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Preliminary Report on the

Lake Massawippi Area

(Orford County)

by

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## INTRODUCTION

The lake Massawippi area lies in the southern part of the Eastern Townships, at about 136 km ESE of Montreal and 20 km SSW of Sherbrooke, covering about 165 square kilometers, and bound by latitudes  $45^{\circ}10'$  and  $45^{\circ}17'$ , and longitudes  $71^{\circ}58'$  and  $72^{\circ}06'10''$ . With lake Massawippi in its centre, the area is located entirely within Hatley township of Orford county, and is covered by the Coaticook, Memphremagog, Sherbrooke and Orford 1/50,000 topographic sheets.

The Massawippi lake area consists mostly of farm land and deciduous bush, with Ayer's Cliff, North Hatley, Ste. Catherine and Massawippi being the main centres of population. Ready access is available by Highway 55 linking Magog with Stanstead, as well as a network of good gravel roads.

Physiographically, the Massawippi lake area consists of gently rolling hills characteristic of the Stoke Mountains in this part of the Appalachian Highlands. Relief is moderate varying from 175m at lake Massawippi to 466m in several hills immediately west of it. The main water bodies include lake Massawippi and part of lake Magog, as well as the Massawippi, Magog and Tomifobia rivers.

Mapping was carried out in the summer of 1974 at a scale of 1/12,000 to locate and evaluate the southeastern extension of the Weedon-Stoke Mountain volcanic belt. The work is the continuation to the southwest of the mapping carried out by R. Lamarche (1965).

Outcrop density is poor to moderate, except along Highway 55 where excellent sections are found. However, general lack of marker horizons and monotonous lithology, as well as structural complexity arising from polyphase deformation make geologic interpretation difficult.

#### GENERAL GEOLOGY

Lying within the western part of the Appalachian foldbelt, the geology of the Lake Massawippi area consists of northeast trending intensely deformed, slightly metamorphosed detrital rocks and pelites with intercalated volcanics and pyroclastics, adjoining a wide belt of carbonate rocks. Igneous rocks include patches of altered granite and peridotite lenses as well as carbonatized dikes and lamprophyres.

The following three lithologic units, each representing separate tectonic belts, are present in the area: 1) the Ascot Formation, which is part of the Quebec Group and of the Stoke Mountain Complex of Lower Ordovician to Cambrian age, 2) the Middle Ordovician Magog Group belonging to the St. Victor Synclinorium, and 3) the Siluro-Devonian rocks of the St. Francis Group forming part of the Gaspé-Connecticut Valley Synclinorium.

The structural history of the area is complex. While at least three or possibly four phases of deformation have affected both the Ascot and Magog rocks, the effects of only two phases are apparent in the Siluro-Devonian St. Francis Group. The prevalent northeasterly trending tectonic grain is mainly controlled by two large anticlinal

