CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
3550 N. Central Ave, 2nd floor
Phoenix, AZ, 85012
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

The following file is part of the Cambior Exploration USA Inc. records

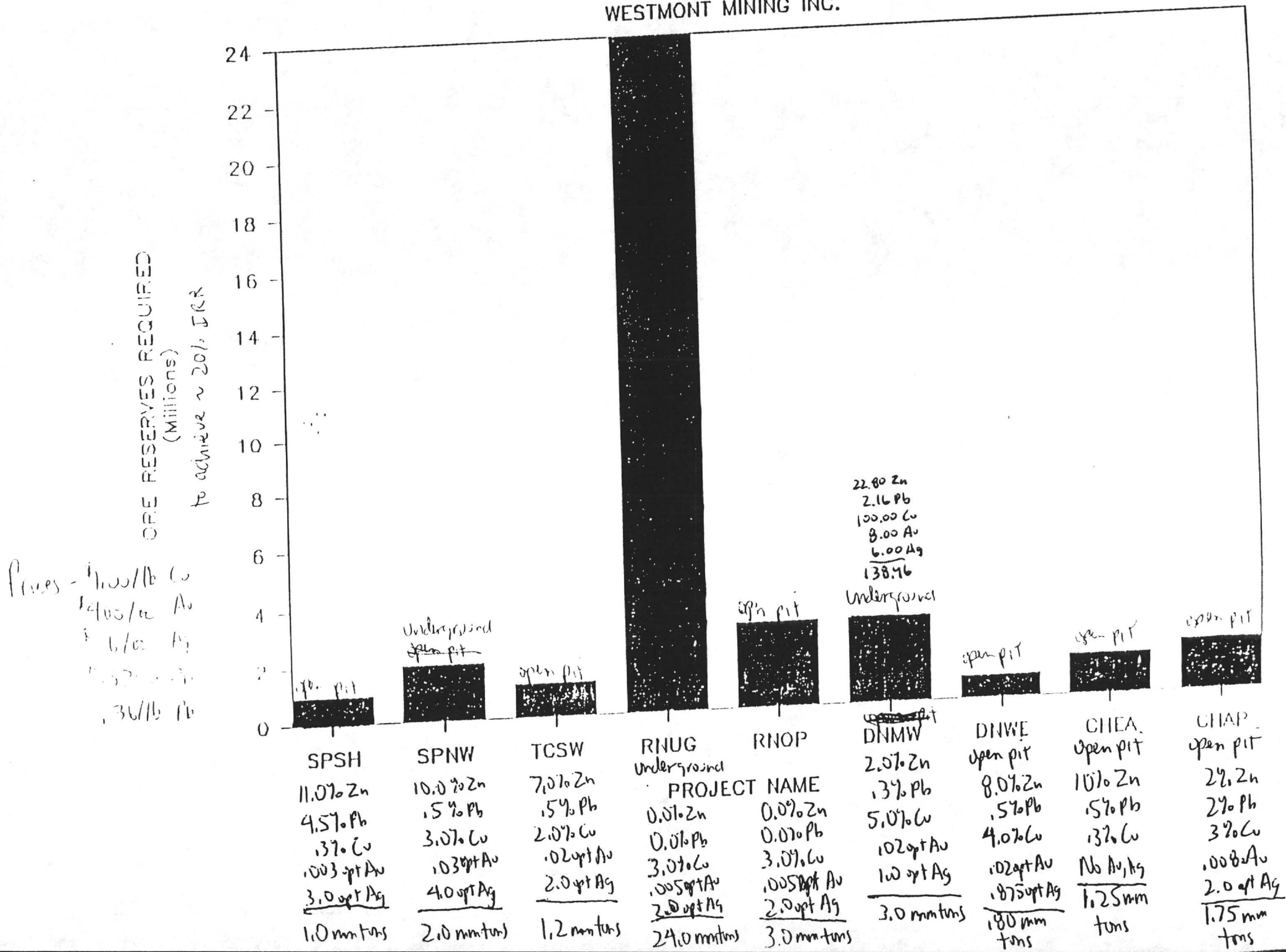
RESERVES—DECEMBER 31, 1984

	Percent Newmont Interest[1]	Location[2]	Total Proven and Probable Reserve (000) ST[3]	Average Mineral Content Gold Oz/Ton	Silver Oz/Ton	Copper %	Lead %	Zinc %	Other
Gold									
Carlin Gold Mining Co.	*100*	USA							
Carlin Mine			4,038	0.153					
Maggie Creek[4]			2,362	0.091					
Gold Quarry[5]			144,499	0.049					
Rain[6]			8,265	0.083					
Newmont Proprietary Limited	*100*	AUS							
Telfer Mine[7]	*70*		11,945	0.102					
Nonferrous Metals									
Magma Copper Co.	*100*	USA							
San Manuel oxide[8]			56,534			0.468			
San Manuel[9]			312,616	0.00158	0.029	0.694			0.028% MoS_2
Kalamazoo[9] Shut down			354,912	0.00158	0.029	0.715			0.028% MoS_2
Superior			4,439	0.026	0.71	5.69			
Pinto Valley Copper Corp.	*100*	USA		10.40	4.26	113.80			= 128.46
Pinto Valley Mine			373,363			0.403			0.015% MoS_2
Miami East Mine			5,976			3.14			$100 ($400,000,000)
Pinto Valley SX-EW									
Miami SX-EW									
Newmont Mines Ltd.	*100*	CAN							
Similkameen Mine			139,870	0.0021	0.035	0.394			
Resurrection Mining Co.[10]	*100*	USA	1,061	0.100	2.56		4.49	9.42	
Palabora Mining Co. Ltd.	*28.6*	RSA	462,000			0.55			
O'okiep Copper Co. Ltd.	*40.2*	RSA	21,071			1.84			
Tsumeb Corp. Ltd.[11]		SWA							
Tsumeb Mine	*32.6*		6,803		2.71	3.31	3.65	1.28	
Kombat/Asis West	*32.6*		2,099		0.56	2.03	2.49		
Asis West (TECO)	*24.5*		1,401		0.88	4.21	1.42		
Asis Ost (TECO)	*24.5*		368		1.23	2.48	1.15		
Matchless	*32.6*		621			2.20			
Otjihase	*22.8*		9,233		0.24	2.17			
