east at a large angle to the younger Basin-and-Range trend, which is northwest. The overall geologic relations suggest the fanglomerate is of middle Tertiary age.

The Helmet fanglomerate almost certainly correlates with the Pantano formation of Brennan,[3] which has its type section about 25 miles southeast of Tucson. This formation is described as a thick deformed sequence of conglomerate, sandstone, siltstone, mudstone, and scarce argillaceous limestone, with intercalated andesite flows which are lithologically like the flows in the Helmet. The pebbles and boulders are predominantly of Cretaceous(?) arkose, sandstone, and volcanic rocks. Boulders of Paleozoic limestone also are present. Schwalen and Shaw (1957, p. 15–22) present evidence that beds like the Pantano probably underlie the central part of the Santa Cruz valley beneath the cover of younger alluvial deposits. The data suggest that the Helmet and Pantano are essentially contemporaneous and are continuous beneath the younger valley fill. The Helmet evidently was deposited nearer the source than the Pantano.

In the San Pedro valley south of Redington (fig. 15), deformed fan deposits have yielded a lower Miocene rhinoceros. These beds resemble the Pantano lithologically and are cut by dikes of andesite macroscopically identical with the flows in the Pantano formation and Helmet fanglomerate. Boulders of the andesite in beds associated with the deformed fan deposits south of Redington suggest that andesite and these fan deposits are nearly contemporaneous (John F. Lance, 1958, oral communication). Tentative correlation of the Pantano, the Helmet, and the deformed fan deposits seems justified. If this correlation is correct, the Helmet fanglomerate is of early Miocene age.

