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PRELIMINARY REPORT ON ACTON AREA, BAGOT AND SHEFFORD COUNTIES

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PRELIMINARY REPORT

ON

ACTON AREA

BAGOT AND SHEFFORD COUNTIES

BY

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1963

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INTRODUCTION

The Acton area was mapped by the writer during the summer of 1961. It covers approximately 150 square miles bounded by latitudes 45°34' and 45°45', and by longitudes 72°45' and 72°30', and includes much of Acton township and parts of Upton and Wickham in Bagot county, as well as parts of Roxton and Milton townships in Shefford county.

The area lies across the boundary between the generally unfolded Ordovician of the St. Lawrence Lowlands to the northwest, and the folded Cambrian and/or Ordovician rocks of the Appalachians to the southeast. The boundary between these two rock provinces is "Logan's Line", the nature of which cannot be inferred in this area, but which is considered elsewhere to be a thrust fault.

The Acton mine near the town of Acton Vale is one of the first mines to have been worked profitably in the Quebec Appalachians. Opened in 1858, it was exploited till about 1870. This had the effect of focusing attention on the mineral possibilities of the Eastern Townships, an impetus which is still felt today.

"Logan's Line" crosses the area in a northeasterly direction. The boundary between the St. Lawrence Lowlands and the hilly country to the southeast is about 3 miles southeast of this fault and parallel to it. The Lowlands has an average altitude of 225 feet above sea-level. The hilly country to the southeast ranges in elevation from 225 to 750 feet but averages approximately 150 feet above the plain.

GENERAL GEOLOGY

The rocks of the Acton area may be divided into four general groups. The oldest, or "Sillery" in the broad sense, is composed of a predominantly sandstone unit with interbedded red and green slates overlain by a unit (2a) composed of red, green and grey slates. The contact between these two units is sharp.

The contact between the slates of Unit 2a and those of Unit 2b, that is, those at the base of the undivided Quebec group, is not precise because these two units are interbedded and the younger is composed mainly of grey to green slates. The slates are followed upward by grey limestones with some interbeds of lavas (Units 3 and 4).

Unit 5 consists of dark grey, impure sandstones with minor dark grey slates and conglomerates. This unit is younger than the "Sillery" sandstones, and is believed to be at least in part stratigraphically equivalent to the limestones of Unit 3.

The St. Germain complex or group (Unit 6) crops out in the Lowlands and consists of dark grey, very limy, fine-grained clastic rocks. This group probably is Middle to Upper Ordovician in age, as indicated by lateral continuity with rocks of such ages to the southwest; also, the high lime content is suggestive of the Trenton.

The fourth and youngest group is made up of intrusions of diorite that were apparently emplaced after the Taconic orogeny of late or post-Ordovician time.

DESCRIPTION OF FORMATIONS

Quebec Group

"Sillery" Sandstones (Unit 1)

The "Sillery" sandstones are mostly green to greenish grey owing to a high content of chloritic clay. Here and there, however, the rock is grey or red, and some beds low in clay have a "quartzitic" texture.

Most of the sandstones are medium and coarse grained. Small-pebble conglomerate occurs locally either in distinct beds or at the bottom of graded beds. The conglomerates are particularly abundant north of St-Valérien, where they carry clasts of pink feldspar that stand out against the predominant whitish, quartz clasts. The associated sandstones here also contain pink feldspar.

Bedding is generally obscure although locally made quite apparent by the presence of conglomerates, or of graded beds, or of thin beds of red, green or grey slate.

Cleavage is common in the sandstones, its intensity increasing with the clay content, and also from west to east. The rocks immediately south of Acton Vale, for instance, are highly cleaved and even, at places, schistose.

Near and west of Roxton Falls, there are some light grey, brown-to-red-weathering, limy or dolomitic sandstones. These beds probably are not restricted to one stratigraphic level.

