



REGIONAL DRAINAGE SEDIMENT AND WATER GEOCHEMICAL DATA

ANAHIM LAKE & NECHAKO RIVER, CENTRAL BRITISH COLUMBIA (NTS 93C & 93F)

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INTRODUCTION

During the 2005 field season, Geoscience BC funded two reconnaissance-scale drainage sediment and water surveys that were completed in central British Columbia (Figure 1). These surveys contribute to an ongoing effort to complete first-level geochemical coverage of the province, complement existing publicly available geochemical data sets and provide the mining and exploration community with new, high-quality geochemical information.

Geoscience BC Report 2006-4 includes results of the 2005 Anahim Lake (NTS 93C) and Nechako River (NTS 93F) surveys. The data has been provided in a variety of digital formats. In addition, data from previous lake sediment surveys¹ conducted within the survey areas have been incorporated into the package. PDF files include survey descriptions and details regarding methods, field and analytical data listings, summary statistics, sample location map, geology map and maps for individual metals. Raw digital data files used in the production process are included in XLS and DBF formats and basemap coverages as Arc SHP files. The results are also available on the BC Government's MapPlace web site.

SURVEY AREA DESCRIPTION

The Anahim Lake and Nechako River map sheets are situated in the Nechako Basin of central British Columbia, in a region of low relief characterized by large expanses of flat and gently rolling landscape (Photo 1). The surface of the Nechako and Fraser plateaus is generally between 1200 and 1500 metres in elevation and comprises a wide variety of physiographic environments, ranging from rocky subalpine peaks to boggy lowlands. To the north, the Fawnie and Nechako ranges break up the plateau landscape, and the Ilgachuz and Itcha ranges interrupt the Fraser Plateau. In the southwest corner, the rugged Coast Mountain Range extends into the study area. The plateaus are mostly forested with subboreal spruce and pine, and are generously dotted

¹ Cook, S.J. and Jackaman, W. (1994): Regional lake sediment and water geochemistry of part of the Nechako River map area (93F/2,3; parts of 93F/6, 11, 12, 13, 14); *BC Ministry of Energy, Mines and Petroleum Resources*, Open File 1994-19.

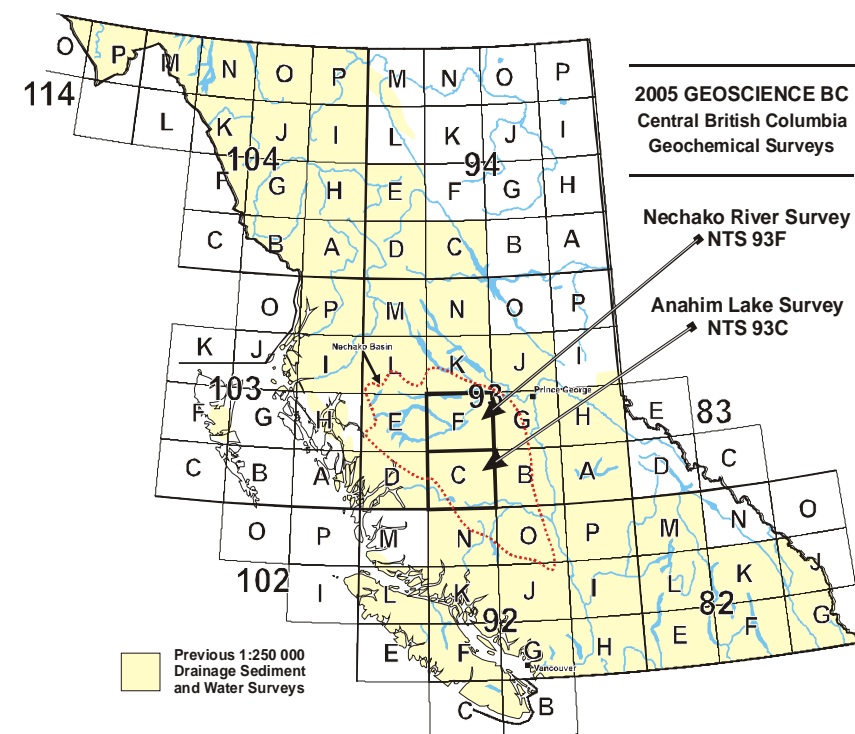


Figure 1. Location of Anahim Lake and Nechako River drainage sediment and water geochemical survey areas, central BC.

with small to medium-sized lakes, as well as extensive wetland systems. Throughout the region, the northern pine beetle kill has significantly impacted extensive areas of forest cover.

