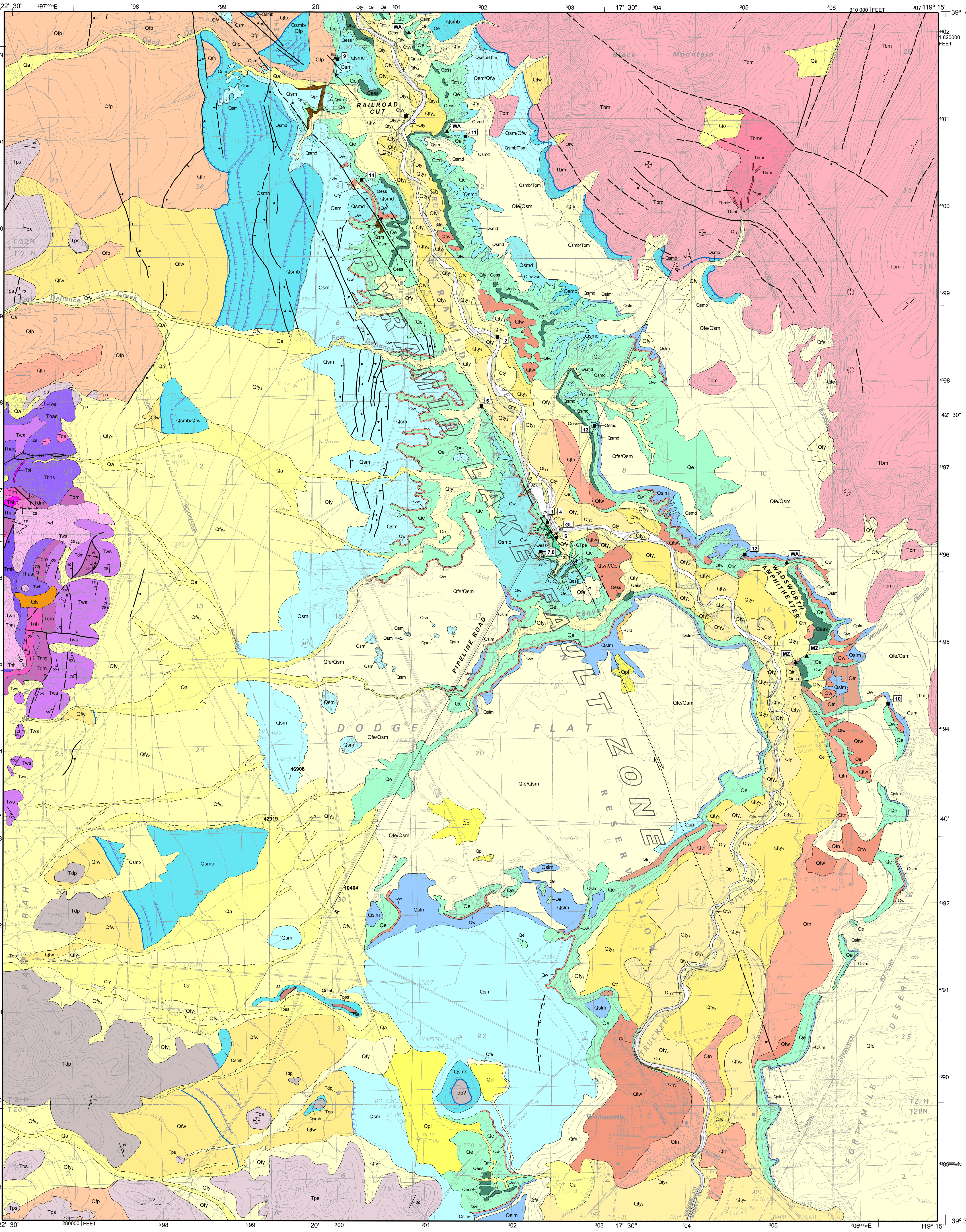
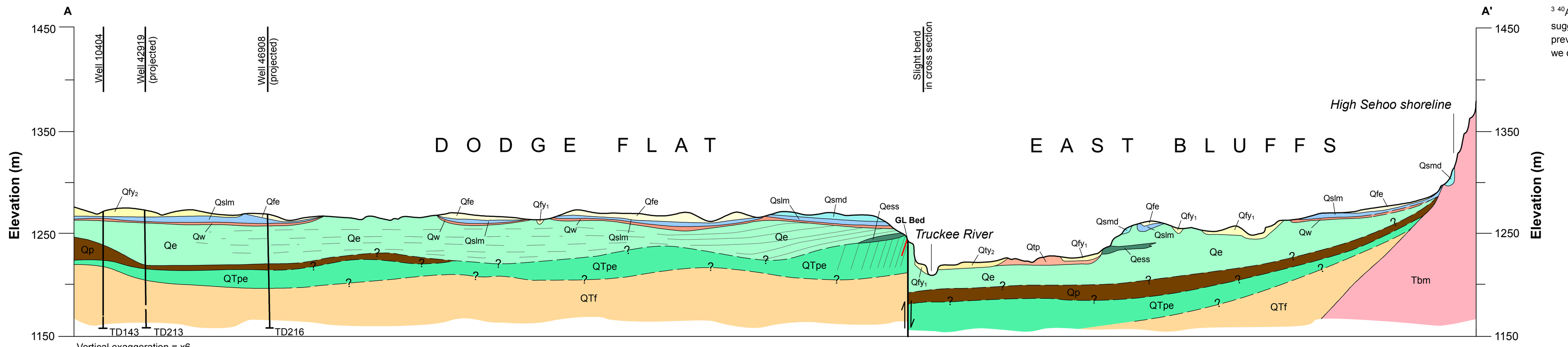


GEOLOGIC MAP OF THE WADSWORTH QUADRANGLE, WASHOE COUNTY, NEVADA

John W. Bell, Larry J. Garside, and P. Kyle House
2005



Vertical exaggeration = x6
Some units vertically exaggerated to show stratigraphic relations not visible on map.

DEPOSITS OF THE TRUCKEE RIVER

The course of the Truckee River as shown on the map (uncolored) is based on digital orthophotoquad (DOQ) imagery taken in 1994; the topographic base map shows the course of the river in 1985. Changes in the course of the river due to the 1997 flood are not reflected in the mapping.

