CUSHMAN FOUNDATION FOR FORAMINIFERAL RESEARCH

SPECIAL PUBLICATION NO. 29

BIOSTRATIGRAPHIC ATLAS OF MIOCENE FORAMINIFERA FROM THE MONTEREY AND MODELO FORMATIONS, CENTRAL AND SOUTHERN CALIFORNIA

by

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La Habra, California 90633-0446

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ABSTRACT

This atlas of foraminifera is designed to update and enhance biostratigraphic correlations in the California Miocene. The study focuses primarily on the Monterey Formation, because it is a major source and reservoir of petroleum, and exclusively on the time interval during which it was deposited, 17.9 to 6.0 million years ago. Most of the recovered fauna derives from nine outcrop sections or areas in central and southern California, representing four Neogene coastal basins: Graves Creek (Salinas Basin), Indian Creek (Salinas Basin), Laguna Hills (Los Angeles Basin), Manville Quarry access road (Santa Maria Basin), Monterey County roadcuts (Salinas Basin), Naples Beach (Ventura Basin), Upper Newport Bay (Los Angeles Basin), San Clemente Island (Los Angeles Basin), and Topanga Canyon (Los Angeles Basin).

The collections yield 112 genera and 391 (350 benthic, 41 planktic) species-group taxa. Eleven new species are described: *Astacolus naplesensis*, *Bolivina exilicostata*, *Bolivina isaacsi*, *Bolivina woodruffi*, *Cancris lippsi*, *Evolutononion dumonti*, *Lenticulina barroni*, *Lenticulina douglasi*, *Lenticulina indianensis*, *Neoeponides navarrettei*, and *Valvulineria mcdougalli*. Sequence checklists for each section tabulate the occurrences and relative abundances of species, the data from which are composited in faunal checklists that reveal provincial trends in the spatial and temporal distribution of each species. Illustrations of all recorded species should enable workers to compare taxa in order to evaluate and incorporate new information into preexisting data banks. They also provide the means for conformity among workers and serve as a training guide for new students.

Future applications in geologic correlation should benefit from the greater degrees of precision and confidence afforded by the revised foraminiferal taxonomy and biostratigraphy presented in this compendium.

INTRODUCTION

Purpose of This Study

The purpose of this atlas is to update documentation of the foraminiferal fauna of the California Miocene through the application of current systematics, sequence checklisting, and extensive scanning electron microscopy. Selected sample localities (Fig. 1) are mostly "classic" sections of the Monterey and Modelo Formations often referred to in the regional micropaleontologic literature. The suite yields a composite foraminiferal fauna representative of "Monterey" time (Fig. 2), ranging from about 17.9 to 6.0 Ma (Fig. 3). Early on, Kleinpell (1938, p. 15) realized that, "As data accumulate and with accompanying extensions in species ranges, . . . the generalizations derived through the procedures of Oppelian zonation become progressively better disciplined." He later expounded this view (Kleinpell, 1971, p. 98):

> "But in scientific matters the first induction is not always the eventual general truth; as available data are added down through the years, generations become progressively better disciplined, and not necessarily in the direction of the earliest inductions. Due to the complexities of organic evolution, in both space and time the distribution of species is uneven and occur-

rences are sporadic; notoriously, species, more often than not, are found to have a much longer range in geologic time than their first-known occurrences usually suggest."

Enhancing Miocene biostratigraphic correlation in central and southern California is the succinct goal of the present study.

Historical Perspective

Since the 1920's, the foraminiferal fauna of the California Miocene has been of particular importance in the petroleum industry for age correlation of source and reservoir rocks (see Kleinpell, 1971 and 1972). For several decades, companies actively exploring in California were well-staffed with micropaleontologists who specialized

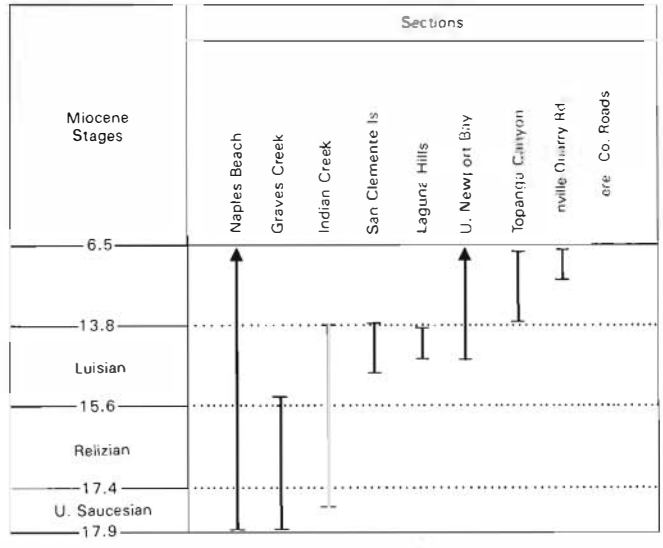

FIGURE 2. Age intervals of sampled sections documented in this study.

