

**U.S. DEPARTMENT OF THE INTERIOR  
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Digital geologic map of the Spokane 1:100,000 quadrangle, Washington  
and Idaho: a digital database for the 1990 N.L. Joseph map

by

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## Introduction

Geologic data from the geologic map of the Spokane 1:100,000-scale quadrangle compiled by Joseph (1990) were entered into a geographic information system (GIS) as part of a larger effort to create regional digital geology for the Pacific Northwest. The map area is located in eastern Washington and extends across the state border into western Idaho (Fig. 1). This open-file report describes the methods used to convert the geologic map data into a digital format, documents the file structures, and explains how to download the digital files from the U.S. Geological Survey public access World Wide Web site on the Internet.

We wish to thank Robert E. Derkey and J. Eric Schuster of the Washington Division of Geology and Earth Resources for their part in initiating this project, and for providing the original stable-base mylar and the funding for it to be scanned.

## Data Sources, Processing, and Accuracy

Joseph (1990) was the sole source of geologic data used to create the digital map. The original stable-base mylar of the geologic linework for the 1:100,000-scale geologic map (Joseph, 1990, pl. 1) was electronically scanned to create a raster digital image. The resulting TIFF-format image (600 dot per inch resolution) was registered to a UTM grid and rectified in Arc/Info. The rectified raster image was then converted to a vector GIS layer using the GRIDLINE vectorization tool included in the Arc/Info GRID extension. Subsequent clean-up of the vector layer was done in PC Arc/Info. Linework for water bodies that obscured geologic contacts was converted from digital line graph (DLG) format files (U.S. Geological Survey, 1993) to PC Arc/Info so as to delineate discrete geologic unit boundaries. The resulting geologic map was attributed, converted to Arc/Info, and then plotted and compared to the original mylar to check for digitizing and attributing errors.

Point data (strike and dip of beds, etc.) were digitized from the original mylar into GSMAP, ver. 8 (Selner and Taylor, 1992) as Cartesian x,y points, transformed to the same map projection as the geologic (UTM, zone 11), and converted to GSMAP, ver. 9 (Selner and Taylor, 1993) in order to output to Arc/Info GENERATE-format files using the GSMGIS utility (G.I. Selner, written commun., 1994). An Arc/Info point location map was then generated, resulting in an Arc/Info coverage in an UTM, zone 11 projection. Because a plot did not match the original mylar, the coverage was transformed to register with the geologic map. And, finally, the points were attributed.

The overall accuracy of the digital geologic map (Figs. 2 and 3) is probably no better than +/- 70 meters.

