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REGIONAL METALLOGENY OF THE VICTORIA LAKE GROUP

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ABSTRACT

The Victoria Lake Group is a structurally complex assemblage of volcanic-flow, pyroclastic, volcaniclastic and sedimentary rocks. Initial age dates suggest two generations of volcanic sequences are present. They are represented by Cambro-Ordovician 'island-arc-tholeiite/ocean-floor basalt' volcanic rocks and by Llanvirn–Llandeillo 'calc-alkaline' mafic to andesitic flows.

The adjacent mafic volcanic sequences south of Red Indian Lake are all 'ocean-floor basalts' type and probably represent 'within-plate' volcanism.

Mineralization within the Victoria Lake Group consists of volcanogenic sulphides and epigenetic gold. The volcanogenic sulphide mineralization is hosted by both the 'tholeiitic' and 'calc-alkaline' sequences. Ti-rich basalts within the Victoria Lake Group, and sequences adjoining the Victoria Lake Group, are not known to contain massive sulphide mineralization.

The gold mineralization is hosted by a variety of rock types and probably has a large age range. Mineralizing styles or types appear to vary from epithermal to 'shear related' and may in most cases, be a combination of the two.

INTRODUCTION

The Victoria Lake Group (Kean, 1977) underlies that part of the Dunnage Zone (Williams, 1979) of central Newfoundland that extends from Grand Falls in the northeast to King George IV Lake in the southwest, and from Red Indian Lake in the north to Noel Paul's Brook in the south (Figure 1).

Access to the area is provided by woods roads from Millertown and Grand Falls. The area is characterized by a heavily forested, gently undulating topography covered by extensive glacial till. Consequently, bedrock exposure is poor except for Tulks Ridge, which extends from Tulks Valley to Victoria River.

Detailed studies of the Victoria Lake Group and adjoining sequences in central Newfoundland were begun in 1984. These studies involved regional rock-geochemical, paleontological, geochronological and metallogenic studies and detailed stratigraphic, structural and geochemical studies in the areas of known mineralization. A regional metallogenic compilation of the Central Mobile Belt in conjunction with the Geological Survey of Canada (H.S. Swinden) was begun in 1987. A brief description of the main showings and prospects is given in the appendix to this report. For detailed descriptions of the major massive sulphide and gold prospects in the Victoria Lake Group, the reader is referred to Kean (1985), Kean and Evans (1986) and Evans and Kean (1986, 1987). Significant new insights into the geology of the Victoria Lake Group and adjoining areas have been developed and preliminary results are herein presented.

GENERAL GEOLOGY

Kean (1977) proposed and defined the 'Victoria Lake Group' to include all pre-Caradocian volcanic and sedimentary rocks between Red Indian Lake and the Rogerson Lake Conglomerate (Figure 1).

The Victoria Lake Group is divided into two regional lithofacies (Kean and Jayasinghe 1980, 1982; Kean, 1985): 1) volcanic rocks in the southwest (Tulks Hill volcanics) and along the group's southeastern margin (Tally Pond volcanics), comprising approximately 60 percent of the group, and 2) a predominantly sedimentary facies in the northeast that is laterally equivalent to, and derived from, the volcanic rocks.

Both of the volcanic units are characterized by linear belts of predominantly felsic pyroclastic rocks. Mafic flows are common in the Tally Pond volcanics but minor in the Tulks Hill volcanics. In the latter, mafic volcanic rocks are mainly pyroclastic, comprising mafic to intermediate aquagene tuff, lapilli tuff, agglomerate and breccia.

The Tally Pond and Tulks Hill volcanic units represent the major products of volcanic activity with associated hydrothermal alteration and mineralization. Small intercalations or lenses of volcanic rocks (Valley Brook and

