New York Talcs, Their Geological Features, Mining, Milling, and Uses

By A. E. J. Engel

Introduction

The New York talc deposits of commercial importance are in St. Lawrence and Lewis counties, in the northwest Adirondack Mountains (Fig 1). All of the deposits are of pre-Cambrian age and occur within highly deformed and recrystallized marble of the Grenville series.

The deposits in St. Lawrence County, near Gouverneur, are the largest and most productive of their type known in the Western Hemisphere. In 1948 the seven mines which are in operation will produce about 130,000 tons of ground talc.

All talc production in Lewis County is from one mine. There the annual production ranges from 15,000 to 30,000 tons.

These so called talcs of New York State include earth materials of different chemical and mineral compositions. In general the mineral talc is subordinate in amount to other minerals in both the Gouverneur and Natural Bridge deposits.

In the Gouverneur district the mineral talc comprises less than 25 per cent of the mined and ground rock. Most of the rock mined is a tremolite- or tremolite-actinolite-schist somewhat altered to serpentine and talc.

FIG 1—Map of New York talc deposits in the Adirondack Mountains.

This characteristic in no way devalues the "talc" for certain markets, and in some instances makes the material more desirable.

The Natural Bridge talcs include types high in serpentine, as well as complex aggregates of serpentine, talc, carbonates, and diopside.

Usage of the term talc, however, for...
these industrial mineral aggregates is widespread and deeply rooted. Accordingly, this usage is followed in this paper. The phrase “the mineral talc” is used herein wherever reference is made to the specific mineral, Mg₃Si₄O₁₀(OH)₂ or in terms of oxides H₂O·3MgO·4SiO₂.

**General Geology**

The talc of the Gouverneur district occurs in elongate zones interlayered within a northeastward-trending belt of impure marble. The marble belt is apparently part of a highly deformed and metamorphosed flank of a northeastward-trending anticline. Cross folds, plunging north to northwest, foliations, shear, and lineations constitute important structural features of the talc zones (Fig 2 and 3).

The zones of commercial talc pinch, swell, and curve in sinuous to complexly folded patterns, Fig 2, but are rudely conformable with adjoining marble layers. The talc zones have a composite strike length of more than six miles, a probable extent down dip in excess of 2000 ft, and widths of as much as 400 ft. Dips along the talc belts are quite variable, ranging from the horizontal through the vertical, but averaging about 45° to the northwest.

Variations in thickness of the talc belts or of any included zone may be either abrupt or gradual. The belt near Talcville, which contains two producing mines, varies up to 300 ft or more in thickness, averaging perhaps 135 ft thick in the mines, Fig 3.

**Table 1. The Approximate Percentages of Constituent Minerals in Layers of Commercial Talc and the Oil Absorption of These Layers**

<table>
<thead>
<tr>
<th>Specimen Number</th>
<th>1</th>
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<th>10</th>
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<tbody>
<tr>
<td>Tremolite</td>
<td>68</td>
<td>98</td>
<td>17</td>
<td>22</td>
<td>&gt;4</td>
<td>45</td>
<td>78</td>
<td>15</td>
<td>88</td>
<td>46</td>
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<tr>
<td>Talc, fibrous</td>
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<tr>
<td>Talc, foliate</td>
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<tr>
<td>Talc, shingled aggregate</td>
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<tr>
<td>Serpentine, massive</td>
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<td>54</td>
<td>21</td>
<td>5</td>
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<tr>
<td>Carbonates</td>
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<tr>
<td>Hexagonite, iron and magnesite oxides, mica, other impurities</td>
<td>trace</td>
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<td>4</td>
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<td>Oil absorption</td>
<td>trace</td>
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1. Pale-pink, tremolite schist, hanging-wall side of talc belt, Talcville, N. Y.
2. Lustrous, white, stubby-bladed tremolite rock interlayered with Specimen No. 1.
3. Pale gray to white, fibrous "talc," Talcville, N. Y.
4. Watery-green, serpentineized diopside rock along footwall talc belt, Talcville, N. Y.
5. Serpentine-tremolite, "quartzite," Talcville, N. Y.
6. Streaked, buff to chalky-tan, serpentinous tremolite, "regular ore," Talcville, N. Y.
7. Watery-gray, fibrous to bladed, tremolitic talc, Ontario mine, Fowler, N. Y.
10. Pale buff, highly schistose "talc," hanging-wall zone, Woodcock mine, Balmat, N. Y.

