



Digital Geologic Map of Arizona: A Digital Database Derived from the 1983 Printing of the Wilson, Moore, and Cooper 1:500,000-scale Map

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Open-File Report 00-409
Version 1.0

Prepared in cooperation with the University of Arizona

2000

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Manuscript approved on October 10, 2000

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Introduction

This report describes a digital geologic GIS database in an Arc/Info format for the “Geologic Map of Arizona” by Wilson and others (1983 edition).

Digital Processing

The production acetates for the geologic map units, linework and points, and the hydrologic linework for the 1983 printing of the map were located in the USGS map archives in Reston VA. These were forwarded to Robert Miller, USGS Menlo Park, CA who affixed fiducial control points to the acetate layers. The acetates were then sent to Optronics Specialty Co., Northridge, CA to be scanned and vectorized. Four Arc/Info datasets were created and minimally attributed for fold axes, contacts and faults as lines; map units as polygons; and the symbols for fold axes and faults, and for cinder cones and diatremes as points. These datasets were delivered under contract to the U.S. Geological Survey.

Each of these four Arc/Info datasets was transformed from rectangular map inches into Lambert Conformal Conic map projection. The transformation with respect to a set of twenty-eight fiducial points (tics) resulted in a Root Mean Square (RMS) error of .004 (see [Appendix B](#)).

The datasets were extensively checked against the original source map (Wilson and others, 1969 and 1983 editions, 1983 acetate) for linework and attributional accuracy. Revisions were made to the linework and attributes as needed. Very small polygons that could not be positively identified were deleted, and other polygons that had been missed in the initial vectorization process were added.

Faults were attributed as displacement unknown if no displacement was indicated on the original map. Faults with U/D labels were attributed as normal faults with indicated throw. Faults with T labels were attributed as thrust faults, however, there was no consistent sense of upper plate or lower plate association for these faults; therefore, no attempt was made to indicate sense of motion in the digital files. One fault in the 1983 edition was labeled with offsetting arrows to indicate right-lateral offset, and it is so labeled in this database.

The overall accuracy (with respect to the location of lines and points) of the digital geologic map is probably no better than +/- 500 meters. This digital database is not meant to be used or displayed at any scale larger than 1:500,000 (e.g., 1:250,000 or 1:100,000).

GIS Database Description

The Arizona GIS database consists of four Arc/Info datasets: AZGEOL (geology), AZFOLD (folds), AZPTFEAT (point features), and AZPTDEC (point decorations). The relationships between these datasets and their respective look-up (related) tables are illustrated in [Figures 1, 2, 3, 4, and 5](#). [Appendix C](#) contains the output from the Arc/Info 'describe' command for each of the four datasets. [Appendix D](#) contains the listing of the explanation of the geologic map units found in the AZGEOL dataset. [Appendix E](#) contains the list of sources used by Wilson and others (1983) to compile the Geologic Map of Arizona. [Appendix F](#) contains the metadata for the digital geologic map database. [Appendix A](#) has the list of files in the Open-File Report.

AZGEOL - Linear and areal (polygon) features

The [AZGEOL](#) dataset contains the arcs representing contacts, faults, and maar craters (designated as calderas in the original manuscript), and the polygons representing the geologic map units. The explanation of geologic map units is given in [Appendix D](#). [Table 1](#) describes the user-defined attributes for items in the arc attribute table (azgeol.aat). [Table 2](#) describes the attributes for items in the contact look-up table (azgeol.con). [Table 3](#) describes the attributes for items in the structure look-up table (azgeol.str). [Table 4](#) describes the user-defined attributes for items in the polygon attribute table (azgeol.pat). [Table 5](#) describes the attributes for items in the geologic map unit look-up table (azgeol.ru).

AZFOLD - Linear features

The [AZFOLD](#) dataset contains those lines that represent fold axes (and their orientation as annotation). [Table 6](#) describes the user-defined attributes for items in the arc attribute table (azfold.aat). [Table 7](#) describes the attributes for items in the structure look-up table (azfold.str).

AZPTFEAT - Point features

The [AZPTFEAT](#) dataset contains points, which represent geologic features, cinder cones and diatremes. These points do not have strike or dip attribution. [Table 8](#) describes the user-defined attributes for items in the point attribute table (azptfeat.pat). [Table 9](#) describes the attributes for items in the geologic points look-up table (azptfeat.lut).

AZPTDEC - Point decorations

The [AZPTDEC](#) dataset consists of points used to symbolize the strike of bedding, foliation, or cleavage, fold axis type, and fold-axis plunge in the AZFOLD dataset or the fault offset in the AZGEOL dataset. [Table 10](#) describes the items and attributes for the point attribute table (azptdec.pat). [Table 11](#) describes the attributes for the geologic points look-up table (azptdec.lut) for the AZPTDEC Arc/Info file.

Figure 1: Arc attribute table and related look-up tables for the **AZGEOL** dataset

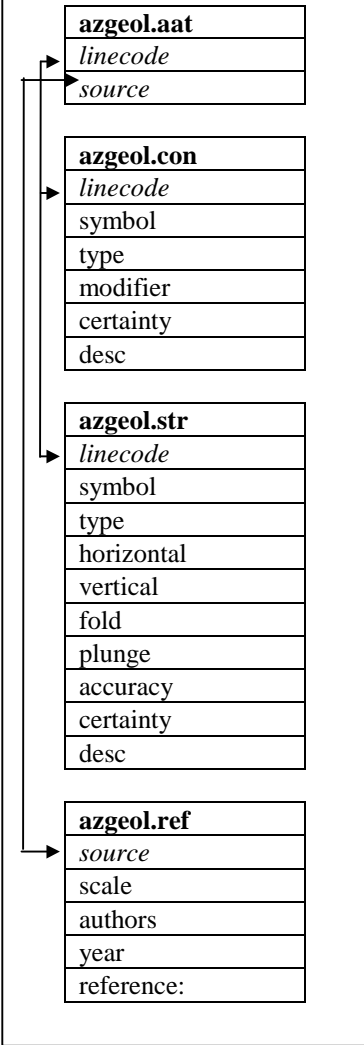


Figure 2: Polygon attribute table and related look-up tables for the **AZGEOL** dataset

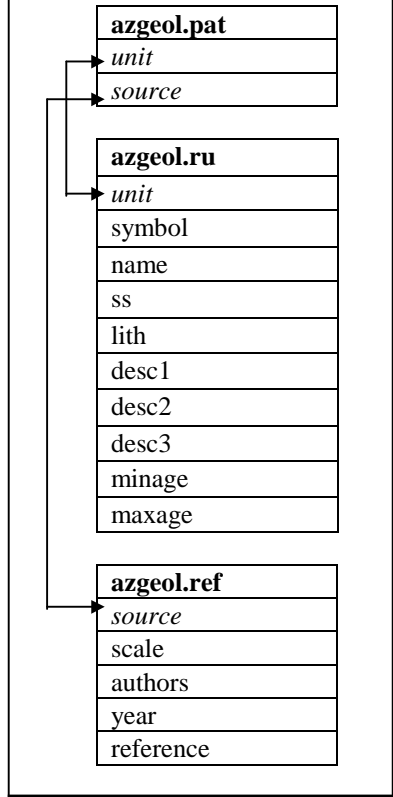


Figure 3: Point attribute table and related look-up tables for the **AZPTFEAT** dataset:

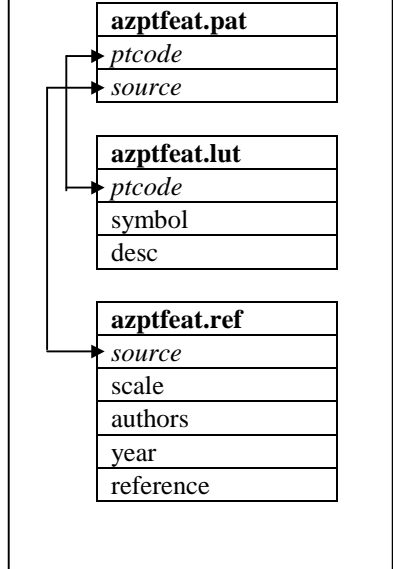


Figure 4: Arc attribute table and related look-up tables for the **AZFOLD** dataset:

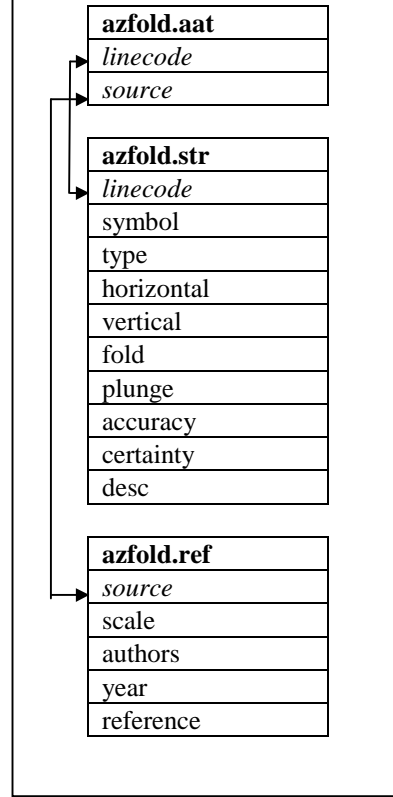
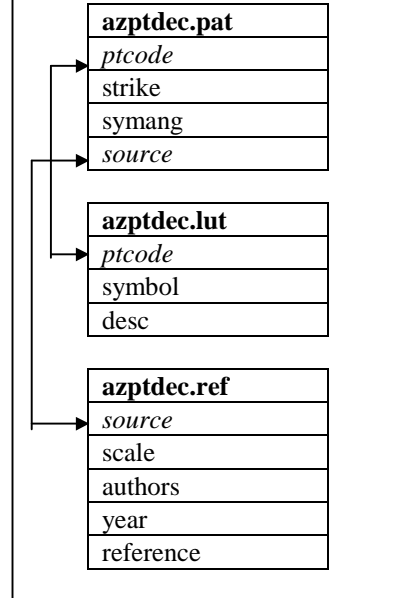


Figure 5: Point attribute table and related look-up tables for the **AZPTDEC** dataset:



AZGEOL – User-defined attributes for linear and areal (polygon) features

Table 1: Description of items in the arc attribute table, **AZGEOL.AAT**, defining contacts, faults, and craters.

AZGEOL.AAT			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
linecode	integer	3	Numeric code used to identify type of linear feature. Linecodes < 100 are used for contacts and boundaries which are described in the AZGEOL.CON file. Linecodes > 100 and < 600 represent structural features which are described in the AZGEOL.STR file.
source	integer	4	Numeric code used to identify the data source for the linear feature. Complete references for the sources are listed in the AZGEOL.REF file.

Table 2: Description of items in the contact (and boundary) look-up table **AZGEOL.CON**

AZGEOL.CON			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
linecode	integer	3	Numeric code (a value < 100) used to identify type of contact or boundary. (This item also occurs in AZGEOL.AAT .)
symbol	integer	3	Line symbol number used by Arc/Info to plot arcs. Symbol numbers refer to the SCAMP2B.LIN lineset (after Matti and others, 1997)
type	character	10	Major type of line, e.g., contact, map boundary.
modifier	character	20	Line type modifier, i.e., approximate, concealed, gradational. No entry implies 'known.'
certainty	character	15	Degree of certainty of contact or boundary, i.e., inferred, uncertain. No entry implies 'certain.'
desc	character	100	Written description or explanation of contact or boundary.

Table 3: Description of items in the structure look-up table **AZGEOL.STR**

AZGEOL.STR			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
linecode	integer	3	Numeric code (a value > 100 and < 600) used to identify type of structural feature. (This item also occurs in AZGEOL.AAT .)
symbol	integer	3	Line symbol number used by Arc/Info to plot arcs. Symbol numbers refer to the SCAMP2B.LIN lineset (after Matti and others, 1997).
type	character	10	Major type of structure, i.e., fault, fracture, other.
horizontal	character	20	Type of horizontal fault movement, e.g., left-lateral, right-lateral. No entry implies 'unknown.'
vertical	character	20	Type of vertical fault movement, e.g., normal. No entry implies 'unknown.'
fold	character	15	Type of fold, not used in this table.
plunge	character	15	Type of plunge on fold, not used in this table.
accuracy	character	15	Line type modifier indicating degree of accuracy, i.e., approximately located, concealed, gradational. No entry implies 'known.'
certainty	character	15	Degree of certainty of structure, i.e., inferred, uncertain. No entry implies 'certain.'
desc	character	100	Written description or explanation of structural feature.

Table 4: Description of items identifying geologic units in the polygon attribute table **AZGEOL.PAT**

AZGEOL.PAT			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
unit	character	10	Alphabetic character string used to identify the geologic map unit, which is described in the AZGEOL.RU look-up table. (This item also occurs in AZGEOL.RU .)
source	integer	4	Numeric code used to identify the data source for the geologic map unit. Complete references for the sources are listed in the AZGEOL.REF file.

Table 5: Description of items in the lithology (geologic map unit) look-up table **AZGEOL.RU** (for use with the **AZ500K.SHD** shadeset).

AZGEOL.RU			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
unit	character	10	Alphabetic character label used to identify the geologic map unit. (This item also occurs in AZGEOL.PAT .)
symbol	integer	3	Shadeset symbol number used by Arc/Info to plot a filled/shaded polygon. The symbol numbers used in this file refer to the AZ500K.SHD shadeset.
name	character	50	The prefix portion of the geologic map unit label that does not include subscripts. (If subscripting is not used in the original geologic map unit label, then the 'name' entry is the same as the 'unit' entry.)
ss	character	4	The suffix portion of the geologic unit label that includes subscripts.
lith	character	25	Major type of lithogenesis of the geologic map unit, i.e., unconsolidated sediments, sedimentary rocks, metasedimentary rocks, intrusive rocks, extrusive rocks, or metamorphic rocks, OR water or ice.
desc1	character	200	Geologic map unit explanation.
desc2	character	200	Continuation of geologic map unit explanation if necessary.
desc3	character	200	Continuation of geologic map unit explanation if necessary.
minage	character	7	Minimum stratigraphic age of geologic map unit, i.e., CRET, TERT, PCY.
maxage	character	7	Maximum stratigraphic age of geologic map unit

AZFOLD - User-defined attributes for linear features

Table 6: Description of items in the arc attribute table, **AZFOLD.AAT**, identifying interpreted linear structural information

AZFOLD.AAT			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
linecode	integer	3	Linecodes > 100 and < 600 represent structural features which are described in the AZFOLD.STR file.
source	integer	4	Numeric code used to identify the data source for the linear feature. Complete references for the sources are listed in the AZFOLD.REF file.

