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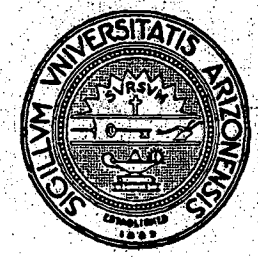

University of Arizona
Bulletin
ARIZONA BUREAU OF MINES

ARIZONA ZINC AND LEAD DEPOSITS

PART I

ARIZONA BUREAU OF MINES, GEOLOGICAL SERIES No. 18,
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The ore consists mainly of sphalerite and chalcopyrite associated with the garnet and apparently localized by closely spaced northeast fissures.

Workings include a vertical shaft 220 feet deep with drifts on the 210, 150, and 120 levels. From the upper levels, which later were flooded, ore up to 15 feet wide was stoped for a length of 120 feet and a height of 50 feet.[26]

[26]H. A. Whitcomb, work cited.

CHAPTER V.—ARAVAIPA DISTRICT

By Eldred D. Wilson

LOCATION AND ACCESSIBILITY

As defined by Ross,[1] the Aravaipa district is in the western part of Graham County, within Tps. 5-7S., Rs. 19-20-E., south of Stanley Butte.

Klondyke and Aravaipa are the main centers of population in the district. Klondyke consists of an old-time store and post office in the ranch community of Aravaipa Valley. One mile north of Klondyke is the Athletic Mining Company concentrator and housing project. Aravaipa, 12 miles north, is inhabited by employees of this company.

By road, Klondyke is 60 miles north of Willcox and 38 miles west of Glenbar, a siding on the Bowie-Miami branch of the Southern Pacific railway. Transportation difficulties have always retarded development of the district.

TOPOGRAPHY

The Aravaipa district is on the southwestern slopes of the Santa Teresa and Turnbull ranges. Southwestward-flowing tributaries of Aravaipa Creek have carved the region into a series of steep-sided gulches and ridges ranging in altitude from 3,200 feet in the western part to over 6,000 feet in the northeastern part. Klondyke is at an altitude of 3,500 feet, and Aravaipa is approximately 1,000 feet higher.

Topography of this region is shown on the Klondyke quadrangle topographic sheet, published by the U. S. Geological Survey on a scale of 1:62,500 and a contour interval of 50 feet.

WATER SUPPLY

Most of the stream channels are dry for the greater part of each year, although they may carry occasional floods of amazing size during wet seasons. Tule Spring, about 2 miles southeast of Aravaipa, and Lawrence Spring, at Landsman's camp, south of the

[1]C. P. Ross, Geology and ore deposits of the Aravaipa and Stanley mining districts, Graham County, Arizona: U.S. Geol. Survey Bull. 763, 1925.

Iron Cap mine, furnish limited domestic supplies, but the only dependable large sources of water known in the area are shallow wells in the valley of Aravaipa Creek.

GEOLOGY

The geology of the Aravaipa district is complex. Not enough work has been done there to determine the age and thickness of all the stratified rocks. Much of the general and detailed structure remains unknown.

The only published description of the geology is by Ross,[2] who spent less than two months within the area of 300 square miles. Additional data have been obtained by the writer and through the courtesy of Athletic Mining Company.

Rocks

Following is a tabulation of the stratified rocks in the Aravaipa district:

Age	Formation	Thickness in feet
Tertiary		
Pliocene	Gila conglomerate: Weakly cemented gravel, sand, and silt. Unconformity.	?
Miocene(?)	Rhyolite, latite, breccia, tuff, and interbedded sedimentary material. Unconformity.	?
Cretaceous (upper)	Sandstone, shale, and conglomerate, with interbedded andesite, breccia, and tuff. Unconformity.	1,000-1,500
Carboniferous Pennsylvanian and Mississippian	Tornado limestone	1,000±
Devonian	Martin limestone: Dark to yellowish limestone and paper shale	100±
	Unconformity	
Cambrian	Bolsa (?) quartzite	200±
	Unconformity	
Pre-Cambrian	Pinal schist and associated igneous rocks.	?

Pinal schist: Ross[3] mapped as Pinal schist two principal areas of which one lies east of Klondyke in the vicinity of Quartz and Buford hills, and the other extends eastward from the southern end of Iron Cap Ridge past Landsman's camp and Cobre Grande Mountain.

The formation in the Buford Hill area is described as quartzitic schist interbedded with fine-grained quartz-sericite-chlorite schist.

The "schist" between the southern end of Iron Cap Ridge and Landsman's camp consists of weakly metamorphosed sedimentary rock, not markedly schistose, which underlies lower Paleozoic beds with low-angle fault contact. It resembles the Cretaceous series, and correlation with the Pinal seems questionable.

[2]C.P. Ross, work cited.
[3]C.P. Ross, work cited.

Bolsa (?) quartzite: Fine-grained, locally pebbly quartzite, weathering brown, forms the fault-block ridge immediately east of Aravaipa. It also crops out in the southern part of Iron Cap Ridge, unconformably below Devonian and faulted above Carboniferous limestone.

Martin limestone: Yellowish-gray limestone with thin-bedded shale appears in the southern part of Iron Cap Ridge, in the next ridge west, and in the bluff east of Aravaipa. Paper shale crops out along the western margin of the quartzite northeast of Aravaipa.

Tornado limestone: Overlying the Martin is well-bedded bluish-gray to light-gray limestone, Mississippian and Pennsylvanian in age, which Ross[4] correlated with the Tornado limestone of Ray and Globe. It forms prominent ridges in the vicinity of Aravaipa and between the Head Center, Grand Central, Iron Cap, and Cobre Grande mines. In general the Mississippian beds are crystalline and relatively pure, whereas the Pennsylvanian tend to be dense, impure, and cherty.

Cretaceous beds: A series of arkosic sandstone, shale, and conglomerate, interbedded with volcanic rocks of predominantly andesitic composition, unconformably overlies Tornado limestone in the northern part of the district. This series contains notable coal deposits[5] in Deer Creek Basin, about 7 miles northwest of Aravaipa. Its age has been established as Upper Cretaceous.

Intrusive rocks: The Cretaceous and older rocks have been intruded by granite, rhyolite, porphyry, andesitic porphyry, and basaltic porphyry. These intrusions presumably occurred during the Laramide interval, from late Cretaceous into early Tertiary time.

As mapped by Ross, the granite is a batholithic mass which forms the main high portions of the Turnbull and Santa Teresa mountains. It is described as a sodic granite, locally approaching quartz monzonite in composition.

The rhyolite porphyry crops out as an irregular belt up to 2 miles wide along the western border of the main granite batholith, branching northwestward through the Head Center and Horse Mountain areas. Rhyolitic dikes are prominent in the northern part of the district. According to Ross, the rhyolite porphyry is intruded by the granite, although the two rocks are closely related in age and origin.

Andesitic and basaltic porphyry occurs as dikes, irregular masses, and sills, particularly north of Aravaipa. These rocks are prevailing fine grained and dark-colored, but one variety is marked by diabasic texture. Some of them are older than the rhyolite porphyry, and some are younger.

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[4]Work cited.

[5]M.R. Campbell, The Deer Creek coal field, Arizona: U.S. Geol. Survey Bull. 225, 1904; C.P. Ross, work cited.

Tertiary rocks: Rhyolite and latite flows, breccia, tuff, and interbedded sedimentary material unconformably overlap the Cretaceous and older rocks. According to Ross[6] this series, of Miocene (?) age, forms Stanley Butte and some isolated ridges in Aravaipa Valley.

Gila conglomerate floors most of the Aravaipa Valley, overlapping all the older rocks along the southwestern margin of the district.

Structure

General statement: Compressive stresses, acting in a southwest-northeast direction, deformed this region after the Cretaceous rocks were laid down and probably before the close of early Tertiary time. The region was bent into broad, open folds of northwest to westward trend and broken by faults of low to steep dip. These structures influenced emplacement of the intrusive bodies and localization of the ore deposits.

Folds: The principal fold exposed in this region is the Deer Creek syncline. It crops out at a point 6 miles northwest of Aravaipa and extends, with a maximum width of more than 5 miles, northwestward for at least 16 miles. Remnants of broad, open folds which have been largely obliterated by igneous intrusions, broken by faults, or concealed by later Tertiary rocks, are exposed in the north part of the Aravaipa district. Probably most of the dips of strata are expressions of either large-scale or drag folding rather than of block tilting.

Low-angle faults: At the Iron Cap mine, Carboniferous limestone has been thrust over gray arkosic sandstone and shale of probably Cretaceous age. The probable continuation of this fault zone appears at the southern end of Iron Cap Ridge where shale and sandstone of Cretaceous aspect are separated by low-angle fault contact from overlying Paleozoic beds.

In the Stanley district, 6 miles north of Aravaipa, Ross[7] mapped overthrusts of Carboniferous limestone on Cretaceous rocks.

The fault zones that contain the Head Center and Grand Central veins dip 30°-45°. These zones are believed to be genetically related to the Iron Cap thrusts although not known to be continuations of them. The Head Center fissure extends for an unknown distance northwest.

In addition, there are numerous bedding-plane faults. Emplacement of the porphyry sills was doubtless influenced by them.

Steeply dipping faults: The steeply dipping faults are of normal and reverse types.

Most of the normal faults strike between north and N. 35° W. On many of them, movement occurred from pre-mineral to post-mineral time. In places they are mineralized. A minor number of normal faults strike east to northeastward and seem to displace the northerly faults.

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[6]Work cited.
[7]Work cited.

At Aravaipa there has been relative uplift of northerly trending blocks of sedimentary rocks and relative depression of intervening belts of andesite porphyry. Easterly faults separate these blocks from porphyry on the north. The occurrence of limestone beneath porphyry at a depth of 500 feet in the Arizona shaft indicates that northern area to be considerably downthrown in reference to the southern part of the district.

A long system of presumably normal fault fissures is marked by the Grand Reef and associated veins. As interpreted by Ross[8] this lode system extends from a point east of Klondyke northward through Imperial Hill and northwesterly past Aravaipa and the Arizona mine, a distance of more than 8 miles.

Steeply dipping reverse faults, of which the hanging wall has moved upward relative to the footwall, have been noted only in the Iron Cap area, although they probably are represented elsewhere in the district. Here most of the numerous displacements trend west or northwesterly and dip 40° to 85° N. They are regarded as results of lateral compressive stresses reacting in a general south or southwesterly direction. Thus the lower angle or overthrust faults are related genetically to the steeper reverse faults, which displace them.

For the examples studied, displacement of the hanging wall seems to be mainly lateral on the faults which dip more than 75°, and mainly upward on those of lesser dip; apparently footwall resistance influenced direction of movement.

The reverse faults are believed to be pre-mineral, although on some of them renewed movement of later age seems to have occurred.

ORE DEPOSITS

Historical Outline[9]

1870-89. Mineral deposits were discovered in the Aravaipa district before 1880. A small smelter is reported to have been built here in the late seventies by Col. C. W. Birdwell, but little is known about production or operations prior to 1890.

1890-95. Aravaipa Mining Corporation, operating in northern part of the district, sank Arizona shaft to its present depth of 580 feet and shipped two cars of ore.

1890-1900. J. W. Mackay opened Grand Reef mine to a depth of 300 feet. Other properties in the district were worked, and presumably some lead-silver and copper ores were shipped.

1900-14. Small-scale operations, mainly by lessees.

1915-19. Grand Reef mine leased by local people who built a small mill and shipped ore and concentrates.

1916. John Gleeson and T. C. Parker, lessees, reportedly shipped $90,000 worth of lead carbonate ore from No. 1 claim.

1919-20. Aravaipa Leasing Company obtained Grand Reef property and made some production.

1921-24. Little activity in district. No production reported during 1921-22.

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[8]Work cited.

[9]Data for years prior to 1923 abstracted from C.P. Ross, work cited.

1925-28. Grand Central Mining Company, headed by Lewis Douglas, acquired the old Aravaipa property, including the Iron Cap and other claims near Aravaipa, in 1925 and built a mill with a flotation capacity of 90 tons per day. In 1927 this plant was operated for five months. Production from crude ore and concentrates shipped during 1926-28 was approximately 3,500,000 pounds of lead, 1,214,797 pounds of zinc, and $20,000 worth of silver.[10]

1929-31. Production was mainly oxidized lead ore from the Grand Reef which in 1931 ranked second as a producer of lead in Arizona.[11]

1932. Little activity and small production.

1937-41. Base-metal production was resumed in the district. The Grand Reef Mining Corporation in 1939 installed a milling plant of 100 tons daily capacity. During 1941, the Calistoga Mining and Development Company treated Grand Reef tailings.

1942-49. Athletic Mining Company bought the Aravaipa group of claims, developed the Iron Cap and Head Center mines, and became the district's largest shipper of lead and zinc ores. This company built at Klondyke a flotation concentrator of 100 tons daily capacity, which was operated throughout 1948 and part of 1949 chiefly on Iron Cap ores, and subsequently on other ores.

Types

The ore deposits of the Aravaipa district consist of veins and replacements. The veins are represented in the Iron Cap, Head Center, Grand Central, and Grand Reef mines. Replacements predominate in the Aravaipa No. 1, No. 2, and Landsman mines, in parts of the Iron Cap mine, and probably in lower levels of the Arizona mine.

The veins occur in low-angle fault zones and related bedding slips, as at the Iron Cap, Head Center, and Grand Central mines, and in steeply dipping fissures, as in the Grand Reef lode system. The rocks most favorable for them are the Pennsylvanian limestone and the intrusive rhyolite.

Irregular replacements are best developed in limestone that has been brecciated or fractured, as in the hanging wall of a low-angle fault, in the footwall of a steep reverse fault, and in some normal faults. In places they occur associated with epidote, garnet, and specularite. Commonly their outcrops are marked by dark oxides of iron and manganese together with silicate minerals.

Some of the ore shoots are localized where northeasterly fissures intersect favorable structures, but this relation has not yet been established as general for the district.

Iron Cap Mine

The Iron Cap mine is 2 miles northeast of Aravaipa and near the head of Arizona Gulch, at an altitude of approximately 5,000 feet.

The first workings in this mine consisted of an upper adit. It was run westerly for 115 feet, following a vein within a reverse fault zone that dips 70° N. in Pennsylvanian limestone. This work

[10]M.J. Elsing and R.E. Heineman, Arizona metal production: Univ. Ariz., Ariz. Bur. Mines Bull. 140, 1936.

[11]U.S. Bureau of Mines, Mineral Res. of the U.S., 1931, pt. I.

PRODUCTION OF ARAVAIPA DISTRICT[12]

Years	Tons Ore	Lead Lb.	Lead Value	Zinc Lb.	Zinc Value	Copper Lb.	Copper Value	Silver Oz.	Silver Value	Gold Oz.	Gold Value	Total Value
1915-20	9,376	5,801,254	$ 412,358	....	....	218,851	$ 52,665	93,486	$ 84,635	53	$ 1,096	$ 550,754
1921-22	....	....	....	....	....	....	....	....	....	....	....	....
1923-28	15,798	2,433,782	166,847	1,214,797	$ 90,248	25,856	3,520	10,274	6,179	....	....	266,794
1929-31	4,495	1,348,648	66,223	....	....	112,134	14,686	40,695	15,926	77	1,591	98,426
1932	....	....	....	....	....	....	....	....	....	....	....	....
1933	135	55,622	2,058	....	....	3,172	222	2,037	712	2	51	3,043
1934-36	....	....	....	....	....	....	....	....	....	....	....	....
1937-41	5,689	958,540	49,694	....	....	84,380	9,398	29,691	22,497	40	1,400	82,989
1942-48	63,285	6,132,500	844,506	3,885,500	487,655	343,700	65,008	53,106	44,858	605	21,175	1,463,202
1915-48	98,778	16,730,346	$1,541,686	5,100,297	$577,903	787,993	$145,499	229,289	$174,807	777	$25,313	$2,465,208

[12]Figures compiled by John W. Anthony

indicated the vein to be from 2 to 4 feet wide and of good lead-zinc content.

Evidently to prospect the downward continuation of this vein, an adit was run at 150 feet lower elevation, southwesterly for 650 feet. It passed through Cretaceous sandstone for 475 feet to reach the Upper Tunnel fault zone, beyond which only Pennsylvanian limestone was encountered.

The lower adit shows several northwestward-trending reverse faults of steep northeastward dip. One of them termed the Winze fault, at a distance of 410 feet from the portal intersects a fault which strikes westerly, dips 40° N., and brings Pennsylvanian beds over Cretaceous. This low-angle fault zone, now known as the East vein, proved to contain the most important ore shoot found in the mine. It might have escaped discovery if the adit had been a few feet farther southeast.

