CRCLEME
Cooperative Research Centre for
Landscape Environments
and Mineral Exploration

CSIRO
EXPLORATION
AND MINING

OPEN FILE
REPORT
SERIES

# INTERPRETATION OF TWO GEOCHEMICAL TRAVERSES ACROSS BASE METAL MINERALIZATION AT THE ARIPUANA PROSPECT - MATO GROSSO, BRAZIL

*M. Cornelius and C.G. Porto*

**CRC LEME OPEN FILE REPORT 190**

**April 2005**

(CSIRO Exploration and Mining Report P2005/132)

CSIRO
EXPLORATION
AND MINING

CRCLEME
Cooperative Research Centre for
Landscape Environments
and Mineral Exploration

# INTERPRETATION OF TWO GEOCHEMICAL TRAVERSES ACROSS BASE METAL MINERALIZATION AT THE ARIPUANA PROSPECT - MATO GROSSO, BRAZIL

*M. Cornelius and C.G. Porto*

**CRC LEME OPEN FILE REPORT 190**

April 2005

(CSIRO Exploration and Mining Report P2005/132 / CRC LEME Report 169R, 2002
2nd Impression 2005.)

---

CRC LEME is an unincorporated joint venture between CSIRO-Exploration & Mining, and Land & Water, The Australian National University, Curtin University of Technology, University of Adelaide, Geoscience Australia, Primary Industries and Resources SA, NSW Department of Mineral Resources and Minerals Council of Australia.

*Headquarters:* CRC LEME c/o CSIRO Exploration and Mining, PO Box 1130, Bentley WA 6102, Australia

**Copies of this publication can be obtained from:**
The Publications Officer, CRC LEME, c/- CSIRO Exploration & Mining, PO Box 1130, Bentley WA 6102, Australia. Information on other publications in this series may be obtained from the above, or from http://crcleme.org.au

**Cataloguing-in-Publication:**
Cornelius, M. & Porto, C.G.
Interpretation of two geochemical traverses across base metal mineralization at the Aripuanã prospect - Mato Grosso, Brazil.
ISBN 1 921039 25 6
1. Base metal mineralization – Mato Grosso, Brazil
2. Biogeochemistry – Mato Grosso, Brazil
3. Soil geochemistry – Mato Grosso, Brazil
I. Title
CRC LEME Open File Report 190.
ISSN 1329-4768

## Addresses and affiliations of authors

**Matthias Cornelius**
Cooperative Research Centre for Landscape Environments and Mineral Exploration
c/- CSIRO Exploration and Mining
26 Dick Perry Avenue,
Technology Park,
Kensington, Western Australia 6151
Australia.

**Claudio.G. Porto**
Departamento de Geologia - Instituto de Geociências - UFRJ
Av. Brigadeiro Trompowski s/n, Bloco G - Ilha do Fundão
Cidade Universitária - Rio de Janeiro 21949-900
Brasil

# EXECUTIVE SUMMARY

A geochemical orientation study at Anglo American plc's prospect in Mato Grosso, Brazil, compared different sample media along two traverses across stratabound Zn-Pb-(Cu-Au-Ag) mineralization, that forms gossanous outcrop and subcrop along a prominent ridge in dominantly erosional terrain.

This report details results on geochemical studies of bark, mull, A-, B- and C-horizon soil samples taken along one traverse, and mull, A- and B-horizon soil samples, taken along another traverse.

The results show that although the geochemical response is strongest in the A-horizon, mull samples clearly define the anomalies and are a viable alternative to soil samples. Bark sampling may have the potential to detect concealed mineralization and needs to be further investigated.

The fine fraction of the soil samples shows higher target element concentrations than the coarse fraction, but anomaly to background ratios are higher in the coarse fraction along Traverse 1. This is probably due to gossan detritus in the colluvium. Whereas coarse fractions are suitable where gossan outcrops, finer size fractions are recommended for sampling outside strongly mineralized areas.

Dr M. Cornelius
Project Leader

## CONTENTS

## LIST OF FIGURES

## LIST OF TABLES

## LIST OF APPENDICES

# ABSTRACT

A small geochemical and biogeochemical survey was undertaken along two traverses at Anglo American Brazil Ltda's Aripuana prospect in the Mato Grosso province of Brazil. The study involved the collection of regolith samples (humic soil (A-horizon); colluvium (B-horizon) and saprolite) along Traverse 1 that intersects an approximately 130 m long gossan body near the top of a ridge. The A-horizon and a more clay-rich and reddish soil (B-horizon) were sampled along a shorter traverse (Traverse 2) in dominantly depositional terrain. Traverse 2 intersects 10-20 m wide base metal mineralization that is concealed by approximately 5-10 m of barren regolith. Gossan chip samples and samples of drill core intersecting the gossan body along Traverse 1 were also taken for comparison. In addition, mull and bark samples were collected along Traverse 1, and mull samples along Traverse 2. The mull comprised a thin (<50 mm) layer of decomposing leaves and fine roots with varying amounts of soil particles embedded in it.

Soil samples were split into <75 µm and <250 µm fractions and analysed following multi acid, aqua regia or fusion digests. Mull and imbauba tree (Moraceae family, genus *Cecropia)* bark samples were prepared by dissolving dried matter and ashed matter (controlled ignition) in aqua regia, followed by an ICP-MS finish.

Target element concentrations along both traverses are on average two times greater in the <75 µm fraction than in the <250 µm fraction. However, anomaly to background ratios in the <250 µm fraction along Traverse 1 are one to two times greater than in the <75 µm fraction. Along Traverse 2, anomaly to background ratios are similar in both size fractions. High anomaly to background ratios in the coarse fraction along Traverse 1 may be due to coarse gossan detritus, derived from the large gossan body uphill and along the traverse.

The results of this survey suggest that fine-grained samples are preferable for regional work, whereas coarser material is more suitable for surveys in the prospect area due to the widespread occurrence of gossan outcrops. A-horizon humic soil samples show the greatest anomaly to background ratios of all sample media. Mull samples (ashed) show similar ratios to those in B-horizon samples and provide adequate information for delineation of the gossan zones along both traverses. Bark samples show very weak signatures of target elements but appear to show concealed mineralization in one sample.

The element suite based on anomaly to background ratios, that best identifies the base metal – precious metal bedrock mineralization in soil at Aripuanã, comprises: Ag, As, Au, Cd, Co, Cu, Fe, In, Mn, Mo, Pb, Sb, Se, Tl and Zn.

Further work is warranted to investigate the use of mull, bark and other organic sample media, to assess their value for routine exploration.

# 1 INTRODUCTION

## 1.1 General project outline

Anglo American Brazil Ltda´s Aripuanã prospect is one of two principal study sites selected for a collaborative research project, investigating the geochemical expression of sulphide-rich mineralization in deeply weathered terrain in Brazil. Following the withdrawal of CVRD from the project and thereby losing access to the Carajas region, the researchers, Professor Dr. Claudio Porto of the Federal University of Rio de Janeiro and Dr. Matthias Cornelius of CRC LEME in Perth, were unable to commence fieldwork as planned. Instead, Dr. Christopher Oates invited them to visit the Aripuanã prospect and to complete an orientation survey of different sampling media for Anglo American plc to benefit the companies' exploration.

The project team first met with Dr. Jose Marques and Mr. Fabio Soares of Anglo American Brazil Ltda in Goiâna to discuss possible work in the Aripuanã area and access to the site. Transport to Aripuanã was by vehicle.

Following their arrival in Aripuanã on Thursday, 24th May, Mr. Sebastiâo Lira led a reconnaissance field trip to the prospect. During the following days, the research team visited former garimpo workings (garimpos are unauthorized goldminers), studied representative drill cores from the prospect and sampled various materials, e.g., saprolite, colluvium, soil, humus, bark, gossan and drill core material. This work was completed on 1st June 2001.

Samples of mull and bark were taken to Rio de Janeiro for further processing; small samples of drill core chips (10-30 g) were also taken to Perth as reference material. The mull, bark, soil and gossan samples were then shipped from Goiâna to Vancouver and analytical work was completed by ACME Laboratories, Vancouver, by the end of December 2001.

## 1.2 Objectives for proposed research

The following principal research objectives were identified in discussion with Dr. C. Oates:

1. Characterize the chemistry of regolith samples (A-horizon soil, B-horizon soil or colluvium, saprolite, gossan) and compare to the current <6 mm soil samples, taken by the Anglo American Brazil Ltda exploration team.
2. Investigate alternative sample media with an orientation survey of the biogeochemistry of surface humus and bark from the imbauba tree, and compare the results to the <6 mm soil geochemistry used by the exploration team.
3. Statistically evaluate and group multi-element analyses of various gossans.
4. Determine the source of Pb and distinguish between barren and fertile gossans, using Pb isotopes.

Due to difficulties in obtaining fresh drill core for Pb isotopic work and additional gossan analyses, in mid January 2002, Anglo American plc requested CRC LEME to exclude objectives three and four, and complete work on the first and second objectives. Data on Anglo American Brazil Ltda's <6 mm soil sampling were unavailable at the time of writing this report and could not be considered for a comparison under objectives one and two.

# 2 SITE STUDY AND METHODS

## 2.1 Site characteristics

The survey area is located approximately 15 km NW of Aripuanã in the NNW of Mato Grosso state, Brazil (Figure 1). The study area is centred on latitude $10^{0}02'$ S and longitude $59^{0}30'$ W. Access to the project area is via gravel road and tracks from Aripuanã, which is located approximately 700 km NW of the city of Cuiabá. Travel to Aripuanã from Cuiabá is by car or aeroplane. The climate is humid tropical with an average annual rainfall of approximately 2000 mm and vegetation comprising dense tropical rainforest. Following partial deforestation during the 1990´s by garimpos, who mined alluvial and primary Au, secondary tropical rainforest now covers most of the prospect area.

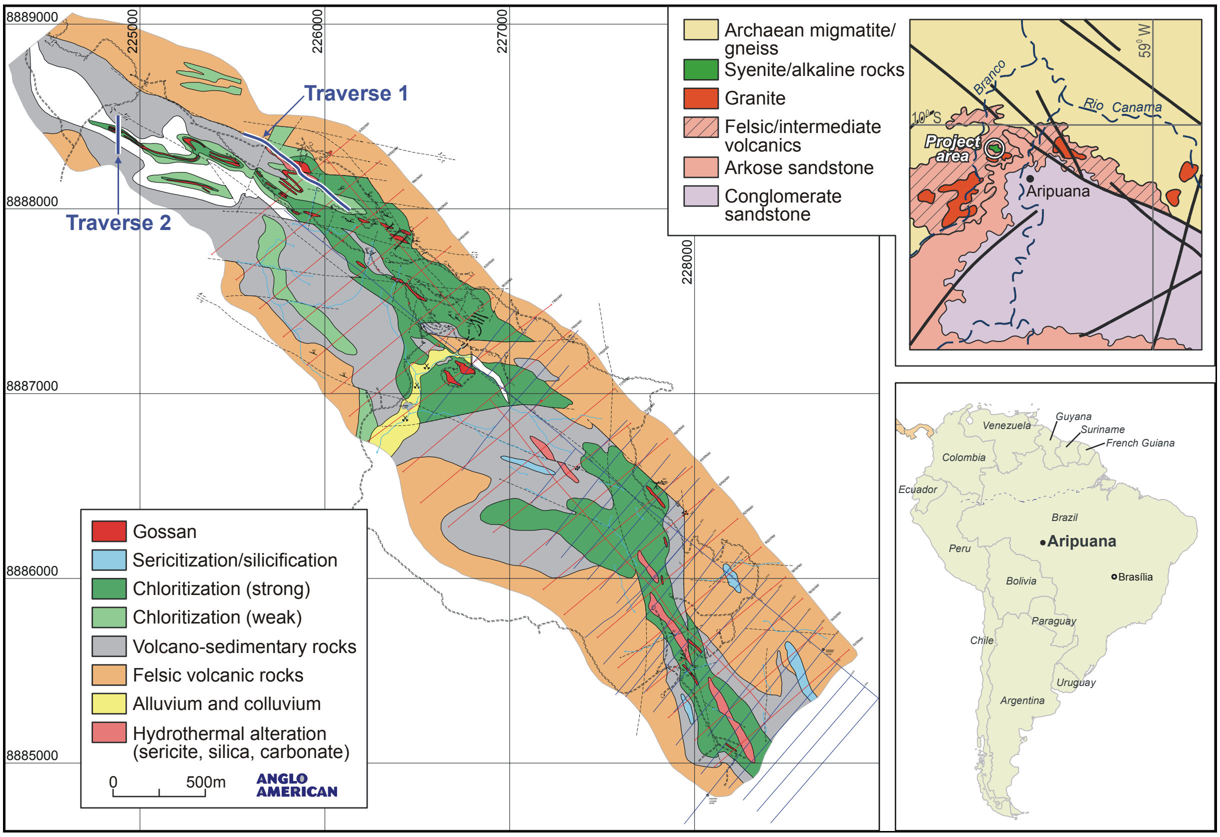


Figure 1. Aripuanã – Location plan and geology (modified after Anglo American Brazil Ltda’s digital map)

## 2.2 Geological setting and mineralization

The Aripuanã Zn-Pb-(Cu-Au-Ag) prospect is located in the Juruena Tectonic Province of the Southern Amazon Craton (Santos et al., 2001). The deposit is hosted by unmetamorphosed felsic to intermediate volcanic and volcano-sedimentary rocks of the Uatuma Group that is possibly related to intra-continental rifting (Almeida, 1974). U-Pb Shrimp dating of zircon from volcanic and intrusive rocks related to the mineralization, yielded ages of 1,762 ± 6 Ma and 1,755 ± 5 Ma respectively (Neder et al., 2000). The mineralization consists of several lenses of massive to semi-massive sulphides and disseminated or vein-type sulphides. Sphalerite-rich sulphides dominate over chalcopyrite-Au-rich ones, and both types are enveloped by a 200-500 m wide alteration zone that comprises an inner chlorite-magnetite halo around the mineralization, surrounded by calc-silicate alteration coupled with carbonatization and silicification, and an outer zone of chlorite-biotite alteration. The ore minerals are in decreasing order of abundance: pyrite, pyrrhotite, sphalerite, galena, chalcopyrite, carbonates, magnetite, arsenopyrite and cassiterite (Neder et al., 2000).

## 2.3 Local regolith setting

The Aripuanã prospect, comprising several low ridges, is located north of an old Precambrian sandstone plateau, in a generally erosional regime with minor depositional components in valleys and along hill slopes. Saprolite, saprock and gossan subcrop and outcrop at the top and along the flanks of the ridges. The relief is moderate with an approximate maximum elevation difference of 100 m; small medium-energy streams drain the area.

The upper parts of the ridges are covered by thin, residual soil, developed on saprolite and saprock. Further down the slope, thin colluvial soil (100-500 mm) covers the saprolite, increasing in thickness to several meters at the foot slopes and along the flanks of small valleys.

## 2.4 Soil sampling and positioning

A GPS was used for positioning and determining sample locations using the UTM projection and the Corrego Allegre datum, zone 21. Despite averaging positions (100-200x over 5-10 mins), significant errors were encountered at the end of traverse 2 and site 7 on traverse 1 where the GPS positions differ more than 200 m from the actual locations on the ground, the first being measured by tape and compass bearing, the second point being located on Anglo American Brazil Ltda's prospect plan. This may be due to poor satellite geometry and/or partial obstruction by the dense canopy. At most other sample locations, the error is estimated to be ±20 m. Sample locations were corrected where necessary onto a digital site plan provided by Anglo American Brazil Ltda, showing the tracks and gossan outcrops. Sample coordinates in the report by Dr. C. Dunn on the vegetation survey (Appendix 8) are based on the uncorrected GPS readings and therefore differ from the coordinates shown herein.

During the field visit to Aripuanã in May/June 2001, the following sampling was completed (sample coordinates and descriptions are listed in Appendix 5).

***Traverse 1***

Traverse 1 was selected because of good exposure of the soil profile along a 4WD track on the SW flank of the prominent NW trending ridge that hosts the mineralization. The track rises gently from the NW to the SE, climbing the slope of the ridge at a low angle, and reaching its peak approximately at the location of a large gossan. The gossan is well exposed for approximately 100 m along the track, and along a sidetrack that intersects the gossan in a N-S direction. The main track then descends gently to the SE at the southern end of the gossan. Along the NE side of the track, the top 1-2 m of the regolith are exposed at several cuttings, providing soil sample sites. At all sites, a complete profile comprising saprolite, colluvium (B-horizon soil), A-horizon soil and mull, was sampled. In addition, gossan and bark samples were taken at selected sites.

From NW to SE, along a 690 m traverse, the sample sites are (Figure 2):

| | |
|---|---|
| Site 10 | (Distance 0 m along traverse – geochemical background sample) The site is a cutting on the track, exposing saprolite, colluvium, B-horizon and A-horizon soil. The colluvium contains fragments of quartz; the saprock is red schistose chlorite schist. |
| Site 9 | (Distance 200 m – geochemical background sample) The site is located at a clearing along the track, that was established for drilling (FAREX 34). The colluvium, which contains fragments of red schistose saprock, is approximately 3-5 m thick at the northern end of the clearing, thinning to 0.5 m near the track where the sample was taken. |
| Site 8 | (Distance 300 m) This site is located 25 m NW of the gossanous zone. Some small pieces of gossanous rubble occur in the colluvium together with fragments of red schistose saprock. The saprolite is light coloured, indicating little chlorite alteration. |
| Site 7 | (Distance 380 m – gossan zone) The site is located along the side track that intersects the gossanous body in N direction and a gossan specimen (# 90890) was collected separately from the soil profile. Thick colluvium (1.5 m) contains fragments of gossan and red schistose saprock. |
| Site 1 | (Distance 420 m – gossan zone) The site is on the main gossan. Gossan fragments occur in the colluvium and gossanous zones (# 90861-90863) and are exposed along the track exposing the saprolite. Vegetation above the gossan is stunted. |
| Site 2 | (Distance 450 m – gossan zone) The site is on the main gossan, two gossan samples (#90864, 90865) were taken from the saprolite. The colluvium contains gossan fragments. The gossan appears to extend further south than shown on Anglo American Brazil Ltda's plan. |
| Site 3 | (Distance 490 m) The site is approximately 50 m SSE of the main gossan that is cut-off by an easterly shear. Fragments of gossan occur higher up the slope, but saprolite at the track cutting is light coloured and appeared unmineralized. Colluvium is less than 200 mm thick. |
| Site 4 | (Distance 520 m) The site is outside the gossan but within the alteration halo, indicated by Anglo American Brazil Ltda's mapping. Saprolite at this site is white to yellowish and the exposed soil profile is approximately 1.8 m thick with more than 500 mm of colluvium. |
| Site 5 | (Distance 580 m – geochemical background sample) The site is within the alteration zone and the saprolite is red to purple; the regolith profile is about 2.5 m thick. |

Site 6 (Distance 690 m – geochemical background sample) This site is the end point of the traverse. The colluvium is well developed with fragments of a red schistose saprock and quartz.

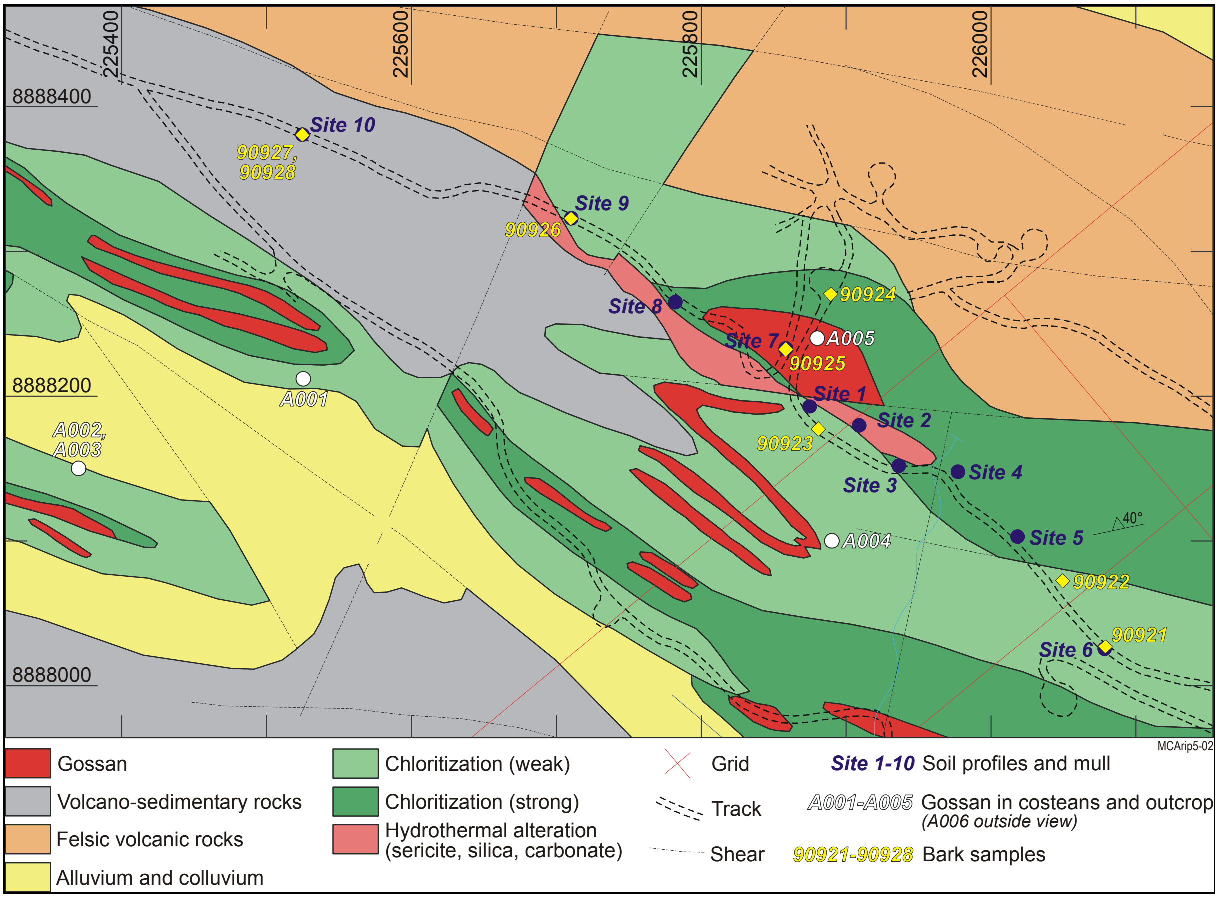


Figure 2. Aripuanã – Sample locations along Traverse 1 (sites 1-10) (modified after Anglo American Brazil Ltda's digital plan)

***Traverse 2***

The second traverse (Figure 3) was selected to test various sample media over buried mineralization) and is located approximately 1 km WNW from Traverse 1, downhill at the foot of the main ridge hosting the mineralization. Drill sections by Anglo American Brazil Ltda showed several metres of colluvial overburden over thin zones of base metal mineralization in the NW part of the prospect. The area is several hundred metres away from the main ridge and less likely to be contaminated by either past exploration activities or gossanous colluvium from other zones of mineralization. The forest along the traverse is primary and the undergrowth less dense than along Traverse 1. Starting point for the traverse was drill hole FAREX 25 at the end of a small, overgrown access track. From there, a 200 m long traverse was cleared by hand along a $180^0$ compass bearing; a tape was used to measure the distance. From N to S, the sample sites are:

Site 6 (Distance 0 m) The site is located approximately 15 m away from the drill collar. A sample of the B-horizon was taken from a 300-400 mm deep hole, dug with a spade. The orange-brown sandy soil extends to a minimum of 600 mm. The A-horizon was sampled from 20-50 mm depth, and the mull was collected from the top 10-20 mm layer.

Site 5 (Distance 50 m) As for site 6.

Site 4 (Distance 75 m) As for site 6.

Site 3 (Distance 100 m) The site is located near a small outcrop of saprolite of felsic schist with no apparent mineralization. The outcrop is the only morphological feature along the otherwise flat traverse.

Site 2 (Distance 150 m) As for site 6.

Site 1 (Distance 200 m) As for site 6.

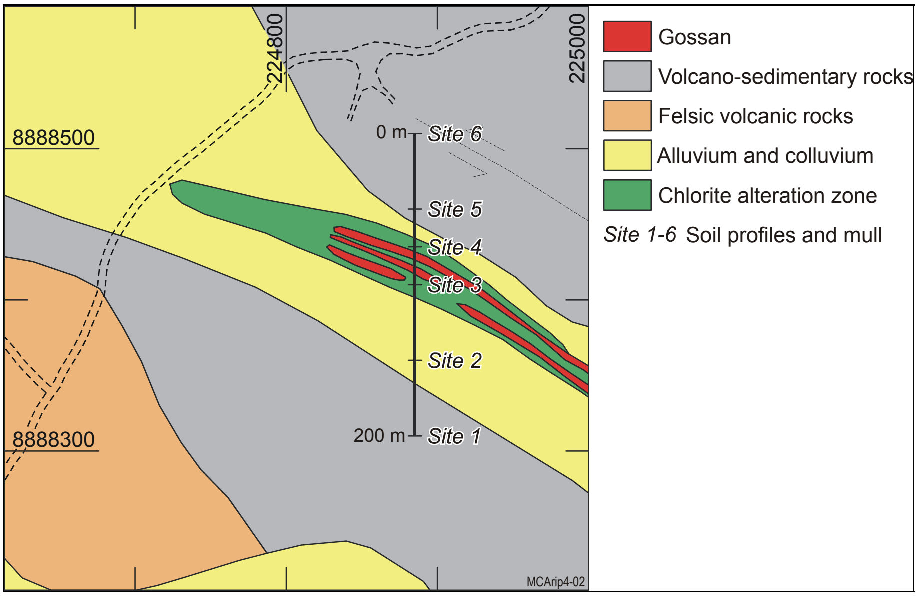


Figure 3. Aripuanã – Sample locations along Traverse 2 (modified after Anglo American Brazil Ltda's digital plan)

The sampling targeted the following media:

- A-horizon along both traverses (sampling depth approximately 50-100 mm). This is the soil immediately beneath the mull. It is a friable soil that generally contains a significant component of decaying organic material, fine roots and insect burrows, and therefore is slightly darker than the B-horizon. It was sampled by scraping off the mull layer (0-50 mm) from a 0.5 x 0.5 m area near the track cutting and taking off approximately 30-50 mm with a shovel from the cleared surface.

- B-horizon along both traverses (sampling depth approximately 300-400 mm). Sampling along the track cutting (Traverse 1) was by digging small holes into the cutting, along Traverse 2 sampling was by digging vertical holes. Along Traverse 1, the material comprised locally derived colluvial sand and clay with coarse gravel and boulders of gossan;

- C horizon – only along Traverse 1 (sampling depth approximately 0.5-2.0 m, and at a minimum of 100-300 mm beneath the B-horizon or colluvium). The material comprised saprolite and saprock of red schistose rock (chlorite schist) and pale white to yellowish schist, and variable amounts of quartz, All samples were taken along the track cutting that provided good access to the saprolite horizon and allowed easy distinction between residual and transported material. Within the gossan zone, gossanous material was sampled separately from non-mineralized saprolite.

## 2.5 Gossan sampling

Gossan formation and use in exploration have been summarized by Taylor & Thornber (1992). Butt (1995) discussed gossan as part of a review of geochemical exploration for base metals in deeply weathered terrain and this is the source of the following paragraphs.

Gossan generally is the result of intense weathering and leaching of primary sulphides in a humid climate, followed by weathering under more arid conditions. The latter leads to an irreversible dehydration of Fe oxides and oxyhydroxides, hardening Fe oxides to ferruginous masses or gossan. Hardening can also occur where gossans are exposed in an elevated position and freely drained. Iron-poor sulphides either produce Fe-poor gossan that may, for example, be Mn or Si-rich instead, or form no gossan at all. Gossans may also fail to develop over disseminated sulphide mineralization leading to ferruginous saprolite. Similar to gossans are pseudo-gossans and other ironstones that may develop as part of a lateritic profile. They can mislead exploration, as can barren gossans, developed over non-mineralized sulphides. The distinction between various gossans and ironstones is best made by comparison of the relative concentrations of a suite of elements by multivariate statistics, given a large enough and sufficiently well characterized dataset.

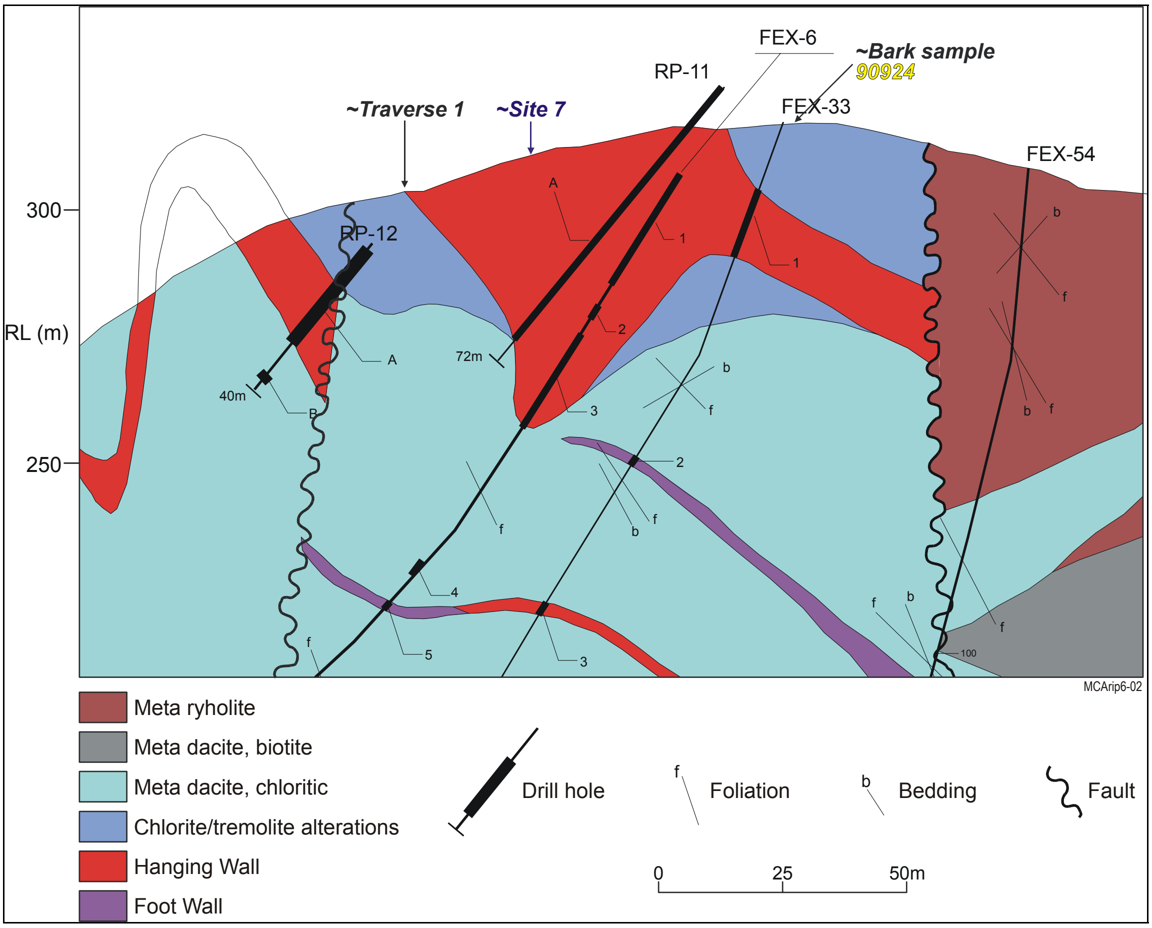


Figure 4. Aripuanã – Drill hole FEX6 and gossan body along Traverse 1 in cross section (modified after Anglo American Brazil Ltda's digital cross section)

The origin of gossans can also be determined using Pb isotopic ratios, based on their differences between economic mineralization, barren sulphides and other rocks. Lead isotopes are produced by the radioactive decay of U and Th; differences in initial U/Pb and Th/Pb ratios, and mixing of Pb from different sources, produces different Pb isotopic ratios. During formation of an ore body, a unique signature of $^{208}\mathrm{Pb}/^{206}\mathrm{Pb}$, $^{207}\mathrm{Pb}/^{206}\mathrm{Pb}$ and $^{206}\mathrm{Pb}/^{204}\mathrm{Pb}$ isotopic ratios is established. In Pb-rich ore bodies, such as at Aripuanã, the Pb isotopic signature is likely to be homogenous and does not change much after formation due to the high Pb/Th and Pb/U ratios. Most importantly, weathering does not influence these isotopic ratios. Barren gossans, false gossans and ironstones may have different Pb isotopic ratios, because they were derived from varying sources during weathering, resulting in a scatter of Pb isotopic signatures.

As part of this study, a small number of gossan samples was collected at outcrops and in costeans in the field. To obtain a more representative number of samples of weathered sulphides for statistical analysis, drill hole FAREX 6 (Figure 4), which intersects the gossanous body that subcrops and outcrops along Traverse 1, was re-sampled by Anglo American Brazil Ltda from surface to a depth of 60 m and analysed for main and trace elements. Further investigation of the gossan, including isotopic work, has been suspended. Complete analyses of the FAREX 6 samples are listed in Appendix 1; element concentrations versus depth are shown in Appendix 2, but will not be discussed further.

## 2.6 Bark and mull sampling

### *Introduction*

Chemical analysis of plant tissues can provide information on the geology and geochemistry of the regolith on which these plants grow. Commonly, if there is an enrichment of certain metals in the ground, this will be reflected in the biogeochemistry. This requires prior knowledge of optimum plant species and plant parts, i.e., bark, trunk, leaves, twigs (Dunn et al., 1992). More recently, Dunn and Angelica (2000) completed an environmental and exploration oriented biogeochemical survey in Amazonia that detected very high Hg and Au concentrations in certain plant species around mine sites. As part of their survey, they investigated leaves of the imbauba tree that show high concentrations of Hg, As and, in particular, Au and Zn.

### *Aripuanã biogeochemical survey*

A small biogeochemical survey was included in this project for two reasons. Firstly, because of the abundance of vegetation; secondly, plant matter may be used to test areas concealed by colluvium or alluvium, where conventional soil sampling may give misleading results. Vegetation above gossanous zones at the Aripuanã prospect appeared to be stunted. This led to the possibility that plants growing on and near base metal mineralization may contain high concentrations of toxic elements that occur in the bedrock mineralization.

The research team had neither the necessary information on plant species in the area nor the time to familiarize itself with the characteristics of local plants. It was decided to sample mull as it represents leaf products of a wide range of plants and is easy to collect. Mull-humus is characteristic of hardwood forests, deciduous forests and grasslands in warm, humid climates. The porous, crumbly humus rapidly decomposes and becomes mixed into the mineral soil, so a distinct layer is not apparent; insects are abundant.

To complement the mull sampling, a preliminary test was designed on a single, easily recognizable tree species. Anglo American Brazil Ltda field staff suggested the imbauba tree, which is very common in secondary rainforest, such as at Aripuanã. The imbauba tree is part of the *Moraceae* family, genus *Cecropia.* Because of the relatively large size of most imbauba specimens in the area (>10 m tall, see Figure 5C), leaves were generally out of reach so the bark was sampled instead. Bark samples of imbauba tree were collected along Traverse 1; no imbauba trees were found along Traverse 2, because this area is in primary rain forest. The complete bark was stripped from part of the tree trunk with a machete (Figure 5B). The collection of bark samples depended on the availability of imbauba trees near the track; samples were collected at the following sites:

| | |
|---|---|
| Sample 90921 | At site 6 (690 m), at the end of the traverse; background sample. |
| Sample 90922 | Between sites 5 and 6 (585 m); background sample. |
| Sample 90923 | Between sites 1 and 2 (435 m); over gossan, generally stunted growth. |
| Sample 90924 | Located immediately north of the main gossan body at FAREX33. In cross section (Figure 4) it is apparent that the tree is located over the gossan zone that is covered by approximately 10-15 m of overburden. |
| Sample 90925 | At site 7 (380 m) at the NW end of the gossan zone. |
| Sample 90926 | At site 9 (200 m); background sample. |
| Sample 90927 | At site 10 (12 m); background sample. |
| Sample 90928 | At site 10 (0 m); background sample. |

Mull samples were taken at all sites along both sample traverses and collected from the surface by hand. The mull layer generally was only 10-50 mm thick, indicating rapid decomposition of organic matter. It contained decayed and semi-decayed plant matter and fine roots. Soil particles were embedded in the fine mesh of roots. Great care was taken to minimize the amount of soil particles, but along the steeper parts of the slope along Traverse 1 and at most sites along Traverse 2, the mull was generally very thin and contained a considerable amount of soil, possibly washed from up slope. The ash yields show inorganic components of up to 29% along Traverse 1 and up to 34% along Traverse 2. Mull was sampled by hand, following clearing of an area of approximately 2-5 m by 10 m from saplings, vines and other vegetation.

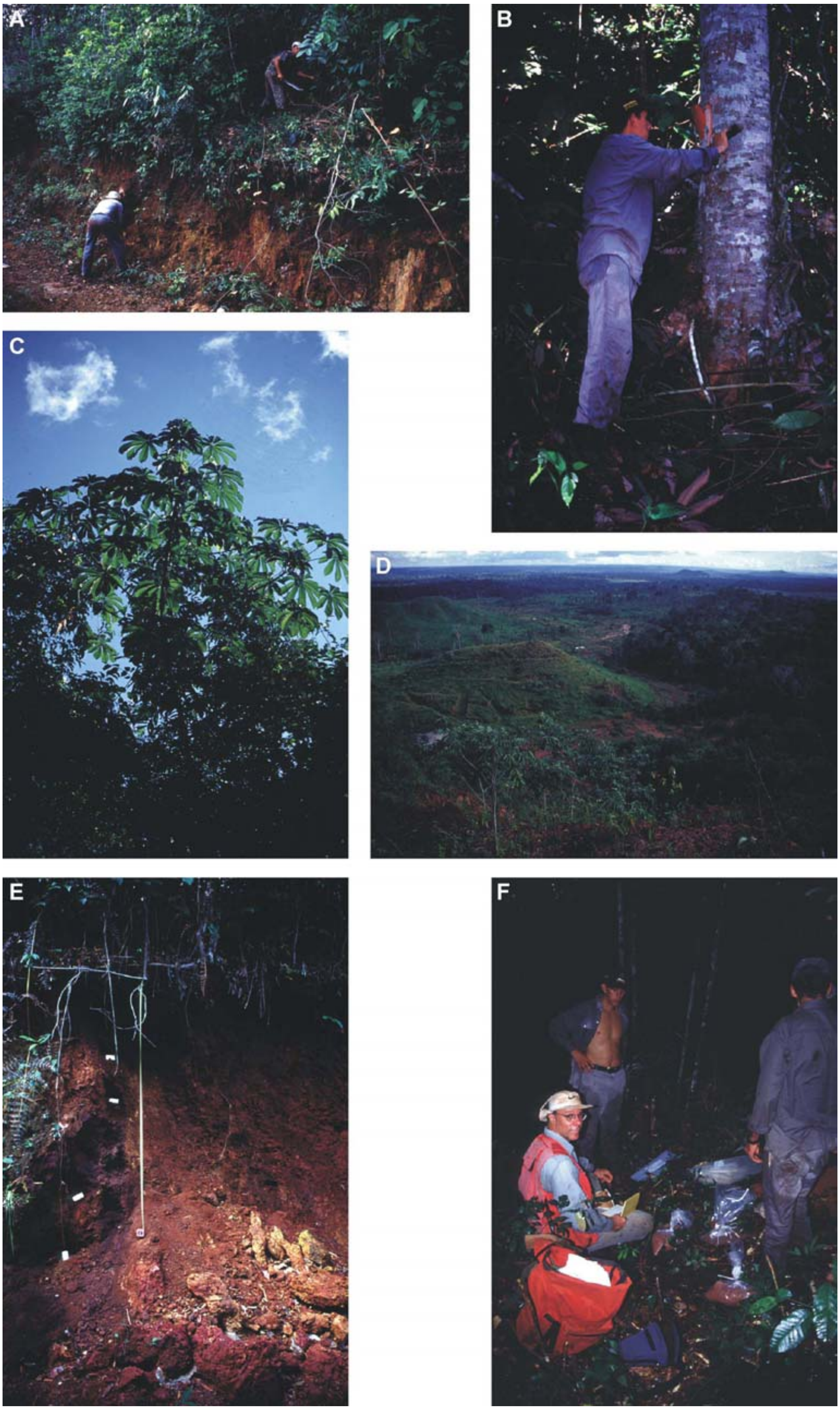


Figure 5. Aripuanã – A: cutting along Traverse 1 and clearing for mull sampling, B: bark sampling along Traverse 1, C: foliage of imbauba tree, D: view south from the main ridge, E: site 1 along Traverse 1, showing saprolite (bottom right) and gossanous material (left with white markers), F: soil and mull sampling along Traverse 2.

The size of the sampling area depended largely on the availability of mull. Along Traverse 1, sampling was north of the track and uphill. Along Traverse 2, sampling covered a 5-10 m radius around the sample sites. In general, material sufficient to fill two large 20 L plastic sample bags was collected. This turned out to be far more than is required and much smaller quantities of approximately 1-2 L would have been sufficient.

Preparation, quality control and interpretation of geochemical results of bark and mull samples were by Dr. Colin Dunn in Vancouver, Canada (see report in Appendix 8).

# 3 ANALYSIS

## 3.1 Introduction

Analyses of major and trace elements in soils, ferruginous materials and fresh rock are listed in Appendix 1; analyses of organic matter are listed in Appendix 8. Box plots of all elements for all sample media are shown in Appendix 3. Analytical results are also stored on a CD attached to this report.

Only a selection of the most useful analytical results is plotted and discussed in this report because of its limited scope.

## 3.2 Sample preparation

Details of the sample preparation are listed in Table 1. Full details on ACME's sample preparation and digests are listed in Appendix 7.

## 3.3 Analytical work

Details of element suites and digests are summarized in Appendix 7; all analyses are listed in Appendix 1. The principal digests were:

- 4BTD - Four acid digest ($HCl$-$HF$-$HClO_4$-$HNO_3$)
- 1FMS - Aqua regia digest ($HNO_3$-$HCl$)
- 4AWR/BWR - Fusion digest using $LiBO_2$ (Dissolved in 5% $HNO_3$)

For most elements, the $LiBO_2$ fusion followed by a digest using 5% $HNO_3$, achieves better results than the acid attacks due to complete dissolution of the sample and is therefore the preferred digest. Barium, for example, shows very poor dissolution by aqua regia in soil and saprolite, probably due to its occurrence in barite. Other elements in the Aripuanã sample suite that are probably hosted by resistant minerals (e.g., zircon, ilmenite, anatase) are Hf, Zr, Nb and Ti. However, acid digests are preferable for elements that require very low detection limits, e.g., Ag, As, Cd, Cr, Sn and Tl. Some of these elements will not be completely digested by acid attack (Hall, 1999). For other more soluble elements in these samples, e.g., Co, Cu, P and Pb, different digests achieve consistent and comparable results (Appendix 4) and there is no real advantage in choosing one or the other.

## 3.4 Quality control

Duplicates are listed in Appendix 6 together with five additional duplicate samples and three internal standards from CSIRO, submitted in January 2002.

Most of the results of duplicate and standard analyses show good precision and accuracy (Appendix 6). ACME Laboratories recognized problems with the base metal analyses for two standards and repeated the respective analyses; Appendix 6 shows the corrected concentrations.

ACME's results for the CSIRO internal standards show poor accuracy for As (26 ppm versus 2 ppm), Cr (321 ppm versus 407 ppm, Li (0.3 ppm versus 12 ppm) and Pb (42 ppm versus 10 ppm).

Precision is best for analyses following $LiBO_2$ fusion digests. However, poor precision between batches (November 2001 and January 2002) was noted for analyses following four-acid and aqua regia digests; e.g., for Tl (1.1 ppm versus 7.4 ppm), Cu, Pb and Zn (precision worse than 10%), As (2300 ppm versus 1685 ppm), Sb (585 ppm versus 444 ppm) and Se (9 ppm versus 25 ppm).

Dr C. Dunn included several internal standards and duplicates with the mull and bark samples; analyses are listed in Appendix 8.

| Sample type | Batch | Sample no start | Sample no end | Number of samples | Preparation 1 | Preparation 2 | Preparation 3 | Preparation 4 |
|---|---|---|---|---|---|---|---|---|
| Drill core samples FEX6 | 640 | 91202 | 91256 | 55 | Crush if necessary | Grind to -75 microns (Low Cr steel mill) | Take 10-30 g reference sample for CSIRO | |
| Soil samples A- and B-horizons | 641 | 90858 | | 32 | Sieve (plastic) to > and < 6 mm. | Take off approximately 50-100 g of < 6 mm material as reference sample for CSIRO Store the > 6 mm fraction until further notice | Grind the < 6 mm fraction to < 75 microns. (Low Cr steel mill) | Take off 30-50 g as reference for CSIRO |
| | | 90859 | | | | | | |
| | | 90866 | | | | | | |
| | | 90868 | | | | | | |
| | | 90871 | | | | | | |
| | | 90872 | | | | | | |
| | | 90874 | | | | | | |
| | | 90876 | | | | | | |
| | | 90879 | | | | | | |
| | | 90880 | | | | | | |
| | | 90883 | | | | | | |
| | | 90884 | | | | | | |
| | | 90887 | | | | | | |
| | | 90888 | | | | | | |
| | | 90892 | | | | | | |
| | | 90893 | | | | | | |
| | | 90896 | | | | | | |
| | | 90897 | | | | | | |
| | | 90900 | | | | | | |
| | | 90901 | | | | | | |
| | | 90903 | | | | | | |
| | | 90904 | | | | | | |
| | | 90906 | | | | | | |
| | | 90907 | | | | | | |
| | | 90909 | | | | | | |
| | | 90910 | | | | | | |
| | | 90912 | | | | | | |
| | | 90913 | | | | | | |
| | | 90915 | | | | | | |
| | | 90916 | | | | | | |
| | | 90918 | | | | | | |
| | | 90919 | | | | | | |
| Saprolite samples (C horizon) | 641 | 90860 | | 10 | Take off reference sample (50-100 g) for CSIRO | Crush if necessary | Grind to < 75 microns (Low Cr steel mill) | Take off 30-50 g as reference for CSIRO |
| | | 90867 | | | | | | |
| | | 90873 | | | | | | |
| | | 90875 | | | | | | |
| | | 90878 | | | | | | |
| | | 90882 | | | | | | |
| | | 90886 | | | | | | |
| | | 90891 | | | | | | |
| | | 90895 | | | | | | |
| | | 90899 | | | | | | |
| Gossanous material from soil profiles | 641 | 90861 | | 6 | Take off reference sample (50-100g) VISUAL CONTROL - PICK DARK PIECES | Crush if necessary ONLY DARK MATERIAL (keep remainder until further notice | Grind to < 75 microns (Low Cr steel mill) | Take off 30-50 g as reference for CSIRO |
| | | 90862 | | | | | | |
| | | 90863 | | | | | | |
| | | 90864 | | | | | | |
| | | 90865 | | | | | | |
| | | 90890 | | | | | | |
| Gossan outcrops | 641 | A001 | | 4 | Take off reference sample (50-100g) | Crush sample | Grind to < 75 microns (Low Cr steel mill) | Take off 30-50 g as reference for CSIRO |
| | | A002 | | | | | | |
| | | A003 | | | | | | |
| | | A004 | | | | | | |
| Bark and mull humus | 680 | 90857 | | 24 | Forward to Dr Colin Dunn | | | |
| | | 90869 | | | | | | |
| | | 90870 | | | | | | |
| | | 90877 | | | | | | |
| | | 90881 | | | | | | |
| | | 90885 | | | | | | |
| | | 90889 | | | | | | |
| | | 90894 | | | | | | |
| | | 90898 | | | | | | |
| | | 90902 | | | | | | |
| | | 90905 | | | | | | |
| | | 90908 | | | | | | |
| | | 90911 | | | | | | |
| | | 90914 | | | | | | |
| | | 90917 | | | | | | |
| | | 90920 | | | | | | |
| | | 90921 | | | | | | |
| | | 90922 | | | | | | |
| | | 90923 | | | | | | |
| | | 90924 | | | | | | |
| | | 90925 | | | | | | |
| | | 90926 | | | | | | |
| | | 90927 | | | | | | |
| | | 90928 | | | | | | |

Table 1. CRC LEME sample preparation instructions to ACME Laboratories, Vancouver, Canada.

# 4 RESULTS

## 4.1 Size of data sets

All data sets discussed in this report, with the exception of rock chip analyses (Fex 6), are small and therefore unsuitable for statistical evaluation. Averages and box plots (Appendix 3) must be treated with caution.

## 4.2 Anomaly to background ratios

To rank element enrichments in the gossanous zone compared to background, arithmetic means were calculated for element concentrations in background samples (sites 5, 6, 9 and 10 along Traverse 1 and sites 1 and 6 along Traverse 2) and compared to those on the gossan zone (sites 1, 2 and 7 along Traverse 1 and sites 3 and 4 along Traverse 2). Samples that are located close to the anomalous zone may be affected by lateral element dispersion and were therefore excluded from the background data set.

The ratios of the average concentration over the anomaly to the average concentration in background samples for all elements for both traverses are listed in Table 2

## 4.3 Saprolite (including gossanous samples)

Ten samples of saprolite and 6 samples of gossanous material were collected along Traverse 1. Along Traverse 2, saprolite was not exposed and therefore could not be sampled. Graphs of all element concentrations along Traverse 1 are shown in Appendix 2.8.

Elements strongly enriched in saprolite and in the gossan are (minimum and maximum concentrations in brackets): **As** (21-3122 ppm), **Au** (4.5–2062 ppb), **Cd** (0.01-6.7 ppm), **Ge** (0.1-2.7 ppm), **In** (0.04-9.55), **Mo** (0.8-127 ppm), **Pb** (231-32331 ppm), **S** (0.01-0.71 %), **Sb** (2-550 ppm), **Se** (0.1-16.5 ppm), and **Zn** (51-12183 ppm).

## 4.3 B-horizon soil

The B-horizon soil was sampled along both traverses. Ten samples were taken along Traverse 1, most of which are locally derived colluvium. Six samples were collected along Traverse 2. Two size fractions, <250 µm and <75 µm, were separated to investigate the influence of grainsize on element concentrations and anomaly definition. Background to anomaly ratios were calculated for Traverse 1 as described above, and are listed in Table 2, graphs of all elements are listed in Appendices 2.7 and 2.13. Elements with high anomaly to background ratios in both traverses are (minimum and maximum concentrations in brackets): **As** (9.6-1852 ppm), **Au** (1.4-713 ppb), **Cd** (0.01-6.06 ppm), **Co** (0.05-96 ppm), **Cu** (15-1311 ppm), **In** (0.02-16 ppm), **Mn** (0.02-5.65 %), **Mo** (0.6-48 ppm), **Pb** (79-33627 ppm), **Sb** (1-349 ppm), **Se** (0.1-8.3 ppm), **S** (0.01-0.27 %) and **Zn** (27-7102 ppm).

Along both traverses, the fine fraction (<75 µm) generally shows higher element concentrations than the coarse fraction (<250 µm) (Table 2). This is particularly so for Ag, Cd, Co, Mn, Pb and Tl along Traverse 1 and, to a lesser degree, along Traverse 2. A possible explanation for this may be the higher clay content in the fine fraction that hosts many of the metals and other elements.

The anomaly to background ratios show a 1-2 times greater contrast in the coarse fraction along Traverse 1, compared to the fine fraction. Along Traverse 2, anomaly to background ratios are similar in both size fractions, given the very small data set.

It appears likely that small fragments of gossan in colluvium on the slope below the large gossan along Traverse 1 may cause greater anomaly to background ratios in the coarse fraction. Along Traverse 2, mineralization is buried and gossan fragments are therefore unlikely to occur in the soil and will not affect the anomaly to background ratios.

## 4.4 A-horizon soil

Samples of the A-horizon soil were taken along both traverses and two size fractions (<250 µm and <75 µm) analysed. One sample (#90901) was lost during transport to ACME laboratories. Similar to the B-horizon, the fine fraction shows a greater concentration of most elements. Also, the anomaly to background ratios are greater in coarse material along Traverse 1, although the ratios in fine and coarse fractions do not differ as much as in the B-horizon soil. This may be due to greater decomposition of gossanous fragments in the A-horizon compared to the colluvium-rich B-horizon. Along Traverse 2, anomaly to background ratios are broadly similar in both size fractions. Element graphs are shown in Appendices 2.5, 2.6, 2.11and 2.12.

Elements with high anomaly to background ratios in the A-horizon along both traverses are (minimum and maximum concentrations in brackets): **As** (8.5-1373 ppm), **Au** (1.3-427 ppb), **Cd** (0.01-5.1 ppm), **Co** (0.05-74 ppm), **Cu** (15-1200 ppm), **In** (0.02-21.5 ppm), **Mn** (0.02-4.5 %), **Mo** (0.5-48.2 ppm)**, Pb** (60-25600 ppm), **Sb** (1-214 ppm), **Se** (0.1-15.5 ppm) and **Zn** (21-5689 ppm). The ratios are generally greater than the equivalent ratios in the B-horizon and saprolite.

### 4.5 Gossan profile (FEX 6) and individual gossan samples

A total of 10 gossan samples were collected in costeans, at outcrops and as part of the soil profiles along Traverse 1. In addition, 55 samples were taken from drill hole FEX6. The gossan sampling was intended to provide data for a study of the geochemical and mineralogical changes in a vertical weathering profile through the gossan, and to contribute to a statistical investigation of gossan geochemistry. These objectives are no longer part of this report and the analyses will not be discussed; data are used for comparison with data on soil and organic matter in box plots (Appendix 3). Analyses and geochemical profiles are listed in Appendices 1 and 2.15.

### 4.6 Mull and bark

Mull and bark analyses are discussed in C. Dunn's report (Appendix 8). Due to the correction of the coordinates for Site 7 along Traverse 1, the element concentration graphs have changed and now show only one gossan zone along Traverse 1. The corrected results show well-defined anomalies over the gossan zones along both traverses (Appendices 2.1-2.4 and 2.9-2.10).

Lead in ashed mull shows the strongest anomaly to background contrast of all elements and sample media. Overall, anomaly to background ratios are somewhat less in ashed mull than in the A-horizon. Similar to the A- and B-horizon samples, mull appears to reflect some downhill movement of anomalous material. Anomalous concentrations of elements associated with the gossan mineralization appear to extend to the SE, beyond the extent of the gossan.

Inorganic material was inadvertently sampled together with the organic matter (ash yields ranging from 3.3% to 33.4%), but appears to have only a minor effect on the shapes of the anomalies and background to anomaly ratios in the present study. The concentrations of Pb in ashed mull versus the respective ash yields for mull samples from Traverses 1 and 2 are shown in Figure 6. If Pb in ashed mull was exclusively from inorganic matter, a correlation should exist between ash yield and Pb (mull) concentrations. This is clearly not the case in this small data set, indicating that Pb in organic matter contributes significantly towards the total Pb concentration in ashed mull.

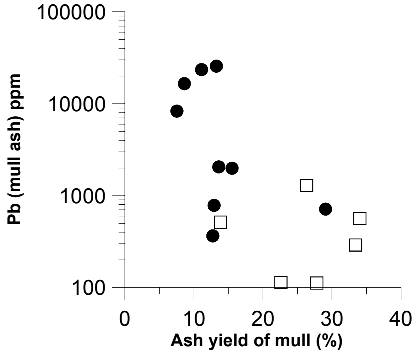


Figure 6. Scatter plot for Traverses 1 and 2, showing Pb (mull ash) versus ash yield (full circles – Traverse 1, empty squares – Traverse 2)

To demonstrate the influence of soil contamination on the shape and amplitude of the Pb anomalies in the mull, corrections can be applied. Lead concentrations in ashed mull have been corrected for the amount of Pb contributed by the inorganic component of A-horizon soil. To account for the normal ash yield of mull without any inorganic component, 3% (lowest ash yield in the present data set) have been deducted from the ash yield prior to the calculation. Thus:

$$\mathrm{Pb}_{\text{(mull ash, corrected)}} = \mathrm{Pb}_{\text{(mull ash)}} - ((\text{Ash yield} - 3\%) \times \mathrm{Pb}_{\text{(A-horizon soil -75 }\mu\text{m)}})$$

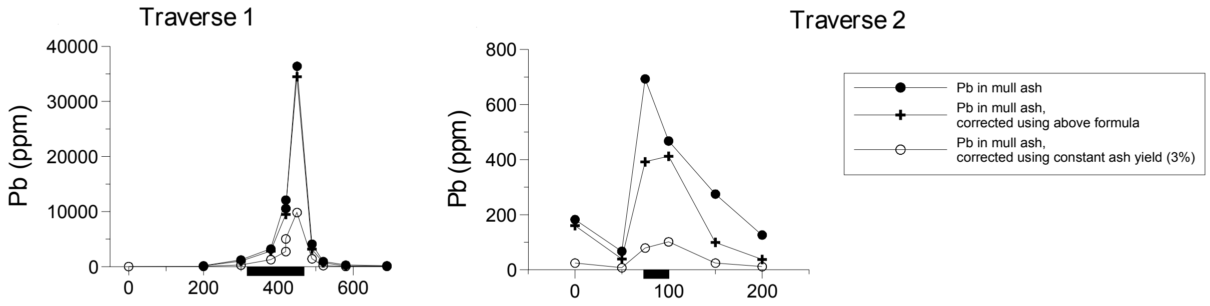


Figure 7. Total Pb concentrations and corrected Pb concentrations along Traverses 1 and 2 (black bar indicates mineralization).

The data can also be normalized to a constant ash yield (Figure 7, empty circles), in this case 3%; this correction does not require analysis of the A-horizon soil.

Although the contrasts vary, the shapes of anomalies for total Pb concentrations and corrected Pb concentrations (using A-horizon soil concentrations or normalization to constant ash yield) in Traverses 1 and 2 (Figure 7) are insignificant along Traverse 1, and minor along Traverse 2. Therefore, no corrections were applied to other elements. It appears that soil, adhering to and mixing with the mull, does not significantly alter the shape of the anomaly along Traverse 1, but has some effect on the shape and amplitude of the anomaly along Traverse 2. Further work is warranted to substantiate these findings and determine how regional variation in mull composition and thickness can influence element concentrations.

Along Traverse 1, anomaly to background ratios in dry mull are significantly less than in ashed mull, nevertheless, some elements in dry mull also clearly outline the gossan. In ashed mull, elements that best outline the anomaly are (minimum and maximum concentrations in brackets): **As** (20-794 ppm), **Au** (9.5-444 ppb), **Cd** (0.09-6 ppm), **Co** (0.8-123 ppm), **In** (0.06-6.48 ppm), **Mo** (0.92-58.6 ppm), **Pb** (84-36400 ppm), **Sb** (0.43-59.4 ppm)**, Se** (0.2-11.4 ppm), **U** (0.6-20.5 ppm), **V** (1-53 ppm) and **Zn** (178-3431 ppm)**.** In dry mull, the best target elements are: **Cd** (0.01-0.42 ppm), **In** (0.01-0.75 ppm), **Mo** (0.15-4.30 ppm), **Pb** (20-1203 ppm) and **Sb** (0.12-9.49 ppm).

Along Traverse 2, **Au** (2-16 ppb), **As** (12-217 ppm), **In** (0.03-0.29 ppm), **Pb** (67-692 ppm), **Sb** (0.75-3.61 ppm) and **W** (0.1-0.9 ppm) in ashed mull, and **As** (2-65 ppm), **In** (0.01-0.08 ppm) and **Sb** (0.22-1.79 ppm) in dry mull best characterize the underlying mineralization.

In ashed and dry bark, a small number of elements show moderately high anomaly to background ratios; these are: **In** (0.01-0.08 ppm)**, Mo** (0.03-105 ppm)**, Pb** (0.65-571 ppm) and **Sb** (0.01-0.82 ppm)**.** Other elements, such as W (0.05-4 ppm) and Zn (4-549 ppm), show high concentrations in one sample taken on the gossan, but low concentrations in two other samples.

