CORRELATION OF STRATIGRAPHIC UNITS OF NORTH AMERICA (COSUNA) DOCUMENTATION RECORDS FOR SOUTHERN ARIZONA AND VICINITY

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S. Thompson, III[4], and J. Wright[4]

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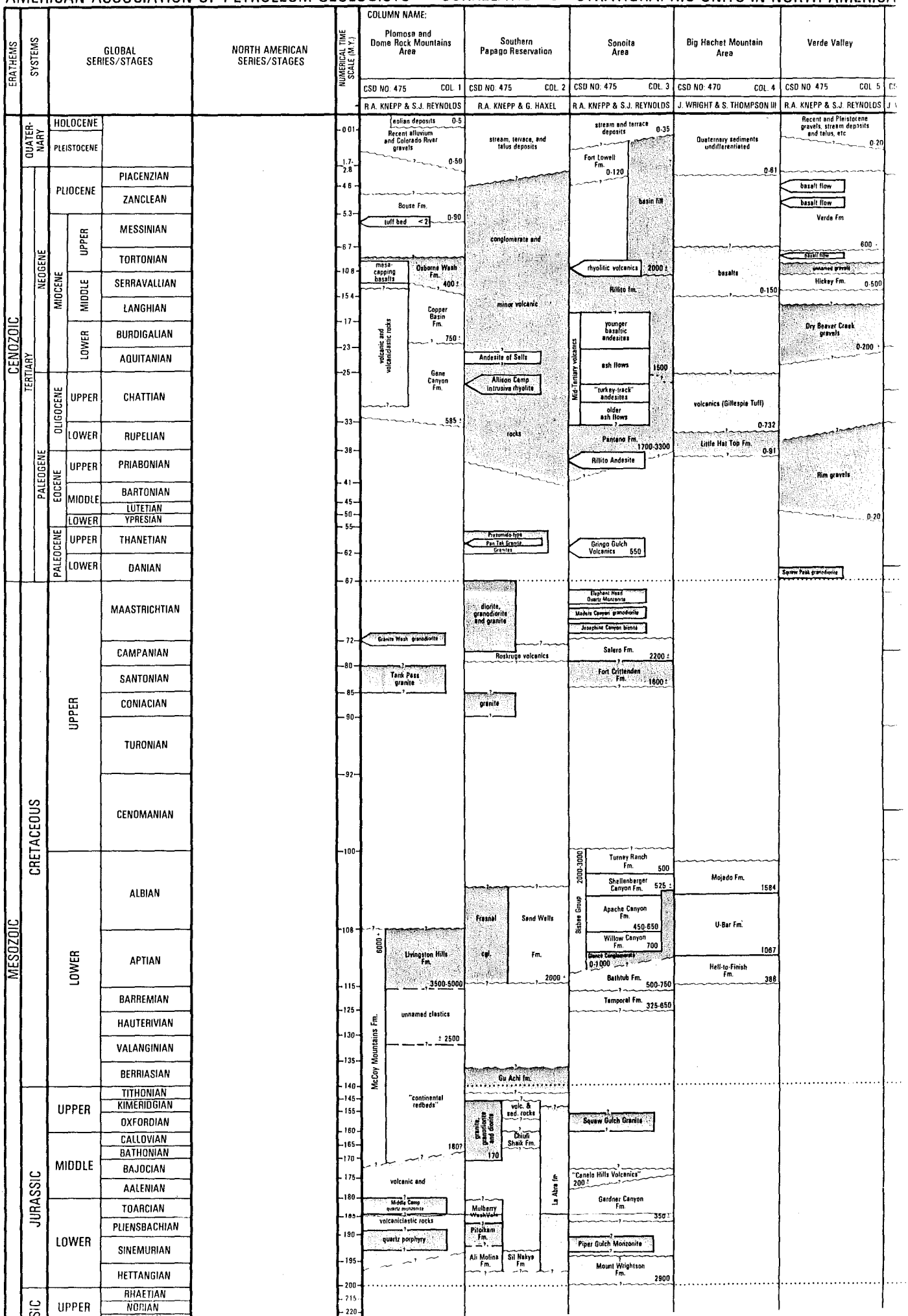
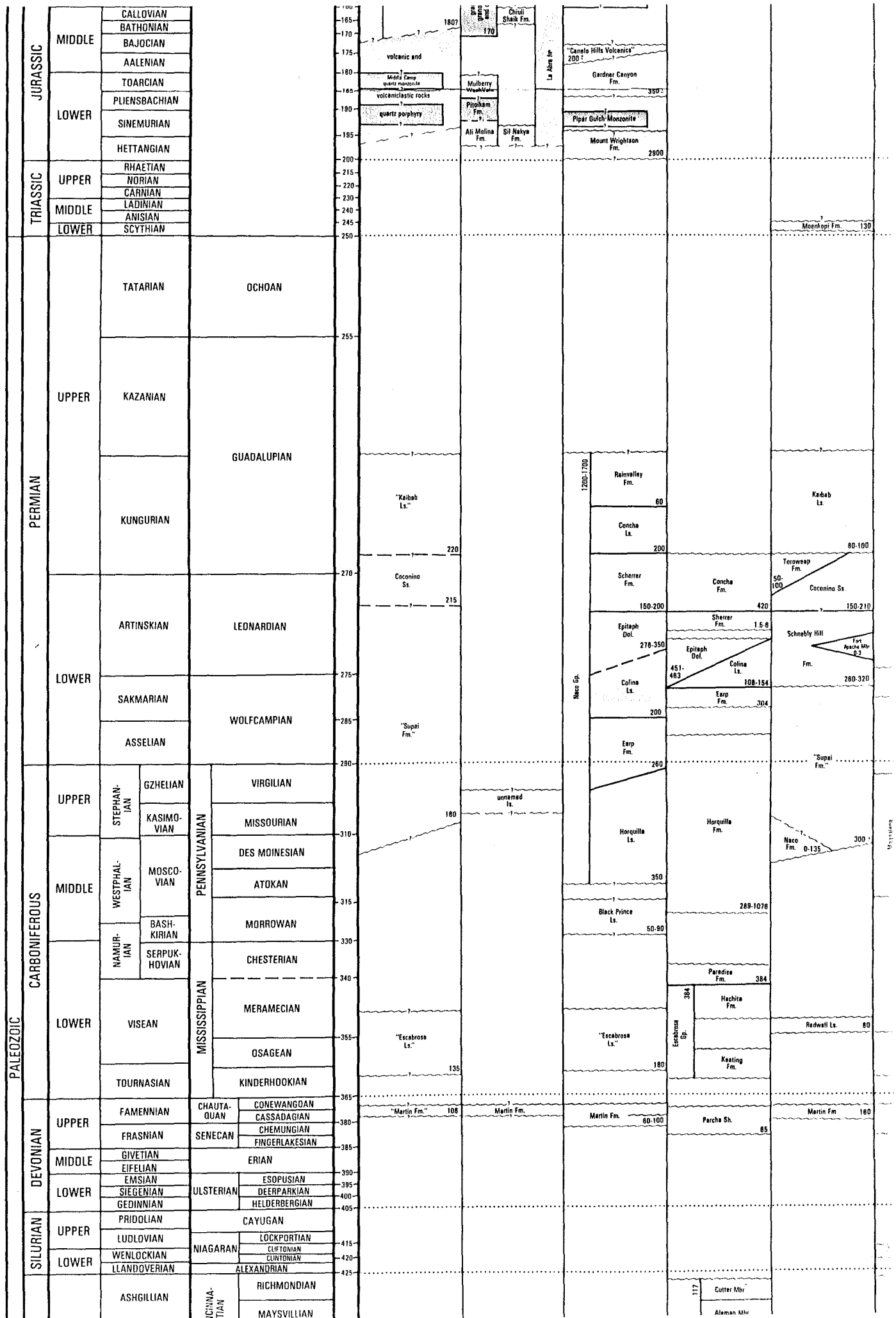
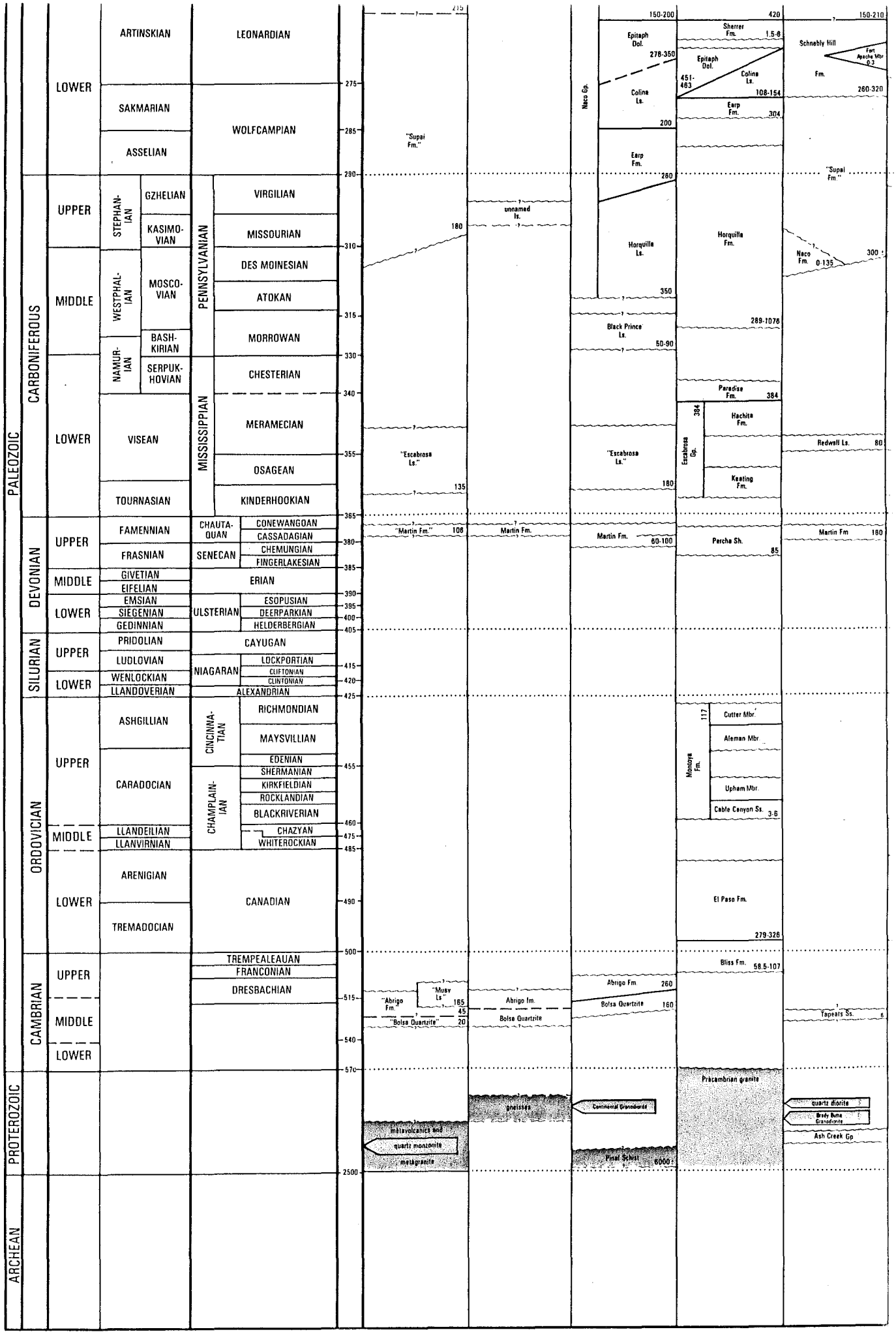
This report is preliminary and has not been edited
or reviewed for conformity with Arizona Geological Survey standards

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS — CORRELATION OF STRATIGRAPHIC UNITS IN NORTH AMERICA



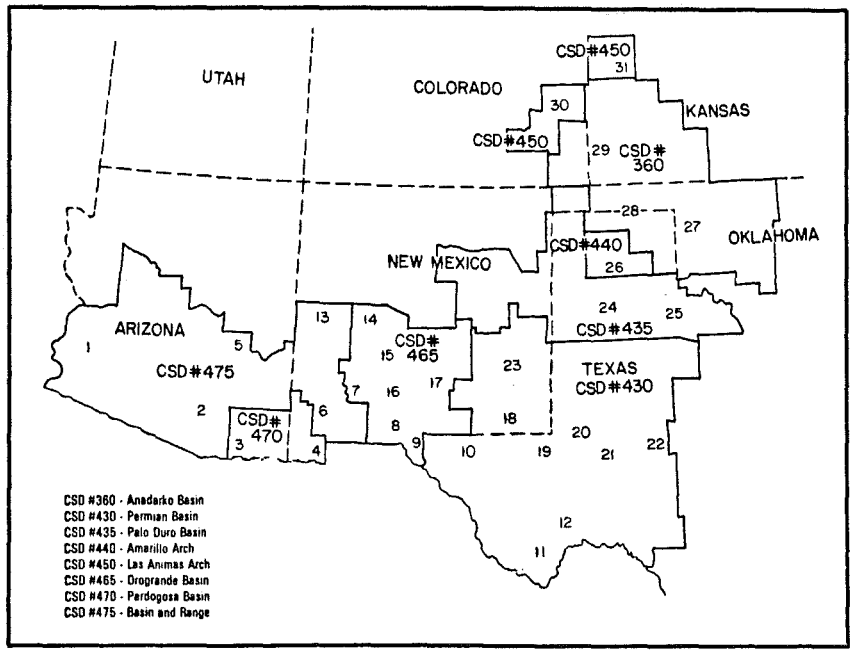

PALEOZOIC
JURASSIC
TRIASSIC
PERMIAN
CARBONIFEROUS
DEVONIAN
SILURIAN
MIDDLE
LOWER
UPPER
CALLOVIAN
BATHONIAN
BAJOCIAN
AALENIAN
TOARCIAN
PLIENSBACHIAN
SINEMURIAN
HETTANGIAN
RHAETIAN
NORIAN
CARNIAN
LADINIAN
ANISIAN
SCYTHIAN
TATARIAN
KAZANIAN
KUNGURIAN
ARTINSKIAN
SAKMARIAN
ASSELIAN
OCHOAN
GUADALUPIAN
LEONARDIAN
WOLFCAMPIAN
STEPHANIAN
WESTPHALIAN
NAMURIAN
GZHELIAN
KASIMOVIAN
MOSCOVIAN
BASHKIRIAN
SERPUKHOVIAN
VISEAN
TOURNASIAN
PENNSYLVANIAN
MISSISSIPPIAN
VIRGILIAN
MISSOURIAN
DES MOINESIAN
ATOKAN
MORROWAN
CHESTERIAN
MERAMECIAN
OSAGEAN
KINDERHOOKIAN
FAMENNIAN
FRASNIAN
GIVETIAN
EIFELIAN
EMSIAN
SIEGENIAN
GEDINNIAN
CHAUTAUQUAN
SENECAN
ULSTERIAN
CONEWANGOAN
CASSADAGIAN
CHEMUNGIAN
FINGERLAKESIAN
ERIAN
ESOPUSIAN
DEERPARKIAN
HELDERBERGIAN
PRIDOLIAN
LUDLOVIAN
WENLOCKIAN
LLANDOVERIAN
CAYUGAN
NIAGARAN
LOCKPORTIAN
CLIFTONIAN
CLINTONIAN
ALEXANDRIAN
ASHGILLIAN
CINCINNATIAN
RICHMONDIAN
MAYSVILLIAN
165
170
175
180
185
190
195
200
215
220
230
240
245
250
255
270
275
285
290
310
315
330
340
355
365
380
385
390
395
400
405
415
420
425
volcanic and
Middle Camp quartz monzonite
volcaniclastic rocks
quartz porphyry
1807
Chiuli Shaik Fm.
170
Mulberry Wash Volc.
Pitoikam Fm.
Ali Molina Fm.
Sil Nakya Fm.
La Abra fm
"Canelo Hills Volcanics"
200
Gardner Canyon Fm.
350
Pipar Gulch Monzonite
Mount Wrightson Fm.
2900
Moenkopi Fm.
130
"Kaibab Ls."
220
Coconino Ss.
215
"Supai Fm."
180
unnamed ls.
"Escabrosa Ls."
135
"Martin Fm."
108
Martin Fm.
1200-1700
Naco Gp.
Rainvalley Fm.
60
Concha Ls.
200
Scherrer Fm.
150-200
Epitaph Dol.
278-350
Colina Ls.
200
Earp Fm.
260
Horquilla Ls.
350
Black Prince Ls.
50-90
"Escabrosa Ls."
180
Martin Fm.
60-100
Kaibab Ls.
80-100
Toroweap Fm.
50-100
Coconino Ss
150-210
Schnebly Hill Fm.
Fort Apache Mbr 0-3
260-320
"Supai Fm."
Naco Fm. 0-135
300
Concha Fm.
420
Sherrer Fm.
1.5-8
Epitaph Dol.
451-463
Colina Ls.
108-154
Earp Fm.
304
Horquilla Fm.
289-1078
Paradise Fm.
384
Escabrosa Gp.
384
Hachita Fm.
Keating Fm.
117
Cutter Mbr
Aleman Mbr
Percha Sh.
85
Redwall Ls.
80
Martin Fm
160
Mississippian


PALEOZOIC
CARBONIFEROUS
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
PROTEROZOIC
ARCHEAN
LOWER
UPPER
MIDDLE
ARTINSKIAN
SAKMARIAN
ASSELIAN
LEONARDIAN
WOLFCAMPIAN
STEPHANIAN
GZHELIAN
KASIMOVIAN
WESTPHALIAN
MOSCOVIAN
BASHKIRIAN
NAMURIAN
SERPUKHOVIAN
VISEAN
TOURNASIAN
PENNSYLVANIAN
VIRGILIAN
MISSOURIAN
DES MOINESIAN
ATOKAN
MORROWAN
MISSISSIPPIAN
CHESTERIAN
MERAMECIAN
OSAGEAN
KINDERHOOKIAN
FAMENNIAN
FRASNIAN
GIVETIAN
EIFELIAN
EMSIAN
SIEGENIAN
GEDINNIAN
CHAUTAUQUAN
SENECAN
CONEWANGOAN
CASSADAGIAN
CHEMUNGIAN
FINGERLAKESIAN
ERIAN
ULSTERIAN
ESOPUSIAN
DEERPARKIAN
HELDERBERGIAN
PRIDOLIAN
LUDLOVIAN
WENLOCKIAN
LLANDOVERIAN
CAYUGAN
NIAGARAN
LOCKPORTIAN
CLIFTONIAN
CLINTONIAN
ALEXANDRIAN
ASHGILLIAN
CARADOCIAN
LLANDEILIAN
LLANVIRNIAN
ARENIGIAN
TREMADOCIAN
CINCINNATIAN
RICHMONDIAN
MAYSVILLIAN
CHAMPLAINIAN
EDENIAN
SHERMANIAN
KIRKFIELDIAN
ROCKLANDIAN
BLACKRIVERIAN
CHAZYAN
WHITEROCKIAN
CANADIAN
TREMPEALEAUAN
FRANCONIAN
DRESBACHIAN
275
285
290
310
315
330
340
355
365
380
385
390
395
400
405
415
420
425
455
460
475
485
490
500
515
540
570
2500
"Supai Fm."
180
"Escabrosa Ls."
135
"Martin Fm."
106
"Abrigo Fm."
165
"Musy Ls"
45
"Bolsa Quartzite"
20
metavolcanics and
quartz monzonite
metagranite
unnamed ls.
Martin Fm.
Abrigo fm.
Bolsa Quartzite
gneisses
Naco Gp.
150-200
Epitaph Dol.
278-350
Colina Ls.
200
Earp Fm.
260
Horquilla Ls.
350
Black Prince Ls.
50-90
"Escabrosa Ls."
180
Martin Fm.
60-100
Abrigo Fm.
260
Bolsa Quartzite
160
Continental Granodiorite
Pinal Schist
6000±
420
Sherrer Fm.
1.5-6
Epitaph Dol.
451-463
Colina Ls.
108-154
Earp Fm.
304
Horquilla Fm.
289-1076
Paradise Fm.
384
Escabrosa Gp.
384
Hachita Fm.
Keeling Fm.
Percha Sh.
85
Montoya Fm.
117
Cutter Mbr.
Aleman Mbr.
Upham Mbr.
Cable Canyon Ss.
3-6
El Paso Fm.
279-326
Bliss Fm.
58.5-107
Precambrian granite
150-210
Schnably Hill Fm.
Fort Apache Mbr
0-3
260-320
"Supai Fm."
Naco Fm.
0-135
300±
Redwall Ls.
80
Martin Fm
180
Tapeats Ss.
8
quartz diorite
Bradys Butte Granodiorite
Ash Creek Gp

INTRODUCTION

The first five stratigraphic columns of the COSUNA chart, SSMC, were constructed to show correlations of stratigraphic units in Southern Arizona, and in the Big Hatchet Mountain Area, just across the border into New Mexico. The construction of the chart was under the supervision of Frank E. Kottlowski, and authors of the columns prepared individual data sheets for each of the stratigraphic units that appears in the geological columns. This is a presentation of the documentation records prepared by the authors of the first five columns of the chart. Contributing authors of the columns were: G. Haxel, R. A. Knepp, S. J. Reynolds, S. Thompson III, and J. Wright. The COSUNA project was under the direction of Orlo E. Childs.

The Correlation of Stratigraphic Units of North America (COSUNA) was a project of the American Association of Petroleum Geologists which has resulted in the publication of sixteen correlation charts depicting modern concepts of the stratigraphy of our nation. On the Southwestern/Southwestern Mid-Continent (SSMC) Correlation Chart 31 complete stratigraphic columns are shown, representing all of the Geological Provinces of the region. Organized by columns numbered from left to right, the Data Sheet Records (each with its own unique Reference Number) of each column are shown here as they are presented on diskettes for use on Personal Computers. Copies of the diskettes are available from the American Association of Petroleum Geologists. These Records are meant to supplement the COSUNA chart, by presenting useful documentation of the information on which the columns were constructed by authors of the chart. It should be noted that some of the names of Stratigraphic Units are presented within quotation marks. This means that there is some question about the application of these stratigraphic names to the unit, and that the name may be incorrectly used.



COLUMN NUMBER: 1

IDENTIFICATION:
1. RECORD NUMBER: 12800
   COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
   LAT 34 N
   LONG 114 W
   STATE ARIZONA
   STAPI CODE - 02
   COUNTY - YUMA
   COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
   PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: METAVOLCANICS AND METAGRANITE
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
   ERA PRECAMBRIAN
   SERIES/STAGE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
   ABOVE - "BOLSA QUARTZITE"
   BELOW - UNKNOWN
12. LITHOLOGY:
   DOMINANT LITHOLOGY - META-VOLCANICS
   SUBORDINATE LITHOLOGY - META-IGNEOUS
14. MAJOR UNCONFORMITIES:
   ANGULAR UNCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PROBABLY INTRUDED BY 1730 M. Y. QUARTZ MONZONITE. INCLUDES SOME METASEDIMENTARY ROCKS BUT IS MAINLY METAVOLCANIC

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { MILLER, F.K. 1970 U.S. GEOLOGICAL SURVEY GEOLOGIC QUADRANGLE MAP GQ-841.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/3/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12801
   COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
   LAT 34 N
   LONG 114 W
   STATE ARIZONA
   STAPI CODE - 02
   COUNTY - YUMA
   COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
   PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: QUARTZ MONZONITE
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
   ERA PRECAMBRIAN
   SERIES/STAGE
11. BOUNDING UNITS:
   ABOVE -
   BELOW -
12. LITHOLOGY:
   DOMINANT LITHOLOGY - QUARTZ MONZONITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 1730 TO 1750 M.Y. "LEAD ISOTOPE ON ZIRCON" L.T. SILVER IN MILLER, 1970.
17. ECONOMIC DATA: NONE
18. OTHER DATA: BIOTITE QUARTZ MONZONITE. APPEARS TO BE IN FAULT CONTACT WITH ALL UNITS EXCEPT MESOZOIC VOLCANICS.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL NAME
20. SIGNIFICANT REFERENCE: { MILLER, F.K. 1970 U.S. GEOLOGICAL SURVEY GEOLOGIC MAP GQ-841
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/30/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12802
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: "BOLSA QUARTZITE"
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CAMBRIAN
SERIES/STAGE MIDDLE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - "ABRIGO FORMATION"
BELOW - METAMORPHIC AND IGNEOUS BASEMENT
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
SUBORDINATE LITHOLOGY - MINOR CONGLOMERATE
13. THICKNESS: 20
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: CORRELATED WITH BOLSA QUARTZITE OF SOUTHEASTERN ARIZONA SOLELY ON THE BASIS OF STRATIGRAPHIC POSITION AND LITHOLOGY.

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 THE GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGLE, ARIZONA: US GEOLOGICAL SURVEY PROFESSIONAL PAPER 21, 168 P.
20. SIGNIFICANT REFERENCE: { MILLER, F.K. 1970 U.S. GEOLOGICAL SURVEY GEOLOGICAL MAP GQ-841.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/3/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12803
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: "ABRIGO FORMATION"
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CAMBRIAN
SERIES/STAGE UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - "MARTIN FORMATION" OR "MUAV LIMESTONE"
BELOW - "BOLSA QUARTZITE"
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDY SHALE
SUBORDINATE LITHOLOGY - SANDSTONE
13. THICKNESS: 45
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: NONE EXCEPT POSSIBLE TRACE FOSSILS
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: DARK GREEN, PURPLE, AND BLACK SHALE, CORRELATED TO LOWER ABRIGO FORMATION BY MILLER (1970) ON BASIS OF LITHOLOGY AND STRATIGRAPHIC POSITION

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 THE GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGLE, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 21, 168 P.
20. SIGNIFICANT REFERENCE: { MILLER, F.K. 1970 U.S. GEOLOGICAL SURVEY GEOLOGIC QUADRANGLE MAP GQ-841.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/3/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12804
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: "MUAV LIMESTONE"
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL (MAY BE INCORRECTLY USED)
9. AGE:
SYSTEM CAMBRIAN
SERIES/STAGE MIDDLE
11. BOUNDING UNITS:
ABOVE - "MARTIN" FORMATION
BELOW - FAULT ONTO ABRIGO FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - DOLOMITIC LIMESTONE
13. THICKNESS: 165
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: POSSIBLE GIRVANELLA SP. (MILLER, 1970)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: MATTLED GRAY AND GOLD DOLOMITIC LIMESTONE. CORRELATION WITH MUAV LIMESTONE OF GRAND CANYON AREA TENTATIVE, BASED ONLY ON LITHOLOGY AND POSSIBLE GIRVANELLA FOSSILS

REFERENCES:
19. ORIGINAL REFERENCE: { NOBLE, L.F. 1914 THE SHINUMO QUADRANGLE, GRAND CANYON DISTRICT, ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 549.
20. SIGNIFICANT REFERENCE: { MILLER, F.K. 1970 U.S. GEOLOGICAL SURVEY GEOLOGIC QUADRANGLE MAP GQ-841
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/7/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12805
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: "MARTIN FORMATION"
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL (MAY BE INCORRECTLY USED)
9. AGE:
SYSTEM DEVONIAN
SERIES/STAGE UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - "ESCABROSA LIMESTONE"
BELOW - "ABRIGO FORMATION"
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE AND DOLOMITE
SUBORDINATE LITHOLOGY - SANDY DOLOMITE
13. THICKNESS: 106
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: BASAL CONTACT WITH "ABRIGO FORMATION" APPEARS GRADATIONAL - CALLED MARTIN FORMATION ONLY BECAUSE OF LITHOLOGIC SIMILARITY TO MARTIN OF SOUTHEASTERN ARIZONA (MILLER, 1970).

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 THE GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGLE, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 21, 168 P.
20. SIGNIFICANT REFERENCE: { MILLER, F.K. 1970 U.S. GEOLOGICAL SURVEY GEOLOGIC QUADRANGLE MAP GQ-841
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/3/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12806
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: "ESCABROSA LIMESTONE"
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL (MAY BE INCORRECTLY USED)
9. AGE:
SYSTEM MISSISSIPPIAN
SERIES/STAGE (KINDERHOOKIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - "SUPAI FORMATION"
BELOW - "MARTIN FORMATION"
12. LITHOLOGY:
DOMINANT LITHOLOGY - DOLOMITE
SUBORDINATE LITHOLOGY - LIMESTONE
13. THICKNESS: 135
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: SYRINGOPORA SURCULARIA GIRTY, VESICULOPHYLLUM SP. (SANDO AND DUNCAN IN MILLER, 1970, P. 2)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: SOME LIMESTONE CONGLOMERATE IN UPPER HALF. MAY BE EQUIVALENT OF EITHER ESCABROSA LIMESTONE OF SOUTHEASTERN ARIZONA OR REDWALL LIMESTONE OF COLORADO PLATEAU.

