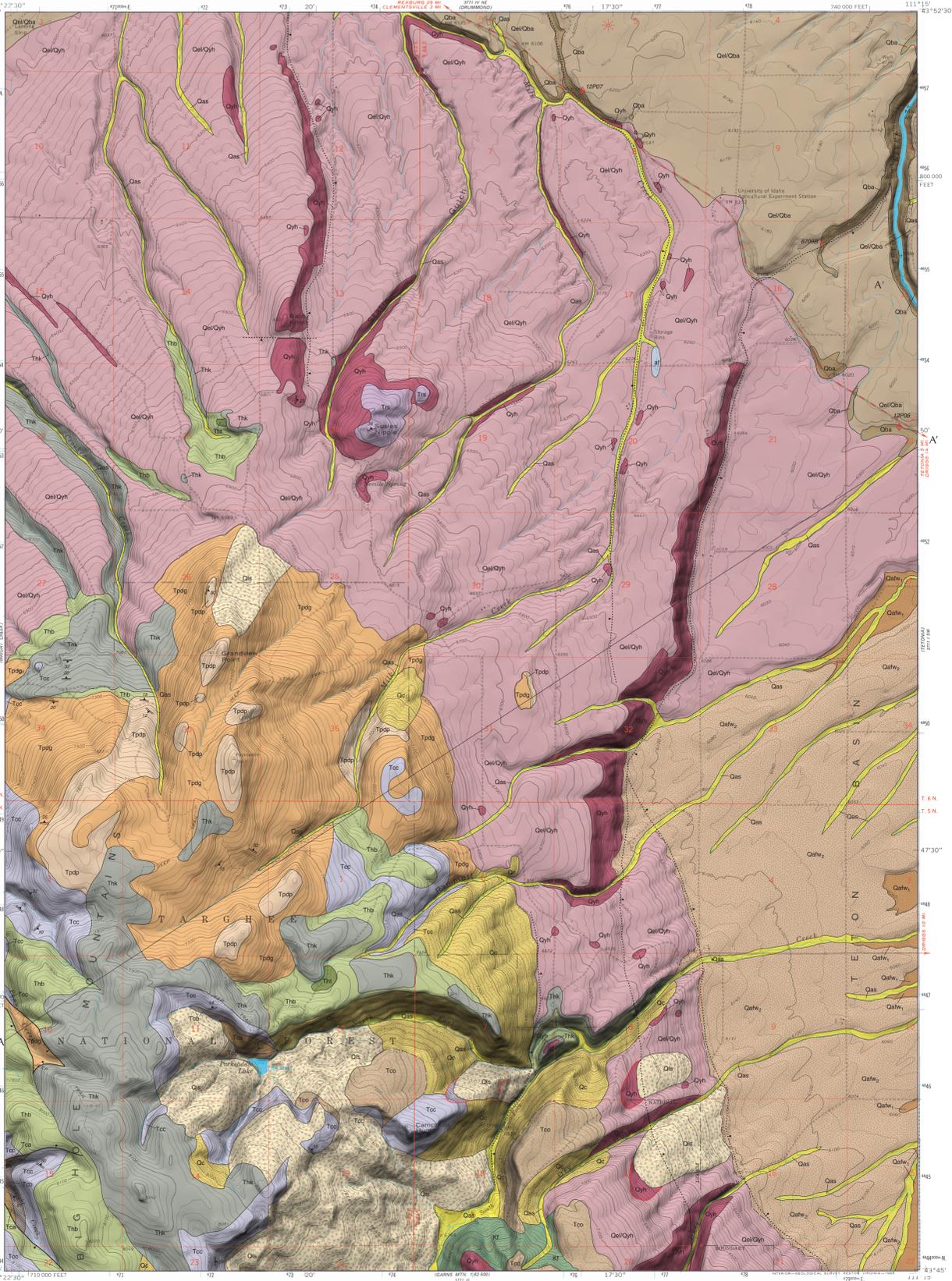


GEOLOGIC MAP OF THE PACKSADDLE LAKE QUADRANGLE, TETON COUNTY, IDAHO

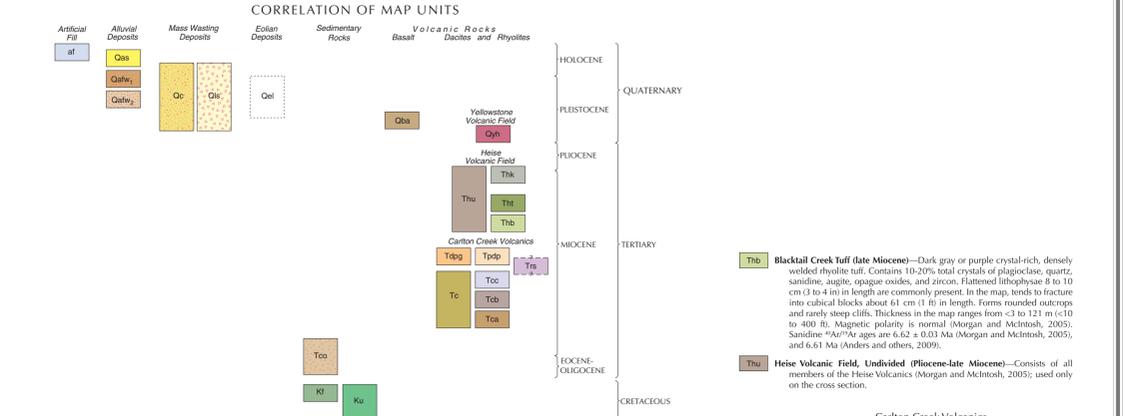
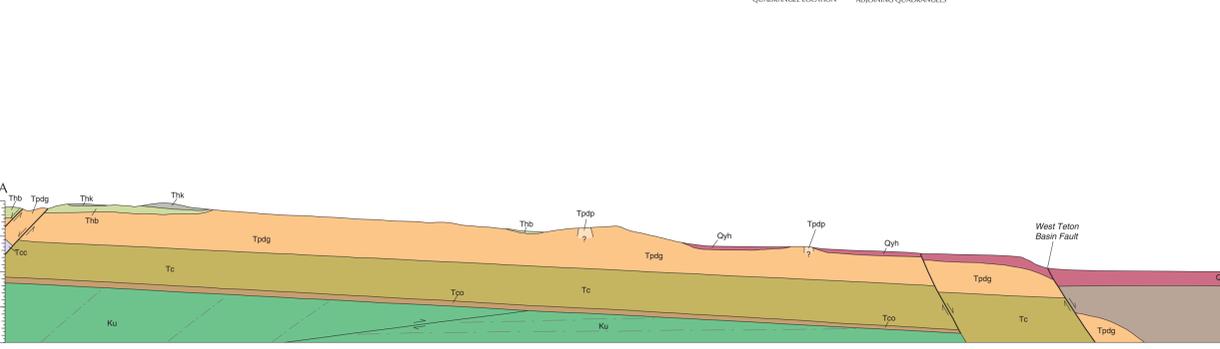
William M. Phillips, Dean L. Garwood, and Glenn F. Embree

2013



Base Map Credit
Base map scanned from 24,000-scale USGS film separates, 1965.
Shaded elevation from 10-m DEM.
Topography by photogrammetric methods from aerial photographs taken 1963. Field checked 1965.
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.

Field work conducted 2012.
This geologic map was funded in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program, USGS Award No. G22AC00113.
Digital cartography by Louisa R. Stanford and Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.
Editorial review by Alison R. Kahl.
Technical review status: Authors only.
Map version 10-28-2013.
PDF (Acrobat Reader) map may be viewed online at www.idahogeology.org.



SYMBOLS

Contact: dashed where approximately located; solid where approximately located; dotted where concealed.
Normal fault: half and bar on downthrown side; dashed where approximately located; dotted where concealed.
Strike and dip of eustatic foliation.
Volcanic vent, concealed.
Geochronological sample.
Paleomagnetism sample.
Landslide scarp and headwall: Steep area adjacent to and below the landslide scarp from which material broke away.

