BEDROCK GEOLOGIC MAP OF THE LEWISTON ORCHARDS NORTH QUADRANGLE, NEZ PERCE COUNTY, IDAHO

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2001

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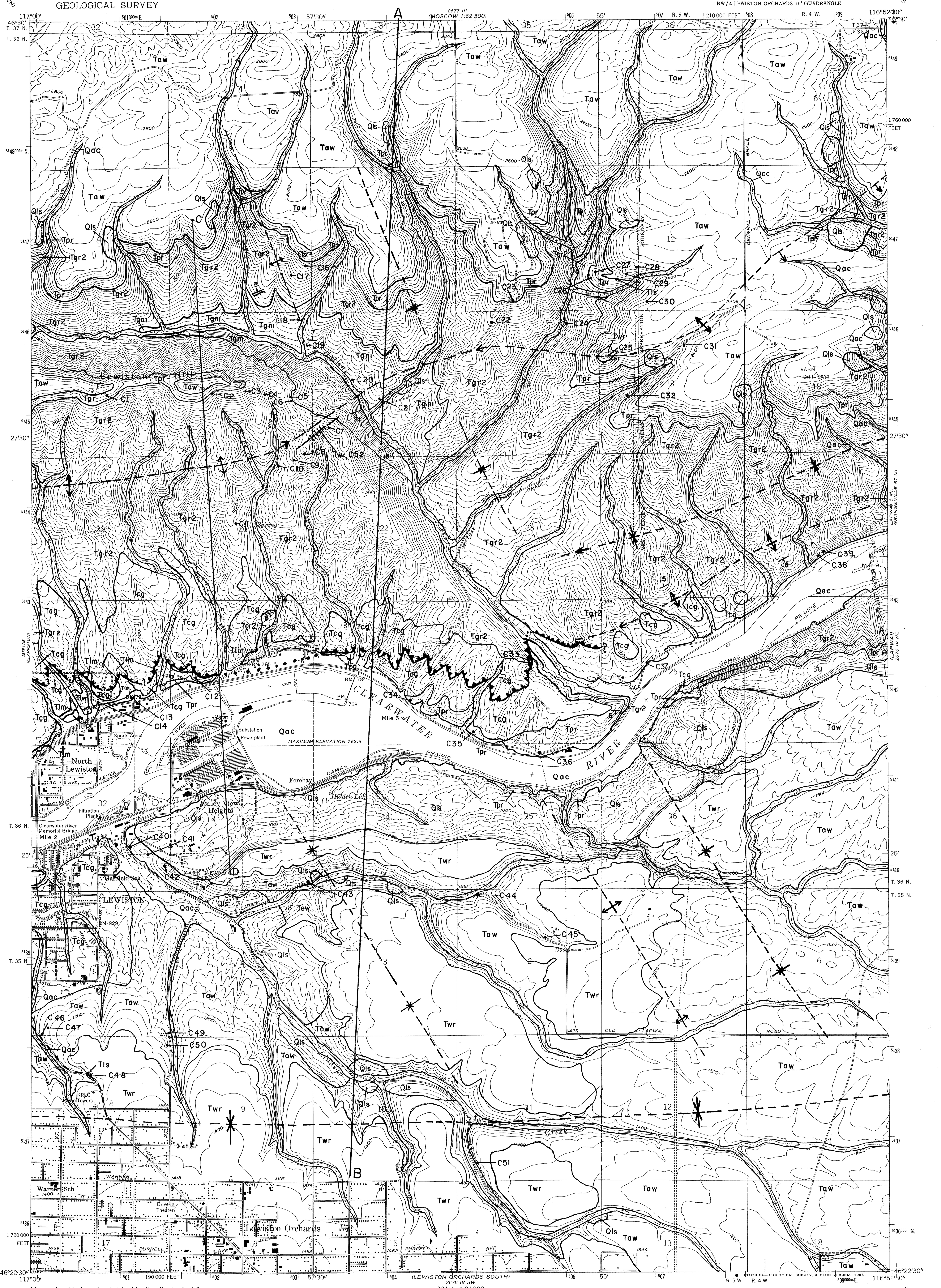
Idaho Geological Survey
Technical Report 01-2
Garwood and Bush
2001



