IDAHO GEOLOGICAL SURVEY DIGITAL WEB MAP 175 IDAHOGEOLOGY.ORG MOSCOW-BOISE-POCATELLO PHILLPS, MOORE, AND FEENEY

Geologic Map of the Poplar Quadrangle, Bonneville County, Idaho

Mapped and Compiled by William M. Phillips, Daniel K. Moore, and Dennis M. Feeney



CORRELATION OF MAP UNITS

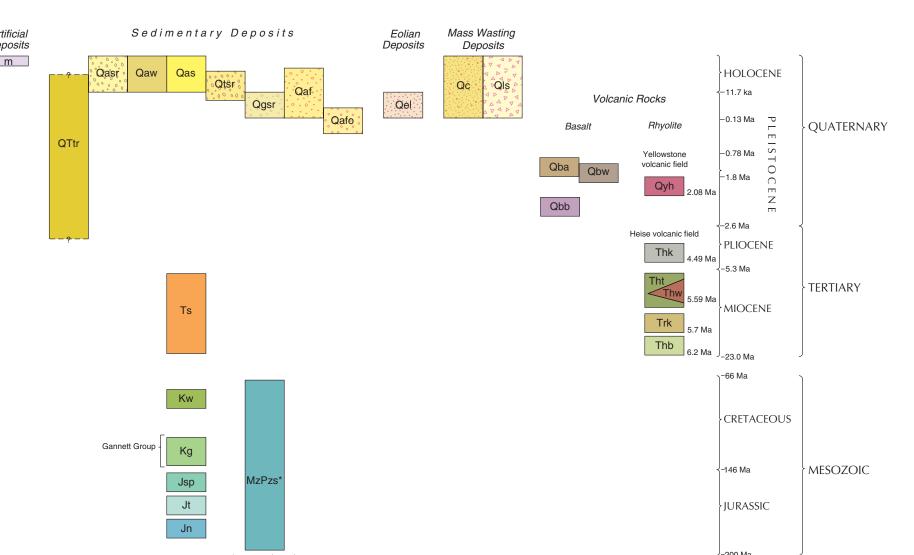


Figure 2. Basalt of Willow Creek (Qbw) at left abutment of Ririe Dam (SW1/4 SW1/4 sec. 15, T.3 N., R. 40 E.). White crystals are plagioclase megacrysts.

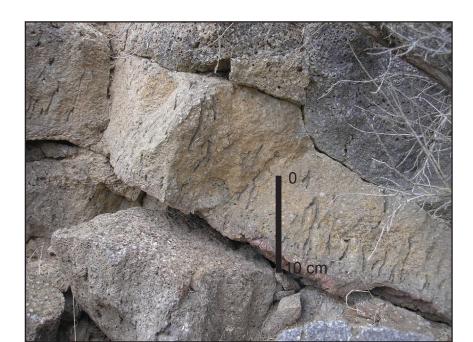


Figure 3. Basalt of Birch Creek (Qbb) in quarry (NE1/4 SW1/4 sec. 14, T.3 N., R. 40 E.) Bar scale is 10 cm. Flow at this site contains abundant plagioclase phenocrysts, chilled zone, and elongated vesicles discussed in text.

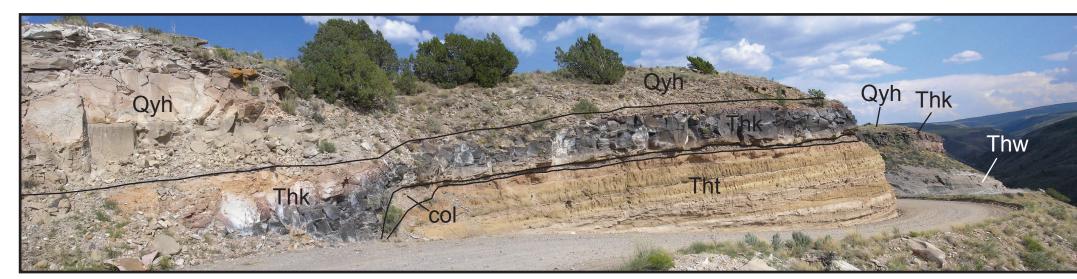


Figure 4. Volcanic units along Call Dugway of Meadow Creek (sec. 1, T. 2 N., R. 40 E.). Qyh exhibits changes in color and jointing described in text. Thk at this site is almost entirely vitrophyric. Col is angular pebbles of Jurassic Nugget Sandstone interpreted as Pliocene colluvium. Tht includes reworked pyroclastic beds with stacked paleosols, "Pre-Kilgore tuff" (not visible), and tuff of Wolverine Creek (Thw) shown

SYMBOLS

basis of stratigraphic succession or position.

