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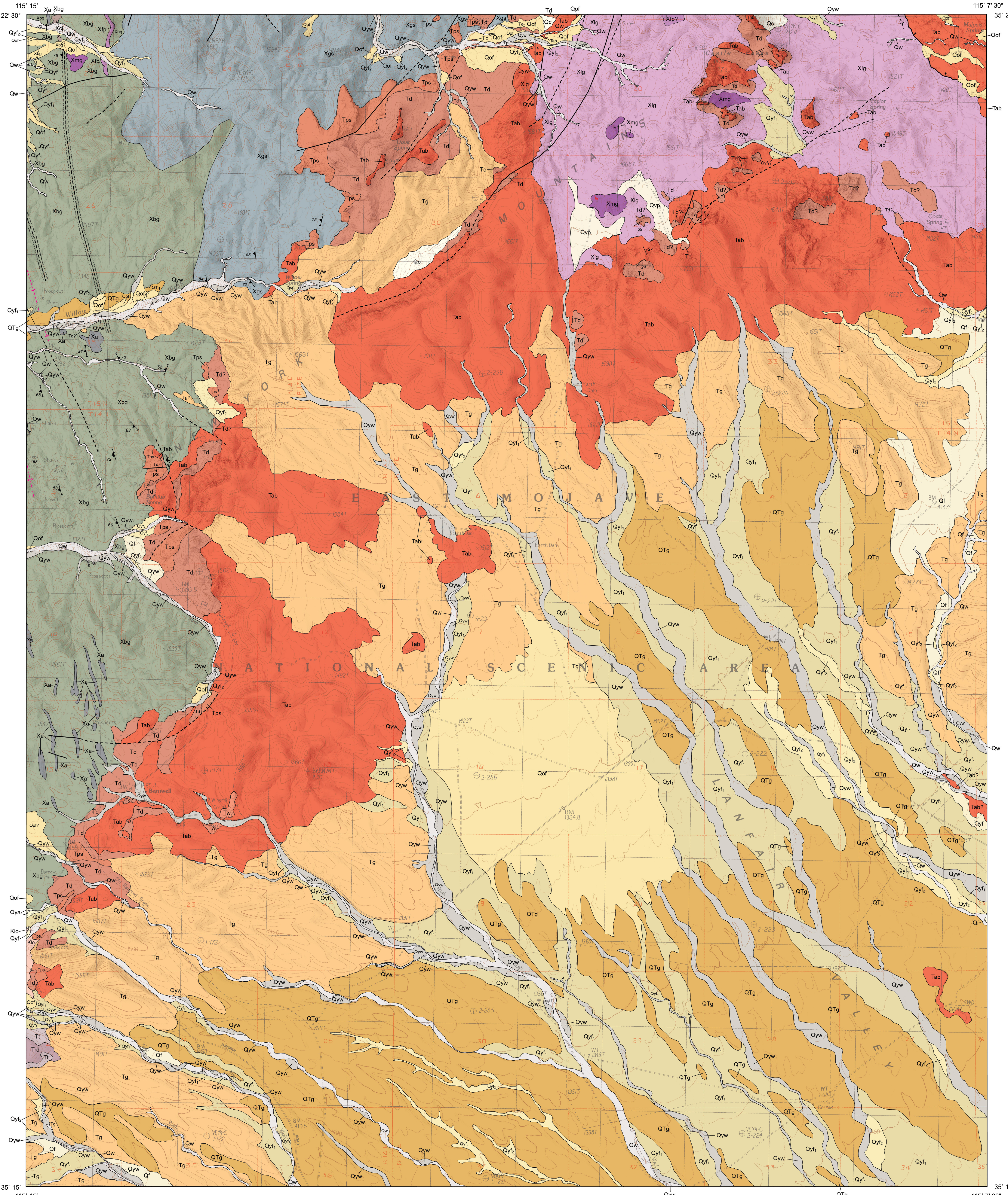

PRELIMINARY GEOLOGIC MAP OF THE CASTLE PEAKS 7.5′ QUADRANGLE, NEW YORK MOUNTAINS, SAN BERNARDINO COUNTY, CALIFORNIA

California Department of Conservation
California Geological Survey

VERSION 1.1

By
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2022

DESCRIPTION OF MAP UNITS

QUATERNARY SURFICIAL DEPOSITS

Qc — **Colluvial deposits (Holocene)—**Unconsolidated to weakly consolidated slope deposits consisting of colluvial debris and talus derived from up-slope outcrops. Some deposits are degraded by erosion and likely older Holocene in age. Distinguished only where deposits are prominent or conceal relationships between underlying units.

