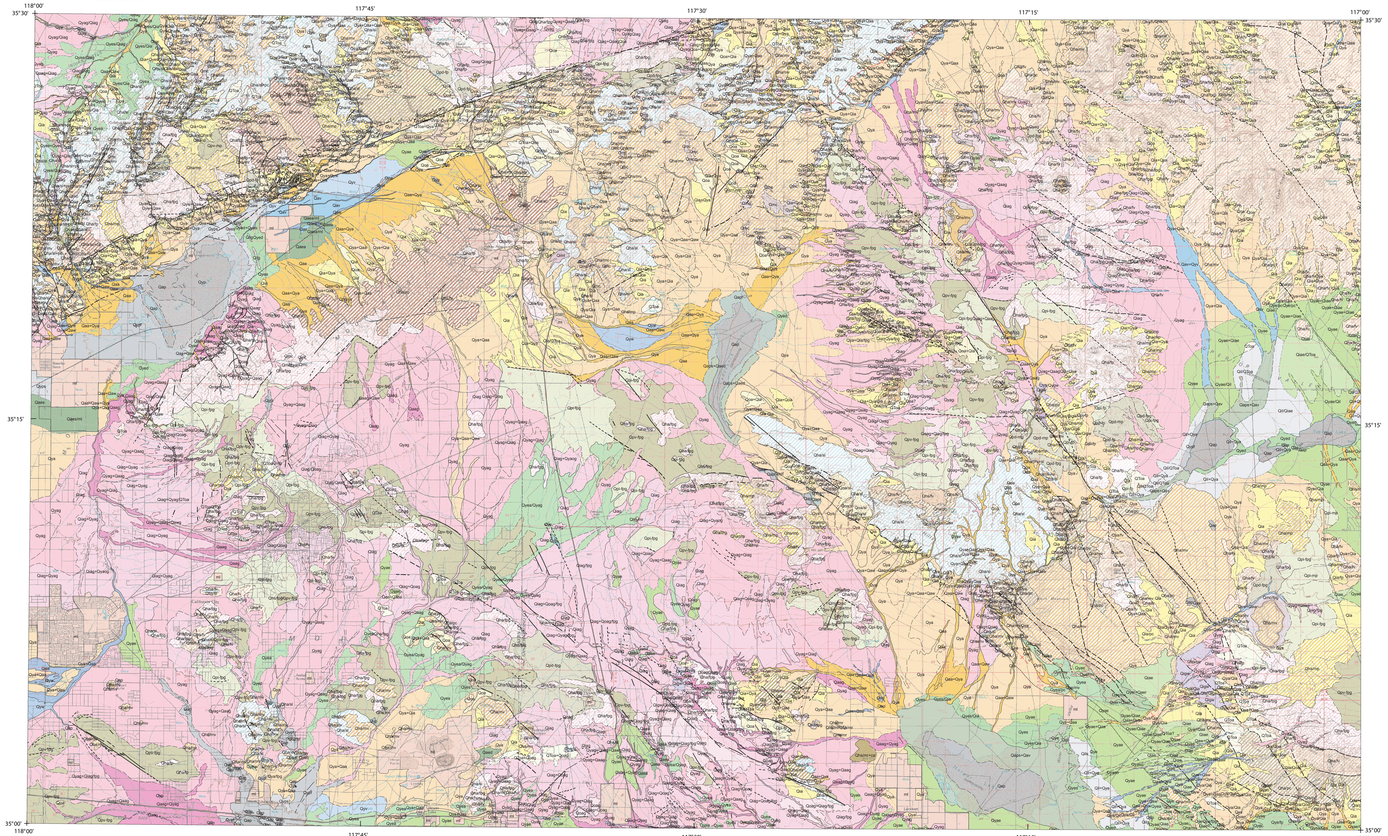
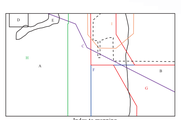
Open File Report 2006-1276
Pamphlet accompanies map
Preliminary Surficial Geologic Map of the Cuddeback Lake
1:100,000-scale quadrangle, California
SHEET 1 OF 1

