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BENTHIC FORAMINIFERA FROM THE LAUREL QUADRANGLE, CALIFORNIA

by

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ABSTRACT

Benthic foraminiferal assemblages were examined from five Cenozoic Formations in the Laurel Quadrangle. Southwest of the San Andreas Fault, the foraminiferal assemblages range in age from late Eocene to early Miocene and represent primarily upper middle bathyal deposition; northeast of the San Andreas Fault, the foraminiferal assemblages are early Eocene in age and represent lower bathyal to abyssal deposition. Newly collected samples as well as published data from the San Lorenzo Formation are assigned to the late Eocene (late Narizian Stage) and to the early Oligocene (early Zemorrian Stage). Assemblages from the late Eocene, Refugian Stage were not sampled but are assumed to be present since only spot samples near formational boundaries were sampled in the present study. The late Narizian portion of the San Lorenzo Formation were deposited at neritic depths whereas the early Zemorrian portion was deposited at upper middle bathyal depths. Foraminiferal assemblages from the Vaqueros Sandstone are assigned to the Zemorrian Stage and suggest upper middle bathyal depths. Late Saucesian and early Relizian foraminiferal assemblages are found in the Lambert Shale and indicate deposition occurred at upper middle bathyal depths. Northeast of the San Andreas fault zone, foraminiferal assemblages from the "mottled mudstone of Mt. Chual" unit is assigned to the early Eocene, Penutian Stage. Foraminiferal assemblages indicate deposition occurred at lower

bathyal to abyssal depths. Samples from the "marine shale and sandstone of Highland Way" were barren in Laurel Quadrangle.

INTRODUCTION

The Laurel 7 1/2 Minute Quadrangle is located in Northern California, south of San Jose in the San Jose 2° sheet (fig. 1). The Laurel Quadrangle is cut by the San Andreas Fault, Sargent Fault, Lomita Fault and Zayante Fault which generally run NW-SE across the area (Clark and others, 1989; fig. 2). Southwest of the San Andreas Fault, Cenozoic formations discussed include the San Lorenzo Formation (Tsl), Vaqueros Sandstone (Tv) and the Lambert Shale (Tla). Several other Cenozoic formations are present southwest of the San Andreas Fault in the Laurel Quadrangle (Clark and others, 1989) but these were not sampled for benthic foraminifers and are not discussed in this paper. Northeast of the San Andreas Fault, Cenozoic formations discussed include the "mottled mudstone of Mt Chual" (Te_1), and "marine shale and sandstone of Highland Way" (Tme). Samples from the Vaqueros Sandstone were poorly preserved, and samples collected from the "marine shale and sandstone of Highland Way" were barren of microfossils. The purpose of this paper is to document the Cenozoic benthic foraminiferal faunas which occur in the Laurel Quadrangle, California, and their age and paleoecology.

Benthic foraminiferal data in the Laurel Quadrangle comes from newly collected samples as well as samples from previous studies on file with the Paleontology and Stratigraphy Branch. Age interpretations are based on the California benthic foraminiferal zonations of Almgren and others (1988), McDougall (1988; 1989), Mallory (1959), and Kleinpell (1938) as well as the bathyal and abyssal zonation proposed by Berggren and Miller (1989) (fig. 3). Planktic foraminiferal and calcareous nannofossil age interpretations are given when available. Environmental interpretations are based on an overview of California benthic foraminifers by Ingle (1980), a study of Atlantic Paleogene benthic foraminifers by Tjalsma and Lohmann (1983), and a study of cosmopolitan deep-water benthic foraminifers by van Morkhoven and others (1986). Only general environmental interpretations are given because statistical data is not available for most of the Laurel Quadrangle samples and because paleoecological controls of many Cenozoic benthic foraminifers are only vaquely known. Correlations to coeval formations in California is not discussed as this work is in progress.

Methods

Samples studied were collected as part of the U.S. Geological Survey National Mapping Program's San Jose 2° Sheet Project (NMP) currently in progress. The geologic mapping of the Laurel Quadrangle was completed in 1989 (Clark and others, 1989). The sample locations are shown on figure 1 and given in Appendix I. Samples collected as part of the NMP were disaggregated with solvent (kerosene) and washed in water through a 63 micron screen. Since the majority of the samples were, too poorly preserved, specimens were not counted and no statistical data was generated. Foraminiferal species identified from these assemblages are given in Tables 1-4. Foraminiferal slides and residues are on file with the Branch of Paleonotogy and Stratigraphy, U.S. Geological Survey, Menlo Park, California.

Material from the earlier planktic foraminiferal studies consisted of residue from which planktic foraminifera and some benthic foraminifers had been picked. Processing techniques are not known. The residues were examined to determine the age and environment. Benthic foraminiferal species identified from these assemblages are included in Tables 1-4.

CENOZOIC FORMATIONS SOUTHWEST OF THE SAN ANDREAS FAULT

San Lorenzo Formation (Tsl)

Four samples were examined from the San Lorenzo Formation: three from exposures in the northwestern part of the quadrangle and one from the eastern part of the quadrangle along Soquel Creek (fig. 2). Sample Mf7660 is late Eocene in age and assigned to the late Narizian Stage, whereas samples Mf1579, Mf7646 and Mf7647 are Oligocene in age and assigned to the early Zemorrian Stage. The benthic foraminiferal assemblages indicate deposition occurred at neritic depths during the late Eocene and at upper middle bathyal depths in the early Oligocene.

The foraminiferal assemblage in sample Mf7660 is poorly preserved and contains common fragments of Lenticulina spp. and Vaginulinopsis spp. (Table 1). Vaginulinopsis saundersi is common in this assemblage. The range of this species is early Eocene (Penutian) through middle Eocene (Ulatisian) (Almgren and others, 1988; McDougall, 1989). Varieties of V. saundersi have, however been noted in the late Eocene, Narizian (Mallory, 1959). This assemblages is therefore no younger than the late Eocene, Narizian Stage and probably not older than early Eocene.

The assemblage in sample Mf7660 is poorly preserved, has low diversity, and suggests deposition occurred at neritic depths (0-150 m). This interpretation is based on the abundance of the genera Vaginulinopsis and Lenticulina which are characteristic of neritic depths (Ingle, 1980; McDougall, 1980).

Samples Mf7646 and Mf7647 were collected from the same general area (fig. 2). These samples are assigned to the early Zemorrian, Uvigerina gallowayi Zone (Kelinpell, 1938) which is early Oligocene in age. Cassidulina crassipunctata, which is abundant in sample Mf7646, ranges from late Refugian to early Zemorrian (Kleinpell, 1938; McDougall, 1980; 1983) and thus indicates an age no younger than early Zemorrian. The presence of Anomalina californiniensis and Bulimina inflata alligata also support this interpretation since these species have similar ranges and are most commonly found in the late Refugian to early Zemorrian.

Species present in sample Mf1579 are not particularily age diagnostic (Table 1). Cassidulina crassapunctata, which dominates sample Mf1579, suggests a late Refugian to early Zemorrian age. The remaining species suggest only a Tertiary age.

The benthic foraminiferal assemblages in samples Mf7646, Mf7647 and Mf1579 suggest deposition occurred at upper middle bathyal depths (500-1500 m). Common Uvigerina gallowayi and few Bulimina inflata alligata have upper depth limits in the upper middle bathyal biofacies (Ingle, 1980). Although the dominant species, Cassidulina crassipunctata, has an upper depth limit in the upper bathyal biofacies (Ingle, 1980), the presence of a sharp, well defined keel suggests greater depths. Smith (1964) observed the development of sharp keels on Holocene cassidulinids at depths greater than 450 m along the Pacific margin. Species with upper depth limits in the outer neritic to upper bathyal biofacies such as Uvigerina cocoaensis, Cibicides elemaensis, Plectofrondicularia packardi and P. vaughani are present in these assemblages and may be either part of the in situ fauna or part of the transported fauna. The large, broken specimens of Lenticulina suggest transport from the neritic biofacies.

Benthic foraminiferal assemblages from the San Lorenzo Formation were described previously by Smith (1971) along Soquel Creek and by Fairchild and others (1969) from the northwest portion of Laurel Quadrangle along Bean Creek and the west branch of Soquel Creek (fig. 2; Clark and others, 1989). These assemblages are assigned to the late Eocene, Narizian Stage and to the Oligocene, Zemorrian Stage. Faunas described in these papers are similar to those from the current study. Refugian assemblages from the San Lorenzo Formation were not sampled in either of these studies.

The San Lorenzo foraminiferal assemblages along Soquel Creek (Smith, 1971) range from late Eocene to early Oligocene in age and are assigned to the late Narizian and Zemorrian Stages. Faunas from the Twobar Shale member are sparse. Eggerella elongata, E. subconica (E. sp. cf. E. ihungia of Smith, 1971), Karreriella mediaaguensis, Uvigerina hispida (U. garzaensis nudorobusta) and Valvulineria tumeyensis are most common in the latest Narizian (Mallory, 1959). Faunas from the Rices Mudstone Member contain a more diverse assemblage and are assigned to the early Zemorrian (early Oligocene). The age interpretation is based on the presence of late Refugian through Zemorrian species, Anomalina californica and Cassidulina crassipunctata, and Zemorrian through Saucesian species, Uvigerinella obesa impolita and U. obesa.

The Oligocene foraminiferal assemblages described by Fairchild and others (1969) from the northwestern portion of the quadrangle are assigned to the early Zemorrian Stage. Age diagnostic species include Anomalina californica, Bulimina rinconensis (Zemorrian through lower Saucesian), Cassidulina crassipunctata, Uvigerina gallowayi, and Uvigerinella obesa impolita (Zemorrian through Saucesian).

Vaqueros Sandstone (Tv)

Three samples were examined from the Vaqueros Sandstone: Mf7438, Mf7439, and Mf7648. These samples are all from approximately the same location on the east side of the quadrangle (fig. 2). The samples contain abundant, poorly preserved arenaceous foraminifers, belonging primarily to the genera Cyclammina or Haplophragmoides. Occassionally specimens of Bolivina, Fursenkoina and Gyroidina occur. These specimens are, however, too poorly preserved to identify to species. No age and environmental interpretations are possible.

Published data from the Vaqueros Sandstone in the Laurel Quadrangle is from Clark (in Brabb and others, 1977), Smith (1971), and Fairchild and others (1969). Foraminiferal assemblages from the Vaqueros Sandstone along Soquel Creek (Smith, 1971) contain few age diagnostic species. However, the presence of Anomalina californica, Cassidulina crassipunctata and Plectofrondicularia miocenica indicate an early Zemorrian age for these assemblages. Foraminiferal assemblages from the northwestern corner of Laurel Quadrangle are younger and suggest an age of late Zemorrian (Fairchild and others, 1969; Clark in Brabb and others, 1977). Age diagnostic species include Cibicides floridanus (Zemorrian-Saucesian), Siphogenerina mayi (late Zemoriran-early Saucesian), S. nodifera (Zemorrian), S. smithi (late Zemorrian) and S. transversa (Zemorrian-Saucesian).

The Vaqueros assemblages suggest deposition occurred at upper middle bathyal depths (500-1500 m) based on the presence of Bolivina marginata, Cibicides floridanus and Siphogenerina nodifera. The common uvigerinellids may be part of the in situ or may have been transported from the upper bathyal biofacies.

Lambert Shale (Tla)

A single sample was examined from the Lambert Shale, Mf7649, along Hinkley Creek on the eastern side of the quadrangle (fig. 2; Table 2). The benthic foraminiferal assemblage indicates an age of late Saucesian or early Relizian, during the early Miocene and that deposition occurred at upper middle bathyal depths (500-1500 m). The age is constrained by the first appearance of Baggina californica which occurs in the early Relizian and the last appearance of Siphogenerina transversa which occurs in late Saucesian. Since Siphogenerina transversa has been found in early Relizian assemblages of the Monterey Formation, Ano Nuevo Section (McDougall, 1983) a early Relizian age is favored here.

Deposition of this assemblage probably occurred in the upper middle bathyal biofacies (500-1500 m). Except for Siphogemerina transversa, species present in the assemblage have upper depth limits of the upper bathyal (Ingle, 1980; Lagoe and McDougall, 1986). The upper depth limit of Siphogenerina transversa is given as in the upper middle bathyal biofacies (Ingle, 1980) and thus, deposition of the assemblage occurred in the upper middle bathyal biofacies. Foraminiferal assemblages from the Lambert Shale exposed in the Mountain Charlie Gulch area are described by Fairchild and others (1969) and Clark (in Brabb and others, 1977). These assemblages are Saucesian in age and contain Dentalina quadrulata (Saucesian), Siphogenerina kleinpelli (Saucesian-Luisian), S. transversa (Zemorrian-Saucesian), Uvigerinella obesa (Saucesian-Relizian) and U. obesa impolita (Zemorrian-Saucesian). The Lambert Shale benthic foraminiferal assemblages suggest deposition occurred at upper middle bathyal depths (500-1500 m) based on the presence of the various species of Siphogenerina as well as Bolivina marginata and Uvigerina gesteri. The increase in shelf and upper bathyal species in the late Saucesian assemblages near Mountain Charlie Gulch is the result of either decreasing water depths in the upper part of the section or increased downslope transport of shelf material.

CENOZOIC FORMATIONS NORTHEAST OF THE SAN ANDREAS FAULT

"Mottled Mudstone of Mt. Chual" (Te_1)

Thirteen samples were examined from the "mottled mudstone of Mt. Chual". These samples were collected from the northeastern part of the quadrangle, just northeast of the San Andreas Fault (fig. 2). Foraminifers occur in all the samples (Tables 3 and 4). Benthic foraminiferal assemblages from these samples are either not diagnostic of age or suggest an early Eocene age and are assigned to the Penutian Stage as modified by McDougall (1988, 1989) which is equivalent to planktic foraminiferal zones P8 through P9. The benthic foraminiferal assemblages from samples Mf2266, Mf2267, Mf2271, Mf7663, and Mf7665 suggest only a Tertiary age. Assemblages from samples Mf2268 through Mf2270, Mf2272 through Mf2274, Mf7664 and Mf7666 are early Eocene in age and assigned to the Penutian Stage. Sample Mf7667 taken from a unit mapped as questionable Cretaceous contains only long-ranging Tertiary species and may also belong in this unit. The foraminiferal assemblages suggest deposition occurred at lower bathyal to abyssal depths ($\geq$ 2000 m).

Arenaceous species dominate the benthic foraminiferal assemblages in samples Mf2266, Mf2267, Mf2271, Mf7663, and Mf7665 (Tables 3 and 4). Since sample Mf2266 contains only long-ranging late Cretaceous and Tertiary benthic foraminiferal species and was barren of planktic foraminifers (Poore, unpublished E and R report, 1974), the age of this sample is unknown. Benthic foraminifers in samples Mf2267 and Mf2271 are also long-ranging late Cretaceous and Tertiary species, but the presence of Silicosigmoilina californica and Tritaxilina colei restrict the age to the lower Tertiary. A Paleocene through middle Eocene age for these samples is suggested by Tritaxilina colei which first appears in the Paleocene and Silicosigmoilina californica which last appears in the middle Eocene (planktic foraminiferal zone P13). This age range is supported by the planktic foraminifers which were interpreted as a late Paleocene to early Eocene in age, planktic foraminiferal zones P5-P8 (sample Mf2271, Poore, unpublished E and R report, 1974).

Samples Mf7663 and Mf7665 are strongly weathered, and the assemblages consists of arenaceous species, questionable internal molds of foraminifers and fragments of planktic foraminifers. The presence of Tritaxilina colei in sample Mf7663 suggests a lower Tertiary age since this species occurs throughout the Paleocene and Eocene in California. Sample Mf7665 contains no age diagnostic species.

The foraminiferal assemblages in samples Mf7664 and Mf7666 are moderately well preserved and contain some calcareous species. The presence of Cibicidoides eocaenus (P6b-P22) and Tritaxilina colei (Paleocene-Eocene) in sample Mf7664 suggest an Eocene age. The more diverse assemblage in Mf7666 suggests the early Eocene, Penutian Stage. The presence of the cosmopolitan deep water species Bulimina macilenta restricts this assemblage to planktic foraminiferal zones P7 to P15. Further restriction of this assemblage to P7 through P9, is based on the presence of Verneuilina triangulata which occurs in the Penutian (Mallory, 1959) and Allomorphina conica which occurs in sediments no younger than early Ulatisian (Mallory, 1959). Similar assemblages are present in the mottled mudstone (Te_1) and marine sandstone and shale (Te_2) in the Laurel and Loma Prieta quadrangles (McDougall, 1989).

Sample Mf7667 contain a poorly preserved nondiagnostic assemblage. Only Siliscosigmoilina californica was identified to species. Silicosigmoilina californica ranges from Cretaceous through middle Eocene (planktic foraminiferal zone P13) and thus does not restrict the age of this assemblage to the Tertiary. Sample Mf7663 contains a fauna similar to Mf7667 whereas the fauna in the ?Ku unit in the Loma Prieta Quadrangle is either barren of benthic foraminifers or contains species which were interpreted as late Eocene in age (McDougall, 1989).

Foraminiferal assemblages in the remainder of the samples from the mottled mudstone unit (Mf2268-2270, Mf2272-2274 and Mf7658) are diverse and contain numerous age diagnostic species. These species suggest a early Eocene age equivalent to the Penutian Stage as modified by McDougall (1988, 1989) and planktic foraminiferal zones P8 through P9. Age diagnostic species in these assemblages include: Anomalina regina (P6a-P10), Bulimina callahani (P6a-P10), Bulimina alazaensis (P8-P14), Bulimina macilenta (P7-P15), Cibicidoides subspiralis (P9-P13), Gonatosphaera eocenica (late P7-P9, possibly P10), Nodosarella advena (P8 and is most common in planktic zones P9 and P10), Plectofrondicularia paucicostata (P12-P20 with questionable occurrences as old as P8), and Uvigerina lodoensis miriamae (late P7-P9) (fig. 3). Sample Mf7658 which contains Eponides mexicanus and Plectofrondicularia vaughani may be the youngest as these species are more characteristic of the middle and late Eocene. Planktic foraminiferal assemblages from these samples are assigned primarily to zone P8 (Poore, unpublished E and R Report, 1974).

The benthic foraminiferal assemblages from the mottled mudstone unit suggest that deposition occurred at lower bathyal to abyssal depths. These assemblages contain Anomalinoides capitatus, Glomospira charoides, Nuttalloides truempyi, and various species of Pleurostomella which suggest deposition occurred at lower bathyal to abyssal depths (≥ 2000 m). Species with upper depth limits on the shelf (E. mexicanus, P. salisburyi, V. asperuliformis, and V. saundersi) are more common in samples Mf2269, Mf2274, and Mf7658, suggesting an increase in downslope transport.

Foraminiferal assemblages from the "mottled mudstone of Mt. Chual" in the Laurel Quadrangle are the same as those found in this unit in the Loma Prieta Quadrangle (McDougall, 1989). Age and environmental interpretations are the same.

