EL1050272C

REF
EPS
PR
96-02
c.2

ENVIRONMENT CANADA
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC & YUKON REGION
WHITEHORSE, YUKON

BASELINE STUDY OF SEDIMENTS OF EAST, FAULT, FINLAYSON, GEONA AND SOUTH CREEKS (KUDZ ZE KAYAH PROJECT) YUKON

Regional Program Report No. 96-02

by

D. Davidge and R. Snider

December, 1996

ABSTRACT

In August of 1995, staff from the Yukon Division of Environmental Protection conducted a baseline study of sediments in the Finlayson Creek area south of Ross River, Yukon. The study was conducted in response to Cominco Ltd.'s proposed mine development in the area at their Kudz ze Kayah mining property on Geona Creek, a tributary of Finlayson Creek.

Sediment samples were collected from fourteen sites within the proposed development area. High levels of arsenic, cadmium, lead and zinc were reported along the upper reaches of Geona Creek, in Geona Creek near the ore deposit and in Fault Creek. The metals concentrations in stream sediments from the lower reaches of Geona Creek were relatively low. East Creek, a tributary to Finlayson Creek downstream of the Geona Creek confluence, had high concentrations of arsenic and zinc indicating the possibility of other small sources of metals in the area.

The high metal concentrations naturally present within the Finlayson Creek watershed reflect the effects of the mineralization in the area. Since the tailings would potentially be acid generating, careful mine planning and proper tailings impoundment design are particularly important in future development at the Kudz ze Kayah property.

Résumé

En août 1995, une étude de base des sédiments dans la région du ruisseau Finlayson, au sud de Ross River au Yukon, a été conduite par des employés de la division du Yukon de la Protection de l'Environnement. L'étude fût menée en réponse au projet de développement minier (Kudz Ze Kayah) proposé par Cominco Ltd. sur le ruisseau Geona, un tributaire du ruisseau Finlayson.

Les échantillons de sédiments ont été recoltés à quatorze stations près du projet minier. De haut niveaux d'arsenic, cadmium, plomb et zinc on été reportés le long du ruisseau Geona et Fault, près du dépôt minier. Les concentrations de métaux dans les sédiments des stations en aval du dépôt minier étaient relativement basses. Le ruisseau East, un tributaire du ruisseau Finlayson, en aval de Geona, avait de hautes concentrations d'arsenic et de zinc, indiquant la possibilité de nouvelles sources de métaux dans les environs.

Les taux de métaux présents naturellement indiquent les effets de la minéralisation dans la région. Puisque les résidus miniers sont potentiellement générateurs d'acide, un planification minière soignée et une conception appropriée de la digue retenant les résidus miniers sont particulièrement important dans le developement du projet Kudz Ze Kayah.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

1.0 INTRODUCTION

In August, 1995, staff from Environmental Protection (Yukon Division) conducted a baseline study of stream sediments in the Finlayson Creek watershed. The purpose of this study was to characterize the site conditions prior to development and update the baseline sediment database. Sediment samples were collected from East, Fault, Finlayson, Geona, and South Creeks. The selection of sample station locations within the study area were based on the mine development plans being proposed by the mining company, Cominco Limited. Most of the sample locations were in close proximity to the sample stations reported by Cominco Ltd. in their Initial Environmental Evaluation (Cominco Ltd., 1996).

Cominco plans to develop an open pit mine, ore concentrator and infrastructure associated with the mines operation at the Kudz ze Kayah property. They plan to mine 1,080,000 tonnes of ore per year for the production of saleable copper, lead and zinc concentrates. The tailings from the mine are expected to range from strongly potentially acid generating (SPAG) to potentially acid consuming rock (Cominco Ltd., 1996). The mine development will result in the complete alteration of the upper reaches of Geona Creek. The tailings pond effluent will discharge to the Geona and Finlayson Creek systems. Consideration by the mine compnay has also been given to discharging water from the pit de-watering system to South Creek.