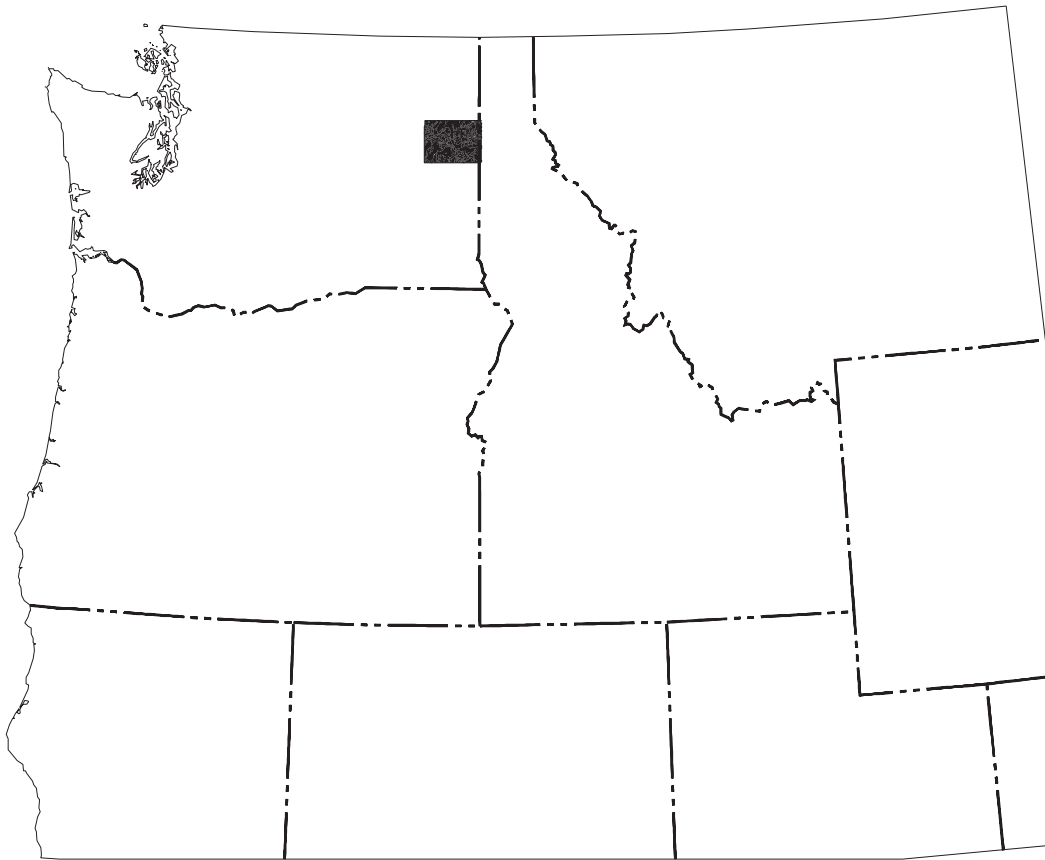


Figure 1. Index map showing the geographic extent of the Spokane 1:100,000-scale quadrangle (black fill) with respect to the Pacific Northwest.



Figure 2. Digital Geologic Map of the Spokane 1:100,000 quadrangle, Washington and Idaho - Explanation

