CANADA
DEPARTMENT
OF
MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

LEGEND

POST-PALÆOZOIC (?)

POST-ORDOVICIAN

4 — *MANICOUAGAN EXTRUSIONS:* mainly massive andesite

3 — *MONT DE BABEL INTRUSIONS:* mainly essexite-anorthosite

PALÆOZOIC

ORDOVICIAN

MIDDLE TO UPPER ORDOVICIAN

2 — *Mainly grey limestone*

PRECAMBRIAN

1 — *GRENVILLE TYPE ROCKS:* mainly granitic gneiss and garnetiferous gneiss; some crystalline limestone, amphibolite, quartzite; granite, syenite, pegmatite, diorite, gabbro

Outcrop, area of outcrop
Bedding (inclined)
Gneissosity (inclined)
Fault (approximate, assumed)
Fold (arrow indicates direction of plunge)
Anticlinal axis
Synclinal axis
Joint pattern
Trend of glaciation

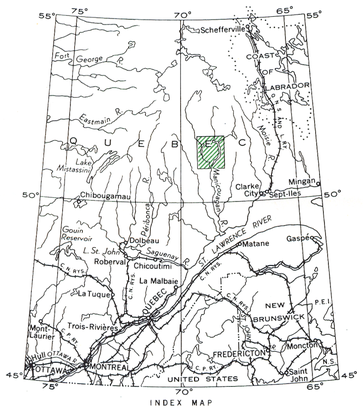
Geology by E. R. Rose, 1954

Intermittent stream
Fall or rapid
Sand or gravel
Height in feet above mean sea-level . . . 645

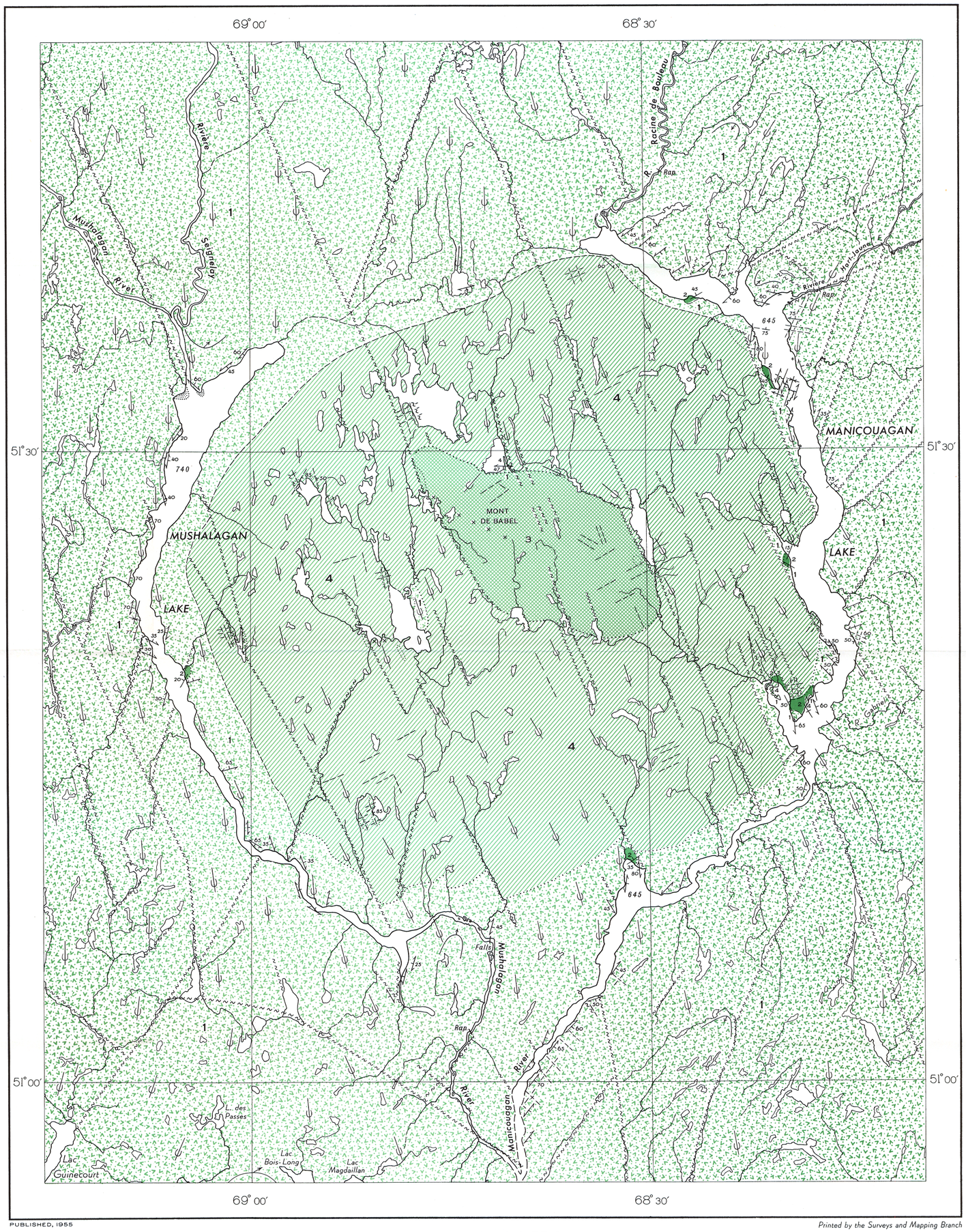
Approximate magnetic declination, 26° 40′ West