Table 7: Description of items in the structure look-up table **AZFOLD.STR**

AZFOLD.STR			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
linecode	Integer	3	Numeric code (a value > 100 and < 600) used to identify type of structural feature. (This item also occurs in AZFOLD.AAT .)
symbol	Integer	3	Line symbol number used by Arc/Info to plot arcs. Symbol numbers refer to the SCAMP2B.LIN lineset (after Matti and others, 1997).
type	Character	10	Major type of fault, not used in this table
horizontal	Character	20	Type of horizontal fault movement, not used in this table.
vertical	Character	20	Type of vertical fault movement, not used in this table.
fold	Character	15	Type of fold, e.g., anticline, syncline.
plunge	character	15	Type of plunge on fold, i.e., horizontal, plunging, plunging in, plunging out.
accuracy	Character	15	Line type modifier indicating degree of accuracy, i.e., approximately located, concealed, gradational.. No entry implies 'known.'
certainty	Character	15	Degree of certainty of structural feature, i.e., inferred, uncertain. No entry implies 'certain.'
desc	Character	100	Written description or explanation of structural feature.

AZPTFEAT - User-defined attributes for point features

Table 8: Description of items identifying geologic points in the point attribute table **AZPTFEAT.PAT**

AZPTFEAT.PAT			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
ptcode	integer	3	Type of point symbol, Cinder cone or Diatreme. (This item also occurs in the AZPTFEAT.LUT file.)
source	integer	4	Numeric code used to identify the data source for the structural map symbol. Complete references for the sources are listed in the AZPTFEAT.REF file.

Table 9: Description of items in the geologic points look-up table **AZPTFEAT.LUT**

AZPTFEAT.LUT			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
ptcode	integer	3	Type of point symbol, Cinder cone or Diatreme. (This item also occurs in the AZPTFEAT.PAT file.)
symbol	integer	3	Marker symbol number used by Arc/Info to identify type of geologic map symbol. Symbol numbers refer to the SCAMP2B.MRK markerset (Matti and others, 1997).
desc	character	70	Written description or explanation of map symbol.

AZPTDEC - User-defined attributes for point decorations

Table 10: Description of items identifying geologic points in the point attribute table, **AZPTDEC.PAT**

AZPTDEC.PAT			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
ptcode	integer	3	Type of point symbol, e.g., fold type, fold plunge or fault offset (This item also occurs in the AZPTDEC.LUT file.)
strike	integer	3	Strike of bedding, foliation or cleavage. Not applicable in this database.
symang	integer	4	The angle used to complete the mathematical rotation of the structural map symbol to its proper orientation on the map. This value is the \$angle pseudo-item value for the point.
source	integer	4	Numeric code used to identify the data source for this map symbol. Complete references for the sources are listed in the AZPTDEC.REF file.

Table 11: Description of items in the geologic points look-up table **AZPTDEC.LUT**

AZPTDEC.LUT			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
ptcode	integer	3	Type of point symbol, e.g., fold type, fold plunge or fault offset (This item also occurs in the AZPTDEC.PAT file.)
symbol	integer	3	Marker symbol number used by Arc/Info to identify type of geologic map symbol. Symbol numbers refer to the SCAMP2B.MRK markerset (Matti and others, 1997).
desc	character	70	Written description or explanation of map symbol.

Source Attributes

Table 12: Description of items in **AZFOLD.REF**, **AZGEOL.REF**, **AZPTDEC.REF**, **AZPTFEAT.REF**, and **SOURCE.REF** files.

AZFOLD.REF / AZGEOL.REF / AZPTDEC.REF / AZPTFEAT.REF / SOURCE.REF			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
source	integer	4	Numeric code used to identify the data source. (This item also occurs in the AZFOLD.AAT , AZGEOL.AAT , AZGEOL.PAT , AZPTDEC.PAT , and AZPTFEAT.PAT files.)
scale	integer	10	Scale of source map. (This value is the denominator of the proportional fraction that identifies the scale of the map that was digitized or scanned to produce the digital map.)
authors	character	200	Author(s) or compiler(s) of source map entered as last name, first name or initial, and middle initial.
year	integer	4	Source (map) publication date
reference	character	250	Remainder of reference in USGS reference format.

Obtaining and Using the Database

Obtaining Digital Data

The complete database for the digital geologic map of Arizona is available in Arc/Info interchange format with associated data files. These data and map images are maintained in a Lambert Conformal Conic projection with the following parameters:

1st standard parallel	33 0 0.00
2nd standard parallel	45 0 0.00
central meridian	-112 0 0.00
latitude of projection's origin	0 0 0.00
false easting (meters)	0.00
false northing (meters)	0.00

To obtain copies of the digital data, do one of the following:
Download the digital files from the USGS public access

World Wide Web site on the Internet:

URL = <http://geopubs.wr.usgs.gov/open-file/of00-409>

or

Anonymous FTP from **geopubs.wr.usgs.gov**, in the directory

pub/open-file/of00-409

The Internet sites contain the complete database for the digital geologic map of Arizona. To manipulate these data in a geographic information system (GIS), you must have a GIS that is capable of reading Arc/Info interchange-format files.

Setting up the GIS database for use in Arc/Info

Create an Arc/Info workspace, move to it, and download all the files from the OFR into that space. Start Arc/Info and run the import.aml program (i.e., Arc: &run import, see Appendix G) to import the Arc/Info interchange format files (*.e00). This procedure must be performed prior to using data in Arc/Info. To open the *.e00 files for use in ArcView, one needs to run "Import71" for each file.

Querying the GIS datasets

To access information contained in the associated tables a "relate" must be established between the coverages (datasets) and the associated INFO tables. A file, **relate1**, has been provided with the digital data to establish relates (relations) between coverage feature attribute tables and associated INFO tables. You can use the relates in Arc/Info to link each feature with associated data.

Seven relates (relations) are defined in **relate1**. Table 13 shows the relations between the various feature attribute table items and INFO database tables.

Table 13: **RELATE1**, relates between feature attribute tables and attributes.

RELATE1						
RELATION	TABLE-ID	DATABASE	ITEM	COLUMN	TYPE	ACCESS
FOLDSTR	azfold.str	info	LINECODE	linecode	ORDERED	RW
GEOLCON	azgeol.con	info	LINECODE	linecode	ORDERED	RW
GEOLSTR	azgeol.str	info	LINECODE	linecode	ORDERED	RW
GEOLRU	azgeol.ru	info	UNIT	unit	ORDERED	RW
PTDEC	azptdec.lut	info	PTCODE	ptcode	ORDERED	RW
PTFEAT	azptfeat.lut	info	PTCODE	ptcode	ORDERED	RW
SOURCES	sources.ref	info	SOURCE	source	ORDERED	RW

To establish (restore) these relates (relations), see the 'relate' command usage in the respective Arc/Info module.

Once you have restored the relates (relations) you can query an INFO table respective to the particular coverage and feature.

*When querying arcs representing contacts, map boundaries, water boundaries, etc. (linecodes 1 to 99) in the **azgeol** dataset, use the relation "**geolcon**" to access information in the look-up table, **azgeol.con**.

*When querying faults and other structural arcs (linecodes greater than or equal to 100) in the **azgeol** dataset, use the relation "**geolstr**" to access information in the look-up table **azgeol.str**.

*When querying polygons in the **azgeol** dataset, use the relation "**geolru**" to access information in the look-up table **azgeol.ru**.

*When querying arcs in the **azfold** dataset, use the relation "**foldstr**" to access information in the look-up table **azfold.str**.

*When querying points in the **azptfeat** dataset, use the relation "**ptfeat**" to access information in the look-up table **azptfeat.lut**.

*When querying points in the **azptdec** dataset, use the relation "**ptdec**" to access information in the look-up table **azptdec.lut**.

An example of querying the AZGEOL dataset and related tables in ArcEdit:

(Text in serif 'Courier New' font represents the prompt and output from ArcEdit, text in sans-serif 'Arial' represents what was typed in at the prompt and additional comments, other words are in **bold** for emphasis)

```
Arcedit: mapextent azgeol
Arcedit: editcoverage azgeol
Arcedit: editfeature polygon
Arcedit: drawenvironment polygon
Arcedit: draw
```

```
Arcedit: items azgeol.pat
```

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME
1	AREA	4	12	F	3	
5	PERIMETER	4	12	F	3	
9	AZGEOL#	4	5	B	-	
13	AZGEOL-ID	4	5	B	-	
17	UNIT	10	10	C	-	
27	SOURCE	4	4	I	-	

(**UNIT** is the key field in the relate between **azgeol.pat** and **azgeol.ru** using the relation "**geolru**")

```
Arcedit: select one
1 element(s) now selected
```

```
Arcedit: list unit source
```

Record	UNIT	SOURCE
725	Pkt	1

```
Arcedit: relate restore relate1
```

```
Arcedit: show relates
```

```
FOLDSTR, GEOLCON, GEOLSTR, GEOLRU, PTDEC, PTFEAT, SOURCES
```

```
Arcedit: show relate geolru
```

```
azgeol.ru, info, UNIT, unit, ORDERED, RW
```

```
Arcedit: items azgeol.ru
```

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME
1	UNIT	10	10	C	-	
11	SYMBOL	3	3	I	-	
14	NAME	50	50	C	-	
64	SS	4	4	C	-	
68	LITH	25	25	C	-	
93	DESC1	200	200	C	-	
293	DESC2	200	200	C	-	

```

493  DESC3          200  200    C    -
693  MINAGE         7    7      C    -
700  MAXAGE         7    7      C    -

```

```

Arcedit: list unit geolru//lith geolru//minage geolru//desc1
725

```

```

UNIT          = Pkt
GEOLRU//LITH  = Limestone
GEOLRU//MINAGE = P
GEOLRU//DESC1 = Kaibab Limestone and Toroweap Formation

```

```

Arcedit: show relates

```

```

FOLDSTR, GEOLCON, GEOLSTR, GEOLRU, PTDEC, PTFEAT, SOURCES

```

```

Arcedit: show relate sources

```

```

sources.ref, info, SOURCE, source, ORDERED, RW

```

```

Arcedit: items sources.ref

```

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYP	EN.DEC	ALTERNATE NAME
1	SOURCE	4	4	I	-	
5	SCALE	10	10	I	-	
15	AUTHORS	200	200	C	-	
215	YEAR	4	4	I	-	
219	REFERENCE	250	250	C	-	

(SOURCE is the key field in the relate between **azgeol.pat** and **sources.ref** using the relation “**sources**”)

```

Arcedit: list unit source sources//scale sources//authors sources//year
725

```

```

UNIT          = Pkt
SOURCE        = 1
SOURCES//SCALE = 500000
SOURCES//AUTHOR = Wilson, Eldred D., Moore, Richard T., Cooper, John R.
SOURCES//YEAR  = 1969

```

Displaying the data on-screen or to a file for plotting

ArcInfo macro files, sheet1.aml (full map), sheet2.aml (north part), and sheet3.aml (south part) ([see Appendix H](#)), have been included for displaying the data represented in the database. The macros allow the user to draw a map composition on-screen (see the Arcplot map composition commands) or to create an ArcInfo output file, which can be plotted directly or processed into a file for plotting (see the ‘display’ command in Arcplot).

The sheet1.gra, sheet2.gra, and sheet3.gra files included with Open-File Report 00-409 are full-color map composition graphic files generated by running sheet1.aml, sheet2.aml, sheet3.aml, respectively, in the Arcplot module of ArcInfo (e.g., Arcplot: display 1040 1, followed by sheet1.gra, and then &run sheet1.aml). The dimensions of the sheet1.gra file is 46 inches wide by 68 inches tall, portrait format (too large to plot on most plotters). The dimensions of sheet2.gra and sheet3.gra files are 46 inches by 35 inches tall, landscape format (sufficient size to plot on 36-inch wide plotters).

The graphic files were converted to raster transfer language (RTL) files for plotting purposes (e.g., Arc: rtl sheet1 sheet1.rtl # 1.0 noopaque # 0 # # # #). Sheets 2 and 3 were rotated 90 degrees counterclockwise before running the RTL command (e.g., Arc: rotateplot sheet2 sheet2r, Arc: rtl sheet2r sheet2.rtl # 1.0 noopaque # 0 # # # #) for plotting to a 36-inch wide color plotter. All three GRA files were rotated and converted to encapsulated postscript files (EPS) (e.g., postscript sheet2r sheet2.eps 1.0 # 300). The EPS files for Sheets 2 and 3 were then converted to portable document files (PDF).

Obtaining Paper Maps

Paper copies of the digital geologic map are not available from the U.S. Geological Survey. However, with access to the Internet and access to a large-format color plotter that can interpret graphics metafiles or HP-RTL files, a 1:500,000-scale paper copy of a geologic-map can be made by downloading, processing, and plotting sheet1.gra, sheet2.gra , and sheet3.gra, or by downloading and plotting the three sheets: sheet1.rtl sheet2.rtl and sheet3.rtl, (described above). Sheet1.rtl can only be plotted on a 46" format plotter. Sheet2.rtl and sheet3.rtl can be plotted on a 36" format plotter.

Acknowledgments

We wish to thank Jonathan Matti, U.S. Geological Survey for his assistance in creating a structure for the digital GIS datasets; Richard Koch for helping to locate the acetate separates used to print the original paper map; and Robert J. Miller for locating and affixing fiducial control points to the acetates prior to the scanning process.

We wish to thank and acknowledge the efforts of our reviewers, Karen Bolm, Floyd Gray, and Pamela Derkey.

References Cited

Matti, J.C., Miller, F.K., Powell, R.E., Kennedy, S.A., Bunyapanasarn, T.P., Koukladas, C., Hauser, R.M., and Cossette, P.M., 1997, Geologic-point attributes for digital geologic-map data bases produced by the Southern California Areal Mapping Project (SCAMP): U.S. Geological Survey Open-File Report 97-859, 7 p.
URL: <http://scamp.wr.usgs.gov/lineset.tar> and <http://scamp.wr.usgs.gov/markerset.tar>

Wilson, E. D., Moore, R. T., and Cooper, J. R., 1969, Geologic Map of Arizona, 1 sheet, scale: 1:500,000. (1969 printing, USGS Map G61063; 1983 printing, USGS Map G810436)

Appendix A: List of files included in this Open-File Report

Only the files created by the authors are listed; the files that accompany a dataset that are automatically created and maintained by Arc/Info are not listed.

