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GEOLOGY OF THE IDAHO ALMADEN QUICKSILVER MINE
NEAR WEISER, IDAHO

By
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Prepared in cooperation with
the United States Geological Survey

University of Idaho
Moscow, Idaho

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ABSTRACT

The Idaho Almaden mine, 11 miles east of Weiser, Idaho, was first developed in 1937, and by 1939 had become a large producer of quicksilver. The deposit is in a downwarped part of the crest of a long anticline in Payette strata (Miocene) on Nutmeg Mountain. The beds have been impregnated and openings cemented with opal, chalcedony, cinnabar, and a little pyrite. These minerals were deposited close to the surface of the ground from hot solutions that rose along faults and spread laterally along permeable sandstone beds, beneath shaly layers. The mineralized ground extends over more than 100 acres, but only a fraction of this has as yet been thoroughly explored. Much of it is probably of too low grade to be of economic interest. Excavations and drill holes have shown the presence of an ore body 250 feet long and 175 feet wide with an average depth of 18 feet. In August, 1939, when the mine was visited, a considerable part of this ore body had been quarried and had yielded 464 flasks of quicksilver. The quicksilver content of the ore treated is reported to have been 5 to 15 pounds to the ton.

INTRODUCTION

LOCATION

The Idaho Almaden mine, the only quicksilver mine in southwestern Idaho, is about 11 miles in an airline or 17 miles by road due east of Weiser, the county seat of Washington County (fig. 1). Weiser is a station on the Oregon Short Line (Union Pacific System) and modern highways join it with points to the north, east, and west. The center of the property is near the common corner of sections 4 and 5, T. 10 N., R. 3 W., and sections 32 and 33, T. 11 N., R. 3 W., Boise Meridian. County roads on both sides of the Weiser River extend from Weiser to the vicinity of the mine, as shown in Figure 1. The one to the north is somewhat the better and passes within half a mile of the property. A link somewhat more than a mile long between this road and the mine camp was in process of being improved in September, 1939.

SCOPE

The quicksilver deposit that is being developed by the Idaho Almaden Mines Company has aroused much interest, both because it is in an area not previously known to contain metallic lodes and because in the two years of its operation it has brought Idaho into the list of states that contribute notably to the production of quicksilver. For these reasons and because of the interest in quicksilver as one of the strategic metals, the writer was authorized to make a preliminary examination of the deposit for the U. S. Geological Survey and the Idaho Bureau of Mines and Geology. Three days late in August, 1939, were devoted to this task. At that time, development at the mine was still too limited to permit adequate estimation of reserves. Ore was exposed in scattered openings over more than 100 acres in such a way as to suggest that enough is present to afford sustained production for some time to come. The deposit resembles those in northern Nevada and southeastern Oregon in which chalcedony and opal are the outstanding gangue minerals. It is in a part of the crest of a long anticline in Tertiary beds where there is a local structural depression, in part the result of faulting. The ore

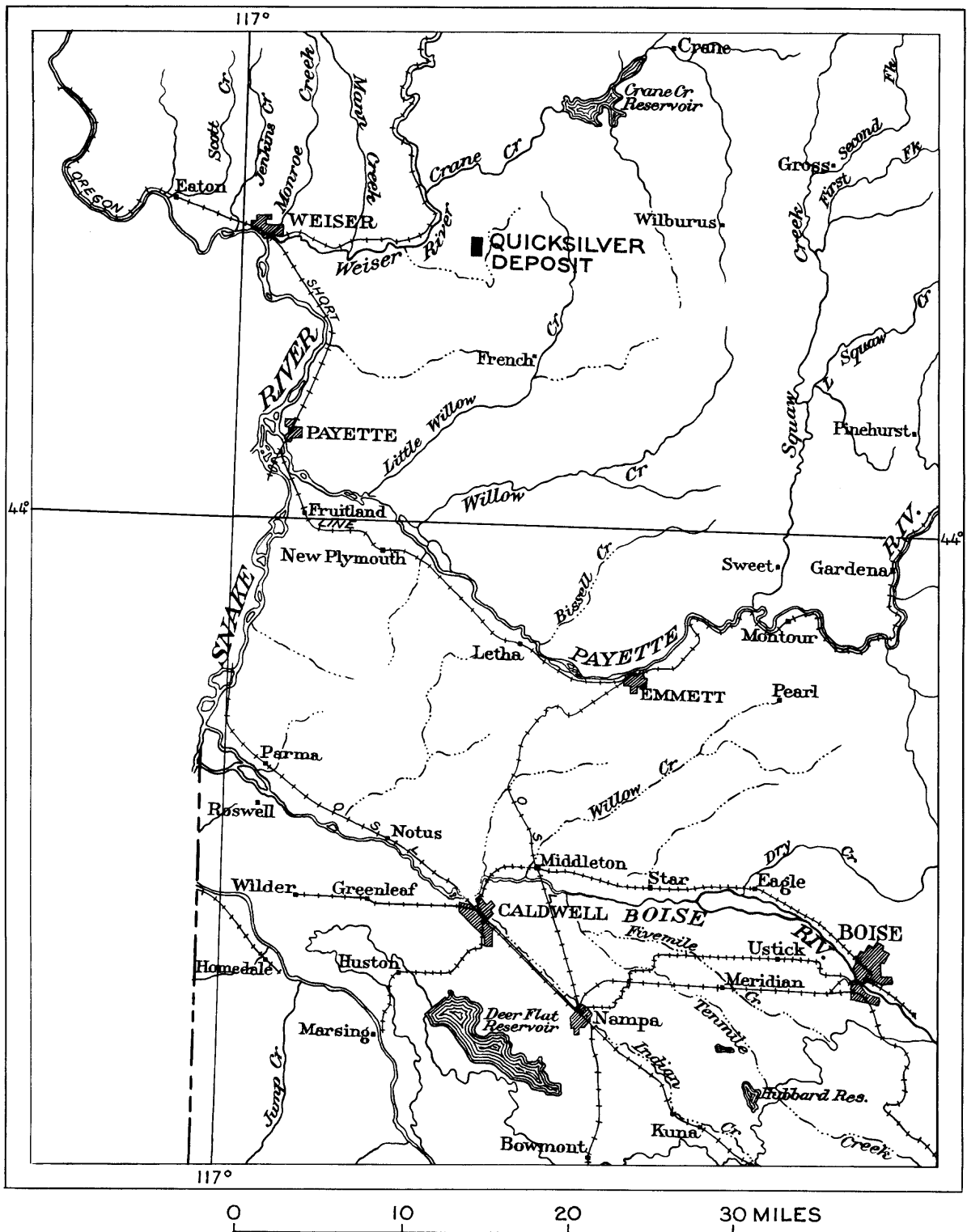


Figure 1 Index map showing location of the Idaho Almaden Mine

minerals have permeated and replaced porous sandstone, in part along fractures, and have been concentrated to some extent under relatively impermeable beds of shale and fine-grained sandstone. Some of the cinnabar appears to be syngenetic with opal, but some was deposited later than most of the opal and chalcedony.

