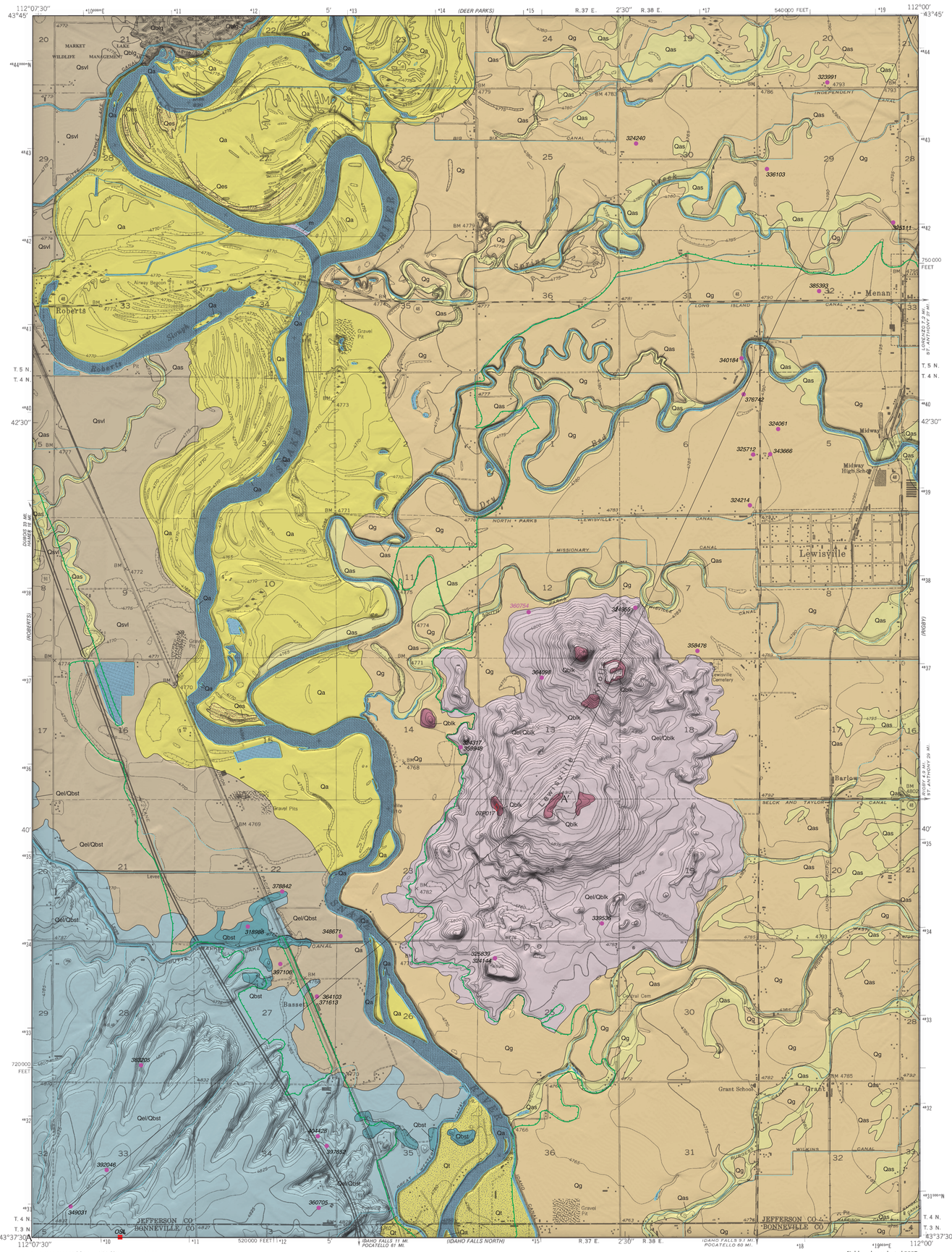
# Geologic Map of the Lewisville Quadrangle, Jefferson and Bonneville Counties, Idaho

William M. Phillips and John A. Welhan

2011




Base map scanned from USGS film positive, 1979.

Shaded elevation from 10 m DEM.

Culture and drainage by multiplex methods from aerial photographs taken 1946. 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.

UTM Grid and 1979 Magnetic North Declination at Center of Map

SCALE 1:24,000

Contour interval 5 feet

QUADRANGLE LOCATION

ADJOINING QUADRANGLES

Field work conducted 2007.

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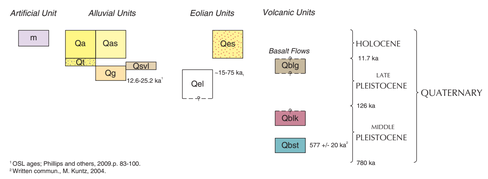
Digital cartography by Collette Gantenbein, Loudon R. Stanford, and Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.

