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Jones Notes on [illegible] Ident. SX Mine

Cret. of SE Ariz. – may be 25,000' thk. Varied beds.
H.W. at SX not always ark – in central part of mine and in HW of #4 ore zone, HW is ravelly arg containing clay.
Contact betw ls & ark-arg often mkd by 6"-12" band h.g. Ark. sepr. from band by 10-12' of f.g., lt grn qtzt, or soft arg.
Ark usu. recog. by salmon pink color and arkose "look" (f.g. tapioca pudding)
Pink color may be due to alt. ls (dense, no vis. grains). If in doubt whether ark, advance another 10' – qtzt may be confused with alt. qtzt of Permian or the lower d.s. Qtzt-arg usu. changes to ark in 10'. Ark resembles poorly sorted grits of lower Permian

Permian in SX

Lower Perm ls mbrs of Yeso Fmn softer, white, dense, in part of series of gyp marl, sh, hornfels (impure alt. ls. Yeso 1500-2000'). Above this series, Snyder Hill series (3 ls beds sep by 2 qtzt beds). Sep. into Scherrer (ls-qte-ls-qte) and Concho ls. Upper qtzt 20-100' thick, lower 400' thk.

All 3 ls beds blue-gy to blk. Some alternating thin blk & wh beds. Sometimes blchd & rextal. Chert nodules occas. abund. in Concho – also fossilif.

Ore zone betwn 17 & ark believed to be Concho. Overlies 100' qtzt bed on surf. & u.g. in E. ½ of mine. Qtzt is brn-gy, m.g. Concho thin & thik bedded in mine area, nearly black in lower part. Irregly thikk bed grn-gy dense silic. rock in mid of ls. Thin sec. class as shaley qtzt, v.f.g., but may be alt. ls. 10 fault forms lower contact of d.s.

No bdg planes in ls above shaley qtzt

On W. side of mine, beneath "17", alternate wh & dk gy ls beds, and d-s (qtzt) rock. 35-100' indiv. beds. Only topmost ls this series productive, tho some narrow zns mnlzn found in sevl places in next lower ls. Gyp beds drilled in W. side area (Hole 238) indic. this series probably Yeso.

In thrusting, SX area, Sny Hill series overrides incomp. Yeso fmn.

[illegible]	[illegible]
Upper qtzt	20 100
[illegible]	
Lower	100 400
Ls	
Yeso	1500-2000
	2000 - [illegible]

50-100
400
ls
20-100
70 300
10 100

Jones - Notes on Geol of San Xavier

17 flt - strike NE, dips S. Irreg in crs & dip. Splits at changes in crs & dip. Intersects bdg planes of h.w. at an angle, resulting in splits leaving main flt along bdg planes. Contacts betw dense shaley qtzt and ls localize some of more prom. splits. Splits into f.w. of 17 have not been recognized. Usually char. by 4-6" grn-gy gg on f.w. Occas. mnlzd, usually in 1-2' of brec. above gg.

Displcmt(?) of ark-ls contact along "17" obscure. Hasn't been measured.

No ore bodies of any size found in f.w. of 17 east of coord 100,200 E (at E wall of 17 Shaft). Ore bodies however may exist in f.w. east.

Bdg folded into syncline pitching SE'ly - E limb truncated by "17" flt. In W ½ mine, below 500 Level, presence of 3 ls & 2 qtzt beds estab, underlain by 3rd d.s. bed. Sketch shows beds butting against, and in fw of "17" ?? Poss. that beds are Yeso, since two gyp beds found in series. Fltg?

"A" ls only mbr productive to date (1949) - 1st shoot of mine in "A" ls where butts against "17" flt. Possibility of ore in B & C ls at intersec. with 17.

Simil. favorable if 17 truncates W. limb syncline.

Syncline also prob. truncated nearer trough of fold by set of steep NE'ly fissures observable on 340 and 270 levels near No 4 shaft, C.D.H No. 1.

Area above 270 Level betw. No 4 and No 1 shaft that has not been suffic. explored - ore may be oxid, if present. Could be drilled from surf, or extend 200 w. face. Some wk this direction from 115, but very little lateral work.

Jones March 14, 49

Fowler Report on Proposed Expl. 5-X 1-27-47

Prod. by Eagle Picher Sept 22, 43 to 12-31-46

Hds. 152,117.35 T (Dry tons) 3.47 Ag 6.01 Pb 16.07 Zn .70 Cu

Sm. ore bodies but high ore content, esp. Zn.

Localize in adjstmt zones in complex geol. envir.

4 devel. ore shoots

Geophys. electromagnetic survey in 47

Mag. contours thot to show contours of basement rks.

Zone of greatest interest lies betw. mine & mag. highs, confirmed by ore devel. to date & study of CD & DD logs & by mag survey.

Known & prosp. ore shoots related to struct. deform., which is more intense here than for many sq miles of surr. area,

Areas next in interest are S from No 6 & No 4 shaft, & SEly from Mine wkgs.

Summary of drilling expl betw No 4 & 6 Shafts (dist. of 1700')

No ore of consequence penetrated betw. 4 & 6 above 500L.

Smaller center of mnlzn located at No 6 shaft area.

In ore penetrated W of No 4 sh., Pb content pract. nil.

Ore at No 6 Sh. chfly Zn-Cu, some Ag.

DDH 57 did not hit Zn-Cu ore of CDH 4.

In DDH 58, only tr of cpy hit at contact where Cu ore was expected.

Hg Zn in 58 264'-293' - prob. same ore body as cut in CDH 4

DDH 52 - Sm size of ore shoot encountered does not warrant further expl.

CDH 9 did not hit ore up dip from that in CDH 8

DDH 53 drilled to intersion rake sm. f.w. ore shoot on 150L. Not intersected.

DDH 49 indic. shp swing s'ly of ark contact just W of CDH 1 - later drilling confirms

Surface showings E & W of the 4 ore shoots not encouraging.

No 6 shaft ore 100L & 150L predom Zn-Cu - doesn't appear to be too hig. on average.

Reserves Sept 54, 250-660 L, 41,337 T 3.1 4.3 12.5 1.08

Reserves Jan 56 420-900 L 51,792 T. No ave. grade.

Ave. of pennyweight ten assays Jan-July, 1952
40,758 T 3.0 4.7 9.6 .79 (as ck for below)

In Sept 1954 – Reserve est

L.	Tons	Assay			
250 L	450	1.0	.1	9.7	.46
340 L	713	3.4	3.6	10.1	1.47
420 L	7164	2.3	3.1	11.2	1.01
500 L	9917	1.3	4.1	11.6	.37
580 L	5715	3.5	5.6	11.7	.63
660 L	17378	4.5	4.5	13.9	1.67

Ave Assay & Tons
41337 3.1 4.3 12.5 1.08

Spl assay data from Hand-cut, muck, and core spl data except for est. assays on 2370 Tons.

Klippen of Concha ls E of Helmet Pk
Few otcs and further east slight cu stng – and, prob. some fmn as drilled in CDH-20 in Cholla No 1
3 otcs Concha ls on Piedra claims, surr. by Qal – no struct. connection with Helmet Pk. can be inferred w/o further drilling.
Lge amt of qtzt & proximity of granite may preclude poss. of ore in western & swestern portions of prop.
Garnetized arkoses in NE portion mapped area (Bobb. & Bonanza Grps), To North, about 500', Sny Hill ls otcs. Separ. from overlying ark by flt contact dipping swly 50°. Easterly 1000', structures of W side of Helmet Pk dip steeply W.
Struct. gap (poss. NE'ly tear flt) betw Hel. Pk & S-X Hills – about 500' NE'ly.
Area may possess SH ls, fltg, garnet. CDH 20 (1000' py. mnlzn) may be assoc. w/ same tear flt.
In W & SW area, qtzt, intr. by SE'ly trending granite neck. Flt contact betw ls & qtzt, dipping sly 50°, ls should underly qtzt at depth but 660 x-cuts to 98,550 N – 99000 E ends in qtzt, DDH 637 in qtzt all the way. Granite 100' below 660.
Unfav. area. Arndt 12-6-56. No recommend. made for drilling or lease

Ore Reserve 1-[illegible]-56

Wkg Place		Probable	Positive
420L	7-3 stope	1813	
500L	12-2 Floor Pillar	300	
	12-1 " "	938	
	12-1 St.	600	
	12-2 "	900	
	3-3 "	900	
580L	Wkd Out		
660L	10-2 FP	638	
	12-1 "	360	
	12-2 "	450	
	6-3 "		9130
	6-1 St		1000
	12-2 "	1800	
	8-2 "	820	
	10-1 Dr	300	
	10-3 St	2000	
	1-1 "	600	
740L	1-1 FP	600	
	8-2 "	800	
	10-1 "	300	
	10-3 "	1350	
	10-4 "	945	
	12-3 "		825
	12-4 "	325	
	4-2S		6500
	4-4S		2600
	12-3S		1238
	12-4S	300	
	8-1S		11110
820L	A-1 FP	110	
	A-2 "	180	
	8-1 "		4400
	12-4 "	413	
	12-1 "		2180
	A-3 Sill Pillar	390	
	6-4 Dr	375	
	10-1 "	300	
	12-1 "		900

900L	A-3 FP	390	
	6-2 "	150	
	6-4 "	375	
	8-1 "	300	
	101 "	300	
	12-1 "	1260	1260
	A-5 St		2475
	2-1 "	450	
	6-3 Dr		225
		3225	3960

Total Prob & Positive reserves 51792 T (Prob. reduced by 1/4)

G. Irwin

DDH 57 9926 98572 3562 V

0-36 Qal
36-121 Ark Fltg at 88 and 93 Scattered wk assays 121-160
121-163 Als, grnt, mnlzd 160-163.5 2.1 .3 3.5 .4
163-268 wls 242-246 1.4 Tr 10.2 .03
268-291 Hornfels wls

DDH 58 99140 98578 3568 V

0-40 Qal
40-213 Ark, sh 264-292.5 Ave 15.3 Zn, low Pb, Ag, Cu, except 289-292.5 had 9.6 Ag 1.3 Pb
213-220 als, grnt
220-404 wls, gls, als, occas. ore
404-417 Probable hornfels 332-338 .1 Tr 9.0 .12

DDH 63 100,108 102 652 3490 N10E -40

0-27 Qal
27-52 Ark
52-403 wls, gls
403-450 Qtzt, wh

DDH 64 99715 98972 N7W -45

0-170 gls. Als 96-131 100-105 .9 .1 2.7 .1
107 (sludge) 1.4 5.9 7.9 .12.

DDH 65 99635 99713 3554 V.

0-30 Qal
30-465 Ark, grn-gy
465-493 Alt, silic. rock. Qtz-Zns 491-3.
493-644 Als, silic., sndy. Flt at 644.
644-696 Hornfels, H-grn-brn
696-701 wls

2DH 424 99546 100149 900L N2W -87
0-125 wls, occas. gyp, org.
125-326 Granite

DDH 14 [illegible]
100079 N5W -82

0-530 Ark
530-565 Arg a/s
565-731 Ark, qtzt, Tr ZnS 727.8 731-3 1.1 12.0 17.1 .02
731-733 Als, grn; qtz, gnt. ZnS
733-757 DS
757-787 Bx, ds, w/s
787-819 G/s
819-843 ds
843-877 G/s
877-887 DS
887-904 w/s
904-910 Gyp
910-918 w/s

DDH 49 99830 3545
99440 V

0-161 Ark, arg, sh - some garn. alt. Flt 56 - red gy
161-220 w/s, a/s, Ore 165-167. .5 3.1 4.2 .12
220-236 ds (a/s?)
236-270 g/s, silic, ZnS cpy (sm amts) 260-70.
270-280 D.s, grn-gy. Flt 270 and 280
280-332 w/s - Flt 303
332-403 g/s, bands w/s. Flt 394 - blchd ls

DDH 52 99657 99307 3558 N70W -55

0-18 Qal
18-22 Ox ore, a/s .5 3.4 3.5 1.0
22-43 g/s
43-46.5 a/s, g/s
46.5-76 ark
76-100 w/s. Grnt & ZnS 84-85.5

DDH 53 99206 3576
98328 V

121-124 1.4 .4 .1 .5
126 3.0 .4 .4 1.0

0-21 Qal
21-110 Ark. Flt 70
110-226 w/s, g/s, a/s, Mnlzn 115-26
226-300 Ds, brn-grn

DDH 56 100600 3475 V
103326

0-34 Qal
34-101 g/s, alt
101-130 w/s
130-277 Qtzt arkosic
277-300 Sand? w/ some g/s

Mnlzd 212-26 wk.
244-267

✓EXCD1 100095 N 3525.0 No assay over .4 Pb .22 Zn .05 Cu
100746 E -666.5

0-230 Ark & arg, py 205-230
230-335 Dense silic. - 1/3 ls
335-645 Gy & wh ls
645-666.5 60-70% l.s. — tr. cpy 645-655, brec. & ggy lost 12'.

