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SURFICIAL GEOCHEMICAL SURVEYS OF AURIFEROUS PORTIONS OF THE ASHUANIPI COMPLEX, WESTERN LABRADOR

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ABSTRACT

The authors conducted the following surveys in those areas of the Archean Ashuanipi Complex defined by previous workers to have a high potential for gold mineralization: (1) soil and stream sediment sampling in the vicinity of lakes containing anomalous contents of gold in their sediment, (2) high-density lake sediment surveys in areas where gold-associated elements such as arsenic, silver and base metals were anomalous in reconnaissance surveys, and (3) sampling and analyzing bedrock samples, including many sulphide-bearing rocks, for gold. Of 172 samples, eight had analyses of 100 to 1875 ppb gold. Multi-element analyses of all samples are in progress.

INTRODUCTION

The discovery of gold mineralization in granulite-grade Archean rocks of the Ashuanipi Complex (Lapointe, 1986) 70 km northwest of Schefferville in Quebec has led to considerable exploration activity in the northern portion of the complex (Figure 1). Work on the Labrador portion of the complex in 1986 by Thomas and Butler (1987) identified several areas having above average abundances of gold in bedrock. They selected areas for study that had anomalously high concentrations of possible gold-pathfinder elements (including As, Ag, Cu, Hg, Mo and Zn) in reconnaissance lake-sediment samples (Geological Survey of Canada, 1982a,b). Recent detailed work by Butler (1987) indicated locally high contents of gold in lake sediment. Percival (1987) also recognized auriferous zones from geological mapping at 1:250,000 scale of the northern half of the complex.

The field program involved the application of several sampling approaches—soil, stream sediment, lake sediment and bedrock. Generally, soil, stream and rock sampling were done in areas that were suspected to be in close proximity to gold mineralization. Lake sediments were collected from areas having regional indications of possible gold mineralization.

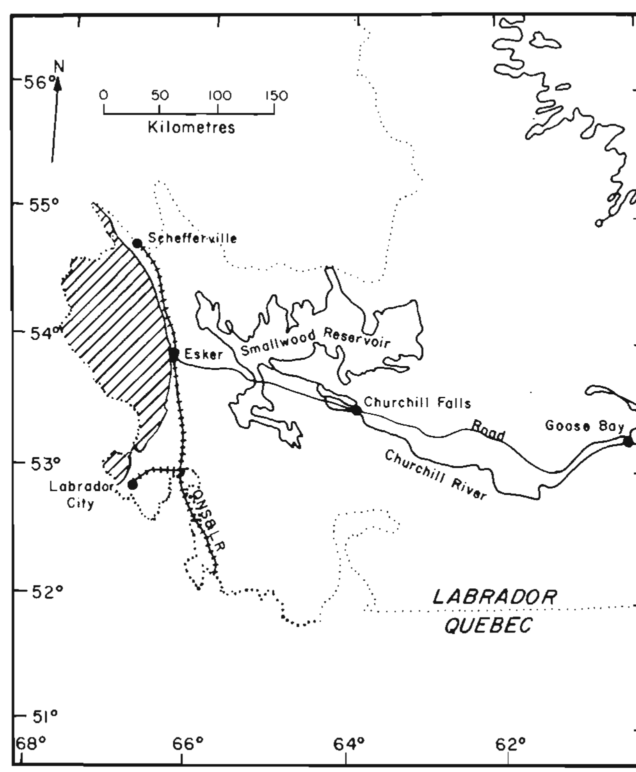

Figure 1. *Location map of Ashuanipi Complex (diagonally lined area).*

LOCATION AND ACCESS

The Labrador portion of the Ashuanipi Complex is located in westernmost Labrador. The area is accessible by float plane from Schefferville, Québec or Wabush—Labrador City, Labrador or by helicopter from Goose Bay, Labrador. It is also possible, though difficult, to gain access to much of the eastern portion by boat from Menihek or Esker, both of which are accessible by road and train. The Québec North Shore and Labrador Railway services Labrador City and Schefferville from Sept-Iles. The Labrador towns are also serviced by Canadian Airlines and Québec Air. Schefferville can be reached by scheduled flights from Wabush.

