances for Cr, Ni, As, Sb, Bi, Mo, Se, and Au.

### Yilgarn Laterites

The maps of the elements can be useful for isolating elevated abundances for further follow-up sampling. In particular, Au (Figures 54a,b) abundances are useful for isolating the more obvious areas of potential economic Au. The results of the principal components (Table 7) indicate that Au occurs as individual Au anomalies (C3) as well as multi-element associations with Sb, W, Mo, Pb, and As (C4). Elevated Au values occur in the Whistlers, Darling Hill, Muradup, Boscabel, north of Trollup Hill, Peringillup, and Cranbrook areas. Although there have been no Au producers in this area, the likelihood of Boddington-like ore deposits should not be overlooked.

The area has historically been known for Sn and associated rare metal deposits and the economical potential of this area is probably greatest for these commodities. The primary target for these deposits is most probably the Archaean areas. There has been no report of Sn deposits found within the Proterozoic rocks. Tin and other rare metal areas have been indicated by individual element maps, principal components analysis (C2 & C10), CHI-6\*X, PEG-4, NUMCHI indices, and chi-square plots. Areas with the greatest Sn, W, Nb, Ta potential occur in the Whistlers, Darling Hill Darkan, Quindanning, Boscabel, north of Trollup Hill and Peringillup areas.

Examination of the elements maps, and principal components results (C2 & C10) indicates that Mo occurs with Sn and As in the Whistlers, Darling Hill, Darkan, Boscabel and north of Trollup Hill areas.

Principal components analysis has indicated that W is associated with As, Mo, Sb, Pb, and Au (C4) and as isolated anomalies (C6). Tungsten anomalies occur in the Whistlers, Darling Hill Darkan, Quindanning, and Boscabel areas.

Silver appears to have a very limited multi-element association as indicated by the principal components analysis. The C7 component indicates an association with Pb and Ga suggesting that Ag is derived from fractionated felsic plutonic rocks. The C8 component indicates that Ag abundance is independent of other elements. Elevated Ag occurs are the Whistlers, Darling Hill, Darkan, and Boscabel areas.

#### **Albany-Fraser Laterites**

There is no record of any production of Au or rare metals from the Proterozoic rocks. Nonetheless, there are anomalous zones that occur throughout the area and warrant further investigation. The results of the principal components analysis (Table 8) shows that elevated multi-element abundances of Au occur with Sn (C5), Sb (C6), W (C9) and Sn (C10). The areas which contain these multi-element associations include the Carbarup Hill, Mt. Barker, Denbarker, Lake Katherine, and Lake Muir areas.

Tin, and Nb occur as single and multi-element associations southeast and southwest of Denbarker, north of Mt. Barker, and the Lake Muir areas. Tin is also associated with Nb, Mn, Zr (C2), Au, Mo, Sb, and Se (C10) in the Denbarker to Lake Katherine and Lake Muir areas.

Molybdenum occurs as single and multi-element associations with As, Sb, Pb (Principal Component 3), As, Ni, Zn and Cr (PC4), Ni, Sb, and Co (PC5) in the Carbarup Hill, Denbarker to Lake Katherine, north of Lake Muir, and Mt. Barker areas.

Tungsten occurs with little or no multi-element signature as indicated by the C7 component. Elevated abundances of W occur in the Denbarker and Lake Muir areas.

As in the Yilgarn laterites, Ag occurs with virtually no multi-element signature (C8). Elevated abundances of Ag occur south of Denbarker, west of Lake Katherine, and the Lake Muir areas.

Other elements are difficult to assess individually. Since most economic commodities being sought have multi-element geochemical signatures, it makes sense to employ methods that make use of these multi-element characteristics. The results of the principal components analysis, the CHI-6\*X, PEG-4, and NUMCHI indices, and Mahalanobis distance methods all show zones that have multi-element enrichment and suggest additional follow-up investigation. Exploration for Au and associated precious metal deposits may be assisted by the use of several of these multi-element methods.

The data and results presented in this report, plus additional geophysical, lithological, lithogeochemical, and structural data, may provide sufficient information for a selective and cost efficient exploration programme.

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## APPENDIX 1

### Data Format of the Albany-Fraser Database

The data are contained on a double sided double density (360Kb) 5.25" floppy diskette formatted for an IBM PC or compatible computer running under DOS.

The names of the files that contains the data are:

AFYILG.SDF: Laterite, Ferricrete, Lateritized Rock data from the Yilgarn Block

AFFROT.SDF: Laterite, Ferricrete, Lateritized Rock data from the Albany Orogenic Belt

Refer to Table 2 for the meaning of the various element codes.

The data are recorded in ASCII format and each record of the file has the following attributes:

Field	Name	Type	Width	Dec	Field	Name	Type	Width	Dec
1	CONFID	Logical	1		22	Zn	Numeric	6	0
2	SAMPLE	Character	7		23	Ni	Numeric	6	0
3	SAMPLETYPE	Character	5		24	Co	Numeric	6	0
4	MAPREF	Character	8		25	As	Numeric	6	0
5	EASTING	Numeric	6	0	26	Sb	Numeric	6	0
6	NORTHING	Numeric	7	0	27	Bi1	Numeric	6	0
7	GEOLOGY	Character	5		28	Bi2	Numeric	6	0
8	ANOMALY	Character	5		29	Mo	Numeric	6	0
9	DESCRIPT	Character	5		30	Sn1	Numeric	6	0
10	SiO <sub>2</sub>	Numeric	6	2	31	Sn2	Numeric	6	0
11	Al <sub>2</sub> O <sub>3</sub>	Numeric	6	2	32	Ge	Numeric	6	0
12	Fe <sub>2</sub> O <sub>3</sub>	Numeric	6	2	33	Ga	Numeric	6	0
13	MgO	Numeric	6	3	34	W	Numeric	6	0
14	CaO	Numeric	6	3	35	Ba	Numeric	6	0
15	TiO <sub>2</sub>	Numeric	6	3	36	Zr	Numeric	6	0
16	Ag	Numeric	6	1	37	Nb	Numeric	6	0
17	Mn	Numeric	6	0	38	Ta	Numeric	6	0
18	Cr	Numeric	6	0	39	Se	Numeric	6	0
19	V	Numeric	6	0	40	Be	Numeric	6	0
20	Cu	Numeric	6	0	41	Au	Numeric	6	0
21	Pb	Numeric	6	0					

For the variable, GEOLOGY, the following codes are used to define the geology of the areas where the samples were collected:

AVR - Acid Volcanic Rocks

BIF - Banded Iron Formation

FGM - Foliated Granite and Migmatite

GIR - Granitic Intrusions

LBU - Layered Basic and Ultrabasic Intrusions

MBU - Metabasic and Ultrabasic Rocks

MSR - Metasedimentary Rocks

UMG - Undifferentiated Massive Granitic Rocks

The codes were derived from the geological maps of the Western Australia Geological Survey.

## APPENDIX 1 (cont'd)

A FORTRAN 77 format statement would read in the data in the following manner

```

LOGICAL CONFID
CHARACTER*5 SAMTYP,GEOL,DESCRIPT,ANOMALY
CHARACTER*7 SAMPLE
CHARACTER*8 MAPREF
REAL*4 EAST,NORTH,
$   SiO2,Al2O3,Fe2O3,MgO,CaO,TiO2,Ag,Mn,Cr,V,Cu,Pb,
$   Zn,Ni,Co,As,Sb,Bi1,Bi2,Mo,Sn1,Sn2,Ge,Ga,W,Ba,Zr,
$   Nb,Ta,Se,Be,Au
READ(5,10) CONFID,SAMPLE,SAMTYP,MAPREF,EAST,NORTH,
$   GEOL,ANOMALY,DESCRIPT,
$   SiO2,Al2O3,Fe2O3,MgO,CaO,TiO2,Ag,Mn,Cr,V,Cu,Pb,
$   Zn,Ni,Co,As,Sb,Bi1,Bi2,Mo,Sn1,Sn2,Ge,Ga,W,Ba,Zr,
$   Nb,Ta,Se,Be,Au
10  FORMAT(L1,A7,A5,A8,F6.0,F7.0,3A5,3F6.2,3F6.3,F6.1,25F6.0)

```

Negative values indicate less than detection limit. The detection limit is defined as the absolute value of the quoted value.

Zero values indicate that no analysis was performed for that element.

Table 3a: Summary statistics for Albany-Fraser Area: Yilgarn Block (Archean)

## Laterites

"R" Samples

Sample types:

LP CP LN CN PN VL MS

No. of Samples in Group: 438

Element	Lab	Method	L.L.D.	#Samples	Percentiles										Element
					1%	5%	10%	25%	50%	75%	90%	95%	99%		
SiO2	Csiro	ICP-FS	0.5	Wt%	438	5.76	10.18	13.08	21.90	38.07	49.39	56.29	60.28	67.04	SiO2
Al2O3	Csiro	ICP-FS	0.5	Wt%	438	10.30	14.45	17.02	20.89	24.88	30.23	38.81	43.79	52.23	Al2O3
Fe2O3	Amdel	AAS-HF	0.1	Wt%	438	3.43	4.72	6.43	10.15	17.73	27.59	35.74	41.18	47.32	Fe2O3
MgO	Csrio	ICP-FS	0.05	Wt%	438	.03	.05	.05	.06	.09	.11	.13	.16	.18	MgO
CaO	Csrio	ICP-FS	0.05	Wt%	438	.03	.04	.05	.05	.06	.07	.09	.11	.16	CaO
TiO2	Csrio	ICP-FS	0.003	Wt%	438	.40	.53	.64	.88	1.21	1.69	2.15	2.47	3.03	TiO2
Ag	Amdel	OES	0.1	ppm	438	.03	.03	.03	.03	.03	.10	.10	.10	.20	Ag
Mn	Amdel	AAS	5.0	ppm	438	7.00	16.00	21.00	37.00	68.00	128.00	204.00	264.00	376.00	Mn
Cr	Amdel	XRF	5.0	ppm	438	47.00	72.00	83.00	111.00	153.00	212.00	311.00	403.00	588.00	Cr
V	Amdel	XRF	10.0	ppm	438	42.00	72.00	104.00	191.00	328.00	594.00	868.00	1043.00	1413.00	V
Cu	Amdel	AA-HF	2.0	ppm	438	.67	.67	3.00	5.00	10.00	27.00	49.00	86.00	166.00	Cu
Pb	Amdel	XRF	4.0	ppm	438	5.00	11.00	14.00	20.00	31.00	47.00	64.00	74.00	119.00	Pb
Zn	Amdel	AA-HF	2.0	ppm	438	3.00	6.00	7.00	9.00	12.00	17.00	22.00	28.00	51.00	Zn
Ni	Amdel	AA-HF	5.0	ppm	438	6.00	11.00	13.00	20.00	27.00	36.00	50.00	60.00	82.00	Ni
Co	Amdel	AA-HF	5.0	ppm	438	1.67	1.67	1.67	1.67	6.00	8.00	12.00	15.00	20.00	Co
As	Analb	XRF	2.0	ppm	438	.67	4.00	6.00	9.00	12.00	17.00	23.00	34.00	100.00	As
Sb	Amdel	XRF	2.0	ppm	438	.67	.67	.67	.67	.67	.67	3.00	4.00	7.00	Sb
Bi1	Amdel	XRF	1.0	ppm	438	.33	.33	.33	.33	.33	.33	2.00	3.00	4.00	Bi1
Bi2	Amdel	OES	1.0	ppm	438	.33	.33	.33	.33	.33	.33	.33	.33	1.00	Bi2
Cd	Amdel	AAS-HF	1.0	ppm	438	.33	.33	.33	.33	.33	.33	.33	.33	1.00	Cd
Mo	Amdel	XRF	2.0	ppm	438	.67	.67	.67	.67	3.00	4.00	6.00	7.00	12.00	Mo
Sn1	Amdel	OES	1.0	ppm	438	.33	.33	.33	.33	.33	1.00	1.00	3.00	5.00	Sn1
Sn2	Amdel	XRF	1.0	ppm	438	.33	.33	.33	.33	2.00	3.00	5.00	7.00	8.00	Sn2
Ge	Amdel	OES	1.0	ppm	438	.33	.33	.33	.33	.33	.33	.33	.33	.33	Ge
Ga	Amdel	OES	1.0	ppm	438	1.00	3.00	5.00	6.00	10.00	10.00	15.00	20.00	20.00	Ga
W	Amdel	XRF	10.0	ppm	438	3.33	3.33	3.33	3.33	3.33	3.33	13.00	15.00	22.00	W
Ba	Csrio	ICP	100.0	ppm	438	16.00	32.00	41.00	58.00	84.00	110.00	142.00	184.00	384.00	Ba
Zr	Csrio	ICP-FS	50.0	ppm	437	160.00	227.00	247.00	321.00	386.00	457.00	544.00	623.00	785.00	Zr
Nb	Amdel	XRF	4.0	ppm	437	4.00	7.00	8.00	10.00	13.00	17.00	23.00	28.00	36.00	Nb
Ta	Amdel	XRF	3.0	ppm	437	1.00	1.00	1.00	1.00	1.00	1.00	1.00	4.00	7.00	Ta
Se	Amdel	XRF	1.0	ppm	438	.33	.33	.33	.33	.33	1.00	3.00	3.00	5.00	Se
Be	Amdel	OES	1.0	ppm	437	.33	.33	.33	.33	.33	.33	.33	.33	.33	Be
Au	Analb	234	1.0	ppb	436	.33	.33	.33	.33	2.00	5.00	7.00	8.00	13.00	Au

Table 3a (cont'd)  
Summary statistics for Albany-Fraser Area: Yilgarn Block (Archean)

Laterites  
"R" Samples

Sample types:

LP CP LN CN PN VL MS

Element	Lab	Method	L.L.D.		#Samples	Minimum	Maximum	Median	Mode	Mean	Std.Dev.	Element
SiO2	Csiro	ICP-FS	0.5	Wt%	438	2.72	76.28	37.92	45.60	36.07	16.10	SiO2
Al2O3	Csiro	ICP-FS	0.5	Wt%	438	2.68	57.94	24.75	25.08	26.37	8.67	Al2O3
Fe2O3	Amdel	AAS-HF	0.1	Wt%	438	2.29	75.49	17.73	8.32	19.60	11.64	Fe2O3
MgO	Csrio	ICP-FS	0.05	Wt%	438	.03	.76	.09	.09	.09	.05	MgO
CaO	Csiro	ICP-FS	0.05	Wt%	438	.02	1.53	.06	.05	.07	.10	CaO
TiO2	Csiro	ICP-FS	0.003	Wt%	438	.12	4.38	1.21	1.10	1.33	.61	TiO2
Ag	Amdel	OES	0.1	ppm	438	.03	1.00	.03	.03	.07	.07	Ag
Mn	Amdel	AAS	5.0	ppm	438	1.67	1696.00	68.00	44.95	96.20	109.57	Mn
Cr	Amdel	XRF	5.0	ppm	438	41.00	2965.00	153.00	115.21	188.06	192.87	Cr
V	Amdel	XRF	10.0	ppm	438	3.33	1884.00	328.00	174.88	427.53	316.07	V
Cu	Amdel	AA-HF	2.0	ppm	438	.67	319.00	10.00	2.80	22.57	36.40	Cu
Pb	Amdel	XRF	4.0	ppm	438	1.33	209.00	31.00	22.04	35.88	23.17	Pb
Zn	Amdel	AA-HF	2.0	ppm	438	.67	398.00	12.00	10.92	15.01	20.11	Zn
Ni	Amdel	AA-HF	5.0	ppm	438	1.67	128.00	27.00	25.88	29.86	15.52	Ni
Co	Amdel	AA-HF	5.0	ppm	438	1.67	103.00	6.00	1.73	6.00	6.74	Co
As	Analb	XRF	2.0	ppm	438	.67	488.00	12.00	10.17	16.88	32.48	As
Sb	Amdel	XRF	2.0	ppm	438	.67	9.00	.67	.68	1.11	1.24	Sb
Bi1	Amdel	XRF	1.0	ppm	438	.33	5.00	.33	.35	.62	.80	Bi1
Bi2	Amdel	OES	1.0	ppm	438	.33	3.00	.33	.00	.35	.18	Bi2
Cd	Amdel	AAS-HF	1.0	ppm	438	.33	3.00	.33	.00	.35	.14	Cd
Mo	Amdel	XRF	2.0	ppm	438	.67	57.00	3.00	.70	3.19	3.48	Mo
Sn1	Amdel	OES	1.0	ppm	438	.33	15.00	.33	.35	.89	1.26	Sn1
Sn2	Amdel	XRF	1.0	ppm	438	.33	38.00	2.00	.37	2.44	2.90	Sn2
Ge	Amdel	OES	1.0	ppm	438	.33	1.00	.33	.00	.34	.06	Ge
Ga	Amdel	OES	1.0	ppm	438	.33	40.00	10.00	10.07	9.54	4.95	Ga
W	Amdel	XRF	10.0	ppm	438	3.33	124.00	3.33	3.39	5.32	7.04	W
Ba	Csiro	ICP	100.0	ppm	438	3.00	470.00	83.00	54.58	93.00	58.16	Ba
Zr	Csiro	ICP-FS	50.0	ppm	437	118.00	1592.00	385.00	423.53	398.37	134.56	Zr
Nb	Amdel	XRF	4.0	ppm	437	1.33	45.00	13.00	11.87	14.50	6.71	Nb
Ta	Amdel	XRF	3.0	ppm	437	1.00	14.00	1.00	1.01	1.29	1.30	Ta
Se	Amdel	XRF	1.0	ppm	438	.33	26.00	.33	.35	1.02	1.66	Se
Be	Amdel	OES	1.0	ppm	437	.33	.33	.33	.00	.33	.00	Be
Au	Analb	234	1.0	ppb	436	.33	76.00	2.00	.37	3.13	5.10	Au

NOTE: Mode estimated by binning of data: # of bins = 100.  
Bin width = (95tile-minimum value)/100.0

