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02/27/90

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES FILE DATA

PRIMARY NAME: REPUBLIC MINE

ALTERNATE NAMES:

ARIZONA UNITED DEVELOPMENT

COCHISE COUNTY MILS NUMBER: 64

LOCATION: TOWNSHIP 15 S RANGE 22 E SECTION 26 QUARTER E2  
LATITUDE: N 32DEG 06MIN 00SEC LONGITUDE: W 110DEG 03MIN 52SEC  
TOPO MAP NAME: DRAGOON - 15 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:

COPPER SULFIDE  
ZINC SULFIDE  
SILVER  
LEAD SULFIDE  
GOLD LODE  
BISMUTH  
BERYLLIUM

BIBLIOGRAPHY:

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USGS PP 416, P. 168 (COPPER CHIEF MINE)  
AZ. MINING JOURNAL 1/15/22, P. 16  
AZBM BULL. 156, P. 30-39  
WAR MINERALS REPORTS  
MINING ENGINEERING VOL. 5, NO. 12  
USGS PP 318, P. 97-100  
ADMMR REPUBLIC MINE FILE  
ADMMR MAPS-UPSTAIRS UNDER AZ. UNITED MINING  
COMPANY  
ADMMR JOHNSON MINE FILE  
ANTHONY, J.W, ET AL MINERALOGY OF AZ P 83



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REPORT ON THE PROPERTY  
OF THE  
ARIZONA UNITED DEVELOPMENT COMPANY  
JOHNSON, ARIZONA.

CU

Dear Sir:-

In accordance with your request, I have examined your property and hereby submit the following report. The property is a good one and very worthy of development.

GENERAL

The property of the Arizona United Development Company is situated in the northwestern part of Cochise Co. Arizona, in the Johnson Mining District. It is seven miles north of Dragoon on the Southern Pacific Railroad and is connected by a branch which was built by the old company. The small town of Johnson, which is partly on the property, has a post office, store, school, and many unoccupied dwellings. The camp is at present idle.

The property contains 40 full or nearly full mining claims and numerous fractions, most of which are patented. These contain in all an area of about 1000 acres and cover 9000 feet along the outcrop of the ore-bearing formations. The attached plan shows the property and surroundings.

The claims lie along the southern foothills of the Little Dragoons in a country with easy rolling topography. The elevation is about 5,000 feet. Wagon roads connect all parts of the property and the railroad reaches all important workings except the Mammoth. Water for camp use is obtained from the mine and it is probable that with greater depth a sufficient supply could be found for milling purposes. In any case water is abundant in the valley to the east.

There is sufficient machinery, smaller equipment and tools on the ground to start development work at any time. The Company also owns numerous dwelling houses, boarding house, offices, etc.; enough for operating purposes for some time.

GEOLOGY

The rocks exposed on the property are entirely Paleozoic sedimentaries which have an average strike of

N-65-W and dip from 26 to 35 degs. to the northeast. Upper Cambrian quartzites outcrop along the southern line of the property and above these are 300 to 400 feet in thickness of impure thin bedded limestone which are probably Devonian and may include the Mississippian. Above these are the purer, heavier bedded Pennsylvanian limestones, of which at least 1,000 feet are exposed in the district. These beds are all in apparent conformity.

The lower impure limestone horizon is much metamorphosed and has become garnetized and silicified. This is the ore bearing horizon. Above here the metamorphism has become less pronounced with diminishing garnet and silica but with more or less marble and finally in passing upward the unaltered Pennsylvanian limestones are found. There is no abrupt change in the formations above the quartzite but rather a gradation into the purer limestones with a gradual decrease in metamorphic effects.

To the southwest a mass of ~~granite~~ granite has intruded the sedimentary formations and is now exposed by erosion. The granite contains values of copper and tungsten and considerable ore was shipped during the late war. Mineralization can be found at many points on or near the contacts of this granite and it was undoubtedly the source of the ores of the Johnson District. It will probably be found to underlie the Arizona United property.

The geology of the district is very simple and there is little folding or faulting. The few north-south faults noted are post-mineral and of small development.

#### ORE OCCURRENCE

The important ore bodies are lenses replacing beds in the lower part of the limestone from 200 to 300 feet above the quartzite and in the middle and upper parts of the garnetized zone. A preference for certain beds is marked; two having been worked in the Republic and one in the Copper Chief and Mammoth. No exploration work has ever been done to prove other beds in any of these workings.

Above the bedded deposits in the less metamorphosed limestone are numerous fractures and veinlets which carry stringers and small lenses of ore. These are found outcropping and considerable ore has been shipped from them from near the surface, especially on the Black Prince and Peabody properties. It is doubtful if these were ever profitable and the main value of these stringer deposits is as an indicator of the probable larger bedded deposits which may exist below them. Such small ore showings are found outcropping above all the known ore bodies except the deeper one in the Republic. Apparently here the ore bearing solutions never ascended to the elevation of the present surface. Between the mineralized zones few copper showings are found on the surface.

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probably available to replacement. The upper ores probably represent only the overflow of copper which was not deposited in the beds below. In this way outcrops of the small showings of copper are highly indicative of bedded deposits below.

It is more than likely that the intrusive granite (the source of the ore) will be found to extend under this portion of the district. I have shown the typical ore occurrence and probable conditions on an attached generalized cross-section. The different ore bodies, so far as known, occur along certain definite lines which undoubtedly represent ancient fracture zones. These are shown on the plan. Along these lines ore bodies are larger and richer on the small rolls in the formation. Practically no exploration has ever been done outside of the ore bodies which have been mined and which were followed down from their outcrops. The only exception is the north cross-cut in the Republic which found the lower ore body, the largest mined in the district.

#### NATURE OF THE ORES

The ores are of the contact-metamorphic type which makes it probable that the granite will be found at greater depth. The gangue is mainly quartz and garnet with a little calcite, amphibole and chlorite. The copper is found in chalcopyrite and bornite and there is little associated pyrite. Zinc occurs in blende but when there is much it lies in lenses apart from the copper ores and could be mined separately if found to be profitable. The ores are all sulphide and primary. The oxidized ores which were found close to the surface have been mined. There was very little secondary enrichment except in a few stringers which extend only to shallow depths.

