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GEOLOGY OF THE JACKS POND VOLCANOGENIC SULFIDE PROSPECTS, VICTORIA LAKE GROUP, CENTRAL NEWFOUNDLAND

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ABSTRACT

The Jacks Pond prospects occur in the felsic volcanic rocks of the Tulks Hill volcanics, Victoria Lake Group. The Tulks Hill volcanics consist predominantly of linear belts of felsic pyroclastics and minor mafic volcanic rocks that are intercalated with mafic to felsic, fine grained, volcaniclastic rocks. The host rocks to the mineralization are variably altered, fine grained, felsic, lapilli tuff, vitric tuff and crystal-vitric tuff.

The Jacks Pond prospects consist of four pyritic, volcanogenic sulfides with low base-metal values. The mineralization occurs mainly as disseminated and stringer sulfides in an alteration stockwork containing minor, exhalative sulfides that exhibit detrital textures. Chloritization, sericitization and silicification are characteristic alteration types.

INTRODUCTION

The Jacks Pond area lies in the Lake Ambrose (12A/10) map area and is accessible by logging roads from Millertown. It is located approximately 10 km northeast of the Tulks East deposit (Figure 1).

During the 1985 field season, 1:13,320 scale mapping was conducted in the vicinity of the Jacks Pond volcanogenic sulfide prospects. A detailed study of drill core from the sulfide lenses was carried out in conjunction with the surface mapping. The present investigation forms part of a B.Sc. honours thesis by Evans, which will examine the general geology, alteration and mineralogy of the deposit.

The Jacks Pond sulfide occurrences were discovered in 1980-81 by personnel from the Mineral Resources Division of Abitibi-Price Inc. The mineralization consists of four dominantly pyritic lenses containing minor amounts of base metals, and range in size form 200,000 to 900,000 tonnes (Barbour and Thurlow, 1982). The sulfide bodies are not exposed and can only be studied in drill core. Two new pyritic, base-metal showings were also discovered during the course of this study.

GENERAL GEOLOGY

The Jacks Pond massive sulfides occur in felsic pyroclastic rocks of the Tulks Hill volcanics near the stratigraphic top of the Victoria Lake Group (Kean and Jayasinghe, 1980). The Victoria Lake Group is a northeast-trending belt of felsic and mafic volcanic rocks, and volcaniclastic and epiclastic volcanic rocks which extends from the Burgeo highway northward to Grand Falls. Limestone lenses near the top of the sedimentary/epiclastic rocks in the northeast have yielded late Llanvirn to early Llandeillo conodonts (Kean and Jayasinghe, 1982). The Victoria Lake Group is thus interpreted to be part of the pre-Carodocian island-arc volcanism in central Newfoundland (Kean and Jayasinghe, 1980). For a more detailed discussion of the regional geology, readers are referred to Kean and Evans (*this volume*). The Tulks Hill volcanics form a 65 km long belt, extending from Pats Pond in the southwest to the mouth of Victoria River in the northeast. Structurally, the rocks occupy the north limb of the Victoria Anticlinorium. The volcanic rocks consist of felsic tuff, lapilli tuff, quartz crystal tuff, breccia and porphyry, intercalated with intermediate and mafic pyroclastic and volcaniclastic rocks (Kean and Jayasinghe, 1980). Mafic flows are not widely developed but are present throughout the unit.

Tulks Hill Volcanics (Units 1 to 5)

The Tulks Hill volcanics consist predominantly of felsic, quartz crystal tuff and crystal-lithic tuff in the Jacks Pond area. Mafic volcanic rocks underlie a small portion of the southern part of the study area. Silicification of the felsic rocks varies from weak to intense; the rocks in the vicinity of the sulfide lenses are highly silicified and sericitized. Pervasive silica replacement obliterates the original textures in the highly silicified areas.