The East Vein ore shoot was mined to a limited extent by Grand Central Mining Company and more completely by Athletic Mining Company. It ranged from a few feet to more than 15 feet thick and from 35 to 100 feet wide throughout a length of more than 200 feet down the dip between the Upper Tunnel fault and the Winze fault. During recent years step-faulted segments of this ore zone were discovered by diamond drilling north of the Winze fault.

A considerable tonnage has been mined from the Upper Stope and West ore bodies, immediately south of the Upper Tunnel fault. They consist of veins, thin stringers, and irregular spotty replacements, associated with bedding slips and fractures in Pennsylvanian limestone.

Most of the ore shoots occur within broad, low anticlines that plunge down the dip.

The Iron Cap ores consist essentially of sphalerite and galena, together with a little pyrite and chalcopyrite. Small amounts of chalcocite and covellite are present locally, but in general the ores are not oxidized to any important extent.

Head Center Mine

The Head Center mine is in Williamson Canyon, about 2½ miles by road northeast of Aravaipa and ½ mile in air line west of the Iron Cap mine.

Prior to 1942, development of the Head Center mine consisted of the present adit, a winze 45 feet deep on the vein, and shallow surface workings. Small tonnages of ore were shipped in 1939 and earlier. Since 1942 development and production of lead ore have been continued by Athletic Mining Company. In 1943 the U.S. Bureau of Mines sampled the mine workings and explored the vein by means of limited diamond drilling.[13]

In the northwestern part of the Head Center claim, rhyolite porphyry has intruded Carboniferous limestone with irregular

[13]T. C. Denton, Aravaipa lead-zinc deposits, Graham County, Arizona: U.S. Bureau of Mines R.I. 4007, 1947.

to sill-like contacts which have been complicated by faulting.

Here the Head Center vein strikes eastward and dips 32°-45° N. It occurs within a brecciated fault zone 10 or more feet wide which from the Head Center portal is traceable for some 500 feet southeast and for an unknown distance westward. Its irregular trend on the surface is partly due to topography and partly to variations of the fault zone.

The mine workings are almost entirely within the vein zone. As of April, 1949, they included an adit extending east for about 210 feet and an inclined shaft 400 feet deep with workings on five levels below the adit. Drifting has extended for a maximum of 250 feet east, and 125 feet west, of the shaft. Stoping on both sides of the shaft indicated that the ore shoot then worked had an east-west dimension of approximately 350 feet.

As exposed in the mine, the vein zone is all in rhyolite porphyry except for the eastern part of the adit, where faulted limestone and rhyolite porphyry form the wall rocks.

The vein ranges in thickness up to about 10 feet in the rhyolite and 14 feet in the limestone. The segment of the vein containing the ore shoot forms a low northward-plunging arch, within which both the strike and dip show local variations of several degrees. Displacement of the vein by cross faults has not exceeded a few feet in the area explored.

Some residual sulfides occur near the surface, but in general oxidation has been thorough to a depth of about 30 feet below the adit and continues downward throughout all the workings; in general, from 70 to 80 per cent of all the lead and zinc minerals occur in nonsulfide form.[14] Sufficient water was encountered below the fourth level to require intermittent pumping.

Galena and sphalerite, together with minor pyrite and a little chalcopyrite, are the sulfide minerals. Some of the sphalerite is pale lemon yellow to colorless. Most of the ore has been suffiiciently low in zinc to be shipped for lead smelting.

No. 1 Mine Area

An area of lead-zinc mineralization on No. 1 and No. 2 claims, in Arizona Gulch immediately west of Aravaipa, was developed from several adits and shafts during the early days.

In this part of the district, Paleozoic limestone, shale, and quartzite have been intruded by sills and dikes of andesite porphyry. Faults and fissures of northwesterly and northeasterly trend have broken these rocks.

The principal mineralization is within a belt a few hundred feet wide on both sides of a fault that strikes N. 65 E., along the course of Arizona Gulch. Within the limestone of this belt are abundant surface croppings of silicates and manganese oxide, locally with irregular masses of galena, sphalerite, pyrite, and oxidized lead and zinc minerals.

[14]Written communication from Raymond F. Orr, President, Athletic Mining Company.

Most of the mine workings are inaccessible. The No. 1 mine, as indicated by maps made by the old Aravaipa Mining Corporation, had an inclined shaft with a few hundred feet of drifts on the 60, 126, and 226 levels. As stated on a previous page, this mine was a notable producer of lead carbonate ore in 1916.

Arizona Mine

The Arizona mine is about a mile north of Aravaipa, on the west slope of a low southward-trending ridge.

Here the prevailing rock is andesite porphyry, intruded by a dike of rhyolite porphyry that strikes S. 20° E., and dips 65°-75° W. This dike, which may be traced on the surface for 3,000 feet, attains a width of about 60 feet at the Arizona shaft. It has been sheared parallel to the dip and along its walls. Its central portion contains the Arizona vein.

The Arizona workings include an adit run east for 600 feet, crossing the vein at 200 feet and connecting with a drift that extends 275 feet south and 400 feet north on the vein; the north drift connects with the 83 level of the Arizona vertical shaft. This shaft is reported to be 580 feet deep and flooded below a depth of 516 feet. Maps made by the old Aravaipa Mining Corporation show several short drifts and stopes extending from the shaft below the 83 level. According to these maps, limestone prevailed below a depth of 500 feet, and on the 569 level an irregular drift about 250 feet long was in limestone containing lead-zinc sulfide ore. On the basis of these old map data, Athletic Mining Company during 1942-43 retimbered the Arizona shaft to the 516 level and from there did several hundred feet of diamond drilling. As shown by this work, gray to pinkish limestone with local silicates and oxidized iron minerals extends for at least 100 feet below the 516 level.

As exposed in the adit level workings, the Arizona vein consists largely of banded to granular quartz from a few inches to about 6 feet wide, locally stained with iron and manganese oxides. In places, especially near the Arizona shaft, small bodies of oxidized lead and zinc minerals with some residual galena are exposed.

Grand Reef Area

Situation: The principal lead mines in the Grand Reef area are on the Grand Reef, Aravaipa, Dog Water, and Silver Cable claims, which are owned by American Zinc, Lead, and Smelting Company, of St. Louis, Mo.

The Grand Reef mine is in Laurel Canyon, about 4 miles by road northeast of Klondyke. The Aravaipa shaft is 1½ miles farther north. The Dog Water and Silver Cable, about ¾ mile south of the Grand Reef mine, were formerly accessible by a branch road from Laurel Canyon. In late 1948 the roads to all these mines were blocked by talus.

Workings.[15] The Grand Reef mine has a total of more than 4,000 feet of workings. Its haulage level is an adit about 1,400 feet long, run northward beneath the main stopes. A winze extending 300 feet below the adit, under the stoped area, has three levels of drifts at 100-foot intervals.

The Aravaipa shaft was less than 100 feet deep. From it were about 500 feet of drifts connecting with the Ten Strike mine and an undetermined amount of stoping.

The Dog Water workings included an adit about 140 feet long, with a small stope to the surface and a short winze.

The Silver Cable mine was opened by an adit a few hundred feet long, with stopes above.

Production: According to Ross[16] these mines during 1915-20 produced 1,506 tons of shipping ore and 2,862 tons of concentrates. Of the shipping ore 1,389 tons came from the Grand Reef and 117 tons from the Grand Reef, Aravaipa, and Dog Water. Of the concentrates 2,613 tons were from Grand Reef, 160 tons from Dog Water, and 89 tons from Aravaipa mine ores. Ross gives the following average assays for the 1,389 tons shipped from Grand Reef:

Gold—0.01 oz. per ton
Silver—20.0 oz. per ton
Lead—40.9 per cent
Zinc—1.4 per cent
Copper—2.83 per cent
Iron—2.4 per cent
Lime—3.1 per cent
Sulfur—6.0 per cent
Insol.—32.3 per cent

The Dog Water ore is reported to have contained cerussite, galena, wulfenite, and a little argentite. Considerable fluorspar was present in the gangue.

The Silver Cable ore was probably somewhat similar to that of the Dog Water.

Except during the year 1916, the Grand Reef mine yielded most of the output of the district during 1915-20, 1929-31, and 1937-41. The Dog Water was mentioned as producing in 1938.[17]

Grand Reef deposit:[18] The Grand Reef lode occurs within iron-stained, silicified breccia cemented with quartz and other vein minerals. In Laurel Canyon the breccia forms a reef more than 100 feet wide and over 200 feet high. It strikes approximately N. 12° W. and dips from 70° W. to almost vertical. Southward it separates into smaller branches such as the Silver Cable and Dog Water lodes.

The reef occurs within rhyolite porphyry which a short distance farther east is intruded by granite of the main batholith. In places diabase appears between the granite and rhyolite. According

[15]Abstracted from C. P. Ross, Geology and ore deposits of the Aravaipa and Stanley mining districts, Graham County, Arizona: U.S. Geol. Survey Bull. 763, p. 79, 1925.
[16]Work cited.
[17]U.S. Bur. of Mines, Minerals Yearbook, 1939.
[18]Abstracted from C. P. Ross, work cited, pp. 81-91.

to D. R. Stewart,[19] a narrow belt of schist is present along the western boarder of the granite.

In 1922 the water level in the winze was 130-140 feet below the adit.

The principal known ore shoot, as stoped on and above the adit level, was 120 feet long and from 15 to more than 30 feet wide. Ore was found below these stopes, to the bottom of the winze. Smaller ore shoots were opened 10 feet west of the main shoot; 600 feet farther north, both on the ridge and in the adit; and south of the winze on the 200 level.

The ore is mainly breccia cemented with fine-grained quartz containing specks of fluorite and flakes of chlorite. Quartz also occurs as irregular bands of light-gray chert, as drusy veinlets, and as white to pink vitreous masses. The most abundant sulphide is galena. It forms irregular fragments and bands and commonly includes tiny blebs of argentite. A little sphalerite and chalcopyrite are associated with the galena, but pyrite is scarce.

The ore is partly oxidized, and a mass of oxidized ore was reported to occur on the 300 level. Limonite, although not plentiful, stains the outcrop.

Structure and alteration at Grand Reef: Some additional features were noted by the writer during a brief visit to the Grand Reef in October, 1948.

The main Grand Reef stope exhibits numerous fractures striking N. 60° E. and dipping about 80° SE. A main break along its axis strikes slightly east of north and dips steeply east to vertically and steeply west downward to the adit level; associated with it is considerable iron stain as well as white clay alteration. Along the west wall of the stope is a vertical break trending approximately north. The southeast apex of the stope is along a fissure that strikes northeast and dips 75° SE.; it is marked by considerable iron oxide, local copper stain, and white clay alteration.

Where exposed, the rhyolite in the hanging wall shows alteration to white clay minerals, intense for more than 50 feet and notable for 1,000 feet west of the Grand Reef stopes. Strong alteration of similar character appears on the west side of the Dog Water lode.

The outcrop over the Grand Reef stopes is marked by a grayish-brown color, in contrast to the darker brown tint that prevails immediately north of the ore shoot.

Much of the reef south of Laurel Canyon is concealed by Tertiary gravels.

Other Properties

The following small lead mines and prospects have been described by Ross[20]: The *Silver Coin,* 3 miles east of Klondyke; *Ten*

[19]Oral communication.
[20]Work cited.

Strike and *Aravaipa,* north of Laurel Canyon; *Bullis group* and *Windsor,* on Imperial Hill; *Bullis-Landsman group,* in the vicinity of Tule Canyon; *Tolman-Babcock group,* east of the Arizona shaft and north of Aravaipa; *Landsman group,* east and south of Iron Cap Ridge; and *Starlight,* 4 miles north of Stanley.

A small production of lead ore from the Silver Coin, Landsman, Starlight, and Stanley Butte properties was reported in 1947.

During 1948, the Sinn Fein mine, southwest of the Head Center, produced several carloads of lead ore, and the Pointer workings, immediately west of the Head Center, yielded similar ore.

CHAPTER VI.—GEOLOGY OF THE ST. ANTHONY (MAMMOTH) AREA, PINAL COUNTY, ARIZONA[1]

By S. C. Creasey[2]

ABSTRACT

The St. Anthony deposit, located in Pinal County, Ariz., has produced intermittently since 1881. Until 1944 gold was the most valuable metal produced, though large amounts of vanadium and molybdenum were recovered. After 1944 galena and sphalerite became the chief ore minerals.

The rocks in the St. Anthony area are chiefly granitic and volcanic; they range in age from pre-Cambrian to Pleistocene. The deposit is of the vein type, controlled by pre-mineral faulting. The wall rocks are chiefly rhyolite and quartz monzonite. Both space filling and replacement have been involved in the emplacement of the deposit. The history of the vein can be divided into several stages during which sulfide and associated silicate minerals were introduced. The deposit was oxidized to a depth of about 900 feet and then faulted into two major segments by the Mammoth fault. Each segment was further broken by smaller faults. Molybdenum- and vanadium-bearing solutions were then introduced into the faults and into the oxidized parts of the veins. Presumably reaction with lead carbonate and possibly with lead sulfate produced wulfenite and vanadinite. The deposit has received further oxidation since the formation of these minerals.

INTRODUCTION

The St. Anthony mine at the town of Tiger is about 50 miles north-northeast of Tucson and 21 miles south of Winkelman. State Highway 77, which passes through Winkelman, runs within

[1]Published by permission of the Director, U.S. Geological Survey.
[2]Geologist, U.S. Geological Survey.

R. I. 4007 FEBRUARY 1947

UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

REPORT OF INVESTIGATIONS

ARAVAIPA LEAD-ZINC DEPOSITS

GRAHAM COUNTY, ARIZ.

BY

THOMAS C. DENTON

R. I. 4007,
February 1947.

REPORT OF INVESTIGATIONS

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

ARAVAIPA LEAD-ZINC DEPOSITS, GRAHAM COUNTY, ARIZONA[1]

By Thomas C. Denton[2]

CONTENTS

ILLUSTRATIONS

INTRODUCTION

This report presents factual data obtained from the examination and exploration by the Bureau of Mines in 1943 of a group of mining claims in the Aravaipa Mining District, Graham County, Arizona. It also presents the results of metallurgical tests made on ore from one of the deposits. The work was part of the wartime program of investigating possible sources of strategic minerals.

1/ The Bureau of Mines will welcome reprinting of this paper provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Report of Investigations 4007."

2/ Mining engineer, Bureau of Mines.

During June 1942, Walter R. Storms, an engineer of the Bureau, examined the district, chiefly the Aravaipa Mining Corp.'s properties, part of which were under lease to the Athletic Mining & Smelting Co. The company was carrying out development work and intended to build a power plant and mill as soon as enough ore could be developed to justify the capital expenditure. As a result of the examination, the Bureau set up project 15173/ to do certain core drilling and other sampling.

ACKNOWLEDGMENTS

In its program of exploration of mineral deposits, the Bureau of Mines has as its primary object the more effective utilization of our mineral resources, to the end that they make the greatest possible contribution to national security and economy. It is the policy of the Bureau to publish the facts developed by each exploratory project as soon as practical after its conclusion. The Mining Branch, Lowell B. Moon, chief, conducts preliminary examinations, performs the actual exploratory work, and prepares the final report. The Metallurgical Branch, R. G. Knickerbocker, chief, analyzes samples and performs beneficiation tests.

With respect to the investigations reported in this paper, the functions of the Mining, and Metallurgical Branches were carried out under the supervision of J. H. Hedges, district engineer for Arizona, and S. R. Zimmerly, regional engineer, respectively. The late R. E. Head, made microscopic examinations of the ore, and A. O. Ipsin was metallurgical test engineer.

The geology of the deposits as given in this report is taken from a private report by Eldred D. Wilson of the Arizona Bureau of Mines for the present operator of the claims. Wilson's report is based upon preliminary field work which he did in 1942.

LOCATION AND ACCESSIBILITY

The property is in the Aravaipa Mining District, Graham County, Arizona, in T. 5 S., Rs. 19 and 20 E. (fig. 1). By existing roads, the nearest rail points are Willcox and Pima, both on the Southern Pacific Railroad. They are reached from the property by a dirt road that runs southeasterly through Klondyke to a point about 20 miles from the property, where the road divides, one branch running to Willcox and the other to Pima. Beginning at the property, the road is narrow and has steep grades for about 11 miles until it enters the valley of Aravaipa Creek. Thereafter it is a good dirt road with a gentle upstream grade. Both branches are good dirt roads without steep grades. Long stretches of the branch that runs to Pima, however, have curves so sharp that they must be negotiated at very slow speed. By these roads, the property is 70 miles from Willcox and 50 miles from Pima. The Pima route probably is the more favorable one over which to freight by truck.

The nearest source of electricity from existing power lines is about 35 miles from the property.

3/ Curtis G. Mohney, project engineer.