✓EXCD3 99573 N 3532.9
100303 E -1202.8

0-10 Qal
10-105 Ark - some qtzt
105-180 Arg - some arkose, Reddish.
180-230 Igneous? Mix. of granite (or ark.) and arg. Magnetic 180-195.
230-650 Ark - some arg
650-960 Sh, gy & grn. Ggy 890-912 (Flt?). Poss. Cret-Perm Contact at 960
960-985 Arg qtzt, minor garnet.
985-1085 Ls - talcy near bottom
1085-1202 Granite, flesh-colored, mg

EXCD4 99890 3506.1
101325 525.2

0-15 Qal
15-380 Arg sh & some ark
380-485 Ls - blchg > 455-480. H_2O course 380-485, below ark-ls contact
485-525.1 Qtzt, gy-brn, fg to mg. 520-5 ggy

EXCD5 99562 3522.1
101078 1193

0-275 Andesite tuff, gy-grn
275-375 Qtzt, lt grn & pinky, some ark
375-675 Arkose
675-845 D.silic. (qtzt?), lt gy; H_2O 835-840, Diss. py.
845-1180 Ls and qtzt. Caving 1175-1180
1180-1193 Qtz, fs, femic - prob. from basement.

EXCD6 99007 3528.9
100784 600

0-7 Qal
7-265 Ark, qtzt, pinkish. Prob steep Flt at 77. Tr cpy in wh qtz.
265-600 And.? - grn-gy, magnetic.

CD8 99079 E 3562.8
355

0-182 Arkose
82-245 Ls, wh-gy; Qtzt-ark 200-220.
245-278 Qtzt
278-330 wh ls
330-355 Blue Blk ls.

	Ag	Pb	Zn	Cu
180-185	.9	3.1	5.3	.10
190	.4	2.0	2.4	.35
195	.3	1.6	1.3	.06
200	.4	2.3	1.6	.06
205	.5	2.3	1.1	.11
210	.3	.6	.5	.04
215	.2	.7	.5	.05
220	.4	1.1	.2	.05
225	.3	1.0	.3	.07

Mnlzd to 240

ExCD 9 99993 N 3557.7
98920 E 549

0-30 Qal
30-270 Ark & qtzt
270-350 Alt. ls - good Pb-Zn 310-350
350-380 Ls, wh.
380-465 Pink ark, some ls. Some mnlzn.
465-549 Ls & qtzt

300-305	1.6	1.4	.8	
375	.2	1.5	.1	
	.8	10.0	8.9	
	1.0	14.2	15.3	
	.8	6.9	6.4	
	1.1	2.4	2.9	
	2.2	4.1	4.8	.33
	2.5	3.0	4.2	.58
	1.0	2.4	3.4	.35
	[illegible]	1.8	1.8	
	.4	.9	.8	

EXCD 10 99316 3558
98740 375.8

0-65 Qal
65-100 Ls. Minor assays 70-85
100-185 Ark
185-375.8 Ls, Qtzte last 20'

ExCD 14 98907 3560
100019 500

0-12 Qal
12-100 Arg.
100-295 And. tuff?
295-500 D. sil. Ltgy-gy (Qtzt)

EXCD 39 99460.5 3551
99136.6 504

0-60 Qal, Mnlzd 35-45 cu + pb 35-40 1.0 1.7 .9 1.8
45 .4 1.0 .6 .9
60-400 D.s.-grn-gy. Ark 180-270. H_2O 385-400.
400-504.2 Ls

EXCD 40 99130 3564.
98770 476

0-40 Qal
40-385 Ark & arg. 2-3% Cpy 335-345
385-476 Ls. Mnlzd 345-380, wk. Up to 1.7 Ag, .6 Pb 7.6 Zn, 2.0 Cu

✓EX CD 41 — 99070 / 98880, — 3558 / 754

0–390	Arkose. Cu-Zn 385-390
390–~~435~~	Ark with ls. G-met 415-420. Cu-Zn mnlzn.
430–735	Ls. Mnlzd to 435.
735–754	Qtz-fs-femic. Close to gr.

385-390 2.7 2.8 3.2 .75
390-395 4.6 2.5 8.5 162
395-405 1-8 % Zn. Ag Pb Cu each < 1%.

✓EX CD 44 — 99352 / 99567 — 3555 / 850

0–25	Qal
25–515	Arg ark
515–555	Ls, wh., xtl.
555–635	Qtzt
635–725	Ls
725–775	Qtzt
775–850	Ls, gy-wh

✓EX CD 45 — 99034 / 99678 — 3558 / 300

0–15	Qal
15–300	Ark

✓EX DH 7 — 99168 / 99339 — 3569 / N10E -70 -250'

0–60	Ls gy-wh
60–168	Ark & qtzt
168–215	Ls, wh-buff
215–230	Sh-arg qtzt
230–250	Ls, lt gy

EX DH 12 — 99133 / 98235 — 3585 / ↓ 400'

0–148	Ark. Alt. from 129
148–167	Ls, alt, some cpy 151-167.
167–400	Ls

✓EX DH 13 — 99195 / 97900 — 3574 / ↓ 330'

0–200	Ark. cpy?-py 146-150
200–305	Ls
305–330	Gr., alaskite

✓ EXDH 18 100102 3497
102 62 N16W -55 502'

0-307 Ls
307-502 Mostly ls, few bands qtzt. Spec. 426-442 & 452-4..
Brec. 484-502, spec-py cem.

✓ EXDH 19 100233 3479
103150 S96W -67 400'

0-209 Ls, lt colored. Poss. flt at 150
209-400 Ls, bl-gy

EXDH 21 96690 3500
104590 N18E -45 379'

0-254 Arkose, some org
254-379 Ls, dk gy

EXDH 21A 97260 3550
105120 S80W -20 435'

0-20 Buff ls
20-200 Ls, dk gy msv,
200-435 Lt to dk gy xtal. ls, chert nodules. Caving

EXDH 22 96580 3500
105-660 N15W -60 233

0-13 Qal
13-52 Ls, dk gy
52-170 Ss, limy, H_2O at 110. Caving
170-233 Ls, lt to dk gy.

EX DH 22A 96690 N15W 3500
105565 -60 26'

0-32 Qal
32-65 Ss, limy, buff
65-267 Ls, lt gy, gets dkr downward.

EXDH 23 99235 3450
104436 S50W -50 110 Caving,

0-30 Ls talus, some ark
30-110 Arg-sh, purp-red.

√EXDH 25 1113? / 103?8 3??? S80W - 45 155

0-30 Ark
30-138 Ls.
138-155 Qtzt, calc. seams

√EXDH 26 100 050 / 103 329 3474 N74W - 63 200

0-25 Qal
25-136 Ls, gy.
136-166 Qtzt
166-200 Ls

√EXDH 42 99170 / 99210 3520 N15E - 65 270'

0-65 Ark
65-247 Ls. Flt 121'. Garnet ls 1-2% ZnS, little cpy, hem 240-247.
247-256 Ark, lt gy
256-270 No recov.

√EXDH 43 99176 / 99479 N15E - 65 3555 300'

0-250 Ls, gy-wh, occas alt to olive grn silic. rk. Few spks ZnS at 193
250-270 Ark, lt color.
270-300 Alt. yel. ls, silic.

√CD-1 100 040 / 99620 3558

0-20 Qal
20-210 Ark. Tr PbS 180-5
210-308 Ls, wh-gy. Qtz, py, ZnS, PbS, cpy 255-265
308-365 Sh, red-grn-buff, soft.
365-475 Ls, some sh. Few traces mnlzn

251.5-256.5 .7 .3 4.3 .35
260 1.2 .7 6.5 .55

√CD-2 99 806 / 100 340 3542

0-5 Qal
5-730 Arkosh
730-829 - Ark-qtzt. Traces mnlzn 810-24, incisg, with garnet to 829.
829-960 - Garnet, some ls. Mnlzd,
960-996 - Ls, wh to bl-gy. Selenite from 971-8.

824-892 Assayed
Ag to 1.8
Pb to 1.5
Zn to 3.6

✓CD3 100,080 3549
100130

0-400 Ark + sh. Mnlzd 297-315.

400-427.5 Garnet-arkose, Mnlzd

297-302 .6 1.2 2.2 1.37
303 .5 .4 .9 1.18
305 .5 1.0 1.4 0.87
307.5 .2 .5 .8 .42
310 315 .2 .4 .7 .5

397.5-400 .7 .5 4.7 .05
402.5 2.1 1.4 8.1 .05
405 1.5 2.0 9.5 .05
407.5 1.6 1.8 9.6 .07
410 1.6 3.0 15.0 .48
412.5 1.7 2.4 7.6 .15
415 .8 1.2 2.7 .1
420-425 .5 2.7 4.7 .05
425-427.5 .2 1.3 2.3 .05

525-530 1.5 .1 .9 .5

427.5-485 Ls, wh, rextal
485-685 D.s. (qtzt?)
685-715 Ls, wh-lt gy

✓CD4 99175
98594

0-25 Qal
25-190 Ark + qtzt
190-195 Ark-ls
195-420 Ls. Ox zone 215-220 (1-2% cu)
420-500.5 Hornfels, lt gy-grn.

Minor assays 230-263.

263-267 -.5 .1 10.6 .08
269 3.4 .1 34.2 4.7
271 4.3 .2 39.5 5.3
273 2.4 .1 24.7 2.7
274 3.9 .1 27.1 1.4
276 .5 .1 16.7 .6
8 .3 .1 16.5 .3
80 .5 .1 12.3 .2
82 .5 .1 8.5 .4
84 .1 .1 4.2 .2
81 1.4 .1 9.5 1.9
89 .3 .1 3.8 .4

Ore zone prob dip 45°

✓CD5 99230 3561
98538

0-40 Qal
40-136 Ark + qtzt
136-190 Garnet f. ls, Mnlzd.
190-255 LS, garnetized, occas. mnlzn.
255-265 Qtzt lt gy
265-276 Ls

Mnlzd 133-236

140-175 2.7 .1 .3 4.96
175-215 Minor amts Ag Pb Cu
Zn .5-2.9, with
185-188 assay 8.02

CD6 99061 3565
98650

0-10 Qal
10-340 Ark + qtzt
340-465 Ls. Mnzn.
465-470. Hornfels.
470-477.5 Ggy ls.

340-2 .7 .1 .2 1.6
4 2.9 .1 .3 7.5
6 1.9 .1 .2 4.5
8 1.0 .1 .2 2.8
50 .9 .6 .1 1.7

Mnlzd to 395

440-460 .1 .2 3.0 .03

/CD-7 99178 98443 3071

0-25 Qal
25-160 Ark-qtzt
160-245 Ls
245-270 Hornfels

Wk mnlzd 160-185

160-5	.1	.1	.2	1.7
7	.1	.1	.2	1.8
70	.1	.4	.3	1.7

/CD 8 99471 99340 3548

0-7 Qal
7-187 Ark-qtzt
187-345 Ls. 75% MnO_2 210-215, 40% MnO_2 210-15. Ls mostly wh.
345-413 Qtzt, some ls.
413-485 Ls, wh & blk.
485-517 Alt, garnetif. ls.
517-525 Gy, silic. rk, with some ls.

Meager mnlzn 210-220
2-6% Zn 345-357
From 475-499, about 1.5 Ag and 3-4% Zn
499-510 2.5-4.0 Ag, 18-20% Zn
510-514 1.5 Ag, 5% Zn.

/CD-9 99610 99269

0-16 Qal
16-160 Ls, gy
160-250 Qtzt, gy
250-360 Ls
360-424 Silic. rock, some ls.
424-545 Ls, wh, with silic. rk from 525

/CD-10 99357 98945

0-5 Qal
5-40 Ls, garnet, strong magnetite 15-30. Cu stn
40-55 Ark
55-92 Ls
92-216 Ark
216-250 Ls
250-358 Hornfels
358-440 Ls

2% Cu 15-30

√CD-11 100,115 3530
101,075

0-10 Qal
10-80 Ark-qtzt
80-270 Ls, gy-wh
270-345 Ls, dk gy
345-415 Ls, mostly wh. Some qtzt.
415-432 D.S. rk, dk grn gy. 1% py.

