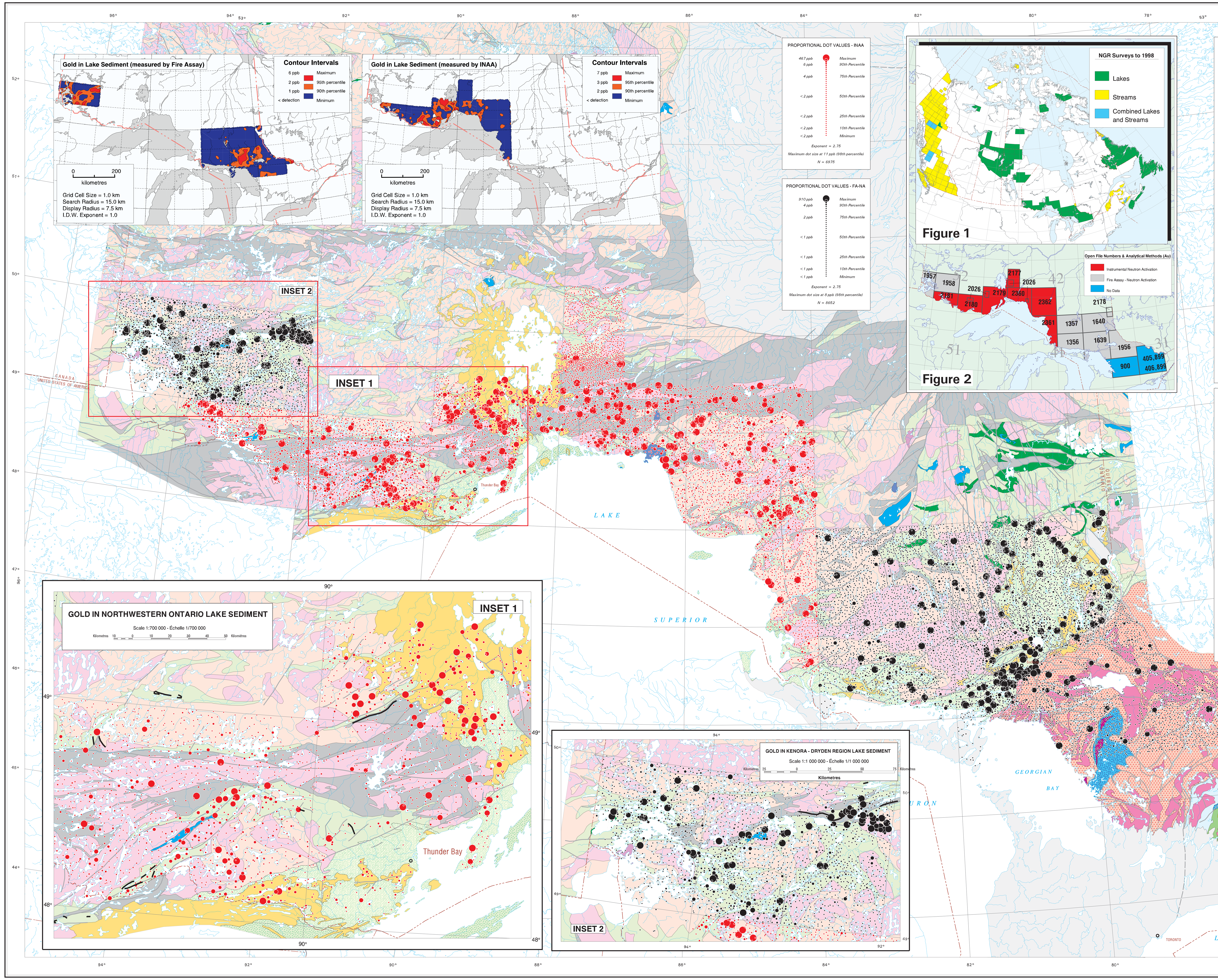
Gold in Lake Sediment (measured by Fire Assay)
Contour Intervals
6 ppb Maximum
2 ppb 90th percentile
1 ppb 50th percentile
< detection Minimum
Grid Cell Size = 1.0 km
Search Radius = 15.0 km
Display Radius = 7.5 km
I.D.W. Exponent = 1.0
Gold in Lake Sediment (measured by INAA)
Contour Intervals
7 ppb Maximum
3 ppb 90th percentile
2 ppb 50th percentile
< detection Minimum
PROPORTIONAL DOT VALUES - INAA
PROPORTIONAL DOT VALUES - FA-NA
NGR Surveys to 1998
Lakes
Streams
Combined Lakes and Streams
Figure 1
Open File Numbers & Analytical Methods (Au)
Figure 2
INSET 2
INSET 1
GOLD IN NORTHWESTERN ONTARIO LAKE SEDIMENT
Scale 1:700 000 - Échelle 1/700 000
Thunder Bay
GOLD IN KENORA - DRYDEN REGION LAKE SEDIMENT
Scale 1:1 000 000 - Échelle 1/1 000 000
LAKE SUPERIOR
GEORGIAN BAY
LAKE ONTARIO