Young terrace deposits of the Truckee River Late Holocene constructional and strath deposits; dominantly floodplain deposits: brown to gray mud, muddy sand, and silt containing organic-rich horizons (black mats), molluscs, gastropods, and vertebrate bones; intercalated layers of axial stream deposits: well-rounded, well-sorted, gray sandy, pebble to cobble gravel. From youngest to oldest in ascending order above the modern river:

Qty_1 Historically active channel and floodplain deposits now standing up to 2 m above modern river level; contains meander scrolls and bar deposits related to modern river level prior to 1906, after which time the elevation of Pyramid Lake declined and the river incised. Locally inundated by the 1997 flood and likely by similar floods in 1986 and 1963.

Qty_2 Recently abandoned channels and floodplain deposits standing up to 3 m above modern river level; fresh, remnant channel meander-scroll morphology visible on the terrace surface, often enhanced by riparian vegetation patterns. Radiocarbon dated at 340–410 yr BP[1] (table 1; samples 1, 2) and 880 yr BP (Briggs and Wesnousky, 2004).

Qty_3 Abandoned channel and floodplain deposits standing up to 5 m above modern river level; subdued, remnant channel meander scroll morphology. Radiocarbon dated at 1300–2120 yr BP (samples 3, 4) and 1790–2230 yr BP (Briggs and Wesnousky, 2004).

Qtn **Deposits of the Nixon terrace** Early to mid-Holocene constructional and strath deposits standing ~10 m above modern river level. Dominantly gray silty, sandy, small pebble to cobble, well-rounded gravel erosionally inset into Pleistocene lacustrine deposits. Forms prominent surface east of the river at Wadsworth and is the principal source of quarry material for Paiute Aggregates, Inc.; gravel pits expose 5–10 m of terrace sand and gravel unconformably overlying lacustrine silt and clay deposits of the Eetza Fm (Qe). Contains the 6.85 ka Mazama ash (Tsoyawata bed; Davis, 1978) at the southern edge of the Wadsworth Amphitheater. Soil: 8- to 10-cm-thick Av, 15–30-cm-thick, platy Bw, and 50-cm-thick stage I Bk horizon. Unit underlies the town of Nixon on the quadrangle to the north.

Qtw **Deposits of the Wadsworth terrace** Early Holocene constructional and strath deposits standing ~15–20 m above modern river level. Dominantly brown to gray sandy, small pebble to cobble, well-rounded gravel unconformably overlying lacustrine deposits. Forms the first areally extensive terrace sequence of post-Lake Lahontan age along the lower Truckee River canyon; it underlies the town of Wadsworth. Inset below and younger than colluvial slope deposits in the Truckee River canyon radiocarbon dated at 9,620 yr BP (sample 6). Soil contains 50-cm-thick Bw horizon.

Qtr **Early terrace deposits of the Truckee River** Late Pleistocene to Holocene strath deposits related to initial development of the present-day lower Truckee River canyon following recession of the middle Sehoo lake. Highest terrace remnants occur at the elevation of the 11–12 ka Qsm deposits of Dodge Flat (~1260 m); south of the Wadsworth Amphitheater, multiple strath terraces are present cutting across Sehoo Fm and older deposits. Terraces are older than colluvial slope deposits within the Truckee Canyon radiocarbon dated at 9,620 yr BP (sample 6), indicating that most of the present-day canyon at Wadsworth was cut between ~9.6 and 12 ka.

ALLUVIAL-FAN, EOLIAN, PLAYA, AND LANDSLIDE DEPOSITS

Qa Recent alluvial deposits in intermittent washes and ephemeral stream channels; variable sedimentology depending on provenance: silty, sandy, subangular to rounded pebble-cobble gravel where originating from alluvial fan sources; dominantly silt, sand to mud, and rounded beach gravel where originating from lake sediment sources.

Qpl Ephemeral playa deposits; silt and mud in small closed depressions on Dodge Flat.

Young alluvial-fan deposits of the Truckee River canyon

Qfy Young alluvial-fan deposits of post-Sehoo (mid- to late-Holocene) age (undifferentiated). Locally subdivided into:

Qfy_1 Young alluvial-fan deposits originating predominantly within the drainages eroded into the margins of the Truckee River canyon; silt and sand with local gravel derived primarily from reworking of lacustrine deposits. Similar in age to Qty_2 and Qty_3 deposits; locally slightly older. Radiocarbon dated at 2800 yr BP (sample 5).

Qfy_2 Young alluvial-fan deposits originating in the upper drainages of the post-Sehoo alluvial piedmont of the Pah Rah Range; silty to sandy, subangular pebble to cobble gravel inset into older pre-Sehoo age alluvial fans and deposited as an alluvial veneer on middle Sehoo lacustrine deposits following recession of the lake. Contains the 6.85-ka Mazama ash in deposits at the mouth of Windmill Canyon as well as immediately west of the quadrangle (Briggs and Wesnousky, 2005).

Qfe **Fallon and Turupah Alloformations, undifferentiated** (Morrison, 1964; Morrison and others, 1965). Brown, medium, well-sorted eolian sand derived from underlying lake sand; sand sheets and dunes ranging in thickness from a thin (<1 m) veneer to >10 m; typically occurs as northeast-trending linear dunes capping the middle Sehoo-age lake deposits, best developed in the Fortymile Desert area east of Wadsworth; prominent linear dunes occur along and parallel to the eastern canyon rim.

Qls **Landslide deposits** Unsorted chaotic mixture of blocks and finer material of Twh, resulting from a landslide on the east flank of White Hill, just west of the quadrangle.

Wyemaha Alloformation (Morrison, 1964; Morrison and others, 1965; Morrison and Frye, 1965; and Morrison, 1991).

Qw Interlacustral, subaerial deposits separating the Eetza and Sehoo Alloformations in buried stratigraphic section; termed the medial gravel by Russell (1885). Middle to late Pleistocene; ranges in age from <155-200,000 yr (based on the age of Wadsworth tephra bed in the upper Eetza Alloformation) to ~40,000 yr BP (based on radiocarbon dates on snails from Wyemaha sand deposits exposed in the canyon just north of the quadrangle boundary). Brown, reddish-brown and gray alluvial silty coarse pebble sand, eolian sand, and muddy to sandy, cobble to boulder fan gravel. Stratigraphically defined in this quadrangle by Morrison and others (1965) based on sedimentary sections exposed in the Wadsworth Amphitheater and the Railroad Cut; ranges in thickness from 1–10 m; crops out discontinuously in the bluffs and tributary drainages flanking both sides of the Truckee River canyon; locally missing where eroded prior to deposition of the Sehoo Alloformation. Contains the Churchill Geosol (Morrison, 1991), which ranges in morphology from multiple, compound stacks of reddened, oxidized cambic B horizons to single, 30–50-cm-thick, red-brown (7.5 YR), prismatic argillic B horizons and stage II Bk horizons. Where the Wyemaha Alloformation is <3 m thick, the deposit is typically oxidized and reddened throughout owing to the presence of cumulic weathering profiles. Cobble to boulder alluvial fan gravels are common along the eastern river bluffs in the Wadsworth Amphitheater and Windmill Canyon area where the deposits are predominantly composed of locally derived volcanic clasts. The relatively high topographic position of the Wyemaha Alloformation in the bluffs on both sides of the present Truckee River canyon (lowest elevation ~1240 m) indicates that no comparably deep canyon was present during Wyemaha time.