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, FL 1904 THE GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGLE, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 21, 168 P.
20. SIGNIFICANT REFERENCE: { MILLER, FK 1970 U.S. GEOLOGICAL SURVEY GEOLOGIC QUADRANGLE MAP GQ-841.
21. AUTHOR (S):
22. DATE: 6/3/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12807
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: "SUPAI FORMATION"
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL (MAY BE INCORRECTLY USED)
9. AGE:
SYSTEM PENNSYLVANIAN-PERMIAN
SERIES/STAGE (DESMOINESIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - "COCONINO SANDSTONE"
BELOW - "ESCABROSA LIMESTONE"
12. LITHOLOGY:
DOMINANT LITHOLOGY - QUARTZITES
SUBORDINATE LITHOLOGY - MUDSTONES AND LIMESTONES
13. THICKNESS: 180
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: BASAL CONGLOMERATE UNIT LESS THAN 0.3 M THICK. LOWER ONE HALF CONSISTS OF QUARTZITES WITH INTERBEDDED MAROON MUDSTONES AND LIMESTONES. UPPER HALF DIFFERS MAINLY IN HAVING A LESSER AMOUNT OF LIMESTONE

REFERENCES:
19. ORIGINAL REFERENCE: { DARTON, N.H. 1910 A RECONNAISSANCE OF PARTS OF NORTHWESTERN NEW MEXICO AND NORTHERN ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 435, 88 P.
20. SIGNIFICANT REFERENCE: { MILLER, F.K. 1970 U.S. GEOLOGICAL SURVEY GEOLOGIC QUADRANGLE MAP GQ-841
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/4/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12808
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: "COCONINO SANDSTONE"
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL (MAY BE INCORRECTLY USED)
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (LEONARDIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - "KAIBAB LIMESTONE"
BELOW - "SUPAI FORMATION"
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
13. THICKNESS: 215
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: MEDIUM TO MASSIVE BEDDING, LARGE SCALE CROSSBEDS NOTED LOCALLY. WELL-SORTED, MODERATELY WELL-ROUNDED QUARTZITES.

REFERENCES:
19. ORIGINAL REFERENCE: { DARTON, N.H. 1910 A RECONNAISSANCE OF PARTS OF NORTHWESTERN NEW MEXICO AND NORTHERN ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 435, 88 P.
20. SIGNIFICANT REFERENCE: { MILLER, FK 1970 U.S. GEOLOGICAL SURVEY GEOLOGIC QUADRANGLE MAP GQ-841
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12809
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: "KAIBAB LIMESTONE"
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL (MAY BE INCORRECTLY USED)
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (GUADALUPIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - VARIABLE UNITS
BELOW - "COCONINO SANDSTONE"
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
13. THICKNESS: 220
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: PENICULARIS SP, TIMANODICTYA SP., AND BICORBIS ARIZONICA (R.E. GRANT AND HELEN DUNCAN IN MILLER, 1970)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: LIMESTONE AND CHERTY LIMESTONE, LIGHT GRAY TO TAN WITH BROWN CHERT LENSES AND NODULES, CONSIDERED FINE-GRAINED AND FETID BY MILLER (1970)

REFERENCES:
19. ORIGINAL REFERENCE: { DARTON, N.H. 1910 A RECONNAISSANCE OF PARTS OF NORTHWESTERN NEW MEXICO AND NORTHERN ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 435, 88 P.
20. SIGNIFICANT REFERENCE: { F.K. MILLER 1970 U.S. GEOLOGICAL SURVEY GEOLOGIC QUADRANGLE MAP GQ-841.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/4/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12810
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: QUARTZ PORPHYRY
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
9. AGE:
SYSTEM JURASSIC
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - VOLCANIC AND VOLCANICLASTIC ROCKS
BELOW - STONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - QUARTZ PORPHYRY OF DACITE
SUBORDINATE LITHOLOGY - QUARTZ MONZONITE PORPHYRY
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: LESS THAN 10 PER CENT FELDSPAR IN MOST PLACES. GROUNDMASS HEAVILY ALTERED TO SERICITE, ALBITE, QUARTZ, AND EPIDOTE. PROBABLY ORIGINALLY A DACITE.

REFERENCES:
19. ORIGINAL REFERENCE: { MILLER, F.K. 1970 (INFORMAL)
20. SIGNIFICANT REFERENCE: { MILLER, F.K. 1970 U.S.G.S. GEOLOGIC QUADRANGLE MAP GQ-841, 3 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/21/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12811
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MIDDLE CAMP QUARTZ MONZONITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
9. AGE:
SYSTEM JURASSIC
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - VOLCANIC AND VOLCANICLASTIC ROCKS
BELOW - SAME
12. LITHOLOGY:
DOMINANT LITHOLOGY - QUARTZ MONZONITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: INTRUDES VOLCANICS/VOLCANICLASTICS

REFERENCES:
19. ORIGINAL REFERENCE: { CROWL, W.J. 1979 GEOLOGY OF THE CENTRAL DOME ROCK MOUNTAINS, YUMA COUNTY, ARIZONA: UNPUBLISHED M.S. THESIS, UNIVERSITY OF ARIZONA, TUCSON, 76 P.
20. SIGNIFICANT REFERENCE: { REYNOLDS, S.J. 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 1-16
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/20/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12812
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: VOLCANIC AND VOLCANICLASTIC ROCKS
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
SYSTEM JURASSIC
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - MCCAY MTNS. FORMATION
BELOW - "KAIBAB LIMESTONE"
12. LITHOLOGY:
DOMINANT LITHOLOGY - META-VOLCANICS, VOLCANICLASTICS
SUBORDINATE LITHOLOGY - META-SEDIMENTS
13. THICKNESS: 5000
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: "DOME ROCK METAMORPHICS" 4 CROWL (1979), MAINLY METAMORPHOSED TO SCHISTS, SOME PHYLLITES. WHALE-ROCK CHEMISTRY SIMILAR TO CALL-ALKALINE VOLCANIC TREND. AGE BASED ON DATING BY L.T. SILVER (CROWL, 1979)

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { CROWL, W.J. 1979 UNPUBLISHED M.S. THESIS, UNIVERSITY OF ARIZONA, 76 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 20 JULY, 1

****

IDENTIFICATION:
1. RECORD NUMBER: 12813
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MCCOY MOUNTAINS FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - TERTIARY VOLCANICS AND SEDIMENT
BELOW - VOLCANICS & VOLCANICLASTICS
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONES
13. THICKNESS: 6000
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
15. FOSSIL DATA: FOSSIL WOOD (PELKA, 1973: HAYES, 1970, USGS PROF. PAPER 658-B)
16. RADIOMETRIC DATA: INTRUDED BY 69 + - 1.0 M.Y. GRANITIES (ARMSTRONG & SUPPE, (1973) GSA BULL 84, P. 1375)
17. ECONOMIC DATA: NONE
18. OTHER DATA: ARKASIC AND LITNARENITE SANDSTONES, MUCH VOLCANIC MATERIAL.

REFERENCES:
19. ORIGINAL REFERENCE: { MILLER, W.J. 1944 GEOLOGY OF PALM SPRINGS-BLYTHE STRIP, RIVERSIDE COUNTY, CALIFORNIA: CALIFORNIA JOURNAL OF MINES AND GEOLOGY, V. 40, N. 1, P. 11-72.
20. SIGNIFICANT REFERENCE: { PELKA, G J 1973 M.S. THESIS, UNIVERSITY OF CALIFORNIA AT SANTA BARBARA, 160 P. (UNPUBLISHED)
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/6/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12814
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: "CONTINENTAL RED BEDS"
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION INFORMAL (MAY BE INCORRECTLY USED)
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - UNNAMED CLASTICS
BELOW - VOLCANIC AND VOLCANICLASTIC ROCKS
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDY MUDSTONE 50%
SUBORDINATE LITHOLOGY - SANDSTONE/CONGLOMERATE 40%
13. THICKNESS: 180
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: INTERFINGER WITH "GREEN BEDS" WHICH INCLUDE SHALES AND SILTSTONES. ROBISON (1980) SUGGESTS INTERFINGERING WITH LIVINGSTON HILLS FORMATION, THE RELATIONSHIP IS DENIED BY L.E. HANDING (PERS. COMM., 1981)

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { ROBISON, B.A. 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 147-154.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12815
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: UNNAMED CLASTICS
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION INFORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - LIVINGSTON HILLS FORMATION
BELOW - "CONTINENTAL RED BEDS"
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
SUBORDINATE LITHOLOGY - SILTSTONE
13. THICKNESS: 2500
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PROBABLY IN CONFORMABLE SEQUENCE WITH REDBEDS AND LIVINGSTON HILLS FORMATION (L.E. HARDING, PERS. COMM., 1981). HAS NOT BEEN DESCRIBED IN LITERATURE.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { NONE
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12816
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: LIVINGSTON HILLS FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - TERTIARY VOLCANICS AND SEDIMENTS
BELOW - UNNAMED CLASTICS
12. LITHOLOGY:
DOMINANT LITHOLOGY - CONGLOMERATE
SUBORDINATE LITHOLOGY - GRAYWACKE & SILTSTONE
13. THICKNESS: 3500-5000
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
15. FOSSIL DATA: FOSSIL WOOD (HAYES, 1970, USGS PROFESSIONAL PAPER 658-B, P.), SOME POLLEN NEAR TOP (G.J. PELKA, 1973, M.S. THESIS, UNIVERSITY OF CALIFORNIA AT SANTA BARBARA)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: UNDERLAIN BY UNNAMED CLASTIC ROCKS NEAR DOME ROCK MOUNTAINS (L.E. HARDING, PERS. COMM., 1981). PROBABLY EQUIVALENT TO MCCOY MOUNTAINS FORMATION. BASAL CONGLOMERATE MEMBER UNDERLAIN BY GRAYWACKE MEMBER

REFERENCES:
19. ORIGINAL REFERENCE: { MILLER, F.K. 1970 GEOLOGIC MAP OF THE QUARTZSITE QUADRANGLE, YUMA COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY GEOLOGIC QUADRANGLE MAP G.Q.-841, 3 P.
20. SIGNIFICANT REFERENCE: { HARDING, L.E. 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 135-145.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 14/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12817
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: TANK PASS GRANITE
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRANITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 69 M.Y., EBERLY AND STANLEY, 1978, GEOL SOC. AMERICA BULLETIN, V. 89, P. 921-940. 65 M.Y., SHAFIGULLAH ETAL., ARIZ. GEOL. SOC. DIGEST, V. 12, P. 201-260. (BOTH ARE COOLING AGES)
17. ECONOMIC DATA: NONE
18. OTHER DATA: AGE RELATIVE RATHER THAN RADIOMETRIC, BASED UPON INTRUSION BY THE GRANITE WASH GRANODIORITE, WHICH HAS BEEN DATED AT 69 M.Y. IN AGE. REPRESENTATIVE OF A SUITE OF GRANITICS FOUND IN PLOMOSA MTS.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { REHRIG, W.A., AND S.J. REYNOLDS 1980 GEOL. SOC. AMERICA MEMOIR 153, P. 131-157.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/16/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12818
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GRANITE WASH GRANODIORITE
8. STRATIGRAPHIC RANK AND STATUS: INFORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRANODIORITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 69 M.Y. K-AR (BIOTITE) EBERLY AND STANLEY, (1978,) GEOL. SOC. AMERICA BULL, V. 89, P. 921-940.
17. ECONOMIC DATA: NONE
18. OTHER DATA: OUTCROP AREA IS IN THE GRANITE WASH MOUNTAINS, NORTHEAST OF COLUMN SITE. INTRUDES TANK PASS GRANITE.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { REHRIG, W.A., AND REYNOLDS, S.J. 1980 GEOLOGICAL SOCIETY OF AMERICA MEMOIR 153, P. 131-157.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12819
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GENE CANYON FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE OLIGOCENE/MIOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - COPPER BASIN FORMATION
BELOW - LIVINGSTON HILLS FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
SUBORDINATE LITHOLOGY - VOLCANICS & CONGLOMERATES & SILTSTONE
13. THICKNESS: 585
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: ARTIODACTYL TRACKS (DAVIS AND OTHERS, 1980, P. 94)
FRESH-WATER GASTROPODS (GASSAWAY, J.S., 1977. UNPUBLISHED M.S. THESIS, SAN DIEGO STATE UNIVERSITY, CALIFORNIA)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PROBABLY CORRELATIVE TO ARTILLERY FORMATION. OUTCROPS DISCONTINUOUS, LITHOLOGIES VARY LATERALLY. SOME LACUSTRINE BEDS, SOME MEGABRECCIA. THICKNESS HIGHLY VARIABLE, MEASURES 585M AT TYPE LOCALITY.

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1931 GEOLOGICAL RECONNAISSANCE OF THE REVISED PARKER SOUTH THROUGH THE WHIPPLE MOUNTAINS: CONSULTING REPORT TO THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA, 10 P.
20. SIGNIFICANT REFERENCE: { DAVIS, G.A., AND OTHERS 1980 GEOLOGICAL SOCIETY OF AMERICA MEMOIR, 153, P. 79 TO 129.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12820
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: VOLCANICS AND VOLCANICLASTICS
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE OLIGOCENE/MIOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - VARIABLE
BELOW - VARIABLE
12. LITHOLOGY:
DOMINANT LITHOLOGY - FLAWS
SUBORDINATE LITHOLOGY - TUFFS, ASH
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 30 TO 14 M.Y.
17. ECONOMIC DATA: NONE
18. OTHER DATA: INTERBEDDED WITH FAN AND ALLUVIAL DEPOSITS

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { SHAFIQUELAH AND OTHERS 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 260-301.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 9/18/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12821
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: COPPER BASIN FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - OSBORNE WASH FORMATION
BELOW - GENE CANYON FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
SUBORDINATE LITHOLOGY - SILTSTONE, VOLCANICS, CONGLOMERATES
13. THICKNESS: 750
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: CAMEL TRACKS (GASSAWAY, J.S., 1977, UNPUBLISHED MS THESIS, SAN DIEGO STATE UNIVERSITY, P. 32-34)
16. RADIOMETRIC DATA: 19-21 M.Y. K-AR (WHOLE ROCK) S. KUNIYOSHI AND T. FREEMAN (1974) GSA ABSTRACTS WITH PROGRAMS, V. 6, P. 204
17. ECONOMIC DATA: NONE
18. OTHER DATA: APPEARS TO GRADE LATERALLY INTO UNDERLYING GENE CANYON FORMATION NORTHEAST OF THE WHIPPLE MOUNTAINS AREA. PROBABLY CORRELATIVE WITH CHAPIN WASH FORMATION.

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1931 GEOLOGICAL RECONNAISSANCE OF THE REVISED PARKER ROUTE THROUGH THE WHIPPLE MOUNTAINS: CONSULTING REPORT TO THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA, 10 P.
20. SIGNIFICANT REFERENCE: { DAVIS, G.A. AND OTHERS 1980 GEOLOGICAL SOCIETY OF AMERICA MEMOIR 153, P. 79-129.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12822
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: OSBORNE WASH FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE (MIDDLE)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - BOUSE FORMATION
BELOW - COPPER BASIN FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - VOLCANICS (TUFFS, AGGLOMERATES)
SUBORDINATE LITHOLOGY - CONGLOMERATES
13. THICKNESS: 400
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
DISCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: SEE MESA-CAPPING BASALTS.
17. ECONOMIC DATA: NONE
18. OTHER DATA: AGE APPROXIMATELY THE SAME AS THE SERIES OF MESA-CAPPING BASALTS (ABOUT 13 M.Y. TO ABOUT 9 M.Y.). CONSISTS MAINLY OF VOLCANICS AND ALLUVIAL FAN DEPOSITS

REFERENCES:
19. ORIGINAL REFERENCE: { UNKNOWN
20. SIGNIFICANT REFERENCE: { DAVIS, G.A., AND OTHERS 1980 GEOLOGICAL SOCIETY OF AMERICA MEMOIR 153, P. 79-129
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12823
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MESA-CAPPING BASALTS
8. STRATIGRAPHIC RANK AND STATUS: INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - BASALT
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 13.1+-0.2 13.0+-0.5 9.2+-0.2 N. SCINESON AND I. LUCCHITTA (1979), ISOCHRON/WEST, NO. 24, P. 25-29.
17. ECONOMIC DATA: NONE
18. OTHER DATA: FLAT-LYING BASALTS INTERBEDDED WITH AND CAPPING OSBORNE WASH FORMATION SEQUENCES. PROBABLY EQUIVALENTS OF COBWEBB BASALT (LASHY AND WEBBER, 1949, U.S.G.S. BULLETIN 961)

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { DAVIS, G.A., AND OTHERS 1980 GEOLOGICAL SOCIETY OF AMERICA MEMOIR 153, P. 79-129.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/6/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12824
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: TUFF BED OF BOUSE FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
BED INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - REST OF BOUSE FORMATION
BELOW - OSBORNE WASH FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - VITRIC TUFF
13. THICKNESS: 2
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 5.47+-0.20 K/AR (GLASS) SHAFIQULLAH AND OTHERS, 1980, ARIZ. GEOL. SOC. DIGEST, V. 12, P. 201-260 (SAMPLE #147)
17. ECONOMIC DATA: NONE
18. OTHER DATA: NEAR BASE OF BOUSE FORMATION. MAY BE CORRELATIVE WITH SIMILAR-AGED BASALTS NEAR YUMA (SEE INGLE, J.C., 1973, GEOLOGICAL SOCIETY OF AMERICA ABSTRACTS WITH PROGRAMS, V. 5, P. 62.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { SHAFIQULLAH AND OTHERS 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 201-260
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12825
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BOUSE FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE PLIOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - RECENT GRAVELS & EOLIAN SANDS
BELOW - OSBORNE WASH FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SILT, CLAY, AND SAND
SUBORDINATE LITHOLOGY - LIMESTONE
13. THICKNESS: 0-90
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE SMITH, P.B., 1970, GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 81, P. 1411-1420, AND TODD, T.N., 1976, JOURNAL OF PALEONTOLOGY, V. 50, P. 462-466.
16. RADIOMETRIC DATA: 5.47 +- 0.2 M.Y. K/AR GLASS SEE TUFF BED DESCRIPTION
17. ECONOMIC DATA: NONE
18. OTHER DATA: APPARENTLY MARGINAL MARINE (BRACKISH WATER) DEPOSITS. THICKENS TOWARD GULF OF CALIFORNIA. PROBABLY EQUIVALENT TO UPPER PART OF IMPERIAL FORMATION.

REFERENCES:
19. ORIGINAL REFERENCE: { METZGER, D.G. 1968 THE BOUSE FORMATION (PLIOCENE) OF THE PARKER- BLYTHE - CEBOLA AREA, ARIZONA AND CALIFORNIA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 600-D, P. D126-D136.
20. SIGNIFICANT REFERENCE: { METZGER, D.E. 1968 U.S.G.S. PROFESSIONAL PAPER 600-D, P. D126-D136.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/4/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12826
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: RECENT ALLUVIUM AND COLORADO RIVER GRAVEL
8. STRATIGRAPHIC RANK AND STATUS: INFORMAL
9. AGE:
SYSTEM QUATERNARY
SERIES/STAGE PLEISTOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - EOLIAN DEPOSITS, SURFACE
BELOW - BOUSE FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SAND, SILT, GRAVEL
13. THICKNESS: 0-50
14. MAJOR UNCONFORMITIES:
DISCONFORMITY WITHIN
DISCONFORMITY BELOW
15. FOSSIL DATA: FOSSIL WOOD, CHARA HOMEMANII WALLMAN: V.W. PROCTOR, IN DICKEY AND OTHERS, 1980.
16. RADIOMETRIC DATA: 6000-700,000, TH 230-U234. C14.
PALEOMAGNETOSTRATIGRAPHY BULL, W.B., AND OTHERS (1975) SOUTHERN CALIFORNIA EDISON CO., APP. 2.5B AND 2.5G.
17. ECONOMIC DATA: NONE
18. OTHER DATA: SEVERAL RIVER TERRACES ARE BROKEN OUT BY DICKEY, ETAL (1980). THICKNESSES OF VARIOUS UNITS HIGHLY IRREGULAR. SO ARE LITHOLOGICS.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { D.D. DICKEY AND OTHERS 1980 U.S.G.S. MISC. INVESTIGATIONS MAP I-1124.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/16/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12827
COLUMN RECORDS RANGE: 12800 - 12827
2. LOCATION:
LAT 34 N
LONG 114 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YUMA
COAPI CODE - 027
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: PLOMOSA AND DOME ROCK MOUNTAINS AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 01

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: EOLIAN DEPOSITS
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
SYSTEM QUATERNARY
SERIES/STAGE ((HOLOCENE))
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW - RECENT ALLUVIUM, ETC
12. LITHOLOGY:
DOMINANT LITHOLOGY - SAND
SUBORDINATE LITHOLOGY - SILT
13. THICKNESS: 5
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: REWORKED FROM COLORADO RIVER DEPOSITS AND FROM BOUSE FORMATION.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { DICKEY, D.D., AND OTHERS 1980 USGS MISCELLANEOUS INVESTIGATIONS SERIES MAP I-1124.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/6/1981

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COLUMN NUMBER: 2

IDENTIFICATION:
1. RECORD NUMBER: 12828
   COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
   LAT 32 N
   LONG 112 W
   STATE ARIZONA
   STAPI CODE - 02
   COUNTY - PIMA
   COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
   PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GNEISSES
8. STRATIGRAPHIC RANK AND STATUS: INFORMAL
9. AGE:
   ERA PRECAMBRIAN (PROTEROZOIC)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
   ABOVE -
   BELOW -
12. LITHOLOGY:
   DOMINANT LITHOLOGY - GNEISS
   SUBORDINATE LITHOLOGY - AUGEN GNEISS
14. MAJOR UNCONFORMITIES:
   ANGULAR UNCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: AGE UNKNOWN PRECAMBRIAN ASSIGNMENT BASED ON LITHOLOGY AND UNPUBLISHED ISOTOPIC DATA

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { HAXEL, G., AND OTHERS 1980 AGS DIGEST, V. 12, P. 17-29.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/81

****

IDENTIFICATION:
1. RECORD NUMBER: 12829
   COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
   LAT 32 N
   LONG 112 W
   STATE ARIZONA
   STAPI CODE - 02
   COUNTY - PIMA
   COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
   PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BOLSA QUARTZITE
8. STRATIGRAPHIC RANK AND STATUS:
   FORMATION
   FORMAL
9. AGE:
   SYSTEM CAMBRIAN
   SERIES/STAGE MIDDLE
10. SURFACE/SUBSURFACE DATA: SUBSURFACE
11. BOUNDING UNITS:
   ABOVE - ABRIGO FORMATION
   BELOW - GNEISS
12. LITHOLOGY:
   DOMINANT LITHOLOGY - SANDSTONE
14. MAJOR UNCONFORMITIES:
   ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: APPEARS AS SEPTA IN PAN TAK GRANITE.

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGLE U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 21
20. SIGNIFICANT REFERENCE: { CARRIGAN, F.J. 1971 UNPUB. M.S. THESIS, UNIV. OF ARIZONA, TUCSON, ARIZONA
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12830
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: ABRIGO FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CAMBRIAN
SERIES/STAGE MIDDLE AND UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - MARTIN FORMATION
BELOW - BOLSA QUARTZITE
12. LITHOLOGY:
DOMINANT LITHOLOGY - SHALE
SUBORDINATE LITHOLOGY - SANDSTONE DOLOMITE
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: APPEARS ONLY AS SEPTA AND/OR ROOF PENDANTS IN PAN TAK GRANITE.

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 U.S. GEOLOGIC SURVEY PROFESSIONAL PAPER 21
20. SIGNIFICANT REFERENCE: { CARRIGAN, F.J. 1971 UNIV OF ARIZONA UNPUBLISHED MS THESIS, TUCSON, ARIZONA
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12831
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MARTIN FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM DEVONIAN
SERIES/STAGE UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - PALEOZOIC LIMESTONE
BELOW - ABRIGO FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - DOLOMITE
SUBORDINATE LITHOLOGY - SANDSTONE
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: APPEARS AS SEPTA AND/OR ROOF PENDANTS IN PAN TAK GRANITE.

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 GEOLOGY AND ORE DEPOSITS OF THE BISKEE QUADRANGLE U.S. GEOLOGIC SURVEY PROFESSIONAL PAPER 21
20. SIGNIFICANT REFERENCE: { CARRIGAN, F.J. 1971 UNPUB. M.S. THESIS, UNIVERSITY OF ARIZONA, TUCSON, ARIZONA
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12832
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: UNNAMED LIMESTONE
8. STRATIGRAPHIC RANK AND STATUS: FORMATION INFORMAL
9. AGE:
SYSTEM PENNSYLVANIAN
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - FAULT
BELOW - FAULT
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: APPEARS AS FAULT SLICES AND STRONGLY METAMORPHOSED ROOF PENDANTS. PALEOZOIC AGE ASSIGNED ON BASIS OF LITHOLOGY

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { HAXEL, G. 1981 U.S. GEOLOGIC SURVEY OPEN. FILE REPORT 81-
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12833
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: ALI MALINA FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE LOWER (HELTANGIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - PITOIKAM FORMATION
BELOW - PALEOZOIC STRATA
12. LITHOLOGY:
DOMINANT LITHOLOGY - RHYOLITIC VOLCANICS
SUBORDINATE LITHOLOGY - SANDSTONE
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 191-194 M.Y. U-PB (ZIRCON) WRIGHT AND OTHERS, 1981, GEOL. SOC. AMERICA ABS. WITH PROGRAMS, V. 13, P. 115
17. ECONOMIC DATA: NONE
18. OTHER DATA: CORRELATED TO MT. WRIGHTSON FORMATION ON BASIS OF AGE AND INCLUDED EOLIAN SANDSTONE. ORIGINALLY NAMED ALI MOLINA METAMORPHIC COMPLEX, RENAMED ALI MOLINA FORMATION BY HAXEL AND OTHERS (1980)

REFERENCES:
19. ORIGINAL REFERENCE: { HEINDL, L.A., AND C.L. FAIR 1965 MESOZOIC ROCKS IN THE BABOQUIVARI MOUNTAINS, PAPAGO INDIAN RESERVATION, ARIZONA. U.S. GEOLOGICAL SURVEY BULLETIN 1194-
20. SIGNIFICANT REFERENCE: { HAXEL, GORDON, AND OTHERS 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 17-29
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12834
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: PITOIKAM FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - MULBENY WASH VOLCANIC FM.
BELOW - ALI MOLINA FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - CONGLOMERATE
SUBORDINATE LITHOLOGY - SILTSTONE, SANDSTONE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { HEINDL, L.A., AND FAIR, C.L. 1965 MESOZOIC ROCKS IN THE BABOQUIVARI MOUNTAINS, PAPAGO INDIAN RESERVATION, ARIZONA: U.S. GEOLOGIC SURVEY BULLETIN 1194-I
20. SIGNIFICANT REFERENCE: { HAXEL, GORDON, AND OTHERS 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 17-29
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12835
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MULBERRY WASH VOLCANIC FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - CHIULI SHAIK FORMATION
BELOW - PITOIKAM FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - RHYOLITE
SUBORDINATE LITHOLOGY - DACITE, CONGLOMERATE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 188-189 M.Y. U-PB (ZIRCON) WRIGHT AND OTHERS, 1981, GEOL. SOC. AMERICA ABS. WITH PROGRAM, V. 13, P. 115
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { HEINDL, L.A., AND C.L. FAIR 1965 MESOZOIC ROCKS IN THE BABOQUIVARI MOUNTAINS, PAPAGO INDIAN RESERVATION, ARIZONA: U.S. GEOLOGIC SURVEY BULLETIN 1194-H
20. SIGNIFICANT REFERENCE: { HAXEL, GORDON, AND OTHERS 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 17-29.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12836
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: SIL NAKYA FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - CHIULI SHAIK FORMATION
BELOW - UNNAMED LIMESTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - RHYOLITE
SUBORDINATE LITHOLOGY - SANDSTONE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 190 M.Y. U-PB, ZIRCON WRIGHT AND OTHERS, 1981, GEOL. SOC. AMERICA ABS. WITH PROGRAM, V. 13, P. 115
17. ECONOMIC DATA: NONE
18. OTHER DATA: LATERAL CORRELATIVE OF ALI MOLINA FORMATION BASED UPON RADIOMETRIC AGE DATES AND LITHOLOGIC SIMILARITY.

