CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
520-770-3500
http://www.azgs.az.gov
inquiries@azgs.az.gov

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James Doyle Sell Mining Collection

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Cpy for JHC

New York, October 27, 1972

RECEIVED
NOV 1 1972
NOV 13 1972 S. W. U. S. EXPL. DIV.

MEMORANDUM FOR: Division Supervisors
Asarco Exploration Department

Annual Meeting
Exploration Department

Since we have not had a formal review for top management in 2 years, the main themes will be:

a) Review of recent major projects

b) Future programs and reasons why

We have a dozen divisions and we cannot expect Company Officers to listen for more than 12 hours. Obviously the larger divisions can have more than one hour and the smaller divisions less, possibly as little as 10 minutes, so as to allow geologists from operating mining units to describe their exploration work. The proverb relating to a picture (illustration) being worth 10,000 words, is pertinent. In addition to room-size illustrations, speakers can also make use of page-size handouts of non-secret material. Details on housing and the program will be issued in January.

Although April 8-11, 1973, is a long way off, speakers should complete their illustrations in January, rehearse their talks in February, and practice delivery (without reading a text) in March, for the Annual Meeting to be held in Knoxville, Tennessee. A tentative program is attached.

A supplementary feature for our meeting could be an evening symposium led by a distinguished lecturer from outside the Company. Your nominations will be welcomed, prior to December 1st.

Provision will be made for underground visits to two of our East Tennessee zinc mines and we can have an extra session on mineralization in these mines and carbonate deposits in general.

As usual, we can plan on averaging two representatives from each Division, some more, some less, depending on the size of the Division. Your nominations of men and topics will be welcomed prior to January 1st so that we can assure reservations at the Holiday Inn, NE.

John J. Collins

John J. Collins

cc:SAAnzalone
MPBarnes
RLBrown
LPEntwistle
DMFletcher
RJLacy
RKKirkpatrick
WLKurtz
RBSprague
KWhiting

Trial Program - April '73 Meeting
Asarco Exploration Department
Knoxville, Tennessee

April 8
Sunday Evening:

Lecture by a distinguished scientist

April 9
Monday A.M. - Underground

		Hours
Afternoon	- Talks	3
Evening	- "	2

April 10

Tuesday - Morning	- Talks	3
Afternoon	"	3
Evening	"	2
		13

April 11
Wednesday A.M. - Underground

Afternoon - Symposium on Mineralization in Carbonate Rocks

J. H. C.

JAN 8 1973

RECEIVED
JAN 8 1973
EXPLORATION DEPT.

AIR MAIL

January 4, 1973

Mr. W. L. Kurtz
Southwestern U.S. Division
Tucson Office

Exploration Meeting
Knoxville, April 8-11, 1973

Dear Sir:

In response to your letter of December 18, the delegates from the Southwestern Division can be: Kurtz, Graybeal, Sell and John King. Sorry to omit Bob Crist, but you should leave someone of his caliber to run the store.

Your proposed topic is O.K. A lot has been published on Graybeal's subject -- what more can he say? Sell's hypothesis on Miami is acceptable if in the scientific tradition he gives adequate representation of an alternative hypothesis -- Staargaard's normal faulting - projecting Johann's illustrations. Not everyone needs to talk, so John King gets a free pass.

More later.

Very truly yours,

Original Signed By
John J. Collins

John J. Collins

cc:JHCourtright

J. H. C.

JAN 9 1973

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

December 18, 1972

Mr. T. C. Osborne
Asst. Director of Exploration
New York Office

Annual Exploration Meeting,
1973 -- Knoxville

In reply to Mr. Collin's request, listed below are my nominations for speakers:

Kurtz -- Review of Projects with statements on the SWED approach to porphyry copper search, reference to the other SWED presentations, and pediment drilling program. OK

Graybeal -- Vertical Zoning in Porphyry Coppers and its exploration significance. skip talk

~~Crist~~ -- Deep Underground Mining -- Methods, costs, risks. out

Sell -- Interpretation of Gravity Sliding in the Miami Mining District and its exploration significance. incl alternat hypot - Shaan gard

King --

I also recommend that John King, one of our promising young geologists, attend.

W. L. Kurtz

W. L. Kurtz

WLK:lab

cc: JHCourtright

J. H. C.

JAN 8 1973

RECEIVED

JAN 8 1973

EXPLORATION DEPT.

AIR MAIL

January 4, 1973

Mr. R. K. Kirkpatrick
Rocky Mountain Division
Denver Office

Exploration Meeting
Knoxville, April 8-11, 1973

Dear Sir:

In answer to your letter of December 19, the following delegates from the Denver Office are accepted: Kirkpatrick, Von Fay and Hoskins. Please inform Chuck Beverly he can come as our representative from Silver Bell.

As for talks, the two you propose are sufficient. The speakers can weave in enough in the way of metallogenic maps to satisfy that requirement. You and Chuck are freed of the burden of preparing talks.

I look forward to seeing you. More later.

Very truly yours,

Original Signed By
John J. Collins

John J. Collins

cc:JHCourtright

RECEIVED
JAN 8 1973
EXPLORATION DEPT.

J. H. C.
JAN 8 1973

AIR MAIL

January 4, 1973

Mr. S. A. Anzalone
Canadian Division
Vancouver Office

Exploration Meeting
Knoxville, April 8-11, 1973

Dear Sir:

In answer to your letter of December 21, we accept your delegation consisting of Anzalone, Gale and Lancaster.

Not everyone need give a speech, however. We can save time and live without the Minto copper prospect. Bob Gale could take a couple of minutes to show the metallogenic map of western Canada (and Alaska?).

More later.

Regards,

Original Signed By
John J. Collins

John J. Collins

cc:JHCourtright

J. H. C. RECEIVED
APR 3 1972 APR 3 1972
EXPLORATION DEPT.

Air Mail

March 29, 1972

Mr. S. Von Fay
Asarco - Denver Office

Copper in Arenaceous Rocks

Dear Steve:

The suggestion in your letter of March 24 is a good one. An intra-company symposium led by you and Jan Krason could be very instructive. Field trips to Creta, Oklahoma and Cuba, New Mexico seem feasible but only our European staff are advantageously located for a visit to Polish and East German occurrences. Is a suite of Zechstein ore specimens available in the USA?

As for timing, you are welcome to issue early invitations, but I wonder if this would not be appropriate for our next Annual Meeting, when a large number might be present.

Sincerely yours,

Original Signed By
John J. Collins

John J. Collins

cc:JHCourtright
JKrason

INVESTIGATIONS
DENVER

RECEIVED
APR 7 1972
EXPLORATION DEPT.

AMERICAN SMELTING AND REFINING COMPANY
ROCKY MOUNTAIN EXPLORATION DIVISION
1805 SOUTH BELLAIRE STREET. DENVER. COLORADO 80222

J. H. C.

April 5, 1972

APR 7 1972

Mr. J.J. Collins
Director of Exploration
ASARCO
120 Broadway
New York, New York 10005

Copper in Arenaceous Rocks

Annual Meeting

Dear Sir:

I thank you for your reply to the suggestion that we hold an intra-company symposium on the Zechstein and its ore deposits.

The annual meeting would appear appropriate for such a symposium. I have reservations, however, about presenting this before a large mixed group. I think that various public and private pressures and attitudes inherent at such a meeting would inhibit careful listening and free discussion, and would require quite rigid structuring of the symposium; and time limitations would require too brief a treatment of various significant features, some controversial.

An appropriate time might be to schedule the symposium the day after the annual meeting. Persons attending should be selected, presumably by you and the various supervisors with a maximum number of about ten. With this suggested schedule, we could then leave for the field trip the day after the symposium, which would be the second day after the annual meeting. If more than ten attend the symposium, we would still of necessity have to limit attendees on the proposed field trip to no more than ten.

Jan does not have Zechstein copper bearing rocks in his possession now. He has been attempting to obtain suites of Zechstein rocks, and is continuing this effort with the appropriate Polish officials. He thinks that the effort may meet with success, but there is no assurance that this will be the case.

We would like your opinion on the idea of holding such a small symposium as a part of, but immediately after the annual meeting. What we would hope to achieve would be free discussion and "exchange of views" in such a group, and we would particularly hope that some of the Mount Isa

Mr. J.J. Collins

April 5, 1972

people would attend and participate vigorously.

Very truly yours,

Stephen Von Fay

Stephen Von Fay

SVF/pn
cc: JHCourtright

Knoxville

DRAFT

EXPLORATION RECORD SHEETS
AND LITERATURE SEARCH

Since my report on progress in the matter of Exploration Record Sheets and Literature Search was mailed out quite recently, I have extra copies here for those who may not have read it.

The revised Record sheet was made available over a year ago. ~~SINCE~~ Some Divisions have given it a good try-out, others have evidently regarded it as a low priority project with the net result being an incomplete ~~or~~ and unsatisfactory test over all. Enough has already been said and written about the Record sheet, its purpose and potential future value in exploration, and I belive it should be continued at least to the point where it has been given a fair trial. Looking 10 years into the future everyone seems to agree to its importance

Any comments?

As for search of the literature ----- as I have noted in the March 30th report, a substantial part of the Record sheets completed are based searches of various publications, company and government files. Otherwise, however literature coverage, <u>as indicated by reading lists sent in</u>, varies from zero in some Divisions to fairly comprehensive in others.

Incidentally, USGS Research publications do not appear to be very popular reading material as it appeared on lists from only one Division, as I recall.

Comments?

JHC

Knoxville

DRAFT

PERSONNEL

In an attempt to improve our chances of acquiring top talent in exploration this year and in the future, we have visited a number of Universities in the Western States and Canada during the past few months ----- at Madison, Toronto, London, Vancouver, Berkeley, Stanford, Reno, and Tucson. Reports on these talent surveys dated January 18th and March 30th have been circulated among North American Divisions.

At the Stanford Job Fair last fall, representatives from industry were invited to air their views, and they did, pointing out that the University encouraged over-education, over-specialization ----- and that men with only Bachelor or MSc at the most degrees were in general more useful in industry. Fritz Krueger, Chairman of the Department of Applied Earth Sciences, retorted that in his estimation a man with no more than a Bachelors was essentially uneducated, and he then asked for our views on the matter. I replied that our Exploration Department would consider employing students at any educational level, providing they possessed a real interest in and enthusiasm for ore search, along with ability.

Several students voiced concern over the lack of summer job openings. I pointed out that this situation could be much improved if vacations were spread out over the four quarters, rather than all occurring in one quarter. The faculty found this suggestion definitely repugnant.

We have heard from two Divisions so far, Spokane and Tucson, with proposals for thesis projects that could deserve Company financial support. I will circulate these and in the meantime we would like suggestions from the so far silent majority.

It is my impression in general that alhtough there still exists a large over-supply of "hard rock" geologists, there is no surplus of superior talent ----- the competition remains keen for outstanding graduates, particularly those with some exploration experience.

Although offering of permanent employment is restricted to staff replacement at this time, you have considerable latitude in the matter of temporary employment for thesis support or otherwise, and, a more aggressive position in this area should be taken as it affords the best opportunity to evaluate talent for the future as well as the present.

3/29/73

1973 PROGRAM - ASARCO EXPLORATION - KNOXVILLE

April 8 — Sunday 2-5:30 PM - East Tennessee Mine Geology

M of C Desvaux

1. J. E. McCormick - Geology and reserves — 30 min.
2. J. Fox - Application of Geology to Mine Development — 15
3. R. Greene - Mineral paragenesis — 30
4. J. N. Biery - Ore guides in East Tennessee Mines — 30
5. D. D. Harper - Mid-Tennessee Ore Guides — 30

Sunday 7-9 PM - Mineralization in Carbonate Rocks outside Tennessee

1. A. V. Greene - Colorado — 20 min.
3. J. J. Sample - Ireland and England — 30
2. M. Barnes - Park City, Utah — 20

April 9 — Monday 8 AM-Noon

M of C T.C. Osborne

A. Europe
1. J. J. Merz - Exploration in Spain — 30 min.

B. Australia - 60 Min.
1. M. Kriewaldt - Recent major projects
2. D. M. Fletcher - Future exploration

C. Salt Lake Region
1. M. P. Barnes - Exploration Program — 20 min.

D. J. R. Wojcik - Nome, Alaska - Gold distribution — 20

Monday 1:30-5 PM

A. Western Canada - 60 min.
1. R. E. Gale - Metallogeny of Western Canada
2. S. A. Anzalone - Porphyry copper exploration
3. M. F. Lancaster - Asbestos exploration

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1. R. L. Brown - Exploration Significance of New Metallogenic Concepts in the Canadian Archean
2. U. Abolins - Exploration Opportunities in the Canadian Archean Greenstones
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1. J. Balla - Exploration Program — 30 min.
2. G. Prescott - Asbestos in No. California — 15

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2. W. G. Hoskins - Our Fluorspar Program — 20

C. S. M. Cameron - Aggregates — 30

D. Literature and Personnel
J. H. Courtright — 20

Tuesday Afternoon (if strike persists, otherwise switch with AM talks)

Underground in the Immel Mine, preceded by Mine Geologist's illustrated talk

Tuesday 7-9PM

Symposium on Mineralization in Carbonate Rocks (R.B. Sprague)

April 11 — Wednesday AM

Underground in New Market Mine, preceded by Mine Geologist's illustrated talk

Wednesday Noon and Afternoon on Tennessee River

Wednesday Evening - 5 PM

Instant 3-dimensional map making on cathode ray tube - show by IBM

April 12 — Thursday 8:30 AM-Noon

Geol. Society of America, Knoxville Meeting - optional, inform Harper
Carbonate Sedimentology

April 73

ASARCO

AMERICAN SMELTING AND REFINING COMPANY
EXPLORATION DEPARTMENT
120 BROADWAY, NEW YORK, N.Y. 10005

JOHN J. COLLINS
DIRECTOR OF EXPLORATION

March 9, 1973

Attendance expected at
Asarco Exploration Department Meeting
April 8-11, 1973, Holiday Inn Northeast, Knoxville, Tenn.

NEW YORK OFFICE

Messrs. C. F. Barber, R. L. Hennebach, F. G. Hamrick, T. A. Snedden,
H. Q. Stringham, R. J. Plumb, Jr.

M. B. Hecox, Jr., W. P. Roe, R. Richter, E. J. Kelly, Jr.

J. J. Collins, T. C. Osborne, J. V. Desvaux

Guest: Mr. J. W. Foots

MINING DEPARTMENT

North American Department - N. Visnes

Eastern Department - R. J. Kupsch

Tennessee Mines Division)
) Staff
American Limestone Division)

NB - Mrs. Barber and Mrs. Foots will stay at the Holiday Inn but will not take part in the meetings.

3/9/73

Attendance expected at Asarco Exploration Department Meeting
April 8-11, 1973, Holiday Inn Northeast, Knoxville, Tenn.

NEW YORK OFFICE
J. J. Collins
T. C. Osborne
J. V. Desvaux

Chief Geologist - J. H. Courtright*

Knoxville
D. D. Harper*, J. N. Biery*, W. L. Hatfield, M. D. VanGaasbeek

Tucson
W. L. Kurtz*, J. D. Sell*, F. Graybeal, J. R. King

Spokane
K. Whiting, J. Balla*, G. W. Prescott*

Denver
R. K. Kirkpatrick, S. Von Fay*, W. G. Hoskins*, A. V. Greene*

Salt Lake Exploration
M. P. Barnes*, J. R. Wojcik*

Exploration Services
R. J. Lacy, C. K. Moss, L. D. James, J. R. Montgomery

Vancouver
S. A. Anzalone*, R. E. Gale*, M. F. Lancaster*

Toronto
R. L. Brown*, U. Abolins*, R. N. Kervin, E. B. Nicholls

Europe
R. R. Sprague, J. J. Merz*, J. J. Sample*

Australia
D. M. Fletcher*, M. Kriewaldt*

Latin America
L. P. Entwistle

Environmental Geology
S. N. Kesten

Mine Geologists
Mt. Isa - B. Mathias

Buchans - E. A. Swanson and E. Perkins or K. Larsen

Coeur d'Alenes - S. H. Huff

Leadville - W. G. Salisbury

Silver Bell - C. E. Beverly

E. Tennessee - J. E. McCormick*, R. Greene*, J. Fox*, F. Rasnick, V. L. Hendrix

Limestone Div. - S. M. Cameron*

Asarco Mexicana-D. F. Coolbaugh

* Indicates speaker

3/7/73

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C. S. M. Cameron - Aggregates — 30
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   J. H. Courtright — 20

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Underground in the Immel Mine, preceded by Mine Geologist's illustrated talk

Tuesday 7-9PM

Symposium on Mineralization in Carbonate Rocks

April 11 — Wednesday AM

Underground in New Market Mine, preceded by Mine Geologist's illustrated talk

Wednesday Noon and Afternoon on Tennessee River

Wednesday Evening - Unscheduled

Professors Dewey and Bird (?) - Plate Tectonics and Ore(?)

April 12 — Thursday 8:30 AM-Noon

Geol. Society of America, Knoxville Meeting - optional, Inform Harper
Carbonate Sedimentology

April 1973

New York, October 27, 1972

RECEIVED NOV 1 1972 S. W. U. S. EXPL. DIV.

