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James Doyle Sell Mining Collection

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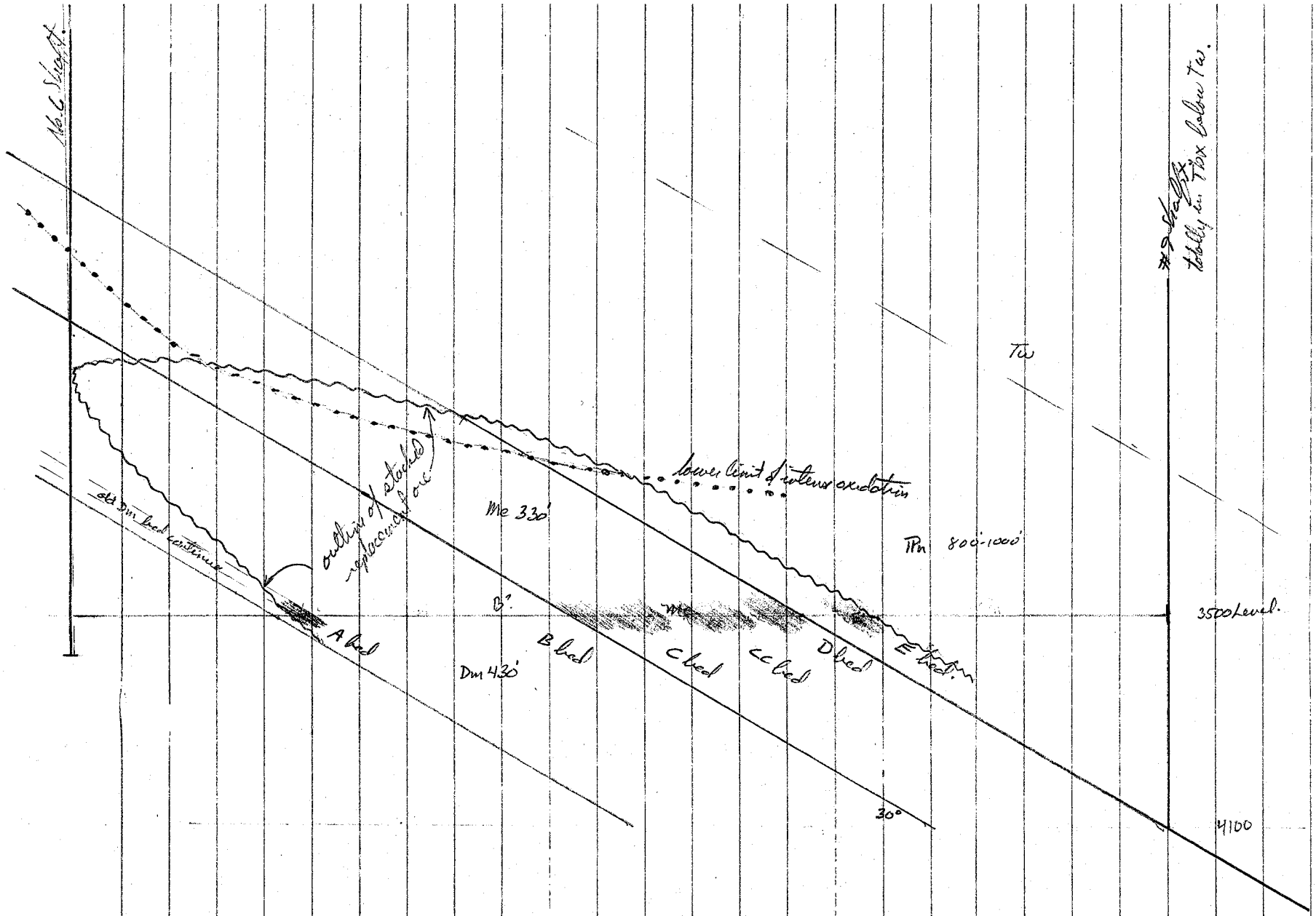
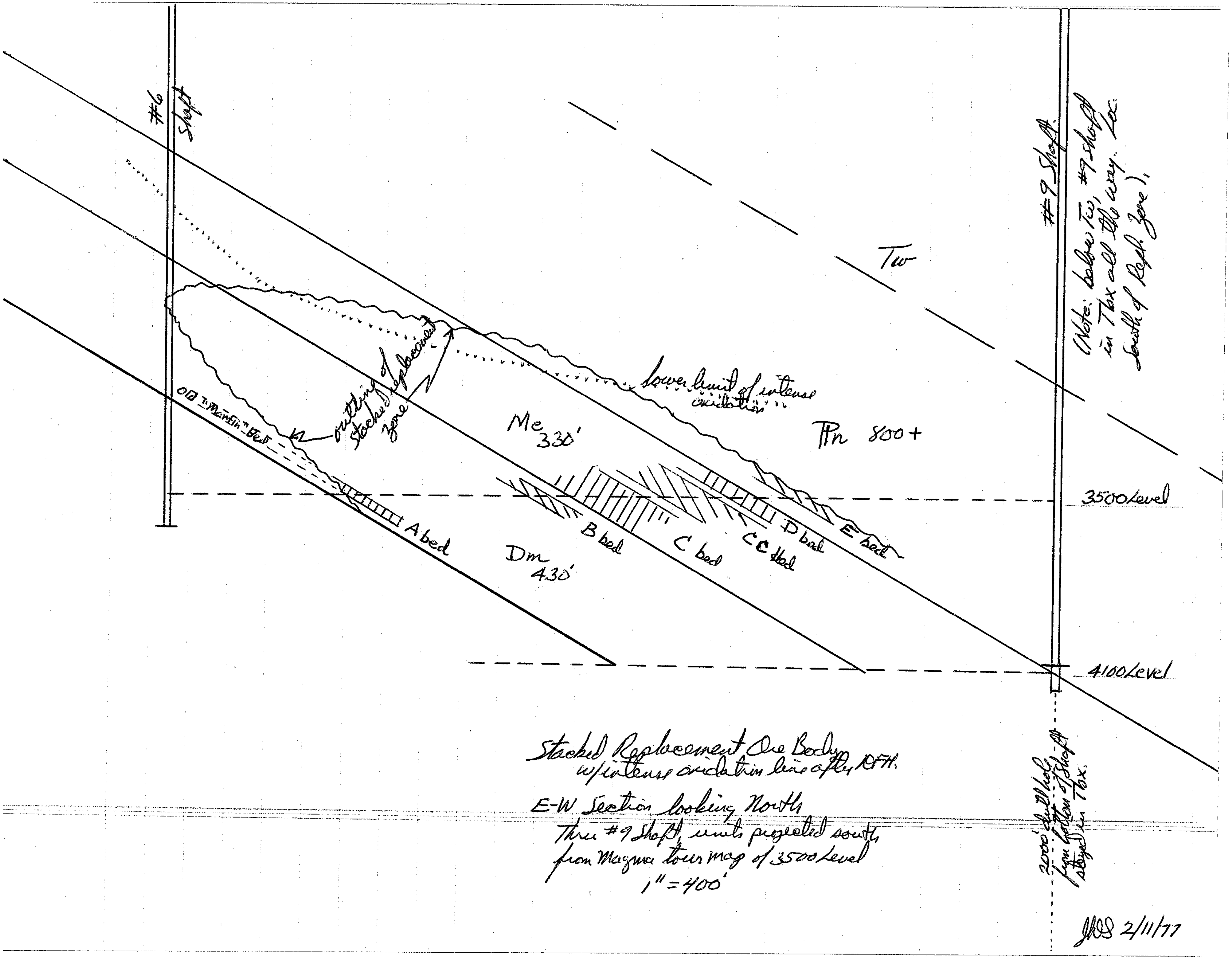


Stoked-replacement orebody w/ oxidized lines from DDH

E-W section, looking north
Thru No. 9 shaft; units projected
from Magma town mag'l of 3500 level.
1" = 400 ft.

JDS 2/11/77



Stacked Replacement Ore Body
w/intense oxidation line after DFH.

E-W Section looking North
Thru #9 Shaft, units projected south
from Magma tour map of 3500 Level
1" = 400'

JDS 2/11/77

ASARCO

Southwestern Exploration Division

May 14, 1976

TO: F. T. Graybeal

FROM: J. D. Sell

Arizona Section - AIME
Underground Section Meeting
Magma Mine, Superior
Pinal County, Arizona

Attached are the two papers plus copies of the two maps (plan and general section) distributed at the meeting. The prints are very poor reproductions and I have annotated the plan map of the 3500 level.

The group I was with was led by Reginald L. Barnes, staff geologist since August of 1975. He has been with Magma several years. Also in the group were Jim Vroman (Cities Service), Bill Josey (Superior Oil), and Robert Crist (Asarco) and his guest Duane Webb (Ranch Broker). As the group was the smallest, we were all able to direct and hear questions and answers.

Of specific interest is the "Mesozoic Conglomerate" (my Tertiary breccia). Reggie says the problem is not yet solved, but the present belief of Russ Webster (Chief Geologist at Magma Superior) is that this mass represents an infaulted block of Mesozoic conglomerate which is some 2 miles N-S by 3-4 miles E-W and bounded on all four sides by faulting. All fault bouldaries are near vertical where they have been seen (which is only in the area of productive mining as shown on the map, plus the earlier views on the 2550 level as I've expressed previously). To the far south, where they have been drilling from the surface, one hole intersected it below Whitetail, while a second hole only around 500 feet further south (i.e., apparently 500 feet south on the perpendicular projection) did not hit "Mesozoic Conglomerate" but passed from Whitetail into Paleozoic carbonates. Reggie did not know if there was any stratigraphic offset between the Paleozoic north of the conglomerate versus those south of the conglomerate.

As Webster feels the conglomerate is an infaulted block, he drilled a vertical hole 2000 feet deep from the lowest level of #9 Shaft, the 4100 level, and bottomed in the "Mesozoic Conglomerate" at the 6100 level! In #9 Shaft, they passed directly from Whitetail Conglomerate into Mesozoic conglomerate at around the 2600 level, giving a vertical thickness for the Mesozoic Conglomerate in excess of 3500 feet. Webster believes the replacement-carbonate section is also infaulted with the block and hence mineralized below the "conglomerate".

Magma does not know how far east it extends, and few drill holes have been drilled east of #9 Shaft (i.e., 4100 level). Reggie felt the "conglomerate" probably goes all the way to Devils Canyon. If this is a true feeling of the staff, then I'm sure they have little interest in Oak Flat, as it would be nearly entirely underlain by the Mesozoic Conglomerate.

The western boundary of the mass is essentially the NS5 West fault.

Magma has drifted on the 3000 and 3200 levels and is preparing to drift on the 3400 and 3600 levels south of #9 Shaft over to the South Vein. This vein was found by diamond drilling. At present two stopes are in operation mining a 6-15 foot wide vein zone with two feet of massive chalcocite-bornite with stringer walls of calcite and quartz in crushed conglomerate wall rock. Very weak ground and they hope to mine it by a thin slot sublevel caving system.

Note that their drawing of the strike of the South Vein, the porphyry dike, and the North boundary (vein) are all subparallel and near the general overall trend of the entire Magma Vein system further west. Also note that the SB (South Branch) Vein curves southeasterly and apparently terminates at the carbonate section-Mesozoic Conglomerate contact. As shown in the poor reproduction of Don Hammer's plan and section in the Sales-Graton Ore Deposits Volume, the South Branch Vein was the principal vein of the replacement beds from the 2550 level eastward and down to the 3000 level (and hence to the 3500 level).

Magma is presently preparing to drift north on 4100 level from #9 Shaft to retest the area of the Magma Vein. On the 2800-3400 levels, they did some stoping north of the Magma Vein, but it was spotty grade and very poor ground conditions on those levels and appeared to be passing downward into massive pyrite.

They have defined reserves from Naco thru Martin down to the 4100 level (approximately due north of #9 Shaft). Eastward they have very limited drilling but have mineralization in the Naco and upper Escabrosa down to around the 4600 level. I strongly suspect that an east drift will be driven from the 4100 level drift going to the Magma Vein, to give access to additional drill stations eastward. (Roughly measured, the 4100 North drift should be in the vicinity of the Maroon Shale, the marker bed between the Escabrosa and Naco, when it gets out of the Mesozoic Conglomerate. Reggie would not speculate on what unit they would be drifting along.)

Webster, a number of years ago, expressed the view that the north boundary of the "conglomerate", going northeasterly, was terminating and cutting out the replacement beds which were then trending easterly. Subsequent drilling and development have shown that the replacement bodies now have turned northeasterly parallel to the north boundary trend of the conglomerate.

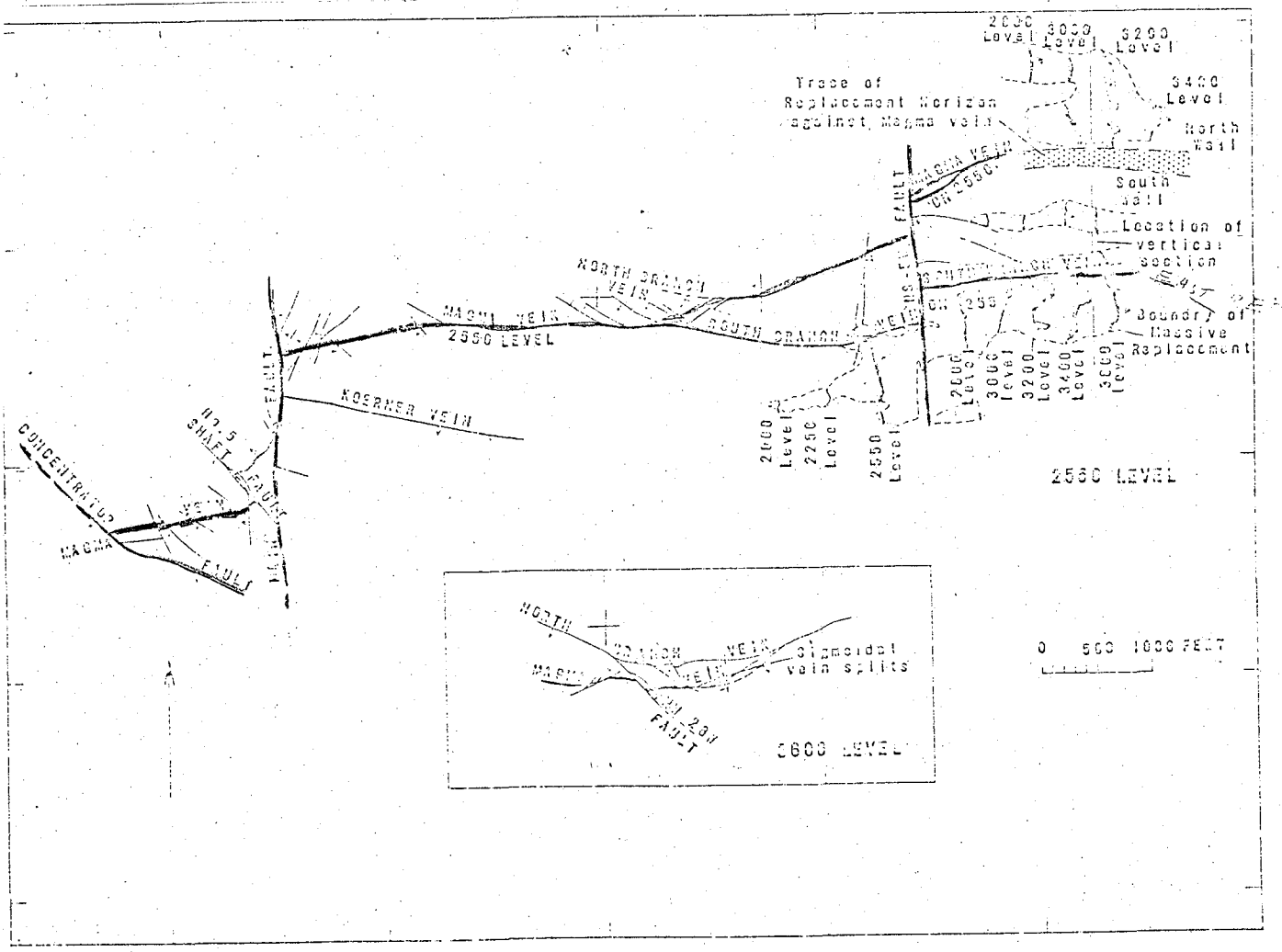
Reggie was strong in expressing that no ore values mineable are found within the Mesozoic Conglomerate other than the South Vein; i.e., no disseminated areas. Although he did say that the north boundary of the Mesozoic Conglomerate was often marked by high grade chalcocite-bornite as in a sheared vein, I could not clarify if such mineralization was always found adjacent or near where the replacement horizons intersected the boundary. He did say that, in general, higher zinc values and lower

copper values are found at depth along this boundary contact. (A zonal pattern also found below the Martin horizon further to the west; i.e., zinc in a sheared crushed zone of the South Branch Vein structure passing upward into the Martin Replacement with high grade bornite-chalcocite and extending upward above the hanging wall section of the Martin replacement unit.)

They have on trial a hard rock Alpine AM-50 miner. This adaption of the coal-field machines cuts a 12' x 14' opening and in Magma's "soft" ground (pyrite-hematite gangue with little silica) produced some 250 tons/shift or three times the blast-muck cycle. John Cesar (General Mine Foreman) stated that rock with psi strength of 15-20 thousand can be cut with this machine. Today they had the machine in a hard silica portion and it was doing a respectable job of cutting the face. A four-man crew is presently running the system (two machine operators and two mucking machine clean-up men). Although a strong water spray was ejected onto the cutters and face, a lot of fine dust was produced. To combat this it was necessary to install a large 24" exhaust flexoid on the wall opposite the cooling air to the face. It was working very well.

James D. Sell

JDS:lb
Atts.



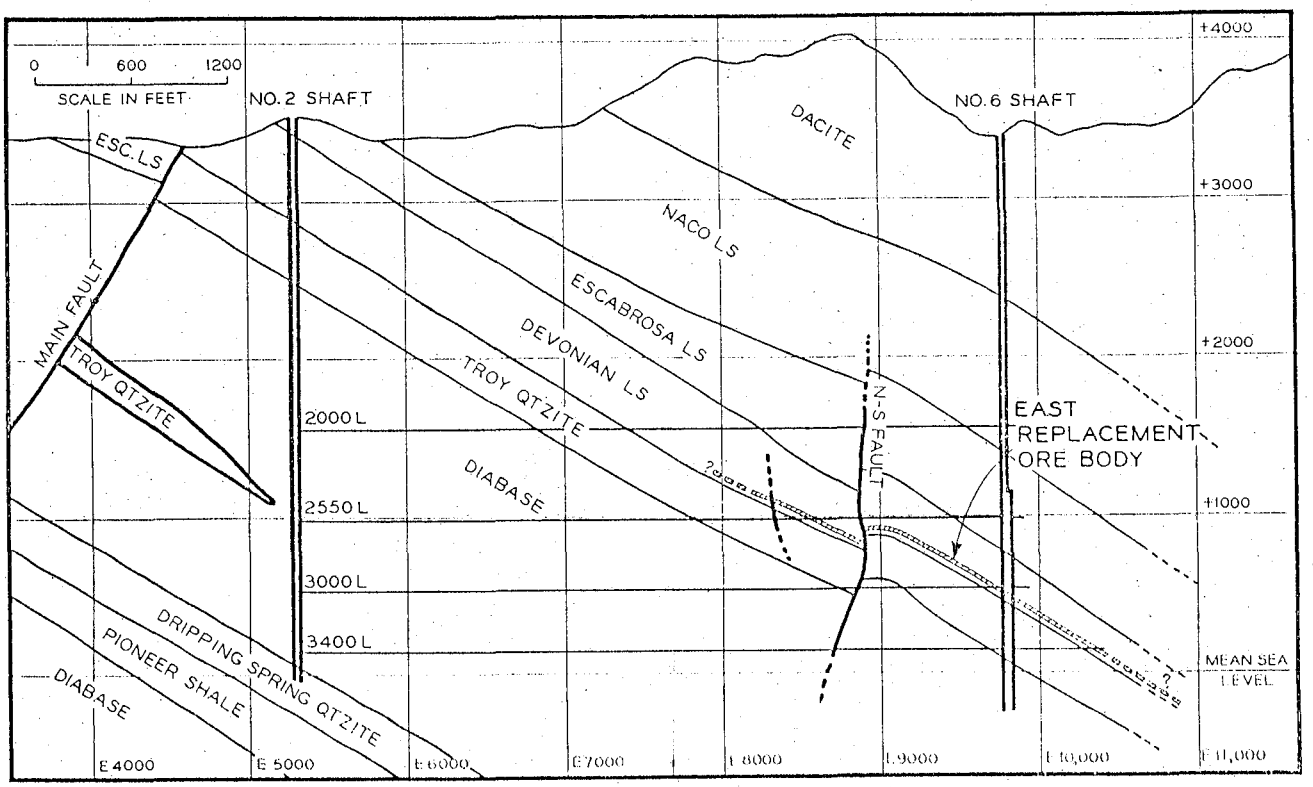
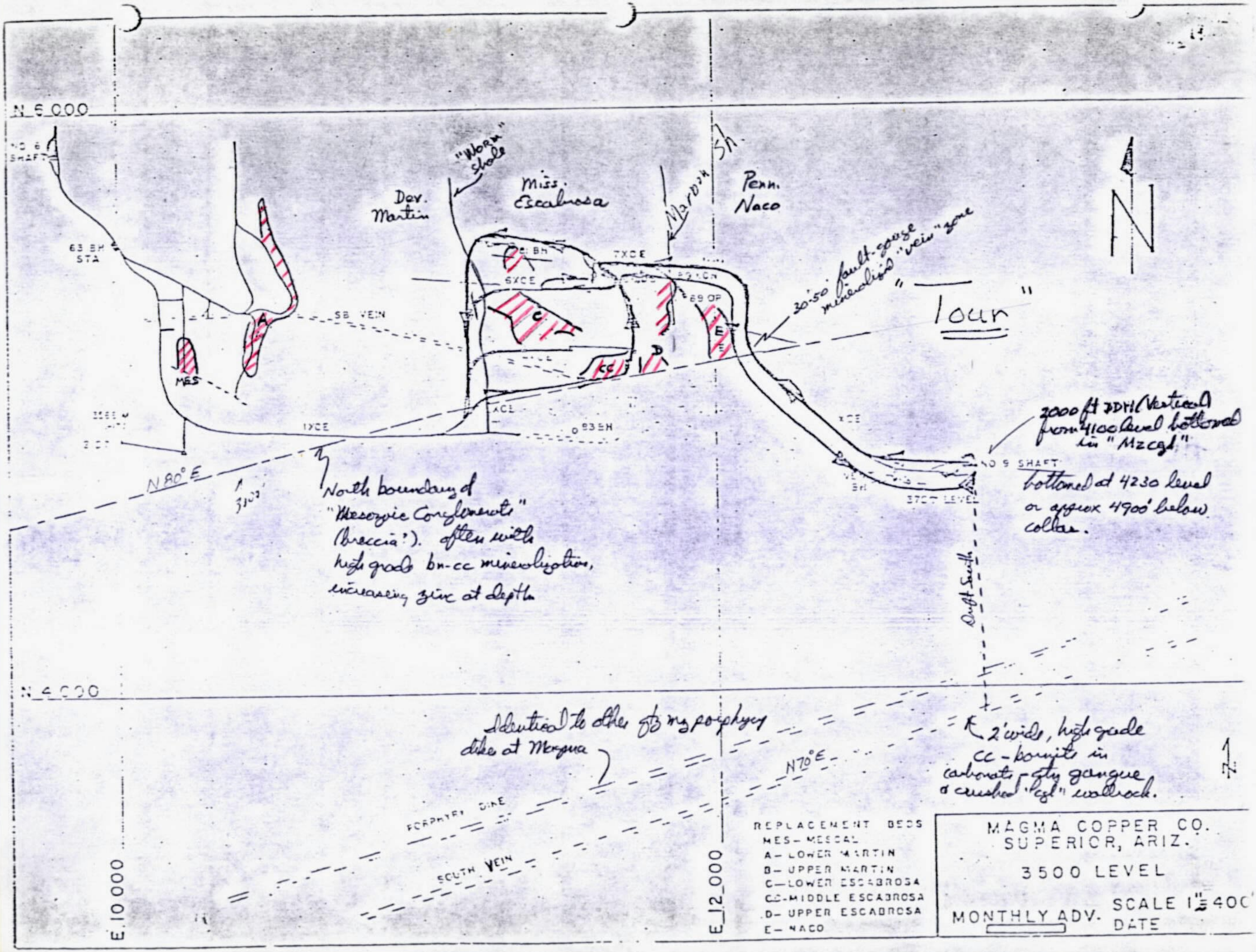


Fig. 2. East Replacement Orebody, east-west vertical section looking north.

Gratton-Sales AIME Vol.



N 6,000
N 4,000
E 10,000
E 12,000
NO 6 SHAFT
63 BH STA
"Worm" shole
Dev. Martin
Miss. Escabrosa
Marcoux
Sh.
Penn. Naco
N
7XCE
6XCE
SB VEIN
69 OP
MES
A
C
CC
D
E
1XCE
XCE
83 BH
XCE
30-50' fault-gouge mineralized "vein" zone
"Tour"
2000 ft DDH (Vertical) from 4100 level bottomed in "Mz cgl"
NO 9 SHAFT
3700 LEVEL
bottomed at 4230 level or approx 4900' below collar.
N 80° E
North boundary of "Mesozoic Conglomerate" (breccia?). often with high grade bn-cc mineralization, increasing zinc at depth
Drift South
2' wide, high grade cc - bornite in carbonate - qtz gangue & crushed "cgl" wallrock.
Identical to other qtz mg porphyry dike at Magma
N 70° E
PORPHYRY DIKE
SOUTH VEIN
REPLACEMENT BEDS
MES – MESCAL
A – LOWER MARTIN
B – UPPER MARTIN
C – LOWER ESCABROSA
CC – MIDDLE ESCABROSA
D – UPPER ESCABROSA
E – NACO
MAGMA COPPER CO.
SUPERIOR, ARIZ.
3500 LEVEL
MONTHLY ADV.
SCALE 1" = 400'
DATE

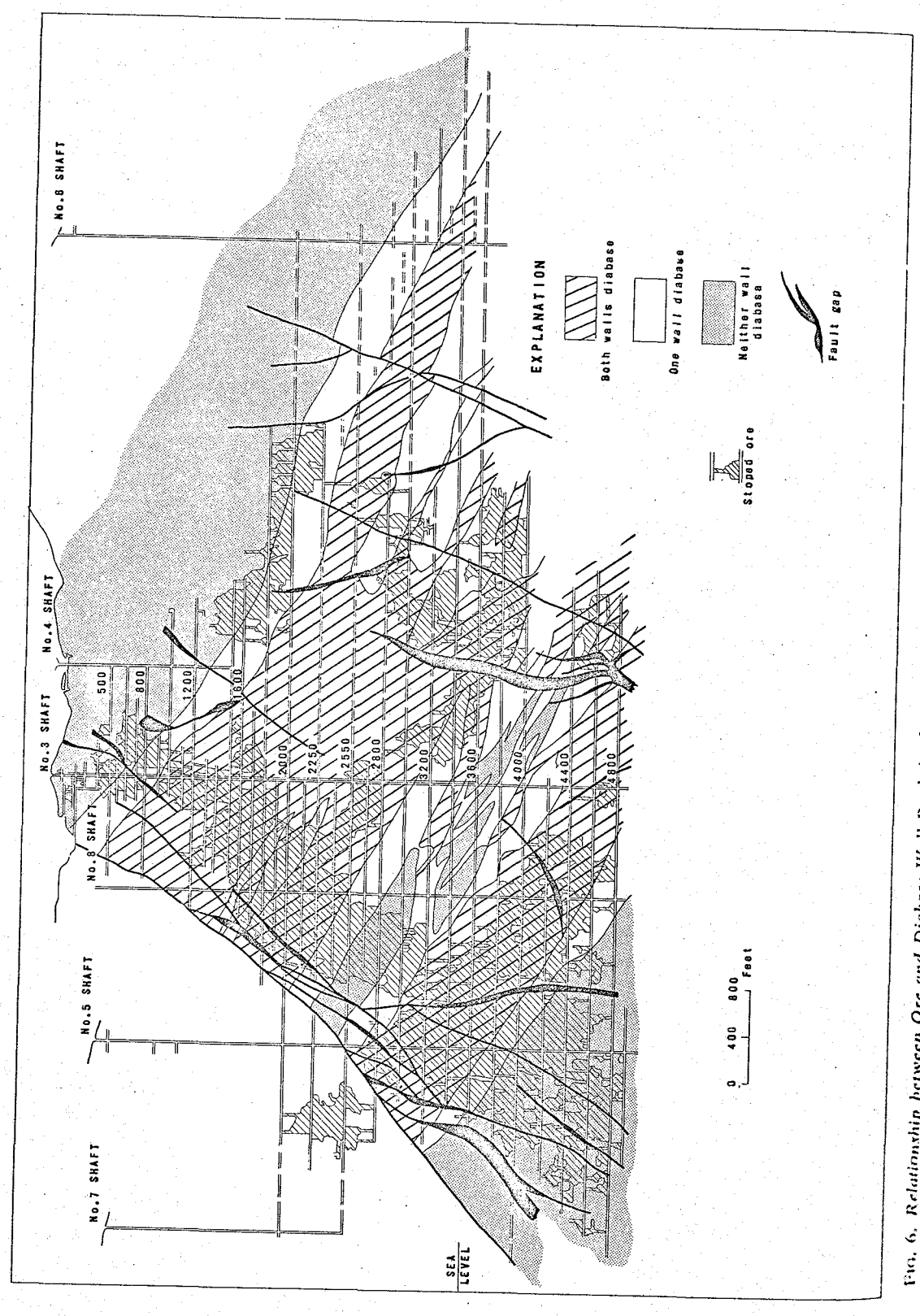


FIG. 6. *Relationship between Ore and Diabase Wall Rock in the Magma Vein, projected to a vertical, east-trending section (after Gustafson.*

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much of the evidence for
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Complex vein splits a
structural characteristic
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e a major factor in loc
ation.

These factors suggest th
dition that determined spe
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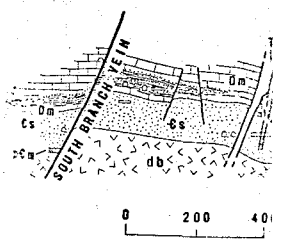


7. Vertical North-Tre
e (looking west). Some
e Figure 5 for location of

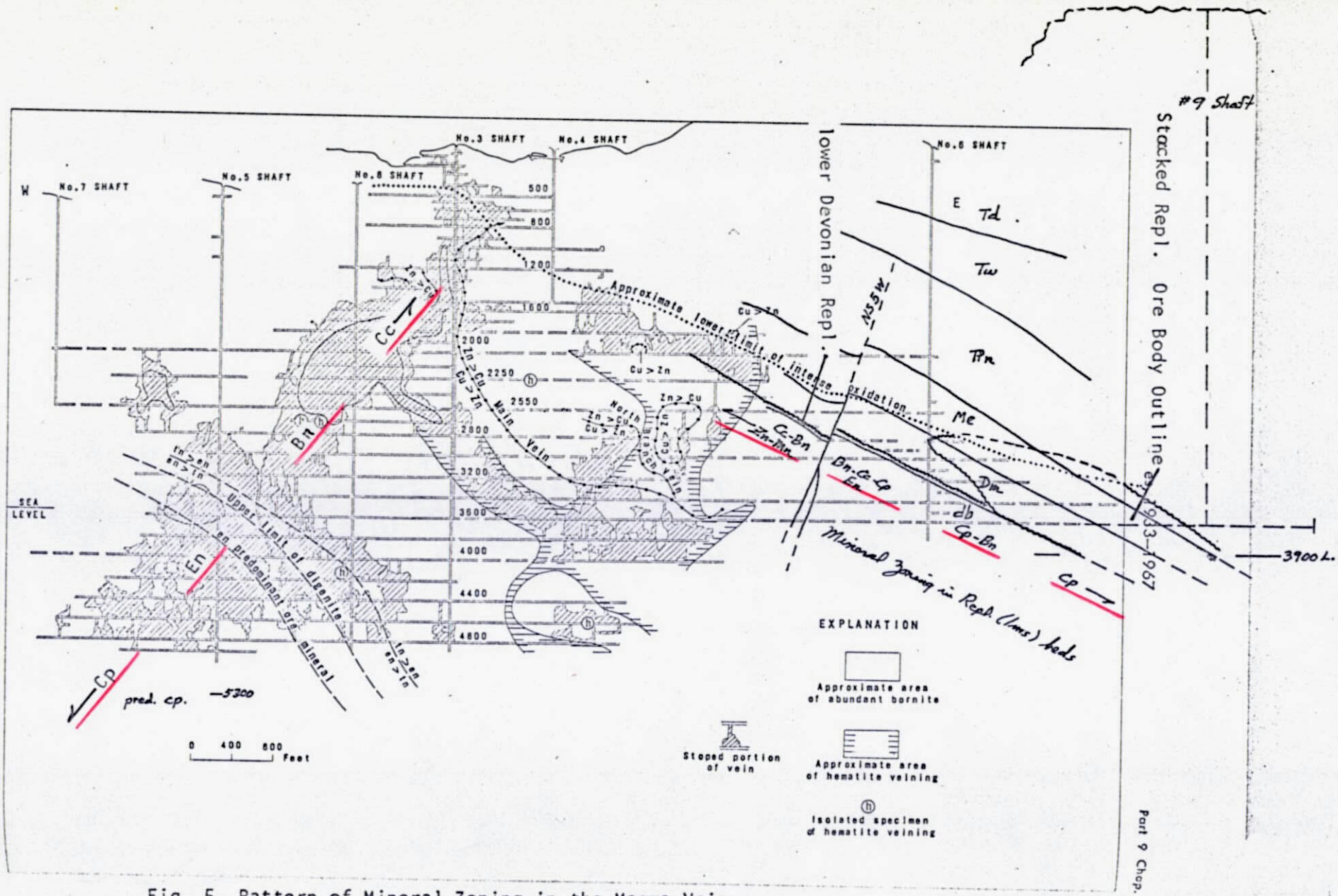


Fig. 5. Pattern of Mineral Zoning in the Magma Vein.

Modified from Hammer (Graton-Sales Vol., AIME)

FIGURE 1

Aa-16A.19.13

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

March 30, 1970

MEMORANDUM

TO: W. E. Saegart

FROM: J. D. Sell

Buried Intrusive Breccia
Magma Copper Company
Superior Division
Pinal County, Arizona

SUMMARY AND RECOMMENDATION:

An intrusive breccia, somewhat mineralized, containing blocks of all known premineral rock types outcropping at Superior, has been recently extended and confirmed. This breccia is blind as it lies under the post-mineral dacite volcanic flows and no expression of this breccia is known on the surface.

With the potential size, the mineralized character, and the fact that Magma's new No. 9 shaft should penetrate this breccia, it is recommended that a land status (claim) study be made of the Dacite Plateau, especially to the southeast, for possible ASARCO participation in exploitation of suggested mineralized porphyries.

GENERAL:

Figure 1 is a plan of the buried intrusive breccia as now confirmed by recent exploration at Magma. Also shown are the lower Devonian replacement ore bodies and the new stacked (lower part of the Devonian through the lower part of the Pennsylvanian) replacement ore bodies.

The information was secured during a recent tour of the new ore body area and discussions with Russell Webster, Chief Geologist at Magma. A cross-section showing the recently announced stacked ore body distribution, as well as the suspected cover rock depth, is shown on Figure 2.

Webster, no doubt, has some feeling of the potential significance of this mineralized breccia and mentioned that Magma should check the replacement beds south of the breccia, but it is unknown as to the Magma land status, or of any others that may be interested in Magma's expansion.

The breccia was first encountered ten years ago on the 2,800 Level when drifting out to pick up the small, southernmost, lower Devonian ore shoot. The drift was driven several hundred feet southward into the breccia before being terminated. Then a horizontal 2,000-foot hole was drilled due south, a 300 (?)-foot hole drilled vertically, and a horizontal 450 (?)-foot hole drilled southeasterly from the face of the drift -- and all terminated in this breccia material.

A 0.35% copper assay was determined on the total core reject collected from all three drill holes. No further work or interest could be generated at this time.

Several years later the breccia was also encountered on the 3400 and/or 3600 levels being driven southward along the lower Devonian replacement ore horizon. In the past several years several holes from the 3400 and 3600 East Level drifts, used in drilling for the new stacked replacement horizons, have encountered the breccia. Several pieces of core are attached separately with this memo showing the breccia character. Note the pyrite-chalcopyrite in some of the fragments. The hole was drilled from the 3600 East level at the 100 East position to check under the No. 9 Shaft position on this level.

Mineralized veinlets are known to cut the breccia which is mostly a rock flour breccia with large blocks of all the premineral rocks at Magma. Fragments of Precambrian Pinal Schist have been found next to fusilinid-bearing Pennsylvanian Naco Limestone which suggest strong mixing of fragments within the breccia.

Drifts are presently being driven from No. 6 Shaft to No. 9 shaft area on the 3000, 3200, 3400, and 3600 Levels in preparation of continued exploration and mining of the new stacked ore bodies. Only the 3400 Level is extended sufficiently to be in breccia, and has now cut some 400 feet of breccia, but apparently Magma is not sampling this breccia although Webster is aware of its mineralized content.

I believe there is a strong possibility that a supergene chalcocite blanket will be found within the breccia under the cover of the post-mineral rocks. Present projections suggest that No. 9 Shaft will enter the breccia immediately under the cover rocks which may be in excess of 2500 feet in the vicinity of No. 9 Shaft.

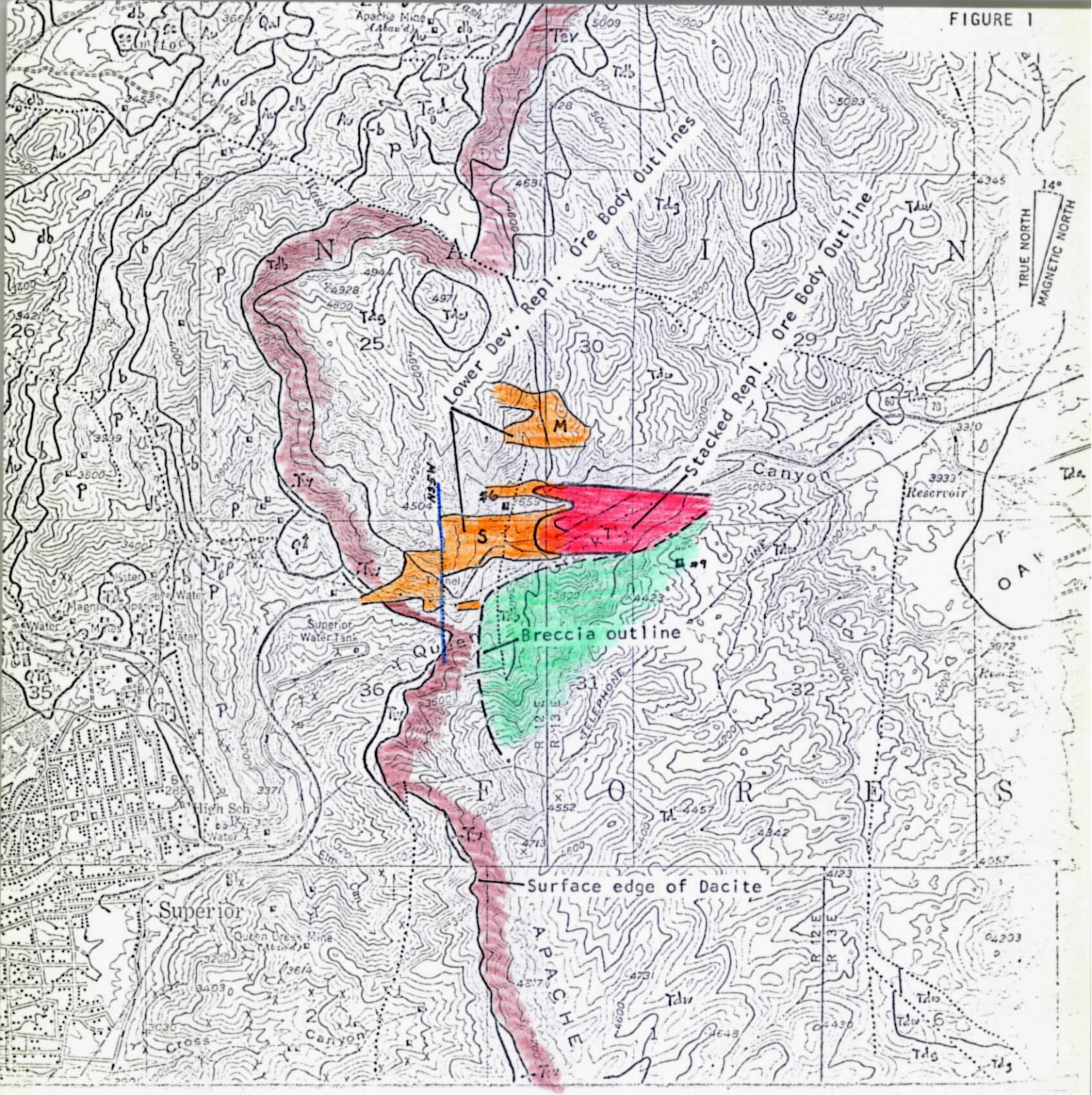
A land status (claim) survey of the entire Dacite Plateau is recommended as a preview of areas available for staking.