Reviewed by J.D. Kauffman, Idaho Geological Survey.

Map version 10-11-2011.

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

## CORRELATION OF MAP UNITS




[1]OSL ages: Phillips and others, 2009,p. 83-100.
[2]Written commun., M. Kuntz, 2004.

Geologic time scale from Walker, J.D., and J.W. Geissman, compilers, 2009, Geologic Time Scale: Geological Society of America, doi: 10.1130/2009.CTS004R2C.

## INTRODUCTION

This map depicts bedrock and surficial geological units in the Lewisville quadrangle. In this region, geological units greatly influence soil properties, availability and characteristics of earth materials used in construction, and groundwater sources and recharge paths. The units (lava flows, river deposits, and loess) are typical of the eastern Snake River Plain and constitute the geological framework for much of southern Idaho's agricultural economy.

## GEOLOGIC HISTORY

The area sits on the edge of the eastern Snake River Plain, a major crustal downwarp associated with the Yellowstone hotspot. Late Miocene – Pliocene rhyolitic volcanic rocks of the Heise Volcanic Field were erupted in this portion of the Snake River Plain between 6.62 – 4.45 Ma (Morgan and McIntosh, 2005). In the Lewisville quadrangle, the Heise rhyolites and ash flow tuffs are covered by hundreds of meters of interbedded Snake River alluvium, lake deposits, and basaltic lava flows. The oldest surface geological units in the quadrangle are Pleistocene basaltic lava flows erupted from Shattuck Butte ~11 km (~7 mi) southwest of the map, and the Lewisville Knolls. During glacial periods at ~160-140 ka (Bull Lake Glaciation) and ~25-14 ka (late Pinedale Glaciation), the headwaters of the Snake River in the Yellowstone-Grand Teton area supported large glaciers (Licciardi and Pierce, 2008). Meltwater from these glaciers greatly increased the discharge of the river, transforming it into a braided stream that transported large volumes of gravel and sand into the area (Scott, 1982). Most surface sediments in the area consist of Pinedale-age outwash, but Bull Lake-age deposits are likely present in the subsurface (Allison, 2001). Much of the Pinedale outwash was deposited in a giant gravel-dominated fan that begins east of the map where the South Fork enters the Snake River Plain. Additional sandy outwash from the Henrys Fork is present along the western edge of the map. During glaciations, strong northeast-directed winds reworked silt and fine sand from glacial outwash to form loess. Loess is the parent material for most of southern Idaho's rich soils. During the Holocene, the Snake River became a meandering stream with its course fixed between the Pinedale gravel fan on the east and lava flows on the west. Meandering branch streams of the South Fork (e.g. Spring Creek and Dry Bed) reworked the outwash material. On June 5, 1976, over half of the map area flooded when the Teton Dam failed. This flood was about 100 times larger than any historic Snake River flood, hence it provides perspective on the effects of exceptionally large prehistoric events (Scott, 1977).

### SUBSURFACE STRATIGRAPHIC RELATIONSHIPS

The cross section depicts subsurface stratigraphic relationships between map units. The oldest unit, basalt of Shattuck Butte (*Qbst*; age ~ 577 ka), is covered with thick loess deposits except where exposed along the Snake River. Loess deposits on basalt of Lewisville Knolls (*Qblk*; age ~200-400 ka) are generally thin and lava flow morphology can still be discerned. Flows from both units can be traced in the subsurface with water well logs. These logs suggest that Lewisville Knoll flows piled up against Shattuck Butte lavas to form a dam or flow constriction on the Snake River. Clay and silt deposits that begin at the edge of Lewisville Knoll basalt in the northeastern portion of the map show that a lake once occupied this region. The lake deposits continue into the adjacent Menan Buttes and Rigby quadrangles. They may form a barrier to groundwater flow that contributes to the high water levels present in this area. Sand and gravels of probable middle to late Pleistocene age lie on top of the lake deposits. Well log data do not permit division of subsurface sediments into units of specific glacial or interglacial periods.

## SOURCES OF DATA

The map is based upon field work conducted in 2007, compilation and consultation of a master thesis from Idaho State University (Allison, 2001), a regional surficial geologic map (Scott, 1982), county soil surveys (Miles, 1981; Jorgensen, 1979), and domestic water well logs (available from Idaho Department of Water Resources at http://www.idwr.idaho.gov/apps/apps well/searchWC.asp).

## DESCRIPTION OF MAP UNITS

### ARTIFICIAL UNIT

m **Artificial fill (Holocene)**—Fill used to construct road beds across of the Snake River.

