Upper Miocene and Pliocene Marine Stratigraphy in Southern Salinas Valley California

By DAVID L. DURHAM *and* WARREN O. ADDICOTT

CONTRIBUTIONS TO STRATIGRAPHY

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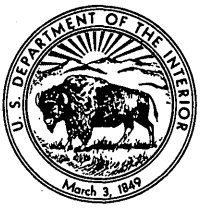

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CONTENTS

ILLUSTRATIONS

TABLE

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CONTRIBUTIONS TO STRATIGRAPHY

UPPER MIOCENE AND PLIOCENE MARINE STRATIGRAPHY IN SOUTHERN SALINAS VALLEY, CALIFORNIA

By DAVID L. DURHAM and WARREN O. ADDICOTT

ABSTRACT

Near the south end of the Salinas Valley, marine sandstone beds of the Santa Margarita Formation overlie the Monterey Shale, but farther north the Santa Margarita intertongues with the upper part of the Monterey. The Pancho Rico Formation comprises sandy marine strata and interbedded finer grained rocks that overlie the Santa Margarita near Vineyard Canyon, and generally overlie the Monterey farther north. The nonmarine Paso Robles Formation overlies the Pancho Rico. Where the Pancho Rico overlies Monterey Shale, the contact is at the base of the stratigraphically lowest sandstone unit above the finer grained rocks typical of the Monterey. Where the Pancho Rico overlies the Santa Margarita, the contact is at the top of the stratigraphically highest beds that contain the giant oyster, *Ostrea titan*. The upper contact of the Pancho Rico is at the top of the stratigraphically highest lithologic unit that contains marine fossils.

The Santa Margarita Formation near Vineyard Canyon contains fossils indicative of a late Miocene age. The Pancho Rico Formation contains fossil mollusks and echinoids indicative of an early Pliocene age.

PREVIOUS STRATIGRAPHIC NOMENCLATURE

In most of the southern Salinas Valley, Monterey and San Luis Obispo Counties, Calif. (fig. 1), the Monterey Shale is overlain by sandy marine strata. In the southernmost part of the valley, including the area near the town of Santa Margarita, beds of light-colored massive coarse-grained arkosic, calcareous sandstone that locally contain giant fossil oysters and that overlie the Monterey (fig. 2) are customarily called the Santa Margarita Formation (Fairbanks, 1904, p. 4). Northeast of Vineyard Canyon, similar sandstone beds of the Santa Margarita Formation overlie the Monterey Shale and underlie a unit described by English (1918, p. 229) as a diatomaceous shale member of the Santa Margarita. This diatomaceous shale unit is

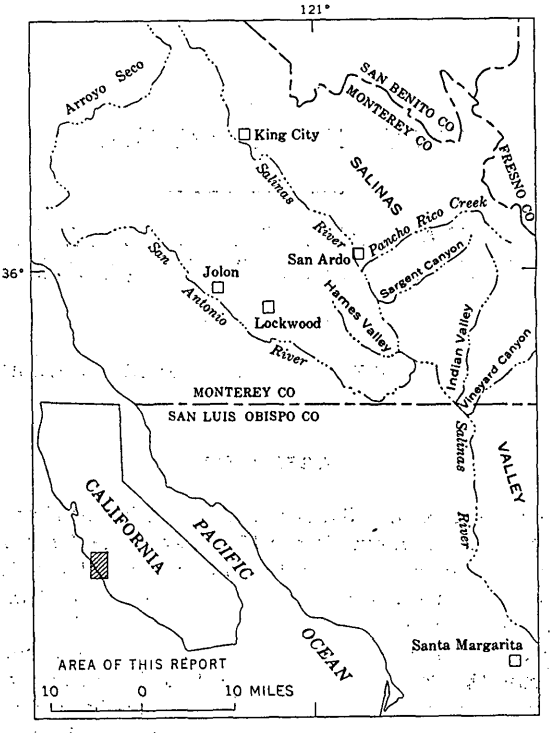

FIGURE 1.—Index map.

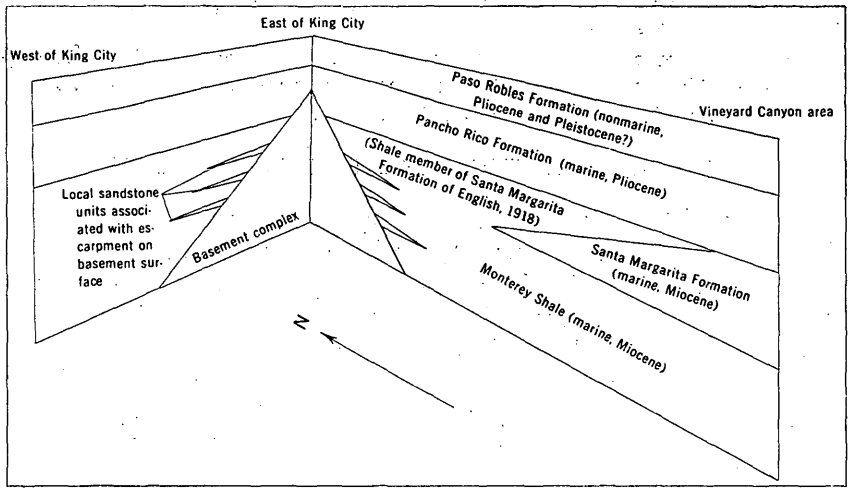

FIGURE 2.—Generalized stratigraphic relations of upper Miocene and Pliocene formations in southern Salinas Valley, Calif.

