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8. APPENDICES

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CLIENT: Matthys Dippenaar (for honours student)

DATE: 22 August 2011

SAMPLES: 11 Samples (Tailings – eastern Bushveld)

ANALYSIS: Qualitative and Quantitative XRD

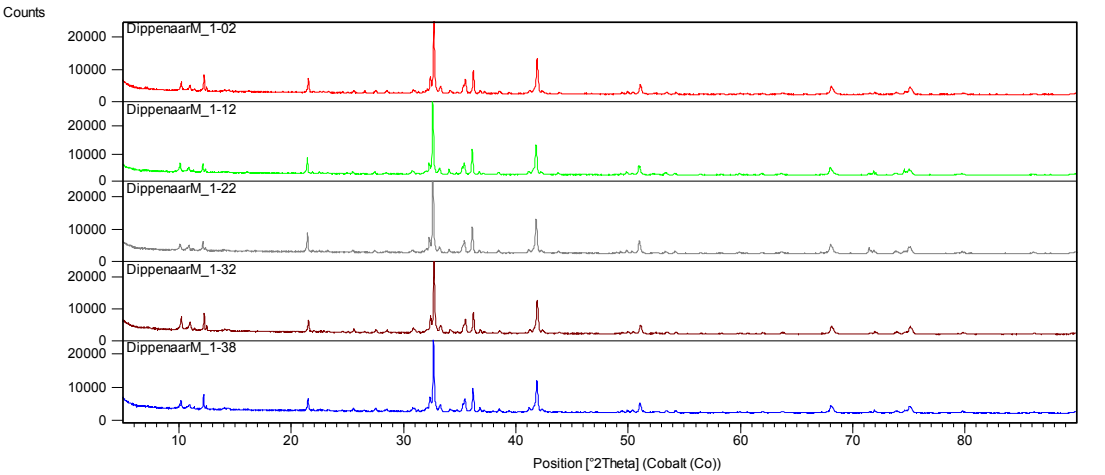
The samples were prepared for XRD analysis using a back loading preparation method.
They were analysed using a PANalytical X'Pert Pro powder diffractometer with X'Celerator detector and variable divergence- and receiving slits with Fe filtered Co-Kα radiation. The phases were identified using X'Pert Highscore plus software. Graphical representations of the qualitative result follow below.
The relative phase amounts (weight %) was estimated using the Rietveld method (Autoquan Program). Errors are on the 3 sigma level in the column to the right of the amount. Amorphous phases, if present were not taken into consideration in the quantification. The quantitative results are listed below.

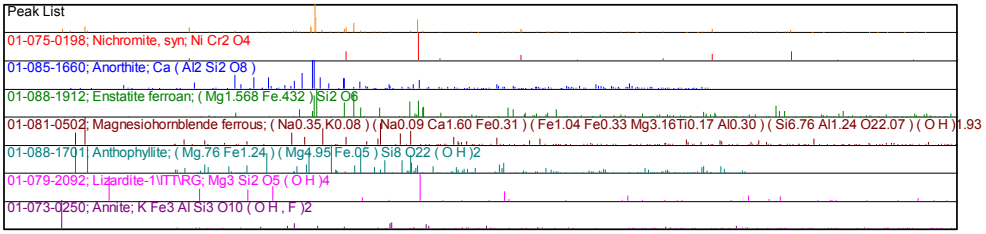
Comment: Chromite, a phase with a spinel structure, which may contain other elements in solid solution and not necessarily Ni – but the structure of Nichromite (in the qualitative program) just fitted best.
The samples do contain a phase with the structure of a phyllosilicate. Since the XRF showed very low potassium values, the phase Annite was identified. Annite is the iron-rich end member of the biotite mica group.

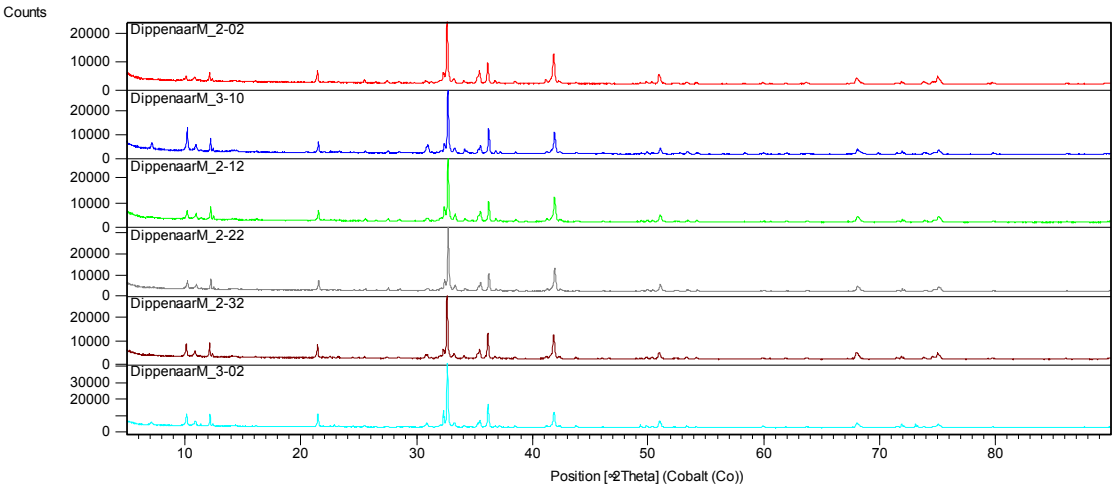
If you have any further queries, kindly contact the laboratory.

