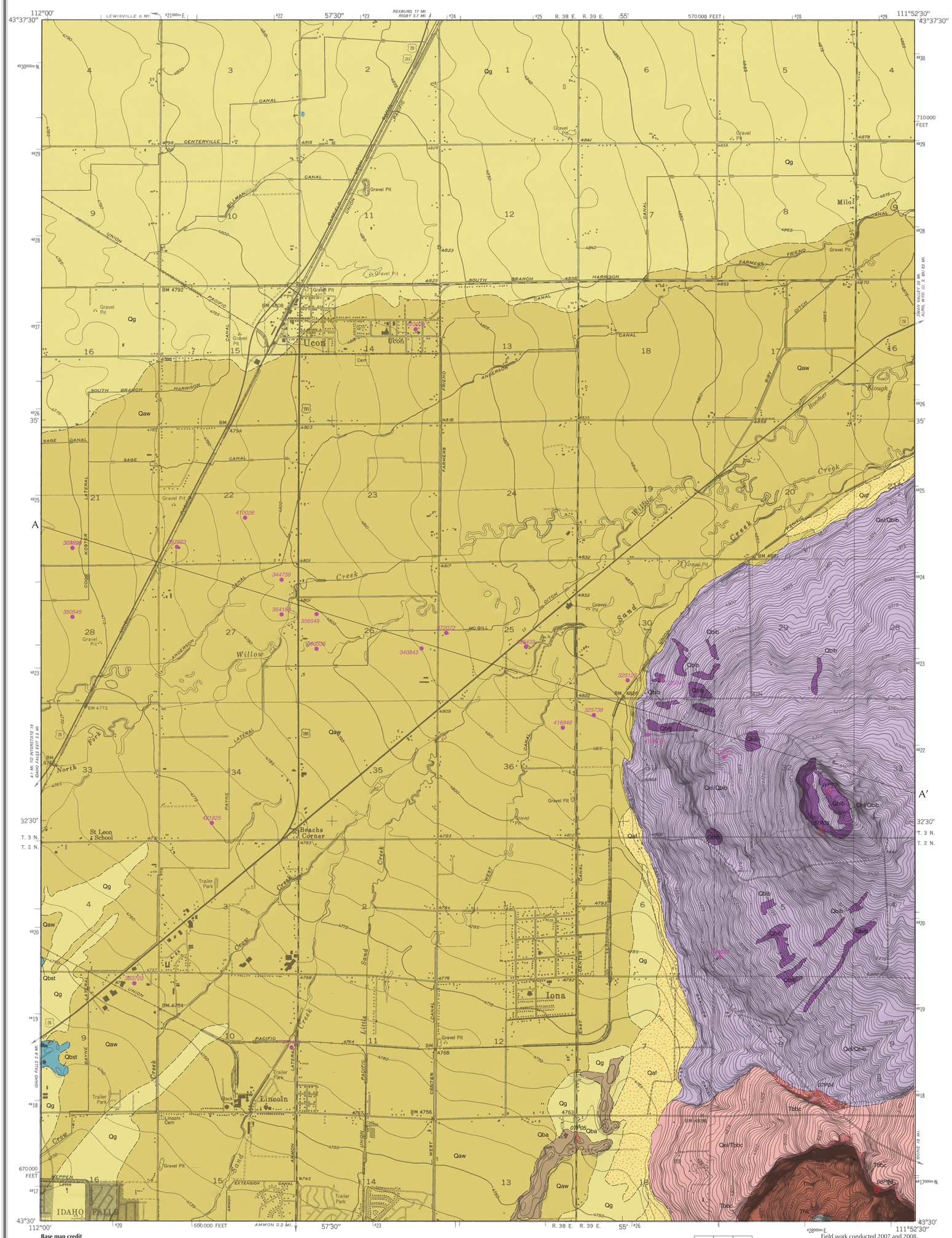
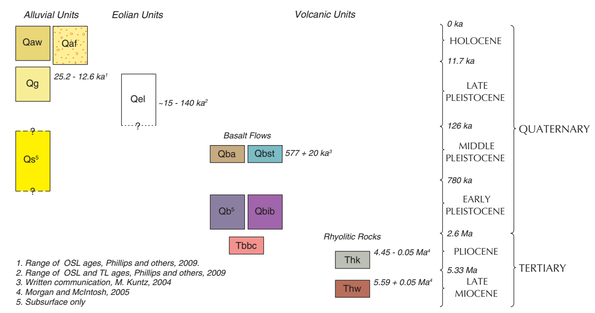
GEOLOGIC MAP OF THE UCON QUADRANGLE, BONNEVILLE COUNTY, IDAHO