Qfw Alluvial-fan deposits of the Wyemaha interlacustral interval; surface equivalent of the Wyemaha Alloformation found elsewhere in buried stratigraphic context. Relict and buried relations are best exposed in the area of Defiance Creek. Soil developed on alluvial fan surfaces typically contain 30- to 40-cm-thick, well-developed argillic (Bt) horizons. Relict soil on a Qfw alluvial fan just above the high Sehoo shoreline 3 km west of Dodge Flat contain 60-cm Bt and 10-cm Bqkm (duripan) horizons (Hawley, 1969).

Paiute Alloformation (Morrison, 1964; Morrison and others, 1965; Morrison and Frye, 1965; and Morrison, 1991).

Qp Interlacustral subaerial deposits separating the Eetza Alloformation from earlier lacustrine sediments in buried stratigraphic section. Dominantly dark-brown to red-brown, sandy to clayey, cobble to boulder volcaniclastic gravel; 3–10 m thick in exposed sections. Middle Pleistocene in age, based on correlation to similar deposits along the Humboldt River Valley which contain the 400-ka Rockland and the ~610-ka Dibekulewe tephra beds (Morrison, 1991). Best exposed in sections near the mouth of Dead Ox Wash, e.g., the Railroad Cut. May contain multiple buried paleosols.

Qfp Alluvial-fan deposits of the Paiute interlacustral interval; surface equivalent of the Paiute Alloformation found elsewhere in buried stratigraphic context; represents major period of subaerial fan building between lake cycles. Principal fan remnants occur along Dead Ox Wash where they are preserved as high, moderately dissected surfaces containing a thick (1–2 m), strongly developed argillic soil with a duripan, the Cocoon Geosol (Morrison, 1991)

QTf **Pleistocene and Pliocene alluvial fan-deposits** Dark-brown to red-brown clayey volcaniclastic gravel; similar to Qfp but occurs topographically higher and is more deeply dissected. May contain multiple paleosols; surface underlain by a strongly developed argillic soil 2 m or more in thickness with a duripan. Age uncertain, but unit is oldest alluvium overlying the Miocene volcanic rocks. May be in part correlative with the 635 to >775 ka Lovelock Alloformation in the Humboldt River Valley (Morrison, 1991).

DEPOSITS OF LAKE LAHONTAN

Sehoo Alloformation (Morrison, 1964; Morrison and others, 1965; Morrison and Frye, 1965; and Morrison, 1991)[2]. Deposits associated with last major lacustral cycle of Lake Lahontan during late Wisconsinan time; called the upper lacustral clays by Russell (1885). Divided into lower, middle, and upper members; only the lower and middle members found in this quadrangle. Numerous radiocarbon ages from throughout the Lake Lahontan basin in western Nevada are between 11 and 35 ka (Broecker and Orr, 1958; Broecker and Kaufman, 1965; Benson and Thompson, 1987; Benson and others, 1991); as much as 39.9 ka based on radiocarbon ages in the Truckee River canyon just north of the quadrangle.

Qsm Middle member of the Sehoo Alloformation; called the dendritic allomember by Morrison (1964; 1991). Offshore deposits of brown to gray silt, sand, mud, and local clay are associated with the maximum lake levels of the Sehoo lacustral period. Lake levels rose to the elevation of Dodge Flat (~1260 m) at 14.7–14.9 ka (samples 11, 12, 13), reached a maximum height of 1332–1337 m in this area at ~13 ka (Morrison, 1991; Adams and others, 1999) and receded to the Dodge Flat elevation at 11.1–12.5 ka (samples 7, 8, 9). Based on the radiocarbon age on post-Sehoo colluvium in the canyon (sample 6), the mid-Sehoo lake receded below an elevation of 1230 m by 9.6 ka. Locally subdivided into:

Qsmb Near- and onshore gravelly beach deposits of the middle member of the Sehoo Alloformation. Gray sandy, pebble to cobble gravel and coarse sand typically 1–3 m thick; generally well-sorted; subangular to well-rounded clasts reworked from underlying bedrock and alluvial fan deposits; occurs as linear shoreline berms and sheets; locally well-developed desert pavement and rock varnish.

Qsmd Tufa-bearing deposits of the middle member of the Sehoo Alloformation. Dendritic, lithoid, and thinolitic tufa in dense colonies, typically forming erosionally resistant layers. Dendritic variety is most common, with tufa heads in this area as large as 1 m in diameter. Believed to form in carbonate-rich water as lake levels remained stable. In this quadrangle the tufa-bearing member is primarily associated with the Dodge Flat lake stand (dendritic terrace) at 1250–1260 m elevation, controlled by the 1265 m Darwin Pass sill at Fernley, and forming a prominent platform on both sides of the Truckee River canyon.

Qslm Lower and middle member of the Sehoo Alloformation, undifferentiated; offshore deposits of brown to gray silt, sand, and mud; not differentiated in this quadrangle because of lack of distinguishable boundaries. Radiocarbon dated at between 26.5 and 39.9-ka, and in the canyon to the north contains the 23-ka Trego Hot Springs tephra, the 27-ka Wono tephra (Benson and others, 1997), the 33.6-ka Marble Bluff tephra (Davis, 1978), and the 46-ka Mt Saint Helens Cy tephra (Berger and Busacca, 1995) in canyon exposures north of this quadrangle. Locally capped by 30–40 cm Bw soil horizon formed during a post-early Sehoo lake recession.

Eetza Alloformation (Morrison, 1964; Morrison and others, 1965; Morrison and Frye, 1965; and Morrison, 1991) Deposits associated with one or more penultimate lacustral cycles of Lake Lahontan during pre-Wisconsinan time (oxygen isotope stages 6, 8, and 10); called the lower lacustral clays by Russell (1885). Unit is composed of beds from multiple lake cycles with interfingering subaerial and deltaic deposits; it is the thickest exposed section of Lake Lahontan deposits in the quadrangle, comprising the major part of Truckee River canyon exposures. Middle Pleistocene; ranges in age from ~130 to 350 ka (Morrison, 1991). Upper part of the formation contains the Wadsworth tephra bed dated at 155–200 ka (Berger, 1991; Sarna-Wojcicki and others, 1991). Uranium-series ages from elsewhere in the Lake Lahontan basin range between 110 and 288 ka (Morrison, 1991).