Qw — **Modern Wash deposits (late Holocene)—**Unconsolidated sand, gravel, cobbles, and local boulders deposited in recently active stream channels. Occur as narrow deposits in canyons upstream of the mountain front and as anastomosing to elongate deposits where active flow paths continue beyond the mountain front and traverse older fan deposits, but do not form fan-shaped landforms; locally includes small areas of Qyf deposits. Sediments are generally derived from local bedrock or reworked from adjacent older Quaternary deposits. Materials subject to mobilization and redeposition during storm events and therefore lack oxidation on clasts and only support local, sparse vegetation.

Qf — **Modern alluvial fan deposits (late Holocene)—**Unconsolidated to weakly consolidated, poorly sorted, sand, gravel, cobble, and local boulder deposits with intermixed silt forming active, essentially undissected, alluvial fans. Fan apices commonly occur at or upstream of the mountain front, and locally form outboard of the mountain front and downgradient of incised older fans. Sediments subject to mobilization and redeposition during storm events and therefore only support local, sparse vegetation. Clasts are derived from up-slope rock sources and reworked from adjacent older fan deposits; clasts typically unweathered with little to no oxidation or desert varnish. Fans are typically braided and include a composite mix of sediment-rich stream deposits and poorly bedded and poorly sorted debris flow deposits, containing angular to sub-angular pebble- to boulder-size clasts closer to the mountain front.

Qyw — **Younger wash deposits (middle Holocene to late Pleistocene)—**Weakly consolidated sand, gravel, cobbles, and local boulder deposits. Commonly occurs as elongate deposits on the margins of active Qw deposits in larger canyons upstream of the mountain front. Sediments are generally derived from bedrock in upstream source areas. Sediments may be subject to mobilization and redeposition during large storm events. Vegetation may be sparse to moderately dense.

Qyf — **Younger alluvial fan deposits, undifferentiated (middle Holocene to late Pleistocene)—**Unconsolidated to weakly consolidated, poorly sorted, sand, gravel, cobble, and local boulder deposits with intermixed silt, generally lacking pedogenic carbonate, form undissected to slightly dissected alluvial fans with ubiquitous small-scale surface roughness. Cones and broad aprons with fan apices typically occur upstream of the mountain front in the larger canyons but also occur at or outboard of the mountain front downstream of older incised fans. Locally includes narrow active Qf/Qw deposits and small areas of Qof. Sediments may be subject to local mobilization and redeposition during large storm events; vegetation may be sparse to moderately dense. Clasts are derived from up-slope sources and reworked from adjacent older fan deposits; clasts are typically weakly weathered with weak oxidation and desert varnish. Fans are composed of a composite mix of sediment-laden stream deposits and poorly bedded, poorly sorted debris flow deposits containing pebble- to boulder-size clasts closer to the mountain front.

Qyf_2 — **Younger alluvial fan deposits, younger facies (middle Holocene to late Pleistocene)—**Younger facies of Qyf that is are undissected to weakly dissected with sparse vegetation and weak oxidation of clasts. Sediments of Qyf_2 are subject to mobilization and redeposition during large storm events and flow avulsions.

Qyf_1 — **Younger alluvial fan deposits, older facies (middle Holocene to late Pleistocene)—**Older facies of Qyf that is slightly to moderately dissected with degraded/smoothed small-scale roughness compared to Qyf_2, sparse to moderate vegetation density, and weak to moderate oxidation of clasts. Deposits mapped as Qyf_1 likely represent more than one age of deposition and may overlap in age with deposits mapped as Qof, particularly on the east flank of the New York Mountains. Qyf_1 locally overlies Qof or Qvof, particularly in the Pinto Valley Quadrangle. Sediments in this unit are rarely subject to mobilization and redeposition by storm runoff.

