mistakably that of pyromorphite.[4] Chemical tests on the pyromorphite concentrate from the bromoform separation showed the presence of abundant chlorine and phosphorus, and the absence of vanadium and arsenic,[5] thus eliminating the possibility of the presence of the closely related minerals, vanadinite or mimetite.

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[4] Bradley, W. F., *x*-Ray Technologist, Illinois State Geological Survey, personal communication.

[5] McVicker, L. D., Analyst, Illinois State Geological Survey, personal communication.

RUTILE IN HARFORD COUNTY, MARYLAND

W. Harold Tomlinson, *Springfield, Pennsylvania.*

On the geological map of Harford County, published by the Maryland Geological Survey, there is shown a narrow belt of serpentine rocks starting from a point about a mile northwest of Pylesville and extending about five miles in a direction south of west. The ultrabasics are intruded into Wissahickon schist. On the north side of this belt, in a field on the east side of the road, a mile north of Clermont Mills, several prospect pits have been opened for rutile.

The formation carrying the rutile is a chlorite rock, probably an altered pyroxenite. It has a slightly schistose structure, much more noticeable in some of the samples collected than in others, but always sufficiently strong to indicate a shearing movement during metamorphism. Little can be learned from the meager outcrop as to the extent of the rutile-bearing formation. A porous talc rock was found in place just east of the pits and again as float southeast of the pits. North of the pits chloritic schist carrying a little rutile is exposed. Except for a few weathered samples found in place, the material examined was collected from the dump of the main pit.

The only mineral that can be considered as a main constituent of the rock is a chlorite with positive optical sign, β index 1.589, birefringence about .008, and weak dispersion. The accessory minerals are magnetite, rutile, apatite, ilmenite, talc, biotite, pyrite and zircon. The first seven of these are distributed unevenly or in pockets. The zircon, which constitutes only a fractional percentage of the rock is rather evenly distributed. It occurs in small and crushed crystals and is probably an original mineral that has remained unchanged during metamorphism.

Of the accessory minerals, magnetite is most abundant. It occurs in well developed octahedrons up to 6 mm. in diameter. These are sparsely distributed all through the formation but are abundant in pockets. No trace of titanium could be found in the mineral. In this district magnetite is a common constituent of chloritic schists of igneous origin which contain little or no rutile and it seems probable that the mineral here has been derived from the alteration of the pyroxene.

The second most abundant accessory mineral is rutile. The mineral shows no unusual physical or optical properties.

TABLE 1. SPECTROGRAPHIC ANALYSIS MADE BY THE JOHN HERMAN LABORATORIES, LOS ANGELES

Analysis of a surface altered sample collected in place north of pits. A thin section showed ilmenite altering to rutile in a rock composed of chlorite, biotite, and traces of osteolite.

	Elements	*Probable Distribution*
% 10. plus	Silicon	Chlorite, biotite
1. –10	Magnesium	Chlorite, biotite
	Iron	Chlorite, oxides
	Aluminum	Chlorite, biotite
	Titanium	Rutile, ilmenite
.1 – 1	Potassium	Biotite
	Manganese	Ilmenite
	Sodium	Biotite
	Calcium	Osteolite
.01 – .1	Barium	
	Nickel	Sulfides
	Vanadium	Rutile
	Tin	Rutile (?)
	Copper	Sulfides
	Zinc	Sulfides
	Cobalt	Sulfides
.001 – .01	Boron	
	Chromium	Rutile
.0001	Silver	Sulfides

Analysis of selected rutile crystals. Examination with lens showed traces of apatite and chlorite adhering to the crystals selected.

	Elements	*Probable Distribution*
% 10. plus	Titanium	Rutile
1. –10	Iron	Rutile, chlorite
	Silicon	Chlorite
.1 – 1	Aluminum	Chlorite
	Magnesium	Chlorite
.01 – .1	Calcium	Apatite
	Boron	
.001 – .01	Vanadium	Rutile
	Lead	
	Tungsten	
	Nickel	
	Manganese	Rutile
.0001– .001	Gold	
	Copper	

A spectrographic analysis made by the John Herman Laboratories of Los Angeles, shows the presence of small quantities of vanadium, tin, chromium, manganese and tungsten. No quantitative chemical analysis is available. The rutile is mostly euhedral in form and occurs in sagenitic groups distributed in pockets through the chlorite rock. In pockets in which it is associated with apatite, the crystals are stouter and the geniculated twinning is not so well developed (Fig. 1). The largest crystal found measured 25×6 mm. Pockets carry up to 16% rutile with an average content of 8%. Samples collected from the outcrops north and east of the pits show ilmenite in process of alteration to rutile. It seems likely that all these rutile-bearing pockets represent alteration of pockets of ilmenite originally present in the pyroxenite.