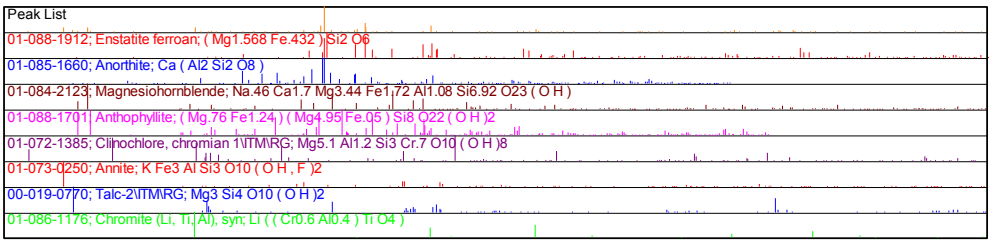
Analyst:

Wiebke Grote


Counts
DippenaarM_1-02
DippenaarM_1-12
DippenaarM_1-22
DippenaarM_1-32
DippenaarM_1-38
20000
10000
0
10
20
30
40
50
60
70
80
Position [°2Theta] (Cobalt (Co))


Peak List
01-075-0198; Nichromite, syn; Ni Cr2 O4
01-085-1660; Anorthite; Ca (Al2 Si2 O8)
01-088-1912; Enstatite ferroan; (Mg1.568 Fe.432) Si2 O6
01-081-0502; Magnesiohornblende ferrous; (Na0.35 K0.08) (Na0.09 Ca1.60 Fe0.31) (Fe1.04 Fe0.33 Mg3.16 Ti0.17 Al0.30) (Si6.76 Al1.24 O22.07) (O H)1.93
01-088-1701; Anthophyllite; (Mg.76 Fe1.24) (Mg4.95 Fe.05) Si8 O22 (O H)2
01-079-2092; Lizardite-1\ITT\RG; Mg3 Si2 O5 (O H)4
01-073-0250; Annite; K Fe3 Al Si3 O10 (O H , F)2


Counts
DippenaarM_2-02
DippenaarM_3-10
DippenaarM_2-12
DippenaarM_2-22
DippenaarM_2-32
DippenaarM_3-02
20000
10000
0
30000
10
20
30
40
50
60
70
80
Position [°2Theta] (Cobalt (Co))


Peak List
01-088-1912; Enstatite ferroan; (Mg1.568 Fe.432) Si2 O6
01-085-1660; Anorthite; Ca (Al2 Si2 O8)
01-084-2123; Magnesiohornblende; Na.46 Ca1.7 Mg3.44 Fe1.72 Al1.08 Si6.92 O23 (O H)
01-088-1701; Anthophyllite; (Mg.76 Fe1.24) (Mg4.95 Fe.05) Si8 O22 (O H)2
01-072-1385; Clinochlore, chromian 1\ITM\RG; Mg5.1 Al1.2 Si3 Cr.7 O10 (O H)8
01-073-0250; Annite; K Fe3 Al Si3 O10 (O H , F)2
00-019-0770; Talc-2\ITM\RG; Mg3 Si4 O10 (O H)2
01-086-1176; Chromite (Li, Ti, Al), syn; Li ((Cr0.6 Al0.4) Ti O4)

Matt 1-02

	weight%	3 σ error
Annite_	2.73	0.63
Anthophyllite_	5.81	0.99
Enstatite(Fe)_	31.63	1.5
Hornblende	7.19	1.32
Lizardite	0	0
Chromite_Fe_	21.25	0.9
Plagioclase		
Anorthite_	26.93	1.95
Talc C-1_	4.47	1.08

Matt 1-12

	weight%	3 σ error
Annite_	3.63	0.87
Anthophyllite_	3.2	0.87
Diopside_	3.08	1.08
Enstatite(Fe)_	39.16	1.74
Hornblende	7.51	1.35
Lizardite	0	0
Chromite_Fe_	21.84	0.9
Plagioclase		
Anorthite_	21.58	1.83

Matt 1-22

	weight%	3 σ error
Annite_	3.38	0.72
Anthophyllite_	3.59	0.87
Diopside_	2.7	0.99
Enstatite(Fe)_	40.72	1.5
Hornblende	8.75	1.02
Chromite_Fe_	22.49	0.87
Plagioclase		
Anorthite_	12.8	1.23
Talc C-1_	5.57	1.35

Matt 1-32

	weight%	3 σ error
Annite_	3.35	0.75
Anthophyllite_	9.54	2.1
Enstatite(Fe)_	28.65	1.59
Hornblende	5.25	1.23
Lizardite	0.33	0.36
Chromite_Fe_	19.66	0.96
Plagioclase		
Anorthite_	28.11	2.01
Talc C-1_	5.11	1.08

Matt 1-38

	weight%	3 σ error
Annite_	3.43	0.78
Anthophyllite_	4.47	1.08
Enstatite(Fe)_	32.75	1.35
Hornblende	8.18	1.2
Lizardite	1.06	0.54
Chromite_Fe_	20.39	0.84
Plagioclase		
Anorthite_	29.72	1.86

Matt 2-02

	weight%	3 σ error
Annite_	2.32	0.78
Anthophyllite_	6.45	1.29
Enstatite(Fe)_	37.71	1.56
Hornblende	7.04	1.14
Lizardite	1.3	0.6
Chromite_Fe_	22.72	0.87
Plagioclase		
Anorthite_	22.47	1.83

Matt 2-12

	weight%	3 σ error
Annite_	2.82	0.63
Anthophyllite_	8.33	0.99
Enstatite(Fe)_	30.47	1.65
Hornblende,		
Magnesium Iron_	5.56	1.23
Chromite_Fe_	19.56	0.9
Plagioclase		
Anorthite_	26.65	1.95
Talc C-1_	6.61	1.08

Matt 2-22

	weight%	3 σ error
Anthophyllite_	3.39	0.93
Chlorite IIb-2_	0.44	0.57
Enstatite(Fe)_	35.21	1.83
Hornblende	7.7	1.38
Chromite_Fe_	21.26	1.05
Plagioclase		
Anorthite_	26.46	2.16
Talc C-1_	5.54	1.32