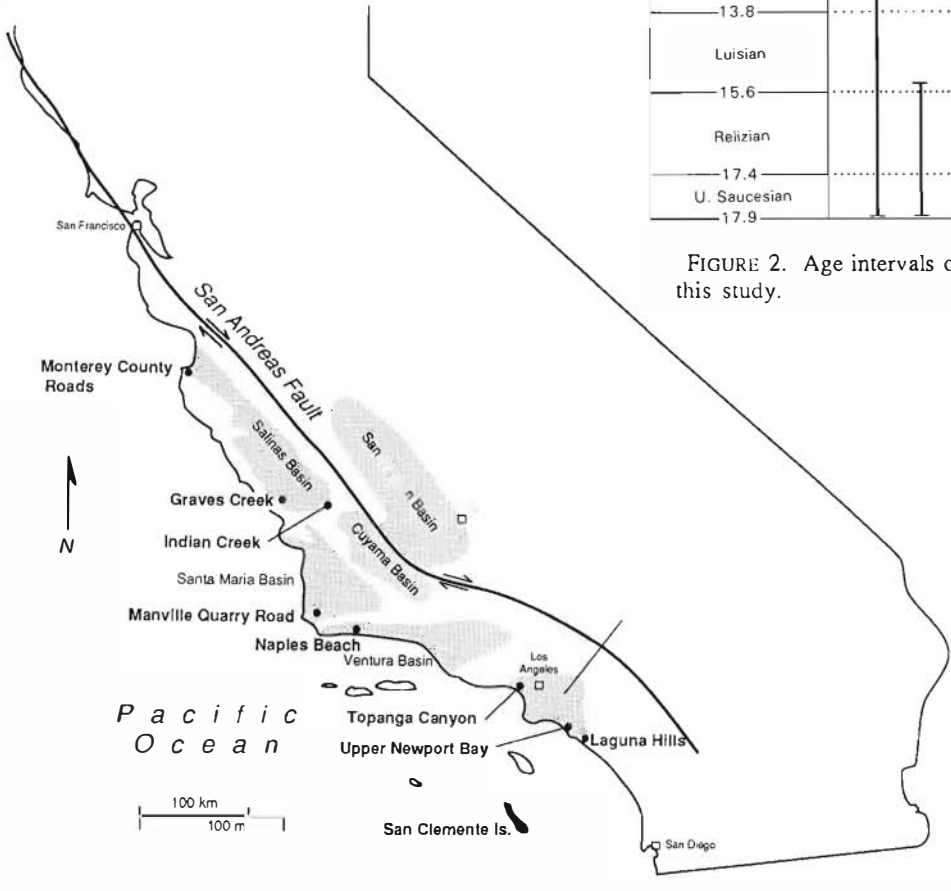

FIGURE 1. Location of California Miocene outcrop sections and depositional basins referred to in this study. (Based on Graham, 1987 and Lagoe, 1987.) Offshore extensions of basins not shown for clarity (see Ogle and others, 1987, fig. 16-1; Isaacs, 1989, fig. 2).