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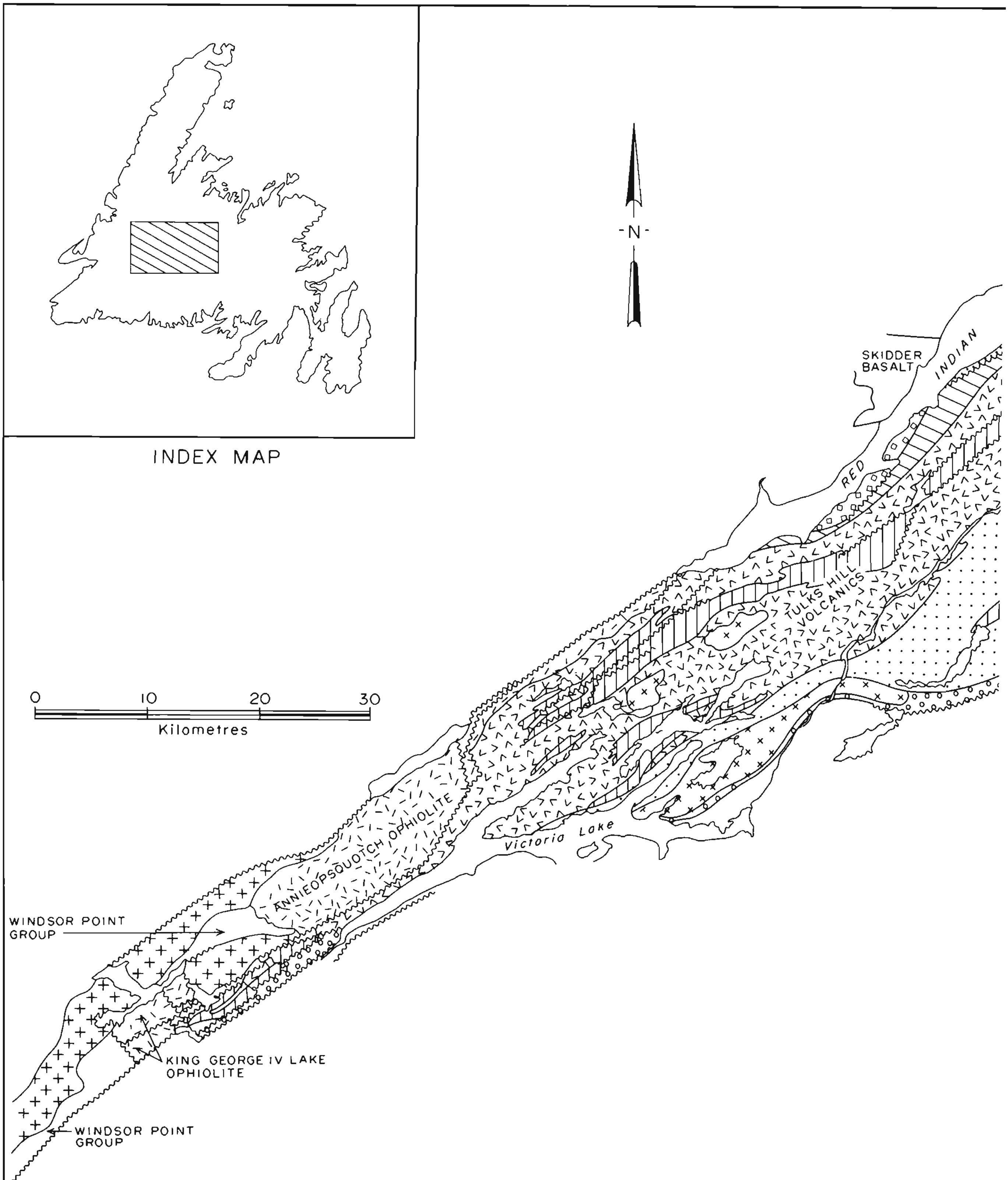
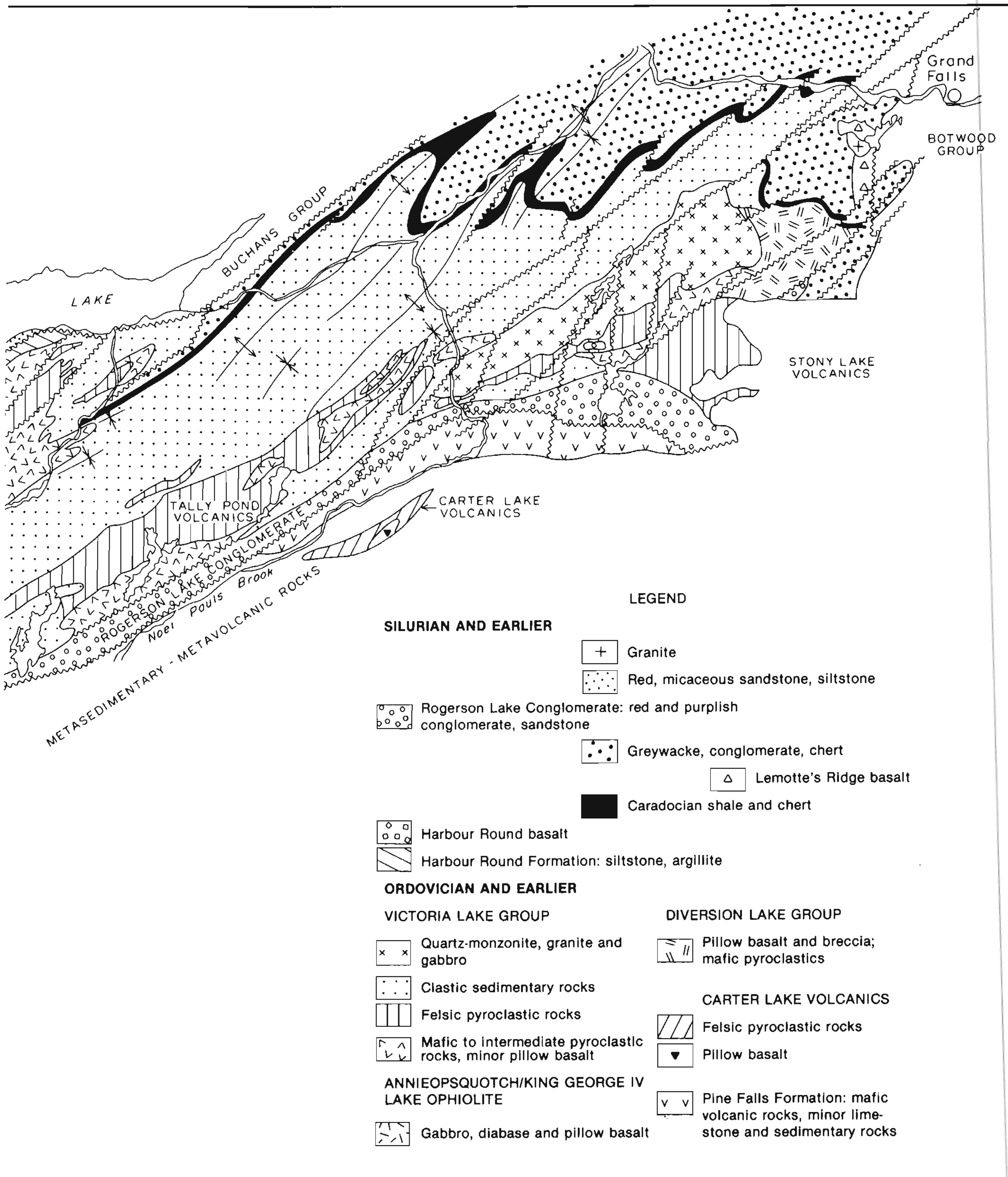


Figure 1. *Simplified geological map of the Victoria Lake Group and adjoining sequences.*



Grand Falls
BOTWOOD GROUP
BUCHANS GROUP
LAKE
STONY LAKE VOLCANICS
TALLY POND VOLCANICS
CARTER LAKE VOLCANICS
ROGERSON LAKE CONGLOMERATE
Noel Pauls Brook
METASEDIMENTARY - METAVOLCANIC ROCKS
LEGEND
SILURIAN AND EARLIER
Granite
Red, micaceous sandstone, siltstone
Rogerson Lake Conglomerate: red and purplish conglomerate, sandstone
Greywacke, conglomerate, chert
Lemotte's Ridge basalt
Caradocian shale and chert
Harbour Round basalt
Harbour Round Formation: siltstone, argillite
ORDOVICIAN AND EARLIER
VICTORIA LAKE GROUP
Quartz-monzonite, granite and gabbro
Clastic sedimentary rocks
Felsic pyroclastic rocks
Mafic to intermediate pyroclastic rocks, minor pillow basalt
ANNIEOPSQUOTCH/KING GEORGE IV LAKE OPHIOLITE
Gabbro, diabase and pillow basalt
DIVERSION LAKE GROUP
Pillow basalt and breccia; mafic pyroclastics
CARTER LAKE VOLCANICS
Felsic pyroclastic rocks
Pillow basalt
Pine Falls Formation: mafic volcanic rocks, minor limestone and sedimentary rocks

Tom Joe Brook basalts) also occur within the sedimentary rocks of the Victoria Lake Group to the northeast.