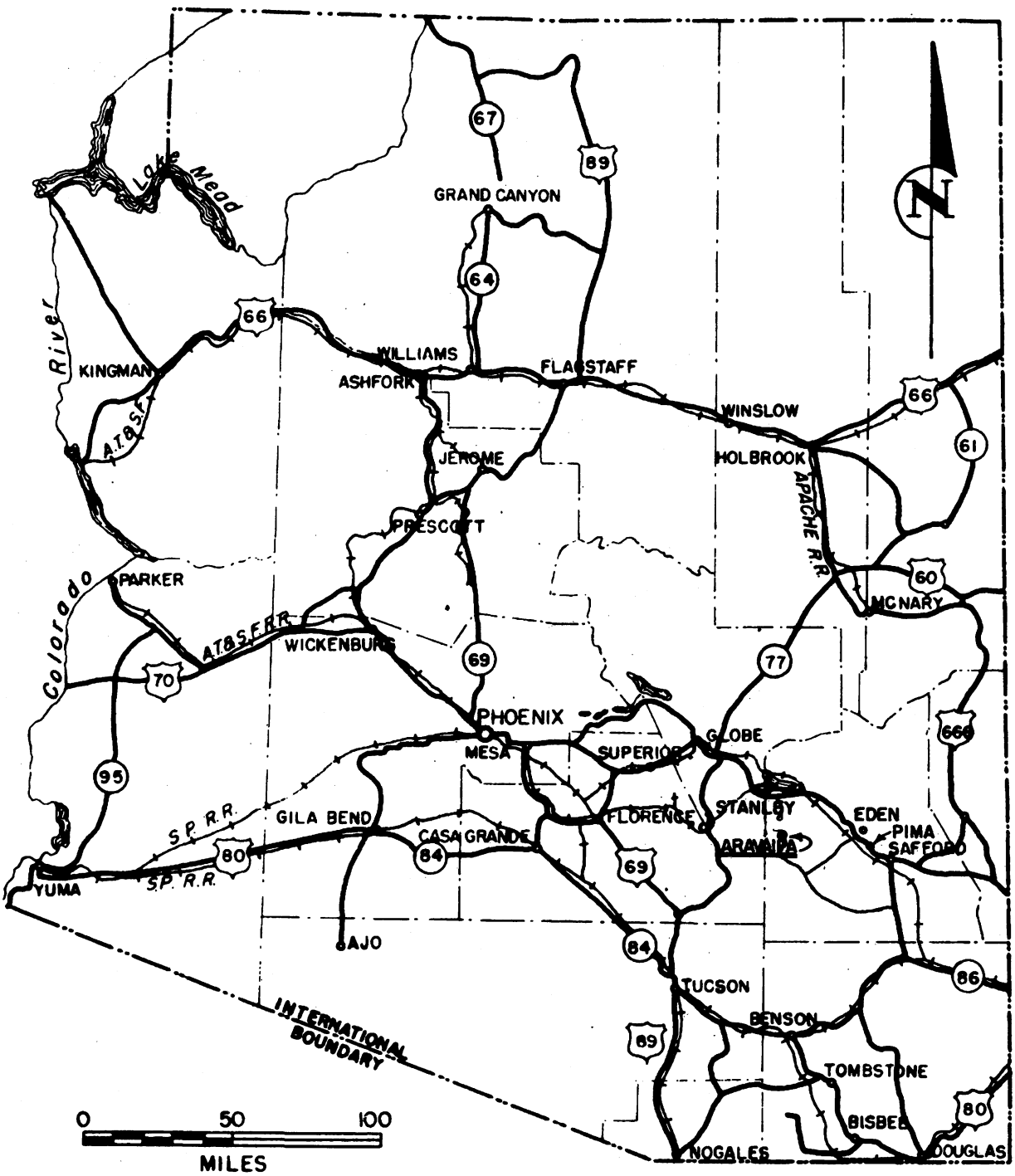


Figure 1.- General location map, Aravaipa lead-zinc property, Graham County, Arizona.

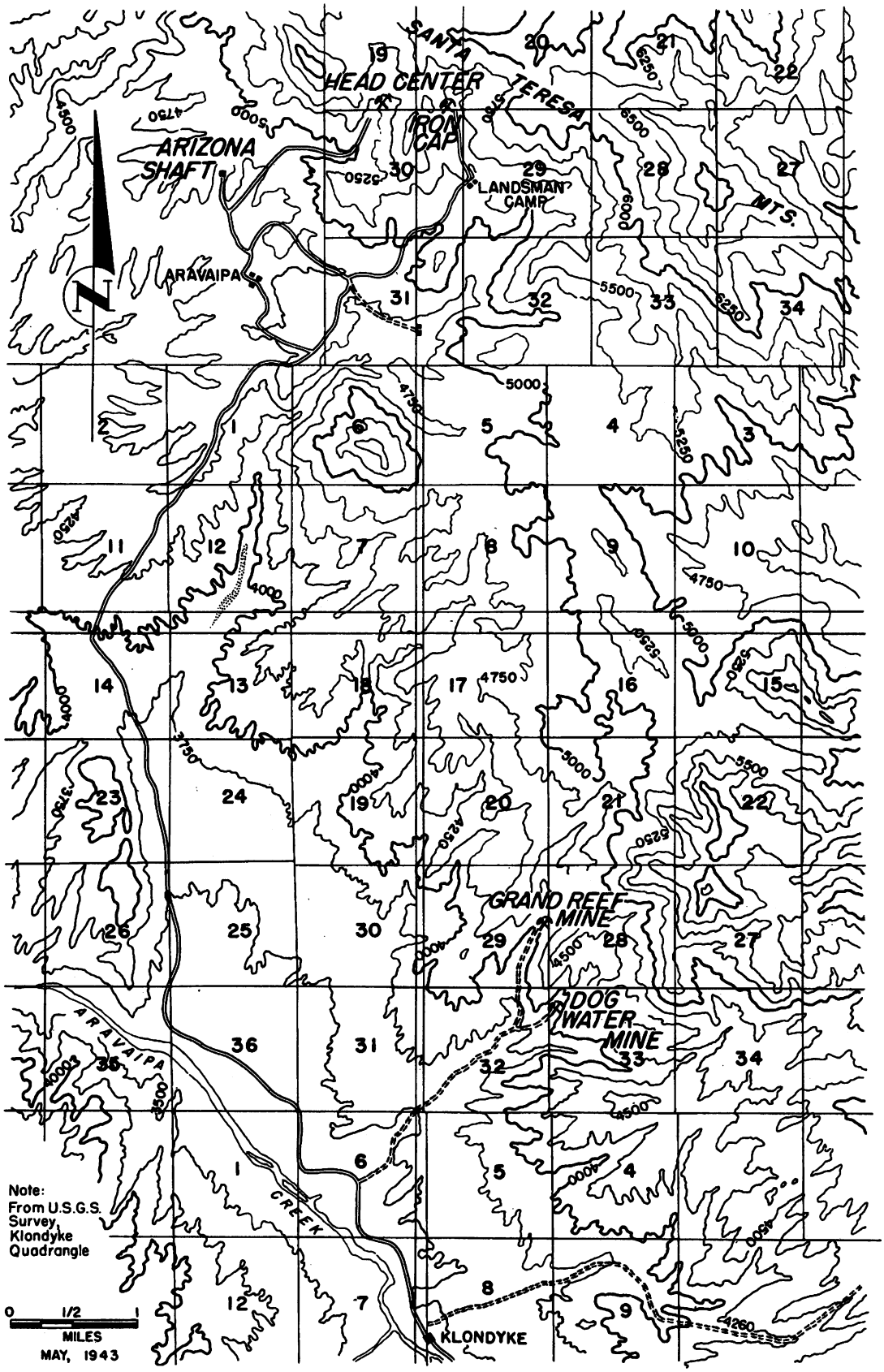


Figure 2.- Aravaipa mining district, Graham County, Arizona.

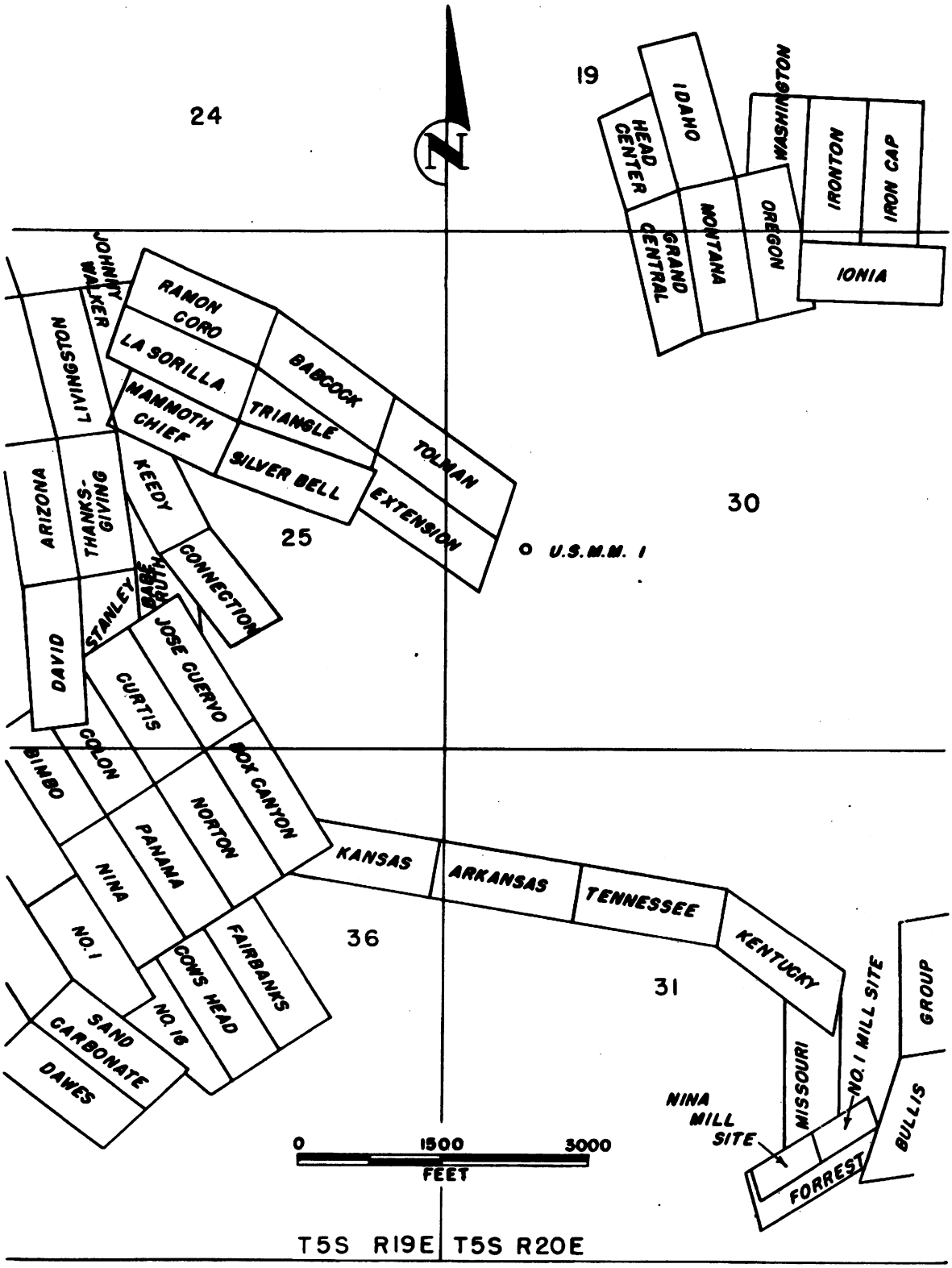


Figure 3.- Athletic Mining Co. claims, Aravaipa, Graham County, Arizona.

PHYSICAL FEATURES AND CLIMATE

The district is contiguous on the west to the Santa Teresa Mountains (fig. 2). Southwesterly drainage to Aravaipa Creek has cut the area into a series of steep-sided gulches. The intervening ridges range in elevation from about 3,800 feet near the creek to over 6,000 feet in the mountains.

The climate is mild in winter and hot (except for comparatively cool nights) in summer. Average annual precipitation of about 20 inches occurs as heavy summer showers and light rains and occasional snow storms from December to April.

In the lower altitudes, vegetation consists of desert-type grasses, shrubs, and small trees. The same vegetation, with some dwarf juniper and oak, occurs at higher elevations. Timber suitable for mining purposes is restricted to a few small trees, which might be used as stulls.

A relatively small quantity of water can be obtained from washes and springs on or near the workings. Water for mining and milling purposes can be obtained from Aravaipa Creek.

PROPERTY AND OWNERSHIP

The property, consisting of a very irregular group of mining claims and two mill sites, is shown in figure 3. The mill sites and 29 of the claims are patented. Included in the group, but not showing in the figure, are several recently located claims.

The Athletic Mining & Smelting Co., Fort Smith, Ark., holds the mill sites and claims shown in figure 2 under lease and option to purchase from the Aravaipa Mining Corp. The company owns some of the recently located claims and holds an option to purchase some of the others from Lon Rutledge of Klondyke, Ariz.

HISTORY AND PRODUCTION

Prospecting and development in the Aravaipa district began in the late 1870's. Development has been desultory and on a small scale throughout its history. Gold and silver ores or oxidized lead ores rich in precious metals have been sought chiefly. In 1878, a small smelter was erected near the Aravaipa claims, and a nominal tonnage of ore was smelted.

Perhaps the best-organized and best-financed attempt to operate the property was begun in 1926 by the Aravaipa Mining Corp. Exploration and development of four widely separated occurrences of lead-zinc ore carrying some values in silver was undertaken. A mill was built said to have been capable of treating 200 tons per day. Ore was mined, some of which was shipped and some milled, but all work had ceased by the end of 1927. The mill was removed or destroyed by fire, and the property remained idle until 1942, when the present operator began small-scale exploratory work, which it has continued to the present.

Production from the Aravaipa claims has been about as follows:

1890-1895	Two carloads of ore for mill tests.
1916	$90,000 worth of lead carbonate ore shipped from the No. 1 claim.
1916	1,000,000 pounds of lead and $10,000 in silver, source unknown.
1926-1927	$35,000 worth of zinc ore shipped.
1926-1930	3,500,000 pounds of lead and $20,000 in silver from the Grand Central claim.

GEOLOGY

The rocks exposed in the district range in age from pre-Cambrian to Quaternary. Stratigraphically, in ascending order, they consist of schist, quartzite, limestone, and a series of conglomerate, arkosic sandstone, and shale interbedded with volcanic rocks. The limestone, Palezoic in age, and older rocks have been intruded by rhyolite and andesitic and basaltic porphyries. These intrusives occur as irregular masses, sills, and dikes. Part of the area is covered by loosely consolidated gravel, sand, and silt, which locally is mantled by alluvium.

The pre-Cambrian schist of granular quartz and sericite occurs as steeply dipping laminae. Its character is attributed to igneous intrusion and intense deformation. Regional compression, during the next period of great deformation, occurred in late Cretaceous to early Tertiary time. This resulted in folding and thrust-faulting of the formations and ended with igneous intrusion followed by steep-angle faulting.

Within the area covered by the Bureau's work, a low-angle thrust fault occurs in the Iron Cap area, and other low-angle faults at the Head Center and Grand Central claims are generally considered to be of thrust origin. The Iron Cap thrust is dropped on the south by a steeply dipping fault of southwestward strike and large vertical displacement. Most of the many steeply dipping faults in the district are normal; others, as exemplified in the Iron Cap working, show evidence of predominantly horizontal displacement.

ORE DEPOSITS

The principal types of deposits on the Aravaipa claims are (1) veins associated with thrust-fault zones, as exemplified by the Head Center and Iron Cap deposits; (2) veins in steeply dipping fissures, as on the Arizona and Panama claims; (3) irregular replacements having some of the characteristics of contact metamorphic occurrences, as on the No. 1, and No. 2 claims and, perhaps, in parts of the Arizona shaft workings.

