Geologic Map of the Niagara Springs Quadrangle, Gooding and Twin Falls Counties, Idaho

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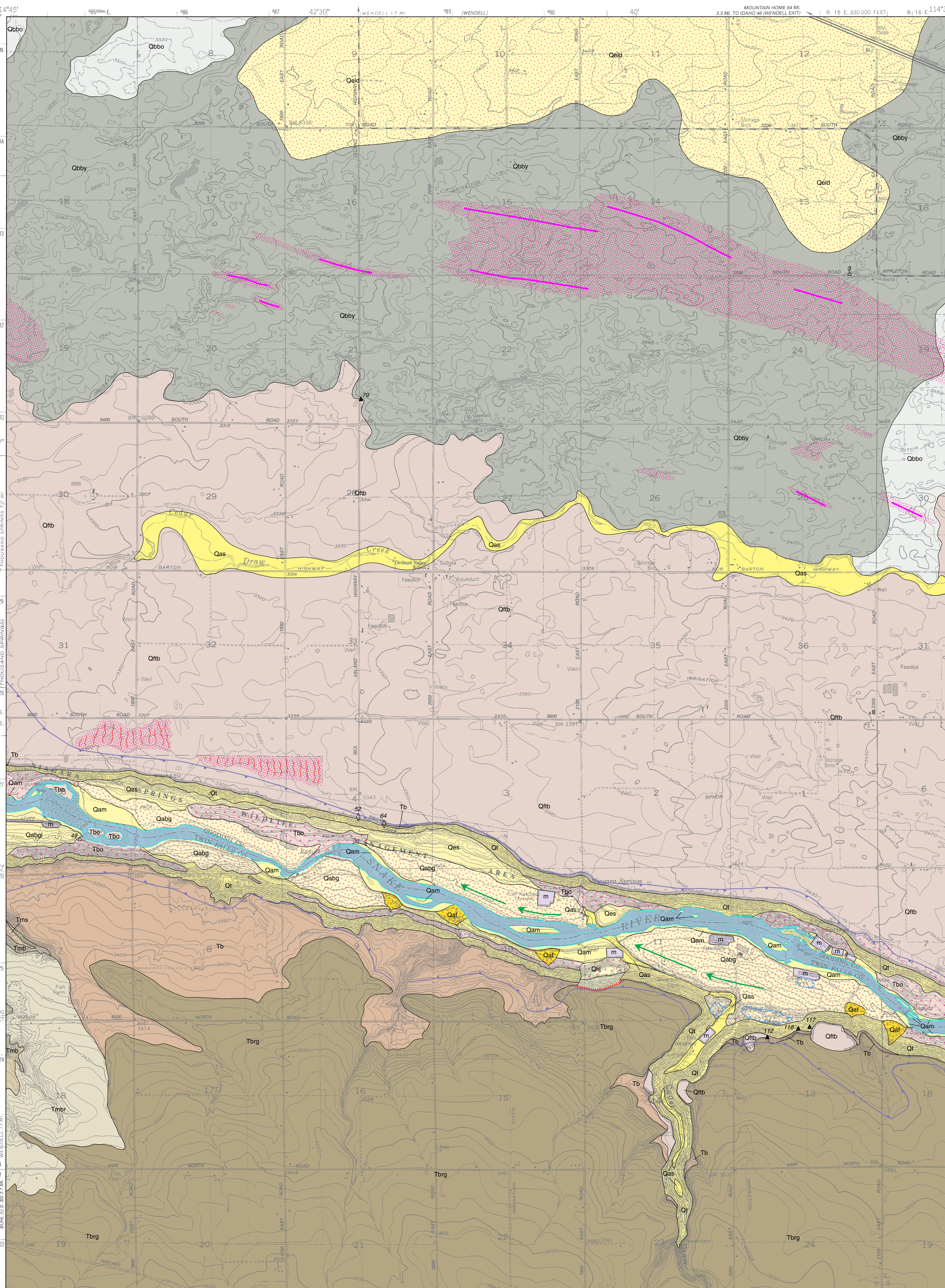


Base map scanned from USGS film-positive base, 1992.

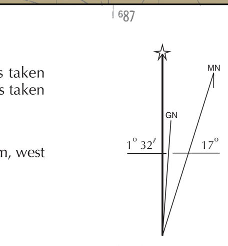
Topography by photogrammetric methods from aerial photographs taken 1946. Information shown has been updated from aerial photographs taken 1987 and field checked. Map edited 1992.