GEOLOGICAL SURVEY OF CANADA — COMMISSION GÉOLOGIQUE DU CANADA

OPEN FILE 3379e

National Geochemical Reconnaissance

ONTARIO COMPILATION
GOLD IN LAKE SEDIMENT
ONTARIO

Scale 1:1 500 000 - Échelle 1/1 500 000

Kilometres 50 0 50 100 150 Kilomètres

Lambert Conic Conformal Projection	Projection conique conforme de Lambert
Standard Parallels 49°N and 77°N	Parallèles d'échelle conservée 49°N et 77°N
CM 85.5°W, Scale Factor 1.0	M.C. 85.5°, facteur d'échelle 1,0
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Compilation by P.W.B. Friske, M.W. McCurdy, and S.J.A. Day

Digital cartography by T.D. West and M.W. McCurdy, Geological Survey of Canada

Any revisions or additional information known to the user would be welcomed by the Geological Survey of Canada

Background geological information modified from Map 2545, Bedrock Geology of Ontario, Geology of Ontario digital map series

Please note that the digital background geology was not originally compiled on Digital Chart of the World topographic maps and has been adjusted (rubber-sheeted) by the GSC to fit this base. Slight geometric distortion of the original geological contacts relative to topography may exist in some areas

Base map assembled from Digital Chart of the World, 1:1 000 000 scale

OPEN FILE
DOSSIER PUBLIC
3379e
GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA
OTTAWA
06/1998

INTRODUCTION

Large areas of Canada have been covered by stream and lake surveys carried out under the National Geochemical Reconnaissance (NGR) program. The goal of this program is to establish and maintain a nationally consistent database of field and analytical data derived from drainage sediment and water samples. Toward this end, systematic surveys have been conducted since 1973. To date (1998), more than 200 surveys have been completed to NGR standards, representing over 190 000 sites covering 2.3 million km^2 throughout Canada (Figure 1). These were carried out mainly by the Geological Survey of Canada, either independently or in cooperation with provinces and territories, under various funding arrangements.

Consistent methods of sample collection, sample preparation and chemical analysis developed and employed at the GSC are the hallmark of NGR surveys (Friske and Hornbrook, 1991). Geochemical surveys carried out by the GSC or provincial/territorial agencies, shown in Figure 1, fulfil these criteria and qualify as NGR surveys.

At present, data for each NGR survey are available in hard copy and digital form. However, to simplify access to such a substantial collection of diverse information, a digital database has been created using Microsoft ACCESS software. As entry of large contiguous blocks of data (e.g. all Labrador lake sediment and water data) is completed, geochemical maps and reports are being produced that display and summarize the data. The aim of this second generation of publications is to increase awareness of NGR data and enhance applications not only to mineral exploration but in other areas as well, such as public health and environmental studies.

This map summarizes the distribution of gold from 15 627 lake sites in Ontario sampled between 1976 and 1989. Figure 2 shows the individual open files that make up the Ontario compilation. Data from infill surveys 2026 and 2178 were not used. Detailed, site-specific information is available in these open files.

