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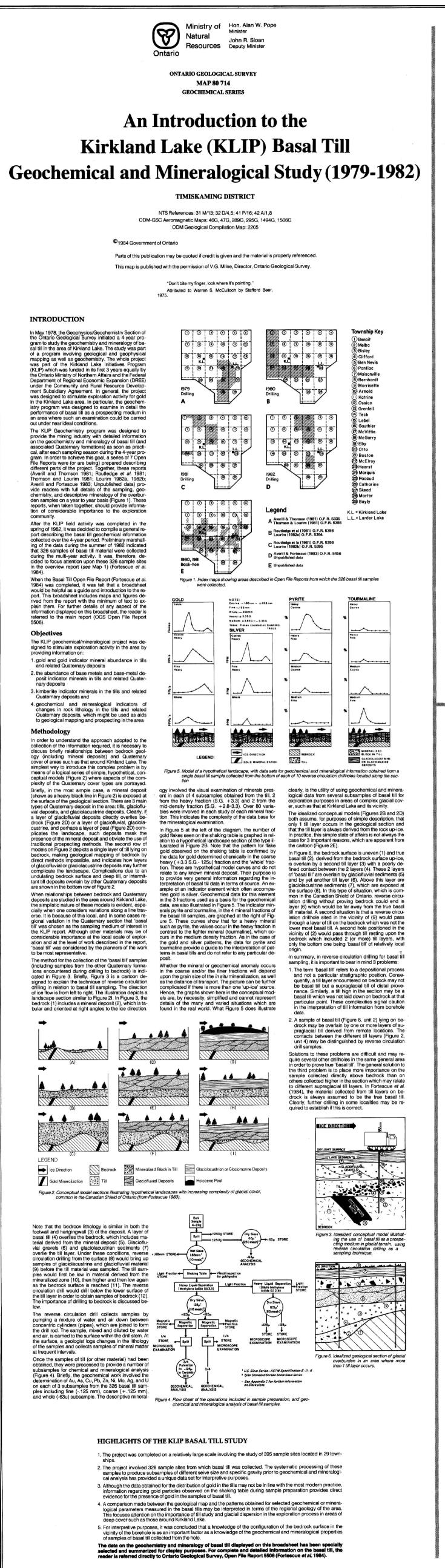
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back pocket). The axis of the synclinorium occurs midway between the 2 batholiths and plunges east (Jersen 1975). The northern and southern limbs of the syr

clinorium are cut by 2 large east-striking fault zones:

e/Larder Lake Fault Zone, respectively. The 2 fault zones divide the area into 3 large fault-blocks with smaller fault-blocks occurring in the fault zones. The rocks of the area have been affected by subgreen-

schist regional metamorphism (Jolly 1974, 1978).

Volcanic rocks were formed during cycles of volcan-

sm associated with sedimentation and plutonism. Each cycle consisted of komatiitic volcanism followed by tholeiitic, calc-alkalic, and finally, alkalic volcanism

(Jensen 1979). Rocks of the older volcanic cycles are

restricted to the outer parts of the synclinorium near the margins of the Lake Abitibi Batholith and the Round Lake Batholith, and are referred to as the Lower Supergroup (Fortescue et al. 1994, Map III in back pocket). Rocks of the younger volcanic cycle form

most of the synclinorium and are referred to as the Up-per Supergroup. The stratigraphic succession is indi-cated in Fortescue et al. (1984, Map IV in back pock-

The Lower Supergroup on the southern limb of the

synclinorium located southeast of Kirkland Lake, contains a cycle of komatiitic, tholeiitic, and calc-alkalic volcanic rocks represented by the Wabewawa, Cath-

erine, and Skead Groups, respectively (Jensen 1979)

tudies have been made on these rocks by Goodwin

1965), Goodwin and Ridler (1970), and Ridler (1969.

1970, 1975). A trachyte-pebble conglomerate at the top of the Skead Group, suggests that a phase of alkalic volcanism may have occurred at the end of the

cycle of volcanism. Below this cycle, the calc-alkalic

volcanic rocks of the Pacaud Tuffs (Goodwin 1965)

uggest that an even older volcanic cycle was devel-

The volcanic cycle represented by the Upper Super-

group consists of komatilitic lavas of the Larder Lake Group succeeded by tholeiltic rocks of the Kinojevis

Group and calc-alkalic rocks of the Blake River Group

Alkalic volcanic rocks of the Timiskaming Group un-conformably overlie the Blake River and Kinojevis

On the northern limb of the synclinorium, the oldest

stroyed or not exposed. Unconformably overlying the

Hunter Mine Group is a komatiito succession called

canic cycle of the Upper Supergroup. The Destor-Por-

he Stoughton-Roquemaure Group (Jensen 1976a, 978b), which forms the basal section of the main vol-

cupine Complex is thought to be analagous to the al-

The Larder Lake Group and Stoughton-Roquemaure

sen and Pyke 1980), where they were referred to as

(1980) (Fortescue et al. 1984, Map III in back pocket). Rocks of an older volcanic cycle, called the Deloro Group (Pyke 1980), underlie these komatiites. The

Hunter Mine, Deloro, Skead, and associated groups

probably represented separate, but roughly time-e-quivalent volcanic piles that were present on the mar-gins of a basin prior to the deposition of the komatilitic

rocks belonging to the younger volcanic cycle (Fortescue et al. 1984, Map III in back pocket). Sediments

presented by the Porcupine Group were deposited

in the basin at the edges of the Deloro volcanic piles prior to and during the deposition of the komatitic rocks of the Tisdale Group (Pyke 1980).