MASS WASTING DEPOSITS

Qc Colluvium (late Pleistocene-Holocene)—Tan to red-brown, silt to boulder-sized debris; angular and unconsolidated. Mostly derived from cliff-forming outcrops of Tdpg and Tdps. Tc and Ttk and Ttk thickness ranges from 10 cm (4 in) to 15 m (49 ft). Undated.

Qas Landslides (Pleistocene-Holocene)—Silt to boulder-sized hummocky masses of debris; landslides south of Packsaddle Lake probably formed by slumping of competent volcanic rocks (Thk, Tth, and Tci) over incompetent limestones of Frontier Formation (Kf). Ranges in thickness from <5 to 30 m (16 to 100 ft). Undated.

LOESS (late Pleistocene-Holocene)—Light to medium gray fine-grained silt to clay, and very fine sand; locally crudely bedded where reworked on hillslopes. Derived from deflation of eolian deposits during glacialations of the Yellowstone Plateau and Teton Range (Scott, 1982; Pierce and others, 2011). Several depositional units separated by buried soils are present in correlative deposits in the upper eastern Snake River Plain. Not dated in this map; regional ages range between 15–25 ka, 35–51 ka, 69–76 ka, and 141–154 ka (Phillips and others, 2009; Pierce and others, 2011). In map, thickness is as much as 12 m (39 ft) over low relief surfaces of Qba and Qyh; decreases with increasing elevation until absent about 6,500–6,700 ft.

SEDIMENTARY ROCKS

Tco Conglomerate (Eocene-Miocene)—Sub-angular to rounded clasts of gray and brown limestone, red and yellow siltstone, and rare white quartzite in fine-grained, poorly cemented, calcareous matrix; overall rock color is tan to red. Clasts are typically 0.5–10 cm (0.2–3.9 in) in length but some quartzite clasts are as long as 90 cm (35 in). Clasts derived from Thaynes, Woodside, Dinwoody, and Wells Formations of Missoula age (Price, 2009). Poorly exposed; commonly consists of jumble of pebbles, cobbles, and boulders. In map forms smooth, gentle upland slopes. Thickness is about 31 m (102 ft).

Kf Frontier Formation (Upper Cretaceous)—Grayish green to brown-bedded sandstone, siltstone, and shale. Sandstone is fine- to coarse-grained, becoming pebbly and glauconitic at top. Local lenses of conglomerate with well-sorted 5 cm (2 in) pebbles of black to gray chert, and white limestone and sandstone. Interbedded with gray black shale and coal. Poorly exposed and subject to slumps and other slope failures. Thickness is about 1,220 m (4,000 ft).

Ku Cretaceous Sedimentary Rocks (Cretaceous)—Cretaceous sedimentary rocks, undated, shown in cross section, not exposed on the map. Consists of shale, sandstone, clay, limestone, clay, and part of the Frontier Formation, Aspen Shale, and Bear River Formation (Staatz and Albee, 1966).

VOLCANIC ROCKS

Basalt of Ard Farms (early-middle Pleistocene)—Light to medium gray fine-grained basalt with rare plagioclase phenocrysts <2 mm and patchy areas of euhedral, interlocking, about 15 to 17 mm (0.5 to 0.67 in) in diameter. Normal magnetic polarity (Table 1). Shown as Qc/Qba where covered by loess. Vent concealed by loess. Probably erupted from a north-trending ridge in SW¼ sec. 5, T. 6 N., R. 4 E., and from a 6,220 ft high point centered at lat. 43.890°N, long. 111.230°W, in the adjacent Drummond quadrangle. From the vent, flows moved southeast over a scarp probably created by a north-south trending normal fault, and west as far as Canyon Creek, about 20 km (12 mi) from the map (Embree and Phillips, 2011). Correlated on the basis of paleomagnetism (Table 1) and geochemistry (Table 2). Undated. The thick loess cover away from canyon edges and presence on both sides of the Teton River canyon (i.e., prior to major stream incision) suggests eruption during the Obolau normal subchron at 1.78–1.95 Ma, rather than during the Brunhes chron after 0.78 ka (paleomagnetic timescale from Ogg, 1993). The name "Ard Farms" was first applied to this unit by Prosska and Embree (1978); it does not appear on U.S. Geological Survey 1:24,000-scale topographic maps.

