UNITED STATES
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

SAN PEDRO AND CARNAHAN MINES, NEW PLACERS MINING DISTRICT

SANTA FE CO., NEW MEXICO

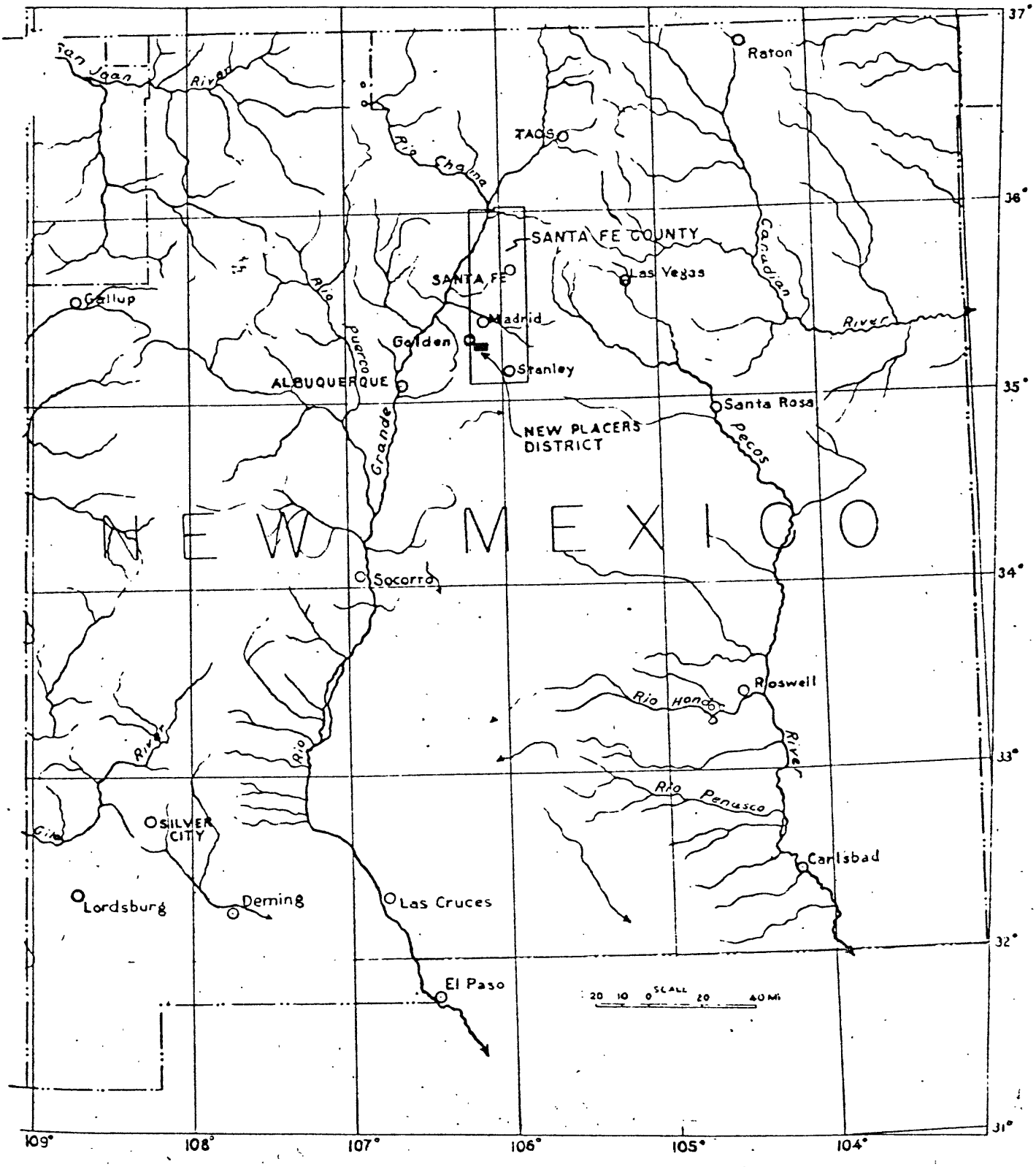
by

J. F. Smith, A. H. Wadsworth, J. R. Cooper, 1907-
F. W. Farwell, A. E. Weissenborn, 1903-
1910-

January 1945.

FIGURE 1

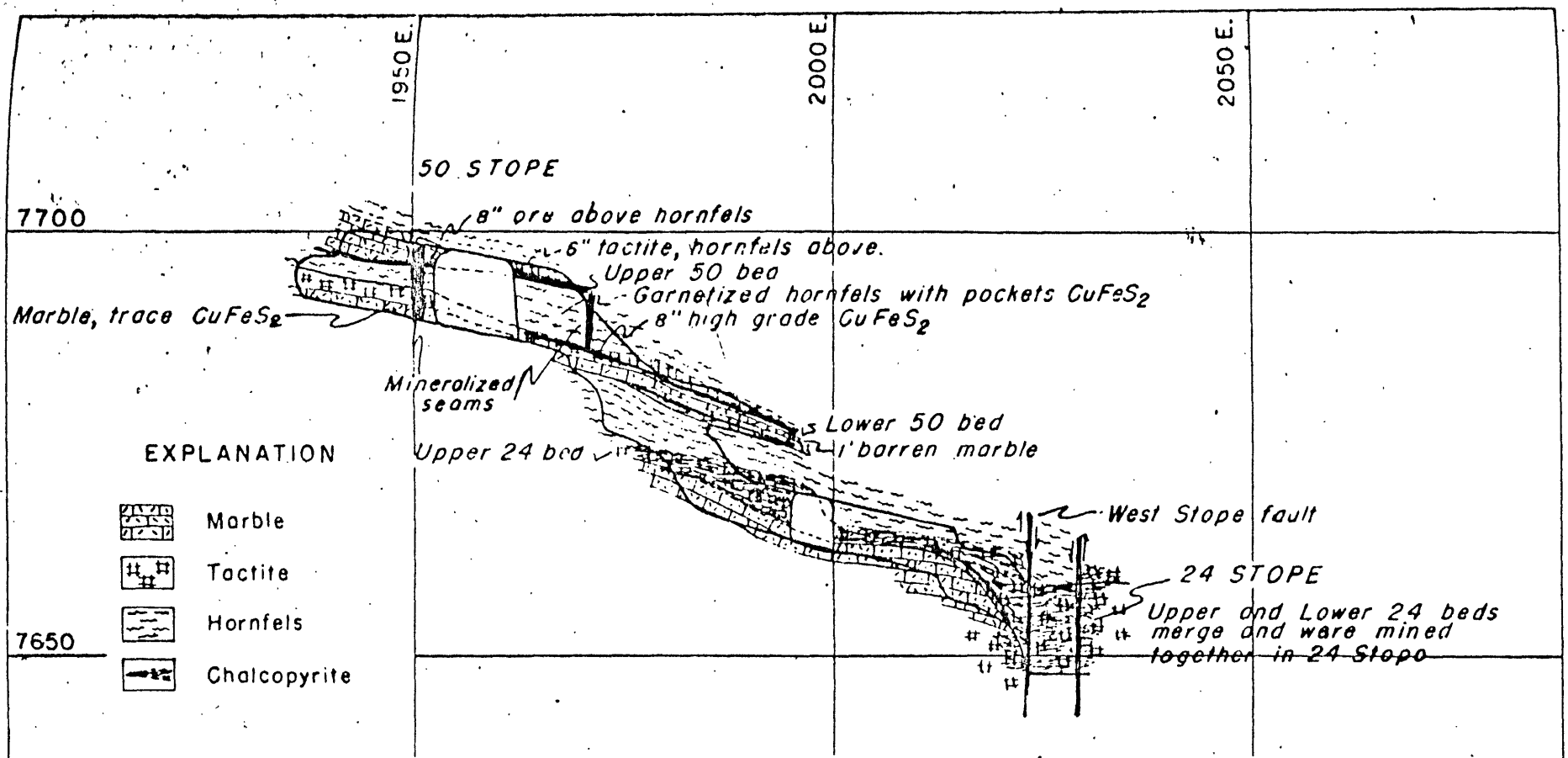
STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



INDEX MAP

SHOWING LOCATION OF NEW PLACERS DISTRICT,

SANTA FE COUNTY, NEW MEXICO



DETAILED SECTION OF RAISE FROM 24 STOPE TO 50 STOPE

SAN PEDRO MINE, NEW PLACERS DISTRICT, SANTA FE COUNTY, NEW MEXICO.

GEOLOGY BY J. R. COOPER, F. W. FARWELL, AND A. E. WEISSENBORN

JULY 1944

FIGURE 2

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INTRODUCTION

The New Placers mining district is in the southwestern part of Santa Fe County, New Mexico, south and east of Golden. The district centers around San Pedro Mountain, which is shown on the old San Pedro Quadrangle of the United States Geological Survey. It is 14 miles by road south of Madrid, and about 20 miles northwest of the railroad at Stanley, formerly used as a shipping point for concentrates. There are no paved roads in the district but the gravel roads are passable most of the year.

The San Pedro copper mine, in the southwest part of the area, has been the largest producer in the district. The Carnahan mine, about 2,000 feet south of the San Pedro mine, has produced some lead and zinc. There are a number of copper prospects in the district as well as some small gold mines and placer deposits. All are at present (1944) inactive.

Mining started in the district about 1839 with the discovery of the gold placer deposits. The first recorded activity at the San Pedro mine was in 1889, and the mine has been worked intermittently since that time. The original operating company was the Santa Fe Gold and Copper Company which built a smelter at the village of San Pedro, and later another at the mine. Operation by this company ceased in 1918. Between 1923 and 1937 the mine was worked intermittently by lessees. The Raskob Mining Interests, Inc. acquired the property in 1938, and installed mine and mill equipment in 1939. The mine was closed in August 1941 and has been

idle since that time. The mine and mill equipment was sold in April 1943, but on July 1, 1944 some of the heavy equipment still remained on the property.

Production at the San Pedro mine from 1904 to 1941 was 233,666 tons of ore which yielded 12,848,550 pounds of copper, 11,170 ounces of gold and 172,893 ounces of silver. Production by years is tabulated in Table 1.

The Carnahan mine, originally known as the Lincoln-Lucky mine, was developed soon after the San Pedro mine and was worked intermittently for lead and zinc until 1927. Except for some prospecting by lessees, it has been idle since that time. No production figures are available.

Copper, lead, and zinc production from other properties in the district has been negligible.

In 1903 Yung and McCaffery 1/ reported on the district. They noted

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1/ Yung and McCaffery: Ore deposits of the San Pedro district, New Mexico; Am. Inst. Min. Engs. Trans. vol. 33, pp. 350-362, 1903. Also Eng. and Min. Jour., vol. 75, pp. 297-299, 1903

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the metamorphic character of the base metal deposits.

Lindgren 2/ referred to the laccolith and the relation of the ore-bearing

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2/ Lindgren, Waldemar, Graton, L. C., and Gordon, C. H. : The ore deposits of New Mexico; U. S. Geol. Survey, Prof. Paper 68, pp. 170-175, 1910

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beds to this body and described the San Pedro ore body as an example of a contact metamorphic deposit. 3/

3/ Lindgren, Waldemar: Mineral Deposits; McGraw Hill Book Company, New York, p. 718, 1933.

(after Johnson, C. H., U. S. Bur. Mines War Minerals Rept. 145 - 1943

Year	Short tons	Gold, ounce	Silver, ounce	Copper, pounds	Lead, pounds	Matte, tons	
melted							
1907	21,298	786.00	17,626	1,223,460	-	-	Metal recoverable from matte
1912	14,533	493.81	13,134	801,895	-	693	Do.
1913	29,506	1,085.00	21,714	1,774,473	-	-	Do.
1914	23,080	242.55	4,767	277,159	-	325	Do.
1915	26,921	1,995.84	23,601	1,673,790	-	1,688	Do.
1916	40,087	3,169.88	29,532	2,140,995	-	2,108	Do.
1917	6,880	328.85	6,380	369,390	-	-	Do.
1918	3,600	158.30	4,645	210,923	-	-	Do.
1907-1918	165,955	8,280.23	121,399	8,472,085	-		
ipped							
1923	84	20.60	245	19,032	-	-	Metal recoverable from crude
1924	534	123.50	1,788	143,152	-	-	Do.
1925	984	166.90	2,939	197,000	-	-	Do.
1926	544	85.90	1,856	141,536	332	-	Metal content of crude
1927	201	18.50	466	34,312	-	-	Do.
1928	2,238	144.70	3,750	245,391	829	-	Do.
1929	1,166	111.10	2,428	185,574	-	-	Do.
1930	365	39.00	865	82,447	211	-	Do.
1934	2	2.93	-	-	-	-	Do.
1935	31	5.00	78	5,604	-	-	Do.
1936	34	6.10	40	3,174	-	-	Do.
1937	6			696	-	-	Do.
1938 5/							
1939 5/							
	6,189	724.23	14,455	1,057,922	-	-	
1940							
ipped	3,297	1,275.00	12,823	1,044,463			Metal content of crude
lled	31,671	1,394.00 6/	24,007 6/	2,026,944 6/			Metal content of heads 7/
ncentrates	3,409 6/	1,336.00	19,739	1,823,543			Metal content of concentrates
1941							
lled	26,554	876.00 6/	20,925 6/	1,646,348 6/			Metal content of heads 8/
ncentrates	2,445 6/	838.00	17,317	1,496,780			Metal content of concentrates
1940-1941	61,522	3,449.00	49,879	4,364,786			
1907-1941	233,666	12,453.46	185,733	13,894,793			

/ Bureau of Mines - Geological Survey Annual Statistics. 5/ Statistics not obtained 6/ Excluded from totals

/ Calculated from reported head assays: Gold, 0.044 oz/ton; silver, 0.758 oz./ton; copper, 3.2 percent

/ Calculated from reported head assays: Gold, 0.033 oz/ton; silver, 0.788 oz./ton; copper, 3.1 percent

In 1916, Augustus Locke and Edward H. Perry were employed as consultants by the Santa Fe Gold and Copper Company to study the San Pedro mine. Their excellent report [9] and maps have been used freely in the preparation

9/ Locke, Augustus and Perry, Edward H.: Private report to the Santa Fe Gold and Copper Mining Company, San Pedro, New Mexico

of this report. Locke and Perry discussed the geology of the ore deposit in considerable detail and made numerous recommendations for exploration.

In 1933, Lasky and Wooton [10] gave a brief history of the district

10/ Lasky, S. G., and Wooton, T. P.: The metal resources of New Mexico and their economic features; New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Bull. No. 7, pp. 96-97, 1933.

with a description of the general geologic conditions.

In April 1943 the United States Bureau of Mines published a War Minerals Report [11] on the San Pedro mine by District Engineer C. H. Johnson.

11/ San Pedro mine, Santa Fe County, New Mexico: War Minerals Report 143, U. S. Bureau of Mines, April 1943.

In the spring and summer of 1943 the district was studied by J. Fred Smith, Jr. and A. H. Wadsworth, Jr. of the United States Geological Survey. The surface in the vicinity of the San Pedro mine was mapped on a scale of 1 inch to 200 feet and a reconnaissance map of the district on a scale of 2400 feet to the inch was prepared from aerial photographs obtained from the United States Soil Conservation Service. The underground workings were mapped on a scale of 1 inch to 60 feet using as a base underground

maps obtained from the Raskob Mining Interests, Inc., supplemented in the newer workings by brunton and tape surveys. In April 1944 Vincent E. Kelley of the University of New Mexico observed the presence of scheelite in the 42 stope while on a field trip to the San Pedro mine with a group of students. As a result, in July and August 1944 John R. Cooper and Fred W. Farwell of the Geological Survey studied the tungsten occurrence and remapped many of the underground workings and a small area on the surface in considerably greater detail than had been attempted by Smith and Wadsworth. A. E. Weissenborn of the Regional Office of the Geological Survey spent about 10 days in the field and assisted Cooper and Farwell with some of the underground mapping. Weissenborn reviewed the original report by Smith and Wadsworth and the later, more detailed information obtained by Farwell and Cooper, combining the findings of the two parties into the present report.

Thanks are due to Mr. C. L. Bradbury of Albuquerque, New Mexico, Vice President of the Raskob Mining Interests, Inc. who kindly furnished maps, assays and reports on the San Pedro mine, and who gave permission to use this information. Acknowledgement is made to Mr. F. E. Landon and other members of the staff of the Map and Drafting Section of the United States Forest Service for the equipment used in preparing the illustrations. The index map, Figure 1, was drafted by Mrs. Irene Naden of the Forest Service.

