PART A

RECOMMENDED VALUES FOR ELEMENTS/CONSTITUENTS IN UTS-1 to UTS-4

INTERLABORATORY PROGRAM

Participating laboratories in the interlaboratory program for the elements/constituents samples are listed in alphabetical order in Table A-1. Each was assigned a code number which bears no relationship to its alphabetical order.

Each laboratory was requested to contribute five replicate results for as many as possible of total iron, titanium, aluminum, calcium, barium, uranium, thorium, total sulphur and sulphate on one bottle of each of UTS-1, UTS-2, UTS-3 and UTS-4 by methods of its choice and to report the results on an "as is" basis. In addition, results for nickel and arsenic were requested for UTS-4. Some laboratories contributed results by more than one method: herein each set was considered statistically independent.

The results of the confirmation of the homogeneity of the tailings samples were included in the interlaboratory program. However, to avoid any biasing of the statistics, only five results, chosen at random out of the 57 available, were used in subsequent calculations. Analytical information is presented in Tables A-2 to A-5. Methodological information is presented in Table A-6 and pertains to all samples with the exception of nickel and arsenic.

STATISTICAL TREATMENT OF ANALYTICAL RESULTS

The consensus values and related statistical parameters were calculated as described above after outlying results were removed. Any sets of results obviously suspect for methodological reasons were rejected. Sets having unusually high variance were examined and any individual outlying results were deleted. Also, the sets of results whose means differed by more than twice the overall standard deviation from the initially calculated mean value were not used in subsequent computations to avoid biasing the statistics. All results that were rejected are identified in Tables A-2 to A-5.

The consensus values and related statistical parameters are summarized in Table A-7.

DISCUSSION

Table A-6 is a summary of a methodological classification of accepted analytical results where there is a clear-out distinction between types of methods in decomposition, separations and determination steps. No attempt was made to detect a statistically significant difference between the overall means of the more common methods for any element or constituent.

The consensus values of the interlaboratory program have been given recommended value status if there were at least nine sets of results and if the between-laboratory agreement was judged on the basis of chemical experience to be reasonable. The values for sulphate in UTS-3 and nickel in UTS-4 do not satisfy these criteria.

The between-laboratory agreement is, in many cases, not as good as is found in general in the interlaboratory programs of CCRMP, but it is, nevertheless, still acceptable to use these tailings samples as reference materials. Previous experience in CCRMP is that magnitude of the uncertainty in a consensus value has little effect on the actual estimation of the consensus value if the number of sets of results is sufficiently large.

Approximate Values

Laboratory 1 provided approximate values for the concentration of SiO_2, Na_2O and K_2O; they are reported in Table A-7.

Sulphur Control

The ratio of sulphate sulphur to total sulphur is an important parameter with respect to the potential environmental hazard posed by uranium tailings as a result of acid generation due to oxidation processes. The values of the ratios for UTS-1 and UTS-4 indicate that most of the sulphur is already present as sulphate and therefore should pose few problems with respect to acid generation. The low total sulphur content of UTS-3 is of course due to prior pyrite mineral separation by flotation. UTS-2 on the other hand contains appreciable amounts of oxidizable sulphur that can lead to deleterious acid generation, a phenomenon which is now being studied in detail in the Elliot Lake area.

Table A-1 - Contributing laboratories

Acme Analytical Laboratories Ltd.
Vancouver, British Columbia
(Dean Toye)
Contract 15SQ.23440-2-9144-1

Assayers (Ontario) Limited
Toronto, Ontario
(J. van Engelen)
Contract 26SQ.23400-5-9101-2

Atomic Energy of Canada Limited,
Radiochemical Company
Kanata, Ontario
(B.F. Raby)

Barringer Magenta Limited
Calgary, Alberta
(C.D. Read)
Contract 15SQ.23440-2-9144-2

Barringer Magenta Limited
Rexdale, Ontario
(R.E. Lett)
Contract 15SQ.23440-2-9144-3

Becquerel Laboratories Inc.
Mississauga, Ontario
(R. Robertson)
Contract 15SQ.23440-3-9116-1

Bondar-Clegg and Company Limited
Ottawa, Ontario
(P. Haulena)
Contract 15SQ.23440-3-9144-4

Bondar-Clegg and Company Limited
North Vancouver, British Columbia
(K.E. Rogers)
Contract 15SQ.23440-3-9144-5

CAN TEST Limited
Vancouver, British Columbia
(R.S. Jornitz)
Contract 15SQ.23440-3-9144-11

Chemex Laboratories Limited
North Vancouver, British Columbia
(R.D. Morse)
Contract 15SQ.23440-3-9144-6

Eco-Tech Laboratories Limited
Kamloops, British Columbia
(F.J. Pezzotti)
Contract 26SQ.23440-3-9101-1

Kamloops Research and Assay Laboratory Limited
Kamloops, British Columbia
(D.A. Blundell)
Contract 15SQ.23440-3-9144-7

Lakefield Research of Canada Limited
Lakefield, Ontario
(A.E. Carr)
Contract 26SQ.23440-3-9101-4

Materials Research Laboratory Limited
Nepean, Ontario
(S.K. Singh)
Contract 15SQ.23440-3-9144-8

Metriclab (1980) Inc.
Ste-Marthe-sur-le-lac, Quebec
(H. Blais)
Contract 26SQ.23440-3-9101-3

Saskatchewan Research Council
Saskatoon, Saskatchewan
(G. Smithson)
Contract SQ.23440-3-9116-2

Technical Service Laboratories
Mississauga, Ontario
(A.H. Debnam)
Contract 15SQ.23440-3-9144-9

X-Ray Assay Laboratories Limited
Don Mills, Ontario
(J.H. Opdebeeck)
Contract 15SQ.23440-3-9144-10

Table A-2a – Laboratory results, means and standard deviations for total iron and titanium in UTS-1

FE(TOTAL)

						MEAN	S.D.
LAB- 1	(PLASMA)	4.79	4.86	4.92	4.83	4.67	4.8140	.0934
LAB- 2	(AA)	4.74	4.83	4.74	4.83	4.83	4.7940	.0493
LAB- 3	(AA)	4.83	4.74	4.74	4.83	4.83	4.7940	.0493
LAB- 3	(PLASMA)	4.81	4.75	4.83	4.92	4.83	4.8280	.0610
LAB- 4	(AA)	4.80	4.84	4.72	4.80	4.80	4.7920	.0438
LAB- 5	(AA)	5.10	5.10	5.00	5.05	5.10	5.0700	.0447
LAB- 6	(TITR)	4.81	4.78	4.81	4.76	4.80	4.7920	.0217
LAB- 6	(AA)	4.75	4.74	4.83	4.81	4.87	4.8000	.0548
LAB- 7	(AA)	5.02	4.97	5.12	5.13	5.03	5.0540	.0688
*LAB- 8	(AA)	5.58	5.72	5.69	5.78	5.79	5.7120	.0847
LAB- 9	(PLASMA)	4.85	4.87	4.91	4.94	4.83	4.8800	.0447
LAB-10	(XRF)	4.995	4.985	4.955	4.935	4.965	4.9670	.0239
LAB-11	(PLASMA)	4.94	4.83	4.85	4.85	4.88	4.8700	.0430

TITANIUM

						MEAN	S.D.
LAB- 1	(PLASMA)	0.57	0.56	0.55	0.58	0.55	.5620	.0130
LAB- 2	(AA)	0.58	0.58	0.58	0.58	0.58	.5800	0.0000
LAB- 3	(AA)	0.58	0.63	0.58	0.58	0.58	.5900	.0224
LAB- 3	(PLASMA)	0.535	0.555	0.552	0.544	0.561	.5494	.0101
*LAB- 4	(COLOR)	0.33	0.33	0.32	0.33	0.34	.3300	.0071
LAB- 5	(COLOR)	0.54	0.54	0.51	0.48	0.51	.5160	.0251
LAB- 6	(COLOR)	0.529	0.514	0.521	0.517	0.525	.5212	.0060
LAB- 7	(AA)	0.48	0.46	0.45	0.46	0.45	.4600	.0122
*LAB- 8	(AA)	0.33	0.33	0.32	0.32	0.32	.3240	.0055
LAB- 9	(PLASMA)	0.52	0.55	0.54	0.55	0.52	.5360	.0152
LAB-10	(XRF)	0.525	0.535	0.525	0.520	0.535	.5280	.0067
LAB-11	(PLASMA)	0.585	0.582	0.577	0.586	0.586	.5836	.0043

*Outliers, not used for computations

Table A-2b – Laboratory results, means and standard deviations for aluminum and calcium in UTS-1