"Marine shale and sandstone of Highland Way" (Tme)

Two samples were examined from the "marine shale and sandstone of Highland Way" (Tme). Samples Mf7611 and Mf7612 are barren of foraminifers.

SUMMARY

Foraminiferal assemblages southwest of the San Andreas Fault in the Laurel Quadrangle range from late Eocene to early Miocene in age (fig. 4). Benthic foraminiferal assemblages from the San Lorenzo Formation are assigned to the late Narizian and early Zemorrian stages. Age diagnostic species from the Vaqueros Sandstone are assigned to the Zemorrian Stage. Both early and late Zemorrian assemblages are present. Foraminiferal assemblages from the overlying Lambert Shale are assigned to the late Saucesian and early Relizian stages. Work was not sufficiently detailed to determine the age or nature of the contact between these formations.

Benthic foraminifers indicate that except for the Butano Sandstone and lower San Lorenzo Formation, deposition occurred primarily at upper middle bathyal depths. Assemblages from the Butano Sandstone suggest deposition occurred at lower bathyal to abyssal depths. Assemblages from the late Narizian portion of the San Lorenzo Formation indicate deposition occurred at neritic depths. Sampling was not extensive enough to determine whether continuous deposition or unconformities are present.

Benthic foraminiferal assemblages from northeast of the San Andreas Fault in the Laurel Quadrangle are from the "mottled mudstone of Mt Chual" (Te_1). No foraminifers were found in the "marine shale and sandstone of Highland Way" (Tme). Age diagnostic benthic foraminifers from the mottled mudstone unit are assigned to the early Eocene, Penutian Stage as modified by McDougall (1988) and coeval with planktic foraminiferal zones P8 through P9 and calcareous nannofossil zones CP10 through CP12. Deposition occurred at lower bathyal to abyssal depths.

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APPENDIX I

SAMPLE LOCALITIES
LAUREL 7 1/2 MIN. QUADRANGLE

Mf Number	Field Number	Latitude Longitude	Comments
Mf1579	EB 622	37° 05'30" N 121° 53'37" W	Tsl Sample taken along Soquel Creek from Rices Mudstone Member of the San Lorenzo Formation. Collector: Brabb, 1968.
Mf2266	ELB-107a		Te_1 Sample taken from south edge of road bordering Lake Elsman, 1,250 feet south of SE 1/4, sec. 25, T9S, R1W. Collector: Berglund, 1974. Barren of planktic foraminifers (Poore, unpublished data, 1974).
Mf2267	ELB-2-21-3		Te_1 Sample taken along Loma Prieta Avenue on north side of road S44° W of SE corner of sec. 30, T9S, R1W. Collector: Berglund, 1974. Barren of planktic foraminifers (Poore, unpublished data, 1974).
Mf2268	ELB-2-12-1		Te_1 Sample taken from east side of NE turn on Loma Prieta Road, approximately 300 feet SSE of intersection of Loma Prieta Road and creek draining into Ashbury Gulch, S5°W of SE corner of sec. 30, T9S, R1E. Collector: Berglund, 1974. Slide with planktic foraminifers.
Mf2269	ELB-2-14-1		Te_1 Sample taken from east side of Loma Prieta Avenue, approximately 250 feet north of intersection with Loma Prieta Road, south of SW 1/4 sec. 29, T9S, R1E. Collector: Berglund, 1974. Slide with planktic foraminifers.

Mf2270	ELB-2-16-5		Te_1 Sample taken approximately 250 feet east of Mf2269, south of SW 1/4 sec. 29, T9S, R1E. Collector: Berglund, 1974. Slide with planktic foraminifers.
Mf2271	ELB-1-15-1		Te_1 Sample taken south side of Loma Prieta Road, approximately 550 feet east of BM 2375, 1 mile south of southern edge of sec. 29, T9S, R1E. Collector: Berglund, 1974. Slide with planktic foraminifers.
Mf2272	ELB-2-8-2		Te_1 Sample taken along a dirt road, approximately 550 feet from intersection with Loma Prieta Road, approximately 1 mile south of southern edge of sec. 29, T9S, R1E. Collector: Berglund, 1974. Slide with planktic foraminifers.
Mf2273	ELB-2-9-1		Te_1 Sample taken along a dirt road approximately 750 feet SW of Mf2272, 1 mile south of southern edge of sec. 29, T(S, R1E. Collector: Berglund, 1974. Slide with planktic foraminifers.
Mf2274	ELB-2-9-2		Te_1 Sample taken along a dirt road approximately 250 feet west of Mf2273, approximately 1 mile south of sec. 29, T9S, R1E. Collector: Berglund, 1974. Slide with planktic foraminifers.
Mf7438	88CB2543A	37° 05'01" N 121° 52'35" W	Tvq Sample was taken from mudstone interbed in a medium bedded sanstone that probably represents the basal part of the Vaqueros Sandstone. Collector: Brabb, 1988. Abundant arenaceous foraminifers too poorly preserved to identify.
Mf7439	88CB2543B	37° 05'01" N 121° 52'35" W	Tvq Sample from same locality as Mf7438 but is 12 inches stratigraphically higher than Mf7438.

			Collector: Brabb, 1988. Sample contains abundant foraminiferal fragments probably representing the genera Cyclammina, Bolivina, Fursenkoina, and Gyroidina.
Mf7611	88CB2563		Tme Sample taken from a hard carbonaceous, siliceous shale similar to that found in samples Mf7606-Mf7609, Loma Prieta Quadrangle. Sample location not on map. Collector: Brabb, 1988. Sample barren of foraminifers.
Mf7612	88CB2563A		Tme Sample taken from a hard carbonaceous, siliceous shale similar to that found in samples Mf7606-Mf7609, Loma Prieta Quadrangle. Sample location not on map. Collector: Brabb, 1988. Sample barren of foraminifers.
Mf7646	88CB2573	37° 07'10" N 121° 56'30" W	Tsl Sample collected about 300 feet downstream from a waterfall in a massive sandstone, from a thin bedded mudstone and minor sandstone; originally thought to be part of the Butano Formation. Collector: Clark and Brabb, 1989.
Mf7647	89CB2574	37° 07'08" N 121° 56'40" W	Tsl Sample was collected 4 feet stratigraphically above a 4 inch thick dark green glauconite bed and just above the top of a 100 foot thick massive, glauconitic sandstone that forms cascades and waterfalls. Probably Rices Mudstone Member of the San Lorenzo Formation. Collector: Clark and Brabb, 1989.
Mf7648	88CB2543B	37° 05'01" N 121° 52'35" W	Tvq Sample from the same locality as Mf7439. Sample Mf7648 is from the basal part of the Vaqueros Formation. Collector: McLaughlin, Clark and Brabb, 1989. Although foraminifers were observed in the hand sample, specimens were not found in the washed residue.

Mf7649	JC 89-1	37° 03'58" N 121° 54'23" W	Tls Sample collected along Hinkley Creek. Collector: J. Clark and R. McLaughlin, 1989.
Mf7658	MSJ-82-89		Te_1 Sample taken from the mottled mudstone unit overlying a glauconite sandstone. Sample came from a relatively fresh outcrop along the south side of Loma Prieta Road, approximately 1200 feet east of BM2375. Collector: McLaughlin, 1989.
Mf7660	89CB2761	37° 07'13" N 121° 57'28" W	Tsl Sample taken from the north side of Laurel Creek about 800 feet upstream from the junction with Burns Creek in Twobar Shale Member, about 25 feet below the contact with the Rices Mudstone Member of the San Lorenzo Formation. Collector: Brabb, 1989
Mf7663	MSJ-124-89		Te_1 Sample taken within 300 feet of main bedrock trace of the San Andreas Fault, along Spanish Ranch Road in the northeast part of Laurel Quadrangle. Collector: McLaughlin, 1989
Mf7664	MSJ-125-89-1		Te_1 Sample taken within 300 feet of main bedrock trace of the San Andreas Fault, along Spanish Ranch Road in the northeast part of Laurel Quadrangle. Collector: McLaughlin, 1989
Mf7665	MSJ-125-89-2		Te_1 Sample taken within 300 feet of main bedrock trace of the San Andreas Fault, along Spanish Ranch Road in the northeast part of Laurel Quadrangle. Collector: McLaughlin, 1989
Mf7666	MSJ-126-89-A		Te_1 Sample taken within 300 feet of main bedrock trace of the San Andreas Fault, along Spanish Ranch Road in the northeast part of

		Laurel Quadrangle. Collector: McLaughlin, 1989
Mf7667	MSJ-126-89-B	?K or Te_1 Sample taken within 300 feet of main bedrock trace of the San Andreas Fault, along Spanish Ranch Road in the northeast part of Laurel Quadrangle. Collector: McLaughlin, 1989

APPENDIX II
TAXONOMIC NOTES

This appendix represents an attempt to bring California benthic foraminiferal taxonomic nomenclature into conformity with nomenclature used worldwide. Generic nomenclature follows Loeblich and Tappan (1964); efforts to bring this nomenclature into conformity with Loeblich and Tappan (1988) are in progress. This section is, therefore, a summary of work in progress and subject to further changes and additions. Data on age and environmental constraints will be continuously refined as more information becomes available. Current sources of environmental data on Paleogene benthic foraminifers are Ingle (1980), Tjalsma and Lohmann (1983), and van Morkhoven and others (1986). Stratigraphic ranges of benthic foraminiferal species given by Mallory (1959) are included in this summary; they may not be accurate and should be used with caution. Occurrence data for each species gives the quadrangle from the San Jose 2° sheet in which the species is found and formations as well as other California occurrences. Formations are abbreviated as follows: Tb = Butano Sandstone, Tsl= San Lorenzo Formation, Tv = Vaqueros Formation, Tla = Lambert Shale, Te_1 = "mottled mudstone of Mt. Chual", Te_2 = "Marine sandstone and shale", and Tme = "marine shale and sandstone of Highland Way".

Alabamina wilcoxensis Toulmin

Alabamina wilcoxensis Toulmin, 1941, p. 603, pl. 81, figs. 10-14.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 227, pl. 19, fig. 10.
- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 13.

Eponides beisseli (White) - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 182, pl. 27, fig. 7.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 237.

RANGE: Mallory (1959) gives range as lower Bulitian to upper Penutian.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Tme); Pacheco Syncline

Allomorphina conica Cushman and Todd

Allomorphina conica Cushman and Todd, 1949, Cushman Lab. Foram. Res., Contr., v. 25, p. 62, pl. 11, fig. 8a-c.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 244, pl. 33, fig. 15a-b, pl. 37, fig. 14a-b.

RANGE: Mallory (1959) gives range as lower Ynezian to lower Ulatisian.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Te_2)

Allomorphina paleocenica Cushman

Allomorphina paleocenica Cushman, 1948, Cushman Lab. Foram. Res., Contr., v. 24, p. 45, pl. 8, fig. 10.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 245, pl. 22, fig. 4.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 140.

RANGE: Mallory (1959) gives range as lower Penutian and lower Ulatisian.

ECOLOGY: Allomorphina paleocenica has an upper depth limit on the outer shelf biofacies, 50-150 m (Ingle, 1980).

OCCURRENCE: Loma Prieta Quad. (Te_1); Laurel Quad. (Te_1)

Allomorphina trigonia Reuss

Allomorphina trigonia Reuss, 1850, p. 380. pl. 480, fig. 14.

- - McDougall, 1980, SEPM Paleontological Monograph, no. 2, p. 33.

OCCURRENCE: Loma Prieta Quad. (Tsl); Laurel Quad. (Te_1)

Ammobaculites sp. of Smith

Ammobaculites sp. of Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 150, pl. 17, fig. 12a-b.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 114, pl. 2, fig. 13a-b; pl. 36, fig. 1a-b.

OCCURRENCE: Loma Prieta Quad. (Tsl); Laurel Quad. (Te_1)

Ammodiscus incertus (d'Orbigny)

Operculina incerta d'Orbigny, 1839, in Ramon de la Sagra, 1839, p. 49, pl. 6, figs. 16-17.

Cornuspira incerta (d'Orbigny) emend. Loeblich and Tappan, 1954, p. 308, tf. 1.

Ammodiscus cf. A. incertus (d'Orbigny) - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 108, pl. 1, figs. 11-12; pl. 39, fig. 2.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 27.
- - Smith, 1971, Univ. Calif. Publ. Geol. Sci., v. 91, p. 24.

Ammodiscus incertus (d'Orbigny)- - McDougall, 1980, SEPM, Paleo. Monograph, no. 2, pl. 1, figs. 2-5.

- - McDougall, 1983, USGS Prof. Paper 1213, p. 74.

Ammodiscus glabratus Cushman and Jarvis - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 6, pl. 1, fig. 6.

COMMENTS: The test is discoidal with an initial globular proloculus surrounded by a planispiral coil. The wall is composed of fine-grained arenaceous material and cement, which does not react with dilute hydrochloric acid.

RANGE: Mallory (1959) gives range as Ynezian through Narizian.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Te_2, Tme)

Amphimorphina ignota Cushman and Siegfus

Amphimorphina ignota Cushman and Siegfus, 1939, Cushman Lab. Foram. Res., Contr., v. 11, p. 27, pl. 6, figs. 10-13.

- - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 18, pl. 3, figs. 10-11.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 215-216, pl. 18, fig. 7; pl. 33, fig. 9.
- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 100.

- - Tjalsma and Lohmann, 1983, Micropaleo., Spec. Pub., no. 4, p. 22, pl. 14, fig. 18.

Amphimorphina (?) sp. - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 172, pl. 24, fig. 1.

RANGE: Mallory (1959) gives range as upper Ynezian to lower Narizian. Upper Ynezian occurrence is in the Media Aqua Creek section. Tjalsma and Lohmann (1983) find this species occurring sporadically throughout the Eocene (P6b-P18).

OCCURRENCE: Loma Prieta Quad. (Te_1); Laurel Quad. (Te_1); Pacheco Syncline

Anomalina californiensis Cushman and Hobson

Anomalina californiensis Cushman and Hobson, 1935, Cushman Lab. Foram. Res., Contr. v. 11, p. 64, pl. 9, figs. 8a-c.

- - Smith, 1956, Univ. Calif. Pubs. Geol. Sci., v. , p. 100, pl. 16, figs. 3a-c.

- - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pubs. Geol. Sci., v. 81, p. 74, pl. 25, figs. 4a-c.

- - McDougall, 1980 SEPM, Paleo. Mono. no. 2, p. 33.

- - McDougall, 1983, USGS Prof. Paper 1213, p. 74, pl. 17, fig. 7.

RANGE: Kleinpell (1938) gives the range as Zemorrian through lower Saucesian. This species has, however, been observed in the Refugian (McDougall, 1980, 1983) in association with late Eocene nannofossils (Poore and Bukry, 1983).

OCCURRENCE: Laurel Quad. (Tsl)

Anomalina regina Martin

Anomalina regina Martin, 1943, Stanford Univ. Publ. Geol. Sci., v. 3, p. 28, pl. 19, fig. 3a-c.

- - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 191, pl. 29, fig. 8.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 154, pl. 9, fig.3a-c.

Anomalina cf. A. regina Martin - - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 154, pl. 14, fig. 5.

Anomalina regina minor Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 192, pl. 29, figs. 2 and 4.

Anomalinoides welleri (Plummer) - - Berggren and Aubert, 1983, U.S.G.S., Prof. Paper 1213, p. 16.

COMMENTS: Smith (1957) descibed the varity minor to include specimens with 9 rather than 12 chambers and a smaller size. Specimens of A. regina and A. regina minor figured by Smith (1957) all contain 9 chambers. There is a slight size difference which is probably due to environmental conditions.

Anomalina regina probably referred to Anomalinoides welleri by Berggren and Aubert (1983); also Berggren and Aubert (1975, p. 151, pl. 5, fig. 3).

Anomalina regina differs from A. garzaensis because A. regina is smaller, has fewer chambers (12 or less rather than $\geq$ 14), smaller pores and sutures, and an umbo ring which is not as limbate or heavy.

RANGE: Mallory (1959) gives range as lower Bulitian to upper Penutian. McDougall (1988) gives range as P6b to P10 and notes the upper limit may be extended.

ECOLOGY: Anomalina regina has an upper depth limit in the upper middle bathyal biofacies, 500-1500 m (Melonis regina, Ingle, 1980).

OCCURRENCE: Laurel Quad. (Te_1; Loma Prieta Quad. (Te_1, Tme); Pacheco Syncline

Anomalinoides capitatus (Gumbel)

Rotalia capitata Gumbel, 1868, K. Bayer. Akad. Wiss., Math.-Physik Cl., Abh., Bd. 10, p. 653, pl. 2, fig. 92.

Anomalinoides capitatus (Gumbel) - - Berggren and Aubert, 1983, U.S.G.S., Prof. Paper 1213.

- - van Morkhoven and others, 1986, Bull. Des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 276-278, pl. 92, figs. 1-2.

Gavelinella capitata (Gumbel) - - Tjalsma and Lohmann, 1983, Micropaleo., Spec. Pub., no. 4, p. 31, pl. 16, figs. 4-5.

Anomalina dorri Cole, 1928, Bull. American Paleo., v. 14, p. 218, pl. 34, figs. 1-2.

Anomalina dorri aragonensis Nuttall, 1930, Jour. of Paleo., v. 4, p. 291, pl. 24, fig. 18; pl. 25, fig. 25.

- - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 191, pl. 31, figs. 1-2.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 259, pl. 35, fig. 5.
- - Almgren and others, 1988, Paleogene Stratigraphy of the West Coast, SEPM Pacific Section, fig. 5 (list).

Anomalina (?) sp. - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 192, pl. 29, fig. 7.

Gavellinella rubiginosa - - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 155.

COMMENTS: Anomalinoides dorri and A. dorri aragonensis are distinquished on the basis of sutural differences. Tjalsma and Lohmann (1983), and van Morkhoven and others (1986) found too many transitional forms to justify the separation at species level. Van Morkhoven and others (1986) also felt that A. dorri and A. aragonensis were junior synonyms of A. capitatus.

RANGE: A late Paleocene (P6a) through early Oligocene (P18) range with doubtful occurrences in early Oligocene Zones P19 and P20 is given by van Morkhoven and others (1986). Forms transitional between A. rubiginosus (range K-P5) and A. capitatus have been observed in the middle Paleocene (P4) and early Eocene (P6b-P11) (van Morkhoven and others, 1986). In California, Berggren and Aubert (1983) found A. aragonensis in association with the early Eocene Lodo (P6-P9) and Kreyenhagen (P8-P9) Formations. Almgren and others (1988) give the range of Anomalinoides dorri aragonensis as zones E and pseudo C which correspond to nannofossil zones CP5 through CP11 (planktic foraminiferal zones P4 through P9). The older occurrences noted by Almgren and others (1988) have not been exammined yet and may be the transitional forms noted by van Morkhoven and others (1986).

