U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division

Whitman Mission National Historic Site

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Whitman Mission National Historic Site

whmi_geology.pdf

Version: 8/8/2022

Geologic Resources Inventory Map Document for Whitman Mission National Historic Site

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Geologic Resources Inventory Map Document

Whitman Mission National Historic Site, Washington and Oregon

Document to Accompany Digital Geologic-GIS Data

whmi_geology.pdf

Version: 8/8/2022

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Whitman Mission National Historic Site, Washington and Oregon (WHMI).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

This document contains the following information:

1) **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.

2) **GRI Digital Map and Source Map Citation** – A listing of the GRI digital geologic-GIS map produced for this project along with the source used in its completion. In addition, a brief explanation of how the source map was used is also provided.

3) **Map Unit List** – A listing of all geologic map units present on maps for this project, generally listed from youngest to oldest.

4) **Map Unit Descriptions** – Descriptions for all geologic map units.

5) **Geologic Cross Sections** – Geologic cross section graphics with source geologic cross section abbreviations.

6) **Ancillary Source Map Information** – Additional source map information.

7) **GRI Digital Data Credits** – GRI digital geologic-GIS data and ancillary map information document production credits.

For information about using GRI digital geologic-GIS data contact:

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About the NPS Geologic Resources Inventory Program

Background

The Geologic Resources Inventory (GRI) provides geologic map data and pertinent geologic information to support resource management and science-informed decision making in more than 270 natural resource parks throughout the National Park System. Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The GRI is one of 12 inventories funded by the National Park Service (NPS) Inventory and Monitoring Program. The Geologic Resources Division of the NPS Natural Resource Stewardship and Science Directorate administers the GRI. The NPS Geologic Resources Division partners with the Colorado State University Department of Geosciences to produce GRI products. Many additional partners participate in the GRI process by contributing source maps or reviewing products.

The GRI team undertakes three tasks for each park in the Inventory and Monitoring program: (1) conduct a scoping meeting and provide a summary document, (2) provide digital geologic map data in a geographic information system (GIS) format, and (3) provide a GRI report. These products are designed and written for nongeoscientists.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: https://www.nps.gov/articles/gri-geodatabase-model.htm

Geologic Reports: GRI reports synthesize discussions from the original scoping meeting, follow up conference call(s), and subsequent research. Chapters of each report discuss the geologic setting of the park, distinctive geologic features and processes within the park, highlight geologic issues facing resource managers, and describe the geologic history leading to the present-day landscape. Each report also includes a poster illustrating these GRI digital geologic-GIS data.

For a complete listing of GRI products visit the GRI publications webpage: https://go.nps.gov/gripubs. GRI digital geologic-GIS data is also available online at the NPS Data Store: https://irma.nps.gov/DataStore/Search/Quick. To find GRI data for a specific park or parks select the appropriate park(s), enter “GRI” as a Search Text term, and then select the Search button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: https://www.nps.gov/subjects/geology/gri.htm. At the bottom of that webpage is a “Contact Us” link if you need additional information. You may also directly contact the program coordinator:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division. Learn more about I&M and the 12 baseline inventories at the I&M webpage: https://www.nps.gov/im/inventories.htm.

GRI Digital Map and Source Map Citation

The GRI digital geologic-GIS map for Whitman Mission National Historic Site, Washington and Oregon (WHMI):

Digital Geologic-GIS Map of Whitman Mission National Historic Site and Vicinity, Washington and Oregon (*GRI MapCode WHMI*)

