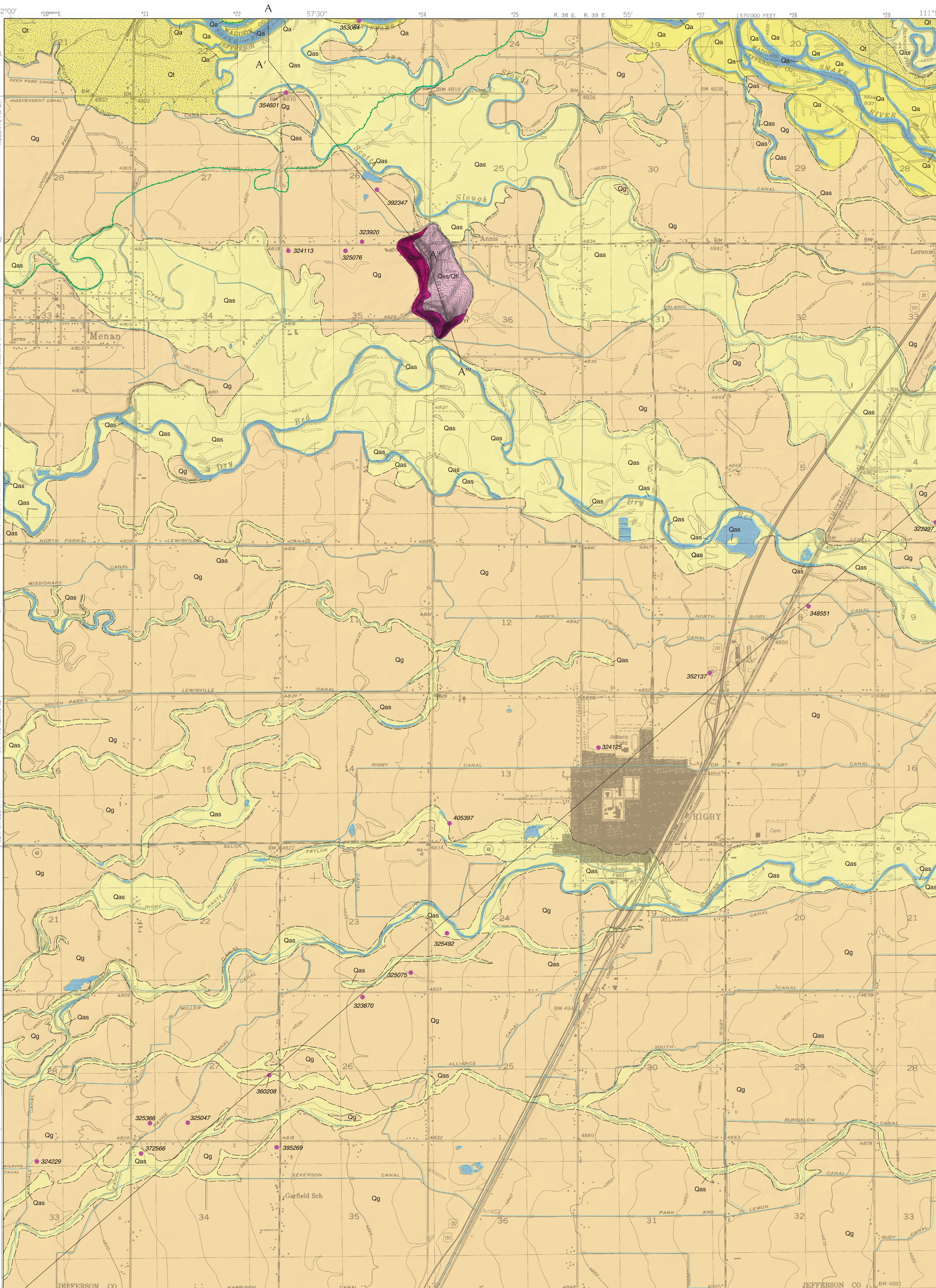
Geologic Map of the Rigby Quadrangle, Jefferson and Bonneville Counties, Idaho

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-food 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.