Komatiitic volcanism, at the start of the younger vol-

canic cycle, occurred throughout the basin and ex-tended onto the margins of the older volcanic piles to

the way around the synclinorium. The komatiitic vol

canic rocks were probably thicker in the central part of

the basin than on the edges of the older volcanic piles. Thick successions of tholeittic and calc-alkalic lavas were also deposited in the basin above the komatilitic succession. For this to have occurred, the original floor of the basin probably sank under the accumulat-

ing volcanic rocks to continuously make room for the upper volcanic successions. Jolly (1978) came to a similar conclusion based on the metamorphism of the

The sinking of volcanic rocks during their accumula-

tion would explain the origin of the synclinorium. If the

inward (Fortescue et al. 1984, Map III in back pocket)

Likewise, the Destor-Porcupine and Kirkland Lake-

piles to the north and south and the floor of the basin

and the basin would have acted as a hinge zone as

the basin began to sink. As the basin continued to sink, the volcanic strata at the hinge zones would have

sheared and been displaced downward on the basin

side of the fault zones. The tilt of the strata at the same

time would have caused tensional forces along the fault zones and allowed fault blocks to drop and create grabens in the fault zones. The grabens would

have then filled with alkalic volcanic rocks and sedi-

Trondhiemitic batholiths probably formed in the cores

canic cycles and in places extended, so that they

intruded the komatiitic rocks at the base of the

ments of the Timiskaming Group.

nitially, the boundary between the older volcanic piles

lavas throughout the area.

Back-hoe Pit...

GENERALIZED GEOLOGY

rondhiemitic Rocks ..

Komatiitic Volcanic Rocks,

MINERALIZATION IN THE

KIRKLAND LAKE AREA (L.I.)

Diabase, Granophyre, Sheets and Dikes

economic base of Kirkland Lake and its nearby com-

munities. The gold deposits are proximal to the east-

has been traced as far east as Val d'Or and Malarti

found away from the fault zone both to the north and

be divided into 2 groups (Jensen 1980). The first group, represented by the Kerr Addison Mine and other past producers in the vicinity of Larder Lake, oc-

cur in strongly folded sedimentary rocks within the ko-

other past producers located in the town of Kirkland

Lake, are hosted by trachytic volcanic and intrusive

Group, which is much younger than the Larder Lake Group.

Gold deposits of the Larder Lake Group occur in finegrained sedimentary beds either rich in carbon, car-bonate, or chert and in quartz-carbonate veins. Gold

places, with chalcopyrite, sphalerite, galena, barite

and scheelite. The gold-bearing beds occur interlay

ered with mass-flow turbiditic conglomerates largely of peridotitic komatiite clasts. Tholeilitic pillowed lavas, iron-formation, argillites, and wackes are also present

in the rock sequence. The conglomerates have been

variably altered. Better preserved conglomerates

ite schists or fuchsite-rich carbonates and carbonate

schists. Gold in native form occurs in quartz-veins

Not at the Kerr Addison Mine, but elsewhere in the

have intruded the same group of sedimentary rocks

pelonging to the Larder Lake Group. In mines such as the La Garre Mine at Larder Lake, gold, in native form and in auriferous pyrite, is erratically distributed in the

metamorphosed and hybrid country rocks, in irregular

The source of gold may have been the auriferous sedi-

In Kirkland Lake, gold is concentrated in quartz-filled

fractures cutting trachyte, syenite, and fluvial sedi-

pyrite. Limited chalcopyrite, arsenopyrite, sphalerite, galena, molybdenite, and hematite occur in some

erals such as tourmaline, chlorite, pyrite, barite, cal-

places with the gold mineralization as do gangue min

Outside the Kirkland Lake-Larder Lake Fault Zone gold occurs mainly in subeconomic sulphide-rich zones associated with the felsic volcanic rocks in the Blake River Group and the Gauthier Group north of the

ault zone and the Skead Group south of the fault

th lesser amounts of sphalerite, galena, and arseno-

Quartz-carbonate veins are common throughout the

cupine Fault Zone, occurrences of gold have been

found which are similar to those described along the

Rase-metal sulphide occurrences are found mainly in

um. They occur as chalcopyrite, sphalerite, galena,

and molybdenite with pyrite in calc-alkalic volcanic

rocks altered to chlorite, uralite, actinolite, epidoti and albitite. Some carbonatization and silicification

