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Physiographic Rim of The Grand Canyon, Arizona: A Digital Database

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Introduction

This Open-File report is a digital physiographic map database. This pamphlet serves to introduce and describe the digital data. There is no paper map included in the Open-File report. The report does include, however, PostScript and PDF format plot files, each containing an image of the map. For those interested in a paper plot of information contained in the database or in obtaining the PostScript plot files, please see the section entitled "For Those Who Don't Use Digital Geologic Map Databases" below.

This physiographic map of the Grand Canyon is modified from previous versions by Billingsley and Hendricks (1989), and Billingsley and others (1997). The boundary is drawn approximately along the topographic rim of the Grand Canyon and its tributary canyons between Lees Ferry and Lake Mead (shown in red). Several isolated small mesas, buttes, and plateaus are within this area, which overall encompasses about 2,600 square miles.

The Grand Canyon lies within the southwestern part of the Colorado Plateaus of northern Arizona between Lees Ferry, Colorado River Mile 0, and Lake Mead, Colorado River Mile 277. The Colorado River is the corridor for raft trips through the Grand Canyon.

Limestone rocks of the Kaibab Formation form most of the north and south rims of the Grand Canyon, and a few volcanic rocks form the north rim of parts of the Uinkaret and Shivwits Plateaus. Limestones of the Redwall Limestone and lower Supai Group form the rim of the Hualapai Plateau area, and Limestones of Devonian and Cambrian age form the boundary rim near the mouth of Grand Canyon at the Lake Mead. The natural physiographic boundary of the Grand Canyon is roughly the area a visitor would first view any part of the Grand Canyon and its tributaries.

For those who don't use digital map databases

For those interested in the physiography of Grand Canyon who do not use a Geographic Information System (GIS) that can read ARC/INFO Export files, we have provided plotfiles containing images of much of the information in the database. Each contains an image of physiographic rim map, one in PostScript format and another in Adobe Acrobat PDF format (see the sections “PostScript plot Files” and “PDF plot files” below).

Those interested who have computer capability can access the plot file packages in any of the three ways described below (see the section “Obtaining the digital database and plotfile packages”). However, it should be noted the plot file packages do require gzip and tar utilities to access the plot files. Therefore additional software, available free on the Internet, may be required to use the plot files (see section “Tar files”).

Those without computer capability can obtain plots of the map files through USGS plot-on-demand service for digital geologic maps (see section “Obtaining plots from USGS Open-File Services”) or from an outside vendor (see section “Obtaining plots from an outside vendor”).

Digital Open-File contents

This Open-File report consists of three digital packages. The first is the PostScript Plotfile Package, which consists of a PostScript plot file of the physiographic rim map. The second is the PDF Plotfile Package, and contains the same plotfile as the first package, but in Portable Document Format (PDF). The third is the Digital Database Package, and contains the physiographic rim map database itself.

Postscript plotfile package

This package contains the image described here in PostScript format (see below for more information on PostScript plot files). The Postscript plot file has been compressed, and may be uncompressed with gzip, which is available free of charge over the Internet via links from the USGS Public Domain Software page (http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/public.html).

gcrim.eps.gz A compressed PostScript plottable file containing an image of the physiographic rim at a scale of 1:250,000.

Name of compressed file	Size of compressed file (uncompressed)	File produced when uncompressed	Data package contained
gcrim.eps.gz	4.6 MB (20.0 MB)	gcrim.eps	PostScript Plotfile Package

PDF plotfile package

This package contains the image described here in PDF format (see below for more information on PDF plot files):

gcrim.pdf A PDF file containing an image of the physiographic rim at a scale of 1:250,000.