GEOLOGY

Sedimentary rocks

Madera formation: The sedimentary rocks of central New Mexico are being studied by Charles B. Read of the United States Geological Survey. Read considers that all of the sediments in the district belong to the Madera formation of the Pennsylvanian Magdalena group except for a small area in the northeast where beds of the Permian (?) Abo formation crop out. In the present report the Abo has been mapped with the Madera.

In the vicinity of the San Pedro mine the lower part of the Madera formation is composed mainly of gray fossiliferous limestone interbedded with minor amounts of shale. Most of the limestone has been more or less recrystallized. This part of the formation is at least 1000 feet thick. The Carnahan mine (Plate 1) is in this section. The upper part of the formation, which is 400 to 450 feet thick, consists of fine to coarse-grained arkosic sandstone and shale with some limestone. The limestone is commonly altered to marble or to garnet-rich tactite, and the shale beds in many places have been altered to hornfels. The individual beds range from white to black in color; some of the lighter beds carry pyrite. The black beds, one of which has been used as a key horizon in the surface mapping (Plates 1 and 2) appear to be discontinuous locally, although the cover of soil and talus makes it difficult to trace any single bed or contact for many feet.

"Favorable series" and "Favorable beds": At the San Pedro mine practically all of the ore has come from a group of beds 80 to 90 feet thick which crop out in an arc around the west side of the district (Plates 1 and 2). These beds are in the upper member of the Madera formation close to its base; they form the "favorable series" of Locke and Perry.[12] This "favorable series" is composed of interbedded altered shale and limestone. The ore is found principally in the metamorphosed limestones, and these ore-bearing beds within the "favorable series" have been termed the "favorable beds" by Locke and Perry. This nomenclature is convenient and has been followed in the present report.

12/ Locke, Augustus and Perry, Edward H.: op. cit.

Seven "favorable beds" have been distinguished in the San Pedro mine. They are listed below in stratigraphic order.

Name of Bed	Thickness
Upper 50 bed	2 to 3 feet
Lower 50 bed	2 to 3 feet
Upper 24 bed	8 to 10 feet
Lower 24 bed	9 to 12 feet
Unnamed bed	2 to 3 feet
West Stope bed	5 to 7 feet
10 bed	3 to 4 feet

Of these the 24 beds have been the principal producers, followed by the 50 beds and the West Stope bed. A small production has come from the 10 bed, and there is one stope on an unnamed bed between the West Stope and 24 beds.

The intervening beds are mostly shale, now altered to hornfels. In some places alteration has gone so far that both limestone and shale have been completely changed to garnet-rich tactite and the individual beds are not now distinguishable. The detailed stratigraphy of the favorable beds and their relation to various geological features are shown on the three sections of Plate 10. Plate 11 is a generalized section showing the position of the favorable series.

Igneous rocks

Rhyolite porphyry: Irregular rhyolite porphyry sills are common in the district. The most persistent of these is approximately 60 feet thick and over most of the area lies stratigraphically from 60 to 150 feet above the favorable beds. (Plates 1, 2, 10 and 11). Over No. 1 stope, however, a sill lies immediately above the Upper 50 bed (Section F-G, Plate 10) and can be seen in a raise above this stope (Plate 6). Determination of the age of the rhyolite must await a more comprehensive study of the surrounding area; it can only be stated at this time that it is younger than the Pennsylvanian and Permian sediments which it intrudes.

Syenite: An intrusive rock here termed syenite, crops out at several places in the New Placers district, the largest exposure being

below the favorable series in the western part of the district (Plates 1 and 2). This rock was identified as a granodiorite by Yung and McCaffery 13/ and as a granodiorite porphyry by Locke and Perry. 13/

13/ op. cit.

In most places it carries a little quartz and varies in composition between a syenite and a monzonite though locally it is more basic. Near the center orthoclase phenocrysts up to an inch long are found. This body conforms to the bedding over most of the area but cuts across the beds in the vicinity of and to the northwest of the slag dump, (Plates 1 and 2) and probably has the form of a laccolith. The top has been removed by erosion, but its minimum thickness near its center is estimated to be at least 400 feet. An exposure of what is probably part of the same body can be seen in a crosscut west from the Swan tunnel (Plate 4). The syenite there contains abundant pyrrhotite and traces of chalcopyrite. An offshoot from the main syenite mass cuts across the rhyolite porphyry sill north of the Spanish cut (Plates 1 and 2), thus establishing the age of the syenite as post-rhyolite porphyry.

A similar rock is found as a small stock in Lazurus Gulch, and syenite dikes and sills are common in the district (Plates 1 and 2). A 334 foot vertical (?) diamond drill hole put down by the Raskob Mining Interests, Inc. somewhere in the vicinity of coordinates 2500 N, 3000 E (DDH 1, Plate 2) cut nothing but syenite. The syenite in this hole might connect at shallow depth with the stock in Lazurus Gulch

and with the smaller bodies which lie west of the stock. Should this be the case, the favorable series will be cut off in depth by the syenite somewhere between the east end of the mine workings and the syenite of Lazurus Gulch.

Diorite: In the eastern part of the district there are several diorite intrusives of stock-like form (Plate 1). At one place the sedimentary strata are turned up vertically along the contact but elsewhere the contacts appear to be discordant. The diorite is younger than the rhyolite porphyry, but its age relative to the syenite is unknown.

Metamorphism of Sedimentary Rocks

Near the San Pedro mine the sedimentary rocks have been extensively metamorphosed. In general the shale beds have been altered to hornfels and the limestone beds have been either recrystallized to marble or altered to garnet-rich tactite. Recrystallization of the limestone is more wide-spread than the garnetization and represents a less intense degree of alteration than does the garnetization. There are, however, noteworthy complexities in the alteration. Hornfels beds locally contain garnet and grade into tactite which is indistinguishable from that derived from the limestone. Locke and Perry maintained [14/]

14/ Locke, Augustus and Perry, Edward H.: op. cit.

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that the tactite derived from hornfels is dense and the garnet fine-grained and greenish. They state that in contrast the tactite derived from marble is commonly vuggy and the garnet is usually coarse-grained and brown or yellow in color. This distinction, however, may not be everywhere valid. In the vicinity of some of the ore bodies,

the limestone beds, together with the intervening shale beds are converted into a mass of tactite in which the individual beds can no longer be distinguished.

In any single calcareous bed the transition from marble to tactite may take place laterally within a few feet, or it may occur in a gradational zone many feet wide. In many places individual beds may be altered to tactite near the top and to marble near the bottom. An example of this is illustrated in figure 2, a mapped section along a raise from 24 stope to 50 stope. Not infrequently a tongue of marble may extend for many feet into the tactite, gradually thinning until all the marble becomes tactite.

In the Number 2 tunnel, and elsewhere, the marble contains patches of light-colored hornfels which seem best interpreted as an alteration of the marble itself, possibly controlled by nodules of chert or other impurities. Where these hornfels patches are small and scattered the rock was mapped as marble; where the hornfels is abundant and uniformly distributed the rock was mapped as hornfels. In the second case the rock is believed to have been derived from a calcareous shale rather than limestone. Two separate rock types were recognized. The first, which was termed "sponge marble", consists of fine sugary marble with a meshwork of hornfels which weathers out in relief, giving the outcrop a rough, sponge-like surface. This rock, which is about half marble and half hornfels, grades into the second type, "hornfels with marble patches", which consists of light-colored hornfels with lenses of fine sugary marble one to six inches in diameter, the hornfels forming more than 50 percent of the rock.

It is not clear what caused the metamorphism of the sedimentary rocks. Locke and Perry ascribed it and the metallic mineralization to the emplacement of the rhyolite porphyry sills. Lindgren believed that the syenite was responsible for the alteration. As is shown on section A-C-E (Plate 11) the area of tactite expands upward toward the rhyolite sill as though the metamorphism was a result of the emplacement of the sill, but the sill seems to be too small a body to have caused such wide-spread metamorphism. Furthermore, the disseminated pyrrhotite with traces of chalcopyrite found in the syenite in the Swan tunnel level suggests that the metallic mineralization is at least as young as the syenite. If the metallic mineralization and the metamorphism of the sedimentary rocks are presumed to be parts of the same processes, then the metamorphism, or at least the bulk of it is later than the rhyolite porphyry because the syenite is younger than the porphyry. Because of the greater mass of the syenite, it seems more reasonable to infer that the syenite was the cause of the metamorphism rather than the rhyolite porphyry. This interpretation, however, is not entirely satisfactory. From surface exposures north of the Spanish cut the garnetization of the favorable beds appears to be most intense where these beds are closest to the laccolith. This is what might be expected if the syenite were the cause of the metamorphism. A few feet ~~Immediately~~ northeast of the mine office, however, the same beds close to the syenite are little metamorphosed and contain abundant, well-preserved fossils.

The lack of garnetization near the syenite strongly suggests that this part of the laccolith did not give off solutions. One possibility is that the mineralizing solutions were given off farther to the north and possibly at greater depths, and that these solutions passed upward through available fractures or along the beds. The rhyolite sill may have acted as a more or less impermeable barrier and forced percolation through the favorable beds. By this explanation at least part of the alteration of the rocks would be closely related to the hydrothermal processes which deposited the ore.

Structure

The structure of the New Placers district is relatively simple. The regional dip is to the east and southeast at angles between 6 and 20 degrees with an average of about 15 degrees. Near the syenite laccolith, however, the bedding appears to be disturbed by the syenite intrusion.

There are gentle warps in the beds which break the regional dip, and these may have had some influence on the deposition of ore. The crest of one of these flexures may be seen in the drift from the top of No. 1 Connection raise to 24 stope, and is shown on section F-G (Plate 10), and on the plan of the Lower 24 bed (Plate 7). The relation of ore bodies in other parts of the mine to similar structures can not be demonstrated without careful, detailed mapping. The company maps lack elevations and therefore cannot be used as base maps for this purpose.

Two sets of fractures have been noted in the mine, one striking approximately east-west and the other trending nearly north-south. The east-west fractures are pre-mineral and it is thought that they were important factors in localizing both the distribution of the tactite and the metallic mineralization. Limonite and weak iron-staining are commonly found along most of these fractures, and sulphide minerals have been noted in three of them. In a few places the wall rock contiguous to the fractures has been garnetized. The east-west fractures are of considerable significance, but the displacement along them is small and the mineralization has obliterated any gouge and sheared rock that may have been developed along them. These fractures are exceedingly difficult to trace, particularly in and near the ore bodies where the only suggestion of their existence is found in the anomalous relationships between tactite and hornfels and in rare vein-like concentrations of high-grade ore.

The most prominent fracture of the north-south system is an important fault passing through the Richman shaft, known as the Shaft fault. It strikes between N 5° E and N 10° E, dips 85 degrees or steeper to the west, and is characterized by several inches to four feet of gouge and brecciated rock. The Shaft fault offsets the ore-bearing beds and is not itself mineralized, thus being clearly post-ore. It can best be seen on the Swan tunnel level (Plate 4). If the ore beds mined east of the Shaft fault are the same as those worked west of the fault, the west side has been displaced 80 to 90 feet downward and perhaps 200 to 250 feet northward relative to the east side (Section B-C-D, Plate 10).

Most of the other fractures of the north-south set are confined to a zone 200 feet on either side of the Shaft fault. The vertical displacement along these fractures nowhere exceeds a few feet, and the movement was almost entirely post-mineralization in age, although a few of these fractures have been weakly mineralized and may have formed before the end of the period of mineralization. Aside from the Shaft fault the best developed member of the north-south system is exposed in the 24 and West stopes (Plates 6 and 7, and Sections B-C-D and F-G, Plate 10) and is known as the West Stope fault. Mapping indicates that the east side of the West Stope fault has been downthrown about 5 feet.

Some doubt exists as to the validity of the correlation of beds across the Shaft fault. The correlation is based on the general similarity in the succession of ore-bearing beds and on their similar relationship to an overlying rhyolite porphyry sill. The validity of the correlation was first questioned when a quartzite bed was discovered in a crosscut west of the Swan tunnel about 60 feet stratigraphically below the West Stope bed on the west side of the Shaft fault (Plate 4) This bed is easily recognizable and has been located and traced for a considerable distance on the surface west of the fault (Plate 2). It appears, therefore, to be a good marker bed. The quartzite has not been found east of the fault, although, if the correlation of beds across the fault be correct, it would be expected east of the fault on the Swan tunnel level. It has not been reported from several diamond drill holes which cut still lower beds. Since the correlation

across the Shaft fault has not been clearly established, the names of the beds east of the fault have been shown on the maps and sections in quotation marks. If the correlation is in error, there may be at least two series of favorable beds.

ORE DEPOSITS

San Pedro mine

Copper mineralization: Throughout a stratigraphic thickness of 80 to 90 feet the ore at the San Pedro mine occurs as replacement deposits in the calcareous beds of the favorable series. Locally the intervening shale beds are ore-bearing. Some beds outside the favorable series have been mineralized, but production from beds above or below this series has been insignificant. Ore has been mined from an irregular zone a few feet to 130 feet in width which extends from the Spanish cut to the bottom of the mine workings, a distance of approximately 2400 feet (Plate 3). The ore bodies are not continuous over this entire distance, and only rarely do all of the favorable beds carry ore in any one place. The ore-bearing zone with few exceptions is confined to the vicinity of the contact between the marmorized limestone and the tactite in the favorable beds.

Composition of the ore. The ore at the San Pedro mine averages about 3 percent copper, although locally in No. 1 stope a much higher grade has been mined. Chalcopyrite, the only important ore mineral, is associated with garnet, calcite, specular hematite, quartz, pyrite, and locally, small quantities of scheelite. Small amounts of molybdenite have been reported from the lower workings of the mine. Pyrrhotite with traces of chalcopyrite occurs disseminated in the syenite in

the Swan tunnel level (Plate 4). Yellow, brown or brownish-red garnet is found in the ore. Green garnet occurs in the ore in a few places and is abundant in the unmineralized hornfels. Pyrite, which is widely disseminated throughout the ore body in small amounts, is said to increase down the dip of the beds. The ore contains small quantities of gold and silver and scattered pockets rich in these metals have been reported.

Oxidation. Oxidation commonly extends to a depth of about 100 feet, and locally along fissures much deeper, but some chalcopyrite and pyrite are found close to the surface. The oxidized copper minerals are mainly malachite and azurite, with lesser quantities of cuprite and melaconite. Locally, thin films of chalcocite coat the chalcopyrite. In general, oxidation has not been an important process in the formation of the ore body; the oxidized ore does not differ greatly in grade from the sulphide ore, and no noteworthy bodies of secondarily enriched ore have been found.

Guides to ore. Locke and Perry 15/ noted the close relationship of

15/ Locke, Augustus and Perry, Edward H.: op. cit.

the ore bodies to the contact between the tactite and the marble, and were the first to point out the importance of this relationship. This contact, which they termed the "marble line" can be traced from the Spanish open cut southeast to the north part of 24 stope where it bends sharply to the south and southwest, continuing through 24 stope and the

Home tunnel and appearing on the surface near the portal of the Home tunnel (Plate 3). East of the Shaft fault the marble line can be traced from the southwest end of 42 stope through 41 stope and eastward through the south side of 30 stope to the east end of the mine. In the deeper workings which are now below the water level the marble line is reported to turn sharply and continue with a trend of about N 30° E. The marble line is shown in greatly generalized form *

* The tactite area increases upward toward the rhyolite; thus no single line can correctly portray the marble line except in one bed.

on Plates 3 and 11, and in greater detail on Plates 5, 6, 7 and 9. The close association of the ore with the marble line holds true even in detail. Within the tactite small marble inclusions only a few feet long are commonly rimmed with chalcopyrite forming miniature ore bodies. It should be remembered, however, that the marble line is not a simple structure. Detailed mapping demonstrates that the contact is highly irregular both in the plane of the beds and in planes normal to the beds. Figure 2, a detailed section through a raise between 24 stope and 30 stope is a typical example of the irregularity of the marble line. Moreover, there are sizeable bodies of unreplaced marble within the tactite which are rimmed by ore. The fact that to date production from such ore occurrences has been small does not preclude the existence of ore bodies of this type. Such bodies would be difficult to find because the occurrence of marble "islands" cannot be predicted. It is also

possible that there may be islands of mineralized tactite within the marble but the one known occurrence which might fall within this category is apparently barren of ore minerals.

Several important ore bodies such as those in 31 and 41 stopes (Plates 3 and 9) are in the tactite 50 to 100 feet from the marble line and separated from it by zones of weak mineralization. If the idea of control by the marble line had been followed rigidly, these ore bodies might never have been discovered. Nevertheless Locke and Perry's premise of the importance of the marble line is amply sustained; the position of the mine workings suggests that most important ore bodies are within 100 or 200 feet of the marble.