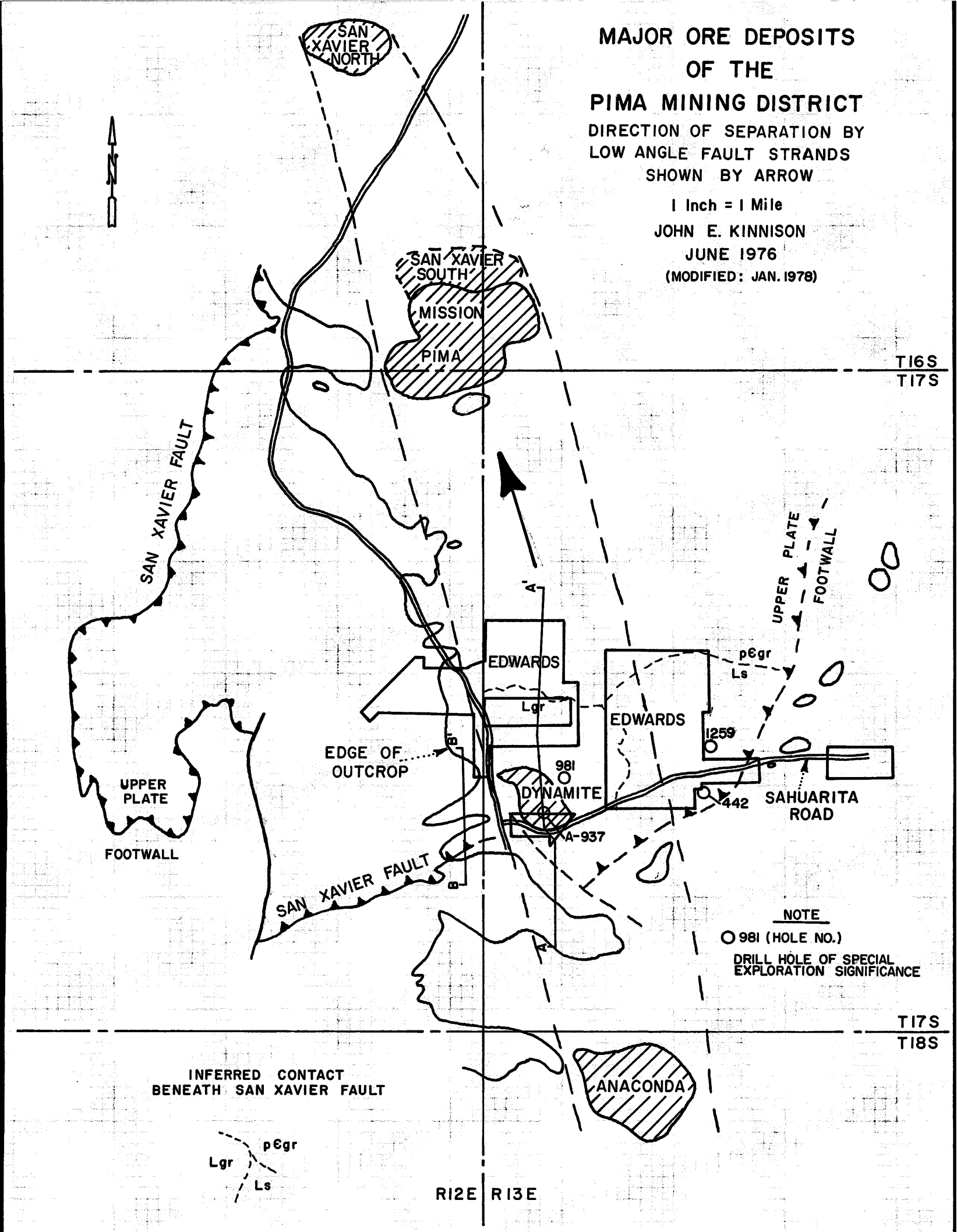
HYPOTHESIS REGARDING DISPLACEMENT

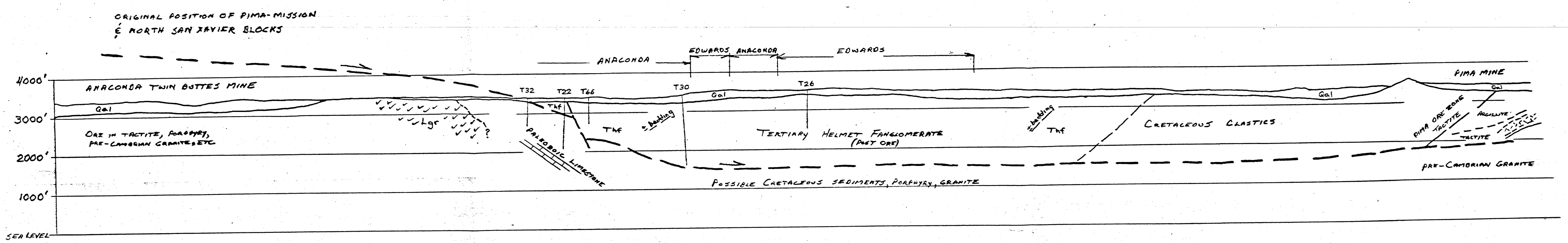
The various suggestions of the direction of movement on the San Xavier thrust are compatible with each other and are also compatible with an hypothesis regarding displacement, suggested by certain similarities in the geology of the Mineral Hill–Helmet Peak area and of the area south of Twin Buttes. The hypothesis is that the exposed part of the San Xavier thrust plate originally lay south of Twin Buttes and has been displaced about 6½ miles to the north-northwest in the direction suggested by faulting of boulders in the Helmet fanglomerate.

The hypothesis requires that prethrust rock units and structural features exposed in the Mineral Hill–Helmet Peak area have their roots south of Twin Buttes. To test whether this is probable or possible, one must imagine that the thrust plate is restored to its hypothetical source. If this is done, there is a crude match in the following geologic features:

1. The anticline on Helmet Peak would correspond with the anticline exposed in the isolated outcrop about 1½ miles southeast of Twin Buttes village. Drag folds suggest that the anticline southeast of Twin Buttes plunges about 25° SE. The Helmet Peak anticline plunges about 60° SE. (See table 5.) The Paleozoic rock in the two folds is not greatly metamorphosed and still contains recognizable fossils. The beds exposed in the Helmet Peak anticline (Concha limestone, Scherrer formation, and upper part of Colina limestone) are stratigraphicaly above those exposed in the anticline southeast of Twin Buttes (lower part of Colina limestone and upper part of Earp formation).
2. The Paleozoic rocks forming the hills near San Xavier would correspond with those containing the Senator Morgan and Contention mines. These rocks are much metamorphosed and contain the only significant concentrations of zinc in the district—at the San Xavier and San Xavier Extension mines in the thrust plate and at the Contention mine in the hypothetical footwall block.
3. The Paleozoic limestones of Mineral Hill would correspond with those immediately south of Twin Buttes village. These limestones are much metamorphosed and contain important copper deposits—the Mineral Hill, Daisy, and Pima deposits in the thrust plate and the deposits at the Minnie, King, Queen, and Glance mines in the hypothetical footwall block.
4. The Paleozoic rocks at the Mission deposit (Richard and Courtright, 1959, p. 201) would lie on the projection of the outcrops of Paleozoic rock northeast of Twin Buttes village.
5. The Cretaceous(?) rocks south and southwest of San Xavier would correspond with those south and southwest of the Senator Morgan mine. These rocks include arkose on the northeast and andesite on the southwest, and they contain small vein deposits of silver, lead, and zinc.
6. The Precambrian granite full of included material southwest of Mineral Hill would correspond with that west and southwest of Twin Buttes.

The two outcrop patterns do not match perfectly, nor should they be expected to do so. According to the hypothesis, the bottom of the thrust plate once matched with the footwall block along a shear plane that was an unknown distance above the present surface of the footwall block. To assume that the outcrop patterns should match perfectly is like assuming that the surface geology over a mine should match perfectly with the geology of a very deep level. Furthermore, the thrust plate probably contains unknown imbricate thrusts, tear faults, or other structural complications formed during the thrusting and confined to the thrust plate; such structural features would tend to obscure an original match.


MAJOR ORE DEPOSITS
OF THE
PIMA MINING DISTRICT
DIRECTION OF SEPARATION BY
LOW ANGLE FAULT STRANDS
SHOWN BY ARROW
1 Inch = 1 Mile
JOHN E. KINNISON
JUNE 1976
(MODIFIED: JAN. 1978)
N
SAN XAVIER NORTH
SAN XAVIER SOUTH
MISSION
PIMA
T16S
T17S
SAN XAVIER FAULT
UPPER PLATE
FOOTWALL
EDWARDS
Lgr
EDWARDS
pЄgr
Ls
1259
981
DYNAMITE
A-937
442
SAHUARITA ROAD
EDGE OF OUTCROP
A
A'
B
B'
UPPER PLATE
FOOTWALL
SAN XAVIER FAULT
NOTE
981 (HOLE NO.)
DRILL HOLE OF SPECIAL EXPLORATION SIGNIFICANCE
T17S
T18S
INFERRED CONTACT
BENEATH SAN XAVIER FAULT
ANACONDA
pЄgr
Lgr
Ls
R12E
R13E