It is important to note that sample 90924 along Traverse 1 was taken from a tree located approximately 20 m north (uphill) from the gossan. The gossan dips north and is projected to be

**Traverse 1**

| | | Mull ash | Mull dry | Bark ash | Bark dry | A <250 um | A <75 um | B <250 um | B <75 um | Saprolite | A-Horizon | B-Horizon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analyte | ACME digest code | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio <75 / <250 | Ratio <75 / <250 |
| Sb | 1FMS | **33.8** | **11.7** | **5.7** | **6.0** | **42.7** | **31.9** | **47.2** | **23.2** | **70.7** | 1.8 | 2.2 |
| Mo | 1FMS | **19.6** | **7.9** | **16.0** | **19.4** | **18.2** | **11.8** | **18.8** | **12.3** | **18.5** | 2.4 | 2.9 |
| Pb | 1FMS | **101.0** | **7.3** | **19.6** | **14.9** | **48.0** | **31.1** | **34.3** | **19.0** | **13.3** | 2.9 | 4.1 |
| As | 1FMS | **13.5** | **5.9** | 2.5 | **4.7** | **15.3** | **12.6** | **13.1** | **7.8** | **18.3** | 1.4 | 1.9 |
| In | 1FMS | **26.2** | **8.0** | **3.7** | 1.0 | **44.2** | **39.5** | **31.2** | **16.3** | **13.5** | 1.5 | 1.6 |
| Zn | 1FMS | **11.6** | **6.8** | 1.9 | 1.8 | **77.0** | **65.2** | **55.4** | **33.5** | **48.3** | 1.7 | 1.9 |
| Cd | 1FMS | **24.3** | **16.8** | 1.0 | 1.1 | **83.1** | **81.6** | **40.1** | **36.1** | **20.2** | 3.4 | 5.3 |
| Se | 1FMS | **25.0** | **3.6** | 1.9 | 1.6 | **16.9** | **11.6** | **11.4** | **7.8** | **19.9** | 1.6 | 2.4 |
| Fe2O3 | 4AWR | **5.5** | **3.1** | 1.8 | 2.3 | **7.4** | **6.7** | **7.1** | **4.5** | **7.2** | 1.3 | 1.5 |
| U | 4BWR | **14.9** | **6.4** | 1.3 | 1.3 | **4.4** | **4.7** | **4.3** | **4.5** | **3.3** | 1.1 | 1.3 |
| Co | 4BWR | **34.2** | **4.2** | 0.8 | 0.7 | **41.0** | **15.2** | **27.0** | **6.4** | **3.1** | 23.7 | 19.6 |
| Au | 1FMS | **16.2** | 1.0 | 2.6 | 2.6 | **15.5** | **11.5** | **14.5** | **15.5** | **46.1** | 1.1 | 1.1 |
| Ge | 1FMS | **5.0** | **3.4** | 1.0 | 0.8 | **4.0** | **6.7** | **4.0** | 2.7 | **14.2** | 1.8 | 1.5 |
| Ag | 1FMS | **3.9** | 2.3 | 1.0 | 0.9 | **5.0** | **7.8** | **4.3** | **4.1** | **9.4** | 2.2 | 11.8 |
| Cu | 1FMS | **5.2** | 2.6 | 0.8 | 0.8 | **15.2** | **13.3** | **11.5** | **8.8** | **8.9** | 1.3 | 1.8 |
| MnO | 4AWR | **5.0** | 1.7 | 0.3 | 0.3 | **35.0** | **26.9** | **53.9** | **14.9** | **5.1** | 3.2 | 6.5 |
| Be | 1FMS | **3.1** | 2.7 | 0.6 | 1.0 | **9.3** | **6.3** | **6.1** | **5.1** | **4.1** | 2.1 | 1.9 |
| V | 1FMS | **16.8** | 2.0 | 1.0 | 1.0 | **7.8** | **8.5** | **7.1** | **5.5** | **3.9** | 1.4 | 2.0 |
| Tl | 1FMS | **9.0** | **3.3** | 0.2 | 1.6 | **9.0** | **14.9** | **6.8** | **6.8** | 2.1 | 2.5 | 7.1 |
| Hg | 1FMS | **3.1** | 1.0 | 1.4 | 0.7 | 2.0 | **3.1** | **6.9** | **10.5** | **8.5** | 1.0 | 1.4 |
| Ni | 1FMS | 2.2 | 1.3 | 0.9 | 1.1 | **8.2** | **3.5** | **9.4** | **5.5** | **7.6** | 2.0 | 1.7 |
| B | 1FMS | 1.2 | 0.7 | 0.9 | 1.1 | **3.3** | **8.3** | **8.3** | **8.7** | **7.5** | 2.4 | 1.1 |
| P2O5 | 4AWR | 1.9 | 1.3 | 0.9 | 1.0 | **3.8** | **4.4** | **8.3** | **8.8** | **4.3** | 0.7 | 1.3 |
| TOT/S | 4ALC | | | | | 2.4 | **3.3** | **5.1** | **9.6** | **53.4** | 1.3 | 2.4 |
| S | 1FMS | 1.8 | 1.1 | 1.5 | 1.2 | 2.2 | **3.5** | **12.3** | **9.3** | **24.6** | 1.2 | 1.6 |
| Ni | 4BTD | | | | | **3.0** | 2.0 | **3.9** | **3.6** | 2.2 | 1.8 | 1.7 |
| La | 4BWR | **3.3** | 1.6 | 1.3 | 2.5 | **3.4** | **3.4** | 1.8 | 1.6 | 0.9 | 1.2 | 1.3 |
| Re | 1FMS | 0.8 | 1.0 | 0.8 | 1.0 | **3.5** | 1.0 | **4.6** | 0.8 | 1.8 | 0.8 | 0.5 |
| Pr | 4BWR | | 1.3 | | 1.0 | **3.8** | **3.9** | 2.4 | 2.2 | 1.4 | 1.1 | 1.1 |
| Nd | 4BWR | | 1.1 | | 1.1 | **3.3** | **3.4** | 2.2 | 2.1 | 1.4 | 1.2 | 1.3 |
| Cr | 1FMS | 1.4 | 0.8 | 0.9 | 1.0 | **4.8** | 1.4 | **3.8** | 1.4 | 1.1 | 3.3 | 2.6 |
| Te | 1FMS | **3.1** | 1.0 | 1.2 | 1.0 | **3.2** | 2.1 | 0.8 | 0.4 | 1.0 | 2.5 | 3.5 |
| W | 4BWR | **5.8** | 0.8 | **15.7** | 1.1 | 1.3 | 0.9 | 1.7 | 1.3 | 0.8 | 2.0 | 1.6 |
| Bi | 1FMS | 2.2 | 0.8 | **4.6** | 1.0 | **3.1** | 2.4 | 2.8 | 1.6 | 0.8 | 1.7 | 2.2 |
| Pt | 1FMS | 1.0 | 0.6 | 1.0 | 1.0 | **4.3** | 1.3 | 1.7 | 2.0 | 1.4 | 1.1 | 1.2 |
| Ce | 4BWR | 2.4 | 0.5 | 0.6 | 0.7 | **3.1** | 1.4 | 2.3 | 1.2 | 0.3 | 2.8 | 3.6 |

**Traverse 2**

| | | Mull ash | Mull dry | A <250 um | A <75 um | B <250 um | B <75 um | A-Horizon | B-Horizon |
|---|---|---|---|---|---|---|---|---|---|
| Analyte | Digest | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio anomaly / back-ground | Ratio <75 / <250 | Ratio <75 / <250 |
| As | 1FMS | **5.0** | **3.8** | **6.0** | **7.0** | **5.9** | **5.8** | 1.4 | 1.3 |
| Sb | 1FMS | **4.2** | **4.0** | **4.9** | **6.1** | **4.6** | **4.6** | 1.4 | 1.3 |
| In | 1FMS | **5.1** | **3.7** | **8.1** | **11.0** | **8.1** | **9.7** | 1.4 | 1.2 |
| Au | 1FMS | **6.5** | 1.1 | **5.7** | **4.2** | **8.3** | **7.0** | 1.0 | 0.8 |
| Pb | 1FMS | **3.8** | 2.9 | **3.2** | **4.3** | **3.5** | **3.1** | 2.2 | 1.9 |
| Na2O | 4AWR | 1.7 | 1.2 | **5.0** | **6.0** | **4.0** | **6.7** | 2.3 | 1.6 |
| Bi | 1FMS | 2.0 | 1.9 | **3.5** | **4.8** | **3.7** | **4.0** | 1.4 | 1.2 |
| Cd | 1FMS | 1.5 | 1.4 | 0.9 | **3.0** | **3.3** | **3.6** | 1.9 | 3.6 |
| Cu | 1FMS | 2.3 | 1.6 | 2.4 | **3.6** | **3.3** | **3.5** | 1.4 | 1.3 |
| Te | 1FMS | 1.7 | 0.8 | 2.4 | **4.0** | **3.4** | 2.7 | 1.6 | 1.4 |
| W | 4BWR | **5.0** | 0.7 | **3.0** | 2.4 | 2.9 | 2.5 | 1.9 | 1.2 |
| Be | 1FMS | 1.8 | 1.0 | 1.4 | **3.0** | 1.4 | 2.3 | 1.6 | 1.8 |

Table 2. Aripuanã – Anomaly to background ratios

approximately 20-25 m beneath the sampled tree (Figure 4). The bark sample from that location shows high Mo, Pb and Sb concentrations, but unlike the other two samples from the gossan, Sn and W concentrations are also high in sample 90924. This appears to indicate that the Imbauba tree may be useful for detecting concealed mineralization. However, as this observation is based on a single case, further work is necessary.

### 4.7 Comparison of sample media

The concentrations of selected elements in bark, mull, A-horizon soil, B-horizon soil and saprolite are shown in Figures 8 (Traverse 1) and 9 (Traverse 2) for comparison. For profiles of all elements, see Appendix 2. Because of the large number of different sample media available for Traverse 1, only data on ashed bark and mull are shown. For A- and B-horizon samples, only data for the <250 µm fraction are shown. For Traverse 2, all available data are shown. The elements comprise those that show enrichment in at least one of the sample media; some elements are normalized to Fe.

In A- and B-horizon soil samples and saprolite, some elements, e.g., Cu, Pb, Zn, Co, Cd and Mo correlate well with Fe and, to a lesser degree, Mn. Normalizing metals for Fe generally reduces the amplitudes of the anomalies but has little influence on their shapes. This is more evident along Traverse 1, where samples on or close to gossan have significantly higher metal to Fe ratios than background samples. Although the effect of normalizing for Fe or calculating residual values on the shapes of the anomalies along both traverses is generally negligible, such correction may be useful for larger data sets and in less well explored areas, i.e., regional surveys. There, it may assist in discriminating between anomalies that are simply related to Fe-rich bedrock or regolith materials, and ones that indicate genuine metal enrichment.

***Traverse 1***

Bark of the Imbauba tree shows the lowest concentrations for all elements except for B, Mn, Mo, P and S. Of these elements, only **Mo** is strongly enriched over the gossan and detectable also in dry bark (see Figure 8). Other elements in bark that clearly mark the gossan zone are **Pb** and **W**.

Ashed mull, and A- and B-horizon soil (<250 µm) samples all show similar concentration levels. Exceptions are B, Hg, Mn, P, S and W, which differ strongly between mull and the inorganic sample media. None of these show strong enrichment over the gossan. Elements that are good indicators of mineralization and are enriched in all three sample media, are: **Ag, As, Au, Cd, Co, Cu, In, Mn**, **Mo, Pb, Sb, Se, U, V** and **Zn,** although U and V anomalies are strongest in ashed mull. Most anomalies in the above sample media appear to extend SE, beyond the gossan (i.e., the concentration patterns appear to be skewed to the right in Figure 9). This is probably colluvial dispersion moving material downslope from the gossan.

Element concentrations in saprolite generally show more erratic patterns, reflecting the *in situ* nature of the material. The elements **As, Au, Cd, Cu, Ge, Hg, In, Mo, Pb, S, Sb, Se** and **Zn** best define the gossan. One location (Site 7 at 380 m) appears to show consistently lower concentrations than the other two samples located in the gossan zone. Field evidence shows that despite the presence of gossan at site 7, the mineralization is less pervasive and lower grade than at the SE end of the gossan.

***Traverse 2***

Selected elements from the different sample media and for different digests (organics – ashed and dry) and size fractions (<250 µm and <75 µm) are plotted in Figure 9.

The elements **As, Au, Be, Bi, Cd, Cu, In, Mo, Na, Pb, Sb, Te**, and **Zn** show high concentrations at the 75 m and 100 m sample sites which is in accordance with the probable position of buried mineralization. The best target delineation, however, is by **As, Au, Bi, In** and **Sb**. The grade of base metal mineralization beneath Traverse 2 is not known to the authors. It can therefore only be speculated whether the comparatively lower Pb and Zn concentrations at surface reflect lower grades in the primary mineralization or higher mobility of other elements. Whereas Au/Fe, As/Fe and, to a lesser degree, Pb/Fe ratios outline the anomaly, Zn/Fe ratios for A- and B-horizon soils show no anomalism. The ratios for mull clearly outline the anomalies and this may reflect a tendency of plants to selectively take up certain elements.

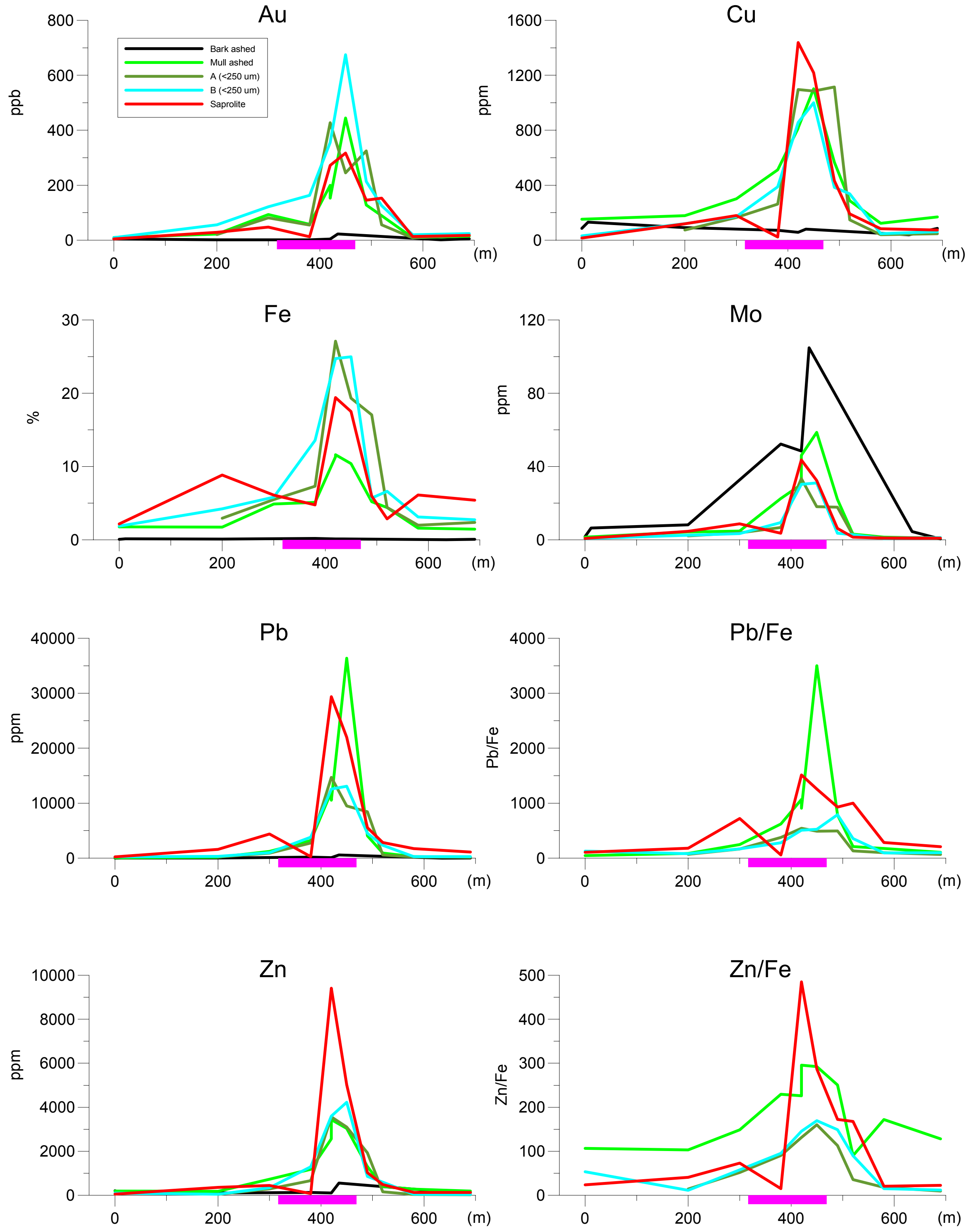


Figure 8. Aripuanã – Traverse 1, element concentrations and Fe ratios in different sample media. The magenta bar marks the gossan.

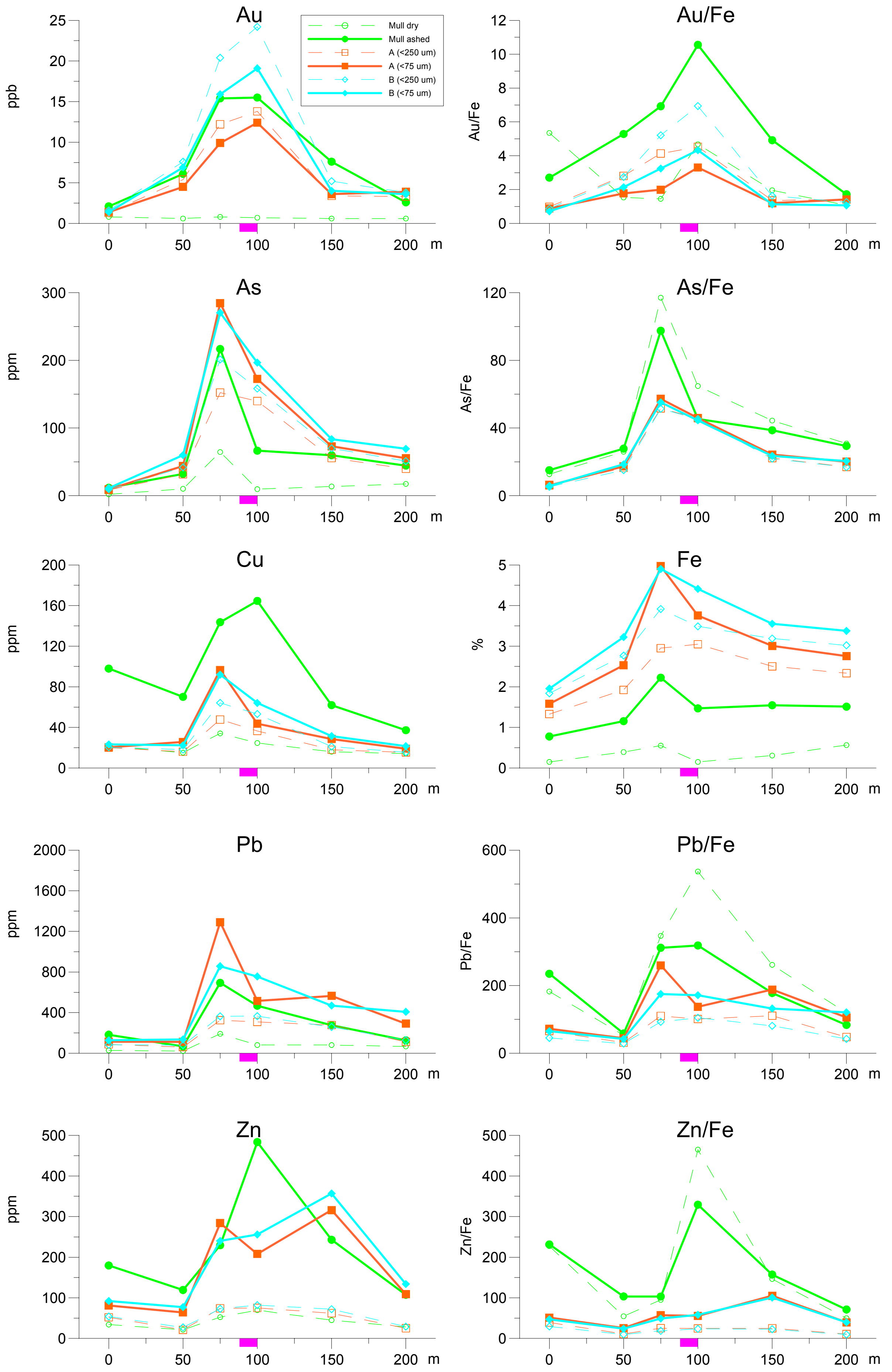


Figure 9. Aripuanã – Traverse 2, element concentrations and Fe ratios in different sample media. The magenta bar marks the gossan.

The comparison between fine and coarse fractions shows that, along Traverse 2, element concentrations in the <75 µm fraction are generally greater than in the <250 µm fraction. Likewise, element concentrations are mostly greater in the A-horizon compared to the B-horizon. A notable exception is Au, which also shows higher concentrations in the coarse fraction. This may be due to a nugget effect.

### 4.8 Rare earth elements

The rare earth elements (REE) La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu, were analysed for soils, dry mull, saprolite and gossan samples. To investigate a possible link between REE and the host rocks of the base metal mineralization and/or alteration zones, normalized La and Lu concentrations and REE patterns are briefly discussed below.

Along Traverse 1, Lu concentrations in A-horizon soil (<75 µm) (Figure 10) appear to show a negative anomaly over the mineralization, whereas La concentrations are higher on and, particularly, either side of the mineralization. Along Traverse 2, La also appears to be show higher concentrations over the mineralised zone. The REE analyses were normalized using an average of post-Archaean shales from Australia (PAAS) (Nance and Taylor, 1976), which approximately reflects the composition of the exposed crust for REE (Taylor and McClennan, 1985).

REE patterns (Figure 11) are shown for Traverses 1 and 2 (no saprolite data). In saprolite (Traverse 1), there are two distinct groups: three samples (200 m, 300 m, 520 m) show light and medium REE-enrichment, all other samples display weak heavy REE-enriched patterns with or without a positive Ce anomaly.

In the soil B-horizon (Traverse 1), four samples (0 m, 200 m, 520 m, 580 m, 690 m) show enriched heavy REE and positive Ce anomalies. The sample from site 10 (0 m) shows very low overall REE concentrations but a similar HREE enriched trend. The second group, (300 m, 380 m, 420 m, 450 m, 490 m) shows flat to weakly enriched medium and light REE patterns with the lowest HREE in samples from the gossan zone. Along Traverse 2, all samples show HREE enriched trends and positive Ce anomalies similar to the first group along Traverse 1.

In the A-horizon along Traverse 1, one group of samples shows dominantly light and medium REE enriched patterns (300 m, 380 m, 420 m, 450 m, 490 m), a second group shows heavy REE-enriched patterns with a positive Ce anomaly (200 m, 520 m, 580 m, 690 m). Along Traverse 2, all samples show HREE enrichment and a positive Ce anomaly, similar to the second group along Traverse 1. However, samples on and close to the mineralized zone show higher LREE and MREE concentrations than samples further away from the mineralization.

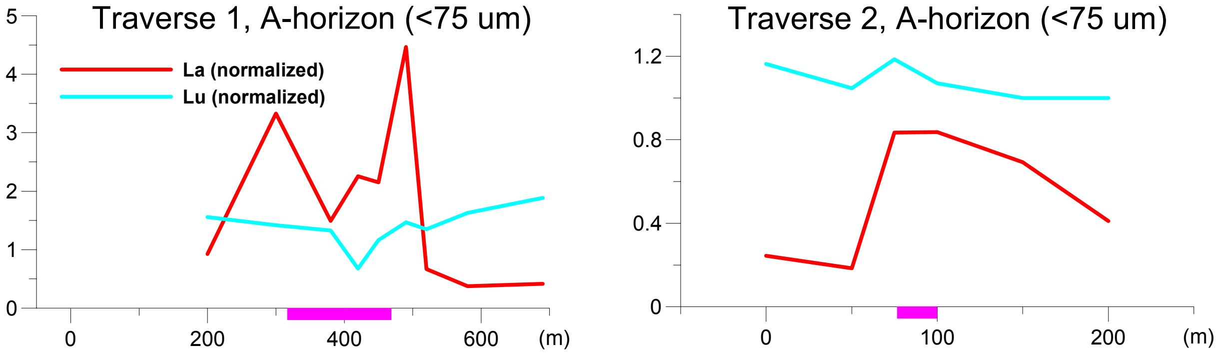


Figure 10. Aripuana – Traverses 1 and 2, normalized (PAAS) La and Lu concentrations in A-horizon soil.

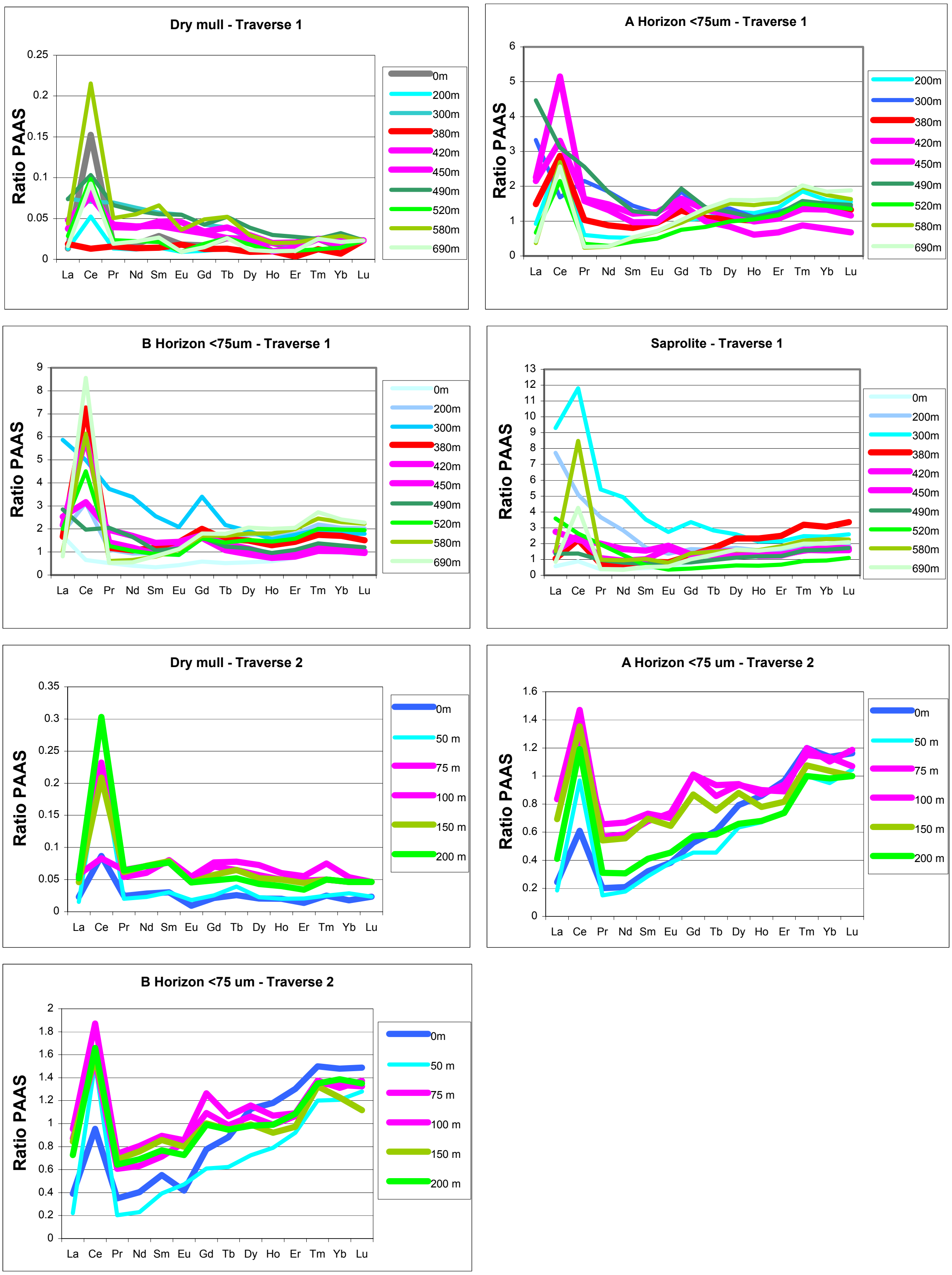


Figure 11. Aripuanã - Traverse 1, REE patterns in different sample media

In the dry mull, all REE patterns are relatively flat but show a positive Ce anomaly. Along both traverses is a weak trend towards LREE and MREE enriched patterns with samples from 300 m, 420 m, 450 m, 490 m and 580 m (Traverse 1) and samples 75 m, 100 m, 150 m and 200 m showing slightly higher overall concentrations of REE. The differences in total REE concentrations may be attributed to the varying amounts of clay inadvertently sampled with the mull.

# 5 CONCLUSIONS

1. Anomalies in all sample media (bark, mull, soil A-horizon, soil B-horizon and saprolite) outline the mineralised zones along Traverses 1 and 2 (proviso: there are no imbauba trees along Traverse 2 and, consequently, no bark assays are available for that traverse).

2. The anomaly to background ratios for target-specific elements are generally highest in the A-horizon, followed by ratios in the B-horizon and mull (ashed). The lowest ratios occur in the saprolite zone. The A-horizon is therefore the preferred soil sample medium.

3. The optimum grain size of soil samples depends on the sampling area. Around outcropping gossans, such as at the Aripuanã prospect, coarser samples will enhance the magnitude of an anomaly due to detrital fragments of gossan that occur at or near surface. These fragments may, however, be derived from so-called 'false gossans', such as the Killara pseudo-gossan (Butt, 1979), and mislead exploration. In regional exploration, finer size fractions are more likely to detect subtle anomalies associated with disseminated mineralization or enrichment in wall rocks, and tend to be more reliable; they are therefore preferable to coarse size fractions.

4. Mull shows well-defined multi-element anomalies along both traverses and therefore appears to be a potential alternative sample medium for the Aripuanã prospect area that has the following advantages compared to soil samples:
   - It is easier and quicker to collect although care must be taken to minimize contamination with A-horizon soil;
   - A sample (1-2 L volume) can easily be gathered over a 10-50 m$^2$ area (or larger), making it more representative than a soil sample taken from an approximately 300x300 mm area.

   Further work is required to substantiate these findings.

5. The potential of bark sampling for exploration cannot be assessed, based on the small number of samples taken from only one tree species. However, bark sampling may have an application in testing for concealed mineralization.

6. An element suite of Ag, As, Au, Cd, Co, Cu, Fe, In, Mn, Mo, Pb, Sb, Se, Tl and Zn, best detects mineralization in soil at Aripuanã.

7. Rare earth element patterns in the A- and B-horizons appear to differ between samples close to and on mineralization, and those further away (background). Distal samples show enrichment of heavy REE, proximal samples show enriched medium and light REE. This may reflect host rock alteration. On a prospect scale, the REE patterns of soil may assist geological mapping and better delineate prospective zones in areas of cover.

# 6 RECOMMENDATIONS

1. Further investigate the use of bark, leaves and twigs of different tree and plant species for detecting concealed base metal mineralization.

2. Consider the use of mull as an alternative sampling medium to soil.

3. The A-horizon soil shows the strongest anomaly to background contrast and is therefore the preferred inorganic sample medium.

4. The optimum grain size of soil samples depends on the survey area. In and around the Aripuanã prospect, coarse fractions are suitable because of the presence of detrital fragments of gossan. Elsewhere, finer fractions are preferable because of higher target element concentrations and better sample homogeneity.

## 7 ACKNOWLEDGEMENTS

We would like to thank Anglo American plc for financial support of the project and, in particular, Dr Christopher J. Oates of Anglo American plc for inviting the research team to Aripuanã.

Dr Lucio Molinari of Anglo American Brazil Ltda provided local logistics and travel to Aripuanã. Sebastion Lira provided assistance and geological knowledge on site. Fernando Barbosa Dos Santos and Vilmar Burdulis assisted with soil and vegetation sampling. Fabio Soares and Roque Coelho provided information and organized the sample transport to Vancouver. All geochemical and biogeochemical analyses were done by ACME Laboratories in Vancouver, Canada. Travis Naughton of CRC LEME prepared the figures and Helena Hink formatted the text. Melvyn J. Lintern and Dr Ian D.M. Robertson reviewed the manuscript. All this assistance is acknowledged with appreciation.

## 8 REFERENCES

Almeida, F.F.M., 1974. Evolucao Tectonica do Craton do Guarore Comparada com o Escudo Baltico. Revista Brasileira de Geosciencias, 4: 191-204.

Butt, C.R.M., 1979. Geochemistry of a pseudo-gossan developed on a black shale-dolerite contact, Killara, Western Australia. Journal of Geochemical Exploration, 11: 131-156.

Butt, C.R.M., 1995. Geochemical exploration for base metals in deeply weathered terrain. Australian Institute of Geoscientists Bulletin, 16: 17-31.

Dunn, C.E. and Angelica, R.S., 2000. Evaluation of biogeochemistry as a tool in mineral exploration and in monitoring environmental mercury dispersion in the Tapajos Gold District, Amazonia, Brazil. Geological Survey of Canada, open file 3838, unpublished.

Dunn, C., Erdmann, J., Hall, G. and Smith, S.C., 1992. Biochemical exploration simplified. Notes for a short course on methods of biogeochemical and geobotanical prospecting – with emphasis on arid terrains. The Association of Exploration Geochemists, Phoenix, Arizona, 22-23 February, 1992.

Hall, G.E.M., 1999. "Near-total " Acid Digestions. Explore, 104: 15-19.

Nance, W.B. and Taylor, S.R., 1976. Rare earth element patterns and crustal evolution-I. Australian post-Archean sedimentary rocks. Geochimica et Cosmochimica Acta, 40: 1539.

Neder, R.D., Figueiredo, B.R., Beaudry, C, Collins, C. and Dexheimer Leite, J.A., 2000. The Expedito massive sulphide deposit, Mato Grosso. Revista Brasileira de Geosciencias, 30: 222-225.

Santos, J.O.S., Hartman, L.A., Gaudette, H.E., Groves, D.I., McNaughton, N.J. and Fletcher, I.R.., 2000. A new understanding of the provinces of the Amazon Craton based on integration of field mapping and U-Pb and Sm-Nd geochronology. Gondwana Research, 3: 453-488.

Taylor, G.F. and Thornber, M.R., 1992. Gossan formation and gossan surveys. In C.R.M. Butt and H. Zeegers (Editors), Regolith Exploration Geochemistry in Tropical and Subtropical Terrains. Handbook of Exploration Geochemistry, 4: 115-202.

Taylor, S.R. and McClennan, S.M., 1985. The Continental Crust: its composition and evolution. Geoscience texts, Blackwell Scientific Publications, Oxford, London, 312pp.

# Appendix 1

## Main and trace element analyses of soil samples, gossan and drill core chips (Fex 6) (File ‘Inorganic analytical data.xls’ on CD)

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ACME Laboratories Vancouver | | | Method: | | | 4AWR | 4AWR | 4AWR | 4AWR | 4AWR | 4AWR | 4AWR | 4AWR | 4AWR | 4AWR | 4AWR | 4AWR | 4AWR | 4AWR | 4ALO | 4ALC | 4ALC | 4AWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR |
| John Gravel | | | Digestion: | | | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | - | - | - | - | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 |
| Nov/Dec 2001 | | | Acid / Strength: | | | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | - | - | - | - | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 |
| | | | Sample Wt (grams): | | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 1 | 0.1 | 0.1 | - | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | | | Units: | | | % | % | % | % | % | % | % | % | % | % | % | ppm | ppm | ppm | % | % | % | % | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | Det. Lim: | | | 0.02 | 0.03 | 0.04 | 0.01 | 0.01 | 0.01 | 0.04 | 0.01 | 0.01 | 0.01 | 0.001 | 5 | 20 | 1 | 0.1 | 0.01 | 0.01 | - | 0.5 | 0.1 | 0.5 | 0.5 | 0.5 | 0.5 |
| | | | Upper Lim: | | | 100 | 100 | 100 | 50 | 60 | 50 | 50 | 50 | 50 | 50 | 40 | 4E+05 | 10000 | 500 | 99 | 50 | 40 | - | 10000 | 5000 | 5000 | 5000 | 5000 | 5000 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sample site | Material | Location | Sample no | ACME batch no | Sample weight (g) | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | Cr2O3 % | Ba ppm | Ni ppm | Sc ppm | LOI % | TOT/C % | TOT/S % | SUM % | Co ppm | Cs ppm | Ga ppm | Hf ppm | Nb ppm | Rb ppm |
| Traverse 1 | Saprolite | 420 | 90860 | A150092A | 0.2 | 27.90 | 21.98 | 27.76 | <.01 | 0.08 | 0.09 | 0.04 | 0.68 | 0.18 | 5.32 | 0.001 | 252 | 20 | 12 | 13.0 | 0.08 | 0.01 | 97.07 | 58.3 | <.1 | 34.7 | 9.4 | 21.5 | 1.6 |
| Traverse 1 | Saprolite | 450 | 90867 | A150092A | 0.2 | 45.57 | 14.26 | 25.03 | 0.03 | 0.09 | 0.09 | <.02 | 0.39 | 0.18 | 2.57 | <.001 | 23 | 23 | 9 | 9.9 | 0.17 | 0.01 | 98.12 | 42.2 | <.1 | 20.6 | 5.5 | 11.5 | 3.1 |
| Traverse 1 | Saprolite | 490 | 90873 | A150092A | 0.2 | 58.23 | 18.96 | 8.53 | 0.90 | 0.02 | 0.05 | 3.88 | 0.62 | 0.16 | 0.40 | 0.001 | 1003 | <20 | 17 | 7.5 | 0.24 | <.01 | 99.36 | 11.0 | 0.9 | 24.8 | 7.8 | 16.4 | 107.1 |
| Traverse 1 | Saprolite | 520 | 90875 | A150092A | 0.2 | 78.93 | 10.55 | 4.09 | 0.32 | 0.02 | 0.04 | 1.46 | 0.16 | 0.08 | 0.10 | 0.001 | 569 | <20 | 6 | 3.9 | 0.04 | <.01 | 99.72 | 2.3 | 0.2 | 8.5 | 3.7 | 8.0 | 32.4 |
| Traverse 1 | Saprolite | 580 | 90878 | A150092A | 0.2 | 61.30 | 18.10 | 8.73 | 0.60 | 0.02 | 0.05 | 2.32 | 0.47 | 0.07 | 0.43 | 0.003 | 1479 | <20 | 13 | 7.3 | 0.19 | <.01 | 99.56 | 10.8 | 0.5 | 23.0 | 7.5 | 15.6 | 43.7 |
| Traverse 1 | Saprolite | 690 | 90882 | A150092A | 0.2 | 59.11 | 19.96 | 7.75 | 1.01 | 0.01 | 0.06 | 4.19 | 0.34 | <.01 | 0.18 | 0.003 | 1514 | <20 | 15 | 6.9 | 0.27 | <.01 | 99.68 | 4.0 | 1.0 | 24.0 | 9.0 | 20.6 | 99.0 |
| REPEAT | | | 90882 | A150092A | 0.2 | 59.26 | 20.03 | 7.93 | 1.02 | 0.01 | 0.05 | 4.26 | 0.34 | <.01 | 0.18 | <.001 | 1515 | <20 | 15 | 6.6 | 0.29 | <.01 | 99.86 | 3.8 | 0.9 | 25.1 | 9.2 | 22.4 | 99.4 |
| Traverse 1 | Saprolite | 380 | 90886 | A150092A | 0.2 | 60.68 | 20.02 | 6.83 | 0.63 | 0.01 | 0.04 | 2.67 | 0.41 | 0.01 | 0.20 | 0.002 | 727 | <20 | 17 | 8.4 | 0.49 | <.01 | 99.99 | 6.0 | 0.7 | 27.8 | 12.9 | 28.0 | 86.3 |
| Traverse 1 | Saprolite | 300 | 90891 | A150092A | 0.2 | 58.93 | 18.35 | 8.70 | 1.01 | 0.03 | 0.09 | 5.00 | 0.51 | 0.22 | 0.76 | <.001 | 1403 | <20 | 16 | 6.0 | 0.14 | <.01 | 99.76 | 21.6 | 1.0 | 22.6 | 8.1 | 18.5 | 133.3 |
| Traverse 1 | Saprolite | 200 | 90895 | A150092A | 0.2 | 56.87 | 18.63 | 12.64 | 0.70 | 0.02 | 0.08 | 3.42 | 0.45 | 0.17 | 0.26 | <.001 | 1001 | <20 | 14 | 6.3 | 0.11 | <.01 | 99.65 | 5.2 | 0.6 | 22.5 | 7.8 | 18.0 | 84.9 |
| Traverse 1 | Saprolite | 0 | 90899 | A150092A | 0.2 | 62.76 | 20.56 | 3.09 | 1.36 | <.01 | 0.08 | 5.83 | 0.33 | 0.01 | 0.19 | 0.004 | 1102 | <20 | 12 | 5.7 | 0.21 | <.01 | 100.05 | 2.7 | 1.2 | 24.3 | 9.0 | 19.7 | 175.5 |
| STANDARD SO17/CSB | | | | A150092A | 0.2 | 61.49 | 14.02 | 5.83 | 2.35 | 4.67 | 4.10 | 1.38 | 0.62 | 0.95 | 0.52 | 0.434 | 400 | 29 | 24 | 3.4 | 2.43 | 5.37 | 99.81 | 18.3 | 3.7 | 19.1 | 11.6 | 24.9 | 22.7 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Traverse 1 | Saprolite/Gossan | 420 | 90861 | A150092B | 0.2 | 2.35 | 0.51 | 86.09 | 0.01 | 0.02 | 0.01 | 0.02 | <.01 | 0.10 | 0.36 | <.001 | 14 | <20 | 1 | 7.9 | 0.04 | 0.17 | 97.38 | 5.8 | <.1 | 1.0 | <.5 | <.5 | 0.7 |
| Traverse 1 | Saprolite/Gossan | 420 | 90862 | A150092B | 0.2 | 4.52 | 3.65 | 74.76 | <.01 | 0.05 | 0.04 | 0.04 | 0.13 | 0.69 | 2.25 | <.001 | 53 | <20 | 4 | 10.6 | 0.10 | 0.27 | 96.74 | 15.3 | <.1 | 7.8 | 1.6 | 3.5 | 0.5 |
| Traverse 1 | Saprolite/Gossan | 420 | 90863 | A150092B | 0.2 | 0.85 | 0.51 | 87.86 | <.01 | 0.02 | 0.01 | 0.02 | <.01 | 0.12 | 0.19 | <.001 | 17 | <20 | 2 | 7.9 | 0.04 | 0.39 | 97.48 | 1.9 | <.1 | 3.7 | <.5 | <.5 | <.5 |
| Traverse 1 | Saprolite/Gossan | 450 | 90864 | A150092B | 0.2 | 44.59 | 0.40 | 46.34 | <.01 | 0.01 | 0.01 | <.02 | 0.01 | 0.08 | 0.10 | <.001 | 28 | <20 | 1 | 6.6 | 0.07 | 0.08 | 98.16 | 2.9 | <.1 | 1.1 | <.5 | 1.7 | 0.5 |
| Traverse 1 | Saprolite/Gossan | 450 | 90865 | A150092B | 0.2 | 3.47 | 2.73 | 76.74 | <.01 | 0.01 | 0.02 | 0.04 | 0.15 | 0.54 | 1.19 | <.001 | 12 | <20 | 2 | 10.4 | 0.08 | 0.84 | 95.29 | 24.5 | <.1 | 11.0 | 2.1 | 7.4 | 2.0 |
| Traverse 1 | Saprolite/Gossan | 380 | 90890 | A150092B | 0.2 | 2.06 | 1.20 | 87.80 | <.01 | 0.01 | 0.01 | 0.12 | 0.05 | 0.58 | 0.07 | <.001 | 22 | <20 | 2 | 7.5 | 0.03 | 0.63 | 99.40 | 2.6 | <.1 | 5.7 | <.5 | 4.1 | 1.0 |
| STANDARD SO17/CSB | | | | A150092B | 0.2 | 61.65 | 13.77 | 5.85 | 2.35 | 4.68 | 4.12 | 1.40 | 0.64 | 0.98 | 0.53 | 0.435 | 401 | 30 | 21 | 3.4 | 2.43 | 5.37 | 99.85 | 18.8 | 4.0 | 20.2 | 12.0 | 24.8 | 22.8 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Costeans | Gossan outcrop | | A001 | A150092C | 0.2 | 6.20 | 1.08 | 82.02 | <.01 | 0.01 | 0.02 | 0.03 | 0.01 | 0.03 | 0.08 | <.001 | 9 | <20 | <1 | 8.7 | 0.42 | 0.01 | 98.18 | 8.2 | <.1 | 4.3 | <.5 | <.5 | 3.3 |
| Costeans | Gossan outcrop | | A002 | A150092C | 0.2 | 3.33 | 1.34 | 78.52 | 0.44 | 0.01 | 0.02 | 0.04 | 0.02 | 0.13 | 1.28 | <.001 | 105 | <20 | 1 | 12.7 | 0.10 | 0.04 | 97.84 | 29.6 | <.1 | 2.6 | <.5 | <.5 | 2.4 |
| Costeans | Gossan outcrop | | A004 | A150092C | 0.2 | 5.08 | 1.90 | 73.98 | <.01 | 0.01 | 0.02 | 0.05 | 0.01 | 0.20 | 2.57 | <.001 | 237 | <20 | 1 | 12.7 | 0.19 | 0.01 | 96.55 | 39.0 | <.1 | 3.4 | <.5 | 0.6 | 1.9 |
| Costeans | Gossan outcrop | | A005 | A150092C | 0.2 | 14.84 | 4.36 | 66.68 | <.01 | 0.02 | 0.03 | 0.05 | 0.07 | 0.22 | 3.25 | <.001 | 117 | <20 | 4 | 7.7 | 0.06 | 0.19 | 97.24 | 26.4 | <.1 | 9.7 | 1.9 | 4.0 | 3.1 |
| STANDARD SO17/CSB | | | | A150092C | 0.2 | 61.49 | 14.02 | 5.83 | 2.35 | 4.67 | 4.10 | 1.38 | 0.62 | 0.95 | 0.52 | 0.434 | 400 | 29 | 24 | 3.4 | 2.43 | 5.37 | 99.81 | 18.3 | 3.7 | 19.1 | 11.6 | 26.1 | 22.7 |

Appendix 1.3 Aripuana - analytical results - Saprolite (Traverse 1) and gossan outcrops/costeans

| ACME Laboratories Vancouver | | | Method: | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BWR | 4BTD | 4BTD | 4BTD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| John Gravel | | | Digestion: | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | LiBO2 | HCl-Hf-HCLO 4- | HCl-Hf-HCLO 4- | HCl-Hf-HCLO 4- |
| Nov/Dec 2001 | | | Acid / Strength | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 18:10:3:6 | 18:10:3:6 | 18:10:3:6 |
| | | | Sample Wt | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.25 | 0.25 | 0.25 |
| | | | Units: | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | Det. Lim: | 1 | 0.5 | 0.1 | 0.1 | 0.1 | 0.1 | 5 | 1 | 0.5 | 0.1 | 0.5 | 0.5 | 0.02 | 0.4 | 0.1 | 0.05 | 0.05 | 0.01 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.01 | 0.5 | 1 | 3 |
| | | | Upper Lim: | 1000 | 5000 | 500 | 1000 | 1000 | 1000 | 10000 | 1000 | 5000 | 5000 | 5000 | 5000 | 500 | 1000 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 4000 | 10000 | 10000 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sample site | Material | Location | Sample no | Sn | Sr | Ta | Th | Tl | U | V | W | Zr | Y | La | Ce | Pr | Nd | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu | Mo | Cu | Pb |
| | | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| Traverse 1 | Saprolite | 420 | 90860 | <1 | 12.1 | 1.3 | 19.3 | 1.4 | 26.5 | 99 | 7 | 310.8 | 38.5 | 56.4 | 199.6 | 9.63 | 29.4 | 5.7 | 1.84 | 6.00 | 0.98 | 5.58 | 1.26 | 3.79 | 0.62 | 4.89 | 0.73 | 43.6 | 1846 | 29378 |
| Traverse 1 | Saprolite | 450 | 90867 | 2.0 | 2.1 | 0.8 | 10.9 | 0.6 | 33.9 | 52 | 13 | 196.1 | 34.6 | 104.3 | 178.2 | 17.81 | 53.0 | 8.7 | 2.05 | 6.23 | 1.14 | 6.76 | 1.22 | 3.62 | 0.64 | 4.38 | 0.68 | 32.4 | 1551 | 22009 |
| Traverse 1 | Saprolite | 490 | 90873 | 3.0 | 3.4 | 1.0 | 15.4 | 0.8 | 10.4 | 64 | 10 | 282.0 | 37.0 | 51.6 | 110.3 | 8.67 | 25.9 | 4.0 | 0.89 | 3.84 | 0.75 | 4.92 | 1.20 | 3.52 | 0.63 | 4.47 | 0.74 | 6.2 | 438 | 5549 |
| Traverse 1 | Saprolite | 520 | 90875 | <1 | 2.2 | 0.5 | 9.2 | 0.4 | 2.9 | 10 | 3 | 115.7 | 17.8 | 136.0 | 211.1 | 17.40 | 40.7 | 3.5 | 0.40 | 2.02 | 0.40 | 2.77 | 0.61 | 1.93 | 0.36 | 2.61 | 0.47 | 1.5 | 210 | 2864 |
| Traverse 1 | Saprolite | 580 | 90878 | <1 | 23.8 | 1.1 | 16.3 | 0.4 | 5.9 | 39 | 4 | 255.6 | 46.1 | 58.2 | 678.5 | 8.70 | 30.3 | 5.8 | 0.87 | 6.56 | 1.15 | 6.91 | 1.59 | 5.31 | 0.88 | 6.42 | 0.97 | 0.9 | 110 | 1750 |
| Traverse 1 | Saprolite | 690 | 90882 | 3.0 | 3.1 | 1.2 | 22.9 | 0.6 | 4.9 | 9 | 6 | 309.5 | 50.0 | 32.5 | 340.4 | 3.57 | 10.8 | 2.9 | 0.61 | 4.75 | 1.00 | 7.14 | 1.55 | 4.94 | 0.80 | 5.61 | 0.90 | 0.9 | 97 | 1129 |
| REPEAT | | | 90882 | 2.0 | 2.9 | 1.3 | 20.6 | 0.5 | 7.2 | 10 | 6 | 315.4 | 52.2 | 32.3 | 368.1 | 3.36 | 10.8 | 3.2 | 0.61 | 4.89 | 1.01 | 6.93 | 1.62 | 5.10 | 0.82 | 5.87 | 0.94 | 0.8 | 95 | 1117 |
| Traverse 1 | Saprolite | 380 | 90886 | 2.0 | 7.6 | 1.9 | 27.6 | 0.4 | 5.8 | 14 | 5 | 456.4 | 73.0 | 39.6 | 179.6 | 6.38 | 22.7 | 4.9 | 0.90 | 5.90 | 1.32 | 10.25 | 2.32 | 7.21 | 1.28 | 8.55 | 1.44 | 3.6 | 33 | 275 |
| Traverse 1 | Saprolite | 300 | 90891 | 4.0 | 67.1 | 1.7 | 19.9 | 0.7 | 10.9 | 48 | 10 | 267.0 | 70.9 | 353.2 | 944.5 | 48.28 | 157.5 | 19.7 | 3.01 | 15.81 | 2.18 | 11.40 | 2.13 | 6.21 | 0.99 | 6.83 | 1.11 | 8.7 | 193 | 4398 |
| Traverse 1 | Saprolite | 200 | 90895 | 1.0 | 24.5 | 1.2 | 15.9 | 0.3 | 6.0 | 33 | 8 | 261.6 | 48.1 | 293.9 | 407.7 | 32.58 | 90.9 | 9.8 | 1.49 | 7.78 | 1.24 | 7.61 | 1.57 | 4.56 | 0.77 | 5.18 | 0.84 | 4.7 | 135 | 1612 |
| Traverse 1 | Saprolite | 0 | 90899 | 3.0 | 9.5 | 1.4 | 24.8 | 0.4 | 5.2 | 15 | 4 | 289.1 | 36.6 | 21.6 | 71.1 | 3.33 | 13.0 | 2.6 | 0.57 | 3.73 | 0.82 | 5.45 | 1.21 | 3.61 | 0.68 | 4.52 | 0.76 | 0.8 | 18 | 231 |
| STANDARD SO17/CSB | | | | 9.0 | 304.2 | 4.1 | 10.3 | 0.4 | 11.6 | 126 | 11 | 339.4 | 27.5 | 10.0 | 22.8 | 2.83 | 13.6 | 2.9 | 1.02 | 3.67 | 0.65 | 4.04 | 0.94 | 2.68 | 0.41 | 2.88 | 0.45 | 10.6 | 128 | 40 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Traverse 1 | Saprolite/Gossan | 420 | 90861 | <1 | 0.6 | <.1 | 0.4 | 0.4 | 8.8 | 29 | 2 | 1.8 | 3.7 | 6.9 | 12.4 | 1.87 | 6.8 | 1.4 | 0.43 | 1.35 | 0.19 | 1.06 | 0.17 | 0.44 | 0.08 | 0.61 | 0.08 | 24.8 | 478 | 10912 |
| Traverse 1 | Saprolite/Gossan | 420 | 90862 | 5.0 | 4.1 | 0.2 | 2.6 | 0.4 | 18.3 | 58 | 5 | 50.7 | 15.1 | 177.6 | 198.9 | 40.72 | 121.7 | 15.7 | 3.13 | 9.89 | 1.14 | 4.98 | 0.68 | 1.61 | 0.25 | 1.64 | 0.24 | 51.4 | 1257 | 26838 |
| Traverse 1 | Saprolite/Gossan | 420 | 90863 | 3.0 | 0.6 | <.1 | 0.4 | 0.5 | 10.3 | 52 | <1 | 3.2 | 5.1 | 21.2 | 92.0 | 5.46 | 15.7 | 3.0 | 0.64 | 2.38 | 0.32 | 1.57 | 0.24 | 0.70 | 0.12 | 0.80 | 0.11 | 32.4 | 330 | 7967 |
| Traverse 1 | Saprolite/Gossan | 450 | 90864 | <1 | <.5 | <.1 | 0.3 | 0.3 | 16.3 | 8 | 3 | 4.6 | 4.8 | 9.7 | 8.0 | 2.55 | 8.4 | 2.0 | 0.68 | 1.45 | 0.25 | 1.25 | 0.21 | 0.57 | 0.08 | 0.60 | 0.10 | 14.9 | 471 | 3291 |
| Traverse 1 | Saprolite/Gossan | 450 | 90865 | 5.0 | 1.6 | 0.5 | 1.8 | 0.3 | 36.1 | 71 | 3 | 70.1 | 12.7 | 261.8 | 75.9 | 50.58 | 132.6 | 9.9 | 1.90 | 3.44 | 0.66 | 3.48 | 0.56 | 1.66 | 0.27 | 1.89 | 0.26 | 78.2 | 1156 | 34331 |
| Traverse 1 | Saprolite/Gossan | 380 | 90890 | 1.0 | 1.6 | 0.3 | 0.7 | 0.1 | 6.6 | 74 | <1 | 16.0 | 6.8 | 112.2 | 25.5 | 19.93 | 56.3 | 5.6 | 0.68 | 2.25 | 0.34 | 1.68 | 0.30 | 0.70 | 0.13 | 0.76 | 0.11 | 126.8 | 157 | 26827 |
| STANDARD SO17/CSB | | | | 9.0 | 314.6 | 4.3 | 10.7 | 0.8 | 11.5 | 129 | 11 | 369.1 | 26.5 | 10.1 | 23.7 | 3.02 | 13.8 | 3.3 | 1.05 | 3.86 | 0.63 | 4.15 | 0.88 | 2.72 | 0.46 | 2.89 | 0.45 | 10.6 | 128 | 40 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Costeans | Gossan outcrop | | A001 | 2.0 | 0.9 | <.1 | 0.2 | 0.1 | 2.3 | 11 | 29 | 2.5 | 36.5 | 4.0 | 2.3 | 3.32 | 19.7 | 7.1 | 1.62 | 7.41 | 1.15 | 6.62 | 1.26 | 3.40 | 0.49 | 2.55 | 0.41 | 17.8 | 2458 | 2585 |
| Costeans | Gossan outcrop | | A002 | <1 | 4.2 | <.1 | 1.0 | 0.3 | 2.8 | 7 | 20 | 12.5 | 25.4 | 11.8 | 24.2 | 4.40 | 22.0 | 6.5 | 1.59 | 5.77 | 0.98 | 6.09 | 1.12 | 2.96 | 0.49 | 3.13 | 0.49 | 20.9 | 2311 | 12883 |
| Costeans | Gossan outcrop | | A004 | <1 | 1.8 | <.1 | 0.3 | 2.0 | 26.2 | 5 | 67 | 6.9 | 12.4 | 4.0 | 30.5 | 2.78 | 13.7 | 5.1 | 1.42 | 3.53 | 0.60 | 3.40 | 0.57 | 1.61 | 0.28 | 1.85 | 0.23 | 13.3 | 3879 | 14702 |
| Costeans | Gossan outcrop | | A005 | <1 | 4.7 | 0.3 | 3.7 | 0.2 | 20.3 | 23 | 3 | 62.1 | 16.1 | 168.6 | 324.7 | 24.88 | 70.6 | 9.0 | 1.84 | 4.75 | 0.77 | 3.98 | 0.62 | 1.65 | 0.29 | 1.86 | 0.26 | 81.1 | 2046 | 27683 |
| STANDARD SO17/CSB | | | | 9.0 | 304.2 | 4.1 | 10.3 | 0.4 | 11.6 | 126 | 11 | 339.4 | 27.5 | 10.0 | 22.8 | 2.83 | 12.9 | 2.9 | 1.02 | 3.67 | 0.65 | 4.04 | 0.94 | 2.68 | 0.41 | 2.88 | 0.45 | 10.6 | 128 | 40 |

Appendix 1.3   Aripuana - analytical results - Saprolite (Traverse 1) and gossan outcrops/costeans

| ACME Laboratories Vancouver | | | Method: | 4BTD | 4BTD | 4BTD | 4BTD | 4BTD | 4BTD | 4BTD | | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| John Gravel | | | Digestion: | HCl-Hf-HCLO4- | HCl-Hf-HCLO4- | HCl-Hf-HCLO4- | HCl-Hf-HCLO4- | HCl-Hf-HCLO4- | HCl-Hf-HCLO4- | HCl-Hf-HCLO4- | | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O |
| Nov/Dec 2001 | | | Acid / Strengtl | 18:10:3:6 | 18:10:3:6 | 18:10:3:6 | 18:10:3:6 | 18:10:3:6 | 18:10:3:6 | 18:10:3:6 | | 2:02:02 | 0 | 0 | 0 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 |
| | | | Sample Wt | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| | | | Units: | ppm | ppm | ppm | ppm | ppm | ppm | ppm | | ppm | ppm | ppm | ppm | ppb | ppm | ppm | ppm | % | ppm | ppm | ppb | ppm | ppm | ppm | ppm | ppm | ppm | % |
| | | | Det. Lim: | 2 | 1 | 2 | 0.2 | 1 | 1 | 0.5 | | 0.01 | 0 | 0 | 0 | 2 | 0.1 | 0.1 | 1 | 0.01 | 0.1 | 0.1 | 0.2 | 0.1 | 0.5 | 0.01 | 0.02 | 0.02 | 2 | 0.01 |
| | | | Upper Lim: | 10000 | 10000 | 10000 | 4000 | 4000 | 4000 | 200 | | 2000 | 10000 | 10000 | 10000 | 1E+05 | 10000 | 2000 | 10000 | 40 | 10000 | 2000 | 1E+05 | 2000 | 10000 | 2000 | 2000 | 2000 | 10000 | 40 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sample site | Material | Location | Sample no | Zn | Ni | As | Cd | Sb | Bi | Ag | Sample | Mo | Cu | Pb | Zn | Ag | Ni | Co | Mn | Fe | As | U | Au | Th | Sr | Cd | Sb | Bi | V | Ca |
| | | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | Wt. gra | ppm | ppm | ppm | ppm | ppb | ppm | ppm | ppm | % | ppm | ppm | ppb | ppm | ppm | ppm | ppm | ppm | ppm | % |
| Traverse 1 | Saprolite | 420 | 90860 | 9414 | 17 | 850 | 6.3 | 56 | 2 | 3.5 | 30.0 | 37.78 | 1438 | 23261 | 6648 | 3783 | 21.8 | 71.9 | 42685 | 17.78 | 680.0 | 19.5 | 271.8 | 13.5 | 6.2 | 6.07 | 45.54 | 1.91 | 101 | <.01 |
| Traverse 1 | Saprolite | 450 | 90867 | 5020 | 9 | 1828 | 1.1 | 303 | 1 | 0.9 | 30.0 | 28.71 | 1218 | 18509 | 3930 | 541 | 13.2 | 49.0 | 21785 | 16.30 | 1559.0 | 26.5 | 317.1 | 7.9 | <.5 | 0.86 | 237.78 | 0.71 | 56 | <.01 |
| Traverse 1 | Saprolite | 490 | 90873 | 1028 | 4 | 846 | 0.6 | 57 | <1 | 2.7 | 30.0 | 5.52 | 433 | 4975 | 886 | 644 | 4.3 | 14.1 | 3423 | 5.13 | 726.3 | 7.4 | 145.4 | 9.8 | 0.8 | 0.42 | 40.33 | 0.67 | 21 | <.01 |
| Traverse 1 | Saprolite | 520 | 90875 | 480 | 1 | 595 | 0.2 | 30 | 1 | 2.8 | 30.0 | 1.01 | 191 | 2445 | 311 | 220 | 1.5 | 3.2 | 790 | 2.46 | 436.6 | 2.1 | 153.1 | 5.7 | 0.5 | 0.15 | 22.85 | 1.13 | 7 | <.01 |
| Traverse 1 | Saprolite | 580 | 90878 | 124 | 4 | 174 | 0.2 | 3 | 3 | 1.8 | 30.0 | 0.99 | 84 | 1767 | 83 | 1655 | 0.8 | 14.1 | 3778 | 5.55 | 141.3 | 1.2 | 13.7 | 11.6 | 11.3 | 0.12 | 2.52 | 2.59 | 26 | <.01 |
| Traverse 1 | Saprolite | 690 | 90882 | 121 | 1 | 64 | <.2 | 3 | 4 | 1.3 | 30.0 | 0.63 | 74 | 1073 | 36 | 554 | 0.4 | 5.5 | 1486 | 4.64 | 54.6 | 1.8 | 17.4 | 14.1 | 0.5 | <.01 | 2.17 | 2.80 | 5 | <.01 |
| REPEAT | | | 90882 | 119 | 2 | 63 | <.2 | 3 | 3 | 1.3 | 30.0 | 0.64 | 70 | 1033 | 35 | 558 | 0.4 | 5.4 | 1430 | 4.47 | 50.1 | 1.8 | 17.0 | 14.0 | <.5 | <.01 | 2.15 | 2.82 | 5 | <.01 |
| Traverse 1 | Saprolite | 380 | 90886 | 71 | 4 | 204 | <.2 | 11 | 2 | 0.7 | 30.0 | 2.65 | 23 | 218 | 42 | 380 | 1.6 | 6.6 | 1608 | 4.07 | 160.8 | 1.2 | 12.4 | 15.2 | 0.9 | 0.06 | 7.26 | 1.41 | 8 | <.01 |
| Traverse 1 | Saprolite | 300 | 90891 | 444 | 3 | 515 | 0.4 | 27 | <1 | 2.1 | 30.0 | 8.03 | 180 | 3918 | 395 | 1453 | 2.9 | 27.6 | 6250 | 5.17 | 407.1 | 6.2 | 47.9 | 15.9 | 13.3 | 0.43 | 20.96 | 0.32 | 20 | 0.01 |
| Traverse 1 | Saprolite | 200 | 90895 | 358 | 3 | 170 | 0.3 | 6 | <1 | 0.7 | 30.0 | 4.42 | 120 | 1355 | 312 | 237 | 1.3 | 6.8 | 2460 | 7.42 | 146.6 | 3.1 | 28.3 | 11.3 | 4.5 | 0.24 | 5.10 | 0.49 | 15 | <.01 |
| Traverse 1 | Saprolite | 0 | 90899 | 51 | 2 | 25 | 0.2 | 2 | <1 | 0.8 | 30.0 | 0.59 | 15 | 234 | 23 | 733 | 0.8 | 2.7 | 1397 | 1.52 | 21.3 | 0.8 | 4.5 | 13.2 | 3.1 | 0.07 | 1.60 | 0.31 | 5 | <.01 |
| STANDARD SO17/CSB | | | | 192 | 35 | 28 | 5.6 | 6 | 5 | <.5 | 30.0 | 9.43 | 119 | 32 | 153 | 288 | 37.4 | 12.0 | 782 | 3.12 | 30.7 | 5.9 | 23.8 | 3.8 | 26.6 | 5.51 | 4.84 | 5.63 | 77 | 0.52 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Traverse 1 | Saprolite/Gossan | 420 | 90861 | 8424 | 5 | 1831 | 2.6 | 141 | 1 | 1.7 | 30.0 | 16.47 | 327 | 7584 | 5244 | 373 | 4.5 | 6.5 | 3777 | 41.64 | 1102.3 | 7.0 | 1017.8 | 0.1 | <.5 | 2.17 | 72.69 | 0.75 | 22 | <.01 |
| Traverse 1 | Saprolite/Gossan | 420 | 90862 | 11078 | 5 | 2849 | 4.9 | 550 | 3 | 1.5 | 15.0 | 49.93 | 1091 | 23964 | 9687 | 1286 | 5.6 | 19.1 | 19827 | 46.00 | 2602.7 | 16.2 | 2062.1 | 2.0 | 2.2 | 4.80 | 623.93 | 3.21 | 61 | <.01 |
| Traverse 1 | Saprolite/Gossan | 420 | 90863 | 11952 | 1 | 2890 | 4.0 | 338 | <1 | 0.5 | 7.5 | 22.80 | 286 | 6127 | 8509 | 549 | 0.8 | 2.3 | 2216 | 45.83 | 2029.7 | 8.4 | 1232.8 | 0.4 | 0.5 | 3.43 | 374.01 | 0.29 | 48 | <.01 |
| Traverse 1 | Saprolite/Gossan | 450 | 90864 | 12183 | 4 | 1155 | 0.9 | 76 | <1 | 23.9 | 30.0 | 15.63 | 467 | 3109 | 11196 | 14902 | 3.8 | 3.7 | 964 | 29.04 | 972.2 | 14.6 | 337.3 | 0.3 | <.5 | 0.92 | 118.28 | 0.07 | 14 | <.01 |
| Traverse 1 | Saprolite/Gossan | 450 | 90865 | 3659 | 2 | 3974 | 0.8 | 331 | 1 | 40.1 | 30.0 | 54.66 | 907 | 28093 | 2914 | 44743 | 3.3 | 29.7 | 11355 | 45.56 | 3122.2 | 32.0 | 1206.5 | 1.1 | 1.0 | 0.84 | 245.72 | 1.03 | 74 | <.01 |
| Traverse 1 | Saprolite/Gossan | 380 | 90890 | 1907 | 2 | 4417 | 0.8 | 192 | 2 | 1.3 | 30.0 | 47.16 | 117 | 21381 | 1218 | 960 | 2.2 | 2.3 | 724 | 41.90 | 2744.1 | 4.8 | 168.7 | 0.4 | 0.8 | 0.62 | 85.71 | 1.27 | 59 | <.01 |
| STANDARD SO17/CSB | | | | 192 | 35 | 28 | 5.6 | 6 | 5 | <.5 | 30.0 | 9.43 | 119 | 32 | 153 | 288 | 37.4 | 12.0 | 782 | 3.12 | 30.7 | 5.9 | 23.8 | 3.8 | 26.6 | 5.51 | 4.84 | 5.63 | 77 | 0.52 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Costeans | Gossan outcrop | | A001 | 9701 | 9 | 845 | 1.6 | 16 | <1 | <.5 | 30.0 | 15.59 | 2186 | 1799 | 7764 | 151 | 7.0 | 9.1 | 1130 | 41.48 | 479.2 | 1.8 | 409.3 | 0.3 | 0.7 | 1.10 | 15.06 | 0.56 | 11 | <.01 |
| Costeans | Gossan outcrop | | A002 | 6702 | 2 | 222 | 21.7 | 127 | 3 | 2.8 | 30.0 | 23.75 | 2679 | 12001 | 6686 | 3618 | 1.4 | 45.6 | 14829 | 43.11 | 213.4 | 2.6 | 1584.6 | 1.2 | 5.1 | 26.91 | 105.44 | 2.96 | 9 | <.01 |
| Costeans | Gossan outcrop | | A004 | 14105 | 3 | 2641 | 3.9 | 82 | <1 | 69.4 | 30.0 | 12.08 | 3461 | 12514 | 12822 | 79787 | 2.9 | 50.7 | 25846 | 41.78 | 2103.1 | 24.4 | 120.3 | 0.4 | 1.5 | 4.19 | 63.80 | 0.45 | 4 | <.01 |
| Costeans | Gossan outcrop | | A005 | 6697 | 5 | 2092 | 2.5 | 77 | 18 | 1.7 | 30.0 | 74.41 | 1669 | 23934 | 6366 | 1224 | 4.8 | 37.1 | 30223 | 40.40 | 1906.4 | 22.6 | 382.9 | 3.9 | 3.0 | 2.62 | 61.83 | 18.57 | 28 | <.01 |
| STANDARD SO17/CSB | | | | 192 | 35 | 28 | 5.6 | 6 | 5 | <.5 | 30.0 | 9.43 | 119 | 32 | 153 | 288 | 37.4 | 12.0 | 782 | 3.12 | 30.7 | 5.9 | 23.8 | 3.8 | 26.6 | 5.51 | 4.84 | 5.63 | 77 | 0.52 |