TABLE OF FORMATIONS

Pleistocene		-Fluvioglacial sands and gravel
ANGULAR UNCONFORMITY		
Post-Devonian		-Lamprophyres carbonatized dikes (12)
ANGULAR UNCONFORMITY		
Siluro-Devonian	St. Francis Group (Gaspé Connecticut Valley Syn- clinorium)	-siliceous argillaceous and carbonaceous limestone; graphitic limy slate
ANGULAR UNCONFORMITY (?)		
Mid-Ordovician	Magog Group (St. Victor Synclinorium)	-black and grey, dull slate with wacke interbeds; minor felsic tuff
ANGULAR UNCONFORMITY		
Lower Ordo- vician		-gabbro (11) -altered granite (10) -serpentinized peridotite (9) -meta-carbonate rock (8)
Cambrian to Lower- Ordovician	Ascot Formation	<p style="text-align: center;">Bunker Hill Unit (5)</p> <ul style="list-style-type: none"> <li>-conglomerate and wacke; minor siltstone and felsic tuff (5a)</li> <li>-mauve and beige chert I (5b)</li> <li>-felsic tuff; minor sericite schist (5c)</li> <li>-meta-andesite and intermediate to basic tuff (5d)</li> <li>-felsic tuff (5e)</li> <li>-mauve chert II (5f)</li> <li>-felsic tuff; welded tuff; felsic agglomerate (5g)</li> </ul> <ul style="list-style-type: none"> <li>-wacke, shale, slate and metasiltstone with interbedded felsic tuff (4)</li> <li>-boulder conglomerate, coarse wacke and micro-conglomerate; graphitic siltstone; minor rhyolitic and lithic tuff interbeds (4a)</li> <li>-rhyolitic tuff; lithic and felsic tuff (4b)</li> <li>-black shale and metasiltstone; minor phyllitic slate and chert; felsic tuff (4c)</li> <li>-wacke with interbedded shale and siltstone; felsic and crystal tuff (4d)</li> </ul> <ul style="list-style-type: none"> <li>-phyllite and slate with metasiltstone; laminated pyroclastic rocks and sericite schists; rhyolitic and felsic tuff (3)</li> <li>-phyllite, phyllitic slate and metasiltstone; graphitic siltstone; minor felsic, laminated tuff (3a)</li> <li>-felsic lithic tuff (3b)</li> <li>-grey limestone (3c)</li> <li>-rhyolite and rhyolitic tuff; minor laminated and crystal tuff; sericite schist (3d)</li> <li>-laminated pyroclastic rocks (aqueous); minor phyllite, sericite schist and metasiltstone rhyolitic and felsic tuff (3e)</li> </ul>

folds. These are parallel to each other and are the products of separate deformations. Various generations of mesostructures and associated folds have their particular style and orientation.

Small, irregular bodies of altered granite and peridotite represent early intrusions into Cambro-Ordovician rocks, while carbonatized dikes and lamprophyres cut across all the other rocks.

Several, large pits of sand and gravel of fluvioglacial origin are concentrated in the central part of the area.

#### ASCOT FORMATION

The belt underlain by the Ascot Formation covers about 60% of the area. Trending northeast, it varies from 5 to 8 km in width and is exposed entirely west of lake Massawippi. Contact relations with the Magog Group to the northwest and the St. Francis rocks to the southeast are not clear. Due to similar lithology and scarcity of outcrop, the position of the contact trace with the Magog Group will certainly have to be revised in the near future.

The rock units making up the Ascot Formation in the area are subdivided into three main groups. Referring to the table of formations, these are: 1) phyllite and slate with metasiltstone; laminated pyroclastic rocks and sericite schist; and rhyolite and felsic tuff, 2) wacke, shale, slate and metasiltstone with interbedded felsic tuff, and 3) the Bunker Hill unit composed of conglomerate, wacke, chert, meta-andesite and tuff. Since contacts between the units are entirely

gradational and no paleontological evidence is available, their age relationships are unknown. Interfingering between the first two units suggests an age similarity. It is believed, however, that the phyllites and sericite schists underlying the hills west of lake Massawippi are in part stratigraphically below the clastic rocks. In any case, both units are structurally above the Bunker Hill assemblage.

Phyllite and slate with metasilstone; laminated pyroclastic rocks and sericite schists; rhyolitic and felsic tuff

The dominant rock types of this group are phyllites, slate and metasilstone. Underlying the area between Magog and Massawippi lakes, they are typically dark and graphitic, and are derived from essentially argillaceous rocks. Sections made up of uniformly laminated pelitic and silty fractions probably represent aqueous tuffs or recycled pyroclastic material. By increased transposition laminated tuffs grade imperceptibly into pelitic and sericite schists.

Two large areas east and southeast of Ste. Catherine are underlain by felsic volcanics. The rhyolite is a blueish-grey very fine-grained and tough rock generally traversed by abundant and irregular quartz-filled fractures. At some places, the rock is cream-coloured or beige, with porous laminae alternating with layers showing flow structures. Clear and angular quartz phenocrysts stand out in a fine-grained kaolinized groundmass. These have been interpreted as rhyolitic tuffs.

