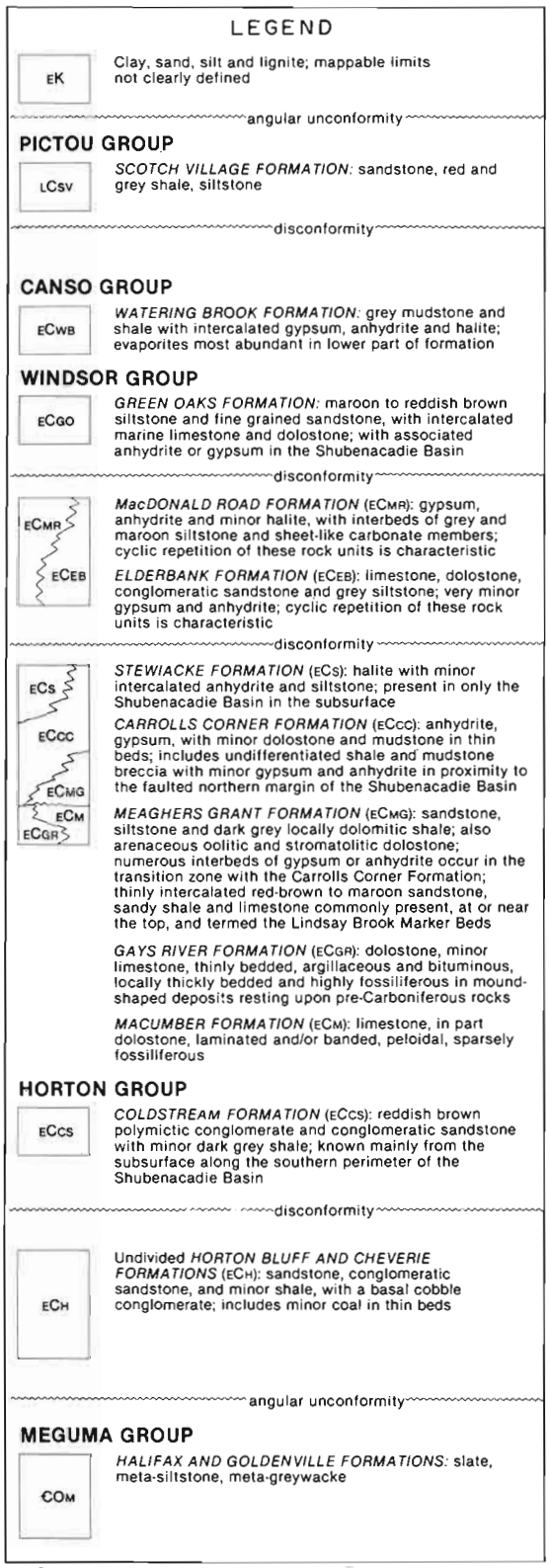
CHAPTER 7. HALIFAX COUNTY



After Giles and Boehner, 1982

Figure 7-1. Geological legend for Halifax County gypsum and anhydrite occurrence maps.

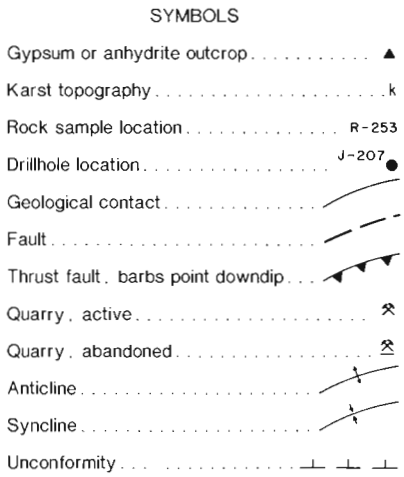


Figure 7-1. Continued.

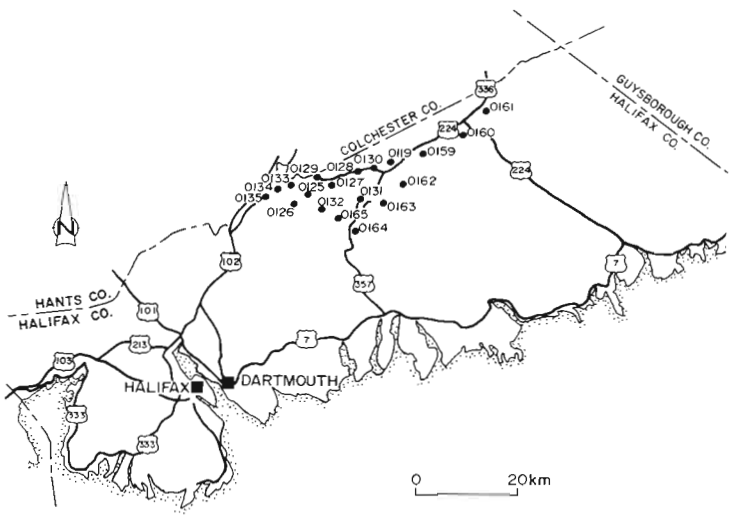


Figure 7-2. Location map for Halifax County gypsum and anhydrite occurrences by reference number.

ANNAND BROOK (0125)
NTS 11D/14C
UTM 472500 E 4982000 N

The Annand Brook occurrence area is located from 1-5 km southeast of the Village of Gays River, Colchester County (Fig. 7-3). It comprises numerous drillhole intersections, as well as an extensive area of karst topography and gypsum/anhydrite outcrop found between Annand Brook and Far Brook.

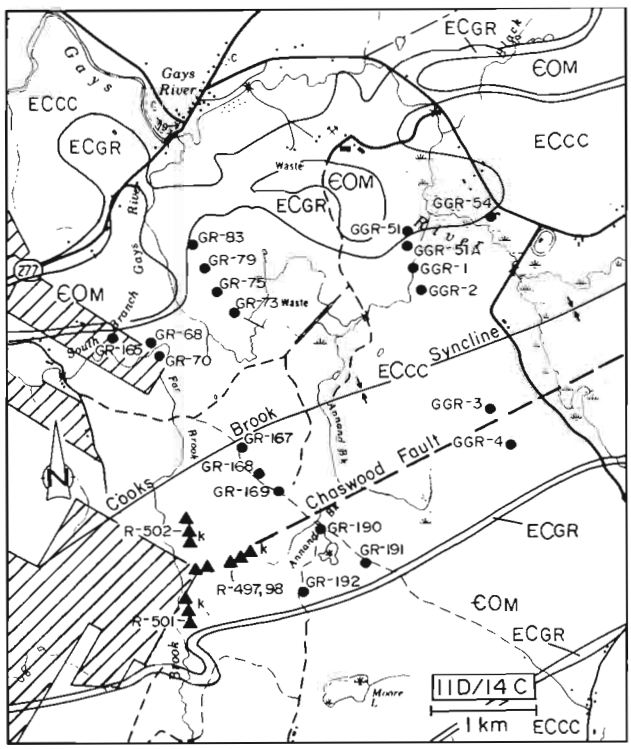


Figure 7-3. Location and geology of the Annand Brook occurrence area. See Figures 7-1 and 7-2 for legend and location.

Regional geological mapping by Giles and Boehner (1982) showed this area as being underlain by the Cycle 1 (A Subzone) Carrolls Corner Formation. This sulphate dominated unit is underlain by the Gays River Formation which overlies metamorphic rocks of the Cambro-Ordovician Meguma Group. The area straddles the Cooks Brook Syncline, a northeasterly trending limb of the Musquodoboit Basin.

At least 20 drillholes have been completed in this area by base metal exploration companies. During 1972-73, Imperial Oil Ltd. drilled 13 holes (Burton, 1974b), and Getty Mines Limited drilled another nine holes in 1973-74 (Comeau, 1973, 1974a). Most of these holes encountered the basal sulphate (Carrolls Corner Formation) before passing through the Gays River Formation carbonate and stopping in the metamorphic basement rocks.

Approximately 40 ha of karst topography with numerous outcrops of gypsum and anhydrite can be found between Annand Brook in the east and Far Book in the west. Karst ranges from light in the east to heavy along Far Brook where sinkholes range up to 25 m in diameter and 10 m in depth. Outcrops contain fine grained, massive, white gypsum overlying light grey to blue-grey, fine grained, massive anhydrite. Hydration ranges from 10->15 m in height in outcrop.

In general, hydration appears to be typical (for Cycle 1 (A Subzone)) in this area, i.e. thickest along the Musquodoboit Basin's margins and thin over most of the area. Exceptions to this are seen in two drillholes, GGR-3 and GR-167, where a deeply hydrated upper portion of 'dirty gypsum' was described in company drillhole records (Burton, 1974b; Comeau, 1973). Hole GGR-3 contains 30.5 m of dirty gypsum with mud and anhydrite interbeds which is overlain by 36.9 m of overburden. In hole GR-167, 40.5 m of variably dirty gypsum was encountered under 16.8 m of overburden. This area is northeast, approximately along strike, of the karst and outcrop area seen east of Far Brook.

The Annand Brook area has good potential for possible gypsum/anhydrite resources. Excellent karst and surface exposure indications as well as drillhole intersections make this area worthy of further exploration.

ANTRIM (0126)
NTS 11D/14C
UTM 468800 E 4980500 N

The Antrim occurrence area is located 3-5 km south of the Village of Gays River, Colchester County (Fig. 7-4). Two areas of karst topography, one with gypsum outcrops, and one diamond-drill hole comprise all of the information currently available on this area. National Gypsum Canada Ltd. has apparently drilled a number of holes in this area, however little of its information is available.

This area includes the western end of the Cooks Brook Syncline as determined by Giles and Boehner (1982). It extends from the Annand Brook occurrence area west to the end of the Syncline. Carrolls Corner Formation sulphates underlie the entire area and are underlain by the basal Windsor Group Gays River Formation. This in turn overlies the metamorphic rocks of the Meguma Group.