Appendix 1.3   Aripuana - analytical results - Saprolite (Traverse 1) and gossan outcrops/costeans

| ACME Laboratories Vancouver | | | Method: | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| John Gravel | | | Digestion: | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O |
| Nov/Dec 2001 | | | Acid / Strengtl | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 |
| | | | Sample Wt | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| | | | Units: | % | ppm | ppm | % | ppm | % | ppm | % | % | % | ppm | ppm | ppb | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm |
| | | | Det. Lim: | 0.001 | 0.5 | 0.5 | 0.01 | 0.5 | 0.001 | 1 | 0.01 | 0.001 | 0.01 | 0.2 | 0.02 | 5 | 0.1 | 0.02 | 0.1 | 0.02 | 0.1 | 0.02 | 0.02 | 0.1 | 0.1 | 0.1 | 0.01 | 0.05 | 0.1 | 0.01 |
| | | | Upper Lim: | 5 | 10000 | 10000 | 30 | 10000 | 10 | 2000 | 10 | 10 | 10 | 100 | 100 | 1E+05 | 100 | 100 | 100 | 2000 | 100 | 1000 | 2000 | 2000 | 100 | 100 | 10 | 2000 | 2000 | 2000 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sample site | Material | Location | Sample no | P | La | Cr | Mg | Ba | Ti | B | Al | Na | K | W | Tl | Hg | Se | Te | Ga | Cs | Ge | Hf | Nb | Rb | Sc | Sn | S | Ta | Zr | Y |
| | | | | % | ppm | ppm | % | ppm | % | ppm | % | % | % | ppm | ppm | ppb | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm |
| Traverse 1 | Saprolite | 420 | 90860 | 0.086 | 22.0 | 15.2 | 0.01 | 224.8 | 0.056 | 17 | 1.58 | 0.003 | 0.02 | 2.1 | 3.51 | 375 | 4.3 | 0.11 | 17.1 | <.02 | 0.6 | 0.88 | 0.86 | 0.3 | 5.8 | 1.1 | 0.05 | <.05 | 29.0 | 8.80 |
| Traverse 1 | Saprolite | 450 | 90867 | 0.087 | 16.9 | 8.5 | <.01 | 21.5 | 0.026 | 9 | 1.12 | 0.003 | <.01 | 2.1 | 0.49 | 370 | 0.7 | 0.18 | 11.1 | <.02 | 0.6 | 0.34 | 0.05 | 0.1 | 5.3 | 1.8 | 0.25 | <.05 | 15.1 | 14.12 |
| Traverse 1 | Saprolite | 490 | 90873 | 0.074 | 20.7 | 9.5 | 0.01 | 32.6 | 0.022 | 1 | 0.65 | 0.001 | 0.09 | 1.2 | 0.11 | 232 | <.1 | 0.12 | 7.7 | 0.04 | <.1 | 0.34 | 0.23 | 3.4 | 2.8 | 1.5 | 0.03 | <.05 | 13.8 | 5.17 |
| Traverse 1 | Saprolite | 520 | 90875 | 0.042 | 60.8 | 3.7 | 0.01 | 25.1 | 0.021 | 1 | 0.46 | 0.001 | 0.06 | 0.8 | 0.04 | 53 | <.1 | 0.02 | 3.6 | 0.03 | <.1 | 0.41 | 0.36 | 1.6 | 1.3 | 0.9 | 0.02 | <.05 | 11.7 | 2.90 |
| Traverse 1 | Saprolite | 580 | 90878 | 0.026 | 21.6 | 9.9 | 0.02 | 521.2 | 0.060 | <1 | 0.84 | 0.001 | 0.07 | 0.3 | 0.65 | 53 | <.1 | 0.18 | 6.4 | 0.07 | 0.1 | 0.58 | 0.71 | 3.2 | 2.0 | 1.2 | 0.01 | <.05 | 19.9 | 6.93 |
| Traverse 1 | Saprolite | 690 | 90882 | 0.008 | 11.0 | 2.9 | 0.02 | 73.2 | 0.010 | <1 | 1.06 | 0.001 | 0.07 | 0.4 | 0.20 | 63 | 0.1 | 0.15 | 6.2 | 0.10 | 0.1 | 0.55 | 0.65 | 4.7 | 3.0 | 1.1 | <.01 | <.05 | 22.5 | 2.88 |
| REPEAT | | | 90882 | 0.008 | 10.2 | 2.7 | 0.01 | 70.5 | 0.009 | 1 | 1.02 | 0.001 | 0.07 | 0.4 | 0.20 | 62 | 0.2 | 0.12 | 6.3 | 0.10 | <.1 | 0.56 | 0.71 | 4.6 | 3.0 | 1.2 | 0.03 | <.05 | 22.3 | 2.90 |
| Traverse 1 | Saprolite | 380 | 90886 | 0.010 | 6.7 | 5.7 | 0.03 | 299.8 | 0.011 | 1 | 1.44 | 0.001 | 0.08 | 0.5 | 0.40 | 61 | 0.3 | 0.11 | 7.5 | 0.11 | <.1 | 0.48 | 1.07 | 5.9 | 2.0 | 1.2 | <.01 | <.05 | 22.5 | 4.06 |
| Traverse 1 | Saprolite | 300 | 90891 | 0.055 | 23.7 | 5.2 | 0.02 | 423.8 | 0.011 | 1 | 0.92 | 0.001 | 0.11 | 0.8 | 0.90 | 127 | 0.1 | 0.04 | 6.6 | 0.06 | 0.1 | 0.45 | 0.33 | 4.4 | 2.5 | 0.8 | 0.01 | <.05 | 18.1 | 16.13 |
| Traverse 1 | Saprolite | 200 | 90895 | 0.053 | 13.9 | 8.3 | 0.01 | 168.0 | 0.027 | 1 | 0.64 | 0.001 | 0.06 | 0.6 | 0.25 | 122 | 0.6 | 0.02 | 7.0 | 0.05 | 0.1 | 0.53 | 0.41 | 2.5 | 2.3 | 0.7 | 0.02 | <.05 | 19.1 | 5.61 |
| Traverse 1 | Saprolite | 0 | 90899 | 0.008 | 3.6 | 1.8 | 0.01 | 122.8 | 0.011 | 1 | 0.42 | 0.001 | 0.09 | 0.2 | 0.22 | 13 | <.1 | 0.03 | 3.0 | 0.03 | <.1 | 0.42 | 0.55 | 3.6 | 0.7 | 0.4 | <.01 | <.05 | 12.0 | 2.30 |
| STANDARD SO17/CSB | | | | 0.086 | 17.2 | 184.5 | 0.57 | 135.0 | 0.081 | 2 | 1.67 | 0.025 | 0.15 | 3.9 | 1.00 | 235 | 1.1 | 1.02 | 6.3 | 5.49 | 0.1 | 0.18 | 1.61 | 13.4 | 2.8 | 6.9 | 0.02 | <.05 | 3.0 | 8.56 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Traverse 1 | Saprolite/Gossan | 420 | 90861 | 0.029 | 3.7 | <.5 | 0.03 | 6.5 | <.001 | <1 | 0.20 | 0.001 | <.01 | 0.5 | 0.38 | 198 | 1.9 | 0.09 | 0.7 | <.02 | 1.2 | 0.02 | 0.24 | 0.1 | 1.5 | 0.5 | 0.11 | <.05 | 0.6 | 2.89 |
| Traverse 1 | Saprolite/Gossan | 420 | 90862 | 0.250 | 71.6 | 2.4 | 0.01 | 47.3 | 0.008 | 1 | 0.85 | 0.004 | 0.01 | 2.2 | 1.05 | 619 | 8.0 | 0.11 | 6.9 | <.02 | 1.4 | 0.33 | 0.99 | 0.1 | 2.9 | 5.6 | 0.22 | <.05 | 10.7 | 10.79 |
| Traverse 1 | Saprolite/Gossan | 420 | 90863 | 0.046 | 7.4 | 1.3 | 0.01 | 11.3 | <.001 | 1 | 0.25 | 0.006 | <.01 | 0.1 | 0.15 | 244 | 0.2 | 0.06 | 3.4 | <.02 | 0.8 | 0.02 | 0.31 | 0.1 | 1.7 | 3.4 | 0.24 | <.05 | 2.0 | 4.77 |
| Traverse 1 | Saprolite/Gossan | 450 | 90864 | 0.031 | 4.1 | 4.5 | <.01 | 15.0 | 0.002 | 1 | 0.30 | 0.002 | <.01 | 2.8 | 0.02 | 1867 | 3.5 | 0.05 | 0.9 | <.02 | 1.3 | 0.07 | 0.20 | 0.1 | 1.0 | 0.9 | 0.08 | <.05 | 2.5 | 4.39 |
| Traverse 1 | Saprolite/Gossan | 450 | 90865 | 0.191 | 99.4 | 8.3 | <.01 | 6.5 | 0.010 | 10 | 1.19 | 0.008 | 0.03 | 0.8 | 0.23 | 544 | 16.5 | 0.08 | 9.1 | <.02 | 2.7 | 0.54 | 0.43 | 1.1 | 1.4 | 5.1 | 0.71 | <.05 | 17.2 | 7.52 |
| Traverse 1 | Saprolite/Gossan | 380 | 90890 | 0.204 | 55.8 | 10.6 | <.01 | 10.6 | 0.011 | 10 | 0.44 | 0.001 | 0.07 | 0.1 | 0.03 | 519 | 0.5 | 0.05 | 4.4 | <.02 | 2.5 | 0.21 | 0.41 | 0.3 | 0.9 | 1.3 | 0.55 | <.05 | 6.9 | 4.70 |
| STANDARD SO17/CSB | | | | 0.086 | 17.2 | 184.5 | 0.57 | 135.0 | 0.081 | 2 | 1.67 | 0.025 | 0.15 | 3.9 | 1.00 | 235 | 1.1 | 1.02 | 6.3 | 5.49 | 0.1 | 0.18 | 1.61 | 13.4 | 2.8 | 6.9 | 0.02 | <.05 | 3.0 | 8.56 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Costeans | Gossan outcrop | | A001 | 0.023 | 3.8 | <.5 | <.01 | 1.7 | 0.007 | 1 | 0.61 | 0.001 | <.01 | 16.2 | <.02 | 32 | 0.3 | <.02 | 5.4 | <.02 | 5.3 | 0.04 | 0.37 | 0.2 | 0.8 | 3.6 | 0.03 | <.05 | 1.7 | 28.14 |
| Costeans | Gossan outcrop | | A002 | 0.055 | 14.5 | 0.6 | 0.03 | 146.0 | 0.002 | <1 | 0.70 | <.001 | 0.02 | 10.0 | 0.34 | 5667 | 0.5 | 0.07 | 2.8 | 0.02 | 2.6 | 0.12 | 0.37 | 0.6 | 1.7 | 3.2 | 0.04 | <.05 | 4.0 | 24.10 |
| Costeans | Gossan outcrop | | A004 | 0.095 | 4.8 | <.5 | <.01 | 273.1 | 0.001 | <1 | 1.01 | 0.001 | 0.02 | 33.3 | 6.57 | 444 | <.1 | 0.08 | 2.2 | <.02 | 3.7 | 0.06 | 0.23 | 0.4 | 1.3 | 0.3 | 0.02 | <.05 | 3.0 | 12.31 |
| Costeans | Gossan outcrop | | A005 | 0.080 | 39.4 | <.5 | 0.01 | 121.8 | 0.012 | 1 | 0.89 | 0.002 | 0.01 | 1.2 | 1.15 | 388 | 43.8 | 0.17 | 8.8 | <.02 | 1.4 | 0.60 | 0.79 | 0.4 | 3.1 | 2.4 | 0.11 | <.05 | 23.9 | 10.92 |
| STANDARD SO17/CSB | | | | 0.086 | 17.2 | 184.5 | 0.57 | 135.0 | 0.081 | 2 | 1.67 | 0.025 | 0.15 | 3.9 | 1.00 | 235 | 1.1 | 1.02 | 6.3 | 5.49 | 0.1 | 0.18 | 1.61 | 13.4 | 2.8 | 6.9 | 0.02 | <.05 | 3.0 | 8.56 |

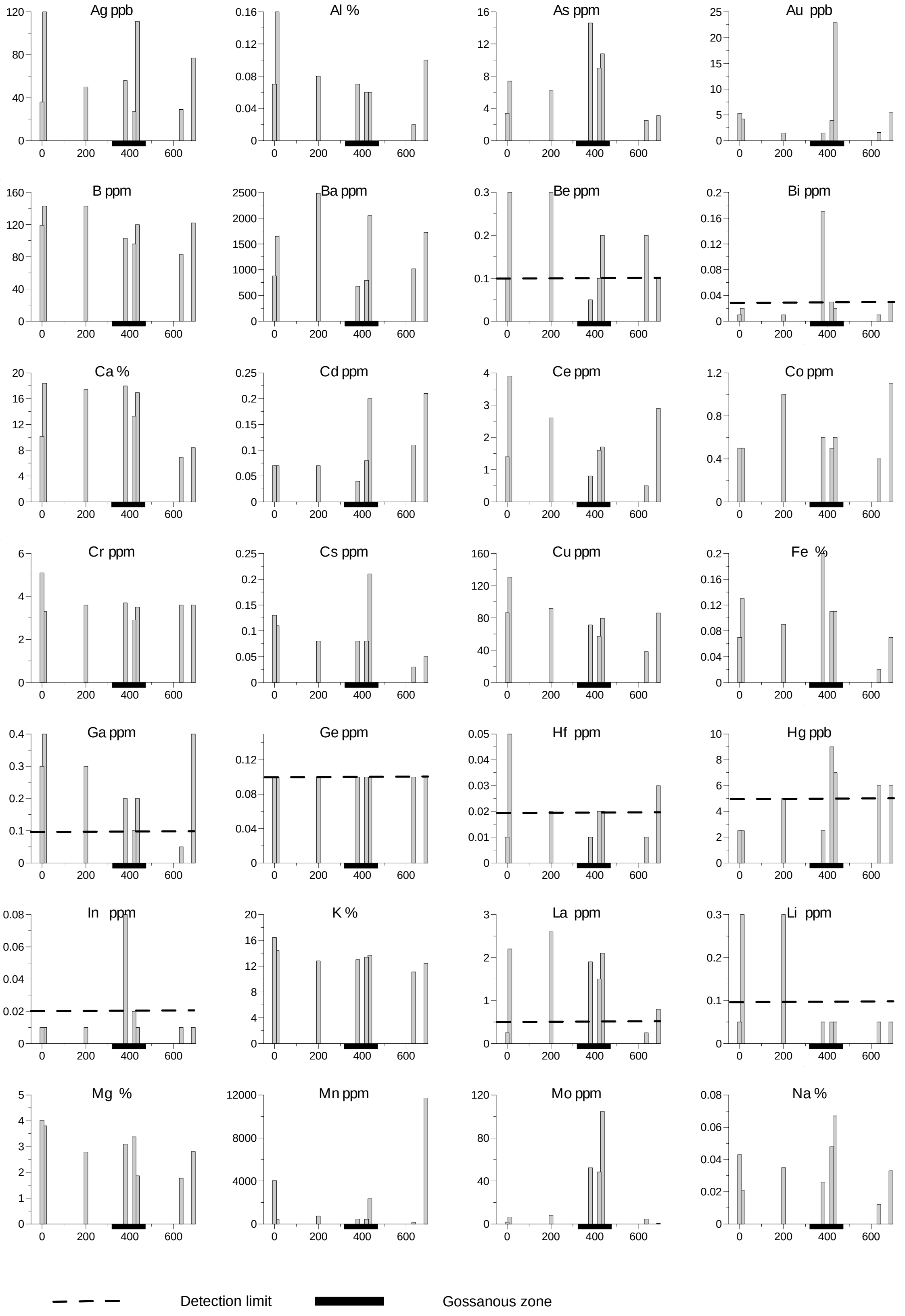
Appendix 1.3   Aripuana - analytical results - Saprolite (Traverse 1) and gossan outcrops/costeans

|  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
| ACME Laboratories Vancouver |  |  | Method: | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS | 1FMS |
| John Gravel |  |  | Digestion: | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O |
| Nov/Dec 2001 |  |  | Acid / Strengtl | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 | 2:02:02 |
|  |  |  | Sample Wt | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
|  |  |  | Units: | ppm | ppm | ppb | ppm | ppm | ppb | ppb |
|  |  |  | Det. Lim: | 0.1 | 0.02 | 1 | 0.1 | 0.1 | 10 | 2 |
|  |  |  | Upper Lim: | 2000 | 1000 | 1E+06 | 1000 | 2000 | 1000 | 1000 |
|  |  |  |  |  |  |  |  |  |  |  |
| Sample site | Material | Location | Sample no | Ce | In | Re | Be | Li | Pd | Pt |
|  |  |  |  | ppm | ppm | ppb | ppm | ppm | ppb | ppb |
| Traverse 1 | Saprolite | 420 | 90860 | 136.4 | 1.82 | 4 | 3.5 | 2.8 | <10 | <2 |
| Traverse 1 | Saprolite | 450 | 90867 | 142.7 | 3.81 | 3 | 3.8 | 2.4 | <10 | <2 |
| Traverse 1 | Saprolite | 490 | 90873 | 88.0 | 1.09 | 2 | 0.9 | 1.1 | <10 | <2 |
| Traverse 1 | Saprolite | 520 | 90875 | 165.7 | 0.44 | <1 | 0.5 | 0.5 | <10 | <2 |
| Traverse 1 | Saprolite | 580 | 90878 | 634.4 | 0.20 | 2 | 0.5 | 1.3 | <10 | <2 |
| Traverse 1 | Saprolite | 690 | 90882 | 315.7 | 0.17 | <1 | 0.3 | 1.8 | <10 | <2 |
| REPEAT |  |  | 90882 | 312.9 | 0.17 | 1 | 0.2 | 2.0 | <10 | <2 |
| Traverse 1 | Saprolite | 380 | 90886 | 122.5 | 0.07 | 1 | 0.6 | 2.7 | <10 | <2 |
| Traverse 1 | Saprolite | 300 | 90891 | 836.0 | 0.20 | 1 | 1.7 | 1.8 | <10 | <2 |
| Traverse 1 | Saprolite | 200 | 90895 | 359.3 | 0.53 | <1 | 0.9 | 1.0 | <10 | <2 |
| Traverse 1 | Saprolite | 0 | 90899 | 47.7 | 0.04 | 1 | 0.3 | 1.3 | <10 | <2 |
| STANDARD SO17/CSB |  |  |  | 29.5 | 2.01 | 2 | 2.0 | 16.3 | <10 | <2 |
|  |  |  |  |  |  |  |  |  |  |  |
| Traverse 1 | Saprolite/Gossan | 420 | 90861 | 9.4 | 0.88 | 1 | 1.3 | <.1 | <10 | <2 |
| Traverse 1 | Saprolite/Gossan | 420 | 90862 | 145.1 | 9.55 | <1 | 3.1 | <.1 | <10 | 2 |
| Traverse 1 | Saprolite/Gossan | 420 | 90863 | 82.8 | 6.88 | 4 | 1.5 | 0.1 | <10 | 2 |
| Traverse 1 | Saprolite/Gossan | 450 | 90864 | 5.3 | 1.05 | 2 | 2.1 | <.1 | <10 | <2 |
| Traverse 1 | Saprolite/Gossan | 450 | 90865 | 48.0 | 4.32 | <1 | 0.9 | 2.3 | 12 | <2 |
| Traverse 1 | Saprolite/Gossan | 380 | 90890 | 11.9 | 0.20 | <1 | 1.5 | 2.8 | <10 | 3 |
| STANDARD SO17/CSB |  |  |  | 29.5 | 2.01 | 2 | 2.0 | 16.3 | <10 | <2 |
|  |  |  |  |  |  |  |  |  |  |  |
| Costeans | Gossan outcrop |  | A001 | 1.1 | 4.75 | 3 | 7.0 | <.1 | <10 | <2 |
| Costeans | Gossan outcrop |  | A002 | 26.4 | 18.30 | 5 | 5.0 | 0.1 | <10 | 3 |
| Costeans | Gossan outcrop |  | A004 | 30.9 | 0.81 | <1 | 5.4 | <.1 | <10 | <2 |
| Costeans | Gossan outcrop |  | A005 | 119.1 | 5.12 | 1 | 2.6 | <.1 | <10 | 5 |
| STANDARD SO17/CSB |  |  |  | 29.5 | 2.01 | 2 | 2.0 | 16.3 | <10 | <2 |

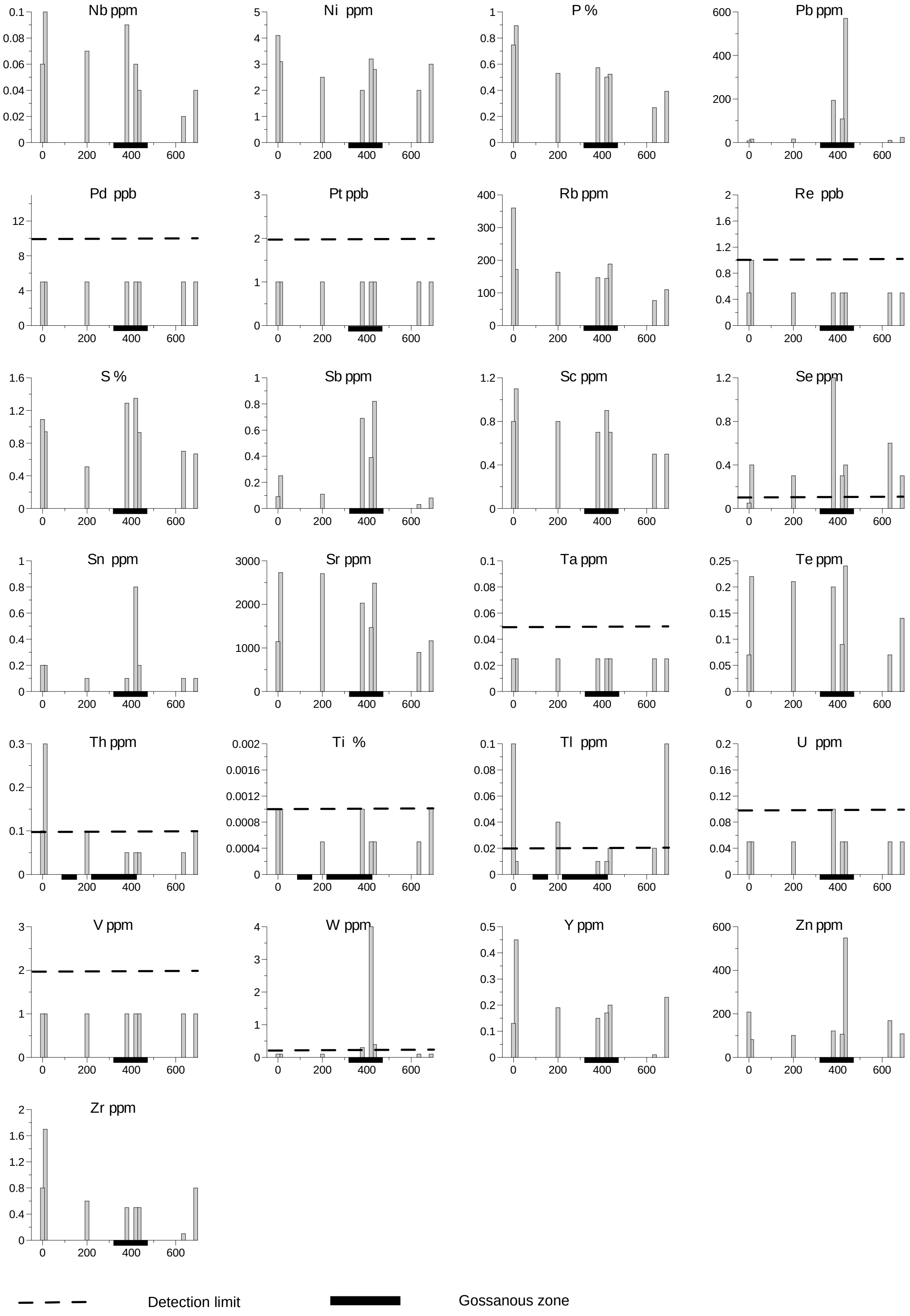
Appendix 1.3 Aripuana - analytical results - Saprolite (Traverse 1) and gossan outcrops/costeans

# Appendix 2

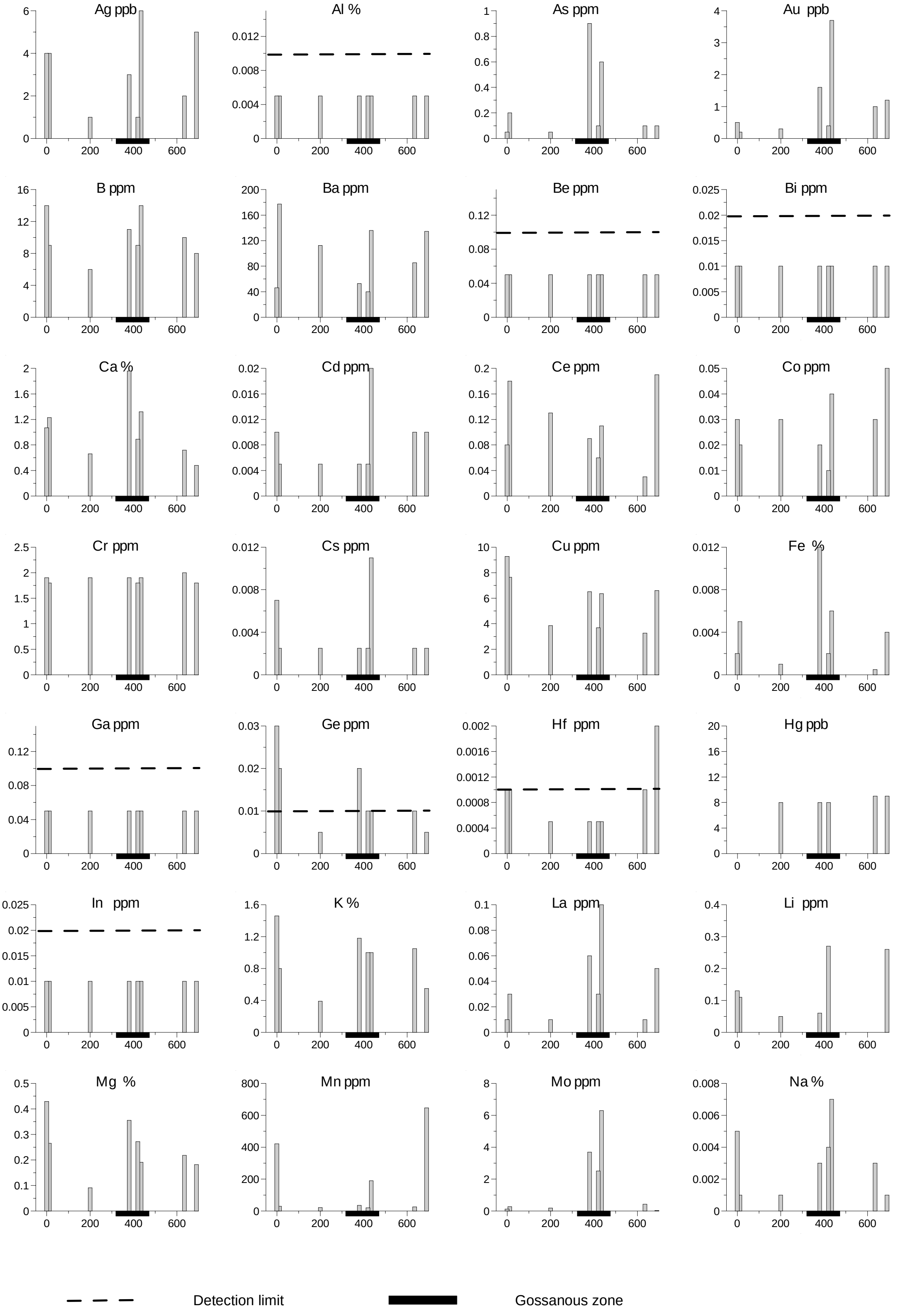
# Graphs of all elements analysed



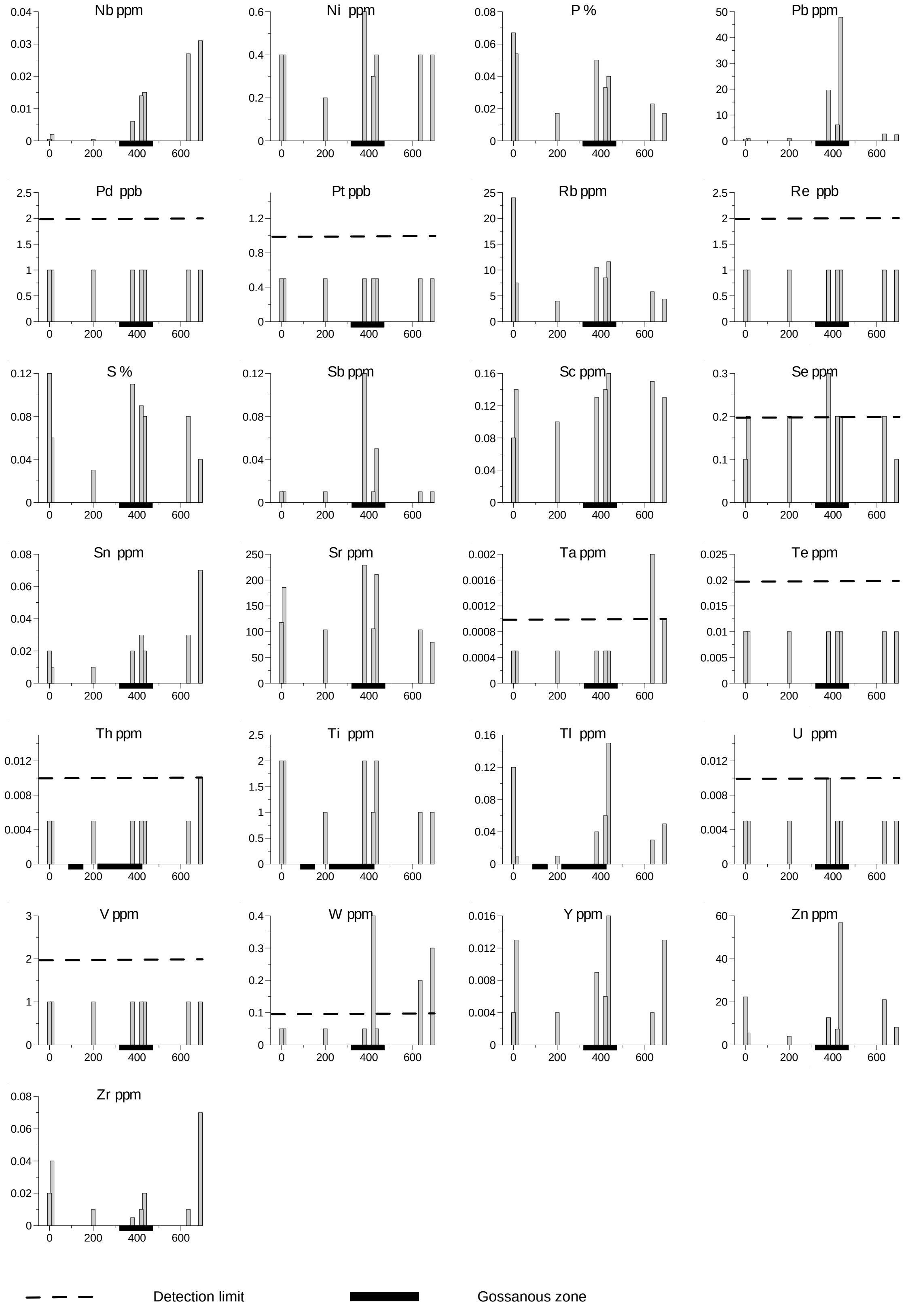
Appendix 2.1.1 Aripuana – Traverse 1 – Bark, ashed – concentrations vs distance (m).



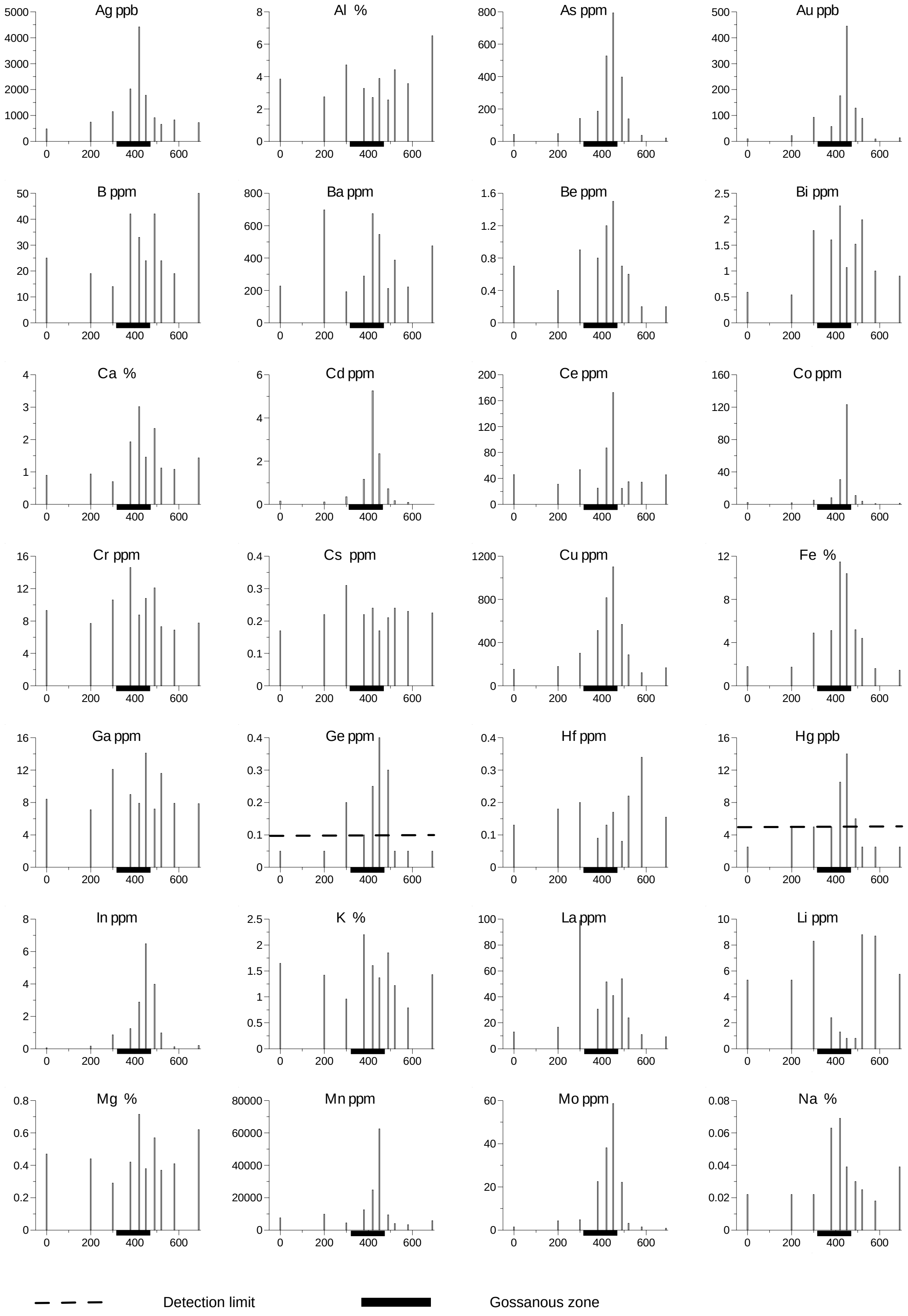
Appendix 2.1.1 Aripuana – Traverse 1 – Bark, ashed – concentrations vs distance (m)



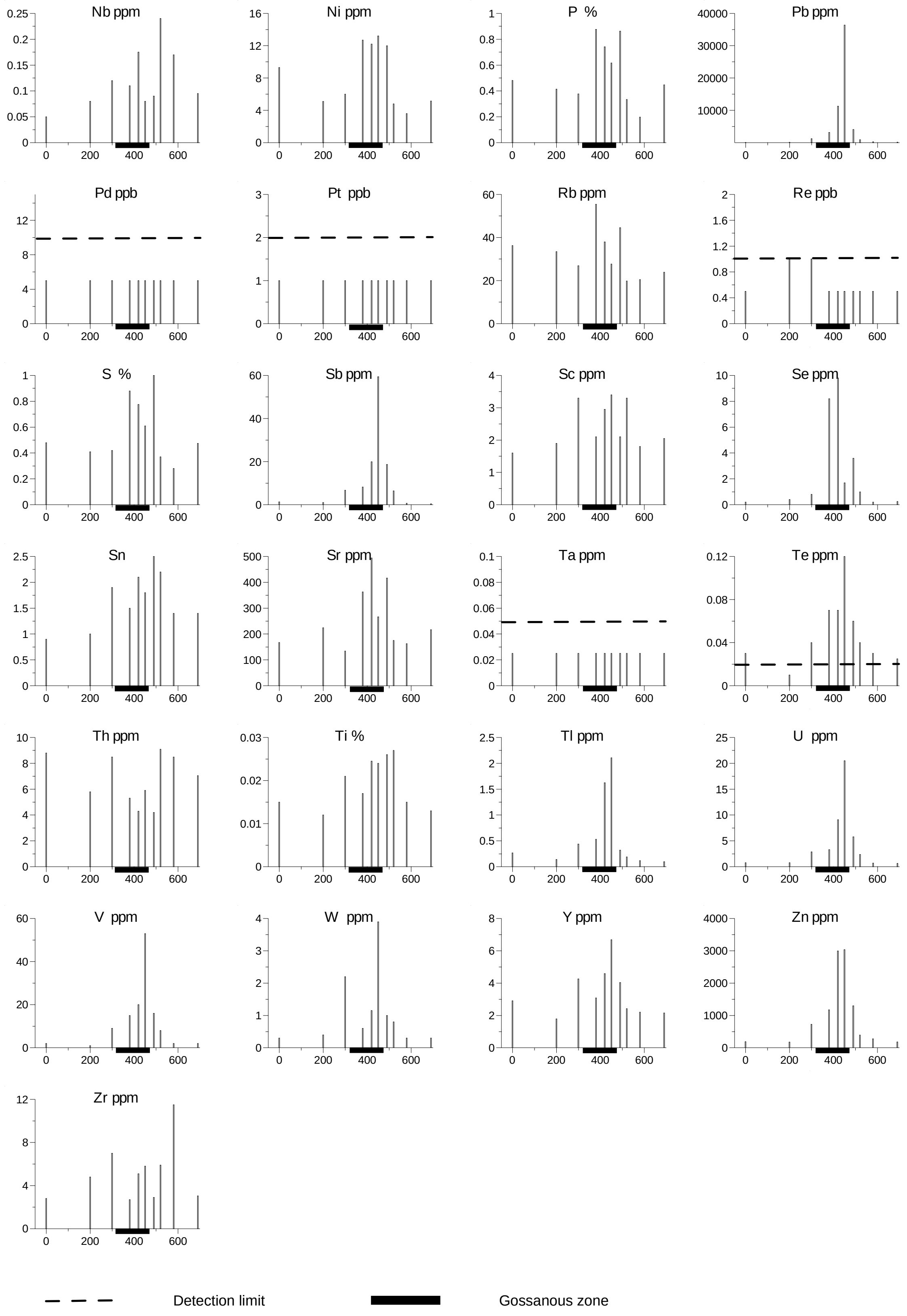
Appendix 2.2.1 Aripuana – Traverse 1 – Bark, dry – concentrations vs distance (m)



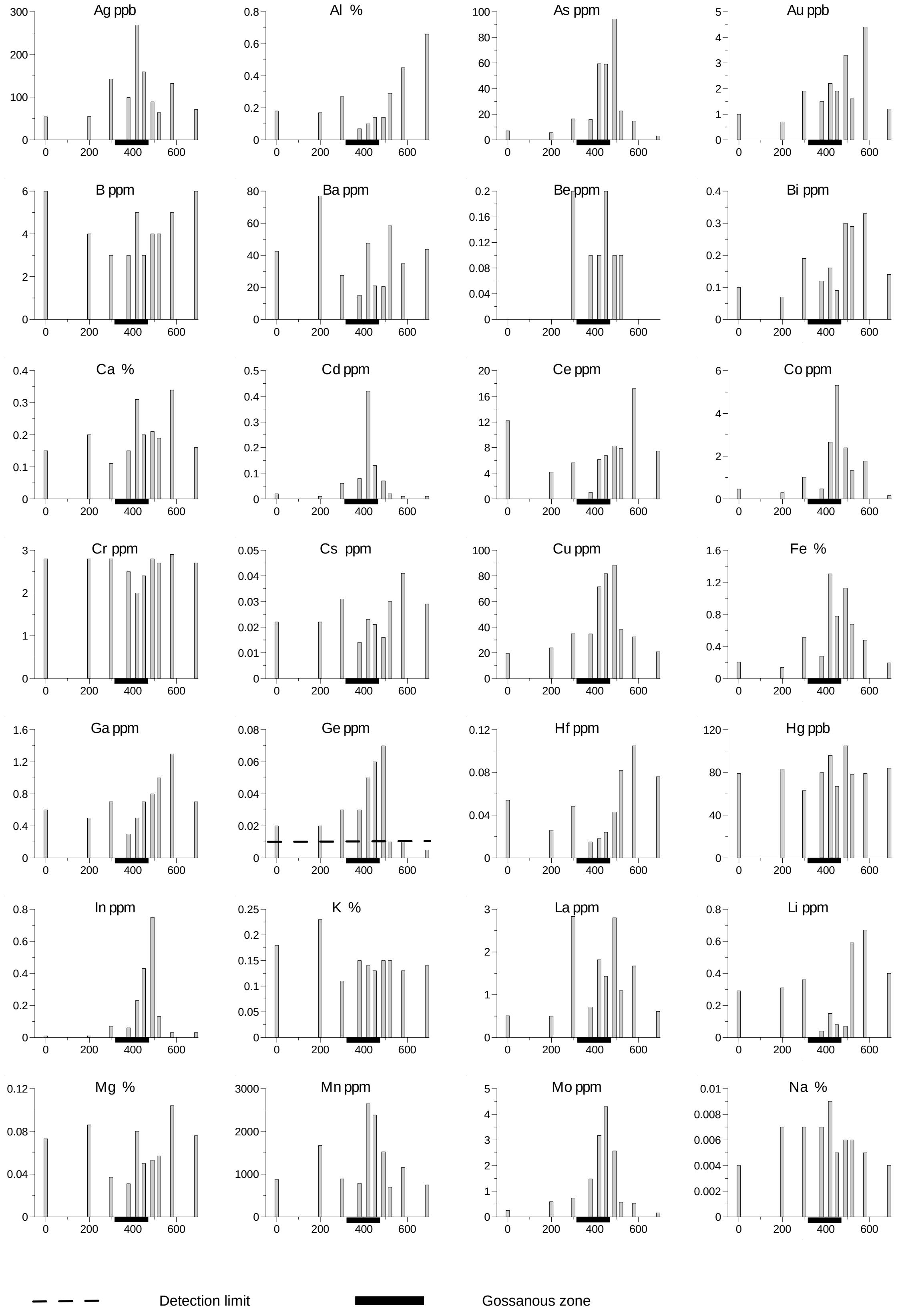
Appendix 2.2.2 Aripuana – Traverse 1 – Bark, dry – concentrations vs distance (m)



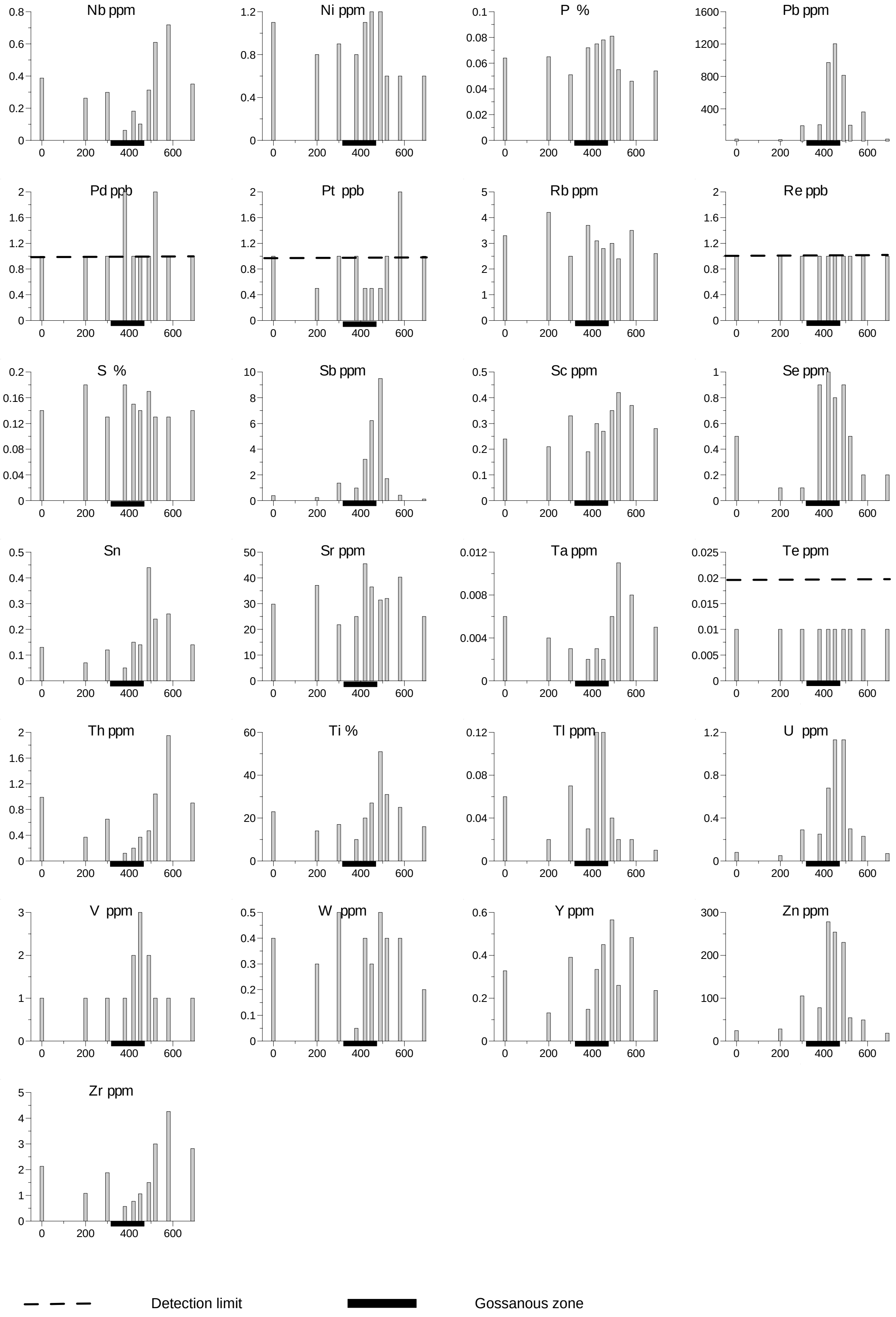
Appendix 2.3.1 Aripuana – Traverse 1 – Mull, ashed – concentrations vs distance (m)



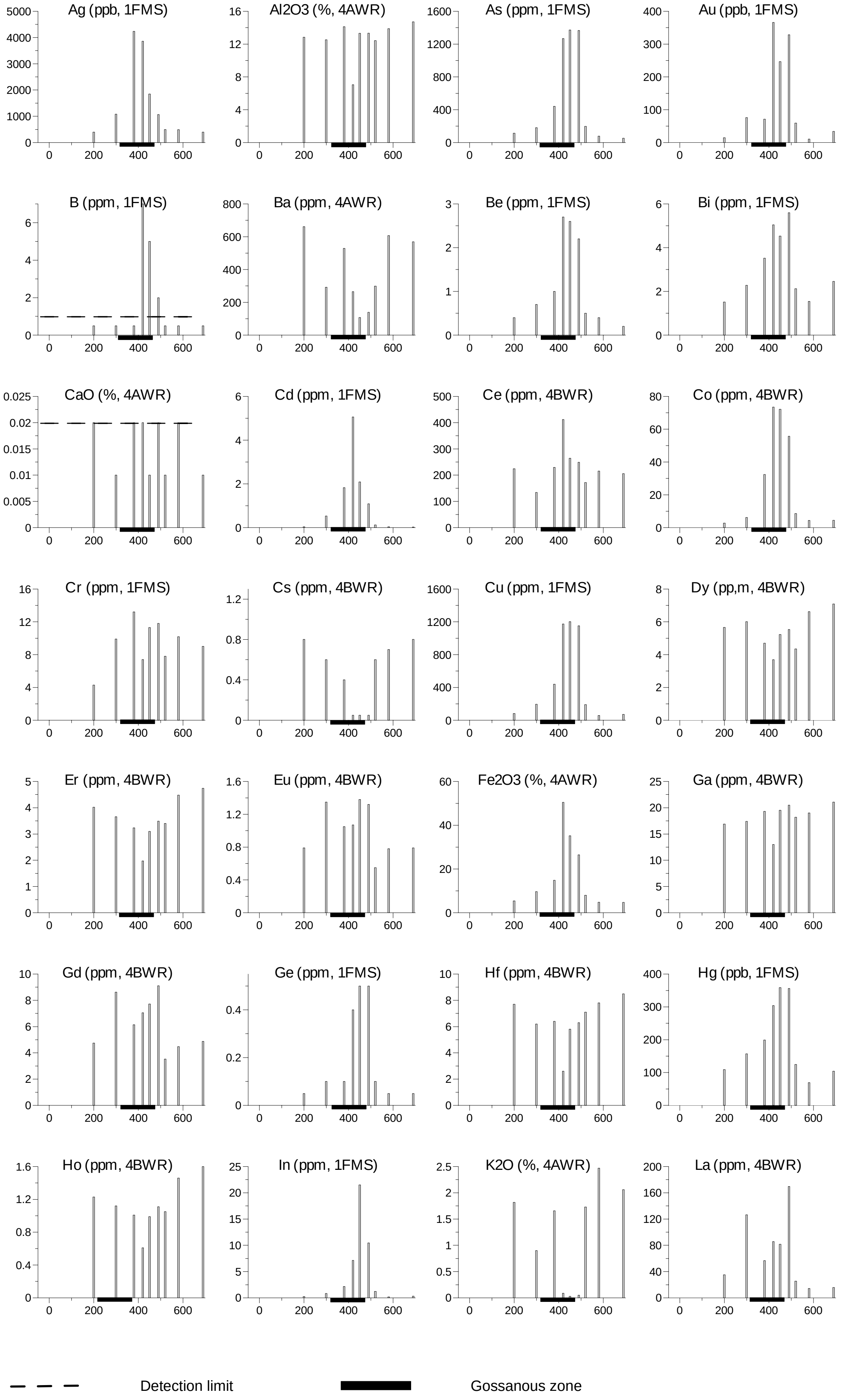
Appendix 2.3.2 Aripuana – Traverse 1 – Mull, ashed – concentrations vs distance (m)



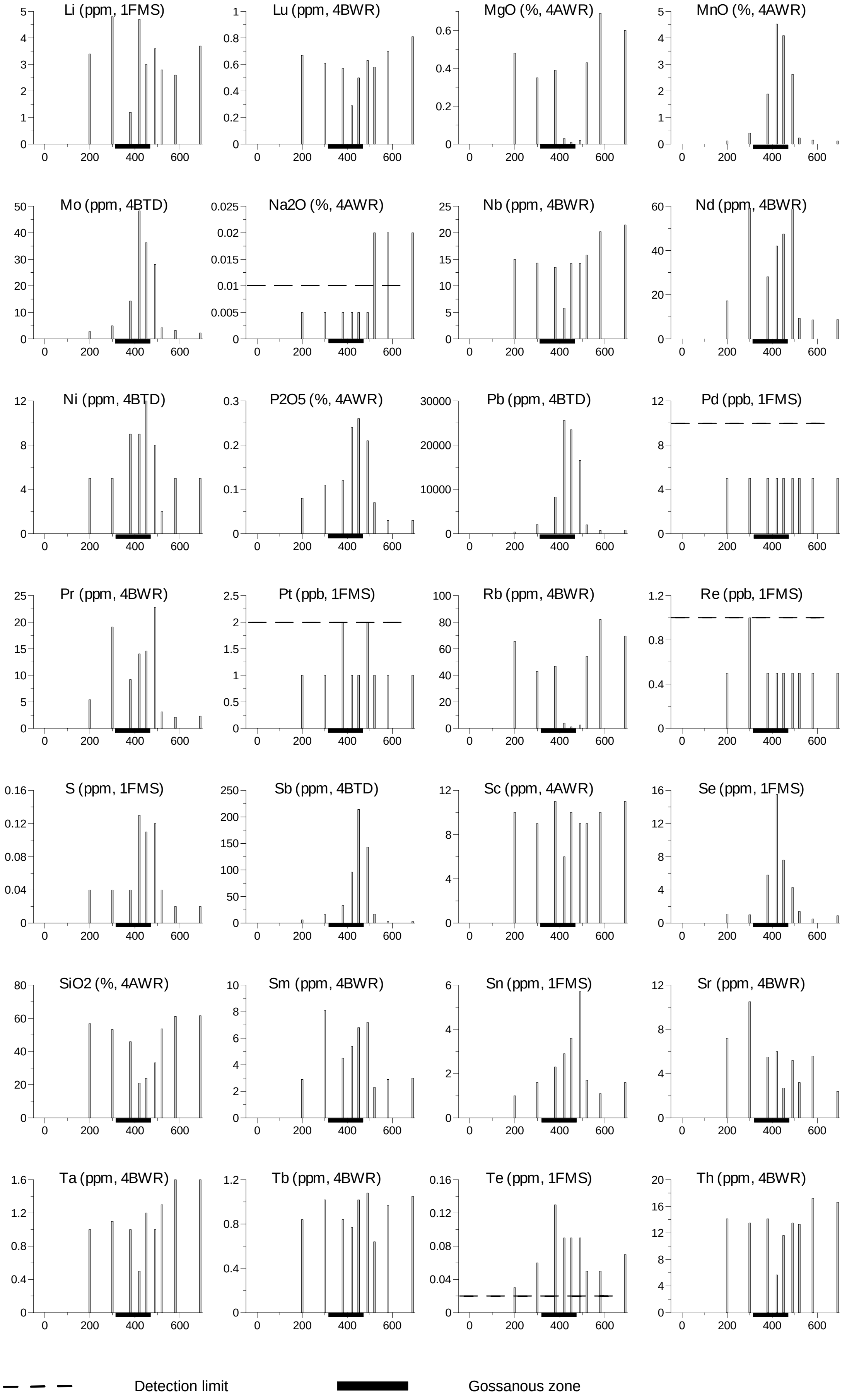
Appendix 2.4.1 Aripuana – Traverse 1 – Mull, dry – concentrations vs distance (m)



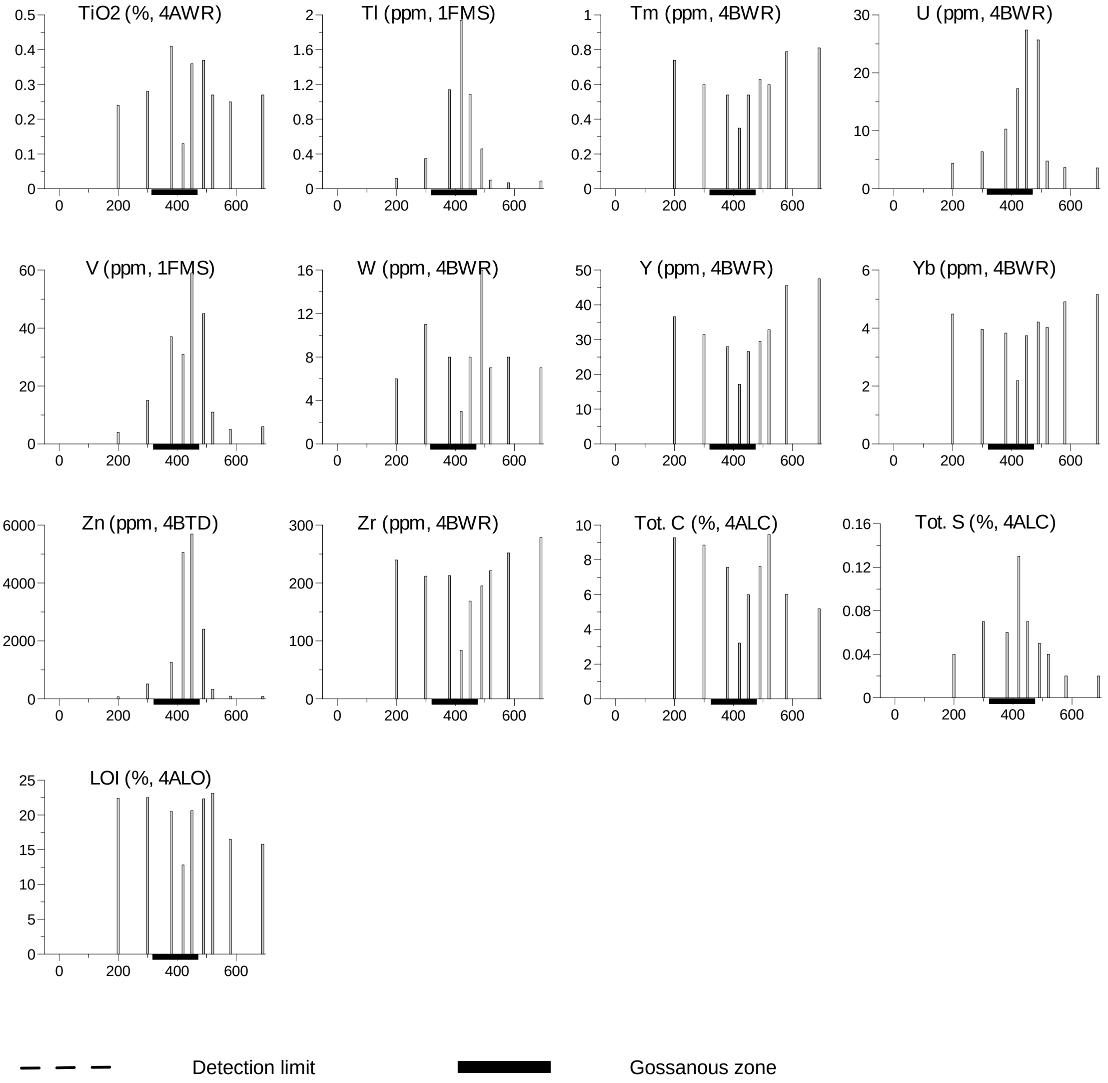
Appendix 2.4.2 Aripuana – Traverse 1 – Mull, dry – concentrations vs distance (m)



