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AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona
March 13, 1958

J. H. C.
MAR 15 1958

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

EAST PIMA
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 ore 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 ore 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 mill 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
LHHart
NWeiss - 2 extra
JDVincent
RJMellen
bc: JHCourtright
JEKinnison

AMERICAN SMELTING 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 feldspar, with some quartz, occurs as host to a small 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

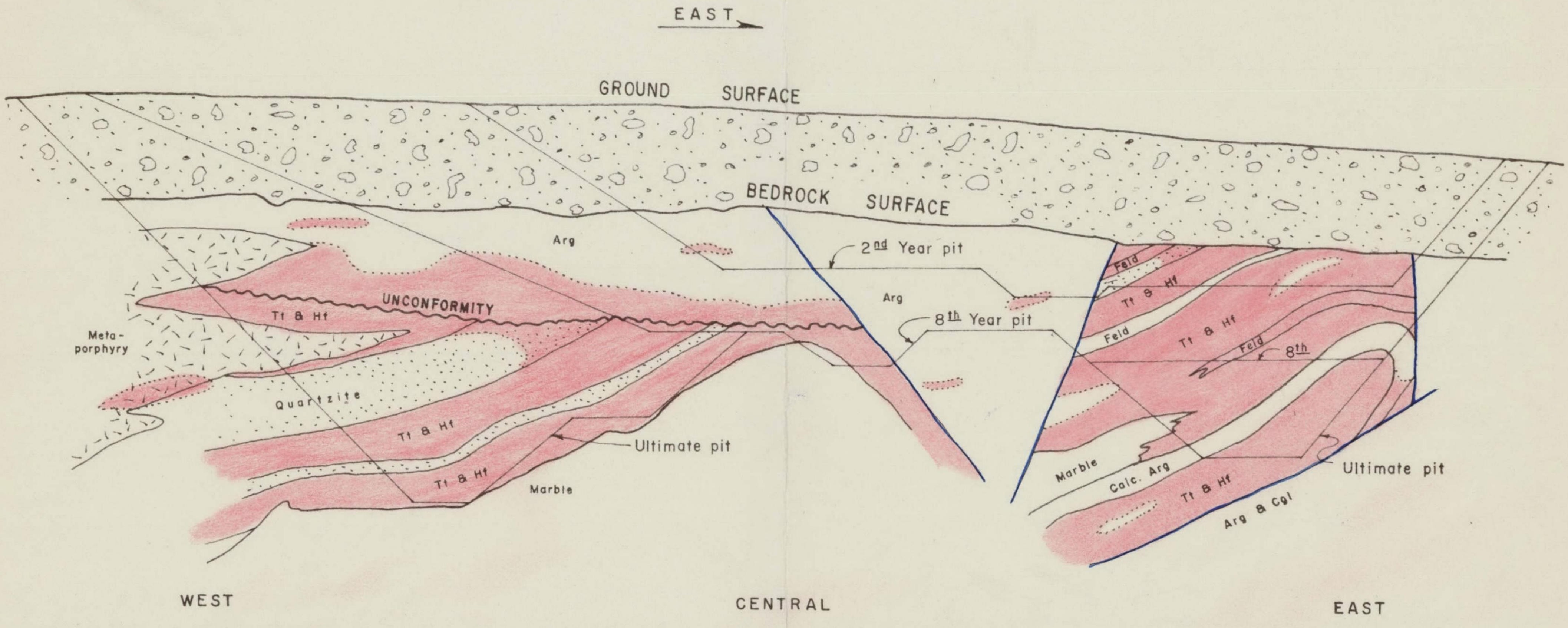
JEK/ds

DIAGRAMATIC CROSS SECTION – EAST PIMA

LOOKING NORTH

Showing Approximate Rock Distribution.

(NOT TO SCALE.)



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.)