REFERENCES:
19. ORIGINAL REFERENCE: { HEINDL, L.A. 1965 MESOZOIC FORMATIONS IN THE COMOBABI AND ROSBRUGE MOUNTAINS, PAPEGO INDIAN RESERVATION, ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 1194-H
20. SIGNIFICANT REFERENCE: { HAXEL, GORDON, AND OTHERS 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V., P. 16-31.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12837
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GRANITE, GRANODIORITE, AND DIORITE
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE MIDDLE-UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRANITE
SUBORDINATE LITHOLOGY - GRANODIORITE, DIORITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: SEE OTHER DATA
17. ECONOMIC DATA: NONE
18. OTHER DATA: INCLUDES GRANITE OF BABOQUIVARI PEAK (147 M.Y., U-PB ZIRCON: HAXEL AND OTHERS (1980) U.S. GEOL. SURVEY MAP MF-1251). GENERAL AGE RANGE OF ABOUT 165-145 M.Y. (HAXEL AND OTHERS, 1980, ARIZONA GEOL. SOC. DIGEST, V. 12, P. 17-29) *

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { HAXEL, GORDON, AND OTHERS 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 16-31.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/16/1981
****

IDENTIFICATION:
1. RECORD NUMBER: 12838
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: CHIULI SHAIK FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - VOLCANIC AND SEDIMENTARY ROCKS
BELOW - SIL NAKYA FORMATION & MULBERRY WASH VOLCANICS
12. LITHOLOGY:
DOMINANT LITHOLOGY - RHYOLITE
SUBORDINATE LITHOLOGY - CONGLOMERATE
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: AGE ASSIGNMENT UNCERTAIN, BASED ON STRATIGRAPHIC POSITION

REFERENCES:
19. ORIGINAL REFERENCE: { HEINDL, L.A., AND C.L. FAIR 1965 MESOZOIC ROCKS IN THE BABOGUIVARI MOUNTAINS, PAPAGO INDIAN RESERVATION, ARIZONA: US GEOLOGICAL SURVEY BULLETIN 1194-I.
20. SIGNIFICANT REFERENCE: { HAZEL, GORDON, AND OTHERS 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 17-29.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12839
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: VOLCANIC AND SEDIMENTARY ROCKS
8. STRATIGRAPHIC RANK AND STATUS: INFORMAL
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE UPPER
11. BOUNDING UNITS:
ABOVE - GU ACHI FORMATION, FRESNAL CGT., SAND WE
BELOW - CHIULI SHAIK FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - VOLCANICS
SUBORDINATE LITHOLOGY - CONGLOMERATE, SANDSTONE
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: MCLUOSES METAMORPHIC AND VOLCANIC ROCKS OF "ARTESA TYPE" (HASEL & OTHERS, 1980) AND ALSO NOLIA VOLCANICS OF HEINDL (1964, U.S.G.S. BULLETIN 1194-H)

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { HASEL, GORDON, AND OTHERS 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 16-31
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12840
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: LA ABRA FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION INFORMAL
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE LOWER-UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - VARIABLE
BELOW - VARIABLE
12. LITHOLOGY:
DOMINANT LITHOLOGY - RHYOLITE
SUBORDINATE LITHOLOGY - SANDSTONE, GRANITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: SEE MAY AND OTHERS (1981)
17. ECONOMIC DATA: NONE
18. OTHER DATA: AGE BASED UPON RADIOMETRIC AGE DETERMINATIONS FOR SIMILAR ROCK BODIES IN SOUTH-CENTRAL ARIZONA AND NORTH-CENTRAL SONORA. CONSISTS MAINLY OF INTERLEAVED THRUST SLICES.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { MAY, D.J. AND OTHERS 1981 GEOL. SOC. AMERICA ABSTRACTS WITH PROGRAM, V. 13, P. 95.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 1/4/1982

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IDENTIFICATION:
1. RECORD NUMBER: 12841
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GU ACHI FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION INFORMAL
9. AGE:
SYSTEM JURASSIC/CRETACEO*
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - CONGLOMERATE
SUBORDINATE LITHOLOGY - SANDSTONE, RHYOLITE
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: AGE EXTREMELY UNCERTAIN, MAY BE OF JURASSIC TO CRETACEOUS AGE (PRE-68.M.Y.)

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { HASEL, GORDON, AND OTHERS 1980 ARIZ. GEOLOGICAL SOCIETY, DIGEST, V. 12, P. 16-31.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/6/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12842
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: FRESNAL CONGLOMERATE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - CONGLOMERATE
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: POSSIBLE CORRELATIVE OF BISBEE GROUP AND SAND WELLS FORMATION

REFERENCES:
19. ORIGINAL REFERENCE: { FAIR, C.L. 1961 POSSIBLE CRETACEOUS-TERTIARY SECTION IN FRESNAL CANYON, BABOQUIVARI MOUNTAINS: ARIZ. GEOLOGICAL SOCIETY DIGEST, V. 4, P. 93-94
20. SIGNIFICANT REFERENCE: { HASEL, GORDON, AND OTHERS 1980 U.S. GEOLOGICAL SURVEY MISC. FIELD DIV. MAP MF-1251.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 1/4/1982

****

IDENTIFICATION:
1. RECORD NUMBER: 12843
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: SAND WELLS FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - ROSKRUGE VOLCANICS
BELOW - GU ACHI FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
SUBORDINATE LITHOLOGY - CONGLOMERATE, VOLCANICS
13. THICKNESS: 2000
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: POSSIBLE CORRELATIVE OF BISBEE GROUP.

REFERENCES:
19. ORIGINAL REFERENCE: { HEINDL, L.A. 1965 MESOZOIC FORMATIONS IN THE COMOBABI AND ROSKRUGE MOUNTAINS, PAPAGO INDIAN RESERVATION, ARIZONA: US GEOLOGICAL SURVEY BULLETIN 1194-H.
20. SIGNIFICANT REFERENCE: { HAXEL, GORDON, AND OTHERS 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 16-31
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/11/81

****

IDENTIFICATION:
1. RECORD NUMBER: 12844
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GRANITE
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRANITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: LATE CRETACEOUS, BASED ON ANDERSON AND ROLDAN-QUINTANA (1979) GSA FIELD TRIP GUIDE #27, P. 80.
17. ECONOMIC DATA: NONE
18. OTHER DATA: POSSIBLE CORRELATIVE OF BISBEE GROUP.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { HAXEL, GORDON 1981 U.S. GEOLOGICAL SOCIETY OPEN-FILE REPORT 81-
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/1/81

****

IDENTIFICATION:
1. RECORD NUMBER: 12845
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: ROSKRUGE VOLCANICS
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - CONGLOMERATES & MINOR VOLCANIC ROCKS
BELOW - SAND WELLS FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - RHYOLITE
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: ORIGINALLY ROSKRUGE RHYOLITE

REFERENCES:
19. ORIGINAL REFERENCE: { HEINDL, L.A. 1965 MESOZOIC FORMATIONS IN THE COMOBABI AND ROSKRUGE MOUNTAINS, PAPAGO INDIAN RESERVATION, ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 1194-H.
20. SIGNIFICANT REFERENCE: { BIKERMAN, MICHAEL 1966 UNPUB. PH.D. DISSERTATION, UNIV. OF ARIZONA, TUCSON, ARIZONA.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 1/5/1982

****

IDENTIFICATION:
1. RECORD NUMBER: 12846
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: DIORITE, GRANODIORITE, AND GRANITE
8. STRATIGRAPHIC RANK AND STATUS: INFORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - DIORITE
SUBORDINATE LITHOLOGY - GRANODIORITE, GRANITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 72-63 M.Y. K/AR, METASEDIMENTARY & MELA-IGNEOUS ROCKS
U.S.G.S. OPEN-FILE REPORT 81-503
17. ECONOMIC DATA: NONE
18. OTHER DATA: HORNBLENDE-BIOTITE TYPE PLUTONIC ROCKS

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { HAXEL, GORDON, AND OTHERS 1980 ARIZONA
GEOLOGICAL SOCIETY DIGEST, V. 12, P. 16-
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/11/81

****

IDENTIFICATION:
1. RECORD NUMBER: 12847
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: PRESUMIDO - TYPE GRANITES
8. STRATIGRAPHIC RANK AND STATUS: INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE PALEOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRANITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: SEE PAN TAK GRANITE
17. ECONOMIC DATA: NONE
18. OTHER DATA: INCLUDES PAN TAK GRANITE, WHICH SEE

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { HAXEL, GORDON, AND OTHERS 1981 ARIZONA
GEOLOGICAL SOCIETY DIGEST, V. 12, P. 16-31
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/11/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12848
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: PAN TAK GRANITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE PALEOCENE (UPPER)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRANITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 58 +- 3 M.Y. U-PB (ZIRCON) WRIGHT, J.E., AND HAXEL, GORDON (1980) G.S.A. ABSTRACTS W. PROGRAMS, V. 12, P. 160.
17. ECONOMIC DATA: NONE
18. OTHER DATA: GARNET-TWO-MICA GRANITE

REFERENCES:
19. ORIGINAL REFERENCE: { HAXEL, GORDON, AND OTHERS 1980 RECONNAISSANCE GEOLOGY OF THE MESOZOIC AND LOWER CENOZOIC ROCKS OF THE SOUTHERN PAPAGO INDIAN RESERVATION ARIZONA: ARIZONA GEOL. SOC. DIGEST, V. 12, P. 17-29.
20. SIGNIFICANT REFERENCE: { HAXEL, GORDON, AND OTHERS 1980 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 12, P. 17-29.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/11/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12849
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: ANDESITE OF SELLS
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE OR OLIGOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - ANDESITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { MAY, D.J. AND OTHERS 1980 U.S. GEOLOGICAL SURVEY MISC. FIELD INV. MAP MF-1166
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/11/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12850
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: ALLISON CAMP INTRUSIVE RHYOLITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE OLIGOCENE OR MIOC*
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY -
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 24-26 M.Y. K/AR AND U/PB HAXEL AND OTHERS (1980)
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { HAXEL, GORDON, AND OTHERS 1980 U.S. GEOL.
SURVEY MAP MF-1251
21. AUTHOR (S): R.A. KNEPP
22. DATE: 1/5/1982

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IDENTIFICATION:
1. RECORD NUMBER: 12851
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: CONGLOMERATES AND MINOR VOLCANICS
8. STRATIGRAPHIC RANK AND STATUS: INFORMAL
9. AGE:
SYSTEM TERTIARY
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - STREAM, TERRACE, AND FALUS DEPS
BELOW - ROSKRUGE VOLCANICS
12. LITHOLOGY:
DOMINANT LITHOLOGY - CONGLOMERATES
SUBORDINATE LITHOLOGY - SANDSTONES & VOLCANICS
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
ANGULAR UNCONFORMITY WITHIN
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NO JOURNAL NOMENCLATURE AS YET. INCLUDES STRATA PROBABLY
EQUIVALENT TO PANTANO, HELMET, SAN XAVIER, & SIL MUSK FORMATIONS.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { NONE
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/11/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12852
COLUMN RECORDS RANGE: 12828 - 12852
2. LOCATION:
LAT 32 N
LONG 112 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA
COAPI CODE - 019
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SOUTHERN PAPAGO RESERVATION
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 02

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: STREAM, TERRACE, AND TALUS DEPOSITS
8. STRATIGRAPHIC RANK AND STATUS: INFORMAL
9. AGE:
SYSTEM TERIARY AND QUATERNARY
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE -
BELOW - CONGLOMERATES & VOLCANIC ROCKS
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRAVELS
SUBORDINATE LITHOLOGY - SANDS
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY WITHIN
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: {
21. AUTHOR (S): R.A. KNEPP
22. DATE: 11/11/81

****

COLUMN NUMBER: 3

IDENTIFICATION:
1. RECORD NUMBER: 12853
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: PINAL SCHIST
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
ERA PRECAMBRIAN (PROTEROZOIC)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - BOLSA QUARTZITE
BELOW - UNKNOWN
12. LITHOLOGY:
DOMINANT LITHOLOGY - SERICITE-CHLORITE-QUARTZ SCHIST
SUBORDINATE LITHOLOGY - GRANITE GNEISS
13. THICKNESS: 6000
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 1715+-10 M.Y. URANIUM-LEAD ON ZIRCON FROM RHYOLITE FLOW. L.T. SILVER IN DREWES (1971, USGS PROF. PAPER 658C, P. C-5)
17. ECONOMIC DATA: NONE
18. OTHER DATA: CONSISTS OF SCHISTS, GRAYWACKES, PLATES, AND METAQUARTZITE IN A HETEROGENOUS UNIT. BOTTOM UNKNOWN, THICKNESS ESTIMATED ONLY. (OCCURS HERE MAINLY AS INCLUSIONS OR PENDANTS IN YOUNGER INTRUSIVES)

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1903 GEOLOGY OF THE GLOBE COPPER DISTRICT, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 12, 168 P.
20. SIGNIFICANT REFERENCE: { COOPER AND SILVER 1964 U.S.G.S. PROF. PAPER 416, 196 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/15/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12854
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: CONTINENTAL GRANODIORITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION FORMAL
9. AGE:
ERA PRECAMBRIAN (PROTEROZOIC)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - BOLSA QUARTZITE
BELOW - UNDERLAIN IN PART BY SEDIMENTARY ROCKS
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRANODIORITE
SUBORDINATE LITHOLOGY - QUARTZ MONZONITE
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 1360+-200 (LEAD-ALPHA, ZIRCON), 1450+-160 (LEAD-ALPHA, ZIRCON) MARVIN AND OTHERS, 1973, US GEOLOGICAL SURVEY BULLETIN 1379, P. 17.
17. ECONOMIC DATA: NONE
18. OTHER DATA: INCLUDES APLITE AND LAMPROPHYRE DIKES THAN EITHER. ALSO CORRELATED WITH TAPEATS SANDSTONE OF COLORADO PLATEAU. BASAL CONTACT IS YOUNGEST IN THE EAST, OLDEST IN THE WEST. UPPER CONTACT WITH ABRIGO FORMATION IS GENERALLY GRADATIONAL.

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HAROLD 1968 NEW AND REVISED STRATIGRAPHIC NAMES IN THE SANTA RITA MOUNTAINS OF SOUTHEASTERN ARIZONA: US GEOLOGICAL SURVEY BULLETIN 1274-C, 15 P.
20. SIGNIFICANT REFERENCE: { DREWES, HAROLD 1976 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 915, 75 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/18/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12855
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BOLSA QUARTZITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CAMBRIAN
SERIES/STAGE MIDDLE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - ABRIGO FORMATION
BELOW - PINAL SCHIST & GRANITES
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE 95%
SUBORDINATE LITHOLOGY - CONGLOMERATE
13. THICKNESS: 160
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: TRACE FOSSILS, INCLUDING SCOLIOLITHUS TUBES AND RARE BRACHIOPODS (HAYES AND CONE, 1975)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: DECREASES IN AVERAGE GRAIN SIZE AND BEDDING THICKNESS TOWARDS TOP. MAY INTERFINGER WITH OVERLYING ABRIGO FORMATION. CORRELATES WITH CORONADO AND BLISS SANDSTONES OF SOUTHEASTERN NEW MEXICO, BUT IS OLDER.

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 THE GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGLE, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 21, 168 P.
20. SIGNIFICANT REFERENCE: { HAYES, P.T., AND CONE, G.C. 1975 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 873, 98 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 4/27/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12856
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: ABRIGO FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CAMBRIAN
SERIES/STAGE MIDDLE-UPPER (DRESBACHIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - MARTIN FORMATION
BELOW - BOLSA QUARTZITE
12. LITHOLOGY:
DOMINANT LITHOLOGY - SHALE & SILTSTONE
SUBORDINATE LITHOLOGY - SANDSTONE & LIMESTONE
13. THICKNESS: 260
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: TRILOBITES, BRACHIOPODS, ECHINODERM DEBRIS, AND BURROWS. SEE HAYES, P.T., AND E.R. LANDIS (1965), U.S. GEOLOGICAL SURVEY BULLETIN 1201-F. AND HAYES, P.T., AND G.C. CONE (1975) U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 873.
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGLE, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 21, 168 P.
20. SIGNIFICANT REFERENCE: { HAYES, P.T., AND G.C. CONE 1975 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 873, 98 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/17/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12857
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MARTIN FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM DEVONIAN
SERIES/STAGE UPPER (FRASNIAN & FAMENNIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - ESCABROSA LIMESTONE
BELOW - ABRIGO FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE, DOLOMITE 75%
SUBORDINATE LITHOLOGY - SANDSTONE 25%
13. THICKNESS: 60-100
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY WITHIN
DISCONFORMITY BELOW
15. FOSSIL DATA: CONODONTS, BRACHIOPODS, COELENTERATES. SEE SCHUMACHER, 1978, NEW MEXICO GEOLOGICAL SOCIETY GUIDEBOOK 29, P. 175-181.
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: FAMENNIAN PORTION CORRELATED WITH PERCHA SHALE OF SOUTHWESTERN NEW MEXICO. HAS BEEN SEPARATED BY SOME AUTHORS

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 THE GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGLE, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 21, 168 P.
20. SIGNIFICANT REFERENCE: NONE
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/13/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12858
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: ESCABROSA LIMESTONE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM MISSISSIPPIAN
SERIES/STAGE LOWER (KINDERHOOKIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - HORQUILLA LIMESTONE & BLACK PRINCE LIMES
BELOW - MARTIN FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE 95%
13. THICKNESS: 180
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE HAYES, P.T., AND LANDIS, E.R., 1965, U.S. GEOLOGICAL SURVEY BULLETIN 1201-F, P. F22-F24. INCLUDES BRYOZOANS, BRACHIOPODS
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: CONTAINS SOME DIASTEMS. CORRELATES WITH REDWALL LIMESTONE OF COLORADO PLATEAU. HAS SIMILAR PALEOKARST SURFACE AT TOP. FURTHER TO EAST IS SEPARATED INTO TWO FORMATIONS IN THE ESCABROSA GROUP.

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGLE, ARIZONA: U.S. GEOLOGICAL SOCIETY PROFESSIONAL PAPER 21, 168 P.
20. SIGNIFICANT REFERENCE: { PURVES, W.J., UNPUB. PH. D. DISS, UNIV OF ARIZONA (1978) PEIRCE, H.W., U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 1110, CHAPTER Z.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/14/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12859
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BLACK PRINCE LIMESTONE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PENNSYLVANIAN
SERIES/STAGE LOWER (MORROWAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - HORQUILLA LIMESTONE
BELOW - ESCABROSA LIMESTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE 85%
SUBORDINATE LITHOLOGY - SHALE 15%
13. THICKNESS: 50-90
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE NATIONS, J.D., 1963, JOURNAL OF PALEONTOLOGY, V. 37, P. 1252-1264. COELENTERATES, FUSULINIDS AND BRACHIOPODS.
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NOT RECOGNIZED IN MULE, SANTA RITA, OR EMPIRE MTS, BUT MAY BE MERELY DUE TO DIFFICULTY IN DISTINGUISHING.

REFERENCES:
19. ORIGINAL REFERENCE: { ROMSLO, T.M. 1949 INVESTIGATION OF KEYSTONE AND ST. GEORGE COPPER-ZINC DEPOSITS, COCHISE COUNTY, ARIZONA: U.S. BUREAU OF MINES REPORT OF INVESTIGATION 4504
20. SIGNIFICANT REFERENCE: { NATIONS, J.D.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/14/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12860
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: NACO GROUP
8. STRATIGRAPHIC RANK AND STATUS:
GROUP FORMAL
9. AGE:
SYSTEM PENNSYLVANIAN AND PERMIAN
SERIES/STAGE (ATOKAN - GUADALUPIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - MESOZOIC VOLCANICS & SEDIMENTARY ROCKS
BELOW - ESCABROSA LS, BLACK PRINCE LS
12. LITHOLOGY:
DOMINANT LITHOLOGY -
13. THICKNESS: 1200-1600
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
DISCONFORMITY WITHIN
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE INDIVIDUAL FORMATIONS
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: ORIGINALLY NACO LIMESTONE, RETAINED AS A FORMATION IN CENTRAL AND PARTS OF EASTERN ARIZONA

REFERENCES:
19. ORIGINAL REFERENCE: { GILLULY, JAMES, COOPER, J.R., AND WILLIAMS, J.S. 1954 LATE PALEOZOIC STRATIGRAPHY OF CENTRAL COCHISE COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, 49 P.
20. SIGNIFICANT REFERENCE: { ROSS, C.A. 1973 AM. ASSOC. PETROL. GEOLOGISTS BULLETIN, V. 57, P. 887-912
21. AUTHOR (S): R.A. KNEPP
22. DATE: 4/27/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12861
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: HORQUILLA LIMESTONE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PENNSYLVANIAN
SERIES/STAGE LOWER TO UPPER (ATOKAN, DESMOINSIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE -
BELOW - BLACK PRINCE LIMESTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
SUBORDINATE LITHOLOGY - SILTSTONE
13. THICKNESS: 350
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE ROSS, C.A., & TYRELL, JR., W.W, 1965, JOURNAL OF PALEONTOLOGY, V. 39, P. 615-635. GILULLY ET AL., 1954, U.S.G.S. PROFESSIONAL PAPER 266.
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PART OF NACO GROUP. ROSS (1973) INDICATES SEVERAL DIASTEMS WITHIN THE HORQUILLA. THESE HAVE NOT BEEN OBSERVED BY OTHER WORKERS

REFERENCES:
19. ORIGINAL REFERENCE: { GILLULY, JAMES, COOPER, J.R., AND WILLIAMS, J.S. 1954 LATE PALEOZOIC STRATIGRAPHY OF CENTRAL COCHISE COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, 49 P.
20. SIGNIFICANT REFERENCE: { ROSS, C.A., AND TYRELL, JR., W.W. 1965 JOURNAL OF PALEONTOLOGY, V. 39, P. 615-635
21. AUTHOR (S): R.A. KNEPP
22. DATE: 4/30/81

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IDENTIFICATION:
1. RECORD NUMBER: 12862
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: EARP FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PENNSYLVANIAN AND PERMIAN
SERIES/STAGE UPPER AND LOWER (VIRGILIAN - WOLFCAMPIAN)
11. BOUNDING UNITS:
ABOVE - COLINA LIMESTONE
BELOW - HORQUILLA LIMESTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - SILTSTONE, SANDSTONE 70%
SUBORDINATE LITHOLOGY - LIMESTONE, MARL 30%
13. THICKNESS: 260
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: GILULLY, ET AL., 1954, U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266. ROSS, C.A., AND TYRRELL, JR., W.W., 1965, JOURNAL OF PALEONTOLOGY, V. 39, P. 615-635
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: FORMS PART OF THE NACO GROUP. IN WESTERN AND NORTHERN PORTIONS OF DEPOSITIONAL BASIN, FORMATION IS MARKED BY A 1-5M THICK CONGLOMERATE, USUALLY OF RED CHERT PEBBLES, LIMESTONE AND SANDSTONE CLASTS, OR LIMESTONE PEBBLES, A BRAIDED STREAM DEPOSIT.

REFERENCES:
19. ORIGINAL REFERENCE: { GILLULY, JAMES, COOPER, J.R., AND WILLIAMS, J.S. 1954 LATE PALEOZOIC STRATIGRAPHY OF CENTRAL COCHISE COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, 49 P.
20. SIGNIFICANT REFERENCE: { ROSS, CA, & TYRRELL, W.W. JR, 1965 JOURNAL OF PALEONTOLOGY, V. 39, P. 615-635.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 4/28/81

****

IDENTIFICATION:
1. RECORD NUMBER: 12863
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: COLINA LIMESTONE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (WOLFCAMPIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - EPITAPH DOLOMITE
BELOW - EARP FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE 95%
13. THICKNESS: 200
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: SEE GILULY, ET AL., 1954, U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266.
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PART OF NACO GROUP. OVERLYING EPITAPH DOLOMITE IS PROBABLY DOLOMITIC FACIES OF COLINA LIMESTONE

REFERENCES:
19. ORIGINAL REFERENCE: { GILLULY, JAMES, COOPER, J.R., AND WILLIAMS, J.S. 1954 LATE PALEOZOIC STRATIGRAPHY OF CENTRAL COCHISE COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, 49 P.
20. SIGNIFICANT REFERENCE: { BUTLER, W.C. 1971 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 9, P. 71-94
21. AUTHOR (S): R.A. KNEPP
22. DATE: 4/27/81

****

IDENTIFICATION:
1. RECORD NUMBER: 12864
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: EPITAPH DOLOMITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (LEONARDIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - SCHERRER FORMATION
BELOW - COLINA LIMESTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - DOLOMITE 90%
SUBORDINATE LITHOLOGY - LIMESTONE/SHALE 10%
13. THICKNESS: 275-350
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: COMPOSITA MEXICANA (HALL), OMPHALOTROCHUS OBTUSISPIRA (SHUMARD). GILLULY, ET AL., 1954, U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PART OF NACO GROUP. THE EPITAPH IS SOMETIMES ABSENT, AT WHICH PLACES THE SCHERRER RESTS CONFORMABLY ON THE COLINA. THE EPITAPH IS VERY LIKELY REPRESENTATIVE OF A DOLOMITIC FACIES OF THE COLINA LIMESTONE

REFERENCES:
19. ORIGINAL REFERENCE: { GILLULY, JAMES, COOPER, J.R., AND WILLIAMS, J.S. 1954 LATE PALEOZOIC STRATIGRAPHY OF CENTRAL COCHISE COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, 49 P.
20. SIGNIFICANT REFERENCE: NONE
21. AUTHOR (S): R.A. KNEPP
22. DATE: 4/27/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12865
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: SCHERRER FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (LEONARDIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - CONCHA LIMESTONE
BELOW - EPITAPH DOLOMITE
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
SUBORDINATE LITHOLOGY - LIMESTONE/SILTSTONE
13. THICKNESS: 150-200
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: ECHINOID SPINES COMPRISE ONLY FAUNA, PROBABLY PERMOCIDARIS SP.
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PART OF NACO GROUP, PRESUMED TO BE A LATERAL EQUIVALENT OF THE COCONINO SANDSTONE OF THE COLORADO PLATEAU AREA.

REFERENCES:
19. ORIGINAL REFERENCE: { GILLULY, JAMES, COOPER, J.R., AND WILLIAMS, J.S. 1954 LATE PALEOZOIC STRATIGRAPHY OF CENTRAL COCHISE COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, 49 P.
20. SIGNIFICANT REFERENCE: { LUEPKE, GRETCHEN 1971 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 9, P. 245-257
21. AUTHOR (S): R.A. KNEPP
22. DATE: 4/28/81

****

IDENTIFICATION:
1. RECORD NUMBER: 12866
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME -
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: CONCHA LIMESTONE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (GUADALUPIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - RAINVALLEY FORMATION
BELOW - SCHERRER FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE 95%
13. THICKNESS: 200
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: BRACHIOPODS. SEE GILLULEY ET AL., 1954, U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266. ALSO GASTROPODS, PELECYPODS, AND FUSULINIDS
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PART OF NACO GROUP. BRYANT AND MCCLYMONDS (1961) PROPOSED A NEW TYPE SECTION, AS THAT OF GILLULY ET AL. WAS INCOMPLETE. USUALLY CORRELATED WITH THE LOWER KAIBAB LIMESTONE AND TOROWEAP FORMATION OF THE COLORADO PLATEAU

REFERENCES:
19. ORIGINAL REFERENCE: { GILLULY, JAMES, COOPER, J.R., AND WILLIAMS, J.S. 1954 LATE PALEOZOIC STRATIGRAPHY OF CENTRAL COCHISE COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, 49 P.
20. SIGNIFICANT REFERENCE: { BRYANT, D.L., AND MCCLYMONDS, N.E. 1961 AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS BULLETIN, V. 45, P. 1324-1333
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/13/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12867
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: RAINVALLEY FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (GUADALUPIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - ANGULAR UNCONFORMITY
BELOW - CONCHA LIMESTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE 97%
SUBORDINATE LITHOLOGY - SANDSTONE 3 %
13. THICKNESS: 60
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: DICTYOCLOSTUS BASSI (MCKEE), CHONETES SP., AVONIA SP., COMPOSITA SP., HUSKDIA SP., PUNCTOSPIRIFER SP., DIELASMA SP., AVICULOPECLEN SP., ACANTHOPECTEN SP.. BRYANT AND MCCLYMONDS, 1961
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PART OF THE NACO GROUP. THE NAME WAS ORIGINALLY PROPOSED IN AN UNPUBLISHED PH.D. THESIS (D.L. BRYANT, 1955, UNIVERSITY OF ARIZONA). CONSIDERED EQUIVALENT OF THE KAIBAB FORMATION OF THE COLORADO PLATEAU

REFERENCES:
19. ORIGINAL REFERENCE: { BRYANT, D.L., AND MCCLYMONDS, N.E. 1961 PERMIAN CONCHA LIMESTONE AND RAINVALLEY FORMATION, SOUTHEASTERN ARIZONA: BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, V. 45, P. 1324-1333.
20. SIGNIFICANT REFERENCE: { BUTLER, W.C. 1971 ARIZONA GEOLOGICAL SOCIETY DIGEST, V 9, P. 71-94.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 4/27/1981

IDENTIFICATION:
1. RECORD NUMBER: 12868
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MOUNT WRIGHTSON FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMAL
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - GARDNER CANYON FORMATION
BELOW - PALEOZOIC STRATA
12. LITHOLOGY:
DOMINANT LITHOLOGY - ANDESITE AND RHYOLITE FLOWS 80%
SUBORDINATE LITHOLOGY - SANDSTONE AND CONGLOMERATE 20%
13. THICKNESS: 2900
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 220+-30 M.Y. LEAD-ALPH OR ZIRCONS T.W. STERN (IN DREWES, 1968, USGS BULLETIN 1274-C, P. C-7)
17. ECONOMIC DATA: NONE
18. OTHER DATA: INTRUDED BY MONZONITE WITH LEAD-ALPHA AGE OF 184 M.Y. +-. SANDSTONES PETROGRAPHICALLY AND LITHOLOGICALLY SIMILAR TO EOLIAN SANDSTONES OF COLORADO PLATEAU. CORRELATED WITH OX FRAME VOLCANICS OF SIERRITA MOUNTAINS.