James D. Sell

J. D. Sell

JDS/kvs
Attachments
cc: SIBowditch
WLKurtz
Route file copy JHC

FIGURE 1



SCALE 1:24000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET

DATUM IS MEAN SEA LEVEL

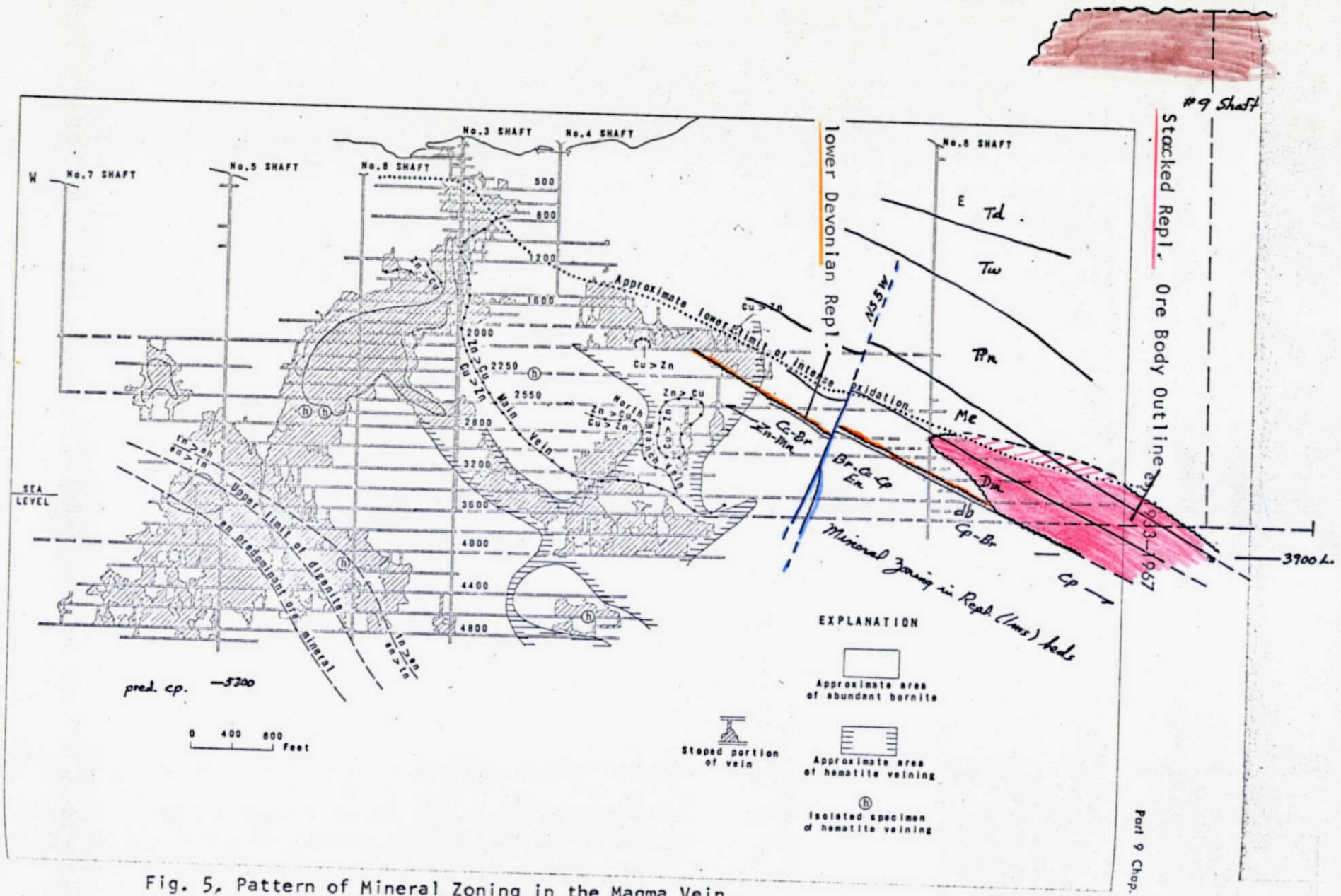


Fig. 5, Pattern of Mineral Zoning in the Magma Vein.

Modified from Hammer (Graton-Sales Vol., AIME)

FIGURE 2

Part 9 Chap. 6

side of the Main fault. The Main ore body has been stoped continuously from near surface to the 4900 level. The "West ore body" is a smaller offset portion of the Magma vein that was mined on the west side of the Main fault between the 2000 and 2800 levels. The "Central ore bodies" make up a zone of discontinuous ore shoots east of No. 3 shaft that, in gross outline, plunge steeply westward roughly parallel to the rake of the Main ore body. The Central ore bodies have been mined discontinuously from the 1600 level to the 4900 level.

The Magma vein occupies an east-striking fault zone that has been opened for more than 10,000 feet along the strike. From the surface outcrop down to a westward-raking "axis of reversal of dip" (Figure 4), the vein dips about 85° N. Below this axis, the dip reverses and continues downward to the deepest (4900) level with an average south dip of about 78°. Direction and amount of net slip along the Magma fault zone has not been determined, owing to the difficulty of matching identical points on the opposite sides of the zone. The best match of geology on the north and south walls of the vein suggests that the net movement is normal (south side down) and is predominantly down the present dip, with only a small component of right-lateral slip. A rotational movement is evident, as the vertical displacement increases from 350 feet near the Main fault to 450 feet toward the east end of the mine.

The structural map (Figure 4) of the 2550 level is a representative example of horizontal section through the vein and also shows branches of the vein and important offsets. Three principal sets of fractures have been recognized in the mine:

(1) The earliest consists of the east-striking Magma vein fault and a persistent set of lesser shears that branch away at small angles toward the northwest and southeast. This is the set of fractures that has been most extensively mineralized.

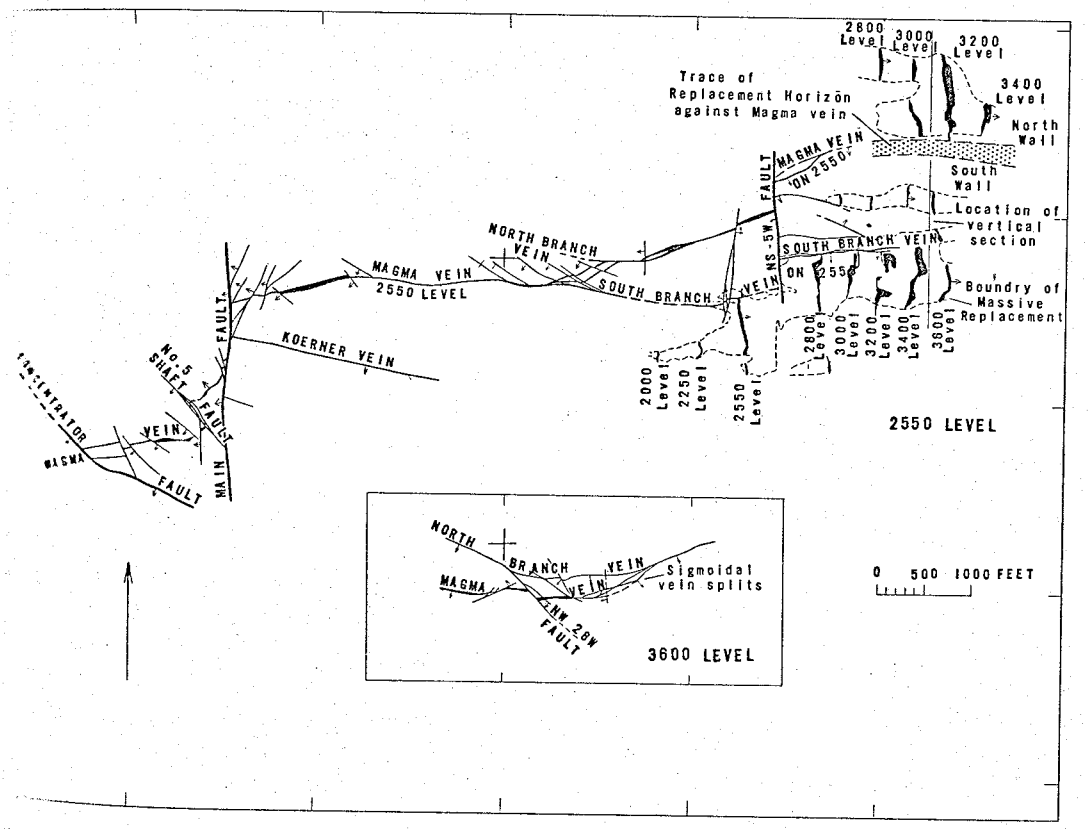


Fig. 4. Structural Map of the 2550 Level of the Magma Mine. The map shows the Magma vein, its major branches, significant subsidiary fractures, offsets by major faults of the north-striking set, and the Koerner vein. The outline of the east-dipping limestone-replacement ore bodies is projected to the diagram. The inset shows a structural map of part of the 3600 level of the mine.

can best be observed. Evidence for localization of ore shoots in the Central part of the Magma vein by premineral transverse structure is abundant. Major crossfaults, many of which have undergone postmineral movement, frequently serve as bounding structures controlling the lateral extent of individual ore shoots. Lesser cross structures appear to have imposed an added permeability upon portions of the vein-fault that are the locus of ore shoots. By inference then, this evidence may be extrapolated to the Main ore body, where much of the evidence for control by transverse structure has been obliterated.

Complex vein splits and branch veins are a structural characteristic of the zone of Central ore bodies above the 4400 level. Increased permeability of this portion of the vein, imposed through splits and branches, appears to be a major factor in localization of mineralization.

These factors suggest that the principal condition that determined specific location of mineral deposition in the Magma vein-fault is permeability imposed by structure. Shearing across irregularities in strike and dip of the vein-fault created some of the permeable zones. The fractures associated with some of the transverse structures created additional permeable zones, but other transverse structures imposed restrictive barriers to the lateral migration of ore fluids along the vein. The net effect of the permeable zones was to provide channelways along which the flow of ore fluids could concentrate.

LIMESTONE-REPLACEMENT DEPOSIT The favorability of the lower part of the Martin Limestone for replacement mineralization has been observed in many mines and prospects throughout southern Arizona. To a lesser extent, specific favorability for replacement has also been shown by the lower and the upper beds of the Escabrosa Limestone in the Superior area. It is not yet known why these beds are particularly subject to replacement, but they obviously were accessible to the ore fluids and susceptible to chemical attack during hydrothermal activity.

Figure 7 shows a north-south section

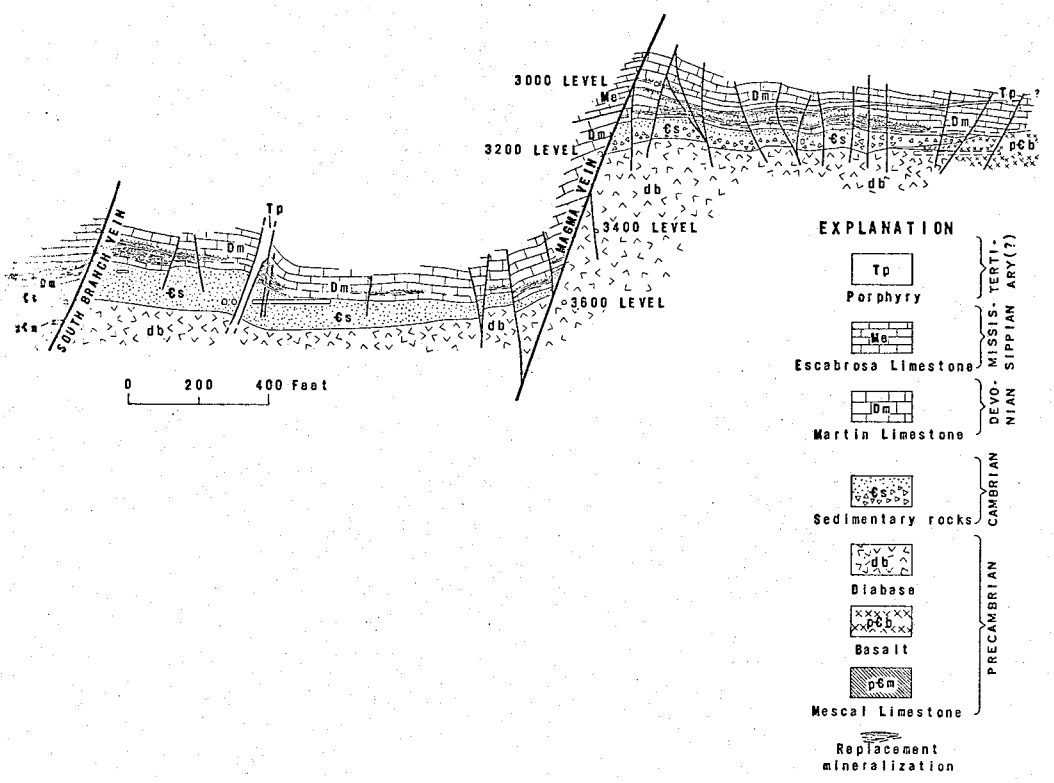


Fig. 7. Vertical North-Trending Section through the Limestone-Replacement Deposit, Magma Mine (looking west). Some ore shoots show direct connection with veins, but others are isolated. (See Figure 8 for location of section).

Shown

~~Shown~~
Mr. Shown

Called again Tuesday, 15 July 1

Holmquist & Kruis Cons Eng
364 N. 1 Ave.
Phoenix 254-6555

Map: Underground Workings of the Grand Pacific Copper Co
Scale 1" = 40' June 1919, Edward L. Hoff, Mining
Engineer, Los Angeles, Calif.
has following Survey Numbers for claims.
Belmont, # 2838. also Mont Carlo
Rawhide, # 2838.
Pacific #13, # 3581
Pacific #22, # 3581
Pacific #19, # 3581
Grand, #3581.

Bearing of 600' side on Mtn View & Iron Cap = N80°54'E
" " 1500' " = N33°29'W.

Other Map
Annex, Apex, Copper Bell = Sur #3093
Iron Cap, Mountain View = Sur 3094
Delaware = Sur 2839A.

Verbal from Don Kennedy, formerly with Magma on #9 shaft problem. Now with Red Hills group (east of Florence).

reported to W Kenty & J Balla during visit to Red Hills on Nov. 19, 1971.

Magma hit the "breccia" under the whitetail at around 3300 feet below the collar of the shaft.

The drill hole south of the shaft on the 3000 level station hit material of 1½% copper. (No info on what it was in).

The "breccia" is some 400 feet in width.

Coochie & Fred Smith have been payed for the Belmont - Grand Pacific area. "Coch" will remain "driving his truck for Magma - & not let the money go to his head!."

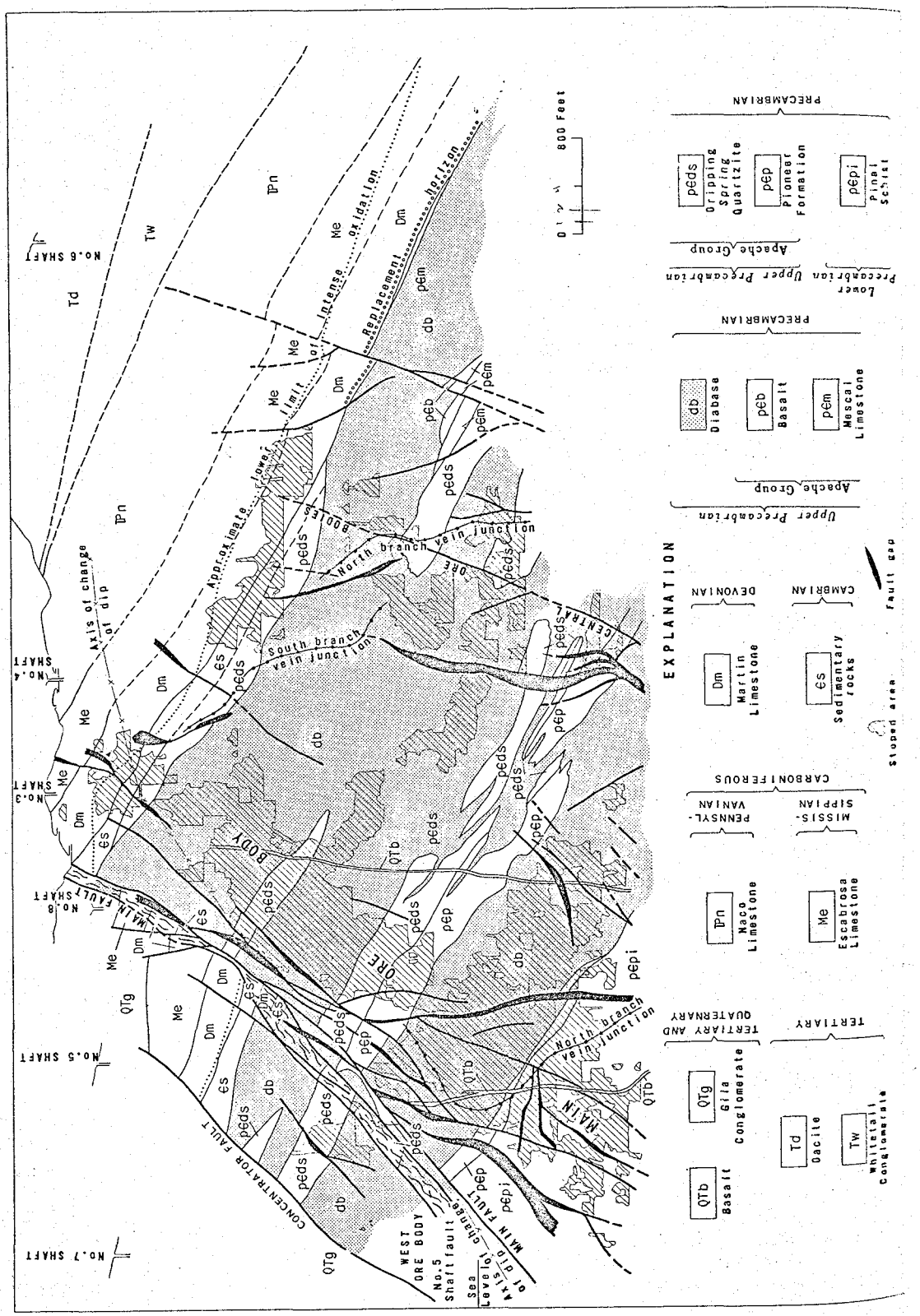


Fig. 3. Level plan of Superior vein.

Structural Map of the ... branches, significan... the Koerner vein. The ... to the diagram. The ir...

1/20/76. G.C. Bhuyan ~~Bethlehem~~, ex Magma Geologist, now with AZ State Tax Dept. says they (Magma) has now drifted over to the vein in the bx SW of #9 shaft. Looks encouraging, but additional drilling is necessary. Widths vary widely as does the grade. Dressler porphyry similar to the porphyry of #6 shaft & the main vein is found. May have 1 mill ton-in structure.

He feels the bx is a cgl and prob. Cretaceous in age & may be the Lobo Hill type volcaniclastic as at Christmas. DF Hamman doing work on it in NW-Mansfield. Bohon says bedding is often well developed & dips 20—25 degrees to east. DFH thinks it is probably a breccia pipe.

Part of Newmont's drilling activity SW of the Belmont is to check for replacement deposit in Me & Dm south of south contact of bx-cgl. So far one bx-cgl in their drill holes. He didn't think the drilling was encouraging to date, but Cu° has been noted in most of the WW total.

The extensive Cp work was to try & determine the bx-cgl configuration but apparently was not to encourage for interpretation.

GCB also thought the drilling was to test the Belmont ground to see if they wished to exercise the option.

Magma apparently will demand drill south of the vein in the bx to test for the southern contact.

GCB also mentioned that Hamman-Kennecott feel there is a chance of finding a large porphyry under the bx-cgl and perhaps find disseminated mineralization in the bx-cgl.

G.C. Bhuyan

V. Over

$\frac{32}{46}$ $\frac{11}{15}$ $\frac{12}{5}$ $\frac{15}{15}$ $\frac{12}{20}$

G.C. Bluejay
Jan. 20, 1976

Un encountered 50' of #9 shaft contains wireless gimp similar to the gimp at #6 shaft. Un width 9'-25', graded +5% - 12%. Drilled from 2800' to 3200' on fan pattern. Few holes to 3600' level.

Covered

ASARCO

Southwestern Exploration Division

January 21, 1976

TO: F. T. Graybeal

FROM: J. D. Sell

Magma Copper
Superior Division
Pinal County, Arizona

I recently was chatting with an ex-Magma geologist and we discussed the "breccia" of No. 9 Shaft and the on-going drilling south of the Belmont. Some of this thoughts:

1) Magma has now completed the drift south of No. 9 Shaft on the 3000 level into the mineralized vein within the breccia mass. Coupled with multiple fan drill holes extending from around 2800 level to the 3200 level with few penetrations to the 3600 level, they now believe:

a) The mineralized structure is parallel to the breccia-limestone contact and hence strikes east-northeasterly.
b) The structure dips southerly at 75°-85°, the same as the bx-lms contact.
c) Porphyry is found irregularly along the structure and is similar to the porphyry at No. 6 Shaft and in the Magma vein.
d) Since the porphyry cuts or fills the breccia, they believe the breccia is Cretaceous in age. (Note: I found a large boulder of the porphyry in the dump of material from the No. 9 Shaft being sunk in the breccia, suggesting part of the porphyry material is involved in the breccia development?)
e) The structure is irregular as a shear zone and varies from 9 to 25 feet in width and with copper grades from 1-1/2 to plus 5%. (The original drill hole contained an intercept of 14% copper.)
f) Reserves of around one million tons are suggested and trackless mining, cut, and fill are being suggested.

2) Don Hammer has been doing some work on the breccia problem during his stay in New York. His thoughts are that the mass is a breccia pipe. (I agree.)

3) The ex-geologist believes the mass to be a volcaniclastic unit, complete with bedded zones which dip 20-25° easterly, similar to the Cretaceous volcaniclastics of the Christmas area.

4) Magma intends to extend their underground drilling to the south to find and test the southern boundary of the breccia mass.

5) As the replacement deposits of Magma apparently occupy the north wall zone of the breccia, Magma feels that similar deposits might occupy the south side. (A thought put out some 15 years ago.)

6) The extensive drilling easterly from the Belmont area is primarily designed to test for replacement zones within the Mississippian and Devonian horizons, and most holes have apparently terminated after entering diabase.

7) Apparently the drilling results are not encouraging from the mineralization viewpoint.

8) The extensive geophysical work conducted by Newmont was designed to outline the extent of the breccia mass and hopefully detect massive replacements. Apparently the work was not encouraging.

9) Magma has apparently NOT completed the payment for the Belmont-Pacific claims and Coochie Smith (part owner) recently stated that if they paid up, then he just might retire. The ex-geologist thought that part of the rush drilling at Belmont might be in regard to holding the land. (Note: Two holes have been drilled just at the dacite front. One hole was completed back of the front and the second, further east, is now in progress on the B-P claim group.) Perhaps Asarco should reacquaint themselves with the situation in the event Newmont does not complete the Belmont-Pacific option.

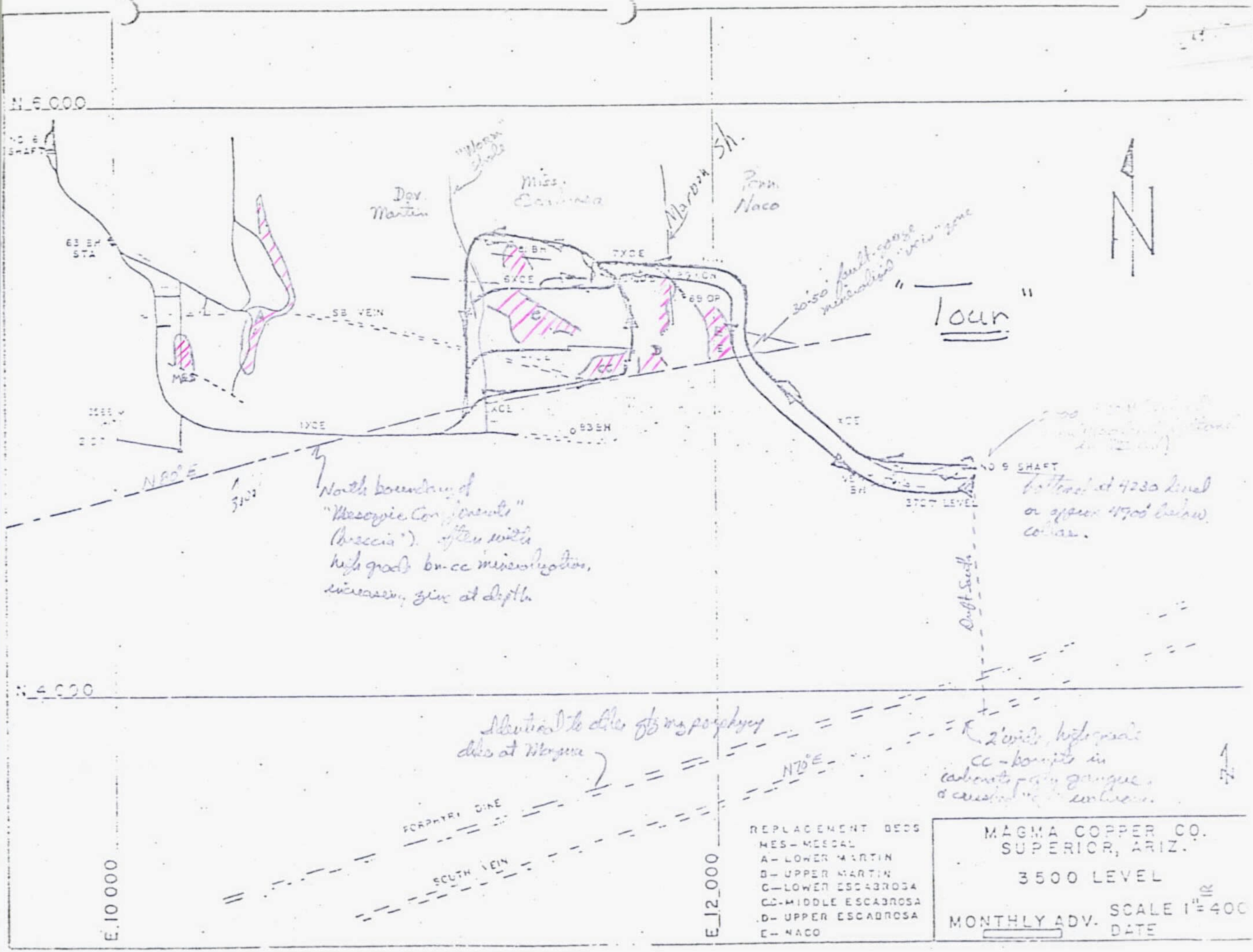
10) A suggestion put out by D. F. Hammer and the Newmont group is that the breccia may be underlain by a more extensive porphyry mass with potential of mineralization within the porphyry, as well as possible disseminated mineralization extending into the breccia mass itself. As far as the ex-geologist knew, no drill holes have been placed below 3600 level, and these probably from the 3400 level drift.

(See my memo to W. E. Saegart, dated March 30, 1970, entitled: "Buried Intrusive Breccia, Magma Copper Company, Superior Division" for early discussion of the breccia. Also, memo to W. L. Kurtz, November 23, 1971, on Magma Mine Area.)

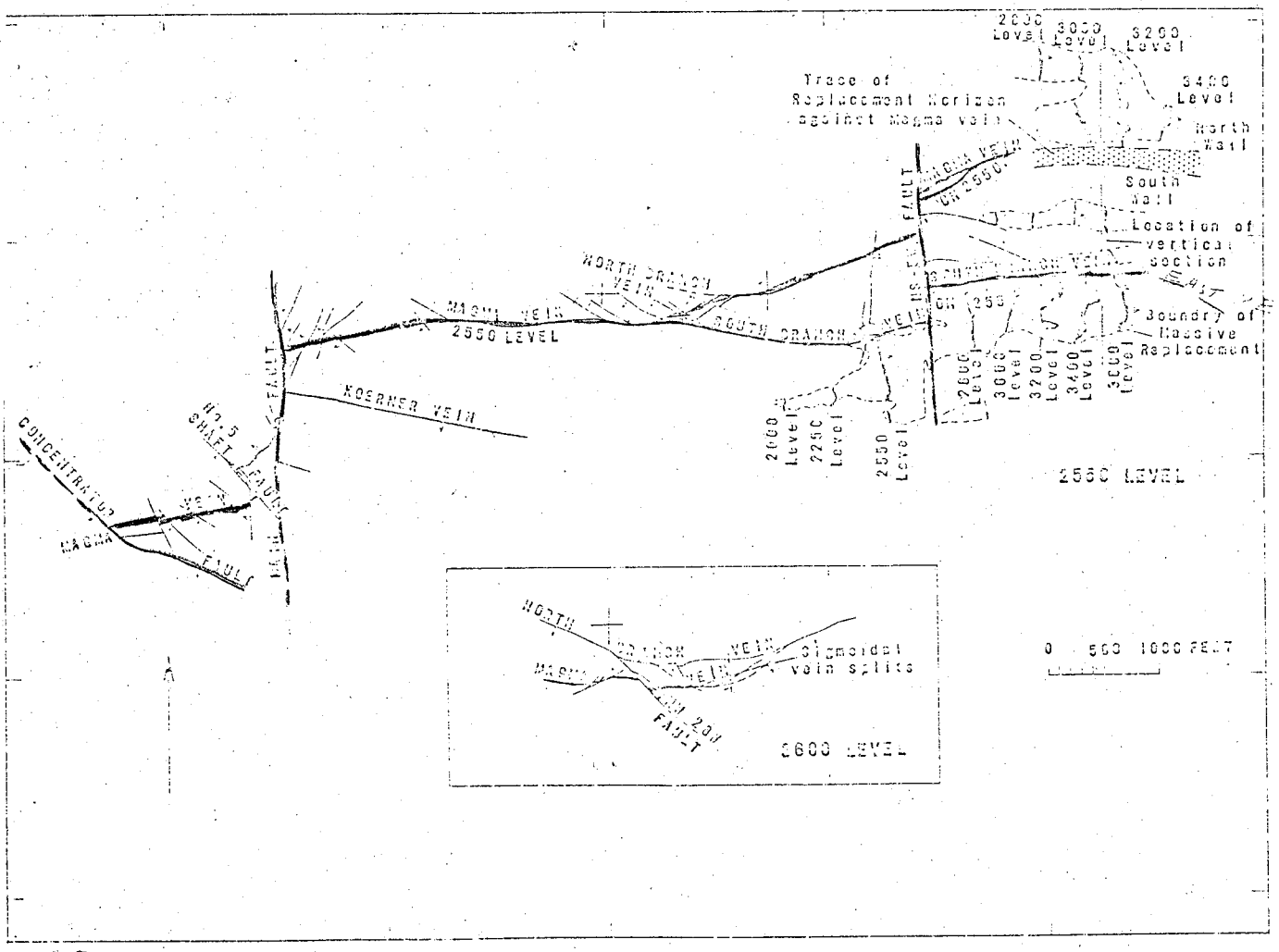
James D. Sell

James D. Sell

JDS:lb



N 6,000
NO. 6 SHAFT
63 SH STA
MES
SB VEIN
Dev. Martin
Miss. Escabrosa
Penn. Naco
6XCE
TXCE
69 OP
"Tour"
N80°E
North boundary of
"Mesozoic Conglomerate"
(breccia"). often with
high grade bn-cc mineralization,
increasing zinc at depth
XCE
63 SH
NO 9 SHAFT
3700 LEVEL
Bottomed at 4230 level
or approx 4700' below
collar.
Drift South
N 4,000
dike at Magma
N70°E
2' wide, high grade
cc-bornite in
PORPHYRY DIKE
SOUTH VEIN
E 10000
E 12,000
REPLACEMENT BEDS
MES- MESCAL
A- LOWER MARTIN
B- UPPER MARTIN
C- LOWER ESCABROSA
CC- MIDDLE ESCABROSA
D- UPPER ESCABROSA
E- NACO
MAGMA COPPER CO.
SUPERIOR, ARIZ.
3500 LEVEL
MONTHLY ADV.
SCALE 1"=400
DATE



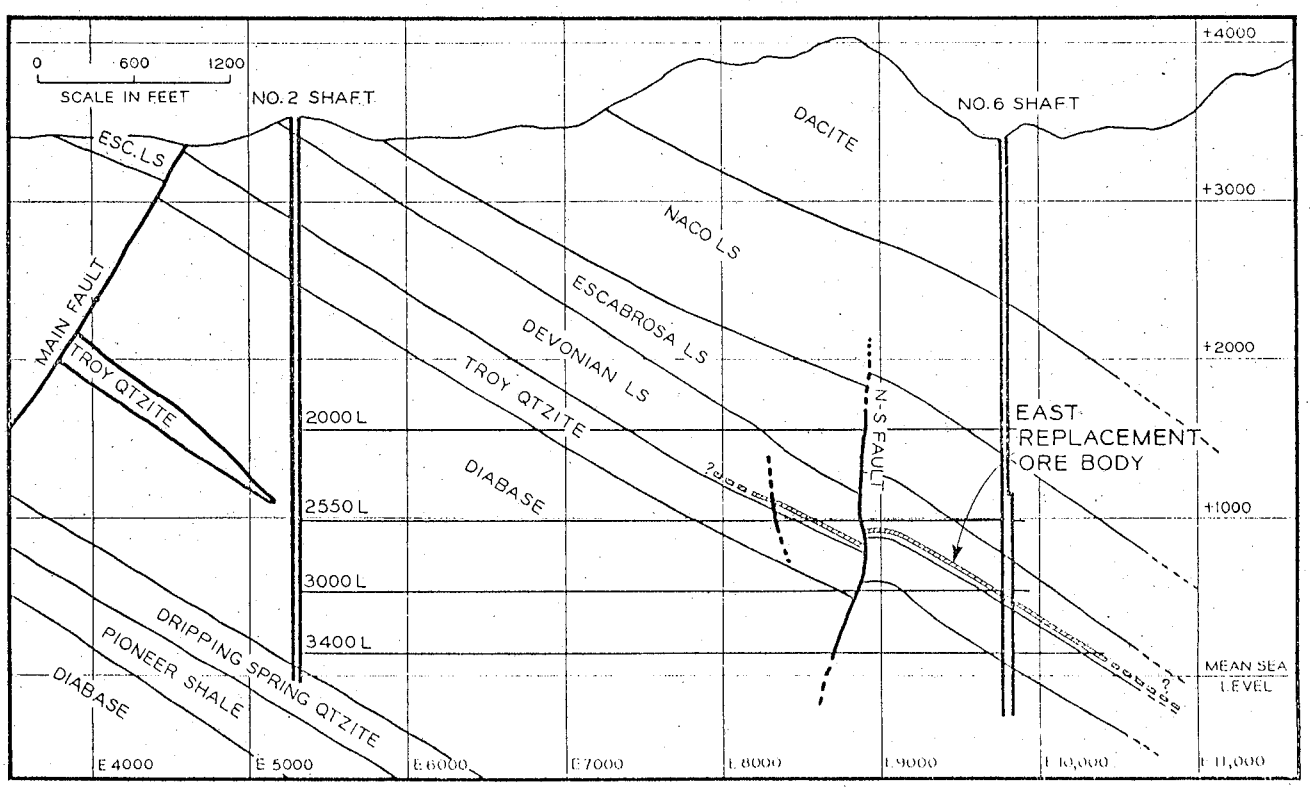


Fig. 2. East Replacement Orebody, east-west vertical section looking north.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

November 23, 1971

TO: W. L. Kurtz

FROM: J. D. Sell

Magma Mine Area
Superior
Pinal County, Arizona

From a telephone conversation of 11/22/71 with Russ Webster and Ben Greene of Magma Copper, the following notes are submitted:

1) They are interested in increasing the available water supply near Superior due to the expansion of mill capacity now in progress. Thus, they were inquiring into the water conditions of our A-4. I informed them that no water problem, either loss into the formation or dilution of drilling fluids from the formation, occurred in the drill hole after we cased the hole. Apparently, the water flow from No. 9 shaft has dropped considerably and is now very little addition to their source.

2) Both acted surprised when asked how they liked the findings in A-4, and both said they'd like to know more. No real clue as to whether they do or do not know what was in the hole. (Could Don Kennedy have still another Magma source?)

3) The shaft has connected into the 3000 level drift (from No. 6 shaft), which is about 500 feet above sea level elevation. Sinking has stopped to allow the installation of some chill-water lines, etc. for the mine areas.

4) Webster said that the Whitetail-other "rock" contact was just above, as he remembered it, the 2550 level. This would place it around 950 feet above sea level or 3250 feet below the collar of No. 9 shaft. I had previously reported the information that they anticipated the contact at 2960 feet below the collar, based on a diamond drill intercept. (My monthly report for June, 1971).

5) I also inquired as to what they had named the "rock" and Webster said they still did not have a name. I asked if it would be possible to tour the 3000 level and shaft area and Webster thought it would be off limits.

6) Webster did say that they now had two drill holes in the "mineralization" to the south of the shaft but that it was not as good as they had originally hoped and that it appeared to be a shear zone in the "rock" ("breccia"). He plans several more holes but says he is not optimistic in believing the mineralization is of any consequence.

7) Native copper was found throughout the Whitetail in No. 9 shaft but Webster questioned the assays they have received on the samples submitted. I said, "Well, I'd think that the assay office might have 0.4% copper just floating around.", and he countered that most of the assays were not that high.

8) Both Webster and Greene had not heard that Magma has payed the $800,000 for the Belmont-Grand Pacific mine area, and although Webster said he might not be the first to know he did doubt that Magma had payed it yet.

9) I mentioned that when and if they should need a joint venture partner in any phase of the work around Magma, please keep us in mind.

J. D. Sell

JDS:lad

#9 Shaft info:
0 = 1875 Tel
1875 - 3250 Tw
3250 - 4900 Thx

(B Green verified 1400 ft of Whitetail in shaft on 8/8/71.

4900
4600
4600
12

4a-14A-19.13

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 5, 1969

FILE MEMORANDUM

Superior Division
Magma Copper Company
Superior (Pinal County), Arizona

The Underground Division of the Arizona Section, AIME, held the Spring meeting at Superior on May 2, 1969. It was attended by J R Wojcik and J D Sell as well as others from the smelter and mining departments.

The mornings activity was taken up with a tour of the presently mining limestone replacement deposit. Stopes and equipment being used in the trackless mining-cemented sandfill areas were visited. These studies are in anticipation for mining the new "Escabrosa" reserves. The raise drill was also inspected as well as several of the 5 foot diameter holes which have been drilled. Following the underground tour the automated surface sand-fill plant was toured. Following lunch a technical session was presented with three papers read: 1) Sand-fill by B. Johnson, 2) Load-and-carry machines by F. Flores, and 3) The Security raise-drill by J. Murry. Attached is the data sheet on the Sandplant--the only paper distributed.

In regard to the Superior Division, Magma Copper released the following statement (Notice to Stockholders, March 28, 1969, p. 38):

> "Extensive diamond drilling has developed additional replacement orebodies in beds lying stratigraphically above the areas presently being mined, and has increased the ore reserves to the highest tonnage in this mine's long history. As of December 31, 1968, total reserves at Superior were estimated at 10,100,000 tons of ore averaging 5.88% copper, before dilution."

They further announced an expansion program to double the production rate from 1500 to 3,000 tons per day. A new shaft (No. 9) is to be put down from the Oak Flat area to a depth of 4,800 feet and will be connected with the mill by a new 9,100 foot haulage tunnel on the 500-foot level. The smelter is to be closed and all concentrates shipped by rail to the expanded San Manuel smelter. Completion date for all phases is 1972.

The pioneer road into the new shaft area is completed and bids for the shaft (22-foot diameter) will be asked this week. The tunnel borer, with laser-beam guidance, for the haulage tunnel is scheduled for delivery in September and will drive a $12\frac{1}{2}$-foot tunnel. The portal area is being prepared and the first 200 feet will be driven by conventional means.

Figure 1, USGS 7½' quad., shows the approximate location of the proposed shaft and haulage tunnel as well as the general outline of the replacement ore-bodies mined to date. The new replacement tonnage given in the announcement is largely from deposits in the Escabrosa Limestone but commercial mineralization has been found in various parts of the Mescal, Martin, Escabrosa, and Naco Limestones. Most of the new reserves lie above and easterly from the "old" Devonian beds as shown. The main sulfide Escabrosa ore-body apparently apexes about the 3000 level and above this the former mineralization has been destroyed by intense oxidation. Native copper and secondary chalcocite is found at the interface. (See various sections in the paper by Hammer and Peterson, 1968: Geology of the Magma Mine Area, Arizona, p-1282-1310 in Ore Deposits in the United States 1933-1967, volume 2, AIME).

Table I lists the production from the Magma Mine (Superior), from Hammer's paper and annual reports, and indicates that the newly announced tonnage reserves, developed in the last three years, is equal to about two-third of the total tons mined to date! Mining within the vein systems essentially terminated in late 1963 and thus the later grade figures reflect those of the old Devonian replacement beds. Thus it would appear that the new reserves at 5.88% copper are going to be somewhat higher than has been mined in the past (dependent upon the amount of dilution). Therreserves are still open ended.

Table I

Tonnage and Production-Magma Copper Co., Superior.

Year	Ore (tons)	Copper(lbs)	Silver(oz)	Gold(oz)	Ave. Grade Cu%	Ag oz	Au oz
1911-1964	13,695,822	1,460,400,223	25,118,086	435,716	5.69	1.93	0.031
1965	439,911	38,904,231	408,366	12,748	4.65	0.99	0.031
1966	431,913	39,262,051	466,334	12,802	4.70	1.13	0.032
1967	219,510	19,100,841	197,419	4,970	4.77	1.01	0.026
1968	333,607	29,412,000	347,119	7,262	4.4*	1.0*	0.022*
Grand Total	15,120,763	1,587,079,346	26,537,324	473,498			

*Calculated from tonnage-production figures.

Figure 2, from Hammer and Peterson, shows the distribution of the old replacement outlines and a cross-section through the deposits. Note that the individual ore bodies are quite continuous down dip and the outlines generally follow the easterly trend of the major mineralized veins.

Drilling for the new replacement horizons was essentially by very long drill holes fanned out from drill positions along the 3200 level east drift which terminated at E 109 position or 3700 feet east of No. 6 shaft (see figure 1). The limestones at this position still maintained their 30 degree eastward dip as is shown on Hammer's sections in the AIME volume.

Sand-fill is the major factor in being able to maintain production in the present mining areas (data presented at the meeting is included as Attachment A). Sand-fill placement since the start up in March 1963, through April 1969, was 650,000 tons of sand-fill. Present rate of production is 11,000 tons of dry sand per month.