Southern Peru Copper Corp.	*10.7*	Peru							
Cuajone			345,810			0.89			
Toquepala			124,502			0.82			
Energy									
Newmont Oil Co.	*100*	USA							
Oil, net (bbls)[12]			7,837,849						oil
Gas, net (million cubic feet)			119,776						natural gas
Peabody Holding Company, Inc.	*30.7*	USA	7,895,000						coal
Dawn Mining Company	*51*	USA	1,131						0.109% U_3O_8
Other Interests									
Foote Mineral Co.	*87.5*	USA							
Kings Mountain Mine			26,599						1.51% Li_2O
Silver Peak			38						100% Li
Salar de Atacama		Chile	121[13]						100% Li
Sherritt Gordon Mines Ltd.	*34.7*	CAN							
Fox Mine			696			1.80		2.42	
Ruttan Mine			21,298			1.46		1.30	

(1) Newmont Mining Corporation's direct and indirect interest at December 31, 1984.
(2) Location USA–United States; CAN–Canada; RSA–Republic of South Africa; SWA–South West Africa (Namibia); AUS–Australia.
(3) Mineral reserves tabulated are proven and probable in short tons. Oil and gas reserves are proven reserves only, in barrels of oil and condensates and natural gas liquids, and cubic feet of natural gas.
(4) Maggie Creek reserves include 1.3 million tons of lower grade ore averaging 0.036 ounces of gold per ton.
(5) Gold Quarry reserves include 51 million tons averaging 0.077 ounces of gold per ton and 93 million tons of lower grade ore averaging 0.034 ounces of gold per ton.
(6) Rain reserves include 3.4 million tons in place averaging 0.147 ounces of gold per ton and 4.9 million tons of lower grade ore in place averaging 0.038 ounces of gold per ton.
(7) Newmont Proprietary Limited, through Newmont Holding Pty. Ltd., has a 70 percent interest in the Telfer gold mine. Reserves include 8.3 million tons of low grade ore averaging 0.072 ounces of gold per ton.