ALUMINUM

						MEAN	S.D.
LAB- 1 (PLASMA)	6.35	6.19	6.24	6.30	6.30	6.2760	.0619
LAB- 2 (AA)	6.162	6.293	6.293	6.192	6.293	6.2466	.0644
LAB- 3 (AA)	6.293	5.895	5.859	5.927	5.996	5.9940	.1746
LAB- 3 (PLASMA)	6.35	6.35	6.30	6.35	6.46	6.3620	.0589
LAB- 4 (AA)	5.92	6.08	6.00	6.12	5.88	6.0000	.1020
LAB- 5 (AA)	6.45	6.45	6.40	6.51	6.40	6.4420	.0455
LAB- 6 (AA)	6.36	6.37	6.34	6.39	6.38	6.3680	.0192
LAB- 7 (AA)	6.07	5.95	6.20	6.07	6.10	6.0780	.0893
LAB- 8 (AA)	6.34	6.43	6.23	6.26	6.35	6.3220	.0792
LAB- 9 (PLASMA)	6.32	6.34	6.32	6.31	6.30	6.3180	.0148
LAB-10 (XRF)	6.25	6.26	6.24	6.21	6.255	6.2430	.0199
LAB-11 (PLASMA)	6.28	6.22	6.27	6.25	6.27	6.2580	.0239

CALCIUM

						MEAN	S.D.
*LAB- 1 (PLASMA)	4.90	4.82	4.73	4.70	4.80	4.7900	.0787
LAB- 2 (AA)	5.32	5.32	5.32	5.32	5.32	5.3200	.0000
LAB- 3 (AA)	5.22	5.32	5.32	5.32	5.32	5.3000	.0447
LAB- 3 (PLASMA)	5.30	5.28	5.27	5.22	5.17	5.2480	.0526
LAB- 4 (AA)	5.00	5.04	5.04	5.12	5.08	5.0560	.0456
LAB- 5 (AA)	5.14	5.18	5.22	5.14	5.14	5.1640	.0358
LAB- 6 (AA)	5.17	5.11	5.10	5.16	5.12	5.1320	.0311
LAB- 7 (AA)	5.36	5.39	5.36	5.46	5.54	5.4220	.0776
LAB- 8 (AA)	5.21	5.27	5.27	5.19	5.08	5.2040	.0780
LAB- 9 (PLASMA)	5.27	5.36	5.33	5.30	5.30	5.3120	.0342
LAB-10 (XRF)	5.225	5.235	5.205	5.19	5.24	5.2190	.0210
LAB-11 (PLASMA)	5.26	5.21	5.25	5.25	5.20	5.2340	.0270

*Outliers, not used for computations

Table A-2c – Laboratory results, means and standard deviations for barium and uranium in UTS-1

BARIUM

						MEAN	S.D.
LAB- 1	(PLASMA)	324.0	321.0	325.0	324.0	324.0	323.60	1.5166
LAB- 4	(XRF)	360.	400.	340.	400.	370.	374.00	26.0768
LAB- 5	(XRF)	370.0	390.0	400.0	390.0	390.0	388.00	10.9545
LAB- 6	(AE)	370.0	370.0	370.0	370.0	370.0	370.00	0.0000
LAB- 7	(AA)	330.	390.	360.	360.	300.	348.00	34.2053
*LAB- 8	(AA)	485.0	483.0	488.0	490.0	491.0	487.40	3.3615
LAB- 9	(PLASMA)	296.0	292.0	297.0	296.0	294.0	295.00	2.0000
LAB-10	(XRF)	350.	350.	360.	350.	350.	352.00	4.4721
LAB-11	(PLASMA)	342.	343.	342.	345.	349.	344.20	2.9496
LAB-15	(XRF)	294.	314.	333.	314.	282.	307.40	19.7939
LAB-17	(AA)	226.	242.	248.	281.	237.	246.80	20.7533
LAB-18	(XRF)	220.	220.	200.	230.	220.	218.00	10.9545

URANIUM

						MEAN	S.D.
*LAB- 1	(PLASMA)	78.0	74.0	82.0	80.0	77.0	78.20	3.0332
LAB- 2	(FLUOR)	55.0	50.0	45.0	50.0	50.0	50.00	3.5355
LAB- 2	(NAA)	48.9	48.4	50.8	48.6	45.2	48.38	2.0179
LAB- 3	(FLUOR)	65.0	60.0	65.0	50.0	55.0	59.00	6.5192
LAB- 3	(NAA)	51.3	53.7	49.5	51.2	48.8	50.90	1.9013
LAB- 4	(FLUOR)	53.0	54.0	50.0	46.0	47.0	50.00	3.5355
LAB- 5	(FLUOR)	31.0	29.0	28.0	30.0	29.0	29.40	1.1402
LAB- 6	(NAA)	50.0	53.0	49.0	50.0	52.0	50.80	1.6432
LAB- 6	(NAA)	54.	53.	48.	47.	49.	50.20	3.1145
LAB- 7	(FLUOR)	30.	41.	50.	31.	44.	39.20	8.5849
LAB- 8	(FLUOR)	52.3	53.6	53.9	54.6	48.0	52.48	2.6395
LAB- 9	(FLUOR)	54.0	63.0	65.0	59.0	60.0	60.20	4.2071
LAB-10	(NAA)	51.7	49.2	49.3	51.5	50.7	50.48	1.1841
*LAB-11	(FLUOR)	23.0	25.0	24.0	22.0	25.0	23.80	1.3038

*Outliers, not used for computations

Table A-2d – Laboratory results, means and standard deviations for thorium and total sulphur in UTS-1

THORIUM

						MEAN	S.D.
LAB- 1 (PLASMA)	165.0	153.0	151.0	155.0	150.0	154.80	6.0166
LAB- 2 (NAA)	140.0	140.0	140.0	130.0	130.0	136.00	5.4772
LAB- 3 (NAA)	130.0	140.0	130.0	140.0	130.0	134.00	5.4772
LAB- 3 (PLASMA)	136.0	142.0	139.0	136.0	141.0	138.80	2.7749
LAB- 4 (XRF)	145.	143.	135.	150.	136.	141.80	6.3008
LAB- 5 (XRF)	137.0	144.0	139.0	140.0	143.0	140.60	2.8810
LAB- 6 (NAA)	170.0	170.0	160.0	170.0	150.0	164.00	8.9443
*LAB- 7 (COLOR)	108.	94.	99.	97.	102.	100.00	5.3385
LAB- 8 (COLOR)	138.0	143.0	126.0	123.0	126.0	131.20	8.7579
LAB- 9 (RADIO)	119.0	145.0	122.0	100.0	105.0	118.20	17.5983
LAB-10 (NAA)	135.	131.	138.	139.	138.	136.20	3.2711
LAB-11 (NAA)	126.	125.	130.	131.	125.	127.40	2.8810

S(TOTAL)

						MEAN	S.D.
LAB- 1 (TITR)	0.888	0.887	0.955	0.944	0.964	.9276	.0373
LAB- 2 (TITR)	0.9	0.9	0.9	0.9	1.0	.9200	.0447
LAB- 3 (TITR)	0.9	1.0	0.9	0.9	1.0	.9400	.0548
LAB- 4 (TITR)	1.04	1.07	1.03	1.16	1.14	1.0880	.0589
LAB- 5 (TITR)	0.94	0.96	0.95	0.96	0.97	.9560	.0114
LAB- 6 (GRAV)	1.004	1.010	0.999	0.999	0.993	1.0010	.0064
LAB- 7 (GRAV)	0.99	1.00	0.99	1.05	1.01	1.0080	.0249
LAB- 8 (COLOR)	0.94	0.95	0.99	1.02	1.00	.9800	.0339
LAB- 9 (TITR)	0.98	1.01	1.00	1.04	1.00	1.0060	.0219
*LAB-10 (XRF)	1.625	1.645	1.645	1.68	1.615	1.6420	.0249
LAB-11 (TITR)	1.20	1.15	1.15	1.17	1.17	1.1680	.0205

*Outliers, not used for computations

Table A-2e – Laboratory results, means and standard deviations for sulphate in UTS-1

SULPHATE

						MEAN	S.D.
LAB- 1 (GRAV)	2.463	2.484	2.622	2.580	2.595	2.5488	.0708
LAB- 4 (TITR)	2.74	2.76	2.72	2.71	2.72	2.7300	.0200
*LAB- 5 (COMB)	0.88	0.93	0.87	0.91	0.91	.9000	.0245
LAB- 6 (GRAV)	2.695	2.683	2.721	2.715	2.728	2.7084	.0188
LAB- 7 (GRAV)	2.68	2.62	2.66	2.69	2.70	2.6700	.0316
*LAB- 8 (COLOR)	1.71	1.68	1.67	1.66	1.69	1.6820	.0192
LAB- 9 (GRAV)	2.56	2.50	2.47	2.49	2.51	2.5060	.0336
LAB-10 (GRAV)	2.61	2.52	2.38	2.635	2.57	2.5430	.1010
LAB-11 (GRAV)	2.65	2.70	2.64	2.65	2.64	2.6560	.0251
*LAB-15 (GRAV)	1.83	1.83	1.81	1.80	1.84	1.8220	.0164
LAB-16 (GRAV)	2.71	2.70	2.69	2.69	2.71	2.7000	.0100
*LAB-17 (COMB)	.262	.299	.300	.265	.290	.2830	.0182
LAB-18 (GRAV)	2.70	2.70	2.70	2.72	2.71	2.7060	.0089