2.0 STUDY AREA

The Kudz Ze Kayah ore deposit is located approximately 110 km south-east of Ross River (see Figure 1). The site is currently accessed by a 24 km all weather access road at km 220 of the Robert Campbell Highway. The area lies on the northern edge of the Pelly Mountains and is characterized by moderate terrain with generally open valleys and gentle slopes (Cominco Ltd.; 1996). The drainage area that is directly effected by the project is Geona Creek a tributary of Finlayson Creek.

The station numbering corresponds to those used by the company in their Initial Environmental Evaluation. A total of fourteen samples stations were established, of which twelve were in close proximity to existing sample sites. Station 7 was relocated downstream from it's original location to accommodate the proposed tailings pond area. An additional Station (EP1), which was not sampled in the environmental evaluation by Cominco Ltd., was added to characterize seepages from the west valley wall of Geona Creek within the mining area. Please refer to Table 1 for a descriptions of the stations and to Figure 2 for the sample station locations.

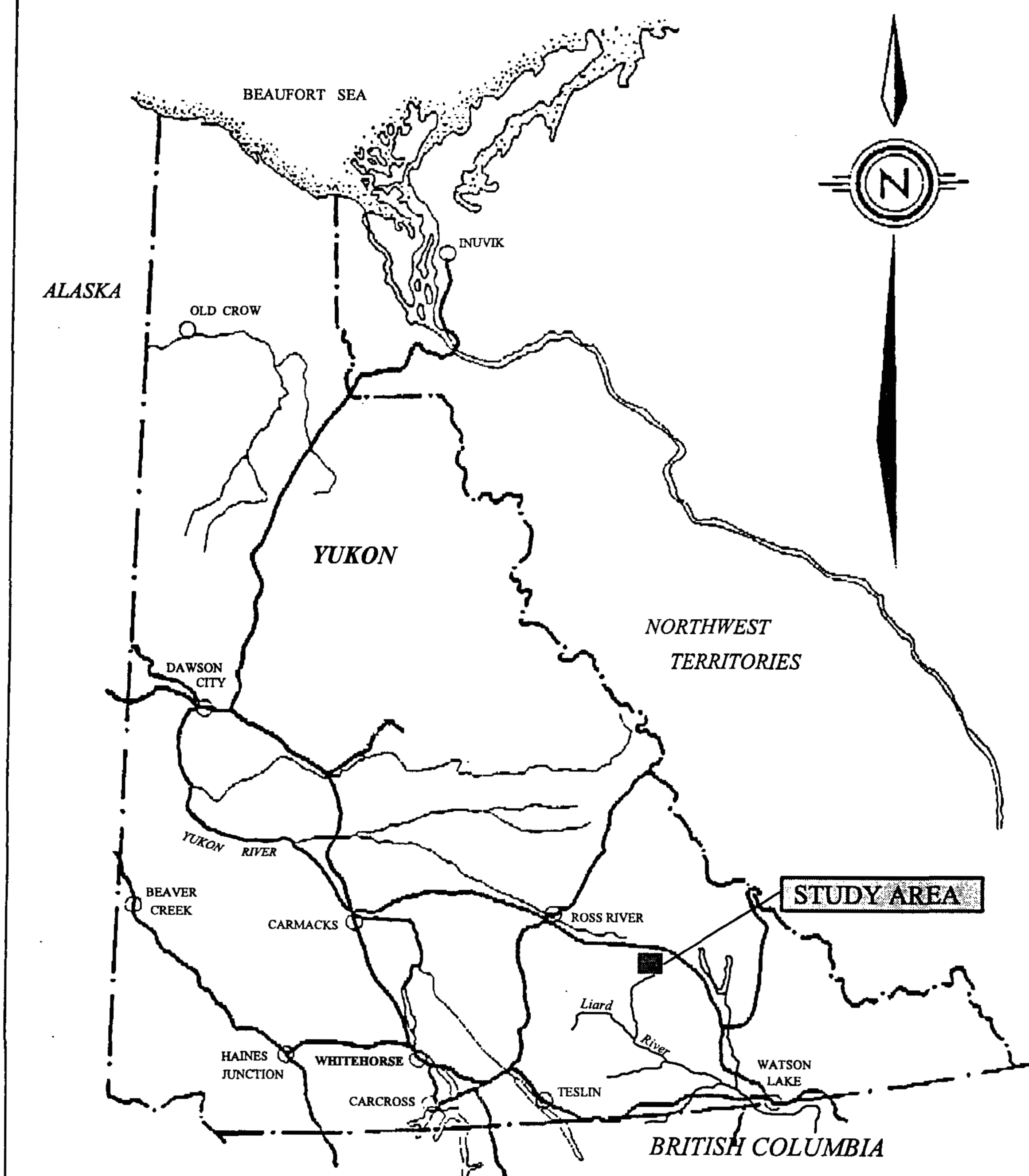

FIGURE 1: LOCATION OF OF STUDY AREA

TABLE 1 SAMPLE STATION DESCRIPTIONS

Station	Location	Comments
14	South Creek u/s of North Lake.	Wide creek composed of pond and riffle areas; boulders covered with fine sediments and algae; alpine vegetation.
13	South Creek at staff gauge.	Creek 1 m wide and 0.3 m deep; stream bed composed of boulders and fine sediments; grass and willows on both sides of creek. Staff gauge reading was 0.28 m.
3	Unnamed west-side tributary to Upper Lake in Geona Creek	Gravel and organic matter on creek bottom; dwarf birch and willow vegetation.
2	Fault Creek at staff gauge.	Creek 1.5 m wide and 5 cm deep; gravel bottom with little vegetation
EP1	Tote Road d/s of fuel tanks and culvert.	Upstream disturbances noticed; flow braided; creek 0.2 m wide.
