SILICOFLAGELLATE BIOSTRATIGRAPHY OF THE
UPPER MONTEREY FORMATION AND SISQUOC
FORMATION OF SOUTHERN CALIFORNIA

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SILICOFLAGELLATE BIOSTRATIGRAPHY OF THE UPPER MONTEREY FORMATION AND LOWER SISQUOC FORMATION, JOHNS-MANSVILLE QUARRY, LOMPOC, CALIFORNIA

by

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THESIS

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ABSTRACT

Fifty-three (53) samples of a Late Miocene marine diatomite were processed for silicoflagellates. Four (4) genera and 13 species: Cannopilus schulzi, Dictyocha aspera: Dictyocha fibula, Dictyocha pentagona, Dictyocha pseudofibula, Distephanus boliviensis, Distephanus quinquangellus, Distephanus speculum, Mesocena diodon, Mesocena elliptica and Mesocena polyactus were found. Counts were made of the species present and relative and total abundances were calculated. Two biostratigraphic zones, in ascending order: Dictyocha pseudofibula Acme-Zone and Distephanus speculum Acme-Zone were recognized. These zones appear to correlate to Bukry's Dictyocha pseudofibula Zone and Distephanus speculum Zone from DSDP Leg 18, site 173 in the northeast Pacific. These zones overlap Barron's Nitzchia fossilis Partial-Range-Zone, Rhaphoneis amphiceros var. elongata Partial-Range-Zone and Nitzchia reinholdii Concurrent-Range-Zone.

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INTRODUCTION

The purposes of this study are to describe fossil silicoflagellates recovered from a stratigraphic section of a marine diatomite which starts in the upper Monterey Formation and extends up in section to the Sisquoc Formation; to determine biostratigraphic zones which might be useful in correlation with the Deep Sea Drilling Project (DSDP) zones in the Pacific; and to provide fossil evidence bearing on the question of the "Delmontian" Stage in the California marine Neogene sequence.

Late Miocene marine rocks of southern California are divided into two benthonic foraminiferal stages (Mohnian and Delmontian) (Kleinpell, 1938). Kleinpell's type Delmontian Stage contains benthonic foraminifers and diatoms that elsewhere are restricted to strata of the Mohnian Stage (Pierce, 1972; Ruth, 1972). Consequently, validity of the Delmontian Stage as originally defined by Kleinpell is being challenged (Barron, 1975).