General averages of east end (Republic) ores from 1913 to 1919 and of west end (Mammoth) recent sampling gave:

	<u>Ag.</u>	<u>Cu.</u>	<u>Zn.</u>	<u>SiO<sub>2</sub></u>	<u>AlO<sub>3</sub></u>	<u>FeO</u>	<u>CaO</u>	<u>S</u>
Republic	0.70	4.46%	8.4%	42.4%	3.0	8.4	15.7	81.0
Mammoth	1.00	6.26	1.3	64.3	Insol.	8.5	4.0	91.0

The sulphur combined as chalcopyrite and bornite would account for from 4% to 7% of pyrite in the ores. A concentrate with 25% copper could probably be obtained.

#### GRADE OF THE ORES

The high grade ores will average 7% and are found in lenses accompanied by low grade ore which will assay from 2% to %. The high grade lenses are large enough to mine separately. It is probable that when mined a high grade product should be shipped direct and the remainder concentrated. A mill head of probably 3% or 3 1/2% could be maintained with a little sorting.



to 5%. The dumps represent rejects from sorting and low grade material from shafts, drifts, etc. The stopes shown on the old maps represent only ores which could be shipped and considerable low grade ores were left standing which would be profitable to concentrate. No estimate of either the mine or the dump ores has ever been made.

From 1913 to 1919 the Republic shipped 226,750 tons of ore which averaged 4.46% copper. High grade ores were shipped before this but known records exist. There are no records of the Copper Chief and Old Mammoth except that in 1918 about 3,000 tons were shipped from the Copper Chief which averaged 3.77%. This was sorted from dumps and taken from the mine. In 1918 and 1919, 3000 tons were shipped from the New Mammoth which averaged 6.50%. Samples from here in 1923 representing 150 feet of shaft and two crosscuts averaged 5.60%. 800 tons from sinking averaged 7%.

The total tonnage mined from this property plus low grade ore left standing would be at least 450,000 tons. This is estimated from shipments plus the dumps and also from the mine maps. From all data available this aggregate ore averaged 4.5% as a conservative figure.

#### PRINCIPAL MINE WORKINGS

These are shown on the attached plan and larger detailed maps have been made by the company.

REPUBLIC- This is the largest mine of the group. There is one 35 deg. incline 700 feet deep. A 600 foot northern cross-cut from the bottom of this leads to two other inclines 300(?) and 700 feet deep respectively. The last are on the lower ore body. The workings are rather extensive but are mainly in the ore and little effective search for new ore bodies has been done. The continuity of the ore along the zone is noteworthy. Ore varies up to 25 feet in thickness with an average of about 8 feet. This is the deepest ore body mined in the district and the surface over this shows little mineralization. A smaller ore body on a lower bed was mined from surface and a still smaller body from an intermediate bed. In all three beds have produced ore.

COPPER CHIEF- Three inclines were sunk on ore bodies which outcropped. The thickness of the ore was 5 or 6 feet on the average. A 280 foot shaft (vertical) was sunk in the hanging wall and a cross-cut run. This work is between two zones and it is not deep enough to have cut the ore bearing beds in any zone. The old workings probably produced 40,000 tons or more.

OLD MAMMOTH- The old stopes have probably produced about 40,000 tons from several ore bodies. No records

are available. The stopes indicate a former thickness of ore of 5 or 6 feet.

NEW MAMMOTH- This is the only point at which any recent work has been done. Since the Development Co. took over the property the incline has been sunk about 180 feet deeper and cross-cuts driven at 90 feet. Samples from 50 feet of the shaft and the two cross-cuts show a thickness of 22 feet of ore averaging 6.22% copper. 800 tons hoisted from this part of the shaft averaged 7.0%. Below the cross-cuts the shaft is in zinc ores but drill holes in the back showed high grade copper. The bottom of the shaft, 90 feet below the cross-cuts and 360 feet below the surface, shows a thickness of 18 feet of 4.75% ore and neither wall was reached. Ore shipped in 1918 and 1919 from the old workings was 3,296 tons averaging 6.52%.

This shaft was entirely in ore and the bottom has the appearance of going into a large body of high grade. The above notes cover the principal workings of the property. There are many smaller openings but they are of little importance.

#### POSSIBILITIES OF THE PROPERTY

The persistence of ore bodies along the zone of shearing is proved by the old workings. There are no evident reasons why other parts of partially developed areas and unexplored zones should not be ore bearing and as good as those opened. By following up these zones in the ore bearing horizon one is almost certain to develop ore.

The old workings have only developed about 15% of the probable ore bearing zones on the property. This suppose only one ore bearing bed, while in the Republic there are at least two. Allowing for the chance of ore on these other beds, the percentage explored of possible ore bearing ground would be almost 10%.

If the remainder of the ground develops as well as that already opened this property has a strong likelihood of containing from 2,500,000 to 4,000,000 tons of 4.5% copper ore.

#### CONCLUSION

This property with its possibilities is an excellent one and very worthy of development.

Respectfully submitted,

Inspiration, Arizona.  
December 24th 1923.

(Signed) C.W. Botsford.

The rocks exposed on the property are entirely Paleozoic sedimentaries which have an average strike of

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EAGLE-PICHER M. & S. CO.  
Inspiration, Arizona.

October 23d 1926.

Dear Sir:-

In accordance with your request, I have visited the property of the Mason Copper Co. (Arizona United) and beg to submit the following additional report. This is supplemental to the report on the Arizona United Development Co. dated Dec. 1923.

NEW YORK: To date the work done by the Mason Copper Co. has consisted in general repairs and preparation for an economical program of mine development. This work is very essential and is progressing nicely.

GEOLOGY: There is nothing to add to the original report as yet. As underground development progresses in the future more detailed information will be obtained and this will be taken up later.