*Outliers, not used for computations

Table A-3a – Laboratory results, means and standard deviations for total iron and titanium in UTS-2

FE(TOTAL)

						MEAN	S.D.
LAB- 1 (PLASMA)	3.34	3.46	3.35	3.44	3.58	3.4340	.0974
LAB- 2 (AA)	3.04	3.13	3.13	3.13	3.13	3.1120	.0402
LAB- 3 (AA)	3.04	3.13	3.13	3.13	3.13	3.1120	.0402
LAB- 3 (PLASMA)	3.15	3.14	3.18	3.18	3.18	3.1660	.0195
LAB- 4 (AA)	3.24	3.24	3.12	3.16	3.16	3.1840	.0537
LAB- 5 (AA)	3.20	3.20	3.25	3.20	3.25	3.2200	.0274
LAB- 6 (TITR)	3.04	3.00	2.98	2.99	3.00	3.0020	.0228
LAB- 6 (AA)	3.05	3.05	3.14	3.04	3.06	3.0680	.0409
LAB- 7 (AA)	3.06	3.12	3.12	2.97	3.06	3.0660	.0615
LAB- 8 (AA)	3.65	3.56	3.60	3.49	3.57	3.5740	.0586
*LAB- 9 (PLASMA)	2.72	2.64	2.75	2.71	2.70	2.7040	.0404
LAB-10 (XRF)	3.055	3.10	3.085	3.075	3.04	3.0710	.0238
LAB-11 (PLASMA)	3.36	3.31	3.30	3.34	3.36	3.3340	.0279

TITANIUM

						MEAN	S.D.
LAB- 1 (PLASMA)	0.22	0.22	0.21	0.22	0.21	.2160	.0055
LAB- 2 (AA)	0.14	0.14	0.14	0.14	0.14	.1400	.0000
LAB- 3 (AA)	0.14	0.14	0.14	0.14	0.14	.1400	.0000
LAB- 3 (PLASMA)	0.138	0.143	0.135	0.123	0.132	.1342	.0075
LAB- 4 (COLOR)	0.200	0.20	0.21	0.22	0.19	.2040	.0114
LAB- 5 (COLOR)	0.21	0.18	0.24	0.21	0.21	.2100	.0212
LAB- 6 (COLOR)	0.202	0.202	0.210	0.203	0.206	.2046	.0034
LAB- 7 (AA)	0.16	0.14	0.15	0.15	0.16	.1520	.0084
LAB- 8 (AA)	0.21	0.21	0.22	0.20	0.22	.2120	.0084
LAB- 9 (PLASMA)	0.22	0.21	0.21	0.20	0.22	.2120	.0084
LAB-10 (XRF)	0.22	0.22	0.215	0.22	0.22	.2190	.0022
LAB-11 (PLASMA)	0.152	0.157	0.152	0.147	0.152	.1520	.0035

*Outliers, not used for computations

Table A-3b – Laboratory results, means and standard deviations for aluminum and calcium in UTS-2

ALUMINUM

						MEAN	S.D.
LAB- 1 (PLASMA)	2.67	2.83	2.65	2.73	2.70	2.7160	.0706
LAB- 2 (AA)	2.64	2.56	2.64	2.64	2.56	2.6080	.0438
LAB- 3 (AA)	2.60	2.56	2.53	2.57	2.57	2.5660	.0251
LAB- 3 (PLASMA)	2.80	2.75	2.72	2.77	2.76	2.7600	.0292
LAB- 4 (AA)	2.56	2.60	2.56	2.60	2.52	2.5680	.0335
LAB- 5 (AA)	2.65	2.70	2.73	2.75	2.70	2.7060	.0378
LAB- 6 (AA)	2.74	2.77	2.79	2.79	2.80	2.7780	.0239
LAB- 7 (AA)	2.74	2.87	2.87	2.67	2.80	2.7900	.0863
LAB- 8 (AA)	2.69	2.76	2.66	2.76	2.72	2.7180	.0438
LAB- 9 (PLASMA)	2.80	2.78	2.76	2.79	2.81	2.7880	.0192
LAB-10 (XRF)	2.90*	2.69	2.685	2.68	2.715	2.7340	.0938
LAB-11 (PLASMA)	2.80	2.79	2.79	2.76	2.80	2.7880	.0164

CALCIUM

						MEAN	S.D.
LAB- 1 (PLASMA)	0.36	0.36	0.35	0.37	0.36	.3600	.0071
LAB- 2 (AA)	0.47	0.47	0.47	0.47	0.47	.4700	.0000
LAB- 3 (AA)	0.47	0.47	0.47	0.47	0.47	.4700	.0000
LAB- 3 (PLASMA)	0.403	0.415	0.415	0.423	0.413	.4138	.0072
LAB- 4 (AA)	0.386	0.384	0.380	0.386	0.370	.3812	.0067
LAB- 5 (AA)	0.43	0.43	0.39	0.39	0.43	.4140	.0219
LAB- 6 (AA)	0.427	0.426	0.425	0.424	0.427	.4258	.0013
LAB- 7 (AA)	0.43	0.43	0.43	0.37	0.41	.4140	.0261
LAB- 8 (AA)	0.45	0.45	0.47	0.47	0.46	.4600	.0100
LAB- 9 (PLASMA)	0.35	0.32	0.34	0.35	0.33	.3380	.0130
LAB-10 (XRF)	0.44	0.44	0.44	0.44	0.44	.4400	.0000
LAB-11 (PLASMA)	0.43	0.43	0.42	0.43	0.42	.4260	.0055

*Outliers, not used for computations

Table A-3c – Laboratory results, means and standard deviations for barium and uranium in UTS-2

BARIUM

						MEAN	S.D.
LAB- 1 (PLASMA)	482.0	475.0	471.0	471.0	466.0	473.00	5.9582
LAB- 4 (XRF)	500.	480.	450.	540.	510.	496.00	33.6155
*LAB- 5 (XRF)	630.0	620.0	630.0	620.0	620.0	624.00	5.4772
LAB- 6 (AE)	490.0	490.0	490.0	490.0	500.0	492.00	4.4721
LAB- 7 (AA)	400.	410.	420.	420.	440.	418.00	14.8324
LAB- 8 (AA)	544.0	540.0	526.0	526.0	533.0	533.80	8.1363
LAB- 9 (PLASMA)	432.0	431.0	419.0	433.0	434.0	429.80	6.1400
LAB-10 (XRF)	520.	530.	530.	520.	510.	522.00	8.3666
LAB-11 (PLASMA)	510.	536.	537.	540.	533.	531.20	12.1120
LAB-15 (XRF)	400.	394.	398.	384.	400.	395.20	6.7231
LAB-17 (AA)	367.	336.	351.	390.	348.	358.40	20.8399
LAB-18 (XRF)	480.	460.	460.	460.	440.	460.00	14.1421

URANIUM

						MEAN	S.D.
*LAB- 1 (PLASMA)	67.0	68.0	66.0	71.0	65.0	67.40	2.3022
LAB- 2 (FLUOR)	55.0	60.0	55.0	55.0	55.0	56.00	2.2361
LAB- 2 (NAA)	56.0	54.0	52.3	55.3	59.6	55.44	2.7190
LAB- 3 (FLUOR)	60.0	50.0	60.0	60.0	50.0	56.00	5.4772
LAB- 3 (NAA)	53.7	53.8	53.3	54.5	54.0	53.86	.4393
LAB- 4 (FLUOR)	55.0	55.0	55.0	54.0	53.0	54.40	.8944
*LAB- 5 (FLUOR)	40.0	40.0	43.0	41.0	43.0	41.40	1.5166
LAB- 6 (NAA)	56.0	55.0	56.0	59.0	55.0	56.20	1.6432
LAB- 6 (NAA)	53.	54.	55.	53.	54.	53.80	.8367
*LAB- 7 (FLUOR)	56.	56.	73.	71.	67.	64.60	8.1425
LAB- 8 (FLUOR)	57.7	55.6	59.3	56.5	58.0	57.42	1.4237
LAB- 9 (FLUOR)	54.0	61.0	59.0	57.0	58.0	57.80	2.5884
LAB-10 (NAA)	56.0	56.9	55.4	56.5	56.6	56.28	.5891
*LAB-11 (FLUOR)	39.0	42.0	39.0	42.0	41.0	40.60	1.5166