346573 - Water well showing Well ID number. Water well logs can be

INTRODUCTION

This map depicts rock units exposed at the surface or underlying a thin

cover of soil or colluvium. Surficial geological units are also depicted

where mappable at a scale of 1:24,000. Many sources of map information

were compiled and consulted (Fig. 1 and references cited in Description of

Map Units). Additional important references include Kirkham (1924),

Prostka and Hackman (1974), and Prostka and Embree (1978). Water well

logs (Idaho Department of Water Resources, 2015) were also consulted in

STRATIGRAPHY

The Poplar quadrangle contains scientifically important, well-preserved,

and easily accessed exposures of rhyolitic ignimbrites of the Heise volcanic

field (HVF). The HVF is the second youngest of eruptive centers along the

Snake River Plain-Yellowstone hotspot trend. The Heise tuffs consist of

ping, nested calderas. Major units consist of the Blacktail Creek Tuff (6.62

Ma), Walcott Tuff (6.27 Ma, not present in Poplar quadrangle), tuff of

Wolverine Creek (5.59 Ma), Conant Creek Tuff (5.5 Ma, not present in

Poplar quadrangle), and Kilgore Tuff (4.49 Ma). Several names have been

applied to the HVF units over the years (Embree and others, 1982;

McBroome and others, 1981); here, we use the nomenclature of Morgan

STRUCTURE

The map contains three structural elements: 1) termination of a portion of

the Idaho overthrust belt consisting of thrust faulted and folded Mesozoic

sedimentary rocks; 2) concealed caldera boundary of the Blacktail Creek

Tuff of the HVF depicted in the cross section as a vertical contact against

Mesozoic and Paleozoic sedimentary rocks; 3) normal faults along the

GEOLOGIC HAZARDS

Spring floods along the Snake River, and Willow Creek where it enters the

Eastern Snake River Plain, were significant hazards prior to construction of

The Heise fault has late Pleistocene offset in the Rexburg area (U.S.

Geological Survey, 2006). No Holocene ground rupture or historical earth-

MINERAL AND ENERGY RESOURCES

The following map units have potential as aggregate resources: sand and

gravel, Qasr, Qtsr; crushed rock, Qbb, Qbw, and Jn. Existing gravel pits and

The Sorenson No. 1 oil and gas exploration well (SW1/4 SW1/4 sec. 33, T. 3

N., R. 41 E.) was drilled in 1928-1930 to a total depth of 1150 m (3774 ft).

No production was reported. Further information including formation tops

is available at Idaho Geological Survey (2015). The well was reported to

Potential geothermal resources include: unnamed spring along Birch Creek

(NW1/4 NW1/4 sec. 32, T. 3 N., R. 41 E.; Spring Number 19-15, Dansart and

others, 1994); inactive hot springs indicated by travertine mound (QTtr)

along Stinking Spring Creek (NW¼ NW¼ sec. 9, T. 3 N., R. 41 E.): and

DESCRIPTION OF MAP UNITS

(2011). Radiometric ages are reported with 2σ errors unless otherwise

noted. Soil information is from Soil Survey Staff (2015).

completed in 1978 (Patrick and Whitten, 1981).

warm water well (22° C) with high dissolved solids and strong sulfur smell

(NW¹/₄ NW¹/₄ sec. 5, T. 3 N., R. 41 E., WellID = 335414, Idaho Department

the Palisades Dam in 1957 and Ririe Dam in 1978.

quakes have occurred on this structure.

quarries are depicted on the map.

of Water Resources, 2015).

bottom in the Carboniferous Wells Formation.

Snake River that are splays of the Grand Valley fault zone (Piety, Sullivan,

large-volume, generally densely welded ignimbrites erupted from overlap-

found at http://www.idwr.idaho.gov/apps/appswell/Related

Docs.asp?WellID=xxxxxx (where "xxxxxx" is the six-digit

▶ 22 Strike and dip of eutaxitic foliation.

SR-1 • Geochemical sample (see Table 2).

RRBC11 ♦ Paleomagnetic sample (see Table 1).

Sorenson - Oil and gas exploration well.

Quarry or gravel pit.

areas of thick loess cover.

and McIntosh (2005).

and Anders, 1992).

Basaltic volcanic vent, concealed.