Qe Offshore, light- to dark-brown, red-brown, light- to medium-gray silt, light-gray to greenish-gray clay, and light-brown silty sand; generally well-stratified, ranging from thin (1–2 cm) to thick (1–3 m) bedded; clay beds exhibit flat, deep-water laminations; exposed sections are more than 50 m thick in this quadrangle. Unit contains interbeds of Gilbert-type deltaic deposits formed as the ancestral Truckee River flowed into shallow, fluctuating lake levels; extensively exposed in and to the north of the Wadsworth Amphitheater (Smoot, 1993). Deltaic facies include tabular, inclined foreset beds of silt and fine sand; and flat bottomset and topset beds of laminated silt and fine sand exhibiting sedimentologic morphologies related to interaction of fluvial deposition and shallow water: tabular and trough fluvial cross-bedding, oscillatory and climbing wave ripples, and interbeds of fluvial sand and gravel.

Qess Fluvial and subaerial deposits of the intralacustral S-Bar-S Allomember (Morrison and Frye, 1965). Prominent layers of gray, coarse fluvial sand and rounded pebble to cobble gravel grading into and interbedded with brown to red-brown alluvial fan deposits; ranges in thickness from 1 to 3 m and forms a resistant, darkly varnished terrace-like platform at an elevation of ~1230 m along the canyon bluffs. Presence of well-rounded granodiorite clasts derived from the Sierra Nevada indicate that these are Truckee River gravels. Alluvial fan facies consist of muddy cobble to boulder gravel composed of locally derived volcanic lithologies. In the Wadsworth Amphitheater, subaerial deposits containing a well-developed red-brown argillic soil separate lacustrine deposits of Eetza age indicating a long intralacustral period.

QTpe **Lacustrine deposits of pre-Eetza age, undifferentiated** May be in part correlative with the Rye Patch Alloformation (Morrison and Frye, 1965; Morrison, 1991) which contains the 640 ka Lava Creek B tephra bed. Tilted beds of offshore gray, red-brown to bluish-brown silt and clay; best exposed in the western river bluff and tributary drainages at and south of the pipeline road where they are overlain with an angular unconformity by Qe and Qess deposits. At the pipeline road, the clay beds contain a 0.5- to 1-cm-thick Glass Mountain tephra bed estimated to be between 0.79 and 1.95 Ma (Andrei Sarna-Wojcicki, written commun., 2003).

BEDROCK UNITS

Tdp **Dacite of Pond Peak** Predominantly dark-reddish-brown-weathering, light-gray and pinkish-gray flows, domes, and lahars of dacite; locally lithophysal. The unit, which crops out near the southwest edge of the quadrangle, is named for an extensive area of outcrop on Pond Peak 8 km to the west in the Olinghouse Quadrangle. Based on thin sections from the adjacent Olinghouse Quadrangle, the unit contains phenocrysts (10–15%) of clear to spongy plagioclase (10–12%, typically ≤1 mm, rarely to 2.5 mm), black, elongate hornblende (~1%, ~1 mm diameter; rarely thinly rimmed by fine pyroxene and Fe-Ti oxides), green orthopyroxene (0–1%, ≤0.4 mm), and trace magnetite (≤0.2 mm) in a locally flow-banded, pilotaxitic to felted groundmass of plagioclase microphenocrysts and glass. Chemical analyses of samples from the Olinghouse Quadrangle indicate that the unit is mostly dacite according to the IUGS classification (Le Maitre, 1989); some samples are rhyolite. Dated by K-Ar methods at 8.3±0.6 Ma in the Olinghouse Quadrangle (Garside and Bonham, 2001; Garside and others, 2000, table 2 and Appendix 1).

Tbm Tbms Tbmi **Basalt of Black Mountain** Tbm, dark-gray, vesicular olivine basalt flows which are part of a probable shield volcano centered on Juniper Peak about 10 km north of the quadrangle. Tbmi, black-and reddish-gray-weathering, dark-gray, fine-grained, narrow dikes of olivine basalt which cut reddish and dark-gray bedded scoria (Tbms). A dike (Tbmi) was dated by K-Ar methods at 9.5±0.3 Ma (Garside and others, 2000, Table 2 and Appendix 1). Probably hundreds of meters thick.

Tbi **Intrusive basalt** A narrow dike (commonly 1–3 m) of basalt or basaltic andesite cuts Thas south of White Horse Canyon. Also, a plug cuts ash-flow tuffs nearby. Similar dikes cut flows of Tps in the Olinghouse Quadrangle to the west. Fine-grained, vesicular, dark-gray, sparsely porphyritic rock, with trachytic to felted texture. A sample from a canyon between Olinghouse Canyon and Green Hill (Olinghouse Quadrangle) contained phenocrysts (~3%) of elongate plagioclase (2–3%, 0.4 to 3 mm long) and minor pyroxene (<0.4 mm) in a groundmass of plagioclase laths (<0.2 mm long), fine pyroxene(?) and glass(?). Age equivalent to Tps or possibly somewhat younger.

Tps Tpss **Pyramid sequence Tps**, undivided basaltic flows, fewer poorly exposed basaltic pyroclastic rocks, and locally, thin, discontinuous epiclastic and silicic pyroclastic beds (where not mapped separately). Flows (~2–10 m) are vesicular, massive to locally brecciated, very dark gray basalt and basaltic andesite, consisting of sparse to common phenocrysts of plagioclase (<5–40%, 0.25–2 mm), olivine (1–3%; 0.4–3 mm, rarely 5 mm), and commonly sparse pyroxene (0–5%, 2 mm) in a trachytic to pilotaxitic (rarely intergranular to ophitic) groundmass of magnetite, plagioclase and pyroxene microphenocrysts, and sparse brown glass. Olivine is commonly partly to completely replaced by iddingsite, and rare, rounded quartz xenocrysts(?) (≤1 mm) and rectilinear clots of fine magnetite (possibly ghosts of basaltic hornblende) are observed locally. Basaltic pyroclastic rocks include bedded reddish-brown scoria (commonly with steep initial dips) and propylitized breccias which have rounded to angular light grayish-green scoraceous clasts (<1 to several centimeters) in a fine-grained, yellowish-gray tuffaceous(?) matrix. Thin (1–2 m), discontinuous, lacustrine, thinly laminated, dark shale (with leaf fossils and rare fish bones and scales) and volcaniclastic sandstone crop out locally, particularly in Pierson Canyon (Axelrod, 1995) of the Olinghouse Quadrangle to the west. The Pyramid sequence has been mapped as Chloropagus Formation in Pierson Canyon (Axelrod, 1995) and to the south of the quadrangle (Rose, 1969). The Pyramid sequence is apparently 11–13 Ma in the southern Pah Rah Range (see Garside and others, 2000; Stewart and others, 1994); however, elsewhere in the region it may be 13–15 Ma or even somewhat older (Henry and others, 2004). Thickness 1 km or more in the Olinghouse Quadrangle. Tpss, gray, steeply dipping, thinly laminated to nonlaminated tuffaceous siltstone and shale of uncertain affinity which crop out in two small areas just south of the road to Olinghouse about 1 km west of State Route 447.