Much of this thickness is commercial talc. A talc belt north of Balmat and southeast and east of Fowler, along which are 4 active mines, varies up to at least 425 ft in thickness, and averages possibly 125 ft thick, Fig 2. In this belt, however, one or several zones of commercial talc 6 to 25 ft thick or rarely as much as 75 ft thick are interlayered with impure or discolored noncommercial zones within the belt. Within these two belts are talc reserves sufficient to last several generations, at the present rate of production, under resourceful mining methods.

The approximate percentages of constituent minerals in various types of commercial talcs from the Gouverneur district are shown in Table 1. A wide variation in proportions of tremolite, anthophyllite, serpentine, and talc are apparent. Other minerals which occur in and along the talc belts include quartz, calcite, dolomite, hexagonite (a manganese-bearing tremolite), iron and manganese oxides, diopside, chlorite, pyrite, mica, feldspars, titanite, magnesite, and manganese-bearing tourmalines, and apatite. Most of these last-named minerals constitute obvious adulterants or impurities and are avoided in mining.

The chemical compositions of some of the more important types of talc are indicated in Table 2. The range of variations in SiO₂ and MgO are readily apparent. Iron and manganese oxides, SO₃, and CO₂ when present in excess of the amounts shown constitute serious impurities for some markets. In general the companies in the Gouverneur district attempt to keep the CaO content between 3 and 7 pct, and the MgO content between 25 and 30 pct. The relatively high CaO content is largely a reflection of the lime present in tremolite and anthophyllite.

**Table 3.** The approximate percentages of commercial talc and the oil absorption of these layers

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<td></td>
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<tr>
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The talc-forming constituents doubtless were derived largely from the quartzite and dolomite beds, but water, silica, magnesia, and other elements were introduced into the present talc belts, and calcite removed by hydrothermal solutions.
Tale Mining

In general, methods used in mining New York talcs are less progressive than those used in the zinc mines of the same region. Until recently, less than 30 pct of the commercial talc in the larger deposits was recovered. The amount of talc recovered from smaller, complex zones and ore bodies was considerably smaller. In general, however, and especially at Natural Bridge, N. Y., numerous natural obstacles in the way of efficient operations are presented by complexities of form, structure and composition of these talc deposits. At present, capable operators, who have introduced modern equipment, are in charge in most of the New York mines, and the projected plans of the several companies, if effected, will result in a more ideal exploitation of the important talc deposits.

Both the tabular deposits of the Gouverneur district and the brecciated talcose marble at Natural Bridge have a moderate to steep dip. In these deposits it is common practice to sink a shaft in the talc, on the footwall side of the desired rock. Since the commercial talc is followed by most of the shafts, changes in dip and plunge of the talc body are reflected in corresponding irregularities of the shafts.

One straight, inclined shaft was sunk in 1934 in the Gouverneur district, and another vertical, concrete-lined shaft is being sunk at present to an adjacent talc body.

In most of the New York mines, drifts and crosscuts driven from shafts are used to explore and outline the body of minable rock, as well as for tramways and subsequent mining needs. Since many deposits are of irregular, folded forms, many drifts are quite crooked. Almost no timbering is done in the Gouverneur district. At Natural Bridge, steel and concrete are employed in the shaft where it cuts a body to drive raises at frequent intervals, often 30 to 50 ft, in whatever minable talc is encountered, as far as the overlying levels, or as far as safety or the upper limit of the talc body permits. Wet drilling is employed exclusively in the New York mines to reduce the hazard of silicosis and fibrosis.

The raises are enlarged into stopes, with the broken rock falling to the drift floor to be mucked by hand or mechanically. A few old stopes in a number of New York mines "work themselves."

Recent practice in the Gouverneur district tends toward the development of conventional sublevel stopes wherever possible, with grizzlies and chutes. A valuable addition is a waterway with a fine-spaced grizzly placed in the intersection of appropriate raises and sublevels to drain off water which would otherwise soak the muck and impede mucking (Fig 4). The underhand stoping (benching) method of mining commonly is employed where possible.

In several mines in the Gouverneur district, blocks of ore are mined by long hole drilling.

Conventional practice in all the mines involves the use of air and electrically operated mucking machines, commonly rocker shovels, for mucking crosscuts and drifts. Small battery locomotives have supplant ed hand tramming in all the mines. One company in the Gouverneur district sorts talc at the mine on steel plates in the head house. Under the steel plates is a series of bins into which talc is sorted according to color and impurities.

