

# Digital geologic map of the Sandpoint 1° x 2° quadrangle, Washington, Idaho, and Montana

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This report is preliminary and has not been reviewed for conformity with U. S. Geological Survey editorial standards. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U. S. Government. The digital spatial database is not meant to be used or displayed at any scale larger than 1:250,000 (e.g., 1:100,000 or 1:24,000).

This database, identified as "Digital geologic map of the Sandpoint 1° x 2° quadrangle, Washington, Idaho, and Montana" has been approved for release and publication by the Director of the USGS. Although this database has been reviewed and is substantially complete, the USGS reserves the right to revise the data pursuant to further analysis and review. This database is released on condition that neither the USGS nor the U. S. Government may be held liable for any damages resulting from its use.

***U.S. DEPARTMENT OF THE INTERIOR***  
***U.S. GEOLOGICAL SURVEY***

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## INTRODUCTION

Open-File Report 99-144 is a digital geologic map of the Sandpoint 1° x 2° quadrangle that includes ARC/INFO (Environmental Systems Research Institute, <http://www.esri.com>) version 7.1.1 coverages, associated tables, Portable Document Format (PDF) files, and this README file. No paper map is included in the Open-File Report, but a plot file containing an image of the geologic map sheet and a list of map units with color-coded boxes is. Also there is a page-size geologic map in the PDF file that is accompanied by two page-size explanation of map units figures. The USGS is currently in the process of setting up a plot-on-demand facility (see following section) from which plots of the geologic map may be purchased. This README file describes the digital spatial data (such as types and general contents of files making up the database), how to obtain the digital files constituting the report, and how to extract and plot the map.

Within the geologic map database, map units are identified by standard geologic map criteria such as formation-name, age, and lithology. Detailed descriptions of the map units and a brief discussion of structure and regional geologic framework are given in the accompanying PDF file. Unit names and line information are contained in the principal Sandpoint line and polygon geologic map coverage, sand250k. Related look-up tables for both polygons and lines contain additional information. Furthermore, detailed information and descriptions of units can also be found in the PDF file.

Support for all geologic mapping of the quadrangle was provided by the National Cooperative Geologic Mapping Program. Support for all digital preparation was provided by the Mineral Resources Program.

Even though this is an Open-File Report and includes the standard USGS Open-File disclaimer, the authors of the report have tried to closely adhere to the U. S. Geological Survey and IUGS rules for stratigraphic nomenclature.

## HOW TO OBTAIN PAPER PLOTS

No paper maps are included in this Open-File report. To obtain only paper plots of the geologic map and accompanying explanation, but not detailed descriptions of map units, contact the U.S. Geological Survey Plot-on-demand facility.

Phone: 1-800-USA-MAPS (1-800-872-6277)

This facility is being set up at the time this Readme was written. If addresses do not appear above, please check at:

<http://wrgis.wr.usgs.gov/open-file/of99-144>

If the above suggestions are unsuccessful, paper plots may be made by persons having access to the Internet and a large-format color plotter that can interpret HPGL2 (Hewlett-Packard Graphics Language). A 1:250,000-scale paper copy of the map can be made, as follows:

1. Download the digital version of the map, **sand250k.hp**, from the USGS public access World Wide Web site on the Internet at:

<http://wrgis.wr.usgs.gov/open-file/of99-144>

or

2. Anonymous FTP the plot file, **sand250k.hp**, from: wrgis.wr.usgs.gov, in the directory: pub/open-file/of99-144

## DATABASE CONTENTS

The files constituting the geologic map database of this Open-File Report are listed below along with the interchange files from which they are extracted.

### GIS Data Package

All files listed below are in a UNIX compressed tar file named **sand250k.tar.Z** (15 MB)

Primary ARC/INFO Interchange file format (\*.e00) for the digital geology:

## **sand250k.e00**

Encapsulated PostScript (\*.eps), ARC/INFO graphics (\*.gra) and HPGL2 map plot (\*.hp) files for the geologic map plate:

**sand250k.eps / .gra / .hp**

Additional ARC/INFO EXPORT-format files (\*.e00) necessary to re-create the geologic map plates:

**calcomp1.shd.e00** shadeset  
**sandu11.e00** exterior boundary of the Sandpoint quadrangle

AML, graphics, key, symbolset and text files necessary to re-create the geologic map plate:

**scale2a.aml** plots scale bar on plate

**sand250k.aml** program that creates a graphics file of the geologic map of the Sandpoint quadrangle

**index\_sd.gra** index map graphic displayed on map plate (showing location of the Sandpoint quadrangle with respect to the Pacific Northwest)

**sd\_line.key** lineset symbol values and descriptive text for lines on the map plate

**sd\_pol.key** shadeset symbol values and descriptive text for geologic map units on the map plate

**geology.lin** lineset

**geo.prj** a text file used to identify real-world (geographic) coordinates— for use in adding latitude and longitude notation around the margins of the map quadrangle

**u11.prj** a text file to identify UTM, zone 11 map projection - for use in adding latitude and longitude notation around the margins of the map quadrangle

**sandcrd.txt** text file listing map credits on the map plate

**sanddisc.txt** disclaimer statement

**sandref.txt** text file listing map references on the map plate

**sand250k.met** formal metadata file

—Use the '00import.aml' to IMPORT all of the \*.e00 files for use in ARC/INFO.

—Use the ARC/INFO 'DRAW' command to plot the sand250k.gra file to your screen. (Make sure the display is set with the ARC/INFO 'DISPLAY 9999 3' command.)

—Use the ARC/INFO 'HPGL2' command to create a HPGL2 file from the \*.GRA file.

—Use the UNIX 'lpr -P<plotter\_name> sand250k.hp' command to send the sand250k.hp file to a large-format color plotter that can interpret Hewlett-Packard Graphics Language.

—To re-create the \*.gra file, open the ArcPlot module, enter 'display 1040', enter a new filename for the graphics file, enter '&run sand250k (and enter 'quit' to exit the ArcPlot module).

## **Other files**

**README.pdf** This document in portable document format  
**sand250k.doc** OFR 99-144 in Word 97 format (without figures)  
**sand250k.pdf** OFR 99-144 in portable document format

## **HOW TO OBTAIN THE DIGITAL FILES**

The complete digital version of the geologic map is available in ARC/INFO Interchange file (\*.e00) format with associated data files. These data and map images are maintained in a Universal Transverse Mercator (UTM) map projection:

Projection:	UTM
Zone:	11
Y-offset (false northing):	-5,000,000 meters
Units:	meters

The Arc/Info Interchange files (\*.e00) and subsequently the data and plot files, constituting the geologic map database of this Open-File Report may be obtained in two ways, both over the Internet.

1. The files can be obtained via the Web from Western Region Geologic Information Server. Go to the web page at <http://wrgis.wr.usgs.gov/open-file/of99-144> and follow the directions to download the files.
2. The files can also be obtained by anonymous ftp over the Internet from **wrgis.wr.usgs.gov**. The files are located in the directory **/pub/open-file/of99-144**. Be sure to use binary transfer mode.

The Internet sites contain the digital geologic map of the Sandpoint 1° x 2° quadrangle both in ARC/INFO INTERCHANGE format files (sand250k.e00) and as an HPGL2 plot file (sand250k.hp), as well as the associated data files and ARC/INFO macro programs which are used to plot the map at a scale of 1:250,000.

To manipulate this data in a geographic information system (GIS), you must have a GIS that is capable of reading ARC/INFO Interchange-format files.

## HOW TO EXTRACT THE GEOLOGIC MAP DATABASE FROM THE TAR FILE

### Digital Database

To download the GIS data file, create a new workspace in a UNIX working environment and copy the **sand250k.tar.Z** file to your new workspace. To uncompress the file, use the command **'uncompress -v sand250k.tar.Z'** and then to extract the files from the resulting **sand250k.tar** file, use the command **'tar -xvf sand250k.tar.'**

To import the ARC/INFO Interchange files into your workspace, open ARC/INFO on your workstation and enter '&run 00import' at the Arc: prompt.