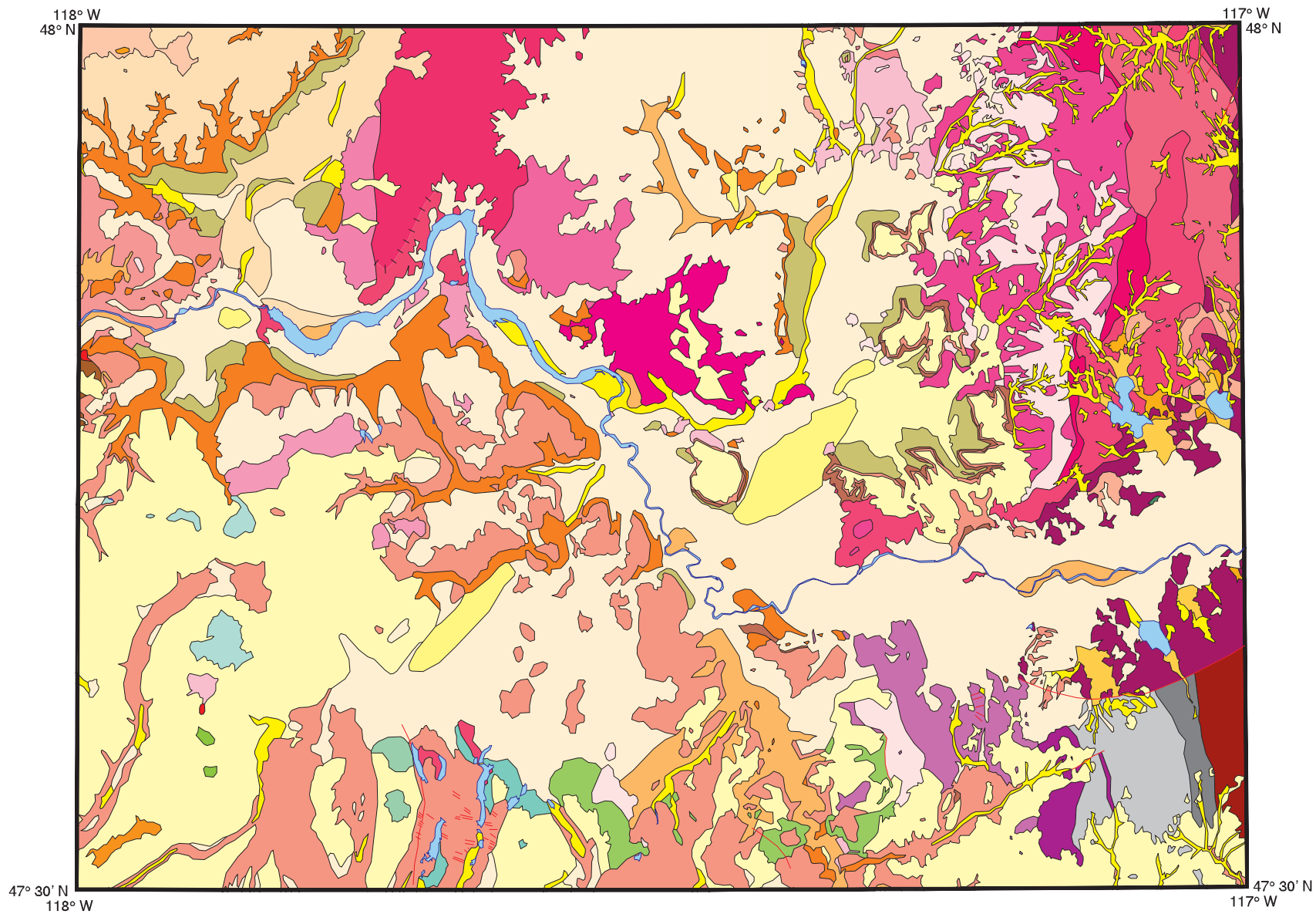


Figure 3. Digital Geologic Map of the Spokane 1:100,000 quadrangle, Washington and Idaho

## GIS Documentation

The digital geologic map of the Spokane 1:100,000 quadrangle includes an arc attribute table, SPOK100K.AAT, that relates to the [SPOK100K.CON](#), [SPOK100K.STR](#), [SPOK100K.LGU](#), and [SPOK100K.REF](#) files; a polygon attribute table, [SPOK100K.PAT](#), that relates to the [SPOK100K.RU](#) and [SPOK100K.REF](#) files; and a point attribute table, [SPOKPNT.PAT](#), that relates to the [SPOKPNT.SYM](#) and [SPOKPNT.REF](#) files (see [Fig. 4](#)). These data files are described below.

### ***Linear Features***

Descriptions of the items identifying contacts, boundaries, structures, and linear geologic units in the arc attribute table, SPOK100K.AAT, are as follows:

<b>SPOK100K.AAT</b>			
<b>ITEM NAME</b>	<b>ITEM TYPE</b>	<b>ITEM LENGTH</b>	<b>ATTRIBUTE DESCRIPTION</b>
<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 <a href="#">SPOK100K.CON file</a> . Linecodes > 100 and < 600 represent structural features which are described in the <a href="#">SPOK100K.STR file</a> . Linecodes > 800 represent linear geologic units which are described in the <a href="#">SPOK100K.LGU file</a> .
<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 <a href="#">SPOK100K.REF file</a> .