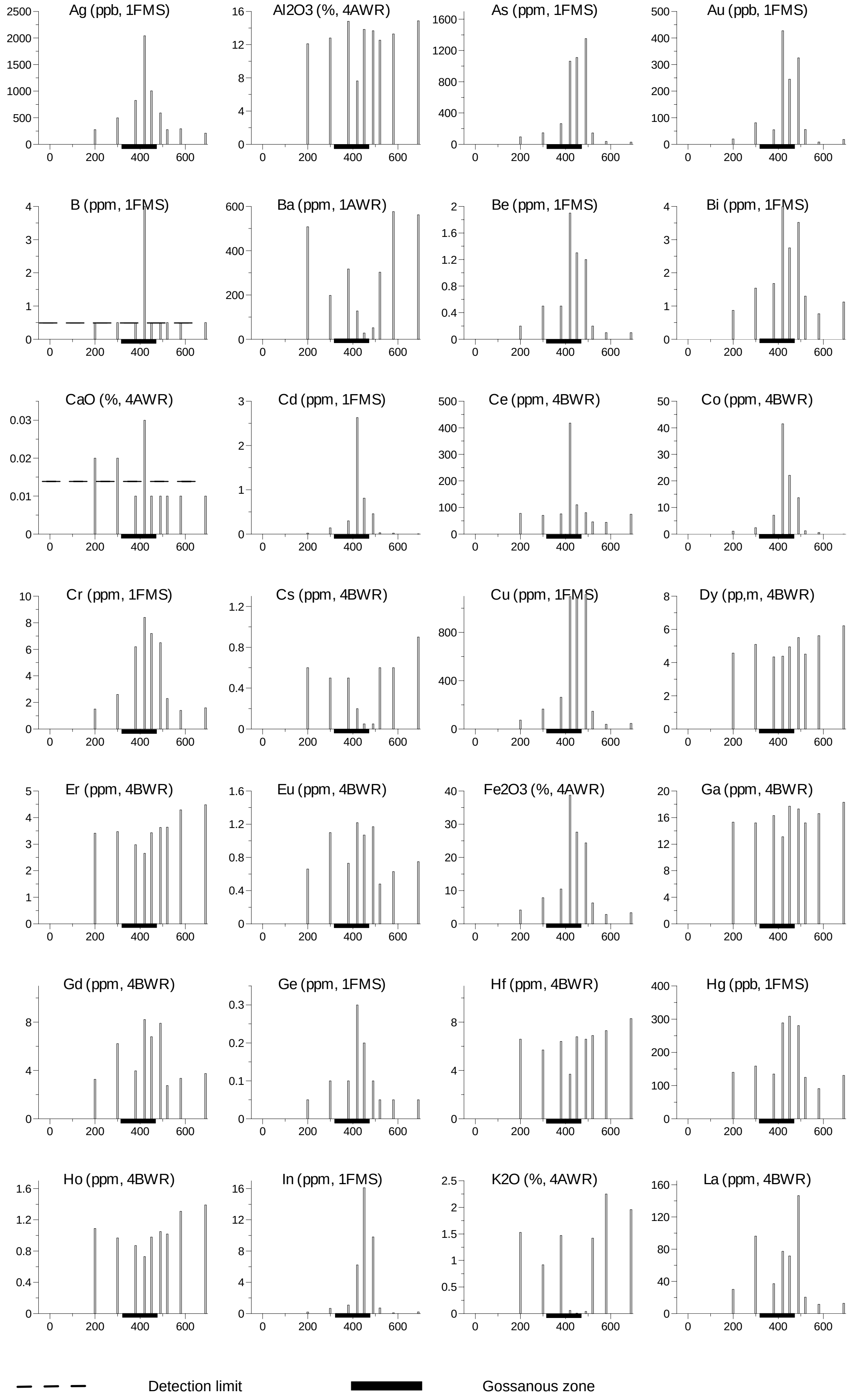
Appendix 2.5.1 Aripuana – Traverse 1 – A-horizon (<75 µm) – concentrations vs distance (m)



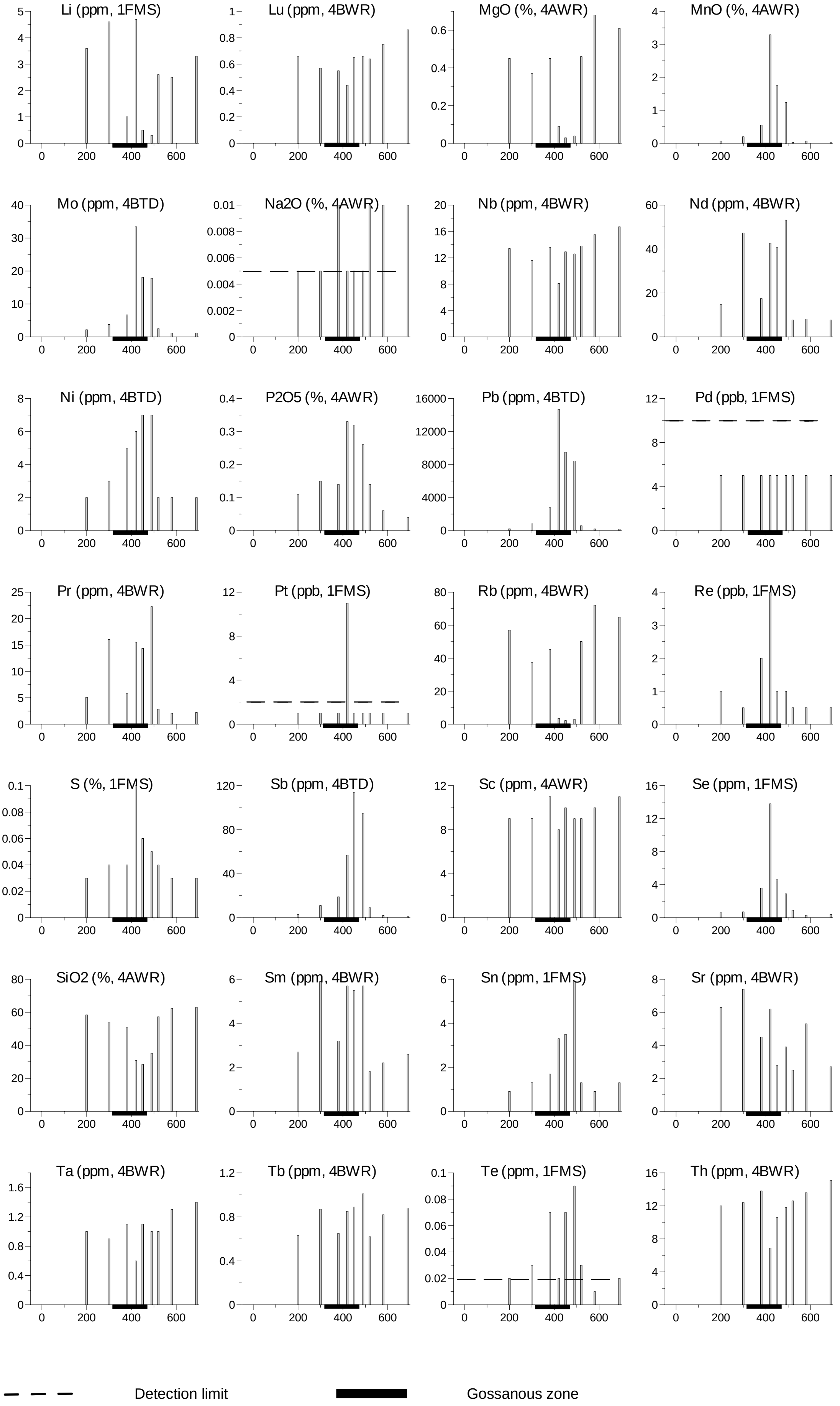
Appendix 2.5.2 Aripuana – Traverse 1 – A-horizon (<75 µm) – concentrations vs distance (m)



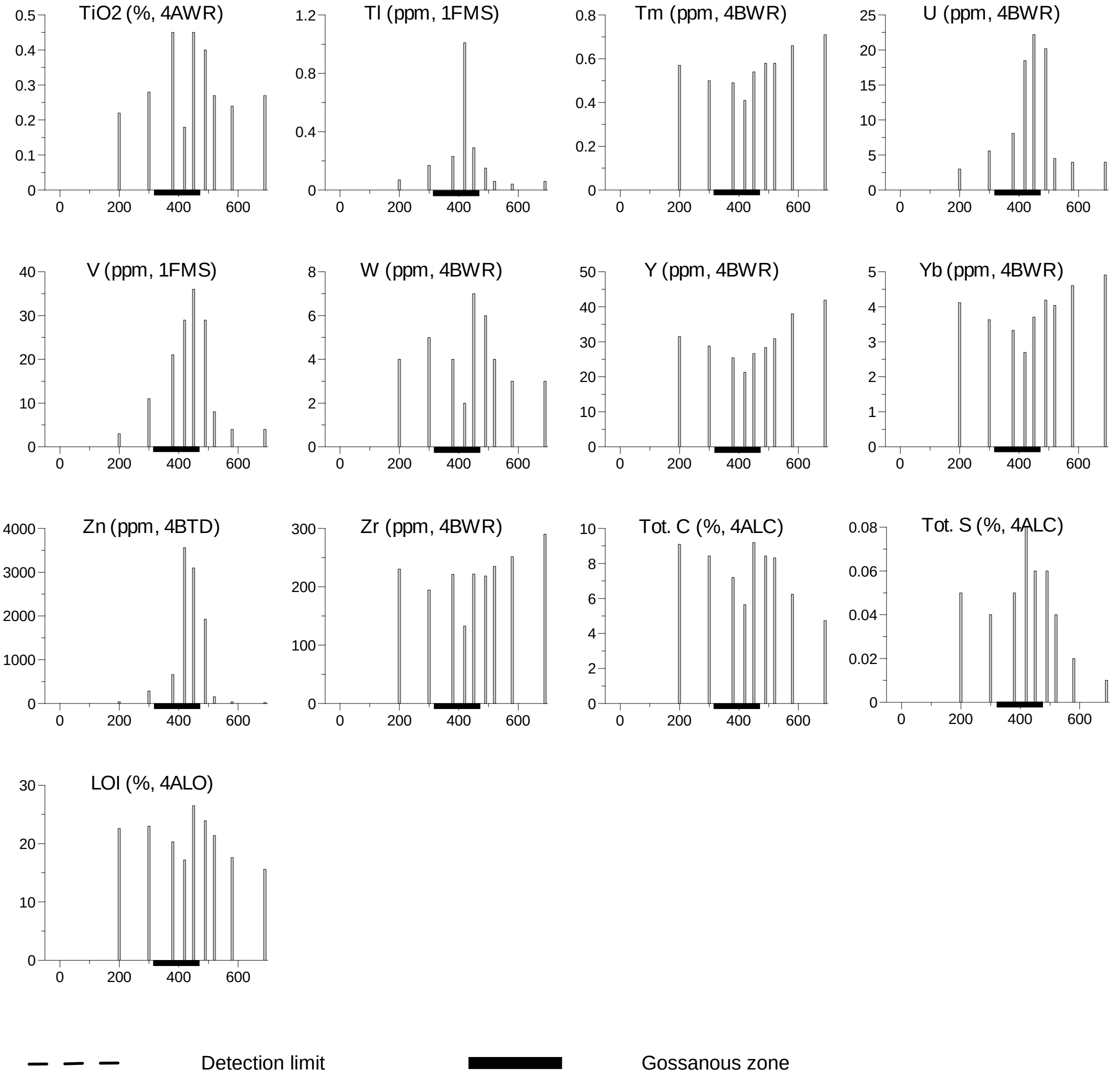
Appendix 2.5.3 Aripuana – Traverse 1 – A-horizon (<75 µm) – concentrations vs distance (m)



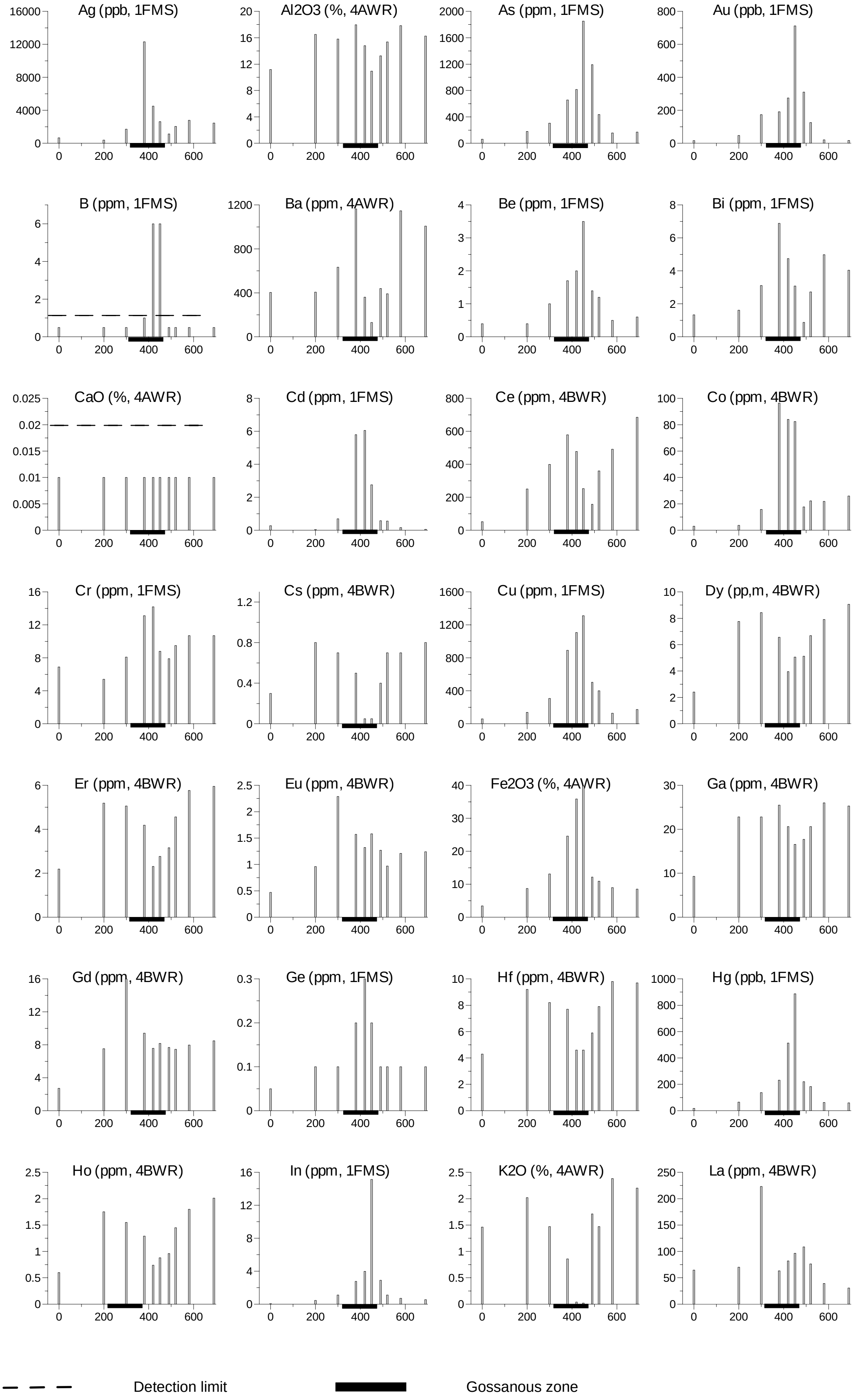
Appendix 2.6.1 Aripuana – Traverse 1 – A-horizon (<250 µm) – concentrations vs distance (m)


Li (ppm, 1FMS)
Lu (ppm, 4BWR)
MgO (%, 4AWR)
MnO (%, 4AWR)
Mo (ppm, 4BTD)
Na2O (%, 4AWR)
Nb (ppm, 4BWR)
Nd (ppm, 4BWR)
Ni (ppm, 4BTD)
P2O5 (%, 4AWR)
Pb (ppm, 4BTD)
Pd (ppb, 1FMS)
Pr (ppm, 4BWR)
Pt (ppb, 1FMS)
Rb (ppm, 4BWR)
Re (ppb, 1FMS)
S (%, 1FMS)
Sb (ppm, 4BTD)
Sc (ppm, 4AWR)
Se (ppm, 1FMS)
SiO2 (%, 4AWR)
Sm (ppm, 4BWR)
Sn (ppm, 1FMS)
Sr (ppm, 4BWR)
Ta (ppm, 4BWR)
Tb (ppm, 4BWR)
Te (ppm, 1FMS)
Th (ppm, 4BWR)

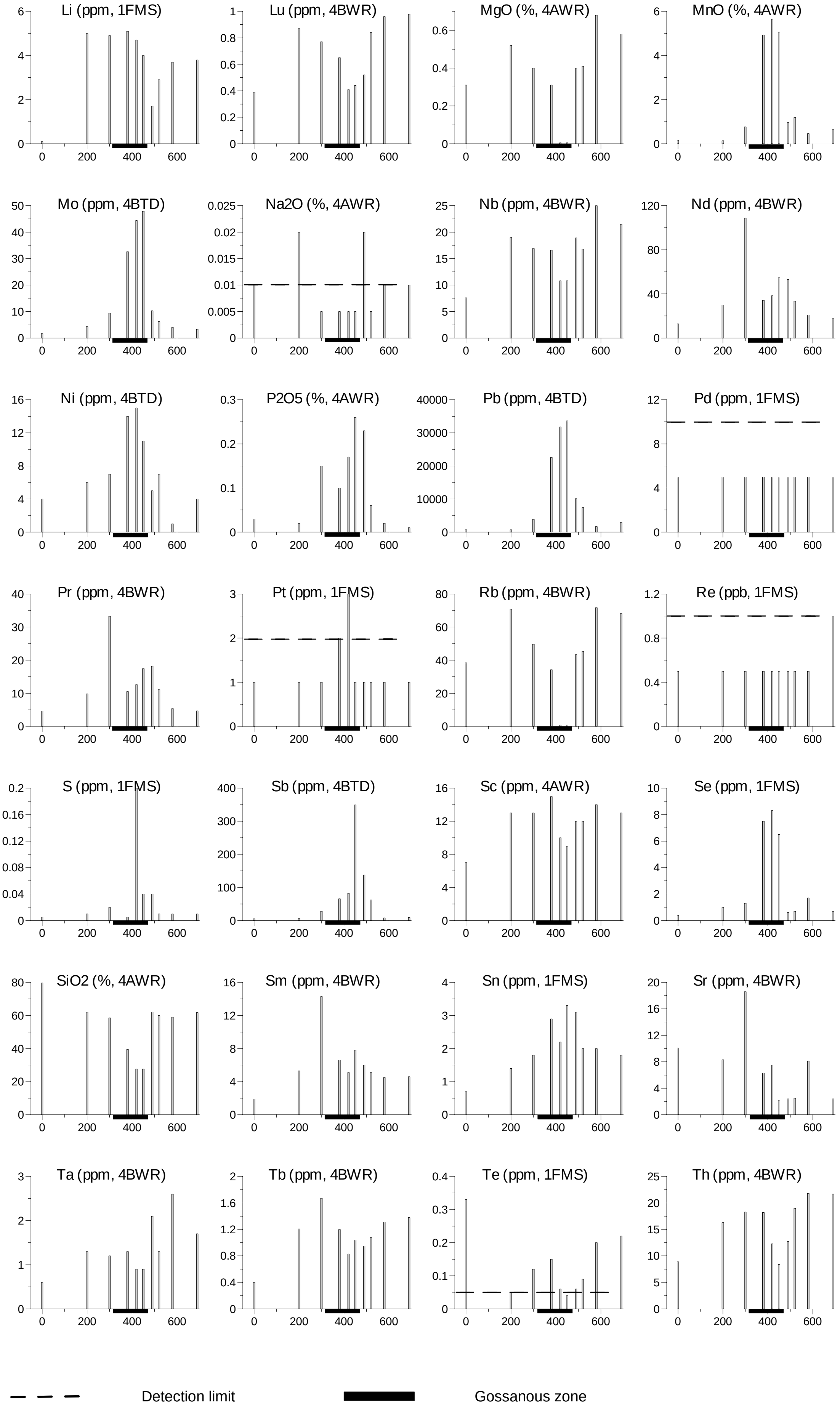
Appendix 2.6.2 Aripuana – Traverse 1 – A-horizon (<250 µm) – concentrations vs distance (m)



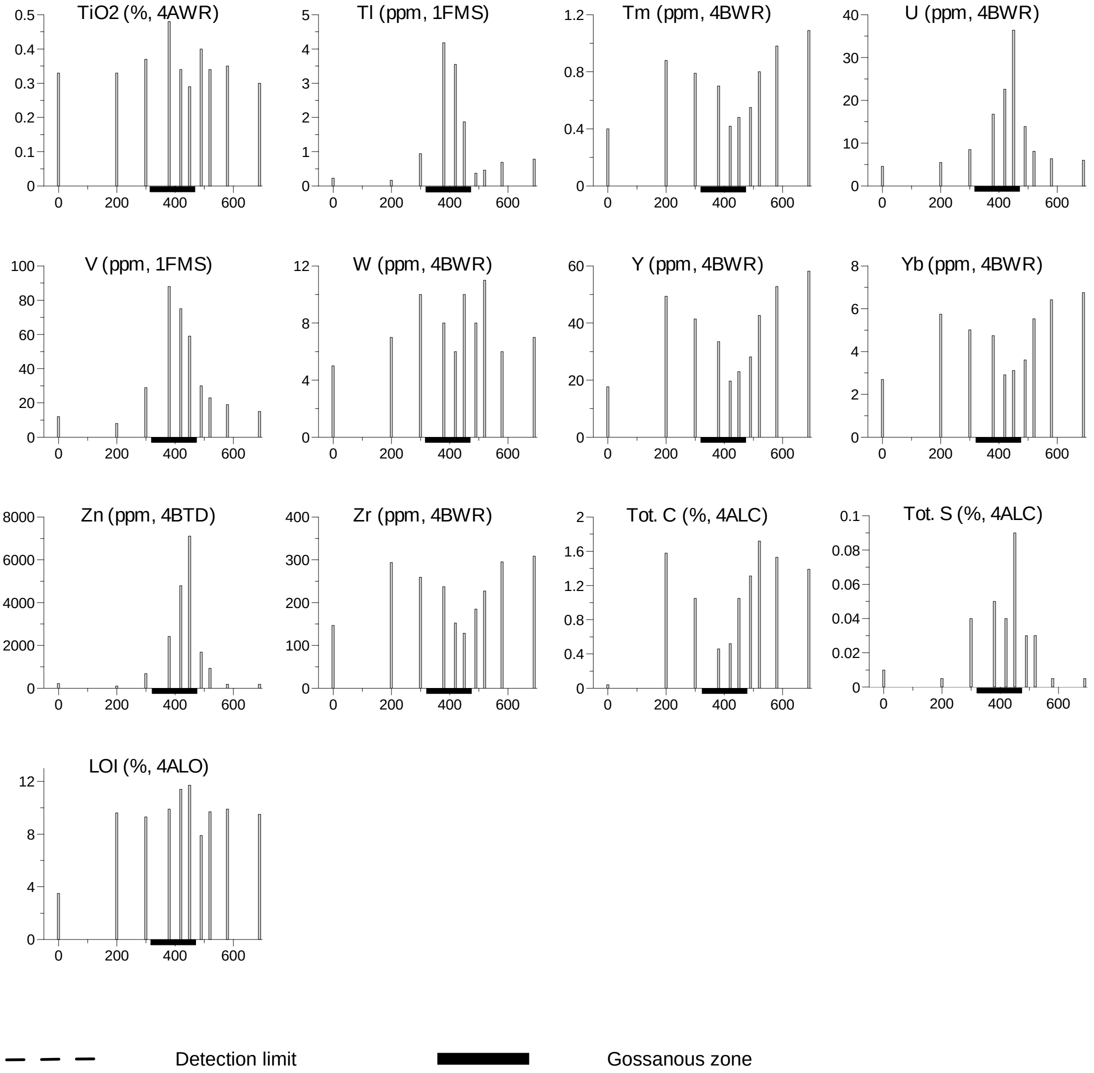
Appendix 2.6.3 Aripuana – Traverse 1 – A-horizon (<250 µm) – concentrations vs distance (m)



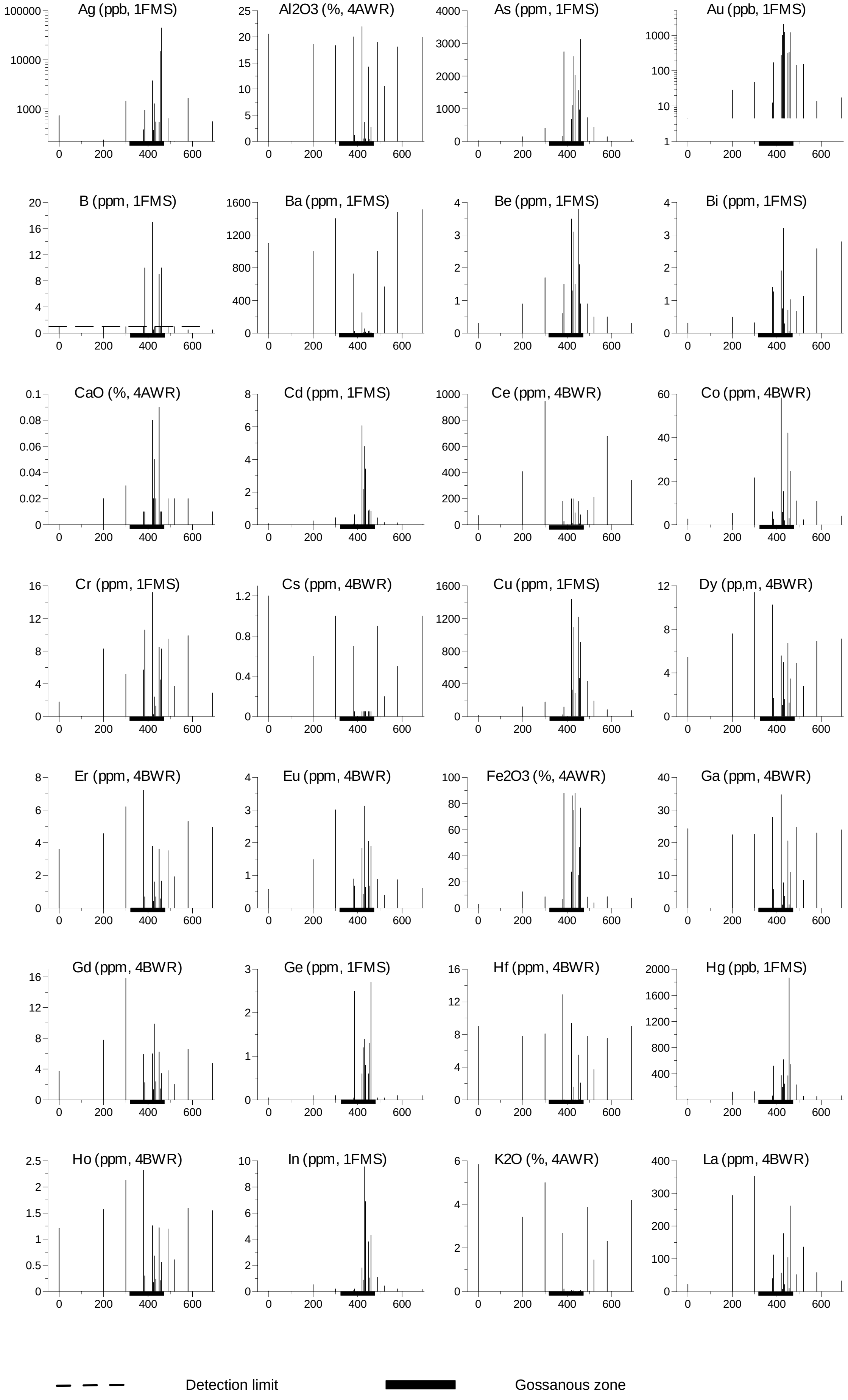
Appendix 2.7.1 Aripuana – Traverse 1 – B-horizon (<75 µm) – concentrations vs distance (m)



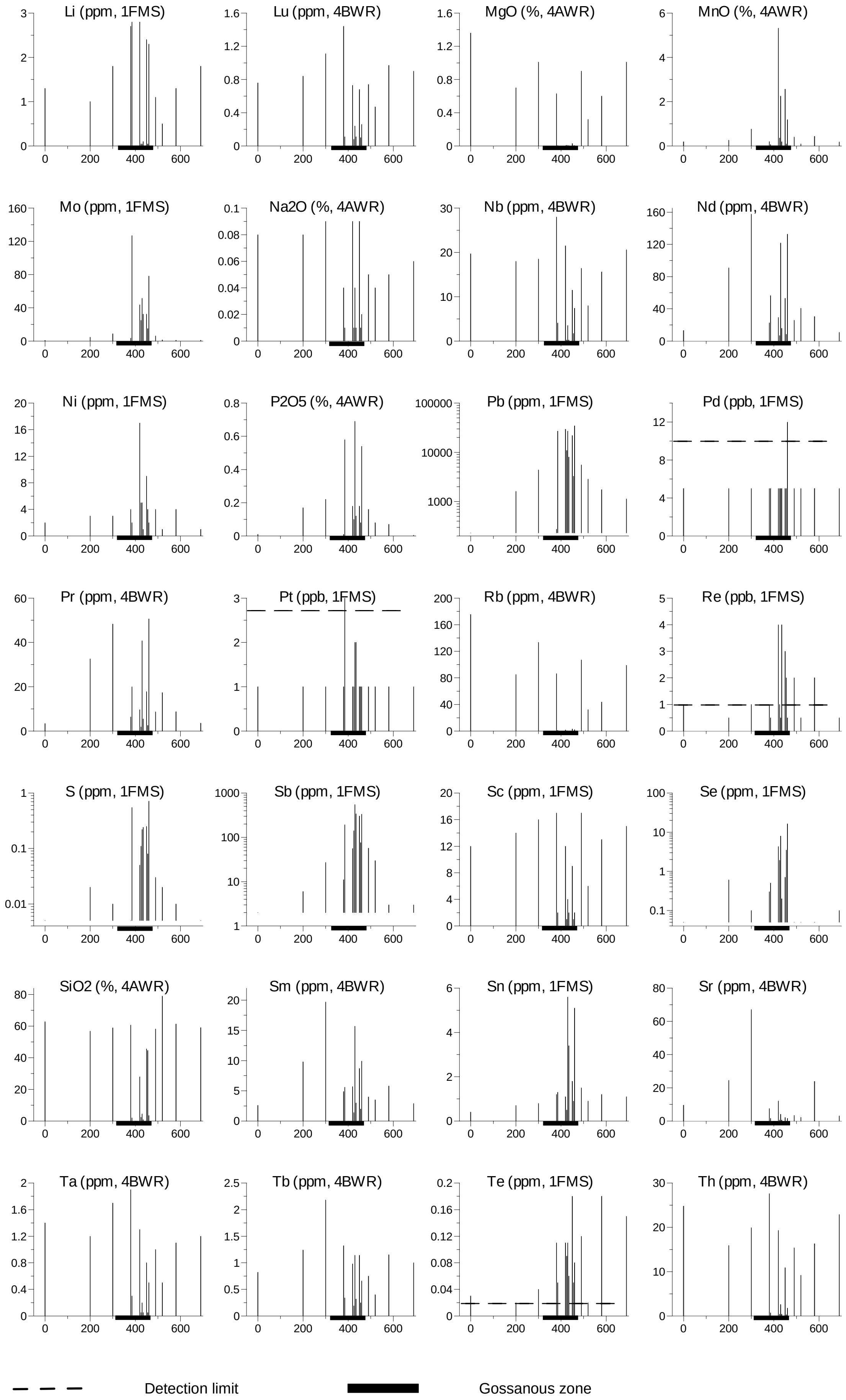
Appendix 2.7.2 Aripuana – Traverse 1 – B-horizon (<75 µm) – concentrations vs distance (m)



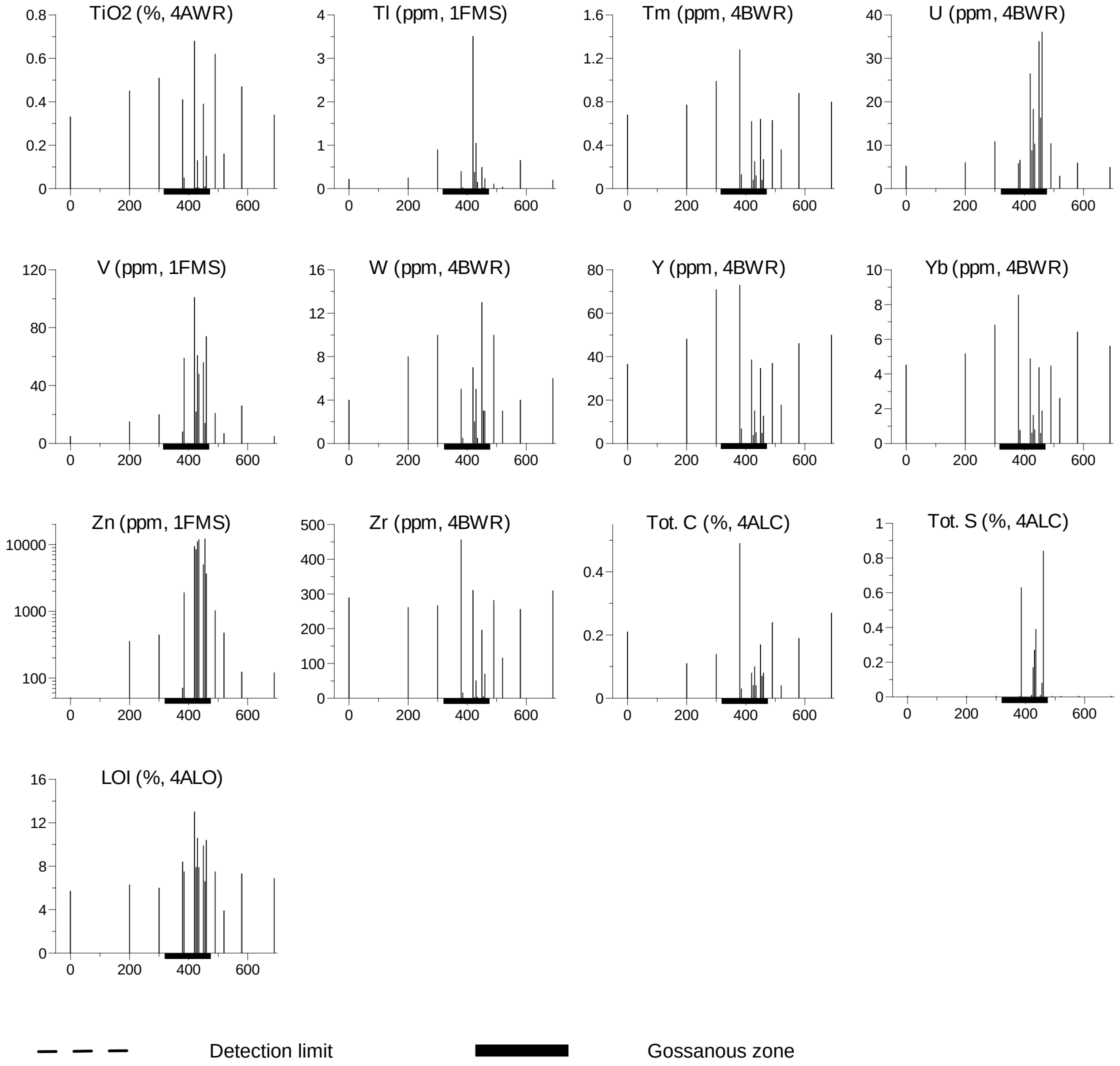
Appendix 2.7.3 Aripuana – Traverse 1 – B-horizon (<75 µm) – concentrations vs distance (m)



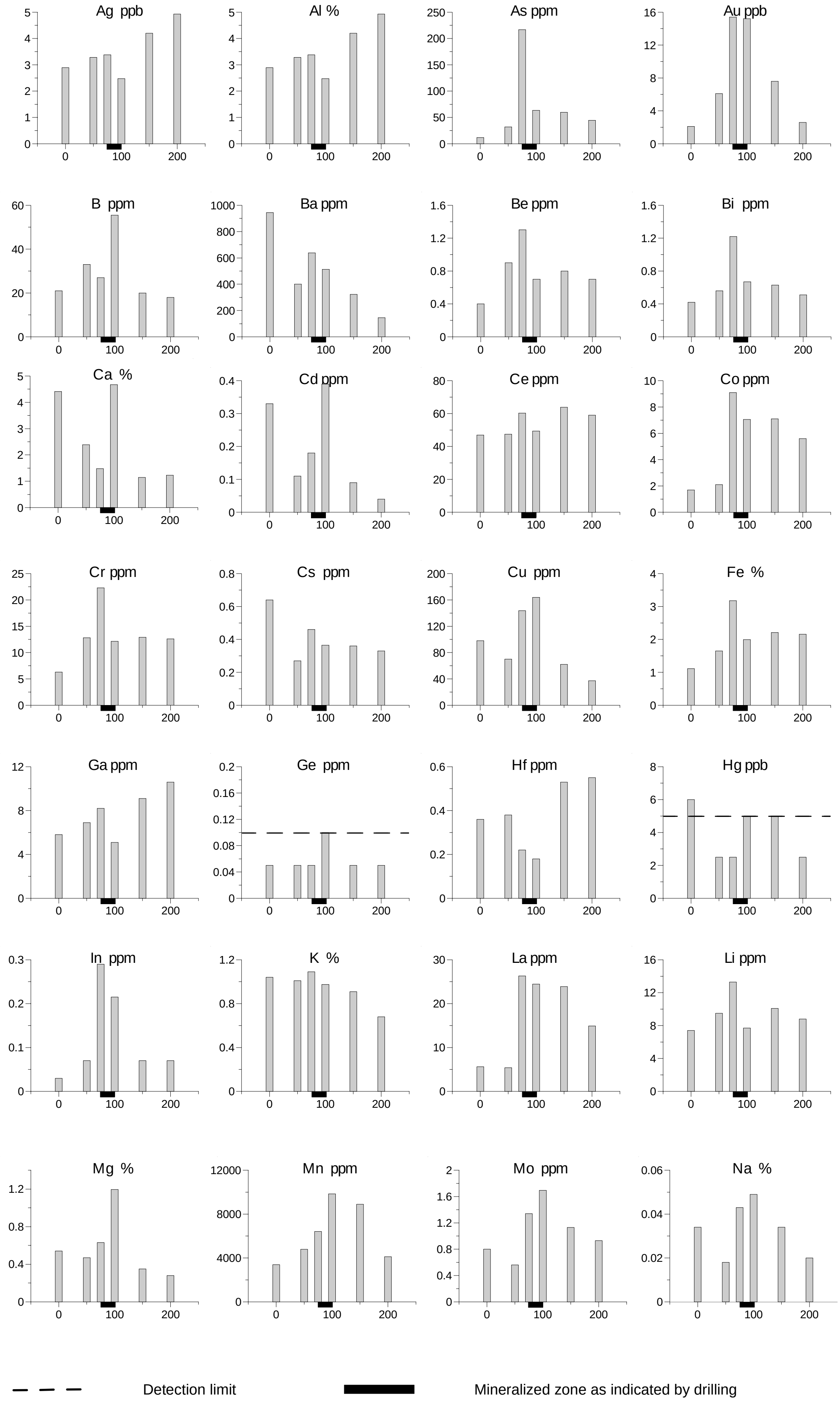
Appendix 2.8.1 Aripuana – Traverse 1 – Saprolite – concentrations vs distance (m)



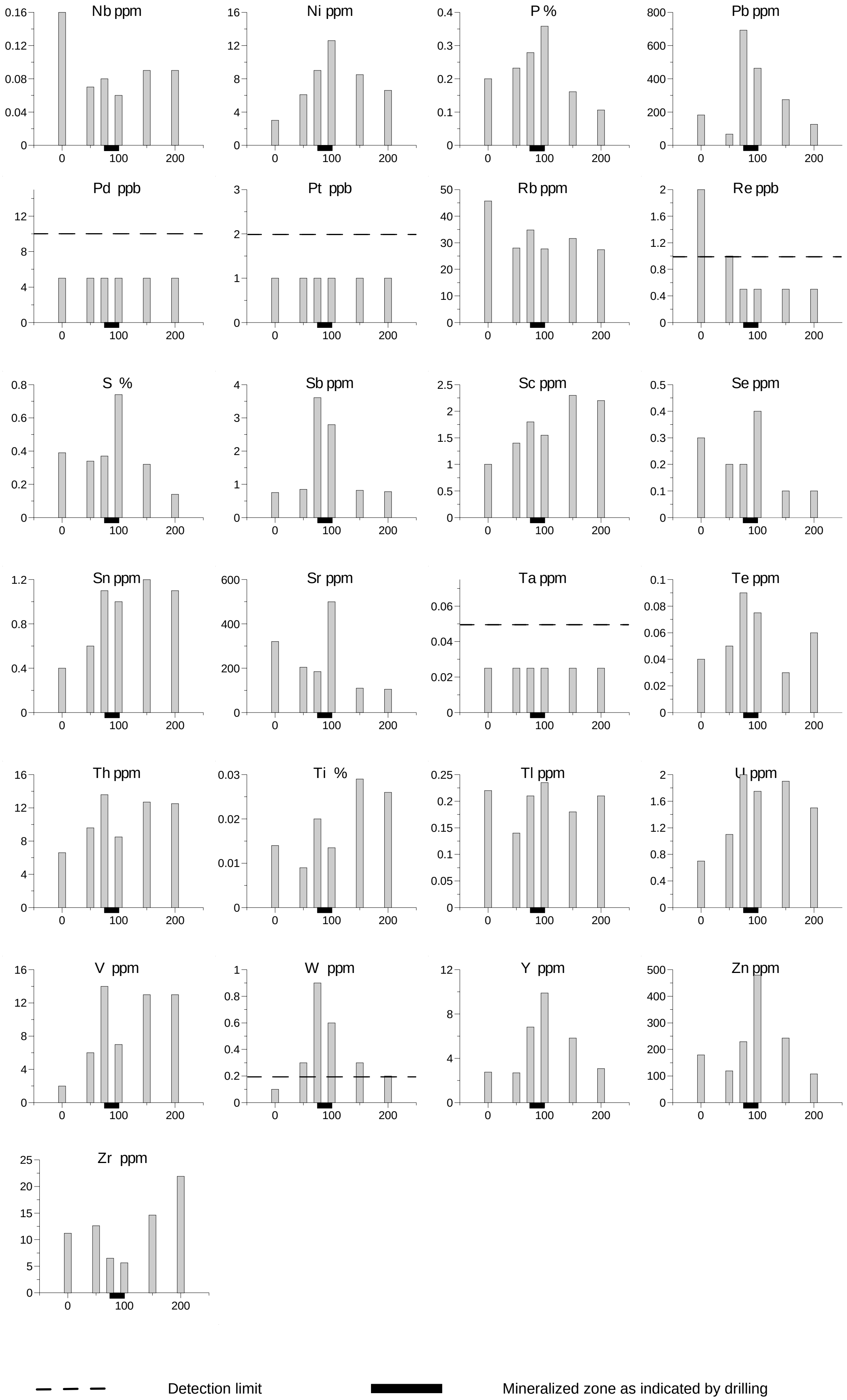
Appendix 2.8.2 Aripuana – Traverse 1 – Saprolite – concentrations vs distance (m)



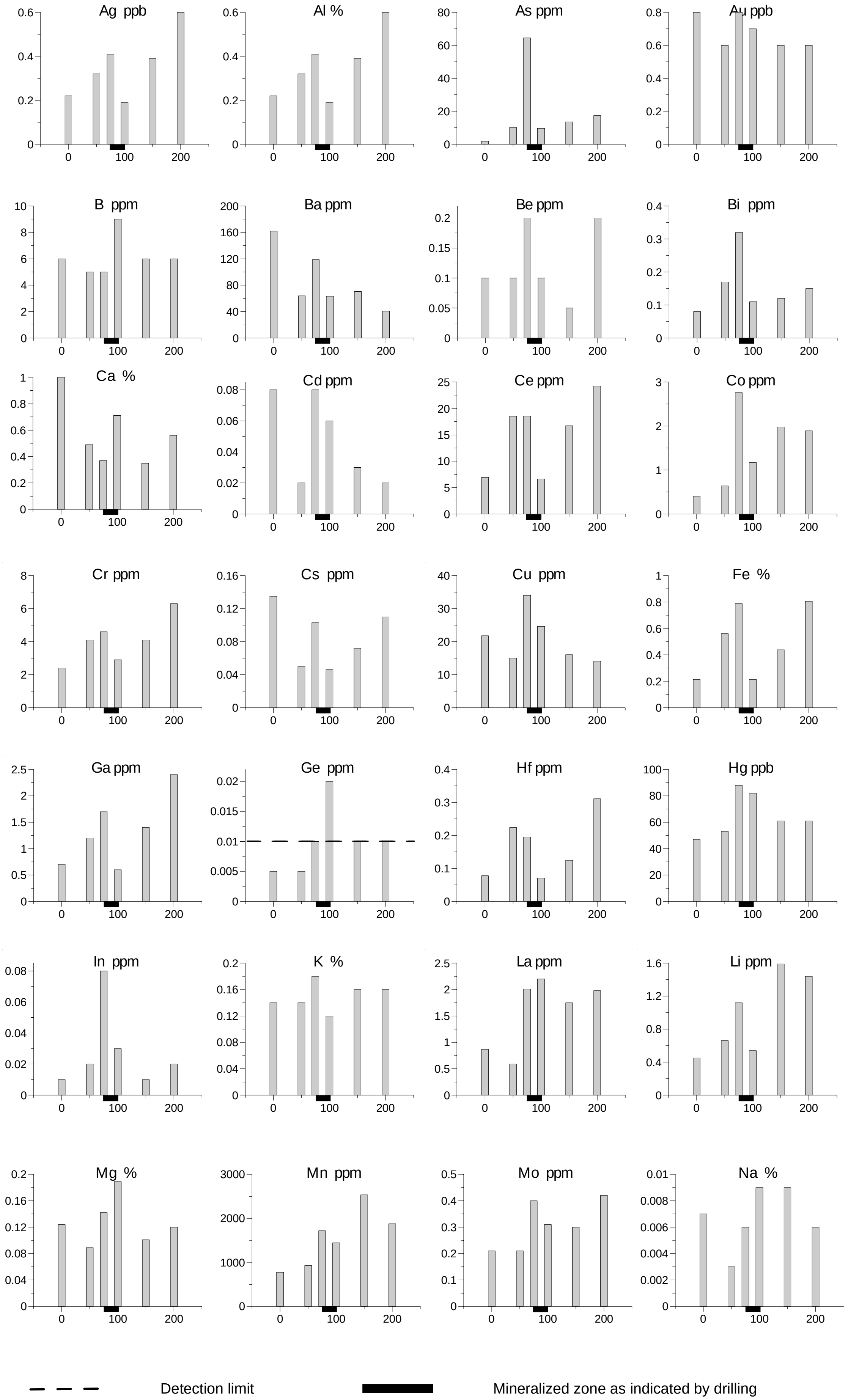
Appendix 2.8.3 Aripuana – Traverse 1 – Saprolite – concentrations vs distance (m)



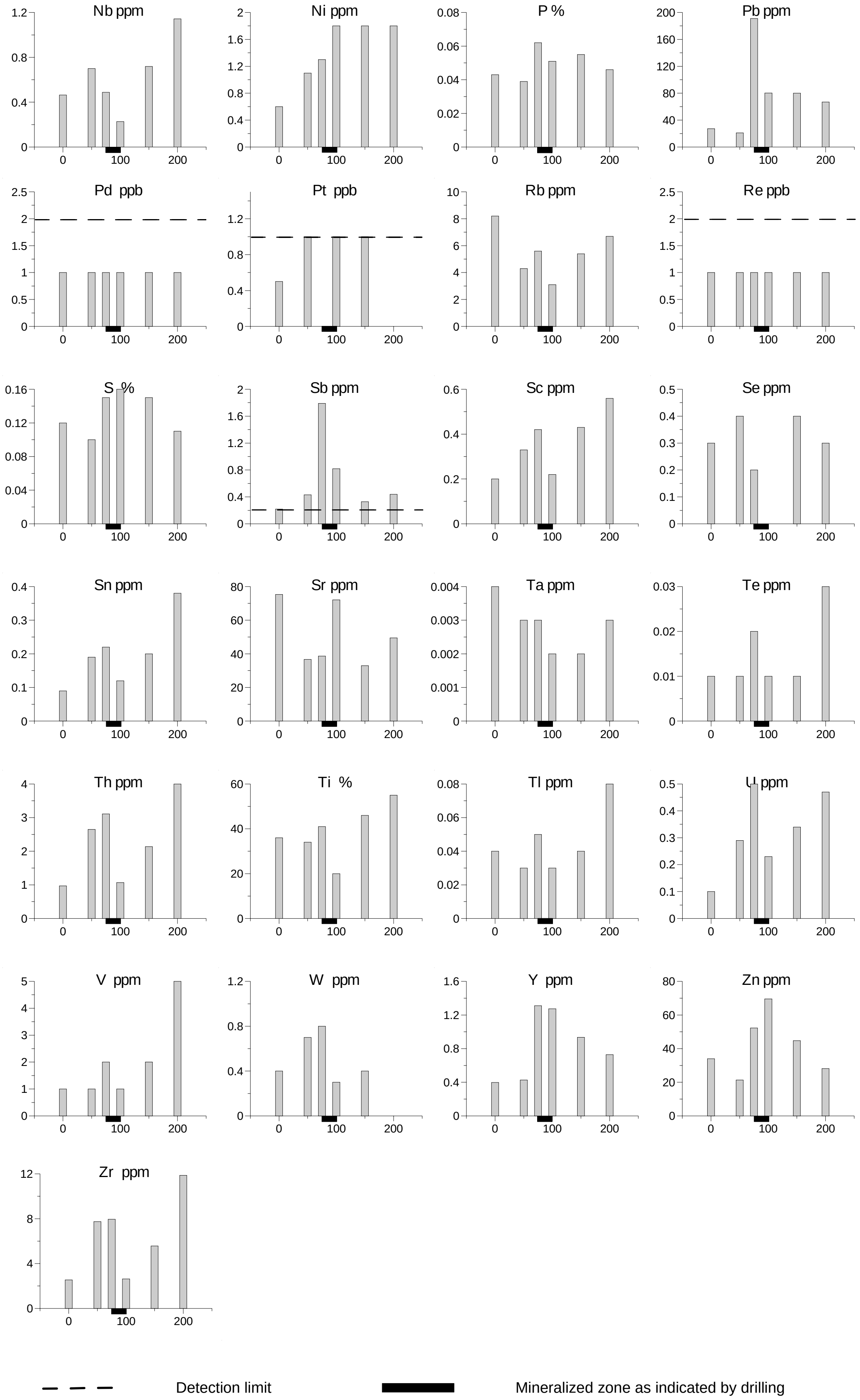
Appendix 2.9.1 Aripuana – Traverse 2 – Mull, ashed – concentrations vs distance (m)



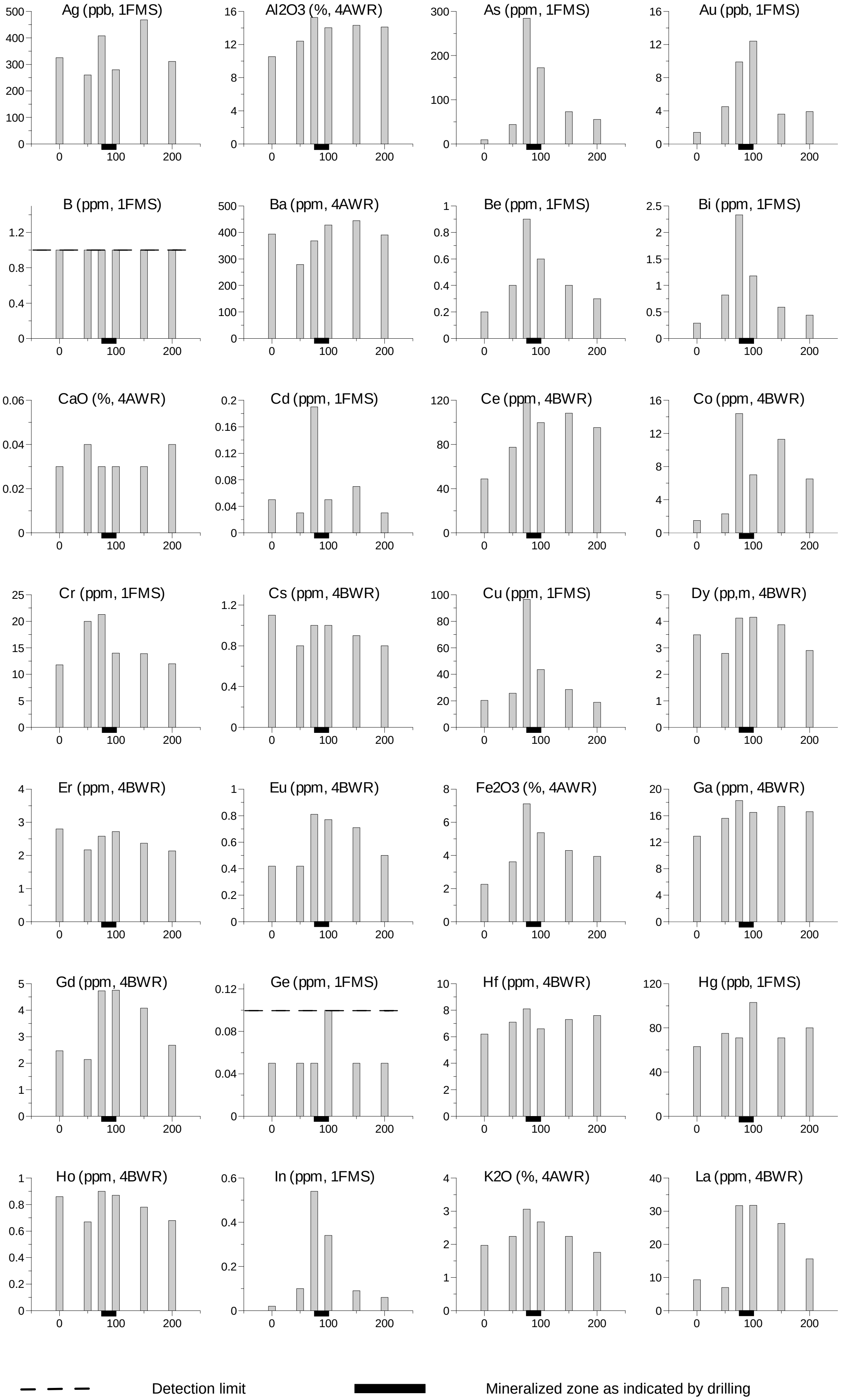
Appendix 2.9.2 Aripuana – Traverse 2 – Mull, ashed – concentrations vs distance (m)



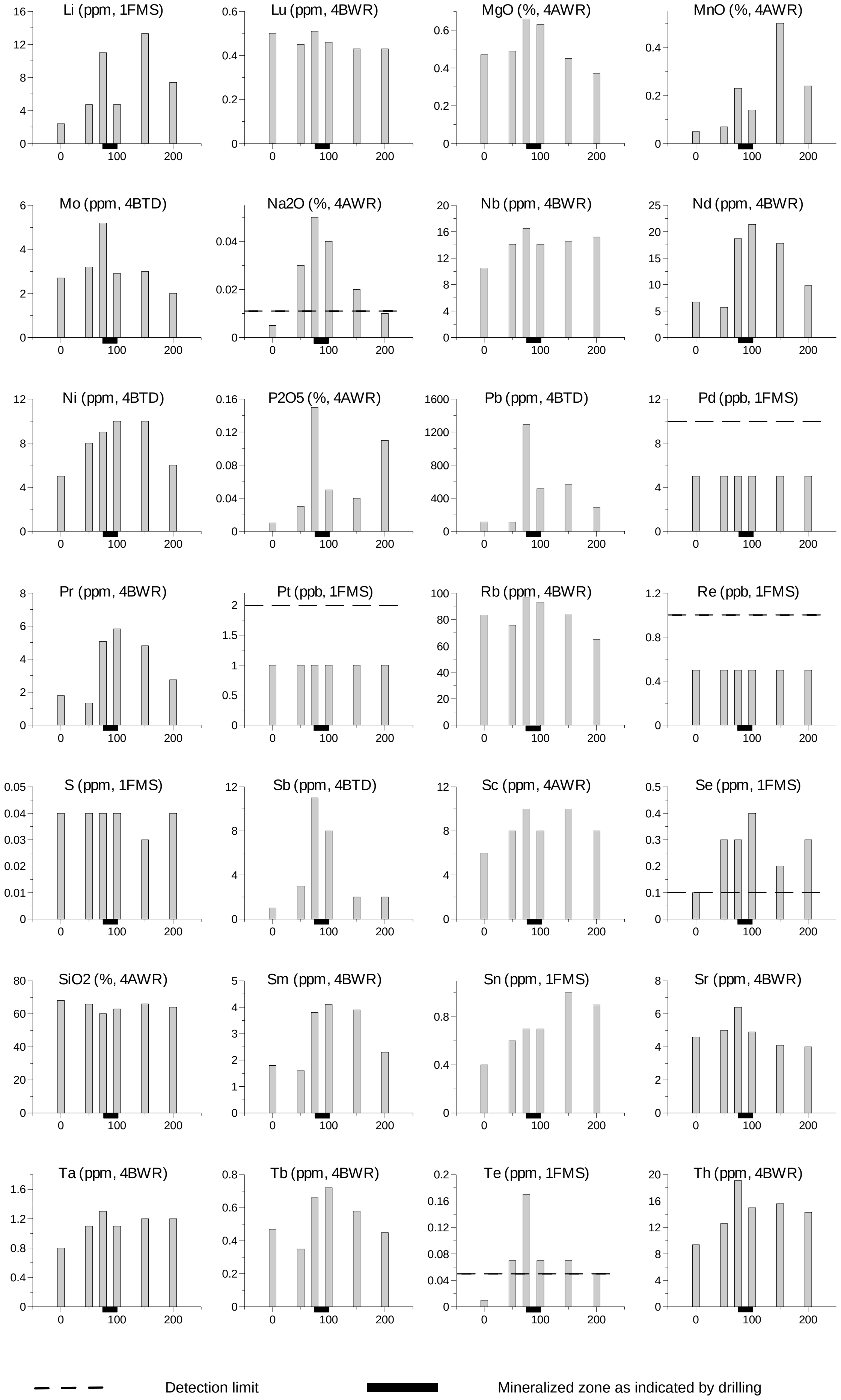
Appendix 2.10.1 Aripuana – Traverse 2 – Mull, dry – concentrations vs distance (m)



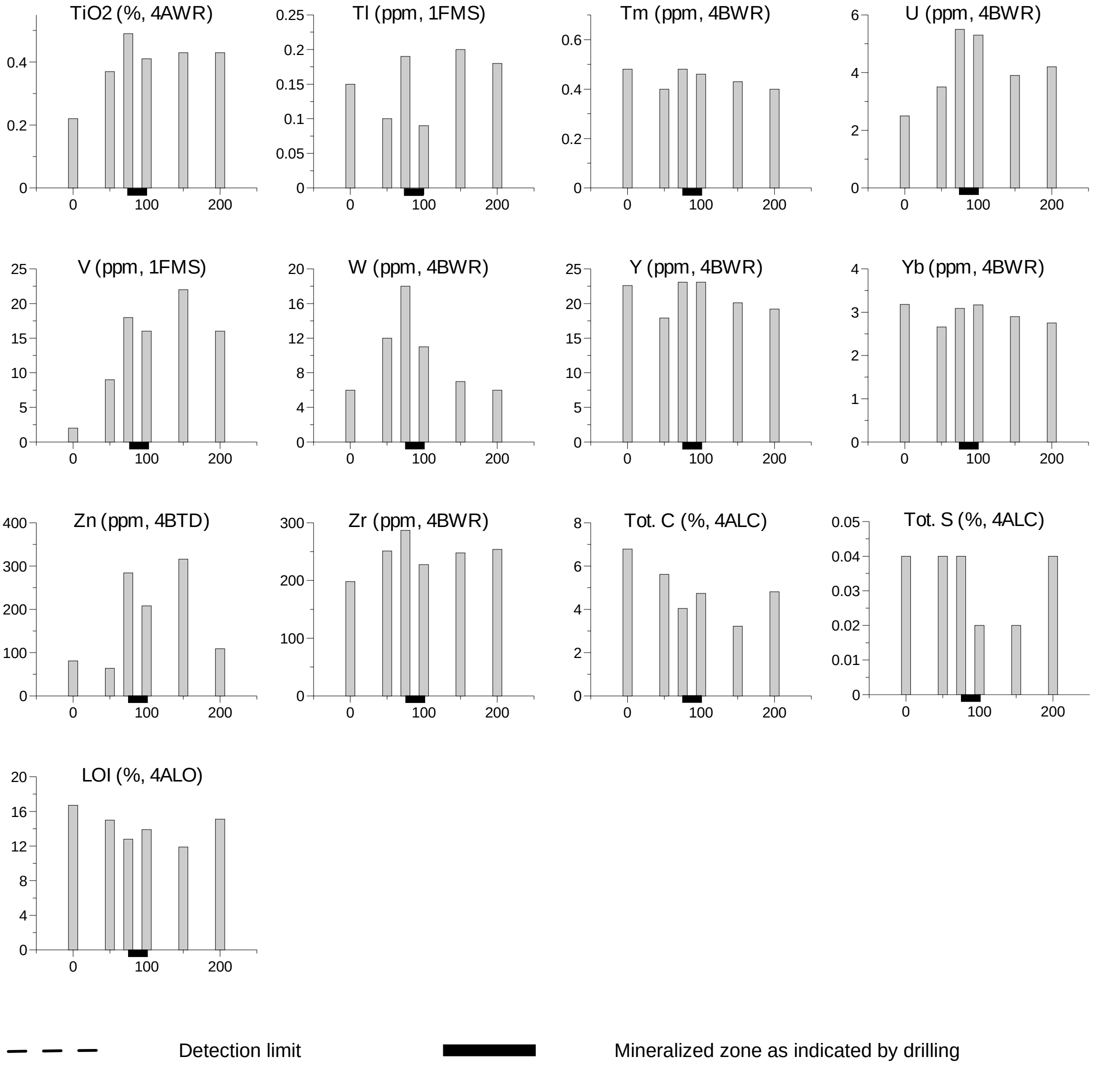
Appendix 2.10.2 Aripuana – Traverse 2 – Mull, dry – concentrations vs distance (m)



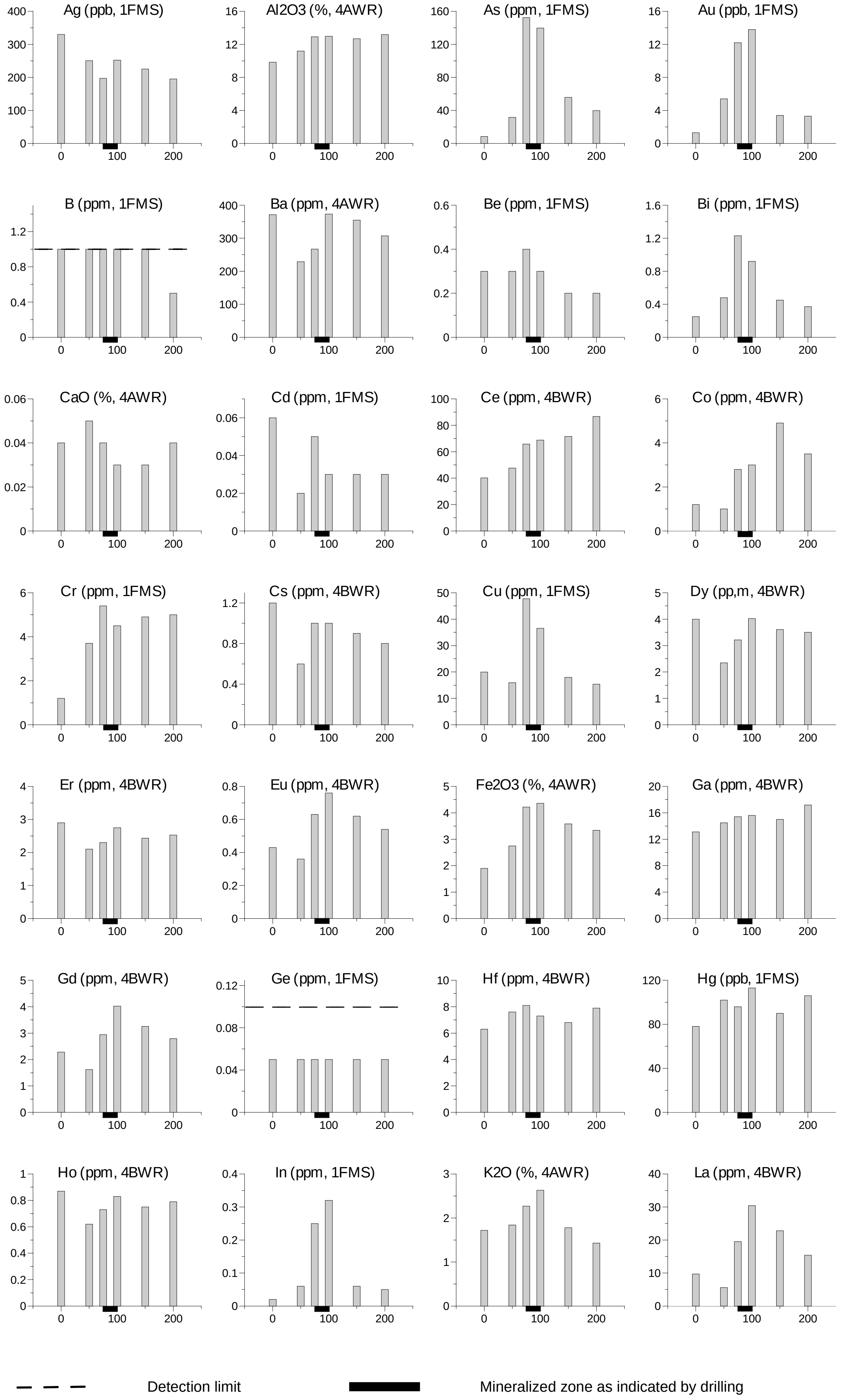
Appendix 2.11.1 Aripuana – Traverse 2 – A-horizon (<75 µm) – concentrations vs distance (m)