Willian M. Phillips and John A. Welhan

2012



CORRELATION OF MAP UNITS



1. Range of OSL ages, Phillips and others, 2009.
2. Range of OSL and TL ages, Phillips and others, 2009
3. Written communication, M. Kuntz, 2004
4. Morgan and McIntosh, 2005
5. Subsurface only

INTRODUCTION

This map depicts bedrock and surficial geological units in the Ucon quadrangle. In this region, geological units greatly influence soil properties, availability and characteristics of earth materials used in construction, and groundwater resources and recharge paths. The units are typical of the eastern Snake River Plain and constitute the geological framework for much of southern Idaho's agriculture economy.

GEOLOGIC HISTORY

The quadrangle sits on the edge of the eastern Snake River Plain, a major crustal downwarp associated with the Yellowstone Hotspot. The oldest bedrock units in the region are late Miocene to Pliocene rhyolitic volcanic rocks (*Thw* and *Thk*) of the Heise volcanic field. They were erupted between 6.7-4.5 Ma as hotspot volcanism progressed through the region (Morgan and McIntosh, 2005). These rocks crop out in the southeast portion of the map together with a basalt lava flow of probable Pliocene age (unit *Qbbc*). Basaltic volcanism in the early Pleistocene created the large shield volcano, informally named Iona Butte, that dominates the eastern edge of the quadrangle (unit *Qbib*). Later in the Pleistocene, basalt eruptions occurred on the Snake River Plain west of the map. Several lava flows from Shattuck Butte reached the quadrangle (units *Qbst* and *Qba*) during this time. During the middle and late Pleistocene, alpine glaciation in the headwaters of the Snake River generated huge volumes of outwash (Scott, 1982). This process transformed the Snake River into a braided stream with a much greater discharge than the present-day river and created a broad glacial outwash plain. West of Iona Butte, the quadrangle is underlain by outwash gravels (unit *Qg*). Deposits of wind-blown silt, clay and fine sand (unit *Qel*) were also deposited over the entire region during glacial periods of the Pleistocene (Scott, 1982; Pierce, Fosberg, and others, 1982). The loess is thickest on the Heise rhyolitic units and on the Iona Butte shield volcano. During the Holocene, Willow Creek meandered over the outwash gravels.

SOURCES OF DATA

Geologic maps by Prostka and Hackman (1974), Scott (1982), and Mitchell and Bennett (1979) were consulted along with a soils map (Miles, 1981). Field work was conducted in 2007 and 2008. Paleomagnetic and geochemical analysis were used to correlate basalts. Domestic water well logs (Idaho Department of Water Resources, 2012) were used to gain understanding of subsurface units. To minimize well location errors, only well logs with GPS locations or well addresses were used.

SYMBOLS

Contact: Line showing the approximate boundary between one map unit and another. The location accuracy of an approximate contact is more than 25 m (80 ft) on the ground.

07P05 — Paleomagnetic sample location (see Table 1).

WP70 — Geochemical sample location (see Table 2).

403269 — Water well showing Idaho Department of Water Resources WellID.

Strike and dip of eutaxitic foliation.

DESCRIPTION OF MAP UNITS

ALLUVIAL UNITS

Qaf **Alluvial fans (Holocene-late Pleistocene)**—Faintly stratified to massive, light gray to pale brown reworked loess along the base of Iona Butte. Thickness is 1.5->3 m (5->10 ft). The Ammon silt loam soil formed on this unit (Miles, 1981).