√CD 12 99,918 3500
101,970 -418

0-5 Qal
5-190 Ark
190-400 Ls, gy
400-418 Qtzt, lt brn

CD 13 97037 N 3548
105 720 E

0-60 Qal
60-85 Andesite, reddish sh
85-130 Ark
130-1300 Sh, andesite, arkose

√CD 14 98930 3470'
104 570

0-5 Qal
5-220 Sh, maroon, Tr cpy-py 140-220
220-447 Ark, some sh.

√CD 15 98185 3520
103015

0-45 Qal
45-585 Red sh & ark

√CD 16 100 425 3440
103 700

0-145 Qal
145-495 Red sh & qtzt 2.05 Cu 220-225

√CD 17 99630 N 3506
101 710 E

0-15 Qal
15-480 Sh, ark, qtzt
480-640 Ls, wh, xtal.
640-720 Qtzt, wh.
720-750 Ls, wh
750-760 Qtzt, wh.

/DDH 4 100340 3455
103390 S70W -53

0-55 ?
55-168 Ls
168-300 Ls. Hole drilled postom. irreg. surf otc of FeOx.

/DDH 11 99815 3538
100510 ✓

0-15 Qal
15-574 Ark
574-663 Ls, wh, xtal, Gy at 597, Mnlzn 670-3
663-670 Brec, wls, ds,
670-673 Brec, ore
673-690 Brec. wls, als
690-722 D.s. (bx?)
722-744 Ore, wls, Hb, ZnS cpy
744-854 wls

670-670.3	2.8	21.1	27.9	1.1
673	0.1	0.2	0.4	0.05
727-730	.8	.3	3.1	.48
738	2.1	13.6	16.7	1.7
739.5-741	2.3	11.2	14.7	4.1
743.5-745	18.2	11.2	21.6	4.1
774-776	4.2	13.6	10.3	0.5

/DDH 12 100047 3546.7
100260 ✓

0-406 Ark-sh
406-433 Garnet, ore 425-433
433-447 Bx, dls, wls, py
447-451 Gy xtal ls (bx?)
451-456 Hbq, ZnS
456-632 DS
632-676 Bx, wls, Als (chlky)
676-687 wls
687-695 Als, chlky, sndy
695-703 wls
703-720 Als, chlky, sndy
720-763 wls, chlky als

419-425	.2	.1	.1	Tr
432	.6	7.9	15.1	.04
451-455	1.7	13.7	17.9	.05

✓DDH 13 99820 3541
100245 ✓

0-673 Ark
673-688 Qtz, py, ZnS
688-692 Ark
692-701 Garnet, Msv py, cpy ZnS
701-734 Bx, Als, wls, ds, some mnlzn
734-832 DS
832-855 wls
855-889 Als, silic., with gyp
889-900 wls

692-701	1.0	Tr	1.5	2.4
714-719.5	1.7	4.1	14.4	.15
6				

CD 18 100,370 140
103,540

0-95 Qal
95-345 Ls, xtal, wh-gy, with occas. qtzt
345-655 Sh, mogolon, w/ lt gy qtzt bands.

CD 19 100825 3540
102585

0-40 Qal
40-462 Qtzt & red & grn sh.

CD 20 99830N 3400
104610E

0-25 Qal
25-45 Andes. alluv.
45-115 And, purple
115-120 And, brn
120-200 Ark lt brn-red
200-235 And, purp
235-485 Ark
485-1275 Ls, silic, dk gy. Tr. cpy, PbS ZnS specks.
1275-1360 And, dk red, ls 1315-1320 and 1345-60.

Neglig. mnlzn (Zn to .2)

DDH 1 99985 3530
100543 N25W -60

0-287 Arkose
287-297 Ore, exc. 291-2, garnet-qtz gangue.

DDH 2 99945 N25W -60 3528
100568

0-325 Ark, reddish
325-337 Ark, blchd
337-341 Good Pb-Zn-Cu ore
341-2 Ls, wh.
342-3 ore - little ls
343-504 Ls, wh-gy. Cgy, w/py 384. L.g. ore 422-8, v.l.g. 428-33, few frgmts ore 475.
Bottomed 505, prob near qtzt underlying ls.

	Cu?				
337.5-341	2.5	4.1	17.5	19.7	4.05
422-428	2.5	.7	7.6	16.2	.25

DDH 3 96955 N10G 3500
104187 -30

0-577 Ark
577-603 Ls

√DDH 639 99710 3625
98445 V

0-5 Qal
5-179 w/s
179-265 Als, with occas thin band d.s. Minor Pb-Zn 197.5-198.5 (1% each)
265-301 w/s & g/s

√DDH 640 98920 3470
104570 W -60

0-16 Qal
16-505 Red sh & ark.
505-506 Qtzt, lt gy. 45° contact 219-229 .1 Cu

√DDH 641 100,890 3510
102 750 V

0-108 Qal
108-133 Qtzt, lt gy, f.g.
133-418 Red sh & ark
418-470 Qtzt, buff, f.g.

Holes on Wilson Prop W of Duval Sec 6-7, T18S R12E
1. 71' deep. Diorite. Cpy & Mo along sm fissures & fracs.
Assays 10-36 were .15-.30 Cu
66-71 .6 Cu
2. 77' Diorite Assay 6-77 .15-.30 Cu

Total DDH's to Apl 57 were 649 holes. All not listed were u.g. holes.

DDH 566 99588 100495 2644 N45 W -89½ 900L

0-93 w/s
93-142 Bx, als
142-290 Mostly wls, bx, als
290-305 Gyp-marl
305-350 wls, gls
350-470 Granite, mg

DDH 615 96185 106148 3504 V

0-10 Qal
10-80 Ark & qtzt. Abandoned hole

DDH 618 96169 106159 3502 V

0-8 No core
8-9 red shale
9-47 w/s
47-258 red sh & buff ark
258-365 Cgl ~~and qt~~ - tuff in lt gy grd mass, A little ark.

✓DDH 636 99085 N 104085 El ? V

0-77 Sh, pink-lt gy, limy
77-770 Mostly gls with beds maroon & gy sh, Gq at 703-8 and 750-759

DDH 637 97100 101020 3555 V

0-78 And
78-650 Mostly wh qtzt. And 118-139.
650-935.5 And, few gyp veinlets.

✓DDH 638 99890 98040 3710 V

0-2 Qal
2-114 gls & wls
114-155 Als, grn & yellow, grnt, silic.
155-172 wls
172-174 Als
174-231 wls & gls
231-307 Qtzt, wh.
307-332 wls.

DDH 432   99495   W -59
105_3   3479

0-20 Qal
20-340 Arkosic qtzt, pinkish
340-715 Arg, pink-grey
715-720 w/s, py, tr ZnS
720-772 Arg, pink to mauve

Only assay of note was 197-197.5 1.4 .8 3.4 4.5
½" veinlets

✓DDH 450   100707   3658
102008   N2W -65

0-8 Qal?
8-115 Qtzt, fg., wh-buff
115-195 fg. g/s
195-275 Ark & sh maroon & grn

✓DDH 453   100249   3538
99583   ✓

0-10 No core
10-110 b/s & ds
110-127.5 Hbg & garnet zone in w/s
127.5-142 w/s, m.g.

1.0% Zn 125-127.5
All else minor

✓DDH 454   99381   3590
98229   ✓

0-10 N.C.
10-140 A/s, g/s, with grnt, hbg
140-150 w/s

65-75	1.0	Tr	5.2	2.0
80	1.0	2.2	3.9	.02
90	1.4	1.8	6.1	.35

✓DDH 456   99331   3560
98254   ✓

0-50 Ark & qtzt, some cu mnlzn 30-50
50-132 silic ls w/ grnt, hbg, some mnlzn
132-160 w/s & a/s

Mnlzd 30-50
65-132

65-70	2.4	Tr	7.6	3.5
105-110	4.7	.9	7.2	.3
115	2.1	.9	4.5	1.7
123	2.0	1.1	13.2	.04

DDH 516   -30   900L

	Core				
45-50	5	.3	.1	19.0	.06
50-55	5	.8	.2	17.5	.02
90-100	5	.1	2.8	Tr	.02
120-130	4	.2	.1	1.5	.03

DDH 550   -28   900L

30-31	1	3	3.5	3.9	.02
43-44	.7	4.9	4.1	6.6	5.6
64-65.5	.6	10.8	4.5	10.8	.7

Wet tons milled from S-X Mine by E-P

	1950 Wet tons	1951	1952
1	6882	2361	6707
2	7298	6412	6211
3	7790	6401	5398
4	6396	6362	5809
5	6940	6845	6138
6	6344	5869	7208
7	5237	6606	5103
8	5964	7259	1952
9	7141	5545	None
10	6471	7763	44326
11	4534	6575	
12	—	6593	
	70967	74597	

70967
74597
44326
189,890

1897-1918	50000
1943-48	295,000
49	80 310
1950-52	189 890
	565,200
	73,500
	688,700

MV
25,000 55
30 000 56
15 500 57
3000 58
73,500

12 ¢ 6000000 ¢ 50000

12 000

TO: Mr. H. E. Harper

FROM: J Douglas Bell

SUBJECT: San Xavier Mine, Pima County, Arizona

DATE: 17 April 1958

Summary

The San Xavier Mine has produced lead-zinc ores, with subsidiary amounts of silver and copper, since 1880. The data indicates that the mineralization is probably hypothermal, and formed as a replacement of Permian limestones and quartzites. Access for the ascending mineralizing solutions was provided by the east-west striking "17" and "10" Fault system, which were caused by adjustments resulting from forces forming the synclinal and anticlinal folds of the area. Within the "17"-"10" fault system, many minor slips of flat to moderate dip resulted, and limestone-quartzite was replaced by ore as the rising solutions were dammed by the flatter slips, resulting in frequent small and irregular ore bodies of high ore content. The lead content decreases downward, although zinc remains fairly constant, in the main ore zone. In the No. 6 Shaft area to the west, lead content is almost nil, suggesting the possibility that a zoning downward may exist with relation to the easterly dipping granite surface underlying the property, with a lead zone formerly overlying the No. 6 Shaft area being eroded away.

The main ore zone has been nearly mined out, with only approximately 30,000 tons remaining as reserve. Some ore undoubtedly exists on, above, and below the 900 Level. The western area has been well-explored, exhibits spotty deposits of high zinc content, and does not appear favorable.

The eastern area has been only lightly explored. The favorable Permian sequence is present, and the "17" Fault apparently extends through the area. In addition, bedding attitudes and formation outcrops indicate the presence of another synclinal fold similar to that in which the San Xavier ores formed. Outcrops and drill-holes have not shown ore in this area to date, but if mineralization is related to the underlying granite, ore may exist at greater depth due to the easterly dip of the granite surface.

Lithologic and structural conditions indicate that further exploration in the eastern area is justified. However, exploration would be of a "wildcat" nature, with no definite indications that ore exists. The sparse surface and drill-hole showings, the split of profits with another company in the precarious base-metals industry, and the lack of more tangible ore guides cause me to conclude that Hecla may find better opportunities elsewhere.

General

The period of February 20-27, 1958, was spent in examination of the San Xavier Mine, Pima Mining District, Arizona. The property is operated under a purchase agreement with Eagle Picher Mining Company by McFarland-Hullinger, Tooele, Utah. A majority of the time was spent in abstracting data from company records; however, the 500, 580, 660, and 740 Levels were visited. The principal exploratory Level, the 660, was traversed for its entire length. The surface outcrops and development were also examined.

Because the potential of the property appears to lie in the undeveloped area of the holdings, rather than in the mine area itself, which is approaching a worked-out status, examination was directed toward obtaining a broad geologic picture of the property, the effort being to determine whether geologic conditions similar to those in the mined ore zone might exist elsewhere on the property. Little or no geologic investigation is being conducted by the present operators; however, Eagle-Picher's records and maps present evidence of some excellent work by Herndon and Jones.

A claim map, 200-scale surface geology map, 100-scale longitudinal section, structure interpretation overlay, 30-scale representative vertical cross-section, and composite of mine workings are included in the map pocket. In a separate packet are 30-scale maps of the 340, 660, 740, 820, and 900 Levels, the 100 and 150 Levels of the No. 6 Shaft area, and three 50-scale vertical cross-sections. These are included to show the extent of development, including underground drilling, and location of various car and wall samples taken during development.