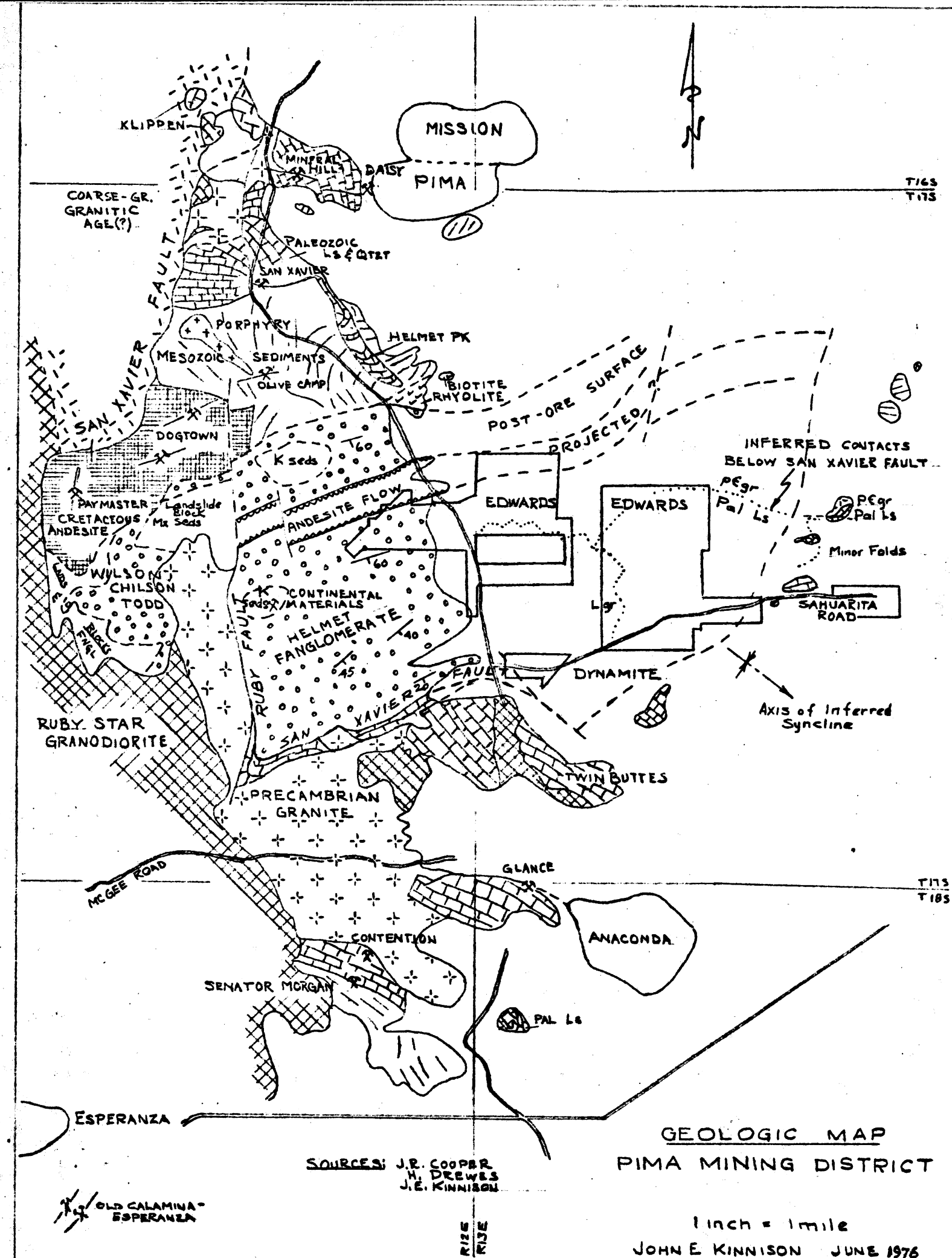


SCALE: 1" = 2000'