The rocks contain an inhomogeneously developed, penetrative foliation, defined by sericite, chlorite and flattened clasts and crystals; it is axial planar to tight to isoclinal folds. A cleavage-bedding intersection in subunit 3b suggests

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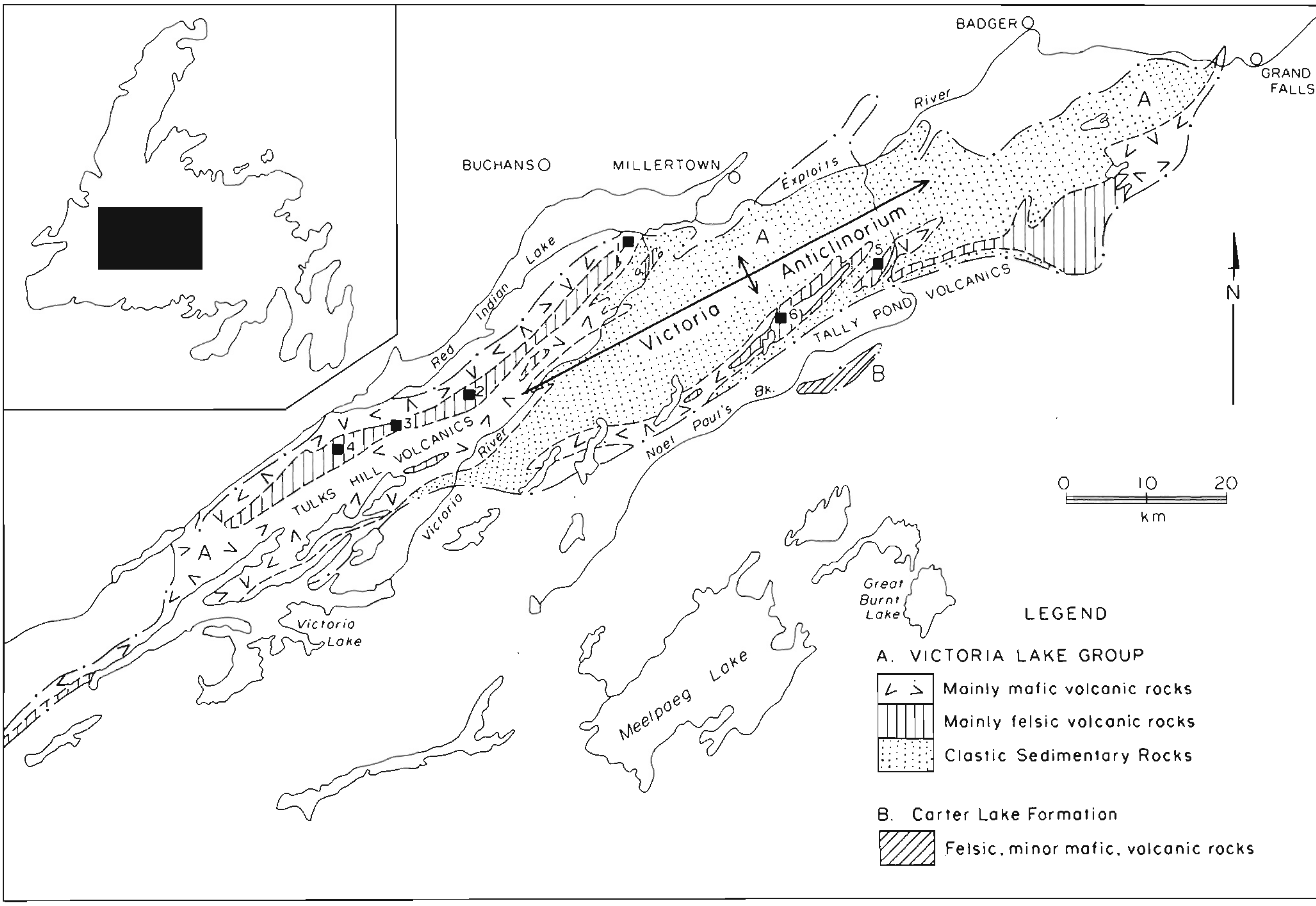

Figure 1: *Early to middle Ordovician volcanic-dominated island-arc sequences and massive sulfide deposits (solid squares) in central Newfoundland. Massive sulfide deposits: 1. Victoria Mine; 2. Jacks Pond; 3. Tulks East; 4. Tulks Hill; 5. Burnt Pond; 6. Tally Pond (after Swinden and Thorpe, 1984).*

that these rocks occupy the south limb of a synform that closes to the northeast. The northeastward extension of the Tulks Valley fault transects the Tulks Hill volcanics in the northern part of the area.

