

THE GEOLOGIC SETTING OF GOLD
OCCURRENCES IN NORTHERN NEW BRUNSWICK

by

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with contributions from

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PROLOGUE

This field guide was hastily prepared and consequently has some rough edges. Be tolerant and kindly notify us of any errors or omissions. It would not have seen the light of day except for the last minute efforts of several people, namely, A. LeBlanc, K. MacKenzie, S. McKinnon, M. Parkhill and G. Philpott. Northeast Exploration Services kindly loaned us their machine to put the pretty covers on the guide.

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INTRODUCTION

In this leg of the trip we will look at gold occurrences in northern New Brunswick that are situated in the Tobique-Chaleurs Zone, part of the Elmtree and Miramichi terranes (Fig.1). The fact that the Elmtree Terrane is underlain by less radiogenic crust than the Miramichi Terrane, which is indicated by Pb-isotope data from intrusive rocks (Bevier 1988), may have important implications for gold exploration, i.e. different crust will yield different amounts of gold when melted.

Emphasis will be placed on the geologic settings of the gold occurrences, which vary depending upon rock type, structural control and the level of erosion. The structurally-controlled deposit near Alcida will be visited first. Intrusion - related occurrences in the Upsalquitch area and a volcanic - hosted epithermal deposit at Rocky Brook will be seen the following day. Stop descriptions are shown in Figures 4 and 5, which are located in Figure 1.

REGIONAL GEOLOGY

The geology of northern New Brunswick comprises three major elements - the Miramichi Massif, the Elmtree Inlier, and the Matapedia Basin (Fyffe and Noble 1985). Respectively, these have been termed the Miramichi Terrane, Elmtree Terrane and Matapedia Cover Sequence by Fyffe and Fricker (1987). The boundary between the Miramichi and Elmtree terranes beneath the Matapedia Cover Sequence is infer-

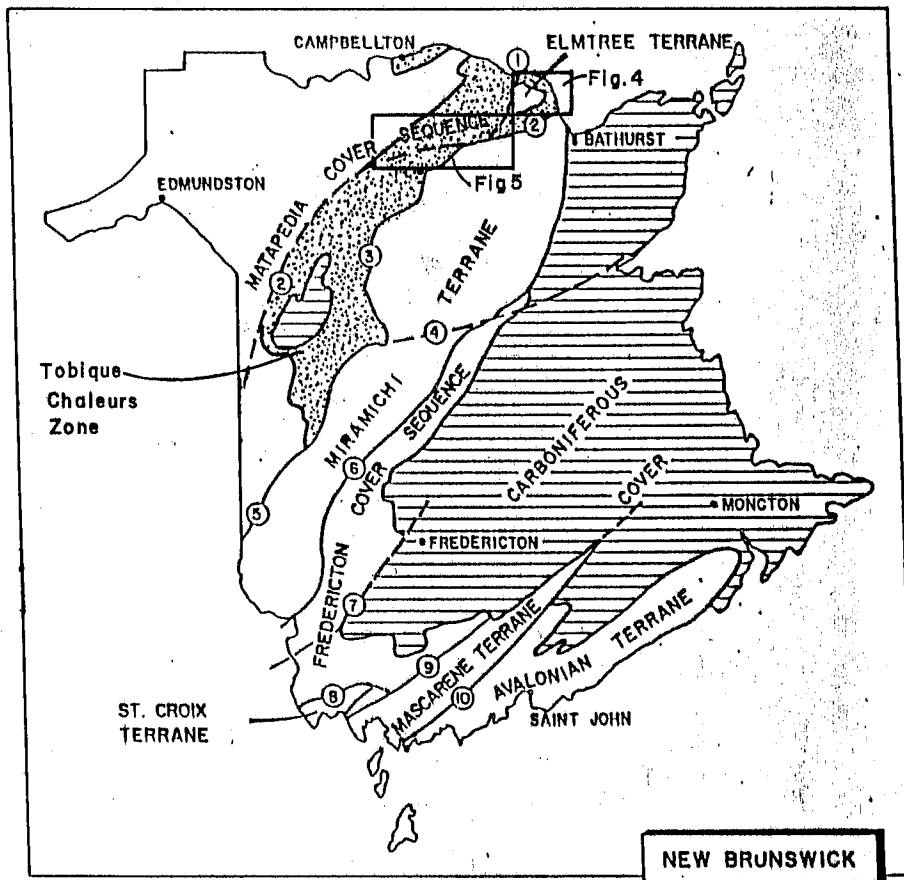


Fig. 1. Tectonostratigraphic terranes and cover sequences of New Brunswick (modified after Fyffe and Fricker, 1987)

1. Jacquet River Fault
2. Rocky Brook-Millstream Fault
3. Portage Lakes-Serpentine River Fault
4. Catamaran Fault
5. Woodstock Fault
6. Bamford Brook-Hainesville Fault
7. Fredericton Fault
8. Honeydale Fault
9. Pendar Brook Fault
10. Belleisle Fault

red to be the Rocky Brook - Millstream Fault. The following description of the regional geology is mainly from Fyffe and Noble (ibid).

Part of the Miramichi Massif is underlain by cordierite-sillimanite-bearing paragneiss that is inter-layered with migmatitic paragneiss (St. Peter 1981). These rocks may represent mobilized Precambrian basement to the surrounding, greenschist-grade, Tetagouche Group (Rast et al. 1976a ; O'Brien 1977).

The lower part of the Tetagouche Group consists of a thick sequence of quartz wacke, quartzite and slate that is locally overlain by a thin calcareous siltstone containing an Early Ordovician (Arenig) brachiopod fauna (Newman 1968; Fyffe 1976). These quartzose rocks have been interpreted as a flysch apron developed off the northern, rifted-margin of the Late Precambrian, Avalon Platform (Rast et al. 1976b; Poole 1976; Ruitenberg et al. 1977).

The upper part of the Tetagouche Group includes felsic and mafic volcanic rocks with intercalated red and black slate, chert, iron formation and minor limestone. Lithic wacke containing abundant volcanic detritus constitutes the youngest part of the group (Helmstaedt 1971; Skinner 1974). Graptolites, trilobites and conodonts indicate that the upper Tetagouche is Late Ordovician (Caradocian) in age (Alcock 1935; Kennedy et al. 1979; Nowlan 1981).

Chaleurs Group conglomerate (New Mills Formation?) unconformably overlies the northern margin of the Miramichi

Massif. It contains clasts of relatively undeformed limestone (LaVielle Formation?) of Late Silurian (Ludlow) age (Helmstaedt 1971).

The Elmtree Inlier, which is exposed to the north of the Miramichi Massif, comprises the Ordovician Fournier and Elmtree Groups. The Fournier Group is an ophiolitic complex (Pajari et al. 1977; Rast and Stringer 1980) with a core of deformed gabbro and peridotite intruded by dykes and veins of plagiogranite. The core is enveloped by pillow basalt, dark gray slate, greywacke, melange and locally, sheeted dykes. The Elmtree Group is composed of lithic wacke and quartz wacke that are interbedded with slate, minor limestone, conglomerate and mafic volcanic rocks. In places, inlier rocks are unconformably overlain by Late Silurian conglomerate (New Mills Formation), but in others, they may be conformably overlain by Early Silurian strata (Van Staal, pers. comm., 1988).

The lowest exposed rocks in much of the Matapedia Basin are wackes and slates of the late Ordovician Grog Brook Group, which has been interpreted as a submarine fan sequence (St. Peter 1978; Nowlan 1983). Late Ordovician to early Silurian thinly bedded limestone and calcareous slate of the Matapedia Group gradationally overlies Grog Brook turbidites (St. Peter 1978).

In the northeast, the Matapedia Group is conformably overlain by rocks that are assigned to the Chaleurs Group (St. Peter 1978; Lee and Noble 1977). These rocks consist of

a shallowing-upward sequence of thinly interbedded siltstone and fine-grained sandstone (Upsalquitch Formation) that is locally overlain by nodular limestone (Limestone Point and/or LaVielle formations). These rocks are overlain by Late Silurian to Early Devonian mafic (locally pillowed) and felsic volcanics that are interbedded with gray, and in places red, siltstones. The Silurian part of this volcanic pile has traditionally been assigned to the Chaleurs Group, whereas the Devonian part has been included in the Dalhousie Group.

Along the coast, the Chaleur Group consists of a basal unit of Early Silurian conglomerate and sandstone (Armstrong Brook Formation); a middle Silurian shelf sequence of calcareous sandstone and nodular limestone (Limestone Point and LaVielle formations); a clastic sequence of red, green and gray siltstone, shale and sandstone possessing turbidite features (Petit Rocher Formation) and Late Silurian (Pridolian), limestone-clast sedimentary breccias (LaPlante Formation). These rocks lie between the Elmtree Inlier and the Miramichi Massif.

Small intrusions are abundant, particularly in the Silurian and older rocks of the Matapedia Basin. Work in progress by G. Philpott shows that most of them have mafic to intermediate compositions (45-68% SiO₂) but some of the larger ones are felsic (73-78% SiO₂). Many of the intrusions are feldspar porphyritic; few contain quartz phenocrysts, even the high-silica ones. The smaller intrusions generally

parallel cleavage, and a few actually possess a poorly developed cleavage. These intrusions are considered to be syn- to post-tectonic, and largely co-magmatic with the Siluro Devonian volcanic pile.

GOLD OCCURRENCES AND ALTERATION

At least three types of gold occurrences can be recognized depending upon rock type, structural control and level of erosion. One type formed relatively deep in the crust, and is hosted by intrusions or brecciated metasedimentary rocks adjacent to intrusions. Another type formed at relatively shallow depth, has classic epithermal characteristics and may also be intrusion related. The third type exhibits strong structural control, and the gold-bearing fluids may be of metamorphic rather than magmatic origin. Intermediate types also exist, and there is a good possibility for skarn type deposits as well (Fig. 2). The style of alteration differs with each type.

Many auriferous intrusions are spatially associated with brecciated and iron-carbonate altered sedimentary rocks with abundant pyrite. Some intrusions have pervasive alteration, some are only slightly altered, whereas others exhibit no alteration effects, even though they may be in contact with highly altered country rocks. Scattered quartz-carbonate veins and/or stockworks cutting these altered intrusions have yielded assays up to 15 g/t Au (Table 1).