Contact: dashed where approximately located. Alluvial Deposits Normal fault: ball and bar on downthrown side; dashed where Normal fault: ball and bar on downthrown side; dashed where approximately located; dotted where concealed. and adjacent to braided channels of the active floodplain; clast grain size and lithologies similar to *Qgsr*. Includes low terraces capped with about 25 Thrust fault: teeth on upper plate; dashed where approximately cm (10 in) silty sand. Maximum thickness from water wells is 30 m (98 ft). Areas underlain by this unit are subject to frequent seasonal flooding and

standing water. Contains ecologically important stands of riparian cotton-Syncline axial trace: dashed where approximately located; dotted wood gallery forest. Qaw Alluvium of Willow Creek (Holocene)—Reddish-gray to gray, silty sand, silty √60 Strike and dip of bedding. clay, gravel, and boulders in Willow Creek floodplain below Ririe Dam; derived from weathered Mesozoic sedimentary rocks, rhyolite, basalt, and ★ Strike and dip of vertical bedding. loess. Thickness ranges from about 9 to 27 m (30 to 90 ft) in drill logs for 80 \$\rightarrow\$ Strike and dip of bedding interpreted to be overturned on the Creek alluvium is traceable downstream from Ririe Dam to its confluence

> Subject to seasonal flooding and high water tables. Qas Alluvium of side streams (Holocene)—Gravel and sand deposits of small tributary channels; thickness generally is less than 3 m (10 ft). Subject to flooding during wet seasons or during intense thundershowers.

Cts? Terrace alluvium of the Snake River (Holocene-late Pleistocene)—Stratified sand, silt, and gravel deposited and incised during large pre-Palisade Dam or prehistoric floods. Lithologies of gravels similar to unit *Qgsr*. Thickness from topographic profiles is about 5.5 m (18 ft). Alluvial fan deposits (Holocene-late Pleistocene)—Gravel, sand, and silt

with the Snake River in the Idaho Falls area (Phillips and Welhan, 2012).

SEDIMENTARY DEPOSITS

deposited where Birch Creek and other major secondary streams join the Snake River outwash plain or floodplain. Thickness from topographic profiles ≤4 m (≤13 ft). May be subject to local flooding during seasonal high runoff or during high-intensity storms. Qgsr Gravel outwash of the Snake River (late Pleistocene)—Gravel and sand deposited during the Pinedale glaciation of the South Fork headwaters; generally poorly exposed in the map. In gravel pit west of the town of Poplar (SE1/4

sec. 2, T. 3 N., R. 40 E.), consists of massive to thickly bedded, wellrounded cobble to pebble gravel, with an open framework filled by subangular sand. Rare beds of coarse to medium sand are cross bedded. Gravel clasts are dominated by quartzite with lesser sandstone, granitic rocks, porphyritic mafic igneous rocks, rhyolite, basalt, and limestone. Water wells indicate maximum thickness of about 21 m (69 ft). Deglaciation ages for Pinedale glaciation of Yellowstone-Grand Teton area are about 18.8 to 13.5 ka (Licciardi and Pierce, 2008). Ages for outwash deposits in the Idaho Falls area range from about 25 to 13 ka (Phillips and others, 2009). Wellunit with as much as 115 to 150 cm (45 to 60 in) of sandy loam covering Qba gravels. Contains aggregate (sand and gravel) resources.

Qafo Older alluvial fan deposits (late to middle Pleistocene)—Relic alluvial fan isolated by stream incision. Surface covered by about 1.5 m (5 ft) of loess over unit *Ts*. Thickness from topographic profiles about 40 m (130 ft). **Eolian Deposits**

Qel Loess (late Pleistocene)—Massive, brown to light-gray, silt, very fine sand, and clay; over 3 m (10 ft) thick in most of the upland portions of the quadrangle. The Ririe and Potell soil series developed in the loess contain multiple pedigenic carbonate (Bk) horizons suggesting several periods of deposition. Loess is associated with glaciation in the headwaters of the Snake River. During glaciations, fine-grained sediments were transported onto the Snake River Plain, then blown by northeast-directed winds onto uplands. Prominent northeast-trending lineaments in loess-covered areas reflect this dominant wind direction. In the Idaho Falls area, loess deposition occurred between 15 to 25 ka, and about 75 ka (Phillips and others, 2009). In the Jackson Hole, Wyoming area, episodic loess deposition occurred between about 16 and 154 ka (Pierce and others, 2011). Loess-rich soils are widely cultivated in the map area for farming of wheat and other grains.

