

SURFICIAL DEPOSITS, HOLOCENE TO MIOCENE

Descriptions modified slightly from House and others (2006)

Aluvial deposits
Deposits of ephemeral washes and alluvial fans. Washes include alluvial fan feeder channels, well-defined alluvial fans, and channels in stable distributary flow networks; alluvial fans include extensive areas of downstream branching, unstable distributary flow networks, broad areas that convey relatively shallow swaths of unconfined flows, and areas of intricately braided washes. In most cases, active washes and fans are closely interrelated or mutually gradational, so no effort has been made to divide them at this scale.

The broad range of soil development on alluvial deposits in the map area and the diverse assemblage of related alluvial landforms indicates a complex history of alluvial fan formation, occupation and abandonment spanning approximately the last 5-6 million years. Alluvial deposits from the bulk of the piedmont area below mountains and hills in the study area (see inset map) correspondingly bear crustal compositions that reflect primary source lithologies shown on the map as follows: Spring Mountains (predominantly Mesozoic and Paleozoic carbonate and siliceous rocks with minor volcanic rocks and Tertiary gravels), the McCullough Mountains (predominantly granitic and gneiss with minor volcanic rocks in the south part), and the Lucy Gray Mountains (predominantly granitic and gneiss with minor volcanic rocks in the north part), and the Lucy Gray Mountains (predominantly granitic and gneiss with minor volcanic rocks in the south part). Alluvial fans are also present below principal drainage that head in the Sheep Mountain area (Paleozoic carbonate and siliceous rocks, minor Paleozoic granitic and gneiss, and the Jean Hill (Triassic) Tertiary volcanic rocks and gravel).

Alluvial deposits are composed predominantly of massive to moderately sorted, moderately to well-sorted sands and gravels ranging from pebbles to boulders. Clay content generally increases with increasing slope and distance from source. Notably, boulder-rich deposits are present near and within the interior parts of the major mountain ranges in the study area and are also common on alluvial fans fed by source areas with extensive outcrops of volcanic rocks. Older alluvial fans are generally coarser than younger ones, but this may largely reflect the fact that the upper and middle parts of the associated alluvial fans are best preserved. In all deposits, the constituent clasts are subangular and moderately sorted, and they are closely to moderately stratified. Degree of consolidation increases markedly with deposit age and ranges from very weak to very strong.

Alluvial fans of different ages in the mapped area are divided on the basis of a suite of surficial and morphologic characteristics, including topographic position, degree of dissection and nature of alluvial drainage pattern (e.g., tributary or distributary), alteration of original depositional morphology (e.g., soil horizon smoothing of surface morphology over time, development of gravel pavement, degree of channel and physical weathering of surface clasts, and soil horizon characteristics of deposits in the Ivanpah Valley area with similar features elsewhere in the Nevada Desert). Features with similar characteristics are assigned to the following units: Young alluvium (undivided Holocene to late Pleistocene), Young active alluvium (late Holocene), Young inactive alluvium (early Holocene to late Pleistocene), Intermediate alluvium, undivided (late to middle Pleistocene), and Old alluvium, undivided (early Pleistocene).

Young alluvium, undivided (Holocene to late Pleistocene)
Coarse-grained alluvial fan and wash deposits from principal drainages in the Spring, Bird, Spring, McCullough, and Lucy Gray Mountains and various local sources. Composed of subangular to angular pebbles, cobbles, and lesser amounts of sand and silt, sand relative proportions vary with nature and proximity to source area. Deposits are generally crudely to moderately stratified. Boulder gravels are common in upstream parts of Gay deposits in high-relief mountain interior and mountain front areas. In many of these cases there is strong evidence of talus flow processes.

Surface and soil characteristics of Gay deposits depend strongly on relative age and frequency of fluvial activity. Surface morphology ranges from high relief, high bar and channel forms reflecting original depositional morphology to progressively more subdued bar and channel forms to planar surfaces. Surface clay weathering ranges from ill to moderate, and carbonate clast etching. Well-developed gravel pavements present only in thick, ancient surfaces (Gay). Relatively weak, loose pavements may be present in swales on surfaces of younger subunits. Associated soil development ranges from ill to weak Bw and Bk horizons (up to stage II Bk in Gay).

Young active alluvium (late Holocene)
Active wash and alluvial fan deposits of poorly to moderately sorted gravel, sand, and minor silt. Fine bar and channel morphology and relatively low density of vegetation. Alluvial fan surfaces have obvious and complex distributary flow patterns, and broad, sheet-like gravelly areas with low well-defined channels. Active washes are well defined and range from single channels with low flanking terraces, to braided channels interspersed with gravel bars. Exposed thickness of unit is typically 1-3 m.

