New Talc Deposit in St. Lawrence County New York

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By C. ERVIN BROWN

CONTRIBUTIONS TO ECONOMIC GEOLOGY

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By C. Ervin Brown

ABSTRACT

Rock apparently similar to that mined for industrial talc near Fowler, N.Y., since 1880 has been mapped at a new locality in western De Kalb Township, St. Lawrence County, N.Y. The rock that has potential commercial value is poorly exposed, but it is about 100 feet thick at one of the few outcrops and consists mainly of layered light-colored schists having various proportions of talc, tremolite, and anthophyllite. These schists are included in a metasedimentary sequence of marble, quartzite, mica schist, and gneiss, all part of the Grenville Series of Precambrian age.

The talc-bearing rock occurs in a doubly plunging syncline that trends N. 30° E. The map pattern of the structure is approximately that of an isosceles triangle having a base of 3,000 to 4,000 feet near the De Kalb-Gouverneur town line and an apex about 3.5 miles to the northeast near the confluence of the valleys of Beaver Creek and the South Branch of Beaver Creek. The talc zone feathers out to the east at the upturned edge of the syncline. The west edge is cut off by a gneissic granite body in the southern part of the area and to the north its westward extension is undetermined. The doubly plunging synclinal structure plunges less than 20°; consequently, the talc-bearing zone is possibly not more than 1,500 feet below the surface at the lowest part of the structure.

INTRODUCTION

Industrial talc, a rock composed of various proportions of talc, tremolite, anthophyllite, and serpentine, is a versatile mineral filler that is used where properties desired include one or a combination of the following: extreme whiteness, smoothness, high covering ability, chemical inertness, high oil absorption, low thermal expansion, high dielectric strength, and a high fusion point. A few of its many uses are for paint extender, ceramic tile, paper, rubber and floor tile filler, ceramic electrical insulators, lubricant additive, insecticide diluent, polishing agent, and nonsticking surfacing powder and filler for tar paper and roofing (Engel and Wright, 1960).

A zone of talc-tremolite-anthophyllite schist potentially usable as industrial talc has been mapped at a new locality near Rock Island Road in the western part of De Kalb Township, St. Lawrence County, N. Y. The talc-bearing schist was recognized in August 1966, and geologic mapping of the deposit and surrounding area was mainly done in the summer of 1967. Some additional work was completed in 1968. The geologic work is part of a continuing study of the structure, stratigraphy, petrology, and economic geology of bedrock in the Richville 7½-minute quadrangle and an adjacent area to the west. The area described in this report was previously mapped at a scale of 1:62,500 by Cushing and Newland (1925). The present geologic interpretation differs significantly from that in the earlier study.

The new talc locality is about 15 miles northwest of the mining district near Fowler, N.Y. (fig. 1), where industrial talc has been mined since 1880. Talc is also being mined at Balmat, N.Y. All deposits are in zones of talc-tremolite-anthophyllite schists formed by metamorphism and metasomatism of siliceous dolomitic marble and interlayered quartzite of the Precambrian Grenville Series.

The author gratefully acknowledges the help given through discussions in the field with H. M. Bannerman, who has mapped an adjacent area to the east, J. S. Brown, A. E. J. Engel, Ingvar Isachsen, and G. I. Smith. The cooperation and kindness extended by residents of the area are also deeply appreciated.

PRECAMBRIAN ROCKS

METASEDIMENTARY ROCKS (GRENVILLE SERIES)

Most of the report area is underlain by metasedimentary rocks of the Grenville Series of Precambrian age which here are regionally metamorphosed to the amphibolite facies. The rocks are well layered and foliated, and foliation parallels layering. Although the pronounced compositional layering undoubtedly reflects bedding, primary structures that indicate tops of beds have been destroyed. In this report these rocks are assumed to be right side up.