*Outliers, not used for computations

Table A-3d – Laboratory results, means and standard deviations for thorium and total sulphur in UTS-2

THORIUM

						MEAN	S.D.
LAB- 1 (PLASMA)	189.0	182.0	182.0	197.0	191.0	188.20	6.3797
LAB- 2 (NAA)	170.0	170.0	180.0	170.0	170.0	172.00	4.4721
LAB- 3 (NAA)	170.0	170.0	160.0	160.0	180.0	168.00	8.3666
LAB- 3 (PLASMA)	179.0	179.0	179.0	187.0	173.0	179.40	4.9800
LAB- 4 (XRF)	177.	179.	185.	186.	188.	183.00	4.7434
LAB- 5 (XRF)	196.0	192.0	200.0	196.0	196.0	196.00	2.8284
LAB- 6 (NAA)	210.0	200.0	210.0	210.0	200.0	206.00	5.4772
LAB- 7 (COLOR)	132.	132.	123.	133.	126.	129.20	4.4385
LAB- 8 (COLOR)	171.0	171.0	157.0	160.0	164.0	164.60	6.3482
LAB- 9 (RADIO)	215.0	161.0	189.0	168.0	174.0	181.40	21.4313
LAB-10 (NAA)	166.	164.	171.	164.	161.	165.20	3.7014
LAB-11 (NAA)	159.	151.	162.	163.	157.	158.40	4.7749

S(TOTAL)

						MEAN	S.D.
LAB- 1 (TITR)	3.340	3.500	3.380	3.340	3.250	3.3620	.0907
LAB- 2 (TITR)	3.1	3.1	3.1	3.1	3.1	3.1000	.0000
LAB- 3 (TITR)	3.0	3.0	3.0	2.9	2.9	2.9600	.0548
LAB- 4 (TITR)	3.50	3.44	3.44	3.43	3.44	3.4500	.0283
LAB- 5 (TITR)	3.14	3.10	3.18	3.14	3.14	3.1400	.0283
LAB- 6 (GRAV)	3.364	3.308	3.362	3.255	3.362	3.3302	.0483
LAB- 7 (GRAV)	3.31	3.31	3.37	3.32	3.11	3.2840	.1004
LAB- 8 (COLOR)	3.43	3.41	3.50	3.31	3.36	3.4020	.0719
LAB- 9 (TITR)	3.17	3.26	3.31	3.29	3.21	3.2480	.0576
LAB-10 (XRF)	3.06	3.115	3.065	3.095	3.075	3.0820	.0228
LAB-11 (TITR)	3.17	3.15	3.20	3.25	3.15	3.1840	.0422

Table A-3e – Laboratory results, means and standard deviations for sulphate in UTS-2

SULPHATE

						MEAN	S.D.
*LAB- 1 (GRAV)	1.109	1.258	1.318	1.258	1.198	1.2282	.0790
LAB- 4 (TITR)	0.92	0.92	0.93	0.91	0.92	.9200	.0071
*LAB- 5 (COMB.)	0.31	0.36	0.31	0.35	0.35	.3360	.0241
LAB- 6 (GRAV)	0.895	0.911	0.902	0.925	0.912	.9090	.0113
LAB- 7 (GRAV)	0.94	0.95	0.96	0.94	0.94	.9460	.0089
LAB- 8 (COLOR)	0.88	0.89	0.92	0.86	0.86	.8820	.0249
LAB- 9 (GRAV)	0.68	0.70	0.75	0.71	0.69	.7060	.0270
LAB-10 (GRAV)	0.695	0.675	0.675	0.675	0.65	.6740	.0160
LAB-11 (GRAV)	0.91	0.90	0.91	0.92	0.90	.9080	.0084
LAB-15 (GRAV)	0.66	0.66	0.67	0.64	0.66	.6580	.0110
LAB-16 (GRAV)	0.892	0.901	0.900	0.901	0.896	.8980	.0039
*LAB-17 (COMB)	8.44	8.51	8.34	8.72	8.24	8.4500	.1822
LAB-18 (GRAV)	0.94	0.91	0.91	0.91	0.91	.9160	.0134

*Outliers, not used for computations

Table A-4a – Laboratory results, means and standard deviations for total iron and titanium in UTS-3

FE(TOTAL)

						MEAN	S.D.
LAB- 1	(PLASMA)	3.28	3.18	3.18	3.24	3.22	3.2200	.0424
LAB- 2	(AA)	3.31	3.31	3.31	3.31	3.31	3.3100	.0000
LAB- 3	(AA)	3.32	3.32	3.27	3.32	3.32	3.3100	.0224
LAB- 3	(PLASMA)	3.03	3.36	3.27	3.27	3.25	3.2360	.1228
LAB- 4	(AA)	3.08	3.16	3.20	3.12	3.20	3.1520	.0522
LAB- 5	(AA)	3.35	3.30	3.35	3.30	3.30	3.3200	.0274
LAB- 6	(TITR)	3.11	3.15	3.11	3.14	3.15	3.1320	.0205
LAB- 6	(AA)	3.15	3.17	3.18	3.10	3.10	3.1400	.0381
LAB- 7	(AA)	3.31	3.28	3.41	3.40	3.38	3.3560	.0577
*LAB- 8	(AA)	3.78	3.78	3.77	3.85	3.79	3.7940	.0321
LAB- 9	(PLASMA)	3.19	3.12	3.18	3.14	3.15	3.1560	.0288
LAB-10	(XRF)	3.425	3.405	3.38	3.355	3.39	3.3910	.0263
LAB-11	(PLASMA)	3.34	3.30	3.32	3.29	3.30	3.3100	.0200

TITANIUM

						MEAN	S.D.
LAB- 1	(PLASMA)	0.24	0.25	0.24	0.24	0.24	.2420	.0045
LAB- 2	(AA)	0.22	0.22	0.22	0.22	0.22	.2200	.0000
LAB- 3	(AA)	0.22	0.22	0.22	0.22	0.22	.2200	.0000
LAB- 3	(PLASMA)	0.195	0.204	0.204	0.206	0.211	.2040	.0058
*LAB- 4	(COLOR)	0.33	0.33	0.33	0.34	0.34	.3340	.0055
LAB- 5	(COLOR)	0.27	0.24	0.24	0.21	0.21	.2340	.0251
LAB- 6	(COLOR)	0.247	0.243	0.247	0.247	0.251	.2470	.0028
LAB- 7	(AA)	0.17	0.16	0.17	0.18	0.17	.1700	.0071
LAB- 8	(AA)	0.23	0.24	0.24	0.24	0.24	.2380	.0045
LAB- 9	(PLASMA)	0.25	0.24	0.24	0.24	0.25	.2440	.0055
LAB-10	(XRF)	0.245	0.245	0.245	0.245	0.25	.2460	.0022
LAB-11	(PLASMA)	0.203	0.208	0.209	0.209	0.2100	.2078	.0028

*Outliers, not used for computations

Table A-4b – Laboratory results, means and standard deviations for aluminum and calcium in UTS-3

ALUMINUM

						MEAN	S.D.
LAB- 1	(PLASMA)	5.61	5.61	5.56	5.61	5.56	5.5900	.0274
LAB- 2	(AA)	5.700	5.800	5.800	5.800	5.70	5.7600	.0548
LAB- 3	(AA)	5.531	5.605	5.541	5.573	5.594	5.5688	.0323
LAB- 3	(PLASMA)	5.93	6.03	5.98	5.98	6.03	5.9900	.0418
LAB- 4	(AA)	5.60	5.64	5.56	5.52	5.68	5.6000	.0632
LAB- 5	(AA)	6.00	6.03	6.00	6.09	6.00	6.0240	.0391
LAB- 6	(AA)	6.02	6.04	5.91	5.98	6.02	5.9940	.0518
LAB- 7	(AA)	5.40	5.53	5.40	5.27	5.27	5.3740	.1088
LAB- 8	(AA)	5.90	5.88	5.93	5.94	5.98	5.9260	.0385
LAB- 9	(PLASMA)	5.93	5.85	5.88	5.86	5.90	5.8840	.0321
LAB-10	(XRF)	5.87	5.885	5.875	5.875	5.915	5.8840	.0182
LAB-11	(PLASMA)	6.03	5.95	5.99	5.97	5.99	5.9860	.0297