5	Geona Creek u/s of weather station.	Creek enlarged in sample area; 2 m wide and 0.3 to 0.45 m deep; reduced water flow; sediments covered with iron hydroxide (red) coating; bed consists of fine sediments and gravel. Black band of sediment in the bottom of the core sampler noticed, indicates sulphate reduction.
7	Geona Creek, sample site relocated d/s to accommodate tailings pond area.	Vegetation in area consists of willows low shrubs; deep incised creek; bank 0.6 m high 0.75 m wide and 0.3 to 0.45 m deep; large boulders in creek; stream sediment characteristics influenced by bank erosion.

Station	Location	Comments
9	Geona Creek near staff gauge.	Bank being under cut; vegetation on both sides; creek 1 m wide; cobble riffle area. Staff gauge reading indicated that the creek was approximately 0.3 to 0.45 m deep.
17	Geona Creek immediately u/s of Finlayson.	Moss covered bottom; creek 2.5 m wide and 0.5 m deep at centre.
16	Finlayson Creek immediately u/s of Geona.	Creek 4 metres wide; 7- 10 cm deep with cobble on bottom.
15	Finlayson Creek d/s of Geona and Finlayson confluence.	Cobble noticed in riffle area; creek approximately 3.5 m wide.
21	East Creek near confluence with Finlayson.	Brownish red sediments encountered 300 to 500 m u/s of Geona Creek confluence. Large boulder with gravel and fines formed small island in creek; moss covered boulders noticed. <u>Left side of island</u> Willows and hanging vegetation present; water green-grey in colour; creek 2 m wide and 0.6 m deep; fast flowing. <u>Right side of island</u> Creek 2.5 m wide and 0.2 m deep; less hanging vegetation on this side of the island.
26	Finlayson Creek u/s of Campbell Highway.	Creek 6 to 7 m wide; riffle area noticed; gravel, cobbles and sands present on creek bed; some snags across the creek; willow and grass along the banks; coniferous vegetation surrounding creek.

