

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

The following file is part of the John E. Kinnison mining collection

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## AMERICAN SMELTING AND REFINING COMPANY Tucson Arizona February 2, 1959

## MEMORANDUM FOR K. E. RICHARD

MISSION PROJECT Screen Analysis of Crushed Sample Reject

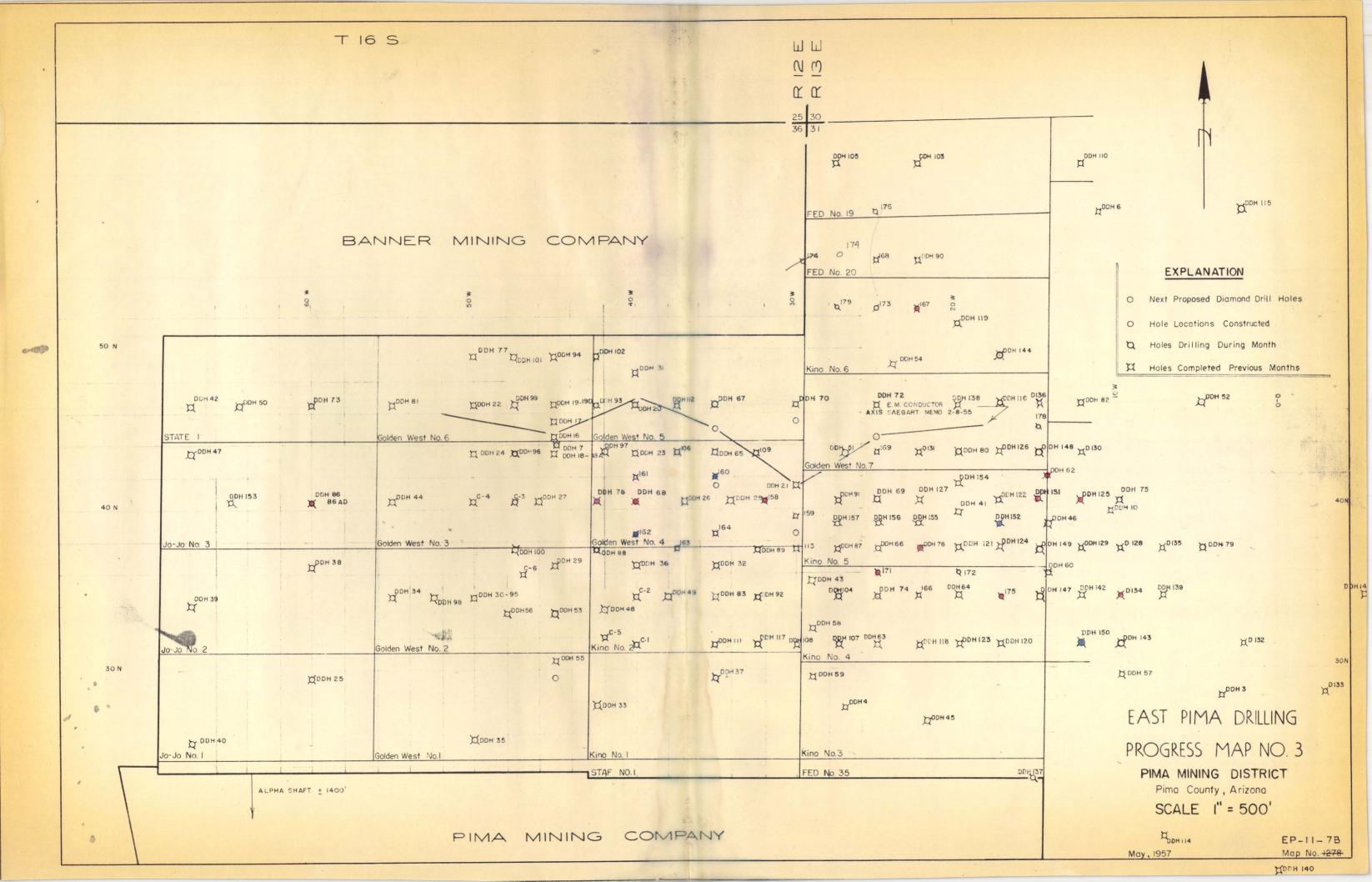
A screen analysis was made of several crushed core samples in storage at the Mission laboratory by passing the rejects through screen sizes of 1/2", 1/4" and 10-mesh. The samples selected for analysis consisted of eleven intercepts of argillite, four of hornfels, and six of tactite.

The following is a tabulation of these data:

Hole	ARGILLAPE	Webstanal and	-2 /00	-1/2" +1/4"	-1/4"	
Number		Wght(lbs) of Sample Reject	+1/2"	(%)	+10 Mesh (%)	-10 Mesh
48 68 68 78 83 88 88 92 111 153 163	287.9 - 294.9 254.2 - 263.9 270.1 - 281.3 320.6 - 331.7 296.8 - 309.4 348.5 - 358.2 385.1 - 397.6 320.9 - 325.9 455.9 - 465.0 269.2 - 279.4 348.0 - 355.0 Weight	3.03 2.69 2.99 3.05 3.04 2.73 2.82 2.24 3.13 2.86 2.50 ed Average	00000000000000	17 21 22 35 14 37 30 37 19 34 20 26	46 49 43 40 53 38 47 39 41 45 44 45	37 30 35 25 33 25 23 22 36 25 35 35
49 68 111 148	HORNFELS 597.2 - 607.9 400.0 - 407.6 620.7 - 630.8 332.7 - 343.0 Weight	3.27 2.77 3.28 3.15 ed Average	0 0 0 1 0	9 13 9 38 18	37 50 40 37 40	54 37 51 24 42
128 128 129 136 142 178	TACTITE 246.3 - 252.2 459.2 - 469.4 430.5 - 438.6 362.0 - 369.7 261.5 - 271.6 304.6 - 314.1 Weight	3.95 3.07 3.15 3.41 3.65 3.62 ed Average	00000000	13 25 20 15 18 28 20	47 52 54 50 51 43 49	40 23 26 35 31 29 31

SCF/ds

cc: JHCourtright JEKinnison SAMUEL C. FALL



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For additional comments use/see reverse	32 - 541'

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By: J.E. K.	Date 1/31/58 etallorgical study.	Date:  Other Locotion:  ***********************************
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45-450'

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Purpose: Sample for metallurgical study	第5年間に上が作ります。またが、1980年には、198
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49-555'

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		Petrographic Roc	k Name:	
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	z veins with

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Megascopic: Soft vary of hornfels, but  cut by quarts veins. Very heavy parite  and chalcopyrite. Molybdenite may be  present in small goantities:	Forms clon: P.ma DDH No. 89 @ 284 ft. Depth Sent for: T.S. P.S. Date: 1/3/58 Other Accetion:
By: J.E.K. Date 1/31/58 Purpose: Sample for metallurgical study	Settlement of the set
	and the control of th

89-2841

Megascopic: Abundant felds, set in a "quartzy" groundm present. Feldspar altered?  pyrite and chalcopyrite	par phenocrysts pass. Quartz veins Disseminated	Destroye control of Benefit Warner	ft. Depth
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1/3 - 383'

## FROMERTY East Pima

Megascopic: Feldspar rock. Coarse-grained  pink feldspar disseminated chalcopyrite  Minor disseminated molybdenite.	Formword: Ping DDH No. 130 @ 327 ft. Depth Sent for: T.S. V P.S.
By: The post of th	Date: 1/31/58 Other Location:
ELCIOS CODA C NV : Militario de la compansión de la compa	
	en der de de versenne en

130-327

Fetrographic Rock Name:  Formation: Ping DDH No. 138 @ 30/ ft. Depth Sent for: T.S. ~ P.S. Date: 1/3/58
Other Location:

Megascopic: Tact, to . Ethedral garnet with some admixed soft material.  Disseminated pyrite and chalcopyrite.	Petrographic Rock Name:  Former Chi Ping  DDH No. /5/ 8 284 ft. Depth  Sent for: T.S. V P.S.  Date: 1/31/58
By J. E. K. Dolle 1/31/58 Purpose Dample For metallurgical study MICTOSCOPIC Dy a	OCHON LOCALIONS:  Debonic transference and transference a

Soft white material.  John No. 151 313 ft. Dept. Sent for: T.S. L. P.S.  Date: 1/31/58 Other Location:  Microscopic by:  Date  Date	Notes and the second of the se	Ping Petrographic Rock Name:	nacioni all'Adiyo, i gondigasa mel upipo cirron ellipo partito a bia modella ge illise elli
BY and J. E. Lamper and the control of the control	replicated the fresh land was a restrict to week to be secret was to such a feel which a fresh be to be secret to the secret to	DDH No. 151 @ 313 Sent for: T.S. \( \sigma\) P.S. Date: 1/31/58	It. Depth
######################################	By: J.E.K. Dece 1/31/58 Furpose: James for metallingues stock		gentarionista escatalistica in escriptica de la constantina ante estre de la constantina constantina de la constantina del constantina de la constantina del constantina de la constantina del constantina de la constantina del constan
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		timent in die einsteren der der Einstein eine einem erweiten zu geschrickgen was der American zugeschaft die d Die einstelle der der der der der der der der der de	·····································
	Minima and the Contract of the	er genet vinten genet vinten program om en	The control of the co

151-313'

Mixed with soft	diopside. Sparsely and chaleopyrite.	DDH No. 15/ @ 3/3 A ft. Dept Sent for: T.S. V P.S. Date: 1/3/58 Other Location:
By: J.F.K. Furpose: Sample for 1	metallurgical study	ACCORDANCE OF THE PROPERTY OF
Microscopic by:	DOTO C	and the state of t
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151-313'A

# PROPERTY East Pima Fetrographic Rock Name:

Megascopic: Soft variety of hornfels white fine-grained granular Chalcopyrile	Pomes 200: Pime
white, fine-grained, granular. Chalcopyrite disseminated in large blebs	Date: 1/31/58
By: J.E.K. Dave 1/31/58 Furpose: Sample for metallurgical study.	Other Locations:
Microscopic by:	
MERCHANIS AND	
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For additional comments use/see reverse

151 - 344'

# PROPERTY East Pima Petrographic Rock Name:

Magascopic: 5.84 variety	of bornfels.	to an east of Life and Lamps de 1994	ACAT TI	ALVERIAN G.	Mind to able a spepal	nitte water read title
white, fine-grained, gr	anular Very heavy	Forms whom: P	ma			
White, fine-grained, gr chalcopyrite dissemina	ted in large bkbs.	Date: 1/31/58		370 P.S.	menter-thritte	Depth
terrenordige with reconstruction of property and an experiment and an experimental and a series	AND CO 1/21/CO	Other Location	WYShaymoutensus	A STATE OF A WING AND ROOM STORAGE.	rikspatel som padar tida	Children de Mille Operation in Spain van
Purpose: Sample for meta	allurgical study	eri PMA di Princesto, Quagos in c e il 1944 (corpo e e e appreziato conflicializações).	e (energy op 500 + 60 a) of	nin galatii antii tiigi ya a alati in ya	and the second	salah melangkish kesas di mala
Microscopic by:	DO TO			1		
models into an international liquidation in consequir proper tenderal per also properties in tenderal per also properties in the properties of the propertie	ead at referencie Monostrop, de talls op in - eine on et 12 describe meas 7,5 as reports en participation and intellers and	and the state of t	Principles of the last	reason of Phillips (gappy) although one	and the same of th	orthodoxide designation and
The second secon	的感染,我们们的时候,我们就是有一个的,我们就是一个时候,我们就是一个的时候,我们们就是一个的时候,我们们的时候,我们们们的一个的时候,这个时候,这个时候,他们 "我们们的时候,我们就是一个时候,我们们们的时候,我们们们就是一个时候,我们们们们的时候,我们们们们们的时候,我们们们们们们们们们们们们们们们们们们们们们们们们	of Remarks of the Confession Benefit and the second process of the confession of the confession and the confession of th	D Targetter adjust 5 stats	manifer on the design of the control		a Diffe of the Colonian and the Colonian
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151 - 370'

fins-grained, gronular chalcopyrite.	ly of hornfels. white, . Heavily disseminated	Formation: Pima DDH No. 151 330 ft. Dep Sent for: T.S. V P.S. Date: 1/31/58 Other Lection:
By: J.E.K. Furpose: Sample for	000 400 000 000 000 000 000 000 000 000	Minimum and the state of t
Sample for	metallurgical study	•
Microscopic by:		100 m
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151 @3801

See file Aa 16.16.20A PIMA HOLES Elev. Depths Collar Bedrock Total Co-ord 350 3302 210 A-93 198 693 3295 1-92/ 207 723 3287 195 474 3285 A-79 205 = 593 3289 0 3285 ? A-52 . 313 202' A-901 946 3278 A-89 215' 1006' 3271 198 938 A-84-3281 275 3265 918 A-91 3268 A-87 225 782 3246 A-58 213? 495 A-67 3243 404 190? A-68 411? 3234 220 ?

