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

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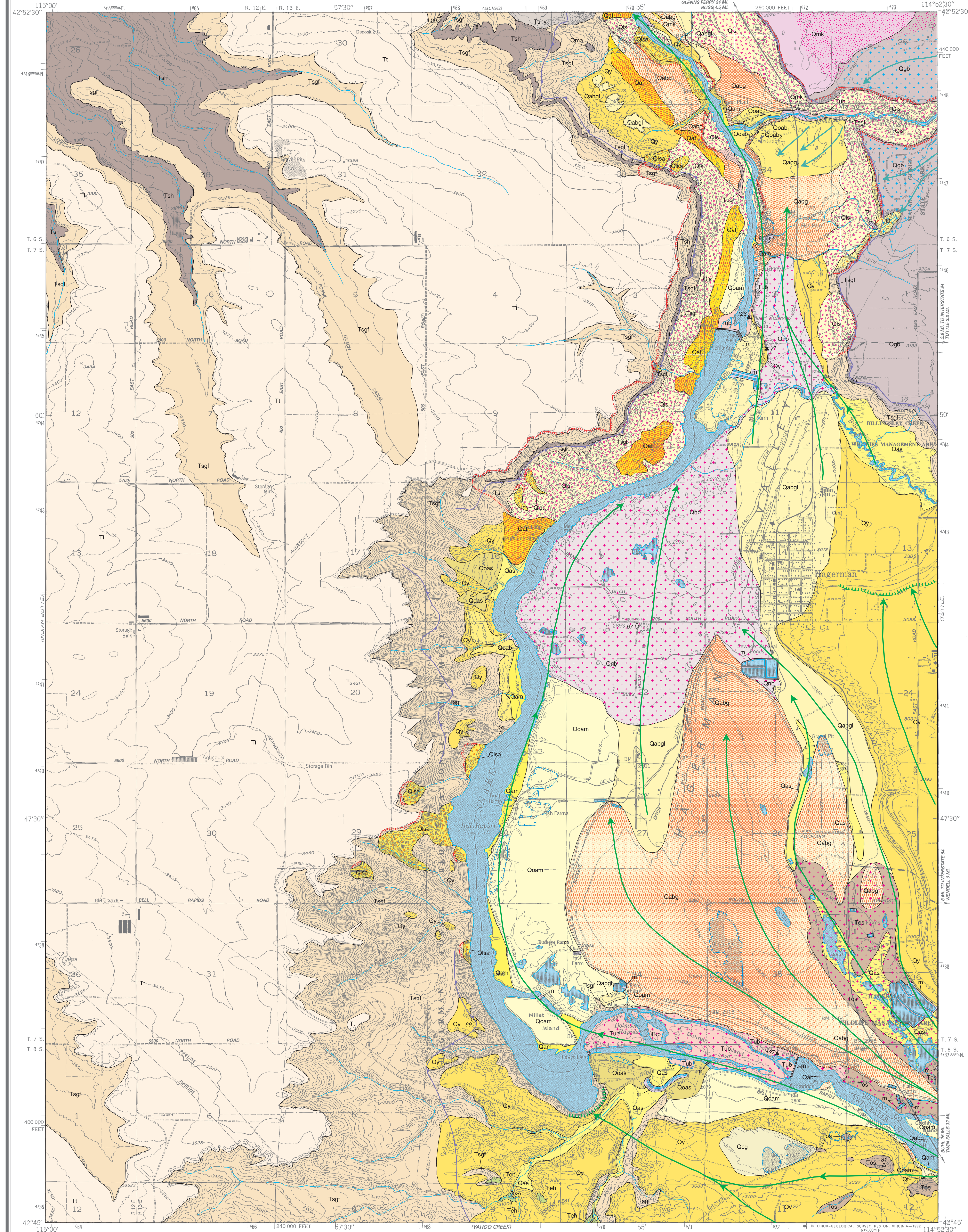
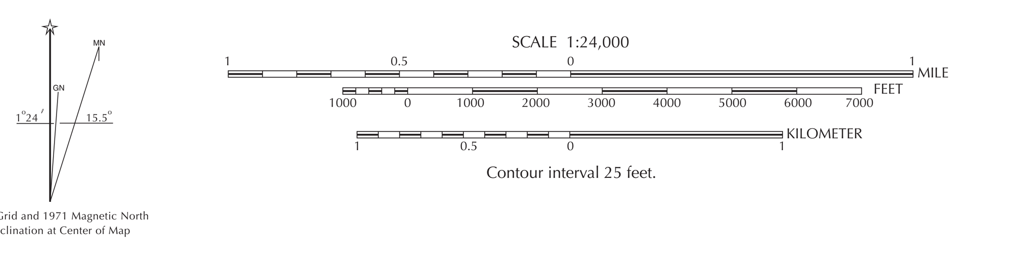
2005