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HARALD 1968 NEW AND REVISED STRATIGRAPHIC NAMES IN THE SANTA RITA MOUNTAINS OF SOUTHEASTERN ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 1274-C, 15 P.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 658-C, 81 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/14/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12869
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: PIPER GULCH MONZONITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - MONZONITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 184+-20 M.Y. LEAD-ALPHA, ZIRCON MARVIN AND OTHERS, 1973, USGS BULL 1379,
17. ECONOMIC DATA: NONE
18. OTHER DATA: MONZONITE TO SYENODIORITE. INTRUDES MT. WRIGHTSON FM, INTRUDED BY SQUAW GULCH GRANITE. PROBABLY A STOCK (DESIGNATED TRIASSIC BY DREWES, 1971)

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HARALD 1968 NEW AND REVISED STRATIGRAPHIC NAMES IN THE SANTA RITA MOUNTAINS OF SOUTHEASTERN ARIZONA: US GEOLOGICAL SURVEY BULLETIN 1274-C, 15 P.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1976 US GEOLOGICAL SURVEY PROFESSIONAL PAPER 915, 75 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/22/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12870
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GARDNER CANYON FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE LOWER-MIDDLE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - "CANELO HILLS VOLCANICS"
BELOW - MT. WRIGHTSON FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SILTSTONES/MUDSTONES 90%
SUBORDINATE LITHOLOGY - CONGLOMERATES & VOLCANICS 10%
13. THICKNESS: 350
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: UNIDENTIFIABLE PLANT FOSSILS IN UPPER MUDSTONES (DREWES, 1971)
16. RADIOMETRIC DATA: 190 +- 20 170 +- 35 210 +- 30 LEAD ALPHA, ZIRCON (DREWES, 1971)
17. ECONOMIC DATA: NONE
18. OTHER DATA: CORRELATED WITH LOWER CANELO HILLS VOLCANICS. INCLUDES INTERCALATED DACETIC TUFFS AND SOME RHYOLITIC BODIES. ALSO INCLUDES BLOCKS OF EXOTIC LETHOLOGIES, AS DOES LOWER CANELO HILLS VOLCANICS TO THE SOUTH

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HARALD 1968 NEW AND REVISED STRATIGRAPHIC NAMES IN THE SANTA RITA MOUNTAINS OF SOUTHEASTERN ARIZONA: US GEOLOGICAL SURVEY BULLETIN 1274-C, 15 P.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 US GEOLOGICAL SURVEY PROFESSIONAL PAPER 658-C, 81 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/22/1981

IDENTIFICATION:
1. RECORD NUMBER: 12871
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: "CANELO HILLS VOLCANICS"
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL (MAY BE INCORRECTLY USED)
9. AGE:
SYSTEM JURASSIC
SERIES/STAGE MIDDLE (AALENIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - TEMPORAL FORMATION
BELOW - GARDNER CANYON FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE 70%
SUBORDINATE LITHOLOGY - TUFF 30%
13. THICKNESS: 200
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 144 +- 6 M.Y. (K-AR, BIOTITE), 144 +- 11 (RB-SR, WHOLE ROCK), WELDED TUFFS. 165 +- 6 (K-AR, BIOTITE), WELDED TUFF. 173 +- 8 (K-AR BIOTITE), RHYOLITE TUFF. MARVIN ETAL, (1973) USGS BULL 1379
17. ECONOMIC DATA: NONE
18. OTHER DATA: THIS EXPOSURE APPARENTLY CORRELATES WITH THE UPPERMOST PORTION OF THE CANELO HILLS VOLCANICS AS EXPOSED TO THE SOUTHEAST OF THE COLUMN. THE FORMATION IN THE SANTA RITA MOUNTAINS HAS NOT BEEN SEPARATED FROM THE CANELO HILLS AS OF THIS DATE.

REFERENCES:
19. ORIGINAL REFERENCE: { HAYES, P.T., SIMONS, F.S., AND RAUP, R.B. 1965 LOWER MESOZOIC EXTRUSIVE ROCKS IN SOUTHEASTERN ARIZONA - THE CANELO HILLS VOLCANICS: U.S. GEOLOGICAL SURVEY BULLETIN 1194-M, 9 P.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 U.S. GEOLOGICAL SOCIETY PROFESSIONAL PAPER 658-C.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/14/1981

IDENTIFICATION:
1. RECORD NUMBER: AA BD
   COLUMN RECORDS RANGE: 12853 - 1289
2. LOCATION:
   LAT 32 N
   LONG 111 W
   STATE ARIZONA
   STAPI CODE - 02
   COUNTY - PIMA SANTA CRUZ
   COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
   PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: SQUAW GULCH GRANITE
8. STRATIGRAPHIC RANK AND STATUS:
   FORMATION
   FORMAL
9. AGE:
   SYSTEM JURASSIC
   SERIES/STAGE UPPER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
   ABOVE -
   BELOW -
12. LITHOLOGY:
   DOMINANT LITHOLOGY - GRANITOIDS
   SUBORDINATE LITHOLOGY - APLITE, LAMPROPHYRE
14. MAJOR UNCONFORMITIES:
   DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 145 +- 6 K-AR, BIOTITE (160 +- 20, LEAD-ALPHA, ZIRCON)
   MARVIN AND OTHERS, 1973, US GEOLOGICAL SURVEY BULLETIN 1379, P. 15
17. ECONOMIC DATA: NONE
18. OTHER DATA: THIS EXPOSURE APPARENTLY CORRELATES WITH THE UPPERMOST PORTION OF THE CANELO HILLS VOLCANICS AS EXPOSED TO THE SOUTHEAST OF THE COLUMN. THE FORMATION IN THE SANTA RITA MOUNTAINS HAS NOT BEEN SEPARATED FROM THE CANELO HILLS AS OF THIS DATE.

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HARALD 1968 NEW AND REVISED STRATIGRAPHIC NAMES IN THE SANTA RITA MOUNTAINS OF SOUTHEASTERN ARIZONA: US GEOLOGICAL SURVEY BULLETIN 1274-C.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1976 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 915, 75 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/18/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12873
   COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
   LAT 32 N
   LONG 111 W
   STATE ARIZONA
   STAPI CODE - 02
   COUNTY - PIMA SANTA CRUZ
   COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
   PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: TEMPORAL FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
   FORMATION
   FORMAL
9. AGE:
   SYSTEM CRETACEOUS
   SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
   ABOVE - BOOTHTUB FORMATION
   BELOW -
12. LITHOLOGY:
   DOMINANT LITHOLOGY - VOLCANICS 70%
   SUBORDINATE LITHOLOGY - SANDSTONE AND CONGLOMERATE 30%
13. THICKNESS: 325-650
14. MAJOR UNCONFORMITIES:
   ANGULAR UNCONFORMITY BELOW
   DISCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 180+-20 M.Y. LEAD-ALPHA M ZIRCON FROM WELDED TUFF. STERN, T.W., IN DREWES, 1971, P. C-34. DREWES DISCOUNTS THIS AGE AS ZENOLITHIC.
17. ECONOMIC DATA: NONE
18. OTHER DATA: CONSISTS OF RHYOLITIC TO ANDESITIC VOLCANIC UNITS (FLOWS, BRECCIAS, AND TUFFS) WITH SOME CONGLOMERATE AND SANDSTONE NEAR THE CENTER.

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HARALD 1968 NEW AND REVISED STRATIGRAPHIC NAMES IN THE SANTA RITA MOUNTAINS OF SOUTHEASTERN ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 1274-C, 15 P.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 U.S.G.S. PROFESSIONAL PAPER 658-C
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/14/1981

IDENTIFICATION:
1. RECORD NUMBER: 12874
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BATHTUB FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - BISBEE GROUP
BELOW - TEMPORAL FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - VOLCANICS 70%
SUBORDINATE LITHOLOGY - SANDSTONE AND CONGLOMERATE 30%
13. THICKNESS: 500-700
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: LOWER PORTION CONSISTS OF STRONGLY LENTICULAR CONGLOMERATES AND SANDSTONES. OVERLAIN BY RHYOLITIC TO ANDESITIC FLOWS, BRECCIAS, AND TUFFS WITH A CAP OF DACITIC VOLCANICS AND SUBORDINATE RHYODACITE TUFFS. MAY INTERCALATE WITH GLANCE CONGLOMERATE.

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HARALD 1968 NEW AND REVISED STRATIGRAPHIC NAMES IN THE SANTA RITA MOUNTAINS OF SOUTHEASTERN ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 1274-C, 15 P.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 658-C, 81 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/14/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12875
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BISBEE GROUP
8. STRATIGRAPHIC RANK AND STATUS:
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER (APTIAN-ALBIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - FORT CRITTENDEN FORMATION
BELOW - BATHTUB FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - CLASTIC SEDIMENTS
SUBORDINATE LITHOLOGY - RARE LIMESTONES
13. THICKNESS: 2000-3000
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: SEE INDIVIDUAL UNITS
16. RADIOMETRIC DATA: SEE GLANCE CONGLOMERATE
17. ECONOMIC DATA: NONE
18. OTHER DATA: TWO DIFFERENT NOMENCLATURAL SCHEMES EXIST, AND CAUSE SOME CONFUSION. IS CORRELATED WITH AMOLE ARKOSE NEAR TUCSON AND ANGELICA ARKOSE FARTHER WEST

REFERENCES:
19. ORIGINAL REFERENCE: { DUMBLE, E.T. 1902 NOTES ON THE GEOLOGY OF SOUTHEASTERN ARIZONA: AMERICAN INSTITUTE OF MINING ENGINEERS, TRANSACTIONS, VOL. 31, P. 696-715
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 US GEOLOGICAL SOCIETY PROFESSIONAL PAPER 658-C, 81 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/12/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12876
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GLANCE CONGLOMERATE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER (APTIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - WILLOW CANYON FORMATION
BELOW - VARIABLE FORMATIONS OF BISBEE GP
12. LITHOLOGY:
DOMINANT LITHOLOGY - CONGLOMERATE/BRECCIA 95%
SUBORDINATE LITHOLOGY - SANDSTONE 5 %
13. THICKNESS: 0-1000
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 220+-35 M.Y. LEAD-ALPHA, ZIRCON, ANDESITE UNIT MARVIN & OTHERS, 1973, USGS BULLETIN 1379. AGE CONSIDERED SPURIOUS BY HAYES (P. 19)
17. ECONOMIC DATA: NONE
18. OTHER DATA: MEMBER OF BISBEE GROUP. ALLUVIAL FAN DEPOSITS ASSOCIATED WITH VERTICAL DISPLACEMENTS. AS SUCH, THE PETROLOGY OF THE CLASTS IN THE CONGLOMERATE IS STRONGLY CONTROLLED BY THE LOCAL PALEOSUBSTRATE. THINS TOWARD SOUTH (EMPIRE MTNS.)

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 THE GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGLE, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 21, 168 P.
20. SIGNIFICANT REFERENCE: NONE
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/12/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12877
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: WILLOW CANYON FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER (APTIAN/ALBIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - APACHE CANYON FORMATION
BELOW - GLANCE CONGLOMERATE
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE 90%
SUBORDINATE LITHOLOGY - SILTSTONE 10%
13. THICKNESS: 700
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: MACTRA SP., OSTREA SP., CORBICULA SP., THRACIA SP., NUCULAVA SP., AND TELLINA SP. (DREWES, 1971, P. C49-C50). VIVIPARUS SP. (FINNELL, T.L., 1970, U.S.G.S. BULL. 1294-A, P. A31)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: MEMBER OF BISBEE GROUP, CORRELATED WITH THE CINTURA FORMATION OF THE MULE MOUNTAINS. GRADATIONAL WITH AND APPEARS TO INTERTONGUE WITH THE UNDERLYING GLANCE CONGLOMERATE. ARKOSIC SANDSTONES, SILTSTONES, AND SOME LIMESTONE LENSES. *

REFERENCES:
19. ORIGINAL REFERENCE: { TYRELL, W.W., JR. 1957 GEOLOGY OF THE WHETSTONE MOUNTAIN AREA, COCHISE AND PIMA COUNTIES, ARIZONA: UNPUB. PH.D. DISS., YALE UNIVERSITY. DISSERTATION ABSTRACTS V. 25, P. 3516 (1964)
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 658-C.
21. AUTHOR (S): R.A. KNEPP
22. DATE:

****

IDENTIFICATION:
1. RECORD NUMBER: 12878
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: APACHE CANYON FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER (APTIAN/ALBIAN)
11. BOUNDING UNITS:
ABOVE - SHELLENBERGER CANYON FORMATION
BELOW - WILLOW CANYON FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SILTSTONE 75%
SUBORDINATE LITHOLOGY - SANDSTONE 25%
13. THICKNESS: 450-650
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NERIDOMUS SP., NERITA SP., MERETRIX SP., TRANSENELLA SP. (DREWES, 1971, P. C-51).
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: MEMBER OF BISBEE GROUP, PROBABLY A LATERAL EQUIVALENT OF THE MORITA FORMATION. INTERTONGUES WITH GLANCE CONGLOMERATE IN PART, ACCORDING TO FINNELL (1970, USGS BULLETIN 1294A, P. A30)

REFERENCES:
19. ORIGINAL REFERENCE: { TYRELL, W.W., JR. 1957 GEOLOGY OF THE WHETSTONE MOUNTAIN AREA, COCHISE AND PIMA COUNTIES, ARIZONA: UNPUBLISHED PH.D. DISSERTATION, YALE UNIVERSITY. DISSERTATION ABSTRACTS V. 25, P. 3516 (1964)
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 US GEOLOGICAL SURVEY PROFESSIONAL PAPER 658-C.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/12/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12879
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: SHELLENBERGER CANYON FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER (ALBIAN)
11. BOUNDING UNITS:
ABOVE - TURNEY RANCH FORMATION
BELOW - APACHE CANYON FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SHALE 50%
SUBORDINATE LITHOLOGY - SILTSTONE 50%
13. THICKNESS: 525
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: TRIGONIA SP. (FINNELL, T.L., 1968, USGS BULLETIN 1294A, P. A33) MACTRA SP., ASTRACODS, PETRIFIED WOOD (SCHAFROTH, D.W., 1968, ARIZONA GEOLOGICAL SOCIETY GUIDEBOOK TO SOUTHERN ARIZONA III, P. 59-67)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: MEMBER OF BISBEE GROUP. NOTE VARIATIONS IN SPELLING, INCLUDING "SCHELLENBURG," "SCHELLENBURGER," AND "SCHELLENBURGER CANYON." SHELLENBERGER CANYON FORMATION APPEARS TO BE PREFERRED BY U.S.G.S. MUCH THICKER IN EMPIRE MTS. (UP TO 1400M) *

REFERENCES:
19. ORIGINAL REFERENCE: { TYRELL, W.W., JR. 1957 GEOLOGY OF THE WHETSTONE MOUNTAIN AREA, COCHISE AND PIMA COUNTIES, ARIZONA: UNPUBLISHED PH.D. DISSERTATION, YALE UNIVERSITY. DISSERTATION ABSTRACTS, V. 25, P. 3516 (1964)
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 658-C
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/12/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12880
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME:
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: TURNEY RANCH FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER (ALBIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - FORT CRITTENDEN FORMATION
BELOW - SHELLENBERGER CANYON FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - MUDSTONE/SILTSTONE 80%
SUBORDINATE LITHOLOGY - SANDSTONE 20%
13. THICKNESS: 500
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
15. FOSSIL DATA: FRAGMENTS OF CLAMS AND GASTROPODS AND PETRIFIED WOOD (DREWES, 1971, P. C53)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: THICKNESS EXCEEDS 1000M IN EMPIRE AND WHETSTONE MOUNTAINS. SANDSTONES TYPICALLY ARKOSIC. DREWES (1971) BELIEVES THE FORMATION TO HAVE BEEN DEPOSITED IN A LAGOONAL OR ESTUARINE ENVIRONMENT.

REFERENCES:
19. ORIGINAL REFERENCE: { TYRELL, W.W., JR. 1957 GEOLOGY OF THE WHETSTONE MOUNTAIN AREA, COCHISE AND PIMA COUNTIES, ARIZONA: UNPUBLISHED PH.D. DISSERTATION, YALE UNIVERSITY. DISSERTATION ABSTRACTS, V. 25, P. 3516 (1964)
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 658-C.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/12/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12881
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: FORT CRITTENDEN FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE UPPER (SANTONIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - SALERO FORMATION
BELOW - BISBEE GROUP
12. LITHOLOGY:
DOMINANT LITHOLOGY - CONGLOMERATE 90%
SUBORDINATE LITHOLOGY - SHALE/SILTSTONE/SANDSTONE 10%
13. THICKNESS: 1600
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: UNIO SP., VIVIPARUS SP, PHYSA SP., VERTEBRATE REMAINS, AND NUMEROUS OTHER MOLLUSCANS (DREWES, 1971, P. C63-C64)
16. RADIOMETRIC DATA: 260+-30 MY LEAD-ALPHA ON ZIRCON (FROM RHYOLITE TUFF) (MARVIN AND OTHERS, USGS BULLETIN 1379). TOO OLD ACCORDING TO DREWES (1971)
17. ECONOMIC DATA: NONE
18. OTHER DATA: SHALES AT BASE (ABOUT 550 FEET) FOLLOWED BY UP TO 4500 FEET OF CONGLOMERATES AND SANDSTONES, CAPPED BY A THIN RHYOLITE TUFF. ACCORDING TO DREWES (1971), THIS TUFF IS THE OLDEST LARAMIDE-AGE VOLCANIC UNIT IN THE REGION

REFERENCES:
19. ORIGINAL REFERENCE: { STOYANOW, A.A. 1936 G.S.A. PROCEEDINGS, 1936, P. 296. LOWER CRETACEOUS STRATIGRAPHY IN EASTERN ARIZONA: G.S.A. MEMOIR 38, P. 1-169 (1949)
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 US GEOLOGICAL SURVEY PROFESSIONAL PAPER 658-C.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/14/1981

IDENTIFICATION:
1. RECORD NUMBER: 12882
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: SALERO FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SERIES/STAGE UPPER (MAASTRICHTIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - GRINGO GULCH VOLCANICS
BELOW - FORT CRITTENDEN FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - VOLCANICS 75%
SUBORDINATE LITHOLOGY - ARKOSIC SANDSTONE 25%
13. THICKNESS: 2200
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 72.5+-3.3 M.Y. K-AR (BIOTITE), RHYODACITE WELDED TUFF
MARVIN AND OTHERS, 1973, U.S. GEOLOGICAL SURVEY BULLETIN 1379.
17. ECONOMIC DATA: NONE
18. OTHER DATA: INTRUDED BY "VERY LATE CRETACEOUS" ROCKS (HAYES, 1970, USGS PROF. PAPER 658-B, P. B17). DACITIC AND RHYODACITIC FLOWS, TUFFS, AND BRECCIAS, GRADES LATERALLY INTO ARKOSIC SANDSTONES AT MANY LOCALITIES

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HARALD 1968 NEW AND REVISED STRATIGRAPHY IN THE SANTA RITA MOUNTAINS, SOUTHEASTERN ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 1274-C, 15 P.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1971 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 658-C
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/14/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12883
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: JOSEPHINE CANYON DIORITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE UPPER (MAASTRICHTIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - DIORITE
SUBORDINATE LITHOLOGY - SYENODIORITE, QUARTZ DIORITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 67+-3 (K-AR, BIOTITE), 60+-10 (LEAD-ALPHA, ZIRCON)
MARVIN AND OTHERS, 1973, US GEOLOGICAL SURVEY BULLETIN 1379, P. 15.
17. ECONOMIC DATA: NONE
18. OTHER DATA: DIORITE, SYENODIORITE, QUARTZ DIORITE, AND RARE QUARTZ MONZONITE. MAINLY FORMS A SERIES OF SMALL STOCKS. INTRUDES SALERO FORMATION, UNCONFORMABLY OVERLAIN BY GRINGO GULCH VOLCANICS

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HARALD 1968 NEW AND REVISED STRATIGRAPHIC NAMES IN THE SANTA RITA MOUNTAINS OF SOUTHEASTERN ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 1274-C, 15 P.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1976 US GEOLOGICAL SURVEY PROFESSIONAL PAPER 915, 75 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/20/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12884
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MADERA CANYON GRANODIORITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE UPPER (MAASTRICHTIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRANODIORITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 67.9+-2.1 (K-AR) P.E. DAMON IN DREWES (1976, P. 47)
17. ECONOMIC DATA: NONE
18. OTHER DATA: CONSIDERED YOUNGER THAN JOSEPHINE CANYON DIORITE AND OLDER THAN ELEPHANT HEAD QUARTZ MONZONITE

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HARALD 1968 NEW AND REVISED STRATIGRAPHIC NAMES IN THE SANTA RITA MOUNTAINS OF SOUTHEASTERN ARIZONA: US GEOLOGICAL SURVEY BULLETIN 1274-C, 15 P.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1976 US GEOLOGICAL SURVEY PROFESSIONAL PAPER 915, 75 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/20/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12885
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART:
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: ELEPHANT HEAD QUARTZ MONZONITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE UPPER (MAASTRICHTIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - QUARTZ MONZONITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 68.2+-3.0 K-AR, BIOTITE (190+-30, LEAD-ALPHA) MARVIN AND OTHERS, 1973, US GEOLOGICAL SURVEY BULLETIN 1379, P. 15
17. ECONOMIC DATA: NONE
18. OTHER DATA: INTRUDES SALERO FORMATION. CONSISTS OF TWO STOCKS. COULD CONCEIVABLY BE JURASSIC BASED ON LEAD-ALPHA AGES. GEOLOGICAL RELATIONSHIPS INDICATE THAT IT IS LATEST CRETACEOUS

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HARALD 1968 NEW AND REVISED STRATIGRAPHIC NAMES IN THE SANTA RITA MOUNTAINS OF SOUTHEASTERN ARIZONA: US GEOLOGICAL SURVEY BULLETIN 1274-C, 15 P.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1976 US GEOLOGICAL SURVEY PROFESSIONAL PAPER 915, 75 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/20/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12886
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GRINGO GULCH VOLCANICS
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE PALEOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - PANTANO FORMATION
BELOW - SALERO FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - VOLCANICS
SUBORDINATE LITHOLOGY - SANDSTONE
13. THICKNESS: 550
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 60.4+-4.2 (K-AR, HORNBLENDE, DACITE PORPHYRY), 60+- (K-AR, BIOTITE, MICROGRANODIORITE). MARVIN & OTHERS, 1973, US GEOLOGICAL SURVEY BULLETIN 1379, P. 14)
17. ECONOMIC DATA: NONE
18. OTHER DATA: INTRUDED BY "VERY LATE CRETACEOUS" ROCKS (HAYES, 1970, USGS PROF. PAPER 658-B, P. B17). DACITIC AND RHYODACITIC FLOWS, TUFFS, AND BRECCIAS, GRADES LATERALLY INTO ARKOSIC SANDSTONES AT MANY LOCALITIES

REFERENCES:
19. ORIGINAL REFERENCE: { DREWES, HARALD 1968 NEW AND REVISED STRATIGRAPHIC NAMES IN THE SANTA RITA MOUNTAINS OF SOUTHEASTERN ARIZONA: US GEOLOGICAL SURVEY BULLETIN 1274-C, 15 P.
20. SIGNIFICANT REFERENCE: { DREWES, HARALD 1972 US GEOLOGICAL SURVEY PROFESSIONAL PAPER 746, 66 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/21/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12887
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: PANTANO FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE EOCENE AND OLIGOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - RILLITO FORMATION
BELOW - VARIED
12. LITHOLOGY:
DOMINANT LITHOLOGY - CONGLOMERATES
SUBORDINATE LITHOLOGY - SILTSTONES, SANDSTONES
13. THICKNESS: 1700-3300
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 38.9+-1.5 K-AR ON INTERCALATED TUFF. MARVIN AND OTHERS, 1973, U.S.G.S. BULLETIN 1379.
17. ECONOMIC DATA: NONE
18. OTHER DATA: TILTED AT ANGLES OF UP TO 30DEG.-40DEG., WIDELY DISTRIBUTED IN RANGES AND TO SOME EXTENT IN BASINS.

REFERENCES:
19. ORIGINAL REFERENCE: { BRENNAN, D.J. 1962 TERTIARY SEDIMENTARY ROCKS AND STRUCTURES OF THE CRENIGA GAP AREA, PIMA COUNTY, ARIZONA: ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 5, P. 4557
20. SIGNIFICANT REFERENCE: { PASHLEY, E.F. 1966 PH. D DISSERTATION (UNPUBLISHED) UNIVERSITY OF ARIZONA, TUCSON
21. AUTHOR (S): R.A. KNEPP
22. DATE: 5/22/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12888
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: RILLITO ANDESITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION FORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE EOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - ANDESITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 38.5+-1.3 M.Y K/AR BIKEMAN AND DAMON, 1966, GSA BULLETIN, V. 77, P. 1227-1234
17. ECONOMIC DATA: NONE
18. OTHER DATA: OLDEST POST-LARAMIDE VOLCANICS IN THE AREA. CONTAINS LARGE FELDSPAR AND BIOTITE PHENOCREPTS. INTERCALATED WITH PANTANO SEDIMENTARY ROCKS.

REFERENCES:
19. ORIGINAL REFERENCE: { BROWN, W.H. 1939 TUCSON MOUNTAINS, AN ARIZONA BASIN RANGE TYPE: GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 50, P. 697-760.
20. SIGNIFICANT REFERENCE: { EBERLY, LD, AND TB STANLEY 1978 GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 89, P. 921-940.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/18/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12889
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MID-TERTIARY VOLCANICS GROUP
8. STRATIGRAPHIC RANK AND STATUS: GROUP INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE OLIGOCENE/MIOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE -
BELOW - INTERCALATES WITH PANTANO FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - ASH FLOWS
SUBORDINATE LITHOLOGY - ANDESITES/BASALTIC ANDESITES
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: RARE PLANT FOSSILS AND VERTEBRATE FOSSILS IN INCLUDED SEDIMENTARY BODIES. SEE DAMON AND MILLER, 1963, ARIZONA ACADEMY OF SCIENCE JOURNAL, V. 2, P. 117-119. AND H. DREWES, USGS PROF. PAPER 746, P. 29, 32, 41.
16. RADIOMETRIC DATA: 32 M.Y. TO 16 M.Y. MANY PUBLISHED DATES AND METHODS, SEE BIBLIOGRAPHY IN SHAFIGULLAH AND OTHERS (1978).
17. ECONOMIC DATA: NONE
18. OTHER DATA: CONSISTS OF FOUR STAGES OF VOLCANISM: OLDER ASH FLOWS, "TURKEY-HACK" ANDESITES, ASH FLOWS, AND YOUNGER BASALTIC ANDESITES. ALWAYS INTERCALATED WITH FANGLOMERATES AND FLUVIDACUSHINE SEDIMENTARY STRATA.