The intrusions are considered to be the source of the

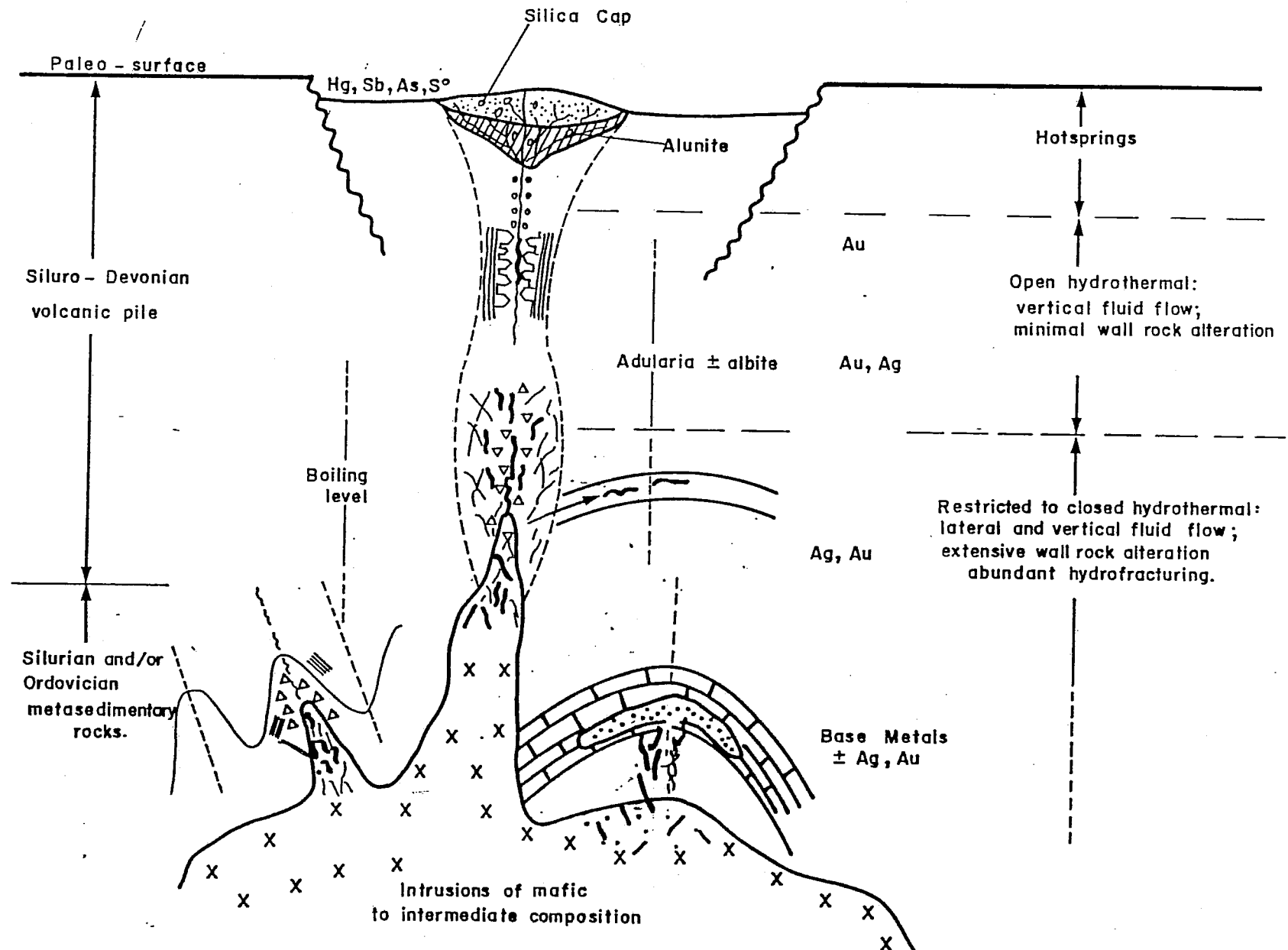


Fig. 2. Diagrammatic section showing inferred deposit characteristics with respect to depth below the paleo-surface. Modified after Panteleyev (1986).

TABLE 1

MAXIMUM CONCENTRATION OF GOLD OBTAINED IN GRAB SAMPLES
FROM THE OCCURRENCES
(after Pronk and Burton, in press)

1.	Upsalquitch Forks	10,345 ppb
2.	Simpsons Field	8,069 ppb
3.	Mulligan Gulch	1,724 ppb
4.	Dalhousie Road	10,345 ppb
5.	McCormack Brook	10,690 ppb
6.	McCormack Brook East	14,826 ppb
7.	Jonpol	15,172 ppb
8.	Southeast Upsalquitch River	1,448 ppb
9.	Rocky Brook	5,700 ppb

hydrothermal fluids that caused the alteration because of the spatial association between intrusions and alteration. Also, there are major faults that clearly cut and overprint the alteration. As the intrusions (magmas) rose through the crust, it is postulated that a CO₂-rich volatile phase evolved from them (perhaps due to adiabatic decompression), collected in cupolas and caused brecciation and alteration of the deformed metasedimentary rocks above these cupolas (stage 1, Fig.3). Magma bodies that "stuck" at a particular level produced additional volatiles by inward cooling, and these volatiles caused fracturing and alteration of their own outer cooled-rim (stage 2a, Fig. 3). Alternatively, parts of magma bodies (dykes) that rose to higher crustal levels may have cross-cut the alteration envelope of their parent intrusion (Stage 2b, Fig. 3).

Epithermal deposits are characterized by argillic and hematitic alteration, brecciation and multi-stage quartz veining. The veins mainly consist of vuggy and chalcedonic quartz and they cross-cut stratigraphy, as well as structure in penetratively deformed rocks. Manganese oxides and purple fluorite are common in the veins, which are geochemically anomalous in mercury. The altered host rocks are generally elevated in antimony, silver, arsenic and base metals (Burton, 1987). At Rocky Brook, there is evidence of some lateral fluid flow along permeable tuff and/or epiclastic beds, i.e. stratiform alteration.

Structurally - controlled deposits have alteration

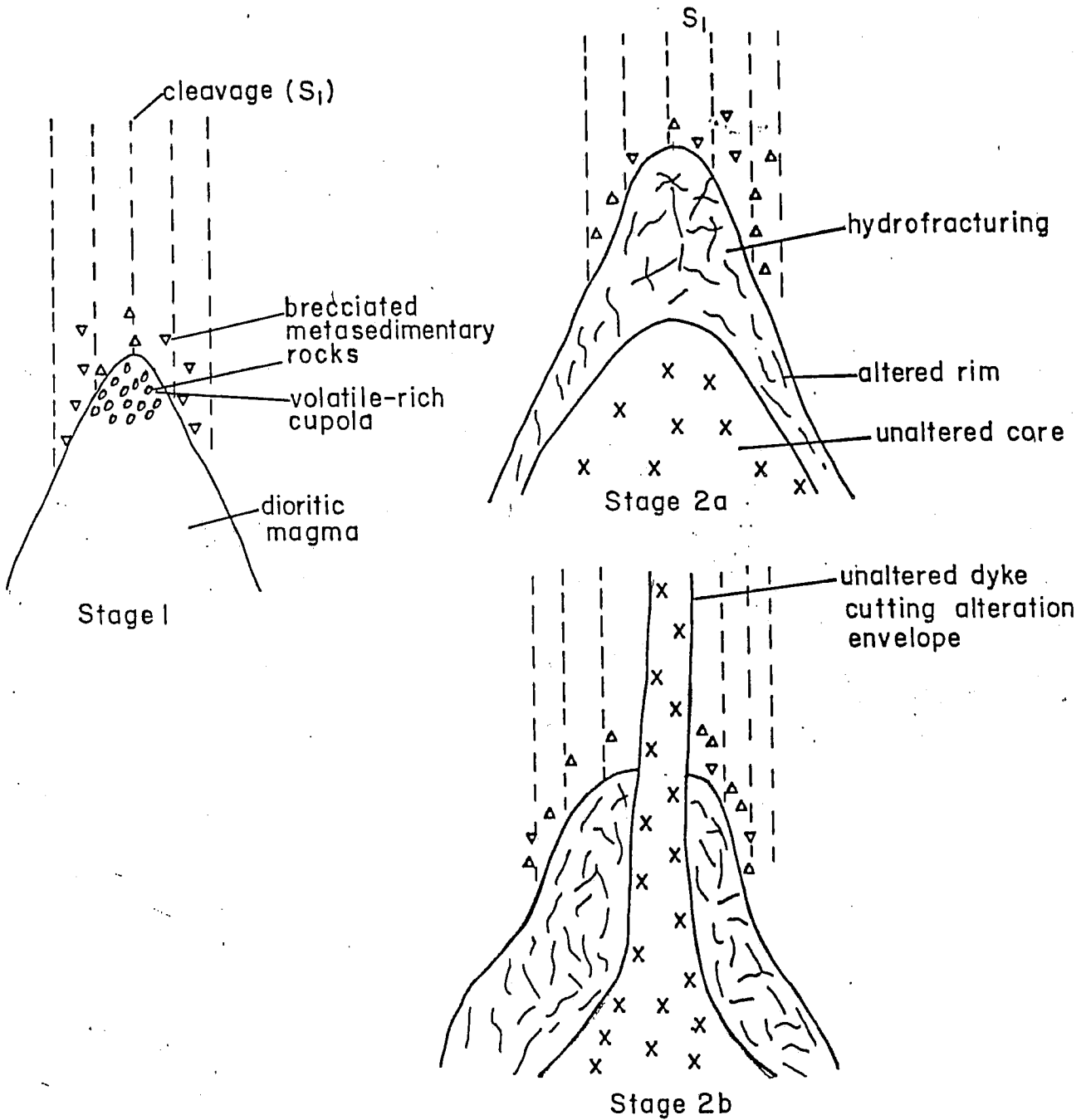


Fig. 3. Cartoons illustrating how intrusion - associated iron carbonate alteration may have developed.

assemblages that are, in part, determined by the composition of their host rocks. For example, the gabbro at the Elmtree deposit exhibits intense saussuritization, chloritization and carbonatization in shear zones because of its original mineralogy. However, external components have also been added because the rocks exhibit effects of albitization and silicification; are cut by quartz veins, and they are highly enriched in arsenic (see Hoy below).

THE ELMTREE DEPOSIT (D. Hoy)

INTRODUCTION

Precious metal mineralization was first discovered at Elmtree, in the fall of 1984, as the result of a grass-roots-prospecting program, largely oriented towards following up stream sediment anomalies within favourable geological settings. Prospecting in the vicinity of anomalous As and Sb sites in Elmtree Brook led to the discovery of semi-massive sulphide-quartz veins carrying Au and Ag values of up to .500 oz/ton (17.5 g/t) and 16.00 oz/ton (555 g/t), respectively. Subsequent prospecting and staking of the Discovery Zone (DZ) led to the discovery of the West Gabbro Zone (WGZ), located some 2000 feet away, along the trend of a favourable structure.

Subsequent to these discoveries, a significant amount of exploration work has been carried out, including ground geophysical and geochemical surveys, geological mapping and

35,000 feet of diamond drilling, largely on the WGZ.

The purpose of this synopsis is to summarize the geological setting, alteration styles and mineralization of the Elmtree deposit, in particular the WGZ.