PREVIOUS GEOLOGIC WORK

The area that contains the quicksilver deposit is part of a broad region, the general geology of which was studied by Kirkham some years ago before the presence of quicksilver was suspected. He showed that the region is underlain mainly by a great thickness of sedimentary and volcanic beds that range in age from Miocene to Pleistocene. These beds have been moderately folded and faulted. Kirkham's map shows that the crest of an anticline fully 35 miles long passes through the quicksilver property. The results of this work are contained in the publications listed below:

- Kirkham, V. R. D., Old erosion surfaces in southwestern Idaho: Jour. Geol., vol. 38, No. 7, pp. 652-663, 1930.
- Revision of the Payette and Idaho formation: Jour. Geol., vol. 39, No. 3, pp. 193-239, 1931.
- Snake River downwarp: Jour. Geol., vol. 39, No. 5, pp. 456-482, 1931.
- Igneous geology of southwestern Idaho: Jour. Geol., vol. 39, No. 6, pp. 564-591, 1931.
- Natural gas in Washington, Idaho, eastern Oregon and northern Utah: Bull. Amer. Assoc. Petroleum Geologists, vol. 19, pp. 231-237, 1935.

ACKNOWLEDGMENTS

The writer appreciates the courtesy of Mr. L. K. Requa, manager of the Idaho Almaden Mines Company, who gave cordial permission to examine the deposit, and in addition contributed information freely. Able assistance in the field work was given by Warren R. Wagner and Rhesa M. Allen.

TOPOGRAPHY

The area that includes the mine is a semi-arid, submaturely dissected plateau a short distance north of the western part of the Snake River Plain. It is drained by the Weiser River and intermittent tributaries. The comparatively undissected plateau remnants are gently rolling uplands at altitudes close to 4,000 feet above sea level. Valley flanks are commonly steep and the Weiser River flows at an altitude of little more than 2,100 feet above the sea. The mine is on Nutmeg Mountain ^{1/}, which is a prominent, nearly flat-topped spur that projects from the upper eastern rim of the valley of the Weiser River. The spur is bounded on the north by precipitous slopes several hundred feet high (pl. 1A), but on the west and south the slopes are not cliffed and provide a relatively easy approach to the quicksilver deposit on the summit. The top of the spur is at

^{1/} Campbell, Arthur, 39th Ann. Report of the Mining Industry of Idaho for the year 1937, p. 274, 1938.

altitudes of 3,700 to 3,800 feet. The spur crest is depressed near its center so that it resembles a rather shallow basin, several acres in extent, that drains northwest but is cut off abruptly by the cliffs on that side of Nutmeg Mountain (pl. 1B).

GENERAL GEOLOGY

SUMMARY NOTE

The quicksilver deposit is in beds of the Payette formation (Miocene) which are overlain by flows of the Columbia River basalt. A short distance south and west the basalt is overlain by the Idaho formation (Pliocene and Pleistocene). The three formations have been folded and faulted. The ore deposit is on the crest of one of a series of broad anticlines of northwest trend at a point where minor faulting and flexure have produced local structural depression.

Since the deformation, the region has been eroded in several stages. The uplands have been beveled in such a way as to strip the basalt and the Idaho formation from the present mine site and streams have cut deeply into this beveled surface. The lowlands near the mine, particularly a segment of the valley of the Weiser immediately to the northwest, have been carved along the crest of the anticline that contains the quicksilver deposit.

STRATIGRAPHY

Payette formation

The Payette formation is made up of well-stratified and compacted sands and clays with an aggregate thickness of about 1,000 feet, according to Kirkham.^{1/} He says that the formation is generally interbedded with the Columbia River basalt. In the vicinity of the mine, however, erosion has not revealed basalt beneath the Payette strata. The beds at the mine include about 100 feet of massive sandstone with fine-grained sandstone and sandy shale intercalated in and above the massive beds.

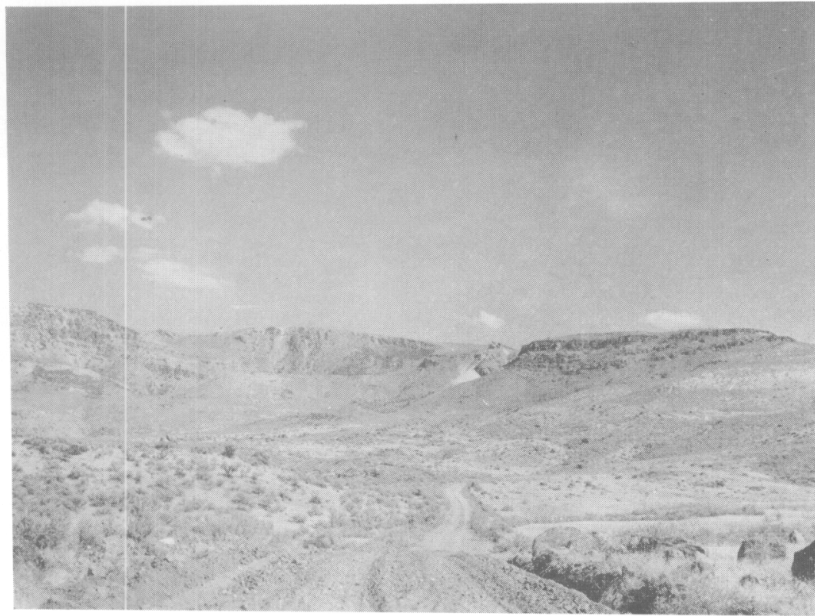
Sandstone

In the massive sandstone, distinctions between beds are based largely on differences in grain size as visible bedding planes are widely spaced. Where thin beds of sandy shale are intercalated, they serve to subdivide the sandstone beds. The massive rocks form cliffs as is illustrated in Plate 1A.