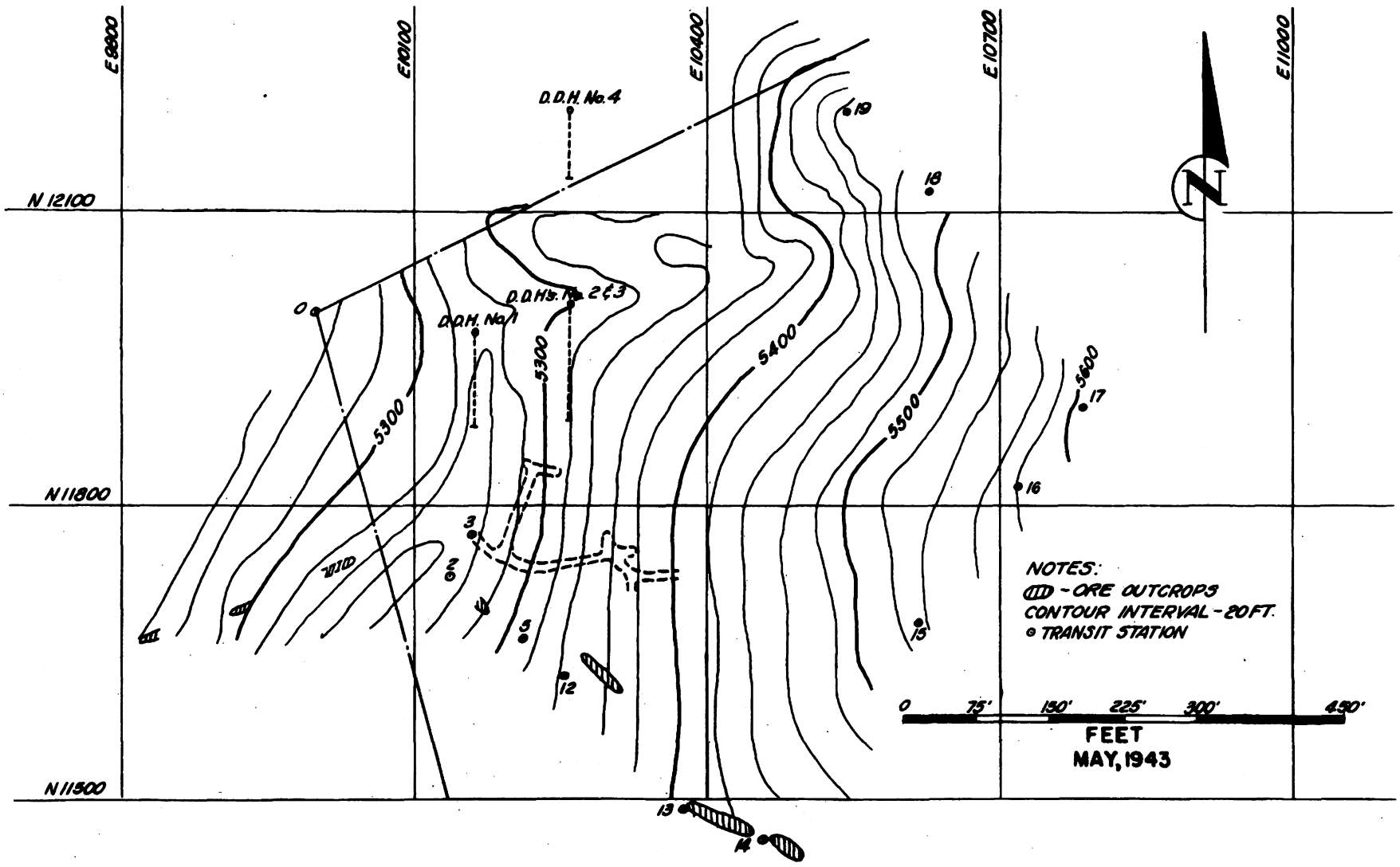
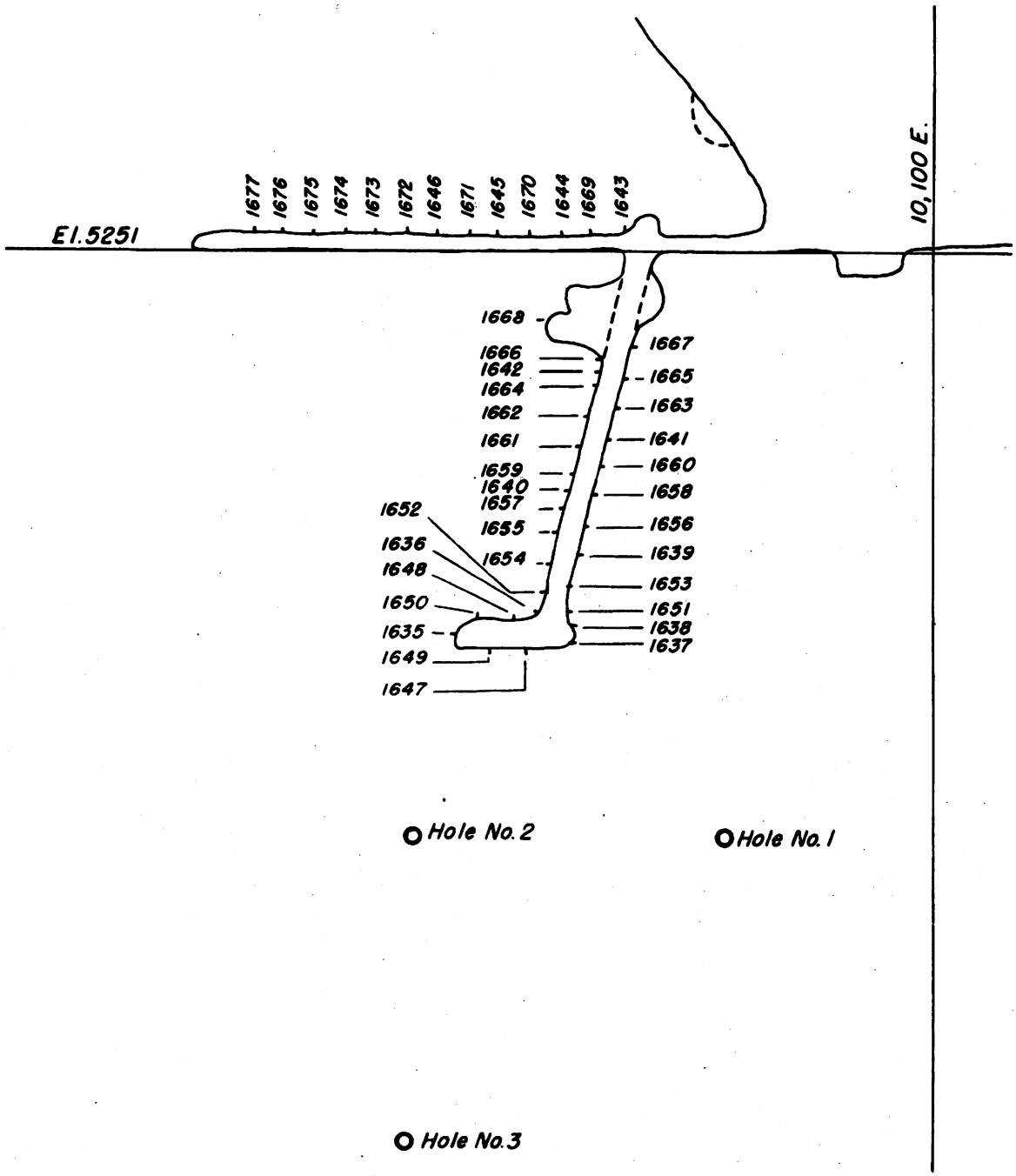


Figure 4.- Head Center mine, Graham County, Arizona.



MAY, 1943

E.W. LONGITUDINAL SECTION IN PLANE OF VEIN, HEAD CENTER MINE

Figure 5.

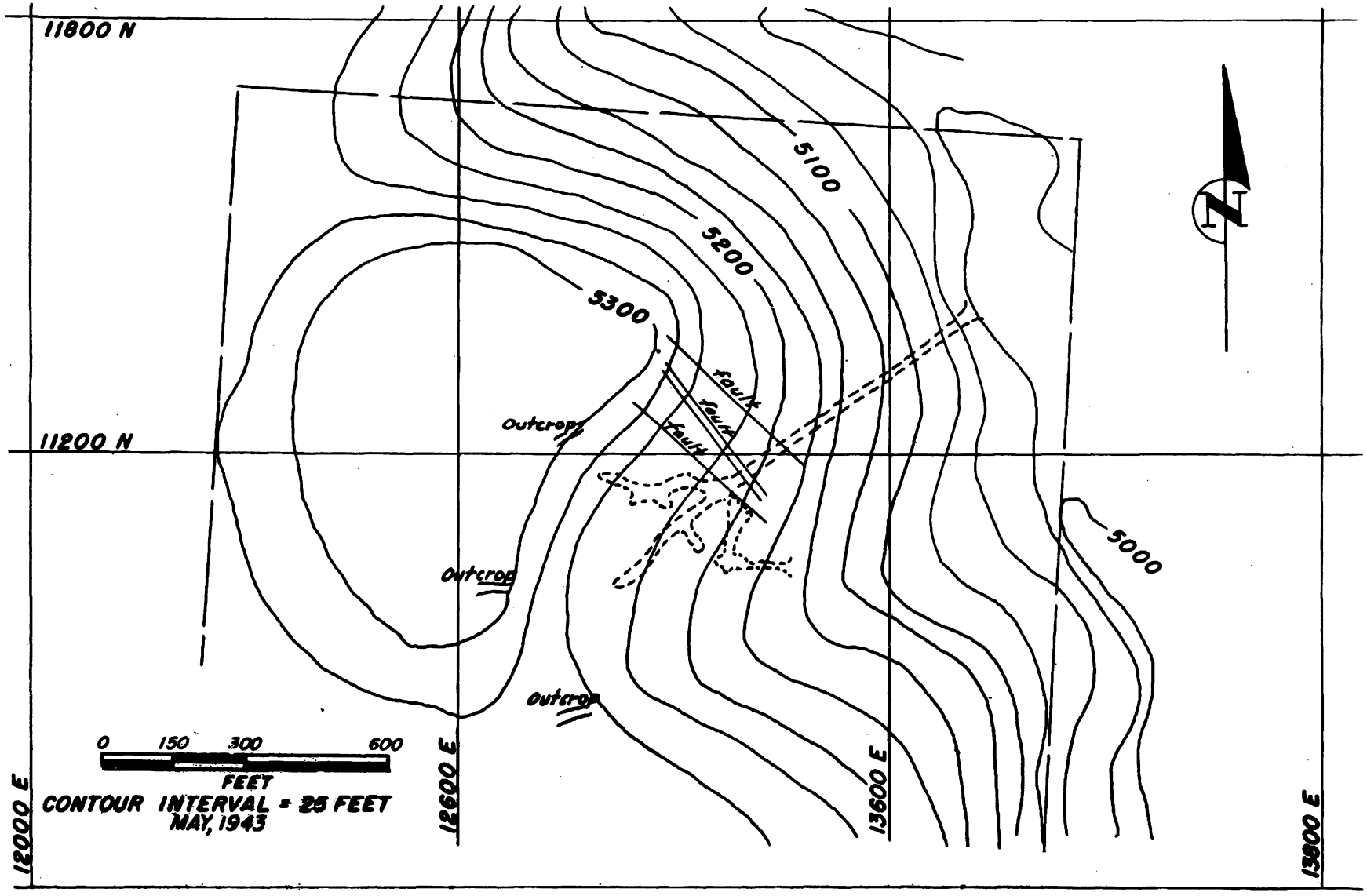


Figure 6.- Iron Cap mine, Graham County, Arizona.

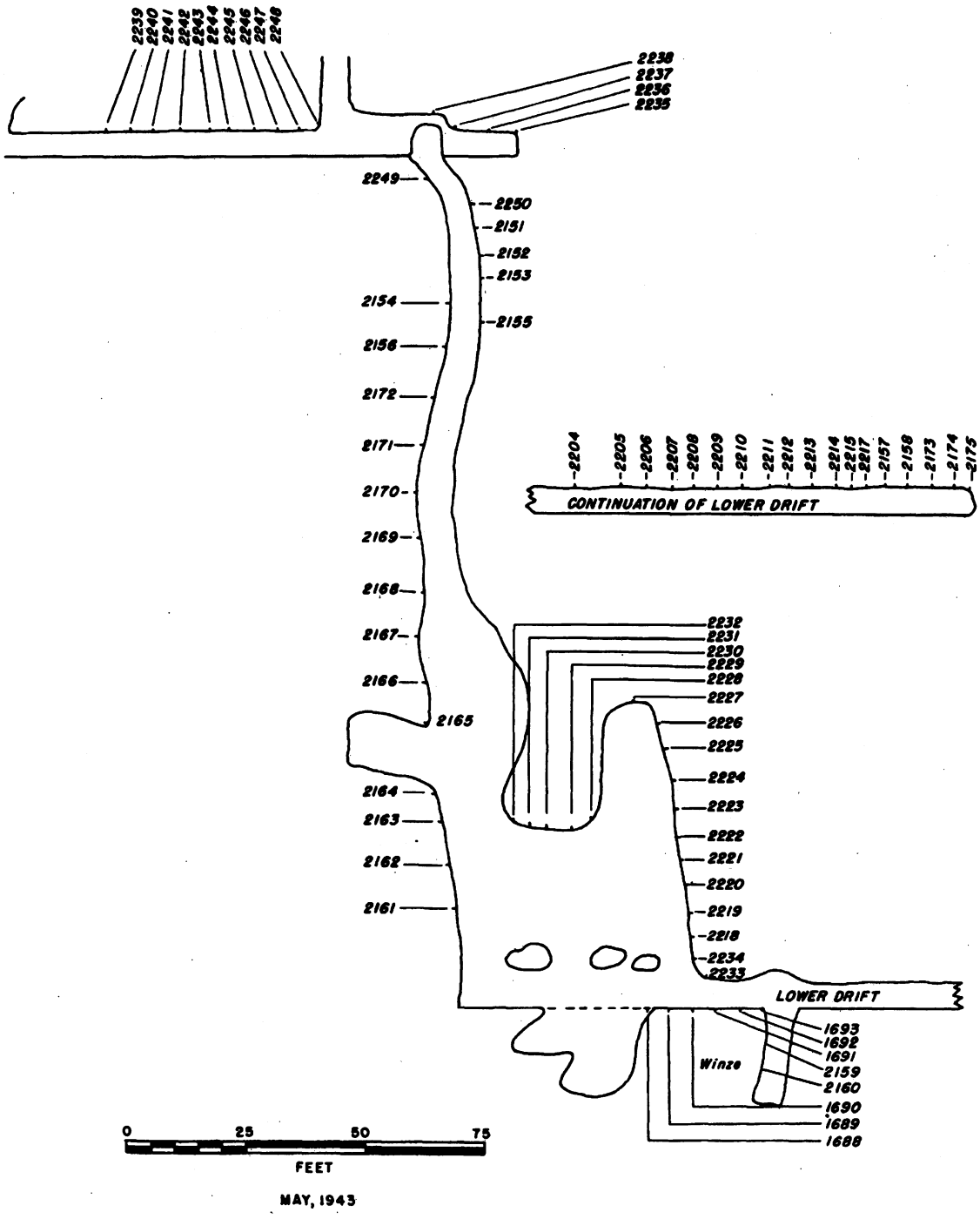


Figure 7.- Iron Cap mine, Graham County, Arizona.

The Head Center vein strikes eastward and dips 37 degrees to the north (figs. 4 and 5). In the tunnel it occurs in a zone of complexly faulted limestone and porphyry and appears to widen extensively where both walls are limestone. Here the ore is largely oxidized, but sulfides are reached in the winze at a depth of 30 feet on the dip below the tunnel.

The mineralized zones occur in the lower tunnel of the Iron Cap mine (fig. 7). The most westerly zone strikes N. 70° W., and its dip, which varies, averages about 40 degrees to the north. The other zone strikes N. 85° W. and is vertical from the surface to 40 feet below the upper tunnel, where it assumes a dip of 40 degrees to the north. The upper tunnel vein may be a fissure that branches from the lower tunnel vein, where the break in dip occurs. Steeply dipping post-mineral faults of north to northwestward strike intersect the thrust fault below the lower tunnel. No evidence is available to indicate that segments have been displaced. The lower tunnel ore zones occur near the base of a limestone thrust block. Oxidation of the ore zones within the district is probably shallowest at these workings, where it extends only a few feet below the surface.

Although lead and zinc are the principal metals in the ore deposits at the Aravaipa claims, some copper, silver, and gold are present. Primary ore minerals common to all three types of deposits are sphalerite, galena, chalcopyrite, and pyrite. They are believed to have been deposited from hydrothermal solutions that ascended from a buried monzonitic magma. Deposition occurred where favorable conbinations of replaceable rocks and structures existed.

Secondary enrichment of lead and zinc is not a factor, but, in Head Center ore secondary copper minerals are of some importance. Microscopic examination of sulfide ore shows much of the sphalerite to be encased with and contain stringers of chalcocite and covellite.

Oxidized lead and zinc minerals occur as cerussite and smithsonite, respectively.

MINE WORKINGS

The seven known ore-bearing areas on the property, named after the claim on which they chiefly occur, are the Head Center, Iron Cap, Arizona, Grand Central, Panama, No. 1, and No. 2.

Workings on the Head Center claim, except for some shallow underhand stopes at the outcrops, are accessible (figs. 4 and 5). They consist of a drift tunnel about 200 feet long from which 150 feet of lateral work has been done, a 130-foot winze from the drift tunnel, and 33 feet of drift from the bottom of the winze.