GEOLOGICAL SETTING

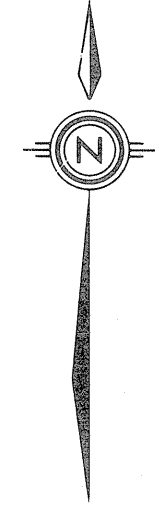
Generally, the property is underlain by Ordovician to Silurian, metasedimentary rocks that are intruded by mafic and felsic sills of probable Devonian age (Davies 1979).

The northern part of the claim group (Figure 1) [NOTE: Figures 1 to 4 in this description of the Elmtree Deposit are numbered separately from the rest of the figures in this guide] is underlain by a monotonous sequence of graphitic argillites, phyllites, slates, and greywackes of the Ordovician, Elmtree Group. Locally, there are interbeds of coarse grit and pebble conglomerate. Skarn is developed within the contact metamorphic aureoles of intrusive rocks.

The Elmtree Group is in fault contact with a thick sequence of calcareous metasediments of the Silurian, Chaleurs Group. Lithologies within the Chaleurs Group include greenish-grey siltstone, argillite, sandstone, pebble to cobble conglomerate and minor limestone. These lithologies generally underlie the southern part of the claim group.

Locally, intrusive rocks cutting the above sequences include mafic to felsic stocks, sills and dykes, comprising diabase, gabbro, granite, feldspar porphyry and felsite.

Structurally, the most important feature on the claim



LEGEND

- DEVONIAN ?**
- 3** INTRUSIVE ROCKS
Medium to coarse grained metagabbro, diabase, etc.
- SILURIAN**
- 2** CHALEUR BAY GROUP
Green & brown conglomerate, calcareous siltstone, sandstone & argillite
- ORDOVICIAN**
- 1** ELMTREE GROUP
Dark grey argillite, conglomerate, metagreywacke, metaquartzite & hornfels cherty conglomerate.
- | | | | |
|--|--|--|----------------|
| | Outcrop | | siltstone |
| | Strike, dip orientation | | metaquartzite |
| | Foliation, shearing orientation | | metagreywacke |
| | Fracturing orientation | | conglomerate |
| | Geological contact, inferred, observed | | quartz veining |
| | Backhoe, bulldozer trench | | pyrite |
| | Diamond drill hole location | | pyrrhotite |
| | Possible fault | | sphalerite |
| | Access road | | galena |
| | Creek | | arsenopyrite |
| | Swampy area | | stibnite |
| | Beaver pond | | marcasite |
- UNCONFORMITY (in part faulted)

FIGURE 1

CMJV
MINING CORPORATION
CANADIAN MINERALS JOINT VENTURE (1980)

**ELMTREE BROOK
PROPERTY GEOLOGY, TRENCH
&
DIAMOND DRILL LOCATION
COMPILATION**

PREPARED	DATE	SCALE	PROJECT	MAP SHEET	FIGURE
D. H.	Dec. 85	1"=200'	7301	21 P/13	

group is the Elmtree Fault, first recognized as a wrench fault by Ruitenberg (pers. comm. 1986), of probable regional extent. The fault is a broad zone of intense shearing, fracturing and deformation, which separates graphitic argillites of the Elmtree Group from calcareous siltstones of the Chaleurs Group. Almost all mineralization discovered to date on the property has been intimately associated with the fault zone or with parallel and en echelon splays from it. The gabbroic sill comprising the WGZ is believed to have been injected in its present orientation, along this zone of structural weakness.

THE WEST GABBRO ZONE

The WGZ consists of a hydrothermally altered and strongly deformed gabbroic sill, bounded by graphitic argillites and hornfels of the Elmtree Group. The sill has been intermittently traced along a strike length of 1500 feet, and ranges in width from 10 to 125 feet. Dips are largely vertical at shallow depth, and take on a more northerly component at depth (Figure 2).

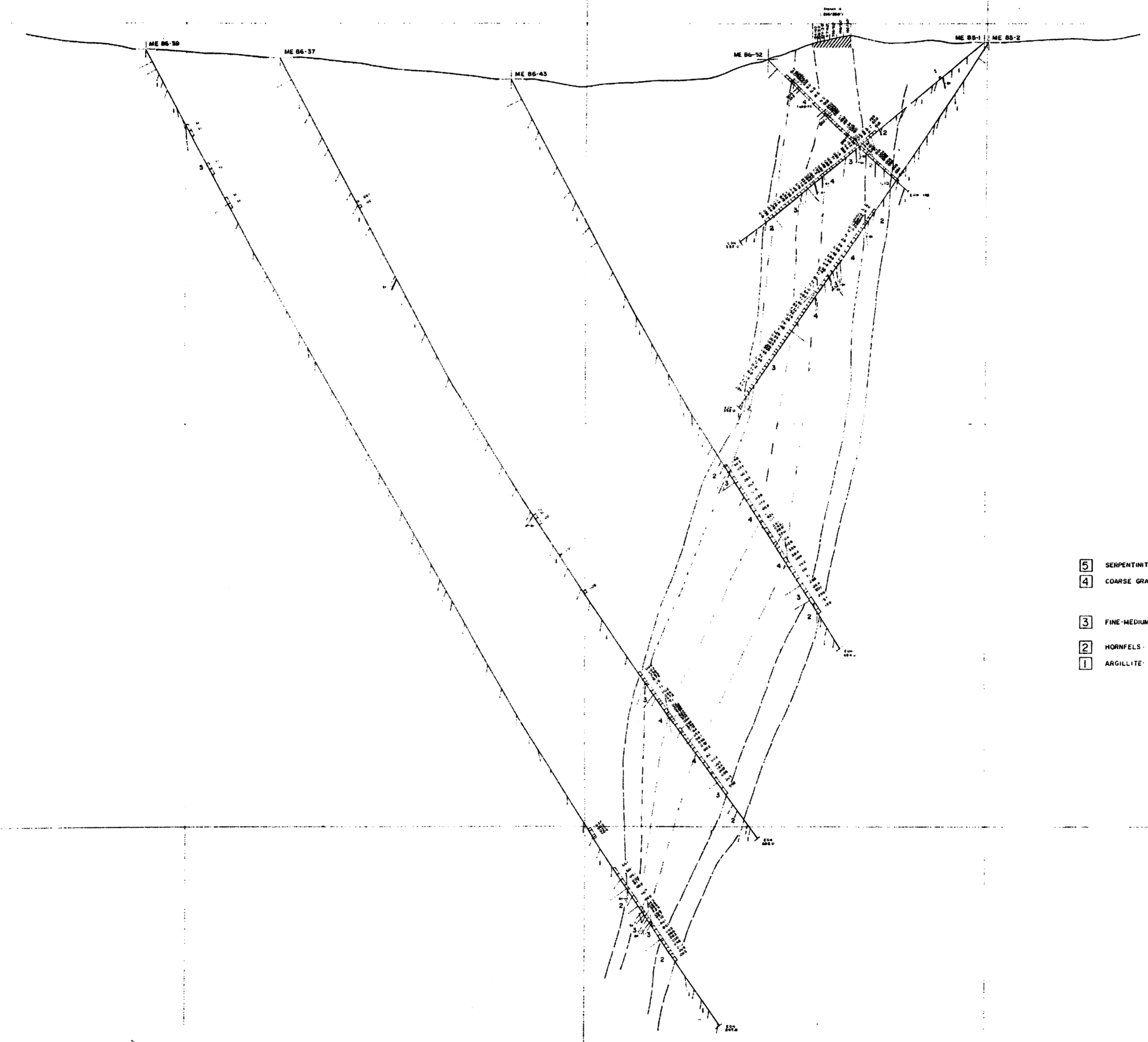
The sill is characterized by fine to medium grained ophitic margins, gradational into a medium to very coarse grained core. Compositionally, the margins are characterized by equigranular gabbro, whereas the cores are gabbroic anorthosite to anorthosite (Figure 3). These coarser grained, more fractionated phases have been termed cumulates, due to the clustering of plagioclase apparent within them (Paktunc

ELEVATION
FEET
EQUATION

VERTICAL DEPTH
FEET
D.O.

100 OBSL

6000



LEGEND

- 5 SERPENTINITE: Medium to dark green, moderately silicified, weakly magnetic
- 4 COARSE GRAINED METAGABBRO: Light grey to dark green, pervasive carbonatization, locally strongly silicified, contains up to 25% combined opy, py, po and minor sphal and cpy
- 3 FINE-MEDIUM GRAINED METAGABBRO: Finer grained equivalent of unit 4
- 2 HORNFELS: Medium to dark grey, largely cherty, 20' hornfelsed metasedim
- 1 ARGILLITE: Dark grey to black, thinly bedded, prominent slaty interbeds to greywacke, id silty argillite-spotted slate, ic: cherty argillite, id: sandstone

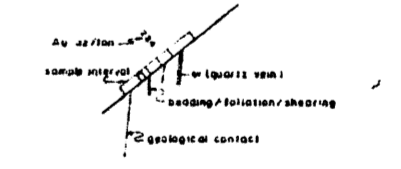
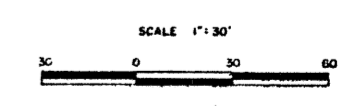


FIGURE 2



SECTION LOOKING AT 060° Az

LACANA MINING CORPORATION					
CANADIAN MINERALS JOINT VENTURE (1980)					
DRILL SECTION 2+00W					
DDH ME-85-1, DDH ME-85-2, DDH ME-86-37					
DDH ME-86-39, DDH ME-86-43, DDH ME-86-52					
WEST GABBRO ZONE					
PREPARED	DATE	SCALE	PROJECT	MAP SHEET	FIGURE
D.H.	Aug 86	1" = 30' (1:360)	7301 ELMTREE	21 P/13	