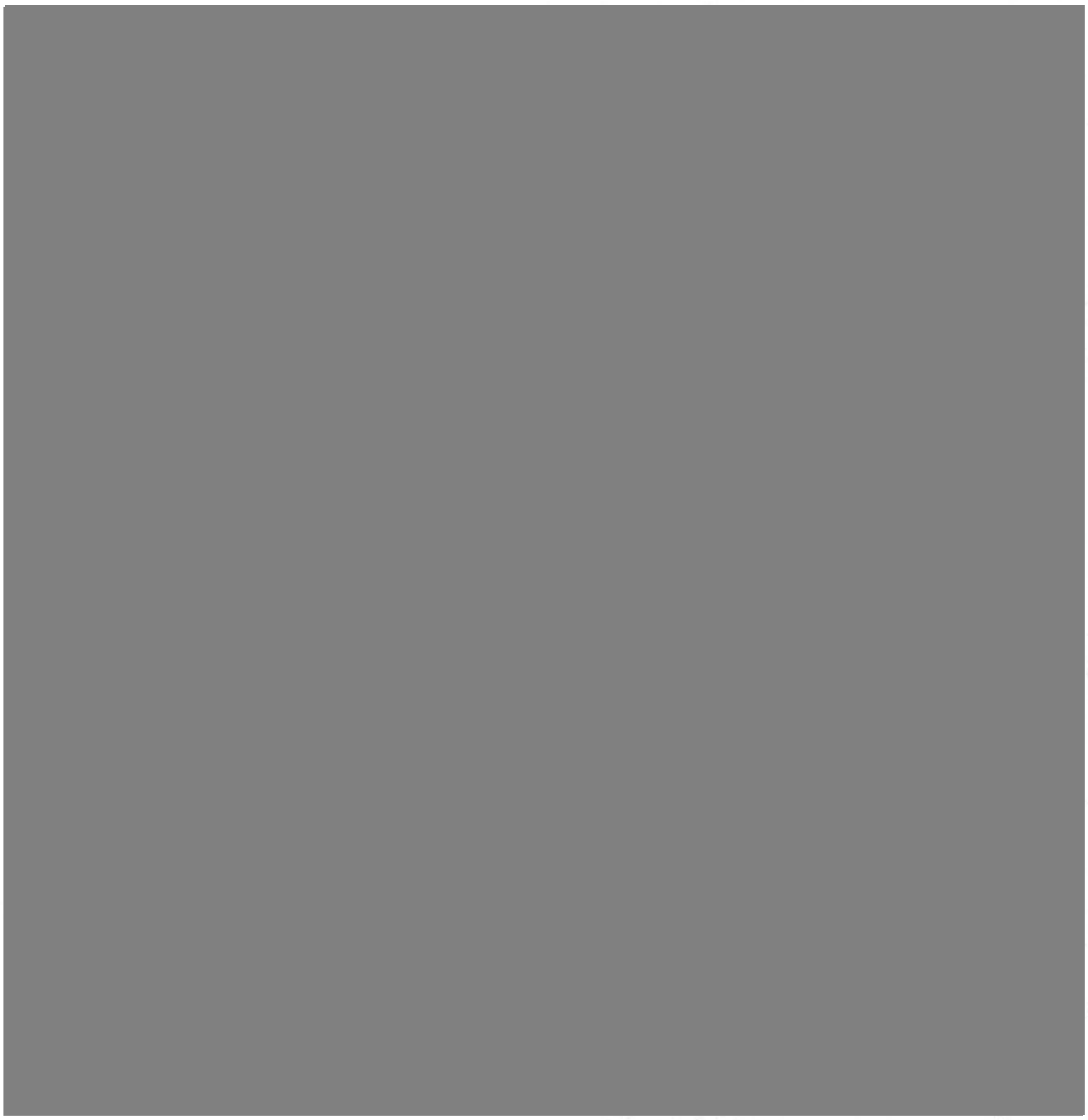
POLYMETALLIC PROJECT EVALUATION

WESTMONT MINING INC.



61. Geology of the Magma Mine Area, Arizona

DONALD F. HAMMER,* DONALD W. PETERSON†



glomerate, and that in turn rests on a presumably deeply eroded surface of mineralized monzonite. Thus if the deposit is Tertiary, as has been suggested, its formation has been succeeded by a long and rather involved history. On the other hand, intense contact metamorphism of Carboniferous (?) limestones in the Growler Mountains to the south may indicate that the major intrusives were post-Carboniferous. As far as direct data go, then, nothing can yet be said with certainty as to its age—the probabilities lie between Permian and early Tertiary.

Mining Methods

The deposit is mined by the open-cut method, with power shovels operating on benches at vertical intervals of 30 feet. The present outline of the pit and its relation to the ore body are shown in Plate XXII. Inasmuch as the oxidized part of the ore body was practically as productive as the sulphide part, there was here no stripping problem of the sort confronting most of the disseminated deposits of the Southwest. To January, 1931, less than 7,000,000 tons of waste had been moved in the mining of 32,400,000 tons of ore, a ratio of 0.21 ton of waste to 1 ton of ore. Much of this waste occurred within the ore body and was not overburden. As the depth of the pit increases, however, a larger proportion of waste will have to be moved in order to maintain a safe angle of slope.

Magma Mine Area, Superior[55]

By

M. N. Short[56] and Eldred D. Wilson

Situation

The Magma Mine is at Superior, in the Pioneer district, 15 miles southwest of Miami and 12 miles northwest of Ray. Superior lies at an altitude of 2,850 feet on the eastern margin of a small basin-shaped valley in the mountainous region between the Superstition and Pinal ranges.

