**DESCRIPTION OF DIGITAL FILES FOR Geologic Map of the Eastern Willapa Hills, Cowlitz, Lewis, and Wahkiakum Counties, Washington**

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**INTRODUCTION**

This readme document serves to introduce and describe the digital files that are included in this publication. They are available for downloading at <http://pubs.usgs.gov/of/2014/1063> and include Geographic Information System (GIS) software files (vector data) that are viewable with an Environmental Systems Research Institute (ESRI)-compatible commercial GIS (or with ESRI’s ArcReader utility; a free map viewer with no editing capabilities) -as well as Portable Document Format (PDF) files that are viewable with Adobe Acrobat Reader or a web browser plug-in available for free on the internet. Two download packages are available depending on the resources available to the user (see the section entitled “Open File Report Digital Contents” below for details). For those interested only in a paper plot of the Open File Report, please see the section entitled "Obtaining Paper Plots" below.

This digital map database was created from the analog geologic map: Wells, R. E., 1981, Geologic Map of the Eastern Willapa Hills, Cowlitz, Lewis, and Wahkiakum Counties, Washington, U.S. Geological Survey Open File Report 81-674. This geodatabase replicates the geologic mapping of the 1981 report with minor exceptions along water boundaries and the northern and southern map boundaries. Slight adjustments were made to contacts along water boundaries due to differences in these boundaries between the topographic base used in the 1981 analog compilation (USGS 15-minute series quadrangle maps at 1:62,500 scale) and the base used for this digital compilation (USGS 7.5-minute series quadrangle maps at 1:24,000 scale). The northern and southern boundaries of the base map for this digital compilation were defined along lines of latitude as compared straight-edge drawn bounding lines used in the 1981 analog map. This boundary adjustment eliminated approximately 45 m or less along the northern map boundary and approximately 107 m or less along the southern map boundary as compared to the area of the 1981 map. These minor adjustments did not materially alter the geologic map. No new mapping was performed in creating this digital map database, and no attempt was made to fit geologic contacts to match the new 1:24,000 topographic base, except as noted above. We did correct typographical errors, formatting errors, and errors of attribution (e.g., name change of Goble Volcanics to Grays River Volcanics following current State of Washington usage; e.g., Walsh and others, 1987). We also updated selected references, substituting published papers for abstracts, and citing published radiometric ages for the volcanic and plutonic rocks. The reader is referred to Magill and others, (1982), Wells and Coe (1985), Walsh and others (1987), Moothart (1993), Payne (1998), Kleibacker (2001), McCutcheon (2003), Wells and others (2009), Chan and others (2012), and Wells and others, (2014) for subsequent interpretations of Willapa Hills geology.

 Locations of point, line and polygon features in this digital compilation were created in reference to a georeferenced image of a stable-base frosted mylar compilation (inked lines and labels on screened topography in grayscale) of the 1981 USGS Open File map. The mylar compilation map was scanned at 300 dpi and georeferenced to USGS 1:24,000-scale DRGs (Digital Raster Graphics). The 1981 map was published at a scale of 1:62,500 using as a topographic base USGS 15-minute series topographic maps composited into a single sheet on mylar.

 This digital database was created using a topographic base USGS 7.5-minute series topographic maps published at 1:24,000 scale. Georeferencing between the 1:24,000- and 1:62,500-scale base maps was carried out mainly using lat-long tiks as link points. Where lat-long tiks were not present on the 1981 map (near the northern and southern map boundaries), corresponding survey benchmarks and intersections of prominent roads were used as link points for georeferencing.

 Digitization of linework shown on the analog map was performed such that digital lines (and boundaries of polygons features derived from such lines) are located within the width of the lines shown on the georeferenced analog map. Due to differences between the topographic base maps used for field mapping and the 1981 map compilation, during digitization particular attention was taken to ensure consistency of contacts in relation to water courses and topographic contours.

 Point locations of structural measurements (attitudes of bedding, foliation) were located from the georeferenced 1981 compilation map. Values for strike azimuth of point features were determined by interactively estimating strike for a given point feature until the digitally symbolized result overlay the strike of the feature as hand-drafted on the georeferenced 1981 analog map. Locations of point features such as bedding and foliation were taken at the mid-point of the strike line of the symbol. Values for dip or plunge of inclined planes or lineations were transcribed from values hand-written on the 1981 map.

 Locations of orientation measurements made by the author for the 1981 analog map correspond to the observation location 'on the ground'. Locations during field mapping were determined using either topographic maps at a scale of 1:62,500 or maps of logging roads at a scale of 1:24,000 to 1:62,500. Locations identified initially on logging road maps were transferred to 1:62,500 topographic maps in compilation mainly on the basis of PLSS (Public Land Survey System) section lines for reference. An uncertainty of 1 mm in plotting point locations on the 15-minute series topographic maps corresponds to a minimum uncertainty at map scale of approximately 63 m in the location of point features. Minimum uncertainty of point locations plotted first on logging road maps and transferred to 15-minute series topographic maps is estimated at 2 mm, or 125 m, given the compilation scale of 1:62,500 of the base used for the 1981 analog map.