Much of the massive sandstone consists of well-sorted, moderately coarse, rounded to subangular grains with finer material in the interstices in some beds (pl. 2A). Grain diameters are commonly 3 to 4 millimeters, but in some beds the average grain diameter is 2 millimeters and locally even less. The rock is highly porous as it is uncemented except where cementing material has been added as a result of mineralization.

The composition of the sandstone suggests that it has been derived by erosion of the granitic rocks of the Idaho batholith, but the rock is not sufficiently feldspathic to be called an arkose. It consists largely of quartz with appreciable amounts of microcline, orthoclase, plagioclase, biotite, muscovite, magnetite, and

^{1/}Kirkham, V. R. D., Revision of the Payette and Idaho formation: Jour. Geol., vol. 39, pp. 193-239, 1931.



A. NUTMEG MOUNTAIN

View of Nutmeg Mountain showing the massive sandstone beds of the Payette formation exposed in the cliffs on the northwest side of the summit; also the local subsidence reflected in a broad shallow sag of the beds along the crest of the anticline. The high rim to which Nutmeg Mountain is attached is in the left of the picture.



B. SUMMIT OF NUTMEG MOUNTAIN

View of a part of the summit of Nutmeg Mountain showing the relatively flat top which is depressed centrally to conform with the shallow synclinal or collapse structure of the mountain. Camp appears on the left, the quarry in the middle foreground, and the plant on the right.

-3-A

zircon. The feldspar grains are commonly as well rounded as the quartz and are little weathered. They are ordinarily plainly visible, especially in weathered specimens.

Shale

Beds of clayey and sandy clayey shale and some of fine-grained clayey sandstone are scattered through the unit in subordinate amount. All these beds are impermeable and somewhat brittle. These features, in different ways, have influenced the distribution of ore minerals. The shale, except where mixed with sand, is exceedingly fine-grained, compact, and massive rather than laminated. It is light gray, but weathers to a pale buff. It consists largely of minute grains that appear to consist of kaolin with scattered shreds of muscovite. Some of the muscovite flakes are large enough to be distinguished in the hand specimen. Much of the shale also contains fragments of quartz and feldspar and crystals of magnetite and pyrite. Such material grades into clayey sandstone. Near the ore bodies, some of the shale has been so altered as to resemble fine-grained rhyolite.

Columbia River basalt

The Columbia River basalt rests conformably on the Payette formation. At the mine, it has been eroded away, but there are outcrops of it a few hundred yards to the east and the flows are widespread in the region to the east. Some of the basalt in nearby outcrops has been somewhat altered by the mineral-bearing solutions. However, this rock is not known to contain quicksilver nor to have any bearing on economic problems. It is consequently not considered further.

STRUCTURE

Folds

The anticlines in this region are parallel, broad-crested, and have the steeper dip on the southwest flanks. The limbs dip outward at angles of 20° to 30° . The fold that contains the quicksilver deposit here described is regarded as the dominant structural feature of the region and may be termed the Nutmeg anticline after the prominent topographic spur on which this deposit is exposed. The anticline trends N. 35° - 45° W. and may be traced for more than 30 miles as is shown on Kirkham's geologic map. ^{1/}

On Nutmeg Mountain, the top of the anticline has been both warped and faulted so that it is flattened and notably depressed. The structural sag is reflected in the topography and is visible in Plate 1A and Plate 1B. The cliffs on the northwest side, shown in Plate 1A, reveal that the northeast rim of the sag is higher than that on the southwest. On the opposite (southwest ?) side of Nutmeg Mountain the beds are bent into a local dome or structural nose that has been somewhat broken by faults.

Faults

Faults were noted only on Nutmeg Mountain. Here they are difficult to trace on the surface because much of the bedrock, except on the cliffs and higher rim, is concealed by a mantle of wash. Only a few of the faults are exposed in the mine cuts. The effects of mineralization may have obscured some of the faults.

^{1/} Kirkham, V.R. D., op. cit., Figure 13, Jour. Geol., vol. 39, No. 3.

Apparently there is a fairly well defined system of north-south and east-west faults with a number of other faults of diverse trends. The beds affected by the north-south faults have been greatly disturbed and near the faults are mineralized. There is a 50-foot scarp about 156 yards south of the camp. This trends due west, with the low side to the north. It may result from a fault of the east-west set with a downthrow of the block to the north of not less than 60 feet. If so, this is one of the largest faults in the vicinity as most of those seen appear to have maximum displacements of only a few feet. Some of the minor faults along which the sandstone has been mineralized strike about N. 45° W., nearly parallel to the anticlinal axis, and dip 75° southwest.

On the south side of Nutmeg Mountain some of the faults may be larger. A body of mineralized rock 40 to 60 feet wide and about 400 feet long appears to follow a fault zone that trends N. 20° E., diagonally across the Nutmeg anticline. Parallel fracture planes in this zone dip about 50° northwest. The fault zone is cut off by other faults that strike N. 70° W. and dip about 50° southwest. In a cut about 500 feet to the northwest on the projected course of the northwesterly fault zone fractures appear to dip northeast. North of this fault zone the beds range in strike from N. 20° E. to N. 30° W. and dip about 45° eastward, whereas on the south side they are nearly flat or dip gently southwest.

The structural depression on Nutmeg Mountain results largely from warping of the beds. Collapse of the anticlinal crest along the different faults described above has, however, been equally potent in causing the depression.