Cartography by the Geological Cartography Unit, 1955

Air photographs covering this map-area may be obtained through the National Air Photographic Library, Topographical Survey, Ottawa, Ontario



INDEX MAP



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PRELIMINARY MAP 55-2

MANICOUAGAN LAKE - MUSHALAGAN LAKE AREA

QUEBEC

Scale: One Inch to Four Miles = $\frac{1}{253,440}$

Miles 4 2 0 4 8 12

DESCRIPTIVE NOTES

The geological map and descriptive notes were prepared as a result of a month's work in the area by the author, as geologist attached to a Dominion Observatory field party during the spring of 1954. Because of the large area to be examined and the scarcity and inaccessibility of outcrops the map contains much inference and interpretation. Particular attention was given the map-area because of the great circular feature displayed there by Manicouagan and Mushalagan Lakes, a feature that suggested an origin by meteorite impact and explosion. Although not disproved the theory of meteoritic origin is heavily discounted because of lack of positive evidence, and geological evidence here presented suggests an origin by differential erosion.

Manicouagan and Mushalagan Lakes are long, sinuous bodies of water that occupy parts of ancient and deep valleys in foliated Precambrian rocks in wilderness about 150 miles northwest of Seven Islands in Quebec. The lakes and valleys form a crudely circular feature some 40 miles in diameter that includes an area of some 1,200 square miles of rough, bush-covered, lake-studded, glaciated terrain in which rock is exposed over only about 5 per cent of the surface. Mushalagan Lake, elevation 745 feet, bottoms near sea-level in places and drops through a series of falls, chutes, and rapids at its southern end to meet Manicouagan Lake, elevation 640 feet, at its southern end. Together they continue as Manicouagan River in a deep valley south to the St. Lawrence. The highest hills within the perimeter of the two lakes are in the central part of the feature, where they are about 3,100 feet high and comparable in elevation to the highest hills in the surrounding district.