ECOLOGY: Anomalinoides capitatus was primarily a bathyal species but ranged to abyssal depths (van Morkhoven and others, 1986). Ingle (1980) considers this species to have and upper depth limit in the lower bathyal biofacies, ≥ 2000 m.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1); Pacheco Syncline

Aragonia aragonensis (Nuttall)

Textularia aragonensis Nuttall, 1930, Jour. Paleo., v. 4, p. 280, pl. 23, fig. 6.

Bolivina aragonensis (Nuttall) - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 199-200, pl. 28, fig. 19a-b.

Aragonia aragonensis (Nuttall) - - Berggren and Aubert, 1983, U.S.G.S., Prof. Paper 1213, pl. 2, figs. 15-17.

- - Tjalsma and Lohmann, 1983, Micropaleontology, Special Pub., v. 4, p. 23, pl. 11, figs. 2a-b.
- - van Morkhoven and others, 1986, Bull. des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 308-314, pl. 101a, figs. 1-3; pl. 101B, figs. 1-4; pl. 101C, figs. 1-3.

Bolivina capdevilensis Cushman and Bermudez, 1937, Contr. Cushman Lab. Foram. Res., v. 13, p. 14, pl. 1, figs. 49, 50.

Aragonia capdevilensis (Cushman and Bermudez) - - Tjalsma and Lohmann, 1983, Micropaleontology, Special Pub., v. 4, p. 23, pl. 11, figs. 3a-b.

Bulimina semireticulata LeRoy, 1953, Geological Society of America, Memoir 54, p. 20, pl. 8, fig. 26.

Aragonia semireticulata (LeRoy) - - Tjalsma and Lohmann, 1983, Micropaleontology, Special Pub., v. 4, p. 23, pl. 11, figs. 1a-b.

COMMENTS: Tjalsma and Lohmann (1983) differentiate A. aragonensis A. capdevilensis and A. semireticulata by the fairly compressed and strongly fan shaped test of A. aragonensis, by the less promeniently fan-shaped test and thick cross section of A. capedevilensis and by the very thin cross section and slightly raised ornamentation of A. semireticulata. Van Morkhoven and others (1986) consider these species as morphotypes of a single Eocene species. They do recognize that the forms vary in thickness and ornamentation and that the older members of the group may be flatter and less ornamented than the younger forms.

RANGE: The range of Aragonia aragonensis is late Paleocene (P5) through latest middle Eocene (P14) (Tjalsma and Lohman, 1983; van Morkhoven and others, 1986). Mallory (1959) gives range as upper Ynezian to lower Narizian.

ECOLOGY: Aragonia aragonensis has an upper depth limit in the upper bathyal, 150-500 m (Ingle, 1980) but is considered primarily a lower bathyal and abyssal form (van Morkhoven and others, 1986).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme)

Baggina californica Cushman

Baggina californica Cushman, 1926, Cushman Lab. Foram. REs., Contrib., v. 2, p. 64, pl. 9, fig. 8.
- - Kleinpell, 1938, Miocene Stratigraphy of California, AAPG, p. 324, pl. 13, figs. 3a-c.

RANGE: Kleinpell (1938) gives range as lower Relizian through upper Mohnian.

OCCURRENCE: Laurel Quad. (Tls)

Baggina robusta Kleinpell

Baggina robusta Kleinpell, 1938, Miocene stratigraphy of California, AAPG, p. 325, pl. XI, figs. 8a-c.
- - McDougall, 1983, USGS Prof. Paper 1213, p. 74, pl. 15, fig. 7.

RANGE: Kleinpell (1938) gives range as upper Zemorrian through upper Luisian.

ECOLOGY: The upper depth limit of Baggina robusta is given as upper bathyal, 150-500 m (Ingle, 1980; Lagoe and McDougall, 1986). This species is transtitional between the outer neritc and upper bathyal biofacies (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Tls)

Bathysiphon eocenicus Cushman and Hanna

Bathysiphon eocenicus Cushman and Hanna, 1927, Calif. Acad. Sci., Proc., 4th Ser., v. 16, p. 270, pl. 13, figs. 2-3.

- - Smith, 1971, Univ. Calif. Publ. Geol. Sci., v. 91, p. 23.

Bathysiphon eocenica Cushman and Hanna - - Graham and Classen, 1955, Cushman Found. Foram. Res., v. 6, p. 6, pl. 1, fig. 1.

- - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 148, pl. 17, fig. 1.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 105, pl. 1, fig. 4.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 25.

- - McDougall, 1983, USGS, Prof. Paper 1213, p. 74.

ECOLOGY: Bathysiphon spp. such as B. eocenicus have upper depth limits in the lower bathyal biofacies, $\geq$ 2000 m (Ingle, 1980).

OCCURRENCE: Loma Prieta Quad. (Te_1, Te_2, Tme, Tbs, Tsl); Pacheco Syncline

Bathysiphon santecruis Cushman and Kleinpell

Bathysiphon santecruis Cushman and Kleinpell, 1934, Cushman Lab. Foram. Res., Contr., v. 10, p. 1, pl. 1, figs. 1-2.

- - Smith, 1971, Univ. Calif. Publ. Geol. Sci., v. 91, p. 23, pl. 1, fig. 1.

Rhabdammina eocenica - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 148, pl. 17, fig. 4.

COMMENTS: Bathysiphon santecruis is usually smaller than B. eocenicus. The cement is siliceous with little arenaceous material.

ECOLOGY: Bathysiphon spp. such as B. santecruis have upper depth limits in the lower bathyal biofacies, $\geq$ 2000 m (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (?Ku_1, Te_1, Te_2); Pacheco Syncline

Bathysiphon sp. (coarse)

?Bathysiphon sp. Graham and Classen, 1955, Cushman Found. Foram. Res., v. 6, p. 6, pl. 1, fig. 3.

COMMENTS: Small compressed fragments composed of sand grains which give a coarse appearance to test.

OCCURRENCE: Laurel Quad (Te_1); Loma Prieta Quad. (Te_1)

Bulimina alazaensis Cushman

Bulimina alazaensis Cushman, 1927, Jour. of Paleontology, v. 1, p. 161, pl. 25, fig. 4.

- - Cushman and Parker, 1946, U.S.G.S., Prof. Paper 210-D, p. 103, pl. 24, figs. 14-16.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 187, pl. 36, fig. 15a-c.

- - Tjalsma and Lohmann, 1983, Micropaleo., Special Pub. 4, p. 24, pl. 14, fig. 4.

Bulimina corrugata Cushman and Siegfus, 1935, Cushman Lab. Foram. Res., Contr., v. 11, p. 92, pl. 14, fig. 7a-b.

- - Cushman and Parker, 1946, U.S.G.S., Prof. Paper 210-D, p. 93, pl. 22, fig. 2.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 189, pl. 28, fig. 13a-b.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 74, pl. 13, fig. 3.
- - Almgren and others, 1988, Paleogene Stratgraphy of the West Coast, SEPM Pacific Section, fig. 5 (list).

Bulimina truncanella Finley, 1940, Roy. Soc. New Zealand, Trans. Proc., v. 69, p. 455, pl. 64, figs. 89-91.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 197, pl. 36, fig. 18a-c.

Bulimina whitei Martin, 1943, Stanford Univ. Publ. Geol. Sci., v. 3, p. 20, pl. 6, fig. 5a-b.
- - Cushman and Parker, 1946, U.S.G.S., Prof. Paper 210-D, p. 97, pl. 30, fig. 11.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 198, pl. 28, fig. 18a-c; pl. 36, fig. 19a-c.

COMMENTS: Several small, costated buliminids have been identified from Eocene sediments: B. alazaensis, B. corrugata, B. truncanella, and B. whitei. Each of these species is described a small, tapering form with longitudinal costate extending from the initial end to the base of the last whorl. Differences between species descriptions are in the number and character of the costae and slight variations in the width and length of the test. These differences appear to be largely related to the age of the specimen (juvenile verses adult). Type figures of Bulimina alazaensis and B. corrugata contain roughly the same number of costate, whereas the type figure of Bulimina whitei contains fewer costae. The illustrated specimen of B. whitei is, however, smaller than the other two species. The size difference may account for the smaller number of costae. Specimens of "B. whitei" from the Lodo Gulch Section, California, which are the same size as the type specimens of B. alazaensis and B. corrugata contain the same number of costae.

RANGE: The range of B. alazaensis is given as earliest Eocene (P6b) into the Oligocene (Tjalsma and Lohmann, 1983). This range spans the ranges give by Mallory (1959) for B. corrugata (lower Ulatisian through upper Narizian), B. truncanella (upper Ynezian through upper Narizian), and B. whitei (lower Bulitian through lower Narizian). Almgren and others (1988) give range of B. corrugata as pseudo C through A-2 zones which is equivalent to nannofossil zones CP11 through CP14b (planktic foraminiferal zones late P8-P14).

ECOLOGY: Bulimina corrugata and Bulimina whitei have upper depth limits in the lower middle bathyal biofacies, 500-1500 m (Ingle, 1980).

OCCURRENCE: Laurel Quad (Te,); Loma Prieta Quad. (Te_1, Tme); Pacheco Syncline

Bulimina callahani Galloway and Morrey

Bulimina callahani Galloway and Morrey, 1931, Bull. American Paleo., v. 15, p. 350, pl. 40, figs. 6.
- - Martin, 1943, Stanford Univ. Publ. Geol. Sci., v. 3, p. 9 (list).
- - Cushman and Parker, 1946, U.S.G.S., Prof. Paper 210-D, p. 87-88, pl. 20, figs. 20, 23.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 188, pl. 16, fig. 10.
- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p.

- - Berggren and Aubert, 1983, U.S.G.S., Prof. Paper 1213, p.
- - Tjalsma and Lohmann, 1983, Micropaleontology, Special Pub., v. 4, p. 24-25, pl. 11, figs. 6a-7c.
- - van Morkhoven and others, 1986, Bull. des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 322-327, pl. 105A, figs. 1-3; pl. 105B, figs. 1-4.

COMMENTS: Bulimina callahani is characterized by the reticulate ornamentation on the lower part of the test (Tjalsma and Lohmann, 1983).

RANGE: Bulimina callahani ranges from the Late Paleocene (P6a) through middle Eocene (P10) (Tjalsma and Lohmann, 1983; van Morkhoven and others, 1986). Mallory (1959) gives range as upper Ynezian through lower Ulatisian.

ECOLOGY: Bulimina callahani is a middle and lower bathyal and abyssal species (van Morkhoven and other, 1986). Its upper depth limit is estimated as 600 m along the Pacific Margin (Berggren and Aubert, 1983). Ingle (1980) places the upper depth limit of this species in upper middle bathyal biofacies, 500-1500 m.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1); Pacheco Syncline

Bulimina inflata alligata Cushman and Laiming

Bulimina inflata alligata Cushman and Laiming, 1931, Jour. Paleo. v. 5, p. 107, pl. 11, figs. 17a-b.
- - Kleinpell, 1938, Miocene Stratigraphy of California, AAPG, p. 254, pl. 7, fig. 1.
- - McDougall, 1983, USGS Prof. Paper, 1213, p. 74, pl. 13, fig. 5.

RANGE: Kleinpell (1938) gives the range as restricted to the Saucesian. In the Santa Cruz Mountains this species has been observed in Saucesian and Zemorrian age strata (McDougall, 1983).

ECOLOGY: Ingle (1980) gives the upper depth limit of Bulimina inflata alligata as upper middle bathyal, 500-1500 m.

OCCURRENCE: Laurel Quad. (Tsl)

Bulimina macilenta Cushman and Parker

Bulimina macilenta Cushman and Parker, 1936, Cushman Lab. Foram. Res., Contr., v. 11, p. 47, pl. 7, figs. 7-8.
- - Cushman and Parker, 1946, U.S.G.S., Prof. Paper 210-D, p. 98-99, pl. 23, figs. 2-3.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 193-194, pl. 28, fig. 15a-c.
- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 108.
- - McDougall, 1980, SEPM Paleo. Monograph, no. 2, pl. 15, figs. 3, 4.
- - Tjalsma and Lohmann, 1983, Micropaleo., Spec. Pub., no. 4, p. 25, pl. 14, fig. 3.

Bulimina pachecoensis Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 175, pl. 24, fig. 14.

COMMENTS: Bulimina macilenta is described as having a medium size test with the margins of the chambers cut into more or less regular flutings or scallops that apparently cover the whole of the bottom of the test because of the narrowness of the chambers. Figures by Cushman and Parker (1946, pl. 23, figs. 2-3) show that the spines are restricted to the margins of the chambers in B. macilenta. "Bulimina macilenta differs from the Paleocene B. midwayensis, to which it seems related, mainly by the distinctive overhang of the chambers over those of the previous whorl, and by the costate basal part of the chambers. Transitional forms which show costae but lack the overhang occur during the latest Paleocene and Early Eocene" (Tjalsma and Lohmann, 1983).

RANGE: Bulimina macilenta occurs rare to frequently in zones P7 to P15 (Tjalsma and Lohman, 1983). Mallory (1959) gives range as upper Ynezian through lower Narizian.

ECOLOGY: Bulimina macilenta has an upper depth limit in the upper middle bathyal biofacies, 500-1500 m (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme); Pacheco Syncline

Bulimina semicostata Nuttall

Bulimina semicostata Nuttall 1930, Jour. Paleo., v. 4, p. 274, pl. 23, figs. 15, 16.

- - Cushman and Parker, 1946, U.S.G.S., Prof. Paper 210-D, p. 93, pl. 21, figs. 28, 29.
- - Tjalsma and Lohmann, 1983, Micropaleontology, Special Publ., v. 4, p. 25, pl. 13, figs. 1-3.
- - van Markhoven and others, 1986, Bull. des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 279-281, pl. 93, figs. 1-5.

Bulimina semicostata lacrima Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 196, pl. 16, fig. 8a-c.

COMMENTS: "Species variation mainly concerns the length/width ratio, the length of the triangular initial part of the test, the degree of inflation in the later chambers, and the coarseness of the costae on the initial part of the test. Specimens with a twisted initial part may have a basal spine" (Tjalsma and Lohmann, 1983).

RANGE: Bulimina semicostata ranges from the early Eocene (P6b) through early Oligocene (P18) (Tjalsma and Lohmann, 1983; van Morkhoven and others, 1986). Mallory (1959) gives range as lower Ulatisian through lower Narizian.

ECOLOGY: Although Bulimina semicostata is primarily a lower bathyal and abyssal species, it has an upper depth limit in the upper middle bathyal biofacies, 500-1500 m (Ingle, 1980; van Morkhoven and others, 1986).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme)

Bulimina trinitatensis Cushman and Jarvis

Bulimina trinitatensis Cushman and Jarvis, 1928, Cushman Lab. Foram. Res., Contr., V. 4, p. 102, pl. 14, fig. 12.

- - Cushman and Parker, 1946, U.S.G.S. Prof. Paper 210-D, p. 86, pl. 20, figs. 16, 17.
- - Tjalsma and Lohmann, 1983, Micropaleo., Spec. Pub., no. 4, p. 7-8.
- - Berggren and Aubert, 1983, U.S.G.S., Prof. Paper 1213, pl. 3, figs. 9, 10.
- - van Morkhoven and others, 1986, Bull. des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 299-303, pl. 98a, figs. 1-2; pl. 98B, figs. 1-4.

RANGE: Bulimina trinitatensis ranges from the early Paleocene (P1) through late Eocene (P16) (Tjalsma and Lohmann, 1983; van Morkhoven and others, 1986).

ECOLOGY: Bulimina trintatensis was primarily a bathyal to abyssal species (van Morkhoven and others, 1986). During the Eocene the upper depth limit may have been as shallow as 500-600 m (Barr and Berggren, 1981; Tjalsma and Lohmann, 1983; van Morkhoven and others, 1986).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme); Pacheco Syncline

Bulimina tuxapamensis Cole

Bulimina tuxapamensis Cole, 1928, Bull American Paleo., v. 14, p. 212, pl. 32, fig. 23.

- - Cushman and Parker, 1946, U.S.G.S. Prof. Paper 210-D, p. 101, pl. 24, fig. 6.
- - Tjalsma and Lohmann, 1983, Micropaleo., Spec. Pub., no. 4, p. 26, pl. 12, figs. 3-4.
- - van Morkhoven and others, 1986, Bull. des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 155-158, pl. 51A, figs. 1-4; pl. 51B, figs. 1-2.

Buliminella bradbury (Martin) - - Berggren and Aubert, 1983, U.S.G.S., Prof. Paper 1213, p. 16, pl. 2, fig. 13.

Uvigerina cf. lodoensis (Martin) - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 178, pl. 25, fig. 7.

COMMENTS: Test stout, tapering, very regular in outline, broadest near the apertural end, very finely perforate; chambers slightly inflated; sutures in most specimens relatively wide, limbate; aperture loop-like or comma shaped, aperture terminal. Bulimina tuxapamensis is relatively featureless, however illustrated specimens appear to have irregular sutures: line of suture is indented as if retral process were present. This species is often included with B. bradbury to which it is closely related. Bulimina bradbury has a more slender test, somewhat more inflated chambers, and is smaller in size (Tjalsma and Lohmann, 1983).

RANGE: Bulimina tuxpamensis ranges from the late Paleocene (P6a) through early middle Miocene (N9) with doubtful occurrences in middle Miocene Zones N10-N13 (Tjalsma and Lohmann, 1983; van Morkhoven and others (1986).

ECOLOGY: Bulimina tuxapamensis is a bathyal to abyssal species which occurs commonly in the upper bathyal biofacies (van Morkhoven and others, 1986). Ingle (1980) indicates the upper depth limit of B. bradburyi is in the upper bathyal biofacies, 150-500 m.

OCCURRENCE: Loma Prieta Quad. (Te_1); Pacheco Syncline

Buliminella grata Parker and Bermudez

Buliminella grata Parker and Bermudez, 1937, Jour. Paleo., v. 11, p. 515, pl. 59, fig. 6a-c.

- - van Morkhoven and others, 1986, Bull. des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 163-165, p. 54, figs. 1-2.

RANGE: An early Paleocene (P1) through middle Miocene (N12) range is given by van Morkhoven and others (1986).

ECOLOGY: Buliminella grata is primarily a bathyal species; maximum abundances occurred at depths of 1-2 km in Atlantic (Tjalsma and Lohmann, 1983; van Morkhoven and others, 1986)

OCCURRENCE: Loma Prieta Quad. (Te_1); Laurel Quad. (Te_1)

Buliminella robertsi (Howe and Ellis)

Bulimina robertsi Howe and Ellis, 1939, p. 63, pl. 8, figs. 32-33.

- - Smith, 1957, Univ. Calif. Pub. Geol. Sci., V. 32, p. 173, pl. 24, fig. 10.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 186, pl. 15, fig. 14.
- - Mallory, 1970, Burke Museum Research Report, no. 2, p. 103.