Qvp — **Pediment veneer deposits (Holocene to middle Pleistocene)—**Weakly to moderately consolidated sand, gravel and local cobble-sized fragments composed of angular to subangular granitic clasts. Unit forms thin veneer of decomposed granite and sheet wash deposits overlying older, fan-like erosional surfaces developed on bed rock units; includes local areas of low bedrock outcrops.

Qya — **Younger alluvium (Holocene and late Pleistocene)—**Unconsolidated silty sand, grusy sand, gravel, cobbles, and local boulders. Deposited in canyon areas upstream of the mountain front, either in broad alluvial valleys or in narrower valleys where active wash deposits are subordinate or lacking. Alluvial surfaces are slightly elevated from active channels and support common vegetation, suggesting they are only inundated during larger, uncommon flood events. Clasts are generally unweathered with little oxidation. Locally more than one level of younger alluvium may be present.

Qof — **Older fan deposits (late to middle Pleistocene)—**Slightly to moderately consolidated, poorly sorted, silty, pebbly sand to coarse gravel and boulder fan deposits. Broad to isolated fan surfaces are typically smooth to moderately dissected and isolated by intervening younger fan deposits; surfaces support stable vegetation and clasts exhibit moderate oxidation/desert varnish patinas and desert pavement. Surfaces are generally elevated at least several meters above active channel grade, and not subject to historic flood inundation. The underlying bedrock is locally exposed around margins of deposits. Qof is commonly overlain by Qyf_1 in the Pinto Valley Quadrangle and exposed due to geologically young incision. Deposits occur both upstream and downstream of the mountain front and typically range from less than 1 m to about 5 m thick on the west flank of the New York Mountains; on the east flank of the range deposits tend to be thicker; deposits mapped as Qoa in the Watson Wash drainage in the Pinto Valley Quadrangle range up to 40 m thick and may be a distinct older unit that includes old wash deposits. Deposits include light to moderate pedogenic carbonate development along selected beds and fractures, which is typically weakly indurated.

QTg — **Ancient gravel deposits (Pleistocene to Pliocene)—**Light-gray weathering, moderately consolidated, pebble, cobble, and sand deposits with locally extensive pedogenic carbonate. Deposits are highly dissected and degraded such that the original alluvial surfaces and oxidation patinas are commonly lost. Deposits range up to 20 m thick and are less related to current topographic conditions than younger alluvial fan deposits. Deposits are most extensive in the Castle Peaks Quadrangle, both on the southeast flank of the New York Mountains and where they locally extend westward across the range crest and infill an ancient drainage. The deposit is also extensive on the northern portion of the Crescent Peak Quadrangle where they overlie Miocene volcanic rock and are commonly tilted down to the southeast and locally cut by faulting.

TERTIARY UNITS

Tg — **Gravels (Miocene)—**Moderately to well consolidated fluvial boulder to pebble gravel to coarse debris-flow deposits; local avalanche breccia and gravity-slide breccia sequences. Exotic clasts of porphyritic and augen gneiss with boulders up to 3 m in diameter. Sand interbeds of siliciclastic, volcaniclastic, and locally arkosic makeup. Caliche development and clast types not derived from local sources are characteristic of unit, indicating through-going fluvial environments and (or) far-travelled breccia sheets. Notable lack of volcanic clasts. Locally interfingers with Tab in the Crescent Peak quadrangle area.

Tt — **Tuff (Miocene)—**A single occurrence within mapped area, roughly two miles south of Barnwell and adjacent to Trd. May represent a pyroclastic eruptive phase of the same magma that produced Trd (Miller and Wooden, 1993).