History

The Magma vein was located in 1874 or 1875 during the period of exploration that led to the discovery of the deposits at Silver King, 2 miles farther north, and at Globe. A vertical shaft, the Silver Queen, was sunk 400 feet, and a few pockets of silver-enriched chalcocite were discovered. Activity largely ceased by 1893. In 1910 the Silver Queen Mine was optioned by William Boyce Thompson and associates who organized the Magma Copper

[55] Paper prepared for the regional meeting of the A.I.M.&M.E. held at Tucson, Arizona, November 1-5, 1938.
[56] Professor of Petrography, University of Arizona.

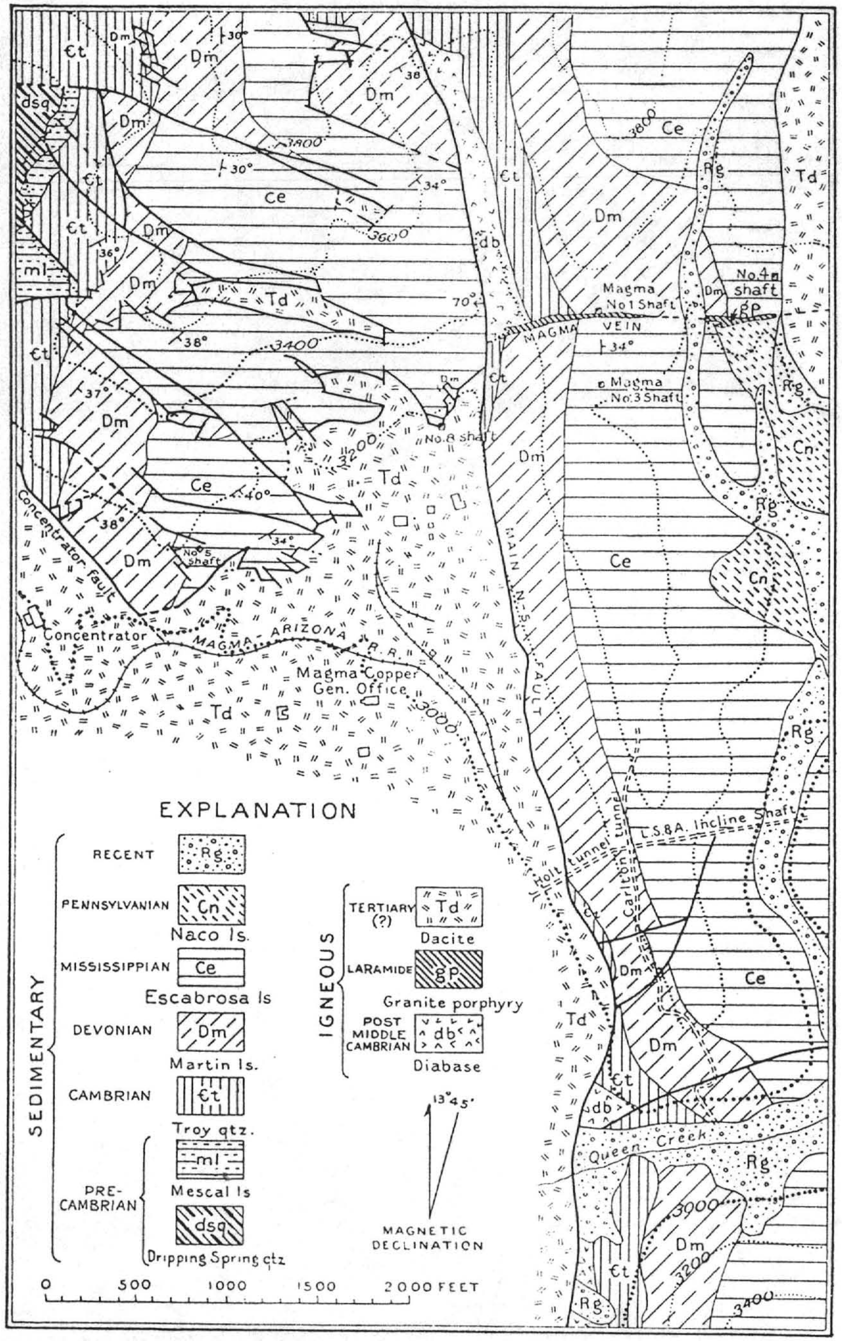


Figure 9.—Geologic surface map of vicinity of Magma Mine. (By Short and Ettlinger.)

Company. This company has maintained nearly continuous operations to the present time. It built a railroad and a concentrator in 1914 and completed its smelter in 1924. The mine, which has reached the 4,000-foot level, is now the deepest in Arizona. The constant high tenor of its ore has made the Magma one of the low-cost producers of the United States, despite depth, temperature, and heavy ground.