PIMA MINE LOGS (Loged By J. Journey) - Summarized for use on East Pina sections. A-89 Bedrock @215 215-393Ark(?) [log Pyroclostic) feld. development. Prob. equiv. to Papago fm. 299-300 A Porphyry. 393-640 Argilite (?) black w/ light colored patches and veining. 0 LLog. Pyroclastic] 633-640, Epidole &chl, limy up gto veins, strong Sulf. 640-723 Argillite(?) - cinamon colored (corresponds to a horizon noted in A-87) 723-855 8+2+ (also penetrated) an A-87) 855-885 Hornfels [109 Diopside HF): 885-893 Pale brown, In-grained limy material u/gta veins. 893-917 Hornfels [ log. Dapside Hf] Tactite [log Garnet Hf] Hornfels [log Diopside Hf] 917 - 957 957- 967 967 - 979 Tactite [ 109 garnet Hf] 979 - 982 Arg?? Porphyry ? (felsite) at 2+ or sand Ary. 982 - 990 990-1006

Bedrock @227 A-93 227-409 Arg (?) [log pyroclastic] 409-429 Fels. te porphyry (??) [109 s. liceous quartgose (watery) matro 429-537 Arg (?) [log pyroclastic] 537-554 Fels. te porphyry [log Rhyolite] 554-562 Hornfels (?) of Fels. te O Porphry. I log, silicitied material w/porphyry] Factite [log Garnet Hf] 562-583 583 - 597 Hornfels (?) [log quartage w/ trace of Hf.] material 597-607 Felsite porphyry Hornfels Ilog Digoside 171 607-611 Fels. te porphyry 611 - 621 621-629 Hornfels Hornfels (?) w/ porphyry 629-639 Ark or Arg of inter-639-693 cepts of Felsite porphyry. BOTTOM

PIMA MINE LOGS
A=90 Bedrock @ 202
202-202 Arg (?) [log. Pyroclustic]
o wy bleaching.
282-289 Porphyry w/short streethes of Arg(?)
of Arg(?)
O 289- 751 Arg (?) [log. Pyroelastic]
751 - 760 Tactite [log Garnet Hf]
760 - 765 Felsite porphyry
165- 789 Hornfels Ilog diopside HI
770-172 Sheared quarter 305e moterial.
789 - 802 Brown Siliceous material,
Some garnel and other limes the
802-811 Tachte. Heavy sulf.
811-820 As 789-802, somegamet.
820-853 Sandy Argillite, dark brown.
0 853 - 872 Hornfels. Gypsum.
872 - 927 Arg or porphyry. light-
colored w/ fine white feld.
O 927-932 Hornfels I log disposide HI]
932-946 Siliceous material like
932-946 Siliceous material like 572-927. Elog pyroclastic?
O BOTTOM

A-50 Bedrock @ 245	
245-350 Arg (?) [109. Pyroclast	(, ]
A-18 Bedrock @ 203-210	0
210- 393 Arg (?) [109 Pyroclas	1
w/ bleaching? veintels.	0
393 - 399 Felsite porphyry (?)	
399-474 Arg (?) dark.	0
Elog Pyroclastic - probably footwall series ]	
BOTTOM	
A-79 Bedrock @ 205 ± (Est.)	
205-225 No Core	,
225- 593 Arg (?) [logged Pyroc)	-
astic] with high-degree of alt.	
feldsporthie? inaterial.	0
339-395 Extensive Shar	Heri
BOTTOM	
	0
	0

PIMA MINE LOGS A-87 Bedrock @ 225 (?) 225-651 Arg? and or Ark [109 pyroclastic] of abundant blebs and veining of feldspathic? 851-672 Arg (?) w/ cinnamon color ( See DDH A-89) 672-782 Qtzite. BUTTOM Bedrock @ 201 A-84 201-938 Ard?) [log pyroclastic] Much feldspathie? verning (or bleaching) 636-917 Breccia material with ciliceous cement, (Pima logs continually refer to "crushed or "shallered "material throughout 0 most "Pyroclastic" (Papago Fm equivelant) intercepts. This reference to Breacion 15, however, uncommon). Epidote throughout un 0 small spots. BOTTOM

A-9P Bedrock @ 215 215 - 677 Arg (?) and ark (?) Ilog pyroclastic ] 677-806 [log. Siliceous quartzose material - marker hanguyuall Physhite of Prina Mino? 806-814 Hornfels. 814-918 Marble BOTTOM · A-92 Bedrock @ 228 228-358 Arg (?) [109 Pyroclastic] 358-379 Felsite porphyry 0 379-433 Otat Felsite people 395-401 433-441 Mixed Felsite perphyry and Arg(?) 441-557 Felsite porphyry 537-565 Arg(?) 565-604 Felsite Porphyry [109 Rhyolites prob. Hanging wall thyolite of Amal nine 604-610 Hornfels, w/ magnetite. 610-625 Felsite porphyry [log rhyolite] 625-658 Hornfels and tactite mixed, 658-675 Hornfels [log silvefred or possibly 675-678 Tactite 673-723 Siliceous, sugary texture. 1, ke 6.77-806 m DDH A-90 BOTTOM

46+43271 DDH 93 56444 N 35 DDH 91 DDH 82. · Bedrock @ 217.5 52+121N-Bedrock @ 169 69+85 W-46+37 WV Bedrock @ 213 169-362 Ark, pink, grey, and 217.5-371 Sandy Arg. 213 - 286 Ark or 0+2+ green. May be some Mp 286 - 288 Metaporphyry 371 - 380 Gg 362 - 388 Mp 388 - 420 Ark. May be some Mp 288 - 745 Ark & Otata No data 380 - 408 limey Arg W/ garnet. 420-430 Grey gfzt(?) with gamet 108 - 423 atzt, white light-grey 11/2 69@301 423 - 617 Tactite at beginning ?) 430 - 448 Hornfels 314-318 Mp(?) 617-680.5 Marble 1' fit @ 350 448 - 516 Tachte BOTTOM 106 - 440 Modissem 516-520 Felsite porphi or DDH 84 52 105 N 3238' 738 - 745 Mp. meta porphyry (assay , 05) 745-770 Hornfels Bedrock @ 206' 520-530 Hornfels 530-519 Tackte ul magnetite 770 - 822 gtat. Grey-white core bro-AVIC? leached 206 - 226 Ken to small pieces. 519- 605 Afrit, gray-white 226 - 231 45° premin. fault. 605-636 Tactite, with a few Ark, course - gr. 231- 384 822-902 Tactite & Hornfels intershort areas of alt. limestone 384- 408 Meta porphyry ADB - 517 Coarse ark to sandy Arg. bedded. on marble, 636-647 Marble, yellow-grey 902-917 Marble w/ wollastonite 517-518 Gouge 647-682 Marble. BOTTOM 518-579.5 hight grey-white gtat. 917-966 Tactite DDH 95 BOTTOM Bedrock & 204 54+23N 966 - 1001 Marble (43 +00 W DDH 89 52+02 N 3251' 204- 687 Ark fgfz+ BOTTOM 809-830 DOH92 54+20N 32311 830 - 888 Bedrock @197. 69 334-335 Bedrock @ 204 45730W Flt zone 178-482 888 - 900 Mp? 643-646 197-262 Meta porphyry - leached to 900 - 994 204- 370 Ark, 262-625 Metaporphyry (?) Local Hf(?) below 610 247-252 Mp? Gyp veintels noted from 370 - 382 Mp. 382 - 537 ArK 537 - 582 Mp. BOTTOM BOTTOM 582 - 602 Ark. (596-602 white to 602 - 615 Hornfels (Serpentine 5 9/2) 615-590 Otat, grey white

Bedrock @ 203 203-280 Mela perph. 280 - 383 Hornf. (arkosic?) 383 - 390 Metaporph. Fault 384-385 399- 400 Gg and HF. 400 - 415 Hornfels 415 - 495 Metaporphyry 485-95 W/ Hf. 495 - 502 Hornfels. 502- 522 At2+, grey white. 522-537 Meja porph. 537-600 Otat, grey white 600 - 625 Hornfels 625-661 Atst, grey white Hornf. 661-682 Tactite 682-716 Hornf? 7/6 - 722 Tachte 722- 731 Marble 731-809 Slightly altered Marbk

DOH 98

BOTTOM

BOTTON

Marble

Hornf.

Marble

69+84 W 410 - 444 Qtat, gray-wh, te 470 - 475 Ofzt, grey -white (Frags) AMERICAN SMELTING AND REFINING COMPANY Tucson Arizona October 3, 1963

MEMO FOR MR. T. A. SNEDDEN:

## MISSION ARGILLITE

Since the first of the year, the Mission mill averaged just over 20,000 tpd on a feed averaging about 23% argillite. As I understand it, this rate is 10-12% higher than indicated by grindability indices of around 12 for tactite-hornfels and 16 for argillite (based on a test of Pima argillite). In addition, day to day fluctuations of the argillite content --- say from zero to 75% --- have not shown corresponding fluctuations in the grinding rate, indicating that either (1) the argillite mined recently is softer than the average for the Mission, or (2) the Pime sample was harder (in terms of grindability) than the Mission average.

Mr. Kinnison and I visited the Mission pit September 30. Mr. Anzalone showed us the areas which produced most of the argillite mined in the past few months --- the south end of the 2770 bench and the southwest part of the 2890 bench. With the exception of very minor amounts of tactite and andesite dike rock, the material exposed is composed entirely of essentially typical argillite. In our opinion it is representative of 80 to 90% of the rock so classified in the Mission ore reserve; accordingly it is concluded that the difference in mill capacity between the predicted and actual is at least in part due to a somewhat higher degree of metamorphism in the Pima argillite than existing in the Mission argillite.

It is our conclusion that the past 9 months milling experience for argillite can be used in forecasting production rates --- with the reservation that something like 10% of the remaining argillite may be somewhat more difficult to grind, say equivalent to the Pima argillite with an index of 16+.

Original signed by J. H. Courtright

J. H. COURTRIGHT

JHC/jk cc: NWeiss RBMeen JDVincent

KERichard JEKinnison

Met Murgical Samples Lot Vol. . 7/10/58 Taction Friable, partly exhedral, garnet, with some admixed soft diopside. The rock as mined is highly fragmented and contains a high proportion of fines. Pyrite and chalcopyrite are diseminated throughout, in more or less equal amounts. The times contain considerable sulfides, and may contain a higher proportion of soft diopside than the rock tragments. Aminor amount of gypsom is present.

Metallorgical samples 7/11/58 Tactite. Massive evhedral friable garnet, with a Variable ( zero to abundant) amount of soft diopside. Pyrite and chalcopyrite are disseminated throughout in fine to coarse grains, and occur both individually and as interlocked grains. A trace of homaf, to is present. Sulfides are locally a ssociated with calcite. The rock as mined is highly fragmented and contains a high proportion of fines. Sulfides are aboundant in the fine material.