MEMORANDUM FOR: Division Supervisors
Asarco Exploration Department

Annual Meeting
Exploration Department

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John J. Collins

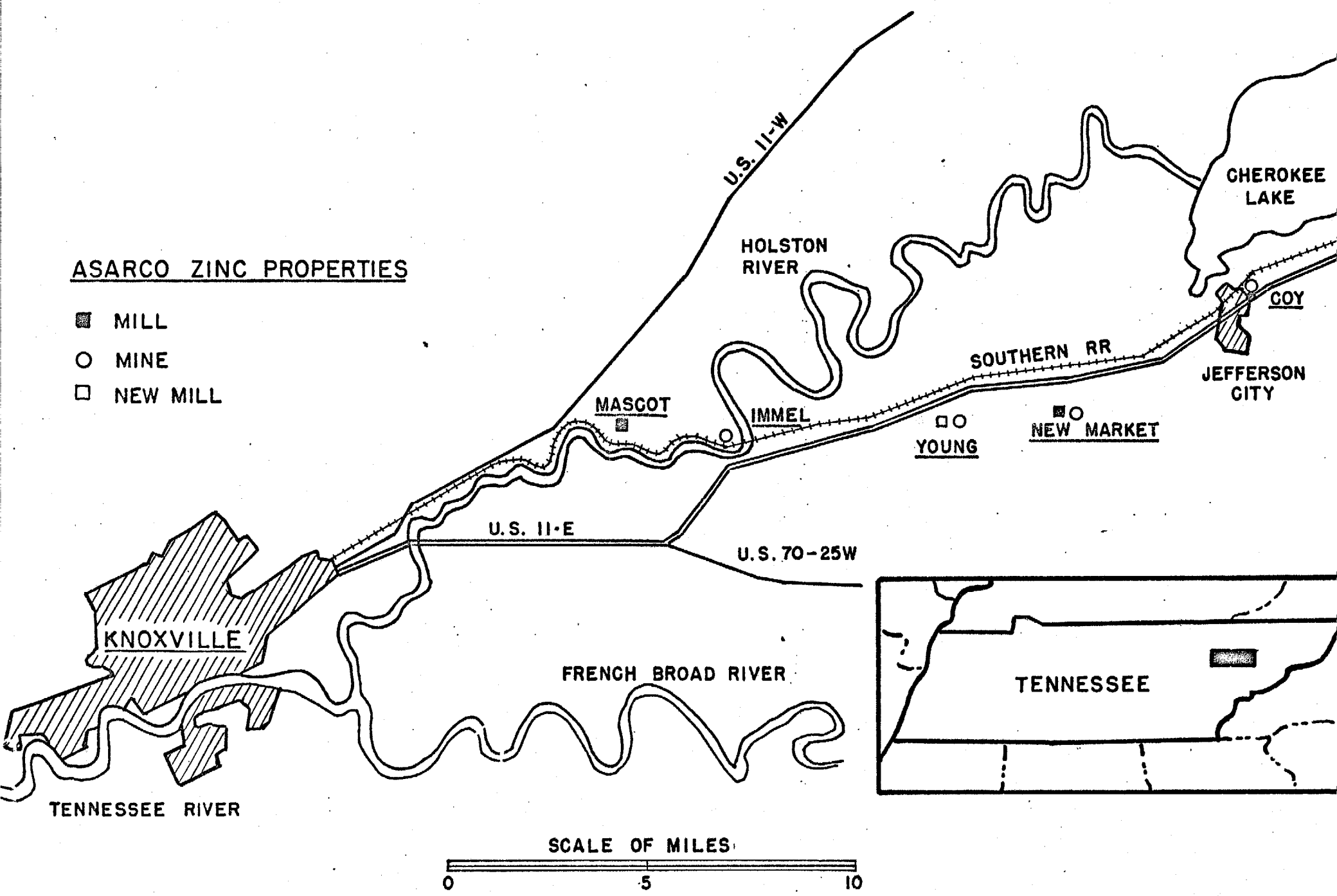
John J. Collins

cc: SAAnzalone
MPBarnes
RLBrown
LPEntwistle
DMFletcher
RJLacy
RKKirkpatrick
WLKurtz
RBSprague
KWhiting

IMMEL UNIT

ANNUAL EXPLORATION MEETING

APRIL, 1973


ASARCO ZINC PROPERTIES
MILL
MINE
NEW MILL
U.S. 11-W
HOLSTON RIVER
CHEROKEE LAKE
COY
SOUTHERN RR
JEFFERSON CITY
MASCOT
IMMEL
YOUNG
NEW MARKET
U.S. 11-E
U.S. 70-25W
KNOXVILLE
FRENCH BROAD RIVER
TENNESSEE RIVER
TENNESSEE
SCALE OF MILES
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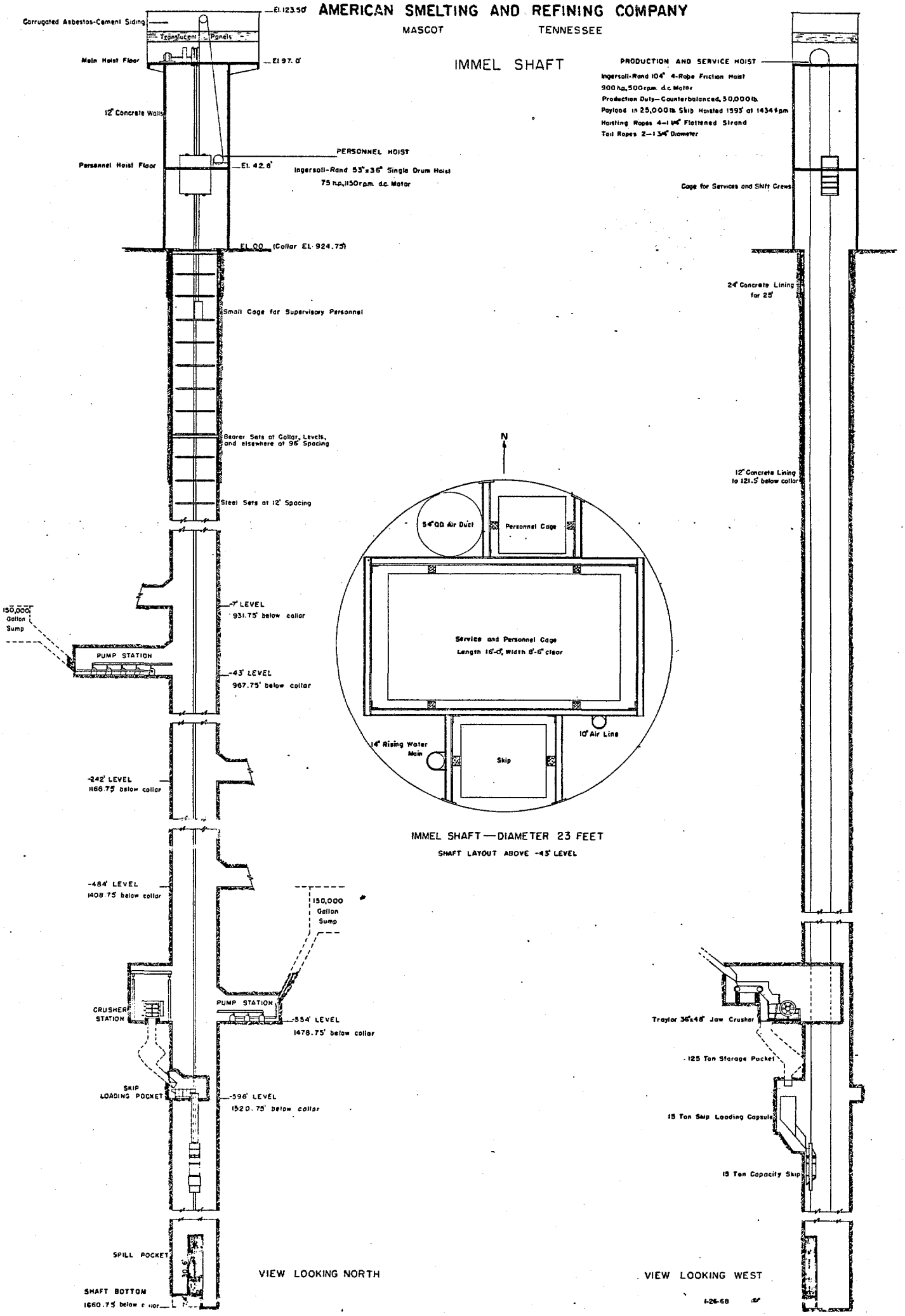
10

AMERICAN SMELTING AND REFINING COMPANY

MASCOT TENNESSEE

IMMEL SHAFT



IMMEL - MINING METHODS

The mining method used at Immel is random room and pillar. The method is complicated by dips up to 20°. Depending upon the thickness of the orebody and the point of entry, the mining sequence consists of "cutting-in" or slabbing, followed by "back-stoping" or shrinkage stoping for high ore and/or benching for low ore. Benching is preferred to backstoping. In benching, the back is scaled and bolted only once and broken bench ore is immediately available for loading. In backstoping, a portion of the broken ore must be held for long periods of time for a working floor and new back is made with each round. New back is subject to support problems.

Ground problems are often encountered when mining crosses the bedding. Frequent prominent bedding planes separate during mining, making the back difficult to support. Problem ground is bolted with 6' x 3/4" roof bolts on four and five foot centers.

Drilling and Blasting

Drill crews consist of a jumbo operator and a jackleg man whose function is to drill a "break" or a second free face for the jumbo and to load explosives. Two methods of crew utilization are used depending upon the availability of working places. With sufficient headings, the jumbo drills continuously while the jack-leg man loads holes in another drilled out heading; if too few headings exist, both men drill and load their own holes.

Jumbos are either rubber tired or tractor mounted and equipped with two booms and JR-300 drills. Steel is 10½' x 7/8" or 1" diameter with a 1¼" Tungsten carbide insert.

Explosives used are 1" x 8" and 1" x 16" 50% dynamite and ANFO. ANFO amounts to 20% of the explosives used. Electric detonators are used for initiation of blasts.

Loading

Loading is done by Joy TL-70 and TL-72 Transloaders and Wagner ST-5 and ST-5A's. Transloaders are used predominantly for production loading as they carry a larger payload. Wagner LHD units are used for development loading and substitute in production

loading. The maximum one-way haul distance is 1400 feet. Capacity of the Transloader and Wagner is 8.5 tons and 5.5 tons respectively.

Haulage

Rail haulage is used for transport of muck from the stoping areas to the shaft ore and waste pass system. Rail is 60 lb. laid to 48" gauge on 6" x 8" x 7' untreated oak ties. Ballast is unclassified development waste rock. Locomotives are Plymouth 12-ton diesels which pull ten, 10-ton capacity bottom dump cars.

IMMEL MINE EQUIPMENT

Drills

39	Ingersoll Rand JR-300A
11	Cleveland Airleg H10AL
9	Atlas Copco Airleg BBC 15W
6	Gardner Denver Airleg S48
4	Gardner Denver Airleg S48F
6	Gardner Denver Airleg S53
1	Gardner Denver D-93
76	

Jumbos

2	Allis Chalmers HD 5
3	Allis Chalmers HD 6
3	Caterpillar D-4
3	Mack Truck B-61
1	Joy Drillmobile
1	Koehring Dumpster
13	

Loaders

4	Joy TL-55
2	Joy TL-70
1	Joy TL-72
1	Wagner ST-5
2	Wagner ST-5A
10	

Locomotive & Mine Cars

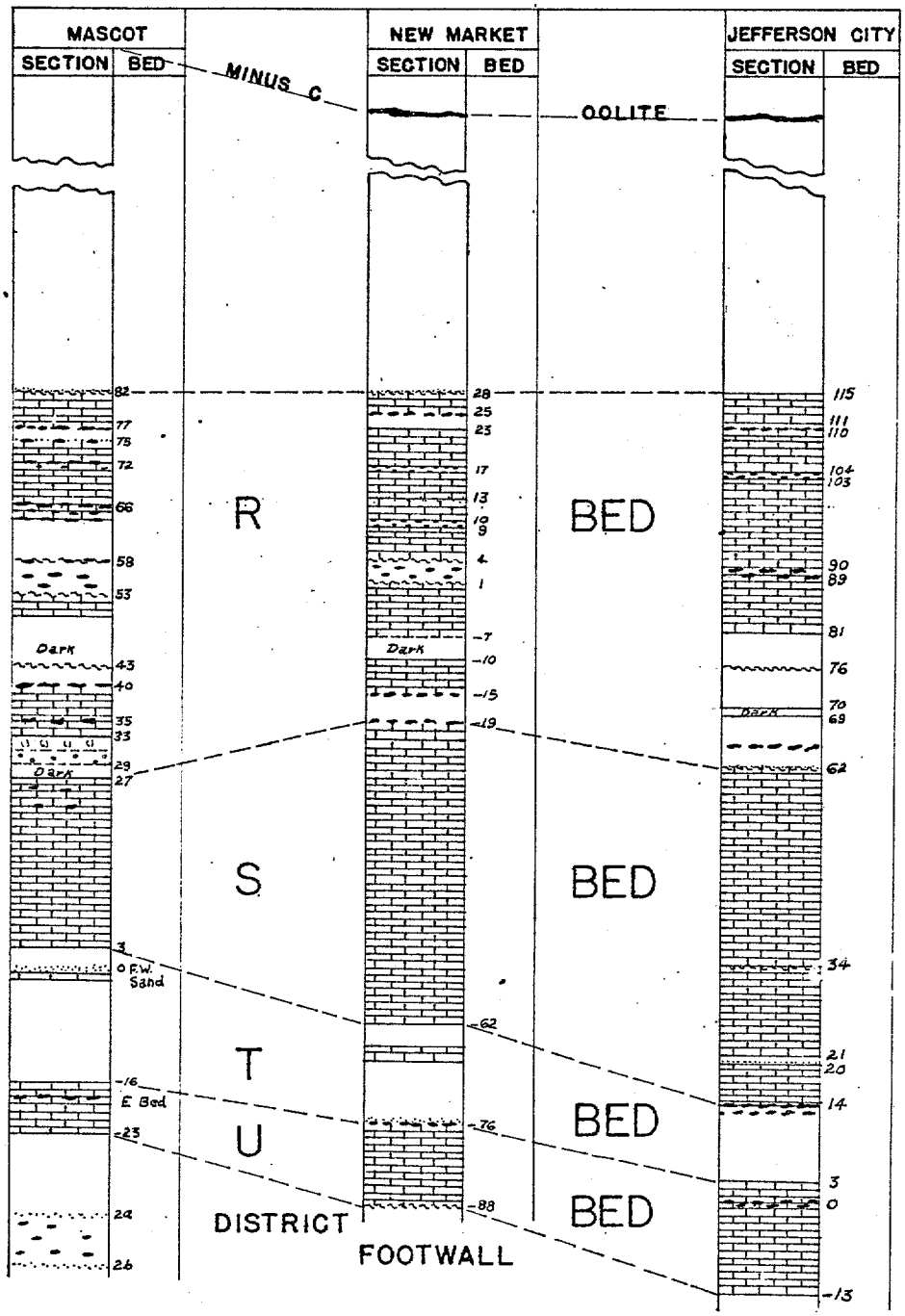
4	Plymouth 12-Ton Locomotive 48" Ga.
30	10-Ton Bottom Dump Mine Cars
34	

Miscellaneous

1	Caterpillar 950 Traxcavator
1	Caterpillar 922 Traxcavator
4	Ford 4400 Industrial Tractors
1	Ford 2000 Industrial Tractor
1	Caterpillar D-4D Dozer
1	John Deere JD-570A Grader
1	Ford Custom 250 Pickup Truck
1	Jeep 4-Wheel Drive
1	Acme RBSD-A Ground Rig
1	Pitman 65' Ground Rig
1	Grout Pump - Ball
1	Grout Pump - Piston
1	Prospect Longhole Rig

Total 16 Miscellaneous

TABLE I BASIC SECTIONS OF G-28 TO T BED ZONE



SCALE:
1 INCH = 20 FEET

EXPLANATION:
- DOLOMITE
- LIMESTONE
- DOLOMITIZED LIMESTONE
- SAND
- CHERT

Geology of the Mascot-Jefferson City Zinc District

Commercial zinc (3.00%) occurs, intermittently, through a strike belt of more than 20 miles from Mascot northeastward to Jefferson City. The district lies within the Appalachian Valley and Ridge province.

The ore, which is pre-Appalachian in age, is found principally in the lower half of the Kingsport formation which belongs to the well-known Knox Dolomite group. The formation, which is Lower Ordovician in age, consists of inter-bedded primary dolomites and limestones. Sphalerite is virtually the only ore mineral present, but it is often associated with secondary "white gangue" dolomite, pyrite, some fluorite and barite and occasionally an abundance of silica in the form of chert or jasperoid.

The ore bodies are irregular in shape and occur in altered limestone, locally called "recrystalline", and fractured dolomites. The collapse-breccia structures were developed as the S and R bed limestones underwent alteration and solution. Volume reduction, caused by dissolution of the limestone, removed the underlying supports and permitted the overlying beds to fracture and collapse. The zinc occurs mainly as open-space filling between breccia blocks and as replacement in bedded recrystalline.

IMMEL

The ore body at the Immel Unit is located on an east-west trending anticlinal structure. The east end of the anticline plunges to the northeast into the Strawberry Plains syncline or basin. The nose of the structure is displaced horizontally to the north by a major water-bearing fault. Formational dips of up to 30 degrees have been observed to date.

Mineralization is associated with a broad expanse of altered S bed, reflecting a modified low domal structure. The ore appears to "top-out" in most cases against the M-82 bed (top of R). Additional mining has occurred within the U-bed. Sphalerite is accompanied by a large amount of interstitial pyrite and occasional pockets of galena.

YOUNG

The Young Unit is situated atop of a domal structure known as the Hodges dome. The dip of the structure is about 10 degrees around its periphery. It has been displaced downward on the north flank by a high angle, post-ore, reverse fault (Cold Water Fault) with a vertical displacement of approximately ± 100 feet.

Mineralization ranges stratigraphically from near the top of the S bed to 30 feet above the R bed. Occasionally, mineralization proceeds into the upper post-R beds to the -C horizon, reflecting the high domal structure so typical of Young.

NEW MARKET

The New Market Unit is structurally located on the eastern flank of the gently plunging New Market syncline, with an average dip of 7 degrees to the west. The syncline includes both the hangingwall and footwall blocks of the Rocky Valley thrust fault.

Mineralization extends from the lower R bed (G -7/10) upward 30 to 40 feet into the Post-R beds. The structures are similar to Young (high domal) except they are narrower, resembling stoped out channel ways.

COY

The orebody at the Coy Unit is located on the southeastern flank of the Cherokee anticline. Local dip averages 10 degrees to the southeast. Although Coy is by far the smallest unit, it contains the highest grade (4.00% Zn.)

Better than 50 per cent of the mining has been in the U bed, the lowermost limestone unit of the Kingsport. Narrow V-shaped ore shoots occur in the U bed, and if alteration and solution are intense enough mineralization will move into the overlying S and R beds, creating breakthroughs.

APPENDIX

IMMEL MINE TOUR

Stop No. 1: 7 North Drift

Stop No. 1 will be a walking inspection of the stratigraphy of the upper Longview formation and the U, T, S and R beds of the lower Kingsport formation.

The inspection will commence at the Holston Quarry Fault where you will pass from lower Kingsport (S Bed) into the upper Longview, about 120 feet below the Kingsport/Longview contact (Mascot (-) 23). An arrow, ⟹, will denote points of interest.

From the fault to the raise slabbing you will be able to observe the character of the upper Longview including Dolomites, Recrystallines and Limestone/Recrystalline edges below the general mining horizon in the lower Kingsport. Surface location of diamond drill CD-23 is marked on the right rib.