Date of deformation

As the Idaho formation, which is of Pliocene and Pleistocene age, is folded with the other formations in this region, deformation must be comparatively recent. The local structural depression on Nutmeg Mountain is thought to have formed after erosion had beveled the folded rocks, but before the beveled surface had been dissected. On this assumption, the depression may be somewhat younger than the first of two Pleistocene erosion surfaces recognized by Kirkham in this region. ^{1/}

QUICKSILVER DEPOSIT

HISTORY AND PRODUCTION

The presence of quicksilver on Nutmeg Mountain was first recognized in 1936 by Harry Brown, who staked 17 claims there in 1937. ^{2/} Early in its development the property was known as the Nutmeg and also as the Osa Anna. It was leased in 1938 by L. K. Requa, and the Idaho Almaden Mines Company has been organized to operate it with Mr. Requa as president and general manager. This company now holds one patented and 24 unpatented claims ^{3/}, which include the entire known deposit. (Figure 2) The results of prospecting in 1938 were so favorable that a 50-ton Gould rotary furnace and condensing system was installed. This plant began operation May 18, 1939. When the property was visited late in August, 464 flasks of quicksilver had already been produced. Production was maintained throughout the year at close to the capacity of the plant on ore that contained from 5 to 15 pounds of quicksilver to the ton, all of which was obtained from shallow excavations. Operations are facilitated by the fact that an adequate supply of water is

^{1/}Kirkham, V. R. D., Erosion surfaces in southwestern Idaho: Jour. Geol., vol. 38, pp. 656-660, 1930.

^{2/}Idaho Almaden - Gem state's first quicksilver mine: Mining World, pp. 9-11, Oct. 1939, Seattle, Washington.

^{3/}Campbell, Arthur, 41st Ann. Rept. of the Mining Industry of Idaho for the year 1939, p. 306, 1940.

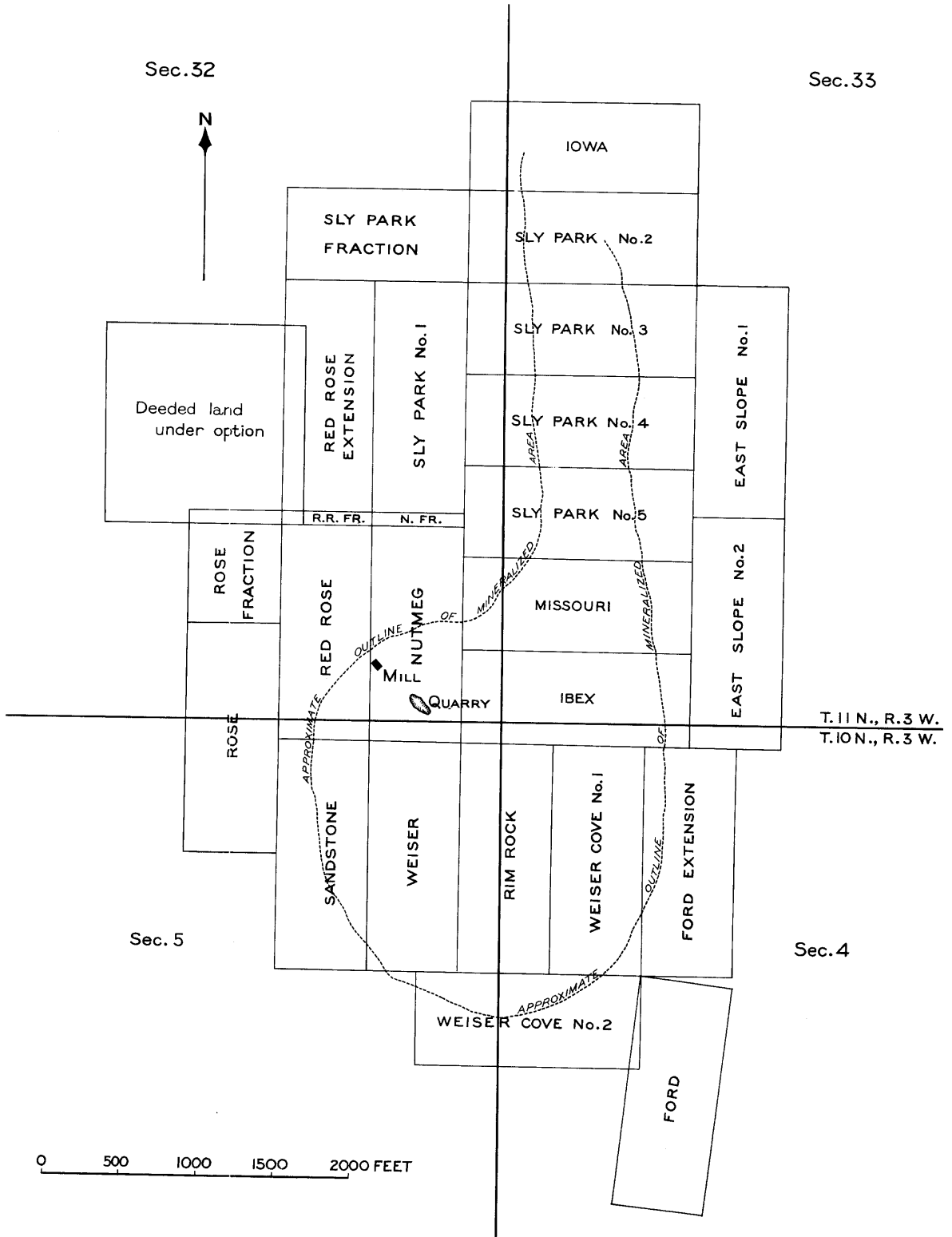


Figure 2. Claim map of Idaho Almaden Mines Company

obtained from springs in the valley a few hundred yards from the base of the precipitous slope of Nutmeg Mountain. This water is pumped a vertical distance of 570 feet to a storage tank above the mine camp. An analysis made for the company shows that it contains only 134 parts per million of dissolved mineral matter and appears suitable for all purposes. It is sufficiently turbid to deposit a little sediment in the tank and pipes.

CHARACTER

The deposit is within an area about a mile long in a northerly direction and about half a mile wide, as sketched on Figure 2. It occupies the summit and upper flanks of Nutmeg Mountain and extends over a part of the high rim to which the mountain is attached. The known ore is confined to the Payette formation, but there is a little opal and chalcedony in the Columbia River basalt a short distance north of Nutmeg Mountain. The ore consists of cinnabar with abundant opal and chalcedony that have impregnated and in part replaced the beds within the structural depression on the crest of the main anticline on the top of Nutmeg Mountain. Some of the ore is localized along fractures and fissures, as is particularly well shown in the cuts on the Sly Park No. 3 and No. 5 claims. The ore minerals have permeated the permeable sandstone beds and to some extent the shale as well. The result is that the deposit appears to form a broad, irregular hood over the depressed part of the crest of the anticline.