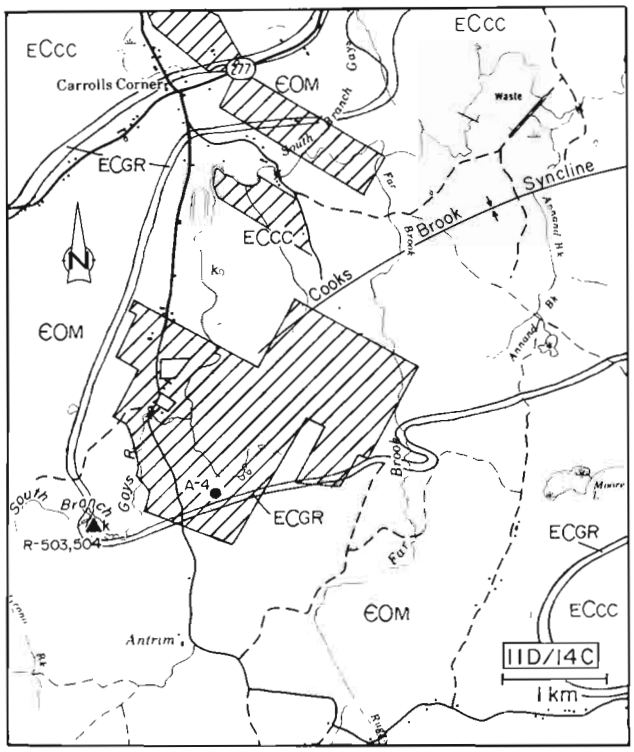


Figure 7-4. Location and geology of the Antrim occurrence area. See Figures 7-1 and 7-2 for legend and location.

Rio Tinto Canadian Exploration Ltd. drilled one diamond-drill hole (A-4) near the southern margin of the basin at Antrim in 1973, as part of a regional base metal exploration program. It intersected 3 m of overburden, 12.2 m of light brown to white gypsum with increasing anhydrite towards the base, before passing into the massive basal anhydrite (Shewman, 1973b).

Several small areas of karst topography can be found in the area, along the western margin of the Cooks Brook Syncline. The only outcrop area found is at the southwestern end of the Syncline on the southern side of the South Branch Gays River. Numerous rounded exposures of fine- to medium-grained, white gypsum are found associated with moderate to heavy karst topography.

This area has good potential for smaller, high purity deposits along the basin margin especially where cross-cutting structures may enhance the depth of hydration in the basal anhydrite. Insufficient information is available at this time to determine the extent of surface hydration, however the thin overburden and moderate gypsum thickness in Rio Tinto Exploration's hole is encouraging for further work.

BLACK BROOK (0129)
NTS 11E/03B
UTM 475000 E 4987000 N

The Black Brook occurrence area is located 3 km northeast of the Village of Gays River, Colchester County (Fig. 7-5). During the early 1970s, this area was the subject of an intense drilling program by Imperial Oil Ltd. in the vicinity of the Gays River mine site. Over 50 drillholes were completed in the area, 20 of which have been used to assess the gypsum and anhydrite resources. Additionally, several gypsum outcrops and a small area of karst topography can be seen along Black Brook.

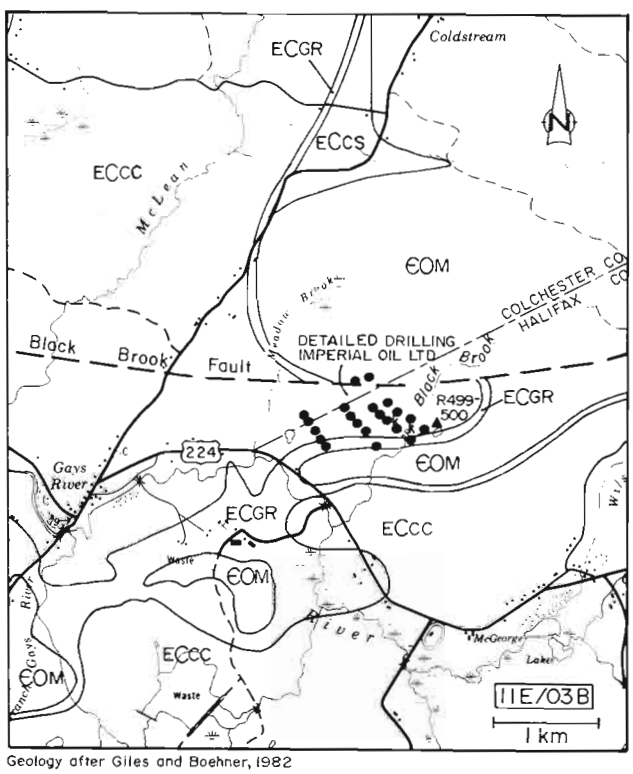


Figure 7-5. Location and geology of the Black Brook occurrence area. See Figures 7-1 and 7-2 for legend and location.

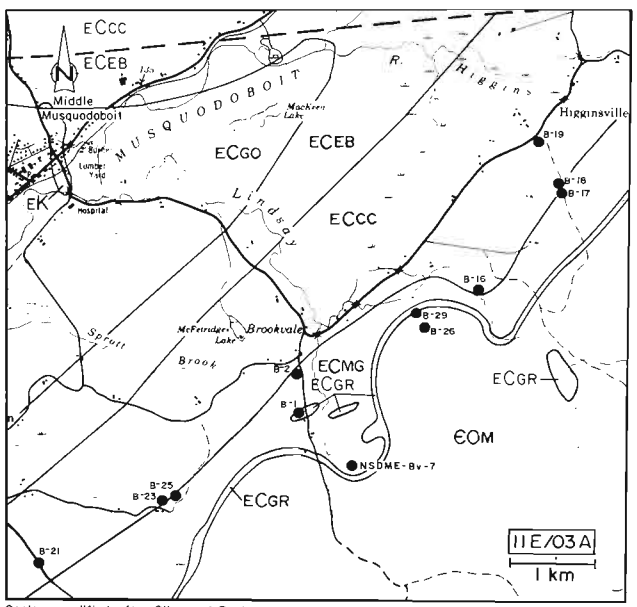
Regional geological mapping by Giles and Boehner (1982) indicated that this area is a small, faulted extension running eastward off the Shubenacadie Basin. It abuts the Pine Grove occurrence area (0123), Colchester County, to the west. Much of the area is underlain, in descending order, by the sulphate dominated Carrolls Corner Formation, by the Gays River Formation and by the Cambro-Ordovician Meguma Group. The Black Brook area is situated in the typical solution trench setting which is well documented elsewhere in the Province (McKay Section (0056), Hants County; Ottawa Brook (0083), Victoria County).

Outcrops in the area consist of fine grained, massive, white gypsum heads up to 10 m in height with minor interstitial, dark grey limestone. These grade to light grey, anhydritic gypsum at their base. Imperial's drilling indicated that, in the subsurface, hydration is restricted to the top 3-6 m of the basal anhydrite (Burton, 1974b). This increases somewhat at the contacts, but no great volumes of gypsum are found in the Black Brook area.

Little potential exists in this area for exploitable gypsum reserves. Large volumes of anhydrite are found underlying a thin cap of gypsum, however this situation is commonplace in this portion of the Shubenacadie Basin.

BROOKVALE (0162)
NTS 11E/03A
UTM 491500 E 4985700 N

The Brookvale occurrence area is located 3 km southeast of the Village of Middle Musquodoboit, Halifax County (Fig. 7-6). This area lies along the southern edge of the



Geology modified after Giles and Boehner, 1982

Figure 7-6. Location and geology of the Brookvale occurrence area. See Figures 7-1 and 7-2 for legend and location.

Musquodoboit Basin, extending between the Elmsvale area (0159) to the northeast and the Murchyville area (0163) to the southwest. No surficial evidence has been noted here, however a number of diamond-drill holes completed by Imperial Oil Ltd. in 1973-74 encountered gypsum and anhydrite (V. Hannon, 1973; P. J. Hannon, 1974b). The drilling was generally carried out near the Basin margin.

Geology mapping by Giles and Boehner (1982) indicated that through this area Windsor Group strata generally strike northeast-southwest and dip gently into the Basin to the northwest. The uppermost units found in the area are the interbedded clastics and carbonates with minor sulphates of the Green Oaks Formation. These overlie the interbedded clastics, carbonates and sulphates of the Elderbank Formation which in turn overlie the sulphate-dominated Carrolls Corner Formation. The Carrolls Corner Formation overlies the Meaghers Grant Formation, a sequence of interbedded clastics and carbonates with minor sulphates which overlies the Gays River Formation basal carbonates. The entire package unconformably overlies metamorphic rocks of the Meguma Group.

Several of Imperial Oil's drillholes collared in the Carrolls Corner Formation and passed through up to 34.4 m of variably impure, selenitic gypsum before entering clastics of the Meaghers Grant Formation below. Accompanying this deep hydration, however, is thick overburden which varies from 23.8-54.3 m over the area. Some shallow holes drilled in the Murchyville area along strike to the southwest did encounter gypsum under thin overburden.

Thus far, no analysis of the gypsum found in the Brookvale area has been undertaken. Drill log descriptions indicated the gypsum encountered to be typical of that seen in some areas where the Carrolls Corner Formation has been moderately disturbed and now consists of variably impure, selenitic gypsum. This area shows good potential with its deep hydration and undeveloped land. The nearest shipping point would be Sheet Harbour which is approximately 60 km to the southeast. Additional drilling could readily determine the quality and extent of gypsum already encountered by Imperial's drilling. Areas having shallower overburden might also be found along strike.

CARROLLS CORNER (0133)
NTS 11E/03B
UTM 469000 E 4985000 N

The Carrolls Corner occurrence area is located 3 km southwest of the Village of Gays River, Colchester County (Fig. 7-7). It lies immediately northeast of National Gypsum (Canada) Ltd.'s East Milford mine site. Although no surface exposures are found in this area, numerous base metal exploration drillholes encountered gypsum and anhydrite at Carrolls Corner.

This area lies along the southeastern margin of the Shubenacadie Basin between the Pine Grove occurrence

area (0123), Colchester County, to the northeast and the East Milford mine site to the southwest. Regional geological mapping by Giles and Boehner (1982) showed the area as being underlain by the calcium sulphate dominated Carrolls Corner Formation which is overlain to the northwest by interbedded carbonates, calcium sulphates and clastics of the MacDonald Road Formation. The Carrolls Corner Formation overlies the basal Windsor Group Gays River Formation carbonate which forms local buildups around Meguma Group basement highs.