1927 North American Datum.

Projection and 10,000-foot grid ticks based on Idaho coordinate system, west zone.

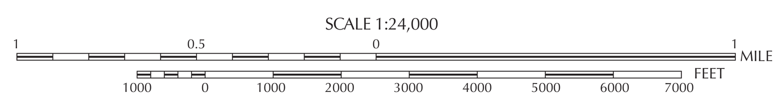
1000-meter Universal Transverse Mercator grid ticks, zone 11.

National geodetic vertical datum of 1929.

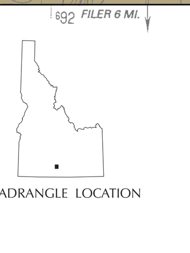


UTM Grid and 1992 Magnetic North Declination at Center of Map

SCALE 1:24,000



Contour interval 40 feet
Supplementary contour interval 20 feet



QUADRANGLE LOCATION

Field work conducted 2002-2004.

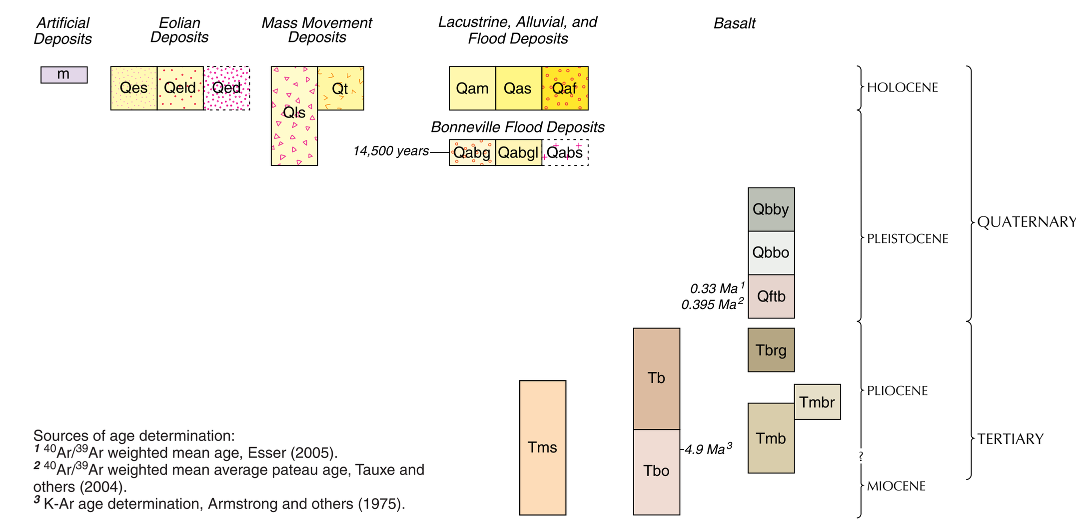
This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program.

Digital cartography by B. Benjamin E. Studer and Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.

Map version 11-29-2005.

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

CORRELATION OF MAP UNITS



Sources of age determination:
1 $^{40}Ar/^{39}Ar$ weighted mean age, Esser (2005).
2 $^{40}Ar/^{39}Ar$ weighted mean average pateau age, Tauxe and others (2004).
3 K-Ar age determination, Armstrong and others (1975).

INTRODUCTION

The geologic map of the Niagara Springs quadrangle identifies both the bedrock and surficial geologic units. It shows the geographic distribution of rock types at the surface and in the shallow subsurface. Basalt represents the principal rock type found in the area. Much of the basalt surface is mantled by deposits such as wind-blown sand and silt which form the soils that are cultivated. The geologic units in the area control soil development, slope stability, groundwater movement and recharge, and geotechnical factors important in construction design and waste management. Land uses in the area include irrigated agriculture, rural and urban residential development, industrial and commercial enterprises, and dairy farms with confined animal feeding operations. The Snake River Plain aquifer underlies the area and discharges as springs in the Snake River Canyon.

Previous geologic studies include work by Gillerman and Schiappa (1994, 2001) who did an investigation of western Jerome County to assess groundwater vulnerability to contamination. Geology of the area south of the Snake River was compiled from previous mapping by Bonnichsen and Godchaux (1996). Earlier studies by Malde and others (1963) and Covington and Weaver (1991) were also reviewed. Field checking of these maps was combined with new field investigations in 2002-2004 of both bedrock and surficial geology. Exposures of the geology were examined and selectively sampled. Aerial photographs were studied to aid in identifying boundaries between map units through photogeologic mapping of landforms. In most areas map-unit boundaries (contacts) are approximate. Contacts are inferred where lack of exposures and poorly defined landforms prevent greater mapping precision. The information depicted at this scale furnishes a useful overview of the area's geology but is not a substitute for site-specific evaluations.