The Tulks Hill volcanics in this area can be locally subdivided into five units on the basis of rock type, composition and degree of alteration (Figure 2); these subdivisions do not necessarily represent stratigraphic units.

Unit 1 consists of dark greenish-gray, chloritic, mafic, tuffaceous rocks and massive mafic rocks. Aphanitic mafic rocks of massive appearance, locally containing calcite amygdules, may be flows; these are referred to as subunit la. Subunit lb consists of dark greenish-gray, fine grained, locally plagiophyric, mafic tuff. The outcrops have a scalloped appearance, which is interpreted to be the result of differential weathering of carbonate-rich zones.

Unit 2 consists of white and rusty weathering, sericitic, crystal and crystal-lithic, felsic tuff, intercalated with zones of chlorite-rich tuff. The felsic tuff is light grayish-green on fresh surfaces and contains abundant quartz crystals up to 1 cm across. Feldspar crystals are locally present and are generally small. Lithic clasts appear to be restricted to narrow zones or beds and are generally of lapilli size. Locally, however, felsic clasts up to 15 cm by 45 cm were observed. The matrix to the clasts is a quartz crystal tuff.

The chloritic zones generally form narrow bands that are locally up to 2m wide. Feldspar crystals (up to 1 cm in length) and small quartz crystals are also present in the chloritic zones. Disseminated pyrite and stringers of coarse grained pyrite also occur.

Unit 3 consists predominantly of quartz crystal tuffs containing local concentrations of feldspar. It also includes breccias, dolomitic beds and silicified tuffs, which are host to volcanogenic sulfides. The unit is subdivided into five subunits based on rock types.

Quartz crystal tuffs, which are locally feldspar rich, constitute subunit 3a. This subunit is slightly silicified and sericitized. It weathers white to gray and is generally light greenish-gray on fresh surfaces. Milkly-white or blue quartz crystals range in size from 2 mm to 1 cm across. Limonitic coatings and flecks are common on fracture and cleavage surfaces within the tuffs, and there is abundant disseminated pyrite. A narrow zone or band of fine to coarse grained, massive pyrite containing quartz gangue occurs in this unit along the south shore of Cathy's Pond.

Subunit 3b is a variably silicified, fine grained, felsic tuff that hosts the Jacks Pond mineralization. The subunit is generally white weathering and greenish-gray on fresh surfaces. Areas of intense silicification are marked by pale-green, fine grained rocks, which give a massive appearance to some outcrops. However, zones containing preserved fragmental textures were observed in one locality. Narrow, intensely sericitized zones are common. Disseminated pyrite and limonitic flecks, and quartz-carbonate veins and veinlets are common.

A narrow zone of fine grained, green to black chlorite containing abundant granular and euhedral pyrite occurs within the silicified felsic volcanic rocks. Rusty quartz-carbonate veins, up to 7.5 cm wide, cut the chloritic zone, and also contain granular pyrite and minor galena.

A breccia, consisting of angular fragments of felsic and minor mafic volcanic rocks in a quartz crystal tuff matrix, constitutes subunit 3c. It weathers rusty white due to the abundance of disseminated pyrite. The fragments are slightly flattened and range in size from less than 1 cm^2 to 25 cm by 50 cm. The felsic fragments are generally quartz porphyritic. The matrix is slightly silicified and sericitized and cut by numerous quartz veins.

Subunit 3d consists of tuffaceous rocks characterized by large, slightly flattened, milky-white, quartz crystals and crystal fragments up to 1.5 cm by 2 cm in size. The greenigh-gray matrix of the tuffs is fine grained, slightly sericitic and siliceous.

Subunit 3e forms a narrow band or bed of dolomite and dolomite-rich tuffs. The dolomitic rocks are beige on weathered surface, brownish-gray on the fresh surface, and are partially recrystallized. Euhedral pyrite, locally up to 3 mm across, is generally present. Dolomitic rocks are not extensive in the Victoria Lake Group, but have been reported from other mineralized areas. For example, in the Victoria Mine area to the northeast, massive to bedded dolomite is associated with lead-zinc mineralization (Kean and Jayasinghe, 1980).