Siliciclastic rocks constitute most of the northeastern sedimentary facies of the Victoria Lake Group (Kean and Jayasinghe, 1982). This facies consists of greywacke and interbedded siltstone, shale, argillite, conglomerate and rare limestone. Siliceous siltstone and chert are more common near the top of the sequence. The sedimentary facies is interpreted to be a shallowing-upward turbidite sequence.

Limestone lenses near the top of the sedimentary facies and near the northeast end of the Tulks Hill volcanics have yielded Late Llanvirn to Early Llandeilo conodonts (Kean and Jayasinghe, 1982). Dunning *et al.* (1987) obtained a U–Pb zircon age of 462^{+4}_{-2} Ma on a subvolcanic rhyolite at Victoria River, approximately 20 m stratigraphically below the fossil locality. Dunning (1986) reported a U–Pb zircon age of approximately 517 Ma for the Tally Pond volcanics.

The Victoria Lake Group is conformably overlain by the Harbour Round Formation and Caradocian chert and shale on its northern margin (Kean and Jayasinghe, 1980; 1982). It is unconformably overlain by the Rogerson Lake Conglomerate along its southeastern margin, although the contact is generally sheared and faulted. The linear, narrow outcrop pattern of the conglomerate and local clast provenance suggest it is a fault-scarp, molasse-type deposit; the original southern margin of the Victoria Lake Group was thus probably fault bounded.

Kean (1985) interpreted rocks of the Victoria Lake Group to occupy a regional northeast-trending anticlinorium (Victoria Anticlinorium). Regionally, the sequence dips steeply and faces northwesterly on the north limb and dips gently and faces southeasterly on the south limb; however, there are many first-order and second-order folds resulting in variable facing directions. A paucity of outcrop generally precludes detailed structural interpretations.

The Victoria Lake Group has an inhomogenously developed, regional penetrative foliation defined by chlorite, sericite, flattened clasts and crystal augen. The intensity of this foliation, which is subparallel to bedding and axial planar to tight and isoclinal folds, increases to the southwest. The rocks have been metamorphosed to the lower-greenschist facies, except locally along their southern margin where middle-greenschist to lower-amphibolite facies rocks are present.

Evans and Kean (1987) broadly discussed the mineralization within the Victoria Lake Group under two main groupings: (1) volcanogenic sulphide, and (2) epigenetic gold mineralization. They demonstrated that the volcanogenic mineralization is of both massive and disseminated stockwork type and is associated with variably altered felsic volcanic rocks. The gold mineralization occurs in a number of different geological environments, and may vary in age from Ordovician to Silurian.

REGIONAL STUDIES

A simplified version of the geological map for the Victoria Lake Group is presented in Figure 1. It is part of a new, 1:500,000-scale, metallogenic map of the Central Mobile Belt that is currently in preparation. This new map reflects our current knowledge of the geological evolution and paleotectonic setting of the Victoria Lake Group. Preliminary results from recent geochemical, geochronological and paleontological studies are presented in point form below.

1) Geochemical data (Figure 2) for mafic flows (Figure 3) indicate: (a) the mafic flows of the Tally Pond volcanics and those mafic flows of the Tulks Hill volcanics occurring along Harmsworth Steady (Victoria River) and associated with the major stratigraphic unit of felsic pyroclastic rocks plot (Figure 3) in the 'island-arc tholeiite'–'ocean-floor basalt'

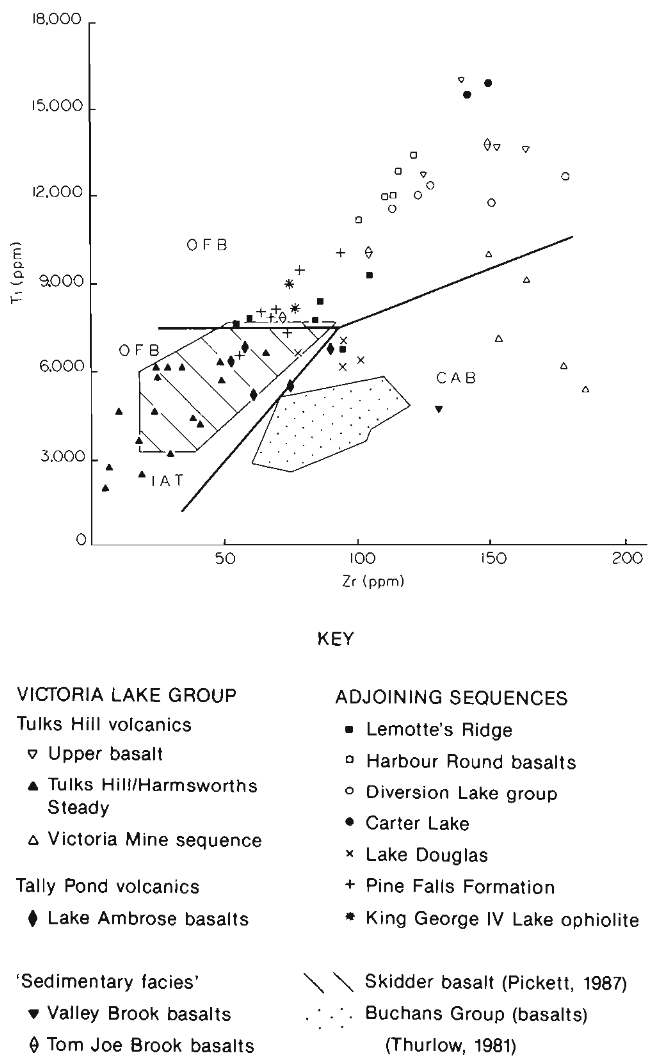


Figure 2. *Ti vs. Zr discriminant diagram for mafic volcanic rocks of the Victoria Lake Group and adjoining sequence. Fields after Garcia (1978): IAT–island-arc tholeiite; OFB–ocean-floor basalt; CAB–calc-alkaline basalt.*

