1 Appendix 1

File "Appendix 1_logs.xls" contains the drill core logs for 2011 and 2012 field campaigns. These logs document the lithology, alteration and sample locations for both campaigns and the veins for the 2012 logging campaign. This document outlines the terminology for these logs.

Lithology sheet

Table 1.1: Lithological codes

Lithology code	Lithology meaning
ALT/OALT	Altered
OVB/OB	Overburden
BCM	Monomictic clast supported breccia
BCMI	Monomictic clast supported igneous breccia
BMM	Monomict matrix supported breccia
BMP	Polymict breccia
IDyk	Intermediate dyke
IPAN	Porphyrytic andesite
IPD	Porphyrytic diorite
IPGD/IPMGD	Porphyrytic granodiorite
MUHO	Hornfels
MUMA	Marble
SCCMRL	Marly limestone

Table 1.2Textural codes

Texture code	Texture meanind
Por_c	Porphyritic (crystals generally >5mm)
OALT	Obscurred by Alteration
Por_f	Porphyritic (crystals generally <5mm)
BRX	Brecciated

EQG	Equigranular
UNKN	Unknown Texture- Write Comments
FRAG	Fragmental
Ang	Angular clasts
BMMI	#N/A
APH	Aphanitic
ThnBed	Bedded Thinly (30-100mm)
MBED	Bedded Medium (10-30cm)
BMM	#N/A

Table 1.3: Contact codes

Contact codes	Meaning
Intr(u)	Intrusive
Struc	Structural contact
Unk(n)	Unknown

Table 1.4Contact qualifiers

Contact qualifiers	Meaning
ChilMar	Chilled margin
Intr	Definitive crosscutting intrusive contact
Brx(d)	Brecciated
Sharp	Sharp change in lithology
Unkn	Contact unknown
Grad	Gradational
XEN	Xenoliths seen

Alteration sheet

The syntax number refers to the sequence of alteration, 1 being earliest and 4 being the latest. The tables below signify the meaning of the codes in this spreadsheet.

Table 1.5: Alteration code

Alteration code	Meaning of code
Pot_Bio	Potassic alteration with biotite dominant alteration mineral
Pot_Felds/Pot/Kspar	Potassic alteration with k-feldspar dominant alteration mineral
PRC/CHL	Propylitic alteration with chlorite as the dominant mineral
SIL	Silicification
ARG	Argillic alteration
PHQ	Phyllic alteration
PRE	Propylitic alteration with epidote as the dominant mineral

Table 1.6: Alteration interpretation codes

Alteration interpretation code	Alteration interpretation meaning
OvPrnt1/2/3	Overprinting alteration
VnEnv	Vein envelope
PrtOvPrnt	Partial overprinting alteration
FraCon	Fracture controlled alteration

Table 1.7: Alteration style codes

Alteration style code	Alteration style meaning
MinRep/Sel	Mineral replacement
Perv/Per	Pervasive alteration
VnEnv	Vein envelope

Table 1.8: Alteration intensity codes

Intensity code	Intensity meaning

VW	Very weak, only seen under handlens
W	Weak, noticeable on close inspection of drillcore
M	Moderate intensity, noticeable change in primary mineralogy
S	Strong, primary mineralogy altered completely
VS	Very strong, primary mineralogy completely altered

Table 1.9: Alteration mineral codes

Alteration mineral code	Alteration mineral
Mont	Montmorillonite
Chl	Chlorite
QTZ	Quartz
Smec	Smecite
Ser	Sericite
Bio	Biotite
Cal	Calcite
Mag	Magnetite
Kaol	Kaolinite
Ill	Illite
Ill/Smec	Illite-smectite
Ep	Epidote
Felds	K-Feldspar
Dik	Dickite
Hem	Hematite
Clay	Clay-unsure
FeOx	Iron oxide
Goe	Goethite

Alteration mineral code	Alteration mineral
Py	Pyrite
CuOx	Copper oxide
Jar	Jarosite
Carbonate	Carbonate-unknown

Vein sheet

Table 1.10: Vein type codes

Vein code	Vein meaning
BRX	Breccia
HBX	Hydrothermal breccia
Vanh	Anhydrite vein
Vbio	Biotite vein
Vcal	Calcite vein
Vcarb	Carbonate vein
Vcc	Calcite vein
VChl	Chlorite vein
Vcpy	Chalcopyrite vein
Vdik	Dickite vein
VDQtz	Dark grey quartz vein
Vhem	Hematite vein
Vkspar	K-feldspar vein
VLQtz	Light grey quartz vein
Vmag	Magnetite vein
Vmo	Molybdenite vein
Vpy	Pyrite vein
VQPy	Quartz-pyrite vein
VQSer	Quartz-sericite vein
VQtz	Quartz vein
VRQtz	Rosy quartz vein
Vzeo	Zeolite vein

Table 1.11Vein modifier codes

Vein modifiers code	Mineral name
±anh	Anhydrite
±bio	Biotite
±bor(n)	Bornite
±cal	calcite
±carb	Carbonate
±cpy	Chalcopyrite
±cov	Covellite
±dik	Dickite
±hem	Hematite
±kaol	Kaolinite
±mag	Magnetite
±moly	Molybdenite
±py	Pyrite
±qtz	Quartz
±sulph	Sulphide
±zeo	Zeolite

Table 1.12Vein style codes

Vein style code	Vein style meaning
INDIV	Individual vein
STKWK	Stockwork vein
MASS	Massive vein
SHEET	Sheeted vein
UND	Undulatory vein
CntrLINE	Centreline vein
FRA	Fracture controlled vein
UNKN	Unsure
MULTI	Mulit-stage vein
HBX	Hydrothermal brecciation
VUG	Vuggy

2 Appendix 2: Whole rock geochemistry

Analytical procedures

The following appendix is an outline of the methods utilised for whole rock chemistry analyses at SGS (Peru) laboratories and provides a comparison of the results from a variety of methods. The technical aspects are primarily extracted from the SGS Rocks to Results guide as ordered from SGS laboratories.

2.1.1 Sample preparation

All samples are weighed, dried, and crushed such that the sample passes through a size 10 mesh (<2mm). The sample is subsequently split and a 250g subsample is pulverised such that 95% passes through a 140 size mesh (105µm).

2.1.2 Methods of digestion

A number of different digestion methods were utilised to ensure a full suite of elemental analyses., resulting in numerous duplicates between methods of digestion. This overlap in results overlap allows for comparative analyses between digestion procedures and overall reproducibility of results. Where there are large discrepancies between results, current literature is utilised to evaluate the best method for element analysis.

Within each digestion procedure, duplicate samples are submitted for analysis. This ensures quality control of the results within each method of digestion.

2.1.2.1 Aqua regia (12B)

A mixture of 1:3 nitric to hydrochloric acids dissolves sulphides and base metals due to the strong oxidisation reaction. Some refractory minerals may not be completely dissolved and thus the elements S, Ba, Be, B, Ca, Ce, Cs, Cr, Sc, Sn, Sr, P, Ga, Ge, Hf, Fe, In, Y, La, Li, Lu, Mg, Mn, Nb, Ni, K, Rb, Na, Tl, Ta, Te, Ti, Th, U, V, Yb, Zn and Zr may not be liberated, a comparative analysis of duplicates indicated that Ti and Zr .

2.1.2.2 Multi-acid digestion (40B)

The multi-acid digestion utilises a combination of hydrochloric (HCl), nitric (HNO_3), hydrofluoric (HF) and perchloric ($HClO_3$) acids to dissolve the majority of silicate minerals. This method ensures

digestion of silicate minerals, however silica is volatilised as SiF_2 and only some refractory minerals are only partially digested.

2.1.2.3 Lithium metaborate fusion (95A)

In this method follows that described in Thompson and Walsh (1989) in which the subsample and lithium metaborate ($LiBO_3$) flux are weighed into a platinum crucible at a ratio of ~1:4. This mixture is fused at 1000°C for 30 minutes, during which the crucible is swirled. Following fusion the crucible is allowed to cool to room temperature and the crucible is immersed in 175 ml of distilled water containing ~10ml of nitric acid. A magnetic stirrer is added and the fused bead is dissolved over a 2 hour period. The solution is then diluted to 250ml and analysed by ICP.

2.1.2.4 Sodium peroxide fusion (90A)

This method is the best method for determination of rare earth elements. The subsample is mixed with a sodium peroxide (Na_2O_2) flux in a carbon crucible. This mixture is heated to ~500°C, limiting the volatilisation of elements. This fused sample is dissolved in a dilute nitric acid solution, which is analysed by ICP.

Following digestion, the solutions are analysed by inductively coupled plasma atomic emission spectroscopy (ICP-AES) or by inductively coupled plasma-mass spectrometry (ICP-MS).

2.1.3 ICP (Inductively coupled plasma)

The plasma is created by inducing a radio frequency through a tesla coil through which argon gas is passed. The resistance of electrons to flow through the induced magnetic field results in the generation of an Ar plasma. The Ar gas is constantly flowing when the solution containing the digested sample is passed through a pneumatic nebuliser, which introduces the sample into the Ar gas as a spray. This argon gas containing the sample spray passes through the inductively coupled plasma torch.

2.1.3.1 AES (Atomic Emission Spectroscopy or Optical Emission Spectroscopy):

This spectroscopic method utilises the emission of light as excited atoms return to the ground state. The high temperature of the plasma causes the lower orbital electrons in an element to a higher energy state. As these excited electrons return to ground state they emit a photon at a specific wavelength characteristic of the element. Following calibration, the intensity of the photon is correlated to the concentration of that element in a sample can be determined. This technique allows

for rapid analysis of a variety of elements simultaneously. Isobaric interferences elements are inferred to be are accounted for by SGS.

The polychromatic light passes into the atomic emission spectrometer. An Echelle diffraction grating splits this light into specific wavelengths correlating to the elements of interest. These are diffracted onto a Charged-Couple-Device (CCD) detectors, which measure the intensity of the emitted light that correspond to a specific element. This is compared to standards, which is then calculated to a specific concentration.

2.1.3.2 MS (mass spectroscopy):

This spectroscopic method determines the concentration of an element by utilising utilisation of mass-to-charge ratio of elemental ions. The plasma ionises the elements into positively charged ions, which are passed through a sampling cone and skimmer cones, which select a small proportion of the ion beam, the rest of the sample is removed by vacuum pump.

The sampled ion beam enters a high vacuum (10^{-5} Torr or less) mass spectrometer that houses a lens system, quadrupole mass spectrometer and dynode detector. The lenses system focuses the ion beam, which enters the quadrupole mass spectrometer. Altering the frequency of the quadrupole mass spectrometer will deflect ions based on their mass-to-charge ratio. This deflection is utilised to deflect ions of no interest whereas specific ions with mass-to-charge ratio hit the dynode detector. Two detectors are commonly used, a first-stage detector measures ions of high concentration, the second-stage has an electron multiplier for amplification of small signals. The sensitivity of this method of analysis allows for the low detection limits.

2.1.4 Analytical procedures for copper, gold and sulphur

2.1.4.1 Sulphur analyses (CSA24V)

The sulphur content was included with ICM12B and ICP40B packages. CSA 24V results used when the S content is greater than 10 wt. %. The CSA 24V method is analysed by LECO sulphur analyser, in which the pulverised sample is heated to approximately 1350°C in an induction furnace. A stream of oxygen is passed through the sample and the released sulphur dioxide is measured by an infrared detection system (LECO).

2.1.4.2 Gold analysis (FAA515 and FAG505)

Gold is measured by two methods post-fire assay: a pre-concentration with di-isobutyl ketone and a flame atomic absorption spectrometry finish (SGS code: FAA515); and a gravimetric finish for samples C11.JL.110 and C11.JL. 202 where gold concentrations exceeded 0.5 ppm (SGS code FAG505).

The fire assay method is a long-standing method for pre-concentrating low concentrations of precious metals (Smith 1947). In this method 50g of powdered sample is fused in a ceramic crucible with lead, a flux and carbon at 900°C in a reducing atmosphere to reduce the lead to form lead droplets. The flux chosen ensures the matrix is broken down, such that the precious metals are liberated and collect in the lead droplets. This is cooled in a conical mold such that the lead dinks to the bottom of the slag. The lead bead is separated from the slag and the bead is heated to 840°C in a porous cupel. The molten lead oxide absorbs into the cupel, leaving a metal alloy-called a prill. This prill is analysed by two methods: the di-isobutyl ketone (DIBK) and flame atomic absorption spectroscopy finish (FAA515); or the gravimetric finish (FAG505).

In the FAA515 method, the prill produced in fire assay is digested by agua regia. The gold in agua regia solution is extracted by liquid-liquid extraction using di-isobutyl ketone (DIBK) (Parkes and Murray-Smith 1979). This DIBK solution is analysed by flame atomic absorption spectroscopy. This pre-concentration step allows for low detection limit of 5 ppb and upper limit of 10 000 ppb.

In the FAG505 method, the prill produced from fire assay is flattened and weighed. It is subsequently treated with warm nitric acid, which dissolves the silver, leaving the solid gold bead, which is subsequently weighed. This method allows for the determination of concentrations as greater than 0.5 ppm.

2.1.4.3 Copper analysis

Copper was included within the ICM-90A, ICM-12B and ICM40B packages. The correlation between the results of these analysis are very good and are discussed in the quality control section. For samples with >1 wt. % (10 000 ppm) the samples were analysed by atomic absorption spectroscopy finish of a multi-acid digestion(AAS 42C), the level of detection using this method is 2 ppm to 5 wt. %. For sample C11.JL.110, where the copper exceeds 5 wt. % the mult-iacid solution was diluted further, such that the level of detection was >0.01 wt% (AAS 41B).

Quality control

2.2.1 Major element analyses

Major element oxides are analysed by ICP-AES with a lithium metaborate fusion (ICP 95A) and a multi acid digestion (ICP 40B). The coefficient of determination (R_2) between these two methods is > 0.8 (Fig. 2.1) with the exception of TiO_2 and P_2O_5, which appear uncorrelated between these methods. Silica dioxide was only analysed by lithium metaborate fusion as multi-acid digestion volatilises silica (in the form of SiF_2).