OUTLINE OF FIELD PROGRAM

Field work during 1987 exploited results of the previous work and focused primarily on 20 areas in which Butler's

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(1987) data had disclosed anomalous contents of gold in lake sediment or where Thomas and Butler (1987) or Percival (1987) had found indications of gold in bedrock (Figure 2). Our overall aim was to apply geochemical exploration methods to understand the nature of the distribution of gold and gold-pathfinder elements in the surficial and bedrock environments. Specific aims were to:

1) evaluate the effectiveness of various surficial geochemical exploration methods in reflecting known or suspected gold mineralization;

2) evaluate the significance of gold anomalies in lake sediment;

3) study the character of the dispersion of gold and related trace elements in the surficial and bedrock environments;

4) conduct detailed lake sediment surveys in areas of high gold potential in order to furnish the exploration industry with new exploration targets;

5) provide a geological framework for interpretation of the surficial geochemistry.

Soil Surveys

Eighteen areas were selected for study and 925 samples of B-horizon soil were collected. Most areas were chosen for their proximity to lakes with anomalous gold values (6 to 13 ppb Au) (Butler, 1987), because of the presence of gold in bedrock (Thomas and Butler, 1987) or to outline the extent of newly discovered sulphide zones.

Survey designs included conventional grid sampling, single-line detailed sampling across mineralized zones and 'loop' sampling. The last-named describes a procedure of sampling around the perimeter of an anomalous lake in an effort to identify the source of metals; where practical, this was done in conjunction with stream sediment sampling of inflowing streams.

There are problems associated with working in a glaciated landscape, the foremost of which is determining the provenance and transport history of the sampled material. Klassen and Thompson (1987) recognized up to 5 directions of glacial advance in the Schefferville area with an easterly to southeasterly one predominating. Our observations in the area south and west of Schefferville support their conclusion of a dominantly easterly ice flow. In several of the study areas, the widespread homogeneity of the underlying bedrock makes it difficult to estimate the provenance and transport distance of pebbles from till. Landforms and the degree of sorting of tills are factors in selecting sample sites; in particular, water-sorted and esker deposits were avoided.

When they become available, the geochemical data from the soils should provide an indication of transport directions and distances.

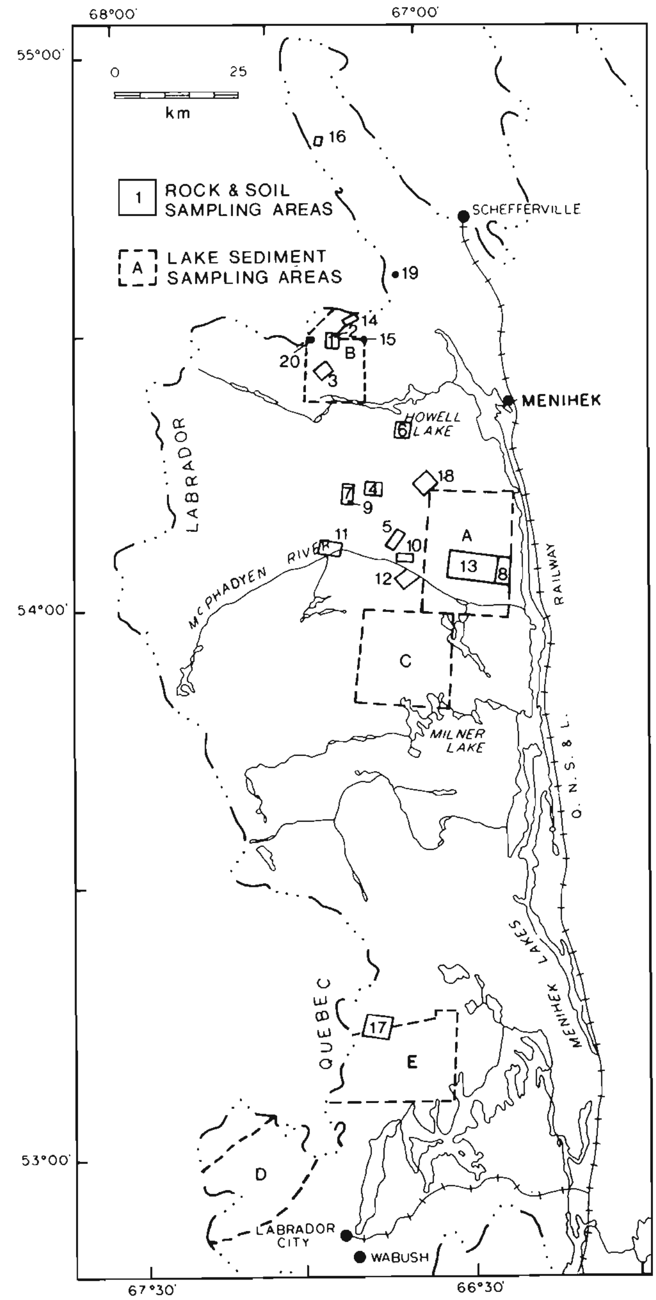

Figure 2. *Locations of study areas.*

Stream Sediment Surveys

Samples of active sediment were obtained to complement soil surveys around anomalous lakes, to obtain fill-in data from soil grids and to obtain data where soil sampling was not practical. Among the last group were stream sediment surveys conducted along lineaments and fault systems that were suspected of being auriferous on the basis of previous lake sediment surveys. Unfortunately, several of the 78 original samples were subsequently destroyed in a laboratory fire resulting from an equipment malfunction.