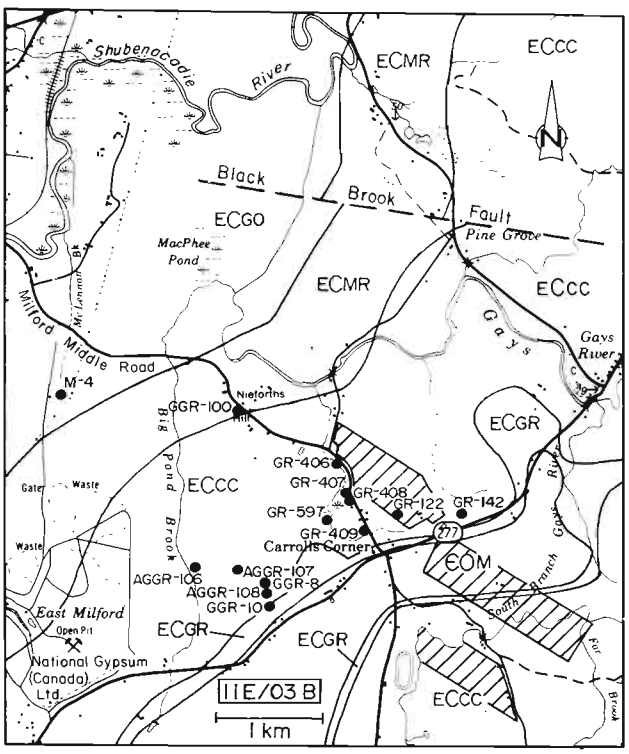


Figure 7-7. Location and geology of the Carrolls Corner occurrence area. See Figures 7-1 and 7-2 for legend and location.

One small sulphide base metal occurrence was reported within the area which probably led to further drilling in the vicinity (Burton, 1974b). At least 31 drillholes have been completed within the Carrolls Corner occurrence area (not all shown on map); all were drilled in the exploration for Gays River type base metal deposits during the early 1970s. Rio Tinto Canadian Exploration Ltd. (Shewman, 1973c) drilled one hole, M-4, 3 km northwest of Carrolls Corner. It encountered Upper Windsor Group clastics and was stopped before encountering any sulphate horizons. Getty Mines Limited drilled five holes in the area (Comeau, 1974-75) and Imperial Oil Limited drilled 25, all in search of base metal mineralization (Burton, 1974b).

Imperial's exploration drilling was concentrated along the Basin margin near the Milford Middle Road, consequently, most of its holes encountered erosionally thinned sections of basal anhydrite capped by thin gypsum horizons. Getty's holes were located further in the Basin and locally encountered the thick hydrated horizon at the boundary between the Carrolls Corner and MacDonald Road Formations which is mined at National's East Milford Quarry. Drillhole AGGR-106 encountered 73.2 m of dirty gypsum overlain by 3.0 m of overburden and hole GGR-100, drilled 1500 m to the north of AGGR-106, encountered 54.9 m of gypsum with clay and anhydrite overlain by 39.6 m of overburden. These sections, as described, resemble the highly disturbed, dark grey, selenitic gypsum mined at the East Milford Quarry.

The Carrolls Corner occurrence area appears to contain an extension of National Gypsum's East Milford Quarry section. Should additional drilling establish this, then development potential would be excellent. Insufficient information is presently available to attempt to determine reserves in this area, although it is believed that they could be substantial.

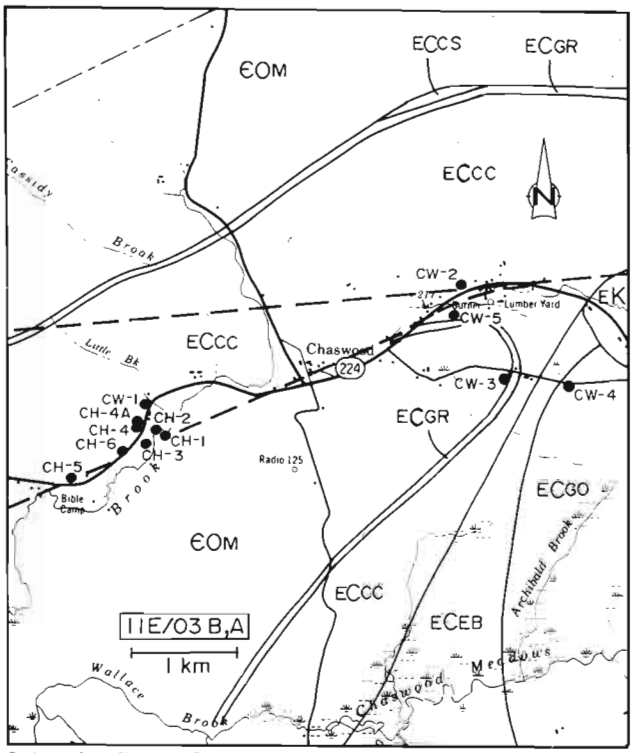
CHASWOOD (0128)

NTS 11E/03B, 11E/03A
UTM 483000 E 4988000 N

The Chaswood occurrence area is found 5 km west of the Village of Middle Musquodoboit, Halifax County (Fig. 7-8). No surficial exposures of gypsum or anhydrite were found in this area, although some hummocky terrain may be attributable to underlying karst. All data available for the area are derived from drillhole information taken from base metal exploration programs.

The Chaswood area includes the eastern end of the Cooks Brook extension of the Musquodoboit Basin. It lies between the Cooks Brook occurrence area (0127) to the west and the Middle Musquodoboit occurrence area (0130) to the east. Much of this area is underlain by the sulphate-dominated Carrolls Corner Formation. Giles and Boehner (1982) indicated that two major faults run through the area. The sulphates are underlain by the basal Windsor Group Gays River Formation which are underlain by the metamorphics of the Meguma Group.

In 1973, Jorex/Imperial Oil Ltd. drilled five exploration holes (CH-2, -4, -4A, -5, -6) in this area which passed through or into the Windsor Group strata as part of a regional base metal exploration program (Johnston, 1973b). Millmor-Rogers Syndicate also drilled three holes (CW-1, -2, -5) within the Chaswood area that same year (Millmor-Rogers Syndicate, 1973).



Geology after Giles and Boehner, 1982

Figure 7-8. Location and geology of the Chaswood occurrence area. See Figures 7-1 and 7-2 for legend and location.

Logs of these drillholes indicate that in the area of the faults, hydration of the basal sulphate extends down to greater than normal depths. Hole CW-2 encountered 95.1 m of "grey gypsum with a few mud seams," under only 11 m of overburden (Millmor-Rogers Syndicate, 1973). Unfortunately the fault area along the southeastern edge of the Musquodoboit Basin is also deeply karsted and infilled to depths of 91.4 m below surface within a few hundred metres of the thick gypsum sections.

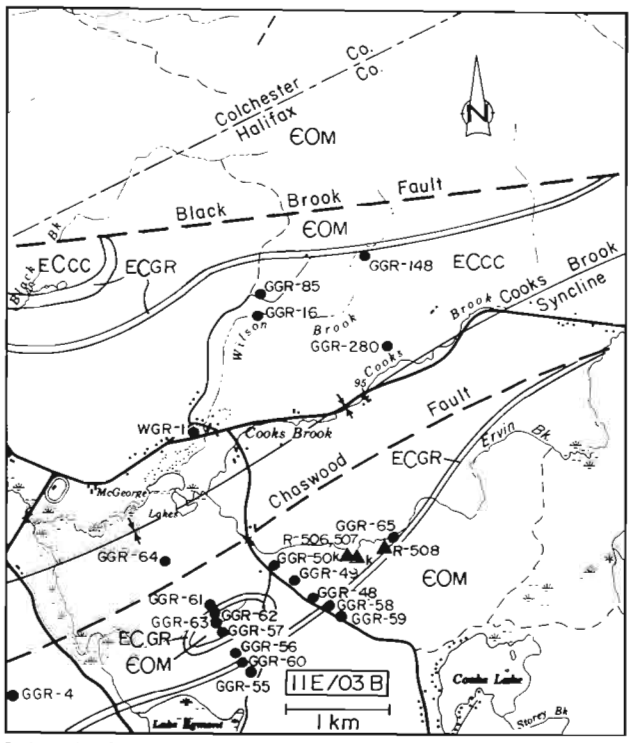
This area holds great potential for considerable reserves of gypsum provided the deep hydration noted in CW-2, CW-5 and CH-6 continues along the faults to the northern side of the Musquodoboit Basin. A small drilling program could readily establish whether this situation exists. The Chaswood area, although 65 km from the shipping facilities at Sheet Harbour, might be amenable to truck haulage.

COOKS BROOK (0127)

NTS 11E/03B

UTM 477900 E 4984400 N

The Cooks Brook occurrence area is located 5 km east of the Village of Gays River, Colchester County (Fig. 7-9). One small area of karst topography with minor outcrops can be found along the southwestern side of Ervin Brook. In addition, a total of 17 diamond-drill holes which have encountered the Windsor Group have been completed in this area.



Geology after Giles and Boehner, 1982

Figure 7-9. Location and geology of the Cooks Brook occurrence area. See Figures 7-1 and 7-2 for legend and location.

This occurrence straddles the Cooks Brook Syncline which runs northeast-southwest through the area. It abuts the Annand Brook occurrence area (0125) to the southwest and the Chaswood occurrence area (0128) to the northeast. Regional geological mapping by Giles and Boehner (1982) indicated that the entire area is underlain by the sulphate dominated Carrolls Corner Formation which is underlain by the Gays River Formation which in turn overlies the metamorphic rocks of the Meguma Group.

Between 1973 and 1975 Getty Mines Ltd. drilled 15 holes in the Cooks Brook area (Comeau, 1973, 1974-75); in 1973 Imperial Oil Limited (Hannon, 1974a) drilled one hole (GR-280); and in 1967 Sedco Exploration drilled one hole (WGR-1) (Nova Scotia Department of Mines, 1967a). The Basin appears to be somewhat shallower in this area than it is to the west in the Annand Brook area (0125) and a basement high parallels the southeastern margin of the Basin. Unfortunately

if either of these factors increased the local depth of hydration, those sections may have been eroded away and the depressions infilled by overburden materials.