Unit 4 consists of quartz crystal tuffs. It is lithologically similar to subunit 3a, but is more silicified; the boundary between the two is interpreted to be gradational. The unit is generally white to gray weathering, and exhibits quartz veining and pervasive silica replacement, particularly in the northern portion of the unit. The southern part of Unit 4 contains numerous narrow zones of sericitic and highly bleached tuffs, each separated by massive, intensely silicified tuffs. The sericitic areas are locally extremely hematitic and rusty. Pyrite, chalcopyrite, galena and sphalerite occur as small patches and disseminations in the altered zones.

Unit 5 consists predominantly of coarse grained, pyroclastic breccia; fine grained, locally carbonate-rich, tuffs occur in the western part. Unit 5 is juxtaposed against Unit 3 by the northeast extension of the Tulks Valley fault from the Tulks East deposit area. In the Jacks Pond area, the fault is expressed by a linear EM anomaly which passes through Cathy's Pond (J. G. Thurlow, personal communication, 1985).

Subunit 5a consists of breccias that contain abundant, angular, felsic blocks ranging in length from 1 cm to 25 cm. Vesicular and chloritic mafic blocks are locally present; these appear to increase in abundance to the west. The matrix of the breccia is white weathering and consists mainly of feldspar crystals and fragments up to 1 cm in size.

Subunit 5b is a sheared, fine grained, carbonate-rich, felsic, lapilli tuff that is generally purplish-gray. Sandy, clastic textures occur locally and may indicate reworking. Brown weathering, white to gray, fine grained dolomite forms a wide band within the felsic tuffs. Euhedral pyrite cubes (2 to 3 mm across) are common.

Volcanogenic Sulfides

The Jacks Pond deposits consist of base metal volcanogenic sulfides concentrated mainly in four lenses, herein called A, B, C and D, and are located to the south of Cathy's Pond (Figure 2). They range in size from 200,000 to 900,000 tonnes (Barbour and Thurlow, 1982). Two significant new showings were discovered during the course of this study (Figure 2). The mineralization in the Jacks Pond area is predominantly pyritic with low base-metal values. Precious metal content ranges from very low to trace amounts.

Jacks Pond Prospects. There appears to be at least two different styles or types of mineralization in the Jacks Pond area. The first type, represented by lenses A and B, is characterized by ellipsoidal mineralized zones consistng of a massive pyritic core that is gradational into stringer and disseminated pyrite. This mineralization is hosted by fine grained, gray to green, feldsparphyric, crystal-vitric tuff and lapilli tuff. The lapilli clasts have indistinct boundaries and appear to be partially replaced. These mineralized zones appear to be stratiform, forming tabular-shaped, northeast-trending and southeast-dipping bodies. The pyritic core consists of massive veins or lenses that have a maximum thickness of 1.5 m and are separated from each other by narrow, sericitic, chloritic, and silicified zones. These zones may be either unmineralized or contain up to 20 to 30 percent pyrite. The pyrite is medium to coarse grained, granular, euhedral to subhedral; locally it is rounded. The semi-massive pyritic core grades into zones containing 10 to 60 percent disseminated and stringer pyrite in a matrix of black chlorite and quartz. Quartz, chlorite and minor calcite gangue in places constitute up to 80 to 90 percent of the zone. Chalcopyrite is a minor constitutent in these lenses and occurs as blebs and stringers within the pyrite. Copper assays up to 2 percent, traces of galena and sphalerite, and silver values have been reported (Barbour and Thurlow, 1982).

A gradational, hydrothermal alteration envelope surrounds the mineralization. The rocks structurally underlying the mineralization to the north display varying degrees of chloritization, sericitization, pyritization and silicification. Minor quartz and calcite veinlets occur locally. To the south, the rocks structurally overlying the mineralization are also variably chloritized, sericitized, pyritized and silicified. Chlorite alteration appears to be slightly more strongly developed than the other alteration types. Coarse grained,