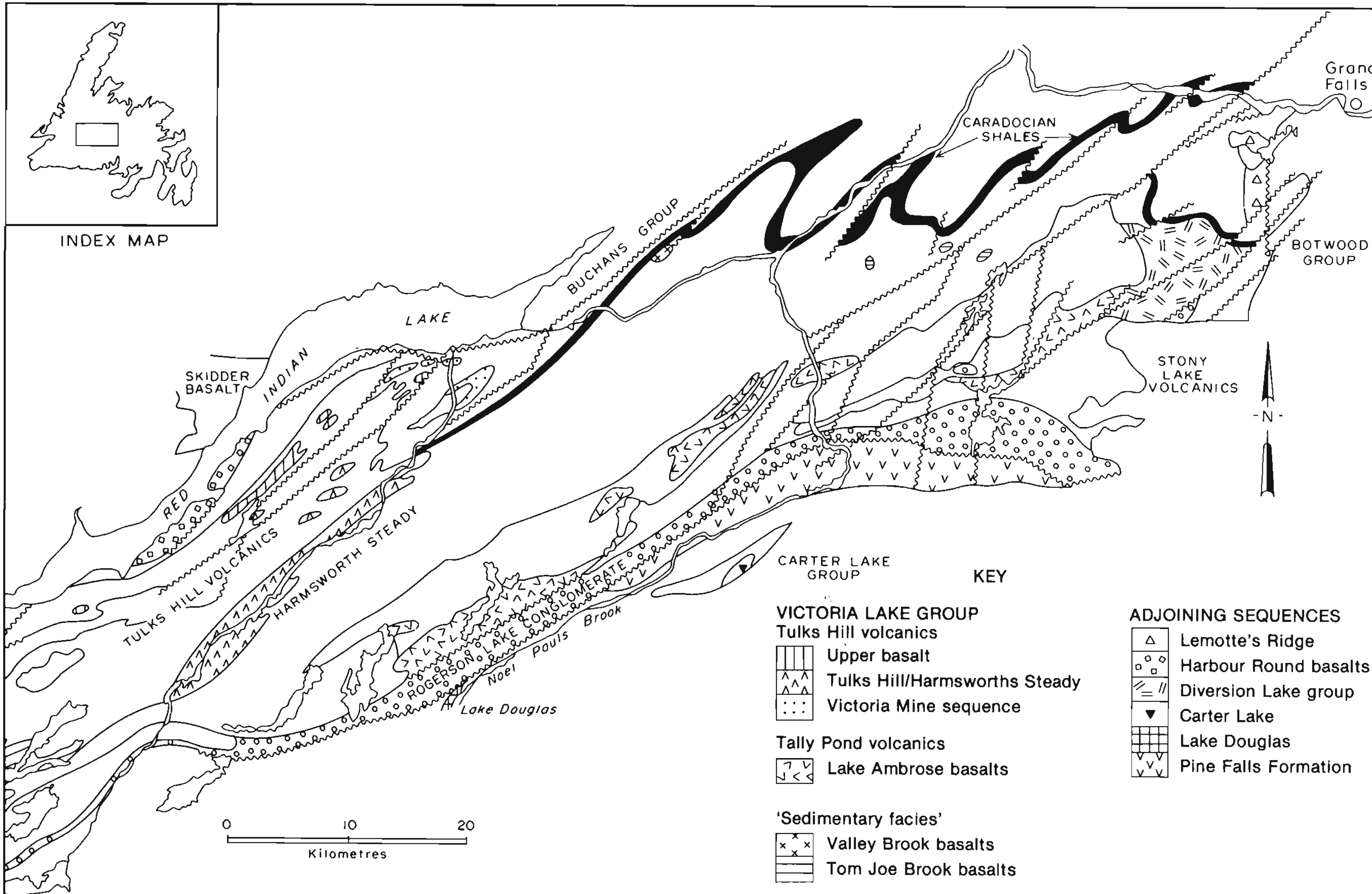


Figure 3. *Distribution of major mafic flow units within and adjoining the Victoria Lake Group.*

field on the discriminant diagram of Garcia (1978). These rocks probably formed as 'island-arc tholeiites'; (b) other mafic flow units within the Tulks Hill volcanics fall within either the 'ocean-floor basalt' or 'calc-alkaline' fields of Garcia (1978). For example, the mafic unit (Upper basalt) overlying the major felsic pyroclastic unit consists of Ti-rich basalts and plot within the 'ocean-floor basalt' field of Garcia (1978). They are tentatively interpreted to represent 'within-plate' volcanism. Mafic flows at the north end of the Tulks Hill volcanics near Victoria Mine, at Victoria River bridge and Valley Brook, plot in the calc-alkaline field; (c) rocks surrounding and/or in contact with the Victoria Lake Group south of Red Indian Lake, all plot in the 'ocean-floor basalt' field. Rocks from the Pine Falls Formation and Lemotte's Ridge basalt appear to be transitional between the 'island-arc tholeiite'–'ocean floor basalt' field and the 'ocean-floor basalt' field. Rocks within the 'ocean-floor basalt' field with high TiO_2 values appear to be represented by rocks of the Harbour Round basalts, Carter Lake volcanics, Upper basalt of the Tulks Hill volcanics and the Diversion Lake group and probably represent 'within plate' basalts.