Two isolated beds of grey-blueish arenaceous limestone were observed about 3 km northeast of Ste. Catherine. They are not continuous.

Wacke, shale, slate, and metasilstone, with interbedded felsic tuff

A 7,2 km wide belt of impure, slightly metamorphosed detrital rocks and interbedded tuff is exposed northwest of Ayer's Cliff. The texture varies greatly from place to place. The predominant rocks are subgreywackes grading into argillaceous sandstones and sandy argillites interbedded with shales and phyllitic slates. Locally the phyllitic material is characterized by dark-grey siderite rhombs; the porphyroblasts are post- $S_2$  foliation and probably syntectonic with  $S_3$ . Some wackes contain a considerable proportion of black subrounded shale and sandstone fragments and represent true microconglomerates.

Of some interest are some conglomeratic horizons spread over a 0,8 km zone crossing Highway 55. The beds are discontinuous containing subangular sandstone and shale clasts varying from 1 to 5 cm across. Particularly conspicuous is a 15 m wide zone of oligomictic conglomerate well exposed on both sides of the above highway, about 3 km northwest of Ayer's Cliff. The clasts are generally composed of medium-grained impure sandstone from one cm to one or two meters in diameter. At one place, the 1,5 m-wide subangular fragments of the boulder conglomerate are slightly oriented and are embedded in a microconglomeratic and silty matrix.

Occasionally, the matrix contains specks of bright green minerals analyzed to be chromiferous (?) chlorite and fuchsite. This would suggest an early origin for ultrabasic rocks in the region. The isolated occurrence of the boulder conglomerate, the size and shape of the fragments, and their slight preferred orientation suggests emplacement by submarine slumping.

The felsic tuffs are discontinuous lenses varying from a few to several tens of meters in width and traceable over short distances. Typically, it is a beige to cream-colored, hard, massive or laminated rock, pitted at places, and containing angular quartz grains. In composition and field appearance they are undistinguishable from felsic pyroclastic rocks in other belts. However, the tuff in the zone farther north contains a higher proportion of sericite thereby resulting in a more pronounced foliation.

Bunker Hill Unit: wacke, conglomerate, chert, meta-andesite and tuff

The Bunker Hill unit, named after the northeast trending ridge 3 km west of Ayer's Cliff, is exposed in two small areas in the diagonally opposite, extreme southwest and northeast corners of the map-area. Both areas form the axial part of the same major northeast trending  $F_2$ -antiform paralleling the western edge of Massawippi lake. Plunge reversals of the fold axis could explain the absence of Bunker Hill rocks in the area between the northern and southern tips of the lake.

Part of the Bunker Hill stratigraphic succession is well shown in a small quarry located 160 m south of Highway 50, a point 1 km west of the Highways 50/55 intersection. From older to younger, the succession consists of meta-andesite or meta-basalt and mafic pyroclastics, followed by banded felsic and rhyolitic tuff, a mauve and beige chert I, an oligomictic conglomerate and a discontinuous tuff lens. Close-spaced traverses revealed that structurally and probably stratigraphically below the meta-andesite are a felsic tuff horizon, a mauve chert II, and finally another felsic tuff.

Metamorphic alteration has brought about great textural variations in the volcanic rocks. At some places, chlorite-rich pockets are associated with irregular concentrations of coarse amphibole and sodic feldspar. At others, distinct laminations indicate the presence of mafic pyroclastics. The overlying felsic tuff is typically beige or shows pink and greenish bands. The glassy and angular quartz grains are clearly visible in the mat and opaque matrix of deeply kaolinized feldspars. At places, massive and tough layers of aphanitic material represent rhyolitic tuffs. Above the pyroclastic rocks is a 15m-thick, steeply southeast dipping zone of mauve and purple chert. Thin, dark brown streaks and swarms of oval lenses a few mm in length and paralleling an early foliation ( $S_1$ ) are typical. Identical rocks have been identified as manganiferous cherts in the Sherbrooke area (Lamarche, oral comm., 1974). Impure

sandstones with conglomeratic pockets showing younging to the southeast are probably the uppermost members of the Bunker Hill unit. The elliptical clasts, strikingly uniform in size and shape, are mostly composed of shale and sandstone, and clearly lie within the early foliation. Their long axes, varying from 1 to 5 cm in length, are parallel to the  $S_0S_1-S_2$  intersection producing the  $L_2$ -lineation. Here too, specks of fuchsite and chromiferous (?) chlorite are present in the matrix.