Your working directory should contain the following files:

<b>000read.me</b>	these instructions on how to extract the geologic map database
<b>00import.aml</b>	ARC/INFO program to import ARC/INFO Interchange files into the user's workspace

Primary ARC/INFO Interchange files (\*.e00) for the digital geology of the Sandpoint quadrangle:

<b>sand250k.e00</b>	principal Sandpoint line and polygon geologic map coverage
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Additional ARC/INFO Interchange files (\*.e00) necessary to re-create the geologic map plates:

<b>calcomp1.shd.e00</b>	calcomp1.shd shadeset
<b>sandu11.e00</b>	exterior boundary of the Sandpoint quadrangle, mathematically generated

ARC/INFO AML, graphics, key, lineset, and text files necessary to re-create the geologic map quadrangle plates:

<b>sand250k.aml</b>	program that creates a graphics file (*.GRA) of the geologic map plate
<b>scale2a.aml</b>	program that generates the customary and metric bar scales and representative fraction for the scales

<b>index_sd.gra</b>	index map showing location of the Sandpoint quadrangle (the mapped area) with respect to the Pacific Northwest.
<b>sd_line.key</b>	keyfile that generates the contact, structure and other lines in the explanation
<b>sd_pol.key</b>	keyfile that generates the geologic map unit explanation
<b>geology.lin</b>	lineset file
<b>geo.prj</b>	a textfile used to identify real-world (geographic) coordinates - for use in adding latitude and longitude notation around the margins of the quadrangle
<b>u11.prj</b>	a textfile used to identify UTM, zone 11 (with a yshift = -5,000,000) map projection—for use in adding latitude and longitude notation around the margins of the quadrangle
<b>sandcrd.txt</b>	a textfile listing map credits
<b>sanddisc.txt</b>	a textfile with a digital data disclaimer statement
<b>sandref.txt</b>	a textfile listing map references

Plotter calibration file:

cal.dat - the color calibration file used in the ARC/INFO 'HPGL2' command to create plot files of the plates for plotting on the USGS HP650C in the Spokane Field Office. This file is a custom file for this particular plotter. Other plotters will require their own custom color calibration file.

Encapsulated PostScript (\*.eps), ARC/INFO graphics (\*.gra) and HPGL2 (\*.hp) files for the digital geologic map quadrangle plate:

sand250.eps  
sand250.gra  
sand250.hp

### **Portable Document Format (PDF) files**

PDF files are not stored as gzip files. They are accessed using Adobe Acrobat Reader software, available free from the Adobe website <http://www.adobe.com>. Follow instructions at the website to download and install the software. Acrobat Reader contains an on-line manual and tutorial.

### **DIGITAL GEOLOGIC MAP SPECIFICATIONS**

Mapping by F.K. Miller, R.F. Burmester, D.M. Miller and R.E. Powell (this report), in addition to Yates (1964 and 1971) for the Deep Creek and Northport areas; Joseph (1990) for the southwest quadrant of the Colville 1:100,000 quadrangle; Harrison and Schmidt (1971) for the Elmira quadrangle; Harrison and Jobin (1965 and 1963) for the Packsaddle Mountain and Clark Fork quadrangles, respectively; and Bennett and others (1975) for the Mount Pend Oreille quadrangle, were the sources of geologic data used to create the digital map.

### **Digital compilation**

A base-stable clear-film blackline of the geologic map linework was electronically scanned to create a digital raster image. This raster image was converted to vector and polygon GIS layers and minimally attributed by Optronics Specialty Co., Inc., Northridge, CA. This initial product was in an Arc/Info Interchange file format in scanner units with only two tic points for registration purposes. A new set of tic points was created based on intersections of geologic contacts and faults with topographic contours. These tic points were then used to transform the digital files to calculated latitude-longitude points for a Universal Transverse Mercator (zone 11, with a -5,000,000 m y-offset) map

projection. The RMS error resulting from the file transformation was moderate (24.177 meters, see Appendix A). The digital files were augmented with an interim geologic map data model (or data base), further attributed and edited, and subsequently plotted and compared to the original stable-base geologic map to check for digitizing and attributing errors. All processing by the U.S. Geological Survey was done in Arc/Info version 7.1.1 installed on a Sun Ultra workstation.

### Spatial resolution

The accuracy of lines in the digital geologic map with respect to lines on the scanned stable-base map is generally better than +/- 70 meters on the ground. Use of this digital geologic map database 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. The fact that this database was edited at a scale of 1:250,000 means that higher resolution information is not generally 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, although higher resolution data is incorporated at a few places, the resolution of the combined output will be limited by the lower resolution data.

### Map accuracy standards

Until uniform National geologic map accuracy standards are developed and adopted, lines and points on this 1:250,000 scale geologic map that are located to within ±150 meters, relative to accurately located features on a base map, are considered to meet map accuracy standards.