Minor weakly disseminated pyrite grains 0.2 to 2 mm

in size are found in all the volcanic, sedimentary, and

intrusive rocks of the Kirkland Lake area. Rusty go

metasomatized volcanic rocks occur random

throughout the area. In the sedimentary rocks, pyrite,

in cubic and in concretionary form, is concentrated in the carbonaceous shales and cherts and iron forma-tions in amounts of up to 25%. Trace amounts of gold,

silver, chalcopyrite, sphalerite, pentlandite, and ga-

lena can be associated with the pyritic gossans and

Kirkland Lake area. Most are <10 cm wide and a fev carry minor native gold with pyrite and chalcopyrite.
North of the Kirkland Lake area, along the Destor-Por-

pyrite occuring as well.

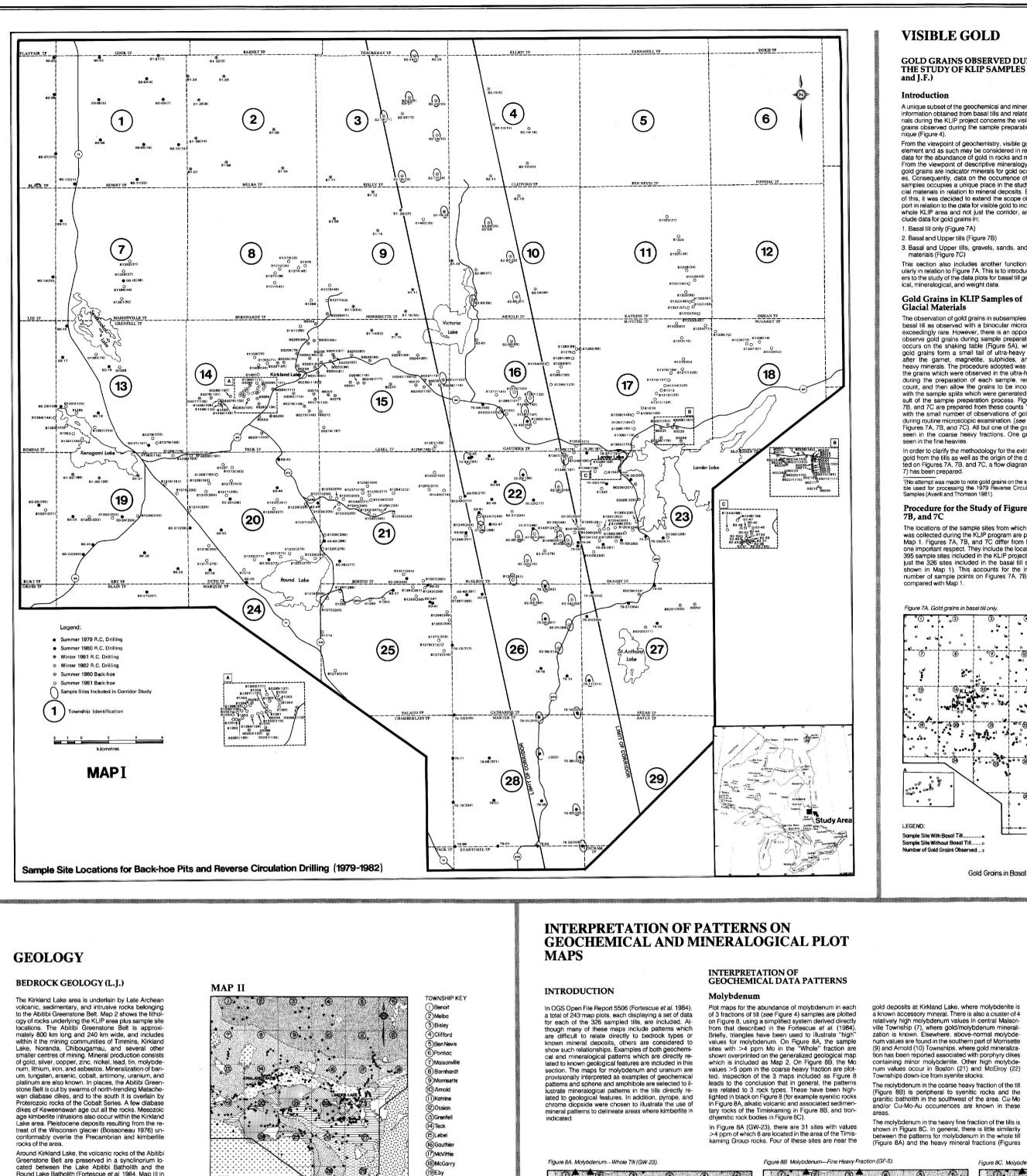
include native gold, various tellurides, and auriferou

quartz veins, and in the margins of the svenite bodies

The important gold deposits along the fault zone can

ercycle Sedimentary Rocks, Calc-alkalic Tuffs, Komatiiti and Ultramafic Intrusive Rocks

The mining of gold with associated silver forms the Magnetite-rich iron formation is mined for iron ore at



②Boston ②McElroy

Marquis 2

25)Pacaud

27)Skead

29Bayly

All samples with >4 ppm

Reverse Circulation Drill Hole...

