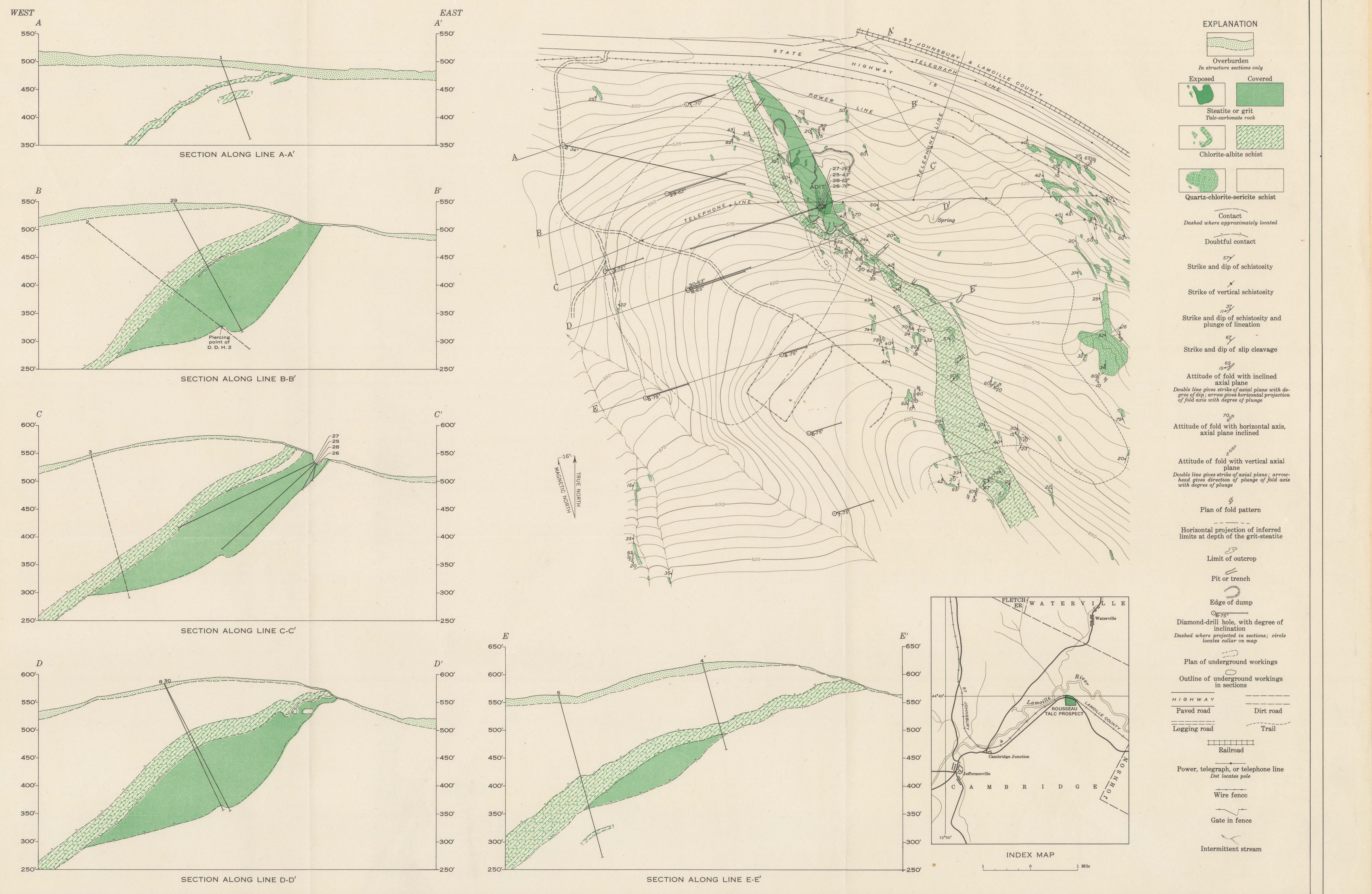

GEOLOGY OF THE ROUSSEAU TALC PROSPECT CAMBRIDGE, VERMONT

By
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INTRODUCTION

The Rousseau talc prospect is in northern Cambridge township, Lamoille County, Vermont, 2.1 miles N. 59° E. of Cambridge Junction. (See index map.) The deposit lies on the south side of the Lamoille River, near the base of the northernmost mountain of the Sterling Range. Relief within the map area is about 190 feet; maximum relief within a radius of one mile is about 800 feet. The deposit crops out between the altitudes of 515 and 565 feet above sea level, about 60 to 110 feet above the flood plain of the Lamoille River. The mapped area is drained by a small intermittent stream that flows northward into the Lamoille River about 1,000 feet northwest of the prospect. The northern and southeastern parts of the talc property are in open pasture. The rest of the area is covered with a dense growth of small spruce, balsam, and cedar.

To reach the locality from Johnson village, drive westward on State Highway 15 for 5.9 miles from the center of the village. The old mine dump is plainly visible about 200 feet south of the highway. The St. Johnsbury & Lamoille County Railroad (formerly the St. Johnsbury & Lake Champlain Railroad) is adjacent to the north side of the prospect, immediately north of the highway.

During 1915 and 1916 an adit and openings that total about 225 feet were driven in the deposit from an outcrop of talc ore, and six diamond-drill holes that total about 1,100 feet were bored. The outline of the underground openings and the locations of the drill holes (numbered 25 to 30) are shown on the accompanying map. Billings and Chidester (1950) mapped the surface and underground geology of the talc prospect in 1945, as part of the Strategic Minerals Investigations program of the U. S. Geological Survey. In July 1950 Mr. Chidester, G. W. Stewart, and D. Morris extended the mapping of Billings and Chidester to assist in the location of additional diamond-drilling sites; eight new holes (numbered 1 to 8) were drilled by the Geological Survey in July and August. The accompanying map and structure sections include the recent additions and modifications and incorporate the information obtained from the new diamond-drill holes.

The Geological Survey is indebted to the Eastern Magnesia Talc Co. for tests on color and percentage of insoluble material of samples of talc ore obtained in diamond-drilling. The Survey also wishes to acknowledge the cooperation of M. L. and M. N. Porter, of Cambridge, Vt., owners of the surface rights, and the Eastern Magnesia Talc Co., owner of the mineral rights, during the investigations.