Mass Wasting Deposits **Colluvium** (Holocene-Pleistocene)—Angular boulders and pebbles of rhyolite and/or basalt mixed with poorly sorted sand and silt that drapes steep hillslopes below cliffs in Willow Creek canyon. Some thicker deposits transition to hummocky slides and slumps (unmapped), or to alluvial fans (unmapped). Topographic profiles indicate thicknesses range from about

1.5 to 5 m (5 to 16 ft). **Landslide deposits (Holocene-late Pleistocene)**—Slumps, rotational slides, and small shallow debris slides; most involve hillslopes in Willow Creek canyon and in Meadow Creek with northeast aspects that are underlain by clay-rich units *Ts* or *Kw*. Influence on landslide occurrence by aspect may be related to high seasonal moisture from buildup of snow produced by northeastdirected winds. Several large landslide complexes involve undercutting of Qbw, Tyh, or Thk by Willow Creek. Operation of Ririe Reservoir may also

SPRING DEPOSITS Travertine (Holocene-Pliocene)—Sloping mound of light-gray to yellowishgray, thin-bedded, vuggy limestone deposited by hot springs adjacent to Stinking Spring Creek. Thickness from topographic profiles about 13 to 30

have contributed to these landslides. Topographic profiles indicate

thicknesses for the larger slides range from about 5 to 20 m (16 to 66 ft).

WEAKLY CONSOLIDATED SEDIMENTS

Sedimentary deposits (Pliocene-Miocene)—Poorly exposed fluvial and lacus-

trine deposits consisting predominantly of light-colored to reddish brown,

reworked rhyolitic ash and pumice, partially devitrified or weathered to

clay; interbedded with thin beds of gravels and sands derived from resistant

(1952) near Willow Creek canyon along western boundary of map where

thickness ranges from about 457 to 610 m (1500 to 2000 ft). Contains fern

fossils (Tempskya sp.) and fragments of bentonitic tuff. Unconformably

overlies the Gannett Group. Unit is landslide-prone along steep hillslopes.

Good exposures of the Wayan Formation are found along Ririe Reservoir in

m (43 to 100 ft). Hot springs location and activity may be influenced by

Mesozoic sandstones such as Nugget Sandstone (In). Shown as Qel/Ts where covered with loess. Likely gradational with unit *Tht* where pyroclastic deposits of the tuff of Wolverine Creek predominate. Exposed along Birch Creek (sec. 30, T. 3 N., R. 41 E.) where about 2 to 3 m (6 to 10 ft) of The metric system is used for sizes of mineral or clast constituents of rocks, thick-bedded sand, silt, and gravel with a white ash bed are present. Known and for small-scale features of outcrops. Unit thickness and distance are primarily from water well logs (e.g. 346573 in sec. 18, T. 3 N., R. 41 E.) given in both meters (m) and feet (ft). Rock colors are after Geological where over 300 ft of interbedded clay, gravel, sand, and rhyolite are Society of America (2013). Grain size classification of sediments and reported, and from construction of the Ririe Dam where clay and silty clays sedimentary rocks is based on the Wentworth scale (Lane, 1947). Volcanic are assigned to the Miocene Salt Lake Formation (Patrick and Whitten, rocks are classified by total alkali versus silica chemical composition 1981). Deposits have distinctive "badlands" geomorphology where not according to IUGS recommendations (Le Bas and Streckeisen, 1991). overlain by Qyh (e.g. portions of secs. 25 and 36, T. 3 N., R. 40 E.). In the Phenocryst abundances in rhyolites are reported as volume percent basis Ammon 15-minute quadrangle, south of the map area, Mansfield (1952, p. where known, or as relative to a well-characterized regional ignimbrite 46) described hundreds of feet of Pliocene(?) Salt Lake Formation as (Blacktail Creek Tuff of the Heise volcanic field; Bolte and others, 2015). conglomerates, calcareous clay, sandstone, grit, and volcanic ash. In the The geologic timescale is after U.S. Geological Survey (2010) with Pleisto-Poplar quadrangle, the unit forms an aguitard that locally limits production cene subseries after Walker and others (2012) and Cohen and Gibbard of ground water.

proximity to normal faults.

sec. 15, T. 2 N., R. 40 E.