Trd — **Rhyolite dome (Miocene)—**Rhyolite Dome of Miller and Wooden (1993). The unit occurs as a single dome within mapped area, roughly two miles south of Barnwell. Described by Miller and Wooden (1993) as aphyric, flow banded rhyolite with zones of minor plagioclase phenocrysts. Likely part of a sequence of dacitic and rhyolitic domes, plugs, and associated flows/flow breccias (Theodore, 2007; Turner and Glazner, 1990) that outcrop within the Castle Mountains Quadrangle dated 16.1±0.4 to 12.8 ± 0.2 Ma (Turner and Glazner, 1990).

Tw — **Wild Horse Mesa Tuff (Miocene)—**Wild Horse Mesa Tuff of McCurry (1988). Occurs locally as a poorly welded, rhyolitic lithic tuff that outcrops along the southeast side of the Cedar Canyon Fault at Pinto Mountain, and approximately 3 miles to the northeast. Regionally the Tw is a sanidine rhyolite ash flow tuff dated to approximately 15.8 Ma (McCurry, 1988) that outcrops over several square miles in the vicinity of Wild Horse Mesa and the Hackberry Mountains (McCurry, 1988; Theodore, 2007). It is likely the result of a large caldera forming eruption in the vicinity of the Woods Mountains (McCurry, 1988).

Tab — **Andesite and basalt (Miocene)—**Andesitic block and ash flow tuffs, volcanic breccias, basalts, and andesites. Block and ash flow tuffs are composed of 40–80%, cm- to m-sized fragments of basaltic andesite and hornblende plagioclase andesite. Hornblende and plagioclase may be present in the matrix, and each may comprise up to 10% of unit. Volcanic breccias include lahar deposits, and contain 40–60%, cm- to 0.5 m-sized blocks of mixed volcanic rock fragments (basalt, hornblende andesite) and lesser intrusive lithic fragments, in matrices of mixed ash, mud, and sand. Large, roughly 10 m outcrops of andesite and basalt may display features such as stretched vesicles, autobrecciation, and columnar joints. Secondary mineralization is sometimes present and includes quartz amygdules and carbonate cementation of breccia matrices. Samples yield ages of 17.6 +/- 0.4 Ma (K-Ar plagioclase) southeast of Nipton, 18.8 +/- 0.5 Ma (K-Ar biotite) and 15.6 +/- 0.4 Ma (K-Ar plagioclase) southeast of Crescent Peak (Miller and Wooden, 1993).

Td — **Dacite (Miocene)—**Andesitic block and ash flow tuffs and lahar breccias. The block and ash flow tuff contains 1cm to 1m blocks of hornblende andesite in an ash matrix and includes thin layers of welded tuff. Hornblende is present in the blocks and matrix and may comprise up to 15% of unit. Lahar breccia contains 50%, cm to m sized volcanic rock fragments (including hornblende andesite, basalt, and intermediate to mafic aphanitic fragments that are altered to purple and red) in a matrix of ash and sub-rounded, medium- to coarse-grained sand.

Tps — **Peach Spring Tuff (Miocene)—**Pink to tan vitric rhyolitic tuffs and volcaniclastic sandstones. Pink tuffs are welded and contain variable amounts of fiamme with lesser abundant (~3%) volcanic lithic fragments and crystals (biotite, hornblende, and abundant sanidine). East of Ivanpah tuffs may be unwelded and tan in color. Sandstone underlies tuffs and is composed of medium- to coarse-grained quartz sand, with lesser abundant ash and dark lithic fragments, including volcanic rock fragments and fiamme. Ar/Ar dating of sanidine yield an age of 18.5 +/- 0.2 Ma (Nielson and Others, 1990).