Calc-alkcalic Volcanic Rocks (Skead Group)...

A total of 30 of the 326 till samples have >2 ppm ura-

nium in the -63 micron fraction (Figure 9A). Because

the Timiskaming Group is known to contain minor ura-

nium mineralization, it is not surprising that above nor-mal uranium values were found in sample sites in Le-bel (15) and Gauthier (16) Townships. Many of the

highest uranium values are clustered over and along the periphery of the syenite stocks in Otto (20) and McElroy (22) Townships (Figure 9A). Radioactive minerals are known along the northern and northeastern

poundaries of the stock in Otto (20) Township. Several nteresting above-normal uranium values are tound

ary rocks which like along the western boundary of

the area (Figure 9). The association of uranium and gold in till samples from this area might be of interest

Figure 9A. Uranium—Whole Till (GW-27).

Back-hoe Pit

Proterozoic .

GENERALIZED GEOLOGY

Tholeiitic Volcanic Rocks .....

Komatiitic Volcanic Rocks

Syenitic Rocks..... Trondhjemitic Rocks...

Reverse Circulation Drill Hole....

Alkalic Volcanic and Associated Sedimentary Rocks

Calc-alkcalic Volcanic Rocks (Skead Group)...

Intercycle Sedimentary Rocks, Calc-cikalic Tuffs, Komatiitic Volcan and Ultramafic Intrusive Rocks

also along the boundary of the Proterozoic sedimen-

Diabase, Granophyre, Sheets and Dikes

GENERALIZED GEOLOGY

Chaleitic Valcanic Rocks

Comatiitic Volcanic Rocks....

Back-hoe Pit....

Syenitic Rocks..... Trondhiemitic Rocks...

ws \_\_\_\_

flows of peridotitic komatiite. Numerous units of ma

netic iron formation (1 to 10 cm thick) are also found throughout the Larder Lake Group and are uneconom-ic. Iron formation is largely absent in the other groups

of volcanic and sedimentary rocks of the Kirkland

matiites and associated ultramafic intrusions of the

Asbestos and talc minerals occur in the peridotitic ko

High background uranium and thorium occur in some

of the trachytes and syenites of the Timiskaming Group. As well, fluorite and scheelite mineralization occurs near the margins of some syenite intrusions in Eby and Otto Townships southwest of Kirkland Lake.

It is evident from the outline presented above that the

bedrock geological conditions and the associated

terial often derived from several rock types, which ma

major periods of glaciation during the Quaternary peri-od. The effects of all but the last, the Wisconsinan, are

unknown and subject to speculation. All surficial materials encountered during the KLIP project are deemed to be Late Wisconsinan in age, although the possibility

exists that older sediments (Missinaibi Formation) ma

be encountered in boreholes (Brereton and Elso

Striae, chatter marks, and flutings indicate that glacial

sulted in the deposition of a silty sand to sandy silt til

The majority of fresh till exposures show the material to

be dense and massive, although fissility is common.
This material was deposited subglacially as either

lodgement (basal) or subglacial meltout till. In a num-

ber of instances, banded or stratified till was encou

tered. Such material is considered to represent a flow

jected to processes which produced sorting and stra-

Till thickness of between 0.5 and 1.0 m are usual, al-

though depths of several metres are common. Surface exposures of till are highly oxidized and weathered to a depth of about 0.5 m, giving this part of the till a san-

Glaciofluvial ice-contact deposits were developed in the area during the last phase of ice cover. The most dominant form of these deposits are the large esker

systems which trend southward across the area. The eskers, composed of sand and gravel, are easily rec-ognized by their crests, or bell-shaped ridges, which vary between 1 and 3 km in length. The crests are sur-rounded by hummocky to level terrain consisting pri-

marily of sand. These sediments were deposited as

either subaqueous fans, deltas, or outwash directly in

As the glacier wasted northward, glacial lakes Barlow and then Ojibway inundated the area. Fine-grained glaciolacustrine sediments deposited in the lakes are

represented by clay, varyed clay, and silt, Varyed clay

Coarse-grained glaciolacustrine sediments, sand and

ments undergo a lateral facies change from sand to

glaciofluvial material reworked by glacial lake waters

As the lake drained and the sand plains became ex-

posed to eolion activity, sand dunes formed. The dunes, composed of fine- to medium-grained sand, are parabolic in shape, indicating a paleowind direc-tion from the west-northwest. After emergence, or-