Base map from USGS scan of film positive, 1992.
Topography by photogrammetric methods from aerial photographs taken 1969. Updated from aerial photographs taken 1987 and field checked. Map edited 1992. Conflicts may exist between some updated features and previously mapped contours.
Polyconic projection. 1927 North American Datum.
10,000-foot grid ticks based on Idaho coordinate system, central zone.
1000-meter Universal Transverse Mercator grid ticks, zone 11.

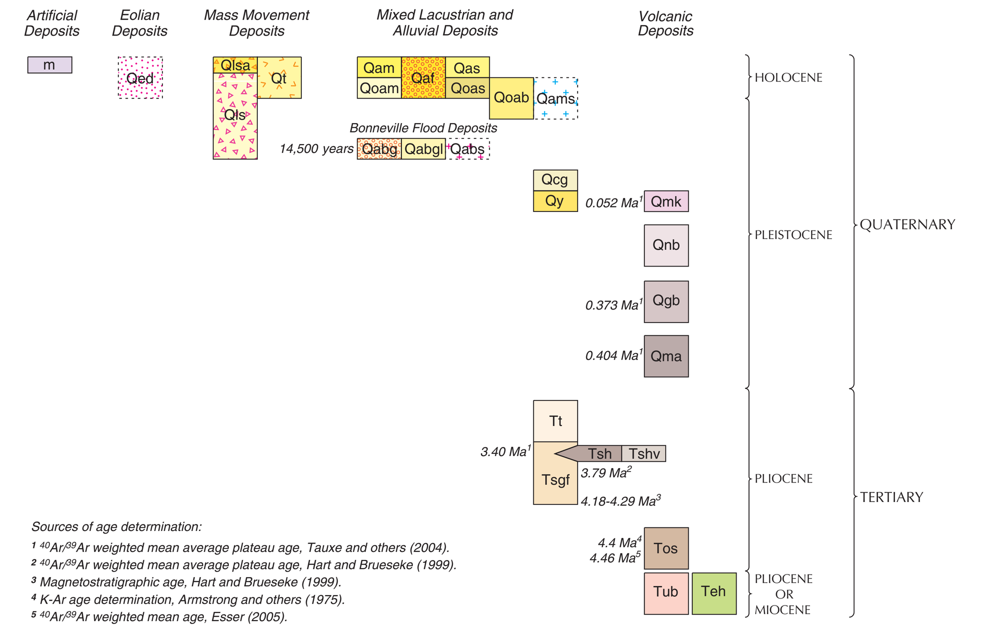


SCALE 1:24,000

Contour interval 25 feet.

Field work conducted 2003.
This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program.
Digital cartography by Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.
Map version 11-29-2005.
PDF map (Acrobat Reader) may be viewed online at www.idahogeology.org.

CORRELATION OF MAP UNITS



Sources of age determination:
1 $^{40}Ar/^{39}Ar$ weighted mean average plateau age, Tauxe and others (2004).
2 $^{40}Ar/^{39}Ar$ weighted mean average plateau age, Hart and Brueseke (1999).
3 Magnetostratigraphic age, Hart and Brueseke (1999).
4 K-Ar age determination, Armstrong and others (1975).
5 $^{40}Ar/^{39}Ar$ weighted mean age, Esser (2005).

INTRODUCTION

The geologic map of the Hagerman 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. The geologic units in the area control soil development, 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. Part of the Snake River Plain aquifer discharges as springs that supply Billingsley Creek and the water in the Hagerman Wildlife Management Area. Recent conflicts over water rights, water quantity and the conjunctive use of groundwater and the surface spring discharges have and will continue to affect economic development in the region.