EDWARDS PROSPECT

TWIN BUTTES – PIMA DISTRICT

ARIZONA

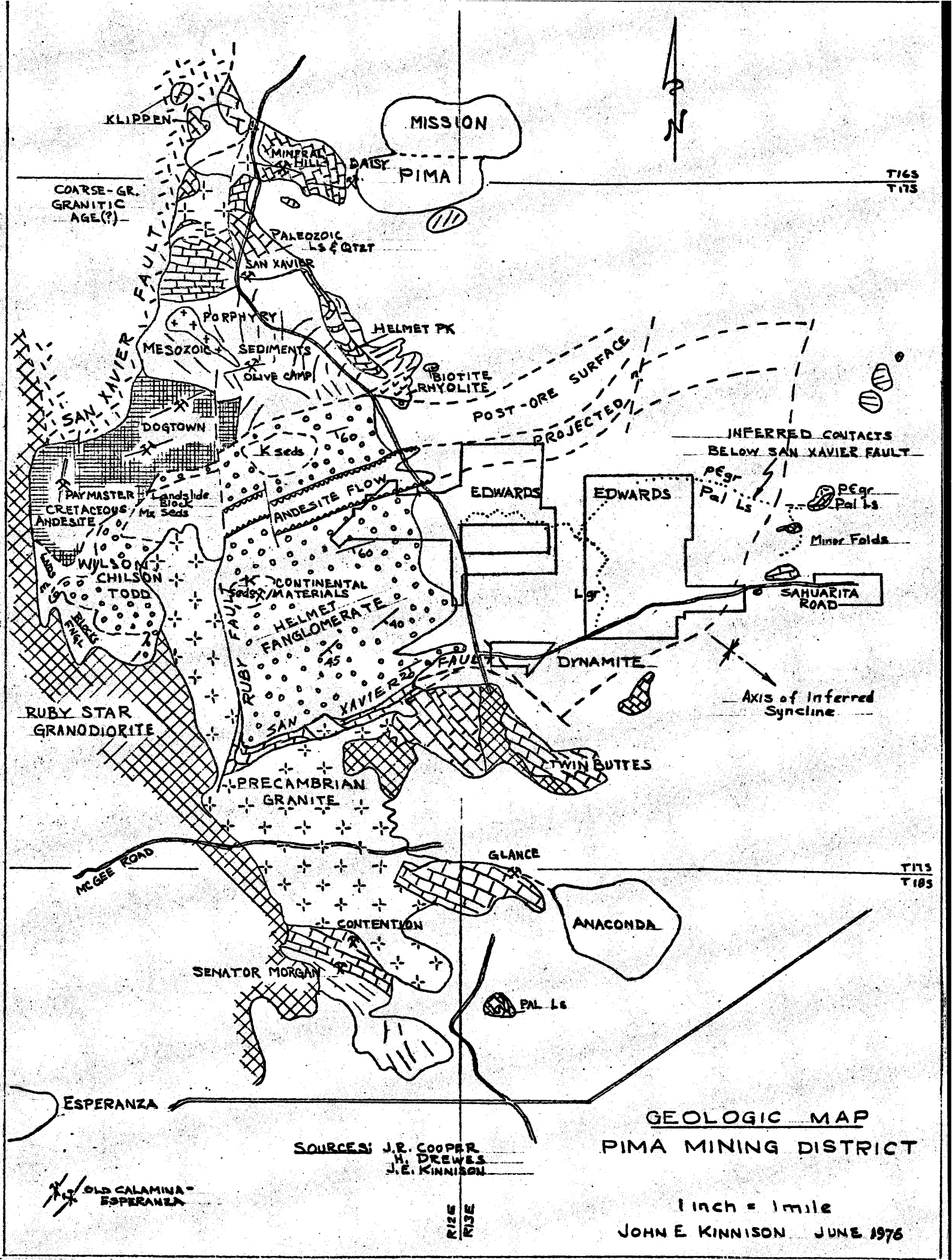


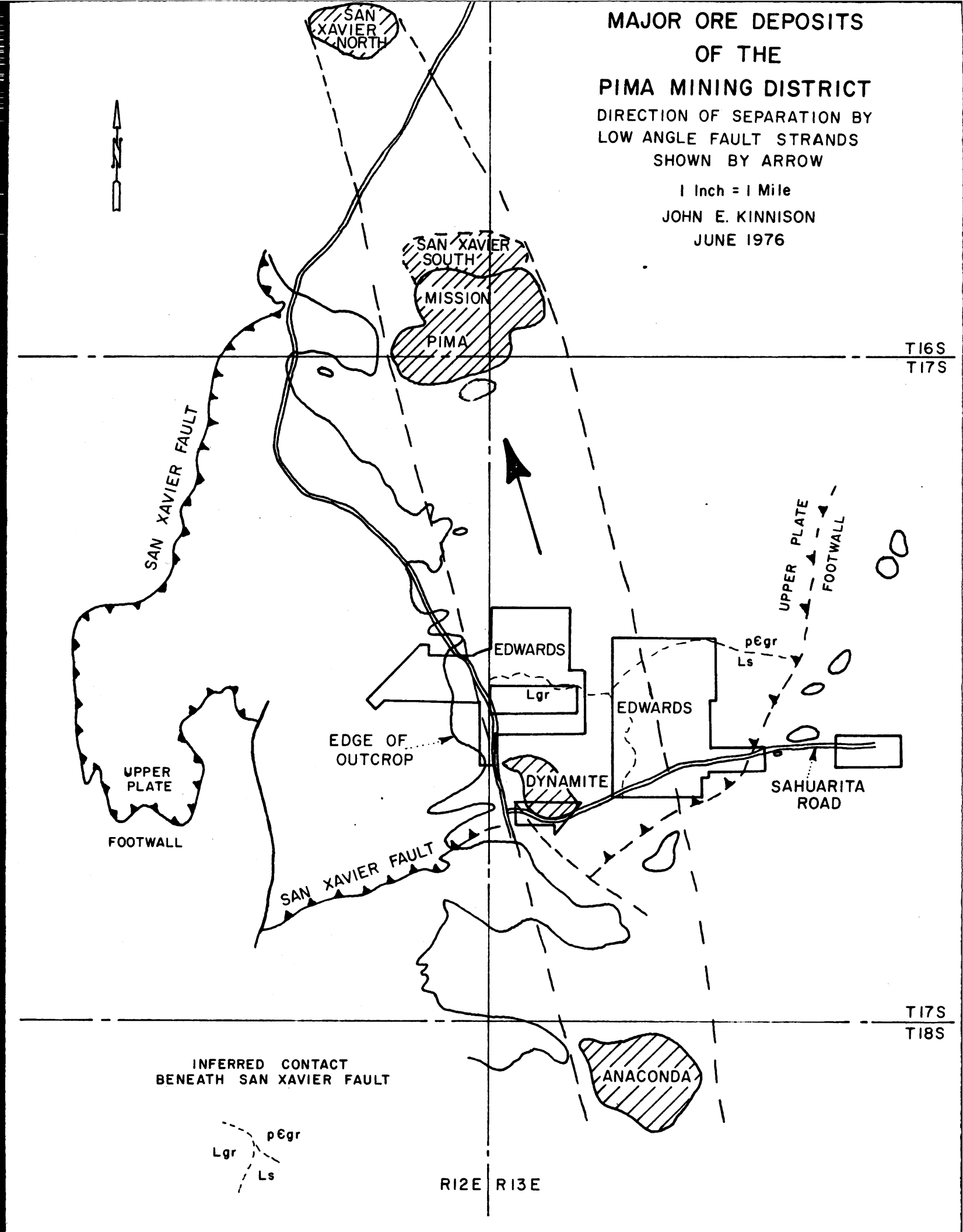
GEOLOGIC MAP
PIMA MINING DISTRICT

SOURCES: J.R. COOPER
H. DREWES
J.E. KINNISON

1 inch = 1 mile

JOHN E. KINNISON JUNE 1976


N
MISSION
PIMA
KLIPPEN
MINERAL HILL
DAISY
T16S
T17S
COARSE-GR. GRANITIC AGE(?)
PALEOZOIC Ls & QTZT
SAN XAVIER
SAN XAVIER FAULT
PORPHYRY
MESOZOIC SEDIMENTS
HELMET PK
OLIVE CAMP
BIOTITE RHYOLITE
POST-ORE SURFACE
PROJECTED
DOGTOWN
K seds
INFERRED CONTACTS BELOW SAN XAVIER FAULT
PAYMASTER
Landslide Block
Mx Seds
CRETACEOUS ANDESITE
ANDESITE FLOW
EDWARDS
EDWARDS
PEgr
Pal Ls
PEgr
Pal Ls
Minor Folds
WILSON
CHILSON
TODD
CONTINENTAL MATERIALS
K seds
HELMET FANGLOMERATE
RUBY FAULT
Lgr
SAHUARITA ROAD
DYNAMITE
SAN XAVIER FAULT
Axis of Inferred Syncline
RUBY STAR GRANODIORITE
TWIN BUTTES
PRECAMBRIAN GRANITE