SURVEY METHODOLOGY

A detailed description of the NGR survey methodology is given in Friske and Hornbrook (1991). Below is a brief summary, with particular reference to the Ontario lake sediment and water surveys.

Sample Collection

Sample collection is carried out by a two-person sampling crew in a helicopter mounted on floats. An ideal sample comes from a lake less than 5 km^2 in size and greater than 3 metres deep, with a single central basin that is the focus of drainage in the area around the sample site.

Sediment is collected from a centre-lake profundal basin using a hollow-pipe, bottom-valve sampler (85 cm long x 7 cm diameter) attached to an external winch and rope system mounted on the fuselage of the helicopter. Generally, the full length of the sampler penetrates into the bottom sediment and the sample represents a 30 to 35 cm section from several tens of centimetres below the sediment-water interface. However, if relatively clastic-rich material is encountered, the sampler may not penetrate its full length, and some surface material is included. The ideal sample material is an organic-rich sediment (gyttja), commonly a greenish-brown to grey thixotropic gel, but clay, marl and/or sandy samples may also be encountered. At each site, field observations such as lake size, lake depth and local relief are recorded.

Lake waters are routinely collected at all lake sediment sites. Rectangular wide-mouth polyethylene bottles (250 ml) are used to sample water from depths of 20 cm or more below the surface of the lake. The inclusion of suspended materials is avoided as much as possible.

Sample Preparation and Analysis

Lake sediment samples are initially field-dried. The fully dried sample is crushed into small (5 mm or less) fragments, followed by further reduction in ceramic mills. Any material not milled or used in the analytical procedures is put into long-term storage.

The existence of an NGR sample archive allows the GSC to take full advantage of improvements and developments in the field of analytical chemistry, and since 1976 Ontario lake sediments have been analyzed and reanalyzed for a considerable range of elements. In all areas shown in Figure 2 data are available for Ag, As, Co, Cu, Fe, loss-on-ignition, Mo, Mn, Ni, Pb, U, and Zn. Over areas shown in red in Figure 2, INAA data are available for As, Au, Ba, Br, Ce, Co, Cr, Cs, Eu, Fe, Hf, La, Lu, Mo, Na, Ni, Rb, Sb, Sc, Sm, Ta, Tb, Th, U, W, and Yb. In addition, F, Hg, V and Cd data exist for some areas. All water samples were analyzed for U, F, and pH. Calcium, magnesium and total alkalinity data are available for some areas. Analytical procedures are a combination of Instrumental Neutron Activation analysis (INAA), atomic absorption spectrometry (AAS), and specific techniques. Data for the elements determined and the methods used are included in individual open files for each area (Fig. 2).

Results from two different analytical procedures are used to present concentrations of gold in Ontario lake sediments. Between 1986 and 1988 samples were analyzed using a combination of fire assay and neutron activation techniques. For this method, a 10 gram sample is fused to produce a lead button, collecting any gold in the sample, which is then cupelled in a muffle furnace to produce a silver (doré) bead. The silver bead is irradiated in a neutron flux for one hour, cooled for four hours, and counted by gamma ray spectrometry. Calibration is carried out using standard and blank beads. The detection level for this method is 1 ppb, depending on the sample size. For lesser weights, a higher detection level is required.

Results from non-destructive instrumental neutron activation analysis (INAA) were released in 1990. In addition, thousands of samples not originally analyzed for gold were reanalyzed by INAA. For INAA, weighed and encapsulated samples are packaged for irradiation along with internal standards and international reference materials. Samples and standards are irradiated together with neutron flux monitors in a two-megawatt pool-type reactor. After a seven-day decay period, samples are measured on a high-resolution germanium detector and the results converted to concentrations. Typical counting times are 500 seconds. The detection limit for gold by this method is 2 ppb, and the concentrations recorded are total amounts in the sediment.