CALCIUM

						MEAN	S.D.
*LAB- 1	(PLASMA)	3.47	3.50	3.44	3.47	3.44	3.4640	.0251
LAB- 2	(AA)	4.09	4.00	4.09	4.00	4.18	4.0720	.0753
LAB- 3	(AA)	4.00	4.00	4.00	4.00	4.00	4.0000	0.0000
LAB- 3	(PLASMA)	3.92	3.99	3.81	3.99	3.97	3.9360	.0760
*LAB- 4	(AA)	3.44	3.52	3.44	3.56	3.56	3.5040	.0607
LAB- 5	(AA)	3.86	3.93	3.89	3.93	3.89	3.9000	.0300
LAB- 6	(AA)	4.07	4.02	4.05	4.02	4.08	4.0480	.0277
LAB- 7	(AA)	4.32	4.27	4.16	4.33	4.15	4.2460	.0862
LAB- 8	(AA)	4.08	4.09	4.02	4.12	4.09	4.0800	.0367
LAB- 9	(PLASMA)	3.97	3.92	4.01	3.96	3.95	3.9620	.0327
LAB-10	(XRF)	4.055	4.045	4.05	4.055	4.07	4.0550	.0094
LAB-11	(PLASMA)	4.00	3.95	3.97	3.96	3.99	3.9740	.0207

*Outliers, not used for computations

Table A-4c – Laboratory results, means and standard deviations for barium and uranium in UTS-3

BARIUM

						MEAN	S.D.
LAB- 1 (PLASMA)	191.0	202.0	191.0	196.0	191.0	194.20	4.8683
*LAB- 4 (XRF)	430.	430.	430.	420.	420.	426.00	5.4772
LAB- 5 (XRF)	230.0	230.0	240.0	240.0	220.0	232.00	8.3666
LAB- 6 (AE)	230.0	220.0	230.0	230.0	230.0	228.00	4.4721
LAB- 7 (AA)	250.	220.	210.	230.	210.	224.00	16.7332
LAB- 8 (AA)	273.0	279.0	264.0	286.0	280.0	276.40	8.3247
LAB- 9 (PLASMA)	204.0	178.0	186.0	167.0	185.0	184.00	13.5093
LAB-10 (XRF)	190.	180.	190.	180.	180.	184.00	5.4772
LAB-11 (PLASMA)	214.	214.	218.	212.	215.	214.60	2.1909
LAB-15 (XRF)	214.	218.	214.	216.	224.	217.20	4.1473
LAB-17 (AA)	219.	196.	218.	213.	185.	206.20	15.0233
LAB-18 (XRF)	160.	170.	170.	180.	180.	172.00	8.3666

URANIUM

						MEAN	S.D.
LAB- 1 (PLASMA)	518.0	516.0	516.0	525.0	517.0	518.40	3.7815
LAB- 2 (FLUOR)	550.0	500.0	500.0	550.0	500.0	520.00	27.3861
LAB- 2 (NAA)	527.0	523.0	518.0	512.0	515.0	519.00	6.0415
LAB- 3 (FLUOR)	500.0	500.0	500.0	500.0	500.0	500.00	0.0000
LAB- 3 (NAA)	531.0	519.0	520.0	528.0	519.0	523.40	5.6833
LAB- 4 (FLUOR)	524.	528.	514.	516.	521.	520.60	5.7271
LAB- 5 (FLUOR)	485.0	515.0	485.0	485.0	490.0	492.00	13.0384
LAB- 6 (NAA)	516.0	518.0	521.0	492.0	500.0	509.40	12.6807
LAB- 6 (NAA)	513.	515.	519.	525.	518.	518.00	4.5826
LAB- 7 (FLUOR)	496.	500.	473.	480.	495.	488.80	11.6490
LAB- 8 (FLUOR)	546.0	569.0	548.0	574.0	543.0	556.00	14.3701
*LAB- 9 (FLUOR)	660.0	630.0	590.0	560.0	610.0	610.00	38.0789
LAB-10 (NAA)	551.	554.	550.	551.	550.	551.20	1.6432
LAB-11 (FLUOR)	450.	450.	460.	455.	450.	453.00	4.4721

*Outliers, not used for computations

Table A-4d – Laboratory results, means and standard deviations for thorium and total sulphur in UTS-3

THORIUM

						MEAN	S.D.
LAB- 1	(PLASMA)	15.0	13.0	13.0	13.0	13.0	13.400	.8944
LAB- 2	(NAA)	9.0	9.0	9.0	9.0	9.0	9.000	0.0000
LAB- 3	(NAA)	10.0	9.0	9.0	9.0	9.0	9.200	.4472
*LAB- 3	(PLASMA)	25.3	26.7	22.7	25.2	25.2	25.020	1.4446
*LAB- 4	(XRF)	131.	148.	136.	137.	131.	136.600	6.9498
LAB- 5	(XRF)	11.0	7.0	12.0	4.0	4.0	7.600	3.7815
LAB- 6	(NAA)	9.0	18.0	9.0	18.0	18.0	14.400	4.9295
*LAB- 7	(COLOR)	38.	34.	34.	35.	46.	37.400	5.0794
LAB- 8	(COLOR)	9.4	9.7	8.4	9.1	8.7	9.060	.5225
LAB-10	(NAA)	9.15	8.9	9.4	8.95	8.95	9.070	.2080
LAB-11	(NAA)	11.0	8.	12.0	11.0	11.0	10.600	1.5166
LAB-12	(NAA)	8.6	7.3	9.1	8.5	9.5	8.600	.8307
LAB-13	(NAA)	8.92	9.16	9.01	9.17	8.90	9.032	.1283
LAB-14	(NAA)	10.2	9.9	9.2	10.4	10.2	9.980	.4712

S(TOTAL)

						MEAN	S.D.
LAB- 1	(TITR)	0.192	0.206	0.217	0.217	0.225	.2114	.0128
LAB- 2	(TITR)	0.2	0.2	0.2	0.2	0.2	.2000	.0000
LAB- 3	(TITR)	0.2	0.2	0.2	0.2	0.2	.2000	.0000
LAB- 4	(TITR)	0.266	0.262	0.260	0.243	0.253	.2568	.0090
LAB- 5	(TITR)	0.22	0.22	0.21	0.23	0.22	.2200	.0071
LAB- 6	(GRAV)	0.209	0.209	0.220	0.220	0.226	.2168	.0075
LAB- 7	(GRAV)	0.21	0.22	0.27	0.24	0.24	.2360	.0230
LAB- 8	(COLOR)	0.22	0.25	0.26	0.26	0.25	.2480	.0164
LAB- 9	(TITR)	0.27	0.24	0.24	0.25	0.27	.2540	.0152
LAB-10	(XRF)	0.22	0.21	0.215	0.195	0.205	.2090	.0096
*LAB-11	(TITR)	0.33	0.30	0.31	0.27	0.30	.3020	.0217

*Outliers, not used for computations

Table A-4e – Laboratory results, means and standard deviations for sulphate in UTS-3

SULPHATE

						MEAN	S.D.
*	LAB- 1 (GRAV)	0.180	0.174	0.183	0.165	0.165	.1734	.0083
	LAB- 4 (TITR)	0.021	0.022	0.012	0.013	0.016	.0168	.0045
	LAB- 5 (COMB)	0.01	0.02	0.03	0.01		.0175	.0096
	LAB- 6 (GRAV)	0.007	0.007	0.003	0.006	0.009	.0064	.0022
	LAB- 7 (GRAV)	0.03	0.03	0.04	0.02	0.02	.0280	.0084
	LAB- 9 (GRAV)	0.07	0.08	0.06	0.07	0.06	.0680	.0084
	LAB-11 (GRAV)	0.082	0.086	0.082	0.086	0.082	.0836	.0022
	LAB-15 (GRAV)	0.04	0.05	0.06	0.05	0.05	.0500	.0071
	LAB-16 (TURBID)	0.013	0.012	0.014	0.014	0.013	.0132	.0008
*	LAB-17 (COMB)	0.782	0.697	0.760	0.691	0.662	.7184	.0504
	LAB-18 (GRAV)	0.03	0.035	0.03	0.03	0.03	.0310	.0022

Outliers, not used for computations

Table A-5a – Laboratory results, means and standard deviations for total iron and titanium in UTS-4

FE(TOTAL)