Digital database package

The database package includes database files for the Grand Canyon physiographic rim map. The digital maps, or coverages, along with their associated INFO directory, have been converted to uncompressed ARC/INFO export files. ARC export files promote ease of data handling, and are usable by some Geographic Information Systems in addition to ARC/INFO (see below for a discussion of working with export files). The ARC export files and the associated ARC/INFO coverages and directories, as well as the additional digital material included in the database, are described below:

ARC/INFO export file	Resultant Coverage	Description of Coverage
border.e00	border	Map border
county.e00	county	County boundaries
grndcynhyp.e00	grndcynhyp	Contours (hypsography) from the U.S. Geological Survey 1:100,000 Cameron quadrangle (1982), Fredonia (1984), Glen Canyon (1984), Grand Canyon (1984), Peach Springs (1986), Mount Trumbull (1986), Tuba City (1983), and Valle (1983)
majorstreets.e00	majorstreets	Roads
rim.e00	rim	Physiographic rim of the Grand Canyon
river.e00	river	Colorado river and tributaries
town.e00	town	Towns

The database package also includes the following files:

gcpamphlet.pdf A PDF version of this file.

gcpamphlet.txt A text-only file containing an unformatted version of gcpamphlet.ps.

import.aml	ASCII text file in ARC Macro Language to convert ARC export files to ARC coverages in ARC/INFO.

The following supporting directory is not included in the database package, but is produced in the process of reconverting the export files into ARC coverages:

info/	INFO directory containing files supporting the databases.

Tar files

The digital database package described above is stored in a tar (UNIX tape archive) file. A tar utility is required to extract the database from the tar file. This utility is included in most UNIX systems, and can be obtained free of charge over the Internet from Internet Literacy's Common Internet File Formats Webpage (http://www.matisse.net/files/formats.html).

The tar file has been compressed, and may be uncompressed with gzip, which is available free of charge over the Internet via links from the USGS Public Domain Software page (http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/public.html). When the tar file is uncompressed and the data is extracted from the tar file, a directory is produced that contains the data in the package as described above. The specifics of the tar and Postscript files are listed below:

Name of compressed file	Size of compressed file (uncompressed)	Directory produced when extracted from tar file	Data package contained
gcrim.tar.gz	34 MB (173 MB)	gcrim	Digital Database Package

PostScript plot files

For those interested in the physiographic rim of the Grand Canyon who don't use a GIS software package capable of reading ARC/INFO Export files we have included a separate data package consisting of one PostScript plot file. The file gcrim.ps contains a color plot of the physiographic rim database at 1:250,000 scale.

The PostScript image of the physiographic rim is 38 inches wide by 30 inches high, so it requires a large plotter to produce paper copies at the intended scale. In addition, some plotters, such as those with continual paper feed from a roll, are oriented with the long axis in the vertical direction, so the PostScript image will have to be rotated 90 degrees to fit entirely onto the page. Some plotters and plotter drivers, as well as many graphics software packages, can perform this rotation.

The PostScript plotfile was produced by the “postscript” command with compression set to zero in ARC/INFO version 7.1.2.

PDF plot files

We have also included a second digital package containing the PDF versions of the PostScript map sheet described above. Adobe Acrobat PDF (Portable Document Format) files are similar to PostScript plot files in that they contain all the information needed to produce a paper copy of a map or pamphlet and they are platform independent. Their principal advantage is that they require less memory to store and are therefore quicker to download from the Internet. In addition, PDF files allow for printing of portions of a map image on a printer smaller than that required to print the entire map without the purchase of expensive additional software. All PDF files in this report have been created from PostScript plot files using Adobe Acrobat

Distiller. In test plots we have found that paper maps created with PDF files contain almost all the detail of maps created with PostScript plot files. We would, however, recommend that those users with the capability to print the large PostScript plot files use them in preference to the PDF files.

To use PDF files, the user must get and install a copy of Adobe Acrobat Reader. This software is available free from the Adobe website (http://www.adobe.com). Please follow the instructions given at the website to download and install this software. Once installed, the Acrobat Reader software contains an on-line manual and tutorial.