MESOZOIC AND PALEOZOIC UNITS

Granitoid rocks of the Teutonia batholith (Cretaceous)

Klo — **Live Oak Canyon Granodiorite (Late Cretaceous)—**Light-gray to salt-and-pepper to tan biotite granodiorite (Miller and Wooden, 1993). Typically, medium- to coarse-grained with hypidiomorphic, equigranular texture; locally porphyritic with alkali feldspar phenocrysts. Plagioclase, alkali feldspar, and quartz are the primary minerals, with biotite the primary mafic mineral. Accessory minerals include hornblende, opaque oxides, sphene, allanite, and apatite (Beckerman, 1982). Quartz porphyry and undifferentiated dikes are common within the unit. Near the gradational contact with the Mid Hills adamellite, the granodiorite develops a porphyritic texture becoming indistinguishable from the adamellite (Beckerman, 1982). Beckerman (1982) report a K-Ar biotite date of 79.9 +/- 2.4 Ma for the granodiorite and Burchfiel and Davis (1977) reported a minimum K-Ar age of 71.7 +/-0.8 Ma for the quartz porphyry dikes. New U-Pb dating of porphyritic Klo produced a Late Cretaceous age of 69.2 +/-0.6 [1.4] Ma (MSWD = 3.7), and dating of the youngest zircons from the longest quartz porphyry dike cutting the Klo pluton in the Ivanpah Quadrangle produced an age of 73.2 +/-1.4 [1.5] (MSWD = 1.7) (age +/-internal 2SE uncertainty; [total 2% uncertainty]). Analyses were conducted on zircons using laser ablation ICPMS analyses at the CSUN Laser Lab. These dates suggest that initial crystallization of the pluton was occurring by about 80 Ma, which was cut by quartz porphyry dikes at about 72 to 73 Ma, and then locally intruded by a younger porphyritic facies at about 69 Ma. The porphyritic Klo and quartz porphyry dike both contained a significant component of inherited Paleoproterozoic zircons, and the quartz porphyry contained a significant population of zircons similar in age to the previously reported K-Ar date.

PROTEROZOIC BASEMENT UNITS

Yd — **Diabase (Mesoproterozoic)—**Dark-green to brown, altered, subophitic diabase. Occurs as dikes in map area. Composed of 50–60% plagioclase and 40–50% clinopyroxene. Dated at 1100 Ma (Howard, 1991).

Xcj — **Granodiorite of Crippled Jack Well (Paleoproterozoic)—**Dark-gray to brown, hornblende-biotite granodiorite with abundant mafic minerals (up to 40%). Accessory garnet locally. Dominantly porphyritic, locally mylonitic. Salt-and-pepper appearance on fresh surfaces, tan to brown on weathered surfaces. Miller and Wooden (1994) report a U-Pb date of 1659 +/-4 Ma on zircon collected at Moore siding and a second U-Pb date of 1,662 +/-7 Ma was obtained near the type locality of the pluton (Miller pers com, Dec. 2021), both based on TIMS analyses. New U-Pb dating of rock mapped as Xcj just north of the Nevada border produced preliminary ages of greater than 1,700 Ma. Analyses were conducted on both titanite and zircon grains mounted in thin section using laser ablation ICPMS analyses at the CSUN Laser Lab. Additional U-Pb analyses are in progress to further assess the age of Xcj crystallization and subsequent deformation and metamorphism.

Xlg — **Leucocratic granite (Paleoproterozoic)—**Metamorphosed, subequigranular, leucocratic granite with accessory biotite, and occasional accessory garnet. Unfoliated to weakly foliated, with localized zones of mylonitic fabric. Locally cuts older mylonites. Weathers light brown to locally white. Forms the dominant rock type along the northern crest of the New York Mountains. Encloses small bodies of Xa, Xmg, and wall rock gneiss to the east, and Xfp, Xbt, and possibly Xcj to the west. Intermingled with Xgnt mainly on the east flank of the range, and commonly associated with local unmapped bodies of light gray to pink pegmatite. Miller and Wooden (1993) report U-Pb ages ranging from 1,672 to 1,695 Ma.

Xfp — **Feldspar porphyry in fine grained matrix (Paleoproterozoic)—**Medium- to dark-gray or greenish-gray rock with 1–2 cm feldspar porphyroclasts in a fine-grained matrix. Feldspar porphyroclasts are commonly rounded during metamorphism and tectonic deformation. This unit commonly forms narrow bands that are overprinted by mylonitic fabric, which may have reduced the grain size of the matrix. Mapped mainly on the west flank of the New York Mountains, where mapped bodies typically include inter-layers of Xlg and Xa; found in proximity to possible Xbt and may be genetically related.