Quartzose Calcitic Marble

The lowermost rock unit in the mapped area (pl. 1) is a west-dipping marble occurring between the South Branch of Beaver Creek and the swampy valley to the west that contains Osborn Lake. Here, the unit is intruded by a thick sheet of gneissic granite. The marble, which has calcite grains as much as a quarter of an inch across, contains thin disjointed layers of quartzite that outline the layering in the marble. Locally, the marble also contains

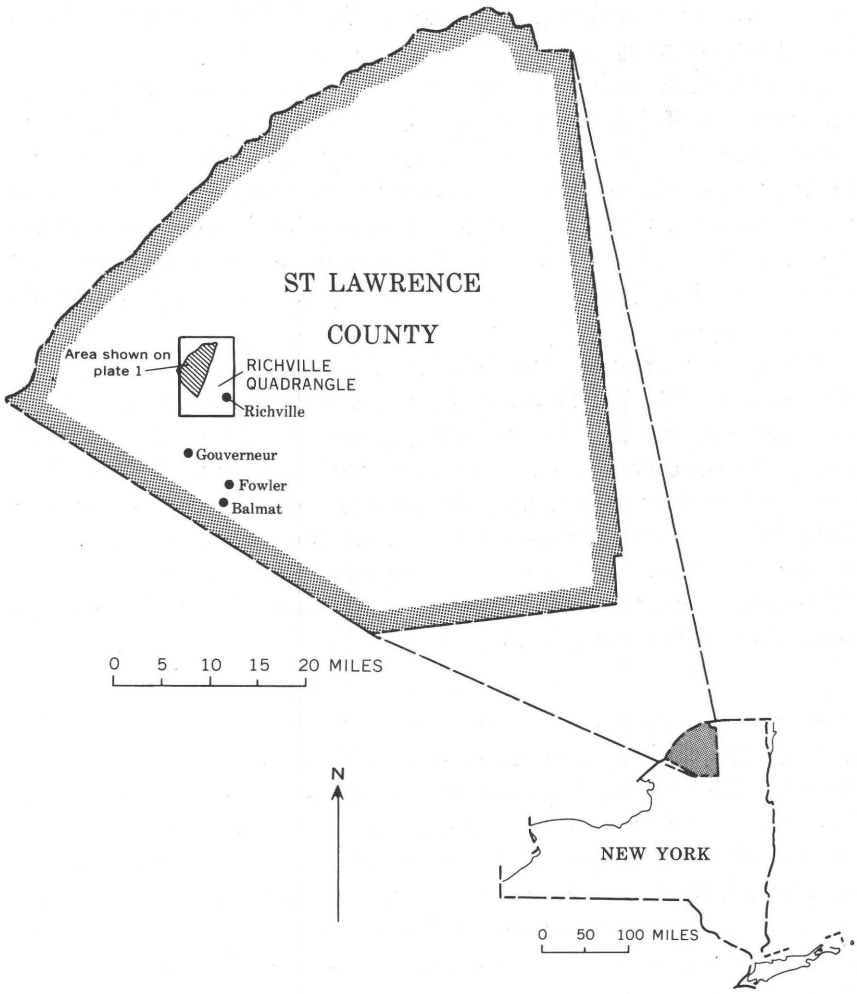

FIGURE 1.—Index map of New York State showing St. Lawrence County and the area of this report.

lenses of feldspathic quartzite as much as 10 feet thick that are difficult to distinguish from aplitic phases of the intruding gneissic granite.

Silicated Dolomitic Marble

Gray to cream dolomitic marble overlies the quartzose calcitic marble. The contact zone is concealed by the Osborn Lake swamp along the east side of the mapped area and is beneath an outlier of Potsdam Sandstone at the south end. The dolomitic marble has

many clots of diopside and tremolite that locally contain 2-inch-long crystals partly altered to talc and serpentine.