Turrilina robertsi (Howe and Ellis) - - Tjalsma and Lohmann, 1983, Micropaleo., Spec. Pub., no. 4, p. 37, pl. 14, fig. 5.
RANGE: latest Paleocene (P6a) through late Eocene (P15) (Tjalsma and Lohmann, 1983)
ECOLOGY: Ingle (1980) gives the upper depth limit of this species as outer neritic, 50-150 m.
OCCURRENCE: Laurel Quad. (Te_1); Pacheco Syncline

Cassidulina crassipunctata Cushman and Hobson

Cassidulina crassipunctata Cushman and Hobson, 1935, Cushman Lab. Foram Res., Contr. v. 1, p. 63, pl. 9, fig. 10.
- - Sullivan, 1962, Univ. Calif. Pubs. Geol. Science, b. 37, p. 282, pl. 20, figs. 6a-b.
- - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pub. Geol. Sci., v. 81, p. 69, pl. 22, figs. 2a-b.
- - McDougall, 1983, USGS Prof. Paper 1213, p. 74, pl. 16, figs. 11-12.

RANGE: Kleinpell (1938) gives range as restricted to the Zemorrian. This species is observed in the San Lorenzo River section in association with planktic foraminifers diagnostic of zones P19/P20 (Zemorrian, early Oligocene).
ECOLOGY: Ingle (1980) gives the upper depth limit of Cassidulina crassipunctata as upper bathyal.
OCCURRENCE: Laurel Quad (Tsl)

Chrysalogonium tenuicostatum Cushman and Bermudez

Chrysalogonium tenuicostatum Cushman and Bermudez, 1936, Cushman Lab. Foram. Res., Contr., v. 12, p. 27, pl. 5, figs. 3-5.
- - Bermudez, 1949, Cushman Lab. Foram. Res., Spec. Pub., no. 25, p. 151, pl. 10, fig. 2.

OCCURRENCE: Laurel Quad (Te_1); Loma Prieta Quad. (Te_1)

Cibicides elemaensis Rau

Cibicides elmaensis Rau, 1948, Jour. Paleo., v. , p. 173, pl. 31, figs. 18-21.
- - McDougall, 1980, SEPM Paleo. Monograph, no. 2, p. 34.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 75.

RANGE: This species ranges from early Refugian through early Zemorrian (McDougall, 1980).
ECOLOGY: The upper depth limit of Cibicides elmaensis is outer neritic (McDougall, 1980).
OCCURRENCE: Laurel Quad (Tsl); Loma Prieta Quad. (Tsl)

Cibicides fortunatus Martin

Cibicides fortunatus Martin, 1943, Stanford univ. Publ. Geol. Sci., v. 3, p. 31, pl. 8, fig. 5a-c.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 265, pl. 24, fig. 1.
- - Mallory, 1970, Burke Museum Research Report, no. 2, p. 158.
- - McDougall, 1980, SEPM, Paleo. Monograph, no. 2, p. , pl. 24, figs. 10-11.
- - Berggren and Aubert, 1983, USGS Prof Paper 1213, pl. 5, figs. 22-24.

RANGE: Mallory (1959) gives range as upper Ynezian to upper Penutian.
ECOLOGY: The upper depth limit of Cibicides fortunatus is upper bathyal (Ingle, 1980)
OCCURRENCE: Laurel Quad. (Te_1)

Cibicidoides eocaenus (Gumbel)

Rotalia eocaena Gumbel, 1868, K. Bayer. Akad. Wiss., Math.-Physik. Cl., Abh., 10, p. 650, pl. 2, fig. 87.

Cibicidoides eocaenus (Gumbel) - - van Morkhoven and others, 1986, Bull. Des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 256-263, pl. 86A, figs. 1-4; pl. 86B, figs. 1-2; pl 86C, figs. 1-3; pl. 86D, figs. 1-2.

Cibicides tuxapamensis Cole, 1928, Bull. American Paleo., v. 14, p. 219, pl. 32, figs. 2-3; pl. 3, figs. 5-6.

Cibicides perlucida Nuttall, 1932, Jour. Paleo., v. 6, p. 33, pl. 8, figs. 10-12.

Cibicides spiropunctatus Galloway and Morrey - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 270, pl. 25, fig. 3.

Cibicides whitei Martin, 1943, Stanford Univ. Publ. Geol. Sci. v. 3, p. 122, pl. 8, figs. 4a-c.

COMMENTS: Mallory (1959, p. 272) believes that C. whitei may belong in the same group as C. perilucidus and C. spiropunctatus, and may not be a valid species. Cibicidoides whitei was recorded by Berggren and Aubert (1983) from the Lodo Gulch Section. These authors do not, however, record C. eocaenus in their assemblages and appear to have used C. whitei instead.

RANGE: An early Eocene (P6b) through late Oligocene (P22) range is given by van Morkhoven and others (1986).

ECOLOGY: Cibicidoides eocaenus was primarily a bathyal species although it ranged from outer neritic to abyssal depths. Ingle (1980) condsidered the upper depth limit of C. perilucidus to be in the lower middle bathyal and of C. spiropunctatus to be in the upper bathyal biofacies.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme)

Cibicidoides praemundulus Berggren and Edwards

Cibicidoides praemundulus Berggren and Edwards, 1985, in van Morkhoven and others, Bull. Des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 264-266, pl. 87, figs. 1-2.

Cibicides ungerianus (d'Orbigny) - - Tjalsma and Lohman, 1983, Micropaleo., Spec. Pub., no. 4, p. 28-29, pl. 18, fig. 1; pl. 21, figs. 5-6.

Cibicides cf. C. ungerianus (d'Orbigny) - - Almgren and others, 1988, Paleogene of the West Coast, SEPM, Pacific Section, fig. 5 (list).

probably not Cibicides cf. C. ungeriana - - Mallory, 1959, Lower Teriary Biostratigaphy of the California Coast Ranges, AAPG, p.
- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p.

RANGE: An early Eocene (P6b) through late Oligocene (P22) range is given by van Morkhoven and others (1986). Almgren and others (1988) restrict this species to zone D which is equivalent to nannofossil zone CP9 and planktic foraminiferal zone P6b.

ECOLOGY: Cibicidoides praemundulus was primarily a lower bathyal and abyssal form, but occurs sporadically in middle bathyal sediments. Greatest abundances are found at abyssal depths (van Morkhoven and others, 1986).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme); Pacheco Syncline

Cibicidoides subspiralis (Nuttall)

Cibicides subspirata Nuttall, 1930, Jour. Paleo., v. 4, p. 292, pl. 25, figs. 9,10, 14.
Cibicidoides subspiratus (Nuttall) - - van Morkhoven and others, 1986, Bull. des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 314-316, pl. 102, figs. 1a-c.
RANGE: A late early Eocene (P9) through late middle Eocene (P13) range is given by van Morkhoven and others (1986).
ECOLOGY: Cibicidoides subspiralis is a bathyal and abyssal species (van Morkhoven and others, 1986).
OCCURRENCE: Laurel Quad (Te_1); Loma Prieta Quad. (Te_1, Tme)

Clavulinoides californicus Mallory

Clavulinoides californicus Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 123, pl. 4, fig. 6a-b.
- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 35, pl. 2, fig. 5a-c.
Clavulinoides sp. - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 8, pl. 1, fig. 20.
RANGE: Mallory (1959) gives range as lower Ynezian through lower Narizian.
ECOLOGY: Clavulinoides californicus has an upper depth limit on the outer shelf biofacies, 50-150 m (Clavulinoides spp., Ingle, 1980).
OCCURRENCE: Laurel Quad (Te_1); Loma Prieta Quad. (Te_1)

Cyclammina clarki (Hanna)

Nonionina clarki Hanna, 1923, Univ. Calif. Pub., Dept. of Geol., Bull., v. 14, p. 324, pl. 59, fig. 2.
Cyclammina clarki (Hanna) - - Kleinpell, 1983, Miocene Stratigraphy of California, AAPG, p. 188.
ECOLOGY: The upper depth limit of Cyclammina clarki is in the lower middle bathyal biofacies, 1500-2000 m (Ingle, 1980).
OCCURRENCE: Laurel Quad (Tsl)

Cyclammina pacifica Beck

Cyclammina pacifica Beck, 1943, Jour. Paleo., v. 17, p. 591, pl. 98, figs. 2, 3.
- - McDougall, 1980, SEPM Paleo. Monograph, no. 2, p. 34.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 75.
RANGE: Mallory (1959) gives range as upper Ulatisian through upper Narizian.
ECOLOGY: Cyclammina pacifica has an upper depth limit in the lower middle bathyal biofacies, 1500-2000 m (Ingle, 1980).
OCCURRENCE: Laurel Quad (Tsl); Loma Prieta Quad. (Tbs, Tsl)

Cyclammina simiensis Cushman and McMasters

Cyclammina simiensis Cushman and McMasters, 1936, Jour. Paleo., v. 10, p. 509, pl. 74, fig. 3a-b.

- - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 6, pl. 1, fig. 9.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, pl. 2, fig. 17.

COMMENTS: The test of Cyclammina simiensis is compressed with a rounded periphery which is often lobate.

OCCURRENCE: Laurel Quad (Te_1); Loma Prieta Quad. (Te_1, Te_2, Tme); Pacheco Syncline

Dentalina communis (d'Orbigny)

Nodosaria (Dentalina) communis d'Orbigny, 1826, Ann. Sci. Nat., ser. 1, v. 7, p. 254.

Dentalina communis (d'Orbigny) - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 162, pl. 12, fig. 11; pl. 41, fig. 6.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 78.

RANGE: Mallory (1959) gives range as upper Ynezian through upper Narizian.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Dentalina consobrina (d'Orbigny)

Nodosaria (Dentalina) consobrina d'Orbigny, 1846, Foraminiferes fossiles du bassin tertiaire de Vienne (Sutriche), Gide et Comp., Paris, p. 46, pl. 2, figs. 1-3.

Dentalina consobrina (d'Orbigny) - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 163, pl. 12, fig. 12; pl. 41, fig. 5.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 78.

COMMENTS: Specimens included here are restricted to forms with a spherical initial chamger, followed by square chamber then a rectangular chamber. Forms with the same basic chamber arrangement but the square and rectangular chambers are more elongated (see Kellough, 1965, pl. 6, fig. 10, p. 101) are now included in D. consobrina not C. elongatum.

RANGE: Mallory (1959) gives range as upper Ynezian through upper Narizian.

OCCURRENCE: Laurel Quad (Te_1); Loma Prieta Quad. (Te_1, Tme)

Dentalina jacksonensis (Cushman and Applin)

Nodosaria jacksonensis Cushman and Applin, 1926, AAPG, p. 170, pl. 7, figs. 14-16.

- - Mallory, 1959, Lower Tertiary of the California Coast Ranges, AAPG, p. 165, pl. 12, fig. 18.

RANGE: Mallory (1959) gives range as upper Ynezian to upper Narizian.

OCCURRENCE: Laurel Quad (Tsl)

Dentalina mucronata Neugeboren

Dentalina mucronata Neugeboren, 1856, K. Akad. Wiss., Math.-Naturw. Cl., Denschr., Osterreich, Bd. 12, Abth. 2, p. 83, pl. 3, figs. 8-11.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 166.

OCCURRENCE: Laurel Quad (Te_1); Loma Prieta Quad. (Te_1)

Dorothia bulletta (Carsey)

Dorothia bulletta (Carsey) - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 125, pl. 4, fig. 9a, b.

Dorothia asiphonia (Andreae) - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 9, pl. 1, fig. 25.

RANGE: Mallory (1959) gives range as lower Ynezian to lower Penutian with rare occurrences noted in the lower Ulatisian and the Narizian. Cretaceous occurrences of this species are noted by Sliter (1968).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Ku_1, Te_1, Te_2)

Dorothia principiensis Cushman and Bermudez

Dorothia principiensis Cushman and Bermudez, 1936, Cushman Lab. Foram. Res., Contr. v. 12, p. 57, pl. 10, figs. 3-4.

- - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 9, pl. 1, fig. 26.
- - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 154, pl. 19, fig. 4.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 125, pl. 27, fig. 8; pl. 33, fig. 2; pl. 36, fig. 3.

RANGE: Mallory (1959) gives range as upper Ynezian through upper Narizian.

OCCURRENCE: Laurel Quad (Te_1); Loma Prieta Quad. (Te_1, Tme); Pacheco Syncline

Eggerella elongata Blaisdell

Eggerella elongata Blaisdell, 1965, Cushman Found. Foram. Res., Contr., v. 16, p. 27, pl. 2, figs. 1-3.

- - Smith, 1971, Univ. Calif. Pub. Geol. Sci., v. 91, p. 34, pl. 2, fig. 5.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 75, pl. 10, fig. 16.

Eggerella sp. Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 124.

RANGE: Mallory (1959) gives range as upper Ulatisian through upper Narizian.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tsl)

Ellipsoglandulina abbreviata Sequenza

Ellipsoglandulina abbreviata Sequenza, 1859, Eco Peloritano, Giornale di Sci., ser. 2, anno 5, fasc. 9, p. 14, fig. 5.

- - Bermudez, 1949, Cushman Lab. Foram. Res., Special Pub. no. 25, p. 227, pl. 14, figs. 44-45.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Ellipsoglandulina labiata (Schwager)

Glanudlina labiata Schwager, 1866, Norara-Exped., Geol. Thril, v. 2, p. 237, pl. 6, fig. 77.
Ellipsoglandulina labiata (Schwager) - - Bermudez, 1949, Cushman Lab. Foram. Res., Special Pub., no. 25, p. 228, pl. 14, figs. 42-43.
- - Beckmann, 1953, Eclog. Geol. Helv., v. 46, p. 379, Pl. 23, figs. 9-11.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Eponides dorfi Toulmin

Eponides dorfi Toulmin, 1941, Jour. Paleo., v. 15, p. 601, pl. 81, figs. 8-9.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 237, pl. 30, fig. 2.
- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 132, pl. 11, fig. 4.
RANGE: Mallory (1959) gives range as lower Ulatisian through lower Narizian with rare occurrences in the upper Ynezian and lower Penutian.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Eponides mexicanus (Cushman)

Pulvinulina mexicana Cushman, 1925, Cushman Lab. Foram. Res., Contr. v. 1, p. 300.
Eponides mexicana (Cushman) - - Smith, 1957, Univ. Calif. Pubs. Geol. Sci., v. , p. 182, pl. 27, fig. 10.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 237, pl. 37, fig. 11; pl. 41, fig. 9.
Neoeponides mexicanus (Cushman) - - Mallory, 1970, Burke Museum, Reserch Report, No. 2, p. 134.
Eponidies frizzelli Kleinpell 1938, Miocene Stratigraphy of California, AAPG, p. 318, pl. 2, figs. 12, 15, 16.
Eponides gaviotensis Wilson, 1954, Univ. Calif. Pub. Geol. Sci., v. 30, p. 43, pl. 16, figs. 11-12.
Eponides guaybalensis Cole, 1927, Am. Paleontol. Bull., v. 14, p. 29, pl. 2, figs. 17-19.
Eponidies kleinpelli Cushman and Frizzell, 1940, Cushman Lab. Foram. Res., Contr., v. 16, p. 42, pl. 8, figs. 11a-c.
RANGE: Mallory (1959) gives range as Bulitian through upper Narizian. Junior synonyms of this species occur in the Refugian (McDougall, 1980) and the early Zemorrian (Kleinpell, 1938).
ECOLOGY: The upper depth limits of E. gaviotaensis and E. kleinpelli is given as inner neritic (Ingle, 1980).
OCCURRENCE: Laurel Quad. (Te_1)

Fissurina marginata (Walker and Boys)

Lagena marginata (Walker and Boys) - - Kleinpell, 1938, Miocene Stratigraphy of California, AAPG, p. 225, pl. 10, fig. 5.
- - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pub. Geol. Sci., v. 81, p. 40, pl. 5, fig. 14.
OCCURRENCE: Laurel Quad. (Te_1)

Fissurina orbignyana Sequenza

Fissurina orbignyana Sequenza, 1862, Deii terreni Terziarii del distretto di Messina; Parte II - Descriptione dei foraminiferi monotalamici delle marne mioceniche del distretto de Messina T. Capra, p. 66, pl. 2, figs. 25-26.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Glandulina laevigata (d'Orbigny)

Nodosaria (Glandulina) laevigata d'Orbigny,1826, Ann. Sci. Nat. Paris, ser. 1, tome 7, p. 252.

Glandulina laevigata (d'Orbigny) - - McDougall, 1983, USGS, Prof. Paper 1213, p. 75.

OCCURRENCE: Laurel Quad. (Te_1)

Globobulimina pacifica Cushman

Globobulimina pacifica Cushman - - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pub. Geol. Sci., v. 81, pl 55, pl. 11, figs. 16a-b.

- - McDougall, 1983, USGS, Prof. Paper 1213, p.

COMMENTS: Specimens of Globobulimina cf. G. pacifica figured in Fairchild and others (1969, pl. 11, figs. 17-18) are placed in synonomy with Praeglobobulimina pupoides.

OCCURRENCE: Laurel Quad (Tsl)

Globocassidulina globosa (Hantken)

Cassidulina globosa Hantken, 1875, K. Ungar. Geol. Anst., Mitt. Jahrb., Bd. 4, Heft. 1, p. 64, pl. 16, figs. 2a-b.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 226, pl. 33, fig. 11a-b.

Globocassidulina subglobosa (Brady) - - Sullivan, 1962, Univ. Calif. Pub. Geol. Sci., v. 37, p. 283, pl. 20, figs. 5a-b.

- - McDougall, 1983, USGS, Prof. Paper 1213, p. 75.

- - Tjalsma and Lohmann, 1983, Micropaleo. Special Publication no. 4, p. 31, pl. 16, fig. 9.

RANGE: Mallory (1959) gives range as lower Penutian through upper Narizian. Tjalsma and Lohmann (1983) indicate that this species first appears in the Paleocene planktic zone P4 and ranges throughout the Eocene and into younger strata.

ECOLOGY: The upper depth limit of G. globosa is in the outer shelf biofacies, 50-150 m (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme)

Glomospira charoides (Jones and Parker)

Trochammina squamata charoides Jones and Parker, 1860, Geol. Soc. London, Quart. Jour., v. 16, p. 304.

Glomospira charoides (Jones and Parker) - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 6, pl. 1, fig. 7.

Glomospira charoides corona Cushman and Jarvis - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 109.
RANGE: Mallory (1959) gives range as lower Ynezian through upper Narizian.
ECOLOGY: Glomospira charoides has an upper depth limit in the lower bathyal biofacies, ≥ 2000 m (Ingle, 1980).
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Gonatosphaera eocenica Mallory

Gonatosphaera eocenica Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 225, pl. 18, fig. 19.
- - Mallory, 1970, Burke Museum Research Report, no. 2, p. 124, pl. 9, fig. 2.