The Nechako Basin is bounded to the north by the Skeena Arch, to the west and south by the Coast Plutonic Complex and to the east by the Cache Creek Group. The area is covered by extensive mafic to felsic volcanic flows of Tertiary to recent age, and much of the region is covered with thick glacial drift that has left very little exposed bedrock (Map 2). Less than one hundred mineral occurrences are currently listed in the provincial mineral inventory database (MINFILE). Several of the more important deposits include epithermal Au-Ag occurrences. These include Wolf (093F 045) and



Photo 1. Typical landscape in southern Nechako Plateau.

Oboy (093C 015), hosted by Ootsa Lake Group felsic volcanic rocks, and the 3Ts developed prospect (Tsacha [093F055], Taken [093F055] and Tam claims), occurring in Hazelton Group intermediate volcanic rocks. Also important are Mo and Cu porphyry occurrences associated with Tertiary intrusions (*e.g.*, C, 093F 004) and porphyry-related precious and base metal mineralization (*e.g.*, Capoose, 093F 040), hosted by Hazelton Group intermediate volcanic rocks associated with crosscutting rhyolitic dikes of Cretaceous age.

SAMPLE COLLECTION

The surveys incorporated methods and specifications that were developed from orientation studies completed by Stephen Cook² in 1992 as well as sampling strategies

² Cook, S.J. (1993a): Preliminary report on lake sediment geochemistry in the northern Interior Plateau, Central British Columbia; *in* geological fieldwork 1992, *BC EMPR*, Paper 1993-1, pages 475-481.

used elsewhere in Canada for the NGR program³. These methods have been successfully used in BC during previous lake sediment programs conducted in the Interior Plateau and parts of northern BC.

Helicopter-supported sample collection was carried out from July to September 2005, during which 2070 drainage sediment and water samples were systematically collected from 1957 sites. Within the low-lying areas, lake sediment and water were collected from 1855 sites. In the Anahim Lake map sheet, stream sediment material was collected from 102 sites in areas of greater relief near Mount Dent and Charlotte Lake. The surveys covered a total area of 19 500 square kilometres and the average sample site density was 1 site per 9.9 square kilometres. In 1993, two lake sediment and water geochemistry surveys were completed in the Fawnie Range and Ootsa Lake areas. At this time a total of 489 sediment and water samples were collected at an average sample density of 1 site per 10.5 square kilometres. Field duplicate sediment and water samples were routinely collected in each analytical block of twenty samples.

Lake sites were accessed using a float-equipped Bell Jet Ranger helicopter (Photo 2). The sampling crews collected sediment material with a torpedo style sampler. Lake water samples are collected prior to deploying the torpedo and were taken approximately 15 centimetres below the lake surface in pre-labeled 250-millilitre water bottles. Sediment and water samples were successfully collected from most of the lakes located in the survey areas. However, some of the smaller ponds were not sampled due to poor landing conditions, and samples were not collected from several very large and deep lakes. Lake bottom material typically consisted of organic gels with varying amounts of organic matter. Field observations and site locations were recorded for each site.

SAMPLE PREPARATION

The bags containing the sediment samples were catalogued and drip dried at a field camp. At the end of the field programs, samples were shipped to a commercial lab,

³ Friske, P.W.B. (1991): The application of lake sediment geochemistry; *in* mineral exploration; *in* Exploration Geochemistry Workshop, *Geological Survey of Canada*, Open File 2390, pages 4.1-4.20.