Qaw **Alluvium of Willow Creek (Holocene)**—Reddish brown silty sand, silty clay, and sand derived from weathered rhyolite and Mesozoic sedimentary rocks in the headwaters of Willow Creek. Thickness is generally 1.5-3 m (5-10 ft). These deposits form the Paul and Paesl soil associations (Miles, 1981).

Qg **Glacial outwash of Snake River (late Pleistocene)**—Well-rounded pebble and cobble gravel, clast supported with a sandy matrix, with thickly parallel bedding separated by minor lenticular cross beds of coarse- to medium-grained sand. Gravel clasts are pink, purple, and gray quartzite with lesser sandstone, granitic rocks, rhyolite, porphyritic mafic igneous rocks, basalt, and limestone. Sand is composed of subangular quartzite, quartz and feldspar crystals, and fragments of basalt and rhyolite. Thickness uncertain because of difficulties separating *Qg* from *Qs* in well logs. Maximum thickness is 3-15 m (10-50 ft) in southern half of map, increasing to 23-38 m (75-125 ft) northward, and to greater than 61 m (200 ft) in the northwest (Fig. 1). Unit consists of glacial outwash deposited by the South Fork of the Snake River during the last (Pinedale) glaciation of the river's headwaters in the Grand Teton area (Scott, 1982). The outwash forms a broad fan deposited where the South Fork enters the Snake River Plain. Unit overlies partially indurated silty gravel and sand of uncertain age (unit *Qs*). Loess-derived soils of the Bannock and Bock soil associations 50-150 cm (20-60 in) thick are developed on the unit (Miles, 1981). Unit dated in adjacent areas by optically stimulated luminescence (OSL) at 25.2-12.6 ka (Phillips and others, 2009). These ages are consistent with cosmogenic surface exposure ages of Pinedale moraines in the Yellowstone headwaters (Licciardi and Pierce, 2008). Unit is mined for gravel and sand, and hosts unconfined aquifer in northwest portion of map.

Qs **Older sediments (middle-early Pleistocene?)**—Silty gravel and sand, locally indurated; also sandy silt. Not exposed in map and known only from water well records. Along western edge of quadrangle, probably consists of loess separating lava flows *Qbst* and *Qb*. Elsewhere, consists of silty or clayey gravel and sand, locally with indurated or cemented zones. In these locations, thickness is uncertain because water well logs cannot reliably separate *Qg* from *Qs* in some situations. On cross section, gravels within 15 m (50 ft) of the surface were classified as *Qg*; gravels below that were classified as *Qs*. Age uncertain but probably middle to early Pleistocene.

EOLIAN UNITS

Qel **Loess (late-middle Pleistocene)**—Light gray to pale brown massive silt, fine sand, and clay. Calcareous except where leached; a carbonate-silica duripan is locally present. Shown as *Qel/Qbib* and *Qel/Tbbc* where covering basaltic and rhyolitic units. Thin loess-derived soils also cover portions of *Qg*, *Thw*, and *Thk*. Soils formed on the unit include the Malm, Potell, and Ririe groups (Miles, 1981). Derived from deflation of fine-grained sediment from outwash deposits along the Snake River by southwesterly winds during glacial periods of the Pleistocene. At least three buried soils consisting of carbonate-silica (Bk-K) and clay (Bt) horizons have been documented in similar deposits of the eastern Snake River Plain and adjacent areas (Pierce, Fosberg, and others, 1982; Pierce, Muhs, and others, 2011; Scott, 1982). The buried soils separate multiple periods of loess accumulation correlated with regional glaciations, i.e. Pinedale (ca. 25-14 ka), early Wisconsinian (ca. 79-36 ka) and Bull Lake (160-130 ka). In the adjacent Idaho Falls North quadrangle (Phillips and Welhan, 2011), loess below a buried soil has an OSL age of 75.3 ka and is capped by loess that accumulated between about 24-15 ka (Phillips and others, 2009). Loess in two buried soils 72 km (45 mi) west of the quadrangle were dated at 28 ± 3 and 74 ± 6 ka by thermoluminescence (Forman and others, 1993). Significant loess accumulations are not present on Holocene basalt lava flows of the eastern Snake River Plain.