The Arc/Info interchange files (*.e00) were created using the default values for compression and max_lines (see the Arc/Info 'export' command). Indented entries are files created by running the Arc/Info 'import' command on the preceding Arc/Info interchange file. The Arc/Info macro named import.aml will do the import process automatically.

Abbreviations used:

A/I - Arc/Info

RTL - Raster Transfer Language

NAME	FORMAT	BRIEF DESCRIPTION
az500k.pdf	Adobe Acrobat PDF	Open-File Report text
az500k.met	text	Metadata file for the database
az500ks.e00	Arc/Info interchange file	
az500k.shd	Arc/Info shadeset	Polygon shades for geologic map units
azfold.e00	Arc/Info interchange file	
azfold	Arc/Info coverage	Geologic fold axes arcs dataset
azfold.str	INFO database table	Look-up table with structure attributes for azfold dataset
azfold.ref	INFO database table	Look-up table with source attributes for azfold dataset
azgeol.e00	Arc/Info interchange file	
azgeol	Arc/Info coverage	Geologic contacts and fault arcs and geologic map unit polygons dataset
azgeol.con	INFO database table	Look-up table with contact attributes for azgeol dataset
azgeol.str	INFO database table	Look-up table with structure attributes for azgeol dataset
azgeol.ru	INFO database table	Look-up table with map unit attributes for azgeol dataset
azgeol.ref	INFO database table	Look-up table with source attributes for azgeol dataset
azptdec.e00	Arc/Info interchange file	
azptdec	Arc/Info coverage	Points to decorate fault and fold axes arcs dataset
azptdec.lut	INFO database table	Look-up table with point attributes for azptdec dataset
azptdec.ref	INFO database table	Look-up table with source attributes for azptdec dataset
azptfeat.e00	Arc/Info interchange file	
azptfeat	Arc/Info coverage	Geologic features points dataset
azptfeat.lut	INFO database table	Look-up table with point attributes for azptfeat dataset
azptfeat.ref	INFO database table	Look-up table with source attributes for azptfeat dataset
disclaim.tex	text	Disclaimer for map sheets
fnt026.e00	Arc/Info interchange file	
fnt026	Arc/Info font file	Font patterns used by scamp2b.lin
fnt037.e00	Arc/Info interchange file	
fnt037	Arc/Info font file	Font patterns used by scamp2b.mrk

geo_dd.prj	text	Arc/Info projection file
import.aml	text	Arc/Info macro to import interchange (*.e00) files
indxbib1.tex	text	Sources bibliography for Wilson and others 1983 map, column 1
indxbib2.tex	text	Sources bibliography for Wilson and others 1983 map, column 2
lamb.prj	text	Arc/Info Lambert projection file
lambinfo.tex	text	Lambert projection parameters for maps
mapbar.aml	text	A/I macro to create a scale bar graphic
mapcred.tex	text	Map and database credits
ofrlin.key	text	Arc/Info line key
ofrmrk.key	text	Arc/Info marker key
ofrshd.key	text	Arc/Info shade key
readme.txt	text	List of files in the Open-File Report
relate1.e00	Arc/Info interchange file	
relate1	INFO database table	Relates for datasets and associated tables
refs.tex	text	Explanation references for Wilson and others 1983 map
scamp2bl.e00	Arc/Info interchange file	
scamp2b.lin	Arc/Info lineset	Line symbols for arcs
scamp2bm.e00	Arc/Info interchange file	
scamp2b.mrk	Arc/Info markerset	Marker symbols for points
sheet1.aml	text	Arc/Info macro to create sheet1.gra - complete state map
sheet2.aml	text	Arc/Info macro to create sheet2.gra - north part of state map
sheet3.aml	text	Arc/Info macro to create sheet3.gra - south part of state map
sheet1.gra	A/I graphics file	46" x 68" geology map composition
sheet2.gra	A/I graphics file	46" x 35" geology map composition
sheet3.gra	A/I graphics file	46" x 35" geology map composition
sheet1.rtl	RTL	46" x 68" geology map composition - complete state map
sheet2.rtl / .pdf	RTL / PDF	35" x 46" geology map (rotated 90 deg.) - north part of state map
sheet3.rtl / .pdf	RTL / PDF	35" x 46" geology map (rotated 90 deg.) - south part of state map
sheetidx.gra	A/I graphics file	Graphic for map sheet index
sources.e00	Arc/Info interchange file	
sources.ref	INFO database table	Source attributes for features in all datasets
srcmap.gra	A/I graphics file	Graphic showing map sources (from Wilson and others, 1983)
usgslogo.gra	A/I graphics file	Graphic for U.S. Geological Survey visual identifier

Appendix B: Transformation report

This listing is the result of the Arc/Info 'transform' command creating the dataset (coverage) **azgeol**, and is typical of the results from the transform used to create the four datasets (coverages) described in this report.

Scale (X,Y) = (12707.431,12696.837)

Skew (degrees) = (-0.023)

Rotation (degrees) = (-0.025)

Translation = (-266712.410,3687089.416)

RMS Error (input,output) = (0.004,54.930)

Affine $X = Ax + By + C$

$Y = Dx + Ey + F$

A = 12707.430 B = 0.421 C = -266712.410

D = -5.588 E = 12696.838 F = 3687089.416

tic id	input x output x	input y output y	x error	y error
14020	6.089	12.923		
	-189338.094	3851133.750	8.540	8.723
14030	6.274	21.664		
	-186895.438	3962102.750	-82.383	21.890
13020	13.537	12.801		
	-94674.781	3849571.000	-17.223	-28.940
13030	13.635	21.543		
	-93453.375	3960560.250	18.388	-14.351
15050	-0.496	39.301		
	-273004.344	4186039.000	3.485	54.671
15070	0.080	56.694		
	-265708.969	4406945.000	35.261	-16.286
14040	6.466	30.388		
	-184456.719	4072892.750	-79.861	-7.812
14050	6.664	39.104		
	-182021.250	4183535.500	5.074	18.692
13040	13.728	30.273		
	-92233.945	4071370.250	-19.506	16.370
13050	13.826	38.984		
	-91016.141	4182033.250	16.517	-44.773
14060	6.856	47.807		
	-179588.312	4294063.000	12.496	-12.357
14070	7.046	56.510		
	-177157.188	4404508.500	7.806	45.478
13060	13.924	47.696		
	-89799.594	4292581.000	46.431	17.887
12020	20.995	12.765		
	0.000	3849050.000	81.912	-3.776
11020	28.443	12.804		
	94674.781	3849571.000	61.224	-68.433
11030	28.343	21.551		
	93453.375	3960560.250	7.327	0.717
10030	35.693	21.676		
	186895.438	3962102.750	-31.770	5.410

tic id	input x output x	input y output y	x error	y error
9030	43.051 280314.875	21.888 3964673.500	52.065	79.409
12040	20.989 0.000	30.232 4070862.750	20.510	-43.241
11040	28.241 92233.945	30.280 4071370.250	-64.599	15.404
10040	35.499 184456.719	30.404 4072892.750	-60.823	30.684
12060	20.990 0.000	47.656 4292087.000	34.856	-29.526
11060	28.052 89799.594	47.701 4292581.000	-23.196	7.473
12070	20.989 0.000	56.356 4402558.500	21.361	-40.306
11070	27.954 88583.961	56.402 4403046.000	-50.505	16.423
10070	34.928 177157.188	56.518 4404508.500	1.098	-8.910
9040	42.757 276657.156	30.609 4075429.750	-27.115	62.199
9050	42.473 273004.344	39.309 4186039.000	22.629	-82.719

Appendix C: Describe output for the Arizona datasets

Description of SINGLE precision coverage AZGEOL

FEATURE CLASSES

Feature Class	Subclass	Number of Features	Attribute data (bytes)	Spatial Index?	Topology?
-----	-----	-----	-----	-----	-----
ARCS		25546	36		
POLYGONS		10807	30		Yes
NODES		18540			

SECONDARY FEATURES

Tics	28
Arc Segments	393360
Polygon Labels	10806

TOLERANCES

Fuzzy = 0.879 V Dangle = 0.100 V

COVERAGE BOUNDARY

Xmin = -265535.875 Xmax = 280908.688
 Ymin = 3775534.000 Ymax = 4406138.000

STATUS

The coverage has not been Edited since the last BUILD or CLEAN.

COORDINATE SYSTEM DESCRIPTION

Projection	LAMBERT
Units	METERS
Spheroid	CLARKE1866
Parameters:	
1st standard parallel	33 0 0.000
2nd standard parallel	45 0 0.000
central meridian	-112 0 0.00
latitude of projection's origin	0 0 0.000
false easting (meters)	0.00000
false northing (meters)	0.00000

Description of SINGLE precision coverage AZFOLD

FEATURE CLASSES

Feature Class	Subclass	Number of Features	Attribute data (bytes)	Spatial Index?	Topology?
ARCS		250	36		
NODES		546			
ANNOTATIONS	(blank)	8			

SECONDARY FEATURES

Tics	28
Arc Segments	3857

TOLERANCES

Fuzzy = 62.753 N Dangle = 0.000 N

COVERAGE BOUNDARY

Xmin = -171110.109 Xmax = 266871.688
 Ymin = 3778380.250 Ymax = 4405908.000

STATUS

The coverage has not been Edited since the last BUILD or CLEAN.

COORDINATE SYSTEM DESCRIPTION

Projection	LAMBERT
Units	METERS
Spheroid	CLARKE1866
Parameters:	
1st standard parallel	33 0 0.000
2nd standard parallel	45 0 0.000
central meridian	-112 0 0.00
latitude of projection's origin	0 0 0.000
false easting (meters)	0.00000
false northing (meters)	0.00000

Description of SINGLE precision coverage AZPTFEAT

FEATURE CLASSES

Feature Class	Subclass	Number of Features	Attribute data (bytes)	Spatial Index?	Topology?
-----	-----	-----	-----	-----	-----
Points		437	24		

SECONDARY FEATURES

Tics 28

TOLERANCES

Fuzzy = 47.353 N Dangle = 0.000 N

COVERAGE BOUNDARY

Xmin = -144648.656 Xmax = 273688.781
 Ymin = 3780243.250 Ymax = 4253694.000

STATUS

The coverage has not been Edited since the last BUILD or CLEAN.

COORDINATE SYSTEM DESCRIPTION

Projection LAMBERT
 Units METERS
 Spheroid CLARKE1866
 Parameters:
 1st standard parallel 33 0 0.000
 2nd standard parallel 45 0 0.000
 central meridian -112 0 0.000
 latitude of projection's origin 0 0 0.000
 false easting (meters) 0.00000
 false northing (meters) 0.00000

Description of SINGLE precision coverage AZPTDEC

FEATURE CLASSES

Feature Class	Subclass	Number of Features	Attribute data (bytes)	Spatial Index?	Topology?
Points		776	30		

SECONDARY FEATURES

Tics 28

TOLERANCES

Fuzzy = 62.518 N Dangle = 0.000 N

COVERAGE BOUNDARY

Xmin = -244386.234 Xmax = 271258.750
 Ymin = 3779326.750 Ymax = 4404510.500

STATUS

The coverage has not been Edited since the last BUILD or CLEAN.

COORDINATE SYSTEM DESCRIPTION

Projection LAMBERT
 Units METERS
 Spheroid CLARKE1866
 Parameters:
 1st standard parallel 33 0 0.000
 2nd standard parallel 45 0 0.000
 central meridian -112 0 0.000
 latitude of projection's origin 0 0 0.000
 false easting (meters) 0.00000
 false northing (meters) 0.00000

Appendix D: Explanation of geologic map units (from Wilson and others, 1983)

- Qs - **SEDIMENTARY DEPOSITS:** Mainly alluvial gravel, sand, and silt in flood plains, terraces, fans, and pediment cappings but locally includes dune sand, lake deposits, and landslide masses. Shown only in areas where they are of appreciable thickness or extent.
- Qb - **VOLCANIC ROCKS:** Basaltic flows, agglomerate, tuffs, and cinders distinguished from older basalts by recognizable cinder cones, craters, and other geomorphic evidence of recent formation.
- Qr - **VOLCANIC ROCKS:** Rhyolitic flows and tuff resting disconformably on Qs. Recognized only in Yuma County.
- Qi - **DIKES AND PLUGS:** Mainly basaltic in composition.
- QTs - **SEDIMENTARY DEPOSITS:** Includes Gila Conglomerate and other stream and lake deposits mainly in intermontane areas. Consists of loosely to firmly consolidated gravel, sand, and silt, local clay, gypsum, marl, limestone, diatomite, and some intercalated basalt flows and felsic tuff beds.
- QTv - **VOLCANIC ROCKS:** Undivided rhyolitic to andesitic flows and pyroclastic rocks; includes some plugs and dikes. Includes units interfingering with QTs and some possibly older units whose debris is in QTs.
- QTb - **VOLCANIC ROCKS:** Basaltic flows, agglomerate, tuff, and cinders. Includes units interfingering with QTs and some possibly older units whose debris is in QTs.
- QTr - **VOLCANIC ROCKS:** Rhyolite flows and pyroclastic rocks. Includes units interfingering with QTs and some possibly older units whose debris is in QTs.
- QTi - **DIKES AND PLUGS:** Mainly andesitic to basaltic in composition but includes some rhyolitic intrusives in central Yuma County.
- Tbs - **SEDIMENTARY DEPOSITS:** Sedimentary part of the Bidahochi Formation (Pliocene) in northeastern Arizona consisting of sandstone, siltstone, and locally bentonitic clay.
- Tc - **SEDIMENTARY DEPOSITS:** Chuska Sandstone (Pliocene?) in Apache County.
- Tps - **SEDIMENTARY DEPOSITS:** Includes: fossiliferous alluvial and lacustrine deposits of middle or early Pliocene age within valleys of the present drainage system and correlative conglomerate, sand, silt, and clay; Daniels Conglomerate of western Pima County and other unfossiliferous alluvial conglomerates that locally contain lava flows, tuffs, and breccias and interfinger with Tertiary volcanic rocks known to be younger than Tms; and terrestrial deposits tentatively correlated with the Chuska Sandstone or Bidahochi Formation.
- Tms - **SEDIMENTARY ROCKS:** Terrestrial conglomerate, sandstone, siltstone, limestone, tuffaceous beds, and andesitic flows and breccias, including Locomotive Fanglomerate, Helmet Fanglomerate, Pantano Formation, and Whitetail Conglomerate; and fossiliferous beds in Pima and Yuma Counties known to be no older than late Oligocene or younger than middle Miocene.
- Ts - **SEDIMENTARY ROCKS:** Mainly conglomerate, sandstone, siltstone, limestone, and tuffaceous beds but locally includes volcanic units ranging from rhyolitic to andesitic in composition.
- Tv - **VOLCANIC ROCKS:** Rhyolitic to basaltic rocks, flows, tuffs, breccias, and agglomerates interfingering in part with Tertiary sedimentary rocks. Includes some plugs and dikes.