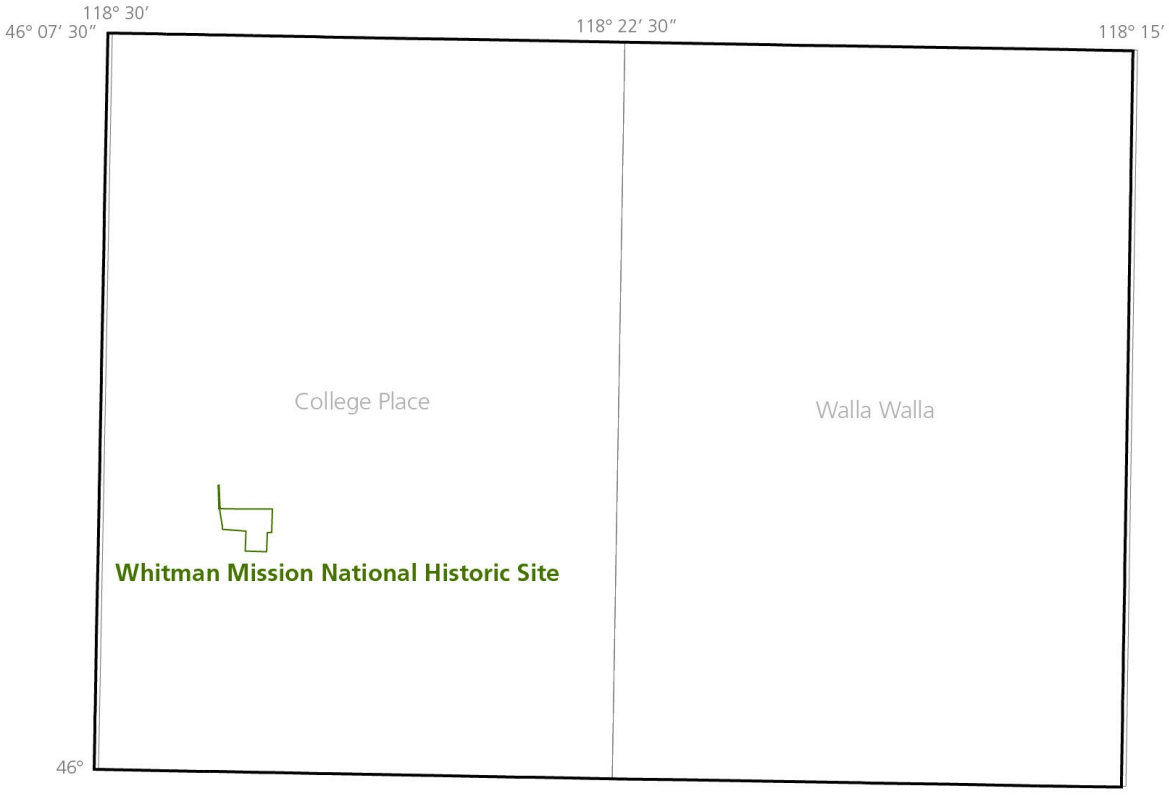
The above GRI digital geologic-GIS map was produced from the source map listed below. The full extent of the source map was used, and all geologic features within the map extent were captured.

> Derkey, R.E., et al., 2006, Geologic Map of the College Place and Walla Walla 7.5-minute Quadrangles, Walla Walla County, Washington, and Umatilla County, Oregon: Washington Division of Geology and Earth Resources, Geologic Map GM-62, scale 1:24,000 (College Place and Walla Walla Quadrangles). (*GRI Source Map ID 74831*).

Additional information pertaining to each source map is also presented in the GRI Source Map Information (WHMIMAP) table included with the GRI digital geologic-GIS data.

Index Map

The following index map displays the extent of the GRI digital geologic-GIS map produced for Whitman Mission National Historic Site (WHMI). The boundary for Whitman Mission National Historic Site (as of August 2022) is outlined in green. The GRI digital geologic-GIS map is defined by the black boundary and covers two 7.5' quadrangles (defined by thin gray line). The extent of the published source map (College Place and Walla Walla Quadrangles) differs slightly (offset by approximately 260 feet to the west and 50 feet to the south) from the true position of the College Place and Walla Walla Quadrangles. When georeferenced using the tics on the published source map, features (such as the WHMI park boundary) present on the basemap in the published source map align with the true position of those features. Therefore it is assumed the relative position of geologic features on the source map are also accurate and no effort was made to adjust the extent of the map to match the true position of the quadrangle boundaries.



Index map by Ron Karpilo (Colorado State University)

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Whitman Mission National Historic Site, Washington and Oregon (WHMI) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qa - Alluvium). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geologic Unit Information (WHMTUNIT) table included with the GRI digital geologic-GIS data. Some source unit symbols, names and/or ages may have been changed in this document and in the GRI digital geologic-GIS data. Unit symbols, names and/or ages in unit descriptions, correlation figures or other source map figures were not edited. If a unit symbol, name or age was changed by the GRI the unit's source map symbol, name and/or age appears with the unit's source map description.

Cenozoic Era

Quaternary Period

Qaf - Modified land
Qa - Alluvium
Qfst2 - Touchet beds, terraces
Qfst1 - Touchet beds, hills
Ql2 - Loess, terraces
Ql1 - Loess, hills

Tertiary Period

PLMIcg - Conglomerate
PLMIf - Fine-grained sediments*
MIvwfs - Wanapum Basalt Formation, Frenchman Springs Member

**Unit shown only in cross sections.*

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below. All unit descriptions were taken from the source map: College Place and Walla Walla Quadrangles

Qaf - Modified land (Recent)

ml - Modified land (Recent) Soil, sediment, or geologic material modified by excavation.

Qa - Alluvium (Holocene)

Discontinuous, unconsolidated deposits of clay, silt, fine sand, and gravel found in and adjacent to stream channels and on the flood plain adjacent to streams on the valley floor; primarily reworked, locally derived loess and flood deposits. Local occurrences of gravel are differentiated from Miocene and Pliocene conglomerate by the absence of weathered basalt clasts, presence of clay matrix, and cementation (Kennedy/Jenks Consultants, 2003, 2004). Contacts between these deposits and the parent materials are rarely exposed.

