GEOLOGIC MAP OF THE FIRTH QUADRANGLE, BINGHAM COUNTY, IDAHO

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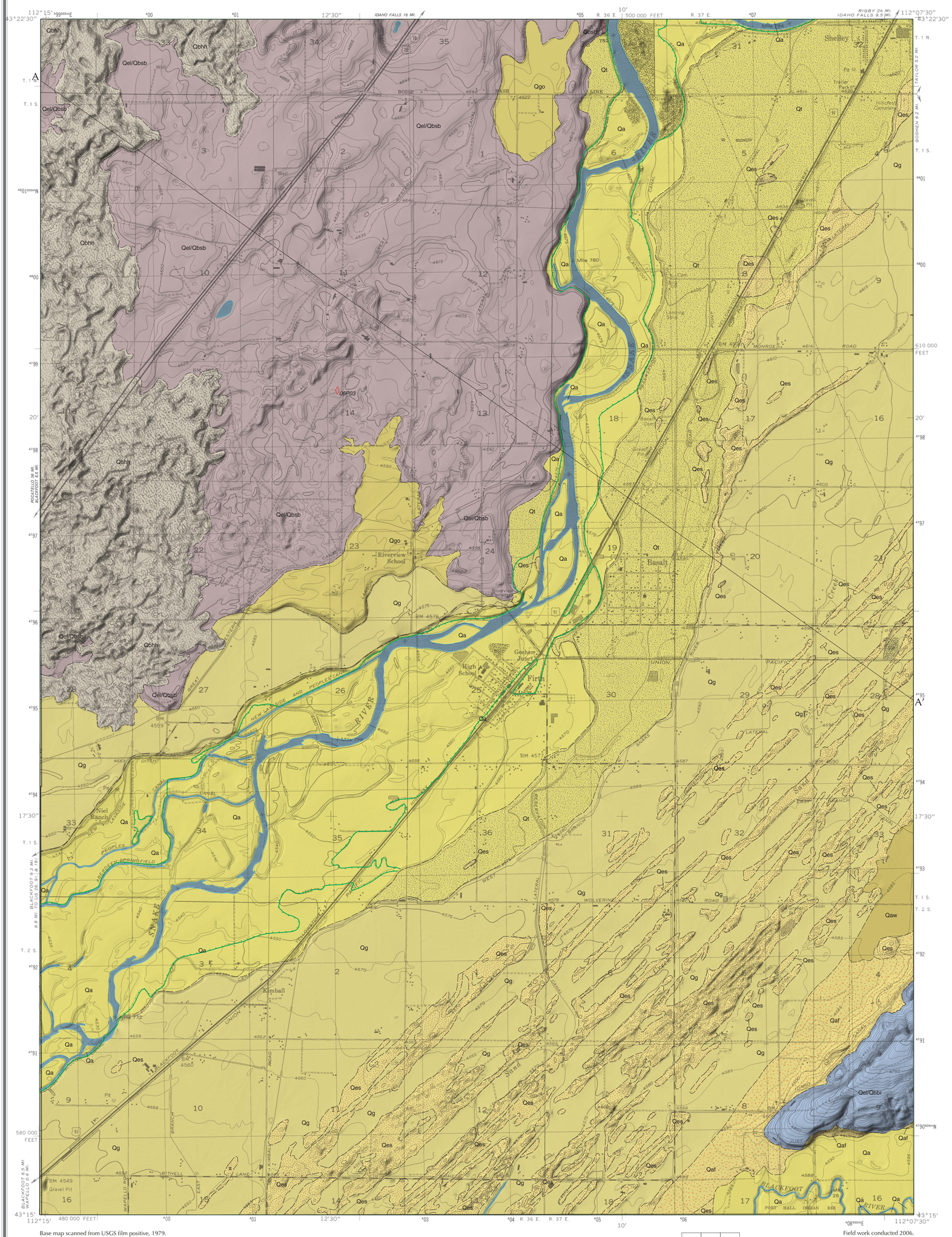
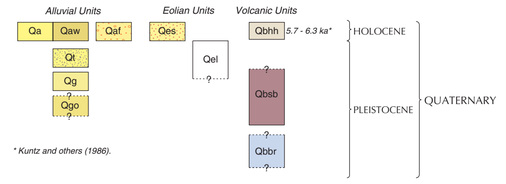
2011



CORRELATION OF MAP UNITS



* Kuntz and others (1986).