All available records were offered for inspection by Wimpy Nelson, mine superintendent, and Jerry Irwin, engineer. Mr. Irwin accompanied me in inspection of the mine and surface.

Property

The San Xavier holdings consist of 16 patented claims (underlined in green on claim map) and 32 unpatented claims. Of the unpatented claims, three, the English, Iguana, and Red Oxide No. 4, are subject to state royalty payments, as they were staked after Section 2 became a School Section.

In addition, the property includes 22 unpatented claims held under lease.

Improvements consist of the mine plant, employee housing, and a 400 tpd flotation mill (located at Sahuarita, 8 miles distant).

The San Xavier claims are located in the Pima Mining District, 18 miles Southwest of Tucson, Arizona, in Sections 2, 3, 10, 11, and 12, T 17 S, R 12 E, Santa Cruz Guide Meridian. The property is accessible from Tucson via the paved Twin Buttes Road.

It is bordered on the north by Banner Mining Company holdings, and on the northeast and east by those of the Pima Mining Company. This area is undergoing extensive development and production of copper ores by the above two companies, and by American Smelting & Refining Company. A number of miles to the south, another large copper deposit, of low grade, is being developed by Duval Potash Company.

Topography

The property is located on the flanks of a small group of hills which rise 200-400 feet above a pediment sloping gently eastward from the Sierrita Mountains to the Santa Cruz River. Elevation at the No. 7 Shaft collar is 3530 feet.

The climate is of the semi-arid desert type, with corresponding vegetation. Operations are conducted throughout the year.

History and Production

The San Xavier silver-lead deposits were known, and worked to a small degree, by the early Spaniards, prior to 1875. In 1880, the mine was purchased by a Colonel C. P. Sykes, and worked intermittently until 1893.

In 1897, some ore was shipped from the property by L. H. Manning. In 1912 the property was purchased by Empire Zinc Company, and Pb-Zn-Ag ore was shipped until 1918.

The mine was purchased in 1942 by Eagle-Picher Mining Company, and operated by that company until 1953. In a report by Fowler, production from September 22, 1943, to December 31, 1946, is described as 152,117.35 dry tons, assaying 3.47 Ag, 6.01 Pb, 11.87 Zn, and 0.70 Cu. Mining was halted in August, 1952, and the next few months were spent in rehabilitation of the No. 7 shaft, at a reported cost of $150,000. Upon completion of shaft repairs, the mine remained dormant until February of 1955, when McFarland-Hullinger was granted a lease-purchase option on the property.

McFarland-Hullinger resumed operation, utilizing a bonus system and a much smaller crew than the prior operators. Grade was improved, and a 2500 ton per month rate of production was profitably maintained in 1955 and 1956.

Production slowed to a rate of 1500 tons per month until June of 1957, when the mine was shut down. In November, because of the continuing maintenance costs, the mine was reopened, and has since produced at the rate of 100 tons per day. Average grade of the McFarland-Hullinger production is estimated by Nelson at 2-3 oz. Ag, 7-8% Pb, 15-16% Zn, and 1-2% Cu.

Mill concentrates are shipped by rail to American Smelting and Refining Company, El Paso (lead), and to American Zinc, Dumas, Texas (zinc).

Total production from the San Xavier Mine, for the period 1897-1958, is estimated at 688,700 tons.

Geology

The general geology of the Pima Mining District has been described in a previous report. In the vicinity of the San Xavier Mine, a repeated series of resistant Permian limestones and quartzites outcrop as low hills above a pediment slope of alluvium and occasional outcrops of Cretaceous arkose and andesite. Pre-ore reverse faulting, and post-ore [illegible] faulting are tear faulting have occurred. The mineralization, consisting of argentiferous galena and sphalerite, with chalcopyrite and pyrite, in a gangue of garnet, quartz, hedenbergite, calcite, hematite, magnetite, and epidote, occurs in the trough and on the flanks of a south-plunging synclinal fold, in association with a zone of reverse faults which are essentially parallel to the bedding.

Fowler describes the mine as containing small ore bodies with high ore content, especially in zinc, which have been localized in adjustment zones in a complex geologic environment. He states that the known and prospective ore shoots are related to structural deformation which is more intense here than for many square miles of surrounding area.

A. Stratigraphy

Jones, Eagle-Picher geologist, in his notes on rock identification in the San Xavier Mine, describes the formations as follows:

Cretaceous: In surrounding districts, up to 25,000 feet in thickness. Composed of varied sediments and volcanic flows. In San Xavier area, composed of arkose and argillite. The arkose is identified by a salmon-pink color, and a texture similar to fine-grained tapioca pudding. It may be confused with pink altered limestone (differentiated by dense appearance, no visible grains), or with the poorly sorted grits of the lower Permian Yeso formation.

In the mine area, the ore is usually separated from the arkose by 10'-12' of fine-grained, light green quartzite or soft argillite. A 6"-12" band of high grade ore is frequently found on the foot-wall of the argillite-quartzite band.

Permian: The Permian sediments have been divided as follows:

	Concho Ls. Csh 100'-200'	Blue-gray to black ls. Fossiliferous. Chert nodules. Thin and thick beds.
	Scherrer Series	
Snyder Hill Formation	Upper Qte: Cmq 20'-100'	Brown-gray, med. grained
	Intermed. Ls: Cml 10'-100'	blue-gray to black (alt. black and white, west part of mine).
	Lower Qte: Csq 400'	Green-gray, very fine-grained, shaley quartzite
	Lower Ls: Csl 70'-300'	Blue-gray to black
Yeso Formation	Cy 1500'-2000'	Gypsum, marl, shale, soft white densels, hornfels

Ore has been found to occur as replacements in the Concho limestone and in the upper members of the Scherrer series.

A 200-scale map of the surface geology of a major portion of the San Xavier area was prepared by Herndon, Jones, and others. Outcrops were mapped by rock types, i.e., quartzite, limestone, et cetera, but the various Permian members were not differentiated. Using the Cretaceous arkose and Permian gypsum-marl as guides, I have interpreted the Permian sequence as shown on the surface geology map. The interpretation is in general agreement with one sketched by Jones.

As seen on the surface map, much of the southern San Xavier area is covered with Cretaceous arkose, argillite, and andesite. Through the central portion of the property, Permian limestones and quartzites outcrop in an east-west trending belt, off-set to the south in the westerly claims. To the north of the western area, a thick series of faulted Mississippian and Pennsylvanian limestones outcrop. In the north central portion of the property, the Permian series is twice repeated by faulting in a triangular wedge bounded on the northeast by a down-dropped block of Concho limestone.

Granite outcrops to the west of the property, the contact dipping easterly under the property. A tongue of the main mass apparently trends southeasterly into the southwestern portion of the claims, outcropping south of the Hoosier claim. In the mine area the granite lies at approximate 2460' elevation in the plane of the longitudinal section. Considerable variation in the granite surface is evidenced by two holes drilled from the 900 Level. Hole 424 encountered granite at 124 feet vertical depth, while Hole 566 encountered it at 349 feet. The age of the granite in the vicinity of the mine has not been determined as yet. It is described as a medium to coarse-grained, biotitic granite.

B. Faulting

A complex system of east, northeast, and northwest trending faults exists in the San Xavier area. In addition, many minor flat slips exist in the mine zone.

Of the various faults, the major contributor to mineralization is the "17" Fault, and its subsidiary "10" Fault. These faults trend east-west, and dip 50°-70° to the south, essentially parallelling the bedding. They do not occur at the limestone-arkose contact, but are within the Permian sequence. The "17" Fault, on the upper levels, is characterized by 4"-6" of green-gray gouge on the footwall. It is occasionally mineralized, usually in 1-2' of breccia overlying the gouge. The "10" Fault parallels the "17", and is in its hanging wall. These are considered to be reverse faults, and are pre-mineral. Within the fault zone, many small flat to moderately steep slips important in localizing ore occur. These are best illustrated on Section HH, enclosed.

While the surface expression is indefinite, a major north trending fault is assumed to pass through the central portion of the property, to the west of the main ore zone. The assumption is made to account for the relation of the Pennsylvanian-Mississippian limestones in the northwestern area to the Permian sequences on the east, and is probably responsible for the offset of the Permian-Cretaceous contact to the south in the westerly part of the claim group. This fault may be evidenced on the 660 Level by a caving zone of N-S faulting dipping 45°-55° easterly in the vicinity of 99,800 E. coordinate. It has been named the Democrat Fault by Eagle-Picher geologists, and is considered to be post-ore, and a tear fault in nature.

A little over one half mile to the east, a probable fault of similar nature, and parallel to the Democrat Fault, is indicated by a topographic low between Helmet Peak and the San Xavier Hills, and may account for relations of the formations in this area. Mention was made by Mr. Irwin that this fault may be the same as that postulated as off-setting the Pima Mineral trend from the Mineral Hill trend (see Pima Mining District report, map).

A third fault, apparently of the same system has been mapped by Mayuga about a mile west of the Democrat Fault, where it marks the contact between granite and limestone.

In addition to the two above described systems, a third system of faulting is noted, with a northwesterly strike. The most pronounced member of this system is the Xavier Fault, which strikes about N 45° W, and dips southwesterly 55°-60°. This fault is also later than the east-west system, as it offsets the "17" fault to the south on the east side. It has been encountered underground in drill-holes, and the present east face of the 660 Level is in a caving zone attributed to the Xavier Fault. No mineralization has been encountered along it, and it is assumed to be post-ore.

The "17" Fault bends abruptly to the south in the western mine area, where it parallels the Democrat Fault. The change in trend is best seen on the 900 Level, where the fault has been followed southward for several hundred feet. The easterly trend curves with the bedding until the Xavier Fault is intersected, where it is offset a short distance to the south, and then continues easterly, marked by formational offsets. Still conforming to the bedding, it probably intersects the assumed tear fault to the east.

The "10" Fault, in the hanging wall of the "17", apparently exists only between the Democrat and the Xavier Faults.

C. Structure

Bedding attitudes and formation configuration in the mine area show the mineralized zone to occur in a rather open synclinal fold plunging 55°-60° to the south. A similar open synclinal fold involving the same formations is indicated by bedding and outcrops to the east, separated from the first by a small anticline. A relatively narrow anticlinal fold is indicated to exist upon the easterly flank of the easterly syncline.

To the north of the mine area, relations of the Permian sequence indicate the presence of a small synclinal fold, repeated by faulting.

In the western portion of the claims, minor irregularities in bedding attitudes and formation configuration are noted, but no major structural features are evidenced.

A structural overlay has been constructed for the 200-scale map, showing principal faulting, structure, and formation relationships.

D. Mineralization

The ore mineralization at the San Xavier Mine consists largely of sphalerite, a lesser amount of galena, minor quantities of chalcopyrite and silver (in unidentified form) and pyrite. Gangue minerals are principally garnet, hedenbergite, quartz, and calcite, the ore most often being associated with garnet and hedenbergite. It occurs in bunches, pods, and disseminations as replacements of the Concho limestone, the upper limestone of the Scherrer series, and, to a lesser extent, of the upper Scherrer quartzite.

The principal mineralization occurs along, and in, the hanging wall of the "17" Fault, extending to the Permian-Cretaceous contact for a width of 50-150 feet. Within this zone, ore occurs in the hanging wall (vicinity of Permian-Cretaceous contact, intermediate zone (between "17" and P-C contact), and footwall (along and in "17" Fault). Four main ore shoots were developed by Eagle-Picher, and a fifth, in the 12 Stope Area, was developed and mined by McFarland-Hullinger. The shoots show a greater continuity downward than laterally (see long. section).

As shown in Section HH, the mineralization tends to build up under thin, flat or moderately dipping slips which intersect the major faults. Shoots are irregular, and where limited upward by such slips, mineralization may follow the slip for a short distance before breaking free to form another pipe-like pod of ore. Blocks have been moved back and forth on the flat slips, and as a consequence, the Permian-Cretaceous contact is quite irregular along the dip.

Examining the longitudinal section, mineralization seems to become more restricted below the 580 Level, although the grade remains fair to the 900 Level. Sampling on the 900 Level indicates that the lead content is decreasing downward. The present reserves, in the neighborhood of 30,000 tons, indicate that little additional ore has been found on the lower levels.

No ore has been cut in the 660 East exploration drift, beyond the 12 Stope Area.