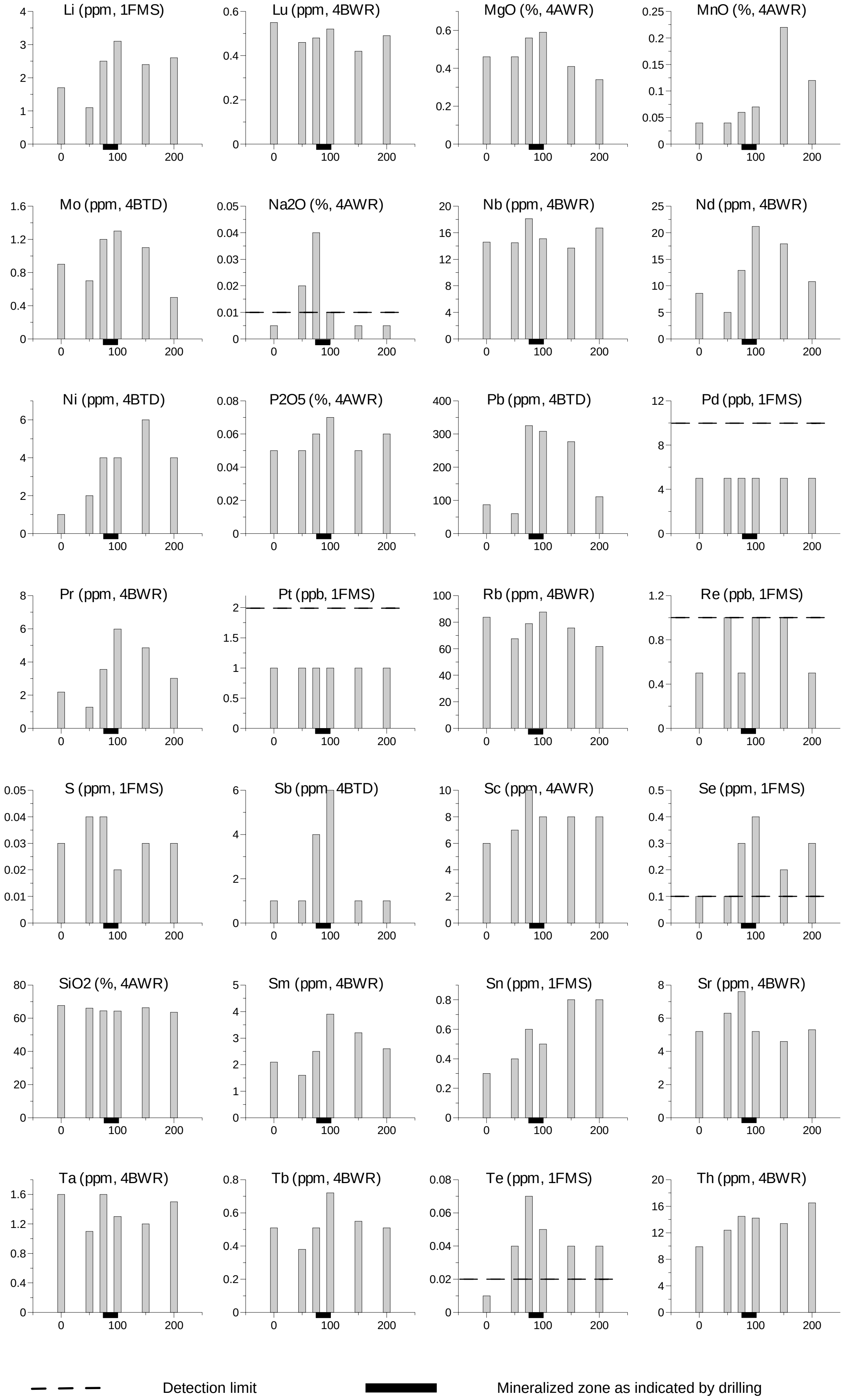
Appendix 2.11.2 Aripuana – Traverse 2 – A-horizon (<75 µm) – concentrations vs distance (m)



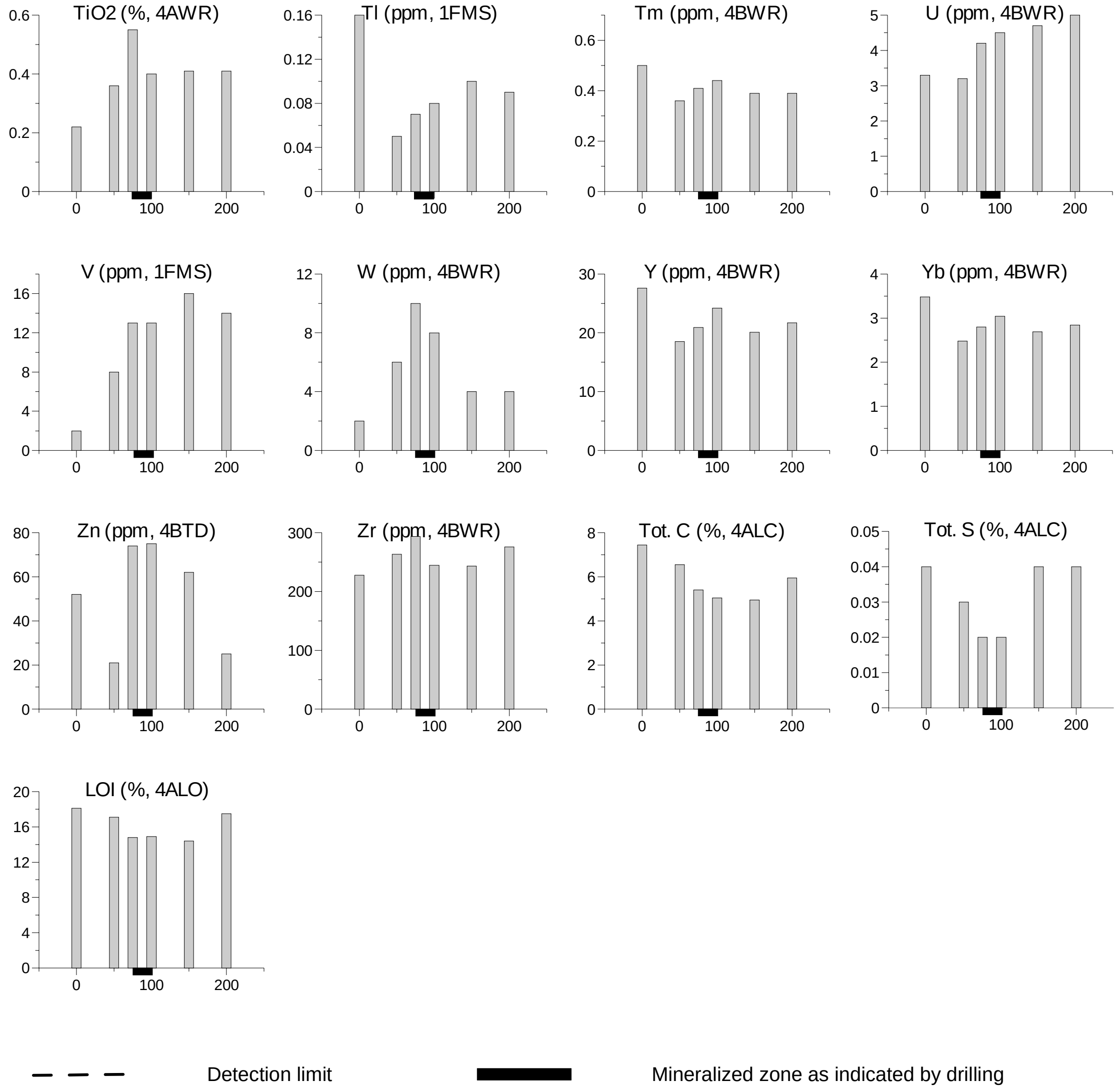
Appendix 2.11.3 Aripuana – Traverse 2 – A-horizon (<75 µm) – concentrations vs distance (m)



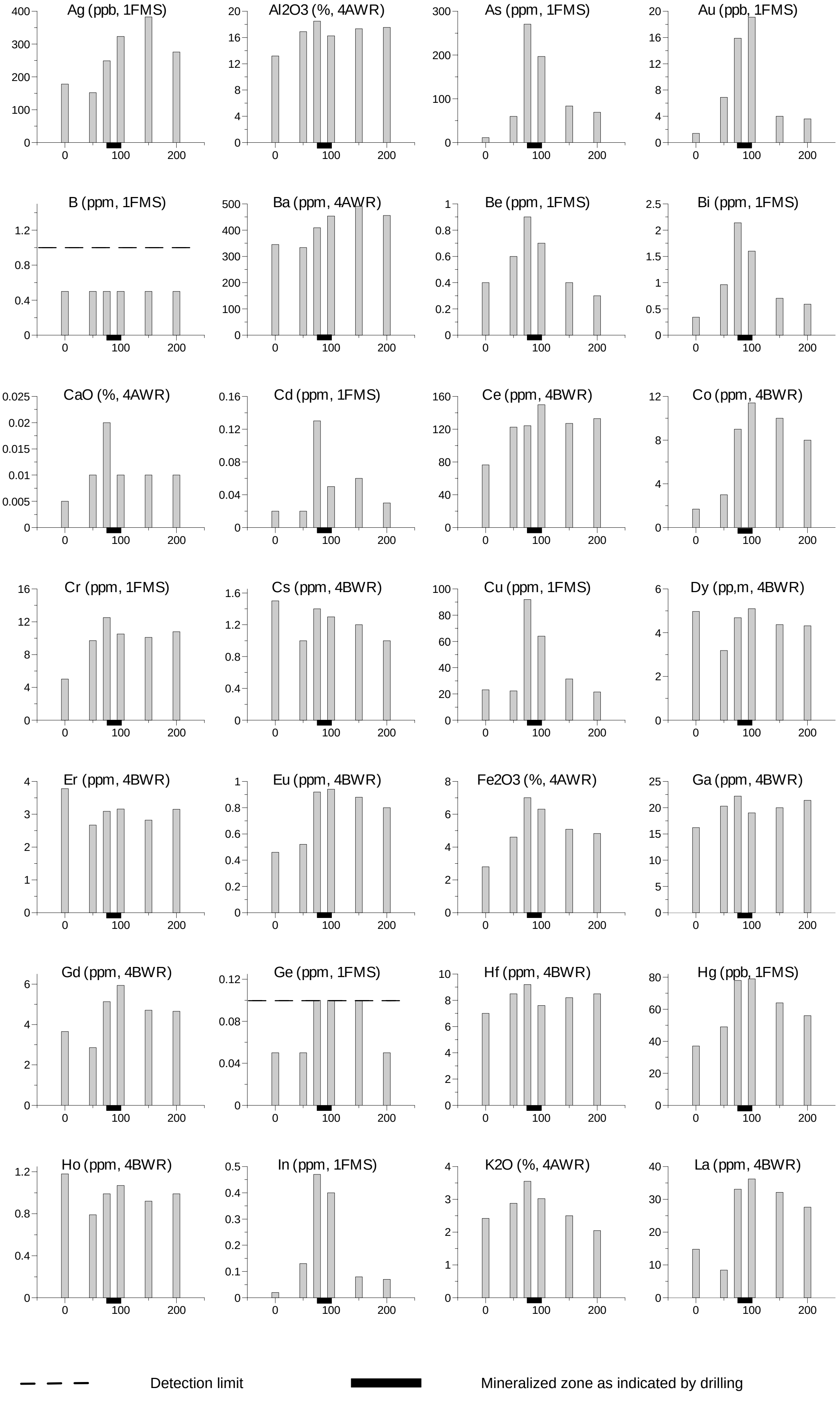
Appendix 2.12.1 Aripuana – Traverse 2 – A-horizon (<250 µm) – concentrations vs distance (m)



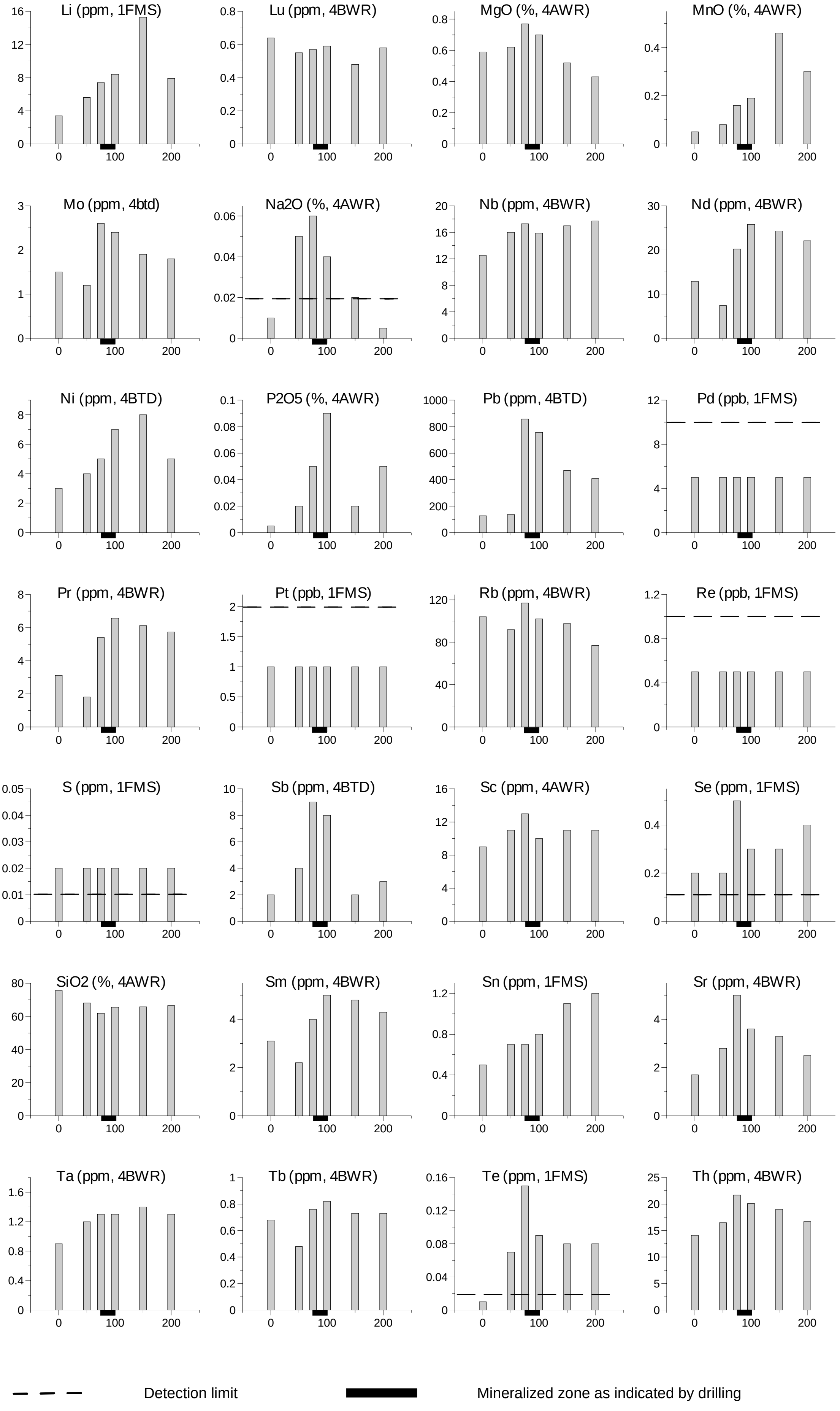
Appendix 2.12.2 Aripuana – Traverse 2 – A-horizon (<250 µm) – concentrations vs distance (m)



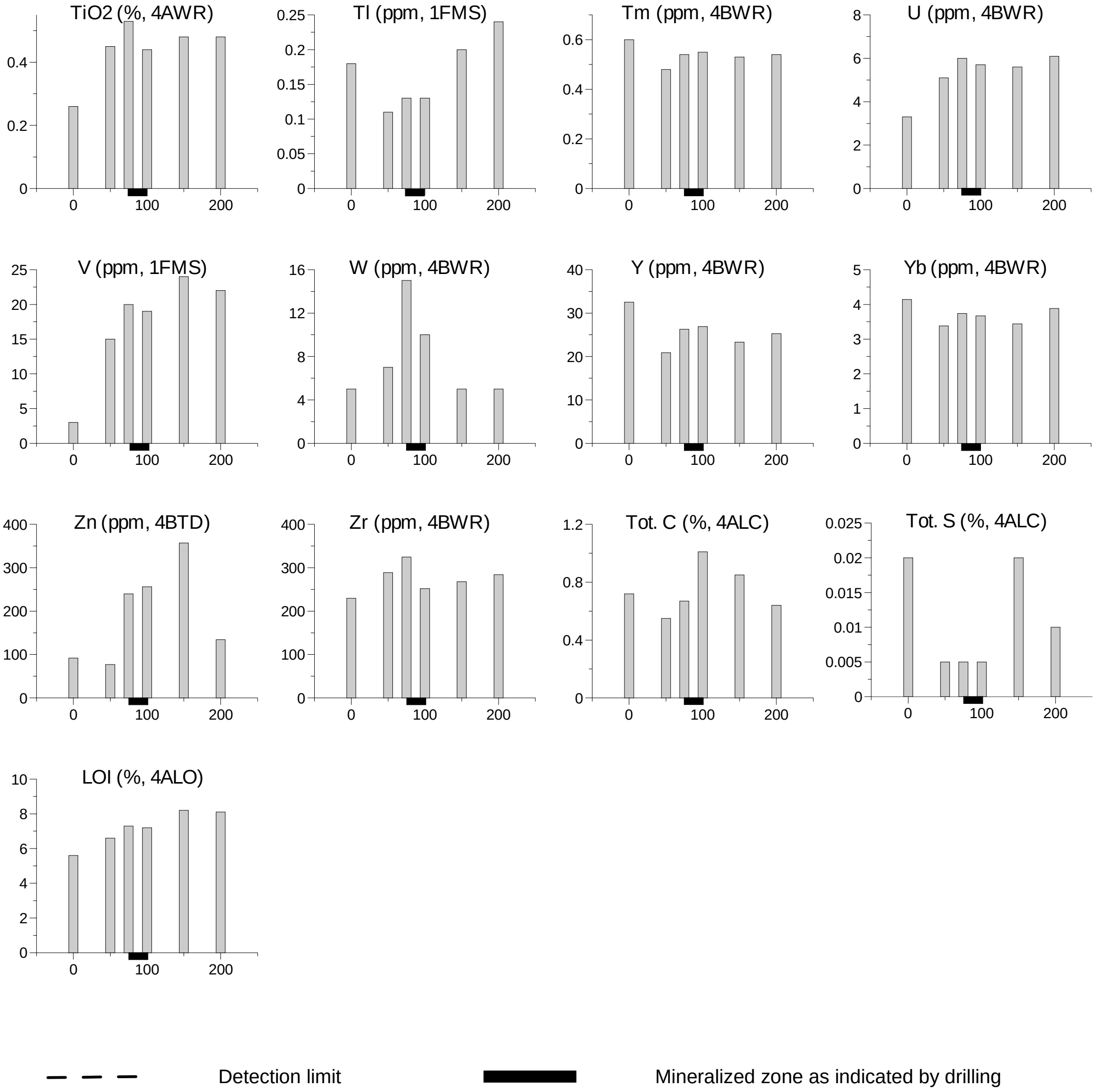
Appendix 2.12.3 Aripuana – Traverse 2 – A-horizon (<250 µm) – concentrations vs distance (m)



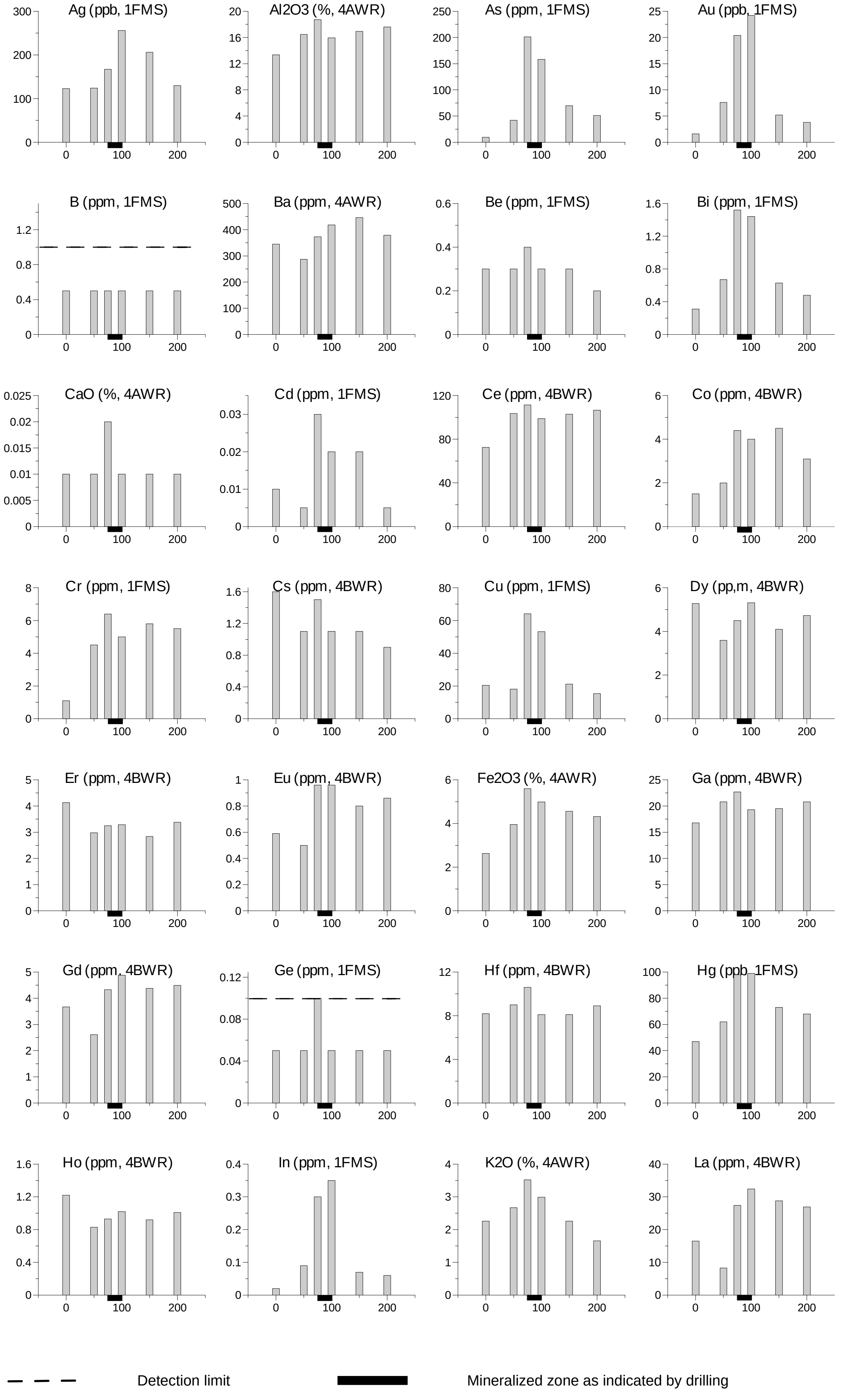
Appendix 2.13.1 Aripuana – Traverse 2 – B-horizon (<75 µm) – concentrations vs distance (m)



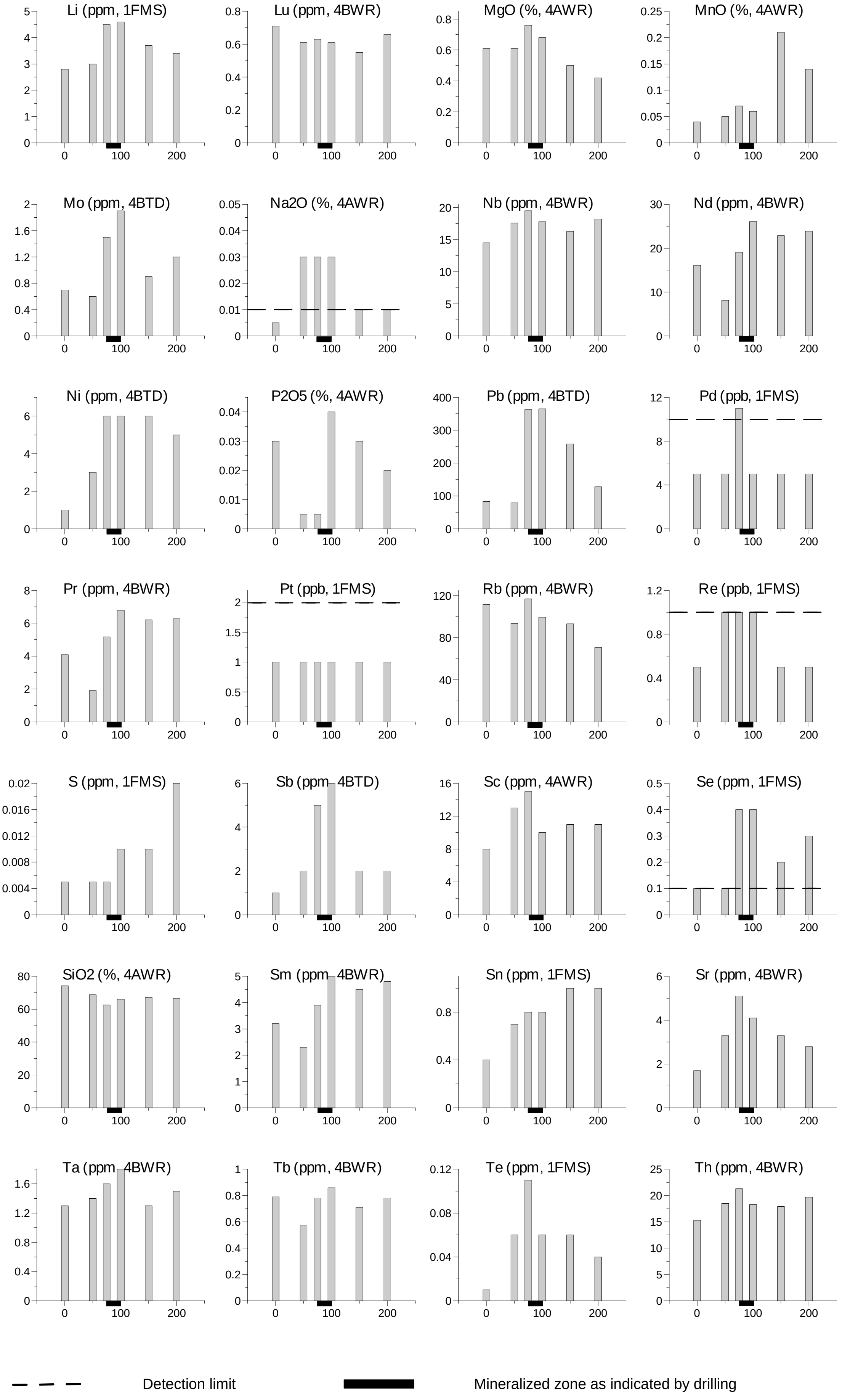
Appendix 2.13.2 Aripuana – Traverse 2 – B-horizon (<75 µm) – concentrations vs distance (m)



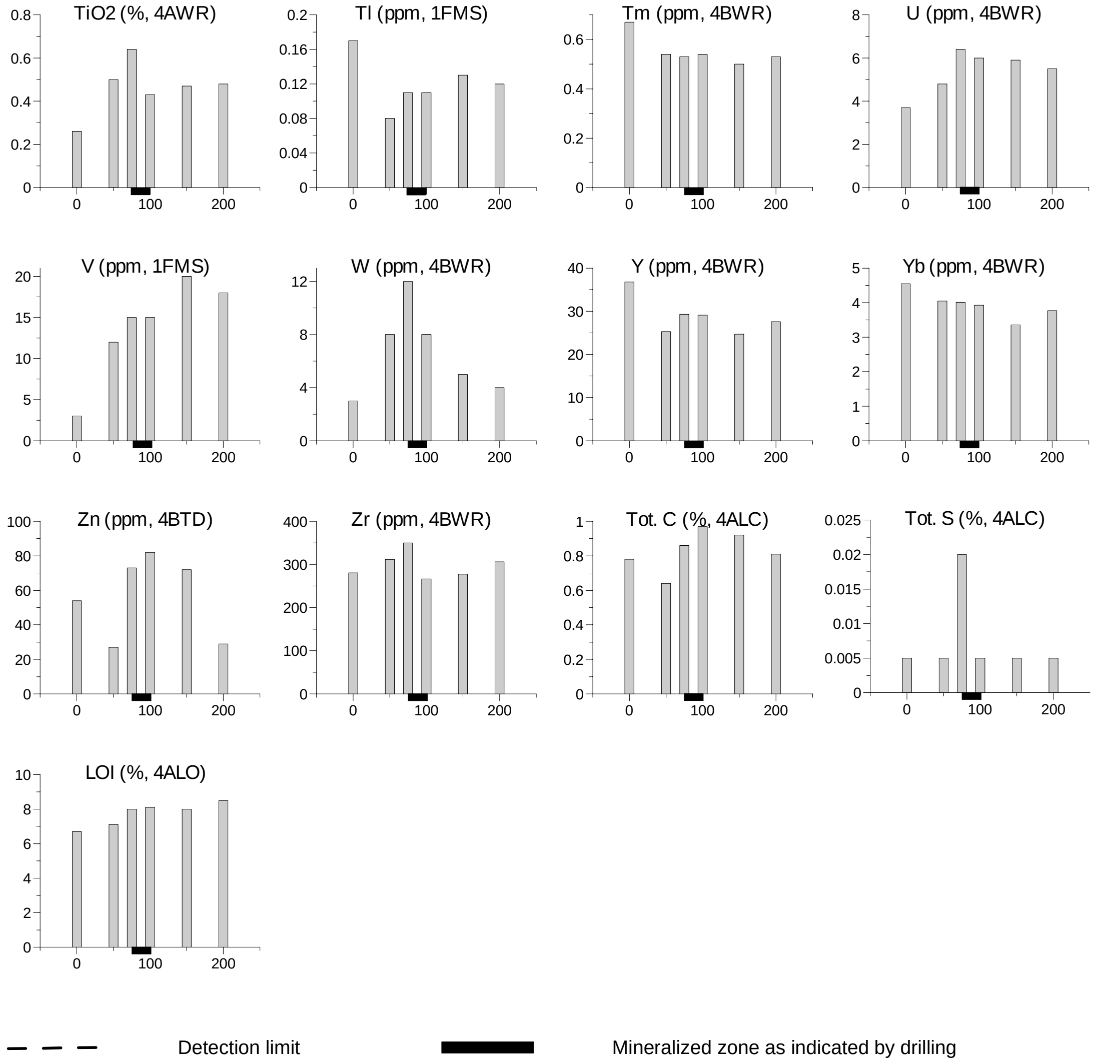
Appendix 2.13.3 Aripuana – Traverse 2 – B-horizon (<75 µm) – concentrations vs distance (m)



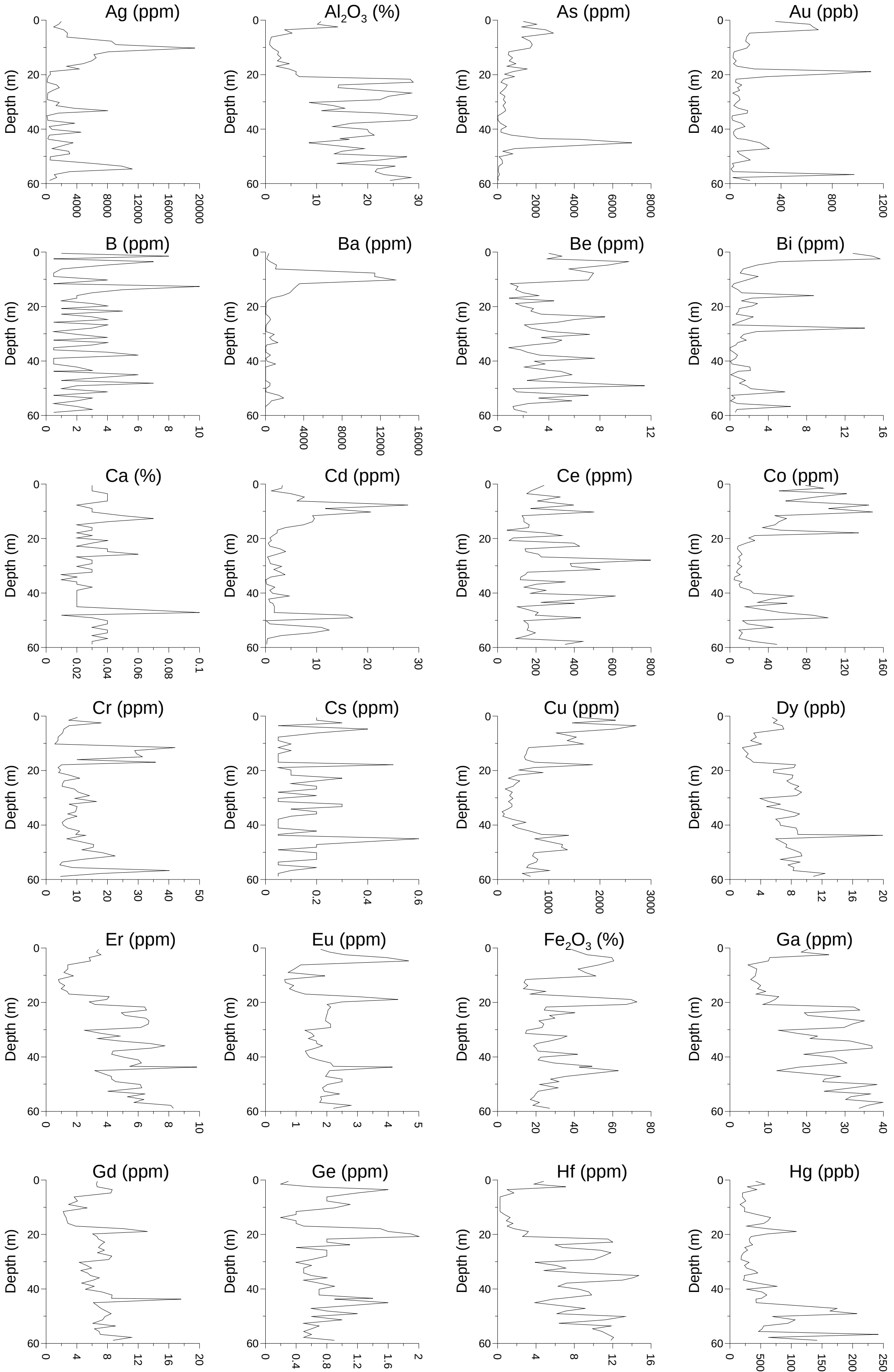
Appendix 2.14.1 Aripuana – Traverse 2 – B-horizon (<250 µm) – concentrations vs distance (m)



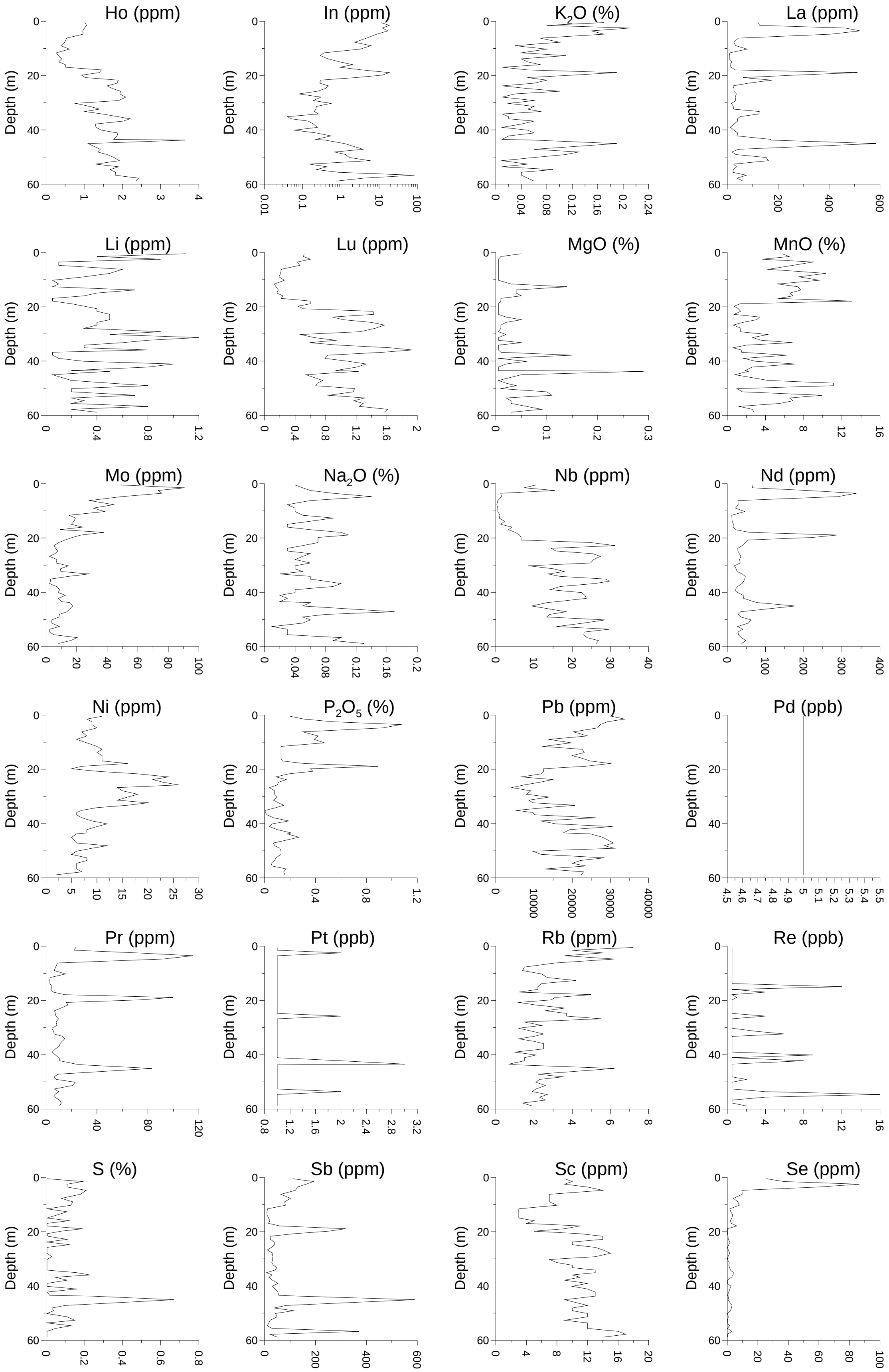
Appendix 2.14.2 Aripuana – Traverse 2 – B-horizon (<250 µm) – concentrations vs distance (m)



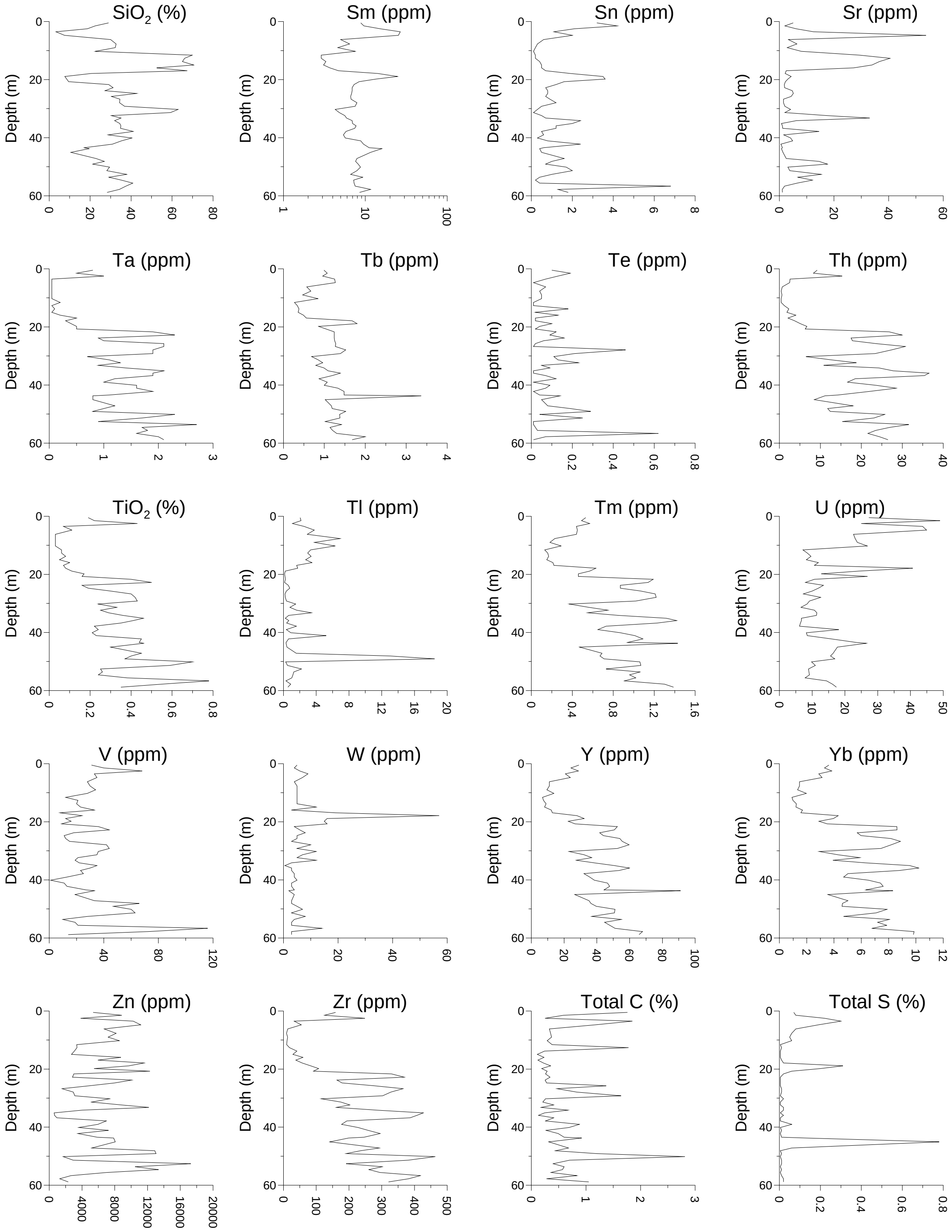
Appendix 2.14.3 Aripuana – Traverse 2 – B-horizon (<250 µm) – concentrations vs distance (m)



Appendix 2.15.1 Aripuana – FEX6 drill hole – down hole analyses



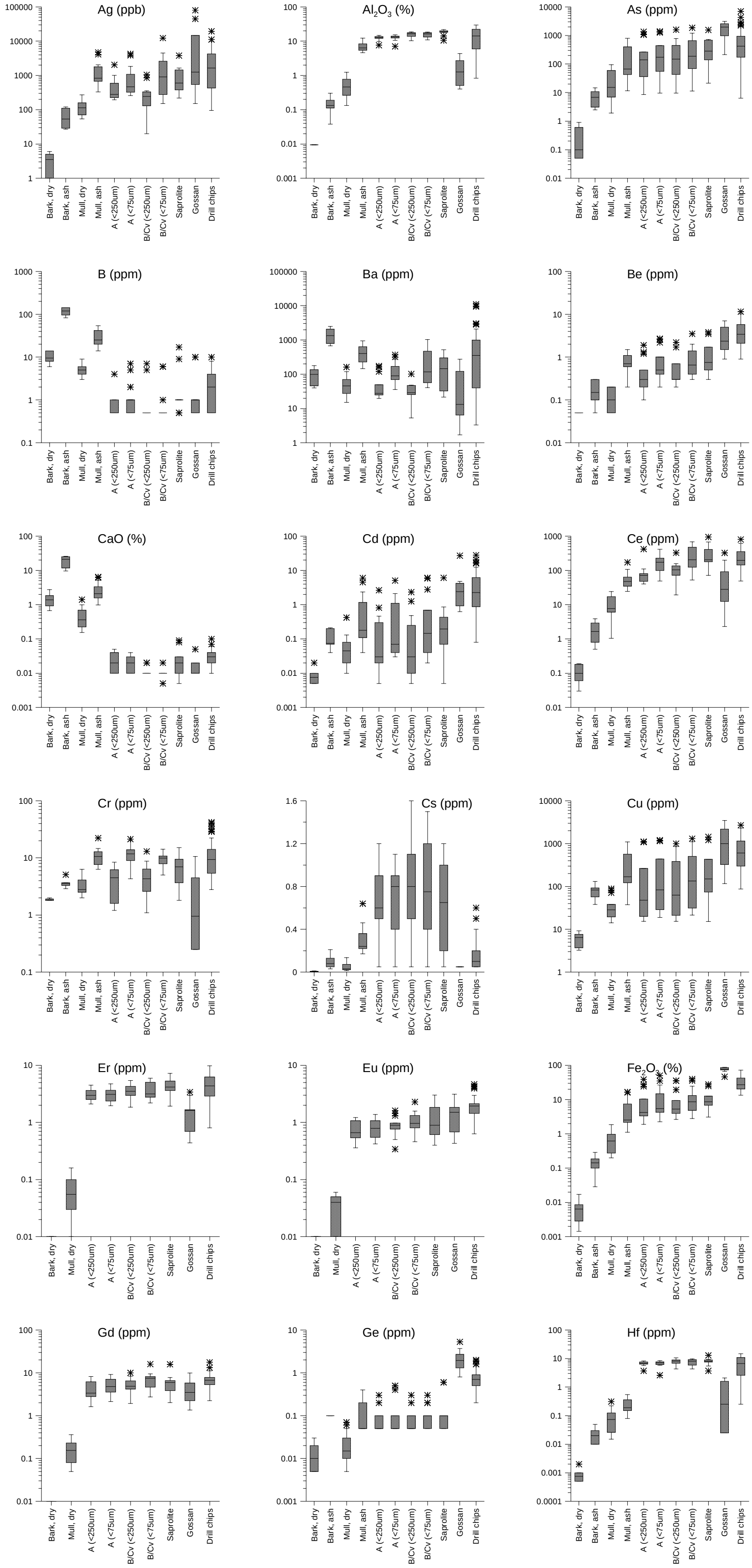
Appendix 2.15.2 Aripuana – FEX6 drill hole – down hole analyses



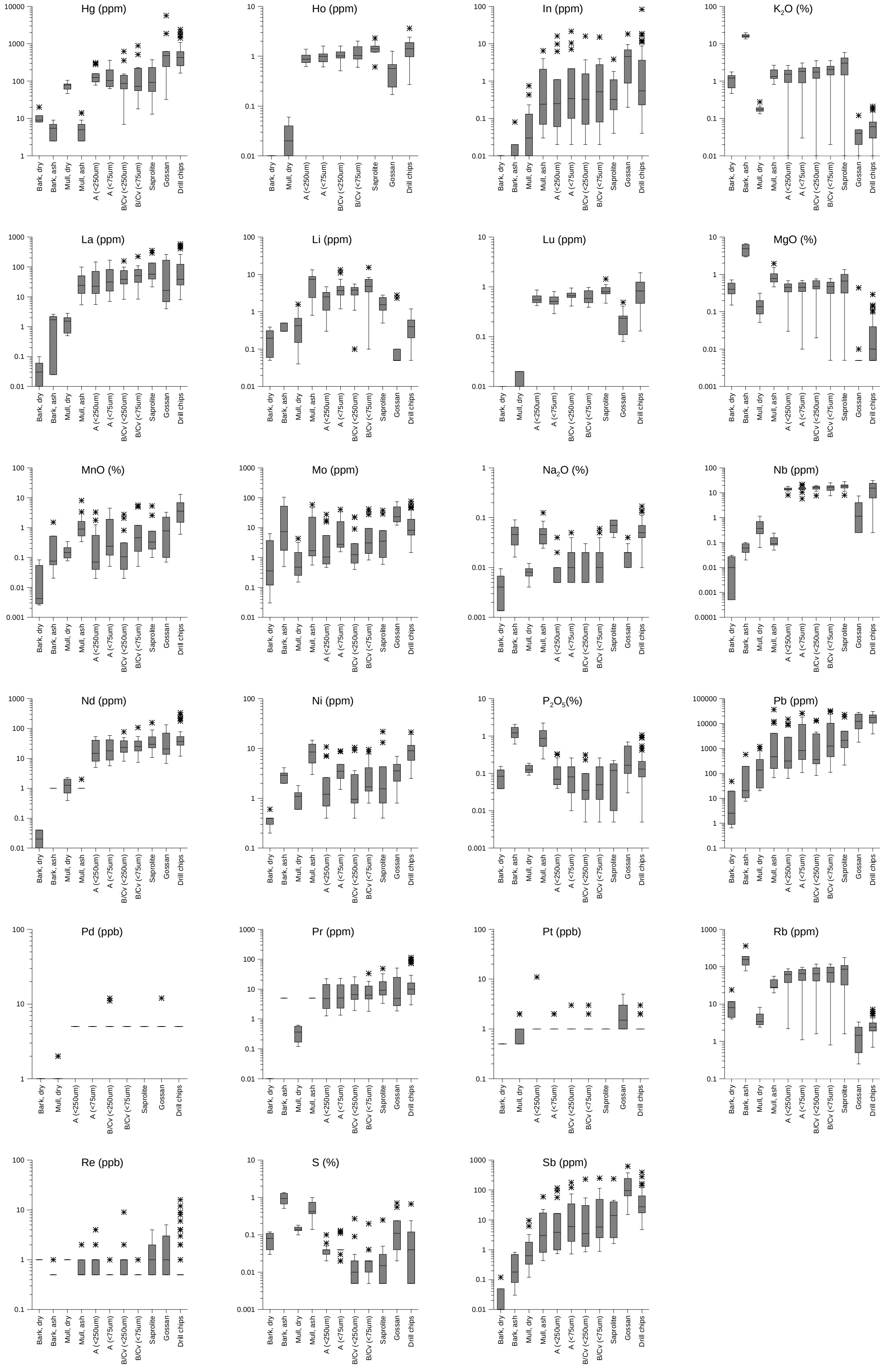
Appendix 2.15.3 Aripuana – FEX6 drill hole – down hole analyses

# Appendix 3

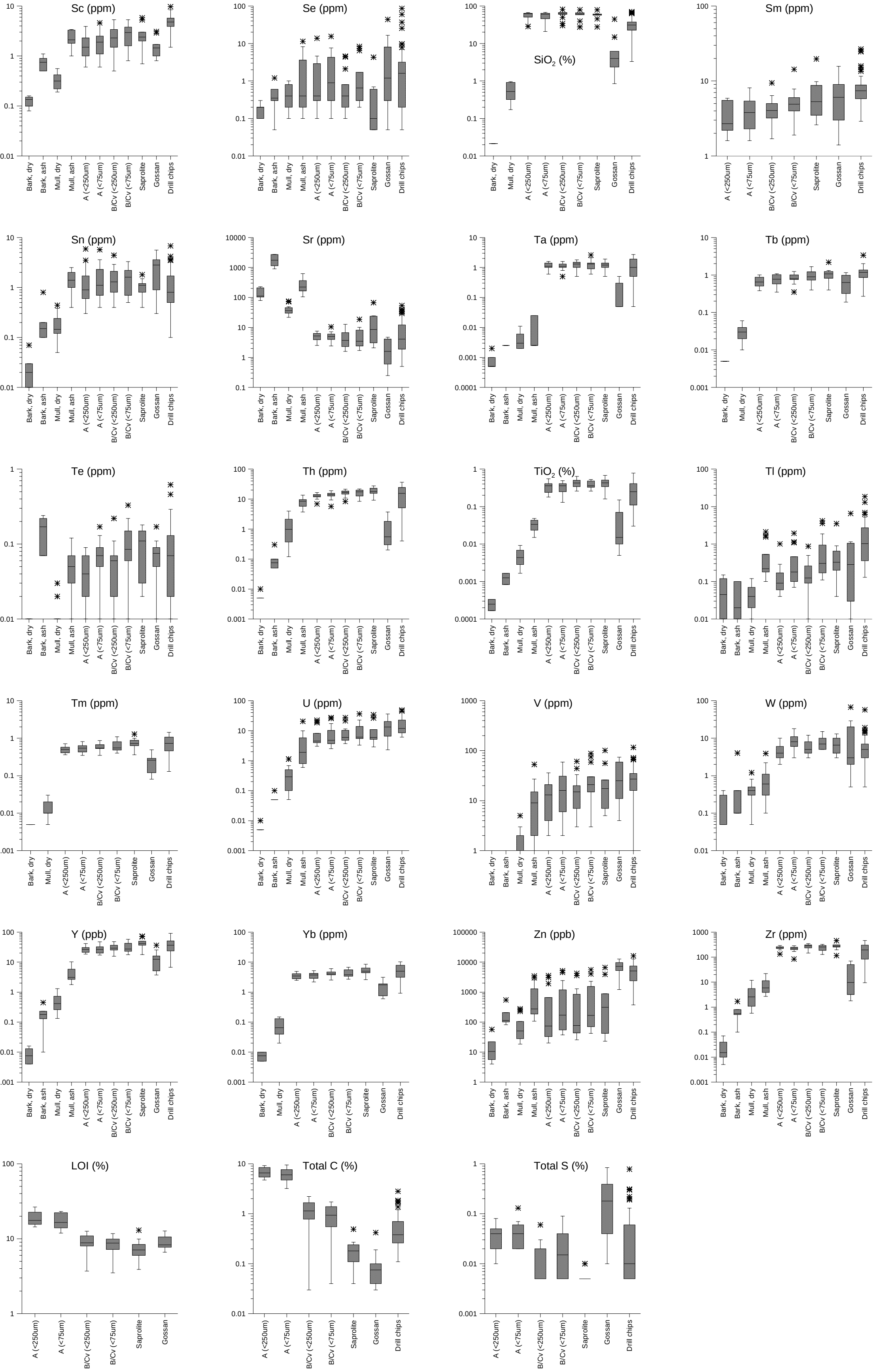
## Box plots for all elements and sample media



Appendix 3.1 Box plots for all elements and sample media



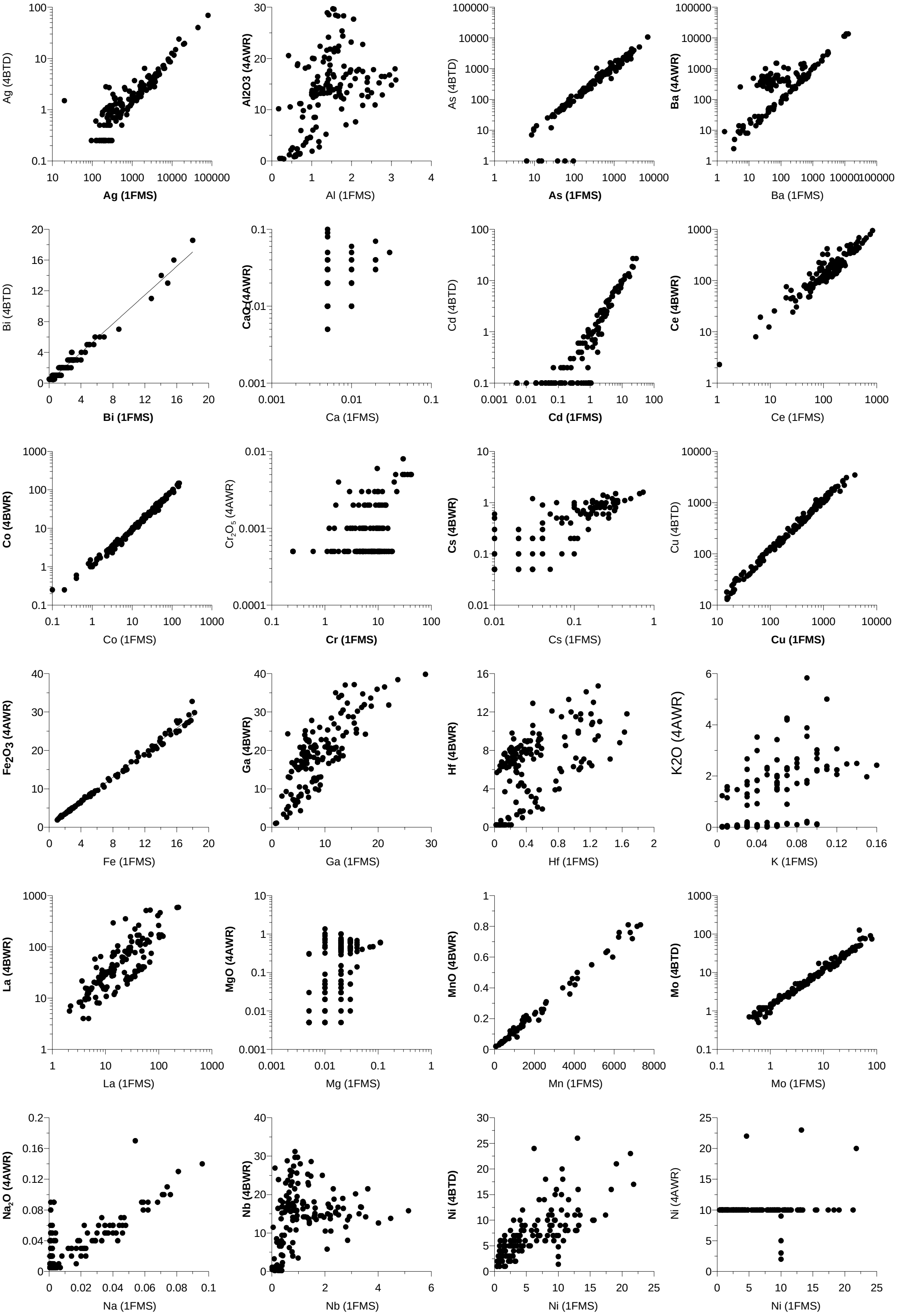
Appendix 3.2 Box plots for all elements and sample media



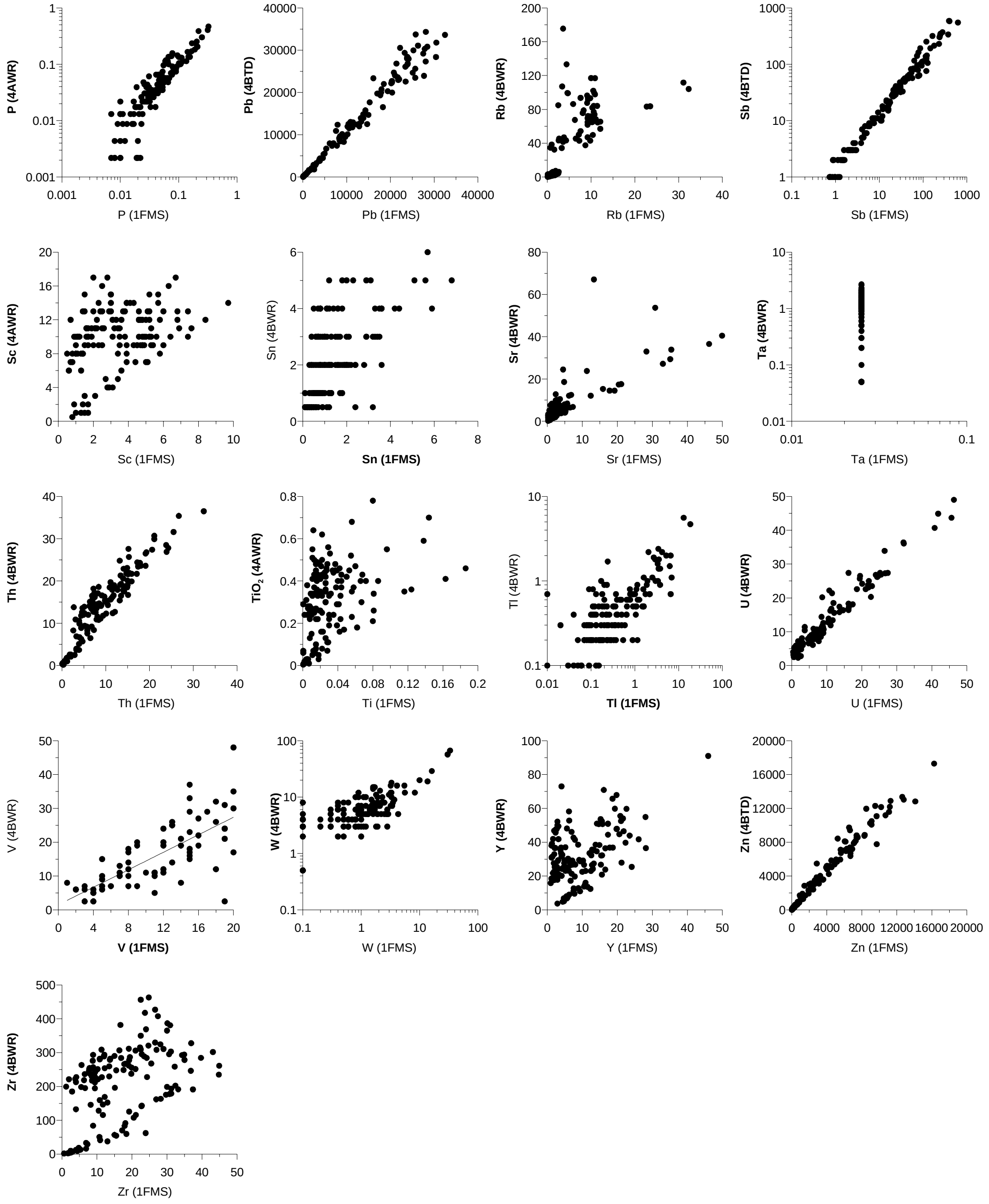
Appendix 3.3 Box plots for all elements and sample media

# Appendix 4

## Comparison of different analytical techniques



Appendix 4.1 Scatter plots of element concentrations by different analytical techniques (some plots with regression lines).



Appendix 4.2 Scatter plots of element concentrations by different analytical techniques (some plots with regression lines).