Matt 2-32

	weight%	3 σ error
Diopside_	3.43	0.93
Enstatite(Fe)_	36.32	1.8
Hornblende	7.95	1.47
Illite1Mt_	3.84	0.66
Chromite_Fe_	21.92	0.99
Phlogopite		
ferrian 1M_	1.64	0.93
Plagioclase		
Anorthite_	20.24	1.83
Talc C-1_	4.66	1.26

Matt 3-02

	weight%	3 σ error
Annite_	7.59	1.35
Anthophyllite_	12.79	1.89
Diopside_	6.95	1.26
Enstatite(Fe)_	29.78	1.89
Hornblende,		
Magnesium Iron_	4.73	1.5
Chromite_Fe_	18.37	1.02
Plagioclase		
Anorthite_	13.71	1.86
Talc C-1_	6.08	1.83

Matt 3-10

	weight%	3 σ error
Annite_	6.73	1.23
Chlorite IIb-2_	6.34	1.92
Enstatite(Fe)_	32.72	1.46
Hornblende,		
Magnesium Iron_	7.62	1.98
Chromite_Fe_	14.76	1.02
Plagioclase		
Anorthite_	27.21	1.79
Talc C-1_	4.62	1.47

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CLIENT: Altus Huisamen

DATE: 26 March 2012

SAMPLES: 13 Samples

ANALYSIS: Qualitative and Quantitative XRD

The samples were prepared for XRD analysis using a back loading preparation method.
They were analysed using a PANalytical X'Pert Pro powder diffractometer with X'Celerator detector and variable divergence- and receiving slits with Fe filtered Co-Kα radiation. The phases were identified using X'Pert Highscore plus software.

The relative phase amounts (weight %) were estimated using the Rietveld method (Autoquan Program). Errors are on the 3 sigma level in the column to the right of the amount. Amorphous phases, if present were not taken into consideration in the quantification. The quantitative results are listed below.

Comments:

- Errors reported for phases occurring in minor amounts are sometimes larger than that of the quantity reported, indicating the possible absence of those phases.
- Chromite, a spinel may contain other elements, apart from their ideal composition, in solid solution.
- Mineral names may not reflect the actual compositions of minerals identified, but rather the mineral group (i.e "Muscovite" and "Biotite" would represent the mineral group "Mica" and "Tremolite" and "Hornblende" the mineral group "Amphibole").
- Due to preferred orientation effects results may not be as accurate as shown in the table.
- Since X-ray diffraction patterns are directly related to crystal structures, X-ray identification is, in principal, better suited to the recognition of structural groups and structural varieties than chemical species.

If you have any further queries, kindly contact the laboratory.

Analyst:

Wiebke Grote

TPH 0-1.2T				TPH 0-1.2B				TPH 1.2-2.4B		
	weight%	3 σ error			weight%	3 σ error			weight%	3 σ error
Anthophyllite_	7.54	1.56		Anthophyllite	4	1.02		Anthophyllite_	4.67	1.5
Chlorite	1	0.81		Chlorite	11	1.6		Chromite	21.88	1.17
Chromite	26.43	1.32		Chromite	19.31	1.26		Enstatite	45.09	2.4
Enstatite	32.38	1.92		Enstatite	30	1.89		Muscovite	1.9	0.9
Muscovite	2.79	0.69		Lizardite	1.45	0.39		Plagioclase Anorthite_	15.83	2.34
Plagioclase Anorthite	18.47	2.31		Muscovite	1.7	0.54		Talc	3.98	1.71
Talc	6.22	1.23		Plagioclase Anorthite_	20.48	2.13		Tremolite_	6.65	1.5
Tremolite_	5.17	1.62		Talc	5.21	1.08				
				Tremolite	6.88	1.11				
TPH 2.4-3.6B				**TPH 3.6-4.8B**				**TPH 4.8-6B**		
	weight%	3 σ error			weight%	3 σ error			weight%	3 σ error
Anthophyllite_	4.21	1.44		Anthophyllite_	2.72	1.02		Anthophyllite_	2.64	0.6
Biotite	5.36	1.05		Biotite	2.46	0.81		Chromite	23.98	1.2
Chromite	22.49	0.87		Chromite	27.44	0.96		Enstatite	35.14	1.95
Diopside	2.64	1.32		Diopside	2.9	1.23		Lizardite	0.28	0.45
Enstatite	45.86	1.77		Enstatite	38.92	1.56		Muscovite_2M1_	3.47	0.72
Hornblende	4.92	1.26		Hornblende	4.62	1.11		Plagioclase Anorthite_	24.42	2.43
Plagioclase Anorthite_	9.2	1.26		Plagioclase Anorthite_	15.11	1.77		Talc	2.1	1.08
Talc	5.32	1.14		Talc	5.84	0.87		Tremolite_	7.96	1.38
TPH 6-7.2T				**TPH 6-7.2B**				**TPH 7.2-8.4T**		
	weight%	3 σ error			weight%	3 σ error			weight%	3 σ error
Anthophyllite_	9.46	1.89		Anthophyllite_	12.71	2.64		Anthophyllite_	9.21	1.89
Biotite	3.56	0.6		Biotite	3.26	0.9		Biotite	3.89	0.87
Chromite_	27.48	0.93		Chromite_	19.86	1.14		Chromite_	25.98	1.14
Diopside	2.18	0.93		Diopside	2.84	1.38		Diopside	1.4	0.87
Enstatite	34.82	1.47		Enstatite	27.77	1.86		Enstatite	34.73	1.86
Hornblende	3.82	0.93		Hornblende	3.29	1.38		Hornblende	3.83	1.02
Plagioclase Anorthite_	13.07	1.59		Plagioclase Anorthite_	24.38	2.34		Plagioclase Anorthite_	15.3	1.71
Talc	5.61	0.78		Talc	5.87	1.35		Talc	5.66	1.08