Qfst2 - Touchet beds, terraces (Pleistocene)

Glacial slackwater flood deposits, consisting of two types: an older sequence with subtle rhythmic bedding and a younger sequence that contains conspicuous rhythmic bedding. The older sequence is predominantly light gray or tan to white sand with minor silt, clay, and sparse pebbles and some local, ice-rafted gravel indicating subaqueous to aqueous origin. It exhibits faint rhythmic bedding when observed from a distance under low-angle light conditions and higher (spring) moisture conditions. The younger sequence consists of well stratified, normally graded, fine- to medium-grained felsic to basaltic sand at the base, grading upward to felsic silt. Rhythmically bedded Touchet beds exhibit soft sediment deformation features. Individual beds range from a few centimeters to 1 m (3 ft) thick (Waitt, 1985). Remnant buttes in Mill Creek valley are rhythmically bedded Touchet beds; north of Mill Creek Valley, well-bedded deposits overlie massive-appearing Touchet beds and are sometimes draped over hilltops of older deposits. Up to 2 m (7 ft) of loess mantles most of the Touchet beds; however, because it is inconsistently distributed and thin, it is not mapped separately. Cross-cutting clastic dikes are common (Fecht and others, 1999) in roadcuts of Touchet beds in the two quadrangles. Unit Qfst1 indicates Touchet beds underlying the older, more dissected rolling hills, and unit Qfst2 is Touchet beds underlying the younger, less dissected terraces.

Qfst1 - Touchet beds, hills (Pleistocene)

Glacial slackwater flood deposits, consisting of two types: an older sequence with subtle rhythmic bedding and a younger sequence that contains conspicuous rhythmic bedding. The older sequence is predominantly light gray or tan to white sand with minor silt, clay, and sparse pebbles and some local, ice-rafted gravel indicating subaqueous to aqueous origin. It exhibits faint rhythmic bedding when observed from a distance under low-angle light conditions and higher (spring) moisture conditions. The younger sequence consists of well stratified, normally graded, fine- to medium-grained felsic to basaltic sand at the base, grading upward to felsic silt. Rhythmically bedded Touchet beds exhibit soft sediment deformation features. Individual beds range from a few centimeters to 1 m (3 ft) thick (Waitt, 1985). Remnant buttes in Mill Creek valley are rhythmically bedded Touchet beds; north of Mill Creek Valley, well-bedded deposits overlie massive-appearing Touchet beds and are sometimes draped over hilltops of older deposits. Up to 2 m (7 ft) of loess mantles most of the Touchet beds; however, because it is inconsistently distributed and thin, it is not mapped separately. Cross-cutting clastic dikes are common (Fecht and others, 1999) in roadcuts of Touchet beds in the two quadrangles. Unit Qfst1 indicates Touchet beds underlying the older, more dissected rolling hills, and unit Qfst2 is Touchet beds underlying the younger, less dissected terraces.

Ql2 - Loess, terraces (Pleistocene)

Silt, clay, and fine sand; tan to light brown in roadcuts and related exposures; massive to poorly stratified silt and very fine sand (Busacca and McDonald, 1994; Baker and others, 1991); brown to dark brown on plowed fields. The only loess included on the map underlies the Touchet beds. Loess that mantles Touchet beds (generally, less than 2 m or 7 ft) was mapped as Touchet beds. Pedogenic calcium carbonate occurs at multiple horizons in large roadcuts. Thickness of the loess ranges from about 5 to 50 ft (Newcomb, 1965). Unit Ql1 indicates loess underlying the older, more dissected rolling hills, and unit Ql2 is loess underlying the younger, less dissected terraces.

Ql1 - Loess, hills (Pleistocene)

Silt, clay, and fine sand; tan to light brown in roadcuts and related exposures; massive to poorly stratified silt and very fine sand (Busacca and McDonald, 1994; Baker and others, 1991); brown to dark brown on plowed fields. The only loess included on the map underlies the Touchet beds. Loess that mantles Touchet beds (generally, less than 2 m or 7 ft) was mapped as Touchet beds. Pedogenic calcium carbonate occurs at multiple horizons in large roadcuts. Thickness of the loess ranges from about 5 to 50 ft (Newcomb, 1965). Unit Ql1 indicates loess underlying the older, more dissected rolling hills, and unit Ql2 is loess underlying the younger, less dissected terraces.

PLMIcg - Conglomerate (Pliocene and Miocene)

MPcg - Conglomerate (Miocene–Pliocene) Consists of a sequence of variably cemented sandy gravel with a muddy to sandy, silicic to calcic matrix that underlies much of the Walla Walla basin. Clasts are predominantly basaltic in composition and are well rounded. This conglomerate is differentiated from younger Quaternary alluvium gravels by the presence of weathered basalt clasts, clay matrix, and cementation, which are absent in the younger gravels.