Locke and Perry recognized that fractures which antedate the period of mineralization may have been important in localizing the ore bodies but concluded that because of the metamorphism these fractures were more difficult to find than the ore itself and consequently were of little value as prospecting guides. Careful detailed mapping might reveal a pattern of pre-mineral faults which would be of some use in prospecting, but the fractures are so obscure that the results might not be reliable.

There is some evidence that minor flexures have influenced ore deposition. Section F-G, Plate 10, is an illustration of this. Because of the lack of elevations on the company maps the possible relation of ore bodies in other parts of the mine to similar structures could not be demonstrated. A transit survey of the underground workings of the San Pedro mine should precede a detailed geologic study.

Tungsten ore. Following Kelley's discovery of scheelite in 42 stope early in 1944, the underground workings of the San Pedro mine were examined with a Mineralight by Cooper and Farwell in July and August 1944. The scheelite-bearing areas were mapped. Although most of the San Pedro mine is virtually barren of tungsten, scheelite concentrations of possible value are present locally in the 42 stope area and in the Home tunnel-51 stope-West stope area. The known areas of tungsten concentration are also areas of copper concentration but the association of tungsten with copper is not close, and it is probable that the two metals were not deposited contemporaneously. Some of the best copper ore is barren of tungsten, and pockets of high-grade scheelite may contain very little copper. It is not known whether tungsten deposition preceded or followed copper deposition.

The scheelite is disseminated in tactite and to a lesser extent in the hornfels. At some places, particularly in the hornfels, the scheelite is clearly associated with minor fractures, but for the most part is distributed fairly uniformly in the tactite without apparent relationship to fractures. The highest grade tungsten ore, estimated to carry 1 to 2 percent WO_3, occurs in irregular lenses a few inches to a few feet in diameter. The average grade of the mineable bodies is probably between 0.1 and 0.5 percent WO_3.

The location and shape of the known tungsten concentrations are are shown on the accompanying maps and sections (Plates 5 to 10). It will be seen that the concentrations are clustered in restricted

areas where they are present in several beds. In the vicinity of the 42 stope the scheelite body is continuous from near the bottom of the "Lower 24" bed into the "Upper 24" bed (Plate 9 and section H-I, Plate 10). In this case the hornfels separator is either absent or so garnetized that it is indistinguishable from the tactite derived from marble. Similar continuous tungsten mineralization was noted between the Upper 24 and the Lower 50 bed in the 51 stope area (Plate 8). The Lower 24 bed in this area is developed by only one small stope which is barren of tungsten but the underlying Unnamed bed and the West Stope bed both carry tungsten (Plates 5, 6 and 7).

Origin of the ore body. There is a considerable difference of opinion regarding the source of the solutions which brought in the copper and tungsten minerals. Locke and Perry believed the ore to be related to the rhyolite porphyry; Lindgren attributed it to the syenite. The presence of pyrrhotite and chalcopyrite in the syenite mass exposed in the Swan tunnel level (Plate 4) suggests that the period of mineralization was at least as late as the syenite, and therefore later than the rhyolite porphyry. There is a third possibility, namely that the ore-forming solutions were differentiated from the syenite at depth and rose along the beds and through fractures. The relatively impermeable rhyolite porphyry may have acted as a barrier to further upward migration, forcing circulation through the favorable beds.

Carnahan mine

The Carnahan mine is in the limey, lower part of the Madera formation below the syenite laccolith. The deposit is a flat-lying pipe-like replacement in limestone beds near the intersections of these beds with steeply-dipping fractures striking northeast to east. Other fractures with a more nearly north-south trend cut the northeast fractures and appear to have localized short lateral projections from the pipe.

The accessible workings consist of: (1) an incline which is approximately in the plane of the beds, and which is open for about 1300 feet, (2) a few short inclines parallel to the main incline and 10 to 20 feet stratigraphically above or below it, and (3) some small stopes, and short lateral drifts to the north and south. The main incline is caved at its intersection with a fault zone approximately 1300 feet from the portal. The principal stopes are said to be east of this fault and are now inaccessible, consequently a thorough examination of the mine is at present impossible. According to verbal reports from miners who are familiar with the workings, the ore in the extreme east end of the mine is cut off by a fault. This fault has not been found on the surface.

The mineralogy of the primary ore is unknown because the deposit is much oxidized throughout the accessible workings. The shale beds exposed in the Carnahan mine have been bleached and indurated. The limestone beds do not appear to be much altered except that they are commonly stained by iron and manganese oxides. Where oxidation has been

most complete there are lenses of vuggy iron and manganese oxides, the vugs being filled with crystals of secondary calcite and other minerals. Remnants of galena were seen at several places, but no zinc minerals were identified.

RESERVES

Although some ore still exists at the San Pedro mine known reserves are not large and the future of the mine is dependent on extending the known ore bodies or finding new ones.

In the flooded workings below 31 incline 146 samples taken by the Raskob Mining Interests, Inc. are reported to have averaged 2.9 percent copper over a mean width of 4.4 feet. One hundred one of these samples are said to have averaged 3.3 percent copper. Due to the flooding of the workings these reports could not be verified. In the vicinity of 30 and 31 stopes all the ore beds do not appear to have been tested thoroughly and there may be a substantial tonnage of milling ore that could be recovered above the water level from this part of the mine. Elsewhere above the water level very little ore remains, although in places all the favorable beds have not been tested adequately.

The tungsten reserves appear to be moderate at best, even assuming that the ore is sufficiently high in grade to be mineable. The following tabulation lists the inferred reserves in the small bodies in various parts of the mine.

Location	Bed	Estimated tonnage of scheelite-bearing rock
42 stope area	Upper and Lower 24	3,500
Home tunnel	Upper 50	2,000
51 stope area	Upper 24, Lower 50	16,800

In the 51 stope area only the north end of the scheelite body is defined in the mine workings. The northwest side has been assumed to coincide essentially with the marble line, the position of which is known approximately (Plate 5). The southwest boundary has been taken at the footwall hornfels (Plate 8) of the Upper 24 bed which is an arbitrary assumption. The southeast side has not been defined in any mine workings, nor is there any known structure against which the scheelite zone might be expected to terminate to the southeast. It is quite possible that the scheelite zone may be an extension of the zone found in the upper part of the Home tunnel, and may extend to the surface. The zone may also continue downward to the showings in the Unnamed bed below the Lower 24 bed and into the West Stope bed, both of which have been ignored in the reserve estimate. The showing in the West Stope bed is very low-grade, but that in the Unnamed bed, although small, is the richest exposed anywhere in the mine.

No assays of the tungsten-bearing rock were made, but from inspection under ultra-violet light, it seems clear that the grade ranges between 0.1 and 0.5 percent WO_3 and is too low to be succesafully mined for tungsten alone under present conditions. The deposit may be of value in the future at some period of abnormally high tungsten prices. If the San Pedro mine were re-opened as a copper mine, the tungsten concentrations would be of potential value, as the tungsten might be recovered as a by-product. The combined value of the tungsten and the copper might make ore of rock which could not be mined for

either metal alone. Future exploration should include lamping for other and possibly more important scheelite bodies.

As the principal stopes of the Carnahan mine are inaccessible, no reserves can be estimated there. No samples were taken and not much confidence can be placed in visual estimates of oxidized lead-zinc ore. In the accessible workings, however, the grade is obviously very low, and judging from the size of the stopes, such high-grade lenses as exist are small. The iron and manganese oxides are said to have been valuable as a flux for the old copper smelter at the San Pedro mine but the concentrations are too small and too low in grade to serve at present as a source of iron or manganese.

At other localities in the district some of the outcrops are copper-stained but prospect pits on the outcrops are not promising. Most of the showings are in beds which are not favorable for replacement deposits.

RECOMMENDATIONS FOR FUTURE PROSPECTING

Although the Raskob Mining Interests, Inc. drilled 33 diamond drill holes from underground stations and 6 from the surface, the ore possibilities of the San Pedro mine have not been completely tested. The best chance for finding additional ore is on the down-dip continuation of the ore below the 31 incline. Previous drilling for this purpose found no ore but two of the surface holes drilled by the Raskob Mining Interests, Inc. give a valuable guide for additional exploration. Neither hole has been located by precise surveys, but their positions have been determined by a brunton survey with sufficient accuracy so

that the holes can be used in planning future exploration. Hole 2-B, coordinates 1190 N. and 3950 E. (Plates 2, 10 and 11) entered the favorable series near 1060 N., 3400 E. and found nothing but marble. Hole 3 drilled from 1590 N., 3620 E. (Plate 2) bottomed near 1650 N., 3300 E. From a study of the old log it is believed that the hole did not extend deep enough to penetrate the favorable series, although the bottom must be close to these beds. The reported occurrence of thin tactite beds in the lower part of the hole indicates that the bottom of the hole is on the tactite side of the marble line. A vertical hole from the surface at approximately 1400 N., 3700 E., about midway between Hole 2-B and 3 would be a logical location for testing the extension of the ore below the 31 incline. Should this hole find marble in the favorable beds, a second hole should be drilled northwest of the first. Should the first hole penetrate tactite but no ore, the second hole should be drilled farther to the southeast in order to locate the marble line. It should be realized, however, that at any given place a section across the marble line might show only low-grade mineralization or even be entirely barren of ore minerals. Should the marble line prove to be barren at the place tested, further prospecting along its trend would be justified before abandoning the drilling.

A second recommendation is for an underground hole into the floor of 31 stope somewhere near its west end. This hole could be either vertical or inclined about 75 degrees to the west, normal to

the beds and should settle beyond dispute the important question of the identity of the ore-beds on either side of the Shaft fault. If the 31 stope is in the 24 beds as has been assumed, then a distinctive quartzite bed should be cut in the proposed hole at a depth of approximately 85 feet. The penetration of this marker bed at an entirely different depth, or its absence in the core would establish the fact that there are at least two series of ore-bearing beds and would enormously increase the potentialities of the San Pedro mine. It is believed that drilling will confirm the present correlation but the matter is of such importance that it should be settled beyond any doubt. The proposed hole would not only accomplish this purpose but would also test the "West Stope" bed which has not been explored in this area. A third objective would be to test other calcareous beds which might be found under the "West Stope" bed. One such bed was reported in a crosscut east from the Richman shaft about 100 feet below the Swan tunnel level. This bed is said to be ore-bearing but has not been tested elsewhere in the mine. With few exceptions, prospecting in the San Pedro mine has not extended far above or below the favorable series although, as stated repeatedly by Locke and Perry in their report, beds similar in composition to the favorable beds, but outside of the favorable series, might also be ore-bearing. It would seem highly desirable therefore to continue the proposed hole until it either penetrated the syenite, or until the intensity of alteration of the rocks decreased to such an extent that it appeared improbable

that more ore would be found. The stratigraphic information obtained from a hole carried to the syenite would be very valuable. Should the beds cut prove to be unfavorable for replacement deposits, it would be useless to test them elsewhere in the mine. On the other hand, should the presence of beds similar to the favorable beds be established, their exploration at other places in the mine would be justified even though they should prove to be barren of ore in the proposed hole.

All but one of the 55 underground diamond drill holes have been plotted on the stope and level maps. (The location of Hole U-21 could not be found.) Inspection of the mine maps and sections indicates that there are a number of places where all the known ore-bearing beds have not been completely tested. For example, the 50 beds which should be found above 30 stope have not been adequately tested in the ore zone. Although the value of such ore should not be ignored by an operating company, the total amount is inconsequential in a long-term appraisal of the San Pedro mine and no recommendations for testing possible ore occurrences of this type are given.

APPENDIX I

Diamond Drill Logs
(furnished by courtesy of Raskob Mining Interests)

R.M.I. Inc. Hole No. 1 San Pedro Mine
(started Nov. 29, 1938)

Date	Footage	Formation	Est. % Sulphides	Assay per ton Au	Ag	Cu	Remarks
11-29-38	0-5	Overburden	Nil				
11-30-38	5-19	"	"				
12-1-38	19-37	"	"				
12-2-38	37-48	Hornblende Porphyry	1				
			1				
			1				
			1				
			1				
			1	Assayed by Root & Simpson, Denver			Assayed by Guy V. Martin, Albuquerque
			1				
12-3-38	48-108	"	1				
			3	0.02	---	Tr.	.005 0.36 Tr
			3	0.01	---	Tr.	.005 0.46 Tr
			3	0.02	---	Tr	.010 0.18 Tr
			1				
			1				Values average too
			1				low to be commercial
12-4-38	108-179	"	1				ore.
			1				
			1				
			1				
			1				
			1				
			1				
12-5-38	179-250	"	1				
			1				
			1				
			1				
			1				
			2	Hole stopped at 334 ft. as the hornblende dyke is dipping nearly			
			1	parallel with drill hole.			
12-6-38	250-319	"	1				
12-7-38	319-334	"	1				

Composites

Depth	Au oz/ton	Ag oz/ton	Cu Percent	Remarks
3-80	0.08	---	Tr.	Assayed by Root and Simpson, Denver
				Recssay of pulp gave 0.075 oz/ton Au
4-80	0.01	0.23	Nil	Assayed by Guy V. Martin, Albuquerque
0-330	0.05	0.23	---	Sample taken by J.C. Barton, assayer not given.
mpos.	0.005	0.34	Nil	Assayer not given
ntire hole				

DIAMOND DRILL LOG
R.M.I. Inc. Hole No. 2-B San Pedro Mine
Started Jan. 27, 1939 Dip 33° Finished Mar. 17, 1939

Depth	Formation	Estimate % Sulphides	Au oz/ton	Ag oz/ton	Cu %	Remarks
-22'	Overburden					
-33'	Gray shale					
-51'	Black shale					
-63'	White silicified sandstone					
-78'	Black shale					
-82'	Mottled vuggy shale					
-123'	Close grained green and gray shale. Some garnet.					
-132'	Gray shale	1				
-150'	Black shale					
-160'	Silicified gray shale	3	0.05	.12	—	
-187'	Black and gray shale	1				
-223'	Silicified black shale					
-230'	Quartzite	¼				
-244'	Quartzite	¼				
-249'	Black shale					
-255'	Mottled shale	3	.005	---	Tr	Garnetized
-269'	Grayish black silicified shale					269-270 pyrite in shale
-270'		10	.02	.36	--	Heavily garnetized
-287'	Black shale	½				
-295'	Gray shale, epidote and pyrite	3	.01	.37	Tr	
-303'	Black shale					
-321'	Gray silicified shale	1				
-335'	Pyrite in gray shale	3	.01	—	Tr	
-341'	Garnets in gray shale					
-343'	Black shale					
-346'	Mottled shale					
-351'	Pyrite in gray shale	3	.005	—	—	
-363'	Dark baked shale					
-467'	Porphyry, some oxides and dendrites					
-480'	Baked black shale					
-487'	Vuggy shale					
-498'	Gray silicified shale					
-567'	Quartz porphyry					
-577'	Black shale					
-593'	Gray shale					
-601'	Marble					
-613'	Calcareous shale					
-626'	Greenish garnet, shale					
-631'	Shale					
-637'	Limestone, some marble and garnets					
-668'	Silicified limestone					
-679'	Black shale					

DIAMOND DRILL LOG
R.M.I. Inc. Hole No. 2-B San Pedro Mine

Depth	Formation	Estimate % Sulphides	Au oz/ton	Ag oz/ton	Cu %	Remarks
[illegible]-692'	Garnetized lime	2	.01	Tr	Tr	
692-722'	Silicified limestone garnets and calcite	1	-	-	-	
722-725'	Vuggy lime					
725-750'	Limestone	1	.02	.34	-	
750-770'	Black shale					
770-773'	Marble					End of Hole 3-17-39

DIAMOND DRILL LOG
R.M.I. Inc. Hole No. 3 San Pedro Mine
Started Dec. 9, 1938 Finished Jan. 14, 1939

Depth	Formation	Estimate % Sulphides	Au oz/ton	Ag oz/ton	Cu %	Remarks
0-34'	Overburden; earth, boulders, slide rock					
34-69'	Baked black shale					Very hard
69-100'	Baked white shale					"Porcelain"-tough drilling
100-104'	Quartzite					
104-129'	Black shale	½				Softer shale
129-133'	Gray and green shale					
133-139'	Black and gray shale					
139-146'	Black shale					
146-150'	Silicified					
150-152'	Sandstone	½				
152-159'	Quartzite, shale					
159-166'	Quartzite	1				
166-177'	Silicified black shale	1				
177-184'	Silicified gray shale	1				
184-189'	Black shale	nil				
189-233'	Quartz porphyry	1				
233-245'	Baked black shale					
245-247'	Gray shale	1				
247-250'	Garnetite					
250-257'	Black shale					J. C. Barton took
257-270'	Metamorphosed gray shale		.01	nil	nil	sample 260-261'
270-277'	Metamorphosed gray shale	1				
277-321'	Undifferentiated shales					
321-360'	White shales					Twin streaks of
360-373'	Black shale	½				pyrite and garnet
373-378'	Garnetized	½				at 333 ft.
378-381'	Black shale					
381-385'	Vuggy silicates					
385-388'	Gray shale	½				
388-392'	Black shale					
392-396	Silicified gray shale					
396-409	Mottled shale					
409-417'	Garnetite					

DIAMOND DRILL LOG
R.M.I. Inc. Hole No. 3 San Pedro Mine

Depth	Formation	Estimate % Sulphides	Au oz/ton	Ag oz/ton	Cu %	Remarks
417-425'	Calcite and garnetite					Some garnets and calcite
425-433'	Silicified shale					
433-435'	Mottled shale					
435-440'	Silicified					
440-449'	Silicified shale					
449-458'	Mottled shale					
458-459'	Silicified black shale	½				
459-464'	Dark gray shale	½				Some garnets
464-468'	Silicified gray shale	½				
468-482'	Silicified white shale					
482-483'	Garnets in shale					
483-490'	Silicified black shale					
490-493'	Garnetite					
493-499'	Silicified white shale					
499-500'	Garnetite					
500-508'	White silicified shale					
508-510'	Garnetite					
510-516'	Silicified white shale					Gray banding
516-521'	White shale					
521-523'	Garnetite					
523-532'	Black shale					
532-533'	Mottled shale					Discontinued drilli at 533 feet.