TABLE OF FORMATIONS

Pleistocene and Recent			Boulders, clays, silts, sands, including eolian, marine, and glacial deposits. Organic deposits (peat).
Post-Taconic	Intrusive rocks		Unit 7: Pyroxene diorite
Middle and Late(?) Ordovician	St. Germain complex		Unit 6: Dark grey siltstones, minor sandstones and impure limestones
Cambrian and/or Ordovician	Quebec Group		Unit 5: Dark grey impure sandstones; minor dark grey slates, and conglomerates
			Unit 4: Amygdular lavas
			Unit 3: Grey limestones, mainly massive
			Unit 2b: Grey to green slates; minor siltstone and sandstone. (Grades into unit below)
		"Sillery"	Unit 2a: Red slates; minor green and grey slates
			Unit 1: Sandstones, impure, mainly green, some red and grey, with minor "quartzitic", conglomeratic, or slaty interbeds.

"Sillery" Slates (Unit 2a)

The contact between the sandstones of Unit 1 and the slate of Unit 2a is sharp. These slates are similar to those interbedded within the sandstones, but they generally lack bedding. They grade upward into the slates of Unit 2b.

In general, red slates occur near the sandstone and are followed upward by green and then by grey slates, the last being associated with the limestone of Unit 3. However, red and grey slates are interbedded locally. Also, field evidences indicate that red slates have been reduced to green and to grey slates by hydrothermal solutions or ground-water. Reciprocally, green and grey slates may have been oxidized into red slates.

The slates at Units 2a and 2b are well cleaved and, at places, both a flow cleavage and a fracture or slip-cleavage are developed.

Grey slates (Unit 2b).

These slates are generally massive, particularly where seen in isolated exposures. However, where exposures are abundant (as east of St-Valérien and in the northeast corner of the area), laminae and thin beds of grey, fine-grained, calcareous sandstones may be seen interbedded with the slates. The slates are light to dark grey for the most part but, in places, they are green.

Limestones and lavas (Units 3 and 4)

These two units actually are interlayered in zones ranging from a few inches to several feet thick, the association being well shown in range VII of Acton township. The relation of the group to other units is not clear.

The lavas are green to grey, finely crystalline, very rarely pillowed, and usually amygdular or vesicular. Most amygdules are calcite; some are cylindrical. The lava has been considered to be mainly andesite, although some lighter grey facies may be more acidic.

The limestones are generally medium grey but range from light to dark grey. They are finely crystalline, relatively pure, and generally massive. Thick beds, however, occur in the quarries near Acton Vale. Locally, irregular brown-weathering layers are present. Some of these layers are sandy, silty and argillaceous and, although irregular as a result of rock flowage, represent beds. Others are more calcareous, irregular, and discontinuous and probably are metasomatic; some, in fact, occur as irregular veins which cut the bedding. The brown-weathering surface of these more calcareous veins or beds probably points to the presence of ankeritic dolomite or ankerite. Towards the eastern end of range IX, Acton township, a few outcrops of dolomite are locally replaced by calcite; such dolomite may be the original carbonate rock of the Acton area.

Bedding, in general, is difficult to determine owing to the massive appearance of the rock as well as to flowage and veining. However, in a few places, beds 2 to 3 feet thick of medium-grained, limy and dolomitic sandstone alternate with the limestone. Here and there grey chert in veins or in irregular small masses occurs. Masses of chert greater than 18 inches are rare, and they commonly range between one and 3 inches.

At the Acton Vale quarries, the limestone is at least 250 feet thick and may be as much as 500 feet.

Dark grey sandstones (Unit 5)

Dark grey sandstones occupy a northeasterly trending band in the southern half of the area. They are predominantly massive, fine grained and dark grey; locally, they are highly feldspathic. A few thick interbeds of dark grey slates are also present. Some of the sandstone beds grade into small-pebble conglomerates.

Grey sandstones, similar to those described above, are also found at two localities in the northern half of the area. They occur near the limestones, a fact which supports the hypothesis here presented that the sandstones in the southern half of the area are facies equivalents of the limestones in the northern half.

St. Germain Complex

The rocks in this area lying to the northwest of the St. Lawrence and Champlain thrust trace ("Logan's Line") are referred to the St. Germain complex or group. Most such rocks probably belong to the St. Lawrence Lowlands Ordovician sequence.