PLMIf - Fine-grained sediments (Pliocene and Miocene)

MPf - Fine-grained sediments (Miocene–Pliocene) Well drillers describe this unit as silt, sandy silt, sandy mud, and blue, green, and yellow clay. In the Oregon part of the basin, sandy and even gravelly intervals are present locally in these fine strata (Kennedy/Jenks Consultants, 2003). This unit varies in thickness over short distances, which may be due to faulting or rapid facies changes, perhaps as clastic debris was shed from the nearby Blue Mountains. The contact between the conglomerate and fine-grained sediments is probably not a single, continuous surface, but rather a series of interfingering conglomeratic and fine-grained sediments.

Unit shown only in cross sections.

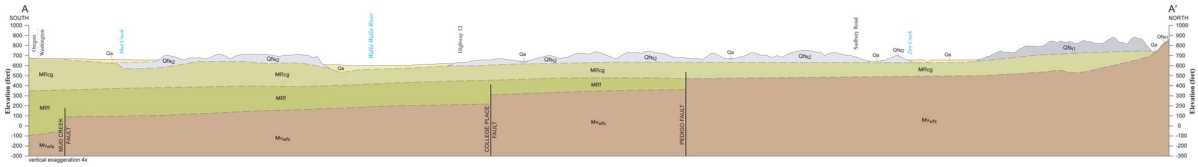
MIvwfs - Wanapum Basalt Formation, Frenchman Springs Member (middle Miocene)

Mwfs - Frenchman Springs Member of the Wanapum Basalt, Columbia River Basalt Group (middle Miocene) Three small exposures of basalt in the northwest corner of the College Place quadrangle are the chemical type of the Frenchman Springs Member and probably either Sentinel Gap or Silver Falls flows (Steve Riedel, Pacific Northwest National Laboratory, written commun., 2006).

Geologic Cross Sections

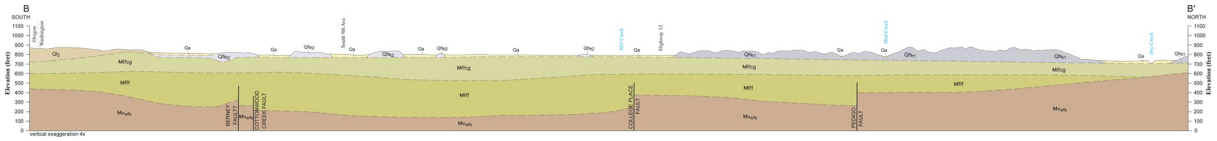
The geologic cross sections present in the GRI digital geologic-GIS data produced for Whitman Mission National Historic Site, Washington and Oregon (WHMI) are presented below. Cross section graphics were scanned at a high resolution and can be viewed in more detail by zooming in (if viewing the digital format of this document).

Cross Section A-A'



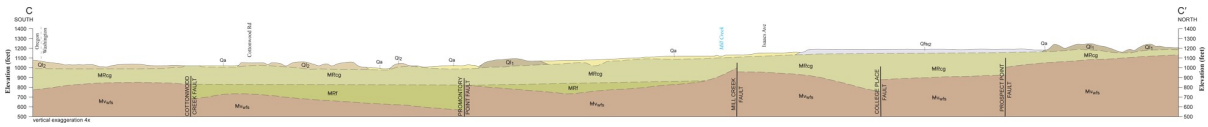
Graphic from source map: College Place and Walla Walla Quadrangles.

Cross Section B-B'



Graphic from source map: College Place and Walla Walla Quadrangles.

Cross Section C-C'



Graphic from source map: College Place and Walla Walla Quadrangles.

Ancillary Source Map Information

The following sections present ancillary source map information associated with sources used for this project.

College Place and Walla Walla Quadrangles

The formal citation for this source.

> Derkey, R.E., et al., 2006, Geologic Map of the College Place and Walla Walla 7.5-minute Quadrangles, Walla Walla County, Washington, and Umatilla County, Oregon: Washington Division of Geology and Earth Resources, Geologic Map GM-62, scale 1:24,000 (*GRI Source Map ID 74831*).

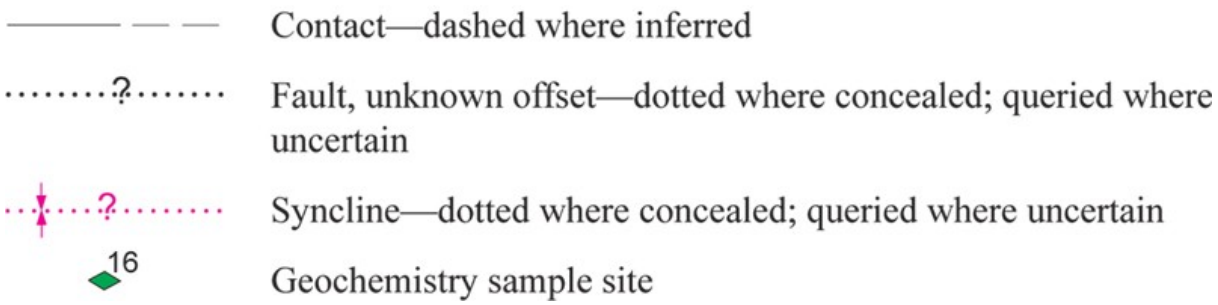
Prominent graphics and text associated with this source:

Digital Data

A digital version of this map can be viewed by clicking GM-62.pdf or by visiting the following link: http://www.dnr.wa.gov/Publications/ger_gm62_geol_map_collegeplace_wallawalla_24k.pdf

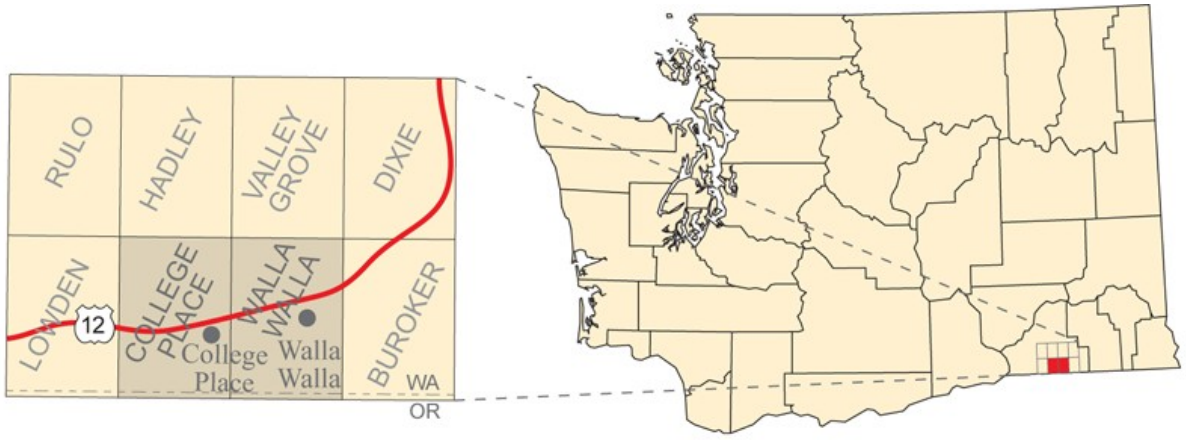
Legend

GEOLOGIC SYMBOLS



Graphic from source map: College Place and Walla Walla Quadrangles

Index Map



Graphic from source map: College Place and Walla Walla Quadrangles

Table 1

MAJOR ELEMENTS—UNNORMALIZED (in weight percent)

Sample	Latitude	Longitude	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Sum
WW11	46.1274028	-118.4738278	50.86	3.082	13.04	13.75	0.218	3.84	8.38	2.91	1.22	0.607	97.91
WW14	46.1347750	-118.4904917	51.12	3.062	12.92	14.02	0.226	4.11	8.24	2.94	1.26	0.610	98.51
WW16	46.1230778	-118.4629361	51.07	3.011	12.96	13.68	0.211	3.97	8.24	2.72	1.35	0.611	97.84
WW39	46.0449639	-118.2430417	53.85	3.117	14.18	9.02	0.171	3.73	8.75	2.97	1.48	0.607	97.89

TRACE ELEMENTS (in parts per million)

Sample	Latitude	Longitude	Ni	Cr	Sc	V	Ba	Rb	Sr	Zr	Y	Nb	Ga	Cu	Zn	Pb	La	Ce	Th	Nd
WW11	46.1274028	-118.4738278	20	22	38	447	636	23	322	203	44	15.5	22	23	147	4	29	63	0	37
WW14	46.1347750	-118.4904917	20	22	38	433	602	30	316	204	44	16.2	20	22	141	5	29	62	1	36
WW16	46.1230778	-118.4629361	19	22	37	428	630	39	324	202	45	16.5	22	24	140	5	27	65	1	33
WW39	46.0449639	-118.2430417	24	45	40	425	1149	38	376	211	48	16.4	24	30	155	3	27	65	0	38

Table 1. Geochemical analyses of four samples from the College Place and Walla Walla area were performed at the Washington State University GeoAnalytical Lab. Instrumental precision is described in Johnson and others (1999). Total Fe is expressed as FeO. Only sample WW16 is from within the map area. WW11 and WW14 were collected just north of the College Place quadrangle in the Hadley quadrangle. WW39 was collected about 2000 ft east of the Walla Walla quadrangle in the Buroker quadrangle. Latitude and longitude are included for each sample. All samples are Frenchman Springs Member of the Wanapum Basalt, Columbia River Basalt Group.

Graphic from source map: College Place and Walla Walla Quadrangles

Description of Map Units

DESCRIPTION OF MAP UNITS

Quaternary Deposits

ml — Modified land—soil, sediment, or geologic material modified by excavation.