The outcrop area along Ervin Brook consists of several small, rounded exposures of white to light brown, fine grained gypsum. Moderate to heavy karst topography can also be found in this area which parallels the Windsor-Meguma contact.

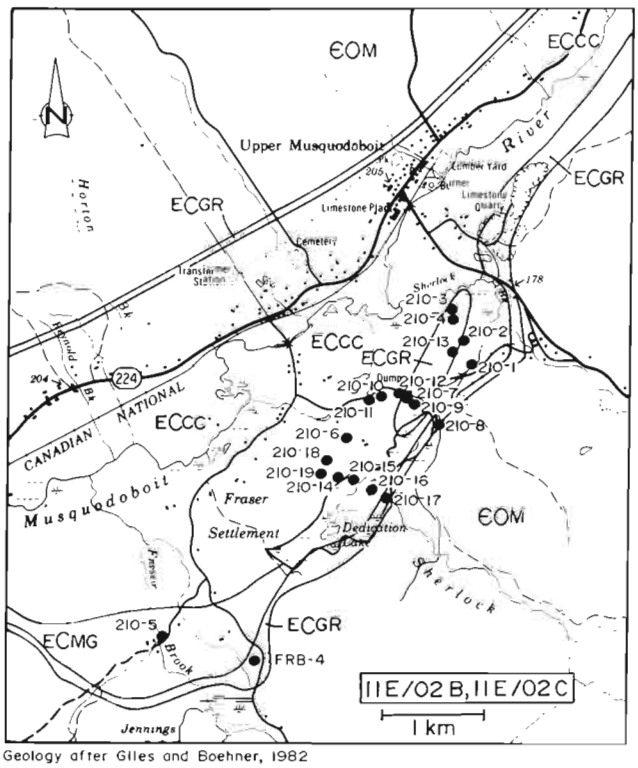
Development potential appears to be quite limited in the Cooks Brook area. Hydrated sections in the drilling are generally <15 m and usually covered by >15 m of overburden. Potential resources may exist along the contact between the Carrolls Corner and Gays River Formations and should be of high purity, but limited volume.

DEDICATION LAKE (0160)
NTS 11E/02B, 11E/02C
UTM 504000 E 4996000 N

The Dedication Lake occurrence area is located 2 km south of the Village of Upper Musquodoboit, Halifax County (Fig. 7-10). Karst topography or exposures of gypsum and anhydrite have not been noted in the area and all the information available for this occurrence is taken from drilling by Noranda Exploration Company Ltd.'s 1974-75 exploration program (Noranda Exploration Company Ltd., 1974; Nash, 1975a).

This area is situated in the northeastern part of the Musquodoboit Basin between the Elmsvale (0159) area to the southwest and the Upper Musquodoboit area (0161) to the northeast. Giles and Boehner (1982) indicated that much of this area is underlain by the sulphate-dominated Carrolls Corner Formation which is underlain to the south by interbedded clastics, carbonates and sulphates of the Meaghers Grant Formation and the basal carbonates of the Gays River Formation. These units generally strike northeast-southwest along the valley of the Musquodoboit River and are underlain by metamorphics of the Meguma Group.

Noranda drilled 19 holes in the area of a Gays River Formation carbonate buildup which occurs on the northern end of Dedication Lake along the southeastern side of the Musquodoboit Basin. No drilling was carried out along the northern side of the Basin within the occurrence area. Although hydration extends as deeply as 167.6 m below surface in the area (hole 210-11) two factors which would inhibit development are obvious from the drillhole information. First, much of the hydrated section of the Carrolls Corner Formation has been removed by erosion. As a result overburden and karst infill material can be as thick as 57.9 m and commonly exceed 30.5 m. Secondly, this dissolution and infilling is also present at depth in drillholes where it has extended downdip to be noted as areas of poor recovery or unconsolidated material underneath competent gypsum units.



Geology after Giles and Boehner, 1982

Figure 7-10. Location and geology of the Dedication Lake occurrence area. See Figures 7-1 and 7-2 for legend and location.

The northern side of the Basin in this area may be underlain by units which have not undergone such extensive dissolution. However, residential development has occupied this portion of the valley and would prevent development. The Dedication Lake occurrence area is of geological interest only. Should these units be less eroded along strike to the northeast or southwest then they may have the potential for development.

DUTCH SETTLEMENT (0135)
NTS 11D/14C, 11E/03B
UTM 465000 E 4982500 N

The Dutch Settlement deposit area is situated southwest of the East Milford deposit area (0134) and National Gypsum (Canada) Ltd.'s mine site (Fig. 7-11). Much of the area is held by Fundy Gypsum Canada Ltd. who are presently proposing to develop the deposit in the near future under the name of the Nova Scotia Gypsum Company.

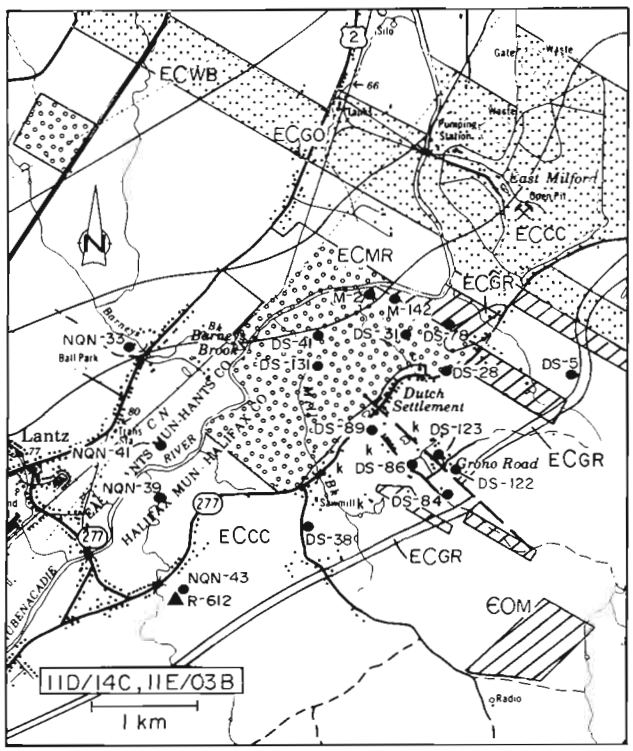


Figure 7-11. Location and geology of the Dutch Settlement occurrence area. See Figures 7-1 and 7-2 for legend and location.

Fundy acquired fee simple holdings as well as leases in this area during the early 1950s, about the same time as National began to develop the East Milford Quarry. Little work had been done on the property until the early 1980s when drilling programs were undertaken to delineate gypsum reserves in the area. Unfortunately, none of the company's information is available at this time. A number of base metal exploration drillholes, however, were put down in this area during the early 1970s by Amax Exploration Inc. and Rio Tinto Canadian Exploration Ltd. (Amax Exploration Inc., 1974e; Lebel, 1974b; Shewman, 1973c). Information from these drill logs is the only available data to describe the deposit.

The Dutch Settlement area lies along the southeastern flank of the Shubenacadie Basin (Giles and Boehner, 1982) which trends roughly northwesterly through the area. Most of the area is underlain by the Cycle 1 (A Subzone) sulphate-dominated Carrolls Corner Formation which is underlain by the basal Windsor Group Gays River carbonate to the southeast. Similar to the East Milford deposit, the Carrolls Corner Formation is overlain to the northwest by the interbedded carbonates, clastics and sulphates of the MacDonald Road Formation. A pronounced basement high approximately 150 m in width with carbonate buildup with associated base metal deposits, similar to the Gays River lead/zinc deposit, runs approximately northeast-southwest through this area, slightly north of Route 277, over a distance of 2000 m at the northwestern end of the area. This feature was extensively drilled by Amax Exploration Inc. (1974e) and may extend further to the southwest, however insufficient drillhole information is available to delineate it further.

More than 37 holes were drilled in this area, one by Rio Tinto (M-2) (Shewman, 1973c), the rest by Amax between 1973 and 1975. Most of these holes are concentrated around the basement high, the rest are scattered through the area. As at East Milford, the thick gypsiferous section appears to occur in a highly disrupted horizon at or near the base of the Cycle 2 (B Subzone) of the Windsor Group. The hydrated section varies from 30-90 m in thickness with abundant (10-30%) intermixed clay and carbonate material. Overburden also varies between 5 and 15 m in thickness and probably averages 10 m in thickness. Hydration appears to thin over the basement highs, however these are coincident with inhabited areas making development impossible.

Gypsum reserves in the Dutch Settlement area, located between Route 277 and the Shubenacadie River on property held by Fundy Gypsum could exceed 50 Mt depending on cultural and mining constraints. Additional reserves are located east of Route 277 towards the Basin margin, however residential development is rapidly encroaching in this karst area with ground of questionable stability. The hydrated section gradually thickens to the west and northwest away from the basement high. The thickest section is in hole DS-131 where 103.6 m of dark grey gypsum with minor intermixed clays is overlain by 9.1 m of overburden (Roth and Lebel, 1975a).

Geologically, the Dutch Settlement area is very similar to the East Milford deposit and appears to have excellent potential reserves of quarriable gypsum. Much additional information is required to more accurately assess the quantity and quality of the gypsum identified in the area. One major concern in this area which might hinder future development by Fundy Gypsum is the rapid residential development of the surrounding area. Resource sterilization in this area as well as in the northeastern continuation of the potential mining zone toward Carrolls Corner is a significant concern.

EAST MILFORD (0134)
NTS 11E/03B
UTM 467000 E 4984000 N

Gypsum has been produced at the East Milford site by National Gypsum (Canada) Ltd. since 1955 (Fig. 7-12). Exploration began on the site in July 1951 and by the fall of 1953 a decision had been made to develop the deposit. This project consolidated National's operations in the Province by replacing its production from sites at Walton (0179), Hants County, and Dingwall (0048), Victoria County. Quarry facilities at East Milford and load-out facilities at Wrights Cove on Bedford Basin were operational by 1955 (Nova Scotia Department of Mines, 1955).