To the west, a second small center of mineralization, beneath a strong garnet outcrop, has been developed by the No. 6 shaft, and three levels. Some stoping was accomplished on the 100 and 150 Levels, but exploration on the 250 Level failed to reveal ore. This ore zone is in the Permian sequence, but occurs well in the footwall of the "17" Fault.

The 340 and 660 Levels were driven southwesterly to explore the ground between the main ore zone and the No. 6 Shaft area, and to effect a connection between the workings. Some stoping was accomplished above the 340 in the 29 area, and some stoping on the 660 Level itself was done in the 21-23 area. Ore in these areas was principally sphalerite, with minor copper and silver, and low lead content. Some additional zinc ore may exist below the 340 Level in the 29 Area, and above and below the 660 Level in the 21-23 Area. It should be noted that the scale is incorrect on the long. section west of the break in the plane of section; according to the 340 Level plane, the 29 stopes actually develop the ore shown in Holes CDH-4 and DDH 58.

Exploration

The mine area has been rather thoroughly explored, as shown by the underground drilling on the various levels. A total of 605 holes have been drilled underground in exploring the potential mineral zone. While other ore bodies may exist, remaining hidden due to their small irregular size, the underground drilling to date has not been too successful. Drilling below the 900 Level has been minor, consisting of two vertical holes and two inclined holes. Of these, Hole 516 shows 10 feet of 18% zinc 20'-30' below the level.

A total of 34 churn drill holes and 44 diamond drill holes have been drilled from the surface, the majority of which have been placed between the No. 4 and No. 6 Shafts, and in the No. 6 Shaft area. Drilling here has shown spotty mineralization of high zinc content, and was followed by underground exploration and development by the No. 6 Shaft and levels, and by the 340 and 660 drifts. Some stopable ore was found, and some probably remains, but the high zinc content, spottiness of the ore, and the large number of barren drill-holes presents an unfavorable outlook for the western area.

To the east of the mine area, a large area of the favorable Permian sequence is evidenced by outcroppings. While little ore mineralization has been noted, a pyritic gossan is present on the Patterson claim. Holes drilled to explore the ground below this gossan have revealed pyrite and specularite, but no ore. Several other holes have been drilled in the eastern area, most of them relatively shallow, with the object of testing magnetic highs disclosed in an electromagnetic survey made by United Geophysical in 1953. None of the holes disclosed mineralization. Axes of the principal highs and lows disclosed by the geophysical survey are shown on the claim map.

Although presently halted, the 660 Level was being extended eastward to explore this easterly zone at depth. After leaving the 12 Stope Area, the drift passes into hard, banded black and white limestones, occasionally cut by open fissures. No ore was encountered between the stope area and the drift intersection with the Xavier Fault. A short cross-cut south, a short distance west of the fault intersection, was driven to explore below some reportedly rich shallow workings, but has not disclosed mineralization to date.

Churn Drill Hole 20 was drilled at Coordinates 99830 N - 104610 E (off map), attaining a depth of 1360 feet. Limestone was encountered from 435' to 1275'. Although considerable pyrite was noted throughout the section, only traces of chalcopyrite, galena, and sphalerite were in evidence. Lack of appreciable ore mineralization in the presence of so much pyrite may indicate considerable distance from the center of mineralization, and may evidence the rude zoning noted by Mayuga (Pima District Report).

Reserves

Reserves of approximately 50,000 tons have been maintained at the San Xavier Mine during its operation. Irregularities of the ore bodies, and the necessity of continuing exploration have made the establishment of reserves difficult. In September, 1954, reserves from the 250 Level to the 660 Level were estimated at 41,337 tons averaging 3.1 Ag, 4.3 Pb, 12.5 Zn, and 1.08 Cu. Reserves as of January 1, 1956, were 51,792 tons of positive and probable ore, grade not described. Reserves on the 900 Level at that time were estimated at 3225 tons positive, and 3960 tons of probable ore.

The present reserves, on a thumbnail estimate by Nelson and Irwin, are approximately 30,000 tons, averaging 2-3 oz. Ag, 7-8% Pb, 15-16% Zn, and 1-2% Cu. The 900 Level has not been unwatered by McFarland-Hullinger.

Acquisition

McFarland-Hullinger have made an agreement with Eagle-Picher to purchase the San Xavier property for a total price of $350,000, paying $10,000 per month. They are presently negotiating for a monthly payment of $5000. With insufficient funds to continue exploration, they are interested in making an operating agreement by which the eastern area can be explored, either by drilling, extension of the 660 drift east, or both. No terms have been mentioned. An arrangement suggested by McFarland would be that if ore sufficient to justify a 500 ton per day operation were found, the larger company would be the operator. If a lesser amount were found, M-H would continue as operator.

Conclusions

The geology of the San Xavier Mine is summarized in the Summary, Page 1. Although further exploration by the operating company appears justified, it is concluded that more favorable opportunities may exist elsewhere for Hecla, for the reasons stated in the Summary. Therefore it is recommended that we reject any interest in the property.

Respectfully submitted,

J Douglas Bell
Geologist, Exploration

Enclosures: Surface geology Map
Longitudinal Section
Cross Section HH
Claim map
Structural Overlay
Level Composite

Separate Packet:
Vertical Cross Sections (3)
Level maps, No. 6 Shaft Area
Level Maps, 340, 660, 740, 820, 900

jan

COPY

C. F. Park, Jr. 1929
"Geology of the San Xavier District" Arizona U. M.S. Thesis

Page 17 - Mineralogy

The mineral deposits of the district as a shole are of the typical contact metamorphic class. They are concentrated along fractures and at the contacts of different sedimentary rocks.

Page 22 - History

The main difficulties of the district in the past seem to have been inadequate transportation facilities, lack of efficient milling equipment, scarcity of water, low grade of the primary ores, which is partly due to the amount of wall rock it is necessary to mine out and finally, the spotty character of the ore is unfavorable to cheap production.

Character of Ore Deposits

The commercial deposits all occur as small replacement shoots and pipes in limestone. Most of the copper output has been from replacemebt bodies along fissures and faults and almost wholly within the oxidized zones. In addition to being small, the ore deposits are discontinuous and frequently widely separated.

Most of the evidence points toward contact metamorphism as the type of deposit, and it seems probable that an intrusive rock is relatively close to the surface throughout nearly all the district.

Page 28 - Genesis of the Ores

As stated previously, most of the fact collected point toward an intrusive body at a relatively shallow depth. Mineralization has been noticed in all types of rocks outcropping at the surface, independent of type or locality. The sediments in general are very much squeezed, folded and faulted. The mineral-bearing solutions are considered as the last phase of the magmatic (??) materials resulting from the crystallization of the intrusive. These solutions have penetrated the strata through numerous channels and deposited their loads under a variety of physical and chemical conditions.

Limestone was the most favorable rock for the formation of commercial orebodies so received a greater percentage of metal than the other rocks. Localization has been influenced to a great extent by the relatively impervious nature of the arkosic and quartzitic sedimentary beds. These arkosic and quartzitic strata, especially where badly shattered, are somewhat mineral ized.

Manuel Nievo Mayuga 1942

"Geology and Ore Deposits of the Helmet Peak Area" Ph.D. Thesis

Page 93 - History & Production
Mineral Hill Consolidated Copper Co.

1898-1918 Production: Cu = 8,000,000#, Ag= $50,000, Grade of Cu approximately 12%

Character of Ore Deposits

The copper deposits of the Mineral Hill Consolidated Copper Co. are of the contact metamorphic type. The ore bodies occur in limestone close to granite intrusive. The largest ore bodies were deposited along the principal fault zone (Mineral fault) and in an irregular zone of contact metamorphism near the intrusive.

Page 99 - San Xavier Mine (Empire Zinc Co). - History

Production: 6,000,000# Pb, and $200,000 Ag. Total value = $500,000 No figures for copper and zinc.

Character of Ore Deposits

The ores of the San Xavier mine belong to the metasomatic lead-zinc silver type.

The shape of the depsits below the #2 and #5 shafts is an inverted elliptical zone with the base close to the surface. The ore bodies are not continuous but are made up of lenticular masses lying one above the other. They occur as replacements in the Permian limestone near the main east-west fault. Localization of the ore shoots is controlled by two systems of fractures N45°E and N70°E.

Page 108 - Olivetti Mine (Olive Mine) - General Statement

Production estimated as high as $750,000, largely silver.

Character and Extent of Ore Deposits

The ore deposits of the Olivetti mine are typical of the silver-lead-zinc ore in narrow fissures, which are numerous in the Olive Camp sub-area.

Page 112 - Helmet Peak Mining & Milling Co. - General Statement

The Helmet Peak Company claims ore deposits are in the complex silver-lead-zinc ore type in brecciated volcanic rock (andesite). The ore bodies occur as replacements in the zone of brecciation.

Page 115 - Extent of Development

Shaft #1 on Camden claim is 600' jdeep, 3500' of lateral work between shaft #1 and #2 which is 400' deep and lies 500' S.W. of shaft #1.

Harold A. Whitcomb - 1948. M.S. Thesis
"Geology of the Morgan Mine Area, Twin Buttes, Ariz"

Page 70 - Economic Geology

Est. Production of Mines:	Glance =	$2,786,126
	Morgan =	2,035,306
	Queen =	1,747,852
	Minnie =	1,339,803
	King +=	275,000

The mineralization of the district is typically contact metamorphic in character, the direct result of the invasion of the sediments by a large intrusive body.

Deposition has been controlled almost entirely by faulting and fracturing of the carboniferous limestones near the intrusive contact and is confined to belts or zones of altered rock in which pyrite and chalcopyrite are intimately assoicated with garnet, amphiboles, pyroxenes and other silicate products of contact metamorphism

Page 72

Browns work at the Queen and Glance mines further revealed that the ore bodies are characteristically irregular in outline, somewhat tabular and of limited extent both vertically and horizontally. At depths ~~xofor~~ of 700 feet the depsits became too low grade to mine.

FREDERICK N. HOUSER - 1949 M. S. Thesis
"The Geology of the Contention Mine Twin Buttes, Ariz"

No details of interest

E. B. Eckel, 1930   M.S. Thesis

"Geology and Ore Deposits of the Mineral Hill Area"

Page 25 – General Character of Ore Depsits

The ore depssits of Mineral Hill are of the replacement type associated with the intrusion of igneous rocks in limestone. They are not "typical contact deposits" in that they are not confined to an area close to the contact of the intrusion with the sedimentary rocks, but are for the most part localized by zones of fractures. For this reason much of the ore is found several hundred feet away from the igneous rocks.

Roaald L. Brown, 1926 M.S. Thesis

"Geology and Ore Deposits of the Twin Buttes District"

Page 39 - Conclusions

The ore deposits at Twin Buttes are clearly contact metasomatic with the development of such characteristic minerals as magnetite, pyrrhotite, chalcopyrite, hedenbergite, andradite, diopside, epidote and actinolite. They were formed in limestone at or near the contact of an intrusive igneous rock which furnished the solutions that caused the mineralization.

PYROMETASOMATIC DEPOSITS AT SAN XAVIER MINE

G. W. Irvin
MacFarland & Hullinger Co.

HISTORY

The lead-zinc-silver deposits of the San Xavier mining district were among the earliest of Arizona's lead-silver producers. They were known and worked by the Jesuits and early Spaniards prior to 1875. Production from the San Xavier mine has been sporadic -- under Col. C. P. Sykes from 1880 to 1893, the Empire Zinc Company from 1912 to 1918, and the Eagle-Picher Mining and Smelting Company from 1943 to 1955. Since 1955, it was first leased and then optioned to the MacFarland & Hullinger Company. Production during the past few years has averaged about 100 tons a day.

GEOLOGICAL SETTING

The principal geological feature in the vicinity of the San Xavier mine is a series of arcuate thrust faults dipping 20° to 55° to the south (fig. 44). These faults are cut by north- to east-trending vertical tear faults. In the western part of the mine area, a wedge of Paleozoic limestone, forming West San Xavier Hill, lies between coarse-grained Precambrian granite on the north and Cretaceous (?) arkose to the south. In the eastern section of the area, which includes Helmet Peak, the Cretaceous (?) sequence lies on both sides of the wedge of Paleozoic limestone which is folded into a tight southwest-plunging anticline. The limestone in the Helmet Peak area appears to have been, at least in part, thrust over the Cretaceous (?) sediments. Limestone klippen are found east and south of the peak. Tertiary granite and andesite plutons that intrude the Cretaceous (?) beds are located immediately south of the mine area.

Within the mine, low-angle thrust faults that dip 15° to 20° south are parallel to the arcuate thrust faults that dip 20° to 55° south and offset them to the north.

