UNITED STATES, DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

PAHAQUARRY COPPER MINE
PAHAQUARRY, N. J.

By

H. R. Cornwall
June, 1943

STRATEGIC MINERAL INVESTIGATIONS: PRELIMINARY REPORT.

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ABSTRACT

The Pahaquarry copper mine is located in Warren County, New Jersey, 13 miles northeast of Columbia, N. J., and one-quarter mile east of the Delaware River. The ore occurs as veinlets, knots and fine disseminated specks of copper minerals, principally chalcocite, in a gray quartzite. The writer estimates a minimum inferred tonnage of 2,435,000 tons of low grade, siliceous ore.

INTRODUCTION

The Pahaquarry copper mine is located in Warren County, New Jersey, in the township of Pahaquarry. It is 13 miles northeast of Columbia, N. J., the nearest accessible village, on a fairly good secondary road which follows the east bank of the Delaware River. The main workings are in a quarry about 350 feet above, and one-quarter mile east of the Delaware River.

Pahaquarry has had an interesting history. It was one of the oldest mining operations in the eastern United States, being first worked by the Dutch about 1650. Mining and quarrying have continued sporadically ever since. The last intensive work was done during the period 1900-1911 by the Montgomery Gold Leaf Mining Company under the direction of Dr. M. S. Keith, chief engineer. The quarry along the top of the ridge, or "Watershed," as it was called by the miners, was systematically trenched and sampled. Also several exploratory inclined shafts and adits were driven, apparently at this time. Keith claims to have taken 100 samples which averaged about 3% copper.1/ This enterprise failed, according to Phyfe, because the method adopted by Keith for the separation of the copper from the ore was not workable. A 200 ton mill, two 40-foot "shaft" furnaces, and a double track tramway, connecting the quarry with the mill were all built before it was discovered that Keith's method of separation of the copper was not workable.

1/ Phyfe, W. L., Copper deposits of New Jersey: Princeton Univ. senior thesis, 1933.

The mill and mining property of Pahaquarry are now owned by the Boy Scouts of America, Washington Council, Trenton, N. J., who maintain a boy's camp during the summer at the old mill site.

The deposit has been described by N. S. Keith 2/ and W. L. Phyfe 1/ among others.

GEOLOGY

The High Falls formation, of Silurian age, is a member of a thick Paleozoic sedimentary sequence of marine origin. It has a uniform strike of N. 50°-55° E., and uniform dip of 40°-45° NW. at Pahaquarry. It is a resistant, ridge-forming member of the stratigraphic section. The Pahaquarry ridge, or "Watershed," is a subsidiary ridge on the northwest flank of the main Kittatiny Ridge.

The copper-bearing horizon in the High Falls formation is a massive gray quartzite, containing occasional red, more or less shaly, lenses one-half to two feet thick. It outcrops along the crest of the "Watershed" where it has been exposed for approximately 50 feet down the dip, and 900 feet along the strike of the inclined beds by quarrying and erosion. To the northeast the "Watershed" is truncated by a ravine up to 150 feet deep called Mine Run. The brook occupying this ravine flows northwest into the Delaware River. On the southwest the "Watershed" is crossed by another stream which likewise flows into the Delaware River. Along the southwest side of Mine Run the copper-bearing bed outcrops almost continuously for 550 ft. down the dip.

ORE DEPOSIT

Mineralogy.—The metallic minerals occurring in the High Falls copper-bearing quartzite are: magnetite (Fe_3O_4), chalcocite (Cu_2S), bornite (Cu_5FeS_4), covellite (CuS), cuprite (Cu_2O), malachite ($Cu_2(OH)_2CO_3$), and limonite ($Fe_2O_3.nH_2O$).

Magnetite is present in all the polished sections as discrete, often irregular but sometimes subhedral (triangular) or rounded grains, 0.01 to 0.05 mm in diameter. The smaller grains are usually irregular, occupying the interstices between quartz grains. The magnetite is evenly disseminated throughout the copper-bearing quartzite.

Chalcocite is abundant only locally as rich veinlets and knots, and as disseminated irregular grains .01 to 0.06 mm in diameter. There are two varieties, one blue gray, the other gray, both isotropic. They often form intergrowths.

2/ Keith, N. S., The copper deposits of New Jersey, Mining Mag., vol. 13, p. 473, 1905.

Bornite occurs with the chalcocite as irregular, rounded inclusions or sub-graphic intergrowths.