Deposits characterized by weak to no soil development. If present soil development may be characterized by C or Av horizons overlying Bw/Bk or buried Bk horizons. Vertical A horizons vary from 1 to 8 cm thick and overlie either Bw (8-23 cm thick) or Bk (10-95 cm thick) horizons containing very slight carbonate coats on clay bottoms. Unit is thin overall and commonly overlies buried soil horizons. Surface clasts are initially weathered and unmineralized. Carbonate-coated clasts reworked from older deposits may be present.

Young active alluvium and recently abandoned active alluvial surfaces (Holocene)
Intermittently active surfaces that flank and grade into Gay surfaces as well as somewhat older abandoned surfaces that are interpreted as chronologically intermediate between Gay and Qay. Surface morphology shows some modification of original depositional morphology and ranges from bar and channel to subdued bar and channel forms. Surface clay weathering ranges from slight to moderate, and carbonate clast etching. Gravel pavements relatively sparse, but may be weakly to moderately developed in some swales. Characterized by a distinct clear on high-resolution satellite imagery and aerial photos, but tone can vary from light white to dark gray depending on soil lithology, vegetation density, and presence of cryptobiotic crust which is locally common. Exposed thickness of unit is typically 1-4 m.

Soil development is characterized by Bk horizons with weak to strong stage I carbonate morphology. A 1-3 cm thick horizons commonly occur in granitic parent materials near Lucy Gray and McCullough Mountains. (Shawnee Av 4-5 cm thick) horizons overlie either Bw (4-10 cm) or Bk (2-11 cm) horizons. Unit is largely unconsolidated. However, somewhat more consolidated buried soils are common at depth.

McDonald and others (2003) Radiometric and mineral tomographic ages of late deposits reported in those studies range from the early Holocene to the late Pleistocene (approximately 92 ka).

Young inactive alluvium (early Holocene to late Pleistocene)
Young, inactive alluvial surfaces characterized by strongly planar morphology, moderate to strongly developed gravel pavement, moderate to moderate to dark rock varnish. Minor etching of carbonate clasts is common. Deposit surface characteristically has a distinctive aerial photograph pattern characterized by 'trellis' or 'alligator skin' appearance expressed as light-colored roughly rectangular areas with gravel pavement separated by roughly rectangular pattern of vegetation bands and active, incised channels. Exposed thickness of unit ranges from 1 to 4 m.

Soil development is characterized by stage I carbonate morphology, and in granitic parent materials, argillic horizons. A or Av horizons (4-8 cm thick) overlie Bw (8-23 cm thick), Bk (8-18 cm thick), and/or Bk (10-95 cm thick) horizons. Bk horizons may contain strong stage I carbonate morphology, but more commonly display stage I carbonate morphology. Argillic horizons contain clay coatings on sand grains. Deposits with carbonate surface and soil characteristics have been described at several localities in the vicinity of Ivanpah Valley (Uhl and others, 1990; McDonald and others, 2003; Page and others, 2005). Radiometric and mineral tomographic ages of late deposits reported in those studies range from the early Holocene to the late Pleistocene (approximately 92 ka).

Intermediate alluvium, undivided (late to middle Pleistocene)
Deposits and surfaces of inactive alluvial fans. Undivided unit includes up to three subunits that are locally divisible on the basis of slight differences in soil carbonate horizon development and topographic position (when adjacent to one another), but overall surface characteristics are very similar and consistent division is difficult at 1:50,000 scale. Surface is distinctly planar with strongly developed, lightly pitted gravel pavement and dark to very dark, varnish. Surface clasts of siliceous composition. Many surface clasts are strongly weathered. Densely sorted and graded carbonate clasts and well-sorted and deaggregated clasts of crystalline rocks, where present, are common. Surface change has lateral extent and depth of about 100 m; generally ranges from 1 to 4 m. Exposed thickness of unit rarely exceeds 5 m. Gay deposits are moderately to strongly consolidated. Typical soil development is characterized by stage II to stage IV petrocalcic carbonate morphology. A/Bw/Bk horizons (1-7 cm thick) overlie Bw (8-10 cm thick), Bk (occurs in granitic alluvium only, 7 cm thick), Bk (20-45 cm thick), and/or Bk (20-157 cm thick) horizons. Carbonate morphology increases with depth. Bk horizons display strong stage I to stage II carbonate morphology and overlie stage III Bk horizons.