Mapped, edited, and published by the Geological Survey
Control by USGS and USC&GS
Topography from aerial photographs by photogrammetric methods
Aerial photographs taken 1955. Field check 1958
Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, west zone
1000-meter Universal Transverse Mercator grid ticks, zone 11, shown in blue
To place on the predicted North American Datum 1983 move the projection lines 16 meters north and 78 meters east as shown by dashed corner ticks
There may be private inholdings within the boundaries of the National or State reservations shown on this map

SCALE 1:24 000
CONTOUR INTERVAL 40 FEET
CONTOUR INTERVAL ON RIVER SURFACE 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ROAD CLASSIFICATION
Heavy-duty ... Light-duty
Medium-duty ... Unimproved dirt
U. S. Route

LEWISTON ORCHARDS NORTH, IDAHO
NW/4 LEWISTON ORCHARDS 15' QUADRANGLE
46116-D8-TF-024
1958
PHOTOREVISED 1972
DMA 2876 IV NW—SERIES V893

Revisions shown in purple compiled from aerial photographs taken 1972. This information not field checked
Purple tint indicates extension of urban areas

INTRODUCTION

The bedrock geologic map of the Lewiston Orchards North quadrangle represents a compilation of previous research and additional field work. Distribution of the loess of the Palouse Formation and some post basalt gravel units are not illustrated in keeping with the emphasis on bedrock geology. However, alluvium and colluvium, landslides, and Pliocene? Clearwater gravels are illustrated because their map patterns often help interpret bedrock structures. Continuous outcrops are not common and the contact lines are interpretive. Regional maps by Bond (1963), Newcomb (1970), Kehew (1976), Rember and Bennett (1979), Swanson and others (1979a, 1980), Hooper and others (1985), and Schuster (1993, 1997) were used in the compilation. In addition, maps of the Lewiston structure by Hollenbaugh (1959) and Camp (1976) were used for some details. The basalt chemistry was analyzed by the GeoAnalytical Laboratory at Washington State University (Table 1). Magnetic polarities were determined using a field fluxgate magnetometer and in places field readings were verified in the paleomagnetic laboratory of the Idaho Geological Survey.

The Lewiston Hill is a prominent topographic feature on this quadrangle. Several previous workers depicted a major east-west fault a few hundred feet below the crest of the hill (Hollenbaugh, 1959; Bond, 1963; Camp, 1976; Swanson and others, 1980; Hooper and others, 1985; and Schuster, 1993). We interpret the hill to owe its origin primarily to anticlinal folding and to be the major feature in an east-west-trending fold belt that extends from the Clarkston quadrangle on the west, eastward to at least the western edge of the Lenore quadrangle. Most researchers agree on the presence of a major anticlinal feature but disagree on the importance of associated faulting. The fracturing and faulting exposed in the numerous roadcuts along the Lewiston Hill are considered to be mostly accommodating features related to anticlinal deformation and not features related to a nearby fault or a regional fault pattern. One of these roadcuts (11T 503336mE, 5144889 mN) was examined in detail using geochemical, paleomagnetic and stratigraphic methods. At that exposure a weathered Lewiston Orchards dike in the center of the anticline makes interpretation difficult. However, it can be demonstrated that stratigraphic offset is minor (<25 feet). Changes in dip across the Grande Ronde-Wanapum contact suggests the presence of a fault. However, these dip changes along the south side of the Lewiston Hill structure are due in part to the presence of a northwest trending cross-fold and to the fact that the contact is an angular unconformity.

