UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAPS SHOWING LATE CENOZOIC DEPOSITS OF THE TURLOCK LAKE QUADRANGLE, MERCED AND STANISLAUS COUNTIES, CALIFORNIA

by

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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; Marchand and Harden, 1978; Marchand, 1980). Our efforts have concentrated on refining and further subdividing the stratigraphic units proposed by earlier workers (Arkley, 1962, 1964; Davis and Hall, 1959) to allow for more precise dating of specific depositional and tectonic events. This particular quadrangle demonstrates the spatial relations between most of the Quaternary and late Tertiary stratigraphic units in the northeastern San Joaquin Valley. The interested reader should consult Marchand and Allwardt (1977) for a schematic cross section of an area just east of this quadrangle and for a more complete discussion of Quaternary stratigraphic relations and ages of the deposits.

The Quaternary deposits of the eastern San Joaquin Valley occur near the Sierra Nevada foothills as a series of nested alluvial terraces. Both fill and strath terraces are present, but the major stratigraphic units appear to fill erosional 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 ten major stratigraphic units--the Mehrten, Laguna, Turlock Lake (two units), and Riverbank (three units) Formations, the lower and upper members of the Modesto Formation, and post-Modesto deposits. Useful criteria for making these relative age assignments are superposition, lithology, degree of consolidaton and soil profile development, degree of erosional modification, position within a sequence of geomorphic surfaces, and cross-cutting soil patterns. Subdivision of the Mehrten Formation in the vicinity of Turlock Lake was by lithology and superposition. These Mehrten units, discussed in detail by Wagner (in preparation), have yielded an extremely rich Hemphillian vertebrate fauna (Wagner, 1976). Bone and tooth material reworked from these beds are found in abundance along the shores of Turlock Lake reservoir.

Mapping was carried out through the use of soil survey maps, old and modern topographic maps, available exposures, auger borings, and aerial photographs. Physiographic evidence for the relative age of the deposits is generally definitive near the foothills. As the depositional surfaces converge westward, geomorphic evidence becomes more ambiguous and separate depositional units are recognized primarily on the basis of stratigraphic unconformities, contrasting degree of development of relict soil profiles, and buried paleosols.

In preparing the maps, boundaries between previously mapped soil units (Arkley, 1964) were transferred manually to standard 1:24,000 7 ½ minute topographic maps. Some soil units were combined, and others were subdivided to define geologic map units following 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 examination of the oldest available topographic maps, as well as interpretation of 1:20,000 U.S. Geological Survey aerial photographs. Faults and folds were identified from reconstruction of the Turlock Lake and Riverbank depositional surfaces, from available field exposures, and in locations where linear geologic contacts coincide with photolineaments.

Mapping and correlation of Cenozoic deposits in Stanislaus County has been greatly facilitated by consultation with R. J. Arkley and J. A. Bartow.

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DESCRIPTION OF MAP UNITS[1/]

mh — undifferentiated late Modesto and Holocene alluvial deposits, locally derived

POST-MODESTO DEPOSITS

pm4 — modern alluvial sand, gravel, and silt of channels and point bars along the Merced River and Dry Creek (Riverwash)