VOLCANIC ROCKS

Qbst **Basalt of Shattuck Butte (middle Pleistocene)**—Medium gray, olivine- and plagioclase-phyric basalt lava flows. Textures vary from glomercrystic with olivine and plagioclase as large as 5 mm, to equigranular and fine-grained. Olivine abundant with individual phenocrysts as large as 1 mm. Many vesicles are filled with soft, white, non-carbonate mineraloid; carbonate and silica coatings also common. Best exposed in the adjacent Idaho Falls North quadrangle (Phillips and Welhan, 2011) where many outcrops appear to have been scoured, probably by the glacial outwash streams that deposited unit *Qg*. Vent is Shattack Butte about 15 km (9.3 m) west of Ucon. Traceable in the subsurface with water wells. Thins eastward from about 30 to 15 m (100 to 50 ft). Not present in the northeastern portion of the quadrangle (Fig. 1). Dated by $^{40}Ar/^{39}Ar$ at 577 ± 20 ka in the Shattuck Butte quadrangle (M.A. Kuntz, written commun., 2004). Excursional paleomagnetism suggests correlation with the Emperor-Big Lost reversal excursion event, dated at 565 ± 14 ka (Champion and others, 1988) and 549 ± 6 ka (Lanphere, 2000). Forms one of the principal hydrological units for groundwater in the quadrangle.

Qba **Basalt of Ammon (middle Pleistocene?)**—Medium gray, vesicular basalt with olivine phenocrysts as large as 1 mm. Correlated with *Qbst* on the basis of excursional paleomagnetic properties (Table 1) and similar lithology.

Qel / Qbib **Basalt of Iona Butte (early Pleistocene?)**—Dark gray dictytaxitic olivine basalt with megacrystic plagioclase phenocrysts as large as 5 – 10 mm. Shown as *Qel/Qbib* where covered with loess. Vent area is elongated northwest, suggesting eruption from a rift. The vent area lacks a central crater or significant exposed deposits of scoria or cinder. Despite being a prominent local landmark, the shield has no name on U.S. Geological Survey topographic maps. The shield is informally named here after the small town of Iona. Western slopes of 3° to >6° are steeper than many eastern Snake River Plain shield volcanoes. Boulder streams and talus of basalt blocks are locally present on west-facing slopes. Water well records indicate that >128 m (>420 ft) of multiple flows with minor cinder interbeds underlie the edifice, and that possibly correlative flows extend in the subsurface without apparent break to the western edge of the quadrangle (these flows are shown in the cross section as unit *Qb*). Unit extends eastward and southward beyond the map, where it unconformably overlies a Pliocene (?) basalt flow (*Tbbc*) and late Miocene-Pliocene Heise rhyolitic rocks (*Thk* and *Thw*). Unit is undated. Reverse magnetic polarity suggests age is >780 ka (Table 1). Unit has similar stratigraphic relationships to basalts dated at about 2 Ma on the Rexburg Bench (G. Embree, written commun., 2008). The Malm and Ririe soils are developed in loess overlying the unit (Miles, 1981).

Qb **Basalt, undivided (Pleistocene)**—Basalt encountered in water wells; not exposed in the map. Forms one of the principal hydrogeological units in the map. Source and age uncertain; tentatively correlated with basalt of Iona Butte (*Qbib*).