Quality Control

One of the most important characteristics of NGR surveys is the structure of the sampling routine. Each block of 20 consecutive field numbers consists of 17 routine field samples, a field duplicate sample, a blind (analytical) duplicate sample and a control reference sample. The field duplicate sample is a separate sample collected at one of the 17 routine sites, at the discretion of the sampling team. One number, always the first in a block of 20 (i.e. 001, 021, 041, etc.) is reserved for a blind duplicate. The sample preparation laboratory splits a sample in the block, preferably one of the field duplicate samples, and places one of the splits into the blind duplicate position. A randomly pre-selected number within a block of 20 is reserved for a control reference sample. Control reference samples are lake or stream sediments with well-established analytical values.

Field duplicates, blind duplicates and control reference samples are incorporated in every block of 20 samples, and are used to monitor and control sampling and analytical variance. As a result of stringent quality control and consistency of analytical methods over time, it is possible to generate a regional compilation for an element with minimal boundary effects between different surveys using the same analytical method. A 10 ppb gold value from a lake sediment analyzed in 1988 by INAA is directly comparable to a 5 ppb gold value determined by the same method in 1998, not only from Ontario, but from any NGR lake sediment survey across Canada.

DATA PRESENTATION

Relative concentrations of gold in Ontario drainage sediments are illustrated with two types of graphic images; shaded contour plots and proportional spot plots. Contour plots depict broad regional trends in the data. Actual values of concentrations at specific sites are represented with proportional dot plots. Proportional dot plots display more detailed information and indicate the location of anomalous values. This style of presentation also facilitates the use of the bedrock geology as a background, allowing easy visual evaluation of the relationship between geology and element distribution.

For contour plots, a grid is produced by interpolating the irregularly spaced sample site data to a regular grid with side dimensions of 2 500 metres. Data are smoothed using a moving average of points within a circular zone of influence (Bonham-Carter, 1994). Up to 15 sites within the maximum search radius of 15 000 metres are assigned equal weights. For display purposes at a scale of 1:7 500 000, a cell size of 7 500 metres is set.

Proportional dot plots are created using filled circles, with the maximum diameter representing sites with values greater than or equal to the 98th percentile. The smallest diameter corresponds to the minimum value, or, if concentrations for some samples are not detectable, then the minimum value is usually set to one-half detection limit. Values between the minimum and maximum correspond to diameters fitting an exponential curve $y=x^{2.75}$.

Percentile values shown for the contour map and the proportional dot map may differ. Weighted distance averages for grid cells determined from log_{10} values are used to calculate percentiles for the contour map, whereas element concentration data from each site are used in the calculation of percentiles for the proportional dot map.

Cumulative probability plots of lake sediment data (bottom right) provide both information about individual sample points and a visual image of the statistical distribution of data (Garrett, 1991). Single populations plot as straight lines and if several straight line sections are observed, if there are gaps in the line formed by individual points or the plot is curved, multiple populations or non-normality is indicated (Hoffman, 1986).

The underlying bedrock geology is a generalized version of the Ontario Geological Survey Earth Resources and Land Information System digital 1:1 000 000 scale Bedrock Geology of Ontario. The original 60 units were reduced to 23 to facilitate data presentation, with emphasis placed on combining similar rock types.