Qa — **Alluvium (Holocene)**—Discontinuous, unconsolidated deposits of clay, silt, fine sand, and gravel found in and adjacent to stream channels and on the flood plain adjacent to streams on the valley floor; primarily reworked, locally derived loess and flood deposits. Local occurrences of gravel are differentiated from Miocene and Pliocene conglomerate by the absence of weathered basalt clasts, presence of clay matrix, and cementation (Kennedy/Jenks Consultants, 2003, 2004). Contacts between these deposits and the parent materials are rarely exposed.

Qfs_{t2}, Qfs_{t1} — **Touchet beds (Pleistocene)**—Glacial slackwater flood deposits, consisting of two types: an older sequence with subtle rhythmic bedding and a younger sequence that contains conspicuous rhythmic bedding. The older sequence is predominantly light gray or tan to white sand with minor silt, clay, and sparse pebbles and some local, ice-rafted gravel indicating subaqueous to aqueous origin. It exhibits faint rhythmic bedding when observed from a distance under low-angle light conditions and higher (spring) moisture conditions. The younger sequence consists of well stratified, normally graded, fine- to medium-grained felsic to basaltic sand at the base, grading upward to felsic silt. Rhythmically bedded Touchet beds exhibit soft sediment deformation features. Individual beds range from a few centimeters to 1 m (3 ft) thick (Waitt, 1985). Remnant buttes in Mill Creek valley are rhythmically bedded Touchet beds; north of Mill Creek Valley, well-bedded deposits overlie massive-appearing Touchet beds and are sometimes draped over hilltops of older deposits. Up to 2 m (7 ft) of loess mantles most of the Touchet beds; however, because it is inconsistently distributed and thin, it is not mapped separately. Cross-cutting clastic dikes are common (Fecht and others, 1999) in roadcuts of Touchet beds in the two quadrangles. Unit Qfs_{t1} indicates Touchet beds underlying the older, more dissected rolling hills, and unit Qfs_{t2} is Touchet beds underlying the younger, less dissected terraces.

Ql_2, Ql_1 — **Loess (Pleistocene)**—Silt, clay, and fine sand; tan to light brown in roadcuts and related exposures; massive to poorly stratified silt and very fine sand (Busacca and McDonald, 1994; Baker and others, 1991); brown to dark brown on plowed fields. The only loess included on the map underlies the Touchet beds. Loess that mantles Touchet beds (generally, less than 2 m or 7 ft) was mapped as Touchet beds. Pedogenic calcium carbonate occurs at multiple horizons in large roadcuts. Thickness of the loess ranges from about 5 to 50 ft (Newcomb, 1965). Unit Ql_1 indicates loess underlying the older, more dissected rolling hills, and unit Ql_2 is loess underlying the younger, less dissected terraces.

Miocene and Pliocene Deposits

MRcg — **Conglomerate (Miocene–Pliocene)**—Consists of a sequence of variably cemented sandy gravel with a muddy to sandy, silicic to calcic matrix that underlies much of the Walla Walla basin. Clasts are predominantly basaltic in composition and are well rounded. This conglomerate is differentiated from younger Quaternary alluvium gravels by the presence of weathered basalt clasts, clay matrix, and cementation, which are absent in the younger gravels.

MRf — **Fine-grained sediments (Miocene–Pliocene)(cross sections only)**—Well drillers describe this unit as silt, sandy silt, sandy mud, and blue, green, and yellow clay. In the Oregon part of the basin, sandy and even gravelly intervals are present locally in these fine strata (Kennedy/Jenks Consultants, 2003). This unit varies in thickness over short distances, which may be due to faulting or rapid facies changes, perhaps as clastic debris was shed from the nearby Blue Mountains. The contact between the conglomerate and fine-grained sediments is probably not a single, continuous surface, but rather a series of interfingering conglomeratic and fine-grained sediments.

Mv_{wfs} — **Frenchman Springs Member of the Wanapum Basalt, Columbia River Basalt Group (middle Miocene)**—Three small exposures of basalt in the northwest corner of the College Place quadrangle are the chemical type of the Frenchman Springs Member and probably either Sentinel Gap or Silver Falls flows (Steve Riedel, Pacific Northwest National Laboratory, written commun., 2006).

Graphic from source map: College Place and Walla Walla Quadrangles

Report

INTRODUCTION

The Walla Walla and College Place 1:24,000-scale quadrangles are located in and near the center of the Walla Walla basin. The most extensive geologic reports for the area include “Geology and ground-water resources of the Walla Walla River basin, Washington–Oregon” by Newcomb (1965) and two reports by Kennedy/Jenks Consultants (2003, 2004) on subsurface geology of a portion of the quadrangles. The quadrangles were mapped in 2005 and 2006 by Robert Derkey and Dale Stradling. Kevin Lindsey and Terry Tolan of Kennedy/Jenks Consultants are included as authors for contributing their extensive knowledge of the subsurface geology of the area, which was incorporated into this report.