						MEAN	S.D.
LAB- 1	(PLASMA)	2.68	2.60	2.64	2.68	2.64	2.6480	.0335
LAB- 2	(AA)	2.69	2.72	2.69	2.69	2.69	2.6960	.0134
LAB- 3	(AA)	2.69	2.69	2.69	2.59	2.69	2.6700	.0447
LAB- 3	(PLASMA)	2.56	2.58	2.52	2.52	2.56	2.5480	.0268
LAB- 4	(AA)	2.56	2.56	2.56	2.60	2.56	2.5680	.0179
*LAB- 5	(AA)	2.90	3.00	3.00	2.95	2.95	2.9600	.0418
LAB- 6	(TITR)	2.53	2.54	2.55	2.52	2.53	2.5340	.0114
LAB- 6	(AA)	2.64	2.61	2.63	2.61	2.64	2.6260	.0152
LAB- 7	(AA)	2.66	2.51	2.75	2.73	2.72	2.6740	.0976
*LAB- 8	(AA)	3.16	3.14	3.13	3.24	3.16	3.1660	.0434
LAB- 9	(PLASMA)	2.50	2.46	2.54	2.25*	2.51	2.4520	.1165
LAB-10	(XRF)	2.755	2.765	2.755	2.73	2.73	2.7470	.0160
LAB-11	(PLASMA)	2.59	2.65	2.56	2.58	2.60	2.5960	.0336

TITANIUM

						MEAN	S.D.
LAB- 1	(PLASMA)	0.26	0.26	0.27	0.28	0.27	.2680	.0084
LAB- 2	(AA)	0.18	0.22	0.22	0.22	0.18	.2040	.0219
LAB- 3	(AA)	0.22	0.22	0.22	0.22	0.22	.2200	.0000
LAB- 3	(PLASMA)	0.212	0.212	0.195	0.184	0.214	.2034	.0133
LAB- 4	(COLOR)	0.28	0.28	0.26	0.29	0.28	.2780	.0110
LAB- 5	(COLOR)	0.24	0.24	0.24	0.24	0.21	.2340	.0134
LAB- 6	(COLOR)	0.258	0.259	0.259	0.259	0.259	.2588	.0004
LAB- 7	(AA)	0.20	0.19	0.19	0.18	0.19	.1900	.0071
LAB- 8	(AA)	0.29	0.30	0.29	0.30	0.29	.2940	.0055
LAB- 9	(PLASMA)	0.26	0.26	0.26	0.26	0.27	.2620	.0045
LAB-10	(XRF)	0.26	0.265	0.265	0.26	0.26	.2620	.0027
LAB-11	(PLASMA)	0.196	0.186	0.184	0.186	0.189	.1882	.0047

*Outliers, not used for computations

Table A-5b – Laboratory results, means and standard deviations for aluminum and calcium in UTS-4

ALUMINUM

						MEAN	S.D.
LAB- 1 (PLASMA)	6.09	5.98	6.03	6.03	5.93	6.0120	.0602
LAB- 2 (AA)	6.192	6.293	6.192	6.192	6.192	6.2122	.0452
*LAB- 3 (AA)	5.906	5.938	5.906	5.832	5.906	5.8976	.0392
LAB- 3 (PLASMA)	6.35	6.35	6.35	6.25	6.35	6.3300	.0447
LAB- 4 (AA)	6.20	6.20	6.20	6.28	6.24	6.2240	.0358
LAB- 5 (AA)	6.30	6.57	6.51	6.35	6.51	6.4480	.1163
LAB- 6 (AA)	6.30	6.36	6.37	6.33	6.33	6.3380	.0277
LAB- 7 (AA)	6.43	6.37	6.48	6.48	6.48	6.4480	.0487
LAB- 8 (AA)	6.48	6.44	6.41	6.49	6.46	6.4560	.0321
LAB- 9 (PLASMA)	6.31	6.26	6.28	6.32	6.34	6.3020	.0319
LAB-10 (XRF)	6.20	6.22	6.215	6.195	6.215	6.2090	.0108
LAB-11 (PLASMA)	6.18	6.21	6.12	6.18	6.25	6.1880	.0476

CALCIUM

						MEAN	S.D.
LAB- 1 (PLASMA)	1.53	1.52	1.55	1.57	1.57	1.5480	.0228
*LAB- 2 (AA)	6.64	6.74	6.64	6.64	6.64	6.6600	.0447
LAB- 3 (AA)	1.80	1.80	1.80	1.80	1.80	1.8000	.0000
LAB- 3 (PLASMA)	1.72	1.79	1.75	1.75	1.77	1.7560	.0261
LAB- 4 (AA)	1.68	1.68	1.64	1.68	1.68	1.6720	.0179
LAB- 5 (AA)	1.75	1.71	1.71	1.75	1.71	1.7260	.0219
LAB- 6 (AA)	1.71	1.74	1.72	1.73	1.74	1.7280	.0130
LAB- 7 (AA)	1.89	1.89	1.90	1.90	1.89	1.8940	.0055
LAB- 8 (AA)	1.82	1.84	1.84	1.87	1.83	1.8400	.0187
LAB- 9 (PLASMA)	1.74	1.71	1.70	1.75	1.78	1.7360	.0321
LAB-10 (XRF)	1.81	1.805	1.805	1.80	1.80	1.8040	.0042
LAB-11 (PLASMA)	1.73	1.77	1.73	1.73	1.74	1.7400	.0173

Outliers, not used for computations

Table A-5c – Laboratory results, means and standard deviations for barium and uranium in UTS-4

BARIUM

						MEAN	S.D.
LAB- 1 (PLASMA)	65.0	72.0	75.0	68.0	73.0	70.60	4.0373
LAB- 4 (XRF)	30.	20.	40.	30.	30.	30.00	7.0711
LAB- 5 (XRF)	70.0	90.0	70.0	100.0	90.0	84.00	13.4164
LAB- 6 (AE)	90.0	90.0	90.0	90.0	90.0	90.00	0.0000
LAB- 7 (AA)	50.	70.	50.	100.	60.	66.00	20.7364
LAB- 8 (AA)	16.0	17.0	15.0	15.0	15.0	15.60	.8944
LAB- 9 (PLASMA)	73.0	71.0	101.0	74.0	74.0	78.60	12.5817
LAB-10 (XRF)	80.	100.	90.	90.	90.	90.00	7.0711
LAB-11 (PLASMA)	80.3	80.8	90.6	80.8	81.7	82.84	4.3673
LAB-15 (XRF)	48.	49.	48.	48.	48.	48.20	.4472
LAB-17 (AA)	80.	77.	54.	34.	34.	55.80	22.2980
LAB-18 (XRF)	60.	70.	60.	80.	90.	72.00	13.0384

URANIUM

						MEAN	S.D.
LAB- 1 (PLASMA)	1065.0	1053.0	1020.0	1095.0	1080.0	1062.60	28.5710
LAB- 2 (FLUOR)	900.0	950.0	1000.0	1050.0	950.0	970.00	57.0088
LAB- 2 (NAA)	989.0	991.0	989.0	991.0	994.0	990.80	2.0494
LAB- 3 (FLUOR)	1050.0	1025.0	1050.0	1050.0	1050.0	1045.00	11.1803
LAB- 3 (NAA)	991.0	996.0	985.0	998.0	999.0	993.80	5.8052
LAB- 4 (FLUOR)	983.	988.	982.	990.	989.	986.40	3.6469
LAB- 5 (FLUOR)	965.0	960.0	930.0	950.0	980.0	957.00	18.5742
LAB- 6 (NAA)	1094.0	1054.0	1129.0	1036.0	1051.0	1072.80	38.0487
LAB- 6 (NAA)	1079.	1076.	1057.	1059.	1043.	1062.80	14.8054
LAB- 7 (FLUOR)	930.	910.	1000.	950.	955.	949.00	33.6155
LAB- 8 (FLUOR)	1047.0	1046.0	1049.0	1049.0	1035.0	1045.20	5.8481
LAB- 9 (FLUOR)	1015.0	1015.0	1045.0	1125.0*	1025.0	1045.00	46.3681
LAB-10 (NAA)	1039.	1037.	1028.	1036.	1035.	1035.00	4.1833
LAB-11 (FLUOR)	930.	920.	1000.	955.	950.	951.00	30.9031

*Outliers, not used for computations

Table A-5d – Laboratory results, means and standard deviations for thorium and total sulphur in UTS-4

THORIUM

						MEAN	S.D.
LAB- 1	(PLASMA)	21.0	21.0	23.0	22.0	22.0	21.80	.8367
LAB- 2	(NAA)	14.0	15.0	14.0	14.0	14.0	14.20	.4472
LAB- 3	(NAA)	15.0	14.0	14.0	14.0	14.0	14.20	.4472
* LAB- 3	(PLASMA)	38.2	38.1	31.2	31.2	38.2	35.38	3.8160
LAB- 4	(XRF)	14.	16.	14.	15.	12.	14.20	1.4832
LAB- 5	(XRF)	21.0	21.0	20.0	20.0	22.0	20.80	.8367
LAB- 6	(NAA)	9.0	18.0	18.0	18.0	18.0	16.20	4.0249
* LAB- 7	(COLOR)	62.	64.	60.	58.	61.	61.00	2.2361
LAB- 8	(COLOR)	13.3	9.4	13.0	14.7	14.1	12.90	2.0676
LAB-10	(NAA)	14.5	14.5	14.3	14.6	14.4	14.46	.1140
LAB-11	(NAA)	17.0	16.0	17.0	16.0	16.0	16.40	.5477
LAB-12	(NAA)	9.2	8.6	7.8	9.3	9.9	8.96	.7956
LAB-13	(NAA)	14.8	15.0	17.6*	15.2	14.7	15.46	1.2116
LAB-14	(NAA)	15.0	15.4	15.5	15.0	15.9	15.36	.3782