Composite Assays by Root and Simpson, Denver

Depth feet	oz/ton Au	oz/ton Ag	% Cu
189-199	.020	.00	.00
199-209	.020	.07	.00
209-219	.010	.00	.00

No commercial values found in this hole - A. Feeney 5/6/39

DIAMOND DRILL LOG
R.M.I. Inc. Hole No. 4 San Pedro Mine

Started Mar. 25, 1939 Vertical Finished Apr. 8, 1939

Depth	Formation	Estimated % Sulphides	Au oz/ton	Ag oz/ton	Cu %	Remarks
0-33'	Vuggy white shale					
33-44'	Black shale					
44-49'	Gray shale					
49-64'	Quartz Porphyry					
64-78'	Black shale					
78-80'	Gray shale					
80-81'	Ore	10% ox.	0.18	2.66	3.6	
81-102'	Dark shale					
102-106'	Lime silicates					
106-107'	Dark shale					
107-112'	Sandy shale, epidote and iron oxide					

DIAMOND DRILL LOG

R.M.I. Inc. Hole No. 4 San Pedro Mine

Depth	Formation	Estimate % Sulphides	Au oz/ton	Ag oz/ton	Cu %	Remarks
112-120'	Black shale					
120-125'	White and mottled shale					
125-126'	Black shale					
126-129'	Green and white shale					
129-131'	Blackish shale					
131-138'	Gray shale					
138-143'	Marble					
143-144'	Black shale					
144-152'	Gray shale					
152-164'	Marble					
164-170'	Dark gray shale					
170-174'	Marble					
174-178'	Fissure					
178-185'	Marble					
185-191'	Gray shale					
191-198'	Pinkish shale					
198-201'	Marble					
201-205'	Vuggy shale	2% ox.				
205-211'	Fissure	3% ox.				Mn. stains
211-215'	Gray shale					
215-231'	Close grained shale					
231-233'	Calcite in shale					
233-267'	Dark gray shale					

DIAMOND DRILL LOG

R.M.I. Inc. Hole No. 5 San Pedro Mine

Started Apr. 12, 1939 Vertical Finished Apr. 28, 1939

Depth	Formation	Estimate % Sulphides	Au oz/ton	Ag oz/ton	Cu %	Remarks
0-22'	Overburden and shale					
22-24'	Sandstone					
24-26'	Shale					
26-52'	Porphyry					No phenocrysts of quartz apparent
52-81'	Black shale					
81-84'	Crushed and altered shale, some Mn.					
84-86'	White shale					
86-90'	Gray shale, some manganese					
90-96'	Close grained gray shale					
96-107'	Mottled shale, pink, white and dark					
107-109'	Black shale					
109-110'	Gray shale					
110-114'	Vuggy shale, spots of manganese and iron	2% ox.				
114-117'	Gray shale					
117-120'	Gray and green shale	1%				
120-128'	Baked, grayish shale, some manganese					

DIAMOND DRILL LOGS
R.M.I. Inc. Hole No. 5 San Pedro Mine

Depth	Formation	Estimate % Sulphides	Au oz/ton	Ag oz/ton	Cu %	Remarks
128-131'	Mottled pink and dark shale.6" black					
131-133'	Vuggy garnetite	1% ox.				
133-139'	Mottled shale					
139-144'	Grayish black shale					
144-166'	Black shale					
166-171'	Gray shale					
171-174'	Vuggy gray shale	1				
174-181'	Black shale					
181-188'	Calcareous gray shale some oxide	2% ox.				
188-192'	Garnets in gray shale					
192-216'	Grayish black shale					
216-235'	Gray shale					
235-237'	Garnetite					
237-251'	Gray shale					
251-253'	Garnets					
253-260'	Crumbly mass of calcareous shale					
260-266'	Gray shale					
266-277'	Green garnetite					
277-281'	Gray shale					
281-282'	Garnetite					
282-290'	Mottled gray shale					
290-292'	Garnetite					
292-300'	Garnetite with gypsum and small quartz crystals					

DIAMOND DRILL HOLE NO. U-1
S. 82° E. Plus 47½°

42 to 45' Quartz porphyry with dendrites and some oxidized iron spots.
37.7 to 42' Black carbonaceous* shale
34.3 to 37.7' Altered lime. Some calcite and pyrite. Assay: gold-nil; silver-trace; copper-nil.
29.0 to 34.3' Mottled grey and green and black shale, spots of pyrite
24.0 to 29.0' Mottled grey and green and black shale, spots of pyrite, ¼" seam of chalcopyrite.
23.3 to 24.0' Close grained greenish white shale
22.3 to 23.3' Garnetite with some chalcopyrite. Assay: gold-nil; silver-0.02; copper-nil.
14.0 to 22.3' Green garnetized shale with spots of iron oxide and calcite
10.5 to 14.0' Altered limestone, chalcopyrite seam 11 to 14½' Assay: gold-nil; silver-0.01 oz/ton; copper 0.40%
9.5 to 10.5' Black calcareous shale
8.5 to 9.5' White shale

* Here, and elsewhere in the logs, the word "carbonaceous" has been substituted for "carboniferous" in the original records. It is believed that "carboniferous" was intended to mean that the rocks are carbon-bearing and does not refer to the geologic age. All the sedimentary rocks are Carboniferous in age.

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7.5' to 8.5'	Altered lime, some calcite, garnets and chalcopyrite
7.0 to 7.5'	Chalcopyrite streak in altered lime. Assay: gold 0.04 oz/ton; silver 1.12 oz/ton; copper 6.9%
6.0 to 7.0'	Grey shale showing some quartz
3.9 to 6.0'	White mottled shale with spots of chalcopyrite
0.0 to 3.9'	Silicified lime, some garnetite, spots of chalcopyrite and specular iron. Assays: gold - nil; silver-0.08 oz./ton; copper 0.2%

DIAMOND DRILL HOLE NO. U-2

N. 20° E. Plus 73½°

1' to 3' 10"	Silicified and garnetized lime with spots of chalcopyrite and knife blade seam of chalcopyrite at 4'
3'10" to 4'10"	Ore seam (no assays)
4'10" to 9'0"	White silicified shale with spots of chalcopyrite
9'0" to 11'5"	Silicified limestone; some calcite and melanterite
11'5" to 12'5"	Garnetized limestone with chalcopyrite spots
12'5" to 14'0"	Oxidized seam showing calcite and iron oxide in carbonaceous limestone
14'0" to 16'0"	Garnetized lime with small spots of chalcopyrite
16'0" to 17'4"	Garnets and calcite in carbonaceous lime
17'4" to 17'6"	Calcite and iron oxide streak
17'6" to 19'0"	Thin bed of shale
19'0" to 21'0"	Garnetized lime with spots of ore
21'0" to 25'0"	Pink and black shale
25'0" to 40'0"	Close grained shale
40'0" to 43'0"	Quartz porphyry

DIAMOND DRILL HOLE NO. U-3A

S. 25° W. Plus 73½°

0.0' to 2'0"	Ore showing chalcopyrite and bornite Assay: gold-0.04 oz/ton; silver 1.40 oz/ton; copper 4.8%
2'0" to 4'0"	Lime silicate with a few spots of chalcopyrite
4'0" to 8'0"	Gray and white shale
8'0" to 10'2"	Chalcopyrite and quartz seam in mixed shale and silicified lime. Assay: gold-0.16; silver-0.24 oz/ton; copper 0.8%.
10'2" to 10'3"	Brownish cherty shale
12'2" to 12'5"	Black shale
12'5" to 13'0"	Garnetized lime with some chalcopyrite and calcite

No. U-3B

1' to 1'11"	Garnetized and calcitized limestone
1'11" to 2'0"	Seam of calcite
2'0" to 3'0"	Garnetized and calcitized limestone with streaks of quartz
3'0" to 4'0"	Blackish cherty shale with some white streaks
4'0" to 5'0"	Garnetized limestone

5'0" to 6'3"	Chalcopyrite in garnetized limestone Assay: 5 to 6'; gold-nil; silver 0.36 oz/ton; copper 1.0%
6'3" to 9'6"	Mottled silicified shale
9'6" to 11'0"	Mottled shale
11'0" to 11'6"	Chalcopyrite in close grained silicate Assay: gold-0.02 oz/ton; silver 0.50 oz/ton; copper 1.5%
11'6" to 15'0"	Mottled shale, white and dark
15'0" to 20'0"	Silicified lime (pyrite 17'6" to 20'0")
20'0" to 24'0"	Black to purple shale
24'0" to 27'0"	Quartz porphyry

DIAMOND DRILL HOLE NO. U-4

N. 82° E. Plus 66°

0 to 1'	Altered limestone containing spots of sulphides
1' to 5'	Garnetized limestone containing shaley spots, also quartz and chalcopyrite
5' to 7½'	Medium to close grained silicified gray shale with black and brown spots
7½' to 8 3/4'	Altered limestone; 1" of white quartz at 8'
8'9" to 9'9"	Chalcopyrite in altered lime Assay: gold-0.04 oz/ton; silver 0.96 oz/ton; copper 4.5%
9'9" to 12'	Garnetite Assay: gold-nil; silver-trace; copper-trace
12 to 15'	Chalcopyrite and quartz seams in lime silicate Assay: gold-0.06 oz/ton; silver-3.5 oz/ton; copper 11.5%
15 to 17'	Spot of chalcopyrite in partly altered limestone Assay: gold-trace; silver 0.48 oz/ton; copper 1.2%
17 to 19'	Calcareous and garnetized limestone; spots of chalcopyrite, quartz, calcite and iron oxide
19 to 23'	Black close grained shale
23 to 36'	Crushed fault plane material
36 to 39'	Mottled shale
39 to 42'	Quartz porphyry

DIAMOND DRILL HOLE NO. U-5

S. 23° W. Plus 69°

o to 1'	Close grained shale
1' to 1'2"	2 inches of quartz, calcite and chalcopyrite
1'2" to 5'3"	White rock; siliceous limestone, some black shale inclusions
5'3" to 5'9"	Spots of pyrite and chalcopyrite in lime silicate Assay: gold-trace; silver 0.16 oz/ton; copper 0.5%
5'9" to 6'3"	Gray silicate
6'3" to 6'5"	2-inch quartz seam containing chalcopyrite, some garnet Assay: gold 0.02 oz/ton; silver 0.78 oz/ton; copper 3.5%
6'5" to 10'	Gray silicate
10' to 11'	Chalcopyrite in altered lime Assay: gold-trace; silver 0.40 oz/ton; copper 1.6%
11' to 16'	Garnetized lime with spots of chalcopyrite
16' to 17'	Calcite and iron seams in altered lime
17' to 19'	Altered limestone
19' to 22'	Black shale

22' to 29'	Crushed and oxidized material; some copper carbonates and iron oxides
29' to 33'	White siliceous shale
33' to 36'	White siliceous shale
36' to 39'	Crushed material with some copper carbonate
39' to 42'	Black shale
42' to 44'3"	Black calcareous shale
44'3" to 45'	Crushed material with some clay
45' to 48'	Quartz porphyry

DIAMOND DRILL HOLE NO. U-6

S. 85° W. Plus 59½°

0 to 1'6"	Silicified limestone with spots of chalcopyrite
1'6" to 3'3"	Close grained gray shale
3'3" to 3'9"	Garnetized lime showing chalcopyrite Assay: gold-trace; silver 1.32 oz/ton; copper 4.0%
3'9" to 5'	Lime silicate
5 to 6'6"	Altered limestone showing chalcopyrite Assay: gold 0.02 oz/ton; silver 0.82 oz/ton; copper 4.1%
6'6" to 7'	Close grained silicate
7 to 9'	Chalcopyrite in altered limestone Assay: gold-0.02 oz/ton; silver 0.94 oz/ton; copper 3.7%
9 to 10'	Siliceous brown shale
10 to 11'	Siliceous brown shale mixed with garnetite
11 to 14'	Altered lime; some calcite and chalcopyrite Assay: gold-nil; silver 0.28 oz/ton; copper 0.7%
14 to 15'6"	Calcite and garnetite in altered lime
15'6" to 18'	Some chalcopyrite in altered lime Assay: gold-nil; silver 0.24 oz/ton; copper 0.4%
18 to 21'6"	Garnetite and some calcite
21'6" to 22'	Black shale - 6"
22 to 22'3"	2 inches quartz and chalcopyrite in shale Assay: gold-0.02 oz/ton; silver 0.34 oz/ton; copper 1.2%
22'6" to 24'	Black shale
24 to 27'6"	Spots of garnet, quartz and calcite in altered lime; chalcopyrite Assay: gold-nil; silver 0.08 oz/ton; copper 0.2%
27'6" to 31'6"	Mottled shale; some chalcopyrite and pyrite
31'6" to 35'	Spots of chalcopyrite and pyrite in silicified lime Assay: gold-nil; silver-trace; copper-nil
35' to 39'	Close grained shaley lime silicate
39 to 47'	Silicified carbonaceous limestone
47 to 50'	Siliceous white rock (shaley)
50 to 55'	Quartz porphyry

DIAMOND DRILL HOLE NO. U-7

S. 22°E. Plus 12°

0 to 0'9"	Altered limestone
0'9" to 1'6"	Chalcopyrite in calcite and garnet Assay: gold 0.02 oz/ton; silver 1.58 oz/ton; copper 7.5%
1'6" to 4'	Silicified limestone with spots of pyrite and chalcopyrite

4' to 5'6"	Quartz and chalcopyrite in lime silicate Assay: gold-nil; silver 0.20 oz/ton; copper 1.3%
5'6" to 14'6"	Close grained lime silicate
14'6" to 17'6"	Black shale
17'6" to 22'	Altered limestone with garnets and calcite; diagonal seam of calcite and some chalcopyrite crossing at 21 feet
22' to 32'	A few bunches of calcite with spots of chalcopyrite and specular iron in black shale
32' to 36'	Altered lime; showing spots of chalcopyrite and 2" calcite streak at 34 feet
36' to 40'	Garnetized limestone with some specularite in calcite blobs
40' to 41'6"	1½' of highly siliceous looking material; looks like porphyry
41'6" to 50'	Black shale
50' to 63'	Oxidized material; calcite, garnet and limonite-altered limestone. The ledge at this point is near a north and south fault.
63' to 65'	Quartz porphyry

DRILL HOLE NO. U-8

N. 35° E. Plus 33°

0 to 7'	Carbonaceous black shale
7' to 11'	Gray close grained silicified lime
11' to 12'	Gray close grained silicified lime with some vugs, garnets and copper and iron spots
12' to 15'	Chalcopyrite in garnetite and calcite Assay: gold-0.06 oz/ton; silver 1.54 oz/ton; copper 5.0%
15 to 18'	Quartz porphyry

DRILL HOLE NO. U-9

N. 25° E. Plus 4½°

0 to 3'	Altered limestone
3 to 5'	Gray shale
5 to 10'	Altered limestone
10 to 11'	Specular iron, limonite, malachite spots in altered lime
11 to 11'3"	3" of solid calcite
11'3" to 14'	Altered limestone, calcite; garnet spots, specular iron, chalcopyrite and pyrite
14 to 17'	Grayish and blackish shale

Note - This hole stopped before reaching ore zone

DIAMOND DRILL HOLE NO. U-10

N. 4° W. Plus 33°

0 to 10'6"	Black carbonaceous shale
10'6" to 12'	Gray shale
12' to 17'6"	Quartz porphyry dendrites
17'6" to 13'	Quartz seam in garnetite, spots of cuprite, chalcopyrite calcite and specular iron Assay: gold-none, silver 0.04 oz/ton; copper nil.