 The topographic base map covers an area of nearly 30' x 30' between longitude 123° 00' 00.00"W and 123° 30' 00.00"W, and latitude 46° 08' 33.00"N (46.142500°N) and 46° 38' 13.00" N (46.636944°N) (NAD27). The topographic base used for this digital compilation was created by assembling into a digital mosaic DRGs of twenty USGS 7.5-minute quadrangles, and clipping this mosaic to a map boundary created from a table of lat-long coordinates at intervals of 0.0025°.

 Eastern and western map boundaries of this digital compilation are identical to those of the 1981 analog compilation map. The northern and southern boundaries of this digital compilation lie along lines of latitude, and differ slightly from those of the 1981 analog compilation map which were hand-drawn using a straight edge. Digital boundaries along lines of latitude accounts for a slight curvature of lines of latitude in the map projection (UTM).

 The base map includes the entire area of 7.5-minute quadrangles between latitude 46.250°N and 46.625°N for the following quadrangles: Abernathy Mountain, Blaney Creek, Boistfort Peak, Boistfort, Curtis, Elochman Pass, Elochoman Lake, Pe Ell, Pluvius, Skamokawa Pass, Skamokawa, and Wildwood. The southern part of the map between latitude 46.142500°N and 46.250000°N includes northern parts of the Cathlamet, Nassa Point, Oak Point and Coal Creek quadrangles. The northernmost part of the map area between latitude 46.625000°N and 46.636944°N includes the southern parts of the Dean Creek, Doty, Rainbow Falls and Adna quadrangles.

 The area of the geologic map includes areas within this base map area only within the State of Washington. The geology of areas within the State of Oregon in the southernmost part of the base map was not mapped in this study.

 Purpose: This geodatabase makes this map, previously available only in analog form (paper), available as a geospatial digital database. This map database increases the availability of the map to the public, professional and engineering geologists, and researchers in academic and government roles. The digital database format allows specific areas or components of the map to be readily extracted for specific purposes using GIS software.

**OPEN FILE REPORT 2014-1063 DIGITAL CONTENTS**

The digital data for this Open File Report consists of:

1. A **Geodatabase** package that contains geologic vector and tabular data stored as data objects within an ESRI-format personal geodatabase, an ESRI map document for use with ArcGIS 10.2 that allows editing and rendering of the data sources, an ESRI published map document for use with ArcReader that allows viewing and querying of the source data along with metadata, and an ArcGIS style for symbolizing the map.

2. A **Shapefile** package that contains shapefiles exported from the personal geodatabase along with supporting files. This package does not contain annotation layers included in the Geodatabase package due to software limitations.

3. Metadata files for the entire database.

4.**PDF** files of the map sheet, base map, and pamphlet.

Each package has been compressed into a single file (.zip extension) using WinZip, a freely downloadable compression software utility (download from [*http://www.winzip.com*](http://www.winzip.com/). Each compressed file will uncompress into a folder containing the associated files.

If you:

* Have access to ArcGIS 10.2, download the Geodatabase package and open the map document (.mxd extension) from ArcGIS.
* Have access to ArcView 3.x (or a GIS that can read shapefiles), download the Shapefile package.
* Do not have access to a GIS but wish to view and query the data, download the Geodatabase package and open the published map document (.pmf extension) from ArcReader (free download from [*http://www.esri.com*](http://www.esri.com/)).
* Do not have access to a GIS and only wish to print the map sheet or parts of it, download the PDF package and open them from Adobe Reader 5.0 or later (free download from *http://www.adobe.com*). Note that the map sheet is approximately 36 x 56 inches and will require a large-format plotter.
* Only wish to have a paper copy of this Scientific Investigations Map, see the section entitled "Obtaining Paper Plots" below.
1. **GEODATABASE PACKAGE**

ofr2014-1063\_db.zip

*ofr2014-1063.mdb*  A personal ESRI geodatabase with simple feature classes:

**Feature Classes Description (feature class = f.c.)**

*EWH\_contacts* Aline f.c. representing the contacts and faults

*EWH\_fault\_names\_Anno*  Annotation to label fault names

*EWH\_fault\_displacement\_relative* A point f.c. of symbols representing relative motion of faults