Part of the Bunker Hill sequence is also exposed in the nose of the plunging  $F_2$ -fold recorded by R. Lamarche (1965), west of the northern extremity of Lake Massawippi. Here, meta-volcanics are successively overlain by felsic tuff, mauve chert II and felsic tuff, welded tuff and felsic agglomerate.

#### MAGOG GROUP

Rocks of the Magog group are exposed in a wide belt in the northwest corner of the area. The contact with the underlying Ascot Formation has nowhere been observed; based on previous work farther north it is assumed to be unconformable. The writer has placed the contact at the first dominant appearance of shales and slates, which are dull and black, in contrast to the wackes and interbedded phyllitic slates of the Ascot Formation. Although much effort was spent to distinguish the units structurally, no discrepancies were found. The structural inventory, particularly as regards mesostructures, is vir-

tually identical in the Ascot and Magog rocks. In fact, some of the lithologies presently placed by the writer within the Ascot Formation are believed to be typical of those found in the Magog group. (St. Julien and Lamarche, pers. Comm., 1974). Because of outcrop scarcity in the area and the lithological as well as structural similarities the present contact location is tentative and should be redefined in the very near future.

The Magog Group lithology in the area consists of black and grey, dull slates with occasional wacke interbeds and felsic tuff horizons. Some lenses of micro-conglomerate exhibit good grain gradation. At some places, schistose wackes contain black shale clasts up to 5cm in diameter. The pyroclastics are similar in appearance to those found in underlying units. The beds are tightly folded with lineations showing evidence of polyphase deformation.

#### ST. FRANCIS GROUP

All the rocks exposed east of lake Massawippi belong to the St. Francis Group of Siluro-Devonian age. The belt strikes northeast near Ayer's Cliff, then swings to the east, and resumes its original trend south of North Hatley. Although no contact relations could be observed in the area due to lack of exposures in critical areas, evidence from farther north indicates an angular relationship with the underlying Ascot Formation to the west.

In the present area the St. Francis is both lithologically and structurally very monotonous. In fact, no significant or mappable units could be made out, chiefly because of slight compositional differences and extremely gradational contacts. The dominant rock types include light to dark grey silty limestone, argillaceous limestones, and dark-grey limy and graphitic slates. At places, such as on the road-cut immediately west of Ayer's Cliff, the St. Francis Group consists of laminated argillaceous-silty limestones interbedded and grading into limy slates. Other excellent and continuous exposures are observed along Highway 55 west-southwest of the above town.

The St. Francis rocks are tightly folded with clear evidence of two phases of deformation. Closed folds are evident at many places with beds and early cleavage showing moderate to steep dips toward the south and southeast.

#### INTRUSIVE ROCKS

Intrusive rocks are scarce in the area. In order of abundance, they include: ultramafic rocks with associated carbonatized zones, and altered granite, located within the Ascot Formation; some carbonatized dikes and lamprophyres, and a small body of gabbro. Foliations similar in pattern and attitude to those of the enclosing rocks suggest that the intrusions, except the lamprophyre dikes, are early injections, probably pre-Taconic or Lower Ordovician in age. The lamprophyre dikes are believed to be Montereian in age (Early Cretaceous).

### Ultramafic Rocks

Several small, irregular bodies of serpentized peridotite are present. The largest of these, about 1000 m long and 350 m wide, forms a prominent northwest trending escarpment southeast of Ste. Catherine. The presence of two other small peridotite masses in line with the above body suggests emplacement of ultrabasics along a northwest-striking weakness zone. The other four masses, 150 to 500 m long, do not appear to be controlled by fractures; they are clustered in the axial part of a  $F_2$ -antiform, west of the northern end of lake Massawippi.