TPH 8.4-9.6T				**TPH 7.2-8.4B**				**TPH 8.4-9.6B**		
	weight%	3 σ error			weight%	3 σ error			weight%	3 σ error
Biotite	6.5	1.3		Anthophyllite_	7.8	1.2		Anthophyllite_	5.23	1.23
Chromite	10.3	0.6		Biotite	4.64	1.05		Biotite	2.35	0.9
Diopside	2.03	0.87		Chromite	26.33	1.02		Chromite_	30.81	1.2
Enstatite	14.1	1.17		Diopside	0.84	0.87		Diopside	1.36	0.72
Kaolinite	14.23	1.17		Enstatite	35.18	1.65		Enstatite	34.96	1.74
Plagioclase Anorthite	39.43	2.01		Hornblende	4.16	0.93		Plagioclase Anorthite	14.78	1.53
Quartz	5.51	0.45		Plagioclase Anorthite_	16.13	1.95		Talc	5.61	1.41
Talc	7.9	1.17		Talc	4.92	0.9		Tremolite	4.91	1.32
TPH 9.6-10										
	weight%	3 σ error								
Chlorite	15.97	2.34								
Chromite_	3.62	0.48								
Enstatite	8.52	1.5								
Kaolinite	34.19	2.01								
Plagioclase Anorthite_	30.66	1.86								
Quartz	7.05	0.9								

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Faculty of Natural & Agricultural Sciences
XRD & XRF Facility
Geology Department

CLIENT: Matthys Dippenaar

DATE: 19-Mar-12

ANALYSIS: The samples were prepared as pressed powder briquettes.
The ARL9400 XP+ Sequential XRF and Uniquant software was used for semi-quantitative analyses.
The software analyse for all elements in the periodic table between Na and U, but only elements found above the detection limits were reported.
The values were normalised, as no LOI was done to determine crystal water and oxidation state changes.
All elements were expressed as oxides

	NimNcert	NIMN	0-1.2T	0-1.2B	1.2-2.4B	2.4-3.6B	3.6-4.8B	4.8-6B	6-7.2T
SiO_2	**52.64**	48.78	26.87	28.30	30.13	30.22	26.60	28.31	27.13
TiO_2	**0.2**	0.16	0.62	0.59	0.55	0.59	0.64	0.61	0.61
Al_2O_3	**16.5**	23.10	13.38	13.47	13.58	13.47	13.42	13.41	13.07
Fe_2O_3	**8.91**	8.04	19.01	18.29	18.08	17.44	19.19	18.34	19.21
MnO	**0.18**	0.16	0.22	0.22	0.23	0.22	0.23	0.22	0.23
MgO	**7.5**	5.16	15.51	15.95	15.51	16.17	15.43	15.90	15.38
CaO	**11.5**	11.28	2.64	2.89	3.19	3.16	2.67	2.89	2.67
Na_2O	**2.46**	2.86	0.54	0.59	0.90	0.72	0.57	0.63	0.65
K_2O	**0.25**	0.27	0.12	0.13	0.17	0.14	0.11	0.12	0.11
P_2O_5	**0.03**	0.02	0.02	0.03	0.04	0.03	0.02	0.01	0.01
Cr_2O_3	**0.0044**	*<0.01*	20.49	19.00	16.84	17.15	20.53	18.97	20.27
NiO	**0.0153**	0.01	0.13	0.12	0.12	0.12	0.12	0.12	0.12
V_2O_5	**0.0393**	0.03	0.22	0.21	0.19	0.19	0.23	0.21	0.21
ZRO2	**0.0031**	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
SO_3		*<0.01*	0.01	0.03	0.19	0.22	0.04	0.08	0.10
WO_3		*<0.01*	0.01	0.01	0.02	0.01	0.01	0.01	0.01
BaO		*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Cl		0.02	0.03	0.03	0.13	0.03	0.03	0.03	0.07
CuO	**0.0018**	*<0.01*	0.01	*<0.01*	0.01	0.01	*<0.01*	*<0.01*	*<0.01*
ZnO		0.01	0.04	0.04	0.04	0.03	0.04	0.04	0.05
Co_3O_4		0.01	0.04	0.04	0.04	0.04	0.04	0.04	0.04
CeO_2		*<0.01*	0.02	*<0.01*	0.02	0.02	*<0.01*	*<0.01*	*<0.01*
SrO		0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01
MoO3		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total	**100.23**	99.97	99.93	99.95	99.97	99.98	99.94	99.95	99.96

ppm	0-1.2T	0-1.2B	1.2-2.4B	2.4-3.6B	3.6-4.8B	4.8-6B	6-7.2T	6-7.2B	7.2-8.4T
As	3.00	3.00	3.00	3.00	5.18	3.00	3.00	3.00	3.00
Cu	32.57	44.16	39.90	36.42	30.67	31.94	39.04	29.20	25.94
Ga	39.67	35.79	29.04	32.99	37.42	35.13	35.59	34.40	35.21
Mo	11.03	9.92	14.29	10.11	10.45	10.83	13.04	10.10	10.79
Nb	11.46	13.78	11.41	12.86	12.97	13.78	12.91	12.64	12.73
Ni	1118.13	1046.39	984.73	1019.30	1098.22	1046.52	1072.59	1027.93	1032.10
Pb	14.89	7.73	15.74	6.28	3.00	17.71	5.96	6.99	13.09
Rb	15.73	14.06	16.41	14.76	15.18	15.34	15.49	13.82	13.59
Sr	60.29	73.34	72.19	71.69	65.20	70.52	63.94	66.74	65.31
Th	24.34	24.67	18.44	20.56	24.51	23.58	24.32	23.73	23.08
U	24.99	26.47	20.99	22.56	26.40	24.91	23.55	23.62	24.86