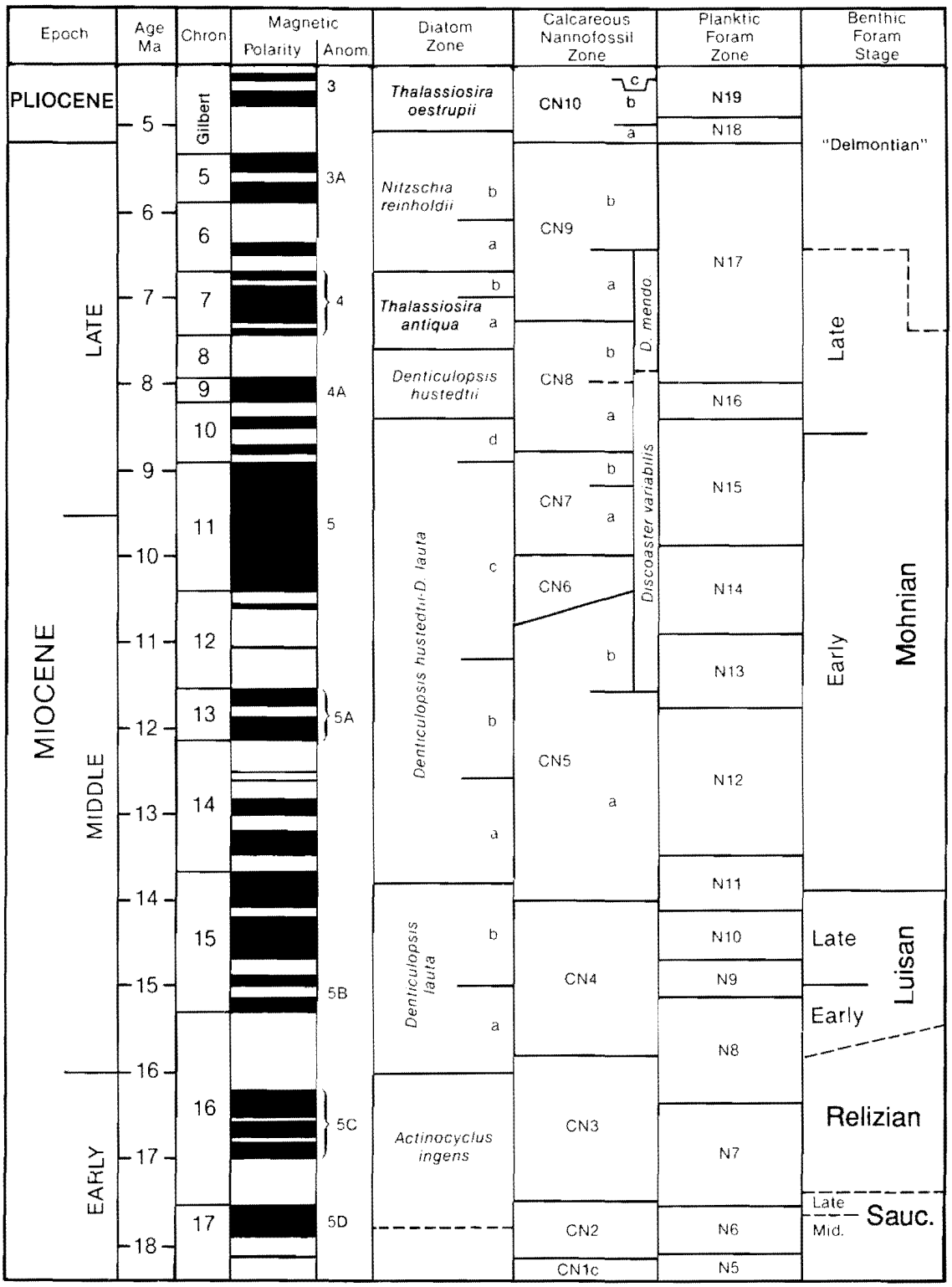

FIGURE 3. Chronostratigraphic correlation chart for the middle Early Miocene to Early Pliocene of California. (Modified from Barron, 1986a, b)

solely on the Foraminifera. Foremost among West Coast foraminiferalogists was R. M. Kleinpell, whose Stanford University dissertation, *Miocene Stratigraphy of California*, was published in 1938 by the American Association of Petroleum Geologists. As the most comprehensive treatment of the regional foraminiferal biostratigraphy, this work served for a half century as the definitive reference. In his subsequent tenure at the University of California, Kleinpell educated the majority of industrial micropaleontologists working West Coast geology in the 1950-1975 interval. Toward the end of his career, Kleinpell and his students staunchly defended his benthic foraminiferal biostratigraphy for the West Coast, although they realized greater precision in age-dating could be obtained with planktic microfossils. The pioneers of California Miocene biostratigraphy based on plankton include O. L. Bandy, J. C. Ingle, and J. H. Lipps on foraminifera, M. N. Bramlette, J. H. Lipps, and J. A. Wilcoxon on calcareous nannoplankton, and G. D. Hanna, K. E. Lohmann, J. W. Ruth, W. W. Wornardt, and J. A. Barron on diatoms. Because planktic taxa allow direct correlation with a more global biostratigraphic framework, they became important complements to established benthic foraminiferalogy. Nevertheless, benthic foraminifera, the specialty of most West Coast micropaleontologists, are the most commonly encountered microfossils in the California Cenozoic, and they are uniquely useful in deciphering depositional paleoenvironments. Hence, they have remained a primary tool in geologic correlation of this region. Kleinpell's 1980 addendum offers much insight into the nature and transformation of his methodology and thinking from the 1930's to the 1970's. It is unfortunate, however, that this intended revision is little more than a supplement to his earlier compendium and, as noted by Lipps (1982, p. 222), "It ignores the work of almost everybody who was not associated with the University of California at Berkeley."

The concept of foraminiferal paleoecology, established on the West Coast by M. L. Natland in 1933 and later applied by O. L. Bandy, J. C. Ingle, R. E. Douglas, and G. H. Blake, among others, has enabled us to interpret the evolution of the Neogene borderland basins and fauna on the basis of current species distributions and ecology. Studies reveal that changes within fossil sequences can be correlated with environmental permutations, although the relationships can be complex. Kleinpell (1938) attributed his Saucesian, upper Mohnian, and Delmontian Stages to orogenic events and block faulting, and his Relizian and early Mohnian Stages to transgressions. Because it is unlikely that these events had a uniform and isochronous effect throughout the Californian Province, faunal responses to local environmental changes, interpreted as biostratigraphic zones, can be difficult to correlate.

Materials and Methods

Outcrop samples examined in this investigation were collected primarily from nine areas representing four Neogene Basins in central and southern California (Fig. 1):

Graves Creek (Salinas Basin)
Indian Creek (Salinas Basin)
Laguna Hills (Los Angeles Basin)
Manville Quarry access road (Santa Maria Basin)
Monterey County roadcuts (Salinas Basin)
Naples Beach (Ventura Basin)
Upper Newport Bay (Los Angeles Basin)
San Clemente Island (Los Angeles Basin)
Topanga Canyon (Los Angeles Basin)

Other collections analyzed were either too stratigraphically incomplete or lacked a sufficient number of samples bearing well-preserved foraminifera to warrant inclusion with the reference sections presented in this report. These were from the following depositional basins and sections:

Cuyama Basin: Caliente Mountain (Phillips, 1974, locality FJP-9; Phillips, 1976).

Los Angeles Basin: Palos Verdes Hills (Woodring and others, 1936).

Salinas Basin: Arroyo Seco, Reliz Canyon (type Relizian; Kleinpell, 1930, 1938; Poore and others, 1981).

Santa Maria Basin: Lions Head (Woodring and Bramlette, 1951; Grivetti, 1982; Wornardt, 1986), Mussel Rock (Woodring and Bramlette, 1951; Pisciotto and Garrison, 1981; Grivetti, 1982; Ingle, 1985), Point Pedernales (Grivetti, 1982; Hornafius and others, 1982; Compton and Siever, 1984; Wornardt, 1986), Miguelito Road, and Sweeny Road (Grivetti, 1982; Ingle, 1985; Akers and others, 1987).

Ventura Basin: El Capitan Beach, Los Sauces Creek (type Saucesian; Cushman and Laiming, 1931), Rodeo Canyon (Compton and Siever, 1984; Wornardt, 1986).