GEOLOGIC FORMATIONS

Quartz-chlorite-sericite schist, chlorite-albite schist, steatite (a rock composed essentially of talc), and grit (a term here used to designate a rock composed essentially of talc and carbonate in roughly equal proportions) are exposed in the map area. The distribution of rock types is shown on the accompanying geologic map and structure sections. Grit and steatite are shown by the same pattern; it is impractical to separate them because the steatite unit is poorly exposed.

The schists have been formed by the metamorphism of sedimentary rocks of Cambrian age that contained interbedded volcanic material. The quartz-chlorite-sericite schist is probably derived from sandy shale, and the chlorite-albite schist is believed to have formed from shale with intermixed basaltic volcanic detritus. All of the grit and most of the steatite are probably derived from ultramafic rocks of Ordovician or later age; a small part of the steatite, and a comparatively large part locally, has been formed by the alteration of quartz-chlorite-sericite schist and chlorite-albite schist.

QUARTZ-CHLORITE-SERICITE SCHIST

Quartz-chlorite-sericite schist is the predominant rock type in the area, and forms the largest outcrops. The rock ranges in color from light greenish gray to dark gray. Proportions of minerals differ considerably, but quartz and chlorite are generally dominant. Graphite occurs locally in moderate amounts and forms concentrations along planes of schistosity that parallel the bedding. Small garnets are locally abundant. The schistosity is commonly wavy, and is locally much folded and contorted. A well-defined slip cleavage is commonly prominent where the schistosity is folded; it parallels the axial planes of the folds. This rock type is gradational into chlorite-albite schist.

CHLORITE-ALBITE SCHIST

Chlorite-albite schist forms about 10 percent of the country rock in the map area. Although this schist is variable in composition and gradational into quartz-chlorite-sericite schist, one bed immediately west of and structurally and stratigraphically above the talc deposit is fairly well defined and forms a reliable key bed. Another, lower bed was encountered in several drill holes, but as it does not crop out and was not intersected in all the drill holes, this lower bed is neither shown on the map nor interpolated in the structure sections.