GLANCE
T17S
T18S
McGEE ROAD
CONTENTION
ANACONDA
SENATOR MORGAN
PAL Ls
ESPERANZA
OLD CALAMINA-ESPERANZA
R12E
R13E
GEOLOGIC MAP
PIMA MINING DISTRICT
SOURCES: J.R. COOPER
H. DREWES
J.E. KINNISON
1 inch = 1 mile
JOHN E. KINNISON JUNE 1976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PIMA MINING DISTRICT
DIRECTION OF SEPARATION BY
LOW ANGLE FAULT STRANDS
SHOWN BY ARROW
1 Inch = 1 Mile
JOHN E. KINNISON
JUNE 1976
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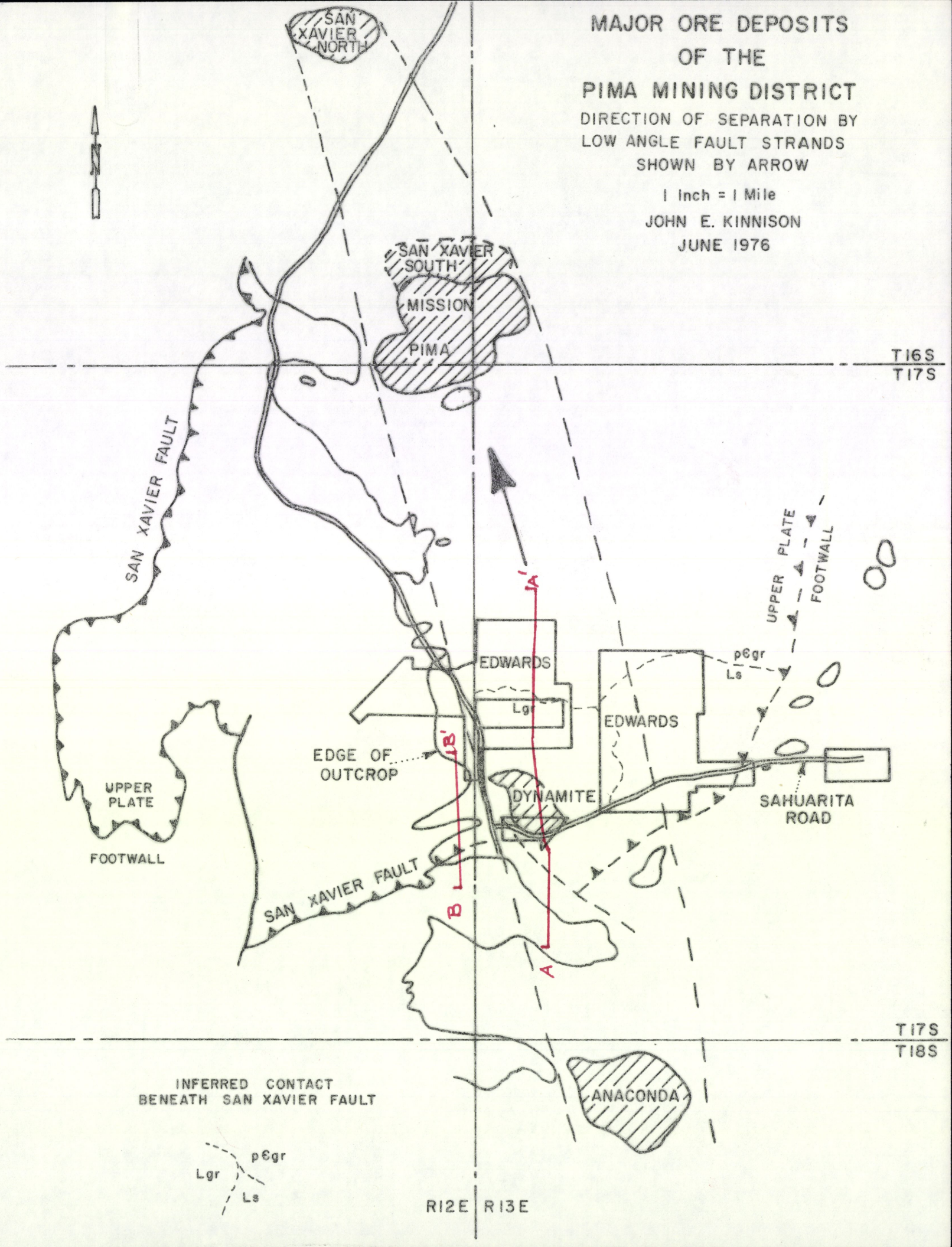
SAN XAVIER SOUTH
MISSION
PIMA
T16S
T17S
SAN XAVIER FAULT
UPPER PLATE
FOOTWALL
EDWARDS
Lgr
EDWARDS
pЄgr
Ls
EDGE OF OUTCROP
DYNAMITE
SAHUARITA ROAD
UPPER PLATE
FOOTWALL
SAN XAVIER FAULT
T17S
T18S
ANACONDA
INFERRED CONTACT
BENEATH SAN XAVIER FAULT
pЄgr
Lgr
Ls
R12E
R13E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Lgr
EDWARDS