The AIME tour did not include any look at the new reserve areas but a geologic tour of the Magma limestone workings for ASARCO personnel can be set up by contacting Mr. Russell Webster, Chief Geologist at the Magma (Superior) Division. Also attached separately is a copy of my thesis on a portion of the Devonian replacement ore body.

James D. Sell

James D. Sell

cc: JRWojcik

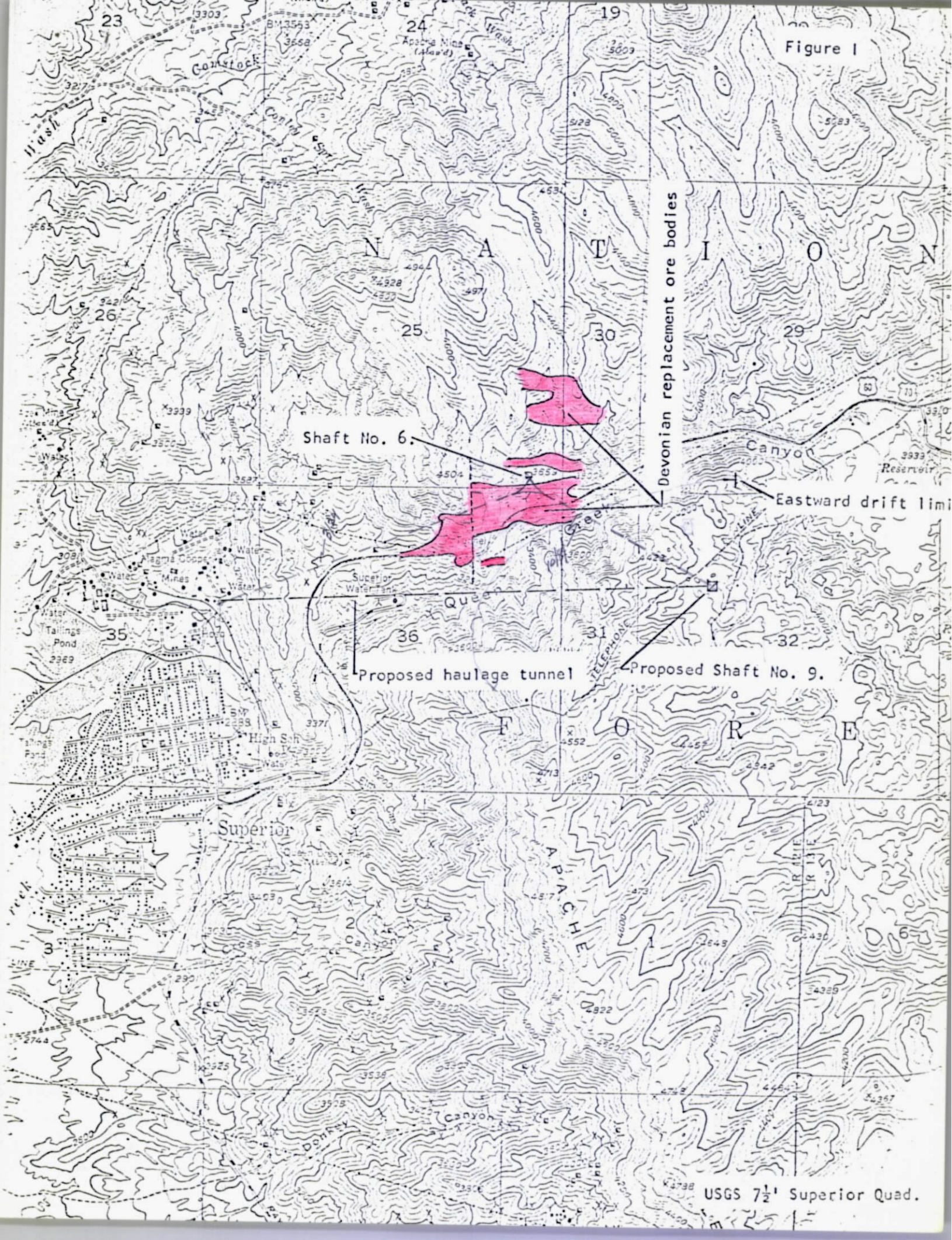


Figure 1
Devonian replacement ore bodies
Shaft No. 6.
Proposed haulage tunnel
Proposed Shaft No. 9.
Eastward drift limi
Superior
USGS 7½' Superior Quad.

Figure 2

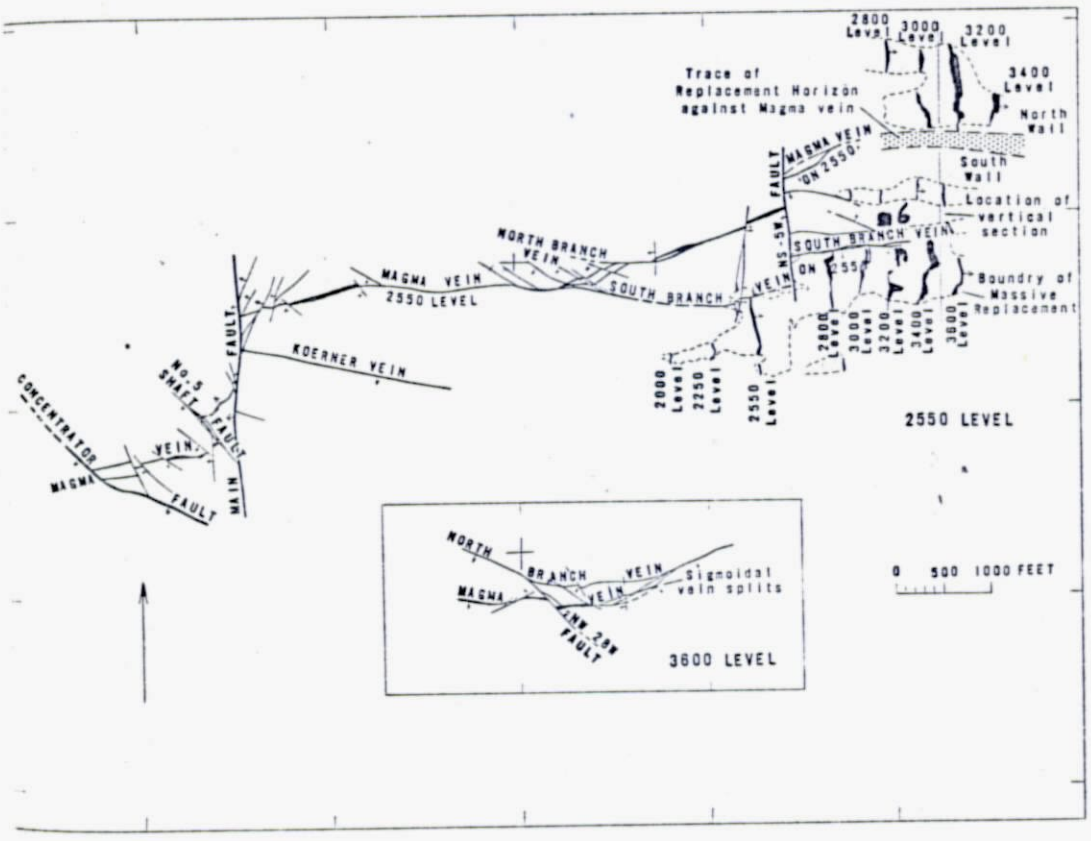


FIG. 4. *Structural Map of the 2550 Level of the Magma Mine. The map shows the Magma vein, its major branches, significant subsidiary fractures, offsets by major faults of the north-striking set, and the Koerner vein. The outline of the east-dipping limestone-replacement ore bodies is projected to the diagram. The inset shows a structural map of part of the 3600 level of the mine.*

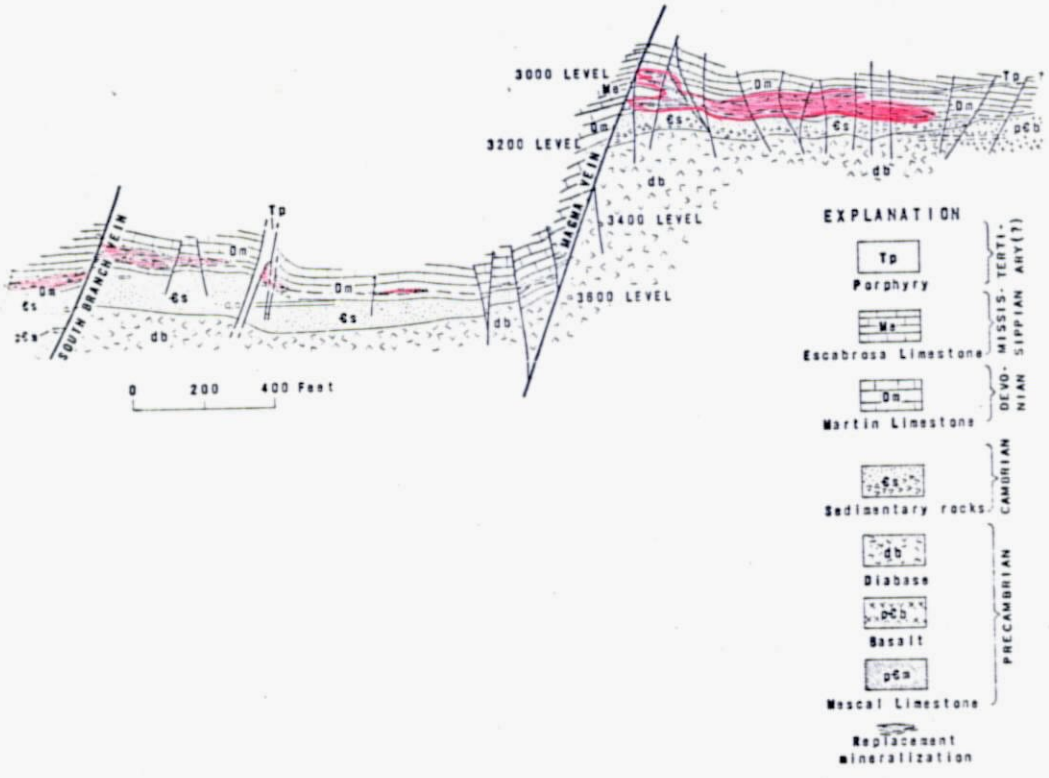


FIG. 7. *Vertical North-Trending Section through the Limestone-Replacement Deposit, Magma Mine (looking west). Some ore shoots show direct connection with veins, but others are isolated. (See Figure 8 for location of section).*

4

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 11, 1971

FILE MEMORANDUM

Whitetail Conglomerate
Magma Copper Company
Superior, Arizona
Pinal County, Arizona

On April 28, 1971, H. L. Crittendon, R. B. Cummings and myself toured a portion of Magma Copper's new tunnel and inspected the dump material from their new No. 9 Shaft.

The tunnel driven on the 500-Level, or Mine Yard Level, is a circular opening and was cut by a tunnel borer with a diameter of 12-1/2 feet. Little trouble has been experienced in holding the tunnel open except in obvious fault areas where some sloughing is occurring, but relatively little in comparison to the conventional drill-blast sequence in other tunnels where timbering is generally a necessary part of the tunnel work. The tunnel trends N70°E toward No. 6 Shaft and at that point, a "Y" is being established to connect with No. 6, while the main tunnel swings S60°E and connects with No. 9 Shaft.

In the tunnel, a down faulted block of dacite is at the entrance followed by Bolsa Quartzite (Cambrian), Martin limestone (Devonian), Escabrosa limestone (Mississippian), Naco limestone (Pennsylvanian), Whitetail conglomerate (Oligocene), and Dacite (Miocene). The pre-Whitetail units dip 30° easterly.

The top of the Escabrosa is marked by a 40-foot (stratigraphic) section of distinctive "maroon shale" very noticeable in the highway cuts near the Queen Creek bridge east of Superior. In the tunnel the base of the Naco was at 2250 feet while the top of the Naco was at 4266 feet, giving a stratigraphic thickness of some 1,000 feet. A surface section of 1079 feet of Naco was measured by H. R. Wanless in 1949 (see Naco Stratigraphic File Memo, dated May 6, 1971).

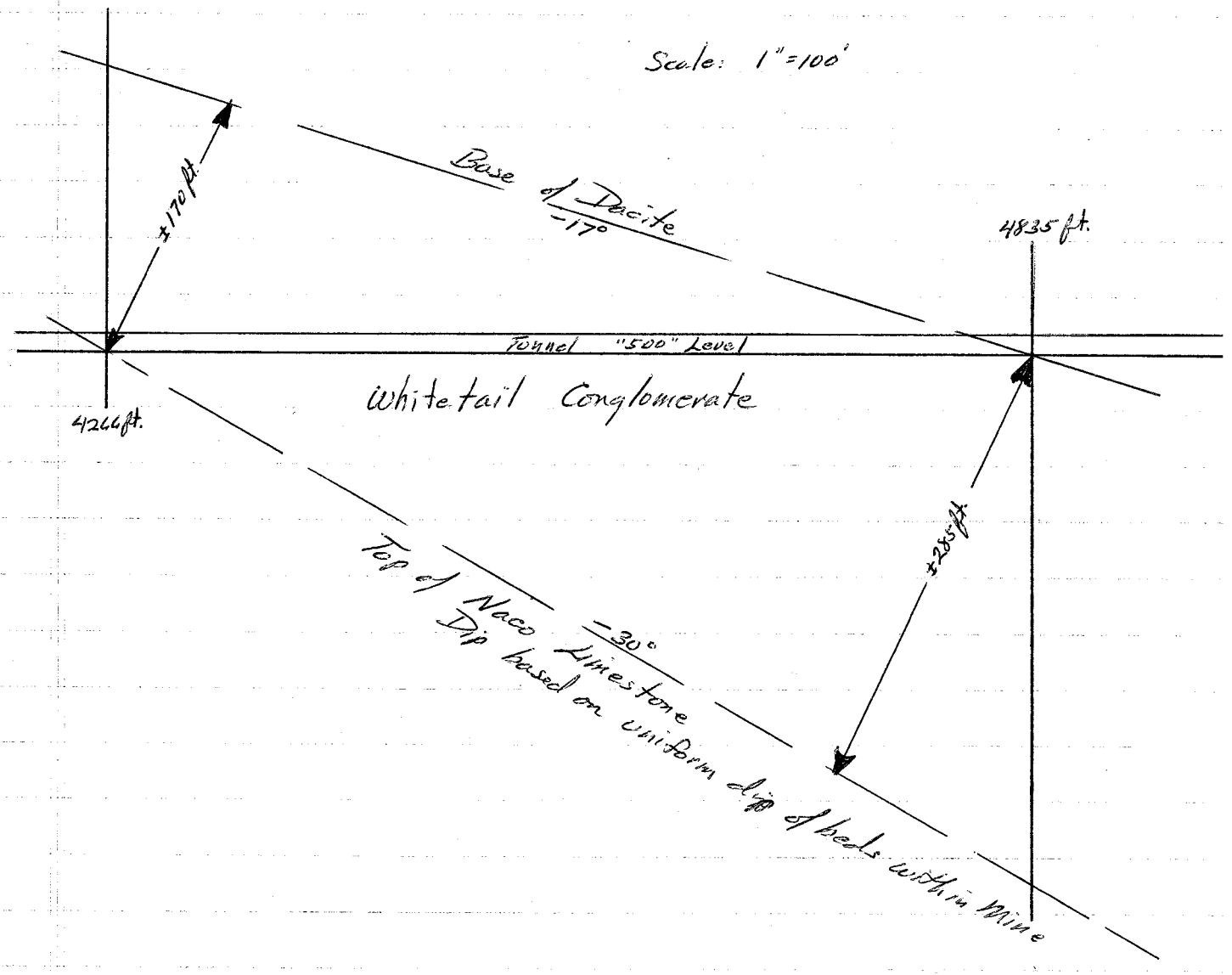
The contact of the Whitetail and Naco strikes about N15°W and dips 30° eastward while somewhat inside the Whitetail the bedding strikes N35°W and dips 16-18°E showing the overall unconformable attitude of the Whitetail. The top of the Whitetail is at 4835 feet in the tunnel with a contact of dacite tuff and overlying vitrophyre. Thus, using a -30°dip for the base of the Whitetail and -17°dip for the top of the Whitetail, it would show approximately 160 feet thick where first encountered and increasing to 290 feet at the eastern contact. Approximately 1000 feet eastward, the Whitetail is reported to be 600 feet thick in No. 6 Shaft. Projected thickness in No. 9 Shaft is 1600-1700 feet. No. 9 Shaft intercepted the top of the Whitetail at 1875 feet below the collar and as of May 7, 1971, was at 2360 and still in Whitetail.

Abundant clasts are found at various sections within the Whitetail and though the matrix character of the Whitetail in the tunnel changes from light colored to a darker color at the top in the tunnel section, no clasts of early volcanics were noted to suggest that part of the Whitetail belongs to the intra volcanic conglomerate. Native copper is found in various places in the tunnel area. The copper occurs as matrix filling as well as within clast such as diabase and schist. At the No. 9 Shaft site, inspection of the dump material of Whitetail from the 2300 foot level (and later from the 2360 foot level) showed clasts of schist, diabase, quartzite, limestone, and one large altered porphyry cobble. Native copper was found in schist, quartzite, and diabase. The porphyry is altered by clay and quartz-sericite and has pyritic casts with darker colors suggesting some copper limonites.

James D. Sell

JDS:van

Information dated Jan. 29, 1971 from Ted Ribici supplemented by visit & talking with R Webster & B Green on April 28, 1971.



No. 9 Shaft: Surface to base of vitrophyre = 1865 ft.
White tuff unit ≅ 10 ft
Thickness of Dacite ≅ 1875 feet.

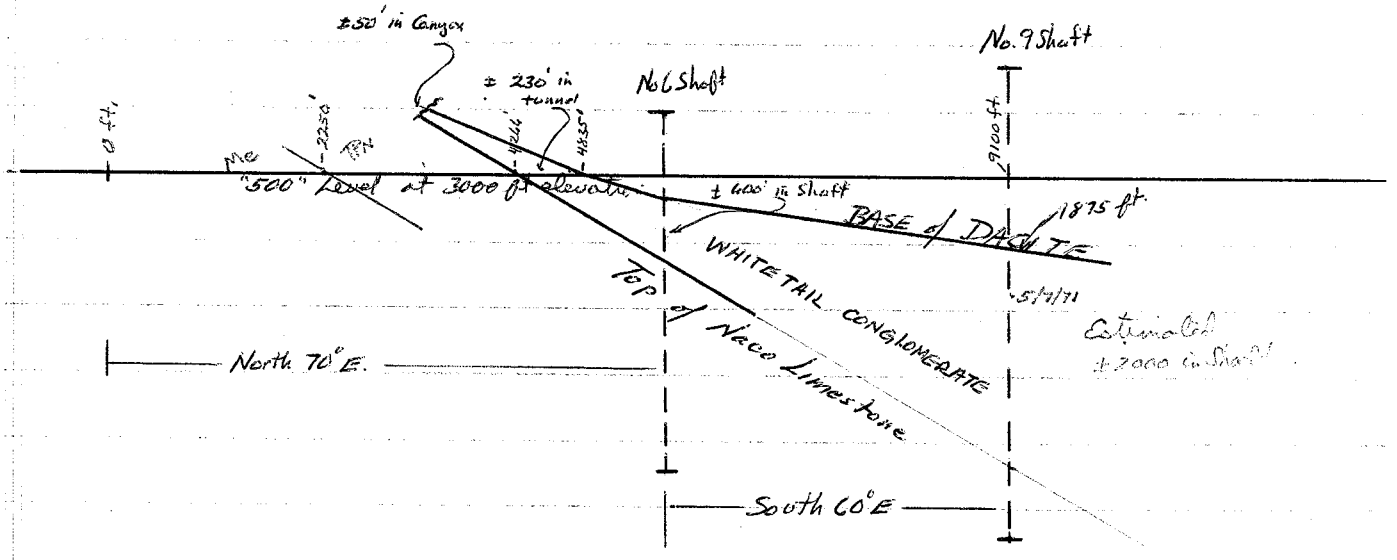
May 7, 1971, Shaft in Whitetail at 2360 feet. Native copper in clasts of schist & diabase.

Verbal Comments of R Webster & B Green : April 25, 1971

East-West Section looking North. Line of Magma New tunnel to No. 9 Shaft.

1" = 2000'.

Whitetail Conglomerate:



TPN-Tw contact strike N 15° W, dips 30° E conformable to bedding in Naco Lms.

Tw internally, bedding strike N 35° W, dips 16-18° E.

Several areas of short (1-1½') imbricate pebble structures suggest Whitetail transport direction is to the east. Most shows little sorting & has dumped appearance.

MAGMA COPPER COMPANY
Superior Division

February 1, 1971

Summary of Diamond Drilling

		INTERSECTION		
	Footage	% Cu	Oz. Ag	Oz. Au
3695 S 71°W - 34°				
Drilling to check the Naco; the Upper Escabrosa and the Lower Escabrosa replacement beds below 3600-6 MXCE, down dip from the intersections in the drift.	Naco replacement intersected at 67'.			

Advance- Month- 85'
To date- - 85'
Estimated Total- 500'

Tons

1969 422,629 @ 4 $526

70 443,212 @ 4 $416

4.526 × 20 = 90.520

422,629 × 90.25

211 3145
845 258
38 0366 10
38,142,267.25 lbs

30,256,577.08

4.416 × 20 = 88.320

443,212 × 88.32

886424
1329636
3545696
3545696
39,144,833.84 ✓

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 6, 1971

FILE MEMORANDUM

Stratigraphy
Naco Limestone (Pennsylvanian)
Superior, Pinal County, Arizona

The attached detailed stratigraphic section of the Pennsylvanian Naco Limestone was measured by H. R. Wanless in the Queen Creek drainage at Superior, Arizona.

As far as known, no other section of the Naco has been measured in this detail in the district.

James D. Sell

JDS:van
Att.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

October 9, 1970

FILE MEMORANDUM:

Subject: Superior Division
Magma Copper Company
Superior (Pinal County), Ariz.

On October 8, 1970, while in the east claim area of our Dacite Group, I ran into Don Hammer, exploration geologist (San Manuel) and Rus Webster, chief geologist (Superior) who were "checking on the activity of ASARCO and the position of known drill holes" on the dacite plateau.

To supplement my memo of March 30, 1970, I learned from Webster that their No. 9 shaft is presently down 1100 feet in Dacite (500 feet deeper than on March 24) and encountering abundant water and even more contractor-manpower problems. The new haulage tunnel is in 6800 feet and has "turned" the corner just south of their No. 6 shaft. This advance is 4800 feet since March 24. Later, a connection will be made to No. 6 shaft.

It was reaffirmed that ASARCO would enjoy a tour of Magma's new workings and a date will be set shortly. Continued discussions will be held with Webster and Hammer to test joint-venture exploration thoughts.

James D. Sell

James D. Sell

JDS:mw
cc: W. E. Saegart

COPPER HILLS MOTOR HOTEL
US HWYS 60 & 70 • RT. 1 BOX 506 • MIAMI, ARIZONA 85539 • (602) 473-2481

Tue - 24 march.

Toured underground at Superior.

Viewed the upper Mastin (B horizon) ; lower Escalante (C horizon) ; upper Escalante (D horizon) ; & lower Naco (E horizon) beds of the new ore reserves.

approx. 50% of the Escalante is mineralized and contains about 50% of the reserves. Lower Mastin = 15%, upper Mastin = 5-7%?, and lower Naco 25-?%. Minor pockets high grade reserves in Mescal limestone.

As many as 5 horizons are mineralized in the Escalante but the two named, "C & D", are the thickest & most persistent. The others pinch out &/or merge &/or split off (both laterally & vertically) from the main horizons.

Reserves have been blocked out to essentially the 3900 Level & mineralization is known via drill holes down to the 4,300 level. No apparent change in dip to that depth !! The top of the main Escalante (~~upper~~ D) is around 2800 Level and is oxidized above this. No raises yet into the oxidized part but No 8 D Raise (in ore shoot near No 6 shaft) is nearing the upper limit & shows high grade chalcocite, plus disseminated native copper on F-W, in the No 6 shaft vein. A drill hole in the oxidized part shows bornite only (assaying c. 12% Cu) & no copper oxides or carbonates. Webster thinks the chalcocite is supergene enrichment !

Going down dip it is suggested that a change from, say N 45 W fault area, the upper ends in chalcocite-evansite-bornite w/ hematite-pyrite to decreasing amounts of cc-evs., ~~to~~ it is mostly chalcopyrite-minor bornite in heavy hematite w/ pyrite, to down on the 3400 & below it is primarily chalcopyrite in pyrite.

This is also true with the lower ~~Boom~~ Mastin main vein beds presently being mined & on the lower limits (3400 ±)

the massive pyrite does not carry sufficient values to be Magma ore (ie - 3% ?!).

Multiple replacement beds have been found over the old South beds (the largest concentration) & over the #6 shaft sheet, but extensive drilling above the Martin beds (old) in the Main Vein area has failed to find much mineral & no ore to date.

The breccia problem still exists but recent work has shown that the contact is quite straight from 3200? to 3400? - with ore beds up to and against the bx, & lower down it curves northward & starts to chop off the downdip proj. of the various ore beds. The bx is still a "volcanic" type or very basic rocks (check & see what TCU looks like!) but still contains minor & spotty py-cp values. — especially near its margin. A 3400 Level drift is within the bx & heading east to connect w/ #9 shaft.

#9 Shaft (± E 12,850 & N 4750) is down 400' in dacite & will hit into the 500 Level tunnel at about 1800 feet below the collar. Thus the 4900 foot shaft will bottom at the 3600 Level of the existing working. Drifts are being driven from 3000, 3200, 3400, & 3600 level to the projected shaft area.

The tunnel bore is in 2200 ft of the proj. 7000 ft and has cut about 80 feet of Marion Shale (Eoc - Naco contact), and it also has cut a very beautiful tunnel requiring only minor support across several dipping faults (& possible formational contact). Going thru the main fault (Basic agglomerate → Bolsa quartzite) gave no problem. Several open water courses have been cut but no veins or mineralized beds (?).

Manganese - zinc appears to be the ore dip zonation of many of the ore-bodies. Possibly good prospecting but & would be key to Valuation!

COPPER HILLS MOTOR HOTEL
US HWYS 60 & 70 • RT. 1 BOX 506 • MIAMI, ARIZONA 85539 • (602) 473-2481

23 March — Passed Asbestos

#9 Shaft down 600 feet in Wash. No shaft here. Only one long drift from 3400 level into projected area!

Tunnel here in 2000 ft and near Maren contact (Escabrosa-Naco).

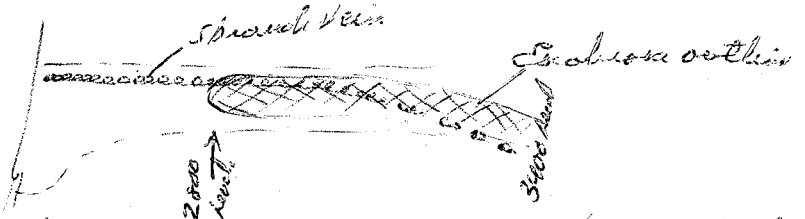
Replacement beds drilled from 3200, 3000, & mainly from 3600 level.

3600 level out to 109 Section.

Escabrosa is main reserves but also in Mescal, upper Rec., and in Naco.

Magma repl Devonian topped at 2530 level. No other repl. beds found as of yet in Magma main area.

The Escabrosa beds lie above and inside the lateral limits of the old lower Rec. repl. outline of east beds!



Rec shows the Escab outline to curve to the south as the 3400 level is reached. He also expressed the idea that the South Branch Vein comes off faster & probably cuts across the Esc. wedge.

2800 is top of sulfides — above is oxidized.

2550 level drifts in west beds strongly leached upper horizons on far south (no commercial) but they have not leached above old west beds

Irwin

23 March

Woody Simmons & Joe Powell

To secure permission to obtain data info it will be necessary to write Woody (c Cait?) a letter of request. Doesn't sound encouraging.

Joe says they have some 13-15 holes drilled on east side of fault into the deep orebody.

The new Castle Dome area is to be known as the Pinto Valley Project as it is separate from the old ore body (by 500' of rock?!).

They apparently are still trying to secure additional claims in area.

Also had claim map in upper Pinto Canyon with Harrell Powell written claim grouping ?

Also reviewed new "Gold" maps of Old Dominion mine as well as old reports on same laying around.

CHESS LAMBERTON, PRESIDENT
FRANKLIN, PA.

W. E. BARROW, SECRETARY-TREASURER
1098 IVANHOE RD., CLEVELAND, O.

UNITED MAGMA COPPER COMPANY

MINES: SUPERIOR, ARIZONA

Maps and reports of United Magma Copper Co., mailed to Belmont Copper Mining Co., Phoenix, Arizona, on Oct. 29, 1926.

- -

No. 1		Large map of underground workings with tracing of progress.
" 2		Location of various mines in district. Small print.
" 3		Large map - Profile of Goodwin Spring Pipe Line.
" 4		" " - Longitudinal projection tunnel sites.
" 5		Mine workings, showing tunnels and shafts.
" 6		Section of State showing various towns and locations.
" 7		Underground Workings.
" 8		Various groups in the Pioneer District.
" 9		Mine Workings.
" 10		"A" Level
" 11		No. 8 Level.
" 12		Main Workings above No. 3 Tunnel.
" 13		Map of United Magma Group of Claims.
" 14		Location of Mines, Water Supply Pipe Lines & Tunnel Sites.
" 15		Group of Grand Pacific Claims and adjoining Claims.
" 16		Report H. W. C. Prommel
" 17	"	Walter Harvey Weed (Apr. 7, 1919)
" 18	"	" " " (" 6, 1918)
" 19	"	" " " (Oct. 27, 1917)
" 20	"	Wm. F. Gordon

Patent plat of the Iron Cap & Mountain View Survey No. 3094.
Map of claims Pioneer District Exploration C & A Mining Co., March 9, 1914

Secured duplicate copies.

10/22/1917

WALTER HARVEY WEED
GEOLOGIST AND MINING ENGINEER
29 BROADWAY
NEW YORK CITY

October 22nd, 1917.

TO THE GRAND PACIFIC COPPER CO.,

PHOENIX, ARIZONA.

I submit herewith a report upon the holdings of the Grand Pacific Copper Co., based upon recent data and maps furnished me, supplementing my own knowledge of the tract.

HOLDINGS

The company's property consists of a rectangular block of ground 9000' long and 3600' wide, covered by 35 mining claims, about 700 acres, in the pioneer district, 2½ miles south of Superior, Arizona. The Magma R.R. at present the S.P. (Arizona Eastern), near Florence.

ECONOMIC CONDITIONS.

The economic conditions are as good as at most Arizona mines, the climate being better than at the nearby camp of Ray. The railway ensures cheap supplies from Phoenix and the Salt River Valley towns, 50 to 65 miles to the west.

LOCATION.

The Grand Pacific property covers a distance of 9000' along the western slope of the Apache Ridge, on the main mineralized belt of the district and contains the most favorable surface conditions observed south of the town of Superior. This belt is now being actively prospected for a distance of six miles or more, from the vicinity of the Silver King Mine, once Arizona's premier silver producer, on the North for a mile south of the Grand Pacific holdings.

GEOLOGY.

The Grand Pacific tract shows practically the same geological and mineralogical conditions observed at the Magma mine, and the amount and character of the ore developed is as good as that of the Magma at the same stage of development.

The general geologic conditions are simple. At the base of the steel mountain ridge that walls in the valley on the east, the foothills are formed mainly of intrusive diabase. Above this rock beded kuartzites appear capped by a series of limestone beds of varying color texture and age. All these beded rocks dip eastward, at about thirty degrees, into the mountain and the varying hardness of different beds emphasizes the structure. This general conditions prevails along the mountain front for several miles, both north and south of Superior. This simple foulding is broken by cross faults, some of which are filled by porphry. The best known fault is that of the Magma mine, and the ore bodies of that property are confined to this crossfault. Other crossfaults occur at various places along the mountain front, displacing the rocks and their outcrops marked by silicification and black manganese staining, but the Sandel vein of the Grand Pacific mine is the only one in which ore has been found in commercial amounts and thus far the only one in which conditions positively warrant the belief that a big orebody of copper ore will be found at or below the water level.

VEINS.

The property shows the outcrop of two cross veins, the

Sandel, at the north end of the tract and the Iron Ridge at the south end. It also has the outcrop of the "Silver" vein, which is believed to be the southern extension of U.S. & A. vein long worked near the Magma at the Lake Superior & Arizona property. This vein is a mineralized bedding fault, slip or fracture, persistent for many miles, marked by iron and managanese stained jasper and considered to me the mother vein of the district. The vein is flat, dips with the bedding of the rocks and is found at or near the quartzite limestone contact.

ORE OCCURRENCE.

The Grand Pacific mine's workings are on the Sandel vein -- a fissure 2' to 5' wide in the upper workings. This vein shows two shoots of ore, material of which was not carried off during the long period of leaching which the vein has been subjected to. The ore occurs in lenses on the footwall; the alignment of the lenses gives an easterly rake to the shoot, whereas the vein dips at about sixty degrees to the north. The vein filling is a leached and oxidized clayey material, locally called gouge, which is probably an altered porphyry, though it cannot be positively identified as such.

DEVELOPMENT.

The development on the vein is not deep enough to reach the zone of unaltered ore. The initial work, on the vein, a tunnel 150' long, disclosed a small ore bunch near the portal and a shoot of silicious, brown jaspery looking ore, carrying 8% to 20% copper. This shoot is 2" - 6' ; It is a lenticular mass pinching and widening as it is followed up to the surface and down a winze to a second tunnel 35' vertically lower.

The second tunnel, almost beneath the first tunnel is 280' and the ore has been followed below this level by 50' winze with a drift run 40' east from the bottom of the winze, showing the continuity of the ore.

A third tunnel, now 800' long and driven as a slanting crosscut, to reach the vein 238' lower than #2 tunnel has not reached the fissure.

The iron Ridge vein at the south end of the property shows fully as attractive surface conditions, marks a strong fault fissure and is bigger than the Sandel vein. It is as yet unprospected, but is regarded as quite as valuable as the Sandel.

PROGNOSIS.

Only small ore bodies were found in the Magma until a depth of 400' was reached; and it was not a big mine until the ore was cut on the 1,200' level. In view of the deep oxidation and leaching on the Grand Pacific property, I consider it unwise to expect large ore bodies until a depth of 600' or more has been reached. Ore actually exists at higher levels but from my personal knowledge of the entire district I expect the main ore supply of the Sandel vein to lie 600 ft. or more below the outcrop. The continuity of the vein is assured by the fact that there is a horizontal displacement of several hundred feet along the vein.

RECOMMENDATIONS.

I recommend that a fund of $100,000.00 be provided for development. The present lower tunnel should of course be continued to cut the Sandel vein and exploratory drifts, run both ways on the vein. A raise comma, for ventillation and development should be driven, preferrably on the ore shoot, to connect with the winze from

the bottom of the Middle on N. 2 tunnel. When this is done, a ~~sunk~~ winze or inclined shaft should be sunk 400' or more below the #2 tunnel level, following the ore body, is possible with drifts at each one hundred foot in depth.

Your present equipment is quite adequate for this work, as the Leadville Super-dreadnaught hoist can be used for raises and sinking to depth of 400' and the 320 cu.ft. compressor, Leymen drill and jackhammers are sufficient for the work outlined.

CONCLUSIONS.

In conclusion I am of the opinion that the property has decided merit, shows conditions as good and quite similar to those of the Magma mine at the same stage of development and that the Grand Pacific is likely to develop into a large and profitable mine.

(sgd) Walter Harvey Weed

4/6/1918

WALTER HARVEY WEED
Geologist & Mining Engineer
42 Broadway
New York City.

Phoenix, Ariz.,
April 6th, 1918.

Mr. J. C. Denton, Manager,
Grand Pacific Copper Co.,
Superior, Ariz.

Dear Sir:--

As a result of a recent examination of the Company's property, I submit herewith a report which is intended to supersede my report of October, 1917.

INTRODUCTORY

The property owned by the Company is situated in the Pioneer, or Superior Mining District, about 2½ miles south of the terminus of the narrow gague Magma railway at Superior, Arizona. This railway connects with the Arizona Eastern of the Southern Pacific systems at Magma Junction near Florence, giving rail connection to the nearby Hayden Smelter and the the Sasco smelter about one hundred miles to the west.

ECONOMIC CONDITIONS:

The town of Superior, a settlement of about 2,000 people is the local supply point and the activity at the Magma Mine ensures an adequate labor supply. Economic conditions are as good as at any Arizona camp and the automobile stage line and rail connection with Phoenix, 76 miles away insures relatively cheap food and mine supplies.

HOLDINGS:

The property consists of a rectangular block of claims 9,000 feet long and 3,600 feet wide comprising 35 contiguous, full size mining claims, or about 700 acres in total area. The group is surrounded by the claims of the Daggs group

of the Consolidated Holding & Trust Co. on the North and West and the New York group on the South.

ADJACENT MINES:

The nearest workings are those made by the Calumet & Arizona Company, half a mile to the north, the Queen Creek Copper Co. 3,500 feet to the south, the Lake Superior and Arizona mine (now worked by the Magma) and the Magma Copper Co's. property 5,500 feet in a straight line northwest; all on the same belt of upturned limestone.

The claims cover the highest slopes immediately beneath the towering cliffs of Apache Leap, the mountain scarp which extends several miles to the northward and south of the town of Superior and is only broken by the deep gorge of Queen Creek at the town.

The general geology of the district is simple and easily understood. The great cliffs of Apache Leap mountain are the eroded edge of a great lave plain or plateau formed of dacite lave resting on older rocks. These older rocks consist of a series of well bedded limestones of varying colors and ages, but forming consistent series resting on several feet of quartzsite, also bedded, underlain by diabase. This diabase is an igneous rock which has not only upturned sedimentary limestones and quartzsite but has intruded between the beds as sheets and along fault breaks as dikes. It is occasionally sparsely mineralized itself but is older than the ore deposits of the region.

The bedded rocks all dip at steep angles eastward into or toward the mountain but the continuity of the beds is disturbed by bross breaks or fissuring along which adjustment of the rocks has taken place, causing more or less

displacement. There is also one great line of slipping, or faulting parallelled to the bedding planes of the limestone, notably the L.S. & A. vein which occurs near the quartzsite contact. The cross breaks show manganese and iron oxides and at the Magma, Queen Creek and Grand Pacific mines, carry copper ore. At the Magma mine a dike of acidic porphyry probably monzonite, fills the cross fracture and the mineralization is unusually generous. The best known cross fault is thes Magma vein.

The lower slopes and foot hills show many detached blocks of quartzsite and limestone, but geological conditions are less regular and I believe less promising than those of the mineral belt in which all the known productive properties of the district are found.

On the Grand Pacific ground there are several strong fissures faulting the rocks. One of these is seen with a throw of 500 feet or more on the No. 19 claim near the portal of No. 3 tunnel and others show even at a distance, in the disturbed position of the limestone reefs or outcrops along the mountain front.

At present, however, only five veins have been prospected on theGrand Pacific ground and three of them have shown good ore. These are the Sandal, Iron and Silver veins.

SANDAL VEIN: The Sandal Vein is now being worked and has received the greatest amount of development work of any of the veins, since it contains high grade copper ore. It is a cross vein whose average course is north 60 degrees E. with a dip the upper levels of 60 deg. to the north, it has a wid+ 2½ feet to ten feet and is a clean cut break across lime that dip at angles of 20 to 40 degrees into the mountain.

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Their displacement along the fissure is not known as yet nor has any porphyry intrusion been definitely identified as the clayey material thought to be porphyry is probably an altered sedimentary rock. The presence of pay ore, howevery is of far more importance than that of porphyry.

The Sandal vein is opened by three tunnels, the uppermost where the discovery was made being called No. 1; the second or No. 2 tunnel following the vein at a level 30 feet lower and the third or No. 3 tunnel 234 vertically below No. 2 & No. 1 tunnel is in ore from the portal to its face, a distance of 115'. The fissure being well defined with clean cut walls. The foot wall being a white clayey material locally termed porphyry. Two winzes, both on ore, connect with No. 2 tunnel. There is a small block of ore stopper out near the face of tunnel No. 1,but a block of ore 110' long, 1 - 5' thick and averaging 30 ' high, is available for mining.

No. 2 tunnel parallells No. 1 and is also driven on the vein but the ore shoot appears to rake or pitch to the east since the ore streak is narrow or spotty beneath No. 1 tunnel until reaching the winze that goes down on the vein below No. 3 tunnel. It is evident, however, that much high grade ore can be recovered from the block 80' long lying between the two upraises that connect with the tunnel above.

The west ore shoot as observable in No. 2 tunnel, extends from the bottom of No.1 winze(or raise to No.1 tunnel) eastward a distance of 80 ' extending 45' east of the face of tunnel No.1 and 50' or so east of the Jewett winze which will soon connect with No.3 tunnel. This ore shoot extends down the winze with a dip of 59½ deg. to a drift on the vein 43' below

No. 2 tunnel, and in the winze still deeper, maintaining its character and ore streak throught, though the thickness of ore varies from a foot to five feet or so. A drift runs for 33 feet east from the Jewett winze. The vein shows fault clay and pebbles cutting out the ore streak in places though ore occurs associated with ankerite spar and black manganese, more or less continuously to the face. A sample cut at the face across a 12 inch ore band that rests on flaky white porphyry clay assays; silver .50 gold trace, value .43. Copper 11.98%.

The roof of the drift shows many limestone boulders and the ore is evidently a replacement of this rock. At ten feet above this 43 ' sub level the vein in the winze shows 6½' of high grade ore against a smooth, well defined hanging wall. The country rock cut by the vein is limestone on both walls and appears to dip at 40 deg. to the north.

A second ore shoot has been cut in No. 2 tunnel 105' east of the Jewett winze, there being a barren stretch of 50' between the two ore shoots. A raise of 20 'high failed to disclose ore in this part of the ledge. The second, ore eastern ore shoot has been developed for a length of only 40', the drift leaving it and following a flat fault slip to the southeast. This ore body though broken by cross fractures is composed of hard high grade ore. One sample cut across 5½' face by myself assays .50 silver value .34, trace gold, 13.46% copper.