This geologic map was funded in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program, USGS Award No. 07HQAG0070.

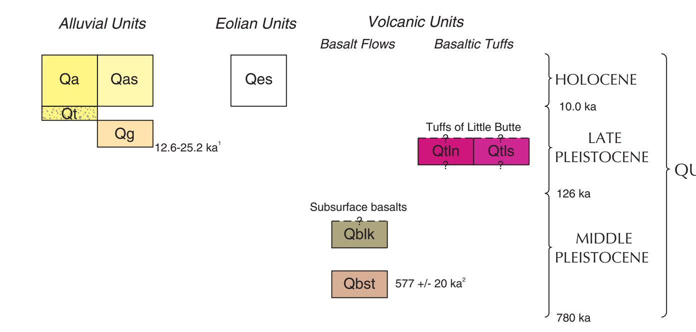
Digital cartography by Collette Gantenbein, Loudon R. Stanford and Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.

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

Map version 10-12-2011.

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

CORRELATION OF MAP UNITS



[1] Stage boundaries of the Pleistocene from Gradstein, F.M., J.G. Ogg, A.G. Smith, Wouter Bleeker, and L.J. Lourens, 2004, A new geologic time scale, with special reference to Precambrian and Neogene: Episodes v. 27 no. 2, p. 83-100.
[2] $^{40}Ar/^{39}Ar$ age; Mel Kuntz, written commun., 2004.
[#] OSL ages; Tammy Rittenour, written commun., 2008.

INTRODUCTION

This map depicts bedrock and surficial geological units in the Rigby quadrangle. 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 as the hotspot passed beneath the region (Morgan and McIntosh, 2005). In the Rigby quad, the Heise rhyolites are covered by Snake River alluvium and basaltic lava flows. Normal faulting along the Grand Valley-Snake River fault zones between about 4.4 – 2.0 Ma influenced the development of the South Fork drainage and produced the topographic low through which the river flows onto the Snake River Plain (Anders and others, 1989). As the hotspot moved away from the region, faulting diminished, while subsidence of the Snake River Plain commenced along with basaltic volcanism and deposition of Snake River alluvium. Beneath the town of Rigby, about 180 m (600 ft) of fluvial sediments lie on top of basalt of unknown age. At least a portion of the fluvial sediments were deposited during Pleistocene glacial periods at ~140 ka (Bull Lake glaciation) and ~25-13 ka (Pinedale glaciation) when the headwaters of the South Fork of the Snake River in the Grand Teton area supported large glaciers (Licciardi and Pierce, 2008; Scott, 1982). Meltwater from these glaciers swelled the South Fork of the Snake River into a much larger stream than it is today. Huge volumes of gravel and sand outwash were deposited in a giant outwash fan at the point where the South Fork enters the Snake River Plain. The outwash sediments continue south downstream about 80 km (50 miles) to the vicinity of Blackfoot (Scott, 1982). These highly porous sediments form an important regional aquifer and are also widely mined for sand and gravel. An unusual phreatomagmatic basaltic tuff cone of probable late Pleistocene age is present at Little (Annis) Butte in sec. 36, T. 5 N., R. 38 E. This feature is part of an 8 km (5 mi) long, north-northwest-trending rift zone along which Menan and Little Buttes were erupted (Ferdock, 1987). Little Butte has excellent exposures of intricately bedded basaltic tuff containing numerous quartzite cobbles. On June 5, 1976, a portion of the map area flooded when the Teton Dam failed (Ray and Bigelow, 1976). 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).