# Appendix 5

## Sample locations

| Count | Prospect | Traverse no | Sample/site no | Distance from start of traverse | Anglo sample no | UTM North | UTM South | Sample type | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ambrex | | A001 | | | 8888212 | 225525 | Surface gossan | |
| 2 | Ambrex | | A002 | | | 8888150 | 225370 | Gossan in trench | |
| 3 | Ambrex | | A003 | | | 8888150 | 225370 | Gossan in trench | |
| 4 | Ambrex | | A004 | | | 8888100 | 225890 | Massive gossan outcrop | |
| 5 | Ambrex | | A005 | | | 8888240 | 225880 | Small gossan beneath soil | |
| 6 | Ambrex | | A006 | | | 8887094 | 226770 | Gossan on top of hill | |
| | | | | | | | | | |
| 7 | Ambrex | Traverse 1 | Site 1 | 420 | 90857 | 8888210 | 225900 | Organic matter | Mull, scraped beneath loose leaves |
| 8 | Ambrex | Traverse 1 | Site 1 | 420 | 90858 | | | A-horizon | Ca. 5-10 cm, reddish brown, qtz fragm. |
| 9 | Ambrex | Traverse 1 | Site 1 | 420 | 90859 | | | Colluvium | 40 cm deep, |
| 10 | Ambrex | Traverse 1 | Site 1 | 420 | 90860 | | | Saprolitic clay | 80 cm deep, yellowish |
| 11 | Ambrex | Traverse 1 | Site 1 | 420 | 90861 | | | Upper gossan | massive black to red |
| 12 | Ambrex | Traverse 1 | Site 1 | 420 | 90862 | | | Friable gossan | blackish |
| 13 | Ambrex | Traverse 1 | Site 1 | 420 | 90863 | | | Lower gossan | massive |
| 14 | Ambrex | Traverse 1 | Site 2 | 450 | 90864 | 8888182 | 225913 | Gossan, silicified | massive |
| 15 | Ambrex | Traverse 1 | Site 2 | 450 | 90865 | | | Gossan, black, friable | black to red |
| 16 | Ambrex | Traverse 1 | Site 2 | 450 | 90866 | | | Colluvium | 20 cm deep |
| 17 | Ambrex | Traverse 1 | Site 2 | 450 | 90867 | | | Saprolite | yellow |
| 18 | Ambrex | Traverse 1 | Site 2 | 450 | 90868 | | | A-horizon | |
| 19 | Ambrex | Traverse 1 | Site 2 | 450 | 90869 | | | Organic matter | |
| 20 | Ambrex | Traverse 1 | Site 3 | 490 | 90870 | 8888152 | 225936 | Organic matter | |
| 21 | Ambrex | Traverse 1 | Site 3 | 490 | 90871 | | | A-horizon | red brown |
| 22 | Ambrex | Traverse 1 | Site 3 | 490 | 90872 | | | Colluvium | poorly developed, few coarse fragm |
| 23 | Ambrex | Traverse 1 | Site 3 | 490 | 90873 | | | Saprolite | Yellowish, little chlorite |
| 24 | Ambrex | Traverse 1 | Site 4 | 520 | 90874 | 8888150 | 225982 | Colluvium | 40 cm deep |
| 25 | Ambrex | Traverse 1 | Site 4 | 520 | 90875 | | | Saprolite | 150 cm deep. white kaolinitic |
| 26 | Ambrex | Traverse 1 | Site 4 | 520 | 90876 | | | A-Horizon | |
| 27 | Ambrex | Traverse 1 | Site 4 | 520 | 90877 | | | Organic matter | |
| 28 | Ambrex | Traverse 1 | Site 5 | 580 | 90878 | 8888103 | 226018 | Saprolite | Chlorite schist, purple-red |
| 29 | Ambrex | Traverse 1 | Site 5 | 580 | 90879 | | | Colluvium | |
| 30 | Ambrex | Traverse 1 | Site 5 | 580 | 90880 | | | A-horizon | brownish yellow |
| 31 | Ambrex | Traverse 1 | Site 5 | 580 | 90881 | | | Organic matter | Very thin, mixed with clay |
| 32 | Ambrex | Traverse 1 | Site 6 | 690 | 90882 | 8888051 | 226092 | Saprolite | orange to light red, wt chl. sh bands |
| 33 | Ambrex | Traverse 1 | Site 6 | 690 | 90883 | | | Colluvium | |
| 34 | Ambrex | Traverse 1 | Site 6 | 690 | 90884 | | | A-horizon | dark brown |
| 35 | Ambrex | Traverse 1 | Site 6 | 690 | 90885 | | | Organic matter | |
| 36 | Ambrex | Traverse 1 | Site 7 | 380 | 90886 | 8888240 | 225855 | Saprolite | pink to orange and white bands |
| 37 | Ambrex | Traverse 1 | Site 7 | 380 | 90887 | | | Colluvium | scattered gossan fragm |
| 38 | Ambrex | Traverse 1 | Site 7 | 380 | 90888 | | | A-horizon] | |
| 39 | Ambrex | Traverse 1 | Site 7 | 380 | 90889 | | | Organic matter | very thick, 20-30 cm |
| 40 | Ambrex | Traverse 1 | Site 7 | 380 | 90890 | | | Gossan | |

| Count | Prospect | Traverse no | Sample/site no | Distance from start of traverse | Anglo sample no | UTM North | UTM South | Sample type | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 41 | Ambrex | Traverse 1 | Site 8 | 300 | 90891 | 8888265 | 225782 | Saprolite | Light color, little chlorite, saprock |
| 42 | Ambrex | Traverse 1 | Site 8 | 300 | 90892 | | | Colluvium | Contains some gossan fragments |
| 43 | Ambrex | Traverse 1 | Site 8 | 300 | 90893 | | | A-horizon | |
| 44 | Ambrex | Traverse 1 | Site 8 | 300 | 90894 | | | Organic matter | |
| 45 | Ambrex | Traverse 1 | Site 9 | 200 | 90895 | 8888304 | 225701 | Saprolite | at FAREX34, |
| 46 | Ambrex | Traverse 1 | Site 9 | 200 | 90896 | | | Colluvium | |
| 47 | Ambrex | Traverse 1 | Site 9 | 200 | 90897 | | | A-horizon | |
| 48 | Ambrex | Traverse 1 | Site 9 | 200 | 90898 | | | Organic matter | Contains clay and silt |
| 49 | Ambrex | Traverse 1 | Site 10 | 0 | 90899 | 8888352 | 225515 | Saprolite | sericite schist, pink to white |
| 50 | Ambrex | Traverse 1 | Site 10 | 0 | 90900 | | | Colluvium | |
| 51 | Ambrex | Traverse 1 | Site 10 | 0 | 90901 | | | A-horizon | |
| 52 | Ambrex | Traverse 1 | Site 10 | 0 | 90902 | | | Organic matter | |
| | | | | | | | | | |
| 53 | Ambrex | Traverse 2 | Site 1 | 200 | 90903 | 8888310 | 224885 | B-horizon | 30-40 cm depth |
| 54 | Ambrex | Traverse 2 | Site 1 | 200 | 90904 | 250 m from road | | A-horizon | 2-5 cm depth |
| 55 | Ambrex | Traverse 2 | Site 1 | 200 | 90905 | | | Organic matter | |
| 56 | Ambrex | Traverse 2 | Site 2 | 150 | 90906 | 8888360 | 224885 | B-horizon | |
| 57 | Ambrex | Traverse 2 | Site 2 | 150 | 90907 | | | A-horizon | |
| 58 | Ambrex | Traverse 2 | Site 2 | 150 | 90908 | | | Organic matter | |
| 59 | Ambrex | Traverse 2 | Site 3 | 100 | 90909 | 8888410 | 224885 | B-horizon | |
| 60 | Ambrex | Traverse 2 | Site 3 | 100 | 90910 | | | A-horizon | |
| 61 | Ambrex | Traverse 2 | Site 3 | 100 | 90911 | | | Organic matter | |
| 62 | Ambrex | Traverse 2 | Site 4 | 75 | 90912 | 8888435 | 224885 | Colluvium | Quartz-chlorite schist |
| 63 | Ambrex | Traverse 2 | Site 4 | 75 | 90913 | | | A-horizon | |
| 64 | Ambrex | Traverse 2 | Site 4 | 75 | 90914 | | | Organic matter | |
| 65 | Ambrex | Traverse 2 | Site 5 | 50 | 90915 | 8888460 | 224885 | B-horizon | |
| 66 | Ambrex | Traverse 2 | Site 5 | 50 | 90916 | | | A-horizon | |
| 67 | Ambrex | Traverse 2 | Site 5 | 50 | 90917 | | | Organic matter | |
| 68 | Ambrex | Traverse 2 | Site 6 | 0 | 90918 | 8888510 | 224885 | B-horizon | |
| 69 | Ambrex | Traverse 2 | Site 6 | 0 | 90919 | 50 m from road | | A-horizon | |
| 70 | Ambrex | Traverse 2 | Site 6 | 0 | 90920 | | | Organic matter | 5-15 cm thick, white |
| | | | | | | | | | |
| 71 | Ambrex | Traverse 1 | Site 6 | 690 | 90921 | 8888050 | 226090 | Bark from Imbauba tree | 25 cm diameter, white |
| 72 | Ambrex | Traverse 1 | Between 5 and | 635 | 90922 | 8888075 | 226050 | Bark from Imbauba tree | 25 cm diameter, white |
| 73 | Ambrex | Traverse 1 | Between 1 and | 435 | 90923 | 8888200 | 225900 | Bark from Imbauba tree | 10 cm diameter, white |
| 74 | Ambrex | Traverse 1 | Site 1 | 420 | 90924 | Farex 33 | | Bark from Imbauba tree | 20 cm diameter, white |
| 75 | Ambrex | Traverse 1 | Site 7 | 380 | 90925 | 8888420 | 225726 | Bark from Imbauba tree | 15 cm diameter, white |
| 76 | Ambrex | Traverse 1 | Site 9 | 200 | 90926 | 8888304 | 225701 | Bark from Imbauba tree | 30 cm diameter, pink |
| 77 | Ambrex | Traverse 1 | Site 10 | 12 | 90927 | 8888352 | 225515 | Bark from Imbauba tree | 10 cm diameter, pink |
| 78 | Ambrex | Traverse 1 | Site 10 | 0 | 90928 | 8888352 | 225515 | Bark from Imbauba tre | 10 cm diameter, white |

# Appendix 6

# Quality control and internal standards

| **Sample number** | **ACME Job** | **Sample weight (g)** | **SiO2** | **Al2O3** | **Fe2O3** | **MgO** | **CaO** | **Na2O** | **K2O** | **TiO2** | **P2O5** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fusion % | Fusion % | Fusion % | Fusion % | Fusion % | Fusion % | Fusion % | Fusion % | Fusion % |
| 91210 original (11/2001) | A150091 | 0.2 | 22.54 | 1.42 | 51.09 | <.01 | 0.03 | 0.04 | 0.08 | 0.03 | 0.47 |
| 91210 1st repeat (11/2001) | A150091 | 0.2 | 23.00 | 1.44 | 50.98 | <.01 | 0.03 | 0.04 | 0.10 | 0.03 | 0.47 |
| **91210 2nd repeat (2/2002)** | A200417 | 0.2 | 22.97 | 1.40 | 52.37 | 0.05 | 0.03 | 0.04 | 0.08 | 0.03 | 0.50 |
| 91244 original (11/2001) | A150091 | 0.2 | 10.54 | 8.51 | 62.99 | 0.05 | 0.02 | 0.05 | 0.19 | 0.3 | 0.27 |
| 91244 1st repeat (11/2001) | A150091 | 0.2 | 10.48 | 8.49 | 63.02 | 0.05 | 0.02 | 0.05 | 0.23 | 0.29 | 0.26 |
| **91244 2nd repeat (2/2002)** | A200417 | 0.2 | 10.65 | 8.55 | 62.72 | 0.13 | 0.02 | 0.04 | 0.22 | 0.31 | 0.3 |
| 90880(-60) original (11/2001) | A150092 | 0.2 | 62.33 | 13.28 | 2.83 | 0.68 | 0.01 | 0.01 | 2.25 | 0.24 | 0.06 |
| 90880(-60) 1st repeat (11/2001) | A150092 | 0.2 | 62.47 | 13.35 | 2.82 | 0.68 | 0.01 | 0.02 | 2.33 | 0.24 | 0.05 |
| 90880(-200) original (11/2001) | A150092 | 0.2 | 61.11 | 13.89 | 4.84 | 0.69 | 0.02 | 0.02 | 2.47 | 0.25 | 0.03 |
| 90880(-200) 1st repeat (11/2001) | A150092 | 0.2 | 60.92 | 13.89 | 4.89 | 0.69 | 0.02 | 0.01 | 2.49 | 0.25 | 0.04 |
| **90880(-200) 2nd repeat (2/2002)** | A200417 | 0.2 | 61.02 | 13.86 | 4.7 | 0.69 | 0.02 | 0.02 | 2.3 | 0.25 | 0.04 |
| 90882 original (11/2001) | A150092A | 0.2 | 59.11 | 19.96 | 7.75 | 1.01 | 0.01 | 0.06 | 4.19 | 0.34 | <.01 |
| 90882 1st repeat (11/2001) | A150092A | 0.2 | 59.26 | 20.03 | 7.93 | 1.02 | 0.01 | 0.05 | 4.26 | 0.34 | <.01 |
| **90882 2nd repeat (2/2002)** | A200417 | 0.2 | 59.47 | 20.11 | 7.72 | 1.00 | 0.02 | 0.05 | 4.10 | 0.35 | 0.01 |
| 90859 (-200) original (11/2001) | A150092 | 0.2 | 27.66 | 14.79 | 35.86 | <.01 | 0.01 | <.01 | 0.04 | 0.34 | 0.17 |
| **90859 (-200) 1st repeat (2/2002)** | A200417 | 0.2 | 26.68 | 14.39 | 38.89 | 0.05 | 0.01 | <.01 | 0.04 | 0.33 | 0.21 |

***Difference between the average of the first and second repeats (November batch) and the third repeat (January batch) in percent***

| | SiO2 | Al2O3 | Fe2O3 | MgO | CaO | Na2O | K2O | TiO2 | P2O5 |
|---|---|---|---|---|---|---|---|---|---|
| *91210* | *0.9* | *-2.1* | *2.6* | | *0.0* | *0.0* | *-11.1* | *0.0* | *6.4* |
| *91244* | *1.3* | *0.6* | *-0.5* | *160.0* | *0.0* | *-20.0* | *4.8* | *5.1* | *13.2* |
| *90880 -60* | *0.2* | *0.5* | *-0.4* | *0.0* | *0.0* | *100.0* | *3.6* | *0.0* | *-16.7* |
| *90880 -200* | *0.0* | *-0.2* | *-3.4* | *0.0* | *0.0* | *33.3* | *-7.3* | *0.0* | *14.3* |
| *90882* | *0.5* | *0.6* | *-1.5* | *-1.5* | *100.0* | *-9.1* | *-3.0* | *2.9* | |
| *90859* | *-3.5* | *-2.7* | *8.4* | | *0.0* | | *0.0* | *-2.9* | *23.5* |

Appendix 6.1 Aripuana - quality control - repeat samples (precision of measurements)

| **Sample number** | **Mn** Fusion % | **Cr** Fusion % | **Ba** Fusion ppm | **Ni** Fusion ppm | **Sc** Fusion ppm | **LOI** 4ALO % | **TOT/C** 4ALC % | **TOT/S** 4ALC % | **SUM** Fusion % | **Co** Fusion ppm | **Cs** Fusion ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 91210 original (11/2001) | 9.64 | <.001 | 13557 | <20 | 8 | 10.1 | 0.29 | 0.06 | 96.95 | 148.9 | 0.1 |
| 91210 1st repeat (11/2001) | 9.67 | <.001 | 13594 | <20 | 9 | 10 | 0.29 | 0.06 | 97.28 | 149.6 | <.1 |
| **91210 2nd repeat (2/2002)** | 9.59 | <.001 | 13113 | <20 | 8 | 10.8 | 0.3 | 0.07 | 99.32 | 131.4 | <.1 |
| 91244 original (11/2001) | 0.81 | <.001 | 8 | <20 | 9 | 13.5 | 0.32 | 0.78 | 97.24 | 15.8 | 0.6 |
| 91244 1st repeat (11/2001) | 0.8 | <.001 | 9 | <20 | 9 | 13.6 | 0.31 | 0.81 | 97.29 | 15.0 | 0.5 |
| **91244 2nd repeat (2/2002)** | 0.86 | <.001 | 14 | <20 | 8 | 15.2 | 0.31 | 0.73 | 99 | 15.2 | 0.3 |
| 90880(-60) original (11/2001) | 0.07 | <.001 | 577 | <20 | 10 | 17.6 | 6.24 | 0.02 | 99.42 | 0.6 | 0.6 |
| 90880(-60) 1st repeat (11/2001) | 0.07 | 0.001 | 576 | <20 | 10 | 17.5 | 6.43 | 0.04 | 99.61 | 0.5 | 0.6 |
| 90880(-200) original (11/2001) | 0.15 | 0.002 | 607 | <20 | 10 | 16.5 | 6.03 | 0.02 | 100.04 | 4.4 | 0.7 |
| 90880(-200) 1st repeat (11/2001) | 0.16 | 0.006 | 610 | <20 | 10 | 16.4 | 5.98 | 0.03 | 99.84 | 5.1 | 0.6 |
| **90880(-200) 2nd repeat (2/2002)** | 0.17 | 0.001 | 605 | <20 | 10 | 16.7 | 6.05 | 0.02 | 99.84 | 4.1 | 0.8 |
| 90882 original (11/2001) | 0.18 | 0.003 | 1514 | <20 | 15 | 6.9 | 0.27 | <.01 | 99.68 | 4.0 | 1.0 |
| 90882 1st repeat (11/2001) | 0.18 | <.001 | 1515 | <20 | 15 | 6.6 | 0.29 | <.01 | 99.86 | 3.8 | 0.9 |
| **90882 2nd repeat (2/2002)** | 0.19 | 0.004 | 1488 | <20 | 15 | 6.6 | 0.29 | <.01 | 99.79 | 4.0 | 0.9 |
| 90859 (-200) original (11/2001) | 5.65 | <.001 | 361 | <20 | 10 | 11.4 | 0.52 | 0.04 | 95.97 | 84.0 | <.1 |
| **90859 (-200) 1st repeat (2/2002)** | 6.65 | 0.002 | 357 | <20 | 10 | 11 | 0.52 | 0.04 | 98.29 | 81.4 | 0.2 |

***Difference between the average of***

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *91210* | *-0.7* | | *-3.4* | | *-5.9* | *7.5* | *3.4* | *16.7* | *2.3* | *-12.0* | |
| *91244* | *6.8* | | *64.7* | | *-11.1* | *12.2* | *-1.6* | *-8.2* | *1.8* | *-1.3* | *-45.5* |
| *90880 -60* | *0.0* | | *-0.2* | | *0.0* | *-0.6* | *3.0* | *100.0* | *0.2* | *-16.7* | *0.0* |
| *90880 -200* | *9.7* | *-75.0* | *-0.6* | | *0.0* | *1.5* | *0.7* | *-20.0* | *-0.1* | *-13.7* | *23.1* |
| *90882* | *5.6* | *33.3* | *-1.7* | | *0.0* | *-2.2* | *3.6* | | *0.0* | *2.6* | *-5.3* |
| *90859* | *17.7* | | *-1.1* | | *0.0* | *-3.5* | *0.0* | *0.0* | *2.4* | *-3.1* | |

Appendix 6.1  Aripuana - quality control - repeat samples (precision of measurements)

| **Sample number** | **Ga** | **Hf** | **Nb** | **Rb** | **Sn** | **Sr** | **Ta** | **Th** | **Tl** | **U** | **V** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fusion<br>ppm | Fusion<br>ppm | Fusion<br>ppm | Fusion<br>ppm | Fusion<br>ppm | Fusion<br>ppm | Fusion<br>ppm | Fusion<br>ppm | 4 acid<br>ppm | Fusion<br>ppm | Fusion<br>ppm |
| 91210 original (11/2001) | 6.6 | <.5 | 0.5 | 2.4 | <1 | 8.0 | <.1 | 0.4 | 1.5 | 26.8 | 25 |
| 91210 1st repeat (11/2001) | 8.2 | <.5 | <.5 | 3.2 | <1 | 8.4 | <.1 | 0.7 | 0.7 | 27.4 | 27 |
| **91210 2nd repeat (2/2002)** | 6.4 | <.5 | <.5 | 1.7 | 3 | 7.8 | <.1 | 0.5 | **7.4** | 24.6 | 25 |
| 91244 original (11/2001) | 12.3 | 3.9 | 9.4 | 6.2 | 1 | 1.3 | 0.8 | 8.5 | 0.3 | 17.7 | 24 |
| 91244 1st repeat (11/2001) | 12.1 | 4.0 | 9.4 | 3.3 | 1 | 1.5 | 0.7 | 7.6 | 0.4 | 16.4 | 23 |
| **91244 2nd repeat (2/2002)** | 11.8 | 4.3 | 9.2 | 4.0 | 4 | 1.9 | 0.6 | 8.9 | 0.5 | 15.7 | 25 |
| 90880(-60) original (11/2001) | 16.6 | 7.3 | 15.5 | 72.1 | 2 | 5.3 | 1.3 | 13.6 | 0.1 | 4.0 | <5 |
| 90880(-60) 1st repeat (11/2001) | 17.4 | 8.0 | 16.4 | 73.9 | 2 | 5.1 | 1.3 | 13.9 | 0.1 | 3.1 | <5 |
| 90880(-200) original (11/2001) | 19.0 | 7.8 | 20.2 | 82.0 | 4 | 5.6 | 1.6 | 17.2 | 0.2 | 3.7 | 6 |
| 90880(-200) 1st repeat (11/2001) | 19.2 | 8.1 | 16.8 | 84.1 | 4 | 6.0 | 1.2 | 16.2 | 0.2 | 4.4 | 7 |
| **90880(-200) 2nd repeat (2/2002)** | 19.4 | 6.8 | 15.9 | 81.2 | 6 | 5.9 | 1.1 | 15.3 | **0.4** | 4.1 | **14** |
| 90882 original (11/2001) | 24.0 | 9.0 | 20.6 | 99.0 | 3 | 3.1 | 1.2 | 22.9 | 0.6 | 4.9 | 9 |
| 90882 1st repeat (11/2001) | 25.1 | 9.2 | 22.4 | 99.4 | 2 | 2.9 | 1.3 | 20.6 | 0.5 | 7.2 | 10 |
| **90882 2nd repeat (2/2002)** | 23.2 | 8.7 | 18.7 | 91.1 | 6 | 2.6 | 1.3 | 18.6 | 0.6 | 5.4 | 13 |
| 90859 (-200) original (11/2001) | 20.6 | 4.6 | 10.8 | 0.8 | 2 | 7.5 | 0.9 | 12.3 | 1.8 | 22.6 | 69 |
| **90859 (-200) 1st repeat (2/2002)** | 20.8 | 5.1 | 10.9 | 1.9 | 7 | 8.4 | 0.7 | 12.2 | **4.3** | 22.5 | 80 |

| ***Difference between the average of*** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *91210* | *-13.5* | | | *-39.3* | | *-4.9* | | *-9.1* | *572.7* | *-9.2* | *-3.8* |
| *91244* | *-3.3* | *8.9* | *-2.1* | *-15.8* | *300.0* | *35.7* | *-20.0* | *10.6* | *42.9* | *-7.9* | *6.4* |
| *90880 -60* | *4.8* | *9.6* | *5.8* | *2.5* | *0.0* | *-3.8* | *0.0* | *2.2* | *0.0* | *-22.5* | |
| *90880 -200* | *1.6* | *-14.5* | *-14.1* | *-2.2* | *50.0* | *1.7* | *-21.4* | *-8.4* | *100.0* | *1.2* | *115.4* |
| *90882* | *-5.5* | *-4.4* | *-13.0* | *-8.2* | *140.0* | *-13.3* | *4.0* | *-14.5* | *9.1* | *-10.7* | *36.8* |
| *90859* | *1.0* | *10.9* | *0.9* | *137.5* | *250.0* | *12.0* | *-22.2* | *-0.8* | *138.9* | *-0.4* | *15.9* |

Appendix 6.1  Aripuana - quality control - repeat samples (precision of measurements)

| **Sample number** | **W** | **Zr** | **Y** | **La** | **Ce** | **Pr** | **Nd** | **Sm** | **Eu** | **Gd** | **Tb** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fusion | Fusion | Fusion | Fusion | Fusion | Fusion | Fusion | Fusion | Fusion | Fusion | Fusion |
| | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| 91210 original (11/2001) | 5 | 11.1 | 13.8 | 78.0 | 502.8 | 15.28 | 45.6 | 7.5 | 1.94 | 5.32 | 0.84 |
| 91210 1st repeat (11/2001) | 5 | 11.3 | 13.6 | 82.1 | 515.3 | 15.3 | 47.1 | 7.5 | 1.31 | 5.32 | 0.79 |
| **91210 2nd repeat (2/2002)** | 5 | 12.9 | 12.6 | 76.8 | **454.9** | 14.8 | 42.5 | 7.2 | 1.84 | **3.73** | 0.73 |
| 91244 original (11/2001) | 4 | 141.7 | 26.5 | 585.0 | 102.3 | 83.1 | 177.7 | 11.6 | 2.09 | 6.17 | 1.02 |
| 91244 1st repeat (11/2001) | 4 | 143.3 | 26.5 | 590.9 | 104.5 | 84.2 | 176.1 | 11.2 | 2.12 | 5.63 | 1.03 |
| **91244 2nd repeat (2/2002)** | 3 | 146.1 | 24.6 | 559.1 | 103.4 | 79.22 | 165.7 | 10.4 | 1.97 | 5.08 | 0.91 |
| 90880(-60) original (11/2001) | 3 | 251.6 | 38.0 | 11.6 | 44.3 | 2.07 | 8.1 | 2.2 | 0.63 | 3.35 | 0.82 |
| 90880(-60) 1st repeat (11/2001) | 3 | 254.6 | 39.1 | 12.4 | 46.4 | 2.27 | 8.1 | 2.3 | 0.72 | 3.44 | 0.79 |
| 90880(-200) original (11/2001) | 8 | 251.7 | 45.6 | 14.2 | 215.3 | 2.11 | 8.6 | 2.9 | 0.78 | 4.47 | 0.97 |
| 90880(-200) 1st repeat (11/2001) | 8 | 257.0 | 46.8 | 14.6 | 218.5 | 2.16 | 8.8 | 2.6 | 0.79 | 4.98 | 0.97 |
| **90880(-200) 2nd repeat (2/2002)** | **4** | 257.3 | 43.6 | 14.5 | **194.5** | 2.1 | **7.2** | **2.2** | **0.62** | **3.73** | 0.94 |
| 90882 original (11/2001) | 6 | 309.5 | 50.0 | 32.5 | 340.4 | 3.57 | 10.8 | 2.9 | 0.61 | 4.75 | 1 |
| 90882 1st repeat (11/2001) | 6 | 315.4 | 52.2 | 32.3 | 368.1 | 3.36 | 10.8 | 3.2 | 0.61 | 4.89 | 1.01 |
| **90882 2nd repeat (2/2002)** | **4** | 298.4 | **42.2** | 30.9 | 321.9 | 3.33 | **9.2** | **2.4** | 0.58 | **2.87** | 0.9 |
| 90859 (-200) original (11/2001) | 6 | 152.4 | 19.7 | 82.0 | 478.0 | 12.66 | 38.3 | 5.1 | 1.32 | 7.58 | 0.83 |
| **90859 (-200) 1st repeat (2/2002)** | **4** | 174.9 | 20.1 | 81.2 | 461.1 | **14.08** | 38.9 | 5.2 | 1.47 | **3.28** | 0.75 |
| ***Difference between the average of*** | | | | | | | | | | | |
| *91210* | *0.0* | *15.2* | *-8.0* | *-4.1* | *-10.6* | *-3.2* | *-8.3* | *-4.0* | *13.2* | *-29.9* | *-10.4* |
| *91244* | *-25.0* | *2.5* | *-7.2* | *-4.9* | *0.0* | *-5.3* | *-6.3* | *-8.8* | *-6.4* | *-13.9* | *-11.2* |
| *90880 -60* | *0.0* | *1.2* | *2.9* | *6.9* | *4.7* | *9.7* | *0.0* | *4.5* | *14.3* | *2.7* | *-3.7* |
| *90880 -200* | *-50.0* | *1.2* | *-5.6* | *0.7* | *-10.3* | *-1.6* | *-17.2* | *-20.0* | *-21.0* | *-21.1* | *-3.1* |
| *90882* | *-33.3* | *-4.5* | *-17.4* | *-4.6* | *-9.1* | *-3.9* | *-14.8* | *-21.3* | *-4.9* | *-40.5* | *-10.4* |
| *90859* | *-33.3* | *14.8* | *2.0* | *-1.0* | *-3.5* | *11.2* | *1.6* | *2.0* | *11.4* | *-56.7* | *-9.6* |

Appendix 6.1 Aripuana - quality control - repeat samples (precision of measurements)

| **Sample number** | **Dy** | **Ho** | **Er** | **Tm** | **Yb** | **Lu** | **Mo** | **Cu** | **Pb** | **Zn** | **Ni** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fusion ppm | Fusion ppm | Fusion ppm | Fusion ppm | Fusion ppm | Fusion ppm | 4 acid ppm | 4 acid ppm | 4 acid ppm | 4 acid ppm | 4 acid ppm |
| 91210 original (11/2001) | 4.12 | 0.61 | 1.77 | 0.29 | 1.97 | 0.26 | 38.3 | 2009 | 19742 | 8554 | 8 |
| 91210 1st repeat (11/2001) | 4.06 | 0.62 | 1.73 | 0.27 | 1.77 | 0.29 | 39.4 | 2034 | 19728 | 8578 | 7 |
| **91210 2nd repeat (2/2002)** | 4.03 | 0.56 | 1.73 | 0.27 | 1.8 | 0.27 | 40 | **1761** | **17243** | **7655** | 8 |
| 91244 original (11/2001) | 5.96 | 1.1 | 3.19 | 0.47 | 3.56 | 0.54 | 17.4 | 1136 | 27963 | 8065 | 5 |
| 91244 1st repeat (11/2001) | 5.78 | 1.13 | 3.53 | 0.51 | 3.58 | 0.53 | 17.3 | 1135 | 28049 | 8106 | 6 |
| **91244 2nd repeat (2/2002)** | 5.73 | 1.02 | 3.35 | 0.52 | 3.58 | 0.53 | 15.8 | **950** | 29810 | **6860** | 3 |
| 90880(-60) original (11/2001) | 5.62 | 1.31 | 4.29 | 0.66 | 4.61 | 0.75 | 1.2 | 39 | 196 | 35 | 2 |
| 90880(-60) 1st repeat (11/2001) | 5.77 | 1.28 | 4.28 | 0.71 | 4.47 | 0.74 | 1.2 | 41 | 198 | 37 | 1 |
| 90880(-200) original (11/2001) | 6.62 | 1.46 | 4.48 | 0.79 | 4.9 | 0.7 | 3.2 | 69 | 714 | 97 | 5 |
| 90880(-200) 1st repeat (11/2001) | 6.63 | 1.53 | 4.58 | 0.82 | 4.98 | 0.75 | 3.2 | 71 | 708 | 98 | 3 |
| **90880(-200) 2nd repeat (2/2002)** | 6.94 | 1.43 | 4.86 | 0.73 | 4.8 | 0.73 | 3.2 | 74 | 737 | 101 | 3 |
| 90882 original (11/2001) | 7.14 | 1.55 | 4.94 | 0.8 | 5.61 | 0.9 | 0.9 | 97 | 1129 | 121 | 1 |
| 90882 1st repeat (11/2001) | 6.93 | 1.62 | 5.1 | 0.82 | 5.87 | 0.94 | 0.8 | 95 | 1117 | 119 | 2 |
| **90882 2nd repeat (2/2002)** | 6.29 | 1.41 | 4.88 | 0.75 | 5.14 | 0.81 | 0.8 | 98 | **1010** | 110 | 1 |
| 90859 (-200) original (11/2001) | 3.95 | 0.74 | 2.31 | 0.42 | 2.91 | 0.41 | 44.4 | 1375 | 31788 | 4788 | 15 |
| **90859 (-200) 1st repeat (2/2002)** | 4.15 | 0.8 | 2.57 | 0.4 | 2.9 | 0.46 | 41.1 | **1116** | **28191** | 4370 | 12 |

***Difference between the average of***

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *91210* | *-1.5* | *-8.9* | *-1.1* | *-3.6* | *-3.7* | *-1.8* | *3.0* | *-12.9* | *-12.6* | *-10.6* | *5.3* |
| *91244* | *-2.4* | *-8.5* | *-0.3* | *6.1* | *0.3* | *-0.9* | *-8.9* | *-16.3* | *6.4* | *-15.2* | *-41.8* |
| *90880 -60* | *2.7* | *-2.3* | *-0.2* | *7.6* | *-3.0* | *-1.3* | *0.0* | *5.1* | *1.0* | *5.7* | *-50.0* |
| *90880 -200* | *4.8* | *-4.3* | *7.3* | *-9.3* | *-2.8* | *0.7* | *0.0* | *5.3* | *3.7* | *3.6* | *-25.0* |
| *90882* | *-10.6* | *-11.0* | *-2.8* | *-7.4* | *-10.5* | *-12.0* | *-5.9* | *2.1* | *-10.1* | *-8.3* | *-13.3* |
| *90859* | *5.1* | *8.1* | *11.3* | *-4.8* | *-0.3* | *12.2* | *-7.4* | *-18.8* | *-11.3* | *-8.7* | *-23.3* |

Appendix 6.1 Aripuana - quality control - repeat samples (precision of measurements)

| **Sample number** | **As** | **Cd** | **Sb** | **Bi** | **Ag** | **ELEMENT** | **Acme** | **Sample** | **Analytical** | **Mo** | **Cu** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 acid ppm | 4 acid ppm | 4 acid ppm | 4 acid ppm | 4 acid ppm | Method: SAMPLES | Batch No | Wt. grams | Order | Aqua Regi ppm | Aqua Regi ppm |
| 91210 original (11/2001) | 2288 | 18.8 | 82 | 2 | 19 | 91210 | A150091 | 30 | 42 | 31.70 | 1674 |
| 91210 1st repeat (11/2001) | 2316 | 18.3 | 84 | 2 | 19.6 | RE 91210 | A150091 | 30 | | 35.09 | 1703 |
| **91210 2nd repeat (2/2002)** | **1685** | 18.3 | 74 | 1.9 | 18.3 | 91210 | A200417 | 7.5 | 1 | 37.93 | 1831 |
| 91244 original (11/2001) | 10668 | 1.1 | 590 | <1 | 4.2 | 91244 | A150091 | 30 | 10 | 11.17 | 731 |
| 91244 1st repeat (11/2001) | 10725 | 1.2 | 581 | <1 | 3.9 | RE 91244 | A150091 | 30 | | 10.78 | 720 |
| **91244 2nd repeat (2/2002)** | **8078** | 1.5 | **444** | 0.4 | **3.1** | 91244 | A200417 | 7.5 | 4 | **15.83** | **819** |
| 90880(-60) original (11/2001) | 42 | <.2 | 2 | 1 | 1.1 | 90880(-60) | A150092 | 30 | 10 | 0.63 | 39 |
| 90880(-60) 1st repeat (11/2001) | 39 | <.2 | 1 | 1 | 1 | RE 90880(-60) | A150092 | 30 | | 0.71 | 41 |
| 90880(-200) original (11/2001) | 70 | <.2 | 3 | 2 | 1.3 | 90880(-200) | A150092 | 30 | 41 | 2.77 | 58 |
| 90880(-200) 1st repeat (11/2001) | 102 | <.2 | 3 | 2 | 1.3 | RE 90880(-200) | A150092 | 30 | | 2.96 | 58 |
| **90880(-200) 2nd repeat (2/2002)** | **73** | <.1 | 3 | 1.4 | 1 | 90880 | A200417 | 15 | 6 | 3.25 | 64 |
| 90882 original (11/2001) | 64 | <.2 | 3 | 4 | 1.3 | 90882 | A150092A | 30 | 6 | 0.63 | 74 |
| 90882 1st repeat (11/2001) | 63 | <.2 | 3 | 3 | 1.3 | RE 90882 | A150092A | 30 | | 0.64 | 70 |
| **90882 2nd repeat (2/2002)** | **51** | <.1 | 3 | 2.5 | 1.2 | 90882 | A200417 | 15 | 3 | 0.66 | 76 |
| 90859 (-200) original (11/2001) | 1132 | 6.5 | 82 | 5 | 6.2 | 90859(-200) | A150092 | 30 | 33 | 35.28 | 1107 |
| **90859 (-200) 1st repeat (2/2002)** | **889** | 5.3 | **60** | 4.8 | **4.5** | 90859 | A200417 | 15 | 8 | 36.19 | 1163 |

| ***Difference between the average of*** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *91210* | *-26.8* | *-1.3* | *-10.7* | *-5.0* | *-5.2* | | | | | *13.6* | *8.4* |
| *91244* | *-24.5* | *30.4* | *-24.1* | | *-23.5* | | | | | *44.2* | *13.0* |
| *90880 -60* | *-7.1* | | *-50.0* | *0.0* | *-9.1* | | | | | *12.7* | *4.7* |
| *90880 -200* | *-15.1* | | *0.0* | *-30.0* | *-23.1* | | | | | *13.4* | *9.7* |
| *90882* | *-19.7* | | *0.0* | *-28.6* | *-7.7* | | | | | *3.9* | *5.3* |
| *90859* | *-21.5* | *-18.5* | *-26.7* | *-4.0* | *-27.4* | | | | | *2.6* | *5.0* |

Appendix 6.1  Aripuana - quality control - repeat samples (precision of measurements)

| **Sample number** | **Pb** | **Zn** | **Ag** | **Ni** | **Co** | **Mn** | **Fe** | **As** | **U** | **Au** | **Th** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aqua Regi ppm | Aqua Regi ppm | Aqua Regi ppb | Aqua Regi ppm | Aqua Regi ppm | Aqua Regi ppm | Aqua Regi % | Aqua Regi ppm | Aqua Regi ppm | Aqua Regi ppb | Aqua Regi ppm |
| 91210 original (11/2001) | 17014 | 7412 | 19395 | 11.1 | 144.4 | 68603 | 28.98 | 1698 | 24.0 | 131.4 | 0.3 |
| 91210 1st repeat (11/2001) | 17290 | 7531 | 20559 | 9.7 | 151.9 | 70154 | 29.39 | 1727 | 27.4 | 131.5 | 0.5 |
| **91210 2nd repeat (2/2002)** | **15193** | 7528 | 22136 | 9.8 | 154.1 | **76714** | **32.29** | **2053** | **21.5** | 122.8 | 0.4 |
| 91244 original (11/2001) | 24168 | 6133 | 3493 | 3.4 | 18.2 | 7320 | 32.18 | 6997 | 16.4 | 235.4 | 5.8 |
| 91244 1st repeat (11/2001) | 23798 | 6054 | 3409 | 3.7 | 18.9 | 7154 | 31.79 | 6918 | 16.2 | 238.7 | 5.8 |
| **91244 2nd repeat (2/2002)** | 23900 | 6326 | 3533 | 4.1 | 17.3 | 6987 | **37.276** | **8758** | **12.52** | **211** | 6.1 |
| 90880(-60) original (11/2001) | 200 | 33 | 293 | 0.7 | 0.4 | 589 | 1.57 | 36 | 0.4 | 8.4 | 4.7 |
| 90880(-60) 1st repeat (11/2001) | 201 | 37 | 315 | 0.8 | 0.4 | 599 | 1.61 | 40 | 0.5 | 9.3 | 5.1 |
| 90880(-200) original (11/2001) | 761 | 66 | 492 | 2.6 | 4.4 | 1426 | 2.85 | 79 | 0.8 | 10.6 | 7.4 |
| 90880(-200) 1st repeat (11/2001) | 762 | 68 | 508 | 2.7 | 4.3 | 1420 | 2.85 | 75 | 0.9 | 8.1 | 7.5 |
| **90880(-200) 2nd repeat (2/2002)** | 806 | 69 | 554 | 3.1 | 4.7 | 1467 | 3.053 | 85 | 0.89 | 9.3 | 8.4 |
| 90882 original (11/2001) | 1073 | 36 | 554 | 0.4 | 5.5 | 1486 | 4.64 | 55 | 1.8 | 17.4 | 14.1 |
| 90882 1st repeat (11/2001) | 1033 | 35 | 558 | 0.4 | 5.4 | 1430 | 4.47 | 50 | 1.8 | 17.0 | 14.0 |
| **90882 2nd repeat (2/2002)** | 1035 | 34 | 577 | 0.4 | 4.6 | 1482 | 4.56 | 60 | 1.6 | 15.2 | 12.5 |
| 90859 (-200) original (11/2001) | 30495 | 4060 | 4496 | 9.5 | 87.8 | 53752 | 21.84 | 817 | 18.6 | 274.9 | 10.1 |
| **90859 (-200) 1st repeat (2/2002)** | **24530** | 4118 | 4705 | 8.9 | 92.2 | 54071 | 23.336 | **1032** | **15.78** | 274.3 | 9.1 |

***Difference between the average of***

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *91210* | *-11.4* | *0.8* | *10.8* | *-5.8* | *4.0* | *10.6* | *10.6* | *19.9* | *-16.5* | *-6.6* | *0.0* |
| *91244* | *-0.3* | *3.8* | *2.4* | *15.5* | *-6.7* | *-3.5* | *16.5* | *25.9* | *-23.2* | *-11.0* | *5.2* |
| *90880 -60* | *0.7* | *12.0* | *7.5* | *14.3* | *0.0* | *1.7* | *2.5* | *9.7* | *25.0* | *10.7* | *8.5* |
| *90880 -200* | *5.8* | *3.1* | *10.8* | *17.0* | *8.0* | *3.1* | *7.1* | *11.1* | *4.7* | *-0.5* | *12.8* |
| *90882* | *-1.7* | *-4.6* | *3.8* | *0.0* | *-15.6* | *1.6* | *0.1* | *14.0* | *-10.6* | *-11.6* | *-11.0* |
| *90859* | *-19.6* | *1.4* | *4.6* | *-6.3* | *5.0* | *0.6* | *6.8* | *26.3* | *-15.2* | *-0.2* | *-9.9* |

Appendix 6.1 Aripuana - quality control - repeat samples (precision of measurements)

| **Sample number** | **Sr** | **Cd** | **Sb** | **Bi** | **V** | **Ca** | **P** | **La** | **Cr** | **Mg** | **Ba** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>% | Aqua Regi<br>% | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>% | Aqua Regi<br>ppm |
| 91210 original (11/2001) | 4.9 | 20.62 | 64.2 | 1.77 | 28 | <.01 | 0.21 | 14.0 | 2.8 | 0.01 | 11073.7 |
| 91210 1st repeat (11/2001) | 5.7 | 22.20 | 68.1 | 1.88 | 26 | <.01 | 0.21 | 16.9 | 4.5 | 0.01 | 12887.0 |
| **91210 2nd repeat (2/2002)** | 4.9 | 21.52 | **83.5** | 2.53 | 26 | <.001 | 0.21 | 14.4 | 2.3 | 0.01 | 12571.7 |
| 91244 original (11/2001) | 1.3 | 1.78 | 392.1 | 0.1 | 19 | <.01 | 0.06 | 221.2 | 6.8 | 0.01 | 5.2 |
| 91244 1st repeat (11/2001) | 1.3 | 1.81 | 399.0 | 0.13 | 22 | <.01 | 0.059 | 234.5 | 8 | 0.01 | 4.6 |
| **91244 2nd repeat (2/2002)** | 1.2 | 1.83 | **518.1** | **0.67** | 20 | <.001 | 0.067 | 218.6 | 5 | 0.01 | 7.6 |
| 90880(-60) original (11/2001) | 2.2 | 0.02 | 0.9 | 0.77 | 4 | 0.01 | 0.02 | 4.5 | 1.4 | 0.02 | 37.3 |
| 90880(-60) 1st repeat (11/2001) | 2.4 | 0.02 | 1.0 | 0.86 | 3 | 0.01 | 0.02 | 4.8 | 1.5 | 0.03 | 40.8 |
| 90880(-200) original (11/2001) | 2.5 | 0.04 | 2.3 | 1.54 | 5 | 0.01 | 0.021 | 4.9 | 10.2 | 0.03 | 70.6 |
| 90880(-200) 1st repeat (11/2001) | 2.6 | 0.04 | 2.4 | 1.62 | 5 | 0.01 | 0.021 | 5.3 | 9.6 | 0.03 | 78.8 |
| **90880(-200) 2nd repeat (2/2002)** | 2.6 | 0.06 | 3.0 | 1.65 | 5 | 0.004 | 0.022 | 5.4 | 10.2 | 0.04 | 76.8 |
| 90882 original (11/2001) | 0.5 | <.01 | 2.2 | 2.80 | 5 | <.01 | 0.01 | 11.0 | 2.9 | 0.02 | 73.2 |
| 90882 1st repeat (11/2001) | <.5 | <.01 | 2.2 | 2.82 | 5 | <.01 | 0.01 | 10.2 | 2.7 | 0.01 | 70.5 |
| **90882 2nd repeat (2/2002)** | <.5 | <.01 | 2.1 | 2.78 | 4 | <.001 | 0.01 | 10.5 | 2.5 | 0.01 | 81.4 |
| 90859 (-200) original (11/2001) | 5.4 | 6.06 | 52.8 | 4.75 | 75 | <.01 | 0.08 | 23.1 | 14.2 | 0.01 | 382 |
| **90859 (-200) 1st repeat (2/2002)** | 5.3 | 5.93 | 55.5 | 5.24 | 82 | <.001 | 0.081 | 24.9 | 10.6 | 0.01 | 362 |

| ***Difference between the average of*** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *91210* | *-7.5* | *0.5* | *26.2* | *38.6* | *-3.7* | | *1.0* | *-6.8* | *-37.0* | *0.0* | *4.9* |
| *91244* | *-7.7* | *1.9* | *31.0* | *482.6* | *-2.4* | | *12.6* | *-4.1* | *-32.4* | *0.0* | *55.1* |
| *90880 -60* | *9.1* | *0.0* | *9.2* | *11.7* | *-25.0* | *0.0* | *4.3* | *6.7* | *7.1* | *50.0* | *9.4* |
| *90880 -200* | *2.0* | *50.0* | *25.8* | *4.4* | *0.0* | *-60.0* | *4.8* | *5.9* | *3.0* | *33.3* | *2.8* |
| *90882* | | | *-3.2* | *-1.1* | *-20.0* | | *0.0* | *-0.9* | *-10.7* | *-33.3* | *13.3* |
| *90859* | *-1.9* | *-2.1* | *5.2* | *10.3* | *9.3* | | *1.3* | *7.8* | *-25.4* | *0.0* | *-5.2* |

Appendix 6.1 Aripuana - quality control - repeat samples (precision of measurements)

| **Sample number** | **Ti** | **B** | **Al** | **Na** | **K** | **W** | **Tl** | **Hg** | **Se** | **Te** | **Ga** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aqua Regi<br>% | Aqua Regi<br>ppm | Aqua Regi<br>% | Aqua Regi<br>% | Aqua Regi<br>% | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>ppb | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>ppm |
| 91210 original (11/2001) | 0.004 | 4 | 0.65 | 0.027 | 0.06 | 1.3 | 6.27 | 241 | 7.9 | 0.05 | 4.9 |
| 91210 1st repeat (11/2001) | 0.005 | 2 | 0.71 | 0.029 | 0.06 | 1.9 | 6.58 | 336 | 10.2 | 0.07 | 5.5 |
| **91210 2nd repeat (2/2002)** | <.001 | <1 | 0.53 | 0.029 | 0.05 | **3.3** | 7.08 | 277 | **24.6** | <.02 | 4 |
| 91244 original (11/2001) | 0.026 | 6 | 1.09 | 0.037 | 0.09 | 0.6 | 0.42 | 428 | 0.5 | 0.05 | 8.4 |
| 91244 1st repeat (11/2001) | 0.041 | 4 | 1.06 | 0.04 | 0.09 | 0.6 | 0.4 | 441 | <.1 | 0.05 | 8.2 |
| **91244 2nd repeat (2/2002)** | <.001 | <1 | 1.34 | 0.033 | 0.09 | **1.44** | 0.41 | 457 | **3.2** | 0.06 | 9.3 |
| 90880(-60) original (11/2001) | 0.009 | <1 | 1.39 | 0.001 | 0.07 | 0.2 | 0.04 | 91 | 0.3 | <.02 | 4.2 |
| 90880(-60) 1st repeat (11/2001) | 0.002 | <1 | 1.45 | 0.001 | 0.08 | 0.2 | 0.05 | 98 | 0.3 | <.02 | 4.7 |
| 90880(-200) original (11/2001) | 0.01 | <1 | 1.51 | 0.002 | 0.13 | 2.2 | 0.07 | 69 | 0.5 | 0.05 | 5.7 |
| 90880(-200) 1st repeat (11/2001) | 0.008 | <1 | 1.54 | 0.003 | 0.14 | 2.4 | 0.08 | 75 | 0.6 | 0.06 | 5.7 |
| **90880(-200) 2nd repeat (2/2002)** | <.001 | <1 | 1.657 | 0.002 | 0.17 | 2.4 | 0.1 | **85** | 0.5 | 0.08 | 6.4 |
| 90882 original (11/2001) | 0.010 | <1 | 1.06 | 0.001 | 0.07 | 0.4 | 0.20 | 63 | 0.1 | 0.15 | 6.2 |
| 90882 1st repeat (11/2001) | 0.009 | 1 | 1.02 | 0.001 | 0.07 | 0.4 | 0.20 | 62 | 0.2 | 0.12 | 6.3 |
| **90882 2nd repeat (2/2002)** | 0.003 | <1 | 1.08 | 0.001 | 0.07 | 0.3 | 0.21 | 60 | <.1 | 0.11 | 5.8 |
| 90859 (-200) original (11/2001) | 0.081 | 6 | 3 | 0.004 | 0.02 | 1.7 | 3.55 | 513 | 8.3 | 0.06 | 11.7 |
| **90859 (-200) 1st repeat (2/2002)** | **0.016** | 1 | 3.272 | 0.001 | 0.02 | 1.6 | 3.85 | 474 | **12** | 0.12 | 12.3 |

***Difference between the average of***

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *91210* | | | *-22.5* | *3.6* | *-10.0* | *106.3* | *10.2* | *-4.0* | *171.8* | | *-23.1* |
| *91244* | | | *24.7* | *-14.3* | *2.2* | *140.0* | *0.0* | *5.2* | *540.0* | *20.0* | *12.0* |
| *90880 -60* | *-77.8* | | *4.3* | *0.0* | *14.3* | *0.0* | *25.0* | *7.7* | *0.0* | | *11.9* |
| *90880 -200* | | | *8.7* | *-20.0* | *28.9* | *4.3* | *33.3* | *18.1* | *-9.1* | *45.5* | *12.3* |
| *90882* | *-68.4* | | *3.9* | *0.0* | *-2.9* | *-20.0* | *5.0* | *-4.0* | | *-18.5* | *-7.2* |
| *90859* | *-80.2* | *-83.3* | *9.1* | *-75.0* | *0.0* | *-5.9* | *8.5* | *-7.6* | *44.6* | *100.0* | *5.1* |

Appendix 6.1 Aripuana - quality control - repeat samples (precision of measurements)

| **Sample number** | **Cs** | **Ge** | **Hf** | **Nb** | **Rb** | **Sc** | **Sn** | **S** | **Ta** | **Zr** | **Y** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>% | Aqua Regi<br>ppm | Aqua Regi<br>ppm | Aqua Regi<br>ppm |
| 91210 original (11/2001) | <.02 | 0.9 | 0.08 | 0.13 | 1.2 | 5.8 | 0.1 | 0.13 | <.05 | 4.4 | 10.49 |
| 91210 1st repeat (11/2001) | 0.02 | 1.4 | 0.10 | 0.10 | 1.4 | 6.0 | 0.1 | 0.19 | <.05 | 4.5 | 11.50 |
| **91210 2nd repeat (2/2002)** | 0.03 | 0.8 | 0.06 | **0.24** | 1.2 | 5.1 | 0.2 | 0.07 | <.05 | 3.6 | 11.32 |
| 91244 original (11/2001) | <.02 | 1.6 | 0.76 | 0.47 | 1.3 | 4.8 | 0.5 | 0.67 | <.05 | 22.7 | 12.9 |
| 91244 1st repeat (11/2001) | <.02 | 1.6 | 0.81 | 0.38 | 1.3 | 4.9 | 0.6 | 0.29 | <.05 | 22.8 | 12.78 |
| **91244 2nd repeat (2/2002)** | <.02 | 2.2 | 0.76 | **0.79** | 1.4 | 4.6 | 0.7 | 0.45 | <.05 | 23.5 | 13.16 |
| 90880(-60) original (11/2001) | 0.12 | <.1 | 0.22 | 2.40 | 9.3 | 1.0 | 0.9 | 0.03 | <.05 | 7.8 | 1.20 |
| 90880(-60) 1st repeat (11/2001) | 0.14 | <.1 | 0.23 | 2.69 | 10.8 | 1.1 | 1.0 | 0.05 | <.05 | 7.9 | 1.33 |
| 90880(-200) original (11/2001) | 0.11 | <.1 | 0.21 | 3.15 | 10.3 | 1.1 | 1.1 | 0.02 | <.05 | 9.1 | 2.35 |
| 90880(-200) 1st repeat (11/2001) | 0.12 | <.1 | 0.21 | 3.34 | 11.4 | 1.2 | 1.2 | 0.02 | <.05 | 8.9 | 1.94 |
| **90880(-200) 2nd repeat (2/2002)** | 0.13 | <.1 | 0.23 | 3.38 | 12.2 | 1.2 | 1.3 | 0.02 | <.05 | 10 | 1.89 |
| 90882 original (11/2001) | 0.10 | 0.1 | 0.55 | 0.65 | 4.7 | 3.0 | 1.1 | <.01 | <.05 | 22.5 | 2.88 |
| 90882 1st repeat (11/2001) | 0.10 | <.1 | 0.56 | 0.71 | 4.6 | 3.0 | 1.2 | 0.03 | <.05 | 22.3 | 2.90 |
| **90882 2nd repeat (2/2002)** | 0.10 | <.1 | 0.49 | 0.61 | 4.8 | 2.8 | 1.1 | <.01 | <.05 | 21.6 | 2.84 |
| 90859 (-200) original (11/2001) | <.02 | 0.3 | 0.34 | 0.91 | 0.3 | 5.3 | 2.2 | 0.2 | <.05 | 13 | 7.85 |
| **90859 (-200) 1st repeat (2/2002)** | 0.03 | 0.4 | 0.23 | 0.68 | 0.2 | 4.5 | 2.2 | 0.06 | <.05 | 11.1 | 6.68 |

| ***Difference between the average of*** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *91210* | *50.0* | *-30.4* | *-33.3* | *108.7* | *-7.7* | *-13.6* | *100.0* | *-56.3* | | *-19.1* | *3.0* |
| *91244* | | *37.5* | *-3.2* | *85.9* | *7.7* | *-5.2* | *27.3* | *-6.2* | | *3.3* | *2.5* |
| *90880 -60* | *16.7* | | *4.5* | *12.1* | *16.1* | *10.0* | *11.1* | *66.7* | | *1.3* | *10.8* |
| *90880 -200* | *13.0* | | *9.5* | *4.2* | *12.4* | *4.3* | *13.0* | *0.0* | | *11.1* | *-11.9* |
| *90882* | *0.0* | | *-11.7* | *-10.3* | *3.2* | *-6.7* | *-4.3* | | | *-3.6* | *-1.7* |
| *90859* | | *33.3* | *-32.4* | *-25.3* | *-33.3* | *-15.1* | *0.0* | *-70.0* | | *-14.6* | *-14.9* |

| **Sample number** | **Ce** | **In** | **Re** | **Be** | **Li** | **Pd** | **Pt** |
|---|---|---|---|---|---|---|---|
| | Aqua Regia<br>ppm | Aqua Regia<br>ppm | Aqua Regia<br>ppb | Aqua Regia<br>ppm | Aqua Regia<br>ppm | Aqua Regia<br>ppb | Aqua Regia<br>ppb |
| 91210 original (11/2001) | 322.8 | 3.18 | <1 | 7.1 | <.1 | <10 | <2 |
| 91210 1st repeat (11/2001) | 405.9 | 3.43 | <1 | 6.3 | 1.1 | <10 | <2 |
| **91210 2nd repeat (2/2002)** | **238.3** | 3.30 | <1 | 6.7 | 1.1 | <10 | 2 |
| 91244 original (11/2001) | 82.6 | 1.25 | <1 | 5.8 | <.1 | <10 | <2 |
| 91244 1st repeat (11/2001) | 85.8 | 1.29 | <1 | 3.8 | 0.3 | <10 | 3 |
| **91244 2nd repeat (2/2002)** | **66.17** | 1.24 | 5 | 4.9 | 0.3 | 20 | <2 |
| 90880(-60) original (11/2001) | 24.2 | 0.10 | <1 | 0.1 | 2.5 | <10 | <2 |
| 90880(-60) 1st repeat (11/2001) | 26.5 | 0.10 | <1 | 0.2 | 2.8 | <10 | <2 |
| 90880(-200) original (11/2001) | 92.4 | 0.19 | <1 | 0.4 | 2.6 | <10 | <2 |
| 90880(-200) 1st repeat (11/2001) | 102.6 | 0.19 | <1 | 0.4 | 2.7 | <10 | <2 |
| **90880(-200) 2nd repeat (2/2002)** | 111.49 | 0.2 | <1 | 0.4 | 3.1 | 18 | <2 |
| 90882 original (11/2001) | 315.7 | 0.17 | <1 | 0.3 | 1.8 | <10 | <2 |
| 90882 1st repeat (11/2001) | 312.9 | 0.17 | 1 | 0.2 | 2.0 | <10 | <2 |
| **90882 2nd repeat (2/2002)** | 331.5 | 0.17 | <1 | 0.3 | 1.8 | <10 | <2 |
| 90859 (-200) original (11/2001) | 278.2 | 3.99 | <1 | 2 | 4.7 | <10 | 3 |
| **90859 (-200) 1st repeat (2/2002)** | 295.22 | 3.93 | 1 | 2.1 | 2.1 | <10 | <2 |

| ***Difference between the average of*** | | | | | | | |
|---|---|---|---|---|---|---|---|
| *91210* | *-34.6* | *-0.2* | | *0.0* | *0.0* | | |
| *91244* | *-21.4* | *-2.4* | | *2.1* | *0.0* | | |
| *90880 -60* | *9.5* | *0.0* | | *100.0* | *12.0* | | |
| *90880 -200* | *14.3* | *5.3* | | *0.0* | *17.0* | | |
| *90882* | *5.5* | *0.0* | | *20.0* | *-5.3* | | |
| *90859* | *6.1* | *-1.5* | | *5.0* | *-55.3* | | |

Appendix 6.1 Aripuana - quality control - repeat samples (precision of measurements)

|  |  |  | Ag<br>ppm | Ag<br>ppb | Al<br>% | Al2O3<br>% | As<br>ppm | As<br>ppm | Au<br>ppb | B<br>ppm | Ba<br>ppm | Ba<br>ppm | Be<br>ppm | Bi<br>ppm | Bi<br>ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method: | ACME |  | 4BTD | 1FMS | 1FMS | 4AWR | 4BTD | 1FMS | 1FMS | 1FMS | 4AWR | 1FMS | 1FMS | 4BTD | 1FMS |
| Method: | ACME |  | 4 acid | Aqua Regia | Aqua Regia | Fusion | 4 acid | Aqua Regia | Aqua Regia | Aqua Regia | Fusion | Aqua Regia | Aqua Regia | 4 acid | Aqua Regia |
| Digestion: | ACME |  | H2O-Hf-HCLO4-HNO3 | HNO3-HCL-H2O | HNO3-HCL-H2O | LiBO2 | H2O-Hf-HCLO4-HNO3 | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | LiBO2 | HNO3-HCL-H2O | HNO3-HCL-H2O | H2O-Hf-HCLO4-HNO3 | HNO3-HCL-H2O |
| Acid / Strength: | ACME |  | 18:10:3:6 | 0.08474537 | 0.08474537 | 5% HNO3 | 18:10:3:6 | 0.08474537 | 0.08474537 | 0.08474537 | 5% HNO3 | 0.08474537 | 0.08474537 | 18:10:3:6 | 2:02:02 |
| Sample Wt (grams): | ACME |  | 0.25 | 30 | 30 | 0.2 | 0.25 | 30 | 30 | 30 | 0.2 | 30 | 30 | 0.25 | 30 |
| Det. Lim: | ACME |  | 0.1 | 2 | 0.01 | 0.03 | 1 | 0.1 | 0.2 | 1 | 5 | 0.5 | 0.1 | 0.1 | 0.02 |
| Upper Lim: | ACME |  | 200 | 100000 | 10 | 100 | 10000 | 10000 | 100000 | 2000 | 400000 | 10000 | 1000 | 4000 | 2000 |
| Method: | Genalysis |  | 4 acid - MS |  |  |  | 4 acid - MS |  | B/ETA | Fusion (Pb) - OES | Fusion (Ni) -MS | 4 acid - MS | 4 acid - MS | 4 acid - MS |  |
| Det. Lim: | Genalysis |  | 0.1 | 1 |  |  | 1 |  | 1 | 50 | 1 | 0.1 | 0.1 | 0.01 |  |
| Digestion: | Ultra Trace |  | 4 acid |  |  | 4 acid | 4 acid |  | Aqua Regia | Fusion | Fusion |  | 4 acid | 4 acid |  |
| Method: | Ultra Trace |  | ICP-MS |  |  | ICP-OES | ICP-MS |  | ICP-MS | ICP-OES | ICP-OES |  | ICP-MS | ICP-MS |  |
| Det. Lim: | Ultra Trace |  | 0.5 |  |  | 0.001 | 0.5 |  | 1 | 10 | 20 |  | 0.1 | 0.1 |  |
| Method: | CSIRO |  | ICP-MS |  |  | ICP | INAA |  | INAA |  | XRF |  | ICP | ICP-MS |  |
| **Sample number** | **Laboratory** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 6 | ACME |  | 0.4 | 17 | 0.087 | 18.39 | **26** | 1.3 | 80.2 | 3 | 313 | 6.3 | 0.1 | 0.2 | 0.1 |
| Std 6 | Genalysis |  | <0.1 |  |  |  | 2 |  | 88 | 54 | 338 | 310 | 1.6 | 0.29 |  |
| Std 6 | Ultra Trace |  | <0.5 |  |  | 20.20 | 0.5 |  | 79 | 50 | 320 |  | 1.4 | 0.3 |  |
| Std 6 | CSIRO | mean | 0.45 |  |  | 18.23 | 2 |  | 86 |  | 330 |  | 1 | 0.3 |  |
| Number of measurements |  |  | 2 |  |  | 25 | 12 |  | 16 |  | 20 |  | 25 | 2 |  |
| % precision |  |  | 19 |  |  | 8 | 22 |  | 17 |  | 7 |  | 210 | 19 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 7 | ACME |  | 0.4 | 304 | 2.588 | 16.99 | **122** | 48.2 | 260.6 | 3 | 31 | 14.6 | 0.5 | 2.6 | 2.58 |
| Std 7 | Genalysis |  | 0.3 |  |  |  | 58 |  | 233 | <0.1 | 36 | 31.4 | 0.7 | 2.55 |  |
| Std 7 | Ultra Trace |  | <0.5 |  |  | 17.40 | 64 |  | 227 | <10 | 40 |  | 0.7 | 2.6 |  |
| Std 7 | CSIRO | mean | 1.46 |  |  | 16.72 | 66 |  | 576 |  | 49 |  | 1 | 2.52 |  |
| Number of measurements |  |  |  |  |  | 19 | 11 |  | 11 |  | 17 |  | 19 |  |  |
| % precision |  |  |  |  |  | 9 | 16 |  | 230 |  | 33 |  | 182 |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 8 | ACME |  | 0.2 | 284 | 0.924 | 21.53 | **984** | 1138.4 | 5679.1 | 6 | 3402 | 124.7 | 1.1 | 48.4 | 52.96 |
| Std 8 | Genalysis |  | <0.1 |  |  |  | 1028 |  | 5452 | 95 | 3506 | 3069.5 | 2.1 | 53.32 |  |
| Std 8 | Ultra Trace |  | <0.5 |  |  | 22.50 | 1100 |  | 5420 | 100 | 3480 |  | 2.2 | 52 |  |
| Std 8 | CSIRO | mean | 0.88 |  |  | 21.20 | 1121 |  | 5497 |  | 3244 |  | 1 | 47.24 |  |
| Number of measurements |  |  | 14 |  |  | 31 | 26 |  | 26 |  | 26 |  | 31 | 14 |  |
| % precision |  |  | 38 |  |  | 6 | 9 |  | 8 |  | 20 |  | 201 | 10 |  |

