**Geological Survey of Canada Open File 1642**
**(Parts of 74C and 74F)**
**CANADA – SASKATCHEWAN MINERAL DEVELOPMENT AGREEMENT (1984 – 1989)**

# REGIONAL LAKE SEDIMENT AND WATER GEOCHEMICAL DATA, NORTHWESTERN SASKATCHEWAN


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|---|---|
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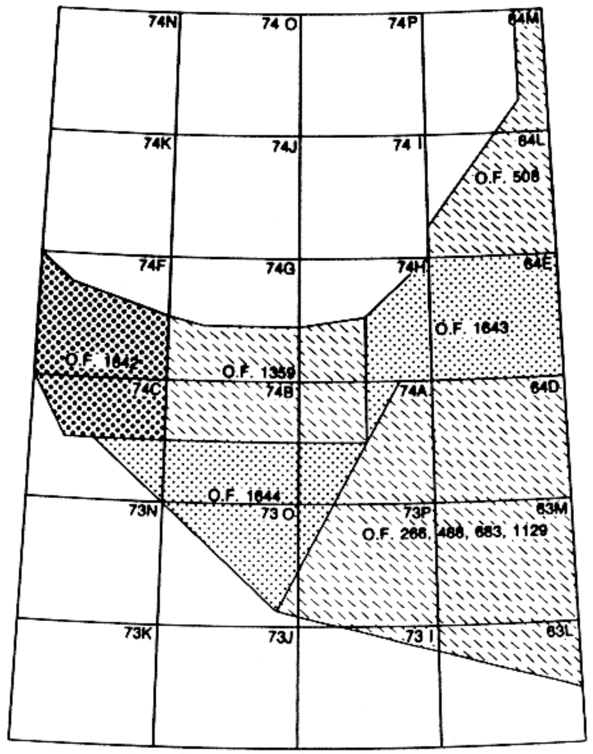
**REGIONAL LAKE SEDIMENT AND WATER GEOCHEMICAL DATA, SASKATCHEWAN 1988,**
**GSC OPEN FILE 1642, NGR 107-1988,**
**PARTS OF NTS 74C, 74F**




NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX
TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS

SYSTÈME NATIONAL DE RÉFÉRENCE CARTOGRAPHIQUE
ET INDEX DES CARTES ATTENANTES PUBLIÉES PAR
LA COMMISSION GÉOLOGIQUE DU CANADA

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## REGIONAL LAKE SEDIMENT AND WATER GEOCHEMICAL DATA, SASKATCHEWAN 1988, GSC OF 1642, NGR 107-1988, PARTS OF NTS 74C, 74F

Geological Survey of Canada Open File 1642
Regional Lake Sediment and water Geochemical Reconnaissance Data
North-Central Saskatchewan, consisting of parts of NTS 74C and 74F

### INTRODUCTION

Open File 1642 is one of three open files (1642, 1643, 1644) covering parts of northern Saskatchewan which were sampled in 1978, 1984 and 1985 respectively and previously published as Open Files 556, 1106 and 1213. The new open files represent additional analyses of archived lake sediment material for 26 elements by instrumental neutron activation.

The reconnaissance survey was originally undertaken in 1978 by the Geological Survey of Canada in conjunction with the Saskatchewan Department of Energy and Mines under the Canada - Saskatchewan Agreement on a Uranium Reconnaissance Program.

The data base of the survey contributes to a national geochemical reconnaissance which is used for resource assessment, mineral exploration and geological mapping. Regional survey sample collection and preparation procedures, analytical methods and repeatability of results are therefore strictly specified and controlled. In this way, consistent data can be systematically obtained in different areas in different years from different analytical laboratories

### CREDITS

E.H.W. Hornbrook directed the survey and archived analysis programs.

P.W.B. Friske coordinated the operational activities of contract and Geological Survey of Canada staff.