A second sample cut across 30 inches of ore on the under side of the fault, about six feet east of the first

assays .50 silver value .43, .02 gold value .40 total .83 Copper 36.43%.

Farther east the drift turning north has again cut the vein with streaks and scraps of ore and much manganese, but has not yet opened up the orebody indicated by the faulted and displaced fragrements.

The lowest or No. 3 tunnel 839' long, or with its branches, a totle of 1230' of workings, cuts through the silver vein, near the portal and connects with an incline shaft on that vein through the workings develop no commercial ore. The tunnel follows the bedding planes of the limestone and at a point 380' from the portal it crosses at an acute angle a fifteen vein, or mineralized fracture zone, dipping south at 45 deg. which is opposed to the dip of the limestone beds.

At 665' from the portal vertically almost beneath the portal of No. 2 tunnel a wide vein is cut which seemingly corresponds with the Sandal vein on dip and in course, though it shows no ore and differs somewhat in mineralogic and physical character. A north crosscut 100' farther east cut this manganese vein and a drift easterly explores it for 280' , but no ore whatever was found. If it be the Sandal vein, it is probable that the easterly pitch of the ore shoots cut in the tunnels above will carry the ore so far to the east that the No. 3 workings do not reach it.

At present an upraise not on the vein is being driven from No. 3 tunnel at an angle of 59½ deg. to connect with the bottom of the winze sunk on ore, for 50' below No. 2 tunnel.

This winze will determine whether the vein flattens and does correspond to the manganese vein explored by No. 3 tunnel, or whether it changes its dip or reverses it. A crosscut driven 110' south from No. 3 tunnel should have cut the vein had it straightened up, but does not extend far enough sough to get beneath tunnel No. 2.

The raise connecting tunnel No. 2 with this lower level will serve as an ore way and enable the management to stope out and ship the ore developed by tunnels No. 1 and 2 and the level below No. 2, for the wagon hauling road extends to the portal of tunnel No. 3.

THE IRON LEDGE OR VEIN:

The Iron Ledge, or vein and the workings on it are in the middle of the group, whereas the Sandal vein and mine workings are situated in the extreme northern end of the property.

The vein has a strong red outcrop, recognizable a long way off, though it is soft and not resistant to erosion. It runs about N. 60 deg. E. and is opened by tunnels, cuts and pits across four claims (No.4,19,15 and 21) a distance of nearly 2000 feet. The dip appears to be vertical, varying frm to 76 deg. and the true character of the vein is clearly shown by fault breccia and clay. The most extensive workings are on claim No. 4, where a tunnel 125 feet long with a 50' drift has been run into the hillside to catch the vein. Although good chryscocolla ore occurs in openings on the ledge higher up the slope. This tunnel has not cut any ore and I question whether it has as yet cut the ledge.

The continuity of the ledge, its known mineralization

with copper and silver and its ready accessability make it an attractive vein for future development.

THE SILVER VEIN:

The silver vein outcrops near the portal of No. 3 tunnel on the Sandal Vein. It is a strong bedded vein, characterized by abundant black manganese and iron, closely resembling in locus and habit the Lake Superior and Arizona Vein of the Magma property and of the Queen Creek Copper Co. workings. In a "Glory Hole" on the vein, a few hundred feet from the compressor house, the vein runs north and south and dips 30 deg. east, but the general course seems to be more nearly N. 30 deg. E. and the dip to cutx the bedding at a very slight angle. The outcrop is traceable across the bare limestone slopes, almost to the Sandle fissure. While there is no doubt it is worthy of exploration, the cross fissure is more attractive and work on this vein should be deferred until the Sandle has been brought on a producing and profitable basis.

PROGNOSIS:

In view of the facts already stated and of the ore bodies actually developed in the mine, I consider the Sandal vein a decidedly attractive property.

Your claims cover its course for over 1500 feet north of the portal of No. 2 tunnel and for 2100 feet south, giving ample extent for development work.

While high grade ore has been actually developed in the veins, its thoroughly oxidized condition on all the levels conforms to general experience in the district and I believe that your large and permanent ore bodies must be sought at or below water level, some 600 or 700' below the outcrop. In view of the similarity of conditions here with those observed

in the early development of the Magma mine, I believe an equally favorable outcome may be reasonable expected and I urgantly recommend the further development of the mine.

CONCLUSIONS.

Development work to date has been intelligently and well done and the new work planned by your management will soon give the data on which to plan future operations. If the orebodies pitch to the east, as it appears probable, the lower tunnel will have to be driven further to cut the ore shoot.

In view of the very successful results so far achieved and of the favorable geological conditions I feel that the Grand Pacific is likely to develop into a large and profitable producing mine.

(SIGNED) Walter Harvey Weed.

Phoenix
April 1st, 1918

(COPY)

4/7/1919

[illegible]

[illegible]
Geologist and Mining Engineer
40 Broadway
New York City.

April 7th, 1919.

Mr. C. D. Weidenhammer, Pres.,
[illegible], Pa.

Dear Sir:

In accordance with your request, I recently visited the Grand Pacific Copper Company, holdings near Superior, Arizona, and submit herewith, a brief report on the facts observed and my opinion thereon. For the convenience of your stockholders and to make the report intelligible to others, I have briefly mentioned the location, geologic features, etc., of the property, although these features were fully covered in my earlier report on the property.

LOCATION: The property consists of 34 claims covering a solid tract 7000 long by 3000 to 4500 feet wide, comprising 700 acres. The new survey of the ground will make this 35 claims, on the west slope of the mountain mass, east of the valley region of Queen Creek and the Gila River. The company's claims are about 1½ miles south of the town of Superior, or 2 miles south of the rich producing copper-silver mine of the Magma Copper Co. and about 8 miles north of the great mines of Ray, Arizona.

Between the Grand Pacific and the town of Superior, lie the holdings of the Queen Creek Copper Co., which are reliably said to show ore in commercial amount, but are not yet producing, while immediately adjacent the Grand Pacific ground, the C. & A. company own a tract, from which lessors were extracting small amounts of ore in 1918.

The Grand Pacific claims lie far up the mountain slopes, above the valley country and in the limestone region beneath the white cliffs known as Apache Leap.

GEOLOGY: The geology of the area is simple and the ore occurence is similar to that of the neighboring Magma mine, save only that at the Grand Pacific, the ore-containing porphyry dike rock is lacking. The claims cover the higher slopes and crest of the mountain mass, that walls in the open Queen Creek Valley. The rolling foot hills show scanty exposures of diabase while the base of the mountain mass has ridges and hills formed of limestone that is in turn capped by

a diabase sheet. Above this diabase a massive quartzite shows on the [illegible] overlain in turn by a thousand feet of well bedded limestones. [illegible] form the highest slopes of the mountain extending up to the base of the lava cap or dacite flow that forms the [illegible] and steep cliffs overlooking the mine. The [illegible] is similar in character and sequence to that observed at the [illegible].

[illegible]: Ore is found on the property in both bedded veins [illegible]. The [illegible] Vein is a strike or bedding fissure [illegible] corresponds to that of the limestone near the [illegible]. The Sandal fissure vein is the best developed of four [illegible] fissures, which break across the limestone, and are [illegible] of [illegible] faulting and adjustment of the [illegible] beds, due [illegible] to the diabase intrusions. In the Grand Pacific property there are five main cross fracture-veins viz: (1) main vein (extending up the gulch from the Grand Pacific camp and past the mine buildings), (2) two lesser cross fractures, one of which is seen in the openings in the bedded S. & A. Vein, (3) Sandal fissure, (4) Gulch Vein, (5) Pine Hill Vein, (6) Iron Ridge Vein.

The underground work already done shows that both the Sandal Vein and the Pine Hill Veins are mineralized but both main development of the company and the ore production, of over $50,000 worth of ore in 1910, came from the Sandal Vein; the Iron Ridge Vein has ore, but the work is not so easily accessible from the company camp site, as the Sandal Vein, and it has received but a limited amount of development, which has so far failed to show any considerable amount of high grade ore.

SANDAL VEIN: The Grand Pacific mine workings are practically confined to the exploration and exploitation of the Sandal Fissure. As is well known to your associates, the Sandal fissure does not show on the surface, save at one point, where the discovery was made.

Briefly summarized the mine workings show that the Sandal vein runs nearly East-West, varies from 20' to 50' wide and is developed for a total length of about 600 feet along its course. The mine workings have so far developed two main ore shoots which extend down from the two upper tunnels. The ore occurs in the hanging wall limestone, usually above a clay gouge seam; the rest of the vein is oxidized and leached at the lines or far driven.

The upper or No. 1 tunnel was driven along the vein, just beneath the discovery and passes thru the discovery orebody and into a well defined ore shoot, stoped up to this level.

UNDERGROUND WORKINGS: As shown on the plan map of the mine working, this fissure vein has been explored by 5 tunnels, the uppermost

called No. one, being driven along the vein in a northerly dir.-
tion for 140 feet from the point where ore was first discovered.
The dip is about 70° which is much steeper than the average dip
on the lower level. This tunnel shows 2' to 3' of good ore in
the face; it is connected with the middle or No. 2 tunnel by two
winzes and there is a small stope above the level near its face.
This upper tunnel is too high up to give any appreciable amount
of tonnage for stoping.

The No. 2, or middle tunnel is about 540 feet long
and 50 feet vertically or 70 feet on the dip of the vein below the
upper tunnel and runs in a general northwesterly to NNE direction.
It crosscuts the ore about 40 feet from the portal and follows the
vein continuously to the breast. This tunnel passes thru two well
defined ore shoots carrying high oxidized ore with copper
glance, occurring mostly in the hanging wall limestone, above the
big seam of clay selvage. The dip averages 65° north, and the ore
lies rather flatter, averaging 6 feet in thickness.

An inclined winze or shaft has been put down 271 ft.
and connects No. 2 (or middle) tunnel and the lower, or No. 3 tun-
nel. This winze has an average dip of 55° between the middle and
lower tunnels and leaves the vein going into the footwall rock.
The vein shows a dip of the vein flattening downward from 50° in
the middle tunnel and A level, to 45° in No. 3 (or lowest) tunnel
-level.

The middle or No. 2 tunnel shows high grade ore near
its eastern end, where cross fractures have permitted the copper
bearing solutions to extend out into and form replacement bodies in
the limestone. The face is turned to the south away from the hang-
ing wall and shows merely vein matter, with low copper content.

The lower or No. 3 tunnel is 1405 ft. long, the main
tunnel being 670' long, and the drift of the vein 150'. This tun-
nel crosses the Sandal Vein at an acute angle, passing into the foot-
wall limestone, in which an incline raise 271' long connects with
the middle tunnel.

Between the lower and middle tunnel, there are three
sublevels, the uppermost called the Intermediate, being 45 feet (on
the dip) below No. 2 tunnel, and driven along the vein fissure for
about 45 feet. Fifty five feet below this Intermediate drift the
"A" level extends eastward on the vein for 350'; a third intermediate
called B level, runs 60' west of the shaft. All these sub-levels
show ore and the richer part of the orebodies has been stopped.

No ore has as yet been cut in the lower No. 3 level,
but I feel confident that this is due to lack of prospecting along
the hanging wall of the vein, since all the ore thus far found (and
nearly 1000 tons of ore of a gross value of $50. per ton was mined
and shipped in 1918) has come from the hanging wall of the vein,

where it was protected from oxidation by fault clay or gouge.

The longitudinal section along the vein, which shows a projection of the stopes on a vertical plane, is useful as indicating the area stoped, but it must be remembered that the vein is from 10 ft. to 40 ft. wide and that it has been broken by faults, parallel with the vein and across it, so that the ore shoots are not regular.

On the lower, or No. 3 level, the main tunnel passes thru the [illegible] vein, near the portal, the [illegible] vein at 370' from the entrance and the [illegible] fissure at 640' from the portal.

The [illegible] vein has an average course of N 60° E and a dip of [illegible] in this lower tunnel. It is well oxidized, [illegible], but thus far the level on the vein has cut the hanging wall in but three places and this work has not disclosed ore. This fact is not considered discouraging because the ore bodies in the [illegible] appear to pitch eastward going down on the vein, and would be east of the work on No. 3 tunnel, if this hypothesis is correct.

In the two cross cuts northward, one where the new shaft is being sunk and the other 10' farther east, there is from 25 to 75' of ledge matter in the ground between the northward dipping [illegible] fissure and the southward dipping [illegible] fissure. The clay seam seen in the shaft station and nearby, is a post mineral fracture, that cuts and slightly shifts the vein.

[illegible]: An inspection of the new shaft now over 100' below No. 3 tunnel, shows [illegible]. [illegible] the result of the leveling of sulphide [illegible] material. It is confidently expected that solid sulphide ore will be found [illegible] the water level, which is assumed to be about 500 ft. below the No. 3 tunnel, but which can only be determined by drilling or shaft sinking.

OPINIONS AND RECOMMENDATIONS: In view of the very favorable geological conditions observed in the mine, as well as the actual occurrence of a considerable tonnage of both high grade and milling ore above the No. 3 tunnel, I consider the property a very meritorious one and well worthy of further work to find sulphide ore at water level.

I earnestly and urgently recommend raising sufficient funds to install a new air compressor, a pump for future water drainage and the expenditure of $10,000 a month for development work. It is good business economy to keep down overhead charges by employing more men underground, especially as work at the two or three points, recommended by me, are liable to develop ore and permit the mine to resume ore shipments.

While the vein still contains much ore between the B level and the upper tunnel, the new ore has lately been opened in the east breast of A level, yet the cost of stoping and teaming to the railroad is such as to make it wiser to defer extraction of the ore in this block of ground until later.

(C O P Y)

THE [illegible] PACIFIC COPPER COMPANY

Pioneer Mineral District, Pinal County, Arizona.

The fifty-three claims which make up this group are about three miles south of Superior, Arizona. The property is advantageously located and is reached by a good automobile road. Water in quantity can be developed on the West side of the property, a short distance down the hill from Camp Douglas. The Camp has been named for Mr. Nelson Douglas, the President of the Company. It is placed in a convenient place with reference to both the mine and water.

GEOLOGY.

Extending in a curve from Hayden, Arizona, to Superior, Arizona, is a mountain range whose formation consists partially of sedimentaries. The lower one is quartzite of unknown thickness. On this quartzite, resting conformably, is a series of limestone of about 600 feet vertical measure. In places the full measure of limestone is left, at others they have been base levelled, leaving only detached fragments. Where the heavy measures of limestone remain are found the mines. Among those mines may be mentioned The Christmas, London, Arizona, Gila Canon Copper, Ray Lead Company, Magma Copper Company. In every case the occurrence is similar.

The sedimentaries are tilted at various angles, are block faulted, and are cut by intrusive dykes of porphyry.

The ore bearing dykes are basic, probably altered diorite, and are the channels through which have entered the ore solutions. These dykes have come up from profound depths, entering through the breaks made by the faults. The ore bearing solutions, on their way up, passed first through the unreceptive quartzite and finally reached the limestone which rests on the quartzite. This ground was easily attacked by the acid solutions making caverns and refilling with the ore. This ore deposits along the fractures and also on the bedding. The lower portion lying next to the quartzite being reached first has been the highest mineralized and the ore shows less and less as greater height is reached and finally in the higher levels only small patches and stringers are found. In other words, the great ore bodies will be found along the faults and dykes, in the limestone, immediately above the quartzite.

The Grand Pacific Copper Company lies in these ore bearing sedimentaries, and shows the typical faults and dykes which are producing so many valuable mines. The ore has reached unusually high in the limestones and there is being mined now quite a quantity of ore from a zone which is usually barren. This speaks very highly for the properties' futurity.

There are two main ore fractures on this property. One running Southeast across claims Pacific 13, 19 and 25. On Claim 25 this frature is crossed at about right angles

by another one whose course is Southwesterly. This latter fracture crosses Claims Pacific 25, 20, 15, 9 and 4.

Running about at right angles to this main fracture are smaller ones. There are several showing prominently.

The main fractures show iron cropping which in places is very pronounced. These iron croppings are the indications of ore and should be followed up.

The principal workings are about center claim No. 19; at this point a stringer of copper ore outcropped on one of the smaller faults. This was followed by tunnel and winze. It was found the ore was following down the fault crevice at about 72°. Another tunnel was started about 30 feet lower down the mountain and the ore again followed on its strike. Again it went down and a winze was sunk from level of lower tunnel which has followed the ore 50 feet. The ore is getting heavier and richer as depth is reached. As this condition is typical of all the similar mines, this could easily be anticipated. The ore will increase in volume and quality until the main deposition is found in the limestones immediately above the quartzite.

RECOMMENDATIONS.

I recommend that the winze in lower tunnel be continued down as rapidly as possible.

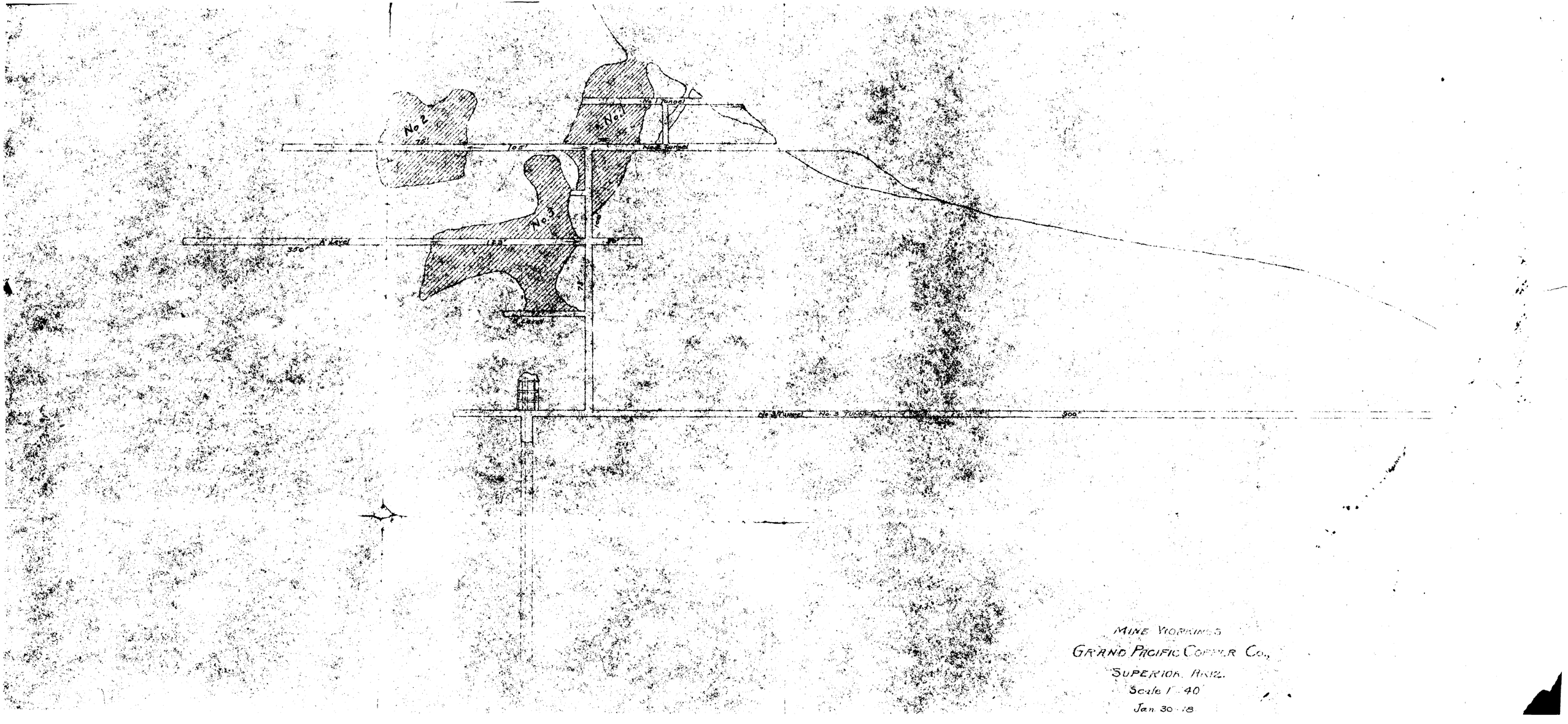
There should be sunk a shaft close to the main fracture which crosses Claims Pacific 13, 19. A good place is where the ground is being prepared now, a short distance above the

rock house at the end of the road. This point is about 150 feet northerly from the main fault. This shaft should be sunk until basal quartzites are reached. From bottom station on shaft a drift should be run which will cut into the country being now explored by above mentioned winze. This drift from bottom of shaft will enter two more fractures before reaching the one now being prospected. And there is every reason to suppose they will carry ore.

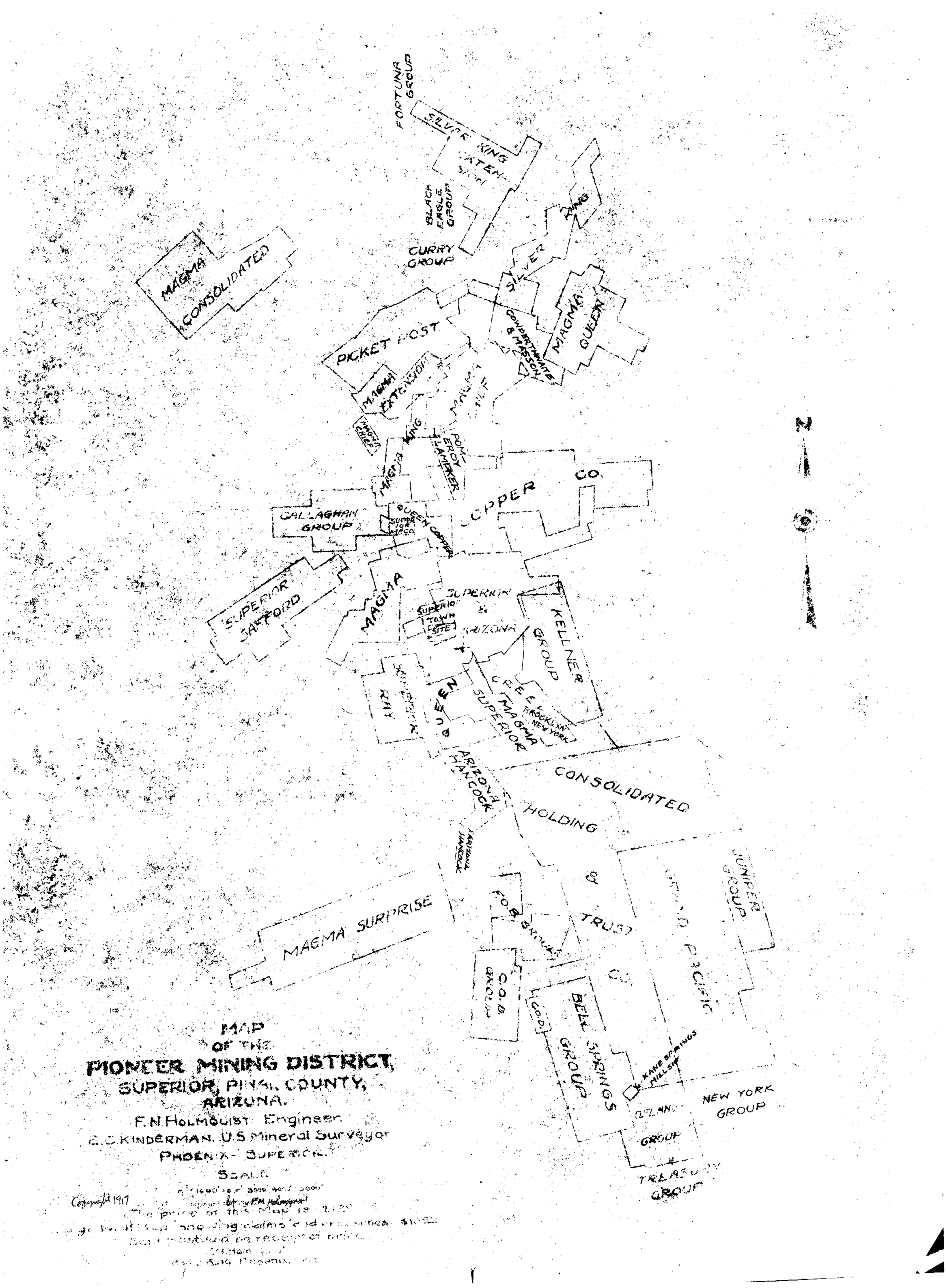
I heartily recommend this property and expect it to make a mine of magnitude.

(WM. F. GORDON)

(Signature copied) from original.



MINE WORKINGS
GRAND PACIFIC COPPER CO.
SUPERIOR, ARIZ.
Scale 1" = 40'
Jan 30 - 18

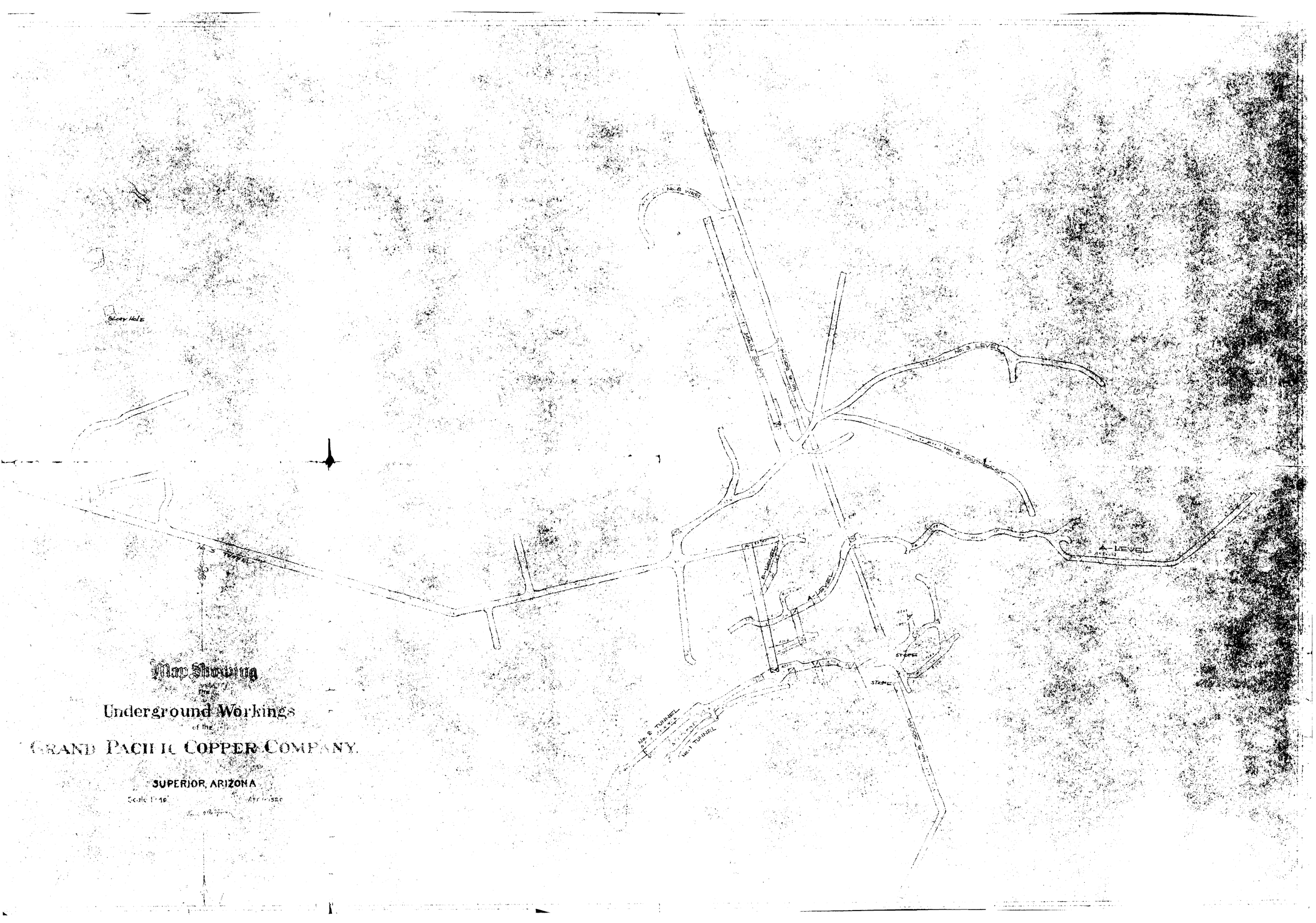


MAP
OF THE
PIONEER MINING DISTRICT,
SUPERIOR, PINAL COUNTY, ARIZONA.

F. N. HOLMQUIST Engineer.
C. C. KINDERMAN. U.S. Mineral Surveyor
PHOENIX - SUPERIOR.

SCALE.

Map Showing
the
Underground Workings
of the
GRAND PACIFIC COPPER COMPANY.
SUPERIOR, ARIZONA
Scale 1" = 10' Apr. 1920



ASARCO

Southwestern Exploration Division

August 17, 1976

TO: F. T. Graybeal

FROM: J. D. Sell

Magma Area
Superior East
Pinal County, Arizona

On Sunday, August 15th, John Cesar (General Mine Foreman at Superior) and his wife stopped by to look at some of my specimens from Superior. Several items were mentioned:

1) Newmont's surface drilling and geophysical work south of #9 Shaft have not been encouraging and will probably be terminated.

2) The drift north on 4100 level from #9 Shaft is now about 300 feet from the projection of the Main (Magma) Vein. As recalled, they mined a little along the Main Vein on up-dip, but the ore was very pyritic and had spotty pods of copper mineralization. Ground support problems were severe, as were ventilation factors. (Note: Based on some mineral trends many years ago, I would think they have an excellent chance of hitting the top of a major ore body in replacement limestones adjacent to the Main Vein at the 4100-4200 level. See my memo dated March 30, 1970, file Aa-16A.19.13, to W. E. Saegart and my memo dated May 14, 1976 to you on the AIME meeting.)

3) They have released the Alpine Miner, a self-contained high-impact rock cutter, after some 8 months of trial work. They do feel it will be of use in the future but, unfortunately, all ground cut by the machine was in active mining areas and subjected to blasting-induced fractures which may have reduced the cutting performance. They did reduce the cost of cutter tips (replaceable carbide tips) from $15.00/ton to $2.00/ton of rock cut.

4) Superior has ordered a dozen or so ice-cooled vests to be used in dead-head drifts. The vest has pockets to place packets of refreezable material (like "Scotch-ice") which then aid in keeping the torso temperature below 100°. (See U.S.B.M. "Report of Investigations 8139 - An ice-cooling garment for mine-rescue teams.") As the packets are removable and changeable, all that is needed is a common freezer plus an extra supply of packets. Each one lasts from 2 to 3 hours at very warm to hot mine temperatures. The vest is designed to be worn under mine-rescue equipment and apparently does not interfere with arm movements, etc.

I did mention to Cesar that I'd be calling for a mine tour after they got into the Main Vein and he said it could probably be arranged. John is VP of the Pinal Mountain subsection of AIME and I'll be in contact with him monthly (they meet on Tuesday of the 3rd week of the month).

James D. Sell

JDS:lb

October 27, 1976

Mr. John Cesar ph. 689-5436
105 Ocatillo
Superior, Arizona 85273

Dear John:

It was a pleasure chatting with you the other night and I will undoubtedly see you in Kearney at the next meeting on November 16th (Tuesday).

Mr. Fred Graybeal and myself would appreciate it very much to be able to tour underground with you on Wednesday, November 17th. It has been awhile since Fred has been in the replacement country so will be interested in the mining aspects with what geology we can glean on the way. Perhaps Barnes could catch up with us somewhere so that we don't take all your time.

I have not reshuffled the boxes yet but do intend to bring a number of the Magma boxes up to go through with Reggie.

Sincerely,

Jim

James D. Sell
2762 W. Holladay St.
Tucson, Arizona 85706

JDS:lb

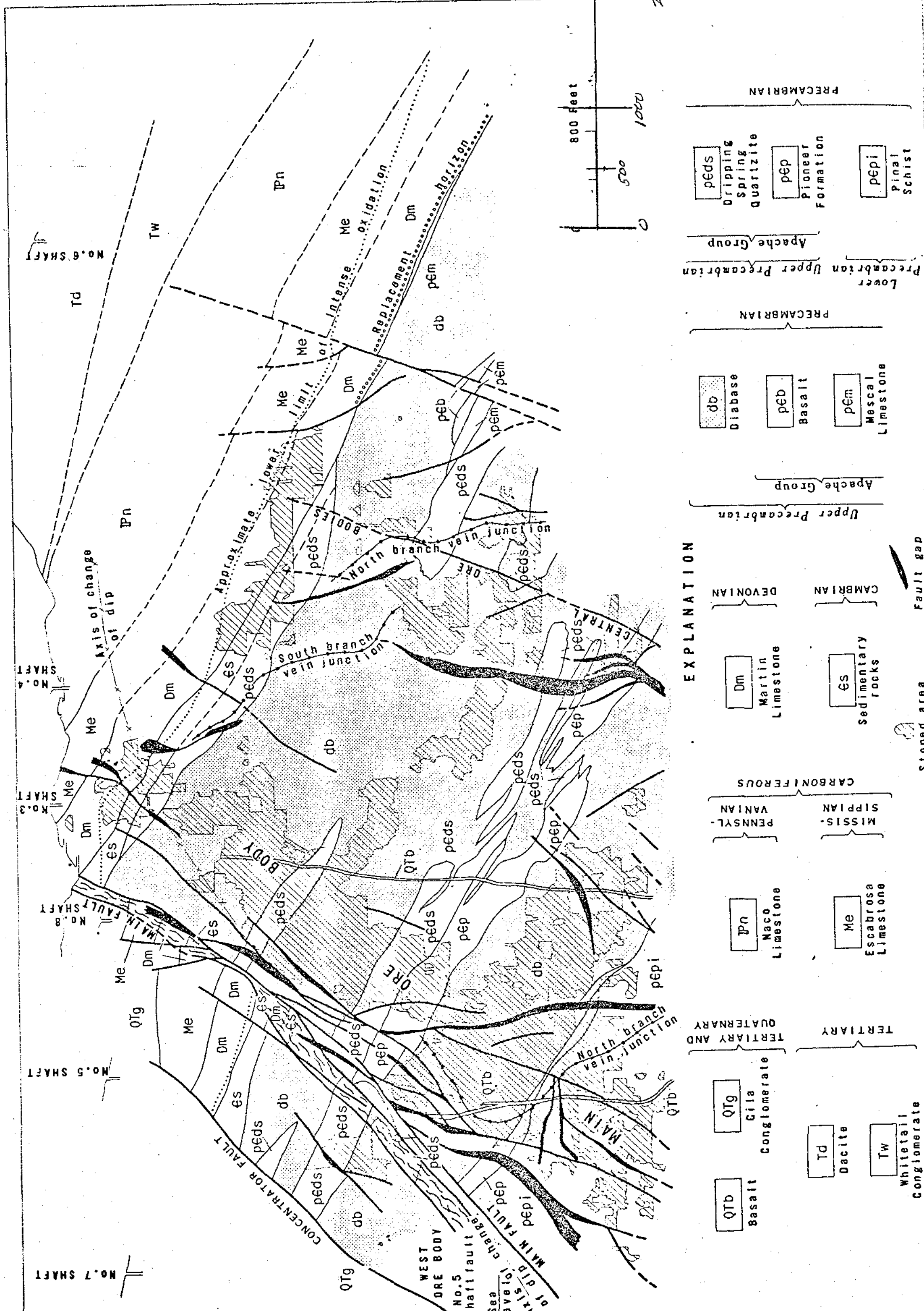


FIG. 3. *Geology of the South Wall of the Magma Vein. The Geology has been projected to a vertical, east-trending plane. Stoped areas, junctions of important branch veins, and axis of change of dip of the vein are indicated.*

side of the Main fault. The Main ore body has been stoped continuously from near surface to the 4900 level. The "West ore body" is a smaller offset portion of the Magma vein that was mined on the west side of the Main fault between the 2000 and 2800 levels. The "Central ore bodies" make up a zone of discontinuous ore shoots east of No. 3 shaft that, in gross outline, plunge steeply westward roughly parallel to the rake of the Main ore body. The Central ore bodies have been mined discontinuously from the 1600 level to the 4800 level.

The Magma vein occupies an east-striking fault zone that has been opened for more than 10,000 feet along the strike. From the surface outcrop down to a westward-raking "axis of reversal of dip" (Figure 4), the vein dips about 65°N. Below this axis, the dip reverses and continues downward to the deepest (4900) level with an average south dip of about 78°. Direction and amount of net slip along the Magma fault zone has not been determined, owing to the difficulty of matching identical points on the opposite sides of the zone. The best match of geology on the north and south walls of the vein suggests that the net movement is normal (south side down) and is predominantly down the present dip, with only a small component of right-lateral slip. A rotational movement is evident, as the vertical displacement increases from 350 feet near the Main fault to 450 feet toward the east end of the mine.

The structural map (Figure 4) of the 2550 level is a representative example of horizontal section through the vein and also shows branches of the vein and important offsets. Three principal sets of fractures have been recognized in the mine:

(1) The earliest consists of the east-striking Magma vein fault and a persistent set of lesser shears that branch away at small angles toward the northwest and southeast. This is the set of fractures that has been most extensively mineralized.

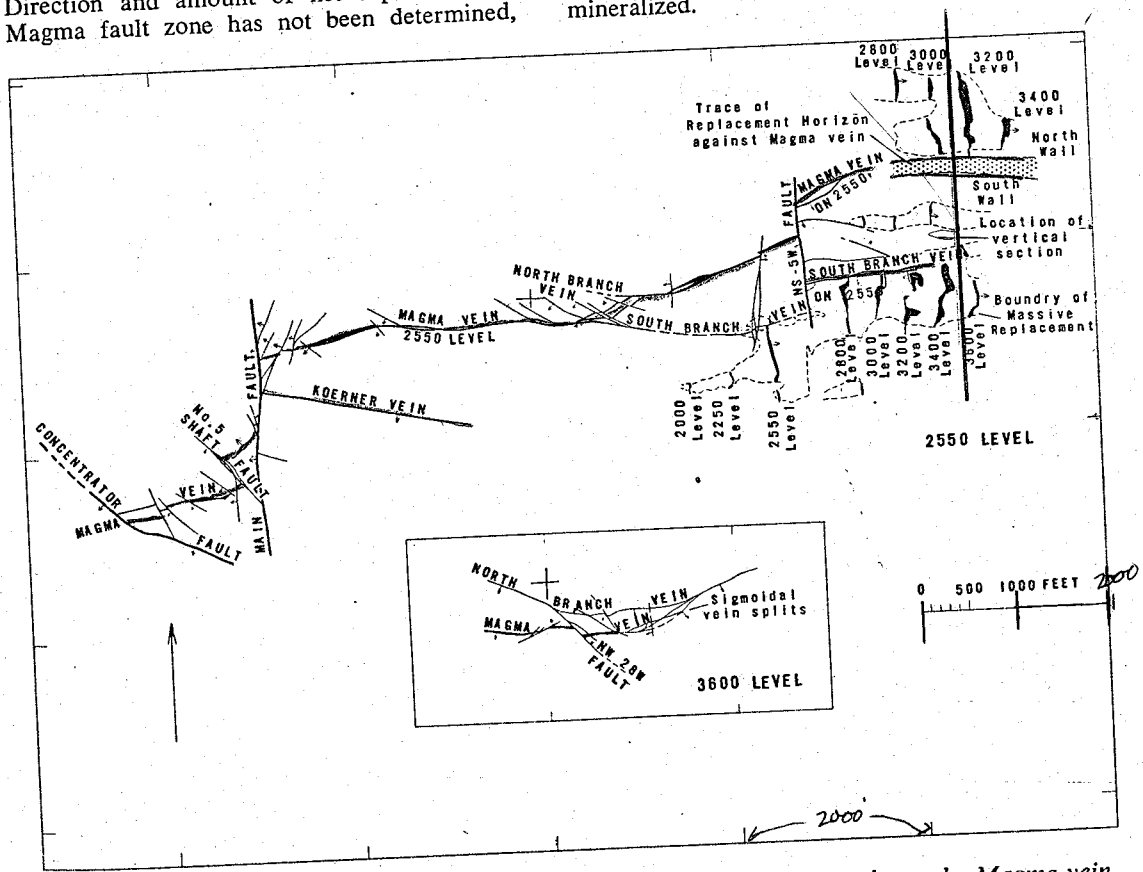


FIG. 4. *Structural Map of the 2550 Level of the Magma Mine. The map shows the Magma vein, its major branches, significant subsidiary fractures, offsets by major faults of the north-striking set, and the Koerner vein. The outline of the east-dipping limestone-replacement ore bodies is projected to the diagram. The inset shows a structural map of part of the 3600 level of the mine.*

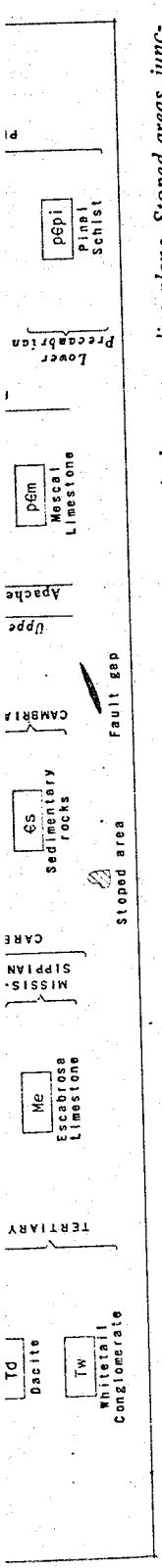


FIG. 3. *Geology of the South Wall of the Magma Vein. The Geology has been projected to a vertical, east-trending plane. Stoped areas, junctions of imporiant branch veins, and axis of change of dip of the vein are indicated.*

can best be observed. Evidence for localization of ore shoots in the Central part of the Magma vein by premineral transverse structure is abundant. Major crossfaults, many of which have undergone postmineral movement, frequently serve as bounding structures controlling the lateral extent of individual ore shoots. Lesser cross structures appear to have imposed an added permeability upon portions of the vein-fault that are the locus of ore shoots. By inference then, this evidence may be extrapolated to the Main ore body, where much of the evidence for control by transverse structure has been obliterated.