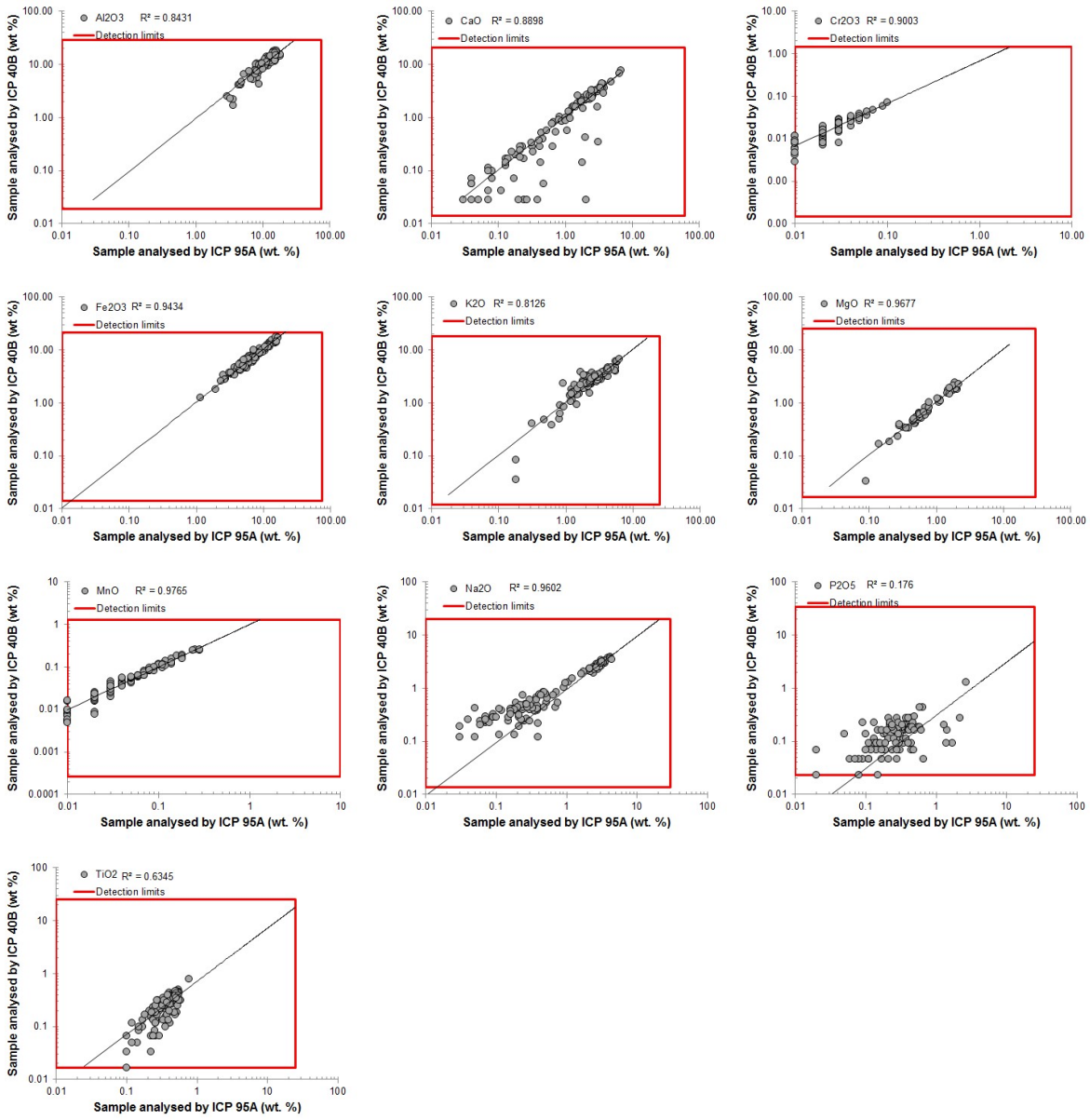


Figure 2.1: Correlations between samples analysed for major element oxide by lithium metaborate fusion (ICP 95A) and multiacid digestion (ICP 40B). Red boxes indicate the detection limits for the element by respective digestion methods.

2.2.1.1 Lithium metaborate fusion (ICP 95A) method

Ten duplicate samples were analysed to ensure reproducibility of ICP95A. These duplicates are compared to the original analysed samples (Fig. 2.2). These typically have a coefficient of determination (R_2) of greater than 0.9, with the exception of SiO_2. When the erroneous duplicate analysis of SiO_2 is removed, the R_2 improves to >0.9. This demonstrates that this method of anaylsis is precise and consistent for major element analyses.

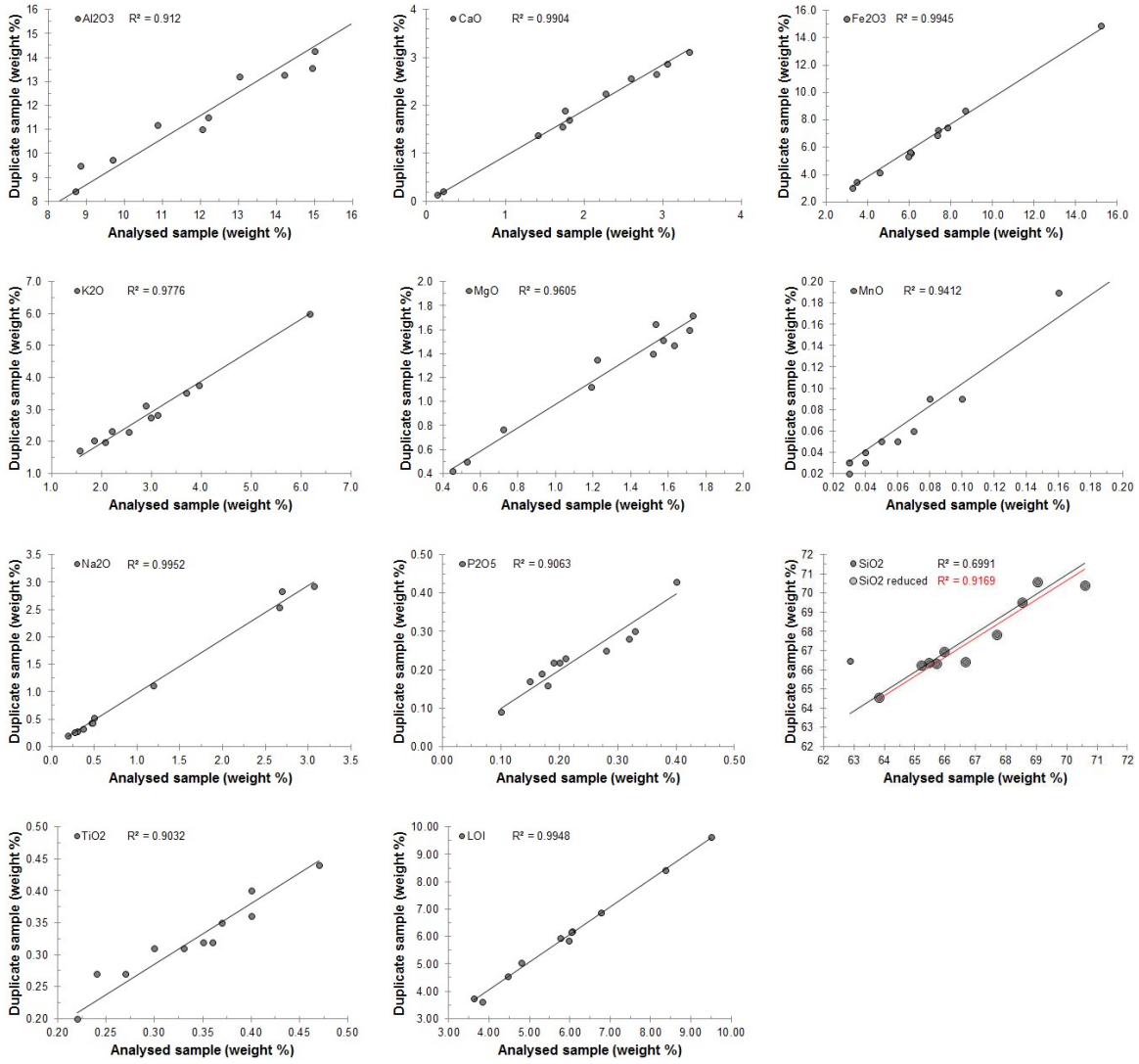
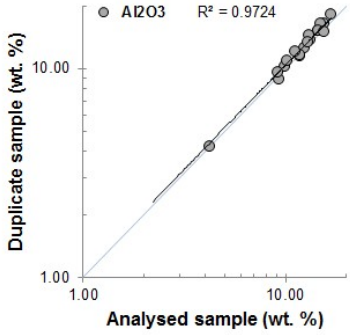
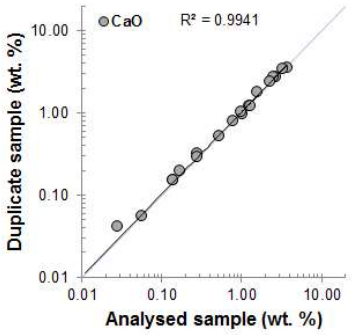


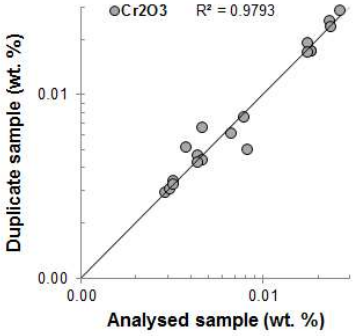
Figure 2.2: Results from sample and duplicate analysis by lithium metaborate fusion (ICP 95A).

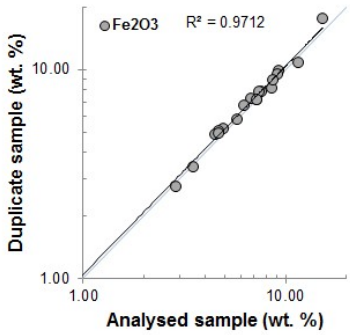
2.2.1.2 Multiacid digestion (ICP40B)

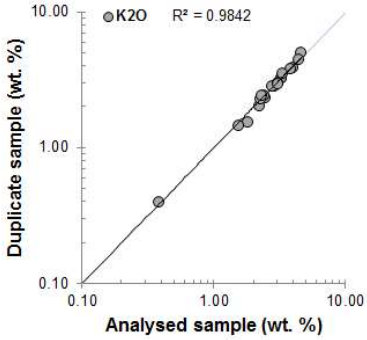
Nineteen duplicate multi-acid digested subsamples were analysed by ICP-AES (ICP-40B). The coefficient of determination (R_2) is greater than 0.9 for these major element oxides (Fig. 2.3).

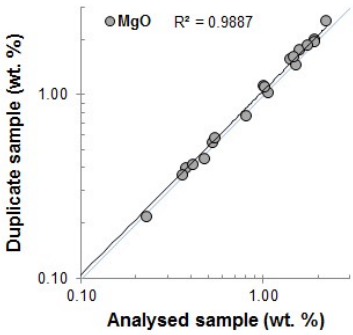

Al2O3
R² = 0.9724
Duplicate sample (wt. %)
Analysed sample (wt. %)
1.00
10.00


CaO
R² = 0.9941
Duplicate sample (wt. %)
Analysed sample (wt. %)
0.01
0.10
1.00
10.00


Cr2O3
R² = 0.9793
Duplicate sample (wt. %)
Analysed sample (wt. %)
0.00
0.01


Fe2O3
R² = 0.9712
Duplicate sample (wt. %)
Analysed sample (wt. %)
1.00
10.00


K2O
R² = 0.9842
Duplicate sample (wt. %)
Analysed sample (wt. %)
0.10
1.00
10.00


MgO
R² = 0.9887
Duplicate sample (wt. %)
Analysed sample (wt. %)
0.10
1.00

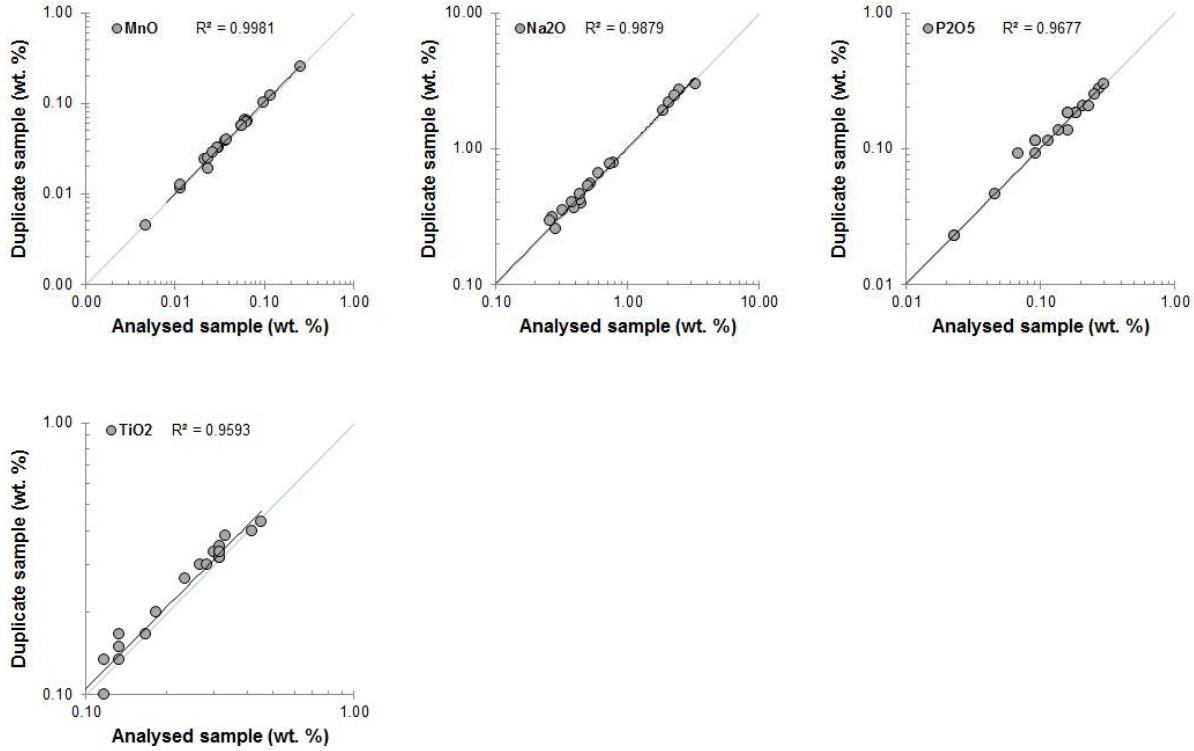
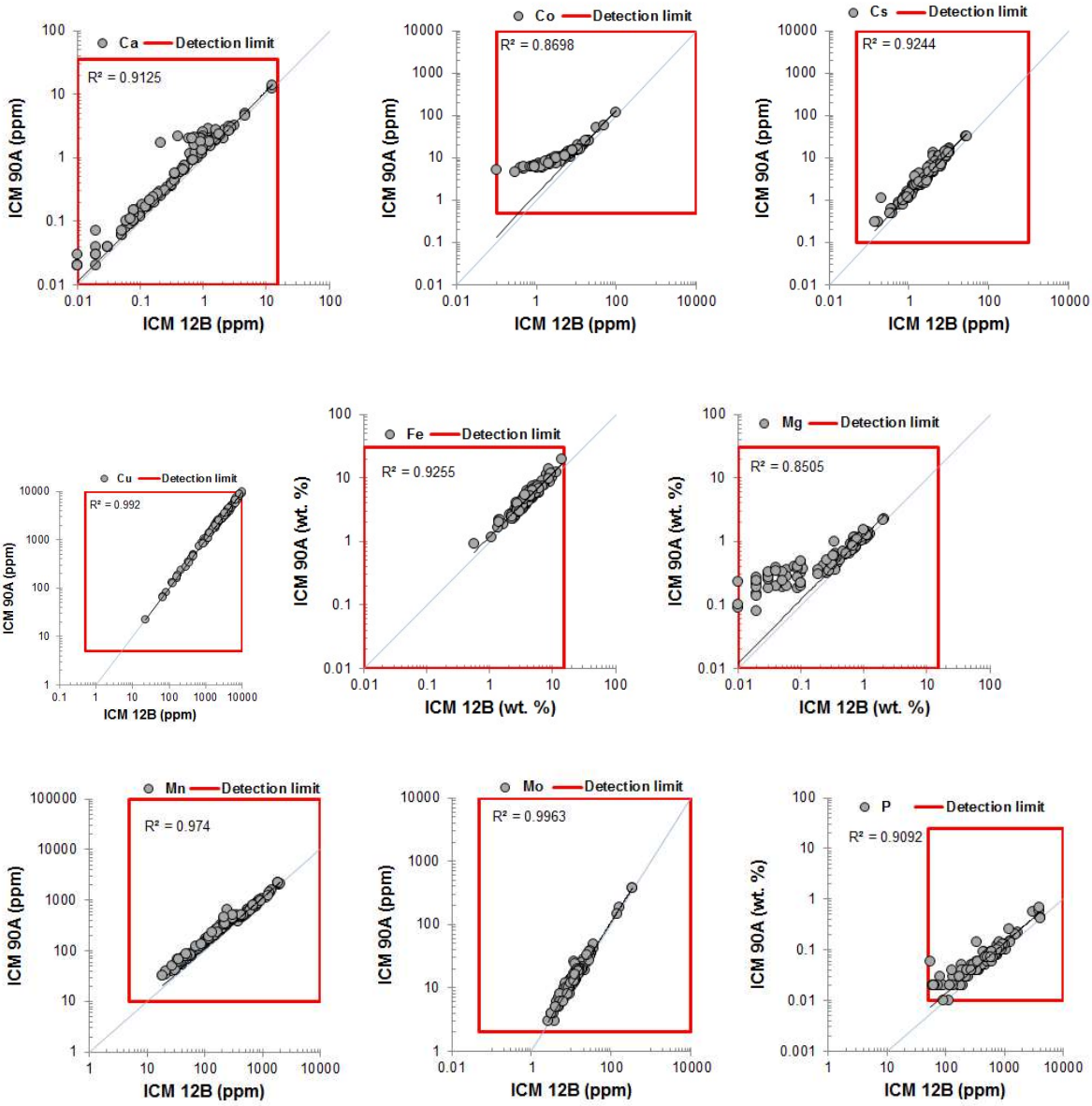


Figure 2.3: Comparison of the major element oxides between duplicate samples digested by multiacid method and analysed by ICP-AES method (SGS code: ICP-40B).