Photo 2. Regional lake sediment and water sampling in the Nechako Plateau using a float equipped helicopter (Fish Lake, June 2005).

where they were air-dried at temperatures below 40°C. After drying, lake sediment samples were pulverized to approximately minus 150 mesh (100 µm) in a ceramic ring mill, and stream sediment samples were sieved through a nylon screen to minus 80-mesh (<177 µm). Analytical splits were extracted from the material for analysis. To monitor and assess accuracy and precision of analytical results, control reference material and analytical duplicate samples were routinely inserted into each block of twenty sediment samples.

SAMPLE ANALYSIS

The sediment samples collected in 2005 were analyzed for base and precious metals, pathfinder elements and rare earth elements by inductively coupled plasma – mass spectrometry (ICPMS) and instrumental neutron activation analysis (INAA). Loss-on-ignition and fluorine were also determined for sediment material. Fluoride,

conductivity and pH were determined for the water samples. A complete list of elements and analytical detection limits is provided in Tables 1 and 2.

Table 1. 2005 Detection Limits: ICPMS.

Element		Detection Limit	Units	Method
Aluminum	Al	0.01	%	ICPMS
Antimony	Sb	0.02	ppm	ICPMS
Arsenic	As	0.1	ppm	ICPMS
Barium	Ba	0.5	ppm	ICPMS
Bismuth	Bi	0.02	ppm	ICPMS
Cadmium	Cd	0.01	ppm	ICPMS
Calcium	Ca	0.01	%	ICPMS
Chromium	Cr	0.5	ppm	ICPMS
Cobalt	Co	0.1	ppm	ICPMS
Copper	Cu	0.01	ppm	ICPMS
Gallium	Ga	0.1	ppm	ICPMS
Gold	Au	0.2	ppb	ICPMS
Iron	Fe	0.01	%	ICPMS
Lanthanum	La	0.5	ppm	ICPMS
Lead	Pb	0.01	ppm	ICPMS
Magnesium	Mg	0.01	%	ICPMS
Manganese	Mn	1	ppm	ICPMS
Mercury	Hg	5	ppb	ICPMS
Molybdenum	Mo	0.01	ppm	ICPMS
Nickel	Ni	0.1	ppm	ICPMS
Phosphorus	P	0.001	%	ICPMS
Potassium	K	0.01	%	ICPMS
Scandium	Sc	0.1	ppm	ICPMS
Selenium	Se	0.1	ppm	ICPMS
Silver	Ag	2	ppb	ICPMS
Sodium	Na	0.001	%	ICPMS
Strontium	Sr	0.5	ppm	ICPMS
Sulphur	S	0.01	%	ICPMS
Tellurium	Te	0.02	ppm	ICPMS
Thallium	Tl	0.02	ppm	ICPMS
Thorium	Th	0.1	ppm	ICPMS
Titanium	Ti	0.001	%	ICPMS
Tungsten	W	0.1	ppm	ICPMS
Uranium	U	0.1	ppm	ICPMS
Vanadium	V	2	ppm	ICPMS
Zinc	Zn	0.1	ppm	ICPMS

Table 2. 2005 Detection Limits: INAA, F, LOI and Waters.

Element		Detection Limit	Units	Method
Antimony	Sb	0.1	ppm	INAA
Arsenic	As	0.5	ppm	INAA
Barium	Ba	50	ppm	INAA
Bromine	Br	0.5	ppm	INAA
Cerium	Ce	5	ppm	INAA
Cesium	Cs	0.5	ppm	INAA
Chromium	Cr	20	ppm	INAA
Cobalt	Co	5	ppm	INAA
Europium	Eu	1	ppm	INAA
Gold	Au	2	ppb	INAA
Hafnium	Hf	1	ppm	INAA
Iron	Fe	0.2	%	INAA
Lanthanum	La	2	ppm	INAA
Lutetium	Lu	0.2	ppm	INAA
molybdenum	Mo	1	ppm	INAA
Rubidium	Rb	5	ppm	INAA
Samarium	Sm	0.1	ppm	INAA
Scandium	Sc	0.2	ppm	INAA
Sodium	Na	0.02	%	INAA
Tantalum	Ta	0.5	ppm	INAA
Terbium	Tb	0.5	ppm	INAA
Thorium	Th	0.2	ppm	INAA
Tungsten	W	1	ppm	INAA
Uranium	U	0.2	ppm	INAA
Ytterbium	Yb	2	ppm	INAA
Sample Weight	Wt	0.01	gm	GRAV
Fluorine	F	10	ppm	ION
Loss on Ignition	LOI	0.1	%	GRAV
pH	PH			ISE
Fluoride	FW	20	ppb	ION
Conductivity	CND	0.01	uS	ISE