INTRODUCTION

This map depicts bedrock and surficial geologic units in the Firth quadrangle. The map area 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 rhyolitic volcanic rocks of the Heise Volcanic Field erupted between 6.7 and 4.5 million years ago as hotspot volcanism progressed through the region. These units are exposed in the Blackfoot Mountains east of the map area. Subsequent Pliocene-Pleistocene basaltic volcanism and subsidence created the lava plains characteristic of the eastern Snake River Plain. The eastern Snake River drainage also developed during this time in response to both regional subsidence and voluminous eruptions of basaltic lavas. Eruptions west of the map area caused the Snake River to occupy a position between basaltic shield vents and flows, and the rhyolitic foothills of the Blackfoot Mountains. Volcanism continued as recently as 5700-6300 cal yr BP when flows of Hells Half Acre were erupted. At least several times during the middle and late Pleistocene, alpine glaciation in the headwaters of the Snake River generated huge volumes of outwash. During these periods, the Snake River was a braided stream with a much greater discharge than the present-day river. This caused a broad outwash plain to be built. Waning discharge near the end of the last (Pinedale) glaciation led to the cutting of a series of channels into the outwash plain, forming fill-cut terraces. These terraces occupy a position between the loess-covered basalt flows of the western map area and the thickest gravel deposits of the outwash plain to the east. The present-day Snake River, now a meandering stream, flows along this course. The outwash plain was an excellent source of eolian sediments during glacial periods. Deposits of fine sand, silt, and clay (loess) were deposited by strong winds during the Pinedale glaciation between ~24-15 ka. Loess thickness varies with the age of underlying units; it is absent on Holocene lava flows of Hells Half Acre and as much as 12 m thick on the oldest flow, basalt of Blackfoot River. Distinct from loess are Holocene-age, sand deposits forming dunes and sand sheets to the east of the Snake River. The dune deposits are elongated southwest-northeast parallel to present-day prevailing winds.

SOURCES OF INFORMATION

The map is based upon compilation of existing geologic mapping (Scott, 1982; Rember and Bennett, 1979; Karlo, 1977; Shadid, 1971), field work conducted in 2006, and analysis of air photos, digital elevation models, soil maps (Salzmann and Harwood, 1973), paleomagnetic measurements of basalt, and drilling logs of water well records (Idaho Department of Water Resources, 2010). Radiocarbon ages were calibrated using CALIB, version 5.0 (Stuiver and Reimer, 1993).

DESCRIPTIONS OF MAP UNITS

ALLUVIAL UNITS

Qa **Alluvium of Snake and Blackfoot rivers (Holocene)**—Well-rounded, pebble and cobble gravel, sand, and minor silt and clay of the Snake River floodplain. Thickness generally less than 3 m. Clast lithologies are same as unit *Qg*. Consists of gravel-rich point-bar deposits of the main channel and low terraces composed of finer-grained overbank deposits overlain by sandy loam soils of the Wardboro, Hayeston, and Heiseton soil associations (Salzmann and Harwood, 1973). Along the Blackfoot River, consists of 2 – 3 m (7–10 ft) of silt, clay, fine sand, and gravel containing limestone and basalt clasts. The Blackfoot loam soil is developed on this unit (Salzmann and Harwood, 1973).

Qaw **Alluvium of Willow Creek (Holocene)**—Reddish brown to pinkish-gray stratified sand and silt derived from weathered rhyolite and Mesozoic rocks of the Blackfoot Mountains. Thickness generally 1.5 – 3 m (5–10 ft). Paesl soils are developed on this unit (Salzmann and Harwood, 1973). Willow Creek is a Yazoo-type stream that flows parallel to the Snake River upon entering the Snake River Plain near Ririe, Idaho. Present-day discharge in Willow Creek is much diminished because of irrigation water diversion and development of the Ririe Dam.