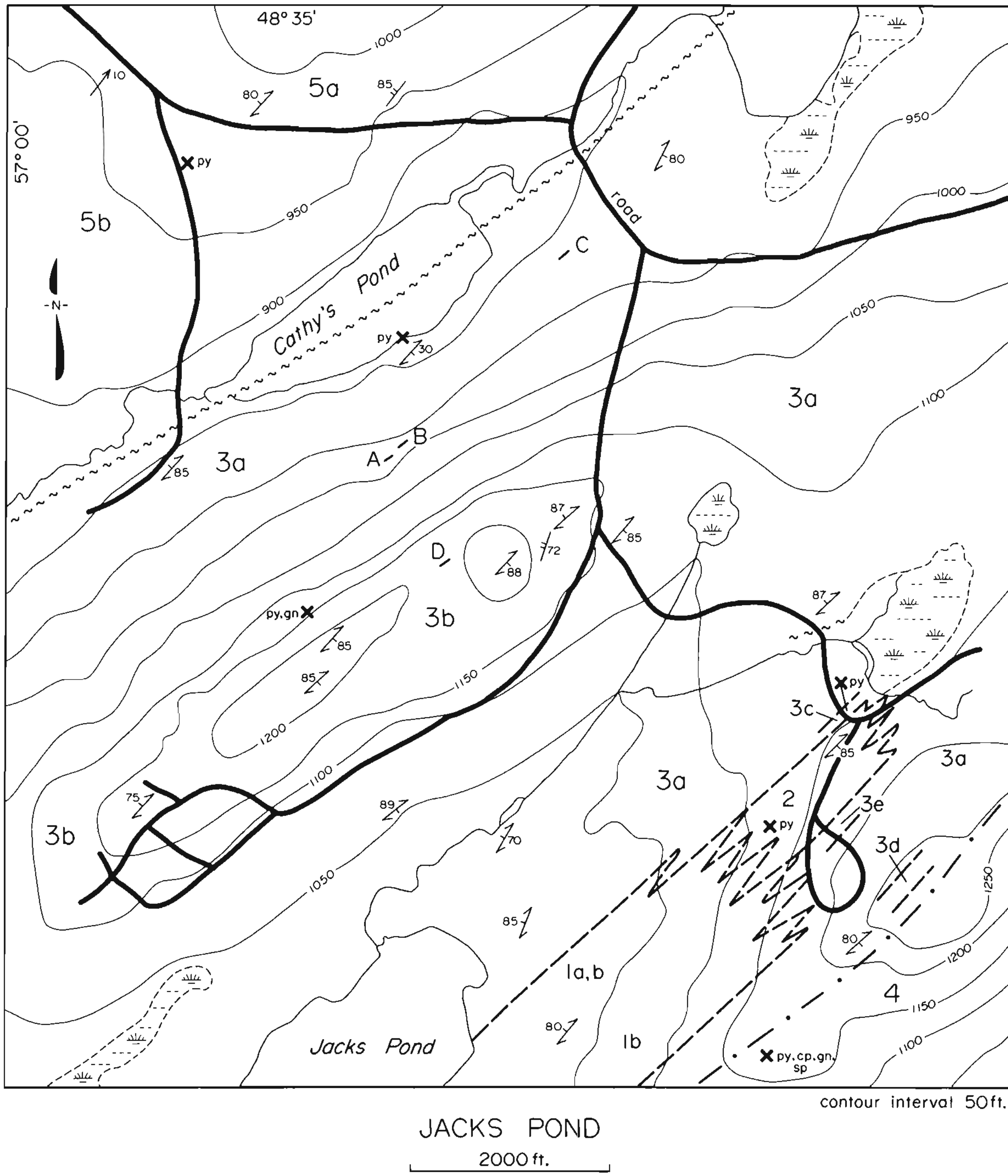

Figure 2: *Geology of the Jacks Pond area.*

LEGEND

MIDDLE ORDOVICIAN OR EARLIER

5	5a, felsic, pyroclastic breccia with matrix of feldspar crystal tuff; 5b, carbonate-rich, felsic, lithic, lapilli tuff.
4	Silicified, quartz crystal tuff.
3	3a, felsic, quartz (± feldspar) crystal tuff; 3b, silicified felsic tuff; 3c, felsic breccia and crystal tuff; 3d, coarse grained, quartz crystal tuff; 3e, dolomite and dolomitic tuff.
2	Felsic quartz crystal tuff and crystal-lithic tuff.
1	1a, chloritic mafic flow (?), locally containing calcite amygdules; 1b, mafic tuff.

granular and euhedral pyrite occurs as disseminations and stringers throughout the rocks and locally reaches up to 80 percent; chalcopyrite values up to 5 percent have been reported (Barbour and Thurlow, 1982). The pyritic stringers may also contain quartz and chlorite and vary in thickness from 1 cm to 1 m. Quartz veining is also developed.