Earlier geologic mapping by Malde and others (1963), Malde and Powers (1972), and Covington and Weaver (1990) was reviewed. Field checking of their maps was combined with new field investigations in 2003-2004 of both bedrock and surficial geology. Exposures of the geologic units were examined and selectively sampled. Aerial photographs were studied to aid in identifying boundaries between map units through photogeologic mapping of landforms. 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 Hagerman quadrangle lies near the center of the Snake River Plain, a large arcuate, lava-filled depression crossing southern Idaho. Pleistocene basalt flows from shield volcanoes to the north and east form the upland surface east of the Hagerman Valley. One of the Pleistocene basalts cascaded over the east rim of the Hagerman Valley and spread out across the floor of the valley mantling older basalt flows. Pliocene sediments form the upland surface and slopes west of the valley. Pleistocene lake clay was deposited in the valley when basalt flows from McKinney Butte dammed the Snake River 9 miles northwest of Hagerman. Approximately 14,500 years ago the Bonneville Flood filled the Hagerman Valley (O'Connor, 1993) and eroded channels in the lake clay, scoured basalt surfaces, and deposited gravel in giant expansion bars. Sometime after the Bonneville Flood, at least four Malad-River floods from the Big Wood River scoured basalt surfaces, deepened and extended Malad Gorge, and deposited boulder gravel.

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 AND LACUSTRINE DEPOSITS

Qam **Alluvium of mainstreams (Holocene)**—Channel and flood-plain deposits of the Snake and Malad rivers. Stratified silt, sand, and gravel of channel bars, islands, and shorelines. Typically 1-10 feet thick.

Qoam **Older alluvium of mainstreams (Holocene)**—Channel and flood-plain deposits of the Snake River that form fill terraces 10-50 feet above reservoir level. Primarily beds of sand and pebble gravel overlain by bedded to massive silt and sand. Grades and interfingers laterally into colluvium and alluvial-fan deposits along valley sides. The Buckeye Ranch terrace west of Hagerman is anomalously high at 2,850 feet elevation, about 50 feet above the reservoir. The aggradation may represent response to a higher base-level caused by landslides downstream.

Qaf **Alluvial-fan deposits (Holocene)**—Stratified silt, sand, and minor gravel that form alluvial fans at the base of steep canyon slopes. Fans modify landslide deposits in the Snake River canyon west of Hagerman. North of Lower Salmon Falls Dam alluvial-fan deposits merge and interstratify with older mainstream alluvium (*Qoam*). Thickness probably 5-30 feet.

Qas **Alluvium of side streams (Holocene)**—Channel and flood-plain deposits of Yahoo Creek, Billingsley Creek, and minor tributaries to the Snake River. Primarily stratified silt, sand, and minor gravel.

Qoas **Older alluvium of side streams (Holocene)**—Channel, flood-plain, and alluvial-fan deposits of ancestral Yahoo Creek and minor tributaries to the Snake River. Primarily stratified silt, sand, and minor pebble gravel. Gravel clast lithologies suggest reworking of eroded Tuana Gravel (*Tt*). Includes debris-flow deposits on steep, alluvial fan slopes west of the Snake River.

Qoab **Older alluvium of Big Wood River (Holocene or Pleistocene)**—Cobble and boulder gravel deposited by high-energy floods of the Big Wood River (Malad River). Gravel forms four terraces (*Qoab¹ - Qoab⁴*) that are 10 feet, 25 feet, 50 feet, and 100 feet, respectively, above the present river level.

Qams **Scoured flood pathways of side streams (Holocene or Pleistocene)**—Surface of basalt scoured by one or more Malad-River overland floods from the Big Wood River that augmented headward erosion of Malad Gorge. Common small scour marks on basalt surfaces are aligned with the direction of water flow. Surface is mantled with thin and discontinuous sand and gravel deposits.

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. Deposited during highest-energy, maximum stage of flood. 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 to sandy pebble-cobble gravel deposited in eddies, side-channel positions, and lower-energy, waning-stage flood channels.

Qabs **Scabland of flood pathways (Pleistocene)**—Flood-scoured surface with variable amounts of flood deposits. In the Hagerman Valley sedimentary cover has been stripped and basalt surfaces have been plucked, gouged, and smoothed. On sedimentary units such as Yahoo Clay, flood waters downcut, backcut, channeled, and streamlined the pre-flood surface. Includes minor deposits of coarse sand that are not mapped at this scale.