Production of the Magma Mine from 1914 to 1937, inclusive, has been as follows:

Ore (tons)	Copper (lbs.)	Gold (oz.)	Silver (oz.)	Total value
3,984,414	468,149,862	144,518	12,331,681	$72,412,678

After about 1902 the Lake Superior and Arizona Mining Company drove the Carlton and Holt tunnels (Fig. 9) and sank a 1,400-foot incline in ground between the Magma vein and Queen Creek. Copper ore, containing some silver and gold, was produced in 1907 and during the World War. Since 1920 the ground has been owned by the Magma Copper Company. In 1932 T. D. Herron and C. Laster leased the mine and opened large bodies of gold ore. Their production during 1932 to 1937, inclusive, as stated in the annual reports of the Magma Copper Company, amounted to 56,649 tons of ore which yielded 372,420 pounds of copper, 53,162 ounces of silver, and 31,598 ounces of gold.

Rocks

At the Magma Mine the rocks are essentially the same as at Ray (p. 81 and Pl. III). The oldest formation, the Pinal schist, of early pre-Cambrian age, has been penetrated by the 3,600-foot level of the Magma Mine. There it is unconformably overlain by the late pre-Cambrian Apache group which normally consists of the basal Scanlan conglomerate, 15 feet thick, overlain by 150 feet of Pioneer shale, 15 feet of Barnes conglomerate, 450 feet of Dripping Spring quartzite, and 225 feet of Mescal limestone, in places with a basalt flow at the top. In the bluff east of Superior the Apache group is overlain by 400 feet of Middle Cambrian Troy quartzite, succeeded by 340 feet of Devonian Martin limestone, 175 feet of Mississippian Escabrosa limestone, and 800 feet of Pennsylvanian Naco limestone.

The Apache and older rocks are intruded by large masses of diabase. In the Magma Mine it forms two sills of which the lower, 1,120 feet thick, invades Pioneer shale, and the upper, 2,000 feet thick, lies between the Troy and Dripping Spring quartzites. Apparently the upper sill engulfed the Mescal limestone, which has not been found in the mine. The age of the diabase has been regarded as early Mesozoic (?) by Ransome, late pre-Cambrian by Darton, and post-Middle Cambrian by Short (p. 15).

The Naco limestone and underlying formations are invaded by dikes and sills of quartz monzonite porphyry. One of these dikes is followed in the upper levels of the mine by the Magma fault and Magma vein. Several other dikes of this rock have been

found by diamond drilling. The porphyry is believed to have been intruded during Laramide (late Mesozoic or early Tertiary) time, as were the Schultze granite at Miami, the granite porphyry at Ray, and the quartz diorite at Silver King. All of these intrusives are probably offshoots of the central Arizona batholith[57] with which the mineralization at Superior, Miami, Globe, Ray, and Silver King is believed to be genetically connected.

Dacite flows, tuff, and agglomerate cover much of the region. This volcanic material is more than 1,000 feet thick on Apache Leap, a short distance east of Superior; 1,300 feet thick, in Picketpost Mountain, 3 miles west of Superior; and 2,500 feet thick in the Superstition Mountains. It was erupted during early Tertiary time, but long after the mineralization, upon a deeply eroded surface of the tilted sedimentary beds. In Apache Leap the hollows of this old erosion surface show remnants of a predacite conglomerate equivalent to the Whitetail conglomerate that, near Ray, attains a thickness of more than 800 feet. Most of the oxidation of the ore bodies is believed to have taken place during the long period of erosion in which this conglomerate accumulated.

Later than the dacite and the Main fault (p. 94) are a few small dikes and pluglike masses of amygdaloidal basalt.

Gravel, sand, and silt, formed by late Tertiary and Quaternary erosion and sedimentation, mantle the valley floor west of Superior.

Structure

During the Laramide revolution, in late Mesozoic or early Cenozoic time, the region underwent extensive deformation, accompanied or closely followed by intrusion of the quartz monzonite porphyry. Due to this deformation the Apache and Paleozoic beds strike north-northwestward, dip about 30 to 35 degrees eastward, and are broken by fractures and faults of eastward trend and by bedding or strike faults. Some of the eastward-trending fissures were sufficiently deep seated to be occupied by dikes of the quartz monzonite porphyry. Reopened by further movement, they afforded permeable channels for mineralizing solutions. The Magma fault, which is the locus of the Magma vein, represents this type of fissure. The Lake Superior and Arizona vein is within the zone of a bedding or strike fault.

Magma fault.—The Magma fault strikes about S. 80 degrees W. Its dip averages about 70 degrees N. from the surface to the 800-foot level, vertical from the 800- to the 900-foot level, and about 80 degrees S. from the 900- to the 4,000-foot level (Fig. 10). Its reversal of dip occurs where the dominant wall rocks change from sedimentary beds to diabase. This fault is not a single dislocation but a zone of closely spaced fractures 5 to 40 feet wide with well-defined footwall and hanging wall. On the west it is dislocated

[57] M. N. Short and I. A. Ettlinger, *Ore Deposition and Enrichment at the Magma Mine, Superior, Arizona* (Am. Inst. Min. Eng., Trans.), LXXIV (1927), 183.

by later transverse faults, but eastward it extends more than 8,000 feet without much dislocation.