STRATIGRAPHIC RELATIONSHIPS

Relationships between map units are shown on cross sections interpreted from water well logs. Cross section A-A′ shows phreatomagmetic tuffs of the Menan Volcanic Complex at Little Butte lying over and interbedded with Snake River sand and gravel deposits (after Ferdock, 1987). Section B-B′ illustrates the interfingering of two basalt lava flows with alluvial deposits. Unit *Qbst* was erupted at Shattuck Butte ~24 km (~15 mi) southwest of Rigby at about 577 ka. Unit *Qblk* was erupted from Lewisville Knolls about 11 km (7 mi) west of Rigby between about 200-400 ka. Clay deposits overlying this unit suggest that *Qblk* lava flows dammed or constricted the Snake River, causing the formation of a lake. The clay probably continues to the northeast of the quadrangle as shown by the log for the town of Rigby well. It may form a barrier to groundwater flow that contributes to high water tables in the northern half of the quadrangle. Gravel and sand of middle-late Pleistocene to Holocene age lie over the clay deposits. Well log data do not permit division of subsurface sediments into units of specific age. Surface deposits consist of Pinedale-age outwash and Holocene sediments of the South Fork and tributary streams.

SOURCES OF DATA

The map is based upon compilation and consultation of master thesis studies from Idaho State University (Ferdock, 1987; Allison, 2001), county soil surveys (Noe, 1981, Miles, 1981, and Jorgensen, 1979), domestic water well logs (available from Idaho Department of Water Resources at http://www.idwr.idaho.gov/apps/appswell/searchWC.asp), and field work conducted in 2007.

DESCRIPTION OF MAP UNITS

ALLUVIAL UNITS

Qa **Alluvium of the South Fork Snake River (Holocene)**—Gravel, sand, and sandy silt. Forms islands, and bar-tops and beaches exposed at low water levels. Gravel clasts have similar composition to unit *Qg*. Thickness generally <3 m (10 ft). Separated in part from unit *Qg* by irregular sinuous topography reflecting numerous partially filled relic stream channels. Subject to flooding and high water tables.

Qas **Alluvium of side streams (Holocene)**—Gravel, sand, and sandy silt; formed by tributaries of the South Fork meandering across the glacial outwash plain deposits of *Qg*. Thickness generally <3 m (10 ft). Deposits largely restricted to relic channels and adjacent to active streams including Annis Slough, Scotts Slough, and Dry Bed. Several of these streams are presently modified to transport irrigation water from the main South Fork. Separated in part from unit *Qg* by irregular sinuous topography reflecting numerous partially filled relic stream channels. Forms parent material for the Hayeston, Xeric Torrifluvents, and Wardsboro soil associations (Jorgensen, 1979).

Qt **Terrace alluvium of the Snake River (late Pleistocene)**—Terraces in northern part of map area separated by low scarps from the floodplain (*Qa*) and outwash plain (*Qg*) units. Poorly exposed in the Rigby quadrangle. In neighboring areas, 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 of the Snake River (Licciardi and Pierce, 2008) and regional OSL ages of unit *Qg* (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. Locally capped with Holocene flood deposits of the Snake River. Parent material for the Annis, Blackfoot, Labenzo, Heiseton, and Harston soils (Noe, 1981; Jorgensen, 1979). These soils display redoximorphic features indicating periodic water saturation and reducing conditions.

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 the quadrangle. Exposures in nearby gravel pits 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 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 suggest minimum thickness of ~50 m (164 ft). Thickness uncertain because possible older units cannot be reliably separated in water well logs. Unit is part of the regional braided-stream outwash plain deposited during the Pinedale glaciation by meltwaters from the Snake River headwaters (Scott, 1982). OSL ages between 25.2 ka and 12.6 ka (Phillips and others, 2009) are consistent with cosmogenic surface exposure ages of Pinedale-age moraines in the Yellowstone headwaters (Licciardi and Pierce, 2008). The Rigby quadrangle lies in the middle of the huge outwash fan deposited where the South Fork of the Snake River enters the Snake River Plain. Separated from units *Qas* and *Qa* in part by smooth geomorphic surfaces with gentle westward slopes. In the northern portion of map, locally capped by stratified sandy silt and clayey silt deposited by floods of the Snake River and tributary streams (parent material for Annis, Blackfoot, Labenzo, and Heiseton soils). South of Rigby, typically capped with 0.5-1.5 m (1.6-5 ft) of loess-derived soils (parent material for Bannock and Bock soils; Noe, 1981; Jorgensen, 1979; Miles, 1981). Water table is seasonally very high in the northern half of the map. Soils in this area display redoximorphic features indicating periodic water saturation and reducing conditions.