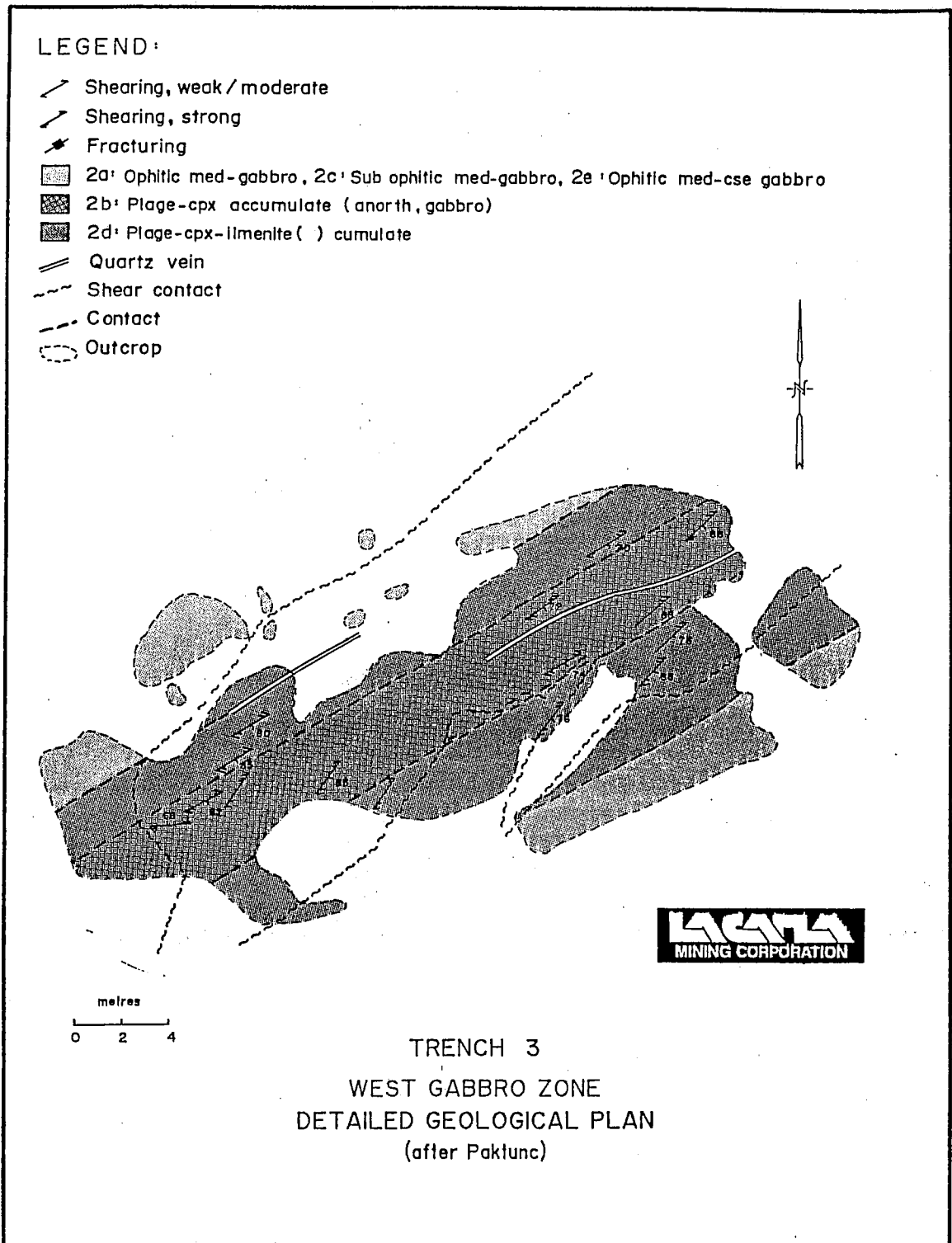


FIGURE 3

1987).

Ductile and brittle deformation is locally very intense within the sill. Petrographic work indicates that original igneous textures are not well preserved and that the original mineralogy of the gabbros consisted of calcic plagioclase and at least one mafic mineral (Murck 1986).

ALTERATION AND MINERALIZATION

The alteration of the gabbros consists of saussuritization of plagioclase, associated with chloritization of ferromagnesium minerals. Within highly deformed gabbro, a microcrystalline alteration assemblage of carbonate, quartz, chlorite, albite and sericite forms a matrix interstitial to plagioclase and mafic mineral remnants. This alteration assemblage is also commonly seen in several generations of veining.

Higher gold values are associated with sulphide-rich zones cutting the coarse grained gabbro. The best zones of sulphide mineralization are closely associated with intensive zones of silica flooding and are proximal to the margins of quartz veins. Within silica rich zones, combined sulphide abundance can reach as high as 25%. The ore mineralogy consists of varying amounts of arsenopyrite, pyrrhotite, and pyrite with minor chalcopyrite, stibnite and sphalerite. SEM work indicates that gold occurs as free grains, generally less than 10 microns in size. It is commonly attached to pyrrhotite and together they occur as fracture fillings in

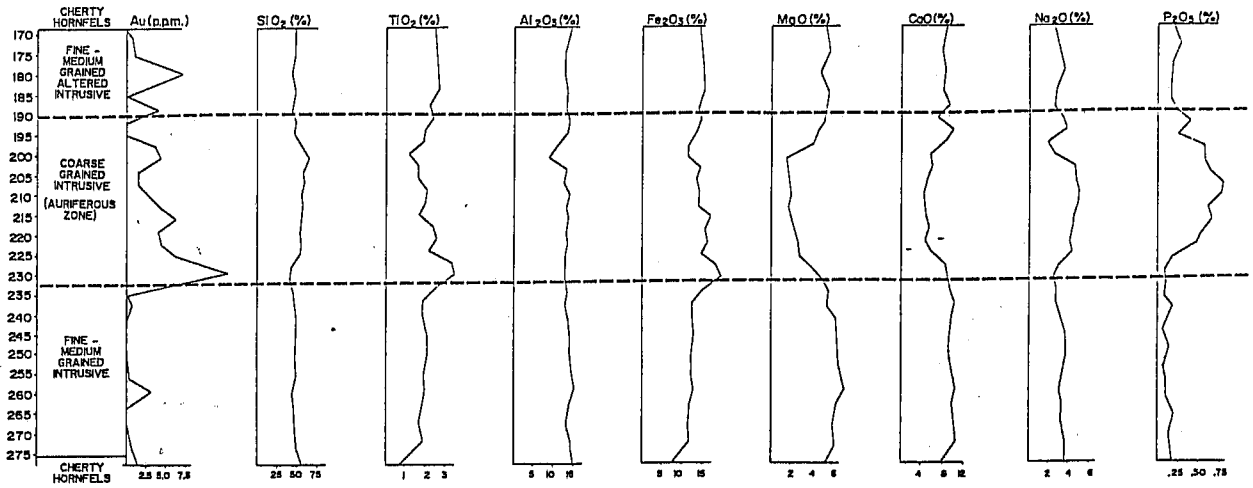
pyrite, arsenopyrite and pyrrhotite and rarely as inclusions within arsenopyrite. Native gold appears to be closely associated with pyrrhotite (Harris 1986).

GEOCHEMISTRY

The geochemistry of a complete section through mineralized and unmineralized gabbro was studied by systematically analyzing drill core pulps from a section through the central part of the sill. The objective of the analyses was to determine the variations in major and trace elements throughout the sill, and compare these to observed mineralogical and alteration changes.

The downhole variation of selected elements is shown in Figure 4. The auriferous zone, comprising coarse grained, highly altered anorthositic gabbro, assays .167 oz/ton (6 g/t) Au across 36.0 feet. The border phases flanking the auriferous zones are comprised of moderately to strongly altered, fine to medium grained gabbro. Both upper and lower intrusive contacts are characterized by the development of cherty hornfels in the enclosing sediments.

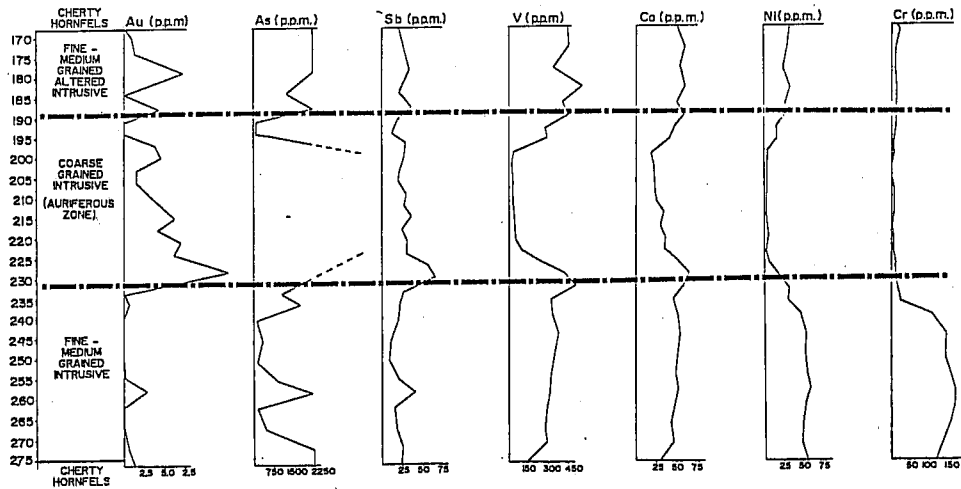
Upon inspection of the data it is evident that the element As is strongly, positively correlated with the auriferous zone. This is hardly surprising, as arsenopyrite is the most abundant sulphide in gold-bearing zones. Moderate, positive correlation of Si, Fe and Na are also evident. Within gold-bearing zones, secondary quartz and albite form major constituents of the microcrystalline



GEOLOGY & MAJOR ELEMENT GEOCHEMISTRY
HOLE ME-85-4
ELMTREE DEPOSIT



FIGURE 4a



GEOLOGY & TRACE ELEMENT GEOCHEMISTRY
HOLE ME-85-4
ELMTREE DEPOSIT



FIGURE 4b

alteration assemblage, and the enrichment of Fe is due to the abundance of sulphides.

On the other hand the elements, Mg and Ca, show moderate negative correlation with the gold zone, which is somewhat surprising given the presence of sericite and carbonate as alteration products. It is probable that both hydrothermal alteration and differentiation processes affected the distribution of these elements. It is suggested that the distribution of Ca and Mg were controlled by differentiation processes within the anorthositic phases as opposed to hydrothermal alteration. The depletion of V, Co, Ni and Cr within the gold zone is similarly controlled by differentiation processes.

SUMMARY AND CONCLUSIONS

- 1) Gold at Elmtree is structurally controlled, and is intimately related to the trend of the Elmtree Fault system.
- 2) The auriferous zone is hosted within a strongly deformed and hydrothermally altered gabbroic sill.
- 3) The main alteration consists of saussurite and chlorite with associated carbonate, quartz, chlorite, sericite and albite as microcrystalline alteration products.
- 4) Geochemical studies suggest that the elements As, Si, Na and Fe, are moderately to strongly enriched within the gold zone. The distribution of these elements is controlled by hydrothermal alteration and

sulphidization. Depletion of Ca, Mg, V, Ni and Cr within the gold zone is controlled by differentiation processes.

- 5) Gold occurs as free grains, generally less than 10 microns, attached to pyrrhotite, healing microfractures in arsenopyrite, pyrite and pyrrhotite, and occasionally as inclusions within arsenopyrite.

STOP DESCRIPTIONS

DAY TWO: (The first day in this field guide)

Stop locations for today are shown in Figure 4.

Kilometers

- 0 The road log starts at the Petit Rocher exit (Exit 326) on Highway 11. Depart eastward on Highway 315.
 2.7(2.7) Turn left on Highway 134.
 2.7(5.4) Turn left on Basin Road.
 2.7(8.1) Stop 1A.