### ALLUVIAL UNITS

Qa **Alluvium of active channels and floodplain of the Snake River (Holocene)**—Gravel, sand, and sandy silt. Forms islands, bar-tops and beaches exposed at low water levels. Gravel composed of quartzite with lesser rhyolite, basalt, sandstone, gneiss, and granitic rocks. Thickness generally less than 3 m (10 ft). Subject to flooding and high water tables.

Qas **Alluvium of side streams of South Fork Snake River (Holocene)**—Thin (<3 m (<10 ft) deposits of gravel, sand, and silt along floodplains of small branches of the South Fork of the Snake River including Spring Creek and Dry Bed Creek. Several of these streams have been modified to transport irrigation water from the main South Fork. Forms parent material for the Hayeston, Xeric Torrifluvents, and Wardsboro soil associations. (Jorgensen, 1979)

Qt **Alluvium of Snake River terraces (late Pleistocene)**—Terraces along the Snake River in the southern part of map separated by low scarps from the floodplain (*Qa*) and outwash plain (*Qg*) units. Terraces become indistinct to the north. Consists of thin (<1.5-3 m; <5-10 ft) planar-bedded gravel with the same clast lithologies as *Qg*. Terrace deposits cannot be separated reliably from unit *Qg* in well logs or with soil development data. The glacial chronology in the Yellowstone-Grand Teton headwaters area (Licciardi and Pierce, 2008) and OSL ages of unit *Qg* (Table 3; Phillips and others, 2009) suggest that stream incision and deposition of the unit coincided with waning discharge during termination of glaciation at about 13-14 ka. Soils of the Harston and Heiseton series are developed on this unit (Jorgensen, 1979; Miles, 1981).

Qsvl **Volcanic lithic sand (late Pleistocene)**—Black to tan, poorly sorted, angular to subrounded, cross-bedded, fine sand to pebble gravel (Allison, 2001). Thickness 6-15 m (20-49 ft). Poorly exposed in the quadrangle except for gravel pits in secs. 9 and 15, T. 4 N., R. 37 E. Gravel and sand composition is mostly basalt, rhyolitic glass shards, and quartz phenocryst grains. Sedimentary lithics and metamorphic grains are rare to absent. The clast composition indicates deposition by the Henrys Fork of the Snake River rather than the South Fork. Undated in the map but appears to post-date unit *Qg*.

Qg **Alluvium of Snake River outwash (late Pleistocene)**—Gravel and sand composed dominantly of very hard pink, purple and gray quartzite with lesser rhyolite, basalt, sandstone, gneiss and granitic rocks. Poorly exposed in map. Exposures in adjacent quadrangles indicate unit is thickly planar to cross bedded, separated locally by thin, cross-bedded sand beds. Gravel is dominantly pebble to cobble sized, clast supported, locally normally graded and imbricated. Gravel framework is filled by subrounded fine to medium sand composed of subangular black obsidian, quartzite, quartz and feldspar phenocrysts, muscovite, and fragments of basalt and rhyolite. Sand beds are locally black because of high obsidian content. Water well logs indicate approximate thickness of ~50 m (164 ft). Thickness uncertain in many places because possible older units cannot be reliably separated in water well logs. Generally capped by 1.5-6 m (5-20 ft) of stratified sandy silt and clayey silt deposited by floods of the Snake River and tributary streams. Undated in the map. Optically stimulated luminescence (OSL) ages from similar deposits in the Idaho Falls area range from about 25–13 ka (Phillips and others, 2009). Parent material for the Annis, Blackfoot, Labenzo, and Heiseton soils (Jorgensen, 1979; Miles, 1981). These soils display redoximorphic features indicating periodic water saturation and reducing conditions.

### EOLIAN UNITS

Qes **Dunes and sand sheets adjacent to the Snake River (Holocene)**—Fine to medium sand, well sorted and loose. Forms small dunes and sand sheets along the Snake River. Thickness <1.5 m (<5 ft). Parent material for the Wolverine soil (Jorgensen, 1981).