DEVELOPMENT PLANNED

MAMMOTH: The incline is being straightened to surface and the machinery moved. This will permit of much cheaper and safer working. The bottom level is being extended to the west. Later this level should be driven east and a little cross-cutting is advisable. The first level should also be driven east. All these points are good prospecting.

The first level tunnel should connect with the old Mammoth No. 1 workings and is necessary to extract the ore remaining there. This will also give ventilation and provide two openings for the workings.

REPUBLIC: The most accessible, as well as a very promising section of the mine, is immediately above the 7th level stopes on the main ore body. I would recommend starting developments here by means of raises and sub-levels. Later, as operations are extended, a more careful study of the mine will be made and small workings started where they will do the most good. This should be prior to laying out extensive development.

The Republic shaft is now being repaired and the starting of much work is somewhat dependent on the completion of the shaft. In all cases, both at the Republic and Mammoth, an effort will be made to keep the mine developments as much as possible in ore. For more extensive prospecting, I would recommend a small diamond drill with a capacity of 500 or 600 feet. This could be started any time.



ORE TONNAGE:

Further study of the mine shows that the ore estimate in the preceding report is undoubtedly "low (too)". Mr. Tenney's estimate of 200,000 tons is probably more nearly correct. The workings are not in shape to permit of any real estimate being made at present.

In irregular ore deposits of this kind there is never any great amount of ore actually blocked out, as it is not feasible to drive the necessary levels and raises so far in advance of extraction. This is the case in the Bisbee ore deposits, which are of the same nature as at Johnson.

Sampling and assaying are needed at once, as well as experimental work in testing the ore for milling. There is sufficient ore assured at this mine to warrant the erection of a 125 ton milling plant at once. This should be designed as a part of a 500 or 600 ton mill.

COST OF OPERATION:

On a small tonnage operation, the cost of mining and milling should not exceed \$7.50 per ton. An ore with 4% copper and 6% zinc has a present extractable value of about \$12.18 and a net value of \$4.70. The annual profit from a 125 ton operation would be about \$180,000.

CONCLUSION:

In my opinion, ~~the cost of mining and milling should not exceed \$7.50~~ this property justifies the erection of a 125 ton plant to be enlarged later. If sufficiently financed, and with good management, this property should be very successful.

Yours very truly,  
(Signed) C.W. Botsford

COSTS (For 125 Ton Daily production)

Mining	\$2.50
Milling	2.00
Freight	1.00
Smelting	1.00
Taxes, Etc.	1.00
	<u>\$7.50</u>

4% Copper at 80% extraction - equals 64# at 12c-	\$7.68
6% Zinc " 75% " " 90# " 5c-	4.50
	<u>\$12.18</u>
	7.50
	<u>\$ 4.68</u>

Net profit per ton-

Cost of 125 Ton Mill about-\$100,000

Cost of 500 Ton Mill about-\$400,000

To develop mine for 125 ton daily production, -say \$100,000.

(See following page -"Future Possibilities")

THIS IS TO CERTIFY THAT THE ABOVE NAMED PERSONS ARE THE OWNERS OF THE PROPERTY DESCRIBED IN THE ABOVE REPORT AND THAT THEY HAVE GIVEN THEIR CONSENT TO THE PREPARATION OF THE SAME AND TO THE PUBLICATION OF THE SAME IN THE ABOVE MANNER.

WITNESSED BY ME, THE CLERK OF THE DISTRICT COURT, AT THE CITY OF PHOENIX, ARIZONA, THIS 22ND DAY OF OCTOBER, 1926.

#### FUTURE POSSIBILITIES

With 200,000 tons of ore assured, the suggested 125 ton mill would have a four year's life or a little more. The proposed plan of this plant is for double power and crushing capacity to operate only on day shift. I feel very confident that by the time the 125 ton plant would be in smooth operation, say eight or ten months, developments in the mine would warrant increasing the capacity at once to 250 or 300 tons per day. This would utilize the full proposed power and crushing equipment and would naturally somewhat reduce the working costs as above outlined. Such an operation should net about \$400,000. per year. This should be ample to finance further expansion.

In the previous report it is stated that there is a strong likelihood that the property will develop from 2,500,000 to 4,000,000 tons of ore. Later examinations confirm this opinion. Allowing, say 15 years, for the economic life of this property, a 600 ton mill will ultimately be needed and this should net about \$1,000,000, annually. The capital required to finance this operation would be \$1,000,000. In my opinion this is a very attractive proposition. This is based on an ultimate 3,000,000 tons of ore which may very confidently be expected. There is a reasonable possibility of much more ore being developed in the future which chance increases the attractiveness somewhat of the proposition.

RESPECTFULLY SUBMITTED,

(signed) C. W. Botsford

Inspiration, Arizona.  
October 22nd 1926.



Johnson Camp, Cochise County, Arizona.

- - - -

The following report is a general report on the above property, from observations during two days spent on the property July 11 and 12, 1926.

General Conclusions: The surface mineralization, covering an area five thousand feet long and one thousand feet wide, is exceptionally strong for the limestone replacement type of deposit of which this is an example. Only a small part of this area has been tested below surface oxidation. Only two of at least ten favorable outcrops have been developed at depth, and these two have proved up excellent ore bodies of commercial primary ore. The outcrops of these two ore-bodies are no stronger than the eight or more other outcrops on which only superficial work has been done.

About 220,000 tons of ore is developed, which will average 3-4% copper and 4-6% zinc. Tests on small lots of this ore have shown it amenable to concentration by selective flotation, to two products:- a copper concentrate of 25-25% copper, and a zinc concentrate of 35-45% zinc. The above reserve is divided between two ore bodies. Both of them have possibilities of from five to ten times the amount already shipped and developed. About 400,000 tons have been shipped which, together with that in reserve, makes a total of 620,000 tons. The possibilities for increased reserves from the two partially developed ore bodies is from three million to six million tons.