Outcrops are most abundant in the small valley southeast of Huckleberry Mountain where a rude stratigraphy is evident. The lower part of the unit is cream-colored, well-layered, medium-grained dolomite that on weathering disintegrates to a coarse dolomite sand. Higher in the section the dolomite contains numerous thin discontinuous layers of fine-grained white diopside and tremolite. Near the top, a few feet of gray, graphitic, dolomitic marble occurs.

The tabular granite body that forms Huckleberry Mountain cuts off the dolomitic marble about half a mile northeast of the mountain (pl. 1). From here the outcrop area of the marble extends 1½ miles southeast, then turns northeast in Osborn Lake valley. The unit disappears beneath the swamp, but reappears north of Osborn Lake where it forms low knobs in the middle of the swamp. South of section *C–C′* (pl. 1) where exposures are abundant, the thickness is about 500 feet. North of Osborn Lake the map pattern suggests that it is considerably thicker.

Talcose Schist and Quartzite

A thin zone of talcose, tremolitic quartzite, and a much thicker zone of talc-tremolite-anthophyllite schist overlies the dolomitic marble. This is the talc-tremolite zone described in detail in a later section of this report. The main outcrop area begins in the valley half a mile east of Huckleberry Mountain and extends southeast for 1 mile, where it lenses out. Outcrops are rare but the unit's presence is known from talc flakes and schist fragments in the soil. At one good exposure the total thickness of the zone is more than 125 feet. Most of the unit is talc-tremolite-anthophyllite schist, and it has as much as 25 feet of quartzite at the base and a chloritic talc schist at the top. The quartzite is in ¼- to 4-inch layers having thin talc-tremolite partings.

One mile north of Osborn Lake the unit also crops out on two low knobs in the swamp. These hills are formed mainly of talcose tremolitic quartzite. The occurrence of talc-tremolite schist in these outcrops suggests that the swamp-covered interval between the low hills probably is underlain by weakly resistant talc-tremolite schists. The talc-bearing zone also occurs in outcrops rising a few feet above the swamp about 1,000 feet north of Osborn Lake.

Interlayered Gneiss, Schist, and Quartzite

Overlying the talc-bearing rocks is a mixed section of feldspathic quartzite, microcline-quartz-oligoclase-biotite paragneiss, and quartz-microcline-mica schist. In all three lithologies, tourmaline occurs as minute scattered stubby crystals and is particularly abundant in quartzite in the lowest part of the unit. The tourmaline-rich rocks, which are mainly exposed directly above the talcose rocks southeast of Huckleberry Mountain contain as much as 30 percent magnesian tourmaline (dravite). The gneisses and schists also locally contain green hornblende and porphyroblasts of scapolite, muscovite, and sillimanite. The quartz-microcline-mica schist is locally pyritic and is very rusty in weathered outcrops.

Interlayered Silicated Marble and Quartzite

The uppermost stratigraphic unit is interlayered quartzite and marble as much as 1,000 feet thick preserved in the broad transverse structural depression south and west of Osborn Lake. The basal part of this unit is mainly thin beds of quartzite with interlayers of silicated marble, all of which is pyritic and weathers to coarse ocherous quartz sand. Massive iron-stained quartzite of this basal zone forms a prominent rusty hill east of the road and half a mile southwest of Osborn Lake.

Much of the rock in the upper part is quartzose calcitic pyritic marble that contains abundant pale-green diopside and tremolite. Most of these rocks are medium-grained, but locally some layers are coarsely recrystallized and have pale-green crystals of diopside and tremolite as much as 6 inches long. At no place where these rocks were observed are they altered to talc, anthophyllite, and serpentine, as are similar rocks of the talc zone. These marbles are more calcitic than the silicated dolomitic marbles below the talc-bearing zone, and the amount of pyrite and the green color of the silicates suggest that they also contain more iron.