<table>
<tr><th colspan="2">Host rock</th><th colspan="4">West & Central Area</th><th colspan="3">East Area</th><th colspan="3">Total</th></tr>
<tr><td colspan="2">Argillite</td><td>35%</td><td>35%</td><td>35%</td><td>35%</td><td>2%</td><td>2%</td><td>2%</td><td>25%</td><td>25%</td><td>25%</td></tr>
<tr><td rowspan="4">Lime silicate rocks</td><td>Tactite</td><td>30</td><td>30</td><td>30</td><td rowspan="4">60</td><td>75</td><td>75</td><td rowspan="4">90</td><td>43</td><td>43</td><td rowspan="4">68</td></tr>
<tr><td>Hard, dense Hf (A)</td><td>9</td><td>10</td><td rowspan="3">30</td><td>—</td><td>—</td><td>4</td><td rowspan="3">25</td></tr>
<tr><td>Fn-gr, granular Hf (B)</td><td>12</td><td rowspan="2">20</td><td>9</td><td rowspan="2">15</td><td>12</td></tr>
<tr><td>Fn-gr, pulverent Hf (C)</td><td>9</td><td>6</td><td>9</td></tr>
<tr><td colspan="2">Feldspar rock</td><td>—</td><td>—</td><td>—</td><td>—</td><td>6</td><td>6</td><td>6</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td colspan="2">Quartzite</td><td>5</td><td>5</td><td>5</td><td>5</td><td>2</td><td>2</td><td>2</td><td>4</td><td>4</td><td>4</td></tr>
</table>

January 17, 1958

EAST PIMA

Mr. Bronson Stringham
Geological Department
University of Utah
Salt Lake City, Utah

Dear Mr. Stringham:

Am sorry to advise that I was mistaken in that we do not have a copy of Mayuga's thesis. However, we have borrowed a copy from the University and have typed the section on igneous rocks which is enclosed herewith.

In answer to the question in your letter of recent date, it can be definitely stated that at least two intrusive porphyries occur in the vicinity of Mineral Hill and Helmet Peak, or the northern part of the Twin Buttes district. One of these, a biotite rhyolite with an aphanitic groundmass, occurs as stock-like masses several thousand feet in diameter. W. H. Brown (Tucson Mountains G.S.A. Bull Vol 50, May, 1939) considered this formation in the South Tucson Mountains to be extrusive. The other is a monzonite porphyry having what appears to have been originally (prior to alteration) a rather fine granular, or granotoid groundmass. It occurs in the form of stocks, dikes and sills.

The main granite mass of the Sierrita Mountains (earlier than the porphyries) is described by Mayuga; however, as you will note, he does not mention the two formations referred to above. This omission is due to the fact that most of the area occupied by these intrusives is covered by gravel deposits.

Yours very truly,

Original signed by
J. H. Courtright
J. H. COURTRIGHT

JHC/ds
cc: KERichard

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

December 4, 1957

J. H. C.
DEC 4 - 1957

FILE MEMORANDUM

EAST PIMA - PETROGRAPHY

Preliminary petrographic study by Dr. DuBois on some thin sections from DDH No. 109 at East Pima renders the following conclusions (see attached log for megascopic and microscopic details).

The rocks above the unconformity have been extensively recrystallized to produce a feldspathic rock containing some medium grained feldspathic areas in a matrix of extremely fine-grained recrystallized feldspar. The rock originally must have been a very fine siltstone or mudstone. The recrystallized areas are interspaced with argillite, sandy argillite, and conglomerate. No information was obtained on the formation of tactite in the Papago formation.

Feldspathic alteration near the Pima-Papago formation contact is fairly common, but the reason for its considerable thickness in DDH No. 109 is not apparent. A similar type of feldspathic alteration of argillite and conglomerate may occur in the northeastern area, such as penetrated in DDH No. 188.

The section at 292' contained an unrecrystallized band of sediment with a very high feldspar content. Some petrographers prefer to use such a composition as an indication of tuffaceous material. In any event, it is unusual for the Papago formation.

JOHN E. KINNISON

JEK/ds
cc: KERichard
JHCourtright

Attachment

RELOG OF D.D.H. 109, EAST PIMA

Bedrock @ 215.5'

215.5' - 240'		Logged arkose, probably argillite.
240 - 265		Logged conglomerate.