W	129.46	80.23	209.29	39.30	79.42	93.45	126.43	56.44	71.31
Y	14.72	14.63	12.56	14.87	14.56	14.13	14.68	14.00	14.55
Zn	408.20	369.18	378.60	341.42	395.37	376.24	429.99	368.93	368.58
Zr	29.22	37.03	30.84	32.47	32.50	28.69	30.97	32.34	36.07
Cl*	73.10	97.93	767.20	130.50	93.68	107.78	344.60	115.13	145.39
Co	174.81	165.20	166.33	148.06	175.88	162.41	177.13	162.50	165.47
Cr	143023.36	132033.65	118859.82	120517.54	142611.58	132145.47	141568.18	132514.08	132448.43
F	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
S	20.96	25.57	164.44	184.11	40.52	74.78	105.25	99.66	89.42
Sc	14.87	15.70	18.00	18.39	15.81	16.81	14.89	17.48	16.53
V	1202.01	1119.57	1027.81	1042.27	1207.20	1128.20	1195.51	1132.14	1128.09
Cs	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43
Ba	18.32	24.49	32.51	26.97	17.96	26.05	20.85	24.34	20.90
La	6.07	4.26	5.40	5.42	7.58	10.98	8.23	4.26	8.23
Ce	4.88	4.88	4.88	4.88	4.88	4.88	4.88	4.88	4.88

If you have any further queries, kindly contact the laboratory.

Analyst: J.E. Dykstra
Senior Technical Assistant (XRF)

6-7.2B	7.2-8.4T	7.2-8.4B	8.4-9.6T	8.4-9.6B	9.6-10
28.31	28.32	26.26	42.53	25.59	47.90
0.61	0.60	0.66	0.41	0.66	0.31
13.38	13.31	13.54	32.96	13.24	40.77
18.35	18.43	19.25	6.66	19.72	3.56
0.22	0.22	0.22	0.09	0.23	0.05
15.90	15.84	15.29	3.44	15.29	0.32
2.84	2.84	2.67	6.08	2.47	4.40
0.65	0.63	0.55	0.71	0.56	0.39
0.12	0.12	0.10	0.25	0.09	0.21
0.02	0.02	0.02	0.07	0.02	0.07
19.02	19.07	20.90	6.24	21.50	1.55
0.12	0.12	0.12	0.04	0.13	0.01
0.21	0.20	0.23	0.08	0.24	0.03
<0.01	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
0.10	0.09	0.03	0.21	0.06	0.27
<0.01	0.01	0.01	0.01	0.01	*<0.01*
<0.01	*<0.01*	*<0.01*	0.01	*<0.01*	0.01
0.03	0.04	0.02	0.10	0.03	0.10
<0.01	0.01	*<0.01*	*<0.01*	*<0.01*	*<0.01*
0.04	0.04	0.05	0.01	0.05	0.01
0.03	0.04	0.04	0.01	0.04	0.01
<0.01	*<0.01*	*<0.01*	0.01	0.02	*<0.01*
0.01	0.01	0.01	0.03	0.01	0.03
0.01	0.01	*<0.01*	0.01	0.01	*<0.01*
99.97	99.96	99.97	99.96	99.94	100.00

7.2-8.4B	8.4-9.6T	8.4-9.6B	9.6-10
3.00	3.00	3.00	3.00
16.36	18.62	15.53	16.05
37.30	26.68	38.78	22.76
11.63	1.60	12.15	1.00
12.79	5.67	14.08	3.10
1072.33	267.24	1075.25	67.99
9.87	3.35	13.33	3.00
12.65	10.39	13.87	4.55
64.92	240.75	56.13	205.38
26.56	3.77	27.68	3.00
25.90	3.00	24.70	3.00

81.48	58.33	89.53	8.85
15.13	7.61	16.75	5.02
416.44	112.59	429.74	42.54
33.89	41.52	34.76	37.63
66.98	620.98	117.51	588.91
173.51	63.57	180.56	20.46
145400.41	46252.13	149564.07	10830.79
100.00	100.00	100.00	100.00
26.19	391.57	50.67	177.21
17.47	9.86	16.40	8.08
1241.08	430.70	1274.58	138.57
9.43	30.72	9.43	36.21
15.27	151.30	12.91	173.81
8.87	4.26	7.22	5.38
4.88	4.88	4.88	18.93

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Faculty of Natural & Agricultural Sciences
XRD & XRF Facility
Geology Department

CLIENT: Matthys Dippenaar (batch 2)

DATE: 16-Aug-11

ANALYSIS: The samples were prepared as pressed powder briquettes.
The ARL9400 XP+ Sequential XRF and Uniquant software was used for analyses.
The software analyse for all elements in the periodic table between Na and U, but only elements found above the detection limits were reported.
The values were normalised, as no LOI was done to determine crystal water and oxidation state changes.
All elements were expressed as oxides