The rocks are dark green, massive, and are typically fractured with abundant, irregular slickensided and polished surfaces. Locally, discontinuous veins of serpentized and talcose material, a fraction of a cm wide, traverse the rock.

### Carbonatized Zones

Marginal to, and surrounding nearly all ultrabasic bodies, are masses of almost wholly carbonatized peridotite, such as 3 km southeast of St. Catherine, where an oblong, carbonatized body is about 1300 m long and 1 km wide. The rock has a reddish brown weathered surface, that may be up to 6 cm deep, while the fresh surface is generally grey-blue and veined with irregular, buff carbonate stringers. Compositionally, the rock consists almost wholly of iron-magnesium carbonates peppered, at places, with magnetite octahedra, and containing an occasional speck of malachite or fuchsite.

### Altered granite

Two small bodies of altered granite which are probably part of the same mass at depth, are present in the area. Partly underlying the high hill southeast of Ste. Catherine the bodies are intruded into a large mass of rhyolite and rhyolitic tuff, and are elongated parallel to the weakness zone mentioned above.

The rock is beige to light green, depending on the amount of chlorite present, is in many places foliated, and can easily be mistaken for a quartz-sericite schist or a pyroclastic rock. However, local coarse-grained fractions consisting of quartz and kaolinized feldspar and minor sericite identify the rock as granite. Although considerably more foliated, it is similar and probably equivalent to the albite granite in the Ascot Corner area, about 30 km northeast of the area (Lamarche, 1967).

### Carbonatized dikes, basic lamprophyres and gabbro

A few dikes and sills, from 1/4 to 2 meters thick and of variable attitude, are found in the area. They weather yellowish-brown and have a light-grey, fine-grained fresh surface. Several steeply northwest dipping dikes have been observed in road cuts of Highway 55, west of Ayer's Cliff. Other carbonatized dikes can be seen in the above-mentioned quarry, 4 km northwest of Ayer's Cliff. Here, the dikes are subparallel to a late cleavage and clearly cut across bedding.

Lamprophyres of basic composition are numerous in the area, and can best be observed in road cuts along Highway 55. Most strike

southeast and are controlled by the prevalent joint system of the region. Generally, they carry large, black amphibole phenocrysts embedded in a dark grey, fine-grained matrix of feldspar and ferromagnesian. They are probably camptonites.

Recently, an absolute age was obtained by the G.S.C. Lab. from a similar lamprophyre dike intersected in an exploratory drill hole at the old Suffield mine, some 4.5 km north of North Hatley. These whole rock, K-Ar determinations yielded an average age of 126.1 m.y.  $\pm$  1.2 m.y., corresponding to the Early Cretaceous age of the Montereian Plutonic Series to the west (Lamarche, written comm., 1975).

A small exposure of coarse-grained gabbro was observed 4 km east-northeast of Ste. Catherine. It is in contact with a 700 m long body of serpentized peridotite with which it is presumably genetically associated.

#### STRUCTURAL GEOLOGY

Rocks of the Ascot Formation and Magog Group in the Massawippi lake area exhibit all the polyphase structures as typically encountered in Cambro-Ordovician tectonites of the Appalachian fold belt. As expected, the structural inventory of the St. Francis Siluro-Devonian carbonates, on the other hand, is more limited. No statistical evaluation of the collected data has been attempted yet, and no final correlation has been made between structures and age of deformation in the three belts. This account is therefore descriptive pending further study.

Except for the extreme southwest and northeast corners, the area lacks marker horizons and there is little stratigraphic control. The following structural evaluation is therefore based on available mesostructures, as observed in the Ascot, Magog, and St. Francis belts.