The south side of the Magma fault has been dropped 500 feet relative to the north side. Due to their eastward dip, the beds on the north side of the fault show a relative horizontal displacement of 400 or 450 feet eastward. The real horizontal displacement exceeds the vertical.

Main and Concentrator faults.—Much later than the Magma fault and later than the dacite are the Main and Concentrator normal faults, between which is a mosaic of fault blocks (Fig. 9).

The Main fault strikes northward and dips steeply westward above the 2,800-foot level, below which its dip flattens to about 35 degrees W. Its vertical displacement apparently amounts to about 500 feet in the mine workings and increases southward, and its west or hanging-wall side has shifted the Magma vein 1,400 feet southward.

The Concentrator fault strikes S. 80 degrees E., dips steeply southward, and locally forms a crushed zone more than 10 feet wide. Its apparent stratigraphic throw is at least 3,500 feet.

Ore Bodies

Distribution.—Exploration of the Magma vein for a length of 8,700 feet and a depth of 4,000 feet has revealed three groups of ore shoots. Most of the production has come from the main or middle ore body. The west ore body was west of the Main fault, below the 2,250-foot level. It consisted of copper ore, now largely mined out. The east ore bodies lie between the main crosscuts and No. 6 shaft. They consist largely of zinc-copper ore of which comparatively little has been mined.

The gold-bearing zones in the Lake Superior and Arizona Mine have been opened north of Queen Creek for a length of more than 3,000 feet (Fig. 9), within which seven principal ore shoots have been found.

Magma Vein

Outcrop.—Considering the size of the Magma ore bodies, the outcrop of its vein is inconspicuous. Above the main ore body the bleached, faulted porphyry dike is stained by copper and iron and locally contains small masses of residual chalcocite.

Main ore body.—The main ore body has its apex between the 400- and 500-foot levels and extends to the lowest workings of the mine. Near the 1,500-foot level it is joined on the west by a branch (Pl. XXIII) that forms an apex a short distance above the 1,200-foot level. In places it has been stoped for a length of 1,200 feet with widths ranging from less than 5 to more than 30 feet. The axis pitches westward, essentially at right angles to the beds.

The ore shoot is of replacement type. Its gangue consists of crushed, altered wall rock and a large proportion of introduced silica. Small stringers of ore minerals occur in the walls, but commercial ore is confined to the fault zone itself.