Near the raise slabbing you will pass into the bottom of the Kingsport, and the general mining horizon, beginning with U bed. The U bed limestone has been dolomitized to the fine type of dolomite that is normally associated with the "primary" dolomites of the section and could not be separated from the overlying T bed which is considered to be a "primary" dolomite. However, the bleached cherts are at the very top of the U bed.

At the far end of the raise slabbing you will be in the lower S bed and will continue up section to the top of R bed at the CD-10 fault.

S bed will be completely limestone with dolomitization first appearing in lower R bed (M35 zone) and increasing to complete alteration at the top of the incline (M66 zone). Collapse of the post-R beds (M82) is evident at the CD-10 fault (note fractures in the back and ribs).

Crossing the CD-10 fault you will return to S bed limestone and proceed into increasing alteration and mineralization including limestone edge and adjacent limestone "rolls", shrinkage of the S bed, brecciation, and many other features of S bed mineralization.

Stop No. 2: 3C-4 Stope

Stop 2 will be at a lower S bed limestone edge. Features available for your inspection include:

1. Shrinkage and Brecciation of the Limestone,

2. Brecciation, Collapse, and Recovery of the Lower R Bed,

3. Black Matrix Breccia, with increasing content of Dolomite crystals away from the Limestone,

4. "Trash" Matrix Breccias,

5. "Varved" material (Kendall, 1960) filling Breccias ,

6. And Brecciated Dolomites showing solution between fragments by lack of filling and stylolites between fragments.

Stop No. 3: 2H-10 Stope

Stop 3 will be in the middle and upper R bed. Your attention is directed to:

1. The lack of brecciation present,

2. Occurrence and texture of the Galena and Sphalerite,

3. R Bed Limestone "Roll",

4. Black and Yellow Sphalerite with a texture similar to the Galena/Sphalerite texture,

5. And mild alteration with associated green shales and breccia.

Stop No. 4: 2H-10 Stope

Stop 4 is in post-R bed brecciation and mineralization. You are standing on about 65 feet of broken ore. Many features are evident with the following being brought to your attention:

1. Linear back fracturing,

2. Local steep dips,

3. And duplication of beds by breccia blocks.

Stop No. 5: 2H-23 Stope

Stop 5 is again at a lower S bed limestone edge as was Stop 2. Your attention is directed to:

1. Sphalerite disseminated along the limestone edge,

2. Recrystalline ore in limestone with a "breakthrough" to an overlying shale,

3. Thinning of limestone to the recrystallines,

4. The M+3 occurs here as a dolomite with a sand at the base which changes laterally to a shale over sand,

5. M-0 sand is located under a thin shaley limestone as opposed to being a basal sand in dolomite at the drift slabbing of Stop No. 1,

6. And accumulation of shaley material, sand, sphalerite fragments and "sphalerites", and distortion and dislocation of carbonate fractures in the residual material from the limestone.

<u>Rib Markings</u>

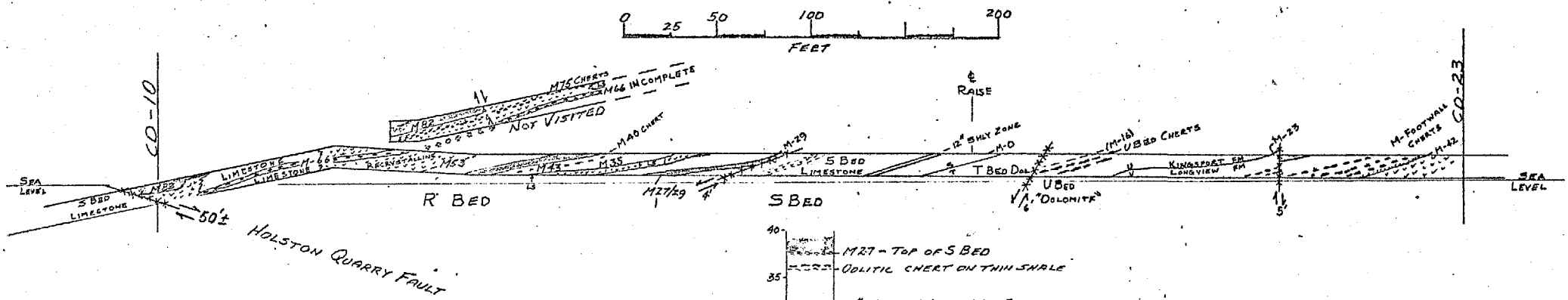
DOLO	=	Dolomite
LS	=	Limestone
RX	=	Recrystalline
M- ___	=	Mascot Bed Numbers
⟶	=	Point of possible interest
.....	=	Floating Sand
-------	=	Marker bed or zone
⬭	=	Chert
OOL	=	Oolitic appearing chert
R,S,T,U	=	Stratigraphic Units
FW	=	Footwall
SHLY	=	Shaly Limestone

ASARCO

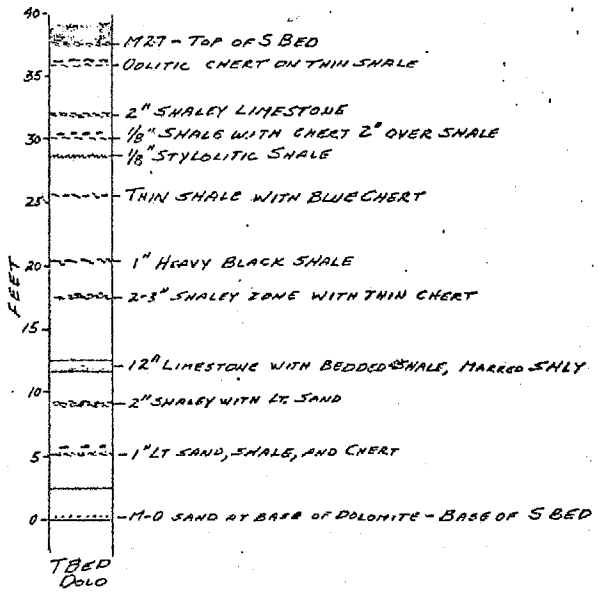
IMMEL MINE

TOUR STOP 1

GENERALIZED SECTION
FROM
CD-23 TO THE HOLSTON QUARRY FAULT



DETAILED S BED SECTION



4/1/73 R.F.H.

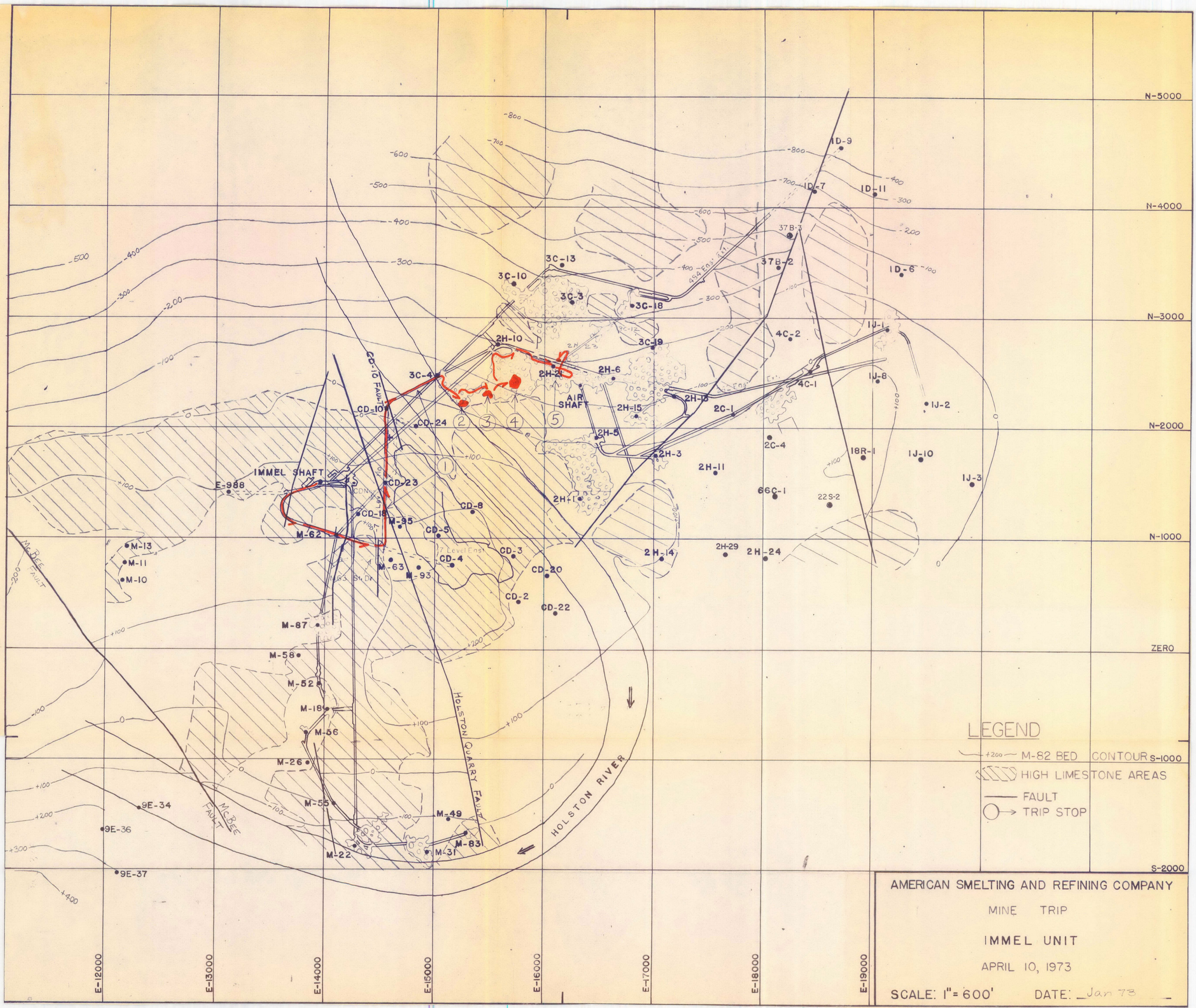

N-5000
N-4000
N-3000
N-2000
N-1000
ZERO
S-1000
S-2000
E-12000
E-13000
E-14000
E-15000
E-16000
E-17000
E-18000
E-19000
IMMEL SHAFT
AIR SHAFT
CD-10 FAULT
McBEE FAULT
HOLSTON QUARRY FAULT
HOLSTON RIVER
LEGEND
+200 M-82 BED CONTOUR
HIGH LIMESTONE AREAS
FAULT
TRIP STOP
AMERICAN SMELTING AND REFINING COMPANY
MINE TRIP
IMMEL UNIT
APRIL 10, 1973
SCALE: 1" = 600'
DATE: Jan 73

Fig. #4

RECENT DISCOVERIES
MASSIVE SULPHIDE DEPOSITS

	MINE	SIZE OF OREBODY IN TONS	GRADE
*	Selco-South Bay Mines Uchi Mine discovered 1968	>900,000	2.7% Cu., 15% Zn. 3.5 oz. Ag.
*	Mattagami Lake-Mattabi Mine discovered 1969	13,000,000	0.91% Cu., 7.6% Zn., 0.84% Pb. 0.007 oz. Au., 3.13 oz. Ag.
*	Sherritt Gordon-Ruttan Lake Mine discovered 1969	51,000,000	1.47% Cu., 1.61% Zn.
*	Consolidated Rambler-Ming Mine discovered 1970 (Paleozoic)	>2,000,000	2.6% Cu., 0.57 oz. Ag.
	Umex-Kapkichi discovered 1970	2,500,000	1.4% Cu., 0.2% Ni.
	Umex-Thierry discovered 1970	10,000,000	1.6% Cu., 0.2% Ni.
	Orchan (Radiore "A")-Norita Mine - discovered 1972	1,637,000	0.7% Cu., 7.6% Zn., 1.0 oz. Ag.
*	Iso-Copperfields-Hebecourt Twp. discovered 1972	3,740,000	1,690,000 - 2.25% Cu., 0.4% Zn., 0.01 oz. Au., 1.2 oz. Ag. 2,050,000 - 0.4% Cu., 5.5% Zn., 0.046 oz. Au., 0.6 oz. Ag.
*	New Insco-Hebecourt Twp. discovered 1973	appears >600,000	insufficient information, massive Cu, Ag. approx. 3% Cu.

* A.E.M. Discoveries

VOLCANIC EXHALATIVE AND ASSOCIATED MASSIVE SULPHIDE DEPOSITS

MINE	SIZE OF OREBODY IN TONS	GRADE
* T.G.S. Kidd Creek Mine discovered 1964	>114,000,000	1.33% Cu, 7.08% Zn, 4.85 oz. Ag. + 0.13% Sn + Cd
Noranda-Horne Mine discovered 1923	56,799,000 200,000,000	2.18% Cu., 0.15 oz. Au + Cd. Pyrite Cu, Zn, Au of economic proportions-metallurgical problems
Noranda-Geco Mine discovered 1953 metasediments-replacement (?)	>49,044,177	1.97% Cu., 4.37% Zn., 1.82 oz. Ag., + minor Pb, Au.
Kerr Addison-Quemont Mine discovered 1945	15,349,000	1.31% Cu., 2.43% Zn. 0.157 oz. Au., 0.9 oz. Ag.
* Mattagami Lake-Mattagami Mine discovered 1957	29,000,000	0.66% Cu., 8.8% Zn. 0.012 oz. Au., 1.08 oz. Ag.
* Mattagami Lake-Mattabi Mine discovered 1969	13,000,000	0.91% Cu., 7.6% Zn. 0.84% Pb. 0.007 oz. Au., 3.13 oz. Ag.
* Sherritt Gordon-Ruttan Lake Mine - discovered 1969 metasediments	51,000,000	1.47% Cu., 1.61% Zn.
* Sherritt Gordon-Fox Lake Mine discovered 1961 metasediments-replacement (?)	14,500,000	1.99% Cu., 2.35% Zn.
Hudson Bay- Flin Flon Mine discovered 1930	65,000,000	2.33% Cu., 4.57% Zn., 0.074 oz. Au., 1.30 oz. Ag.

* A.E.M. Discoveries

BASE METAL DEPOSITS
(other than volcanic exhalative)

MINE	SIZE OF OREBODY IN TONS	GRADE
Sudbury Camp (Inco and Falconbridge) (97,000,000)	>250,000,000	0.7% Cu., 1.3% Ni., + Pt., Au., Ag.
Thompson Camp discovered 1956	>100,000,000	2.0% Ni. + precious metals
Sherritt Gordon-Lynn Lake Mine discovered 1950	63,000,000	0.4% Cu., 0.8% Ni.
McIntyre (Copper) discovered 1963 porphyry Cu.	8,895,945	0.8% Cu. + Mo., Au., Ag.
East Sullivan Mine discovered 1947 massive & disseminated zones in tuff	15,892,053	0.89% Cu., 0.37% Zn., 0.006 oz. Au., 0.24 oz. Ag.
Manitou Barvue Mine discovered 1940 massive & disseminated zones in pyroclastics	9,601,278	5,601,278 - 0.82% Cu., 2.93% Zn., 0.71 oz. Ag. + Pb. 4,000,000 - 3.5% Zn., 1.3 oz. Ag.
Patino-Copper Rand Mine discovered 1960 stockwork in meta-anorthosite	13,246,083	2.34% Cu., 0.036 oz. Au.
Campbell Chibougamau-Henderson Mine, discovered 1960 shear zone veining in meta-anorthosite	16,000,000	2.30% Cu., 0.06 oz. Au., + Co.
Teck-Tribag Mine discovered 1967 breccia pipe in andesite	1,274,000	2.0% Cu.
Coppercorp Mine discovered 1963 veins along fault in Proterozoic	1,540,000	2.1% Cu.
Falconbridge Cu. - Opemiska discovered 1950 shear zone veining in gabbro sill	17,000,000	3.0% Cu., 0.05 oz. Au., 0.5 oz. Ag.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

March 30, 1973

TO: DIVISION SUPERVISORS

EXPLORATION RECORD SHEETS
AND LITERATURE SEARCH

The tabulation below records progress for the past two years (to March 1973) as indicated by Record sheets and Literature lists received at this office.

Division Office	Number of Exploration Record Sheets Received		Submitted Lists of Publications Read (X)	
	To March 1972	To March 1973	To March 1972	To March 1973 (date of lists)
Vancouver	80	---	X	---
Toronto	97	170	X	---
Spokane	7	32	X	3- 8-72
Salt Lake City	---	41	-	6- 6-72
Denver	40	27	X	4-11-72
Knoxville	129	39	X	---
Tucson	25	11	X	4- 6-72
Tucson (Latin America)	---	---	-	---
London	11	372	-	6- 8-72
Perth	38	20	X	6- 8-72

As may be noted, there is considerable variation among Divisions in the quantity of Record sheets submitted (from zero to plus 300) and I might add that the quality of reporting is also variable, however, general improvement is evident in the presentation of data and conclusions thereon during the past year, which can be in part attributed to the revised format of the sheet.

A substantial percentage of the Record sheets received are based on searches of the literature, government records, company files, etc., literature coverage otherwise, as indicated from lists submitted, varies from zero to fairly comprehensive.

A reminder that the report year would end March 1st was mailed December 7, 1972. Only 3 Divisions have responded since that date. In two instances the man responsible for reporting has been assigned work in another Division during the past 4 or 5 months, but in several other cases, a definite lack of cooperation is evident.

Originally, it was requested that reporting be on a monthly basis. This perhaps is an unnecessarily short interval. In the future kindly arrange to have reports submitted at the end of each calendar quarter.

J. H. Courtright
J.H. COURTRIGHT

JHC:kre
cc: J.J. Collins

THE GEOPSYCHIC PROSPECTING METHOD

by

R. E. Wagner

Bonne Terre, Missouri
February 2, 1961

THE GEOPSYCHIC PROSPECTING METHOD

by

R. E. Wagner

Introduction

Having been engaged in exploration and prospecting work for St. Joseph Lead Company during the past 30 years, I have during that period inevitably developed certain basic principles and methods applying to the search for ore. The fact that a certain amount of success was met with in this search has led some people to feel that these principles could be of value to others engaged in exploration activities. Consequently, it has been suggested to me from time to time that I put some of these principles on paper for the benefit of others who may be interested.

I have hesitated to do this for several reasons. A hunter may be an excellent shot on birds but probably cannot make an expert shot of another just by telling him how. The same holds good for fishing and other endeavors. Since the search for ore, for game, and for fish are all part of the same hunt and search technique, I am doubtful whether any ability I may have developed during these 30 years could be transmitted to others merely by talking about it.