U.S. Department of the Interior
U.S. Geological Survey

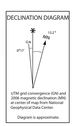
30X60 MINUTE SERIES



Modified base from U. S. Geological Survey, 1976
Projection, zone 11 Universal Transverse Mercator
1927 North American Datum



Index to mapping



SCALE 1:100,000

CONTOUR INTERVAL 50 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Contours and elevations in meters
Geology by Lee Amoroso and David M. Miller, 1999-2005

PRELIMINARY SURFICIAL GEOLOGIC MAP OF THE CUDDEBACK LAKE 30'x60' QUADRANGLE, CALIFORNIA

By

Lee Amoroso and David M. Miller

2006

INDEX MAP

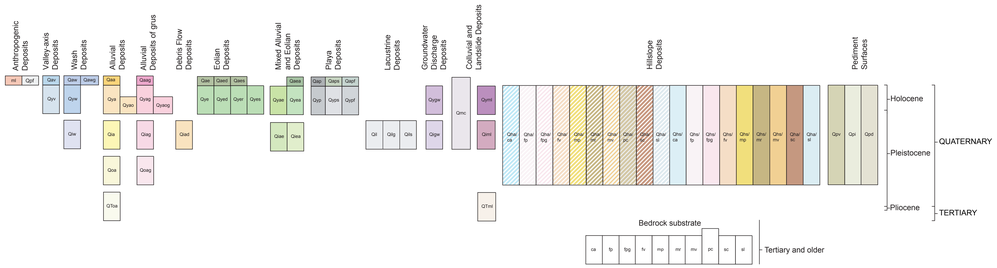
EXPLANATION

- anticline, approximately located
- anticline, inferred
- anticline, inferred, plunge
- contact, approximately located
- contact, certain
- contact, gradational
- fault, approximately located
- fault, certain
- fault, concealed
- fault, queried
- lineament

A. L. Amoroso, compiled and mapped 2002-2005
B. D.M. Miller, mapped 1999-2005
C. Dibblee, 1967
D. Cox and Diggles, 1986
E. Carr et al., 1997
F. Dibblee, 1968
G. Oskin and Iriondo, 2004
H. Troxel and Morton, 1962
I. Smith, 1964

The dashed line marks the approximate boundary of the China Lake Naval Weapons Center and the U.S. Air Force Cuddeback Gunnery Range.

CORRELATION OF MAP UNITS



LIST OF MAP UNITS

(Detailed descriptions of map units are in the accommpanying pamphlet.)

QUATERNARY SURFICIAL DEPOSITS

Anthropogenic deposits

- **md** — **Made land or artificial fill (latest Holocene)**
- **Qpf** — **Ponded fill (latest Holocene)**

Valley-axis deposits

- **Qav** — **Active valley-axis deposit (latest Holocene)**
- **Qvy** — **Young valley-axis deposit (Holocene and latest Pleistocene)**

Wash deposits

- **Qaw** — **Active wash deposit (latest Holocene)– Includes:**
- **Qawg** — **Active wash deposit dominantly composed of grus (latest Holocene)**
- **Qyw** — **Young wash deposit (Holocene and latest Pleistocene)**
- **Qiw** — **Intermediate-age wash deposit (late and middle Pleistocene)**

Alluvial deposits

- **Qaa** — **Active alluvial fan deposit (latest Holocene)**
- **Qya** — **Young alluvial fan deposit (Holocene and latest Pleistocene)– Includes:**
- **Qyao** — **Older young alluvial fan (early Holocene and latest Pleistocene)**
- **Qia** — **Intermediate-age alluvial fan deposit (late and middle Pleistocene)**
- **Qoa** — **Old alluvial fan deposit (middle and early Pleistocene)**
- **QTos** — **Oldest Quaternary–Tertiary alluvial fan deposit (early Pleistocene and Pliocene)**