There are two ways to use Acrobat Reader in conjunction with the Internet. One is to use the PDF reader plug-in with your Internet browser. This allows for interactive viewing of PDF file images within your browser. This is a very handy way to quickly look at PDF files without downloading them to your hard disk. The second way is to download the PDF file to your local hard disk, and then view the file with Acrobat Reader. We strongly recommend that large map images be handled by downloading to your hard disk, because viewing them within an Internet browser tends to be very slow.

To print a smaller portion of a PDF map image using Acrobat Reader, it is necessary to cut out the portion desired using Acrobat Reader and the standard cut and paste tools for your platform, and then to paste the portion of the image into a file generated by another software program that can handle images. Most word processors (such as Microsoft Word) will suffice. The new file can then be printed. Image conversion in the cut and paste process, as well as changes in the scale of the map image, may result in loss of image quality. However, test plots have proven adequate.

Digital database format

The databases in this report were compiled in ARC/INFO, a commercial Geographic Information System (Environmental Systems Research Institute, Redlands, California). The files are COVERAGE (ARC/INFO vector data) format. Coverages are stored in uncompressed ARC export format (ARC/INFO version 7.1.2). ARC/INFO export files (files with the .e00 extension) can be converted into ARC/INFO coverages in ARC/INFO (see below) and can be read by some other Geographic Information Systems, such as MapInfo via ArcLink and ESRI's ArcExplorer (available for free from ESRI's web site:
HYPERLINK http://www.esri.com).

Obtaining the Digital Database and Plotfile Packages

The digital data can be obtained in any of three ways:

a. From the Western Region Geologic Information Web Page.
b. Anonymous ftp over the Internet
c. Sending a tape with request

To obtain tar files of database or plotfile packages from the USGS web pages:

The U.S. Geological Survey now supports a set of graphical pages on the World Wide Web. Digital publications
(including this one) can be accessed via these pages. The location of the main Web page for the entire USGS is

http://www.usgs.gov

The Web server for digital publications from the Western Region is

http://wrgis.wr.usgs.gov

Go to

http://wrgis.wr.usgs.gov/open-file/of99-30

to access this publication. Besides providing easy access to the entire digital database, the Western Region Web page also affords easy access to the PostScript plot files for those who do not use digital databases (see below).

To obtain tar files of database or plotfile packages by ftp:

The files in these reports are stored on the U.S. Geological Survey Western Region FTP server. The Internet ftp address of this server is:

ftp://wrgis.wr.usgs.gov

The user should log in with the user name "anonymous" and then input their e-mail address as the password. This will give the user access to all the publications available via ftp from this server.

The files in this report are stored in the subdirectory:

pub/open-file/of99-30

To obtain tar files of database or plotfile packages on tape:

Database files, PostScript plotfiles, and related files can be obtained by sending a tape with request and return address to:

Grand Canyon Physiographic Rim Database
c/o Database Coordinator
U.S. Geological Survey
345 Middlefield Road, M/S 975
Menlo Park, CA 94025

Do not omit any part of this address!

NOTE: Be sure to include with your request the exact names, as listed above, of the tar files you require. An Open-File
Report number is not sufficient, unless you are requesting both the database package and plotfile package for the report.

The compressed tar file will be returned on the tape. The acceptable tape types are:

2.3 or 5.0 GB, 8 mm Exabyte tape.

Obtaining plots from a commercial vendor

Those interested in the map of the Grand Canyon physiographic rim, but who use neither a computer nor the Internet, can still obtain the information. We will provide the PostScript plot files on digital tape (details below) for use by commercial vendors who can make large-format plots. Send a blank tape with request and return address to:

Grand Canyon Physiographic Rim Database Plotfiles
c/o Database Coordinator
U.S. Geological Survey
345 Middlefield Road, M/S 975
Menlo Park, CA 94025

Do not omit any part of this address!