18' to 24'	Mixture garnetite, quartz, chalcopyrite, spots of copper and specular iron Assay: gold-nil; silver-trace; copper nil.
24 to 24'6"	White crystalline quartz. Assay: gold-nil, silver-trace; copper-nil.
24'6" to 25'2"	Yellowish to brown siliceous rock, spots of specular iron Assay: gold-nil; silver-trace, copper-nil
25'2" to 27'	Altered limestone, garnetite, calcite, spots of specular iron and chalcopyrite. Assay: gold-nil; silver-trace; copper 0.2%
27' to 32'	Mixture of calcite, silicified lime, garnetite and vuggy white quartz 31 to 32 feet. Assay: gold-nil; silver-nil; copper-nil
32 to 40'	Same mixture as above with some shale- core recovery 3' short Probably vug hole losses Assay: gold-nil; silver-nil; copper-nil.
40 to 62'	Quartz porphyry Assay: 50 to 63', gold-nil; silver-trace; copper nil.

DRILL HOLE NO. U-11

N. 12° W. Minus 48°

0 to 3'	Gray shale
3' to 3'3"	Pyrite and chalcopyrite in calcite groundmass
3'3" to 8'	Close grained calcareous shale, small seam 1/8" chalcopyrite at 7'3"
8' to 9'6"	Vuggy garnetite with quartz seams and some calcite
9'6" to 10'6"	Spots of chalcopyrite in altered limestone.
10'6" to 14'	Few spots of chalcopyrite in silicified limestone, some garnets
14' to 15'	Quartz veinlets in limestone, spots of chalcopyrite, malachite and calcite
15' to 17'	Chalcopyrite in garnetite inclusions in mottled shale
17' to 22'	Garnetite and shale mixture
22' to 25'	1" bands of calcite and quartz in shale showing considerable garnetite
25' to 25'5"	5" of yellowish bull quartz
25'5" to 27'	Garnetized limestone, spots of chalcopyrite and specularite
27' to 30'	Gray to black shale seams of calcite
30' to 33'	Silicified limestone
33' to 34'	Considerably vuggy calcite in limestone
34' to 35'	Shaley mixture
35' to 44'	Garnetized and calcitized limestone
44' to 48'	Altered limestone, specular iron, chalcopyrite spots and calcite and garnet
48' to 60'	Massive garnetite with some calcite, good chalcopyrite showing between 58 and 59'
60 to 66'	Highly silicified white rock. ½" chalcopyrite and other spots from 62-63 feet
66 to 70'	Chalcopyrite in alluvial (?) limestone

70 to 72'	Close grained reddish brown to white shale, a few spots of chalcopyrite
72 to 75'	Well mineralized altered limestone
75 to 87'	Altered limestone, calcite and garnetite
87 to 96'	Shale with about 1' altered limestone at 92'

DIAMOND DRILL HOLE NO. U-12

S. 48° E. Plus 34½°

0 to 2'	Altered limestone, some chalcopyrite
2' to 10'	Bluish gray shale
10' to 12'	Altered limestone
12' to 16'	Shale
16' to 19'	Chalcopyrite showing in altered limestone, good prospect
19' to 24'	Shale, grayish close grained
24' to 26'	Altered limestone, spots of calcite and chalcopyrite; good prospect
26' to 46'	Bluish shale, spots of malachite at 29'
46' to 58'	Oxidized, shaley material showing considerable calcite

DRILL HOLE NO. U-13

N. 80° W. Plus 51°

0 to 7'	Altered limestone
7' to 9'	Bluish gray shale
9' to 12'	Partly garnetized limestone
12' to 15'	Close grained shale, few spots chalcopyrite
15' to 17'	Garnetized limestone
17' to 22'	Vuggy garnetized limestone, malachite, cuprite and melaconite spots
22' to 26'	Mottled shale
26' to 31'	Garnetized limestone
31' to 37'	Oxidized and partly altered garnetite, seam at 37'
37' to 40'	Blue crystalline limestone
40' to 42'	Highly siliceous shale
42' to 45'	Crushed up material (fault?) part of core missing (2½')
45' to 48'	Close grained bluish-gray shale

DIAMOND DRILL HOLE NO. U-14

S. 84° E. Plus 49°

to 5'	Brown, yellow, black and green garnetite with spots of specularite and calcite
' to 12'	Garnetite
' to 14'	Altered limestone, garnets and calcite
' to 14'3"	Solid red garnets
' 3" to 21'	Garnetite
' to 24'	White shale
' to 24'6"	Garnetite

24'6" to 27'	Black and white shale with small seams of garnetite
27' to 30'	Lime silicate (white)
30 to 34'	Mottled shale
34' to 35'	Garnetite, with spots of chalcopyrite and malachite
35' to 41'	Mottledwhite and dark shale
41' to 42'6"	Garnetite with stains of malachite
42'6" to 44'6"	Mottled shale
44'6" to 47'	Garnetite and shale mixture
47' to 49'	Altered limestone
49' to 51'	Mottled shale
51' to 66'	Reddish garnetite
66' to 75'	Crushed fault plane material—clay, calcite, garnetite, spots of pyrite and chalcopyrite, iron and copper stains
75' to 76'	Porphyry
76' to 86'	Garnetite
86' to 87'	Crushed material—some stains of copper
87' to 109'	Garnetite
109' to 111'6"	Crushed material, iron and copper stains
111'6" to 118'	Shale
118' to 119'5"	Garnetite
119'5" to 121'	Shale
121' to 125'	Garnetite
125' to 127'	White and black shale
127' to 133'	Garnetite
133' to 141'	Light shale
141' to 157'	Dark shale

DRILL HOLE NO. U-15

N. 43° W. Minus 30½°

0 to 19'	Garnetite with a few spots of chalcopyrite and malachite at 8'. Spots of chalcopyrite at 15'
19' to 25'	Close grained bluish shale—white shale and brown shale.
25' to 28'	Mixture of garnetite shale and calcite
28' to 35'	Garnetite, spots of chalcopyrite at 31' to 35', also few spots of malachite
35' to 36'	Shale

Note - Mr. McCarthy's comment "This would stand a prospect crosscut".

DIAMOND DRILL HOLE NO. U-16

S. 42° E. Plus 32½°

0 to 6'	Garnetite with spots of calcite
6' to 8'	Garnetite, shale and calcite mixture. Small seams of chalcopyrite at 7½'
8' to 9½'	Close grained bluish shale
9½' to 13½'	Vuggy garnetite with limonite areas. Spots of chalcopyrite at 11½' and 13½'
13½' to 15'	Bluish shale
15' to 16'	Mixed garnetite and calcite, spots of chalcopyrite

16' to 21'	Close grained bluish and black shale
21' to 24'	Pyrite in lime silicate, some garnetite
24' to 28'	Close grained lavendar shale
28' to 30'	Mottled white and black shale
30' to 36'	Garnetite
36' to 43'	Mottled shale

DRILL HOLE NO. U-17

N. 58° E. Plus 33½°

0 to 10'	Grayish blue shale
10' to 17'6"	Garnetite
17'6" to 19'	White shale
19' to 19'6"	Calcite spots in altered limestone
19'6" to 25'6"	Blue and white mottled shale
25'6" to 27'	Garnetite
27' to 33'	Brownish shale
34' to 37'	Garnetite
37' to 47'	Gray shale
47' to 53'	Garnetite
53' to 54'	Shale
54' Plus	Garnetite

DIAMOND DRILL HOLE NO. U-18

N. 45° E. Minus 46½°

0 to 5'	Brownish, greenish and white mottled shale
5' to 5½'	Copper carbonates on cracks in shale
5½' to 13'	Bluish shale, some manganese on seams
13' to 18'6"	Calcite spots in highly oxidized and altered limestone; spots of malachite and limonite. Assay: gold-nil; silver-nil; copper-0.4%
18'6" to 19'	Chalcopyrite spots in garnetite Assay: gold-nil; silver-trace; copper 0.7%
19' to 20'9"	Altered limestone, garnetite and calcite
20'9" to 21'9"	Spots of chalcopyrite in altered lime, showing considerable calcite sulphides Assay: gold-nil; silver-trace; copper-0.6%
21'9" to 24'	Mixture of limestone and shale, few spots of chalcopyrite and iron sulphides.
25' to 34'6"	Close grained black shale, calcite and chalcopyrite on seams, some pyrite
34'6" to 39'	Garnetite with spots of sulphides
39' to 39'8"	Gray shale
39'8" to 42'	Altered limestone showing considerable calcite in seams and bunches
42' to 49'	Black shale showing spots of chalcopyrite and pyrites Assay: gold-nil; silver-nil; copper-trace

49' to 53'	Close grained gray shale
53' to 56'6"	Black shale
56'6" to 58'	Greenish and white mottled shale, showing chalcopyrite in 3½-inch seams
	Assay: gold-nil; silver-nil; copper 0.4%
58'-	Grayish and black shale.

DRILL HOLE NO. U-19

S. 52° W. Minus 46½°

0 to 1'	Spots of malachite and limonite in crushed material
1 to 3'	Blocky dark shale, spots of chalcopyrite at 3'
3 to 17'	Mottled shale
17' to 18'	Garnetite showing specular iron and calcite spots.

Note- The cores of this section got mixed up, but Mr. McCarthy reports nothing of value in this section

37'6" to 43'	Altered limestone, considerable calcite, spots of specular iron and a few spots of pyrite
43' to 48'	Black shale, spots of pyrite
48' to 54'	Mottled shale
54' to 60'	Dark shale

DIAMOND DRILL HOLE NO. U-20

S. 5° W. Minus 44°

0 to 4'	Oxidized shale
4 to 6'	Mottled shale
6 to 8'	Bluish shale
8 to 17'	Garnetite showing a few spots of malachite and chalcopyrite
17 to 19'	Mottled shale
19 to 25'	Mixed shale and garnetite spots
25 to 27'	Sandy spots in shale
27 to 30'	Garnetite, spots of chalcopyrite at 29'
30 to 33'	Mixture of shale and garnetite
33 to 35'	Some chalcopyrite
35 to 35'6"	Chalcopyrite in garnetite
	Assay: gold-nil; silver-trace; copper 0.5%
35'6" to 37'	Close grained bluish gray shale
37 to 42'	Altered limestone showing calcite and garnetite
42 to 45'	Considerable calcite and some specular iron and iron oxide in altered limestone
45 to 54'	Close grained bluish shale
54 to 58'	Mottled bluish and white shale

DRILL HOLE NO. U-21

S. 57° W. Plus 44½°

1 to 3'	Mottled shale
3 to 8'	Marbleized

8 to 12'	Mottled bluish and greenish shale
12 to 15'	Marble
15 to 16'	Mottled blue and white shale
16 to —	Altered spots of specular iron and garnetite
Note:	Cores got mixed up in this section. Mr. McCarthy reports nothing of value in this section
30 to 33'	Close grained greenish gray shale
33 to 40'	Olive green shale
40 to 43'	Altered limestone, some calcite
43 to 45'	Close grained gray shale
45 to 49'	Marble
Note:	Cores got mixed up in this section. Mr. McCarthy reports nothing of value in this section
55 to 57'	Gray shale with manganese spots
57 to 60'	Garnetite with bunches of malachite
	Assay: gold-nil; silver-trace; copper-0.6%
64 to 66'	White shale showing black spots of manganese
66 to 68'	Garnetite
68 to 81'	Blue and white shale complex, showing garnetite mixture at 73 to 75' and from 79 to 80'
81 to 87'	Shale showing manganese spots

DIAMOND DRILL HOLE NO. U-22

S. 62° E. Plus 50°

0 to 3'	Gray shale
3 to 6'	Spots of garnetite in close grained shale
6 to 6.3'	Spots of carbonate and sulfides of copper
	Assay: gold-nil; silver-nil; copper-trace
6.3 to 8.5'	Gray shale
8.5 to 11'	Garnetite
11 to 16'	Shale, grayish to yellow
16 to 17'	Garnetite showing calcite
17 to 25'	Light blue shale
25 to 35'	Gray shale
35 to 37'	Silicified limestone merging—
37 to 39'	into altered limestone showing calcite, garnetite and spots of chalcopyrite
39 to 42'	Sulfide ore 39 to 39½', then oxidized ore
	Assay: gold-trace; silver 0.52 oz/ton; copper 1.8%
42 to 46'	Oxides of copper in garnetite
46 to 51'	Garnetite showing carbonates of copper
51 to 54'	Soft material (lost water—no core)
54 to 57'	Decomposed white shale, spots of iron oxide
57 to 59'	Lime silicate
59 to 60'	Garnetite, some calcite

SLUDGE ASSAYS

42 to 50'	Gold-nil; silver-trace; copper 0.7%
42 to 46'	Gold-nil; silver-trace; copper 0.6%
46 to 51'	Gold-nil; silver-nil; copper-trace

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DRILL HOLE NO. U-23

N. 20° E. Minus 47°

0 to 3'	Black shale
3 to 6'9"	Light blue shale
6'9" to 7'3"	Altered limestone, some calcite
7'3" to 12'6"	Garnetite
12'6" to 15'	White close grained shale
15' to 23'6"	Mottled white and black shale
23'6" to 24'	Garnetite
24' to 26'	Light brown shale (polishes)
26 to 34'	Shale; bluish white with copper stains on joint planes at 33'; 3-inch garnetite at 28'. Dendrites and nodules of iron and copper stained material. A few garnets and spots of iron and copper oxide and sulfides
34 to 36'	Marble
36 to 38'	Garnetized
39' to 41'3"	Dark shale
41'3" to 43'5"	White shale
43'5" to 47'	Shale
47' to 48'	Altered lime, some garnets.
48 to 51'	White rock, calcareous and silicified
51 to 64'	Mottled shale, partly crystallized with calcite and siliceous bunches through the ground mass.

DIAMOND DRILL HOLE NO. U-24

S. 30° E. Plus 45½°

0 to 2'	Garnetite and chalcopyrite 1 to 2'
	Assay: gold-0.01; silver-0.40; copper-2.1%
2 to 3'	Lime silicate
3 to 9'	White shale, merging into green silicate
9 to 11'	Light brown shale
11 to 14'	Marble
14 to 19'	Mottled green and white shale
19 to 21'6"	Mottled shale
21'6" to 36'3"	Dark green shale
36'3" to 50'	Marble-copper stain at 40'6"
50 to 57'	Lavendar shale
57 to 61'	Marble merging into garnetite and altered limestone from 60'2" to 61'
61 to 63'	Close grained mottled shale, some garnets
63 to 64'	Black shale
64 to 71'	White shale with one foot of black shale between 66' and 67'
71' to 77'6"	Mottled shale
77'6" to 80'6"	Black and blue shale
80'6" to 83'	Pyrite in white silicified lime
	Assay: gold-nil; silver-trace; copper-nil
83 to 90'3"	Mottled slate. (shale!). 1/16" chalcopyrite at 86'9"; spots of malachite and iron oxide at 88'

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90'3" to 95'	Altered limonite, calcite and garnet with a few crystals of limonite and malachite at 93'
95' to 103'	Shale
103 to 105'	Garnetite with a few copper and iron stains
105 to 111'	Shale
111 to 113'	Quartz porphyry

DIAMOND DRILL HOLE NO. U-25

S. 4° W. Plus 39°

0 to 1'	Garnetite
1 to 2'	Chalcopyrite ore Assay: gold-0.06 oz/ton; silver-0.70 oz/ton; copper 3.9%
2 to 7'	Lime silicate showing some garnets and calcite
7 to 8'	Bluish green silicate
8 to 17'	Garnetite; spots of malachite and chalcopyrite at 10'3"; 3" highly mineralized with chalcopyrite, malachite and iron oxide at 15'3"; 1" seam of chalcopyrite at 17'
17 to 22'6"	Altered limestone, calcite, garnets, etc.
22'6" to 24'	Shale
24 to 28'	Altered limestone
28 to 29'	Cracked shale, oxidized on seams, fault
29 to 30'	Garnetite
30 to 36'	Marble
36 to 38'	Altered limestone, some calcite and a few spots of chalcopyrite
38 to 40'	Garnetite
40 to 49'	Blue shale
49 to 50'	Brown shale, some dendrites
50 to 56'	Blue shale
56 to 66'	Sandy shale
66 to 68'	Bluish shale, some dendrites