Youngest subunit within Qai is possibly as young as late Pleistocene (25 to 50 ka; Page and others, 2005), the older and more widespread subunit(s) possibly date to late-middle Pleistocene (>50 to 350 ka; Sowers and others, 1988; Page and others, 2005).

Old alluvium, undivided (early Pleistocene)
Deposits and surfaces of alluvial fans. Typically characterized by concordant, weakly to moderately rounded surface remnants separated by deeply (3-6 m) dissected tributary drainage networks. Surface clasts include moderately to deeply weathered fluvial pebbles and cobbles and sparse boulder gravels; abundant angular clasts of numerous soil carbonates; exposed matrix of eolian silt locally common. Abundant surface carbonates that result in a somewhat light to much lighter surface tone than typical of Qai and Qay surfaces. Exposed thickness of Qai ranges from 5 to >10 m.

Soils characterized by strongly developed, thick, stage IV petrocalcic horizons. A/Bw/Bk (1-8 cm thick) overlie either Bk (8-39 cm thick) or Bk (15-36 cm thick) horizons that display stage I to stage II carbonate morphology. Bk horizons occur in granitic parent materials in the southeast part of the study area and contain well-developed clay coats and clay lenses between grains. The underlying, strongly indurated Bk horizon (50+ cm thick) is characterized by a laminar cap of silt.

Qai soil and surface characteristics generally correspond to deposits in parts of Las Vegas Valley that are older than 730 ka (Sowers and others, 1988).

Old alluvium, undivided (early Pleistocene to late Miocene)
Old alluvial fan deposits derived from granitic bedrock sources (Unit 70a). The only extensive outcrop area in the valley between the McCullough and Lucy Gray Mountains. Likely contains silt to Qay and Tey (see below) in other parts of the mapped area. Deposits consist predominantly of subangular to subrounded gravel (pebbles to boulders) and coarse gray sand and pebbles. Surface morphology ranges from deeply dissected ridge-and-ravine topography with concordant, faulted surfaces to subdued, rounded ridges with discordant ridge crests. Surface clasts include deeply weathered fluvial pebbles to boulder gravel and less common broken fragments from underlying petrocalcic soil horizons. Extensive gravel pavements are rare on Qai surfaces because of moderate vegetation density. Pavements may be present locally as patches on surface crests and side slopes where they are interpreted as relict features. Qai deposits overlie bedrock erosion surfaces in some upper piedmont areas. Deposition ranges from typically less than 5 m in upper piedmont areas to more than 15 m in lower piedmont areas.

Qai soils are characterized by moderately to strongly developed stage III to IV petrocalcic horizons. Buried soils with stage III Bk horizons are present in some Qai deposits. One or more of the following horizons are also observed. (a) C or A horizons, Bk (15-17 cm thick), Bk (25 cm thick), and Bk (20-28 cm thick) containing stage I and II carbonate morphology.

BEDROCK UNITS, MIOCENE TO PALEOZOIC

Descriptions modified slightly from House and others (2006)

This map shows five principal bedrock units divided on the basis of major lithologic characteristics, including middle Miocene to Oligocene siliceous sedimentary rocks (conglomerates, sandstones, and minor mudstones); Mesozoic and Paleozoic sedimentary rocks (carbonate and siliceous, unbedded); Miocene volcanic rocks (basalt, andesite, and basalt); Miocene to Cretaceous siliceous intrusive rocks; and Paleozoic crystalline basement rocks (granite, quartz monzonite, and gneiss). No structure or individual formations are indicated on the map.

Young sedimentary rocks, undivided (Miocene to Oligocene?)
Vastly consolidated deposits of gravel conglomerate and minor sandstone and mudstone. Consists in part of the early gravel of Howell (1951). Conglomerate is most widely exposed faces and contains subrounded to rounded fluvial pebbles, cobbles, and boulders in many outcrops; clast composition includes abundant subrounded to well-rounded quartzite clasts. Observed degrees of clast rounding and the presence of quartzite are uncommon in all younger alluvial deposits in the study area and indicate a very different type of depositional system. Gravel is generally clay-supported, moderately sorted to well-sorted, well bedded, and commonly bed and faulted. Tey deposits are commonly associated with well-developed, high-standing bedrock landforms characterized by highly developed, gravelly mudstone, massive petrocalcic soil horizons. A series of Tey basins north of Jean Hill define a diversity linear, north-south-trending, fault-controlled. A large Tey outcrop to the immediate northeast of Good Springs exhibits a thick, bed sequence that contains an internal turbidite sequence. Localized Tey outcrops occur on the upper piedmont of the southern Spring Mountains.