Contracts were let to the following companies for sample collection, preparation and analysis and were managed by the following staff of the Exploration Geochemistry Subdivision:

Collection: Marshall, Macklin Monaghan Ltd., Toronto, Ontario
E.H.W. Hornbrook
W.B. Coker

Preparation: Golder Associates, Ottawa, Ontario
J.J. Lynch

Analysis: Chemex Labs Ltd., Vancouver, British Columbia
Barringer Magenta Limited, Toronto, Ontario
Atomic Energy of Canada Ltd., Ottawa, Ontario
Bondar Clegg and Company Ltd., Ottawa, Ontario (1988)
J.J. Lynch

H.R. Schmitt coordinated and edited open file production.

A.C. Galletta and D. Wright managed the digital geochemical data, provided computer processing support, and developed software to plot the open file, symbol and regional trend maps. Computing services were provided by the Computer Science Centre, EMR. The plotting was done by Canada Lands Data Systems staff at Environment Canada, Hull, Quebec.

H.A. Gross developed microcomputer software to produce data listings and summary statistics

J. Yelle and F. Williams of the Geological Information Division supervised the preparation of open file base maps by Cartography Unit A-2.

M. McCurdy, S. Cook and C.C. Durham provided technical support and editing assistance.

J.C. Belec provided word processing support.

## DESCRIPTION OF SURVEY AND SAMPLE MANAGEMENT

Helicopter supported sample collection was carried out during the summer of 1978.

Lake sediment and water samples were collected at an average density of one sample per 13 square kilometres throughout the 15,000 square kilometers of the northwestern Saskatchewan survey area.

Sample site duplicate samples were routinely collected in each analytical block of twenty samples.

In Ottawa, field dried samples were air-dried, crushed, ball milled and sieved. The minus 80 mesh (177 microns) fraction was used for subsequent analyses. At this time, control reference and blind duplicate samples were inserted into each block of twenty sediment samples. For the water samples, only control reference samples were inserted into the block. There were no blind duplicate water samples.

On receipt, field and analytical data were processed with the aid of computers.

The field data were recorded by the field contract staff on standard lake sediment field cards (Rev. 74) used by the Geological Survey of Canada (Garrett, 1974).

The sample site positions were marked on appropriate 1/250,000 scale NTS maps in the field. These maps were digitized at the Geological Survey in Ottawa to obtain the sample site UTM coordinates.

The sample site coordinates were checked as follows: a sample location map was produced on a Calcomp 1051 drum plotter using the digitized coordinates; the field contractor's sample location map was then overlayed with the Calcomp map; the two sets of points were checked for coincidence. The dominant rock types in the lake catchment basins were identified on appropriate geological maps used as the bedrock geological base on RGR maps.

Thorough inspections of the field and analytical data were made to check for any missing information and/or gross errors.

Quality control and monitoring of the geochemical data was undertaken by a standard method used by the Exploration Geochemistry Subdivision at the Geological Survey of Canada.

## ANALYTICAL PROCEDURES

### Instrumental Neutron Activation Analysis (INAA)

The weighed sample (generally 5 to 10 g) is irradiated for 20 minutes in a neutron flux whose approximate density is 5.3 x 10 to the exp. 11 neutrons/square cm/second. Counting is begun seven days after irradiation. The counting time is somewhat variable (6 to 11 minutes) and is matrix dependent. Counting is done on a germanium-lithium co-axial counter. The counting data is accumulated on a VAX computer and is subsequently converted to concentrations. Numerous international reference samples are irradiated with each batch of routine samples.

Elements determined by INA analyses include: Na, Sc, Cr, Fe, Co, Ni, Zn, As, Se, Br, Rb, Zr, Mo, Ag, Cd, Sn, Sb, Te, Cs, Ba, La, Ce, Sm, Eu, Tb, Yb, Lu, Hf, Ta, W, Ir, Au, Th, and U. Data for Zn, Se, Zr, Ag, Cd, Sn, Te and Ir are not published because of inadequate detection limits and/or precision.