IGNEOUS ROCKS

Gneissic Granite

Tabular bodies of gneissic granite ranging in size from the thick sheet that forms Huckleberry Mountain to dikes only a few feet thick intrude the metasedimentary sequence. Although most bodies are low dipping like the country rock, crosscutting relationships are evident from the map pattern. This is shown by three tongues of granite near the Huckleberry triangulation station close to the center of the map (pl. 1). The thick Huckleberry Mountain sheet cuts at a low angle through the entire metasedimentary

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sequence from the uppermost unit three-fourths of a mile north of Huckleberry Mountain to the lowermost quartzose calcitic marble where the granite emerges east of Osborn Lake valley (pl. 1, section *C–C'*). East of the lake the sheet seems to be as much as 1,200 feet thick.

The gneissic structure is weak in most of the granite and is seen best where outlined by streaky patches of biotite. Foliation and lineation generally are parallel to those structures in the country rock. The rock is normally pale pink and dark minerals are scarce, but granite dikes cutting the uppermost silicated marble and quartzite are gray and essentially nonfoliated.

Diabase Dikes

A steeply dipping diabase dike crosses Rock Island Road half a mile north-northwest of Osborn Lake. From there it extends southwestward for 2 miles and northeastward for half a mile. The width of the dike averages about 30 feet and reaches a maximum of 55 feet. The dike rock has diabasic texture and is undeformed. Cushing and Newland (1925) saw this dike where it crosses Rock Island Road and called it upper Precambrian. Buddington (1934) also assigned this age to a similar dike about 5 miles to the southwest in the Hammond 15-minute quadrangle.

CAMBRIAN ROCKS—POTSDAM SANDSTONE

Potsdam Sandstone of Late Cambrian age is present only as erosional remnants filling sinkholes and valleys in the pre-Potsdam erosional surface. The sandstone is tan and is streaked by iron stain, generally along bedding. At all occurrences the principal underlying bedrock is marble. The tongue of sandstone half a mile east of Huckleberry Mountain rests on marble adjacent to the granite and seems to fill an ancient valley.

Most of the sandstone is brecciated and erratically dipping. This seems to be a consequence of solution of the underlying carbonate rock, which allowed the sandstone to settle and collapse as support was removed from below.

PEAT AND MUCK

The swampy flat-bottomed areas along Beaver Creek and the valley containing Osborn Lake are filled by peat and an undetermined thickness of lacustrine clay and silt.

In 1968, Cornelia Cameron, a peat specialist with the U.S. Geological Survey, and the author drilled 12 holes through the peat along a traverse extending S. 75° E. across the swamp half a mile north of Osborn Lake. The peat is 15 feet thick northwest

of the low dolomitic marble ridge (pl. 1) and from 30 to 40 feet thick southeast of the ridge. The peat contains very little silt and clay. It rests on an undetermined thickness of sticky blue-gray clay except close to the ridge of marble where it rests on rock.

STRUCTURE

Although the author believes the rocks in this area are part of a large recumbent fold, the near-surface geologic structure pertinent to this report is characterized by open low-plunging folds (pl. 1). The major structure is a plunging syncline with its apex near the northeast corner of the mapped area where it is overturned (pl. 1, section *A–A'*). The plunge of 15° S. 30° to 40° W. gradually decreases southwestward for about 2 miles to a transverse axis of depression, where it is reversed. From this axis to the south part of the mapped area, a distance of 1½ miles, the northeastward plunge in turn gradually increases from zero to as much as 20°. To the southwest, the syncline becomes a minor synclinorium (pl. 1, section *C–C'*) as it spreads out into a series of plunging minor folds. Southwest of the axis of depression, a northeast-plunging anticlinal axis lies west of the synclinal structure. The axis of the anticline trends N. 55° E. and passes close to Huckleberry Mountain.

Two steeply dipping minor faults that trend N. 50° E. were found (pl. 1). One fault cuts the south outcrop area of the talc zone and has about 20 feet of vertical offset. Another fault in the central part of the map also has minor vertical offset.