2.2.2 Trace element analyses

Comparison of 138 samples analysed by ICP-MS with an aqua regia digestion (ICM-12B) and a sodium peroxide fusion (ICM-90A) allows for determination of reproducibility and best method of digestion for the majority trace (and a few major) elements. A good correlation (R_2>0.8) occurs between the elements: Ca, Co, Cs, Cu, Fe, Mg, Mn, Mo, P, Pb, Sb, Tl, U, Y and Zn (Fig. 2.4). Although there is a good correlation, the results for Co, Mg, Tl and U are generally lower in the aqua regia digestion (12B) than the sodium peroxide fusion (90A). The elements Ag, Al, Ba, Ce, Ga, K, La, Lu, Nb, Ni, Rb, Sc, Sn, Sr, Ta, Tb, Th, Ti, V, W, Y, Yb and Zr show poor correlation between these methods (Fig. 2.5) with the aqua regia digestion (12B) having lower values than the sodium peroxide fusion (90A) method.


Ca
Detection limit
R² = 0.9125
ICM 90A (ppm)
ICM 12B (ppm)
Co
Detection limit
R² = 0.8698
ICM 90A (ppm)
ICM 12B (ppm)
Cs
Detection limit
R² = 0.9244
ICM 90A (ppm)
ICM 12B (ppm)
Cu
Detection limit
R² = 0.992
ICM 90A (ppm)
ICM 12B (ppm)
Fe
Detection limit
R² = 0.9255
ICM 90A (wt. %)
ICM 12B (wt. %)
Mg
Detection limit
R² = 0.8505
ICM 90A (wt. %)
ICM 12B (wt. %)
Mn
Detection limit
R² = 0.974
ICM 90A (ppm)
ICM 12B (ppm)
Mo
Detection limit
R² = 0.9963
ICM 90A (ppm)
ICM 12B (ppm)
P
Detection limit
R² = 0.9092
ICM 90A (wt. %)
ICM 12B (ppm)

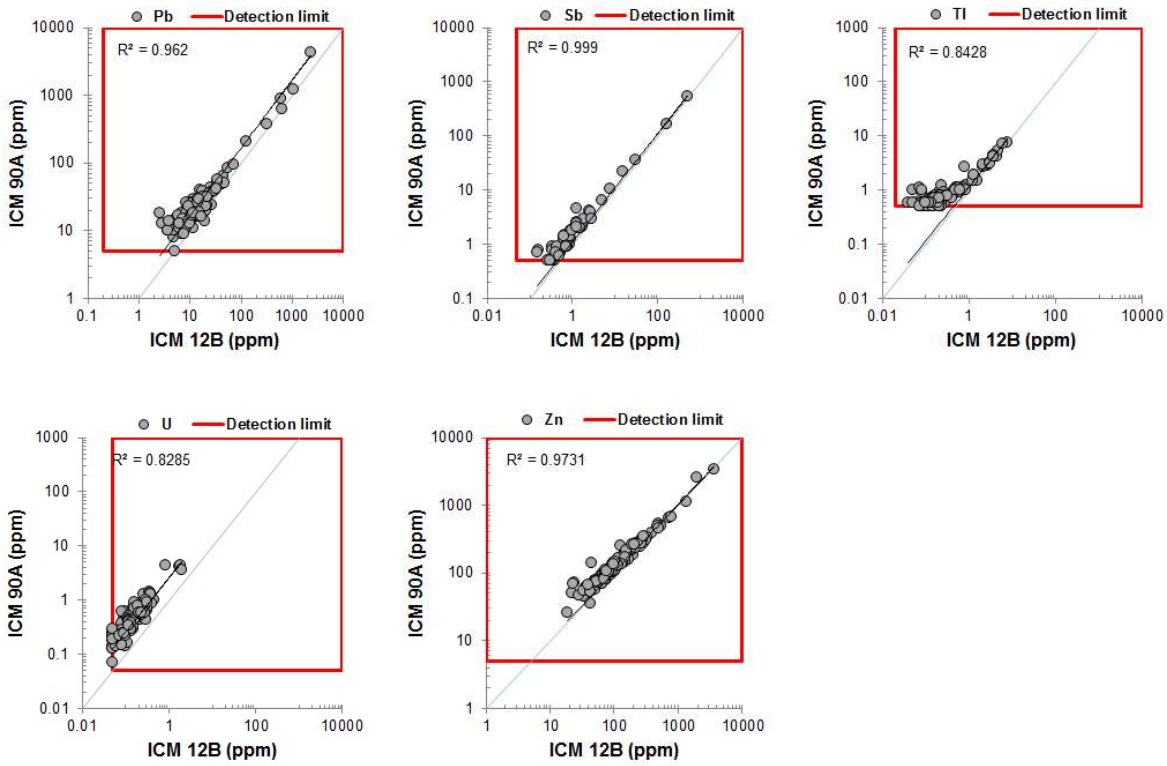
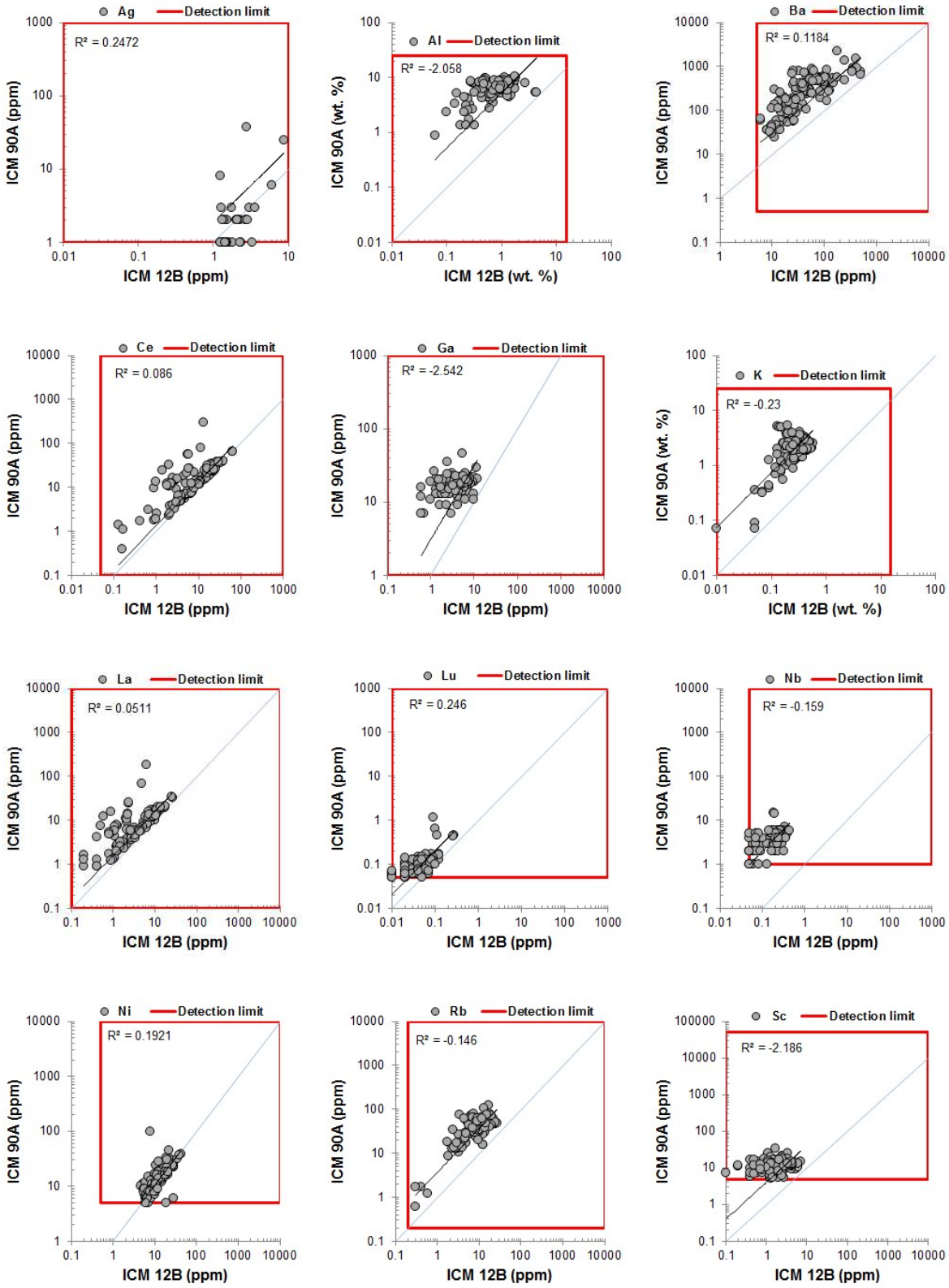
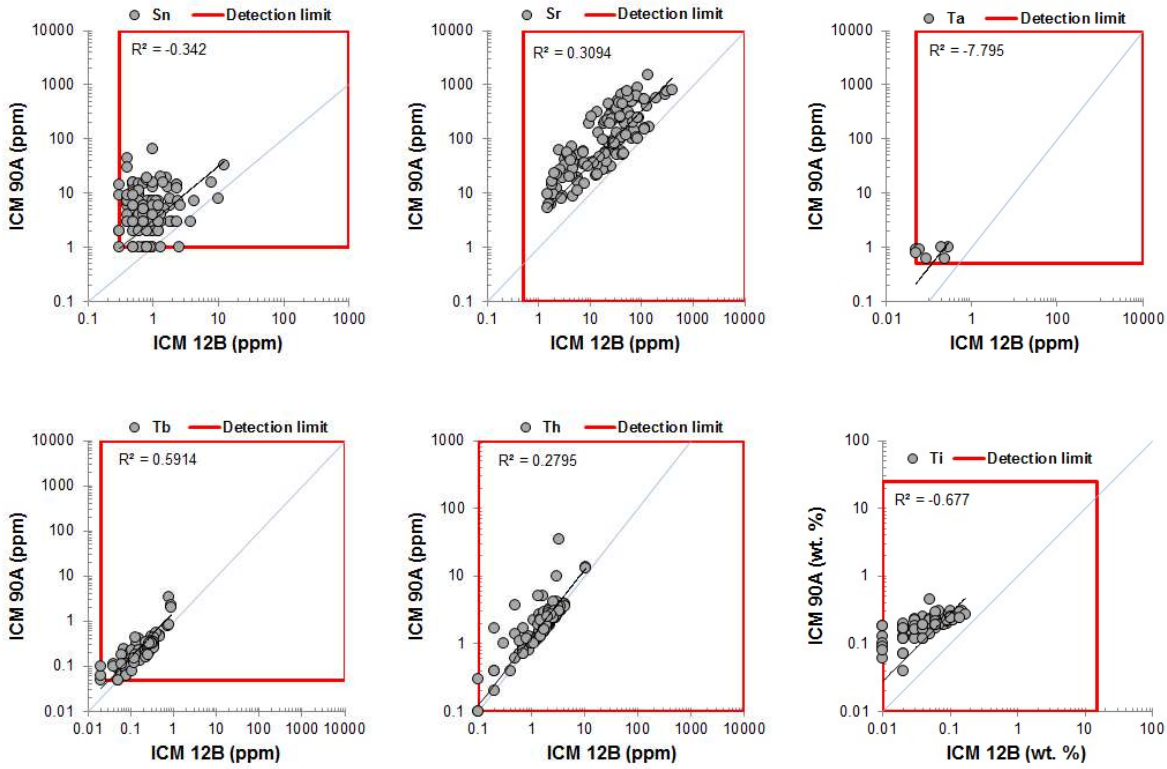


Figure 2.4: Comparison of results with good correlation (R2>0.8) analysed by ICP-MS using aqua regia digestion (ICM12B) and sodium peroxide fusion (ICM 90A).