Alluvial deposits composed of grus

- **Qaag** — **Active alluvial fan deposit composed of grus (latest Holocene)**
- **Qyag** — **Young alluvial fan deposit composed of grus (Holocene and latest Pleistocene)**
- **Qyaog** — **Older young alluvial fan composed of grus (early Holocene and latest Pleistocene)**
- **Qiag** — **Intermediate-age alluvial fan deposit composed of grus (late and middle Pleistocene)**
- **Qoag** — **Old alluvial fan deposit composed of grus (middle and early Pleistocene)**

Debris flow deposits

- **Qiad** — **Intermediate-age alluvial fan composed of debris flow deposits (late and middle Pleistocene)**

Eolian deposits

- **Qae** — **Active eolian sand deposit (latest Holocene)– Includes:**
- **Qaed** — **Active eolian sand dune deposit (latest Holocene)**
- **Qaes** — **Active eolian sand sheet deposit (latest Holocene)**
- **Qye** — **Young eolian sand deposit (Holocene and latest Pleistocene)– Includes:**
- **Qyed** — **Young eolian sand dune deposit (Holocene and latest Pleistocene)**
- **Qyer** — **Young eolian sand ramp deposit (Holocene and latest Pleistocene)**
- **Qyes** — **Young eolian sand sheet deposit (Holocene and latest Pleistocene)**

Mixed alluvial and eolian deposits

- **Qaea** — **Active mixed eolian sand and alluvial deposit (latest Holocene)**
- **Qyae** — **Young mixed alluvial and eolian sand deposit (Holocene and latest Pleistocene)**
- **Qyea** — **Young mixed eolian sand and alluvial deposit (Holocene and latest Pleistocene)**
- **Qiae** — **Intermediate-age mixed alluvial and eolian sand deposit (late and middle Pleistocene)**
- **Qiea** — **Intermediate-age mixed eolian sand and alluvial deposit (late and middle Pleistocene)**

Playa deposits

- **Qap** — **Active playa deposit (latest Holocene)– Includes:**
- **Qapf** — **Active playa fringe facies deposit (latest Holocene)**
- **Qaps** — **Active playa sandy facies deposit (latest Holocene)**
- **Qyp** — **Young playa deposit (Holocene and latest Pleistocene)– Includes:**
- **Qypf** — **Young playa fringe deposit (Holocene and latest Pleistocene)**
- **Qyps** — **Young playa sandy facies deposit (Holocene and latest Pleistocene)**

Lacustrine deposits

- **Qil** — **Intermediate-age lacustrine deposit (late and middle Pleistocene)– Includes:**
- **Qilg** — **Intermediate-age lacustrine gravel deposit (late and middle Pleistocene)**
- **Qils** — **Intermediate-age lacustrine sandy facies deposit (late and middle Pleistocene)**

Groundwater discharge deposits

- **Qygw** — **Young groundwater wetland deposit (Holocene and latest Pleistocene)**
- **Qigw** — **Intermediate groundwater wetland deposit (late and middle Pleistocene)**

- **Qmc** — **Young and intermediate colluvial deposit (Holocene, late and middle Pleistocene)**
- **Qymt** — **Intermediate-age landslide deposit (late and middle Pleistocene)**
- **Qimt** — **Intermediate-age landslide deposit (late and middle Pleistocene)**
- **QTmt** — **Oldest Quaternary–Tertiary landslide deposit (middle and early Pleistocene and Pliocene)**