The chlorite-albite schist is commonly mottled by white albite porphyroblasts in a matrix of green chlorite. Locally, where the albite content is low or where the albite is fine-grained, the rock is a uniform green or light green. The albite content of the rock ranges from a few percent to more than 50 percent. Chlorite is the other principal mineral, but irregular crystals and aggregates of carbonate are common. Biotite occurs locally and increases at the expense of chlorite; in a few places the rock is a biotite-albite-chlorite schist. Quartz and sericite occur in small amounts at most places, but where they are more abundant the rock may grade insensibly into quartz-chlorite-sericite schist.

A well-defined bedding schistosity is readily discernible except where disturbed by the abundant growth of albite porphyroblasts. The schistosity is locally folded and a slip cleavage formed, but not as commonly as in the quartz-chlorite-sericite schist.

GRIT AND STEATITE

The talc deposit contains two rock types, grit and steatite (not shown separately on the map and sections). The grit occurs as a central lenticular mass in an irregular, commonly thin envelope of steatite.

Grit.--Most of the talc ore is grit, composed essentially of talc and carbonate. It ranges from medium gray to light gray. Commonly the carbonate forms less than 50 percent of the rock, but in some places the grit contains as much as 70 percent carbonate. The carbonate forms anhedral crystals and aggregates rarely as much as 2 inches across, but commonly not more than half an inch across. The talc is fine-grained and generally nonschistose.

Steatite.--Steatite, composed essentially of the mineral talc, makes up only a minor part of the talc deposit, but it occurs locally in relatively large amounts. It ranges from light gray to pale greenish gray and is commonly schistose. Some of the steatite is gradational into schist and contains easily distinguishable relict bedding. The relict bedding is marked by thin bands of sericite and graphite and is folded and contorted in a manner identical with that of the unaltered schist.

STRUCTURAL FEATURES

The talc deposit is on the western limb of the Green Mountain anticlinorium, about 2 miles from the axis. The structures within the mapped area reflect the folds of the anticlinorium and are therefore believed to have been formed during the same period of folding. The structural features include folds, a prominent bedding schistosity, and a well-defined slip cleavage. Structures range from tiny crinkles to folds as large as 20 feet from trough to crest. The contact between the talc deposit and the schist is folded in a few places. The fold axes plunge rather gently south parallel to the plunge of the axis of the anticlinorium at this latitude. The folds are of the drag type, with the longer limbs of the anticlines on the side away from the anticlinorial axis, or to the west in the vicinity of the prospect.

A well-defined, rather coarse schistosity is conspicuous in nearly all outcrops of schist and is parallel to lithologic units, believed to be bedding, that are as much as 1 foot thick. The steatite generally has a good schistosity that is parallel to that of the nearby schist; and the grit shows a fair schistosity locally. At some places the schistosity within the steatite and grit is believed to be an inherited structure that was retained during steatitization of the schist and possibly of schistose serpentinite. The schistosity strikes slightly west of north and dips, in general, 20° to 40° W. It is wavy and crinkled and in many places much folded. The axes of the crinkles and the traces of the slip cleavage on the schistosity form a pronounced lineation that is generally parallel to the axes of the folds.

The slip cleavage is more prominent in the quartz-chlorite-sericite schist, particularly where the schist is graphitic, but it is also common in the chlorite-albite schist. The slip cleavage is parallel to the axial planes of small folds and crinkles in the bedding schistosity, and is formed best where the folds and crinkles are most abundant. In surface outcrops it strikes rather uniformly a little east of north and dips steeply to the west, but in some of the drill cores the attitude was found to change rather abruptly through a fairly wide range. A slip cleavage was observed in the steatite at a few places underground and in the drill cores. It has not been determined whether the slip cleavage observed is an inherited feature or was formed after the steatitization.

The contact between the talc deposit and the schist is essentially parallel to the bedding schistosity of the country rock at most places where the contact relations can be observed. Drill hole data show that the overall relationship, however, is slightly crosscutting. It is difficult, with the information available, to determine the nature of this crosscutting relationship. Probably, it is due chiefly to an original crosscutting inherited from the parent ultramafic rock, and is expressed now as a series of small offsets from parallelism with the schistosity; but uneven steatitization of the country rock appears locally to be responsible for an irregular, crosscutting boundary between the talc deposit and the schist.