The rocks to which opal and chalcedony have been added are more resistant than the unaltered Payette strata. No ore need be expected where the beds are not sufficiently silicified to resist erosion. On the other hand, silicified rock is not necessarily ore-bearing. For example, in a locality north of Weiser the sandstone contains abundant chalcedony, but no cinnabar.

MINERALOGY

Opal

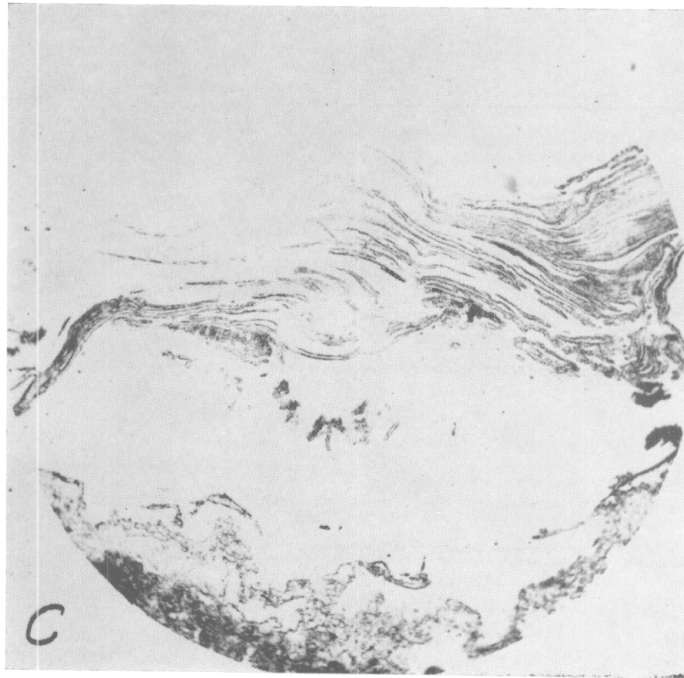
The mineralized rock contains about equal amounts of opal and chalcedony, but the proportions vary from place to place. Where abundant, all traces of the original sedimentary textures are obliterated, except that shadowy outlines of the sand grains or remnants of the grains themselves may remain. At the borders of the opalized masses, opal may appear as a matrix cementing the sand grains (pl. 2A).

There are two slightly different forms of the opal, the grayer one being apparently the younger of the two. The early, white opal, which appears to contain no cinnabar, is in somewhat ovoidal blocks less than an inch long, in part cemented by later opal and chalcedony, and, locally, in loose porous aggregates. In places, imperfectly replaced remnants of the early opal impart a mottled appearance to the later opal. The ovoidal blocks of early opal contain numerous cracks, presumably the result of dehydration. This feature is illustrated in Plate 2B.

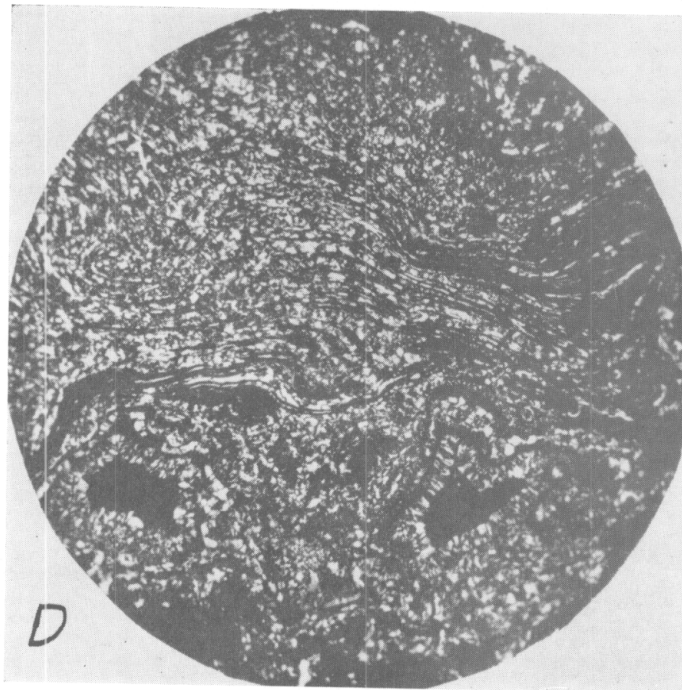
The younger opal seems to be much the more abundant. It is white to gray, except where tinted pink by finely disseminated cinnabar. It forms narrow, compact bands; also thin, platy shells which may be either straight or curved. The shells are parallel and are separated by spaces somewhat wider than the shells themselves that have locally been filled with chalcedony (pl. 2C and pl. 2D).

Chalcedony

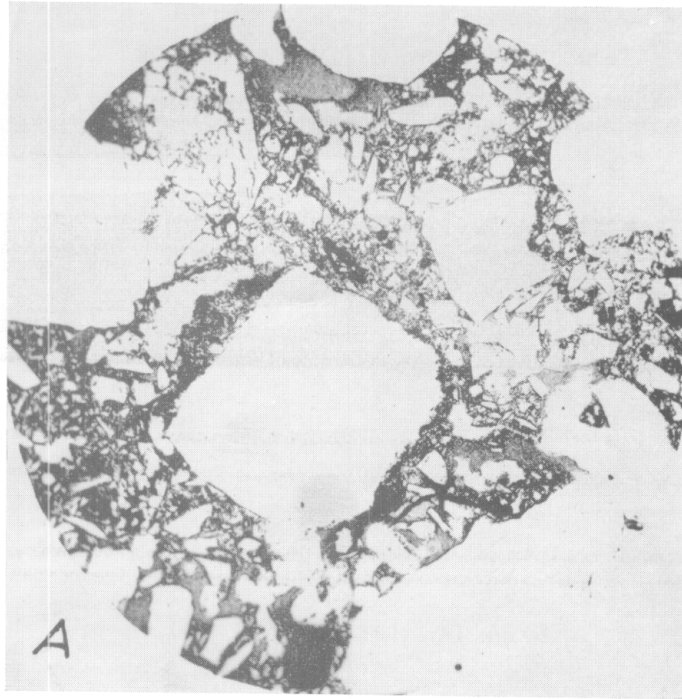
Chalcedony penetrates the opal as nodules, bands, and irregular masses. It fills pores and other openings in the opalized rock, and in places the bordering