However, as a hunter can teach a novice the basic rules for good shooting and give him pointers which have assisted the hunter in gaining his skill, so it seems possible that the presentation of the basic concepts and methods used in searching for ore may be of some assistance to others. The extent to which this is true will depend on the native ability of the student. There are people who will never be expert shots no matter how long they practice, and there are people who couldn't find ore if it was exposed and in sight, possibly because their scientific deductions have convinced them that the location is not favorable for ore.

This article then is an attempt to summarize the concepts and methods comprising the Geopsychic Prospecting Method which is the result of 30 years of exploration work in Southeast Missouri. With modifications, the Method can be applied to other districts and other countries. For the sake of brevity, it is known simply as G.P.P., or the Method.

At various times it has been inferred that the element of luck has played a large part in the making of some of these discoveries. I would be the first to admit that a good argument could be made for this viewpoint if the normal concept of what is meant by luck is applied. But it is my belief that the process of

being lucky is very much misunderstood. I believe there are valid psychic processes operating which subconsciously lead to decisions that result in success in any endeavor which involves the element of choice of several alternatives. Since the decision that led to success sometimes cannot be explained by science and logic, the ordinary observer will ascribe the success to luck. It is this element of psychic prompting which needs to be explained in order to understand the principles and methods of prospecting developed by the author.

Basic Concepts

We live in a world in which unseen physical and energy phenomena invade the body from all directions. The force of gravity pulls downward at variable rates, changing even as the moon passes overhead. Magnetic lines of force pass through in differing intensities and directions, varying with eruptions on the sun. We are subjected to minute electrical currents from all directions. Radio and television waves pass through our bodies in all directions in a crescendo of bewilderment. The conclusion seems inescapable that all of these forces and phenomena must affect the state of the body in some fashion.

Imagine the human body enlarged to such a degree that we could see the individual protons, neutrons, etc. in the individual atoms whirling around under the control of negative and positive charges. Imagine standing back and looking at this huge enlarged mass of a man, watching the waves of energy and force and particles composing the above mentioned phenomena as they pass through this mass. It would be ridiculous to say that they would have no effect on the mass. As well say that a 40-mile gale could pass through a tree in leaf without shaking a single leaf.

Fortunately, we have an invisible shield between our conscious and subconscious natures which screens out these effects so that we are not consciously aware of them. Life would be intolerable if this were not so. Probably some of our feelings of ill health are caused by disturbances in our atomic structure from which some effects leak through the screen into our consciousness. The increase of arthritic pains during weather changes and similar phenomena may be the result of such forces.

Geologists and engineers have scoffed for decades about the claims of the brotherhood of dowsers with their water witching and mineral finding equipment. This is the result of two basic errors. The dowsing fraternity doesn't usually understand the forces with which it is working and tends to make claims for their ability which are not valid. The scientific brotherhood tries to explain all

phenomena in the light of limited knowledge as to the character of the forces in nature without allowing for the effects that these forces may have on the human body, demanding measurable mechanical manifestations of these effects which are partly physical and partly psychic. The first error is well illustrated by the enthusiastic and misguided claims of Kenneth Roberts concerning the ability of his protege, Henry Gross. It is ridiculous to claim that Henry could locate water in a place miles away by taking a map of that place in his office and exercising his powers thereon. This removes his ability from the sound basis of scientific possibility to the realm of the occult. It would be impossible for the physical forces operating at the place in question to be transmitted through a piece of paper. Such claims are the result of having a man with literary background delving into the realities of science of which he knows nothing and have done the dowsing profession more harm than good. Investigation of the validity of dowsing phenomena should be made neither by people with no scientific background nor by scientists who believe only what they have read in books,but,rather, by people with scientific background and an open mind who recognize the possibility that physical forces existing at the earths surface may, in certain individuals with the proper psychic responses, be transmuted into physical reactions.

We have learned to measure and utilize with magnetometers, gravimeters, voltmeters, etc. the various physical forces we know about. With these instruments we can tell if the magnetic or gravity readings are exceptionally high or low at a certain point. Electrical phenomena are subject to similar interpretations. In general, what we look for are anomalous conditions, points at which the normal field or background is disturbed by something unusual. There may be other forces of whose existence we are not aware. Much work has been done in the field of extra sensory perception and the conclusion of most experts is that there are forces existing of an unknown nature which are responsible for results that cannot otherwise be explained.

One of the most valuable features of modern instrumentation is the ability to make permanent records that can be examined and re-examined through the years. Our mind is the ultimate in recording instruments. Students of the subject state that everything we have ever experienced, every thought or idea we have ever had, is recorded in the memory storehouse in the subconscious recesses of our mind, subject to recall by our conscious mind. It is plausible to assume that the responses of our body to physical forces which do not reach the conscious mind are also recorded in the subconscious.

This is the basic concept on which geopsychic prospecting is founded, namely that besides the memory of all conscious experience stored in the subconscious, there is also a record of all of the reactions to invisible phenomena which have never reached our consciousness. Every time one's body moves across a point of high magnetic intensity the record of that experience is stored away even though one is not aware of it. More important to the exploration profession, the physical phenomena associated with the presence of such things as a sulfide ore body, for which we search with I.P., E.M.F., etc. make their record in our subconscious memory as we come into their influence. In normal geophysical studies we combine the results of gravity, magnetic and electrical surveys in an attempt at solution of anomalous conditions. In the subconscious mind these combinations are already made. Unfortunately, since the forces have not been experienced by the conscious mind they cannot be easily recalled by the conscious mind.

The essence of geopsychic prospecting lies in utilizing the knowledge stored in the subconscious, that is difficult to recall with the conscious mind. The problem is how to make this storehouse of knowledge available to the conscious self. It is here that we leave the field of dignified and accepted scientific rules and consequently, from this point on, my thesis will be accepted with scepticism by most scientific minds, or even will be rejected in its entirety. Only the rare few will have vision enough to see that the greatest truths in this life are neither obvious nor provable by mathematical formulae. Although we have advanced with tremendous strides in scientific knowledge during the last few decades, we have come only a short distance towards a complete understanding of all of nature. We are able to set up equations and rules as to what will happen in given situations but we are still abysmally ignorant as to the exact nature of matter, energy, body processes, guidance systems in birds and fishes, and dreams. In the present day world of four dimensional continua, undecidable identities, and indeterminacies who would be bold enough to say that psychic processes are not valid because they cannot be proved mathematically? Who can be certain that an individual carrying a forked stick across the ground is not able to receive, in some not yet understood fashion, the vibrations being recorded in his subconscious and to translate them into physical reactions?

The field of psychic phenomena and extrasensory perception into which we must enter in order to utilize our subconscious knowledge is subject to the same limitations as the fields of scientific endeavor, namely that we do not understand the nature of the forces but are able to study and analyze certain phenomena resulting from these forces. It is not the purpose of this article to make a

study of this field. A considerable number of university groups, such as the one at Duke University, have made detailed studies of psychic phenomena over long periods of time and any one interested can study the subject in greater detail through the findings of these groups. Sufficient for this article is the statement that we know that it is possible to deliberately evoke transfer of knowledge from the subconscious to the conscious although we have only rudimentary knowledge of the methods necessary to accomplish this. A clue is seen in our ability to go to sleep at night thinking of a problem and to awaken in the morning with the problem solved. A most fruitful field of study is the matter of so-called "hunches". It is evident that, more often than not, these are actually promptings by the subconscious and not merely hap hazard guesses.

Having set up the basic ideas on which G.P.P. is predicated we can proceed to the actual methods employed.

Preparation

By this time the impression may have been made that, in geopsychic prospecting, psychic methods are substituted for accepted scientific methods. If so, this is erroneous. G.P.P. utilizes every scientific aid known to the geologist in his search for ore and the psychic methods are superimposed in order to utilize the knowledge stored in the subconscious which otherwise would not be available in making decisions. The expert will still have the advantage over the amateur as he will still use all the knowledge he has gained through experience. He will go through all of the proper steps ordinarily used in choosing an area for exploration and developing a prospecting plan. These include complete studies of everything known about the lithology, structure and mineralization in the area. Many articles have been published outlining proper exploration procedures during the last decade and we need go into no further detail here.

Geophysical studies which may be applicable to the project may be made and should be of assistance but are not quite as important as when only ordinary prospecting methods are used. This is because, with the G.P.P. method, ordinary geophysical methods are supplemented by another step in preparation. Besides making all normal studies advisable, it is absolutely necessary that the geologist be physically present in the area under study. He should traverse the area fairly thoroughly, traveling over the main roads and foot trails with occasional traverses across country. The spacing of the traverses will depend on the size of the target sought. A large target requires only limited coverage; much greater detail is needed for small targets. It is best to be on foot as much

as possible. There is some indication, though not completely proven, that it may be advisable not to wear rubber footwear which might insulate the body from small currents traveling through the earth. I have heard of one geologist using the method who works barefooted but I do not believe this to be necessary.

The reason for this part of the preparation is inherent in our basic concept. Not only must we cram every bit of pertinent knowledge into the storeroom of memory that our conscious mind has been able to pick up but the record of the anomalous physical forces in the area to which our body is subjected and of which we are unconscious must be made by the subconscious mechanism. Only in this way can our conscious and subconscious minds, working together, arrive at a proper judgment.

Application

The final and most difficult part of the method, having made the necessary preparations, is its actual use in the solution of a specific problem. It is also the most difficult to explain. In the final analysis the method of evoking knowledge stored by the subconscious is a highly individual problem and will be solved according to the ability of the individual. The method which operates successfully for the author may not be effective for another. Some general rules may be of help. It is advisable to learn as much as possible concerning studies of the subconscious. An understanding of psychiatric methods is valuable. It is not necessary to enroll in courses in school for this. Simply to lie on the couches of several psychiatrists, studying their methods, will be sufficient. A simple introduction of yourself as an exploration geologist will probably gain access to as many of these couches as you desire.

The climax of all the planning comes at the moment you sit down before your map or maps and make the decision as to the specific area on which you are going to concentrate the prospecting program. Having made that decision, you take your pencil in hand and spot a group of locations for drilling in the chosen area. This is the moment of truth, the justification for the geologists existence. If he fails, if he has not adequately tapped his subconscious processes, he may not have many opportunities to try again. This is the time for the extreme effort and in the G.P.P. method it is just that.

No matter what techniques have been developed to aid in releasing the subconscious, one thing is necessary and that is to put oneself in the proper frame of mind. This can be likened to that of a poet or writer when creating his tale. He becomes oblivious to his surroundings and, when sufficiently inspired, the tale comes pouring, almost without thought, from the tip of his

pen, almost writing itself. This is the state of mind which the geologist must attain at this point. Getting rid of all distractions and firmly grasping his pencil in hand, he passes into what might be called a semiconscious state in order that the wedding of the conscious and subconscious may occur and the desired progeny be produced. In this state the conscious part continues to function, analyzing the problem and trying to reach a decision, but in a passive manner, leaving the way open for the prompting of the subconscious. It is similar to the transition period between dreaming and waking.

The ability to attain this semiconscious state will vary with individuals. With some it will require little effort - may seem almost normal; to others, it may be impossible. The unsuccessful ones will never be able to use the Method and will have to struggle along with standard methods, limited though they may be. Many exploration geologists have undoubtedly used the method unconsciously and have ascribed their results to a "hunch".

Having reached the proper state of mind the urge will finally come to put crosses on certain spots on the map. Do not question these urges, and continue the process until the program has been laid out. Upon completion of a program of the desired size, it is advisable to return to complete consciousness. Continued analyzation may result in uncertainty and confusion.

At this point the application of Finagle's Law should be considered. This law, sometimes known as "Finagle's Universal Laws for Naive Engineers" was developed many years ago by Dr. Avagadro Finagle, who is said to have been struck by lightning while standing at the bottom of a sixty-foot well. It is the law of the improbable and, in essence, states that, in certain given situations, the improbable will happen much more often than it should, according to the laws of probability.

J. W. Odell and T. O. Seiberling, of the St. Joseph Lead Company's geological staff, were the first to point out to me the applicability of this law to their work in Subsurface Geology and Mapping. If a geologist is mapping in a mine stope with a dry floor, and there is a pool of water 2 feet in diameter in the stope, a map accidently dropped will probably, according to Finagle's Law, fall in the pool of water. If one drop of water falls from the mine roof while he is working in the stope, it will probably drop on his map.

Finagle's Law applies to prospecting methods at the point where the prospecting plan has been laid out according to the prescribed procedure and drilling is about to start. At this time there is a tendency to re-evaluate the drilling plan and to decide that one or two of the locations are improbable spots

for locating ore and to eliminate them. If these locations were laid out by the Method, never change them on second thought. Finagle's Law indicates that these locations are the very ones which, because of their supposed improbability, are most likely to hit the ore target. Any geologist who has done considerable exploration work can attest to the truth of this. It might be said that this is due to poor geological reasoning in the first place but this is not the case. Finagle's Law applies to the work of the most brilliant and successful exploration geologist as well as to that of the amateur.

Associated with Finagle's Law is the tendency, when drilling a group of exploratory holes, to hit the mineral target with the last hole in the group to be drilled. Usually this creates considerable confusion as generally the area covered by the group of holes has been all but abandoned because of the results in the earlier holes, much equipment has been moved out, statements have been made about the area that now will have to be eaten, etc. Usually the most likely appearing holes are drilled first and the least likely left to last and this tendency to find mineral in the least likely and last drilled hole is known as the Corrigan Effect in Finagle's Law. The younger generation may not recall "Red" Corrigan who started from the Atlantic coast, in his plane, for California and landed in Ireland. It would seem simple to counteract the Corrigan effect by having the drill contractor drill the last hole first but in my years of experience I have found this to be a very difficult thing to accomplish. No matter how much thought is given to the matter and how many instructions are given, the contractor or Drilling Department will usually drill the last hole last. To date, I have no good answer to this problem.

Conclusions

Proper judgment in preparing a prospecting plan is dependent on having all the pertinent information that is available. All of the information must be properly used in order to arrive at the most complete answer. The addition of psychic methods to the ordinary standard procedures releases additional information from the subconscious which is otherwise not available.

The Geopsychic Prospecting Method is not a cure-all. It is not a corrective for ignorance. It does not eliminate hard work and long hours. It will not put mineral in an area where there is no mineral. Properly used, it will add that extra touch which is the difference between success and failure.

I hope this dissertation will be of assistance to all exploration geologists who read it. I have only one request to make. Please be honest about it. Too many people in the past have used the psychic approach in

prospecting, have found mineral, and then have written learned dissertations on the scientific deductions responsible for the find, tailoring the tale to fit the discovery, and ignoring the real truth for fear of being considered merely lucky instead of competent. This explanation of the psychic angle in prospect planning should eliminate some of the superciliousness of the intelligentsia toward the "lucky" prospector and restore the word "luck" to the logitimacy it deserves.

In conclusion, I wish to express my appreciation for the stimulation provided by the many ideas freely offered by various members of the St. Joseph Lead Company's geology staff in regard to this subject. Besides those mentioned previously, I am particularly grateful to Dr. John S. Brown and Dr. Frank G. Snyder for the many observations by them which have found their way into my subconscious files to be used later without being fully conscious of their source. And I would be remiss in my obligations if I failed to acknowledge the debt of gratitude I owe to various members of the dowsing profession who first made me aware of the possession of powers inherent in my physical and mental entity of which I had been taught nothing in the halls of learning.

REW/jcp

AMERICAN SMELTING AND REFINING COMPANY

SUBJECT

ACCOUNTING AND TAX TREATMENT OF MINE EXPLORATION AND DEVELOPMENT EXPENDITURES

KNOXVILLE, TENNESSEE

APRIL 8, 1973

AMERICAN SMELTING AND REFINING COMPANY

ACCOUNTING AND TAX TREATMENT OF MINE EXPLORATION AND DEVELOPMENT EXPENDITURES

(Presented at Asarco Exploration Department Meeting, April 8-11, 1973, Knoxville, Tennessee, by Robert Richter, Assistant Comptroller - Taxes. Collaborators in Preparation of the Paper: Paul A. Barrese, Assistant Tax Manager, and Edward J. Kelly, Jr., Chief Accountant).

Gentlemen, it is a great pleasure for me to have been invited to attend this Exploration Department Meeting. I must admit at the outset that my technical competence in the field of geology is absolutely nil. I wouldn't know the difference between a brecciated chalcopyrite and a magnetic, sedimentary sphalerite; if I tried to pretend that I did, it wouldn't be too long before my Pre-Cambrian Ertsberg would be showing.

John Collins has asked for a discussion of the accounting and tax treatment of mine exploration expenditures. I should make the point early that the method of handling these expenditures on the Company's books differs from that which is permitted for Federal income tax purposes. We will turn our attention first to the policies followed with respect to exploration and development expenditures in the book accounts.

Let me start by reading to you footnotes (i) and (j)

to the financial statements in Asarco's published Annual Report for 1972:

> "Exploration expenses - Tangible and intangible costs incurred in the search for new mining properties are charged against earnings when incurred. When a commercial ore body is discovered, the related exploration costs previously expensed are capitalized and credited to earnings."
>
> "Development costs to bring new mineral properties into production and for major programs of a special nature at existing mines are capitalized, and amortized on the ore reserve basis when production begins."

Prior to 1966, all exploration costs incurred on specific projects were charged to deferred expense on the balance sheet pending a determination as to whether the exploration was fruitful. If a commercial ore deposit resulted, the accumulated deferred charges with respect to the deposit were transferred to the property account as part of the cost of the mineral deposit. If a decision was reached to terminate the exploration activities on a project, the accumulated deferred charges on such project were written off in the profit and loss statement. Field office expenses, which are exploration of a general nature,

and on which no specific project appropriation has been requested, were charged to earnings currently.

Commencing in 1966, Asarco altered its accounting policy in regard to exploration expenses, prompted in some degree by Congress' passage of the Ullman Bill, but more particularly by the fact that we were carrying on our Balance Sheet an "asset" which experience had shown would be eventually written off as abandoned projects.

The Ullman Bill permitted current deductibility for tax purposes of domestic exploration expenses except for those outlays made for depreciable property and land acquisition costs. Asarco's new policy adopted in 1966 went beyond the Ullman Bill; the new policy, adhered to since that time, is to charge off currently to profit and loss all exploration expenses with few exceptions. This includes foreign as well as domestic expenditures and also includes option payments, rentals and depreciable property acquisition costs. The field office expenses, written off currently under former policy, continue to be so handled.

When a commercial ore body is discovered, the related exploration costs previously expensed are capitalized and restored to earnings on the books. Obviously, it is necessary to maintain records which identify with particularity the mineral prospects on which exploration expenses are being incurred. Also, detailed record keeping is required in order to identify those items of exploration expense written off on the books which are not deductible in the federal income tax return.