Twh **Rhyolite of White Hill** Very light-gray and pinkish-gray rhyolite intrusive rock (76% SiO_2), locally flow banded and spherulitic. Probable flow dome; short flows are mapped in the adjacent Olinghouse Quadrangle. Consists of phenocrysts (10–20%) of rounded to equant and embayed to vermicular smoky quartz (5–10%, 1–2 mm), plagioclase (~4%, 1–4 mm long), alkali feldspar (~4%; 1–3 mm), and books of biotite (1%, 0.4–0.8 mm) in a fine-grained, originally devitrified groundmass of alkali feldspar and quartz. Biotite is chloritized and light-colored minerals are altered to sericite and calcite. Alkali feldspar is found mainly as skeletal remnants. Geologic relationships in the Olinghouse Quadrangle suggest an approximate age equivalence to the Pyramid sequence because rhyolite flows appear to interfinger with basalt flows.

Tmb **Megabreccia** Poorly exposed unit apparently consisting almost entirely of small to large (<1 cm to 5 m) angular to subrounded clasts of ash-flow tuffs (units Tdm, Tnh, Tcs, and the tuff of Painted Hills which lies above Tcs in the Olinghouse Quadrangle) as well as sparse clasts of amygdaloidal basalt and hornblende andesite. The unit overlies and cuts(?) across ash-flow tuff units of which it contains clasts. Matrix of megabreccia is apparently pyroclastic, containing phenocrysts similar to those of Twh (Geasan, 1980). The megabreccia appears to be overlain by some Tps flows and yet contains basalt clasts that are probably from Tps. It is thus considered equivalent in age to at least part of Tps. Spatially associated with, and intruded by, Twh; the megabreccia may be a vent breccia related to Twh volcanism. Thickness unknown.

Thas **Hornblende andesite of Stud Horse Canyon** Intrusive bodies of light-gray to medium-dark-gray andesite or dacite(?), consisting of phenocrysts (30%) of equant to elongate plagioclase (15–25%, 0.04–2.5 mm, rarely 2 x 5 mm), elongate hornblende (~8%, <0.5 x 2.4 mm), trace small (~0.2 mm) quartz, locally small biotite (trace to 2%), and orthopyroxene (<3%, ≤1.2 mm) in a fine-grained holocrystalline anhedral-granular or pilotaxitic groundmass of predominantly plagioclase and magnetite microphenocrysts. An age of 20.3±0.7 Ma (K-Ar on hornblende; Garside and others, 2000, table 2) may be slightly too young, as the unit is suspected to be related to 22.39 Ma rocks (dated by $^{40}Ar/^{39}Ar$ methods) in the adjacent Olinghouse Quadrangle, where the unit was named and dated (Garside and Bonham, 2003).

Tcs **Tuff of Chimney Spring** Moderate reddish-brown weathering, ledge-forming, slightly to moderately welded rhyolitic ash-flow tuff. Contains phenocrysts (~25%) of commonly smoky or reddish, corroded, embayed, and vermiculated quartz (<10%, 1–2 mm), equant, adularescent sanidine (~10%, 1–2 mm), a few percent plagioclase, rare altered biotite (<1%, ≤1 mm in diameter), and accessory Fe-Ti oxides. Contains sparse, indistinct pumice (most 3 x 12 mm, but locally in the Olinghouse Quadrangle to the west, up to 3 x 12 cm) and sparse lithic fragments of flow-banded rhyolite and intermediate volcanic rock (commonly ≤1 cm, but rarely ≤4 x 6 cm). Parts weather to rounded, reddish boulders of decomposition. A ~1 m plane-bedded tuff (ground surge?) is found locally at the base in the Olinghouse Quadrangle; it grades upward into basal, nonwelded Tcs. Thickness about 150 m in the adjacent Olinghouse Quadrangle; only small areas of exposure in the Wadsworth Quadrangle. Age, 25.06±0.07 Ma north of Reno (Garside and others, 2003).

Tnh Tnhg **Nine Hill Tuff Tnh,** Brownish-weathering, pinkish-gray or grayish, strongly welded rhyolite ash-flow tuff. Contains phenocrysts (~3–15%, ~1 mm) of mostly alkali feldspar (sanidine and anorthoclase), with considerably less plagioclase, trace small biotite, and accessory Fe-Ti oxides. Locally contains flow-banded(?) rhyolite lithic fragments (<1 cm to 10 x 15 cm) that are similar to Tnh. Commonly moderate to strong vapor-phase alteration, with formation of tridymite and alkali feldspar in cavities (former pumice sites); elsewhere devitrified. Distinctive compressed pumice (1:3 to 1:7 aspect ratio) from less than 1 mm x 5 mm to 5 x 25 cm. Thickness < 200 m; variable. Deposited on surface which had local topographic relief. Age 25.23±0.07 Ma (Garside and others, 2003). Tnhg, sandstone and conglomerate deposited in a probable paleovalley below Tnh at one locality near the west edge of the Quadrangle. The unit consists of 0–20 m of plane- and cross-bedded tuffaceous sandstone, epiclastic clast-supported conglomerate, and lithic-fragment-rich reworked(?) Tdm. Conglomerate clasts resemble the underlying Tdm, and sparse quartz grains are found in the sandstone.

Tdm **Tuff of Dogskin Mountain** Light- to dark-gray, slightly to moderately welded, dacite ash-flow tuff with a distinctive phenocryst assemblage (~15–20%) of elongate to equant plagioclase (15%, <2 mm) and biotite (~3%, 0.6–2 mm) in a shard-rich matrix. Biotite and elongate plagioclase are aligned parallel to compaction foliation. Contains a few percent moderately compressed pumice lapilli and commonly sparse pinkish-lithic fragments (1–2 cm, rarely 10 cm) of biotite-plagioclase volcanic rock. Locally very lithic rich, containing up to 25% rounded pale-purple rhyolitic lithic fragments (0.5–10 cm). Correlates with and replaces in stratigraphic usage the tuff of Coyote Spring (e.g., Garside and Nials, 1998). Thickness <150 m. Ages: 29.32±0.17 Ma (Garside and Nials, 1998) and 29.21±0.10 Ma (Garside and others, 2003) from the area north of Reno.