Milling

Talc milling in New York, as elsewhere, is largely a grinding operation, accompanied by air separation. Seven talc mills are in operation in New York, six of them in the Gouverneur district. Driers are employed in three of these mills in the Gouverneur district since 1934.

<table>
<thead>
<tr>
<th>Specimen Number</th>
<th>1</th>
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<td>SiO₂</td>
<td>59.80</td>
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<td>67.0</td>
<td>56.50</td>
<td>59.40</td>
<td>57.26</td>
<td>47.90</td>
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<td>Al₂O₃</td>
<td>4.05</td>
<td>5.48</td>
<td>4.75</td>
<td>3.98</td>
<td>4.09</td>
<td>3.98</td>
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<td>Fe₂O₃</td>
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<td>16.20</td>
<td>15.60</td>
<td>15.70</td>
<td>15.30</td>
<td>15.60</td>
<td>15.30</td>
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<td>MnO</td>
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<td>0.69</td>
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<td>0.80</td>
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<td>CaO</td>
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<tr>
<td>MgO</td>
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<td>25.71</td>
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<td>SO₃</td>
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<td>4.80</td>
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<td>1.49</td>
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<td>Ignition loss</td>
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<td>Water (105°C)</td>
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<td>CO₂</td>
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</table>

Table 2... Chemical Analyses of Industrial Talcs Mined in New York State


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Talc taken from some of the mines may include blocks a foot or more in wet material reduces mill capacity as much as 30 pct.

Talc goes directly from the mines to crushing plants at the mills, where primary and secondary crushers are used to reduce the talc to ½, ¾, 1½ or 2½ in. products. Finer grinding is achieved in tube mills. Raymond mills, and Hardinge mills, in closed circuits with Sturtevant, Raymond or other type air separators.

Much New York talc is ground to a wide variety of uses, some 75,000 tons of talc from the state are employed annually by the paint industry. The fibrous form of the minerals anthophyllite and talc especially seems to hold heavier paint pigments in suspension longer, and to prevent caking and settling. The fibrous and blade-like mineral forms are also believed to serve as locking or bonding agents in the paint film. Better grades of Gouverneur talc have values of 90 or better in the standard industry whiteness scale.

A conventional standard for classifying New York talces prepared for paints is the Gardner-Coleman oil absorption test. In general, fine grinding increases the quantity of a given oil required to wet thoroughly all the absolute particle surface of the talc. For approximately uniform particle sizes, the talces composed largely of the mineral talc, or serpentine, have a higher oil absorption than talces rich in tremolite, quartz, or carbonates. Highly fibrous or flaky grains have greater oil absorption than equant grains of roughly the same size groups as indicated by conventional screening.

New York talces range from 30 to 60 in the scale of oil absorption. The slightly serpentinous or talcose tremolite schist so common in the mines of the Gouverneur district tests between 40 and 45 when ground so 97.5 percent of the talc will pass through a 325 mesh screen. Essentially unaltered tremolite, ground to about the same size averages between 30 to 34 in oil absorption.

Table 1. This same tremolite rock, ground to mean grain sizes of 1 to 25 microns, tests about 40 to 42 in oil absorption. Obviously the extent of surface area in relation to the mass of the grain is an important factor in determining oil absorption.

The ceramic industry used about 25,000 tons of New York talc in 1947, and probably will use a larger tonnage in 1948. In the manufacture of white-ware bodies, the CaO content of 4.5 to 6.5 which characterizes much Gouverneur talc is not at all objectionable, and in fact, may be desirable.

Besides the consumption of New York talc in the paint and ceramic industries, appreciable tonnages are used in the insecticide, rubber, and textile industries.

In general, consumer demand has and continues to be for a talc of uniform chemical and physical properties. Accordingly, present philosophies in the two New York districts are to establish practical and efficient means of blending and averaging out the variations along and across the strike and down dip inherent in the talce deposits.

Acknowledgments

The writer’s studies of New York talces were undertaken for the U. S. Geological Survey, and welcomed and enlivened by the staffs of mining companies in the New York districts.

I also wish to acknowledge the inestimable contributions to my efforts made by H. M. Bannerman, C. N. Bozian, A. F. Buddington, James Page and many other members of the U. S. Geological Survey.

References