S(TOTAL)

						MEAN	S.D.
LAB- 1	(TITR)	1.840	1.740	1.750	1.810	1.770	1.7820	.0421
LAB- 2	(TITR)	1.7	1.7	1.7	1.7	1.7	1.7000	.0000
LAB- 3	(TITR)	1.7	1.7	1.7	1.7	1.7	1.7000	.0000
LAB- 4	(TITR)	1.86	1.91	1.91	1.86	1.86	1.8800	.0274
LAB- 5	(TITR)	1.72	1.72	1.78	1.76	1.74	1.7440	.0261
LAB- 6	(GRAV)	1.761	1.814	1.867	1.708	1.760	1.7820	.0605
LAB- 7	(GRAV)	1.84	1.84	1.88	1.84	1.82	1.8440	.0219
LAB- 8	(COLOR)	1.77	1.79	1.79	1.83	1.78	1.7920	.0228
LAB- 9	(TITR)	1.85	1.84	1.81	1.80	1.83	1.8260	.0207
*LAB-10	(XRF)	3.12	3.19	3.13	3.105	3.12	3.1330	.0331
*LAB-11	(TITR)	2.27	2.30	2.26	2.35	2.25	2.2860	.0404
LAB-15	(COMB)	1.76	1.77	1.75	1.73	1.72	1.7460	.0207
LAB-16	(GRAV)	1.88	1.86	1.84	1.87	1.88	1.8660	.0167
LAB-17	(COMB)	2.17	1.93	2.01	1.84	1.82	1.9540	.1426
LAB-18	(COMB)	1.794	1.795	1.794	1.797	1.792	1.7944	.0018

Outliers, not used for computations

Table A-5e – Laboratory results, means and standard deviations for sulphate and nickel in UTS-4

SULPHATE

						MEAN	S.D.
LAB- 1 (GRAV)	5.231	4.913	4.973	5.183	4.943	5.0486	.1471
LAB- 4 (TITR)	5.30	5.35	5.25	5.30	5.33	5.3060	.0378
*LAB- 5 (COMB)	1.72	1.75	1.74	1.72	1.78	1.7420	.0249
LAB- 6 (GRAV)	5.270	5.303	5.250	5.354	5.248	5.2850	.0445
LAB- 7 (GRAV)	5.26	5.25	5.27	5.25	5.28	5.2620	.0130
LAB- 8 (COLOR)	3.61	3.60	3.63	3.62	3.63	3.6180	.0130
LAB- 9 (GRAV)	5.17	5.10	5.12	5.15	5.10	5.1280	.0311
LAB-10 (GRAV)	5.28	5.20	5.40	5.20	5.275	5.2710	.0819
LAB-11 (GRAV)	5.39*	5.27	5.28	5.24	5.27	5.2900	.0579
*LAB-15 (GRAV)	3.57	3.69	3.52	3.53	3.51	3.5640	.0740
LAB-16 (GRAV)	5.17	5.18	5.16	5.17	5.19	5.1740	.0114
*LAB-17 (COMB)	0.172	0.172	0.129	0.150	0.150	.1546	.0180
LAB-18 (GRAV)	5.16	5.17	5.20	5.18	5.19	5.1800	.0158

NICKEL

						MEAN	S.D.
LAB- 1 (PLASMA)	175.0	178.0	175.0	176.0	185.0	177.80	4.2071
LAB- 2 (AA)	85.0	85.0	85.0	85.0	85.0	85.00	0.0000
LAB- 3 (AA)	85.0	85.0	85.0	85.0	85.0	85.00	0.0000
LAB- 3 (PLASMA)	121.0	121.0	122.0	121.0	122.0	121.40	.5477
LAB- 4 (AA)	140.	150.	140.	140.	140.	142.00	4.4721
LAB- 5 (AA)	150.0	170.0	150.0	150.0	180.0	160.00	14.1421
LAB- 6 (AA)	150.0	150.0	150.0	150.0	150.0	150.00	0.0000
LAB- 7 (AA)	160.0	160.0	160.0	160.0	160.0	160.00	0.0000
LAB- 8 (AA)	194.0	197.0	206.0	209.0	201.0	201.40	6.1887
LAB- 9 (AA)	214.0	200.0	204.0	195.0	201.0	202.80	7.0498
LAB-10 (AA)	130.	130.	130.	130.	130.	130.00	0.0000
LAB-11 (PLASMA)	195.	194.	192.	194.	192.	193.40	1.3416

*Outliers, not used for computations

Table A-5f – Laboratory results, means and standard deviations for arsenic in UTS-4

ARSENIC

						MEAN	S.D.
LAB- 1 (PLASMA)	44.0	43.0	44.0	39.0	41.0	42.20	2.1679
LAB- 4 (TITR)	34.0	32.0	39.0	32.0	39.	35.20	3.5637
LAB- 2 (AA)	33.6	32.8	32.0	33.6	32.0	32.80	.8000
LAB- 3 (AA)	36.8	36.8	36.8	33.6	34.4	35.68	1.5595
LAB- 5 (COLOR)	38.0	35.0	37.0	38.0	36.0	36.80	1.3038
LAB- 6 (NAA)	40.0	40.0	40.0	40.0	40.0	40.00	0.0000
LAB- 7 (COLOR)	35.0	40.0	37.0	31.0	33.0	35.20	3.4928
LAB- 8 (COLOR)	40.0	41.0	41.0	40.0	41.0	40.60	.5477
LAB- 9 (AA)	40.0	36.0	40.0	38.0	38.0	38.40	1.6733
LAB-10 (NAA)	40.5	41.0	42.0	40.5	41.	41.00	.6124
*LAB-11 (AA)	52.0	53.0	52.0	53.0	52.0	52.40	.5477

*Outliers, not used for computations

Table A-6a – Summary of analytical methods for total iron

Laboratory	Decomposition	Separation, reagents, procedure	Finish
1	$LiBO_2$ fusion		ICP-AE
2,3b,6b	$HNO_3 + HClO_4 + HF$		AA
3a,11	$HCl + HNO_3 + HClO_4 + HF$		ICP-AE
4,5	Na_2O_2 fusion		AA
6a	Na_2O_2-NaOH fusion	dichromate titration	Titrimetry
7,8	Na_2O_2 or $Na_2O_2 + Na_2CO_3$ fusion		
9	$Li_2CO_3 + H_3BO_3$ fusion		ICP-AE
10	$Li_2B_4O_7$ button fusion		Xrf

Table A-6b – Summary of analytical methods for titanium

Laboratory	Decomposition	Separation, reagents, procedure	Finish
1	$LiBO_2$ fusion		ICP-AE
2,3b	$HNO_3 + HClO_4 + HF$		AA
3a,11	$HCl + HNO_3 + HClO_4 + HF$		ICP-AE
4,5	Na_2O_2 fusion	Ti color developed with H_2O_2	Colorimetry
6	$K_2S_2O_7$ fusion	Ti color developed with H_2O_2	Colorimetry
7,8	Na_2O_2 or $Na_2O_2 + Na_2CO_3$ fusion		AA
9	$Li_2CO_3 + H_3BO_3$ fusion		ICP-AE
10	$LiBO_2$ button fusion		Xrf

Table A-6c – Summary of analytical methods for aluminum

Laboratory	Decomposition	Separation, reagents, procedure	Finish
1	$LiBO_2$ fusion		ICP-AE
2,3b,4,5,6	$HNO_3 + HClO_4 + HF$		AA
3a,11	$HCl + HNO_3 + HClO_4 + HF$		ICP-AE
7,8	Na_2O_2 or $Na_2O_2 + Na_2CO_3$ fusion		AA
9	$Li_2CO_3 + H_3BO_3$ fusion		ICP-AE
10	$LiBO_2$ button fusion		Xrf

Table A-6d – Summary of analytical methods for calcium

Laboratory	Decomposition	Separation, reagents, procedure	Finish
1	$LiBO_2$ fusion		ICP-AE
2,3b,4,5,6	$HNO_3 + HClO_4 + HF$		AA
3a,11	$HCl + HNO_3 + HClO_4 + HF$		ICP-AE
7	$HCl + HNO_3$		AA
8	$Na_2O_2 + Na_2CO_3$ fusion		AA
9	$Li_2CO_3 + H_3BO_3$ fusion		ICP-AE
10	$LiBO_2$ button fusion		Xrf