The Lewiston Hill itself is part of a doubly plunging east-west-trending anticline with the highest elevations representing the undulating crests of the fold and the lows generally representing shallow northwest-plunging cross-folds. Fold geometry is complicated by folding during extrusion and by the presence of later northwest-southeast-trending low-amplitude, long-wavelength cross folds. These folds are difficult to map because the low-angle dips and the strike directions are difficult to determine. The northwest-southeast folds illustrated are rarely visible in the field and were delineated by detailed correlation of individual units over long distances and by interpretation of map patterns.

The thrust fault on the north side of the Clearwater River is exposed in a small bulldozer cut in the middle of section twenty-six. At that locality basalt from the R_2 magnetostratigraphic unit of the Grande Ronde overlies Clearwater gravels which are late Pliocene in age (Hooper and others, 1985; Othberg and others, in preparation). Kehew (1976) described a similar exposure approximately one mile to the west. The fault dips to the north between twenty-five and thirty degrees (see cross-section). We extended the fault westward where we interpret it to cut the Lower Monumental flow.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the assistance of the many ranchers and landowners that allowed access to their property during the course of our field work. John Bond provided important well data in addition to numerous insights to specific areas. Steve Reidel reviewed our work in the field and our chemical data. Discussions with Bond and Reidel were especially useful. Special thanks to the Idaho Geological Survey for funding, moral support, and geological assistance. In particular we would like to thank Dan Weisz of the Idaho Geological Survey for assistance with the paleomagnetic research and numerous other important projects. The authors would also like to thank John Kauffman for his critical review of the map descriptions.

DESCRIPTION OF MAP UNITS

The stratigraphic nomenclature for the Columbia River Basalt Group is based on that presented by Swanson and others (1979b). The group is divided into four formations: from base upward, these are the Imnaha, Grande Ronde, Wanapum, and Saddle Mountains. These units can be subdivided into four magnetostratigraphic units (Swanson and others, 1979b). Only the N_1 and R_2 members are present in the Lewiston Orchards North quadrangle. Chemistry, stratigraphic position, lateral tracing, and magnetic polarity were used to map the two units in the field.

Several basalt flows are separated in places by sediments that belong to the Latah Formation. Locally, these sediments may be laterally continuous but overall they are too thin to map across the entire quadrangle. The sediments change thickness and composition over short distances. Rare exposures occur primarily in recent roadcuts and quarries. Exposures of Latah sediments are noted on the map, but they are not depicted as separate, continuous units.

SURFICIAL DEPOSITS

Qac Alluvium and colluvium (Holocene) -- Stream, slope-wash, and debris-flow deposits. In the plateau areas, composition commonly consists of reworked loess or mixtures of loess and basalt. Downstream from the plateau edges, basalt comprises most of the deposits until the drainages reach lower elevations where the deposits include incorporated parts of post-basalt sediments. Compositions are highly variable at the lower elevations because of the influence of several different types of river, slope-wash, and catastrophic flood sediments common to the Lewiston basin area. Composition of the surficial sediments is locally influenced by erosion of nearby Latah sediments and post-basalt Tertiary sediments. Though dominated by basalt, the Clearwater River contains sediments with a high percentage of prebasalt lithologies, reflecting headwater erosion through and beyond the eastern edge of the Clearwater embayment.

Qls Landslide deposits (Holocene-Pleistocene) -- Highly variable rock and soil masses ranging from slumped coherent blocks to earth flows. The map pattern of this unit was modified from Othberg and others (in preparation). Slump blocks consist primarily of intact and broken sections of basalt and interbed sediments. Earth flows mainly consist of unstratified, unsorted gravel rubble in a clayey matrix derived from liquified Sweetwater Creek sediments (Othberg and others, in preparation). Location of landslides is controlled by stratigraphic position of sedimentary interbeds and the hydrogeologic regime. The largest landslides occur where valley incision has cut through the Saddle Mountains Basalt sequence exposing sedimentary interbeds to steep topography. The landslides are not considered to be relic features that are stable today (Othberg and others, in preparation). The landslide debris can be highly unstable when modified, either because of natural changes in precipitation or artificial modifications such as cuts, fills, and changes in surface drainage and ground-water infiltration.