### Atomic Absorption Spectroscopy (AAS) and Other Analyses

For the determination of Zn, Cu, Pb, Ni, Co, Ag, Mn, Fe, Cd, and As a 1 gram sample was reacted with 6 mL of a mixture of 4 M HNO3 and M HCl in a test-tube overnight at room temperature. After digestion, the test-tube was immersed ina hot water bath at room temperature and brought up to 90° C and held at this temperature for 2 hours with periodic shaking. The sample solution was then diluted to 20 mL with metal-free water and mixed. Zn, Cu, Pb, Ni, Co, Ag, Mn, Fe and Cd were determined by atomic absorption spectroscopy using an air-acetylene flame. Background corrections were made for Pb, Ni, Co, and Ag.

Arsenic was determined by atomic absorption using a hydride evolution method wherein the hydride (AsH3) is evolved and passed through a heated quartz tube in the light path of an atomic absorption spectrophotometer. The method is described by

Aslin (1976). Detection limit = 1 ppm.

Molybdenum and vanadium were determined by atomic absorption spectroscopy using a nitrous oxide acetylene flame. A 0.5 gram sample was reacted with 1.5 mL concentrated $HNO_3$ at 90° C for 30 minutes. At this point 0.5 mL concentrated HCl was added and the digestion was continued at 90° C for an additional 90 minutes. After cooling, 8 mL of 1250 ppm Al solution were added and the sample solution was diluted to 10 mL before aspiration. Detection limit = Mo - 2 ppm; V - 5 ppm.

Loss on ignition was determined using a 500 mg sample. The sample, weighed into 30 mL beaker, was placed in a cold muffle furnace and brought up to 500° C over a period of 2 - 3 hours. The sample was left at this temperature for 4 hours, then allowed to cool to room temperature for weighing. Detection limit = 1.0 pct.

Uranium was determined using a neutron activation method with delayed neutron counting. A detailed description of the method is provided by Boulanger et al. (1975). In brief, a 1 gram sample is weighed into a 7 dram polyethylene vial, capped and sealed. The irradiation is provided by the Slowpoke reactor with an operating flux of 10 to the exp. 12 neutrons/sq cm/sec. The samples are pneumatically transferred from an automatic loader to the reactor, where each sample is irradiated for 60 seconds. After irradiation, the sample is again transferred pneumatically to the counting facility where after a 10 second delay the sample is counted for 60 seconds with six $BF_3$ detector tubes embedded in paraffin. Following counting, the samples are automatically ejected into a shielded storage container. Calibration is carried out twice a day as a minimum, using natural materials of known uranium concentration. Detection limit = 0.5 ppm.

Fluoride in lake water samples was determined using a fluoride electrode. Prior to measurement an aliquot of the sample was mixed with an equal volume of TISAB II buffer solution (total ionic strength adjustment buffer). The TISAB II buffer solution is prepared as follows: to 50 mL metal free water add 57 mL glacial acetic acid, 58 gm NaCl and 4 gm CDTA (cyclohexylene dinitrilo tetraacetic acid). Stir to dissolve and cool to room temperature. Using a pH meter, adjust the pH between 5.0 and 5.5 by slowly adding 5 M NaOH solution. Cool and dilute to one litre in a volumetric flask. Detection limit = 20 ppb.

Hydrogen ion activity (pH) was measured with a combination glass-calomel electrode and a pH meter.

Uranium was determined by fission track analysis. 225 mL of water was acidified with 3 mL concentrated $HNO_3$. After a two week waiting period to ensure total dissolution of precipitated uranium, a 5 microlitre aliquot of the sample was removed, placed on a polycarbonate tape and dried. The tape was irradiated in a nuclear reactor at McMaster University for 1 hour at a flux of 10 to the exp. 13 neutrons/sq cm/sec. The irradiated tape was etched with 25% NaOH solution and the fission tracks were counted with an optical counter fitted to a microscope. The number of tracks was proportional to the uranium concentration. Each tape contained its own calibration standards, blanks and sample duplicates.

Table 1 provides a summary of analytical data and methods.

## PRESENTATION AND INTERPRETATION OF GOLD DATA

The following discussion reviews the format used to present the Au geochemical data and outlines some important points to consider when interpreting this data. This discussion is included in recognition of the special geochemical behaviour and mode of occurrence of Au in nature and the resultant difficulties in obtaining and analyzing samples which reflect the actual concentration level at a given site.