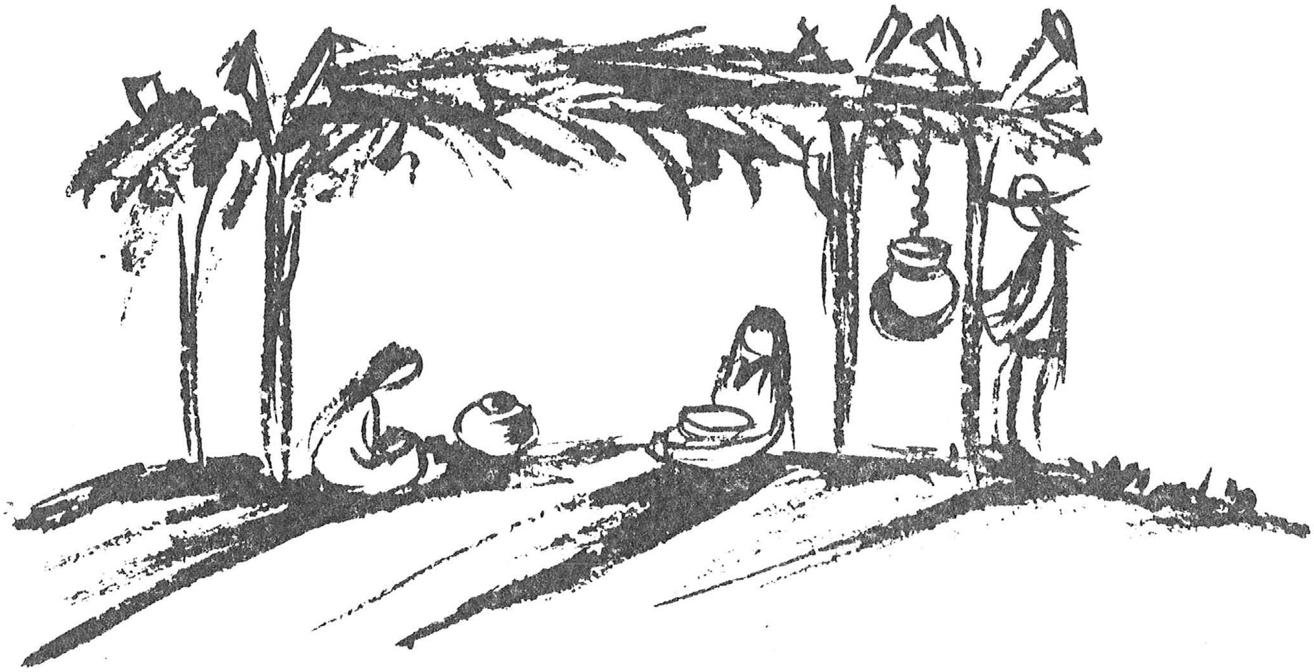
ORE MINERALIZATION

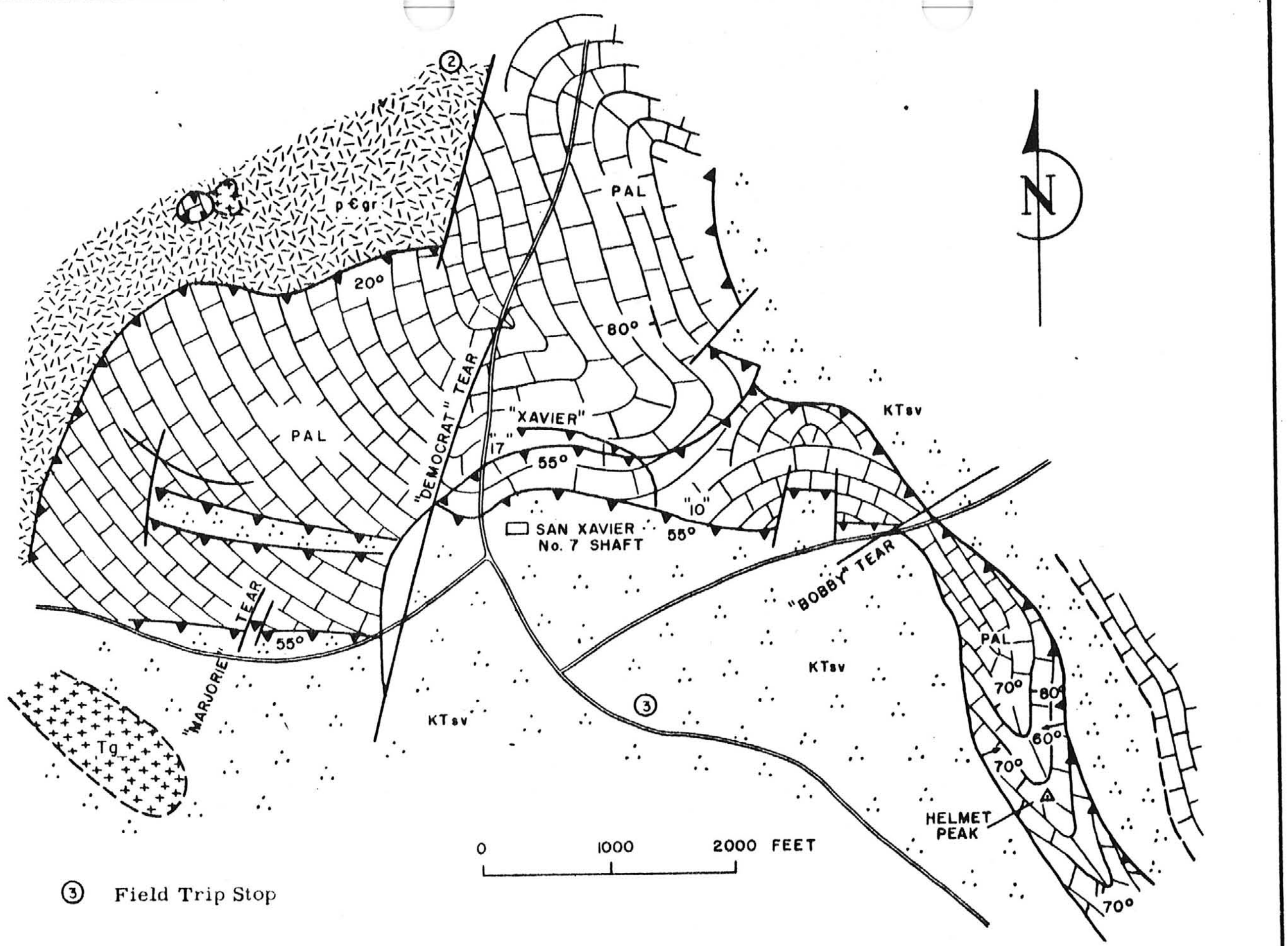
Ore in the San Xavier mine is composed principally of lead and zinc with substantial values in copper and silver. The ore is characteristic of pyrometasomatic deposits although it cannot be related directly to contacts with any known intrusive body.

Developed ore bodies are of two types -- steeply dipping pipes and flat-lying ore shoots. The pipe deposits are localized principally in breccia zones along the intersections made by the "No. 10" and "No. 17" faults (fig. 42A) with tear faults, and the flat-lying ore shoots occur at the intersection of the steeper thrust faults with the flat thrusts. Ore mineralization has replaced the brecciated zones within the Paleozoic limestone, particularly where earlier metamorphism had converted the limestone to a hedenbergite tactite. Ore bodies have been developed to a depth of 900 feet below the surface and drill holes indicate that the mineralization continues below this level.

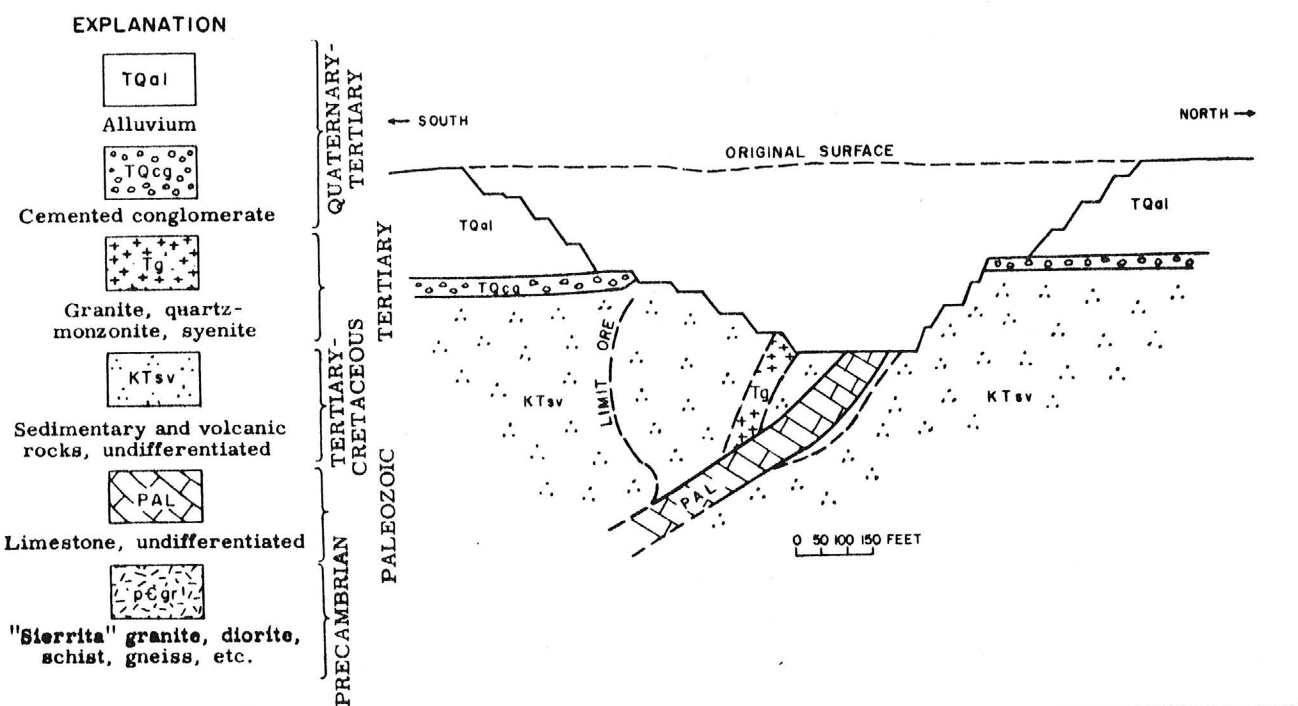
Galena, sphalerite, and chalcopyrite constitute the principal ore minerals and are usually accompanied by specularite, magnetite, pyrite, calcite, and quartz. The minerals are closely associated with and replace silicates such as hedenbergite, garnet, and chlorite.

Although locally sulphides are encountered at depths of 30 feet below the surface, the oxidized zone extends irregularly to depths of about 400 feet below the surface. This depth corresponds closely with the surface of the water table in the mine. The usual assemblage of oxides, sulphates, and carbonates of lead and copper are found in the oxidized zone.





A. Generalized geologic map of the vicinity of the San Xavier mine.



B. Diagrammatic geologic cross section through the Pima mine pit.

FIGURE 42. Generalized geologic map of the San Xavier mine and diagrammatic cross section of the Pima mine pit, East Sierrita area (fig. 44), Arizona.

dd San Xavier
Pima Co.

General Description Of The San Xavier Mine Laboratory

The San Xavier Mine Laboratory (SXML) is located approximately 23 miles south of Tucson, Arizona in the Pima Mining District. Access to the mine from Tucson is gained by traveling south on interstate, I-19, to the Valencia Road exit going west, proceeding west on Valencia Road to Mission Road and turning south on Mission Road. The mine is located near the intersection of Mission Road and Ocotillo Road. Access from the Tucson International Airport is gained by traveling west on Valencia Road to Mission Road, etc. Figure 1 shows the general location of SXML in relation to Tucson and the major open pit mines in the area. Figure 2 shows the surface features of the mine site.

SXML consist of three working levels: the Adit level, the 100 level and the 150 level. The Adit level consists of approximately 650 feet of 8 x 8 ft drifts; the 100 level consists of approximately 650 feet of 4 x 6 ft drift and the 150 level consists of approximately 600 feet of 4 x 6 ft drift. In addition the 100 and 150 levels are interconnected to large stopes and to abandoned workings extending beyond the mine property.