FIG. 1. (Right). Sagenitic rutile in chlorite rock. Light gray, rutile; medium gray, magnetite; black with lustre, chlorite. (Left). Rutile in pocket with apatite. White is apatite. Photo of polished slabs about $\frac{2}{3}$ natural size.

The apatite, white in color, occurs in irregular masses of granular texture and occasionally in rough euhedral crystals. The mineral usually shows effects of crushing. It is very unevenly distributed and is found always in pockets in which it forms a high percentage of the rock. Its indices, $\epsilon = 1.644$, $\omega = 1.648$ are too high for pure fluorapatite and suggest the presence of chlorine. It seems probable that apatite was an original mineral in the pyroxenite and was crushed and recrystallized during metamorphism.

Veins of pure white talc 3 mm. to 5 mm. wide were found cutting the chlorite rock. Biotite was found in pockets in some of the samples. It occurs in well developed crystals of light yellow color and shows no sign of alteration. In a thin section the mineral is colorless with no noticeable pleochroism. The beta index, 1.61, suggests a biotite low in iron.

A few scattered crystals of pyrite were found in some samples but the mineral is very sparsely distributed. It may be an original constituent of the pyroxenite.

Ilmenite was found in specimens collected from the outcrops. North of the pits it was found in small platy crystals disseminated through the chlorite in association with magnetite. Most of the crystals show incipient alteration to rutile. East of the pits ilmenite was found showing an advanced stage of alteration to rutile. It seems probable that ilmenite was an original mineral of the pyroxenite.

Origin of the Formation

There are in the vicinity of this rutile-bearing formation, large bodies of hypersthene gabbro which grade into pyroxenite. Ilmenite occurs in the gabbro and has been reported as locally abundant in the pyroxenite. Apatite also occurs in the gabbro and has been reported as forming, in pockets, as much as 12% of the rock (Mt. Hope Station).

It seems probable that this rutile-bearing formation represents a pyroxenite originally rich in ilmenite and apatite which has separated from the gabbro and which has been altered, first by deuteric action, to an amphibolite rich in ilmenite and apatite, and later, during regional metamorphism, to a chlorite rock rich in rutile and apatite.

At the amphibolite stage of its metamorphism the rock would correspond in its mineral composition to a hornblende nelsonite as described by Thos. L. Watson (*Bull.* **111A,** *Va. Geol. Surv.*).

The Harford County rock differs from hornblende nelsonite as described by Dr. Watson in that it contains euhedral rutile in place of ilmenite and chlorite in place of hornblende. The writer would therefore classify the formation as a regionally altered hornblende nelsonite.

Supposed Troilite from Llallagua, Bolivia, is Probably Tetradymite

In the recently published Mineralogy of the Tin Mines of Cerro de Llallagua, Bolivia (*Proc. Acad. Nat. Sci. Phila.* **XCVI,** 308–310, and Fig. 18), several minute crystals found in tiny vugs in the porphyry adjacent to a vein were identified as troilite on the basis of the closeness of the angular measurements of the crystals to recorded data of Rose for pyrrhotite from a meteorite.

The writer is indebted to Professor Martin J. Brueger for a reëxamination of the crystals. He discovered them to be plastic: a crystal could be smeared into tiny flakes, with curling of the basal plane. To quote from his letter "Since pyrrhotite is known to be non-plastic, I am sure that the crystals you sent me are not troilite, but rather something tetradymite-like. This opinion is reinforced by the rhombohedral habit of the crystals."

Another inexcusable error occurred on page 281, where the reference to the synthesis of cassiterite by Daubreé in 1849 "(the first synthesis of a mineral!)" should have been a more correct quotation from Clarke's Data of Geochemistry as the first synthesis of *the* mineral.

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