Qcg **Crowsnest Gravel (Pleistocene)**—Stratified sand and pebble gravel that overlies Yahoo Clay (*Qy*). At location along Crowsnest Road overlies well-bedded clay, silt, and rippled sand. Gravel clasts composed of felsic volcanic rocks, quartzite, and chert. Map location suggests unit is channel deposits of ancestral Yahoo Creek that prograded across Yahoo Clay as McKinney Lake regressed. Thickness about 6 feet. Original thickness and extent unknown owing to erosion by Bonneville Flood.

Qy **Yahoo Clay (Pleistocene)**—Laminated to thin-bedded clay and silty clay. Pinkish white to light yellowish brown and conchoidal fracture when dry. Common partings along bedding and vertical jointing produce small blocks when exposed. Malde (1982) described the type locality near the mouth of Yahoo Creek, the lava-dam origin, and the distribution of the clay in the Snake River canyon from near Bliss to the Melon Valley. Stratigraphic evidence demonstrates the Yahoo Clay is younger than the basalt of Notch Butte (*Qnb*), but older than the Bonneville Flood. Malde (1982) attributes the clay to McKinney Lake, a temporary lake formed by damming of the Snake River by basalt of McKinney Butte (*Qmk*). Malde's interpretation of the lake is compelling and his stratigraphic evidence was confirmed by our field mapping. East and south of Hagerman, Malde and Powers (1972) and Covington and Weaver (1990) show the Yahoo Clay buried by Crowsnest Gravel except where dissected. However, our field mapping and the soil survey by Johnson (2002) suggest the Yahoo Clay is the significant mappable unit at the land surface. Yahoo Clay was scoured by the maximum stage of the Bonneville Flood. Flood features include streamlined topography and a relict cataract and plunge pool one-half mile east of Hagerman.

Tt **Tuana Gravel (Pliocene)**—Well-bedded and sorted pebble and cobble gravel interbedded with layers of sand, silt, and clay. Gravel clasts are well rounded and commonly disc-shaped. Imbrication of clasts is common. Gravel-clast lithologies and imbrication directions suggest the gravel was deposited by an ancestral Salmon Falls Creek that prograded braided-stream deposits across a high, nearly flat plain formed on the Glenns Ferry Formation. Original extent unknown owing to erosion. Highest erosion remnants are mantled by 10-25 feet of loess with several buried soils. A thick duripan just above the gravel often forms an erosion-resistant cap "rock". It is locally so well cemented that it may rank as a calcrete. Late Pleistocene loess with a weakly developed soil commonly mantles gently sloping surfaces of irrigated farmland. Named by Malde and Powers (1962). Sadler and Link (1996) describe lithofacies and interpret provenance, paleocurrents, and age of the Tuana Gravel, which largely corroborate the descriptions of Malde and Powers (1962). The Tuana Gravel overlies Glenns Ferry Formation at the Hagerman Fossil Beds National Monument where the upper Glenns Ferry Formation records the base of the Kaena reverse polarity subchron with an estimated age of 3.11 Ma (Neville and others, 1979; Hart and Brueseke, 1999). The age of Tuana Gravel remains poorly constrained, but Malde (1991) and Othberg (1994) suggest the Tuana Gravel and the Tenmile Gravel near Boise, apparently graded to the same base level, are correlative. A minimum age for Tuana Gravel mapped to the northwest is 1.92 ± 0.16 Ma (Malde, 1991). A minimum age for the Tenmile Gravel is 1.58 ± 0.085 (Othberg, 1994). These gravels represent fluvial and glacial regimes driven by cooler climate in late Pliocene but before Pleistocene incision of the western Snake River Plain (Othberg, 1994).

Tsgf **Glenns Ferry Formation (Pliocene)**—Poorly consolidated, bedded lake and stream deposits. In Hagerman Valley primarily flood plain lithofacies that include calcareous olive silt, dark clay, sand locally cemented, and fine-pebble gravel (Malde and Powers, 1962; Malde and Powers, 1972; Malde, 1972; McDonald and others, 1996). The formation includes intercalated but laterally impersistent beds of tephra and basalt flows (*Tub*, for example). Repenning and others (1995) interpret the ages of various localities included in the Glenns Ferry Formation, and present a paleogeographic history of Pliocene to early Pleistocene lake and stream deposits in the western Snake River Plain. The basin-filling contribution of the Glenns Ferry Formation to the western Snake River Plain's tectonic subsidence is described by Wood and Clemens (2002). Mammalian fossils in deposits at the Hagerman Fossil Beds National Monument are Blancan (Pliocene) in age (Repenning and others, 1995). Hart and Brueseke (1999) corroborate the Pliocene age with Ar-Ar dates on intercalated basalt flows and ash beds ranging from 3.4 to 3.8 Ma.