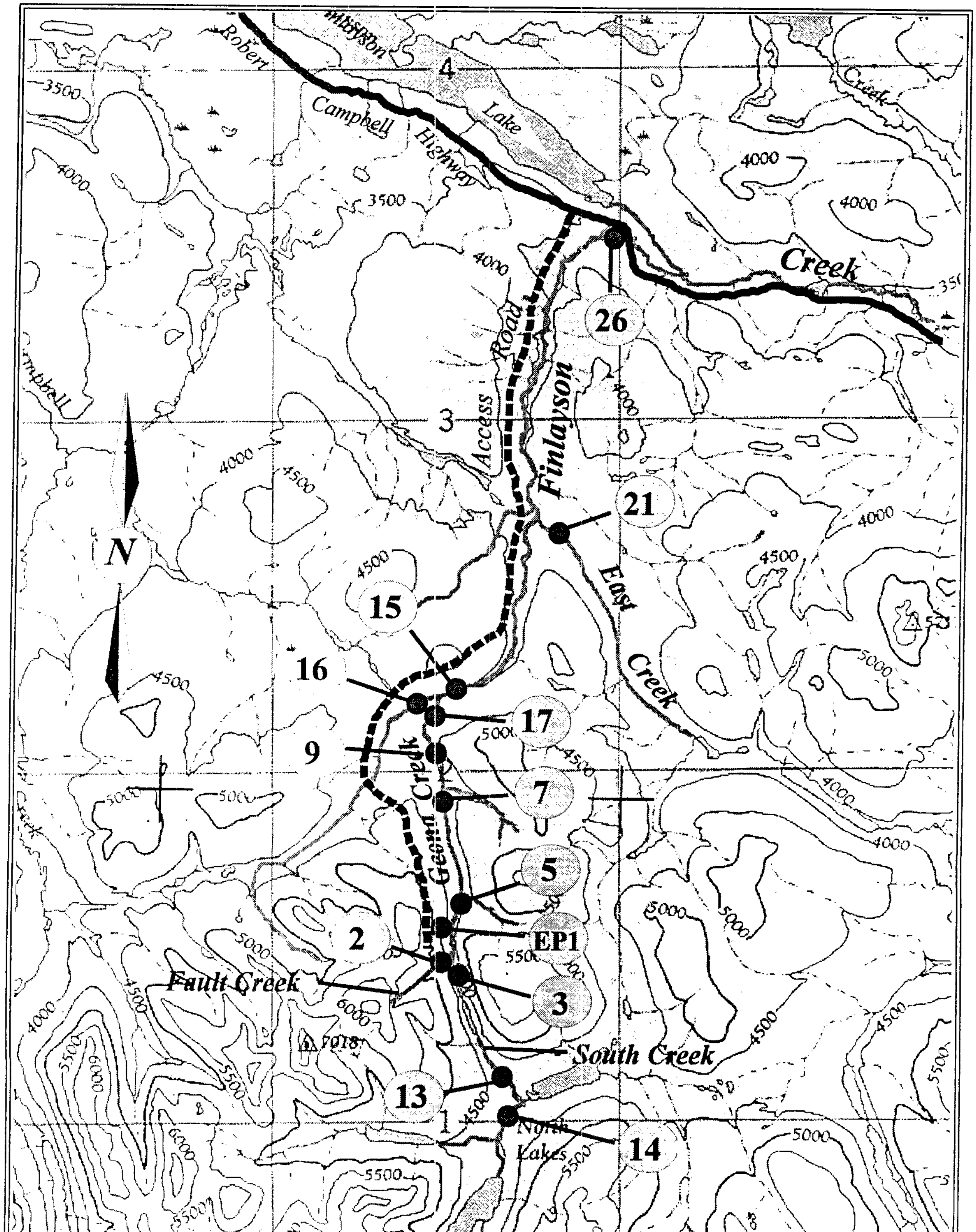

FIGURE 2: LOCATION OF SAMPLE STATIONS
Scale: 1cm = 2 km

3.0 METHODS

Environmental Protection staff collected sediment samples from the sample stations on August 29, 1995. All sites were accessed by helicopter, however, an all weather road does provide for access to many of the sample sites. Four replicate sediment samples were collected at each station using a plexiglass core tube. Each individual sediment grab sample was placed in acid washed 250 ml glass jar. Sediment samples below the 63 μm fraction size were later analyzed for the following metal concentrations:

Aluminium (Al)	Copper (Cu)	Silicon (Si)
Antimony (Sb)	Iron (Fe)	Silver (Ag)
Arsenic (As)	Lead (Pb)	Sodium (Na)
Barium (Ba)	Magnesium (Mg)	Strontium (Sr)
Beryllium (Be)	Manganese (Mn)	Tin (Sn)
Cadmium (Cd)	Molybdenum (Mo)	Titanium (Ti)
Calcium (Ca)	Nickel (Ni)	Vanadium (V)
Chromium (Cr)	Phosphorous (P)	Zinc (Zn)
Cobalt (Co)	Potassium (K)	

Sediment samples were submitted to the Pacific Environmental Science Centre in Vancouver for metals analysis and fixed and volatile residue analysis (SFR and SVR).

Sampling protocols and Quality Assurance/Quality Control (QA/QC) for field sampling were carried out in accordance with the "Sampling for Water Quality" (Environment Canada, 1983) and "The Inspector's Field Sampling Manual" (Environment Canada, 1995).

Systematic error and sample contamination during analysis at the Pacific Environmental Science Centre are minimised through duplicate analysis, procedural blanks and the use of standard reference materials. Internal lab quality control is carried out routinely in all water and sediment analysis before results are released.

4.0 RESULTS/CONCLUSIONS

The sediment metal analysis is provided in Appendix I. The total ICP metal concentrations, fixed residue and volatile residue and the average and standard deviation of the replicate samples are reported (the number of samples per site = 4). In addition, a reference standard (NTS 1646) was analyzed in triplicate for ICP metal and included in Appendix I.

Total metals concentrations for arsenic, cadmium, lead, and zinc at Stations 13 and 14 on South Creek were low relative to other sites sampled in the study area. The upper reaches of Geona Creek and the surrounding area had high levels of all or a combination of arsenic, cadmium, lead, and zinc. Station 3, an unnamed tributary of Geona Creek along the west valley wall, reported cadmium, lead and zinc levels of 9.63, 147 and 1607 µg/g, respectively. Station EP1 along the access road upstream of the road culvert had elevated values of arsenic, cadmium, lead and zinc of 102.8, 10.78, 211 and 2617 µg/g, respectively. The zinc concentration at station EP1 was the highest of all stations sampled. However, the high metal levels at station EP1 could be at least in part caused by the upstream disturbances. Station 5, farther downstream on Geona Creek, had elevated levels of cadmium, lead and zinc of 10.68, 115 and 1514 µg/g, respectively. Station 2, along Fault Creek displayed elevated zinc levels of 482 µg/g.

Stations 9 and 17 along Geona Creek reported some high metal levels. Station 9 had levels of arsenic, cadmium and zinc of 125.3, 12.23 and 844 µg/g, respectively. Station 17 displayed levels of 13.25 and 1256 µg/g of cadmium and zinc, respectively. The high concentrations at the stations along Fault and Geona Creek indicate that the area is being directly impacted by the ore body.

At Finlayson creek, immediately downstream of the confluence with Geona Creek (station 15), the metal levels were lower, with cadmium and zinc concentrations of 5.88 and 496 µg/g respectively. The lower values were expected since Finlayson Creek upstream of Geona Creek confluence did not display high levels of either arsenic, cadmium, lead or zinc.

Based on the metal concentrations observed in the downstream section of Geona Creek it was predicted that station 7 would also have high levels. However, the concentrations of most metals at station 7 were among the lowest of all the stations sampled. The low values are likely the result of the dilution of the existing sediments due to the recent introduction of terrestrial soil into the stream as a result of stream bank erosion.

East Creek showed levels of arsenic and cadmium of 187.5 and 3.50 µg/g, respectively. Although East Creek is several kilometers from where the main mineralized deposit is located on Geona Creek, the sediment metals results from Station 21 indicate that other mineralization may occur nearby. The cadmium values were the highest reported at all of the stations sampled.

The high concentrations of arsenic, cadmium, lead and zinc at many of the stations indicate that East, Fault, Finlayson and Geona Creeks are influenced by the Kudz ze Kayah mineral deposit and possible other deposits in the area. Development of the ore body by Cominco Limited may potentially increase the heavy metals concentrations in stream sediments. Preventative measures may be required to mitigate impacts from any future mine development.