SEDIMENTARY ROCKS **Wayan Formation (Early Cretaceous)**—Pale yellowish-brown, light-red, and ARTIFICIAL DEPOSITS nottled greenish-gray sandstone, shale, carbonaceous shale, conglomer-Man-made land (Holocene)—Ririe Dam, an earth- and rock-fill structure 76 m ate, and limestone; medium- to thick-bedded. Identified by Mansfield (251 ft) high, 256 m (840 ft) long, and 12 m (40 ft) wide at the crest;

ump and Preuss Formations, undivided (Middle-Late Jurassic)—Stump Formation consists of gray-green, thick-bedded, fine-grained silty limestone; gray-green shale and calcareous siltstone; and gray-green to forming, red to reddish-gray, thin-bedded calcareous siltstone grading upward into thicker bedded hematitic-red calcareous sandstone. Generally poor exposure conditions precluded separation of the units on map. Thickness in the Caribou Mountains is about 49 m (160 ft) for Stump and about 114 m (375 ft) for Preuss (Jobin and Schroeder, 1964); in the Snake River Range, about 57 to 76 m (186 to 250 ft) for Stump and 6.4 to 20 m (21 to

(>1000 ft) of the Group.

68 ft) for Preuss (Staaz and Albee, 1966). Twin Creek Limestone (Middle Jurassic)—Dark-gray, thin-bedded shaly limestone; characteristically weathers to light-gray and yellowish-gray, splintery or pencil-shaped fragments 7-10 cm; interbedded with sandy oolitic medium-bedded limestone. Thickness is about 365 m (1200 ft) in the Caribou Range (Jobin and Schroeder, 1964) and about 265 m (870 ft) in the Snake River Range (Staaz and Albee, 1966).

Gannett Group (Early Cretaceous)—Consists of Draney Limestone, Bechler

Formation, Peterson Limestone, and Ephraim Conglomerate. Poor exposure

conditions precluded separation of the units on map. Mapped on occur-

rence of distinctive sublithographic, white-weathering limestones with a

conchoidal fracture (Draney or Peterson) separated by red shale or

mudstone beds (Bechler). Less frequently identified were the diagnostic

pebble conglomerate interbedded with heterogeneous red, gray-green or

purple sandstones and siltstones of the Ephraim Conglomerate. Thickness

totals about 367 m (1205 ft) in the Caribou Range (Jobin and Schroeder,

1964); and about 442 m (1452 ft) in the Snake River Range (Staaz and

Albee, 1966). In both areas, the Ephraim Conglomerate makes up >300 m

Nugget Sandstone (Early Jurassic)—Pale reddish-brown to moderate reddishorange, medium-bedded and cross-bedded, fine- to medium-grained, quartz arenite. Shown as Qel/Ts where covered by loess. Typically forms ow ridges covered with boulders of sub-rounded, very hard sandstone. Thickness is about 163 m (535 ft) in the Caribou Range (Jobin and Schroeder, 1964) and about 78 to 91 m (255 to 299 ft) in the Snake River Range

(Staaz and Albee, 1966). Unit suitable for use as crushed rock. Mesozoic to Paleozoic Sedimentary Rocks (Cretaceous to Carboniferous)—

VOLCANIC ROCKS

drained Bannock, Bock, Heiseton, and Packham soils are developed on Qel Basalt of Antelope Creek (early Pleistocene)—Dark-gray to black, vesicular, olivine- and plagioclase-phyric basalt; thickness 30 to 60 m (100 to 200 ft). Shown as Qel/Qba where covered by loess. Erupted from concealed vent n Antelope Flat about 24 km (15 mi) upstream of the town of Poplar where it formed a lava dam complex on the Snake River (Dossett and others, 2012). Exposures on map are remnants of intercanyon facies of dam complex. Reverse magnetic polarity. Undated. Shares similar stratigraphic position and geochemical composition with Qbw and basalts of the Sommers Butte-Lyons Creek volcanic rift in neighboring Moody and Heise quadrangles (Embree and others, 2016; Phillips and others, 2016).