Covellite, likewise associated with chalcocite, is rare.

Cuprite and malachite are quite common as spots replacing chalcocite, and occasionally as veinlets. Sometimes the grains contain specks of unaltered chalcocite.

The weathered outcrops of the copper-bearing quartzite are usually spotted with limonite specks about 1 mm in diameter.

Occurrence of copper.—Exploration and development have been largely confined to a 40-foot horizon in the moderately dipping gray quartzite (see pls. 1 and 2 and fig. 1). The richest occurrence of copper is at the main quarry. A composite sample from this area ran 0.38% Cu. The assays in table 1, p. 3 indicate that, although the copper mineralization may be uniform throughout the 40-foot horizon, the rock is low grade, averaging from 0.1 to 0.2 percent copper. Locally there are rich seams up to two inches across, and knots up to three inches in diameter, of chalcocite. Surrounding these the quartzite contains disseminated chalcocite grains. The rich chalcocite seams usually occupy fractures which are parallel to the bedding. These fractures also often contain vuggy quartz.

Table 1

Rock analyses of the Pahaquarry copper mine, Pahaquarry, N. J.

Sample	SiO_2	Al_2O_3	CaO	MgO	Cu	Fe	S	H_2O
SF1a	75.59%	12.31%			0.19%	2.64%	0.06%	2.45%
SF1b	74.00%	13.15%			0.32%	2.65%	0.04%	2.50%
SF1aMJ	74.89%	9.87%	0.78%	2.11%	0.31%			
SF2MJ	79.11%	9.23%	——	——	0.13%			
SF3MJ	80.49%	8.84%	——	——	0.12%			
SF4MJ	——	——	——	——	0.13%			
SF5MJ	——	——	——	——	0.11%			
SF6MJ	——	——	——	——	0.24%			
SF8MJ	——	——	——	——	0.38%			

Location and description of samples in Table 1

Sample	Analysis by	
SF1a	USGS Chem Lab part 1	composite sample of the main quarry and main ore dump.
SF1aMJ	Ledoux	
SF1b	USGS Chem Lab part 2	
SF2MJ	Ledoux	composite sample of trenches 1, 2, and northwest 40 ft. of 3.
SF3MJ	"	southeast 220 ft. of trench 3.
SF4MJ	"	composite sample of trenches 4, 5, and 6.
SF5MJ	"	composite sample of tunnel 1.
SF6MJ	"	composite sample of tunnel 2.
SF8MJ	"	composite sample of main quarry.

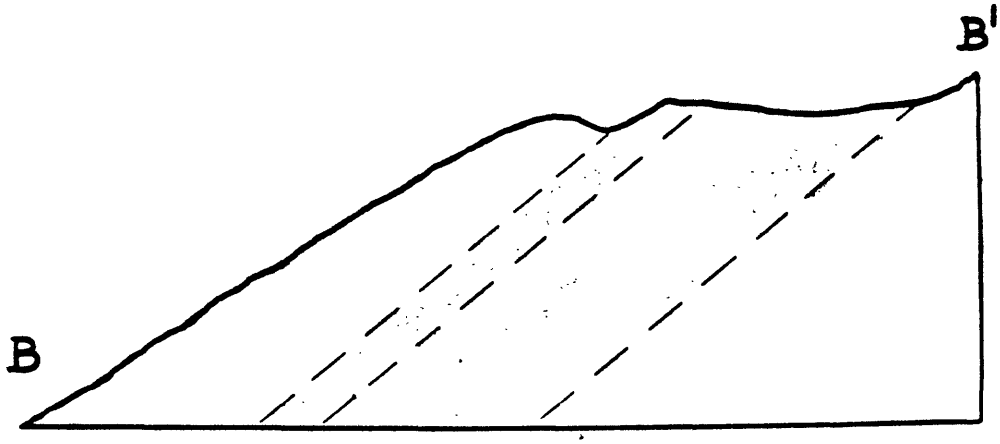
ORE RESERVES

The copper assays in table 1, p. 3, together with a study of over 40 polished sections indicate that the copper-bearing quartzite is mineralized uniformly for at least 650 feet down the dip, over 1,000 feet along the strike, and 40 feet across the bedding. The average of the assays is 0.22 percent copper. Using a tonnage factor of 13 cubic feet per ton, there are approximately 2,000,000 tons in this block. It is too low grade to be workable.