Ag
Detection limit
R² = 0.2472
ICM 90A (ppm)
ICM 12B (ppm)
Al
Detection limit
R² = -2.058
ICM 90A (wt. %)
ICM 12B (wt. %)
Ba
Detection limit
R² = 0.1184
ICM 90A (ppm)
ICM 12B (ppm)
Ce
Detection limit
R² = 0.086
ICM 90A (ppm)
ICM 12B (ppm)
Ga
Detection limit
R² = -2.542
ICM 90A (ppm)
ICM 12B (ppm)
K
Detection limit
R² = -0.23
ICM 90A (wt. %)
ICM 12B (wt. %)
La
Detection limit
R² = 0.0511
ICM 90A (ppm)
ICM 12B (ppm)
Lu
Detection limit
R² = 0.246
ICM 90A (ppm)
ICM 12B (ppm)
Nb
Detection limit
R² = -0.159
ICM 90A (ppm)
ICM 12B (ppm)
Ni
Detection limit
R² = 0.1921
ICM 90A (ppm)
ICM 12B (ppm)
Rb
Detection limit
R² = -0.146
ICM 90A (ppm)
ICM 12B (ppm)
Sc
Detection limit
R² = -2.186
ICM 90A (ppm)
ICM 12B (ppm)


Sn
Detection limit
R² = -0.342
ICM 90A (ppm)
ICM 12B (ppm)
Sr
Detection limit
R² = 0.3094
ICM 90A (ppm)
ICM 12B (ppm)
Ta
Detection limit
R² = -7.795
ICM 90A (ppm)
ICM 12B (ppm)
Tb
Detection limit
R² = 0.5914
ICM 90A (ppm)
ICM 12B (ppm)
Th
Detection limit
R² = 0.2795
ICM 90A (ppm)
ICM 12B (ppm)
Ti
Detection limit
R² = -0.677
ICM 90A (wt. %)
ICM 12B (wt. %)

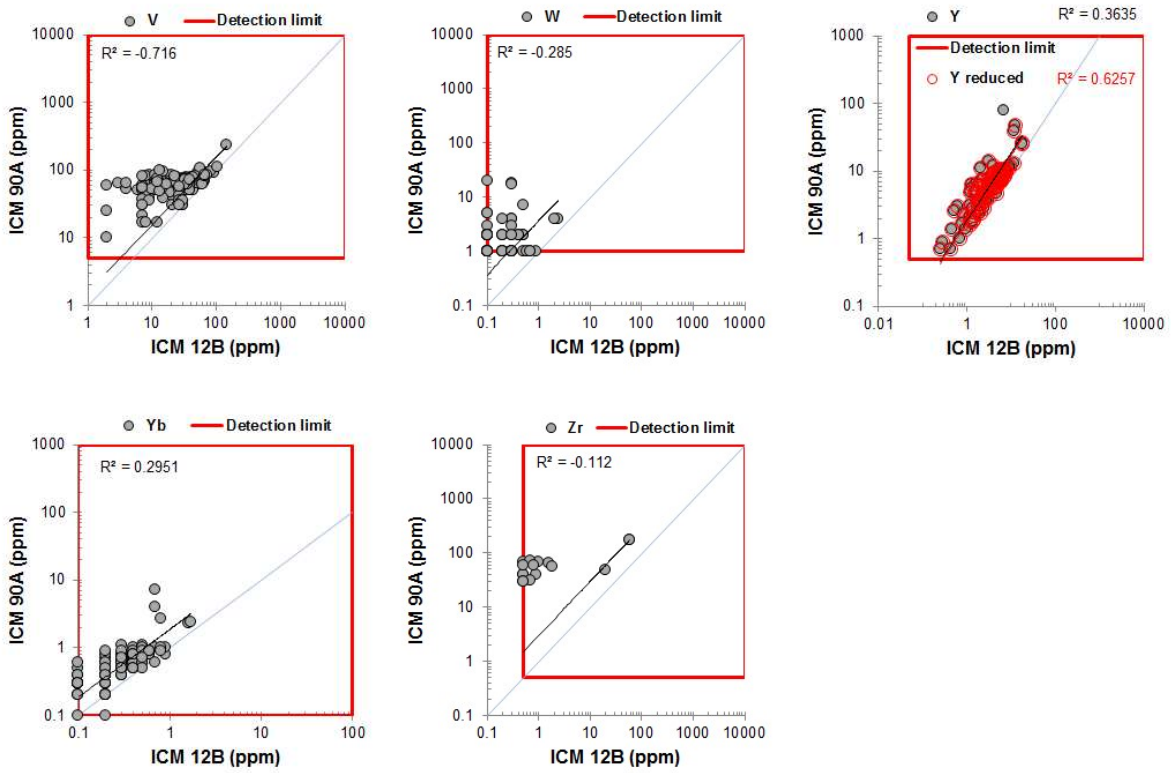
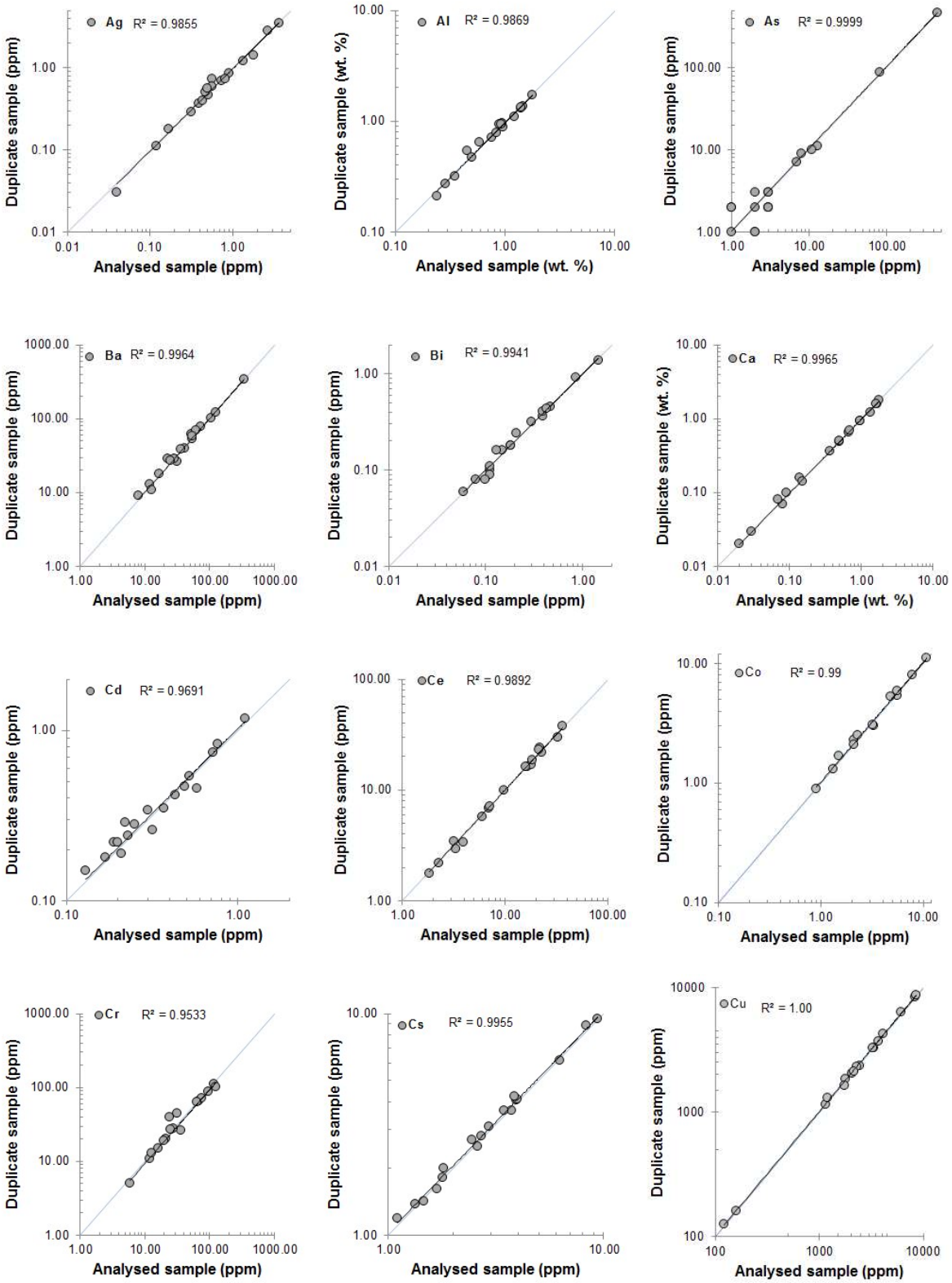
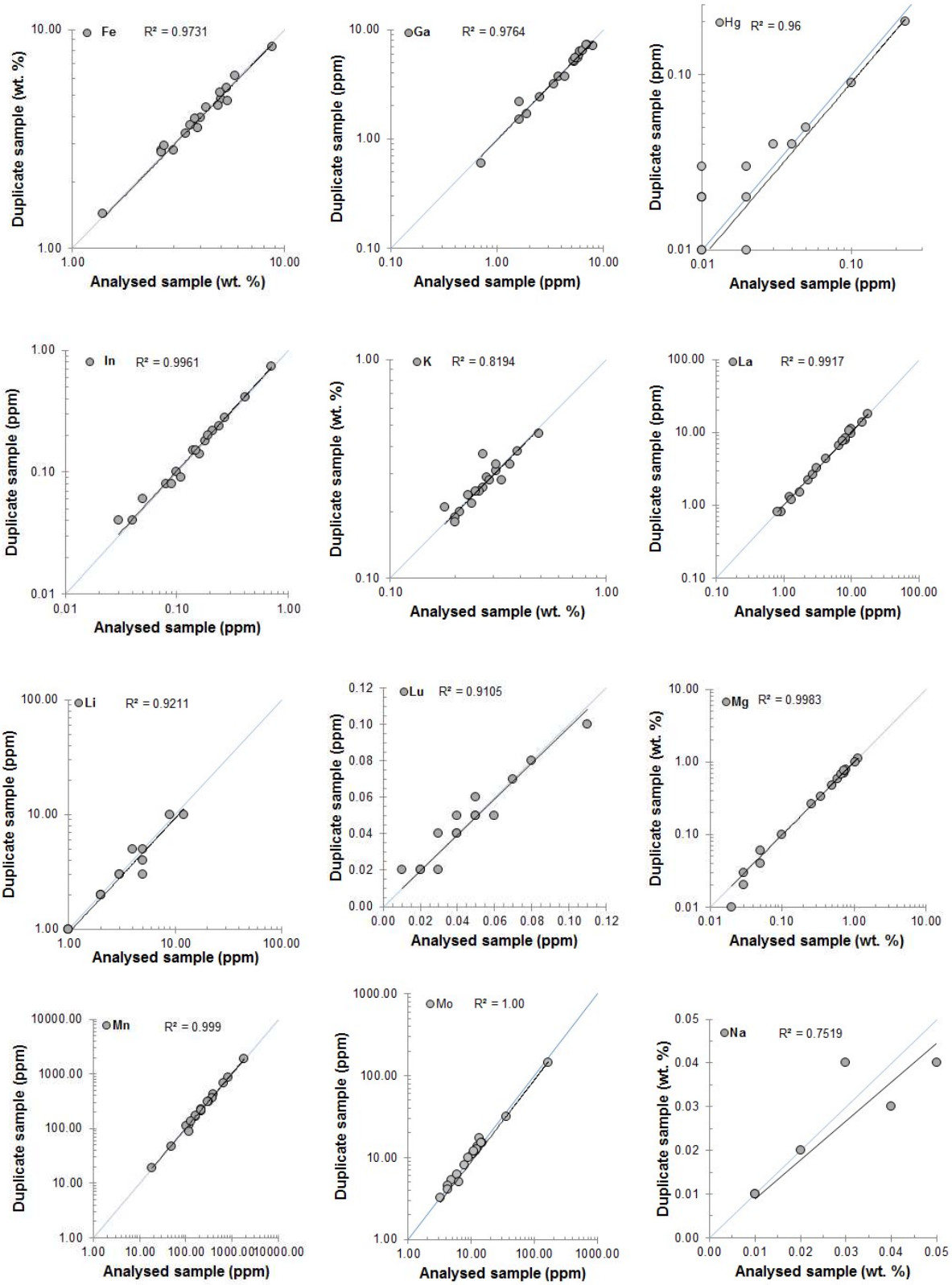


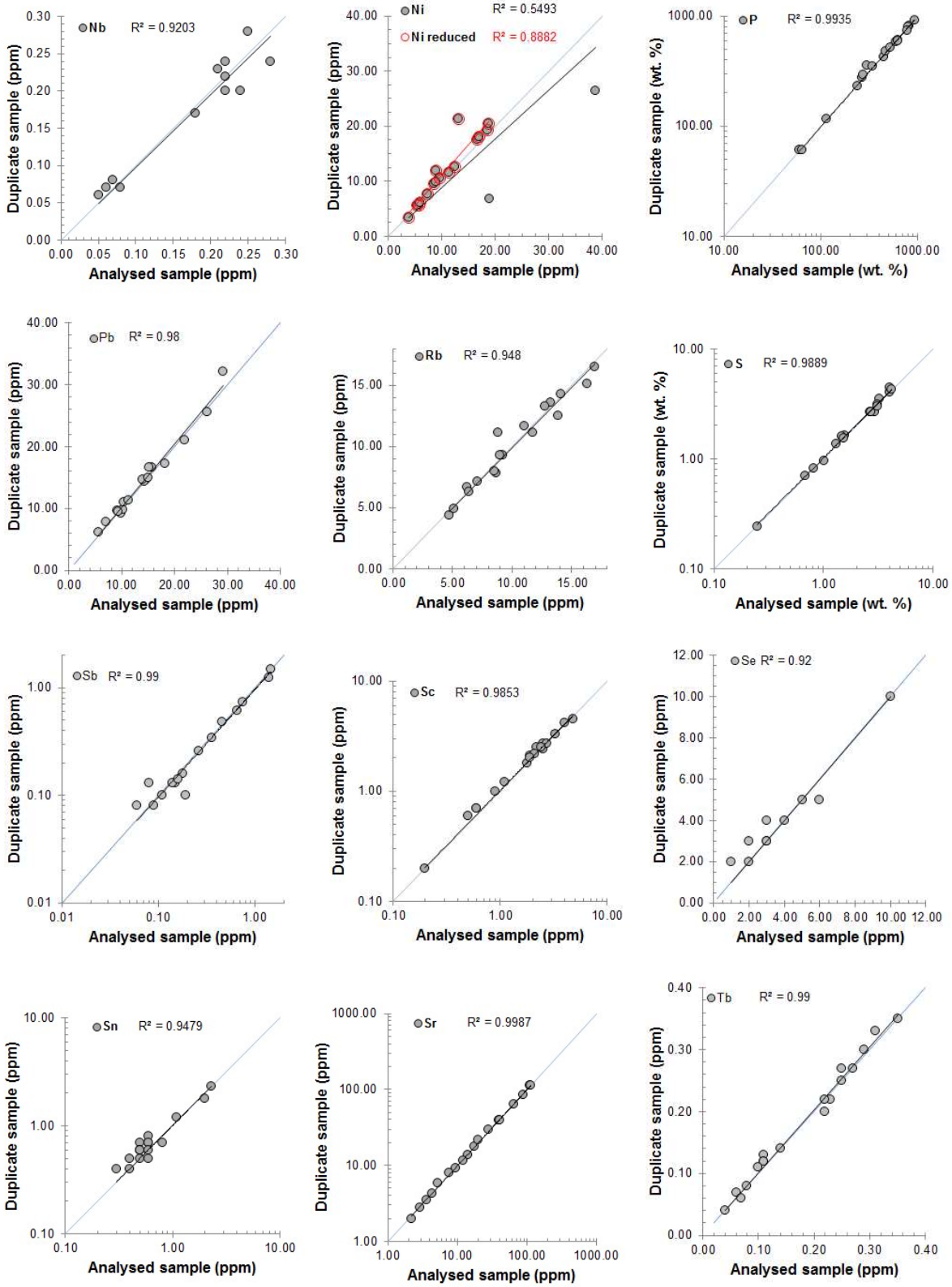
Figure 2.5: Comparison of results with poor correlation analysed by ICP-MS using aqua regia digestion (ICM12B) and sodium peroxide fusion (ICM 90A).

2.2.2.1 Multi-acid digestion method (ICM-12B)

Eighteen samples and duplicates are digested by multi-acid were analysed by ICP-MS (ICM12B method). The resulting coefficient of determination for all analyses was greater the 0.9 (Fig. 2.6), with the exception of K, Na and Ni which had $R_2 > 0.7$, these are excluded from the final dataset (Table 2.3, Table 2.4 and Table 2.5). Tellurium, Se and Hg were added to the element list for comprehensive element analysis.