### Ascot Formation

The most dominant structural features in the Ascot Formation are bedding ( $S_0$ ), and various secondary foliations ( $S_1$ ,  $S_2$ ,  $S_3$ ). Grain gradation is frequently present in the coarse clastics in the southeastern part of the Ascot Formation. Schistosity is everywhere apparent and is formed by orientation of phyllosilicates, and by flattened and elongated grains and clasts. It strikes northeast and its steep to moderate dip varies at many places from southeast to northwest.  $S_1$  is generally subparallel to  $S_0$ , suggesting the presence of isoclinal folds, to which it is axial planar. Only a few  $F_1$ -folds were observed in the field. However, indications of early folding are provided by colour banding or ribbing on some  $S_1$ -planes and clast orientation parallel to  $S_1$ . The resulting  $L_1$ -lineation plunges moderately to steeply to the northeast. In addition, numerous dip reversals of  $S_0$  and  $S_1$  suggest the presence of  $F_1$ -folds. At many places,  $L_1$ -lineation plunges moderately to the east and southeast, suggesting refolded  $F_1$ -fold axes. Sedimentary structures and foliations as well as outcrop pattern suggest that members of the Bunker Hill unit are involved in a large  $F_1$ -structure, 4 km northwest of Ayer's Cliff. It appears that the sequence, as it is exposed in a quarry, is located on the normal flank of a  $F_1$ -syncline, which

itself is refolded into a steeply northeast-plunging  $F_2$ -antiform.

Transposition of  $S_0$ - $S_1$  surfaces, resulting in mesoscopic intrafolial, isoclinal  $F_2$ -folds, is commonplace in the rocks of the Ascot Formation. The accompanying  $S_2$ -foliation is clearly axial planar to minor folds and to crenulations on the  $S_1$ -surfaces. Generally, the attitude of the  $L_2$  lineation is only slightly different from that of  $L_1$ , suggesting that  $F_1$  and  $F_2$ -folds are nearly coaxial. Although  $S_2$  strikes generally northeast, at places, it trends east and southeast, similarly,  $L_2$  locally plunges moderately to the east. Such drastic change in attitude of both  $S_2$  and  $L_2$  is most likely the result of post- $F_2$  deformation. The most prominent  $F_2$  structure is the antiform paralleling the western outline of Massawippi lake. Plunging northeast at the southern extremity of the lake, the fold passes through several culminations and depressions to emerge again in the vicinity of North Hatley.

Structures attributable to the third deformational phase are evident everywhere. The  $S_3$ -foliation, occurring as fracture and crenulation cleavage, cuts across all the S-planes, and dips gently to moderately to the northwest. It is axial planar to shallow northeasterly plunging  $F_3$  folds. These are generally mesoscopic in size and are associated with an  $L_3$ -lineation obviously superposed on earlier linear structures. In general, the attitudes of all the structures attributable to the third deformational phase are strikingly uniform across the whole Ascot belt. Many  $F_3$ -folds are open and have the appearance of chevron or kink folds, the axial plane of which dips consistently to the north-

west. The plane tangent to these folds (Faltenspiegel) generally dips to the northeast. Although several broad flexures appear to be present, the dominant  $F_3$  antiformal axis is located between Massawippi and Magog lakes and trends northeast, parallel to the regional tectonic grain.

#### Magog Group

Since the position of the contact between the Magog and Ascot rocks is still uncertain, a full evaluation of the structural inventory of the Magog is not yet possible. Exposures along Highway 55, immediately south and farther north of the Ste. Catherine-Magog overpass show evidence of only two deformations. The style and orientation of foliations and folds indicate that the structures are genetically equivalent to those associated with the second and third deformational phases found in the Ascot rocks. However, evidence of three generations of structures has been observed in undisputably Magog rocks recently exposed on road cuts 6300 and 8200 m east of St. Elie d'Orford, about 20 km north-northeast of the map-area.

#### St. Francis Group

Evidence of two deformational phases is present in the St. Francis rocks. Tight, similar-type and symmetrical, mesoscopic folds are abundant. South of Massawippi lake, their axial planes strike northeast and dip steeply northwest, with fold axes plunging northeasterly at  $60^\circ$ . Forming a large Z-shaped flexure, the folds resume their northeast trend north of Massawippi village, with axial lineations plunging moder-

ately east. The fold pattern and orientation indicate that the above structures are coeval with  $F_2$  folds of the Ascot belt.