Metallurgical Samples Lot No. 3 7/14/58 Tactite. Massive garnet, both echedral and structuress aggregates. Some disposide associated. Also a minor amount of diopside hornfels and a soft douse harnfels which is probably fine-growned diopside. Preste dissemma led principally as small cubes, and chalcopyrite is heavily disseminated in large and small grows and as this stringers. Trace of Moly bedente of sphalerite. Minor amount of heavy chake pyrite in guartz gangue. The rock as mined is well broken with a high proportion of fines, which contain considerable sulfites.

Metallurgical Samples Tactite. Principally exhedral median-gramed garnet, with Osmall and variable amount of diopside. Pyrite is weakly disseminated in grains and thin Veinlets. Chakopyrite is present but in less quantity than Pyrite, The rock as mined is well broken and conforms a high proportion of fines.

Metallorgical Samples
Lot Ne 5 Tactite. Massive structurless and echedral garnet, with a moderate to locally heavy amount of soft diopside. Pyrite and chalcopyrite are heavily disseminated in about equal amounts, and vary from fine grains to large masses. Calcite is present, often associated with the sulfides, in small and large masses. A frace of sphalerite is present. Hemotife is prevelent as tracture couting. Some quartz is interlocked with the sulfides. The rock as mined is highly frag mented and contains a high proportion of fines, which contain considerable solfides,

Lot Nº 6 Metallurgical Samples Tactite. Mostly structurless garnet with fairly abondant disposede j quantity Some what variable. Pyrite and chalcopynte disseminated inabout equal amounts. Concentration of sulfides is sporty the heavier dissemination generally occuring as large blebs. Some of. the chalcopyrite is tarnshed, Calente fairly 0 common, associated with Sulfides. Hematite courts fractures, Rock as mused is well fragmented with a high proportion of fines con faming considerable sulfides.

Lot Nº 7 Metallurgical samples. Hornfels. Fine-grained soft diopside hornfels. Cpy 15 well disseminated in med-10m to large blebs and as thin venlets. Py is occurs in minor quantities Some of the vein cpy 13 well tarnished. Sphalerite occurs in minor amount along some epy verns. The rock as mined 13 well fragmented, but contains more coarse moterial and fewer fines than did previous lots consisting of tactite. The fines confain some sulfides but less than the tactite fines 9

Metallurgical Samples Lot Nº 10 Horntels. White, soft diopside, mostly fine-grained granular, but partly as bladed or fibrous (probably heden bergite mole cule present), fine-grained aggregates. Chalcopyrite 15 the principal sultide, and occurs as small to large heavily disseminated blebs and in short discontinous stringers. Pyrite is present as disseminated blebs. The rock as mined is well tragmented and contains a high proportion of fines, in about the same quantity as previous lots of horntels. The fines contain some sulfides.

Metallurgical Samples Lot Nº 8 Hornfels. Fine-grained Soft diopside. The principal Sulfide is chalcopyrite, heavily dissemmated in blebs and stringers. Pyrite 13 present but in a lesser quantity. The rock as mined is well frogmented, and contains a high proportion of fines, but In lesser amount than the previous lots of tactite. The fines contain a slightly greater amount of sulfides than the times of lot Nº7.

#### METALLURGICAL SAMPLES

Hanging wall rock from Pima Mine pit - Cote 11

Argillite and sandy argillite. Light to dark brown, dense, but year hard argillite with local concentrations of small round quartz grains. The rock is quite hard to break with a geology pick, and breaks to a semi-conchoidal uneven fracture. Sulfides are disseminated moderately throughout the rock, but occur in equal abundance as thin vein fillings. Sulfides are mainly pyrite and chalcopyrite in about equal amounts, but either one may locally exceed the other. Individual disseminated grains are usually 1/2 to 2 mm. in size. The chalcopyrite shows preventent tarnish, but some small amount of the tarnished sulfide may be bornite.

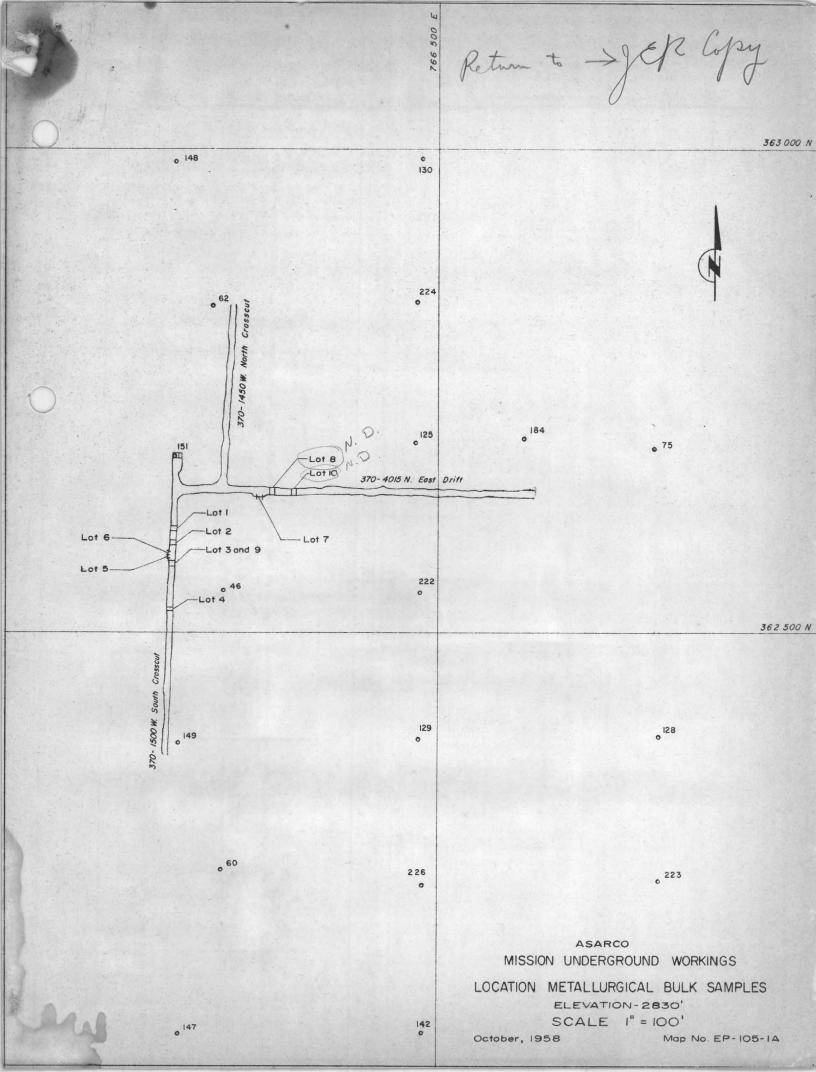
Epidote and chlorite are frequently associated with the sulfide grains. Chlorite is also present as thin films on fracture surfaces. A trace of galena and sphalerite is present. The rock as brought from the Pima pit contains many large fragments, exceeding one foot, but no boulders. A small percentage of fines are present.

Essentially identical.

This sample contains rocks/paragraph to at least a part

This sample contains rocks (confident to at least a part of the argillite rocks at East Pima which will be milled. It does, however, compares to the hardest type which will be encountered, and possibly a large portion of the East Pima argillite is somewhat softer, at least from a crushing standpoint. The ration of pyrite to chalcopyrite from this lot(about 1:1) is not representative, however, of most of the East Pima argillite. The At East Pima the ratio of pyrite to chalcopyrite will normally exceed 1:1, and may at times be several times greater. The sulfides at East Pima will be principally disseminated, and contain fewer sulfide veinlets, in contrast to this sample.

Met. Sumples -Lot No 1 - 170 69.3-74.1 5.D. 2 - 230 83.9-88.8 5.0 3 - 31D 106.8-112.0 S.D 4- 53D 154.3.158.8 S.D 0 5 - 5/ab, West wall S.D. 6 - 5/ab west wall 5.D. 96.0-100.0 1 - slab, so. Wall E.D. 81.3 - 86.8 -8-97D 95.0-10.0 N.D. 9 - (Same as Lot 3) 310 106.8-112.0 0 - 10 - 109 D -117.3-122.7 A.D. 11 - Pima Pit Lots Numbered past 11 are composites of the above.



AMERICAN SMELITING AND REFINING COMPANY Tucson
July 8, 1958

### FILE MEMORALDIA

#### PAST PENA Pilot Mill Semples

It is planned that Mr. Rinnison will carefully inspect each batch of material before it is transported to the pilot mill. He will make a note-form mineralogical description of this material. A penciled copy of this description will be handed to Mr. Romey by the truck driver as the material arrives at the mill. Subsequently the description will be typed, with copies going to those listed below.

The first batch being crushed July 8, proparatory to transportation to the mill, is described as follows by Mr. Einnison:

Inctite; massive structureless garnet, some soft dispeide. Chalcopyrite in 1/4" disseminated blobs. Pyrite-chalcopyrite ranges down in size, disseminated throughout in fair quantity. Maybe a trace of maly as pin point disseminated grains. Rock well broken.

Normally the exact location the material come from will be recorded with the description, but at the time the description was made for this first batch the location had not been measured.

Any suggestions regarding a change in this procedure, or in the character of the descriptions, will be welcome.

Original Signed By K. Richard

KENYON RICHARD

EN/ds se: ACHALL Wowldler Nicles JDVincent ARCONCY

be: KERichard JEKinnison AMERICAN SMELTING AND REFINING COMPANY Tucson

July 17, 1958

FILE MEMORANDUM

MISSION - LOT I Metallurgical Samples

Description - 7/10/58

Tactite. Friable, partly euhedral, garnet, with some admixed soft diopside. The rock as mined is highly fragmented and contains a high proportion of fines. Pyrite and chalcopyrite are disseminated throughout, in more or less equal amounts. The fines contain considerable sulphides, and may contain a higher proportion of soft diopside than the rock fragments. A minor amount of gypsum is present.

Original Signed By K. Richard

KENYON RICHARD

JEK/ds

cc: ACHall

WCWaldler

NWeiss

**JDV** incent

ABRomney

bc: KERichard

JEKinnison ...

AMERICAN SHELTING AND REFINING COMPANY Tucson
July 17, 1958

FILE MEMORANDUM

MISSION - LOT 2 Metallurgical Samples

Description - 7/11/58

Tactite. Massive euhedral friable garnet, with a variable (zero to abundant) amount of soft diopside. Pyrite and chalcopyrite are disseminated throughout in fine to coarse grains, and occur both individually and as interlocked grains. A trace of hematite is present. Sulphides are locally associated with calcite. The rock as mined is highly fragmented and contains a high proportion of fines. Sulphides are abundant in the fine material.

Original Signed By K. Richard

KENYON RICHARD

JEK/ds

cc: ACHall

WCWaidler Mieiss JBV incent ABRowney

bc: KERichard

JEKinnison -

AMERICAN SMELTING AND REFINING COMPANY Tucson
July 17, 1958

#### FILE MEMORANDUM

MISSION - LOT 3 Metallurgical Samples

Description - 7/14/58

Tactite. Massive garnet, both as euhedral and structureless aggregates. Some diopside associated. Also a minor amount of diopside hornfels and a soft dense hornfels which is probably fine-grained diopside. Pyrite disseminated principally as small cubes, and chalcopyrite is heavily disseminated in large and small grains and as thin stringers. Trace of molybdenite and sphalerite. Minor amount of heavy chalcopyrite in quartz gangue. The rock as mined is well broken with a high proportion of fines, which contain considerable sulphides.

Original Signed By K. Richard

KENYON RICHARD

JEK/ds

cc: ACHall

WEVaidler

NWeiss JDV Incent ABRomney

bc: KERichard

JEKinnison -

AMERICAN SHELITING AND REFINING COMPANY Tucson
July 28, 1958

FILE MEMORANDER

MISSION - LOT 4 Netallurgical Samples

Tactite. Principally cubedral medium-grained garnet, with a small and variable amount of diopside. Pyrite is weakly disseminated in grains and thin veinlets. Chalcopyrite is present but in less quantity than pyrite. The rock as mined is well broken and contains a high proportion of fines.