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Ls
EDGE OF OUTCROP
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A'
DYNAMITE
SAHUARITA ROAD
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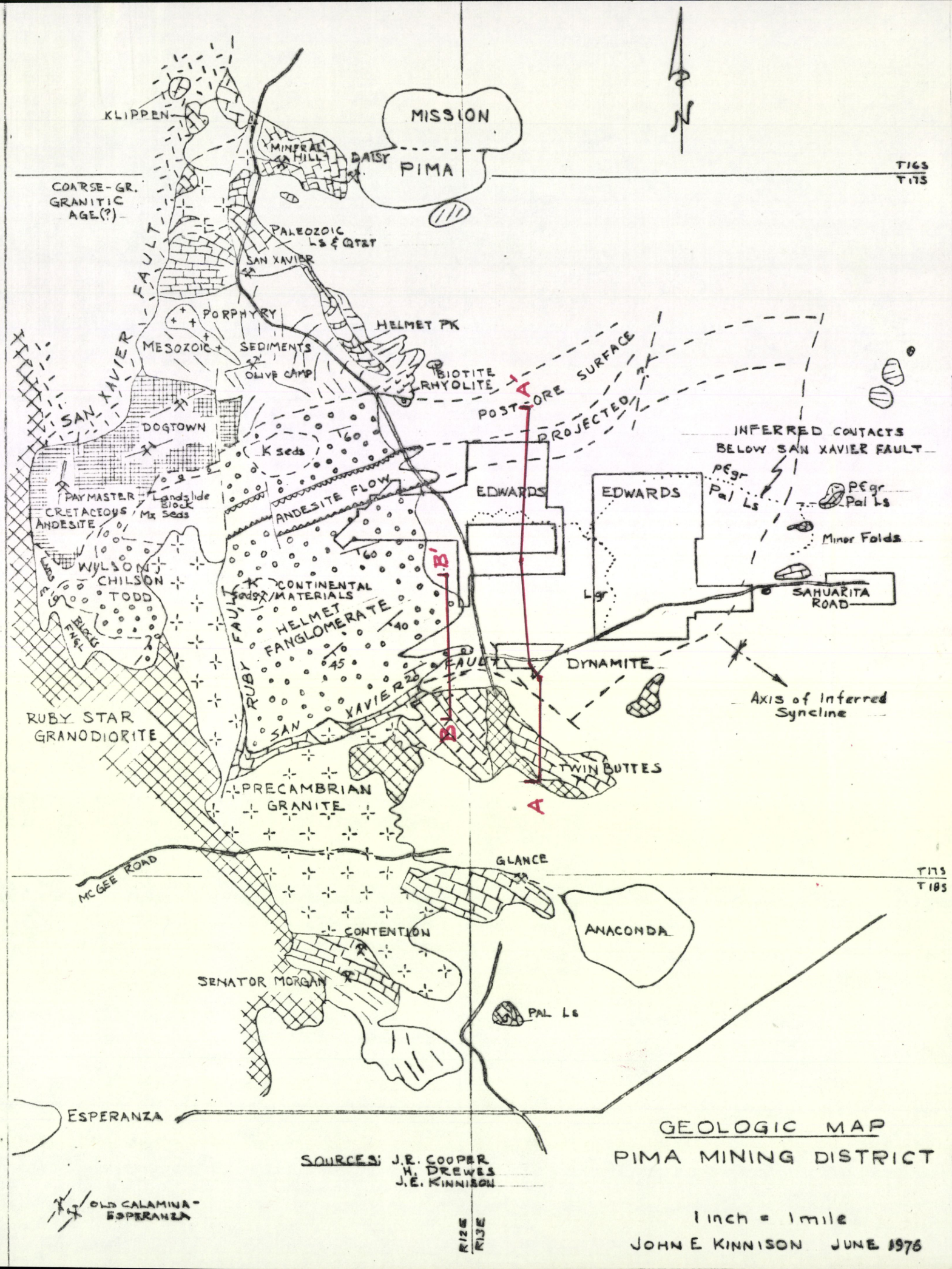
B
A
T17S
T18S
ANACONDA
INFERRED CONTACT
BENEATH SAN XAVIER FAULT
pЄgr
Lgr
Ls
R12E
R13E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SAN XAVIER FAULT
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HELMET PK
MESOZOIC
SEDIMENTS
OLIVE CAMP
BIOTITE RHYOLITE
POST-ORE SURFACE
PROJECTED
DOGTOWN
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INFERRED CONTACTS BELOW SAN XAVIER FAULT
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CRETACEOUS ANDESITE
ANDESITE FLOW
EDWARDS
EDWARDS
pEgr
Pal Ls
Minor Folds
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CONTINENTAL MATERIALS
HELMET FANGLOMERATE