2) Geochronological and paleontological studies indicate that at least two generations of volcanic sequences are present within the Victoria Lake Group. The Tally Pond volcanics give a late Cambrian U–Pb zircon age of approximately 517 Ma (Dunning, 1986). Felsic volcanic rocks in the southernmost part of the Tulks Hill volcanics have yielded a similarly old U–Pb zircon age (G.R. Dunning, personal communication, 1987). A single conodont, collected from a limestone locality near the Jacks Pond prospect within the Tulks Hill volcanics, was identified as Tremadoc in age (C.R. Barnes, personal communication, 1987). This indicates that the Tulks Hill and Tally Pond volcanics are of similar age. However, the rocks at the mouth of Victoria River, interpreted to be at the north end of the Tulks Hill volcanics, give a U–Pb zircon age of $462\ ^{+4}_{-2}$ (Dunning, *et al.*, 1987), which is in agreement with a conodont age of Llanvirn–Llandeilo (Kean and Jayasinghe, 1980, 1982). This suggests a stratigraphic and/or structural break within the Tulks Hill volcanics. This is also supported by the lead-isotope data, which indicate that lead from the Victoria Mine is more radiogenic than lead from deposits in the southern part of the Tulks Hill volcanics (Swinden and Thorpe, 1984), and by the geochemical data presented above. Geochronological and paleontological studies of the Tulks Hill volcanics are still in progress.

3) Infrared imagery and gradiometer data (Geological Survey of Canada, 1985a,b,c,d,e) show a number of northeast and north-northeast-trending linears and anomalies (Figure 4). These can be interpreted as faults, in particular thrust and strike-slip faults, and indicate that faulting may be an important element of the geological history of this area. A number of north-northeast-trending gradiometer anomalies are coincident with physiographic linears and may represent significant structural breaks, e.g., the north-northeast-trending linear anomaly coincident with Rogerson Lake. There is also a number of cross-structures that could be faulting or fracturing related to late regional flexuring.

4) Many of the mineral showings occur along or close to the interpreted structures (Figure 4), raising the possibility that these structures acted as conduits for fluids. Some of the northeast-trending structures may be developed on earlier, older structures that controlled loci of volcanism and massive sulphide deposition (Kean and Evans, 1986). Epithermal-like alteration systems appear to be restricted to the northeast-trending structures within the major felsic pyroclastic units of the Tulks Hill volcanics. However, shear-related gold mineralization appears less restricted and occurs along structures of various orientation.

5) The volcanogenic massive sulphide deposits and showings are the same age as the enclosing felsic volcanic rocks. Hence, there are at least two ages of volcanogenic mineralization within the Victoria Lake group, because the mineralization occurs both in the Upper Cambrian–Lower Ordovician 'island-arc tholeiite' sequences (e.g., Tulks Hill, Tulks East, Jacks Pond and Duck Pond) and the Llanvirn–Llandeillo 'calc-alkaline' sequences (e.g., Victoria Mine). The 'within-plate' 'ocean-floor basalt' sequences contain no known mineralization.

The gold mineralization occurs in a variety of rock types and may be of widely varying ages. For example, gold occurs associated with epithermal-style alteration in Cambro-Ordovician rocks and in quartz veins in shear zones developed along Silurian(?) and Devonian nonconformities. However, as all types of gold mineralization are associated with shear zones and auriferous quartz veins that are both deformed by and postdate the shearing, the age of mineralization is not well defined. The shear-zone model may at least represent an important remobilization factor for the mineralization associated with the epithermal-style alteration (e.g., Midas Pond, Bobbys Pond). Shearing is probably the major controlling factor for the mineralization associated with faults developed along stratigraphic and/or lithological breaks and other structural linears. This mineralization occurs in a number of different lithologies of different ages, including granite, conglomerate and chloritoid-bearing felsic volcanics of the Tally Pond volcanics (e.g., Spencers Pond area).

$^{40}Ar/^{39}Ar$ age dating of sericite from three massive sulphide deposits and one gold showing all give similar Early Devonian ages (Figure 5, Table 1). These ages probably reflect overprinting (resetting) by the Acadian deformation.

6) Newly mapped exposures of conglomerate similar to the Rogerson Lake Conglomerate occur to the south and east of the Crippleback Lake Quartz Monzonite of Kean and Jayasinghe (1982). Similar outcrops also occur east of Diversion Lake to the northeast. The conglomerate is interpreted to swing eastwards in the Sandy Lake area; however, it also appears to continue to the northeast following the trend of the Victoria Lake Group. This suggests that the conglomerate may also nonconformably overlie the Crippleback Lake Quartz Monzonite (a similar situation to the Valentine Lake area—see appendix, #20). Extensive alteration is also present in felsic volcanic rocks that underlie the conglomerate.