Tvs - VOLCANIC ROCKS: Silicic volcanic rocks, flows, tuffs, breccias, and agglomerates interfingering in part with Tertiary sedimentary rocks. Includes some plugs and dikes.

Tvi - VOLCANIC ROCKS: Intermediate volcanic rocks, flows, tuffs, breccias, and agglomerates interfingering in part with Tertiary sedimentary rocks. Includes some plugs and dikes.

Tvm - VOLCANIC ROCKS: Mafic volcanic rocks, flows, tuffs, breccias, and agglomerates interfingering in part with Tertiary sedimentary rocks. Includes some plugs and dikes.

Ti - DIKES, SILLS, AND PLUGS: Rhyolitic to basaltic in composition.

TKs - SEDIMENTARY ROCKS: Includes Clodburst Formation in Pinal County and unnamed shale, sandstone, conglomerate, and limestone units in southern and western parts of the State; locally contains volcanic rocks.

TKv - VOLCANIC ROCKS: Andesitic to rhyolitic in composition, including flows, pyroclastic rocks, and associated conglomerates consisting largely of volcanic debris. Where in contact with penecontemporaneous intrusive rocks (TKg, TKdi, TKi), the intrusive rocks generally cut the volcanic rocks.

TKa - VOLCANIC ROCKS: Predominantly andesitic in composition, including flows, pyroclastic rocks, and associated conglomerates consisting largely of volcanic debris. Where in contact with penecontemporaneous intrusive rocks (TKg, TKdi, TKi), the intrusive rocks generally cut the volcanic rocks.

TKr - VOLCANIC ROCKS: Predominantly rhyolitic in composition, including flows, pyroclastic rocks, and associated conglomerates consisting largely of volcanic debris. Where in contact with penecontemporaneous intrusive rocks (TKg, TKdi, TKi), the intrusive rocks generally cut the volcanic rocks.

TKg - INTRUSIVE ROCKS: Granite, quartz monzonite, granodiorite, quartz diorite, and some porphyry equivalents of these rocks

TKdi - INTRUSIVE ROCKS: Diorite; includes laccoliths of diorite porphyry in Carrizo Mountains

TKi - INTRUSIVE ROCKS: Granitic, dioritic, rhyolitic, and andesitic dikes, sills, and plugs.

TKsc - METAMORPHIC ROCKS: schist and phyllite

TKgn - METAMORPHIC ROCKS: Gneiss derived mainly from intrusive rocks of early Tertiary and Late Cretaceous age but locally includes phases derived from sedimentary and igneous rocks ranging in age from Precambrian through Cretaceous in eastern Pima County.

Kmv - MESAVERDE GROUP: In Black Mesa area includes Yale Point Sandstone, Wepo Formation, and Toreva Formation

Km - MANCOS SHALE

Kd - DAKOTA SANDSTONE

Kus - SEDIMENTARY ROCKS: Includes Pinkard Formation in Greenlee County and probably equivalent beds in Graham and Pinal Counties. Upper Cretaceous beds in the Santa Rita Mountains are included with undivided Cretaceous rocks (Ks).

Kls - SEDIMENTARY ROCKS: Includes Bisbee Group in the southeastern part of the State; in northern Cochise County also includes underlying Jurassic(?) or Triassic(?) volcanic rocks.

Ks - SEDIMENTARY AND VOLCANIC ROCKS: Includes Amole Arkose and Recreation Red Beds of Brown (1939) and other units of known or supposed Cretaceous age.

Kv - VOLCANIC ROCKS: Rhyolitic to andesitic flows and tuffs.

Kr - VOLCANIC ROCKS: Predominantly rhyolitic flows and tuffs

Ka - VOLCANIC ROCKS: Predominantly andesitic flows and tuffs

Kvs - SEDIMENTARY AND VOLCANIC ROCKS: Intercalated sedimentary and rhyolitic to andesitic volcanic rocks.

Jm - MORRISON FORMATION: Mapped with San Rafael Group south of latitude 35°50' north.

Jsr - SAN RAFAEL GROUP: Includes Bluff and Cow Springs Sandstones, Summerville Formation, Todilto Limestone, and Entrada Sandstone of Late Jurassic age, and Carmel Formation of Late and Middle Jurassic age.

JTRgc - GLEN CANYON GROUP: Includes Navajo Sandstone (Jurassic and Triassic?), Kayenta Formation (Upper Triassic?), Moenave Formation (Upper Triassic?), and Wingate Sandstone (Upper Triassic).

JTRg - INTRUSIVE ROCKS: Granite, quartz monzonite, alaskite, and granitic to monzonitic porphyries.

TRc - CHINLE FORMATION

TRcs - CHINLE FORMATION: Shinarump Member of Chinle Formation mapped separately north of latitude 35°10' north.

TRm - MOENKOPI FORMATION: Includes Hoskinnini. Member of Triassic(?) age in Monument Valley area.

MZsc - MESOZOIC METAMORPHIC ROCKS: Schist and phyllite derived from Mesozoic sedimentary rocks.

MZgn - MESOZOIC METAMORPHIC ROCKS: Gneiss

MZgr - MESOZOIC GRANITE TO QUARTZ DIORITE

MZv - MESOZOIC VOLCANIC ROCKS: Rhyolitic to andesitic flows and pyroclastic rocks; locally includes interfingering shale, sandstone, and conglomerate. Includes units known to predate Lower Cretaceous rocks in the Huachuca and Patagonia Mountains.

MZs - MESOZOIC SEDIMENTARY ROCKS: Includes limestone, shale, and sandstone, and conglomerate; locally metamorphosed.

MZPZs - MESOZOIC AND PALEOZOIC SEDIMENTARY ROCKS: Mesozoic and Paleozoic sedimentary rocks undivided

Pkt - KAIBAB LIMESTONE AND TOROWEAP FORMATION

Pc - COCONINO SANDSTONE

Pdc - DE CHELLY SANDSTONE

Pct - CUTLER FORMATION: Includes De Chelly Sandstone Member, Organ Rock Tongue, Cedar Mesa Sandstone Member, and Halgaito Tongue in the Monument Valley area.

Ph - HERMIT SHALE

PPPn - NACO GROUP UNDIVIDED

Pnu - NACO GROUP UPPER FORMATIONS: Includes Rainvalley Formation, Concha Limestone, and Scherrer Formation.

PPPnl - NACO GROUP LOWER FORMATIONS: Includes Epitaph Dolomite (Permian), Colina Limestone (Permian), Earp Formation (Permian and Upper Pennsylvanian), and Horquilla Limestone (Pennsylvanian). Also includes the Naco Formation as used in central Arizona.

PPPs - SUPAI FORMATION

PPPc - PAKOON AND CALLVILLE LIMESTONES: Pakoon Limestone (Permian) and Callville Limestone (Pennsylvanian) of McNair (1951) undivided.

PZs - PALEOZOIC SEDIMENTARY ROCKS: Paleozoic sedimentary rocks undivided

MDs - SEDIMENTARY ROCKS: Includes Upper Mississippian Paradise Formation of Stoyanow (1926) and Hernon (1935) in extreme southeastern Arizona; Escabrosa Limestone (Upper and Lower Mississippian) and Martin Formation (Devonian) in much of southern and central Arizona; Redwall Limestone (Mississippian) and Temple Butte Limestone (Upper? Devonian) in northern Arizona; Modoc Limestone (Lower Mississippian) and Morenci Shale (Upper Devonian) in western Greenlee County; and locally Pennsylvanian limestone.

Ocs - SEDIMENTARY ROCKS: Includes Longfellow Limestone (Lower Ordovician and Upper Cambrian) and Coronado Quartzite (Upper Cambrian) in Greenlee County; El Paso Limestone (Lower Ordovician), Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartzite (Middle Cambrian) in eastern Cochise County; Abrigo Formation and Bolsa Quartzite in western Cochise, Graham, Pima, Santa Cruz, Pinal, Gila, and Maricopa Counties; Tonto Group (Middle and Lower Cambrian) in northern and central Arizona; and Ordovician(?) and Cambrian limestone and dolomite in northwestern Mohave County.

pCdb - DIABASE: Locally includes post-Precambrian diabase.

pCt - TROY QUARTZITE: Locally may contain Cambrian sandstone and quartzite.

pCg - GRAND CANYON SERIES: Includes Chuar and Unkar Groups.

pCa - APACHE GROUP: Includes Mescal Limestone and associated basalt flows, Dripping Spring Quartzite, and Pioneer Shale.

pCgr - INTRUSIVE ROCKS: Granite, quartz monzonite, granodiorite, and quartz diorite. Locally includes areas of granitic rocks and other igneous rocks of post-Paleozoic age.

pCdi - INTRUSIVE ROCKS: Diorite, diorite porphyry, and gabbro.

pCpy - INTRUSIVE ROCKS: Pyroxenite.

pCm - MAZATZAL QUARTZITE: Locally includes Deadman Quartzite and Maverick Shale of Wilson (1939).

pCry - RHYOLITE: Mainly flows and intrusive material but includes minor amounts of agglomerate and breccia.

pCsc - METAMORPHOSED SEDIMENTARY AND VOLCANIC ROCKS: Includes Vishnu Schist in Grand Canyon area, Yavapai Series in central Arizona, Pinal Schist in southeastern Arizona, and unnamed schistose units. Mainly phyllite, slate, mica schist, chlorite schist and amphibolite derived from interbedded shale, sandstone, and rhyolitic to basaltic flows and tuffs but locally includes intrusive rhyolite, diorite, gabbro, and pyroxenite.

pCgs - METAMORPHOSED SEDIMENTARY AND VOLCANIC ROCKS: Mainly nonfoliated greenstone units derived from metamorphism of mafic flows and intrusive rocks. Mainly phyllite, slate, mica schist, chlorite schist and amphibolite derived from interbedded shale, sandstone, and rhyolitic to basaltic flows and tuffs but locally includes intrusive rhyolite, diorite, gabbro, and pyroxenite.

pCgn - METAMORPHOSED SEDIMENTARY AND VOLCANIC ROCKS: Gneiss; includes some areas of undivided schist and granite. Mainly phyllite, slate, mica schist, chlorite schist and amphibolite derived from interbedded shale, sandstone, and rhyolitic to basaltic flows and tuffs but locally includes intrusive rhyolite, diorite, gabbro, and pyroxenite.

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Appendix E: Sources for the Geologic Map of Arizona (from Wilson and others, 1983)

(keyed to Figure E1)

Source citations have been locally modified or adjusted by the authors or by collaborating members of the staff of the U. S. Geological Survey.

* indicates published.

+ indicates unpublished map made for use in compiling county map or maps published by the Arizona Bureau of Mines, 1957-60.

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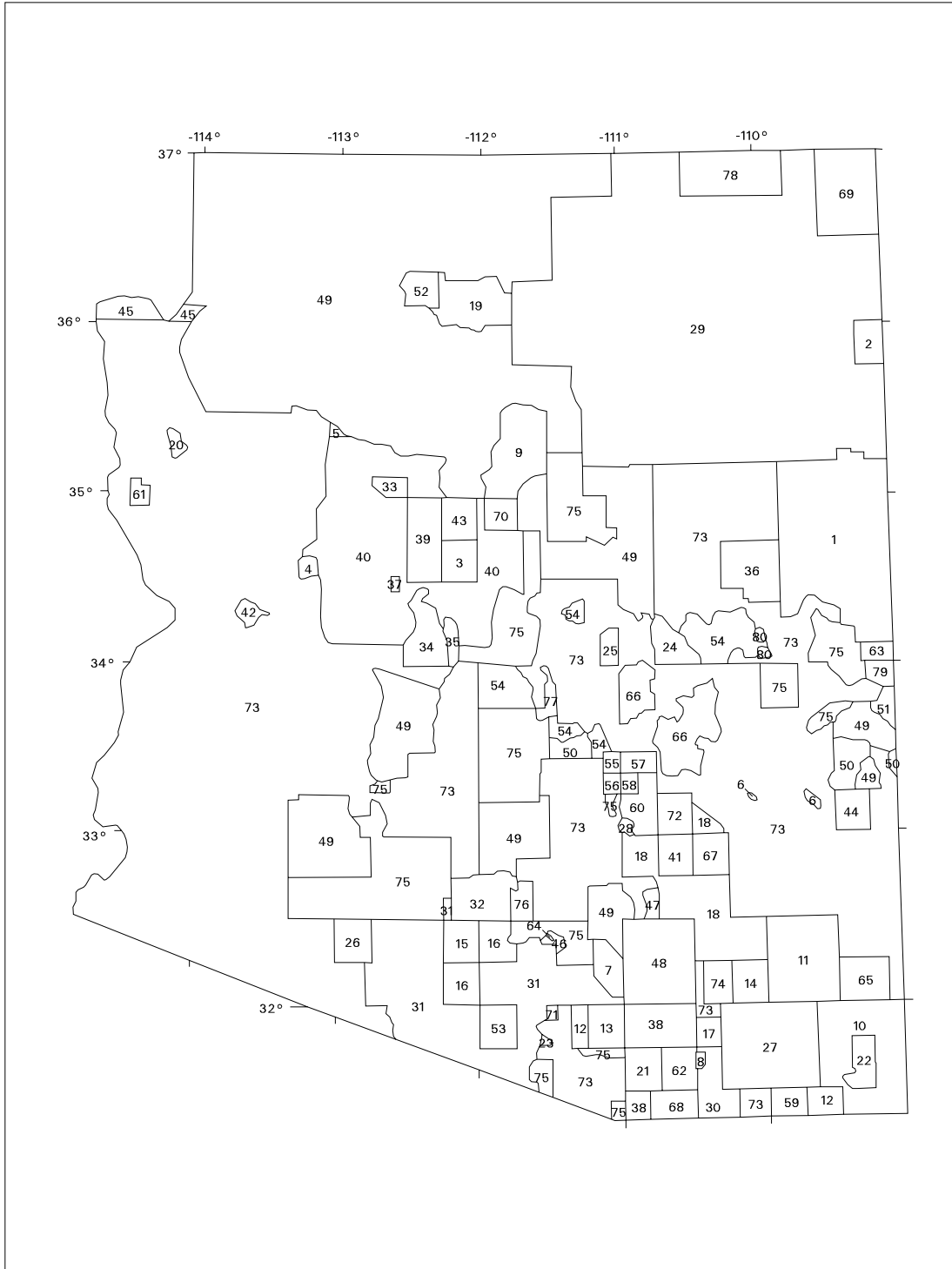


Figure E1: Sources Index Map

Appendix F: Metadata (az500k.met)

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Douglas M. Hirschberg

Originator: G. Stephen Pitts

Publication_Date: 2000

Title: Digital geologic map of Arizona: a digital database
derived from the 1983 printing of the
Wilson, Moore, and Cooper 1:500,000-scale map

Edition: Digital Version 1.0

Geospatial_Data_Presentation_Form: map

Series_Information:

Series_Name: USGS Open-File Report

Issue_Identification: OFR 00-409

Publication_Information:

Publication_Place: Menlo Park, California

Publisher: U.S. Geological Survey

Online_Linkage: URL=<http://geopubs.wr.usgs.gov/open-file/of00-409/>

Description:

Abstract:

The Geologic Map of Arizona was compiled at a scale of 1:500,000 by Eldred D. Wilson, Richard T. Moore and John R. Cooper, in 1969 and reprinted in 1977, 1981, and 1983.