The compressed tar file will be returned on the tape. The acceptable tape types are:

2.3 or 5.0 GB, 8 mm Exabyte tape.

Make sure your vendor is capable of reading these tape types and PostScript plot files. Important information regarding tape file format is included in the sections “Database Release Format,” “Tar Files,” and "PostScript Plot Files" above, so be certain to provide a copy of this document to your vendor.

Obtaining plots from USGS Open-File Services

NOTE: As of this writing, plot-on-demand is not available from USGS. It is anticipated later in 1998.

U.S. Geological Survey is planning to provide a plot-on-demand service for map files, such as those described in this report, through Open-File Services. In order to obtain plots, contact Open-File Services at:

USGS Information Services
Box 25286
Denver Federal Center
Denver, CO 80225-0046

(303) 202-4200
1-800-USA-MAPS

FAX: (303) 202-4695

e-mail: infoservices@usgs.gov

Be sure to include with your request the Open-File Report number and the exact names, as listed in the Database Contents section above, of the plotfiles you require. An Open-File Report number and its letter alone may not be sufficient, unless you are requesting plots of all the plotfiles for that report.

Converting ARC export files

ARC export files are converted to ARC coverages using the ARC command IMPORT with the option COVER. To ease conversion and maintain naming conventions, we have included an ASCII text file in ARC Macro Language that will convert all of the export files in the database into coverages and create the associated INFO directory. From the ARC command line type:

Arc: &run import.aml

ARC export files can also be read by some other Geographic Information Systems. Please consult your GIS documentation to see if you can use ARC export files and the procedure to import them.

Digital compilation

The physiograhic rim coverage contains one polygon. It was developed using elevation information contained in 100k digital line graphs (DLGs). The hypsography DLGs were downloaded from a USGS FTP (file transfer protocol) site (edcftp.cr.usgs.gov /pub/data/DLG/100K) and imported into ARC/INFO using the DLGARC command. Using on-screen digitizing, the edge of the Grand Canyon was estimated and drawn to form the rim coverage. Adjustments to this first draft of the rim were hand drawn onto a 200,000 scale paper plot of the rim, which included the DLG hypsography. These new lines were digitized into the existing rim coverage using an Altec AC32 digitizing tablet. This editing procedure was repeated one more time to produce the final rim coverage.

Spatial resolution

Uses of this digital map should not violate the spatial resolution of the data. Although the digital form of the data removes the constraint imposed by the scale of a paper map, the detail and accuracy inherent in map scale are also present in the digital data. All base layers used in the creation of the map had a scale of 1:100,000. This database was designed at a scale of 250,000. The fact that this database was compiled at a digital scale of 1:100,000 and edited on paper plots of 1:200,000 means that higher resolution information is not present in the dataset. Plotting at scales larger than 1:250,000 will not yield greater real detail, although it may reveal fine-scale irregularities below the intended resolution of the database. Similarly, where this database is used in combination with other data of higher resolution, the resolution of the combined output will be limited by the lower resolution of these data.

Database specifics

The map databases consist of ARC coverages and supporting INFO files, which are stored in a UTM (Universal Transverse Mercator) projection (Table 1). Digital tics define a 7.5 minute grid of latitude and longitude in the contour coverages.

Table 1 - Map Projection
The maps are stored in UTM projection

PROJECTION UTM		
UNITS METERS		-on the ground
ZONE 12		-UTM zone
FALSE EASTING	0	
FALSE NORTHING	0	
SPHEROID CLARKE1866		
DATUM NAD27		

The content of the database can be described in terms of the points, lines and areas that compose the map. Descriptions of the database fields use the terms explained in Table 2.

Table 2 - Field Definition Terms

ITEM NAME	name of the database field (item)
WIDTH	maximum number of digits or characters stored
OUTPUT	output width
TYPE	B-binary integer, F-binary floating point number, I-ASCII integer, C-ASCII character string
N. DEC.	number of decimal places maintained for floating point numbers

border - arcs, polygon, tics (4)

This coverage was created using the ARC/INFO command GENERATE. It is one polygon that forms a border around the contour lines.