EOLIAN UNITS

Qes **Sand sheet and small dunes (Holocene?)**—Fine to medium sand, well sorted and loose; overlies Tuff of Little Butte (*Qes/Qtl*); thickness <1.5-3 m (<5-10 ft); includes partly eroded, well-developed soil with K (pedogenic carbonate) and Bt (illuviated clay) horizons.

VOLCANIC ROCK UNITS

Menan Volcanic Complex–Little (Annis) Buttes

The Little Buttes are remnants of two tuff rings formed when basaltic magma erupted through thick alluvial sediments of the Snake River. Steam explosions mixed quenched basalt magma with gravels and sands, forming distinctive phreatromagmatic structures. The Little Buttes are the southern end of an 8 km (5 mi)long line of tuff cones extending north-northeast into the Menan Buttes and Deer Parks quadrangles. Undated; considered by Ferdock (1987) to be ~70 ka on basis of field relations and geomorphology of the cones. The descriptions below are after Ferdock (1987).

Qes/Qtl, Qtln **Scoria and tuff of Little North Butte (late Pleistocene)**—Black scoria composed of juvenile black bombs and lapilli, massive to thin bedded; and brown to tan, medium-bedded to massive, planar, medium to fine palagonitic tuffs. Where covered by eolian sand, mapped as *Qes/Qtl*. The tuff is interspersed between the scoria at seemingly random intervals and with variable thickness. Both the scoria and tuff contain pebble to cobble sized accidental lithics. Lithics comprise up to 50 percent by volume of the scoria while the tuff contains about 5 percent. Ballistic sag structures are commonly associated with lithics larger than 3 cm. Most lithics are pink, white, and gray-green quartzites but also include basalt, granite, marl, welded rhyolite tuff, and gneiss. Many lithics exhibit angular faces indicating fracturing during emplacement. Based on the presence of rounded faces and ubiquitous presence of quartzite, the clasts were derived from South Fork alluvium. Quartz grains of sand size is also present. Most are quartz fragments derived from the alluvium but some consist of small, well-formed doubly terminated quartz probably derived from rhyolitic tuffs. A thin section of a juvenile bomb has a hyalopilitic texture consisting of 78 percent groundmass, 13 percent vesicles, and 8 percent phenocrysts of plagioclase and olivine.

Qes/Qtl, Qtls **Tuffs of Little South Butte (late Pleistocene)**—Green-brown to light tan, generally massive, fine palagonite tuff with abundant pebbles and cobbles of accidental rounded lithics and scoria of lapilli and coarse ash size. Where covered by eolian sand, mapped as *Qes/Qtl*.

Basalt Lava Flows

Qblk **Basalt of Lewisville Knolls (middle Pleistocene)**—Not exposed on surface; correlated by well logs and illustrated in Section B-B′. Erupted from Lewisville Knolls, about 11 km (7 mi) west of the town of Rigby. Undated but considered to be about 200-400 ka.

Qbst **Basalt of Shattuck Butte (middle Pleistocene)**—Not exposed on surface; correlated by well logs and illustrated in Section B-B′. Erupted from Shattuck Butte, about 12 miles southwest of the town of Rigby. Dated by $^{40}Ar/^{39}Ar$ at 577 ± 20 ka (Mel Kuntz, written commun., 2004).