The alteration varies in intensity and does not appear to be stratigraphically controlled; however, in places the silicification appears to be more strongly developed in the structural footwall. The stratigraphic footwall cannot be definitely determined on the basis of alteration. The limited available evidence suggests that these lenses could be part of a hydrothermal alteration system or stockwork, rather than exhalative or massive sulfides.

The second type of mineralization, represented by lenses C and D, has a syngenetic aspect to it. The C lens consists of massive, fine grained, saccharoidal pyrite, with quartz generally present as gangue. Chalcopyrite occurs as a minor constituent in the pyrite, and traces of sphalerite and galena are present. There is no well defined banding or layering and the lens has a massive appearance suggestive of a syngenetic origin. Contacts with the host rocks are sharp.

The structural hangingwall to the C lens consists of gray to green tuff and lapilli tuff that are sericitized, veined by quartz and moderately pyritized. Small feldspar crystals occur locally. The structural footwall consists of moderately sericitized tuff and lapilli tuff. Quartz veining and pyrite stringers are generally present. A unit of aphanitic, amorphous, green to gray vitric rock is present in the deeper levels of the footwall. This rock is locally feldsparphyric and is transected by seams of green and yellow sericite. It may be part of a rhyolitic dome structure.

The D lens consists of zones of fine grained, locally layered, massive pyrite, with some zones displaying clastic textures. Clasts consist of pyrite and minor chalcopyrite, and felsic volcanic rocks. The sulfides are in gradational contact with overlying tuffaceous rocks, marked by a decrease in the amount of sulfide clasts and sulfide in the matrix. The D lens is in sharp contact with structurally underlying rocks. The lens contains minor chalcopyrite and traces of sphalerite and galena.

The structural hangingwall to the D lens consists of white, bleached, silicified rhyolite and felsic tuff, cut by quartz veinlets and pyrite stringers and disseminations. The structural footwall consists of gray, sericitic tuff with pyrite and sericite veinlets.

C and D lenses are interpreted to be syngenetic massive sulfides deposited on the surface at the rock/water interface. The D lens consists of detrital sulfide fragments, thus supporting the conclusion of Barbour and Thurlow (1982) that, at least in part, it was mechanically transported.

Cathy's Pond showing. This prospect, discovered during the current study, forms a small, partially submerged, exposure on the south shoreline of Cathy's Pond. It consists of fine to medium grained, semi-massive to massive, banded pyrite with a quartz gangue. It occurs in highly silicified and bleached quartz-feldspar crystal tuff.

Side of the Hill showing. This prospect, also discovered during the current study, occurs on the southwest side of the hill to the east of Jacks Pond. It consists of disseminations and patches of pyrite, chalcopyrite, galena and sphalerite in bleached, sericitic quartz-crystal tuffs. The sericitic zones are generally white weathering but in places are hematitic and rusty weathering. The mineralized, sericitized volcanic rocks form narrow zones up to 1.5 m wide in highly silicified, massive looking, quartz crystal tuffs.

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REFERENCES

Barbour, D. M. and Thurlow, J. G.
1982: Case histories of two massive sulphide discoveries in central Newfoundland. *In* Prospecting in areas of glaciated terrain. *Edited by* P.H. Davenport. Canadian Institute of Mining and Metallurgy Geology Division, Montreal, pages 300-320.

Kean, B.F. and Evans D.T.W.
This volume. Metallogeny of the Tulks Hill volcanics, Victoria lake Group, central Newfoundland

Kean, B. F. and Jayasinghe, N. R.
1980: Geology of the Lake Ambrose (12A/10) - Noel Paul's Brook (12A/9) map areas, central Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 80-2, 29 pages.

1982: Geology of the Badger map area (12A/16), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 81-2, 37 pages.

Swinden, H. S. and Thorpe, R. I.
1984: Variations in style of volcanism and massive sulfide deposition in early to middle Ordovician island - arc sequences of the Newfoundland Central Mobile Belt. Economic Geology, Volume. 72, pages 1596-1619.