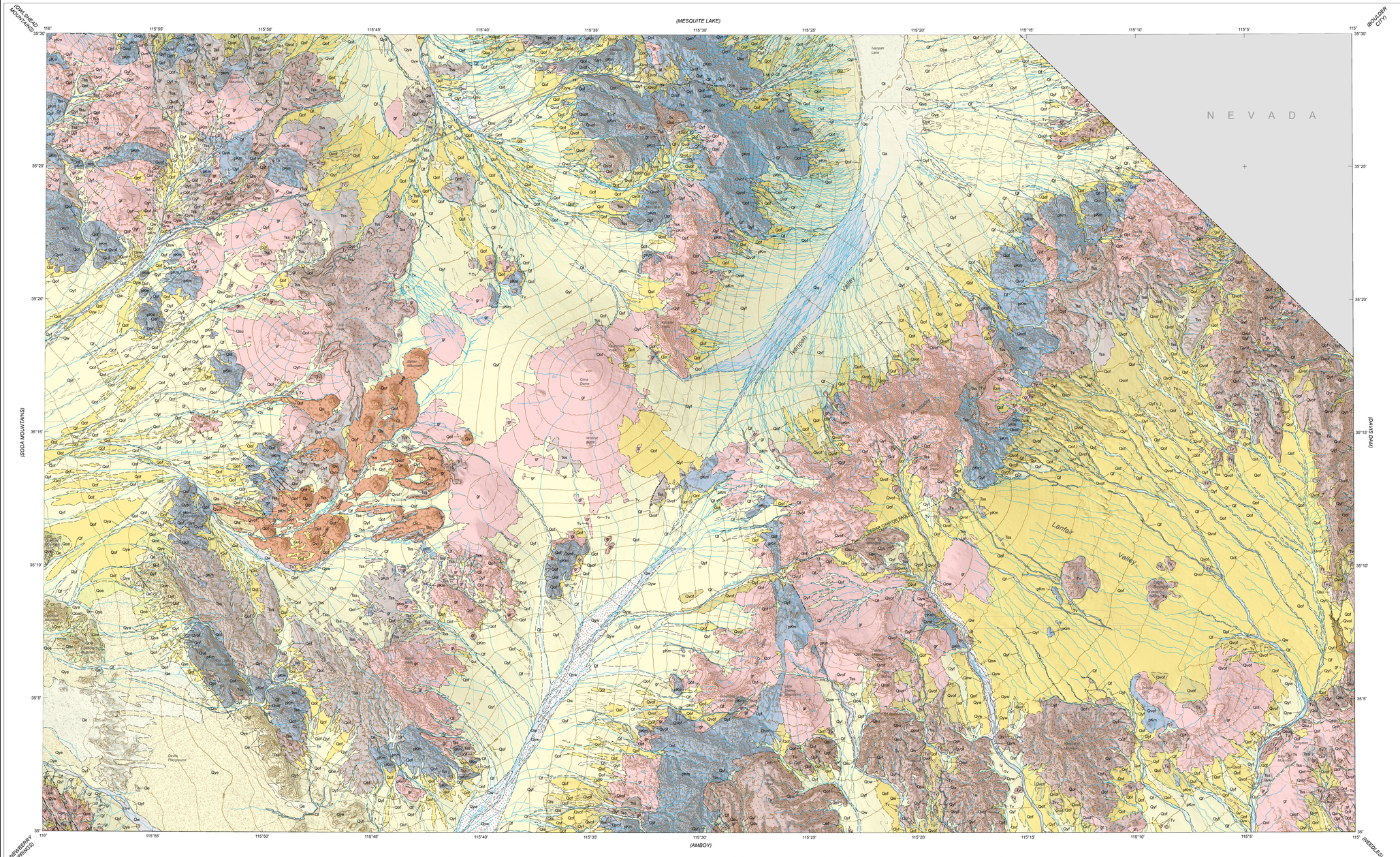

GEOLOGIC COMPILATION OF QUATERNARY SURFICIAL DEPOSITS IN SOUTHERN CALIFORNIA
IVANPAH 30' X 60' QUADRANGLE

A Project for the Department of Water Resources by the California Geological Survey

Compiled from existing sources by
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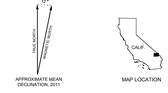
Projection: Universal Transverse Mercator, Zone 11 North, North American Datum of 1983.