Comparison of an acetate copy of the 1983 map with existing paper copies of earlier maps shows some updating of the original by 1983.

This 1983 acetate was scanned and vectorized by Optronics Specialty Co., Inc. in 1998, and put into an Arc/Info geographic information system (GIS).

The digital geologic map database can be queried in many ways to produce a variety of derivative geologic maps.

Original Publication:

Geologic Map of Arizona

by: Eldred D. Wilson, Richard T. Moore, and John R. Cooper

Digitizers: Optronics Specialty Co., Inc, and Douglas M. Hirschberg

Digital Version of:

Geologic map of Arizona, 1:500,000, 1983 printing

by: Eldred D. Wilson, Richard T. Moore, and John R. Cooper

Digital Database by Douglas M. Hirschberg and G. Stephen Pitts

Purpose:

This database was developed to provide a GIS of the geologic map of the State of Arizona for use at a scale of 1:500,000 or smaller. This GIS is intended for use in future spatial analysis by a variety of users.

The geologic unit descriptions for this map may be updated

to reflect more current description of structures and the geochronology of the map units.

This database is not meant to be used or displayed at any scale larger than 1:500,000 (e.g., 1:100,000 or 1:24,000)

Supplemental_Information:

This GIS database consists of 4 Arc/Info datasets:
one line and polygon file (azgeol)
containing geologic contacts and structures (lines)
and geologic map rock units (polygons),
one line file (azfold) containing the folds and
crater boundaries,
one point file (azptfeat) containing geologic features,
cinder cones and diatremes.
one point file (azptdec) containing decorations, and

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 2000

Currentness_Reference: Publication Date of Open-File Report 00-409

Status:

Progress: Complete

Maintenance_and_Update_Frequency: Uncertain

May update newer structure and geochronology in future

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -115.00

East_Bounding_Coordinate: -108.75

North_Bounding_Coordinate: 37.00

South_Bounding_Coordinate: 31.25

Keywords:

Theme:

Theme_Keyword_Thesaurus: none

Theme_Keyword: geology

Theme_Keyword: geologic map

Place:

Place_Keyword_Thesaurus: none

Place_Keyword: Arizona

Access_Constraints: none

Use_Constraints:

These data are not to be used at scales greater than 1:500,000.

Any hardcopies utilizing these data sets shall clearly indicate their source. If the user has modified the data in any way they are obligated to describe the types of modifications they have performed on the hardcopy map. User specifically agrees not to misrepresent these data sets, nor to imply that changes they made were approved by the U.S. Geological Survey.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: G. Stephen Pitts

Contact_Organization: U.S. Geological Survey

Contact_Position: GIS Lab coordinator, contractor

Contact_Address:

Address_Type: (mailing and physical address)

Address: 520 N. Park Ave, suite 355

City: Tucson

State_or_Province: Arizona

Postal_Code: 85719

Country: USA

Contact_Voice_Telephone: 1-520-670-5511

Contact_Facsimile_Telephone: 1-520-670-5571

Contact_Electronic_Mail_Address: bear@usgs.gov

Data_Set_Credit:

Eldred D. Wilson, Richard T. Moore, and John R. Cooper compiled the geologic map of which an acetate archive copy of the separates were located in Reston VA.

Robert Miller (USGS) attached fiducial ticks to assure registration accuracy. Optronics Specialty Co., Inc. scanned the geologic map and provided minimally attributed Arc/Info interchange-format files to the USGS.

Douglas M. Hirschberg imported the files, transformed them to Lambert Conformal Conic, attached and attributed an interim geologic map data model, verified arc, point, and polygon attribution, added, re-positioned, or re-attributed features as needed, and assisted in creating the look-up tables.

G. Stephen Pitts assisted with the design of the data model, entered the explanatory and source text, assisted in creating the look-up tables, and wrote the metadata.

Native_Data_Set_Environment:

SunOS, 5.6, sun4u UNIX

ARC/INFO version 7.2.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

Accuracy of the Attribution was verified by manual comparison of the sources with hard copy printouts and plots.

Logical_Consistency_Report:

Polygon and chain-node topology present.

Polygons intersecting the neatline are closed along the border.

Segments making up the outer and inner boundaries of a polygon tie end-to-end to completely enclose the area. Line segments are a set of sequentially numbered coordinate pairs. No duplicate features exist nor duplicate points in a data string. Intersecting lines are separated into individual line segments at the point of

intersection. All nodes are represented by a single coordinate pair which indicates the beginning or end of a line segment. The map boundary came from the scan, was projected to Lambert Conformal Conic.

Completeness_Report:

The digital dataset was produced from a previously published map (Wilson, Moore, & Cooper, 1969) which is considered to be a high quality cartographic product, generally speaking contacts exist where mapped, and the best available at 1:500,000. From subsequent mapping, errors are known to exist with the structure and geochronology.

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:

The horizontal positional accuracy for the digital data may be no better than +/- 500 meters (1 mm at mapscale). It was tested by visual comparison of the source acetate and available paper maps with hard copy plots.

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: Eldred D. Wilson, Richard T. Moore, John R. Cooper

Publication_Date: 1983

Title: Geologic Map of Arizona

Geospatial_Data_Presentation_Form: map

Series_Information:

Series_Name: map series: G

Issue_Identification: 81036

Publication_Information:

Publication_Place: Reston, VA

Publisher: U.S. Geological Survey

Source_Scale_Denominator: 500000

Type_of_Source_Media: acetate separate

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 1983

Source_Currentness_Reference: 1983, date of publication

Source_Citation_Abbreviation: Wilson and others (1983)

Source_Contribution: geologic units, contact, and structure

Process_Step:

Process_Description:

The original separates for this map were not locatable in Menlo Park, CA, and after extensive search, thought to no longer exist. By thorough investigation, two separates, the water layer and the geologic units, were found in a map tube in Reston, VA., and forwarded to Menlo Park, CA. where Robert Miller attached Lat-Lon tics to the acetate layer of the geologic units to assure registration accuracy

Process_Date: 1998

Process_Step:

Process_Description:

The registered acetate separate of the geologic units, contacts, and structure was scanned, vectorized, minimally attributed, and exported to an Arc/Info interchange-format by Optronics Specialty Co., Inc and files were given to the USGS in Tucson

Process_Date: 1998

Process_Step:

Process_Description:

The four coverages were transformed to Lambert Conformal Conic projection using 28 tics which produced an RMS error of 0.004. All linework, points, and attributions were verified by extensively comparison between printed versions of the map, the 1983 source acetate, and hard copy plots derived from the database. Some very small polygons were not identifiable on the original printed maps or the acetate, and were eliminated. Some small polygons were missing from the initial capture, and were re-captured by D.M. Hirschberg.

All faults were attributed as Throw Unknown, Normal, Thrust, or Strike Slip, as determined from visual inspection of attributions on the paper map. Faults where attributed, were identified as U/D, T, or, in two cases on the 1983 map, with the right lateral strike slip decoration. Sense of up or down was determined by placement of the letters U and D on the paper map. Sense of upper plate, lower plate for thrust faults was inconsistent, (T on side of older rock in some cases and on side of younger rocks in other), so no upper plate / lower plate attribution was made on the Trust faults.

All coverages and associated files and macros are included in the Open-File Report 00-409, available on the internet at <http://geopubs.wr.usgs.gov/open-file/of00-409>

Process_Date: 1999

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Point

Point_and_Vector_Object_Count: 10803

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: String

Point_and_Vector_Object_Count: 25546

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains

Point_and_Vector_Object_Count: 10807

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Lambert Conformal Conic

Lambert_Conformal_Conic:

Standard_Parallel: 33

Standard_Parallel: 45

Longitude_of_Central_Meridian: -112

Latitude_of_Projection_Origin: 0

False_Easting: 0.00000

False_Northing: 0.00000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: coordinate pair

Coordinate_Representation:

Abscissa_Resolution: 25.39368057251

Ordinate_Resolution: 25.39368057251

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927

Ellipsoid_Name: Clarke 1866

Semi-major_Axis: 6378206.4

Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Overview_Description:

Entity_and_Attribute_Overview:

The 'Digital Geologic Map of Arizona; a digital database from the 1983 printing of the Eldred D. Wilson and Richard T. Moore, and John R. Cooper 1:500,000-scale map' Open-File Report 00-409 contains a detailed description of each attribute code and a reference to the associated map symbols on the map source materials.

This GIS database consists of four Arc/Info datasets:

one line and polygon file, azgeol,
containing geologic contacts and structures (lines)
and geologic map rock units (polygons),
one line file, azfold, containing the folds and
crater boundaries,
one point file, azptfeat, containing geologic features,
cinder cones and diatremes, and
one point file, azptdec, containing decorations.

Azgeol contains an arc attribute table, azgeol.aat, which relates geologic linework arc attribution to the contact look-up table, azgeol.con, the structural attribute table, azgeol.str and the source reference look-up table, sources.ref. Azgeol also contains a polygon attribute table, azgeol.pat, which relates the polygons to the rock-unit look-up table, azgeol.ru, and the source reference look-up table, sources.ref.

Azfold contains an arc attribute table, azfold.aat, which relates to the structural attribute table, azfold.str, and

the source reference look-up table, sources.ref.

Azptfeat contains the point attribute table, azptfeat.pat, which relates the feature points to their descriptions in azptfeat.lut, and the source reference look-up table, sources.ref.

Azptdec contains the point attribute table, azptdec.pat, which relates the points to descriptions in the look-up table, azptdec.lut, and the source reference look-up table, sources.ref.

Entity_and_Attribute_Detail_Citation

A detailed description of the items in the Arizona 500K GIS database is given in the text of the Open-File Report 00-409 available in Adobe Acrobat PDF format on the World Wide Web at <http://geopubs.wr.usgs.gov/open-file/of00-409>

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: U.S. Geological Survey Information Services

Contact_Address:

Address_Type: mailing and physical address

Address: Open-File Reports, Box 25286

City: Denver

State_or_Province: CO

Postal_Code: 80225

Country: USA

Contact_Voice_Telephone: 1-303-202-4200

Contact_Facsimile_Telephone: 1-303-202-4693

Contact_Information:

Contact_Person_Primary:

Contact_Person: G. Stephen Pitts

Contact_Organization: U.S. Geological Survey

Contact_Position: GIS Lab coordinator

Contact_Address:

Address_Type: (mailing and physical address)

Address: 520 N. Park Ave, suite 355

City: Tucson

State_or_Province: Arizona

Postal_Code: 85719

Country: USA

Contact_Voice_Telephone: 1-520-670-5511

Contact_Facsimile_Telephone: 1-520-670-5571

Contact_Electronic_Mail_Address: bear@usgs.gov

Distribution_Liability:

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In no event shall the USGS have any liability whatsoever for payment of any consequential, incidental, indirect, special, or tort damages of any kind, including, but not limited to, any loss of profits arising out of use of or reliance on the geographic data or arising out of the delivery, installation, operation, or support by USGS.

This digital geologic map GIS of the Geologic Map of Arizona at a scale of 1:500,000, is not meant to be used or displayed at any scale larger than 1:500,000 (e.g., 1:62,500 or 1:24,000).

Metadata_Reference_Information:

Metadata_Date: 19990924

Metadata_Review_Date: 19990911

Metadata_Future_Review_Date: 19990925

Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: U.S. Geological Survey

Contact_Person: G. Stephen Pitts

Contact_Position: GIS lab manager, contractor

Contact_Address:

Address_Type: mailing and physical address

Address: 520 N. Park Ave, suite 355

City: Tucson

State_or_Province: Arizona

Postal_Code: 85719

Country: United States of America

Contact_Voice_Telephone: 520.670.5511

Contact_Facsimile_Telephone: 520.670.5571

Contact_Electronic_Mail_Address: bear@usgs.gov

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: FGDC-STD-001-1998

Metadata_Access_Constraints: none

Metadata_Use_Constraints:

This GIS is not meant to be used or displayed at any scale larger than 1:500,000 (e.g., 1:100,00 or 1:24,000).