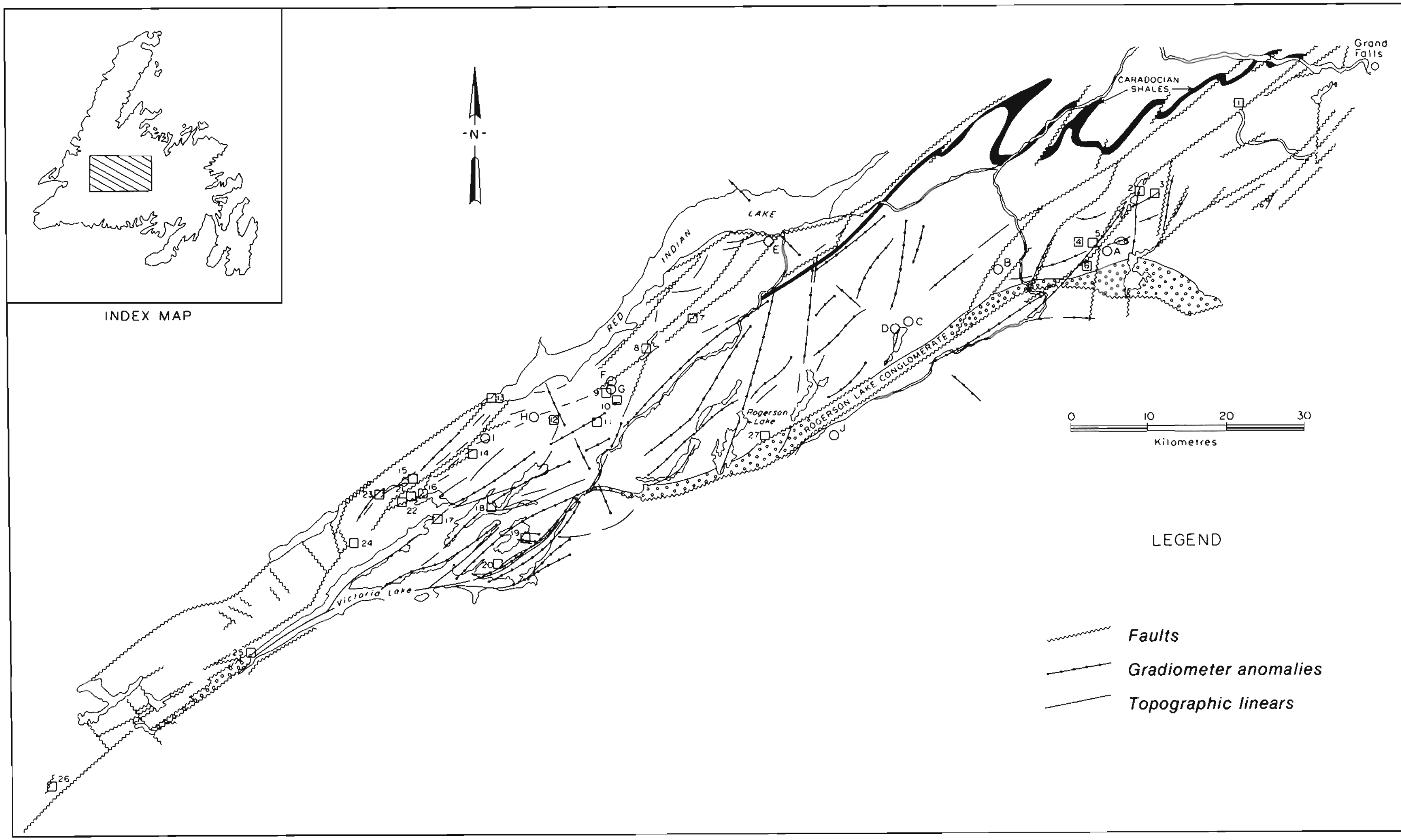


Figure 4. *Distribution of major structural linears and geophysical anomalies in the area showing the distribution of significant mineralization–alteration. O–volcanogenic sulphides; □–epigenetic alteration and gold mineralization. Letters and numbers keyed to the appendix.*

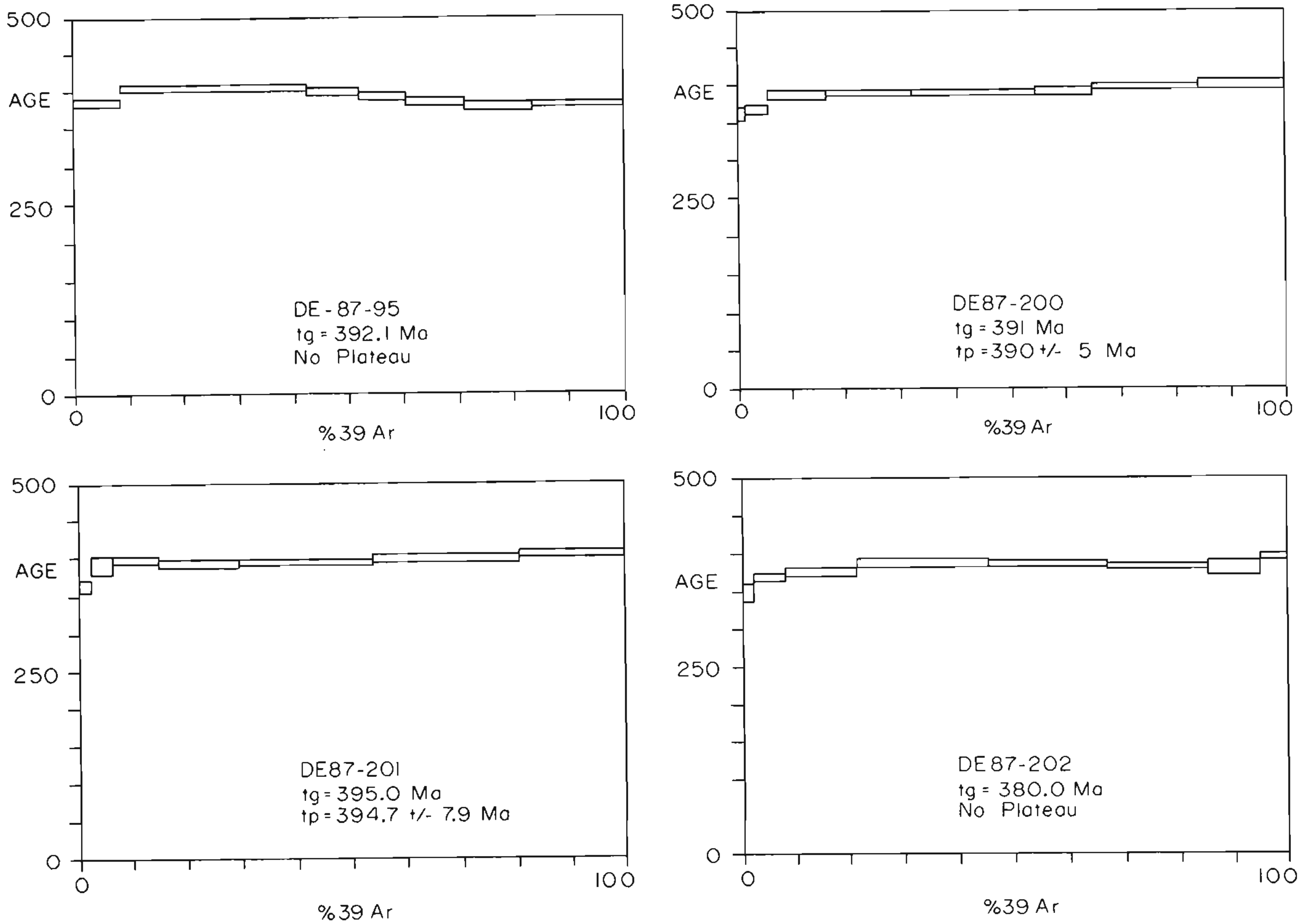


Figure 5. *$^{40}Ar/^{39}Ar$ incremental-release spectra of sericites from Bobby's Pond (DE-87-95); Tulks Hill (DE-87-200); Jacks Pond (DE-87-201); and Duck Pond (DE-87-202).*

Table 1. $^{40}Ar/^{39}Ar$ ages of sericite obtained from massive sulphide and epigenetic gold deposits.