I regret not having included any material from the economically important contemporaneous units of the San Joaquin Basin. Although that fauna has much in common with those of the Monterey and Modelo Formations, it is characterized by distinct interpretation problems (see Bandy and Arnal, 1969). The San Joaquin fauna is certainly worthy of a thorough and separate review beyond the scope of the present study.

More than 1000 samples were examined throughout the course of this study. An estimated 10 million specimens were examined and 100,000 of them were picked onto micropaleontologic slides, sorted, and identified. The 39 plates included in this report consist of 1,565 scanning electron micrographs and two light photomicrographs; ef-

forts were made to include the best preserved specimens typical of each species and to illustrate views critical for their recognition. Newly illustrated specimens have been deposited in the University of California Museum of Paleontology (type numbers UCMP 38668 to 39335) collection. For the taxonomic part of the study, comparisons were made with collections at the following locations: Chevron U.S.A. (Western Region), Stanford University, U.S. National Museum of Natural History, U.S. Geological Survey (Menlo Park), University of Southern California, and University of California (Berkeley). Private collections of the late R. W. Crouch and the late M. L. Natland, generously donated by their spouses, were also beneficial to this study.

RESULTS

Faunal Recovery

Taxa identified in this atlas include 112 genera and 391 species-groups (350 benthic, 41 planktic). With rare exceptions, the generic assignments are based on Loeblich and Tappan (1987) and the systematics follow accordingly. All taxa are checklisted and illustrated among the approximately 1,000 specimens on Plates 1-39. The plates are prefixed with four indices arranged by morphotypes, systematics, genera, and species, respectively, to enhance searches for particular taxa. Plate-figure configurations closely follow the systematic ordering. A total of 295 "good" (N>300) assemblages are checklisted by section (Tables 2-10) and in several composite modes (Tables 11-15) to readily reveal the temporal and spatial distributions of the species.

Discussion

It is not within the scope of this atlas to provide a detailed review of Kleinpell's (1938, 1980) work, as regional paleontologists continually modified their biostratigraphic schemes in response to data gathered over the years. The information presented here will enable workers to better scrutinize taxonomic concepts and age ranges of individual taxa, thereby permitting more realistic applications of the biostratigraphic units built upon such information. However, some comments on the utility of benthic foraminifers in geologic applications are certainly appropriate here.

Because California Miocene foraminiferal biostratigraphy is based on the stratigraphic distribution of benthic species, applying Kleinpell's (1938) zonal concepts to the provincial region is often risky, if not futile. In erecting his zones, Kleinpell (1938; see Wornardt, 1972) emphasized characteristic associations as opposed to individual marker species because he recognized that few species were confined to any one zone. He de-emphasized acmes in 1980, thereby restricting his zonal criteria to first and last appearance datums, or the basic components of concurrent range zones. The data presented herein reveal that many species ranges extend beyond those charted by Kleinpell (1938, table 18) and subject to some of his later revisions (Kleinpell, 1980). It is critical to any interpretation of the California Miocene fauna to realize several factors that affect benthic species distributions in time and space:

(1) The geographic distributions of benthic species are facies-controlled.
(2) Sedimentary facies and related biofacies can be time-transgressive.
(3) Most of these fossil assemblages are mixed associations of neritic and bathyal species.
(4) Reliance on a supposedly short-ranged taxon for age-dating may be an illusion of insufficient data or unjustifiably strict taxonomic criteria differentiating gradational phenotypes.

In their evolutionary study of benthic foraminifera living on the Atlantic margin of North America, Buzas and Culver (1984) found that species durations average 16 million years for those living at water depths above 200 m and 25 to 26 million years for those occurring in water depths deeper than 200 m. Thus, much of the modern Northwest Atlantic foraminiferal fauna appears to have evolved by the late Oligocene. It would seem logical to deduce that the average duration of a species on the Pacific Coast would be shorter than 25 million years because the deep-water basins along this tectonically active margin are more prone to environmental change than is the Atlantic continental slope. How much shorter has yet to be calculated, although many of the late Tertiary species are known to be extant. Appearances and disappearances of species recorded in stratigraphic sequences must be considered from all possible perspectives. Water mass changes cause vertical and horizontal alterations in the distributions of species, accompanied by the regional or interregional evolution of lineages. Last appearances recorded for one section may represent a local disappearance (within a particular basin), while those for the region may represent provincial extinction. Elsewhere, the species may live on. Hence, species checklists for individual sections (Tables 2-10) are useful references for intrabasinal correlation, while composite checklists (Tables 11-15) merging data from the nine primary sections analyzed in this study are more appropriate for regional correlation.

Table 1. Species binomina recorded by Kleinpell (1938, table 18) from the Upper Saucesian-Delmontian interval that either are not found, not recognized, or synonymized in the present study.

