UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAPS SHOWING CENOZOIC DEPOSITS OF THE COOPERSTOWN AND LA GRANGE QUADRANGLES STANISLAUS AND TUOLUMNE COUNTIES, CALIFORNIA

by

Denis E. Marchand, J. Alan Bartow, and Susan Shipley

Open-File Report 81-1049

1981

This report is preliminary
and has not been reviewed
for conformity with
U. S. Geological Survey editorial standards
and stratigraphic nomenclature

INTRODUCTION

This is one of a series of preliminary geologic maps depicting late Cenozoic deposits of the San Joaquin Valley in a manner that will facilitate understanding of the depositional and tectonic history of the valley (for example--Marchand, 1976, 1980, 1981; Marchand and Wagner, 1980). Our efforts have concentrated on refining and further subdividing the stratigraphic units proposed by earlier workers (Arkley, 1964; Davis and Hall, 1959) to allow for more precise dating of depositional and tectonic events. The interested reader should consult Marchand and Allwardt (1981) for a more complete discussion of the late Cenozoic stratigraphy.

Quaternary deposits of the eastern San Joaquin Valley occur near the Sierra Nevada foothills as a series of nested alluvial terraces. Though these are locally found as straths, major terrace-forming units generally appear as fills in valleys carved into Mesozoic, Tertiary, and older Quaternary units. The depositional surfaces of the terraces converge westward and open onto alluvial fans such that successively younger fans bury older fans toward the San Joaquin Valley axis.

Geologic, pedologic and physiographic evidence was used to separate the Cenozoic deposits within the map area into thirteeen stratigraphic units--from oldest to youngest, the Ione, Valley Springs, Mehrten, and Laguna Formations, the North Merced Gravel, the Turlock Lake (two units), Riverbank (three units) and Modesto (two members) Formations, and post-Modesto deposits. Useful criteria for differentiating these units include superposition, lithology, degree of consolidation, degree of soil profile development, degree of erosional modification,and position within a sequence of geomorphic surfaces.

Mapping was carried out through the use of soil survey maps, old and modern topographic maps, available exposures, auger borings, aerial photographs and pre-existing geological maps. Physiographic evidence for the relative age of the deposits is generally definitive near the foothills. As the depositional surfaces converge westward, geomorphic evidence becomes ambiguous and depositional units are separated primarily on the basis of unconformities, buried paleosols, or contrasting degree of development of relict soils. Emphasis in mapping was placed on the Quaternary units. Contacts of pre-Quaternary units were field checked locally and are based primarily on soil survey maps and airphotos, augmented by the field mapping of Mannion (1960) and Woodward-Clyde Consultants (1977).

In preparing the maps, boundaries between previously mapped soil units (Arkley, 1964) were transferred manually to 1:24,000 scale 7.5-minute topographic maps. In defining stratigraphic units, some soil units were combined and others were subdivided on the basis of field observation of soils exposed in auger holes, river bluffs, roadcuts, canal excavations and other suitable exposures. The geologic contacts obtained from this soil information were then modified by means of additional field reconnaissance and, in some cases, by examination of the oldest available topographic maps or interpretation of 1:20,000 scale U. S. Geological Survey aerial photographs. The short fault on Rydberg Creek on the Cooperstown quadrangle was identified from field exposure. The faults on the La Grange quadrangle were modified from Mannion (1960).

Mapping and correlation of Cenozoic deposits in Stanislaus County has been greatly facilitated by consultation with R. J. Arkley. R. L. Blum of the Pacific Gas and Electric Company generously provided a preliminary copy of a geologic map of the Stanislaus Nuclear Project Site (Woodward-Clyde Consultants, 1977). The authors, however, are responsible for any inaccuracies in this report. C.A. Price provided invaluable assistance by completing drafting of the maps and compiling data for the explanation after the death of Denis Marchand in January, 1981.

REFERENCES CITED

Arkley, R. J., 1964, Soil survey of the eastern Stanislaus area, California: U. S. Department of Agriculture, Soil Survey Series 1957, no. 20 60 p.

Davis, S. N. and Hall, F. R., 1959, Water quality of eastern Stanislaus and northern Merced Counties, California: Stanford University Publication of Geological Sciences, v. 6, no. 1, 112 p.

Mannion, L. E., 1960, Geology of the La Grange quadrangle: unpublished Ph.D dissertation, Stanford University, 188 p.

Marchand, D. E., 1976, Preliminary geologic maps showing Quaternary deposits of the northern Merced area, eastern San Joaquin Valley, Merced and Stanislaus Counties, California: U. S. Geological Survey Open-File Report 76-836, scale 1:24,000.

Marchand, D. E. , 1980, Preliminary geologic maps showing last Cenozoic deposits of the Ceres, Denair, and Montepelier quadrangles, California: U. S. Geological Survey Open-File 80-607, scale 1:24,000.