Big Tiger Wash Sequence (Paleoproterozoic)

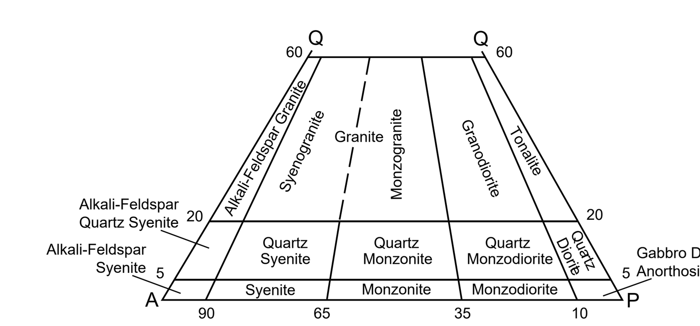
Xmg — **Mesotype granite (Paleoproterozoic)—**Gray, salt-and-pepper appearance, subequigranular, mesotype biotite granite with common fine-grained accessory garnets. Exposed as numerous small, isolated pods and larger, mappable bodies near the Nevada border within Xlg and Xgnt on the east flank of New York Mountains in the Crescent Peak Quadrangle. Miller and Wooden (1993) note close association of Xmg with Xlg. Outcrops commonly display a swirled pattern of internal banding, and outcrops are spatially associated with local migmatite and gneiss. Localized, coarse recrystallization of feldspars occurs along compositional banding. In some areas this unit is cut by pegmatitic dikes and small, garnet clot bearing apophyses. Miller and Wooden (1994) report age of crystallization from U-Pb ages of zircons at about 1685 Ma.

Metamorphic rocks of Willow Wash (Paleoproterozoic)

Xbg — **Biotite-garnet gneiss (Paleoproterozoic)—**Gray to brown, well-foliated, interspersed biotite garnet gneiss, quartzo-feldspathic gneiss, biotite-sillimanite gneiss, and migmatite. Mineral composition ranges from a quartzo-feldspathic gneiss with 95% quartz plus feldspar and 5% biotite; to the biotite-sillimanite gneiss with 70% quartz plus feldspar, 20% biotite, 5% sillimanite, 3% garnet, and 2% opaque minerals. Other accessory minerals throughout the unit include hornblende and apatite. The unit also includes 1- to 2-m-wide, foliation-parallel, medium grained phaneritic to porphyritic, quartzo-feldspathic dikes or leucosomes, with and without garnet. This unit forms the dominant rock type in the Willow Wash and Ivanpah areas. The unit becomes increasingly mylonitized to the east near the contact with Xgs. The mylonitization produced augen shaped, feldspar porphyroclasts and an augen-gneissic texture in this area. Miller and Wooden (1994) report U-Pb and Pb-Pb ages of zircons ranging from 1.7 Ga to 1.9 Ga.

Xgs — **Granitoid gneiss and schist (Paleoproterozoic)—**Interspersed poorly foliated quartzo-feldspathic gneiss, schistose biotite gneiss, and migmatite. The quartzo-feldspathic gneiss is gray, poorly foliated, and comprised primarily of quartz and feldspar, with 5 to 15% biotite and occasional garnets. The limited mafic minerals and lack of mineral segregation contribute to the poor foliation. The schistose biotite gneiss contains quartz, feldspar, and greater amounts of biotite than the quartzo-feldspathic gneiss with equally poor mineral segregation and foliation. Both rock types have migmatitic variations that display greater mineral segregation, but also lack well developed foliation.

Xa — **Amphibolite (Paleoproterozoic)—**Black to salt-and-pepper appearance, massive to foliated amphibolite. The amphibolite ranges from fine-to coarse-grained, and is comprised of plagioclase, hornblende, quartz, +/- clinopyroxene, +/- biotite, and rare garnets. Xa includes granulite facies mafic rocks, containing orthopyroxene (Miller and Wooden, 1993). Interlayered in all metamorphic units, mapped where large bodies are present.



