NOTES AND NEWS

A SERICITE OF UNUSUAL COMPOSITION

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INTRODUCTION

Pilot Knob is a conically shaped mountain located one mile northeast of Ironton, Missouri, and is similar to others that characterize that part of Missouri. The lower part of the mountain is the typical rhyolite porphyry of the area. Beds of specular iron ore rest on the porphyry and above the iron ore is one hundred or more feet of a ferruginous conglomerate that forms the top of the mountain.

A dominantly greenish but also gray or tan colored mineral is found in this conglomerate. The mineral occurs in variously sized masses, some nearly as large as a football, but the majority only two or three inches across. They are very irregularly shaped and appear to be either altered pebbles that compose the conglomerate, or streaks of material between the pebbles. They occur throughout the conglomerate.

The mineral ranges in hardness from 1 to 4. Usually the fresh material is soft, but after exposure it becomes harder. Because of its soft greasy feel it has often been called steatite. Some specimens show a lustrous surface indicating the micaceous character of the mineral, other specimens are dull. As noted above, it is dominantly green, but gray, tan, yellow, red, and even purple colored varieties have been noted.

This mineral has been given various names, most often steatite, by those who have studied the Pilot Knob iron ores. The mineral was called steatite or clay by Raphael Pumpelly;[1] serpentine by Adolf Schmidt;[2] steatite by J. R. Gage;[3] sericite by Frank Nason;[4] and talcose clay by G. W. Crane.[5] In view of this disagreement as to its character and the incomplete data relative to its composition, it was decided to investigate the material and to determine, if

[1] *Report of the Geol. Sur. of Missouri*, Part **1**, pp. 4, 15–16, 1872.

[2] *Ibid.*, p. 113.

[3] *Trans. Acad. Sci., St. Louis*, vol. **III**, p. 189, 1873.

[4] *Missouri Geol. Survey*, vol. **II**, *Report on the Iron Ores*, pp. 38–39, 1892.

[5] *Missouri Bur. Geology and Mines*, vol. **X**, 2nd series, p. 128, 1912.

possible, the composition and the correct mineralogical name. The mineral analyzed was collected by Professor W. A. Tarr.

Composition

The mineral was examined qualitatively by chemical, mineralogical, and optical tests. Iron, aluminum, potassium, sodium, silicon, and water were found to be present. The quantitative determinations gave the following results:

	1.	2.	Average
SiO_2	47.30	47.30	47.30
Al_2O_3	36.38	36.24	36.31
Fe_2O_3	2.17	2.17	2.17
Na_2O	5.26	5.28	5.27
K_2O	2.63	2.78	2.70
H_2O	5.75	5.86	5.80
	99.49	99.63	99.55

Although the physical characters suggested sericite, the above analysis showed the sodium to be present in larger amounts than potassium. This composition lead to a study of the available analyses of sericite and related minerals in order to determine its true chemical relationship. It was found that very few chemical analyses of sericite are available. The available analyses of sericite show the alkali content varying from almost 12% K_2O and no Na_2O to almost equal amounts of the two alkalies. Dana shows in the following analysis almost equivalent quantities of the two alkalies.

	Sericite[6]
SiO_2	54.00
Al_2O_3	26.23
Fe_2O_3	3.81
MgO	0.83
CaO	0.52
K_2O	4.41
Na_2O	4.00
TiO_2	1.51
H_2O	4.31
	99.62

The silica and total alkali content of the Pilot Knob mineral is quite similar to paragonite, but the alumina content, as well as other properties, indicate that it is not paragonite.

[6] Dana, *A System of Mineralogy*, **1895**, p. 618, No. 40.

Winchell[7] makes the statement that: "Recent data (Shannon[8]) suggest that sericite contains less potash and more water***** than ordinary muscovite." This is true of the mineral under discussion. In common muscovite the ratio between water and the alkalies is 2 to 1. In the Pilot Knob mineral the ratio is nearly 3 to 1. Dana[9] states that: "Mica at times becomes hydrated, losing its elasticity and transparency, and often some portion of the potash; and at the same time it may take up magnesia, lime, or soda. These changes may be promoted by waters containing carbonates of these bases."

Although the molecular formula $3\ (H,K,Na)_2O.3(Al,Fe)_2O_3.6\ SiO_2$ or $(H,K,Na)_3(Al,Fe)_3(SiO_4)_3$, derived from the chemical analysis of the mineral studied, approaches the formula for sericite as closely as most of the analyses, the higher water content and lower percentages of the alkalies yield ratios of nearly 3 to 1 instead of 2 to 1. The slightly higher percentage of silica as well as the ferric oxide are probably due to impurities. A few flakes of specularite (Fe_2O_3) could be seen in the mineral with a binocular microscope. Its presence is to be expected because the material was derived from a conglomerate associated with a specularite deposit.

Other Physical Properties

The specific gravity of the mineral used in this study was determined to be 2.69, while the specific gravity of sericite is generally given as 2.67 – 2.83.[10] This wide range doubtless is due to the variable chemical composition of sericite. The presence of a larger amount of soda than of potash in the Pilot Knob mineral would tend to decrease its specfic gravity as compared with normal sericite. Sericite, as well as the mineral studied, when heated before the blowpipe fuses to a white-gray enamel. This aids in distinguishing the mineral from kaolinite and muscovite.[11]

Apparently no work on the dehydration of sericite has been done. The dehydration curve of the material studied (see Fig. 1.) shows a very slight loss of water between the temperatures of 85°–450° and from 600°–1080°C. Between 450°–600° a rapid loss

[7] Winchell, N. H., and Winchell, A. N., *Elements of Optical Mineralogy*, p. 363, **1927**.