The other outcrops have possibilities of developing into equally good ore-bodies, as their outcrops are equally strong, so that the ultimate possibilities are from three million to twenty million tons for the complete mineralized zone.

The two ore-bodies so far developed are exceptional in their regularity in shape and persistence, making prospecting and development cheap as compared to the average for this type of deposit.

The ore is hard and stands well without timber, making for cheap mining. This advantage is slightly offset by the higher concentrating cost due to high crushing expense.

The property is a very attractive one, and with judicious management, should yield handsome profits.

Property and Equipment: The property consists of a compact group of sixty-eight claims, of which thirty-eight are patented. The group is situated at the camp of Johnson, seven miles north of the station of Dagoon, on the Southern Pacific Railroad North Line. The town of Johnson is in the Little Dagoon Mountsins, a spur of the Dagoon Range. The altitude is 5000 feet above sea level. A right of way exists from Dagoon into Johnson, and the grading for a standard gage railroad line is complete, necessitating only the laying of ties and rails to put it into commission.

The property has three deep incline shafts and one vertical shaft. The deepest shaft is at the southern edge of the property, the Republic Shaft, seven hundred feet deep on a 42° inclination. Several thousand feet of drifting have been done off this shaft. The Copper Chief Shaft is in the middle of the property and is four hundred feet deep on a 35° inclination. The Copper Chief Vertical Shaft, about 300 feet from the incline shaft, is four hundred feet deep. Very little work has been done from these two shafts. The Mammoth Incline is at the north end of the property, and is 600 feet deep on a 25° incline. Some stoping and a little



drifting has been done off this shaft.

The property is well equipped with machinery, so that only a small outlay would be necessary to put the property in a condition for an extensive development campaign.

All shafts are equipped with good air and gasoline driven hoists of ample size for a development campaign. Two large steam driven air compressors capable of running the hoists, pumps, and twenty or more machine drills, are set up and in excellent condition. Two 200 HP oil burning boilers accompany the compressors, and are of ample size and in good condition. Two small dynamos are set up, and are large enough to supply the camp with electric light.

Underground rails, air lines, and water lines are laid and ready for use. Ample pumping equipment, both for sinking and for permanent pumps, are underground and in good condition.

The only equipment necessary to buy, to start operations, is six or seven machine drills, several hundred feet of air line, a supply of drill steel, and miscellaneous incidental equipment.

Housing equipment, with a few repairs, is ample. A well equipped general office and assay office, power-house, six small dwellings, bunk house, boarding house, and about ten small one room houses need only a small amount of repairs to put them in excellent shape.

General Geology: The ore occurrence is of the limestone replacement type of deposit, of which Bisbee, a part of Morenci, Tombstone, Gleeson and Courtland are examples in Arizona.

The limestone most favorable for replacement at Johnson is a part of a series of beds from 3000 to 6000 feet thick, striking about N.25° W. and dipping to the northeast about 35°. The favorable horizon in this series is the bottom 600 feet composed of thin bedded impure limestone.

In the mineralized belt, which follows the strike of the favorable beds for a distance of 5000 feet, this limestone series of beds is intensely altered, partly to garnet and silica, and much iron-stained. In this altered zone with a width of from 600 to 1000 feet, at least eight outcrops of oxidized copper exist, varying from 20 to 300 feet in strike (N W & S E) and from 2 to 10 feet in width. They have most of them been stoped on by leasers at different times, who have taken out a very considerable tonnage of ore, but in all but two of them only shallow work was done, with depths of from 10 to 50 feet. This shallow work in nearly every case was carried on until the oxidized ore changed to comparatively lean primary sulphide ore.

At the Republic Shaft, at the south end of the belt, one of these showings was followed down 300 feet where the ore body was lost either through faulting or through exhaustion. The shaft was continued to a depth of 700 feet on the incline, and crosscutting from the bottom level out a second level of ore which was here entirely oxidized and of good grade. Development of this shoot led to an ore body 300 feet on the strike, and 25 feet wide, which led on the dip up to an oxidized copper showing of insignificant size. The distance followed on the dip from the surface to the bottom (which is still over) was over 1500 feet. This ore shoot is only partly developed and shows actual reserves of about 200,000 tons of 3% copper and 6% zinc ore, all unoxidized and amenable by differential flotation by tests on several ton lots, to concentration to copper and zinc concentrates.



The higher grade portion of the Republic ore body was stoped and about 400,000 tons of 5% copper ore shipped direct to the smelters, a great part of it during the war years of high copper prices. The sides of these old stopes all of which are standing open, and large pillars left between stopes, constitute the reserve tonnage given above. From a general survey of the probable extensions in leaner portions, it is safe to assume that from 5 to 10 times the amount produced and in reserve (600,000) tons could be developed of good milling grade, or from 3,000,000 to 6,000,000 tons of 3% copper and 6% zinc.

The Mammoth Incline was started on a copper oxide showing at the north end of the property, about two feet thick. At a depth of thirty feet sulphides were encountered which continued to a depth of 450 feet. At this point, the values left the shaft, which was continued 150 feet further in barren material.

Subsequent small test stopes off the shaft demonstrated that the ore shoot steepened at 450 feet and dipped under the shaft. This test stoping proved a thickness of 25 feet for this ore shoot and a width of 75 feet for this, with a possibly greater width as all values had not left the drift. The value of this ore shoot averaged, for 2000 tons stoped and shipped, about 6% copper and 3% zinc. Pillars left between stopes show a reserve of about 20,000 tons for this ore shoot, with indefinite possibilities, on further development.

For a distance of 1500 feet south of the Mammoth shaft, the surface is intensely mineralized and about 20 outcrops of oxidized copper were worked on by leasors and a considerable tonnage shipped. Most of this work is inaccessible, but all that are accessible show sulphides coming in at the bottom, of apparently as good grade as in the Mammoth and Republic ore shoots. In those whose workings are caved, the last material taken out (on the far edge of the dumps) shows in most cases, evidence of sulphides coming in. All of these shoots have possibilities for developing into sizable primary milling ore shoots at shallow depths.