Access to the 100 and 150 level is through a shaft and through a raise between the Adit level and the 100 level. The 100 and 150 levels are also interconnected by a raise. The attached map shows the general layout of the levels in relation to each other and the surface facilities.

The shaft is not equipped with a cage consequently, materials are lowered to either level with a small air driven tugger hoist.

Ventilation to the Adit level is provided by a fan located on the surface near the Auxiliary Shaft and connected to ventilation ductwork on the two main drifts. Ventilation to the 100 and 150 levels can be maintained either by natural ventilation or by use of the large 10HP fan located on the surface above the raise connecting the Adit level and 100 level. The fan can be used in a downcast or upcast mode.

Water, compressed air and electricity is available in all areas of the Adit Level and at the shaft station of the 100 level.

From a geological point of view, the mine is situated in a group of small hills rising steeply from the alluvial plain. The surface rocks are mainly of sedimentary origin. Limestones of various ages comprise most of the exposed sedimentary rock with some quartzite and textured, intrusive, igneous rocks - mainly granite and granodiorite. In places, porphyry dikes cut through the sedimentaries. The mine workings are in the limestone sedimentaries where the mineralization occurred. Galena, sphalerite, chalcopyrite, and pyrite were the main minerals extracted and these occurred in small and discontinuous ore bodies.

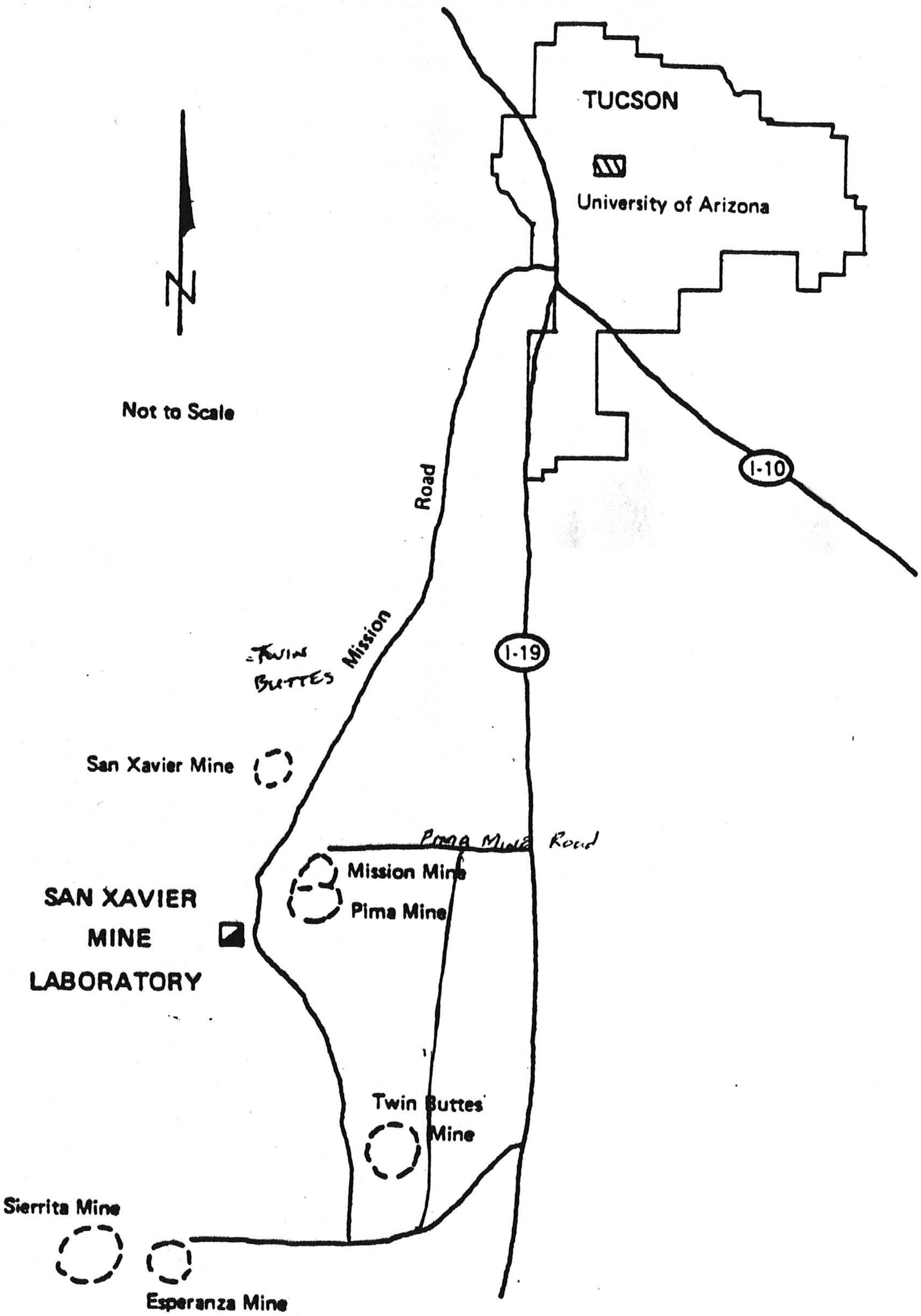


Figure 1. Geographical Location of San Xavier Mine Laboratory

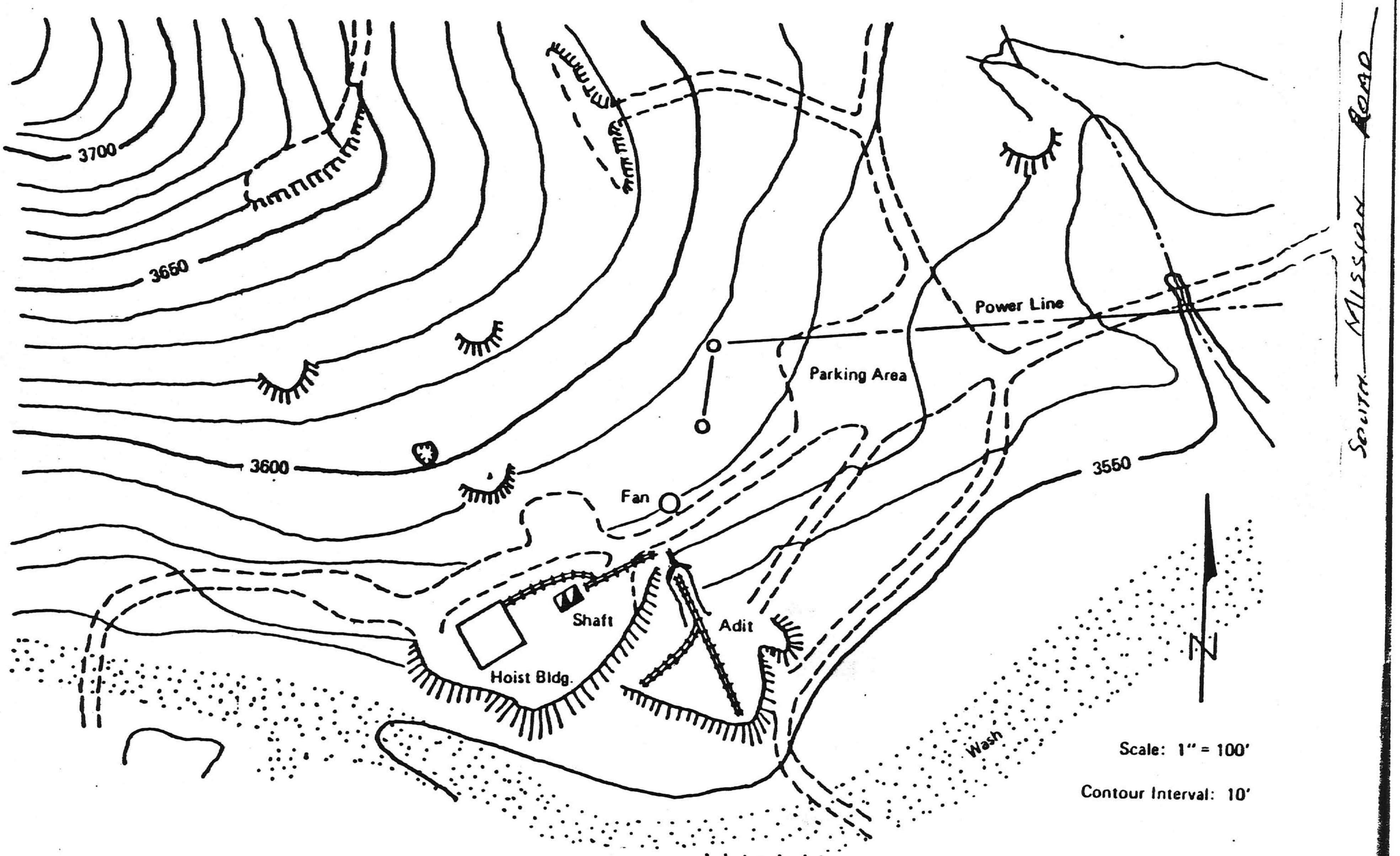
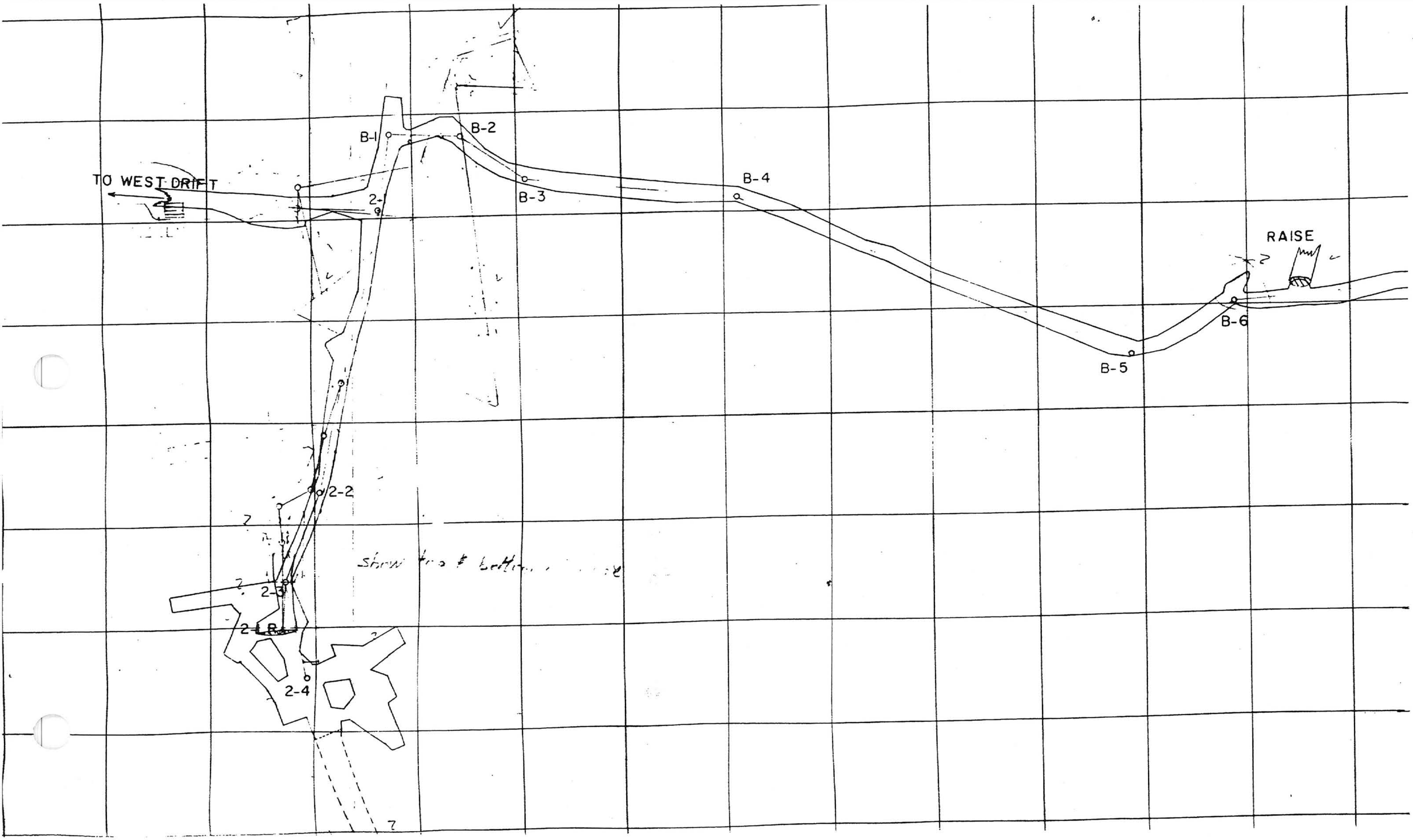