Complex vein splits and branch veins are a structural characteristic of the zone of Central ore bodies above the 4400 level. Increased permeability of this portion of the vein, imposed through splits and branches, appears to be a major factor in localization of mineralization.

These factors suggest that the principal condition that determined specific location of mineral deposition in the Magma vein-fault is permeability imposed by structure. Shearing across irregularities in strike and dip of the vein-fault created some of the permeable zones. The fractures associated with some of the transverse structures created additional permeable zones, but other transverse structures imposed restrictive barriers to the lateral migration of ore fluids along the vein. The net effect of the permeable zones was to provide channelways along which the flow of ore fluids could concentrate.

LIMESTONE-REPLACEMENT DEPOSIT The favorability of the lower part of the Martin Limestone for replacement mineralization has been observed in many mines and prospects throughout southern Arizona. To a lesser extent, specific favorability for replacement has also been shown by the lower and the upper beds of the Escabrosa Limestone in the Superior area. It is not yet known why these beds are particularly subject to replacement, but they obviously were accessible to the ore fluids and susceptible to chemical attack during hydrothermal activity.

Figure 7 shows a north-south section

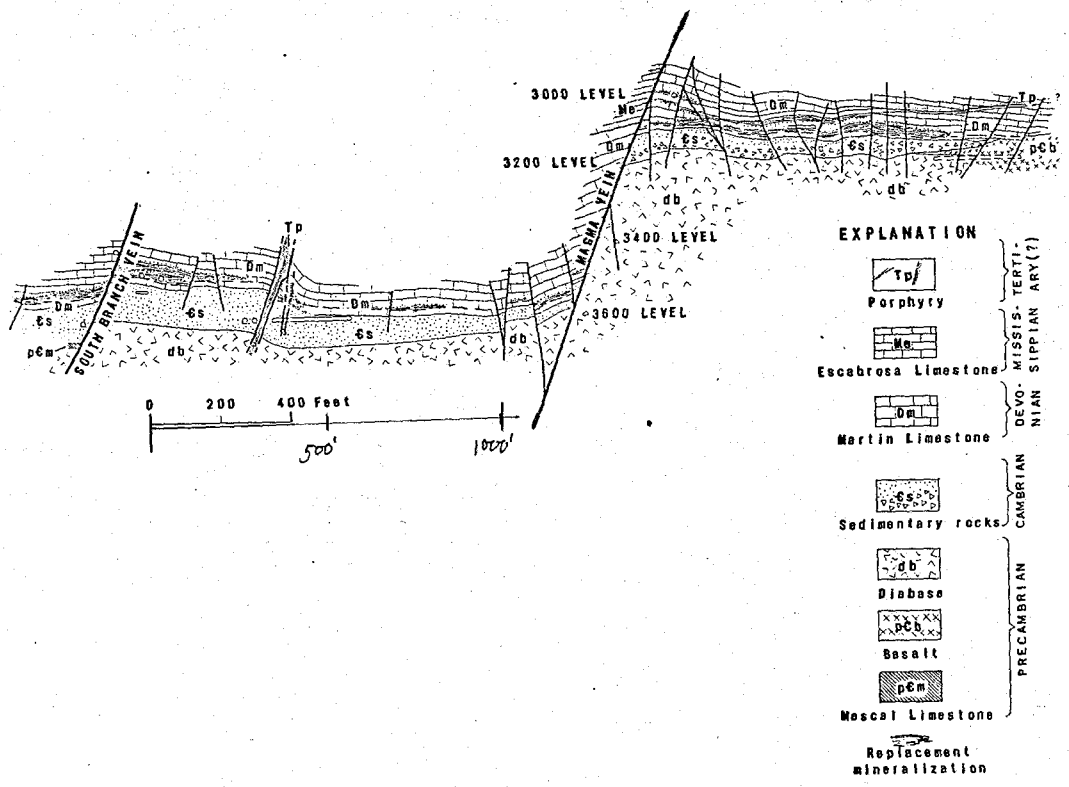


FIG. 7. *Vertical North-Trending Section through the Limestone-Replacement Deposit, Magma Mine (looking west). Some ore shoots show direct connection with veins, but others are isolated. (See Figure 5 for location of section).*

FIG. 6. *Relationship between Ore and Diabase Wall Rock in the Magma Vein, projected to a vertical, east-trending section (after Gustafson, 14). Stoped areas indicate areas of ore, and specific patterns indicate where either both walls, one wall, or neither wall is diabase. These relationships show that diabase had no appreciable effect on the distribution of ore in the vein.*

rec'd 2/21/77

Superior Arizona
Feb 17 1977

Helow James D. Sell.
it has been some time since
I have Written you a letter
/in regards to Mineing Claims
I have Developed quit a bit
more on these Claims that I
have. I have got copper Bornite
and quit a lot of silver ore.
and Gold now. I want you
to come see these Claims or a
Repsentive that knows I would
like to see this lot of Claims
Developed with option and
Lease. I have all the work done
on these Claims. I would go
along with a Reasonble Deal
let me here from you soon
yours Very Truely
Oren L Harris.

after 5 days Return To
Oren L Harris / 46 Neary ave.
Superior Arizona 85273.

PHOENIX, AZ 850
PM
17 FEB
1977

James D. Sell
American Smelting and Refining company.
P. O. Box 5747.
Tucson. Arizona. 85703.

4th Febo 1977 Superior Ariz

Dear sirs Inregard
To Silver Bornite copper lead.
I have some Bornite silver orr.
also I have a good showing of
vain Materail West Side of Lime
Point now this Bornite that I
have found lays in the vain
materail below the Windmill
I am still interested for you
to come have a look at what I
have. Would you Please answer
this litter soon as you have
told me you would come back
and take a look around Lime
Point as we did not do this
at the time before did not take
time. yours Very Truely

Oren L Harris
146 Neary ave
Superior Ariz 85273

Return To. Oren L Harris.
146. Neary ave.
Superior Arizona

PHOENIX, AZ 850
PM
4 FEB
ASARCO

USA 13c LIBERTY TREE

American Smelting and Refining Co
P. O. Box 5747
Tucson. arizona 85703

I Superior arizona.
March 5. 1977.

Helow there James got your answer to the letter I Sent to you sure was so glade to get your letter. and that you will be through here the middle of month now James I Depend on you this is why I have contacted you for I feel you will do what you can for me. I feel that I have a mine or I would not Stayed With it like I have. I have some /nportent talk With you When we get together. a Lease and Option we need this location of claims Drilled and Developed for it is located in through all this large fault zone. coming down from magma copper mine. which is only a short Distent from my claims Well you call me When you come here to superior

so I can know you well
be here you can call
Harold Harris. his NO
is 55-22. he can let me
know & I am just next
House from him
146 Neary ave. little old
House just up the street
/ house. I have my
Trailer Set up in the yard
which will help you to
find me.

your very truely

Oren L Harris.

Return Orew L Harris.
146 Neary ave
Superior Arizona.
85273.

FM
5 MAR
1977

YOUR VISION

USA 13c LIBERTY TREE

ASARCO. Incorporation Division
Southwestern United States Exploration
P. O. Box 5747. Tucson. Arizona
85703

ASARCO

Exploration Department
Southwestern United States Division

March 3, 1977

Mr. Oren L. Harris
146 Neary Avenue
Superior, AZ 85273

Dear Mr. Harris:

Your letter of February 17 has been received and it is good to hear that you've been busy on some claims south of Superior.

I still get up in your country now and again and hope to contact you around the middle of the month.

Sincerely,

James D. Sell

JDS:lb

ASARCO Incorporated P. O. Box 5747 Tucson, Az 85703
1150 North 7th Avenue (602) 792-3010

To Jim with best regards, Don

THE GEOLOGY OF PICKETPOST MOUNTAIN, NORTHEAST PINAL COUNTY, ARIZONA*

DONALD W. PETERSON
U. S. GEOLOGICAL SURVEY
MENLO PARK, CALIFORNIA

INTRODUCTION

Picketpost Mountain is a prominent local landmark about 4 miles southwest of Superior, Pinal County, Arizona (Fig. 1). It is a butte-shaped

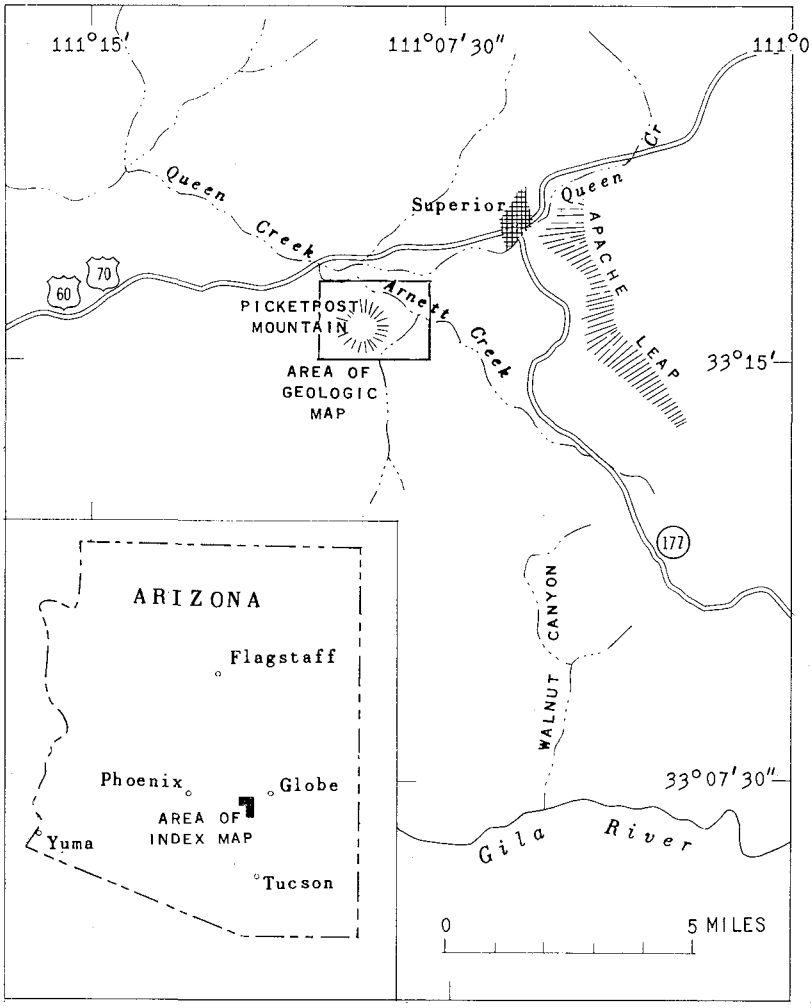


FIGURE 1. Index map.

*Publication authorized by the Director, U. S. Geological Survey.

Arizona Geological Society Digest, vol. 8, Dec. 1966

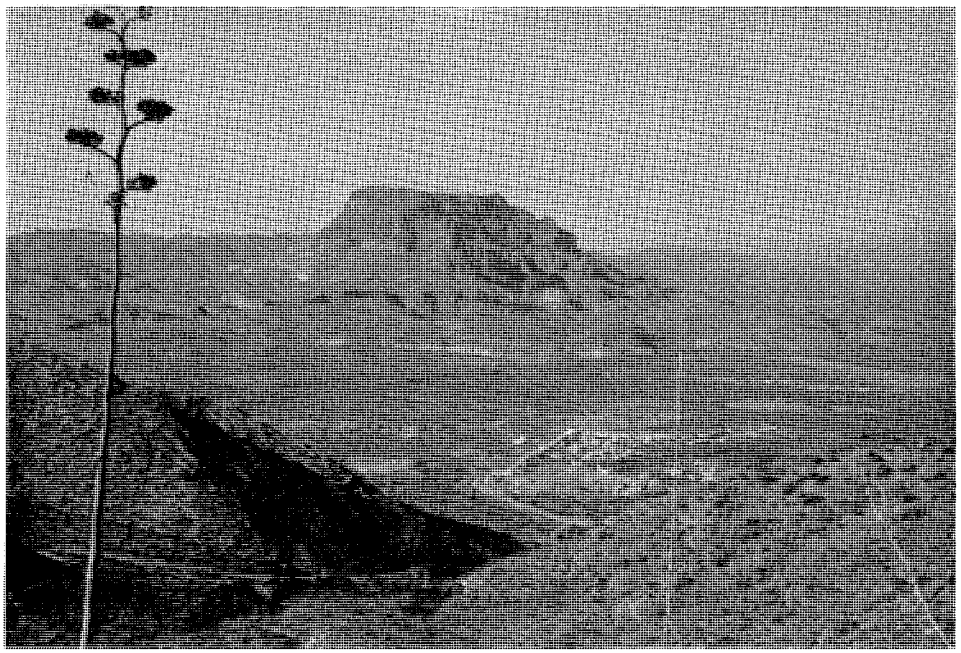


FIGURE 2. Picketpost Mountain viewed from east-northeast. The valley in the mid-foreground is occupied by Tertiary and Quaternary alluvial gravels, beyond which rhyolite lava flows around the base of the mountain. Tuff beds occupy the lower left flanks of the mountain; these are intruded by a quartz latite vent occupying the central slopes. The mountain is capped by nearly horizontal quartz latite lava flows. Key to symbols: sc — schist; rh — rhyolite; tu — tuff; br — breccia; ql — quartz latite.

mountain, nearly circular in outline, whose steep flanks rise abruptly to a flat top (Figs. 2 and 3). The summit of the mountain at 4,375 feet is from 1,500 to 2,000 feet higher than the surrounding area.

The area shown in Figure 4 was mapped in 1955, and further investigations were made in 1961. The area was studied chiefly to determine the relations between the volcanic rocks on Picketpost Mountain and the dacitic ash-flow sheet widely exposed in the Globe-Superior area.

I would like to acknowledge stimulating discussions with Donald F. Hammer of the Magma Copper Co., Superior, on the geological problems of this area. Donald C. Lamb of the University of Cincinnati, who has been studying the area to the south, has pointed out geologic relations important in developing some of the conclusions.

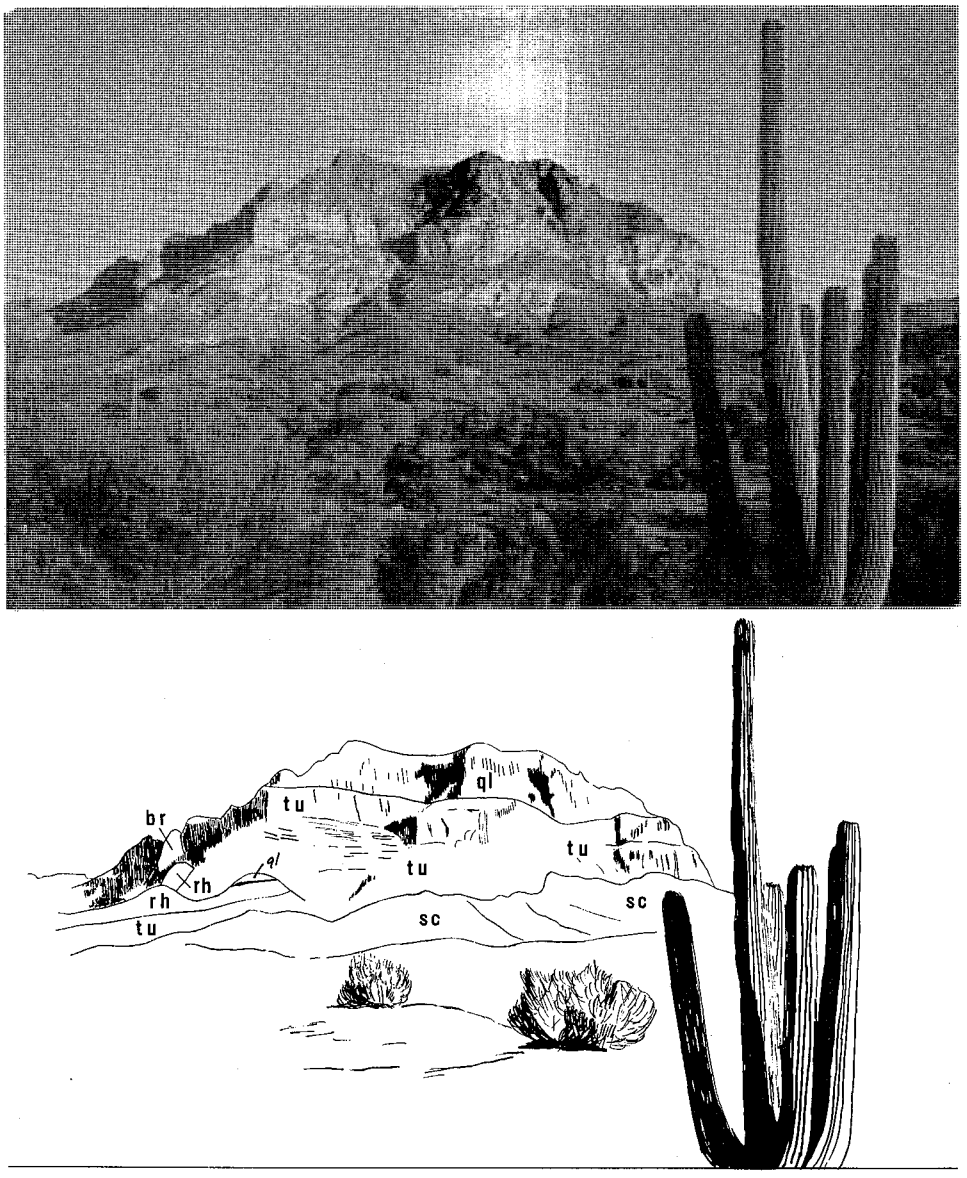


FIGURE 3. Picketpost Mountain viewed from the northwest. The dark slopes at the base of the mountain are Pinal Schist which is overlain by the light-colored beds of tuff. The darker layers whose base is about two-thirds of the way to the top are quartz latite lava flows. Rhyolite caps a low ridge on the left, and a small quartz latite plug is visible. Key to symbols: sc — schist; tu — tuff; rh — rhyolite; br — breccia; ql — quartz latite.

GEOLOGIC SETTING OF PICKETPOST MOUNTAIN

Picketpost Mountain stands at the southwest edge of the northwest- to west-trending valley of the Queen Creek drainage system. The hilly to mountainous terrain to the south and west is mostly underlain by the Pinal

Schist of early Precambrian age. Directly south of Picketpost Mountain is a mile-wide belt of vertical to steeply eastward-dipping sedimentary rocks of the Apache Group of Precambrian age. Both the schist and the sedimentary rocks have been intruded by diabase. The hills and mountains on the opposite side of the valley of Queen Creek, to the north and east, are underlain by rocks ranging in age from Precambrian to Tertiary. The Precambrian and Paleozoic sedimentary rocks generally dip eastward, and are cut by a complex network of faults (Short and others, 1943; Peterson, D. W., 1962). Much of this area is covered by a widespread dacitic ash-flow sheet of mid-Tertiary age. The valley of Queen Creek near Picketpost Mountain is filled with alluvial gravels of Tertiary and Quaternary age.

Extending around the base of the mountain from the north to the southeast side are rhyolitic lava flows interlayered with pyroclastic beds. These volcanic rocks extend a considerable distance to the southeast and cover an area of several tens of square miles. Their age is uncertain but is probably either Tertiary or Quaternary. Picketpost Mountain is composed entirely of volcanic rocks, which include rhyolitic lava, water-laid and air-fall tuff, and both vent rocks and lava flows of quartz latite composition. The rocks at Picketpost Mountain are briefly described by Wilson and Roseveare (1945, p. 5-6).

The origin of Picketpost Mountain and the relation of its rocks to the dacite exposed on Apache Leap (Fig. 1) are subjects of considerable local interest. The observer notices, from a distance, that the rocks capping Picketpost bear a marked resemblance to the dacite on Apache Leap, and he also can readily project the basal contact across the several-mile interval. It is natural to speculate that Picketpost Mountain might be an erosional outlier of the dacite sheet. Short and others (1943, p. 45) regard the rocks on Picketpost as being part of the dacite series.

Because of the questions on the relationship between the quartz latite capping Picketpost Mountain and the dacitic ash-flow sheet, considerable attention is devoted to the quartz latite unit and to speculation on its origin, but the prevolcanic rocks and the rhyolitic, tuffaceous, and basaltic rocks at the base and on the flanks of the mountain are only briefly discussed. It is concluded that the quartz latite has an entirely different origin from the dacitic ash-flow sheet. Furthermore, an examination of neighboring areas shows that the rocks on Picketpost are distinctly younger than the dacite.

The geologic map (Fig. 4) shows that the flat top of the mountain is composed of a quartz latite lava flow that overlies the bedded pyroclastic rocks. The lava flow extends from a vent that occupies much of the northwestern flank of the mountain. The cross sections (Fig. 5) are interpretations of the structure of the mountain.

DESCRIPTION OF ROCK UNITS

Prevolcanic Rocks

The oldest rock of the area, the Pinal Schist, crops out along the western edge of the geologic map, and underlies the western flanks of the mountain (Figs. 3, 4). It is a fine-grained quartz-mica schist, with moderately to well-developed foliation.

The schist is overlain, with nearly vertical contact, by the sedimentary rocks of the Apache Group. These rocks include the Pioneer Formation with the Scanlan Conglomerate Member at its base, and the Dripping Spring Quartzite with the Barnes Conglomerate Member at its base. The sedimentary strata strike north and dip steeply eastward, and some of the beds are vertical. Diabase of probable Precambrian age has intruded both the Apache Group and the Pinal Schist; the diabase and Apache Group rocks have been combined as a single map unit in Figure 4. Detailed descriptions of these formations are given by Ransome (1903, 1919), Short and others (1943), and in other reports on adjacent regions.

Basalt

Basalt crops out in several areas along Arnett Creek north of Picketpost Mountain. Outcrops are subdued, the rock is generally massive, but locally shows partings along flow planes. The weathered basalt is medium to dark gray and commonly has a bluish cast; it is locally vesicular. The base of the basalt is not exposed, and the relationships and age relative to adjacent rocks have not been established with certainty. The basalt bodies, however, are interpreted here as lava flows that were extruded before the eruption of the overlying tuff.

On the fresh surfaces the rock is dark gray to greenish black; it grades to lighter shades of gray where altered. Megascopically it is a dense rock with a uniform aphanitic texture, and it completely lacks phenocrysts. The microscopic texture is intergranular, and the rock is composed of about 55 per cent plagioclase (An_{65-70}), 30 per cent pyroxene, and 15 per cent opaque minerals. Equant grains of pyroxene and the opaque minerals are uniformly distributed through a felted mass of thin plagioclase laths. The plagioclase laths average 0.1 to 0.2 mm. long and have a maximum length of 0.5 mm.; the pyroxene and opaque grains average about 0.05 mm. in diameter, and reach a maximum diameter of about 0.1 mm.

Tuff

The steep-sided flanks of Picketpost Mountain are mainly composed of distinctly bedded, light-colored tuff (Fig. 3). Tuff also occupies part of the canyon cut by Arnett Creek north of Picketpost Mountain, and it crops out in several localities southeast of the mountain (Fig. 4). It continues beyond the area of Figure 4 and crops out over several square miles to the south and southeast, and scattered outcrops are also found to the north.

Beds range from thin to thick, and crossbedding is locally common. The weathered tuff tends to stand as steep cliffs, and outcrops are generally very pale shades of grayish yellow or brown, but on fresh surfaces the color generally ranges from pale grayish yellow to very light gray to nearly white. Lithology is highly varied and the rock ranges widely in composition and texture, but perhaps the most common type can be classed as vitric crystal tuff. Differing amounts of fine-grained crystals of plagioclase, quartz, and biotite, and scarce to abundant lithic fragments and pumice lumps are set in a fine-grained vitric matrix which shows slight to complete devitrification and alteration.

The tuff unconformably overlies the Precambrian rocks at the western and southern base of the mountain, and conformably overlies the basalt in the canyon of Arnett Creek. The tuff in Arnett Creek and in Telegraph Canyon (Fig. 4) is overlain by rhyolite flows; in turn, the rhyolite is overlain by additional tuff beds on the flanks of Picketpost Mountain. In the southeastern corner of the area, tuff is both underlain and overlain by rhyolite. Sections AA′ and BB′ (Fig. 5) illustrate the interlayering of tuff with rhyolite. The tuff high on the flanks of the mountain is overlain by quartz latite.

Rhyolite

Rhyolitic lava flows cover much of the low-lying ground from the northern to the southeastern side of Picketpost Mountain (Figs. 2, 4), and similar flows are found in several localities within 5 or 10 miles of the mountain both to the north and south. The rock weathers to bold, craggy outcrops and generally forms very rough terrain. The weathered rock is light to dark gray, and locally may be stained various shades of brown.

Flow structures are generally prominent, and they change at random from even and regular, through broad, swirling arcs, to tightly contorted folds. Locally the flow structures become inconspicuous or disappear, and the rock assumes a massive appearance. Lithophysae, quartz- or opal-lined cavities, and other spheroidal structures are locally abundant.

The rock varies from aphanitic to glassy, and phenocrysts are either absent or sparse. The aphanitic rock results from devitrification and alteration, and consists of microscopic crystallites of feldspars and silica minerals. Flow planes are defined by variations in degree and kind of crystallization. Completely crystallized rock grades into rock with alternating layers of crystallized and glassy material, and to entirely glassy rock. The glassy rock is generally characterized by moderately to well-developed perlitic structures.

At several places along and beyond the eastern margin of Figure 4, the glassy perlitic rock has expansion properties that meet commercial requirements and is being mined as perlite from several pits. The commercial perlite is light gray to milky white. Strongly developed spheroidal perlitic structures, from a millimeter to several tens of centimeters in diameter, are

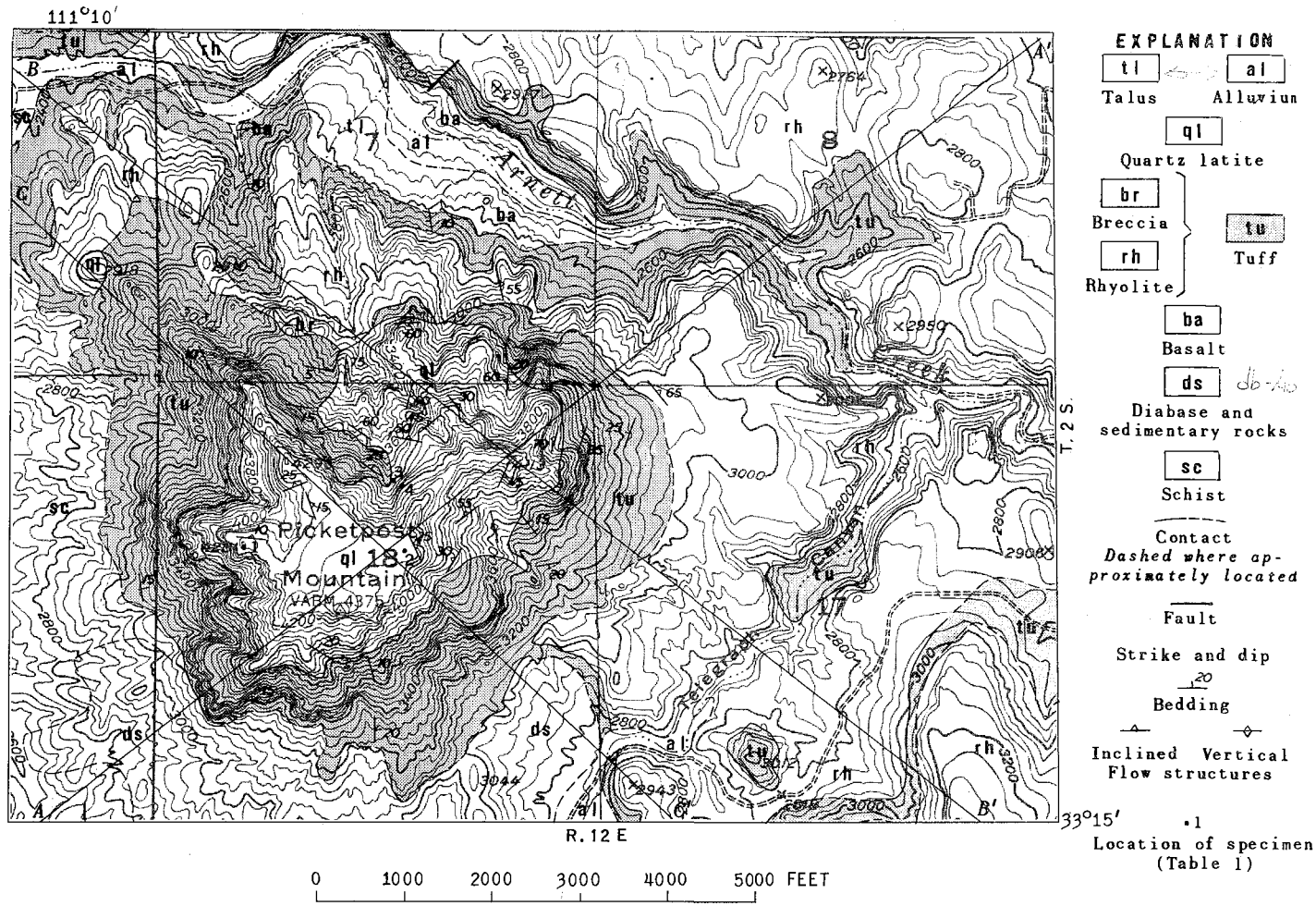
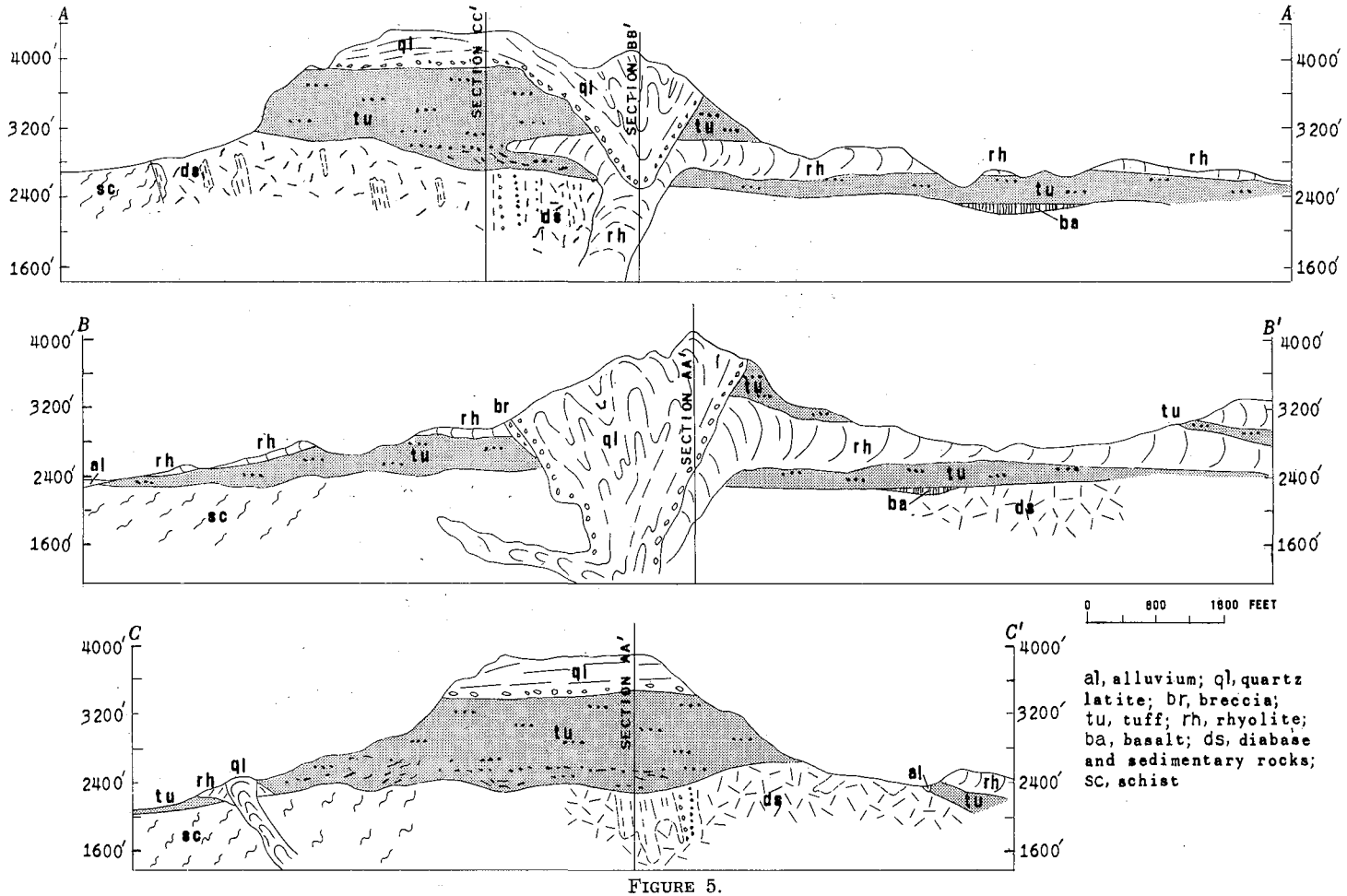


FIGURE 4. Geological map of Picketpost Mountain and adjacent area.


A
A
4000′
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SECTION CC′
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ql
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br
al
C
C′
SECTION WA′
0 800 1600 FEET
al, alluvium; ql, quartz latite; br, breccia; tu, tuff; rh, rhyolite; ba, basalt; ds, diabase and sedimentary rocks; sc, schist

FIGURE 5.

successively superimposed one upon another. Randomly scattered through the rock, like plums in a pudding, are subspheroidal nodules of black obsidian, known technically as marekanites, or commonly as Apache tears. The main mass of perlite contains several per cent water, whereas the nodules have a very low water content. The perlite is described by Wilson and Roseveare (1945, p. 5), Anderson and others (1956, p. 11), and Jaster (1956, p. 380), and the nature of the bonding of water in this perlite is discussed by Keller and Pickett (1954).

The rhyolite rests everywhere on tuff within the area of Figure 4. The interpretations of Figure 5 indicate that flows are interbedded with later tuff beds, as illustrated by sections AA′ and BB′. The interpretation presented here shows a hypothetical source vent of rhyolite partly cut by a younger vent of quartz latite.

Breccia

A body of volcanic breccia that stands in bold outcrops forms a tall pinnacle about a third of the way up the north flank of Picketpost Mountain. It is shown on the map of Figure 4, and is visible in both Figures 2 and 3. Several other irregular bodies of breccia crop out on the flanks of the mountain, but because of either their small size or vague boundaries, they have not been separately mapped.

The breccia is composed of angular blocks and fragments of tuff and other lithic material such as diabase, rhyolite, and schist in a heterogeneous pyroclastic matrix. The breccia forms a steep dike (Fig. 6) that has intruded along the contact between tuff and rhyolite and cuts across tuff beds at nearly right angles.

Quartz Latite

Quartz latite lava flows which form the flat-topped cap of Picketpost Mountain emerge from a steep-walled conical vent that occupies the northeastern flank (Figs. 4, 5). Quartz latite also forms a small plug near the northwestern base. The quartz latite crops out as cliffs and steep slopes and weathers to shades of reddish brown and grayish brown.

The lava flows at the summit of the mountain (Fig. 7) are characterized by broadly undulating, closely spaced flow planes. The planes tend to lie close to horizontal, but the rather random undulations result in gentle variable dips in every direction. The continuity and general regularity of the planes impart a layered appearance to the rock. The flow planes commonly weather to series of partings, whereas on fresh surfaces the planes are expressed by color and density changes. Thin, irregular, vuggy zones are common along the flow partings. Some of the layers exposed in the steep cliffs near the summit are cut by well-developed columnar joints. The columns stand nearly vertical as they are approximately at right angles to the flow planes, and most columns are between 1½ and 3 feet in diameter.

Fig. 7

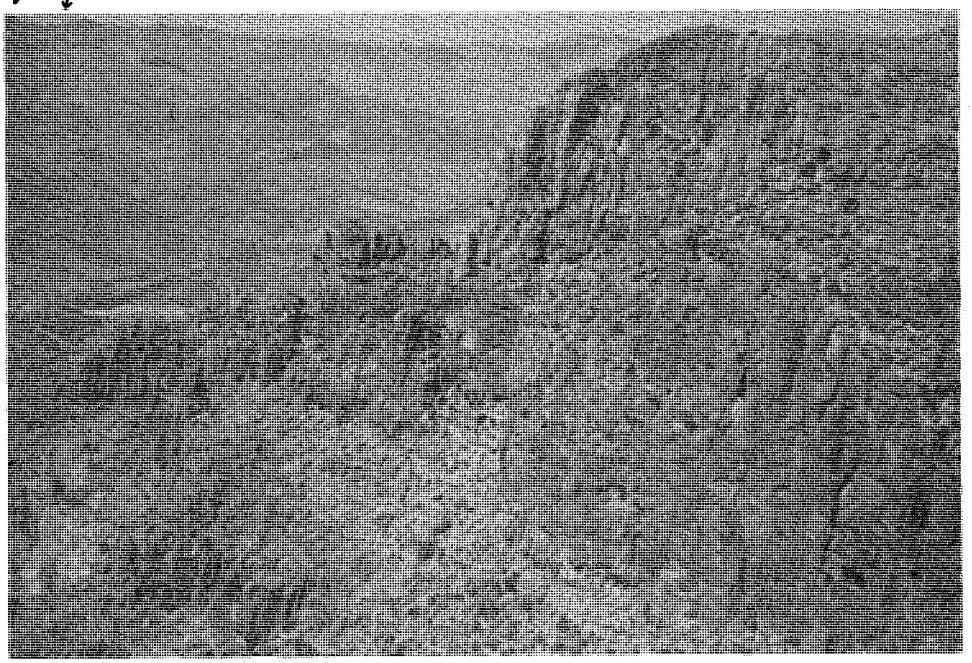

FIGURE 6. Thin-bedded tuff, on left, intruded by dike of breccia. This contact is just east of the prominent breccia pinnacle on the north flank of Picketpost Mountain.

The rock in the vent on the northeastern flank of the mountain is characterized by flow planes similar to those on the summit except that, instead of being flat or gently dipping, they are broadly swirling and wildly contorted, and their dips range from horizontal to vertical. The walls of the vent dip steeply inward, and the vent has the shape of an inverted cone (Fig. 5, sections AA′ and BB′).

A small plug of quartz latite crops out low on the northwestern flank of the mountain (Figs. 3, 4, and 5, sec. CC′). It is nearly circular in outline, and is about 200 feet in diameter. It intrudes both tuff and rhyolite, has steeply dipping to vertical walls, and shows well-developed flow layering parallel to the walls.

The quartz latite is porphyritic, and its groundmass exhibits a wide variety of textures, ranging from glassy to aphanitic, and from flow-layered to brecciated. Regardless of the texture of the groundmass, however, the phenocrysts are nearly uniformly distributed throughout both the vent rock and the extrusive flow, and they comprise from 20 to 30 per cent of the rock. Most phenocrysts are euhedral or subhedral, but many quartz crystals and a few feldspar crystals have deeply embayed boundaries. Phenocrysts range from a fraction of a millimeter to about 4 mm. in diameter, and average

Fig. 6

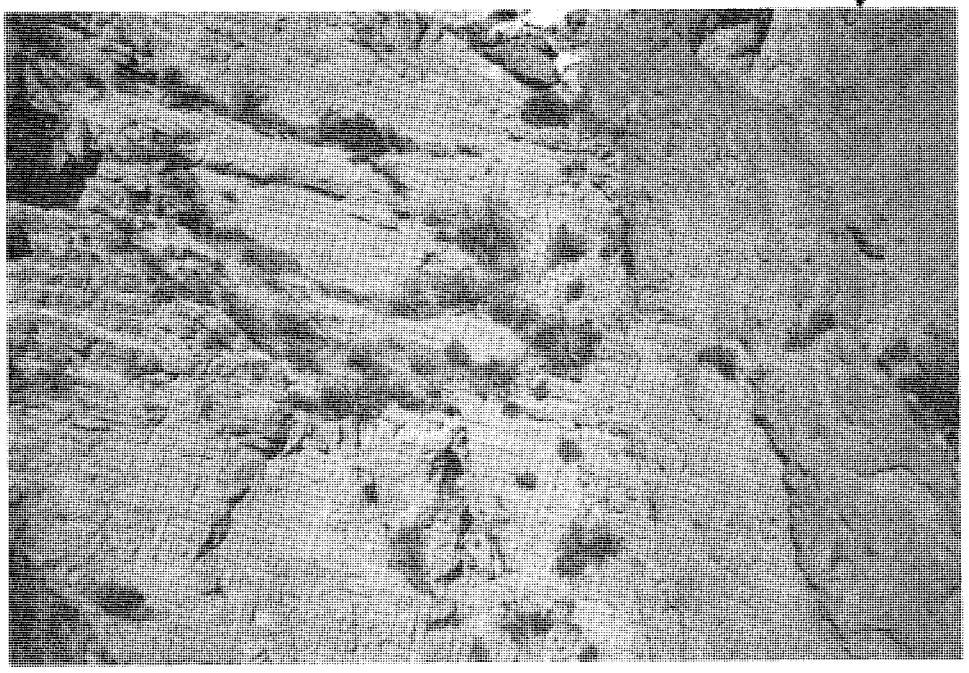

FIGURE 7. Nearly horizontal flow structures in the quartz latite show broad, gentle undulations, and are locally cut by well-developed columnar joints.

from ½ to 1 mm. Modal analyses by point counting methods have been made of a few thin sections, and relative proportions of phenocrysts are shown in Table 1. Throughout most of the rock the groundmass is free of broken fragments of phenocrysts.

TABLE 1. MODES OF QUARTZ LATITE SPECIMENS
(Location of specimens shown on geologic map)

Specimen No.	*1*	*2*	*3*	*4*
Phenocrysts	25	27	30	27
Groundmass	75	73	70	73
Relative Proportions of Phenocryst Minerals				
Plagioclase (An_{35-40})	55	51	66	61
Sanidine	6	11	2	1
Quartz	23	25	12	16
Biotite	13	9	11	14
Hornblende	3	3	7	7
Opaque minerals	tr	1	2	1
Accessories (sphene, apatite)	tr	tr	tr	tr

Although plagioclase is the most abundant phenocryst mineral, the rock is classed as a quartz latite because, with only 20 to 30 per cent phenocrysts, appreciable quartz and some sanidine occur as phenocrysts. This suggests that the magma was saturated with these constituents at the time of solidification; hence the matrix is likely to be richest in potential silica and potassic minerals.