In connection with an exploration activity which may cover broad areas, it is desirable to assign or collect costs against subdivisions or designated target areas within the broad areas. The importance of this point will be brought out later in this paper under the detailed tax discussion of exploration expenses.

When it is determined that any exploration project is without commercial value, any interest or claims should be relinquished and appropriate notice of such relinquishment should be sent promptly to the land owner.

After the existence of a commercial ore body has been ascertained, all further costs are considered as development rather than exploration. Such costs include drilling to define the limits of the ore deposit, drilling to determine appropriate sites for permanent facilities such as a milling plant, removal of waste and stripping of over-burden in preparation for actual mining. More about development costs later on.

There is no need to take the time to go into further details about the book accounting treatment of exploration expenses. You are all familiar with the procedures required in obtaining New York Office appropriations for mineral exploration on specific projects and also with the reporting requirements as monies are spent. In the interest of time conservation, I'd like to move on now to the tax implications and considerations involved in exploration expenses.

There are two sections of the Internal Revenue Code which deal with exploration expenditures paid or incurred for the purpose of ascertaining the existence, location, extent, or quality of any deposit of ore or other mineral. The sections are Sec. 615 and Sec. 617. Neither of these sections applies to exploration expenditures incurred in connection with deposits of oil and gas which are governed by a separate set of tax rules which I do not intend to discuss here today. Everything that I propose to say is concerned with what we generally describe as "hard minerals."

As to Sec. 615, I will say that the tax rules thereunder are applicable only with respect to expenditures paid or incurred prior to January 1, 1970. Hence, I will not spend time on the details of the Sec. 615 provisions. So, we zoom right in on Sec. 617.

Under Sec. 617, a taxpayer is allowed an unlimited current deduction for exploration expenditures paid or incurred with respect to mineral prospects located in the United States or on the Outer Continental Shelf. The Sec. 617 allowance is not applicable to foreign exploration except in the case of a taxpayer who has not previously utilized in full the $400,000 maximum allowance provided for under Sec. 615. Inasmuch as Asarco long ago used up this $400,000, the exception is inapplicable and only domestic exploration expenditures qualify for Sec. 617 treatment in the case of Asarco.

You will recall that in discussing the treatment of exploration expenditures on the books, we stated that all such outlays are written off currently without regard to whether they are incurred domestically or on foreign mineral prospects. We must give consistent, uniform accounting treatment to like assets or transactions. When the Federal tax return is prepared, foreign exploration expenditures on prospects not dropped but still actively under examination must be deferred and may not be written off for tax purposes unless and until each prospect is dropped.

The allowance of an unlimited current deduction for domestic exploration expenditures is subject to a "recapture" provision in the case of any mineral prospect which ultimately becomes a producing mine or is sold. The recapture may be made in either of two ways, at the election of the taxpayer, as follows:

(A) If a mineral prospect becomes a producing mine, in the year in which such mine reaches the producing stage, the taxpayer may include in gross income for such year the entire amount of the previously deducted exploration expenditures; or

(B) The amount of any percentage depletion otherwise allowable with respect to any mine on which exploration

expenditures have previously been deducted shall be disallowed until the total disallowed depletion is equal to the exploration expenditures deducted on such mine.

In general, the second of the two choices will be elected by a taxpayer, that is, foregoing percentage depletion on a property after it comes into production, since usually the recapture period through this method can be spread over two or more years. In addition to the extended tax deferral period permitted by this option, there is the possibility in the case of a marginal mine that the percentage depletion deductions may never equal the amount of the exploration expenses previously deducted. If the taxpayer elects the first alternative, namely, the inclusion of the exploration expenditures in gross income for the year in which the property goes into production, he may find that the mine may have to be shut down before his aggregate depletion deductions equal the amount of the exploration expenses. Thus, if exploration expenses to be recaptured were $1,000,000 and depletion is running about $100,000 annually, at the end of three years, $300,000 will have been recaptured under the (B) alternative above. If the mine is then shut down, the remaining $700,000 does not get recaptured until production is resumed and depletion begins again. Of course, if the (A) alternative is adopted, the inclusion of the exploration expenses in gross income increases the basis of the property and in the event of sale or abandonment of the property, the higher basis

would provide tax benefit through a greater loss (or smaller gain).

In the case of a sale of a mineral prospect on which exploration expenditures have been written off for tax purposes, the amount of any gain resulting from the sale must be treated as ordinary income up to the amount of the exploration expenditures previously deducted and only the balance of the gain is eligible for capital gain treatment.

In the earlier discussion of how exploration is handled for accounting purposes, the statement was made that it was important to accumulate costs and expenses against small target areas or subdivisions within broader areas of exploration activity. Let us assume a broad area of mineral interest which covers several hundred square miles and an exploration program involving several hundred thousand dollars. If the whole area consists of five or six groups of claims, it would be important to apportion the total costs of the program among the five or six groups of claims. It may ultimately turn out that only one group yields a commercial ore body. In such a case, perhaps the prospecting rights with respect to the four or five other groups of claims can be relinquished and the accumulated costs of exploration thereon which have been deducted in the tax return (assumes domestic exploration) will not be subject to recapture. Without the apportionment of the total exploration costs among the five or six groups of claims, however, Internal Revenue Service could argue that the whole area consisted of a single area of interest and that all the costs were attributable

to the one commercial deposit found, thus making all of the costs recapturable. The same apportionment of costs among segments of an exploration program over a large area is desirable in the case of foreign prospecting in order to be able to write off and deduct the costs applicable to the non-productive segments.

Thus far, I have spent time discussing the treatment of exploration expenses on the books of account and in the Federal income tax returns in a manner which assumes that we all know what exploration expenses comprise. I guess that the accountants, the geologists and the tax specialists could all agree that diamond drilling, certain mapping, soil sampling, aerial photography and a host of other activities are embraced in exploration costs. But the perplexing part of the matter is that many of these same activities may also constitute mine development! So how can any of us be sure whether we are talking about exploration expenses or mine development expenses?

Back in January, 1966, I prepared a memorandum for Mr. Collins on this subject of distinguishing between exploration and development expenses. I reviewed this memorandum just last week and found that in large part, it is still applicable today in spite of the enactment of the Ullman Bill; inasmuch as I wrote it, I will presume to commit plagiarism and reiterate parts of that memorandum.

Under the U.S. tax laws all expenditures prior to ascertaining the existence of ores and minerals in commercially marketable quantities are considered to be exploration expenditures. All expenditures made after ascertaining the existence

of ores or minerals in commercially marketable quantities are classified as development expenditures.

At the election of the taxpayer, development expenditures, whether in the pre-production or production stage of any mine, may be written off currently for U.S. tax purposes or deferred and amortized ratably as the units of the produced ore or minerals benefited by such expenditures are sold. The election provided under the Internal Revenue Code is a very liberal one in that it may be made "mine by mine" and "year by year." In other words, a taxpayer may elect in any year to write off development expenses on one mine and to defer development expenses on another mine. In the next year, he may elect to do just the opposite with respect to development expenses incurred on the same two mines.

Just as in the case of exploration expenditures, for tax purposes, development expenditures do not include items of a character subject to depreciation. However, depreciation expense on property used in exploration becomes an element of exploration expense and so too, depreciation expense on property used in development is considered part of such development expense.

We have pointed out earlier in this paper that Asarco's policy on exploration expenditures is to charge them all to profit and loss on the books currently, whether foreign or domestic, tangible or intangible. Asarco's policy with respect to pre-production development expenditures on the books

is different. We are now dealing with an asset, a commercial ore body, and therefore all such expenditures are capitalized in an account called Mineral Land No. 2 and they are amortized as the ore uncovered by the development costs is mined and sold. Development expense at operating properties is ordinarily written off to profit and loss currently on the books, although occasionally extraordinary development expenditures even at a producing mine may be deferred and amortized if the development work consists of expenditures which will open up ore reserves which will be mined over a substantial future period such as 10 years.

For tax purposes, generally taxpayers will elect the current deduction of development expenditures rather than deferral and amortization. This is because the deduction may be applied against taxable income from other sources thus producing immediate tax benefit. In addition, getting the development expenditures written off currently means that there will be no amortization charges against net income from the property for purposes of percentage depletion after the property goes into production, thus increasing the depletion allowance in those cases where the allowance is limited to 50% of net income.

The question of when a mining prospect passes from the exploration stage to the development stage is an area of great controversy between taxpayers in the mining industry and the Internal Revenue Service. The reason, of course, is that even though both exploration and development expenses may be

deducted, exploration expenses must be recaptured as previously explained, but development expenses are not recapturable. Obviously, it is to the advantage of the Internal Revenue Service to take the position that the exploration stage was of longer duration than the taxpayer asserts.

Under the tax regulations, the development stage of a mine is deemed to begin at the time when, in consideration of all the facts and circumstances (including the actions of the taxpayer), deposits of ore are shown to exist in sufficient quantity and quality to reasonably justify commercial exploitation by the taxpayer. The phrase "including the actions of the taxpayer" is very important; it is based on the old adage that "actions speak louder than words." Among taxpayer actions helping to establish that a property has passed from the exploration stage to the development stage are the following:

(1) If there is an option to purchase the property, the exercise of such option as early as possible, consistent with prudent conclusions as to the favorable nature of the deposit.

(2) Submission of a report by the geologist in charge of the project setting forth estimated ore reserves, assays, estimated tons of recoverable metals, together with an opinion that the property can be operated profitably at certain metal prices.

(3) Commencement of stripping operations or the sinking of a shaft.

(4) Construction of access roads.

(5) Designing of the pit and a plan for mining the ore.

(6) Engineering work for construction of a mill and auxiliary facilities.

In any event, it is to the taxpayer's advantage to assert the earliest possible defensible date, within the intent of the tax statute, for the commencement of the development stage of a mine because it gives the taxpayer a better starting point in the bargaining and compromise negotiations which customarily take place with the Internal Revenue Service in this realm of settling tax liability.

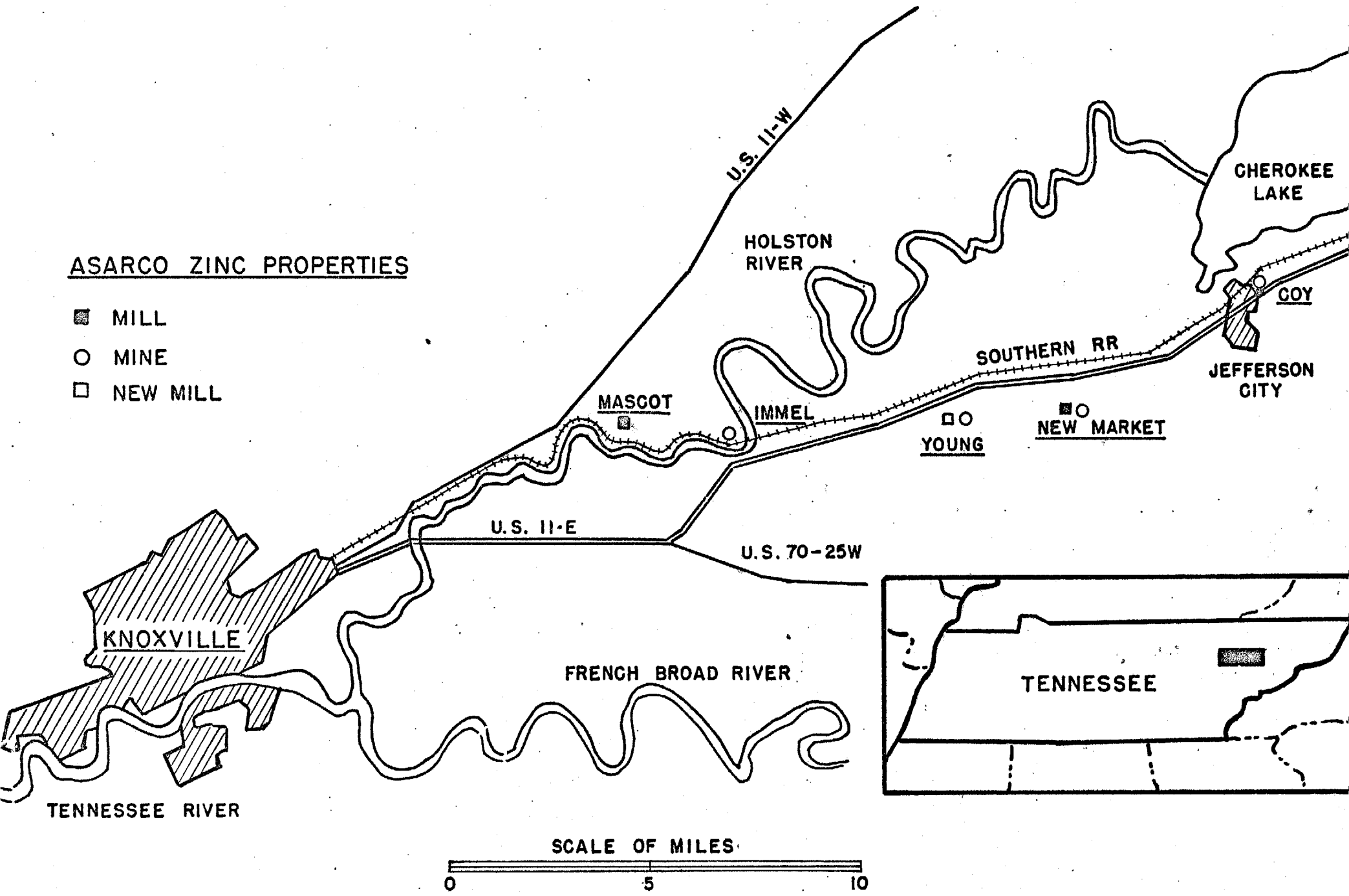
Gentlemen, I think it's time I stopped this discourse. Everything that I have said is concerned with the every-day, pedestrian housekeeping chores of recording exploration expenditures in a careful manner. This is necessary so that Asarco can report your work correctly to the shareholders in its financial statements and also to facilitate the maximum utilization of provisions of the U.S. Internal Revenue Code which, either through permanent tax savings or tax deferment, can result in the availability of more working capital for you to carry on your search for new mineral deposits. Only you can bring in the new Silver Bells, the new Missions, the new Galenas. But we in the Comptroller's Department can help

by making Asarco's exploration dollars stretch farther through proper accounting and tax handling of expenditures thereon.

YOUNG UNIT

ANNUAL EXPLORATION MEETING

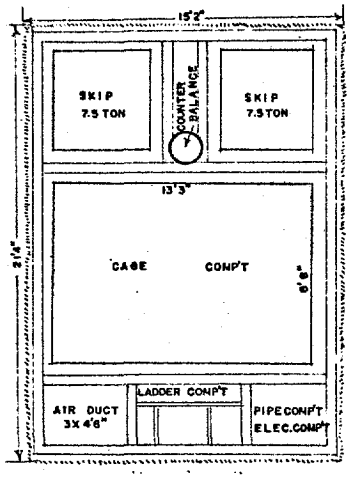
APRIL, 1973


ASARCO ZINC PROPERTIES
MILL
MINE
NEW MILL
U.S. 11-W
HOLSTON RIVER
CHEROKEE LAKE
COY
SOUTHERN RR
JEFFERSON CITY
MASCOT
IMMEL
YOUNG
NEW MARKET
U.S. 11-E
U.S. 70-25W
KNOXVILLE
FRENCH BROAD RIVER
TENNESSEE RIVER
TENNESSEE
SCALE OF MILES
0
5
10

Collar 1012.07

NOTE: ELEVATION BASED ON SEA LEVEL DATUM OF 1929

HOISTS ALLIS CHALMERS 600h.p
ORE. DOUBLE DRUM OPERATING 2
SHIFTS @ 1850 TONS/SHIFT
CAPABLE OF HOISTING 2000 TON/SHIFT
IN 2-7½ TON BOTTOM DUMP SKIPS
MAN & MATERIAL HOIST DOUBLE DRUM
OTTUMWA 450 h.p.
COMPRESSORS
3 INGERSOLL RAND XLE 400h.p 2060CFM
2 JOY CLASS WN112 150h.p. 787CFM
1 JOY CLASS WN224 400h.p. 2080CFM
1



PLAN VIEW

412 Level EL=412.07

356 Level EL=356.07

Ore & Waste Transfer Raises

276 Level EL=276.07

2-1225 G.P.M Centrifugal
& 1-150 G.P.M Pomona
for Shaft

204 Level EL=204.07

350,000 Gal
Sump

200 Ton Skip Pocket

Lip of Chute = 148.0

Skip Pocket
EL=144.0

2-1225 G.P.M
Centrifugal Pumps

Skips - 2- Lake Shore Eng
Co Bottom Dump
150 Cu ft Cap (7½ Tons)

PUMPING @ RATE OF 200 GPM
NO FLUCTUATIONS
1

Bottom of Shaft = 76.0

LOOKING NORTH

LOOKING WEST

REV 1 3-10-64 HOIST & DUMP DATA ADDED

ASARCO
MASCOT TENNESSEE
SECTION THRU YOUNG SHAFT
Scale 1" = 60FT Date Feb 26, 64
DWG No YC401DL File No DL-63

Shaft 936' deep starting at 1012' Elev

Level above sea level

Production 3500 tons/day of 3% Zn lead free but yellow sphalerite

Young mine 30,000,000 ton reserve

? 50+ million down to 2500 ft below surface

± 300,000,000 ton total prob. reserve for entire district

YOUNG MINE UNIT

MINING METHODS AND EQUIPMENT

cut-off of 2½% Zn

Young Mine has been developed for open stoping, using diesel powered Load-Haul-Dump units to transport broken ore to storage millholes for gravity transfer to a rail haulage system below the stoping areas. Rail haulage on a radial pattern is tributary to a single hoisting shaft near the center of the mine. Down-dip ore below rail haulage levels on the flanks of the domal ore zone is elevated and moved into the central mining and haulage area on long 48-inch, cable suspension, belt conveyors.

Mining is done in six stages:

1. Development for mining by driving an extension of the main haulage system under a new mining section, driving 2 raises between haulage and stoping levels (one raise for ore storage and transfer, and the other for ventilation), extending track or conveyor past the transfer raise, construction of an ore transfer chute at the throat of the transfer (millhole) raise, reaming the transfer raise for storage capacity, building an electric power substation for fans, pumps, etc., and establishing a forced ventilation loop through the air raise by means of a permanent brattice and fan installation.