Beginning of relogging

265 - 273 Arg., light grey to white. A very few 1/2" rounded pebbles or alteration areas. Bottom contact sharp.

273 - 282 Tactite. Slight resemblance to hornfels. Fine-grained. At 277': 2" qtz. vein or qtzt. lens, dipping 45°±. Just below are 2" of banded cpy-py-hematite as 1/8" layers, with abundant chlorite. At the upper contact, separating it from the 2" qtz. vein (?), is a thin Bx or arkose lens.

282 - 288 Feld. rock. Pink or salmon colored dense material with angular patches, and veinlets of chlorite. Brecciated appearance near top. Petrographic: At 283' argillite. Local qtz.-feld. replacement plus local recrystallization forming a feldspar matrix (very fine-grained, probably orthoclase.)

288 - 289 Arg. dark grey.

289 - 312 Sandy arg. Pinkish colored rock with some chlorite veins and patches, and about 30% small (1/2-1 mm) qtz. grains. Looks generally like 282-288', but contains less chlorite. A considerable part of this intercept is entirely aphanitic.

302' - 303' Tactite.
307' - 312' Tactite with gradational aspects into argillite.

Petrographic: At 292'. This section contains (1) a band of sandy arg. with high orthoclase content and (2) feldspathic rock as in section 283' described above.

At 300' considerable feld. formed from recrystallization, set in a fine grained feldspathic matrix. Unrecrystallized areas show some mineral outlines of igneous aspect.

At 303'. Same as 300', with more intense recrystallization, The grain size varies from coarse to fine. Note: this ample is at the fringe of a 1' tactite layer, and contains a band of garnet cutting the rock. The section failed to cut this band, and an additional one will be made.

312'	- 347'	Feldspar rock with chlorite, slightly brecciated. Like 282-288, mixed gradationally with sandy argillite and conglomerate.
		Petrographic: At 315'.Like 283' At 320'.Sandy arg.
347	- 386	Sandy arg. and arkose with occasional dark grey pebbles 1/2' max. 1/4" more common. Local alteration (?) banding at 55° dip. Local conglomerate.
		354' - 4" feld. rock.
		Petrographic: At 379. Sandy arg.
386	- 392	Feld. rock - pinkish, slightly brecciated. Gradational upper contact. Bottom contact grades to tactite through about 2'. Qtz. grains as in 289-312 near bottom contact.
		At 387'. Qtz. veins (1/8") parallel, forming "ribbonrock".

- - - - - - - - - Papago fm. - - - - - Probable location unconformity - - -
Pima fm.

392	- 408	Tactite. Below 398' contains patches and veins of qtz.-feldspar.
		Petrographic: At 398'. Qtz.-feld. banded rock. At 406'. Orthoclase - garnet rock with epidote.
408	- 423	Andesite.
423	- 427	Mb. Thin sulfide veins bordered by a white granular silicate.
427	- 433	Dark brown tactite with interstitial qtz. Hematite veining.
433	-	Hornfels. White, granular. Local garnet areas. Local marble. Hematite heavy below 438.
		445'. End of relogging.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona
November 29, 1957

J. H. C.
DEC 4 - 1957

MEMORANDUM FOR KENYON RICHARD

Late Tertiary Geology
Pima Mining District

The geologic mapping southwest of Helmet Peak and on Black Mountain and the results of the drilling on the reservation indicate that all of the post-mineral Tertiary rocks are of approximately the same age and have undergone the same folding and faulting.

It is suggested that all of these rocks be tentatively included in the San Xavier formation and that the San Xavier formation be divided into five members.

Lower Conglomerate

This member is exposed on Black Mountain where its thickness is unknown and southwest of Helmet Peak where it is approximately 1000 feet thick. It has been partially penetrated by two drill holes on the reservation, both to a depth of about 15 feet. The Lower Conglomerate probably varies considerably in thickness and is probably less than 100 feet thick where it has been intersected by the drilling.