Quartz latite with a black glassy groundmass, a vitrophyre, is confined to a single zone which is near the base of the lava flow and which continues around the border of the vent. The vitrophyre zone ranges from 3 to 20 feet thick. Much of the vitrophyre, both at the base of the flow and along the walls of the vent, is a breccia composed of blocks and fragments of vitrophyre in a matrix of very similar material. The vitrophyre is locally randomly intermixed with irregular stringers of pyroclastic rock, some extending upward or inward from the adjacent tuff, and some disconnected from it. The glassy zone is generally separated from the bedded tuff by a few feet of somewhat porous aphanitic breccia. The vitrophyre is interpreted as an autobreccia forming the chilled base of the flow and border of the vent. During emplacement, the chilled crust of lava was locally broken up by continuing movement, and blocks were incorporated in the still-fluid portions of the lava. Autobreccias are common at the base of silicic lava flows and at borders of vents. A zone of vitrophyre also encircles the small plug on the northwest side of the mountain.

The aphanitic quartz latite, away from the chilled border zone, is typically characterized by more or less regular, continuous flow structures (Fig. 7). On the fresh surface these are expressed by alternations in color which largely reflect variations in the degree of crystallinity of the groundmass. On the fresh surface the groundmass alternates among various shades of gray. Microscopic examination shows that the darker gray rock is relatively less crystallized and is composed mostly of glass, whereas the lighter gray rock shows a greater degree of crystallization. Some rocks are completely crystalline and the groundmass is a microcrystalline mass of low birefringence. In some the crystallization has progressed far enough to enable feldspars and silica minerals to be recognized. Some of the partly crystalline rocks contain tiny but well-defined spherulites with radial structure.

In some places, within both the vent and the extrusive flow, the rather uniform texture is interrupted by an abrupt transition to distinctly pyroclastic texture. The pyroclastic material ranges from tiny microscopic stringers to definite layers a few inches thick interbedded with the flow rocks. The pyroclastic texture is unmistakable, and even the groundmass of this material is full of minute fragments of broken phenocrysts and dust, imparting a clastic rather than a fluidal texture to the rock.

The quartz latite lava flow rests nearly conformably on the underlying tuff. The quartz latite vent intrudes this tuff, cutting across beds with a

sharply discordant contact. The adjacent tuff is generally little disturbed, but blocks, fragments, and particles of tuff have been torn loose and incorporated in the brecciated quartz latite near the contact.

ORIGIN OF THE QUARTZ LATITE

In recent years, throughout the western United States, many bodies of silicic volcanic rock that in earlier times would have been designated as lava flows have been identified as ash flows (ignimbrite). Evidence pertinent to proper identification may sometimes be difficult to recognize, and criteria are often gradational, so a careful study should be made before designating the origin of a silicic volcanic rock. Among the best discussions of criteria for recognizing ash flows are papers by Ross and Smith (1961) and Smith (1960a).

An extensive sheet of silicic volcanic rock covers much of the area near Picketpost Mountain. Ransome (1903, p. 88-95) identified the rock as a dacite, and believed it to be a lava flow which rested on a basal tuff. Later studies have shown that the rock is an ash-flow sheet and that much of it is composed of welded tuff (Peterson, N. P., 1962; Peterson, D. W., 1961). Evidence supporting this conclusion includes the wide lateral extent of the sheet, zoning typical to ash-flow sheets based on both degree of welding and type of groundmass crystallization, relict deformed pyroclastic textures, and gradation into basal nonwelded tuff.

Ransome's name of dacite was based on the predominance of plagioclase and the presence of quartz phenocrysts in the rock. Chemically the rock is a quartz latite (Peterson, 1961, p. 8, 111), but because of firmly established usage both locally and in geologic literature, and because dacite correctly describes phenocryst mineralogy by megascopic and microscopic classification schemes, the name dacite has been retained for the rock. This illustrates the inconsistencies inherent in naming many volcanic rocks. Insofar as possible, a chemical scheme should be used because it reflects the composition of the entire rock rather than the fractional portion represented by phenocrysts. Volcanic rock classification schemes, however, generally have sufficient flexibility to permit deviations due to special circumstances.

Picketpost Mountain is 4 to 5 miles west of Apache Leap, which is capped by hundreds of feet of the dacite. The quartz latite on Picketpost Mountain lies at the same general elevation as the dacite on Apache Leap. The question of whether they belong to the same rock unit must be considered.

From a distance the outcrops are similar, both in color and in weathering characteristics. In hand specimen the rocks are similar, but not identical. Both are readily recognized as silicic volcanic rocks, and they may be very close in color. Both are porphyritic, with a predominance of plagioclase phenocrysts and lesser amounts of quartz, sanidine, biotite, hornblende, and opaque minerals. Microscopic studies show that the percentage of

phenocrysts in the dacite is appreciably higher, ranging from 35 to 45 per cent, where the quartz latite contains 20 to 30 per cent phenocrysts, but this criterion is not necessarily diagnostic. Much of the dacite contains a relatively higher proportion of plagioclase phenocrysts and a lower proportion of quartz phenocrysts than does the quartz latite, but phenocryst proportions of part of the dacite do overlap with those of the quartz latite. Phenocrysts in the quartz latite tend to be unbroken, whereas those in the dacite commonly show broken faces.

The following criteria have been used to reach the conclusion that the quartz latite is indeed a lava flow instead of an ash flow:

(1) Flow structures in the quartz latite are continuous and regular (Fig. 7). Flowlike structures in ash flows, including the dacite, are lenticular and discontinuous.

(2) Pyroclastic and vitroclastic textures, pumice fragments, shards, and eutaxitic structure are missing from the bulk of the quartz latite, and no relict textures can be distinguished. These textures are an important criterion in identifying the dacite as an ash-flow sheet. The pyroclastic bodies mentioned in the description of quartz latite lie in discrete layers and comprise but a small fraction of the rock; the adjacent nonpyroclastic layers contain no trace or sign of pyroclastic texture.

(3) Zoning typical of ash flows is lacking. One of the principal criteria for recognition of ash flows is a zoning based on systematic downward increase in degree of welding of shards and pumice fragments (Smith, 1960b); this is well displayed in the dacite, but because there are no appropriate particles or fragments in the quartz latite, such zoning is completely lacking. Zoning by type of crystallization of the groundmass is also a characteristic of ash flows (Smith, 1960b) and is well developed in the dacite, but no evidence for this type of zoning has been observed in the quartz latite. Instead, strong differences are observed in the degree of crystallization of the groundmass between adjacent flow layers.

(4) Broken fragments of phenocrysts are absent or rare in the groundmass of most of the quartz latite. In rocks where broken crystal fragments are abundant, a violent eruption, such as an ash flow or pyroclastic explosion is suggested. The dacite groundmass contains abundant broken crystal fragments. Their rarity in the quartz latite is consistent with a quieter, fluidal type of eruption, such as a lava flow.

(5) The autobreccia at the base of the flow and around the walls of the vent is typical of many lava flows. Although the basal rocks of ash flows may contain abundant xenoliths, they do not characteristically contain autobrecciated zones.

The above criteria are probably sufficient to establish that the quartz latite represents a lava flow issuing from a vent, but a few seemingly contrary facts must be explained.

The pyroclastic layers within the quartz latite perhaps can be most readily explained either as: (1) pieces of semiconsolidated wallrock or

underlying tuff torn off by the advancing lava and intimately intermixed during subsequent movement, or (2) as products of pyroclastic eruptions landing on and intermixing with still-fluid lava. Both of these mechanisms may have operated.

The flow layering on the flat-topped summit of the mountain is uniform instead of contorted, and it varies from horizontal to gently dipping without abrupt changes (Fig. 7). A lava flow as silicic as this rock would be expected to be viscous and to exhibit highly contorted flow structures. Another feature rarely observed in silicic lavas is polygonal columnar jointing (Fig. 7). Such joints are common in basalt and andesite lava flows and in silicic ash flows, so if this rock is a lava flow, their presence is paradoxical. The columnar joints and the regular, uniform flow layering may well be related to the same basic cause. Two alternate possibilities are proposed here to explain how both features might develop in a silicic lava.

One possibility is that the flow issued from the vent as an unusually thick mass that moved uniformly across a surface of low relief. The uniform movement and the lack of topographic irregularities resulted in gently undulating rather than highly contorted flow structures. A further result would be that during the cooling history isotherms were smooth and regular, and that major flow movement ceased before the principal hardening of the groundmass. These are conditions conducive to the formation of vertical columnar joints.

Another possibility is that the lava had an abnormally low viscosity for a silicic rock. It may be that an unusually high content of volatiles lowered the viscosity to a degree permitting both uniform flow and a regular pattern of isotherms during the cooling.

The criteria favoring a lava-flow origin for the quartz latite seem distinctly stronger and more definite. The apparently contrary criteria are not as compelling, and they do have rational, though somewhat speculative, explanations. The evidence, therefore, distinctly favors the viewpoint that the quartz latite is a lava flow. The even flow layering, columnar joints, and pyroclastic layers suggest an unusual type of lava flow, however, and the rock should be an interesting subject for future studies.

The age of the quartz latite relative to the dacite cannot be learned from evidence in the immediate area of Picketpost Mountain, for dacite does not crop out close by. However, the geologic relationships exposed in Walnut Canyon, about 8 miles south-southeast of Picketpost Mountain (Fig. 1), suggest that the quartz latite on Picketpost Mountain erupted during an episode of volcanic activity later than the dacite. These relationships, described below, were shown to me by D. C. Lamb.

Dacite crops out over a broad area in Walnut Canyon and vicinity. In several localities it is overlain by tuff beds which crop out almost continu-

ously from Walnut Canyon to Picketpost Mountain and in scattered areas to the north. It is likely that the tuff on the flanks of Picketpost Mountain correlates with the tuff in Walnut Canyon and, if so, it is younger than the dacite. As the quartz latite both intrudes and overlies the tuff, it is younger than both the tuff and the dacite.

GEOLOGIC HISTORY OF PICKETPOST MOUNTAIN

During mid-Tertiary time, the Picketpost Mountain area was a land of moderate relief. Former geological events had tilted and faulted rocks from Precambrian to late Paleozoic in age, and all were exposed in various places at the surface. Stream-carried gravels were accumulating in local basins. During the Miocene Epoch, nearby volcanic activity was climaxed by eruptions of huge ash flows which covered the region with a dacite sheet from several hundred to some 2,000 feet in thickness. Practically a complete section of this sheet is presently exposed in Queen Creek Canyon a few miles to the east, yet no dacite crops out near Picketpost Mountain. The Picketpost area almost undoubtedly was covered by the dacite, though it may have been considerably thinner than in Queen Creek Canyon, and erosion removed this dacite before the subsequent volcanic activity. This suggests considerable uplift in the Picketpost area relative to the area a few miles east.

A resumption of volcanic activity included basalt flows followed by the eruption of a moderate amount of tuff, some of which was deposited as air-fall beds and some of which was reworked by streams. The tuff was deposited over an area of several tens of square miles, including the site of the present Picketpost Mountain and neighboring areas both to the north and south. At the site of the mountain the tuff was deposited upon steeply dipping Precambrian rocks, whereas a few miles south it was deposited on dacite. This affirms that the period between the dacite emplacement and the tuff eruptions was one of considerable local uplift and erosion. Contemporaneous with the tuff deposition, rhyolite flows were erupted and covered several square miles. Some may have issued from vents at the site of the present mountain, and these vents may also have supplied some of the tuff and breccia. Tuff eruptions continued after the rhyolite flows ceased.

Ultimately one or more lava flows of quartz latite issued from a vent which cut through the recently deposited tuff and reached a diameter of about 3,000 feet. The flows advanced an unknown distance over the neighboring area. The vent probably stood as a moderately sloping topographic high point during the volcanic activity. After volcanism ceased, erosion began cutting at the margins of the quartz latite flow and has continued to the present time. A small remnant of the flow capping and protecting the softer tuff beds underneath forms the summit of the prominent mountain of today. Erosion has exposed the upper part of the quartz latite vent

on the northeast flank of the mountain, and has cut through and removed much of the tuff and part of the rhyolite flows. The sections of Figures 5 illustrate the degree of dissection.

Between Picketpost Mountain and the Gila River (Fig. 1) other volcanic rock bodies intrude, are interbedded with, and overlie the tuff, indicating fairly widespread volcanic activity during the general period in which Picketpost Mountain formed (Lamb, D. C., oral communication, 1960).

Meanwhile, further regional tectonic activity reversed the previous relative movements, and the eastward block and its dacite sheet were raised to their present relatively high elevation.

Much remains to be learned about the geology of Picketpost Mountain and the nearby areas. A detailed study of the tuff may reveal distinctions between different beds, different modes of eruption and deposition, and establish a stratigraphy. Further studies should reveal more definitely the relationships among the tuff, rhyolite, and breccia units. Detailed studies of the rhyolite flows may reveal information concerning the origin of perlite. The quartz latite possibly represents an unusual type of lava flow which further studies will help to understand. Additional problems include the nature of the complex deformation that occurred between the time that the dacite was emplaced and the time of the tuff and rhyolite eruptions, the structural framework that determined the location of the vent at Picketpost Mountain, and the type and extent of the deformation, erosion, and sedimentation following the eruption of the quartz latite lava flow.

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4/12/77

FROM: F. T. GRAYBEAL

TO: JDSell Magma

Arthur Brant made the comment the other night that in 10 years the only mines Newmont would have operational would be Carlin and San Manuel.

Perhaps company line but Magma not included

ASARCO

Southwestern Exploration Division

March 18, 1977

TO: F. T. Graybeal

FROM: J. D. Sell

Superior Division
Magma Copper Company
Pinal County, Arizona

Magma Copper early in March announced at a School Board meeting in Superior that their valuation figure was drastically cut and furthermore they had only six years of reserves.

At a previous meeting and election the Board and citizens had approved a bond issue for a new school. With the Magma announcement the Board has tabled the issue because of anticipated lack of revenue for repayment.

Magma Superior presently mines 2,800 tons per day on a seven days per week schedule or around 1 million tons per year.

Magma had announced a 10.2 million ton reserve as of Jan. 1, 1971. Production from 1971 thru 1975 amounted to 3.2 million or approximately 4.2 million tons thru 1976. This would leave 6.0 million tons.

But, their reserve was based to the 3900 level altho drilling had shown mineralization to the 4300 level. The bottom of No. 9 shaft corresponds to the 4100 level and they are presently in mineralized limestone beds north of the shaft after passing through the breccia mass. No hard facts are presently known by me as to the grade of the present 4100 level mineralization, altho the statement was made that a high-grade bornite-chalcocite "vein" was found on the breccia-limestone contact.

Mr. Joe Murry, General Manager, quit as of March 15 and is now with United Nuclear at Grants, New Mexico. A Mr. Freeman from San Manuel is over as the new General Manager. Freeman has been with Newmont at San Manuel for the past two years, with three years in the New York office, and an English firm prior to that.

James D. Sell

JDS:lb

ASARCO

Southwestern Exploration Division

May 20, 1977

TO: F. T. Graybeal

FROM: J. D. Sell

New Vein
Magma Breccia Area
Superior Division
Pinal County, Arizona

I have been able to confirm from several sources that Magma has recently encountered a new vein in the breccia area south of No. 9 Shaft.

The structure is located some 2000 feet south of No. 9 Shaft and is near vertical. No info was gleaned as to the strike and width of the structure. Two holes have presently penetrated the structure and indicate high-grade bornite-chalcocite as found in the "breccia vein" to the north and also at the north edge of the breccia mass (see sketch).

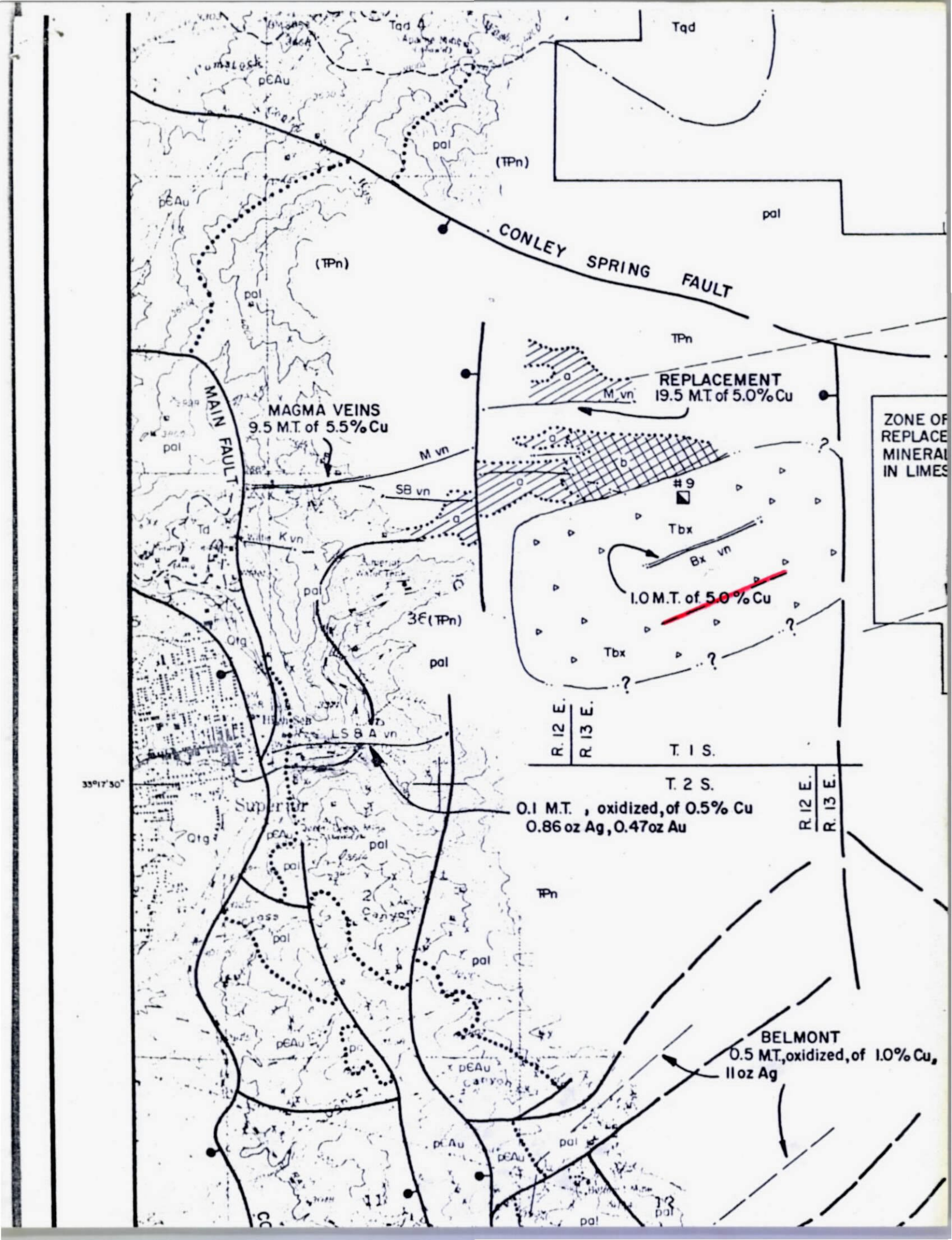
Magma has drifted from No. 9 Shaft on the 3000 Level and is presently mining in the "breccia vein". I assume the drilling which encountered the new vein was from a 3000 Level breccia vein station.

Also rumored is that Magma intends to bring in a geophysical company to probe the vein and to determine its dimensions. Apparently this will be by the "acoustical logging" method similar to the work done for Asarco in the Galena Mine in 1974(?). An ex-Asarco engineer from there who is now at Magma is disturbed that they intend to make the probe without knowing the location of the drill holes; that is, the holes are unsurveyed.

This discovery places more emphasis on the Oak Flat Withdrawal Area to the east of the present and known Magma discoveries and workings.

James D. Sell

JDS:lb
Att.


Tqd
pCAu
pal
(TPn)
CONLEY SPRING FAULT
TPn
REPLACEMENT
19.5 M.T. of 5.0% Cu
M vn
MAGMA VEINS
9.5 M.T. of 5.5% Cu
MAIN FAULT
M vn
SB vn
K vn
#9
Tbx
Bx vn
1.0 M.T. of 5.0% Cu
Td
Qtg
3ε(TPn)
LS & A vn
R. 12 E.
R. 13 E.
T. 1 S.
T. 2 S.
33°17'30"
0.1 M.T., oxidized, of 0.5% Cu
0.86 oz Ag, 0.47 oz Au
Superior
BELMONT
0.5 M.T., oxidized, of 1.0% Cu,
11 oz Ag
Canyon
ZONE OF
REPLACE
MINERAL
IN LIMES

ASARCO

Southwestern Exploration Division

April 1, 1977

FILE MEMO

Magma Copper Company
Superior East Project
Pinal County, Arizona

The new General Manager for the Superior Division of Magma Copper Company (Newmont) is:

Charles G. Freeman

formerly Assistant to the Vice President of Magma. Joined Newmont in 1971, with mining experience in Africa, etc. Graduate of the Royal School of Mines, London, England. Is presently moving to Superior with his wife Jayne.

James D. Sell

JDS:lb

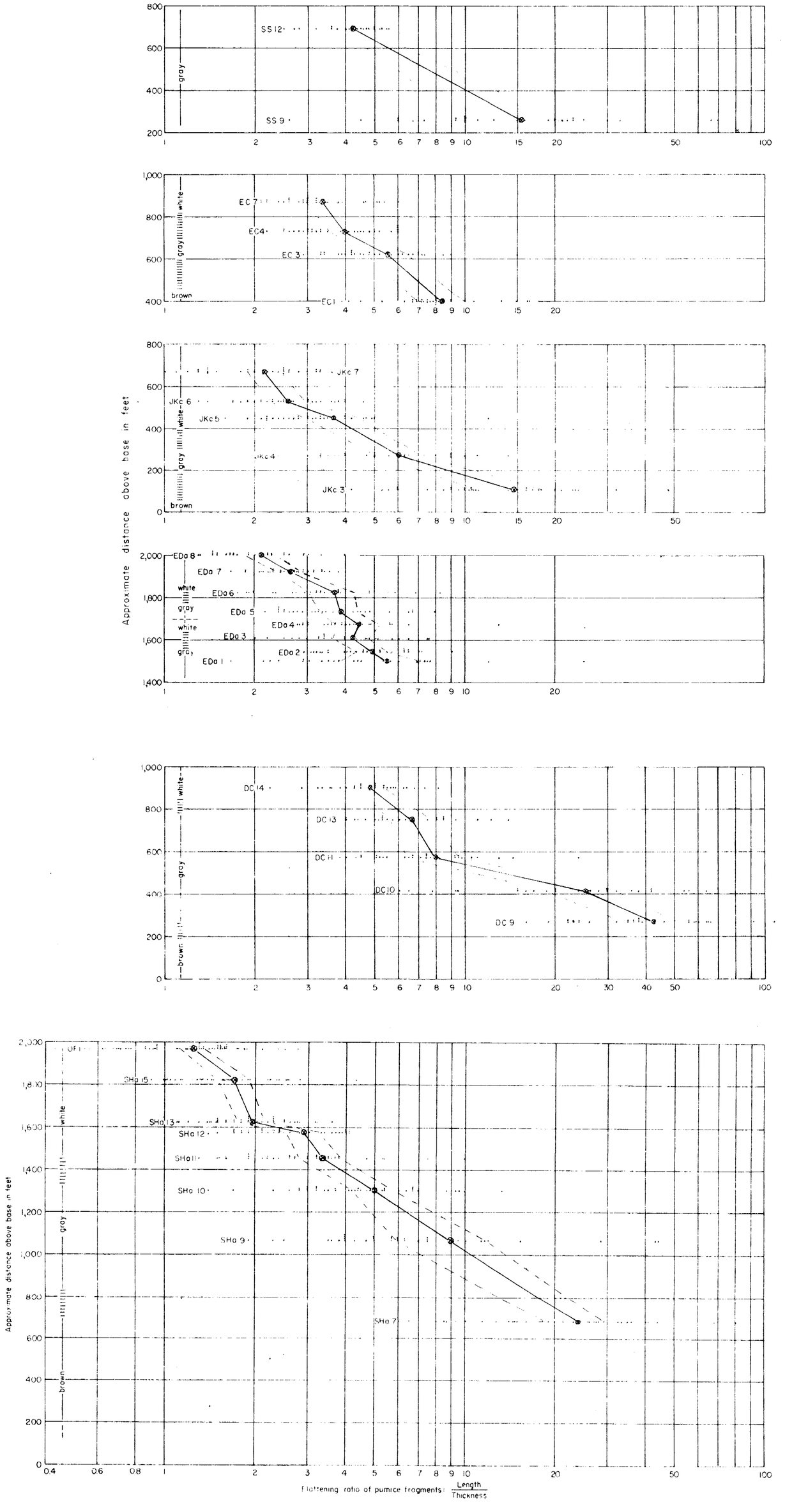


Plate 2. Relation between the flattening ratio of pumice fragments and the distance above the base. The average flattening ratio is shown by a solid line, 95% confidence limits are shown by dashed lines, and individual fragments by dots.

PLATE 3.

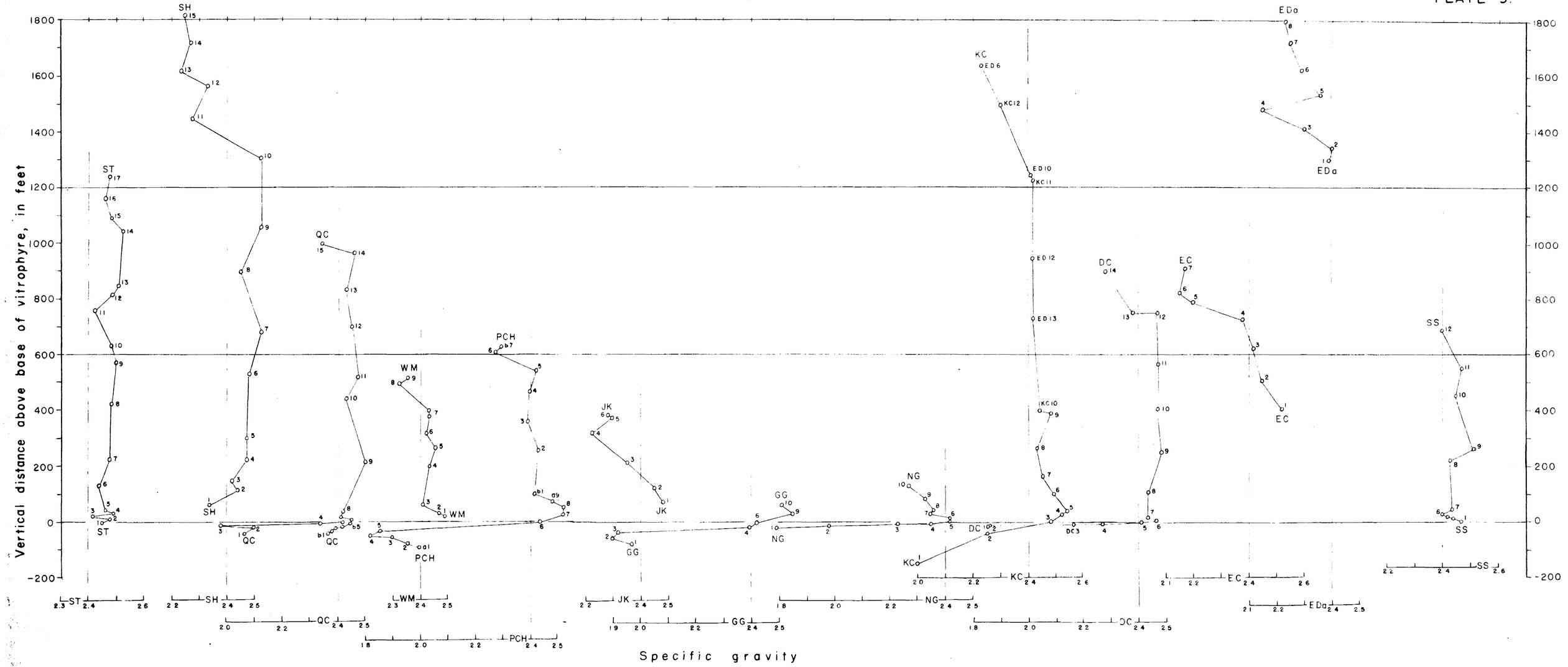


Plate 3.--Relation of specific gravity to the vertical distance of the specimen above the base of the vitrophyre

PLATE 4.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

SUPERIOR QUADRANGLE
ARIZONA-PINAL CO.
7½ MINUTE SERIES (TOPOGRAPHIC)

EXPLANATION

QT — Post-volcanic rocks
Principally Gila conglomerate and alluvium

Td (Tda, Tdw, Tdg, Tdb) — Dacitic ash flows
Tdb - basal tuff, vitrophyre and brown zone; Tdg - gray zone; Tdw - white zone; Tda - air-fall tuff; Td - undivided

Tev — Earlier volcanic rocks
Mostly rhyolite and obsidian flows, tuffs, and tuff breccias

TERTIARY AND QUATERNARY

TERTIARY(?)

pv — Pre-volcanic rocks
Metamorphic, sedimentary, and igneous rocks

PRECAMBRIAN TO TERTIARY(?)

Contact
Dashed where approximately located

165 — Fault, showing dip
Dashed where approximately located

235 — Number of feet of vertical separation on fault. Symbol on downthrown side

15 — Strike and dip of planar structure in volcanic rocks

⊕ Horizontal planar structure

(2.55) / (5.37) — Average flattening ratio of pumice fragments on opposite sides of fault

SCALE 1:24,000
1 ½ 0 1 MILE
1000 0 1000 3000 5000 7000 FEET
1 .5 0 1 KILOMETER

Contour interval 40 feet
Datum is mean sea level

14° True north / Magnetic north

Geology by D. W. Peterson, 1958-60.

Plate 4.--Partial geologic map of the Superior quadrangle, Arizona. Pre-volcanic and post-volcanic rocks generalized; dacitic ash flows partly divided into zones.

See Note on back of Progress Map

Tucson – Oracle Jct – Rural Parkway – Florence –
Florence Jct – Gonzales Pass – Superior Log.

MP	Mile Post (Mileage Log)	
74.8	0.0	Ina Road at Oracle Highway. This log utilizes the green Arizona milepost markers located each mile. From Tucson the Oracle Highway has climbed up several terraces of the Rillito River system and presently traverses over the outwash fans from the Catalina Mtn complex.
		The Catalina Mtns (1-3 o'clock) are a metamorphic complex recently mapped by Banks, et al ( )
		The Tucson Mtns and Safford Peak (7-9 o'clock) are part of the volcanic complex
		Far away Ragged Top and the Silver Bell Mtns (9-10 o'clock) peer through the haze.
		At 11 o'clock, the Tortolita Mtn Range occupy much of the view. Banks, Davis, et al ( ) share their interpretation of the area.
		For the next several miles note the profusion of thornbrush – cactus – mesquite – a variety of foothills above base habitat
		At the left end of the Tortolita Mtns, on a good day, the tops of Picacho Peak (miles) can be seen. Picacho Peak in the past was a landmark for travelers leaving the Presidio de Tucson and making their way to the Pima Villages & hence to California via the Gila River.
77.2	2.4	Oro Valley Municipal Center on right. Starting to drop off the fan deposits. Excellent end on view of Pusch Ridge (3 o'clock) — Home of the Arizona Big Horn Sheep.
79.0	1.8	The Cañada del Oro drainage has a wide active flood plain which has truncated, then entrenched itself, in the gravel-mudstone terrace fan deposits (which you pass thru on the long curve between MP 78 & 79). Vegetation of mixed Desert Broom – mesquite – Palo Verde. As you continue north note the two terrace development levels on your right. Pusch Ridge escarpment (3 o'clock). Note sprinkler system of irrigation (9 o'clock).

MP	Mile Post (Mileage bis)	
80.5	1.5	AHD roadside marker (9 o'clock). "Cañada del Oro. For Earlier Travelers the Road Through this Canyon was One of the Most Dangerous in Arizona. Indians attacked Lone Riders and Wagon Trains along this Route from Tucson to Old Camp Grant on the San Pedro River. Despite the Canyon's name, very Little Gold Was Ever Found Here." Press On!
		Peering over the gravel deposits (2 o'clock), prior to traversing over the bridge of Cañada del Oro, you will note a ridge of the metamorphic complex exhibiting a large amplitude anticline fold.
80.9	0.4	Bridge over Cañon del Oro. Looking down axial plane of anticline fold (2:30 o'clock). (See Sashby & McCullough)
81.5	0.6	Climbing out of the side drainage of Cañada del Oro alongside Big Wash with the road cutting through dissected gravel-silt terrace deposits.
81.8	0.3	Good views (4 o'clock) of anticlinal folding in metamorphic complex along lower slope of range.
82.0	0.2	View of terrace surfaces (9 o'clock).
82.2	0.2	The rough "granite" exposures (3 o'clock) at the foot of the Catalina Mountains is the Gneiss Monzonite of Romanesa Ridge, as is the upper skyline crags. (Banks MF-747).
		On the Tortolita Mtns (9-10 o'clock) the low foothill granites are the of Banks MF-814
84.8	2.6	White scars (2 o'clock) in the Tortolita Mtns are marble gneiss units of Paleozoic being quarried for roof coverings, front yards etc.
85.1	0.3	Missle Silo Complex (2 o'clock). Sleep tight, Big Brother is Watching Over You.
86.0	0.9	Welcome to Tradeville — Land of Sunshine & Hope. The

MP	Milepost (mileage bk)	
		Tortolita Land Plan Complex on left side of road expect 50-100,000 people by 1985. Buy Now!
87.8	1.8	Entering Pinal County. Horse breeder-trainer complex (2-3 o'clock) — very nice addition to visual impact of area.
~~90.5~~	~~2.7~~	
90.5	2.7	Junction with Arizona Hwy 77 is half mile ahead. Stay straight ahead to Florence of US 89.
91.0	0.5	Oracle Jct. See AZ Bur Mines Bull for road log to Oracle etc along Hwy 77.
91.5	0.5	Entering Pinal Pioneer Parkway. Monument built of schist, gneiss, quartzite, granitoids, pegmatite, & quartz veins of Tortolita complex plus ads & exds of epidote-garnet-malachite-chrysocolla. Vegetation is dominant cateclaw, mesquite, desert broom, various cholla's, barrel cactus, & yucca (See Wells: "Meet the Southwest Deserts", SWPMA Pub.) Also various prickly pear & saddlecactus.
91.7	0.2	Bridge over Big Wash. Note the ground cover differences between Parkway and outside of grazing fence. High fire fuel feed along Parkway is easily set afire and then fans large swaths into outside grazing area.
96.0	4.3	Tortilla Range (12-2 o'clock), another mid-Tertiary metamorphic complex. Galiuro Range across San Pedro River in far skyline (3-4 o'clock).
98.0	2.0	Dunbar Hills-Owl Heads (10 o'clock) in near range of hills. On skyline is massive "granite" (grey) of Picacho Mountain complex (10-11 o'clock) with jagged volcaniclastic units (dark grey-black) of Picacho Peak on far 2 o'clock. In between 65 miles away, in far background is Table Top Mountain located southwest of the Saxton property. Note that the vegetation here at 3400 feet elevation has given way to palo verde, cholla, prickly pear, catclaw, grassewood flora.

Milepost	Mileage bis
99.0	1.0 Volcanics at 12 o'clock with Titan missile site at base.
99.7	0.7 Conglomerate in curve road cut. (Banks -
100.3	0.6 Volcanics in Three Buttes (9 o'clock)
101.4	1.1 Jct - stay on Florence Hwy. Park Link Dairy (left) Red Rock and Eloy: Ragged Top and Silver Bell Mtns (9:30 o'clock) in far distance. Owl Head Buttes, 6 miles away at 9 o'clock.
101.9	0.5 Cadillac (Coronado) Wash bridge with reddish conglomerate in right bank wash wall and bottom.
102.3	0.4 Low rolling slope at 9 o'clock next to road is dike of basalt s/ ase, with conglomerate on both sides.
102.5	0.2 Conglomerate in road cut on curve before Forman wash bridge.
104.0	1.5 Suigo Mtns (10-11 o'clock) Picacho Mtn & Peak in far background.
104.3	0.3 Olsen wash bridge with Tertiary basalt in right side wash wall.
~~104.6~~	~~0.3~~
104.6	0.3 Road cut with "schist-gneiss" of Oracle granite derivation. Banks , ASARCO thin-section #.
106.0	1.4 Vegetation at 2000 foot elevation giving way to greasewood (creosote bush) - catclaw - palo verde - saguaro cactus assemblage
108.0	2.0 Northern end of Durham Hills (10 o'clock) with pinkish Samaniego granite having medium grey dioritic border phase on east hill (11 o'clock). Entering magnetic sand project of Black Sands Iron Corporation.
110.0	2.0 Ninety Six Hill area (3 o'clock) and Picacho Peak Mtn (9 10 o'clock) showing through dense cover of Palo Verde

Milepost	(mileage last)	
		and Cholla forest.
111.6	1.6	Freeman Road cut off with Pinal Schist hills (1 o'clock) cut by aplite, pegmatite and dike of Samaniego diorite phase. Also minor copper oxide occurrences.
115.5	3.9	Tom Mix Memorial Rest Area. (Jan 6, 1880 – Oct. 12, 1940 ..... who's spirit left his body on this spot .....").
117.0	1.5	Low hills (2 o'clock) of muscovite granite cut by numerous and diversified dikes of 96 Hills SW complex.
118.0	1.0	North Star Mine area (Geol. MF-) in low hills (10 o'clock) on north end of Peridot Mountains.
121.4	3.4	Leaving Pinal Pioneer Parkway.
127.6	6.2	Cactus Forest Jct. Note 8 foot high ~~rock~~ round, rock structure on NW side of Jct (to right), Built of altered and leached coping and copper oxide boulders, (Probably from Red Hill deposit ??), with some granite-latite. Note flora change (elevation) to grease wood-cholla-saguaro-format.
130.0	2.4	Superstition volcanic complex (1-2 o'clock) on far skyline (Sheridan et al). North and South Butte (3 o'clock), potential site of Butte Dam of Central Az Storage Project. Note grenser "rift" associated volcanic complex behind the Butte. Pinal Mountain (11 o'clock) is the far semi-rounded mass. Saddle - San Tan Mountain complex of Bella (10-11 o'clock). "F" Hill at Florence of basalt (12 o'clock).
131.5	1.5	Ocotillo cactus appearing.
132.0	0.5	One-way road split. Keep right (south, by Florence).
133.0	1.0	Florence, Arizona. State Prison and fields on right. No

	Mile Post (Mileage last)	
		not pick-up lady hitchhikers.
135.0	2.0	"F" Mtn (Poston Butte) with rock pyramid on top. Basalt flows, tilted, with altered Precambrian granite at base on west side. Discovery outcrop of ASARCO's project in area. Drilled and dropped. Later picked up by Conoco with abundant further drilling. Shaft and office building to left of Poston Butte. Conoco has also put the project on the shelf. Walker Butte core at 9 o'clock.
135.5	0.5	Gila River bridge. Associated flood plains of several stages, and wide inner terrace with shallow Gila River entrenchment.
135.9	0.4	Historical note on left, AHD. "Poston's Butte - Final Resting Place of "Father of Arizona". Charles D. Poston, born Kentucky, 1825, Arizona's First Delegate to Congress is buried in accordance with his wishes atop the Hill two miles West. It was to have been the site of Poston's Temple To The Sun, but that effort failed and he died in Poverty in Phoenix 1902. Not until years later were His Remains Brought to the Place called Parsee Hill, but known to Local Residents as Poston's Butte."
136.4	0.5	Railroad Crossing. Rails go variously to Ray - Hayden - Sun Manuel.
136.8	0.4	Florence Federal Detention Facilities on left, followed by retirement trailers for Sunshine & Golf.
137.5	0.7	Near low hills (1 o'clock) of basalt interlayered with gravels of Gila River system. Major skyline (2-3 o'clock) is mainly a volcanic - tuff - conglomerate complex of Mid-Tertiary age. View (3 o'clock) of North and South Buttes with Gila River drainage between. On far background (right) of South Butte is Graybeck Mountain. The volcanic - tuff - conglomerate occupies a depressed

Mile Post	Mileage last	
		block with outflow units lapping only Precambrian Pinal Schist both to the east and west of the depressed block. (Probably an early Miocene initiated rift system which cuts northwesterly through Central Arizona).
138.2	0.7	Rising out of the road (12 o'clock) is the three peaks of the ~~Mogyl~~ Mogyl Mogyl Range some 65 miles away.
139.0	0.8	Superstition Mtn Volcanic Complex (11 - 1 o'clock). Smog of Phoenix to left. Left side cliff face of Superstition is the Dacite Head dacite, the oldest intrusive of the complex. Nat. layered flows to right then jumbled units on further right. The jumbled units are youngest of the complex and lie within the rift portion. Far right background is schist-gneiss pC complex on far side of rift. As at the Buttes area - outflow units lap east onto the higher basement walls on both sides of the rift.
140.4	1.4	Road to Arizona Farms. At the NE corner of the jct, a local air hammer men drilled (State Lease) through the surface sands & gravels, then a layer of basalt, back into gravels. While day-dreaming & drilling ahead the hole ballooned on him and the cuttings piled up behind the bit. All tools were abandoned for several weeks before he returned & worked the tools free.
142.0	1.6	Increasing better & views of Superstition Mtn. Near skyline masses at 3 o'clock are pC Pinal Schist with rift volcanics peaking from behind. at 2 o'clock is small erbit outcrop of base of Schist. Dulled porphyry - See Hank K.
147.1	5.1	Left side of road across fence are pits and spoil piles of an oil well test. 20" hole cratered, hole reported to stay in gravels. Reject is mainly schist with minor diabase.