REFERENCES:
19. ORIGINAL REFERENCE: { DAMON, P.E. (COORDINATOR) 1964 ANNUAL PROGRESS REPORT C00-689-42, CONTRACT AT(11-1)-689, U.S. ATOMIC ENERGY COMMISSION: TUCSON, GEOCHRONOLOGY LABS, UNIVERSITY OF ARIZONA.
20. SIGNIFICANT REFERENCE: { M. SHAFIQULLAH AND OTHERS 1978 NEW MEXICO GEOLOGICAL SOCIETY GUIDEBOOK 29, P. 231-241.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/22/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12890
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: OLDER ASH FLOWS
8. STRATIGRAPHIC RANK AND STATUS: FORMATION INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE OLIGOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - "TURKEY-TRACK ANDESITES"
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - VOLCANICS
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: ABOUT 32 TO 30 M.Y., VARIOUS AGES
17. ECONOMIC DATA: NONE
18. OTHER DATA: INCLUDES SUCH UNITS AS THE PANTANO TUFF AND SAFFORD TUFF (BIKERMAN AND DAMON, 1966, G.S.A. BULLETIN, V. 77, P. 1275-1234.) INTERCALATES WITH PANTANO FORMATION, GRADES INTO "TURKEY TRACK" ANDESITE

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL USAGE
20. SIGNIFICANT REFERENCE: { BIKERMAN AND DAMON 1966 GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 77, P. 1225-1234
21. AUTHOR (S): KNEPP
22. DATE: 6/22/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12891
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: "TURKEY-TRACK" ANDESITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE OLIGOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - ASH FLOWS
BELOW - OLDER ASH FLOWS
12. LITHOLOGY:
DOMINANT LITHOLOGY - ANDESITE PORPHYRY
SUBORDINATE LITHOLOGY - PORPHYRITIC ANDESITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: AGES RANGE FROM 30 M.Y.A. TO 26 M.Y.A.
17. ECONOMIC DATA: NONE
18. OTHER DATA: THIS REPRESENTS A WIDESPREAD GROUP OF SIMILAR FLOWS, ALL OF WHICH BEAR DISTINCTIVE PLAGIOCLASE PHENOCREPTS. OCCURS AS FLOWS, DIKES, OR SILLS, INTERCALATED WITH SEDIMENTS AND USUALLY ALSO WITH ASH FLOWS

REFERENCES:
19. ORIGINAL REFERENCE: { COOPER, JR 1961 ARIZONA GEOLOGICAL SOCIETY DIGEST, V. 4, P. 17-33.
20. SIGNIFICANT REFERENCE: { M. SHAFIQULLAH AND OTHERS 1978 NEW MEXICO GEOLOGICAL SOCIETY GUIDEBOOK 29, P. 231-241.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/22/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12892
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: ASH FLOWS
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE OLIGOCENE & MIOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE -
BELOW - "TURKEY-TRACK" ANDESITES
12. LITHOLOGY:
DOMINANT LITHOLOGY - RHYOLITIC & ANDESITIC TUFFS
SUBORDINATE LITHOLOGY - RHYOLITIC AND ANDESITIC FLOWS
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 26 M.Y. TO ABOUT 22 M.Y.
17. ECONOMIC DATA: NONE
18. OTHER DATA: THESE STRATA REPRESENT THE "IGNIMBRITE FLARE-UP" OF CONEY (1976). INCLUDES PROBABLE MAJOR CALDERAS IN THE GALIUO AND CHIRICAHUA MOUNTAINS, WITH ASSOCIATED SUBVOLCANIC PLUTONISM AT THESE SITES.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL USAGE
20. SIGNIFICANT REFERENCE: { CONEY, PJ 1976 NEW MEXICO GEOLOGICAL SOCIETY SPECIAL PUBLICATION NO. 6, P. 5-10.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/22/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12893
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: YOUNGER BASALTIC ANDESITES
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - BASALTIC ANDESITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 22 M.Y. TO 16 M.Y.
17. ECONOMIC DATA: NONE
18. OTHER DATA: LAST STAGES OF "MID-TERTIARY OROGENY." INTERCALATES WITH RILLITO FORMATION, YOUNGER AGE LIMIT APPROXIMATES END OF "SEVERE" VOLCANISM.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL USAGE
20. SIGNIFICANT REFERENCE: { EBERLY AND STANLEY 1978 GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 89, P. 921-940.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/22/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12894
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART:
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: RILLITO FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - BASIN FILL
BELOW - PANTANO FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - CONGLOMERATE
SUBORDINATE LITHOLOGY - SANDSTONE, MUDSTONE
13. THICKNESS: 1500
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
ANGULAR UNCONFORMITY BELOW
DISCONFORMITY WITHIN
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: SEE 18 (OTHER DATA)
17. ECONOMIC DATA: NONE
18. OTHER DATA: USUALLY LESS DEFORMED THAN THE PANTANO FORMATION, BUT MORE DEFORMED THAN THE FLAT-LYING BASIN FILL. CONTAINS CLASTS OF 22 M.Y. OLD IGNEOUS ROCKS, OVERLAIN BY 10-13 M.Y. OLD BASALT/RHYOLITE FLOWS

REFERENCES:
19. ORIGINAL REFERENCE: { PASHLEY, E.F. 1966 STRUCTURE AND STRATIGRAPHY OF CENTRAL, NORTHERN, AND EASTERN PARTS OF THE TUCSON BASIN, ARIZONA: UNIVERSITY OF ARIZONA, TUCSON, UNPUB. PH.D. DISSERTATION, 173 P.
20. SIGNIFICANT REFERENCE: { DAVIDSON, ES 1973 US GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1939-E (REFERS TO "TINAJA BEDS")
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/18/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12895
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: RHYOLITIC VOLCANICS
8. STRATIGRAPHIC RANK AND STATUS: FORMATION INFORMAL
9. AGE:
SYSTEM TERTIARY
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY -
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: INTERCALATED WITH ALLUVIAL FAN AND LACUSTRINE DEPOSITS OF THE BASIN FILL. PART OF A "BIMODAL BASALT-RHYOLITE" SUITE OF VOLCANICS ASSOCIATED WITH THE BASIN AND RANGE DISTURBANCE

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL USAGE
20. SIGNIFICANT REFERENCE: { EBERLY AND STANLEY 1978 GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 89, P. 921-940.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/22/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12896
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: FORT LOWELL FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TERTIARY AND QUATERNARY
SERIES/STAGE PLIOCENE & PLEISTOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - STREAM DEPOSITS & TERRACE GRAVELS
BELOW - VARIABLE
12. LITHOLOGY:
DOMINANT LITHOLOGY - SAND 80%
SUBORDINATE LITHOLOGY - GRAVEL 20%
13. THICKNESS: 0-120
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
DISCONFORMITY ABOVE
15. FOSSIL DATA: POSSIBLE VERTEBRATE PUNA - SEE LANCE (19
GEOLOGICAL SOCIETY DIGEST, V. 3, P. 155-159
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: EQUIVALENT TO UPPER PORTION OF BASIN FILL. WHERE NAMED, FORT LOWELL USUALLY OVERLIES THE PEDIMENT WITHOUT INTERVENING UNITS, I.E. FORT LOWELL FORMATION IS NOT DEFINED IN THE DEEP FORTIONS OF THE BASINS

REFERENCES:
19. ORIGINAL REFERENCE: { DAVIDSON, E.S. 1973 GEOHYDROLOGY AND WATER RESOURCES OF THE TUCSON BASIN, ARIZONA: U.S. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1939-E, 81 P.
20. SIGNIFICANT REFERENCE: { DAVIDSON, 1973 PASHLEY, E.F., 1966, UNPUB. PH.D. DISSERTATION, UNIVERSI
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/19/1981

IDENTIFICATION:
1. RECORD NUMBER: 12897
COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
LAT 32 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - PIMA SANTA CRUZ
COAPI CODE - 019 023
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BASIN FILL
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION INFORMAL
9. AGE:
SYSTEM TERTIARY QUATERNARY
SERIES/STAGE MIOCENE-PLIOCENE
11. BOUNDING UNITS:
ABOVE - RECENT ALLUVIUM, ETC.
BELOW - RILLITO FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - CONGLOMERATES
SUBORDINATE LITHOLOGY - SANDSTONE, SILTSTONE
13. THICKNESS: 2000
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
DISCONFORMITY ABOVE
15. FOSSIL DATA: VERTEBRATE FAUNA, SOME PLANT FOSSILS, FRESH-WATER INVERTEBRATES
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: FLAT-LYING STRATA ASSOCIATED WITH BASIN AND RANGE UPLIFTS. AGE RANGE FROM APPROXIMATELY 10-13 M.Y.A. TO PLEISTOCENE AND/OR RECENT.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { EBERLY AND STANLEY 1978 GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 89, P. 921-940
21. AUTHOR (S): R.A. KNEPP
22. DATE: 9/15/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12898
   COLUMN RECORDS RANGE: 12853 - 12898
2. LOCATION:
   LAT 32 N
   LONG 111 W
   STATE ARIZONA
   STAPI CODE - 02
   COUNTY - PIMA SANTA CRUZ
   COAPI CODE -
3. CSD PROVINCE NUMBER 475
   PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: SONOITA AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 03

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: STREAM AND TERRACE DEPOSITS
8. STRATIGRAPHIC RANK AND STATUS: FORMATION INFORMAL
9. AGE:
   SYSTEM QUATERNARY
   SERIES/STAGE PLEISTOCENE & HOLOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
   ABOVE -
   BELOW - BASIN FILL
12. LITHOLOGY:
   DOMINANT LITHOLOGY - GRAVEL
   SUBORDINATE LITHOLOGY - SAND
13. THICKNESS: 35
14. MAJOR UNCONFORMITIES:
   DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { NONE
20. SIGNIFICANT REFERENCE: { MELTON, M.A. 1965 JOURNAL OF GEOLOGY, V. 73, P. 1-38.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 6/18/1981

****

COLUMN NUMBER: 4

IDENTIFICATION:
1. RECORD NUMBER: 12922
   COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
   LAT 32 N
   LONG 109 W
   STATE NEW MEXICO
   STAPI CODE - 30
   COUNTY - HIDALGO
   COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
   PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: PRECAMBRIAN GRANITE
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
   ERA PRECAMBRIAN
   SERIES/STAGE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
   ABOVE - BLISS FORMATION
   BELOW -
12. LITHOLOGY:
   DOMINANT LITHOLOGY -
13. THICKNESS: 107
14. MAJOR UNCONFORMITIES:
   DISCONFORMITY ABOVE
   DISCONFORMITY BELOW
15. FOSSIL DATA: EOORTHIS SP., SKOLITHOS
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: CORRELATES TO BOLSA QUARTZITE IN ARIZONA. THERE IS A LOCALLY PROMINENT BASAL CONGLOMERATE WITHIN THE BLISS FM. IN THIS AREA.

REFERENCES:
19. ORIGINAL REFERENCE: {
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): WRIGHT
22. DATE: 1980

****

IDENTIFICATION:
1. RECORD NUMBER: 12921
   COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
   LAT 32 N
   LONG 109 W
   STATE NEW MEXICO
   STAPI CODE - 30
   COUNTY - HIDALGO
   COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
   PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BLISS FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
   FORMATION
   FORMAL
9. AGE:
   SYSTEM CAMBRIAN-ORDOVICIAN
   SERIES/STAGE UPPER-LOWER (TREMPEALEAUAN-CANADIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
   ABOVE - EL PASO FORMATION
   BELOW - PRECAMBRIAN GRANITE
12. LITHOLOGY:
   DOMINANT LITHOLOGY - SANDSTONE & ARKOSE GRADING INTO
   SUBORDINATE LITHOLOGY - DOLOMITE
13. THICKNESS: 59-107
14. MAJOR UNCONFORMITIES:
   DISCONFORMITY BELOW
15. FOSSIL DATA: EOORTHIS SP., SKOLITHOS
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: CORRELATES TO BOLSA QUARTZITE IN ARIZONA. THERE IS A LOCALLY PROMINENT BASAL CONGLOMERATE WITHIN THE BLISS FM. IN THIS AREA.

REFERENCES:
19. ORIGINAL REFERENCE: { G.B. RICHARDSON 1904 UNIVERSITY OF TEXAS, MINERAL SURVEY BULLETIN 9
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12920
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: EL PASO FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM ORDOVICIAN
SERIES/STAGE LOWER (CANADIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - MONTOYA FORMATION
BELOW - BLISS FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
SUBORDINATE LITHOLOGY - DOLOMITE (UPPER BEDS ONLY)
13. THICKNESS: 279-326
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: FAUNAL LIST IN NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES MEMOIR 16
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { G.B. RICHARDSON 1904 UNIVERSITY OF TEXAS, MINERAL SURVEY BULLETIN 9
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12919
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: CABLE CANYON MEMBER OF MONTOYA FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
MEMBER
FORMAL
9. AGE:
SYSTEM ORDOVICIAN
SERIES/STAGE UPPER (CHAMPLAINIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - UPHAM MEMBER
BELOW - EL PASO FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
13. THICKNESS: 3-6
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE ZELLER (1965)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: MEMBERS OF MONTOYA ARE OF INSUFFICIENT THICKNESS TO WARRANT FORMATIONAL RANK SO THEY ARE DESIGNATED AS MEMBERS OF THE MONTOYA FORMATION IN THE BIG HATCHET MOUNTAINS AREA. BASAL SAND PROBABLY CORRELATES WITH HARDING SANDSTONE OF COLORADO.

REFERENCES:
19. ORIGINAL REFERENCE: { V.C. KELLEY AND C. SILVER 1952 UNIVERSITY OF NEW MEXICO PUBLICATION, GEOLOGY SERIES, NO. 4.
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16.
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12918
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: UPHAM MEMBER OF MONTOYA FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
MEMBER
FORMAL
9. AGE:
SYSTEM ORDOVICIAN
SERIES/STAGE UPPER
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - ALEMAN MEMBER
BELOW - CABLE CANYON MEMBER
12. LITHOLOGY:
DOMINANT LITHOLOGY - DOLOMITE
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: SEE ZELLER (1965)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { V.C. KELLEY AND C. SILVER 1952 UNIVERSITY OF NEW MEXICO PUBLICATION, GEOLOGY SERIES, NO. 4, P. 59-60.
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12917
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: ALEMAN MEMBER OF MONTOYA FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
MEMBER
FORMAL
9. AGE:
SYSTEM ORDOVICIAN
SERIES/STAGE UPPER
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - CUTTER MEMBER
BELOW - UPHAM MEMBER
12. LITHOLOGY:
DOMINANT LITHOLOGY - DOLOMITE
SUBORDINATE LITHOLOGY - CHERT
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE ZELLER (1965)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { V.C. KELLEY AND C. SILVER 1952 UNIVERSITY OF NEW MEXICO PUBLICATION, GEOLOGY SERIES, NO. 4, P. 60-62.
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12916
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: CUTTER MEMBER OF MONTOYA FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
MEMBER
FORMAL
9. AGE:
SYSTEM ORDOVICIAN
SERIES/STAGE UPPER (CINCINNATIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - PERCHA SHALE
BELOW - ALEMAN MEMBER
12. LITHOLOGY:
DOMINANT LITHOLOGY - SHALE
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: SEE ZELLER (1965)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { V.C. KELLEY AND C. SILVER 1952 UNIVERSITY OF NEW MEXICO PUBLICATION, GEOLOGY SERIES, NO. 4, P. 62-64.
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12915
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: PERCHA SHALE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM DEVONIAN
SERIES/STAGE UPPER (FRASNIAN-FAMENNIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - ESCABROSA GROUP
BELOW - MONTOYA FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - MUDSTONE
SUBORDINATE LITHOLOGY - LIMESTONE
13. THICKNESS: 85
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE ZELLER (1965)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { C.H. GORDON 1907 AMERICAN JOURNAL OF SCIENCE, 4TH SERIES, V. 24, P. 58-64
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12914
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: KEATING FORMATION OF ESCABROSA GROUP
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CARBONIFEROUS
SERIES/STAGE MISSISSIPPIAN (KINDERHOOKIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - HACHITA FM. OF ESCABROSA GROUP
BELOW - PERCHA FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
SUBORDINATE LITHOLOGY - CHERT
13. THICKNESS: 385
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE ZELLER (1965)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: MAY CORRELATE WITH REDWALL FORMATION (ARIZONA), LEADVILLE LIMESTONE (COLORADO), AND MADISON LIMESTONE--MAY CORRELATE IN PART WITH THE LAKE VALLEY FORMATION.

REFERENCES:
19. ORIGINAL REFERENCE: { A.K. ARMSTRONG 1962 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12913
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: HACHITA FORMATION OF ESCABROSA GROUP
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CARBONIFEROUS
SERIES/STAGE MISSISSIPPIAN (MERAMECIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - PARADISE FORMATION
BELOW - KEATING FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE ZELLER (1965)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { A.K. ARMSTRONG 1962 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 8
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12912
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: PARADISE FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CARBONIFEROUS
SERIES/STAGE UPPER (CHESTERIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - HORQUILLA FORMATION
BELOW - ESCABROSA GROUP
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
SUBORDINATE LITHOLOGY - SANDSTONE
13. THICKNESS: 97
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: EXTENSIVE FAUNAL LIST IN ZELLER (1965, P. 29).
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PARADISE FORMATION MAY CORRELATE WITH THE HELMS FORMATION OF SOUTHEASTERN NEW MEXICO AND WEST TEXAS.

REFERENCES:
19. ORIGINAL REFERENCE: { A.A. STOVANOW 1926 AMERICAN JOURNAL OF SCIENCE, 5TH SERIES, V. 12, P. 316-320
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

****

IDENTIFICATION:
1. RECORD NUMBER: 12911
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: HORQUILLA FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CARBONIFEROUS-PERMIAN
SERIES/STAGE MORROWAN-WOLFCAMPIAN
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - EARP FORMATION
BELOW - PARADISE FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
SUBORDINATE LITHOLOGY - MUDSTONE
13. THICKNESS: 990-1080
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: EXTENSIVE FAUNAL LIST IN ZELLER (1965, P. 29).
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: UPPER PORTION GRADES FROM LIMESTONE IN THE NORTH TO MUDSTONE IN THE SOUTH. MASSIVE BIOHERMAL REEFS OCCUR IN THE UPPER HALF OF THE FORMATION (BIG HATCHET REEF).

REFERENCES:
19. ORIGINAL REFERENCE: { J. GILULY, J.R. COOPER, AND J.S. WILLIAMS 1954 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, P. 16-18.
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

****

IDENTIFICATION:
1. RECORD NUMBER: 12910
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: EARP FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (WOLFCAMPIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - COLINA LIMESTONE
BELOW - HORQUILLA FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - MUDSTONE
SUBORDINATE LITHOLOGY - SANDSTONE
13. THICKNESS: 304
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: WALCHIA PINIFORMIS (SCHLOTHEIM)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PROBABLE CORRELATION WITH SUPAI FORMATION OF ARIZONA--MAY ALSO REPRESENT A TONGUE OF THE ABO FORMATION.

REFERENCES:
19. ORIGINAL REFERENCE: { J. GILULY, J.R. COOPER, AND J.S. WILLIAMS 1954 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, P. 18-23
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12909
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: COLINA LIMESTONE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (LEONARDIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - EPITAPH DOLOMITE
BELOW - EARP FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
13. THICKNESS: 108-158
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: SEE ZELLER (1965)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { J. GILULY, J.R. COOPER, J.S. WILLIAMS 1954 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, P. 23-25, 38-41
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12908
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: EPITAPH DOLOMITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (LEONARDIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - SCHERRER FORMATION
BELOW - COLINA LIMESTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - DOLOMITE
SUBORDINATE LITHOLOGY - SHALE GYPSUM
13. THICKNESS: 451-463
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: SEE ZELLER (1965)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: EPITAPH DOLOMITE MAY REPRESENT IN PART A TONGUE OF THE SUPAI FORMATION. RED SHALE AND EVAPORITE ZONE MAY CORRELATE WITH THE YESO FORMATION ELSEWHERE IN NEW MEXICO.

REFERENCES:
19. ORIGINAL REFERENCE: { J. GILULY, J.R. COOPER, AND J.S. WILLIAMS 1954 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, P. 25-27, 41.
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16.
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

****

IDENTIFICATION:
1. RECORD NUMBER: 12907
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: SCHERRER FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (LEONARDIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - CONCHA FORMATION
BELOW - EPITAPH DOLOMITE
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
SUBORDINATE LITHOLOGY - LIMESTONE
13. THICKNESS: 2-6
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE ZELLER (1965)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: MAY CORRELATE WITH THE COCONINO SANDSTONE OF ARIZONA.

REFERENCES:
19. ORIGINAL REFERENCE: { J. GILULY, J.R. COOPER, AND J.S. WILLIAMS 1954 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 266, P. 27-29, 42
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

****

IDENTIFICATION:
1. RECORD NUMBER: 12906
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: CONCHA FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (LEONARDIAN-WOLFCAMPIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - HELL-TO-FINISH FORMATION
BELOW - SCHERRER FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
SUBORDINATE LITHOLOGY - CHERT
13. THICKNESS: 420
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
DISCONFORMITY ABOVE
15. FOSSIL DATA: SEE ZELLER (1965, P. 53-54)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PROBABLE CORRELATION WITH KAIBAB LIMESTONE, THE "CHIRICAHUA" LIMESTONE, AND THE SAN ANDRES FORMATION.

REFERENCES:
19. ORIGINAL REFERENCE: { J. GILULY, J.R. COOPER, AND J.S. WILLIAMS 1954 U.S. GEOLOGICAL SURVEY BULLETIN 266, P. 29-30, 42-43
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

****

IDENTIFICATION:
1. RECORD NUMBER: 12905
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: HELL-TO-FINISH FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER (APTIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - U-BAR FORMATION
BELOW - CONCHA FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SHALE, MUDSTONE
SUBORDINATE LITHOLOGY - SILTSTONE, SANDSTONE
13. THICKNESS: 389
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: NOTHING DIAGNOSTIC. SEE ZELLER (1965).
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16.
20. SIGNIFICANT REFERENCE: { SAME AS ABOVE
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

****

IDENTIFICATION:
1. RECORD NUMBER: 12904
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: U-BAR FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER (APTIAN-ALBIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - MOJADO FORMATION
BELOW - HELL-TO-FINISH FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
SUBORDINATE LITHOLOGY - MUDSTONE
13. THICKNESS: 1070
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: FAUNAL LIST IN ZELLER (1965, P. 65)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: A MASSIVE REEF LIMESTONE (20 TO 500 FT) OCCURS NEAR THE TOP OF THIS FORMATION.

REFERENCES:
19. ORIGINAL REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16.
20. SIGNIFICANT REFERENCE: { SAME AS ABOVE
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

****

IDENTIFICATION:
1. RECORD NUMBER: 12903
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MOJADO FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CRETACEOUS
SERIES/STAGE LOWER (ALBIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - LITTLE HAT TOP FORMATION
BELOW - U-BAR FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE AND SHALE
13. THICKNESS: 1584
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
15. FOSSIL DATA: FAUNAL LIST IN ZELLER (1965, P. 69-72)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: CORRELATED WITH CRETACEOUS SANDSTONE AT SIERRA RICA, CINTURA FORMATION OF SOUTHEASTERN ARIZONA, JOHNNY BULL SANDSTONE IN THE PELONCILLO MOUNTAINS.

REFERENCES:
19. ORIGINAL REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
20. SIGNIFICANT REFERENCE: { SAME AS ABOVE
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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IDENTIFICATION:
1. RECORD NUMBER: 12902
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: LITTLE HAT TOP FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE OLIGOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - QUATERNARY ALLUVIUM
BELOW - MOJADO FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - CONGLOMERATE
13. THICKNESS: 0-92
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: {
20. SIGNIFICANT REFERENCE: {
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

****

IDENTIFICATION:
1. RECORD NUMBER: 12901
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GILLESPIE TUFF AND OTHER VOLCANICS
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE OLIGOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - UNNAMED BASALTS
BELOW - LITTLE HAT TOP FM.
12. LITHOLOGY:
DOMINANT LITHOLOGY -
13. THICKNESS: 0-732
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: {
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

****

IDENTIFICATION:
1. RECORD NUMBER: 12900
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: UNNAMED BASALTS
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - QUATERNARY SEDIMENTS
BELOW - GILLESPIE TUFF
12. LITHOLOGY:
DOMINANT LITHOLOGY - BASALT
13. THICKNESS: 0-150
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: {
20. SIGNIFICANT REFERENCE: {
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

****

IDENTIFICATION:
1. RECORD NUMBER: 12899
COLUMN RECORDS RANGE: 12899 - 12922
2. LOCATION:
LAT 32 N
LONG 109 W
STATE NEW MEXICO
STAPI CODE - 30
COUNTY - HIDALGO
COAPI CODE - 023
3. CSD PROVINCE NUMBER 470
PROVINCE NAME - PEDREGOSA BASIN
4. COLUMN NAME: BIG HACHET MOUNTAIN AREA
5. COSUNA CHART: SSMC
6. COLUMN NUMBER: 4

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: QUATERNARY ALLUVIUM
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
SYSTEM QUATERNARY
SERIES/STAGE PLEISTOCENE-HOLOCENE (UPPER PLEISTOCENE)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE -
BELOW - LITTLE HAT TOP FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SAND
13. THICKNESS: 0-183
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: {
20. SIGNIFICANT REFERENCE: { R.A. ZELLER 1965 NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, MEMOIR 16
21. AUTHOR (S): J. WRIGHT & S. THOMPSON III
22. DATE: 1980

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COLUMN NUMBER: 5

IDENTIFICATION:
1. RECORD NUMBER: 12950
   COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
   LAT 35 N
   LONG 111 W
   STATE ARIZONA
   STAPI CODE - 02
   COUNTY - YAVAPAI
   COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
   PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: ASH CREEK GROUP
8. STRATIGRAPHIC RANK AND STATUS:
   FORMAL
9. AGE:
   ERA PRECAMBRIAN
   SERIES/STAGE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
   ABOVE - VARIABLE
   BELOW -
12. LITHOLOGY:
   DOMINANT LITHOLOGY - META-VOLCANICS
   SUBORDINATE LITHOLOGY - META-SEDIMENTS
14. MAJOR UNCONFORMITIES:
   ANGULAR UNCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 1820+-10 M.Y. U-PB(ZIRCON)QTZ PORPHYRY IN DECEPTION RHYOLITE (L.T. SILVER, IN ANDERSON, C.A., AND OTHERS, 1971, USGS BULL 1374-C)
17. ECONOMIC DATA: NONE
18. OTHER DATA: INFORMALLY RENAMED.

REFERENCES:
19. ORIGINAL REFERENCE: { C.A. ANDERSON AND S.C. CREASEY 1958 GEOLOGY AND ORE DEPOSITS OF THE JEROME AREA, YAVAPAI COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P.
20. SIGNIFICANT REFERENCE: { C.A ANDERSON AND J.T. NASH 1972 ECONOMIC GEOLOGY, V. 67, P. 845-863.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 9/14/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12949
   COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
   LAT 35 N
   LONG 111 W
   STATE ARIZONA
   STAPI CODE - 02
   COUNTY - YAVAPAI
   COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
   PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GADDES BASALT
8. STRATIGRAPHIC RANK AND STATUS:
   FORMATION
   FORMAL
9. AGE:
   ERA PRECAMBRIAN
   SERIES/STAGE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
   ABOVE - BUZZARD RHYOLITE
   BELOW -
12. LITHOLOGY:
   DOMINANT LITHOLOGY - BASALT
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { ANDERSON, C.A., AND S.C. CREASEY 1958 GEOLOGY AND ORE DEPOSITS OF THE JEROME AREA, YAVAPAI COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P
20. SIGNIFICANT REFERENCE: {
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/29/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12948
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BUZZARD RHYOLITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
ERA PRECAMBRIAN
SERIES/STAGE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - SHEA BASALT
BELOW - GADDES BASALT
12. LITHOLOGY:
DOMINANT LITHOLOGY - RHYOLITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { ANDERSON, C.A., AND S.C. CREASEY 1958 GEOLOGY AND ORE DEPOSITS OF THE JEROME AREA, YAVAPAI COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P.
20. SIGNIFICANT REFERENCE: {
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/29/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12947
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: SHEA BASALT
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
ERA PRECAMBRIAN
SERIES/STAGE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - DECEPTION RHYOLITE
BELOW - BUZZARD RHYOLITE
12. LITHOLOGY:
DOMINANT LITHOLOGY - BASALT
SUBORDINATE LITHOLOGY - ANDESITE AND DACITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: FLOWS AND INTERBEDDED TUFFS, FLOWS WITH DIABASIC TEXTURE

REFERENCES:
19. ORIGINAL REFERENCE: { ANDERSON, C.A., AND S.C. CREASEY 1958 GEOLOGY AND ORE DEPOSITS OF THE JEROME AREA, YAVAPAI COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P.
20. SIGNIFICANT REFERENCE: { CA ANDERSON & SC CREASEY 1958 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7-29-1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12946
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT:
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
ERA PRECAMBRIAN
SERIES/STAGE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - GRAPEVINE GULCH FORMATION
BELOW - SHEA BASALT
12. LITHOLOGY:
DOMINANT LITHOLOGY -
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 1820+-10 M.Y. U-PB (ZIRCON), QUARTZ PORPHYRY L.T. SILVER, IN ANDERSON, C.A., AND OTHERS (1971), U.S.G.S. BULLETIN 1374-C.
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { ANDERSON, C.A., AND CREASEY, S.C. 1958 GEOLOGY AND ORE DEPOSITS OF THE JEROME AREA, YAVAPAI COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P.
20. SIGNIFICANT REFERENCE: { ANDERSON, C.A., AND J.T. NASH 1972 ECONOMIC GEOLOGY, V. 67, P. 845-863.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/29/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12945
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: GRAPEVINE GULCH FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
ERA PRECAMBRIAN
SERIES/STAGE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE -
BELOW - DECEPTION RHYOLITE
12. LITHOLOGY:
DOMINANT LITHOLOGY -
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 1820 M.Y. PB-PB (GALENA) LIVINGSTON, D.E., AND P.E. DAMON, 1968, CANADIAN JOURNAL OF EARTH SCIENCES V. 5, P. 763-772.
17. ECONOMIC DATA: NONE
18. OTHER DATA: NONE

REFERENCES:
19. ORIGINAL REFERENCE: { ANDERSON, C.A., AND S.C. CREASEY 1958 GEOLOGY AND ORE DEPOSITS OF THE JEROME AREA, YAVAPAI COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P.
20. SIGNIFICANT REFERENCE: { ANDERSON, C.A., AND J.T. NASH 1972 ECONOMIC GEOLOGY, V. 67, P. 845-863.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/29/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12944
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BRADY BUTTE GRANODIORITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
ERA PRECAMBRIAN
SERIES/STAGE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRANODIORITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 1770+-10 M.Y. U-PB (ZIRCON) L.T. SILVER, IN ANDERSON, C.A., AND OTHERS, 1971, U.S.G.S. BULLETIN 1374-C
17. ECONOMIC DATA: NONE
18. OTHER DATA: IN SOME AREAS, THE BASAL PALEOZOIC SANDSTONE IS ONLY NOMINALLY OF CAMBRIAN AGE, AND HAS BEEN THOUGHT TO BE MORE LIKELY A LOWER MEMBER OF THE MARTIN FORMATION. IT IS USUALLY SEPARATED FROM THE MARTIN BY A THIN CONGLOMERATE.

REFERENCES:
19. ORIGINAL REFERENCE: { ANDERSON, C.A., AND S.C. CREASEY 1958 GEOLOGY AND ORE DEPOSITS OF THE JEROME AREA, YOVAPAI COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P.
20. SIGNIFICANT REFERENCE: { C.A. ANDERSON AND S.C. CREASEY 1958 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7-29-1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12943
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME -
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: QUARTZ DIORITE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
9. AGE:
ERA PRECAMBRIAN
SERIES/STAGE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - QUARTZ DIORITE
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 1760+-15 U-PB (ZIRCON) L.T. SILVER, IN ANDERSON, C.A., AND OTHERS (1971) U.S.G.S. BULLETIN 1374-C
17. ECONOMIC DATA: NONE
18. OTHER DATA: IN SOME AREAS, THE BASAL PALEOZOIC SANDSTONE IS ONLY NOMINALLY OF CAMBRIAN AGE, AND HAS BEEN THOUGHT TO BE MORE LIKELY A LOWER MEMBER OF THE MARTIN FORMATION.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL NAME
20. SIGNIFICANT REFERENCE: { C.A. ANDERSON AND S.C. CREASEY 1958 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7-29-1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12942
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: TAPEATS SANDSTONE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM CAMBRIAN
SERIES/STAGE MIDDLE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - MARTIN FORMATION
BELOW - PRECAMBRIAN STRATA
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
SUBORDINATE LITHOLOGY - SHALE
13. THICKNESS: 6
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
DISCONFORMITY ABOVE
15. FOSSIL DATA: WORM TUBES (SCOLITHOS AND/OR COROPHIOIDES TYPE) REPORTED IN M.H. KRIEGER (1965), U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 467, P. 53.
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: IN SOME AREAS, THE BASAL PALEOZOIC SANDSTONE IS ONLY NOMINALLY OF CAMBRIAN AGE, AND HAS BEEN THOUGHT TO BE MORE LIKELY A LOWER MEMBER OF THE MARTIN FORMATION.