> Basalt of Willow Creek (early Pleistocene)—Dusky-red to grayish-brown, dense, sparsely vesicular basalt with abundant plagioclase megacrysts, 1 to 4 cm (Fig. 2); also contains sparse olivine and pyroxene phenocrysts, 1 to 3 mm, and locally abundant calcite amygdules. Groundmass is fine grained to glassy. Shown as Qel/Qbw where covered with loess. Thickness near Ririe Dam varies between 4.6 to 39 m (15 to 128 ft) (Patrick and Whitten, 1981). Vent has not been identified but must lie south of the map. Normal magnetic polarity (Table 1). Dated by K-Ar methods at 3.1 ± 0.2 Ma (Patrick and Whitten, 1981, p. 23); this date is clearly erroneous as it is older than the age of Qyh which lies beneath Qbw. Unit consists of an intercanyon flow that unconformably overlies channel gravels of ancestral Willow Creek. Flowed onto the Snake River Plain where it is overlain by late Pleistocene (circa 15-24 ka) glacial outwash deposits. The unit has a similar stratigraphic position and geochemical composition as *Oba* and nearby basalts of the Sommers Butte-Lyons Creek volcanic rift which are dated at about 2.0 Ma (Embree and others, 2016; Phillips and others, 2016). However, the Sommer Butte-Lyons Creek and *Qba* basalts have reverse magnetic polarity so they are not precisely correlative. Position of Qbw along the canyon rim of Willow Creek indicates emplacement prior to most incision and suggests an early Pleistocene age during the normal polarity Olduvai subchron (1.95-

Basalt of Birch Creek (early Pleistocene to Pliocene)—Dark- to light-gray, medium-grained, dense to vesicular, olivine- and plagioclase-phyric, diktitaxitic basalt; locally contains very abundant clusters or rosettes of tabular plagioclase up to 1 cm. Shown as Qel/Qbb where covered with loess. At Ririe Dam, consists of five flows as indicated by interbedded clays (gray-green and very plastic), flow breccias (orange to brown), and/or lithologic dissimilarity (Patrick and Whitten, 1981). Total thickness at Ririe Dam is about 76 m (250 ft). In quarry along Birch Creek (NE1/4 SW1/4 sec. 14, T.3 N, R. 40 E.), elongated vesicles 5-10 cm long lie above a light-red chill zone 3-5 cm wide and terminate upward at fractures (Fig. 3). Preliminary location of vent (SW1/4 SW1/4, sec. 18, T. 3 N., R. 40 E.) is concealed by loess and Qyh deposits and therefore based on topography and landscape position. Reverse magnetic polarity (Table 1). Dated by K-Ar methods at 6.7 \pm 0.7 Ma and 7.3 \pm 0.4 Ma (Patrick and Whitten, 1981, p. 23); these dates are clearly erroneous as they are older than the age of *Thk* which lies beneath Qbb. The unit has a similar stratigraphic position as the basalt of Rexburg which is dated at about 3.3 Ma in the nearby Ririe 7.5-minute quadrangle (Phillips and others, 2014). However, these flows are not the same unit as indicated by differences in paleomagnetic, trace element, and petrological data, as well as probable vent location. Unit may be suitable

1.77 Ma). Unit may be suitable for use as crushed rock.

Yellowstone volcanic field

Huckleberry Ridge Tuff (early Pleistocene)—Rhyolitic ignimbrite with moder-

ately abundant (~10 percent), small (1 to 4 mm) phenocrysts of sanidine and quartz with lesser plagioclase and pyroxene. Shown as *Qel/Qyh* where covered by loess. Degree of welding, color, phenocryst abundance, and jointing vary significantly within some outcrops (e.g. Fig. 4). At Ririe Dam (NW1/4 sec. 22, T. 3 N., R. 40 E.), base of unit is weakly welded, low density, and moderate pink, with sparse phenocrysts and thin, eccentrically oriented, columnar joints. Overlying this with a sharp contact is mediumgray and light brownish-gray tuff, densely welded, with moderately abundant phenocrysts, and blocky to flaggy horizontal jointing. Along the Ririe Reservoir boat ramp road (SE1/4 sec. 22, T. 3 N., R. 40 E.), the Qyh section consists of white unwelded air fall tuff, overlain by reddish weakly welded tuff, and topped by a more densely welded brown to gray tuff. Three Huckleberry Ridge Tuff members (A, B, and C) were erupted from the Big Bend Ridge caldera in the Yellowstone volcanic field about 70 km (43 mi) north of the map (Christiansen, 2001). However, all known exposures in map area are Member A (C. Wilson, written communication, 2015); hence, color, density, and jointing changes within outcrops do not indicate different members. Thickness of Huckleberry Ridge Tuff ranges from 1.8 to 20 m (6 to 65 ft) in vicinity of Ririe Dam (Patrick and Whitten, 1981). Magnetic polarity is excursional with subhorizontal inclination and southwesterly declination (Reynolds, 1977). U-Pb ages from zircons in Member A in the adjacent Rigby SE quadrangle (43.49919°, -111.77514°) have a mean age of 2.0798 ± 0.0094 Ma, similar to U-Pb zircon and single-crystal laser fusion 40Ar/39Ar analyses of sanidine for members A, B, and C from other

localities (Wotzlaw and others, 2015 and references cited therein).