Table 3b: Summary statistics for Albany-Fraser Area: Yilgarn Block (Archean)

Laterites

"F2/F3" Samples

Sample types:

LP CP LN CN PN VL MS

No. of Samples in Group: 105

Element	Lab	Method	L.L.D.		#Samples	1%	5%	10%	25%	Percentiles 50%	75%	90%	95%	99%	Element
Fe2O3	Amdel	AAS-HF	0.1	Wt%	105	4.58	6.43	8.15	16.44	26.31	37.17	41.75	42.75	55.33	Fe2O3
Ag	Amdel	OES	0.1	ppm	105	.03	.03	.03	.03	.03	.10	.10	.20	2.00	Ag
Mn	Amdel	AAS	5.0	ppm	105	17.00	36.00	41.00	50.00	88.00	183.00	297.00	333.00	440.00	Mn
Cr	Amdel	XRF	5.0	ppm	105	50.00	84.00	100.00	127.00	170.00	215.00	282.00	381.00	740.00	Cr
V	Amdel	XRF	10.0	ppm	105	30.00	60.00	108.00	239.00	360.00	626.00	890.00	1001.00	1600.00	V
Cu	Amdel	AA-HF	2.0	ppm	105	3.00	3.00	4.00	5.00	10.00	25.00	59.00	105.00	170.00	Cu
Pb	Amdel	XRF	4.0	ppm	105	8.00	13.00	16.00	24.00	34.00	48.00	58.00	71.00	82.00	Pb
Zn	Amdel	AA-HF	2.0	ppm	105	3.00	5.00	6.00	7.00	12.00	16.00	24.00	27.00	52.00	Zn
Ni	Amdel	AA-HF	5.0	ppm	105	1.67	6.00	10.00	16.00	22.00	32.00	44.00	49.00	70.00	Ni
Co	Amdel	AA-HF	5.0	ppm	105	1.67	1.67	1.67	1.67	1.67	10.00	13.00	16.00	24.00	Co
As	Analb	XRF	2.0	ppm	105	.67	5.00	8.00	11.00	15.00	34.00	84.00	110.00	150.00	As
Sb	Amdel	XRF	2.0	ppm	105	.67	.67	.67	.67	.67	.67	4.00	5.00	6.00	Sb
Bi1	Amdel	XRF	1.0	ppm	105	.33	.33	.33	.33	.33	.33	2.00	3.00	5.00	Bi1
Bi2	Amdel	OES	1.0	ppm	105	.33	.33	.33	.33	.33	.33	.33	.33	.33	Bi2
Cd	Amdel	AAS-HF	1.0	ppm	66	.33	.33	.33	.33	.33	.33	1.00	1.00	2.00	Cd
Mo	Amdel	XRF	2.0	ppm	105	.67	.67	2.00	3.00	4.00	7.00	10.00	12.00	27.00	Mo
Sn1	Amdel	OES	1.0	ppm	105	.33	.33	.33	.33	1.00	1.00	2.00	3.00	3.00	Sn1
Sn2	Amdel	XRF	1.0	ppm	105	.33	.33	.33	.33	2.00	4.00	5.00	7.00	11.00	Sn2
Ge	Amdel	OES	1.0	ppm	105	.33	.33	.33	.33	.33	.33	.33	.33	.33	Ge
Ga	Amdel	OES	1.0	ppm	105	1.00	6.00	6.00	10.00	10.00	15.00	20.00	20.00	30.00	Ga
W	Amdel	XRF	10.0	ppm	105	3.33	3.33	3.33	3.33	3.33	10.00	15.00	20.00	25.00	W
Nb	Amdel	XRF	4.0	ppm	105	1.33	6.00	8.00	10.00	13.00	17.00	22.00	28.00	40.00	Nb
Ta	Amdel	XRF	3.0	ppm	105	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6.00	8.00	Ta
Se	Amdel	XRF	1.0	ppm	105	.33	.33	.33	.33	.33	1.00	2.00	4.00	7.00	Se
Be	Amdel	OES	1.0	ppm	105	.33	.33	.33	.33	.33	.33	.33	.33	.33	Be
Au	Analb	234	1.0	ppb	66	.33	.33	.33	.33	1.00	1.00	2.00	9.00	12.00	Au



Table 3b: (cont'd)  
Summary statistics for Albany-Fraser Area: Yilgarn Block (Archean)

Laterites  
"F2/F3" Samples

Sample types:

LP CP LN CN PN VL MS

Element	Lab	Method	L.L.D.		#Samples	Minimum	Maximum	Median	Mode	Mean	Std.Dev.	Element
Fe203	Amdel	AAS-HF	0.1	Wt%	105	4.15	56.47	26.02	12.84	26.35	12.69	Fe203
Ag	Amdel	OES	0.1	ppm	105	.03	2.00	.03	.03	.11	.33	Ag
Mn	Amdel	AAS	5.0	ppm	105	10.00	440.00	86.00	50.38	127.66	100.78	Mn
Cr	Amdel	XRF	5.0	ppm	105	50.00	800.00	165.00	127.78	190.60	112.67	Cr
V	Amdel	XRF	10.0	ppm	105	12.00	1620.00	358.00	353.21	458.07	323.40	V
Cu	Amdel	AA-HF	2.0	ppm	105	3.00	183.00	10.00	3.51	23.91	34.63	Cu
Pb	Amdel	XRF	4.0	ppm	105	8.00	87.00	34.00	20.91	37.22	17.60	Pb
Zn	Amdel	AA-HF	2.0	ppm	105	2.00	82.00	12.00	6.13	13.86	10.30	Zn
Ni	Amdel	AA-HF	5.0	ppm	105	1.67	80.00	22.00	18.00	25.03	14.26	Ni
Co	Amdel	AA-HF	5.0	ppm	105	1.67	27.00	1.67	1.74	5.77	5.47	Co
As	Analb	XRF	2.0	ppm	105	.67	209.00	15.00	12.15	30.78	37.39	As
Sb	Amdel	XRF	2.0	ppm	105	.67	7.00	.67	.69	1.32	1.40	Sb
Bi1	Amdel	XRF	1.0	ppm	105	.33	11.00	.33	.35	.86	1.42	Bi1
Bi2	Amdel	OES	1.0	ppm	105	.33	2.00	.33	.00	.35	.16	Bi2
Cd	Amdel	AAS-HF	1.0	ppm	66	.33	2.00	.33	.34	.42	.28	Cd
Mo	Amdel	XRF	2.0	ppm	105	.67	28.00	4.00	2.99	5.47	4.37	Mo
Sn1	Amdel	OES	1.0	ppm	105	.33	6.00	1.00	1.01	1.01	.89	Sn1
Sn2	Amdel	XRF	1.0	ppm	105	.33	12.00	2.00	.37	2.35	2.43	Sn2
Ge	Amdel	OES	1.0	ppm	105	.33	.33	.33	.00	.33	.00	Ge
Ga	Amdel	OES	1.0	ppm	105	.33	40.00	10.00	10.07	12.00	5.83	Ga
W	Amdel	XRF	10.0	ppm	105	3.33	30.00	3.33	3.42	6.47	5.81	W
Nb	Amdel	XRF	4.0	ppm	105	1.33	46.00	13.00	10.00	14.31	7.05	Nb
Ta	Amdel	XRF	3.0	ppm	105	1.00	17.00	1.00	1.02	1.52	2.04	Ta
Se	Amdel	XRF	1.0	ppm	105	.33	8.00	.33	.35	.97	1.42	Se
Be	Amdel	OES	1.0	ppm	105	.33	.33	.33	.00	.33	.00	Be
Au	Analb	234	1.0	ppb	66	.33	12.00	1.00	.98	1.49	2.41	Au

NOTE: Mode estimated by binning of data: # of bins = 100.  
Bin width = (95%ile-minimum value)/100.0

Table 4a: Summary statistics for Albany-Fraser Area: Proterozoic

Laterites

"R" Samples

Sample types:

LP CP LN CN PN VL MS

No. of Samples in Group: 350

Element	Lab	Method	L.L.D.		#Samples	1%	5%	10%	25%	Percentiles	50%	75%	90%	95%	99%	Element
SiO2	Csiro	ICP-FS	0.5	Wt%	350	13.16	24.31	29.14	37.05	44.29	50.46	57.03	58.78	62.71		SiO2
Al2O3	Csiro	ICP-FS	0.5	Wt%	350	6.84	12.40	15.66	18.63	21.54	24.94	27.80	29.67	33.38		Al2O3
Fe2O3	Amdel	AAS-HF	0.1	Wt%	350	3.00	4.43	5.00	8.58	14.01	22.88	33.88	40.75	65.05		Fe2O3
MgO	Csrio	ICP-FS	0.05	Wt%	350	.03	.05	.05	.06	.08	.10	.12	.13	.17		MgO
CaO	Csiro	ICP-FS	0.05	Wt%	350	.01	.03	.04	.05	.05	.06	.08	.09	.12		CaO
TiO2	Csiro	ICP-FS	0.003	Wt%	350	.27	.40	.51	.65	.79	1.01	1.21	1.35	1.94		TiO2
Ag	Amdel	OES	0.1	ppm	350	.03	.03	.03	.03	.03	.10	.10	.10	.10		Ag
Mn	Amdel	AAS	5.0	ppm	350	10.00	14.00	17.00	24.00	38.00	63.00	103.00	135.00	187.00		Mn
Cr	Amdel	XRF	5.0	ppm	350	65.00	84.00	96.00	121.00	164.00	226.00	295.00	391.00	571.00		Cr
V	Amdel	XRF	10.0	ppm	350	42.00	85.00	107.00	163.00	258.00	406.00	594.00	784.00	1225.00		V
Cu	Amdel	AA-HF	2.0	ppm	350	.67	.67	3.00	5.00	9.00	24.00	51.00	82.00	160.00		Cu
Pb	Amdel	XRF	4.0	ppm	350	7.00	10.00	14.00	20.00	30.00	45.00	63.00	79.00	101.00		Pb
Zn	Amdel	AA-HF	2.0	ppm	350	4.00	5.00	6.00	8.00	11.00	15.00	20.00	25.00	35.00		Zn
Ni	Amdel	AA-HF	5.0	ppm	350	9.00	14.00	19.00	27.00	41.00	60.00	79.00	98.00	150.00		Ni
Co	Amdel	AA-HF	5.0	ppm	350	1.67	1.67	1.67	1.67	6.00	9.00	13.00	16.00	26.00		Co
As	Analb	XRF	2.0	ppm	350	4.00	8.00	11.00	16.00	25.00	52.00	143.00	227.00	632.00		As
Sb	Amdel	XRF	2.0	ppm	350	.67	.67	.67	.67	.67	.67	4.00	5.00	7.00		Sb
Bi1	Amdel	XRF	1.0	ppm	350	.33	.33	.33	.33	.33	1.00	4.00	6.00	8.00		Bi1
Bi2	Amdel	OES	1.0	ppm	350	.33	.33	.33	.33	.33	.33	.33	.33	1.00		Bi2
Cd	Amdel	AAS-HF	1.0	ppm	350	.33	.33	.33	.33	.33	.33	.33	.33	2.00		Cd
Mo	Amdel	XRF	2.0	ppm	350	.67	.67	.67	3.00	4.00	6.00	9.00	13.00	28.00		Mo
Sn1	Amdel	OES	1.0	ppm	350	.33	.33	.33	.33	.33	1.00	1.00	1.00	2.00		Sn1
Sn2	Amdel	XRF	1.0	ppm	350	.33	.33	.33	.33	.33	1.00	2.00	3.00	5.00		Sn2
Ge	Amdel	OES	1.0	ppm	350	.33	.33	.33	.33	.33	.33	.33	.33	.33		Ge
Ga	Amdel	OES	1.0	ppm	350	.33	1.00	2.00	3.00	6.00	10.00	10.00	10.00	15.00		Ga
W	Amdel	XRF	10.0	ppm	350	3.33	3.33	3.33	3.33	3.33	3.33	3.33	12.00	17.00		W
Ba	Csiro	ICP	100.0	ppm	349	20.00	29.00	35.00	49.00	69.00	99.00	127.00	151.00	342.00		Ba
Zr	Csiro	ICP-FS	50.0	ppm	349	179.00	214.00	238.00	287.00	341.00	403.00	507.00	599.00	899.00		Zr
Nb	Amdel	XRF	4.0	ppm	350	1.33	1.33	5.00	7.00	9.00	12.00	15.00	17.00	25.00		Nb
Ta	Amdel	XRF	3.0	ppm	350	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6.00		Ta
Se	Amdel	XRF	1.0	ppm	350	.33	.33	.33	.33	.33	2.00	3.00	4.00	6.00		Se
Be	Amdel	OES	1.0	ppm	350	.33	.33	.33	.33	.33	.33	.33	.33	.33		Be
Au	Analb	234	1.0	ppb	350	.33	.33	.33	1.00	3.00	5.00	8.00	10.00	18.00		Au

Table 4a: (cont'd)  
Summary statistics for Albany-Fraser Area: Proterozoic

Laterites  
"R" Samples

Sample types:

LP CP LN CN PN VL MS

Element	Lab	Method	L.L.D.		#Samples	Minimum	Maximum	Median	Mode	Mean	Std.Dev.	Element
SiO2	Csiro	ICP-FS	0.5	Wt%	350	10.41	69.84	44.07	39.67	43.21	10.66	SiO2
Al2O3	Csiro	ICP-FS	0.5	Wt%	350	1.89	37.11	21.54	23.14	21.54	5.34	Al2O3
Fe2O3	Amdel	AAS-HF	0.1	Wt%	350	1.57	73.49	14.01	9.60	17.56	12.78	Fe2O3
MgO	Csrio	ICP-FS	0.05	Wt%	350	.03	.35	.08	.08	.09	.03	MgO
CaO	Csiro	ICP-FS	0.05	Wt%	350	.01	.15	.05	.05	.06	.02	CaO
TiO2	Csiro	ICP-FS	0.003	Wt%	350	.19	2.28	.79	.66	.84	.30	TiO2
Ag	Amdel	OES	0.1	ppm	350	.03	.80	.03	.03	.06	.05	Ag
Mn	Amdel	AAS	5.0	ppm	350	1.67	291.00	37.00	23.67	50.53	40.75	Mn
Cr	Amdel	XRF	5.0	ppm	350	44.00	1785.00	163.00	125.54	190.53	133.74	Cr
V	Amdel	XRF	10.0	ppm	350	3.33	2343.00	256.00	225.82	321.09	246.46	V
Cu	Amdel	AA-HF	2.0	ppm	350	.67	170.00	9.00	5.14	21.01	29.70	Cu
Pb	Amdel	XRF	4.0	ppm	350	4.00	120.00	30.00	17.13	34.86	20.47	Pb
Zn	Amdel	AA-HF	2.0	ppm	350	3.00	73.00	11.00	9.05	12.57	7.18	Zn
Ni	Amdel	AA-HF	5.0	ppm	350	6.00	219.00	40.00	26.70	46.48	28.72	Ni
Co	Amdel	AA-HF	5.0	ppm	350	1.67	65.00	6.00	1.74	6.40	6.21	Co
As	Analb	XRF	2.0	ppm	350	2.00	1282.00	25.00	12.13	62.12	119.30	As
Sb	Amdel	XRF	2.0	ppm	350	.67	10.00	.67	.69	1.47	1.68	Sb
Bi1	Amdel	XRF	1.0	ppm	350	.33	11.00	.33	.36	1.15	1.80	Bi1
Bi2	Amdel	OES	1.0	ppm	350	.33	1.00	.33	.00	.34	.07	Bi2
Cd	Amdel	AAS-HF	1.0	ppm	350	.33	2.00	.33	.00	.37	.21	Cd
Mo	Amdel	XRF	2.0	ppm	350	.67	90.00	4.00	4.06	5.41	6.22	Mo
Sn1	Amdel	OES	1.0	ppm	350	.33	10.00	.33	.34	.64	.65	Sn1
Sn2	Amdel	XRF	1.0	ppm	350	.33	6.00	.33	.35	.92	1.05	Sn2
Ge	Amdel	OES	1.0	ppm	350	.33	1.00	.33	.00	.34	.06	Ge
Ga	Amdel	OES	1.0	ppm	350	.33	20.00	6.00	5.99	6.51	3.64	Ga
W	Amdel	XRF	10.0	ppm	350	3.33	21.00	3.33	3.38	4.10	2.78	W
Ba	Csiro	ICP	100.0	ppm	349	3.00	565.00	69.00	36.30	80.56	56.53	Ba
Zr	Csiro	ICP-FS	50.0	ppm	349	165.00	931.00	341.00	306.05	362.78	121.09	Zr
Nb	Amdel	XRF	4.0	ppm	350	1.33	32.00	9.00	7.99	9.47	4.58	Nb
Ta	Amdel	XRF	3.0	ppm	350	1.00	7.00	1.00	.00	1.14	.74	Ta
Se	Amdel	XRF	1.0	ppm	350	.33	8.00	.33	.35	1.37	1.46	Se
Be	Amdel	OES	1.0	ppm	350	.33	1.00	.33	.00	.34	.04	Be
Au	Analb	234	1.0	ppb	350	.33	80.00	3.00	.38	4.01	5.29	Au

NOTE: Mode estimated by binning of data: # of bins = 100.  
Bin width = (95%ile-minimum value)/100.0

Table 4b: Summary statistics for Albany-Fraser Area: Proterozoic

Laterites

"F2/F3" Samples

Sample types:

LP CP LN CN PN VL MS

No. of Samples in Group: 106

Element	Lab	Method	L.L.D.	#Samples	Percentiles										Element
					1%	5%	10%	25%	50%	75%	90%	95%	99%		
SiO2	Csiro	ICP-FS	0.5	Wt%	6	37.07	37.07	37.07	37.66	46.56	49.72	56.50	56.50	56.50	SiO2
Al2O3	Csiro	ICP-FS	0.5	Wt%	6	16.33	16.33	16.33	18.72	24.32	26.04	27.45	27.45	27.45	Al2O3
Fe2O3	Amdel	AAS-HF	0.1	Wt%	106	4.72	5.58	7.15	11.44	20.30	27.74	37.46	40.46	49.04	Fe2O3
MgO	Csrio	ICP-FS	0.05	Wt%	6	.04	.04	.04	.07	.07	.10	.11	.11	.11	MgO
CaO	Csiro	ICP-FS	0.05	Wt%	6	.04	.04	.04	.04	.05	.05	.05	.05	.05	CaO
TiO2	Csiro	ICP-FS	0.003	Wt%	6	.57	.57	.57	.62	.99	1.01	1.13	1.13	1.13	TiO2
Ag	Amdel	OES	0.1	ppm	106	.03	.03	.03	.03	.03	.10	.10	.20	1.00	Ag
Mn	Amdel	AAS	5.0	ppm	106	24.00	30.00	35.00	48.00	68.00	105.00	180.00	360.00	690.00	Mn
Cr	Amdel	XRF	5.0	ppm	106	36.00	67.00	77.00	107.00	165.00	248.00	345.00	409.00	440.00	Cr
V	Amdel	XRF	10.0	ppm	106	73.00	110.00	152.00	243.00	375.00	607.00	820.00	914.00	1120.00	V
Cu	Amdel	AA-HF	2.0	ppm	106	.67	3.00	4.00	5.00	10.00	23.00	63.00	92.00	200.00	Cu
Pb	Amdel	XRF	4.0	ppm	106	6.00	12.00	15.00	22.00	31.00	52.00	66.00	88.00	126.00	Pb
Zn	Amdel	AA-HF	2.0	ppm	106	4.00	4.00	5.00	6.00	8.00	12.00	18.00	20.00	54.00	Zn
Ni	Amdel	AA-HF	5.0	ppm	106	1.67	17.00	20.00	27.00	40.00	54.00	79.00	87.00	150.00	Ni
Co	Amdel	AA-HF	5.0	ppm	106	1.67	1.67	1.67	1.67	1.67	7.00	13.00	16.00	32.00	Co
As	Analb	XRF	2.0	ppm	106	11.00	13.00	14.00	21.00	49.00	156.00	320.00	420.00	828.00	As
Sb	Amdel	XRF	2.0	ppm	106	.67	.67	.67	.67	.67	2.00	3.00	4.00	5.00	Sb
Bi1	Amdel	XRF	1.0	ppm	106	.33	.33	.33	.33	.33	.33	3.00	3.00	4.00	Bi1
Bi2	Amdel	OES	1.0	ppm	106	.33	.33	.33	.33	.33	.33	.33	.33	.33	Bi2
Cd	Amdel	AAS-HF	1.0	ppm	85	.33	.33	.33	.33	.33	.33	.33	1.00	2.00	Cd
Mo	Amdel	XRF	2.0	ppm	106	.67	2.00	3.00	4.00	5.00	8.00	13.00	17.00	56.00	Mo
Sn1	Amdel	OES	1.0	ppm	106	.33	.33	.33	.33	.33	.33	1.00	1.00	3.00	Sn1
Sn2	Amdel	XRF	1.0	ppm	106	.33	.33	.33	.33	1.00	2.00	3.00	4.00	6.00	Sn2
Ge	Amdel	OES	1.0	ppm	106	.33	.33	.33	.33	.33	.33	.33	.33	.33	Ge
Ga	Amdel	OES	1.0	ppm	106	1.00	2.00	6.00	10.00	10.00	15.00	20.00	20.00	20.00	Ga
W	Amdel	XRF	10.0	ppm	106	3.33	3.33	3.33	3.33	3.33	3.33	13.00	15.00	22.00	W
Ba	Csiro	ICP	100.0	ppm	6	32.00	32.00	32.00	56.00	67.00	81.00	168.00	168.00	168.00	Ba
Zr	Csiro	ICP-FS	50.0	ppm	6	302.00	302.00	302.00	308.00	329.00	356.00	487.00	487.00	487.00	Zr
Nb	Amdel	XRF	4.0	ppm	106	1.33	1.33	1.33	6.00	9.00	11.00	14.00	15.00	20.00	Nb
Ta	Amdel	XRF	3.0	ppm	106	1.00	1.00	1.00	1.00	1.00	1.00	3.00	4.00	9.00	Ta
Se	Amdel	XRF	1.0	ppm	106	.33	.33	.33	.33	.33	.33	2.00	3.00	4.00	Se
Be	Amdel	OES	1.0	ppm	106	.33	.33	.33	.33	.33	.33	.33	.33	.33	Be
Au	Analb	234	1.0	ppb	85	.33	.33	.33	1.00	2.00	4.00	5.00	6.00	16.00	Au

Table 4b: (cont'd)  
Summary statistics for Albany-Fraser Area: Proterozoic

Laterites  
"F2/F3" Samples

Sample types:

LP CP LN CN PN VL MS

Element	Lab	Method	L.L.D.		#Samples	Minimum	Maximum	Median	Mode	Mean	Std.Dev.	Element
SiO2	Csiro	ICP-FS	0.5	Wt%	6	37.07	56.50	41.93	37.17	44.91	7.52	SiO2
Al2O3	Csiro	ICP-FS	0.5	Wt%	6	16.33	27.45	23.51	16.39	22.73	4.32	Al2O3
Fe2O3	Amdel	AAS-HF	0.1	Wt%	106	4.00	53.47	20.16	21.32	20.91	10.99	Fe2O3
MgO	Csrio	ICP-FS	0.05	Wt%	6	.04	.11	.07	.04	.08	.02	MgO
CaO	Csiro	ICP-FS	0.05	Wt%	6	.04	.05	.05	.04	.05	.01	CaO
TiO2	Csiro	ICP-FS	0.003	Wt%	6	.57	1.13	.74	.58	.84	.23	TiO2
Ag	Amdel	OES	0.1	ppm	106	.03	6.00	.03	.03	.13	.59	Ag
Mn	Amdel	AAS	5.0	ppm	106	21.00	3503.00	68.00	56.60	130.59	346.46	Mn
Cr	Amdel	XRF	5.0	ppm	106	34.00	457.00	163.00	110.88	186.08	101.54	Cr
V	Amdel	XRF	10.0	ppm	106	70.00	1522.00	373.00	243.02	439.00	268.14	V
Cu	Amdel	AA-HF	2.0	ppm	106	.67	430.00	10.00	3.86	25.37	49.67	Cu
Pb	Amdel	XRF	4.0	ppm	106	1.33	142.00	31.00	27.77	39.02	24.67	Pb
Zn	Amdel	AA-HF	2.0	ppm	106	3.00	56.00	8.00	8.02	10.48	8.01	Zn
Ni	Amdel	AA-HF	5.0	ppm	106	1.67	155.00	40.00	20.01	44.96	25.52	Ni
Co	Amdel	AA-HF	5.0	ppm	106	1.67	37.00	1.67	1.74	5.31	6.04	Co
As	Analb	XRF	2.0	ppm	106	5.00	1026.00	48.00	15.38	122.41	171.55	As
Sb	Amdel	XRF	2.0	ppm	106	.67	5.00	.67	.68	1.39	1.25	Sb
Bi1	Amdel	XRF	1.0	ppm	106	.33	8.00	.33	.35	.86	1.17	Bi1
Bi2	Amdel	OES	1.0	ppm	106	.33	.33	.33	.00	.33	.00	Bi2
Cd	Amdel	AAS-HF	1.0	ppm	85	.33	2.00	.33	.34	.38	.23	Cd
Mo	Amdel	XRF	2.0	ppm	106	.67	58.00	5.00	4.01	7.26	8.24	Mo
Sn1	Amdel	OES	1.0	ppm	106	.33	3.00	.33	.34	.56	.50	Sn1
Sn2	Amdel	XRF	1.0	ppm	106	.33	6.00	1.00	.35	1.37	1.41	Sn2
Ge	Amdel	OES	1.0	ppm	106	.33	.33	.33	.00	.33	.00	Ge
Ga	Amdel	OES	1.0	ppm	106	.33	30.00	10.00	10.07	11.39	5.38	Ga
W	Amdel	XRF	10.0	ppm	106	3.33	23.00	3.33	3.39	5.66	4.80	W
Ba	Csiro	ICP	100.0	ppm	6	32.00	168.00	56.00	55.80	76.67	47.55	Ba
Zr	Csiro	ICP-FS	50.0	ppm	6	302.00	487.00	320.00	302.92	350.33	69.59	Zr
Nb	Amdel	XRF	4.0	ppm	106	1.33	52.00	8.00	6.05	8.87	5.73	Nb
Ta	Amdel	XRF	3.0	ppm	106	1.00	9.00	1.00	1.01	1.47	1.46	Ta
Se	Amdel	XRF	1.0	ppm	106	.33	5.00	.33	.35	.78	.96	Se
Be	Amdel	OES	1.0	ppm	106	.33	.33	.33	.00	.33	.00	Be
Au	Analb	234	1.0	ppb	85	.33	16.00	2.00	.36	2.81	2.86	Au

NOTE: Mode estimated by binning of data: # of bins = 100.  
Bin width = (95%ile-minimum value)/100.0

Table 5: Ranked Samples > 95th Percentile  
 Albany-Fraser Area: Yilgarn Block "R/F2/F3" Samples  
 Laterites: LP CP LN CN PN VL MS

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples
SiO2 Wt%	Csiro	ICP-FS	0.5	438	Al2O3 Wt%	Csiro	ICP-FS	0.5	438
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value	
G07736 R	533900.	6246950.	76.280		G07906 R	465950.	6330050.	57.940	
G07199 R	483400.	6282300.	75.140		G07418 R	466750.	6241600.	56.540	
G07741 R	550500.	6239100.	70.820		G07194 R	474550.	6277750.	56.440	
G07780 R	514050.	6260900.	69.670		G07414 R	465500.	6250250.	56.010	
G07733 R	531800.	6251750.	67.040		G05990 R	469600.	6280000.	52.230	
G07241 R	495500.	6283500.	66.990		G07406 R	462800.	6237500.	52.060	
G07789 R	512250.	6271150.	65.080		G07295 R	455250.	6238250.	50.500	
G07229 R	491100.	6281500.	64.710		G05956 R	477800.	6295700.	49.070	
G07835 R	539150.	6216000.	63.350		G07415 R	464100.	6248000.	48.990	
G07784 R	505650.	6269600.	63.220		G05978 R	480450.	6293050.	47.670	
G07836 R	541850.	6213650.	63.140		G07879 R	471150.	6322250.	47.450	
G07743 R	554950.	6241900.	62.040		G07326 R	470500.	6248800.	46.460	
G07735 R	533900.	6248800.	61.980		G07195 R	473300.	6275600.	46.450	
G07734 R	533900.	6251350.	61.870		G05930 R	466000.	6302200.	46.240	
G07719 R	540700.	6244300.	61.730		G05910 R	476950.	6311300.	46.140	
G07706 R	521000.	6270900.	61.660		G05928 R	464300.	6302000.	46.050	
G05922 R	464400.	6309900.	61.570		G07907 R	468200.	6331600.	45.850	
G07708 R	518550.	6270350.	61.550		G07287 R	457350.	6235450.	45.130	
G07353 R	455300.	6256400.	61.370		G07863 R	459800.	6325100.	44.840	
G07227 R	488650.	6285400.	60.670		G07196 R	476600.	6278250.	44.620	

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples
Fe2O3 Wt%	Amdel	AAS-HF	0.1	543	MgO Wt%	Csiro	ICP-FS	0.05	438
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value	
G07400 R	456100.	6244650.	75.490		G07325 R	471100.	6251800.	.761	
G08484 F3	502250.	6232910.	56.470		G05941 R	474500.	6298200.	.687	
G07745 R	552500.	6246000.	56.330		G05960 R	475150.	6300700.	.210	
G08482 F3	502485.	6232790.	55.330		G05949 R	484700.	6295800.	.183	
G07251 R	498600.	6269700.	52.900		G07326 R	470500.	6248800.	.182	
G07838 R	549350.	6209500.	52.470		G07319 R	480200.	6239350.	.179	
G08475 F3	502300.	6233500.	47.470		G07277 R	497000.	6240000.	.177	
G05945 R	488550.	6299200.	47.320		G07212 R	488400.	6264250.	.175	
G07761 R	491100.	6251200.	47.040		G07783 R	503700.	6268400.	.173	
G07317 R	477600.	6244650.	47.040		G07240 R	498200.	6284400.	.171	
G07260 R	493350.	6253000.	46.890		G05908 R	473700.	6312500.	.165	
G08507 F3	467450.	6259050.	46.750		G07254 R	500300.	6263100.	.163	
G07271 R	495000.	6246300.	46.610		G07831 R	544300.	6214000.	.162	
G07259 R	498200.	6254950.	46.320		G07316 R	475600.	6246350.	.162	
G07779 R	512600.	6263150.	45.610		G07865 R	456300.	6336700.	.161	
G07312 R	468750.	6250800.	45.320		G05973 R	465100.	6312050.	.159	
G08514 F3	466550.	6256700.	44.750		G07259 R	498200.	6254950.	.159	
G07732 R	502000.	6227600.	44.750		G05980 R	481250.	6284800.	.158	
G05959 R	476500.	6303350.	44.320		G07271 R	495000.	6246300.	.158	
G07327 R	467150.	6247500.	44.030		G05922 R	464400.	6309900.	.157	

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples
CaO Wt%	Csiro	ICP-FS	0.05	438	TiO2 Wt%	Csiro	ICP-FS	0.003	438
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value	
G07325 R	471100.	6251800.	1.530		G07287 R	457350.	6235450.	4.380	
G05941 R	474500.	6298200.	1.430		G07760 R	502600.	6233350.	3.920	
G05960 R	475150.	6300700.	.486		G07262 R	488350.	6257700.	3.470	
G05980 R	481250.	6284800.	.163		G05985 R	477800.	6283200.	3.060	
G05979 R	480100.	6287400.	.160		G05937 R	469400.	6295000.	3.030	
G07865 R	456300.	6336700.	.156		G05967 R	480100.	6304600.	3.020	
G07258 R	501450.	6256100.	.151		G07223 R	495300.	6274500.	2.970	
G07762 R	487800.	6249350.	.148		G07903 R	461000.	6331350.	2.950	
G07737 R	536650.	6248950.	.143		G07203 R	484100.	6274700.	2.820	
G05913 R	482100.	6309600.	.133		G07190 R	485550.	6286150.	2.700	
G07277 R	497000.	6240000.	.131		G07312 R	468750.	6250800.	2.690	
G07260 R	493350.	6253000.	.127		G07729 R	502300.	6236600.	2.660	
G07831 R	544300.	6214000.	.124		G07286 R	459200.	6234150.	2.620	
G05949 R	484700.	6295800.	.123		G05957 R	477800.	6299500.	2.600	
G07732 R	502000.	6227600.	.120		G05962 R	472900.	6306200.	2.580	
G07312 R	468750.	6250800.	.120		G05902 R	468200.	6319600.	2.560	
G05921 R	466600.	6309000.	.118		G07343 R	467200.	6255000.	2.560	
G07880 R	472900.	6319350.	.117		G05976 R	475800.	6291900.	2.560	
G07769 R	496450.	6260750.	.116		G07226 R	490900.	6278200.	2.550	
G07188 R	488900.	6291000.	.116		G07317 R	477600.	6244650.	2.530	