GEOLOGY AND GEOMORPHOLOGY

Miocene Columbia River Basalt Group is the oldest exposed rock in the quadrangles. It is overlain by Miocene–Pliocene clastic deposits, which in turn are overlain by Quaternary deposits. The lower of two Miocene–Pliocene clastic sediment units is predominantly fine grained and is known only from water well logs. Thickness distribution of the lower unit appears to be controlled by faulting in the two quadrangles. Exposures of the upper unit are limited to two gravel pits. We suggest that the Miocene–Pliocene sediments represent deposits shed from the rising Blue Mountains to the southeast of the quadrangles. Fine-grained clastic deposits that predominated in the earlier stages of uplift were followed by deposition of coarser clastic material (conglomerate) from continued uplift.

The majority of sediments exposed in the two quadrangles are Quaternary— loess, slackwater flood sediments or Touchet beds (Flint, 1938), and alluvium. Cross sections generated from contours of subsurface units in the Kennedy/Jenks reports (2003, 2004), however, demonstrate that the thickness of the Quaternary units is small relative to the underlying Miocene and Pliocene units.

We have divided the quadrangles into geomorphic units that we call rolling hills, terraces, and modern valleys. The rolling hills are found in the north-central, northeast corner, and east-central areas of the quadrangle. The terraces are found in the gently west-sloping area immediately north of Mill Creek valley, the area east and southeast of the City of Walla Walla, and isolated hills surrounded by the stream valleys that occur west and southwest of Walla Walla. The modern valleys consist of the active flood plains of the Walla Walla River and its tributaries. The deposits underlying the rolling hills and terraces are different in different parts of each unit. Consequently, we have avoided suggesting any genesis for these two units. We feel the extent of our mapping throughout the area is insufficient for any genetic interpretations. The rolling
hills and terraces are quite evident when traveling through the two quadrangles.

To delineate the approximate extent of the rolling hills and terraces, we have designated the underlying deposits with numeric subscripts on the unit symbols. The subscript ‘1’ indicates that the geologic unit is in the rolling hills (unit Qfst1 or Ql1). Polygons containing unit symbols with a subscript ‘2’ are part of the terraces (unit Qfst2 and Ql2). Colors depicting the geologic units in the rolling hills on the map are also slightly darker colored than their counterpart in the terraces.

Loess was deposited fairly continuously throughout much of the Pleistocene as windblown dust across treeless areas south of the glacial front. An older loess sequence (unit Ql1) underlies the rolling hills in the northeast and eastern parts of the Walla Walla map area. We believe the younger loess sequence (unit Ql2) is a terrace developed over portions of the older loess sequence.

Slackwater flood deposits called ‘Touchet beds’ were deposited intermittently near the end of the Pleistocene when catastrophic floodwaters ponded behind Wallula Gap (Waitt, 1985), which is immediately downstream of the confluence of the Walla Walla River with the Columbia River. Two types of Touchet beds are recognized in the two quadrangles— an older sequence with subtle rhythmic bedding and a younger sequence with conspicuous rhythmic bedding. The difference between the two types of Touchet beds appears to be the presence or absence of silt at the top of an individual bed; silt at the top of each bed delineates their rhythmic nature.

Where the older, subtly rhythmic Touchet beds occur exclusive of the conspicuously rhythmic Touchet beds, they have been mapped separately (unit Qfst1). This corresponds to the rolling hills of the north central and northwest parts of the Walla Walla map area. The Touchet beds underlying most of the terraces are the younger, conspicuously rhythmic beds. The younger Touchet beds form most of the extensive terrace area north of the valley of Mill Creek and the erosional remnants in the valleys of Mill Creek and the Walla Walla River. In the western part of the Walla Walla map area, erosion has dissected portions of the terraces exposing the older, subtly rhythmic Touchet beds. Limited exposures precluded mapping the two types of Touchet beds separately in the terraces. The younger sequence is also draped over hills of the older sequence, notably along Ireland Road near the western edge of the College Place quadrangle.

Touchet beds occur to an altitude of 1100 to 1200 ft (335–366 m) in the Walla Walla Valley and are of variable thickness due to deposition on an irregular paleosurface (Newcomb, 1965; Kennedy/Jenks Consultants, 2004). In the many roadcuts we examined, we did not identify any slackwater deposits in the loess, nor did we identify any loess interbedded with Touchet beds. We suggest that the loess and Touchet beds were deposited with little overlap.

A thin veneer of post-flooding loess, ranging from 0 to 6 ft (0–2 m) in thickness, overlies the Touchet beds. The amount was difficult to determine because exposures are poor and limited to roadcuts. On plowed fields, loess is brown and the Touchet beds are light gray; thus, we could distinguish extensive areas without loess cover that we mapped as Touchet beds. It was difficult to determine the amount of post-flooding loess deposited on older loess because they are difficult to distinguish from each other. We estimate that the amount of post-flooding loess deposited on older loess is similar to the amount deposited on the Touchet beds, that is, 0 to 6 ft (0–2 m).