Heise volcanic field

Kilgore Tuff (Pliocene)—Rhyolitic ignimbrite, densely welded, with sparse (2-7 percent), small (<2 mm) phenocrysts of plagioclase, quartz, and sanidine. Maroon and dark-gray, flattened pumice 3 to 3.5 cm in length are locally abundant. Most commonly exposed along Willow Creek and Meadow Creek as ledge-forming, pale-purple to grayish-purple, devitrified rhyolite with lithophysae 1 to 3 cm in diameter that forms very resistant blocky outcrops with rounded edges. Shown as *Qel/Thk* where covered by loess. Thickness varies abruptly in map, from <2 m (6.5 ft) to about 15 m (49 ft). At top of Call Dugway of Meadow Creek (Fig. 4), unit consists of about 2 m (6.5 ft) of black to dusky-blue basal vitrophyre overlain by dusky-red to medium-red, glassy to vitric ash with abundant lithics (Watts and others, 2011). Reference section defined in south-facing ravine along Meadow Creek (NW¹/₄ SW¹/₄ sec. 1, T. 2 N., R. 40 E; Morgan and McIntosh, 2005, Data Repository 2005059) is 11.5 m (38 ft) thick. Reverse magnetic polarity that can be measured in field with fluxgate magnetometer. Mean ages from vstal laser-tusion 40Ar/39Ar analyses are 4.45 ± 0.05 Ma (Morga and McIntosh, 2005; FC-1 standard 27.84 Ma) and 4.61 ± 0.01 Ma (Anders and others, 2014, FC-1 standard 28.201 Ma; error on age 1σ). Formerly called "tuff of Heise C" (Prostka and Embree, 1978) on southeastern margin of the Eastern Snake River Plain; and "tuff of Spencer" on northern side (McBroome and others, 1981).

Rhyolitic tuffs and sediments (Pliocene-Miocene)—Consists of stratigraphic interval between Thk and Thb where poor exposures and complex stratigraphy do not permit separation of distinct units at the map scale of 1:24,000. Shown as Qel/Tht where covered by loess. Beginning at base of Thk in Meadow Creek, at least four yellow-brown to reddish paleosols are developed in about 12 m (39 ft) of rhyolitic tuffs, and tuffaceous floodplain and lacustrine sediments (Fig. 4). An unwelded, pumiceous, crystal-poor rhyolitic tuff informally termed "Pre-Kilgore tuff" is present near the base of this section. Zircons from this tuff yielded a U-Pb age of 4.87 \pm 0.20 Ma (Watts and others, 2011; sample 06HS-14). Below this unit is about 50 m (164 ft) of tuff of Wolverine Creek (Thw), which is included in Tht in Meadow Creek but mapped separately in the Heise cliffs area (sec. 4, T. 3

Tuff of Wolverine Creek (Miocene)—Unwelded, pumiceous, rhyolitic fall and pyroclastic surge deposits (Doherty, 1976; Morgan and McIntosh, 2005). Black obsidian glass, and black and white glass shards dominate; pale yellowish-brown pumice fragments and very sparse (<1 percent) crystals of plagioclase, augite, and sanidine are also present. Stratification is massive, planar and cross-bedded, consistent with locally reworked, fall and surge deposits. Laser-fusion single-crystal 40Ar/39Ar ages from sanidine yielded an age of 5.59 ± 0.05 Ma for the tuff of Wolverine Creek (Morgan and McIntosh, 2005). Gradational with unit *Ts* where reworked ash, gravels, clays, and silts predominate. Mapped as part of *Tht* in Meadow Creek.

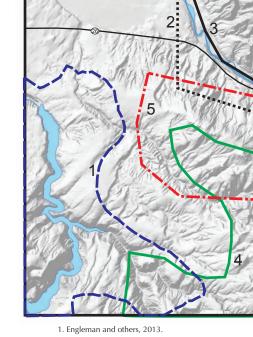
Rhyolite of Kelley Canyon (Miocene)—Rhyolite lava flows, crystal poor, with a range of textures and colors. Many exposures are brown, devitrified, and massive with closely-spaced joints, some of which conform to regional bedding and others which are highly eccentric. Less commonly consists of gray perlite with black and orange obsidian remnants. Diagnostic features are maroon, flow-deformed chips and blocks 5 to 20 cm contained in aphyric groundmass. Maximum thickness in map is 300 m (984 ft). K-Ar age is 5.7 ± 0.1 Ma (Morgan and McIntosh, 2005).