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Ag	ppm	Amdel	OES	0.1	543	Mn	ppm	Amdel	AAS	5.0	543
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G08474	F3	502580.	6233610.	2.000	G07400	R	456100.	6244650.	1696.000		
G08394	F2	507100.	6278400.	2.000	G07343	R	467200.	6255000.	444.000		
G08393	F2	510100.	6278100.	2.000	G08510	F3	467050.	6257150.	440.000		
G05949	R	484700.	6295800.	1.000	G08511	F3	467000.	6257550.	440.000		
G07790	R	509250.	6273600.	.600	G07271	R	495000.	6246300.	402.000		
G08399	F2	506500.	6275500.	.400	G05960	R	475150.	6300700.	396.000		
G07191	R	484500.	6283850.	.400	G07838	R	549350.	6209500.	376.000		
G07786	R	509000.	6268700.	.200	G08514	F3	466550.	6256700.	370.000		
G08499	F3	469200.	6253700.	.200	G08425	F2	467700.	6241800.	369.000		
G08390	F2	512000.	6272700.	.200	G07312	R	468750.	6250800.	355.000		
G05922	R	464400.	6309900.	.200	G07268	R	497000.	6246750.	350.000		
G07763	R	490700.	6246400.	.200	G07316	R	475600.	6246350.	348.000		
G07300	R	477600.	6253200.	.200	G08517	F3	467550.	6257500.	335.000		
G07203	R	484100.	6274700.	.200	G08405	F2	521800.	6266800.	333.000		
G07742	R	553350.	6237850.	.200	G07245	R	494150.	6269900.	328.000		
G07237	R	493150.	6287200.	.100	G08509	F3	466500.	6257300.	320.000		
G08505	F3	466550.	6259880.	.100	G08409	F2	469600.	6252650.	314.000		
G08418	F2	468500.	6259400.	.100	G08410	F2	469800.	6255800.	314.000		
G07228	R	491100.	6283800.	.100	G07908	R	467550.	6334000.	311.000		
G08403	F2	522200.	6265850.	.100	G07262	R	488350.	6257700.	309.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Cr	ppm	Amdel	XRF	5.0	543	V	ppm	Amdel	XRF	10.0	543
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07420	R	463500.	6242700.	2965.000	G07732	R	502000.	6227600.	1884.000		
G07277	R	497000.	6240000.	2177.000	G07223	R	495300.	6274500.	1735.000		
G08486	F3	500960.	6233010.	800.000	G07265	R	493000.	6256500.	1624.000		
G07874	R	459900.	6322600.	777.000	G08480	F3	502830.	6233200.	1620.000		
G08476	F3	501770.	6234185.	740.000	G08485	F3	501100.	6233500.	1600.000		
G07417	R	467750.	6240800.	623.000	G07262	R	488350.	6257700.	1508.000		
G05959	R	476500.	6303350.	588.000	G07190	R	485550.	6286150.	1413.000		
G05921	R	466600.	6309000.	581.000	G07761	R	491100.	6251200.	1385.000		
G07772	R	512300.	6258800.	547.000	G08479	F3	502600.	6233200.	1360.000		
G07254	R	500300.	6263100.	509.000	G07302	R	482700.	6250700.	1347.000		
G07282	R	468400.	6233300.	505.000	G07226	R	490900.	6278200.	1275.000		
G07294	R	455750.	6239300.	492.000	G07255	R	502150.	6262200.	1218.000		
G07780	R	514050.	6260900.	486.000	G07189	R	487250.	6288500.	1206.000		
G07406	R	462800.	6237500.	478.000	G07317	R	477600.	6244650.	1183.000		
G07297	R	459950.	6243500.	473.000	G07312	R	468750.	6250800.	1136.000		
G07261	R	489350.	6253000.	453.000	G07713	R	553950.	6249700.	1132.000		
G07729	R	502300.	6236600.	452.000	G08440	F2	487900.	6289650.	1100.000		
G07340	R	464100.	6262350.	445.000	G07282	R	468400.	6233300.	1091.000		
G08405	F2	521800.	6266800.	442.000	G07754	R	533550.	6215200.	1087.000		
G07255	R	502150.	6262200.	441.000	G07271	R	495000.	6246300.	1070.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Cu	ppm	Amdel	AA-HF	2.0	543	Pb	ppm	Amdel	XRF	4.0	543
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07276	R	498550.	6238200.	319.000	G07254	R	500300.	6263100.	209.000		
G07237	R	493150.	6287200.	301.000	G07772	R	512300.	6258800.	154.000		
G05960	R	475150.	6300700.	271.000	G07865	R	456300.	6336700.	152.000		
G07422	R	470300.	6235800.	191.000	G07786	R	509000.	6268700.	133.000		
G08409	F2	469600.	6252650.	183.000	G07276	R	498550.	6238200.	119.000		
G08511	F3	467000.	6257550.	170.000	G07742	R	553350.	6237850.	111.000		
G07265	R	493000.	6256500.	166.000	G07189	R	487250.	6288500.	108.000		
G07351	R	455800.	6253100.	154.000	G07349	R	453800.	6254300.	107.000		
G07347	R	459050.	6256500.	150.000	G07848	R	538500.	6222700.	104.000		
G08517	F3	467550.	6257500.	145.000	G07720	R	541100.	6248100.	98.000		
G07845	R	541250.	6208750.	145.000	G05980	R	481250.	6284800.	89.000		
G07268	R	497000.	6246750.	144.000	G08425	F2	467700.	6241800.	87.000		
G07728	R	499800.	6236700.	143.000	G05909	R	476000.	6314100.	83.000		
G08403	F2	522200.	6265850.	143.000	G07779	R	512600.	6263150.	83.000		
G07232	R	491100.	6287150.	136.000	G05989	R	470050.	6282750.	83.000		
G05920	R	469500.	6309200.	135.000	G07348	R	458150.	6258200.	82.000		
G07400	R	456100.	6244650.	129.000	G07740	R	549300.	6240400.	82.000		
G05959	R	476500.	6303350.	127.000	G07238	R	495600.	6287400.	82.000		
G07755	R	539000.	6220000.	126.000	G08440	F2	487900.	6289650.	82.000		
G07713	R	553950.	6249700.	117.000	G08449	F2	477400.	6298100.	81.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Zn	ppm	Amdel	AA-HF	2.0	543	Ni	ppm	Amdel	AA-HF	5.0	543
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07400	R	456100.	6244650.	398.000	G07728	R	499800.	6236700.	128.000		
G08482	F3	502485.	6232790.	82.000	G07299	R	456400.	6243600.	103.000		
G07422	R	470300.	6235800.	80.000	G07237	R	493150.	6287200.	93.000		
G07417	R	467750.	6240800.	68.000	G07277	R	497000.	6240000.	84.000		
G07197	R	478650.	6277000.	57.000	G07340	R	464100.	6262350.	82.000		
G08484	F3	502250.	6232910.	52.000	G08476	F3	501770.	6234185.	80.000		
G07329	R	475250.	6242400.	51.000	G07351	R	455800.	6253100.	76.000		
G07239	R	498000.	6287200.	45.000	G07730	R	501200.	6234300.	72.000		
G05946	R	492400.	6297400.	41.000	G07239	R	498000.	6287200.	71.000		
G07312	R	468750.	6250800.	40.000	G08486	F3	500960.	6233010.	70.000		
G08483	F3	502720.	6232780.	39.000	G07780	R	514050.	6260900.	69.000		
G07268	R	497000.	6246750.	39.000	G07314	R	470600.	6244600.	67.000		
G07262	R	488350.	6257700.	38.000	G07261	R	489350.	6253000.	66.000		
G05980	R	481250.	6284800.	37.000	G07323	R	469950.	6241000.	66.000		
G07244	R	499050.	6279600.	36.000	G07330	R	473150.	6242000.	65.000		
G07276	R	498550.	6238200.	35.000	G07214	R	490500.	6262100.	65.000		
G07413	R	467100.	6252150.	33.000	G07276	R	498550.	6238200.	63.000		
G08479	F3	502600.	6233200.	32.000	G07327	R	467150.	6247500.	62.000		
G07760	R	502600.	6233350.	32.000	G07291	R	456500.	6232650.	62.000		
G07340	R	464100.	6262350.	31.000	G07413	R	467100.	6252150.	62.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Co	ppm	Amdel	AA-HF	5.0	543	As	ppm	Analb	XRF	2.0	543
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07400	R	456100.	6244650.	103.000	G07349	R	453800.	6254300.	488.000		
G05983	R	476300.	6288900.	36.000	G07311	R	469700.	6253800.	400.000		
G07239	R	498000.	6287200.	30.000	G08415	F2	469800.	6254500.	209.000		
G07237	R	493150.	6287200.	27.000	G07292	R	454650.	6234400.	163.000		
G08394	F2	507100.	6278400.	27.000	G08497	F3	470200.	6253650.	150.000		
G08515	F3	467550.	6257060.	24.000	G08493	F3	470200.	6253650.	150.000		
G07728	R	499800.	6236700.	20.000	G08496	F3	470600.	6253680.	135.000		
G07755	R	539000.	6220000.	20.000	G08495	F3	470470.	6252600.	130.000		
G07846	R	537300.	6218000.	19.000	G07796	R	504000.	6274950.	119.000		
G07302	R	482700.	6250700.	19.000	G08414	F2	470650.	6253200.	110.000		
G07215	R	492700.	6260300.	18.000	G08515	F3	467550.	6257060.	105.000		
G08514	F3	466550.	6256700.	18.000	G07301	R	480500.	6253700.	100.000		
G07245	R	494150.	6269900.	18.000	G07341	R	467100.	6259750.	100.000		
G07217	R	492200.	6268000.	18.000	G08412	F2	468000.	6256950.	95.000		
G07301	R	480500.	6253700.	18.000	G08411	F2	468200.	6255950.	93.000		
G08401	F2	506750.	6274050.	17.000	G07338	R	466050.	6257400.	89.000		
G07740	R	549300.	6240400.	17.000	G08418	F2	468500.	6259400.	87.000		
G07238	R	495600.	6287400.	17.000	G08510	F3	467050.	6257150.	84.000		
G07276	R	498550.	6238200.	17.000	G08500	F3	469650.	6254150.	84.000		
G08436	F2	480700.	6282600.	16.000	G08498	F3	469650.	6253250.	84.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Sb	ppm	Amdel	XRF	2.0	543	Bi	ppm	Amdel	XRF	1.0	543
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07911	R	454100.	6333100.	9.000	G08480	F3	502830.	6233200.	11.000		
G07847	R	535150.	6220700.	8.000	G08412	F2	468000.	6256950.	5.000		
G08475	F3	502300.	6233500.	7.000	G05967	R	480100.	6304600.	5.000		
G07877	R	466000.	6324100.	7.000	G08486	F3	500960.	6233010.	5.000		
G07866	R	461000.	6327100.	7.000	G08493	F3	470200.	6253650.	5.000		
G07840	R	546900.	6209800.	7.000	G07728	R	499800.	6236700.	5.000		
G08476	F3	501770.	6234185.	6.000	G07743	R	554950.	6241900.	4.000		
G07874	R	459900.	6322600.	6.000	G05902	R	468200.	6319600.	4.000		
G07740	R	549300.	6240400.	5.000	G07796	R	504000.	6274950.	4.000		
G08441	F2	483800.	6295750.	5.000	G07718	R	543300.	6244300.	4.000		
G07858	R	538550.	6252800.	5.000	G07839	R	549400.	6211800.	4.000		
G07202	R	486200.	6275200.	5.000	G07869	R	505400.	6266800.	4.000		
G07859	R	468400.	6324600.	5.000	G05989	R	470050.	6282750.	4.000		
G07745	R	552500.	6246000.	5.000	G07840	R	546900.	6209800.	3.000		
G07746	R	549750.	6244950.	5.000	G05997	R	466600.	6291000.	3.000		
G07910	R	454450.	6336100.	5.000	G07725	R	498550.	6231550.	3.000		
G07248	R	497950.	6265600.	5.000	G07193	R	477450.	6280900.	3.000		
G07271	R	495000.	6246300.	5.000	G08404	F2	522600.	6266600.	3.000		
G07903	R	461000.	6331350.	5.000	G07836	R	541850.	6213650.	3.000		
G07865	R	456300.	6336700.	5.000	G07213	R	488200.	6261900.	3.000		



Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Cd	ppm	Amdel	AAS-HF	1.0	504	Mo	ppm	Amdel	XRF	2.0	543
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07836	R	541850.	6213650.	3.000	G05933	R	469500.	6306400.	57.000		
G08391	F2	511000.	6274200.	2.000	G08479	F3	502600.	6233200.	28.000		
G08395	F2	507650.	6280750.	1.000	G08515	F3	467550.	6257060.	27.000		
G08399	F2	506500.	6275500.	1.000	G07347	R	459050.	6256500.	16.000		
G07788	R	511050.	6269150.	1.000	G08480	F3	502830.	6233200.	16.000		
G08407	F2	520300.	6266400.	1.000	G07299	R	456400.	6243600.	14.000		
G08402	F2	522650.	6266050.	1.000	G07715	R	556600.	6246800.	14.000		
G07743	R	554950.	6241900.	1.000	G08473	F3	502825.	6233700.	14.000		
G07744	R	552400.	6244000.	1.000	G08493	F3	470200.	6253650.	13.000		
G08389	F2	514100.	6275400.	1.000	G07863	R	459800.	6325100.	12.000		
G07736	R	533900.	6246950.	1.000	G07874	R	459900.	6322600.	12.000		
G08406	F2	521050.	6266200.	1.000	G08432	F2	502500.	6234650.	12.000		
					G08478	F3	502600.	6233450.	12.000		
					G08415	F2	469800.	6254500.	11.000		
					G07403	R	465900.	6245000.	10.000		
					G08500	F3	469650.	6254150.	10.000		
					G05928	R	464300.	6302000.	10.000		
					G08483	F3	502720.	6232780.	10.000		
					G08414	F2	470650.	6253200.	10.000		
					G05943	R	487200.	6305100.	9.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Sn	ppm	Amdel	XRF	1.0	543	Ga	ppm	Amdel	OES	1.0	543
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G05990	R	469600.	6280000.	38.000	G08493	F3	470200.	6253650.	40.000		
G05980	R	481250.	6284800.	26.000	G05928	R	464300.	6302000.	40.000		
G08420	F2	464950.	6257950.	12.000	G07282	R	468400.	6233300.	40.000		
G08453	F2	473200.	6308350.	11.000	G05966	R	477700.	6306250.	30.000		
G07194	R	474550.	6277750.	10.000	G08478	F3	502600.	6233450.	30.000		
G07352	R	457600.	6255050.	10.000	G05906	R	471450.	6318350.	30.000		
G07287	R	457350.	6235450.	8.000	G08445	F2	484100.	6291100.	30.000		
G08454	F2	475500.	6304550.	8.000	G08495	F3	470470.	6252600.	30.000		
G07878	R	464450.	6326150.	8.000	G07281	R	465500.	6232400.	20.000		
G07876	R	462050.	6320800.	8.000	G07235	R	494300.	6292650.	20.000		
G07863	R	459800.	6325100.	8.000	G05996	R	468200.	6293000.	20.000		
G07912	R	455400.	6330150.	8.000	G07262	R	488350.	6257700.	20.000		
G07348	R	458150.	6258200.	8.000	G05999	R	472700.	6252400.	20.000		
G05949	R	484700.	6295800.	8.000	G07198	R	481100.	6278500.	20.000		
G08485	F3	501100.	6233500.	8.000	G08498	F3	469650.	6253250.	20.000		
G05941	R	474500.	6298200.	7.000	G07191	R	484500.	6283850.	20.000		
G07411	R	460350.	6253600.	7.000	G05941	R	474500.	6298200.	20.000		
G07862	R	462700.	6323900.	7.000	G08485	F3	501100.	6233500.	20.000		
G07347	R	459050.	6256500.	7.000	G07414	R	465500.	6250250.	20.000		
G08446	F2	486500.	6293550.	7.000	G07286	R	459200.	6234150.	20.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
W	ppm	Amdel	XRF	10.0	543	Ba	ppm	Csirs	ICP	100.0	438
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07352	R	457600.	6255050.	124.000	G07767	R	491750.	6258250.	470.000		
G08480	F3	502830.	6233200.	30.000	G07865	R	456300.	6336700.	448.000		
G08416	F2	468000.	6254300.	25.000	G07214	R	490500.	6262100.	404.000		
G07760	R	502600.	6233350.	25.000	G05941	R	474500.	6298200.	389.000		
G07874	R	459900.	6322600.	24.000	G07325	R	471100.	6251800.	384.000		
G07839	R	549400.	6211800.	23.000	G07269	R	493300.	6248200.	342.000		
G08403	F2	522200.	6265850.	23.000	G07835	R	539150.	6216000.	325.000		
G07838	R	549350.	6209500.	22.000	G07713	R	553950.	6249700.	286.000		
G07222	R	492200.	6274500.	21.000	G07711	R	551400.	6252450.	281.000		
G08498	F3	469650.	6253250.	20.000	G07199	R	483400.	6282300.	277.000		
G08419	F2	466000.	6260000.	20.000	G07725	R	498550.	6231550.	273.000		
G08449	F2	477400.	6298100.	20.000	G07709	R	544100.	6260100.	258.000		
G07296	R	460500.	6238550.	19.000	G07425	R	476450.	6236650.	245.000		
G07739	R	545950.	6240300.	19.000	G05949	R	484700.	6295800.	243.000		
G07400	R	456100.	6244650.	19.000	G05973	R	465100.	6312050.	237.000		
G07415	R	464100.	6248000.	19.000	G07271	R	495000.	6246300.	210.000		
G07795	R	501000.	6274300.	17.000	G07848	R	538500.	6222700.	204.000		
G07258	R	501450.	6256100.	17.000	G05934	R	470200.	6303250.	202.000		
G08408	F2	519200.	6266850.	17.000	G07732	R	502000.	6227600.	192.000		
G07863	R	459800.	6325100.	17.000	G07716	R	558350.	6247000.	188.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Zr	ppm	Csiro	ICP-FS	50.0	437	Nb	ppm	Amdel	XRF	3.0	542
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07265	R	493000.	6256500.	1592.000	G08416	F2	468000.	6254300.	46.000		
G07318	R	478700.	6241800.	1021.000	G05967	R	480100.	6304600.	45.000		
G07855	R	545400.	6249300.	923.000	G07749	R	548700.	6248000.	44.000		
G07287	R	457350.	6235450.	843.000	G08454	F2	475500.	6304550.	40.000		
G07401	R	460400.	6245550.	785.000	G07287	R	457350.	6235450.	38.000		
G07720	R	541100.	6248100.	743.000	G07910	R	454450.	6336100.	37.000		
G07419	R	465150.	6242800.	700.000	G07419	R	465150.	6242800.	36.000		
G07267	R	498300.	6248650.	697.000	G07352	R	457600.	6255050.	36.000		
G07266	R	498200.	6252800.	697.000	G07912	R	455400.	6330150.	36.000		
G07324	R	470050.	6242750.	692.000	G05923	R	461200.	6309900.	35.000		
G05943	R	487200.	6305100.	686.000	G07720	R	541100.	6248100.	34.000		
G05977	R	478700.	6290650.	672.000	G07863	R	459800.	6325100.	33.000		
G05900	R	464900.	6321800.	669.000	G05910	R	476950.	6311300.	33.000		
G07268	R	497000.	6246750.	663.000	G07875	R	459300.	6320050.	33.000		
G07339	R	464100.	6259550.	663.000	G07318	R	478700.	6241800.	33.000		
G07315	R	473100.	6244300.	659.000	G08446	F2	486500.	6293550.	32.000		
G07296	R	460500.	6238550.	658.000	G08449	F2	477400.	6298100.	32.000		
G07878	R	464450.	6326150.	654.000	G07721	R	496000.	6236950.	32.000		
G07749	R	548700.	6248000.	653.000	G05937	R	469400.	6295000.	31.000		
G07403	R	465900.	6245000.	628.000	G07878	R	464450.	6326150.	31.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Ta	ppm	Amdel	XRF	3.0	542	Se	ppm	Amdel	XRF	1.0	543
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G08428	F2	502750.	6232650.	17.000	G07867	R	462900.	6329500.	26.000		
G07838	R	549350.	6209500.	14.000	G07839	R	549400.	6211800.	9.000		
G07774	R	507400.	6261700.	13.000	G08394	F2	507100.	6278400.	8.000		
G08400	F2	505350.	6274200.	8.000	G07276	R	498550.	6238200.	7.000		
G07795	R	501000.	6274300.	8.000	G08511	F3	467000.	6257550.	7.000		
G07870	R	501400.	6267700.	7.000	G05959	R	476500.	6303350.	6.000		
G07331	R	479300.	6250200.	7.000	G08403	F2	522200.	6265850.	6.000		
G08416	F2	468000.	6254300.	7.000	G08405	F2	521800.	6266800.	5.000		
G08422	F2	468650.	6258100.	7.000	G07707	R	518550.	6272100.	5.000		
G07785	R	508500.	6269950.	7.000	G07763	R	490700.	6246400.	5.000		
G07912	R	455400.	6330150.	6.000	G05930	R	466000.	6302200.	4.000		
G07316	R	475600.	6246350.	6.000	G07323	R	469950.	6241000.	4.000		
G07721	R	496000.	6236950.	6.000	G08507	F3	467450.	6259050.	4.000		
G05967	R	480100.	6304600.	6.000	G05965	R	479550.	6307900.	4.000		
G07848	R	538500.	6222700.	6.000	G07779	R	512600.	6263150.	4.000		
G08438	F2	483800.	6286550.	6.000	G07762	R	487800.	6249350.	4.000		
G08447	F2	486600.	6295350.	6.000	G07740	R	549300.	6240400.	4.000		
G07768	R	496200.	6262650.	5.000	G07262	R	488350.	6257700.	4.000		
G07845	R	541250.	6208750.	5.000	G07233	R	490700.	6289700.	4.000		
G05995	R	471100.	6291600.	5.000	G05901	R	468100.	6321900.	4.000		