JOHN E. KINNISON

JEK/ds ce: ACHell WCMidler NNeiss JDVincent Alexamey AMERICAN SPERIFING AND REFINING COMPANY Tucson
July 28, 1958

FILE MEMORANDIAM

MISSION - LOT 5 Metallurgical Samples

Tactite. Massive structureless and suhedral garmet, with a moderate to locally heavy amount of soft diopside. Pyrite and chalcopyrite are heavily disseminated in about equal amounts, and vary from fine grains to large masses. Calcite is present, often associated with the sulphides, in small and large masses. A trace of sphalerite is present. Hematite is prevalent as fracture coating. Some quarts is interlocked with the sulphides. The rock as mined is highly fragmented and contains a high proportion of fines, which contain considerable sulphides.

JOHN E. KINNISON

JEE/ds ce: ACHall WCWaidler EWeiss JDVincent AERosney AMERICAN SMELTING AND REFINING COMPANY
Tucson
August 4, 1958

#### FILE MEMORANDUM

MISSION - Lot 6 Metallurgical Samples

Tactite. Mostly structureless garnet with fairly abundant diopside, quantity somewhat variable. Pyrite and chalcopyrite disseminated in about equal amounts. Concentration of sulphides is spotty, the heavier dissemination generally occurring as large blebs. Some of the chalcopyrite is tarnished. Calcite fairly common, associated with sulphides. Hematite coats fractures. Rock as mined is well fragmented with a high proportion of fines containing considerable sulphides.

JOHN E. KINNISON

JEK/ds
cc: ACHall
WCWaidler
KRichard
NWeiss
JDVincent
ARRowney

AMERICAN SMELTING AND REPTRING COMPANY Tucuca August 6, 1958

FILE MEMORARDAM

MISSION - Lot 7 Metallurgical Samples

Hornfels. Fine-grained soft diopside hornfels. Cpy is well disseminated in medium to large blobs and as thin veinlets. Py occurs in minor quantities. Some of the vein cpy is well tarnished. Sphalerite occurs in minor amount along some cpy veins. The rock as mined is well fragmented, but contains more coarse material and fewer fines than did previous lots consisting of tactite. The fines contain some sulphides, but less than the tactite fines.

JOHN B. KINTEGON -

JEK/ds
ec: ACHOLL
WCWnidler
ERichard
NWeiss
JEVincent
Alkomoy

AMERICAN SMELTING AND REFINING COMPANY Tucson
August 11, 1958

FILE MEMORANDUM

MISSION - Lot 8 Metallurgical Samples

Hornfels. Fine-grained soft diopside. The principal sulfide is chalcopyrite, heavily disseminated in blebs and stringers. Pyrite is present but in a lesser quantity. The rock as mined is well fragmented, and contains a high proportion of fines, but in lesser amount than previous lots of tactite. The fines contain a slightly greater amount of sulfides than the fines of Lot No. 7.

JOHN E. KINNISON 4

JEK/z
cc: ACHall
WCWaidler
KRichard
tWeiss
JDVincent
ABROMNey

P-2.2.1

AMERICAN EMELITING AND REPUBLING COMPANY Tucsion August 18, 1958

#### PILE MEMORANDUM

#### MISSION - LOT 10 Metallurgical Samples

Hornfels. White, soft dispaide, mostly fine-grained granular, but partly as bladed or fibrous (probably hedenbergite molecule present), fine-grained aggregates. Chalcopyrite is the principal sulphide, and occurs as small to large heavily disseminated blebs and in short discontinuous stringers. Pyrite is present as disseminated blebs. The rock as minod is well fragmented and contains a high proportion of fines, in about the same quantity as previous lots of hornfels. The fines contain some sulphides.

JOHN B. KINNISON

JEK/ds
cc: ACHALL
WCWaidler
RRichard
INVelos
JDVincent
ARRowney

AMERICAN SMELITING AND REFINING COMPANY Tucocon August 18, 1958

FILE MEMORANDUM

Lot No. 9 NESSTON MUTALLIBRICAL SAISTES

Lot No. 9 was a repeat of Lot No. 3 and therefore is not described.

JOIN B. KINNIBON L

ce: ACBALL
WCMLdler
KNichent
INcies
JDVinomt
Alkomey

AMERICAN SMELITING AND REFINING COMPANY Tucson August 22, 1958

FILE MENORALDIM

MISSION - LOT 11 Metallurgical Samples

Hanging wall rock from Fine bline pit.

Ampillite and sandy ampillite. Light to dark brown, dense, very hard, highly recrystallized ampillite with local concentrations of small round quarts grains. The rock is quite hard to break with a geology pick, and breaks to a semi-conchoidal uneven fracture. Sulphides are disseminated moderately throughout the rock, but occur in equal abundance as thin vein fillings. Sulphides are mainly pyrite and chalcopyrite in about equal amounts, but either one may locally exceed the other. Individual disseminated sulphide grains are usually 1/2 to 2 mm. in size. The chalcopyrite shows provalent tarnish, but some small amount of the tarnished sulphide may be bornite. Spidote and chilorite are frequently associated with the sulphide grains. Chlorite is also present as thin films on fracture surfaces. A trace of galena and sphalorite is present. The rock as brought from the Pima pit contains many large fragments, esceeding one foot, but no boulders. A small percentage of fines is present.

This sample contains rocks essentially identical to a substantial part of the argillite rocks at East Pinn which will be miled. It compares to the hardest type which will be encountered. Possibly a large portion of the East Pinn argillite is somewhat softer, at least from a crushing standpoint. The ratio of pyrite to chalcopyrite from this lot (about 1:1) is not representative, however, of most of the East Pinn argillite. At East Pinn the ratio of pyrite to chalcopyrite will normally exceed 1:1, and may at times be several times greater. The sulphides at East Pinn will be principally disseminated, and contain fewer sulphide veinlets, in contrast to this sample.

JOHN E. KINNISON

JEK/ds cc: ACHall WCMaidler KRicherd IMeiss JDVincent AERomey AMERICAN SMELITING AND REPINISH COMPANY Tuccon September 2, 1958

PILE MEMORARDIN

MISSION - 107 12

Lot 12 is the same material as Lot 11 and therefore is not described.

JOHN E. KINNISON

ds ce: ACHALL WCMaidler KRichard NWeiss

JDVincent Allhouncy AMERICAN SMELTING AND REFINING COMPANY Tucson Arizona September 4, 1959

#### MEMORANDUM FOR T. A. SNEDDEN

MISSION ORE BODY Analyses of Molybdenum And Other Elements -Composite Samples

This describes a collection of composite sample analyses for molybdenum and other metals through the entire Mission ore body. This basic information has, for the most part, already been used by you and others in your metallurgical considerations. The data is compiled here merely to get it all in one place for the record.

Sometime ago it was determined by Mr. Boss at Silver Bell that, due to the presence of tungsten, most of the molybdenum assays made during the course of the main drilling campaign were in error, or at least suspect. This was due to the obscure fact that in conventional analytical determinations of moly, any tungsten present tends to produce an erratic moly value, usually on the high side.

Early in the drilling program it was observed in the core that moly was in spotty occurrence and not in sufficient abundance to warrant systematic assaying of all individual core samples for moly. Occasionally, individual samples were assayed for moly in order to gain a general idea of the grade range. The fact that these random samples are now thought to be in error is of no particular consequence. The values for these random samples are recorded only on the "Drill Assay Logs" which are on file at the Mission Laboratory.

Eventually, a method for accurate analysis of moly was worked out by Silver Bell and checked. Composite samples then were made up to determine the average amount and distribution of moly in the ore body. These composites had the following specifications:

All samples were inside or within a reasonable distance of the ultimate pit limit. All ore lenses of more than 30' in drillhole length were included. Each composite pulp was made up by combining weighed amounts from pulps of individual core samples, proportioned according to length of core run. Each composite consisted of ore lenses from several holes depending on area and ore type. The areas were selected as being structural units in a general sense. They are shown on the attached map (Att. A), whereon Areas A through D represent the eastern one-third of the ore body, and E through K the western two-thirds. The ore in each area was further subdivided according to the following ore types:

September 4, 1959

1. Tactite-Hornfels

2. Argillite (Papago formation, principally)

3. Mixed intercepts: tactite-hornfels with argillite and gypsum (intruded in part by thin metaporphyry sills)

4. Quartzite

The number of composite samples was limited due to the complexity and expense of the moly determinations.

Attachment B is a tabulation (1) of the individual core intervals constituting each of the 28 composite samples, (2) of the percent Gu of the composites as calculated (weighted) from original, individual core sample assays (Silver Bell), and (3) of the MoS2-Cu-WO3 assays of the composite samples by Silver Bell, using their revised and checked analytical procedure for moly and tungsten.

The drillhole intervals are plotted on a working set of the 100-scale Geological Sections in my office, and also on that set of 100-scale sections in Mr. Schubel's office which shows the ore blocks and yearly pit outlines.

The composite samples individually represent blocks of ore ranging in size from 0.5 to 7.8 million tons. Although the distribution of moly within each of these large blocks of ore is not known with any precision, by visual inspection of core it is erratic. The moly probably is somewhat concentrated in small zones sporadically distributed through the ore blocks. This condition is further evidenced by the fact that the above-average moly composite samples represent only one-third of the total ore body. Moly does not follow the copper; that is, higher grade copper are does not necessarily contain better moly value, and some small occurrences of moly, up to .7 or .8% in grade, are in material which is below ore grade in copper. In some instances these small pockets of relatively high grade moly might be milled regardless of their sub-ore Cu content.

There appears to be no consistent favorability of moly for any one of the principal ore types, as shown on the following table:

Ore Type	Drillhole Length	Weighted % MoS2
Tactite-Hornfels Argillite Mixed Quartzite	7467.9 3403.9 402.2 1246.8	.024 .023 .075 .021
Total and Average	12,520.8	.025

Although the lenses of "mixed" ore types on the above tabulation are erratically high in moly content, they constitute only a small portion of the ore body.

The following table groups the composites according to the areas shown on Attachment A:

A1ºce	Drillhole Length	Weighted
A B C D E F G H I	1176.5 1023.5 1624.3 316.2 1202.3 444.2 1937.7 1232.2 768.4 883.5 1912.0	.039 .02k .014 .018 .035 .030 .014 .025 .028 .044
Total & Average	12,520.8	.025
Eastern Area (A thru D)	4,140.5	.૦૨૫
Western Area (E thru K)	8,380.3	4026
Total & Average	12,520.8	.025

The above data suggest that the higher values in area A are related to the East vein, and those in areas I and J are associated with metaporphyry sills. Otherwise, there is no clear relation between the distribution of moly and those structures which are believed to influence copper distribution.

The composite sample blocks are re-calculated to correspond to the yearly ore production intervals of the ore reserve report of March 2, 1959, as follows:

Interval	Weighted % MoS2	Weighted % Cu		
Pre-Mine	•030	-96		
lst Year	.020	-95		
2	.025	•95		
3 4	-023	-97		
Ĩ.	.027	1.09		
5	.026	1.30		
6	.031.	1.07		
7	.027	-94		
8	.027	.73		
Ultimate	# 023	·78		
Average	.025	-90		

- 4 - September 4, 1959

When applied to the yearly open pit outlines, each composite sample becomes subdivided, and the assay value may appear in weighted proportion in several yearly intervals. As can be noted above, this has the effect of smothing the moly values. This would seem to indicate that the mixing effect of mining will provide a uniform moly content in mill feed. However, this applies only when averaged over large production intervals. It is important to recognize that in short intervals of days or weeks the moly content of mill feed may fluctuate radically.