ganic deposits began to accumulate in rock basins

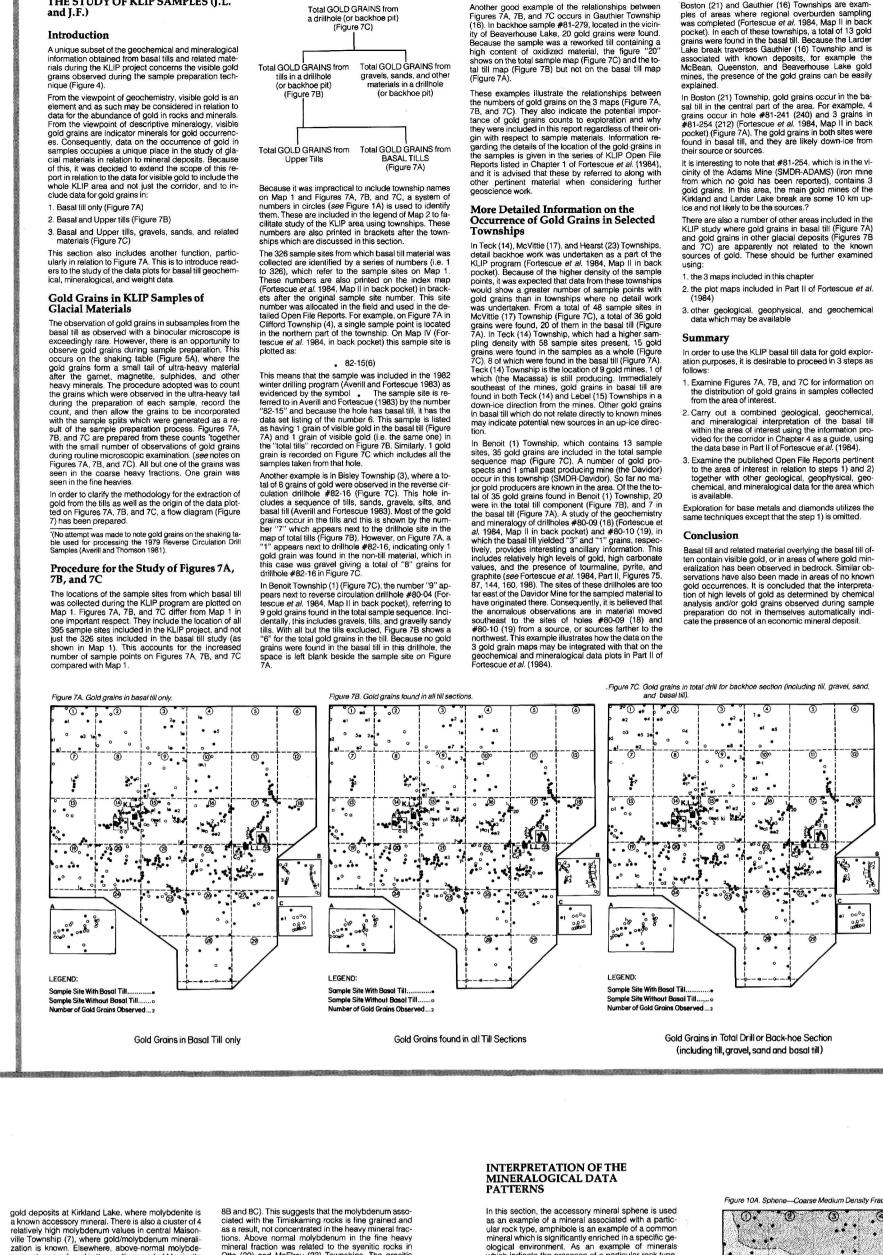
dier appearance.

and averaging 10 to 12 mm.

amicton to well sorted sand.

**OUATERNARY GEOLOGY (C.B.)** 

Larder Lake Group.



chrome diopside and pyrope garnet are used as inc

Sphene is a common accessory mineral of the syenitic rocks of the Kirkland Lake area. This association is

shown clearly in the distribution pattern for coarse sphene in the S.G. + 3.3 fraction (Figure 10A). Greater than 5% sphene is found over and down-ice from the major syenitic stocks, as well as in the vicinity of the smaller intrusive rocks within the Timiskaming

Group. Down-ice dispersal of coarse sphene (+5

ter in the vicinity of the Kirkland Lake gold deposits

for a distance of up to 8 km is evident around the

McEroy (22) stock. The above associations are also well illustrated for coarse-grained sphene in the 2.8 - 3.3 S.G. fraction (Figure 10B), with an additional clus-

The amphibole patterns were chosen as an example

coarse fraction of the +3.3 S.G. fraction (Figure 11A)

especially where these rocks fringe the syenitic stocks in Otto (20), Boston (21), and McElroy (22) Townships. The abundance of 'heavy' amphibole could be the re-

s relatively abundant over the komatilitic sequence

sult of the presence of iron-rich amphiboles in this uni

especially where iron formations are prevalent. Some

of these heavy amphiboles may also be derived from the rims of the syenite stocks where iron and alkali-rich amphiboles may be found. By contrast, the lighter

coarse amphibole (Figure 11B) tends to be abundar

of only in association with the komatiitic sequences but also over the Timiskaming Group, especially in Teck (14) and Lebel (15) Townships. The marked drop in the quantity of amphibole in the northern part of the

region reflects the relative paucity of amphibole in the Blake River calc-alkalic volcanic rocks.