Qt **Snake River terraces (late Pleistocene)**—One or more terrace tread surfaces along the Snake River separated by a 1.5-4.5 m (5-15 ft) scarp from the floodplain (*Qa*) and a 3-6 m scarp from the outwash plain (*Qg*). Both scarps are well-developed near Basalt (sec. 19, T. 1 S., R. 37 E.) The terraces are largely erosional surfaces cut into underlying outwash alluvium rather than depositional features. Exposures in gravel pits suggest that terrace alluvium consists of thin (<1.5 m; <5 ft) planar-bedded gravel truncating underlying outwash. Terrace deposits cannot be separated reliably from unit *Qg* in most exposures or in well logs because of similar clast lithology, texture, and sedimentary structures. Generally covered by 0.5-1.5 m (1.6-6 ft) of loess-derived soils of Bannock and Bock associations with a Bk horizon developed at 30-70 cm (1-2.3 ft) (Salzmann and Harwood, 1973). The terraces are inferred to have formed near the end of Pinedale glaciation between ~14 – 13 ka because of diminishing discharge.

Qg **Alluvium of Snake River outwash (late Pleistocene)**—Well-rounded, clast-supported gravel, thickly planar- to cross-bedded, separated locally by thin, cross-bedded sand beds. Gravel is dominantly pebble- to cobble-sized, locally normally-graded. Gravel framework is filled by subrounded fine- to medium sand. Gravel clasts are dominated by very hard, pinkish to gray quartzite with lesser sandstone, granitic rocks, rhyolite, porphyritic mafic igneous rocks, basalt, and limestone. Grains in sand beds are composed of subangular black obsidian, quartzite, quartz and feldspar phenocrysts, and fragments of basalt and rhyolite. Sand beds are locally black because of high obsidian content. Capped by 0.5 - 1.5 m (1.6 -10 ft) of loess-derived soils of the Bannock and Bock soil associations with a Bk horizon developed at 30-70 cm (1-2.3 ft); (Salzmann and Harwood, 1973). On the east side of the Snake River, forms a broad, nearly flat, gently southwest sloping surface covered in many places with thin eolian deposits of unit *Qes*. Similar deposits on west side of river are tentatively correlated with *Qg* based upon their great extent southwest into the Rose quadrangle. Gravels are as much as 30 m (100 ft) thick. The unit is part of the huge braided-stream outwash plain deposited during the Pinedale glaciation by meltwaters from the Snake River headwaters in the Yellowstone Plateau (Scott, 1982). OSL ages ranging from ~25 to ~13 ka (Phillips and others, 2009) are consistent with cosmogenic surface exposure ages of moraines in the Yellowstone headwaters (Licciardi and Pierce, 2008). Well logs suggest unit overlies partially cemented gravels, sands, and silt-rich units of uncertain age along the eastern border of the map area. Unit is important regional source of sand and gravel.

Qgo **Older alluvium of Snake River (late to middle Pleistocene?)**—Poorly exposed gravel, sand, and minor clay overlain by loess; known largely from water well logs. Near Riverside School (sec. 23, T. 1 S., R. 36 E.) underlies slightly hummocky surface separated from unit *Qg* by a loess-draped scarp 4.5–6 m (15-20 ft) high that probably corresponds to the flow edge of underlying basalt of Shelley Bridge (*Qbsb*). Entirely surrounded by basalt of Shelley Bridge in sec. 1, T. 1 S., R. 36 E. Well logs in this area show 0.5 – 5 m (1.6-16 ft) loess overlying 3 – 6 m (10-20 ft) of gravel, sand and clay that in turn overlie basalt. Age and correlation uncertain. Older than about 25 ka based on ages of units *Qg* and *Qel*. Regional stratigraphy (e.g. Pierce, 2003; Forman and others, 1993) suggests correlation with either the Bull Lake glaciation (~140-160 ka) or an early Wisconsinian glaciation (~60-80 ka).

Qaf **Alluvial fans (Holocene)**—Silt and fine sand (reworked loess) along the base of steep slopes in southeast portion of map area. Derived from erosion of loess covering the basalt of Blackfoot River. Overlies unit *Qg*. Soils of the Ammon series are developed on this unit (Salzmann and Harwood, 1973).