REFERENCES:
19. ORIGINAL REFERENCE: { NOBLE, L.F. 1914 THE SHINUMO QUADRANGLE, GRAND CANYON DISTRICT, ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 549, 100 P.
20. SIGNIFICANT REFERENCE: { KRIEGER, M.H. 1965 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 467, 127 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/30/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12941
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MARTIN FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM DEVONIAN
SERIES/STAGE UPPER (FRASNIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - REDWALL LIMESTONE
BELOW - TAPEATS SANDSTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE 85%
SUBORDINATE LITHOLOGY - MUDSTONE & SANDSTONE
13. THICKNESS: 160
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE TEICHERT (1965, P. 55-66)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: THE MARTIN HAS BEEN DIVIDED INTO A JEROME MEMBER (UPPER) AND THE BECKERS BUTTE SANDSTONE MEMBER (LOWER).

REFERENCES:
19. ORIGINAL REFERENCE: { RANSOME, F.L. 1904 THE GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGL
20. SIGNIFICANT REFERENCE: { TEICHERT, CURT 1965 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 464, 181 P.
{ HEREFORD, RICHARD (1977) GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 82, P. 199-211.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/30/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12940
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: REDWALL LIMESTONE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM MISSISSIPPIAN
SERIES/STAGE (OSAGEAN - MERAMECIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - SUPAI FORMATION, NACO FORMATION
BELOW - MARTIN FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
13. THICKNESS: 80
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE MCKEE AND GUTSCHICK (1969, P. 125-552).
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: WHERE IT IS THICKER, THE REDWALL LIMESTONE HAS BEEN SUBDIVIDED INTO FOUR MEMBERS, HOWEVER THE VERDE VALLEY AREA IS APPARENTLY EROSIONALLY AND DEPOSITIONALLY THINNED SO THAT ONLY A FRACTION OF THE TIME IS REPRESENTED.

REFERENCES:
19. ORIGINAL REFERENCE: { GILBERT, G.K. 1875 REPORT ON THE GEOLOGY OF PORTIONS OF NEW MEXICO AND ARIZONA: U.S. GEOGRAPHY AND GEOLOGY SURVEYS WEST OF THE 100TH MERIDIAN, V. 3, P. 21-187.
20. SIGNIFICANT REFERENCE: { MCKEE, E.D., AND GUTSCHICK, R.C. 1969 G.S.A. MEMOIR 114, 726 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/30/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12939
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY -
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: NACO FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PENNSYLVANIAN
SERIES/STAGE (ATOKAN AND DEMOINESIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - SUPAI FORMATION
BELOW - REDWALL LIMESTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - SILTSTONE
SUBORDINATE LITHOLOGY - SHALE, LIMESTONE
13. THICKNESS: 0-135
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: COELENTERATES, BRACHIOPODS, MOLLUSCANS, AND CRINOIDS. WELL-DOCUMENTED FUSULINID CHRONOLOGY. SEE BREW (1979) AND BREW AND BEUS (1976, JOURNAL OF PALEONTOLOGY, V. 50, P. 888-906).
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: THE NACO FORMATION IS RECOGNIZED ONLY AT THE EASTERN EXTREMITIES OF THE VERDE VALLEY AREA.

REFERENCES:
19. ORIGINAL REFERENCE: { F.L. RANSOME 1904 THE GEOLOGY AND ORE DEPOSITS OF THE BISBEE QUADRANGLE, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 21, 168 P.
20. SIGNIFICANT REFERENCE: { BREW, D.C. 1979 AMERICAN GEOLOGICAL INSTITUTE SELECTED GUIDEBOOKS SERIES NO. 2, P. 119-125.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/30/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12938
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: SUPAI FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMAL
9. AGE:
SYSTEM PENNSYLVANIAN AND PERMIAN
SERIES/STAGE (DESMOINESIAN-WOLFCAMPIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - SCHNEBLY HILL FORMATION
BELOW - NACO FORMATION OR REDWALL LIMESTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
SUBORDINATE LITHOLOGY - CONGLOMERATE-MUDSTONE-LIMESTONE
13. THICKNESS: 300
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY WITHIN
15. FOSSIL DATA: SEE WINTERS (1963) GEOLOGICAL SOCIETY OF AMERICA MEMOIR 89.
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: TYPE SUPAI FORMATION, GEOLOGICAL SOCIETY OF AMERICA MEMOIR 89.

REFERENCES:
19. ORIGINAL REFERENCE: { DARTON, N.H. 1910 A RECONNAISSANCE OF PARTS OF NORTHWESTERN NEW MEXICO AND NORTHERN ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 435, 88 P.
20. SIGNIFICANT REFERENCE: { D.L. BAARS, 1962, AM. ASSOC. PET. GEOL. BULL., V. 46, P. 149-218 { R.C. BLAKEY, 1979, AM. GEOL. INST., SEL. GUIDEBOOKS SER.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7-30-1981

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IDENTIFICATION:
1. RECORD NUMBER: 12937
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: SCHNEBLY HILL FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION, INFORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (WOLFCAMPIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - COCONINO SANDSTONE
BELOW - SUPAI FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
SUBORDINATE LITHOLOGY - SILTSTONE
13. THICKNESS: 260-320
14. MAJOR UNCONFORMITIES:
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: THE SCHNEBLY HILL FORMATION INCLUDES THE STRATA YOUNGER THAN THE SUPAI GROUP IN THE GRAND CANYON AREA (SEE BAARS, 1962, AAPG BULLETIN)

REFERENCES:
19. ORIGINAL REFERENCE: { BLAKEY, R.C. 1979 LOWER PERMIAN STRATIGRAPHY OF THE SOUTHERN COLORADO PLATEAU: IN BAARS, D.L., ED., PERMIANLAND: FOUR CORNERS GEOLOGICAL SOCIETY GUIDEBOOK, V. 9, P. 115-129.
20. SIGNIFICANT REFERENCE: { BLAKEY, R.C. 1980 ROCKY MTN. SECTION SOC. ECON. PALEONTOLOGISTS & MINER
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/31/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12936
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: FORT APACHE MEMBER
8. STRATIGRAPHIC RANK AND STATUS:
MEMBER
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
13. THICKNESS: 0-3
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: LEONARDIAN MARINE INVERTEBRATES
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: ORIGINALLY WITHIN SUPAI FORMATION

REFERENCES:
19. ORIGINAL REFERENCE: { STOYANAW, A.A. 1936 GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 47, P. 533-536.
20. SIGNIFICANT REFERENCE: { GERRARD, T.A. 1969 FOAR CORNERS GEOLOGICAL SOCIETY GUIDEBOOK 5, P. 174-180.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8/4/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12935
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME:
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: COCONINO SANDSTONE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER (LEONARDIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - TOROWEAP FORMATION/KAIBAB LIMESTONE
BELOW - SCHNEBLY HILL FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE 95%
13. THICKNESS: 150-210
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: TRACE FOSSILS ONLY
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: MAY INTERTONGUE WITH UNDERLYING SCHNEBLY HILL TO SOME EXTENT

REFERENCES:
19. ORIGINAL REFERENCE: { N.H. DARTON 1910 A RECONNAISSANCE OF PARTS OF NORTHWESTERN NEW MEXICO AND NORTHERN ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 435, 88 P.
20. SIGNIFICANT REFERENCE: {
21. AUTHOR (S): R.A. KNEPP
22. DATE: 9/15/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12934
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: TOROWEAP FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER-UPPER (LEONARDIAN)
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - KAIBAB LIMESTONE
BELOW - COCONINO SANDSTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - SANDSTONE
SUBORDINATE LITHOLOGY - LIMESTONE
13. THICKNESS: 50-100
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
15. FOSSIL DATA: MCKEE (1938): MOLLUSCAN, BRACHIOPODS, CORALS. SEE ALSO KIRKLAND (1962, UNIV. NEW MEXICO UNPUB MS THESIS) AND BUES AND BREED (1968, PLATEAU, V. 40, N. 4)
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: THE TOROWEAP FORMATION IS DISTINGUISHABLE FROM THE COCONINO SANDSTONE ONLY IN THE NORTHERN AND WESTERN PORTIONS OF THE STUDY AREA, ELSEWHERE IT CONSISTS ONLY OF SANDSTONES MUCH LIKE THE COCONINO.

REFERENCES:
19. ORIGINAL REFERENCE: { MCKEE, E.D. 1938 THE ENVIRONMENT AND HISTORY OF THE TOROWEAP AND KAIBAB FORMATIONS OF NORTHERN ARIZONA AND SOUTHERN UTAH: CARNEGIE INSTITUTE OF WASHINGTON PUBLICATION 492, 268 P.
20. SIGNIFICANT REFERENCE: { MCKEE, E.D., AND BREED, W. 1969 NEW MEXICO GEOLOGICAL SOCIETY SPECIAL PUBLICATION 3, P. 12-26
21. AUTHOR (S): R.A. KNEPP
22. DATE: 7/31/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12933
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: KAIBAB LIMESTONE
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM PERMIAN
SERIES/STAGE LOWER-UPPER (LEONARDIAN-GUADALUPIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - MOENKOPI FM TO RECENT
BELOW - TOROWEAP FM., COCONINO SS.
12. LITHOLOGY:
DOMINANT LITHOLOGY - LIMESTONE
SUBORDINATE LITHOLOGY - SANDSTONE
13. THICKNESS: 80-100
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
DISCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: CHARACTERISTICALLY SANDY LIMESTONE BEARING BEDDED CHERT. OFTEN INTERBEDDED WITH SANDSTONE

REFERENCES:
19. ORIGINAL REFERENCE: { DARTON, N.H. 1910 A RECONNAISSANCE OF PARTS OF NORTHWESTERN NEW MEXICO AND NORTHERN ARIZONA: U.S. GEOLOGICAL SURVEY BULLETIN 435, 88 P.
20. SIGNIFICANT REFERENCE: { MCKEE, E.D., AND BREED, W. 1969 NEW MEXICO GEOLOGICAL SOCIETY SPECIAL PUBLICATION 3, P. 12-26.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8/4/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12932
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: MOENKOPI FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TRIASSIC
SERIES/STAGE LOWER (SCYTHIAN)
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - TERTIARY BASALT FLOWS
BELOW - KAIBAB LIMESTONE
12. LITHOLOGY:
DOMINANT LITHOLOGY - SILTSTONE & MUDSTONE 75%
SUBORDINATE LITHOLOGY - SANDSTONE & CONGLOMERATE 25%
13. THICKNESS: 130
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: SEE STEWART AND OTHERS, 1972, P. 64-70
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: PRESERVED UNDER TERTIARY LAVA FLOWS ABOVE SYCAMORE CANYON (W.E. PRICE, 1949, PLATEAU, V. 21, NO. 4, P. 49-54). THIS IS THE ONLY EXPOSURE OF MOENKOPI ALONG THE MOGOLLON RIM.

REFERENCES:
19. ORIGINAL REFERENCE: { WARD, L.F. 1901 GEOLOGY OF THE LITTLE COLORADO VALLEY: AMERICAN JOURNAL OF SCIENCE, V. 12, P. 401-413.
20. SIGNIFICANT REFERENCE: { J.H. STEWART AND OTHERS 1972 U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 691, 195 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8/4/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12931
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME -
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: SQUAW PEAK GRANODIORITE
8. STRATIGRAPHIC RANK AND STATUS:
9. AGE:
SYSTEM TERTIARY
11. BOUNDING UNITS:
ABOVE -
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRANODIORITE
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: THE RIM GRAVELS ARE THE TOPOGRAPHICALLY HIGHEST CENOZOIC GRAVELS OF THE MOGOLLON RIM AREA. WHERE DATED, THEY HAVE A MAXIMUM AGE (FOR A CLAST) OF 54 M.Y. AND ARE OVERLAIN BY BASALTS OF 22 TO 28 M.Y. OF AGE.

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL NAME
20. SIGNIFICANT REFERENCE: { ROE, R.R. 1976 UNPUB M.S. THESIS, UNIVERSITY OF ARIZONA, TUCSON, ARIZONA, 102 P.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8/4/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12930
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: RIM GRAVELS
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE EOCENE OLIGOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - TERTIARY BASALTS OR SURFACE
BELOW - KAIBAB LS. OR SUPAI FM.
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRAVEL
13. THICKNESS: 0-20
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
DISCONFORMITY WITHIN
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: THE RIM GRAVELS ARE THE TOPOGRAPHICALLY HIGHEST CENOZOIC GRAVELS OF THE MOGOLLON RIM AREA. WHERE DATED, THEY HAVE A MAXIMUM AGE (FOR A CLAST) OF 54 M.Y. AND ARE OVERLAIN BY BASALTS OF 22 TO 28 M.Y. OF AGE.

REFERENCES:
19. ORIGINAL REFERENCE: { W.E. PRICE 1950 CENOZOIC GRAVELS ON THE RIM OF SYCAMORE CANYON, ARIZONA: GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 61, P. 501-507.
20. SIGNIFICANT REFERENCE: { PEIRCE, H.W., AND OTHERS (1979) TECTONOPHYSICS, V. 61, P. 1-24 MCKEE, E.D., AND MCKEE, E.H. (1972) GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 83, P. 1923-1931
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8/4/1981

****

IDENTIFICATION:
1. RECORD NUMBER: 12929
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: DRY BEAVER CREEK GRAVELS
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - HICKEY FM. OR SURFACE
BELOW - SUPAI FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRAVEL
13. THICKNESS: 0-200
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: THE HICKEY BASALTS ENCOMPASS THE TIME OF THE BASIN AND RANGE DISTURBANCE. AND ARE IN PART DEFORMED. THE ASSOCIATED GRAVELS CONSIST OF CLASTS OF ROCKS THAT RANGE IN AGE FROM PRECAMBRIAN TO EARLY HICKEY FLOWS.

REFERENCES:
19. ORIGINAL REFERENCE: { ANDERSON, C.A., AND CREASEY, S.C. 1958 GEOLOGY AND ORE DEPOSITS OF THE JEROME AREA, YAVAPAI COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P.
20. SIGNIFICANT REFERENCE: { PEIRCE, H.W., AND OTHERS 1979 TECTONOPHYSICS, V. 61, P. 1-24.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8-4-1981

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IDENTIFICATION:
1. RECORD NUMBER: 12928
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: HICKEY FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - VERDE FM TO SURFACE
BELOW - SUPAI FM, GRAVELS, ETC.
12. LITHOLOGY:
DOMINANT LITHOLOGY - BASALTIC VOLCANICS 60%
SUBORDINATE LITHOLOGY - CONGLOMERATE
13. THICKNESS: 0-500
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
ANGULAR UNCONFORMITY BELOW
DISCONFORMITY WITHIN
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: RANGE FROM 14.6 TO 9.7 K-AR (B+ OR WHOLE ROCK) BASALTS MCKEE, E.D., AND ANDERSON, C.A. (1971) GEOL. SOC. AMERICA BULL., V. 82, P. 2767-2782
17. ECONOMIC DATA: NONE
18. OTHER DATA: THE HICKEY BASALTS ENCOMPASS THE TIME OF THE BASIN AND RANGE DISTURBANCE. AND ARE IN PART DEFORMED. THE ASSOCIATED GRAVELS CONSIST OF CLASTS OF ROCKS THAT RANGE IN AGE FROM PRECAMBRIAN TO EARLY HICKEY FLOWS.

REFERENCES:
19. ORIGINAL REFERENCE: { ANDERSON, C.A., AND CREASEY, S.C. 1958 GEOLOGY AND ORE DEPOSITS OF THE JEROME AREA, YAVAPAI COUNTY, ARIZONA: U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 308, 185 P.
20. SIGNIFICANT REFERENCE: { EBERLY AND STANLEY 1978 GEOLOGICAL SOCIETY OF AMERICA BULLETIN, V. 89, P. 921-940.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8-4-1981
****

IDENTIFICATION:
1. RECORD NUMBER: 12927
COLUMN RECORDS RANGE: 12923 - 12950
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LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART:
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: UNNAMED GRAVELS
8. STRATIGRAPHIC RANK AND STATUS: BEDS,INFORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - TERTIARY VOLCANICS OR SURFACE
BELOW - USUALLY SUPAI FM.
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRAVEL
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY ABOVE
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: ORIGINALLY INCLUDED WITH GRAVELS OF DRY BEAVER CREEK BY TWENTER AND METZGER (1963, USGS BULL. 1177).

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { PEIRCE, H.W., AND OTHERS 1979 TECTONOPHYSICS, V. 61, P. 1-24
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8/5/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12926
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BASALT FLOW
8. STRATIGRAPHIC RANK AND STATUS:
BED
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE
11. BOUNDING UNITS:
ABOVE - VERDE FORMATION
BELOW - UNNAMED GRAVELS
12. LITHOLOGY:
DOMINANT LITHOLOGY - BASALT
SUBORDINATE LITHOLOGY - BASALTIC TUFF
14. MAJOR UNCONFORMITIES:
DISCONFORMITY ABOVE
DISCONFORMITY WITHIN
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 7.5 M.Y. D.F. ELSTON AND E.H. MCKEE, IN BRESSLER AND BUTLER (1978, P. 320)
17. ECONOMIC DATA: NONE
18. OTHER DATA: OCCURS WITH BASALTIC TUFFS. GIVES MAXIMUM AGE FOR DEPOSITION OF VERDE FORMATION

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { BRESSLER, S.L., AND R.F. BUTLER 1978 EARTH AND PLANETARY SCIENCE LETTERS, V. 38, P. 319-330
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8-5-1981

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IDENTIFICATION:
1. RECORD NUMBER: 12925
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: VERDE FORMATION
8. STRATIGRAPHIC RANK AND STATUS:
FORMATION
FORMAL
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE MIOCENE-PLIOCENE
10. SURFACE/SUBSURFACE DATA: BOTH
11. BOUNDING UNITS:
ABOVE - STREAM GRAVELS, ETC.
BELOW - HICKEY FM, SUPAI FM.
12. LITHOLOGY:
DOMINANT LITHOLOGY - MUDSTONE
SUBORDINATE LITHOLOGY - SANDSTONE, CGT, LIMESTONE, VOLCANICS
13. THICKNESS: 600
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
DISCONFORMITY ABOVE
15. FOSSIL DATA: INVERTEBRATES (MOLLUSCANS AND OSTRACODES), VERTEBRATES (REPTILE AND MAMMAL), AND PLANTS (J.D. NATIONS, G.S. AMERICA ROCKY MTN. SECTION MTG, FLAGSTAFF, ARIZ, 1974, P. 611-629)
16. RADIOMETRIC DATA: SEE BASALT FLOWS IN VERDE FORMATION
17. ECONOMIC DATA: NONE
18. OTHER DATA: PROBABLY DEPOSITED IN HYPERSALINE LACUSTRINE ENVIRONMENT.

REFERENCES:
19. ORIGINAL REFERENCE: NONE
20. SIGNIFICANT REFERENCE: { TWENTER AND METZGER (1963, USGS BULLETIN 1177) BRESSLER AND BUTLER (1978, EARTH AND PLAN. SCI. LETTERS, V. 38, P. 319-330.
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8-5-1981

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LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE -
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: BASALT FLOWS
8. STRATIGRAPHIC RANK AND STATUS:
BED
9. AGE:
SYSTEM TERTIARY
SERIES/STAGE PLIOCENE
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - WITHIN VERDE FORMATION
BELOW -
12. LITHOLOGY:
DOMINANT LITHOLOGY - BASALT
14. MAJOR UNCONFORMITIES:
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: 4.5+-0.2 AND 5.5+-0.2 M.Y. K/AR (WHOLE ROCK) E.H. MCKEE AND C.A. ANDERSON (1971) GEOL. SOC. AMERICA BULLETIN, V. 82, P. 2767-2782
17. ECONOMIC DATA: NONE
18. OTHER DATA: INTERBEDDED WITH LACUSTRINE SEDIMENTS OF THE VERDE FORMATION

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { BRESSLER & BUTLER 1978 EARTH AND PLANETARY SCIENCE LETTERS, V. 38, P. 319-330
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8/5/1981

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IDENTIFICATION:
1. RECORD NUMBER: 12923
COLUMN RECORDS RANGE: 12923 - 12950
2. LOCATION:
LAT 35 N
LONG 111 W
STATE ARIZONA
STAPI CODE - 02
COUNTY - YAVAPAI
COAPI CODE - 025
3. CSD PROVINCE NUMBER 475
PROVINCE NAME - BASIN AND RANGE
4. COLUMN NAME: VERDE VALLEY
5. COSUNA CHART: SSMC
6. COLUMN NUMBER : 5

GEOLOGICAL INFORMATION:
7. STRATIGRAPHIC UNIT: PLEISTOCENE AND RECENT STREAM GRAVELS, TALUS
8. STRATIGRAPHIC RANK AND STATUS:
BEDS
9. AGE:
SYSTEM QUATERNARY
SERIES/STAGE PLEISTOCENE AND RECENT
10. SURFACE/SUBSURFACE DATA: SURFACE
11. BOUNDING UNITS:
ABOVE - SURFACE
BELOW - VERDE FORMATION
12. LITHOLOGY:
DOMINANT LITHOLOGY - GRAVELS
SUBORDINATE LITHOLOGY - SAND/SILT
13. THICKNESS: 0-20
14. MAJOR UNCONFORMITIES:
ANGULAR UNCONFORMITY BELOW
DISCONFORMITY BELOW
15. FOSSIL DATA: NONE
16. RADIOMETRIC DATA: NONE
17. ECONOMIC DATA: NONE
18. OTHER DATA: MOSTLY DEPOSITS OF VERDE RIVER AND ITS TRIBUTARIES. SOME ALLUVIAL FAN DEPOSITION NEAR BLACK HILLS

REFERENCES:
19. ORIGINAL REFERENCE: { INFORMAL
20. SIGNIFICANT REFERENCE: { TWENTER AND METZGER 1963 U.S. GEOLOGICAL SURVEY BULLETIN 1177, P. 58-60
21. AUTHOR (S): R.A. KNEPP
22. DATE: 8/5/1981

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Correlation of Stratigraphic Units of North America — COSUNA

— ORLO E. CHILDS

Chronostratigraphic and Geochronometric Scales in COSUNA Stratigraphic Correlation Charts of the United States

AMOS SALVADOR —

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The American Association of Petroleum Geologists Bulletin
V. 69, No. 2 (February 1985), P. 173-180, 1 Fig., 1 Table

Correlation of Stratigraphic Units of North America—COSUNA[1]

ORLO E. CHILDS[2]

INTRODUCTION

Periodically, ambitious efforts have been made to synthesize existing knowledge of North American stratigraphy in the form of correlation charts that display recognized rock units shown in relative age relationships. At the close of the 19th Century, the "Correlation Papers" of the U. S. Geological Survey were issued, and at the start of the 20th Century, Willis' "Index to Stratigraphy" was published (1912) but quickly went out of print. In 1932, W. H. Twenhofel, chairman of geology and geography of National Research Council, inaugurated the Committee on Stratigraphy, with the objective of constructing new correlation charts. This committee was under the chairmanship of Carl O. Dunbar. With ten members, each one a specialist in a particular system (i.e., Cambrian, Ordovician, etc), all major divisions of geologic time were represented. Under Dunbar, committee members included: G. Arthur Cooper, Carey Croneis, B. F. Howell, Raymond C. Moore, John B. Reeside, Lloyd W. Stephenson, Charles K. Swartz, W. H. Twenhofel, and C. E. Weaver. The work of these scientists is familiar to all modern geologists, and a more respected group could hardly have been assembled in 1932. Each committee member chaired the efforts of a subcommittee for a given system. With the collaboration of 70 additional American stratigraphers, the work extended over the next 10 years. The first of 12 planned charts was printed in 1942 in the *Bulletin of the Geological Society of America* (GSA) (Stephenson et al, 1942).

Over the next 18 years, correlation charts appeared in the *GSA Bulletin*. The final chart was published in 1960 (Dunbar et al, 1960). Although 12 charts originally had been planned, 16 were prepared and published, and more than 140 scientists had been involved. Along with the charts, annotations and explanations appeared in the text of accompanying *GSA Bulletin* articles, thus providing useful interpretations. This elaborate set of charts has served the science of geology well and has established basic standards in nomenclature usage over the past three decades. In the short article (Dunbar et al, 1942) that announced the publication of the first chart, Chairman C. O. Dunbar cautioned, "... these charts are no more than an attempt to express our present knowledge. Considerable parts of the stratigraphic record are still imperfectly known, and future work will certainly indicate many corrections in the present correlations."

Now, 40 years later, and after nearly 7 years of effort involving more than 450 volunteer workers, the COSUNA project of AAPG has printed newly constructed correlation charts. On those charts, 570 complete geological columns are shown representing the geologic provinces of the United States (including Alaska) and using both surface and subsurface data. However, again it must be emphasized that the correlations depicted on these new charts should not be construed as final and fixed. They represent only the authors' best statements of the present stage of knowledge. In the next cycle of stratigraphic synthesis, undoubtedly there will be refinements, corrections, and new inclusions. Such is the nature of progress in our advancing knowledge of stratigraphic geology.

History of Project

For several years prior to 1976, discussions were held in the Research Committee of the American Association of Petroleum Geologists (AAPG) concerning the need for updated correlation charts of the United States and neighboring countries. The last complete lexicon had been published by the U. S. Geological Survey in 1938 (Wilmarth, 1938), and in subsequent years individual bulletins had recorded additions to the lexicon of geological names. The U. S. Geological Survey apparently had decided not to attempt an entirely new lexicon, but rather to update and change the existing listings on a state-by-state basis with the new revisions to be placed in retrievable computer storage.

Still recognizing the basic value of the existing GSA correlation charts, the AAPG goal was to update the charts and add the large amount of subsurface information that has accumulated during the past 20 years. One of the limitations generally recognized in existing charts is the fact that the emphasis upon individual geologic systems has dictated the format. The principal outcrops of rocks of the systems became the sites to be represented on the GSA charts, making it essentially impossible to assemble total geologic columns in any given region using the charts. For example, the selected locations of Jurassic and Permian rocks were not the same. In striving for greater utility, a new format was desirable.

Stemming from the discussions within the AAPG Research Committee, the interest of other geologic societies was solicited. A group of scientists representing those societies gathered under the chairmanship of Grant Steele, chairman of both the Research Committee and the Stratigraphic Correlation Committee of the AAPG. These representatives, forming the Steering Committee for the COSUNA project, included Grant Steele, Chairman, Gulf Oil and Mineral Co., representing AAPG; Frank Kottlowski, New Mexico Bureau of Mines, representing the Association of American State Geologists; Joseph E. Hazel, Branch of Paleontology and Stratigraphy, representing the U. S. Geological Survey; F. X. Miller, AMOCO

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[1]Manuscript received, September 21, 1984; accepted, November 19, 1984. Manuscript adapted from final report to U. S. Geological Survey on COSUNA.

[2]University of Arizona, Arid Lands Building, Room 17A, 845 North Park Avenue, Tucson, Arizona 85719.

Production Co., representing the American Association of Stratigraphic Palynologists; Norman F. Sohl, U. S. Geological Survey, representing the North American Commission on Stratigraphic Nomenclature; William W. Hay, University of Miami, representing the JOIDES Planning Committee; Robert Jordan, Delaware Geological Survey, representing the GSA; and Thomas Charles Buschback, Illinois Geological Society, representing the Society of Economic Paleontologists and Mineralogists (SEPM).

A proposal for support of the AAPG project was made to the U. S. Geological Survey, and a formal research contract was given in March 1977.

Fortuitously, three important publications were available at the beginning of the project.

1. After many years of work, the AAPG Committee on Statistics of Drilling (CSD) had published a code map of the geologic provinces of the conterminous United States, under the editorship of Richard F. Meyer (1968, revised 1974). This map showed the outlines of geologic provinces following county lines throughout the United States. A subsequent map of Alaska (AAPG Committee on Statistics of Drilling and U. S. Geological Survey, 1978), where there are no counties, showed provinces following township grids. Because the provinces are named and coded by number, these maps have become a useful base for accumulating and storing drilling information, seismic information, land ownership, and many other items pertinent to geologic data. The AAPG-CSD map provided a very useful base for COSUNA work. From the beginning, there had been plans for storage of stratigraphic information in a carefully coded computer access program. This map became the basic planning code for constructing the correlation charts of COSUNA.

2. From the International Subcommission on Stratigraphic Classification of the IUGS (International Union of Geological Sciences) Commission on Stratigraphy, a book edited by Hollis D. Hedberg (1976), entitled *International Stratigraphic Guide,* was published. This modern and useful reference book provides a guide to stratigraphic classification and terminology. It is up-to-date, and covers many items that did not appear in the Code of Stratigraphic Nomenclature (American Commission on Stratigraphic Nomenclature, 1970). It formed a useful reference document for all the COSUNA workers. Subsequently, a revised North American Stratigraphic Code (North American Commission on Stratigraphic Nomenclature, 1983) was published during the last year of the project, but too late for inclusion of some details of complex aspects of the modern code—particularly in Pleistocene rocks—to be used by project workers.

3. After 8 years of preparation by the Geological Survey of Canada, the Economic Geology Series 1, fifth edition, was published (Douglas, 1967). This publication was in three parts; part C presented four geotectonic correlation charts covering all of Canada. These charts represented a new approach in the display of correlation. The entire geologic column from the Precambrian through the Pleistocene was shown for selected geographic sites throughout Canada. The formations of the geologic column were colored to depict dominant lithologic character, and thickness of the stratigraphic units was shown by numbers. Time lines extended across the charts from chronostratigraphic charts along the lateral margins. Hence, the correlation of the exhibited units was clearly displayed. This manner of correlation presentation is in strong contrast to earlier correlation charts drawn on the format of individual geological systems. From the beginning of the COSUNA project, this new format was most appealing, and the Canadian charts became working models.