Anomalina hughesi (Rankin)
Anomalina cf. *A. patella* (Egger)
Baggina cancriformis Kleinpell
Baggina robusta var. *globosa* Kleinpell
Bathysiphon arenacea Cushman
Bolivina advena var. *striatella* Cushman
Bolivina barbarana Cushman and Kleinpell
Bolivina goudkoffi Rankin
Bolivina imbricata var. *inflata* Kleinpell
Bolivina malagaensis Kleinpell
Bolivina marginata Cushman
Bolivina marginata var. *gracillima* Cushman
Bolivina obliqua Barbat and Johnson
Bolivina perrini Kleinpell
Bolivina aff. *B. plicata* d'Orbigny
Bolivina rankini Kleinpell
Bolivina seminuda Cushman
Bolivina sinuata var. *alisoensis* Cushman and Adams
Bolivina subhughesi Kleinpell
Bolivina tumida var. *cuneata* Kleinpell
Bolivina vaughani Natland
Bulimina delreyensis Cushman and Galliher
Bulimina montereyana Kleinpell
Bulimina montereyana var. *delmonteensis* Kleinpell
Bulimina ovata d'Orbigny
Bulimina ovula var. *pedroana* Kleinpell
Bulimina pseudoaffinis Kleinpell
Bulimina pyrula d'Orbigny
Buliminella dubia Barbat and Johnson
Buliminella henryana Cushman and Kleinpell
Cancris brongniartii (d'Orbigny)
Cassidulina barbarana Cushman and Kleinpell
Cassidulina crassa d'Orbigny
Cassidulina limbata Cushman and Hughes
Cassidulina margareta Karrer
Cassidulina panzana Kleinpell
Cassidulina pulchella d'Orbigny
Cassidulina quadrata Cushman and Hughes
Cassidulina subglobosa Brady
Cassidulina williami Kleinpell
Chilostomella cf. *ovoidea* Reuss
Cibicides altamiraensis Kleinpell
Cibicides americanus (Cushman)
Cibicides cf. *basiloba* (Cushman)
Cibicides floridanus (Cushman)
Cibicides illingi (Nuttall)
Cibicides relizensis Kleinpell
Clavulina patens
Dentalina adolphina d'Orbigny
Dentalina barnesi Rankin
Dentalina cf. *communis* d'Orbigny
Dentalina consobrina d'Orbigny
Dentalina cf. *filiformis* (d'Orbigny)
Dentalina cf. *guttifera* d'Orbigny
Dentalina insolita (Schwager)
Dentalina obliqua (Linné)
Dentalina pauperata d'Orbigny
Dorothia californica Cushman and Kleinpell
Elphidium hughesi Cushman and Grant
Eponides exigua (Brady)
Eponides mansfieldi Cushman
Flabellina crassa Cushman and Kleinpell
Frondicularia foliacea Schwager
Gaudryina triangularis Cushman
Gaudryina trinitatensis Nuttall
Glandulina laevigata d'Orbigny
Globigerina bilobata d'Orbigny
Globigerina conglomerata Schwager
Globigerina cretacea d'Orbigny
Globigerina cyclostoma Galloway and Wissler
Globigerina dubia Egger
Globigerina quadrilatera Galloway and Wissler
Globigerina aff. *triloba* Reuss
Globobulimina pacifica Cushman
Globulina gibba d'Orbigny
Gyroidina soldanii d'Orbigny
Haplophragmoides trullissata (Brady)
Lagena acuticosta Reuss
Lagena apiculata Reuss
Lagena costata (Williamson)
Lagena crenata Parker and Jones
Lagena globosa (Montagu)
Lagena gracilis Williamson
Lagena hexagona var. *scalariformis* (Williamson)
Lagena marginata (Walker and Boys)
Lagena sulcata (Walker and Jacob)
Lagena sulcata var. *apiculata* Cushman
Lenticulina relizensis Kleinpell
Nodogenerina advena var. *hughesi* (Cushman)
Nodosaria longiscata d'Orbigny
Nodosaria tornata Schwager
Nodosaria typaniplectriformis Schwager
Nonion belridgensis Barbat and Johnson
Nonion cf. *N. communis* (d'Orbigny)
Nonion incisum var. *kernensis* Kleinpell
Nonion mediocostatum (Cushman)
Nonion montereyanum Cushman and Galliher
Nonion montereyanum var. *carmeloensis* Cushman and Galliher
Nonion pizarrensis Berry
Nonion umbilicatum (Montagu)
Nonion cf. *N. umbilicatum* var. *pacificum* Cushman
Planulina cf. *ariminensis* d'Orbigny
Planulina depressa (d'Orbigny)
Planulina ornata (d'Orbigny)
Plectofrondicularia miocenica var. *directa* Cushman and Laiming
Pullenia miocenica var. *globula* Kleinpell
Pullenia moorei Kleinpell
Pullenia multilobata Chapman
Pullenia pedroana Kleinpell
Pulvinulinella cf. *P. bradyana* Cushman
Pulvinulinella parva Cushman and Laiming
Pulvinulinella cf. *P. pontoni* Cushman
Pulvinulinella relizensis Kleinpell
Pulvinulinella subperuviana var. *minuta* Cushman and Laiming
Quinqueloculina cf. *Q. oblonga* (Montagu)
Robulus americanus (Cushman)

Robulus americanus var. *spinosus* Cushman
Robulus mohnensis Kleinpell
Robulus nikobarensis var. *cushmani* Galloway and Wissler
Robulus cf. *R. nitida* (d'Orbigny)
Robulus simplex (d'Orbigny)
Robulus warmani Barbat and von Estorff
Rotalia beccarii (Linné)
Rotalia orbicularis d'Orbigny
Siphogenerina collomi Cushman
Siphogenerina kleinpelli Cushman
Siphogenerina nuciformis Kleinpell
Siphogenerina reedi Cushman
Sphaeroidina bulloides d'Orbigny
Sphaeroidina variabilis Reuss
Suggrunda californica Kleinpell
Textularia laevigata d'Orbigny
Uvigerina angelina Kleinpell
Uvigerina carmeloensis Cushman and Kleinpell
Uvigerina joaquinensis Kleinpell
Uvigerina modeloensis Cushman and Kleinpell
Uvigerina proboscidea? Schwager
Uvigerinella californica var. *gracilis* Cushman and Kleinpell
Uvigerinella californica var. *parva* Kleinpell
Uvigerinella nudocostata Cushman
Uvigerinella obesa Cushman
Uvigerinella obesa var. *impolita* Cushman
Valvulineria californica var. *appressa* Cushman
Valvulineria californica var. *obesa* Cushman
Valvulineria depressa Cushman
Valvulineria grandis Cushman and Galliher
Valvulineria joaquinensis Cushman and Kleinpell
Valvulineria williami Cushman
Virgulina californiensis var. *grandis* Cushman and Kleinpell
Virgulina californiensis var. *ticensis* Cushman and Kleinpell
Virgulina delmonteensis Cushman and Kleinpell
Virgulina pontoni Cushman
Virgulinella miocenica Cushman and Ponton