Hillslope deposits

- **Qhaca** — **Abundant hillslope deposit (Holocene and Pleistocene) overlying carbonate bedrock**
- **Qhafp** — **Abundant hillslope deposit (Holocene and Pleistocene) overlying felsic plutonic bedrock**
- **Qhafpg** — **Abundant hillslope deposit (Holocene and Pleistocene) overlying felsic plutonic bedrock that weather to grus**
- **Qhafv** — **Abundant hillslope deposit (Holocene and Pleistocene) overlying felsic volcanic bedrock**
- **Qhamp** — **Abundant hillslope deposit (Holocene and Pleistocene) overlying mafic plutonic bedrock**
- **Qhamm** — **Abundant hillslope deposit (Holocene and Pleistocene) overlying metamorphic bedrock**
- **Qhamv** — **Abundant hillslope deposit (Holocene and Pleistocene) overlying mafic volcanic bedrock**
- **Qhapc** — **Abundant hillslope deposit (Holocene and Pleistocene) overlying partly consolidated bedrock**
- **Qhass** — **Abundant hillslope deposit (Holocene and Pleistocene) overlying schistose bedrock**
- **Qhasi** — **Abundant hillslope deposit (Holocene and Pleistocene) overlying siliciclastic bedrock**
- **Qhsca** — **Sparse hillslope deposit (Holocene and Pleistocene) overlying carbonate bedrock**
- **Qhsfp** — **Sparse hillslope deposit (Holocene and Pleistocene) overlying felsic plutonic bedrock**
- **Qhsfpg** — **Sparse hillslope deposit (Holocene and Pleistocene) overlying felsic plutonic bedrock that weathers to grus**
- **Qhsfv** — **Sparse hillslope deposit (Holocene and Pleistocene) overlying felsic volcanic bedrock**
- **Qhsmp** — **Sparse hillslope deposit (Holocene and Pleistocene) overlying mafic plutonic bedrock**
- **Qhsmm** — **Sparse hillslope deposit (Holocene and Pleistocene) overlying metamorphic bedrock**
- **Qhsmv** — **Sparse hillslope deposit (Holocene and Pleistocene) overlying mafic volcanic bedrock**
- **Qhspc** — **Sparse hillslope deposit (Holocene and Pleistocene) overlying partly consolidated bedrock**
- **Qhssi** — **Sparse hillslope deposit (Holocene and Pleistocene) overlying siliciclastic bedrock**

Pediment surfaces-- Gently-sloping erosional surfaces in various stages of erosion and burial. Generally forms in felsic granite (fp and fpg) and mafic plutonic rocks (mp). Substrate materials indicated after hyphen (-) in unit symbol. Excellent examples of pediments are found on the south flank of the Rand Mountains, south of Twin Buttes, and east of Cuddeback Lake. Divided into three classes defined by the degree of dissection:

- **Qpv-fpp** — **Pediment in felsic plutonic rocks with veneer of grus**
- **Qpv-mp** — **Pediment in mafic plutonic rocks with veneer of sediment**
- **Qpi-fp** — **Incised pediment in felsic plutonic rocks**
- **Qpi-fpg** — **Incised pediment in felsic plutonic rocks that weather to grus**
- **Qpi-mp** — **Incised pediment in mafic plutonic rocks**
- **Qpd-fp** — **Deeply dissected pediment in felsic plutonic rocks**
- **Qpd-fpg** — **Deeply dissected pediment in felsic plutonic rocks that weather to grus**
- **Qpd-mp** — **Deeply dissected pediment in mafic plutonic rocks**

Bedrock substrate materials

(Tertiary and older)– Shallowly buried rock and partly consolidated materials that may lie under surficial deposits, and as pediment and hillslope veneers. Ages range from Pliocene to early Proterozoic. Dibblee (1967), Carr and others (1997), and Cox and Diggles (1986) are the primary sources of bedrock mapping data in the western portion of the quadrangle. The following are subdivided into categories based on initial chemical composition, weathering characteristics, and erosion products. No color is shown for bedrock as units occur only with overlying Quaternary units (e.g., Qha/ca).

- **ca** — **Carbonate rocks**
- **fp** — **Felsic plutonic rocks**
- **fpg** — **Felsic plutonic rocks that weather to grus**
- **fv** — **Felsic volcanic rocks**
- **mp** — **Mafic plutonic rocks**
- **mr** — **Metamorphic rocks**
- **mv** — **Mafic volcanic rocks**
- **pc** — **Partly consolidated**
- **sc** — **Schistose rocks**
- **si** — **Siliciclastic rocks**