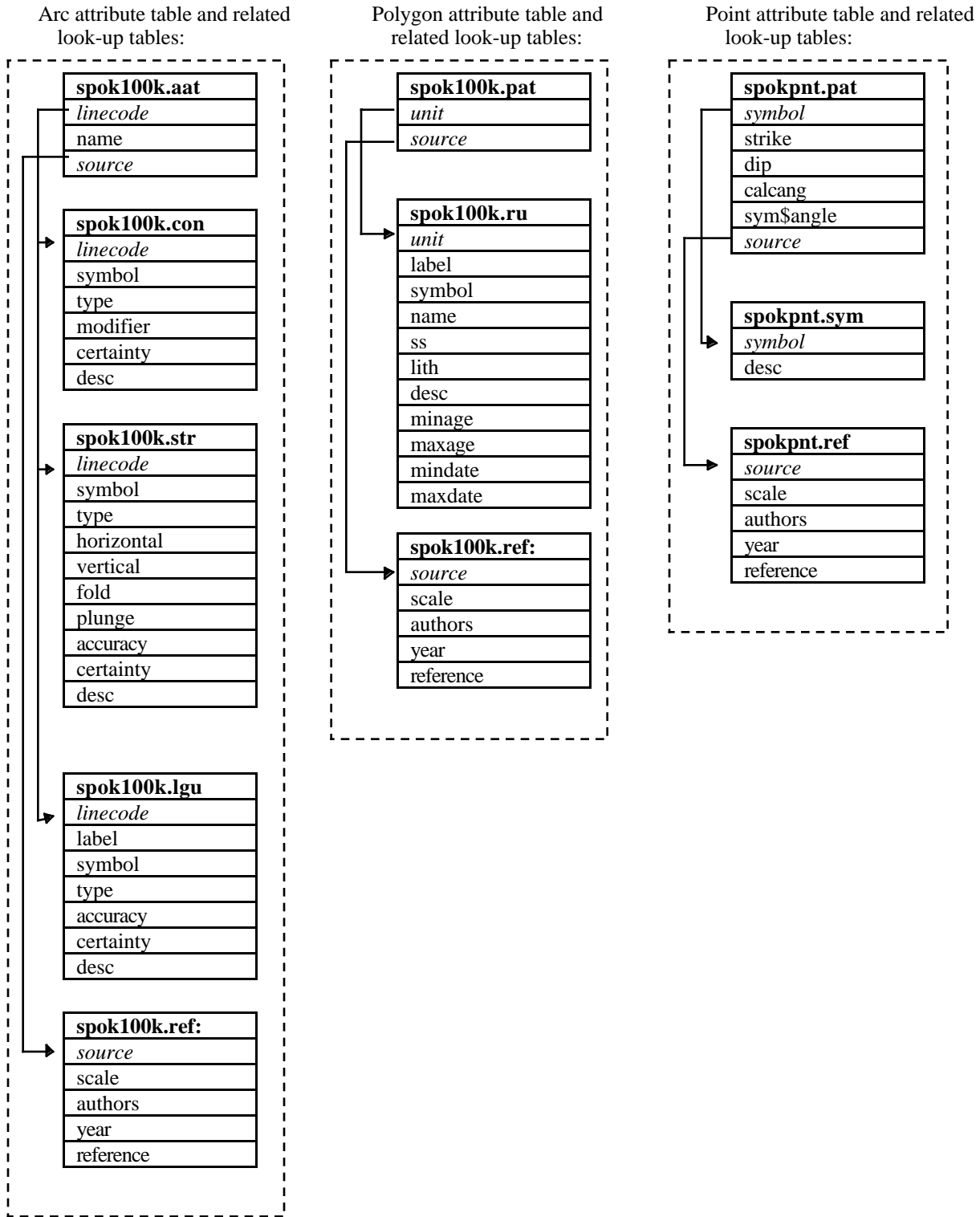


Figure 4: Relationships between feature attribute tables and look-up tables.



Attribute descriptions for items in the contacts and boundaries look-table, SPOK100K.CON, are as follows:

<b>SPOK100K.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 <a href="#">SPOK100K.AAT.</a> )
<b>symbol</b>	integer	3	Line symbol number used by Arc/Info to plot arc. (Symbol numbers refer to lineset PLOTTER.)
<b>type</b>	character	10	Major type of line, i.e., contact, water, ice, outcrop, political, neat, limit.
<b>modifier</b>	character	20	Line type modifier, i.e., approximate, concealed, gradational
<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 contact or boundary.

Attribute descriptions for items in the structures look-up table, SPOK100K.STR, are as follows:

<b>SPOK100K.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 <a href="#">SPOK100K.AAT.</a> )
<b>symbol</b>	integer	3	Line symbol number used by Arc/Info to plot arc. (Symbol numbers refer to lineset CARTO)
<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, i.e., strike-slip, left-lateral, right-lateral. No entry implies 'unknown.'
<b>vertical</b>	character	20	Type of vertical fault movement, i.e., normal, low-angle, reverse, thrust, detachment, vertical. No entry implies 'unknown.'
<b>fold</b>	character	15	Type of fold, i.e., anticline, syncline, monocline.
<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., approximate, concealed, gradational.
<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 contact or boundary.

Attribute descriptions for items in the linear geologic units look-up table, SPOK100K.LGU, are as follows:

<b>SPOK100K.LGU</b>			
<b>ITEM NAME</b>	<b>ITEM TYPE</b>	<b>ITEM LENGTH</b>	<b>ATTRIBUTE DESCRIPTION</b>
<b>linecode</b>	integer	3	Numeric code (a value > 800) used to identify type of linear geologic unit. (This item also occurs in <a href="#">SPOK100K.AAT</a> .)
<b>label</b>	character	10	Geologic unit label used in the map proper to identify map unit.
<b>symbol</b>	integer	3	Line symbol number used by Arc/Info to plot arc. (Symbol numbers refer to lineset CARTO.)
<b>type</b>	character	10	Major type of linear geologic unit, i.e., dike, vein, or other.
<b>accuracy</b>	character	15	Line type modifier indicating degree of accuracy, i.e., approximate, concealed, gradational.
<b>certainty</b>	character	15	Degree of line type certainty, i.e., inferred, uncertain. No entry implies 'certain.'
<b>desc</b>	character	60	Written description or explanation of contact or boundary.