At the Copper Chief Shaft, oxidized ore was stoped for a depth of 400 feet on the incline, and about 150 feet wide. The bottom of this work penetrated sulphides of the same character as that at the Republic and Mammoth, and of about the same grade. No work was done at depth.

**Prospecting and Development:** The ore shoots so far developed have shown remarkable persistence and regularity. Further development looking towards blocking out ore for milling, could be done very economically by combined drifting, and diamond drilling from selected underground points. It is entirely probable that with an intensive campaign carried on intelligently, within a period of from two to three years, the property can be sufficiently developed to warrant the erection of a large concentrator for the treatment of the ore.

**Mining Methods:** The ground below oxidation in the primary sulphide zone, which is reached at shallow depth, is very hard, and stands well without timber. The regularity in shape of the ore bodies already developed would indicate that shrinkage stoping, or some adaptation of it could be used. The cost per ton should be small. At least two new working shafts would be necessary for economic handling of the ore on a large scale. If developments are successful at least two hundred and fifty tons of ore a day could be mined, and possibly double that tonnage.

Milling Methods: Tests carried on on small lots of ore at the Inspiration Cons. Copper Co's mill at Miami, have shown the ore to be easily treated, by crushing to 200 mesh, and flotation. Two products can be made, a copper concentrate of from 25-27% copper, and a zinc concentrate of from 35-45% zinc. Preliminary tests demonstrate that the iron first thrown down with the zinc can be separated, leaving a clean zinc product. The cost of grinding will be heavy due to the hardness of the ore. The extraction obtained was 87% for copper and 80% for zinc.

Markets: The copper product can be sold to smelters at Douglas, Hayden, or El Paso, depending upon the demand of the different plants. All of them are close and the freight rates small.

The zinc product can be shipped to oxide plants at Wisconsin or Kansas, both granting favorable contracts for this type of product. The freight rates are high to these plants, but not prohibitive.

The profit from operations figured on the present market for copper and zinc, both of which are at low points, shows a fair net profit per ton of ore mined and treated.

Respectfully submitted,

J.B. Tenney

Mining Geologist



### General

The property of the Arizona United Development Company is situated at the northwestern part of Cochise Co. Arizona in the Johnson mining district. It is 7 miles north of Dragoon on the Southern Pacific Railroad and is connected by a branch which was built by the Old Company. The small town of Johnson, which is partly on the property, has a post-office, store, school and many unoccupied dwellings. The camp is at present idle.

The property contains 40 full or nearly full mining claims and numerous fractions, most of which are patented. These contain in all an area of about 1000 acres and cover 9000 feet along the outcrop of the ore-bearing formations. The attached plan shows the property and surroundings.

The claims lie along the southern foothills of the Little Dragoon mountains in a country with easy rolling topography. The elevation is about 5000 feet. Wagon roads connect all parts of the property and the railroad reaches all important workings except the Mammoth. Water for camp uses is obtained from the mine and it is probable that with greater depth a sufficient supply would be found for milling purposes. In any case water is abundant in the valley to the east.

There is sufficient machinery, smaller equipment and tools on the property to start development at any time. The Company also owns numerous dwelling houses, boarding house, offices, etc; enough for operating purposes for some time.

### GEOLOGY

The rocks exposed on the property are entirely Paleozoic sedimentaries which have an average strike of about N-65-W and dip  $26^{\circ}$  to  $35^{\circ}$  to the northeast. Upper Cambrian quartzites outcrop along the southern line of the property and above these are 300 to 400 feet in thickness of impure thin bedded limestones which are probably Devonian and may include the Mississippian. Above these are the purer, heavier bedded Pennsylvanian limestones, of which at least 1000 feet are exposed in the district. These beds are all in apparent conformity.

The lower impure limestone horizon is much metamorphosed and has become garnetized and silicified. This is the ore-bearing horizon. Above here the metamorphism becomes less pronounced with diminishing garnet and silica but with more or less marble and finally in passing upward the unaltered Pennsylvanian limestones are found.

The geology of the district is very simple and there is little folding or faulting. The few north-south faults noted are post-mineral and of small displacement.

### ORE OCCURRENCE

The important ore bodies are lenses replacing beds in the lower part of the limestones from 200 to 500 feet above the quartzite and in the middle and upper parts of the garnetized zone. A preference for certain beds is marked; two have been worked in the Republic and one in the Copper Chief and Mammoth. No exploration work has ever been done to prove other beds in any of these workings.

Above the bedded deposits in the less metamorphosed limestones are numerous fractures and veinlets which carry stringers



and small lenses of ore. These are found outcropping and considerable ore has been shipped from them from near the surface, especially on the Black Prince and Peabody properties. It is doubtful if these were ever profitable and the main value of these stringer deposits is as an indicator of the probable larger bedded deposits which may exist below them. Such small ore showings are found outcropping above all the known ore bodies except the deeper one in the Republic. Apparently, here the ore bearing solutions never ascended to the elevation of the present surface. Between the mineralized zones few copper showings are found on surface.

Copper bearing solutions which deposited these upper ores must have passed through the lower beds so particularly favorable to replacement. The upper ores probably represent only the overflow of copper which was not deposited in the beds below. In this way outcrops of the small showings of copper are highly indicative of bedded deposits below.

It is more than likely that the intrusive granite (the source of the ores) will be found to extend under this portion of the district. I have shown the typical ore occurrence and probably extensions on an attached generalized cross-section.

The different ore bodies, so far as known, occur along certain definite lines which undoubtedly represent ancient fracture zones. These are shown on the plan. Along these lines are ore bodies are larger and richer on the small rolls in the formation. Practically no exploration has ever been done outside of the ore bodies which have been mined and which were followed down from their outcrops. The only exception is the north cross-cut in the Republic which found the lower ore body, the largest mined in the district.