The Niagara Springs quadrangle lies near the center of the Snake River Plain, a large arcuate, lava-filled depression crossing southern Idaho. The incised Snake River Canyon cuts west-northwest across the Niagara Springs quadrangle and is the most prominent topographic feature. It exposes a thick pile of nearly horizontal basalt flows topped by a thin skin of surficial loess and sand. Some of the older basalts, exposed in the bottom of the canyon, are altered or water-affected. Thin layers of sediment and pillow basalt exposed in the canyon walls are evidence of local lakes and streams that existed while the Pleistocene shield volcanos were active. The Bonneville Flood, which occurred approximately ,500 years ago, filled the ancestral Snake River Canyon and overflowed the top in the west side of the quadrangle. The flood scoured the canyon and deposited coarse-grained gravel in giant bars. These deposits have been mined for aggregate.

DESCRIPTION OF MAP UNITS

ARTIFICIAL DEPOSITS

m — **Made ground (Holocene)**—Artificial fills composed of excavated, transported, and emplaced construction materials typically derived locally. Primarily areas modified for fish ponds.

ALLUVIAL DEPOSITS

Qam — **Alluvium of mainstreams (Holocene)**—Channel and flood-plain deposits of the Snake River. Primarily stratified sandy silt and silty sand of bars and islands. Gravelly where channel is shallow and formed directly in basalt. Typically 1-10 feet thick.

Qas — **Alluvium of side-streams (Holocene)**—Channel and flood-plain deposits of tributaries to the Snake River. Includes fine sand in a poorly developed stream drainage from Flat Top Butte (Cedar Draw Creek, Gooding County). Probably eroded and reworked dune sand. Deposits primarily relict. Natural drainage now mostly part of irrigation systems.

Qaf — **Alluvial-fan deposits (Holocene)**—Stratified silt, sand, and gravel that form small fans adjacent to the Snake River in the canyon. Merges and is interstratified with mainstream alluvium (*Qam*). Thickness varies, but typically ranges 5-30 feet.

Tms — **Sediment of Melon Valley (Pliocene or Miocene?)**—Light tan to white, pale greenish, or pinkish, fine- to medium-grained, bedded lake and stream deposits with tephra beds and rare, glassy plagioclase-olivine phyric, valley-filling basalt flows. Typically very fine-grained, nondescript sediments, but greenish-gray and local conglomeratic beds with rounded cobbles of Paleozoic rocks were noted at several localities. At one locality, a buried soil horizon was exposed suggesting an intermittent erosional unconformity within the unit. Malde and Powers (1972) mapped the unit as Tbs (Sedimentary deposits of the middle part of the Banbury) and noted brownish channel sands and pebble gravels as well as the lake deposits with local diatomite and silicic ash beds. They ascribe a thickness of as much as 100 feet to the unit, which seems reasonable for the exposed part of the section. However, driller's logs from water wells drilled in the Melon Valley area suggest there may be several hundred feet of interbedded lava flows and sediments below the current exposure level.

Bonneville Flood Deposits

Qabg — **Sand and gravel in giant flood bars (Pleistocene)**—Stratified deposits of boulders, cobbles, and pebbles of basalt in a matrix of coarse sand. Forms streamlined giant expansion bars with large-scale crossbeds, and eddy deposits in which gravel sizes are smaller (O'Connor, 1993). Similar to Melon Gravel (Malde and Powers, 1962; Malde and others, 1963; and Covington and Weaver, 1991), but restricted to Bonneville Flood constructional forms and deposits.

Qabgl — **Sand and gravel in eddy deposits and lower-energy bars (Pleistocene)**—Stratified coarse sand and pebble-cobble gravel deposited in side channel positions and in lower-energy, waning-stage flood channels. Mantled with thin loess and minor fine-grained alluvium and slope wash.

Qabs — **Scabland of flood pathways (Pleistocene)**—Flood-scoured basalt surface. Butte and basin topography is common. Where above the canyon rim, approximates extent of flood at maximum stage (O'Connor, 1993). Character of scoured surface ranges from areas of original basalt morphology stripped of pre-flood soils, to areas where the original basalt surface has been plucked, gouged, and molded. Includes thin and discontinuous sheets and bars of flood sand and gravel that are not mapped at this scale. Some areas include pavements or strings of boulders transported by flood traction forces or that are lags from erosion by lower-energy regime during late stages of the flood.