	GSNcert	GSN	MATT1-02	MATT1-12	MATT1-22	MATT1-32	MATT1-38	MATT2-02	MATT2-12
SiO_2	**65.8**	62.95	34.48	31.81	30.09	35.62	35.81	33.69	34.63
TiO_2	**0.68**	0.59	0.53	0.57	0.58	0.50	0.55	0.55	0.52
Al_2O_3	**14.67**	18.49	15.62	14.17	13.71	15.43	15.42	14.91	15.51
Fe_2O_3	**3.75**	3.37	14.31	16.42	17.04	13.95	14.06	15.24	14.26
MnO	**0.06**	0.05	0.18	0.21	0.22	0.18	0.19	0.20	0.19
MgO	**2.3**	2.03	16.14	16.19	15.96	16.49	16.15	16.22	16.14
CaO	**2.5**	2.56	4.66	3.78	3.62	4.78	5.00	4.24	4.77
Na_2O	**3.77**	3.88	0.85	0.74	0.78	0.81	0.88	0.79	0.85
K_2O	**4.63**	5.08	0.18	0.14	0.13	0.21	0.20	0.16	0.19
P_2O_5	**0.28**	0.30	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Cr_2O_3	**0.008**	0.01	12.52	15.40	16.63	11.59	11.27	13.51	12.17
NiO	**0.0043**	*<0.01*	0.10	0.11	0.11	0.10	0.09	0.10	0.10
V_2O_5	**0.01**	0.01	0.15	0.18	0.19	0.13	0.13	0.15	0.14
SO_3	**0.03**	0.09	0.09	0.13	0.76	0.03	0.05	0.06	0.38
WO_3		0.06	0.01	0.01	0.01	0.01	*<0.01*	*<0.01*	*<0.01*
Cl		0.15	0.03	0.03	0.04	0.03	0.03	0.03	0.03
CuO		0.02	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
ZnO		0.01	0.03	0.04	0.03	0.02	0.02	0.03	0.03
Co_3O_4		0.01	0.03	0.03	0.03	0.03	0.02	0.03	0.02
CeO_2		*<0.01*	0.01	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
SrO		0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.01
MoO3		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
BaO		0.14	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Total	**99.82**	**99.86**	**99.96**	**99.97**	**99.97**	**99.95**	**99.94**	**99.94**	**99.97**

ppm	GSNcert	GSN	1-02	1-12	1-22	1-32	1-38	2-02	2-12
As	**1.6**	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Cu	**20**	93.26	11.69	12.14	14.91	9.81	11.43	12.54	11.68
Ga	**22**	20.44	26.16	28.75	29.21	24.33	24.80	27.26	26.23
Mo	**1.2**	1.00	8.39	12.76	10.88	8.22	7.21	10.02	9.15
Nb	**21**	21.06	7.47	11.27	9.75	7.64	8.16	9.45	7.83
Ni	**34**	31.94	869.94	969.19	980.53	845.69	815.98	896.41	863.56
Pb	**53**	48.47	4.69	3.00	3.00	8.32	4.77	5.28	3.05
Rb	**185**	183.83	13.58	13.12	12.74	12.77	14.61	14.27	13.16
Sr	**570**	571.57	115.29	84.75	76.93	115.32	122.49	100.43	115.43
Th	**42**	42.24	13.35	20.78	20.50	11.99	13.21	16.50	14.07
U	**8**	7.04	12.70	16.99	19.82	9.48	11.90	14.20	12.35

W*	**450**	495.69	100.49	19.77	28.31	40.97	27.21	23.81	6.00
Y	**19**	10.79	12.75	14.08	13.25	13.09	12.42	14.09	11.99
Zn	**48**	72.83	240.04	288.11	300.12	231.69	225.42	254.67	231.68
Zr	**235**	210.06	29.13	25.68	30.93	27.14	29.20	29.51	27.93
Cl*	**450**	895.51	87.32	59.09	142.47	36.95	82.33	47.00	41.70
Co	**65**	63.17	133.76	144.62	155.17	125.46	122.28	133.53	122.90
Cr	**55**	71.69	92710.74	112311.84	120685.18	86233.00	83240.63	99440.21	90124.33
F*	**1050**	502.28	100.00	100.00	100.00	100.00	100.00	100.00	100.00
S*	**140**	114.35	157.81	266.42	1521.86	71.38	110.30	151.21	771.24
Sc	**7**	4.52	19.57	17.63	17.71	18.88	19.63	18.54	18.51
V	**65**	61.11	758.56	927.37	986.14	713.85	704.76	820.71	744.52
Cs	**5**	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43
Ba	**1400**	1305.90	36.18	25.61	21.71	44.30	45.82	34.21	41.49
La	**75**	58.88	13.68	15.20	16.07	15.00	13.30	16.55	16.87
Ce	**135**	151.10	4.88	4.88	4.88	4.88	4.88	4.88	4.88

If you have any further queries, kindly contact the laboratory.

Analyst: J.E. Dykstra
Senior Technical Assistant (XRF)

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MATT2-22	MATT2-32	MATT3-02	MATT3-10
33.47	31.04	31.44	35.99
0.53	0.59	0.58	0.51
15.05	14.01	14.43	19.40
14.80	16.98	16.55	13.27
0.20	0.22	0.22	0.18
15.97	16.29	15.92	12.47
4.57	3.56	3.73	5.23
0.86	0.70	0.77	0.64
0.17	0.13	0.15	0.21
0.04	0.02	0.03	0.02
13.07	15.96	15.41	11.55
0.11	0.11	0.12	0.09
0.15	0.18	0.17	0.13
0.89	0.04	0.34	0.11
<0.01	*<0.01*	*<0.01*	*<0.01*
0.03	0.02	0.06	0.03
0.01	*<0.01*	*<0.01*	*<0.01*
0.03	0.04	0.03	0.03
0.03	0.03	0.03	0.02
0.02	0.01	*<0.01*	0.02
0.01	0.01	0.01	0.01
<0.01	*<0.01*	0.01	0.01
<0.01	*<0.01*	*<0.01*	*<0.01*
99.98	**99.95**	**99.99**	**99.94**

2-22	2-32	3-02	3-10
3.00	3.00	3.00	3.00
14.29	8.88	13.50	13.40
26.54	30.28	27.47	21.92
9.92	10.37	10.17	7.89
7.46	10.77	9.97	7.94
878.00	983.36	950.01	731.44
3.00	3.00	3.00	3.00
12.81	14.14	12.77	13.06
108.16	79.50	89.19	124.44
15.89	19.86	17.11	13.78
12.30	19.63	15.72	9.42