To correctly interpret Au geochemical data from regional stream sediment or lake sediment surveys requires an appreciation of the unique chemical and physical characteristics of Au and its mobility in the surficial environment. Key properties of Au that distinguish its geochemical behaviour from most other elements include (Harris, 1982):

(1) Au occurs most commonly in the native form which is chemically and physically resistant. A high proportion of the metal is dispersed in micron-sized particulate form. Gold's high specific gravity results in heterogeneous distribution, especially in stream sediment and clastic-rich (low LOI) lake sediment environments. Au distribution appears to be more homogeneous in organic-rich fluviatile and lake sediment environments.

(2) Gold typically occurs at low concentrations in the ppb range. Whereas gold

concentrations of only a few ppm may represent economic deposits, background levels encountered from stream and centre-lake sediments seldom exceed 10 ppb, and commonly are near the detection limit of 1 ppb.

These factors result in a particle sparsity effect wherein very low concentrations of Au are heterogeneously enriched in the surficial environment. Hence, a major problem facing the geochemist is to obtain a representative sample. In general, the lower the actual concentration of Au the larger the sample size, or the smaller the grain size required to reduce uncertainty over whether subsample analytical values truly represent actual values. Conversely, as actual Au concentrations increase or grain size decreases, the number of Au particles to be shared in random subsamples increases and the variability of results decreases (Clifton et al., 1969; Harris, 1982). The limited amount of material collected during the rapid, reconnaissance-style regional surveys and the need to analyze for a broad spectrum of elements, precludes the use of a significantly large sample weight for the Au analyses. Therefore, to the extent that sample representivity can be increased, sample grain size is reduced by sieving and ball milling of all samples.

The following control methods are currently employed to evaluate and monitor the sampling and analytical variability which are inherent in the analysis of Au in geochemical mediums:

(1) For each block of twenty samples:

(a) random insertion of a standard reference sample to control analytical accuracy and long-term precision;

(b) collection of a field duplicate (two samples from one site) to control sampling variance;

(c) analysis of a second subsample (blind duplicate) from one sample to control short-term precision.

(2) For both stream sediments and lake sediments, routine repeat analyses on a second subsample are performed for all samples having values that are statistically above approximately the 90th percentile of total data set. This applies only to gold analyses by fire assay preconcentration followed by neutron activation. **Such routine repeat analyses are not performed for INA analyses of archived samples.**

(3) For lake sediments only, a routine repeat analysis on a second subsample is performed on those samples with LOI values below 10%, indicating a large clastic component. On-going studies suggest that the Au distribution in these samples is more likely to be variable than in samples with a higher LOI content. Again, routine repeat analyses are performed only when the fire assay preconcentration/neutron activation method is used.

Au data presentation, statistical treatment and the value map format are different than for other elements. Au data listed in the open file may include initial analytical results, values determined from repeat analyses, together with sample weights and corresponding detection limits for all analyzed samples. The gold, statistical parameters and regional symbol trend plots are determined using the following data population selection criteria:

(1) Only the first analytical value is utilized.

(2) Au values determined from sample weights less than 10 g are excluded, except where determined by instrumental neutron activation analyses.

(3) Au values less than the detection limit (<1 ppb) for 10 g samples are set to 0.5 ppb.

On the value map, repeat analysis values, where determined (not field duplicates), are placed in brackets following the initial value determination. All values determined on a sample less than 10 g are denoted by an asterisk. Actual sample weight used can be determined from the text. Following are possible variations in data presentation on a value map:

| | |
|---|---|
| * | No data |
| + 27 | Single analysis, 10 g sample weight |
| + 27* | Single analysis, <10 g sample weight |
| + 27 (14) | Repeat analysis, both samples 10 g |
| + 27 (14*) | Repeat analysis, first sample 10 g, repeat <10 g |
| + <1 | Single analysis, 10 g sample, less than detection limit of 1 ppb |

In summary, geochemical follow-up investigations for Au should be based on a careful consideration of all geological and geochemical information, and especially a careful appraisal of gold geochemical data and its variability. In some instances, prospective follow-up areas may be indirectly identified by pathfinder element associations in favourable geology, although a complementary Au response due to natural variability may be lacking. Once an anomalous area has been identified, field investigations should be designed to include detailed geochemical follow-up surveys and collection of large representative samples. Subsequent repeat subsample analyses will increase the reliability of results and permit a better understanding of natural variability which can then be used to improve sampling methodology and interpretation.