Figure 11A. Amphibole—Coarse Fraction (MHIC-72)

O A - 40 - 3

>10% amphibole ...

GENERALIZED GEOLOGY

Tholeiitic Volcanic Rocks ......

Reverse Circulation Drill Hole ... .

Calc-alkcalic Volcanic Rocks (Skead Group).

Komatiitic Volcanic Rocks Diabase, Granophyre, Sheets and Dikes

Intercycle Sedimentary Rocks, Calc-alkalic Tuffs, Komatilitic Vol-and Ultramatic Intrusive Rocks

GENERALIZED GEOLOGY

Tholeiitic Volcanic Rocks ...

Proterozoic ..... Syenitic Rocks Trondhjemitic Rocks ....

Komatiitic Volcanic Rocks...

Syenitic Rocks..... Trondhjemitic Rocks....

Reverse Circulation Drill Hole ....

Alkalic Volcanic and Associated Sedimentary Rocks

Figure 12A, Kimberlite Indicator Mineral—Spinel (MHII 125, 126, 127)

chrome diopside

GENERALIZED GEOLOGY

Komatiitic Volcanic Rocks...

Alkalic Volcanic and Associated Sedimentary Rocks.

Calc-alkcalic Volcanic Rocks (Skead Group)
Tholeiitic Volcanic Rocks

Diabase, Granophyre, Sheets and Dikes

Back-hoe Pit ....

Syenitic Rocks Trondhjemitic Rocks

Proterozoic ....

Calc-alkcalic Volcanic Rocks (Skead Group)...

lows ===

of patterns for a common mineral which have geological implications on a regional scale. Amphibole in the

tions. Above normal molybdenum in the fine hear

ringed on its eastern border by several high molyb

small granitic stocks which occur in the area.

mineral fraction was related to the syenitic rocks in Otto (20) and McElroy (22) Townships. The granitic batholith in the southwestern corner of the area is

showings are known in this area. Other highs for mol-ybdenum over the Blake River rocks are related to

From the regional perspective, it is quite practical to

rpretation is that the data from different types of

subsamples is interpreted in different ways. One of the

reasons why molybdenum was chosen for this exam

ple is that molybdenite is rarely seen in tills although the distribution of the metal has significant patterns

Figure 8C. Molybdenum—Coarse Heavy Fraction (GC-14).

All samples with >5 ppm

GENERALIZED GEOLOGY

Komatiitic Volcanic Rocks

All samples with

Back-hoe Pit....

Proterozoic ....

ows Intercycle Sedimentary Rocks, Calc-alkalic Tuffs, Komatiitic Volcanic Flows Intercycle Sedimentary Rocks, Calc-alkalic Tuffs, Komatiitic Volcanic Flows and Ultramafic Intrusive Rocks

>18 ppm uranium ...

GENERALIZED GEOLOGY

Komatiitic Volcanic Rocks...

Calc-alkcalic Volcanic Rocks (Skead Group) ... Tholeiitic Volcanic Rocks .....

Diabase, Granophyre, Sheets and Dikes

Alkalic Volcanic and Associated Sedimentary Rocks

Calc-alkcalic Volcanic Rocks (Skead Group)... Tholeitic Volcanic Rocks

Intercycle Sedimentary Rocks, Calc-alkalic Tuffs, Komatiitic Volcani and Ultramafic Intrusive Rocks

The geochemical patterns for molybdenum and ura

clearly that basal till may provide geochemical data

which can be interpreted under favourable conditions

sible even though the uniformity of the sample site

elements supports the contention that more than

cation density was not uniform. The data for these

Back-hoe Pit

Proterozoic.

In the coarse heavy fraction of the tills, values >9 ppm nium is more abundant in the fine heavy fraction was found in the fine heavies along the Proterozoic

higher than normal uranium values are also found over

and down-ice from syenitic rocks especially in Otto

and the Blake River Group calc-alkalic rocks in the

north. The source of the uranium here is likely to be the

pattern for molybdenum in the -63 micron fraction and

showings in the area may have associated uranium

minerals as well giving rise to this pattern. As in the case of the -63 micron data (Figure 9A), high uranium

ownship. Here, down-ice dispersion for a distance of

All samples with >5 ppm

GENERALIZED GEOLOGY

yenitic Rocks.....rondhjemitic Rocks.