Element	Lab	Method	L.L.D.	#Samples	
Au	ppb	Analb	234	1.0	502
Sample Type	Easting	Northing	Value		
G07704	R	521900.	6266350.	76.000	
G07760	R	502600.	6233350.	50.000	
G07418	R	466750.	6241600.	20.000	
G07739	R	545950.	6240300.	20.000	
G07756	R	546200.	6231800.	13.000	
G08437	F2	482750.	6283650.	12.000	
G07831	R	544300.	6214000.	12.000	
G07352	R	457600.	6255050.	11.000	
G07762	R	487800.	6249350.	11.000	
G08431	F2	501250.	6232950.	11.000	
G07705	R	524700.	6266000.	11.000	
G08420	F2	464950.	6257950.	10.000	
G07773	R	510700.	6260100.	10.000	
G07858	R	538550.	6252800.	10.000	
G07832	R	545000.	6216600.	10.000	
G07791	R	506050.	6274800.	10.000	
G08423	F2	466150.	6240800.	9.000	
G07763	R	490700.	6246400.	9.000	
G07757	R	508950.	6231950.	9.000	
G07835	R	539150.	6216000.	9.000	

Table 6: Ranked Samples > 95th Percentile  
Albany-Fraser Area: Proterozoic "R/F2/F3" Samples

Laterites: LP CP LN CN PN VL MS

Element	Lab	Method	L.L.D.	#Samples
SiO2 Wt%	Csiro	ICP-FS	0.5	356
Sample Type	Easting	Northing	Value	
G07678 R	519000.	6184650.	69.840	
G07563 R	490800.	6174550.	68.290	
G07558 R	498100.	6179200.	64.650	
G07648 R	526750.	6193800.	62.710	
G07453 R	557700.	6180900.	62.530	
G07559 R	497500.	6176200.	62.350	
G07541 R	536250.	6158350.	62.010	
G07576 R	482450.	6179600.	61.130	
G07649 R	526450.	6195500.	61.100	
G07463 R	556400.	6181400.	60.910	

Element	Lab	Method	L.L.D.	#Samples
Al2O3 Wt%	Csiro	ICP-FS	0.5	356
Sample Type	Easting	Northing	Value	
G07569 R	488900.	6178300.	37.110	
G07630 R	524300.	6184700.	36.540	
G07570 R	488600.	6176950.	35.370	
G07828 R	558700.	6165350.	33.380	
G07667 R	510300.	6184200.	33.180	
G07492 R	552750.	6166700.	32.330	
G07493 R	544500.	6193000.	32.060	
G07360 R	533550.	6175600.	31.810	
G07529 R	537200.	6181100.	31.760	
G07550 R	508650.	6172800.	31.710	

Element	Lab	Method	L.L.D.	#Samples
Fe2O3 Wt%	Amdel	AAS-HF	0.1	456
Sample Type	Easting	Northing	Value	
G07457 R	566600.	6179150.	73.490	
G07527 R	540400.	6172700.	68.340	
G07481 R	553000.	6193250.	67.770	
G07651 R	517800.	6193100.	65.050	
G07473 R	564500.	6183800.	62.910	
G07640 R	525300.	6189350.	62.620	
G07521 R	540100.	6179800.	57.620	
G07619 R	526600.	6190450.	53.760	
G07504 R	526650.	6167700.	53.040	
G07511 R	530300.	6181000.	51.610	

Element	Lab	Method	L.L.D.	#Samples
MgO Wt%	Csiro	ICP-FS	0.05	356
Sample Type	Easting	Northing	Value	
G07483 R	546900.	6194750.	.351	
G07601 R	539050.	6194250.	.321	
G07816 R	497350.	6195250.	.191	
G07463 R	556400.	6181400.	.174	
G07697 R	503500.	6197300.	.165	
G07602 R	539100.	6197400.	.163	
G07617 R	529250.	6187700.	.158	
G07851 R	479750.	6202100.	.149	
G07823 R	493600.	6198500.	.144	
G07474 R	565100.	6186900.	.143	

Element	Lab	Method	L.L.D.	#Samples
CaO Wt%	Csiro	ICP-FS	0.05	356
Sample Type	Easting	Northing	Value	
G07458 R	565650.	6181400.	.153	
G07491 R	557300.	6185300.	.126	
G07697 R	503500.	6197300.	.120	
G07498 R	531350.	6195700.	.119	
G07481 R	553000.	6193250.	.116	
G07514 R	532850.	6177900.	.114	
G07617 R	529250.	6187700.	.111	
G07493 R	544500.	6193000.	.109	
G07495 R	538600.	6191150.	.101	
G07600 R	525150.	6198600.	.101	

Element	Lab	Method	L.L.D.	#Samples
TiO2 Wt%	Csiro	ICP-FS	0.003	356
Sample Type	Easting	Northing	Value	
G07820 R	487350.	6195850.	2.280	
G07453 R	557700.	6180900.	2.010	
G07658 R	505150.	6193650.	1.970	
G07580 R	482050.	6181950.	1.940	
G07694 R	490000.	6187500.	1.870	
G07538 R	542400.	6160000.	1.750	
G07696 R	501700.	6192100.	1.740	
G07489 R	552150.	6189800.	1.530	
G07654 R	501100.	6182800.	1.480	
G07591 R	481050.	6185950.	1.470	

Element	Lab	Method	L.L.D.	#Samples
Ag ppm	Amdel	OES	0.1	456
Sample Type	Easting	Northing	Value	
G07577 R	479600.	6178200.	.800	
G07691 R	497650.	6187900.	.400	
G07522 R	540700.	6177350.	.100	
G07483 R	546900.	6194750.	.100	
G07560 R	496750.	6173800.	.100	
G07660 R	509300.	6195400.	.100	
G07644 R	550000.	6187500.	.100	
G07391 R	508700.	6175900.	.100	
G07496 R	536700.	6192650.	.100	
G07587 R	496000.	6181750.	.100	

Element	Lab	Method	L.L.D.	#Samples
Mn ppm	Amdel	AAS	5.0	456
Sample Type	Easting	Northing	Value	
G07538 R	542400.	6160000.	291.000	
G07820 R	487350.	6195850.	280.000	
G07600 R	525150.	6198600.	229.000	
G07457 R	566600.	6179150.	187.000	
G07504 R	526650.	6167700.	173.000	
G07821 R	487350.	6198550.	173.000	
G07505 R	532250.	6164700.	168.000	
G07503 R	531700.	6166700.	165.000	
G07393 R	511900.	6178100.	163.000	
G07666 R	513000.	6185200.	159.000	

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Cr	ppm	Amdel	XRF	5.0	456	V	ppm	Amdel	XRF	10.0	456
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07810	R	487450.	6190450.	1785.000	G07527	R	540400.	6172700.	2343.000		
G07670	R	517250.	6184500.	1035.000	G07696	R	501700.	6192100.	1269.000		
G07824	R	494050.	6183300.	695.000	G07820	R	487350.	6195850.	1231.000		
G07521	R	540100.	6179800.	571.000	G07683	R	507200.	6192500.	1225.000		
G07454	R	560600.	6179900.	543.000	G07489	R	552150.	6189800.	1107.000		
G07597	R	482000.	6190550.	501.000	G07807	R	486900.	6182950.	1097.000		
G07374	R	537400.	6167600.	497.000	G07514	R	532850.	6177900.	1053.000		
G07683	R	507200.	6192500.	479.000	G07515	R	534450.	6178900.	1036.000		
G07468	R	549100.	6181600.	451.000	G07685	R	506000.	6189100.	955.000		
G07630	R	524300.	6184700.	440.000	G07454	R	560600.	6179900.	931.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Cu	ppm	Amdel	AA-HF	2.0	456	Pb	ppm	Amdel	XRF	4.0	456
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07820	R	487350.	6195850.	170.000	G07579	R	478700.	6179700.	120.000		
G07591	R	481050.	6185950.	168.000	G07476	R	561700.	6187300.	111.000		
G07635	R	535400.	6190100.	165.000	G07807	R	486900.	6182950.	105.000		
G07651	R	517800.	6193100.	160.000	G07681	R	515900.	6189300.	101.000		
G07603	R	538700.	6188200.	159.000	G07377	R	532050.	6162000.	95.000		
G07598	R	477450.	6195800.	147.000	G07853	R	484750.	6199500.	90.000		
G07827	R	488400.	6187700.	140.000	G07454	R	560600.	6179900.	89.000		
G07626	R	534100.	6184800.	135.000	G07514	R	532850.	6177900.	87.000		
G07454	R	560600.	6179900.	122.000	G07683	R	507200.	6192500.	86.000		
G07625	R	535600.	6182700.	120.000	G07474	R	565100.	6186900.	86.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Zn	ppm	Amdel	AA-HF	2.0	456	Ni	ppm	Amdel	AA-HF	5.0	456
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07819	R	490300.	6197000.	73.000	G07670	R	517250.	6184500.	219.000		
G07527	R	540400.	6172700.	49.000	G07469	R	555150.	6183150.	168.000		
G07591	R	481050.	6185950.	45.000	G07518	R	544800.	6179300.	167.000		
G07395	R	516600.	6175800.	35.000	G07488	R	552650.	6186100.	150.000		
G07510	R	530300.	6179200.	33.000	G07483	R	546900.	6194750.	150.000		
G07603	R	538700.	6188200.	33.000	G07824	R	494050.	6183300.	150.000		
G07454	R	560600.	6179900.	32.000	G07624	R	536600.	6184850.	136.000		
G07580	R	482050.	6181950.	32.000	G07605	R	538600.	6185000.	130.000		
G07505	R	532250.	6164700.	32.000	G07611	R	540900.	6188700.	122.000		
G07363	R	527000.	6177000.	32.000	G07625	R	535600.	6182700.	120.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Co	ppm	Amdel	AA-HF	5.0	456	As	ppm	Analb	XRF	2.0	456
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07518	R	544800.	6179300.	65.000	G07527	R	540400.	6172700.	1282.000		
G07611	R	540900.	6188700.	41.000	G07514	R	532850.	6177900.	951.000		
G07626	R	534100.	6184800.	27.000	G07473	R	564500.	6183800.	729.000		
G07614	R	529150.	6193100.	26.000	G07443	R	567400.	6172800.	632.000		
G07603	R	538700.	6188200.	25.000	G07822	R	490600.	6199800.	517.000		
G07490	R	554850.	6187350.	23.000	G07471	R	561200.	6183800.	486.000		
G07521	R	540100.	6179800.	22.000	G07679	R	518700.	6190250.	390.000		
G07524	R	537300.	6172750.	21.000	G07627	R	531150.	6184350.	360.000		
G07462	R	555250.	6180150.	21.000	G07474	R	565100.	6186900.	355.000		
G07612	R	534600.	6191700.	21.000	G07457	R	566600.	6179150.	330.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Sb	ppm	Amdel	XRF	2.0	456	Bi	ppm	Amdel	XRF	1.0	456
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07640	R	525300.	6189350.	10.000	G07499	R	528600.	6196650.	11.000		
G07527	R	540400.	6172700.	10.000	G07540	R	537500.	6161750.	10.000		
G07524	R	537300.	6172750.	8.000	G07548	R	500150.	6171150.	9.000		
G07651	R	517800.	6193100.	7.000	G07536	R	542950.	6162750.	8.000		
G07511	R	530300.	6181000.	7.000	G07605	R	538600.	6185000.	8.000		
G07522	R	540700.	6177350.	7.000	G07640	R	525300.	6189350.	7.000		
G07674	R	509100.	6182250.	7.000	G07533	R	543200.	6168600.	7.000		
G07618	R	528000.	6187400.	6.000	G07531	R	535600.	6181650.	7.000		
G07853	R	484750.	6199500.	6.000	G07549	R	502800.	6170800.	7.000		
G07536	R	542950.	6162750.	6.000	G07525	R	536200.	6170700.	7.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Cd	ppm	Amdel	AAS-HF	1.0	435	Mo	ppm	Amdel	XRF	2.0	456
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07632	R	528400.	6182700.	2.000	G07683	R	507200.	6192500.	90.000		
G07636	R	531200.	6189000.	2.000	G07446	R	563650.	6175000.	36.000		
G07455	R	562950.	6178100.	2.000	G07568	R	492050.	6178000.	28.000		
G07624	R	536600.	6184850.	2.000	G07512	R	530200.	6173000.	28.000		
G07628	R	527000.	6184800.	1.000	G07459	R	556400.	6175000.	22.000		
G07800	R	496750.	6198300.	1.000	G07537	R	545100.	6160400.	20.000		
G07801	R	494400.	6196000.	1.000	G07650	R	522400.	6196500.	20.000		
G07622	R	522100.	6185850.	1.000	G07518	R	544800.	6179300.	20.000		
G07563	R	490800.	6174550.	1.000	G07441	R	562150.	6170300.	17.000		
G07561	R	499900.	6174250.	1.000	G07440	R	547650.	6164700.	16.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
Sn	ppm	Amdel	XRF	1.0	456	Ga	ppm	Amdel	OES	1.0	456
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07820	R	487350.	6195850.	6.000	G07555	R	516500.	6178150.	20.000		
G07580	R	482050.	6181950.	5.000	G07659	R	506300.	6195750.	20.000		
G07676	R	517900.	6182350.	5.000	G07694	R	490000.	6187500.	20.000		
G07388	R	505450.	6174600.	5.000	G07667	R	510300.	6184200.	15.000		
G07384	R	512150.	6169500.	5.000	G07573	R	482900.	6174650.	15.000		
G07806	R	487000.	6185000.	5.000	G07817	R	494300.	6191250.	15.000		
G07444	R	568250.	6175000.	4.000	G07594	R	478800.	6190650.	15.000		
G07476	R	561700.	6187300.	4.000	G07636	R	531200.	6189000.	15.000		
G07443	R	567400.	6172800.	4.000	G07818	R	497400.	6192800.	15.000		
G07584	R	483600.	6183600.	4.000	G07825	R	497100.	6182950.	15.000		

Element	Lab	Method	L.L.D.	#Samples	Element	Lab	Method	L.L.D.	#Samples		
W	ppm	Amdel	XRF	10.0	456	Ba	ppm	Csirs	ICP	100.0	355
Sample Type	Easting	Northing	Value		Sample Type	Easting	Northing	Value			
G07504	R	526650.	6167700.	21.000	G07578	R	477700.	6176850.	565.000		
G07686	R	506000.	6187650.	19.000	G07503	R	531700.	6166700.	531.000		
G07355	R	540200.	6167150.	17.000	G07521	R	540100.	6179800.	345.000		
G07538	R	542400.	6160000.	17.000	G07378	R	529150.	6165400.	342.000		
G07696	R	501700.	6192100.	17.000	G07483	R	546900.	6194750.	320.000		
G07446	R	563650.	6175000.	16.000	G07502	R	529200.	6168200.	269.000		
G07493	R	544500.	6193000.	14.000	G07816	R	497350.	6195250.	197.000		
G07575	R	487900.	6180700.	14.000	G07514	R	532850.	6177900.	190.000		
G07397	R	517400.	6172100.	14.000	G07595	R	479100.	6193600.	184.000		
G07383	R	515200.	6169500.	13.000	G07374	R	537400.	6167600.	177.000		

Element	Lab	Method	L.L.D.	#Samples		Element	Lab	Method	L.L.D.	#Samples	
Zr	ppm	Csiro	ICP-FS	50.0	355	Nb	ppm	Amdel	XRF	3.0	456
Sample Type		Easting	Northing	Value		Sample Type		Easting	Northing	Value	
G07506	R	534850.	6166450.	931.000		G07503	R	531700.	6166700.	32.000	
G07578	R	477700.	6176850.	912.000		G07505	R	532250.	6164700.	32.000	
G07505	R	532250.	6164700.	910.000		G07538	R	542400.	6160000.	31.000	
G07503	R	531700.	6166700.	899.000		G07540	R	537500.	6161750.	25.000	
G07542	R	538950.	6157650.	764.000		G07805	R	489400.	6185150.	25.000	
G07378	R	529150.	6165400.	736.000		G07453	R	557700.	6180900.	24.000	
G07663	R	513400.	6190550.	713.000		G07580	R	482050.	6181950.	21.000	
G07658	R	505150.	6193650.	691.000		G07506	R	534850.	6166450.	21.000	
G07569	R	488900.	6178300.	677.000		G07659	R	506300.	6195750.	21.000	
G07450	R	559100.	6173600.	674.000		G07694	R	490000.	6187500.	19.000	