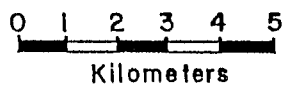
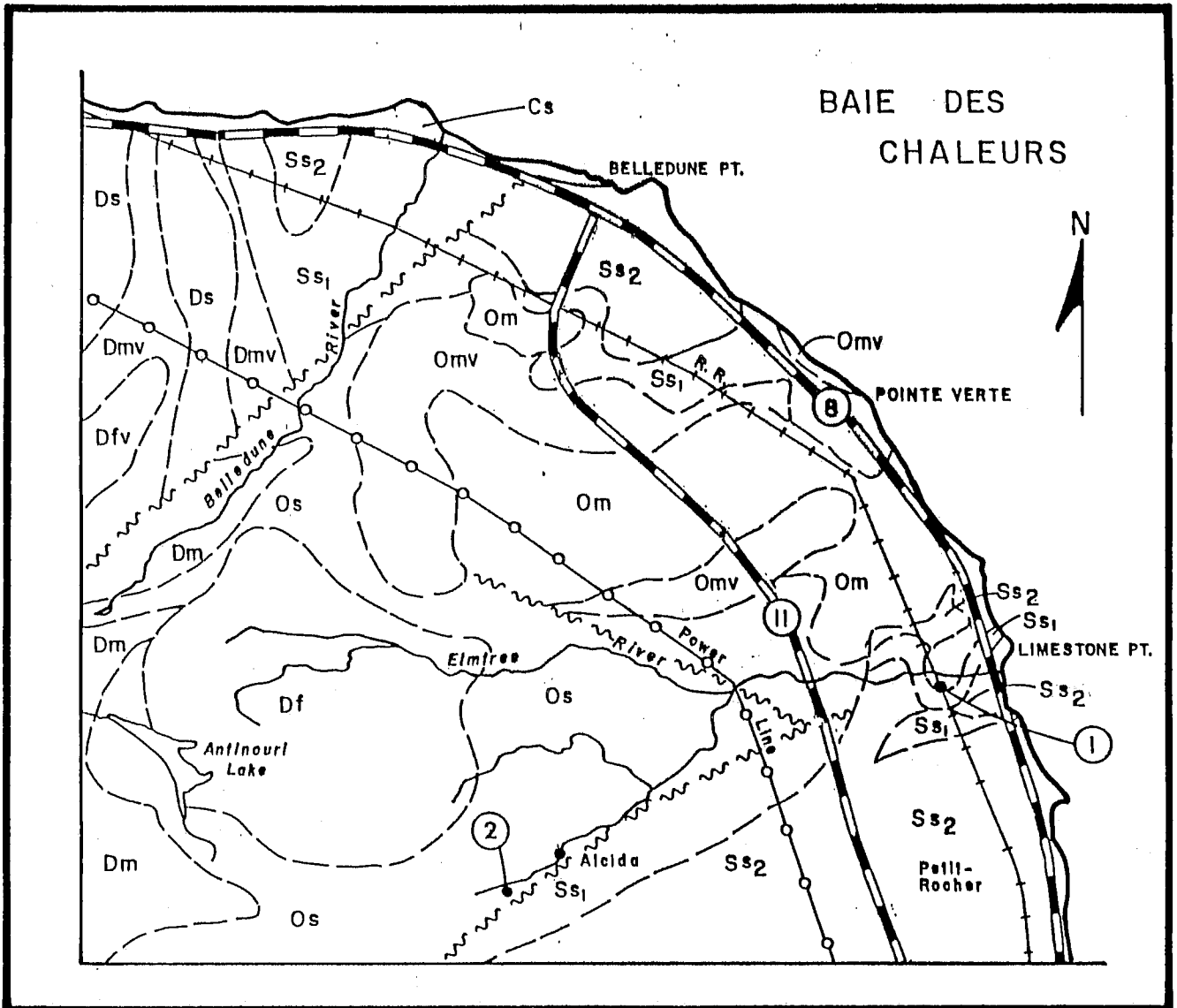
Stop 1A: (J. Langton)

Coarse grit and conglomerate containing clasts of quartz, pink feldspar, maroon slate and mafic volcanic rocks. About 150m northeast, through the field, typical maroon pebble-conglomerate of the lower Silurian Armstrong Brook Formation is exposed.

- 0.2(5.6) Turn right
 0.2(5.8) Stop 1B

Stop 1B: Elmtree River Railcut (J. Langton)

Metabasites of the Deveraux Formation, the ^{oldest} lowest member of the Ordovician Fournier Group, are exposed along the railway for about 1 km. Diabasic and gabbroic dykes of variable thickness ^{are} intruded ^{by} phyrlic to aphanitic mafic flows and/or high



LEGEND

CARBONIFEROUS
Cs sedimentary rocks

DEVONIAN
Df granite
Dm diabase, gabbro
Dfv felsic volcanic rocks
Dmv mafic volcanic rocks
Ds sedimentary rocks

SILURIAN
Ss₂ calcareous siltstone,
limestone, shale, sand-
stone, minor conglomerate
Ss₁ conglomerate, minor
shale and limestone