In addition, from the U. S. Geological Survey, Division of Geological Nomenclature, state-by-state computer-printed runs were made and distributed. These lists showed the revisions of lexicon information in the data bank. Preliminary lists and revisions of the approved lithologic unit names were sent to COSUNA workers. Thus, COSUNA had available the worksheets of the long-term project of the U. S. Geological Survey. The finished work was published as *Geologic Names of the United States through 1975* by Roger W. Swanson et al (1981). Background materials were distributed widely throughout the COSUNA project to achieve a commonality of approach.

The first three COSUNA correlation charts were printed and available from AAPG in October 1983 (AAPG, 1983a, b, c). Three more were added in 1984 (AAPG, 1984a, b, c), and others are to be added to the set as final drafting and printing allow.

Acknowledgments

Basic to the success of COSUNA activities has been the annual financial support from the U. S. Geological Survey over 6½ years. From the beginning, coordinators (Table 1) have sought contributors from various geologic disciplines. With over 450 volunteer contributors, it is appropriate to acknowledge and appreciate this extensive involvement. Unfortunately, it is not possible to list all those who participated in the construction of the COSUNA correlation charts. The contribution of COSUNA to the science of geology is attributable to the dedicated work of the coordinators who guided the efforts of the large number of contributors and reviewers. The coordinators, all well-known regional geologists, were chosen to work in each of the regions designated on the AAPG-CSD map. Geologic provinces were grouped into operating regions and the coordinators enlisted the aid of other local experts who were acquainted with the stratigraphy of each of the provinces within the region. Volunteer workers who contributed invaluable data included university professors, geologists from state geological surveys, geologists from major and small independent oil companies, and scientists from the U. S. Geological Survey. Eleven of the coordinators are state geologists or directors of state geological surveys. In fact, over half of the activity was coordinated by state geological survey individuals.

In preparation of charts and the data sheets for each lithologic unit, an important contribution has been made by graduate student research assistants. Coordinators have received valuable assistance from 40 graduate stu-

Table 1. COSUNA Coordinators

Name and Affiliation	Regional Responsiblity
Frank J. Adler Phillips Petroleum Co.	Central Mid-Continent
William W. Ballard Belcron Oil Co.	Northern Rocky Mountains
Charles Bishop and James F. Davis California Division of Mines and Geology	California
Jules Braunstein University of New Orleans	Gulf Coast
Elton Couch and Rex A. Knepp Gulf Oil Co.	Central Rocky Mountains
Lee C. Gerhard and John P. Blumle North Dakota Geological Survey	Williston Basin
Wyatt G. Gilbert and Ross B. Schaff Alaska Division of Geology and Geophysical Survey	Alaska
Michael Higgins U.S. Geological Survey	Piedmont–Blue Ridge
John Hills University of Texas–El Paso	Southwest Mid-Continent
Lehi F. Hintze Brigham Young Univesity	Great Basin–Columbia Plateau
Donald A. Hull Oregon Dept. of Geology and Mineral Industries	Northwest
John M. Armentrout Mobil Oil Co.	
Robert J. Jordan and Richard V. Smith Delaware Geological Survey	Atlantic Coast
Harry C. Kent Colorado School of Mines	Southern Rocky Mountains and Colorado Plateau
Frank E. Kottlowski New Mexico Bureau of Mines	Southern Basin and Range
Charles J. Mankin Oklahoma Geological Survey	Texas-Oklahoma Tectonic
William McLemore and Paul Huddleston Georgia Geologic and Water Resource Division, Dept. of Natural Resources	South Georgia–Florida
Douglas G. Patchen, Katherine L. Avery, and Robert B. Erwin West Virginia Geologic and Economic Survey	Appalachians
Robert H. Shaver Indiana Geological Survey, Dept. of Natural Resources	Midwestern Basin and Arch
James W. Skehan, S.J. Weston Observatory, Boston College	New England
Matt Walton and Douglas Bergstrom Minnesota Geological Survey	Northern Mid-Continent

dents over the 6-year period of the project. Many have been supported by universities and state geological surveys. The AAPG Foundation, through the Michel T. Halbouty Fund, has supported graduate students as assistants to the coordinators.

From industrial sources, a fund was established to meet unexpected costs. Of particular importance was the 1982 grant from Exxon Corp. to help meet the additional needs for computer entry of data. The financial need surpassed the original expectations set forth in the original project plans. A major commitment to COSUNA has been made by Gulf Oil Co. in assuming the cost and work of drafting printer-ready copy of the charts. The cost of equipment, materials, and professional time surpasses the dollar contribution to the project from any other source. This has insured a minimum price for the published charts.

Throughout the planning and project work, Grant Steele (Gulf Oil Co.), Amos Salvador (formerly with Exxon Corp., now professor at University of Texas at Austin), and Orlo E. Childs (University of Arizona) have worked together with responsibilities for related aspects of the project, and are listed as project directors on each chart. F. Alan Lindberg (Gulf Oil Co.) has been deeply involved in the project through the final 3 years of the work. As map editor, he was responsible for supervising the final chart drafting, preparation, and editing. Douglas Kinney, former U. S. Geological Survey map editor, served as an advisor throughout the entire project, giving valuable guidance for chart layout and printing.

The AAPG headquarters staff has been responsible for selection of the printer and marketing the finished charts through the "AAPG Bookstore."

In addition to chart construction, a data sheet has been prepared for each of the lithologic units displayed. The total includes approximately 18,000 entries. These data have been coded and entered into a computer retrieval program (COSU) of the Information System of the Energy Resources Center, University of Oklahoma. The University of Oklahoma has generously contributed to part of the cost of data input, and this cooperative attitude has greatly aided the workers of the project during the long process of data sheet preparation and storage.

RESEARCH AND DATA ACCUMULATION

Project Objectives

The objective of the COSUNA project has been to assemble the necessary geologic data and to construct correlation charts that depict the complete geologic columns representing parts of each of the geologic provinces shown on the AAPG-CSD map. Arranging these columns in 16

charts, it is possible to show the correlation of named stratigraphic units as they appear in the columns. In addition to the COSUNA correlation charts, the rationale of constructing each of the columns is documented in sets of data sheets, including one sheet for each of the units displayed on the columns. The data sheets were carefully designed for computer entry, and they comprise a program of geologic information to be retrieved from computer storage.

Stratigraphic columns of the charts do not represent single geographic sites. However, some are columns constructed on information from a single well such as the offshore wells on the continental shelf off the Atlantic coast. In most cases, the stratigraphic column is drawn as a composite that may cover an area of 100 mi^2 (260 km^2) or more. There is no consistency with regard to the area covered because the complexities of structure and other geologic aspects control the lateral applicability of the column. In essence, this is a collection of composite geologic columns with particular emphasis on the age designation of the recognized lithologic units. Each rock unit is colored to represent the dominant lithology of the unit. Also, the normal (metric) thickness of the unit is shown by numbers within the named unit. It has been an objective of the work to relate the units to an agreed upon chronostratigraphic scale showing global series and stages, as well as commonly used series and stage designations within North America. Because of stratigraphic complexities within certain geologic systems, and because of the absence of rocks representing other systems, it has been impossible to retain a standard vertical scale for all of the charts. A numerical time scale is shown in the margins of each chart, and reference to those numbers will aid the reader in recognizing the absence of a consistent vertical scale. Therefore, although the lithology and thickness of stratigraphic units are indicated, the vertical element of the chart is a variable time scale.

The sequence of columns on most of the charts is normally from west to east across the geologic provinces. However, the complexities of regional geology are sometimes best represented by not following this simple principle, as in the case of the Appalachian basin, New England, and others. In a project of this national scope, it is not possible to treat each area with the same degree of detail. The authors have attempted to present information to depict stratigraphic correlation and time assignments. Simplification and accurate generalization have been objectives. Detailed lateral tracing of facies changes and structural relationships have not been attempted.

The colors that were used on the charts also emphasize generalities. It is impossible here to identify lithologic variety within a given unit. Hence, the presentation depicts only the dominant lithology of the units. The lateral changes of thickness so important to regional understanding could not be shown in a chart where the vertical scale varies with time. Many thicknesses are shown as ranges.

Because the primary objective of the chart is to depict correlation, other geological detail is limited. In attempting to show generalized and perhaps overly simplified geologic information, the project authors have been able to present only part of the known geologic complexity. The chart, then, is a correlation framework that is useful in identifying and placing stratigraphic units within relative time limits. The information serves only as a first step toward the understanding and demonstration of complex geologic relations.

Stratigraphic Nomenclature and Chart Format

The COSUNA project was greatly influenced by the availability of H. D. Hedberg's *International Stratigraphic Guide.* Clear definitions of stratigraphic terms in this reference were invaluable in attempting to establish standardized usage of terms. As an example, on each of the charts the stratigraphic units are identified, using binomial nomenclature, such as the "Morrison Formation" or the "Madison Group." If the formations are of informal rank, the second name begins in lower case.

The continental scale of the project introduces variations based on the completeness of geologic study in remote areas as well as regions that have been studied and reported on for many years. There was always the temptation to include the complexities of detailed information wherever available. The large scale of continental coverage was not conducive to depiction of detailed geologic information beyond the basic needs of correlation chart displays. Thus, the effort throughout the project has been one of simplifying and generalizing. In the detailed stratigraphic breakdown that has been traditional in areas such as the Mid-Continent, the Carboniferous studies have included groups, formations, members, beds, and horizons showing lithocorrelations in finite detail. However, the purposes of this project are met by simply identifying the time span represented by a recognized formation; the additional information about identity of individual beds or horizons goes beyond the scope of the COSUNA correlation charts. Workers were encouraged to be "lumpers," not "splitters."

With so many workers contributing to the project from all regions of the United States, varied forms of correlation charts reflected regional tradition. It was difficult, therefore, to achieve a standardized format for charts of the entire country. Standardization for consistency has definite limitations. Usefulness of the final product would have been eroded by clinging too tightly to a rigid format. Consequently, a reasonable degree of individual preference was encouraged, and as a result, a comparison of the 16 charts will show many differences in detail. The reader must be cautioned to look at each chart as a separate entity and not attempt broad generalizations or comparisons of charts with each other.

The value of using regional experts to coordinate and contribute to the project is greater than any negative aspect resultant from the charts not all being prepared in the same manner. It is clear that complexities of local geology are best represented by allowing some latitude in the correlations. A common approach to definitions and format was made, but failure to reach absolute consistency is a strength of the charts, rather than a weakness.

Early in the project, it was recognized that it is impossible to show all the stratigraphic details about a particular region simply because of a contributor's familiarity with

certain systems. Generalization within limits of usefulness was required. The identification and assignment of recognized stratigraphic units to a particular time span in the chronostratigraphic chart was the primary requirement of chart construction. It was critical that the time assignment be the core of the project effort.

In some regions, the recognition of stratigraphic units within the rank of "group" was all that could be done, but in other areas, formations and members could be recorded. Rarely were marker beds or horizons necessary in reaching the usefulness desired. Yet, when a contributor judged that the identification of certain formal members was necessary, every effort was made to accommodate those judgments.

Once the compiler had drawn rough draft columns for the chart, an elaborate system of cross-checking and reviewing was employed. The coordinators usually sent copies of the draft to other workers of the region to ensure a compatibility of columns within the region. In addition, the review by system experts was sought by the coordinators. By the time charts had been drawn involving over 600 stratigraphic columns, the magnitude of the project posed a problem for national review by stratigraphic experts. To solve this problem, in the 5th year of the project, important regional and national technical meetings were used as the site for review by the geologic public. The meetings were selected to provide exposure of the work within appropriate areas covered by the charts.

The fifth year of the project was essentially a review year. In October 1980, the meetings of both the Eastern Section of AAPG in Evansville, Indiana, and the Gulf Coast Section of AAPG in Lafayette, Louisiana, were the sites of rough-draft column exhibits. At the GSA national convention in Atlanta, Georgia, in November 1980, stratigraphic columns representing operating regions east of the Mississippi River were shown. In April 1981, at the Southwest Section of AAPG in San Angelo, Texas, and at the Rocky Mountain Section of AAPG in Albuquerque, New Mexico, columns from the regions of the Rocky Mountains and Mid-Continent were exhibited for review. In May 1981, at the AAPG national convention in San Francisco, columns from the operating regions west of the Mississippi were exhibited on a 100-ft long wall space. During this series of exhibits, hundreds of geologists inspected the rough-draft charts. These exhibits attracted much attention, and helpful suggestions (corrections and additions) were provided by those interested.

This valuable critique reviewed the use of stratigraphic nomenclature, the placement of stratigraphic units within the time frame of the chart, and the judgments of stratigraphic rank. Besides the importance of testing the acceptance of the work, the plan of exhibit accelerated the completion of columns and data sheets in preparation for final drafting. Deadlines are great catalysts.

Despite the elaborate nature of this review plan, not all interested geologists received an opportunity for review and contribution. Prior to publication, it is difficult for a project of this scope to achieve adequate national review within acceptable time limits. It is interesting to note that last-minute corrections occurred virtually up to the date of completion of some final drafts.

ASSEMBLY OF CHARTS

Standardization of Chart Conventions

It is easy to confuse the objective of constructing stratigraphic cross sections with the time designation of stratigraphic units, in which correlation of those units is the primary objective. The desire to show lateral lithologic changes and documentation of environmental controls of deposition is a constant temptation. Particularly, this is true when one is attempting to add the additional information of dominant lithology, thickness, and unconformable relationships (as was accomplished by the Canadian charts). This additional information too was to be a guiding feature of the COSUNA charts; but the variable vertical scale of the charts, and the fact that some columns may represent strata separated by 200 mi (320 km), mitigated against anything except traditional time-controlled placement of units in the stratigraphic columns.

A special effort was made to simplify and standardize the conventions used on the charts. The conventions adopted are consistent on all the charts. Explanatory notes on the charts identify the fact that structural relationships are not depicted. As an example, igneous intrusions are shown opposite the age of the rock itself, and relationship to the host rock is not indicated.

On the Canadian charts, the ages of orogenies were identified. No such effort was made in the COSUNA charts, so no tectonic implications are intended. Time-rock implications are the primary objective of the charts, and the standardization of conventions is aimed at that concept.

Because time designation is the basic feature of all the charts, the selection of a chronostratigraphic chart for all potential users was of paramount importance. Early in the project, Amos Salvador provided a chronostratigraphic chart somewhat different from those scales used in the Canadian charts. The COSUNA scale was the result of recent decisions made by international stratigraphic subcommissions. At least five revisions of the chronostratigraphic chart were made during the project; the final form was the November 1981 revision. This revision is the chart that appears on each of the COSUNA sheets. A review of the procedures involved in preparing the COSUNA chronostratigraphic chart was prepared by Amos Salvador (1985) as a separate article.

Chart Boundaries

Once the 600 planned columns of the project had been constructed, it became obvious that many of the columns showed a duplication of information. Hence, many columns were deleted. Limitations of printing-press size (40 × 50 in. or 102 × 127 cm) and the design of the final charts resulted in only 30 to 36 columns being readily duplicated on a sheet. Also, geologic affinities between some of the working regions required consolidating neighboring provinces into a single chart. There were exceptions to this, however; the Appalachian chart needed two sheets to show the columns of a single province. Also, the diversity of information in California required three sheets to show all the necessary columns. The Alaska columns

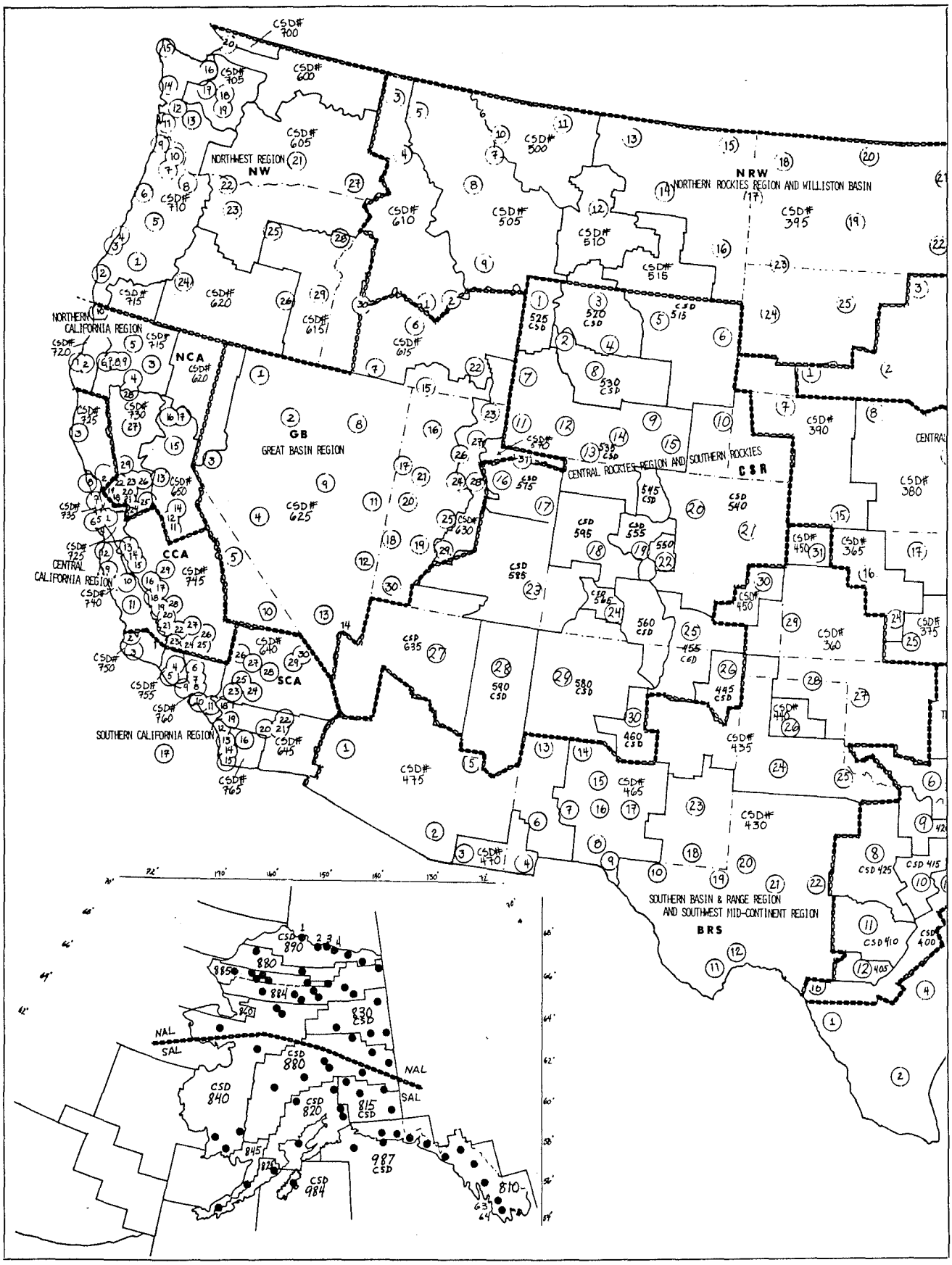
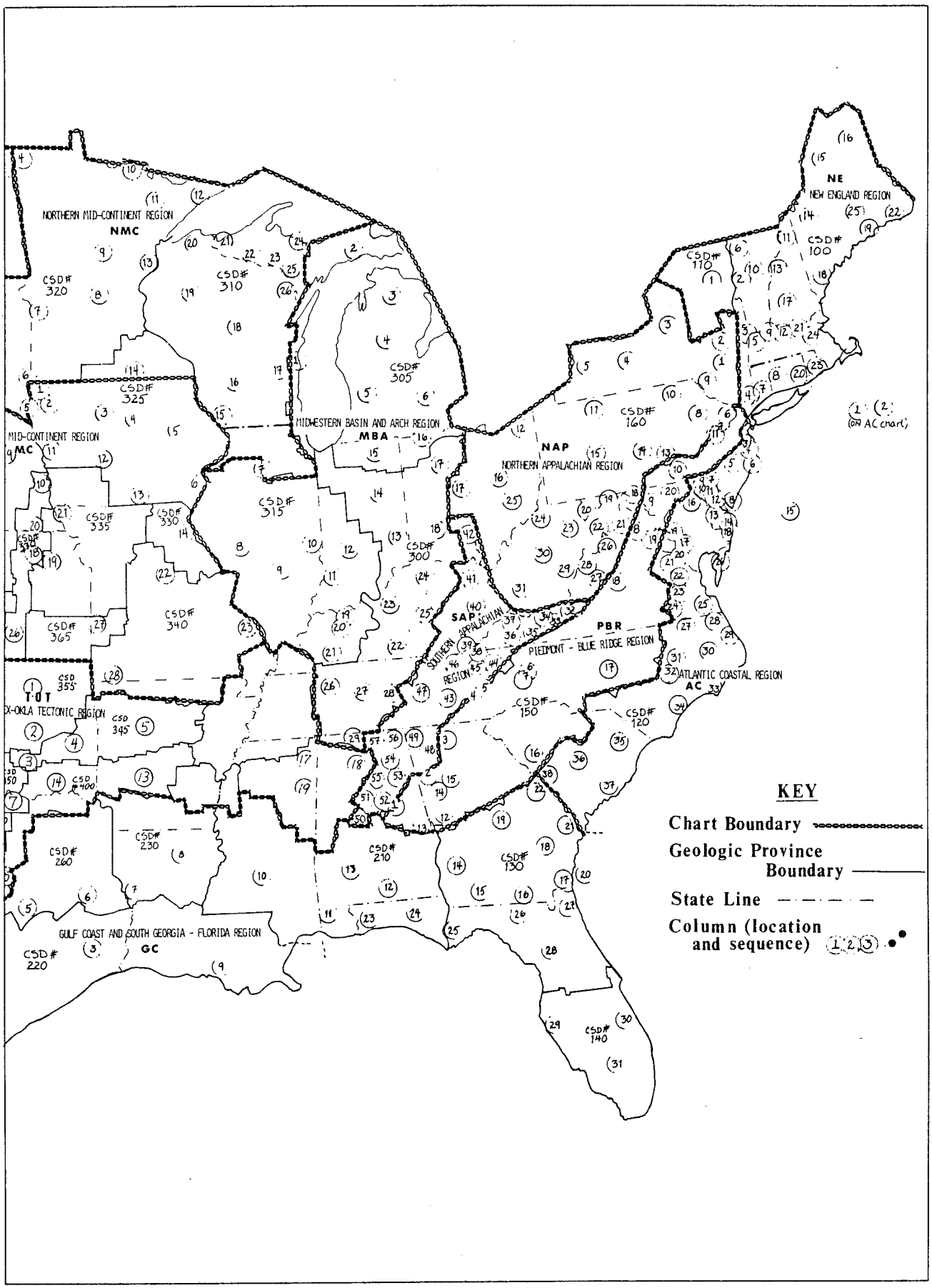


Figure 1—Index map of COSUNA charts, showing geologic provinces. Inset at lower left shows Alaska region.


NORTHERN MID-CONTINENT REGION
NMC
MID-CONTINENT REGION
MC
MIDWESTERN BASIN AND ARCH REGION
MBA
NAP
NORTHERN APPALACHIAN REGION
NE
NEW ENGLAND REGION
SAP
SOUTHERN APPALACHIAN REGION
PBR
PIEDMONT - BLUE RIDGE REGION
ATLANTIC COASTAL REGION
AC
T-O-T
TEX-OKLA TECTONIC REGION
GULF COAST AND SOUTH GEORGIA - FLORIDA REGION
GC
(ON AC chart)
KEY
Chart Boundary
Geologic Province Boundary
State Line
Column (location and sequence)

could best be shown with a minimum of two sheets. These three regions are the only multiple sheet charts of the project; all other charts are shown on a single sheet.

Location of each of the final 570 columns are numbered within the selected chart boundaries shown on Figure 1, an index map of all the charts of the project.

Data Sheet Preparation

Preparation of data sheets representing each of the lithologic units of the geologic columns of the charts was one of the most tedious efforts of the project; yet it was of vital importance to the usefulness of the correlation charts. Because very little space is allocated to meaningful annotations on the charts themselves, and to recover the rationale behind the construction of the stratigraphic columns, the data sheets represent the major contribution of recording the geologic knowledge behind chart construction.

These data sheets contain a large amount of reference material and lexicon-type data necessary to document the work exhibited in the charts. Because the information recorded on the data sheets is available by computer recovery, this portion of the project provides opportunity for future revision and addition to the record of correlation exhibited on the COSUNA charts. The data sheets have been carefully cross-checked against the representations on the charts themselves. Once the charts have been printed, they cannot be changed without major revision and reprinting. However, the information presented on the charts can be changed readily be revision of the data as it appears in the codified computer programs. Thus, the opportunity for revision and change of the decisions of correlations represented in this project still exists. It may not be necessary to wait for another 20-year cycle before major changes in our understanding of geologic correlation can be made available to the geologic community. This potential for future revision may represent one of the principal contributions of the COSUNA project to ever-expanding geologic knowledge.

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Chronostratigraphic and Geochronometric Scales in COSUNA Stratigraphic Correlation Charts of the United States[1]

AMOS SALVADOR[2]

INTRODUCTION

During 1976, the American Association of Petroleum Geologists undertook the ambitious task of preparing a new set of stratigraphic correlation charts for the United States. The project named "Correlation of Stratigraphic Units of North America," or COSUNA for short, was as needed as it was ambitious. The last comprehensive set of stratigraphic correlation charts had been published by the Geological Society of America between 1942 and 1960. The charts were in urgent need of revision.

Orlo E. Childs accepted the post of project director, and a Steering Committee was created that included representatives from the American Association of Petroleum Geologists, Association of American State Geologists, U.S. Geological Survey, American Association of Stratigraphic Palynologists, North American Commission on Stratigraphic Nomenclature, JOIDES Planning Committee, Geological Society of America, and Society of Economic Paleontologists and Mineralogists. Grant Steele served as chairman of the Steering Committee for the entire life of the project. To advise the project director on technical matters, a Stratigraphic Technical Committee also was established.

The United States was divided into appropriate geologic provinces, and regional coordinators were appointed to direct the construction of stratigraphic correlation charts for each province. The coordinators, in turn, selected knowledgeable stratigraphers to assist them in assembling the charts. In total, over 450 volunteer workers have labored for nearly 7 years in the COSUNA project. Six charts are now printed and on sale (AAPG, 1983a, b, c, 1984a, b, c), and 13 more will soon be available.

To make the COSUNA stratigraphic correlation charts more useful, all charts include a common reference chronostratigraphic scale and a common geochronometric (numerical time) scale in millions of years. This makes possible the comparison not only between the stratigraphic units of the various geologic provinces of the United States, but also between the American units and those of other parts of the world. The task of preparing the chronostratigraphic and geochronometric scales was assigned to the Stratigraphic Technical Committee composed of Amos Salvador (chairman), Timothy A. Anderson, and Raymond D. Woods.

The chronostratigraphic and geochronometric scales for the Paleozoic, Mesozoic, and Cenozoic used in the COSUNA stratigraphic correlation charts are shown on Figures 1-3. The numerical time scale is linear for all three, but a different spacing has been used for each. In the COSUNA stratigraphic correlation charts, it was not possible to use linear numerical time scales. For each chart, it was necessary to use a flexible vertical spacing to fit best the stratigraphy of the area and to make the charts most legible. Part of the reference vertical scales needed to be expanded while others needed to be compressed.

CHRONOSTRATIGRAPHIC SCALES

To provide the desired capability for international correlation, the reference chronostratigraphic scale of the COSUNA stratigraphic correlation charts is composed of chronostratigraphic terms (erathems, systems, series, and stages) recognized and used in most parts of the world; in other words, it attempts to be a "Standard Global Chronostratigraphic Scale." In addition, the charts also include scales of the local chronostratigraphic units most commonly used in the United States. This framework of reference chronostratigraphic scales makes the COSUNA charts useful not only to North American stratigraphers but also to geologists in others parts of the world who want to relate their local stratigraphy to that of the United States.

Preparation of a "Standard Global Chronostratigraphic Scale" was not easy. Whereas few problems were encountered in selecting the terms to be used for systems and units of higher rank, there were many conflicts concerning the terms to be selected for series and stages. Good accord exists concerning the chronostratigraphic terminology of the Triassic, Jurassic, and Cretaceous Systems, probably because it is based on the precise biostratigraphic zonation provided by ammonites; but agreement fades rapidly when moving downward and upward in the stratigraphic section. Discrepancies become most acute in the lowest Paleozoic and in the uppermost Tertiary and the Quaternary.