2. First mining cut 12-ft. high, 40 ft. wide rooms, 40 ft. diameter pillars, at approximately the same elevation as the millhole — room headings are advanced by slabbing to a cut.

3. Longhole (percussion) Drilling is used to determine the vertical extent of ore above and below the 12' first mining cut, and to probe for lateral extensions of completed first mining cuts.

4. Backstoping (shrinkage) is carried up in successive horizontal slices to the top of the ore, starting from the completed first cut, retaining most of the broken ore in the stope as a drilling and roadway base. Upon reaching the top, the back is scaled and often rockbolted for safety in subsequent operations.

5. The accumulated backstope ore is removed in varying daily amounts in tonnage needed to regulate overall daily production at a constant level.

6. Benchstoping of remaining ore below the first cut is done in a series of horizontal benching slices, using horizontal blastholes, after backstope ore has all been removed.

Drilling And Blasting

The usual drilling crew consists of two men, one of whom operates a diesel-powered two-boom drill jumbo, and the other an airleg which is carried on the jumbo. Most holes drilled are horizontal or of flat inclination, approximately 1¼" diameter, 10 ft. deep, and drilled with Atlas-Copco integral drill steel.

Most jumbo drilling consists of slabbing or benching to the open stope or to a vee-cut provided by the airleg man. The airleg man scales, helps set up the jumbo, drills "block" holes for secondary breakage, drills cut holes and some slabbing holes, and helps load and connect wires for the blast and move the equipment out. Each production stope face drilled is loaded to blast at the end of the same shift by the drilling crew. Electric blasting connections are also made by them, but the actual blast is made by a foreman after shift when men have been checked out of the working areas. Similar jumbo equipment and practices are used in drift development. Short-legged airlegs are used for raising.

Load-Haul-Dump

All production loading at Young is done with diesel-powered Transloaders at the present time. One TL-72 and two TL-70s do most of the loading on hauls up to 1400 feet. The remainder of the loading is done with TL-55s, which are obsolete models in process of replacement. Two Scooptrams are used exclusively for development, primarily on declining drifts. The TL-55s are well adapted to stope level development and are used for that purpose also.

Main Haulage

Ten-car motor trains are operated on two levels (356 & 204). Both trolley and diesel locomotives are used on these levels, but only one train on a level at any one time for safety reasons. Sixty pound rails with Thermite welded joints is laid on 48" gauge and ½% grade in favor of the load. Cars are Sanford-Day automatic bottom dumping self-cleaning types. Some are 11-ton and some 8-ton, but the 8-ton cars are scheduled for conversion to the larger size. Twenty-one haulage chutes feed the radial rail haulage systems on the two levels at the present time. Maximum hauling distances at the four radial extremeties of the system run from 2/3 to 1-1/8 miles. Conveyor belt haulage extends the system southwest another 3600 ft. downhill at 10% grade, for a total running distance of approximately 1-2/3 miles in this direction. Another belt haulage conveyor, half completed, will eventually extend the system 2300 ft. downhill to the southeast at 11% grade for a total distance of 1¼ miles from the shaft in that direction. A third conveyor, running 2000 ft. northwest at 15% grade, has recently been completed and will deliver ore and waste directly to the shaft pocket system. A second 2000 ft. conveyor in sequence with the first will eventually extend this conveyor gallery to 4000 ft. from the shaft and take ore from levels down to -132 elevation. All rail haulage loading points are served by steel pneumatic arc-undercut-gate chutes, and conveyor loading points are equipped with vibrating feeders for uniform belt load. All ore and waste is handled mine-run through 32" millholes. There are no crushers anywhere in the system. Conveyors are remote-controlled from loading points and equipped with closed-circuit TV for transfer-point monitoring. Additional rail haulage is contemplated at deeper levels to feed the conveyors.

Boyd W. Venable

YOUNG MINE UNIT

MINING AND DEVELOPMENT EQUIPMENT

Drilling Equipment

43 Joy T300 3-1/8" Drifter Drills
2 GD AR93 3½" Drifter Drills
18 Atlas-Copco BBC-15 Airleg Drills
16 GD S48 Airleg Drills
8 Two-Boom Jumbos, Crawler Mounted
4 Two-Boom Jumbos, Truck Mounted
1 Two-Boom Jumbo, Transloader Conversion (under construction)
4 Joy Air-Powered Two-Boom Drillmobiles (obsolete)

Load-Haul-Dump Equipment

1 Joy TL-72 Transloader
2 Joy TL-70 Transloaders
1 Wagner ST5-A Scooptram
1 Wagner ST5 Scooptram
10 TL-55 Transloaders (4 TL5.5 Sanford-Day-Scoopmobiles, 4 Sanford-Day TL5.5, 1 Joy TL55, 1 Joy TL55-3)

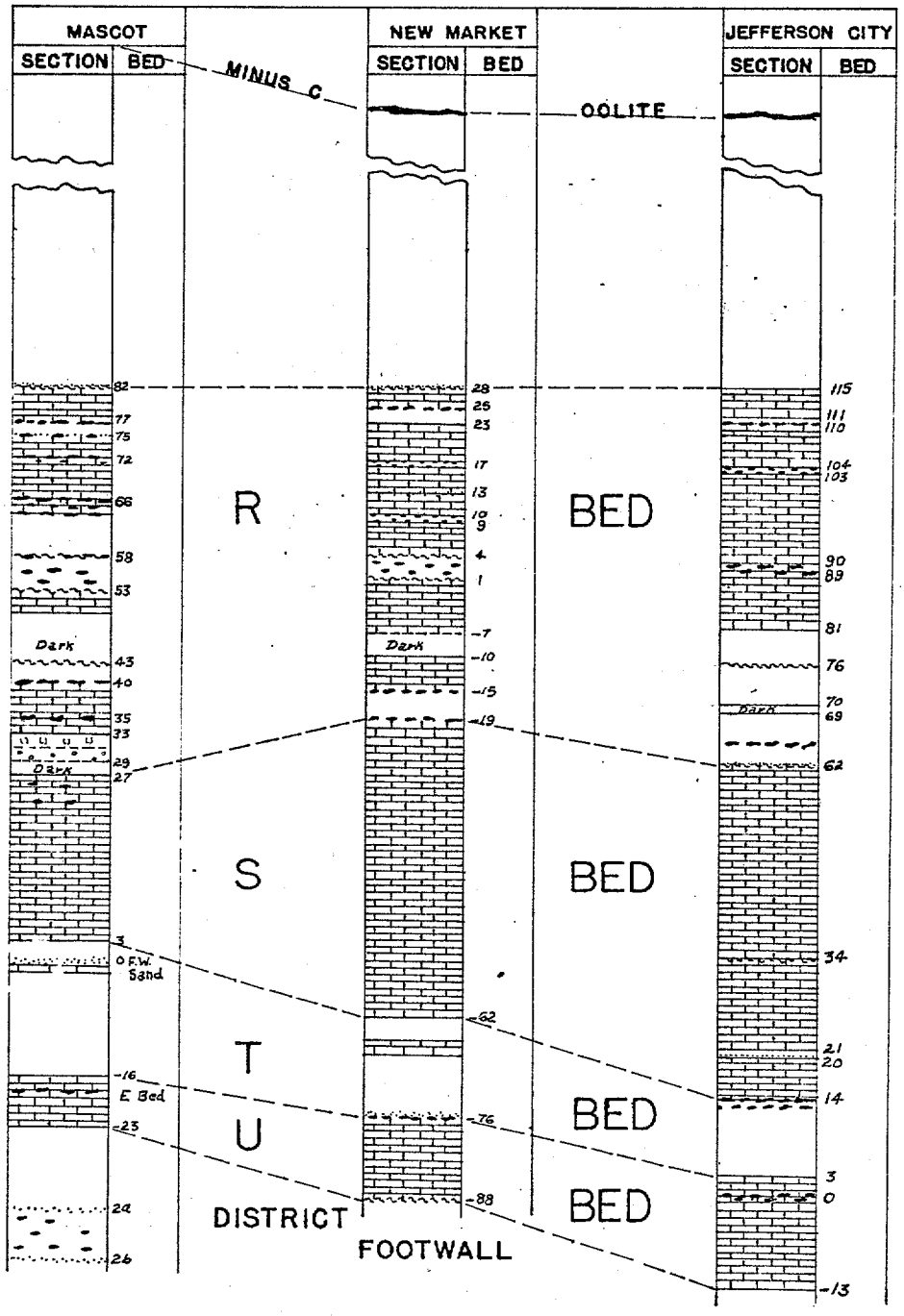
Haulage Equipment

3 13-Ton Trolley Locomotives, GE & Westinghouse
1 Plymouth 12-Ton Diesel Locomotive
21 Sanford Day 11-Ton Drop-Bottom Mine Cars
27 Sanford Day 8-Ton Drop-Bottom Mine Cars
1 Continental 1835 ft. 150 HP 48" Belt Conveyor (71-76 Gallery)
1 Continental 1315 ft. 200 HP 48" Belt Conveyor (85-15 Gallery)
1 Continental 2000 ft. 200 HP 48" Belt Conveyor (14-48 Gallery)
1 Continental 886 ft. 150 HP 48" Belt Conveyor (71-76 Gallery)
5 Carman Vibrating Feeders, 60" x 84"
3 Sanford Day Cardumping Tipples
1 Sanford Day "Piggyback" Ramp

Miscellaneous Mobile Equipment

6 Ford 4400 Tractors With Pickup Truck Beds
4 Ford Tractors, Various Old Obsolete Models
1 Caterpillar D4D Bulldozer
1 Allis Chalmers DD Grader
1 Pitman 75HDH Aerial Platform
1 Caterpillar Traxcavator
2 Old Allis Chalmers HD-5 Tractors - Sealing Rig
1 Old Allis Chalmers HD-5 Tractor - Pipe Rig
1 KW Truck (not in use)

TABLE I BASIC SECTIONS OF G-28 TO T BED ZONE



SCALE:
1 INCH = 20 FEET

EXPLANATION:
- DOLOMITE
- LIMESTONE
- DOLOMITIZED LIMESTONE
- SAND
- CHERT

Geology of the Mascot-Jefferson City Zinc District

Commercial zinc (3.00%) occurs, intermittently, through a strike belt of more than 20 miles from Mascot northeastward to Jefferson City. The district lies within the Appalachian Valley and Ridge province.

The ore, which is pre-Appalachian in age, is found principally in the lower half of the Kingsport formation which belongs to the well-known Knox Dolomite group. The formation, which is Lower Ordovician in age, consists of inter-bedded primary dolomites and limestones. Sphalerite is virtually the only ore mineral present, but it is often associated with secondary "white gangue" dolomite, pyrite, some fluorite and barite and occasionally an abundance of silica in the form of chert or jasperoid.

The ore bodies are irregular in shape and occur in altered limestone, locally called "recrystalline", and fractured dolomites. The collapse-breccia structures were developed as the S and R bed limestones underwent alteration and solution. Volume reduction, caused by dissolution of the limestone, removed the underlying supports and permitted the overlying beds to fracture and collapse. The zinc occurs mainly as open-space filling between breccia blocks and as replacement in bedded recrystalline.

IMMEL

The ore body at the Immel Unit is located on an east-west trending anticlinal structure. The east end of the anticline plunges to the northeast into the Strawberry Plains syncline or basin. The nose of the structure is displaced horizontally to the north by a major water-bearing fault. Formational dips of up to 30 degrees have been observed to date.

Mineralization is associated with a broad expanse of altered S bed, reflecting a modified low domal structure. The ore appears to "top-out" in most cases against the M-82 bed (top of R). Additional mining has occurred within the U-bed. Sphalerite is accompanied by a large amount of interstitial pyrite and occasional pockets of galena.

YOUNG

The Young Unit is situated atop of a domal structure known as the Hodges dome. The dip of the structure is about 10 degrees around its periphery. It has been displaced downward on the north flank by a high angle, post-ore, reverse fault (Cold Water Fault) with a vertical displacement of approximately ± 100 feet.

Mineralization ranges stratigraphically from near the top of the S bed to 30 feet above the R bed. Occasionally, mineralization proceeds into the upper post-R beds to the -C horizon, reflecting the high domal structure so typical of Young.

NEW MARKET

The New Market Unit is structurally located on the eastern flank of the gently plunging New Market syncline, with an average dip of 7 degrees to the west. The syncline includes both the hangingwall and footwall blocks of the Rocky Valley thrust fault.

Mineralization extends from the lower R bed (G -7/10) upward 30 to 40 feet into the Post-R beds. The structures are similar to Young (high domal) except they are narrower, resembling stoped out channel ways.

COY

The orebody at the Coy Unit is located on the southeastern flank of the Cherokee anticline. Local dip averages 10 degrees to the southeast. Although Coy is by far the smallest unit, it contains the highest grade (4.00% Zn.)

Better than 50 per cent of the mining has been in the U bed, the lowermost limestone unit of the Kingsport. Narrow V-shaped ore shoots occur in the U bed, and if alteration and solution are intense enough mineralization will move into the overlying S and R beds, creating breakthroughs.

APPENDIX

Young Mine Tour

Stop No. 1: G.S.A. Stope

This small stope exhibits several important characteristics that are typical of the ore-bearing structures at Young mine. The stratigraphic sequence exposed within this stope ranges from the G-9/10 bed at the floor to the G-17 bed near the back. Breccia blocks of the G-28/34 bed can be observed on the north rib.

Several features to be noted in this stope are:

1. The collapse breccia and its relationship to the recrystalline limestone edge.

2. The prominent lineation of fractures in the back and their relationship to the edge condition.

3. The limestone-recrystalline edge and the mineral occurrence at the edge within the recrystalline.

Stop No. 2: 67-20 Stope

This stope is part of one of the most extensively mineralized areas encountered at Young mine. It is at the apex of the Hodges dome. The stratigraphic section exposed in this stope ranges from the G-9/10 bed to the -C horizon. The map of the mine shows how this stope is related to the limestone-recrystalline edge.

The important characteristics exhibited within this stope are:

1. The progression of brecciation away from the limestone recrystalline edge from light mosaic breccia to heavy rubble breccia.

2. The pronounced "shears" exposed in the pillars and their relationship to the limestone-recrystalline edge.

3. The occurrence of the zinc mineralization within the "shears" and the rotated breccia on the north rib. Oxidation present is due to a water-bearing fault 20 feet to the north.

Stop No. 3: 86-13 Stope

This stope is located near the center of a broad, high domal structure. Significant. high angle shears on the north (right) rib are associated with a relatively small limestone island within the larger structure. Mining is progressing to the northwest toward a massive limestone edge.

Features to be noted in this stope are:

1. The strong shearing in the back and north (right) rib.

2. The mineral occurrence in respect to the shearing.

3. The stratigraphically higher units within the Post-R beds.

4. The overhand or backstoping mining method being used.

AMERICAN SMELTING AND REFINING COMPANY
YOUNG UNIT
SCALE: 1" = 600'
DATE: 4-8-73
CODE
LIMESTONE
CONTOURS
FAULTS
COLD WATER FAULT
MCCORMICK FAULT
NEW JERSEY FAULT
BIG MUDDY FAULT
HEIM FAULT
CANNON FAULT
SHAFT
204 W
3 NE
40 N
65 39 W
65 39 E
S-2000
S-3000
S-4000
S-5000
S-6000
S-7000
S-8000
S-9000
W-8000
W-7000
W-6000
W-5000
W-4000
W-3000
W-1000
ZERO
E-1000
E-2000

J D Sell

February 9, 1973

Attendance expected at
Asarco Exploration Department Meeting
April 8-11, 1973, Holiday Inn Northeast, Knoxville, Tenn.

NEW YORK OFFICE
C. F. Barber, R. L. Hennebach, T. A. Snedden, A. J. Gillespie, M. B. Hecox, W. P. Roe, H. Q. Stringham, J. J. Collins, T. C. Osborne, J. V. Desvaux. Guest: Mr. J. W. Foots

No. Amer. Mining Dept.
N. Visnes

Chief Geologist
J. H. Courtright*

Eastern Mining Dept.
R. J. Kupsch

Tennessee Mines Division)
American Limestone Division) Staff

Knoxville
D. D. Harper*, J. N. Biery*, W. L. Hatfield, M. D. VanGaasbeek

Tucson
W. L. Kurtz*, J. D. Sell*, F. Graybeal, J. R. King

Spokane
K. Whiting, J. Balla*, G. W. Prescott*

Denver
R. K. Kirkpatrick, S. Von Fay*, W. G. Hoskins*, A. V. Greene*

Salt Lake Exploration
M. P. Barnes*, J. R. Wojcik*

Exploration Services
R. J. Lacy, C. K. Moss, L. D. James, J. R. Montgomery

Vancouver
S. A. Anzalone*, R. E. Gale*, M. F. Lancaster*

Toronto
R. L. Brown*, U. Abolins*, R. N. Kervin*, E. B. Nicholls

Europe
R. B. Sprague*, J. J. Merz*, J. J. Sample*

Australia
D. M. Fletcher*, M. Kriewaldt*

Latin America
L. P. Entwistle

Mines

Mt. Isa	- B. Mathias
Buchans	- E. A. Swanson and E. Perkins or K. Larsen
Coeur d'Alenes	- S. H. Huff
Leadville	- W. G. Salisbury
Silver Bell	- C. E. Beverly
E. Tennessee	- J. E. McCormick*, R. Greene*, J. Fox*, F. Rasnick, V. L. Hendrix
Limestone Div.	- S. N. Cameron*

* indicates speaker

2/9/73

PROGRAM - ASARCO EXPLORATION

April 8 — Sunday 2-5:30 PM - East Tennessee Mine Geology

1. J. E. McCormick - Geology and reserves
2. J. Fox - Application of Geology to Mine Development
3. R. Greene - Mineral paragenesis
4. J. N. Biery - Ore guides in East Tennessee Mines
5. D. D. Harper - Mid-Tennessee Ore Guides

Sunday 7-9 PM - Mineralization in Carbonate Rocks outside Tennessee

1. A. V. Greene - Colorado
2. J. J. Sample - Ireland
3. J. J. Merz - Spain
4. M. P. Barnes - Park City, Utah

April 9 — Monday 8 AM-Noon

A. Carbonate ore continued
   1. J. J. Sample - Ireland
   2. J. J. Merz - Spain
B. Australia
   1. M. Kriewaldt - Recent major projects
   2. D. M. Fletcher - Future exploration

Monday 1:30-5 PM

A. Western Canada
   1. R. E. Gale - Metallogeny of Western Canada
   2. S. A. Anzalone - Porphyry copper exploration
   3. M. F. Lancaster - Asbestos exploration
B. Eastern Canada
   1. R. L. Brown - Exploration Significance of New Metallogenic Concepts in the Canadian Archean
   2. U. Abolins - Exploration Opportunities in the Canadian Archean Greenstones
   3. R. N. Kervin - Exploration for Asbestos in Eastern Canada

Monday 7-9 PM - SW USA

1. W. L. Kurtz - Exploration Program
2. J. D. Sell - Gravity Sliding vs Normal Faulting in the Miami District

April 10 — Tuesday 8 AM-12:30 PM

A. Northwestern USA
   1. J. Balla - Exploration Program
   2. G. Prescott - Asbestos in No. California
B. Rocky Mountains
   1. S. Von Fay - Exploration for Porphyry Copper
   2. W. G. Hoskins - Our Fluorspar Program
C. Salt Lake
   1. M. P. Barnes - Geologic Computer Programs
   2. J. R. Wojcik - Nome, Alaska - Gold distribution
D. Europe
   1. R. B. Sprague - Exploration Program

Tuesday Afternoon (If strike persists, otherwise in AM)

Underground in the Immel Mine, preceded by Mine Geologist's Illustrated talk

Tuesday - 7-9PM

Symposium on Mineralization in Carbonate Rocks

April 11 — Wednesday AM

Underground in New Market Mine, preceded by Mine Geologist's Illustrated talk

Wednesday Noon and Afternoon on Tennessee River

1. S. N. Cameron - Aggregates

Wednesday Evening - Unscheduled - End of Meeting

INTERPRETATION OF A COMPLEX DISTRICT

GLOBE-MIAMI DISTRICT, ARIZONA

Talk to be Presented at
Knoxville, Tennessee
ASARCO Exploration Meeting
April 9, 1973

by James D. Sell

INTRODUCTION

Slide One ~~& Handout Sheet~~

The Globe-Miami district in central Arizona (Slide One), shown in diagonal lines on the slide, is one of Arizona's earliest mining areas, having been established in 1878 when silver and gold were found in the Globe area. Soon thereafter, in 1882, copper became a mineable commodity and numerous vein deposits were opened in the Globe area. The most productive of these was the Old Dominion Mine.