ORDOVICIAN
Om gabbro
Omv pillow basalt
(Fournier Grp)
Os phyllite and
greywacke
(Elmtree Group)

~~~~~ Fault

① Field Stop

FIGURE 4. FIELD STOPS: DAY 2

level intrusions. Possible relict pillows and amygdaloidal basalts can be seen in the more southerly outcrop. Medium to coarse grained gabbro with well developed cumulate textures becomes progressively more abundant to the north of the Elmtree River indicating deeper levels of intrusion. This section is interpreted as a section of oceanic crust transitional between layer 3 cumulate gabbros and layer 2 dykes and flows.

Return to Exit 326 at Highway 11. Reset road log to zero.

- 0.(0) Exit 326. Proceed westward on Highway 315.
- 0.5(0.5) Laplante 4-way intersection; continue westward.
- 3.7(4.2) T-intersection. Turn right to Alcida.
- 1.6(5.8) Turn left.
- 2.4(8.2) Stop and park. With the permission of Lacana Mining Corporation in Bathurst and the landowner you may, walk in the road to the right about 650m. This brings you onto the property map (Figure 1 in Hoy's description) at Line 19 west. Stops 2A and 2B are located on Figure 1, respectively, near lines 22W and 28W.

#### Stop 2A: Elmtree Trench # 14

The trenched area exposes oxidized coarse grained plagioclase cumulates (anorthositic gabbros) in contact with medium grained ophitic gabbro (border phases). Farther down the hill towards the brook are sporadic subcroppings of black argillite of the Elmtree Group (enclosing sediments). Channel samples taken across the trench assayed 8 g/t Au across 9 m.

#### Stop 2B: Elmtree Trenches # 16 and 17

This trench exposes altered, shrewd, and fractured plagioclase-clinopyroxene cumulates (anorthositic gabbro)

with ophitic to sub-ophitic fine to medium grained gabbro forming the margins. Quartz veins have subsequently healed shear and fracture zones in places. A 9 m channel sample cut across the trench assayed 4.7 g/t Au.

DAY THREE: Stop locations for today are shown in Figure 5.

#### Kilometers

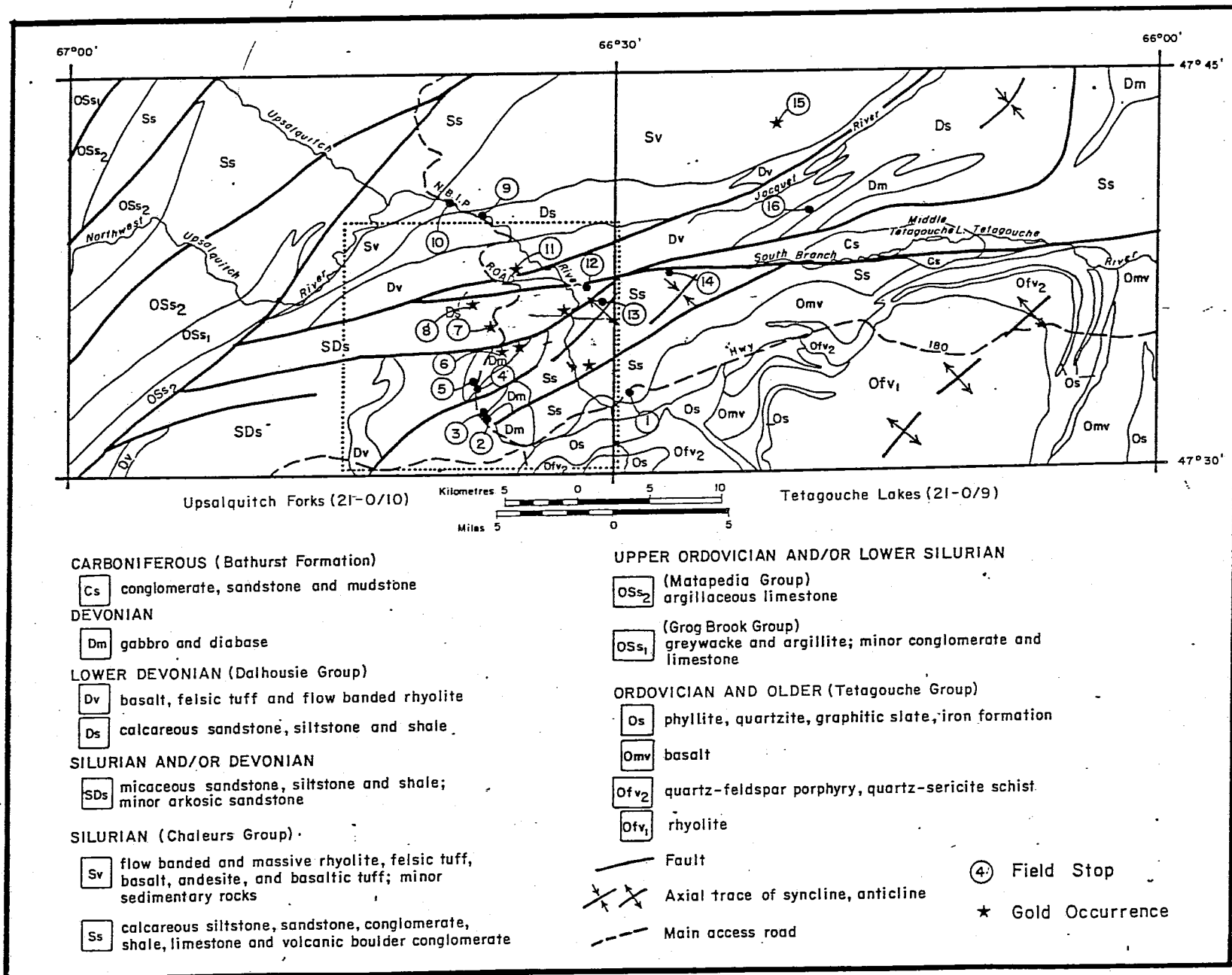
0 (0) Depart westward on the "Road to Resources" from Exit 310 at the Atlantic Host Motel.  
61.8(61.8) Stop 1

#### Stop 1: Eighteen Mile Brook Roadcut

This stop is to examine unaltered Silurian rocks at the southern margin of the Matapedia Basin. Greenish grey, thinly bedded sandstone and siltstone dominate the outcrop along the southeast side of the road. At the east end of this outcrop, unbedded sedimentary breccia fills a channel cut into these rocks. The same type of breccia (debris flow) dominates the outcrop on the northwest side of the road. It contains abundant limestone clasts that have Late Silurian (Ludlow) fossils (Helmstaedt 1971). Subtle changes in the attitude of primary layering are due to open folds that have axes subparallel to the road.

The next outcrops to the west are stratigraphically lower and consist of red sandstones and grits with a cobble-conglomerate at the apparent base of the section. This conglomerate contains mafic volcanic and gabbro clasts from the underlying Tetagouche Group. Some of these clasts were deformed prior to being incorporated in the conglomerate.

FIGURE 5 FIELD STOPS: DAY 3



- 9.3 (71.1) Turn right on NBIP Road to Dalhousie  
 2.1 (73.2) Stop 2

#### Stop 2: Ramsay Brook Burrow Pit

This stop is to examine fine-grained Silurian rocks that are basinward-from (geographically) the coarse-grained ones seen at the last stop. The burrow pit on the east side of the road contains dark grey, very thinly bedded siltstone (probably Upsalquitch Formation). The rocks are folded and have a well developed slaty cleavage. Rocks like this may have been the protolith to carbonate-altered breccias, which will be seen in the next stops.

- 1.8 (75.0) Turn right on bush road.  
 1.5 (76.5) Stop 3

#### Stop 3: Ramsay Brook Bridge

The outcrop just before the bridge on the left side of the road is a gabbroid with brown-weathering carbonate alteration. The same alteration occurs in outcrops along the bank going downstream toward the bend in the brook. Superficially, the rocks look the same, but those near the bend in the brook are brecciated metasediments. The contact between the two rock types is somewhere between.

Return to NBIP road to Dalhousie

- ~~1.5~~ (78.0) Turn right  
 3.0 (81.0) Stop 4

#### Stop 4

Subcrop of carbonate-altered hydrothermal breccia occurs along the east side of the road. This breccia appears to be polymictic rather than mono-lithologic like the others.

Continue northward along NBIP road

## 1.3 (81.3) Stop 5

## Stop 5

There are outcrops of carbonate-altered, hydrothermal breccia associated with altered and unaltered intrusive rocks in the cleared area on the left side of the road. Pyritic, metasedimentary clasts in the breccia vary in size from one to several tens of centimeters. Specularite is common in the diabase dyke close to the road.

## 0.8 (82.1) Stop 6

## Stop 6

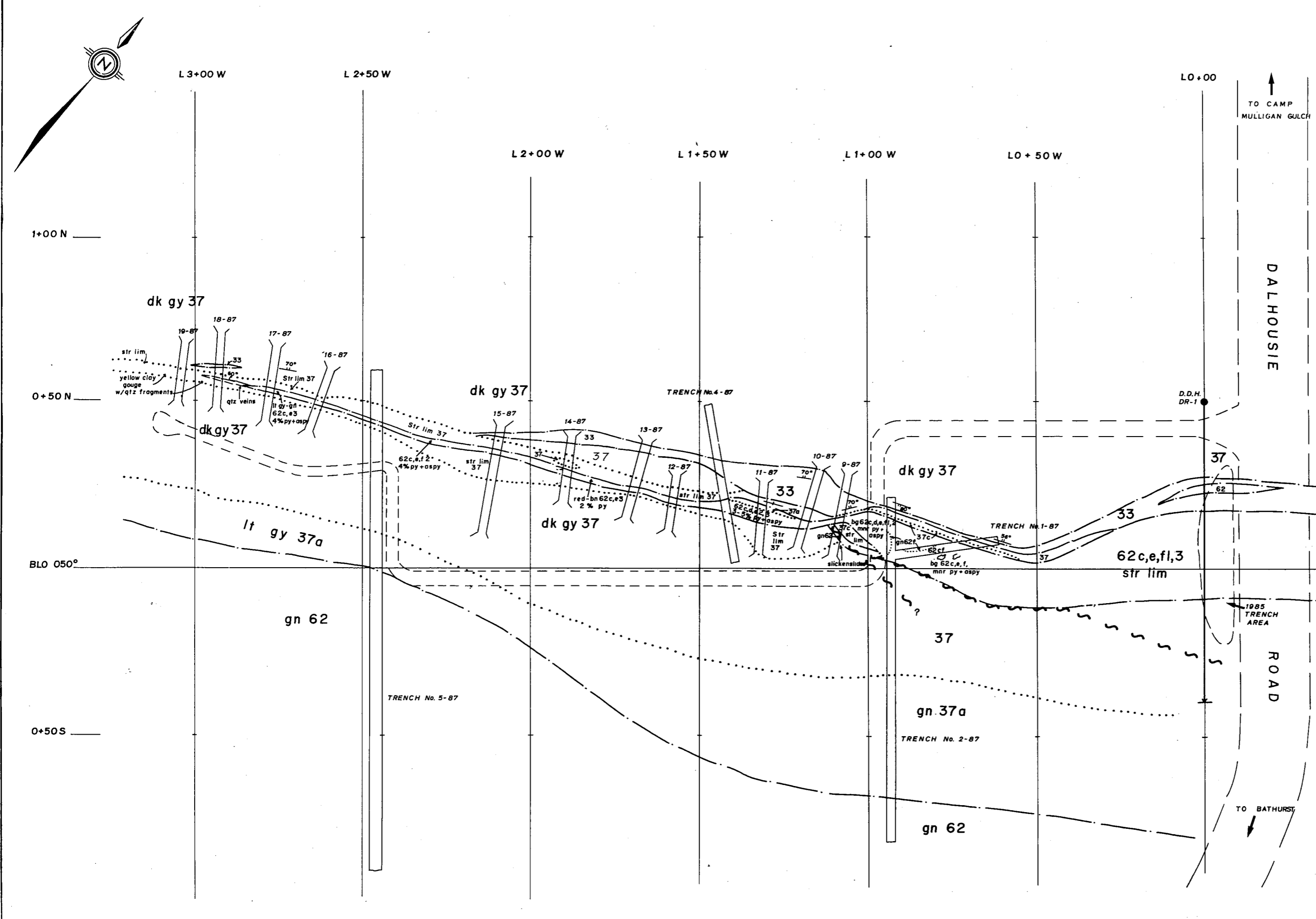
Variably altered diorite outcrops along the right side of the road. Fracture-control of the brownish-colored carbonate alteration is apparent.

## 1.6 (83.7) Stop 7

## Stop 7: Dalhousie Road Showing (R. Adair)

This was one of the first gold occurrences found (post-1980) in the Upsalquitch area. Noranda currently holds this property and has kindly provided the geology map and drill-section, respectively figures 6 and 7. An enlargement of the upper part of the legend for Figure 6 is shown in Figure 6a.

A bleached, silicified carbonate-altered dioritic intrusion outcrops along the left side of the road, and contains quartz and quartz-carbonate veins. Grab-samples from these veins have yielded up to 10 g/t Au (Table 1). Note that the limestone and siltstone in contact with the intrusion are practically unaffected by the alteration demonstrating that



**SYMBOLS**

□ Fragmental breccia  
 □ Quartz-feldspar porphyry  
 □ Gneiss  
 □ Gabbro, diorite, dioritic  
 □ Serpentinite

□ Chlorite  
 □ Chlorite + hornblende  
 □ Biotite + quartz  
 □ Hornblende  
 □ Amphibole  
 □ Garnet  
 □ Calcite  
 □ Pyrite  
 □ Sphalerite  
 □ Epidote  
 □ Magnetite  
 □ Hematite  
 □ Magnetite  
 □ Pyrite  
 □ Sphalerite  
 □ Epidote  
 □ Magnetite  
 □ Hematite

**SPECIAL**

□ Basalt  
 □ Granite  
 □ Igneous gneiss  
 □ Metabasalt  
 □ Amphibolite  
 □ Gabbro  
 □ Diorite  
 □ Garnet gneiss  
 □ Hornblende gneiss  
 □ Quartzite  
 □ Siltstone  
 □ Sandstone  
 □ Shale  
 □ Claystone  
 □ Tuff  
 □ Volcanic breccia  
 □ Metavolcanic conglomerate  
 □ Metasedimentary breccia

□ Flow breccia  
 □ Pyroclastic flow  
 □ Pyroclastic breccia  
 □ Lava flow  
 □ Lava flow  
 □ Lava flow  
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**LEGEND**

--- bedding (horizontal, inclined)  
 --- schistosity (horizontal, inclined)  
 --- joint (horizontal, inclined)  
 --- syncline, overturned  
 --- fold axis (plunge, sense)  
 --- drag fold/arrow indicates plunge  
 --- fault (inclined, approximate)  
 --- geological contact (conformity, unconformity)  
 --- structural zones (fracture, shear, zone)  
 --- lake, pond  
 --- swamp, marsh  
 --- measurement (gravel, stone)  
 --- fence  
 --- utility, man-made  
 --- diamond drill hole (location, depth, diameter)  
 --- site area (location, approximate, boundary)  
 --- drill hole trace  
 --- road  
 --- road name, number  
 --- fence (inclined, vertical)  
 --- trench section  
 --- alteration contour

--- outcrop  
 --- registration  
 --- alteration outcrop  
 --- fault  
 --- alteration plunger and  
 --- stream  
 --- 5-5° strike-slip fault  
 --- micro-syncline

**ABBREVIATIONS**

dk - dark grey  
 gn - green  
 gy - grey  
 st - silty  
 sli - slickensided  
 str - stratigraphic  
 str lim - stratigraphic layer  
 w - with  
 w/ - with  
 yellow - yellow  
 clay - clay  