The Lower Conglomerate is red in color and is composed of weakly consolidated silt, arkose, and angular to subrounded cobbles and boulders. It contains fragments of the rocks that outcrop in the area except the Sierrita granite, Basalt porphyry and Vesicular basalt.

Basalt Porphyry

This is exposed on Black Mountain where it appears to be both intrusive and extrusive, in the southwest corner of Tract 1, and southwest of Helmet Peak where it appears to be a flow. Southwest of Helmet Peak the Basalt Porphyry is about 1200 feet thick. It has been partially penetrated to depths of 6, 10, 22 and 23 feet on the reservation, and is probably less than 100 feet thick in the vicinity of the drilling.

Middle Conglomerate

This has been recognized only on Black Mountain where it was deposited on the irregular surface of the Basalt Porphyry and varies in thickness from 0 to over 10 feet. It is a red weakly to moderately consolidated siltstone and arkose containing fragments of Basalt Porphyry.

Vesicular Basalt

The Vesicular Basalt outcrops on Black Mountain and on Tract 3. This basalt did not extend far south of Black Mountain and is not present in the southern half of Tract 1. It is many hundreds of feet thick on Black Mountain. The Vesicular Basalt has been partially penetrated by drilling to depths of 3, 11, 13 and 31 feet on the reservation.

The Vesicular Basalt consists of a series of flows, some of which are highly vesicular.

Upper Conglomerate

The Upper Conglomerate cannot be distinguished from the Lower Conglomerate except where it contains fragments of the Basalt Porphyry and Vesicular Basalt. It has been recognized on the surface only southwest of Helmet Peak where it overlays the Basalt Porphyry and is at least 700 feet thick. The apparent thickness in that area has been increased by thrust faulting. It has been partially penetrated to depths of 72, 174, and over 250 feet by drilling on the reservation.

Structure

The area from southwest of Helmet Peak to north of the reservation may be underlain by a post San Xavier formation thrust. The direction of thrust would probably have been from about S25E.

The thrust sheet would contain the San Xavier formation and up to several thousand feet of early Tertiary, Cretaceous, and Paleozoic rocks. The rocks above the thrust would have been folded by the same forces that caused the thrusting, and the axes of the folds would trend about N65E. The East Pima, Pima, San Xavier, and Banner ore bodies would be in a large anticline or anticlinorium extending from just south of Helmet Peak to just north of the southern limit of the reservation.

The San Xavier formation southwest of Helmet Peak dips about 60° to the southeast. However it is possible that the attitude of the San Xavier formation may not be steeper than 20° over most of the reservation.

Mapping has indicated the presence of several north and north~~east~~west striking faults with movements on them of possibly hundreds of feet.

RICHARD E. CRIBBS

REC/ds
cc: JHCourtright
JLClark
JEKinnison

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 24, 1957

Mr. L. H. Hurt, Chief Geologist
New York Office

<u>EAST PIMA STRUCTURE,</u>
<u>STRATIGRAPHY, PETROGRAPHY</u>

Dear Sir:

Under the guidance of Mr. Courtright, for the past few weeks Mr. Kinnison has been carefully studying and reviewing cores and sludge boards and revising structural interpretations in the East Pima ore zone. In conjunction with this work, Dr. Dubois of the University has been doing petrographic work. As a result the principal elements of structure and stratigraphy now are fairly well understood. In the attached file memorandum with legend, Mr. Kinnison carefully describes the sedimentary and igneous units which he and Mr. Courtright have worked out and which we now are adopting as standard nomenclature for use in future core logging and on new 100-scale sections now being drafted.

Although most of the features of structure and stratigraphy which relate to the distribution of copper have been plotted on our work sections in pencil note form, new 100-scale tracings will have to be drafted in order to illustrate these features properly. A series of plan maps showing structure and mineralization on different levels also will be compiled. This drafting has been started, but it will be an extensive job. It will be several weeks, then, before a set of prints can be completed and sent to you. The ore outlines which will be shown on these sections and plan maps should, of course, be taken into account in any final ore reserve calculation system. Mr. Schubel is aware of this,and this information will be made available to him as soon as possible. He plans to use it in any final ore reserve estimates he may make.