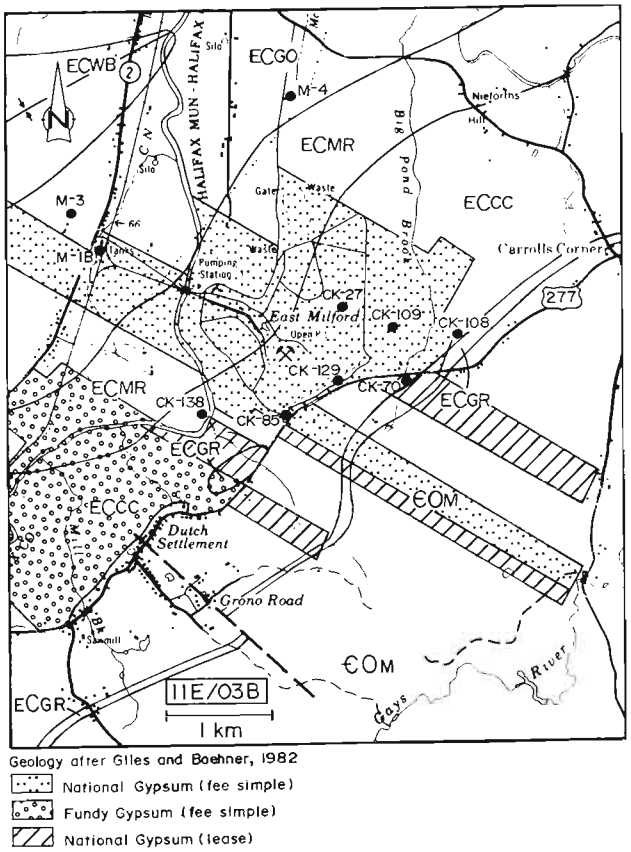


Figure 7-12. Location and geology of the East Milford occurrence area. See Figures 7-1 and 7-2 for legend and location.

Between 1955 and 1987 a total of 64 644 677 t were produced at the East Milford Quarry (total from Nova Scotia Department of Mines and Energy, Annual Reports, 1956-1988). It is believed to be the most productive open-pit gypsum mine in the western world. Gypsum from the Quarry is shipped by rail 42 km to load-out facilities on Bedford Basin. Ocean-going vessels transport the material to markets in Central Canada and the Eastern United States from Portsmouth, New Hampshire, to New Orleans, Louisiana (Fowler and Adams, 1988).

The East Milford deposit appears to occur in a highly disrupted horizon at or near the base of the Cycle 2 (B Subzone), of the Windsor Group. Within the Quarry section, which ranges from 50-90 m in thickness, recognizable interbeds of carbonates or clastics cannot be traced over even short distances. Waste materials, which are removed from the quarried material by screening after it is crushed, are believed to comprise +25% of the total. This figure is approximately equal to the amount of interbedded material which is mass-wasted in Lower Cycle 2 (B Subzone) quarries operated at Miller Creek (0183), Hants County, and Little Narrows (0087), Victoria County. A unique explanation for this greater degree of structural disturbance at East Milford has not yet been determined, however, as at other sites, it appears to have been the mechanism which allowed hydration of the sulphate horizons to such great depths below present day surfaces.

The Quarry section is underlain by the massive anhydrite of the Cycle 1 (A Subzone) which thins towards the Shubenacadie Basin margin to the southeast. The anhydrite is underlain by thin basal carbonate of the Gays River Formation which locally form mounds on basement highs at or near the Basin margin. Meguma Group metamorphic rocks underlie the Gays River carbonates. The Cycle 2 (B Subzone) MacDonald Road Formation is overlain to the northwest by interbedded clastics, carbonates and minor sulphates of the Upper Windsor Green Oaks Formation (Giles and Boehner, 1982).

Unfortunately, due to the highly disturbed nature of the Quarry section, detailed examination and interpretation of the stratigraphy is virtually impossible. The only academic study undertaken thus far in this vicinity was a B.Sc. thesis by Colin McKenzie at Dalhousie University (1971). His study area was located 1500 m along strike to the southwest of the East Milford Quarry on an area being investigated by the Fundy Gypsum Company Ltd. (Dutch Settlement occurrence 0135). McKenzie (1971) was unable to carry out stratigraphic correlations using Fundy's drillcores due to "a combination of rapid and profound facies changes, complex structural and technical problems ..." (McKenzie, 1971, p. 16).

One possible mechanism which could produce this apparently highly disturbed Cycle 2 (B Subzone) section overlying the undeformed basal sulphate of Cycle 1 (A Subzone) would be gravity sliding (Moore, personal

communication *in* McKenzie, 1971). Similar geological sections, mined at Miller Creek, Hants County, and Little Narrows, Victoria County, are folded and faulted, but not as deformed as that seen at East Milford. Boehner (in press) reinforces this idea that more mobile, salt-bearing strata of the Upper Cycle 1 (A Subzone) Stewiacke Formation and lower part of the Cycle 2 (B Subzone) MacDonald Road Formation are most susceptible to decollement type deformation. The concentration of highly soluble salt seen at the top of Cycle 1 and lower part of Cycle 2 further contributes to an enhanced plumbing system (hydration) due to fault-fracturing and solution collapse in near surface (above 300 m depth) environments. This results in a greater degree of deformation in the less competent strata as seen at East Milford than in those units observed stratigraphically both above and below.

Whatever the mechanism, the Quarry section at East Milford appears to represent a highly disturbed portion of the Lower Cycle 2 (B Subzone) confined between an otherwise undisturbed stratigraphic section of the rest of the MacDonald Road Formation and the underlying Carrolls Corner Formation. This zone appears to extend northeast-southwest along the Cycle 1/Cycle 2 contact parallel to the Basin margin.

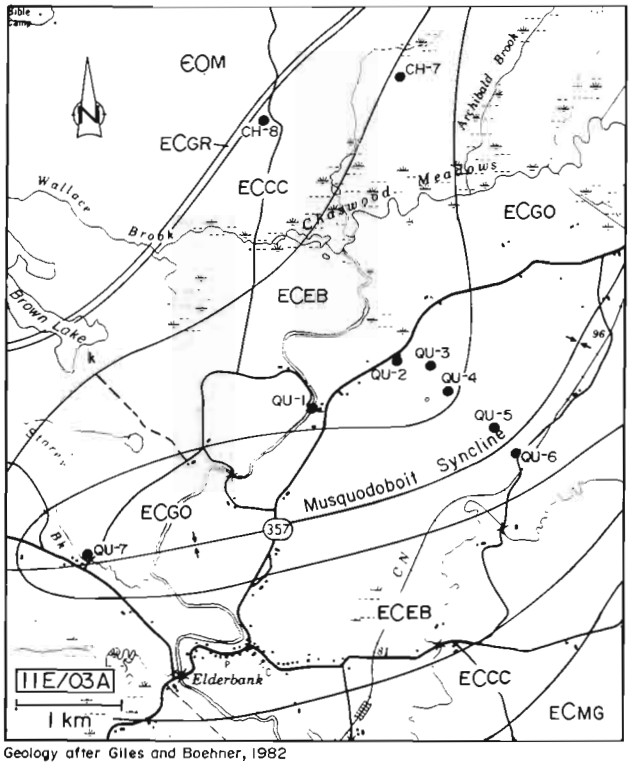
National Gypsum carried out exploration drilling programs in recent years on areas adjacent to the Quarry site, and, although incomplete, its appears that the Quarry section extends along a northeasterly trend both north and south away from the Quarry. In addition, some reserves have also been found of higher purity surface hydrated Cycle 1 (A Subzone) gypsum towards the Basin margin. A few base metal exploration drillholes in the area around the Quarry substantiate National's results (Amax Exploration Inc., 1974f; Burton, 1974b; Hannon, 1973a, b).

With drill indicated minable sections between 50-90 m thick continuing to the northeast on National's property and minimal overburden of 7.2 m over the same area, the future of the operation appears quite good for at least 10-15 years. Further work will have to be carried out to increase its reserves, however all indications appear to be positive.

Huge reserves of high purity anhydrite exist at East Milford beneath the gypsiferous horizon. Thus far, National has used only a limited volume of anhydrite on its site for road building purposes. The potential exists for National to sell anhydrite to some of its cement industry customers in the future.

ELDERBANK (0131)
NTS 11E/03A
UTM 484500 E 4983000 N

The Elderbank occurrence area is located 6 km southwest of the Village of Middle Musquodoboit, Halifax County (Fig. 7-13). Some evidence of karst topography can be seen at the southern end of Brown Lake, however the only gypsum and anhydrite observed in this area is found in drillholes. Nine drillholes were completed in this vicinity in 1973; two by Jorex Ltd. failed to reach bedrock (Johnston, 1973b) and seven drilled by Quebec Uranium Mining Corp., all encountered sulphate horizons beneath the Elderbank Formation (Hannon, 1973c).



Geology after Giles and Boehner, 1982

Figure 7-13. Location and geology of the Elderbank occurrence area. See Figures 7-1 and 7-2 for legend and location.

This occurrence area encompasses the northwestern side of the Musquodoboit Syncline between Middle Musquodoboit and Elderbank. Much of the area was mapped by Giles and Boehner (1982) as being underlain by the interbedded clastics, carbonates and minor sulphates of the Green Oaks and Elderbank Formations which overlie the sulphate-dominated Carrolls Corner Formation. This is underlain by the carbonate dominated Gays River or Meaghers Grant Formation which

usually overlies either Horton Group clastics or Meguma Group metamorphic rocks.

The Jorex holes were drilled close to the Musquodoboit Basin margin and encountered thick Pleistocene and Cretaceous sequences (67 and 94 m for CH-8 and CH-7, respectively). This indicates deep dissolution and dissection of the sulphates in this area (Johnston, 1973b) and may explain the lack of karst topography. The seven Quebec Uranium holes (QU-1 to QU-7) were drilled in the middle of the Basin and all penetrated the top of the Carrolls Corner Formation (Hannon, 1973c). Sulphate horizons encountered were generally described as gypsum or anhydrite mixed with varying amounts of silt or carbonate material. These sections are +100 m below surface.

Little opportunity exists for development of the gypsum encountered at depth in the Elderbank area. Although minimal information is available along the Basin margin, the lack of karst topography and outcrop suggests that the sulphates present are deeply eroded and infilled. The Brown Lake area along the southern side of the Chaswood ridge may warrant some further investigation.