Westward, six miles across an alluvial covered valley, the Miami area was also prospected and claims established, but production lagged as the value was primarily copper and, being disseminated in schist and porphyry, the copper values were of a much lower tenor than found in the vein deposits of the Globe area.

However, by 1911, testing by drilling and sampling of the disseminated deposits had established 14 million tons of 2.75% copper ore in the Miami Copper Company area and 45 million tons of 2.0% copper ore in the adjacent Inspiration Copper Company area.

Also shown on the slide is the adjacent area of the ASARCO Superior East Project which has been discussed at previous meetings.

PRODUCTION AND RESERVES

Table One Handout Sheet

Since the early development, a number of mines have been established within the Globe-Miami district. Table One, on your hand-out sheet, is a list of the productive deposits grouped in three subdistricts. The Table lists the year of major activity or discovery, the recorded production, reported reserves, and additional estimated reserves. The distribution (Slide Two) of these deposits and subdistricts is illustrated on the slide along with the subdistrict copper production and reserve figures.

Slide Two

Slide Three As can be seen on the Table One, the eastern (Slide Three) or Globe subdistrict is mainly vein deposits with lead and silver production along with the copper. The Globe subdistrict has produced 940 million pounds of recovered copper from 9.6 million tons of ore. As noted, Table One, the bulk of the copper production is from the Old Dominion Mine which produced 765 million pounds of copper. The remaining 175 million pounds of copper came primarily from the same northeasterly trending fault system. Interestingly, the silver to copper ratio increases to the northeast.

No reported reserves exist in the subdistrict and only the Old Dominion Mine is thought to have any potential reserves. Some 40 million tons may be as disseminated values in diabase near the vein system.

Slide Four To the northwest (Slide Four) is the Cactus-Copper Cities subdistrict which has produced one billion 242 million pounds of recovered copper from 98 million tons of ore. The subdistrict has 407 million tons of reported ore reserves, with an additional 647 million tons of estimated reserves.

Slide Five In the Miami (Slide Five) subdistrict, located in the south-central part of the area, some 6 billion 895 million pounds of copper have been produced from 417 million tons of ore. The subdistrict also has a reported reserve of 432 million tons of ore with 620 million tons of estimated additional reserves.

The Globe-Miami district between 1878 and 1953 had produced its first billion dollars of total value metal production and now is well along on its second billion dollars. The reserve picture suggests that the third milestone is a reality.

Slide Six Three other mines have been added to the list for comparison purposes (Slide Six). The vein and limestone replacement deposits of Magma Copper at Superior, located twelve miles to the west, have recovered one billion 700 million pounds of copper from 16 million tons of ore. The impressive Ray deposit, sixteen miles to the southwest has produced 4 billion 337 million

pounds of copper from 217 million tons of ore. The San Manuel mine, 50 miles to the south, has produced 2 billion 489 million pounds of copper from 189 million tons of ore. The latter two deposits are disseminated porphyry deposits with impressive reported reserves.

Slide Seven

Shown on the next slide (Seven) in green is ASARCO's joint venture land position and two drill hole locations in the Miami area. More will be said about this area later.

ASARCO's ENTRY

ASARCO's entry into the Miami area was sparked by geologic studies conducted around the exposed premineral edges of the Superior East Project area. (These studies included work by Friel (1971), Clyde Rees (1971, 1972), John King (See Rees), Fred Graybeal (1971a, 1971b, 1972) and myself (1972a) of the ASARCO staff.)

Through a literature study of the district, primarily Ransome's USGS Professional Paper #12 (1903) and #115 (1919), Peterson's USGS Professional Paper #342 (1962) and Clary's thesis (1970), coupled by several tours of the various open pit operations, it was apparent that low-angled fault movement may have been more important in the district than previously suspected (Sell, 1972b).

Slide Eight

Slide Eight is a photo of Peterson's Globe-Miami geologic map. Previously documented blocks involving movement along low angled planes include one of Precambrian Madera diorite (1540 m.y.) moved over Late Tertiary Dacite (20 m.y.) in the Old Dominion area. Westward, several plates are known and one includes the Cactus-Carlota mineral deposit where a small chalcocite ore body has been truncated and transported to its present position. The root area is still undiscovered. At Cactus-Carlota the moved unit is Precambrian Pinal Schist (1715 m.y.) overlying Pinal Schist and Precambrian diabase (1140 m.y.).

Adjacent to the block is another segment in which Pinal Schist overlies mid-Tertiary Whitetail Conglomerate (35 m.y.).

In three of the ASARCO drill holes in the Superior East Project, located southwest of the map, blocks of Tertiary Schultze Granite (58 m.y.) and/or Precambrian Pinal Schist were found in flat fault relationships with Whitetail Conglomerate. In the two holes with Schultze Granite, one block was 80 feet thick, while the other was 188 feet in thickness, and both were overlain and underlain by Whitetail Conglomerate. The one block which was totally cored revealed sedimentary deposition of the Whitetail on the top of the block, but the base of the moved block, as well as the adjacent Whitetail, was brecciated and sheared by the movement.

IGNEOUS GEOLOGY

The Miami-Globe district, as shown on the slide, is in the contact zone between Older Precambrian Pinal Schist (1715 m.y.) on the south (south of Sleeping Beauty fault) and Older Precambrian Ruin Granite (1420 m.y.) on the north (north of Sleeping Beauty fault). Younger Precambrian Manitou Granite and Solitude Granite (800 m.y.) were then intruded along this zone in the schist side. Note that the Manitou Granite occurs in two separated areas along the northeast trend.

In Early Tertiary time (See Balla, 1972, for discussion of relationship of Laramide stocks to structure) igneous activity resumed with the intrusion of the Willow Spring Granodiorite. Again note that four outcrop areas of Willow Spring are found in a northeasterly trend with the eastern two having a stippled border phase. As noted in Peterson's Professional Paper #342, the eastern border phase tends to overlie with gently dipping contacts on the main phase, whereas the middle outcrop has a steeper contact between the two phases. No border phase is noted around the western two exposures.

Another granodiorite, the Gold Gulch, is found in the Castle Dome area.

The Lost Gulch Quartz Monzonite (62 m.y.) was next in the sequence and is the major host for mineralization in both the Copper Cities and Castle Dome areas. The intrusive is an extensive mass colored light green on the map. The mass at Castle Dome intrudes part of the Gold Gulch Granodiorite. South of Castle Dome is another outcropping area of Lost Gulch Quartz Monzonite and here it intrudes part of one of the masses of Willow Spring Granodiorite.

Minor Diorite Porphyry dikes appear to be next in the sequence and occur in the Copper Cities areas where they intrude the Lost Gulch Quartz Monzonite.

The largest intrusive mass in the district is the Schultze Granite (58 m.y.) and its outline and axial elongation follows the northeasterly trend previously established. The Schultze is colored reddish on the map. In general the Schultze was emplaced into the Precambrian Pinal Schist. As noted, south of Castle Dome, the Schultze also intrudes Precambrian Manitou Granite and Early Tertiary Willow Spring Granodiorite and Lost Gulch Quartz Monzonite.

The Granite Porphyry (55 m.y.), colored pink on the map, is a late-stage differentiate in the intrusive sequence and is intimately associated with the major ore deposits of the district. Granite Porphyry intrudes Lost Gulch Quartz Monzonite at Castle Dome and Copper Cities and intrudes or has gradational contacts with the Schultze Granite in the exposed pits of Live Oak, Red Hills, Thornton, and Miami. Damon recently dated (55 m.y.) a porphyry submitted by Miami Copper from their drilling in the Miami East segment where it was intrusive into Pinal Schist.

CHARACTERISTICS OF THE CASTLE DOME & COPPER CITIES DEPOSITS

The Castle Dome and Copper Cities deposits have a number of common characteristics which suggest a common affinity to an igneous-alteration-mineralization system. The characteristics include:

1) Both deposits are within large masses of Lost Gulch Quartz Monzonite.

2) Both have Granite Porphyry which intrudes the monzonite.

3) Mineral and alteration zoning tends to radiate outward from the porphyry (Peterson 1951, 1954; Simmons 1966).

4a) At Copper Cities the alteration-mineralization is terminated on the north by the Sleeping Beauty fault. The alteration-mineralization is most intense near the fault and the Granite Porphyry and radially decreases outward to the south.

4b) At Castle Dome the alteration-mineralization is terminated on the south by an unnamed fault, which is on line and strikes parallel to the Sleeping Beauty fault. Mineralization-alteration is associated with the Granite Porphyry located adjacent to the fault and radiates outward with decreasing intensity to the north.

5) At Copper Cities is a complex shear-fault system, named the Coronado fault zone, which trends northerly; while at Castle Dome is the complex Dome fault zone having a similar strike and dip.

6) Both deposits have high pyrite to chalcopyrite ratios. This is in contrast to the Inspiration-Miami ore bodies which have a higher chalcopyrite to pyrite ratio.

7) They both have similar uranium-thorium content and distribution with the greatest concentration paralleling the copper content along the Lost Gulch Quartz Monzonite - Granite Porphyry contact (Still, 1962).

From the mapped outcrop distribution, it would appear that the Castle Dome area is presently exposed to a deep level in massive monzonite, Granite Porphyry, and Diabase; whereas, at Copper Cities the exposure level is much higher and shows numerous small dikelets of Granite Porphyry and Diorite Porphyry with small engulfed Diabase masses, suggestive of a roof zone area for both the Porphyry and the Lost Gulch Quartz Monzonite.

GENERAL STRUCTURE

Complex faulting also characterizes the Globe-Miami District.

The major mapped faults having a steep dip with normal movement in excess of several thousand feet include the west-dipping Gold Gulch system on the west and the adjacent and parallel but east-dipping Jewell Hill fault system. These two systems outline the Castle Dome uplifted or horst block which trends northwest parallel to the strike of the faults.

In the central part of the map is the north-northeasterly trending Miami fault which dips to the east, and the unexposed Flat Creek fault, which is known from underground workings and drill holes, which trends north-northwesterly and dips westerly. The Miami and Flat Creek structures bound a large alluvial filled graben structure. These faults also have several thousand feet of normal displacement.

The Sleeping Beauty fault exposed north of Copper Cities also has a steep dip and separates significantly different rock types. The fault trends northeast and has an apparent displacement in excess of one thousand feet. The unnamed fault south of Castle Dome is parallel in trend to the Sleeping Beauty and has a steep dip.

Two other faults south of the Live Oak pit have steep dips and trend east-west. These have been named the Sulfide and Southwest faults.

Within or nearby to this large triangular block outlined by the steep dipping faults of the Sleeping Beauty and extension, the Gold Gulch system and the Miami fault, occur all of the major productive porphyry type deposits known in the Globe-Miami District.

All other faults named by Peterson (1962) within this triangular block are arcuate, shallow-dipping structures in contrast to those outside the block. In the Inspiration-Miami area the shallow-dipping structures include the Needle Mountain, Barney, Live Oak, #5 Shaft, Keystone, Bulldog, Pinto, and Moonshine

faults. Nearly all of these faults terminate on their north side in Webster Gulch or along its straight line projection in zones of distortion in the Pinal Schist. This alignment of distortion in the schist and northern fault terminations has been named the Webster Gulch fault zone.

The mapped faults north of the middle outcrop of Willow Spring Granodiorite have been named the William faults. These faults are also semi-arcuate and their south ends terminate at the Webster Gulch fault zone.

IMBRICATE FAULT BLOCKS

You have just been exposed to a resume of some of the ground truths in the complex Globe-Miami District. The recognition of some of the structural and mineralogical problems in the district were partly alluded to by the writings of Peterson (1951, 1962), Olmstead (1966), and Simmons (1966), but relatively little information in resolving the problems has been published.

The Problems and a Resolution. To recap, some of the problems include: a) the known flat faulting in the Live Oak and Thornton mines, often involving Dacite, which has placed primary chalcopyrite ore values on top of leached zones with secondary chalcocite ore values, and this feature repeated several times in a single hole; b) the fact that drill holes in both the Bluebird area and the Granite Oxhide (Oxhide South) area have penetrated the mineral zones by intercepting a shallow-dipping fault structure, after which they penetrate into barren rock; c) the observation that at Castle Dome the alteration-mineralization abruptly terminates at a fault on the south, while at Copper Cities the alteration-mineralization abruptly stops at a fault on the north; d) the increasing of primary mineralization grade at depth in the Castle Dome and Copper Cities deposits (Simmons, 1966); e) the outcrop distribution of two groups of Manitou Granite and four masses of Willow Spring Granodiorite; and f) the number of arcuate faults and the occurrence of tilted blocks of

Dacite or Whitetail Conglomerate preserved in the cupped areas of these arcuate faults.

Method of Working. The thorough study of the published maps, together with information from mine visits, field mapping, and drilling at Superior East, suggest that reconstruction (Slide Nine) of this major mining district on the basis of imbricate faulting solved many of the above-mentioned problems.

Slide Nine

This included the reconstruction of rock unit contacts and alteration-mineralization patterns along a system of shallow-dipping imbricate faults bounded by steep-dipping boundary faults which established a continuity of the various features and permit a resolvement of many of the various problems. With this development, the Miami District is shown to contain two imbricate fault blocks -- the Castle Dome-Copper Cities block on the north, and the Inspiration-Miami block on the south.

Slide Ten & Handout Sheet

Slide Ten, or Figure Two of your hand-out sheet, illustrates these two imbricate blocks and their direction of extension. As shown, the imbricate blocks are bounded by two side buttress steep-dipping faults which connect across the bottoms -- as in a shallow U-shaped or canoe-shaped feature in cross-section.

Slide Eleven

Castle Dome-Copper Cities Fault Block. Slide Eleven is a closer look at the structural and geologic elements and shows the Castle Dome-Copper Cities imbricate fault block to be bounded on the north by the Sleeping Beauty side buttress fault and by the Webster Gulch side buttress fault on the south. The two buttress faults are connected by the same named flat-dipping Webster Gulch fault which forms the basement sole fault (decollement).

As noted previously and shown here, the imbricate block or its adjacent basement contains two masses of Manitou Granite and four masses of Willow Spring Granodiorite in outcrop. Originally, prior to movement along the imbricate

fault system, the two masses of Manitou Granite were one continuous body, as were the four masses of Willow Spring Granodiorite; but, as the faulted segments moved eastward along the imbricate fault system, the intrusives were extended into the outcrop segments as now shown on the geologic map.

Cross-section X-X^1 was first constructed through these outcrops and by using the Manitou Granite-Willow Spring Granodiorite and the schist-diabase contacts as reference points, the individual offset along the imbricate fault segments could be determined. Some 30,600 feet of accumulated offset is involved in the various slices.

Extending this information to section W-W^1, also within the block, the alteration-mineralization involving the Copper Cities deposit could be reconstructed and moved back westward. A remarkable fit resulted when Copper Cities was moved the accumulated offset and Copper Cities was found to lie opposite the Castle Dome area. Thus, some "ground truth" problems have a more finite answer; such as a) the fingering out features found in the eastern Manitou Granite outcrops, compared to the massive outcrops in the western exposure, are compatible with the upper termination features of an intrusive; b) the flatter border phase contact of the easternmost Willow Spring Granodiorite is, similarly, the upper part of the intrusive while the steeper contacts of the middle eastern outcrop were originally somewhat deeper and the two western exposures were originally at a depth below where border phase relationships were not developed -- again a compatible relationship; c) the alteration-mineralization outlines of Copper Cities and Castle Dome now assume the logical elliptical outline with a central core of Granite Porphyry; and d) the two anomalous fault structures of Coronado and Dome align as a primary structure of the reconstructed picture.

Slide Twelve

Slide Twelve illustrates the hypothetical evolution of the features along Section W-W[1]. Stage I is the emplacement of the Tertiary Lost Gulch Quartz Monzonite into the Precambrian terrain of Pinal Schist, diabase and Manitou Granite. Into the monzonite the Granite Porphyry and its attendant alteration-mineralization was emplaced. Note the position of the incipient sole fault, the Webster Gulch fault, and the remaining imbricate faults. Stage II portrays the movement along the Webster Gulch and Black faults. Stage III is continued extension along the Empress and William fault zones to the final extension. Stage IV is the present distribution after block faulting, post-mineral cover deposition, and erosion into the present geomorphology.