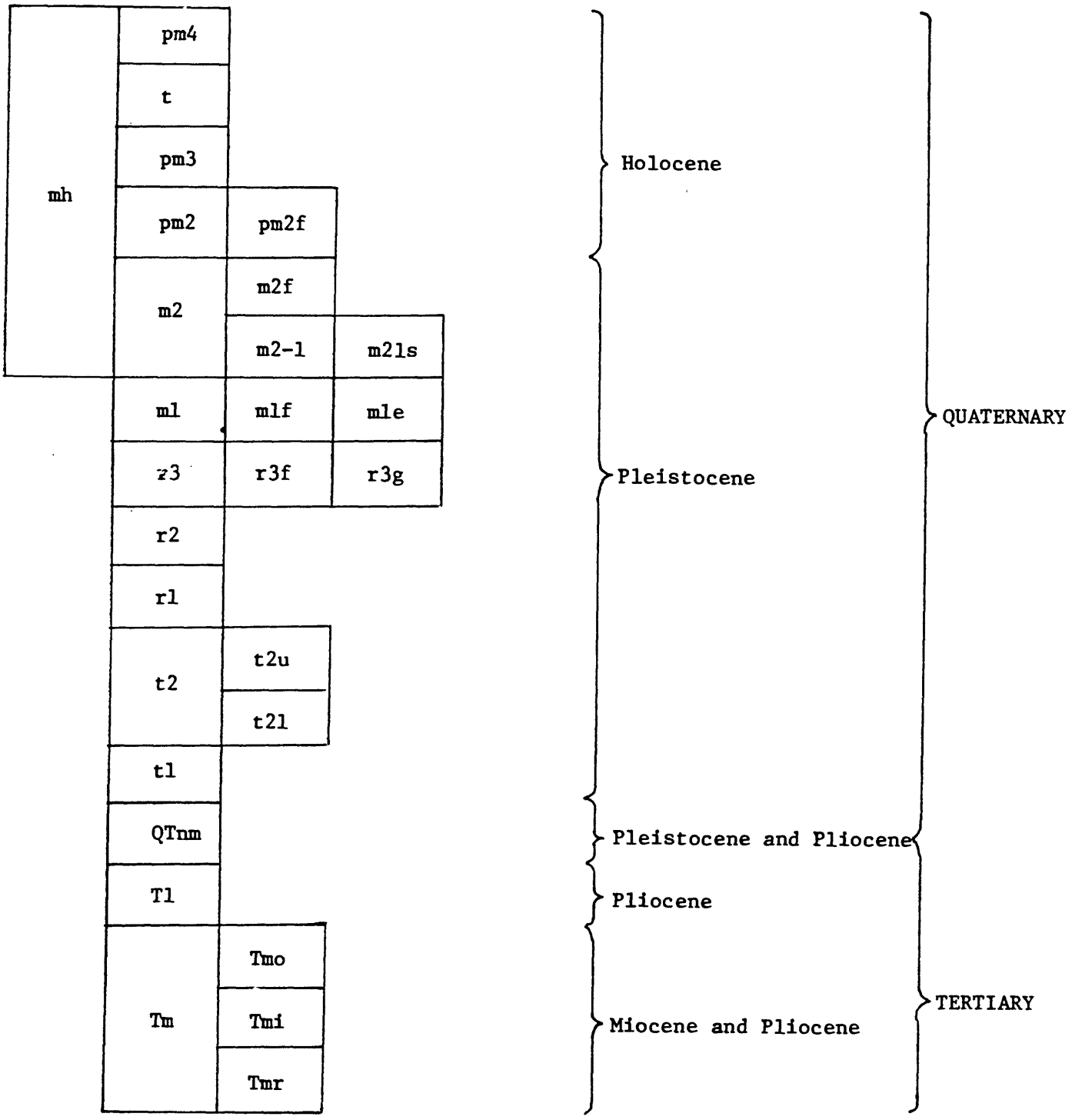
t — Dredge tailings; gravel debris from placer mining, younger than pm3

pm3 — historic alluvial gravel, sand, and overbank silt along the Merced River associated with natural levees, meanders, meander scars, and low benches about 2 m above base flow levels (Grangeville, Foster, and Tujunga soils)

pm2 — late Holocene arkosic alluvial gravel, sand, and overbank silt along the Merced River forming a prominent low terrace about 0.5-1.5 m above pm3 levels (Grangeville, Hanford, Foster, and Tujunga soils)

pm2f — late Holocene alluvial sand, gravel, and silt along Dry Creek derived from andesitic and metamorphic sources; grades to and interfingers with pm2 terrace alluvium of the Merced River (Honcut soils)