ELMSVALE (0159)
NTS 11E/03A
UTM 495000 E 4992000 N

The Elmsvale occurrence area is located 7 km northeast of the Village of Middle Musquodoboit, Halifax County (Fig. 7-14). Drillhole information from exploration work carried out by Imperial Oil Ltd. in 1973-74 (V. Hannon, 1973; P. J. Hannon, 1974b) and by Noranda Exploration Company in 1974 (Nash, 1975b) showed interesting intersections of gypsum and anhydrite in this area.

The occurrence area is located on the northern side of the Musquodoboit Basin. Giles and Boehner (1982) indicated that the area is underlain by a section of the Lower Windsor Group including the interbedded clastics, carbonates and minor sulphates of the Elderbank Formation which overlies the sulphate dominated Carrolls Corner Formation. Along the southeastern side of the Basin, the Meaghers Grant Formation underlies the Carrolls Corner Formation. The basal unit of the Windsor Group in this area is the Gays River Formation which underlies both the Meaghers Grant Formation and the Carrolls Corner Formation and rests upon either clastics of the Horton Group or Meguma Group metamorphics.

Unlike other areas in the Province, in the Musquodoboit Basin the thick sulphates of the Carrolls Corner Formation are described as containing large amounts of intermixed clastic and carbonate material (up to 50%). As a result, it is difficult to evaluate this area for development potential since none of the cores have ever been tested for gypsum or anhydrite quality. Drillholes in the Carrolls Corner Formation, on both sides of the Basin in this area, however, encountered deeply hydrated sections, i.e. 93.3 m of "mixed gypsum and silt" under 29.9 m of overburden in hole B-4 and 75.6 m of "gypsum with calcareous mud seams" under 17.1 m of overburden in hole 209-3 (Hannon, 1973).

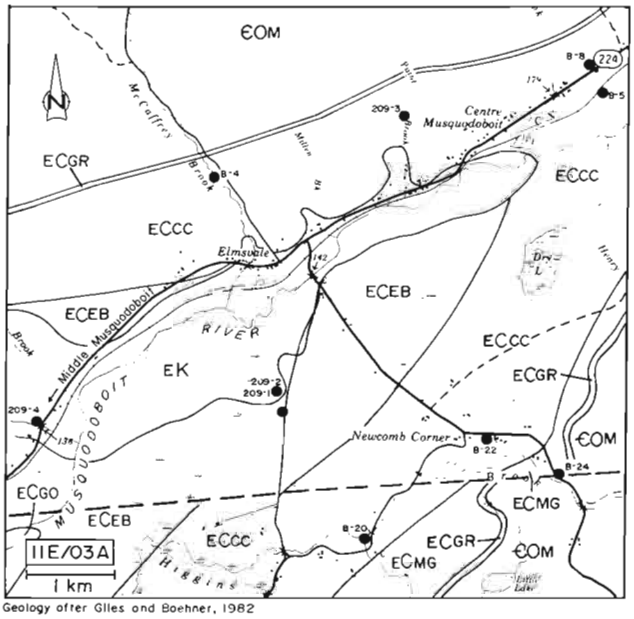


Figure 7-14. Location and geology of the Elmsvale occurrence area. See Figures 7-1 and 7-2 for legend and location.

The Elmsvale area has good potential for gypsum and should be drilled in order to establish the quality and quantity of the gypsum and anhydrite. If sufficient material were present in the area to warrant development, then the nearest shipping facility would be located at Sheet Harbour, 55 km to the southwest.

GLENMORE (0119)
NTS 11E/03A
UTM 489650 E 4989700 N

The Glenmore occurrence area is located 1.5 km northeast of the Village of Middle Musquodoboit, Halifax County (Fig. 7-15). Although a small area of rounded outcroppings and karst topography can be found south of Dickey Brook, most of the information available comes from drillhole data.

Regional geological mapping by Giles and Boehner (1982) indicated that the Glenmore area is underlain by

a basement (Meguma Group) high surrounded by units of the basal Windsor Group Gays River and Carrolls Corner Formations. The margin of the Windsor Basin lies just to the north of this area, striking northeast-southwest and deepening rapidly to the south of the area where it is overlain by Upper Windsor units. Thick sand and clay units of Cretaceous age can be found along strike from the area both to the northeast and southwest.

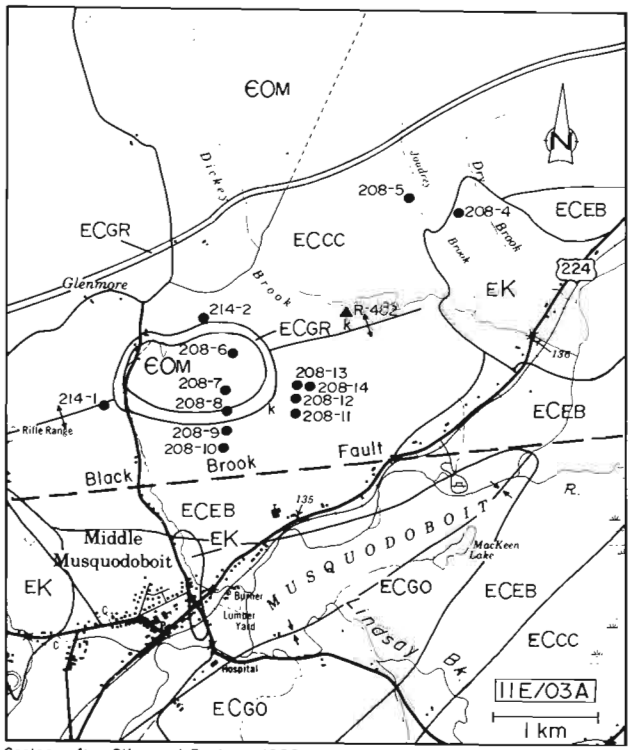


Figure 7-15. Location and geology of the Glenmore occurrence area. See Figures 7-1 and 7-2 for legend and location.

A small area of karst topography with small gypsum outcrops can be found just south of Dickey Brook, 2 km upstream west-northwest of Route 224. The gypsum seen here is light greyish brown, fine grained, with minor to trace amounts of interlaminated dark grey siltstone. A total of 13 diamond-drill holes were completed in the area by Noranda Exploration Company Ltd. in 1974-75 (Nash, 1975b; Leahey, 1976) as part of a regional basement exploration program.

Thick sulphate horizons (up to 100 m) were found throughout much of this area. Unfortunately the drill logs filed by Noranda generally refer to these horizons as 'gypsum/anhydrite' and therefore it is impossible to determine the depth of hydration in most holes (Nash, 1975b; Leahey, 1976). Some of this core is still available (208-4 to 208-14 at Nova Scotia Department of Natural Resources, Core Library in Debert) and should be looked at to help evaluate the area. Overburden cover can be quite thick here, but is generally 10-20 m.

This area warrants much additional work considering the known sulphates and their potential for deeper hydration at the basal contact both along the Basin margin and around the basement high. This area is located approximately 65 km northwest of Sheet Harbour which is a potential shipping point.

LAKE EGMONT (0132)

NTS 11D/14C
UTM 547500 E 4980000 N

The Lake Egmont occurrence is located 7 km southwest of the Village of Gays River, Colchester County (Fig. 7-16). Scattered sinkholes are found in the Cranberry Lake area and several small rounded exposures of fine grained, white gypsum are located near the head of Milne Brook in the northeastern portion of the area.

This area includes a small westward extension of the Musquodoboit Basin northwest of the Meaghers Grant area (0164). Giles and Boehner (1982) mapped this area as being underlain by the sulphate dominated Carrolls

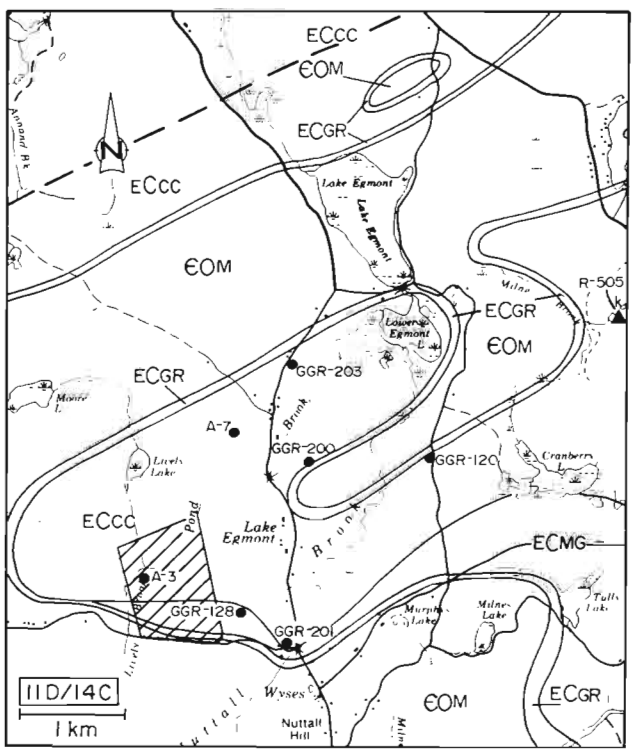


Figure 7-16. Location and geology of the Lake Egmont occurrence area. See Figures 7-1 and 7-2 for legend and location.

Corner Formation. This is underlain to the north and west by the Gays River Formation and to the south by the interbedded clastics, carbonates and sulphates of the Meaghers Grant Formation.