Ag R² = 0.9855
Duplicate sample (ppm)
Analysed sample (ppm)
Al R² = 0.9869
Duplicate sample (wt. %)
Analysed sample (wt. %)
As R² = 0.9999
Duplicate sample (ppm)
Analysed sample (ppm)
Ba R² = 0.9964
Duplicate sample (ppm)
Analysed sample (ppm)
Bi R² = 0.9941
Duplicate sample (ppm)
Analysed sample (ppm)
Ca R² = 0.9965
Duplicate sample (wt. %)
Analysed sample (wt. %)
Cd R² = 0.9691
Duplicate sample (ppm)
Analysed sample (ppm)
Ce R² = 0.9892
Duplicate sample (ppm)
Analysed sample (ppm)
Co R² = 0.99
Duplicate sample (ppm)
Analysed sample (ppm)
Cr R² = 0.9533
Duplicate sample (ppm)
Analysed sample (ppm)
Cs R² = 0.9955
Duplicate sample (ppm)
Analysed sample (ppm)
Cu R² = 1.00
Duplicate sample (ppm)
Analysed sample (ppm)


Fe R² = 0.9731
Duplicate sample (wt. %)
Analysed sample (wt. %)
Ga R² = 0.9764
Duplicate sample (ppm)
Analysed sample (ppm)
Hg R² = 0.96
Duplicate sample (ppm)
Analysed sample (ppm)
In R² = 0.9961
Duplicate sample (ppm)
Analysed sample (ppm)
K R² = 0.8194
Duplicate sample (wt. %)
Analysed sample (wt. %)
La R² = 0.9917
Duplicate sample (ppm)
Analysed sample (ppm)
Li R² = 0.9211
Duplicate sample (ppm)
Analysed sample (ppm)
Lu R² = 0.9105
Duplicate sample (ppm)
Analysed sample (ppm)
Mg R² = 0.9983
Duplicate sample (wt. %)
Analysed sample (wt. %)
Mn R² = 0.999
Duplicate sample (ppm)
Analysed sample (ppm)
Mo R² = 1.00
Duplicate sample (ppm)
Analysed sample (ppm)
Na R² = 0.7519
Duplicate sample (wt. %)
Analysed sample (wt. %)


Nb R² = 0.9203
Ni R² = 0.5493
Ni reduced R² = 0.8882
P R² = 0.9935
Pb R² = 0.98
Rb R² = 0.948
S R² = 0.9889
Sb R² = 0.99
Sc R² = 0.9853
Se R² = 0.92
Sn R² = 0.9479
Sr R² = 0.9987
Tb R² = 0.99
Duplicate sample (ppm)
Duplicate sample (wt. %)
Analysed sample (ppm)
Analysed sample (wt. %)

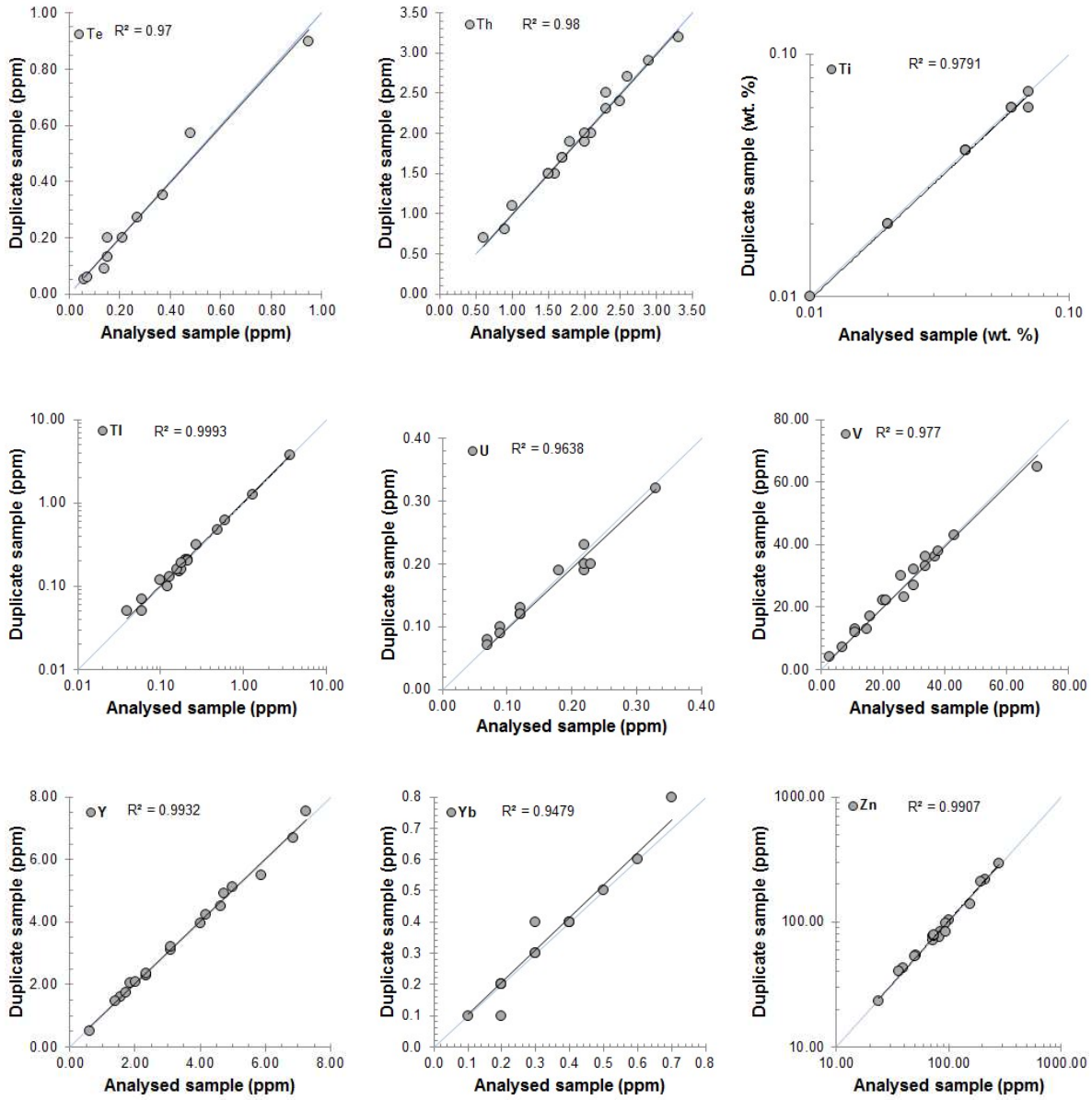
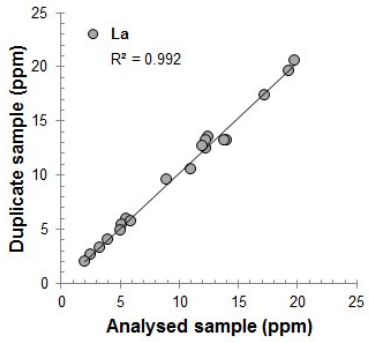
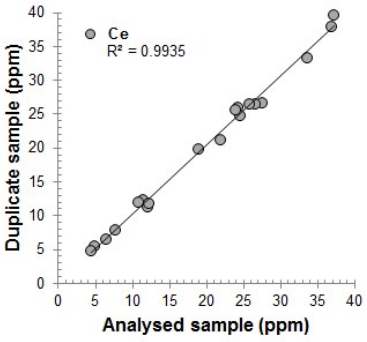


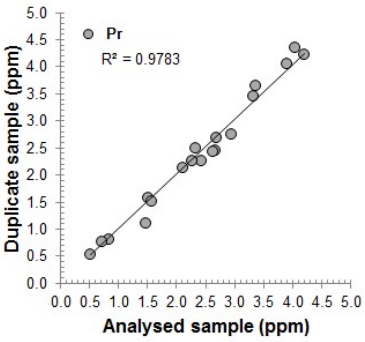
Figure 2.6: Results from samples and duplicates analysed by ICP-MS method with an aqua regia digestion (ICM 12B).

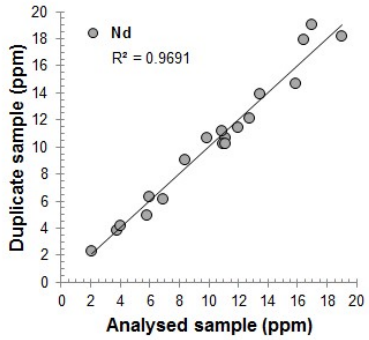
2.2.3 Rare earth elements

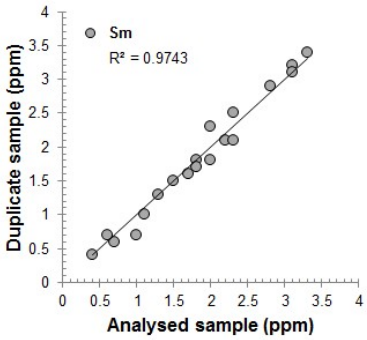
The ICP-MS method with a sodium peroxide fusion (ICM 90A) was selected for digestion of whole rock and liberation of the rare earth elements, Sc and Y into solution. These solutions are analysed by ICP-MS. The results have R_2>0.9, with the exception of Tb, Ho, Tm, Sc and Lu values are less well correlated using this method (Fig. 2.7). Scandium and Lu are excluded from the final dataset, due to poor correlations (Table 2.6).

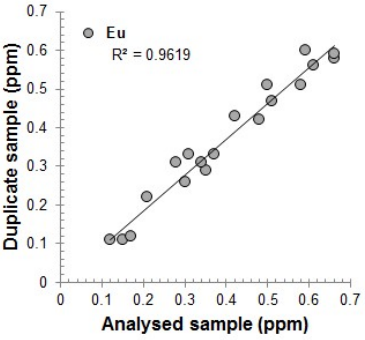

La
R² = 0.992
Duplicate sample (ppm)
Analysed sample (ppm)

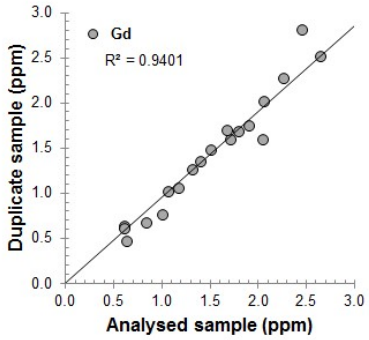

Ce
R² = 0.9935
Duplicate sample (ppm)
Analysed sample (ppm)

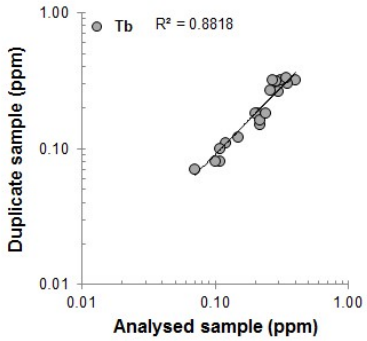

Pr
R² = 0.9783
Duplicate sample (ppm)
Analysed sample (ppm)

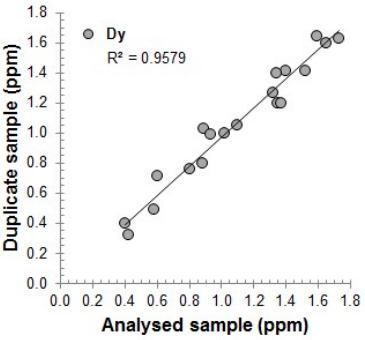

Nd
R² = 0.9691
Duplicate sample (ppm)
Analysed sample (ppm)

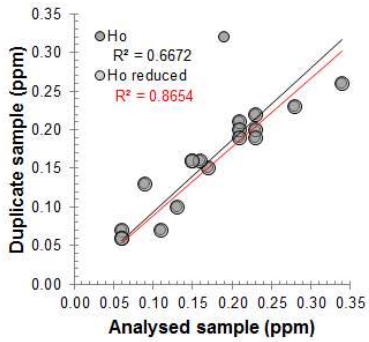

Sm
R² = 0.9743
Duplicate sample (ppm)
Analysed sample (ppm)

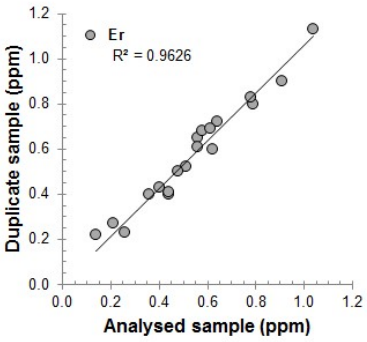

Eu
R² = 0.9619
Duplicate sample (ppm)
Analysed sample (ppm)

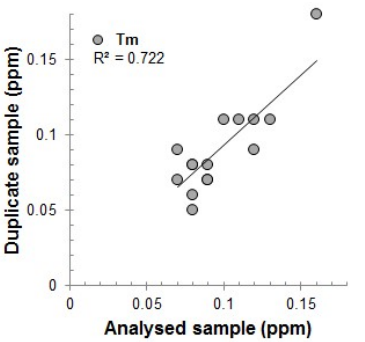

Gd
R² = 0.9401
Duplicate sample (ppm)
Analysed sample (ppm)


Tb
R² = 0.8818
Duplicate sample (ppm)
Analysed sample (ppm)


Dy
R² = 0.9579
Duplicate sample (ppm)
Analysed sample (ppm)


Ho
R² = 0.6672
Ho reduced
R² = 0.8654
Duplicate sample (ppm)
Analysed sample (ppm)


Er
R² = 0.9626
Duplicate sample (ppm)
Analysed sample (ppm)


Tm
R² = 0.722
Duplicate sample (ppm)
Analysed sample (ppm)

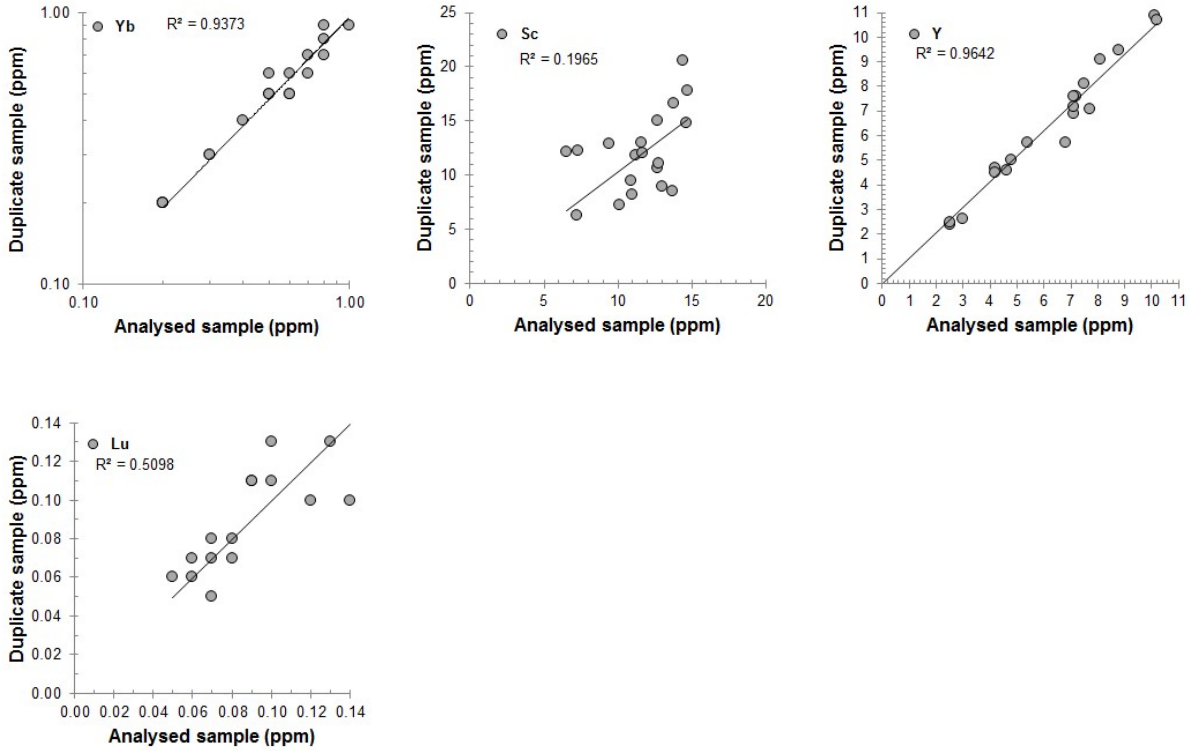


Figure 2.7: Correlation between duplicate analyses for rare earth elements, Sc and Y using ICM-90A.