Mile Post	Mileage Inst.	
148.0	0.9	Another view of the altered porphyry (3 o'clock) near the schist-granite contact. Note clumps in flow to grasswood with mesquite-cholla mixed in drainage.
148.3	0.3	Magma Az Railroad Crossing.
149.0	0.7	Low hills in front (12-2 o'clock) are dacite of Geronimo Head resting on pC granite. These are outside the rift.
150.2	1.2	Florence Jct. Keep right to Superior on US 60 East.
(150.7)	0.5	Hardey Tungsten factory on left.
		NOTE: Az mileage marker Number Designation changed at the Jct.
213.0		Closer view of dacite (9 o'clock) at west end of Superstition Mts., the unit rest on pC granite and Apache Group.
214.3	1.3	Queen Valley Road to left, & crossing of Magma Az Railroad. Stay straight ahead. See Addendum log for Queen Valley Road log.
214.5	0.2	Pink brown dacite hills (12 o'clock) resting on grey-green Basal Schist (hill behind).
215.0	0.5	At 10 o'clock, quick glimpse of valley with reddish dacite on left, grey-green schist on right. Beyond is jumbled volcanics in rift. Far skyline is pC metamorph complex. 9 o'clock, good view of Weaver's Needle within Superstition Wilderness Area.
215.9	0.9	9-10 o'clock, View of younger jumbled units within rift system
216.7	0.8	3 o'clock, view of older dacite block with pC schist unit in gulch in front of outflow unit.

Mile Post	Mileage Last	
218.0	1.3	Climbing up Thru Basal Schist.
218.6	0.6	Gonzales Pass. Occasional glimpses (9 o'clock) of jumbled volcanics in left zone, flanked on this side by pC schist along road and pC metamorphics on skyline in back.
219.2	0.6	Mass of Picket Post Mtn at 12 o'clock. See Peterson-Dig 5. AGS
219.5	0.3	12 o'clock. View into Segerion with pC sediments thru Permian lens overlain by Dacite (with whitish rock a thru, and Earlier Volcanics to the north.).
221.0	1.5	Road cuts with schist overlain by red ash (Olberg beds) overlain by dacitic water-lain tuffs. These tuffs are found on schist for the next mile on both sides of the road.
221.2	0.2	Road cut of Blue basalt of Bleecher.
221.7	0.5	Mined bench cuts (1 o'clock) near road were used for flagstone (water-lain tuff) and building blocks around Segerion. On left in road cut, pC schist overlain by 30° East dipping red ash overlain by blue basalt; then cut by a 70° W dipping fault; then schist-ash-basalt sequence repeated. Last ~~[illegible]~~ of road cut is all blue basalt ~~[illegible]~~ (Earlier Volcanic sequence) cut by numerous vertical fault-box zones. On the initial entrance right wall, a unit of red ash is dropped over a faulted schist block, then repeated as on north (left) wall.
222.0	0.3	9 o'clock view of jumbled volcanics in left. Road cut in blue basalt.
222.2	0.2	Queen Creek bridge with blue basalt in creek. Next several road cuts also blue basalt.

Mile Post	Mileage Int	
223.1	0.9	Entrance to Boyce Thompson Arboretum.
223.2	0.1	Partial road cut on right has Whitetail Cgl resting on pt schist. Cuts on left are lower units of Ari and water lain tuffs.
223.5	0.3	Roadside Marker: "Picket Post Mountain — A Landmark and Lookout Point During Indian Wars; Site of Outpost of Camp Pinal which was located at Head of Stevenson Grade to the East. Soldiers Protected Pinal City and the Silver King Mine from Apache Raiders. It was the Home of Col William Boyce Thompson, Mining Magnate and Founder of the Southwest Arboretum at the foot of the Mountain." Col. Thompson's house (castle) is the tile roofed edifice at 2 o'clock. Thompson formed Newmont Corp as his holding company for investment in Magma, Anaconda, Bisbee Copper, Inco etc at the turn of the century.
224.1	0.6	Readout of Quaternary Gila Conglomerate
224.5	0.4	Readout of Earlier Volcanics
225.1	0.6	STOP ONE. Park along side of fence adjacent to airport building at top of rise.

Supplement Log – Green Valley Road – Willow Creek Road

Mile Post	Mileage	
214.3	0.0	Take Green Valley Road N. north.
ξ		(Note: No mileage markers along this route; convert to
0	0.0	speedometer readings).
0.4	0.4	Green Creek drainage crossing.
1.9	1.5	SLOW. Road fork – keep right on dirt road following Mogul Arizona RR tracks.
2.2	0.3	Crossing MARR tracks.
2.3	0.1	Crossing drainage with fragmental (basal) dacite
2.7	0.4	Dacite in roadbed; basal tuff in creek bed to left.
2.8	0.1	Cattle Guard. Start of Tonto Nat. Forest Service Road # 35-7.
2.9	0.1	Creek crossing with sheared schist and precambrian granite aplite overlain by dacite on left bank.
3.1	0.2	Precambrian schist along road; also in gulches beyond tracks (9 o'clock); schist-dacite contact covered at point of break in slope from dacite capped hill.
3.3	0.2	Precambrian granite in shallow road cut and in wash. Dacite hills at 9 o'clock. Dacite tuff on ridges between road and railroad tracks.
3.5	0.2	MARR Crossing
3.6	0.1	Gravel Embankment
3.7	0.1	Trail to left. Hillside at 9 o'clock is Precambrian granite overlain by dacite.

This sequence shows the wide extent of rhyolite rocks. Continued age dating should help in unraveling the history of the rift system.

JDS Copy

ASARCO

Rocky Mountain
Exploration Division

July 10, 1978

TO: F.T. Graybeal

FROM: J.D. Sell

Replacement Limestone Assays
Queen Creek Area
Superior East Project
Pinal County, Arizona

As an additional calibration and for research purposes, seven samples were taken in the Queen Creek area by D. Krasowski and myself in the replacement textures and environment. The samples were submitted to ASARCO Salt Lake geochemistry for mercury analysis and Skyline Labs (Tucson) for emission spectrography and mercury analysis. Their report sheets are attached. The sample sites and numbers are shown on the MF-253 excerpt along with the vertical projection of Magma's Devonian horizon replacement body. This horizon tops out approximately two thousand feet below the surface at this point. Similarly, the Mississippian and Pennsylvanian ore body blocks also top out around 2500 feet below the surface and 2500-3000 feet east of the furthest western point on the Devonian horizon. (Note: The "A" designation indicates the sample was taken near or at the same sample site as reported in my memo of November 28, 1973, "Comparative Results - Emission Spectrographic Analysis, Superior East and Boheme Project Areas.")

As noted, the Skyline mercury values are very non-indicative whereas the SLC values have a range, and these have been added to the Skyline report.

Sample 1A was cut on a manganese-rich bed in the middle part of the Naco (Pennsylvanian) Limestone. The sample point would be on the south edge of the updip projection of the Naco body (located some 2500 feet below the sample point and 3000feet easterly). Silver is weakly anomalous (15ppm) while barium (200ppm), zinc (1000ppm), and mercury (105ppb) are anomalous. The original sample also ran 53,000ppm manganese and 76.0% silica which indicates its mineralization system. Low lead and copper values were associated with the sample.

Sample 2A was taken in a manganese-rich bed at the top of the Escabrosa Mississippian) Limestone and would also be on the southern edge as projected

and some 4000 feet westerly and updip from the ore body block. Silver (200ppm), lead (1000ppm), zinc (5000ppm), and mercury (220ppb) are all anomalous in the horizon that contained 130,000ppm manganese and 37.7% silica (original sample). Copper again is a low value.

Two samples were taken along the LS & A vein structure which have no counterparts in the original sampling program. Sample 101 was taken about 45 feet above the karst surface in the Naco Limestone with only minor fracturing of the rock and very minor manganese-iron stain. Sample 102 was taken on the same structure and below the karst in the upper Escabrosa where manganese-rich mineralization and silica spread out from the vein and formed a mushroom of 20-30 feet of width. The sample is from the same horizon as QC-2A mentioned previously. Sample 101 (Naco) shows only anomalous silver (10ppm) and manganese (greater than 10,000ppm) values, indicating some leakage from the system going through the karst material. Sample 102 (Escabrosa) is very anomalous in silver (100ppm), barium (300ppm), lead (2000ppm), zinc (10,000ppm), and mercury (125ppb), as well as manganese (+10,000ppm) and undoubtedly silica. As noted, in comparison to a similar sample and horizon of QC-2A, the 102 sample has approximately twice the values noted. The LS & A vein system projects to be the second vein of bornite found in the breccia south of #9 shaft. This vein has not, to my knowledge, been checked eastward from the surface, nor tested underground when the replacement beds were exploited in the 1950's-early 60's.

Sample 3A is from the middle replacement horizon of the Escabrosa Limestone and in the wallrock of the original QC-3 sample. It is south of the LS & A vein and shows a weakly manganiferous addition but excellent replacement texture in outcrop. Although it does have 1500ppm manganese, no other values appear to be indicative that the sample site was within a mineralization pathway. (Whereas the original sample, cut on a small vein structure, contained 3000ppm lead, 3000ppm zinc, 200,000ppm manganese, and 24.5% silica with 50ppm silver.)

Sample 7A is the lower Martin Limestone replacement horizon and has excellent replacement texture with minor manganese. The values recorded are similar to the Escabrosa sample of 3A above.

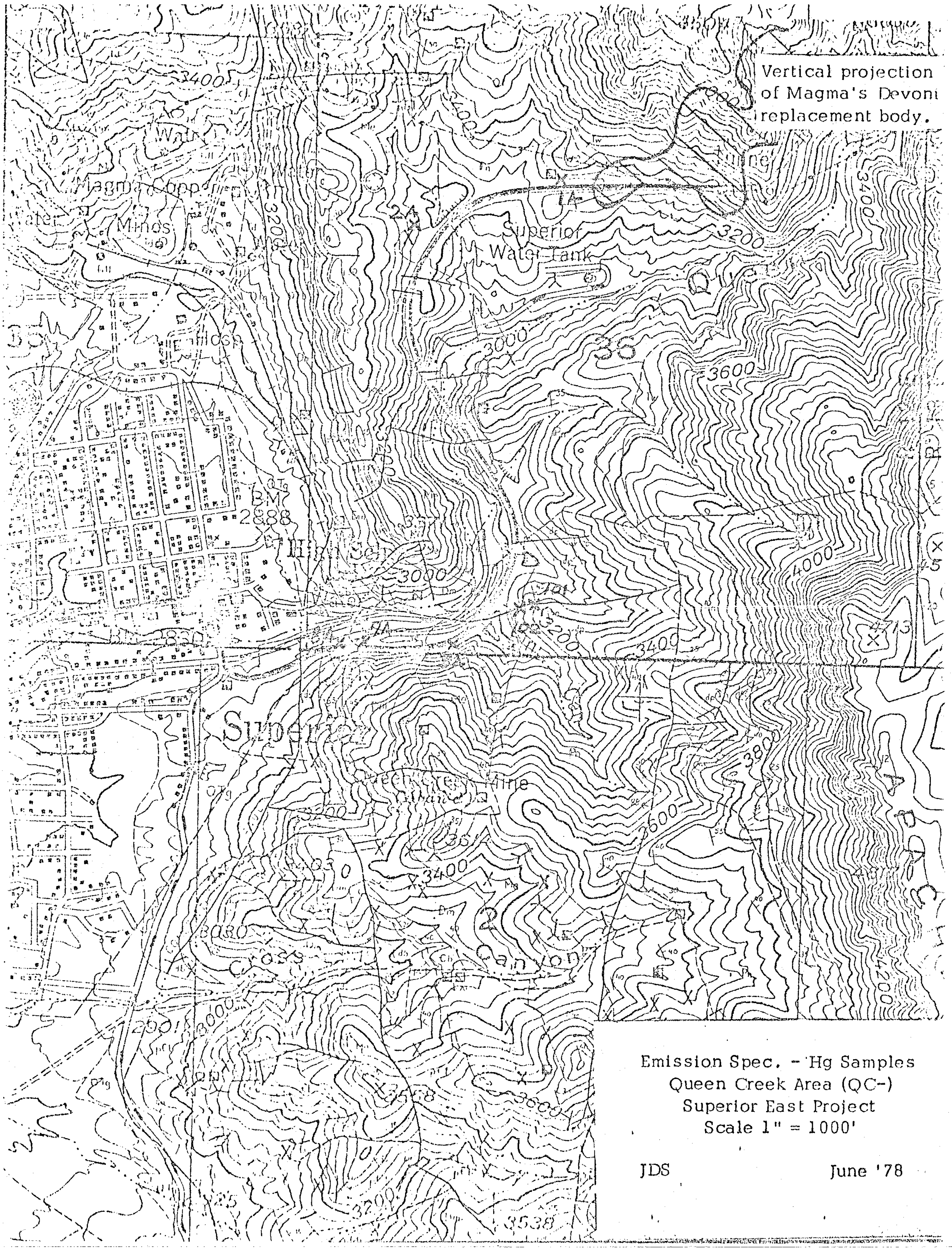
Sample 8A is of the highly fractured and iron-stained Bolsa (Cambrian) quartzite underlying sample 7A. It contains about the same values as 7A except for an anomalous titanium (1500ppm) content probably reflective of the detrital magnetite grains and an anomalous mercury (135ppb) value.

Overall, in the Queen Creek area, it appears that we can see the plumbing system and leakage from the massive ore bodies mined (and to be found?) at a distance of 2000-3000 feet vertically and laterally (updip) by the use of silver, lead, zinc, mercury, manganese, and silica values. Closer to the ore bodies the increase in mercury, calcium and for magnesium should be apparent as wallrock additions.

James D. Sell

James D. Sell

JDS:slr
Attachments
cc: DMSmith, Jr.
DJKrasowski



Emission Spec. – Hg Samples
Queen Creek Area (QC–)
Superior East Project
Scale 1" = 1000'

JDS June '78

ITEM NO.		SAMPLE NO.
1	=	QC-1A
2	=	QC-2A
3	=	QC-3A
4	=	QC-7A
5	=	QC-8A
6	=	QC-101
7	=	QC-102

ITEM	1	2	3	4	5	6	7
	Naco repl.	Escabrosa, upper repl.	Escabrosa, middle, repl test, identical to original QC-3 sample.	Martin lower repl. test	Bolsa, Fe stained	Naco, lime, calcite	Escabrosa upper, mushroom ...
ELEMENT							
Fe	0.1%	0.5%	0.5%	0.5%	7%	0.5%	0.7%
Ca	3%	5%	>20%	20%	0.5%	>20%	0.2%
Mg	0.05%	0.05%	10%	10%	0.05%	0.1%	0.05%
As	15	200	1	1	1	10	100
As	<500	<500	<500	<500	<500	<500	<500
B	<10	10	<10	<10	10	<10	<10
Ba	200	<10	<10	<10	<10	<10	300
Be	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	<5	<5	<5	<5	<5
Cr	10	20	10	<10	150	10	70
Cu	100	200	10	30	500	20	200
Ga	<10	10	<10	<10	<10	<10	<10
Ge	<20	<20	<20	<20	<20	<20	<20
La	50	70	20	20	<20	30	20
Mn	>10000	>10000	1500	1500	1000	>10000	>10000
Mo	<2	20	<2	<2	5	2	15
Nb	<20	<20	<20	<20	20	<20	<20
Ni	5	5	<5	5	<5	5	7
Pb	70	1000	70	30	20	50	2000
Sb	<100	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	<10	<10	<10
Sn	<10	10	10	<10	<10	10	<10
Sr	500	300	<100	<100	500	200	200
Ti	50	70	20	50	1500	200	50
V	70	50	10	50	50	30	50
W	<50	<50	<50	<50	<50	<50	<50
Y	<10	10	<10	<10	<10	<10	<10
Zn	1000	5000	200	500	200	200	10000
Zr	<20	<20	<20	<20	100	<20	<20
Hg (SLC) ppb	105	220	45	45	135	65	125

SKYLINE LABS, INC.
P.O. Box 50100 • 1700 West Grant Road
Tucson, Arizona 85703
(602) 622-4836

Charles E. Thompson
Arizona Registered Assayer No. 9127

William L. Lehmbeck
Arizona Registered Assayer No. 9425

James A. Martin
Arizona Registered Assayer No. 11122

CERTIFICATE OF ANALYSIS

ITEM NO.	SAMPLE IDENTIFICATION	Hg ppm		Hg ppb
1	QC- 1A	<0.01		<10
2	2A	<0.01		<10
3	3A	0.02		20
4	7A	0.01		10
5	8A	0.01		10
6	101	<0.01		<10
7	QC-102	0.01		10

TO:
ASARCO INCORPORATED
P.O. Box 5747
Tucson, Arizona 85703
Attn: James D. Sell

REMARKS:
Trace Analysis

CERTIFIED BY:

DATE REC'D: 2/2/78

DATE COMPL.: 6/27/78

JOB NUMBER: TAJ 091 Part 1

Project 78-41 ASARCO Page 1

GEOCHEMICAL DATA

Area

Date June 2, 1978

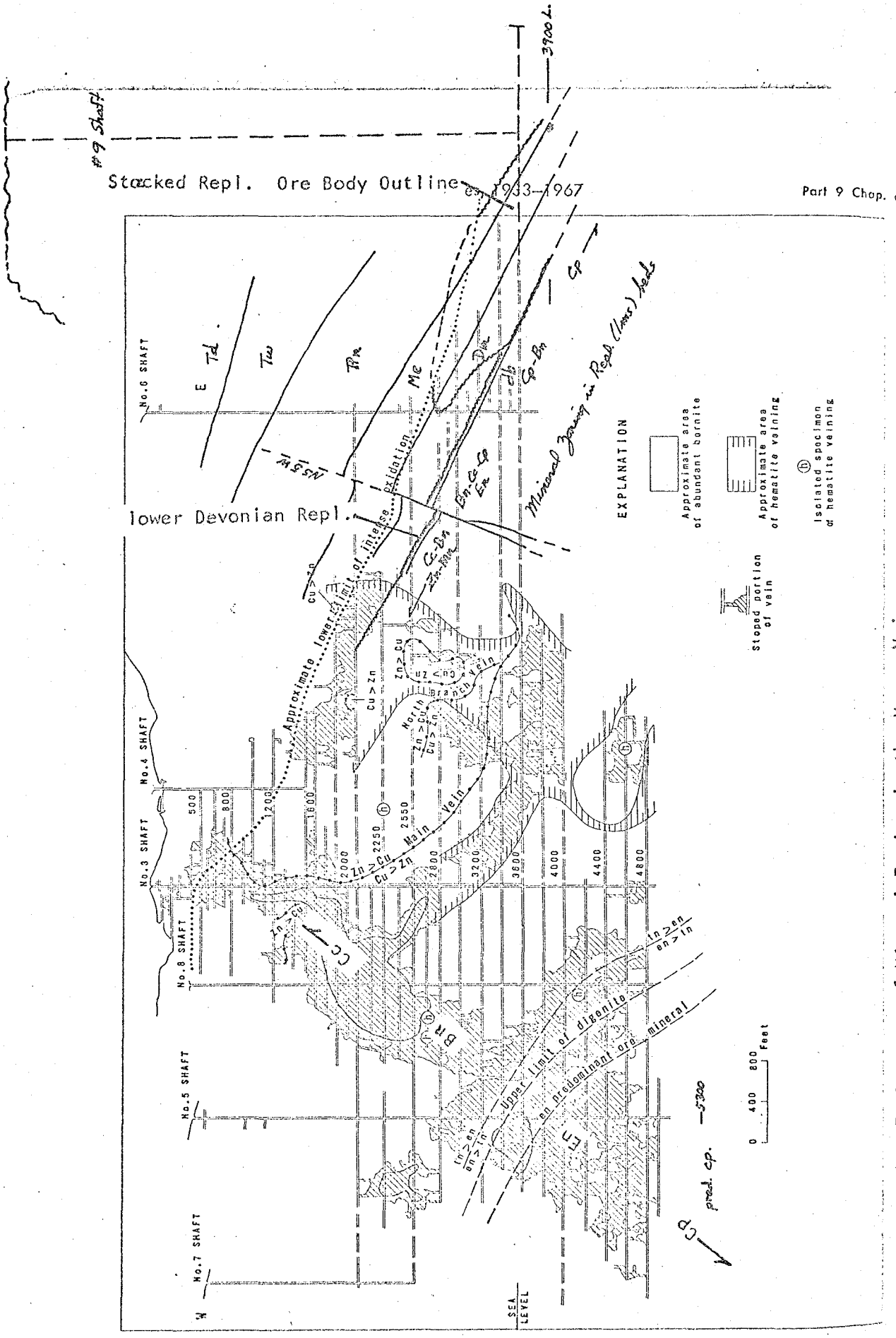
Requested By J. D. Sell, Tucson Office

No. Samples 7

SAMPLE NUMBER	Hg ppb
)C-1A	105
)C-2A	220
)C-3A	45
)C-7A	45
)C-8A	135
)C-101	65
)C-102	125

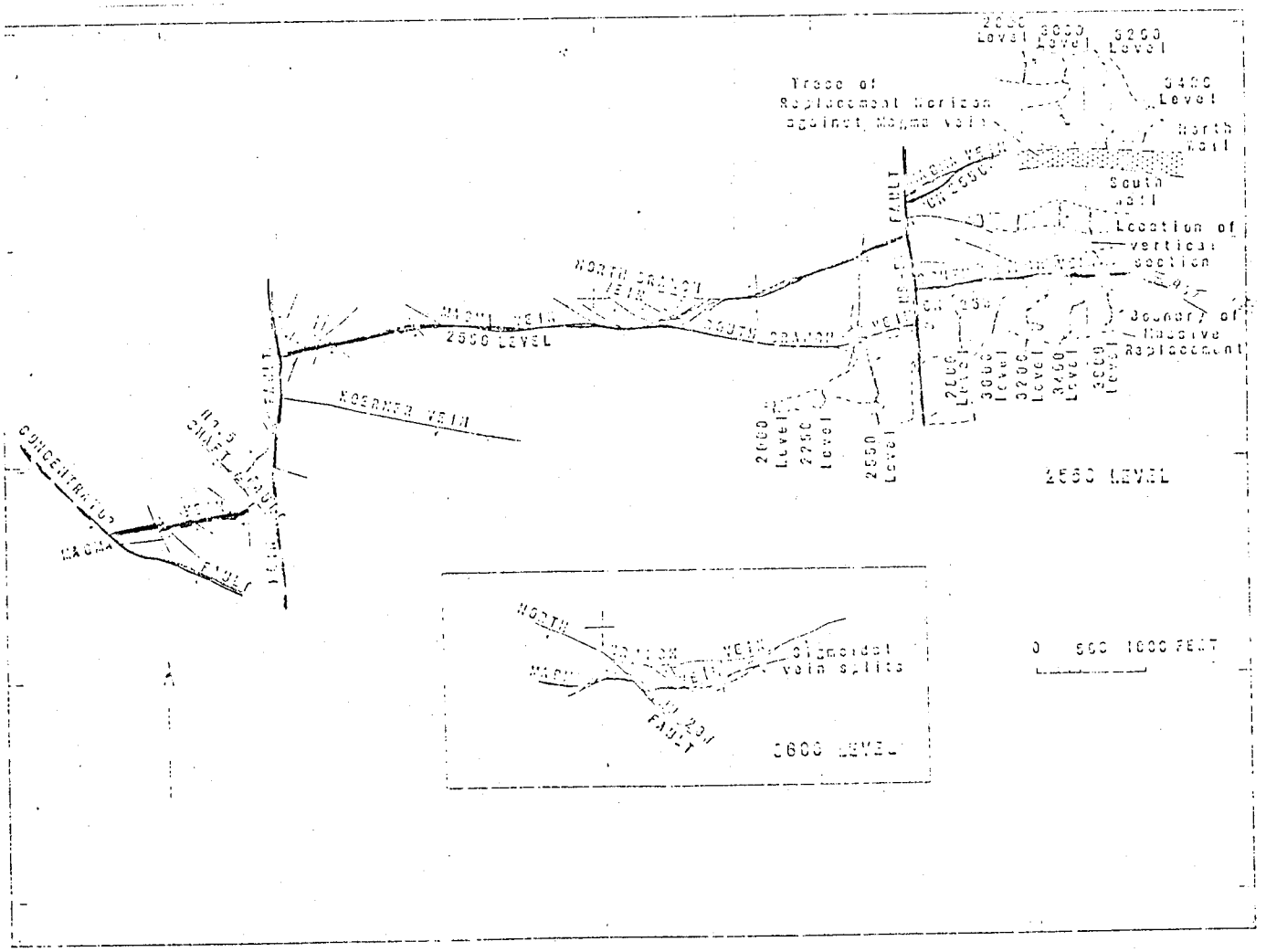
FIGURE 1


Apache Mine
Lower Dev. Repl. Ore Body Outlines
Stacked Repl. Ore Body Outline
Breccia outline
Vns in bx
Surface edge of Dacite
Queen
Superior
Canyon
Reservoir
TRUE NORTH
MAGNETIC NORTH
14°
SCALE 1:24000
1 MILE
7000 FEET
1 KILOMETER
CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL



Modified from Hammer (Graton-Sales Vol., AIME)

Fig. 5. Pattern of Mineral Zoning in the Magma Vein.



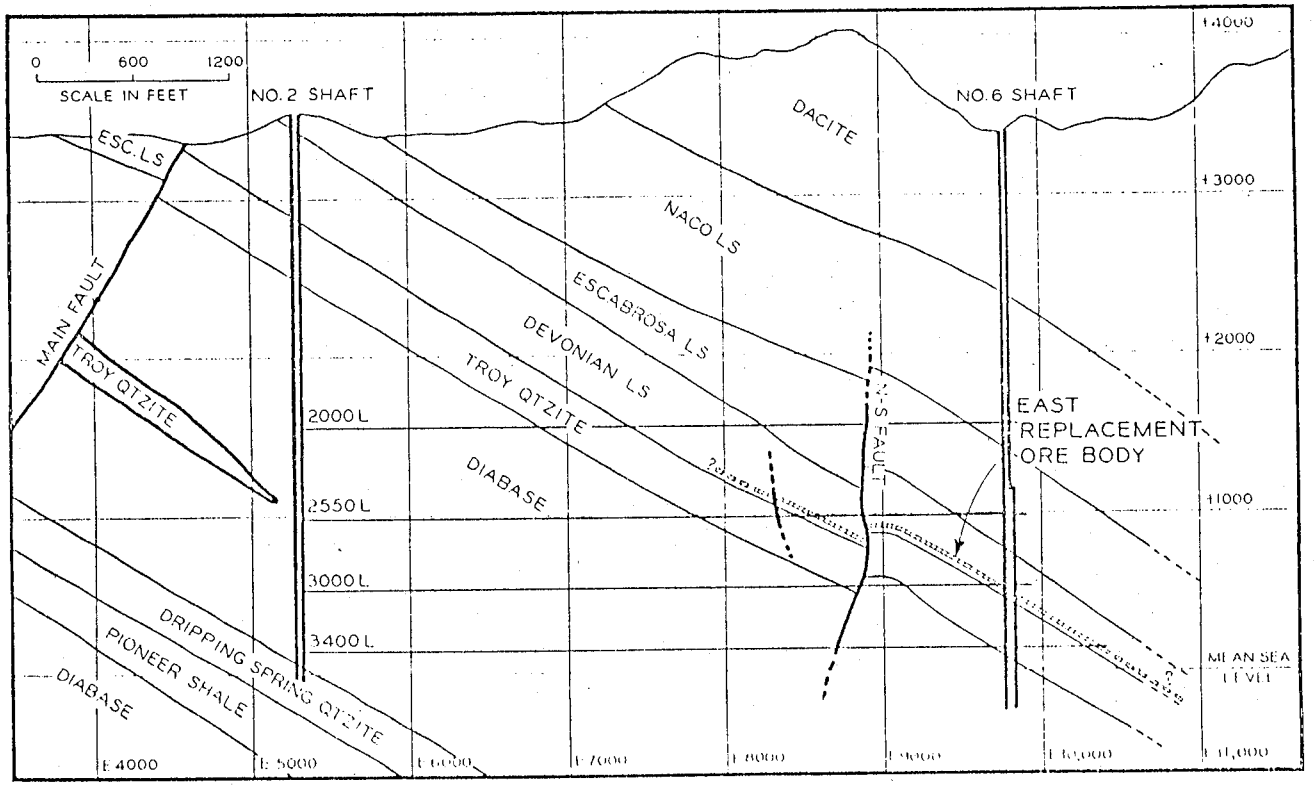
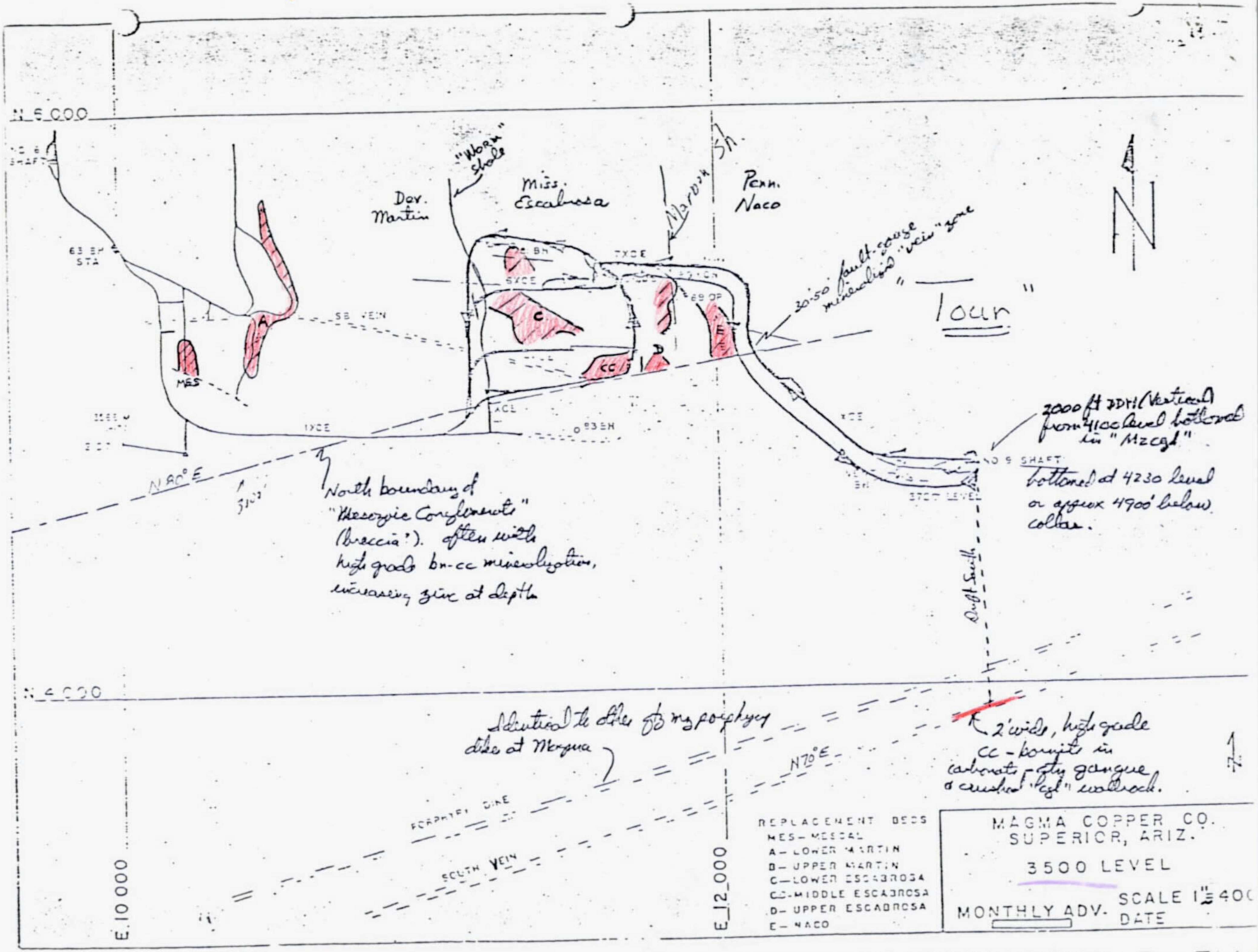
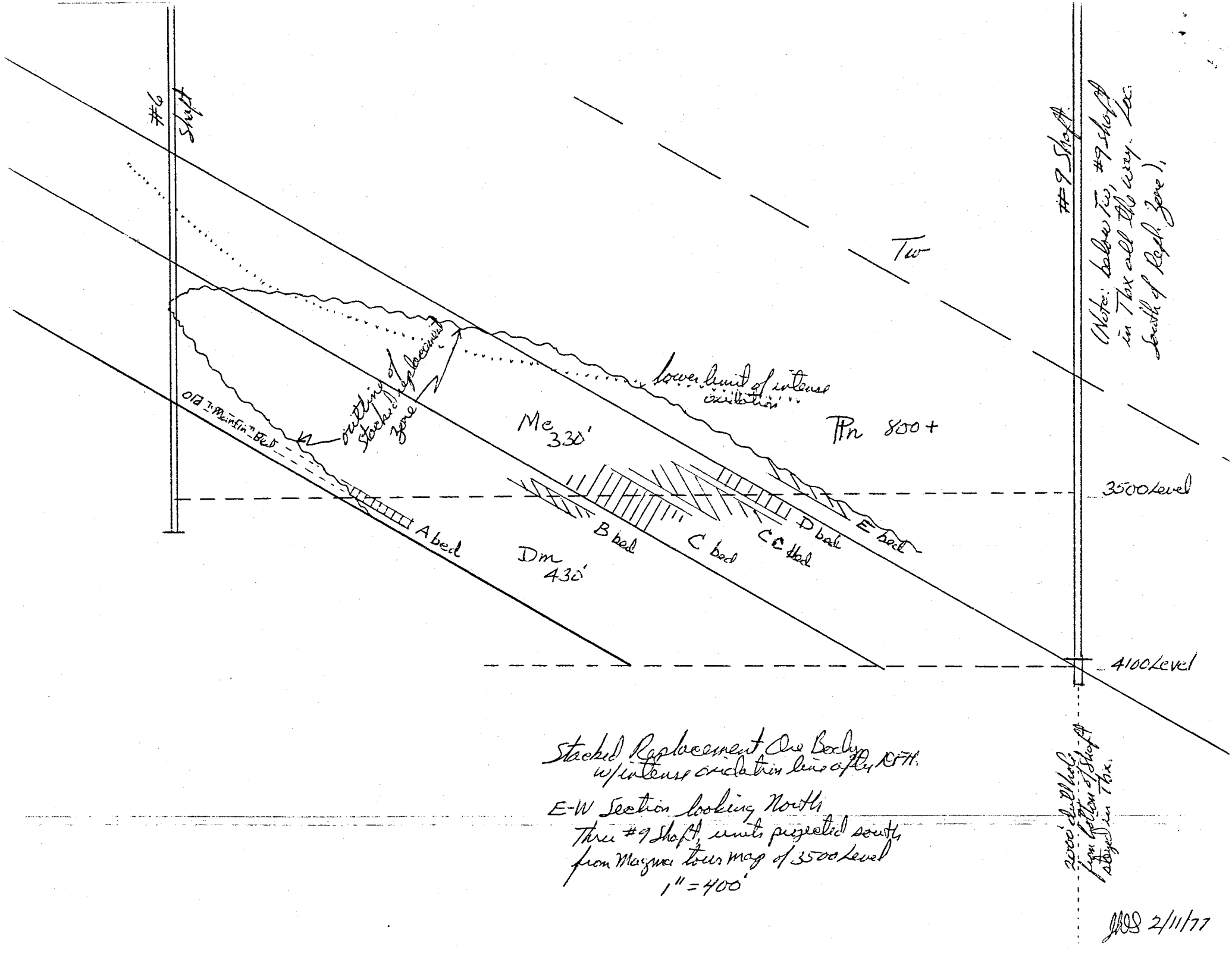


Fig. 2. East Replacement Orebody, east-west vertical section looking north.

Gratton-Sales AIME Vol.



N 6000
NO 6 SHAFT
"Worm" shale
Dev. Martin
Miss. Escabrosa
Naco Sh.
Penn. Naco
63 EH STA
7XCE
6XCE
69 OP
SB VEIN
MES
A
C
CC
D
E
30-50° fault gouge mineralized "vein" zone
"Tour"
N 80° E
North boundary of "Mesozoic Conglomerate" (breccia?). often with high grade bn-cc mineralization, increasing zinc at depth
2000 ft DDH (Vertical) from 4100 level bottomed in "Mzcgl"
NO 9 SHAFT bottomed at 4230 level or approx 4900' below collar.
3700 LEVEL
Drift South
N 4000
Identical to other ~~[illegible]~~ porphyry dike at Magma
2' wide, high grade cc-bornite in carbonate-qtz gangue & crushed "cgl" wallrock.
N 70° E
PORPHYRY DIKE
SOUTH VEIN
E 10000
E 12000
REPLACEMENT BEDS
MES- MESCAL
A- LOWER MARTIN
B- UPPER MARTIN
C- LOWER ESCABROSA
CC- MIDDLE ESCABROSA
D- UPPER ESCABROSA
E- NACO
MAGMA COPPER CO.
SUPERIOR, ARIZ.
3500 LEVEL
MONTHLY ADV.
SCALE 1" = 400
DATE



Stacked Replacement Ore Body
w/intense oxidation line after 1971.

E-W Section looking North
Thru #9 Shaft, units projected south
from Magma tours mag of 3500 Level
1" = 400'

JHS 2/11/77

12/6/78 tour of Red (3600 Level)
w/ Les Kresnyk & Ben Greene.

Red units are recrystallized dolostone unit
intervening beds are pure lime w/ little or no recrystallization.
"Calcetification" (Hansen) is not an envelope around beds
but is lateral & above the replaced (mineralized) unit
as thin calcite stringers. Not expelled CO2 from replaced
unit.

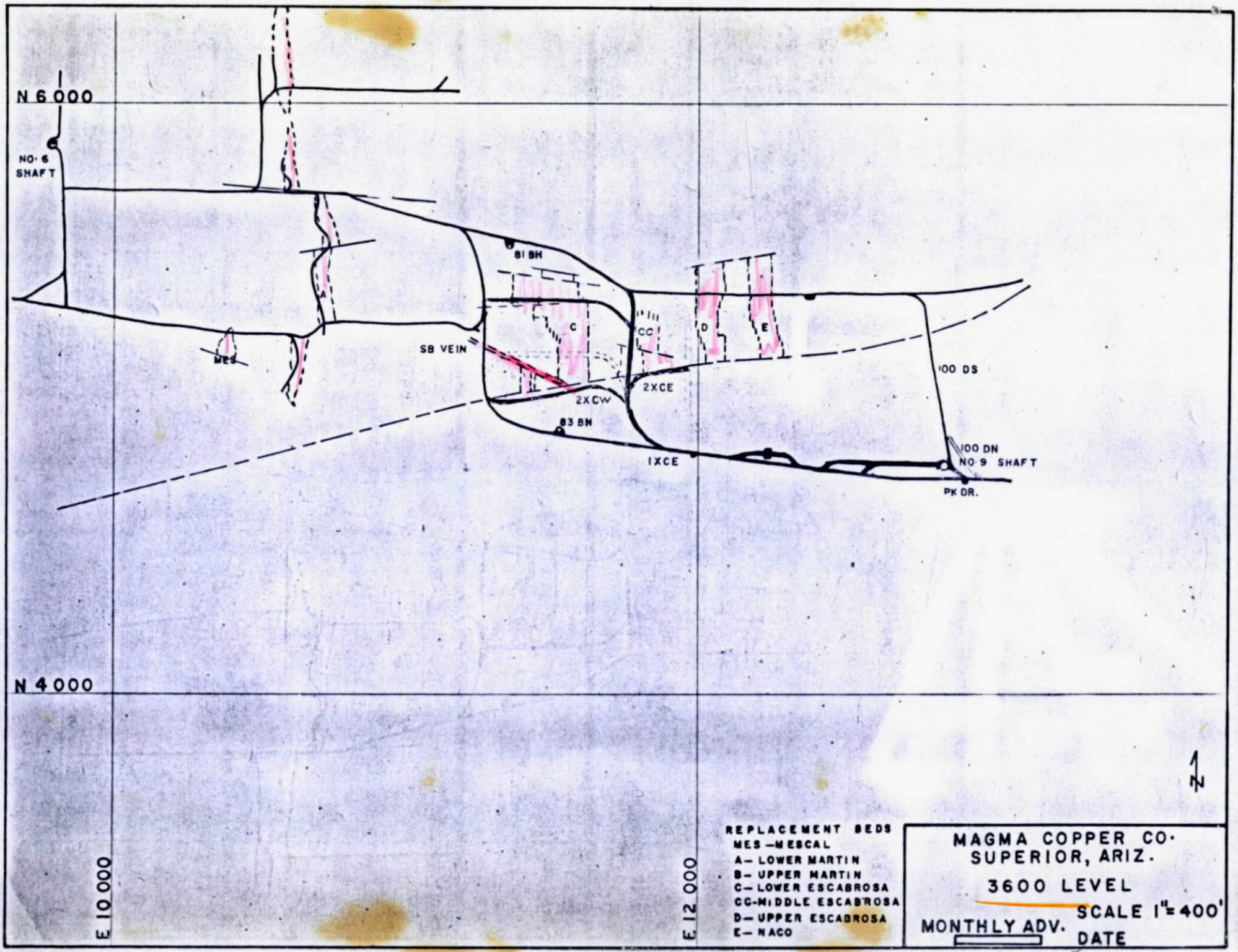
On 4100 Level N drift, the uppermost D beds (Marcasite) is
unit encountered. Contain variable mineral.

A bed turning to pyrite below 3800 feet

B bed rather non-descript so far but is becoming richer
& more consistent from & below 3800.

They have reopened the low grade portion of the Mosman Vein
and are back at E(7 position (17 x 75 = 1275' E of #3 shaft) doing exploration
drilling.

Also drilling down off 4100 Level DH testing ABCcc' beds;
some "holes" in ore grade material, needs extensive drilling to
outline reserves.