In compiling the Global Chronostratigraphic Scale for the COSUNA stratigraphic correlation charts, invaluable advice was received from the chairmen and/or secretaries of the subcommissions of the IUGS (International Union of Geological Sciences) International Commission on Stratigraphy dealing with each of the systems of the stratigraphic section. Other stratigraphers particularly knowledgeable on specific matters of chronostratigraphic classification were also consulted. Each contributor was asked to recommend the preferred series and stage terms that he or she believed are or could become recognized

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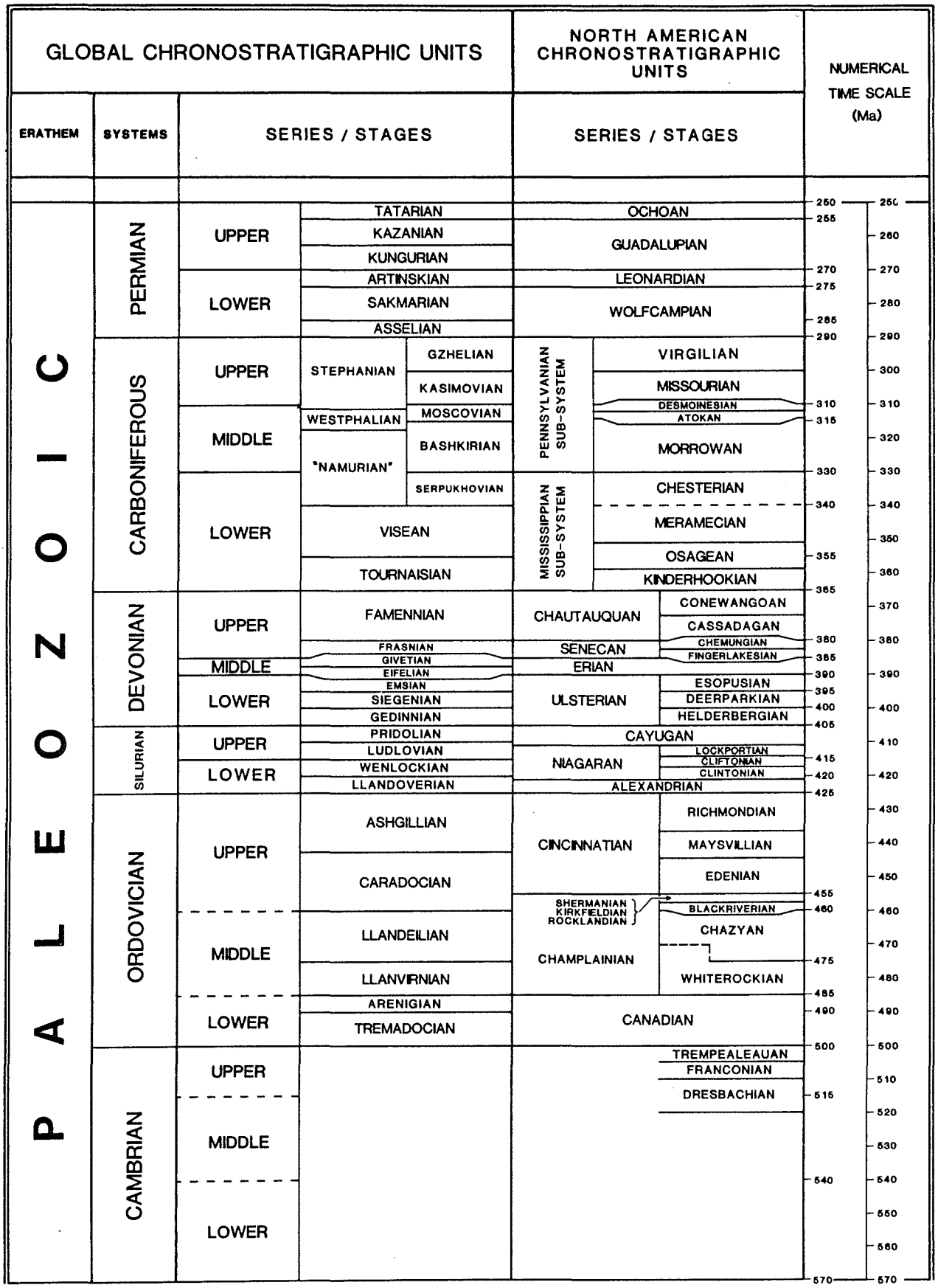

Figure 1—Chronostratigraphic and geochronometric scales for the Paleozoic.

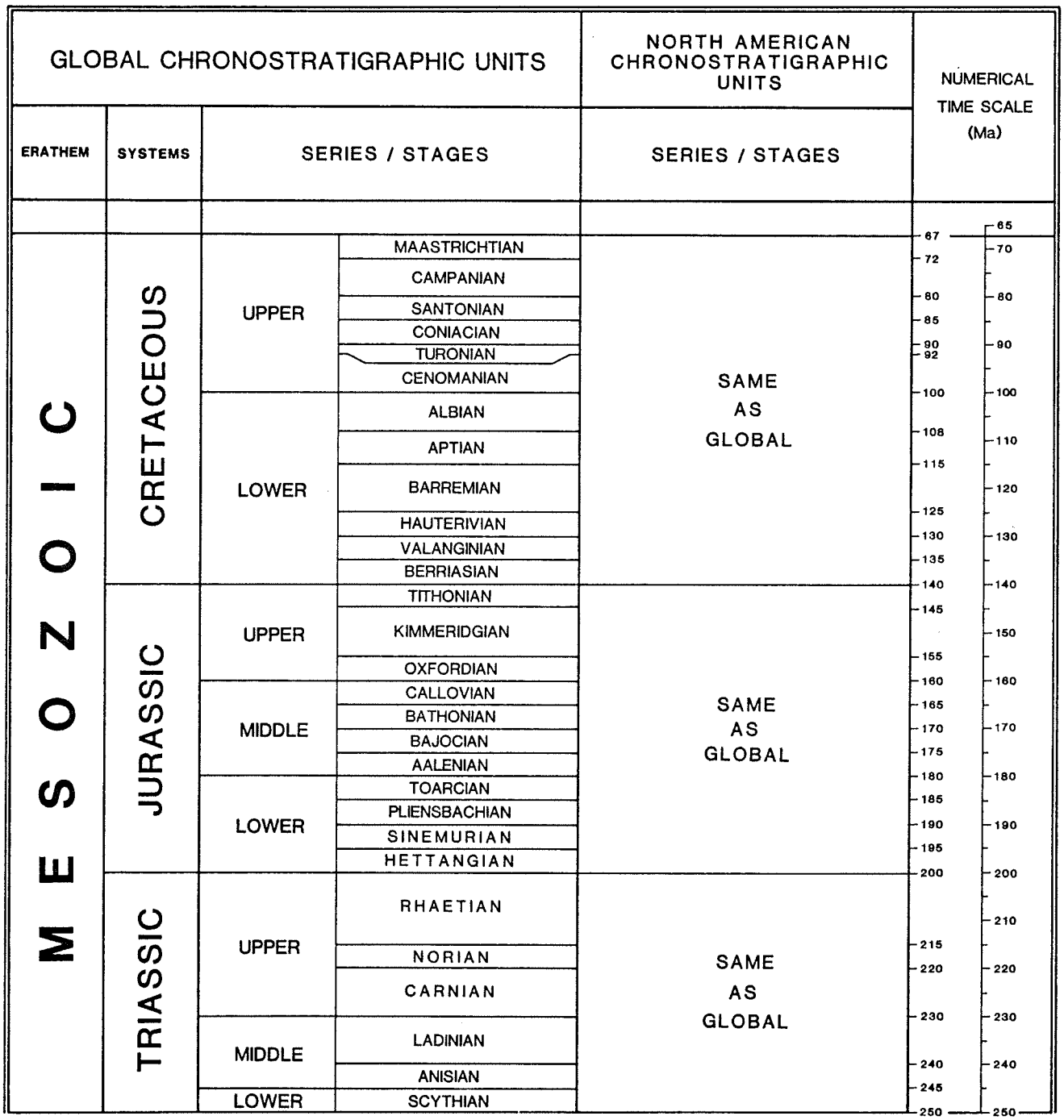

Figure 2—Chronostratigraphic and geochronometric scales for the Mesozoic.

worldwide as standard. Response was prompt and informative. The assistance of the following colleagues is sincerely appreciated: Precambrian: Jack E. Harrison, Harold L. James, and Paul K. Sims; Cambrian: J. W. Cowie, A. R. Palmer, and R. A. Robison; Ordovician: S. M. Bergstrom and R. J. Ross, Jr.; Silurian: C. H. Holland; Devonian: W. Ziegler; Carboniferous: C. F. Winkler Prins and G. L. Wilde; Permian: B. F. Glenister, S. V. Meyen, and G. L. Wilde; Triassic: N. J. Silberling and C. Virgili; Jurassic: N. F. Hughes and A. Zeiss; Cretaceous: T. Birkelund and F. Surlyk; Paleogene: W. A. Berggren and C. Pomerol; Neogene: M. B. Cita and J. Senes; Quaternary: R. P. Suggate.

The North American chronostratigraphic scales were not any easier to construct. Disagreements exist concerning not only the choice of terms but also about the correlation between units in different geologic provinces of the United States and between the North American units and those of the Global Chronostratigraphic Scale. Here again, COSUNA's Stratigraphic Technical Committee

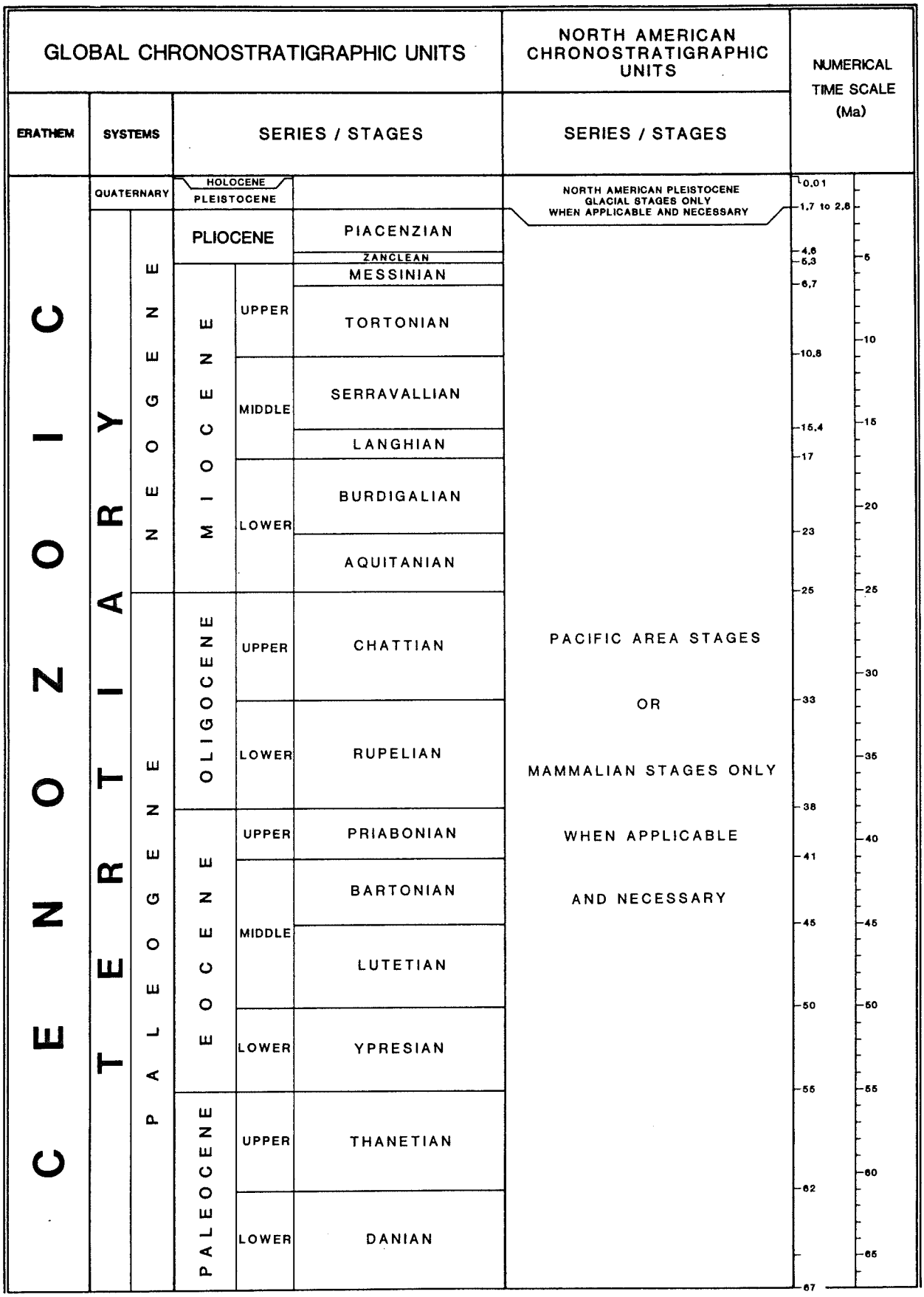

Figure 3—Chronostratigraphic and geochronometric scales for the Cenozoic.

received invaluable help from many stratigraphers, all recognized authorities in the diverse problems of North American and worldwide chronostratigraphic correlation. Nevertheless, the Stratigraphic Technical Committee assumes sole responsibility for the final decisions made in the preparation of both the global and the North American chronostratigraphic scales.

Although proved usefulness and accepted usage were the main criteria for the selection of the units used in the chronostratigraphic scales of the COSUNA charts, the final choice does not represent a general consensus. Many problems and irreconcilable differences of opinion still remain concerning the name, rank, and boundaries of units and the equivalence between local North American chronostratigraphic units and those of the Global Chronostratigraphic Scale.

To avoid some of the differences of opinion concerning the rank of some of the chronostratigraphic units included in the scales—some authors regard certain units as series whereas others consider them stages—series and stage names have been shown in a common column. It is hoped that action by international bodies, such as the International Commission on Stratigraphy, will eventually resolve some of these disagreements.

Many of the problems encountered in preparing the chronostratigraphic scales for the COSUNA stratigraphic correlation charts stem from the use of different sets of local chronostratigraphic units in different parts of the world. Many of these local chronostratigraphic units, based for the most part on equally local lithostratigraphic units, are poorly defined, their boundaries are vague, and their projection beyond the area of occurrence of the lithostratigraphic unit on which they are based is often controversial at best.

The ultimate answer to these problems undoubtedly lies in accepting and using everywhere in the world one single chronostratigraphic reference scale, a "Standard Global Chronostratigraphic Scale." First, of course, the units of such a standard scale and their boundaries need to be properly defined, "stratotyped," and accepted by most of the world's stratigraphers. This process is being carried out for the higher rank units by working groups of the International Commission on Stratigraphy, but it still remains a distant objective for units of lower rank.

The use of local schemes of chronostratigraphic classification cannot, therefore, be condemned although it may be discouraged when it is possible to refer the local stratigraphic sections to the "Standard Global Chronostratigraphic Scale." In the years to come, when such a standard scale has been better defined and more generally accepted, local chronostratigraphic scales may be eliminated from future stratigraphic correlation charts. It is a worthy objective for the future, but one that cannot yet be achieved.

For these reasons, COSUNA's Stratigraphic Technical Committee encouraged the regional coordinators to include local North American chronostratigraphic scales in the charts, but only when they could contribute to improve the clarity and usefulness of the charts, not just for the sake of completeness or historical interest. Use of local chronostratigraphic scales should, in any case, be kept to a minimum—used only when necessary and useful, and when well defined and generally accepted.

The system of Paleozoic chronostratigraphic units in common use in the United States has been included in all those charts to which it applies. Until the American Paleozoic sections can be referred with considerable certainty to the "Standard Global Chronostratigraphic Scale," the local terms should be retained. To discard them at this time would only cause confusion.

Other local North American chronostratigraphic units have also been used, but only in those areas where such units are now commonly accepted. Examples of such local units are the Tertiary stages of California and other Pacific areas, the stages based on mammalian faunas in regions of nonmarine Tertiary sequences, and the North American Pleistocene glacial stages. The decision to include in certain charts these or other local North American chronostratigraphic units and the selection of their terminology was the joint responsibility of the regional coordinators and the Stratigraphic Technical Committee.

On the other hand, the Stratigraphic Technical Committee felt that no useful purpose could be served by including in the COSUNA charts the multitude of seldom-used Mesozoic and Cenozoic chronostratigraphic terms introduced in different parts of the United States when clear reference can better be made to the generally recognized units of the "Standard Global Chronostratigraphic Scale."

Some of the choices of chronostratigraphic terminology used in the COSUNA stratigraphic correlation charts need explanation.

Cambrian

No international agreement exists at this time concerning the subdivision of the Cambrian System. A three-part subdivision is generally favored, but the location of the boundaries and the selection of lower rank units are still under consideration. For these reasons, the COSUNA charts show only the subdivision of the Cambrian into three series—Lower, Middle, and Upper—but their boundaries are represented by dashed lines to indicate the uncertainty concerning their placement. The North American chronostratigraphic classification of the Cambrian is equally unsettled. Agreement exists only about the recognition of the Dresbachian, Franconian, and Trempealeauan in the upper part of the section. The base of the Dresbachian, however, does not seem to correspond with the base of the Upper Cambrian.

Ordovician

A tripartite partition of the Ordovician System has been shown in the COSUNA stratigraphic scales even though there is no international agreement concerning this subdivision of the Ordovician. For this reason, the boundaries between Lower, Middle, and Upper Ordovician have been shown as dashed lines.

The North American chronostratigraphic scale for the Ordovician is now unsettled, and future stratigraphic correlation charts may show appreciable changes. The

COSUNA regional coordinators generally agreed, however, on elimination of the term "Trentonian." It has been replaced, in ascending order, by Rocklandian, Kirkfieldian, and Shermanian, even though this may prove to be only a temporary solution.

Carboniferous

The construction of a reference chronostratigraphic scale for the Carboniferous proved to be particularly difficult. The three areas in the world where the Carboniferous has been studied in greatest detail are western Europe, the United States, and the USSR, and different terminologies have been used in each area. The lower part of the Carboniferous has been assigned, both in western Europe and in the USSR, to the Tournaisian and Visean (as series by some and as stages by others), but the remaining part of the system has been named differently in western Europe and in the USSR because correlation is not certain between the predominantly nonmarine section of western Europe and the richly fossiliferous marine sequence in the USSR. At first sight, it may appear preferable to use the more marine sequence in the USSR as the reference scale for the upper part of the Carboniferous, but the western European terminology—Namurian, Westphalian, and Stephanian, in ascending order—is in such common use in the literature that until a standard chronostratigraphic terminology is internationally accepted for the Carboniferous, it is more useful and realistic to include in the COSUNA charts both the western European and the Russian scales. The term "Namurian" has been shown in quotes because it has not been properly defined and has consequently been used over the years with a variety of meanings.

The correspondence between the Russian, western European, and North American terminologies for the Carboniferous is by no means well established. The correlations shown in the COSUNA charts are those favored at the present time, but they probably will be subject to considerable revision in future years.

Cretaceous

Following the recommendation of the Subcommission on Cretaceous Stratigraphy, the terms "Neocomian" and "Senonian" have not been shown in the COSUNA charts. Those terms have never been properly defined, have been used in different contexts, and preferably should only be used in an informal way to convey a general idea of the age of certain stratigraphic sequences.

Pliocene-Pleistocene Boundary

The selection of a stratotype for the Pliocene-Pleistocene boundary and the numerical age for this boundary has been, and continues to be, the subject of controversy. Depending on where the boundary is placed, estimates of its geochronometric age range from 1.7 to 2.8 Ma. It appears that the Working Group on the Pliocene-Pleistocene Boundary of the International Commission on Stratigraphy will soon recommend the designation of a stratotype for this boundary at Vrica, in Calabria, southern Italy, within a marine fossiliferous section representing essentially continuous deposition. After this is done, it is hoped that biostratigraphic and magnetic-polarity studies, as well as isotopic dating, will result in a better estimate of the numerical age of the Pliocene-Pleistocene boundary. Meanwhile, the COSUNA stratigraphic correlation charts indicate the existing disagreement by showing the age of this boundary as ranging between 1.7 and 2.8 Ma.

Pleistocene

At this time, great disagreement exists concerning the subdivisions of the Pleistocene, because, among other reasons, careful recent studies have clearly indicated that important gaps and overlaps occur between the traditionally recognized Pleistocene "stages" in both the marine and nonmarine sequences. The decision was made, therefore, not to show in the COSUNA charts any subdivisions for the Pleistocene.

GEOCHRONOMETRIC (NUMERICAL TIME) SCALE

The first attempts to prepare a geochronometric scale for the COSUNA stratigraphic correlation charts were based mainly on the 1964 and 1971 publications of the Geological Society of London on the Phanerozoic time scale (Harland et al, 1964; Evans, 1971; Harland and Francis, 1971), and on the Geotectonic Correlation Charts published in 1970 by the Geological Survey of Canada (Douglas, 1970). Useful information was also drawn from the two papers by van Hinte (1976a, b) on the Jurassic and Cretaceous time scales and from the excellent papers presented at the Geological Time Scale Symposium of the 25th International Geological Congress (Sydney, Australia, August 1976) and published as *AAPG Studies in Geology 6* (Cohee et al, 1978).

In subsequent years, the initial geochronometric scale was modified on the basis of the increasing number of papers published on geochronometry and following the advice of the chairmen and secretaries of the subcommissions of the International Commission on Stratigraphy. Some of the dates are based on factual and reliable data; others on the very dubious method of linear extrapolation. Particularly valuable in the construction of the geochronometric scale was the counsel of Norman J. Snelling, chairman of the Subcommission on Geochronology. His recommendations were based on the latest determinations of decay constants and the newest isotopic age findings and contributed greatly to the updating of the geochronometric scale.

For the sake of graphic simplification, the range of accuracy of the geochronometric dates was not shown in the charts. This may be a weakness. Uncertainty, however, is difficult to quantify with confidence.

With the exception of the younger Tertiary and the Quaternary, all geochronometric dates have been rounded to the nearest one million years. For example, 25 Ma was used for the close of the Oligocene instead of 24.65 Ma; 67 Ma for the Cretaceous-Tertiary boundary instead of 66.7; etc. The degree of precision of the geochronometric determinations justifies this rounding.

OTHER REFERENCE SCALES

In the construction of the COSUNA charts, regional coordinators were encouraged to include, in addition to the reference chronostratigraphic and geochronometric scales already discussed, any other yardstick of geologic time or scales of reference that would serve to improve the clarity and usefulness of the charts: magnetic-polarity scale, biostratigraphic zonations (faunal or floral zones), etc. Biostratigraphic zonations, for instance, may be particularly desirable in certain areas or in certain stratigraphic intervals where controversies still exist concerning the age of certain lithostratigraphic units or concerning the terminology or boundaries of the chronostratigraphic units. Ammonite zones, the Upper Cretaceous and Tertiary planktonic foraminiferal zones, or the Carboniferous-Permian fusulinid zones—all in wide use throughout much of the world—are good examples of biostratigraphic zonal schemes useful in long-distance chronostratigraphic correlation. The regional coordinators were discouraged, however, from including in the charts additional reference scales when they did not contribute to appreciably improve the clarity and usefulness of the charts.

THE PRECAMBRIAN

Because a well-defined global chronostratigraphic subdivision of the Precambrian has not yet been accepted internationally, the COSUNA stratigraphic correlation charts do not show a chronostratigraphic subdivision of this earliest and longest segment of the stratigraphic record. The Precambrian, following the recommendations of Harrison and Peterman (1980, 1982) has been subdivided into only two units (Archean and Proterozoic) with their boundary at 2,500 Ma. As defined by Harrison and Peterman, the Archean and Proterozoic are not chronostratigraphic units but geochronometric units—direct subdivisions of geologic time without corresponding rock sequences to which they may be referred. They are established, and rocks are assigned to them, on the basis of any method that permits numerical dating, principally isotopic age determinations.

In considering the Archean and Proterozoic as eras rather than as eons—an alternative considered by Harrison and Peterman (1980)—the COSUNA scale differs from that recommended by Harrison and Peterman (1980, 1982). It also differs in not subdividing further these units into "Early," "Middle," and "Late" as they suggested. The Precambrian may be considered an eon/eonothem (corresponding in rank to the Phanerozoic Eon/Eonothem) or, as favored by Harrison and Peterman (1982), it may be simply "regarded as a general term for that part of geologic time that preceded the Cambrian."

The subdivision of the Precambrian used in the COSUNA charts is, of course, temporary. It is to be hoped that it will some day be replaced by an appropriate chronostratigraphic scale if such a scale is proposed and becomes internationally accepted.

RECENT LITERATURE ON CHRONOSTRATIGRAPHIC AND GEOCHRONOMETRIC SCALES

In preparing the COSUNA charts for publication, a deadline date was established, after which no more revisions to the charts were allowed. This was particularly difficult to do in the case of the geochronometric (numerical time) scale because new and excellent papers were appearing in the literature with great regularity. In mid-1982, as the first charts went into final drafting, revisions to the chronostratigraphic and geochronometric scales had to be stopped. Though unavoidable, it was unfortunate because late in 1982 two significant additions to the literature on chronostratigraphic terminology and geochronometry were published: G. S. Odin's two-volume *Numerical Dating in Stratigraphy* (and a short paper by the same author in *Episodes*), and the informative "A geologic time scale" by W. B. Harland et al. Nor was it possible to take advantage of the results of a symposium sponsored jointly by the Geological Society of London and the IUGS Subcommission on Geochronology entitled "Chronology of the Geological Record," which took place in London on May 11, 1982 (Snelling, 1982), or of the geological time scale prepared by the Geological Society of America (GSA) for its centennial program, the "Decade of North American Geology" (Palmer, 1983). Like many scientific documents, the COSUNA stratigraphic correlation charts are condemned to being out of date as soon as they are published.

Fortunately, the discrepancies between the COSUNA chronostratigraphic and geochronometric scales and those of Odin, Harland et al, and the GSA are not significant.

It needs to be stated that whereas Harland et al and the GSA use units of geologic time (i.e., geochronologic units: periods, epochs, ages) in their geologic time scales, the COSUNA stratigraphic correlation charts use the corresponding chronostratigraphic units (systems, series, and stages). Because the COSUNA charts are concerned with the correlation of rock units, it is appropriate to refer them to a chronostratigraphic, not a geochronologic, scale. The scales of Harland et al and of the GSA are time scales; the COSUNA scales serve as reference for lithostratigraphic units (units of rock). The discrepancy, however, is not important; the terminology of the two kinds of stratigraphic units is the same (e.g., Cretaceous Period and Cretaceous System).

The differences in the chronostratigraphic and geochronologic classification and terminology between the various scales are, for the most part, minor: differences in spelling of some terms, the use by Harland et al of "Lias," "Dogger," and "Malm" in the Jurassic, and of "Neocomian" and "Senonian" in the Cretaceous, and the use of "Neocomian" by the GSA—terms which were not used in the COSUNA chronostratigraphic scales for reasons discussed above. Harland et al and Odin use a more detailed breakdown of some of the systems than that shown in the COSUNA and GSA scales. Only in four cases do the COSUNA chronostratigraphic scales show more important differences with the scales of Harland et al, Odin, or the GSA. (1) The GSA scale does not include the Rhaetian as the uppermost stage of the Triassic, whereas the others

Table 1. Comparison of Geochronometric Scales

		Millions of Years Before Present (Ma)			
		COSUNA	Harland et al (1982)	Odin (1982a, b)	GSA (Palmer, 1983)
Holocene		0.01	0.01		0.01
Pleistocene		1.7-2.8	2.0		1.6
Pliocene		5.3	5.1		5.3
Miocene		25	24.6	23	23.7
Oligocene		38	38.0	34	36.6
Eocene		55	54.9	53	57.8
Paleocene		67	65	65	66.4
Cretaceous	Late	100	97.5	95	97.5
	Early	140	144	130	144
Jurassic	Late	160	163	150	163
	Middle	180	188	181	187
	Early	200	213	204	208
Triassic		250	248	245	245
Permian		290	286	290	286
Carboniferous	Pennsylvanian	330	320		320
	Mississippian	365	360	360	360
Devonian		405	408	400	408
Silurian		425	438	418	438
Ordovician		500	505	495	505
Cambrian		570	590	530	570
Proterozoic		2500	2500		2500
Archean					

do. (2) Both the GSA and Harland et al subdivide the Upper Permian, from bottom to top, into the Ufimian, Kazanian, and Tatarian Stages, and place the Kungurian Stage in the Lower Permian, whereas the COSUNA scale places the Kungurian in the Upper Permian and does not recognize the Ufimian Stage. Odin does not recognize the Ufimian either. (3) The GSA subdivides the Paleocene, from bottom to top, into Danian, an unnamed stage, and Thanetian, and they group the last two into a Selandian Stage, whereas COSUNA, Odin, and Harland et al recognize only two stages in the Paleocene: the Danian below and the Thanetian above. (4) Harland et al have avoided, whenever possible, the use of "early," "middle," and "late" for subdivisions of the periods, because these terms "have often been used in different senses and are also liable to confusion with the informal usage" of the same terms. Odin seems to have followed a similar course. Even though Harland et al have a valid point, it may be a long time before the terms "early," "middle," and "late" (or "lower," "middle," and "upper") can be replaced by more appropriate terms of geographic derivation.

The lack of significant differences in the terminology used in the chronostratigraphic/geochronologic scales of the COSUNA charts and in those of Harland et al, Odin, and the GSA is most encouraging. This gives reason to hope that in the foreseeable future international agreement may be reached in recognizing a single chronostratigraphic scale of reference—a "Standard Global Chronostratigraphic/Geochronologic Scale." Such an internationally accepted standard scale will have to be periodically revised as new results from many geologic fields become available, but there is further reason to hope that these revisions will become decreasingly important. The acceptance of a "Standard Global Chronostratigraphic/Geochronologic Scale" will favor the abandonment of many of the local scales in use today and foster easier and more effective communication among all stratigraphers.

As in the case of the chronostratigraphic/geochronologic scales, the geochronometric scale of the COSUNA charts does not differ significantly from those of Harland et al (1982), Odin (1982a, b), or the GSA (Palmer, 1983),

or apparently from those favored at the London symposium on "Chronology of the Geological Record" (see Snelling, 1982). This is particularly encouraging when considering the increasing amounts of new information becoming available in the field of geochronometry. International agreement, therefore, may be reached soon, too, concerning a global geochronometric scale.

Comparison of the principal numerical dates used in the geochronometric scales of the COSUNA charts with those of Harland et al (1982), Odin (1982a, b), and the GSA (Palmer, 1983) are shown in Table 1. As can be seen, the differences between the COSUNA scales and any of the others are no greater than those among the other three scales.

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