Tcg Clearwater Gravels (Pliocene?) -- Primarily mainstream channel gravel and sand deposits that form a highly dissected terrace. This unit was modified from Othberg and others (in preparation). Terrace surface remnants, from east to west, range from 1,080 feet to 1,050 feet in elevation; an alluvial fan facies forms remnant slopes graded to the terrace. Gravel clast lithologies, foreset cross-bedding, and cobble imbrication indicates a source and westward current direction similar to the present Clearwater River (Webster and others, 1982; Hooper and others, 1985; Othberg and others, in preparation). The gravels and sands are more weathered than typical Quaternary deposits, showing yellow to brown iron oxides in the matrix, local cementation, and softening of some gravel clasts. Recent field observations by Othberg and others (in preparation) suggest a complex facies in this unit, reflecting interaction of mainstream and sidestream sources. These deposits and their stratigraphic relationships are exposured uphill from the site described by Kuhns (1980), in the POE Asphalt gravel pit in north Lewiston, and three miles to the east in a gravel pit adjacent to Groundcovers Inc. (Othberg and others, in preparation). As described by Kehew (1977), Webster and others (1982), Hooper and others (1985), and Othberg and others (in preparation) the Clearwater Gravel, in its downstream correlative Clarkston Heights Gravel, represent a major aggradational event in which an ancestral valley was filled to an elevation of about 1,150 feet.

LATAH FORMATION

Tls Latah Formation sedimentary interbeds (Miocene) -- Clay, silt, sand, and gravel deposits that in places separate basalt flows. The most notable Latah unit is the Sweetwater Creek interbed of Bond (1963). The Sweetwater overlies the uppermost Priest Rapids flow throughout the quadrangle. It is as much as 241 feet in thickness (unpublished well data) and consists of intercalated sand, silt, clay, and ash-rich strata with local gravel stringers. Gaylord and others (1989) describe the Sweetwater Creek interbed for the Lewiston basin and conclude that deposition resulted primarily from fluvial and mixed fluvial-lacustrine sedimentation. These sediments, along with the Wilbur Creek and Asotin flows of the Saddle Mountains Formation, thicken westward toward the center of the Lewiston syncline and thin northward toward the Genesee quadrangle. Natural exposures of Latah beds are rare.

COLUMBIA RIVER BASALT GROUP: SADDLE MOUNTAINS FORMATION

Tlm Lower Monumental Member (Miocene) -- Dense, fine-grained basalt with microphenocrysts of olivine that are readily visible with a hand lens. The basalt has a normal magnetic polarity (Choiniere and Swanson, 1979) and has been isotopically dated at 6 Ma (Mckee and others, 1977). Occurs as erosional remnants along the Snake and Clearwater rivers. Characterized by its generally consistent hackly entablature jointing.

Twr Weissenfels Ridge Member (Miocene) -- Medium- to coarse-grained basalt with microphenocrysts of plagioclase and olivine in an intergranular groundmass with minor glass (Hooper and others, 1985). In the Lewiston basin, there are four flows of this member with normal polarity that can be distinguished from each other in the field on the basis of size, character, and relative abundance of plagioclase and/or olivine phenocrysts (Swanson and others, 1980). On the Lewiston Orchards North quadrangle, the chemistry at three locations (C25, C48, C51) is similar to the basalt of Lewiston Orchards as reported by Hooper and others (1985). Although dikes of this flow are common in the Lewiston basin (Hooper and others, 1985; Schuster, 1993) only one was identified on the Lewiston Orchards North quadrangle, located near the center of the Lewiston Hill anticlinal structure (C51). Swanson and others (1979a) show the basalt of Lewiston Orchards to be laterally continuous over much more of the quadrangle. Some of the covered, higher elevation areas are possibly underlain by this basalt. Our map patterns for this unit are interpretive, derived from both our research and the map of Swanson and others (1979a).