Qel / Tbbc / Tbbc **Basalt of Black Canyon (Pliocene?)**—Dark gray equigranular basalt with sparse olivine glomerocrysts 1-2 mm; thickness 3-9 m (10–30 ft). Weathers dark brown. Forms resistant ledges and cliffs on mesa edges. Vertical cooling joints display prominent flow banding on scale of 5-10 cm. Informally named for Black Canyon in adjacent Ammon and Ozone quadrangles; undated. Reverse polarity (Table 1) suggests age is >780 ka. Gently inclined toward the southwest as a result of regional Snake River Plain subsidence. Overlies Heise volcanic units *Thk* and *Thw*.

Thk **Kilgore Tuff of the Heise Volcanic Field (Pliocene)**—Densely welded rhyolitic ignimbrite with plagioclase, quartz, sanidine, augite, magnetite, and zircon phenocrysts making up 2-10 percent of the tuff (Morgan and McIntosh, 2005). Typical exposures in map consist of 1.5-3 m (5-10 ft) brown, ledge-forming tuff with abundant lithophysae overlain by <1.5 m (<5 ft) of pinkish tuff with maroon pumice chips. Unit is one of the most widespread welded tuffs in the eastern Snake River Plain (Watts and others, 2011). Dated by $^{40}Ar/^{39}Ar$ at 4.45 ± 0.05 Ma (Morgan and McIntosh, 2005).

Thw **Tuff of Wolverine Creek of the Heise Volcanic Field (late Miocene)**—Light gray to yellowish gray, obsidian-bearing, crystal-poor, pumiceous, unwelded tuff. Greater than 15 m (50 ft) thick in map. Forms rounded hills and gentler slopes relative to ridge-forming welded tuff units. Dated by $^{40}Ar/^{39}Ar$ at 5.59 ± 0.05 Ma (Morgan and McIntosh, 2005). Mined for pumice in adjacent Ammon quadrangle.

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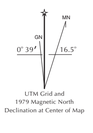
ACKNOWLEDGMENTS

We thank property owners for permitting access to their lands.

Base map credit

Base map scanned from USGS film positive, 1979.
Shaded elevation from 10 m DEM.
Topography by plane-table methods 1948. Photorevised 1979.
Projection: Idaho coordinate system, east zone (Transverse Mercator). 1927 North American Datum.
10,000-foot grid ticks based on Idaho coordinate system, east zone.
1000-meter Universal Transverse Mercator grid ticks, zone 12.
National Geodetic Vertical Datum of 1929.



SCALE 1:24,000

1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0.5 0 1 KILOMETER

Contour interval 5 feet

QUADRANGLE LOCATION

ADJOINING QUADRANGLES

Field work conducted 2007 and 2008.

This geologic map was funded in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program, USGS Award No. 06HQAG0020.

Digital cartography by Collette Gantenbein, Jesse S. Bird, Loudon R. Stanford, and Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.

Map reviewed by John L. Kauffman, Idaho Geological Survey.

Map version 7-9-2012.

PDF (Acrobat Reader) map may be viewed online at idahogeology.org.

Table 1. Paleomagnetic data for the Ucon quadrangle.

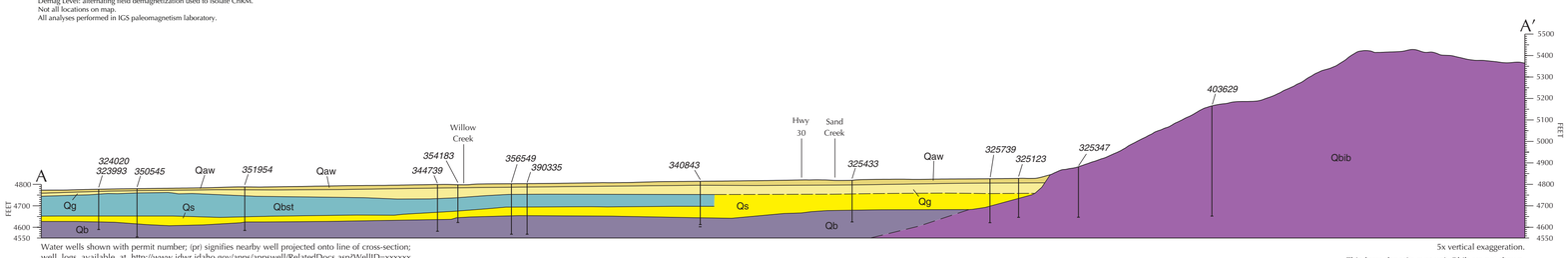
Sample number	Unit name	Latitude	Longitude	n	D	I	α_{95}	R	κ	Polarity	Demag Level (mT)
07P03	Qbib	43.54062	-111.88844	2/8	165	-60	6.4	2.000	1524	R	60
07P04	Qbbc	43.51341	-111.88904	6/8	216	-63	7.8	5.933	74	R	40
07P05	Qba	43.50864	-111.92330	8/8	101	55	3.5	7.972	246	E	60
08P06	Qbbc	43.50325	-111.88052	5/8	201	-66	3.5	4.992	486	R	60