### ***Areal Features***

Descriptions of the items identifying geologic units in the polygon attribute table, SPOK100K.PAT, are as follows:

<b>SPOK100K.PAT</b>			
<b>ITEM NAME</b>	<b>ITEM TYPE</b>	<b>ITEM LENGTH</b>	<b>ATTRIBUTE DESCRIPTION</b>
<b>unit</b>	integer	4	Numeric code used to identify the geologic unit which is described in the <a href="#">SPOK100K.RU</a> look-up table
<b>source</b>	integer	4	Numeric code used to identify the data source for the areal (polygon) feature. Complete references for the sources are listed in the <a href="#">SPOK100K.REF</a> file.

Attribute descriptions for items in the lithology (rock unit) look-table, SPOK100K.RU, are as follows:

<b>SPOK100K.RU</b>			
<b>ITEM NAME</b>	<b>ITEM TYPE</b>	<b>ITEM LENGTH</b>	<b>ATTRIBUTE DESCRIPTION</b>
<b>unit</b>	integer	4	Numeric code used to identify the geologic unit which is described in this SPOK100K.RU look-up table
<b>label</b>	character	10	Geologic unit label used in the map proper to identify map unit.
<b>symbol</b>	integer	3	Shade symbol number used by Arc/Info to plot a filled/shaded polygon. (Symbol numbers refer to shadeset CALCOMP1.)
<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>ss</b>	character	3	The suffix portion of the geologic unit label that includes subscripts.
<b>lith</b>	character	20	Major type of lithology, i.e., unconsolidated sediment, sedimentary, metasedimentary, intrusive, extrusive, metamorphic, 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 an age date was performed.
<b>maxdate</b>	integer	4	Maximum radiometric age (in millions of years) if an age date was performed.

The reader is referred to Joseph (1990) for detailed descriptions of map units.

### Point Features

Descriptions of the items identifying geologic map symbols are given in the point attribute table, SPOKPNT.PAT which is defined as follows:

SPOKPNT.PAT			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
<b>symbol</b>	integer	3	Marker symbol number used by Arc/Info to identify type of geologic map symbol which is described in <a href="#">SPOKPNT.SYM look-up table</a> . Symbol numbers refer to the ALCGEOL.MRK markerset.
<b>gsmap_symbol</b>	integer	3	Numeric code used by the GSMAP program (Selner and Taylor, 1993) to identify map symbols.
<b>strike</b>	integer	3	Strike of bedding or foliation, bearing of lineation, or sample number. The strike or bearing (azimuth) is an angle measured (in degrees from 0 to 360) in a clockwise direction from North on a Brunton compass, thus bedding striking due East and dipping North would have a strike of 90. Sample number may refer to a rock sample used for geochemical analysis or radiometric age dating.
<b>dip</b>	integer	3	Dip of bedding or plunge of foliation. This value is an angle measured (in degrees from 0 to 90) down from the horizontal, thus a horizontal dip would equal 0 and a vertical dip would be 90.
<b>calcang</b>	integer	3	An interim value used in calculating alc\$angle. $\text{calcang} = \text{strike} - 270$ .
<b>alc\$angle</b>	integer	3	The angle used to mathematically rotate the symbol to its proper position on a map plot. This value equals the \$angle pseudoitem value for the symbol. $\text{alc\$angle} = 0 - \text{calcang}$
<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 <a href="#">SPOK100K.REF</a> and <a href="#">SPOKPNT.REF</a> files.