CORRELATION OF MAP UNITS



MODESTO FORMATION

upper member includes:

m2 arkosic alluvial sand and underlying silt along the Tuolumne River, not differentiated as to terrace level; represents glacial outwash from the core of the Sierra Nevada (Hanford, Oakdale, and Greenfield soils)

m2f locally (foothill) derived alluvial silt, sand, and gravel forming low terraces along Dry Creek and smaller drainages tributary to the Merced and Tuolumne Rivers; abundant volcanic detritus derived from the Mehrten Formation (Wyman and some Honcut soils)

m2-1 arkosic alluvial sand and underlying silt associated with the highest late Modesto terrace along the Tuolumne River (Hanford and Greenfield soils)

m21s arkosic silt and clay deposited in local lakes, swamps, and marshes formed at the mouths of small gulleys tributary to the Tuolumne River where blocked by rapid mainstream late Modesto (m2-1) aggradation (Meikle soils)

lower member includes:

m1 arkosic alluvial sand associated with terraces at or slightly above the m2-1 level along the Tuolumne and Merced Rivers; represents glacial outwash from the core of the Sierra Nevada (Greenfield soils)

m1f locally (foothill) derived alluvial silt, sand, and gravel forming terraces along Dry Creek slightly above the m2f surfaces; contains abundant volcanic detritus derived from the Mehrten Formation (Ryer soils)

m1e arkosic eolian sand, moderately well sorted (Greenfield soils)

RIVERBANK FORMATION

upper unit includes:

r3 arkosic glacial outwash sand forming terraces at or slightly above m2-1 and ml levels along the Tuolumne and Merced Rivers (Snelling, Madera, and San Joaquin soils)

r3f locally (foothill) derived alluvial silt and sand forming terraces along Dry Creek and other small streams tributary to the Merced and Tuolumne Rivers slightly above mlf surfaces; contains abundant volcanic detritus derived from the Mehrten Formatin (Yokohl, Snelling, San Joaquin soils)

r3g locally derived gravelly alluvium graded to r3 and r3f levels (Redding, Keyes soils)

middle unit includes:

r2 arkosic glacial outwash sand forming terraces about 3-5 m above r3 levels along the Tuolumne and Merced Rivers (Snelling, San Joaquin soils)

lower unit includes:

r1 arkosic glacial outwash sand forming terrace remnants about 3-6 m above r2 levels along the Merced River (Snelling, San Joaquin soils)

TURLOCK LAKE FORMATION

upper unit includes:

t2 undifferentiated arkosic glacial outwash underlying rolling, hilly topography (Rocklin, Whitney soils)

t2u arkosic coarse sand and pebbly sand 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 includes:

t1 arkosic glacial outwash sand, silt, and pebble gravel; exposed only in valleys or on lower hillslopes where it underlies the upper unit (Montpelier, Rocklin, and Whitney soils)

NORTH MERCED GRAVEL

QTnm Thin, locally derived gravel veneer overlying a pediment surface cut across the Mehrten and Laguna Formations in this area; stands slightly above the reconstructed Turlock Lake depositional surface (Redding soils)

LAGUNA FORMATION

Tl — Thick gravel with subordinate sand and silt (beneath the gravel cap); derived from mixed metamorphic, volcanic, and granitic sources from the Tuolumne and Merced drainages (Redding and Corning, and Hopeton soils).

MEHRTEN FORMATION

Tm — Undifferentiated mudstone, siltstone, sandstone, conglomerate, and lahars derived from andesitic volcanic centers near the crest of the Sierra Nevada (Raynor, Pentz, Peters, and Keyes soils)

Tmo — brown sandstone, siltstone, and local conglomerate unconformably overlying Tmi and Tmr; fine-grained beds near the top contain some biotite and abundant quartz and feldspar; contains abundant bone fragments (coarser beds) and a few leaf impressions (siltstones and mudstones); (mainly Pentz, Keyes, and Raynor soils)

Tmi — pinkish-gray and gray siltstone and minor sandstone, overlain by pale yellowish-brown siltstone; all deposits clearly of andesitic derivation (Peters soils)

Tmr — brown to pale reddish-brown tan, white, and grayish-pink andesitic sandstone with interbedded siltstone; contains a white, waterlain tuff; moderately developed soil locally preserved at top of unit (Raynor, Pentz, and Peters soils)

1/ The most characteristic soil series as mapped by Arkley (1954) are given in parenthesis after each unit description

DESCRIPTION OF MAP SYMBOLS

Fault

Photolineament

Topographic Lineament

Anticlinal axis

Synclinal axis, showing plunge

Dotted where concealed, dashed where inferred or uncertain; queried where doubtful