11.27	6.00	8.89	6.00
12.84	14.48	14.67	12.50
244.75	291.46	268.17	208.61
29.18	30.76	29.15	32.41
67.62	7.58	242.86	73.94
133.43	147.70	144.94	109.70
96798.74	116390.72	110656.74	85012.47
100.00	100.00	100.00	100.00
1859.01	89.09	614.40	197.00
17.59	18.46	16.83	15.64
791.34	947.04	902.02	711.61
9.43	9.43	9.43	9.43
35.85	21.31	26.04	60.84
18.70	14.32	12.31	20.08
4.88	4.88	4.88	4.88

WATERLAB (Pty) Ltd

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SANAS Accredited Testing Laboratory
No. T0391

CERTIFICATE OF ANALYSES
GENERAL WATER QUALITY PARAMETERS

Date received: 2012 - 03 - 19 **Date completed:** 2012 - 03 - 28

Project number: 215 **Report number: 34574** **Order number: 0418**

Client name: University of Pretoria – Geology Department **Contact person: Mr. M.A Dippenaar**

Address: Private Bag X20, Hatfield, 0028 **e-mail:** altus.huisamen@mtd.blackberry.com

Telephone: 012 804 8120 **Facsimile: -** **Mobile: -**

Analyses in mg/ℓ (Unless specified otherwise)	**Method Identification**	**Sample Identification**		
		TRPMW6S	**TOEDRAIN**	**TRPMW9S**
Sample Number		819	820	821
pH – Value at 25°C *	WLAB001	7.4	8.3	7.6
Electrical Conductivity in mS/m at 25°C	WLAB002	157	121	171
Total Dissolved Solids at 180°C *	WLAB003	1 180	814	1 076
Total Alkalinity as $CaCO_3$	WLAB007	388	240	576
Chloride as Cl *	WLAB046	192	171	210
Sulphate as SO_4	WLAB046	168	165	108
Fluoride as F	WLAB014	<0.2	<0.2	<0.2
Nitrate as N*	WLAB046	11	1.6	2.3
Ortho Phosphate as P *	WLAB046	<0.2	<0.2	<0.2
ICP-OES Scan *	WLAB015	See Attached Report: 34574-A		
% Balancing	---	95.5	98.5	98.1

*** = Not SANAS Accredited**
Tests marked "Not SANAS Accredited" in this report are not included in the SANAS Schedule of Accreditation for this Laboratory.

[s] = Analyses performed by a Sub-Contracted Laboratory

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SANAS Accredited Testing Laboratory
No. T0391

CERTIFICATE OF ANALYSES
GENERAL WATER QUALITY PARAMETERS

Date received: 2012 - 05 - 04 **Date completed:** 2012 - 05 – 08

Project number: 215 **Report number: 35085** **Order number: 0419**

Client name: University of Pretoria **Contact person: Mr. M.A. Dippenaar**

Address: Private Bag X20, Geology Department, Hatfield, 0028 **e-mail: altus@gptglobal.co.za madip@up.ac.za**

Telephone: - **Facsimile: -** **Mobile: 083 352 0223**

Analyses in mg/ℓ (Unless specified otherwise)	**Method Identification**	**Sample Identification**
		STP RIV
Sample Number		3084
Total Alkalinity as $CaCO_3$	WLAB007	156
Chloride as Cl *	WLAB046	7
Sulphate as SO_4	WLAB046	12
Fluoride as F	WLAB014	<0.2
Nitrate as N*	WLAB046	4.5
ICP-OES Scan *	WLAB015	See Attached Report: 35085-A
% Balancing	---	97.7

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Ard van de Wetering

Technical Signatory:

WATERLAB (PTY) LTD

CERTIFICATE OF ANALYSIS

Project Number : **215**
Client : **University of Pretoria**
Report Number : **35085-A**

Sample Origin	Sample ID	Note: all results in parts per million (ppm) unless specified otherwise										
		Ag	**Al**	**As**	**B**	**Ba**	**Be**	**Bi**	**Ca**	**Cd**	**Co**	**Cr**
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Lowest Reported Concentration		<0.025	<0.100	<0.010	<0.025	<0.025	<0.025	<0.025	<2	<0.005	<0.025	<0.025
STP RIV	3084	<0.025	0.228	<0.010	<0.025	<0.025	<0.025	<0.025	29	<0.005	<0.025	<0.025

Sample Origin	Sample ID											
		Fe	**K**	**Li**	**Mg**	**Mn**	**Mo**	**Na**	**Ni**	**P**	**Pb**	**Sb**
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Lowest Reported Concentration		<0.025	<1.0	<0.025	<2	<0.025	<0.025	<2	<0.025	<0.025	<0.020	<0.010
STP RIV	3084	0.133	<1.0	<0.025	23	<0.025	<0.025	8	<0.025	<0.025	<0.020	<0.010

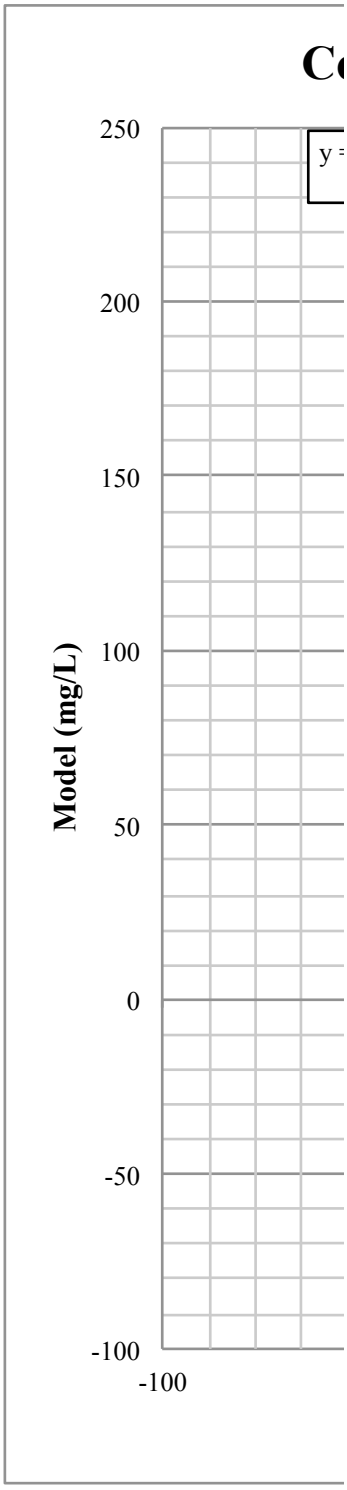
Sample Origin	Sample ID									
		Se	**Si**	**Sn**	**Sr**	**Ti**	**V**	**W**	**Zn**	**Zr**
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Lowest Reported Concentration		<0.020	<0.2	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
STP RIV	3084	<0.020	7.5	0.084	0.103	<0.025	<0.025	<0.025	<0.025	<0.025