EOLIAN DEPOSITS

Qed **Dune sand (Holocene)**—Stratified fine sand of stabilized wind dunes. Fills swales between basalt pressure ridges but sand is generally less than 4 feet thick. Agricultural modifications to the land have tended to smooth dune morphology.

MASS MOVEMENT DEPOSITS

Qt **Talus of Snake River Canyon walls (Holocene)**—Angular pebble-, cobble-, and boulder-size 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. Not mapped where thin talus partially covers older units.

Qlsa **Deposits of active landslides (Holocene)**—Primarily unsorted and unstratified silt and clay in slumps, slides, and debris flows that originate in Glenns Ferry Formation, Yahoo Clay, or in older landslide deposits. On west side of Snake River new landslides have activated since 1979. The recent activity correlates with irrigated farming on the upland west of bluffs of the Snake River valley (Hagerman Fossil Beds National Monument, 2004). Aerial photographs flown in 1998 and 2004 were used to identify and map active landslides.

Qls **Landslide deposits (Holocene and Pleistocene)**—Unsorted and unstratified deposits comprised of fragments of sediments to broken clasts of basalt depending on location. The walls of Malad Gorge are formed of a complex of slumps composed of large basalt blocks and jumbled, angular cobbles and pebbles of basalt. West of the Snake River, slumps, slides, and debris flows originating in the Glenns Ferry Formation are composed of unsorted and unstratified silt and clay. In the Snake River canyon north of Hagerman slumps and slides have displaced Yahoo Clay and basalt of McKinney Butte. The oldest landslides may have initiated during or just after the Bonneville Flood; others are probably Holocene. 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).

BASALT UNITS

In the northeast part of the quadrangle Pleistocene basalt flows form the capping units along the east bluff of the Snake River canyon. They also occur as intracanyon flows on the valley floor west and north of Hagerman. Isolated erosional remnants of these basalts occur west of the Snake River. These lava flows were extruded from several shield volcanoes to the east and north. Nearly all of the basalt is slightly to very vesicular and most of the units are diktytaxitic to some degree (i.e., containing voids with protruding crystals). Even units with a fine-grained groundmass commonly have a coarse, grainy texture. Older basalt flows are exposed at several locations along the Snake River and on the slopes west of the river intercalated with sediments of the Glenns Ferry Formation. These older units are generally grainy textured, less vesicular, and commonly altered. These characteristics cause the basalt to weather into fine granular detritus.

Qmk **Basalt of McKinney Butte (Pleistocene)**—Fine-grained basalt with very abundant plagioclase phenocrysts as crisscrossed interlocking crystals up to 1 cm in length, or as glomerocrysts commonly with olivine grains and clots. Voids are common among the interlocking crystals. The abundance of phenocrysts and the voids give the rock a coarse-textured appearance. Remanent magnetic polarity is normal (Malde, 1971). Source is McKinney Butte located 15 miles north of Hagerman. Named McKinney Basalt by Stearns and others (1938); name retained by Malde (1971), Malde and Powers (1972) and Covington and Weaver (1990). Tauxe and others (2004) report an $^{40}Ar/^{39}Ar$ weighted mean plateau age of 0.052 Ma (their sample sr16, McKinney Basalt). Forms a thin capping unit north of Malad Gorge. Eolian sand (*Qed*) partly buries and smooths the unit's surface in the Hagerman quadrangle, but the sand diminishes 3 miles to the north where the basalt's surface is characterized by youthful flow features such as lava channels, tubes, collapse pits, and pressure ridges. Surface drainage is undeveloped.