Polygons

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME	INDEXED?
1	AREA	4	12	F	3		-
5	PERIMETER	4	12	F	3		-
9	STUDYAREAUTM#	4	5	B	-		-
13	STUDYAREAUTM-ID	4	5	B	-		-

county - arcs, annotation (COUNTY subclass = county names), tics (273)

This data is from the Arizona Land Resource Information System (ALRIS) at the Arizona State Land Department. A description of its items can be found at the following URL: http://www.state.az.us/gis3/alris/doc/counties.txt.

grndcynhyp - arcs

This coverage was created from DLG files downloaded from the USGS FTP site (edcftp.cr.usgs.gov /pub/data/DLG/100K) and imported into ARC/INFO using the DLGARC command. Data Users Guides for Digital Line Graphs from 1:100,000-Scale Maps are available at: ftp://mapping.usgs.gov/pub/ti/DLG/100kdlgguide.

majorstreets - arcs, points, annotation (HWY subclass = hwy numbers), tics (4)

This data is from the Arizona Land Resource Information System (ALRIS). A description of arc items can be found at the following URL: http:// www.state.az.us/gis3/alris/doc/streets.txt. The point file (.pat) was created to add highway markers to the map and its items are listed below:

Points

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME	INDEXED?
1	AREA	4	12	F	3		-
5	PERIMETER	4	12	F	3		-
9	MAJORSTREETS#	4	5	B	-		-
13	MAJORSTREETS-ID	4	5	B	-		-
17	HWYNO	4	4	C	-		-
21	HWYMARKER	2	2	I	-		-

rim - arcs, polygons, anno (PHYS subclass = place names), tics (324)

Using on-screen digitizing, the rim (edge) of the Grand Canyon was estimated and drawn to form the rim coverage. Adjustments to this first draft of the rim were hand drawn onto a 200,000 scale paper plot of the rim, which included the DLG hypsography. These new lines were digitized into the existing rim coverage using an Altec AC32 digitizing tablet. This editing procedure was repeated one more time to produce the final rim coverage. The annotation file contains the names of the plateaus, valleys, and cliffs surrounding the physiographic rim.

Polygons

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME	INDEXED?
1	AREA	8	18	F	5		-
9	PERIMETER	8	18	F	5		-
17	RIM#	4	5	B	-		-
21	RIM-ID	4	5	B	-		-

ANNOTATION PHYS 24 Physiographic names

river - arcs, polygons, tics (67)

This data is from the Arizona Land Resource Information System (ALRIS). A description of this file's attributes can be found under the "streams" data set at the following URL: http://www.state.az.us/gis3/alris/doc/hyrdo.txt.

town - points, annotation (subclass TOWN), tics (324)

This point file was digitized on-screen by estimating the location of towns appearing on 100K hard copy quadrangle topological maps.

Points

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME	INDEXED?
1	AREA	8	18	F	5		-
9	PERIMETER	8	18	F	5		-
17	TOWN#	4	5	B	-		-
21	TOWN-ID	4	5	B	-		-
25	TOWNSYMBOL	3	3	I	-		-

References Cited

Billingsley, George H., and Hendricks, John D., 1989, Physiographic features of northwestern Arizona: in Elston, Donald P., Billingsley, George H., and Young, Richard A., eds., Geology of Grand Canyon, Northern Arizona with Colorado River guides, 28th International Geological Congress Field Trip Guidebook T115/315, Washington D.C., American Geophysical Union, p. 67-72.

Billingsley, George H., Spamer, Earle, E., and Menkes, Dove, 1997, Quest for the pillar of gold, the mines and miners of the Grand Canyon: Grand Canyon Association Monograph No. 10, Grand Canyon, Arizona, 112 p.