n = number of cores used/number of cores measured.
D = site mean declination of characteristic remanent magnetization (ChRm).
I = site mean inclination of ChRM.
α_{95} = confidence limit for the mean direction at the 95% level.
κ = precision parameter.
Polarity: N = normal; R = reverse.
Demag Level: alternating field demagnetization used to isolate ChRM.
Not all locations on map.
All analyses performed in IGS paleomagnetism laboratory.

Table 2. Major oxide and trace element chemistry of samples collected in the Ucon quadrangle.

Sample number	Latitude	Longitude	Unit name	Map unit	Major elements in weight percent (unnormalized)												Trace elements in parts per million (unnormalized)																					
					SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Sum	LOI	Ni	Cr	Sc	V	Ba	Rb	Sr	Zr	Y	Nb	Ga	Cu	Zn	Pb	La	Ce	Th	Nd	U
08P06	43.50325	-111.88052	Basalt of Black Canyon	Qbbc	45.78	2.51	15.49	13.55	0.20	7.37	10.80	2.69	0.35	0.49	99.22	0.46	101	160	30	300	349	4	320	214	35	19	21	40	134	3	19	47	0	29	1
WP70	43.54476	-111.88720	Basalt of Iona Butte	Qbib	44.57	4.16	12.87	17.39	0.25	5.79	9.65	2.77	0.57	0.90	98.94	n/a	53	96	36	409	521	9	307	396	55	31	22	31	187	5	37	80	0	47	1

* Fe expressed as FeO.
All analyses performed at Washington State University GeoAnalytical Laboratory, Pullman, Washington.



Water wells shown with permit number; (pr) signifies nearby well projected onto line of cross-section; well logs available at http://www.idwr.idaho.gov/apps/appswell/RelatedDocs.asp?WellID=xxxxxx where "xxxxxx" is the well identification number or Idaho Department of Water Resources, 322 E. Front St., PO Box 83720, Boise, ID 83720-0098.

5x vertical exaggeration.
Thin loess deposits over unit Qbib are not shown.

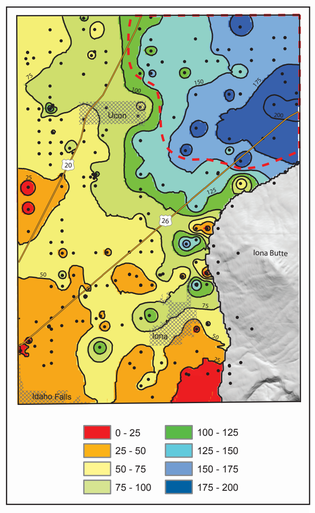


Figure 1. Map showing thickness of sediments (ft) above basalt in the Ucon quadrangle. Contour interval is 7.6 m (25 ft). Gray areas are bedrock. Circles are water well locations (Idaho Department of Water Resources, 2012). Red dashed line shows area where basalts were not intersected by wells. Sediment thicknesses are minimums in this area. Only wells with GPS locations and/or well addresses were used. The sediments include *Qg* and part of *Qs* because of difficulties inseparating the units with water well logs.

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