DRILL HOLE NO. U-26

S. 59° E. Plus 39°

1 to 4'	Gray shale
4 to 5'	Marble
5 to 7'6"	Silicified lime; a few spots of chalcopyrite and a little calcite and garnetite
7'6" to 10'	Marble
10' to 14'	White shale with few spots of garnet
14' to 16'6"	Marble
16'6" to 20'	Shale
20' to 20'6"	Crumbly decomposed shale
20'6" to 30'	Marble
30 to 34'6"	Gray shale, manganese on seams
34'6" to 37'	Black shale
37 to 43'3"	Marble
43'3" to 44'	Greenish shale showing iron pyrites
44 to 45'	Gray shale
45 to 47'	Black shale
47 to 48'	Greenish-bluish and white mottled shale
48 to 53'	Marble

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53 to 60'	Dark shale with bands of white shale
60 to 61'	Gray shale with dendrites and oxidized iron on seams

DRILL HOLE NO. U-27
N. 54° W. Minus 39½°

0 to 1'	Loose rock--muck
1 to 3'	Altered limestone; some garnets and chalcopyrite Assays: gold-0.02 oz/ton; silver 0.38 oz/ton; copper 1.3%
3 to 6'	Altered limestone, some garnets and chalcopyrite Assay: gold-0.01 oz/ton; silver-0.28 oz/ton; copper 1.6%
6 to 11'	Bluish gray shale, some alteration between 9 and 10' marks
11 to 13'	White banded gray shale
13 to 17'	A few spots of pyrite and chalcopyrite in gray shale Assay: gold-nil; silver-nil; copper-trace
17 to 29'	Close grained gray shale
29 to 41'	Close grained calcareous shale, a few spots of pyrite

DIAMOND DRILL HOLE NO. U-28
N. 6° W. Minus 39½°

0 to 7'	Ore Assay: gold-0.01; silver-0.10; copper-1.0%
7 to 7'6"	Shale
7'6" to 10'	Altered limestone, spots of chalcopyrite
10 to 12'	6" of altered lime containing chalcopyrite between seams of shale
12 to 17'	Close grained shale

DRILL HOLE NO. U-29
N. 20° W. Minus 42°

0 to 4'6"	Altered limestone
4'6" to 7'	Shale
7 to 7'6"	Altered limestone
7'6" to 17'6"	Gray shale
17'6" to 20'	Bluish gray shale, partly altered with limonite and manganese spots

DRILL HOLE NO. U-30
N. 17° W. Plus 50°

0 to 2'	Oxidized altered limestone, spots of chalcopyrite and malachite
2 to 3'	Shale
3 to 6'9"	Altered limestone, some garnetite
6'9" to 7'6"	9" of ore Assay: gold-0.12 oz/ton; silver-2.38 oz/ton; copper 14.1%
7'6" to 10'6"	Altered limestone

NEW PLACERS MINING DISTRICT

SAN PEDRO AND CARNAHAN MINES

by
J. F. Smith, A. H. Wadsworth, J. R. Cooper, F. W. Farwell, A. E. Weissenborn

ABSTRACT

In the New Placers mining district of southwestern Santa Fe County, New Mexico, copper, lead and zinc ores have been mined from sedimentary rocks of Pennsylvanian age. The sediments, which locally have been much metamorphosed, have an average dip of 15 degrees to the east and southeast and are cut by numerous intrusive bodies. A syenite laccolith in the western part of the district is believed to have metamorphosed the overlying sediments.

At the San Pedro mine, the principal mine in the district, the known ore occurs as replacement deposits in seven metamorphosed limestone beds which form a unit 80 to 90 feet thick. Over the central part of the laccolith the beds have been altered to tactite; around the tactite area the limestone beds have been marmorized. Ore is found in a zone between the tactite and the marmorized limestone and the beds have been mined for a distance of 2400 feet. Only rarely are all the beds productive at any one place. Chalcopyrite, the only important copper mineral, is associated with garnet, calcite, quartz, specular hematite, and pyrite. There has been little oxidation of the ore. Lamping of the mine has revealed the presence of two scheelite-bearing areas. The scheelite bodies are probably too low in grade to be minable at present prices for tungsten, but tungsten might be recovered as a by-product of copper mining. A fault which passes through the Richman shaft separates the ore body into two parts. The ore beds east of the fault are presumed to be the same as those west of the fault but the presence of a distinctive quartzite bed west of the fault and its absence to the east casts some doubt on the validity of the correlation.

At the Carnahan mine, oxidized lead-zinc ore occurs as flat-lying pipe-like replacement deposits in limestone beds near their intersections with steeply dipping fractures striking northeast to east. The mine is only partly accessible and the principal stopes are said to be in the inaccessible part of the mine. The visible mineralization is low in grade.

Suggestions are given for prospecting at the San Pedro mine.

DIAMOND DRILL HOLE NO. U-33

N.47°W. Plus 51°

0 to 4'	Blocky fault plane material, granular and crushed; some iron oxide
4 to 7'	Altered limestone, garnetite and some calcite
7 to 8.5'	Garnetite
8.5' to 9'	6 inch ore showing chalcopyrite
9 to 11'	Shale
11 to 12'	Altered limestone, garnetite
12 to 20'	Decomposed and blocky shale
20 to 23.5'	Close grained siliceous blue shale
23.5 to 31'	Garnetite; a few spots of chalcopyrite at 24- 28-30' Decomposed and altered from 26 to 27'
31 to 31'1"	¼ inch seam of chalcopyrite and specular iron
31'1" to 36'	A few spots of chalcopyrite and considerable iron oxide in garnetite
36 to 40'	Shattered garnetite heavily impregnated with iron oxide at 37 and 39'
40 to 50'	More compact garnetite with blobs of chalcopyrite at 40'6" and carbonates of copper at 46' and 50'
50 to 52'11"	Highly altered rock with streaks of calcite and garnetite and iron oxide
52'11" to 53'3"	Three inches of ore
53'3" to 56'	Garnetite with a few blobs of chalcopyrite
56 to 62'	Oxidized garnetite
62 to 66'	Oxidized shale-shattered and cream colored between 62'5" and 64', some iron oxide
66 to 68'	Shale, more compact; black shale 67 to 68'
68 to 71'	Oxidized shale between two crushed zones
71 to 73'	Black shale
73 to 82'	Garnetite, partly altered; some calcite at 80 to 81'
82 to 86'6"	Altered limestone, partly garnetized, few spots of chalcopyrite and carbonates.
86'6" to 87'9"	Shale
87'9" to 88'	Seams of altered rock showing limonite and copper carbonate
88 to 89'	Altered limestone, garnetite and calcite
89 to 103'	Mottled shale, light to dark
103 to 106'	Mottled shale, light to dark
106 to 110'	Black shale
110 to 111'	Cream colored shale, some calcite
111 to 114.5'	Altered white rock, some clay, etc. (probably sympathetic fault)
114'3" to 115'3"	Ore seams Assays: gold-nil; silver 0.32 oz/ton; copper 0.9%
115'3" to 115'10"	Ore seams Assays: gold-trace; silver-0.80 oz/ton; copper 2.7%
115'10" to 116'2"	Sulphides Assays: gold-0.24 oz/ton; silver 6.08 oz/ton; copper 19.8%
116'2" to 151'	Highly siliceous wihte rock. No quartz phenocrysts noticeable, some spots of limonite and manganese

10'6" to 12'6"	Spots of chalcopyrite in altered lime Assay: gold-nil; silver-0.12; copper 0.6%
12'6" to 21'6"	Garnetite, few spots of chalcopyrite
21'6" to 24'	Broken up shale
24 to 28'	Oxidized garnetite with bands of chalcopyrite. Assay: gold-0.26 oz/ton; silver 0.86 oz/ton; copper 4.3%
28 to 29'6"	Oxidized garnetite Assay: gold-0.10 oz/ton; silver 0.14 oz/ton; copper 1.6%
29'6" to 31'	Shale with some malachite (part of this core missing, may be iron oxide fines.)
31' to 34'6"	Garnetite Assay: 31' to 33' - gold-nil; silver-trace; copper 0.5%
34'6" to 35'	White and blue shale
41'6" to 44'	Bluish shale, some carbonates on seams.
44 to 47'	Carbonates and iron stains in shaley rock. Assay: gold-nil; silver-0.06 oz/ton; copper-2.4%
47 to 49'	White shale; some malachite and manganese spots
49 to 57'	Porphyry, some manganese and a few quartz phenocrysts

DIAMOND DRILL HOLE NO. U-31

S.18°W. Plus 49°

0 to 5'	Altered limestone, some garnets--bornite, chalcopyrite and malachite in small spots
5 to 6'	Shale
6 to 8'	Altered limestone, some calcite and garnets
8 to 9½'	Dark and light shaley mixture, spots of calcite
9½ to 15'	Garnetite
15 to 18½'	Altered limestone, shale and garnetite
18½ to 21'	Black shale
21 to 26'	Altered limestone, showing considerable garnetite
26 to 28'	Some shale and spots of copper, showing in garnetite
28 to 31'	Shale
31 to 33'	Altered limestone, with garnets and calcite (small seam of chalcopyrite at 32' in garnetite)
33' ----	3 inches of chalcopyrite ore (no assay)
33'3" to 35'	Gray Shale
35 to 39'	Shale interspersed with bands of garnetite
39 to 42'	Bluish white shale
42 to 43'	Some pyrite, chalcopyrite and limonite in altered shale Assay: gold-nil; silver-trace; copper-0.3%
43 to 46'	Chalcopyrite and limonite bunches in altered rock Assay: gold-nil; silver-trace; copper 0.3%
46 to 47'	Altered limestone with some garnets.
47 to 51'	Shale (a 3 inch streak of calcite and altered lime containing considerable chalcopyrite)

DIAMOND DRILL HOLE NO. U-32

N.25°W. Plus 39°

0 to 7'	Crushed material near Swan Tunnel fault
7 to 9'	Hole caved; discontinued

FIGURE 1

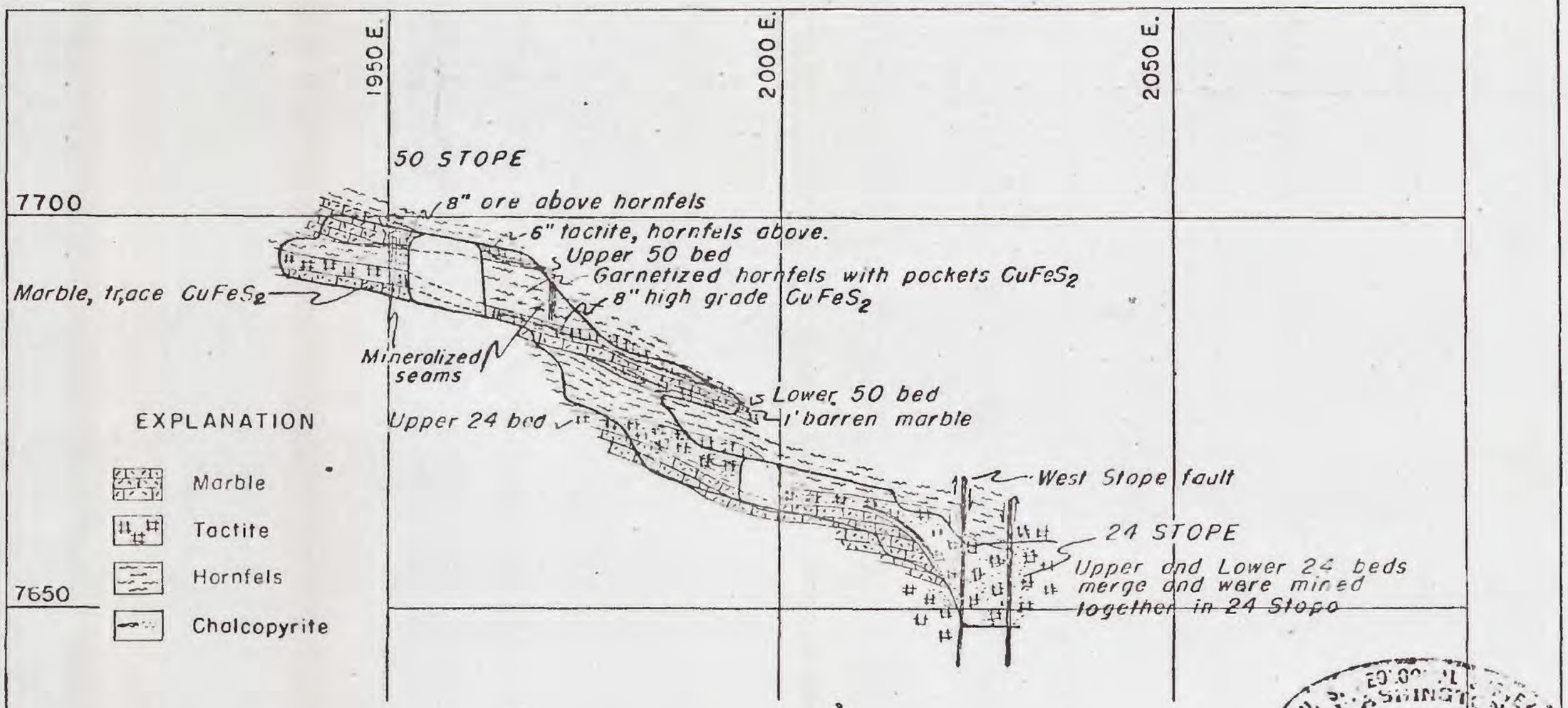
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

INDEX MAP

SHOWING LOCATION OF NEW PLACERS DISTRICT,

SANTA FE COUNTY, NEW MEXICO

45-21 (200) TR290 no.244



DETAILED SECTION OF RAISE FROM 24 STOPE TO 50 STOPE

SAN PEDRO MINE, NEW PLACERS DISTRICT, SANTA FE COUNTY, NEW MEXICO.

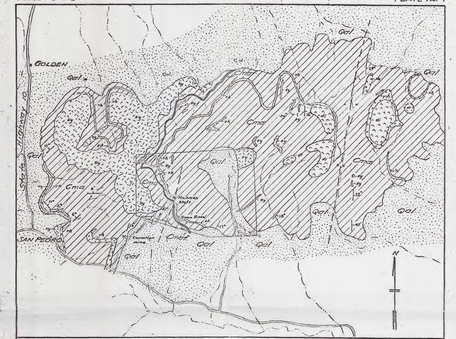
GEOLOGY BY J. R. COOPER, F. W. FARWELL, AND A. E. WEISSENBORN

JULY 1944

FIGURE 2

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

PLATE No. 1



Base uncorrected aerial photographs.

Geology by: J. Fred Smith, Jr.
A. H. Wentworth, Jr.
July 1943

RECONNAISSANCE MAP OF NEW PLACERS DISTRICT

SANTA FE COUNTY, NEW MEXICO

0 2000 4000 FEET
SCALE

EXPLANATION

SEDIMENTARY ROCKS

- Qal — Quaternary alluvium.
- Cmg — Madera formation of Magdalena group (Metamorphosed limestone, shale and sandstone)
- Pennsylvanian — Ore bearing beds in Madera formation, limestone and shale mostly altered to marble, hornfels and tactite; "forefield series" of Locke and Perry.
- Fault
- Strike and dip of beds.
- Area covered by detailed mapping.

IGNEOUS ROCKS

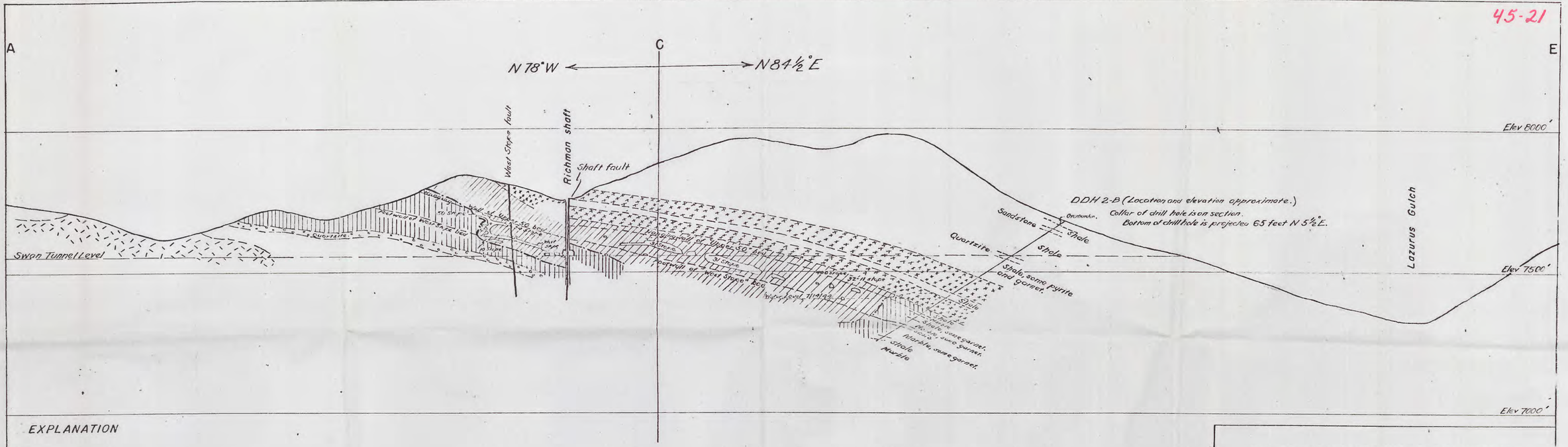
- Diorite
- Syenite
- Rhyolite porphyry
- Shaft
- Adit
- Mine working

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STRATEGIC MINERALS INVESTIGATION
PRELIMINARY MAP

PLATE II.