Topographic contours derived from USGS 1/3 arc-second National Elevation Dataset (NED). Shaded topographic relief derived from USGS 1 arc-second NED. Base map of hydrography from National Hydrography Dataset Plus (NHDPlus) and California Department of Fish and Game. Base map of geographic names from USGS Geographic Names Information System (GNIS).

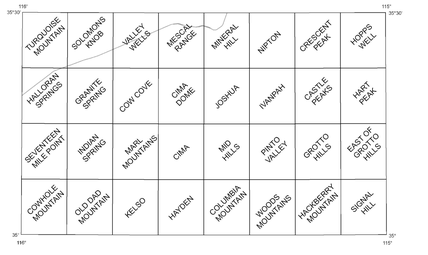


SCALE 1:100,000

5 0 2.5 0 5 MILES
5000 0 5000 10000 15000 20000 25000 30000 35000 40000 45000 50000 FEET
5 2.5 0 5 10 KILOMETERS
5000 0 5000 10000 METERS

CONTOUR INTERVAL 50 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

INDEX TO USGS 7.5' QUADRANGLES



MAP EXPLANATION

This map of Quaternary surficial deposits in the Ivanpah 30' x 60' quadrangle was compiled by the California Geological Survey (CGS) for the Department of Water Resources (DWR) to assist in identifying where flooding and deposition of sediment occurred in the geologically recent past. The focus of this project is on Quaternary (Q) surficial deposits (less than 1.8 million years) on alluvial fans, floodplains, and in basins where such deposits are subject to a number of geologic hazards including flooding, amplification of seismic shaking, liquefaction, and collapsible soils. In general, areas of most recent deposition during Late Holocene time (within the last 500 years) have a greater potential to be areas of future flooding and deposition than those underlain by older surficial deposits.

Project Overview

The Ivanpah 30' x 60' quadrangle represents one of several 100,000 scale quadrangles included in the detailed Geographic Information System (GIS) based geologic data set compiled by CGS from recent high resolution geologic mapping available for southern California. The GIS database merges more than 1400 geologic units from source maps published primarily by the U.S. Geological Survey (USGS) and by CGS (Source GIS Database) into a common format that depicts 40 derivative categories of surficial deposits and bedrock for the entire area (Derivative GIS Database). Quaternary surficial deposits are divided into 28 categories modified from the methodology of Matti and Cossette (2007), the Southern California Areal Mapping Project (SCAMP, 2000), and the USGS and CGS (2000). While specific variations in age and physical properties exist within units on each source map, CGS retained the basic premise of Matti and Cossette (2007) that surficial deposits within each of the Quaternary derivative map units formed during a particular range of geologic time, have a similar origin, and have generally similar physical properties. Within the 28 derivative units, progressively older surficial deposits are typically better consolidated and more highly dissected by erosion, have more developed and/or eroded soil profiles with stronger degrees of weathering and surface armoring, and occupy a higher topographic position within alluvial fan and floodplain terrains. Geologic bedrock formations from the source geologic maps are divided into 12 categories on the derivative maps, based on age and rock type. The bedrock categories can be used to provide a general understanding of the relative erodibility of the upland materials and the general character of the derived sediments. CGS also rectified inconsistencies along the boundaries of mapped areas to create a seamless Derivative GIS Database, but retained links to the original mapping in the Source GIS Database so that the more detailed basic geologic information can be retrieved. Correlation of equivalent deposits across the whole southern California project area is represented in the GIS table entitled Correlation of Derivative and Source Geologic Map Units.