Qnb **Basalt of Notch Butte (Pleistocene)**—Fine-grained, dark gray to black basalt with common to abundant olivine phenocrysts and clots 0.5 to 1.5 mm in diameter. Locally contains a few small plagioclase phenocrysts up to about 1 mm in length, or scarce to rare glomerocrysts of plagioclase and olivine up to about 5 mm in length. Remanent magnetic polarity is normal, as determined in the field and through laboratory analysis. Source is Notch Butte located 25 miles east of Hagerman. Several fingers of lava cascaded into the ancestral Snake River valley. Bonneville-Flood scoured remnants of the basalt are found west of Hagerman and at Lower Salmon Falls dam north of Hagerman. These areas were mapped as Sand Springs Basalt by Stearns and others (1938), Malde and others (1963), Malde and Powers (1972), and Covington and Weaver (1990), who identified the source as a shield volcano northeast of Twin Falls. However, based on paleomagnetic directions and chemical analyses, this Hagerman-Valley basalt probably originated from Notch Butte.

Qgb **Basalt of Gooding Butte (Pleistocene)**—Fine-grained basalt with scattered to abundant plagioclase phenocrysts up to 1 cm in length, and plagioclase-olivine intergrowths up to 1 cm in diameter. Olivine is olive-greenish-brown and is mostly clustered. The basalt is diktytaxitic and vesicular, with vesicles ranging from small and spherical to large and irregular. Common carbonate filling and coating in voids. Remanent magnetic polarity is normal, as determined in the field and through laboratory analysis. Source is Gooding Butte located 10 miles northeast of Hagerman. Outcrops uncommon on upland surface but well exposed in Malad Gorge and on the east Snake River canyon wall north of Hagerman. Equivalent to Thousand Springs Basalt, Malad Member of Malde and others (1963). Almost no basalt pressure ridges rise above a nearly complete mantle of loess, except where scoured by Malad River floods. Surface drainage is moderately developed. Thickness of mantle ranges 3-25 feet; commonly 3-12 feet thick. Soil caliche (duripan) is typically well developed within the soil profile (Johnson, 2002) and at the soil-basalt contact, but the thickness of caliche is highly variable. Most of the land is cultivatable.

Qma **Basalt of Madson Spring (Pleistocene)**—Fine- to medium-grained, dark gray basalt with very abundant olivine grains and clots up to 4 mm in diameter. Exposed at one location west of the Snake River near the north edge of the quadrangle where it occurs as an erosional remnant resting on Glenns Ferry sediments. Equivalent to the Madson Basalt of Malde and Powers (1972). Remanent magnetic polarity is normal, as determined in the field and through laboratory analysis. Tauxe and others (2004) report an $^{40}Ar/^{39}Ar$ weighted mean plateau age of 0.404 Ma for this unit (their sample sr12, Madson Basalt). Source undetermined, but Malde (1971) suggests the source was likely to the east. It may represent early eruptions from Gooding Butte.

Tsh **Basalt of Shoestring Road (Pliocene)**—Basalt of Shoestring Road (Pliocene)—Medium-grained, gray to sooty brown basalt with common to abundant plagioclase laths as long as 1 cm and weathered olivine crystals. Remanent magnetic polarity is reverse, as determined in the field and as reported by Neville and others (1979). Forms a thin layer 30-50 feet thick within the Glenns Ferry sediments on the west side of the Snake River that extends northward from the Hagerman Horse Quarry (McDonald and others, 1996; Hart and Brueseke, 1999). Locally, the basalt flow thins, pinches out, or is replaced by layered volcaniclastic deposits. A thicker sequence of basalt is exposed in the northwest part of the quadrangle. Source may be vent of Tshv unit, or may be from an unidentified source to the north. Equivalent to the Shoestring Basalt of Malde and Powers (1972). May include the Deer Gulch basalt of Hart and Brueseke (1999) who dated the Shoestring basalt at 3.68 Ma and the Deer Gulch basalt at 3.40 Ma, although they report that both units occupy the same stratigraphic horizon in the Glenns Ferry Formation, and chemical compositions of the two units are very similar (Hart and Brueseke, 1999).