2.2.4 Sulphur total

The sulphur content was analysed by ICM12B, ICP40B and CSA24V. The results of these analysis show that they are all well correlated with R2 >0.9 (Fig. 2.8). The ICM 12B method shows consistently lower results than those ICP 40B and CSA 24V methods. The ICP 40B method shows the best range for the sulphur contents of the analysed rocks, with CSA 24V results used when the S content is greater than 10 wt. %.

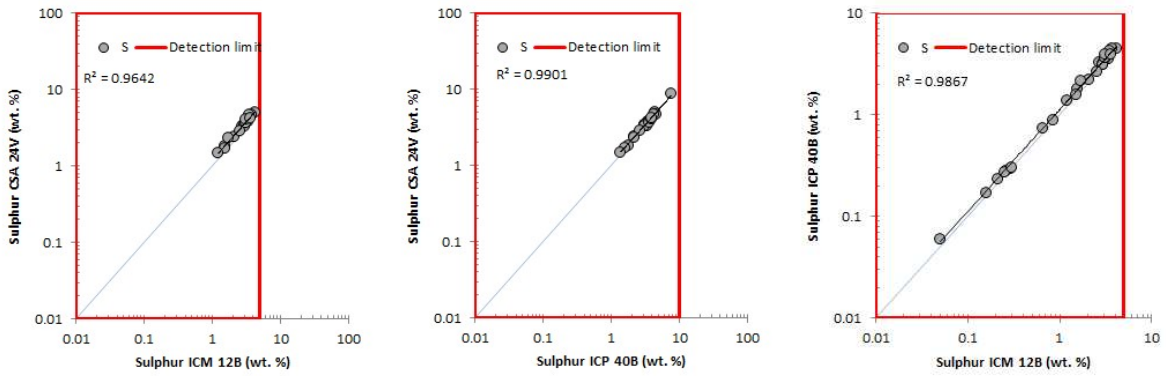


Figure 2.8: Comparison of results between CSA 24V, ICM12B and ICP 40B methods, with very good coefficient of determination.

Seventeen samples were duplicated using CSA 24V method, eighteen samples duplicated for the ICM 12B method and 21 samples had duplicate runs using the ICP 40B method (Fig. 2.9). The ICP 40B produced the most reproducible results and correlates very well with other methods, thus these results are used for lithogeochemistry. When results are > 10wt. % the results of CSA 24V are utilised (Table 2.7).

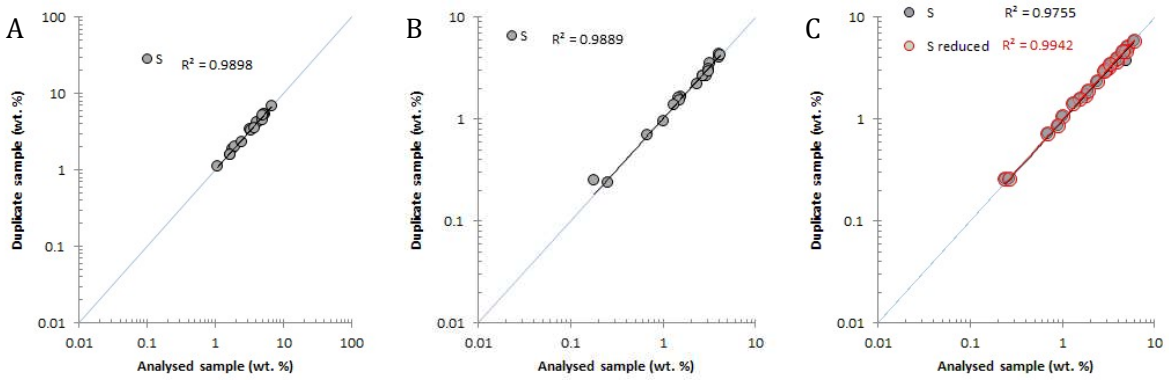


Figure 2.9: Correlation between samples and duplicates for A) CSA 24A; B) ICM12 B and; C) ICP 40B methods.

2.2.5 Gold

The majority of samples had concentrations between 5 and 5000 ppb, thus eleven duplicates were run using the FAA515 method. The results of which produce consistent results, with an R_2>0.9 (Fig. 2.10). As only one sample had results greater than 0.5 ppm, no duplicates of the FAG 505 method were run.

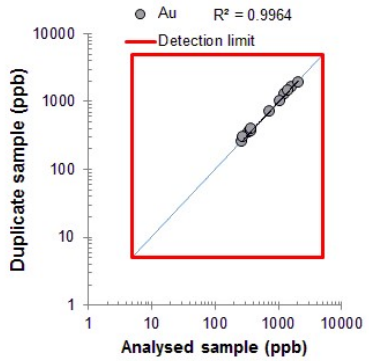


Figure 2.10: Comparison of duplicate analyses using the FAA 515 method show very good correlation.

2.2.6 Copper

ICM12B and ICP90A methods have very good correlation for copper between 0.5-10 000ppm (Fig. 2.4). The results of samples analysed by both ICM12B and ICP 40B methods produce equally good results (Fig. 2.11).

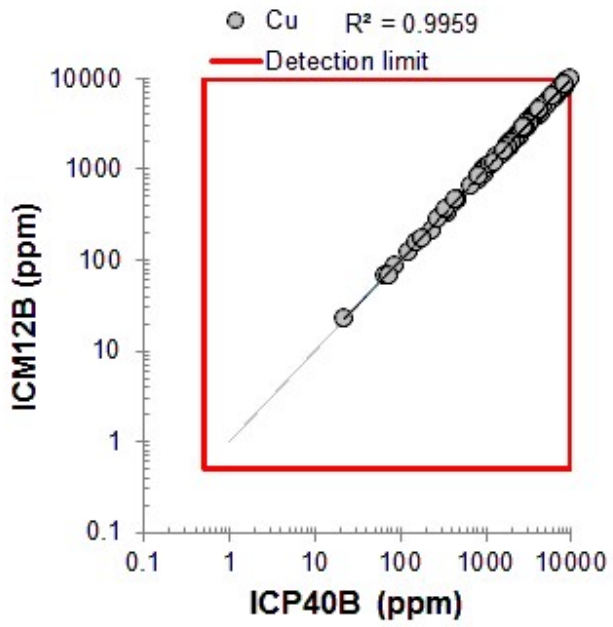


Figure 2.11: Comparison between samples analysed by ICM12B and ICP 40B method.

For samples with concentrations > 1 wt. % the atomic absorption spectroscopy (AAS 42C and AAS 41B) were used. Unfortunately no duplicates were run using this method, thus preclude quality control of copper-rich samples.

Results

2.3.1 Major elements

2.3.1.1 ICP 95A major element oxide results

Table 2.1: Table 2.1: Results of major element oxide content for whole rock samples analysed by ICP 95A method. Abbreviations: QD1= early biotite quartz diorite, QD2= post-mineralisation biotite quartz diorite, k/s=kaolinite-smectite alteration, i/s=illite-smectite alteration, b.d.=below detection limit.

Alteration type	Samples	Al_2O_3	CaO	Cr_2O_3	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	LOI	Total
Least altered-QD2-west	C11.JL - 105	15.17	3.57	b.d.	5.55	1.63	2.02	0.04	3.01	0.21	63.65	0.53	3.86	99.24
Least altered-QD2-west	C11.JL - 38	16.81	3.26	0.02	5.08	2.28	1.93	0.04	3.88	0.43	61.32	0.54	3.39	98.98
Least altered-QD1	C11.JL - 177	14.31	2.47	0.02	5.46	2.19	1.65	0.09	2.95	0.24	63.84	0.49	4.38	98.09
Least altered-QD1	C11.JL - 32	16.27	2.84	0.02	5.90	2.8	1.89	0.07	4.19	0.22	60.99	0.54	4.21	99.94
Potassic	C11.JL - 178	12.69	1.00	b.d.	7.15	4.75	1.08	0.03	2.45	0.15	66.84	0.41	2.10	98.65
Potassic	C11.JL - 179B	13.67	1.54	0.03	5.12	4.13	1.16	0.03	2.96	b.d.	68.03	0.39	2.76	99.82
Potassic-propylitic	C11.JL - 183	14.97	1.72	0.02	4.69	3.13	1.84	0.03	3.33	0.22	65.01	0.49	4.02	99.47
Potassic	C11.JL - 194	14.22	1.02	0.02	5.31	5.78	0.32	0.02	3.11	0.40	64.4	0.10	3.97	98.67
Propylitic	C11.JL - 35	8.72	2.92	b.d.	7.82	3.95	1.19	0.07	0.47	0.18	69.04	0.36	4.46	99.18
Propylitic	C11.JL - 36	8.77	2.09	0.03	11.41	2.73	1.32	0.05	0.53	0.31	67.03	0.33	4.71	99.31
Propylitic	C11.JL - 92	8.84	1.41	b.d.	7.38	2.89	1.22	0.08	0.37	0.20	70.58	0.30	4.80	98.07
Propylitic	C11.JL - 128	9.03	0.16	0.03	11.11	3.04	1.12	0.03	0.22	0.15	68.42	0.26	4.61	98.18
Sericitic	C11.JL - 24	12.12	1.28	b.d.	4.40	3.69	0.56	0.03	0.48	0.05	72.36	0.36	4.10	99.43
Sericitic	C11.JL - 25	16.56	1.14	0.03	2.69	5.47	0.37	0.02	0.75	0.28	67.92	0.52	3.47	99.22
Sericitic	C11.JL - 138	18.34	0.65	0.01	7.60	3.51	0.50	0.03	0.20	0.61	57.55	0.46	8.84	98.30

Alteration type	Samples	Al_2O_3	CaO	Cr_2O_3	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	LOI	Total
Sericitic	C11.JL - 193	9.52	0.48	0.02	4.46	2.27	0.36	b.d.	0.23	0.45	77.37	0.29	3.70	99.15
Sericitic	C11.JL - 205	4.31	0.03	0.03	11.54	1.21	0.14	0.01	0.03	0.17	75.24	0.10	6.58	99.39
Sericitic	C11.JL - 190	15.78	2.99	b.d.	4.11	1.99	2.17	0.05	0.30	1.43	58.23	0.56	12.29	99.9
Sericitic	C11.JL - 199	8.14	0.41	0.06	4.33	2.75	0.77	0.02	0.18	0.14	78.61	0.26	4.26	99.93
Sericitic	C11.JL - 200	10.03	0.20	0.02	9.44	2.35	0.56	b.d.	0.16	0.25	71.05	0.26	4.06	98.38
Sericitic	C11.JL - 201	3.66	0.11	0.09	4.99	1.19	0.57	0.02	0.11	0.21	85.39	0.10	2.35	98.79
Argillic-dickite	C11.JL - 95	3.61	0.24	0.07	22.54	0.18	0.15	0.02	0.18	0.09	57.04	0.16	14.56	98.84
Argillic-dickite	C11.JL - 108	8.44	3.07	0.05	16.28	0.31	0.19	0.02	0.21	2.21	54.94	0.28	13.05	99.05
Argillic-dickite	C11.JL - 110	7.04	1.86	b.d.	25.34	b.d.	0.06	0.01	0.08	2.70	31.14	0.12	15.28	83.63
Argillic-k/s	C11.JL - 78	9.83	0.46	0.03	8.61	3.69	1.66	0.28	0.92	0.29	66.85	0.38	6.30	99.3
Argillic-k/s	C11.JL - 96	8.39	0.07	0.01	10.66	0.82	0.26	0.01	0.07	0.08	72.94	0.22	5.39	98.92
Argillic-k/s	C11.JL - 121	12.15	0.14	b.d.	6.97	2.29	0.47	0.01	0.39	0.06	66.97	0.38	8.53	98.36
Argillic-i/s	C11.JL - 74	12.56	2.25	0.02	5.41	2.44	1.39	0.03	0.19	0.44	63.97	0.41	9.05	98.16
Argillic-i/s	C11.JL - 75	12.21	2.27	b.d.	5.94	2.21	1.73	0.06	0.50	0.33	65.96	0.37	8.37	99.95
Argillic-i/s	C11.JL - 76	12.18	3.57	0.02	3.70	0.90	0.50	0.07	0.09	0.43	69.85	0.34	7.24	98.89
Argillic-i/s	C11.JL - 115	11.63	3.51	b.d.	6.67	3.15	1.84	0.07	0.71	0.17	59.44	0.49	11.23	98.91

2.3.1.2 ICP 40B Major element oxide results

Table 2.2: Results of major element oxide content for whole rock samples analysed by ICP 90B method. Abbreviations: QD1= early biotite quartz diorite, QD2= post-mineralisation biotite quartz diorite, k/s=kaolinite-smectite alteration, i/s=illite-smectite alteration, b.d.=below detection limit, a.d=above detection limit

Alteration type	Samples	Al_2O_3	CaO	Cr_2O_3	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	TiO_2
Least altered-QD2-west	C11.JL - 105	14.51	3.54	0.04	5.03	1.75	1.92	0.42	3.06	0.27	0.35
Least altered-QD2-west	C11.JL - 38	15.48	3.43	0.14	5.29	2.57	1.87	0.45	3.69	0.27	0.42
Least altered-QD1	C11.JL - 177	14.45	3.04	0.16	5.15	2.48	1.71	0.82	2.79	0.18	0.38
Least altered-QD1	C11.JL - 32	14.87	3.23	0.12	6.45	2.67	1.92	0.72	3.80	0.23	0.50
Potassic	C11.JL - 178	12.85	0.98	0.04	6.28	4.64	1.03	0.30	2.28	0.02	0.27
Potassic	C11.JL - 179B	14.59	2.56	0.19	4.49	4.05	1.11	0.24	2.53	0.05	0.32
Potassic-propylitic	C11.JL - 183	18.29	2.00	0.08	4.55	3.51	1.94	0.34	3.24	0.23	0.38
Potassic	C11.JL - 194	12.81	0.88	0.11	4.92	5.87	0.35	0.19	2.97	0.09	0.02
Propylitic	C11.JL - 35	10.07	3.06	0.05	8.52	4.13	1.26	0.67	0.84	0.14	0.32
Propylitic	C11.JL - 36	8.41	2.50	0.28	12.15	2.89	1.39	0.52	0.65	0.11	0.25
Propylitic	C11.JL - 92	9.73	1.57	0.03	8.76	3.04	1.36	0.85	0.61	0.14	0.22
Propylitic	C11.JL - 128	7.80	0.22	0.23	11.27	2.95	1.18	0.23	0.49	0.09	0.18
Sericitic	C11.JL - 24	11.58	1.59	0.07	5.19	3.26	0.61	0.34	0.43	0.14	0.15
Sericitic	C11.JL - 25	14.98	1.25	0.18	2.87	3.96	0.38	0.22	0.53	0.27	0.18
Sericitic	C11.JL - 138	14.47	0.28	0.03	7.46	3.84	0.53	0.31	0.43	0.16	0.32
Sericitic	C11.JL - 193	9.03	0.06	0.10	4.23	2.41	0.33	0.07	0.26	0.07	0.07
Sericitic	C11.JL - 205	4.04	0.03	0.15	11.37	1.49	0.17	0.10	0.12	0.07	0.03