Ivanpah Quadrangle

The Ivanpah quadrangle lies within the eastern Mojave Desert of southern California. The area encompasses several mountain ranges, cinder cones, and primarily Miocene pediments, or low-relief erosional surfaces that cut into bedrock (Miller and others, 1991). Elevations vary from approximately 320 meters to 2250 meters (1050 feet to 7382 feet). The quadrangle is bisected by two large mountain-bound washes, Cedar Wash and Oro Wash, which drain roughly northeast-southwest and southwest-northeast, respectively, from the Cima Dome area in the center of the quadrangle (Jennings, 1961). Cedar Wash is located in Cedar Creek Canyon in the south central portion of the quadrangle, while Oro Wash is located in Ivanpah Valley in the north central portion of the quadrangle. These regions are dominated by alluvial fan and alluvial wash deposits ranging from late Holocene to late Pleistocene in age. Older alluvial fan deposits are present along the margins of the mountains and interspersed throughout the washes. Ivanpah Lake, which is a short-lived or ephemeral dry lake (playa), occupies the mouth of Oro Wash at the northern edge of the quadrangle and is dominated by white to brown, calcareous clay to sand (Miller, 2012). Active alluvial valley deposits are present at the transition from Ivanpah Lake to Oro Wash.

In the southeastern portion of the quadrangle, Lanfair Valley is comprised mainly of older, late to middle Pleistocene age alluvial fan deposits with numerous active and Holocene to Late Pleistocene age channels. Very old alluvial fan deposits flank the valley to the north, while small related alluvial fans of Holocene to middle Pleistocene age lie to the south of this valley. Lanfair Valley is also framed by, and interspersed with, bedrock units of sedimentary, volcanic, granitic and metamorphic origin. Other large alluvial fan networks of Holocene to late Pleistocene age lie northwest of Cima Dome, in the central segment of the quadrangle, and south of Halloran Wash, along the western edge of the quadrangle. An eolian, mixed eolian, and alluvial system consisting of active, modern, and middle Holocene eolian deposits is present in the lower southwestern corner of the quadrangle in the Devil's Playground and Cowhole Mountain regions. Smaller alluvial networks are also located southeast of Black Tank Wash and east of Little Thorn Mountains. Active alluvial fan and wash deposits typically form in discrete channels that are prone to flooding and sheet flow during intense or long-lasting precipitation events (Bedford, Miller, and Phelps, 2010).

Several Quaternary age faults lie within the Ivanpah 30' x 60' quadrangle, but do not appear to have been active during Holocene time (Miller, 2012). The Cedar Canyon Fault separates Pinto Mountain and Mid Hills from the New York Mountains and is considered to be middle Pleistocene or older. In the Cinder Cones Lava Beds area several Quaternary faults cut middle Pleistocene lava flows and display scarps in the Miocene gravels (Miller, 2012). According to Miller, displacements along faults along the southwest front of Old Dad Mountain also appear to be older than middle Pleistocene time, while linear features in the Cima area indicate Pliocene to Pleistocene rupture.

In preparing this derivative map of the Ivanpah 30' x 60'quadrangle, CGS used geologic source data compiled in digital format by Miller (2012). CGS retained the boundaries of Quaternary age surficial deposits shown on the source map with very few revisions. Quaternary surficial deposits on the source map are represented on this map by 19 of the 28 generalized project derivative units; boundaries of more detailed source map subdivisions are shown without label within the generalized derivative unit. This indicates more detailed geologic information is available in the Source GIS Database. For example, an area designated Qyf (young alluvial fan deposits) on this map may have been further divided on the source map into several units to distinguish different depositional surfaces and compositions. Bedrock units identified by Miller (2012) are represented on this map by 5 of the 12 project derivative bedrock units (see Map Units and Correlation of Map Units). Quaternary surficial deposits and geologic formation names originally compiled by Miller (2012) are correlated with derivative categories used by CGS in the Geologic Labels GIS spreadsheet for the Ivanpah quadrangle.