## LAKE SEDIMENT DATA LIST LEGEND AND DIGITAL FIELD RECORD FORMAT

Table 2 lists both the field and map information which is recorded at each sample site and is listed in the accompanying data listings, and the digital record format for the tape or diskette version of the open file. For the digital record A = alpha; X = numeric, unless indicated otherwise.

## REFERENCES

Aslin, G.E.M. (1976). The determination of arsenic and antimony in geological materials by flameless atomic absorption spectrophotometer; Journal of Geochemical Exploration, Vol. 6, pp. 321-330.

Boulanger, A., Evans, D.J.R., and Raby, B.F. (1975). Uranium analysis by neutron activation delayed neutron counting; Proceedings of the 7th Annual Symposium of Canadian Mineral Analysts, Thunder Bay, Ontario, September 22 - 23, 1975.

Clifton, H.E., Hunter, R.E., Swanson, F.J., and Phillips, R.L. (1969). Sample size and meaningful gold analysis; U.S. Geological Survey Professional Paper 625-C.

Garrett, R.G. (1974). Field data acquisition methods for applied geochemical surveys at the Geological Survey of Canada: Geol. Survey of Canada Paper 74-52.

Hall, G.E.M. (1979). A study of the stability of uranium in waters collected from various geological environments in Canada; In Current Research, Part A, Geological Survey of Canada Paper 79-1A, p. 361-365.

Harris, J.F. (1982). Sampling and analytical requirements for effective use of geochemistry in exploration for gold; In Levinson, A.A., Editor, Precious Metals in the Northern Cordillera, proceedings of a symposium sponsored by the Association of Exploration Geochemists and the Cordilleran Section of the Geological Association of Canada, pp. 53-67.

Jonasson, I.R., Lynch, J.J., and Trip, L.J. (1973). Field and laboratory methods used by the Geological Survey of Canada in geochemical surveys; No. 12, Mercury in Ores, Rocks, Soils, Sediments and Water, Geological Survey of Canada Paper 73-21.

**Table 1. Summary of Analytical Data and Methods**

| Element | | Detection Level (1978) | | Detection Level (1988) | | Method(s) |
|---|---|---|---|---|---|---|
| Sediments: | | | | | | |
| Zn | Zinc | 2 | ppm | 100 | ppm | AAS/INA |
| Cu | Copper | 2 | ppm | | | AAS |
| Pb | Lead | 2 | ppm | | | AAS |
| Ni | Nickel | 2 | ppm | 20 | ppm | AAS/INA |
| Co | Cobalt | 2 | ppm | 5 | ppm | AAS/INA |
| Ag | Silver | 0.2 | ppm | 2 | ppm | AAS/INA |
| Mn | Manganese | 5 | ppm | | | AAS |
| As | Arsenic | 1 | ppm | 0.5 | ppm | AAS/INA |
| Mo | Molybdenum | 2 | ppm | 1 | ppm | AAS/INA |
| Fe | Iron | 0.02 | pct | 0.2 | pct | AAS/INA |
| LOI | Loss-on-ignition | 1.0 | pct | | | GRAV |
| U | Uranium | 0.2 | ppm | 0.2 | ppm | NADNC/INA |
| V | Vanadium | 10 | ppm | | | AAS |
| Cd | Cadmium | | | 5 | ppm | INA |
| Sb | Antimony | | | 0.1 | ppm | INA |
| Na | Sodium | | | 0.02 | pct | INA |
| Sc | Scandium | | | 0.2 | ppm | INA |
| Cr | Chromium | | | 20 | ppm | INA |
| Se | Selenium | | | 5 | ppm | INA |
| Br | Bromine | | | 0.5 | ppm | INA |
| Rb | Rubidium | | | 5 | ppm | INA |
| Zr | Zirconium | | | 200 | ppm | INA |
| Sn | Tin | | | 100 | ppm | INA |
| Te | Tellurium | | | 10 | ppm | INA |