#### NATURE OF THE ORES.

The ores are of the contact-metamorphic type which makes it probable that the granite will be found at greater depth. The gangue is mainly quartz and garnet with a little calcite, amphibole and chlorite. The copper is found in chalcopyrite and bornite and there is little associated pyrite. Zinc occurs in blende but when there is much it lies in lenses apart from the copper ores and could be mined separately if found to be profitable. The ores are all sulphides and primary. The oxidized ores which were found close to the surface have been mined. There was very little secondary enrichment except in a few stringers which extend only to shallow depths.

General averages of east and (Republic) ores from 1913 to 1919 and of west end (Mammoth) recent sampling gave:

	Ag.	Cu.	Zn	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	CaO	S	
Republic	0.70	4.46%	2.4	42.4	3.0	8.4	15.7	8.0
Mammoth	1.00	6.25%	1.3	64.3	Insol.	8.5	4.0	9.0

The sulphur uncombined as chalcopyrite and bornite would account for from 4% to 7% of pyrite in the ores. A concentrate with 25% copper could probably be obtained.

#### GRADE OF THE ORES

The high grade ores will average 7% and are found in lenses accompanied by low-grade ores which will assay from 2% to 4%. The high grade lenses are large enough to mine separately. It is probably that when mined a high grade product should be shipped direct and the remainder concentrated. A mill head of probably 3% or 3-1/2% could be maintained with a little sorting



There are now on the old dumps and in the old workings at least 100,000 tons of ore which could easily be sorted to 3%. The dumps represent rejects from sorting and low grade material from shafts, drifts, etc. The stopes shown on the old maps represent only ores which could be shipped and considerable low grade ores were left standing which would be profitable to concentrate. No estimate or sampling of either the mine or the dump ores has ever been made.

From 1913 to 1919 the Republic shipped 226,750 tons of ore which averaged 4.46% copper. High grade ores were shipped and smelted before this but no known records exist. There are no records of the Copper Chief and Old Mammoth except that in 1918 about 3000 tons were shipped from the Copper Chief which averaged 3.77%. This was sorted from dumps and taken from the mine. In 1918 and 1919, 3,295 tons were shipped from the New Mammoth which averaged 6.50%. Samples from here in 1923 representing 150 feet of shaft and two cross-cuts averaged 5.60%. 800 tons from sinking averaged 7%.

The total tonnage mined from this property plus low grade ore left standing would be at least 450,000 tons. This is estimated from shipments plus the dumps and also from the stope maps. From all data available this aggregate ore averaged 4.5% as a conservative figure.

#### PRINCIPAL MINE WORKINGS

These are shown on the attached plan and larger detailed maps have been made by the Company.

REPUBLIC. This is the largest mine of the group. There is one 25° incline 700 ft. deep. A 600 ft. northern cross-cut from the bottom of this leads to two other inclines 300' and 700' deep respectively. The last are on the lower ore body. The workings are rather extensive but are mainly in the ore and little effective search for new ore bodies has been done. The continuity of the ore along the zone is noteworthy. Ore varies up to 25' in thickness with an average of about 8'. This is the deepest ore body mined in the district and the surface over this shows little mineralization.

A smaller ore body on a lower bed was mined from surface and a still smaller body from an intermediate bed. In all, three beds have produced ore.

COPPER CHIEF. Three inclines were sunk on ore bodies which outcropped. The thickness of the ore was 5 or 6' on the average. A 280' vertical shaft was sunk in the hanging wall and cross-cut run. This work is between two zones and is not deep enough to have cut the ore bearing beds in any zone. The old workings probably produced 40,000 tons or more.

OLD MAMMOTH. The old stopes have probably produced about 40,000 tons from several ore bodies. No records are available. The stopes indicate a former thickness of ore of 5 or 6 feet.

NEW MAMMOTH. This is the only point at which any recent work has been done. Since the Development Co. took over the property the incline has been sunk about 180' deeper and crosscuts driven at 90'. Samples from 50' of the shaft and the two crosscuts show a thickness of 22' of ore averaging 6.26% copper. 800 tons hoisted from this part of the shaft averaged 8.00%. Below the crosscuts the shaft is in zinc ores but drill holes in the back showed high grade copper. The bottom of the shaft, 90' below the crosscuts and 360' below the surface, shows a thickness of 18' of 4.75% ore and neither wall was reached. Ore shipped in 1918 and 1919 from the old workings was 3,296 tons averaging 6.52%.

This shaft has been entirely inore and the bottom has the appearance of going into a large body of high grade.

The above notes cover the principal workings on the property. There are many smaller openings but they are of little importance.

#### POSSIBILITIES OF THE PROPERTY.

The persistence of ore bodies along the zones of shearing is proved by the old workings. There are no evident reasons why other parts of partially developed zones and unexplored zones should not be ore bearing and as good as those opened. By following up these zones in the ore bearing horizon one is almost certain to develop ore.

The old workings have only developed about 15% of the probable ore bearing zones on the property. This supposes only one ore-bearing bed, while in the Republic there are at least two. Allowing for the chance of ore on these other beds, the percentage explored of possible ore bearing ground would be about 10%.

If the remainder of the ground develops as well as that already opened this property has a strong likelihood of containing from 2,500,000 to 4,000,000 tons of 4.5% copper ore.

#### CONCLUSIONS.

This property with its possibilities is an excellent one and veryworthy of development.

Respectfully submitted

(Signed) C.W.Botsford

Inspiration, Arizona  
December 24, 1923.



SEE: USGS PP # 416 p. 168 (Copper Chief Mine)

See: Arizona Mining Journal 1-15-22 p. 16

See: ~~Report in Eagle Picher "A" Confidential files~~ *Now in this file*  
ABM Bull. 187, p. 30

See: War Minerals Reports, Report # 36, 6 pages, Bureau of Mines,  
Department of the Interior, (1942) 3/10/77, a.p.

ABM Bull. 156 , p. 30-39

Mining Engineering, Vol. 5, No. 12, p. 1272-1277; AIME Trans. V. 10, p. 334-345

USGS PP. NO. 318 p. 97,99, 100.