45-21



EXPLANATION

- Syenite
- Rhyolite
- Main ore bearing beds
- Quartzite marker bed
- Faults
- Formation boundary

ALTERATION FACIES

- Tactite-hornfels facies
- Marble-hornfels facies
- Generalized "marble line"

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

GENERALIZED SECTION THROUGH RICHMAN SHAFT
SHOWING
MAIN ORE BEARING BEDS, ALTERATION OF ROCKS
AND POSITION OF "MARBLE LINE"

SAN PEDRO MINE

NEW PLACERS DISTRICT SANTA FE COUNTY
NEW MEXICO

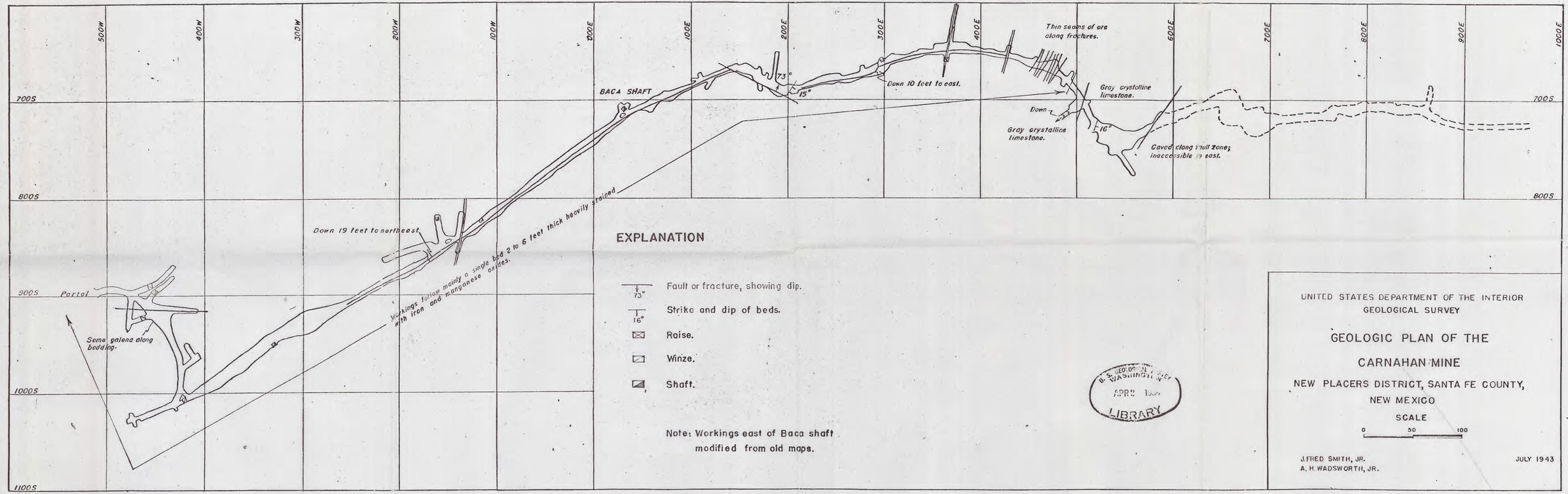
SCALE
0 200 400 FEET

GEOLOGY BY
JOHN R. COOPER FRED W. FARWELL
JULY 1944

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP

PLATE 12



EXPLANATION

- 73° — Fault or fracture, showing dip.
- 16° — Strike and dip of beds.
- Raise.
- Winze.
- Shaft.

Note: Workings east of Baca shaft modified from old maps.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

GEOLOGIC PLAN OF THE CARNAHAN MINE

NEW PLACERS DISTRICT, SANTA FE COUNTY, NEW MEXICO

SCALE

0 50 100

J.FRED SMITH, JR.
A. H. WADSWORTH, JR.

JULY 1943

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP PLATE 3.

COMPOSITE PLAN OF THE SAN PEDRO MINE SHOWING MARBLE LINE.

NEW PLACERS DISTRICT, SANTA FE COUNTY, NEW MEXICO.

Scale
0 200 400 600 feet

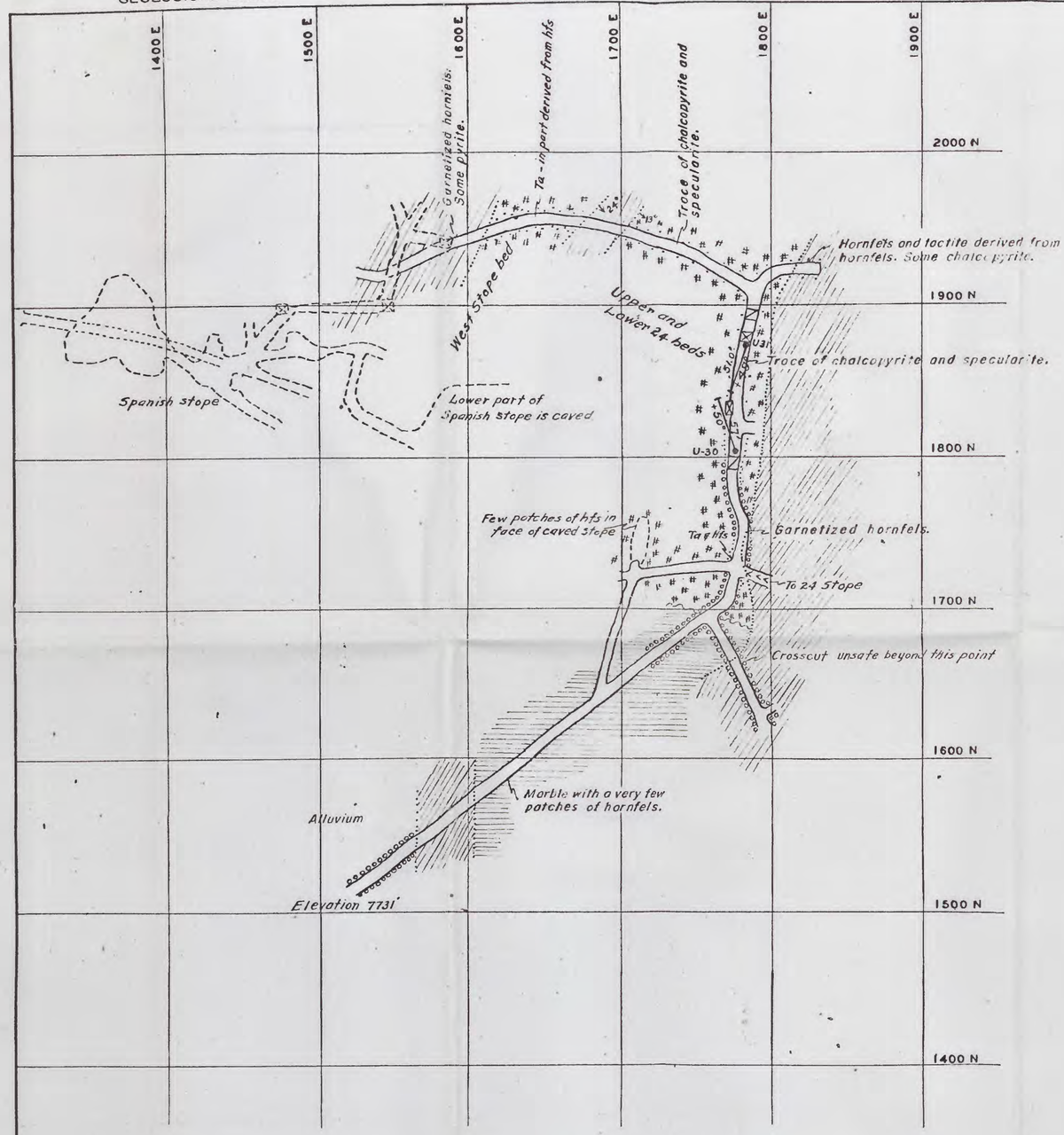
Workings from maps by the Roscoe Mining Interests, Inc.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

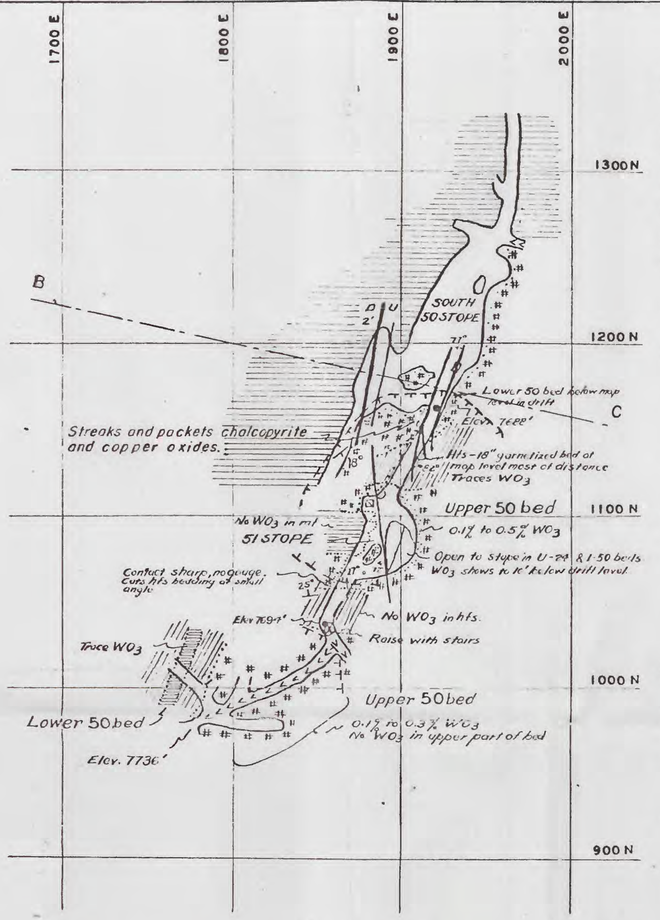
STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP

PLATE 5

45-21



NO 2 TUNNEL



HOME TUNNEL AND CONNECTION TO SOUTH 50 STOPE

EXPLANATION

- mi — Marble
- Ta — Tactite
- hfs — Hornfels
- Formation boundary
- D 2' / 72° — Fault, showing downthrown side dip and displacement
- 22° — Strike and dip of beds
- Copper concentrations
- Outline of scheelite lens
- Raise
- Winze
- Incline (up)
- Lagging
- 570' / +50° U-30 — Diamond drill hole showing length and inclination of hole

WO_3 content estimated under ultraviolet light

BASED ON MAP BY A. LOCKE AND E. H. PERRY 1916
LATER WORK HAS BEEN ADDED

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

GEOLOGIC PLAN
OF
NO. 2 TUNNEL AND HOME TUNNEL

SAN PEDRO MINE

NEW PLACERS DISTRICT, SANTA FE COUNTY,
NEW MEXICO

SCALE
0 25 50 100 FT.

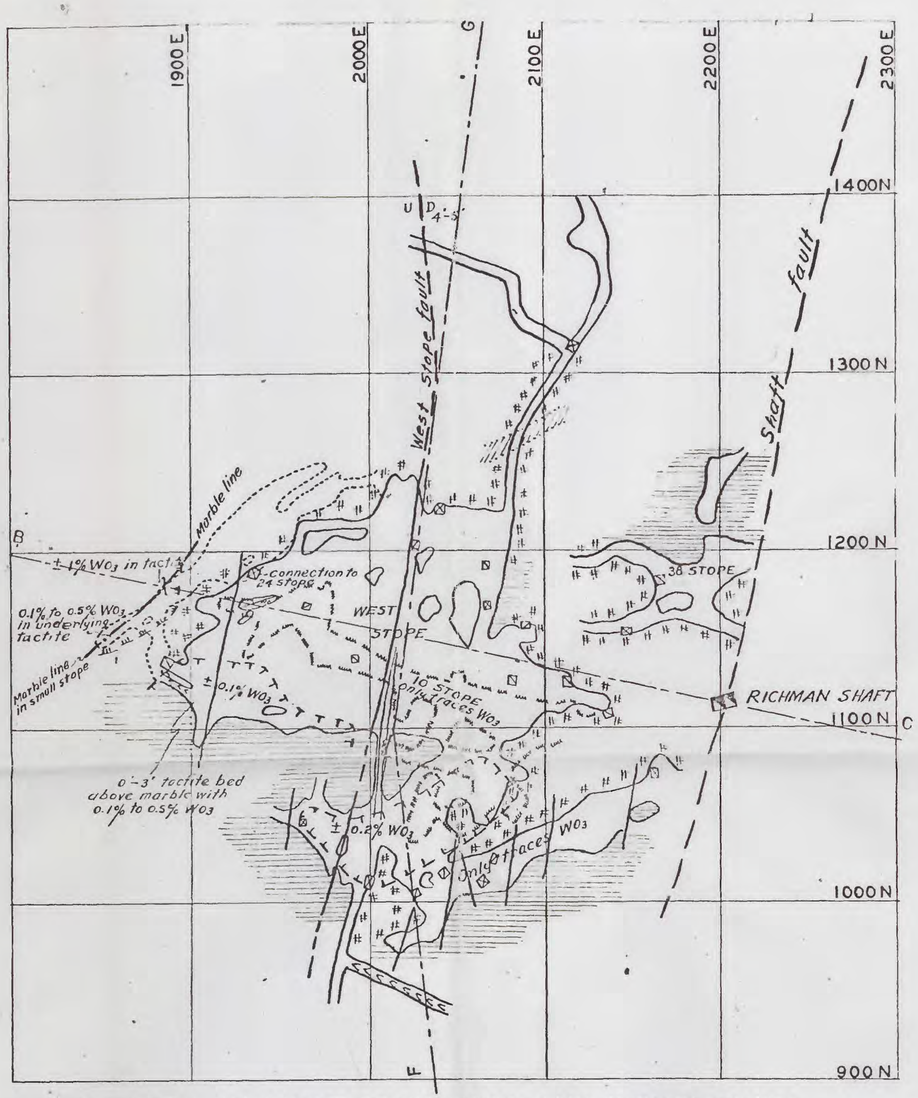
GEOLOGY BY

J. FRED SMITH, JR. JULY 1943
A. H. WADSWORTH, JR.
JOHN R. COOPER JUNE 1944
FRED W. FARWELL

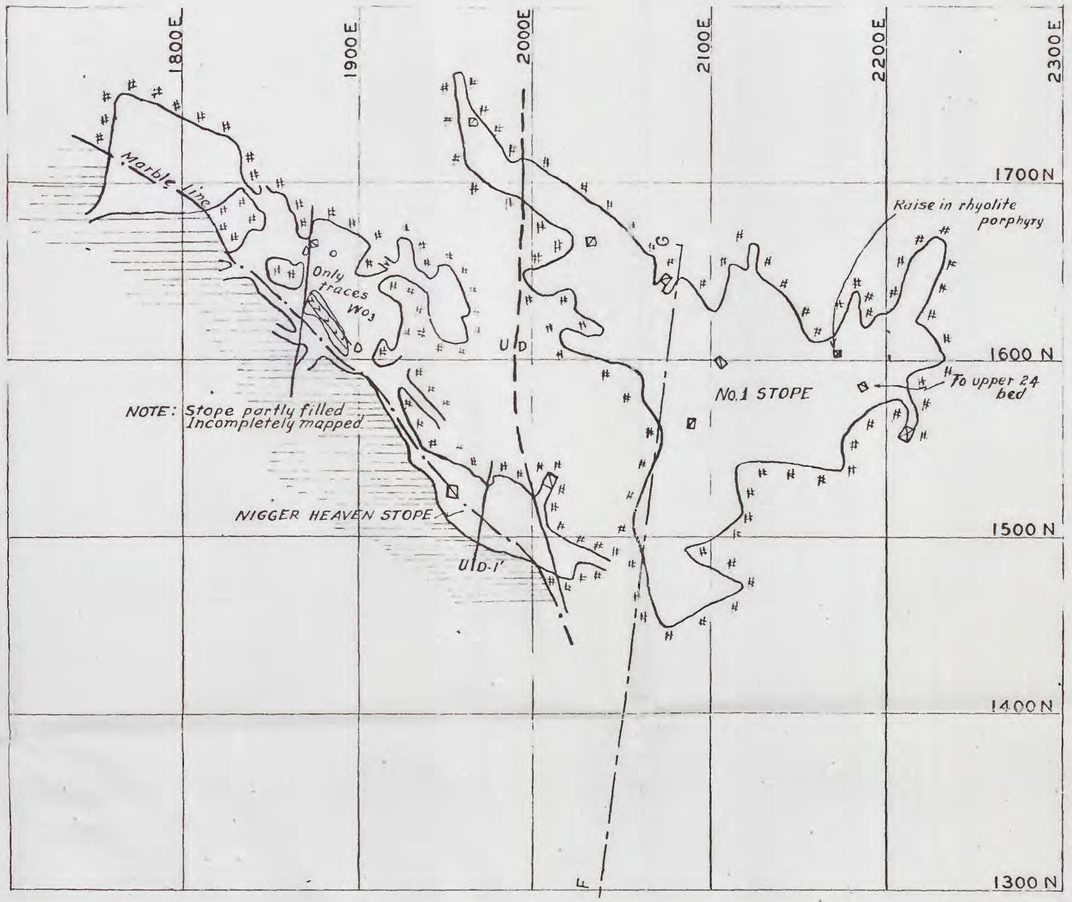
PLATE 6

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP



STOPES IN WEST STOPE BED AND OTHER BEDS



STOPES IN 50 BEDS
UPPER AND LOWER 50 BEDS COINCIDE IN MOST PLACES

EXPLANATION

- Marble
- Tactite
- Hornfels
- Marble line
- Scheelite concentrations in unnamed bed
- Scheelite concentrations in West Stope bed
- D 4' — Fault, showing downthrown side and displacement
- Workings in unnamed bed above West Stope bed
- Workings in West Stope bed
- Workings in 10 bed
- Raise
- Winze
- Incline Up
- WO_3 content estimated under ultraviolet light