Cu
mg/l
<0.025
<0.025

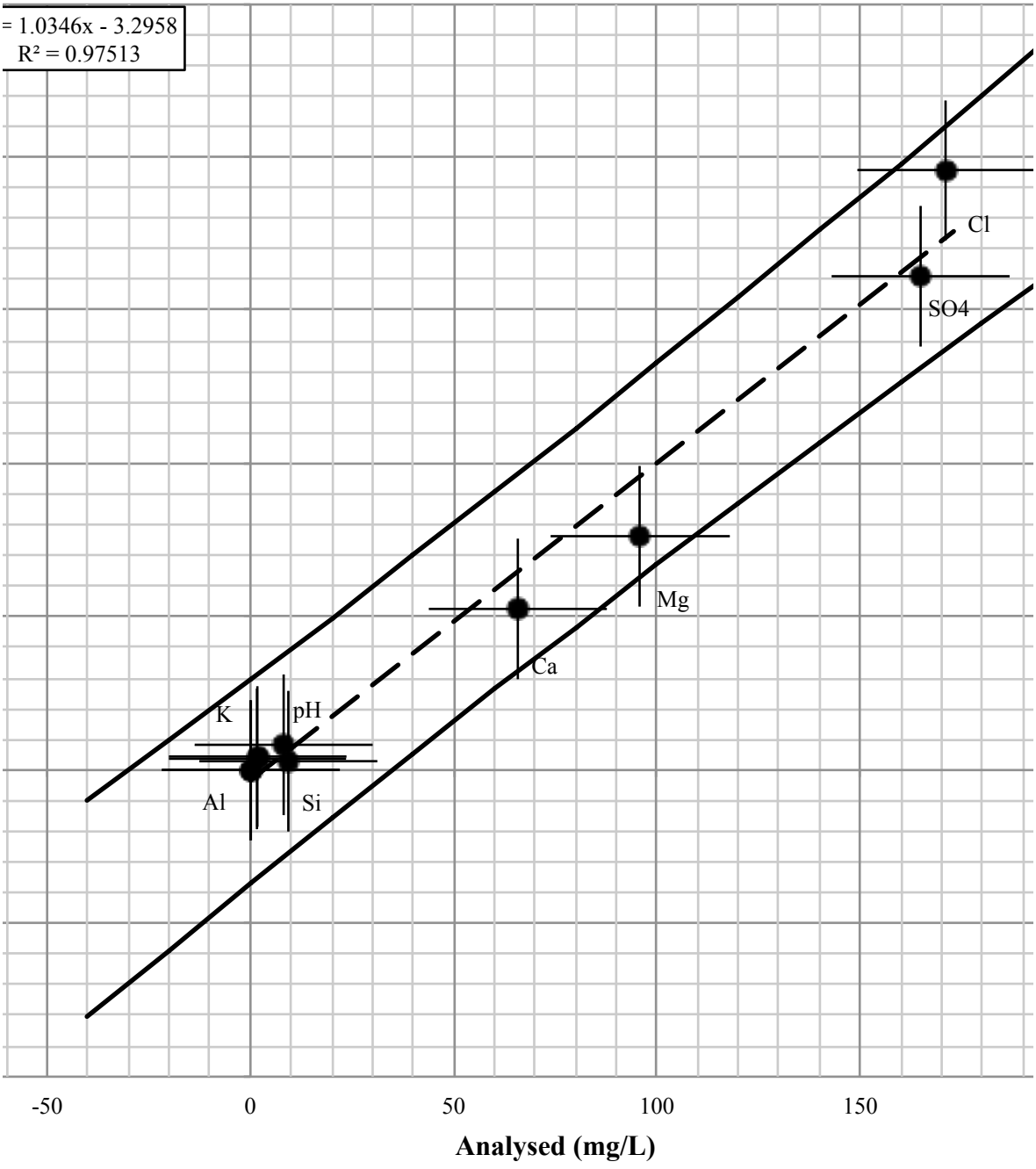
Constituent	Model (mg/L)	Analysed (mg/L)
Ca	52.49	66
Mg	76.28	96
SO_4	161	165
Cl	195.7	171
Al	0.05	0.156
Cr	0.04	0
K	4.3	1.7
Si	2.7	9.5
NO_3	3.7	1.6
pH	8.02	8.3

Regression line confidence interval

x	Cl	y+Cl	y-Cl
-40	35.40	-9.89	-80.70
-20	34.27	9.73	-58.81
0	33.37	29.59	-37.15
20	32.73	49.70	-15.75
40	32.35	70.08	5.38
60	32.26	90.74	26.23
80	32.44	111.69	46.80
100	32.90	132.91	67.10
120	33.63	154.39	87.13
140	34.61	176.13	106.91
160	35.82	198.09	126.46
180	37.23	220.26	145.80
200	38.82	242.61	164.97



orrelation of Modelled and Analysed Water Chemical Dat



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