assigned here to the upper part of the Monterey. It is in turn overlain by a sequence of sandy marine beds that has a complicated nomenclatural history, as shown in table 1. The reason for much of the confusion in nomenclature indicated in table 1 can be attributed to misapplication of the term "Santa Margarita" and failure to recognize the identity of other post-Monterey marine strata. In an attempt to clarify the situation, the term "Santa Margarita" is here restricted in the Salinas Valley to strata that are similar to the type Santa Margarita in both lithologic character and stratigraphic position. The Pancho Rico Formation is redefined to apply to sandy beds stratigraphically above the Monterey Shale and Santa Margarita.

TABLE 1.—*Names applied by other investigators to strata here assigned to the Pancho Rico Formation*

Formation name	*Reference*
San Pablo Formation	Eldridge (1901, p. 408–410).
Santa Margarita Formation	Hamlin (1904, p. 15, 18); Pack and English (1915, p. 133); English (1918, p. 229, 231); Reed (1925, p. 593); Kleinpell (1930, p. 30); Clark (1930, p. 781, 782); Taliaferro (1943, p. 459, 460).
Santa Margarita Sandstone	Bramlette and Daviess (1944).
Jacalitos and Etchegoin Formations	English (1918, p. 231).
Jacalitos horizon	Clark (1930, p. 767).
Etchegoin Formation	Taliaferro (1943, p. 460).
King City Formation	Clark (1940).
Poncho Rico Formation	Reed (1925, p. 591); Clark (1940).
Pancho Rico Formation	Bramlette and Daviess (1944).

MONTEREY SHALE AND SANTA MARGARITA FORMATION

The Santa Margarita Formation exposed near Vineyard Canyon contains a fossil fauna indicative of late Miocene age. The fauna is characterized by *Ostrea titan* Conrad and includes *Lyropecten estrellanus* (Conrad), *Chione* cf. *C. temblorensis* (Anderson), and *Balanus gregarius* (Conrad). The age equivalence of the typical Santa Margarita Formation and the upper part of the Monterey Shale (Richards, 1937; Kleinpell, 1938, p. 166, 167; Bramlette, 1946, p. 4, 20) and the progressively younger age of the Santa Margarita northward from the type area (Kleinpell, 1938, p. 167; Bramlette and Daviess, 1944; Kilkenny, 1948, p. 2259, 2260) are generally accepted concepts. However, the authors prefer the view that the Santa Margarita overlies the Monterey near the south end of the Salinas Valley but that farther north the Santa Margarita intertongues with and underlies the uppermost part of the Monterey. The Santa Margarita pinches out northward, not far north of the south border of Monterey County. Accord-

ingly, the Santa Margarita in southern Monterey County may be considered, in effect, a lenticular sandstone unit at or near the top of the Monterey. Beds of Pliocene age that suggested to others the idea of a northward decrease in age of the Santa Margarita are assigned to the Pancho Rico Formation as here redefined.

PANCHO RICO FORMATION

The Pancho Rico Formation, as here redefined, consists of beds of sandstone, mudstone, porcelanite, porcelaneous mudstone, diatomaceous mudstone, and conglomerate, but the most characteristic type of rock is fine to very fine grained marine sandstone. The Pancho Rico generally overlies the marine Monterey Shale and underlies the nonmarine Paso Robles Formation; however, northeast of King City it lies nonconformably on basement complex, and near Vineyard Canyon it lies conformably on the Santa Margarita Formation. Reed (1925, p. 591, 606), who first named the unit, failed to define it adequately, although presumably he intended that beds exposed along Pancho Rico Creek should be considered the type section.

Where the Pancho Rico Formation overlies the Monterey Shale, the lower contact of the Pancho Rico is placed at the base of the stratigraphically lowest sandstone unit above the fine-grained strata of the Monterey. Sandstone beds that occur locally in the Monterey Shale in the subsurface are distinguished from beds in the Pancho Rico by their lower stratigraphic position and their proximity to a buried escarpment on the surface of the basement complex. The contact is both gradational and intertonguing. Shale beds lithologically similar to those of the Monterey occur above the basal sandstone of the Pancho Rico, and the sandstone tongues at the base are not everywhere at the same stratigraphic horizon.