TALC-TREMOLITE ZONE

STRUCTURE AND DISTRIBUTION

The talc-tremolite zone includes both talc-tremolite schist and quartzite; however, only the talc-tremolite schist, which may also contain varying amounts of anthophyllite and serpentine, is potentially usable for industrial talc. The schist has few outcrops, but the associated quartzite does crop out and can be used as a guide to the distribution of the talc zone. The talc-tremolite schist and quartzite crop out inconspicuously (pl. 1) below gneiss, schist, and quartzite on the south-facing slope of the small valley ½ to 1½ miles southeast of Huckleberry Mountain. The entire outcrop area, which possibly includes the thickest part of the talc-tremolite zone, is here confined to the axial part of the minor synclinorium. Close to the upturned east flank of the synclinorium the talc zone pinches out (pl. 1). In its outcrop near Huckleberry Mountain, the talc zone plunges northeastward toward the transverse axis of de-

pression where projection of dip and plunge angles indicates that the zone is possibly not more than 1,500 feet beneath the surface. North of the transverse axis of depression, the zone rises on the southwest plunge of the fold and reappears at the surface in the swamp north of Osborn Lake. Outcrops in the swamp are mainly thinly layered quartzite with talc-tremolite partings. Northwest-dipping talc-tremolite schist crops out on the two low knobs in the middle of the swamp 1 mile north of Osborn Lake and probably occurs beneath the swamp between the outcrops (pl. 1). Talc-tremolite schist also crops out 1,000 feet north of Osborn Lake.

Brown and Engel (1956) and Engel (1962) show that the talc zones in the Balmat-Fowler district are extremely deformed, have pinch outs, and are commonly thickened in the apical parts of folds. The talc-bearing zone in De Kalb Township also pinches out and is thickened in the axial part of the fold. The reappearance of the zone north of Osborn Lake on the trend of the plunge of folding suggests that it can occur more or less continuously on this trend in the subsurface between the two main outcrop areas.

LITHOLOGY

The talc-tremolite zone is well exposed at only one place, 800 feet west of Rock Island Road directly northeast of the De Kalb-Gouverneur town line. About half the talc-bearing zone is exposed at this outcrop, and the lithology of the remainder can be inferred from float fragments (fig. 2). The basal rocks are thinly layered buff quartzite with talc-tremolite partings. Individual layers of quartzite average less than 1 inch in thickness, and the total thickness of the unit is about 15 feet. Above the quartzite, more than 100 feet of talc-tremolite-anthophyllite schist occurs in layers ½ to 3 feet thick. The lower part is made up of hackly, randomly oriented tremolite crystals as much as 4 inches long, which are largely altered to fibrous talc and anthophyllite. The rock in the lower part also contains quartzite lenses that would hinder its use for industrial talc but the quartz content decreases sharply upward in the section. The overlying talc-tremolite rock is finer grained and more massive, and the randomly oriented altered tremolite crystals are less numerous. The rock near the stream is an extremely well lineated massive white tremolite schist. North of the stream most of the upper part of the talc zone does not crop out. The few outcrops and float fragments are of a well-foliated and partly chloritized talc schist that contains abundant small brownish-pink tourmaline grains.