Appendix 6.2 Aripuana - quality control - accuracy, using CSIRO internal standards (bold indicates significant difference between ACME results and other data.
Percent precision = 100 (2s/x) where s is the standard deviation and x is the mean)

| | | **Ca**<br>% | **CaO**<br>% | **Cd**<br>ppm | **Cd**<br>ppm | **Ce**<br>ppm | **Ce**<br>ppm | **Co**<br>ppm | **Co**<br>ppm | **Cr**<br>ppm | **Cr**<br>ppm | **Cs**<br>ppm | **Cs**<br>ppm | **Cu**<br>ppm | **Cu**<br>ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method: | ACME | 1FMS | 4AWR | 4BTD | 1FMS | 4BWR | 1FMS | 4BWR | 1FMS | 4AWR | 1FMS | 4BWR | 1FMS | 4BTD | 1FMS |
| Method: | ACME | Aqua Regia | Fusion | 4 acid | Aqua Regia | Fusion | Aqua Regia | Fusion | Aqua Regia | Fusion | Aqua Regia | Fusion | Aqua Regia | 4 acid | Aqua Regia |
| Digestion: | ACME | | | | | | | | | | | | | | |
| Acid / Strength: | ACME | HNO3-HCL-H2O<br>2:02:02 | LiBO2<br>5% HNO3 | ?O-Hf-HCLO4-HN(<br>18:10:3:6 | HNO3-HCL-H2O<br>2:02:02 | LiBO2<br>5% HNO3 | HNO3-HCL-H2O<br>2:02:02 | LiBO2<br>5% HNO3 | HNO3-HCL-H2O<br>2:02:02 | LiBO2<br>5% HNO3 | HNO3-HCL-H2O<br>2:02:02 | LiBO2<br>5% HNO3 | HNO3-HCL-H2O<br>2:02:02 | ?O-Hf-HCLO4-HN(<br>18:10:3:6 | HNO3-HCL-H2O<br>2:02:02 |
| Sample Wt (grams): | ACME | 30 | 0.2 | 0.25 | 30 | 0.2 | 30 | 0.2 | 30 | 0.2 | 30 | 0.2 | 30 | 0.25 | 30 |
| Det. Lim: | ACME | 0.01 | 0.01 | 0.1 | 0.01 | 0.5 | 0.1 | 0.5 | 0.1 | 0.001 | 0.5 | 0.1 | 0.02 | 0.1 | 0.01 |
| Upper Lim: | ACME | 40 | 60 | 4000 | 2000 | 5000 | 2000 | 10000 | 2000 | 40 | 10000 | 5000 | 2000 | 10000 | 10000 |
| Method: | Genalysis | | | 4 acid - MS | | Fusion (Ni) -MS | 4 acid - MS | 4 acid - MS | | Fusion (Pb) - OES | 4 acid - OES | Fusion (Ni) -MS | 4 acid - MS | 4 acid - OES | Fusion (Pb) - OES |
| Det. Lim: | Genalysis | | | 0.1 | | 0.1 | 0.01 | 0.1 | | 50 | 2 | 0.05 | 0.005 | 1 | 20 |
| Digestion: | Ultra Trace | | Fusion | | Aqua Regia | Fusion | | | Aqua Regia | Fusion | | 4 acid | | 4 acid | |
| Method: | Ultra Trace | | ICP-OES | | ICP-MS | ICP-MS | | | ICP-MS | ICP-OES | | ICP-MS | | ICP-OES | |
| Det. Lim: | Ultra Trace | | 0.1 | | 0.1 | 0.5 | | | 0.2 | 50 | | 0.1 | | 1 | |
| Method: | CSIRO | | ICP | | ICP-MS | INAA | | | INAA | INAA | | INAA | | XRF | |
| **Sample number** | **Laboratory** | | | | | | | | | | | | | | |
| Std 6 | ACME | 0.006 | 0.02 | 0.2 | <.01 | 32 | 23 | 0.9 | 0.5 | 137 | 9.5 | 7.2 | 0.27 | 8 | 3.22 |
| Std 6 | Genalysis | | | <0.1 | | 35 | 36 | 0.6 | | 127 | 100 | 7.8 | 7.364 | 7 | <1 |
| Std 6 | Ultra Trace | | <0.1 | | <0.05 | 36 | | | 0.5 | 150 | | 8.0 | | 19 | |
| Std 6 | CSIRO | | 0.03 | | <0.05 | 31 | | | 0.7 | 120 | | 7.6 | | 6 | |
| Number of measurements | | | 25 | | 2 | 18 | | | 6 | 18 | | 17 | | 22 | |
| % precision | | | 71 | | | 14 | | | 106 | 6 | | 17 | | 140 | |
| | | | | | | | | | | | | | | | |
| Std 7 | ACME | 0.068 | 0.19 | <0.1 | 0.01 | 14 | 9 | 8.4 | 5.4 | **321** | 385.2 | 1.3 | 0.88 | 38 | 25.62 |
| Std 7 | Genalysis | | | <0.1 | | 12 | 11 | 9.1 | | 422 | 435 | 1.2 | 1.202 | 47 | 53 |
| Std 7 | Ultra Trace | | 0.10 | | 0.05 | 13 | | | 4.5 | 400 | | 1.2 | | 51 | |
| Std 7 | CSIRO | | 0.21 | | 0.42 | 9 | | | 9.9 | 407 | | 1.7 | | 50 | |
| Number of measurements | | | 19 | | | 11 | | | 11 | 11 | | 11 | | 17 | |
| % precision | | | 19 | | | 50 | | | 17 | 6 | | 81 | | 24 | |
| | | | | | | | | | | | | | | | |
| Std 8 | ACME | 0.101 | 0.28 | <0.1 | 0.1 | 120 | 84 | 157.1 | 154 | **110** | 66.8 | 9.3 | 2.75 | 189 | 182.71 |
| Std 8 | Genalysis | | | 0.1 | | 149 | 135 | 152.8 | | 170 | 138 | 10.1 | 9.659 | 198 | 199 |
| Std 8 | Ultra Trace | | 0.30 | | 0.15 | 135 | | | 130 | 150 | | 10.1 | | 208 | |
| Std 8 | CSIRO | | 0.28 | | 0.24 | 119 | | | 175 | 138 | | 9.5 | | 212 | |
| Number of measurements | | | 31 | | 14 | 26 | | | 26 | 23 | | 11 | | 30 | |
| % precision | | | 9 | | 114 | 14 | | | 9 | 10 | | 18 | | 14 | |

Appendix 6.2  Aripuana - quality control - accuracy, using CSIRO internal standards (bold indicates significant difference between ACME results and other data.
Percent precision = 100 (2s/x) where s is the standard deviation and x is the mean)

|  |  | Dy ppm | Er ppm | Eu ppm | Fe % | Fe2O3 % | Ga ppm | Ga ppm | Gd ppm | Ge ppm | Hf ppm | Hf ppm | Hg ppb | Ho ppm | In ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method: | ACME | 4BWR | 4BWR | 4BWR | 1FMS | 4AWR | 4BWR | 1FMS | 4BWR | 1FMS | 4BWR | 1FMS | 1FMS | 4BWR | 1FMS |
| Method: | ACME | Fusion | Fusion | Fusion | Aqua Regia | Fusion | Fusion | Aqua Regia | Fusion | Aqua Regia | Fusion | Aqua Regia | Aqua Regia | Fusion | Aqua Regia |
| Digestion: | ACME |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Acid / Strength: | ACME | LiBO2 5% HNO3 | LiBO2 5% HNO3 | LiBO2 5% HNO3 | HNO3-HCL-H2O 2:02:02 | LiBO2 5% HNO3 | LiBO2 5% HNO3 | HNO3-HCL-H2O 2:02:02 | LiBO2 5% HNO3 | HNO3-HCL-H2O 2:02:02 | LiBO2 5% HNO3 | HNO3-HCL-H2O 2:02:02 | HNO3-HCL-H2O 2:02:02 | LiBO2 5% HNO3 | HNO3-HCL-H2O 2:02:02 |
| Sample Wt (grams): | ACME | 0.2 | 0.2 | 0.2 | 30 | 0.2 | 0.2 | 30 | 0.2 | 30 | 0.2 | 30 | 30 | 0.2 | 30 |
| Det. Lim: | ACME | 0.05 | 0.05 | 0.05 | 0.01 | 0.04 | 0.5 | 0.1 | 0.05 | 0.1 | 0.5 | 0.02 | 5 | 0.05 | 0.02 |
| Upper Lim: | ACME | 500 | 500 | 500 | 40 | 100 | 5000 | 100 | 500 | 100 | 5000 | 1000 | 100000 | 500 | 1000 |
| Method: | Genalysis | Fusion (Ni) -MS | Fusion (Ni) -MS | Fusion (Ni) -MS |  |  | Fusion (Ni) -MS | 4 acid - MS | Fusion (Ni) -MS | 4 acid - MS | Fusion (Ni) -MS | 4 acid - MS | CM/CVAP | Fusion (Ni) -MS | 4 acid - MS |
| Det. Lim: | Genalysis | 0.1 | 0.1 | 0.1 |  |  | 1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.01 | 0.01 | 0.1 | 0.01 |
| Digestion: | Ultra Trace | 4 acid | 4 acid | 4 acid |  | Fusion | Fusion |  | Aqua Regia | Aqua Regia | 4 acid |  | Aqua Regia | 4 acid | 4 acid |
| Method: | Ultra Trace | ICP-MS | ICP-MS | ICP-MS |  | ICP-OES | ICP-MS |  | ICP-MS | ICP-MS | ICP-MS |  | ICP-MS | ICP-MS | ICP-MS |
| Det. Lim: | Ultra Trace | 0.05 | 0.05 | 0.05 |  | 0.01 | 2 |  | 0.05 |  | 0.2 |  |  | 0.02 | 0.02 |
| Method: | CSIRO |  |  | INAA |  | INAA | XRF |  |  | XRF | INAA |  |  |  | ICP-MS |
| **Sample number** | **Laboratory** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 6 | ACME | 1.21 | 0.8 | 0.5 | 0.038 | 0.37 | 23.2 | 0.3 | 1.1 | <.1 | 2.3 | 0.12 | <5 | 0.23 | <.02 |
| Std 6 | Genalysis | 1.4 | 0.8 | 0.5 |  |  | 23 | 22.9 | 1.3 | 3.4 | 2.9 | 2.37 | <10 | 0.3 | 0.05 |
| Std 6 | Ultra Trace | 1.1 | 0.75 | 0.6 |  | 0.46 | <50 |  | 0.55 | <1 | 4.2 |  | <10 | 0.24 | 0.04 |
| Std 6 | CSIRO |  |  | 0.5 |  | 0.42 | 23 |  |  | 3 | 2.7 |  |  |  | 0.1 |
| Number of measurements |  |  |  | 17 |  | 16 | 19 |  |  | 22 | 17 |  |  |  | 2 |
| % precision |  |  |  | 59 |  | 23 | 8 |  |  | 43 | 10 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 7 | ACME | 1.08 | 0.73 | 0.3 | 17.257 | 28.45 | 36.6 | 32.3 | 0.89 | 0.2 | 5.8 | 1.62 | 44 | 0.22 | 0.19 |
| Std 7 | Genalysis | 1.1 | 0.6 | 0.3 |  |  | 36 | 35.7 | 0.9 | 1.6 | 5.8 | 3.68 | 50 | 0.3 | 0.18 |
| Std 7 | Ultra Trace | 0.8 | 0.5 | 0.3 |  | 29.50 | <50 |  | 0.7 | <1 | 4.4 |  | 40 | 0.16 | 0.18 |
| Std 7 | CSIRO |  |  | 0.3 |  | 28.07 | 33 |  |  | 1 | 5.6 |  |  |  | 0.19 |
| Number of measurements |  |  |  | 11 |  | 11 | 13 |  |  | 17 | 11 |  |  |  |  |
| % precision |  |  |  |  |  | 5 | 9 |  |  | 173 | 18 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 8 | ACME | 3.49 | 1.77 | 1.9 | 9.573 | 17.80 | 29.5 | 6 | 4.91 | 0.1 | 4.2 | 0.39 | 57 | 0.57 | **0.19** |
| Std 8 | Genalysis | 4.1 | 1.7 | 2.8 |  |  | 27 | 27.7 | 5.8 | 2.5 | 3.7 | 2.97 | 70 | 0.7 | 0.46 |
| Std 8 | Ultra Trace | 3.05 | 1.65 | 2.8 |  | 17.70 | <50 |  | 3.7 | <1 | 3.2 |  | 40 | 0.62 | 0.5 |
| Std 8 | CSIRO |  |  | 2.3 |  | 16.52 | 29 |  |  | 2 | 3.5 |  |  |  | 0.49 |
| Number of measurements |  |  |  | 11 |  | 11 | 28 |  |  | 30 | 11 |  |  |  | 14 |
| % precision |  |  |  | 22 |  | 10 | 14 |  |  | 121 | 29 |  |  |  | 21 |

Appendix 6.2 Aripuana - quality control - accuracy, using CSIRO internal standards (bold indicates significant difference between ACME results and other data.
Percent precision = 100 (2s/x) where s is the standard deviation and x is the mean)

|  |  | K | K2O | La | La | Li | Lu | Mg | MgO | Mn | Mn | Mo | Mo | Na | Na2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | % | % | ppm | ppm | ppm | ppm | % | % | ppm | ppm | ppm | ppm | % | % |
| Method: | ACME | 1FMS | 4AWR | 4BWR | 1FMS | 1FMS | 4BWR | 1FMS | 4AWR | 4AWR | 1FMS | 4BTD | 1FMS | 1FMS | 4AWR |
| Method: | ACME | Aqua Regia | Fusion | Fusion | Aqua Regia | Aqua Regia | Fusion | Aqua Regia | Fusion | Fusion | Aqua Regia | 4 acid | Aqua Regia | Aqua Regia | Fusion |
| Digestion: | ACME | HNO3-HCL-H2O | LiBO2 | LiBO2 | HNO3-HCL-H2O | HNO3-HCL-H2O | LiBO2 | HNO3-HCL-H2O | LiBO2 | LiBO2 | HNO3-HCL-H2O | O-Hf-HCLO4-HN | HNO3-HCL-H2O | HNO3-HCL-H2O | LiBO2 |
| Acid / Strength: | ACME | 2:02:02 | 5% HNO3 | 5% HNO3 | 2:02:02 | 2:02:02 | 5% HNO3 | 2:02:02 | 5% HNO3 | 5% HNO3 | 2:02:02 | 18:10:3:6 | 2:02:02 | 2:02:02 | 5% HNO3 |
| Sample Wt (grams): | ACME | 30 | 0.2 | 0.2 | 30 | 30 | 0.2 | 30 | 0.2 | 0.2 | 30 | 0.25 | 30 | 30 | 0.2 |
| Det. Lim: | ACME | 0.01 | 0.04 | 0.5 | 0.5 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 1 | 0.5 | 0.01 | 0.001 | 0.01 |
| Upper Lim: | ACME | 10 | 50 | 5000 | 10000 | 2000 | 500 | 30 | 50 | 50 | 10000 | 4000 | 2000 | 10 | 50 |
| Method: | Genalysis |  |  | Fusion (Ni) -MS | 4 acid - MS | 4 acid - MS | Fusion (Ni) -MS |  |  | Fusion (Pb) - OES | 4 acid - OES | 4 acid - MS |  |  |  |
| Det. Lim: | Genalysis |  |  | 0.1 | 0.01 | 0.1 | 0.05 |  |  | 20 | 1 | 0.1 |  |  |  |
| Digestion: | Ultra Trace |  | Fusion | Fusion |  | Fusion | 4 acid |  | Fusion | 4 acid |  | 4 acid |  |  | 4 acid |
| Method: | Ultra Trace |  | ICP-OES | ICP-MS |  | ICP-MS | ICP-MS |  | ICP-OES | ICP-OES |  | ICP-MS |  |  | ICP-OES |
| Det. Lim: | Ultra Trace |  | 100 | 0.5 |  | 1 | 0.02 |  | 0.01 | 1 |  | 0.2 |  |  | 0.001 |
| Method: | CSIRO |  | AAS | INAA |  | AAS | INAA |  | ICP | XRF |  | INAA |  |  | AAS |
| **Sample number** | **Laboratory** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 6 | ACME | 0.026 | 4.09 | 18.5 | 14.6 | **0.3** | 0.14 | 0.04 | 0.30 | <77 | 13 | 0.7 | 0.21 | 0.112 | 0.38 |
| Std 6 | Genalysis |  |  | 19.2 | 18.39 | 12.9 | 0.14 |  |  | <20 | 5 | 0.5 |  |  |  |
| Std 6 | Ultra Trace |  | 3.60 | 18 |  | 12 | 0.12 |  | 0.33 | 7 |  | 0.6 |  |  | 0.39 |
| Std 6 | CSIRO |  | 3.54 | 21.6 |  | 11.4 | 0.1 |  | 0.34 | 8 |  | 3 |  |  | 0.40 |
| Number of measurements |  |  | 3 | 18 |  | 3 | 4 |  | 25 | 19 |  | 5 |  |  | 3 |
| % precision |  |  | 2 | 7 |  | 16 | 35 |  | 18 | 87 |  | 49 |  |  | 1 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 7 | ACME | 0.041 | 0.17 | 6.1 | 3.4 | 6.4 | 0.13 | 0.07 | 0.21 | 155 | 90 | 2.7 | 2.1 | 0.005 | 0.05 |
| Std 7 | Genalysis |  |  | 4.4 | 4.16 | 13.2 | 0.14 |  |  | 216 | 207 | 2.7 |  |  |  |
| Std 7 | Ultra Trace |  | 0.15 | 4.5 |  | 13 | 0.08 |  | 0.27 | 226 |  | 2.8 |  |  | 0.08 |
| Std 7 | CSIRO |  | 0.14 | 5.3 |  | NA | 0.2 |  | 0.24 | 181 |  | 6 |  |  | 0.03 |
| Number of measurements |  |  |  | 11 |  |  | 2 |  | 19 | 13 |  | 2 |  |  |  |
| % precision |  |  |  | 21 |  |  | 100 |  | 20 | 5 |  | 164 |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 8 | ACME | 0.223 | 5.36 | 41.1 | 23.6 | **3.9** | 0.24 | 0.29 | 1.00 | 310 | 289 | 5.4 | 5.16 | 0.732 | 1.59 |
| Std 8 | Genalysis |  |  | 51.2 | 43.54 | 21.8 | 0.19 |  |  | 351 | 366 | 5.2 |  |  |  |
| Std 8 | Ultra Trace |  | 5.05 | 41 |  | 23 | 0.24 |  | 1.08 | 372 |  | 5.6 |  |  | 1.73 |
| Std 8 | CSIRO |  | 4.81 | 47.2 |  | 17.5 | 0.3 |  | 1.09 | 323 |  | 6 |  |  | 1.73 |
| Number of measurements |  |  | 2 | 26 |  | 2 | 11 |  | 31 | 28 |  | 18 |  |  | 2 |
| % precision |  |  |  | 12 |  | 32 | 40 |  | 11 | 14 |  | 31 |  |  |  |

Appendix 6.2  Aripuana - quality control - accuracy, using CSIRO internal standards (bold indicates significant difference between ACME results and other data.
Percent precision = 100 (2s/x) where s is the standard deviation and x is the mean)

|  |  | Nb ppm | Nb ppm | Nd ppm | Ni ppm | Ni ppm | Ni ppm | P % | P2O5 ppm | Pb ppm | Pb ppm | Pd ppb | Pr ppm | Pt ppb | Rb ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method: | ACME | 4BWR | 1FMS | 4BWR | 4AWR | 4BTD | 1FMS | 1FMS | 4AWR | 4BTD | 1FMS | 1FMS | 4BWR | 1FMS | 4BWR |
| Method: | ACME | Fusion | Aqua Regia | Fusion | Fusion | 4 acid | Aqua Regia | Aqua Regia | Fusion | 4 acid | Aqua Regia | Aqua Regia | Fusion | Aqua Regia | Fusion |
| Digestion: | ACME | LiBO2 | HNO3-HCL-H2O | LiBO2 | LiBO2 | O-Hf-HCLO4-HN | HNO3-HCL-H2O | HNO3-HCL-H2O | LiBO2 | O-Hf-HCLO4-HN | HNO3-HCL-H2O | HNO3-HCL-H2O | LiBO2 | HNO3-HCL-H2O | LiBO2 |
| Acid / Strength: | ACME | 5% HNO3 | 2:02:02 | 5% HNO3 | 5% HNO3 | 18:10:3:6 | 2:02:02 | 2:02:02 | 5% HNO3 | 18:10:3:6 | 2:02:02 | 2:02:02 | 5% HNO3 | 2:02:02 | 5% HNO3 |
| Sample Wt (grams): | ACME | 0.2 | 30 | 0.2 | 0.2 | 0.25 | 30 | 30 | 0.2 | 0.25 | 30 | 30 | 0.2 | 30 | 0.2 |
| Det. Lim: | ACME | 0.5 | 0.02 | 0.4 | 20 | 0.1 | 0.1 | 0.001 | 0.01 | 0.1 | 0.01 | 10 | 0.02 | 2 | 0.5 |
| Upper Lim: | ACME | 5000 | 2000 | 1000 | 10000 | 10000 | 10000 | 5 | 50 | 10000 | 10000 | 1000 | 500 | 1000 | 5000 |
| Method: | Genalysis | Fusion (Ni) -MS | 4 acid - MS | Fusion (Ni) -MS | Fusion (Pb) - OES | 4 acid - OES |  |  |  | 4 acid - MS |  |  | Fusion (Ni) -MS | 4 acid - MS | Fusion (Ni) -MS |
| Det. Lim: | Genalysis | 10 | 0.05 | 0.1 | 20 | 1 |  |  |  | 2 |  |  | 0.05 | 0.005 | 0.5 |
| Digestion: | Ultra Trace | 4 acid |  | 4 acid |  | 4 acid |  |  | 4 acid | 4 acid |  | Aqua Regia | 4 acid | Aqua Regia | Fusion |
| Method: | Ultra Trace | ICP-MS |  | ICP-MS |  | ICP-OES |  |  | ICP-OES | ICP-MS |  | ICP-MS | ICP-MS | ICP-MS | ICP-MS |
| Det. Lim: | Ultra Trace | 0.5 |  | 0.05 |  | 1 |  |  | 10 | 1 |  | 10 | 0.02 | 5 | 0.2 |
| Method: | CSIRO | XRF |  |  |  | XRF |  |  |  | XRF |  |  |  |  | XRF |
| **Sample number** | **Laboratory** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 6 | ACME | 2.4 | <.02 | 11.4 | <20 | 7.5 | 2 | 0.002 | <100 | **42** | 12.2 | <10 | 3.17 | <2 | 98 |
| Std 6 | Genalysis | 12 | 0.73 | 11.8 | 24 | 10 |  |  |  | 13 |  |  | 3.21 | 3.532 | 103 |
| Std 6 | Ultra Trace | 0.5 |  | 11.3 |  | 24 |  |  | 150 | 13 |  | <10 | 3.4 | <5 | 101 |
| Std 6 | CSIRO | 4 |  |  |  | 9 |  |  | 300 | 10 |  |  |  |  | 109 |
| Number of measurements |  | 22 |  |  |  | 22 |  |  |  | 22 |  |  |  |  | 19 |
| % precision |  | 64 |  |  |  | 33 |  |  |  | 35 |  |  |  |  | 4 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 7 | ACME | 7.3 | 0.33 | 5.3 | 96 | 42.8 | 13.9 | 0.008 | <100 | **62** | 29.3 | <10 | 1.31 | <2 | 11 |
| Std 7 | Genalysis | 18 | 6.39 | 5.1 | 59 | 44 |  |  |  | 27 |  |  | 1.18 | 1.181 | 12 |
| Std 7 | Ultra Trace | 8.5 |  | 4.1 |  | 50 |  |  | 350 | 26 |  | <10 | 1.1 | <5 | 11 |
| Std 7 | CSIRO | 6 |  |  |  | 40 |  |  | 100 | 23 |  |  |  |  | 12 |
| Number of measurements |  | 17 |  |  |  | 17 |  |  |  | 17 |  |  |  |  | 13 |
| % precision |  | 54 |  |  |  | 28 |  |  |  | 32 |  |  |  |  | 17 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 8 | ACME | 5.4 | 0.07 | 43.2 | 92 | 95.4 | 101.3 | 0.073 | 1500 | **14** | 20.88 | <10 | 10.39 | <2 | 116 |
| Std 8 | Genalysis | <10 | 4.87 | 51.2 | 127 | 112 |  |  |  | 22 |  |  | 13.34 | 12.421 | 122 |
| Std 8 | Ultra Trace | 5.5 |  | 36.7 |  | 120 |  |  | 1650 | 21 |  | <10 | 10.1 | <5 | 120 |
| Std 8 | CSIRO | 6 |  |  |  | 94 |  |  | 800 | 14 |  |  |  |  | 127 |
| Number of measurements |  | 30 |  |  |  | 30 |  |  |  | 30 |  |  |  |  | 28 |
| % precision |  | 60 |  |  |  | 17 |  |  |  | 29 |  |  |  |  | 9 |

Appendix 6.2 Aripuana - quality control - accuracy, using CSIRO internal standards (bold indicates significant difference between ACME results and other data.
Percent precision = 100 (2s/x) where s is the standard deviation and x is the mean)

| | | Rb | Re | S | Sb | Sb | Sc | Sc | Se | SiO2 | Sm | Sn | Sn | Sr | Sr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppb | % | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm |
| Method: | ACME | 1FMS | 1FMS | 1FMS | 4BTD | 1FMS | 4AWR | 1FMS | 1FMS | 4AWR | 4BWR | 4BWR | 1FMS | 4BWR | 1FMS |
| Method: | ACME | Aqua Regia | Aqua Regia | Aqua Regia | 4 acid | Aqua Regia | Fusion | Aqua Regia | Aqua Regia | Fusion | Fusion | Fusion | Aqua Regia | Fusion | Aqua Regia |
| Digestion: | ACME | HNO3-HCL-H2O | HNO3-HCL-H2O | HNO3-HCL-H2O | !O-Hf-HCLO4-HN( | HNO3-HCL-H2O | LiBO2 | HNO3-HCL-H2O | HNO3-HCL-H2O | LiBO2 | LiBO2 | LiBO2 | HNO3-HCL-H2O | LiBO2 | HNO3-HCL-H2O |
| Acid / Strength: | ACME | 2:02:02 | 2:02:02 | 2:02:02 | 18:10:3:6 | 2:02:02 | 5% HNO3 | 2:02:02 | 2:02:02 | 5% HNO3 | 5% HNO3 | 5% HNO3 | 2:02:02 | 5% HNO3 | 2:02:02 |
| Sample Wt (grams): | ACME | 30 | 30 | 30 | 0.25 | 30 | 0.2 | 30 | 30 | 0.2 | 0.2 | 0.2 | 30 | 0.2 | 30 |
| Det. Lim: | ACME | 0.1 | 1 | 0.02 | 0.1 | 0.02 | 1 | 0.1 | 0.1 | 0.02 | 0.1 | 1 | 0.1 | 0.5 | 0.5 |
| Upper Lim: | ACME | 2000 | 1000000 | 10 | 4000 | 2000 | 500 | 100 | 100 | 100 | 500 | 1000 | 100 | 5000 | 10000 |
| Method: | Genalysis | 4 acid - MS | | 4 acid - OES | 4 acid - MS | Fusion (Ni) -MS | Fusion (Pb) - OES | 4 acid - OES | 4 acid - MS | | Fusion (Ni) -MS | Fusion (Ni) -MS | 4 acid - MS | Fusion (Ni) -MS | 4 acid - MS |
| Det. Lim: | Genalysis | 0.05 | | 10 | 0.05 | 0.5 | 20 | 1 | 2 | | 0.1 | 2 | 0.1 | 20 | 0.05 |
| Digestion: | Ultra Trace | | 4 acid | 4 acid | 4 acid | | 4 acid | | 4 acid | Fusion | 4 acid | Fusion | | Fusion | |
| Method: | Ultra Trace | | ICP-MS | ICP-OES | ICP-MS | | ICP-OES | | ICP-MS | ICP-OES | ICP-MS | ICP-MS | | ICP-MS | |
| Det. Lim: | Ultra Trace | | 0.1 | 10 | 0.1 | | 1 | | 1 | 0.01 | 0.05 | 10 | | 1 | |
| Method: | CSIRO | | | | INAA | | INAA | | INAA | ICP | INAA | ICP-MS | | XRF | |
| **Sample number** | **Laboratory** | | | | | | | | | | | | | | |
| Std 6 | ACME | 0.7 | <1 | 0.01 | 7 | 1.36 | 13.0 | 0.8 | 0.1 | 71.94 | 1.8 | 3 | <.10 | 58 | 2.2 |
| Std 6 | Genalysis | 102.92 | | 143 | 7.67 | 13 | <20 | 13 | <2 | | 1.9 | <2 | 0.6 | 84 | 57.73 |
| Std 6 | Ultra Trace | | <0.1 | 200 | 7.2 | | 13.6 | | <1 | 69.70 | 1.85 | <10 | | 50 | |
| Std 6 | CSIRO | | | | 12.8 | | 13.8 | | 2 | 72.21 | 2.3 | 0.75 | | 68 | |
| Number of measurements | | | | | 18 | | 17 | | 4 | 25 | 17 | 2 | | 22 | |
| % precision | | | | | 9 | | 5 | | 23 | 7 | 9 | 57 | | 4 | |
| | | | | | | | | | | | | | | | |
| Std 7 | ACME | 5.2 | 1 | 0.02 | 3.4 | 0.83 | 57.0 | 33.3 | 0.7 | 42.02 | 1 | 6 | 2.4 | 12 | 8.5 |
| Std 7 | Genalysis | 11.43 | | 248 | 1.3 | 1.4 | 61 | 58 | 2 | | 1.1 | 3 | 2.5 | 46 | 11.86 |
| Std 7 | Ultra Trace | | <0.1 | 240 | 1.2 | | 57.2 | | 3 | 44.50 | 0.9 | <10 | | <50 | |
| Std 7 | CSIRO | | | | 1.1 | | 64.4 | | 3 | 42.83 | 1.4 | 2.52 | | 11 | |
| Number of measurements | | | | | 11 | | 11 | | 1 | 19 | 11 | | | 17 | |
| % precision | | | | | 25 | | 8 | | | 8 | 14 | | | 29 | |
| | | | | | | | | | | | | | | | |
| Std 8 | ACME | 13.8 | 1 | 0.27 | 7 | 6.22 | 9.0 | 2.1 | 1.2 | 44.19 | 7.6 | 6 | 0.3 | 100 | 19.1 |
| Std 8 | Genalysis | 114.41 | | 2984 | 8.51 | 8.8 | <20 | 10 | <2 | | 8.9 | <2 | 2 | 138 | 95.21 |
| Std 8 | Ultra Trace | | <0.1 | 3060 | 8.4 | | 10.2 | | 2 | 46.40 | 6.65 | <10 | | 100 | |
| Std 8 | CSIRO | | | | 7.8 | | 10.3 | | 4 | 45.05 | 8.6 | 2.05 | | 100 | |
| Number of measurements | | | | | 26 | | 11 | | 3 | 31 | 11 | 14 | | 30 | |
| % precision | | | | | 12 | | 10 | | 68 | 6 | 9 | 22 | | 6 | |

Appendix 6.2 Aripuana - quality control - accuracy, using CSIRO internal standards (bold indicates significant difference between ACME results and other data.

Percent precision = 100 (2s/x) where s is the standard deviation and x is the mean)

|  |  | Ta ppm | Ta ppm | Tb ppm | Te ppm | Th ppm | Th ppm | Ti % | TiO2 % | Tl ppm | Tl ppm | Tm ppm | TOT/C % | TOT/S % | U ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method: | ACME | 4BWR | 1FMS | 4BWR | 1FMS | 4BWR | 1FMS | 1FMS | 4AWR | 4BTD | 1FMS | 4BWR | 4ALC | 4ALC | 4BWR |
| Method: | ACME | Fusion | Aqua Regia | Fusion | Aqua Regia | Fusion | Aqua Regia | Aqua Regia | Fusion | 4 acid | Aqua Regia | Fusion | 4ALC | 4ALC | Fusion |
| Digestion: | ACME | LiBO2 | HNO3-HCL-H2O | LiBO2 | HNO3-HCL-H2O | LiBO2 | HNO3-HCL-H2O | HNO3-HCL-H2O | LiBO2 | O-Hf-HCLO4-HN | HNO3-HCL-H2O | LiBO2 | - | - | LiBO2 |
| Acid / Strength: | ACME | 5% HNO3 | 2:02:02 | 5% HNO3 | 2:02:02 | 5% HNO3 | 2:02:02 | 2:02:02 | 5% HNO3 | 18:10:3:6 | 2:02:02 | 5% HNO3 | - | - | 5% HNO3 |
| Sample Wt (grams): | ACME | 0.2 | 30 | 0.2 | 30 | 0.2 | 30 | 30 | 0.2 | 0.25 | 30 | 0.2 | 0.1 | 0.1 | 0.2 |
| Det. Lim: | ACME | 0.1 | 0.05 | 0.01 | 0.02 | 0.1 | 0.1 | 0.001 | 0.01 | 0.1 | 0.02 | 0.05 | 0.01 | 0.01 | 0.1 |
| Upper Lim: | ACME | 500 | 2000 | 500 | 100 | 1000 | 2000 | 10 | 50 | 1000 | 100 | 500 | 50 | 40 | 1000 |
| Method: | Genalysis | Fusion (Ni) -MS | 4 acid - MS | Fusion (Ni) -MS | 4 acid - MS | Fusion (Ni) -MS | 4 acid - MS |  |  | 4 acid - MS | Fusion (Pb) -MS | Fusion (Ni) -MS |  |  | 4 acid - MS |
| Det. Lim: | Genalysis | 0.1 | 0.01 | 0.05 | 0.1 | 0.1 | 0.01 |  |  | 0.02 | 0.2 | 0.1 |  |  | 0.01 |
| Digestion: | Ultra Trace | 4 acid |  | 4 acid | 4 acid | Fusion |  |  | Fusion | 4 acid |  | 4 acid |  |  | 4 acid |
| Method: | Ultra Trace | ICP-MS |  | ICP-MS | ICP-MS | ICP-MS |  |  | ICP-OES | ICP-MS |  | ICP-MS |  |  | ICP-MS |
| Det. Lim: | Ultra Trace | 0.05 |  | 0.02 | 0.2 | 0.5 |  |  | 0.01 | 0.1 |  | 0.02 |  |  | 0.05 |
| Method: | CSIRO | INAA |  |  |  | INAA |  |  |  |  |  |  |  |  | INAA |
| **Sample number** | **Laboratory** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 6 | ACME | 0.2 | <.05 | 0.18 | 0.02 | 4.6 | 1.6 | <.001 | 0.45 | 0.8 | 0.02 | 0.12 | 0.01 | <.01 | 1.1 |
| Std 6 | Genalysis | 0.4 | 0.27 | 0.23 | <0.1 | 4.6 | 4.91 |  |  | 0.65 | 0.7 | 0.1 |  |  | 1.16 |
| Std 6 | Ultra Trace | <0.05 |  | 0.22 | <0.2 | 3.5 |  |  | 0.40 | 0.7 |  | 0.12 |  |  | 1.1 |
| Std 6 | CSIRO | 0.4 |  |  |  | 4.5 |  |  | 0.37 |  |  |  |  |  | 1 |
| Number of measurements |  | 17 |  |  |  | 17 |  |  |  |  |  |  |  |  | 17 |
| % precision |  | 91 |  |  |  | 8 |  |  |  |  |  |  |  |  | 21 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 7 | ACME | 0.8 | <.05 | 0.18 | 0.05 | 26.8 | 25.8 | 0.049 | 1.38 | 0.1 | 0.04 | 0.1 | 1.81 | 0.01 | 5.9 |
| Std 7 | Genalysis | 1 | 0.98 | 0.16 | 0.2 | 28.3 | 29.5 |  |  | 0.11 | <0.02 | 0.1 |  |  | 5.72 |
| Std 7 | Ultra Trace | 0.95 |  | 0.14 | <0.2 | 26.5 |  |  | 1.40 | <0.1 |  | 0.08 |  |  | 5.2 |
| Std 7 | CSIRO | 1.3 |  |  |  | 26.5 |  |  | 1.48 |  |  |  |  |  | 4 |
| Number of measurements |  | 11 |  |  |  | 11 |  |  |  |  |  |  |  |  | 11 |
| % precision |  | 88 |  |  |  | 6 |  |  |  |  |  |  |  |  | 94 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 8 | ACME | 0.3 | <.05 | 0.64 | 0.68 | 6.4 | 4.4 | 0.009 | 0.51 | 1.1 | 0.15 | 0.24 | 0.06 | 0.29 | 2.2 |
| Std 8 | Genalysis | 0.4 | 0.64 | 0.8 | 0.8 | 8.2 | 7.6 |  |  | 1.22 | 1.2 | 0.3 |  |  | 2.23 |
| Std 8 | Ultra Trace | 0.25 |  | 0.7 | 0.8 | 7 |  |  | 0.50 | 1.3 |  | 0.22 |  |  | 2 |
| Std 8 | CSIRO | 0.7 |  |  |  | 7 |  |  | 0.53 |  |  |  |  |  | 2 |
| Number of measurements |  | 3 |  |  |  | 11 |  |  |  |  |  |  |  |  | 3 |
| % precision |  | 46 |  |  |  | 16 |  |  |  |  |  |  |  |  | 69 |

Appendix 6.2 Aripuana - quality control - accuracy, using CSIRO internal standards (bold indicates significant difference between ACME results and other data.
Percent precision = 100 (2s/x) where s is the standard deviation and x is the mean)

|  |  | U ppm | V ppm | V ppm | W ppm | W ppm | Y ppm | Y ppm | Yb ppm | Zn ppm | Zn ppm | Zr ppm | Zr ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method: | ACME | 1FMS | 4BWR | 1FMS | 4BWR | 1FMS | 4BWR | 1FMS | 4BWR | 4BTD | 1FMS | 4BWR | 1FMS |
| Method: | ACME | Aqua Regia | Fusion | Aqua Regia | Fusion | Aqua Regia | Fusion | Aqua Regia | Fusion | 4 acid | Aqua Regia | Fusion | Aqua Regia |
| Digestion: | ACME | HNO3-HCL-H2O | LiBO2 | HNO3-HCL-H2O | LiBO2 | HNO3-HCL-H2O | LiBO2 | HNO3-HCL-H2O | LiBO2 | O-Hf-HCLO4-HN | HNO3-HCL-H2O | LiBO2 | HNO3-HCL-H2O |
| Acid / Strength: | ACME | 2:02:02 | 5% HNO3 | 2:02:02 | 5% HNO3 | 2:02:02 | 5% HNO3 | 2:02:02 | 5% HNO3 | 18:10:3:6 | 2:02:02 | 5% HNO3 | 2:02:02 |
| Sample Wt (grams): | ACME | 30 | 0.2 | 30 | 0.2 | 30 | 0.2 | 30 | 0.2 | 0.25 | 30 | 0.2 | 30 |
| Det. Lim: | ACME | 0.1 | 5 | 2 | 1 | 0.1 | 0.1 | 0.01 | 0.05 | 1 | 0.1 | 0.5 | 0.1 |
| Upper Lim: | ACME | 2000 | 10000 | 10000 | 1000 | 100 | 5000 | 2000 | 500 | 10000 | 10000 | 5000 | 2000 |
| Method: | Genalysis |  | Fusion (Pb) - OES | 4 acid - OES | Fusion (Ni) -MS | 4 acid - MS | Fusion (Ni) -MS | 4 acid - MS | Fusion (Ni) -MS | 4 acid - OES |  | Fusion (Ni) -MS | 4 acid - MS |
| Det. Lim: | Genalysis |  | 50 | 2 | 1 | 0.1 | 0.5 | 0.05 | 0.1 | 1 |  | 5 | 0.1 |
| Digestion: | Ultra Trace |  | 4 acid |  | Fusion |  | Fusion |  | 4 acid | 4 acid |  | Fusion |  |
| Method: | Ultra Trace |  | ICP-OES |  | ICP-MS |  | ICP-MS |  | ICP-MS | ICP-OES |  | ICP-MS |  |
| Det. Lim: | Ultra Trace |  | 2 |  | 5 |  | 1 |  | 0.05 | 1 |  | 10 |  |
| Method: | CSIRO |  | XRF |  | INAA |  | XRF |  | INAA | XRF |  | XRF |  |
| **Sample number** | **Laboratory** |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 6 | ACME | 0.05 | 80 | 3 | 6 | 0.26 | 7.1 | 1.11 | 0.84 | 12 | 3 | 87.2 | 2.3 |
| Std 6 | Genalysis |  | 89 | 91 | 7 | 3.7 | 7 | 6.33 | 1 | 11 |  | 104 | 81.9 |
| Std 6 | Ultra Trace |  | 90 |  | 5 |  | 7 |  | 0.8 | 14 |  | 70 |  |
| Std 6 | CSIRO |  | 102 |  | 6 |  | 7 |  | 0.8 | 5 |  | 120 |  |
| Number of measurements |  |  | 22 |  | 18 |  | 19 |  | 17 | 22 |  | 22 |  |
| % precision |  |  | 6 |  | 33 |  | 19 |  | 16 | 52 |  | 5 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 7 | ACME | 3.85 | **670** | 610 | 13 | 0.55 | 4.8 | 2.97 | 0.79 | 38 | 12.9 | 175.5 | 51.9 |
| Std 7 | Genalysis |  | 768 | 787 | 15 | 14.5 | 5.2 | 3.18 | 0.9 | 29 |  | 207 | 92.4 |
| Std 7 | Ultra Trace |  | 776 |  | 15 |  | 6 |  | 0.5 | 32 |  | 170 |  |
| Std 7 | CSIRO |  | 851 |  | 11 |  | 5 |  | 0.8 | 20 |  | 183 |  |
| Number of measurements |  |  | 17 |  | 11 |  | 13 |  | 11 | 17 |  | 17 |  |
| % precision |  |  | 8 |  | 67 |  | 43 |  | 16 | 21 |  | 7 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Std 8 | ACME | 1.15 | 95 | 24 | 37 | 15.75 | 17.4 | 11.63 | 1.56 | 98 | 72.1 | 163 | 17.6 |
| Std 8 | Genalysis |  | 97 | 100 | 36 | 38.7 | 16 | 15.07 | 1.5 | 110 |  | 158 | 108.7 |
| Std 8 | Ultra Trace |  | 98 |  | 45 |  | 17 |  | 1.45 | 114 |  | 160 |  |
| Std 8 | CSIRO |  | 103 |  | 34 |  | 16 |  | 1.3 | 95 |  | 158 |  |
| Number of measurements |  |  | 29 |  | 26 |  | 28 |  | 11 | 30 |  | 30 |  |
| % precision |  |  | 23 |  | 13 |  | 15 |  | 24 | 16 |  | 11 |  |

Appendix 6.2 Aripuana - quality control - accuracy, using CSIRO internal standards (bold indicates significant difference between ACME results and other data.
Percent precision = 100 (2s/x) where s is the standard deviation and x is the mean)

# Appendix 7

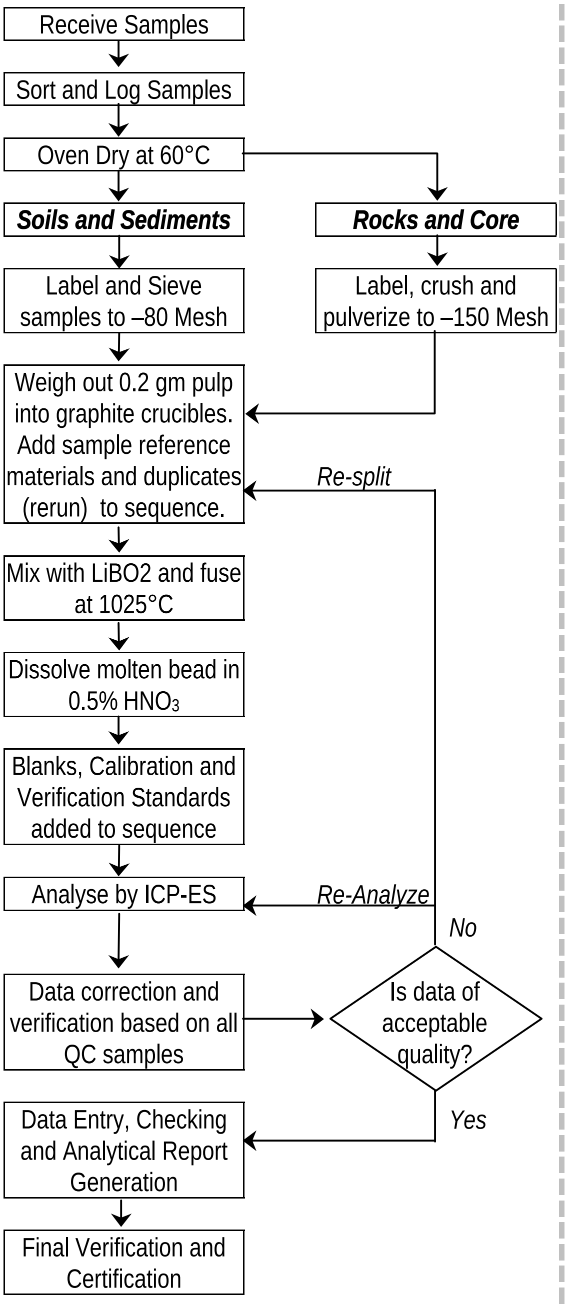
## Analytical and sample preparation procedures by ACME Laboratories, Vancouver, Canada.

**ACME**
**ANALYTICAL LABORATORIES LTD.**

852 East Hastings Street • Vancouver, British Columbia • CANADA • V6A 1R6
Telephone: (604) 253-3158 • Fax: (604) 253-1716 • Toll free: 1-800-990-ACME (2263) • e-mail: info@acmelab.com

# METHODS AND SPECIFICATIONS FOR ANALYTICAL PACKAGE GROUP 4A: WHOLE ROCK ANALYSIS BY ICP

## Analytical Process



## Comments

### Sample Preparation

Soils and sediments are rarely analysed by Group 4A, however method of sample preparation is provide for completeness. Soil and sediment samples are dried (60°C) and sieved to -80 mesh ASTM (-177 microns). Moss-mat samples are dried (60°C), macerated then sieved to recover -80 mesh sediment or ashed at 550°C (upon a client's request). Rocks and drill core are crushed and pulverized to -150 mesh ASTM (-100 microns). Sample splits (0.2 gm) are placed in graphite crucibles and a LiBO$_2$ flux is added. Duplicate splits of crushed (rejects duplicate) and pulverized (pulps duplicate) fractions are included with every 34 drill core or trench samples to define sample homogeneity (reject duplicate) and analytical precision (pulp duplicate). Duplicate pulp splits (only) are included in every batch of soil, sediment and routine rock samples. A blank and in-house standard reference material STD SO-15 are carried through weighing, digestion and analytical stages to monitor accuracy. STD SO-15 has been certified in-house against USGS CRMs AGV-1, BCR-2, G-2, GSP-2 and W-2.

### Sample Digestion

Crucibles are placed in an oven and heated to 1025°C for 25 minutes. The molten sample is dissolved in 5% HNO$_3$ (ACS grade nitric acid diluted in demineralised water). Calibration standards and reagent blanks are added to the sample sequence.

### Sample Analysis

Sample solutions are aspirated into an ICP emission spectro-graph (Jarrel Ash AtomComp Model 975) for the determination of the basic package consisting of the following 17 major oxides and elements: $SiO_2$, $Al_2O_3$, $Fe_2O_3$, CaO, MgO, $Na_2O$, $K_2O$, MnO, $TiO_2$, $P_2O_5$, $Cr_2O_3$, Ba, Ni, Sr, Sc, Y and Zr. The extended package also includes: Ce, Co, Cu, Nb, Ta and Zn. Loss on ignition (LOI) is determined for both packages by igniting a 1 g sample split at 950°C for 90 minutes then measuring the weight loss. Total Carbon and Sulphur are determined by the Leco method (Group 2A).

### Data Evaluation

Raw and final data from the ICP-ES undergoes a final verification by a British Columbia Certified Assayer who must sign the analytical report before release to the client. Chief assayer is Clarence Leong, other certified assayers are Dean Toye and Jacky Wang.

ACME ANALYTICAL LABORATORIES LTD.
852 East Hasting St. • Vancouver, B.C. • V6A 1R6
Phone (604)253-3158 Fax (604) 253-1716

Quality Control Report

## Group 4A - Whole Rock Analysis for Major Oxides and Minor Elements

| | | | Official Values | | | Certified Reference Materials | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Element | Detection Limit | Unit | STD SO-17 Official Value | SO-17 Upper Limit | SO-17 Lower Limit | CRM SY-4 | CRM AGV-1 | CRM G-2 | CRM GSP-2 | CRM W-2 |
| $SiO_2$ | 0.02 | % | 61.17 | *63.00* | *59.39* | 49.90 | 58.84 | 69.14 | 66.60 | 52.68 |
| $Al_2O_3$ | 0.03 | % | 13.72 | *14.13* | *13.32* | 20.69 | 17.15 | 15.39 | 14.90 | 15.45 |
| $Fe_2O_3$ | 0.04 | % | 5.80 | *5.98* | *5.63* | 6.21 | 6.77 | 2.66 | 4.90 | 10.83 |
| MgO | 0.01 | % | 2.33 | *2.40* | *2.25* | 0.54 | 1.53 | 0.75 | 0.96 | 6.37 |
| CaO | 0.01 | % | 4.64 | *4.78* | *4.50* | 8.05 | 4.94 | 1.96 | 2.10 | 10.86 |
| $Na_2O$ | 0.01 | % | 4.09 | *4.21* | *3.97* | 7.10 | 4.26 | 4.08 | 2.78 | 2.20 |
| $K_2O$ | 0.01 | % | 1.37 | *1.44* | *1.30* | 1.66 | 2.92 | 4.48 | 5.38 | 0.63 |
| $TiO_2$ | 0.01 | % | 0.59 | *0.63* | *0.55* | 0.29 | 1.05 | 0.48 | 0.66 | 1.06 |
| $P_2O_5$ | 0.01 | % | 0.98 | *1.03* | *0.93* | 0.13 | 0.50 | 0.14 | 0.29 | 0.14 |
| MnO | 0.01 | % | 0.53 | *0.57* | *0.49* | 0.11 | 0.09 | 0.03 | | 0.17 |
| $Cr_2O_3$ | 0.001 | % | 0.433 | *0.446* | *0.420* | 0.002 | 0.001 | | 0.002 | 0.014 |
| Ba | 5 | ppm | 398 | *418* | *378* | 340 | 1230 | 1880 | 1340 | 170 |
| Ni | 20 | ppm | 35 | *70* | *<20* | 9 | 16 | | 17 | 70 |
| Sr | 10 | ppm | 300 | *330* | *270* | 1191 | 660 | 478 | 240 | 190 |
| Zr | 10 | ppm | 348 | *385* | *310* | 517 | 227 | 309 | 550 | 100 |
| Y | 10 | ppm | 27 | *40* | *14* | 119 | 20 | 11 | 28 | 23 |
| Sc | 1 | ppm | 24 | *28* | *20* | 1 | 12 | 4 | 6 | 36 |
| LOI | 0.1 | % | 3.4 | *3.7* | *3.1* | 4.6 | 1.2 | | | |
| Ce | 20 | ppm | 23 | *46* | *<20* | 122 | 67 | 160 | 420 | 23 |
| Co | 20 | ppm | 19 | *40* | *< 20* | 3 | 15 | 5 | 7 | 43 |
| Cu | 20 | ppm | 59 | *80* | *38* | 7 | 60 | 11 | 43 | 110 |
| Nb | 20 | ppm | 26 | *52* | *< 20* | 13 | 15 | 12 | 27 | 8 |
| Ta | 20 | ppm | <20 | *< 20* | *< 20* | 1 | 1 | 1 | | 1 |
| Zn | 20 | ppm | 75 | *95* | *55* | 93 | 88 | 86 | 115 | 80 |
| C* | 0.01 | % | 2.40 | *2.52* | *2.28* | | | | | |
| S* | 0.01 | % | 5.30 | *5.58* | *5.02* | | | | | |

* Standard STD CSB for carbon and sulphur

13-Oct-01

ACME ANALYTICAL LABORATORIES LTD.
852 East Hasting St. • Vancouver, B.C. • V6A 1R6
Phone (604)253-3158 Fax (604) 253-1716

Quality Control Report

## Group 4B - Geochemical Analysis for Whole Rock Trace Elements

| | | | Sample Standards Official Values | | | | | | Certified Reference Materials* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | Detection Limit | Unit | STD SO-17 Official Value | SO-17 Upper Limit | SO-17 Lower Limit | STD KM-3 Official Value | STD KM-3 Upper Limit | STD KM -3 Lower Limit | CRM SY-4 | CRM AGV-1 | CRM GSP-2 | CRM G-2 | CRM W-2 |
| Co | 0.5 | ppm | 18.7 | 19.7 | 17.7 | 184.0 | 194.0 | 166.4 | 2.8 | 15.0 | 7.4 | 4.6 | 43.0 |
| Cs | 0.1 | ppm | 3.5 | 3.9 | 3.2 | 18.0 | 19.0 | 16.3 | 1.5 | 1.3 | 1.2 | 1.3 | 1.0 |
| Ga | 0.5 | ppm | 20.3 | 22.3 | 18.3 | 184.9 | 196.0 | 168.0 | 35.0 | 20.0 | 22.0 | 23.0 | 17.0 |
| Hf | 0.5 | ppm | 11.9 | 13.1 | 10.7 | 57.9 | 60.9 | 51.9 | 10.6 | 5.1 | 14.1 | 7.9 | 2.6 |
| Nb | 0.5 | ppm | 25.6 | 27.0 | 24.2 | 53.6 | 56.6 | 47.6 | 13.0 | 15.0 | 27.0 | 12.0 | 7.9 |
| Rb | 0.5 | ppm | 22.8 | 24.0 | 20.6 | 210.0 | 220.5 | 190.0 | 55.0 | 67.0 | 245.0 | 170.0 | 21.0 |
| Sn | 1 | ppm | 11 | 15 | 8 | 175 | 186 | 160 | 3 | 4 | - | 3 | 3 |
| Sr | 0.5 | ppm | 300 | 315 | 285 | 201 | 213 | 183 | 1191 | 660 | 240 | 475 | 195 |
| Ta | 0.1 | ppm | 4.2 | 4.6 | 3.8 | 39.0 | 41.4 | 35.6 | 0.9 | 0.9 | - | 0.5 | 0.5 |
| Th | 0.1 | ppm | 11.3 | 12.4 | 10.1 | 207.0 | 218.0 | 187.0 | 1.4 | 6.5 | 104.0 | 25.0 | 2.4 |
| Tl | 0.1 | ppm | 0.2** | 0.4 | <0.1 | 1.5 | 2.2 | 1.0 | - | 0.3 | 1.1 | - | - |
| U | 0.1 | ppm | 12.4 | 13.6 | 11.2 | 190.0 | 203.5 | 175.0 | 0.8 | 1.9 | 2.4 | 2.1 | 0.5 |
| V | 5 | ppm | 128 | 141 | 115 | 205 | 215 | 186 | 8 | 120 | 52 | 36 | 260 |
| W | 1 | ppm | 10 | 14 | 7 | 198 | 210 | 183 | 0.4 | 0.6 | - | 0.2 | - |
| Zr | 0.5 | ppm | 348 | 365 | 330 | 2240 | 2464 | 2016 | 517 | 227 | 550 | 309 | 100 |
| Y | 0.1 | ppm | 27.2 | 28.5 | 25.9 | 263.0 | 278.3 | 243.0 | 119.0 | 20.0 | 28.0 | 11.0 | 23.0 |
| La | 0.5 | ppm | 10.5 | 12.0 | 9.0 | 405.0 | 425.5 | 360.0 | 58.0 | 38.0 | 180.0 | 89.0 | 10.0 |
| Ce | 0.5 | ppm | 23.0 | 24.2 | 21.8 | 300.5 | 315.5 | 280.5 | 122.0 | 67.0 | 420.0 | 160.0 | 23.0 |
| Pr | 0.02 | ppm | 2.88 | 3.02 | 2.74 | 28.68 | 30.18 | 25.88 | 15.0 | 7.6 | 52.0 | 18.0 | - |
| Nd | 0.1 | ppm | 13.7 | 15.1 | 12.3 | 45.0 | 47.7 | 41.0 | 57.0 | 33.0 | 200.0 | 55.0 | 13.0 |
| Sm | 0.1 | ppm | 3.1 | 3.4 | 2.8 | 24.0 | 25.6 | 22.0 | 12.7 | 5.9 | 27.0 | 7.2 | 3.3 |
| Eu | 0.05 | ppm | 0.99 | 1.08 | 0.90 | 17.20 | 18.25 | 15.68 | 2.00 | 1.60 | 2.30 | 1.40 | 1.00 |
| Gd | 0.05 | ppm | 3.91 | 4.30 | 3.50 | 23.50 | 24.97 | 21.50 | 14.00 | 5.00 | 12.00 | 4.30 | - |
| Tb | 0.01 | ppm | 0.65 | 0.72 | 0.58 | 16.00 | 16.80 | 14.40 | 2.60 | 0.70 | - | 0.48 | 0.63 |
| Dy | 0.05 | ppm | 4.16 | 4.37 | 3.95 | 22.50 | 23.63 | 20.25 | 18.20 | 3.60 | 6.10 | 2.40 | 3.60 |
| Ho | 0.05 | ppm | 0.89 | 0.98 | 0.80 | 19.00 | 19.95 | 17.10 | 4.30 | 0.68 | 1.00 | 0.40 | 0.76 |
| Er | 0.05 | ppm | 2.72 | 2.86 | 2.58 | 12.00 | 12.60 | 10.80 | 14.20 | 1.70 | 2.20 | 0.92 | 2.50 |
| Tm | 0.05 | ppm | 0.41 | 0.46 | 0.36 | 17.60 | 18.48 | 15.84 | 2.30 | 0.34 | 0.29 | 0.18 | 0.38 |
| Yb | 0.05 | ppm | 2.89 | 3.04 | 2.74 | 21.00 | 22.05 | 18.90 | 14.80 | 1.72 | 1.60 | 0.80 | 2.10 |
| Lu | 0.01 | ppm | 0.42 | 0.46 | 0.38 | 19.53 | 20.50 | 17.58 | 2.10 | 0.27 | 0.23 | 0.11 | 0.33 |

* CCRMP and USGS Certified Reference Materials

**Tl value is provisional

25-Sep-01

# GROUP 1F-MS & 1T-MS   ULTRATRACE BY ICP-MS

**Group 1F-MS** A 1, 15 or 30 gm sample split is digested in aqua regia. Results are total to near total for precious and base metals and partial for rock-forming elements*. The 15 or 30 gm option is recommended for reducing the nugget effect for elements in rare or coarse-grained minerals (eg. Au). Intended for lean geological materials, samples undergo a primary ICP-ES scan. ***High-grade samples (See upper limits in table) will be analysed by the High-grade Option (See below.)***

| | Cdn | U.S. |
|---|---|---|
| 1st element | **$8.50** | **$6.55** |
| Any 6 elements | **$10.00** | **$7.70** |
| Any 11 elements | **$11.50** | **$8.85** |
| Full Suite | **$15.50** | **$11.95** |
| Run 15 gm sample............add | **$3.00** | **$2.30** |
| Run 30 gm sample............add | **$5.00** | **$3.85** |
| Pt, Pd, Os ........................add | **$3.90** | **$3.00** |
| Optional elements...........each | **$0.70** | **$0.50** |
| Rare earth element suite...add | **$5.20** | **$4.00** |
| High-grade Option<br>(0.25 g sample, 10X higher det. lim.) | **$23.00** | **$17.75** |

**Group 1T-MS** A 0.25 gm split is digested in a 4-Acid solution. A 1.0 gm option is available. Results are total to near total for all elements. Some elements may be partially lost due to volatilization‡.