Dr. Dubois has been using the thin sections of Ernesto Sirvas, as well as a large number of sections prepared from specimens selected by Courtright, Kinnison, Clark and himself. This work has been very helpful in eliminating many uncertainties as to sedimentary or igneous origin, in tracing sedimentary horizons, and in permitting rocks to be grouped in a manner which clarifies the whole picture of structure. You will note that qfm has been identified as an igneous rock. This applies principally to the large mass in the western part of the zone. However, throughout the ore body there are pods of quartz-feldspar-mica rock which represent true replacement material. The petrographic reports on individual thin sections by Sirvas have been well done and have been useful to us. However, I doubt that by restudy of cores, as suggested in your letter of May 20, he now would be able to improve our present correlations. He is welcome to look over the core again if he cares to do so in order to improve or clarify the thesis itself.

I believe the men working on this intricate problem are to be complimented for having done a long way toward solving it.

Yours very truly,

Original Signed By
K. Richard

KENYON RICHARD

KR/ds
cc: RJLacy WOSchubel
JHCourtright JLClark
JKinnison HEDubois
(all w/attachments)

FILE MEMORANDUM

Proposed Rock Classification: East Pima

The rocks of East Pima as now known represent (1) originally chemical (limy or gypsiferous) sediments, (2) clastic sediments, and (3) igneous.

It is proposed that these rocks be grouped by generalized lithology and/or original composition, and further subdivided by rock types readily determined in the field.

These basic groups are as follows:

1. A clastic rock series consisting of siltstone, arkose, conglomerate, in part originally calcareous, which forms the presently known hanging wall unit. This might be termed the Papago formation.

2. A fairly thick originally limy series, in part gypsiferous, now consisting of lime-silicate minerals of varying composition and texture, with inter-bedded quartzites, which lies below group No. 1 above. It might be termed the Pima formation.

3. A clastic-volcanic(?) unit consisting of siltstone, conglomerate, arkose, and pyroclastics (?), which forms the presently known footwall. This might be termed the Kino formation.

4. An altered igneous rock presently termed Q.F.M. (quartz, feldspar, mica rock). This rock appears to be a porphyry of original dacitic composition with introduced quartz and orthoclase. It is proposed that this rock type be termed meta-porphyry.

5. Andesite - The term andesite as now used should be retained.

6. Other volcanic-textured acid porphyry rocks of sometimes undetermined (due to alteration) composition. These might be generally termed felsite porphyry.

The sedimentary rocks should be classified on the basis of readily identifiable field criteria, but at the same time related to petrographic classification.

Proposed terminology for clastic rocks:

1. Arkose - A granular-textured rock similar to quartzite but containing enough feldspar grains to be readily recognizable as such. The arkose can be further described as 1. fine-grained--1/4-1 mm; 2. medium-grained--1-2 mm; and 3. coarse-

grained--2-4 mm. 1/4 mm is approximately the minimum limit of identification with the hand lens.

2. Quartzite - a pure quartzite with grains large enough to be distinguished with a hand lens. The same grain size limits as for arkose would apply.

3. Argillite - a hard, dense, massive rock in which no grains can be identified with a hand lens. Petrographic work to date shows this type to be a siltstone or sandy siltstone, and in field use would include those rocks with some quartz grains in an argillite matrix.

4. Conglomerate - a rock containing 25% or more of fragments greater than 4 mm (Wentworth classification).

5. Graywacke - this term should be used in the manner of general acceptance, in preference to more recent classification by Pettyjohn; i.e. a rock consisting of numerous fragments of dark silt or volcanic rocks and/or ferro-magnesian minerals as grains or in the matrix. This definition emphasizes the ferro-magnesian content. To date no rocks of this type have been verified petrographically at East Pima.

<u>Proposed terminology for the metamorphosed (or metasomatized) limy sediments:</u>

1. Tactite - a coarse-grained rock with garnet and/or other lime-silicates. <u>Scarn</u> implies magnetite and therefore is not suitable as a general term in this instance.