Sample Number	Location	Sample Description	Association	$^{40}Ar/^{39}Ar$ Age
DE-87-95	Bobbys Pond	Sericite	Epithermal alteration	392 ± 4
DE-87-200	Tulks Hill	Sericite	Massive sulphide	391 ± 4
DE-87-201	Jacks Pond	Sericite	Massive sulphide	395 ± 8
DE-87-202	Duck Pond	Sericite	Massive sulphide	380 ± 5

SUMMARY

The Victoria Lake Group consists of a Upper Cambrian–Lower Ordovician sequence of 'island-arc tholeiites' and more Ti-rich, 'within plate' basalts and a Llanvirn–Llandeillo sequence of 'calc-alkaline' basalt and andesite. The mafic volcanic rocks adjoining the Victoria Lake Group on the south side of Red Indian Lake appear to be mostly formed in a 'within-plate', ocean-floor paleotectonic setting. The identification of linears interpreted to be faults and thrusts, and often associated with major lithological and/or stratigraphic contacts, may be crucial in reconstructing the stratigraphy, structure, paleotectonic environment and identifying potential sites of mineralization.

The volcanogenic sulphide mineralization, hosted by felsic volcanic rocks, appears to be restricted to 'island-arc tholeiitic' and 'calc-alkaline' volcanic rocks. The Ti-rich sequences contain no known significant mineralization. The gold mineralization occurs in a variety of rock types and probably represents mineralizing systems ranging in age from Cambro-Ordovician to Siluro-Devonian. A common feature to all the gold mineralization is their presence within shear zones.

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APPENDIX

Mineralization in the Victoria Lake Group

(Data Sources: Tuach, 1987; BP-Selco; Noranda; Kean, 1985; Kean and Evans; 1986; Evans and Kean, 1986, 1987). Keyed to Figure 4.

Epigenetic alteration and gold mineralization:

1. *Lynx Pond:* Fine grained, massive pyrite veins in greywacke (Au–155 ppb).

2. *Evans showing:* Carbonatized, chloritized, sericitized, and pyritized sheared quartz monzonite with pyrite stringer and quartz–carbonate veins carrying pyrite and galena.

3. *Coronation Lake:* Disseminations and veins of pyrite, molybdenite and chalcopyrite in silicified zones in the mafic phase of the Crippleback Lake Quartz Monzonite (Au–60 ppb).

4. *Island Pond:* Possible stockwork alteration developed in Crippleback Lake Quartz Monzonite. It consists of sericite, carbonate and pyrite and hydrothermal breccias containing minor disseminated and stringer chalcopyrite and traces of molybdenite (Au–90 ppb).

5. *Jims Hill:* Disseminated and stringer pyrite, minor chalcopyrite and galena in carbonate-altered Crippleback Lake Quartz Monzonite.

6. *Shoulder Blade Lake:* Disseminated pyrite and coarse grained euhedral arsenopyrite. Developed in strongly hematized and silicified felsic volcanics containing quartz–carbonate veins (Au–245 ppb in arsenopyrite bearing felsic volcanics).

7. *Bobbys Pond and North Pond:* Altered felsic volcanic rocks of the Tulks Hill volcanics characterized by sericite, pyrophyllite, alunite, native sulphur and orpiment. Semimassive pyrite with pyrophyllite and sericite–silica alteration developed in similar rocks approximately 2.5 km to northeast at North Pond. The alteration zone is surrounded by sericite schist and appears to be preserved as large boudins. It probably represents an epithemal alteration system (Au–156 ppb in sericite schist envelope).

8. *Harbour Round:* Disseminated and stringer pyrite in Tulks Hill volcanics. No further information available.

9. *Jacks Pond West:* Quartz-carbonate veins containing coarse grained pyrite and minor galena in sericitized felsic volcanic rocks of the Tulks Hill volcanics (Au–70 ppb).

10. *Side of the Hill:* Disseminated and stringer pyrite, chalcopyrite, galena and sphalerite in sericitized felsic volcanics of the Tulks Hill volcanics (Au–20 ppb, Ag–10.7 ppm, Zn–4,500 ppm, Pb–6,600 ppm, Cu–465 ppm, Hg–1700 ppb; and Cd–11.5 ppm.)

11. *Roebucks Pond:* Altered Tulks Hill volcanics. No further information available.

12. *Costigan Brook:* Altered Tulks Hill volcanics. No further information available.

13. *Star Brook:* Sheared and altered volcanic rocks with quartz veins (Au–0.12 oz/t, Ag–0.7 oz/t).

14. *Tulks Extension:* Boulders with auriferous quartz veins.

15. *West Tulks:* Silicified, banded and possibly mylonitized cherty-type rocks of the Tulks Hill volcanics containing galena and Au-bearing quartz veins. Probably in part silicified volcanic rocks and/or silica precipitate.

16. *Midas Pond:* Pyrite, carbonate, feldspar, tourmaline, paragonite and gold-bearing quartz veins hosted by sericitized, silicified, pyrophyllitized and kaolinitized, quartz-eye felsic volcanics of the Tulks Hill volcanics. The pyrophyllitized rock contains thin fluorite veinlets and forms the structural hanging wall to the sericitized and silicified, quartz-veined mineralized zone. A banded mafic unit (tuff?) exhibiting strong carbonate and pyrite alteration is in gradational contact with and forms the structural footwall to the mineralized zone. The alteration system is developed within an anastomising northeast-trending shear zone (Au–7300 ppb).

17. *Victoria Lake NW:* Disseminated pyrite in altered felsic volcanic rocks of the Tulks Hill volcanics. No assays available.