N 6 000
NO. 6 SHAFT
81 SH
C
CC
D
E
SB VEIN
MES
2XCW
2XCE
83 SH
1XCE
100 DS
100 DN
NO 9 SHAFT
PK DR.
N 4000
E 10 000
E 12 000
N
REPLACEMENT BEDS
MES — MESCAL
A — LOWER MARTIN
B — UPPER MARTIN
C — LOWER ESCABROSA
CC — MIDDLE ESCABROSA
D — UPPER ESCABROSA
E — NACO
MAGMA COPPER CO.
SUPERIOR, ARIZ.
3600 LEVEL
SCALE 1" = 400'
MONTHLY ADV.
DATE
1970

AIME Transactions, vol. 74, 1926.
rm 48 p.

I

East Moline Ill

Dec 8. 1981

Below there James I am Sending you some word I am at my home here in East Moline Ill. it has begian to look like some Winter Wather here we do not have any snow here yet but it is beginning to git ready for it ha Well as far as I am Concern it Will be just fine if I never see it, I have a Friend over in Glob that has been doing the acessment Work on my Claims he is a good Honest Friend to me. he took the claim Work and labor on with me for a Deal of 10 Percent thats Depends if I Would make a Deal with Co that Would buy it or lease. I dont halft to Pay any thing to do the Work just Gamble like I am.

Over

so I well give you his name and address so you can call him or whatever. I was over to see him when he done the work on the claims and he talked like he would be interested in starting to mine the claims. I told him about you a darn good Engineer and he should see you or Contact you to come look over the Property would you do this for me as I was there in superior just at the time we done the accessment work Could you have the time to contact him at Globe and arrange for the time to go take a look at the claims I have these claims all Recorded through the BLM I sure would like for this Property to be drilled for it is in the large fault I one right next to the maga Co Mine

over

I sure Wished I could be there to asist you around I have lots samples I have taken from these Claims the is one thing that is in my mind and I beleave on tile this Property is drilled to find the ore Vains that Well be the sure Way. I told my Friend over at Globe if he Would start to mine I Would be interested to go ahead for 7 Per cent Sheller return, all right let me here from you soon as you can. or some one that is interested

yours very Truely

Oren L Harris

This Friend of mine address he has got things to start mineing

DALMOLIN EXCAVATING
118 Central ave.
Globe arizona

AFTER 5 DAYS RETURN TO
Oren L Harris
221-28 ave. 61244
East Moline Ill
ZIP CODE 61244

ASARCO James D. Sell
ASACO, Incorporated
Southwestern United States
Exploration Division
P. O. Box 5747, Tucson, Arizona
85703

ASARCO Incorporated
DEC 11 1981
SW Exploration

ASARCO

Southwestern Exploration Division

February 22, 1982

To: W. D. Payne

From: F. R. Koutz

Field Trip to Magma Mine
Superior, Pinal Co., Arizona

On January 22, 1982 Steve Catlin, Barney Mason and I visited Newmont's Magma Mine at Superior, Arizona. The following set of notes is intended for the files, J. D. Sell and the other participants as I elected myself note taker.

The Magma Geological staff consists of:

Russell N. Webster, Chief Geologist
B. L. Green, Assistant Chief Geologist
*Donald E. Atkinson, Geologist
*Reg. L. Barnes, Geologist
*S. Mark Hay, Jr., Geologist
Plus several technical aides and samplers

The three geologists(*) above presented an excellent orientation for about one hour and Atkinson led us underground for 3-4 hours on the 3600-3800 levels, No. 9 shaft. The trip emphasized limestone replacement mineralization and vein mineralization in the South vein.

Stratigraphy - Mining Horizons:

Precambrian diabase + local Mescal Ls - only minor replacement mineralization. Not being mined but was a major wall rock in old vein mining.

L. Martin Repl.: A Bed

U. Martin Repl.: B Bed, 100' max thickness (?). We were not shown A or B beds as on 3600 they are thin, discontinuous or mined out.

L. Escabrosa: C Bed 400' strike length

M. Escabrosa: "CC" Bed - little pods

U. Escabrosa: "D" Bed

A red shale marker (Moon Bed) - 40-50' thick at base of Naco - changes to green around ore.

Naco - E. Bed: Dirty, cherty open-cavity-filling in E. Bed.

These replacement horizons, which plunge to the east with the stratigraphy at about 30°, are sharply bounded on the south by the N80E-striking, 80°S dipping North Boundary vein (actually a fault). South of the N. Boundary

vein is the "conglomerate" - a conglomerate to breccia containing well rounded to angular clasts of much of the local Paleozoic and Precambrian section, volcanics, and intrusive porphyry. On the north side mineralization feathers out against minor E-W faults of short strike length or dies out into the wall rock. Both the north and south margins of mineralization converge slightly to the east and with depth. Tertiary porphyry dikes, generally E-W striking, occur in and south of the North Boundary vein. The whole stacked manto or run is a splay off the "East Replacement vein" and in plan the mineralized zone on 3600 is about 600' wide (N-S) on the west end and 200' wide (N-S) on the east end and about 1000' E-W. About 20-30% of the area in this trapezoid was mined out or colored red. This would make a relatively small drilling target at these depths!

According to Reg. Barnes the manto starts at about the 2850 level, first mining was on the 3000 level and presently extends to the 3800 level. The deepest level is 4200 off the No. 9 shaft and the 4100 level is the lowest active exploration level. Grade is fairly consistent from the C Bed up: 4.5% Cu, 1-2 oz. Ag/T., .01-.02 oz. Au/T. There is minor sphalerite and galena (grades?) but these are not recovered. In some areas galena and sphalerite are relatively common on the margins of the copper ore but Cu grades are too low to mine these areas. Atkinson didn't know whether Mn was high on the margin of the mantos. Ore mineralogy (Ls. Repl.) is 75% cpy, 22-23% bn, 2-3% cc.

On the 3600 level the C, D, and E beds are replaced by banded hematite/pyrite. There is more pyrite on the SE end of run and pyrite often forms an outer "hood" or halo to mineralization (esp. "C" bed, 3620). Pyrite/hematite ratio has been increasing with depth.

Magma mines 3000+ TPD O+W but ships everything. They plan this year to start hoisting some development waste using the No. 9 shaft and start a new dump to the east of the shaft. Mining is by undercut (10' widths) and sandfill. Lower cutoff on the books is 3.0% Cu but with 15% average mining dilution, development waste, etc. actual mill feed is 2-2½% Cu. Rock temperature is 160°F on the 4100 level, but we encountered almost no excessive heat on the 36-38 levels.

Oracle Drilling (Cementation, Inc.) does Magma's diamond drilling, about 1500'/month using both Joy 22 and Diamex 250 (AX) drills. Average hole length is 500'. Cost a year or two ago was $17.00/ft.

The lowest level we were shown a map of was 3990. On 3990 the north and south walls almost converge. We were not shown maps of or told much about the South vein in the office and Atkinson did not carry a map underground but apparently it has a +1000' strike length of "interesting" mineralization on 36-3800. Magma has drilled some additional veins in

the conglomerate and apparently is doing significant exploration in the conglomerate judging by drill stations and fans recently posted on the level plans (one new vein intercept south of the east nose of the manto on the 3600 level runs 0.86% Cu over 21').

Don Atkinson confirmed Jim Sell's rumor of high silver on the 4100 level: consisting of one, 1 foot galena vein running 330 oz. Ag/T. Atkinson also mentioned there was local native Cu in hematite in the "C Bed" on 4100 and some Cu° had been found in the conglomerate higher up.

Underground on the 3600 level we examined the "conglomerate" near the No. 9 shaft. We saw a variety of textures including well rounded limestone clasts up to 1 foot diameter in a grit- to silt-sized matrix. Many of the clasts had a siliceous rim and some limestone clasts had a coarse-grained rim with pink to sideritic carbonate which showed Mn and Fe oxides from post-mine oxidation. There was some pyrite in the altered rims of the conglomerate and the matrix but no good evidence of pre-breccia mineralization. Most sulfide in the clasts is described as "replacement" (post breccia). Lots of the development muck from the conglomerate runs .3-.8% Cu but Atkinson thought that any significant incept of conglomerate would run "only a few tenths % Cu".

Atkinson mentioned that there is actually more skarn alteration in the conglomerate than the carbonates, especially epidote and garnet in the vicinity of porphyry dikes which cut the conglomerate. The most common alteration in the conglomerate was epidote, green clay or chlorite, sericite ("bleaching") and silicification.

Cross bedding was locally noted as were well sorted beds of gravel to cobble-sized clasts but, as a whole, the conglomerate was poorly sorted. Dip (?) where measurable was 10-30°E to ESE.

The matrix sometimes appeared to be igneous consisting of porphyry. Atkinson mentioned that he knew of no petrographic difference between the porphyry clasts and fragments included in the breccia and dikes which cut the breccia. He mentioned that when matrix specimens are sent to Newmont's Research Lab for thin section, they usually describe the matrix as being igneous or volcanic.

The North Boundary (of the conglomerate?) vein or fault has some post-mineral movement and is mineralized as we noted sheared sulfides (mostly pyrite). We saw several crushed zones up to 10' wide but the fault is not one sharp shear but often 20-50' of crushed material. Tertiary porphyry dikes have been noted in the fault. Atkinson thinks that replacement mineralization followed the fault into the carbonate beds and noted a throw of 3000+ feet on fault, apparently based on the maximum known thickness of conglomerate.

To me the conglomerate appeared to be an ash-flow tuff conglomerate or breccia very similar to some of the volcanics/sediments in the Hardshell group or Chief group in the Patagonias. Very little that we saw was inconsistent with the idea that the "conglomerate" is the product of a diatreme.

The replacement ores were spectacular--often running 50-70% sulfide within stopes--which would make an excellent geophysical target. Limestone near mineralization was only weakly recrystallized but one would have no trouble concluding it was altered. There was little open space filling or major vuggy zones except in the E bed of the Naco. Magma feels that the porphyries are responsible for the mineralization but Atkinson was not specific in detail.

Magma has encountered 4 intercepts or areas of porphyry in the limestone replacement area which run 1-11% Cu (py>cpy>>bn) but are not of mineable width.

I asked Atkinson how they could tell in core or underground that they were near ore. He mentioned hematite/specularite, pyrite, and bleached limestone. He did say that there is probably lots of hydrothermal dolomite, mentioning a few 9-13% MgO assays in Escabrosa "CC" beds that an exploration-type had done. Newmont's Exploration Department has done some metal zoning/trace element studies in the replacement ores but the staff geologists never see the reports. Most of the alteration in the porphyry in limestone was described as sericitic but Atkinson says that the research people have found that most "sericite" is actually clay and carbonate flooding. One area with a dacite porphyry sill on the 3000 level contains considerable zeolites--sometimes terminated crystals in vugs.

Minor east-west, high-angle faulting-shearing exerts some lateral control on mineralization but many of the ore "shoots" are pod-like with some thickening of the section. Some bedding-plane-slip is especially notable on the margins of stopes and it was not clear to what extent this thickening was post-mineral. Atkinson said that Sells's thesis (1961) was that the sulfides replaced the core of the thickened section in minor folds--probably caused by movement on E-W faults such as the North Boundary fault.

We visited the South vein on the 3670 to 3800 levels about 800' south of the No. 9 shaft. Both walls were conglomerate but some of the vein is parallel to porphyry dikes, say 50-200 feet north of the vein, but clear contacts could be seldom discerned through the lagging and dirt on the walls. They mine a 10' cut on the vein zone which averages 3-3.25% Cu in the faces we saw. Silver was somewhat higher (2-3 oz./T) in the vein, where we saw it, than the replacements--maybe because of more stromeyerite (AgCuS).

The vein strikes N 65°E and dips 75-80°S and consists of multiple dendritic stringers of sulfide up to 3-4" wide over several feet--with other thin stringers in the hanging wall which they sometimes try to mine with a second 10' cut. There was notably more quartz and carbonate in the vein but mostly disseminated between sulfide stringers. The mineralization appears to have a much higher bn/cpy ratio and more chalcocite than the replacement mineralization. Some of the faces we examined did not have a clear-cut fault involved with the sulfides--only weak crushing over 1-2 feet. The conglomerate near the vein was often better silicified and bleached than access drifts. There was some lateral variation in epidote and chlorite (?) or green clay distribution but relationship to the veins was not clear.

Atkinson admitted that much of the South vein was of marginal grade considering the mining width and development costs but they hope that by hoisting some development waste they can keep the overall mine grade up as more vein material in the conglomerate is developed. Atkinson did not know or would not admit that they had done any exploration underground much south of the South vein and said that Exploration was in charge of surface drilling and didn't tell the mine geologists much.

In conclusion the Magma Mine contains some very interesting geology. Unfortunately the staff geologists spend much of their time on routine production, surveying, etc. and not much time thinking about exploration although in a recap of our tour on the surface, it was apparent that Mr. Webster knew much more on the "conglomerate" problem than he was willing to admit. We said we would forward any interesting findings in thin section on the conglomerate.

Of passing interest is that Magma/Newmont is also being troubled by Gold Depository Loan Co. The three staff geologists starred above are also avid mineral collectors and I confirmed the rumor that the Flux mine had been closed by ASARCO. The three had made a trip to Flux around Christmas 1980 during the great cerussite rush but found very little. They were amazed by the amount of work Thompson and crew had done. Also along was the son of the President of Newmont who was working for them as a mine sampler at the time.

F. R. Koutz

FRK/cg

xc: JDSell
SACatlin
BEMason

SOCIETY OF MINING ENGINEERS of AIME
345 EAST 47TH STREET, NEW YORK, N. Y. 10017

PREPRINT NUMBER
73-I-48

OBTAINING GEOLOGICAL INFORMATION FROM DEEP MINERAL EXPLORATION TARGETS UTILIZING OIL FIELD ROTARY DRILL RIGS

Theodore H. Eyde
Senior Geologist
The Superior Oil Company
Tucson, Arizona

This paper is to be presented at the AIME Annual Meeting - Chicago, Illinois - February 25 - March 1, 1973.

In 1971, the Minerals Division of The Superior Oil Company acquired exploration rights to an unpatented claim group in the Superior (Pioneer), Arizona mining district, lying west of the Concentrator fault. This major post-mineral fault displaces the Magma vein-fault, which is mined in the Magma Mine at Superior, Arizona. The Magma vein-fault and the enclosing section of pre-mineral rocks consisting of Paleozoic and younger Precambrian sediments and diabase, is overlain by a thick section of post-mineral rocks, consisting of the Gila conglomerate, the Apache Leap dacite, and the Whitetail conglomerate. Geologic information on the thickness and attitudes of the rocks obtained from previous diamond drilling indicated that the section of post-mineral rocks might be from 3,000 to over 4,000 feet thick within the target area. (Figure 1)

The Magma vein-fault is a steeply dipping vein which has produced nearly a billion dollars of copper, zinc, silver, and gold. It has been mined continuously for nearly 10,000 feet along the strike and nearly 5,000 feet vertically down the dip. It ranges from less than a foot to over 50 feet wide and contains sulfide mineralization consisting of pyrite, chalcopyrite, bornite, and chalcocite.

Though the exploration target might extend for a great distance both along strike and down dip it was thin in relation to length and considering its steep dip represented a small exploration target. Nevertheless, the geologic information obtained from the previous exploration program combined with the results from Superior's seismic survey appeared to outline a target which might be explored effectively by two deep vertical drill holes. (Figure 2)

The target was a well defined seismic discontinuity which cut the pre-mineral rocks and, similar to the Magma vein-fault, did not extend upward into the post-mineral rocks. The principal target was linear and appeared to represent the continuation of the Magma vein-fault on the west side of the Concentrator fault. A secondary target was the replacement horizon in the Martin formation.

The great thickness of post-mineral rocks covering the targets ruled out using geophysical techniques for better target resolution. The targets, therefore, could best be explored by drilling. Fortunately, two diamond drill holes previously drilled on the property provided a good approximation of the depth of Tertiary age post-mineral cover as well as the attitude of the underlying pre-mineral Apache series which host the Magma vein-fault.

The seismic survey results and the geologic information from the diamond drill holes defined the drilling target. Exploration of the target would be expensive, therefore, it would be necessary to obtain the maximum amount of geological information from a minimum number of holes. The post-mineral cover thickened to the east, meaning that the best exploration target was adjacent to the Concentrator fault and close to the productive portion of the Magma vein-fault where the post-mineral rock cover was thickest.

Several factors influenced the choice of a drilling method. The method chosen must be capable of drilling:

1. A straight hole.
2. Rapidly, because of pending option payments.

3. Directionally utilizing either an oriented whipstock or a dyna-drill.
4. Hard formations such as quartzite.
5. Spot cores within the target area.
6. At costs competitive with other drilling methods.

After reviewing the requirements, three methods were compared:

Diamond Drilling

Advantages

1. Obtains a core which can be studied and analyzed.
2. Proven ability to penetrate hard formations particularly the dacite and quartzite which had not been successfully penetrated using small rotary drilling equipment.
3. Low cost footage rate.
4. Low mobilization and site preparation costs.

Disadvantages

1. Slow penetration rate. The previous holes were drilled at an average rate of 60 feet per day when two shifts were employed. It appeared, therefore, that the proposed two-hole drilling program might require nearly a year to complete. This meant work requirements could not be met and substantial option payments would fall due before the program could be completed.
2. Difficulty in drilling a straight hole through dipping sedimentary formations.
3. Limited directional drilling capabilities.
4. Inability to utilize most bore hole logging tools because

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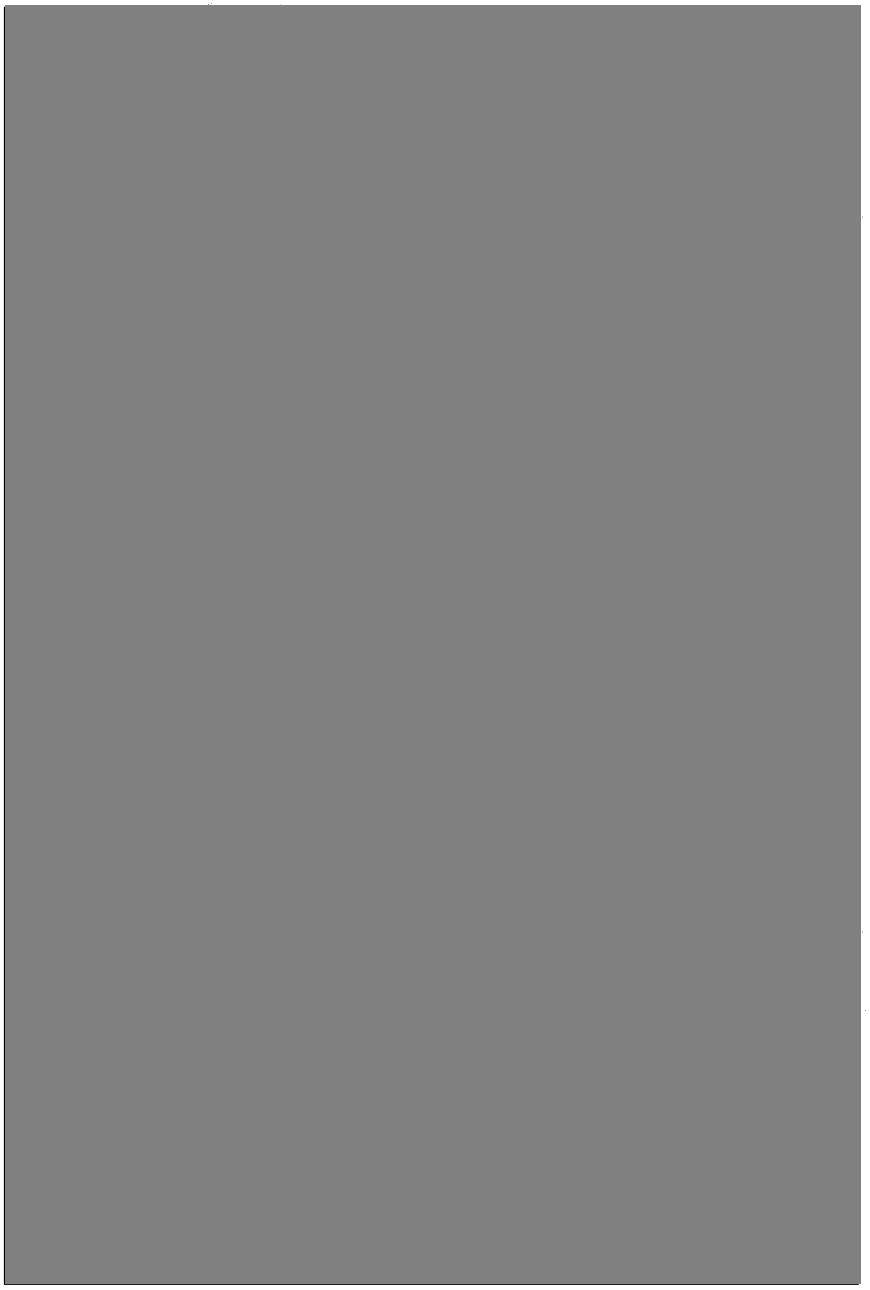

12/13/93

See Belmont Mine Area file for
Magma drill holes South of #9 Shaft.

NB-3, 5, 6, 7, 9, 10, 11, 11A, 11B, 12, 12A.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

December 28, 1970

TO: W. E. Saegart

FROM: J. D. Sell

Re: Production and Operating Costs
Magma Copper Company
Pinal County, Arizona

Attached are excerpts from a May 5, 1969 report to the Newmont Mining Corporation stockholders giving the five year (1964-1968) production and cost figures for the San Manuel and Superior operations of Magma Copper Company.

James D. Sell

JDS:mw
Att.
cc: J. H. Courtright
W. L. Kurtz

Notice of Annual Meeting of Stockholders ; Excerpt from:
May 5, 1969.

BUSINESS AND PROPERTIES OF MAGMA

Magma Copper Company was incorporated in Maine in 1910. It has been engaged in the business of producing copper from its Magma mine near Superior, Arizona, since 1911 and from its San Manuel mine near San Manuel, Arizona, since 1956.

The Company's subsidiaries are the San Manuel Arizona Railroad Company, which serves the San Manuel Division, and the Magma Arizona Railroad Company, which serves the Superior Division. Both railroads provide the Company with rail transportation to the lines of the Southern Pacific Railroad.

Total copper production of the two mines for 1966, the last full year of uninterrupted operation, was approximately 242,041,000 pounds, which is the current rated annual capacity and on the basis of which the Company ranked as the fourth largest copper producer in the United States.

The industry-wide labor strike, which shut down all Magma's operations from July 15, 1967 to March 15, 1968, greatly reduced production in both those years. Total copper production for 1967 was approximately 127,027,000 pounds, and for 1968 was 173,561,000 pounds. In 1967, the Company sold 155,863,000 pounds, the excess over production coming from inventories. Sales in 1968 were 23,081,000 pounds less than production as the depleted inventories were restored to normal levels.

Gold and silver are recovered as by-products of the copper production at both mines, and molybdenum concentrates also are recovered at San Manuel.

Blister copper produced at Superior is sold f.o.b. the Superior smelter to a single buyer under a long-term contract, which provides for payment on the basis of market or agreed-upon prices for the copper, gold and silver content less freight, refining and marketing allowances. San Manuel's copper is custom refined and marketed by an independent sales agent. The molybdenum concentrates are sold under a contract extending through 1971 at prices based on market quotations.

A Statement of Income of the Company and its subsidiaries for the past five years appears on page 15, while its other financial statements are set forth on pages 55 through 59 hereof.

The earnings for 1967 and 1968, as shown by the summary, were adversely affected by the long labor strike. Fluctuations in copper prices have an important impact on Magma's net income. For example, a 1¢ increase or decrease in average annual price would increase or decrease at present capacity Magma's annual earnings by approximately $0.55 per share (presently outstanding) before income taxes.

Domestic refinery copper prices over the last ten years ranged from a high of 42.22¢ in 1968 to a low of 28.00¢ per pound in 1961, and the averages of such prices for each such year were as follows:

	1968	1967	1966	1965	1964	1963	1962	1961	1960	1959
Average Copper Price, ¢ per lb.....	41.85	38.23	36.17	35.02	31.96	30.60	30.60	29.92	32.05	31.18

On March 20, 1969, the domestic refinery copper price was 44.44 cents per pound.

The new labor agreements with the United Steelworkers of America and other unions made at the settlement of the strike in March 1968, extend to July 1, 1971, and provide for an average total wage increase of 55.3 cents per hour over the 39½ months of the contract, of which approximately 14.5 cents became effective at once, with subsequent increases becoming effective January 1, 1969, November 1, 1969 and September 1, 1970. Monthly pensions were increased by the agreements from $2.50 to $5.00 times years of service, with some increases for employees already retired and with new pension benefits to widows of employees who die after age 55. Vacations, health and welfare, unemployment, death and disability, and other benefits also were increased.

The federal income tax returns filed by Magma Copper Company and its subsidiaries have been examined by and settled with the Internal Revenue Service through 1962. In subsequent years, the operating results of Magma have been included in the consolidated federal income tax returns filed by Newmont Mining Corporation. Newmont's returns for the years 1963, 1964 and 1965 are currently being examined.

The Company's long-term debt at December 31, 1968 was $36,000,000, consisting of the $15,000,000 bank debt referred to below, and the $21,000,000 balance of a 5½% unsecured note payable to The Prudential Insurance Company of America which is due in semi-annual installments of $1,500,000 from June 1, 1972 to December 1, 1978, with certain rights of prepayment available to the Company. The note agreement requires that the Company maintain at least $10,000,000 of consolidated working capital and also contains certain restrictions on dividend payments. At December 31, 1968, approximately $37,140,000 of retained earnings were unrestricted as to the payment of dividends.

In March 1968, in connection with the purchase of the Kalamazoo property hereinafter mentioned, the Company borrowed a total of $15,000,000 in equal amounts from two New York banks. The loans mature in March 1970. The Company anticipates that these loans will be paid from cash flow from operations or will be refinanced, possibly when financing is arranged for the Magma expansion program hereinafter described.

Two legal actions against the Company have been pending since 1959 and 1960. The first is a patent infringement suit involving smelter converter practices at San Manuel, in which the federal court has held the patent valid and infringed, and in March, 1969 found the amount of damages due for the infringement to be approximately $983,000, plus interest, attorneys fees and costs. The interest to date plus attorneys fees and costs aggregate approximately $453,000. In the second action, which claims compensation for use of the same invention prior to the issuance of the patent in 1959, a jury verdict for $400,000 against the Company in the Arizona state court was set aside on appeal by the Company, and a new trial was held in February, 1969, resulting in a jury verdict of $165,000 plus interest and costs. The interest to date and costs in this case amount to approximately $106,000. The Company is taking further action in both cases preliminary to possible appeals.

San Manuel Division

The San Manuel mine and plant is currently producing and treating approximately 40,000 tons of ore per day.

The mine is a large underground mine worked by block caving methods. The major part of the orebody, from which production has been obtained, is sulphide ore. There is in addition an area of oxide ore overlying a portion of the sulphide ore which may be leached in place or mined and leached or otherwise treated at some future time. A small part of the orebody lies in State lands held under long-term mineral leases, and another small part is held under a long-term lease and option from The Anaconda Company. The latter requires future payment of rent or royalty in the total sum of $4,350,000 in annual installments through 1988 and, if the purchase option is exercised, an additional payment of $1,500,000.

The surface plant consists of a mill, power plant, smelter, transportation and other facilities required for the current rate of operations. Townsite housing and facilities for San Manuel employees are owned and maintained by San Manuel Townsite Division of the Company, and a fully-equipped hospital is owned and maintained by the Company at San Manuel. The lands occupied by these facilities and ranch and other lands in the area are owned or held under lease by the Company.

Mine production to date has been obtained from the first and second levels. The first level was about 1,400 feet below the surface, and mining there has been completed. The second level, about 2,000 feet below surface, is now being mined. A third level about 600 feet below the second and an intermediate level half way between, will be prepared for start of production about mid-1974. Mining from the second and third levels will be accelerated to 60,000 tons of ore per day when the expansion program described below is completed, and while development work is done on the adjacent Kalamazoo orebody to prepare

it for future production. The Company has spent approximately $5,487,000 annually for the past five years in mine development expenditures. These expenses, together with costs capitalized in prior years with respect to shaft sinkings and attendant installations for the San Manuel orebody, are being charged to operating costs ratably as copper is produced from the ore developed and mined.

Sulphide ore reserves of the San Manuel mine as of December 31, 1968 are estimated, using an average 0.50% sulphide copper cut-off, to be 496,800,000 tons of 0.728% net sulphide copper, before dilution, of which 228,500,000 tons of 0.71% sulphide copper are above and can be mined from the second level. In addition, the estimated oxide ore reserves are 130,000,000 tons of 0.70% total copper (0.47% oxide copper), before dilution, all lying above the second level.

In March 1968, the Company purchased from Quintana Minerals, Ltd., under an agreement with that company and Newmont Mining Corporation, the Kalamazoo copper property adjoining the San Manuel mine in Arizona for $27,000,000 in cash and stock equivalent. Quintana received from Magma $15,000,000 in cash and 42,478 shares of Magma common stock, and from Newmont 78,208 shares of Newmont common stock and $4,800,000 in cash, and Newmont received from Magma 169,912 shares of Magma common stock. The Kalamazoo property is estimated to contain 565,000,000 tons of sulphide ore averaging 0.72% net sulphide copper, before dilution. This orebody is believed to be similar to the San Manuel orebody though lying at a considerably greater depth with the top of the orebody approximately 2,500 feet below the surface of the ground.

San Manuel's production and costs for the past five years have been as follows:

	1968	1967	1966	1965	1964
Ore mined:					
Tons	11,367,640	7,891,854	14,391,355	13,504,024	12,442,752
% Sulphide copper	0.701	0.758	0.772	0.773	0.828
Payable metal content:					
Copper (tons)	72,074	53,963	101,390	93,767	92,589
Molybdenum sulphide (tons)	2,298	2,001	3,544	2,863	2,486
Silver (ounces)	245,316	166,893	311,699	273,610	282,334
Gold (ounces)	14,303	10,534	22,396	21,550	20,746
Gross value per ton ore mined	$ 5.97	$ 6.18	$ 6.47	$ 5.66	$ 5.46
Operating costs[1] per ton ore mined	$ 3.72	$ 4.03	$ 3.33	$ 3.42	$ 3.39
All other costs[2] per ton ore mined	$ .85	$ 1.08	$ 1.26	$ .83	$ .69

(1) Including all operating costs, all Arizona taxes, federal social security taxes, and amortization of deferred development, but excluding depreciation, depletion and interest. Includes effect of strike expenses in 1968 and 1967.

(2) Includes depreciation, depletion, interest and federal income taxes.

The above results for the years 1967 and 1968 reflect the adverse effect of the prolonged labor strike already mentioned.

Superior Division

The Magma mine at Superior is an underground mine having replacement or bedded-type orebodies. It is provided with access, transportation and aircooling facilities required for current operations. The surface plant includes a concentrator, smelter and related auxiliary facilities.

Production and costs at the Magma mine for the past five years have been as follows.

	1968	1967	1966	1965	1964
Ore mined:					
Tons	333,607	219,510	431,913	439,911	377,575
% Copper	4.63	4.77	4.70	4.65	4.78
Payable metal content:					
Copper (tons)	14,706	9,551	19,631	19,452	17,064
Silver (ounces)	347,119	197,419	466,334	408,366	306,269
Gold (ounces)	7,263	4,970	12,802	12,748	11,078
Gross value per ton ore mined	$42.38	$45.37	$44.02	$38.48	$31.51
Operating cost,(1) per ton ore mined	$45.47	$54.01	$40.34	$35.50	$37.58
Other costs,(2) per ton ore mined	$ 0.43	$ 0.93	$ 0.48	$ 0.18	$ 0.18

(1) Including all operating costs, all Arizona taxes and federal social security taxes, but excluding depreciation and depletion. Includes strike expenses in 1968 and 1967.

(2) Includes depreciation, depletion and federal income taxes.

Operating costs have been high principally due to extensive timbering required to support the underground workings, high temperatures and humidity underground requiring expensive cooling facilities, long distances underground from existing shafts to the working areas, and to the obsolescence of much of the surface and underground facilities, and also in 1967 and 1968 costs were adversely affected by the eight months labor strike.

Extensive diamond drilling has developed additional replacement orebodies in beds lying stratigraphically above the areas presently being mined, and has increased the ore reserves to the highest tonnage in this mine's long history. As of December 31, 1968, total reserves at Superior were estimated at 10,100,000 tons of ore averaging 5.88% copper, before dilution.

The increased ore reserves have made feasible the commencement of an expansion program at Superior as described below.

Expansion Programs

As a result of the Kalamazoo acquisition, the Company has commenced a program to increase capacity at the San Manuel mine and plant from 40,000 to 60,000 tons of ore per day. This will require additional shaft sinking, mine development and plant expansion. Completion of the program is planned for 1971.

At Superior an expansion program also is underway to double the ore production there from 1,500 to 3,000 tons per day. The program includes an additional 4,800 foot mine ore shaft, a 9,100 foot tunnel on the 500 foot level, and modernization and expansion of the mine, mill and related facilities. The Superior smelter, however, will be abandoned, and the mill concentrates shipped to the expanded San Manuel smelter for smelting. Completion of the Superior expansion is scheduled for late 1972 with the production increase being gradual and fully accomplished two years after the program is completed.

Contracts for certain phases of the expansion programs at both mines have been negotiated. The cost of the two programs is expected to be in excess of $100,000,000. The amount and nature of such

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

March 30, 1970

TO: W. E. Saegart

FROM: J. D. Sell

Stacked Replacement Ore Bodies
Superior Div., Magma Copper Co.
Pinal County, Arizona

The Superior Division of Magma Copper Company announced total ore reserves of 10,100,000 tons averaging 5.88% copper, before dilution, as of December 31, 1968. (See my File Memorandum dated May 5, 1969).

Since this time Magma has been busy preparing to confirm and mine the reserves by sinking a new (No. 9) shaft 4900 feet through the Dacite, connecting the shaft to the mill area by a new 9000-foot haulage tunnel on the 500 level, and driving drifts and raises into the new area underground. As of March 24 the No. 9 Shaft was 600 feet deep and the 500 level haulage was in 2000 feet. Drifts are being driven from No. 6 Shaft to the projected No. 9 Shaft on the 3000, 3200, 3400 and 3600 levels. From these workings new diamond drilling is being conducted as well as some exploratory raises.

As shown on Figure 1, Magma has mined replacement ore from the lower part of the Devonian in three main areas (in orange): a) Off of the Magma Vein (M), b) the small No. 6 shoot, and c) the main production from the South Branch (S) vein area. All these ore bodies are blind in that they do not outcrop. The Main Vein (M) ore shoot terminated in minable amounts on about the 2600 level. The No. 6 shoot terminated near the 2550 level. The South Branch (S) beds were productive up to the 2000 level. All terminated into low grade values around the 3400-3600 levels with fingers of ore grade going somewhat deeper.

The new stacked ore body is comprised of similar mineralization as found in the lower Martin beds ("A" horizon) and as is found in replaced beds in the upper Martin ("B" horizon), lower Escabrosa ("C" horizon), upper Escabrosa ("D" horizon) and lower Naco ("E" horizon). Composite cross-sections show that numerous beds are mineralized which pinch and swell in strike and dip, but collectively they have been grouped in the above-lettered horizons.

Figure 2 shows the essential outline of the now known stacked ore-bodies and the extent of the old lower Devonian beds. As known by drilling only, the lower Escabrosa ("C") horizon extends highest up-dip of the new beds and terminates at about the 2800 level. The upper Devonian ("B") horizon is local and is found mainly on the up-dip end. The upper Escabrosa and lower Naco horizons trail off eastward and their up-dip extensions are highly oxidized with less than 0.20% copper remaining in the horizons. Outside the ore body outline the horizons may contain pyrite and specularite (where not oxidized) but very minor copper values. Thus these ore horizons are also blind.

The down-dip extension of the new reserves have been drilling and calculated to the 3900 level but the mineralized beds are known to extend to the 4300 level although they are being cut-off by a mass of intrusive breccia.

Interestingly, the stacked ore bodies are found mainly over the South Branch (S) area and to a minor part over the No. 6 ore shoot area (the only area presently being mined in the stacked horizons). Extensive drilling has been done over the Magma Vein (M) area but rarely are the horizons even mineralized with pyrite and hematite.

The South Branch Vein structure is near the north boundary of the old Devonian (S) area but is now thought (and mapped) to curve southward as it is followed to the east. Also, the plan of the stacked bodies has a slight curvature to the south as viewed down dip. The full significance of these curvatures and the limits and distributions of the various horizons is not known, but it is interesting to speculate that a central intrusive porphyry stock area is off to the southeast of No. 9 Shaft and that a similar relationship as found at Christmas is present here. Rus Webster (Chief Geologist at Superior) recognizes this possibility when he stated that Magma should explore the south side of the breccia mass (whose extent is unknown).

Approximately 50% of the Escabrosa Limestone is mineralized and contains 50% of the new reserves. The remaining 50% is distributed (approximately) as follows: lower Martin 20%, upper Martin 5%, lower Naco 20%, and Mescal (Precambrian limestone) 5% with very high grade values. These reserves include previously known but unmined values in the lower Martin and Mescal beds in the vicinity of the Magma Vein and the No. 6 ore shoot.

The No. 9 Shaft (22 foot circular) is being sunk without the benefit of any pilot hole. Diamond drill hole 3600 E 100 was drilled horizontally due south (?) on the 3600 level to check the shaft site at this level and encountered mineralized intrusive breccia. The shaft is scheduled to be 4900 feet deep which corresponds to bottoming

on the 3600 level. As ore reserves extend to 3900 and mineralization is known to extend to the 4300 level, it is believed that they will ultimately deepen the shaft as needed.

The 9000-foot (12 1/2 foot circular) haulage tunnel is now in 2000 feet and is in the "Marron Shale" marker bed which is at the top of the Mississippian Escabrosa Limestone. It is being driven using a boring-machine, which, when going well, cuts 75-90 feet per day. The tunnel is raw and only several places have needed support. The "Never Sweat" tunnel (so named over the portal) is being driven on the 500-foot, or mill, level and will intercept the No. 9 Shaft some 1800 feet below the No. 9 collar.

James D Sell

J. D. Sell

JDS/kvs

FIGURE 1

SCALE 1:24000

1 0 ½ 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET

DATUM IS MEAN SEA LEVEL

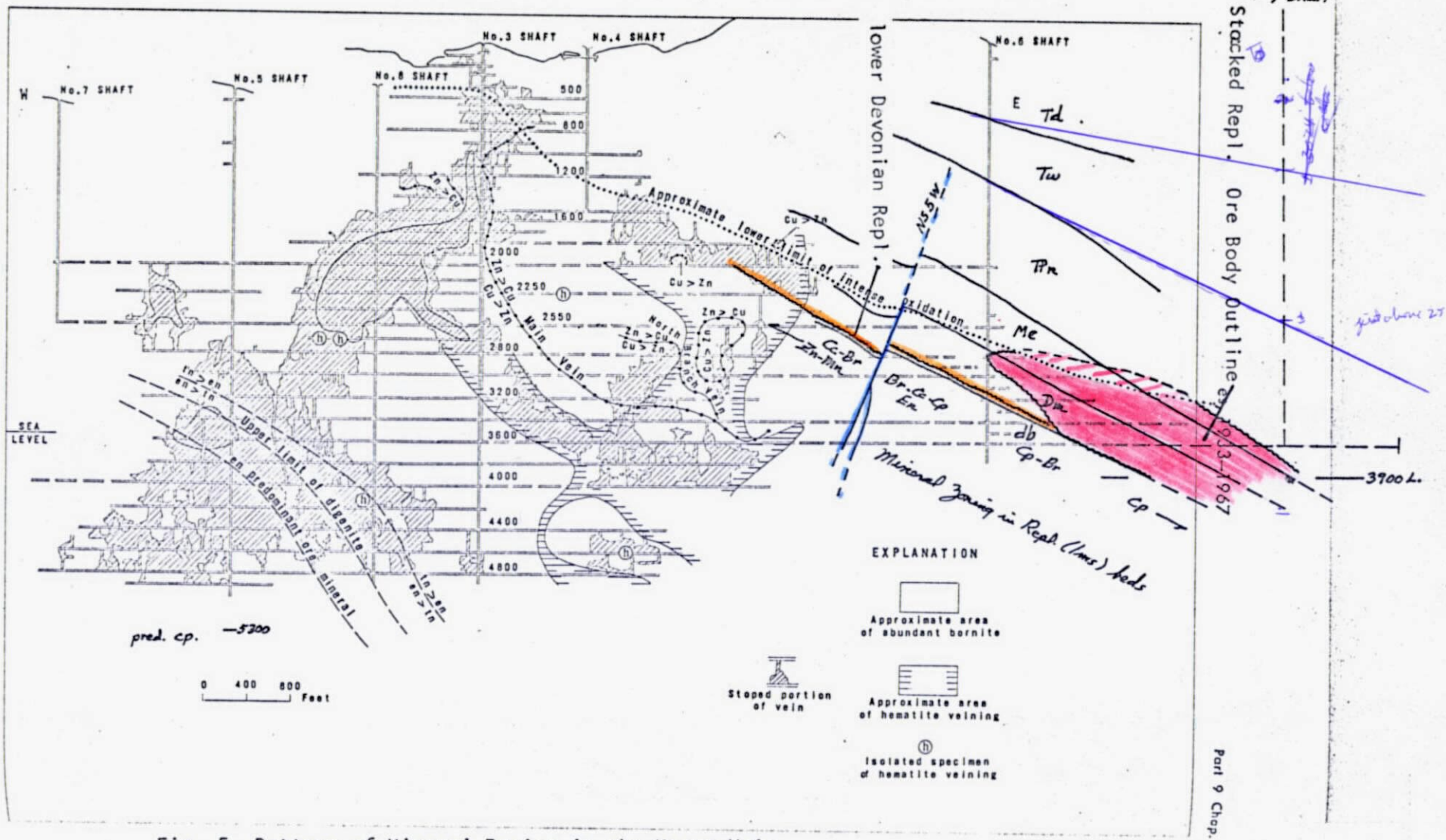

Fig. 5. Pattern of Mineral Zoning in the Magma Vein.

Modified from Hammer (Graton-Sales Vol., AIME)

FIGURE 2