Taw Asotin and Wilbur Creek Members (Miocene) -- Consists of fine- to coarse-grained basalt that is sparsely plagioclase phyric and has normal magnetic polarity. Although not consistent, the basalt of the Asotin Member tends to be denser than that of the Wilbur Creek. The lowermost basalt, generally the Wilbur Creek, overlies the Sweetwater interbed of Bond (1963). Outcrops of these two members dominate the exposures south of the Clearwater River. No feeder dikes have been identified (Schuster and others, 1997).

Reidel and Fecht (1987) have shown that flows from these two members locally mixed at the surface to form the Huntzinger flow in the Pasco basin, indicating nearly simultaneous eruption. Chemical analyses from this study support this idea. Wilbur Creek flows generally have higher TiO_2 and lower MgO than Asotin flows. In the Lewiston basin, the Asotin overlies the Wilbur Creek which contains an upper subunit called the basalt of Lapwai (Reidel and Fecht, 1987). Analyses from this study show a range of chemistry with "mixed" chemistry being the basalt of Lapwai. Most workers attempted to delineate between the Asotin and Wilbur Creek Members and correlate between outcrops (Swanson and others, 1979a; Swanson and others, 1980; and Hooper and others, 1985). Chemically, the two members can be distinguished (Camp, 1984). Where there are good outcrops the flows can be distinguished using stratigraphic and chemical data. However, the basalts in these members were emplaced as valley-filling flows over irregular surfaces and our research showed that they cannot be correlated from locality to locality as laterally continuous units over long distances.

COLUMBIA RIVER BASALT GROUP: WANAPUM FORMATION

Tpr Priest Rapids Member (Miocene) -- Medium- to coarse-grained basalt with microphenocrysts of plagioclase and olivine in a groundmass of intergranular pyroxene, ilmenite blades, and minor devitrified glass. Distinguished from overlying Saddle Mountains basalt flows by its reverse polarity and distinctive chemistry (Table 1). This unit was previously identified and described by Wright and others (1973) and Swanson and others (1979a and 1980). Mapping of this unit east and northeast of the Lewiston Hill shows that it thickens and thins in relation to the folding in that area. Northeast of the hill and north of the steepest plunge of the fold, the Priest Rapids is more than two hundred feet thick, consists of two flows, and rests on a poorly developed saprolite atop thick R_2 flows of the Grande Ronde that have very large well developed columns in thick flow units. In the Lewiston Hill area near the highest crest of the anticline, the Priest Rapids thins to less than 150 feet, consists of one flow, and it rests over a well developed saprolite atop R_2 flows that locally consist of thin flow units with small poorly developed columns. These changes in flow unit thickness and column configuration are interpreted to have been caused by thinning over the developing anticline in the Lewiston Hill area. The same flows were ponded and developed into thicker flow units in the area east of the crest, probably due to intersection of the east-west-trending anticline with a northwest-southeast-trending syncline.

COLUMBIA RIVER BASALT GROUP: GRANDE RONDE FORMATION

Tgr_2 R_2 magnetostratigraphic unit (Miocene) -- Two to three fine-grained to very fine-grained reverse magnetic-polarity flows of Grande Ronde chemical type (Wright and others, 1973; Swanson and others, 1979a; Reidel and others, 1989). Locally, the uppermost basalt unit is abundantly plagioclase-microphyric. Our comparisons suggest that the uppermost unit correlates to the Meyer Ridge unit and the lower flows to the Wapshilla Ridge unit of Reidel and others (1989). The entire sequence is at least 600 feet in thickness. Based on nineteen samples (Table 1), the basalt has intermediate to very low MgO (5.36-3.31wt%) and high to very high TiO_2 (1.72-2.54wt%) compared to other Grande Ronde units. The R_2 flows in the map area form the uppermost surface of the Grande Ronde Basalt, which is deeply weathered to saprolite at most locations.