### Faults and landslides

This database is sufficiently detailed to identify and characterize many actual and potential geologic hazards represented by faults and landslides, but it is not sufficiently detailed for site-specific determinations. Although there is very little seismic activity in the region, and that very low-level, faults shown do not take the place of fault-rupture hazard zones.

### Database specifics

The digital geologic map of the Sandpoint 1° x 2° quadrangle includes a geologic linework arc attribute table, **SAND250K.AAT**, that relates to the **SAND250K.CON**, **SAND250K.STR**, **SAND250K.LGU** and **SAND250K.SR\*** files; and a rock unit polygon attribute table, **SAND250K.PAT**, that relates to the **SAND250K.RU** and **SAND250K.SR\*** files. These data files are described below.

#### Linear Features

Descriptions of the items identifying linear features such as contacts, boundaries (e.g., lines of latitude and longitude) and structures in the arc (or line) attribute table, **SAND250K.AAT**, are as follows:

<b>SAND250K.AAT</b>			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
<b>linecode</b>	integer	3	Numeric code used to identify type of linear feature. Linecodes < 100 are used for contacts and boundaries which are described in the SAND250K.CON file. Linecodes > 100 and < 600 represent structural features which are described in the SAND250K.STR file. Linecodes > 800 represent linear geologic units (e.g., dikes) which are described in the SAND250K.LGU file.
<b>name</b>	character	30	Name given to structural feature.
<b>source</b>	integer	4	Numeric code used to identify the data source for the linear feature. Complete references for the sources are listed in the SAND250K.REF file.

Attribute descriptions for items in the contact (and boundary) look-table, **SAND250K.CON** (for use with the **PLOTTER.LIN** lineset), are as follows:

<b>SAND250K.CON</b>			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
<b>linecode</b>	integer	3	Numeric code (a value < 100) used to identify type of contact or boundary. (This item also occurs in SAND250K.AAT.)
<b>symbol</b>	integer	3	Line symbol number used by Arc/Info to plot arc (line). Symbol numbers refer to the <b>PLOTTER.LIN lineset</b> .
<b>type</b>	character	10	Major type of line, e.g., contact, shoreline, lines of latitude and longitude used for neatlines.
<b>modifier</b>	character	20	Line type modifier, i.e., approximate, concealed, gradational. No entry implies 'known.'
<b>certainty</b>	character	15	Degree of certainty of contact or boundary, i.e., inferred, uncertain. No entry implies 'certain.'
<b>desc</b>	character	100	Written description or explanation of contact or boundary.

Attribute descriptions for items in the structure look-up table, SAND250K.STR [for use with the GEOLOGY.LIN lineset (Fitzgibbon and Wentworth, 1991)], are as follows:

<b>SAND250K.STR</b>			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
<b>linecode</b>	integer	3	Numeric code (a value > 100 and < 600) used to identify type of structural feature. (This item also occurs in SAND250K.AAT.)
<b>symbol</b>	integer	3	Line symbol number used by Arc/Info to plot arc (line). Symbol numbers refer to the <b>GEOLOGY.LIN lineset</b> (Fitzgibbon and Wentworth, 1991).
<b>type</b>	character	10	Major type of structure, i.e., fault, fracture, fold, other.
<b>horizontal</b>	character	20	Type of horizontal fault movement, e.g., left-lateral, right-lateral. No entry implies 'unknown.'
<b>vertical</b>	character	20	Type of vertical fault movement, e.g., normal. No entry implies 'unknown.'
<b>fold</b>	character	15	Type of fold, e.g., anticline, syncline.
<b>plunge</b>	character	15	Type of plunge on fold, i.e., horizontal, plunging, plunging in, plunging out.
<b>accuracy</b>	character	15	Line type modifier indicating degree of accuracy, i.e., approximately located, concealed, gradational.. No entry implies 'known.'
<b>certainty</b>	character	15	Degree of certainty of contact or boundary, i.e., inferred, uncertain. No entry implies 'certain.'
<b>desc</b>	character	100	Written description or explanation of structural feature.