Figure 2. Topographic Map of SXML Property



TO WEST DRIFT
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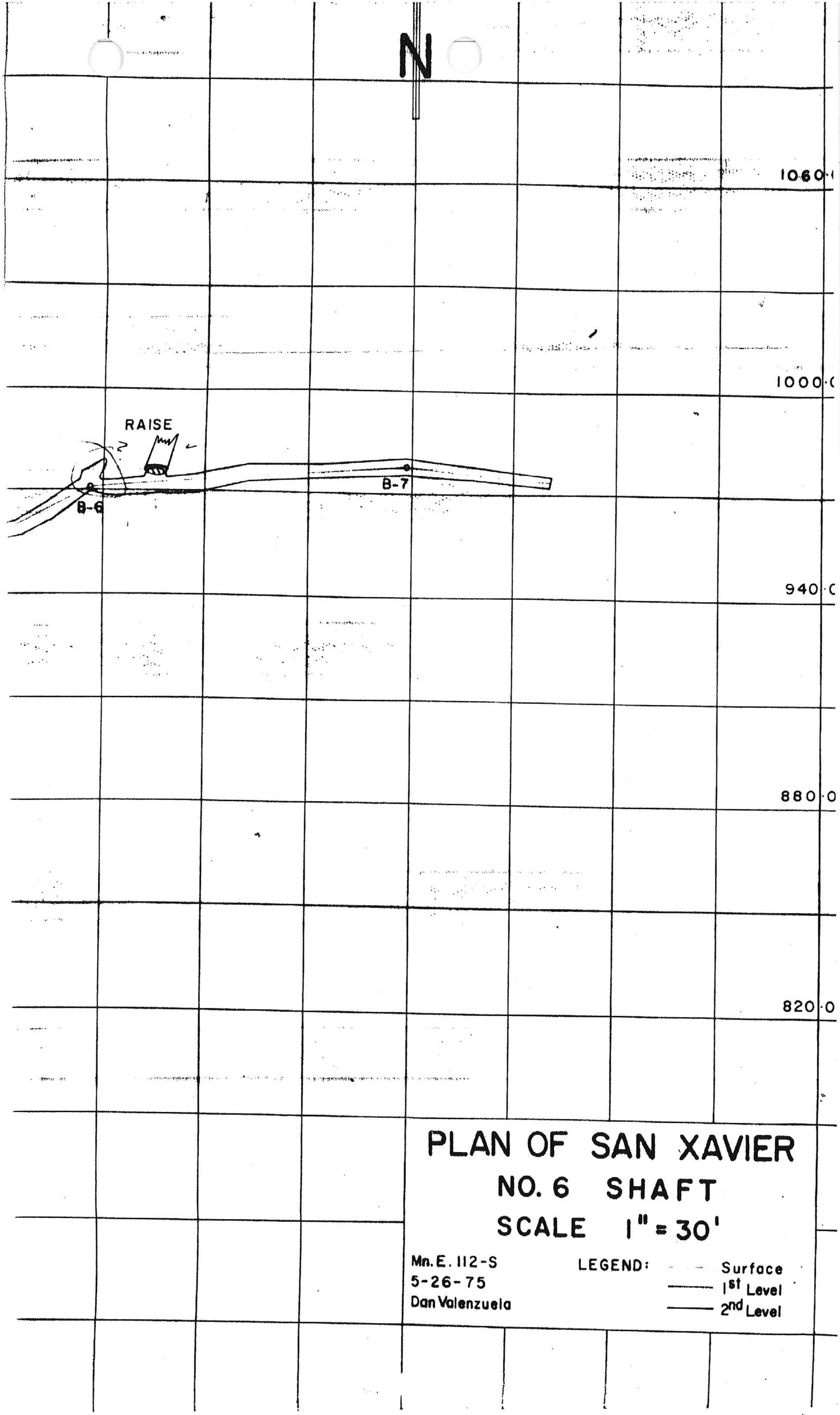
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PLAN OF SAN XAVIER
NO. 6 SHAFT
SCALE 1" = 30'
Mn. E. 112-S
5-26-75
Dan Valenzuela
LEGEND:
Surface
1st Level
2nd Level

STRUCTURAL INTERPRETATION OF THE RUBY STAR RANCH AREA, PIMA MINING DISTRICT, PIMA COUNTY, ARIZONA

by

Richard R. Weaver

A Thesis Submitted to the Faculty of the

DEPARTMENT OF GEOLOGY

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

1965

STATEMENT BY AUTHOR

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APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

______________________ ______________________

Evans B. Mayo
Professor of Geology

Date

C O N T E N T S

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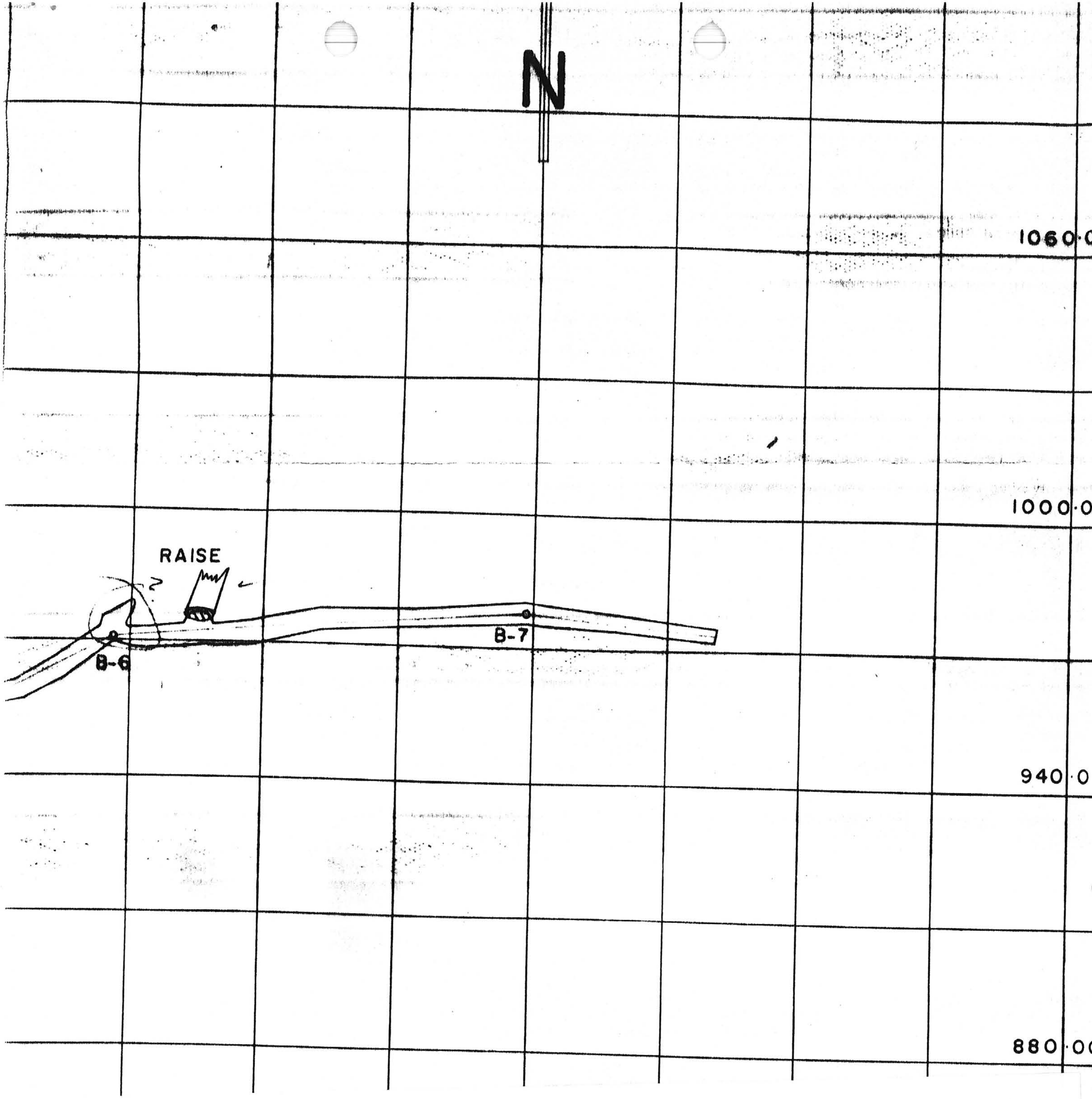
I L L U S T R A T I O N S

LIST OF FIGURES

LIST OF PLATES



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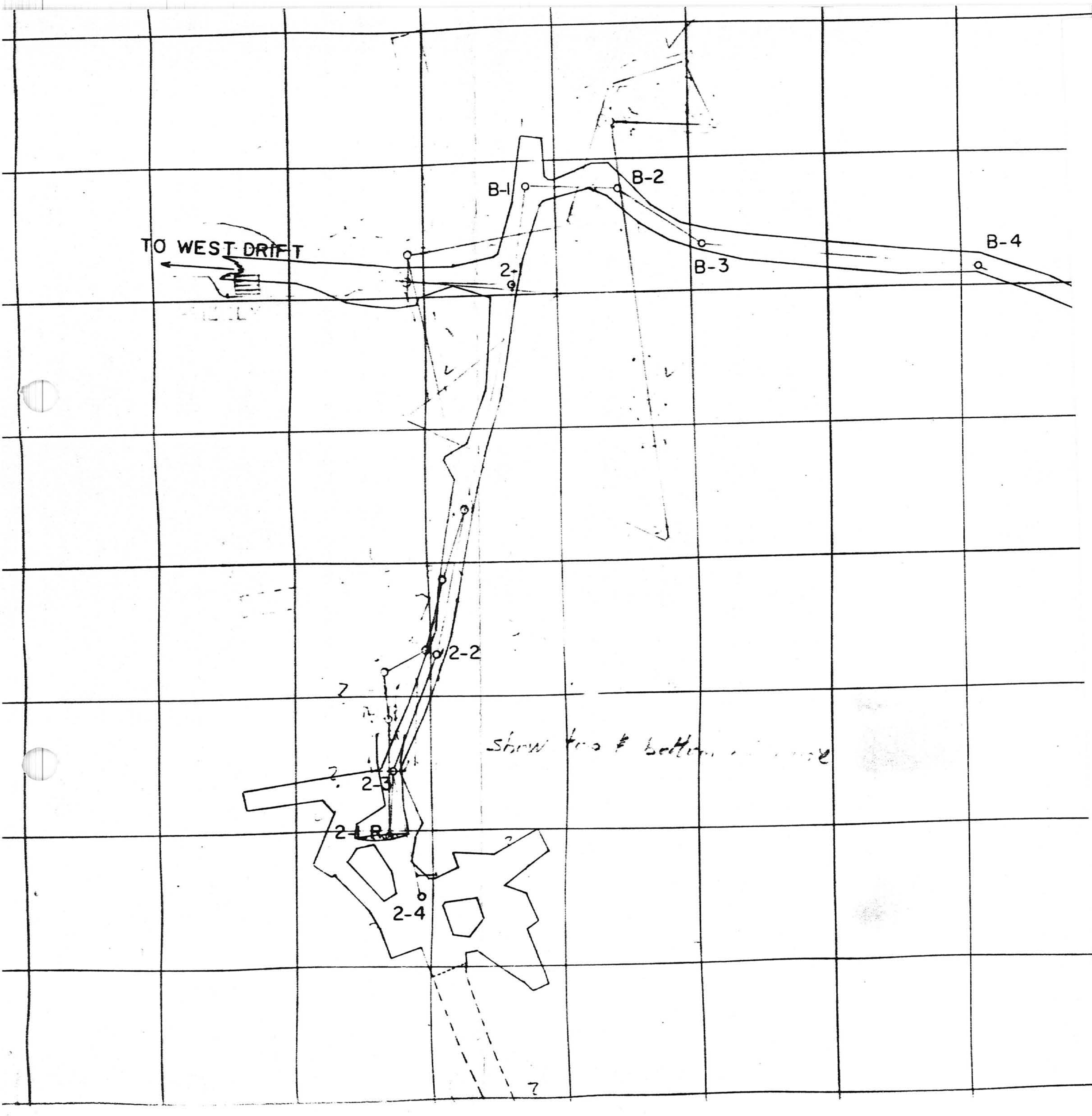
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