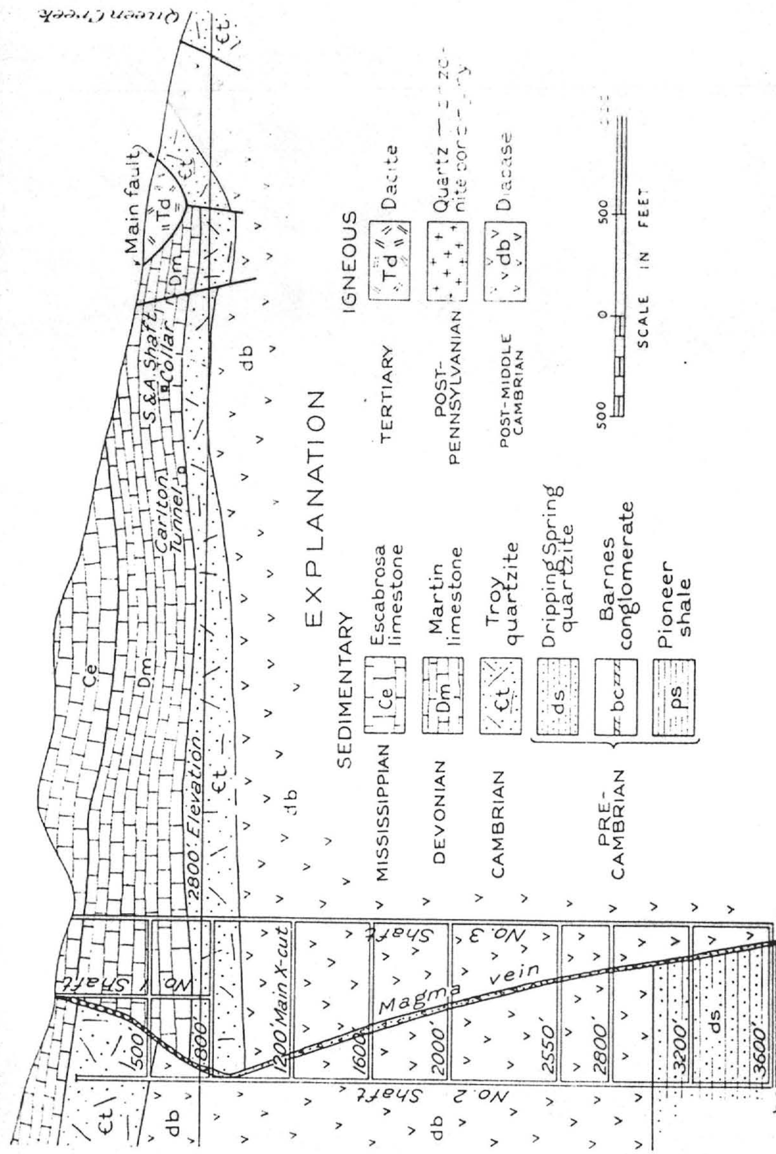


Figure 10.—North-south geologic sections through shafts at Magma Mine, Pinal County.

There are no replacement ore bodies in the limestones. The ore shoot is richest where its walls are of diabase. The total tonnage of sulphide ore in that part of the ore shoot where quartzite or shale forms both walls of the vein is perhaps equal to that developed where diabase forms either or both walls but is of lower grade. For example, on the 3,000-foot level where the walls are mainly sedimentary rocks, the ore consists of low-grade pyrite together with some streaks and admixed masses of chalcopyrite but with very little bornite. On the 3,600-foot level where the walls are the lower diabase sill, the ore consists mainly of bornite, together with chalcopyrite, tennantite, enargite, and chalcocite.

On most levels, bornite is the principal hypogene mineral, although in places chalcopyrite predominates. Pyrite is abundant with the chalcopyrite but less so where bornite is the dominant mineral.

Above the 1,200-foot level, the western branch of the main ore shoot contains no copper minerals but consists of sphalerite and galena. Below that level it changes abruptly into a bornite-rich ore with little or no zinc and lead. There is also a marked tendency for zinc and lead to occur on the eastern, but not on the western, margin of the ore shoot.

Tennantite is important from the 1,200- to the 3,600-foot level where enargite takes its place in the western part of the ore body.

Deep-level chalcocite accounts for about 5 per cent of the copper in the lower levels of the main ore body. There it invariably occurs intergrown with bornite and not alone or intergrown with other minerals. The weight of evidence favors its hypogene origin, as discussed in an earlier publication.[58] A comparison of specimens collected indicates chalcocite to be approximately of the same abundance on the 2,000- and 3,600-foot levels.

In the main ore body supergene chalcocite persisted to about the 800-foot level. The bottom of the oxidized zone dips eastward and corresponds rather closely with the base of the Martin limestone.

West (No. 5) ore body.—The sinking of No. 5 shaft between the Main and Concentrator faults disclosed an ore body in the Magma vein that extended from 100 feet above the 2,250-foot level to approximately 100 feet below the 2,500-foot level. Stoped for a length of approximately 250 feet and a width of 15 feet, this ore body averaged 7 per cent copper, principally as bornite. The ore was strongly oxidized, with chalcocite, cuprite, and native copper locally abundant on the 2,550-foot level. Oxidation is relatively more intense near the Main fault, which indicates part, at least, of the oxidation to be later than the fault. Much of it, however, may antedate the downfaulting of the ore body.

East ore bodies.—Several small ore shoots have been found in the Magma vein east of the main crosscuts between the 1,600- and 3,200-foot levels (Pl. XXIII). Their ore is principally sphalerite,

[58] Short and Ettlinger, *op. cit.*, p. 207.

but copper minerals are locally abundant. In places, strong oxidation extends below the 2,000-foot level.

These ore bodies, which have not been extensively mined, form a valuable reserve of zinc and copper ores.

Wall-rock alteration.—Within the Magma fault zone the diabase is bleached, with a development of quartz, sericite, and carbonates. As this rock had already been rendered impervious by extensive serpentinization and uralitization, the influence of the ore solutions dies out a short distance from the permeable fault zone.

Alteration of the siliceous and aluminous sedimentary beds likewise consists of silicification and sericitization, but less intense than in the diabase.

Gold Deposits

The rocks in the vicinity of the Lake Superior and Arizona Mine are Cambrian quartzite and Devonian limestone which strike northward and dip about 30 degrees E. The vein occurs within the zone of a strike fault that has brecciated the quartzite-limestone contact and the lower beds of the limestone. As stated by Ransome,[59] this brecciation is associated in surface exposures with limonite, manganese oxide, quartz, and hematite, and in places with malachite and chrysocolla.