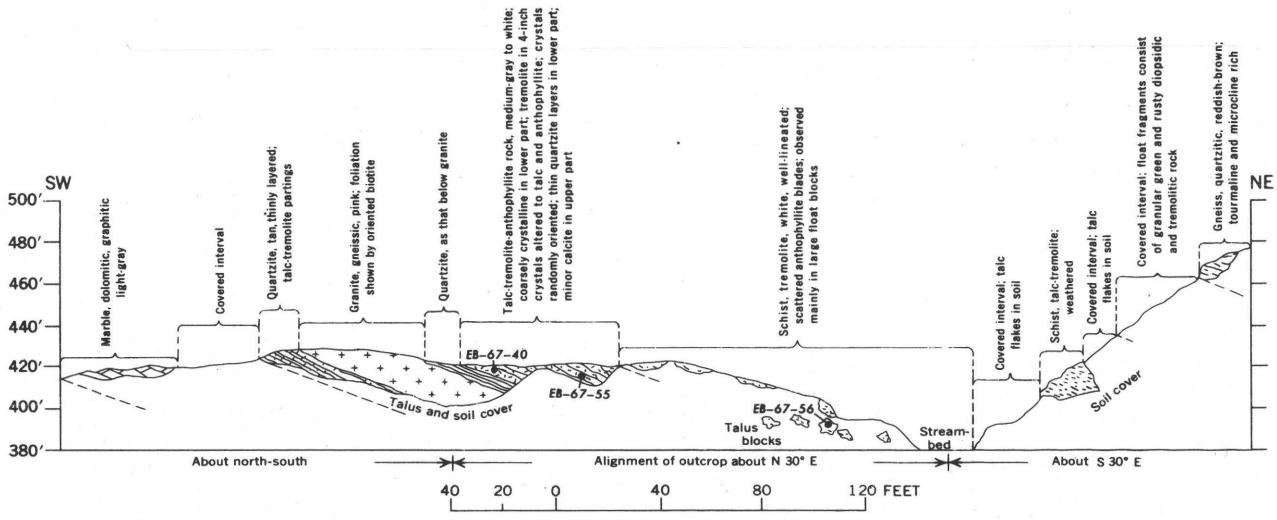

FIGURE 2.—Diagrammatic sketch of the De Kalb-Gouverneur town-line outcrop of the talc-tremolite zone, showing lithology and sample locations. See plate 1 for location of line of section.

Outcrops of the talc-bearing zone north of Osborn Lake are mainly of thinly layered quartzite (pl. 1). The quartzite is iron stained, and silicates include some green chlorite. At the extreme north tip of the eastern ridge, massive northwest-dipping talc-tremolite schist overlying 25 feet of quartzite is exposed in moss-covered outcrops that rise only a few feet above the swamp. Talcose schist possibly underlies much of the swamp from here west to the other low hill of talc-bearing rocks. The latter outcrop which includes the underlying dolomite is believed to be along the axis of a minor anticline overturned to the southeast. In this vicinity the geology has been studied only in reconnaissance, and more careful study should determine the structure in greater detail.

SAMPLING AND ANALYSES

Four surface samples of talc-bearing schist were collected from the two main outcrops of the zone to determine its suitability for industrial talc. Surface material is discolored to a depth of a few inches and slight staining, mainly along fractures, extends much deeper. The samples were obtained by breaking down large blocks with a sledge hammer so as to collect relatively fresh material. The three samples taken at the De Kalb-Gouverneur town-line outcrop (pl. 1 and fig. 2) are representative of the main lithologies that appear potentially useful. The fourth sample was taken at the low outcrop of talc-tremolite schist in the swamp 1¼ miles north of Osborn Lake. Despite some unavoidable surface discoloration and a medium-gray color for sample EB–67–40, all four samples when pulverized were surprisingly white. Color measurements were not made because of the obvious stains; however, unstained rock for this test probably could be collected by trenching with a bulldozer.

Rapid-rock and semiquantitative spectrographic analyses of the four samples (table 1) compare favorably with analyses of industrial talc mined in the Fowler-Balmat area. A wide range in the proportions of talc, tremolite, anthophyllite, and serpentine is acceptable for the various grades of industrial talc, but other minerals such as biotite, quartz, calcite, pyrite, and tourmaline are deleterious. Iron and manganese oxides, SO_3, and CO_2, where present in quantities of more than 1 percent, are objectionable (Chidester and others, 1964). Sample EB–67–55 has about 3 percent calcite, which is too high for some uses. Sample EB–67–56 is relatively high in CaO because of the high tremolite content which is not objectionable. Fibrous talc and anthophyllite in sample EB–67–40 cause the pulverized material to be fluffy and

capable of being packed together like felt. Fibrous talc is highly desired for certain purposes.