Yellowstone Plateau Volcanic Field

Member B of Huckleberry Ridge Tuff (early Pleistocene)—Compound cooling unit of crystal-rich welded rhyolite ignimbrite. Shown as Qc/Qyh where covered by loess. Major phenocrysts are sanidine and quartz; plagioclase and pyroxene are much sparser. Phenocrysts are abundant (20–30%) in lower parts of the unit, which consists of black basal vitrophy overlain by grayish-brown to grayish-pink densely welded devitrified tuff with well-developed euhedral textures; locally grades upward into a lithofluid zone composed of closely spaced, 1-cm spherical lithophasae. The lower part of the section is as much as ~10 m (33 ft) thick and is exposed as massive blocks up to several meters in diameter. The upper part of the unit is light brownish-gray to pale pink, slabby weathering, relatively crystal poor (<5%), moderately to poorly welded, devitrified tuff. Maximum exposed thickness of the entire unit is approximately 60 m (200 ft) in the map. Forms broad, gently northward dipping slopes generally underlain by crystal-poor subunit, and steep blocky cliffs generally underlain by crystal-rich subunit. The Huckleberry Ridge Tuff was erupted from the Big Bend Ridge Caldera in the Yellowstone volcanic field and is divided into members A, B, and C (Christiansen, 2001). Only member B has been identified in the map. The mean ⁴⁰Ar/³⁹Ar age for 22 individual sanidine crystals is 2.111 ± 0.008 Ma (Ellis and others, 2012). Paleomagnetic inclination and declination are anomalous for members A and B (Reynolds, 1977) and are correlated with the Brunhes Normal-Inclivity Subchron (C2r.1a) between 2.120–2.140 Ma (Ellis and others, 2012).

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STRUCTURE

South of the map, three gently dipping thrust faults and associated folds are present (Price, 2009; Price and Rodgers, 2010; Staatz and Albee, 1966). These structures play little role in the map besides contributing to the large-scale landscape complex south of Packsaddle Lake. These landforms appear to be influenced by steep-dipping, thrust-faulted and folded, incompetent late Cretaceous strata that underlie the Tertiary section.

A series of north-south trending, down-to-the-east normal faults are present along the east side of the map where they form the western margin of the Teton Basin. The largest structure is the West Teton Basin fault, with at least 79 m (260 ft) of offset on Qyh. Fault throw appears to generally decrease westward from the West Teton Basin structure. However, at Baldy Knoll (SW¼ sec. 13, T. 6 N., R. 4 E.), a 60 m (200 ft) scarp is present in Qyh. The basalt of Ard Farms appears to have erupted within and ponded in a fault-bounded depression. Offset on the basalt is much less than Qyh. The other normal faults are characterized by subdued scarps in loess-covered Qyh. Limited evidence suggests that Heise and Carlton Creek units are also faulted, with offsets that increase with age (Price, 2009). In SW¼ sec. 2, T. 5 N., R. 4 E., Tth and Ttk are faulted down to the level of Packsaddle Creek by a fault that continues northward for at least 1.6 km (1 mi).

DESCRIPTION OF MAP UNITS

Artificial Fill (Holocene)—Loess and topsoil excavated during landscaping; about 3 m (10 ft) thick.

ALLUVIAL DEPOSITS

Qas Alluvium of tributary streams (Holocene)—Thin < 3 m (10 ft) cobble-sized gravel, coarse sand, and silt; clast compositions are mostly rhyolite and obsidian derived from Qyh, and black dacite derived from Tdpg and Tc. On northern flanks of the Big Hole Mountains, streams contained in steep-walled channels are incised into loess-covered slopes. East of the West Teton Fault, deposits are contained in shallow, relatively broad ephemeral channels.