Instrumental Neutron Activation Analysis (INAA)

Weighed and encapsulated samples were packaged for irradiation along with internal standards and international reference materials. Samples and standards were irradiated together with neutron flux monitors in a two-megawatt pool type reactor. After a seven-day decay period, samples were measured with a high-resolution germanium detector. Typical counting times were 500 seconds. Elements determined by INAA are listed in Table 1. Data for silver, cadmium, iridium, nickel, selenium, tin,

tellurium, zinc, and zirconium are not published because of inadequate detection limits and/or precision.

Inductively Coupled Plasma Mass Spectrometry (ICPMS)

For the determination of 36 elements listed in Table 2, a 0.5-gram sample was leached with 3 ml of a mixture of HCl, HNO₃, and distilled, deionized water (2:2:2 v/v) at 95°C for one hour. The sample solution was diluted to 10 ml and analysed by inductively coupled plasma emission spectroscopy on a Jarell-Ash instrument and inductively coupled plasma mass spectrometry on a Perkin-Elmer Elan instrument. Data for boron was not published because of inadequate detection limits and/or precision.

Other Sediment Analyses

Loss-on-ignition was determined using a 1-gram sample. The sample, weighed into a Leco® crucible, was placed into a 100°C muffle furnace and brought up to 500° C for one hour. The oven was cooled to 100°C and crucibles transferred to a desiccator for cooling to room temperature. The crucibles were re-weighed, and the difference was reported as loss-on-ignition (GRAV).

To measure fluorine, a 0.25-gram sample was fused with 1-gram of sodium carbonate-sodium nitrate. After being leached with metal free water for 1 hour, 10 ml of 10% citric acid solution is added. Fluoride was measured using specific ion electrode analysis (ION).

Water Analysis

The pH of waters was determined using a Hanna Instruments pH/EC/TDS meter with automatic temperature compensation, a range of 0.00 to +14.0 pH, resolution of 0.01 pH and an accuracy of ±0.01 pH. Meters were calibrated using commercial buffer solutions with pH values of 4.0, 7.0 and 10.0.

Conductivity of waters was determined using a Hanna Instruments pH/EC/TDS meter with automatic temperature compensation and a range of 4000 µS/cm, a

resolution of 1 $\mu\text{S}/\text{cm}$ and a full-scale accuracy of $\pm 1\%$. Meters were calibrated using commercial conductivity standards.

Fluoride in waters was determined by specific ion electrode analysis (ION).

DATA PRESENTATION

Geochemical information compiled in this report includes field and analytical results from samples collected during regional surveys conducted in 2005 (N = 2068) and surveys originally conducted in 1993 (N = 489). Results from each survey have been determined to be accurate and complete. With the exception of silver and bismuth, analytical results from the previous 1993 surveys have been incorporated with the 2005 results into a single data set.

It should be noted that the data is being presented in its raw form. As a result, inherent variations between the data sets may exist. These differences can be attributed to the analytical methods used and associated detection limits. The most recent surveys utilized ICPMS analysis by Acme Labs (Vancouver) and INAA by Becquerel Labs (Mississauga, Ont.). In 1993, Barringer Magenta Laboratories (Calgary) analyzed sediment samples by atomic absorption spectroscopy (AAS) and INAA was completed by Activation Labs (Ancaster, Ont.). Table 3 provides a complete list of elements and analytical detection limits reported in 1993.