Major environmental parameters affecting the geometry and sedimentary geology of California borderland basins include water depth, type of substrate, temperature, oxygenation, current patterns, and upwelling. The most significant times of environmentally induced faunal turnover in the California borderland were (1) at the beginning of Monterey deposition, when many basins were actively downwarping or had already rapidly subsided, and when they became sediment-starved, (2) in the middle Miocene (Luisian/ Mohnian transition), when oceans cooled and stratified with the formation of antarctic bottom water, and (3) in the late Miocene (late Mohnian siliceous facies), when global oceanic cooling and the prevalence of upwelling off California favored the proliferation of a siliceous microbiota (see Ingle, 1980). Although many species found in Miocene rocks are living off California today, the most significant transition occurred in the middle Miocene, from a subtropical Luisian to a subtemperate Mohnian fauna. This is the only evidence of a provincial change that consistently correlates with any of the four stage boundaries delineated within the 12 million-year interval of Monterey deposition. Differences between the other stages are relatively subtle and appear to be based more on localized data; their boundaries may have been defined by sequence changes across unrecognized hiatuses in type sections and correlative strata. Because localized data is more likely to vary with the depositional history of a particular basin, the benthic thanatofacies defining biostratigraphic units in one basin may not have any resemblance to coeval sediments in another. Furthermore, there may be little resemblance between thanatofacies deposited on the flanks, on submarine bank tops, and in the depocenter of the same basin.

Comparison of New Data With Kleinpell's Zones

It is difficult to evaluate many of Kleinpell's interpretations because his species concepts are not always clear. Many species listed by Kleinpell (1938, table 18) are not recognized in this study (see Table 1); although some appear to be limited to other localities, most are probably junior subjective synonyms. Kleinpell (1980) admitted that there was a need for further illustrations of the fauna, particularly the *Valvulineria* that Cushman (1926) type figured with line drawings and the siphogenerids which lacked the adequate pictures and clarity needed to distinguish species. Yet, the identifications of the many drawings included in his "revision" render these and other species concepts more confusing than ever before. Nevertheless, I shall attempt to comment on the criteria that he presented in his 1938 book and revised in his 1980 supplement for differentiating the benthic foraminiferal zones. Nomina in parentheses refer to those adopted in this report for the same taxon.

Late Middle Saucesian:

Plectofrondicularia miocenica Zone

Restricted occurrences: *Bolivina marginata adelaidana, Eponides nanus, Plectofrondicularia miocenica* var. *laimingi, Siphogenerina tenua.*

Last appearances: *Bulimina carneroensis carneroensis, B. rinconensis, Cancris sagra, Cibicides americanus crassiseptus, C. elmaensis, Uvigerina gallowayi, Valvulineria casitasensis casitasensis.*

First appearances: *Bolivina adelaidana, Siphogenerina kleinpelli.*
Comments: None of these species are recognized in the assemblages studied herein.

Late Saucesian: *Uvigerinella obesa* Zone
Last appearances: *Anomalina* cf. *A. patella, Bulimina alligata, Cibicides floridanus, Epistominella parva, Marginulina subbullata, Robulus mayi, R. warmani, Siphogenerina transversa, Uvigerinella obesa impolita.*
First appearances: *Bolivina californica, B. conica, B. floridana, B. tumida, Cassidulina panzana, C. pulchella*(?), *Elphidium granti, Eponides keenani, Epistominella relizensis, E. subperuviana subperuviana, E. subperuviana minuta, Planularia luciana, Pullenia multilobata, Valvulineria williami.*
Comments on the species recognized in the present study: *Bulimina alligata* last appears in the Saucesian, as indicated. *Cibicides floridanus* (*sensu* Kleinpell = *Cibicidoides cushmani*) ranges into the Relizian. *Uvigerinella obesa impolita* ranges into the Relizian and probably higher, where it appears to be within the grade of *Uvigerina subperegrina. Marginulina subbullata* and *Robulus mayi* (= *Astacolus*) range into the Mohnian.

Early Relizian: *Siphogenerina hughesi* Zone
First appearances: *Baggina californica, Bolivina imbricata, Hemicristellaria beali, Nodogenerina advena hughesi, Pulvinulinella pacifica, Valvulineria californica appressa.*
Last appearances: *Gyroidina soldanii*, typical *Robulus simplex.*
Comments on the species recognized in the present study: *Baggina californica* first appears in the Relizian, as indicated. *Bolivina imbricata, Hemicristellaria* (= *Marginulinopsis*) *beali, Pulvinulinella pacifica* (*sensu* Kleinpell = *Epistominella smithi*), and *Valvulineria californica* s.l. (subspecies are phenotypic variants) range into the Saucesian. *Robulus simplex* is a phenotypic or diagenetic variant of *Lenticulina smileyi*, which ranges into the Mohnian.