EOLIAN DEPOSITS

Qed — **Dune sand (Holocene)**—Stratified fine sand of stabilized wind dunes. Shown only where identified on aerial photographs (1972 NASA false-color infrared; 1993 NAPP black and white). Formerly more extensive based on descriptions of Poulson and Thompson (1927) and Youngs and others (1929). Fine-sand soils with little or no pedogenic horizonation were associated with dune morphology when present in the early 20th century (Poulson and Thompson, ; Youngs and others, 1929). These exist today only where agriculture is prohibited in the Niagara Springs Wildlife Management Area as seen on 1993 aerial photographs (NAPP black and white), and in a few other areas as of 1972 (NASA color infrared photography). Poulson and Thompson (1927) describe "hummocky or dune-like" landforms and areas of actively blowing sand after field plowing in the early 20th century. Continued agricultural modifications to the land have tended to smooth topography and homogenize soils. The result has been an obliteration of the original topography, which probably included extensive areas of stabilized dunes.

Qeld — **Loess and dune sand, undifferentiated (Holocene)**—Wind-blown silt and sand. Typical textures are fine sandy silt, silty fine sand, and fine sand. Generally 6-10 feet thick and buries original undulating basalt-flow surface. Rock outcrops are rare.

Qes — **Eolian sand of the Snake River Canyon (Holocene)**—Uncompacted fine sand deposited by wind along the base of canyon walls. Locally reworked by water, possibly irrigation-return water from the canyon rim.

MASS MOVEMENT DEPOSITS

Qt — **Talus (Holocene)**—Angular pebble-, cobble-, and boulder-sized fragments of basalt that have broken off nearly vertical rock walls and accumulated below. Deposits are characterized by a steeply sloping surface that is at or near the angle of repose. Talus postdates the Bonneville Flood, and the thick, mappable talus has nearly to completely buried a "stepped" canyon wall formed by differential erosion of younger versus older basalt exposed in the canyon. Not mapped where thin talus partially covers older basalt. Unit includes small deposits of eolian or water-reworked fine sand that typically occur at the toes of the talus slope, and which are similar to *Qes*.

Qls — **Landslide deposits (Holocene and Pleistocene)**—Unsorted and nonstratified basalt cobbles and boulders mixed with silt and clay. Unit is largely one intact slump block composed of a sequence of thin-bedded sand, silt, and clay. The slumped sediments were probably interbedded with Tertiary basalt flows. In addition to the landslide deposit, the unit includes the landslide scarp and the headwall (steep area adjacent to and below the landslide scarp) from which material broke away (see Symbols). The headwall area includes talus formed after landslide movement.

BASALT UNITS

The surface geology of the Snake River Plain north of the Snake River is primarily Pleistocene basalt flows of the Snake River Group. On the Niagara Springs quadrangle, the basalt flows primarily originated from the shield volcanoes of Flat Top Butte, five miles east of Jerome, and Bacon Butte, 6 miles northeast of Jerome, and Berger Butte, 9 miles southwest of Twin Falls city. Each volcano probably extruded numerous lava flows or flow lobes, although individual flows cannot easily be mapped because the surfaces are subdued by surficial deposits. Nearly all of the basalt is vesicular to extremely vesicular and most of the units are also diktytaxitic to some degree (i.e., containing voids with protruding crystals). Even units with a fine-grained groundmass have a coarse, grainy texture.

Petrography of selected basalt samples shows that phenocrysts consist of fine to coarse-grained, fresh plagioclase laths and euhedral to anhedral olivine grains. Square chromite inclusions occur in the euhedral olivine. Swallowtail shapes to skeletal plagioclase suggest rapid crystal growth and quenching. Matrix is basaltic glass to crystalline clinopyroxene plus opaque iron-titanium oxides. Textures are ophitic to hyalophitic. Youngest flows (*Qrb* and *Qbby*) have the most glassy texture. The oldest unit, Tb, includes the most altered flows.