The St. Germain rocks are predominantly dark grey, massive, calcareous siltstones. These grade in places into non-calcareous siltstones and, by increase in grain size, into fine-grained sandstones. Beds, where seen, range up to one inch thick. Some beds that may be classed as impure limestones and dolomites also occur. All these rocks are well cleaved and locally they are carbonaceous (graphitic?).

Conglomerates of two types crop out in range III, of de Ramsay Seigniory, within the area of St. Germain rocks. The more abundant type is composed of siltstone granules and pebbles and some limestone clasts in a matrix of sand. The other type is made up of limestone cobbles in a matrix of silt.

Diorite

Several intrusive bodies of diorite are found in the area. Seven are concentrated in a northeasterly trending zone between St. Valérien and the northeast corner of the area, and one occurs near Roxton Falls in the southeast corner.

The diorite is 25% to 75% black pyroxene and the remainder is mainly plagioclase. Granularity ranges from very fine to coarse (about 5 mm.). The colour is light grey to black in general, although some chloritized and saussuritized portions are greenish. Zones of varying grain sizes suggest multiple intrusions. Many outcrops have xenoliths of a grey, fine-grained, silicified(?) sandstone, with disseminated sulphides.

Pleistocene and Recent

Clayey boulder till, and outwash gravel deposits, are common in the area. Some are overlain by well-bedded clays and silts, which locally yield fossils typical of the Champlain Sea sediments such as Saxicava sp., Macoma sp., Tellina sp.,

Mytilus sp., Nuculana (Leda) sp., foraminifera, and gastropods. The silts and clays also contain cobbles here and there.

Peat bogs locally overlie the silts and clays. They are found mostly in a northeasterly trending zone between Upton and Ste-Hélène-de-Bagot. At Acton Vale, and to the north-northeast, eolian sands form dunes and other deposits. Conifers have been planted in an attempt to arrest movement of these sands.

Structural Geology

Logan's Line divides the rocks of the Quebec group from those of the St. Germain complex. From the meagre data that could be obtained it would seem that the St. Germain complex is severely deformed.

Folds in rocks of the Quebec group are difficult to outline because of the lack of marker beds, inconsistency of trends and steep dips. However, top determinations in the "Sillery" green sandstones indicate the presence southwest of Acton Vale of a major anticline trending northeasterly. Some tops also suggest that a minor syncline is present on the southeast flank of this anticline, south and southeast of Acton Vale. These folds are slightly overturned to the northwest, as the bedding generally dips steeply east. The distribution of the slates on either flank of this anticline indicates that the slates are above the sandstones. The slates presumably occupy a narrow syncline southeast of the anticline and are followed southeasterly by another anticlinal zone of sandstones. Northwesterly the slate presumably underlies the dark grey sandstones of Unit 5 and the limestones of Unit 3 east of Acton Vale. Thus, the grey sandstones and Acton Vale limestones possibly occupy a syncline that runs parallel to the major anticline mentioned above. Top determinations in the grey sandstones do not, however, give unequivocal support to this interpretation. Northwest of this syncline the "Sillery" green sandstones reappear. Tops of bedding, within the "Sillery" sandstones west of the western limit of the slate, indicate again that the slates are above the "Sillery" sandstones. The limestone (Unit 3) found within this northwest band of green sandstones, and at its southeastern edge, if not thrust over the sandstones, may be at the top or within the lower "Sillery" or contemporaneous with the "Sillery" slates (2a). There may be, therefore, more than one horizon of limestone.

The diorite intrusions are undeformed and thus may be post-orogenic. Some bodies contain xenoliths of sedimentary rocks.

ECONOMIC GEOLOGY

Acton copper deposit: lot 32, range III, Acton township.

High-grade copper ore made up of chalcopyrite and bornite was extracted from the Acton mine between the years 1858 and 1870. Later attemps to find more ore, the latest being by Steeprock Iron Mines, Limited, in 1959, apparently failed. Workings at the mine are still visible. Some of the rock exposed in earlier days is now covered, but, on the other hand, quarrying for limestone has produced new exposures. The largest and farthest-north of the three quarries is near the Acton-Richmond highway (Route 32) and is owned by "Acton Vale Quarry, Limited". Rare veinlets of pyrite and chalcopyrite cross the limestone here.