Tholeiitic Volcanic Rocks

uranium were selected as being of interest (Figure 9B). The source of these high values, which are largely

confined to the svenitic rocks of Otto (20), Boston (21)

and McElroy (22) Townships, is almost certainly radio-active minerals in the alkalic intrusive rocks; down-ice

The uranium values in the heavy fine fraction were

found to be relatively uniform with 150 results between

18 and 36 ppm. Consequently, a large number of tri-

values are associated with the Timiskaming rocks wi

limited down-ice movement. It is of interest that at the

western end of the Timiskaming belt uranium highs are

All samples with

GENERALIZED GEOLOG

Calc-alkcalic Volcanic Rocks (Skead Group)....

Diabase, Grunophyre, Sheets and Dikes...... Calc-alkalic Volcanic Rocks (Blake River Group

Alkalic Valcanic and Associated Sedimentary Rocks

Syenitic Rocks...... Trondhjemitic Rocks

Calc-alkalic Volcanic Rocks

Tholeitite Volcanic Rocks

Komatiitie Volcanic Rocks

Diabase, Grunophyre, Sheets

Calc-alkalic Volcanic Rocks (E

Back-hoe Pit....

Proterozoic ....

transport of uranium minerals appears to be minimal.

Intercycle Sedimentary Rocks, Calc-alkalic Tuffs, Komatiitic Volcanic Flows and Ultramafic Intrusive Rocks

Ultramafic Intrusive Rocks

Reverse Circulation Drill Hole...

Calc-alkcalic Volcanic Rocks (Skead Group)...

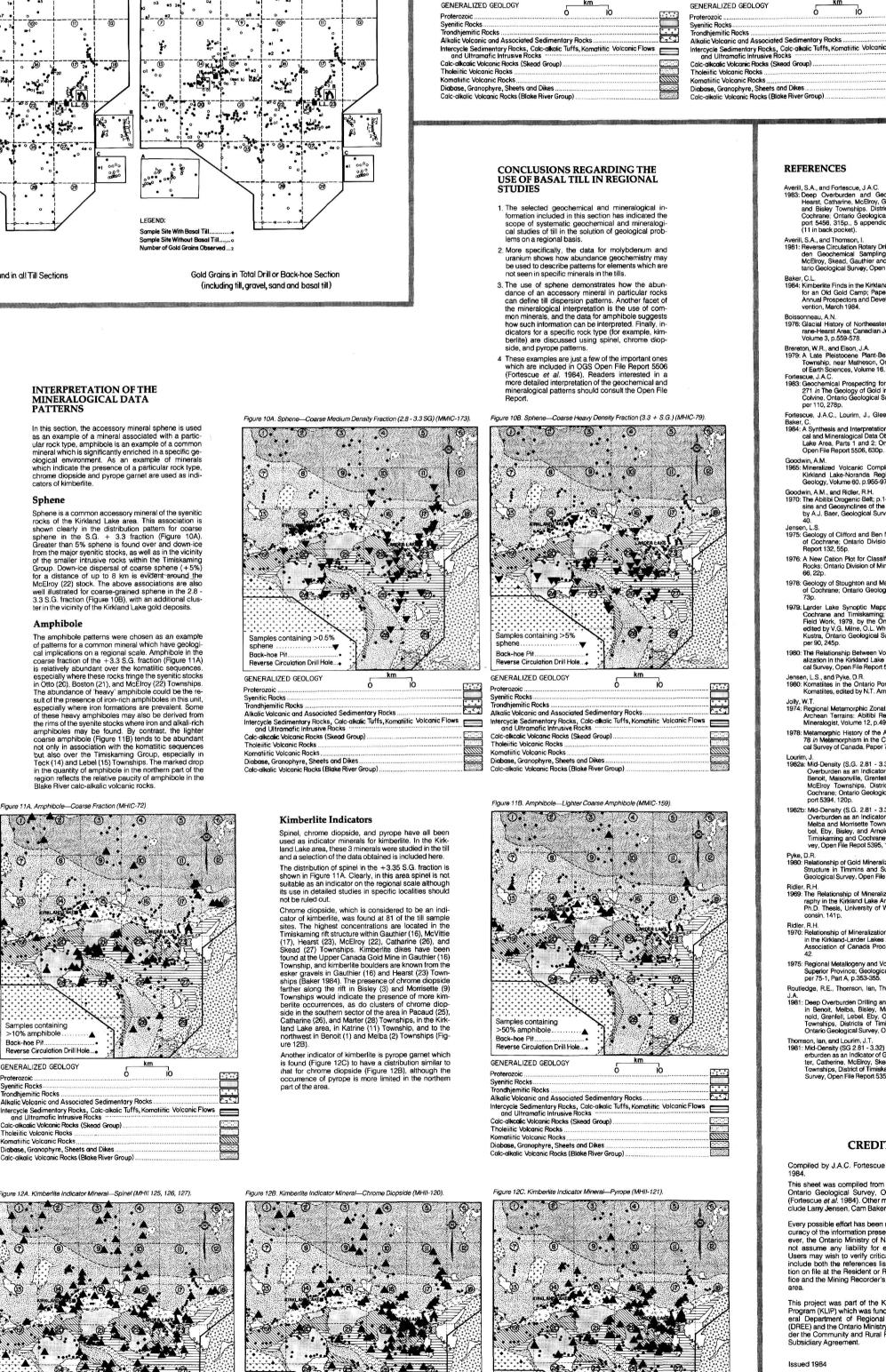
Komatiitic Volcanic Rocks
Diabase, Granophyre, Sheets and Dikes

Figure 7. Flow diagram showing the origin of data on gold grains included in Figures 7A, 7B, and 7C.