Qbby — **Basalt of Bacon Butte, younger unit (Pleistocene)**—Fine- to medium-grained, dark gray basalt with common to abundant olivine as grains and clots as large as 3 mm and scattered small plagioclase laths. Similar in texture and appearance to basalt of Notch Butte, although slightly coarser grained overall. Remanent magnetic polarity is normal, as determined in the field and through laboratory analysis. Forms a raised, hilly surface of partly exposed pressure ridges that extends 5 miles westward to the Snake River canyon in the Sand Springs area, where Malde and others (1963) mapped it as Sand Springs Basalt. However, we interpret it as a younger flow or series of flows erupted from Bacon Butte that entered the Snake River valley in the Sand Springs area. Surface drainage is poorly developed. Discontinuous loess and eolian sand deposits cover less than 50 percent of the surface and are 1-10 feet thick. Soil caliche (duripan) is commonly well developed within the soil profile (Youngs and others, 1929; Johnson, 2002) and at the soil-basalt contact, but the thickness of caliche varies considerably. Some of the land is cultivatable and some is used as pasture.

Qbbo — **Basalt of Bacon Butte, older unit (Pleistocene)**—Fine-grained, dark gray basalt with common to abundant plagioclase laths as much as 5 mm in length and common olivine grains and clots; olivine commonly forms intergrowths with plagioclase. Locally diktytaxitic. May exhibit abundant carbonate accumulation in vesicles and fractures. Remanent magnetic polarity is normal, as determined in the field and through laboratory analysis. Also erupted from Bacon Butte shield volcano northeast of Jerome. Included in Thousand Springs Basalt by Malde and others (1963) and mapped as West Basalt by Gillerman and Schiappa (2001). Topography contrasts with area of basalt of Notch Butte (*Qnb*) to the northeast and the basalt of Bacon Butte, younger unit (*Qbby*). Few basalt pressure ridges rise above a nearly complete mantle of loess and dune sand. Surface drainage is moderately developed. Thickness of mantle ranges from 3-25 feet; commonly 3-12 feet thick. Soil caliche (duripan) is typically well developed within the soil profile (Youngs and others, ; Johnson, 2002) and at the soil-basalt contact, but the thickness of caliche varies considerably. Most of the land is cultivatable.

Qftb — **Basalt of Flat Top Butte (Pleistocene)**—Fine-grained, medium gray basalt with scattered to very abundant plagioclase-olivine intergrowths 4-7 mm across and olivine grains and clots 1-4 mm in diameter. Flows typically vesicular near the top and more dense in the center, but diktytaxitic throughout with abundant fine-grained plagioclase laths. Carbonate coatings and fillings common in voids but not pervasive. Remanent magnetic polarity is normal, as determined in the field and through laboratory analysis. Erupted from the Flat Top Butte shield volcano located near Jerome about 11 miles east of the Niagara Springs quadrangle. Equivalent to Thousand Springs Basalt of Malde and Powers (1962), Malde and others (1963), and Gillerman and Schiappa (2001). Includes some areas mapped as Sand Springs Basalt by Malde and others (1963) and Covington and Weaver (1991). Tauxe and others (2004) report an $^{40}Ar/^{39}Ar$ weighted mean plateau age of 0.395 Ma for this unit (their sample sr09, Thousand Springs Basalt). An $^{40}Ar/^{39}Ar$ weighted mean age of 0.33±0.8 Ma was obtained on our sample 02P002B (Esser, 2005). Basalt flows of unit inundated through-flowing drainage and formed location of ancestral Snake River along which the present canyon has been cut. Forms relatively smooth topography with consistent westerly slope stretching east to west across the quadrangle. Topography contrasts with area of *Qbby* to the north. Few basalt pressure ridges rise above a nearly complete mantle of modified dune sand. Surface drainage is moderately developed. Prior to agriculture about 10-20 percent of the surface was basalt outcrop or shallow to basalt (Youngs and others, 1929). The dune sand has been extensively modified by cultivation and remnants of dunes are rare (see *Qed*). Sand thickness ranges 1-20 feet; commonly 3-10 feet thick. Soil caliche (duripan) is commonly well developed within the soil profile (Youngs and others, 1929; Johnson, 2002) and at the soil-basalt contact, but the thickness of caliche is highly variable. Most of the land is cultivatable.

Tbrg — **Basalt of Burger Butte (Pliocene)—**Fine- to medium-grained basalt generally with abundant plagioclase phenocrysts as large as 5 mm and olivine phenocrysts about 1 mm in diameter. Remanent magnetic polarity is reverse as determined in the field and through laboratory analysis. Source is Burger Butte and associated satellite vents located 9 miles southwest of Twin Falls city. Most of the unit is equivalent to the "basalt of Sucker Flat" unit of Bonnichsen and Godchaux (1996). No basalt pressure ridges rise above loess mantle. Surface drainage is moderately well developed. Loess thickness ranges 5-25 feet and typically comprises a younger deposit with weak soil development and an underlying older loess with a thick caliche (duripan) horizon (Baldwin, 1925; Ames, 2003).