Appendix G: Arc/Info macro language program used to import the Arizona datasets (import.aml)

```
/**=====
/**----- 1) PRIMARY AML INFORMATION
/**      NAME: import.aml
/**      TITLE: Import Arc/Info export files
/**      VERSION: Aug-02-2000
/**      PURPOSE: Imports the files listed in the body of this file for the Arizona 1:500,000-scale
/**                digital geology.
/**      USAGE: Arc: &run import.aml
/**
/**----- 2) REQUIRES AND CALLS:
/**      REQUIRES: The export (.e00) files listed in the body of the aml.
/**      CALLS: bail.rou (error routine)
/**
/**----- 3) AML HISTORY AND SECONDARY INFO.
/**      CREATED: BY: Doug Hirschberg   DATE: Sep-21-1999
/**      PLATFORM: Run successfully on Arc/Info 7.2.1, Sun Solaris 2.6 OS.
/**      VARIABLES: (none)
/**      CATEGORY: Arc
/**      DISCLAIMER: This program has been tested and has worked to perform the specified purpose.
/**                  No warranty is expressed or implied as to its performance on any other system.
/**=====
/*&echo &on  /** optional
/***** BAILOUT SETUP *****/
&severity &error &routine bail.rou

/***** IMPORT SEQUENCE *****/
import cover azfold.e00 azfold
import cover azgeol.e00 azgeol
import cover azptdec.e00 azptdec
import cover azptfeat.e00 azptfeat

import font fnt026.e00 fnt026
import font fnt037.e00 fnt037

import info sourcesr.e00 sources.ref
import info relate1.e00 relate1

import lineset scamp2bl.e00 scamp2b.lin
import markerset scamp2bm.e00 scamp2b.mrk
import shadeset az500ks.e00 az500k.shd

/***** NORMAL END PROGRAM *****/
&return \ %AML$FILE% has ended successfully! \

/***** BAILOUT ROUTINE *****/
&routine bail.rou
&return \ Error in: %AML$FILE% line: %AML$ERRORLINE%, stopping! \

/** end of import.aml program ***/
```

Appendix H: Arc/Info macro language programs used to create graphics files for viewing and printing maps of the Arizona datasets (sheet1.aml, sheet2.aml, sheet3.aml)

sheet1.aml

```
/**=====
/**----- 1) PRIMARY AML INFORMATION
/**      NAME: sheet1.aml
/**      TITLE: Sheet 1, Map of all of Arizona 1:500,000-scale Geology, USGS OFR 00-409
/** LATEST VER: 1, Dec-12-2000
/**      PURPOSE: Draws map sheet 1; All of the "Digital Geologic Map of Arizona ..." GIS database
/**                (AZ500K) on one 46-inch by 68-inch sheet (portrait orientation).
/**                Includes explanation.
/** CALLED BY: User in Arcplot (see usage)
/**      USAGE: Arcplot: display 1040, sheet1, &run sheet1.aml
/**
/**----- 2) REQUIRES (Files shipped with Arc/Info 7.2.1 are not listed):
/**      AMLS: mapbar.aml
/** DATASETS: azfold, azgeol, azptdec, azptfeat
/** FAT ITEMS: azfold.aat-linecode; azgeol.aat-linecode; azgeol.pat-unit
/**                azptdec.pat-ptcode; azptfeat-ptcode
/** FONT FILES: fnt026, fnt037
/** KEY FILES: ofrlin.key, ofrmrk.key, ofrshd.key
/** LOOKUPS: azfold.str, azgeol.con, azgeol.ru, azgeol.str, azptdec.lut, azptfeat.lut
/** GRAPHICS: sheetidx.gra, srcmap.gra, usgslogo.gra
/** SYMBOLSETS: az500k.shd, scamp2b.lin, scamp2b.mrk
/** TEXT FILES: disclaim.tex, geo_dd.prj, indxbib1.tex, indxbib2.tex, lamb.prj, lambinfo.tex,
/**                mapcred.tex, refs.tex
/**
/**----- 3) AML HISTORY AND SECONDARY INFO.
/**      CREATED: By: Doug Hirschberg   Date: July-05-2000
/** PLATFORM: Arc/Info 7.2.1, Sun Solaris 2.6 OS.
/** VARIABLES: maplimx2 -Maplimits in mapunits (meters)
/** CATEGORY: ArcPlot
/** DISCLAIMER: This program has been tested and has worked to perform the specified purpose.
/**                No warranty is expressed or implied as to its performance on any other system.
/**=====
/*&echo &on      /** optional
/*&messages     /** optional

/******* S E T U P *****

/******* Arcplot Bailout Setup *****
/*&sv home [show &workspace]      /** optional
&severity &error &routine apbail.rou

/******* Arcplot Setup *****
pagesize 46 68
pageunits inches
mapproj off
mapunits meters
mapscale 500000      /** At this scale .1" = 1270 meters
mapextent -254985,3770600,290910,4410850
```

```
mappos 17963,4090725 23.7,40.3
maplimits 0.75 3 45.25 65.8
&sv maplimx2 [show maplim map]
mapshift none
mapwarp off
mapinfo          /** optional
```

```
/****** Symbolsets *****/
```

```
linedelete all; linescale 1
lineset scamp2b.lin
markerdelete all; markerscale 1
markerset scamp2b.mrk
shadedelete all
shadeset az500k.shd
textdelete all
textset font
/**--- 1) Call Makelines ---
&call makelines.rou
```

```
/****** M A P *****/
```

```
clearsel
clipmape off
```

```
/**----- 2) Call Geology Features *****/
```

```
&call geology.rou
```

```
/****** C O L L A R *****/
```

```
clipmape off
textstyle simple
textquality constant
textspacing 0,0
```

```
/****** Outlines *****/
```

```
linesym 1
box 0.05 0.05 45.95 67.95 /** page outline
```

```
/****** 3) Call Top Collar margin *****/
```

```
&call topcollar.rou
```

```
/****** 4) Call Bottom Collar Margin *****/
```

```
&call botcollar.rou
```

```
/****** 5) Call Neatline *****/
```

```
&call neatline.rou
```

```
/****** 6) Call Legend Explanation *****/
```

```
&call legend.rou
```

```
/****** 7) Call Sources Map & Bibliography *****/
```

```
&call index.rou
```

```
/****** E N D *****/
```

```
/****** Normal End Program *****/
```

```
&call cleanup.rou
&return \ %AML$FILE% has ended successfully! \
```

```

/***** Arcplot Bailout Routine *****/
&routine apbail.rou
&call cleanup.rou
&return \ Error in: %AML$FILE% line: %AML$ERRORLINE%, stopping! \

```

```

/***** Cleanup Routine *****/
&routine cleanup.rou
neatline off; mapprojection off
clipmape off; clearsel
&echo &off; &wat &off; &dv *
linescale 1; markerscale 1
mapshift none; mapwarp off
&return

```

```

/***** C A L L S *****/

```

```

/***** 1) Routine: Makelines *****/
&routine makelines.rou

```

```

pensize 0.005
/**--- 998 Anticline ---
linelayer 1; linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 0; linecolor 1

linelayer 2; linetype marker 37 51; linesize 0.200
lineinterval 0.050; lineinterval 0.00; lineoffset 0.00
linetemplate 050311; linecolor 1
lineput 998

```

```

/**--- 997 Syncline ---
linelayer 1; linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 0; linecolor 1

linelayer 2; linetype marker 37 59; linesize 0.200
lineinterval 0.050; lineinterval 0.00; lineoffset 0.00
linetemplate 050311; linecolor 1
lineput 997

```

```

/**--- 996 Monocline ---
linelayer 1; linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 0; linecolor 1

linelayer 2; linetype marker 37 94; linesize 0.200
lineinterval 0.050; lineinterval 0.00
lineoffset -0.015
linetemplate 050311; linecolor 1
lineput 996

```

```

/**--- 994 Strike-slip fault ---
linelayer 1; linetype wide; linesize 0.011
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 011; linecolor 1

```

```
linelayer 2; linetype marker 37 70; linesize 0.20
lineoffset 0.00; lineinterval 0.300; lineoffset -0.001
linetemplate 011; linecolor 1
lineput 994
```

```
/**--- 993 Thrust fault ---
linelayer 1; linetype wide; linesize 0.015
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 011; linecolor 1
```

```
linelayer 2; linetype marker 17 84; linesize 0.060
lineoffset 0.00; lineinterval 0.300; lineoffset 0.05
linetemplate 011; linecolor 1
lineput 993
```

```
/**--- 992 Normal fault ---
linelayer 1; linetype wide; linesize 0.015
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 011; linecolor 1
```

```
linelayer 2; linetype marker 17 68; linesize 0.060
lineoffset 0.00; lineinterval 0.300; lineoffset 0.05
linetemplate 011; linecolor 1
```

```
linelayer 3; linetype marker 17 85; linesize 0.060
lineoffset 0.00; lineinterval 0.300; lineoffset -0.05
linetemplate 011; linecolor 1
lineput 992
```

```
linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00; linetemplate 0
```

```
&return
```

```
/**----- 2) Routine: Geology Features -----
&routine geology.rou
```

```
/**--- Polys: azgeol ---
polygonshades azgeol unit azgeol.ru
```

```
/**--- Arcs: azgeol ---
resel azgeol arcs linecode lt 100
arclines azgeol linecode azgeol.con
clearsel
resel azgeol arcs linecode ge 100
arclines azgeol linecode azgeol.str
clearsel
```

```
/**--- Arcs: azfold ---
arclines azfold linecode azfold.str
```

```
/**--- Points: azptdec ---
markerscale 1
resel azptdec points pcode = 120
pointmarkers azptdec pcode azptdec.lut
markerscale 0.7
```

```

nset azptdec points
pointmarkers azptdec pcode azptdec.lut
markerscale 1

/**--- Points: azptfeat ---
markersym 522
resel azptfeat point pcode = 405 /** Cinder cones
points azptfeat noids
clearsel
markersym 524
resel azptfeat point pcode = 410 /** Diatremes
points azptfeat noids
clearsel

/**--- Smaller polygon text: azgeol ---
textsym 12; textsize 0.12 0.12; textjust cc
textoffset 0,0; textalign center; textcolor 1
resel azgeol polys area gt 60000000 and area lt 500000000 and unit ne 'water'
labeltext azgeol unit
clearsel

/**--- Larger polygon text: azgeol ---
textsym 3; textsize 0.14 0.14; textjust cc
textalign center; textoffset 0,0; textcolor 1
resel azgeol polys area gt 500000000 and unit ne 'water'
labeltext azgeol unit
clearsel

/**--- Arc text: azgeol ---
textsymb 1; textalign left; textjust ll
annotext azfold

&return

/***** 3) Routine: Top Collar Margin *****/
&routine topcollar.rou

textsym 14
textsize 0.3 0.3
textoffset 0,0

/**--- Left ---
plot usgslogo.gra box 0.5 66.5 4.5 67.5 /** USGS Logo
textjust ul
move 4.2 67.3
text 'DEPARTMENT OF THE INTERIOR'
move 4.2 66.8
text 'U.S. GEOLOGICAL SURVEY'

/**--- Center ---
textjust uc
move 23 67.3
text 'PREPARED IN COOPERATION WITH THE'
move 23 66.8
text 'UNIVERSITY OF ARIZONA'

```

```

/**--- Right ---
textjust ur
move 45.5 67.3
text 'OPEN-FILE REPORT 00-409'
move 45.5 66.8
text 'SHEET 1 OF 3, VERSION 1.0'

&return

/***** 4) Routine: Bottom Collar Margin *****/
&routine botcollar.rou

/**--- Projection Info. ---
textsymbol 14
textsize 0.15
textjust ll
move 1 2.75
textfile lambinfo.tex

/**--- Title ---
textsymbol 3
textsize 0.4
textjust uc
move 23 2.8
text 'Digital Geologic Map of Arizona:'
move 23 2.2
text 'a digital database derived from the 1983 printing of the Wilson, ~
Moore, and Cooper 1:500,000-scale map'

/**--- By/Date Line ---
textsymbol 1
textjust uc
textsize 0.15
move 23 1.6
text 'by'
textsize 0.3
move 23 1.3
text 'Douglas M. Hirschberg and G. Stephen Pitts'
move 23 0.9
text '2000'

textsymbol 14
textsize 0.15
textjust ll
/**--- Map/Database Credit ---
move 40.8 2.75
textfile mapcred.tex

/**--- Manuscript approval ---
move 40.8 2.1
text 'Manuscript approved on October 10, 2000'

/**--- Disclaimer ---
move 40.8 1.6
textfile disclaim.tex

```

```

/**--- Scalebar ---
&run mapbar.aml 2.5 1.5 500000

lineset scamp2b.lin /** reset because mapbar.aml uses plotter.lin

/**--- Sheet index graphic ---
plot sheetidx.gra box 37 0.55 40.5 2.85

&return

/***** 5) Routine: Neatline *****/
&routine neatline.rou

/**--- Neatline ---
mapprojection lamb.prj lamb.prj
linesymbol 1
neatline %maplimx2% lamb.prj

textsymbol 1
textsize 0.14 0.14
textstyle typeset
&format 0

/**--- 1
linesymbol 0
neatline -273502,3924258,291648,4414575 lamb.prj
textjust cr; textoffset -0.05,0
neatlinelabels 1 left 1 2 3 4 5 geo_dd.prj DD '% 1% !pat1857'
textjust lc; textoffset 0,0.05
neatlinelabels 1 top 1 2 3 4 5 6 7 geo_dd.prj DD '-% 1% !pat1857'
textjust cl; textoffset 0.04,0
neatlinelabels 1 right 1 2 3 4 5 geo_dd.prj DD '% 1% !pat1857'
linesymbol 1; linecolor gray
neatlinegrid 1 1 geo_dd.prj

/**--- 2
linesymbol 0
neatline -216875,3872000,-133400,3924258 lamb.prj
textjust uc; textoffset 0,-0.05
neatlinelabels 1 bottom 1 geo_dd.prj DD '-% 1% !pat1857'
linesymbol 1; linecolor gray
neatlinegrid 1 1 geo_dd.prj

/**--- 3
linesymbol 0
neatline -133400,3837500,-40730,3924258 lamb.prj
textjust cr; textoffset -0.05,0
neatlinelabels 1 left 1 geo_dd.prj DD '% 1% !pat1857'
textjust uc; textoffset 0,-0.05
neatlinelabels 1 bottom 1 geo_dd.prj DD '-% 1% !pat1857'
linesymbol 1; linecolor gray
neatlinegrid 1 1 geo_dd.prj

/**--- 4
linesymbol 0
neatline -40730,3802000,51800,3924258 lamb.prj

```



```

textjust uc; textoffset 0,-0.05
  neatlinelabels 1 bottom 1 geo_dd.prj DD '-% 1% !pat1857'
linesymbol 1; linecolor gray
neatlinegrid 1 1 geo_dd.prj

/**--- 5
linesymbol 0
neatline 51800,3773346,291648,3924258 lamb.prj
textjust cl; textoffset 0.04,0
  neatlinelabels 1 right 1 geo_dd.prj DD '% 1% !pat1857'
textjust uc; textoffset 0,-0.05
  neatlinelabels 1 bottom 1 2 geo_dd.prj DD '-% 1% !pat1857'
textjust uc; textoffset -0.05,-0.05
  neatlinelabels 1 bottom 3 geo_dd.prj DD '-% 1% !pat1857'
linesymbol 1; linecolor gray
neatlinegrid 1 1 geo_dd.prj

/**--- Restore parameters
textangle 0; textjust ll
textoffset 0 0; textstyle simple
linesymbol 1; linecolor 1
neatline off; mapprojection off

&return

/***** 6) Routine: Legend Explanation *****/
&routinel legend.rou

/**--- Headline ---
textsymboll 1
textsize 0.3 0.3
textjust lc
move 27.7 14.6
text 'EXPLANATION'

textsize 0.14 0.14
textjust ll
textstyle typeset
textqual prop
linesymboll 1
pensize 0.005

/**-- Shades --
textoffset -0.1,0
keyarea 11.7 3.6 45 14.3
keybox 0.6 0.35
keysep 0.3 0.2
keyshade ofrshd.key

/**-- Lines --
keyposition 39.3 11.6
keybox 0.6 0
keysep 0.2 0.3
textoffset 0,0.06
keyline ofrlin.key nobox