USGS Survey Map MR-22

MILS Sheet sequence number 0040030203

MAPS - Set of Maps, Republic Mine and Map showing all Claims - These maps have  
been microfilmed and the originals stored upstairs in the flat file







*Johns Camp  
(Republic Mine)*

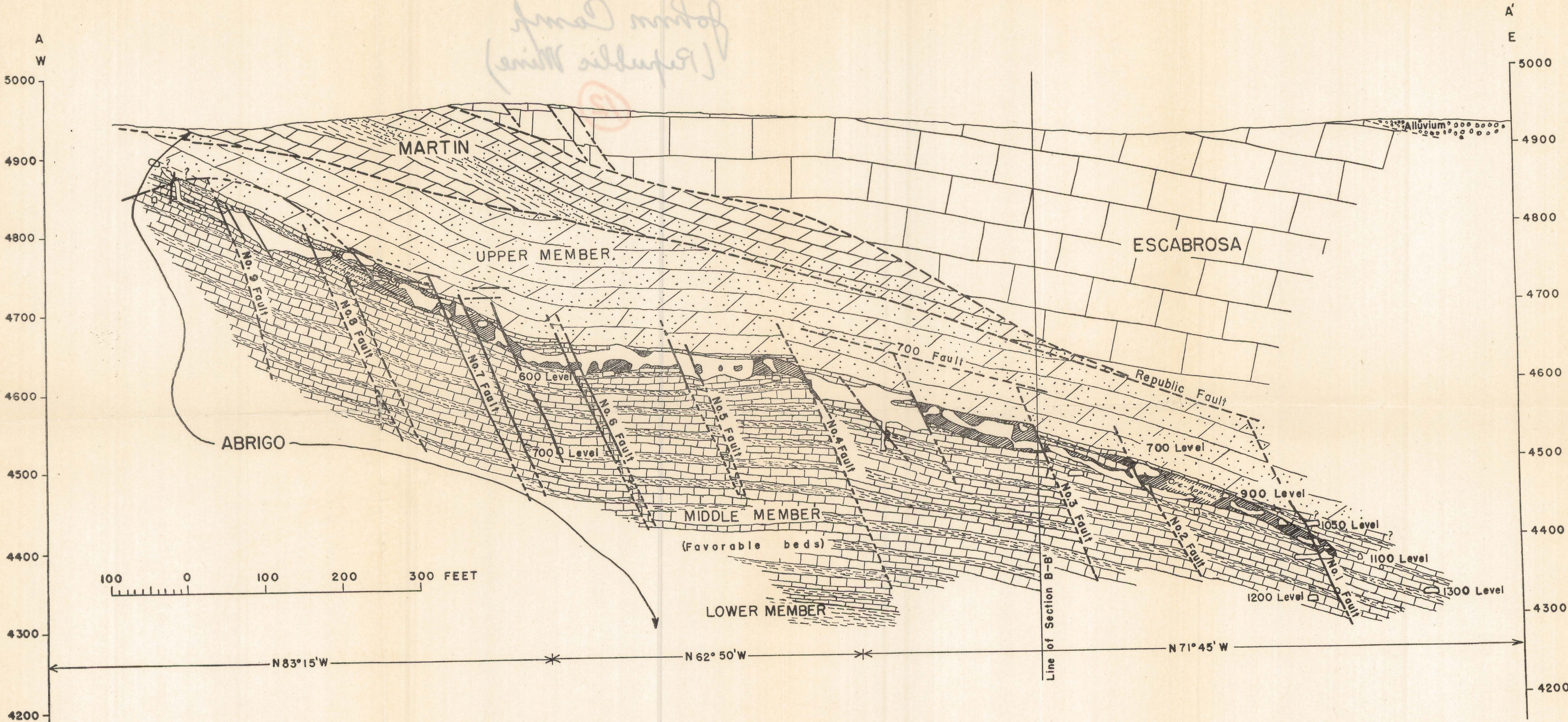


Figure 16.—Cross section A-A (Main Manto), Republic mine.