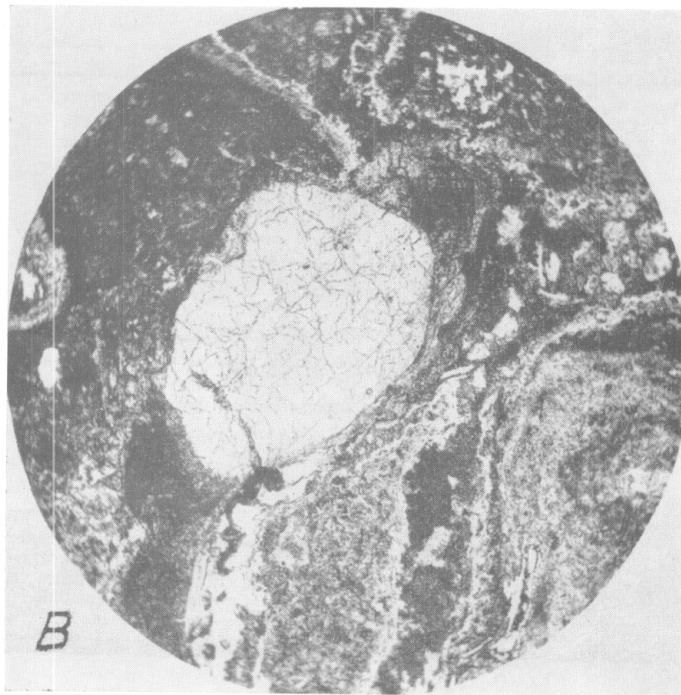
C. Photomicrograph showing the shell or sinter-like structure of the younger opal with the openings between the shells filled with colorless chalcedony and with the shells also appearing in the chalcedony in shadow-like outline as residual of replacement. Uncrossed nicols. X 46



D. Photomicrograph same as C but with the nicols crossed to bring out the presence of the infiltrated chalcedony between the opal shells and the disappearance of the opal in the chalcedony. X 46



A. Photomicrograph of sandstone of the Payette formation cemented by opal. Some grains and small granular aggregates of cinnebar (black) appear here and there in the opal. Uncrossed nicols. X 46



B. Photomicrograph showing ovoid grains of early opal (marked by dehydration cracks) in a matrix of the later opal. Uncrossed nicols. X 46

6-A

sandstone. Some of it fills openings in the porous opal, but the larger masses have formed by replacement of opal. Some of the latter preserve shadowy traces of the texture of the opal as is illustrated in Plate 2C and 2D. The banding in both the opal and the chalcedony is rudely parallel to the bedding of the original sedimentary rock. Chalcedonized rock is denser and less brittle than that in which opal predominates. It has a distinctive gray to blue color except where colored pink to red by disseminated cinnabar. A relatively small amount of the chalcedony, which may be slightly later than the rest, forms banded crusts and druses which line openings that remained after the opalized rock had been partly replaced by chalcedony, as illustrated in Plates 3A and 3B. This late chalcedony is coarser than the rest.

Pyrite

The opalized shale in a cut on the Sly Park No. 5 claim contains irregular gray streaks of finely disseminated pyrite. This mineral is almost entirely absent in other exposures examined. Assays show that some of the quicksilver ore contains 0.01 to 0.02 ounce of gold to the ton and one sample from a fissure on the northern margin of the deposit contained 0.09 ounce to the ton. The amounts of gold present are too small to be of any economic value.

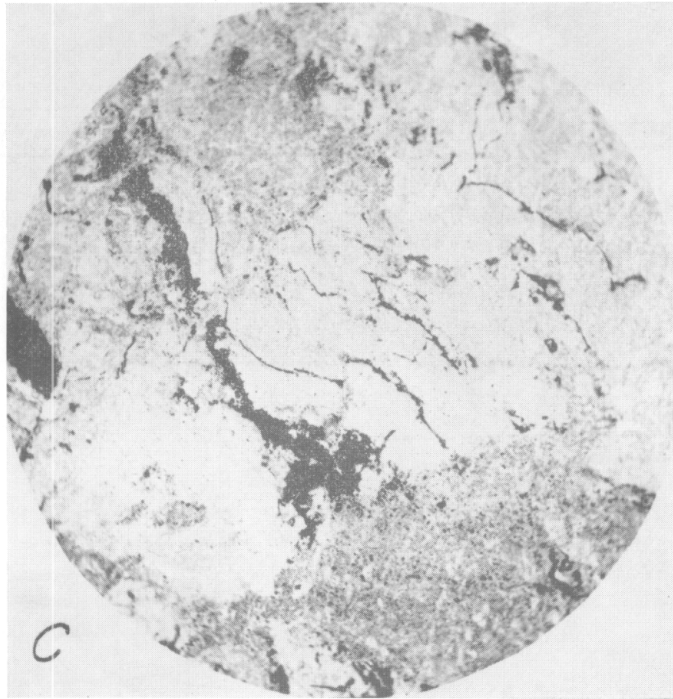
Cinnabar

Cinnabar is widespread throughout the silicified rocks and even extends into overlying beds of shale and clayey sandstone. Some of it is so diffused through the later opal (pl. 3A and 3B) as to suggest that the two were deposited simultaneously, but most of it is in scattered grains, granular aggregates and minute veinlets (pl. 3C and 3D). In general, the distribution and form of the cinnabar are most irregular. In places, the cinnabar occurs in more or less porous opal and is absent in the chalcedony, but nearby it may be present in the dense chalcedony and absent in the opal. Little of the cinnabar coats the walls of open spaces. Most of it appears to impregnate and replace the opal and chalcedony (pl. 3). Much of the cinnabar in shale beds occupies minute ramifying fractures but some is in grains disseminated through the shale. As most of the veinlets seem wider than the original fractures the cinnabar may have replaced the wall rock. Some of the shale contains enough cinnabar to constitute ore.