This map, along with others in the Geologic Compilation of Quaternary Surficial Deposits in Southern California Derivative GIS Database, is regional in nature and should not be used as a substitute for detailed geologic studies in any specific area. It is intended only for rapid identification of areas subject to previous and potential future flooding and other geologic hazards on alluvial fans and floodplains.

MAP REFERENCES

DIGITAL GEOLOGIC DATA FILE USED IN GIS COMPILATION OF QUATERNARY UNITS

Miller, D.M., 2012, Surficial geologic map of the Ivanpah 30' x 60' quadrangle, San Bernardino County, California, and Clark County, Nevada: U.S. Geological Survey, Scientific Investigations Map 3206, 31 p., scale 1:100,000.

REFERENCES USED IN PREPARING LEGENDS AND MAPS FOR QUATERNARY UNITS

Matti, J. C., and Cossette, P.M., 2007, Classification of surficial materials, Inland Empire Region, southern California: conceptual and operational framework: U.S. Geological Survey, Open-File Report.

Southern California Areal Mapping Project (SCAMP), 2000, A proposed classification for surficial geologic materials in southern California, version 1.0.

U.S. Geological Survey and California Division of Mines and Geology, 2000, Classification of Quaternary deposits, Southern California Areal Mapping Project (SCAMP), a working model, version 1.0: (09/10/2000).

OTHER SELECTED PUBLICATIONS USED AS REFERENCES

Bedford, D.R., Miller, D.M., and Phelps, G.A., 2010, Surficial geologic map of the Amboy 30' x 60' quadrangle, California: U.S. Geological Survey, Scientific Investigations Map 3109, 26 p., scale 1:100,000, http://pubs.usgs.gov/sim/3109/index.html.

Jennings, C.W. (compiler), 1961, Geologic map of California, Olaf P. Jenkins edition, Kingman sheet: California Division of Mines and Geology, scale 1: 250,000.

Miller, D.M., Miller, R.J., Nielson, J.E., Wilshire, H.G., Howard, K.A., and Stone, P., 1991, Preliminary geologic map of the East Mojave National Scenic Area, California: U.S. Geological Survey, Open File Report 91-435, scale 7 p., scale 1:100,000.

MAP UNITS

Late Holocene (Surficial Deposits)

Artificial Fill - deposits of fill resulting from human construction, mining, or quarrying activities; includes engineered fill for buildings, roads, dams, airport runways, harbor facilities, and waste landfills

Undifferentiated Surficial Deposits - includes colluvium, slope wash, talus deposits, and other surface deposits of all ages; generally unconsolidated but locally may contain consolidated layers

Landslide Deposits - may include debris flows and older landslides of various earth material and movement types; unconsolidated to moderately well-consolidated

Alluvial Wash Deposits - unconsolidated sandy and gravelly sediment deposited in recently active channels of streams and rivers; may contain loose to moderately loose sand and silty sand

Alluvial Fan Deposits - unconsolidated boulders, cobbles, gravel, sand, and silt recently deposited where a river or stream issues from a confined valley or canyon; sediment typically deposited in a fan-shaped cone; gravelly sediment generally more dominant than sandy sediment

Alluvial Valley Deposits - unconsolidated clay, silt, sand, and gravel recently deposited parallel to localized stream valleys and/or spread more regionally onto alluvial flats of larger river valleys; sandy sediment generally more dominant than gravelly sediment

Lacustrine, Playa, and Estuarine (Paralic) Deposits - mostly unconsolidated fine-grained sand, silt, mud, and clay from fresh water (lacustrine) lakes, saline (playa)-dry lakes that are periodically flooded, and estuaries; deposits may contain salt and other evaporites

Eolian and Dune Deposits - unconsolidated, generally well-sorted wind-blown sand; may occur as dune forms or sheet sand

Holocene to Late Pleistocene (Surficial Deposits)