*EWH\_contacts\_concealed* Aline f.c. representing the concealed contacts

*EWH\_geology\_polys* A polygon f.c. representing geologic units

*EWH\_geology\_polys\_Anno*  annotation of geologic unit symbols

*EWH\_bedding* A point f.c. representing inclined bedding measurements

*EWH\_bedding\_anno* Annotation of dip values for inclined bedding

*EWH\_folds* A line f.c. representing the locations of fold axes

*EWH\_fold\_names\_Anno*  Annotation of fold names

*EWH\_fold\_sense\_symbols* A point f.c. representing fold type and orientation of fold axis

*EWH\_foliation* A point f.c. representing orientations of fracture foliation in igneous rocks

*EWH\_foliation\_Anno*  Annotation of dip of foliation

*EWH\_cross\_section\_lines* A line f.c. representing cross sections

*EWH\_cross\_section\_lines\_Anno* Annotation identifying the end-points and mid-point of a cross section line

*EWH\_data\_sources\_lines* A line f.c. representing sources of data

*EWH\_data\_sources\_polys* A poly f.c. representing areas of sources of data

*EWH\_fault\_attitudes* A point f.c. representing orientation of fault planes

*EWH\_fault\_attitudes\_Anno*  Annotation to label fault orientation symbols with dip values for inclined faults

*EWH\_fault\_slickensides* A point f.c. representing slickenside lineations on fault slip surfaces

*EWH\_fault\_slickensides\_Anno* Annotation showing plunge of slickensides

*EWH\_map\_boundary\_line* A line f.c. representing the map boundary

*EWH\_map\_boundary\_poly* A polygon f.c. representing the map boundary

*EWH\_water\_boundaries\_N\_of\_Columbia\_River* A line f.c. representing boundaries of water bodies north of the Columbia River

*EWH\_water\_well* A point f.c. representing water well location

*ofr2014-1063.mxd*  Map document created in ArcGIS 10.2 containing the data rendering and symbolization information that was used in the production of the Open File Report map sheet. For this release, the layers were grouped logically and given aliases in order to be more usable

**2. SHAPEFILE PACKAGE**

ofr2014-1063\_shp.zip

**Shapefiles Description** (exported from the geodatabase--see Geodatabase Package above)

*EWH\_contacts .shp* A line shapefile of the contacts feature class

*EWH\_fault\_displacement\_relative.shp* A point shapefile of symbols representing relative motion of faults

*EWH\_contacts\_concealed.shp* Aline shapefile representing the concealed contacts

*EWH\_geology\_polys.shp* A polygon shapefile representing geologic units

*EWH\_bedding.shp* A point shapefile representing inclined bedding measurements

*EWH\_folds.shp* A line shapefile representing the locations of fold axes

*EWH\_fold\_sense\_symbols* A point shapefile representing fold type and orientation of fold axis

*EWH\_foliation* A point shapefile representing orientations of fracture foliation in igneous rocks

*EWH\_cross\_section\_lines* A line shapefile representing cross sections

*EWH\_data\_sources\_lines* A line shapefile representing sources of data

*EWH\_data\_sources\_polys* A poly shapefile representing areas of sources of data

*EWH\_fault\_attitudes* A point shapefile representing orientation of fault planes

*EWH\_fault\_slickensides* A point shapefile representing slickenside lineations on fault slip surfaces

*EWH\_map\_boundary\_line* A line shapefile representing the map boundary

*EWH\_map\_boundary\_poly* A polygon shapefile representing the map boundary

*EWH\_water\_boundaries\_N\_of\_Columbia\_River* A line shapefile representing boundaries of water bodies north of the Columbia River

*EWH\_water\_well* A point shapefile representing water well location

**3. METADATA**

**Files Description**

*eastern\_willapa\_hills\_geodatabase\_metadata.txt* Metadata for the geodatabase, ofr2014-1063.mdb

*EWH\_bedding\_Anno\_metadata.txt* Metadata of the f.c. annotation for bedding

*EWH\_bedding\_metadata.txt* Metadata of the f.c. bedding

*EWH\_contacts\_metadata.txt* Metadata of the f.c. contacts

*EWH\_cross\_section\_lines\_Anno\_metadata.txt* Metadata of the f.c. annotation of the cross section lines

*EWH\_cross\_section\_lines\_metadata.txt* Metadata of the f.c. cross section lines

*EWH\_data\_sources\_lines\_metadata.txt* Metadata of the f.c. data source lines

*EWH\_data\_sources\_polys\_metadata.txt* Metadata of the f.c. data source polygons

*EWH\_fault\_attitudes\_Anno\_metadata.txt* Metadata of the f.c. annotation of the fault attitudes

*EWH\_fault\_attitudes\_metadata.txt* Metadata of the f.c. attitudes on the faults

*EWH\_fault\_displacement\_relative\_metadata.txt* Metadata of the f.c. relative displacement of the faults

*EWH\_fault\_names\_Anno\_metadata.txt* Metadata of the f.c. annotation for the fault names