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PRECAMBRIAN GRANITE
GLANCE
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T18S
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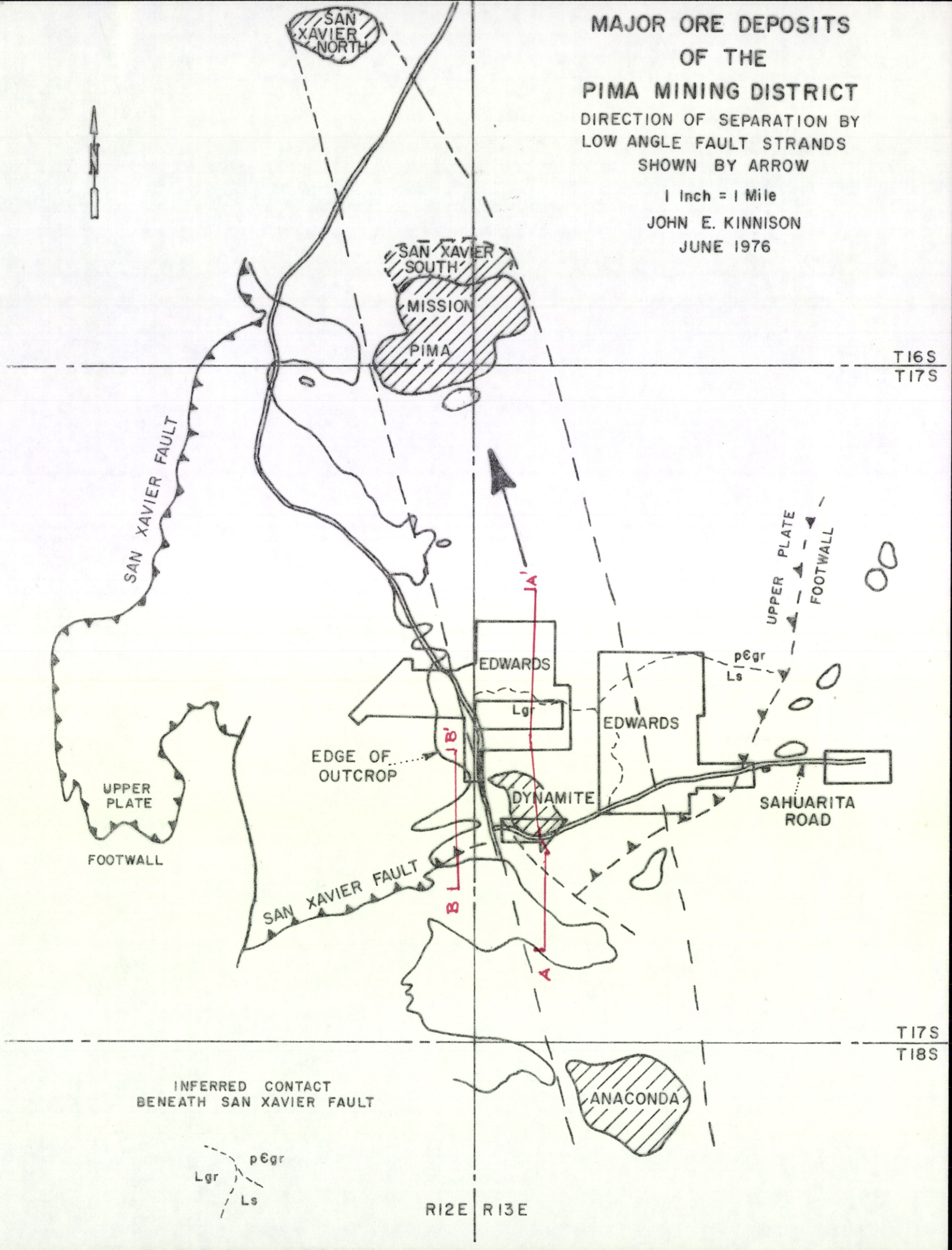
CONTENTION
ANACONDA
SENATOR MORGAN
PAL Ls
ESPERANZA
OLD CALAMINA-ESPERANZA
R12E
R13E
SOURCES: J.R. COOPER
H. DREWES
J.E. KINNISON
GEOLOGIC MAP
PIMA MINING DISTRICT
1 inch = 1 mile
JOHN E. KINNISON JUNE 1976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Lgr
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Ls
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EDGE OF OUTCROP
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SAHUARITA ROAD
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SAN XAVIER FAULT
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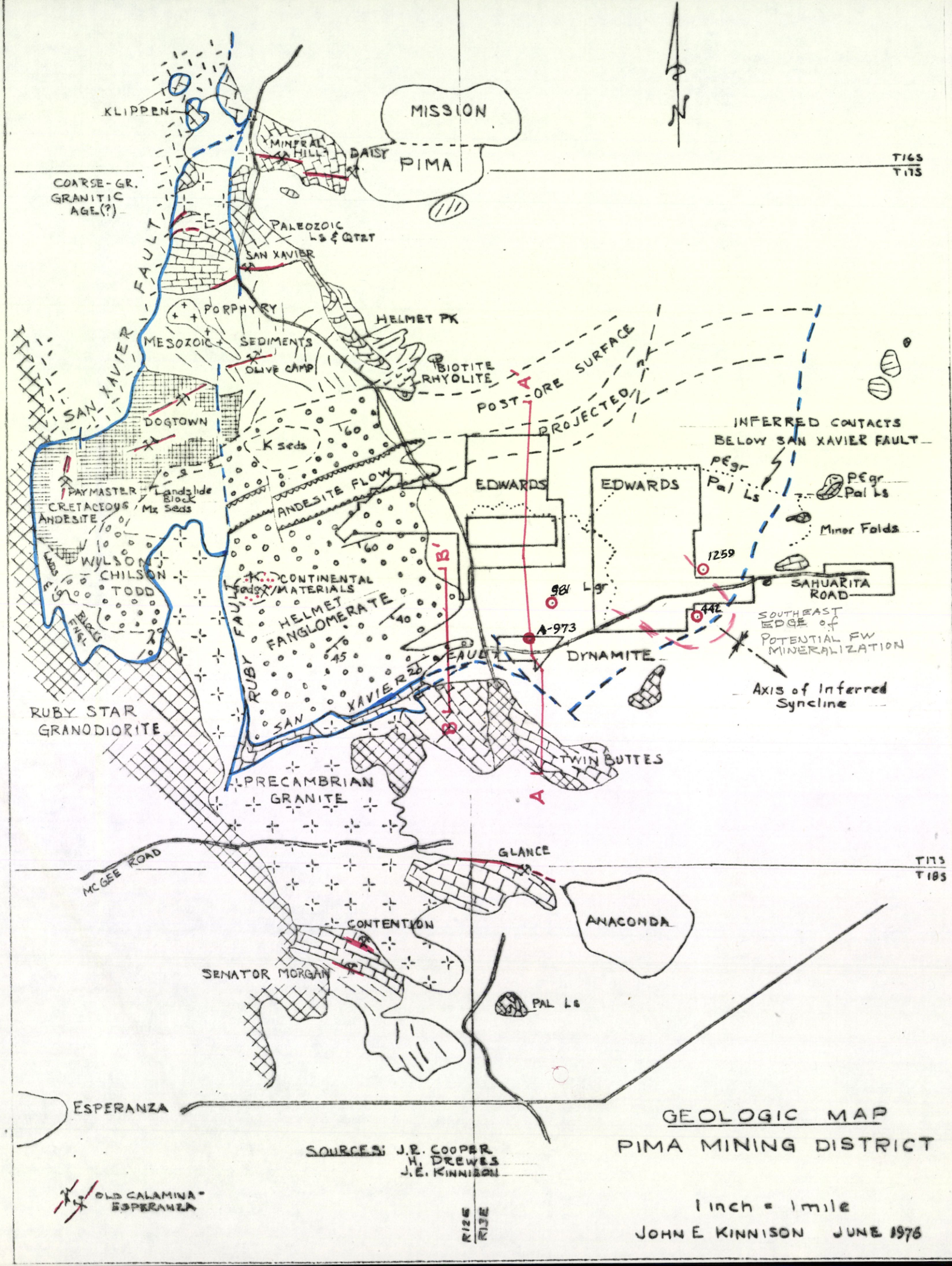
BENEATH SAN XAVIER FAULT
pЄgr
Lgr
Ls
R12E
R13E