All of the composite samples have been analyzed spectrographically by our Central Research Laboratories. As a matter of record these results are included as Attachment C. Mr. Courtright and I discussed these data with Messrs. Weiss and Vincent. It was concluded that, with the exception as noted below of Pb and Zn, no elements other than moly are in sufficient abundance to be of present concern from the standpoint of extractive metallurgy.

Attachment D is a tabulation of the Zn-Pb-Au-Ag values in the composite samples, as reported by Jacobs of Tucson. He told me that accurate determinations of Zn and Pb in such small amounts are difficult, but that he took all possible care with these determinations. The Au-Ag assays were made merely to confirm the opinion that no significant concentrations of these metals occur within the ore body.

With the exception of one small composite, Jl, which contains 0.46% Zn, the Zn and Fb assays range from trace to 0.06%. This demonstrates that, as an average through the ore body, these metals exist neither in recoverable nor in deleterious quantities. However, there are a number of irregular pods and lenses which contain from 1.0 to 10.0% of both Fb and Zn. Most of these bodies probably are small -- up to a few thousand tons -- and only rarely contain more than 1.0 or 2.0% Fb and Zn. But there is one occurrence in the eastern part of the ore body which might consist of as much as 100,000 tons. This is penetrated by drillhole 152 which shows 40.5° with an average of 8.3% Fb and 12% Zn. (See El Paso Flotation test 612F, 10/4/57.) Also, at the bottom of the ore body in the western part there is a fairly consistent layer containing sphalerite and lesser galena which ranges from 1 to 10 feet in thickness. This layer usually contains less than 4.0 or 5.0% Zn-Fb combined, but occasionally it will carry more.

Although these various Zn-Fb occurrences are of no consequence in terms of the whole ore body, they may possibly seem big for an occasional day's or week's mill run, say, unless this material is sorted out (stockpiled?) during mining in order to avoid short-term metallurgical difficulties.

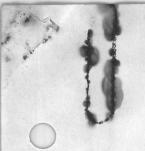
In answer to a request from the Smelting Department for chemical analyses of the various ore types, six of the composite samples were selected as being representative, and were analyzed at the El Paso Umpire Laboratory. These results have already been reported in your letter of June 12, 1959 to Mr. Pope, but they are repeated here because they provide additional information on the distribution of elements in the ore body.

Gompo	site						
No	G nequipments	Cu	S102	Fe	CaO	A1203	MgO
A	1	1.61	40.68	10.15	24.26	5.53	5.35
C	1	1.01	41.06	8.66	25.82	3.93	7.70
C-	lų .	1.35	49.27	8.04	13.85	8.23	3.51
G.	2	0.84	61.34	5.14	5.45	10.09	2.88
Hen	1	1.10	45.35	10.13	20.0	3-43	6.65
I-	3	0.48	44.18	3.17	15.08	4.83	3.45

Original Signed By K. Richard

KENYOW RICHARD

Attachments - A, B, C, D
KR/ds
cc, With attachments:
 DJPope
 CFPollock
 NWeiss
 JDVincent
 ACHall
 RBMeen
File Copy routed to:
 Woschubel
 JECourtright
 SVFay
 JEKinnison



AMERICAN SMELTING AND REFINING COMPANY Tucson Arizona

March 13, 1958

Mr. Morman Weiss Milling Engineer American Smelting and Refining Company 600 Crandall Building Salt Lake City, Utah

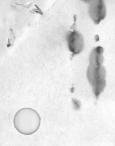
> EAST FIMA Metallurgical Ore Types and Distribution

Dear Sir:

Enclosed is a memorandum by Mr. Kinnison with attached diagrammetic section and tabulation giving relative percentages among ore types. The ore is subdivided into those physical types which seem to have fairly distinctive metallurgical characteristics, particularly as regards grinding and crushing. (As stated in the last sentence of Kinnison's memorandum, the ore body cannot yet be subdivided into types having clearly contrasting flotation characteristics.)

At one time I indicated to you that we possibly could determine the tonnages of the various metallurgical one types within specified production periods. It now is apparent that this cannot be done accurately because the physical differences are too subtle and tend to vary too widely within each small, individual stratigraphic and structural unit of the ore body. However, when compared with his diagrammetic section showing one in relation to the 2-year, 8-year and ultimate shape of the pit, Kinnison's tabulation provides a general idea of the proportions of the ore types and the periods during which the principal ones will predominate in the mill feed. Even though these data are no more than generalizations, they may be of help in the mill planning.

As we discussed during your last visit here, the physical character (in terms of grinding and crushing) of ore mined from this deposit will vary much more widely than at Silver Bell or any of the other large-scale disseminated deposits. This applies when considering hourly and daily production units as well as monthly and yearly intervals. Among the so-called porphyry plants, the Kennecott will at McGill has probably handled the greatest variety of ore types during the past 20 years. This mill has treated large tonnages of material similar to some of the East Pima ore types, particularly tactite and hornfels. Of course, McGill's major tonnage has been ordinary porphyry ore, and I would not know the scheduling and mixing procedures. In any case, it would seem to me that the McGill mill feed may represent the closest



physical comparison to some of the East Pima conditions, although it will not reflect the extremes during short time intervals which should be anticipated at East Pima.

A set of 18 specimens of typical ores has been selected and thin sections, petrographic descriptions and photomicrographs are now being prepared with emphasis on metallurgical problems, in accordance with our discussions with you. These will be sent to you soon.

By his copy Mr. Pope will be advised that a suite of typical ore specimens will be sent to him shortly.

Yours very truly,

Original Signed By K. Richard

KENYON RICHARD

Attachments
cc - all with attachments:
DJPope
IHHart
NWeiss - 2 extra

JDVincent

RJMellen

bc: JHCourtright JEKinnison

#### AMERICAN SMELFING AND REFINING COMPANY Tucson Arizona March 10, 1958

#### MEMORANDUM TO K. E. RICHARD

EAST PIMA Metallurgical Ore Types and Distribution

The attached diagram and tabulation of rock distribution illustrates the occurrence and proportions of the different types of ore bearing rocks in the East Pima copper deposit.

The host rock types shown on the diagram and tabulation sheet constitute over 95 per cent of the material which will be milled, and with but slight modification are classified in the same manner as used on the geological sections prepared last summer (both Mr. Hart in the New York office and Mr. Lacy in the Salt Lake office have a set of these 100-scale sections).

The per cent distribution of the host rock types was estimated visually by studying the geological cross sections, and by utilizing general familiarity with East Pima geology. As such, this estimate is not a precise measurement but is the product of personal judgment guided by the data recorded on the geological cross sections. Furthermore, only ore bearing rocks within the ultimate pit (engineer's design of 1957) were considered, and any change in the shape of the pit will change somewhat the estimated per cent distribution.

The tests conducted at El Paso (Serial 612) have made apparent the fact that different rocks from East Pima react variously to grinding and require different flotation treatment.

From a metallurgical viewpoint, the following rock types are the most important:

- 1. Argillite. A generally very hard, siliceous rock, but commonly fractured. In part it contains stringers of chlorite and serpentine. It is essentially a silt-sized arkose with a variable quantity of small (less than 3/4 mm) sand grains. The grade of ore in this rock type is normally less than 0.8 per cent copper.
- 2. Quartzite. A pure, fine-grained quartzite, with silica cement. The grade of ore is normally less than 0.8 per cent copper.
- 3. Feldspar rock. In the eastern ore body coarse-to fine-grained felds-par, with some quartz, occurs as host to a smell tonnage of better grade ore. It probably would compare metallurgically to the argillite.

- 4. Tactite. A garnet rich rock which varies from euhedral friable to structureless masses. It commonly contains admixed soft diopside, sometimes constituting a major portion of the rock. Some of the tactite is extremely hard and tough, but the diopside-rich type is a hybrid rock containing both hard and soft minerals which may produce a differential grinding problem.
- 5. Hornfels. The hornfels variety of host rock is more variable in character than are most of the other rocks. It is dominantly a diopside rock, with minor garnet, but exhibits 3 physical types.
  - A. Hard, dense. This rock is massive and uniform, and microscopic work suggests that this type may contain more iron than types B. or C., and possibly it grades toward a fine-grained hedenbergite rock. This type may be hard to crush, but may grind more easily than tactite.
  - B. Fine-grained, granular. This type appears "sandy." It consists of granular massive diopside. The rock crushes fairly easily, and as indicated by El Paso mill test grinds easily also.
  - C. Fine-grained, pulverent. Similar to type B., but is finer grained and tends to disintegrate easily. This type may be expected to crush and grind easily.

Of these rock types, the tactite and siliceous rocks (argillite, quartzite, feldspar rock) are hard rocks, and the hornfels types are softer and require less grinding time. However, the hornfels types as a group show a wide range of physical properties.

There is as yet no clearly definable relation between the host rocks described above and the copper recovery or grade of concentrate.

JOHN E. KINNISON

JEK/ds

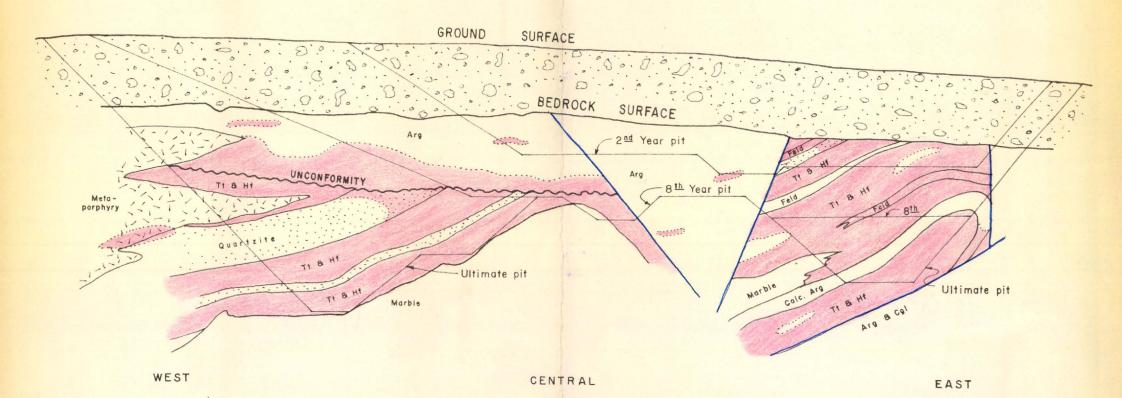
# DIAGRAMATIC CROSS SECTION - EAST PIMA

LOOKING NORTH

Showing Approximate Rock Distribution.

(NOT TO SCALE.)

EAST



Potential ore zones shown diagramatically in red.

TO ACCOMPANY Letter DATED Mar. 10, 1958

BY John Kinnison

# TABULATION - ORE HOST ROCKS.

(Within the ultimate pit.)

Но	st rock	We	est & Centro	al Area			East Area		Total			
	Argillite	35%	35%	35%	35 %	2%	2%	2%	25%	25%	25%	
	Tactite	30	30	30		75	75		43	43		
silica	Hard, dense Hf (A)	9	10		60			90	4			
	Fn-gr, granular Hf (B)	12	30	20	20 30	60	9	15	90	12	25	68
	Fn-gr, pulverent Hf (C)	9	20		6	15		9				
	Feldspar rock		_	_	-	6	6	- 6	3	3	3	
	Quartzite	5	5	5	5	2	2	2	4	4	4	

May 23, 1958

R. L. DuBois, Geologist 1309 East Elm Street Tucson, Arizona

> EAST PIMA PETROGRAPHIC Descriptions for Metallurgy

Dear Sir:

We recently reviewed briefly with our metallurgists, Mr. Weiss and Mr. Vincent, your petrographic reports on the eighteen thin sections of specimens selected for metallurgic purposes. The metallurgists seemed quite pleased with this information and expect to make use of it during test work to be conducted with the University Pilot Plant here beginning in June or July. It seems to me that at that time they may have occasion to go into this matter further with you.

I believe that John Kinnison has already advised you that the metallurgists would like another set of the microphotographs, probably on dull finish prints, with some of the minerals identified in some manner by ink symbols.