The valleys of Manicouagan and Mushalagan Lakes are encised in peneplaned Grenville-type rocks, consisting mainly of granitic and garnetiferous gneisses but including bands of schist, amphibolite, crystalline limestone, quartzite, syenite, granite, diorite, and dykes of gabbro, diabase, and pegmatite. Several outcrops of more or less folded Palæozoic (Middle to Upper Ordovician) limestone occur on the inner shores of the lakes. This Palæozoic limestone in places rests directly and unconformably upon a clean swept surface of folded and faulted Precambrian granitic gneiss, schist, and pegmatite, and the gneisses display a marked rectangular joint-fault pattern that is not evident in the less folded overlapping Palæozoic limestone beds. Inward from the lakes outcrops of volcanic rocks, including brownish and greyish green andesite, reddish brown felsite, trachyte, trachytic tuff, chocolate-brown basalt, and agglomerate, are found, and most of the central area between the lakes appears to be composed of these rocks. Apart from a pronounced rhombohedral joint and fault pattern, and in some places vesicles, these rocks appear structureless, massive, and unmetamorphosed. A large, dissected massif occupies a central position within the circle. It is composed mainly of mottled, light grey to pink, fine- to medium-grained, igneous rock that consists predominantly of equigranular crystals of twinned, acid labradorite, and for which the term essexite-anorthosite is proposed. Together with the surrounding volcanic rocks this is the core or plateau around which the lake valleys are formed. The presence of a few elevated exposures of garnetiferous gneiss and schist in the area between the lakes suggests that such Precambrian rocks there form the floor upon which the lavas were extruded. Spatial distribution and similarities in chemical and mineralogical composition between the essexite-anorthosite and the surrounding extrusions suggest that they are genetically related and that they may be related also to the Monteregian suite of intrusions. A 2-foot dyke of greenish grey, amygdaloidal andesite intrudes crumpled beds of Ordovician limestone on the west shore of Manicouagan Lake, which, together with the unaltered condition of the lithologically similar extrusions of the central area, suggests that the latter are post-Ordovician and not Proterozoic in age, as had previously been thought[1]. Both the essexite-anorthosite and the surrounding lavas exhibit a rectilinear joint-fault pattern that appears to be related to other such structures in the underlying basement rocks. Linear elements formed by these features are characteristically shown in aerial photographs and topographic maps of areas in this region, and they are not confined to the immediate vicinity of the two lakes. It would appear that the younger igneous rocks were broken principally along northwesterly and northeasterly trending planes in response to adjustments in the Precambrian rocks below.

Heavy continental glaciation of the area, from the north, is shown by widespread drift cover, semi-parallel arrangement of drift ridges, valleys, drumlins, and eskers, and by large erratics and boulder dumps. Much of the glacial ice seems to have been deflected around the central massif. The valleys of Manicouagan and Mushalagan Lakes are terraced in part with flat-lying deposits of stratified sand and fine grey silt of recent, possibly marine, origin. The most recent sand beaches on the rivers and lakes characteristically carry concentrated bands of magnetite and garnet in natural emery sands.

The map shows a marked development of subsequent streams following a rectilinear joint-fault pattern and curvilinear fold pattern. In addition, a strong radial drainage pattern is developed around the ring of the two large lakes. All stages in development of these streams are shown from youth to maturity and individual streams may show the features of each in their courses. Rejuvenation of an ancient surface is thus suggested, and glacial modification is in many places indicated.

A reconstructed geological history of the area begins with the deposition of Grenville-type sediments, their intrusion by igneous bodies and transformation to gneisses, with accompanying folding and faulting in response to mountain building forces acting in Precambrian time. Following a long period of erosion in which the mountains were peneplaned, Ordovician seas invaded low-lying valleys, and fossiliferous limestone was deposited as a thin cover upon the eroded edges of the gneisses. These beds were later crumpled, probably during and after the period in which the central core of igneous rocks was formed. Subsequent dislocations of the rocks continued during the long period prior to Pleistocene glaciation, and marine waters may have reached the lakes in Recent time.

Consideration of the geological history and of lineaments of the area suggests that the roughly circular topographic trench, in which Manicouagan and Mushalagan Lakes lie, is the result of differential erosion along an intersecting system of faults and folds about a plateau of resistant igneous rock. It is suggested that the feature was initiated in Precambrian time, developed after the formation of the central igneous core, probably in post-Ordovician time, and brought to its present configuration by Pleistocene glaciation and Recent erosion.

[1] Tectonic Map of Canada, G.A.C. 1950.
W. P. Hammond, University of Toronto, Masters thesis, 1945.
M. L. Keith, unpublished report, Mining Corporation of Canada, 1944.

PRELIMINARY MAP 55-2
MANICOUAGAN LAKE - MUSHALAGAN LAKE AREA
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