GEOLOGIC MAP
PIMA MINING DISTRICT

SOURCES: J.R. COOPER
H. DREWES
J.E. KINNISON

1 inch = 1 mile

JOHN E KINNISON JUNE 1976

~~DCK 1919 405 - 415~~

~~1919 504 - 4~~

~~415 - 504~~

DRL 2542	p 274	$600 Drilling Anaconda R. Lyman 65		
2834	373	- 383 Ore Reserve 1966		
3051	731	- Drilling $600 1967		
3339	142	- Geophy. - Hanna 1968		
3570	333	- Drilling ? - Metler 1969		
3827	642	- Field Geol, ore Reserves etc	Hanna	1970
~~40 3888~~ 430	434	Drilling to greater Depth.	~~Smith~~	1971 ~~1970~~
~~4088~~	410	~~Nothing~~		~~1971~~
4263	512	- Drilling to greater Depth	Smith	1972
4527	698	- Drilling to greater Depth	"	1973
4818	326	- Drilling to greater Depth	"	1974

~~4088~~ 410 - Drilling on Dyn 21 that Not Smith 1971

27	1.07	28.89
9	3.37	30.33
46	1.40	64.40
82		123.66/82 = 1.508
+ 55 @ .27		14.85
		138.51 ÷ 137 = 1.01
137' 1.01		138.37
		- 123.66
		14.71

137-82 = $\frac{14.71}{55}$ = .26

4652 - 848 Phx -

Bet. Sept 1, 72 and Sept 1 73 $4,500 of work and improvements Chum drilling

4652 - 848 PHx

Bet 9/1/72 - 9/1/73 $ 500 of work and impr. Rot. Drilling

4652 - 850

West PHx 1-14
29-40

For West PHx 1-8
10-18
20
22 & 23
25

Bet 9/1/72 - 9/1/73 $ 4700 work and impr. Chum Drilling & Rocal Rejoin

---

4390 @ 725 PHx Bet 1 Sept 1/71 - Sep 9/72 1600 Chum Drilling

726 PHx 9/1/71 - 9/872 $ 500 Rot Drilling

BK 4595 64 & p 65 By Gary L Bennett

Emmons 11-25
26, 27, 40
41, 42
51
D-4
F-6
H-8
K-11
N-14
~~40~~

Bert 24 & 25
26
31 & 32

Sam 1-8 placer

Phx 52-55
7-10

47 Claims
$ 4700
Drilling, Site prep and.

Index Affl/h

1973

✓ Phoenix 1-6, 11-22, 24, 25, 27, 28
29-44, 45-49, 50 & 51, 50 & 51 amend. Book 4652 @ 848

✓ Phoenix 56-58, 60, 62, 64
C. G. Edwards Book 4652 @ 849

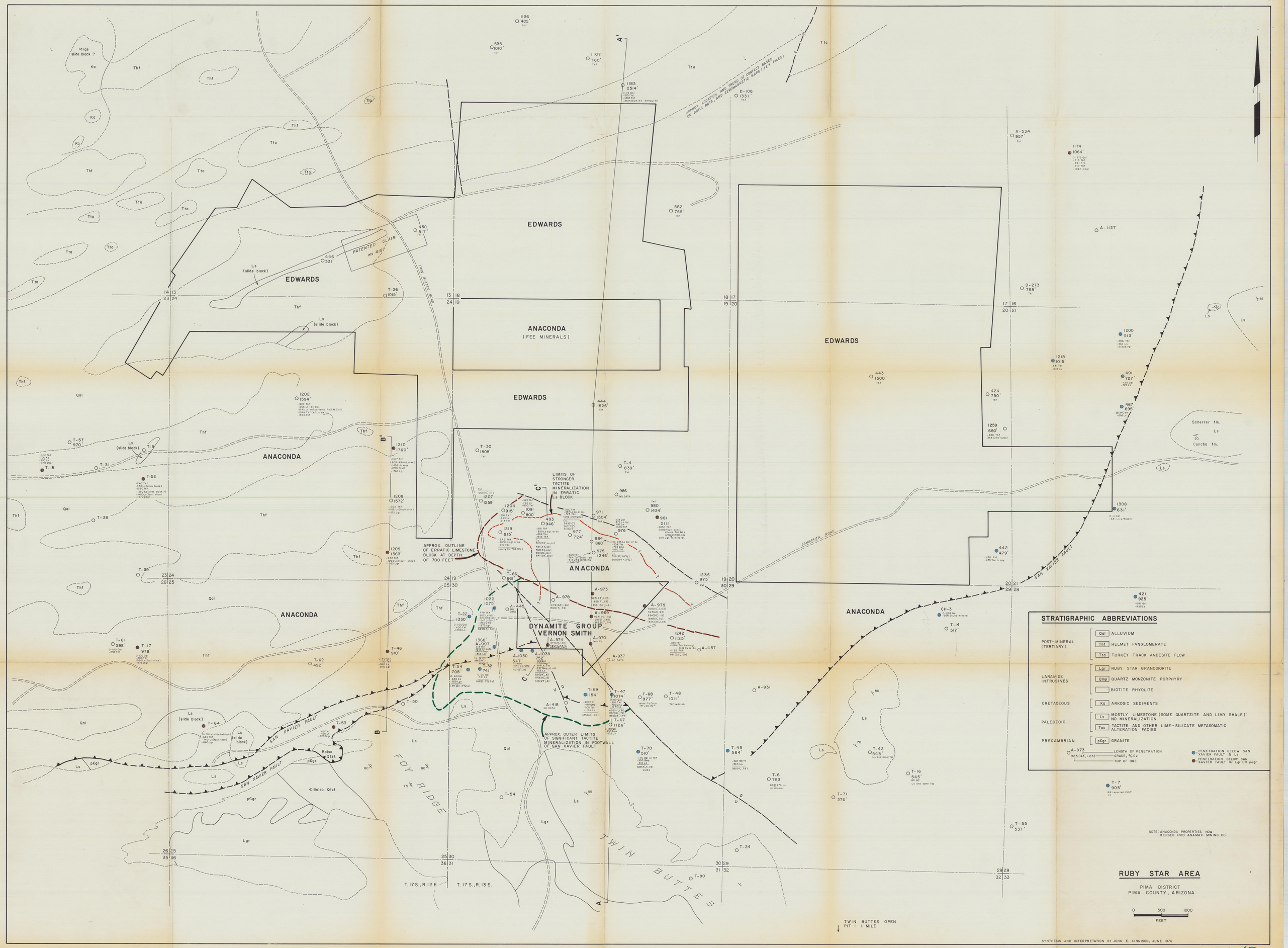
Phoenix 29-44 1972 Book 4390 @ 725
56, 58, 60, 62, 64 4390 @ 726
C. G Edwards

Phoenix 52-55 and 7-10 Book 4228 @ 173
Gary L. Bennett

Phoenix 57, 59, 61, 63, 65
52-55, 7-10 Anocarola 4595 @ 60 & 64

West Phoenix 29-40 C. G. Edwards 4652 @ 850
✓ 1-14

Emmons 11-25 et al Anocarola 4595 - 65



Attachment B