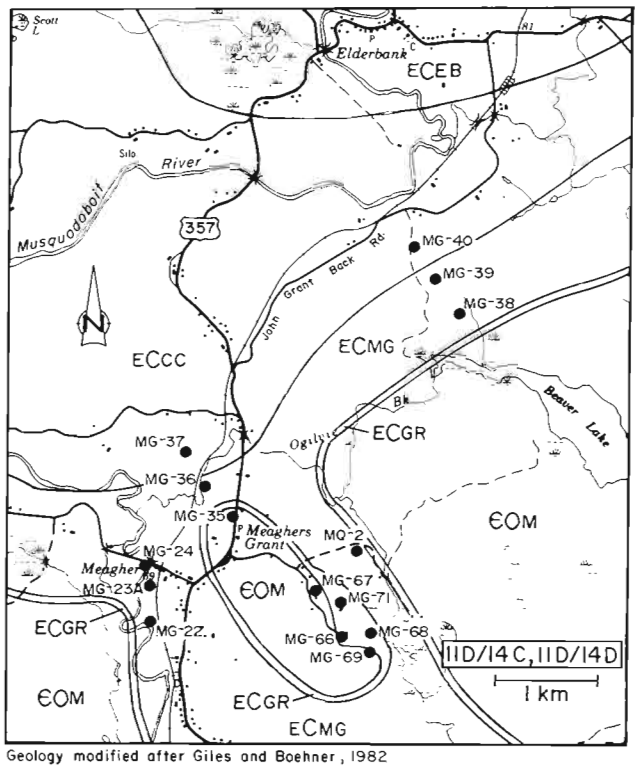
Seven drillholes are located in the area. Rio Tinto Canadian Exploration Ltd. drilled two holes in 1973 (A-3, A-7) (Shewman, 1973b) and Getty Mines Ltd. drilled five more into the Windsor Group in 1975 (GGR-120, -128, -200, -201, -203) (Getty Mines Ltd., 1975). In general, the overburden is thick (+24 m) and the depth of hydration of the basal anhydrite is shallow. Although the drillholes available are insufficient to accurately assess the potential of the area, it does not appear to be very promising. The vicinity around the surface exposure on Milne Brook, however, is moderately to heavily karsted over a small area and might warrant some additional work.

MEAGHERS GRANT (0164)
NTS 11D/14C, 11D/14D
UTM 482000 E 4978000 N

Located 15 km south-southwest of the Village of Middle Musquodoboit, Halifax County, the Meaghers Grant occurrence area includes the eastern portion of the southwestern end of the Musquodoboit Basin (Fig. 7-17). Outcrop exposures or karst topography are not evident within this area, however a large number of diamond-drill holes put down by Getty Mines Limited in 1973-1975 provide the basic information on the gypsum and anhydrite units in the subsurface (Comeau, 1974b; Boehner, personal communication).

Giles and Boehner (1982) indicated that much of this area is underlain by units of the sulphate-rich Carrolls Corner Formation and the underlying interbedded clastics, carbonates and sulphates of the Meaghers Grant Formation which strike northeast-southwest. This area is underlain to the south and southeast by the basal carbonate Gays River Formation which rests upon Meguma Group metamorphics. Basinward, to the north, the Carrolls Corner is overlain by the interbedded clastics, carbonates and sulphates of the Elderbank Formation.

Only two of Getty's drillholes in the area collared in the Carrolls Corner Formation, MG-37 and MG-40. Hole MG-40 encountered 57.9 m of dark grey, dolomitic gypsum overlain by 28.3 m of overburden and hole MG-37 passed through 29.3 m of selenitic gypsum with minor interbedded and intermixed clastics under 19.5 m of overburden (Comeau, 1974b).



Geology modified after Giles and Boehner, 1982

Figure 7-17. Location and geology of the Meaghers Grant occurrence area. See Figures 7-1 and 7-2 for legend and location.

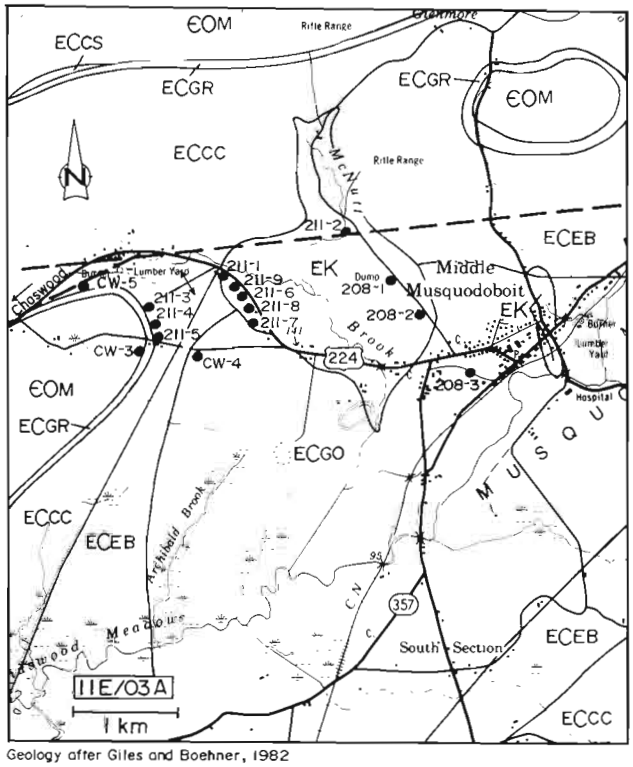
No evaluation of the gypsum has yet been made, however the area warrants additional drillholes around the John Grant Back Road. As is the case along much of the southeastern margin of the Musquodoboit Basin, favourable geology and depth of hydration combined with the lack of rural settlement make it an attractive site for potential development. Shipping possibilities would be limited to the Sheet Harbour facility, located 70 km to the southeast either north via Upper Musquodoboit or south via Musquodoboit Harbour.

MIDDLE MUSQUODOBOIT (0130)
NTS 11E/03A
UTM 486500 E 4987500 N

The Middle Musquodoboit occurrence area includes the area of the Village of Middle Musquodoboit, Halifax County, and west towards Chaswood (Fig. 7-18). Although some hummocky terrain is noted in this area, no surface occurrences have been located to date. A total of 15 diamond-drill holes were completed in this area in 1973-74 as part of regional base metal exploration programs (Millmor-Rogers Syndicate, 1973; Nash, 1974). The occurrence area includes the northwestern side of the Musquodoboit Basin between the Glenmore

occurrence area (0119) to the northeast and the Elderbank occurrence area (0131) to the southwest.

Regional mapping by Giles and Boehner (1982) indicated that much of this area is covered by a thick layer of Cretaceous material. This is underlain by interbedded clastics and carbonates of the Green Oaks and Elderbank Formations (Major Cycles 2-4) which overlie the sulphate dominated Carrolls Corner Formation. The basal Windsor Group Gays River carbonate underlies these sulphates and lies upon either Horton Group clastics or Meguma Group metamorphic rocks.



Geology after Giles and Boehner, 1982

Figure 7-18. Location and geology of the Middle Musquodoboit occurrence area. See Figures 7-1 and 7-2 for legend and location.

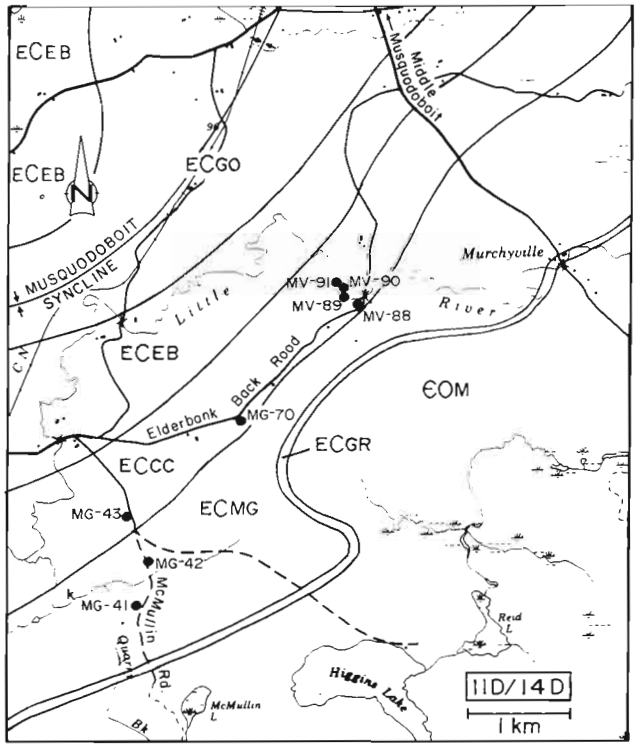
Millmor-Rogers Syndicate drilled three holes in 1973 (CW-3, -4, -5) (Millmor-Rogers Syndicate, 1973) and Noranda Exploration Company Ltd. drilled 12 holes in 1973 and 1974 within this area (Nash, 1974). Three holes (211-3, -4 and -5) encountered significant thicknesses of gypsum (+20 m) near the Meguma-Windsor contact. Unfortunately, these are covered by even greater thicknesses of overburden. Farther out in the Basin three holes penetrated thick hydrated sections of the same gypsum horizon, Cycle 1 (A Subzone) Carrolls Corner at depth. The top 43 m from 177-205 m of the basal anhydrite was described as gypsum in hole 208-3 (Nash, 1974).

Drilling to date indicates good potential for significant tonnages of gypsum at depth in the Middle Musquodoboit area, however much additional work would be required to prove up resources. Unfortunately, at this time, there is little interest in deeply buried gypsum deposits distant from shipping points in Nova Scotia. Therefore, this area is of more geological than economic interest.

MURCHYVILLE (0163)

NTS 11D/14D
UTM 484500 E 4979300 N

The Murchyville occurrence area is located 6 km south of the Village of Middle Musquodoboit, Halifax County (Fig. 7-19). Situated along the southeastern margin of



Geology after Giles and Boehner, 1982

Figure 7-19. Location and geology of the Murchyville occurrence area. See Figures 7-1 and 7-2 for legend and location.

the Musquodoboit Basin, this area lies between the Brookvale area (0162) to the northeast and the Meaghers Grant area (0164) to the southwest. Some probable karst topography occurs in the area of Quarry Brook west of McMullin Road and along the Little River northwest of Elderbank Back Road. No outcrops were found in the area, however access was not obtained to the Quarry Brook area where Faribault (1907) noted the presence of a small gypsum quarry. Information is also available from a series of exploration drillholes completed by Getty Mines Limited in 1974-76 (Comeau,

1974b; Boehner, personal communication) as well as four short holes by the Nova Scotia Department of Mines in 1968 as part of the clay and shale project (Wright, 1969a, b).

Regional geological mapping by Giles and Boehner (1982) showed much of this area to be underlain by the sulphate-dominated Carrolls Corner Formation which strikes northeast-southwest through the area and is overlain to the northwest by the interbedded sulphates, carbonates and clastics of the Elderbank and Green Oaks Formations. The interbedded clastics, carbonates and sulphates of the Meaghers Grant Formation underlie the Carrolls Corner Formation to the southeast. These are in turn underlain by the basal Gays River Formation carbonate and subsequently by metamorphic rocks of the Meguma Group.