Again let me say that the form and context of your reports are excellent.

Yours very truly,

Original Signed By K. Richard

KENYON RICHARD

KR/ds
cc: NWeiss
JDVincent
JEKinnison

East Penra Metallurgy. Memo to K. E. Richard The following descriptions perfain to a selected suit of samples collected for use Papago formation D.D.H 96@262' Argelito. This sample shows some chloritie alteration, and is typical of much of the ove bearing argillet, although some varties are more dense and hard and lack the chloritie alteration. This rock type constitutes an important host in the central and western areas. Arkose (minor quantity) and conglomerate (locally dominant) have similar pool siliceous characters. DDH. 48@ 351' Arigillite. This sample shows some chlorities and argillie (?) alteration. D.D. H 88@375' Argillete. Some chloritie alteration. Sulficles associated with quarty veins. This sample may be considerably recrystallied.

Peina formation. D.D.H. 151 @ 344 Diopsicle hornfelo. The fine-grained a moderately saft varies of this rock type is an important kest rock throughout the deposit. Itemenerals Containing are dispuids and calcute in varying amounts, which is the dominant type of hompels. D.D.H. 151@ 370 D, opside hornfels. Like above sample, showing heavy suffedes DDH. 138@ 301' Diopsiels hornfels, Soft "clay-like" variety. This is a prominent type of ore host. D.D. H. 151@ 380' Diopsiels homfels. Like 151@ 344', showing heavy, disseminated sulfiales. D.D.H. 113@ 383' Diopoich homfels. Abundant calcit. Hematite veins and aliesemenation, and disseminated sifedos. D.D.H. 151 @ 313 Tactite with diopside. This sample shows a mounts, and represents a transition phase between pure factite and disposals formfels. Tocteto. Massive garnet with possibly a D.D.H. 113 @ 374 small quantity of admissed dispuids. Hemalite and sulfides heavy. This type constitutes and important is important elsewhere.

PD.H. 49@ 555

Quartyte. This sample is typical of the quartites of the Pina formation, They are not an important host rock.

D.D. H 32@541

Wollastonito hornfels with gurnet. This sample shows typical cause-grained fibrous wallostonito. onussive garnet occurs throughout the sample in large blebe. Telfede dessemmated in large blebe. Wollatonite is only locally supertant as a hoatrock.

I greous

D.D.H. 101 @ 336 Metaporphyry. Typical sample, but showing more Kaolingalion (?) of the felalopar than normal. This rock only rarely consitutes an are host.

#### AMERICAN SMELFING AND REFINING COMPANY Arizona Tueson Hovember 29, 1957

demonation for Mr. K. E. RICHARD

HAST PIMA ML Paso Tests - Serial 612-F

In reference to a letter by Mr. Mornan Weiss, dated October 15, 1957. the following points seem pertinent:

Mr. Weiss classified the results of Serial report 612-F (El Paso Ore Testing Laboratory) into groups labeled good, fair, and poor. For the reasons listed below, in only one case is it fair to suscribe the poor results to an inherent rock characteristic.

# Recovery possibly related to rock type or alteration

Test C, DEN 152-U

COURSE 13,55

Conct. Recovery 67.0

Rock Type Hornfels cund. Tactite

Both with clay alteration. Some Pb-En. Lons to rougher end cleener tail.

# Positive correlation to rock type impossible

Test H, DDH 160	Peed	Copper Conct.	Recovery	Rock Type
	•58	20.76	83.9	Sili- ceous

# Comment

This sample contained values concentrated in a small part of the whole sample, therefore is a mixture of ore and waste. The grade of feed is such that in these tests somewhat lower grade concentrate would be expected. The feed con-tained 146+65 mesh. The cleaner tail contained 1.62% Cu @ 6.6% recovery.

Test D, DDH 152-D .62 2.43

74.8

bonate

Siliceous This sample contained abundant with onr- Pb-Zn and a Pb-Cu conct was produced. This unusual type needs special treatment.

Tactite Test M, DDH 164 90.7

This rock contained a high pyrite-chalcopyrite ratio. The grade of feed is such that in these tests a somewhat lower grade of conct would be expected. The combination of factors may have resulted in the very low conct grade.

Serial 612-F	Food	Copper Conet	Recovery	Rock Type	Rovember 29, 1957
Test L, DDH 160	1.98	28.19	64.3	Horn- fels	The rougher tailing contained 27%+65 mesh assaying 1.13% Cu.
Test E, DDH 15	1.64	22.75	77.4	Tac- tite	The rougher tailing contained 15.7% +65 mesh assaying .37%Cu, and the cleaner tailing loss was 10.5% to a product assay- ing 3.49% Cu.
Test O, DER 167	2.70	28.30	77.0	Horn- fels	The rougher tailing contained 6.5%+65 mesh assaying 2.55% Cu. In addition the sample contained a small amount of copper oxides and native copper, and a significant amount of chalcocite.

A definable relation between recovery and type of rock or alteration, with sufficient knowledge thereof to allow visual recognition with sufficient accuracy on which to estimate quantities, will probably require additional ore testing.

The following list of rocks which occur in the Pina formation (principal and most diverse of the host formations) suggests the magnitude of host rock complexity. It also should be remembered that these types may often occur in beds too small to be separated in an open pit mining operation.

# Possible gangue combinations in Pina formation

Tuctite

I. Massive garnet, varying from subsdral frishle masses to structureless, soft to hard masses, with or without clay alteration.

2. Garnet in a matrix of other minerals such as diopside, serpentine, or others.

Hornfels

Hard, dense (massive) to soft and pulverent, and hard and gramular. Mineral composition may vary and occur with or without veinlets of actinolite or serpentine, and clay alteration.

2. The above types with amounts of garnet, increasing transitional to tactite.

Tactite-homfels

Mixture of the above mentioned types in patches large enough to be classified by themselves, but too small to be individually logged or separated on seclosical maps.

Others

Massive, fine to coarse-grained, actinolite or wollastonite. Marble.
Feldspathic tactite, or garnetiferous feldspar rock.
Quartzite and argillite, with or without minor garnet.

#### AMERICAN CARLIFING AND REFINING COMPANY Artsona Transcen Hovenber 29, 1997

## remanamental for her. K. E. RICHARD

PAGE PEN El Peso Tests - Seriel 612-F

tors may have resulted in the

very low coact grade.

In reference to a letter by Mr. Norman Wedge, dated October 15, 1997, the following points seen pertinent:

Mr. Weiss classified the results of Serial report 612-F (Ed. Poso Ore Testing Laboratory) into groups labeled good, fair, and poor. For the resonant listed below, in only one case is it fair to superibe the poor results to an inherent rock characteristic.

### Recovery possibly related to rock type or alteration

Tout C, DM 152-U	Copper		
	eed Conct. Recovery	570e	Consent with clay alteration.
	46 13.40 67.0		
		Testite and c	Po-Za. Loss to rougher
		Attraction land belong to	

Positive convelation	n to I	ock type	imposite	4	
Tout H, DEH 160	<u>rest</u>	Copper Conct.	Pecovery	Pock 2002	Content
	•38	10.76	83.9	8114-	This sample contained values concentrated in a small part of the whole sample, therefore is a sixture of one and waste. The grade of feed is such that in these tests acceptate would be expected. The feed contained 10/465 mech. The cleaner tail contained 1.625 Gz & 6.65 recovery.
Test D, DDH 192-D	.02	2.43	74.8		This sample contained abundant Fb-Sh and a Fb-Cu conet was produced. This unusual type needs special treatment.
Test M, DE 164	.0.	9.56	90.7	Toolite	This rock excitained a high pyrite-chalcopyrite ratio. The grade of feed is such that in these tests a scannial lower grade of conet would be ex- pected. The continuation of fac-

E. Pima El Peso Testa Serial 612-F					November 29, 1957		
	<u>Ieel</u>	Copper Const	Recovery	Type Type	Comments		
Test L, DON 162	1.98	28.19	64.3	Home- folis	The rougher tailing contained 275+65 much accepting 1.135 Cu.		
Toot B, DDE 154	1.64	22.75	77.4	Tac- tite	The rougher tailing contained 15.7% +05 mech accepting .37%Cu, and the cleaner tailing loss was 10.5% to a product accep- ing 3.49% Cu.		
Tent 0, 10H 167	2.70	28.30	77.0	Inch- fole	The rougher tailing contained 6.5%+65 mesh assaying 2.5% Cu. In addition the sample contained a small amount of copper oxides and native copper, and a significant amount of chalcocite.		

A definable relation between recovery and type of rock or alteration, with sufficient knowledge thereof to allow visual recognition with sufficient accuracy on which to estimate quantities, will probably require additional ove testing.

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## Possible gangue combinations in Pina formation

### Tuctite

I. Mosive garnet, varying from embedral frieble masses to structureless, soft to hard masses, with or without clay alteration.

2. Carnet in a matrix of other minerals such as dispeide, serpentine, or others.

### Hamfels

"hard, dense (massive) to soft and pulverent, and hard and granular. Mineral composition may vary and occur with or without veinlets of actinolite or serpentine, and clay alteration.

The above types with amounts of gamet, increasing transitional to tactite.

### Tectite-homfels

Mixture of the above mentioned types in patches large enough to be classified by themselves, but too small to be individually logged or separated on geological maps.

#### Others

Massive, fine to coarse-grained, actinolite or vollastonite. Marble. Feldspathic tactite, or gametiferous feldspar rock. Quartaite and avgillite, with or without minor gamet.

John B. Kriminger

A - 4 - 140' - 20

K-1-282 40 K-2-1090 154 K-4-275 39

7/200

B-1 -1045'- 150

C-1 - 1305' - 186

C-4-205' - 29

D-1-315 - 45

E-1- 942 /35

E-2 - 270' 38

F-1 - 325 46

F-Z - 85 12

6-1-790 110

6-2-795 113

G-4-190 27

H-1-632 90

H-2 - 295 42

H-4- 75 118

I-1 - 350' 50

I-2 - 210 30

I-3 - 90' 13

I-4 - 85 12

J-1 - 155 2.2

J-2 - 300 43

J-3 - 320 46

5-4-115 16

Court outer services

ruations 1. Tac- Hufls. 2. Papago 3. Milapos. Ti-Hi (Arg. & gyssifenus)
uf thin Mp 5.1/s 4. Qts. Ireal 6 Castern Western 7/3

all compy within reasonable, distance of ult. pit. all ore lenter out ± 30 in drill hole length

Fife Memorendum Memorandom for: Mr Kenyan Richard East Pina El Paro Luis - Serval GIZF Dear Sir: In reference to a letter by Mr. Norman week, dated October 15, 1957, the following points seem pertenent: Mr Weiss classified the results of senal report

6/2-F. (El Paso Ore testing laboratory) into groups labeled

good, fair, and poor. For the reasons listed below, is is it fair to suscribe the poor results to an inherent rock characteristic in only one cases. Recovery Possibly related to rock type or alteration Reck Type Coment Test C, DD.H. 152-U. Feed Conct. Recovery

. 46 13.48 67.0 Hornfels and Toelets)
both with clay afteration.
Some Pb-Zn. Loss to trougher and cleaner tail. Positive correlation to rock type impossible Comment Rock Type Recovery This sample confuned arabies concentrated Feed conct. Test H, DOH. 160 Siliceous. 83.9 10.76 in a small part of the whole sample, therefore is a mixture of one and waste. The grade of feed is such that our in these tests and toward in these tests to the second of the grade concentrate would be expected. The freed Contained 14 % +65 med The cleaner tail contained 1.62 % Cu @ 6.6% Me = This sample consiliceous with 152 D .62 74.8 tained abundant Pb-2r, carbonate. avelor Pb-Cn conet was produced. This unusual type needs a pecial treatment,

Possible gangue combinations ~ Pina formation 1 actito 1. Massive garnet, varying from enhedral friable masses to structureles, soft to hard morses, with or without clay alteration.