Total GOLD GRAINS from

**VISIBLE GOLD** 

GOLD GRAINS OBSERVED DURING



pyrope garnets ... Back-hoe Pit......

Syenitic Rocks...... Trondhjemitic Rocks ...

Tholeitic Valcanic Rock

Komatiitic Volcanic Rocks....

Intercycle Sedimentary Rocks, Calc-alkalic Tuffs, Komatiitic Volcanic Flows and Ultramafic Intrusive Rocks

Reverse Circulation Drill Hole ....

GENERALIZED GEOLOGY

Calc-alkcalic Volcanic Rocks (Skead Group)

Diabase, Granophyre, Sheets and Dikes

>164 ppb gold

## **GOLD IN TILL SAMPLES** THE ABUNDANCE OF GOLD IN TILL SAMPLES Figure 7E. Gold—Fine Heavy Fraction (GF-8). is interesting to compare the data for gold observ on the shaking table during sample preparation (Fig-ures 7A, 7B, and 7C) with the patterns obtained for the oundance of gold in the 3 fractions of till sample hich were selected for geochemical analysis (Figure ). The latter were included as 7D, 7E, and 7F. A detailed discussion of these patterns is quite beyond th scope of this broadsheet. Briefly, there is a relative grain counts. High gold values are prevalent in areas where gold deposits and occurrences are common (for example, Kirkland Lake, Larder Lake, Catharine (28), and Skead (27) Townships). However, there are ther areas where high gold was indicated but n showings have been reported. Examples here are in Boston (21) and Marter (28) Townships, in southwest Otto (20) Township, Grenfell (13) Township, and across the northern part of the area. Gold in the fine raction of the heavy mineral concentrates is more dispersed than in the coarse fraction. In addition to the areas already mentioned for gold i ne coarse fraction, there are above normal amounts in the fine heavy fraction (Figure 7E) of samples derived from unknown sources in the Maisonville (7) and Bernardt (8) Townships. The lack of gold in the coars rained gold mineralization in the underlying rock. A Back-hoe Pit... ner complication is that in samples of the -63 micro raction, the gold determined may not accurately re-ect the distribution of gold in the sit-clay fraction of he tills owing to loss during the process of drilling. All GENERALIZED GEOLOGY these factors complicate the interpretation of the geo Proterozoic ... chemical gold data and require further study. In summary, the data for 'geochemical gold' provide a confirmation of patterns obtained from the gold ob-served on the shaking table during sample prepar-Intercycle Sedimentary Rocks, Calc-alkalic Tuffs, Komatiitic Volcanio and Ultramafic Intrusive Rocks ation. However, there are problems in the interpre Calc-alkcalic Volcanic Rocks (Skead Group)... Tholeitic Volcanic Rocks ..... tion of the gold patterns, which require further study prior to a firm interpretation of the data. Komatiitic Volcanic Rocks... Diabase, Granophyre, Sheets and Dikes..... Calc-alkalic Volcanic Rocks (Blake River Gra Figure 7D. Gold—Coarse Heavy Fraction (GC-1. iaure 7F. Gold-Whole Till (GW-26)

All samples with

Volume 3, p.559-578

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cal Survey of Canada, Paper 78-10.

2a: Mid-Density (S.G. 2.81 - 3.32) Mineratogy of Glacial Overburden as an Indicator of Gold Mineralization in Benoit, Maisonville, Grenfell, Eby, Otto, Boston, and McEiroy Townships, Districts of Timiskaming and Cochrane; Ontario Geological Survey, Open File Re-port 5394, 120p.

Overburden as an Indicator of Gold Mineralization Melba and Morrisette Townships and portions of L bel, Eby, Bisley, and Arnold Townships, Districts

Superior Province; Geological Survey of Canada, Paper 75-1, Part A, p.353-355.

erburden as an Indicator of Gold Mineralization in Mar-er, Catherine, McElroy, Skead, Gauthier, and Hearst

Townships, District of Timiskaming; Ontario Geological Survey, Open File Report 5355, 112p.

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eral Department of Regional Economic Expansion (DREE) and the Ontario Ministry of Northern Affairs un-

Information from this publication may be guoted if

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Back-hoe Pit..