Where the Pancho Rico overlies the Santa Margarita Formation in Vineyard Canyon, the lower contact of the Pancho Rico is placed at the top of the stratigraphically highest bed that contains the giant fossil oysters typical of the Santa Margarita.

The upper contact of the Pancho Rico with the nonmarine Paso Robles Formation is placed at the top of the stratigraphically highest lithologic unit that contains marine fossils. The Pancho Rico may have some intertonguing nonmarine beds in the upper part.

The Pancho Rico Formation crops out on the east side of the Salinas Valley from northeast of King City southeastward for more than 50 miles to Vineyard Canyon and beyond. It crops out at places on the west side of the valley from Arroyo Seco southeastward for more than 40 miles to the San Antonio River and beyond. Farther west, it crops out in the San Antonio River Valley north and northwest of Jolon and south of Lockwood.

The Pancho Rico Formation is about 275 feet thick northeast of King City, where it lies on the basement complex, 450–550 feet thick near Sargent Canyon, and 650 feet thick near Indian Valley. It is about 850–1,000 feet thick northwest of King City, 900 feet thick north of Jolon, and 100–200 feet thick northeast of Hames Valley.

The Pancho Rico Formation contains a moderately large fauna of fossil marine invertebrates, including mollusks, clypeasteroid echinoids, brachiopods, and barnacles. The mollusks and echinoids are indicative of Pliocene age, in the generally accepted Pacific Coast provincial chronology (Durham, 1954, p. 24). Among the more than 100 molluscan taxa collected from the Pancho Rico Formation are such characteristic Pliocene gastropods as *Turritella vanvlecki* Arnold, *Bittium casmaliense* Bartsch, *Calicantharus kettlemanensis* (Arnold), *Nassarius coalingensis* (Arnold), *Nassarius grammatus* (Dall) [*N. moranianus* (Martin), of authors], and *Clavus coalingensis* (Arnold). Pelecypods that indicate a Pliocene age are *Mytilus* cf. *M. coalingensis* Arnold, *Ostrea atwoodi* Gabb, *Patinopecten lohri* (Hertlein), and *Lyropecten terminus* (Conrad). The giant barnacle *Balanus gregarius* (Conrad) and echinoids of the genus *Astrodapsis*, both late Miocene to early Pliocene taxa in California, are abundant at many localities.

If the richly fossiliferous sequence of Pliocene beds in the Coalinga district, California, described by Nomland (1917, p. 211–213), is taken as a provincial standard of reference, then much or all of the Pancho Rico Formation may be early Pliocene. Three fossil mollusks in the Pancho Rico that suggest an early Pliocene age are *Lyropecten terminus* (Conrad), *Turritella cooperi nova* Nomland, and *Clavus coalingensis* (Arnold). The echinoids *Astrodapsis* and *Dendraster* occur together in the Pancho Rico Formation between Pancho Rico Creek and Sargent Canyon, about 250 feet above the base of the formation, which is about 550 feet thick in that area. The late Miocene to early Pliocene range of *Astrodapsis* and the Pliocene to Recent range of *Dendraster* seem to be firmly established; their joint occurrence in the Pancho Rico suggests an early Pliocene age for at least part of the formation. Among the many species of *Astrodapsis* reported from the Pancho Rico are *A. arnoldi* Kew and *A. fernandoensis* Pack, which are regarded as distinctive and diagnostic of early Pliocene age.

Beds here considered part of the Pancho Rico Formation have been assigned an early Pliocene age by some geologists and a late Miocene age by others, probably because of generalized identification of pectinids by early investigators. Later workers (Kew, 1920; Richards, 1935; Grant and Hertlein, 1938) classified several species of *Astrodapsis* from the Pancho Rico Formation as late Miocene, presumably because the echinoids were associated with pectinids that Arnold

(1906, p. 73, 76) and others listed as the Miocene species *Lyropecten estrellanus* (Conrad) and *Lyropecten crassicardo* (Conrad). These names very likely were applied to right and left valves, respectively, of *Lyropecten terminus* (Arnold). This 14- to 16-ribbed species is characteristic of the Pancho Rico Formation, as well as of strata of early Pliocene age elsewhere in California. In spite of notice by Clark (1943, p. 190) and Woodring (*in* Woodring and Bramlette, 1950, p. 102) that the larger invertebrate fossils in the Pancho Rico Formation (or the King City Formation of Clark, 1940) indicate a Pliocene age, the notion persists that at least part of the unit is of late Miocene age (Hall, 1962; Gribi, 1963). Assignment of a late Miocene age to species of *Astrodapsis* that occur in the Pancho Rico (Hall, 1962) was based on equivocal foraminiferal evidence from Kleinpell (1938, p. 25), rather than on associated larger invertebrate fossils. Hughes (1963, p. 95) subsequently discussed evidence for the Pliocene age of Foraminifera from the Pancho Rico Formation.

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