In the main quarry and in a small cut at the northwest end of trench 4, the quartzite contains more copper. A composite sample taken at the main quarry ran 0.38 percent copper. Assuming the beds in the main quarry, and in the block between it and trench 4 to be uniformly mineralized to this grade for a width of 40 feet, 19,000 tons of ore could be quarried without stripping.

RECOMMENDATION

The writer recommends that no more work be done at the Pahaquarry copper mine. The tonnage is large but the grade is too low. It might be possible to mine a few thousand tons of 0.4 percent copper, but the cost per ton would be high on such a small tonnage.

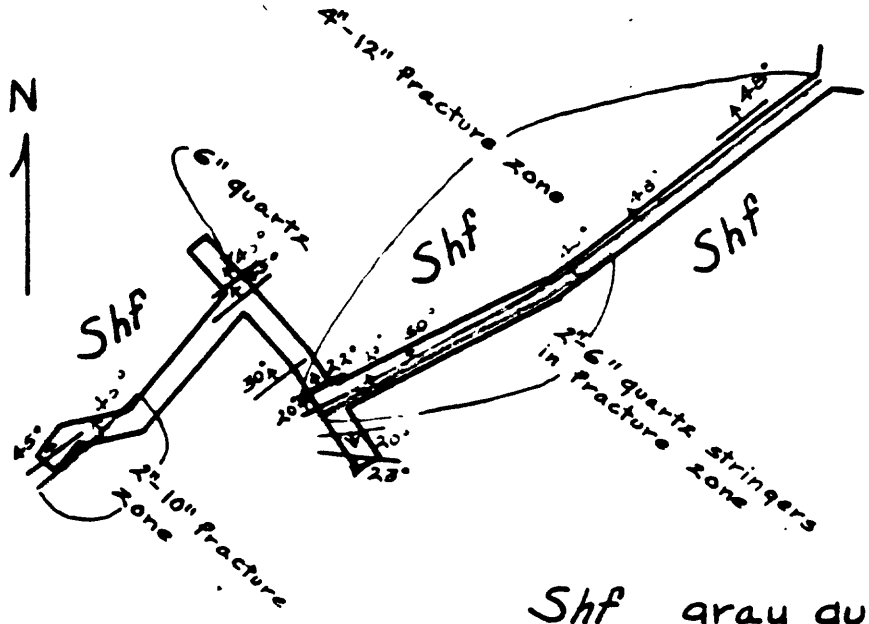


Section B - B' 1 in. = 200 ft.

Uniform copper mineralization as indicated by 7 trenches, 3 inclines & 2 tunnels

Uniform copper mineralization as indicated by 1 trench at main quarry

Fig. 1 Cross section B-B' of the whole area developed.



TUNNEL #1

1 in. = 50 ft.

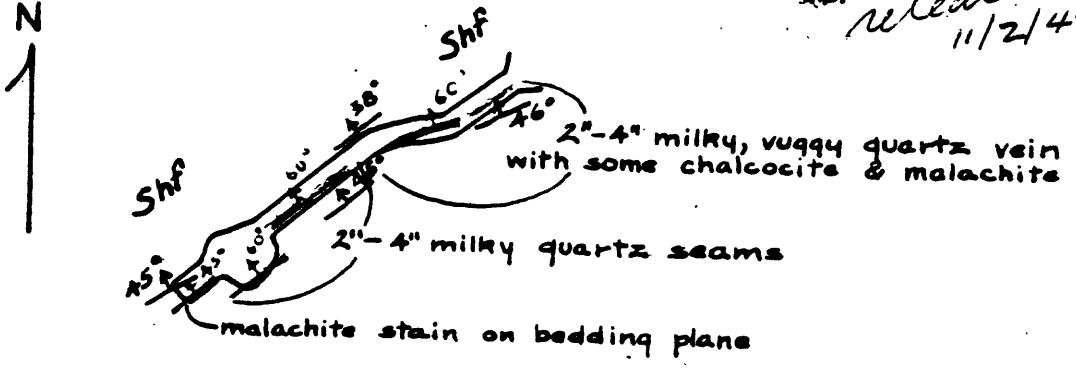
Shf gray quartzite with shaly lenses up to 1 ft.

fracture zone

quartz veins

strike & dip of beds

Fig. 2 Plan of Tunnel 1.



TUNNEL #2

1 in. = 50 ft.

Shf Gray quartzite (Silurian)

Milk quartz seams

Chalcocite & malachite stringers

Strike & dip of beds

Fig. 3 Plan of Tunnel 2.