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Copper Rock type Comment Recovery Feed Conct Test M DDH 164 This rock contained a high Pyrite -90.7 9.56 .64 chalcopyrite ratio. The grace of feed is such that in these texts an lower Tactite grade of court, would be perpected. more-The combination of factore may have resulted in thowery low conet grade. The rougher tailing 64.3 Hornfels 162 1.58 28.19 contained 27 % + 65 mesh assaying 1.13 % an. The rougher failing contained 77. 4 Toctite E. 154 1.64 15.7 % + 65 wesh assaying .37 % cu, and the cleaner taling loss was 101.5 % to a product arraying 3.49 % au. The rougher tailing contained 2.70 28.30 Hornfels. 6.5% +65 mesh issaying 2.55 % a. In addition the sample contained a small amonot of copper oxides and native copper, and a significent amount of chalcocite. A definable relation between and type of rock of with sufficient knowledge thereof to allow visual recognition with with sufficient types with a sufficient to of occuracy an which to estimate quantities, will probably require additional one testing As an ovelecation of the past rock camplesty, The following list of rocks which seems in the Penner formation (principal and most diverse of the host formations) suggests the magnitude of host rock complexity. It also should be remembered that these types may noccur in heds too small to be separated in an open put mining operation.

5, / ceans Rocks

Not useful for this analysis

DDH 150 20% heads

152 High Pb-2n produce Pb-Can Cone.

160 19% +65 mesh

DDH

Tossib. lities

Possib. lities

Cl Tail (also contained (P. f.)

Some Ce)

Low grade Conc.

DOH	Possibilities	
	2	Pof different Cal
158		Pgf and in Ball mil
162	2	- CIS Aug shorts 1200 time
17/ 324-338	?	Pgf and Tt-feld-Arg starts Restina
175 326-350	?	Pof Mixed Tt, HF, Arg.

A review of flotation testo made at El Paso, for the purpose of involent arriving at some conclusions regarding the relation of rock types to flotation recovery, has trought to light the following points which must be closed up before amerabilition of test result for purposes of this review can be completed.

1. The data spects of period reports 612 to 612 c

report, among other things, these critical data: per cent copper

in "copper concentrato", "cleaner taili", and rougher fails", together with the

weight and per cent recovery of each. The nevery of copper cent recovery

May the three products equilo 100 per cent. The recovery of copper is

of obtained by using the weight and assay of the heads in nation with

the weight and array of the product. Due to inherent limit of accuracy

these percentages do not total precisely 100 per cent, and are adjusted

in potion with the weights of the products. My attempts to displicate

this works show small differences with that given by El Paso,

which may result from methods of rounding off fegure, or possibly

Serial 6.12-c test A. 3 cycle Measured Rec. Adjusted Rec.

Feed - 3000 grams 2.17 % Cus

Copper cone. - 198 30.84 94.1 % 2.7 2.7 2.7

Cleaner Tails - 60 2.92 2.7 2.7 2.7

Rougher Tails 2742 .077 3.2 × 3.2 3.2

Totals 3000

these figures were computed by sliche rule at El Poso. Two examples

Test B single Cycle Serial 612-C JEK Calculation Adjusted Rec Assays .58 % Measured Rec Weights Recoveries Feed 1000 grams 57.1% 58.7% 24.33 57.1% Copper conc 14 28.6 Cleaner Tail 86 27.9 28.3 1.93 Rougher Tail . 098 900 15.2 14.8 14.6 ,00 102,5 1000 100 From the data presented on the test sheets, summares are compliled which guot the percent copper in the copper concentrate, together with the comes panding recovery. The fount I wish to make is that the cleaner fails, which are really a middling, and are returned to the second stage rougher in the three cycle test, apround cerculating lood which would part of the total copper recovery in closed cerenit mill spection. The flow sheet of the tests, as I understand it, is: - Returned to rougher & Heads Rougher Regnad Cleaner Tails-1

1000 gm. 1 cy.
3000 gm. 3 cy. mixed with next batch of feed in the three eyele Conc .. The concentrate weight surfaces in three cycle lests are presumably obtained from the combined concentrates. The cleaner failing weight and assay is probably (3) the third cycle product probably (?) the third cycle product. Only in the first report (612) are the recoveries for copper concentrate and cleaner tailing combined in the summary to indicate total copyer recovery. Taggert has the following comment on laboratory texts:

Taggart, p.1230 [warmile] "The recovery will come close to the molecated explosition Colculated by the formula (10), p. 1236, from the laboratory results, if, in the calculation, the figure for good of concentrate is that obtained from the cleaner speration, the figure for the and the middling or cleaner tailing of famed in the below tony is disregarded, provided that the givele of this welding product so not more than twice the goode of the original heads, and That the mineralogical character of the middling is not markedly different from that of the original feed." framler 10, p 1236. Recovery (%) = 100x array of core, (Assay of feed - Assay of tuil) Assay of feed ( Assay of cone - Assay of Fail) Using Test B, Serial 612-c (see table store), this formula 100 x 24.33 (.58-.098) = 83.4 % Recovery I this formula, in effect, assumes that only the copper in the rougher taile is lost, and that, uncle the limitation set forth, all the cleaner tailing will be recovered. This, adding the cleaner concentrate and cleaner tailing recoveries yields an equivelent result: 57.1 + 28.3 = 83.4 % recovery. The difference in results is explained by the foot that one methoduses assays only, and the other uses aways (some for different products), and weights which are reported to the meanest gram.

The foregoing anolysis lads me to believe that ther exists a fundamental error in the method of reporting results; from the concentration ratio, where reported, has been derived directly from the weights of the feed and "copper concentrate", thus ignoring the possible effect of the circulate book from the cleaner tailing, which may be appreciable is some instances.

2. In the fests of Serial report 612-0 to 612-F, a threecycle flour sheet from which the third cycle cleaner produces a "second copper concentrate", which is combined with the "first appear concentrate"

flow sheet pin which the third cycle cleaner produces a "second cycle concentrate", which is combined with the "first appear comentate in the summary results. Since I do not understand the mechanics of producing the two concentrates, there is nothing an which to bose any opinion concerning the relation of the cleaner toils to 'a finil recovery.

conclusions: Prefore attempting to analyze the effect of rock type on flotation results, the above points must be clarified.

Festel 148-149-150-151-152 individually Country time 9,-200 641/2 31/2 296-306} #f y some grnt. 57 1/2 148 51/2 68 Tt & gratiferous H f. \$6-Hf .3 1/2 432-452 148 64 4 1/2. 236-281 It. some It at beginning. 149 61 281-359 5 149 46.8 363-408 T+ 149 Arg w/ some ark. 794-834 150 63 3 /2 280-301) Tt - 21' Tt & HF 354-385) HA Fn-gr gamber dut. 151 26 /2 9 152 314-355 Tt

65.28

612 My 1 1956 I conshel sample gon poor recovery (294.3-305.8)
"Monfels" bypo. Woll, some serp., Mb, and dense mineral I unenshed sample (DDH 62) gar good recov. 612 A - July 1956 Granding was not lested accurately but the time to against through the same much size is as follows DDH 68 407-420 - Hornfels 5 minutes (75% 200)
76 408-418 - Tachte 10 , (76% (sludge board) 78 276-332 - Ark or Arg 16 " (?) 68 - 28.65% cover w/ 84.9% o recor (best of 3 tent) 76 - 29.72 " 87.9% " (bed 1 2 test) 78 - 29.23 " 89.2% " (one test) 612 A - March 1957 DOH 125 282-330'- Tt. w/herr the place tested molly 91.2 % rec. 29,74 % comet 92.0 612-c April 1957 DDA 134 243-287 } 2.17 %. Cu | 68% Mossine feldspar 297 - 304 112 292 - 288 3 .58 %, Cu Tack, 1/1 Gradery time 134-20 minute 192 - 12 minutes 134 agaves 94 % recovery in a 30.8% conet. 142 would jield no better than 83 10 recovery in a 25% conct. Mellen attributes this too high Py-cpy ratio (.58/0 an avel 9.8% Fe). 612.0- Composit of 8 sumples

Not useful for analysis

DDH 162 - 27% +65 mesh

Good Test

DOH

151 280-301

Possibilities

Cl Tail

Not typical Hf.

Tt & drop Hf.

Fair Test

DOH

151 443-486

Possibilities

al & Ro Tail

cl & Ro Tail

51 75% -200

Poor Test
Possibilities
Ro Tail

Mixed Hf-TH- Qfm high Fe/Carolio

167

RoTail

Arg. Hf. 40% core

# High conc.

Good Ro Rec

125 - Cl

148 206-306 Cl-Ro? Mixed

432.452 Ro?

148 Cl? (HA)

168 Cl? (HA)

171 388- Cl - 10%+65

171 417 Cl - 10%+65

- 174 Cl, Ro. (H.A.)

For Ro Ree Poor Ro Rec.

76 Mixed

112 Cl

149 236- Cl! Mixed

149 363408 Cl

178 413.450 Q Mixed

Low Conc

152 937 486 Ro-cl poor Mixed, clay act.

158 310- Ro fair 161 951- Ro fair Cl govel Mixed., silic.

161 321-347 Ro good Cl fair

16A Pofain Olgood High Felan

166 Rofar Olgoval Tt Egtat

(HA) 173 Rofair high Fe/cu

178 250-299 Po fair el fair

178 299-365 Ro-cl good

Polished sections of probable intrest to me to Clurgical tests. X- Section Thin section (Dubois classification) Geol, Hole & depth Log Sirvas No. - TS. Diop. Tran. - Act. Hf DDH 42 @ 392.5 422.0 - (TS-427'- Tt) 77 418.0 P7a - No TS -H 456.5 (T+) Hf- P13 766.0 56 80.4.5 - (T.S-795 gtz-diop Hf) HF- 17 45 745,0 78 366.D - TS 364 D.OP Hf. H - P 20 9.0

The metallugical sample results furnished by El Paso, analyzed by rock type, show the following trends. The tests of siliceons rocke incorclusively singgest that, good recoveres can be made. Of the 9 tests on siliceons types, 3 were not subject to analysis, Two gave good recoveries with good concentrates and a possibility of additional seconery from the cleaner tail, The remaining four, two of which were mixed took to and argillate, gave low grocle concentrates. There weeks need further festing, portrailorly checking the possibility of the low growle concentrates were caused by locked print-chologists grains, and soit require a finer grind. The test of houndels show mixed reaction. Of the 7 tests recoveries, two gave fair results, and two gave pour results, A One of the good tests was nacle on a sample not typical of the hombile as a general group; the fair tests show the possibility of further recovery from the cleaner tailing, but also a signible loss to the rangher tailing; and the poor tests, one of which was made on a mixed work not typical of hornfel and one on the soft variety of housel, both gave a high loss to the rougher tailing. The latter test on soft hornfels, however, we complicated by nearly half the sample contains some choleverts. These weeks need further testing.