RANGE: Mallory (1959) gives range of Gonatosphaera eocenica as lower Penutian through lower Ulatisian. Gonatosphaera eocenica occurs in the Media Agua Creek section in assemblages interpreted as Ulatisian in age by Mallory (1959). These assemblages are interpreted by McDougall (unpublished data, 1988) as Penutian and occur with planktic foraminifers assigned to zone P8 (Poore, 1980). In the Pacheco syncline, G. eocenica occurs in assemblages interpreted as Penutian (McDougall, unpublished data, 1988) and in association with nannofossils assigned to zone CP10/CP11 (Bukry, unpublished data, 1988). The documented range of Gonatosphaera eocenica is Penutian.
OCCURRENCE: Laurel Quad. (Te_1); Pacheco Syncline

Guttulina problema d'Orbigny

Guttulina problema d'Orbigny, 1826, Ann. Sci. Nat., v. 7, p. 266.
- - Cushman and Ozawa, 1931, Proceedings U.S. Nat. Mus., v. 77, p. 19-22, pl. 2, figs. 1-6; pl. 3, fig. 1a-c.

ECOLOGY: Guttulina problema has an upper depth limit in the outer shelf biofacies, 50-150 m (Ingle, 1980).
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Gyroidina condoni (Cushman and Schenck)

Eponides condoni Cushman and Schenck, 1928, Univ. Calif. Pubs. Geol. Sci., v. 17, p. 313, pl. 44, figs. 6, 7a-c.
Gyroidina condoni (Cushman and Schenck) - - Sullivan, 1962, Univ. Calif. Pub. Geol. Sci., v. 37, p. 280, pl. 18, figs. 1a-c.
- - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pubs. Geol. Sci., v. 81, p. 73, pl. 23, fig. 11.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 75.

ECOLOGY: The upper depth limit of Gyroidina condoni is upper middle bathyal, 500-1500 m (Ingle, 1980).
OCCURRENCE: Laurel Quad. (Tsl)

Gyroidina orbicularis planata Cushman

Gyroidina orbicularis condoni Cushman, 1935, USGS PRof. Paoer 181, p. 45, pl. 66, figs. 4-6.
- - Sullivan, 1962, Univ. Calif. Pubs. Geol. Sci., v. 37, p. 280, pl. 18, figs. 1a-c.

- - McDougall, 1983, USGS, Prof. Paper 1213, p. 75, pl. 17, fig. 4.

ECOLOGY: The upper depth limit of Gyroidina orbicularis planata is upper bathyal, 150-500 m (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Tsl)

Gyroidina soldanii d'Orbigny

Gyroidina soldanii d'Orbigny, 1826, Ann. Sci. Nat., ser. 1, v. 7, p. 278.

- - McDougall, 1983, USGS, Prof. Paper 1213, p. 75.

ECOLOGY: Gyroidina soldanii has an upper depth limit in the lower bathyal biofacies, $\geq$ 200 m (Ingle, 1980)

OCCURRENCE: Laurel Quad. ($Te_1$1, Tsl); Loma Prieta Quad. (Te_1, Tme, Tsl)

Gyroidina soldanii octocamerata Cushman and Hanna

Gyroidina soldanii octocamerata cushman and Hanna, 1927, p. 223, pl. 14, figs. 16-18.

- - Smith, 1957, Univ. Calif. Pubs. Geol. Sci., v. 32, p. 181, pl. 27, fig. 5.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 236, pl. 30, fig. 1; pl. 42, fig. 1.

ECOLOGY: The upper depth limit of Gyroidina soldanii octocamerata is lower bathyal (Ingle, 1980).

OCCURRENCE: Laurel Quad ($Te_1$1)

Haplophragmoides eggeri Cushman

Haplophragmoides eggeri Cushman - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 111, pl. 2, fig. 6.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 32.

Haplophragmoides sp. - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 6, pl. 1, fig. 10.

RANGE: Mallory (1959) gives range as Ynezian through lower Narizian.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (?Ku_1, Te_1, Te_2, Tme, Tbs)

Karreriella chapapotensis (Cole)

Textularia chapatoensis Cole, 1928, Bull. American Paleo., v. 14, p. 206, pl. 33, fig. 9.

Karreriella chapapotensis (Cole) - - Tjalsma and Lohmann, 1983, Micropaleo., Spec. Pub., no. 4, p. 32.

Karreriella chapapotensis monumentensis Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 126, pl. 5, fig. 3.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 47.

COMMENTS: Tjalsma and Lohmann (1983) consider Mallory's variation to represent the microspheric form of K. chapapotensis which ranges from the early Eocene to Oligocene.

RANGE: Mallory (1959) gives the range of K. chapapotensis monumentensis as lower Ulatisian through lower Narizian. Tjalsma and Lohmann give the range of K. chapapotensis as from early Eocene (P6b) into the Oligocene.

ECOLOGY: Karreriella chapapotensis has an upper depth limit in the upper middle bathyal biofacies, 500-1500 m (Ingle, 1980).
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme)

Karreriella elongata Mallory

Karreriella elongata Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 127, pl. 5, fig. 4a-c.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 75, pl. 11, fig. 1.

COMMENTS: Differs from K. chilostoma in narrower test, greater length, more oblique chambers (Mallory, 1959). Karreriella elongata is probably a junior synonym of Karreriella subglabra (Gumbel).
RANGE: Mallory (1959) finds this species restricted to the lower Narizian. The range of K. subglabra is P8 through Oligocene (Tjalsma and Lohmann, 1983)
ECOLOGY: Karreriella elongata has an upper depth limit in the lower middle bathyal biofacies, 1500-2000 m (Ingle, 1980).
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme)

Lagena becki Sullivan

Lagena becki Sullivan, 1962, Univ. Calif. Pubs. Geol. Sci., v. 37, p.266, pl. 10, figs. 16a-b.
- - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pubs. Geol., v. 81, p. 39, pl. 5, fig. 10.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 75.

OCCURRENCE: Laurel Quad. (Tsl); Lodo Gulch

Lenticulina inornata (d'Orbigny)

Robulina inornata d'Orbigny, 1846, Foraminiferes fossiles du bassin tertiaire de Vienne, Gide et Cie., p. 102, pl. 4, figs. 25-26.
Lenticulina inornata (d'Orbigny) - - Sullivan, 1962, Univ. Calif. Pubs. Geol. Sci., v. 37, p. 258, pl. 5, figs. 5a-b.
- - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pubs. Geol. Sci., v. 81, p. 42, pl. 6, fig. 1.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 76.

COMMENTS: Note that the specimen illustrated by Fairchild and others (1969) has too many chambers and may not be this species.
OCCURRENCE: Laurel Quad. (Tsl)

Lenticulina limbosus hockleyensis (Cushman and Applin)

Cristellaria limbosus hockleyensis Cushman and Applin, 1926, AAPG, v. 10, p. 171, pl. 8, figs. 3-4.
Robulus limbosus hockleyensis (Cushman and Applin) - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 139, pl. 6, fig. 15.
RANGE: Mallory (1959) gives range as upper Ulatisian through upper Narizian.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Lenticulina pseudocultratus (Cole)

Robulus pseudocultratus Cole, 1927, Bull. American Paleo., v. 14, p. 19, pl. 1, fig. 5.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 76, pl. 12, fig. 3.

RANGE: Mallory (1959) gives range as upper Bulitian through upper Narizian.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Lenticulina pseudovortex (Cole)

Robulus pseudovortex Cole, 1927, Bull. American Paleo., v. 14, p. 19, pl. 1, fig. 12.
- - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 158, pl. 20, figs. 12-13.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 141, pl. 7, figs. 2-3; pl. 27, fig. 13.
- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 60.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 76, pl. 12, fig. 4.

RANGE: Mallory (1959) gives range as lower Bulitian through lower Narizian.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1); Pacheco Syncline

Lenticulina terryi (Coryell and Embich)

Robulus terryi Coryell and Embich, 1937, Jour. Paleo., v. 11, p. 299, pl. 41, fig. 17.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 141, pl. 6, fig. 1.

RANGE: Mallory (1959) gives range as upper Ynezian through lower Narizian.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Lenticulina vortex (Fitchel and Moll)

Robulus vortex (Fitchel and Moll) - - Smith, 1957, p. 159, pl. 21, fig. 2.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1); Pacheco Syncline

Lituotuba cf. L. lituiformis (Brady)

Lituotuba cf. L. lituiformis (Brady) - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 109, pl. 1, fig. 17.
?Trochamminoides sp. A - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 7, pl. 1, fig. 11.
?Trochamminoides sp. B - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 7, pl. 1, fig. 12.
RANGE: Mallory (1959) gives range as Ulatisian with rare occurrences in the upper Ynezian and lower Penutian.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad (Te_1)

Marginulina exima Neugeboren

Marginulina exima Neugeboren, 1851, Siebenb. Ver. Naturw. Hermannstadt. Verh. Mitt., Jahrg. 2, p. 129, pl. 4, fig. 17.
- - Sullivan, 1962, Univ. Calif. Pubs. Geol. Sci. v. 37, p. 262, pl. 8, figs. 9a-b.

- - McDougall, 1983, USGS, Prof. Paper 1213, p. 76.

Marginulina eximia Neugeboren - - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pub. Geol. Sci., v. 81, p. 44, pl. 8, fig. 4.

RANGE: Mallory (1959) gives range as lower Bulitian through lower Narizian.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tsl)

Marginulina subbullata Hantken

Marginulina subbullata Hantken, 1875, K. Ungar. Geol. Anst., Mitt., Jahrb., v. 4, p. 46, pl. 4, figs. 9-10.; pl. 5, fig. 9.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 151, pl. 9, figs. 13-15.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 69.

- - McDougall, 1983, USGS, Prof. Paper 1213, p. 76, pl. 12, fig. 10.

Marginulina bullata augens Cushman and Todd - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 161, pl. 21, fig. 15.

Enantiomarginulina sp. - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 170, pl. 23, fig. 16.

RANGE: Mallory (1959) gives range as upper Ynezian through upper Narizian.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Martinotiella communis (d'Orbigny)

Clavulina communis d'Orbigny, 1846, Foraminiferes fossiles du bassin tertiaire de Vienne Gide et Cie., p. 196, pl. 12, figs. 1-2.

- - McDougall, 1980, SEPM, Paleo. Monograph, no. 2, p. 36.

OCCURRENCE: Laurel Quad. (Te_1 - cf.)

Nodosarella advena Cushman and Siegfus

Nodosarella advena Cushman and Siegfus, 1939, Cushman Lab. Foram. Res., Contr., v. 15, p. 30, pl. 6, figs. 19-20.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 220, pl. 18, fig. 22a-b; pl. 29, fig. 12a-b.

RANGE: Mallory (1959) gives range as lower Ulatisian through lower Narizian. Nodosarella advena has been found in strata which is assigned to the Penutian Stage and occurs with nannofossils assigned to zone CP12 in the Devils Den section, California (unpublished data, McDougall and Bukry, 1989, sample DDM-14-89). This species has also been found in strata assigned to the Penutian Stage and in association with planktic foraminifers assigned to zones P8 through P9 in the Media Agua Creek section (Mallory, 1959; Poore, 1980). These occurrences suggest that the range of N. advena in Penutian through early Ulatisian, and equivalent to planktic foraminiferal zones P8 through at least P9 and possibly P10.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Nodosaria latejugata Gumbel

Nodosaria latejugata Gumbel, 1868, K. Acad. Wiss Munchen, Math.-Physik. Cl., Abh., Bd. 10, Abt. 2, p. 619, pl. 1, fig. 32.

- - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 167, pl. 22, fig. 23.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 171, pl. 13, fig. 20; pl. 28, fig. 8; pl. 41, fig. 1.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 85.

RANGE: Mallory (1959) gives range as lower Ynezian through upper Ulatisian.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Nonionella florinense (Cole)

Nonion florienense Cole, 1927, Bull. American Paleo., v. 14, p. 22, pl. 4, fig. 4.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 183, pl. 15, fig. 8.

- - Mallory, 1970, Burke Museum Resarch Report, no. 2, p. 96.

Nonion frankei Cushman of Smith, 1957, Univ. Calif., Pub. Geol. Sci., v. 32, p. 171, pl. 23, fig. 21.

OCCURRENCE: Laurel Quad. (Te_1); Pacheco Syncline

Nuttalloides truempyi (Nuttall)

Eponides truempyi Nuttall, 1930, Jour. Paleo., v. 4, p. 287, pl. 24, figs. 9, 13, 14.

Nuttalloides truempyi (Nuttall) - - van Morkhoven and others, 1986, Bull. des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 288-295, pl. 96A, figs. 1-4; pl. 96B, figs. 1-3; pl. 96C, figs. 1-4; pl. 96D, figs. 1-2.

Astigerina crassaformis Cushman and Siegfus, 1935, Cushman Lab. Foram. Res., Contr., v. 11, p. 94, pl. 14, fig. 10.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 242, pl. 37, fig. 13a-c.

- - McDougall, 1983, USGS Prof. Paper 1213, p. 74.

Astigerina crassaformis umbilicatula Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 242, pl. 22, fig. 1a-c.

Astigerina crassaformis umbilicatula Mallory - - Almgren and others, 1988, Paleogene of the West Coast, SEPM, Pacific Section, fig. 5 (list).

COMMENTS: Astigerina crassaformis umbilicatula which ranges from lower Penutian through lower Narizian, has the large clear umnbilical boss which is characteristic of many middle and late Eocene forms of the species Nuttalloides truempyi.

RANGE: A late Cretaceous (Campanian) through late Eocene (P17) range is given by van Morkhoven and others (1986). Berggren and Aubert (1983) considered the extinction of N. truempyi a useful event for identification of the Eocene/Oligocene boundary in deep-water sediments. Mallory (1959) gave the range of Astigerina crassaformis as lower Ulatisian through upper Narizian and the range of A. crassaformis umbilicatulum as lower Penutian through lower Narizian. Both ranges fall within the broader range given for Nuttalloides truempyi. The range of Astigerina crassaformis umbilicatula given by Almgren and others (1988) is zones C through A-2 which are equivalent to nannofossil zones CP9 through CP14 (planktic foraminiferal zones P7-P14) and also falls within the broader range of Nuttalloides truempyi.

ECOLOGY: The upper depth limit of Nuttalloides truempyi is in the lower bathyal biofacies, 1500-2000 m (Ingle, 1980) but Nuttalloides truempyi is most common at abyssal depths (van Morkhoven and others, 1986).

OCCURRENCE: Laurel Quad (Te_1); Loma Prieta Quad. (Te_1, Tme); Pacheco Syncline

Oridorsalis umbonatus (Reuss)

Rotalina umbonata Reuss, 1851, Deutsch. Geol. Ges., Zeitschr., Berlin, Bd. 3, p. 75, pl. 5, fig. 35.

Eponides umbonata (Reuss) - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 183, pl. 27, figs. 12, 14.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 239, pl. 30, fig. 3; pl. 37, fig. 11.

- - Sullivan, 1962, Univ. Calif. Pubs. Geol. Sci., v. 37, p. 281, pl. 18, figs. 7a-c.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 133.

Eponides umbonatus (Reuss) - - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pubs. Geol. Sci., v. 81, p. 63.

Oridorsalis umbonatus (Reuss) - - McDougall, 1983, USGS, Prof. Paper 1213, p. 76, pl. 17, figs. 5-6.

- - Tjalsma and Lohmann, 1983, Micropaleo., Spec. Pub., no. 4, p. 18, pl. 6, fig. 8.

RANGE: Mallory (1959) gives range as upper Ynezian through upper Narizian.

ECOLOGY: Ingle (1980) gives upper depth limit of Oridorsalis umbonatus as upper bathyal in the Paleogene and as upper middle bathyal in the Neogene.

OCCURRENCE: Laurel Quad. (Te_1, Tsl); Lodo Gulch; Loma Prieta Quad. (Te_1, Tme); Pacheco Syncline

Osangularia mexicana (Cole)

Pulvinulinella culter mexicana Cole, 1927, Bull. American Paleo., v. 14, p. 31, pl. 1, figs. 15-16.

Eponides lodoensis martini Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 182 (in part).

RANGE: Similar forms identified by Mallory (1959) as Parrella culter midwayana and Parrella tenuicarinata range from lower Ynezian through the lower Narizian and upper Bulitian through upper Narizian.

ECOLOGY: The upper depth limit of Osangularia mexicana is upper middle bathyal, 500-1500 m (Ingle, 1980)

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme); Pacheco Syncline

Plectina garzaensis Cushman and Siegfus

Plectina garzaensis Cushman and Siegfus, 1935, Cushman Lab. Foram. Res., Contr., v. 11, p. 92, pl. 14, figs. 3-4.

- - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 9, pl. 1, fig. 29.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 126, pl. 4, fig. 13.

- - Sullivan, 1962, Univ. Calif. Pubs. Geol. Sci., v. 37, p. 281, pl. 18, figs. 7a-c.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 76, pl. 11, figs. 5-6.

RANGE: Mallory (1959) gives range as lower Ulatisian through upper Narizian with rare occurrences in the lower Penutian.

OCCURRENCE: Loma Prieta Quad. (Te_1, Tme, Tsl)

Plectofrondicularia packardi Cushman and Schenck

Plectofrondicularia packardi Cushman and Schenck, 1928, Univ. Calif. Pub. Geol. Sci., v. 17, p. 311, pl. 43, figs. 14-15.
- - McDougall, 1980, SEPM, Paleo. Monograph, no. 2, p. 37.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 76, pl. 13, fig. 1.

Plectofrondicularia aff. P. basispinata - - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pubs. Geol. Sci., v. 81, p. 47, pl. 8, fig. 16.

Plectofrondicularia miocenica Cushman - - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pubs. Geol. Sci., v. 81, p. 47-48, pl. 9, figs. 5, 12.

COMMENTS: Keel present on specimen identified as P. aff. P. basispinata by Fairchild and others (1969) is artifact of poor preservation and recrystallization.

Fairchild and others (1969) give location of P. miocenica as B4385 on plate description but checklist gives location as B4386. Based on assemblage compsition specimen probably from B4386.

RANGE: Mallory (1959) gives range as upper Narizian into the Refugian. Kleinpell (1938) notes rare P. packardi in the early Zemorrian and early Saucesian. Almgren and others (1988) note the first appearance of this species in the Ulatisian Stage, equivalent to planktic foraminiferal zone P10.

OCCURRENCE: Laurel Quad. (Tsl); Loma Prieta Quad. (Tsl)

Plectofrondicularia paucicostata Cushman and Jarvis

Plectofrondiuclaria paucicostata Cushman and Jarvis, 1929, Contr. Cushman Lab. Foram. Res., v. 5, p. 10, pl. 2, figs. 11-12, 13.
- - van Morkhoven and others, 1986, Bull. Des Centres de Recherches Elf-Aquitaine, Mem. 11, p. 273, pl. 91, figs. 1-2.

Plectofrondicularia kerni Cook - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 212, pl. 18, fig. 2; pl. 33, fig. 10a-b.