Tgn_1 N_1 magnetostratigraphic unit (Miocene) -- Several fine-grained aphyric, normal magnetic-polarity flows of Grande Ronde chemical type (Wright and others, 1973; Swanson and others, 1979a; Reidel and others, 1989). The unit is dominated by the intermediate to high MgO and relatively low TiO_2 flows described by Reidel and others (1989) and may correlate to their China Creek unit. Only the uppermost flows of this unit are exposed on the Lewiston Orchards North quadrangle.

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Table 1. Major chemical elements* of sampled basalt units

Map #	Unit	Smpl. #	SiO_2	Al_2O_3	TiO_2	FeO**	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5
C1	Tpr	LON4	50.70	13.62	3.230	13.13	0.238	9.18	5.20	1.10	2.83	0.786
C2	Tgr2	LON3	54.89	14.37	1.760	10.62	0.184	8.70	4.96	1.16	3.10	0.287
C3	Tgr2	LON2	55.35	13.79	2.532	11.81	0.350	7.07	3.48	1.72	3.43	0.470
C4	Tgr2	LON1	56.67	13.91	2.374	10.73	0.185	7.13	3.31	1.83	3.44	0.465
C5	Tgr2	LON105	54.73	13.86	2.162	12.01	0.202	8.06	4.26	1.32	3.03	0.360
C6	Tgr2	LON100	55.16	13.89	2.004	11.54	0.222	7.95	4.21	1.47	3.15	0.392
C7	Tgr2	LON106	55.99	14.37	2.118	9.81	0.191	8.17	4.15	1.66	3.14	0.404
C8	Tgr2	LON101	55.17	13.74	2.077	12.23	0.184	7.35	4.19	1.40	3.32	0.335
C9	Tgr2	LON102	54.96	14.44	1.721	10.64	0.177	8.78	4.89	1.11	3.02	0.260
C10	Tgr2	LON103	54.98	13.84	2.018	12.12	0.220	7.88	4.07	1.35	3.14	0.392
C11	Tgr2	LON104	54.62	13.64	2.126	12.78	0.208	7.49	4.12	1.33	3.32	0.362
C12	Tlm	LON107	50.39	13.70	2.98	14.13	0.226	8.70	4.99	1.46	2.77	0.66
C13	Tpr	LON130	50.20	13.66	3.30	13.28	0.230	9.41	5.38	1.21	2.52	0.80
C14	Tlm	LON124	50.30	13.85	2.982	13.74	0.228	8.83	5.11	1.55	2.74	0.674
C15	Tpr	LON404	49.98	13.64	3.259	13.55	0.241	9.38	5.35	1.20	2.61	0.79
C16	Tgr2	LON403	53.77	14.37	1.789	10.91	0.232	9.32	5.14	1.21	2.94	0.302
C17	Tgr2	LON402	55.97	13.83	2.402	11.20	0.213	7.17	3.43	2.09	3.22	0.487
C18	Tgn1	LON401	54.65	13.68	2.225	12.41	0.216	7.77	3.89	1.76	3.00	0.410
C19	Tgn1	LON400	56.30	13.99	2.104	11.06	0.198	7.51	3.74	1.61	3.15	0.335
C20	Tgn1	LON138	56.26	13.83	2.090	10.94	0.194	7.73	3.89	1.64	3.13	0.296
C21	Tgn1	LON137	56.64	13.88	2.078	10.83	0.198	7.47	3.70	1.78	3.08	0.333
C22	Tgr2	LON139	54.58	14.59	1.811	9.86	0.207	9.31	5.12	1.28	2.95	0.295
C23	Tpr	LON506	50.27	13.49	3.29	13.42	0.235	9.26	5.34	1.25	2.61	0.83
C24	Tgr2	LON505	55.22	14.11	1.869	11.18	0.221	8.33	4.37	1.35	3.03	0.321