Detection limits may change without notice due to nature of some samples. Massive sulphide samples will cause elevated detection limits.

| | Cdn | U.S. |
|---|---|---|
| 1st element | **$11.00** | **$8.50** |
| Any 6 elements | **$12.50** | **$9.65** |
| Any 11 elements | **$14.00** | **$10.75** |
| Full Suite | **$18.00** | **$13.85** |
| Rare earth element suite...add | **$5.20** | **$4.00** |
| Optional 1 gm analysis......add | **$3.00** | **$2.30** |

**(Minimum analytical charge of CDN $25.00 or US $19.25)**

| | Group 1F-MS Detection | Group 1T-MS Detection | Upper Limit |
|---|---|---|---|
| **Au** | 0.2 ppb | - | 100 ppm |
| **Ag** | 2 ppb | 20 ppb | 100 ppm |
| **Al*** | 0.01 % | 0.02 % | 10 % |
| **As‡** | 0.1 ppm | 0.2 ppm | 10000 ppm |
| **B*** | 1 ppm | - | 2000 ppm |
| **Ba*** | 0.5 ppm | 1 ppm | 10000 ppm |
| **Bi** | 0.02 ppm | 0.04 ppm | 2000 ppm |
| **Ca*** | 0.01 % | 0.02 % | 40 % |
| **Cd** | 0.01 ppm | 0.02 ppm | 2000 ppm |
| **Co** | 0.1 ppm | 0.2 ppm | 2000 ppm |
| **Cr*** | 0.5 ppm | 1 ppm | 10000 ppm |
| **Cu** | 0.01 ppm | 0.02 ppm | 10000 ppm |
| **Fe*** | 0.01 % | 0.02 % | 40 % |
| **Hg** | 5 ppb | - | 100 ppm |
| **Ga** | 0.1 ppm | 0.02 ppm | 100 ppm |
| **K*** | 0.01 % | 0.02 % | 10 % |
| **La*** | 0.5 ppm | 1 ppm | 10000 ppm |
| **Mg*** | 0.01 % | 0.02 % | 30 % |
| **Mn*** | 1 ppm | 2 ppm | 10000 ppm |
| **Mo** | 0.01 ppm | 0.02 ppm | 2000 ppm |
| **Na*** | 0.001 % | 0.002 % | 10 % |
| **Ni*** | 0.1 ppm | 0.2 ppm | 10000 ppm |
| **P*** | 0.001 % | 0.002 % | 5 % |
| **Pb** | 0.01 ppm | 0.02 ppm | 10000 ppm |
| **S*** | 0.01 % | 0.02 % | 10 % |
| **Sb‡** | 0.02 ppm | 0.02 ppm | 2000 ppm |
| **Sc*** | 0.1 ppm | 0.1 ppm | 100 ppm |
| **Se** | 0.1 ppm | - | 100 ppm |
| **Sr*** | 0.5 ppm | 1 ppm | 10000 ppm |
| **Te** | 0.02 ppm | - | 100 ppm |
| **Th*** | 0.1 ppm | 0.2 ppm | 2000 ppm |
| **Ti*** | 0.001 % | 0.002 % | 10 % |
| **Tl** | 0.02 ppm | - | 100 ppm |
| **U*** | 0.1 ppm | 0.2 ppm | 2000 ppm |
| **V*** | 2 ppm | 4 ppm | 10000 ppm |
| **W*** | 0.2 ppm | 0.4 ppm | 100 ppm |
| **Zn** | 0.1 ppm | 0.2 ppm | 10000 ppm |
| **Be** | **0.1 ppm** | 1 ppm | 1000 ppm |
| **Ce** | **0.1 ppm** | 0.02 ppm | 2000 ppm |
| **Cs** | **0.02 ppm** | 0.1 ppm | 2000 ppm |
| **Ge** | **0.1 ppm** | - | 100 ppm |
| **Hf** | **0.02 ppm** | 0.02 ppm | 1000 ppm |
| **In** | **0.02 ppm** | - | 1000 ppm |
| **Li** | **0.1 ppm** | 0.2 ppm | 2000 ppm |
| **Nb** | **0.02 ppm** | 0.04 ppm | 2000 ppm |
| **Rb** | **0.1 ppm** | 0.1 ppm | 2000 ppm |
| **Re** | **1 ppb** | - | 1000 ppm |
| **Sn** | **0.1 ppm** | 0.1 ppm | 100 ppm |
| **Ta** | **0.05 ppm** | 0.1 ppm | 2000 ppm |
| **Y** | **0.01 ppm** | 0.1 ppm | 2000 ppm |
| **Zr** | **0.1 ppm** | 0.2 ppm | 2000 ppm |
| **Pt** | **2 ppb** | - | 500 ppb |
| **Pd** | **10 ppb** | - | 500 ppb |
| **Os** | **1 ppb** | - | 500 ppb |

**SHADED ELEMENTS ARE OPTIONAL**

# WHOLE ROCK MAJOR AND TRACE ELEMENT ANALYSES

## GROUP 4A WHOLE ROCK BY ICP

A 20-parameter suite giving major oxides, 6 other elements, LOI, and Total C & S for a highly competitive price. Majors are determined by a $LiBO_2$ fusion and ICP analysis. Carbon and sulphur are by Leco. Requires 5 gm sample pulp.

| | Cdn | U.S. |
|---|---|---|
| One element | **$9.00** | **$6.95** |
| Full Suite | **$17.50** | **$13.50** |
| Extended package*<br>(includes Ce Co Cu Nb Ta Zn) | **$20.00** | **$15.40** |

## GROUP 4B WHOLE ROCK TRACE ELEMENTS BY ICP MS

ICP-MS analysis of 41 minor and trace elements including the rare earths. Based on the $LiBO_2$ fusion. Base metals‡ are by aqua regia digestion ICP. Perfect add-on to Group 4A. Needs 5 gm of sample pulp.

| | Cdn | U.S. |
|---|---|---|
| One element | **$12.00** | **$9.25** |
| Full Suite (41 elements) | **$20.00** | **$15.40** |
| **Group 4A + 4B** | **$30.00** | **$23.10** |

## GROUP 4X WHOLE ROCK BY XRF

$LiBO_2$ fusion followed by XRF analysis for major oxides and LOI. Analysis by an affiliated lab. Requires 25 gm sample pulp.

| | Cdn | U.S. |
|---|---|---|
| Full Suite | **$20.00** | **$15.40** |

## GROUP 5A NEUTRON ACTIVATION AU + 34 ELEMENTS

Total determination by gamma ray analysis following nuclear irradiation. All analyses are conducted by ACTLABS of Ancaster, Ontario. Requires 5 - 30 gm pulp.

| | Cdn | U.S. |
|---|---|---|
| Full Suite | **$14.00** | **$10.80** |

| | Group 4A Detection | Group 4B Detection | Group 4X Detection |
|---|---|---|---|
| **$SiO_2$** | 0.02 % | - | 0.02 % |
| **$Al_2O_3$** | 0.03 % | - | 0.03 % |
| **$Fe_2O_3$** | 0.04 % | - | 0.04 % |
| **CaO** | 0.01 % | - | 0.01 % |
| **MgO** | 0.01 % | - | 0.01 % |
| **$Na_2O$** | 0.01 % | - | 0.01 % |
| **$K_2O$** | 0.04 % | - | 0.04 % |
| **MnO** | 0.01 % | - | 0.01 % |
| **$TiO_2$** | 0.01 % | - | 0.01 % |
| **$P_2O_5$** | 0.01 % | - | 0.01 % |
| **$Cr_2O_3$** | 0.001 % | - | - |
| **LOI** | 0.1 % | - | 0.1 % |
| **C** | 0.01 % | - | - |
| **S** | 0.01 % | - | - |
| **As** | - | 1 ppm‡ | - |
| **Ba** | 5 ppm | 0.5 ppm | - |
| **Bi** | - | 0.5 ppm‡ | - |
| **Cd** | - | 0.1 ppm‡ | - |
| **Co** | 20 ppm* | 0.5 ppm‡ | - |
| **Cs** | - | 0.1 ppm | - |
| **Cu** | 20 ppm* | 1 ppm‡ | - |
| **Ga** | - | 0.5 ppm | - |
| **Hf** | - | 0.5 ppm | - |
| **Mo** | - | 0.2 ppm‡ | - |
| **Nb** | 20 ppm* | 0.5 ppm | - |
| **Ni** | 20 ppm | 1 ppm‡ | - |
| **Pb** | - | 2 ppm‡ | - |
| **Rb** | - | 0.5 ppm | - |
| **Sb** | - | 0.5 ppm‡ | - |
| **Sc** | 1 ppm | - | - |
| **Sn** | - | 1 ppm | - |
| **Sr** | 10 ppm | 0.5 ppm | - |
| **Ta** | 20 ppm* | 0.1 ppm | - |
| **Th** | - | 0.1 ppm | - |
| **Tl** | - | 0.1 ppm | - |
| **U** | - | 0.1 ppm | - |
| **V** | - | 5 ppm | - |
| **W** | - | 1 ppm | - |
| **Y** | 10 ppm | 0.1 ppm | - |
| **Zn** | 20 ppm* | 1 ppm‡ | - |
| **Zr** | 10 ppm | 0.5 ppm | - |
| **La** | - | 0.5 ppm | - |
| **Ce** | 20 ppm* | 0.5 ppm | - |
| **Pr** | - | 0.02 ppm | - |
| **Nd** | - | 0.4 ppm | - |
| **Sm** | - | 0.1 ppm | - |
| **Eu** | - | 0.05 ppm | - |
| **Gd** | - | 0.05 ppm | - |
| **Tb** | - | 0.01 ppm | - |
| **Dy** | - | 0.05 ppm | - |
| **Ho** | - | 0.05 ppm | - |
| **Er** | - | 0.05 ppm | - |
| **Tm** | - | 0.05 ppm | - |
| **Yb** | - | 0.05 ppm | - |
| **Lu** | - | 0.01 ppm | - |

| | Group 5A Detection |
|---|---|
| **Au** | 2 ppb |
| **Ag** | 5 ppm |
| **As** | 0.5 ppm |
| **Ba** | 50 ppm |
| **Br** | 0.5 ppm |
| **Ca** | 1 % |
| **Ce** | 3 ppm |
| **Co** | 1 ppm |
| **Cr** | 5 ppm |
| **Cs** | 1 ppm |
| **Eu** | 0.2 ppm |
| **Fe** | 0.01 % |
| **Hf** | 1 ppm |
| **Hg** | 1 ppm |
| **Ir** | 5 ppb |
| **La** | 0.5 ppm |
| **Lu** | 0.05 ppm |
| **Mo** | 1 ppm |
| **Na** | 0.01 % |
| **Nd** | 5 ppm |
| **Ni** | 20 ppm |
| **Rb** | 15 ppm |
| **Sb** | 0.1 ppm |
| **Sc** | 0.1 ppm |
| **Se** | 3 ppm |
| **Sm** | 0.1 ppm |
| **Sn** | 0.01 % |
| **Sr** | 0.05 % |
| **Ta** | 0.5 ppm |
| **Th** | 0.2 ppm |
| **Tb** | 0.5 ppm |
| **U** | 0.5 ppm |
| **W** | 1 ppm |
| **Yb** | 0.2 ppm |
| **Zn** | 50 ppm |

ACME ANALYTICAL LABORATORIES LTD.
852 East Hasting St. • Vancouver, B.C. • V6A 1R6
Phone (604)253-3158 Fax (604) 253-1716

Quality Control Report

# GROUP 1F-MS - STD DS3

## Standard Package

| ELEMENT | Unit | Detection Limit | Official Value | Standard Deviation | %RSD |
|---|---|---|---|---|---|
| **Au** | ppb | 0.2 | **21.0** | **6.5** | **30.8%** |
| **Ag*** | ppb | 2 | **281** | **11** | **3.9%** |
| **Al** | % | 0.01 | **1.70** | **0.05** | **2.7%** |
| **As*** | ppm | 0.1 | **29.7** | **2.4** | **8.0%** |
| **B** | ppm | 1 | **2** | **1** | **44.4%** |
| **Ba** | ppm | 0.5 | **147.6** | **7.8** | **5.3%** |
| **Bi** | ppm | 0.02 | **5.60** | **0.36** | **6.5%** |
| **Ca** | % | 0.01 | **0.52** | **0.01** | **2.8%** |
| **Cd*** | ppm | 0.01 | **5.55** | **0.27** | **4.9%** |
| **Co*** | ppm | 0.1 | **12.0** | **0.4** | **3.7%** |
| **Cr*** | ppm | 0.5 | **181.9** | **4.7** | **2.6%** |
| **Cu*** | ppm | 0.01 | **126.55** | **2.60** | **2.1%** |
| **Fe*** | % | 0.01 | **3.07** | **0.07** | **2.2%** |
| **Ga** | ppm | 0.1 | **6.2** | **0.2** | **3.1%** |
| **Hg*** | ppb | 5 | **235** | **31** | **13.4%** |
| **K** | % | 0.01 | **0.16** | **0.01** | **5.4%** |
| **La** | ppm | 0.5 | **17.4** | **0.7** | **3.8%** |
| **Mg** | % | 0.01 | **0.59** | **0.02** | **2.7%** |
| **Mn*** | ppm | 1 | **793** | **19** | **2.3%** |
| **Mo*** | ppm | 0.01 | **9.32** | **0.33** | **3.6%** |
| **Na** | % | 0.001 | **0.028** | **0.002** | **5.4%** |
| **Ni*** | ppm | 0.1 | **35.9** | **1.1** | **3.0%** |
| **P** | % | 0.001 | **0.900** | **0.003** | **0.4%** |
| **Pb*** | ppm | 0.01 | **34.92** | **1.00** | **2.9%** |
| **S** | % | 0.02 | **0.02** | **0.01** | **42.9%** |
| **Sb*** | ppm | 0.02 | **5.19** | **0.37** | **7.2%** |
| **Sc** | ppm | 0.1 | **2.7** | **0.1** | **4.9%** |
| **Se** | ppm | 0.1 | **1.2** | **0.1** | **10.0%** |
| **Sr** | ppm | 0.5 | **28.4** | **1.2** | **4.1%** |
| **Te** | ppm | 0.02 | **1.11** | **0.06** | **5.2%** |
| **Th** | ppm | 0.1 | **3.9** | **0.2** | **5.2%** |
| **Ti** | % | 0.001 | **0.090** | **0.004** | **4.3%** |
| **Tl** | ppm | 0.02 | **0.99** | **0.06** | **5.9%** |
| **U** | ppm | 0.1 | **6.3** | **1.1** | **18.0%** |
| **V*** | ppm | 2 | **76** | **2** | **2.5%** |
| **W** | ppm | 0.2 | **3.7** | **0.3** | **8.0%** |
| **Zn*** | ppm | 0.1 | **154.9** | **2.7** | **1.8%** |

## Optional Elements

| ELEMENT | Unit | Detection Limit | Official Value | Standard Deviation | %RSD |
|---|---|---|---|---|---|
| **Be** | ppm | 0.1 | **2.4** | **0.2** | **9.6%** |
| **Ce** | ppm | 0.02 | **31.49** | **1.18** | **3.7%** |
| **Cs** | ppm | 0.1 | **5.7** | **0.2** | **3.0%** |
| **Ge** | ppm | 0.1 | **0.1** | **0.0** | **14.4%** |
| **Hf** | ppm | 0.02 | **0.15** | **0.03** | **17.7%** |
| **In** | ppm | 0.02 | **2.14** | **0.12** | **5.7%** |
| **Li** | ppm | 0.1 | **15.9** | **0.5** | **3.1%** |
| **Nb** | ppm | 0.02 | **1.52** | **0.09** | **5.8%** |
| **Rb** | ppm | 0.1 | **13.7** | **0.6** | **4.5%** |
| **Re** | ppb | 1 | **1** | **1** | **72.9%** |
| **Sn** | ppm | 0.02 | **7.11** | **0.26** | **3.7%** |
| **Ta** | ppm | 0.05 | **< 0.05** | **0.00** | **-** |
| **Y** | ppm | 0.1 | **8.2** | **0.3** | **3.3%** |
| **Zr** | ppm | 0.1 | **2.8** | **0.2** | **7.6%** |
| **Pt** | ppb | 2 | **< 2** | **0** | **-** |
| **Pd** | ppb | 10 | **< 10** | **1** | **-** |
| **Os** | ppb | 1 | **< 1** | | |

## Rare Earth Elements

| ELEMENT | Unit | Detection Limit | Official Value |
|---|---|---|---|
| **Pr** | ppm | 0.02 | **3.50** |
| **Nd** | ppm | 0.02 | **13.00** |
| **Sm** | ppm | 0.02 | **2.70** |
| **Eu** | ppm | 0.02 | **0.57** |
| **Gd** | ppm | 0.02 | **2.30** |
| **Tb** | ppm | 0.01 | **0.31** |
| **Dy** | ppm | 0.02 | **1.50** |
| **Ho** | ppm | 0.02 | **0.28** |
| **Er** | ppm | 0.02 | **0.78** |
| **Tm** | ppm | 0.01 | **0.14** |
| **Yb** | ppm | 0.01 | **0.76** |
| **Lu** | ppm | 0.02 | **0.09** |

***DS3 was certified against CANMET Reference Materials TILL-4, LKSD-4 and STSD-1 for these elements**

**n = 347**

**period: Apl to Jul 2001**

Precision: Based on sample duplicates and given in multiples of detection limit. These apply to most elements, some elements can display higher precision error in some samples owing to the nature of those samples.

| Multiples of Detection Limit: | 0.3 | 1 | 2 | 5 | 10 | 20 | 50 | 1000 | Upper Limit |
|---|---|---|---|---|---|---|---|---|---|
| Precision: | >100% | 100% | 50% | 25% | 17.5% | 12.5% | 10% | 12.5% | |

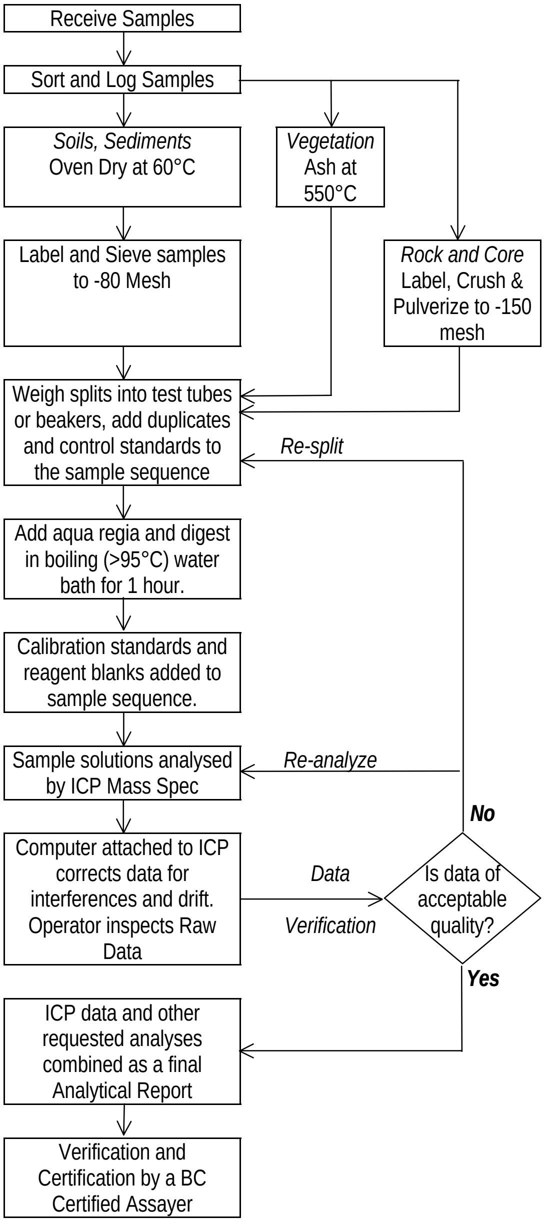
**ACME ANALYTICAL LABORATORIES LTD.**

ISO 9002 REGISTERED KPMG VANCOUVER 1996

852 East Hastings Street • Vancouver, British Columbia • CANADA • V6A 1R6
Telephone: (604) 253-3158 • Fax: (604) 253-1716 • Toll free: 1-800-990-ACME (2263) • e-mail: info@acmelab.com

# METHODS AND SPECIFICATIONS FOR ANALYTICAL PACKAGE GROUP 1F-MS – ULTRATRACE BY ICP-MS • ANGLO OPTION

## Analytical Process



## Comments

### Sample Collection

Samples may consist of soil, sediment, plant or rock. A minimum field sample weight of 200 gm is recommended.

### Sample Preparation

Soils and sediments are dried (60°C) and sieved to -80 mesh (-177 microns). Moss-mat samples are dried (60°C), pounded to loosen trapped sediment, then sieved to -80 mesh. Rocks are dried (60°C) crushed (>75% -10 mesh) and pulverized (>95% -150 mesh). Splits weighing 1 to 30 g (Optional packages) are placed in bottles. Each batch (34 samples) contains a duplicate pulp split for monitoring precision and reference material DS2 for monitoring accuracy.

### Sample Digestion

Aqua Regia is added to each bottle (3mL/gm of sample). Aqua Regia is a 2:2:2 mixture of ACS grade concentrated HCl, concentrated $HNO_3$ and distilled $H_2O$. Sample solutions are heated for 1 hr in a boiling hot water bath (95°C). The solutions are then diluted to 20:1 mL/gm ratio. A reagent blank is carried in parallel through leaching and analysis.

### Sample Analysis

Analysis is by an Elan 6000 ICP Mass Spec. For the Anglo Option, 51 elements are determined comprising: Au, Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Ge, Hf, Hg, In, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Re, S, Sb, Sc, Se, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, W, Y, Zn and Zr. Other optional elements include the REE suite, Pt and Pd. Sample volumes of 10 to 30 gm are recommended when the determination of Au or other elements subject to the nugget effect are of importance.

### Data Evaluation

Raw data are reviewed by the instrument operator and by the laboratory information management system. The data is subsequently reviewed and adjusted by the Data Verification Technician. Finally all documents and data undergo a final verification by a British Columbia Certified Assayer who then signs the Analytical Report before it is released to the client. Chief Assayer is Clarence Leong, other certified assayers are Dean Toye and Jacky Wang.

# Appendix 8

## Report on ‘Aripuanã – Brazil Analysis of organic materials’, prepared by Colin E. Dunn, PhD, P.Geo, Consulting Geochemist, Sidney, BC, Canada.

| Number | Sample # | Anglo sample# | Northing | Easting | Description | Field Notes | Lab Notes (ashing) |
|---|---|---|---|---|---|---|---|
| 17 | | 90921 | 8888050 | 226090 | Bark from Imbauba tree | 25 cm diameter, white | Medium grey ash |
| 18 | | 90922 | 8888075 | 226050 | Bark from Imbauba tree | 25 cm diameter, white | Dark grey ash |
| 19 | | 90923 | 8888200 | 225900 | Bark from Imbauba tree | 5 cm diameter, white | Stringy bark. Pale grey ash |
| 20 | | 90924 | Farex 33 | | Bark from Imbauba tree | 20 cm diameter, white | Stringy bark. Dark grey ash |
| 21 | | 90925 | 8888420 | 225726 | Bark from Imbauba tree | 15 cm diameter, white | Stringy bark. Dark grey ash |
| 22 | | 90926 | 8888304 | 225701 | Bark from Imbauba tree | 40 cm diameter, purple | Chunky bark. White ash |
| 23 | | 90927 | 8888352 | 225515 | Bark from Imbauba tree | 10 cm diameter, purple | Pale grey ash |
| 24 | | 90928 | 8888352 | 225515 | Bark from Imbauba tree | 10 cm diameter, white | Medium grey ash |

Table 1: Field Notes (as received from Brazil)
with Sample Prep notes in red
BARK

| Sample | Condition | Material | Cross Ref. | QC |
|---|---|---|---|---|
| **ARIP_dry_V1** | **Dry** | **Bark** | | **V6 dry** |
| **ARIP_dry_V2** | **Dry** | **Bark** | **90921** | |
| **ARIP_dry_V3** | **Dry** | **Bark** | **90922** | |
| **ARIP_dry_V4** | **Dry** | **Bark** | **90923** | |
| **ARIP_dry_V5** | **Dry** | **Bark** | **90924** | |
| **ARIP_dry_V6** | **Dry** | **Bark** | | **V6 dry** |
| **ARIP_dry_V7** | **Dry** | **Bark** | **90925** | |
| **ARIP_dry_V8** | **Dry** | **Bark** | **90926** | |
| **ARIP_dry_V9** | **Dry** | **Bark** | **90927** | |
| **ARIP_dry_V10** | **Dry** | **Bark** | **90928** | |
| **ARIP_dry_V11** | **Dry** | **Bark** | | **CLV-2 dry** |
| **ARIP_dry_V12** | **Dry** | **Bark** | | **CLV-1 dry** |
| ARIP_ash_V1 | Ash | Bark | | V6 ash |
| ARIP_ash_V2 | Ash | Bark | 90921 | |
| ARIP_ash_V3 | Ash | Bark | 90922 | |
| ARIP_ash_V4 | Ash | Bark | 90923 | |
| ARIP_ash_V5 | Ash | Bark | 90924 | |
| ARIP_ash_V6 | Ash | Bark | | V6 ash |
| ARIP_ash_V7 | Ash | Bark | 90925 | |
| ARIP_ash_V8 | Ash | Bark | 90926 | |
| ARIP_ash_V9 | Ash | Bark | 90927 | |
| ARIP_ash_V10 | Ash | Bark | 90928 | |
| ARIP_ash_V11 | Ash | Bark | | V6 ash |
| ARIP_ash_V12 | Ash | Bark | | V7 ash |
| ARIP_ash_V13 | Ash | Mull | 90857(1) | |
| ARIP_ash_V14 | Ash | Mull | 90857(2) | |
| ARIP_ash_V15 | Ash | Mull | | 90857bag(rotted) |
| ARIP_ash_V16 | Ash | Mull | 90869 | |
| ARIP_ash_V17 | Ash | Mull | 90870 | |
| ARIP_ash_V18 | Ash | Mull | | V6 ash |
| ARIP_ash_V19 | Ash | Mull | 90877 | |
| ARIP_ash_V20 | Ash | Mull | 90881 | |
| ARIP_ash_V21 | Ash | Mull | 90885a | duplicate |
| ARIP_ash_V22 | Ash | Mull | 90885b | duplicate |
| ARIP_ash_V23 | Ash | Mull | 90889 | |
| ARIP_ash_V24 | Ash | Mull | 90894 | |
| ARIP_ash_V25 | Ash | Mull | 90898 | |
| ARIP_ash_V26 | Ash | Mull | 90902 | |
| ARIP_ash_V27 | Ash | Mull | 90905 | |
| ARIP_ash_V28 | Ash | Mull | | V6 ash |
| ARIP_ash_V29 | Ash | Mull | 90908 | |
| ARIP_ash_V30 | Ash | Mull | 90911a | duplicate |
| ARIP_ash_V31 | Ash | Mull | 90911b | duplicate |
| ARIP_ash_V32 | Ash | Mull | | 90911bag(intact) |
| ARIP_ash_V33 | Ash | Mull | 90914 | |
| ARIP_ash_V34 | Ash | Mull | 90917 | |
| ARIP_ash_V35 | Ash | Mull | 90920 | |
| ARIP_ash_V36 | Ash | Mull | | V6 ash |
| ARIP_ash_V37 | Ash | Mull | | V7 ash |

**Table 2: List of Dry and Ashed Bark, and Ashed Mull samples prepared for ICP-MS (1F) analysis at Acme**

| **Site#** | **Easting** | **Northing** | **Sequ.#** | **Lab Ref.** | **Mo** | **Cu** | **Pb** | **Zn** | **Ag** | **Ni** | **Co** | **Mn** | **Fe** | **As** | **U** | **Au** | **Th** | **Sr** | **Cd** | **Sb** | **Bi** | **V** | **Ca** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ***Fig.4*** | | *ppm* | *ppm* | *ppm* | *ppm* | *ppb* | *ppm* | *ppm* | *ppm* | *%* | *ppm* | *ppm* | *ppb* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *%* |
| 90921 | 226090 | 8888050 | 7 | ARIP-DRY-V2 | 0.03 | 6.6 | 2.41 | 8.2 | 5 | 0.4 | 0.05 | 646 | 0.004 | 0.1 | < .01 | 1.2 | 0.01 | 79.3 | 0.01 | < .02 | < .02 | < 2 | 0.48 |
| 90922 | 226050 | 8888075 | 6 | ARIP-DRY-V3 | 0.43 | 3.26 | 2.63 | 21 | 2 | 0.4 | 0.03 | 26 | < .001 | 0.1 | < .01 | 1 | < .01 | 103.5 | 0.01 | < .02 | < .02 | < 2 | 0.72 |
| 90923 | 225900 | 8888200 | 5 | ARIP-DRY-V4 | 6.29 | 6.36 | 47.84 | 56.8 | 6 | 0.4 | 0.04 | 190 | 0.006 | 0.6 | < .01 | 3.7 | < .01 | 210.5 | 0.02 | 0.05 | < .02 | < 2 | 1.32 |
| 90924 | 225800 | 8888300 | 4 | ARIP-DRY-V5 | 2.51 | 3.69 | 6.26 | 7.3 | < 2 | 0.3 | 0.01 | 20 | 0.002 | 0.1 | < .01 | 0.4 | < .01 | 105.7 | < .01 | < .02 | < .02 | < 2 | 0.89 |
| 90925 | 225726 | 8888420 | 3 | ARIP-DRY-V7 | 3.69 | 6.51 | 19.64 | 12.7 | 3 | 0.6 | 0.02 | 36 | 0.012 | 0.9 | 0.01 | 1.6 | < .01 | 229 | < .01 | 0.12 | < .02 | < 2 | 1.96 |
| 90926 | 225701 | 8888304 | 2 | ARIP-DRY-V8 | 0.19 | 3.86 | 0.96 | 4 | < 2 | 0.2 | 0.03 | 22 | 0.001 | < .1 | < .01 | 0.3 | < .01 | 103.4 | < .01 | < .02 | < .02 | < 2 | 0.66 |
| 90927 | 225515 | 8888352 | 1 | ARIP-DRY-V9 | 0.28 | 7.64 | 0.89 | 5.6 | 4 | 0.4 | 0.02 | 30 | 0.005 | 0.2 | < .01 | 0.2 | < .01 | 185.5 | < .01 | < .02 | < .02 | < 2 | 1.23 |
| 90928 | 225515 | 8888352 | 1 | ARIP-DRY-V10 | 0.12 | 9.27 | 0.65 | 22.3 | 4 | 0.4 | 0.03 | 421 | 0.002 | < .1 | < .01 | 0.5 | < .01 | 117.9 | 0.01 | < .02 | < .02 | < 2 | 1.07 |

**Table 3.2 - Dry Bark.**
**Analysis at Acme by ICP-MS**

| **Site#** | **P** | **La** | **Cr** | **Mg** | **Ba** | **Ti** | **B** | **Al** | **Na** | **K** | **W** | **Tl** | **Hg** | **Se** | **Te** | **Ga** | **Cs** | **Ge** | **Hf** | **Nb** | **Rb** | **Sc** | **Sn** | **S** | **Ta** | **Zr** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *%* | *ppm* | *ppm* | *%* | *ppm* | *ppm* | *ppm* | *%* | *%* | *%* | *ppm* | *ppm* | *ppb* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *%* | *ppm* | *ppm* |
| 90921 | 0.017 | 0.05 | 1.8 | 0.182 | 134.6 | 1 | 8 | < .01 | 0.001 | 0.55 | 0.3 | 0.05 | 9 | 0.1 | < .02 | < .1 | < .005 | < .01 | 0.002 | 0.031 | 4.4 | 0.13 | 0.07 | 0.04 | 0.001 | 0.07 |
| 90922 | 0.023 | 0.01 | 2 | 0.218 | 85.3 | 1 | 10 | < .01 | 0.003 | 1.05 | 0.2 | 0.03 | 9 | 0.2 | < .02 | < .1 | < .005 | 0.01 | 0.001 | 0.027 | 5.8 | 0.15 | 0.03 | 0.08 | 0.002 | 0.01 |
| 90923 | 0.04 | 0.1 | 1.9 | 0.191 | 136 | 2 | 14 | < .01 | 0.007 | 1 | < .1 | 0.15 | 12 | 0.2 | < .02 | < .1 | 0.011 | 0.01 | < .001 | 0.015 | 11.6 | 0.16 | 0.02 | 0.08 | < .001 | 0.02 |
| 90924 | 0.033 | 0.03 | 1.8 | 0.272 | 40 | 1 | 9 | < .01 | 0.004 | 1 | 0.4 | 0.06 | 8 | 0.2 | < .02 | < .1 | < .005 | 0.01 | < .001 | 0.014 | 8.5 | 0.14 | 0.03 | 0.09 | < .001 | 0.01 |
| 90925 | 0.05 | 0.06 | 1.9 | 0.355 | 52.8 | 2 | 11 | < .01 | 0.003 | 1.18 | < .1 | 0.04 | 8 | 0.3 | < .02 | < .1 | < .005 | 0.02 | < .001 | 0.006 | 10.5 | 0.13 | 0.02 | 0.11 | < .001 | < .01 |
| 90926 | 0.017 | 0.01 | 1.9 | 0.091 | 112.3 | 1 | 6 | < .01 | 0.001 | 0.39 | < .1 | < .02 | 8 | 0.2 | < .02 | < .1 | < .005 | < .01 | < .001 | < .001 | 4 | 0.1 | < .02 | 0.03 | < .001 | 0.01 |
| 90927 | 0.054 | 0.03 | 1.8 | 0.265 | 177.4 | 2 | 9 | < .01 | 0.001 | 0.8 | < .1 | < .02 | 12 | 0.2 | < .02 | < .1 | < .005 | 0.02 | 0.001 | 0.002 | 7.5 | 0.14 | < .02 | 0.06 | < .001 | 0.04 |
| 90928 | 0.067 | 0.01 | 1.9 | 0.429 | 46.2 | 2 | 14 | < .01 | 0.005 | 1.46 | < .1 | 0.12 | 20 | 0.1 | < .02 | < .1 | 0.007 | 0.03 | 0.001 | < .001 | 24 | 0.08 | 0.02 | 0.12 | < .001 | 0.02 |

**Table 3.2 - Dry Bark.**
**Analysis at Acme by ICP-MS**

| Site# | Y | Ce | In | Re | Be | Li | Pr | Nd | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu | Pd | Pt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *ppm* | *ppm* | *ppm* | *ppb* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppb* | *ppb* |
| 90921 | 0.013 | 0.19 | < .02 | < 2 | < .1 | 0.26 | < .02 | 0.04 | < .02 | < .02 | < .02 | < .01 | < .02 | < .02 | < .02 | < .01 | 0.01 | < .02 | < 2 | < 1 |
| 90922 | 0.004 | 0.03 | < .02 | < 2 | < .1 | 0.31 | < .02 | < .02 | < .02 | < .02 | < .02 | < .01 | < .02 | < .02 | < .02 | < .01 | 0.01 | < .02 | < 2 | < 1 |
| 90923 | 0.016 | 0.11 | < .02 | < 2 | < .1 | 0.39 | < .02 | 0.04 | < .02 | < .02 | < .02 | < .01 | < .02 | < .02 | < .02 | < .01 | 0.01 | < .02 | < 2 | < 1 |
| 90924 | 0.006 | 0.06 | < .02 | < 2 | < .1 | 0.27 | < .02 | 0.02 | < .02 | < .02 | < .02 | < .01 | < .02 | < .02 | < .02 | < .01 | < .01 | < .02 | < 2 | < 1 |
| 90925 | 0.009 | 0.09 | < .02 | < 2 | < .1 | 0.06 | < .02 | 0.02 | < .02 | < .02 | < .02 | < .01 | < .02 | < .02 | < .02 | < .01 | < .01 | < .02 | < 2 | < 1 |
| 90926 | 0.004 | 0.13 | < .02 | < 2 | < .1 | 0.05 | < .02 | < .02 | < .02 | < .02 | < .02 | < .01 | < .02 | < .02 | < .02 | < .01 | < .01 | < .02 | < 2 | < 1 |
| 90927 | 0.013 | 0.18 | < .02 | < 2 | < .1 | 0.11 | < .02 | 0.03 | < .02 | < .02 | < .02 | < .01 | < .02 | < .02 | < .02 | < .01 | 0.01 | < .02 | < 2 | < 1 |
| 90928 | 0.004 | 0.08 | < .02 | < 2 | < .1 | 0.13 | < .02 | 0.02 | < .02 | < .02 | < .02 | < .01 | < .02 | < .02 | < .02 | < .01 | < .01 | < .02 | < 2 | < 1 |

**Table 3.2 - Dry Bark.**
**Analysis at Acme by ICP-MS**

Analytical Accuracy
Control V6 (dry tissue)

| ELEMENT | Unit | Detection Limit | Official Value | This Study Mean n=4 |
|---|---|---|---|---|
| Au | ppb | 0.2 | 0.7 | 0.85 |
| Ag* | ppb | 2 | 18 | 16 |
| Al | % | 0.01 | 0.05 | 0.04 |
| As* | ppm | 0.1 | 0.5 | 0.5 |
| B | ppm | 1 | 9 | 9.5 |
| Ba | ppm | 0.1 | 10.5 | 9.3 |
| Be | ppm | 0.1 | <0.1 | <0.1 |
| Bi | ppm | 0.02 | 0.02 | 0.02 |
| Ca | % | 0.01 | 0.79 | 0.8 |
| Cd* | ppm | 0.01 | 0.22 | 0.20 |
| Ce | ppm | 0.01 | 1.62 | 1.59 |
| Co* | ppm | 0.01 | 0.39 | 0.36 |
| Cr* | ppm | 0.05 | 4.15 | 4 |
| Cs | ppm | 0.005 | 0.026 | 0.025 |
| Cu* | ppm | 0.01 | 8.24 | 7.30 |
| Dy | ppm | 0.02 | 0.08 | 0.08 |
| Er | ppm | 0.02 | 0.04 | 0.04 |
| Eu | ppm | 0.02 | 0.03 | 0.03 |
| Fe* | % | 0.001 | 0.075 | 0.074 |
| Ga | ppm | 0.1 | 0.1 | 0.1 |
| Gd | ppm | 0.02 | 0.11 | 0.12 |
| Ge | ppm | 0.01 | 0.02 | 0.025 |
| Hf | ppm | 0.001 | 0.010 | 0.01 |
| Hg* | ppb | 1 | 40 | 38 |
| Ho | ppm | 0.02 | 0.02 | 0.02 |
| In | ppm | 0.02 | <0.02 | <0.02 |
| K | % | 0.01 | 0.10 | 0.09 |
| La | ppm | 0.01 | 0.85 | 0.80 |
| Li | ppm | 0.01 | 0.38 | 0.44 |
| Lu | ppm | 0.02 | <0.02 | <0.02 |
| Mg | % | 0.001 | 0.119 | 0.110 |
| Mn* | ppm | 1 | 49 | 44 |
| Mo* | ppm | 0.01 | 0.27 | 0.24 |

| ELEMENT | Unit | Detection Limit | Official Value | This Study Mean n=4 |
|---|---|---|---|---|
| Na | % | 0.001 | 0.008 | 0.007 |
| Nb | ppm | 0.001 | 0.095 | 0.08 |
| Nd | ppm | 0.02 | 0.76 | 0.78 |
| Ni* | ppm | 0.1 | 3.5 | 3.95 |
| Os | ppb | 1 | 1 | nd |
| P | % | 0.001 | 0.049 | 0.042 |
| Pb* | ppm | 0.01 | 18.75 | 17.52 |
| Pd | ppb | 2 | < 2 | 2 |
| Pr | ppm | 0.02 | 0.20 | 0.18 |
| Pt | ppb | 1 | 1 | 1.8 |
| Rb | ppm | 0.1 | 1.0 | 0.8 |
| Re | ppb | 2 | <2 | <2 |
| S | % | 0.01 | 0.06 | 0.06 |
| Sb* | ppm | 0.02 | 0.05 | 0.05 |
| Sc | ppm | 0.1 | 0.19 | 0.21 |
| Se | ppm | 0.1 | 0.1 | 0.3 |
| Sm | ppm | 0.02 | 0.14 | 0.13 |
| Sn | ppm | 0.02 | 0.20 | 0.15 |
| Sr | ppm | 0.5 | 36.0 | 33 |
| Ta | ppm | 0.001 | 0.002 | 0.002 |
| Tb | ppm | 0.01 | 0.02 | 0.02 |
| Te | ppm | 0.02 | 0.01 | <0.01 |
| Th | ppm | 0.01 | 0.10 | 0.09 |
| Ti | ppm | 1 | 19 | 15 |
| Tl | ppm | 0.02 | <0.02 | <0.02 |
| Tm | ppm | 0.01 | 0.01 | 0.01 |
| U | ppm | 0.01 | 0.04 | 0.04 |
| V* | ppm | 2 | 2 | <2 |
| W | ppm | 0.2 | <0.2 | <0.2 |
| Y | ppm | 0.001 | 0.465 | 0.441 |
| Yb | ppm | 0.01 | 0.04 | 0.04 |
| Zn* | ppm | 0.1 | 39.1 | 38.0 |
| Zr | ppm | 0.01 | 0.29 | 0.26 |

Table 4: Comparison of mean values obtained for V6 dry (n=4) with Acme's recently developed 'official' value

| | Site# | QC | Ash yield | Mo | Cu | Pb | Zn | Ag | Ni | Co | Mn | Fe | As | U | Au | Th | Sr | Cd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | *ppm* | *ppm* | *ppm* | *ppm* | *ppb* | *ppm* | *ppm* | *ppm* | *%* | *ppm* | *ppm* | *ppb* | *ppm* | *ppm* | *ppm* |
| **Precision (duplicates)** | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V7 | 90925 | Lab Dup | 9.3 | 52.3 | 71 | 194 | 121 | 56 | 2 | 0.6 | 447 | 0.2 | 14.6 | 0.1 | 1.5 | <.1 | 2026.8 | 0.04 |
| RE ARIP-ASH-V7 | 90925 | Lab Dup | 8.3 | 53.9 | 72 | 193 | 122 | 55 | 2.1 | 0.4 | 439 | 0.17 | 14.1 | 0.1 | 1 | <.1 | 2003.5 | 0.02 |
| | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V13 | 90857 | Field dup | 13.25 | 30.2 | 814 | 12086 | 2563 | 4722 | 9.8 | 34.4 | 23472 | 11.33 | 520.9 | 8.3 | 200.1 | 3.7 | 364.6 | 4.53 |
| ARIP-ASH-V14 | 90857 | Field dup | 6.29 | 46.1 | 818 | 10544 | 3431 | 4111 | 14.6 | 26.6 | 26109 | 11.61 | 534.4 | 9.9 | 153 | 4.9 | 623.3 | 5.98 |
| **ARIP-ASH-V15** | **90857** | **Bag (rotted)** | **1.36** | **11.7** | **315** | **1983** | **1288** | **1941** | **37.1** | **14.2** | **11176** | **5.61** | **160.3** | **3.6** | **314.5** | **5.5** | **524.7** | **3.44** |
| | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V21 | 90885 | Lab split | 12.92 | 0.9 | 169 | 156 | 187 | 715 | 5.1 | 1.3 | 6045 | 1.46 | 19.7 | 0.6 | 14.3 | 6.8 | 223.6 | 0.13 |
| ARIP-ASH-V22 | 90885 | Lab split | 12.92 | 0.8 | 164 | 163 | 182 | 739 | 5.2 | 1.3 | 5609 | 1.43 | 20.6 | 0.7 | 13.6 | 7.3 | 210.3 | 0.13 |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V30 | 90911 | Lab split | 13.85 | 1.7 | 165 | 468 | 484 | 981 | 12.2 | 7.2 | 9134 | 2.1 | 66.5 | 1.8 | 15.5 | 8.7 | 494 | 0.41 |
| ARIP-ASH-V31 | 90911 | Lab split | 13.85 | 1.7 | 163 | 460 | 476 | 904 | 13 | 6.9 | 10546 | 1.89 | 60.3 | 1.7 | 14.9 | 8.3 | 505.3 | 0.37 |
| **ARIP-ASH-V32** | **90911** | **Bag (intact)** | **1.84** | **3.3** | **220** | **272** | **517** | **2242** | **47.8** | **9.3** | **3875** | **2.49** | **60.3** | **1.7** | **371.9** | **9** | **363.4** | **1.21** |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Accuracy (Control samples)** | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V1 | | V6-ash | | 5.1 | 114 | 252 | 600 | 254 | 38.5 | 6.8 | 879 | 1.36 | 12.2 | 1 | 4 | 2.5 | 570 | 2.94 |
| ARIP-ASH-V6 | | V6-ash | | 6.1 | 141 | 252 | 686 | 286 | 44.3 | 6.9 | 947 | 1.47 | 8.8 | 1.2 | 4.5 | 3.7 | 676 | 3.32 |
| ARIP-ASH-V11 | | V6-ash | | 6.5 | 130 | 269 | 762 | 330 | 44.7 | 8 | 1039 | 1.57 | 8.4 | 1.2 | 5.8 | 2.9 | 686 | 3.72 |
| ARIP-ASH-V18 | | V6-ash | | 7.3 | 130 | 301 | 860 | 351 | 49.4 | 7.6 | 1098 | 1.57 | 10.7 | 1.4 | 10.8 | 5.1 | 808 | 4.05 |
| ARIP-ASH-V28 | | V6-ash | | 6.2 | 118 | 267 | 688 | 296 | 47.7 | 6.9 | 990 | 1.46 | 9.7 | 1.2 | 7.7 | 2.7 | 690 | 3.25 |
| ARIP-ASH-V36 | | V6-ash | | 6.2 | 150 | 263 | 758 | 311 | 49.6 | 7.2 | 953 | 1.52 | 10.8 | 1.2 | 8.6 | 2.6 | 686 | 3.29 |
| **Average -V6 ash** | | | | **6.3** | **130** | **267** | **726** | **305** | **45.7** | **7.2** | **984** | **1.49** | **10.1** | **1.2** | **6.9** | **3.3** | **686** | **3.43** |
| | | | | | | | | | | | | | | | | | | |
| *Prev. data - (Acme, 2001)* | | *V6 (n=20)* | | *5.48* | *117* | *243* | *664* | *243* | *37* | *6.3* | *910* | *1.48* | *7.6* | *0.93* | *6.2* | *2.56* | *644* | *2.60* |
| *Prev.Std.dev - (Acme, 2001)* | | *V6 (n=20)* | | *0.56* | *11.4* | *22* | *101* | *25* | *4* | *0.6* | *73.7* | *0.13* | *1.1* | *0.09* | *1.6* | *1.05* | *64* | *0.26* |
| | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V12 | | V7-ash | | 1.7 | 440 | 21 | 2206 | 2810 | 1729 | 57 | 11774 | 1.16 | 5.1 | 0.3 | 20.4 | 0.5 | 1718 | 2.16 |
| ARIP-ASH-V37 | | V7-ash | | 1.5 | 419 | 20 | 1977 | 2488 | 1522 | 49 | 8583 | 1.13 | 4.1 | 0.3 | 10.3 | 0.5 | 1565 | 1.55 |
| RE ARIP-ASH-V37 | | V7-ash | | 1.4 | 448 | 20 | 2070 | 2542 | 1618 | 53 | 8856 | 1.35 | 4.2 | 0.3 | 8.1 | 0.5 | 1580 | 1.6 |
| | | | | | | | | | | | | | | | | | | |
| ***Prev. Ave (ActLabs, 1999)*** | | ***V7 (n=46)*** | | ***1.58*** | ***378*** | ***15*** | ***1422*** | ***2076*** | ***1307*** | ***45*** | ***10633*** | ***1.4*** | | ***0.36*** | ***14.2*** | ***0.44*** | ***1787*** | ***1.62*** |
| *Prev. Std.Dev. (ActLabs,1999)* | | *V7 (n=46)* | | *0.22* | *39.3* | *1* | *220* | *89* | *113* | *3* | *975* | *0.3* | | *0.04* | *8.2* | *0.04* | *113* | *0.19* |
| | | | | | | | | | | | | | | | | | | |
| STANDARD DS3 | | Acme std | | 9.3 | 123 | 34 | 153 | 277 | 34.7 | 11.9 | 817 | 3.28 | 28.3 | 5.6 | 19.9 | 3.5 | 26.5 | 5.29 |
| STANDARD DS3 | | Acme std | | 8.9 | 125 | 34 | 160 | 269 | 37.7 | 11.1 | 860 | 3.24 | 28.9 | 5.4 | 19 | 3.5 | 29.1 | 5.36 |

## Table 5.4 - Quality Control Data (and analysis of sample bags in red) of samples inserted with ash of bark and mull

| | Site# | QC | Sb | Bi | V | Ca | P | La | Cr | Mg | Ba | Ti | B | Al | Na | K | W | Tl | Hg | Se |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *ppm* | *ppm* | *ppm* | *%* | *%* | *ppm* | *ppm* | *%* | *ppm* | *%* | *ppm* | *%* | *%* | *%* | *ppm* | *ppm* | *ppb* | *ppm* |
| **Precision (duplicates)** | | | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V7 | 90925 | Lab Dup | 0.69 | 0.17 | <2 | 17.96 | 0.573 | 1.9 | 3.7 | 3.1 | 677.7 | 0.001 | 103 | 0.07 | 0.026 | 13.01 | 0.3 | <.02 | <5 | 1.2 |
| RE ARIP-ASH-V7 | 90925 | Lab Dup | 0.67 | 0.09 | <2 | 18.3 | 0.543 | 1.8 | 3.4 | 3.13 | 685.5 | 0.001 | 100 | 0.06 | 0.023 | 12.85 | 0.3 | 0.02 | <5 | 0.6 |
| | | | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V13 | 90857 | Field dup | 22.61 | 2.9 | 13 | 2.36 | 0.514 | 50.2 | 6.9 | 0.51 | 490.2 | 0.021 | 25 | 2.43 | 0.045 | 1.1 | 1.2 | 1.56 | 7 | 11.4 |
| ARIP-ASH-V14 | 90857 | Field dup | 17.24 | 1.61 | 27 | 3.67 | 0.97 | 53 | 10.6 | 0.92 | 857.5 | 0.028 | 41 | 3 | 0.093 | 2.11 | 1.1 | 1.69 | 14 | 8.2 |
| **ARIP-ASH-V15** | **90857** | **Bag (rotted)** | **230.6** | **1.02** | **38** | **5.42** | **1.772** | **26.5** | **40.6** | **2.29** | **629.1** | **0.123** | **134** | **2.61** | **4.188** | **11.22** | **1.5** | **0.45** | **10** | **2.5** |
| | | | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V21 | 90885 | Lab split | 0.43 | 0.88 | 2 | 1.48 | 0.435 | 8.8 | 7.8 | 0.63 | 454.6 | 0.013 | 47 | 6.5 | 0.037 | 1.45 | 0.3 | 0.1 | <5 | 0.3 |
| ARIP-ASH-V22 | 90885 | Lab split | 0.44 | 0.93 | 2 | 1.39 | 0.459 | 9.6 | 7.7 | 0.61 | 496 | 0.013 | 53 | 6.56 | 0.041 | 1.41 | 0.3 | 0.1 | 5 | 0.2 |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V30 | 90911 | Lab split | 3.02 | 0.68 | 8 | 4.59 | 0.369 | 25.5 | 12.4 | 1.18 | 520 | 0.014 | 54 | 2.54 | 0.046 | 0.97 | 0.7 | 0.24 | 9 | 0.4 |
| ARIP-ASH-V31 | 90911 | Lab split | 2.57 | 0.66 | 6 | 4.75 | 0.348 | 23.4 | 11.9 | 1.21 | 505.7 | 0.013 | 57 | 2.41 | 0.052 | 0.98 | 0.5 | 0.23 | <5 | 0.4 |
| **ARIP-ASH-V32** | **90911** | **Bag (intact)** | **200.06** | **1.7** | **25** | **4.68** | **1.172** | **22.9** | **36.1** | **1.9** | **465.4** | **0.134** | **181** | **2.9** | **4.173** | **9.95** | **2.2** | **0.07** | **11** | **0.8** |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Accuracy (Control samples)** | | | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V1 | | V6-ash | 1.01 | 0.28 | 30 | 13.27 | 0.776 | 16.1 | 42.8 | 1.9 | 203 | 0.03 | 168 | 0.92 | 0.128 | 1.73 | 0.5 | 0.12 | 5 | 0.6 |
| ARIP-ASH-V6 | | V6-ash | 1.13 | 0.34 | 32 | 13.74 | 0.78 | 18.3 | 44 | 2.12 | 238 | 0.031 | 147 | 0.98 | 0.142 | 1.85 | 0.5 | 0.14 | 8 | 0.5 |
| ARIP-ASH-V11 | | V6-ash | 1.23 | 0.36 | 34 | 14.06 | 0.801 | 19.2 | 49.2 | 2.14 | 238 | 0.033 | 135 | 1.02 | 0.181 | 1.86 | 0.5 | 0.12 | 7 | 0.5 |
| ARIP-ASH-V18 | | V6-ash | 1.37 | 0.41 | 37 | 15.02 | 0.9 | 23.3 | 51 | 2.27 | 285 | 0.035 | 197 | 1.11 | 0.189 | 2.27 | 0.6 | 0.14 | <5 | 0.3 |
| ARIP-ASH-V28 | | V6-ash | 1.1 | 0.34 | 33 | 14.51 | 0.839 | 18.6 | 42.9 | 2.07 | 240 | 0.032 | 168 | 1.02 | 0.126 | 1.96 | 0.4 | 0.15 | <5 | 0.6 |
| ARIP-ASH-V36 | | V6-ash | 1.24 | 0.36 | 38 | 13.69 | 0.936 | 17.5 | 47.4 | 2.13 | 263 | 0.031 | 198 | 1.08 | 0.164 | 2.03 | 0.5 | 0.1 | 8 | 0.6 |
| **Average -V6 ash** | | | **1.2** | **0.3** | **34** | **14.05** | **0.8** | **18.8** | **46.2** | **2.1** | **245** | **0.032** | **169** | **1.02** | **0.155** | **1.95** | **0.5** | **0.13** | **7.0** | **0.5** |
| | | | | | | | | | | | | | | | | | | | | |
| *Prev. data - (Acme, 2001)* | | *V6 (n=20)* | *1.0* | *0.28* | *28.1* | *14.52* | *0.9* | *16.4* | *33.75* | *2.12* | *183* | *0.033* | *178* | *1.04* | *0.134* | *1.962* | *0.33* | *0.11* | *2.8* | *0.56* |
| *Prev.Std.dev - (Acme, 2001)* | | *V6 (n=20)* | *0.1* | *0.03* | *4.56* | *1.019* | *0.1* | *3.32* | *4.67* | *0.08* | *17* | *0.004* | *19.3* | *0.06* | *0.011* | *0.189* | *0.08* | *0.02* | *0.9* | *0.11* |
| | | | | | | | | | | | | | | | | | | | | |
| ARIP-ASH-V12 | | V7-ash | 0.23 | 0.12 | 5 | 20.4 | 2.398 | 32.8 | 23.9 | 4.24 | 3618 | 0.016 | 305 | 0.5 | 0.053 | 8.93 | 0.2 | 0.21 | <5 | 1.2 |
| ARIP-ASH-V37 | | V7-ash | 0.25 | 0.12 | 3 | 17.9 | 2.628 | 26.5 | 28.2 | 3.93 | 2885 | 0.02 | 316 | 0.49 | 0.04 | 8.52 | <.2 | 0.15 | <5 | 0.9 |
| RE ARIP-ASH-V37 | | V7-ash | 0.23 | 0.14 | 3 | 18.71 | 2.596 | 28.7 | 24.1 | 4.08 | 3087 | 0.024 | 318 | 0.52 | 0.042 | 8.74 | <.2 | 0.15 | <5 | 1.1 |
| | | | | | | | | | | | | | | | | | | | | |
| ***Prev. Ave (ActLabs, 1999)*** | | ***V7 (n=46)*** | ***0.21*** | ***0.24*** | | ***22.04*** | | ***24.4*** | | ***3.93*** | ***165*** | ***0.03*** | ***207*** | ***0.42*** | ***0.054*** | | ***0.12*** | ***0.20*** | ***5.6*** | |
| *Prev. Std.Dev. (ActLabs,1999)* | | *V7 (n=46)* | *0.03* | *0.21* | | *2.03* | | *2.37* | | *0.57* | *130* | *0.005* | *66.8* | *0.07* | *0.009* | | *0.14* | *0.03* | *4.2* | |
| | | | | | | | | | | | | | | | | | | | | |
| STANDARD DS3 | | Acme std | 4.43 | 5.13 | 81 | 0.53 | 0.084 | 16.6 | 183.1 | 0.59 | 138.4 | 0.1 | <1 | 1.69 | 0.027 | 0.15 | 4.1 | 0.93 | 220 | 1.1 |
| STANDARD DS3 | | Acme std | 4.67 | 5.09 | 82 | 0.52 | 0.093 | 16.8 | 177.4 | 0.6 | 141.8 | 0.098 | 4 | 1.73 | 0.027 | 0.17 | 4.3 | 0.91 | 234 | 1.2 |

**Table 5.4 - Quality Control Data**
**(and analysis of sample bags in red)**
**of samples inserted with ash of bark and mull**

|  | Site# | QC | Te | Ga | Cs | Ge | Hf | Nb | Rb | Sc | Sn | S | Ta | Zr | Y | Ce | In | Re | Be | Li | Pd | Pt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *%* | *ppm* | *ppm* | *ppm* | *ppm* | *ppm* | *ppb* | *ppm* | *ppm* | *ppb* | *ppb* |
| **Precision (duplicates)** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ARIP-ASH-V7 | 90925 | Lab Dup | 0.2 | 0.2 | 0.08 | 0.1 | <.02 | 0.09 | 146.8 | 0.7 | 0.1 | 1.29 | <.05 | 0.5 | 0.15 | 0.8 | 0.08 | <1 | <.1 | <.1 | <10 | <2 |
| RE ARIP-ASH-V7 | 90925 | Lab Dup | 0.18 | 0.2 | 0.08 | 0.1 | 0.03 | 0.1 | 143.5 | 0.6 | 0.1 | 1.27 | <.05 | 0.5 | 0.13 | 1.1 | 0.07 | <1 | <.1 | <.1 | <10 | <2 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ARIP-ASH-V13 | 90857 | Field dup | 0.07 | 6.9 | 0.18 | 0.2 | 0.18 | 0.16 | 26 | 2.5 | 2.2 | 0.74 | <.05 | 6.3 | 3.78 | 67.9 | 3.68 | <1 | 1.3 | 1.3 | <10 | <2 |
| ARIP-ASH-V14 | 90857 | Field dup | 0.07 | 8.9 | 0.3 | 0.3 | 0.08 | 0.19 | 49.9 | 3.4 | 2 | 0.81 | <.05 | 3.9 | 5.4 | 106.4 | 2.08 | <1 | 1.1 | 1.3 | <10 | <2 |
| **ARIP-ASH-V15** | **90857** | **Bag (rotted)** | **0.07** | **8.5** | **1.68** | **0.3** | **0.04** | **0.64** | **144.2** | **3.1** | **8.7** | **1.27** | **<.05** | **2.2** | **4.54** | **35.6** | **0.97** | **<1** | **0.4** | **13.6** | **<10** | **<2** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ARIP-ASH-V21 | 90885 | Lab split | 0.02 | 7.8 | 0.22 | <.1 | 0.15 | 0.1 | 24 | 2 | 1.4 | 0.49 | <.05 | 3.1 | 2.16 | 43.6 | 0.22 | <1 | 0.3 | 5.6 | <10 | <2 |
| ARIP-ASH-V22 | 90885 | Lab split | 0.03 | 7.9 | 0.23 | <.1 | 0.16 | 0.09 | 23.8 | 2.1 | 1.4 | 0.46 | <.05 | 3 | 2.15 | 47.9 | 0.18 | <1 | 0.1 | 5.9 | <10 | <2 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ARIP-ASH-V30 | 90911 | Lab split | 0.06 | 5.2 | 0.38 | 0.1 | 0.19 | 0.06 | 28.4 | 1.6 | 1 | 0.73 | <.05 | 5.1 | 10.2 | 48.1 | 0.24 | <1 | 0.7 | 7.7 | <10 | <2 |
| ARIP-ASH-V31 | 90911 | Lab split | 0.09 | 5 | 0.35 | 0.1 | 0.17 | 0.06 | 27 | 1.5 | 1 | 0.75 | <.05 | 6.2 | 9.57 | 50.6 | 0.19 | <1 | 0.7 | 7.7 | <10 | <2 |
| **ARIP-ASH-V32** | **90911** | **Bag (intact)** | **0.06** | **7.8** | **1.53** | **0.2** | **0.05** | **0.6** | **134.7** | **2.5** | **9.6** | **1.43** | **<.05** | **2.5** | **9.91** | **42.7** | **0.25** | **2** | **0.7** | **17.6** | **<10** | **3** |
| **Accuracy (Control samples)** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ARIP-ASH-V1 |  | V6-ash | 0.1 | 3.1 | 0.72 | 0.2 | 0.13 | 0.25 | 22.9 | 1.9 | 4.2 | 0.52 | <.05 | 3.5 | 7.75 | 33.9 | 0.05 | 3 | 0.4 | 10.1 | <10 | <2 |
| ARIP-ASH-V6 |  | V6-ash | 0.11 | 3.2 | 0.82 | 0.2 | 0.16 | 0.34 | 25.8 | 2 | 3.7 | 0.57 | <.05 | 4 | 9.74 | 34.3 | 0.04 | 5 | 0.3 | 7.8 | <10 | 4 |
| ARIP-ASH-V11 |  | V6-ash | 0.09 | 3.4 | 0.81 | 0.2 | 0.14 | 0.32 | 26.7 | 2.2 | 3.9 | 0.6 | <.05 | 4 | 9.49 | 38.4 | 0.05 | 7 | 0.2 | 6.7 | <10 | 4 |
| ARIP-ASH-V18 |  | V6-ash | 0.11 | 3.9 | 0.9 | 0.2 | 0.15 | 0.4 | 28.1 | 2.3 | 4.7 | 0.67 | <.05 | 3.8 | 9.55 | 42.9 | 0.05 | 4 | 0.2 | 9.4 | <10 | 5 |
| ARIP-ASH-V28 |  | V6-ash | 0.12 | 3.7 | 0.79 | 0.1 | 0.12 | 0.36 | 25.3 | 2.1 | 4.1 | 0.61 | <.05 | 4.1 | 9.15 | 33.5 | 0.05 | 9 | 0.3 | 8.3 | <10 | 5 |
| ARIP-ASH-V36 |  | V6-ash | 0.08 | 3.7 | 0.72 | 0.1 | 0.1 | 0.26 | 25.2 | 2 | 3.7 | 0.57 | <.05 | 3.6 | 8.99 | 31.7 | 0.06 | 10 | 0.1 | 10.9 | <10 | <2 |
| **Average -V6 ash** |  |  | **0.10** | **3.5** | **0.79** | **0.2** | **0.13** | **0.32** | **25.7** | **2.1** | **4.1** | **0.59** |  | **3.8** | **9.11** | **35.8** | **0.05** | **6** | **0.3** | **8.9** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *Prev. data - (Acme, 2001)* |  | *V6 (n=20)* | *0.05* | *3.34* | *0.65* | *0.13* | *0.09* | *0.24* | *22.3* | *1.92* | *3.29* | *0.53* | *0.03* | *3.32* | *7.79* | *28.7* | *0.04* | *7.1* | *0.33* | *8.24* |  |  |
| *Prev.Std.dev - (Acme, 2001)* |  | *V6 (n=20)* | *0.02* | *0.2* | *0.04* | *0.05* | *0.02* | *0.02* | *1.7* | *0.15* | *0.45* | *0.06* | *0* | *0.45* | *0.45* | *2.5* | *0.04* | *1.8* | *0.1* | *0.71* |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ARIP-ASH-V12 |  | V7-ash | 0.28 | 1.5 | 1.5 | 0.2 | 0.03 | 0.48 | 396 | 1.4 | 0.7 | 0.56 | <.05 | 1.5 | 5.29 | 32.8 | <.02 | 5 | 0.6 | 5.9 | 36 | 9 |
| ARIP-ASH-V37 |  | V7-ash | 0.24 | 1.5 | 1.22 | 0.2 | 0.03 | 0.4 | 346 | 1.3 | 0.6 | 0.53 | <.05 | 1.4 | 4.75 | 27 | <.02 | 5 | 0.5 | 6.7 | 28 | 19 |
| RE ARIP-ASH-V37 |  | V7-ash | 0.18 | 1.6 | 1.28 | 0.2 | 0.03 | 0.42 | 361 | 1.4 | 0.8 | 0.51 | <.05 | 1.4 | 4.75 | 28.7 | <.02 | 6 | 0.4 | 6.9 | 30 | 23 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ***Prev. Ave (ActLabs, 1999)*** |  | ***V7 (n=46)*** | ***1.08*** | ***2.56*** | ***1.39*** | ***0.09*** | ***-0.1*** | ***0.47*** | ***447*** | ***1.67*** | ***0.54*** |  | ***-0.1*** | ***0.67*** | ***4.46*** | ***31.1*** | ***0.01*** | ***0*** | ***0.42*** | ***4.67*** | ***85*** | ***59*** |
| *Prev. Std.Dev. (ActLabs,1999)* |  | *V7 (n=46)* | *0.24* | *1.09* | *0.11* | *0.1* | *0* | *0.06* | *31* | *1.19* | *0.15* |  | *0* | *0.39* | *0.22* | *3.4* | *0* | *0* | *0.09* | *1.31* | *18* | *51* |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| STANDARD DS3 |  | Acme std | 1.01 | 5.7 | 5.26 | 0.1 | 0.14 | 1.59 | 14.3 | 2.6 | 6.5 | 0.03 | <.05 | 2.1 | 8.22 | 30.4 | 1.94 | <1 | 1.9 | 15.4 | <10 | <2 |
| STANDARD DS3 |  | Acme std | 1 | 6.2 | 5.36 | 0.1 | 0.13 | 1.55 | 13.9 | 2.6 | 6.6 | 0.04 | <.05 | 2.3 | 8.41 | 30.2 | 1.93 | 1 | 2 | 15.3 | <10 | <2 |

**Table 5.4 - Quality Control Data**
**(and analysis of sample bags in red)**
**of samples inserted with ash of bark and mull**