EOLIAN UNITS

Qes **Dune sand (Holocene)**—In the south portion of the map area, fine to medium sand composed of quartzite grains, quartz phenocrysts, mafic and feldspathic lithics, and black obsidian; well-sorted, and loose. Forms relic to active, parbolic and hairpin dunes that trend southwest-northeast, parallel to present-day prevailing winds. Deposits range from low sand sheets <3 m (<10 ft) high to 10 m (33 ft) dunes. Buried soils are locally present indicating multiple periods of dune activation. Dunes and sand sheets thicken and become more numerous toward the southwest. They are traceable for 155 km from Rupert, Idaho area to near Ammon, Idaho. Scott (1982) suggested derivation of dune sand from 17.4 ka Bonneville flood deposits. OSL ages from a dune in SE 1/4 sec. 6 (T. 2 S., R. 37 E.) are 3.05 ± 0.17 ka for a sample between paleosoils, and 15.61 ± 1.77 ka from loess at base of the dune (T. Rittenour, written communication, 2009). Regionally, OSL ages in paleosols indicate multiple periods of dune activation at 3000 yr, 2000 yr, 1200 yr, 700 yr, and as recently as 80-140 years ago (Rittenour, 2009). Also consists of low hummocky dunes draped over southwest-facing terrace scarps along the Snake River; these deposits were probably derived from the Holocene Snake River floodplain. The Wolverine soil is developed on this unit (Salzmann and Harwood, 1973).

Qel **Loess (late Pleistocene)**—Massive, light gray to pale brown, silt, clay, and very fine sand. Calcareous except in leached near-surface soil horizons. Thickness generally correlates with age of underlying unit. In the Firth quadrangle, maximum thicknesses of loess are: over basalt of Blackfoot River (*Qbbh*) 4-12 m (13-39 ft); 6-9 m (20-30 ft) thick over basalt of Shelley Bridge (*Qbsb*) and 0.5-1.5 m (1.6-5 ft) on outwash gravels (*Qg*). No significant loess is present on basalt of Hells Half Acre (*Qbhh*). Surface soils developed on this unit include the Pancheri and Polatis soil associations (Salzmann and Harwood, 1973). At least three buried paleosoils consisting of carbonate-silica (Bk) and clay (Bt) horizons have been documented in loess elsewhere in the eastern Snake River Plain (Pierce and others, 1982). The buried soils separate multiple periods of loess accumulation correlated with regional glaciations, i.e. Pinedale (ca. 25-14 ka), early Wisconsinian (ca. 65-70 ka) and Bull Lake (160-130 ka). OSL ages of depth profiles in near-surface loess in the nearby Woodville and Idaho Falls North quadrangles range from ~24 to 17.5 ka. Regression age-depth models indicate deposition rates of 0.63-0.56 m/ka and the end of deposition between 17.2-15.7 ka (Phillips and others, 2009).

VOLCANIC UNITS

Qbhh **Basalt of Hell's Half Acre (Holocene)**—Black to light gray, vesicular, olivine- and plagioclase-phyric basalt with groundmass of olivine, plagioclase, augite, and glass. Erupted from a single vent about 24 km northwest of the map area (Karlo, 1977). Normal magnetic polarity. Dated by radiocarbon on bulk organic matter beneath the flow at 5653-6284 cal yr BP (5200 ± 150 yr BP; Kuntz et al., 1986, p. 166). Consists of several overlapping, inflated pahoehoe flow units. Thickness ranges from 9-18 m (30-29 ft) to <1.5 m (<5 ft) at flow edges. Flow fronts are steep and extremely rough with pressure ridges, plateaus, collapse pits, pahoehoe lobes, and aa-like rubble. Away from fronts, relief is low and surface almost flat. Unit is unweathered, with minimal soil development and loess cover.