The principal workings on the Iron Cap claim are accessible through two entries (figs. 6 and 7). The upper entry, 149 feet vertically above the lower one, is a tunnel driven west on a vein for 110 feet. Development from this drift tunnel consists of a 20-foot raise and crosscuts into both

walls of the vein. The lower entry, a 630-foot crosscut, intersects a vein 430 feet southwest of its portal. A drift extends westerly for 200 feet from this intersection. From the drift, some stoping has been done and a winze 20 feet deep has been sunk. A raise from the top of the stope connects with the upper workings. Another drift from a point in the crosscut 75 feet southwest of the vein intersection extends 56 feet southeastward.

Development on the Arizona claim is largely inaccessible. Principally, it consists of drifting on an adit level and a two-compartment vertical shaft reported to be 580 feet deep. A number of short drifts, the lowest on the 569-foot level, have been driven from the shaft. Workings on the other claims are largely inaccessible.

WORK DONE BY BUREAU OF MINES

On both the Head Center and the Iron Cap claims, the workings were mapped and sampled. Also, the topography of the surface was mapped above and well beyond the workings. Laboratory extraction tests were run on Head Center ore at the Bureau's Salt Lake laboratories.

The Head Center ore deposit was diamond-drilled. Although preliminary inspection failed to indicate it, drilling the rock was found to be uniquely difficult and costly. Bits and core shells lasted but a few feet. Core barrels scoured rapidly. Progress did not often exceed 7 feet per shift. Four holes were started from the surface, three of which were completed. The fourth was abandoned at 110 feet. A total of 848.5 feet was drilled.

The diamond-drill holes, in plan, and pertinent surface togography of the Head Center claim are shown on figure 4. Drill hole intersections with the mineralized zone and locations where underground samples were obtained are shown on figure 5. For the Iron Cap claim, surface topography and sample locations are shown on figures 6 and 7, respectively. The analyses of samples, excepting those obtained by diamond drilling, are shown in table 1. Analyses of diamond drill-hole samples are included with the logs of holes and are attached to this report.

Metallurgical Testing

Head Center ore was tested on a representative sample of sulfide ore obtained from the winze. The head sample cut from this analyzed:

	Percent		Percent
Zn	15.8	CaO	1.7
Pb	10.3	Insol.	38.6
Cu	1.72	SiO_2	33.9
Zn ox.	1.6	Al_2O_3	11.3
Pb ox.	1.4		Oz./ton
Cu ox.	Nil.	Ag.	1.72
Fe	6.6	Au.	Tr.
S	13.0		

By combined gravity flotation, the results summarized below were obtained:

Product	Assay, percent			Recovery, percent		
	Pb	Zn	Cu	Pb	Zn	Cu
Clean Pb concentrate	51.0	7.8	1.9	53.7	4.9	12.6
Retort Zn concentrate ...	14.5	47.2	6.2	20.8	40.6	56.0
Clean Zn concentrate	2.8	52.9	2.2	3.3	39.3	14.9

The two zinc products could be combined for shipment to a retort plant or, if desirable, marketed separately.

Up to two-thirds of the tailings losses were in oxide minerals.

Inspection of Iron Cap ore indicates that it can be treated more readily than Head Center ore, with better recoveries and higher-grade products.

TABLE 1. - Analyses of samples

Head Center Samples

Sample	Length, feet	Percent zinc	Percent lead	Percent copper	Ounce gold	Ounce silver
1635	3.0	19.2	0.1	2.22	0.005	1.20
1636	3.0	18.8	28.2	2.28	.005	5.70
1637	2.4	12.2	10.8	.19	.035	2.45
1638	1.9	15.4	38.2	2.60	.005	4.60
1639	3.5	25.0	14.8	1.98	.005	2.15
1640	3.5	19.5	13.2	1.70	.005	2.55
1641	2.0	21.8	15.9	1.25	.005	1.85
1642	4.5	22.0	18.3	1.93	.005	3.55
1643	4.5	7.5	18.0	1.21	.010	2.65
1644	4.0	7.6	6.5	.98	.020	2.05
1645	4.0	4.6	2.0	.16	.025	.35
1646	4.0	3.9	1.7	.28	tr.	.05
1647	3.5	11.1	18.7	1.50	0.020	2.30
1648	3.5	12.0	10.1	1.86	.010	.80
1649	3.5	9.5	7.4	2.36	.010	1.30
1650	3.5	15.0	5.3	2.05	.010	1.10
1651	4.5	17.4	13.0	1.50	.065	4.85
1652	4.0	16.8	13.2	2.20	.015	2.00
1653	3.0	21.3	28.2	2.16	.020	5.30
1654	3.2	27.3	11.2	1.84	.010	1.90
1655	3.5	17.8	14.3	2.07	.010	1.60
1656	5.4	14.6	23.2	1.35	.010	2.30
1657	2.5	29.4	16.8	1.45	.015	7.90
1658	4.0	27.3	11.8	3.06	.010	4.10
1659	4.0	21.7	11.1	1.90	.005	2.00
1660	3.3	9.8	18.4	5.73	.015	7.00
1661	3.2	19.4	11.4	3.29	.010	1.60
1662	4.8	16.4	12.6	1.12	.010	3.70
1663	2.7	14.7	9.6	1.76	.005	1.30
1664	4.0	22.1	8.1	1.82	.010	2.40
1665	3.5	14.4	8.8	1.27	.005	1.90
1666	3.3	13.9	22.6	3.55	.010	2.00
1667	3.0	14.6	16.0	2.45	.010	1.70
1668	1.2	5.4	17.7	2.20	.010	2.00
1669	4.0	8.3	4.9	.49	.010	.90
1670	4.0	8.0	4.5	.25	.065	1.05
1671	3.3	2.6	.2	.19	.010	.30
1672	4.2	6.4	4.3	.18	.145	.45
1673	2.0	.6	.1	.18	tr.	.10
1674	3.5	3.0	.1	.24	0.040	.45
1675	2.5	7.4	5.4	.60	.025	2.30
1676	3.0	1.2	1.2	.06	.010	.40
1677	2.0	.6	.8	.25	tr.	.10
1678[1/]	2.5	.6	.1	.20	tr.	.40
1679[1/]	1.5	1.2	.1	.27	tr.	.40
1680[1/]	2.0	.4	.1	.22	tr.	.20

1/ Samples not shown in figure 5 were taken in oxidized material in the drift tunnel.

TABLE 1. - Analyses of samples (Cont'd.)

Iron Cap Assays

Sample	Width, feet	Percent zinc	Percent lead	Percent copper	Ounce gold	Ounce silver
1681[2/]	5.0	8.4	3.8	0.07	tr.	0.60
1682[2/]	6.0	.6	.1	.04	tr.	.10
1683[2/]	6.0	3.1	.6	.02	tr.	.10
1684[2/]	5.0	.7	.4	.02	tr.	.10
1685[2/]	5.0	7.3	.4	.02	tr.	.10
1686[2/]	5.7	2.2	.4	.02	tr.	.05
1687[2/]	3.0	20.2	7.9	.14	0.005	.80
1688	3.7	21.7	11.8	.29	.005	.90
1689	4.0	24.9	15.7	.17	.005	1.00
1690	4.5	16.7	13.9	.09	tr.	.40
1691	5.5	9.3	3.2	.04	tr.	.20
1692	4.0	9.8	4.6	.17	tr.	.15
1693	6.0	15.5	1.6	.28	tr.	.50
1694	6.0	11.0	.6	.11	tr.	.30
1695	5.5	12.5	.7	.17	0.005	.70
1696	6.0	11.6	3.1	.15	tr.	.30
1697	4.3	8.4	1.7	.12	tr.	.30
1698	4.0	.5	.1	.04	tr.	.05
1699	3.0	3.3	.1	.05	tr.	.10
1700	3.3	4.6	1.7	.14	tr.	.05
2201	3.0	2.8	1.3	.04	tr.	None
2202	3.5	3.6	1.4	.06	tr.	0.10
2203	5.0	4.4	.1	.08	tr.	None
2204	5.0	6.2	.2	.08	tr.	0.15
2205	4.5	4.3	.9	.05	tr.	.30
2206	6.0	13.0	2.3	.25	0.005	.60
2207	6.5	10.6	4.2	.61	.005	.60
2208	5.0	19.4	6.4	.35	.005	1.70
2209	6.0	9.6	2.0	.11	.005	1.00
2210	5.5	18.1	10.9	.25	.005	1.10
2211	8.0	10.7	1.7	.28	.005	.70
2212	6.5	15.0	5.9	.42	.005	.90
2213	8.0	10.9	3.3	.52	tr.	.45
2214	6.0	2.0	.5	.19	tr.	.15
2215	6.0	6.9	5.4	.59	0.005	.95
2216	8.0	8.2	3.5	.42	tr.	.30
2217	5.0	1.0	.1	.08	tr.	.05
2218	3.0	21.4	11.9	.18	0.005	.70
2219	2.6	22.2	8.3	.27	.005	.90
2220	4.0	22.8	7.1	.33	tr.	.40
2221	2.5	15.6	7.1	.72	0.005	1.50
2222	2.5	22.4	6.8	.32	.005	.60
2223	4.3	19.7	11.3	.45	.005	.70
2224	4.0	12.2	4.3	.12	.005	3.20

2/ Samples 1681 to 1687 are not pertinent to ore-reserve calculations and are not located on the attached figures. Samples 1681 to 1686, inclusive, were taken at 10-foot intervals in the east stub drift from the main crosscut (fig. 6); sample 1687 was taken near 1688 (fig. 7).

DIAMOND DRILL HOLE LOGS

Hole No. 1

Project: Aravaipa, 1517
Location: Graham Co., Arizona, 11968 N., 10167 E.
Elevation of collar: 5260 feet

Depth: 180 feet
Dip: 60°
Bearing: South
Core dia: 1-1/8 inches

Footage		Core Recovery			Sample	Analyses					Formation
						Percent			Ounces		
From-	To-	Feet	Feet	Percent	No.	Zinc	Lead	Copper	Gold	Silver	
0	18.0	18.0	2.0	11							Sand, gravel, boulders.
18.0	45.0	27.0	18.1	67							Silicified limestone, quartz porphyry.
45.0	77.5	32.5	27.3	84							Quartz porphyry.
77.5	80.5	3.0	3.0	100							Conglomerate?, quartz porphyry.
80.5	106.0	25.5	25.5	100							Quartz porphyry.
106.0	118.6	12.6	9.9	78							Do.
118.6	129.2	10.6	9.0	84							Do.
129.2	136.2	7.0	6.1	87	1609	1.1	>0.1	>0.02	tr.	0.10	Mineralized zone.
136.2	137.8	1.6	1.3	81	1610	5.9	6.1	.20	tr.	.00	Do.
137.8	141.6	3.8	3.8	100	1611	10.4	6.2	1.70	0.025	2.55	Do.
141.6	150.0	8.4	6.5	77	1612	>0.1	0.1	>0.02	tr.	.30	Do.
150.0	180.0	30.0	29.1	97							Quartzite, limestone.

Hole No. 2

Project: Aravaipa, 1517
Location: Graham Co., Arizona, 11997 N., 10267 E.
Elevation of collar: 5,312 feet

Depth: 272 feet
Dip: 60°
Bearing: South
Core dia: 1-5/8" to 25';1-1/8, 25' to bottom

Footage			Core recovery		Sample	Analyses					Formation
						Percent			Ounces		
From-	To-	Feet	Feet	Percent	No.	Zinc	Lead	Copper	Gold	Silver	
0	12.0	12.0	7.2	60							Fractured quartz porphyry.
12.0	25.0	13.0	2.5	19							Do.
25.0	41.0	16.0	2.2	14							Do.
41.0	65.5	24.5	14.1	57							Do.
65.5	71.0	5.5	2.2	40							Do.
71.0	77.3	6.3	2.2	35							Do.
77.3	92.0	14.7	14.5	98							Do.
92.0	96.0	4.0	2.9	72							Do.
96.0	112.0	16.0	12.6	78							Do.
112.0	140.0	28.0	21.2	75							Do.
140.0	154.0	14.0	11.7	83							Do.
154.0	169.3	15.3	12.2	79							Do.
169.3	179.0	9.7	6.8	70							Do.
179.0	193.5	14.5	11.5	79							Do.
193.5	200.0	6.5	6.4	98							Do.
200.0	206.0	6.0	5.1	85							Cut vein at 201.3 feet
201.3	201.8	0.5	0.5	100	1613	8.8	0.9	0.11	0.005	0.35	Quartzite 201.8 to 202.9 ft., oxidized
202.9	205.1	2.2	2.0	90	1614	10.2	30.0	.75	.010	2.70	some sulfate; 6 inches galena at 204 ft.
206.0	207.7	1.7	1.3	76	1615	17.7	9.3	1.60	.005	.95	Siliceous, partly oxidized.
207.7	210.0	2.3	2.0	87	1616	18.7	22.9	3.81	.005	3.55	Do.
210.0	214.5	4.5	3.3	75	1617	4.2	5.7	.34	tr.	.35	Manganiferous.
214.5	218.0	3.5	2.6	75	1618	1.6	1.0	.11	tr.	.25	Oxidized.
218.0	219.5	1.5	1.3	90	1619	5.4	>0.1	.13	tr.	.25	Oxidized, siliceous.
218.0	228.0	10.0	8.1	81							Footwall vein at 219.5 feet.
228.0	244.0	16.0	11.3	70							Altered quartzite.
244.0	262.0	18.0	16.1	89							Do.
262.0	272	10.0	7.3	73							Do.

Hole No. 3

Project: Aravaipa, 1517
Location: Graham Co., Arizona, 11998 N., 10267 E.
Elevation of collar: 5,316 feet

Depth: 286.5 feet
Dip: 85°
Bearing: South
Core dia. 1-5/8" to 68; 1-1/8", 60' to bottom

Footage			Core recovery		Sample	Analyses					Formation
						Percent			Ounces		
From-	To-	Feet	Feet	Percent	No.	Zinc	Lead	Copper	Gold	Silver	
0	14.0	14.0	5.4	38							Clay, boulders, quartz porphyry.
14.0	23.0	9.0	3.7	43							Broken quartz porphyry, caving, cemented.
23.0	33.0	10.0	7.6	76							Do.
33.0	44.0	11.0	7.5	68							Do.
44.0	68.0	24.0	20.6	85							Do.
68.0	100.0	32.0	17.3	54							Do.
100.0	105.0	5.0	3.9	78							Broken quartz porphyry, mud seams, cemented.
105.0	130.0	25.0	16.7	67							Do.
130.0	140.0	10.0	5.5	55							Do.
140.0	150.0	10.0	4.6	46							Do.
150.0	160.0	10.0	8.0	80							Do.
160.0	168.0	8.0	7.5	93							Do.
168.0	173.0	5.0	3.8	76							Do.
173.0	183.0	10.0	3.3	33							Do.
183.0	192.0	9.0	6.3	70							Do.
192.0	205.0	13.0	9.0	69							Do.
205.0	225.0	20.0	19.2	96							Do.
225.0	228.5	3.5	3.5	100							Quartz porphyry.
228.5	230.5	2.0	2.0	100	1625	0.6	0.3	0.12	tr.	0.15	Vein, quartz with pyrite.
230.5	234.0	3.5	3.1	88	1626	.6	.1	.05	tr.	.05	Vein, quartz partly oxidized.
234.0	237.0	3.0	2.5	83	1627	.6	.1	.05	tr.	.00	Vein, oxidized, leached.
237.0	241.5	4.5	3.1	68	1628	2.8	.2	.03	tr.	.00	Do.
241.5	247.0	5.5	3.0	60	1629	2.0	.4	.08	tr.	.00	Do.
247.0	249.7	2.7	1.3	48	1630	5.2	3.9	.05	tr.	.20	Vein, oxidized, leached, some galena.
249.7	251.5	1.8	0.5	27	1631	3.0	1.2	.05	0.020	.65	Vein, oxidized, leached, soft, talcy.
251.5	255.5	4.0	3.7	92	1632	2.4	.2	.09	tr.	.15	Vein, oxidized, leached, some porphyry.
255.5	263.0	7.5	5.4	72							Broken quartz porphyry, mud seams.
263.0	279.0	16.0	14.0	87							Porphyry and quartzite? a little fluorspar.
279.0	286.5	7.5	4.7	62							Broken porphyry, mud seams.

Hole No. 4

Project: Aravaipa, 1517
Location: Graham Co., Arizona, 12237 N., 10267 E.
Elevation of collar: 5,338 feet.

Depth: 110 feet
Dip: 60-1/2°
Bearing: South
Core Dia: 1-5/8" to 38'; 1-1/8", 38' to bottom.