Qel **Loess (late Pleistocene to middle Pleistocene?)**—Massive light gray to pale brown, silt, clayey silt, and very fine to fine sand. Calcareous except where leached in near-surface soil horizons. Thickness is greatest over flows of basalt of Shattuck Butte (*Qbst*) where loess is as much as 20 m (66 ft) thick; <1.5-4.5 m (<5-15 ft) thick over basalt of Lewisville Knolls. Basalt of Little Grassy Butte has intermittent loess cover. Thin reworked loess caps are also present on units *Qg*, *Qt*, and *Qsvl*. At least three buried soils consisting of carbonate-silica (Bk) and clay (Bt) horizons have been documented in similar deposits of the eastern Snake River Plain (Pierce and others, 1982). The buried soils separate multiple periods of loess accumulation that are correlated with regional glaciations, i.e. Pinedale (ca. 25-14 ka), early Wisconsinian (ca. 65-70 ka) and Bull Lake (160-130 ka). In the Michelson soil pit in sec. 4, T. 3 N., R. 37 E., loess below a buried soil has an OSL age of 75.3 ka and is capped by loess that accumulated between about 24-16 ka (Table 2; Phillips and others, 2009). Loess in two buried soils 45 miles west of the map were dated at 28 ± 3 and 74 ± 6 ka by thermoluminescence (Forman and others, 1993). Significant loess accumulations are not present on the 5200 $^{14}C$ year BP flows of Hells Half Acre south of the map, or on other Holocene basalt flows of the eastern Snake River Plain (Kuntz and others, 1986). Pinerich series soils (Miles, 1981; Jorgensen) are developed on the unit.

### VOLCANIC ROCK UNITS

Qblg **Basalt of Little Grassy Butte (late Pleistocene)**—Gray to dark gray, porphyritic to nonporphyritic, tube-fed pahoehoe lava flows erupted from Little Grassy Butte, about 32 km (20 mi) north of Lewisville quadrangle (Kuntz, 1979). Consists of rare phenocrysts of olivine (1 mm) and plagioclase (3 mm) in a diktytaxitic groundmass of plagioclase, olivine, and augite crystals (<0.5 mm). In the map, pressure ridges and tumuli as much as 9 m (30 ft) high and well-preserved pahoehoe flow surfaces are surrounded by local accumulations of eolian sediment. Well-drained loam soils have formed on these deposits (Mathon-Modkin-Bondranch complexes; Jorgensen, 1979). Water well logs and exposures at edges of unit indicate flow thicknesses of 2-10 m (7-33 ft). Normal magnetic polarity. Unit is undated; possibly 10-20 ka based on thin loess cover (Kuntz, 1987, quoted in Ferdock, 1987, p. 45).

Qel Qblk Qblk **Basalt of Lewisville Knolls (middle Pleistocene)**—Gray to black, vesicular, plagioclase and olivine-phyric basalt flows. Water wells indicate maximum thickness exceeds 90 m (295 ft). Normal magnetic polarity (Table 1). Generally poorly exposed because of loess cover but topographic features and isolated outcrops indicate at least 3 eruptive centers are present. Reddish scoria and spatter, together with thin pahoehoe flows are present on the hills in secs. 12-13, T. 4 N., R. 37 E. Alignment of the hills suggests eruptions occurred along a northwest-trending fissure. The large edifice in secs. 13 and 24, T. 4 N., R. 37 E. is capped with relatively crystal-rich flows. Undated but considered to date between 200-400 ka (Mel Kuntz, written commun., 2004). Forms parent material for the Modkin-Bondranch complex soil (Jorgensen, 1981).

Qel Qbst Qbst **Basalt of Shattuck Butte (middle Pleistocene)**—Medium gray, vesicular olivine- and plagioclase-phyric basalt lava flows. Textures vary from glomercrystic with olivine and plagioclase 1-5 mm, to equigranular and fine-grained. Water wells indicate thickness exceeds 90 m (295 ft). Excursional paleomagnetic properities with declination of about 80 to 90 is unique to area. Poorly exposed due to thick loess cover except in irrigation canals and adjacent to Snake River. Dated at Shattuck Butte at 577 ± 20 ka by $^{40}Ar/^{39}Ar$ (M. Kuntz, written commun., 2004). Paleomagnetic properties suggest correlation with the Emperor-Big Lost reversal excursion event, dated at 565 ± 14 ka (Champion and others, 1988) and 549 ± 6 ka (Lanphere, 2000).

## SYMBOLS

Contact: dashed where approximately located.

348671 Water well and Idaho Department of Water Resources WellID number.

07P017 Paleomagnetic sample location (see Table 1).

OSL Optically stimulated luminescence sample location (see Table 2; Phillips and others, 2009).

Extent of the 1976 Teton Dam flood (Ray and Bigelow, 1976); tic on side of flooding.

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Table 1. Paleomagnetic data for basalt of Lewisville Knolls.