Tws **Tuffs of Whisky Spring** Sequence of several commonly moderately welded rhyolitic ash-flow tuffs. Usually light-brown- or pale-reddish-brown-weathering-, pale-orange to light-brown and light-pinkish-gray rocks containing phenocrysts of platy-fractured sanidine, plagioclase, biotite, and sparse to trace quartz. Moderately welded ash-flow tuffs commonly contain 1–2 mm phenocrysts (~10–15%) of sanidine (~0–10 %), plagioclase (5–15%), biotite (commonly <1%), and rarely, hornblende. A distinctive feature of the tuffs is the shard-rich nature of the matrix, visible in thin section and hand lens. Locally, a "nubbly" weathering surface is observed on rock outcrops; this probably represents closely spaced joints developed during hydration of originally glassy rock. Contains compressed pumice (commonly >5%, ≤1 to several centimeters in diameter) and common lithic fragments (0.5 to several centimeters) of siltstone, and silicic and intermediate volcanic rocks. Crops out as several ledges, which are probable cooling units; some of these are separated in a few places by 1–5 m of tuffaceous and volcaniclastic siltstone, sandstone, and pebbly sandstone (with poorly preserved fossil twigs(?) and leaves at one locality). Commonly contains variable amounts of hydrothermal alteration minerals (sericite, chlorite, epidote, and clays). Thickness 300+ m in the quadrangle. The unit was originally named for ash-flow tuffs exposed near Whisky Spring in the southern Pah Rah Range; these tuffs have been subdivided elsewhere into several significant ash-flow tuffs ranging in age from 29–31 Ma (e.g., Henry and others, 2004). Probably correlative with a much thicker and more complex group of ash-flow tuffs exposed in Secret and Jones Canyons of the adjacent Olinghouse Quadrangle.

PRINCIPAL QUATERNARY STRUCTURAL-STRATIGRAPHIC RELATIONS OF THE PYRAMID LAKE FAULT ZONE

The Pyramid Lake fault is part of the Walker Lane belt, a transcurrent right-lateral strike-slip system extending for more than 600 km across western Nevada (Stewart, 1988). In the Wadsworth Quadrangle, structural deformation associated with the Pyramid Lake fault occurs in Lake Lahontan and younger deposits along a N20–30ºW-striking series of faults lying along the west margin of the Truckee River canyon. The principal zone of faulting is marked by a singular trace that extends across the quadrangle from Dead Ox Wash on the north to Fortymile Desert on the south. The oldest structurally deformed sediments are found near the pipeline road in the western river bluff where 0.79–1.95-Ma Qpe deposits are tilted 35º to the west; in nearby tributary washes south of the road, Qe deposits are west-tilted and folded. About 300 m north of the pipeline road, units Qsmd and Qw are offset 10–16 m respectively by an east-dipping normal fault. This feature was interpreted as a slump block by Smoot (1993). The trace of this fault can be followed to the north near the Rail Cut where exposures show 40–50 m of normal displacement of Qw and Qe deposits.

To the west of this principal trace, faulting is characterized by graben and nested graben with 1–2 m scarps in Qsm parallel and subparallel to the main trace. To the south of Gardella Canyon, the fault is generally concealed beneath Dodge Flat and the floodplain, but trenching revealed 0.5–1 m offsets in Qsm and Qfy deposits (Briggs and Wesnousky, 2004).

Most slip indicators found along the main fault show that it is dominantly a normal, dip-slip structure. Vertical slickenlines are found at several fault exposures, and the tilted and folded Qe and Qpe sediments are suggestive of roll-over structure produced by large-scale normal faulting. The graben that cut Qsm deposits are further indicators of extension-dominated motion along this segment of the Pyramid Lake fault. Some geomorphic evidence, however, is suggestive of strike-slip motion; reversal of fault dip (scissoring) along the southeastern portion of the fault is commonly associated with strike-slip behavior. Briggs and Wesnousky (2004) described several tributary washes that are laterally offset 34–43 m, but this study could not confirm this amount of lateral offset. Based on our mapping, movement along the Pyramid Lake fault segment in the Wadsworth Quadrangle is believed to be dominated by extensional faulting with a minor component of right-lateral slip.

Contact Dashed where approximately located, queried where uncertain, short dashes for contacts within map units. Underlying units, where known, indicated by additional label, e.g. Qfe/Qsm.

Fault Showing dip, short arrow shows direction and plunge of lineation; dashed where approximately located, queried where uncertain, dotted where concealed.

Lineament

Quartz vein or ledge

Hydrothermal alteration along fault

Sehoo lake high shoreline

Recessional shoreline

River paleomeander trace

Strike and dip of beds
Inclined

Approximate strike and dip of beds or flows
Inclined — Horizontal

Strike and dip of compact foliation in ash-flow tuff
Inclined

Strike and dip of foliation in igneous rocks
Inclined — Vertical

Strike and dip of joints
Inclined

^{14}C sample location (Table 1)

Sample location for volcanic tephra

MZ - Mazama
WA - Wadsworth
GL - Glass Mountain

10404 Well Hole

Scale 1:24,000

0 — 0.5 — 1 kilometer

0 — 0.5 — 1 mile

0 1000 2000 3000 4000 5000 feet

CONTOUR INTERVAL 10 METERS

Base map:
U.S. Geological Survey Wadsworth 7.5' Quadrangle, 1985
Universal Transverse Mercator projection,
1927 North American Datum

[1] Ages reported for radiocarbon samples are in radiocarbon yr BP; corresponding calendar-corrected (calibrated) ages for each sample are listed in table 1.

[2] A note regarding stratigraphic nomenclature: Lake Lahontan and related subaerial deposits were considered lithostratigraphic units in the early studies of Morrison and were designated as formations. With the revision of the North American Stratigraphic Code in 1983, new allostratigraphic and pedostratigraphic unit definitions were added which allowed the definition of time-transgressive, lithology-independent rock units and soils. Morrison (1991) redefined the Lake Lahontan sequence according to these new code definitions, a convention which we follow here.