**Table 1 - Continued**

| Element | | Detection Level (1978) | | Detection Level (1988) | | Method(s) |
|---|---|---|---|---|---|---|
| Cs | Cesium | | | 0.5 | ppm | INA |
| Ba | Barium | | | 50 | ppm | INA |
| La | Lanthanum | | | 2 | ppm | INA |
| Ce | Cerium | | | 5 | ppm | INA |
| Sm | Samarium | | | 0.05 | ppm | INA |
| Eu | Europium | | | 1 | ppm | INA |
| Tb | Terbium | | | 0.5 | ppm | INA |
| Yb | Ytterbium | | | 2 | ppm | INA |
| Lu | Lutecium | | | 0.2 | ppm | INA |
| Hf | Hafnium | | | 1 | ppm | INA |
| Ta | Tantalum | | | 0.5 | ppm | INA |
| W | Tungsten | | | 1 | ppm | INA |
| Ir | Iridium | | | 50 | ppb | INA |
| Au | Gold | | | 2 | ppm | INA |
| Th | Thorium | | | 0.2 | ppm | INA |
| Waters: | | | | | | |
| F | Fluoride | 20 | ppb | | | ISE |
| pH | | | | | | GCM |
| U | Uranium | 0.01 | ppb | | | FT |
| Wt | Test weight | | | ± 0.01 g | | GRAV |

| | |
|---|---|
| AAS | Atomic absorption spectrometry |
| INA | Instrumental Neutron Activation Analysis |
| GRAV | Gravimetry |
| ISE | Ion selective electrode |
| GCM | Glass Calomel electrode and pH meter |
| NADNC | Neutron Activation delayed neutron counting |
| FT | Fission Track analysis |

## TABLE 2. DATA LIST AND DIGITAL FORMAT LEGEND
### Record 1 – Field Data

| FIELD RECORD | DEFINITION | TEXT CODE | DIGITAL RECORD COLUMN AND CODE |
|---|---|---|---|
| MAP | National topographic system (NTS): lettered quadrangle (1:250,000 scale or 1:50,000 scale). | | **1 - 6** |
| | Part of sample number | | **"XXXAXX"** |
| SAMPLE ID | Remainder of sample number: | | **7 - 12** |
| | Year | 19XX | **"XX    "** |
| | Field Crew | 1, 3, 5, 7 | **"  X   "** |
| | Sample sequence number | 001 - 999 | **"   XXX"** |
| UTM COORDINATES | Universal Transverse Mercator (UTM Coordinate system; digitized sample location coordinates. | | |
| ZN | Zone<br>7 to 22 | | **13 – 14**<br>**"XX"** |
| EASTING | UTM Easting in metres | | **15 – 20**<br>**"XXXXXX"** |
| NORTHING | UTM Northing in metres | | **21 – 27**<br>**"XXXXXXX"** |
| ROCK TYPE | Major rock type of lake catchment area: | | **28 - 31** |
| | Mesozoic | | |
| | Mannville G: sandstone | SMRK | **"SMRK"** |
| | Paleozoic | | |
| | Methy Fm: sandstone | LMDM | **"LMDM"** |
| | Athabasca Fm: sandstone | SNDS | **"SNDS"** |
| | Precambrian | | |
| | Pelitic gneiss and schist | PCSC | **"PCSC"** |
| | Metasedimentary and meta-volcanic rocks | MPRK | **"MPRK"** |
| | Migmatite | MGMT | **"MGMT"** |
| | Amphibolite | APBG | **"APBG"** |
| | Granite, granodiorite | GRNT | **"GRNT"** |
| LAKE AREA | The area of the water body sampled: | | |
| | Pond | POND | **"1   "** |
| | ¼ to 1 sq km | .25 – 1 | **" 1  "** |
| | 1 to 5 sq km | 1 – 5 | **"  1 "** |
| | greater than 5 sq km | >5 | **"   1"** |