RANGE: Mallory (1959) gives range as lower Penutian through lower Narizian. The range of middle Eocene (P12) through early Oligocene (P20) with doubtful occurrence from early Eocene P8 through middle Eocene P11 (van Morkhoven and others, 1986) is broader.

ECOLOGY: Plectofrondicularia paucicostata is a middle bathyal to abyssal species (van Morkhoven and others, 1986).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1); Pacheco Syncline

Plectofrondicularia vaughani Cushman

Plectofrondiuclaria vaughani Cushman, 1927, Cushman Lab. Foram Res., Contrib., v. 3, p. 112, pl. 23, fig. 3.
- - Sullivan, 1962, Univ. Calif. Pubs. Geol. Sci., v. 37, p. 271, pl. 12, fig. 7.

- - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pubs. Geol. Sci., v. 81, p. 48, pl. 9, fig. 10.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 76, pl. 13, fig. 3.

RANGE: The last occurrence of Plectofrondicularia vaughani is in planktic foraminiferal zone N17 (Berggren and Miller, 1989).

OCCURRENCE: Laurel Quad. (Te_1, Tsl)

Pleurostomella acuta Hantken

Pleurostomella acuta Hantken, 1875, K. Ungar. Geol. Anst., Mitt. Jahrb., Budapest, Bd. 4, p. 44, pl. 13, fig. 18.

RANGE: Mallory (1959) gives range as upper Ynezian through upper Narizian.

ECOLOGY: Pleurostomella acuta has an upper depth limit in the lower bathyal biofacies, 1500-2000 m (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme)

Pleurostomella alternans Schwager

Pleurostomella alternans Schwager, 1866, Novara Exped., Geol. Theil, Bd. 2, Abt. 2, p. 238, pl. 6, figs. 79-80.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 77, pl. 16, fig. 4.

ECOLOGY: The upper depth limit of this species is in the lower bathyal biofacies, $\geq$2000 m (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Pleurostomella gredalensis Cook

Pleurostomella gredalensis Cook in Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 218, pl. 18, fig. 15; pl. 35, fig. 3a-b.

COMMENTS: Morphologically this species is very similar to P. nuttalli.

RANGE: Pleurostomella gredalensis is reported by Mallory (1959) in the upper Ynezian of Media Agua Creek section.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Pleurostomella nuttalli Cushman and Siegfus

Pleurostomella nuttalli Cushman and Siegfus, 1939, Contr. Cushman Lab. Foram. Res., v. 15, p. 29, pl. 6, figs. 17, 18.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 219, pl. 18, fig. 16.

RANGE: Mallory (1959) gives range as lower Bulitian through lower Narizian.

ECOLOGY: Pleurostomella nuttalli has an upper depth limit in the lower bathyal biofacies, 1500-2000 m (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Pseudonodosaria conica (Neugeboren)

Glandulina conica Neugeboren, 1850, Siebenb. ver. Naturw. Hermannstadt, Verh. Mitt., Hermanstadt, v. 1, p. 51, pl. 1, fig. 5a-b.

Pseudonodosaria conica (Neugeboren) - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 173, pl. 33, fig. 4; pl. 36, fig. 11.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 87.

RANGE: Mallory (1959) gives range as upper Ynezian through upper Narizian.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Pseudonodosaria inflata (Bornemann)

Glandulina inflata Bornemann, 1855, Deutsch. Geol. Ges., Zeitschr., Berlin, v. 7, p. 320, pl. 12, figs. 6-7.

Pseudonodosaria inflata (Costa) - McDougall, 1980, SEPM Paleo. Monograph, no. 2, p. 37.

Nodosaria ovata (Cushman and Applin) - - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pubs. Geol. Sci., v. 81, p. 36.

OCCURRENCE: Laurel Quad. (Te_1, Tsl); Loma Prieta Quad. (Te_1, Tme, Tsl)

Pullenia eocenica Cushman and Siegfus

Pullenia eocenica Cushman and Siegfus, 1939, Contr. Cushman Lab. Foram. Res., v. 15, p. 31, pl. 7, fig. 1a-b.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 246, pl. 30, fig. 4a-b.

- - Tjalsma and Lohmann, 1983, Micropaleo., Spec. Pub., no. 4, p. 36, pl. 16, fig. 2.

RANGE: Mallory (1959) gives range as upper Bulitian through upper Narizian. Pullenia eocenica is common from early Eocene zone P9 through late Eocene P17 with rare occurrences as old as P6a (late Paleocene) (Tjalsma and Lohmann, 1983).

ECOLOGY: Pullenia eocenica has an upper depth limit in the upper middle bathyal biofacies, 500-1500 m (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme)

Pullenia quinqueloba (Reuss)

Nonionina quinqueloba Reuss, 1851, Deutsch. Geol. Ges., Zeitschr., Berlin, v. 3, p. 71, pl. 5, fig. 31.

Pullenia quinqueloba (Reuss) - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 246, pl. 34, fig. 1a-b.

RANGE: Mallory (1959) gives range as upper Ynezian through lower Narizian.

ECOLOGY: Ingle (1980) gives the upper depth limit of this species as in both outer shelf and upper middle bathyal biofacies. The upper middle bathyal depth is believed to be correct.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Pullenia salisburyi Stewart and Stewart

Pullenia salisburyi Stewart and Stewart, 1930, Jour. Paleo., v. 4, p. 72, pl. 8, fig. 2.

- - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 188, pl. 28, fig. 11.
- - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pubs. Geol. Sci., v. 81, p. 73.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 77.

RANGE: Although Mallory (1959) gives the range as Narizian, Pullenia salisburyi is reported from the Refugian (McDougall, 1980), Zemorrian and Saucesian as well as questionably in the Relizian and Luisian (Kleinpell, 1938).

ECOLOGY: Pullenia salisburyi has an upper depth limit in the outer shelf biofacies, 50-150 m (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1); Pacheco Syncline

Pyrulina cylindroides (Roemer)

Polymorphina cylindroides Roemer, 18538, Neues Jahrb. Min. Geogn. Geol. Petref.-Kund, p. 385, pl;. 3, fig. 26a-b.

Pyrulina cylindroides (Roemer) - - McDougall, 1980, SEPM Paleo. Monograph, no. 2, p. 37.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Reophax pilulifera Brady

Reophax pilulifera Brady, 1883 Rep. Scientific Results Explor. Voyage HMS Challenger, Zool., v. 9, p. 292, pl. 30, figs. 18-20.
- - McDougall, 1980, SEPM Paleo. Monograph, no. 2, p. 37.

Reophax pilulifer - - McDougall, 1983, USGS, Prof. Paper 1213, p. 77, pl. 10, fig. 2.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Rhabdammina eocenica Cushman and Hanna

Rhabdammina eocenica Cushman and Hanna, 1927, Calif. Acad. Sci. Proc., 4th ser., v. 16, p. 209, pl. 13, fig. 3.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 104, pl. 1, figs. 1-2; pl. 27, fig. 1.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 76, pl. 10, fig. 1.

Rhabdammina sp. - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 148, pl. 17, fig. 3 (in part).

ECOLOGY: Rhabdammina eocenica has an upper depth limit in the upper middle bathyal biofacies, 1500-2000 m (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme, Tbs, Tsl); Pacheco Syncline

Saracenaria hantkeni Cushman

Saracenaria arcuata hantkeni Cushman, 1933, Cushman Lab. Foram. Res., Contr., v. 9, p. 4, pl. 1, figs. 11-12.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Silicosigmoilina californica Cushman and Church

Silicosigmoilina californica Cushman and Church, 1929, Calif. Acad. Sci. Proc., 4th ser., v. 18, p. 502, pl. 36, figs. 10-12.

- - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 10, pl. 1, fig. 32.
- - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 155, pl. 19, figs. 8 and 12.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 129.
- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 50.
- - Almgren and others, 1988, Paleogene of the West Coast, SEPM, Pacific Section, fig. 5 (list).

COMMENTS: Silicosigmoilina californica is probably a junior synonym of Rzehakina epigona (Rzehak). Sliter (1968) seperates these species in the Cretaceous and lists several differences between the two species: S. californica is larger, less circular in outline and has sigmoidal chambers and an apertural tooth.

RANGE: The range of Rzehakina epigona is late Cretaceous (Campanian through early Eocene (P9) doubtful occurrence in middle Eocene zones P10 through P13 (van Morkhoven and others, 1983). The range of Silicosigmoilina californica given by Mallory is Ynezian through Narizian and it is most characteristic of the Paleocene. Almgren and others (1988) give range as zones D through A-2 which is equivalent to nannofossil zone CP4 through CP14 (planktic foraminiferal zones P4 thorugh P14). Only rare or questionable occurrences of S. californica are noted in zone A-2 (P10-P14) (Almgren and others, 1988).

ECOLOGY: Rzehakina epigona is common in bathyal and abyssal environments (van Morkhoven and others, 1986).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (?Ku_1, Te_1, Te_2, Tme, Tbs); Pacheco Syncline

Siphogenerina transversa Cushman

Siphogenerina raphanus transversa Cushman, 1918, U.S. Natl. Mus. Bull. 103, p. 64.

Siphogenerina transversa Cushman - - Kleinpell, 1938, Miocene Stratigraphy of California, AAPG, p. 305.

- - McDougall, 1983, USGS Prof. Paper 1213, p. 77.

RANGE: Kleinpell (1938) gives range as Zemorrian through Saucesian. Berggren and Miller (1989), record the last occurrence of Rectuvigerina transversa as in the upper part of planktic foraminiferal zone N11 which correlates with the Luisian Stage.

ECOLOGY: The upper depth limit of Siphogenerina transversa is in the upper middle bathyal biofacies, 500-1500 m (Ingle, 1980).

OCCURRENCE: Laurel Quad (Tls)

Spiroloculina texana Cushman and Ellisor

Spiroloculina texana Cushman and Ellisor, 1944, Cushman Lab. Foram. Res., Contr., v. 20, p. 51, pl. 8, figs. 14-15.

- - McDougall, 1983, USGS, Prof. Paper 1213, p. 77.

Spiroloculina wilcoxensis Cushman and Garrett - - Sullivan, 1962, Univ. Calif. Pubs. Geol. Sci., v. 37, p. 257, pl. 4, figs. 9.
Spiroloculina sp. - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 9, pl. 1, fig. 24.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme)

Spiroplectammina directa (Cushman and Siegfus)

Spiroplectoides directa Cushman and Siegfus, 1939, Cushman Lab. Foram. Res., Contr., v. 15, p. 26, pl. 6, figs. 7-8.
Spiroplectammina directa (Cushman and Siegfus) - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 116, pl. 3, fig. 5a-b.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 77, pl. 10, fig. 9.
Spiroplectammina sp. - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 7, pl. 1, figs. 14, 15, 16.
COMMENTS: Spiroplectammina specialis maybe the senior synonym of S. directa.
RANGE: Mallory (1959) lists this species as occurring in the Ulatisian and Narizian Stages. Spiroplectammina specialis has, however, been found in early Eocene benthic foraminiferal assemblages in association with calcareous nannofossil assemblages which are diagnostic of Zone CP11 (early Eocene planktic foraminiferal zones late P8 and P9) (McDougall and Bukry, unpublished data, 1988). Spiroplectammina specialis which may be the senior synonym ranges from the late Cretaceous to P22 (Oligocene).
ECOLOGY: The upper depth limit of Spiroplectammina directa is in the outer neritic biofacies, 50-150 m (S. gryzbowski of Ingle, 1980).
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme, Tsl)

Spiroplectammina richardi Martin

Spiroplectammina richardi Martin, 1943, Stanford Univ. Publ. Geol. Sci., v. 3, p. 14, pl. 5, fig. 3a-b.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 118, pl. 3, fig. 9; pl. 27, fig. 5.
- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 38.
- - McDougall, 1983, USGS, Prof. Paper 1213, p. 77, pl. 10, fig. 8.
Spiroplectammina? cf. S. richardi Martin - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 118, pl. 3, fig. 10.
Spiroplectammina adamsi Lalicker - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 7, pl. 1, fig. 13.
Spiroplectammina gryzbowski Frizzel - - Almgren and others, 1988, Paleogene of the West Coast, SEPM, Pacific Section, fig. 5 (list).
Textularia mississippiensis (Cushman) - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 151-152, pl. 18, figs. 1-3.
COMMENTS: Spiroplectammina? cf. S. richardi of Mallory (1959) is from the lower Point of Rocks in the Media Agua Creek Section. This form is a variation of the type; additional specimens have been identified from lower in the Lodo Formation at Media Agua Creek (McDougall, unpublished data).

RANGE: Mallory (1959) gives range as lower Bulitian through lower Narizian. Almgren and others (1988) give the range as zones E through A-2 which is equivalent to nannofossil zones CP4 through CP14 (planktic foraminiferal zones P4 through P14).
ECOLOGY: Spiroplectammina richardi has an upper depth limit in the outer neritic biofacies, 50-150 m (Ingle, 1980).
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1); Pacheco Syncline

Textularia adalta Cushman

Textularia adalta Cushman, 1926, Cushman Lab. Foram. Res., Contr., v. 2, p. 29, pl. 4, fig. 2.
Textularia cf. T. adalta Cushman - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 51, pl. 18, fig. 5.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 119.
Karreriella chilostoma (Reuss) - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 9, pl. 1, fig. 27.
RANGE: Mallory (1959) gives range as lower Ynezian through lower Narizian.
OCCURRENCE: Loma Prieta Quad. (Te_1); Laurel Quad (Te_1)

Trifarina wilcoxensis (Cushman and Ponton)

Pseudouvigerina wilcoxensis Cushman and Ponton, 1932, Cushman Lab. Foram. Res., Contr., v. 8, p. 66, pl. 8, fig. 18.
Angulogerina wilcoxensis (Cushman and Ponton) - - Smith, 1957, Univ. Calif. Pub. Geol. Sci., v. 32, p. 179, pl. 25, fig. 9.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 211, pl. 37, fig. 6.
- - Mallory, 1970, Burke Museum, Research Report, no. 2, p. 117, pl. 8, fig. 5.
Trifarina wilcoxensis (Cushman and Ponton) - - McDougall, 1983, USGS, Prof. Paper 1213, p. 77, pl. 15, fig. 5.
COMMENTS: Criteria used to separate this species from T. advena californiensis include the presence of two distinct ribs at each corner angle and a channel between. Also chambers in T. wilcoxensis are more lobate and do not form the smooth sides as seen in T. advena californiensis.
RANGE: Mallory (1959) gives range as upper Bulitian through lower Penutian with a questionable occurrence in the upper Ulatisian.
ECOLOGY: The upper depth limit of T. wilcoxensis is given as outer neritic - transitional to upper bathyal (Ingle, 1980).
OCCURRENCE: Laurel Quad. (Te_1)

Tritaxilina colei Cushman and Siegfus

Tritaxilina colei Cushman and Siegfus, 1935, Cushman Lab. Foram. Res., Contr., v. 11, p. 92, pl. 14, figs. 5-6.
- - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 10, pl. 1, figs. 30, 31.
- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 128, pl. 27, fig. 9a-b.

- - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pubs. Geol. Sci., v. 81, p. 34, pl. 4, fig. 8a-b.

RANGE: Mallory (1959) gives range as upper Ynezian through upper Narizian.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Tme)

Trochammina globigeriniformis (Parker and Jones)

Lituola globigeriniformis Parker and Jones, 1865, R. Soc. London Philos. Trans., v. 155, p. 407, pl. 15, figs. 46-47.

Trochammina globigeriniformis (Parker and Jones) - - McDougall, 1980, p. 38.

Trochammina cf. T. globigeriniformis (Parker and Jones) - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 156, pl. 19, fig. 14-16.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 133, pl. 5, fig. 16.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 51.

?Trochammina sp. - - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 10, pl. 1, figs. 33, 34.

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Te_2; Tsl)

Trochamminoides contortus Mallory

Trochamminoides contortus Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 110, pl. 2, fig. 1a-b.

RANGE: Mallory (1959) gives range as upper Bulitian through lower Narizian with questionable occurrences in the upper Ynezian.

OCCURRENCE: Loma Prieta Quad. (Te_1)

Uvigerina cocoaensis Cushman

Uvigerina cocoaensis Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, p. 67,

- - Boersma, 1984, Handbook of Common Tertiary Uvigerina, Microclimates Press, Stony Point, N.Y., p. 35-36, pl. 1-2.

RANGE: Uvigerina cocoaensis ranges from P9 through P22 (Boersma, 1984). On the West Coast U. cocoaensis is most common in the late Eocene.

ECOLOGY: The upper depth limit of U. cocoaensis is upper bathyal (Boersma, 1984).

OCCURRENCE: Laurel Quad (Tsl)

Uvigerina gallowayi Cushman

Uvigerina gallowayi Cushman, 1929, Cushman Lab. Foram. Res., Contr. v. 5, p. 94-95, pl. 13, figs. 33-34.

- - McDougall, 1983, USGS, Prof. Paper 1213, p. 76, pl. 13, fig. 14.

- - Boersma, 1984, Handbook of Common Tertiary Uvigerina, Microclimates Press, Stony Point, N.Y., p. 62-64, pl. 1.

not Uvigerina gallowayi Cushman - - Sullivan, 1962, Univ. Calif. Pubs. Geol. Sci., v. 37, p. 277, pl. 16, figs. 9a-c.

RANGE: Uvigerina gallowayi ranges from the early Miocene through late Miocene, planktic foraminiferal zones N4-N5 through N15. The California species identified as U.

gallowayi may be U. alazaensis which is similar to U. gallowayi and is restricted to the Oligocene (Boersma, 1984).

ECOLOGY: The upper depth limit of Uvigerina gallowayi is on the outer shelf to upper bathyal biofacies in organic and/or clay rich sediments (Ingle, 1980; Boersma, 1984).

OCCURRENCE: Laurel Quad (Tsl)

Uvigerina lodoensis miriamae Mallory

Uvigerina lodoensis miriamae Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 209, pl. 17, figs. 8-9; **not** pl 40, fig. 9.

Uvigerina spp. Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 179, pl. 25, fig. 10, **not** pl. 26, fig. 3.

COMMENTS: Boersma (1984) suggest that U. lodoensis Mallory is conspecific with U. elongata Cole and that U. lodoensis represents the completely triserial form of this species. Penutian specimens of U. lodoensis miriamae figured by Mallory (1959) are more triangular in outline than the Ulatisian specimen (pl. 40, fig. 9). Boersma (1984) also notes that U. lodoensis does have a compressed final chamber which is not found in U. elongata.