CLASSIFICATION OF MAP UNITS

Classification of the Quaternary geologic units and surficial deposits are based on previous work by Yount and others (1994), and follows work by Birkeland and others (1991) and Birkeland (1999). On this map the first two characters of the unit label designate the age followed by a geomorphic process label and a modifier. The first letter is for the Quaternary Period, the second letter is the relative age, the third letter is an abbreviation for the geomorphic process, and the fourth letter is for an additional modifier of the process, age or material. The relative ages of the units are presented youngest to oldest. For example, a Qya deposit is active, a Qya deposit is young, a Qia deposit is intermediate age, and a Qoa deposit is old. The 'a' is a placeholder for geomorphic process or landscape position such as 'a' for alluvium, 'e' for eolian, and 'p' for playa. Unless observed in the field and specifically mapped, a given age surficial deposit may be composed of different subunits. For example, alluvial units may have significant contributions from eolian or mass-wasting processes. Subunits such as mass-wasting deposits may be more common than shown here but could not be reliably identified using remote sensing imagery.

Active aggradation surfaces (Qax) have received deposition within the last few decades or centuries. They are characterized by unconsolidated sediment and are prone to flooding and sediment transport. They are typically unvegetated or moderately vegetated and have significant microtopography such as prominent gravel bars with intervening swales of fine-grained materials or debris-flow lobes and levees. Active surfaces cover a small area on alluvial fans and usually form discrete channels. Young surfaces (Qys) are middle and early Holocene age but are abandoned or receive sediment infrequently. These surfaces are characterized by loose to to slightly compact sediments. Soils are thin with incipient to weak development characterized by a sandy vesicular (Av) horizon over a weak cambic horizon (Bw). Soils with Stage I carbonate morphology can be seen in the older (Qys) deposits. Young surfaces are moderately vegetated and show smoother microtopography with low to moderate relief bar and swale. Desert pavement is not present but the clasts may show some desert varnish and rubification (reddening) on the clast undersides. Intermediate-age surfaces (Qia) are late and middle Pleistocene in age and have been abandoned for tens to several hundred thousand years. Sediments are slightly to moderately compact. These surfaces may have moderately to well-developed desert pavement with moderate to strong desert varnish on clasts. The surface microtopography is nearly flat, the original bar and swale form has been destroyed. There may be up to several meters of incision into these deposits. Moderate to strong pedogenesis has resulted in a silty Av horizon beneath the desert pavement. There is moderate to strong Bt horizon development (significant clay) and the sediment may show from Stage I+ to III+ carbonate morphology (Gile, 1981; Machette, 1985). Time-dependent processes used to evaluate surficial unit age, such as pedogenesis, desert varnish development, and the vertical separation of different age deposits were best judged from field relationships.

Unit descriptions in the pamphlet are formatted as follow: 1) grain size, sorting, rounding, and composition, 2) sedimentary structures and degree of consolidation, 3) surface morphology, 4) soil development, 5) inset relations and landscape position, 8) common vegetation, and 9) human implications and impacts along with diagnostic features. The primary categories are grouped by depositional process with the units listed from youngest to oldest.

Composite symbols

Surficial geologic units are commonly thin (<2 m) veneers over older units including bedrock. Where this is common, the unit descriptors are shown on the map separated by a slash (/). The younger, overlying unit is listed first. For example, Qya/Qoa indicates a veneer of younger alluvial deposits overlying old alluvial deposits and Qyv/fpg indicates a young eolian deposit over grus-producing felsic plutonic rock. This usage also applies to hillslope deposits, for example Qha/mv indicates abundant hillslope deposits over mafic volcanic rock.

The areal extent of some deposits is too small to show at the map scale, these are indicated by two or more deposits (covering more than 20% of the area) separated by a plus sign (+). The most common deposit is listed first, for example Qiag+Qoag indicates that both deposits are present and Qiag is more abundant than Qoag. Other deposits may be present and are less than 20% of the unit area. Compound units may also be veneers on older deposits. For instance, the unit Qye+Qae/Qilg indicates that the mixed eolian unit Qye+Qae overlies an older lacustrine unit.

Not edited for U.S. Geological Survey cartographic standards
Digital map layout and cartography by Lee Amoroso and David M. Miller
Color and pattern selections on the geologic map by Kevin M. Schmidt

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