### TABLE 2 – Continued

| FIELD RECORD | DEFINITION | TEXT CODE | DIGITAL RECORD COLUMN AND CODE |
|---|---|---|---|
| LAKE DEP | Sample depth from surface of water body to lake bottom in feet | 1 - 999 | **36 - 38**<br>**"XXX"** |
| RS | Replicate status; the relationship of the sample to others within the analytical block of 20: | | |
| | Routine regional sample | 00 | **"00"** |
| | First of field duplicate | 10 | **"10"** |
| | Second of field duplicate | 20 | **"20"** |
| RLF | Relief of the lake catchment basin: | | **41 - 43** |
| | Low | Lw | **"1  "** |
| | Medium | Md | **" 1 "** |
| | High | Hi | **"  1"** |
| CNT | Contaminaton, human or natural: | | **48 - 51** |
| | None | | **"    "** |
| | Work | Wo | **"1   "** |
| | Camp | Ca | **" 1  "** |
| | Fuel | Fu | **"  1 "** |
| | Gossan | Go | **"   1"** |
| COLR | Sediment sample colour; up to two colours may be selected: | | **52 – 57** |
| | Tan | Tn | **"1     "** |
| | Yellow | Yl | **" 1    "** |
| | Green | Gn | **"  1   "** |
| | Grey | Gy | **"   1  "** |
| | Brown | Br | **"    1 "** |
| | Black | Bk | **"     1"** |
| SUSP | Suspended matter in water: | | |
| | None | | **"  "** |
| | Heavy | Hvy | **"1 "** |
| | Light | Lgt | **" 1"** |
| AGE | Stratigraphic age of dominant rock type in catchment basin: | | |
| | Cenozoic | 44 | **"44"** |
| | Lower Cretaceous | 36 | **"36"** |
| | Cambrian | 12 | **"12"** |
| | Proterozoic | 04 | **"04"** |

**Record 2 – Neutron Activation Analytical Data**

| FIELD RECORD | DEFINITION | UNITS | DETECTION LEVEL | DIGITAL RECORD COLUMN AND CODE |
|---|---|---|---|---|
| Na | Sodium in lake sediments | pct | 0.02 | 16 – 21 |
| Sc | Scandium in lake sediments | ppm | 0.2 | 22 – 27 |
| Cr | Chromium in lake sediments | ppm | 20 | 28 – 33 |
| Fe | Iron in lake sediments | pct | 0.2 | 34 – 39 |
| Co | Cobalt in lake sediments | ppm | 5 | 40 – 45 |
| Ni | Nickel in lake sediments | ppm | 20 | 46 – 51 |
| Zn* | Zinc in lake sediments | ppm | 100 | 52 – 57 |
| As | Arsenic in lake sediments | ppm | 0.5 | 58 – 63 |
| Se* | Selenium in lake sediments | ppm | 5 | 64 – 69 |
| Br | Bromine in lake sediments | ppm | 0.5 | 70 - 75 |

**Record 3 – Neutron Activation Analytical Data**

| FIELD RECORD | DEFINITION | UNITS | DETECTION LEVEL | DIGITAL RECORD COLUMN AND CODE |
|---|---|---|---|---|
| Rb | Rubidium in lake sediments | ppm | 5 | 16 – 21 |
| Zr* | Zirconium in lake sediments | ppm | 200 | 22 – 27 |
| Mo | Molybdenum in lake sediments | ppm | 1 | 28 – 33 |
| Ag* | Silver in lake sediments | ppm | 2 | 34 – 39 |
| Cd* | Cadmium in lake sediments | ppm | 5 | 40 – 45 |
| Sn* | Tin in lake sediments | ppm | 100 | 46 – 51 |
| Sb | Antimony in lake sediments | ppm | 0.1 | 52 – 57 |
| Te* | Tellurium in lake sediments | ppm | 10 | 58 – 63 |
| Cs | Cesium in lake sediments | ppm | 0.5 | 64 – 69 |
| Ba | Barium in lake sediments | ppm | 10 | 70 – 75 |