Qahw Alluvial fan of West Teton Basin (Holocene-late Pleistocene)—Low relief surfaces lying in broad valleys and fans that cut older alluvial fans (Qahv); deposits rarely exposed, consists of thickly bedded gravel and sand overlain by about 100 cm (40 in) of loess-derived soils with Bt and Bk horizons. Gravel is cobble to granule in size, and composed dominantly of well-rounded rhyolite derived from Qyh with lesser sandstone from Kf. Driggs silt loam and Packsaddle loam soils are developed on the unit. The Packsaddle soil has a 28 cm (11 in) Bt horizon and a 53 cm (21 in) Bk horizon. The Driggs soil lacks a Bt horizon (Soil Survey Staff, 2011).

Alluvial fan 2 of West Teton Basin (late to middle Pleistocene)—Loess-covered, incised alluvial fans and fan remnants; deposits rarely exposed. Exposures on west side of Teton River consist of medium to light gray sand and gravel beds, planar to cross-bedded, interbedded with several light brown, massive silt beds interpreted to be less (Phillips and others, 2013). Fans are about 15–30 m (50–100 ft) in thickness. Source of the alluvial fans is the scarp of the West Teton Basin fault, and small streams draining portions of

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Table 1. Paleomagnetic data for basalt of Ard Farms.

Sample number	Unit name	Latitude	Longitude	n	D	I	α_{95}	R	K	Polarity	Treatment
12010	Qba	43.8946	-111.2311	48	309	35	3.797	248	10	N	PCA
12016	Qba	43.8332	-111.2529	40	333	41	3.796	170	8	N	PCA
12017	Qba	43.8621	-111.2955	38	355	41	4.0	298	9	N	PCA
3670B	Qba	43.8540	-111.4800	48	335	36	3.6	707	240	N	no
3720B	Qba	43.8900	-111.6000	78	345	44	1.8	676	162	N	no
4620B	Qba	43.8800	-111.5000	48	336	43	3.3	707	314	N	no
4750B	Qba	43.8200	-111.2600	78	330	43	2.4	692	130	N	no

n = number of cores used; *n* / number of cores measured.
D = true declination; *I* = true inclination; *R* = remanent magnetization (OERMs).
K = confidence limit for the mean declination at the 95% level.
Polarity: N = normal; E = reverse.
Treatment: method used to obtain OERMs: PCA = principal component analysis; n = not available; no = not done on map.
^aAcquisition performed by Duane Champion, U.S. Geological Survey; all other analyses performed by Idaho Geological Survey.

Table 2. Major oxide and trace element chemistry of basalt of Ard Farms.

Sample number	Latitude	Longitude	Rock name	Unit name	Map used	Major elements in weight percent ^a											Trace elements in parts per million																		
						SiO ₂	TiO ₂	Al ₂ O ₃	FeO ^b	MnO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	LOI	Sum	Ni	Cr	Sc	V	Zr	Y	Ba	Sr	Pb	La	Ce	Sm	Nd	U					
10705	43.8396	-111.2351	basalt	basalt of Ard Farms	Qba	66.78	2.34	15.75	13.33	0.272	7.54	3.82	3.05	0.44	0.42	0.42	96.93	93	42	30	301	60	4	279	300	14	19	20	15	2	20	41	2	25	1
10706	43.8332	-111.2529	basalt	basalt of Ard Farms	Qba	65.95	2.30	15.62	13.95	0.21	6.59	3.55	2.88	0.34	0.40	0.91	97.95	81	41	30	304	62	2	280	236	35	18	20	140	4	20	15	2	25	2
13907	43.8621	-111.2955	basalt	basalt of Ard Farms	Qba	64.09	2.46	14.35	13.70	0.20	6.64	3.26	2.93	0.46	0.50	1.41	97.80	82	59	30	316	51	5	282	206	37	19	20	115	2	24	51	1	28	0

^aMajor and trace elements are not normalized.
^bMajor and trace elements are not normalized.
All analyses performed at Washington State University Geochronology Laboratory, Pullman, Washington.