Table A-6e – Summary of analytical methods for barium

Laboratory	Decomposition	Separation, reagents, procedure	Finish
1	$LiBO_2$ fusion		ICP-AE
4,5,18		Energy dispersive spectrometry	Xrf
6	Na_2CO_3 fusion		Flame emission
7	$LiBO_2$ fusion		AA
8	$Na_2O_2 + Na_2CO_3$ fusion		AA
9	$Li_2CO_3 + H_3BO_3$ fusion		ICP-AE
10		8:2 sample: binder pelletization	Xrf
11	$HCl + HNO_3 + HClO_4 + HF$		ICP-AE
16	$HF + H_2SO_4$; residue fused with Na_2CO_3	$BaCO_3$ precipitated; dissolved with HCl and precipitated as $BaSO_4$; millipore filtration	Xrf
17	$HNO_3 + HF + HCl$	$BaSO_4$ precipitated; filtered and fused with $LiBO_2$; leach with HNO_3	AA

Table A-6f – Summary of analytical methods for uranium

Laboratory	Decomposition	Separation, reagents, procedure	Finish
1	$HNO_3 + HClO_4 + HF$		ICP-AE
2,3a,4,5,7,8			
9,11	$HNO_3 + HClO_4 + HF$	NaF-LiF fusion disc	Fluorimetry
2b,3b		Delayed neutron counting	NAA
6a,6b,10		Instrumental neutron activation	NAA

Table A-6g – Summary of analytical methods for thorium

Laboratory	Decomposition	Separation, reagents, procedure	Finish
1,3a	$HNO_3 + HClO_4 + HF$		ICP-AE
2,3b,12,13,14		Slowpoke reactor, measure 312 keV peak of ^{233}Pa	NAA
4,5		Wave-length dispersive spectrometry	Xrf
6,10,11		Instrumental neutron analysis	NAA
7	Na_2O_2 fusion	The color developed with Arsenazo III	Colorimetry
8	$Na_2O_2 + Na_2CO_3$ fusion	The color developed with thoron	Colorimetry
9		Direct measurement	α-spectrometry

Table A-6h – Summary of analytical methods for total sulphur

Laboratory	Decomposition	Separation, reagents, procedure	Finish
1,2,3,4,5 8,9,11,15, 17,18	Combustion (Leco furnace)	SO_2 dissolved in HCl + KI; I_2 titrated with KIO_3	Combustion-titrimetry
6,16	HNO_3 + Br_2; Na_2O_2 fusion of insolubles	$BaSO_4$ precipitation	Gravimetry
7	Na_2CO_2 + KNO_3 fusion	$BaSO_4$ precipitation	Gravimetry
10		8:2 sample: binder pellet	
		Cr oxidation	Xrf
16	HCl + HNO_3 + Br_2	Fe reduced with $H_2NOH.HCl$	
		$BaSO_4$ precipitated	Gravimetry

Table A-6i – Summary of analytical methods for sulphate

Laboratory	Decomposition	Separation, reagents, procedure	Finish
1,9,10,11, 15,16	Boiled with 10% HCl for 1 h	$BaSO_4$ precipitation	Gravimetry
2,3	Sulphide minerals decomposed with HI + $HgCl_2$	H_2S absorbed as CdS; oxidized with excess I_2; remaining I_2 titrated with $Na_2S_2O_3$; sulphate is total sulphur – sulphide sulphur	Combustion-titrimetry
4,5	Sulphide minerals decomposed with H_3PO_4 + Sn	Residual sulphur by combustion (Leco furnace)	Combustion-titrimetry
6	Hot water leach	$BaSO_4$ precipitation	Gravimetry
7	Sulphide minerals decomposed with HCl; residue fused with Na_2CO_3 + KNO_3	$BaSO_4$ precipitation	Gravimetry
15,17,18	Boiled with 10% HCl for 1 h; sulphur in residue determined by Leco-furnace-iodiometry	Sulphate in total sulphur minus sulphur after HCl leach	Combustion-titrimetry
16	Boiled with 10% HCl for 1 h	Dissolved sulphate precipitated as $BaSO_4$	Gravimetry for UTS-1 to UTS-3 Turbidimetry for UTS-4

Table A-6j – Summary of analytical methods for nickel

Laboratory	Decomposition	Separation, reagents, procedure	Finish
1,3a,11	HNO_3 + $HClO_4$ + HF		ICP-AE
2,3b,4,5 6,7,9,10	HNO_3 + $HClO_4$ + HF		AA
8	Na_2O_2 + Na_2CO_3 fusion		AA

Table A-6k – Summary of analytical methods for arsenic

Laboratory	Decomposition	Separation, reagents, procedure	Finish
1	$HNO_3 + HClO_4 + HF$		ICP-AE
2,3	$K_2S_2O_7$ fusion	Arsine vapor evolution	AA
4,5,8	$HNO_3 + HClO_4 + HF$	Arsine vapor absorbed in silver dithiocarbamate-pyridine	Colorimetry
6,10		Instrumental neutron activation	NAA
7	$HNO_3 + HClO_4 + HF$	Molybdarsenate separation by extraction into chloroform-butanol and stripping into aqueous phase	Colorimetry
9	$HCl + HNO_3$	Arsine vapor evolution	AA
11	$HNO_3 + HClO_4$	Arsine vapor evolution	AA

Table A-7a – Consensus values and related statistical parameters for UTS-1

Constituent	No. of sets of results	Total No. of results	Consensus value	95% CL Low	95% CL High	σ_A
Fe(total)	12	60	4.87%	4.81	4.94	0.05
Ti	10	50	0.54%	0.51	0.57	0.01
Al	12	60	6.24%	6.15	6.33	0.06
Ca	11	55	5.24%	5.17	5.31	0.04
S(total)	10	50	1.00%	0.94	1.05	0.03
Sulphate	9	45	2.64%	2.58	2.71	0.04
Ba	11	55	324 µg/g	288	360	13
U	12	60	49 µg/g	44	54	3
Th	11	55	138 µg/g	130	147	6

Table A-7b – Consensus values and related statistical parameters for UTS-2

Constituent	No. of sets of results	Total No. of results	Consensus value	95% CL Low	95% CL High	σ_A
Fe(total)	12	60	3.20%	3.09	3.30	0.04
Ti	12	60	0.18%	0.16	0.21	0.01
Al	12	59	2.71%	2.65	2.76	0.04
Ca	12	60	0.42%	0.39	0.44	0.01
S(total)	11	55	3.23%	3.13	3.33	0.05
Sulphate	10	50	0.84%	0.76	0.92	0.01
Ba	11	55	464 µg/g	425	504	12
U	10	50	56 µg/g	55	57	2
Th	12	60	174 µg/g	162	187	6

Table A-7c – Consensus values and related statistical parameters for UTS-3

Constituent	No. of sets of results	Total No. of results	Consensus value	95% CL Low	95% CL High	σ_A
Fe(total)	12	60	3.25%	3.18	3.31	0.04
Ti	11	55	0.23%	0.21	0.24	0.007
Al	12	60	5.80%	5.66	5.94	0.04
Ca	10	50	4.03%	3.96	4.10	0.04
S(total)	10	50	0.23%	0.21	0.24	0.01
Sulphate	9	44	0.04%	0.01	0.08	0.005
Ba	11	55	212 µg/g	192	232	8
U	13	65	513 µg/g	497	529	9
Th	11	55	10.0 µg/g	8.6	11.4	1.4

Table A-7d – Consensus values and related statistical parameters for UTS-4

Constituent	No. of sets of results	Total No. of results	Consensus value	95% CL Low	95% CL High	σ_A
Fe(total)	11	54	2.62%	2.57	2.67	0.03
Ti	12	60	0.24%	0.22	0.26	0.008
Al	11	55	6.29%	6.20	6.38	0.05
Ca	11	55	1.75%	1.69	1.81	0.02
S(total)	13	65	1.80%	1.76	1.84	0.04
Sulphate	9	44	5.21%	5.15	5.28	0.04
Ba	12	60	65 µg/g	50	80	10
U	14	69	1010 µg/g	984	1036	19
Th	12	59	15.4 µg/g	13.2	17.5	1.0
Ni	12	60	151 µg/g	125	176	5
As	10	50	38 µg/g	36	40	2

Table A-8 – Approximate chemical composition values

Constituent	UTS-1	UTS-2	UTS-3	UTS-4
	mass %			
SiO_2	61.9	64.0	65.4	57.8
Na_2O	5.0	0.1	5.1	0.2
K_2O	2.0	2.0	0.3	0.4