TABLE 1.—*Results of chemical analyses, in weight percent, of industrial talc rock from deposit in De Kalb Township, St. Lawrence County, N. Y.*

[Major elements analyzed by Paul Elmore, Lowell Artis, G. W. Chloe, J. L. Glenn, S. D. Botts, Hezekiah Smith, and James Kelsey using methods described by Shapiro and Brannock (1962) and supplemented by atomic absorption. Minor elements analyzed by J. L. Harris and A. W. Helz using semiquantitative spectrographic analysis]

Constituent	Sample field number and laboratory number			
	EB–67–40 W169489	EB–67–55 W169490	EB–67–56 W169491	EB–67–88 W169492
Major elements				
SiO_2	61.8	55.2	59.4	59.4
Al_2O_3	.11	.70	.55	.39
Fe_2O_3	.22	.60	.07	.00
FeO	.80	.36	.24	.15
MgO	30.9	25.4	25.2	26.4
CaO	.52	9.8	12.2	8.8
Na_2O	.08	.26	.58	.36
K_2O	.13	.62	.09	.15
H_2O-	.43	.15	.03	.10
H_2O+	3.5	1.3	.60	1.6
TiO_2	.05	.12	.10	.07
P_2O_5	.07	.17	.05	.00
MnO	.08	.07	.07	.03
CO_2	<.05	1.4	<.05	.65
Volatiles other than CO_2 and H_2O	1.4	1.0	.13	1.2
S as SO_3	.00	.00	.00	.00
Sum	100	[1] 97	99	99
Minor elements				
B	0.005	0.003	0.003	0.003
Ba	.003	1.5	.005	.005
Cr	.0003	.0015	.0003	.0003
Cu	.0001	.0003	.001	.0005
Mo	.0007	0.	0.	.001
Sr	0.	.015	.001	.0007
V	.001	.0015	.0015	.0015
Zr	.002	.001	0.	0.

[Results are reported in percent to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1, and so forth; numbers represent approximate midpoints of interval data on a geometric scale. The assigned interval for semiquantitative results will include the quantitative value about 30 percent of the time. Elements looked for, but not detected: Ag, As, Au, Be, Bi, Cd, Ce, Co, Ga, Ge, Hf, Hg, In, La, Li, Nb, Ni, Pb, Pd, Pt, Re, Sb, Sc, Sn, Ta, Te, Th, Tl, U, W, Y, Yb, Zn, Eu]

[1] Spectrographic analysis shows 1.5 percent barium. Barium-bearing mineral not identified.

Sample	*Location*	*Approximate mode (in volume percent)*
EB–67–40	See fig. 2	Talc, 90; tremolite, 5; anthophyllite, 5.
EB–67–55	See fig. 2	Tremolite, 65; talc, 32; calcite, 3.
EB–67–56	See fig. 2	Tremolite, 83; anthophyllite, 12; other minerals, 5.
EB–67–88	1¼ miles north-northeast of Osborn Lake, 2,000 ft southeast of Rock Island Road (pl. 1).	Tremolite, 57; talc, 37; feldspar, 3; calcite, 1; other minerals, 2.

Variation in the mineralogic composition in these samples should not hinder the commercial value, because the many uses for industrial talc require a variety of physical properties that ultimately depend on variation in the proportion and habit of constituent minerals.