Element	Lab	Method	L.L.D.	#Samples		Element	Lab	Method	L.L.D.	#Samples	
Ta	ppm	Amdel	XRF	3.0	456	Se	ppm	Amdel	XRF	1.0	456
Sample Type		Easting	Northing	Value		Sample Type		Easting	Northing	Value	
G07817	R	494300.	6191250.	7.000		G07454	R	560600.	6179900.	8.000	
G07687	R	511900.	6195400.	6.000		G07696	R	501700.	6192100.	7.000	
G07854	R	485750.	6194900.	6.000		G07820	R	487350.	6195850.	7.000	
G07821	R	487350.	6198550.	6.000		G07581	R	481950.	6183800.	6.000	
G07376	R	534650.	6163900.	5.000		G07620	R	523800.	6191150.	6.000	
G07572	R	483500.	6177450.	5.000		G07502	R	529200.	6168200.	6.000	
G07591	R	481050.	6185950.	4.000		G07640	R	525300.	6189350.	6.000	
G07850	R	477300.	6202850.	4.000		G07509	R	530500.	6178650.	5.000	
G07499	R	528600.	6196650.	4.000		G07575	R	487900.	6180700.	5.000	
G07470	R	558600.	6182500.	4.000		G07608	R	564800.	6167200.	5.000	

Element	Lab	Method	L.L.D.	#Samples	
Au	ppb	Analb	234	1.0	435
Sample Type		Easting	Northing	Value	
G07676	R	517900.	6182350.	80.000	
G07703	R	481400.	6187550.	32.000	
G07645	R	547400.	6192000.	18.000	
G07700	R	481600.	6197100.	18.000	
G07830	R	549750.	6171400.	16.000	
G07650	R	522400.	6196500.	14.000	
G07582	R	479500.	6181100.	13.000	
G07363	R	527000.	6177000.	13.000	
G07635	R	535400.	6190100.	12.000	
G07701	R	483200.	6195850.	12.000	

Table 7  
Albany-Fraser Yilgarn Block Laterites "R/F2/F3"  
Robust Principal Components

Observations: 435

Variables: 20

Robust Correlation Matrix

	Fe2O3	Ag	Mn	Cr	V	Cu	Pb	Zn
Fe2O3	1.0000	-.0021	.6666	.5208	.8310	.4578	.3429	.4653
Ag	-.0021	1.0000	-.0004	.0055	-.0014	.0039	.0153	.0048
Mn	.6666	-.0004	1.0000	.2829	.6472	.5065	.1642	.6218
Cr	.5208	.0055	.2829	1.0000	.5692	.1885	.1981	.3163
V	.8310	-.0014	.6472	.5692	1.0000	.4194	.2751	.4629
Cu	.4578	.0039	.5065	.1885	.4194	1.0000	.1528	.4001
Pb	.3429	.0153	.1642	.1981	.2751	.1528	1.0000	.1723
Zn	.4653	.0048	.6218	.3163	.4629	.4001	.1723	1.0000
Ni	-.0758	.0084	-.0118	.2264	.0253	.2120	.0617	.0475
Co	.0733	.0051	.1602	.0297	.1484	.2531	.1545	.1756
As	-.0084	.0035	-.1404	.0165	.0273	-.0635	.0179	-.0786
Sb	.1388	-.0001	.0701	.0233	.1058	.0430	.1025	.0292
Mo	.0478	.0020	-.1369	.1547	-.0083	-.0126	.0698	-.0344
Sn	.0719	.0014	-.0185	.1534	.0630	-.1043	-.0527	.0744
Ga	.0366	.0048	-.0061	.2019	.0631	-.2166	.0923	.0895
W	.1378	.0071	.0582	.1200	.1247	-.0344	.0150	.0406
Zr	.0727	.0005	.1381	.1002	.0713	-.1404	-.0529	.1466
Nb	-.0506	.0004	.0622	.0063	-.0548	-.2100	-.0206	.0449
Se	.2433	.0070	.1299	.0841	.2108	.2054	.1797	.1891
Au	-.0532	.0060	-.0401	-.1613	-.0768	-.0260	.0873	-.1172
	Ni	Co	As	Sb	Mo	Sn	Ga	W
Fe2O3	-.0758	.0733	-.0084	.1388	.0478	.0719	.0366	.1378
Ag	.0084	.0051	.0035	-.0001	.0020	.0014	.0048	.0071
Mn	-.0118	.1602	-.1404	.0701	-.1369	-.0185	-.0061	.0582
Cr	.2264	.0297	.0165	.0233	.1547	.1534	.2019	.1200
V	.0253	.1484	.0273	.1058	-.0083	.0630	.0631	.1247
Cu	.2120	.2531	-.0635	.0430	-.0126	-.1043	-.2166	-.0344
Pb	.0617	.1545	.0179	.1025	.0698	-.0527	.0923	.0150
Zn	.0475	.1756	-.0786	.0292	-.0344	.0744	.0895	.0406
Ni	1.0000	.4216	.1810	-.1068	-.0115	-.1766	-.1660	-.0549
Co	.4216	1.0000	.1132	.0292	-.1036	-.1852	-.1696	.0582
As	.1810	.1132	1.0000	.0002	.1925	.0120	-.0979	.0256
Sb	-.1068	.0292	.0002	1.0000	.0337	.0022	-.0275	.0441
Mo	-.0115	-.1036	.1925	.0337	1.0000	.2520	.1384	.0644
Sn	-.1766	-.1852	.0120	.0022	.2520	1.0000	.2637	.0659
Ga	-.1660	-.1696	-.0979	-.0275	.1384	.2637	1.0000	.0259
W	-.0549	.0582	.0256	.0441	.0644	.0659	.0259	1.0000
Zr	-.1799	-.1080	.0885	.0338	.0019	.3608	.2094	.0938
Nb	-.2944	-.1386	-.0642	.0711	.1419	.4540	.3032	.0586
Se	.0414	.0596	.0367	.0206	.0220	-.0763	-.0566	-.0499
Au	-.1171	.1125	.0022	.1366	-.0672	-.1383	-.1074	.1131
	Zr	Nb	Se	Au				
Fe2O3	.0727	-.0506	.2433	-.0532				
Ag	.0005	.0004	.0070	.0060				
Mn	.1381	.0622	.1299	-.0401				
Cr	.1002	.0063	.0841	-.1613				
V	.0713	-.0548	.2108	-.0768				
Cu	-.1404	-.2100	.2054	-.0260				
Pb	-.0529	-.0206	.1797	.0873				
Zn	.1466	.0449	.1891	-.1172				
Ni	-.1799	-.2944	.0414	-.1171				
Co	-.1080	-.1386	.0596	.1125				
As	.0885	-.0642	.0367	.0022				
Sb	.0338	.0711	.0206	.1366				
Mo	.0019	.1419	.0220	-.0672				
Sn	.3608	.4540	-.0763	-.1383				
Ga	.2094	.3032	-.0566	-.1074				
W	.0938	.0586	-.0499	.1131				
Zr	1.0000	.6056	-.1072	-.1621				
Nb	.6056	1.0000	-.1088	-.0527				
Se	-.1072	-.1088	1.0000	-.0428				
Au	-.1621	-.0527	-.0428	1.0000				

Table 7 (cont'd)

Robust	Means	Component	Eigen values	%Trace	Cumulative Trace
Fe2O3	18.92	1	3.8170	19.0849	19.0849
Ag	.10	2	2.6316	13.1581	32.2430
Mn	90.52	3	1.5023	7.5117	39.7547
Cr	169.37	4	1.3391	6.6955	46.4502
V	412.14	5	1.2397	6.1984	52.6486
Cu	18.76	6	1.0505	5.2526	57.9012
Pb	33.77	7	1.0172	5.0858	62.9870
Zn	13.48	8	.9917	4.9583	67.9453
Ni	28.99	9	.8917	4.4586	72.4039
Co	7.11	10	.8574	4.2872	76.6911
As	13.92	11	.7880	3.9399	80.6310
Sb	2.21	12	.6774	3.3871	84.0181
Mo	3.32	13	.6563	3.2816	87.2997
Sn	2.51	14	.5518	2.7590	90.0587
Ga	9.56	15	.5113	2.5567	92.6154
W	10.46	16	.4708	2.3541	94.9695
Zr	395.60	17	.3487	1.7437	96.7132
Nb	14.50	18	.3134	1.5668	98.2800
Se	1.36	19	.1974	.9870	99.2670
Au	3.07	20	.1466	.7330	100.0000

## Principal Component R-Scores

	1	2	3	4	5	6	7	8
Fe2O3	.8741	-.0947	-.0741	.1359	-.1451	.0384	-.1301	.0766
Ag	.0061	.0025	.0222	.0322	.0117	.0128	.5855	.8067
Mn	.7987	-.0467	-.3047	-.1611	.1604	-.0265	-.0526	.0432
Cr	.6088	-.1865	.3791	-.0008	-.1568	.3382	.0090	-.0328
V	.8686	-.0686	.0026	.0660	-.0670	.1041	-.1063	.0541
Cu	.6316	.3297	-.0701	-.1346	.0458	-.1693	-.1146	.0954
Pb	.3968	.0588	.0859	.3916	-.1752	-.0888	.4591	-.3208
Zn	.6994	-.0943	-.0985	-.2248	.1303	-.0831	.0708	-.0266
Ni	.1330	.4878	.5866	-.2096	.2608	.0963	.1573	-.1245
Co	.2624	.4377	.2074	.0620	.5671	-.0286	.2603	-.2009
As	-.0344	.0696	.5862	.2694	.2229	-.3004	-.2386	.1509
Sb	.1281	-.0601	-.2186	.5231	.0895	-.2866	-.0220	-.0408
Mo	.0045	-.2714	.5308	.3229	-.2852	-.1272	-.1481	.0897
Sn	.0360	-.6845	.2050	-.0190	.0337	-.0839	-.0660	.0524
Ga	.0378	-.5592	.1055	-.0170	-.2410	.2580	.3898	-.2799
W	.1256	-.1444	.0208	.4089	.2811	.5463	-.2337	.1845
Zr	.0781	-.6916	.0181	-.1295	.4470	-.1860	.0030	.0051
Nb	-.0561	-.7716	-.0651	.0055	.3055	-.2101	.1402	-.0914
Se	.3186	.1736	.0395	.0534	-.3456	-.4722	.0619	.0142
Au	-.1045	.2058	-.3431	.6177	.1854	.0848	.0904	-.0667

	9	10
Fe2O3	.0161	-.1145
Ag	-.0592	-.0279
Mn	-.0054	.0475
Cr	-.1583	-.1819
V	-.0001	-.1843
Cu	-.1496	.3416
Pb	.1364	-.0533
Zn	.0504	.1671
Ni	-.1559	.0123
Co	.0124	.1705
As	.2047	-.3466
Sb	-.5840	-.2400
Mo	-.1689	.4749
Sn	-.0870	.2809
Ga	.0253	-.0407
W	.3194	.1223
Zr	.1227	-.2065
Nb	.0374	.1219
Se	.4956	.0372
Au	.1058	.1997



Table 7 (cont'd)

Relative Contributions: Variables

	1	2	3	4	5	6	7	8
Fe203	76.4037	.8960	.5498	1.8482	2.1044	.1471	1.6931	.5872
Ag	.0037	.0006	.0493	.1035	.0137	.0164	34.2766	65.0702
Mn	63.7948	.2181	9.2842	2.5940	2.5723	.0705	.2766	.1869
Cr	37.0621	3.4797	14.3694	.0001	2.4596	11.4362	.0081	.1074
V	75.4379	.4701	.0007	.4357	.4491	1.0836	1.1297	.2932
Cu	39.8904	10.8689	.4917	1.8119	.2100	2.8669	1.3125	.9107
Pb	15.7461	.3456	.7383	15.3322	3.0703	.7886	21.0783	10.2916
Zn	48.9217	.8885	.9710	5.0546	1.6982	.6912	.5019	.0710
Ni	1.7699	23.7905	34.4104	4.3938	6.8033	.9281	2.4755	1.5506
Co	6.8874	19.1564	4.2995	.3849	32.1606	.0819	6.7769	4.0352
As	.1186	.4841	34.3680	7.2564	4.9687	9.0222	5.6914	2.2757
Sb	1.6399	.3613	4.7782	27.3655	.8018	8.2121	.0484	.1666
Mo	.0020	7.3674	28.1791	10.4272	8.1317	1.6176	2.1944	.8054
Sn	.1298	46.8505	4.2034	.0362	.1134	.7032	.4352	.2744
Ga	.1430	31.2748	1.1126	.0289	5.8094	6.6551	15.1914	7.8342
W	1.5772	2.0851	.0432	16.7199	7.9042	29.8409	5.4596	3.4025
Zr	.6107	47.8300	.0328	1.6770	19.9828	3.4581	.0009	.0026
Nb	.3145	59.5442	.4244	.0030	9.3352	4.4145	1.9658	.8351
Se	10.1531	3.0122	.1560	.2854	11.9438	22.2992	.3826	.0202
Au	1.0916	4.2373	11.7720	38.1522	3.4366	.7184	.8164	.4454

	9	10	11	12	13
Fe203	.0258	1.3103	1.1541	.3651	.3067
Ag	.3502	.0780	.0176	.0016	.0003
Mn	.0029	.2254	1.5247	.1459	1.7484
Cr	2.5060	3.3091	.2246	.8299	8.0860
V	.0000	3.3981	.9126	.1648	1.0093
Cu	2.2383	11.6681	.3498	.6149	.0189
Pb	1.8602	.2837	2.0282	24.9482	.1632
Zn	.2540	2.7928	.0464	3.5574	8.0271
Ni	2.4315	.0151	2.1350	.0704	2.4256
Co	.0155	2.9054	.8263	.5922	.0626
As	4.1883	12.0156	8.7581	2.4803	3.2316
Sb	34.1016	5.7591	14.6846	.6575	.6295
Mo	2.8523	22.5556	.4597	.0739	5.1982
Sn	.7562	7.8897	.0096	.0218	13.9174
Ga	.0639	.1658	.0133	14.7422	7.3998
W	10.1988	1.4964	15.2950	2.0598	2.0932
Zr	1.5056	4.2639	.0024	1.1473	.1147
Nb	.1396	1.4860	.0611	.5483	.6253
Se	24.5618	.1382	19.5217	3.6385	3.0854
Au	1.1195	3.9876	10.7740	11.0812	7.4896

Table 8  
Albany-Fraser Proterozoic Laterites "R/F2/F3"  
Robust Principal Components

Observations: 355  
Variables: 20

Robust Correlation Matrix

	Fe2O3	Ag	Mn	Cr	V	Cu	Pb	Zn
Fe2O3	1.0000	.0023	.3810	.2057	.4052	.3028	.4121	.4729
Ag	.0023	1.0000	.0015	.0019	.0014	.0013	.0005	.0019
Mn	.3810	.0015	1.0000	.1328	.2535	.2636	.0767	.4272
Cr	.2057	.0019	.1328	1.0000	.5102	.2164	.1732	.1395
V	.4052	.0014	.2535	.5102	1.0000	.4311	.3711	.2715
Cu	.3028	.0013	.2636	.2164	.4311	1.0000	.1440	.4352
Pb	.4121	.0005	.0767	.1732	.3711	.1440	1.0000	.1795
Zn	.4729	.0019	.4272	.1395	.2715	.4352	.1795	1.0000
Ni	-.1712	.0002	.0054	.2606	.0564	.2527	.0058	.1165
Co	.1488	.0011	.0447	.0510	.1740	.3882	.1195	.2218
As	.2929	.0021	-.0010	.0628	.3037	-.0092	.3194	.0757
Sb	.2674	.0021	.1661	.0219	.1593	.0851	.0484	.1686
Mo	-.0017	.0015	-.0214	.0169	.0354	-.0930	.0893	-.0904
Sn	.0344	.0007	.1138	.1075	.0576	-.0381	.0747	-.0562
Ga	-.3591	.0003	-.0806	.0951	-.0813	-.1514	-.1811	-.1930
W	.0962	.0028	.1045	-.0036	.0102	-.0341	.0259	-.0109
Zr	-.2413	.0000	.1500	-.0481	-.1773	-.2594	-.1174	-.1193
Nb	-.2666	.0007	.1864	-.0493	-.1879	-.1745	-.1152	-.0377
Se	.3104	.0024	.1601	.1176	.1787	.1831	.1666	.2259
Au	-.0485	.0021	-.0971	.0072	.0529	.1274	-.0198	-.0470

	Ni	Co	As	Sb	Mo	Sn	Ga	W
Fe2O3	-.1712	.1488	.2929	.2674	-.0017	.0344	-.3591	.0962
Ag	.0002	.0011	.0021	.0021	.0015	.0007	.0003	.0028
Mn	.0054	.0447	-.0010	.1661	-.0214	.1138	-.0806	.1045
Cr	.2606	.0510	.0628	.0219	.0169	.1075	.0951	-.0036
V	.0564	.1740	.3037	.1593	.0354	.0576	-.0813	.0102
Cu	.2527	.3882	-.0092	.0851	-.0930	-.0381	-.1514	-.0341
Pb	.0058	.1195	.3194	.0484	.0893	.0747	-.1811	.0259
Zn	.1165	.2218	.0757	.1686	-.0904	-.0562	-.1930	-.0109
Ni	1.0000	.4824	-.0086	.0241	.0756	-.0341	.0034	-.0343
Co	.4824	1.0000	.0131	.1498	.0848	-.0622	-.1958	-.0540
As	-.0086	.0131	1.0000	.1440	.3038	-.0453	-.1378	.0084
Sb	.0241	.1498	.1440	1.0000	.1183	-.1434	-.1928	-.0137
Mo	.0756	.0848	.3038	.1183	1.0000	.0274	-.1145	.0925
Sn	-.0341	-.0622	-.0453	-.1434	.0274	1.0000	.0226	.0239
Ga	.0034	-.1958	-.1378	-.1928	-.1145	.0226	1.0000	-.0029
W	-.0343	-.0540	.0084	-.0137	.0925	.0239	-.0029	1.0000
Zr	-.1722	-.1657	-.0451	-.0699	.1068	.0817	.2779	-.0053
Nb	-.1328	-.2088	-.1202	-.0903	.1110	.1405	.3069	.0191
Se	.0140	.0105	.0541	.1895	.0482	-.0789	-.1358	.0665
Au	-.0578	.0102	-.0332	-.0804	-.0988	-.0524	.1644	-.0028