SYMBOLS

Contact: dashed where approximately located.

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

Strike and dip of bedding of tuffs of Little Butte (from Ferdock, 1987).

325047 Water well and Idaho Department of Water Resources Well ID number.

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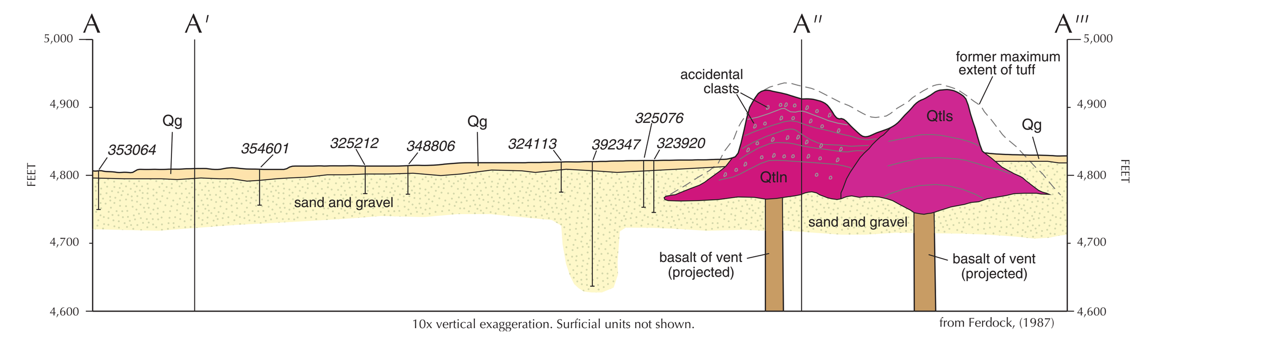
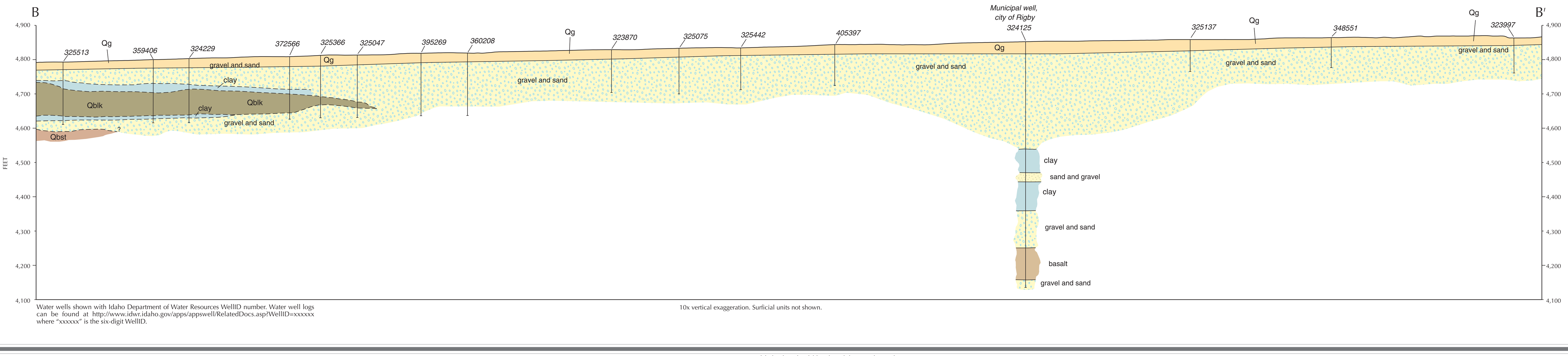
ACKNOWLEDGMENTS

We thank the landowners in the area for access to their property.



10x vertical exaggeration. Surficial units not shown.

from Ferdock, (1987)



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. Surficial units not shown.

Published and sold by the Idaho Geological Survey
University of Idaho, Moscow, Idaho 83844-3014