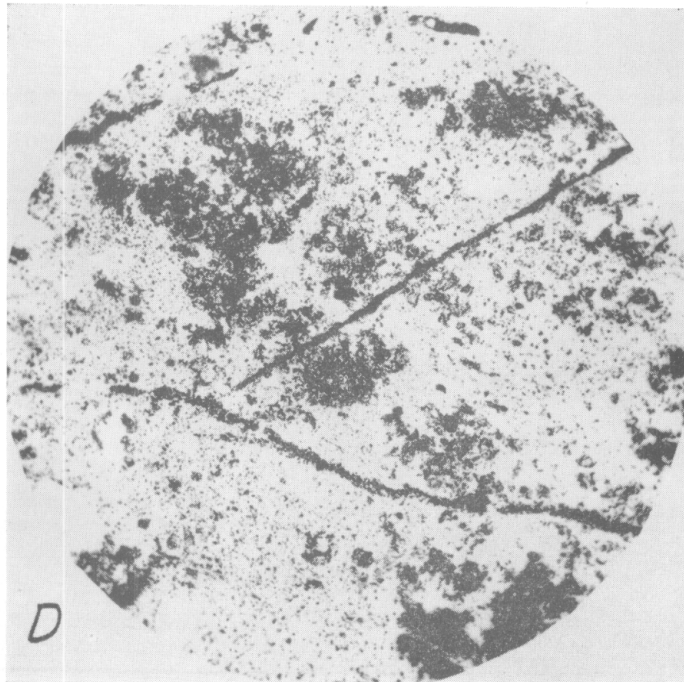
In most of the ore, the cinnabar is so finely divided that it constitutes a delicate pigment in which individual grains are distinguishable only under the microscope. In most places, the veinlets are much less than a millimeter in width. In the relatively rich ore in cuts on the Sly Park No. 5 claim, however, some of the cinnabar-bearing bands are 3 millimeters thick and are bordered by zones in which cinnabar is disseminated for a width of 6 millimeters on either side.

DESCRIPTION OF THE ORE

The mineralized rock is most heterogeneous in color, structure, and texture, as can be judged from the mineralogic descriptions given above. Some of the silicified rock is banded roughly parallel to the bedding, but the bands are neither uniform in thickness nor persistent. Most of it has the appearance of a breccia of opal fragments, cemented, and in part obscured by chalcedony. Some of the ore is in included masses of partly silicified sandstone and shale, and some of this material is also brecciated. In general, the cinnabar produces irregular and ill-defined splashes, streaks, and mottlings of pink and red against a mottled background of nearly white opal and grayish blue chalcedony. Where exposed to sunlight, the cinnabar is tarnished to a dull blue-black, a fact that has delayed

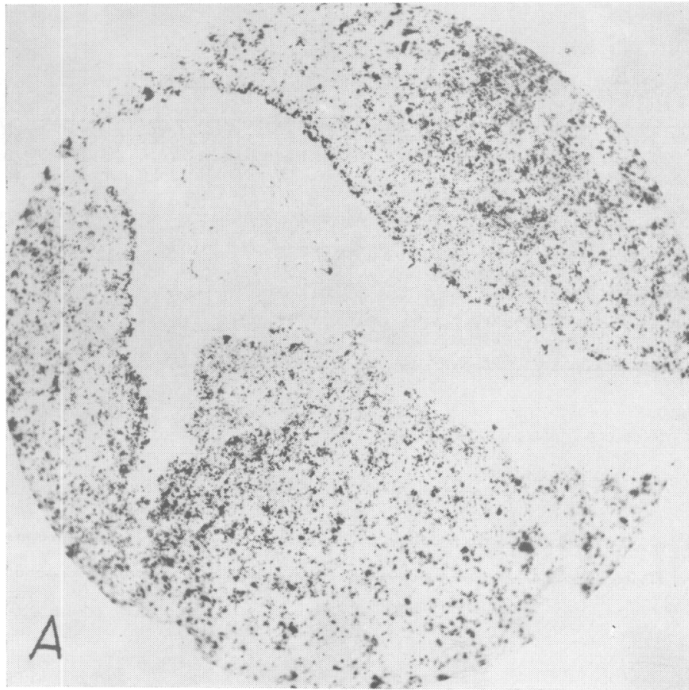


C. Photomicrograph showing irregular veinlets of cinnabar (black) in and along fractures in opal, the veinlets enlarged by replacement of bordering walls. Uncrossed nicols. X 46

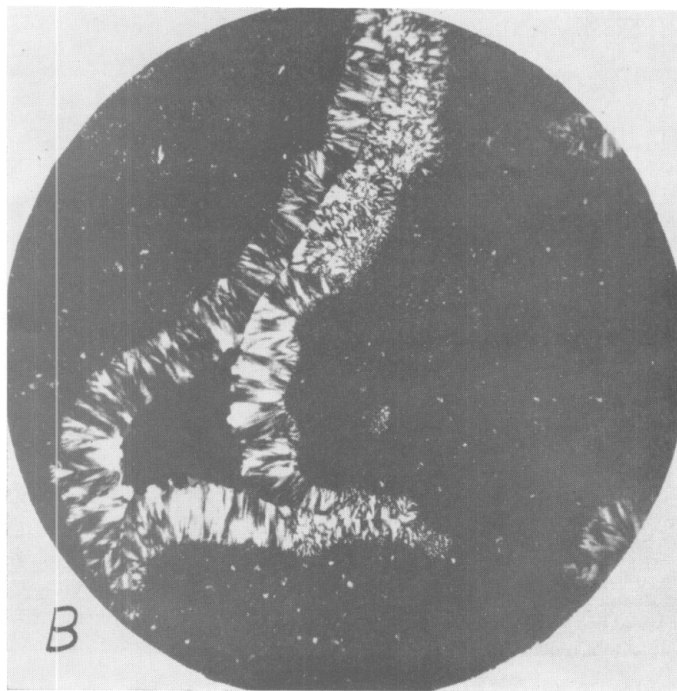


D. Photomicrograph showing the distribution of cinnabar (black) in grains, granular aggregates, and in short discontinuous seams in the opal. Uncrossed nicols. X 46

-7-B



A. Photomicrograph of opal which contains disseminated grains of syngenetic cinnabar (black) with an open space partly filled with drusy chalcedony (colorless).
Uncrossed nicols. X 46



B. Photomicrograph same as A but with nicols crossed to show the structure of the chalcedony. X 46

-7-19

recognition of the presence of the mineral in this locality.