**Record 4 – Neutron Activation Analytical Data**

| FIELD RECORD | DEFINITION | UNITS | DETECTION LEVEL | DIGITAL RECORD COLUMN AND CODE |
|---|---|---|---|---|
| La | Lanthanum in lake sediments | ppm | 2 | 16 – 21 |
| Ce | Cerium in lake sediments | ppm | 5 | 22 – 27 |
| Sm | Samarium in lake sediments | ppm | 0.05 | 28 – 33 |
| Eu | Europium in lake sediments | ppm | 1 | 34 – 39 |
| Tb | Terbium in lake sediments | ppm | 0.5 | 40 – 45 |
| Yb | Ytterbium in lake sediments | ppm | 2 | 46 – 51 |
| Lu | Lutetium in lake sediments | ppm | 0.2 | 52 – 57 |
| Hf | Hafnium in lake sediments | ppm | 1 | 58 – 63 |
| Ta | Tantalum in lake sediments | ppm | 0.5 | 64 – 69 |
| W | Tungsten in lake sediments | ppm | 1 | 70 - 75 |

**Record 5 – Neutron Activation Analytical Data**

| FIELD RECORD | DEFINITION | UNITS | DETECTION LEVEL | DIGITAL RECORD COLUMN AND CODE |
|---|---|---|---|---|
| Ir* | Iridium in lake sediments | ppb | 50 | 16 – 21 |
| Au | Gold in lake sediments | ppb | 2 | 22 – 27 |
| Th | Thorium in lake sediments | ppm | 0.2 | 28 – 33 |
| U | Uranium in lake sediments | ppm | 0.2 | 34 – 39 |
| Wt | Tungsten in lake sediments | gram | | 40 – 45 |

* Data not included in Open File release because of inadequate detection limit and/or precision.

**Record 6 - Atomic Absorption Spectrometry and Other Data**

| FIELD RECORD | DEFINITION | UNITS | DETECTION LEVEL | DIGITAL RECORD COLUMN AND CODE |
|---|---|---|---|---|
| Zn - SEDS | Zinc in lake sediments | ppm | 2 | 21 - 25 |
| Cu - SEDS | Cerium in lake sediments | ppm | 2 | 26 – 30 |
| Pb – SEDS | Lead in lake sediments | ppm | 2 | 31 - 35 |
| Ni – SEDS | Nickel in lake sediments | ppm | 2 | 36 - 40 |
| Co – SEDS | Cobalt in lake sediments | ppm | 2 | 41 – 45 |
| Ag – SEDS | Silver in lake sediments | ppm | 0.2 | 46 - 50 |
| Mn – SEDS | Manganese in lake sediments | ppm | 5 | 51 – 55 |
| As – SEDS | Arsenic in lake sediments | ppm | 1 | 56 – 60 |
| Mo - SEDS | Molybdenum in lake sediments | ppm | 2 | 61 - 65 |
| Fe - SEDS | Iron in lake sediments | pct | 0.02 | 66 - 70 |
| V – SEDS | Vanadium in lake sediments | ppm | 10 | 71 – 75 |
| LOI – SEDS | Loss-on-ignition | pct | 1 | 76 - 79 |

**Record 7 - Atomic Absorption Spectrometry and Other Data**

| FIELD RECORD | DEFINITION | UNITS | DETECTION LEVEL | DIGITAL RECORD COLUMN AND CODE |
|---|---|---|---|---|
| U - SEDS | Uranium in lake sediments | ppm | 2 | 21 - 25 |

**Record 8 - Atomic Absorption Spectrometry and Other Data**

| FIELD RECORD | DEFINITION | UNITS | DETECTION LEVEL | DIGITAL RECORD COLUMN AND CODE |
|---|---|---|---|---|
| U - WATERS | Uranium in lake waters | ppb | 0.01 | 21 - 25 |
| pH - WATERS | pH of lake waters | | | 26 – 30 |
| F - WATERS | Fluoride in lake waters | ppb | 20 | 31 - 35 |