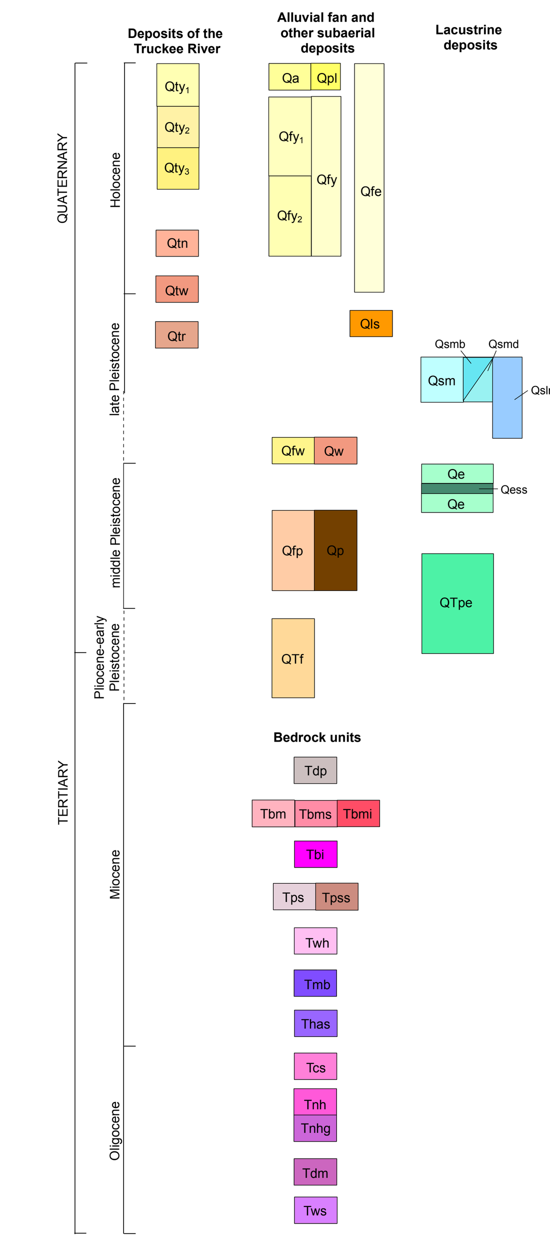
[3] $^{40}Ar/^{39}Ar$ ages reported in Garside and others (2000, 2003) used an age of 27.84 Ma for the neutron flux monitor, sanidine from Fish Canyon Tuff. Recent work suggests an age of 28.02 Ma is more appropriate for Fish Canyon Tuff (Renne and others, 1998). Therefore, ages reported here were recalculated by multiplying the previously reported ages by 28.02/27.84. Although not precisely correct, this method gives ages that differ from the correct ages only in the third decimal place, which we do not report.

Table 1. Radiocarbon dates from Wadsworth Quadrangle

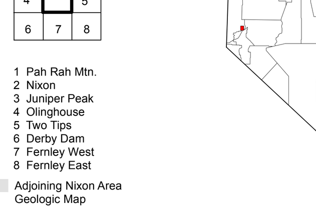
Sample no.	Lab no.	Material dated	^{14}C age (yr BP)	Calibrated age (1σ range; cal BP)	Unit
1	GX-29817-AMS	charcoal	340 ± 40	317–463	Qfy_1
2	GX-28036-AMS	charcoal	410 ± 40	454–513	Qfy_2
3	Beta-165927	clam shell	1,300 ± 40	1182–1284	Qfy_3
4	GX-29818-AMS	charcoal	2,120 ± 70	1995–2297	Qfy_1
5	GX-28204-AMS	charcoal	2,800 ± 40	2856–2952	Qfy_1
6	GX-29815-AMS	charcoal	9,620 ± 100	10,788–11,167	Qfy
7	GX-29216	tufa	11,160 ± 90	12,959–13,134	Qsm
8	GX-29217-AMS	snails	11,720 ± 40	13,464–13,647	Qsm
9	GX-28034	snails	12,470 ± 150	14,229–14,822	Qsm
10	GX-28035	tufa	12,790 ± 160	14,833–15,368	Qsm
11	GX-29219-AMS	snails	14,750 ± 40	17,819–18,017	Qsm
12	GX-29816-AMS	snails	14,910 ± 70	18,019–18,481	Qsm
13	GX-29218-AMS	snails	14,940 ± 40	18,053–18,482	Qsm
14	GX-31720-AMS	snails	16,530 ± 80	19,552–19,803	Qsm