*EWH\_fault\_slickensides\_Anno\_metadata.txt* Metadata of the f.c. annotation of the slickensides on the faults

*EWH\_fault\_slickensides\_metadata.txt* Metadata of the f.c. slickensides on the faults

*EWH\_folds\_metadata.txt* Metadata of the f.c. folds

*EWH\_fold\_names\_Anno\_metadata.txt* Metadata of the f.c. annotations of the fold names

*EWH\_fold\_sense\_symbols\_metadata.txt* Metadata of the f.c. symbols on the folds

*EWH\_foliation\_Anno\_metadata.txt* Metadata of the f.c. annotation on the foliation

*EWH\_foliation\_metadata.txt* Metadata of the f.c. foliation

*EWH\_geology\_metadata.txt* Metadata of the Feature Dataset Geology

*EWH\_geology\_polys\_Anno\_metadata.txt* Metadata of the f.c. annotation of the geology polygons

*EWH\_geology\_polys\_metadata.txt* Metadata of the f.c. geology polygons

*EWH\_map\_boundary\_line\_metadata.txt* Metadata of the f.c. map boundary line

*ewh\_map\_boundary\_poly\_metadata.txt* Metadata of the f.c. map boundary polygon

*EWH\_water\_boundaries\_N\_of\_Columbia\_River\_metadata.txt* Metadata of the f.c. water boundaries of the North of the Columbia River

*EWH\_water\_well\_metadata.txt* Metadata of the f.c. water well

**4. PORTABLE DOCUMENT FORMAT** (ADOBE ACROBAT 7.0) FILES

**Files Description**

*ofr2014-1063\_map.pdf* An image of the map sheet exported from Adobe Illustrator

**OBTAINING THE DIGITAL DATA**

The digital data for this map can be obtained in two ways:

1) Download from the U.S. Geological Survey Web Site

2) Request a compact disc (CD) of the files

1) TO OBTAIN THE FILES FROM THE U.S. GEOLOGICAL SURVEY WEB SITE:

The U.S. Geological Survey 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 U.S. Geological Survey is *http://www.usgs.gov.* The Web server for digital publications is *http://pubs.usgs.gov.* To access files for this Open File Report, go to [*http://pubs.usgs.gov/of/2014-1063/*](http://pubs.usgs.gov/of/2014-1063/)

2) TO OBTAIN A CD OF THE FILES:

A CD of any or all of the digital files described here can be obtained by sending a request and return address to: Karen L. Wheeler or Ray E. Wells

U.S. Geological Survey

345 Middlefield Road, M/S 973

Menlo Park, CA 94025

or by email: *kwheeler@usgs.gov* or *rwells@usgs.gov*

**OBTAINING PAPER PLOTS**

TO OBTAIN PLOTS FROM A COMMERCIAL VENDOR:

First obtain the PDF package via a download or by requesting a CD of the PDF package as described above. Take that package to a commercial vendor with a large-format plotter. Make sure the vendor is capable of reading CDs and PDF files and provide the vendor with a copy of this document.

TO OBTAIN PAPER PLOTS FROM THE U.S. GEOLOGICAL SURVEY:

The U.S. Geological Survey provides a print on demand service for digital maps such as this report. To obtain plots, contact the U.S. Geological Survey:

**USGS Information Services**

**Box 25286**

**Denver Federal Center**

**Denver, CO 80225-0046**

**(303) 202-4200**

**1-888-ASK-USGS**

**FAX: (303) 202-USGS**

**e-mail:** ***infoservices@usgs.gov***

Be sure to include with your request the Open File Report 2014-1063.

**DIGITAL COMPILATION**

Several different feature classes were generated within a geodatabase during the construction of the Eastern Willapah Hills geologic map. The topographic base map remains as a digital raster and is overlain on the geology feature class in ArcMap at a 60% transparency level. Some custom menus were used to project, transform, edit, tag, and build points in the map. A digital map collar was made with Adobe Illustrator. The map was exported from the layout view in ArcMap as an Adobe Illustrator file and added to a single Adobe Illustrator file that also contained the description of map units, correlation of map units, cross sections, and an index map. Differences between the maps as they appear in the final map sheet and as they appear in the .mxd file represent changes made in the Adobe Illustrator file to the symbology only and do not reflect any changes in the actual source data. The map is in Universal Transverse Mercator (UTM) projection, NAD27 datum, zone 10, meters, and 1:62,500 scale.

**SPATIAL RESOLUTION**

Uses of this digital geologic 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. The fact that this database was edited at a scale of 1:62,500 means that higher resolution information is not present in the dataset. Plotting at scales larger than 1:62,500 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.

**ACKNOWLEDGMENTS**

We thank Karen L. Wheeler for a digital review of this database and completion of the geodatabase for digital release, including (metadata, readme, and shapefile creation).