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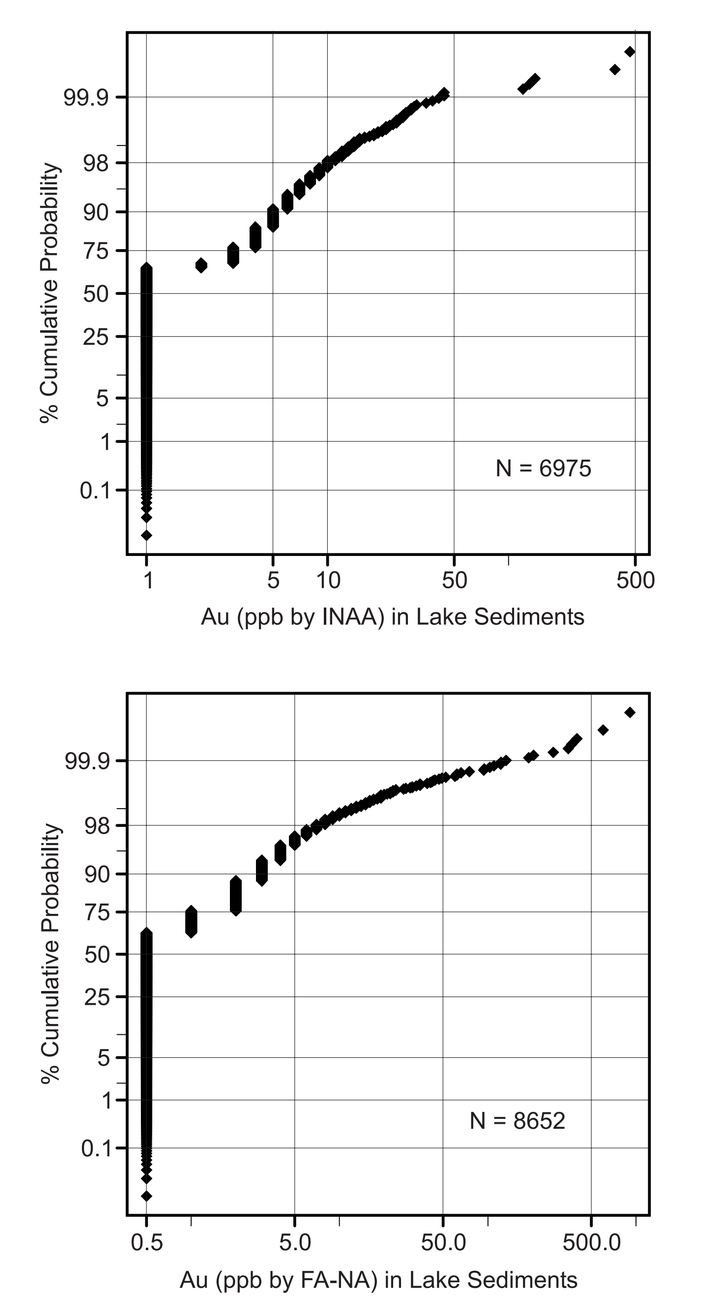
SUMMARY STATISTICS FOR SELECTED ELEMENTS

	Au1	Au2	As	Cu	Hg	Ni	Zn
Lake sediments							
Number of Values	8 652	6 975	6 975	17 934	13 814	17 935	17 935
Detection Limit	1	2	0.5	2	10	2	2
Units	ppb	ppb	ppm	ppm	ppb	ppm	ppm
Analytical Method	FA-NA	INAA	INAA	AAS	CV-AAS	AAS	AAS
Mean	1.8	2.6	4.0	37.8	119	24.1	108
Std Deviation	14.8	8.2	32.2	54.4	198	97.6	77.2
Median	0.5	1	2.5	29	110	16	100
Minimum Value	<1	<2	<0.5	<2	<10	<2	4
5th Percentile	***<1***	***<2***	***1.2***	***10***	***35***	***6***	***42***
10th Percentile	<1	<2	1.4	8	47	8	56
25th Percentile	<1	<2	1.8	20	70	11	77
50th Percentile	***<1***	***<2***	***2.5***	***29***	***110***	***16***	***100***
75th Percentile	2.0	4.0	3.7	42	150	25	129
90th Percentile	3.5	6.0	5.9	64	195	37	161
95th Percentile	***5.0***	***7.5***	***8.9***	***85***	***222***	***46***	***188***
98th Percentile	8.0	11	16.5	124	260	67	226
Maximum Value	910	467	2 470	3 030	21 000	8 000	7 000

AAS - *atomic absorption spectrometry*
INAA - *Instrumental Neutron Activation Analysis*
FA-NA - *fire assay - neutron activation*
CV-AAS - *cold vapour / atomic absorption spectrometry*

CUMULATIVE PROBABILITY PLOTS



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