References

Adams, K.D., Wesnousky, S.G., and Bills, B.G., 1999, Isostatic rebound, active faulting, and potential geomorphic effects in the Lahontan basin, Nevada and California: Geological Society of America Bulletin, v. 111, p.1739–1756.
Axelrod, D.I., 1995, The Miocene Purple Mountain flora of western Nevada: University of California Publications in the Geological Sciences, v. 139, p. 1–62.
Benson, L.V., and Thompson, R.S., 1987, Lake level variation in the Lahontan basin for the past 50,000 years: Quaternary Research, v. 28, p. 69–85.
Benson, L.V., Currey, D.R., Dorn, R.I., Lajoie, K.R., Oviatt, C.G., Robinson, S.W., Smith, G.I., and Stine, S., 1991, Chronology of expansion and contraction of four Great Basin lake systems during the past 35,000 years: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 78, p. 241–286.
Benson, L., Currey, D., Lao, Y., and Hostetler, S., 1992, Lake-size variations in the Lahontan and Bonneville basins between 13,000 and 9,000 14C yr BP: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 95, p.19–32.
Berger, G.W., 1991, The use of glass for dating volcanic ash by thermoluminescence: Journal of Geophysical Research, v. 96, no. B12, p. 19,705–19,720.
Berger, G.W., and Busacca, A.J., 1995 Thermoluminescence dating of late Pleistocene loess and tephra from eastern Washington and southern Oregon and implications for the eruptive history of Mount St. Helens: Journal of Geophysical Research, v. 100, No. B11, p. 22361–22374.
Briggs, R.W., and Wesnousky, S.G., 2004, Late Pleistocene fault slip rate, earthquake recurrence, and recency of slip along the Pyramid Lake fault zone, northern Walker Lane, United States: Journal of Geophysical Research, v. 109, B08402, doi:10.1029/2003JB002717.
Briggs, R.W., Wesnousky, S.G., and Adams, K.D., 2005, Late Pleistocene and late Holocene lake highstands in the Pyramid Lake subbasin of Lake Lahontan, Nevada, USA: Quaternary Research, v. 64, p. 257–263
Briggs, R.W., and Wesnousky, S.G., 2005, Late Pleistocene and Holocene paleoearthquake activity of the Olinghouse fault zone, Nevada: Bulletin of the Seismological Society of America, v. 95, no. 4, p. 1301–1313.
Broecker, W.S., and Orr, P.C., 1958, Radiocarbon chronology of Lake Lahontan and Lake Bonneville: Geological Society of America Bulletin, v. 69, p. 1009–1032.
Broecker, W.S., and Kaufman, A., 1965, Radiocarbon chronology of Lake Lahontan and Lake Bonneville II: Geological Society of America Bulletin, v. 76, p. 537–566.
Davis, J.O., 1978, Quaternary tephrochronology of the Lake Lahontan area, Nevada and California: Nevada Archeological Survey Research Paper No. 7, 137 p.
Garside, L.J., and Bonham, H.F., 2003, Geologic map of the Olinghouse Quadrangle, Nevada: Nevada Bureau of Mines and Geology Open-File Report 03-28, 1:24,000.
Garside, L.J., Castor, S.B., dePolo, C.M., and Davis, D.A., 2003, Geology of the Fraser Flat Quadrangle and the western half of the Moses Rock Quadrangle, Washoe County, Nevada: Nevada Bureau of Mines and Geology Map 146, 1:24,000.
Garside, L.J., Castor, S.B., Henry, C.D., and Faulds, J.E., 2000, Structure, volcanic stratigraphy, and ore deposits of the Pah Rah Range, Washoe County, Nevada: Geological Society of Nevada field trip guidebook, GSN 2000, 180 p.
Garside, L.J. and Nials, F.L., 1998, Geologic map of the Griffith Canyon Quadrangle, Nevada: Nevada Bureau of Mines and Geology Open-File Map OF99-4, 1:24,000.
Geasan, D.L., 1980, The geology of a part of the Olinghouse Mining District, Washoe County, Nevada [M.S. thesis]: University of Nevada, Reno, 118 p.
Hawley, J.W., 1969, Report on geologic-geomorphic setting of argillic horizon study sites in western Nevada: unpub. field trip report, U.S. Soil Conservation Service, 67 p.
Henry, C.D., Faulds, J.E., dePolo, C.M., and Davis, D.A., 2004, Geologic map of the Dogskin Mountain Quadrangle, Nevada: Nevada Bureau of Mines and Geology Map 148, 1:24,000.
Le Maitre, R.W., ed., 1989, A classification of igneous rocks and glossary of terms; recommendations of the International Union of Geological Sciences Subcommission on the Systematics of Igneous Rocks: Blackwell Scientific Publications, Oxford,193 p.
Morrison, R.B., 1964, Lake Lahontan: Geology of the southern Carson Desert, Nevada: U.S. Geological Survey Professional Paper 401, 156 p.
Morrison, R.B., 1991, Quaternary stratigraphic, hydrologic, and climatic history of the Great Basin, with emphasis on Lake Lahontan, Bonneville, and Tecopa, in Morrison, R.B., ed., Quaternary nonglacial geology: Conterminous U.S.: Geological Society of America, Geology of North America, v. K-2, p. 283–320.
Morrison, R.B., Mifflin, M., and Wheat, M., 1965, Badland amphitheater on the Truckee River north of Wadsworth, in INQUA 7th Congress, Guidebook, Field Conference I (Northern Great Basin and California: Lincoln, Nebraska Academy of Science, p. 26–36.
Morrison, R.B., and Frye, J.C., 1965, Correlation of the middle and late Quaternary successions of Lake Lahontan, Lake Bonneville, Rocky Mountain (Wasatch Range), southern Great Plains, and eastern Midwest areas: Nevada Bureau of Mines and Geology Report 9, 45 p.
Renne, P.R., Swisher, C.C., Deino, A.L., Karner, D.B., Owens, T.L., and DePaolo, D.J., 1998, Intercalibration of standards, absolute ages and uncertainties in 40Ar/39Ar dating: Chemical Geology, v. 145, p. 117–152.
Rose, R.L., 1969, Geology of parts of the Wadsworth and Churchill Butte Quadrangles, Nevada: Nevada Bureau of Mines and Geology Bulletin 71, 27 p.
Russell, I.C., 1885, Geological history of Lake Lahontan, a Quaternary lake of northwestern Nevada: U.S. Geological Survey Monograph 11, 288 p.
Sarna-Wojcicki, A.M., Lajoie, K.R., Meyer, C.E., Adam, D.P., and Rieck, H.J., 1991, Tephrochronologic correlation of upper Neogene sediments along the Pacific margin, conterminous United States, in Morrison, R.B., ed., Quaternary nonglacial geology: Conterminous U.S.: Geological Society of America, Geology of North America, v. K-2, p. 117–140.
Smoot, J.P., 1993, Field trip guide: Quaternary-Holocene lacustrine sediments of Lake Lahontan, Truckee River canyon north of Wadsworth, Nevada: U.S. Geological Survey Open-File Report 93-689, 35 p.
Stewart, J.H., 1988, Tectonics of the Walker Lane belt, western Great Basin, in Mesozoic and Cenozoic deformation in a zone of shear, W.G. Ernst, ed., Metamorphism and crustal evolution of the western United States: Prentice-Hall, Englewood Cliffs, New Jersey, p. 683–713.
Stewart, J.H., McKee, E.H., and John, D.A., 1994, Map showing compilation of isotopic ages of Cenozoic rocks in the Reno 1- by 2-degree Quadrangle, Nevada and California: U.S. Geological Survey Miscellaneous Field Studies Map MF-2154-D.



Adjoining 7.5' quadrangle names



1 Pah Rah Mtn.
2 Nixon
3 Juniper Peak
4 Olinghouse
5 Two Tips
6 Derby Dam
7 Fernley West
8 Fernley East
Adjoining Nixon Area Geologic Map

NEVADA BUREAU OF MINES AND GEOLOGY
MACKAY SCHOOL OF EARTH SCIENCES AND ENGINEERING
UNIVERSITY OF NEVADA, RENO

Field work 1989-1993, 1998-2004.
Geologic mapping was supported by the U.S. Geological Survey COGEOMAP Program and the Pyramid Lake Paiute Tribe

Reviewed by:
Marith Reheis (U. S. Geological Survey), Ken Adams (Desert Research Institute), and Chris Henry (NBMG)

Digital geologic compilation by: John W. Bell and P. Kyle House
Cartography by: Robert Chaney and Jennifer Mauldin
Edited by: Dick Meeuwig
Printed by: Nevada Bureau of Mines and Geology
First Edition, 2005 (Revised March 2, 2006)

Nevada Bureau of Mines and Geology
University of Nevada, Mail Stop 178
Reno, Nevada 89557-0088
(775)784-6691, ext. 2
www.nbmg.unr.edu, nbmgsales@unr.edu