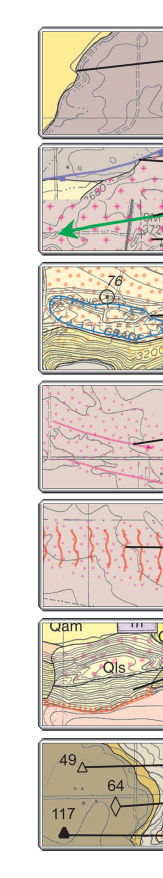
Tb — **Basalt flows, undivided (Pliocene?)**—Fine- to coarse-grained, unaltered to altered undivided basalt flows exposed in the Snake River canyon. Stratigraphically above *Tbo* unit and commonly separated from it by a thin orange baked soil or sediment horizon 1-2 feet thick. Source(s) unknown, but probably consists of flows from different sources of different ages. Includes some basalt mapped as "Sucker Flat basalt, altered" by Bonnichsen and Godchaux (1996). Sources may be Tertiary shield volcanoes southeast of Twin Falls.

Tmbr — **Basalt of Melon Valley, reverse polarity flows (Pliocene?)**—Brownish-weathering, fresh to altered aphyric to phyric, olivine-plagioclase and olivine basalt. Remanent magnetic polarity is reverse based on field and laboratory analysis. In the field, a few flows have weak normal or conflicting polarity. Columnar flows are as thick as 50 feet and thinner vesicular flows are about 15 feet thick. Normally overlies *Tms* unit but may locally lie directly on *Tmb* or *Tmbn* flows. At least four flows are present beneath a basalt of Sunset Butte flow in Salmon Falls Creek canyon and may be a series of early flows erupted from Sunset Butte. Other flows may be from shield volcanoes south of the map area. Includes some water-affected basalt (Sucker Flat basalt, altered facies) of Bonnichsen and Godchaux (1996) in the Melon Valley area. Malde and Powers (1972) mapped much of this basalt as Tbu, "Banbury Basalt, basalt of upper part."

Tmb — **Basalt of Melon Valley, undivided (Pliocene or Miocene?)**—Brownish-weathering, fresh to altered aphyric to phyric, olivine-plagioclase and olivine basalt. Probably contains normal and reverse polarity flows. Within Melon Valley, may be equivalent in part to *Tmbr* or may be an unrelated sequence of basalt flows. Equivalent in part to undivided basalt flows (*Tb*) east of Melon Valley.

Tbo — **Older basalt flows, undivided (early Pliocene to Miocene)**—Medium- to coarse-grained, gray to sooty brown, mostly altered and (or) weathered basalt flows primarily exposed in the lower part Snake River canyon. Thin section from near Auger Falls shows a typical basalt of plagioclase and olivine phenocrysts in matrix of crystalline pyroxene and sparse opaques, but lacking in open vesicles and with 25% of secondary minerals lining voids and replacing olivine and pyroxene. Alteration minerals include light green to brown clays, iddingsite and chlorite. Source(s) unknown but probably erupted from the south and southeast. Age poorly constrained but probably includes flows from different sources of different ages. One K/Ar age determination on this unit by Armstrong and others (1975), from an outcrop in the canyon at the base of Clear Lakes grade, resulted in an age of 4.9±0.6 Ma. All flows included in this unit that were analyzed for remanent magnetism have reverse polarity, although all may not be age-equivalent and not all flows were analyzed. Equivalent to the Banbury Basalt of Malde and Powers (1962), Malde and others (1963), Covington and Weaver (1991), and Gillerman and Schiappa (2001). Extensively scoured by the Bonneville Flood.

SYMBOLS



Contact: Line showing the approximate boundary between one map unit and another. The apparent ground width of the line representing the contact is about 80 feet at this scale (1:24,000).

Approximate extent of Bonneville Flood at maximum stage.

Bonneville Flood flow direction.

Flood-scoured basalt surface (see *Qabs* description).

Gravel pit that exposes a map unit.

Trend of dune field. Arrow points in the downwind direction.

Stabilized-dune crests.

Landslide scarp and headwall: Ticks show top of scarp.

Sample site for chemical analysis.*

Sample site for paleomagnetic analysis.*

Sample site for chemical and paleomagnetic analyses.*

*Data available at Idaho Geological Survey, igs@uidaho.edu.

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