REFERENCES

Cominco Ltd., *Initial Environmental Evaluation, Kudz Ze Kayah project, Yukon Territory. Volume 1.* February, 1996.

Environment Canada, *Conservation and Protection Laboratory Standard Operating Procedures Manual*, 1992 Update.

Environment Canada, Sampling for Water Quality, Water Quality Branch, Inland Waters Directorate, Ottawa, 1983.

Environment Canada, The Inspector's Field Sampling Manual, Environment Canada, 1995.

APPENDIX I

Stream Sediment Data

APPENDIX 1 TABLE 1

SEDIMENT ANALYSIS FOR AUGUST 29, 1995

Station	ICP Total Ag (ug/g)	ICP Total Al (ug/g)	ICP Total As (ug/g)	ICP Total Ba (ug/g)	ICP Total Be (ug/g)	ICP Total Ca (ug/g)	ICP Total Cd (ug/g)	ICP Total Co (ug/g)	ICP Total Cr (ug/g)	ICP Total Cu (ug/g)	ICP Total Fe (ug/g)
2	< 1.0	14180	18.3	189	0.8	9580	3.2	10.8	67	39.2	29825
	+/- 0.0	+/- 1815	+/- 1.0	+/- 17	+/- 0.1	+/- 1606	+/- 0.3	+/- 0.5	+/- 36	+/- 3.5	+/- 1580
3	1.8	21963	21.8	374	0.4	8140	9.6	8.1	43	71.7	24983
	+/- 0.5	+/- 3800	+/- 1.7	+/- 108	+/- 0.4	+/- 1533	+/- 5.0	+/- 1.3	+/- 5	+/- 15.3	+/- 1946
5	1.8	30723	43.5	700	1.2	9598	10.7	22.3	66	88.9	68850
	+/- 0.5	+/- 3199	+/- 13.8	+/- 274	+/- 0.2	+/- 887	+/- 5.4	+/- 1.8	+/- 4	+/- 12.0	+/- 30768
7	< 1.0	17475	9.5	151	0.6	9410	0.9	10.8	45	26.2	34910
	+/- 0.0	+/- 878	+/- 0.6	+/- 26	+/- 0.1	+/- 437	+/- 0.2	+/- 0.5	+/- 2	+/- 1.9	+/- 2190
9	3.0	17578	125.3	775	0.9	19198	12.2	26.8	70	56.9	72200
	+/- 0.8	+/- 889	+/- 37.1	+/- 172	+/- 0.1	+/- 2197	+/- 1.7	+/- 2.8	+/- 21	+/- 8.8	+/- 10729
13	< 1.3	21048	9.8	571	0.1	13233	1.4	13.4	56	23.4	29045
	+/- 0.5	+/- 2371	+/- 3.1	+/- 128	+/- 0.0	+/- 438	+/- 0.6	+/- 2.3	+/- 7	+/- 3.7	+/- 5161
14	< 1.3	22335	20.5	499	0.5	11550	0.9	15.9	84	31.0	41963
	+/- 0.5	+/- 721	+/- 3.9	+/- 73	+/- 0.4	+/- 1015	+/- 0.1	+/- 1.0	+/- 6	+/- 3.4	+/- 3638
15	< 1.0	19755	67.5	587	0.8	12838	5.9	24.1	95	51.7	55433
	+/- 0.0	+/- 1726	+/- 7.2	+/- 75	+/- 0.1	+/- 1851	+/- 1.9	+/- 1.3	+/- 40	+/- 3.3	+/- 2529
16	< 1.0	20843	39.5	334	0.8	11525	2.0	20.4	98	44.2	48215
	+/- 0.0	+/- 1000	+/- 2.9	+/- 24	+/- 0.1	+/- 310	+/- 0.5	+/- 1.4	+/- 19	+/- 4.4	+/- 2746
17	4.0	19205	96.8	937	1.0	15660	13.3	24.8	61	45.8	65100
	+/- 0.8	+/- 2057	+/- 9.5	+/- 41	+/- 0.1	+/- 762	+/- 1.3	+/- 1.1	+/- 6	+/- 2.2	+/- 909
21	2.0	16263	187.5	731	1.0	18673	3.5	20.8	61	25.2	* 50550
	+/- 0.8	+/- 1314	+/- 13.5	+/- 35	+/- 0.1	+/- 1784	+/- 0.4	+/- 1.2	+/- 9	+/- 3.1	+/- 33788
26	< 1.3	24490	51.0	748	1.0	15210	1.6	17.3	91	53.4	46925
	+/- 0.5	+/- 6040	+/- 3.6	+/- 172	+/- 0.1	+/- 1393	+/- 0.1	+/- 0.8	+/- 32	+/- 6.0	+/- 2248
EP1	2.8	25493	102.8	442	0.1	9820	10.8	15.1	55	104.5	39800
	+/- 1.0	+/- 1877	+/- 21.7	+/- 69	+/- 0.0	+/- 550	+/- 2.3	+/- 1.2	+/- 5	+/- 9.0	+/- 2166
Reference Standard	< 1.0	29893	9.7	80	1.0	4443	0.7	7.9	52	16.9	30033
(NTS1646)	+/- 0.0	+/- 2411	+/- 0.6	+/- 11	+/- 0.0	+/- 161	+/- 0.0	+/- 0.3	+/- 3	+/- 0.5	+/- 767