Classification of plutonic rock types (from Streckeisen, 1973; 1976).
A, alkali feldspar; P, plagioclase feldspar; Q, quartz.

MAP SYMBOLS

Contact between map units – Solid where accurately located; long dash where approximately located.

Fault – Solid where accurately located; long dash where approximately located; short dash where inferred; dotted where concealed; queried where identity or existence is uncertain.

Normal Fault – Balls on upper plate, solid where accurately located; long dash where approximately located; short dash where inferred; dotted where concealed; queried where identity or existence is uncertain.

Synform – Solid where accurately located; long dash where approximately located; short dash where inferred; dotted where concealed; queried where identity or existence is uncertain.

Antiform – Solid where accurately located; long dash where approximately located; short dash where inferred; dotted where concealed; queried where identity or existence is uncertain.

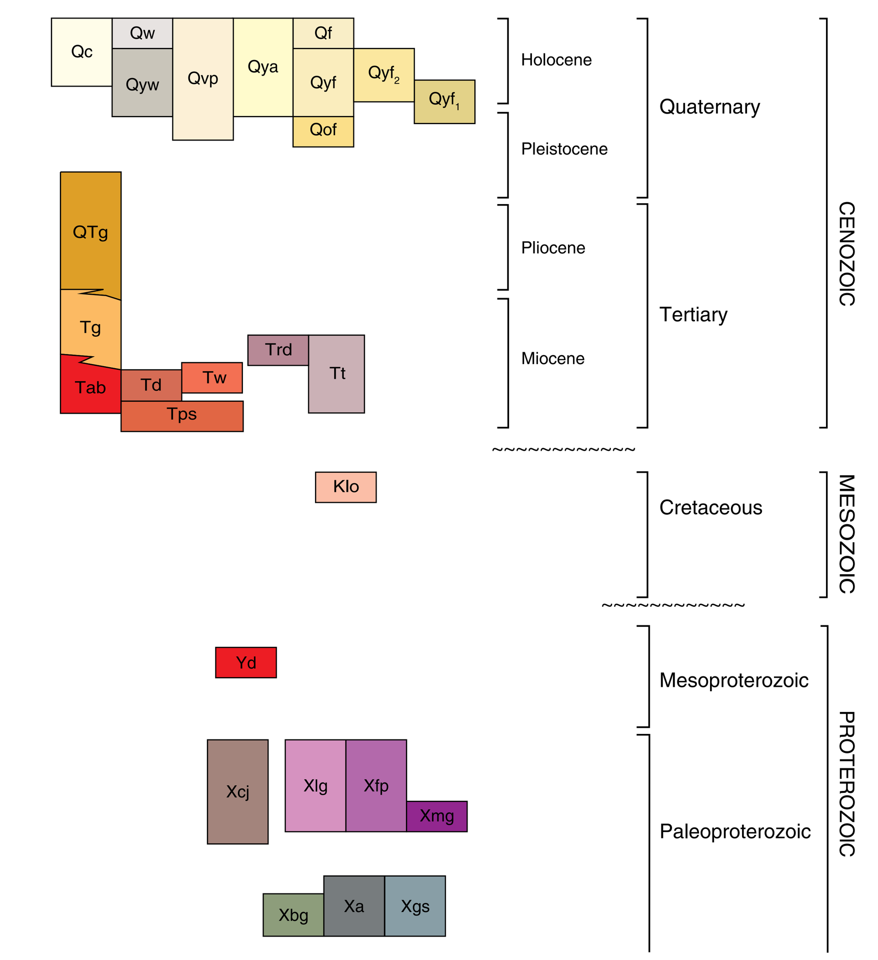
Diabase dike

Mylonite zone

Strike and dip of geologic structure; number indicates dip angle in degrees.

