NOTES AND NEWS

MINERAL NOTES FROM THE MICHIGAN IRON COUNTRY

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It is the purpose of this paper to place on record the occurrence of several minerals heretofore unreported from the iron districts of Michigan. They are *stilpnomelane*, *halloysite*, *nontronite*, and *dihydrite*.

The first mineral, *stilpnomelane*, comes from the ferruginous Upper Huronian slates of Crystal Falls, where it is exposed along the east bank of the Paint River, four to five hundred feet below the power dam. It was formed by hydrothermal reaction accompanying the emplacement of quartz-adularia pegmatite veins. It borders these veins in plates or books up to twelve centimeters across, and branches out into the slate as veinlets with scattered adularia inclusions. To a slight extent, also, it replaces the slate as a fine-grained schist, and it enters the quartz and adularia as apophyses which occasionally develop a crude comb structure similar to that illustrated by Grout and Thiel[1] from the Minnesota iron formations. Unlike their material, the Crystal Falls stilpnomelane contains no potash, is exceptionally high in ferric iron and low in ferrous, and, in addition, contains appreciable manganese, as shown in the following analysis by my colleague, Professor Bartholow Park, and myself:

STILPNOMELANE, CRYSTAL FALLS, MICHIGAN

SiO_2	42.42
Al_2O_3	6.71
Fe_2O_3	33.24
FeO	0.85
MnO	2.27
MgO	5.20
H_2O+	8.33
H_2O-	1.45
Total	100.47

To prove the absence of potash Professor Park used the arc spectrograph. Other elements whose lines do not show in the photographs include calcium, chromium, and titanium. Present in traces are sodium, lithium, cobalt, nickel, vanadium, barium, and zinc. All material used in our analysis was carefully selected under the microscope to insure freedom from contamination, especially by quartz, feldspar, pyrite, or manganese stain. As is to be expected from the amount of ferrous iron,

[1] *Am. Mineral.*, **9**, 228–231 (1924).

less than one per cent, the color is not the usual green, but is chestnut brown, and the streak is distinctly brownish. The luster is resinous and splendent, to earthy. The mineral is very slowly decomposed by hydrochloric acid, is not at all attacked by sulphuric, but is rapidly soluble in warm hydrofluoric—factors which called for the "borax snow" method in the determination of the ferrous iron. The optical data are not at all unusual; the refractive indices are: β and $\gamma = 1.730 \pm 1$, and $\alpha = 1.634 \pm 2$. The optic angle does not differ perceptibly from 0°. Y and Z are golden yellow to chestnut brown, depending upon the thickness, and X shows much less absorption. Fractures normal to the micaceous cleavage are common and, whether or not fortuitous, the extinction angles in such slices are predominantly 4° or 13°.

Halloysite, the next mineral to be described, was encountered in the New Richmond iron pit, two and one quarter miles east of Palmer, Michigan, on the Cascade Range. There it is most abundant as a cavity lining in coarse specularite-tourmaline-quartz veins, but it also occurs along with nontronite as a filling of narrow cracks in the ore. Its deposition is more readily accounted for by supergene agencies than by hydrothermal. The halloysite was identified by its isotropic character (although flecked with spots showing faint double refraction), by its refractive index of 1.555 ± 2, and by its x-ray diffraction pattern. Another colleague, Professor Roy Drier, supervised the x-ray analysis. Several extra lines show up faintly in the film; they are due neither to kaolinite nor to alunite, the two most common impurities. The alumina in the halloysite, nearly forty per cent, must have been introduced from outside, since the rock from this mine, a siliceous hematitic ore, carries but 1.17 per cent.[2]

Nontronite, $(Ca, Mg)O.\ 2Fe_2O_3.8\ SiO_2.7 \pm H_2O$, another clay mineral from the same pit, is abundant as a gouge in a shatter zone, where its deposition followed that of botryoidal hematite and limonite, and goethite. Judged from this association, the nontronite is clearly supergene. It also lines thin seams in the ore along with slightly earlier or overlapping halloysite. Its properties follow. The nontronite, originally green or bluish-green like chrysocolla, turns black and magnetic before the blowpipe. It is very slowly soluble in hydrochloric acid, with gelatinization. With the hand lens it appears either dull and earthy or smooth and enamel-like, although occasional fibers are coarse enough to produce a silky luster. Most of these fibers measure but 0.0025 mm. in thickness. Under the microscope their elongation is determined as positive (with parallel extinction), and their refractive indices are 1.565 ± 2 for α and 1.586 ± 2 for γ. The arc spectrum as photographed by Professor Park

[2] Analysis Booklet for 1938 issued by the Lake Superior Iron Ore Association.

shows the presence of magnesium to the amount of one per cent, but only the barest traces of calcium and aluminum. An *x*-ray diffraction pattern agrees closely with Gruner's published data[3] for the mineral. Since establishing its identity the writer has encountered films of nontronite in ores from the Menominee and Gogebic ranges as well. Apparently it is not at all an uncommon species in the Michigan iron districts.

The fourth mineral, *dihydrite*, a hydrous copper phosphate, was found by a student, Charles Upson, while looking for nontronite, and was at first mistaken for that iron clay. The location is about four and one-half miles west of the New Richmond mine, and eight hundred feet south of the East pit of the Tilden mine. It occurs as thin crusts in a fault zone passing through sericitized granite sills in Middle Huronian slate, and is evidently hydrothermal. The usual emerald green color is diluted to a robin's-egg blue in the films, which average 0.01 mm. in thickness. Around the edges of this earthy aggregate high magnification resolves fibers and bladed crystals which, despite their near-colloidal size (seven microns in width and three in thickness), lend themselves remarkably well to identification by optical means. The crystals, being microlitic, are of simple habit, elongated parallel to the vertical axis and flattened parallel to the side pinacoid. The termination is nearly, but not quite, perpendicular to the *c* axis. A second habit, comparatively rare, shows a polysynthetic twinning which brings basal and side pinacoids together in a common plane. These give extinction angles of five and of twenty-one degrees, respectively. Thus our specimens, optically at least, are triclinic—in *Dana's System of Mineralogy* dihydrite is recorded as "monoclinic or triclinic." There the pleochroism formula is given as: Z = deep bluish green; Y = yellowish green; and Z = bluish green. In our specimens the X and Y colors are reversed. Our refractive indices ($\alpha = 1.708 \pm .002$, $\beta = 1.753 \pm .002$, $\gamma = 1.800 \pm .005$) are slightly lower than those given in Larsen's tables.[4]

In conclusion, it may be stated that, in our attempts to identify the nontronite, an iron silicate, we first made blowpipe tests for copper, for phosphorus, and for other elements that might be the source of the green color. When dihydrite, the actual copper phosphate, came to hand, ironically enough no chemical tests were made until the optical data suggested its identity.

[3] *Am. Mineral.*, **20,** 478 (1935).
[4] *U. S. Geol. Sur., Bull.* **848,** 197.