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

GEOLOGIC PLAN OF STOPES
IN
50 BED, WEST STOPE BED AND OTHER BEDS

SAN PEDRO MINE

NEW PLACERS DISTRICT, SANTA FE COUNTY,
NEW MEXICO

SCALE
0 25 50 100 200 FEET

Geology By J. Fred Smith, Jr. and A.H. Widdsworth, Jr. *July 1943*

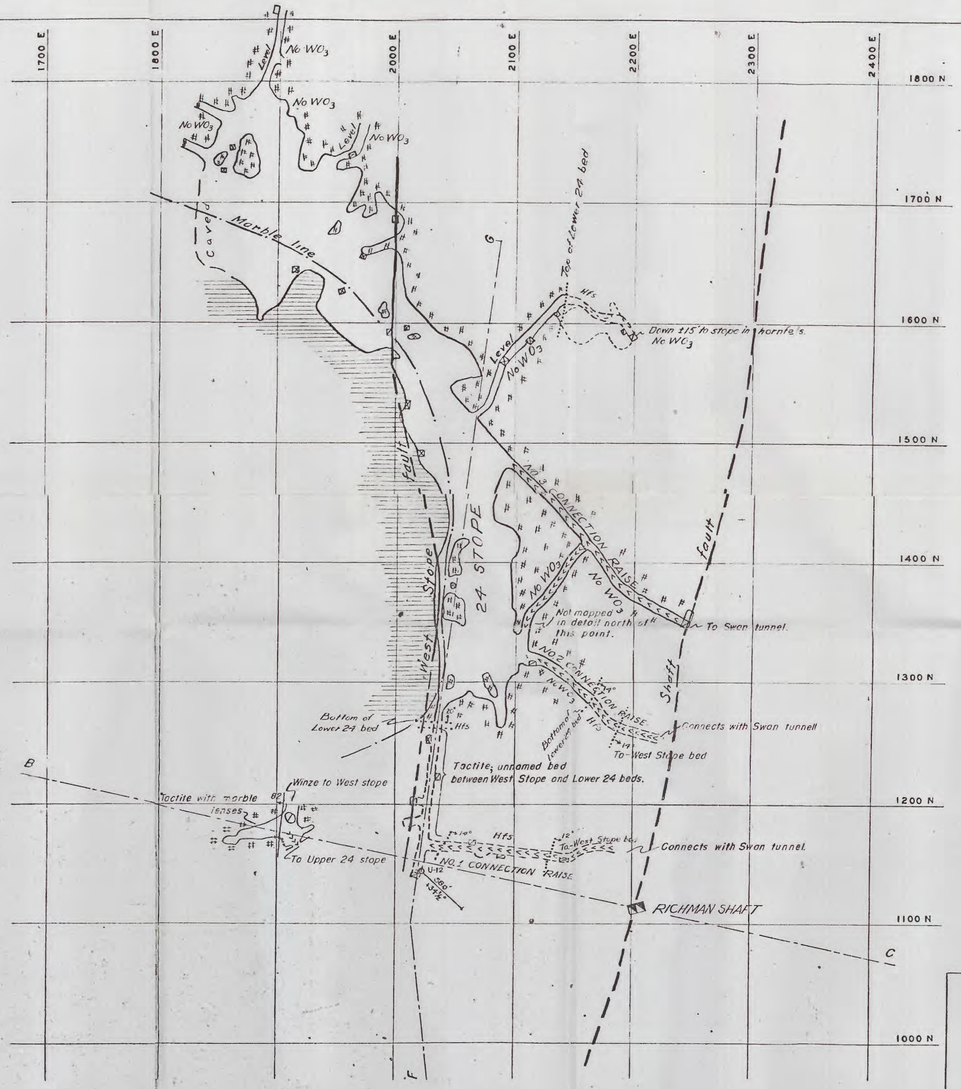
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP

PLATE 7
(200)
R290
no. 244

45-21

UPPER 24 BED



LOWER 24 BED

BASED ON MAP BY A LOCKE AND E.H. PERRY 1916
LATER WORK HAS BEEN ADDED.

EXPLANATION

- Marble
- Tactite
- Hornfels
- Fault
- Vertical fault
- Marble line
- Contact
- Copper concentrations, mapped only in part.
- Scheelite concentrations
- Workings in 24 beds
- Workings above or below 24 beds
- Raise
- Winze
- Incline
- U-12 Diamond drill hole, showing length and inclination of hole
- WO_3 content estimated under ultraviolet light

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PLAN OF STOPES AND CONNECTING WORKINGS
ON
UPPER AND LOWER 24 BEDS

SAN PEDRO MINE

NEW PLACERS DISTRICT, SANTA FE COUNTY,
NEW MEXICO

SCALE
0 25 50 100 200 FT.

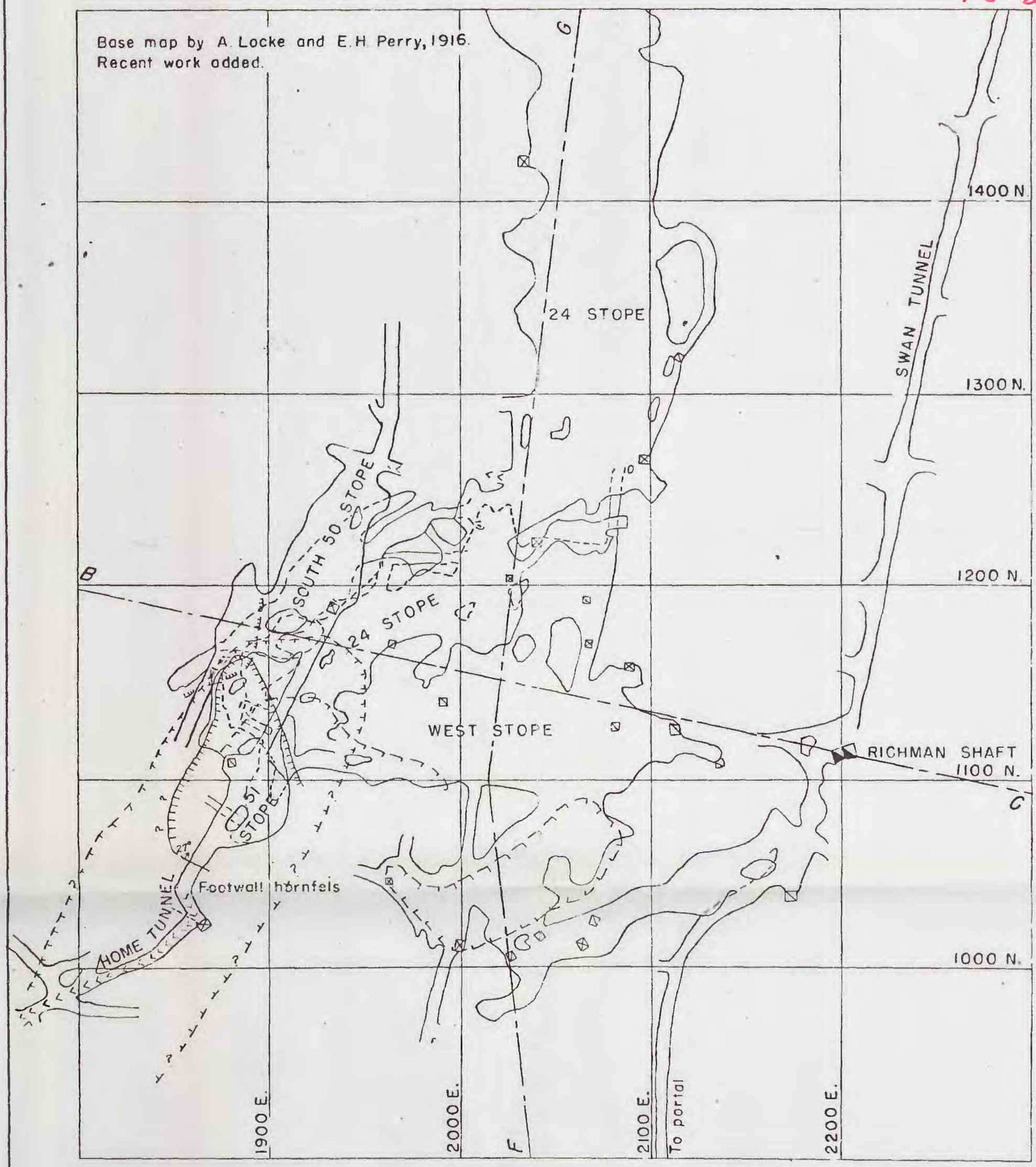
GEOLOGY BY
J. FRED SMITH, JR. JULY 1943
A. H. WADSWORTH, JR.
JOHN R. COOPER
FRED W. FARWELL
A. E. WEISSENBORN
JUNE 1944

PLATE 8

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP

Base map by A. Locke and E.H. Perry, 1916.
Recent work added.



EXPLANATION

- Scheelite concentrations in 50 beds
- Scheelite concentrations in Upper 24 beds
- Scheelite concentrations in unnamed bed below Lower 24 bed
- Scheelite concentrations in West Stope bed
- Workings in 50 beds
- Workings in Upper 24 bed
- Workings in unnomed bed below Lower 24 bed
- Workings in West Stope bed
- Shoft
- Winze
- Raise
- Incline

COMPOSITE PLAN OF STOPES WEST OF SHAFT FAULT SHOWING SCHEELITE CONCENTRATIONS

SAN PEDRO MINE

NEW PLACERS DISTRICT, SANTA FE COUNTY, NEW MEXICO

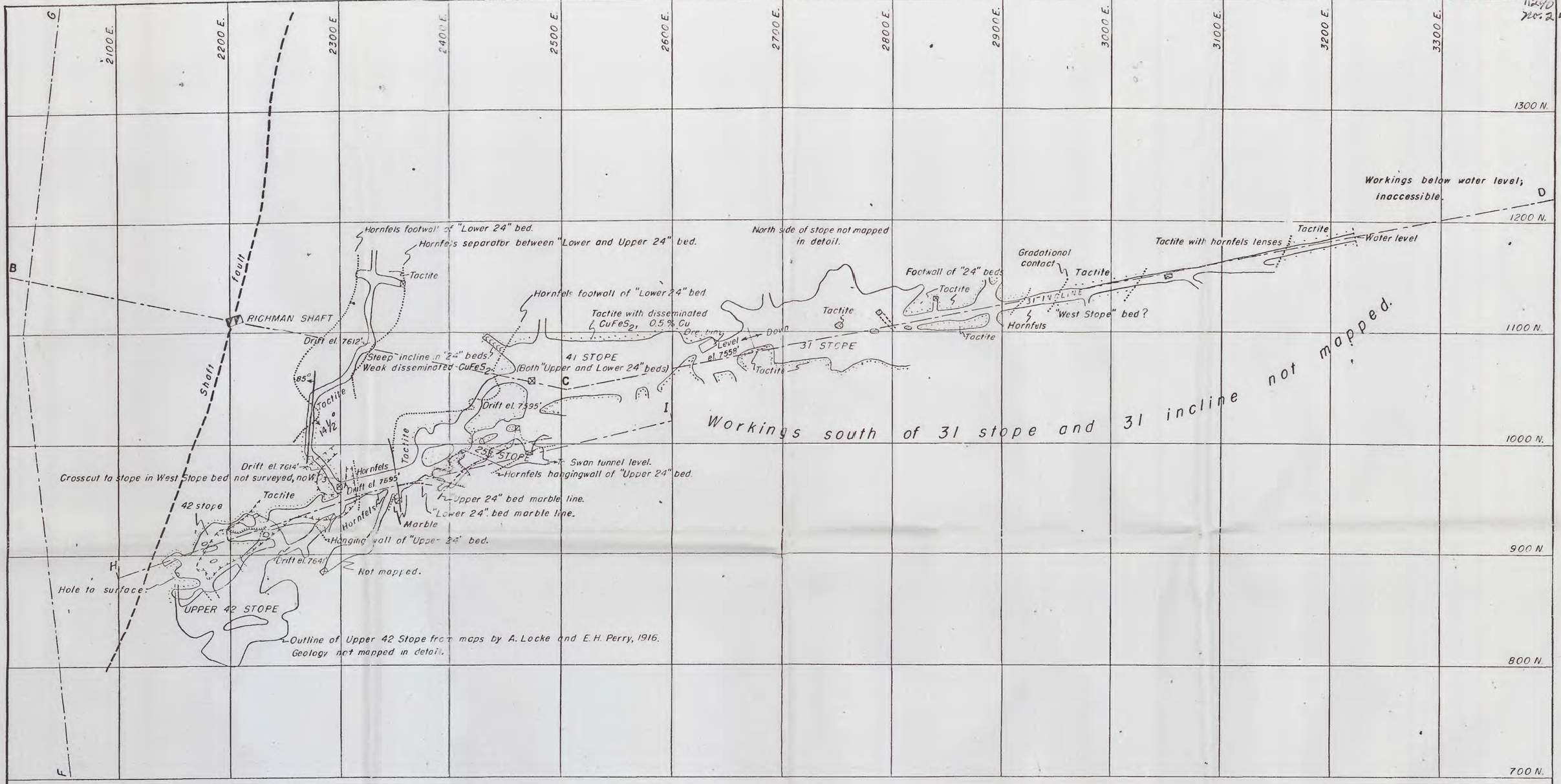
Scale
0 100 200 feet

Geology by John R. Cooper and Fred W. Forwell, July, 1944.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STRATEGIC MINERALS INVESTIGATIONS PLATE 9
PRELIMINARY MAP 45-21

(200)
R290
no. 244



EXPLANATION

- Contact and dip of contact
- 85° Fault and dip of fault plane
- Scheelite concentrations in "Upper 24" bed } Estimated 0.1% to 0.5% WO_3
- Scheelite concentrations in "Lower 24" bed }
- Copper concentrations
- Workings in "Upper 24" bed
- Workings in "Lower 24" bed
- Workings in both Upper and Lower "24" beds
- Workings in "West Stope" bed
- Raise
- Winze

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

COMPOSITE PLAN OF STOPES EAST OF SHAFT FAULT SHOWING SCHEELITE CONCENTRATIONS

SAN PEDRO MINE

NEW PLACERS DISTRICT, SANTA FE COUNTY,
NEW MEXICO

SCALE
0 50 100 200 FEET

GEOLOGY BY
JOHN R. COOPER AND FRED W. FARWELL