Late Relizian: *Siphogenerina branneri* Zone
Restricted occurrence: *Lenticulina relizensis.*
First appearances: *Bulimina pseudotorta, Dentalina obliqua, Robulus miocenicus, Robulus smileyi, Valvulineria californica obesa.*
Last appearances: *Bulimina pseudoaffinis, Cibicides americanus, Nodogenerina advena hughesi, Planulina baggi, Robulus reedi.*
Comments on the species recognized in the present study: *Bulimina* (= *Protoglobobulimina*) *pseudotorta* (which is the subjective senior synonym of *B. pseudoaffinis*), *Dentalina obliqua* (= *D. pseudoobliqua*), *Planulina* (= *Holmanella*) *baggi, Robulus* (= *Lenticulina*) *reedi, Robulus* (= *Lenticulina*) *smileyi*, and *Valvulineria californica* s.l. (subspecies are phenotypic variants) range Saucesian to Mohnian.

Early Luisian: *Siphogenerina reedi* Zone
Restricted occurrences: *Baggina robusta globosa, Flabellina crassa.*
First appearances: *Bulimina montereyana, Buliminella californica, Frondicularia foliacea, Siphogenerina reedi, Valvulineria californica* s.s.
Last appearances: *Siphogenerina branneri, Valvulineria depressa, Bulimina pseudotorta, Valvulineria californica appressa* in appreciable numbers.
Comments on the species recognized in the present study: *Baggina* (= *Valvulineria*) *robusta globosa* (subspecies is not worthy of taxonomic distinction), *Bulimina* (= *Protoglobobulimina*) *pseudotorta*, and *Siphogenerina branneri* range into the Mohnian, although the latter species rarely occurs in the Mohnian. *Valvulineria miocenica*, the subjective senior synonym of *V. depressa*, ranges Saucesian to Luisian. *Buliminella californica* (which is a phenotypic variant of *B. subfusiformis*) and *Valvulineria californica* range into the Saucesian.

Middle Luisian: *Siphogenerina nuciformis* Zone
First appearances: *Siphogenerina nuciformis, Eponides rosaformis, Siphogenerina collomi.*
Last appearance: *Bolivina advena* var. *ornata.*
Comments on the species recognized in the present study: *Eponides* (= *Gyroidina*) *rosaformis* ranges into the Saucesian. *Bolivina advena ornata* ranges into the Mohnian.

Late Luisian: *Siphogenerina collomi* Zone
Restricted occurrences: *Dorothia californica, Valvulineria joaquinensis.*
Last appearances: *Anomalina salinasensis, Bolivina imbricata, Dentalina obliqua, Hemicristellaria beali, Pullenia miocenica, Robulus miocenicus, Siphogenerina nuciformis, S. reedi*, and the *Valvulineria californica* gens.
First appearances: *Pullenia moorei, Uvigerina joaquinensis, Bolivina parva, Dentalina barnesi, Pulvinulinella capitanensis, P. gyroidinaformis.*
Comments on the species recognized in the present study: *Hemicristellaria* (= *Marginulinopsis*) *beali* and *Robulus* (= *Lenticulina*) *miocenicus* last appear in the Luisian, as indicated. *Bolivina imbricata, Dentalina obliqua* (= *D. pseudoobliqua*), *Pullenia miocenica*, and *Valvulineria californica* range into the Mohnian. *Dentalina barnesi* ranges into the Saucesian. *Pulvinulinella* (= *Megastomella*) *capitanensis* ranges into the Relizian.

Early Mohnian: *Bolivina modeloensis* Zone

Restricted occurrences: *Cassidulina monicana, Bolivina modeloensis, Virgulina californiensis ticensis, Suggrunda californica.*

Last appearances: *Bolivina marginata gracillima, Eponides mansfieldi, Eponides rosaformis, Nonion miocostatum.*

First appearances: *Bolivina bramlettei, Baggina subinequalis, Cassidulina monicana, C. modeloensis, Cibicides illingi, Epistominella capitanensis, Galliherina uvigerinaformis uvigerinaformis, Gyroidina soldanii rotundimargo, Nonion montereyanum carmeloensis, N. multicameratum, Uvigerina hootsi, U. segundoensis, Valvulineria araucana, V. grandis.*

Comments on the species recognized in the present study: *Galliherina uvigerinaformis* first appears in the Mohnian and *Eponides mansfieldi* (*sensu* Kleinpell = *Buccella oregonensis*) and *Eponides* (= *Gyroidina*) *rosaformis* last appear in the Mohnian, as indicated. *Cassidulina* (= *Islandiella*) *modeloensis, Cibicides illingi* (= *Hanzawaia depaoloi*), *Uvigerina hootsi*, and *U. segundoensis* range into the Saucesian. *Baggina* (= *Valvulineria*) *subinequalis, Epistominella* (= *Megastomella*) *capitanensis*, and *Gyroidina soldanii rotundimargo* (= *Hansenisca rotundimargo*) range into the Relizian. *Bolivina bramlettei, Cassidulina* (= *Globocassidulina*) *monicana*, and *Nonion* (= *Pseudononion*) *multicameratum* range into the Luisian.