[8] *Proc. U. S. Nat. Mus.*, vol. **62**, Art. 15, p. 10, 1923.

[9] Dana, *Loc. cit.*, p. 620.

[10] Dana, *Loc. cit.*, p. 620.

[11] Shannon E. V., *Ibid.*, pp. 6–11.

of water was noted. This gives a very distinct curve that is somewhat similar to the dehydration curves of many clay minerals as plotted by Ross and Kerr.[12] The curve for sericite is so distinctive that it should be useful in future determinations of the mineral. The water content for sericite is consistently given between 4.5 and 6 per cent. The mineral studied has 5.80 per cent of water.

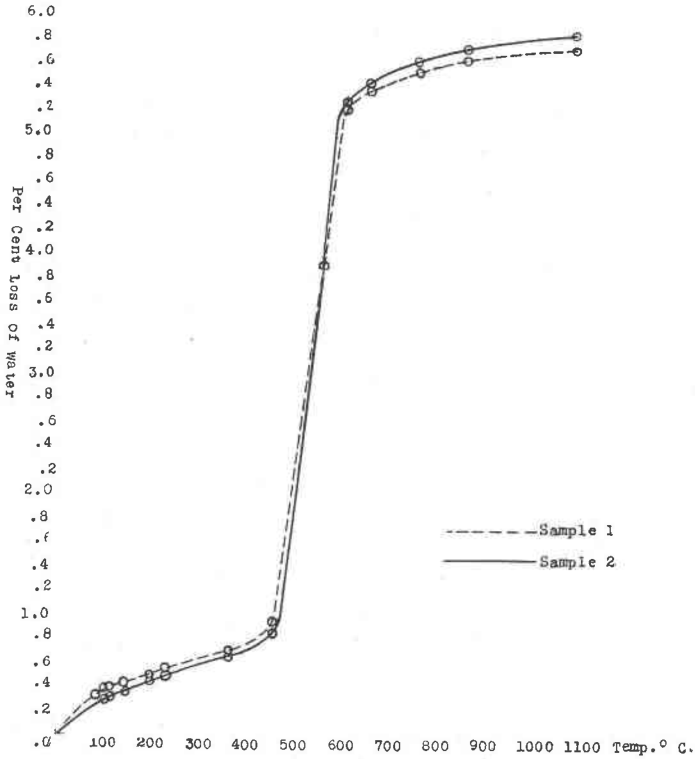

FIG. 1. Dehydration curve of sericite from Pilot Knob.

The crystals of the investigated material were too small to obtain any optical data other than a mean index of refraction. This value was determined as 1.580± .003. Ross[13] gives the indices of

[12] Ross, C. S., and Kerr, P. F., The Kaolin Minerals: pp. 166–167. *U. S. Geol. Survey, Prof. Paper* **165E,** 1931.

[13] Shannon, E. V., Notes on the Mineralogy of Three Gouge Clays from Precious Metals Veins: *Proc. U. S. Nat. Mus.,* vol. **62,** Art. 15, 1923. Optical work done by C. S. Ross.

refraction of sericite from the Carroll-Driscoll Mine in Boise County, Idaho, as 1.585± .003 for beta and 1.587± .003 for gamma. Both of these indices are close to the single mean index 1.580 found for the material analyzed. The indices for sericite and muscovite are similar, but paragonite has indices somewhat higher, 1.60.[14] Because of its high soda content a further check upon its identification seemed desirable, hence, a sample was sent to Dr. Paul F. Kerr of Columbia University, for *x*-ray analysis. He reported that the *x*-ray pattern was that of the mineral sericite, thus furnishing conclusive proof as to the identification of the mineral.

Origin

As noted above the sericite occurs scattered irregularly through the conglomerate at the top of Pilot Knob. This conglomerate contains many varieties of rocks but certain ones have evidently been more susceptible to the type of alteration that produced the sericite. Although commonly derived from orthoclase or microcline, sericite may also be derived from plagioclase feldspars. The composition of the sericite from Pilot Knob suggests that it was derived from plagioclase or that the potash had been replaced by sodium. A mixture of albite and orthoclase might well have been the original source material thus furnishing both the alkalies.

From the above data on its physical, chemical, the optical properties that could be determined, and the *x*-ray pattern, the mineral undoubtedly belongs to the muscovite mica group of minerals and is sericite.

LINEAR MINERALOGICAL ARITHMETIC

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In calculating the norm of a rock from a chemical analysis it is customary to divide the percentages of the oxides by the molecular weights to obtain the molecular proportions, or to consult tables of molecular proportions. From these proportions the minerals are calculated by multiplying certain molecular proportions by the molecular weight of the mineral concerned. With tables giving the molecular proportions to three decimal places the total mineral percentage seldom agrees with the total for the analysis.

[14] Larsen, Esper S., The Microscopic Determination of Nonopaque Minerals, *U. S. Geol. Survey*, Bull. **679,** p. 254.