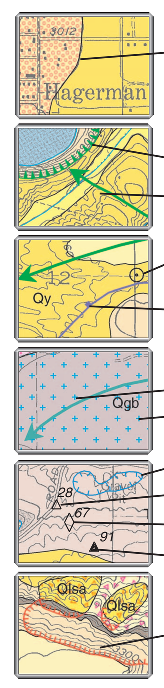
Tshv **Basalt and vent material, basalt of Shoestring Road? (Pliocene)**—Basalt and vent-derived scoriaceous and ropy rubble, spatter, and basalt fragments. Basalt is fine grained and glassy in places with abundant plagioclase laths and glomerocrysts up to 1 cm long, and common to abundant olivine grains and clots 0.5-3 mm in diameter. Some olivine and plagioclase intergrowths. Invasive into Glenns Ferry Formation sediments, which are baked for several inches at the basalt-sediment contact. Malde and Powers (1972) considered this a vent for the Shoestring Basalt, but we did not confirm that correlation in the field and therefore have mapped it as a separate unit. Its position within the Glenns Ferry sediments, however, gives credence to their interpretation.

Tos **Basalt of Oster Lakes (early Pliocene)**—Grainy, fine- to medium-grained but coarse-textured vesicular basalt. Dark gray to brownish gray or brick colored with a light purplish hue in places. Abundant plagioclase phenocrysts as much as 5 mm in length; groundmass is glassy in places. Unit is subaerial and quite fresh where exposed near the fish hatcheries at Oster Lakes. Remanent magnetic polarity is normal, as determined in the field and through laboratory analysis. Field relations suggest it stratigraphically and probably unconformably overlies the Tvd vent tephras and the altered basalt flows (*Tub*), which have reverse polarity where analyzed. Source or sources undetermined, but may be to the west or southwest. Previously mapped as "Banbury Basalt, basalt of upper part" by Malde and Powers (1972) and Covington and Weaver (1990). A K-Ar age determination by Armstrong and others (1975) on this unit is 4.4±0.6 Ma. An $^{40}Ar/^{39}Ar$ weighted mean age of 4.46±0.39 Ma was obtained on our sample 03VG039 (Esser, 2005).

Teh **Basalt of Elmas Hill(Pliocene to late Miocene)**—Medium-grained abundantly plagioclase-phyric to dense, fine-grained aphyric basalt. Plagioclase-phyric basalt is very vesicular with a significant amount of caliche coating or filling in the vesicles. Some outcrops appear fresh while others are altered or degraded. Remanent magnetic polarity is reverse as determined in the field and from laboratory analysis. Named for butte just southwest of the map area with a survey point "Elmas" noted on the Crows Nest NE 7.5' topographic map. In the lower part of Yahoo Creek, Teh forms a gentle dip slope to about Crows Nest Road, where the unit steepens to about 15 degrees and dips beneath Glenns Ferry Formation sediments (*Tsgf*). Two flows are present in the gully where the dip steepens. The upper flow is dense, fine-grained and aphyric, but the older flow is degraded with sooty weathering and a more grainy texture. The chemical compositions of the two flows are dissimilar, indicating either chemical changes in the erupting magma or possibly different sources. Textural differences between plagioclase-phyric and aphyric exposures may be due to distance from the source or to separate eruptive events from one or more sources.

Tub **Older basalt flows, undivided (early Pliocene to late Miocene)**—Medium- to coarse-grained, gray to sooty brown, dense to altered or weathered basalt flows exposed in the vicinity of Dolman Rapids and Dolman Island south of Hagerman, and at several locations along the Snake River north of Hagerman. Includes fine-grained sediments either intercalated with or underlying the basalt near the mouth of Malad River. Source(s) unknown but may be from the south and southwest. Age is poorly constrained, but underlies sediment of the Glenns Ferry Formation (*Tsgf*). All flows 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. Malde and Powers (1972) included most of these flows in their "Banbury Basalt, basalt of upper part". Stearns and others (1938) included them in the Banbury volcanics.

MAP SYMBOLS



Contact: Line showing the approximate boundary between one map unit and another. The location accuracy of an approximate contact is more than 80 feet on the ground.

Relict cataracts of Bonneville Flood.

Flow direction of Bonneville Flood.

Location of evidence for maximum stage of Bonneville Flood. Numbered location reported by O'Connor (1993).

Approximate extent of Bonneville Flood at maximum stage.

Flow direction of Big Wood River flood.

Flood scoured basalt surface (see Qabs and Qams).

Gravel pit that exposes a map unit

Sample site for chemical analysis.*

Sample site for paleomagnetic analysis.*

Sample site for chemical and paleomagnetic analyses.*

Landslide scarp and headwall: ticks show top of scarp.

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

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