	Zr	Nb	Se	Au
Fe2O3	-.2413	-.2666	.3104	-.0485
Ag	.0000	.0007	.0024	.0021
Mn	.1500	.1864	.1601	-.0971
Cr	-.0481	-.0493	.1176	.0072
V	-.1773	-.1879	.1787	.0529
Cu	-.2594	-.1745	.1831	.1274
Pb	-.1174	-.1152	.1666	-.0198
Zn	-.1193	-.0377	.2259	-.0470
Ni	-.1722	-.1328	.0140	-.0578
Co	-.1657	-.2088	.0105	.0102
As	-.0451	-.1202	.0541	-.0332
Sb	-.0699	-.0903	.1895	-.0804
Mo	.1068	.1110	.0482	-.0988
Sn	.0817	.1405	-.0789	-.0524
Ga	.2779	.3069	-.1358	.1644
W	-.0053	.0191	.0665	-.0028
Zr	1.0000	.6352	-.1278	-.0266
Nb	.6352	1.0000	-.1603	-.0720
Se	-.1278	-.1603	1.0000	-.0153
Au	-.0266	-.0720	-.0153	1.0000

Table 8 (cont'd)

Robust	Means	Component	Eigen values	%Trace	Cumulative Trace
Fe203	16.86	1	3.5891	17.9456	17.9456
Ag	.10	2	1.9140	9.5699	27.5155
Mn	49.14	3	1.6860	8.4300	35.9455
Cr	185.71	4	1.4567	7.2835	43.2289
V	310.51	5	1.4033	7.0164	50.2453
Cu	20.03	6	1.1178	5.5891	55.8343
Pb	34.58	7	1.0353	5.1765	61.0108
Zn	12.15	8	.9998	4.9991	66.0098
Ni	46.12	9	.9741	4.8707	70.8806
Co	7.64	10	.8158	4.0789	74.9594
As	57.31	11	.8058	4.0292	78.9886
Sb	2.43	12	.6898	3.4489	82.4375
Mo	5.37	13	.6262	3.1310	85.5685
Sn	1.36	14	.5540	2.7700	88.3385
Ga	6.66	15	.5093	2.5464	90.8849
W	10.22	16	.4793	2.3967	93.2816
Zr	362.61	17	.4770	2.3852	95.6668
Nb	9.59	18	.3458	1.7288	97.3956
Se	1.67	19	.3085	1.5424	98.9380
Au	3.93	20	.2124	1.0620	100.0000

## Principal Component R-Scores

	1	2	3	4	5	6	7	8
Fe203	.7428	.2547	-.2628	-.2241	-.1005	.0694	-.0424	.0076
Ag	.0034	.0042	.0003	.0020	-.0002	-.0183	.0796	.9955
Mn	.3877	.5713	.2501	-.3044	.2149	.0689	.0485	-.0024
Cr	.3916	.1782	.3880	.3649	-.3447	-.0094	.1165	-.0310
V	.6725	.1991	.1405	.2452	-.3509	-.0988	-.0515	-.0050
Cu	.6278	-.1126	.4434	-.1267	.0050	-.0579	-.0289	.0104
Pb	.4979	.1870	-.2302	.2664	-.2473	.1098	-.1515	.0176
Zn	.6092	.2070	.2242	-.3359	.1929	-.0215	-.1132	.0125
Ni	.2361	-.3769	.5048	.4197	.3419	.0669	.1562	-.0162
Co	.4394	-.3568	.3214	.2206	.4208	.0386	-.0568	.0204
As	.3386	.1700	-.4597	.4718	-.0638	-.1983	-.1752	.0161
Sb	.3591	.0709	-.2214	-.0716	.3935	-.3641	-.0345	-.0120
Mo	.0509	.1895	-.3069	.5996	.3592	-.1005	.1700	-.0089
Sn	-.0427	.3130	.1290	.1580	-.2034	.6797	-.0204	.0220
Ga	-.4436	.1737	.4276	.1419	-.2962	-.3221	.0965	-.0187
W	.0368	.1807	-.1312	-.0278	-.0119	.0897	.8644	-.0536
Zr	-.4487	.6295	.1721	.1086	.2057	-.1867	-.1216	.0090
Nb	-.4416	.6547	.2673	.0647	.2280	-.0803	-.0844	.0088
Se	.4194	.0962	-.1359	-.2060	.0009	-.2253	.3212	-.0432
Au	-.0315	-.1635	.1878	-.0657	-.4486	-.4779	.0389	.0194
	9	10						
Fe203	.0695	-.0139						
Ag	-.0479	-.0072						
Mn	.0444	.0000						
Cr	-.4284	-.0036						
V	-.0894	-.0094						
Cu	.2045	.0359						
Pb	.1727	-.1897						
Zn	.0985	-.2010						
Ni	-.0979	-.0779						
Co	.2921	.0496						
As	.1344	-.1955						
Sb	-.2557	.3429						
Mo	.1278	.2322						
Sn	.0880	.5061						
Ga	-.1123	-.1163						
W	.2703	-.2074						
Zr	.0931	-.0045						
Nb	.0952	-.0353						
Se	-.3246	.2667						
Au	.5301	.3667						

Table 8 (cont'd)

## Relative Contributions: Variables

	1	2	3	4	5	6	7	8
Fe203	55.1797	6.4889	6.9063	5.0233	1.0109	.4816	.1802	.0058
Ag	.0012	.0018	.0000	.0004	.0000	.0333	.6341	99.0932
Mn	15.0334	32.6345	6.2558	9.2651	4.6165	.4740	.2356	.0006
Cr	15.3359	3.1757	15.0569	13.3179	11.8817	.0088	1.3583	.0961
V	45.2301	3.9633	1.9738	6.0112	12.3099	.9754	.2655	.0025
Cu	39.4104	1.2680	19.6607	1.6061	.0025	.3351	.0836	.0107
Pb	24.7889	3.4967	5.2971	7.0991	6.1162	1.2067	2.2947	.0310
Zn	37.1112	4.2842	5.0269	11.2850	3.7226	.0463	1.2818	.0155
Ni	5.5725	14.2042	25.4857	17.6124	11.6892	.4474	2.4404	.0261
Co	19.3084	12.7306	10.3311	4.8683	17.7085	.1490	.3230	.0416
As	11.4660	2.8908	21.1369	22.2561	.4065	3.9318	3.0691	.0258
Sb	12.8945	.5022	4.9010	.5133	15.4807	13.2583	.1192	.0143
Mo	.2592	3.5910	9.4214	35.9535	12.9040	1.0110	2.8893	.0079
Sn	.1824	9.7939	1.6648	2.4951	4.1385	46.2014	.0414	.0482
Ga	19.6825	3.0156	18.2840	2.0125	8.7716	10.3756	.9319	.0349
W	.1354	3.2658	1.7216	.0771	.0143	.8045	74.7227	.2870
Zr	20.1328	39.6285	2.9603	1.1800	4.2299	3.4851	1.4789	.0081
Nb	19.4991	42.8641	7.1447	.4182	5.1990	.6445	.7117	.0078
Se	17.5891	.9255	1.8459	4.2428	.0001	5.0769	10.3166	.1862
Au	.0991	2.6722	3.5254	.4317	20.1243	22.8343	.1512	.0377
	9	10						
Fe203	.4834	.0193						
Ag	.2295	.0053						
Mn	.1975	.0000						
Cr	18.3538	.0013						
V	.7987	.0089						
Cu	4.1800	.1291						
Pb	2.9816	3.5980						
Zn	.9709	4.0395						
Ni	.9594	.6066						
Co	8.5308	.2464						
As	1.8067	3.8206						
Sb	6.5362	11.7547						
Mo	1.6333	5.3907						
Sn	.7744	25.6125						
Ga	1.2608	1.3525						
W	7.3085	4.3032						
Zr	.8667	.0020						
Nb	.9056	.1246						
Se	10.5387	7.1121						
Au	28.0981	13.4500						

Table 9: Ranked Albany-Fraser Laterite Principal Component Scores  
Yilgarn Block  
Robust Principal Components  
"R/F2/F3" Samples

Component 2 <5th Percentile (Fe Mn Zn Cr Cu)					Component 2 >95th Percentile (Cu Ni Co Au)				
Sample	Type	Easting	Northing	Score	Sample	Type	Easting	Northing	Score
G07352	CP	457600.	6255050.	-.4715	G07307	PN	475050.	6255400.	.1134
G05990	CP	469600.	6280000.	-.4502	G07753	LN	533700.	6216750.	.1147
G05933	CP	469500.	6306400.	-.3135	G05959	MS	476500.	6303350.	.1192
G05967	LP	480100.	6304600.	-.2987	G07730	LN	501200.	6234300.	.1230
G07287	LN	457350.	6235450.	-.2616	G07349	LN	453800.	6254300.	.1238
G07863	LP	459800.	6325100.	-.2558	G05960	LN	475150.	6300700.	.1248
G05928	LP	464300.	6302000.	-.2511	G07751	LN	537100.	6214800.	.1255
G05980	LP	481250.	6284800.	-.2411	G05983	LN	476300.	6288900.	.1262
G07874	LP	459900.	6322600.	-.2148	G07755	LN	539000.	6220000.	.1281
G05910	LP	476950.	6311300.	-.1938	G07841	PN	545650.	6212850.	.1305
G07878	LP	464450.	6326150.	-.1869	G07845	PN	541250.	6208750.	.1432
G05906	LP	471450.	6318350.	-.1782	G07846	LN	537300.	6218000.	.1490
G07855	LP	545400.	6249300.	-.1752	G07239	LN	498000.	6287200.	.1543
G07907	LP	468200.	6331600.	-.1687	G07215	CN	492700.	6260300.	.1568
G07286	LP	459200.	6234150.	-.1660	G07704	LN	521900.	6266350.	.1658
G07318	LN	478700.	6241800.	-.1603	G07351	MS	455800.	6253100.	.1669
G05966	LN	477700.	6306250.	-.1599	G07237	LN	493150.	6287200.	.2117
G05957	CP	477800.	6299500.	-.1591	G07728	LN	499800.	6232700.	.2229
G07876	LP	462050.	6320800.	-.1563	G07276	LN	498550.	6238200.	.2678
G07749	LN	548700.	6248000.	-.1543	G07400	VL	456100.	6244650.	.3454

Component 3 <5th Percentile (Au Sb)					Component 3 >95th Percentile (As Mo Ni)				
Sample	Type	Easting	Northing	Score	Sample	Type	Easting	Northing	Score
G07704	LN	521900.	6266350.	-.3404	G07786	LN	509000.	6268700.	.1351
G07400	VL	456100.	6244650.	-.2670	G07796	LN	504000.	6274950.	.1479
G07760	LN	502600.	6233350.	-.2110	G07347	LN	459050.	6256500.	.1530
G07838	MS	549350.	6209500.	-.1395	G07336	LP	460900.	6259650.	.1588
G07903	LN	461000.	6331350.	-.1187	G07874	LP	459900.	6322600.	.1773
G07756	PN	546200.	6231800.	-.1151	G07403	LN	465900.	6245000.	.1837
G05960	LN	475150.	6300700.	-.1139	G07338	LN	466050.	6257400.	.1845
G05920	LN	469500.	6309200.	-.1113	G07341	LN	467100.	6259750.	.1936
G07271	LN	495000.	6246300.	-.1103	G07191	LN	484500.	6283850.	.2111
G07858	MS	538550.	6252800.	-.1086	G07728	LN	499800.	6236700.	.2638
G07861	LN	468400.	6327850.	-.1040	G07291	LN	456500.	6232650.	.2844
G05946	MS	492400.	6297400.	-.1013	G07790	LN	509250.	6273600.	.2998
G07769	LP	496450.	6260750.	-.1004	G07292	LN	454650.	6234400.	.3094
G07312	MS	468750.	6250800.	-.0996	G07299	LN	456400.	6243600.	.3138
G07707	LN	518550.	6272100.	-.0948	G07301	LN	480500.	6253700.	.3401
G07705	LN	524700.	6266000.	-.0933	G07277	LN	497000.	6240000.	.3545
G07745	LP	552500.	6246000.	-.0916	G07420	LN	463500.	6242700.	.4466
G07865	LN	456300.	6336700.	-.0898	G05933	CP	469500.	6306400.	.5853
G07847	LN	535150.	6220700.	-.0888	G05949	LN	484700.	6295800.	.6572
G07869	MS	505400.	6266800.	-.0884	G07349	LN	453800.	6254300.	1.0031

Component 4 >95th Percentile (Au Sb W Mo As)				
Sample	Type	Easting	Northing	Score
G07418	LP	466750.	6241600.	.1555
G07865	LN	456300.	6336700.	.1581
G07877	LP	466000.	6324100.	.1583
G07742	LN	553350.	6237850.	.1637
G07840	LN	546900.	6209800.	.1691
G07786	LN	509000.	6268700.	.1750
G07911	LN	454100.	6333100.	.1969
G07847	LN	535150.	6220700.	.2293
G07866	LN	461000.	6327100.	.2322
G07739	LN	545950.	6240300.	.2547
G07191	LN	484500.	6283850.	.2573
G07839	LN	549400.	6211800.	.3254
G07874	LP	459900.	6322600.	.3317
G05933	CP	469500.	6306400.	.3480
G07790	LN	509250.	6273600.	.5063
G07349	LN	453800.	6254300.	.5414
G07760	LN	502600.	6233350.	.5594
G07704	LN	521900.	6266350.	.6880
G05949	LN	484700.	6295800.	.9319
G07352	CP	457600.	6255050.	1.2631

Table 9 (cont'd)

## Component 11

&lt;5th Percentile (Au As)

Sample	Type	Easting	Northing	Score
G07349	LN	453800.	6254300.	-.6566
G05949	LN	484700.	6295800.	-.5128
G07704	LN	521900.	6266350.	-.4508
G07790	LN	509250.	6273600.	-.2875
G07292	LN	454650.	6234400.	-.2082
G07796	LN	504000.	6274950.	-.1973
G07338	LN	466050.	6257400.	-.1557
G07191	LN	484500.	6283850.	-.1486
G07341	LN	467100.	6259750.	-.1403
G07760	LN	502600.	6233350.	-.1276
G07418	LP	466750.	6241600.	-.1195
G05933	CP	469500.	6306400.	-.1149
G07786	LN	509000.	6268700.	-.1067
G07756	PN	546200.	6231800.	-.0998
G07742	LN	553350.	6237850.	-.0920
G07761	LN	491100.	6251200.	-.0908
G07845	PN	541250.	6208750.	-.0860
G07772	LN	512300.	6258800.	-.0855
G07798	LN	501900.	6280250.	-.0845
G07254	LN	500300.	6263100.	-.0837

## Component 11

&gt;95th Percentile (W Sb Se, Au)

Sample	Type	Easting	Northing	Score
G07746	LP	549750.	6244950.	.0870
G07233	CP	490700.	6289700.	.0878
G07906	LN	465950.	6330050.	.0995
G07262	LN	488350.	6257700.	.1005
G07426	CN	474850.	6237150.	.1029
G07838	MS	549350.	6209500.	.1144
G07415	LP	464100.	6248000.	.1153
G05959	MS	476500.	6303350.	.1164
G07847	LN	535150.	6220700.	.1175
G07276	LN	498550.	6238200.	.1319
G07248	LN	497950.	6265600.	.1340
G07296	LP	460500.	6238550.	.1392
G07740	LN	549300.	6240400.	.1449
G07222	LP	492200.	6274500.	.1528
G07420	LN	463500.	6242700.	.1534
G07400	VL	456100.	6244650.	.1645
G07911	LN	454100.	6333100.	.1783
G07874	LP	459900.	6322600.	.2548
G07839	LN	549400.	6211800.	.3536
G07352	CP	457600.	6255050.	1.4109

## Component 12

&gt;95th Percentile (Au-W, Pb)

Sample	Type	Easting	Northing	Score
G07329	LP	475250.	6242400.	.0862
G05930	LP	466000.	6302200.	.0914
G05966	LN	477700.	6306250.	.0927
G05928	LP	464300.	6302000.	.0979
G07191	LN	484500.	6283850.	.1068
G07790	LN	509250.	6273600.	.1070
G07197	LP	478650.	6277000.	.1074
G07292	LN	454650.	6234400.	.1184
G07420	LN	463500.	6242700.	.1194
G07277	LN	497000.	6240000.	.1204
G07417	LP	467750.	6240800.	.1213
G07262	LN	488350.	6257700.	.1235
G07763	LN	490700.	6246400.	.1237
G07282	LN	468400.	6233300.	.1538
G05949	LN	484700.	6295800.	.1597
G07418	LP	466750.	6241600.	.1673
G07760	LN	502600.	6233350.	.2768
G07349	LN	453800.	6254300.	.2836
G07704	LN	521900.	6266350.	.4446
G07400	VL	456100.	6244650.	.6536

Table 10: Ranked Albany-Fraser Laterite Principal Component Scores  
Proterozoic  
Robust Principal Components  
"R/F2/F3" Samples