Lake Sediment Surveys

Lake sediment samples were collected at 621 sites from five areas that had been identified from the reconnaissance lake-sediment data (Geological Survey of Canada, 1982a,b) as having high contents of such gold-sympathetic elements as arsenic, silver and mercury (Figure 2). Analyses of these may define additional gold ± base-metal targets.

Bedrock Sampling and Mapping

Several of the study areas were mapped and all but one were sampled. The scale of mapping varied from 1:2,500 to 1:50,000 according to the abundance of outcrop, the size of the area and the time available. Nearly all sulphide (gossan) zones encountered were sampled and numerous samples of apparently unmineralized country rock were also obtained.

ANALYSES

Sample Preparation

Soil and sediment. These samples were field-dried and then oven-dried at 40°C. Soils were seived to -63 microns and the fine fraction retained for analyses. Stream sediments were seived and the -180 micron fraction retained for analyses. Lake sediments were disaggregated with a rubber hammer before being seived to -180 microns.

Rock. Samples were processed initially through a jaw-crusher and then pulverized in a tungsten-carbide shatterbox. Such treatment precludes obtaining meaningful cobalt and tungsten analyses.

Analytical Methods

Several methods are being employed to obtain chemical analyses; these are summarized in Table 1. Analyses for gold are being done by Becquerel Laboratories using instrumental neutron activation analysis (INAA) with a nominal detection limit of 1 ppb Au. This non-destructive method also gives useful analyses of 24 other elements (Davenport, *this volume).* Rock samples were also analysed for gold by fire assay/atomic absorption spectrometry (FA/AA, Chemex Laboratories) with a 5 ppb detection limit.

PRELIMINARY RESULTS

To date, only gold analyses (FA/AA) for rocks are available. These data have been released (McConnell *et al.*, 1987) along with geological descriptions of the areas, to which the reader is referred for more detail.

Geological Summary

The 8500 km² of the Ashuanipi Complex in Labrador comprises a roughly oval area of high-grade, migmatitic gneisses and younger, variably homogeneous and foliated intrusive rocks. The plutons range from granodiorite to tonalite, to charnockite. The area is transected by two sets of lineaments; a dominant one trending 130°, which controls drainage to the southeast, and another trending northeast. Overall, regional structures trend northwest and have moderate to steep northeast dips. On a 500-m to 1-km scale, folds are commonly upright and open with shallowly plunging to horizontal fold axes.

Table 1. Analytical methods and element suites

Sample Type	Method and Element Suite
Soil	INAA, AA, LOI
Stream Sediment	INAA, AA, LOI
Lake Sediment	INAA, AA, LOI
Rock	FA/AA, INAA, AA, AA (oxides)

INAA:	As, Au, Ba, Br, Ce, Co, Cr, Cs, Eu, Fe, Hf, La, Lu, Na, Rb, Sc, Se, Sm, Ta, Tb, Th, U, W, Yb, Zr
AA:	atomic absorption spectroscopy; Ag, Cd, Co, Cu, Fe, Mn, Mo, Ni, Pb, Zn
FA/AA:	fire assay/atomic absorption; Au
LOI:	loss-on-ignition as estimate of organic content
AA (oxides):	major and minor element oxides by AA
Note:	AA, AA (major) and LOI are determined in the departmental laboratory using methods described by Wagenbauer *et al.* (1983).

Garnet–orthopyroxene–biotite–plagioclase ± K-feldspar–quartz assemblages predominate throughout, reflecting granulite-grade metamorphism (Percival, 1987). Locally, upper-amphibolite-facies rocks occur in the south, and granulite-grade rocks are partially retrograded to greenschist facies where they are associated with Grenvillian thrusting. Occurrences of disseminated to massive sulphides, dominantly pyrite, are widespread.