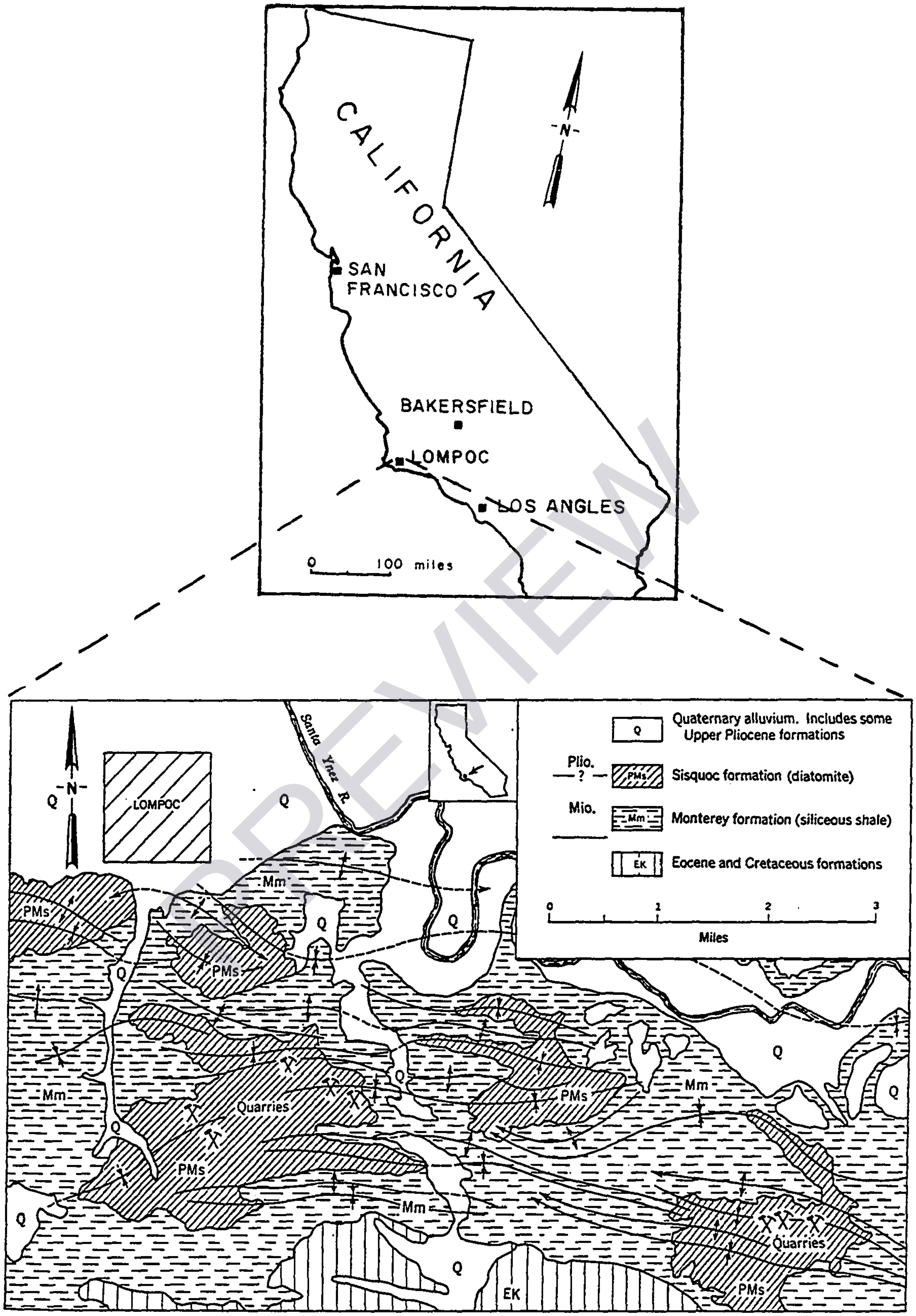
A stage is a chronostratigraphic unit representing a relatively minor interval of geologic time. It is considered the basic working unit of chronostratigraphy because it is suited in scope and rank to the practical needs and purposes of interregional chronostratigraphic classification. As stages are used to relate units in one geologic area to those in another with respect to time of origin, a stage which is time-transgressive is invalid. There appears to be a definite

change in the biostratigraphy of the Late Miocene, as seen in the diatom biostratigraphy (Barron, 1975). Determination of the presence or absence of this change in the silicoflagellate biostratigraphy is a major objective of this study.

GEOGRAPHIC LOCATION

The section studied was collected 6 and 27 May, 1970 by Dr. W. C. Cornell, John R. Ruth and Dr. A. R. Loeblich, Jr., at the Johnston Mansville Quarry and adjacent outcrops in Lompoc, Santa Barbara County, California (Fig. 1). Lompoc is located in western Santa Barbara County and contains the most extensive known diatomite of marine origin in the world (Clark, 1978). The town of Lompoc is located approximately 90 mi (145 km) north of Los Angeles and the Johns-Mansville Quarry is located 2 mi (3.2 km) south of the town. Samples of the studied section were obtained from Dr. W. C. Cornell.

Diatomite and diatomaceous sedimentary rocks are widely distributed in California. These rocks range in age from Cretaceous to Holocene, but the most extensive and purest diatomite deposits are Miocene and Pliocene in age. Thick sequences of diatomite and diatomaceous shale are found along the northern foothills of the Santa Ynez Mountains, south of the town of Lompoc.



Geologic map of the Lompoc diatomite district, Santa Barbara County, California

(Clark, 1978)

Figure 1. Index map.