About 1902, this zone was opened by a shaft, some 1,400 feet deep, that inclines 26 degrees E. and connects with eight levels of drifts. Most of the drifting is on the second or Carlton tunnel level which extends southward for some 2,000 feet and opens into Queen Creek Canyon. East of its portal is an old vertical shaft, the Vivian, that taps the vein at a depth of 140 feet. These old workings, which were mainly in the footwall portion of the vein, exposed only a few small bodies of oxidized copper ore, and material that contained generally less than 0.2 ounce of gold per ton.

The present lessees, by crosscutting along transverse fissures for a few feet towards the hanging wall, discovered seven or more shoots of gold ore within a horizontal distance of 3,000 feet. These ore bodies average 4 feet wide by 15 feet long, and the most persistent one extends, with interruptions, to the bottom level of the mine. The ore consists mainly of hematite, limonite, and fine-grained grayish to greenish yellow quartz of epithermal aspect. As a rule, the gold is spongy to fine grained and erratically distributed. According to Mr. Herron, the ore mined contained generally an ounce or more of gold and an ounce of silver per ton.

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[59] F. L. Ransome, *Copper Deposits near Superior, Arizona* (U.S. Geol. Survey Bull. 540, 1913), p. 155.

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Bagdad Mine, Eureka District[60]

By

B. S. Butler and Eldred D. Wilson

Introduction

The Bagdad Mine is in the Eureka district, western Yavapai County, 27 miles by road from Hillside, a station on the Santa Fe railway. Bagdad camp is on Copper Creek, a few miles upstream from its junction with Burro Creek, at an altitude of about 3,200 feet.

Little has been published regarding the geology of the Bagdad area, though several studies have been made and reports prepared for the Bagdad Copper Corporation and its predecessors.

The following discussion is largely based on these reports and other data furnished by the company. The map (Pl. XXV) was originally prepared by Rogers, Mayer, and Ball in 1918 and modified by H. N. Witt and P. C. Benedict in 1926.

The writers are particularly indebted to J. W. Still, mine manager, for information.

History and Production

Prior to 1907, eight claims in the Bagdad area were patented by John Lawler. Between 1907 and 1910 this group was obtained by the Copper Creek Development Company, Inc., which did additional development work and located additional claims which were later patented. By various successions the property was acquired in turn by the Arizona Nevada Copper Company, by the Bagdad Copper Company, by the Arizona Bagdad Copper Company, and in March, 1927, by the Bagdad Copper Corporation.

[60] Paper prepared for the regional meeting of the A.I.M.&M.E. held at Tucson, Arizona, November 1-5, 1938.

Additional development work was done by each of these companies. In the past considerable underground work has been done for the purposes of checking churn drill assays, to provide ore for metallurgical test work in pilot mills, and to check the caving system of mining proposed for a larger operation. The estimated ore reserves, hereinafter mentioned, are based on information obtained from 123 churn drill holes, approximately 20,000 feet of underground work, and approximately 8,000 feet of underground diamond drilling.

The property now has mill and power plant equipment installed sufficient to handle 250 tons per day.

During 1937 a total of 75,512 tons of ore with an average copper content of 1.37 per cent yielded 1,792.76 tons of concentrates averaging 42.87 per cent copper.

Operating costs of delivering concentrates on cars at Hillside, Arizona, were $2.045 per ton, distributed as follows:

Mining	$0.732 per ton
Milling	1.021 per ton
Camp, etc.	0.292 per ton

Production in 1937 was 1,537,396 pounds of copper at a cost of 0.137 cents per pound.

Rocks

The oldest rocks at Bagdad are amphibolite and mica schists which, because of their lithology and metamorphism, have been correlated with the pre-Cambrian Yavapai schist of the Prescott-Jerome region. Their composition suggests derivation from both igneous and sedimentary rocks. Intrusive into the schists is a granitic rock that resembles the pre-Cambrian Bradshaw granite. The presence of schist suggests that the Bagdad area is near the margin or in the roof of the granite batholith, which is of wide extent. Both the granite and the schist contain abundant pegmatite bodies, also suggestive of the margin or roof of a batholith. The rock in which the Bagdad ore occurs is intrusive into the schist and pre-Cambrian granite.

Dr. C. P. Berkey, in a report to the company, classifies the later intrusive as granite porphyry that ranges widely in composition. Locally it is known as "monzonite." Both orthoclase and plagioclase are present with abundant quartz. Biotite is variable in amount though abundant in much of the rock. The age of this intrusion is not known; it may be Laramide.

Overlying the pre-Cambrian rocks and the later intrusive body is an irregular thickness of sedimentary material laid down on an old land surface. This material is largely conglomerate that fills old valleys. Locally it has some marly lake beds near the top. Capping the surrounding mesas and covering the conglomerate and all but the higher points of the earlier rocks are flows of basaltic lavas. The sedimentary material and the lava are presumably of late Tertiary or Quaternary age.