50 Gneissic foliation
50 Mylonitic foliation
25 Bedding

CORRELATION OF MAP UNITS



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AERIAL PHOTO/DIGITAL IMAGERY

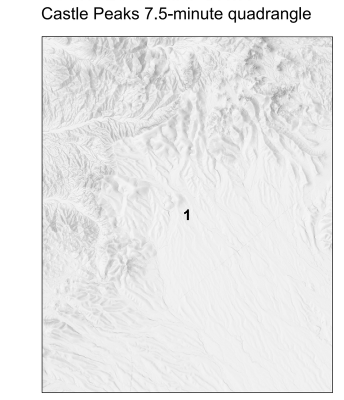
U.S. Department of Agriculture, 2020, Farm Service Agency–Aerial Photography Field Office, National Agriculture Imagery Program (NAIP), 60cm, resolution. http://datagateway.nrcs.usda.gov/

U.S. Geological Survey, 2015, NASA ASTER Level 1T Digital Geospatial Data, U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center.

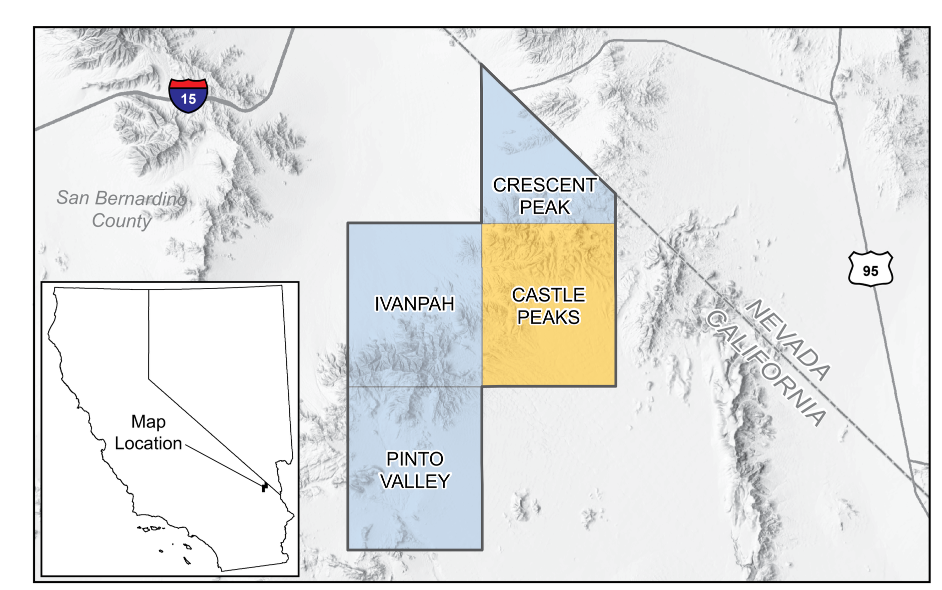
U.S. Geological Survey, 2020, USGS Lidar Point Cloud CA_MountainPass_2019: U.S. Geological Survey.

SOURCES OF MAP DATA

Castle Peaks 7.5-minute quadrangle



1. Miller, D.M., and Wooden., J.L., 1993*
*Data source covers entire quadrangle



USGS 7.5-minute quadrangles within USGS Earth MRI New York Mountains project
Currently mapped quad
Other New York Mountains quads

Coordinate System:
Universal Transverse Mercator, Zone 11N, North American Datum 1927

Topographic base from U.S. Geological Survey,
Castle Peaks 7.5-minute quadrangle, 1984.
Shaded relief image derived from USGS Lidar DEM, 2019.

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Scale 1:24,000

1 1/2 0 1 Miles
1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 Feet
1 0.5 0 1 Kilometers

Contour Interval: 10 Meters
National Geodetic Vertical Datum of 1929

11.2°
TRUE NORTH
MAGNETIC NORTH
Approximate Mean Declination, 2022

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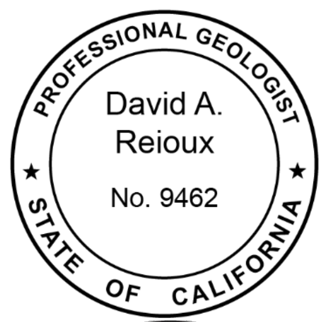

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