Attribute descriptions for items in the geologic map symbols look-up table, SPOKPNT.SYM, are as follows:

<b>SPOKPNT.SYM</b>			
ITEM NAME	ITEM TYPE	ITEM LENGTH	ATTRIBUTE DESCRIPTION
<b>symbol</b>	integer	3	Marker symbol number used by Arc/Info to identify type of geologic map symbol. Symbol numbers refer to the ALCGEOL.MRK markerset. (This item also occurs in the <a href="#">SPOKPNT.PAT</a> file.)
<b>desc</b>	character	250	Written description or explanation of map symbol.

### **Source Attributes**

Descriptive source or reference information for the SPOK100K and SPOKPNT coverages is stored in the SPOK100K.REF and SPOKPNT.REF files, respectively. Attribute descriptions for items in the SPOK100K.REF and SPOKPNT.REF data source files are as follows:

<b>SPOK100K.REF / SPOKPNT.REF</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 <a href="#">SPOK100K.AAT</a> , <a href="#">SPOK100K.PAT</a> , and <a href="#">SPOKPNT.PAT</a> files.)
<b>scale</b>	integer	10	Scale of source map. (This is the scale of the dataset or map that was digitized or scanned to produce the digital map.)
<b>authors</b>	character	100	Author(s) or compiler(s) of source map entered as last name, first name or initial, and middle initial.
<b>Year</b>	integer	4	Source (map) publication date
<b>reference</b>	character	250	Remainder of reference in USGS reference format.

### **Obtaining Digital Data**

The complete digital version of the geologic map is available in Arc/Info EXPORT 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 easting): -5,000,000 meters  
Units: meters

To obtain copies of the digital data, do one of the following:

1. Download the digital files from the USGS public access World Wide Web site on the Internet: **URL = [http://wrgis.wr.usgs.gov/docs/northwest\\_region/ofr98-115.html](http://wrgis.wr.usgs.gov/docs/northwest_region/ofr98-115.html)**
- or
2. Anonymous FTP from **wrgis.wr.usgs.gov**, in the directory  
**pub/geologic/northwest\_region/geology/ofr98-115**

The Internet sites contain the digital geologic map of the Spokane 1:100,000 quadrangle both in Arc/Info EXPORT-format files (spok100K.e00 and spokpnt.e00) and as an HPGL2 plot file (spok100K.hp), as well as the associated data files and Arc/Info macro programs which are used to plot the map at a scale of 1:100,000.

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

## Obtaining Paper Maps

Paper copies of the digital geologic map are not available from the USGS. However, with access to the Internet and access to a large-format color plotter that can interpret HPGL2 (Hewlett-Packard Graphics Language), a 1:100,000-scale paper copy of the map can be made, as follows:

1. Download the digital version of the complete map, **spok100k.hp**, from the USGS public access World Wide Web site on the Internet using the **URL = [http://wrgis.wr.usgs.gov/docs/northwest\\_region/ofr98-115.html](http://wrgis.wr.usgs.gov/docs/northwest_region/ofr98-115.html)**
- or
2. Anonymous FTP the plot file, **spok100K.hp**, from: **wrgis.wr.usgs.gov**, in the directory:  
**pub/geologic/northwest\_region/geology/ofr98-115**
3. This file can be plotted by any large-format color plotter that can interpret HPGL2. The finished plot is about 29 by 39 inches.

Paper copies of the map can also be created by obtaining one of the versions of the digital files as described above (in 'Obtaining Digital Data'), and then creating a plot file in a GIS.

## References Cited

Joseph, N.L., compiler, 1990, Geologic map of the Spokane 1:100,000 quadrangle, Washington-Idaho: Washington Division of Geology and Earth Resources Open File Report 90-17, 29 p. and 1 plate, (scale 1:100,000).

- Selner, G.I. and Taylor, R.B., 1992, GSMAP, GSMEDIT, GSMUTIL, GSPOST, GSDIG and other programs, for the IBM PC and compatible microcomputers, to assist workers in the earth sciences (version 8): U.S. Geological Survey Open-File Report 92-217, 217 p.
- Selner, G.I. and Taylor, R.B., 1993, GSMAP, and other programs for the IBM PC and compatible microcomputers, to assist workers in the earth sciences (version 9): U.S. Geological Survey Open-File Report 93-511, 363 p.
- U.S. Geological Survey, 1993, 1:100,000-scale digital line graph (DLG) data - hydrography and transportation, Area 13 - Northwestern states: U.S. Geological Survey, US GeoData (optional format), 1 CD-ROM.