Tey gravel deposits rest unconformably on Mesozoic and Paleozoic sedimentary rocks (Maz) and are overlain by Miocene volcanic rocks (V). This relation was first noted in the Jean area by Kohn (1978). Other than this key stratigraphic constraint, the age of Tey is not known with certainty. We interpret the age of this unit as Miocene to Oligocene in correlation with the overlying volcanic rocks and suggest that the deposits may be correlative to the lower part of the 26-14 Ma Horse Spring Formation (Bosman, 1972; Kohn, 1978; Bristow, 1991). Extensive exposures occur in the Hidden Valley, Jean Hill, and Late Mountain areas. Smaller outcrops occur in the Bird Spring Range and in the upper piedmont of the McCullough Mountains. Localized Tey outcrops occur on the upper piedmont of the southern Spring Mountains.

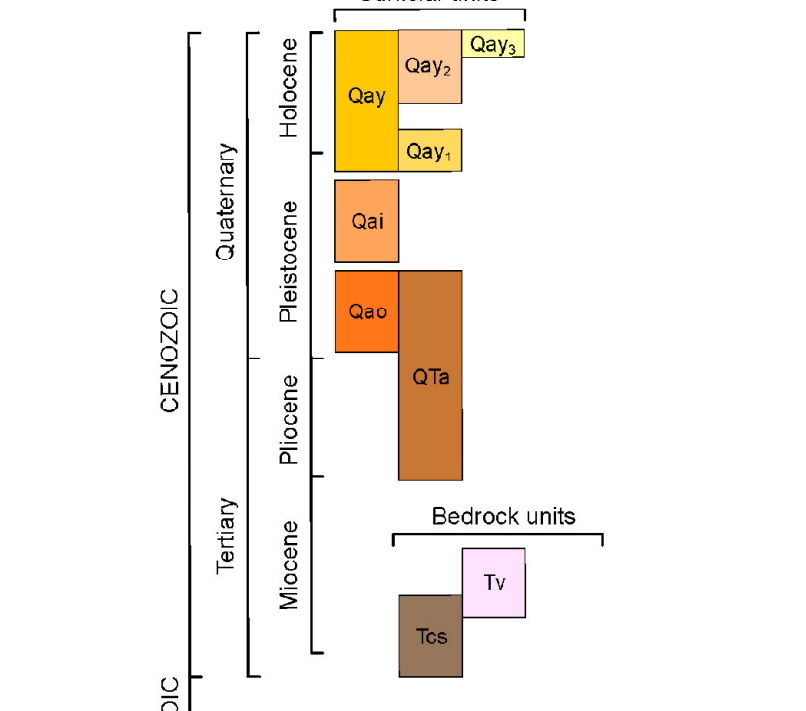
Ancient intrusive and metamorphic rocks, undivided (Proterozoic)
Includes granite, granitic gneiss, granitic aspen gneiss, and quartz monzonite. These rocks form the bulk of the Lucy Gray Mountains and the south range of the McCullough Mountains (Bingler and Bornman, 1972; DeWitt and others, 1999).

Young volcanic rocks, undivided (late to middle Miocene)
Includes numerous volcanic rock units ranging in composition from basalt to rhyolite (Howell, 1931, 1936; Bingler and Bornman, 1972; Kohn, 1978; Bristow, 1991). Extensive exposures occur in the Hidden Valley, Jean Hill, and Late Mountain areas. Smaller outcrops occur in the Bird Spring Range and in the upper piedmont of the McCullough Mountains. Localized Tey outcrops occur on the upper piedmont of the southern Spring Mountains.