 gouge - gouge  
 w/ - with  
 qtz - quartz  
 frags - fragments  
 red - red  
 bn - biotite  
 62c, e, f - 62c, e, f  
 2% py - 2% pyrite  
 mnr py - minor pyrite  
 aspy - asphyxiated  
 62c, d, e, f - 62c, d, e, f  
 37a - 37a  
 62c, e, f, 3 - 62c, e, f, 3  
 str lim - stratigraphic layer  
 1985 - 1985  
 TRENCH AREA - TRENCH AREA  
 ROAD - ROAD  
 TO BATHURST - TO BATHURST

**MAP BY:** B.E. Mitton  
**J. Burns**

**INTERPRETATION:** B.E. Mitton

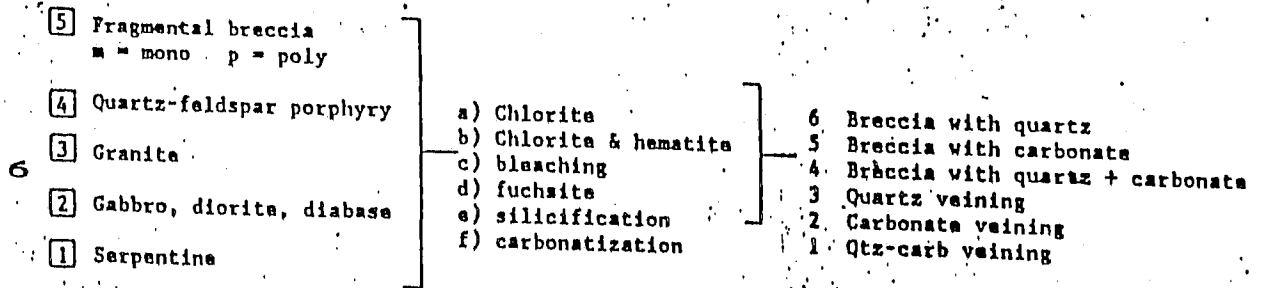
**SCALE:** 1:400 metre

**0 10 20 40 m.**

Figure 6. Dalhousie Road Showing - Geology and Trenching

|                                               |                    |                        |
|-----------------------------------------------|--------------------|------------------------|
| REVISED                                       | GEOLOGY            |                        |
|                                               | DALHOUSIE RD. GRID |                        |
| DWG. No.                                      | PROJECT            | MCCORMACK - LUCERO     |
| PROJ. 4231                                    | DRAWN BY:          | D. Pitre DATE: Dec. 87 |
| N.T.S.                                        | SCALE              | 1:400                  |
|                                               |                    | <b>noranda</b>         |
| Noranda Exploration Co. Ltd. - Bathurst, N.B. |                    |                        |

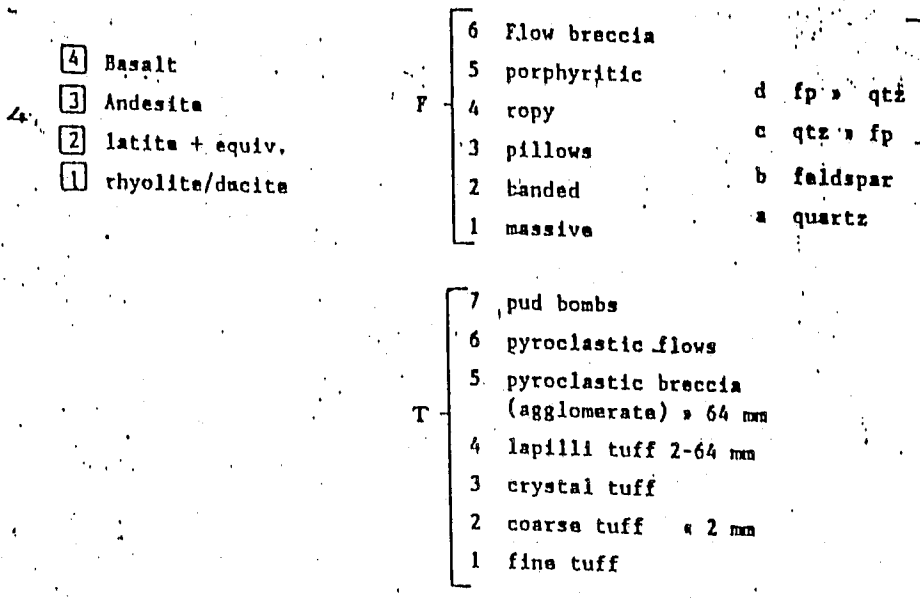
DEVONIAN



SILURIAN

Volcanics

- 5
- c Volcaniclastic breccia
  - b Volcaniclastic conglomerate
  - a Volcaniclastic sandstone, silts



SEDIMENTS

- 3
- 7 fine clastics, siltstone, shale
  - 6 sandstone
  - 5 grit, coarse
  - 4 conglomerate
  - 3 limestone, nodular limestone
  - 2 fine clastics
  - 1 greywacke, conglomerate

Alteration

- a) silicification
  - b) carbonitization
  - c) silicification/  
carbonitization
  - d) skarn
  - e) bleaching
- |   |   |                  |
|---|---|------------------|
| } | 5 | Quartz breccia   |
|   | 4 | Qtz-carb breccia |
|   | 3 | Qtz veining      |
|   | 2 | carb veining     |
|   | 1 | Qtz-carb veining |

Fig. 6a. Enlargement of the upper part of the legend for Fig. 6.



← 140° Az

0+50S

0+00

0+30N

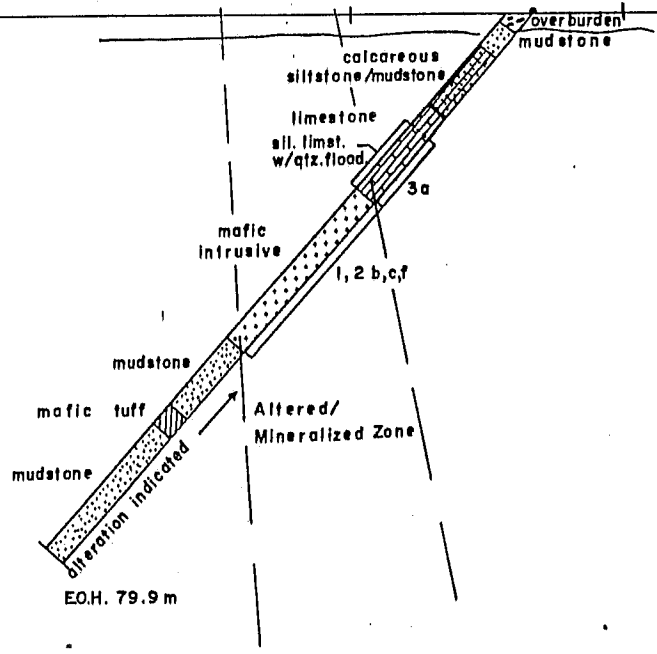
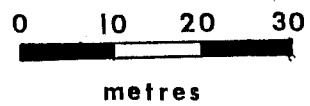


Figure 7. Drill Hole Section DR-2 (Facing Southwest)



LEGEND

- 13 intermediate to mafic intrusives - gabbro / diabase
- 12 mafic tuffs - chloritic - med to dark green
- 11 mudstone/ siltstone - grey-green
- 10 calcareous siltstone / mudstone
- 9 limestone

ALTERATION

| <u>Intensity</u> | <u>Type</u>                              |
|------------------|------------------------------------------|
| 1) Weak          | a) silicification                        |
| 2) Moderate      | b) carbonatization (mainly Fe carbonate) |
| 3) Strong        | c) sericitization                        |
|                  | d) potassie                              |
|                  | e) pyrophyllitization                    |
|                  | f) saussuritization                      |
|                  | g) chloritization                        |

FIG. 14

|                |                                            |         |
|----------------|--------------------------------------------|---------|
| REV. NO.       | Dalhousie Road Grid                        |         |
|                | SECTION LINE 1+00E                         |         |
|                | DDH DR-2 (140° Az)                         |         |
| Proj. No.      | SURVEY BY                                  | DATE    |
| N.T.S. 2/10/10 | D. Pitre                                   | Jan. 86 |
| DWG No.        | SCALE                                      | 1:500   |
|                | <b>brunswick mining</b>                    |         |
|                | Brunswick Mining and Smelting Corp Ltd     |         |
|                | Mining Division Box 3000 Stouffville, N.B. |         |

the hydrothermal fluids were magmatically derived. However, in drill core it is obvious that the limestone is strongly silicified adjacent to the intrusion (Figure 7).

- 1.3 (85.0) Turn left  
 2.6 (87.6) There is a road to the right just beyond the small stream. Park. Walk in the road about 200 m to where the road forks. Take the left branch and follow it about 100 m until you come to a cleared area. Stop 8

#### Stop 8: Mulligan Gulch Showing

Most of the cleared area is underlain by reddish-colored feldspar (minor quartz) porphyry with dark gray siltstone exposed at the eastern end. The effects of silicification and minor carbonatization can be seen at the porphyry-siltstone contact. Light to dark gray zones (2-5 wide) within the porphyry are characterized by argillic and silicic alteration, in places with stockwork quartz veining and brecciation. These zones locally contain up to 20% pyrite and/or arsenopyrite. Three 1-3 m wide, northeast trending, quartz veins have yielded the best gold assays (Table 1).

- Return to NBIP road.  
 2.6 (90.2) Turn left.  
 10.4 (100.6) Turn right into parking area at Flying Eddy Pool. Lunch Stop.  
 After lunch continue north on NBIP road.  
 2.2 (102.8) Bridge over southeast Upsalquitch River. Turn right at the road just past the bridge.  
 0.8 (103.6) Stop 9

#### Stop 9

The large outcrop on the left, by the little brook, is porphyritic microgranite. It contains phenocrysts of feldspar (up to 5mm) and minor quartz in a microgranitic groundmass.

A shear-related, argillic alteration zone can be seen at the end of the outcrop closest to the brook.

- Return to NBIP road.
- 0.8 (104.4) Turn right.
- 1.2 (105.6) Stop 10.

#### Stop 10

Reddish-colored rhyolite outcrops on the right side of the road. It is flow-banded and exhibits well developed flow folds. Like the porphyritic microgranite at the last stop, it contains feldspar (about 1mm) and minor quartz phenocrysts. Quartz-filled, lithophysal cavities occur locally.

- Turn around and drive back towards Bathurst.
- 1.2 (106.8) Bridge over Southeast Upsalquitch River.
- 8.5 (115.3) Turn left onto 9-Mile Brook road.
- 2.0 (117.3) Stop 11.

#### Stop 11: Upsalquitch Forks Showing.

Low relief outcrop along the right side of the road consists of altered to unaltered dioritic rocks that are cut by quartz-calcite-sulphide veins. The northern (downhill) end of the outcrop is strongly sheared ( $090^\circ$ ) and non-magnetic, whereas the southern (uphill) end is practically undeformed and magnetic. Even though some of the rocks are reddish colored, stained slabs show that they are devoid of K-feldspar. The dominant vein orientation is  $090-105^\circ$  with a second set trending  $140-155^\circ$ . Besides pyrite, the veins also contain visible chalcopyrite and galena. The highest gold assay from this locality was an initial grab that yielded 10 g/t (Table 1). Unlike other occurrences in the area, this one contains a significant amount of copper - up to 8.3% from one grab sample and the rocks are also anomalous in mercury (over

1000 ppb) and bismuth (up to 723) (Burton 1987).

- 1.3 (118.6) Bridge over the Southeast Upsalquitch River.
- 6.9 (125.5) Three-way junction in the road. Take the middle branch.
- 0.3 (125.8) Stop 12.

#### Stop 12

From this point, one can see widespread Fe-carbonate alteration, reflected by the reddish brown color of the till, in the clear-cut area to the left. The prominent valley is the trace of the Rocky-Brook-Millstream Fault.

- 0.3 (126.1) Stop 13

#### Stop 13

Highly deformed redbeds on the left side of the road have been correlated with the red conglomerate that we saw at the first stop this morning (See Map NR3 by Davies 1979). Note the stretched clasts in the conglomerate. Behind is a good overview of the Rocky-Brook-Millstream Fault valley.