Blacktail Creek Tuff (Miocene)—Rhyolitic ignimbrite, densely welded, with most abundant (10 to 20 percent by volume) phenocrysts of any Heise unit. Shown as Qel/Thb where covered by loess. Phenocrysts in order of abundance are plagioclase, quartz, sanidine, augite, opaque oxides (magnetite and ilmenite), and pigeonite (Bolte and others, 2015). Plagioclase and quartz are 1 to 2 mm; sanidine about 1 to 0.5 mm; and pyroxene < 0.5 mm. Most exposures in map are cliff-forming, medium-gray, devitrified ignimbrite; intensely welded, locally with lithophysal cavities 5 to 10 cm. Type section was defined by Morgan and McIntosh (2005) at the Blacktail Creek Recreation Area boat ramp on Ririe Reservoir in the adjacent Rigby SE quadrangle (NE1/4 SW1/4 SE1/4 sec. 16, T. 2 N., R. 40 E.). There, a fault separates about 7.5 m (25 ft) of extracaldera facies from >150 m (> 492 ft) of intracaldera facies. The thick intracaldera facies is well exposed in the map along Meadow Creek (sec. 12, R. T. 2 N., R. 40 E.) where it has characteristic vertical columnar joints. Unit has strong normal magnetic polarity easily verified with fluxgate magnetometer in the field. Mean age from single-crystal laser-fusion 40 Ar/ 39 Ar analyses is 6.62 \pm 0.03 Ma (Morgan and McIntosh, 2005; FC-1 standard 27.84 Ma) and 6.66 ± 0.01 Ma (Anders and others, 2014, FC-1 standard 28.201 Ma; error on age 1σ). Formerly called "tuff of Spring Creek" or "Heise A" on southern margin of Snake River Plain (Prostka and Embree, 1978), and "tuff of Edie School" on northern margin

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2. Dossett and others, 2012. 3. Barney and others, in preparation. Roger Hoggan, unpublished mapping, 1970s and/or early 1980s, Ricks College, Idaho. From files held by Geology Department, BYU-Idaho, 5. David Doherty, Wayne State University, unpublished mapping, 1970s and/or early 1980s. From files held by Geology Department,

Figure 1. Sources of Mapping.

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caldera rim (location approximate)

Thb (intra-caldera facies) $\kappa = \text{precision parameter}$ Units Qt, Qgsr, and Qel are too thin to show. 2x vertical exaggeration. 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

Thb (extra-caldera facies) Thb

Table 1. Paleomagnetic data for basalt collected in the Poplar guadrangle.

ımber name Latitude Longitude n D° I° $lpha_{_{lpha s}}$ R κ Polarity Treatm ϵ RDMB11 Qbw 43.5802 -111.7383 3/8 5.9 57.7 6 2.992 250 N PCA RRBC11 Qbb 43.5779 -111.7058 7/8 181.9 -47.6 3.8 6.976 249 R PCA

confidence limit for the mean direction at the 95% level. Polarity: N = normal; R = reverse.

Treatment used to isolate ChRM; PCA = principal component analysis of AF demagnetization steps. Il samples from Engleman and others, 2013.

 $D^\circ=$ site mean declination of characteristic remanent magnetization (ChRm) $l^\circ=$ site mean inclination of ChRM.

= number of cores used / number of cores measured.

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

Major elements in weight percent Trace elements in parts per million number Latitude Longitude Unit name unit SiO₂ TiO₂ Al₂O₃ FeO* MnO MgO CaO Na₂O K₂O P₂O₅ A-Sum LOI Ni Cr Sc V Ba Rb Sr Zr Nb La Ce Nd SR-7 43.54290 -111.73610 basalt of Willow Creek Qbw 50.46 3.48 13.55 15.15 0.24 3.73 7.9 2.65 1.66 1.19 99.65 -0.35 6 1 27 237 1056 33 319 398 33 61 76 54 SR-1 43.57791 -111.70582 basalt of Birch Creek Qbb | 46.94 2.42 16.35 13.37 0.2 7.31 10.21 2.51 0.28 0.41 98.91 -0.39 | 117 278 28 268 280 3 288 157 15 20 42 29 *Major elements are normalized to 100% on a volatile-free basis with total Fe expressed as FeO.

XRF analyses performed at Brigham Young University, Provo, Utah.

A-SUM is total of major elements prior to normalization.

Data compiled from Engleman and others, 2013.