APPENDIX 1 TABLE 1

SEDIMENT ANALYSIS FOR AUGUST 29, 1995

Station	:P Total K (ug/g)	ICP Total Mg (ug/g)	ICP Total Mn (ug/g)	ICP Total Mo (ug/g)	ICP Total Na (ug/g)	ICP Total Ni (ug/g)	ICP Total P (ug/g)	ICP Total Pb (ug/g)	ICP Total Sb (ug/g)	ICP Total Si (ug/g)	ICP Total Sn (ug/g)
2	5462	6328	904	6.0	113	51	1225	80	< 7.0	879	21.0
	+/- 644	+/- 552	+/- 69	+/- 2.7	+/- 25	+/- 25	+/- 96	+/- 10	+/- 0.0	+/- 50	+/- 12.5
3	4355	7720	362	1.8	538	26	1060	147	11.0	860	< 7.0
	+/- 1029	+/- 404	+/- 47	+/- 0.5	+/- 242	+/- 5	+/- 162	+/- 51	+/- 2.0	+/- 46	+/- 0.0
5	7882	12500	3268	2.8	250	65	1350	115	< 8.0	941	< 7.0
	+/- 943	+/- 983	+/- 2628	+/- 1.3	+/- 43	+/- 14	+/- 195	+/- 13	+/- 1.4	+/- 73	+/- 0.0
7	2721	9013	473	2.0	135	30	2150	27	< 7.0	950	< 7.0
	+/- 193	+/- 390	+/- 60	+/- 0.0	+/- 25	+/- 2	+/- 52	+/- 4	+/- 0.0	+/- 71	+/- 0.0
9	2934	10365	9708	7.0	143	131	2788	40	< 7.0	1440	10.0
	+/- 344	+/- 1228	+/- 3091	+/- 2.0	+/- 29	+/- 21	+/- 332	+/- 8	+/- 0.0	+/- 175	+/- 5.4
13	3974	8163	1898	< 2.0	310	40	2025	29	9.5	901	< 7.0
	+/- 555	+/- 1047	+/- 970	+/- 1.2	+/- 29	+/- 11	+/- 209	+/- 4	+/- 1.0	+/- 12	+/- 0.0
14	4539	11400	1727	3.5	365	113	1700	33	7.8	930	< 7.0
	+/- 69	+/- 648	+/- 743	+/- 0.6	+/- 35	+/- 19	+/- 26	+/- 4	+/- 1.5	+/- 50	+/- 0.0
15	3176	10503	5920	8.0	205	139	2245	48	< 7.0	1148	21.3
	+/- 349	+/- 832	+/- 1381	+/- 4.7	+/- 31	+/- 28	+/- 200	+/- 19	+/- 0.0	+/- 151	+/- 26.5
16	2973	12825	1775	5.5	178	84	2018	36	< 7.3	977	16.0
	+/- 274	+/- 922	+/- 253	+/- 1.3	+/- 15	+/- 17	+/- 128	+/- 7	+/- 0.5	+/- 44	+/- 4.7
17	3665	9398	15875	7.3	223	203	2365	35	< 8.5	1121	< 7.0
	+/- 621	+/- 663	+/- 1803	+/- 1.9	+/- 25	+/- 9	+/- 88	+/- 6	+/- 1.7	+/- 161	+/- 0.0
21	3164	9405	* 5052	< 1.5	248	132	2248	24	< 7.0	1195	< 9.8
	+/- 405	+/- 956	+/- 1998	+/- 1.0	+/- 33	+/- 14	+/- 56	+/- 12	+/- 0.0	+/- 77	+/- 4.9
26	6342	12958	1686	4.3	310	116	1508	36	< 8.3	969	< 19.0
	+/- 2540	+/- 2962	+/- 278	+/- 1.9	+/- 88	+/- 31	+/- 67	+/- 18	+/- 1.5	+/- 121	+/- 22.0
EP1	4556	8585	967	2.0	403	31	1353	211	20.5	869	< 7.0
	+/- 208	+/- 491	+/- 299	+/- 0.0	+/- 105	+/- 2	+/- 130	+/- 67	+/- 2.1	+/- 53	+/- 0.0
Reference Standard	7358	9263	261	1.7	10567	26	567	22	< 7.0	943	< 7.0
(NTS1646)	+/- 792	+/- 247	+/- 9	+/- 0.6	+/- 153	+/- 1	+/- 15	+/- 4	+/- 0.0	+/- 43	+/- 0.0