- 8.9 (135.0) Island Lake Road. Turn left.
- 3.0 (138.0) Road to Island Lake Canteen. Turn left.
- 1.3 (139.3) Road forks. Take the right hand branch.
- 0.5 (139.8) The start of an Fe-carbonate alteration zone (reddish brown till) that continues for nearly 2 km along the Rocky-Brook-Millstream Fault valley.
- 1.1 (140.9) Stop 14.

#### Stop 14

The outcrop along the left side of the road is composed of Fe-carbonate altered sedimentary rocks. Note the well-defined bedding and its contorted nature. The trace of the Rocky-Brook-Millstream Fault is a short distance north of this outcrop.

- 0.3 (141.2) End of Fe-carbonate alteration zone.  
4.1 (145.3) Knowles Road. Turn left.  
18.7 (164.0) Stop 15.

Stop 15: Rocky Brook Prospect (P. Dimmell)

Lacana Mining Corporation owns this property and has provided the map (Figure 8) of the area, and details of the geology and geochemistry that are described below.

The property is underlain by rocks that are assigned to the Chaleurs Group on Map NR3 (Davies 1979). Six units are recognized and they are numbered 1 to 6 in Figure 8. Units 1 to 4 comprise an apparently conformable sequence of felsic tuff, maroon mudstone, amygdaloidal basalts, and felsic pyroclastics that strikes east-west and dips southward at 25-30°. Units 5 and 6 are, respectively, mafic and felsic dykes.

An alteration zone is associated with unit 2, at surface, and it can be traced for at least 4 km along strike. The zone appears to be tens of meters wide with the strongest alteration (up to 10 m in width) in the siltstone. The zone is structurally controlled because it has a subvertical, or steep northerly, dip. It is characterized by typical epithermal features such as brecciation, strong silification and multistage veining (vuggy and drusy to chalcedonic quartz). Weak to strong argillic alteration, manifested by white to green colors, is found within and bounding the silicified parts of the zone. Hematite and manganese oxides are abundant near surface. Vuggy white quartz veins with purple fluorite occur in the felsic volcanic rocks.

Soil geochemistry shows that the alteration zone is

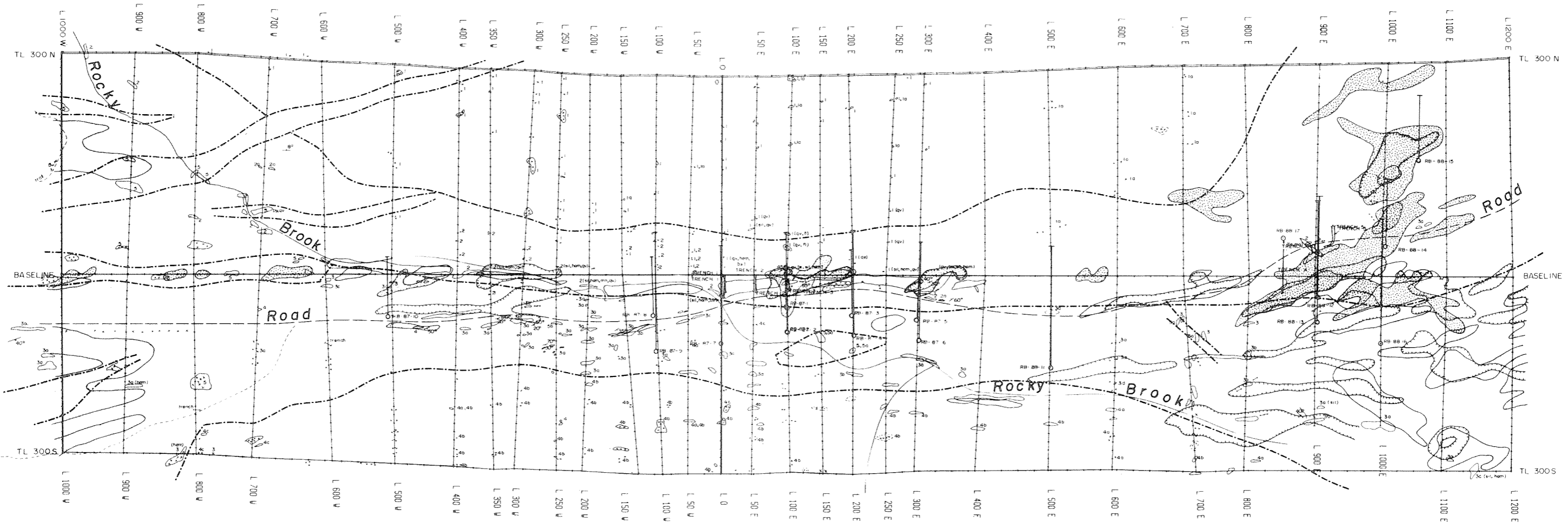
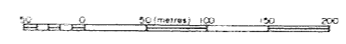


Figure 8. Rocky Brook Showing Geology, Soil Geochemistry and Diamond Drilling Compilation

- SYMBOLS**
- shearing orientation
  - fracturing orientation
  - bedding orientation
  - outcrop
  - talus field
  - talus and float
  - geological contact - assumed
  - trench
  - creek
  - roads
  - DR-87-116 sample location
  - diamond drill hole location



- LEGEND**
- POST-SILURIAN
- FELDSPAR PORPHYRY DIKES - feldspar phenocrysts in a siliceous groundmass, often sericitized
- SILURIAN
- GABBRO & DIABASE - dark green to grey, medium to coarse grained gabbro 5, diabase 5a
  - FELSIC VOLCANICS & VOLCANOCLASTICS - red to maroon banded rhyolite tuff 4a, agglomerate 4b, welded tuff 4c
  - MAFIC VOLCANICS - purple to dark green, vesicular to amygdaloidal basalt 3, dark grey to green fine grained basalt 3a, interbedded crystal lens tuff and sandstone 3b
  - MAROON MUDSTONE - red to maroon, massive to stratified mudstone siltstone 2, grit and conglomerate 2a
  - RHYOLITE TUFF - red to pink, banded to massive, rhyolite porphyry 1a
- Soil Anomalies
- Ag > 2 ppm
  - Ar > 75 ppm
  - Hg > 150 ppm
- bleached alteration zones - commonly brecciated, alteration includes sericitization, pyritization, silicification and kaolinitization, usually abundant hematite, manganese and quartz veining
- Dr Diabase  
 Gg gabbro  
 Spn spineliferite  
 Fl fluorite  
 Chp chlorite  
 Mn manganese  
 Hem hematite  
 Ss sericite  
 Bx breccia  
 Qv quartz vein

Baseline at 085° Az

**LACANA MINING CORPORATION** EXADOR RESOURCES  
 LACANA EX (1981) INC.

CANADIAN MINERALS JOINT VENTURE (1985)

OVERLAY  
 COMPILATION  
 DIAMOND DRILL HOLES & GEOCHEMISTRY  
 (SOILS)

ROCKY BROOK GROUP

|          |        |       |         |           |        |
|----------|--------|-------|---------|-----------|--------|
| PREPARED | DATE   | SCALE | PROJECT | MAP SHEET | FIGURE |
| M.G.     | MAR 88 |       | 7215    | 21 G/9    |        |

anomalous in mercury (up to 700ppb), silver (up to 35ppm), antimony (up to 65ppm) and arsenic (up to 700ppm), particularly in the eastern part of the grid. Analyses for gold gave spotty, erratic values up to 450 ppb.

The discovery showing along the Knowles Road, 100 m east of Rocky Brook, consists of highly altered (silicified and brecciated) hematite-and manganese-rich siltstone. An initial grab sample from this locality yielded 4 g/t Au and 89.6 g/t Ag.

Another showing, the eastern showing, is approximately 800 m east of the discovery showing. It consists of green to buff altered zones, containing brecciated quartz veins, in red siltstone. Chip sampling gave a value of 36.2 g/t Ag over 1.3 m, and composite grab samples yielded values up to 281 g/t Ag. Another composite grab sample from the bulldozer push just to the east gave values of 75.2 g/t Ag and 164 ppb Au.

Three trenches tested the discovery zone at Rocky Brook on lines 0, 0 + 50 E and 1 + 00 E (trenches 1 to 3 in Figure 8). All were dug through rhyolite talus that had slumped down the steep hillside to the north. All trenches were chip sampled at about 1 m intervals. The best gold value, 996 ppb over 1 m, was obtained from trench 2, near the south end; the best silver value, 20.7 ppm over 1 m, was at the south end of trench 3, with a value of 603 ppb Au (over 0.5 m) immediately to the north. A 20 m wide zone in trench 1 gave silver values in the 3 ppm range with one gold value of 343 ppb over 1 m.

Trenches 4 and 5 were dug on either side of the eastern showing. Both trenches are near line 9 + 00 E. Values of 959 ppb Au and 221 g/t Ag over 0.7 m and 127 ppb Au and 74.8 g/t Ag over 1.3 m were obtained from the quartz-rich, altered zones in trench 4. the highest values in Trench 5, 151 ppb Au and 354 g/t Ag over 0.5 m, were found over quartz breccia of the original showing.

The Rocky Brook alteration zone has been tested by 17 diamond drill holes (see Figure 8 for locations). Holes 1 to 11 tested the area near the discovery showing; holes 12 to 17 tested the area near the eastern showing. Most of the results have not been released yet.

All but one of the first 11 holes, hole RB-87-10 on line 5 + 00 W, intersected alteration within red mudstone and felsic tuff, giving a minimum strike length of 600 m for the discovery zone. One reported intersection from hole RB-87-2 gave 220.8 g/t Ag and 1.44 g/t Au over 2.2 m.

Drill holes RB-88-12 and RB-88-13 tested silver (up to 35 ppm), mercury (up to 360 ppb) and arsenic (up to 183 ppm) soil anomalies on line 9 + 00 E. Zones of yellowish green to white argillic alteration, with silicified breccia veins, were intersected and they appear to dip northward at approximately 80°. The drill holes were nearly perpendicular to stratigraphy but intersected the alteration zones at a shallow angle. Maximum true-width of a single alteration zone is about 10 m. Reported intersections from hole RB-88-12 include 207 g/t Ag over 3 m and 332.5 g/t Ag over 1.8 m.



Reported intersections from hole Rb-88-13 include 0.77 g/t Au and 150.9 g/t Ag over 2.5 m plus 5.72 g/t Au and 921.6 g/t Ag over 0.3 m.

- 18.7 (182.7) Retrace the route to the intersection of Island Lake and Knowles roads. Bear left.  
2.3 (185.0) Stop 16.

#### Stop 16

Dalhousie Group basalt on the left side of the road contains well-developed pillows. This pillow basalt can be traced to the northeast for at least 1.6 km.

Continue eastward on this road to Robertville and then take Highway 11 back to Bathurst. Trip ends.

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