Footage		Core recovery			Formation and remarks
From-	To-	Feet	Feet	Percent	
0	22	22	13.6	61	Broken and weathered quartz porphyry.
22	27	5	4.8	96	Quartz porphyry, and mud seams.
27	38	11	5.3	48	Do.
38	43	5	3.8	76	Quartz porphyry, caving.
43	44	1	0.25	25	Do.
44	47	3	1.8	60	Do.
47	49	2	0.3	15	Do.
49	52	3	0.3	10	Do.
52	69	17	5.2	30	"Turkey Track" (andesite and basaltic) porphyry at 56 feet.
69	88	19	11.3	59	"Turkey Track" (andesite and basaltic) porphyry to 81 feet.
88	96	8	2.5	31	Quartz porphyry and mud seams.
96	110	14	8.2	58	Quartz porphyry and mud seams, hole stopped at 110 feet.
					No samples taken for analysis.

TABLE 1. - Analyses of samples (Cont'd.)

Sample	Width, feet	Percent zinc	Percent lead	Percent copper	Ounce gold	Ounce silver
2225	4.5	10.9	4.5	0.16	tr.	0.45
2226	3.5	7.8	6.3	.22	tr.	.30
2227	2.0	7.6	1.2	.14	tr.	.40
2228	6.0	15.2	11.4	.15	tr.	.45
2229	5.5	12.9	8.2	.15	0.005	1.60
2230	4.6	28.6	10.2	.15	.005	1.60
2231	3.5	28.0	14.0	.25	tr.	1.10
2232	3.0	22.5	12.6	.13	0.005	1.65
2233	3.7	13.6	4.9	.11	tr.	.40
2234	2.0	20.2	18.9	.12	0.005	.90
2235	4.0	.8	.2	.02	tr.	.15
2236	5.0	6.0	19.3	.59	0.005	1.10
2237	6.0	10.8	11.6	.39	tr.	.60
2238	6.0	5.6	7.9	.63	tr.	.30
2239	6.0	8.4	3.2	.19	tr.	.50
2240	3.0	4.3	2.0	.53	tr.	.45
2241	3.0	1.5	.9	.11	tr.	.30
2242	3.0	4.5	2.3	.55	tr.	.50
2243	3.0	10.7	4.0	.12	tr.	.45
2244	3.0	11.8	7.6	.35	tr.	.30
2245	3.0	13.5	18.2	2.95	0.005	1.70
2246	3.2	14.9	9.7	.10	.005	1.25
2247	2.5	20.5	3.4	.22	tr.	.70
2248	1.2	35.5	8.0	.10	tr.	.80
2249	3.0	13.7	3.6	.17	tr.	.40
2250	4.0	16.6	6.1	.33	tr.	.55
2151	4.0	15.9	8.7	.23	tr.	.60
2152	4.3	17.8	8.3	.24	0.005	.90
2153	5.0	9.9	4.4	.12	.005	.85
2154	4.0	13.0	3.9	.17	tr.	.50
2155	4.0	11.0	2.7	.19	tr.	.10
2156	4.0	10.2	3.6	.16	tr.	.25
2157	6.0	3.3	.7	.18	tr.	.20
2158	6.0	11.5	6.6	.19	tr.	.75
2159	5.0	19.2	.2	.26	tr.	.20
2160	5.0	19.0	.7	.19	tr.	.35
2161	5.0	10.0	1.2	.12	tr.	.45
2162	5.0	19.2	5.4	.11	tr.	.60
2163	5.0	13.7	3.7	.06	tr.	.20
2164	5.2	15.2	8.2	.24	tr.	.70
2165	4.5	22.3	7.2	.15	tr.	.45
2166	4.4	23.1	4.3	.21	tr.	.45
2167	3.6	15.5	7.1	.97	tr.	1.20
2168	4.2	19.1	5.7	.69	tr.	.65
2169	7.0	15.9	13.7	.53	tr.	.60
2170	5.0	18.0	6.6	.34	tr.	.85
2171	5.0	18.0	8.4	.29	tr.	.30
2172	4.3	11.2	5.1	.47	tr.	.05
2173	5.2	14.1	0.1	.10	tr.	.45
2174	6.2	6.0	0.1	.02	tr.	.40
2175	6.0	4.7	5.4	.02	tr.	1.80

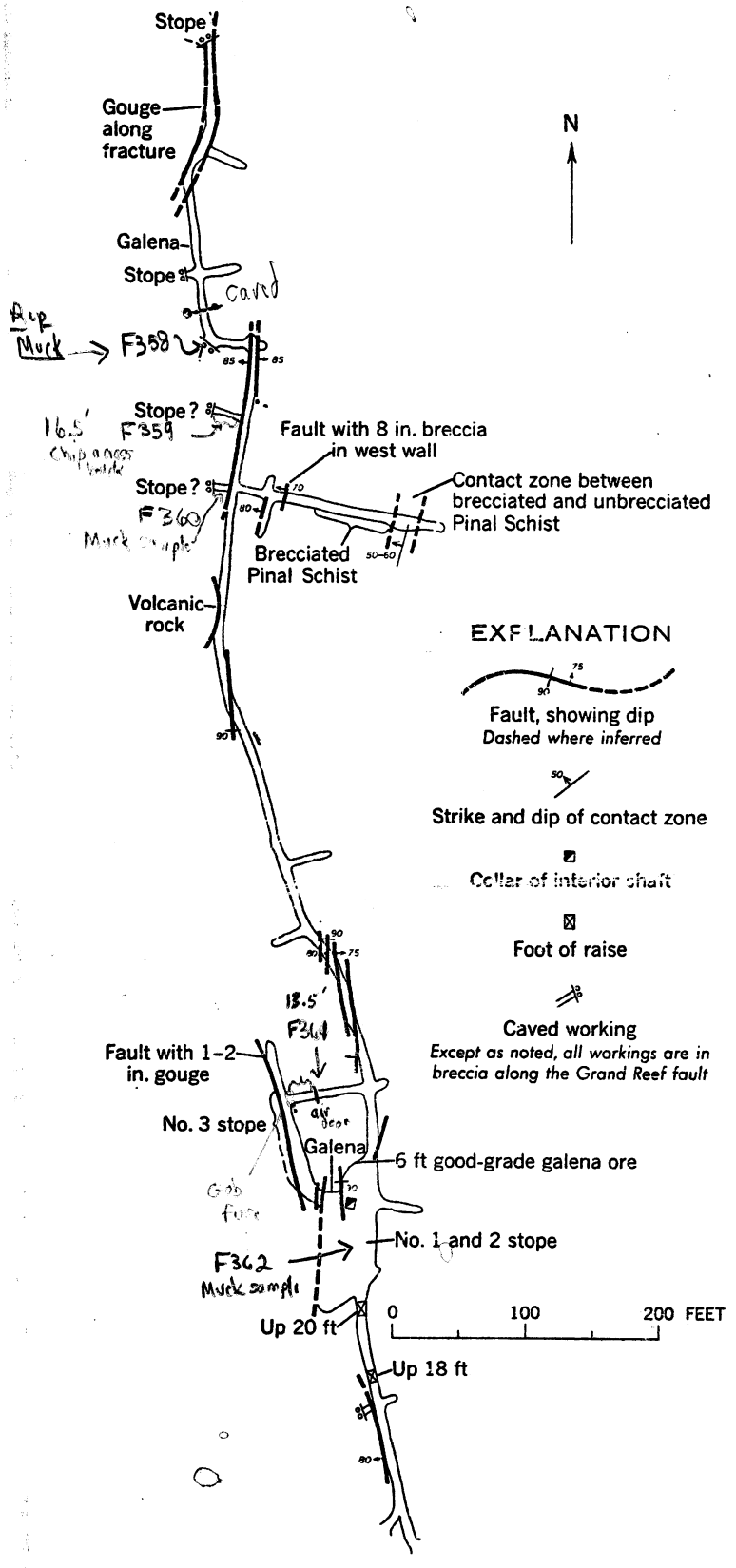


FIGURE 39.—Geologic map of the adit level of the Grand Reef mine.

notch where it crosses the Grand Reef. The Grand Reef mine workings are all north of the canyon.

The reef breccia consists of various-sized angular fragments of Pinal Schist in a matrix of silicic dike rock and quartz. So little ore is left in the accessible parts of the underground workings that not much is known about the occurrence of the ore minerals within the breccia, but apparently the breccia is replaced locally by massive galena. Specks of galena, sphalerite, and chalcopyrite also are disseminated in a granular quartz-fluorite breccia matrix. Pyrite appears to be scarce. Supergene minerals include considerable anglesite and minor cerussite, malachite, azurite, and chrysocolla. The only hypogene gangue minerals of consequence are quartz and fluorite.

The main ore shoot is reported by Ross to have a stope length of 120 feet and a width of 15–30 feet or more on the adit level. At a distance of 70 feet below the adit level, the main stope is 40–50 feet long and 10–15 feet wide and has a clearly defined north-striking vertical fracture along its west wall. The No. 3 stope extends from 30 feet below the adit level nearly to the surface and has a stope length of 60 feet and a width of 3 feet. Sizes of the other stopes are not known, but that near the north end of the adit may have been as much as 200 feet long. Wilson (1950, p. 62) also reports a stope on the 200-foot level south of the shaft.

DOGWATER MINE

The Dogwater mine is in an east branch of Laurel Canyon in the NW. cor. sec. 33, T. 6 S., R. 20 E. It was described briefly by Ross (1925a, p. 79, 85, fig. 4). The only production reported is an unknown part of 117 tons of mixed ore from the Grand Reef, Aravaipa, and Dogwater mines in 1920, and the size of the workings indicates that only a small amount of ore could have been produced.

Mine workings consist of an adit 190 feet long, driven S. 10°–25° E. on a vein along a fault of the Grand Reef structure, and a stope to the surface in the interval between 110 and 160 feet from the portal. The vein dips 80°–90° SW. In the face of the adit, the vein structure is 4–5 feet wide, and the vein consists of silicified fault breccia containing galena concentrated in small bunches in a layer 6–8 inches wide along the southwest wall or disseminated in silicic gangue. Gangue minerals are quartz, chalcedony, and purple to white fluorite. Supergene minerals include anglesite, cerussite, and a little malachite, azurite, chrysocolla, and plumbojarosite. Wulfenite in veins as much as an inch thick and in vugs is sufficiently abundant to suggest that it may be a hypo-

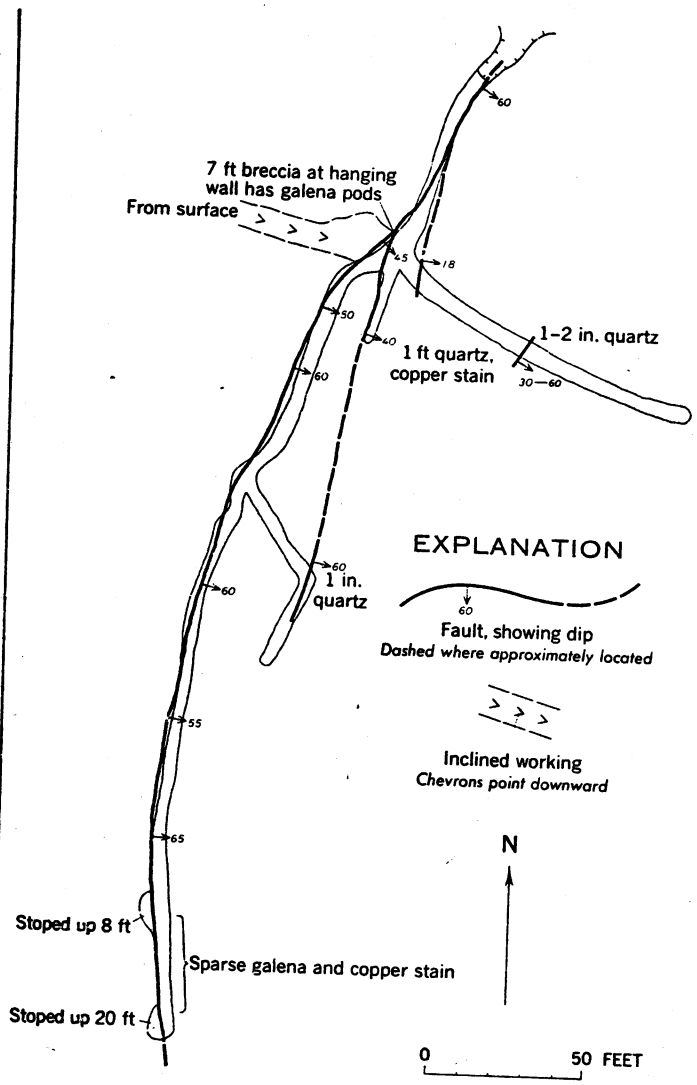


FIGURE 31.—Geologic map of the adit level of the Abe Reed mine.

the mine yielded 150 tons of ore assaying 12.5 percent lead, 2.4 percent zinc, 1.3 ounces of silver per ton, and 0.07 ounce of gold per ton (C. S. Bromfield, written communication, 1951). In 1951 the output was 107 tons of ore, and in 1952, 418 tons. Development consists of a shaft 100 feet deep, a caved shaft reported to be 115 feet deep, and short drifts. The mine was inaccessible at the time of this study.

The shafts explore a breccia along a steeply plunging trough at the intersection of two faults in Escabrosa(?) Limestone that is intruded by a rhyolite dike. Veinlets and irregular masses of galena in a gangue of quartz, fluorite, and specularite are enclosed in the breccia. The galena is largely oxidized to cerussite and anglesite.

COBRE GRANDE MINE

The Cobre Grande mine area is near the corner common to secs. 21, 22, 27, and 28, T. 5 S., R. 20 E., about seven-tenths of a mile north of Cobre Grande Moun-

tain. The area may be reached from Landsman Camp over 2.5 miles of steep trail, or from Monkey Spring, Goodwin Canyon, and the valley of the Gila River over a rough and steep jeep road. Ross (1925a, p. 103) reports production of one carload of ore.

Mine workings are in a block of Escabrosa (and Horquilla?) Limestone that here and there is silicated or has irregular zones of iron oxide and sparse copper stain. Workings include an adit (the Cowboy tunnel of Ross), several other adits, one of which on the road to Monkey Spring is reported by Ross to have been 700 feet long, a shaft said to be 160 feet deep, and several bulldozer cuts made by Duval Sulphur and Potash Co. during exploration carried out in 1958–59.

The main adit trends S. 30° W., is mainly in limestone, and has about 250 feet of workings, a 30-foot winze, two 15-foot raises, and an irregular small stope, presumably along the bedding of the limestone, that dips 20° SE. A little chalcanthite coats the walls of the stope. Ross reports pyrite, chalcopyrite, a little galena, quartz, calcite, chlorite, epidote, garnet, specularite, and magnetite. The adit on the road to Monkey Spring trends N. 55° W. in Pinal Schist and is caved 180 feet from the portal, but probably reached the fault (the Cobre Grande fault, p. 112) between Pinal Schist and limestone, as Ross reports that the face was in limestone.

A bulldozer cut northwest of the main adit exposes dark-gray fetid crinoidal limestone that is irregularly and sporadically replaced near a quartz porphyry dike by chalcopyrite, iron oxide, johannsenite, chrysocolla, and malachite. A shaft south of the south end of the cut is sunk on an epidotized fault zone in limestone; the zone strikes north-northwest, dips 80°–90° W., and is about 8 feet wide. The footwall of the zone is marked by sparse copper stain. On the dump is a little massive fine-grained pyrite having a faint iridescent copper stain.

An adit at the end of the Cobre Grande mine road is driven S. 15° W. 60 feet along an irregular narrow copper-stained slip in epidotized limestone. The slip dips 45°–90° W. Malachite and chrysocolla form thin layers along the walls of the slip.

Just northwest of the main adit, a vague belt of silicated limestone 500–600 feet long and ranging in width from 10 to 70 feet has been prospected by bulldozer. The altered zone seems to trend about N. 70°–80° W. On one bulldozer terrace near the west end of the explored area, the north wall of the zone dips steeply south and the south wall more gently south, perhaps 20°–30°. Fine-grained gray limestone is irregularly replaced both along bedding and in zones that cut across bedding, by epidote, johannsenite, and locally, much yellow garnet. Some replaced beds are now solid epidote, others solid johannsenite. The altered limestone contains small amounts of chalcopyrite and its oxidation products malachite, chrysocolla, and tenorite. Chalcopyrite appears to be concentrated in narrow northwesterly-trending streaks. At its east end, across a gully from the main adit, the altered zone consists of about 10 feet of nearly solid epidote.

Altered limestone along a silicic dike has been explored by bulldozer on a low ridge west of the main adit. On the south side of the ridge the dike is 40–50 feet wide. Along its northeast side it is flanked by 15–20 feet of epidote-johannsenite rock which grades away from the dike into 20 feet or so of epidotized limestone and finally into more or less unaltered limestone. This entire area is closely faulted and the rocks are so strongly altered that the relations of dike, altered dike, and limestone are obscure.