Another quarry (Kennedy Construction Company) to the south, which also shows rare mineralization, is well described by Goudge (1938). The third, and most southern, quarry is the Acton mine, of which Bancroft (1915) has given a full account.

According to previous estimates, 16,000 tons of ore averaging 12% copper were produced from three large masses occurring within a zone about 720 feet long. The masses contained bornite, chalcopyrite, and pyrite, and were, for the most part, in a locally brecciated limestone layer 20 to 80 feet thick. The limestone is underlain by dark grey "shales", 3 to 75 feet thick, and overlain by other dark "shales". The lower shales are in turn underlain by the main mass of limestone at Acton Vale. Throughout this sequence the beds dip 35° to 70° NW. Bancroft (p.86) mentions that the upper (producing) limestone and the shales were intruded by irregular dyke-like masses up to a few yards wide of amygdaloidal greenstone having the composition of a highly altered diabase. Also (p. 87), that "Complex block faulting has taken place, in which the throws usually do not exceed a few feet". The disseminated copper minerals in the upper limestone and adjoining shales are thought to be related to the greenstone and to have been further concentrated by down-seeping meteoric waters. Thus, limestone would have been enriched down dip at a level at which the ore is found, whereas the upper part was eroded away.

To Bancroft's account the writer may add that the Acton mine is in an area of complex faulting that corresponds closely in position to a synclinal axis which, at the mine, bends sharply from east-west to north. The copper minerals are in impure and pure limestone, argillaceous siltstone, silty slate, and a sheared, greenish grey, fine-grained, calc-silicate rock. The silicate rock in the northern quarries lies west of the limestones, and is locally separated from them by the siltstone and silty slate. At the mine itself, the silicate rock occurs east of the limestone, perhaps because of faulting, and trends approximately north along an apparent shear zone in the limestone. The diorite intrusive west of Acton Vale is probably in part responsible for the deposit as well as for the local structural complexity.

Other copper prospects

Most outcrops of limestone in the Acton area have been prospected and, in most pits, a careful search will reveal some metallic minerals. The more mineralized outcrops are shown on the accompanying map.

Other metallic mineral occurrences

Here and there within or near the diorite bodies both the intrusive and the country rocks show some mineralization. Nine assays from eight localities including silicified (?) wall rock, quartz veins, intrusive rock, and contact aureoles yielded traces of copper, nickel, lead, zinc, silver, and gold.

Limestone

Extensive outcrops of limestone are found both at Acton Vale and to the northwest in range V, Acton township. At Acton Vale the limestone is quarried for crushed stone, but from the point of view of quantity and purity it could be exploited for most commercial purposes.

Three analyses of Acton Vale limestone given by Goudge (1935) are reproduced below:-

a- Kennedy Construction Co. quarry, Acton Vale. Sample exclusive of siliceous (i.e., chert-bearing) bands.
b- Kennedy Construction Co. quarry, at Acton Vale (screenings)
c- lot 34, range V, Acton township (one mile northwest of Acton Vale).

	a %	b %	c %
SiO_2	3.66	6.92	6.06
Fe_2O_3	0.72	0.72	0.91
Al_2O_3	1.08	1.48	0.33
$Ca_3(PO_4)_2$	0.26	0.22	0.26
$CaCO_3$	87.52	84.64	79.39
$MgCO_3$	6.98	6.23	12.82
S	tr	0.16	0.07
CaO	49.15	47.52	44.60
MgO	3.34	2.98	6.13

REFERENCES

BANCROFT, J.A. (1915), Report on the Copper Deposits of the Eastern Townships of the Province of Quebec; Que. Dept. Colon., Mines and Fisheries, Mines Branch.

GOUDGE, M.F. (1935), Limestones of Canada, Part III, Quebec; Canada, Mines Br. Publ. 755.