18. *Long Lake:* Pyrite and gold-bearing quartz veins associated with a granite emplaced into a shear zone developed in volcanic rocks of the Tulks Hill volcanics. No assays available.

19. *Frozen Ear Pond:* Quartz vein in altered Valentine Lake Quartz Monzonite. No further information available.

20. *Valentine Lake:* Gold-bearing, pyrite–tourmaline–andradite quartz–feldspar veins in the sheared margin of the Valentine Lake Quartz Monzonite. Scheelite and tungstenite are also present. Similar quartz veins also cut the overlying conglomerate. Mineralization may be related to a shear zone developed parallel to the nonconformity between the monzonite and the Silurian(?) Rogerson Lake Conglomerate.

21. *Road (Camp) showing:* Galena, sphalerite and pyrite-bearing quartz veins in sericitized and carbonate-rich felsic volcanics of the Tulks Hill volcanics (Au–5500 ppb).

22. *Glitter Pond:* Massive barite lens or vein with local anomalous gold values.

23. *Stag Pond:* Auriferous arsenopyrite-bearing quartz boulders.

24. *Pats Pond:* Boulders containing quartz veins with pyrite, sphalerite, galena, scheelite, stibnite and significant gold values. (Float: Au–0.60 oz/t, Ag–36.7 oz/t, Cu–0.08%, Pb–7.5%, Zn–1.1%, WO_3–2.9%, Bi–0.3%; Drill Hole (4.9 ft.): Au–0.01 oz/t, Ag–3.2 oz/t, Cu–.05%, Pb–0.78%, Zn–1.1%.)

25. *Victoria Lake South:* Pyritized and sheared gabbroic rocks within the Victoria Lake Group (Au–900 ppb).

26. *Second Exploits:* Gold, galena, sphalerite and specular hematite in quartz float and 1- to 2-cm-wide quartz–carbonate veins cutting altered granite. Stratigraphically beneath the nonconformably overlying Devonian Windsor Point Group. Developed within a splay of the Cape Ray fault system. *(In situ* veins: Au–7.5 g/t, Ag–8 g/t. Float: visible gold (Au–25 g/t)).

27. *Spencers Pond:* Sericitic felsic volcanics and synvolcanic intrusives of the Tally Pond volcanics. Anomalous gold values associated with chloritoid-bearing volcanics; local pyrophyllite development.

Volcanogenic sulphides

A. *Old Sandy Road:* Massive to banded pyrite and trace chalcopyrite in mafic volcanics of the Tally Pond volcanics.

B. *Burnt Pond:* Thin lens of zinc, copper and minor lead in felsic volcanic rocks of the Tally Pond volcanics. Associated sericite and chlorite alteration.

C. *Boundary:* Volcanogenic massive sulphide containing zinc, copper, minor lead, and silver. Occurs in felsic pyroclastic rocks of the Tally Pond volcanics. Breccia ore and well-bedded, laminated massive sulphides present with associated sericite–chlorite pyrite–chalcopyrite stockwork (0.5 million tonnes at 4% Zn, 3.5% Cu, 1% Pb and 34 g/t Ag, (Au)).

D. *Duck Pond:* Zinc, copper and minor lead (Au, Ag) volcanogenic massive sulphide in felsic volcanic rocks of the Tally Pond volcanics. Banded, massive (unbanded) and brecciated sulphides are present and there is an associated sericite, chlorite, pyrite–chalcopyrite stockwork (As of Nov., 1987: 3.6 million tonnes at 7.58% Zn, 3.71% Cu, 1.36% Pb, 72.34 g/t Ag, and 1.2 g/t Au).

E. *Victoria Mine:* Copper, zinc and lead volcanogenic sulphides in altered felsic pyroclastic rocks of the Tulks Hill volcanics. The mineralization occurs both as stratiform massive sulphides and as stockwork stringers and disseminations. Lead mineralization is mainly associated with the dolomitic cap to the massive sulphides. Hydrothermal alteration consisting of sericite, chlorite, pyrite and chalcopyrite accompanies the mineralization. (Grab samples from the dumps: 7.5% Cu, 2.4% Zn, 1.5% Pb, 140 ppb Au and 12 ppm Ag.)

F. *Cathy's Pond:* Massive pyrite with trace base metals hosted by felsic volcanics of the Tulks Hill volcanics (Au–165 ppb).

G. *Jacks Pond:* Pyritic, minor chalcopyrite, volcanogenic sulphide deposit in felsic volcanics of the Tulks Hill volcanics. Appears to be mainly stockwork mineralization with associated sericite, silica and chlorite alteration (4 lenses up to 1.0 million tonnes with sporadic Cu, Pb and Zn values).

H. *Tulks East:* Pyritic volcanogenic massive sulphide in felsic volcanic rocks of the Tulks Hill volcanics. It consists of three stratifrom massive sulphide lenses (A, B and C) containing 5.6 million tonnes of pyritic massive sulphides with low base-metal values. Sericite, silica, chlorite and pyrite–chalcopyrite stockwork associated with the stratiform sulphides: A) 4.5 + million tonnes: 1.5 % Zn, 0.24% Cu, 0.12% Pb, 8.5 g/t Ag, trace Au; B) 0.2 million tonnes: 8.7% Zn, 0.66% Cu, 1.26% Pb, 58.7 g/t Ag, 0.14 g/t Au and C) 0.9 million tonnes: Less than 1% combined base metals).

I. *Tulks Hill:* Zinc, copper and minor lead volcanogenic massive sulphides in felsic pyroclastic rocks of the Tulks Hill volcanics. Four stratiform lenses with a total tonnage of approximately 0.75 million tonnes underlain by sericite, silica, chlorite and pyrite–chalcopyrite stockwork alteration. (0.75 million tonnes 5-6% Zn, 2% Pb, 1.3% Cu, 0.4 g/t Au and 41 g/t Ag).

J. *Havens Steady:* Zinc–copper and minor lead volcanogenic sulphide mineralization in felsic volcanic rocks. Stringer and disseminated sulphides in sericitic alteration characterizes this prospect.