RANGE: Mallory (1959) lists range as Penutian and Ulatisian. Uvigerina lodoensis miriamae occurs in the Penutian of Media Agua Creek (McDougall unpublished data, 1989; Mallory, 1959), and the Pacheco Syncline (Smith, 1957). These specimens occur with nannofossils charateristic of early Eocene zones CP10 and CP10/CP11 undifferentiated (Bukry, unpublished data, 1988 and 1989) which is equivalent to planktic foraminiferal zones late P7 to P9. In the Devils Den area, U. lodoensis miriamae occurs in an assemblage assigned to the early Ulatisian (McDougall, unpublished data, 1989) and in association with nannofossils assigned to zone CP12a (Bukry, unpublished data, 1989). Smith (1957) included several different species under Uvigerina spp. and thus the stratigraphic range of Uvigerina lodlensis miriamae is difficult to determine. Other Ulatisian occurrences given by Mallory have not be confirmed. The range of U. lodoensis miriamae based on California data is P8 through P10. This range is more restricted than the range of U. elongata (P9-P20, Boersma, 1984).

ECOLOGY: Boersma (1984) finds U. elongata in shallow shelf depth sediments, frequently in warmer regions and associated with glauconite.

OCCURRENCE: Loma Prieta Quad. (Te_1); Laurel Quad. (Te_1); Pacheco Syncline

Uvigerinella obesa Cushman

Uvigerinella obesa Cushman Kleinpell, 1938, Miocene Stratigraphy of California, AAPG, p. 290, pl. 9, fig. 15.

- - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pub. Geol. Sci., v. 81, p. 58-59, pl. 14, fig. 9a-b.

RANGE: Kleinpell (1938) gives range of U. obesa as Saucesian through upper Relizian.

ECOLOGY: The upper depth limit of Uvigerinella obesa is in the upper bathyal biofacies (Ingle, 1980).

OCCURRENCE: Laurel Quad (Tls)

Uvigerinella sparsicostata Cushman and Laiming

Uvigerinella sparispicostata Cushman and Laiming, 1931, Jour. Paleo., v. 5, p. 111, pl. 12, figs. 11a-b.

- - Fairchild, Wesendunk and Weaver, 1969, Univ. Calif. Pub. Geol. Sci., v. 81, p. 59, pl. 14, fig. 8a-b.

- - McDougall, 1983, USGS, Prof. Paper 1213, p. 76, pl. 15, fig. 6.

RANGE: Kleinpell (1938) gives range as upper Zemorrian.

ECOLOGY: The upper depth limit of U. sparsicostata is in the upper bathyal biofacies (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Tsl)

Vaginulinopsis asperuliformis (Nuttall)

Cristellaria asperuliformis Nuttall, 1930, Jour. Paleo., v. 4, p. 282, pl. 23, figs. 9, 10.

Vaginulinopsis asperuliformis (Nuttall) - - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 155, pl. 27, fig. 20a-b.

- - Almgren and others, 1988, Paleogene of the West Coast, SEPM, Pacific Section, fig. 5 (list).

RANGE: Mallory (1959) gives range as upper Bulitian through lower Narizian. Almgren and others (1988) give range as zone C through A-2 (rare) which correspond to nannofossil zones CP9 through CP14 (planktic foraminiferal zones P6b-P14).

ECOLOGY: Vaginulinopsis asperuliformis has an upper depth limit in the outer neritic biofacies, 50-150 m (Ingle, 1980).

OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Vaginulinopsis saundersi (Hanna and Hanna)

Cristellaria saundersi Hanna and Hanna, 1924, Univ. Washington Pub. Geol. Sci., v. 1, p. 61, pl. 13, figs. 5, 6, 15.

Vaginulinopsis mexicana var. C of Laiming - - Almgren and others, 1988, Paleogene of the West Coast, SEPM, Pacific Section, fig. 5 (list).

Vaginulinopsis saundersi (Hanna and Hanna) - - Smith, 1957, Univ. Calif. Publ. Geol. Sci., v. 32, p. 162, pl. 22, figs. 1-2.

- - Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 157, pl. 11, fig. 10.

- - Mallory, 1970, Burke Museum, Res. Rept., no. 2, p. 74, pl. 4, fig. 13.

- - McDougall, 1983, USGS, Prof. Paper 1213, p. 77, pl. 12, fig. 14.

RANGE: Mallory (1959) lists occurrences of V. saundersi in the upper Ynezian through Ulatisian and notes varieties of this species in the Narizian. Almgren and others (1988) give range as zones B-4 through B-2 which is equivalent to nannofossil zones CP10 through CP11 (planktic foraminiferal zones late P7-P9).

OCCURRENCE: Laurel Quad. (Te_1, Tsl); Loma Prieta Quad. (Te_1)

Verneuilina triangulata Cook

Verneuilina triangulata Cook in Mallory, 1959, Lower Tertiary Biostratigraphy of the California Coast Ranges, AAPG, p. 120, pl. 4, fig. 1a-c; pl. 33, fig. 1a-b.

RANGE: Mallory (1959) gives range as lower Penutian.
ECOLOGY: The upper depth limit of V. triangulata is in the outer neritic biofacies, 50-150 m (Ingle, 1980).
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1)

Vulvulina curta Cushman and Siegfus

Vulvulina curta Cushman and Siegfus, 1935, Cushman Lab. Foram. Res., Contr., v. 11, p. 91, pl. 14, figs. 1, 2.
- - Graham and Classen, 1955, Contr. Cushman Found. Foram. Res., v. 6, p. 8, pl. 1, fig. 19.

RANGE: Mallory (1959) gives range as upper Ynezian through upper Narizian.
OCCURRENCE: Laurel Quad. (Te_1); Loma Prieta Quad. (Te_1, Te_2)

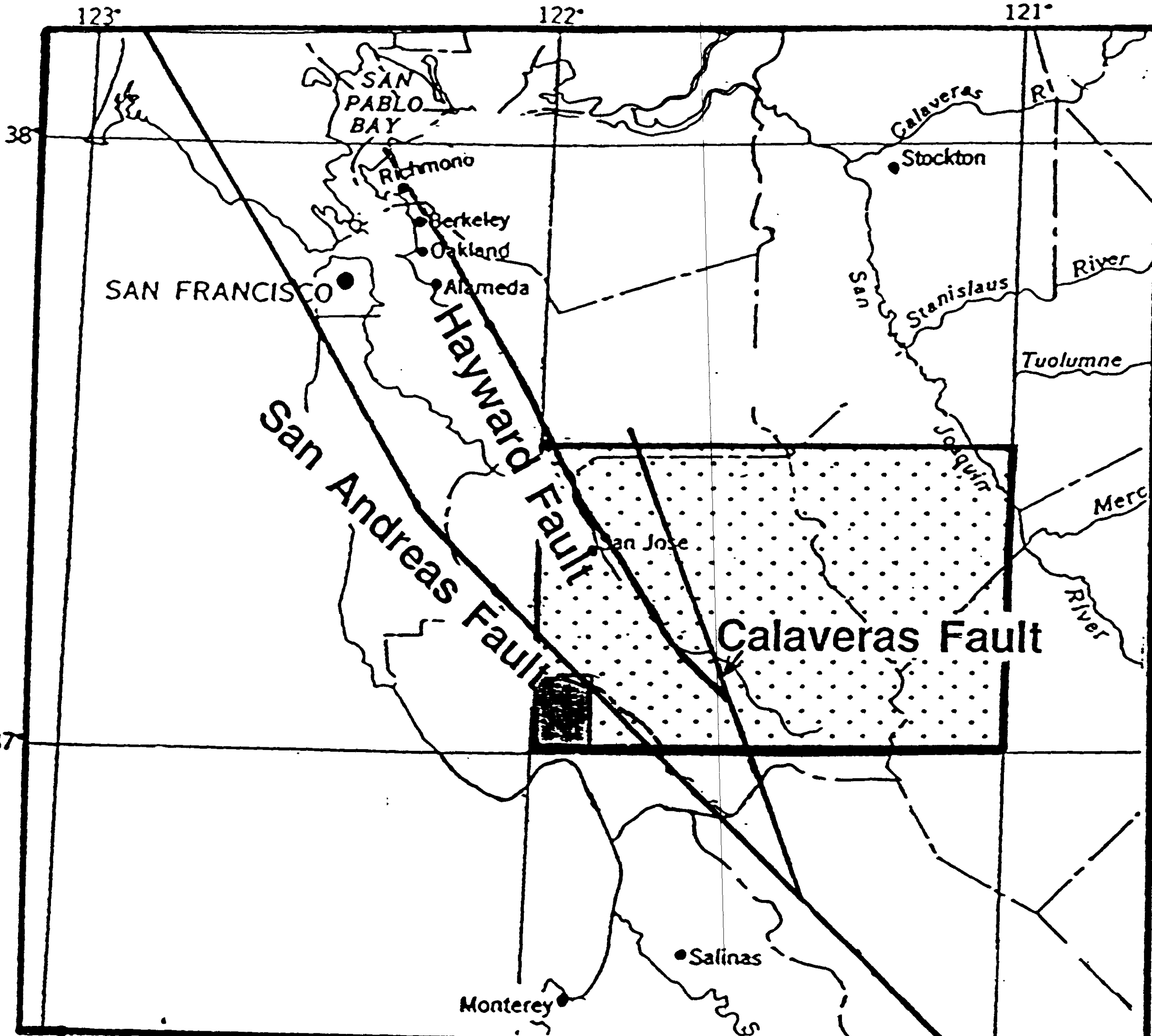
FIGURES

Figure 1 Location of the San Jose 2° sheet (shaded), Laurel Quadrangle (shaded) and the major faults in the area.

Figure 2 Sample locations and general geology of the northern half of the Laurel Quadrangle. Distribution and location of the Cenozoic formations discussed and the major faults in the Laurel Quadrangle are simplified from Clark and others (1989). Cenozoic formations include the Butano Sandstone (Tb), San Lorenzo Formation (Tsl), Vaqueros Formation (Tv), Lambert Shale (Tla), "mottled mudstone of Mt Chual" (Te_1), "marine sandstone and shale" (Te_2), and "marine shale and sandstone of Highland Way" (Tme). four major faults cut the area: Sargent, Lomita, San Andreas, and Zayante. Only portions of these fault systems are shown.

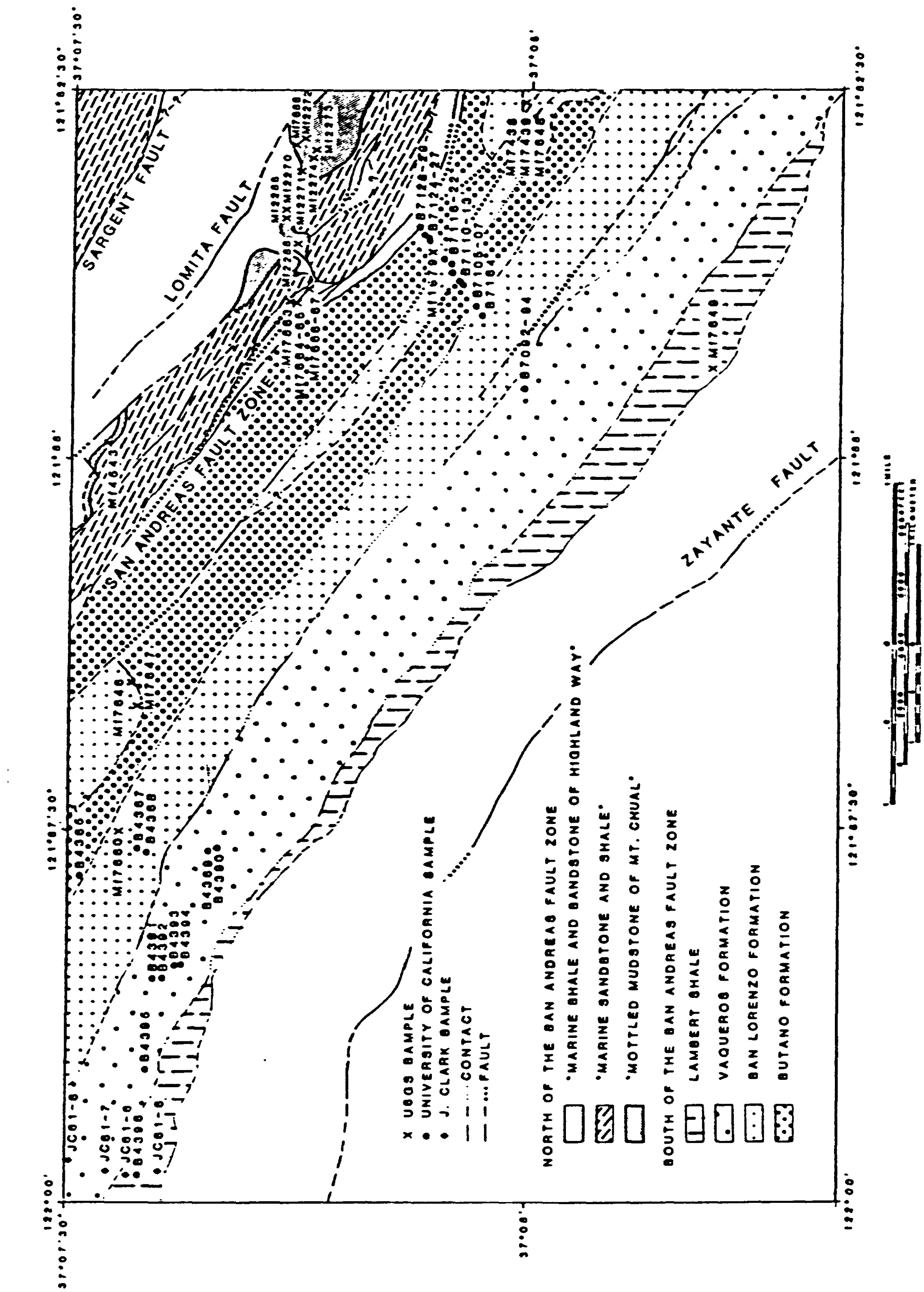
Figure 3 Benthic foraminiferal biostratigraphic framework used for the Paleogene Laurel Quadrangle assemblages. Placement of the planktic foraminiferal and calcareous nannofossil zones follows Berggren and others (1985). Age and correlation of benthic foraminiferal zonations follows McDougall (1989) with some adjustments related to the use of the Berggren and others (1985) time scale. The bathyal and abyssal benthic foraminiferal zonation of Berggren and Miller (1989) is also shown. Foraminiferal ranges are from Tjalsma and Lohmann (1983) and van Morkhoven and others (1986). Other sources are referenced in Appendix II (Taxonomic Notes).

Figure 4 Age of Cenozoic formations studied in the Laurel and Loma Prieta quadrangles. Time scale is from figure 3. Age of formations based on benthic foraminiferal assemblages. Age and nature of contacts between formations was not examined in this study.


123°
122°
121°
38°
37°
SAN PABLO BAY
Richmond
Berkeley
Oakland
Alameda
SAN FRANCISCO
Hayward Fault
San Andreas Fault
Calaveras Fault
San Jose
Stockton
Calaveras R
San Joaquin
Stanislaus
River
Tuolumne
Merc
River
Salinas
Monterey

59-A

FIG. 1



SARGENT FAULT
LOMITA FAULT
SAN ANDREAS FAULT ZONE
ZAYANTE FAULT
X USGS SAMPLE
• UNIVERSITY OF CALIFORNIA SAMPLE
• J. CLARK SAMPLE
CONTACT
FAULT
NORTH OF THE SAN ANDREAS FAULT ZONE
"MARINE SHALE AND SANDSTONE OF HIGHLAND WAY"
"MARINE SANDSTONE AND SHALE"
"MOTTLED MUDSTONE OF MT. CHUAL"
SOUTH OF THE SAN ANDREAS FAULT ZONE
LAMBERT SHALE
VAQUEROS FORMATION
SAN LORENZO FORMATION
BUTANO FORMATION
37°07'30"
37°05'
122°00'
121°57'30"
121°55'
121°52'30"