Two of Getty's drillholes (MG-43 and -70) and all four of Wright's holes (MV-88 to -91) appear to have collared in the Carrolls Corner Formation. Although the descriptive log of hole MG-70 does not distinguish gypsum and anhydrite, it is believed to be similar to hole MG-43 (1400 m to the southwest) in which 42.2 m of dark grey, selenitic gypsum was encountered beneath 15.8 m of overburden. Hole MG-70 was described as having 36.6 m of evaporites overlain by 14.3 m of overburden.

Unfortunately, analysis of the gypsum from this area has not been carried out to date. The sections in the available drilling appear to be very encouraging. In addition the area itself is undeveloped and would probably be amenable to mining. Additional work needs to be done in this area to determine the depth and lateral extent of hydration of the Carrolls Corner Formation sulphates. Should sufficient resources be available then possible shipments could be made via the facilities at Sheet Harbour located 65 km to the southeast.

UPPER MUSQUODOBOIT (0161)

NTS 11E/02C
UTM 507800 E 5000700 N

Located 4.5 km northwest of the Village of Upper Musquodoboit, Halifax County, this occurrence area includes the northeastern end of the Musquodoboit Basin (Fig. 7-20). Karst topography and gypsum outcrops can be found on both sides of the Musquodoboit River at this locale and in two exploration diamond-drill holes put down by George Logan (Boehner, personal communication).

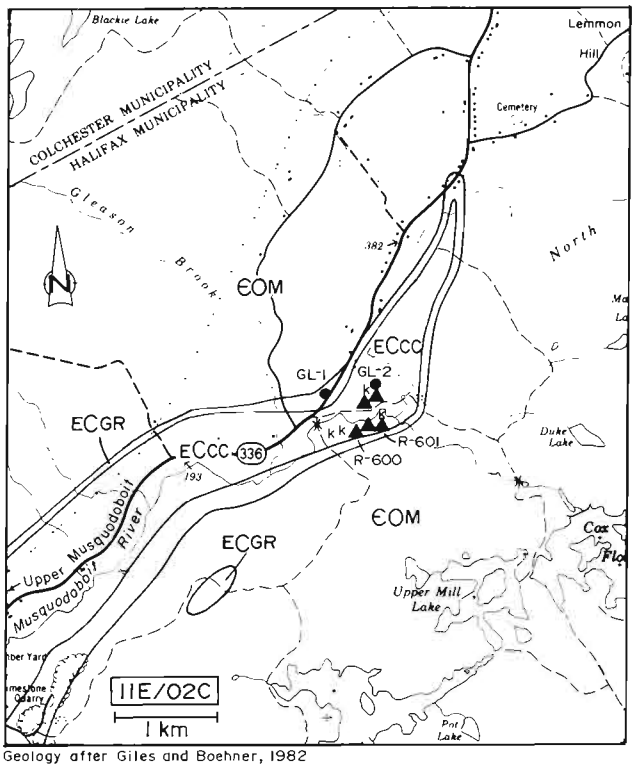


Figure 7-20. Location and geology of the Upper Musquodoboit occurrence area. See Figures 7-1 and 7-2 for legend and location.

Regional mapping by Giles and Boehner (1982) showed the area as being underlain by the sulphates of the Carrolls Corner Formation which are underlain by the Gays River Formation carbonates and the Meguma Group metamorphic rocks. The Windsor Group units trend northeast-southwest with the Basin ending to the northeast. Hydration of the basal anhydrite down both northern and southern edges of the Basin has left several blocks of high purity, fine grained, white gypsum with minor intermixed carbonate in this area.

Two drillholes by Logan in the mid 1970s are useful in defining the basal sulphate in this area (125.6 m in GL-2) (Boehner, personal communication). Description of the gypsum portion of the core is vague and it is not clear how deeply the anhydrite may be hydrated, however recent excavations by Mosher Limestone of an exposure on the northern side of the Musquodoboit River indicates it should extend >10 m below surface. This exposure is located at least 200 m southeast of the contact between the Carrolls Corner and Gays River Formations.

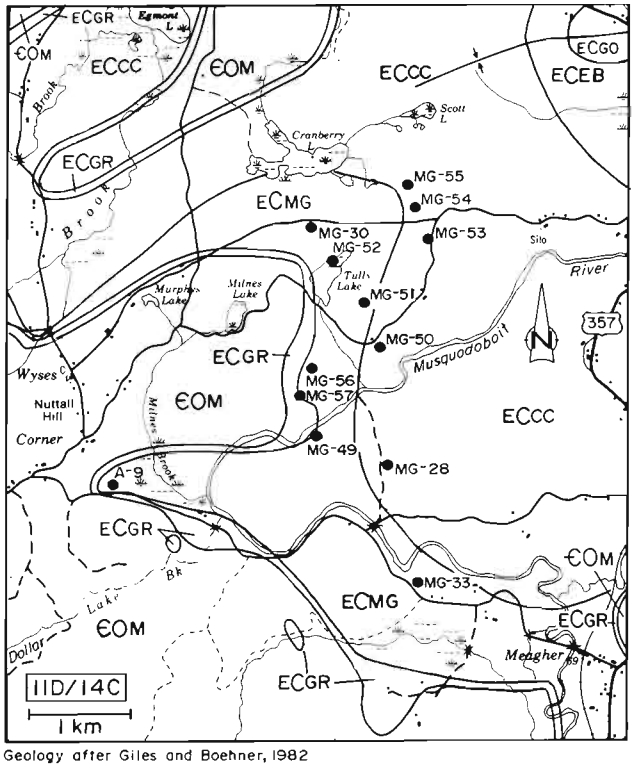
Although probably limited in size the quality of gypsum and anhydrite and its location away from

developed areas give the Upper Musquodoboit area good development potential. Mosher Limestone has already taken some stone out for use as agricultural grade gypsum, a market which has the potential for expansion. Additional drilling is required to further determine depths of hydration and dissolution in the area which would greatly affect the potential tonnages. Possible shipping facilities are available at Sheet Harbour about 50 km to the southeast.

WYSES CORNER (0165)

NTS 11D/14C
UTM 479000 E 4979000 N

The Wyses Corner occurrence area is located 15 km south-southwest of the Village of Middle Musquodoboit, Halifax County, at the southwestern end of the Musquodoboit Basin (Fig. 7-21). It lies between the



Geology after Giles and Boehner, 1982

Figure 7-21. Location and geology of the Wyses Corner occurrence area. See Figures 7-1 and 7-2 for legend and location.

Meaghers Grant occurrence area (0164) to the southeast and the Lake Egmont occurrence area (0132) to the northwest. A number of small lakes found within this area may be the result of karstification, however no obvious karst topography was noted and no outcrops of gypsum or anhydrite were found. Virtually all of the information available for the Wyses Corner area is taken from drillhole information gathered by Getty Mines Limited (Comeau, 1974b; Boehner, personal communication) and Rio Tinto Canadian Exploration Ltd. (Shewman, 1973b) during the early 1970s.

Geological mapping by Giles and Boehner (1982) indicated that much of this area is underlain by the sulphate-dominated Carrolls Corner Formation which is overlain to the north by the interbedded sulphates, carbonates and clastics of the Elderbank Formation. Intercalated with and underlying the Carrolls Corner are the interbedded clastics, sulphates and carbonates of the Meaghers Grant Formation which are underlain by the basal Windsor Group Gays River Formation carbonate which is underlain by metamorphics of the Meguma Group.

The Musquodoboit Basin margin is quite irregular in the Wyses Corner area, possibly reflecting an irregular basement paleotopography. Consequently, the contact between the Meaghers Grant and Carrolls Corner Formations is also very irregular. This irregularity and related facies variations causes difficulties in assessing the area's gypsum/anhydrite potential using the limited drillhole data that are available. Some drillholes collared near the Basin margin in the Meaghers Grant Formation appear to have encountered sections containing few interbeds of carbonate or clastic materials in the basal sulphate (i.e. MG-49, -51, -52 and A-9). These sections resemble those typical of the base of the Carrolls Corner Formation, but do not correspond with the typical Meaghers Grant section (Boehner, 1977b).

Several interesting gypsum sections have been described in drillholes in the area. Getty holes MG-49, -52, -53, -56 and -57 all encountered >26.5 m of gypsum. The thickest hydrated section was encountered in hole MG-50 where 46.6 m of white-grey to grey-brown gypsum was overlain by 30 m of overburden. The thinnest overburden was seen in hole MG-53 where 29.9 m of variably dolomitic gypsum was found underneath 17.4 m of overburden (Comeau, 1974b).

The apparent complexity of the geology in the Wyses Corner area causes problems in determining its resource potential. Additional investigation is warranted to further establish lateral and vertical extent as well as the quality of the gypsum horizons already encountered. Should sufficient reserves be proven, shipping possibilities do exist via Sheet Harbour which is located approximately 70 km to the southeast.

carbonates and clastics of the Elderbank Formation. Intercalated with and underlying the Carrolls Corner are the interbedded clastics, sulphates and carbonates of the Meaghers Grant Formation which are underlain by the basal Windsor Group Gays River Formation carbonate which is underlain by metamorphics of the Meguma Group.

The Musquodoboit Basin margin is quite irregular in the Wyses Corner area, possibly reflecting an irregular basement paleotopography. Consequently, the contact between the Meaghers Grant and Carrolls Corner Formations is also very irregular. This irregularity and related facies variations causes difficulties in assessing the area's gypsum/anhydrite potential using the limited drillhole data that are available. Some drillholes collared near the Basin margin in the Meaghers Grant Formation appear to have encountered sections containing few interbeds of carbonate or clastic materials in the basal sulphate (i.e. MG-49, -51, -52 and A-9). These sections resemble those typical of the base of the Carrolls Corner Formation, but do not correspond with the typical Meaghers Grant section (Boehner, 1977b).

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The apparent complexity of the geology in the Wyses Corner area causes problems in determining its resource potential. Additional investigation is warranted to further establish lateral and vertical extent as well as the quality of the gypsum horizons already encountered. Should sufficient reserves be proven, shipping possibilities do exist via Sheet Harbour which is located approximately 70 km to the southeast.