Attribute descriptions for items in the linear geologic units (e.g., dikes and rock units that can only be mapped as linear features at a scale of 1:250,000) look-up table, SAND250K.LGU, [for use with the GEOLOGY.LIN lineset (Fitzgibbon and Wentworth, 1991)], are as follows:

<b>SAND250K.LGU</b>			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
<b>linecode</b>	integer	3	Numeric code (a value > 800) used to identify type of linear geologic unit. (This item also occurs in SAND250K.AAT.)



<b>label</b>	character	10	Map label used in the map proper to identify rock unit.
<b>symbol</b>	integer	3	Line symbol number used by Arc/Info to plot linear geologic unit. Symbol numbers refer to <b>GEOLOGY.LIN lineset</b> . (Fitzgibbon and Wentworth, 1991).
<b>type</b>	character	10	Major type of linear geologic unit, e.g., dike or formation.
<b>accuracy</b>	character	15	Line type modifier indicating degree of accuracy, i.e., approximate, concealed, gradational. No entry implies 'known.'
<b>certainty</b>	character	15	Degree of line type certainty, i.e., inferred, uncertain. No entry implies 'certain.'
<b>desc</b>	character	100	Written description or explanation of linear geologic unit.

*Areal Features*

Descriptions of the items identifying geologic units in the polygon attribute table, SAND250K.PAT, are as follows:

<b>SAND250K.PAT</b>			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
<b>unit</b>	integer	4	Numeric code used to identify the rock unit which is described in the SAND250K.RU look-up table. (This item also occurs in SAND250K.RU.)
<b>source</b>	integer	4	Numeric code used to identify the data source for the rock unit. Complete references for the sources are listed in the SAND250K.SR* files.
<b>label</b>	character	10	Rock unit label (abbreviation) used to label unit on map.
<b>desc</b>	character	100	Formal or informal unit name

Attribute descriptions for items in the lithology (rock unit) look-table, SAND250K.RU (for use with the CALCOMP1.SHD shadeset), are as follows:

<b>SAND250K.RU</b>			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
<b>unit</b>	integer	4	Numeric code used to identify rock unit. (This item also occurs in SAND250K.PAT.)
<b>label</b>	character	10	Rock unit label (abbreviation) used to label unit on map.
<b>symbol</b>	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 <b>CALCOMP1.SHD shadeset</b> .)
<b>name</b>	character	7	The prefix portion of the geologic unit label that does not include subscripts. (If no subscripts are used in the label, then the 'name' entry is the same as the 'label' entry.)
<b>lith</b>	character	20	Major type of lithostratigraphic unit, i.e., unconsolidated sediments, sedimentary rocks, metasedimentary rocks, intrusive rocks, extrusive rocks, metamorphic rocks, water, ice.
<b>desc</b>	character	100	Formal or informal unit name
<b>minage</b>	character	7	Minimum stratigraphic age of lithologic unit, i.e., CRET, TERT, PCY.
<b>maxage</b>	character	7	Maximum stratigraphic age of lithologic unit
<b>mindate</b>	integer	4	Minimum radiometric age (in millions of years) if determined.
<b>maxdate</b>	integer	4	Maximum radiometric age (in millions of years) if determined.

**Source Attributes**

Descriptive source or reference information for the SAND250K coverage is stored in the SAND250K.SR1 and SAND250K.SR2 files. Attribute descriptions for items in each of the data source files are as follows:

<b>SAND250K.SR1</b>			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
<b>source</b>	integer	4	Numeric code used to identify the data source. (This item also occurs in the SAND250K.AAT and SAND250K.PAT files.)
<b>year</b>	integer	4	Source (map) publication date
<b>scale</b>	integer	8	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.)
<b>authors</b>	character	200	Author(s) or compiler(s) of source map.

<b>SAND250K.SR2</b>			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
<b>source</b>	integer	4	Numeric code used to identify the data source. (This item also occurs in the SAND250K.AAT and SAND250K.PAT files.)
<b>ref</b>	character	250	Remainder of reference in USGS reference format.

## REFERENCES

- Fitzgibbon, Todd T. and Wentworth, Carl M., 1991, ALACART user interface - executable AML code and demonstration maps: U.S. Geological Survey Open-File Report 91-587A (as updated October 17, 1996 for version 3.1).
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- Yates, R.G., 1964, Geologic map and sections of the Deep Creek area, Stevens and Pend Oreille counties, Washington: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-412, scale 1:31,680.
- Yates, R.G., 1971, Geologic map of the Northport area, Washington: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-603, scale 1:31,680.