```

```

/**-- Markers --
keyposition 39.7 7.4
keybox 0.3 0.3
keysep 0.2 0.1
textoffset -0.1,-0.08
keymarker ofrmrk.key nobox

/**--- Explanation references ----
textsize 0.18 0.18
textjust lc
move 41.7 5.2
text 'REFERENCES CITED'

textsym 14
textsize 0.14 0.14
textjust ll
textspac 1.1,1.1
textalign left
textoffset 0,0
move 39.8 3.5
textfile refs.tex block

/**--- Restore ---
textstyle simple
textquality constant
textspacing 0,0
linesym 1
linecolor 1

&return

/***** 7) Routine: Sources Index Map & Bibliography *****/
&routine index.rou

/**--- Sources Map Graphic ---
plot srcmap.gra box 1.5 14 9.3 22.4

/**--- Sources "Geologic Map of Arizona" Title Lines ---
textstyle typeset
textprecision automatic
textquality prop
textspacing 1.1,0
textalign left
textoffset 0,0

textsymbol 16
textsize 0.24 0.24
textjustification lc

move 5.6 13.5
text 'Data sources for the "Geologic Map of Arizona"'

textsize 0.16 0.16

move 5.6 13.2
text '( Wilson, E. D., Moore, R. T., and Cooper, J. R., 1969, Geologic Map of Arizona'

```

```

move 5.6 12.9
text '[1983 printing]: U. S. Geological Survey Map G81036, scale 1:500,000 )'

/**--- Bibliography Explanation ---
textsymbol 14
textsize 0.14 0.14
textjust ll

move 1.6 12.6
text 'Sources cited have been locally modified or adjusted by the authors or by collaborating members of the staff of
the United States Geological Survey.'

move 1.7 12.4
text ' * Indicates published.'

move 1.7 12.2
text ' + Indicates unpublished map made for use in compiling county map or maps published by the Arizona Bureau
of Mines, 1957-60.'

/**--- Bibliography Text ---
textstyle typeset      /** Default is simple
textprecision automatic /** Default is auto
textquality prop      /** Default is constant
textspacing 1.1,0     /** Default is 0,0
textalign left        /** Default is left
textoffset 0,0

textsymbol 14
textsize 0.14 0.14
textjust ll

move 1.3 3.4
textfile indxbib1.tex block

move 6.1 3.82
textfile indxbib2.tex block

/**--- Restore Parameters ---
textsym 1; textsize 0.1
textspac 0,0; textstyle simple
textoffset 0,0
linecolor 1

&return
/**** end of sheet1.aml program ***/

```

sheet2.aml

```
/**=====
/**----- 1) PRIMARY AML INFORMATION
/**      NAME: sheet2.aml
/**      TITLE: Sheet 2, Map of the Northern Part of Arizona 1:500,000-scale Geology, USGS OFR 00-409
/** LATEST VER: 1, Dec-12-2000
/**      PURPOSE: Draws map sheet 2; The northern portion of the "Digital Geologic Map of Arizona ..."
/**                  GIS database (AZ500K) on a 46-inch by 34.8-inch page (landscape orientation).
/** CALLED BY: User in Arcplot (see usage)
/**      USAGE: In Arcplot: displs 1040, sheet2, &run sheet2.aml
/**
/**----- 2) REQUIRES (Files shipped with Arc/Info 7.2.1 are not listed):
/**      AMLS: mapbar.aml
/** DATASETS: azgeol, azfold, azptdec, azptfeat
/**      FONTS: fnt026, fnt037
/**      KEY FILES: -
/**      INFO: azfold.str, azgeol.con, azgeol.str, azgeol.ru, azptdec.lut, azptfeat.lut
/**      GRAPHICS: sheetidx.gra, usgslogo.gra
/** SYMBOLSETS: az500k.shd, scamp2b.lin, scamp2b.mrk
/**      TEXT FILES: disclaim.txt, geo_dd.prj, lamb.prj, lambinfo.tex, mapcred.tex
/**
/**----- 3) AML HISTORY AND SECONDARY INFO.
/**      CREATED: By: Doug Hirschberg   DATE: July-05-2000
/**      PLATFORM: Arc/Info 7.2.1, Sun Solaris 2.6 OS.
/**      VARIABLES: maplimx2 -Maplimits in mapunits (meters)
/**      CATEGORY: ArcPlot
/**      DISCLAIMER: This program has been tested and has worked to perform the specified purpose.
/**                  No warranty is expressed or implied as to its performance on any other system.
/**=====
/*&echo &on      /** optional
/*&messages      /** optional

/***** S E T U P *****/

/***** Arcplot Bailout Setup *****/
/*&sv home [show &workspace]      /** optional
&severity &error &routine apbail.rou

/***** Arcplot Setup *****/
pageunits inches
pagesize 46 35
mapunits meters
mapscale 500000
mapextent -254985,4029800,280825,4410850
mapposition 280825 4410850 44.5 33 /** upper right corner
maplimits 0.75 3 45.25 33
mapshift none
mapwarp off
&sv maplimx2 [show maplim map]
mapinfo      /** optional
weeddraw off

/***** Symbolsets *****/
linedelete all
```

```

linescale 1
lineset scamp2b.lin
markerdelete all
markerscale 1
markerset scamp2b.mrk
shadedelete all
shadeset az500k.shd
textdelete all
textset font
/**--- 1) Call makelines ---
&call makelines.rou

/***** M A P *****/
clearsel
clipmape off

/***** 2) Call Geology Features *****/
&call geology.rou

/***** C O L L A R *****/
clipmape off
textstyle simple
textquality constant
textspacing 0,0

/***** Outlines *****/
linesymbol 1
box 0.05 0.05 45.95 34.95 /** pageline

/***** 3) Call Top Collar Margin *****/
&call topcollar.rou

/***** 4) Call Bottom Collar Margin *****/
&call botcollar.rou

/***** 5) Call Neatline *****/
&call neatline.rou

/***** E N D *****/

/***** Normal End Program *****/
&call cleanup.rou
&return \ %AML$FILE% has ended successfully! \

/***** Arcplot Bailout Routine *****/
&routin apbail.rou
&call cleanup.rou
&return \ Error in: %AML$FILE% line: %AML$ERRORLINE%, stopping! \

/***** Cleanup Routine *****/
&routin cleanup.rou
neatline off; mapprojection off
clipmape off; clearsel
&echo &off; &wat &off; &dv *
linescale 1; markerscale 1
mapshift none; mapwarp off

```

&return

/****** CALLS *****/

/****** 1) Routines: Makelines *****/

&routine makelines.rou

pensize 0.005

/*--- 998 Anticline ---

linelayer 1; linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 0; linecolor 1

linelayer 2; linetype marker 37 51; linesize 0.200
lineinterval 0.050; lineinterval 0.00; lineoffset 0.00
linetemplate 050311; linecolor 1
lineput 998

/*--- 997 Syncline ---

linelayer 1; linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 0; linecolor 1

linelayer 2; linetype marker 37 59; linesize 0.200
lineinterval 0.050; lineinterval 0.00; lineoffset 0.00
linetemplate 050311; linecolor 1
lineput 997

/*--- 996 Monocline ---

linelayer 1; linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 0; linecolor 1

linelayer 2; linetype marker 37 94; linesize 0.200
lineinterval 0.050; lineinterval 0.00
lineoffset -0.015
linetemplate 050311; linecolor 1
lineput 996

/*--- 994 Strike-slip Fault ---

linelayer 1; linetype wide; linesize 0.011
/*linelayer 1; linetype wide; linesize 0.015
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 011; linecolor 1

linelayer 2; linetype marker 37 70; linesize 0.20
lineoffset 0.00; lineinterval 0.300; lineoffset -0.001
linetemplate 011; linecolor 1
lineput 994

/*--- 993 Thrust Fault ---

linelayer 1; linetype wide; linesize 0.015
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 011; linecolor 1

linelayer 2; linetype marker 17 84; linesize 0.060

```
lineoffset 0.00; lineinterval 0.300; lineoffset 0.05
linetemplate 011; linecolor 1
lineput 993
```

```
/**--- 992 Normal Fault ---
```

```
linelayer 1; linetype wide; linesize 0.015
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 011; linecolor 1
```

```
linelayer 2; linetype marker 17 68; linesize 0.060
lineoffset 0.00; lineinterval 0.300; lineoffset 0.05
linetemplate 011; linecolor 1
```

```
linelayer 3; linetype marker 17 85; linesize 0.060
lineoffset 0.00; lineinterval 0.300; lineoffset -0.05
linetemplate 011; linecolor 1
lineput 992
```

```
linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00
linetemplate 0
```

```
&return
```

```
/**----- 2) Routine: Geology Features -----
&routine geology.rou
```

```
/**--- Polys: azgeol ---
polygonshades azgeol unit azgeol.ru
```

```
/**--- Arcs: azgeol ---
resel azgeol arcs linecode lt 100
arclines azgeol linecode azgeol.con
clearsel
resel azgeol arcs linecode ge 100
arclines azgeol linecode azgeol.str
clearsel
```

```
/**--- Arcs: azfold ---
arclines azfold linecode azfold.str
```

```
/**--- Points: azptdec ---
markerscale 1
resel azptdec points pcode = 120
pointmarkers azptdec pcode azptdec.lut
markerscale 0.7
nset azptdec points
pointmarkers azptdec pcode azptdec.lut
markerscale 1
```

```
/**--- Points: azptfeat ---
markersym 522
resel azptfeat point pcode = 405 /** Cinder cones
points azptfeat noids
clearsel
markersym 524
```

```

resel azptfeat point pcode = 410 /** Diatremes
points azptfeat noids
clearsel

/**--- Smaller polygon text: azgeol ---
textsym 12; textsize 0.12 0.12
textjust cc; textoffset 0,0
textalign center; textcolor 1
resel azgeol polys area gt 60000000 and area lt 500000000 and unit ne 'water'
labeltext azgeol unit
clearsel

/**--- Larger polygon text: azgeol ---
textsym 3; textsize 0.14 0.14
textjust cc; textalign center
textoffset 0,0; textcolor 1
resel azgeol polys area gt 500000000 and unit ne 'water'
labeltext azgeol unit
clearsel

/**--- Arc text: azgeol ---
textsym 1
textalign left
textjust ll
annotext azfold

&return

/******* 3) Routine: Top Collar Margin *****
&routinetopcollar.rou

textsym 14
textsize 0.3 0.3
textoffset 0,0

/**--- Left ---
plot usgslogo.gra box 0.5 33.5 4.5 34.5 /** USGS Logo
textjust ul
move 4.2 34.3
text 'DEPARTMENT OF THE INTERIOR'
move 4.2 33.9
text 'U.S. GEOLOGICAL SURVEY'

/**--- Center ---
textjust uc
move 23 34.3
text 'PREPARED IN COOPERATION WITH THE'
move 23 33.9
text 'UNIVERSITY OF ARIZONA'

/**--- Right ---
textjust ur
move 45.5 34.3
text 'OPEN-FILE REPORT 00-409'
move 45.5 33.9
text [quote SHEET 2 OF 3, VERSION 1.0]

```


&return

/****** 4) Routine: Bottom Collar Margin *****/
&routine botcollar.rou

/**--- Projection Info. ---
textsymbol 14
textsize 0.15
textjust ll
move 0.75 2.75
textfile lambinfo.tex

/**--- Title ---
textsymbol 3
textsize 0.4
textjust uc
move 23 2.75
text 'Digital Geologic Map of Arizona:'
move 23 2.1
text 'a digital database derived from the 1983 printing of the Wilson, ~
Moore, and Cooper 1:500,000-scale map'

/**--- By/Date Line ---
textsymbol 1
textsize 0.15
textjust uc
move 23 1.45
text 'by'
textsize 0.3
textjust uc
move 23 1.2
text 'Douglas M. Hirschberg and G. Stephen Pitts'
move 23 0.8
text '2000'

textsymbol 14
textsize 0.15
textjust ll
/**--- Map/Database Credit ---
move 40.9 2.75
textfile mapcred.tex

/**--- Manuscript Approval ---
move 40.9 2.1
text 'Manuscript approved on October 10, 2000'

/**--- Disclaimer ---
move 40.9 1.6
textfile disclaim.tex

/**--- Scalebar ---
&run mapbar.aml 2 1.25 500000

lineset scamp2b.lin /** reset because mapbar.aml uses plotter.lin

```

/**--- Sheet Index Graphic ---
plot sheetidx.gra box 37 0.6 40 2.9

&return

/***** 5) Routine: Neatline *****/
&routine neatline.rou

textquality constant

/**--- Neatline ---
mapprojection lamb.prj lamb.prj
linesym 1
neatline %maplimx2% lamb.prj

linecolor gray
neatlinegrid 1 1 geo_dd.prj
linecolor 1

textsymb 14
textsize .12 .12
textjust ll
textoffset 0 0
textstyle typeset

/**--- TOP neatline labels ---
textjust lc; textoffset 0,0.05
neatlinelabels 1 top 1 2 3 4 5 6 7 geo_dd.prj DD '-%1%!pat1857'

/**--- RIGHT neatline labels ---
textjust cl; textoffset 0.05,0
neatlinelabels 1 right 1 2 3 4 5 geo_dd.prj DD '%1%!pat1857'

/**--- Restore Parameters
textangle 0; textjust ll
textoffset 0 0; textstyle simple
linesymbol 1; linecolor 1
neatline off; mapprojection off

&return

/**** end of sheet2.aml program ****