An omnipresent second foliation parallels the axial planes of broad flexures that deform the above folds. Excellent examples of refolded folds can be observed on road cut exposures 2 km west of Ayer's Cliff town centre. Their axial plane has a consistent northwesterly dip. While the second foliation is equivalent to the  $S_3$ -cleavage, the flexures associated with it are coeval with the  $F_3$ -folds encountered in the Ascot belt.

Based on the observations above, the  $F_2$  and  $F_3$  structures of the Ascot belt are likely to be of the same generation as the fold structures encountered in the Siluro-Devonian St. Francis rocks. They are probably products of the Acadian orogeny. This is essentially in agreement with the results of structural work carried out recently by S. Robinson (1974). Furthermore, it is probable that the  $F_1$  structures observed in the Magog and Ascot belts, but absent in the St. Francis rocks, are associated with the Taconian deformation.

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### Joints and faults

A prevalent set of 120° to 140° striking and steeply dipping joints has controlled the emplacement of most lamprophyre dikes. Less well-developed joints trend northeast with moderate dips to the southeast.

Although there is no positive evidence of translation, the conspicuous escarpment and the presence of aligned ultrabasic bodies suggest a northwest-trending weakness zone southeast of Ste. Catherine. Similarly, the wide valley adjoining the Bunker Hill escarpment to the southeast, may be the site of a strike fault. The marked break in slope between Massawippi lake and Fitch Bay, a distance of almost 10 km, possibly suggests an important zone of dislocation.

### PLEISTOCENE

Extensive deposits of glaciofluvial gravel and sand are concentrated in a 2 km<sup>2</sup> area, 3 km southwest of Ste. Catherine, where

large pits have been opened up to serve local needs.

Glacial striae suggest a 130° to 165° ice movement.

### ECONOMIC GEOLOGY

#### Copper

A copper-bearing showing is located in Range VI, lot 13, on the farm of J.B. Marticorena about 3,7 km in an azimuthal direction of 145°-148° from Ste. Catherine, Mineralization consists of specks or small clusters of chalcopyrite, bornite, pyrrhotite and malachite irregularly disseminated in a 1-meter wide zone paralleling the main foliation. The host rock is grey rhyolitic and laminated tuff, the foliation of which strikes 355° dipping 55° east. A 30 m long and 2 m wide trench has been blasted parallel to the foliation.

A grab sample of the mineralized rhyolitic tuff assayed 1.61% Cu. A sample from one of the shallow pits about 150 m northeast of the trench analyzed 0.15% Cu. Apparently, the area has been examined by McIntyre Porcupine Mines Limited reporting 1.5% Cu and lower values. According to Mr. Marticorena, an Ontario based company has done 700 meters of drilling. Finally, SOQUEM optioned the property in 1967, but its results were inconclusive. In 1971, an Ecole Polytechnique lab. analysis reported Ni values below 0.15%.

There is little doubt that this area is favourable for prospecting. Mineralization lies within a northwest striking, possibly 2 km long weakness zone in close proximity to a granitic body and ultrabasic

lenses that show widespread carbonatization. Certainly structural and lithological controls as well as the assay results are encouraging and warrant further search.

A 1 m wide foliation and carbonatized zone trending 60° and dipping 60° north is located 1 km NNW from a covered bridge near the Highways 50/55 intersection. Mineralization consist of malachite encrustations in cream-colored rhyolitic and laminated tuff. The ochre-colored carbonatized zone also contains irregularly distributed concentrations of a green, flaky mineral, which is probably chlorite. This may indicate the presence of an ultrabasic lens at depth.

#### Quarrying

A small, now inactive, quarry within the Bunker Hill sequence is located 4 km northwest of Ayer's Cliff. Meta-andesite, chert, rhyolitic tuff and conglomerate were extracted previous to 1970 by the Seroc Company of Sherbrooke to provide crushed stone for the Highway 55 construction.

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