Young Alluvial Wash Deposits - unconsolidated to slightly consolidated, undissected to slightly dissected sandy and gravelly stream bed sediments in marginal parts of active and recently active washes and river channels

Young Alluvial Fan Deposits - unconsolidated to slightly consolidated, undissected to slightly dissected boulder, cobble, gravel, sand, and silt deposits issued from a confined valley or canyon

Young Alluvial Valley Deposits - unconsolidated to slightly consolidated, undissected to slightly dissected clay, silt, sand, and gravel along stream valleys and alluvial flats of larger rivers

Young Lacustrine, Playa, and Estuarine (Paralic) Deposits - unconsolidated to slightly consolidated, undissected to slightly dissected fine-grained sand, silt, mud and clay from lake, playa, and estuarine deposits of various types

Young Eolian and Dune Deposits - unconsolidated to slightly consolidated, undissected to slightly dissected wind-blown sands

Late to Middle Pleistocene (Surficial Deposits)

Old Alluvial Wash Deposits - slightly to moderately consolidated, moderately dissected sand and gravel; typically elevated above modern washes

Old Alluvial Fan Deposits - slightly to moderately consolidated, moderately dissected boulder, cobble, gravel, sand, and silt deposits issued from a confined valley or canyon

Old Alluvial Valley Deposits - slightly to moderately consolidated, moderately dissected clay, silt, sand, and gravel along stream valleys and alluvial flats of larger rivers

Old Eolian and Dune Deposits - slightly to moderately consolidated, moderately dissected wind-blown sands

Middle to Early Pleistocene (Surficial Deposits)

Very Old Alluvial Fan Deposits - moderately to well-consolidated, highly dissected boulder, cobble, gravel, sand, and silt deposits issued from a confined valley or canyon

Very Old Lacustrine, Playa, and Estuarine (Paralic) Deposits - moderately to well-consolidated, highly dissected fine-grained sand, silt, mud, and clay from lake, playa, and estuarine deposits of various types

Quaternary (Bedrock)

Pleistocene age and younger formations of volcanic origin

Tertiary (Bedrock)

Coarse-grained Tertiary age formations - primarily sandstone and conglomerate

Tertiary age formations of volcanic origin

Mesozoic and Older (Bedrock)

Cretaceous and Pre-Cretaceous metamorphic formations of sedimentary and volcanic origin

Granitic and other intrusive crystalline rocks of all ages

SYMBOL EXPLANATION

For geologic line symbols: lines are solid where location is accurate, long-dashed where location is approximate, short-dashed where location is inferred, dotted where location is concealed. Queries added where identity or existence may be questionable.

- Contact
- Fault -- Includes strike-slip, normal, reverse, oblique, and unspecified slip
- Folds -- Showing direction of plunge where appropriate
  - Anticline
  - Syncline
- Stream
- Spring
- Road
- County boundary

CORRELATION OF MAP UNITS*

Quaternary Surficial Deposits	Artificial Fill	Undiff. Surficial Deposits	Landslide Deposits	Alluvial Wash Deposits	Alluvial Fan Deposits	Alluvial Valley Deposits	Lacustrine, Playa, and Estuarine Deposits	Eolian and Dune Deposits
				Alluvial Deposits				
Late Holocene	af	Qsu	Qls	Qw	Qf	Qa	Ql	Qe
Holocene to Late Pleistocene				Qyw	Qyf	Qya	Qyl	Qye
Late to Middle Pleistocene				Qow	Qof	Qoa		Qoe
Middle to Early Pleistocene					Qvof		Qvol	

Quaternary (Bedrock)	Coarse-grained	Volcanic
		Qv

Tertiary (Bedrock)		Volcanic
	Tss	Tv

Mesozoic and Older (Bedrock)	Cretaceous and Pre-Cretaceous Metamorphic (sedimentary and volcanic)	Granitic Rocks (all ages)
	pKm	gr

* Boundaries of Quaternary units are gradational and time transgressive in a regional sense.

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