COPPER BAR AND SAM JONES PROSPECTS

The Copper Bar shaft and adit are on the north side of Copper Canyon just south of the center of sec. 32, T. 5 S., R. 20 E., and the Sam Jones adit is directly opposite across the canyon (fig. 32). These workings were described by Ross (1925a, p. 92–95) as the Royal Tinto Mining and Smelting Co. group. He reports that 15 tons of picked chalcocite ore assaying 29.7 percent copper and several dollars in

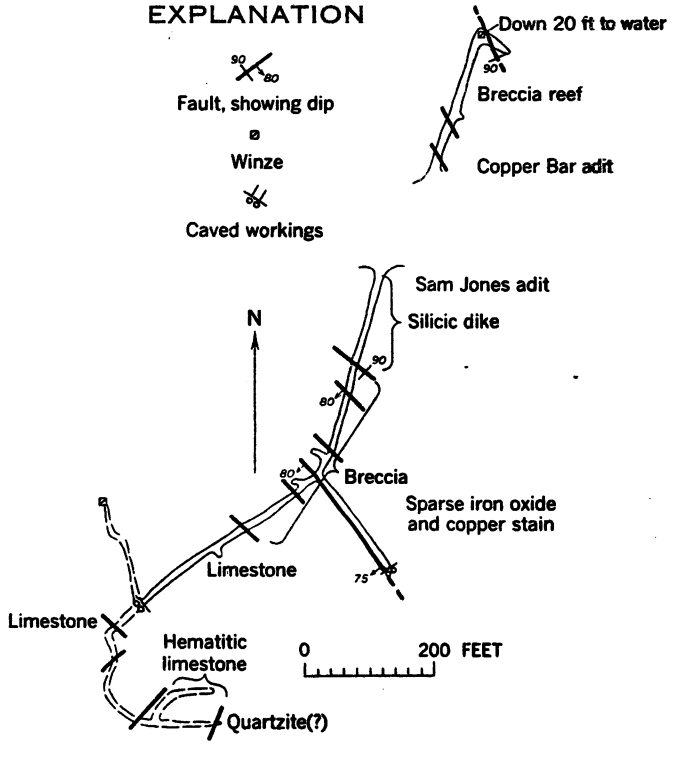


FIGURE 32.—Geologic sketch map of the Copper Bar and Sam Jones adits. Modified after Ross (1925a, fig. 8).

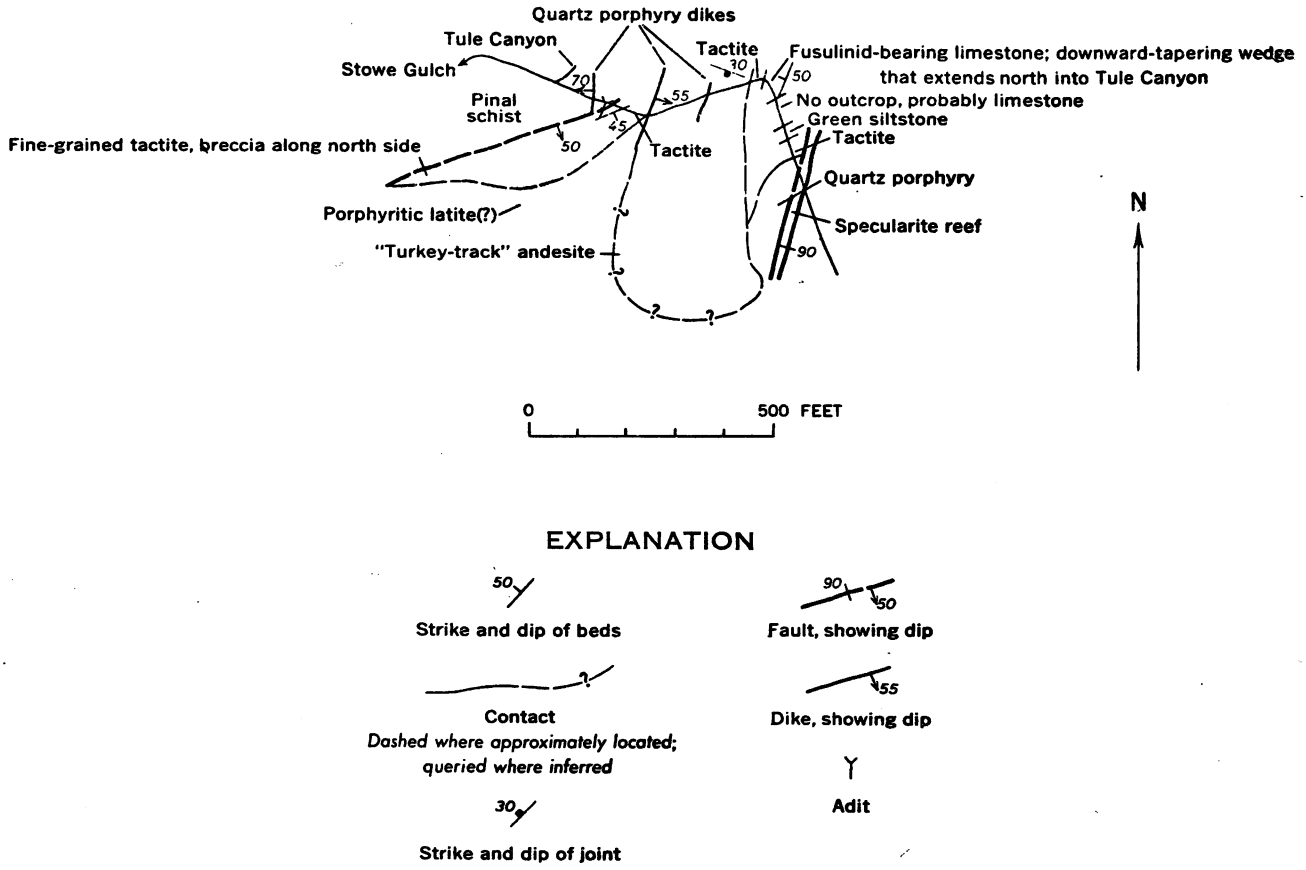


FIGURE 33.—Geologic sketch map of the Lead King mine area along Stowe Gulch.

breccia, laminated and comb quartz, amethystine quartz, chalcedony, and here and there a little galena, anglesite, chalcopyrite, malachite, and chrysocolla. On the dump of the raise, barren breccia contains a little fluorite.

PRINCESS PAT MINE

The Princess Pat mine is just north of Old Deer Creek in the NW¼ sec. 13 (unsurveyed), T. 5 S., R. 19 E., at the north edge of the Klondyke quadrangle. It may be reached by road from a point on old U.S. Highway 70 about 7 miles east of Coolidge Dam. The mine was described by Ross (1925a, p. 106–107), and little if any prospecting appears to have been done in the area since his examination. Ross reports that 1 ton of oxidized copper ore was shipped "from workings near the northwest corner of the property."

Rocks of the area are purple andesitic lava and tuff of the Williamson Canyon Volcanics. Lava flows just above the adit strike east and dip 25° N. The volcanic rocks are cut by a fracture zone trending about N. 20° W. and dipping steeply west, along which the Princess Pat adit has been driven. The fracture zone is as much as 6 feet wide and is stained by iron oxide and small amounts of azurite and malachite. Ross states that a little sphalerite, pyrite, chalcopyrite, and galena(?) were found along a zone 7 feet wide in a westerly-trending crosscut 320 feet from the portal of the adit.

Mine workings include a main adit, now flooded and inaccessible, reported by Ross to be 870 feet long and as having two crosscuts to the west each 120 feet long and a third crosscut to the east 70 feet long, and several small opencuts on the hillside above the adit. In addition to the underground workings, a concrete tank 60 feet long and 20 feet wide for leaching oxidized copper ore, a second tank 55 feet long and 3 feet wide for precipitation of cement copper using scrap iron, and a large concrete water storage tank were built, apparently fairly recently, near the portal of the adit; neither the leaching nor precipitation tank appears to have been used to any extent.

SINN FEIN MINE

The Sinn Fein mine is near and at the end of the Williamson Canyon road, on the line between secs. 19 and 30, T. 5 S., R. 20 E. It is a short distance west and southwest of the Head Center mine. According to

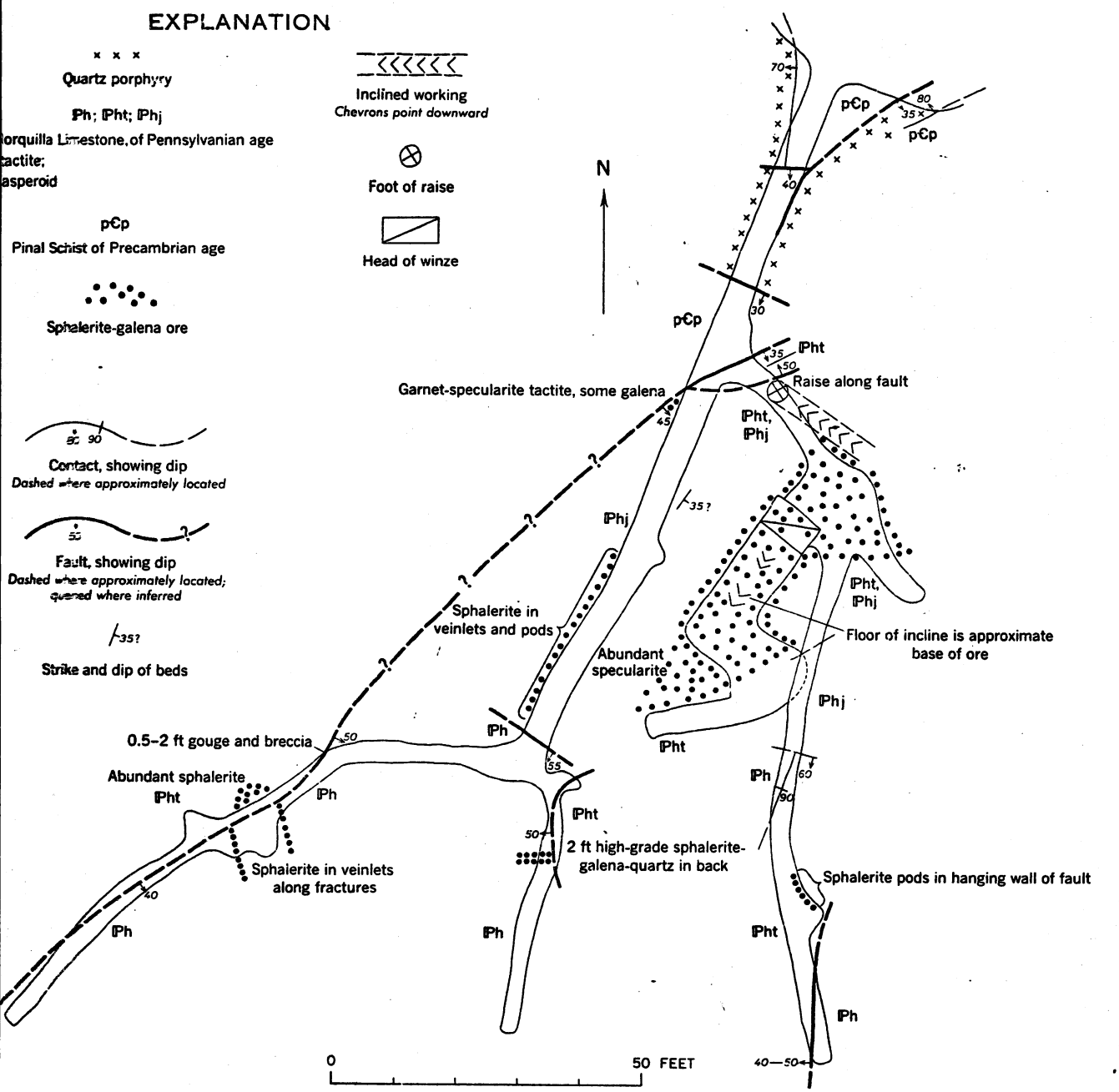


FIGURE 34.—Geologic map of the Lead King mine.

(1925a, p. 100), three carloads of ore had been ed prior to 1925. During the period 1947–53, Sinn Fein mine produced the following amounts of ore: 1947, a few tons; 1948, 1,021 tons; 1949, tons; 1950, 1,538 tons; 1951, 1,868 tons; 1952, tons; 1953, 440 tons. Ore produced during the d 1950–52 assayed about 17 percent lead, 1.3 nt copper, 2.3 ounces of silver per ton, and 0.2 e of gold per ton.

re workings consist of two separate groups, an winze, and winze level 50 feet below the adit that will be referred to as the old Sinn Fein mine, and the principal inclined shaft and levels of the new Sinn Fein mine, a few hundred feet north of the old mine. The new workings were extended in 1957 by the Balboa Mining and Development Co., of Grand Junction, Colo., but little ore was shipped. An inclined shaft 50 feet deep was sunk opposite the portal of the old workings in 1958–59.

The old workings are along a faulted contact between Horquilla Limestone to the east in the hanging wall and a latite(?) dike to the west (fig. 36). The fault

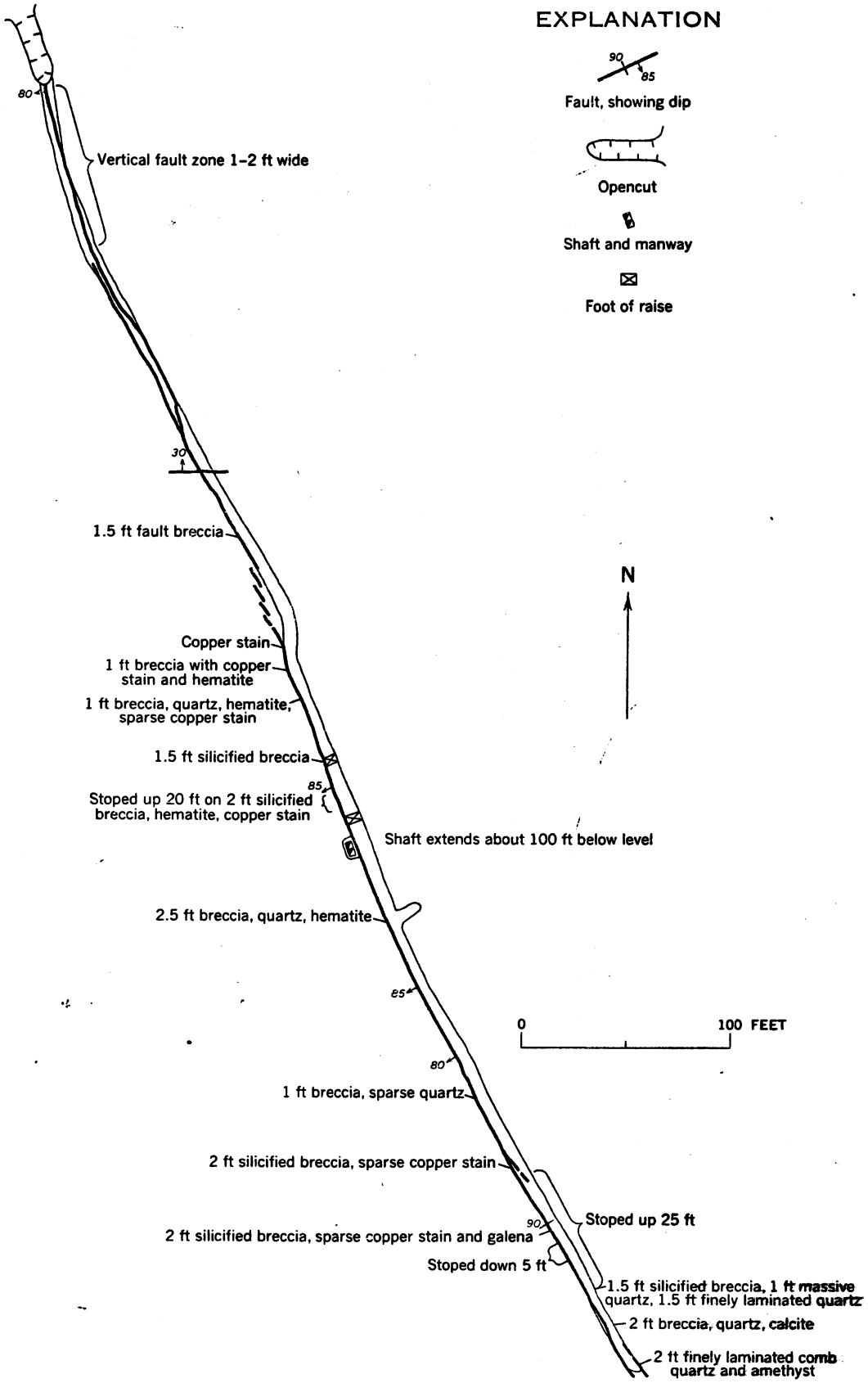


FIGURE 35.—Geologic map of the Orejana adit.