Siliceous Cleaner cone Ro Tail Cleaner fail Psf Remarks POH NO % Cu % Rec % Cu % Fe % Cu % Rec. % Cu %Rec 5.4 89.2 4.8 29.23 ,72 5,4 Massive feldspor & some 9/2t w/minor Tt. Ce 134 4.7 2.17 94.1 30.84 2,92 2.7 ,077 3,2 14.15 150 ,20 4.0 .57 69.6 1296 17.8 .038 Pre-min Bx and cgl. 152 545 Pb-an Conc. Pof 158 253-298 1.13 6.3 1.00 14.05 87.5 3.4 .116 9.1 14 % +65 Pgf .58 6.6 9.5 ,060 3.5 83.9 1.62 10.76 Arg (feld) and Pof 171 324-338 9.9 ,57 17:87 87.6 . 44 6.0 2.5 .060 307-316 Tt and Arg (Feld) 2.39 8.5 94.6 21.50 .090 3.1 2.3 .089 Pgf 14.54 -162 .85 3.3 88.9 9.3 141 -1.8 ,087

	Feed		Tactit	cons	C/e	oner Tark	Ro	Tail	
I 4 No		% Fe	% Cu			a like		1/0 Rec	Remarks
76	.90	1,50	29.72	87.4	.86		. 097	10.3	studge board, Log Hf w/grnt
125	1.11	12.9	29.74	91.2	1.50	5,3	.039	3,2	Whematite. (Mo come)
142.	58	9.8	25,50	83	1.09	4.7	.068	12. 3	MASSIVE Grat.
148 296.1-301	1.69	6.5	31,08	88.5	6.00	5.7	.105	5.8	Sludge Board. Low Gratious Hf
148 432-452	3.14	8.2	27.3/	96.6	1.11	.6	.100	5.7	
149 236-281	.58	6.3	22.85	87.4	169	2.2	.063	10.9	cs yx Axinite.
149 280-359	.33	3. /	28.89	79.3	1.43	3.0	.059	17.7	Axinites.
363-408	42 Change	7.9	28.75	84.6	.87	2.5	1053	12.9	21 Th
152 314-355	1.29	8.1	16.13	89.9	.34	1.4	,026	8.7	7+ & HF
152 437-486	.46	6.4	13.48	67.0	2.37	11.8	1079	16, 4	It and HF, both clay
154	1.64	8.9	22.75	77.4	3.49	10.5	,221	12.1	Tt & silic. Hf. 15%+65
158 310-348	.70	7.3	19.59	88.8	.34	1.1	.075	10.1	/
161 451-504	2.23	10.4	23.917	90.9	,85	1.9	1180	7.2	Tt & Silie. Hf., some
169	.64	13.5	9.56	90.7	144	2.2	105	7./	7t \$ 1/2/
166	,55	5.8	14.87	90.6	,28	1.8	,045	7.6	Tt & arg (Pgf)
168 50'	1.93	11.2	29.79	95.0	1.19	1.2	.078	3.8	Ce? lost 10' H. A.
171 388-417	5.31	19.4	26.75	96.4	2,00	1.6	.139	2.0	10% +65
173	.39	16.6	17.00	89.8	.33	1.3	,036	8.9	uf Hem. H-A
174	2.78	18,0	28.39	93./	2.09	1.9	.158	5.0	H-A
178 250-299	.66	11.6	23.35	90.9	1.17	2,4	,031	6.7	
178	1.20	11.0	23.46	97.3	.36	.7	,025	2.0	
178 356-413	1.49	9.1	30.30	96.0	1.32	1.4	.041	2.6	Possible Tr Cc.
178 413-450	2,29	12.1	29.89	84.6	5.36	8.8	.168	6.6	72 é dense Hf
16/ 389 - 404	1.38	6.3	22.27	93.3	. 82	2.0	073	4.7	Tt, deise HF, and 9/2+
									74.72
									4
		POST IN							

Hornfels cleaner conc cleaner tout Ro Tail
yo au 1. Rec 16 au - 1. Rec 4. Cut. Rec Feed Remarks 4 No % Cu % Fe "Hornfels" type. Woll & Mb w/ Some serp and dense white silicate. 62 .026 1.97 4.34 - 2.64 1.15 -33,60 - 92.6 68 1.02 -28.65 - 84.9 .84 - 2.2 .14 12.9 LOG 5/4. 151 354-385 2.04 7.4 Hf- fn-gr gram. diop. 31 .69 - .5 29.17 - 97.9 .037 1.6 9-fm & Hf & Tt. .61 16.0 28,28 - 83.2 .78 - 2,0 ,094 14.8 86 AD Hf (arg) & Mb 158 10.5 151 443-486 1.38 3.9 26.82 - 86.8 .95 - 2.7 prtly crushed. Sulfide von: Act halos. 27% +65 Arg. 11. (20) 444-464 162 483-493 1.58 3.3 28,19 - 64.3 1.05 .567 32,5 3.2 167230-284 2.70 4.1 .165 .2 ,686 22.8 28,30 77.0

DDH 86H  28.28  83.2  0.78  20.0 X  86.8  83.2  0.78  2.0 X  86.8  0.85  2.7 X  0.52  13.48  67.0  2.37  16.6  152  154  122.75  77.4  3.49  10.5  158  14.05  87.5  1.00  3.47  160  10.76  13.9  162  161  22.27  93.3  0.82  2.0 X  162  14.54  88.9  141  1.8  162  14.54  88.9  141  1.8  162  14.87  90.6  164  9.56  90.7  0.44  2.2  166  14.87  90.6  0.28  1.8  171  17.87  87.6  0.44  2.05  171  17.87  87.6  0.44  2.05  171  17.87  87.6  0.44  2.05  171  17.87  87.6  0.44  2.05  171  17.87  87.6  0.44  2.05  171  17.87  87.6  0.44  2.05  171  171  26.75  96.4  70.0  16.8  173  17.00  87.8  0.33  1.3  174  28.39  93.1  2.09  1.9 X  175  21.50  94.6  0.09  2.3	Hale	Final Conct Cl. Tail
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		GRADE Recovery Grade Recovery
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		28.28 83.2 0.78 2.0 X
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0,52	13.48 67.0 2.37 16.6
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	152	P6-C0
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	154	
$160$ $10.76$ $83.9$ $1.62$ $6.6$ $161$ $22.27$ $93.3$ $0.82$ $2.0 \times$ $161$ $23.81$ $90.8$ $0.85$ $1.9 \times$ $162$ $14.54$ $88.9$ $.41$ $1.8$ $162$ $28.19$ $64.3$ $1.05$ $3.2 \times$ $164$ $9.56$ $90.7$ $0.44$ $2.2$ $164$ $9.56$ $90.7$ $0.44$ $2.2$ $166$ $14.87$ $90.6$ $90.28$ $1.8$ $167$ $28.30$ $77.0$ $90.163$ $90.2 \times$ $168$ $29.79$ $95.0$ $1.19$ $1.2 \times$ $171$ $17.87$ $87.6$ $9.44$ $2.00$ $1.6 \times$ $171$ $26.75$ $96.4$ $2.00$ $1.6 \times$ $173$ $17.00$ $89.8$ $9.33$ $1.3$ $174$ $28.39$ $93.1$ $2.09$ $1.9 \times$ $174$ $28.39$ $93.1$ $2.09$ $1.9 \times$ $175$ $21.50$ $94.6$ <th>158</th> <th>14.05 87.5 1.00 3.4</th>	158	14.05 87.5 1.00 3.4
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	158	19.59 88.8 0.34 1.1 X
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	160	
162 $14.54$ $88.9$ $.41$ $1.8$ $.62$ $28.19$ $64.3$ $1.05$ $3.2$ $.64$	161	22.27 93.3 0.82 2.0 X
162 $14.54$ $88.9$ $.41$ $1.8$ $162$ $28.19$ $64.3$ $1.05$ $3.2$ $164$ $9.56$ $90.7$ $0.44$ $2.2$ $166$ $14.87$ $90.6$ $0.28$ $1.8$ $ 167$ $28.30$ $77.0$ $0.165$ $0.2$ $168$ $29.79$ $95.0$ $1.19$ $1.2$ $171$ $17.87$ $87.6$ $0.44$ $2.5$ $ 171$ $26.75$ $96.4$ $7.00$ $1.6$ $1.6$ $17.00$ $1.6$ $1$	761	23.91 90.9 0.85 1.9X
$162$ $28.19$ $64.3$ $1.05$ $3.2 \times 164$ $9.56$ $90.7$ $0.44$ $2.2 - 166$ $14.87$ $90.6$ $0.28$ $1.8 - 167$ $28.30$ $77.0$ $0.165$ $0.2 \times 168$ $29.79$ $95.0$ $1.19$ $1.2 \times 17$ $171$ $17.87$ $87.6$ $0.44$ $2.5 - 17$ $171$ $26.75$ $96.4$ $2.00$ $1.6 \times 17$ $170$ $88.8$ $0.33$ $1.3 - 174$ $28.39$ $93.1$ $2.09$ $1.9 \times 175$ $21.50$ $94.6$ $0.09$ $2.3 - 175$	162	
$166$ $14.87$ $90.6$ $0.28$ $1.8$ $167$ $28.30$ $77.0$ $0.165$ $0.2 \times$ $168$ $29.79$ $95.0$ $1.19$ $1.2 \times$ $171$ $17.87$ $87.6$ $0.44$ $2.5$ $171$ $26.75$ $96.4$ $2.00$ $1.6 \times$ $173$ $17.00$ $89.8$ $0.33$ $1.3$ $174$ $28.39$ $93.1$ $2.09$ $1.9 \times$ $175$ $21.50$ $94.6$ $0.09$ $2.3$	162	첫 지원 : [18] [18] [18] [18] [18] [18] [18] [18]
$167$ $28.30$ $77.0$ $0.165$ $0.2 \times$ $168$ $29.79$ $95.0$ $1.19$ $1.2 \times$ $171$ $17.87$ $87.6$ $0.44$ $2.5$ $ 171$ $26.75$ $96.4$ $2.00$ $1.6 \times$ $17.00$ $89.8$ $0.33$ $1.3$ $174$ $28.39$ $93.1$ $2.09$ $1.9 \times$ $175$ $21.50$ $94.6$ $0.09$ $2.3$	164	- 전문이 지역하다 전에 바이팅을 못 위한 1980의 요리를 하게 되었다면 보다면 보고 있다고 있다. 그는 이번 보고 있는 사람들은 보고 있다. 그 보다 보고 보다 보다 보다 보다 보다 보다 보다 사
$167$ $28.30$ $77.0$ $0.165$ $0.2 \times$ $168$ $29.79$ $95.0$ $1.19$ $1.2 \times$ $171$ $17.87$ $87.6$ $0.44$ $2.5  171$ $26.75$ $96.4$ $2.00$ $1.6 \times$ $173$ $17.00$ $89.8$ $0.33$ $1.3  174$ $28.39$ $93.1$ $2.09$ $1.9 \times$ $175$ $21.50$ $94.6$ $0.09$ $2.3 -$	166	14.87 90.6 0.28 1.8 -
$171$ $17.87$ $87.6$ $0.44$ $2.5$ $ 171$ $26.75$ $96.4$ $7.00$ $1.6 \times$ $173$ $17.00$ $89.8$ $0.33$ $1.3$ $ 174$ $28.39$ $93.1$ $2.09$ $1.9 \times$ $175$ $21.50$ $94.6$ $0.09$ $2.3$ $ 129$	167	
171 26.75 96.4 2.00 1.6 × 173 17.00 89.8 0.33 1.3 - 174 28.39 93.1 2.09 1.9 × 175 21.50 94.6 0.09 2.3 -		29.79 95.0 1.19 1.2 ×
173 17.00 89.8 0.33 1.3 - 174 28.39 93.1 2.09 1.9 × 175 21.50 94.6 0.09 2.3 -	171	17.87 87.6 0.44 2.5
174 28.39 93.1 2.09 1.9 × 175 21.50 94.6 0.09 2.3	171	26.75 96.4 2.00 1.6 X
175 21.50 94.6 0.09 2.3 -	173	17.00 89.8 0.33 1.3-
120 21 35	174	28.39 93.1 2.09 1.9 ×
178 23.35 90.9 1.17 2.4	175	21.50 94.6 0.09 2.3 -
	178	23.35 90.9 1.17 2.4
178 23.46 97.3 0.36 0.74	178	. D. 4. (1992년 - 1994년 -
178 30.30 96.0 1.32 1.4		30.30 96.0 1.32 1.4*
178 29.89 84.6 5.36 8.8	178	

AMERICAN SMELTING AND REFINING COMPANY SILVER BELL UNIT Silver Bell, Arisona

November 20, 1957

### MOTICE

THANKSGIVING DAY, NOVEMBER 28, WILL BE OBSERVED AS A HOLIDAY. DO NOT REPORT FOR WORK UNLESS SO INSTRUCTED BY YOUR FOREMAN.

D. R. Purvis Superintendent