ORIGIN OF THE DEPOSIT

The entire deposit is composed of grit and steatite; so there is little direct evidence of its original character. The grit and steatite have presumably been derived in large part from an ultramafic mass, which was first completely serpentinized. This origin is suggested by small amounts of dark-green serpentine in the grit in a few places, by the crosscutting relationship, and by compositional, textural, and structural similarities to other deposits that are clearly derived from ultramafic rocks. Part of the steatite, and locally rather large amounts, has formed by alteration of quartz-chlorite-sericite schist and chlorite-albite schist.

The mode of emplacement of the original ultramafic body, and likewise the process and time of serpentinization relative to emplacement, must be inferred from indirect evidence. Study of many bodies of ultramafic rocks in Vermont (Chidester, et al., 1951) has led the writer to favor the conception that ultramafic bodies such as the body at the Rousseau prospect (pp. 3-4) were emplaced by solid intrusion, and that serpentinization took place during the intrusion (pp. 7-8).

Alteration to steatite and grit was later than serpentinization and was entirely independent of that process, and probably took place in the later stages of folding. The steatite was produced by hot aqueous solutions of uncertain origin. The solutions may have been mobilized from the sedimentary rocks during metamorphism, or they may have been derived from underlying magmas.

ECONOMIC GEOLOGY

The data from surface and underground studies and diamond-drill exploration enable one to infer fairly accurately the size and shape of the deposit and the grade and quality of the talc ore.

The deposit is roughly lenticular. Irregularities are due to folding and probably also to uneven steatitization of the country rock and to original irregularities in the contacts of the original intrusive mass. The deposit is about 700 feet long; the long axis plunges about 20°-25° S. 15° W. The intermediate axis is about 500 feet long and plunges about 30° N. 60° W. The short axis, about 130 feet long, is at right angles to the other two and plunges about 50° N. 70° E. The horizontal projection of the inferred limits of the talc body at depth is shown on the accompanying map, and the shape and attitude of the deposit are shown in the structure sections.

Nearly all of the talc ore in exposures and in drill cores is grit of good quality. The ore is exceptionally white for talc ore associated with ultramafic rocks. Color (whiteness) tests made on representative samples indicate that a total of 164 feet of drill core recovered from talc ore averages 76.4 percent reflectance compared with standard magnesium oxide (MgO) as 100, and ranges from 75.0 to 78.5 percent. (Reflectance is a measure of the percentage of light reflected by a powdered sample of material.) In the same samples, the percentage of material soluble in hot hydrochloric acid (HCl), a fairly accurate indication of the proportion of carbonate present, averages 29.4 percent, and ranges from 11.2 to 32.5 percent.

The ore is suitable without beneficiation for many intermediate grades of talc product requiring moderately good color, but in which high carbonate content is not objectionable. It is believed that concentration by flotation would yield a product of sufficient whiteness and purity to qualify for most industrial uses other than industrial steatite. None of the material exposed or encountered in drilling is suitable for sawing into pencils or crayons for such uses as marking structural steel.

REFERENCES

Billings, M. P., and Chidester, A. H., 1950, Geologic maps and structure sections of the Rousseau talc prospect, Cambridge, Vt.: U. S. Geol. Survey Strategic Minerals Investig. Prelim. Map 3-227.
Chidester, A. H., Billings, M. P., and Cady, W. M., 1951, Talc investigations in Vermont, preliminary report: U. S. Geol. Survey Circ. 95, 33 pp.

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.

Modifications and additions to U. S. Geological Survey Strategic Minerals Investigations Preliminary Map 3-227, 1950, by A. H. Chidester, G. W. Stewart, and D. Morris July 1950

For sale by U. S. Geological Survey, price 40 cents

GEOLOGIC MAP
OF THE
ROUSSEAU TALC PROSPECT, CAMBRIDGE, VERMONT

By A. H. Chidester, G. W. Stewart, and D. Morris

100 0 100 200 Feet

Contour interval 5 feet
Datum is mean sea level

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