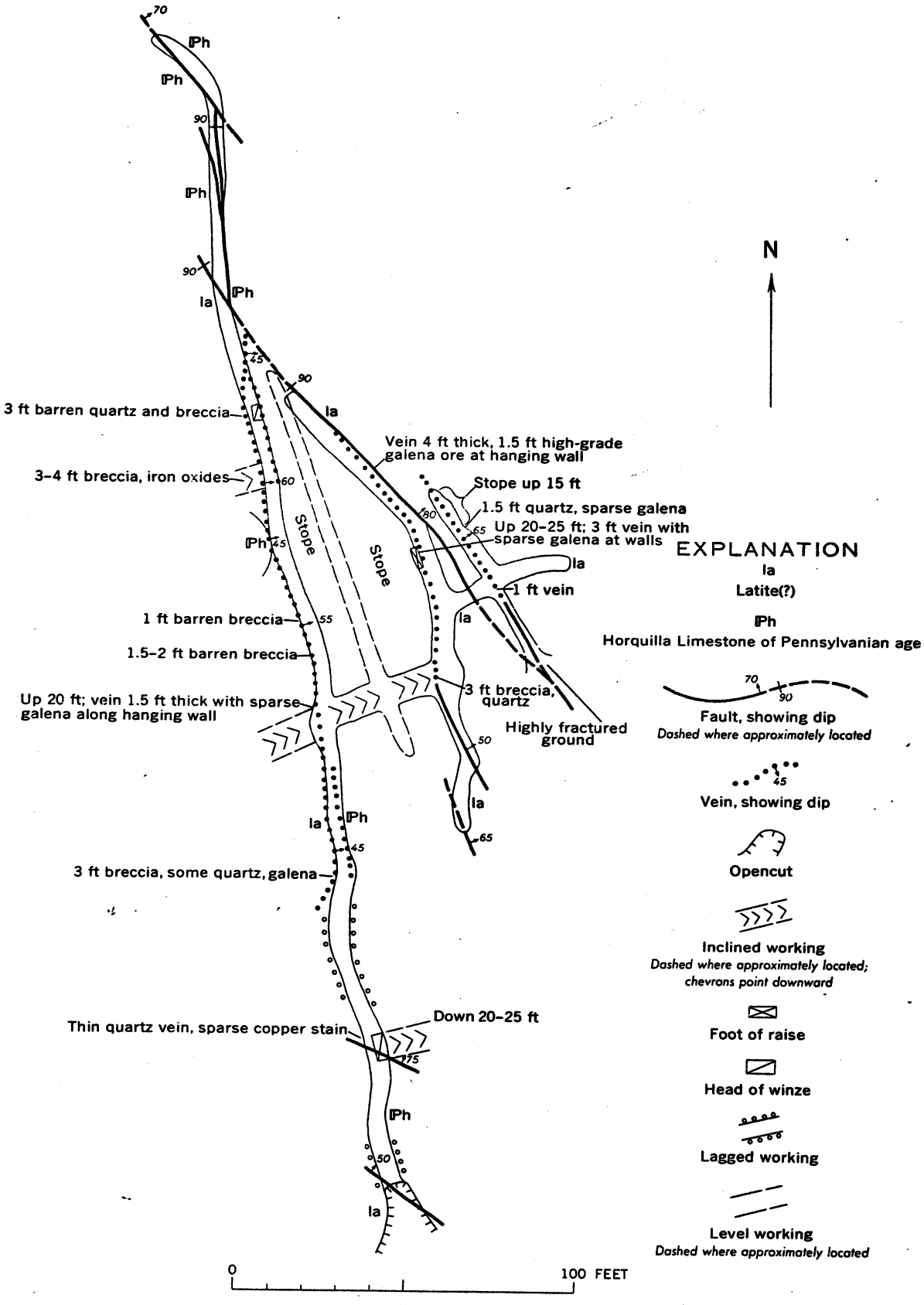


FIGURE 36.—Geologic map of the old Sinn Fein mine workings.

A little rusty quartz and galena were found. About 500 feet farther west, an inclined shaft and pit explore a quartz-amethyst vein 1–2 feet wide, striking N. 5° W. and dipping 75° W. The vein has a core of amethyst, flanked locally by thin layers of galena. The size of the dump indicates that the shaft and other possible workings are several hundred feet in extent.

A shaft 20 feet deep and a pit on the ridge just north and west of Williamson Canyon in the NW¼ sec. 30, T. 5 S., R. 20 E., are along a fracture in Horquilla Limestone. The fracture strikes N. 50° W., dips 80° SW., and has along it a little quartz, amethyst, galena, malachite, chrysocolla, and wulfenite. According to an old claim notice, the workings are on the Booker T. Washington claim.

A layer of brecciated jasperoid in Escabrosa Limestone in the center of the N½ sec. 30, T. 5. S., R. 20 E., 2,000 feet southeast of the Head Center mine, has been explored by an inclined shaft about 60 feet deep and an open stope 75 feet long. The breccia strikes N. 55° W., dips 65° NE., and has a strike length of

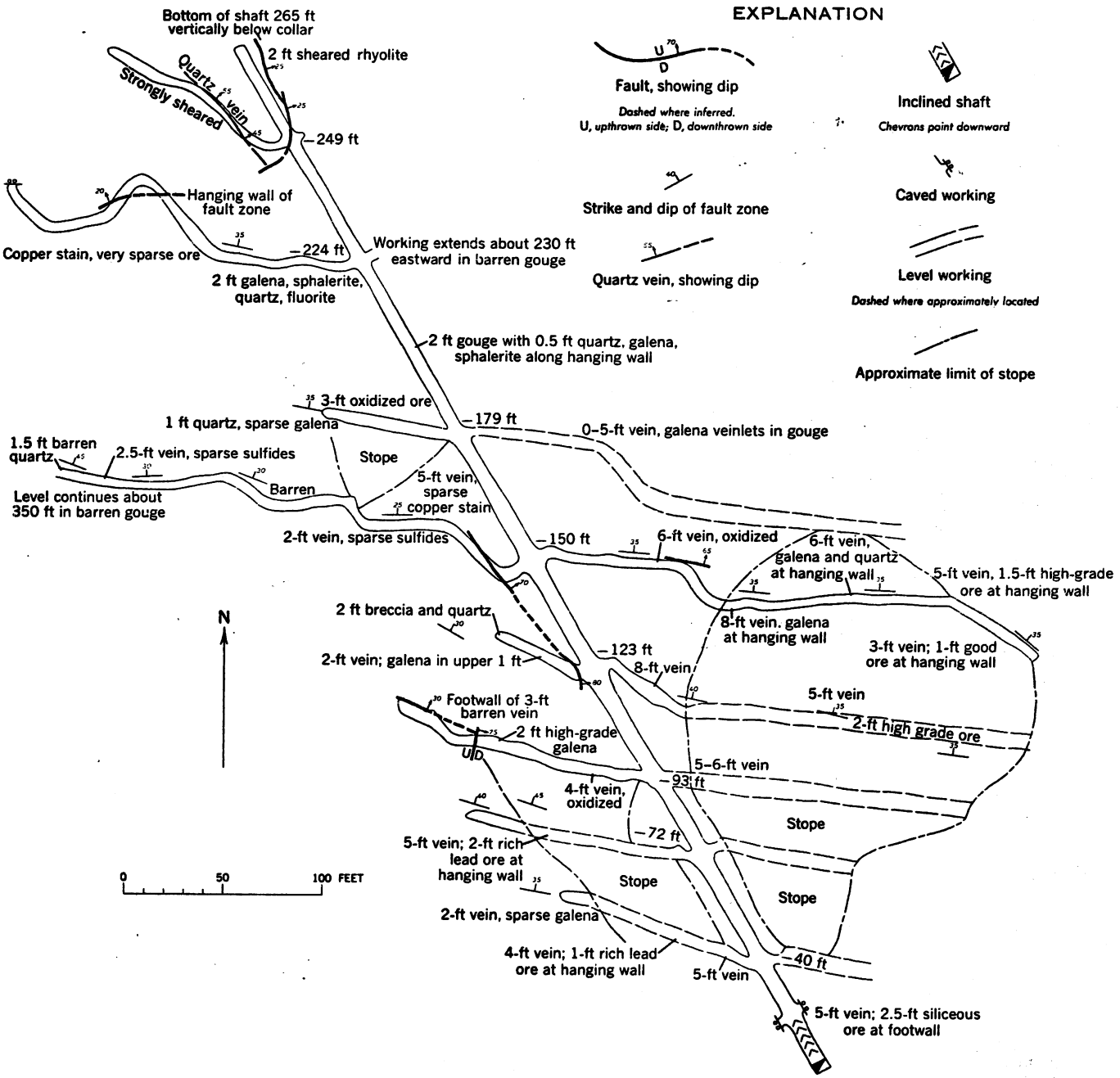


FIGURE 37.—Geologic map of the inclined shaft workings of the new Sinn Fein mine.

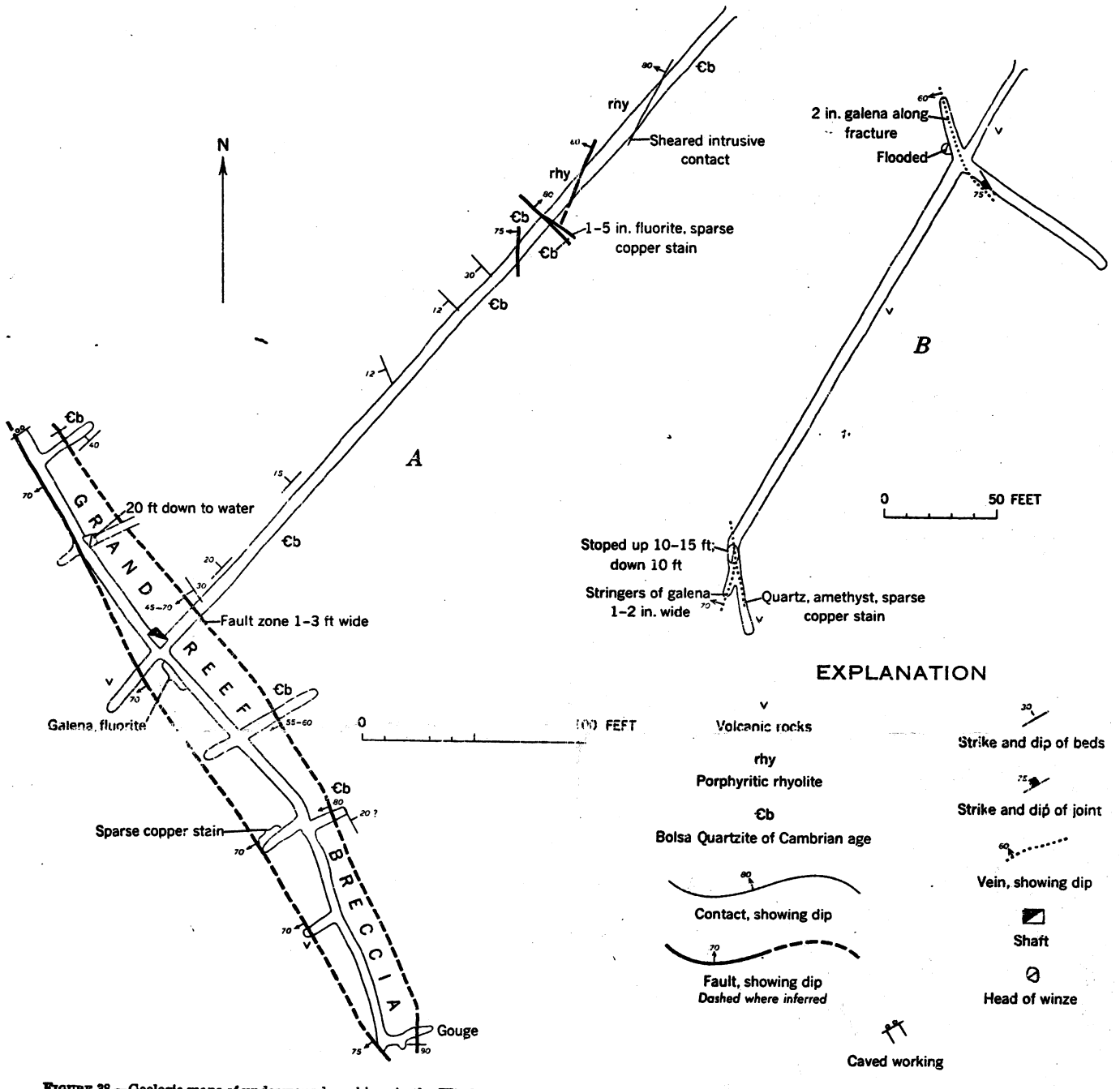


FIGURE 38.—Geologic maps of underground workings in the Windsor mine area. *A*, Adit level of the Windsor mine. *B*, Adit on the May Tustin(?) claim.

for the most part although some may be dike rock. Mine workings are shown in figure 47*B*. The veins are fracture zones having thin stringers of quartz, amethyst, and galena.

Several other shafts and adits penetrate Imperial Mountain; some along the Grand Reef were noted in the description of that structure (p. 109), and others are inaccessible or provide no evidence of mineralization.

PROSPECTS BETWEEN IMPERIAL MOUNTAIN AND THE TENSTRIKE MINE

Between Imperial Mountain and the Tenstrike mine, the Grand Reef has been prospected at several places.

In the SW. cor. sec. 8, T. 6 S., R. 20 E., a shaft now flooded is sunk on a breccia zone at least 20 feet wide.

Two prospects on the Grand Reef are in the SW¼ NW¼ sec. 17, half a mile northwest of the Tenstrike mine. At the northwestern prospect, the reef strikes N. 30° W., dips 75° SW., and is explored down the

INTER-OFFICE CORRESPONDENCE

COPIES TO:

TO J. B. Imswiler

FROM P. O. Sandvik

DATE June 24, 1975

SUBJECT Arizona Au & Fe Referral

Enclosed is an offer by Mr. James M. Gough of a couple of prospects in Arizona. Since they are in your bailiwick I will let you handle direct.

POS

P. O. Sandvik/mp
Enc.

GOUGH MINING PROSPECTS
4601 Evergreen Dr. Sierra Vista, Arizona 85635

cc

MINING & EXPLORATION

Referred_____ Answered_____

RECEIVED JUN 23 1975

File Adm. - Com. - Loc. - Dist. - Exp. - Prod.

Subject_____

To: IMC
Att: Chief Geologist
Mining Department

Dear Sir;
I am a independant prospector and at the present time I have two very good mines. I am willing to accept a suitable settlement, such as a finders fee, or the sale of the mineral rights.

The Golden Star Mine in located in the Arivaca mining district about four miles north of Arivaca in Pima County, Arizona. It is, also in the Las Guijas Mountains and I believe it is in section 8, Range R. 9E T. 20 S, very easy to get to.

The last assay showed Gold ozs. per ton 1.75, Silver ozs. per ton 1 4/10, there is copper, but I never bothered to have an assay of the copper.

The other mine is known as The Gough Mine, it is located in the Santa Teresa Mountains, in Graham County, Arizona. The mine is in the Aravaipa mining district, about ½ mile from Landsman Camp in a East-Southeast direction from Landsman Camp and on the Southeast quarter section of section 29, R 20 E. T 5 S at the upper fork of Tule Canyon.

The last assay showed Gold trace, Silver trace, Lead 0.21 and Iron 69.79. The Iron ore is hematate and I have taken samples to a Professor of Geology at the University of Arizona. He told me that there should be pockets of Gold underneath the Iron at perhaps 100 to 1000 ft. underground. I did have three claims in this same area, but I decided to just hold unto one. I personally believe there is a hundred million tons or more of this high grade Iron ore right where I have located.

The Gough Mine is not easy to find, so if your company might be interested, I would be willing to guide you to the Golden Star or to The Gough Mine.

I would consider leasing, especially the Iron ore deposit.

Very truly yours,

James M. Gough

James M. Gough

July 22, 1975

Mr. James M. Gough
Gough Mining Prospects
4601 Evergreen Drive
Sierra Vista, Arizona 85635

Dear Mr. Gough:

Your recent letter to Dr. P. O. Sandvik, our Chief Geologist, regarding the Golden Star Mine and the Gough Mine has been referred to my attention.

Inasmuch as I frequently travel to Arizona, I will try to gather more information on these particular mines and if they appear to be of interest to IMC, I will contact you at that time.

Thank you for thinking of IMC.

Very truly yours,

J. Bruce Imswiler
Manager of Exploration
Western U.S.A.

:lvj