2. Hornfels - a generally hard but sometimes soft, generally slightly greenish, fine-grained rock consisting of lime silicates. This rock may have been originally an argillaceous limestone.

3. Marble - a limestone which shows some recrystallization.

4. A presently indeterminant "siliceous" rock unit which may be metamorphosed limestone. Petrographic studies will determine its type, and a name may then be applied.

JOHN KINNISON

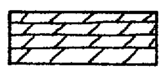
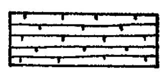
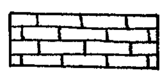
Att: Legend

EAST PIMA GEOLOGIC SYMBOLS

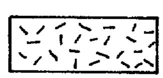
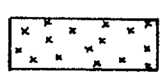
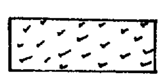
(See attached explanation)

ROCKS

META-SEDIMENTS (Note: The term META applies to nearly all sediments in mineralized area)

Group	Rock	Symbol	Abbreviation
Clastic	Argillite		Arg.
	Arkose		Ark.
	Quartzite		Qtzt.
	Conglomerate		Cgl.
Limy	Tactite		Tt.
	Hornfels		Hf.
	Marble		Mb.

IGNEOUS

Group	Rock	Symbol	Abbreviation
Pre-ore	Meta-porphyry		Mp.
	Felsite porphyry		Fp.
Post-ore ~	Andesite		And.

ABBREVIATIONS:

MINERALS -

Quartz – Qtz.
Feldspar - Fld.
Gypsum - Gyp.
Wollastonite - Woll.
Garnet - Grnt
Diopside - Diop.
Magnetite - Mag.
Pyrite - Py.
Chalcopyrite - Cpy.
Chalcocite - Cc.
Molybdenite - Mo.
Sphalerite - Sph.

OTHERS -

Gouge - Gg.
Breccia - Bx.
Massive - Mass.
Siliceous - Sil.
Silicified - Silf.
Silicated - Silct.
Gypsiferous - Gyp.

FORMATIONS

Pgf	Pif	Kf
Papago formation	Pima formation	Kino formation

J. H. C.
MAR 14 1957

February 18, 1957

Dr. Robert DuBois
Geology Department
University of Arizona
Tucson, Arizona

EAST PIMA PROJECT
Petrographic Study

Dear Sir:

This will confirm our conversation of February 15, during which it was agreed that you would do petrographic work for us amounting to at least 10 or 15 hours a week for the next several weeks. You will be spending some time with Mr. Courtright becoming acquainted with the problem. This may involve studying our sludge boards here in the office, but more particularly you probably will be looking over certain boxes of core at our laboratory. We have a petrographic microscope at our lab which is available to you if you care to use it at the laboratory. However, you mention that you have a complete setup of microscopic equipment at your home. It is, of course, all right with us if you prefer to make your thin section studies at your home.

We have a few thin sections available for you to begin work on, but undoubtedly you will need a considerable number of additional sections from specimens which you will pick out yourself. It is understood that you will be able to arrange for these thin sections to be made locally at our expense.

You have stated that your fee for this petrographic work will be $5.00 an hour. We would expect you to include any of your traveling expenses in connection with this work.

Eventually we would expect to have a written report from you, but this is a matter which we can work out later as the work progresses.

Yours very truly,

KENYON RICHARD

KR/ds
cc: LHHart
JHCourtright

(See attached note)

R. DuBois
E. Pima Petrographic Study

February 18, 1957

Blind Note to LMHart - with all copies:

The day before I received your letter of February 13 on this subject, and with Mr. Snedden's approval, I had already contacted DuBois, who is an expert microscopist with a lot of experience. As a result of our preliminary discussion with him, Mr. Courtright and I are confident that he is going to be able to help us. He has dealt with similar rocks before, which is a rather unusual circumstance and fortunate for us.

Cribbs will probably be doing some petrographic work in connection with his own field mapping, but I did not want him to get involved yet with the drill hole problems because I believe his mapping program is sufficiently complicated and important that he should devote his time fully to it.

Kenyon Richard