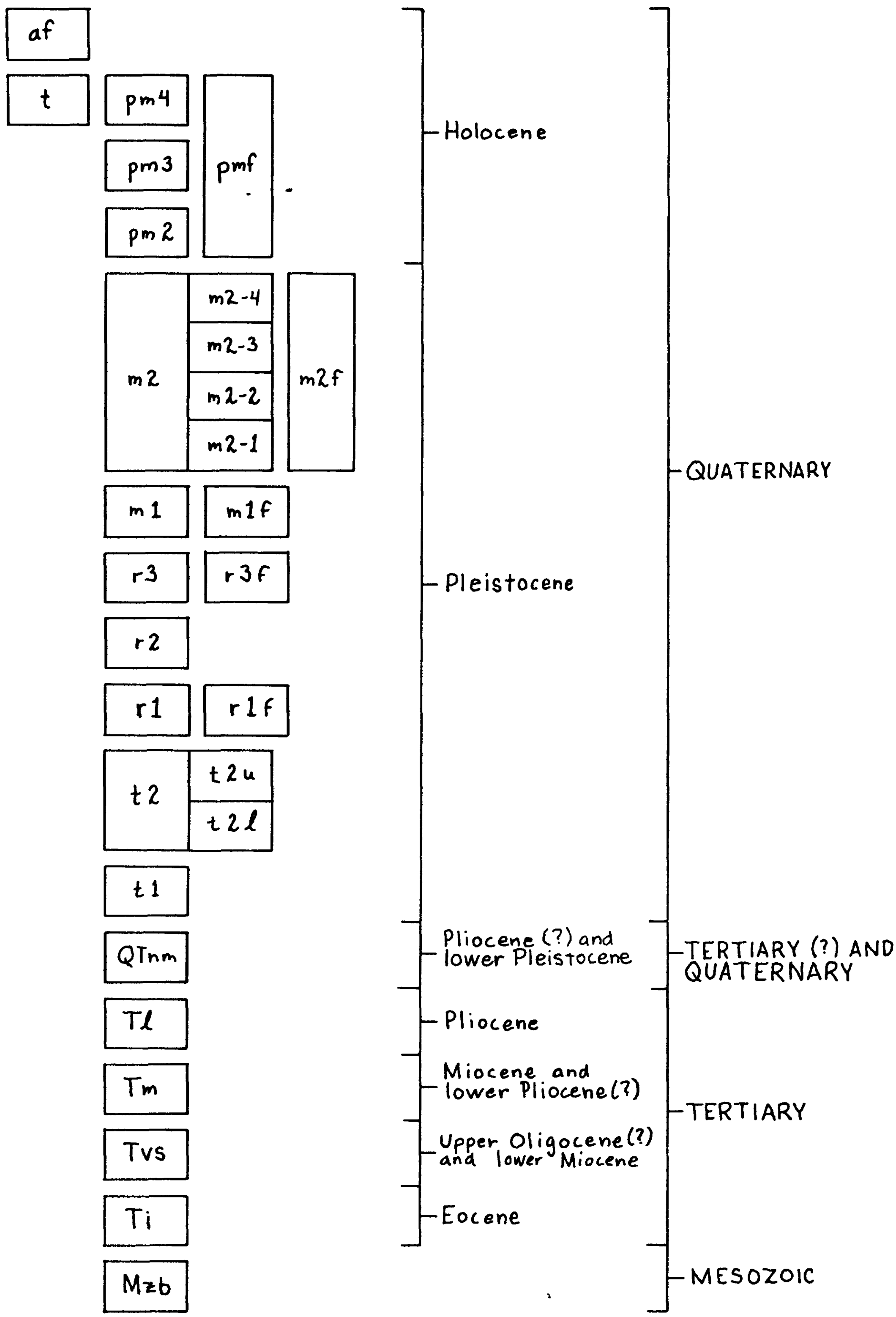
Marchand, D. E., 1981, Preliminary geologic maps showing Cenozoic deposits of the Snelling and Merced Falls quadrangles, Merced and Stanislaus Counties, California: U. S. Geological Survey Open-File Report 81-107, scale 1:24,000.

Marchand, D. E. and Allwardt, Alan, 1981, Late Cenozoic stratigraphic units, northeastern San Joaquin Valley, California: U. S. Geological Survey Bull. 1470, 70 p.

Marchand, D. E., and Wagner, Hugh, 1980, Preliminary geologic map showing late Cenozoic deposits of the Turlock Lake quadrangle, Merced and Stanislaus Counties, California: U. S. Geological Survey Open-File Report 80-913, scale 1:24,000.

Woodward-Clyde Consultants (for Pacific Gas and Electric Co.), 1977, Preliminary areal geology and outcrop map of the Stanislaus Nuclear Project: unpublished, scale 1:24,000.