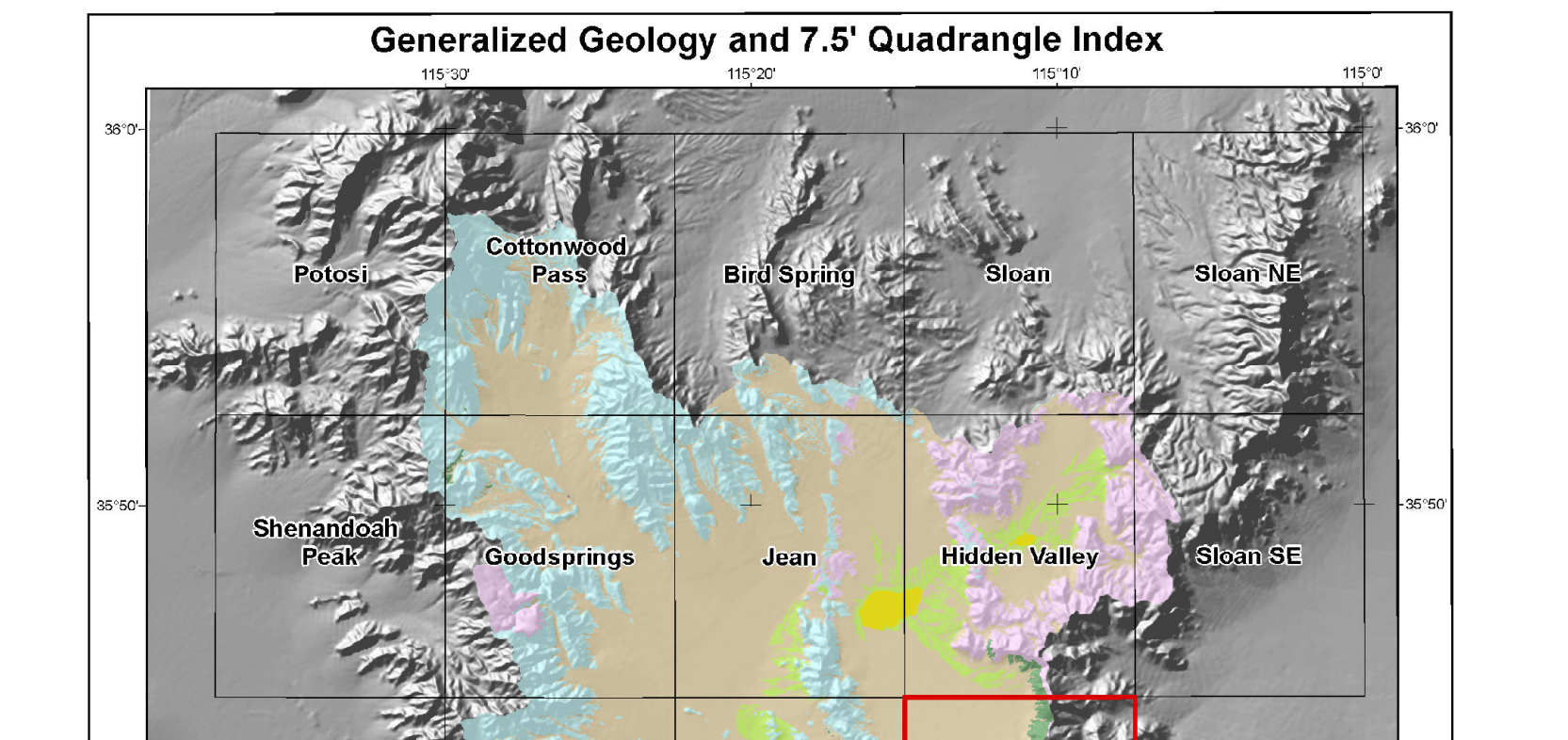
Basal to middle Miocene volcanic rocks, undivided (Miocene)
Includes numerous volcanic rock units ranging in composition from basalt to rhyolite (Howell, 1931, 1936; Bingler and Bornman, 1972; Kohn, 1978; Bristow, 1991). Extensive exposures occur in the Hidden Valley, Jean Hill, and Late Mountain areas. Smaller outcrops occur in the Bird Spring Range and in the upper piedmont of the McCullough Mountains. Localized Tey outcrops occur on the upper piedmont of the southern Spring Mountains.

Proterozoic crystalline basement rocks, undivided (Proterozoic)
Includes granite, granitic gneiss, granitic aspen gneiss, and quartz monzonite. These rocks form the bulk of the Lucy Gray Mountains and the south range of the McCullough Mountains (Bingler and Bornman, 1972; DeWitt and others, 1999).

A checklist of the geology polygons is available at: <http://www.nv.gov/nbg/geo/polygons>



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Base map: U.S. Geological Survey, McCullough Pass, NV, 7.5' Quadrangle, 1989
CONTOUR INTERVAL: 40 FEET
and U.S. Geological Survey, McCullough Mountain, NV, 7.5' Quadrangle, 1989
CONTOUR INTERVAL: 40 FEET
Projection: Universal Transverse Mercator, zone 11
Datum: 1983 North American Datum

SCALE 1:24,000
0 0.5 1 Mile
0 1,000 2,000 3,000 4,000 5,000 Feet

Contact: Dashed where approximately located

Watershed Boundary

NEVADA BUREAU OF MINES AND GEOLOGY
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UNIVERSITY OF NEVADA, RENO
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This map is extracted directly from the House and others (2006) 1:50,000 scale geologic map. The data have not been explicitly reviewed at 1:24,000 scale.
Preliminary geologic map.
Has not undergone office or field review.
Has not been reviewed for publication.
Will be revised before publication.
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