Gold Analyses

The 172 rock samples were analysed for Au by FA/AA using a 10-g aliquot. As a check on analytical precision and accuracy, duplicates and standards of known gold content were included. With the exception of one duplicate pair, the duplicates are satisfactory although most are below the detection limit (Table 2). The standard samples also reproduced satisfactorily (Table 3).

Some statistical measures of the distribution of Au analyses are summarized in Table 4. Geometric means and log standard deviations are used to minimize the influence of the strongly positively skewed distribution. For comparative purposes, samples are grouped into those

Table 2. Analytical duplicates (ppb Au) of rock samples using FA/AA

Sample Pair	Analysis #1	Analysis #2
1	<5	<5
2	<5	25
3	<5	<5
4	<5	<5
5	<5	<5
6	<5	10
7	10	20

Table 3. Analytical standards used for Chemex Au analyses (ppb).

Standard Sample	Accepted Value	Analytical Results	
GTS-1	346	320	390
CH-1	240	200	210
CH-2	1330	960	1130

exhibiting visible sulphides and those not. It is apparent both from Table 4 and from the histograms in Figure 3 that the higher gold analyses tend to be associated with sulphide-bearing rocks, although Au values up to 80 ppb are encountered in rocks lacking visible sulphides. These data from sulphide-free rocks suggest that background levels of gold in these areas are uncommonly high.

Eight samples had analyses equal to, or exceeding, 100 ppb Au; these are listed in Table 5. Most of these samples are from outcrops where the extent of visible mineralization, as revealed by the presence of gossans, is very restricted, usually forming patches less than 1 m in diameter. However, samples 144 and 99 are from a zone about 1 m wide that can be traced in excess of 100 m before disappearing under surficial cover. Sample 34 is from a small outcrop in an otherwise largely till-covered area. At the time of writing (November, 1987), the areas around some of these sample sites had recently been staked.

The release of complementary soil and stream sediment data from the vicinity of most of these rock samples may give a better understanding of the extent of mineralized zones. Some preliminary soil data indicate that gold from mineralized bedrock is being reflected in the soil chemistry. These data may be smoother and more representative of the bedrock than the analyses of bedrock grab samples that are more prone to being influenced by the 'nugget effect'.

Table 4. Summary statistics of gold analyses in rocks (ppb)

Sample Set	N	$\overline{X}$	$\overline{X}$ + 1 S.D.	Minimum*	Maximum
All samples	172	4.7	20	2	1875
Sulphide-free rocks	59	2.7	5.9	2	80
Samples with visible sulphides	113	6.3	32	2	1875

* Values below detection limit are assigned a value of 2 ppb.

N – number of samples

$\overline{X}$ – geometric mean

SD – standard deviation

Table 5. Rock analyses and descriptions listed in order of decreasing gold content

Sample Number	Au (ppb)	Grid Number	NTS	U.T.M. Easting	U.T.M. Northing	Comments
57	1875	3	23J11	615900	6040375	1% sulphides
34	1200	16	23J14	605775	6088750	0.5% pyrite
109	550	7	23J06	620650	6020150	5% pyrite, trace graphite
13	515	1	23J11	618450	6045700	trace pyrite
99	400	9	23J06	624022	6012921	1% pyrite, trace chalcopyrite
55	130	1	23J11	617825	6044900	0.5% pyrite
7	100	1	23J11	617300	6046550	trace sulphides
155	100	9	23J06	623981	6012920	5% pyrite, trace chalcopyrite

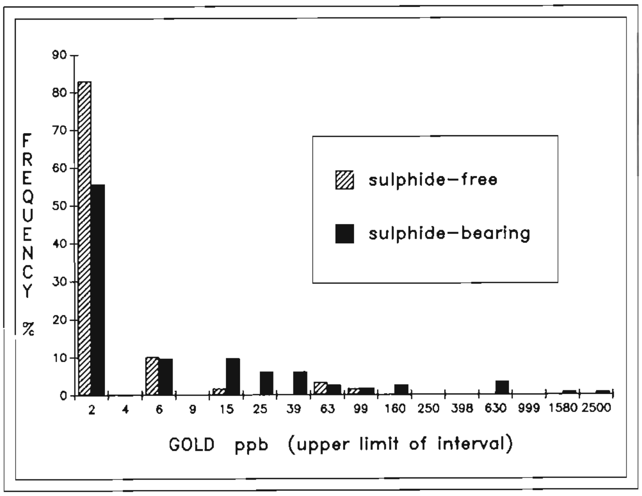

Figure 3. *Histograms of gold in sulphide-free rocks and in sulphide-bearing rocks.*

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