STRUCTURE

Strike-slip faulting controls the geometry of the Walla Walla basin. Kennedy/Jenks Consultants (2004) reported that “previous geologic and hydrogeologic investigations (Newcomb, 1965; Farooqui and Thoms, 1980; Foundation Sciences, Inc., 1980; Swanson and others, 1980; Schuster, 1994) have identified a number of faults and folds within the project area”. The locations of faults identified or inferred by previous investigators were slightly modified for this study and, in some cases, extended. All faults are concealed and locations were based on changes in elevation of the top of the basalt, determined from water well logs. The faulting is oblique-slip with relative down and upfaulted portions giving the impression of horst and graben blocks. Some of the faulting is projected from bedrock exposures east of the two quadrangles (Kennedy/Jenks Consultants, 2004). A brief discussion of each structure on the map follows.

Walla Walla syncline— Based on a top-of-basalt map produced from water well logs, Newcomb (1965) postulated a broad syncline, which he named the Walla Walla syncline. Additional depth-to-basalt data of Kennedy/Jenks Consultants (2003, 2004) suggest that rather than a broad syncline, faulting may be the reason for the postulated syncline. The syncline axis shown on the geologic map is that of Newcomb (1965). Cottonwood Creek fault—This fault was originally mapped by Swanson and others (1980), based on observed offset in basalt southeast of the map area at the headwaters of Cottonwood Creek. Vertical offset is unknown, but could range from 100 ft to more than 200 ft down to the northeast (Kennedy/Jenks Consultants, 2004). Our contouring suggests that offset could be in excess of 300 ft near the southwest corner of the Walla Walla quadrangle.

Promontory Point fault— Clive F. Kienle, Jr., (Foundation Sciences, Inc., 1980, p. 41) described the Promontory Point fault as a right-lateral oblique-slip fault with at least 250 ft of apparent stratigraphic offset (down to the south) southeast of the map area in the foothills of the Blue Mountains (Kennedy/ Jenks Consultants, 2004). The trend is similar to that of the Cottonwood Creek fault. Our contouring suggests the offset could be that great along a portion of its length.

Prospect Point fault— The trend of this fault is similar to the trend of the Cottonwood Creek and Promontory Point faults. Apparent offset is down to the southwest. Based on field relations, Kienle (Foundation Sciences, Inc., 1980) inferred that the Prospect Point fault is a right-lateral oblique-slip

fault like the Promontory Point fault. Swanson and others (1980) and Schuster (1994) believed stratigraphic offset across this fault to be greater than 100 to 200 ft.

Mill Creek fault— The name “Mill Creek fault” is here applied to a possible eastwest-trending fault along the southern side of the Mill Creek valley. Truncated spurlike features on the south side of Mill Creek that form the contact between loess and the stream valley are suggestive of a fault; however, depth to basalt in wells in the vicinity of the suggested fault does not indicate much, if any, displacement. Kienle (Foundation Sciences, Inc., 1980) inferred a displacement on the order of 50 to 100 ft, which could be hard to identify from the approximate location of water wells.

Berney fault— A pronounced drop in top of basalt indicates that there is a relatively sharp, 200 to 300 ft drop (down to the west) in elevation from the east to west side of this fault. Inferred faults southwest of the initially identified Berney fault (Kennedy/Jenks Consultants, 2004) were added due to similar elevation decreases and are labeled “Berney Fault(?)”. The orientation of these faults is consistent with an origin as a secondary shear associated with the dextral oblique-slip Promontory Point, Mill Creek, Prospect Point, and Cottonwood Creek faults (Kennedy/Jenks Consultants, 2004). If the Berney fault is offset by the Promontory Point and Cottonwood Creek faults, the right-lateral offset is in the range of 5000 to 10,000 ft for each fault.

College Place fault— This fault, originally called the “College Place Flexure” by Newcomb (1965), is a ground-water barrier in the Walla Walla area. Newcomb (1970) changed his interpretation of this structure from a flexural fold to a fault. Apparent stratigraphic offset was estimated by Kienle (Foundation Sciences, Inc., 1980) to be 100 to 200 ft.

Pedigo fault— We included a new fault to account for a rapid change in elevation of the top of the basalt surface north of and parallel to the College Place fault. Offset is about 150 ft. The fault occurs at the transition from rhythmically bedded Touchet beds of the gently west-sloping younger terrace to massive bedded Touchet beds of the older rolling hills terrace. We suggest that there could have been movement on this fault following deposition of massive-bedded Touchet beds and before deposition of rhythmically bedded Touchet beds.

Mud Creek fault— We propose another new fault based on a change in elevation of the top of the basalt, which drops to below sea level (Bush and others, 1973) on the south side of the fault. Relief on this probable fault in the Lowden quadrangle west of the College Place quadrangle is over 200 ft.

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Report from source map: College Place and Walla Walla Quadrangles

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