FIG 2

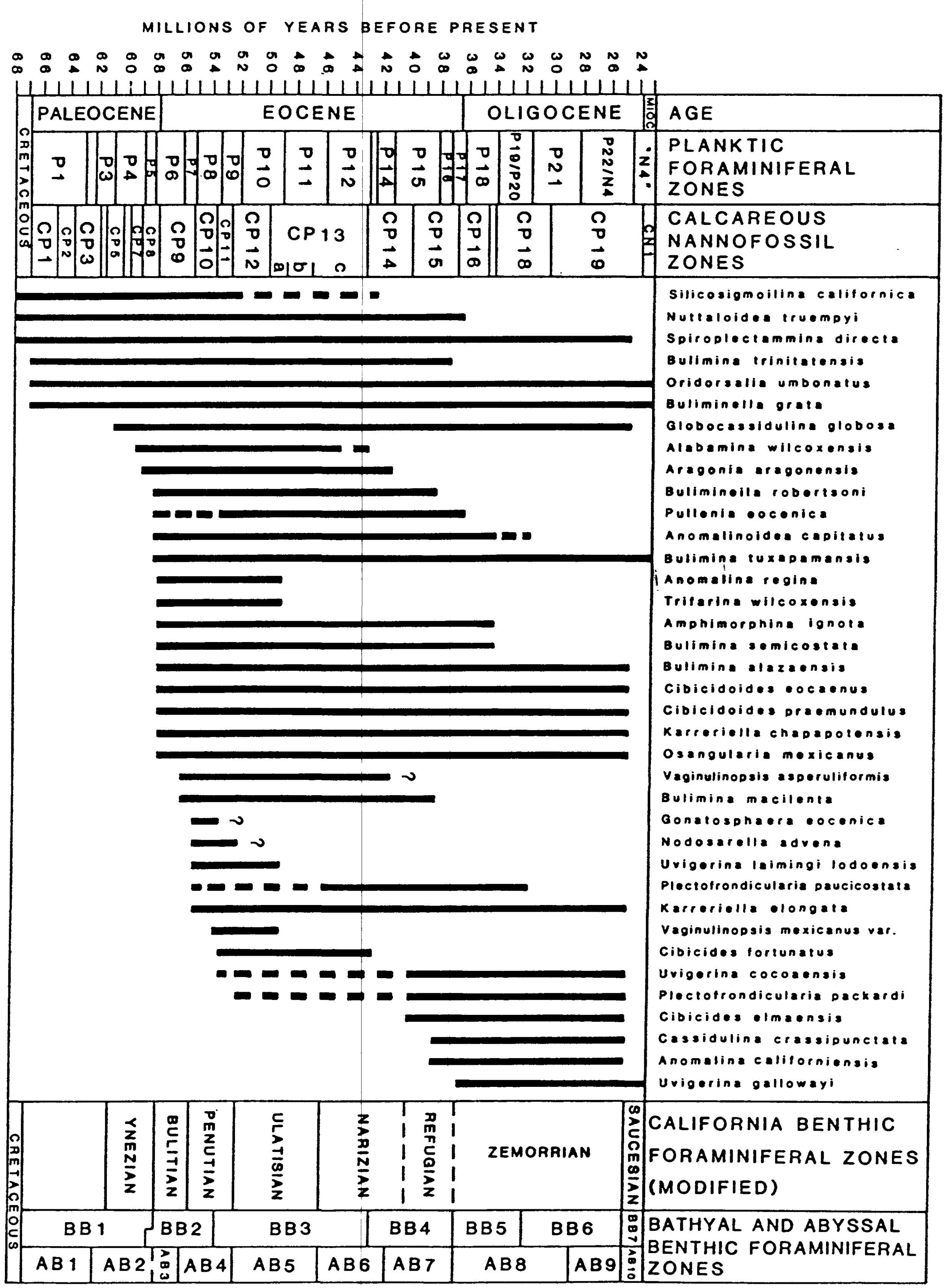
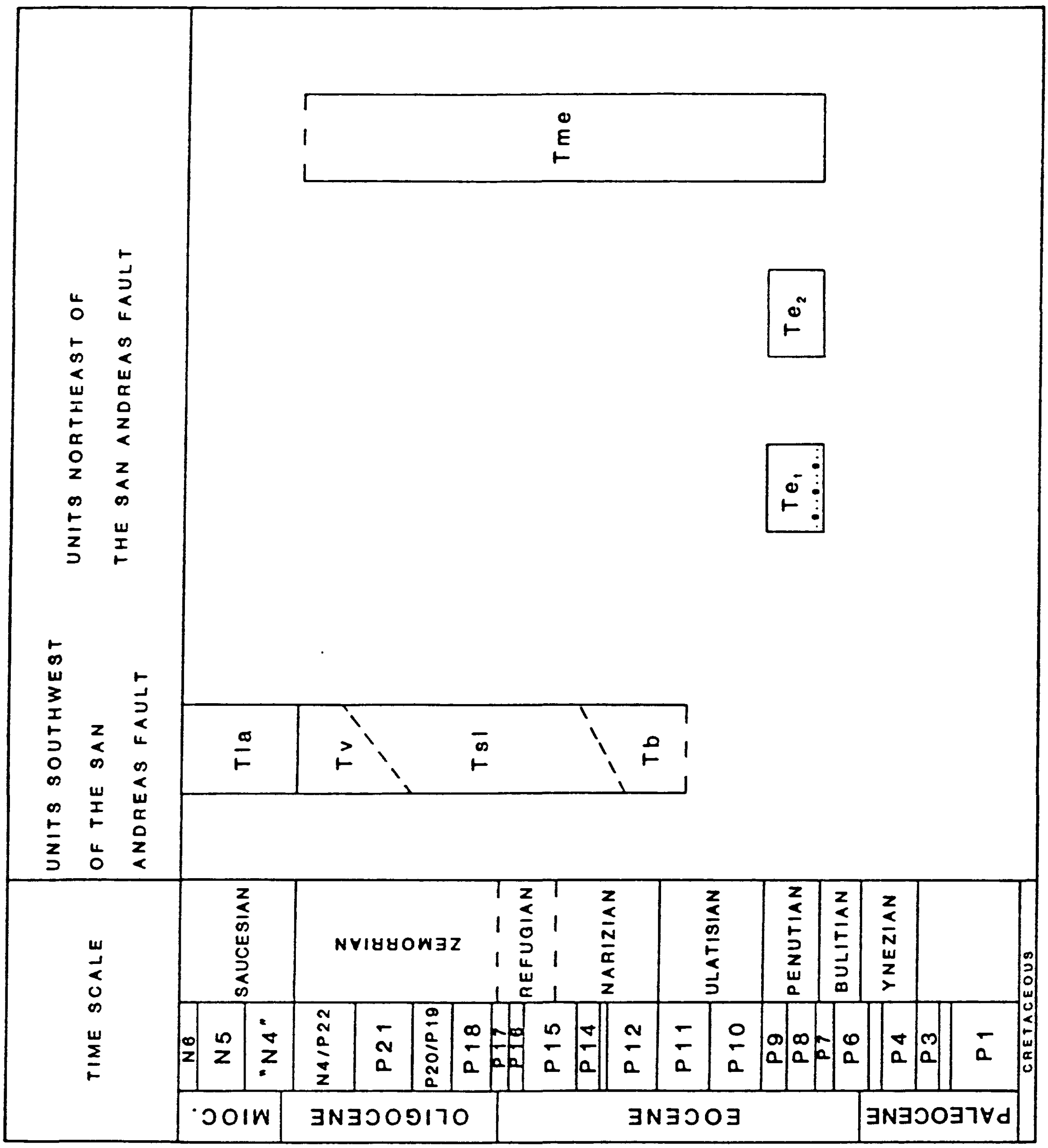

MILLIONS OF YEARS BEFORE PRESENT
68 66 64 62 60 58 56 54 52 50 48 46 44 42 40 38 36 34 32 30 28 26 24
AGE
CRETACEOUS
PALEOCENE
EOCENE
OLIGOCENE
MIOC
PLANKTIC FORAMINIFERAL ZONES
P1 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P14 P15 P16 P17 P18 P19/P20 P21 P22/N4 "N4"
CALCAREOUS NANNOFOSSIL ZONES
CP1 CP2 CP3 CP6 CP7 CP8 CP9 CP10 CP11 CP12 CP13 a b c CP14 CP15 CP16 CP18 CP19 CN1
Silicosigmoilina californica
Nuttaloidea truempyi
Spiroplectammina directa
Bulimina trinitatensis
Oridorsalia umbonatus
Buliminella grata
Globocassidulina globosa
Alabamina wilcoxensis
Aragonia aragonensis
Buliminella robertsoni
Pullenia eocenica
Anomalinoidea capitatus
Bulimina tuxapamensis
Anomalina regina
Trifarina wilcoxensis
Amphimorphina ignota
Bulimina semicostata
Bulimina alazaensis
Cibicidoides eocaenus
Cibicidoides praemundulus
Karreriella chapapotensis
Osangularia mexicanus
Vaginulinopsis asperuliformis
Bulimina macilenta
Gonatosphaera eocenica
Nodosarella advena
Uvigerina laimingi lodoensis
Plectofrondicularia paucicostata
Karreriella elongata
Vaginulinopsis mexicanus var.
Cibicides fortunatus
Uvigerina cocoaensis
Plectofrondicularia packardi
Cibicides elmaensis
Cassidulina crassipunctata
Anomalina californiensis
Uvigerina gallowayi
CALIFORNIA BENTHIC FORAMINIFERAL ZONES (MODIFIED)
CRETACEOUS
YNEZIAN
BULITIAN
PENUTIAN
ULATISIAN
NARIZIAN
REFUGIAN
ZEMORRIAN
SAUCESIAN
BATHYAL AND ABYSSAL BENTHIC FORAMINIFERAL ZONES
BB1 BB2 BB3 BB4 BB5 BB6 BB7
AB1 AB2 AB3 AB4 AB5 AB6 AB7 AB8 AB9 AB10

FIG 3


TIME SCALE
UNITS SOUTHWEST OF THE SAN ANDREAS FAULT
UNITS NORTHEAST OF THE SAN ANDREAS FAULT
MIOC.
OLIGOCENE
EOCENE
PALEOCENE
CRETACEOUS
N6
N5
"N4"
N4/P22
P21
P20/P19
P18
P17
P16
P15
P14
P12
P11
P10
P9
P8
P7
P6
P4
P3
P1
SAUCESIAN
ZEMORRIAN
REFUGIAN
NARIZIAN
ULATISIAN
PENUTIAN
BULITIAN
YNEZIAN
Tla
Tv
Tsl
Tb
Tme
Te_1
Te_2

59-D

FIG 4

TABLES

Table 1
Benthic foraminifers from the
San Lorenzo Formation (Tsl), Laurel Quadrangle

	Mf7660	Mf1579	Mf7647	Mf7648
Anomalina californiensis	.	.	X	.
Bulimina inflata alligata	.	.	X	.
Cassidulina crassipunctata	.	X	X	.
Cassidulina spp.	.	X	.	.
Cibicides elmaensis	.	.	X	.
Cyclammina cf. C. clarki	.	X	.	.
Cyclammina pacifica	.	.	X	.
Cyclammina spp.	X	.	.	.
Dentalina jacksonensis	.	X	.	.
Globobulimina pacifica	.	.	X	.
Gyroidina condoni	.	.	X	.
Gyroidina orbicularis planata	.	.	X	.
Gyroidina soldanii	.	X	.	.
Haplophragmoides spp.	X	X	.	.
Lagena becki	.	.	X	.
Lenticulina inornata	.	.	X	X
Lenticulina spp.	X	X	X	X
Oridorsalis umbonatus	.	.	X	.
Plectofrondicularia packardi	.	.	X	.
Plectofrondicularia vaughani	.	X	.	.
Pseudonodosaria inflata	.	.	X	X
Uvigerina cocoaensis	.	.	.	X
Uvigerina gallowayi	.	.	X	X
Uvigerinella sparsicostata	.	.	?	.
Vaginulinopsis saundersi	X	.	.	.
Vaginulinopsis spp.	X	.	.	.

Table 2
Benthic foraminifers from the
Lambert Shale (Tla), Laurel Quadrangle

	Mf7649
Baggina californica	X
Baggina cf. B. robusta	X
Lenticulina spp.	X
Siphogenerina transversa	X
Uvigerinella obesa	X

Table 3
Benthic foraminifers from the "mottled mudstone of Mt. Chual" (Te_1), Laurel Quadrangle

	Mf2266	Mf2267	Mf2268	Mf2269	Mf2270	Mf2271	Mf2272	Mf2273	Mf2274	Mf7658
Alabamina sp.	.	.	?	.	.	.	.	.	.	.
Alabamina wilcoxensis	.	.	.	.	.	.	.	.	?	.
Allomorphina conica	.	.	.	X	.	.	X	.	X	.
Allomorphina paleocenica	.	.	.	.	.	.	X	.	.	.
Allomorphina trigonia	.	.	.	.	.	.	.	.	.	X
Ammobaculites sp. of Smith (1957)	.	.	.	X	.	.	.	.	X	.
Ammodiscus incertus	.	X	.	.	X	.	X	.	.	.
Amphimorphina ignota	.	.	.	.	X	.	X	.	X	.
Anomalina regina	.	.	X	X	X	.	X	.	X	X
Anomalinoides capitatus	.	.	.	X	X	.	X	.	X	X
Anomalinoides cf. A. capitatus	.	.	.	.	.	.	.	.	.	X
Aragonia aragonensis	.	.	.	X	.	.	X	.	.	.
Bathysiphon santecruis	X	X	X	X	.	X	X	X	X	.
Bathysiphon sp. (coarse)	X	.	X	X	X	.	X	.	X	X
Bulimina alazaensis	.	.	X	X	.	.	.	.	X	.
Bulimina callahani	.	.	X	X	X	.	.	.	X	X
Bulimina macilenta	.	.	X	X	X	.	X	.	X	X
Bulimina semicostata	.	.	.	X	X	.	X	.	X	.
Bulimina spp.	.	.	.	.	.	.	.	.	X	.
Bulimina trinitatensis	.	.	X	X	X	.	.	.	.	.
Bulimina tuxapamensis	.	.	.	.	.	.	.	.	X	.
Buliminella grata	.	.	X	X	.	.	.	.	.	.
Buliminella robertsi	.	.	.	.	X	.	X	.	.	X
Chrysalongonium tenuicostatum	.	.	.	.	X	.	.	.	X	X
Cibicides fortunatus	.	.	.	.	X	.	X	.	X	.
Cibicides - Cibicidoides spp.	.	.	X	.	.	.	X	.	.	X
Cibicidoides eocaenus	.	.	X	.	X	.	X	.	X	X
Cibicidoides praemundulus	.	.	X	.	.	.	X	.	.	.
Cibicidoides subspiralis	.	.	X	.	.	.	.	.	.	.
Clavulinoides californicus	.	.	.	X	.	.	.	.	.	.
Cyclammina simiensis	.	.	X	X	X	.	X	X	.	.
Cyclammina spp.	.	X	.	.	.	.	.	X	.	.
Dentalina communis	.	.	X	.	.	.	.	.	.	.
Dentalina consobrina	.	.	.	.	X	.	.	.	.	.

Table 3 (continued)

	Mf2266	Mf2267	Mf2268	Mf2269	Mf2270	Mf2271	Mf2272	Mf2273	Mf2274	Mf7658
Dentalina mucronata	.	.	.	.	.	.	X	.	.	.
Dentalina spp.	.	.	.	.	.	.	.	.	.	X
Dorothia bulletta	.	.	.	X	X	.	X	.	X	X
Dorothia principiensis	.	.	.	.	.	.	.	X	.	.
Eggerella elongata	.	.	.	.	.	.	X	.	.	X
Ellipsoglandulina abbreviata	.	.	.	.	.	.	X	.	.	.
Ellipsoglandulina labiata	.	.	.	.	X	.	.	.	.	.
Eponides dorfi	.	.	X	X	X	.	X	.	.	X
Eponides mexicanus	.	.	.	.	.	.	.	.	.	X
Fissurina marginata	.	.	X	X	.	.	X	.	.	.
Fissurina orbignyana	.	.	X	.	.	.	.	.	.	.
Glandulina laevigata	.	.	.	.	.	.	X	.	.	.
Globocassidulina globosa	.	.	X	.	X	.	X	.	.	X
Glomospira charoides	X	.	X	.	X	.	X	.	X	.
Gonatosphaera eocenica	.	.	.	.	.	.	.	.	X	.
Guttulina problema	.	.	.	.	cf	.	.	.	.	.
Guttulina spp.	.	.	X	.	.	.	.	.	.	.
Gyroidina soldanii	.	.	X	X	X	.	X	.	.	X
Gyroidina soldanii octocamerata	.	.	.	X	X	.	.	.	.	.
Haplophragmoides eggeri	X	.	.	.	X	X	X	X	X	X
Karreriella chapapotensis	.	.	X	X	X	.	X	.	X	.
Karreriella elongata	.	.	X	.	.	.	.	.	.	.
Karreriella sp.	.	.	.	.	.	.	X	.	X	.
Lenticulina limbosus hockleyensis	.	.	.	.	X	.	X	.	X	.
Lenticulina pseudocultratus	.	.	.	.	X	.	.	.	X	.
Lenticulina pseudovortex	.	.	X	.	X	.	.	.	.	X
Lenticulina spp.	.	.	.	X	X	.	X	.	.	X
Lenticulina terryi	.	.	.	.	X	.	.	.	X	.
Lenticulina vortex	.	.	.	.	.	.	.	.	.	X
Lituotuba cf. L. lituiformis	.	.	.	.	X	.	.	X	.	.
Marginulina exima	.	.	.	X	.	.	X	.	.	.
Marginulina subbullata	.	.	.	.	X	.	X	.	.	X
Martinotiella cf. M. communis	.	.	.	.	.	.	.	.	.	X
Nodosarella advena	.	.	.	X	.	.	.	.	.	X
Nodosaria latejugata	.	.	.	.	X	.	.	.	.	.
Nodosaria spp.	.	.	.	.	.	.	X	.	.	.

Table 3 (continued)

	Mf2266	Mf2267	Mf2268	Mf2269	Mf2270	Mf2271	Mf2272	Mf2273	Mf2274	Mf7658
Nonionella florinense	.	.	.	.	.	.	X	.	.	.
Nuttalloides truempyi	.	.	X	X	X	.	X	.	.	X
Oridorsalis umbonatus	.	.	X	X	X	.	X	.	X	.
Osangularia mexicana	.	.	X	X	X	.	X	.	X	.
Plectina garzaensis	.	.	.	.	X	.	X	.	.	.
Plectofrondicularia paucicostata	.	.	.	.	.	.	.	.	X	.
Plectofrondicularia vaughani	.	.	.	.	.	.	.	.	.	X
Pleurostomella acuta	.	.	X	X	X	.	X	.	X	.
Pleurostomella gredalensis	.	.	X	.	.	.	.	.	.	.
Pleurostomella nuttalli	.	.	.	.	X	.	X	.	.	.
Pleurostomella spp.	.	.	.	.	X	.	.	.	.	.
Pseudonodosaria conica	.	.	.	X	.	.	.	.	.	.
Pseudonodosaria inflata	.	.	.	X	.	.	X	.	X	.
Pullenia eocenica	.	.	.	X	X	.	X	.	X	.
Pullenia quinqueloba	.	.	X	.	.	.	.	.	.	.
Pullenia salisburyi	.	.	.	.	.	.	.	.	.	X
Pyrulina cylindroides	.	.	.	X	X	.	X	.	.	.
Pyrulina spp.	.	.	.	.	.	.	X	.	.	.
Reophax pilulifera	.	.	.	.	X	.	.	.	.	.
Rhabdammina eocenica	.	.	.	.	.	.	X	.	.	.
Saracenaria hantkeni	.	.	X	.	.	.	.	.	.	.
Silicosigmoilina californica	.	X	X	X	X	X	X	X	X	.
Spiroloculina texana	.	.	.	.	.	.	.	.	X	.
Spiroplectammina directa	.	.	X	.	.	.	.	X	.	.
Spiroplectammina richardi	.	.	.	X	.	.	.	.	X	.
Textularia adalta	.	.	X	X	X	.	X	X	X	.
Trifarina wilcoxensis	.	.	.	.	.	.	.	.	X	.
Tritaxilina colei	.	X	X	X	.	.	X	X	X	X
Trochammina globigeriniformis	.	.	.	.	X	X	X	.	.	X
Trochamminoides contortus	.	.	.	.	.	.	.	.	X	.
Uvigerina lodoensis mirmiamae	.	.	.	X	.	.	.	.	.	.
Vaginulinopsis asperuiliformis	.	.	.	X	.	.	.	.	X	X
Vaginulinopsis saundersi	.	.	.	X	aff	.	.	.	.	.
Verneuilina triangulata	.	.	X	X	X	.	X	.	X	X
Vulvulina curta	.	.	.	.	.	.	.	.	X	.

Table 4
Benthic foraminifers from the "marine sandstone and shale" (Te_1) and ?Cretaceous unit, Laurel Quadrangle

	Mf7663	Mf7664	Mf7665	Mf7666	Mf7667
Allomorphina conica	.	.	.	X	.
Bathysiphon spp.	X	X	.	X	X
Bulimina macilenta	.	.	.	X	.
Bulimina semicostata	.	.	.	X	.
Cibicidoides eocaenus	.	X	.	X	.
Dorothia bulletta	.	X	.	X	.
Dorothia spp.	.	?	X	.	.
Haplophragmoides eggeri	.	.	X	.	.
Haplophragmoides spp.	X	X	.	X	X
Lenticulina pseudocultratus	.	.	.	X	.
Lenticulina spp.	.	X	.	.	.
Nodosaria latejugata	.	.	.	X	.
Nodosaria spp.	.	?	.	X	.
Nuttalloides truempyi	.	.	.	X	.
Oridorsalis umbonatus	.	.	.	X	.
Pleurostomella alternans	.	.	.	X	.
Pleurostomella nuttalli	.	.	.	X	.
Pullenia eocenica	.	.	.	X	.
Silicosigmoilina californica	.	.	.	.	X
Tritaxilina colei	X	X	.	X	.
Verneuilina triangulata	.	.	.	X	.
Unidentified arenaceous fragments	X	.	.	.	.