Republic Mine  
Camp

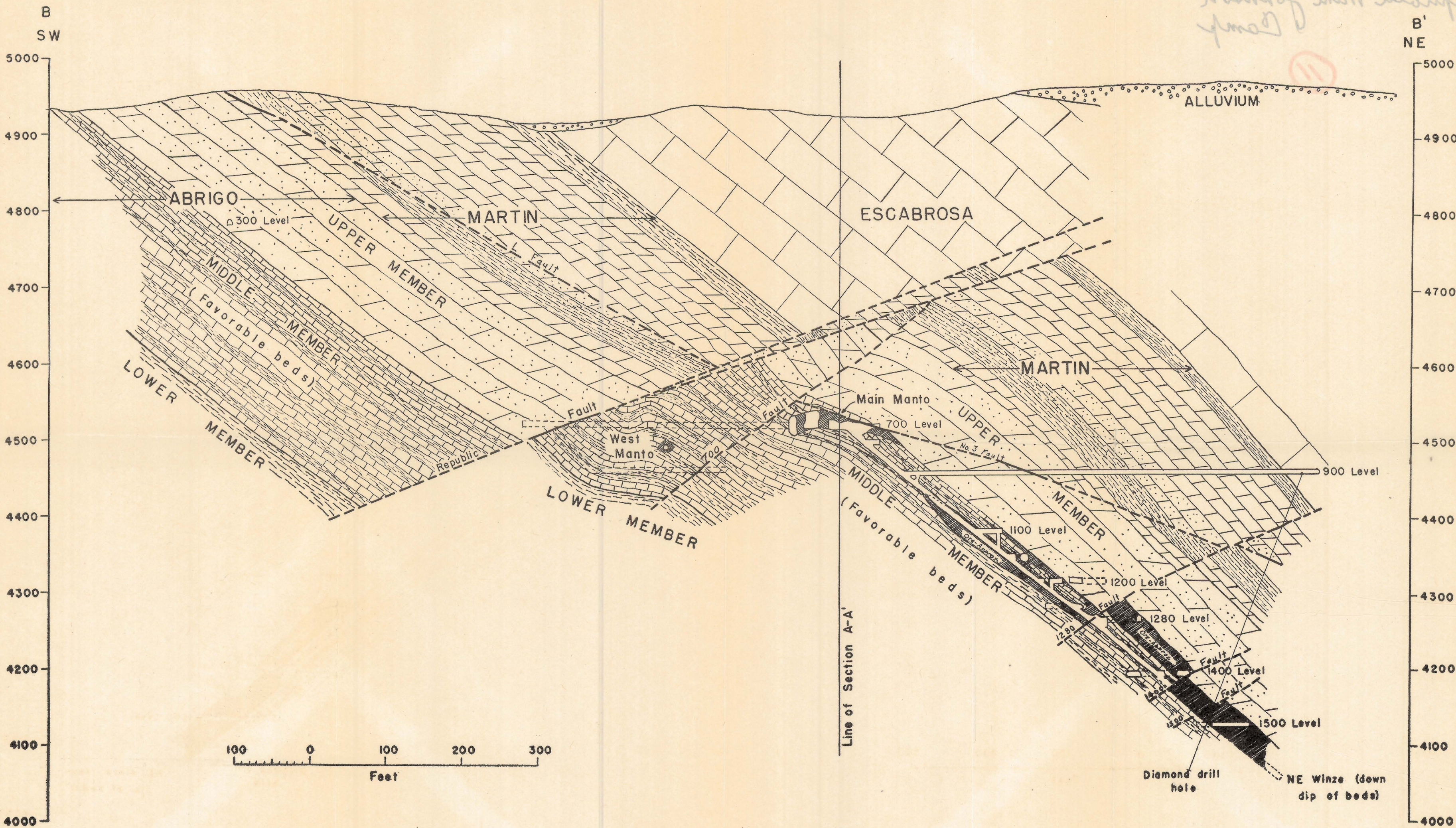


Figure 17.—Cross section B-B (Northeast Winze), Republic mine.



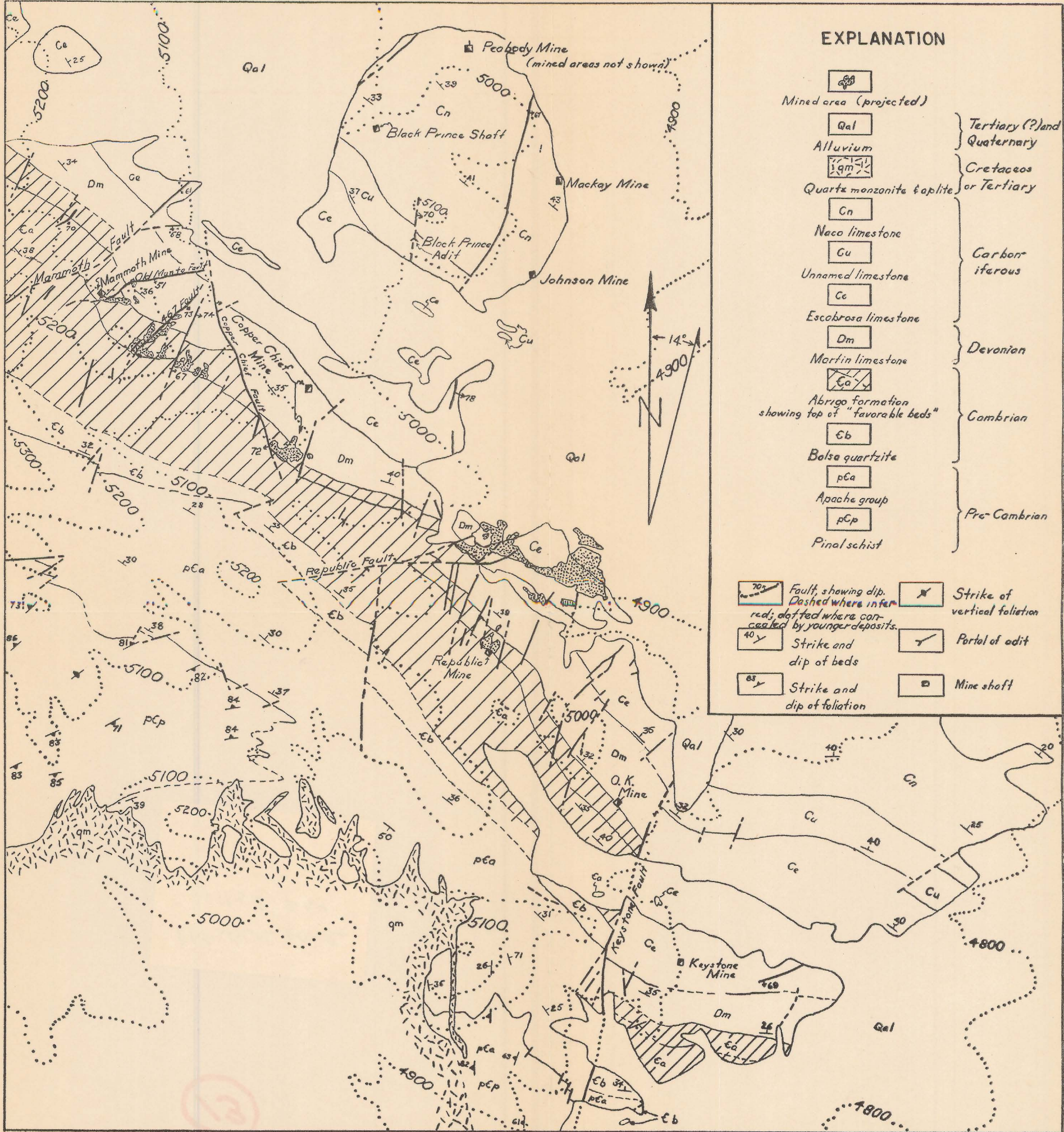


Figure 14.—Geologic map of the Johnson camp copper-zinc area.