```

sheet3.aml

```
/**=====
/**----- 1) PRIMARY AML INFORMATION
/**      NAME: sheet3.aml
/**      TITLE: Sheet 3, Map of the Southern Part of Arizona 1:500,000-scale Geology, USGS OFR 00-409
/** LATEST VER: 1, Dec-12-2000
/**      PURPOSE: Draws map sheet 3; The southern portion of the "Digital Geologic Map of Arizona ..."
/**                GIS database (AZ500K) on a 46-inch by 34.8-inch page (landscape orientation).
/**                Includes explanation.
/** CALLED BY: User in Arcplot (see usage)
/**      USAGE: In Arcplot: display 1040, sheet3, &run sheet3.aml
/**
/**----- 2) REQUIRES (Files shipped with Arc/Info 7.2.1 are not listed):
/**      AMLS: mapbar.aml
/**      DATASETS: azgeol, azfold, azptdec, azptfeat
/**      FONTS: fnt026, fnt037
/**      KEY FILES: ofrlin.key, ofrmrk.key, ofrshd.key
/**      INFO: azfold.str, azgeol.con, azgeol.str, azgeol.ru, azptdec.lut, azptfeat.lut
/**      GRAPHICS: sheetidx.gra, srcmap.gra, usgslogo.gra
/**      SYMBOLSETS: az500k.shd, scamp2b.lin, scamp2b.mrk
/**      TEXT FILES: disclaim.txt, geo_dd.prj, indxbib1.tex, indxbib2.tex, lamb.prj, lambinfo.tex,
/**                mapcred.tex, refs.tex
/**
/**----- 3) AML HISTORY AND SECONDARY INFO.
/**      CREATED: BY: Doug Hirschberg   DATE: July-05-2000
/**      PLATFORM: Arc/Info 7.2.1, Sun Solaris 2.6 OS.
/**      VARIABLES: maplimx2 -Maplimits in mapunits (meters)
/**      CATEGORY: ArcPlot
/**      DISCLAIMER: This program has been tested and has worked to perform the specified purpose.
/**                No warranty is expressed or implied as to its performance on any other system.
/**=====
/*&echo &on      /** optional
/*&messages     /** optional

/***** S E T U P *****/

/***** Arcplot Bailout Setup *****/
/*&sv home [show &workspace]      /** optional
&severity &error &routine apbail.rou

/***** Arcplot Setup *****/
pageunits inches
pagesize 46 35
mapunits meters
mapscale 500000
mapextent -271375,3770600,290910,4109500
mapposition -271375 3770600 1 10.8 /* Lower left corner
maplimits 0.75 3 45.25 33
mapshift none
mapwarp off
&sv maplimx2 [show maplim map]
mapinfo
weeddraw off

/***** Symbolsets *****/
```

```

linedelete all
linescale 1
lineset scamp2b.lin
markerdelete all
markerscale 1
markerset scamp2b.mrk
shadedelete all
shadeset az500k.shd
textdelete all
textset font
/**--- 1) Call Makelines ---
&call makelines.rou

/***** M A P *****/
clearsel
clipmape off

/***** 2) Call Geology Features *****/
&call geology.rou

/***** C O L L A R *****/
clipmape off
textstyle simple
textquality constant
textspacing 0,0

/***** Outlines *****/
linesymbol 1
box 0.05 0.05 45.95 34.95 /** pageline

/***** 3) Call Top Collar margin *****/
&call topcollar.rou

/***** 4) Call Bottom Collar Margin *****/
&call botcollar.rou

/***** 5) Call Neatline *****/
&call neatline.rou

/***** 6) Call Legend Explanation *****/
&call legend.rou

/***** 7) Call Sources Map & Bibliography *****/
&call index.rou

/***** E N D *****/

/***** Normal End Program *****/
&call cleanup.rou
&return \ %AML$FILE% has ended successfully! \

/***** Arcplot Bailout Routine *****/
&routin apbail.rou
&call cleanup.rou
&return \ Error in: %AML$FILE% line: %AML$ERRORLINE%, stopping! \

```

```

/***** Cleanup Routine *****/
&routine cleanup.rou
  neatline off; mapprojection off
  clipmape off; clearsel
  &echo &off; &wat &off; &dv *
  linescale 1; markerscale 1
  mapshift none; mapwarp off
&return

/***** C A L L S *****/

/***** 1) Routine: Makelines *****/
&routine makelines.rou

pensize 0.005
/**--- 998 Anticline ---
linelayer 1; linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 0; linecolor 1

linelayer 2; linetype marker 37 51; linesize 0.200
lineinterval 0.050; lineinterval 0.00; lineoffset 0.00
linetemplate 050311; linecolor 1
  lineput 998

/**--- 997 Syncline ---
linelayer 1; linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 0; linecolor 1

linelayer 2; linetype marker 37 59; linesize 0.200
lineinterval 0.050; lineinterval 0.00; lineoffset 0.00
linetemplate 050311; linecolor 1
  lineput 997

/**--- 996 Monocline ---
linelayer 1; linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 0; linecolor 1

linelayer 2; linetype marker 37 94; linesize 0.200
lineinterval 0.050; lineinterval 0.00
lineoffset -0.015
linetemplate 050311; linecolor 1
  lineput 996

/**--- 994 Strike-slip Fault ---
linelayer 1; linetype wide; linesize 0.011
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 011; linecolor 1

linelayer 2; linetype marker 37 70; linesize 0.20
lineoffset 0.00; lineinterval 0.300; lineoffset -0.001
linetemplate 011; linecolor 1
  lineput 994

```

```

/**--- 993 Thrust Fault ---
linelayer 1; linetype wide; linesize 0.015
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 011; linecolor 1

linelayer 2; linetype marker 17 84; linesize 0.060
lineoffset 0.00; lineinterval 0.300; lineoffset 0.05
linetemplate 011; linecolor 1
lineput 993

/**--- 992 Normal Fault ---
linelayer 1; linetype wide; linesize 0.015
lineoffset 0.00; lineinterval 0.00; lineoffset 0.00
linetemplate 011; linecolor 1

linelayer 2; linetype marker 17 68; linesize 0.060
lineoffset 0.00; lineinterval 0.300; lineoffset 0.05
linetemplate 011; linecolor 1

linelayer 3; linetype marker 17 85; linesize 0.060
lineoffset 0.00; lineinterval 0.300; lineoffset -0.05
linetemplate 011; linecolor 1
lineput 992

linetype hardware; linesize 0.005
lineoffset 0.00; lineinterval 0.00
linetemplate 0

&return

/***** 2) Routine: Geology Features *****/
&routine geology.rou

/**--- Polys: azgeol ---
polygonshades azgeol unit azgeol.ru

/**--- Arcs: azgeol ---
resel azgeol arcs linecode lt 100
arclines azgeol linecode azgeol.con
clearsel
resel azgeol arcs linecode ge 100
arclines azgeol linecode azgeol.str
clearsel

/**--- Arcs: azfold ---
arclines azfold linecode azfold.str

/**--- Points: azptdec ---
markerscale 1
resel azptdec points pcode = 120
pointmarkers azptdec pcode azptdec.lut
markerscale 0.7
nset azptdec points
pointmarkers azptdec pcode azptdec.lut
markerscale 1

```

```

/**--- Points: azptfeat ---
markersym 522
resel azptfeat point pcode = 405 /** Cinder cones
  points azptfeat noids
clearsel
markersym 524
resel azptfeat point pcode = 410 /** Diatremes
  points azptfeat noids
clearsel

/**--- Smaller polygon text: azgeol ---
textsym 12; textsize 0.12 0.12
textjust cc; textoffset 0,0
textalign center
textcolor 1
resel azgeol polys area gt 60000000 and area lt 500000000 and unit ne 'water'
  labeltext azgeol unit
clearsel

/**--- Larger polygon text: azgeol ---
textsym 3; textsize 0.14 0.14
textjust cc; textalign center
textoffset 0,0; textcolor 1
resel azgeol polys area gt 500000000 and unit ne 'water'
  labeltext azgeol unit
clearsel

/**--- Arc text: azgeol ---
textsym 1; textalign left; textjust ll
annotext azfold

&return

/***** 3) Routine: Top Collar Margin *****/
&routine topcollar.rou

textsym 14
textsize 0.3 0.3
textoffset 0,0

/**--- Left ---
plot usgslogo.gra box 0.5 33.5 4.5 34.5 /** USGS Logo
textjust ul
move 4.2 34.3
text 'DEPARTMENT OF THE INTERIOR'
move 4.2 33.9
text 'U.S. GEOLOGICAL SURVEY'

/**--- Center ---
textjust uc
move 23 34.3
text 'PREPARED IN COOPERATION WITH THE'
move 23 33.9
text 'UNIVERSITY OF ARIZONA'

/**--- Right ---

```

```

textjust ur
move 45.5 34.3
text 'OPEN-FILE REPORT 00-409'
move 45.5 33.9
text [quote SHEET 3 OF 3, VERSION 1.0]

&return

/***** 4) Routine: Bottom Collar Margin *****/
&routine botcollar.rou

/**--- Projection Info. ---
textsymbol 14
textsize 0.15
textjust ll
move 0.75 2.75
textfile lambinfo.tex

/**--- Title ---
textsymbol 3; textsize 0.4
textjust uc
move 23 2.75
text 'Digital Geologic Map of Arizona:'
move 23 2.1
text 'a digital database derived from the 1983 printing of the Wilson, ~
Moore, and Cooper 1:500,000-scale map'

/**--- By/Date Line ---
textsymbol 1; textsize 0.15
textjust uc
move 23 1.45
text 'by'
textsize 0.3; textjust uc
move 23 1.2
text 'Douglas M. Hirschberg and G. Stephen Pitts'
move 23 0.8
text '2000'

textsymbol 14; textsize 0.15
textjust ll
/**--- Map/Database Credit ---
move 40.9 2.75
textfile mapcred.tex

/**--- Manuscript approval ---
move 40.9 2.1
text 'Manuscript approved on October 10, 2000'

/**--- Disclaimer ---
move 40.9 1.6
textfile disclaim.tex

/**--- Scalebar ---
&run mapbar.aml 2 1.25 500000

lineset scamp2b.lin /** reset because mapbar.aml uses plotter.lin

```



```

/**--- Sheet index graphic ---
plot sheetidx.gra box 37 0.6 40 2.9

&return

/***** 5) Routine: Neatline *****/
&routine neatline.rou

textquality constant

/**--- Neatline ---
mapprojection lamb.prj lamb.prj
linesym 1
neatline %maplimx2% lamb.prj

textsymb 14; textsize .12 .12
textjust ll; textoffset 0 0
textstyle typeset

/**--- 1
linesymbol 0
neatline -274550,3924258,290600,4052539 lamb.prj
textjust lc; textoffset 0,0.05
neatlinelabels 1 top 1 2 3 4 5 6 7 geo_dd.prj DD '-%1%!pat1857'
textjust cl; textoffset 0.05,0
neatlinelabels 1 right 1 2 3 4 5 geo_dd.prj DD '%1%!pat1857'
linesymbol 1; linecolor gray
neatlinegrid 1 1 geo_dd.prj

/**--- 2
linesymbol 0
neatline -216875,3876000,-120500,3924258 lamb.prj
linesymbol 1; linecolor gray
neatlinegrid 1 1 geo_dd.prj

/**--- 3
linesymbol 0
neatline -120500,3838500,-40730,3924258 lamb.prj
linesymbol 1; linecolor gray
neatlinegrid 1 1 geo_dd.prj

/**--- 4
linesymbol 0
neatline -40730,3804000,51800,3924258 lamb.prj
linesymbol 1; linecolor gray
neatlinegrid 1 1 geo_dd.prj

/**--- 5
linesymbol 0
neatline 51800,3773346,290600,3924258 lamb.prj
textjust cl; textoffset 0.05,0
neatlinelabels 1 right 1 geo_dd.prj DD '%1%!pat1857'
linesymbol 1; linecolor gray
neatlinegrid 1 1 geo_dd.prj

```

```
/**--- Restore Parameters
textangle 0; textjust ll
textoffset 0 0; textstyle simple
linesymbol 1; linecolor 1
neatline off; mapprojection off
```

```
&return
```

```
***** 6) Routine: Legend Explanation *****
&routine legend.rou
```

```
/**--- Headline ---
textsymbol 14; textjust ll
textstyle typeset; textqual prop
```

```
textsize 0.35 0.35
textspacing 1.2,0
move 13.5 14
text 'EXPLANATION'
```

```
textsize 0.14 0.14; textspacing 0,0
linesymbol 1
pensize 0.005
```

```
/**--- Shade key ---
textoffset -0.1,0
keyarea 12 3.5 45 10.6
keybox 0.5 0.3
keysep 0.2 0.1
keyshade ofrshd.key
```

```
/**--- Line key ---
keyarea 12 10.9 18 13.5
keybox 0.7 0
keysep 0.45 0.3
textoffset -0.3,0.06
keyline ofrlin.key nobox
```

```
/**--- Marker key ---
keyposition 16.6 12.1
keybox 0.4 0.3
keysep 0.2 0.1
textoffset -0.1,-0.08
keymarker ofrmrk.key nobox
```

```
/**--- Legend References ---
textsymbol 14
textstyle typeset
textqual prop
```

```
textsize 0.17 0.17
textjust lc
move 42.3 5.2
text 'REFERENCES CITED'
```

```
textsize 0.14 0.14; textjust ll
```

```
textspac 1.1,1.1; textalign left
textoffset 0,0
move 40.2 3.5
textfile refs.tex block
```

```
&return
```

```
/****** 7) Routine: Sources Index Map & Bibliography *****/
&routine index.rou
```

```
textstyle typeset; textprecision automatic
textqual prop; textspacing 1.1,0
textalign left; textoffset 0,0
```

```
/*--- Sources Map Graphic ---
plot srcmap.gra box 3.2 13.4 8.8 18.9
```

```
/*--- Sources "Geologic Map of Arizona" Title Line ---
textsymbol 16; textsize 0.24 0.24
textjust lc
move 6 13
text 'Data sources for the "Geologic Map of Arizona"'
```

```
textsize 0.18 0.18
move 6 12.7
text '( Wilson, E. D., Moore, R. T., and Cooper, J. R., 1969, Geologic Map of Arizona'
move 6 12.45
text '[1983 printing]: U. S. Geological Survey Map G81036, scale 1:500,000 )'
```

```
/*--- Bibliography explanation ----
textsymbol 14
textsize 0.12 0.12
textjust ll
move 2 12.1
text 'Sources cited have been locally modified or adjusted by the authors or by collaborating members of the staff of
the United States Geological Survey.'
move 2 11.9
text ' * Indicates published.'
move 2 11.7
text ' + Indicates unpublished map made for use in compiling county map or maps published by the Arizona Bureau
of Mines, 1957-60.'
```

```
/*--- Bibliography Text ---
textsymbol 14
textsize 0.14 0.14
textjust ll
move 1.3 3.15
textfile indxbib1.tex block
move 6.3 3.6
textfile indxbib2.tex block
```

```
&return
```

```
*** end of sheet3.aml program ***
```