Component2 <5thPercentile(NiCo)					Component2 >95thPercentile(SnWMo)				
Sample	Type	Easting	Northing	Score	Sample	Type	Easting	Northing	Score
G07518	LN	544800.	6179300.	-.2462	G07696	CN	501700.	6192100.	.1578
G07611	CN	540900.	6188700.	-.2161	G07600	LN	525150.	6198600.	.1683
G07626	CN	534100.	6184800.	-.1813	G07446	LN	563650.	6175000.	.1722
G07638	PN	542500.	6193600.	-.1660	G07810	LN	487450.	6190450.	.1743
G07635	LN	535400.	6190100.	-.1353	G07506	LN	534850.	6166450.	.1790
G07624	LN	536600.	6184850.	-.1290	G07504	LN	526650.	6167700.	.1805
G07641	CN	521700.	6191550.	-.1289	G07578	LP	477700.	6176850.	.1808
G07645	LN	547400.	6192000.	-.1199	G07378	LN	529150.	6165400.	.1891
G07676	LN	517900.	6182350.	-.1182	G07540	LN	537500.	6161750.	.1986
G07475	CN	565900.	6189250.	-.1174	G07374	LN	537400.	6167600.	.2015
G07637	LN	544400.	6190400.	-.1151	G07535	LN	542900.	6165450.	.2054
G07467	LN	546500.	6184800.	-.1128	G07580	LN	482050.	6181950.	.2066
G07362	LN	529500.	6176450.	-.1115	G07542	LN	538950.	6157650.	.2092
G07621	LN	522100.	6188500.	-.1111	G07527	MS	540400.	6172700.	.2355
G07678	LN	519000.	6184650.	-.1099	G07820	LN	487350.	6195850.	.2684
G07495	CN	538600.	6191150.	-.1080	G07683	LN	507200.	6192500.	.2975
G07703	LN	481400.	6187550.	-.1079	G07503	LN	531700.	6166700.	.3590
G07632	CN	528400.	6182700.	-.1076	G07577	LP	479600.	6178200.	.4188
G07389	LN	502600.	6180800.	-.1055	G07505	LN	532250.	6164700.	.4429
G07469	LN	555150.	6183150.	-.1039	G07538	LN	542400.	6160000.	.4527

Component 5 <5th Percentile (Au Ga Cr Sn V Pb)					Component 5 >95th Percentile (Mo Sb Ni Co)				
Sample	Type	Easting	Northing	Score	Sample	Type	Easting	Northing	Score
G07676	LN	517900.	6182350.	-.5673	G07510	MS	530300.	6179200.	.1157
G07810	LN	487450.	6190450.	-.3038	G07522	LN	540700.	6177350.	.1182
G07703	LN	481400.	6187550.	-.2073	G07501	LN	521400.	6174400.	.1203
G07806	LN	487000.	6185000.	-.1570	G07640	CN	525300.	6189350.	.1211
G07696	CN	501700.	6192100.	-.1543	G07504	LN	526650.	6167700.	.1212
G07812	LN	487100.	6193100.	-.1471	G07450	LN	559100.	6173600.	.1232
G07588	LP	489050.	6182500.	-.1431	G07462	LN	555250.	6180150.	.1233
G07514	LN	532850.	6177900.	-.1391	G07459	LN	556400.	6175000.	.1266
G07476	LN	561700.	6187300.	-.1365	G07620	VL	523800.	6191150.	.1296
G07685	LN	506000.	6189100.	-.1332	G07536	LN	542950.	6162750.	.1351
G07701	LP	483200.	6195850.	-.1328	G07603	LN	538700.	6188200.	.1467
G07807	LN	486900.	6182950.	-.1294	G07512	LN	530200.	6173000.	.1764
G07597	LN	482000.	6190550.	-.1261	G07503	LN	531700.	6166700.	.1837
G07824	LN	494050.	6183300.	-.1214	G07524	LN	537300.	6172750.	.2025
G08305	LN	539750.	6174500.	-.1202	G07683	LN	507200.	6192500.	.2095
G07454	MS	560600.	6179900.	-.1199	G07611	CN	540900.	6188700.	.2217
G07822	LN	490600.	6199800.	-.1157	G07518	LN	544800.	6179300.	.4001

Table 10 (cont'd)

## Component 6

## &lt;5th Percentile (Au Sb Se)

Sample	Type	Easting	Northing	Score
G07577	LP	479600.	6178200.	-1.9515
G07691	LN	497650.	6187900.	-.8692
G07676	LN	517900.	6182350.	-.4084
G07527	MS	540400.	6172700.	-.2395
G07683	LN	507200.	6192500.	-.2271
G07703	LN	481400.	6187550.	-.2248
G07700	LN	481600.	6197100.	-.1843
G07503	LN	531700.	6166700.	-.1385
G07674	LN	509100.	6182250.	-.1344
G07696	CN	501700.	6192100.	-.1265
G07640	CN	525300.	6189350.	-.1254
G07825	LN	497100.	6182950.	-.1243
G07830	LN	549750.	6171400.	-.1151
G08304	LN	541000.	6173600.	-.1105
G07631	LN	524100.	6185850.	-.1074
G07512	LN	530200.	6173000.	-.1073
G07492	LN	552750.	6166700.	-.1047

## Component 6

## &gt;95th Percentile (Sn)

Sample	Type	Easting	Northing	Score
G07584	LN	483600.	6183600.	.1039
G07355	MS	540200.	6167150.	.1049
G07443	CN	567400.	6172800.	.1084
G07820	LN	487350.	6195850.	.1162
G07546	LN	503000.	6174350.	.1184
G07486	LN	548400.	6189250.	.1203
G07436	LN	547200.	6171400.	.1219
G07435	LN	548900.	6173200.	.1221
G07444	LN	568250.	6175000.	.1261
G07397	LN	517400.	6172100.	.1268
G07483	LN	546900.	6194750.	.1398
G07476	LN	561700.	6187300.	.1513
G07806	LN	487000.	6185000.	.1758
G07388	LN	505450.	6174600.	.1765
G07580	LN	482050.	6181950.	.1872
G07384	LN	512150.	6169500.	.1971
G08303	LN	538500.	6173500.	.2067

## Component 9

## &lt;5th Percentile (Au W)

Sample	Type	Easting	Northing	Score
G07593	LN	476550.	6188750.	.0988
G07397	LN	517400.	6172100.	.1025
G07631	LN	524100.	6185850.	.1053
G07595	LN	479100.	6193600.	.1070
G07551	LN	519650.	6177300.	.1081
G07611	CN	540900.	6188700.	.1092
G07645	LN	547400.	6192000.	.1165
G07568	LN	492050.	6178000.	.1174
G07614	LN	529150.	6193100.	.1202
G07626	CN	534100.	6184800.	.1312
G07580	LN	482050.	6181950.	.1335
G07603	LN	538700.	6188200.	.1335
G07650	LN	522400.	6196500.	.1363
G07635	LN	535400.	6190100.	.1371
G07518	LN	544800.	6179300.	.1492
G07686	LN	506000.	6187650.	.1828
G07504	LN	526650.	6167700.	.1889
G07446	LN	563650.	6175000.	.1905
G07703	LN	481400.	6187550.	.2328
G07676	LN	517900.	6182350.	.6763

## Component 10

## &lt;5th Percentile (Pb Zn As W)

Sample	Type	Easting	Northing	Score
G07577	LP	479600.	6178200.	-.8051
G07691	LN	497650.	6187900.	-.3532
G07514	LN	532850.	6177900.	-.1655
G07686	LN	506000.	6187650.	-.1568
G07471	LN	561200.	6183800.	-.1440
G07819	LN	490300.	6197000.	-.1347
G07504	LN	526650.	6167700.	-.1279
G07474	LN	565100.	6186900.	-.1227
G07538	LN	542400.	6160000.	-.1155
G07395	LP	516600.	6175800.	-.1087
G07473	CN	564500.	6183800.	-.1008
G07822	LN	490600.	6199800.	-.0987
G08301	LN	539000.	6172150.	-.0947
G07457	VL	566600.	6179150.	-.0928
G07588	LP	489050.	6182500.	-.0898
G07500	LN	516600.	6173700.	-.0840
G07355	MS	540200.	6167150.	-.0792

## Component 10

## &gt;95th Percentile (Sn Au Se Sb)

Sample	Type	Easting	Northing	Score
G07824	LN	494050.	6183300.	.1006
G07650	LN	522400.	6196500.	.1112
G07700	LN	481600.	6197100.	.1114
G07674	LN	509100.	6182250.	.1162
G07384	LN	512150.	6169500.	.1232
G07529	MS	537200.	6181100.	.1238
G07388	LN	505450.	6174600.	.1269
G07620	VL	523800.	6191150.	.1293
G07584	LN	483600.	6183600.	.1338
G07806	LN	487000.	6185000.	.1441
G07512	LN	530200.	6173000.	.1578
G07703	LN	481400.	6187550.	.1781
G07640	CN	525300.	6189350.	.1895
G07651	LN	517800.	6193100.	.1983
G07683	LN	507200.	6192500.	.2479
G07820	LN	487350.	6195850.	.2663
G07676	LN	517900.	6182350.	.6361



Table 11a: Albany-Fraser Yilgarn Block Laterites "R/F2/F3" Samples  
Chi-6\*X indices

Sample	Type	Easting	Northing	Chi-6*X
G07352	CP	457600.	6255050.	1582.9
G05990	CP	469600.	6280000.	1306.5
G05980	LP	481250.	6284800.	835.2
G07349	LN	453800.	6254300.	648.0
G07874	LP	459900.	6322600.	499.9
G08419	LN	466000.	6260000.	482.6
G07863	LP	459800.	6325100.	467.9
G08420	LP	464950.	6257950.	444.5
G05967	LP	480100.	6304600.	430.4
G08416	CP	468000.	6254300.	405.9
G07291	LN	456500.	6232650.	403.5
G07415	LP	464100.	6248000.	402.9
G08453	CP	473200.	6308350.	398.2
G07839	LN	549400.	6211800.	380.7
G07221	LP	488700.	6272700.	373.9
G05933	CP	469500.	6306400.	373.2
G08449	LP	477400.	6298100.	369.9
G07412	CP	462600.	6254150.	366.7
G05941	LP	474500.	6298200.	366.5
G07203	LP	484100.	6274700.	363.7
G07194	LP	474550.	6277750.	362.2
G05949	LN	484700.	6295800.	354.7
G07338	LN	466050.	6257400.	344.9
G08415	LN	469800.	6254500.	343.2
G05928	LP	464300.	6302000.	338.9

Table 11b: Albany-Fraser Yilgarn Block Laterites "R/F2/F3" Samples  
Peg-4 indices

Sample	Type	Easting	Northing	Peg-4
G07861	LN	468400.	6327850.	86.0
G07772	LN	512300.	6258800.	85.2
G07324	LN	470050.	6242750.	85.2
G08451	LN	476500.	6301000.	85.2
G07841	PN	545650.	6212850.	85.0
G07769	LP	496450.	6260750.	84.5
G07727	LP	497650.	6235100.	84.0
G07742	LN	553350.	6237850.	83.2
G08437	CN	482750.	6283650.	82.9
G07724	LN	495900.	6232700.	82.2
G07738	LP	536200.	6246000.	82.0
G07256	LN	500250.	6259300.	82.0
G07785	LN	508500.	6269950.	81.2
G07725	LN	498550.	6231550.	80.9
G07773	LN	510700.	6260100.	80.2
G07212	LP	488400.	6264250.	79.8
G07408	LP	467800.	6235900.	79.5
G07279	CN	495300.	6243100.	79.5
G07330	LN	473150.	6242000.	79.5
G05929	LP	466850.	6299800.	79.2
G07845	PN	541250.	6208750.	79.2
G07751	LN	537100.	6214800.	79.2
G07881	LN	477200.	6316450.	79.0
G07344	LN	463900.	6251700.	79.0
G07780	PN	514050.	6260900.	78.9

Table 11c: Albany-Fraser Yilgarn Block Laterites "R/F2/F3" Samples  
NUMCHI indices

Sample	Type	Easting	Northing	NUMCHI
G07276	LN	498550.	6238200.	4.0
G07839	LN	549400.	6211800.	4.0
G07352	CP	457600.	6255050.	3.0
G07400	VL	456100.	6244650.	3.0
G05980	LP	481250.	6284800.	3.0
G07740	LN	549300.	6240400.	3.0
G05989	MS	470050.	6282750.	3.0
G07760	LN	502600.	6233350.	3.0
G07863	LP	459800.	6325100.	3.0
G07874	LP	459900.	6322600.	3.0
G08403	LN	522200.	6265850.	3.0
G07323	LN	469950.	6241000.	3.0
G08412	LN	468000.	6256950.	3.0
G08419	LN	466000.	6260000.	3.0
G07348	LN	458150.	6258200.	3.0

Table 12a: Albany-Fraser Proterozoic Laterites "R/F2/F3" Samples  
Chi-6\*X indices

Sample	Type	Easting	Northing	Chi-6*X
G07527	MS	540400.	6172700.	1486.1
G08350	LN	507450.	6193800.	1303.5
G07514	LN	532850.	6177900.	1020.5
G08329	VL	532100.	6180100.	989.9
G07443	CN	567400.	6172800.	846.2
G08355	LN	515600.	6189900.	817.2
G07473	CN	564500.	6183800.	811.0
G08360	CN	573400.	6169750.	708.2
G07683	LN	507200.	6192500.	651.6
G08385	LN	487600.	6200100.	612.9
G07822	LN	490600.	6199800.	585.2
G08357	LN	515800.	6188500.	576.0
G08331	VL	534200.	6180100.	555.7
G07471	LN	561200.	6183800.	552.2
G08386	LN	488000.	6202300.	515.9
G08304	LN	541000.	6173600.	510.2
G08339	LN	518700.	6190900.	507.5
G07397	LN	517400.	6172100.	506.9
G07446	LN	563650.	6175000.	480.9
G08354	CN	516700.	6189100.	477.1

Table 12b: Albany-Fraser Proterozoic Laterites "R/F2/F3" Samples  
Peg-4 indices

Sample	Type	Easting	Northing	Peg-4
G07527	MS	540400.	6172700.	133.7
G08350	LN	507450.	6193800.	112.6
G07514	LN	532850.	6177900.	92.0
G08329	VL	532100.	6180100.	82.2
G08355	LN	515600.	6189900.	75.8
G07473	CN	564500.	6183800.	69.8
G07443	CN	567400.	6172800.	69.6
G07822	LN	490600.	6199800.	55.7
G07471	LN	561200.	6183800.	54.7
G08360	CN	573400.	6169750.	54.5
G08304	LN	541000.	6173600.	50.8
G08339	LN	518700.	6190900.	48.7
G07627	CN	531150.	6184350.	47.4
G08385	LN	487600.	6200100.	47.1
G07474	LN	565100.	6186900.	44.1
G08354	CN	516700.	6189100.	44.1
G07683	LN	507200.	6192500.	43.9
G08331	VL	534200.	6180100.	42.2
G07679	CN	518700.	6190250.	42.1
G08357	LN	515800.	6188500.	41.9

Table 12c: Albany-Fraser Proterozoic Laterites "R/F2/F3" Samples  
NUMCHI indices

Sample	Type	Easting	Northing	NUMCHI
G08321	LN	529500.	6180750.	5.0
G07454	MS	560600.	6179900.	4.0
G08357	LN	515800.	6188500.	4.0
G07640	CN	525300.	6189350.	4.0
G07651	LN	517800.	6193100.	3.0
G07527	MS	540400.	6172700.	3.0
G07683	LN	507200.	6192500.	3.0
G07820	LN	487350.	6195850.	3.0
G07853	MS	484750.	6199500.	3.0
G08360	CN	573400.	6169750.	3.0
G08385	LN	487600.	6200100.	3.0
G07603	LN	538700.	6188200.	3.0

Table 13a: Albany-Fraser Yilgarn Block Laterites "R/F2/F3"

Sample	Type	Easting	Northing	Observed Mahalanobis Distance	Expected Value
G08479	LN	502600.	6233200.	188.42	24.68
G08493	LN	470200.	6253650.	202.04	24.86
G07237	LN	493150.	6287200.	227.18	25.04
G07790	LN	509250.	6273600.	233.03	25.24
G07839	LN	549400.	6211800.	240.23	25.44
G07276	LN	498550.	6238200.	246.30	25.66
G05980	LP	481250.	6284800.	258.32	25.89
G07774	LN	507400.	6261700.	423.04	26.13
G05990	CP	469600.	6280000.	486.95	26.39
G07838	MS	549350.	6209500.	559.66	26.67
G07311	MS	469700.	6253800.	634.46	26.98
G08480	LN	502830.	6233200.	655.43	27.31
G05949	LN	484700.	6295800.	784.69	27.68
G08428	LN	502750.	6232650.	844.29	28.09
G05933	CP	469500.	6306400.	906.83	28.56
G07349	LN	453800.	6254300.	999.27	29.09
G07400	VL	456100.	6244650.	3121.66	29.73
G08393	LN	510100.	6278100.	3420.36	30.52
G08474	LN	502580.	6233610.	3434.17	31.57
G08394	LN	507100.	6278400.	3436.36	33.12
G07352	CP	457600.	6255050.	3886.83	36.36

Table 13b: Albany-Fraser Proterozoic Laterites "R/F2/F3"

Sample	Type	Easting	Northing	Observed Mahalanobis Distance	Expected Value
G07577	LP	479600.	6178200.	189.04	23.90
G08339	LN	518700.	6190900.	191.26	24.07
G08468	LN	507390.	6192670.	193.54	24.25
G08492	CN	516280.	6189200.	200.12	24.44
G08488	LN	516200.	6189470.	231.91	24.63
G08472	LN	507180.	6192910.	273.75	24.84
G07504	LN	526650.	6167700.	283.19	25.06
G08305	LN	539750.	6174500.	284.97	25.29
G07687	LN	511900.	6195400.	287.91	25.54
G07854	LN	485750.	6194900.	291.95	25.80
G07821	LN	487350.	6198550.	303.44	26.09
G08385	LN	487600.	6200100.	332.51	26.40
G08331	VL	534200.	6180100.	339.11	26.74
G08352	VL	508250.	6192900.	349.54	27.11
G08371	LN	517150.	6181850.	358.54	27.52
G07527	MS	540400.	6172700.	426.57	27.99
G08350	LN	507450.	6193800.	481.28	28.54
G07817	LN	494300.	6191250.	500.44	29.18
G07683	LN	507200.	6192500.	557.47	29.98
G08343	LN	517500.	6188500.	1131.08	31.03
G08325	LN	533400.	6182300.	1222.17	32.60
G08386	LN	488000.	6202300.	13685.21	35.86