C25	Twr	LON10	48.71	15.09	2.211	12.19	0.200	11.38	6.83	0.44	2.44	0.514
C26	Tpr	LON504	50.30	13.63	3.262	13.24	0.245	9.36	[illegible]	1.23	2.63	0.78
C27	Tpr	LON503	50.19	13.49	3.278	13.53	0.241	9.24	5.38	1.22	2.65	0.79
C28	Taw	LON501	50.37	16.34	1.502	9.30	0.160	11.36	7.94	0.47	2.35	0.200
C29	Taw	LON502	50.34	16.22	1.483	9.41	0.161	11.14	8.12	0.61	2.32	0.197
C30	Taw	LON500	50.79	16.64	1.422	8.80	0.156	11.49	7.70	0.48	2.34	0.181
C31	Taw	LON11	50.08	16.20	1.422	9.45	0.156	11.37	8.31	0.54	2.30	0.180
C32	Tgr2	LON108	54.98	13.80	2.540	12.13	0.197	7.31	3.63	1.82	3.14	0.458
C33	Tgr2	LON700	55.04	14.19	2.054	11.29	0.204	8.15	4.12	1.38	3.22	0.375
C34	Tpr	LON111	50.37	13.53	3.276	13.55	0.235	9.34	5.03	1.08	2.78	0.81
C35	Tpr	LON110	49.74	13.44	3.199	14.05	0.239	9.21	5.33	1.24	2.77	0.79
C36	Tpr	LON109	50.07	13.40	3.239	13.77	0.236	9.16	5.40	1.12	2.80	0.80
C37	Tgr2	LON131	53.84	14.29	1.777	11.32	0.255	8.71	5.36	1.16	3.00	0.284
C38	Tgr2	LON135	56.25	14.36	2.083	9.67	0.207	8.09	4.18	1.56	3.21	0.393
C39	Tgr2	LON136	55.11	13.99	2.026	11.36	0.216	8.10	4.31	1.45	3.06	0.371
C40	Taw	LON115	51.32	16.73	1.492	8.99	0.155	11.77	6.50	0.43	2.42	0.192
C41	Taw	LON116	50.53	16.06	1.518	9.49	0.155	11.14	7.75	0.67	2.48	0.210
C42	Taw	LON117	50.44	16.25	1.461	9.43	0.152	11.43	7.76	0.42	2.47	0.185
C43	Taw	LON114	53.56	14.55	1.847	11.16	0.166	8.79	4.94	1.59	2.91	0.477
C44	Taw	LON113	52.83	14.96	1.729	10.59	0.164	9.41	5.82	1.35	2.74	0.404
C45	Taw	LON112	50.11	16.13	1.420	9.46	0.160	11.31	8.28	0.49	2.46	0.176
C46	Taw	LON118	55.31	15.06	1.976	9.69	0.160	8.79	3.87	1.73	2.86	0.539
C47	Taw	LON119	50.72	16.51	1.461	9.67	0.150	11.48	7.11	0.37	2.34	0.187
C48	Twr	LON120	49.41	14.30	2.54	12.00	0.198	11.25	6.77	0.57	2.37	0.59
C49	Taw	LON122	50.19	16.20	1.442	9.56	0.153	11.37	8.09	0.50	2.30	0.183
C50	Taw	LON121	49.75	16.18	1.441	10.03	0.158	11.33	8.23	0.36	2.34	0.18
C51	Taw	LON123	52.32	14.89	1.712	11.13	0.168	9.49	6.05	1.25	2.60	0.389
C52	Twr	LON2000	49.74	14.25	2.687	11.82	0.190	11.14	6.69	[illegible]	2.23	0.611

*Weight-percent analysis at Washington State University's GeoAnalytical laboratory by X-ray fluorescense under the direction of P.R. Hooper. Analyses are normalized on a volatile-free basis.

**Total Fe expressed as FeO.

SYMBOLS

- Anticline axial trace
- Syncline axial trace
- Monocline axial trace
- Thrust fault
- Fault
- Contact
- Dike
- Strike and dip (12)
- Inferred strike and dip (19)
- Chemistry sample (C25)
- Latah sediment exposure (Tls)