Qel / Qbsb / Qbsb **Basalt of Shelley Bridge (middle to late Pleistocene)**—Light gray, dense, olivine-phyric basalt. Shown as *Qel/Qbsb* where covered with loess. In the Firth quadrangle, outcrops mostly limited to an area north of Riverside School (sec. 14 and 11, T. 1 S., R. 36 E.). About 3 m (10 ft) of a single flow is exposed at Shelley Bridge (SE 1/4 sec. 36, T. 1 N., R. 36 E.). A prominent scarp 3-6 m (10-20 ft) high formed by the eroded, loess- and gravel-draped margin of this unit can be traced for several km north and south of the outcrop. Water well records show that the unit both under and overlies gravel-rich Snake River alluvium. Paleomagnetic orientation is similar to *Qbrr* (Table 1). Unit has not been dated. Interbedding with Snake River alluvium suggests possible correlation with the Bull Lake glaciation (~140-160 ka) or an early Wisconsinian glaciation (~60-80 ka).

Qel / Qbbr **Basalt of Blackfoot River (middle Pleistocene?)**—dark gray, dense, very fine-grained basalt; shown as *Qel/Qbbr* because entirely covered by 4-12 m (13-39 ft) of loess in the Firth quadrangle. Well-exposed along the Blackfoot River in the adjacent Goshen quadrangle. Contains rare olivine phenocrysts up to 0.25 mm and abundant plagioclase microlites. Normal magnetic polarity. Water well logs indicate thickness of 3-20 m (10-98 ft). Consists of several intercanyon flows along the Blackfoot River; interpreted to have spread out over underlying Miocene tuffs upon reaching the Snake River Plain. Separated from the Snake River outwash plain and Blackfoot River floodplain by a prominent 15 m (49 ft) erosional scarp. Undated; normal polarity, intercanyon character in the Blackfoot River, prominent scarp, and thick loess cover suggest early middle Pleistocene age of <780 ka.

SYMBOLS

Contact: Line showing the approximate boundary between one map unit and another; dashed where approximately located.

06P03 Paleomagnetic sample location (see Table 1).

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

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Base map scanned from USGS film positive, 1979.

Shaded elevation from 10 m DEM.

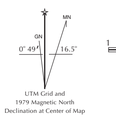
Topography by photogrammetric methods from aerial photographs taken 1946 and plane-table surveys, 1951 and 1955. Map edited 1979.

Projection: Idaho coordinate system, east zone (Transverse Mercator). 1927 North American Datum.

10,000-foot grid ticks based on Idaho coordinate system, central zone.

1000-meter Universal Transverse Mercator grid ticks, zone 12.

National Geodetic Vertical Datum of 1929.



UTM Grid and 1979 Magnetic North Declination at Center of Map

SCALE 1:24,000

1 0.5 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 2006.

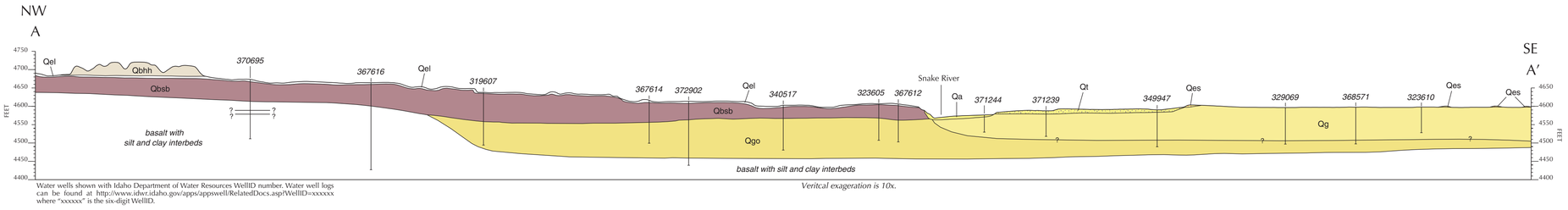
This geologic map was funded in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program, USGS Award No. 06HQAG0020.

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

Reviewed by Dean L. Garwood, Idaho Geological Survey.

Map version 2-11-2011.

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



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.

Veritcal exageration is 10x.

Table 1. Paleomagnetic data for the Firth quadrangle.

Sample number	Unit name	Latitude	Longitude	n	D	I	α95	k	Polarity	Demag Level (mT)
06P03	Qbsb	43.33619	-112.20747	8	348	49	4.8	136	N	15
06P07*	Qbsb	43.37588	-112.16892	5	351	43	3.7	227	N	30

*Sample from Woodville 7.5′ quadrangle

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