APPENDIX 1 TABLE 1

SEDIMENT ANALYSIS FOR AUGUST 29, 1995

Station		Total Sr (ug/g)		ICP Total Ti (ug/g)		ICP Total V (ug/g)		ICP Total Zn (ug/g)		SFR (mg/kg)		SVR (mg/kg)
2		36		958		30		482		979500		20400
	+/-	4	+/-	265	+/-	5	+/-	19	+/-	3317	+/-	3161
3		39		2172		54		1607		926000		74000
	+/-	10	+/-	386	+/-	9	+/-	548	+/-	11165	+/-	11039
5		46		1902		80		1514		878500		121500
	+/-	7	+/-	278	+/-	5	+/-	233	+/-	5802	+/-	5802
7		40		1824		59		265		959250		40750
	+/-	3	+/-	135	+/-	3	+/-	12	+/-	1893	+/-	2004
9		83		1103		65		844		894250		105750
	+/-	6	+/-	148	+/-	3	+/-	190	+/-	23908	+/-	23928
13		61		3290		74		214		951500		48475
	+/-	2	+/-	430	+/-	7	+/-	44	+/-	11475	+/-	11678
14		53	*	2506		73		188		887750		112325
	+/-	7	+/-	421	+/-	2	+/-	9	+/-	14292	+/-	14192
15		61		1459		78		496	**	909333	**	90733
	+/-	9	+/-	106	+/-	6	+/-	118	+/-	10263	+/-	10269
16		48		1881		84		188		946000		53850
	+/-	4	+/-	239	+/-	2	+/-	10	+/-	9129	+/-	9223
17		82		1159		64		1256		857500		142500
	+/-	3	+/-	204	+/-	6	+/-	139	+/-	8103	+/-	8103
21		93		1030		61		248		857750		142250
	+/-	2	+/-	184	+/-	4	+/-	13	+/-	15392	+/-	15392
26		74		832		99		205		918000		81733
	+/-	6	+/-	149	+/-	28	+/-	13	+/-	918001	+/-	6213
EP1		49		3088		69		2617		930500		69300
	+/-	4	+/-	272	+/-	4	+/-	219	+/-	8660	+/-	8924
Reference Standard		38		939		65		116		Not Done		Not Done
(NTS1646)	+/-	2	+/-	63	+/-	3	+/-	1				