THE ORE BODIES

Much of the "opalite" is confined to the fracture planes, joints, and other openings, and the adjacent wallrocks, but it has also spread so widely along porous sandstone beds as to give the deposit as a whole a bedded appearance. In exposures in the cliffs on the flanks of Nutmeg Mountain some of the more thoroughly opalized sandstone beds have shale lenses both above and below. Masses of opal and chalcedony are exposed here and there all around the periphery of Nutmeg Mountain, and also in the cliffs both north and east of that mountain. Opal is exposed some distance down the slope on the southeast side of the mountain, far below any visible cinnabar masses, but is confined to the vicinity of the top on the northwest side. Thus, the effects of mineralization are spread over a wide area. However, only a portion of the mineralized rock contains enough cinnabar to be of value. Indeed, so far as can be judged from exposures at the time of visit, the ore may be confined to the vicinity of the principal fissures. The ore body in the quarry that supplied all the ore handled in 1939 is a blanket-like mass capped by shale. Most of it is on one side of a prominent fault that may have served as a feeding channel. When visited, the ore-bearing horizon had been proved by excavations and drill holes for a length of 250 feet, a width of 175 feet, an average thickness of 18 feet and a maximum depth of 40 feet, and much of this ore body had already been mined. The cinnabar appears to be erratically distributed, but the average tenor of the ore mined is close to half of one per cent of quicksilver per ton.

ORIGIN

The deposit is believed to have formed from hot alkaline hydrothermal solutions that ascended close to the surface and deposited their load at temperatures between 100° and 150° C., and at pressures close to atmospheric. ^{1/} As the initial solutions permeated the rocks, especially the more porous sandstone beds, they apparently dissolved and removed a large part of the rock and filled the openings with a silica jell that consolidated as opal. Some of the opal appears to have formed by direct metasomatic replacement of the sandstone and the whole process of solution and deposition probably took place nearly contemporaneously. The opal formed at this stage was not sufficient to fill entirely the voids produced in the sandstone by solution. Collapse of the cavernous rock thus produced may have been one of the causes of the local structural depression on Nutmeg Mountain and of the fractures in the opalized rock,

Next an even greater volume of opal filled openings and replaced the earlier opalized rock. At this stage, some cinnabar was deposited with the opal, in and close to fissures. Some of the opal so closely resembles hot spring sinter that it must have been formed in open spaces very near the surface of the ground. After the deposition of this younger opal, chalcedony was deposited in similar fashion by combined filling of open space and substitution for the opal previously formed. Later, cinnabar filled fractures and other openings and replaced the adjacent silicified rock.

As the quicksilver mineralization took place after beds that include the Idaho formation (Pliocene and Pleistocene) had been folded, it can not be older than Pleistocene. Since the local structural depression on Nutmeg Mountain is thought to have formed after erosion had beveled the folded rocks but before the

^{1/}Dreyer, R. M., The Geochemistry of Quicksilver Mineralization, Part I, Econ. Geol., vol. 35, p. 22, 1940.

beveled surface had been dissected and to have in part at least accompanied the mineralization, the mineral deposition must have occurred just before or during the early stages of the present cycle of valley cutting.

THE WORKINGS

When visited in August, 1939, there was a shallow quarry roughly 200 feet long in the southern part of the Nutmeg claim (fig. 2) which had yielded all the ore so far mined. This quarry is shown in Plate 1B. Ten men working one shift here supply the 50 tons of ore necessary to keep the mill in continuous operation. The beds in the quarry dip very gently south or southeast. Most of the overlying, shaly beds have been eroded from the north end of the quarry, but, because of the southward dip of the beds, the shale beds descend to the floor of the quarry at the southeast end. At this end, 8 to 10 feet of opalized shaly rock are exposed in the face. This rock contains sufficient cinnabar to be mined as ore. It is overlaid by barren, crumbly, opalized sandy shale.

Ore is exposed in four small cuts a short distance down the east slope of the high rim on the Sly Park No. 3 claim. It is in thin silicified beds interbedded with coarse sandstone with thin layers of barren fine-grained sandstone. Some of the mineralized beds are 2 to 3 feet thick. One cut, 4 feet deep, discloses a fissure zone 2.5 feet wide which strikes N. 45° W. and dips 75° southwest. Cinnabar extends outward from this zone in permeable sandstone beds. From this point north to the basalt outcrops, and thence along the upper slopes of the ridge to the south side of the camp, the rock at the surface is largely silicified and contains some cinnabar. Two cuts on the Sly Park No. 5 claim expose rich ore. These cuts are high on the steep slope on the northern flank of Nutmeg Mountain. In the lower and more northerly of the cuts the beds strike N. 40° W. and dip 55° to 60° northeast, but their attitude has been disturbed by hillside creep. This cut exposes 6 feet of light gray, rather thin-bedded shale which overlies a dark gray opalized shale, at least 3 feet thick, the base of which is not exposed. Some of the opalized shale contains finely disseminated pyrite. The upper cut contains rock similar to the uppermost barren bed in the quarry, but in the cut this rock is in places brecciated and the fractures are filled with seams and masses of cinnabar.

In addition to the quarry and minor cuts, the deposit and its immediate vicinity have been explored by drill holes. At the time of visit, exploration by drilling was still in progress and a shaft had been started in the quarry floor. At the close of 1939, there are reported to have been 17 shafts on the property.^{1/} The deepest of these was 155 feet deep with levels at depths of 30 and 50 feet. The total development aggregated 630 feet, of which 550 feet were in shafts.

^{1/} Campbell, Arthur, Forty-first Ann. Report of the Mining Industry of Idaho for the year 1939, pp. 306-307, 1940.