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS[1]

Unit	Description
af	ARTIFICIAL FILL
t	DREDGE TAILINGS Gravelly debris from placer mining since deposition of unit pm3
	POST-MODESTO DEPOSITS
pm4	Modern alluvial sand, gravel, and silt of channels and point bars along the Tuolumne River (Riverwash)
pm3	Historic alluvial gravel, sand, and overbank silt along the Tuolumne River associated with natural levees, meanders, meader scars, and low benches about 2 m above base flow levels (Riverside and Hanford soils)
pm2	Late Holocene arkosic alluvial gravel, sand and overbank silt along the Tuolumne River (Hanford, Tujunga, Bear Creek and Grangeville soils)
pmf	Locally (Sierra Nevada foothill) derived undifferentiated alluvium (Honcut soils)
	MODESTO FORMATION Upper member includes:
m2	Arkosic sandy alluvium along the Tuolumne River, not differentiated as to terrace level; represents glacial outwash from the core of the Sierra Nevada (Hanford and Tujunga soils)
m2-4	Phase four-arkosic alluvium forming low terraces along the Tuolumne River; terraces are closer in elevation to the holocene terraces than to phase 2 or phase 3 surfaces (Hanford soils)
m2-3	Phase three-arkosic alluvium forming terraces between phase 2 and phase 4 surfaces (Hanford soils)
m2-2	Phase two - arkosic alluvium forming terraces between phase 1 and phase 3 surfaces (Hanford soils)
m2-1	Phase one - arkosic alluvium forming the highest of the upper member terraces (Hanford soils)
m2f	Locally (Sierra Nevada foothill) derived alluvial silt, sand, and gravel forming low terraces; contains abundant volcanic and metamorphic detritus (Hanford, Wyman, and Bear Creek soils)
	Lower member includes:
m1	Arkosic sandy alluvium associated with terraces at or slightly above the highest m2 level along the Tuolumne River; represents glacial outwash from the core of the Sierra Nevada (Greenfield and Dinuba soils)
m1f	Locally (foothill) derived alluvial silt, sand and gravel forming terraces slightly above the m2f surfaces; contains abundant volcanic and metamorphic detritus (Ryer soils)

1 The most characteristic soil series as mapped by Arkley (1964) are given in parentheses after unit description.

	RIVERBANK FORMATION Upper unit includes:
r3	Arkosic glacial outwash sand forming terraces slightly above the highest m2 surfaces along the Tuolumne River (Madera and Snelling soils)
r3f	Locally (foothill) derived alluvial silt and sand forming terraces slightly above m1f surfaces (Whiterock and Yokohl soils) Middle unit:
r2	Arkosic glacial outwash sand forming terraces about 3-5 m above r3 levels along the Tuolumne River (Snelling and Montpelier soils) Lower unit includes:
r1	Arkosic glacial outwash sand forming terrace remnants about 3-6m above r2 levels along the Tuolumne River (San Joaquin soils)
r1f	Locally (foothill) derived alluvial silt, sand, and gravel forming terrace remnants about 3-6m above r2 levels along the Tuolumne River (San Joaquin soils)
	TURLOCK LAKE FORMATION Upper unit includes:
t2	Undifferentiated arkosic glacial outwash underlying rolling, hilly topography (Montpelier and Whitney soils)
t2u	Arkosic coarse sand and gravel forming upper part of the upper unit; underlies a hilly, rolling topography; represents coarse glacial outwash (Montpelier soils)
t2l	Arkosic fine sand, silt, and clay forming lower part of the upper unit; crops out on lower hillslopes below t2u; represents fine glacial outwash and rock flour from the core of the Sierra Nevada (Whitney soils) Lower unit:
t1	Arkosic sand silt, and pebble gravel; represents glacial outwash; exposed only in valleys or hillslopes where it underlies the upper unit (Rocklin soils)
QTnm	NORTH MERCED GRAVEL Thin, locally derived gravel veneer overlying a pediment surface cut across Tertiary and Mesozoic rocks (Corning and Redding soils)
Tl	LAGUNA FORMATION Gravel, sand and silt derived from mixed sources (Corning soils)
Tm	MEHRTEN FORMATION Gray andesitic sandstone, brown to pink claystone, and gray sandy to pebbly andesitic mudstone
Tvs	VALLEY SPRINGS FORMATION Light greenish grey to tan claystone, tuffaceous claystone, light gray vitric tuff, siltstone, sandstone and conglomerate

Ti

IONE FORMATION

White to brown quartzose kaolinitic sandstone, quartzose conglomerate, and greenish grey claystone to clayey siltstone; remnants of lateritic paleosol found locally at top

Mzb

BASEMENT ROCKS

Metavolcanic rocks and slate

MAP SYMBOLS

Contact

Fault
Dashed where approximately located, dotted where concealed

Topographic or photo lineament
Dashed where approximately located

Limit of geologic mapping