The 2005 data package has been prepared as a PDF document and presents survey results in three appendices that are described as follows:

Appendix 'A': Is a complete listing of site location information, field observations and analytical results for the 2005 and 1993 surveys. Tables preceding the data listings define codes used for field observations and underlying geology.

Appendix 'B': Presents summary statistics for individual elements and a more detailed summary based on the underlying bedrock geology determined at each sample site. The calculations have been determined from raw data

Table 3. 1993 Analytical Summary.

Element		Detection		
		Limit	Units	Method
Antimony	Sb	0.2	ppm	AAS
Arsenic	As	0.2	ppm	AAS
Bismuth	Bi	0.2	ppm	AAS
Cadmium	Cd	0.1	ppm	AAS
Cobalt	Co	2	ppm	AAS
Copper	Cu	2	ppm	AAS
Iron	Fe	0.02	%	AAS
Lead	Pb	2	ppm	AAS
Magnesium	Mg	5	%	AAS
Mercury	Hg	10	ppb	AAS
Molybdenum	Mo	1	ppm	AAS
Nickel	Ni	2	ppm	AAS
Silver	Ag	0.2	Ppm	AAS
Vanadium	V	5	ppm	AAS
Zinc	Zn	2	ppm	AAS
Antimony	Sb	0.1	ppm	INAA
Arsenic	As	0.5	ppm	INAA
Barium	Ba	50	ppm	INAA
Bromine	Br	0.5	ppm	INAA
Cerium	Ce	3	ppm	INAA
Cesium	Cs	1	ppm	INAA
Chromium	Cr	5	ppm	INAA
Cobalt	Co	1	ppm	INAA
Europium	Eu	0.2	ppm	INAA
Gold	Au	2	ppb	INAA
Hafnium	Hf	1	ppm	INAA
Iron	Fe	0.01	%	INAA
Lanthanum	La	0.5	ppm	INAA
Lutetium	Lu	0.05	ppm	INAA
Molybdenum	Mo	1	ppm	INAA
Neodymium	Nd	5	ppm	INAA
Rubidium	Rb	5	ppm	INAA
Samarium	Sm	0.1	ppm	INAA
Scandium	Sc	0.1	ppm	INAA
Sodium	Na	0.01	%	INAA
Tantalum	Ta	0.5	ppm	INAA
Terbium	Tb	0.5	ppm	INAA
Thorium	Th	0.2	ppm	INAA
Tungsten	W	1	ppm	INAA
Uranium	U	0.5	ppm	INAA
Ytterbium	Yb	0.2	ppm	INAA
Loss on Ignition	LOI	0.1	%	GRAV
Fluoride	FW	20	ppb	ION
pH	PH			ISE

combined from the 2005 and 1993 surveys. For the 2005 data, values reported by the labs at less than detection limit have been set to half the detection limit. Data from the previous 1993 surveys is being used as originally published. At this time gold values below detection limit were set at half the detection limit and all other results reported below detection limits had been set to the detection limit. Silver and bismuth results from the 1993 surveys have been excluded due to poor compatibility with the 2005 results.

Appendix 'C': Includes a sample location map, simplified geology and mineral occurrence map and proportional symbol maps for each element. Symbol size and colour reflects data ranges that are based on the 30th, 50th, 70th, 90th and 95th percentiles as determined from the raw data. Maximum symbol size is assigned to values greater than the 95th percentile. Portraying high values with large, bold symbols, with background values represented by relatively smaller dots, helps highlight regional trends and anomalous sample sites.

The data summary presented in this package is not considered exhaustive. In order to accommodate more detailed assessments, raw digital data files have been included in XLS and DBF formats and digital base map coverages have been included as Arc SHP files.

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Preparation:	ACME Analytical Laboratories Ltd., Vancouver, BC
Analysis:	ACME Analytical Laboratories Ltd., Vancouver, BC Becquerel Laboratories Ltd., Mississauga, Ont

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