Alteration type	Samples	Al_2O_3	CaO	Cr_2O_3	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	TiO_2
Sericitic	C11.JL - 190	16.85	1.59	0.03	4.70	2.32	2.24	0.56	0.61	0.16	0.32
Sericitic	C11.JL - 199	7.46	0.36	0.44	5.33	3.31	1.03	0.23	0.39	0.09	0.12
Sericitic	C11.JL - 200	8.12	0.03	0.13	9.99	2.58	0.63	0.08	0.36	0.11	0.25
Sericitic	C11.JL - 201	2.23	0.04	0.58	5.05	1.07	0.60	0.19	0.13	0.05	0.07
Argillic-dickite	C11.JL - 95	1.70	0.03	0.48	a.d	0.04	b.d	0.09	0.13	0.05	b.d
Argillic-dickite	C11.JL - 108	6.97	0.35	0.27	17.13	0.41	0.15	0.08	0.19	0.27	0.13
Argillic-dickite	C11.JL - 110	5.22	1.45	0.02	a.d	0.10	0.03	0.05	0.23	1.28	0.05
Argillic-k/s	C11.JL - 78	10.60	0.39	0.24	8.38	3.58	1.54	2.47	1.02	0.16	0.25
Argillic-k/s	C11.JL - 96	5.80	0.03	0.04	9.68	0.90	0.25	0.08	0.23	0.02	0.15
Argillic-k/s	C11.JL - 121	10.79	b.d	0.04	5.93	1.53	0.41	0.05	0.22	0.05	0.23
Argillic-i/s	C11.JL - 74	13.53	2.80	0.15	6.68	3.72	1.61	0.34	0.54	0.18	0.12
Argillic-i/s	C11.JL - 75	12.47	2.70	0.05	7.25	2.87	1.92	0.64	0.78	0.18	0.17
Argillic-i/s	C11.JL - 76	12.04	4.16	0.17	4.65	2.37	0.58	0.82	0.32	0.18	0.32
Argillic-i/s	C11.JL - 115	13.09	4.43	0.10	6.86	2.90	1.84	0.73	0.85	0.16	0.17

2.3.2 Trace elements

2.3.2.1 ICM12B trace element results

Table 2.3: Results from ICM 12B

Alteration type	Samples	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga
Least altered-QD2-west	C11.JL - 105	<0.01	1.44	2	<10	109	0.1	0.05	0.98	0.17	19.30	0.9	12	3.08	85	3.49	6.4
Least altered-QD2-west	C11.JL - 38	0.46	1.46	2	<10	95	0.1	0.06	1.33	0.17	23.20	2.7	57	3.90	760	3.68	6.7
Least altered-QD1	C11.JL - 177	0.64	1.12	1	<10	91	0.1	0.04	1.00	0.46	25.00	0.8	59	6.72	1854	3.34	6.1
Least altered-QD1	C11.JL - 32	0.84	2.73	2	<10	143	0.1	0.10	1.46	0.50	23.80	4.2	75	4.00	1965	4.40	10.2
Potassic	C11.JL - 178	0.47	0.59	1	<10	61	0.1	0.06	0.50	0.30	7.08	1.3	24	1.11	2159	3.77	6.0
Potassic	C11.JL - 179B	0.99	0.67	2	<10	47	0.1	0.07	0.91	0.46	15.40	1.4	69	0.98	2899	2.76	5.8
Potassic-propylitic	C11.JL - 183	0.19	1.41	1	<10	243	0.1	0.02	0.71	0.15	17.40	<0.1	30	0.85	459	2.81	7.0
Potassic	C11.JL - 194	1.26	0.27	1	<10	33	<0.1	0.27	0.46	0.20	6.59	12.8	44	0.90	6407	3.35	1.0
Propylitic	C11.JL - 35	1.77	1.13	2	<10	44	0.1	0.13	2.12	0.74	21.10	7.0	30	5.03	7579	5.53	7.7
Propylitic	C11.JL - 36	2.37	1.38	3	<10	16	0.1	0.19	1.58	0.80	7.55	14.8	99	3.98	8887	8.45	11.7
Propylitic	C11.JL - 92	1.26	1.26	1	<10	29	0.1	0.24	0.95	0.25	14.00	1.2	15	3.25	7893	5.97	6.9
Propylitic	C11.JL - 128	1.53	1.25	7	<10	51	0.1	0.32	0.08	0.21	3.98	4.4	101	6.30	9698	7.50	7.0
Sericitic	C11.JL - 24	0.23	0.37	2	<10	21	<0.1	0.18	0.83	0.10	18.00	5.2	32	2.93	1085	2.90	1.3
Sericitic	C11.JL - 25	0.12	0.29	3	<10	12	<0.1	0.15	0.67	0.17	36.40	<0.1	69	1.47	120	1.40	0.7
Sericitic	C11.JL - 138	0.81	0.50	82	<10	17	0.2	0.43	0.15	0.37	2.26	<0.1	12	9.40	3302	4.89	2.5
Sericitic	C11.JL - 193	0.70	0.15	1	<10	20	<0.1	0.66	0.03	0.87	2.01	<0.1	38	0.34	2743	2.82	0.6
Sericitic	C11.JL - 205	2.15	0.10	5	<10	10	<0.1	0.26	<0.01	0.28	0.17	8.3	70	0.92	9940	6.87	1.2
Sericitic	C11.JL - 190	0.17	1.78	2	<10	41	0.2	0.21	0.95	0.72	16.00	0.9	6	1.79	1205	2.70	5.4

Sericitic	C11.JL - 199	1.44	0.59	1	<10	26	0.1	0.57	0.19	0.31	11.50	11.3	166	0.69	8545	3.20	2.7
Sericitic	C11.JL - 200	2.16	0.66	3	<10	21	<0.1	0.24	0.01	0.42	7.71	8.3	50	2.51	>10000	4.23	4.2
Sericitic	C11.JL - 201	3.05	0.32	3	<10	14	<0.1	0.11	0.02	0.32	2.10	<0.1	224	0.96	>10000	3.01	3.0
Argillic-dickite	C11.JL - 95	0.32	0.06	24	<10	18	<0.1	0.17	0.01	0.53	0.42	0.9	190	<0.05	2154	>15	0.6
Argillic-dickite	C11.JL - 108	8.67	0.24	64	<10	19	<0.1	0.44	0.21	2.30	11.40	96.1	115	0.75	>10000	11.34	1.8
Argillic-dickite	C11.JL - 110	>10	0.22	97	<10	<5	<0.1	0.73	0.61	11.80	13.40	32.0	10	0.14	>10000	13.83	2.7
Argillic-k/s	C11.JL - 78	0.55	1.16	2	<10	395	0.1	0.16	0.20	0.42	8.79	1.2	87	8.47	2365	4.98	7.3
Argillic-k/s	C11.JL - 96	0.17	0.26	18	<10	11	<0.1	0.24	0.01	0.07	1.04	4.7	27	1.22	656	5.34	2.4
Argillic-k/s	C11.JL - 121	0.55	0.65	54	<10	8	<0.1	0.19	<0.01	0.17	2.95	3.8	14	4.06	3169	4.10	1.8
Argillic-i/s	C11.JL - 74	0.63	0.88	1	<10	34	0.1	0.54	1.61	0.10	22.00	3.4	58	2.44	2365	3.79	2.8
Argillic-i/s	C11.JL - 75	0.56	1.40	2	<10	106	0.1	0.39	1.63	1.10	22.60	2.3	20	3.73	2415	4.00	5.7
Argillic-i/s	C11.JL - 76	0.96	0.60	10	<10	12	0.1	0.07	2.54	0.94	19.20	1.9	60	4.49	2014	2.55	2.8
Argillic-i/s	C11.JL - 115	0.32	1.64	3	<10	175	0.2	0.42	2.72	0.54	22.30	14.4	47	10.30	895	4.78	5.2

Table 2.4: Results from ICM 12B continued

Alteration type	Samples	Ge	Hf	Hg	In	La	Li	Lu	Mg	Mn	Mo	Nb	P	Pb	Rb	S	Sb
Least altered-QD2-west	C11.JL - 105	0.1	0.06	0.01	0.03	8.2	5	0.06	1.14	228	2.59	0.22	1023	7.80	15.80	0.16	0.06
Least altered-QD2-west	C11.JL - 38	0.1	<0.05	0.04	0.04	10.1	5	0.08	1.11	237	6.83	0.22	959	2.50	11.50	0.29	<0.05
Least altered-QD1	C11.JL - 177	0.1	<0.05	<0.01	0.08	10.9	5	0.07	0.90	607	10.63	0.32	703	10.40	16.90	0.26	<0.05
Least altered-QD1	C11.JL - 32	0.1	0.05	0.01	0.14	10.4	9	0.08	1.15	545	19.01	0.17	898	16.10	21.60	0.21	0.33
Potassic	C11.JL - 178	0.1	<0.05	<0.01	0.08	3.1	2	<0.01	0.59	165	10.99	0.25	60	9.30	6.20	0.25	<0.05
Potassic	C11.JL - 179B	0.1	<0.05	0.02	0.12	6.8	3	0.02	0.65	139	14.14	0.26	90	8.40	7.10	0.30	<0.05

Potassic-propylitic	C11.JL - 183	0.1	<0.05	0.02	0.02	8.0	7	0.08	1.03	194	12.29	0.24	746	13.20	19.50	0.05	0.06
Potassic	C11.JL - 194	<0.1	<0.05	<0.01	0.32	3.2	<1	0.02	0.06	95	6.96	<0.05	189	11.70	3.40	3.41	0.09
Propylitic	C11.JL - 35	0.1	<0.05	0.03	0.26	8.9	2	0.05	0.68	506	13.09	0.35	403	15.60	15.80	0.84	0.13
Propylitic	C11.JL - 36	0.1	<0.05	0.06	0.30	3.2	5	0.03	0.74	290	14.13	0.17	347	24.50	8.60	3.16	0.16
Propylitic	C11.JL - 92	0.1	<0.05	0.01	0.30	6.4	3	0.03	0.66	636	7.03	0.17	433	12.10	9.30	0.66	<0.05
Propylitic	C11.JL - 128	0.1	<0.05	0.02	0.22	1.8	3	0.02	0.62	129	11.90	0.14	359	6.20	12.60	2.91	0.29
Sericitic	C11.JL - 24	<0.1	<0.05	0.20	0.06	8.3	1	0.03	0.06	190	13.20	<0.05	369	4.70	5.80	2.74	1.72
Sericitic	C11.JL - 25	<0.1	<0.05	0.05	<0.02	17.6	<1	0.03	0.02	117	10.68	<0.05	814	7.00	4.70	1.56	0.65
Sericitic	C11.JL - 138	0.1	<0.05	0.10	0.15	0.9	1	0.05	0.03	166	3.20	0.07	622	14.20	11.70	4.20	1.38
Sericitic	C11.JL - 193	<0.1	<0.05	0.03	0.20	1.0	<1	<0.01	0.02	21	5.85	<0.05	<50	12.40	2.40	2.95	0.08
Sericitic	C11.JL - 205	<0.1	<0.05	0.04	0.34	<0.1	<1	<0.01	<0.01	34	14.14	0.05	<50	12.10	2.90	>5	0.18

Table 2.5: ICM 12B results continued

Alteration type	Samples	Sc	Se	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	U	V	W	Y	Yb	Zn	Zr
Least altered-QD2-west	C11.JL - 105	4.2	<1	0.4	49.9	<0.05	0.30	<0.05	3.2	0.11	0.15	0.28	72	<0.1	6.25	0.5	81	0.7
Least altered-QD2-west	C11.JL - 38	4.6	<1	<0.3	306.0	<0.05	0.32	0.11	3.6	0.07	0.07	0.19	74	<0.1	7.30	0.5	71	<0.5
Least altered-QD1	C11.JL - 177	3.9	<1	0.4	33.0	<0.05	0.30	0.18	3.0	0.11	0.20	0.27	62	<0.1	5.84	0.5	107	<0.5
Least altered-QD1	C11.JL - 32	7.1	<1	1.0	284.7	<0.05	0.32	<0.05	2.8	0.15	0.13	0.22	90	0.1	7.53	0.6	145	1.0
Potassic	C11.JL - 178	2.1	1	0.6	19.8	<0.05	0.08	<0.05	0.6	0.06	0.04	<0.05	26	<0.1	1.41	<0.1	75	<0.5
Potassic	C11.JL - 179B	2.6	<1	0.5	26.6	<0.05	0.17	0.14	2.9	0.06	0.04	0.06	26	0.1	2.88	0.2	68	<0.5
Potassic-propylitic	C11.JL - 183	4.2	<1	1.0	187.4	<0.05	0.27	0.05	3.4	0.11	0.15	0.24	59	0.1	5.94	0.5	92	<0.5
Potassic	C11.JL - 194	0.4	2	0.3	24.5	<0.05	0.09	0.36	0.9	<0.01	0.05	<0.05	7	0.1	1.82	0.1	36	<0.5
Propylitic	C11.JL - 35	2.8	2	1.0	21.4	<0.05	0.26	0.05	2.2	0.08	0.13	0.10	42	0.3	5.30	0.3	111	<0.5
Propylitic	C11.JL - 36	2.5	3	1.0	19.3	<0.05	0.13	0.45	1.3	0.02	0.13	0.05	57	0.1	3.29	0.2	187	<0.5

Propylitic	C11.JL - 92	2.0	2	0.6	39.1	<0.05	0.18	0.11	2.2	0.02	0.08	0.09	38	<0.1	3.71	0.2	139	<0.5
Propylitic	C11.JL - 128	1.7	3	1.2	3.7	<0.05	0.06	0.05	1.2	0.03	0.29	0.05	26	<0.1	1.45	0.1	69	<0.5
Sericitic	C11.JL - 24	0.5	2	0.4	13.0	<0.05	0.18	0.29	1.4	<0.01	0.07	<0.05	6	<0.1	2.51	0.2	22	<0.5
Sericitic	C11.JL - 25	0.2	<1	<0.3	13.9	<0.05	0.35	0.37	2.0	<0.01	0.06	<0.05	7	0.3	4.01	0.3	39	<0.5
Sericitic	C11.JL - 138	1.9	<1	0.5	3.6	<0.05	0.11	<0.05	1.5	<0.01	3.61	0.23	11	0.1	3.09	0.4	82	<0.5
Sericitic	C11.JL - 193	0.5	3	<0.3	5.6	<0.05	0.02	0.27	0.6	<0.01	0.05	<0.05	7	<0.1	0.28	<0.1	133	<0.5
Sericitic	C11.JL - 205	0.4	5	1.0	10.4	<0.05	<0.02	1.35	0.1	<0.01	0.40	<0.05	12	<0.1	0.25	<0.1	79	<0.5
Sericitic	C11.JL - 190	3.3	1	0.5	114.7	<0.05	0.25	0.05	2.1	0.01	0.10	0.12	38	0.6	4.72	0.5	95	<0.5
Sericitic	C11.JL - 199	1.3	6	0.8	20.0	<0.05	0.13	0.13	0.7	<0.01	0.09	<0.05	14	0.1	1.77	0.1	51	<0.5
Sericitic	C11.JL - 200	1.2	3	1.4	1.8	<0.05	0.08	0.15	1.0	0.05	0.19	0.10	34	0.7	1.34	0.1	110	<0.5
Sericitic	C11.JL - 201	1.4	4	1.0	1.6	<0.05	0.03	0.12	0.2	0.02	0.16	<0.05	12	<0.1	0.42	<0.1	39	<0.5
Argillic-dickite	C11.JL - 95	<0.1	14	0.8	24.2	<0.05	<0.02	1.96	0.2	<0.01	0.27	<0.05	7	0.3	0.18	<0.1	93	<0.5
Argillic-dickite	C11.JL - 108	0.4	19	7.7	18.9	<0.05	0.40	0.19	2.9	<0.01	1.49	0.22	9	2.4	3.86	0.3	393	0.7
Argillic-dickite	C11.JL - 110	0.5	24	12.1	45.9	0.29	0.80	0.93	3.2	<0.01	4.35	0.83	8	0.3	6.90	0.7	1958	<0.5
Argillic-k/s	C11.JL - 78	2.4	<1	1.1	17.5	<0.05	0.14	<0.05	2.1	0.05	0.23	0.17	38	0.3	2.44	0.2	168	<0.5
Argillic-k/s	C11.JL - 96	1.5	<1	0.8	1.9	<0.05	0.02	0.55	0.7	<0.01	0.61	0.05	18	0.4	0.78	0.1	19	<0.5
Argillic-k/s	C11.JL - 121	1.5	2	0.6	1.8	<0.05	0.07	<0.05	1.6	<0.01	2.62	0.08	22	0.1	1.75	0.2	102	<0.5
Argillic-i/s	C11.JL - 74	0.8	9	0.4	74.0	<0.05	0.21	0.17	3.1	<0.01	0.14	0.20	11	<0.1	3.85	0.3	33	<0.5
Argillic-i/s	C11.JL - 75	1.8	4	0.5	65.4	<0.05	0.22	0.15	2.5	0.01	0.21	0.18	21	0.1	4.64	0.4	213	<0.5
Argillic-i/s	C11.JL - 76	2.2	1	0.4	43.2	<0.05	0.25	<0.05	2.6	<0.01	0.34	0.32	18	<0.1	5.94	0.5	264	<0.5
Argillic-i/s	C11.JL - 115	2.0	3	0.3	73.0	0.09	0.30	0.15	2.2	<0.01	0.21	0.10	32	<0.1	7.39	0.6	139	<0.5

2.3.3 Rare earth elements

Table 2.6: Rare earth element results from ICP-MS analysis of sodium peroxide fusion (ICM 90A). Concentrations are in ppm. N/A is not analysed. The results of Scandium and Lu are removed from this dataset, with the results from ICM-12B showing more reproducible results for these elements.