Slide Thirteen

Inspiration-Miami Fault Block. Slide Thirteen, and Figure 2 of your hand-out sheet, shows the relative position of the Inspiration-Miami Fault Block. This imbricate block is more complex than the patterns in the northern or Castle Dome-Copper Cities block (Slide Fourteen), partially because of the more intensive study and drill hole information available, but also due to secondary deformation when the Miami fault was downdropped to the east in post-Dacite time. This faulting effectively cut the toe of the imbricate block and subsequent movement took place along the imbricate faults such as Live Oak, #5 Shaft, Keystone, and Bulldog. This movement preserved remnants of Dacite and Whitetail Conglomerate in tilted cupped shaped areas of the arcuate structures. Obviously, secondary movement of this type probably reactivated some type of movement on most of the faults in the system.

Slide Fourteen

Two cross-sections were constructed for this block; one through the porphyry alteration-mineralization deposits and another through the adjacent oxide mineralized deposits. Again, available rock unit contacts as well as alteration-mineralization characteristics were used. To include the porphyry recently reported in the Miami East segment would require a total extension of around 19,000 feet for this block.

LOCATION OF UNDISCOVERED MINERAL DEPOSITS

The mental, geologic, and structural gymnastics of this study involved the reconstruction of the Miami District into a compatible sequence of events and forms the basis of an exploration concept. The results suggest that within the two imbricate fault systems is a mineralized root zone and several faulted segments which have yet to be discovered. Possible areas of discovery area as follows:

1) The Live Oak root zone for the exposed Live Oak, Thornton, and Miami ore bodies lies to the northwest of the present Oxhide North (Schist) ore body. The root lies in the unmoved basement block under the flat-dipping Needle Mountain fault and was not exposed to an enrichment cycle. The area is covered by post-mineral Gila Conglomerate at present, but weak alteration and mineralization is found in the exposed bedrock to the west and is suggestive of fringe mineralization to the root area.

2) The named Needle Mountain segment is an imbricate faulted segment and lies above the Needle Mountain fault and below the Barney fault. All of this area is also covered by post-mineral Gila Conglomerate, but prior to the late cover rocks, the segment would have been exposed to an enrichment cycle. During the past three years, Inspiration Copper Company has been drilling the exposed oxide-silicate mineralization in their Barney area.

Last year ICC (Annual Report, 1971, p. 12) reported that "Preliminary drilling has confirmed geophysical indications of ore in an area between the Live Oak and Oxhide mines." ICC has named this the Montezuma area and recent verbal discussions have gleaned that their exploration concept was to continue to drill along the southwesterly extension of the Miami-Inspiration ore zone. The early drilling was just outside the Live Oak pit and east of the outcrop of the Barney fault. These holes, collared in post-mineral Gila Conglomerate,

penetrated the Barney fault, and then passed into mineralized ground. The Montezuma area structure is complex as some of the drill holes west of the Barney fault pass from Gila Conglomerate into Dacite, into Whitetail (the normal sequence) and then into mineralized rock, whereas others go from the Gila directly into mineralized rock, then into a fault zone under which is Dacite and Whitetail and more oxide-silicate under these units. The latest holes to the west have drilled sufficient chalcocite to warrant block-caving studies (Eastlick, verbal, 1972).

3) The Copper Cities root zone lies south of the Castle Dome deposit and is located in the unmoved rocks under the Webster Gulch flat-fault. Premineral rocks, moved in along the imbricate faults, covered the main part of the Copper Cities root and precluded exposure to an enrichment cycle. Also, a considerable portion of the zone may lie west of the Gold Gulch normal faults. Presently, post-mineral Gila Conglomerate and associated basalt flows cover this western area. Of interest is a verbal comment by Simmons of Miami Copper that they drilled a 4,000-foot hole in the southwest side of the Castle Dome deposit and the mineral values stayed above 0.4% copper for the entire distance. This would suggest a large mineral system for the area. The hole was terminated by drilling difficulties -- not by the lack of mineral components.

4) The Black segment is located under the Dacite cover of the Bohme holdings and is projected to lie above the Black fault and below the Empress fault. It would have been uncovered for a time and subjected to a chalcocite enrichment cycle.

5) Another segment block, the Empress, should be found just southwest of the Diamond H ore body now in production. As envisioned, the Diamond H is part of the Empress segment and has been uplifted and exposed by subsequent movement along structures parallel to the Sleeping Beauty fault. Interestingly,

Miami Copper has drilled a few holes in weakly mineralized, complexly faulted rocks to the west of the postulated zone and these intercepts may be fringe to the buried Empress zone.

Slide Fifteen

Slide Fifteen again shows these last three postulated segments in cross-section.

THE BOHME HOLDINGS

Slide Sixteen

Slide Sixteen shows the outline of the Bohme holdings, which were also shown on Slide Seven earlier this evening. The Bohme holdings are an independent group of claims owned by several individuals and which, for the most part, (Slide Seventeen) have only post-mineral gravels or Dacite as the exposed rock unit.

Slide Seventeen

Slide Eighteen

Hanna Mining Company held an option on the property (Slide Eighteen) and placed four drill holes into premineral units -- three in the southeast corner near the Barney oxide and one in the east central part. None of the holes found sufficient mineral to be further pursued by them. ASARCO had held talks with Hanna prior to their drilling of holes 2, 3, and 4, and subsequently, after BC-4 was drilled, a joint venture agreement was obtained to further test the holdings.

ASARCO proposed three holes -- two to test the area of the Black segment, where a chalcocite enrichment cycle was probable, and the third to test the vicinity of the Live Oak root.

THE MOMENTS OF TRUTH

An exploration concept such as the one you have listened to tonight is so many words on paper and colors on maps. It is the drilling of holes and favorable results thereof which are most helpful.

The first joint venture hole, named AH-1, is the middle location on the

Slide Nineteen

map. Under the concept it would be collared in post-mineral Dacite, (Slide Nineteen) pass into post-mineral Whitetail Conglomerate, and then into premineral rock units similar to those of the Castle Dome-Copper Cities area.

Although six other drill holes had been previously drilled in this block, discounting the three Hanna holes in the extreme southeast, only two succeeded in securing a premineral rock penetration. Hanna's core hole, BC-4, located 5000 feet northeast of AH-1, penetrated Dacite, Whitetail, a Precambrian shale unit, diabase, and bottomed in Precambrian Pinal Schist at 1081 feet. Miami's churn drill hole, CDX-2, located 3500 feet to the northwest, penetrated Dacite, Whitetail, a limestone (Devonian?), a quartzite (Precambrian?) and bottomed in diabase at 2852 feet.

ASARCO used the previously successful method developed during the Superior East program whereby a rotary drill is utilized to penetrate the surface rocks and general lost circulation zones and then sets casing at core point. A CP-50 diamond core rig then takes over with NC or NX coring.

Drill hole AH-1 penetrated 1150 feet of Dacite, then continued in post-mineral Whitetail. The Whitetail is an amazing unit in that it continues to amaze me in each hole we encounter the unit. Results from the Superior East drilling suggested that the Whitetail basins were the result of rapid uplift and tilting of blocks and, as a consequence, were violently filled with erosional debris from a nearby source and, thus, contained large sized fragments; then, as the basin filled up, the gradient was decreased and finer and finer material was transported into the basins. Also, the clast composition depended upon the source area, but in general the Paleozoic limestones were first to be eroded and deposited in the lower part of the basin, and later the Precambrian quartzites and diabase and finally the Precambrian schist in the upper part of the basin fill. This resulted in a "reversed stratigraphy" for the clast composition of the basin.

Slide Twenty

So we anticipated the same in the Bohme basin. Slide Twenty is a typical box of core from high in the Whitetail section. Note the predominance of gray-black Precambrian diabase and pinkish to reddish Precambrian quartzites. The ratio of diabase to limestone fragments was high and at 1700 feet was 6 to 1. The ratio gradually changed downward and reached 2 to 1 at 2500 feet (Slide Twenty-One) and a bedrock penetration was eagerly awaited. Such was not the case, as the limestone clast content in the matter of a few runs reverted to a ratio of 4 to 1 and increased to 10 to 1 (Slide Twenty-two) as a fault zone was encountered below 2650 feet (Slide Twenty-three). The sparseness of limestone clasts continued to 3350 feet (Slide Twenty-four) by which time little limestone was visible. To top it off, the Whitetail unit changed from a coarse clast conglomerate to a fine-grained mudstone with water-lain volcanic ash components and few pebble lense zones, suggestive of quiet water-type deposition.

Slide Twenty-One

Slide Twenty-Two

Slide Twenty-Three

Slide Twenty-Four

Slides Twenty-Five & Twenty-Six

The next few boxes (Slides Twenty-five and Twenty-six) show the lowest intervals of Whitetail with the appearance of quartzite clasts and, finally, (Slide Twenty-seven) angular slabby limestone clasts deposited on the top of bedrock at 3539 feet (Slide Twenty-eight).

Slide Twenty-Seven

Slide Twenty-Eight

Bedrock is Mississippian limestone which is brecciated and recrystallized with various beds and zones replaced by manganese and various iron oxides and containing iron pseudomorphs after pyrite. The hole cut 239 feet of Mississippian limestone (Slides Twenty-nine, Thirty, Thirty-one) before going into the underlying shale marker of the Devonian limestone (Slide Thirty-two) at 3678 feet. As noted (Slide Thirty-three), the Devonian is also highly oxidized with limonite along partings, some brecciation (Slide Thirty-four) and recrystallization. Near the base of the unit is a marker bed for mineralization and in AH-1 the bed at 3818-3826 feet (Slides Thirty-five and Thirty-six) was totally

Slides Twenty-Nine, Thirty, & Thirty-One

Slides Thirty-Two & Thirty-Three

Slide Thirty-Four

Slides Thirty-Five & Thirty-Six

replaced by manganese, magnetite, specularite, and various oxidized limonites. The replacement horizon rests on or just above the basal quartzite-conglomerate unit of the Devonian. Here, the quartzite-conglomerates (Slide Thirty-seven) are also highly stained and impregnated by oxidized limonites and pyrite pseudomorphs.

Slide Thirty-Seven

Drill hole AH-1 was lost at 3863 feet (Slide Thirty-eight) in basal Devonian when the core barrel and 440 feet of rods twisted off and were not recovered.

Slide Thirty-Eight

Drill hole AH-2 (Slide Thirty-nine) was collared in Dacite some 3500 feet northerly from AH-1. The anticipated units were originally similar to those of AH-1. In AH-2 the Dacite was penetrated at 555 feet and an earlier volcanic tuff at 728 feet, where Whitetail was then encountered. By 2000 feet (Slide Forty), the ratio of diabase to limestone clasts was 2 to 1 and continued to drop to 1 to 1 by 2250 feet (Slide Forty-one) in coarse conglomerate.

Slide Thirty-Nine

Slide Forty

Slide Forty-One

But, again, a shear zone was encountered and the ratio reverted to 3 to 1 by 2350 feet (Slide Forty-two) and continued to increase to 10 to 1 and higher by 2900 feet (Slide Forty-three). At 2909 feet (Slide Forty-four) a basalt dike with chilled borders was cut. Below the dike (Slide Forty-five) the Whitetail changed characteristics, now being a volcanic sand matrix conglomerate with variable sized clasts but little limestone to 3100 feet (Slide Forty-six). Below this point, which is also the base of another shear zone, the diabase clasts dissappear (Slide Forty-seven) and limestone becomes dominant along with the reddish water-lain ash at 3270 feet (Slide Forty-eight). The ash continued (Slide Forty-nine) until 3384 feet (Slide Fifty) where the ash rested on a nine-foot thickness (Slide Fifty-one) of limestone. The limestone is underlain by seven feet of conglomerate (Slide Fifty-two) before the true bedrock of Mississippian Escabrosa Limestone (Slide Fifty-three) was intercepted. The limestone is relatively unaltered and has only a few bleached and manganiferous

Slide Forty-Two

Slides Forty-Three & Forty-Four

Slide Forty-Five

Slide Forty-Six

Slide Forty-Seven

Slide Forty-Eight

Slides Forty-Nine, Fifty & Fifty-One

Slides Fifty-Two & Fifty-Three

Slides Fifty-Four & Fifty-Five

replacement zones (Slides Fifty-four and Fifty-five). The remainder of the hole down into the Devonian Martin Limestone is equally poor in mineralization indicators. With only a few Py pseudomorphs in the fore regl. hosy + in the lower glyphs.

INTERPRETATION OF THE DRILLING RESULTS

Slide Fifty-Six

The ASARCO-Hanna drilling results (Slide Fifty-six) have suggested that drill hole AH-1 is within the manganese-zinc fringe zone to a major porphyry deposit, similar to that of Jewell Hill to the Pinto Valley deposit. The clean, relatively unmineralized limestones of drill hole AH-2 further suggest that the mineralized body does not lie northerly from AH-1. The occurrence of totally oxidized iron, manganese, and zinc values attest to the erosional cycle to which the rock units were subjected prior to burial by Whitetail Conglomerate. A chalcocite-enriched deposit is a reality under these conditions.

Slide Fifty-Seven

In regard to structural interpretations, the drilling in the basinal area (Slide Fifty-seven) could be indicative of a detached slide block, whereby an open area is created or left behind the moved, detached, block. The rather flat dip of the bedrock contact between AH-1 and AH-2 might be explained by a low-angled fault plane, but this interpretation is tempered by the finding of representative Paleozoic sediments in the bottom of the basin.

Slide Fifty-Eight

The suggestion that all faulting is of the high-angled steep-dip vertical tectonic style is certainly suggestive in cross-section, but in three dimension and plan (Slide Fifty-eight) the present drilling and geology suggests the basin to be a relatively small (1-1/2 miles by 2-1/2 miles) feature and has no representative large block faults other than the Jewell Hill system on the west. Thus, a "plug" appears to have been plucked from the bottom to account for the downdrop of the Paleozoic section.

Additional drilling is warranted to follow-up the results of drill hole AH-1. The hole, in the large covered area to the south, would strongly indicate the remaining potential of the project.

Thank you.

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Reg

Thank you for the opportunity to bring to your our interpretation of a complex diction. This paragraph ~~[illegible]~~ which ~~[illegible]~~ involved with an exploration concept

The approach had with an exploration concept

J.D.Sell

WLL

Lawson Entwistle

Reservations to Knoxville

Saturday Apr. 7 TUS/CHA 945 am AA 138
DAL/KNX 100 pm AA 516
MW 523 pm

Thursday Apr. 12 KNX/DAL 545 am AA 495
DAL/TUS 1215 pm AA 135
BSU 125 pm

copy for
Mail for yourself
Jim Hill
Jud Gray Exec
J. Kim
E Bindy

Dear Lett.
Please advise your mom

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2/12/73

W.L.L.
FEB 13 1973

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J. O. S.

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JAN 8 1973
S. W. U. S. EXPL. DIV.

AMERICAN SMELTING AND REFINING COMPANY
EXPLORATION DEPARTMENT
120 BROADWAY, NEW YORK, N.Y. 10005

JOHN J. COLLINS
DIRECTOR OF EXPLORATION

AIR MAIL

January 4, 1973

Mr. W. L. Kurtz
Southwestern U.S. Division
Tucson Office

Exploration Meeting
Knoxville, April 8-11, 1973

Dear Sir:

In response to your letter of December 18, the delegates from the Southwestern Division can be: Kurtz, Graybeal, Sell and John King. Sorry to omit Bob Crist, but you should leave someone of his caliber to run the store.

Your proposed topic is O.K. A lot has been published on Graybeal's subject -- what more can he say? Sell's hypothesis on Miami is acceptable if in the scientific tradition he gives adequate representation of an alternative hypothesis -- Staargaard's normal faulting - projecting Johann's illustration. Not everyone needs to talk, so John King gets a free pass.

More later.

Very truly yours,

John J. Collins

John J. Collins

cc:JHCourtright

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

December 18, 1972

Mr. T. C. Osborne
Asst. Director of Exploration
New York Office

Annual Exploration Meeting,
1973 -- Knoxville

In reply to Mr. Collin's request, listed below are my nominations for speakers:

Kurtz -- Review of Projects with statements on the SWED approach to porphyry copper search, reference to the other SWED presentations, and pediment drilling program.

Graybeal -- Vertical Zoning in Porphyry Coppers and its exploration significance.

Crist -- Deep Underground Mining -- Methods, costs, risks.

Sell -- Interpretation of Gravity Sliding in the Miami Mining District and its exploration significance.

I also recommend that John King, one of our promising young geologists, attend.

W. L. Kurtz

WLK:lab

cc: JHCourtright

~~Cpy for JHC~~

New York, October 27, 1972

RECEIVED
NOV 1 1972
S. W. U. S. EXPL. DIV.

MEMORANDUM FOR: Division Supervisors
Asarco Exploration Department

Annual Meeting
Exploration Department

Since we have not had a formal review for top management in 2 years, the main themes will be:

a) Review of recent major projects

b) Future programs and reasons why

We have a dozen divisions and we cannot expect Company Officers to listen for more than 12 hours. Obviously the larger divisions can have more than one hour and the smaller divisions less, possibly as little as 10 minutes, so as to allow geologists from operating mining units to describe their exploration work. The proverb relating to a picture (illustration) being worth 10,000 words, is pertinent. In addition to room-size illustrations, speakers can also make use of page-size handouts of non-secret material. Details on housing and the program will be issued in January.

Although April 8-11, 1973, is a long way off, speakers should complete their illustrations in January, rehearse their talks in February, and practice delivery (without reading a text) in March, for the Annual Meeting to be held in Knoxville, Tennessee. A tentative program is attached.

A supplementary feature for our meeting could be an evening symposium led by a distinguished lecturer from outside the Company. Your nominations will be welcomed, prior to December 1st.

Provision will be made for underground visits to two of our East Tennessee zinc mines and we can have an extra session on mineralization in these mines and carbonate deposits in general.

As usual, we can plan on averaging two representatives from each Division, some more, some less, depending on the size of the Division. Your nominations of men and topics will be welcomed prior to January 1st so that we can assure reservations at the Holiday Inn, NE.

John J. Collins

John J. Collins

cc:SAAnzalone
MPBarnes
RLBrown
LPEntwistle
DMFletcher
RJLacy
RKKirkpatrick
WLKurtz
RBSprague
KWhiting

Kurtz
Coist
Sell/Greenhead
King

Trial Program - April '73 Meeting
Asarco Exploration Department
Knoxville, Tennessee

April 8
Sunday Evening:

Lecture by a distinguished scientist

April 9
Monday A.M. - Underground

	Hours
Afternoon - Talks	3
Evening - "	2

April 10

Tuesday - Morning - Talks	3
Afternoon "	3
Evening "	2
	13

April 11
Wednesday A.M. - Underground

Afternoon - Symposium on Mineralization in Carbonate Rocks