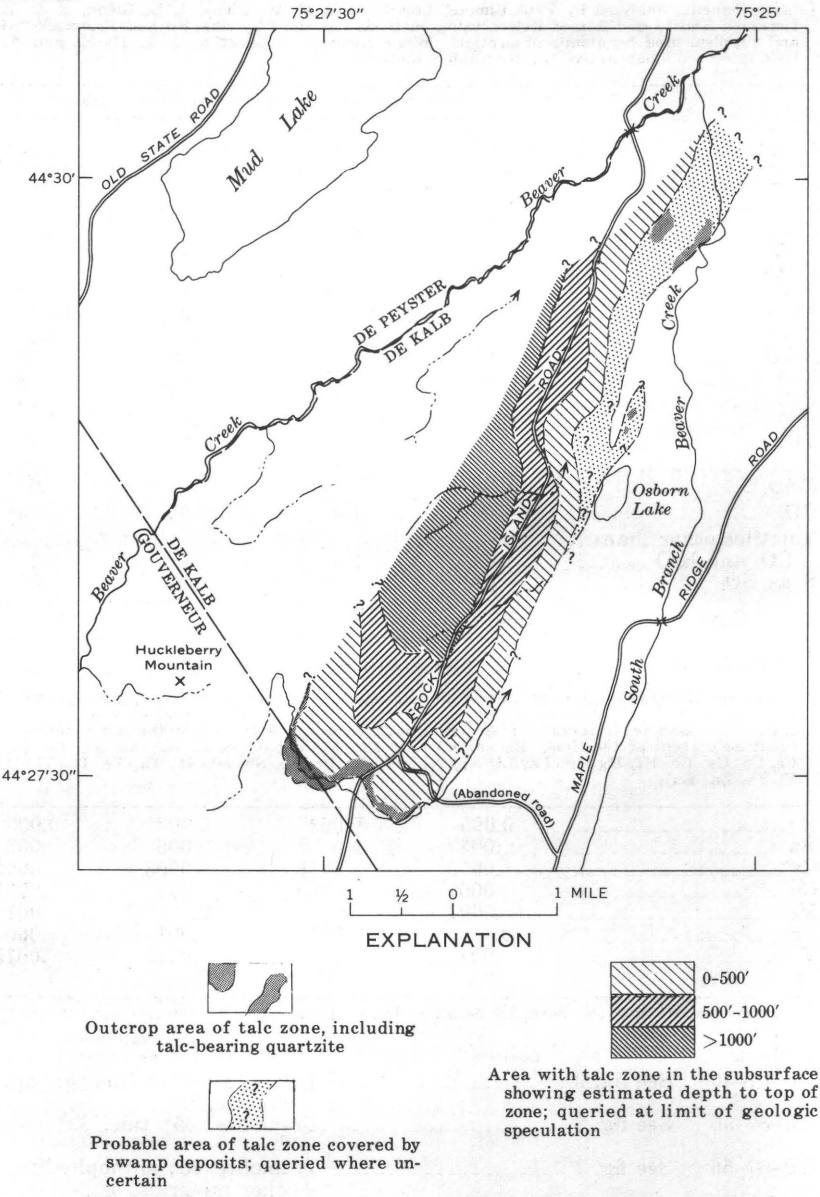

FIGURE 3.—Outcrop area of talc-tremolite zone and probable occurrence at depth.

SUGGESTIONS FOR FURTHER WORK

Preliminary exploration of the talc-tremolite zone can best be done by bulldozer trenching in the vicinity of the De Kalb-Gouverneur town-line outcrop. Such trenching should give an indication of the depth of staining and provide samples for mill tests to determine the suitability of this rock for industrial talc. Trenching in the vicinity of the swamp outcrop north of Osborn Lake would be more difficult because water occasionally stands in much of that area. Draining of the swamp is not feasible as it has a gradient of about 1 foot per mile from this area to the mouth of Beaver Creek about 10 miles downstream.

Beyond the outcrop areas and in the swamp, drilling is necessary to prove the extent and quality of the deposit. Drill holes located along the minor fold axes a few hundred feet northeast of the southern fringe of the talc zone (fig. 3), and angled holes drilled eastward along the eastern fringe of the gneiss-schist-quartzite unit north of Osborn Lake, should intersect the talc zone at shallow depths. Holes in these places might have thick intersections of talc-bearing rock because of the possibility of thickening in the axial parts of folds. For the same reason, deeper holes drilled in the vicinity of the transverse axis of depression 2,500 feet southwest of Osborn Lake might intersect thick sections of the zone.

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