Alteration type	Samples	Y	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
Least altered-QD2-west	C11.JL - 105	10.9	17.3	34.2	4.20	16.9	N/A	3.1	0.82	2.41	0.45	1.93	0.39	0.89	0.16	1.1
Least altered-QD2-west	C11.JL - 38	10.5	17.6	34.5	3.27	15.3	N/A	2.6	0.66	2.61	0.38	1.76	0.33	1.11	0.16	1.0
Least altered-QD1	C11.JL - 177	8.9	14.3	27.3	2.91	15.3	N/A	2.5	0.71	1.95	0.25	1.60	0.24	0.62	0.11	0.9
Least altered-QD1	C11.JL - 32	9.7	14.9	29.6	3.12	14.5	N/A	2.7	0.69	2.16	0.34	1.73	0.36	0.84	0.12	0.8
Potassic	C11.JL - 178	2.5	4.0	7.8	0.72	4.0	N/A	0.6	0.50	0.85	0.11	0.40	0.06	0.14	<0.05	0.2
Potassic	C11.JL - 179B	5.7	8.1	16.3	1.54	9.0	N/A	1.8	0.47	1.25	0.15	0.87	0.13	0.39	0.08	0.4
Potassic-propylitic	C11.JL - 183	9.0	14.3	27.7	2.22	12.7	N/A	2.6	1.07	1.90	0.23	1.49	0.24	0.60	0.14	0.6
Potassic	C11.JL - 194	3.3	4.0	7.2	0.73	4.0	N/A	1.0	0.61	0.74	0.08	0.69	0.07	0.18	0.05	0.3
Propylitic	C11.JL - 35	7.1	11.6	24.7	2.55	12.6	N/A	2.0	0.45	2.15	0.30	1.33	0.24	0.53	0.09	0.5
Propylitic	C11.JL - 36	4.2	6.0	12.1	1.51	6.7	N/A	1.0	0.23	1.22	0.18	0.95	0.21	0.43	0.10	0.4
Propylitic	C11.JL - 92	5.5	6.9	14.7	2.00	8.1	N/A	1.3	0.32	1.23	0.18	1.15	0.16	0.45	0.07	0.4
Propylitic	C11.JL - 128	2.2	2.3	4.8	0.55	2.6	N/A	0.5	0.21	0.56	0.07	0.32	<0.05	0.21	<0.05	0.3
Sericitic	C11.JL - 24	4.4	10.9	21.4	2.14	10.2	N/A	2.0	0.29	1.47	0.19	0.91	0.14	0.45	0.06	0.4
Sericitic	C11.JL - 25	8.8	19.8	37.3	3.90	19.0	N/A	3.1	0.42	2.66	0.30	1.59	0.23	0.79	0.08	0.7
Sericitic	C11.JL - 138	5.4	5.1	10.9	2.12	8.4	N/A	1.5	0.21	1.18	0.15	0.89	0.15	0.51	0.12	0.6
Sericitic	C11.JL - 193	0.9	1.3	2.3	0.29	1.2	N/A	0.2	0.07	0.35	<0.05	0.11	<0.05	0.11	<0.05	0.1
Sericitic	C11.JL - 205	0.7	0.5	1.1	0.27	1.5	N/A	0.5	0.06	0.25	<0.05	0.14	<0.05	0.07	<0.05	0.1
Sericitic	C11.JL - 190	7.5	12.2	25.8	2.32	12.8	N/A	2.3	0.58	1.68	0.27	1.34	0.21	0.48	0.10	0.8

Sericitic	C11.JL - 199	3.4	7.1	14.2	1.07	6.6	N/A	1.7	0.45	1.04	0.14	0.73	0.09	0.37	0.06	0.4
Sericitic	C11.JL - 200	2.8	4.5	9.4	0.89	5.1	N/A	1.0	0.18	0.76	0.06	0.35	0.09	0.13	<0.05	0.2
Sericitic	C11.JL - 201	0.7	1.2	2.5	0.22	1.1	N/A	0.2	<0.05	0.25	<0.05	0.18	<0.05	<0.05	<0.05	0.1
Argillic-dickite	C11.JL - 95	<0.5	0.9	1.7	0.17	0.6	N/A	0.1	0.05	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Argillic-dickite	C11.JL - 108	11.9	69.2	78.5	18.54	70.4	N/A	10.7	0.96	6.75	0.54	2.66	0.48	1.00	0.10	0.7
Argillic-dickite	C11.JL - 110	79.9	187.1	296.1	50.49	202.2	N/A	32.6	2.74	24.89	3.50	16.97	2.78	7.55	1.26	7.1
Argillic-k/s	C11.JL - 78	5.9	6.7	14.3	2.29	9.6	N/A	1.9	0.64	1.32	0.20	1.22	0.18	0.43	0.10	0.4
Argillic-k/s	C11.JL - 96	1.7	1.3	2.6	0.30	1.4	N/A	0.2	0.06	0.23	0.06	0.17	<0.05	0.18	<0.05	0.1
Argillic-k/s	C11.JL - 121	3.7	4.3	9.0	1.32	5.6	N/A	0.9	0.16	0.87	0.15	0.69	0.11	0.33	0.05	0.5
Argillic-i/s	C11.JL - 74	7.4	13.7	26.0	2.91	11.8	N/A	2.1	0.59	1.55	0.21	1.40	0.22	0.67	0.10	0.8
Argillic-i/s	C11.JL - 75	7.1	13.8	26.6	2.94	12.0	N/A	2.2	0.51	2.05	0.29	1.32	0.23	0.56	0.09	0.6
Argillic-i/s	C11.JL - 76	7.2	11.0	22.8	2.70	10.7	N/A	2.1	0.37	1.91	0.30	1.55	0.27	0.86	0.09	0.7
Argillic-i/s	C11.JL - 115	8.5	18.3	34.8	3.66	14.5	N/A	3.2	0.76	2.25	0.37	1.80	0.36	0.77	0.12	0.9

2.3.4 Sulphur

Table 2.7: Results for sulphur values using a variety of methods, results are in wt. %. The ICP40B method is interpreted to produce the most consistent results. When sulphur contents are > 10 wt. % the CSA 24V results are used. "N/A" means sample not analysed

Alteration type	Samples	Total	S	S
		CSA24V	ICM12B	ICP40B
Least altered-QD2-west	C11.JL - 105	N/A	0.16	0.17
Least altered-QD2-west	C11.JL - 38	N/A	0.29	0.29
Least altered-QD1	C11.JL - 177	N/A	0.26	0.28
Least altered-QD1	C11.JL - 32	N/A	0.21	0.23
Potassic	C11.JL - 178	N/A	0.25	0.27
Potassic	C11.JL - 179B	N/A	0.3	0.3
Potassic-propylitic	C11.JL - 183	N/A	0.05	0.06
Potassic	C11.JL - 194	3.78	3.41	3.52
Propylitic	C11.JL - 35	N/A	0.84	0.89
Propylitic	C11.JL - 36	3.69	3.16	3.55
Propylitic	C11.JL - 92	N/A	0.66	0.74
Propylitic	C11.JL - 128	3.41	2.91	3.13
Sericitic	C11.JL - 24	3.34	2.74	3.29
Sericitic	C11.JL - 25	1.83	1.56	1.78
Sericitic	C11.JL - 138	4.99	4.2	4.49
Sericitic	C11.JL - 193	3.41	2.95	3.16
Sericitic	C11.JL - 205	8.76	>5.00	7.63
Sericitic	C11.JL - 190	1.69	1.54	1.57
Sericitic	C11.JL - 199	3.31	2.93	3.08
Sericitic	C11.JL - 200	2.37	2.09	2.19
Sericitic	C11.JL - 201	2.88	2.52	2.67
Argillic-dickite	C11.JL - 95	19.81	>5.00	>10.00
Argillic-dickite	C11.JL - 108	14.67	>5.00	>10.00
Argillic-dickite	C11.JL - 110	21.15	>5.00	>10.00
Argillic-k/s	C11.JL - 78	1.48	1.22	1.39
Argillic-k/s	C11.JL - 96	3.72	3.14	3.67
Argillic-k/s	C11.JL - 121	4.74	3.71	4.51
Argillic-i/s	C11.JL - 74	4.64	3.52	4.27
Argillic-i/s	C11.JL - 75	4.09	3.14	3.93
Argillic-i/s	C11.JL - 76	2.31	1.72	2.16
Argillic-i/s	C11.JL - 115	4.25	3.62	3.92

2.3.5 Gold

Table 2.8: Results of gold analysed by atomic absorption spectroscopy (FAA 515) and gravimetric analysis(FAG 505). Concentrations are in ppb for . N/A is used to denote samples that are not analysed.

Alteration type	Samples	Au FAA515	Au FAG 505
Least altered-QD2-west	C11.JL - 105	23	N/A
Least altered-QD2-west	C11.JL - 38	118	N/A
Least altered-QD1	C11.JL - 177	296	N/A
Least altered-QD1	C11.JL - 32	290	N/A
Potassic	C11.JL - 178	326	N/A
Potassic	C11.JL - 179B	415	N/A
Potassic-propylitic	C11.JL - 183	66	N/A
Potassic	C11.JL - 194	876	N/A
Propylitic	C11.JL - 35	1637	N/A
Propylitic	C11.JL - 36	2220	N/A
Propylitic	C11.JL - 92	1246	N/A
Propylitic	C11.JL - 128	3155	N/A
Sericitic	C11.JL - 24	47	N/A
Sericitic	C11.JL - 25	65	N/A
Sericitic	C11.JL - 138	1604	N/A
Sericitic	C11.JL - 193	52	N/A
Sericitic	C11.JL - 205	1429	N/A
Sericitic	C11.JL - 190	173	N/A
Sericitic	C11.JL - 199	1286	N/A
Sericitic	C11.JL - 200	2773	N/A
Sericitic	C11.JL - 201	1326	N/A
Argillic-dickite	C11.JL - 95	110	N/A
Argillic-dickite	C11.JL - 108	3472	N/A
Argillic-dickite	C11.JL - 110	>5000	15.26
Argillic-k/s	C11.JL - 78	425	N/A
Argillic-k/s	C11.JL - 96	229	N/A
Argillic-k/s	C11.JL - 121	887	N/A
Argillic-i/s	C11.JL - 74	570	N/A
Argillic-i/s	C11.JL - 75	260	N/A
Argillic-i/s	C11.JL - 76	412	N/A
Argillic-i/s	C11.JL - 115	140	N/A

2.3.6 Copper

Table 2.9: Results of copper analysed by four methods. "N/A" denotes samples that are not analysed.

Alteration type	Samples	Cu AAS42C (wt. %)	Cu AAS41B (wt. %)	Cu ICP40B (ppm)	Cu ICM90A (ppm)	Cu ICM12B (ppm)
Least altered-QD2-west	C11.JL - 105	N/A	N/A	87.6	82	85
Least altered-QD2-west	C11.JL - 38	N/A	N/A	828.2	856	760.3
Least altered-QD1	C11.JL - 177	N/A	N/A	1811.4	1750	1854
Least altered-QD1	C11.JL - 32	N/A	N/A	1978	2013	1965
Potassic	C11.JL - 178	N/A	N/A	2283.1	2362	2159
Potassic	C11.JL - 179B	N/A	N/A	2798.8	2671	2899
Potassic-propylitic	C11.JL - 183	N/A	N/A	468.8	484	459
Potassic	C11.JL - 194	N/A	N/A	5996	5576	6407
Propylitic	C11.JL - 35	N/A	N/A	7115.5	6995	7579
Propylitic	C11.JL - 36	N/A	N/A	8636.3	8588	8887
Propylitic	C11.JL - 92	N/A	N/A	7566.4	7526	7893
Propylitic	C11.JL - 128	N/A	N/A	8975.8	9192	9698
Sericitic	C11.JL - 24	N/A	N/A	1018.8	1048	1085
Sericitic	C11.JL - 25	N/A	N/A	122.7	131	120
Sericitic	C11.JL - 138	N/A	N/A	3082.2	3081	3302
Sericitic	C11.JL - 205	N/A	N/A	9676.5	9785	9940
Sericitic	C11.JL - 190	N/A	N/A	1291	1374	1205
Sericitic	C11.JL - 199	N/A	N/A	8153.8	7963	8545

Sericitic	C11.JL - 200	11409	N/A	>10000	>10000	>10000
Sericitic	C11.JL - 201	10734	N/A	>10000	>10000	>10000
Argillic-dickite	C11.JL - 95	N/A	N/A	2116.6	2169	2154
Argillic-dickite	C11.JL - 108	42067	N/A	>10000	>10000	>10000
Argillic-dickite	C11.JL - 110	>50000	14.71	>10000	>10000	>10000
Argillic-k/s	C11.JL - 78	N/A	N/A	2387.1	2470	2365
Argillic-k/s	C11.JL - 96	N/A	N/A	686.6	739	656.3
Argillic-k/s	C11.JL - 121	N/A	N/A	3106	3094	3169
Argillic-i/s	C11.JL - 74	N/A	N/A	2476.9	2496	2365
Argillic-i/s	C11.JL - 75	N/A	N/A	2449.2	2539	2415
Argillic-i/s	C11.JL - 76	N/A	N/A	2131.7	2288	2014
Argillic-i/s	C11.JL - 115	N/A	N/A	964.7	1034	895.4

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