GENERAL GEOLOGIC SETTING

California is divided into several different geomorphic provinces, each of which is characterized by a distinct geologic record. The study area is in the Transverse Range Province.

> "The Transverse Range Province extends about 325 miles (520 km) from Point Arguello and San Miguel Island on the west into Joshua Tree National Monument on the east, where it merges with the Mohave and Colorado deserts" (Norris and Webb, 1976).

At the northern boundary of the province is the San Andreas fault system. This fault system deviates from its usual north-south trend at this boundary, suggesting that it too was influenced by the forces that produced this oddly aligned province (Norris and Webb, 1976).

The Transverse Range Province is easily subdivided into individual ranges with intervening valleys. The Santa Ynez Mountains is the range in which the samples were collected. The Santa Ynez Mountains are an anticlinal flexure with a major fault along the axis.

The Franciscan Formation, as defined by Woodburne (1975), is a highly mixed assemblage of deep water marine sedimentary rocks and altered basalt, serpentinite and ultrabasic crystalline rocks thought to be derived from oceanic crust. They are the oldest rocks exposed in the Santa Ynez

Mountains. These Franciscan rocks are assigned a Late Jurassic/Early Cretaceous age and are the local basement rock. The process that formed the Franciscan assemblage evidently terminated during the Late Cretaceous

No Paleocene rocks are exposed in the Santa Ynez Mountains. Eocene rocks, composed of shales and sandstone of marine origin, are present in the section. In the eastern part of the Santa Ynez Mountains, Oligocene rocks are composed of sands, gravels and silts, indicating marine regression. Marine conditions, however, still existed in the western part of the area as documented by marine sands. Shallow marine conditions continued through the Oligocene, indicated gy well preserved, heavy-shelled scallops in the Vaqueros Formation (Norris and Webb, 1976).

By Miocene time, deep marine water conditions were present, as indicated by fine silts and clays of the Rincon Formation. By Middle Miocene time, development of deep marine basins, similar to those in the Gulf of California, formed. Material accumulating on the sea bottom was organic rather than of detrital origin. This organic sediment was mostly in the form of diatomaceous oozes of diatom tests and clay size particles, which compose the Monterey Formation. During early Monterey time, volcanic activity was widespread. Locally, ash beds are present in the Santa Ynez Mountains.

The Sisquoc Formation was laid down over the Monterey Formation and indicates a similar depositional environment.

The highly disputed Mio-Pliocene boundary is placed within the Sisquoc Formation. The Mio-Pliocene boundary is generally defined by a complete change in the paleogeography of southern California. The Sisquoc Formation is interpreted as a continuously sedimented rock sequence which does not reveal a change in environment; therefore, many geologists think it is inappropriate to place a Mio-Pliocene boundary within the formation.

During the Pleistocene, the Pasadenan Orogeny elevated marine areas and formed the Santa Ynez Mountains. Based on current tectonic activity, Norris and Webb (1976) believe the orogeny continues today.

PREVIOUS WORK IN AREA OF STUDY

The first geologic work done in the Lompoc area was by Antisell, who accompanied a party of engineers sent by the United States War Department to explore a route for a transcontinental railroad in 1856 (Dibblee, 1950). Arnold and Anderson (1907) mapped the geology of the "old Lompoc" quadrangle on the scale of 1:125,000. The area was mapped by Dibblee (1950) on the scale of 1:62,500. A portion of Dibblee's map is shown in Figure 1. An area just south of the Johns-Mansville Quarry was studied in even greater detail by Kenneth Arnestad (1950) in his Master's Thesis entitled "The Geology of a Portion of the Lompoc Quadrangle, Santa Barbara County, California."

Because of the economic value of the diatomite at the Johns-Mansville Quarry, it has been studied in great detail. Segregation of deposits into different ore grades and stratigraphic units has been done by the Johns-Mansville Corporation. Most other work has dealt with systematic studies of the diatoms (Wornardt, 1967). Barron (1975) established biostratigraphic zones based on changes in the diatom assemblage.