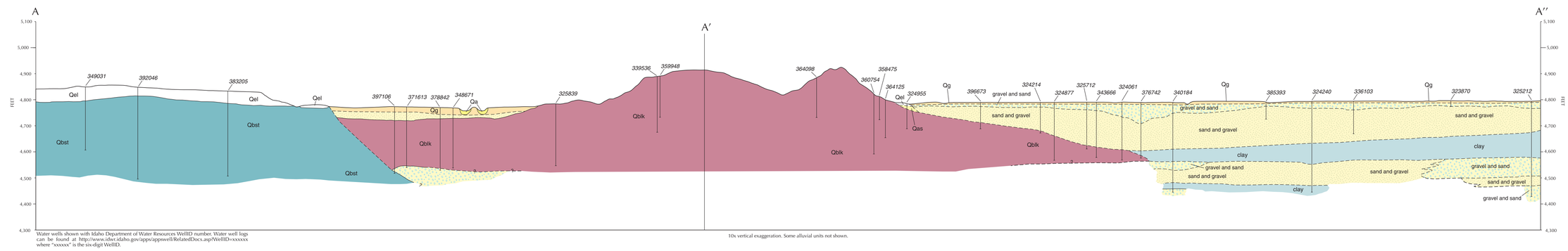
| Site number* | Unit | Latitude | Longitude | n | D | I | $\alpha_{95}$ | k | Polarity | Demag level (mT) |
|---|---|---|---|---|---|---|---|---|---|---|
| 07P017 | Qblk | 43.66902 | -112.05952 | 7 | 6.3 | 66.4 | 2.1 | 801.7 | N | 40 |

n = number of oriented cores.
D = site mean declination of characteristic remnant magnetism.
I = site mean inclination of characteristic remnant magnetism.
αγς = confidence limit for the mean direction at the 95% level.
k = precision parameter.
N = normal polarity.

Table 2. Optical luminescence (OSL) ages in the Lewisville quadrangle.

| | | | | Dose Information | | | | | | | | OSL Age Information | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample number | Latitude | Longitude | Unit name | Depth (m) | Grain Size (μm) | $H_2O$* (%) | U (ppm) | Th (ppm) | $K_2O$ (%) | $Rb_2O$ (ppm) | Cosmic (Gy/ka) | USU Number | Number of Aliquots | Equiavlent Dose (Gy) | Dose Rate (Gy/ka) | OSL Age (ka) |
| SR 11-11-7 | 43.62505 | -112.11256 | Qel | 1.05 | 63-150 | 1.8 | 2.5 | 10.8 | 2.17 | 95.9 | 0.23 | USU-090 | 22 | 58.51 ± 13.73 | 3.34 ± 0.14 | 17.52 ± 1.22 |
| SR 11-11-8 | 43.62505 | -112.11256 | Qel | 1.78 | 63-180 | 1.8 | 3.0 | 12.1 | 2.35 | 93.4 | 0.2 | USU-091 | 20 | 67.50 ± 11.63 | 3.67 ± 0.16 | 18.40 ± 1.14 |
| SR 11-11-9 | 43.62505 | -112.11256 | Qel | 2.78 | 63-150 | 2.3 | 2.6 | 9.3 | 2.01 | 84.8 | 0.17 | USU-092 | 27 | 75.83 ± 12.07 | 3.07 ± 0.13 | 24.67 ± 1.44 |
| SR 11-11-10 | 43.62505 | -112.11256 | Qel | 3.12 | 63-150 | 2.3 | 2.7 | 9.5 | 1.94 | 82.6 | 0.16 | USU-093 | 20 | 61.90 ± 10.69 | 3.01 ± 3.69 | 20.55 ± 1.30 |
| SR 11-11-11 | 43.62505 | -112.11256 | Qel | 3.80 | 63-150 | 2.9 | 3.0 | 11.0 | 1.75 | 83.7 | 0.14 | USU-094 | 22 | 72.16 ± 09.39 | 3.30 ± 0.15 | 21.87 ± 1.29 |
| SR 11-12-14 (1) | 43.62505 | -112.11256 | Qel | 5.22 | 63-150 | 3.6 | 2.8 | 11.4 | 1.65 | 93.4 | 0.11 | USU-097 | 25 | 226.42 ± 47.80 | 3.01 ± 0.15 | 75.29 ± 5.16 |

All samples are from the Mickelson soil pit (Phillips and others, 2009).
*In situ water content of sample.
OSL analysis by Tammy Rittenour, Luminescence Laboratory, Utah State University; errors are 1σ.
Age error includes random and systematic errors calculated in quadrature.




Water wells shown with Idaho Department of Water Resources WellID number. Water well logs can be found at http://www.idwr.idaho.gov/apps/appswell/RelatedDocs.asp?WellID=xxxxxx where "xxxxxx" is the six-digit WellID.

10x vertical exaggeration. Some alluvial units not shown.

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