Early Middle Mohnian: *Bolivina barbarana* Zone

Restricted occurrences: *Robulus mohnensis.*

Last appearance: *Bolivina modeloensis, Nonion costiferum* s.l., *N. multicameratum, Pullenia moorei, Uvigerina carmeloensis.*

First appearances: *Bolivina barbarana, B. decurtata, B. pseudospissa, B. sinuata alisoensis, B. woodringi, Eponides healdi, Galliherina uvigerinaformis warreni, Nonion montereyanum montereyanum, Robulus nikobarensis* var. *cushmani*, and *Uvigerina modeloensis.*

Comments on the species recognized in the present study: *Bolivina modeloensis, Nonion* (= *Pseudononion*) *costiferum* s.l., and *N.* (= *Pseudononion*) *multicameratum* last appear in the Mohnian, and *Bolivina woodringi* and *Galliherina uvigerinaformis* s.l., first appear in the Mohnian, as indicated. *Bolivina pseudospissa, B. sinuata alisoensis* (which is the junior synonym of *B. hughesi*), *Eponides* (= *Gyroidina*) *healdi*, and *Uvigerina modeloensis* (the microspheric junior synonym of *U. hootsi*) range into the Saucesian.

Late Middle Mohnian: *Bolivina wissleri* Zone

Restricted occurrences: *Bolivina bramlettei, B. girardensis, B. goudkoffi, B. granti, B. hootsi, B. hughesi, Buliminella semihispida.*

First appearances: *Anomalina hughesi, Bolivina girardensis, B. granti, B. hughesi, B. seminuda, B. sinuata sinuata, Buliminella semihispida, Discorbinella valmonteensis, Galliherina uvigerinaformis doanei, Hopkinsina magnifica, Virgulina delmonteensis.*

Last appearances: *Baggina californica, Bolivina advena advena, Cibicides illingi, Epistominella capitanensis, E. gyroidinaformis, Galliherina uvigerinaformis uvigerinaformis, G. uvigerinaformis warreni, Uvigerina modeloensis, Virgulinella miocenica.*

Comments on the species recognized in the present study: As indicated, *Bolivina girardensis* and *Buliminella semihispida* are restricted to the Mohnian, *Discorbinella* (= *Holmanella*) *valmonteensis, Galliherina uvigerinaformis* s.l., and *Hopkinsina magnifica* first appear in the Mohnian, and *Baggina californica, Bolivina advena, Cibicides illingi* (*sensu* Kleinpell = *Hanzawaia depaoloi*), *Epistominella* (= *Megastomella*) *capitanensis, E.* (= *Concavella*) *gyroidinaformis, Galliherina uvigerinaformis* s.l., *Uvigerina modeloensis* (the microspheric junior synonym of *U. hootsi*), and *Virgulinella miocenica* (*sensu* Kleinpell = *V. pertusa*) last appear in the Mohnian. *Bolivina granti* (which is the subjective senior synonym of *B. goudkoffi* and *B. hootsi*) ranges into the Relizian; Kleinpell also lists them as restricted to the Late Mohnian.

Late Mohnian: *Bolivina goudkoffi* Zone

Restricted occurrence: *Cassidulinella renulinaformis.*

Last appearances: *Anomalina hughesi, Bolivina bramlettei*(?), *B. californica, B. decurtata*(?), *B. girardensis*(?), *B. granti, B. hughesi*(?), *Buliminella californica, B. semihispida*(?), *Cassidulina modeloensis, Discorbinella valmonteensis*(?), *Nonion montereyanum carmeloensis, Planularia cushmani.*

First appearances: *Bolivina goudkoffi, B. hootsi, B. seminuda foraminata, Cassidulina quadrata, Uvigerina hannai.*

Comments on the species recognized in the present study: The last appearances of a number of species listed above are questioned by Kleinpell (1980), as he recognized the supposed occurrence of these species in his Delmontian Stage, which has not been recognized in the present study. *Cassidulinella renulinaformis* is restricted to the Mohnian, as indicated. *Bolivina foraminata* and *Uvigerina hannai* range into the Relizian. *Bolivina granti* (which is the subjective senior synonym of *B. goudkoffi* and *B. hootsi*) ranges into the Relizian; Kleinpell also lists their first appearances in the late Middle Mohnian.

Delmontian: *Bolivina obliqua* Zone

First appearances: *Bolivina obliqua, Galliherina delreyensis, Nonion schencki.*

Last appearances: *Bolivina barbarana, B. brevior, B. marginata, Bulimina montereyana* s.s., *Nonion mon-*

tereyanum, Valvulineria grandis.

First appearances: Typical *Cassidulina delicata, Pulvinulinella* cf. *P. bradyana, Virgulina subplana.*

Comments on the species recognized in the present study: *Nonion schencki* first appears in the Mohnian, which is now the age assigned to the Delmontian stratotype (Barron, 1975, 1976a). "Typical" *Cassidulina* (= *Paracassidulina*) *delicata* ranges into the Relizian. *Virgulina subplana* ranges into the Luisian.

CONCLUSIONS

In the foregoing review of Kleinpell's zonal criteria, it is evident that I did not encounter or recognize many of the species which he referred to as diagnostic components of his zonal congregations, even though he recorded many of these taxa from the same sections that I have examined. This suggests that these species are either too rare or too ambiguously described to be used as reliable markers. Of those that I recognize, I comment on range extensions for 50 and confirm only 26 as *stage* indices. Although the data presented for distinguishing stage correlative faunules are substantial (see Table 15), it is evident that the criteria used to define Kleinpell's zones are inadequate. In attempts to subdivide my sequences into his zones, delimitations and affiliations of such units were generally made with little or no confidence. Hence, zonal assignments were discarded from the biostratigraphic interpretation.

Because stage boundaries coincide with zonal boundaries, difficulties are also encountered in delineating these longer units. Wherever a faunal sequence has an abrupt break that demarcates a stage boundary, a fault or hiatus should be suspected. It is doubtful that the differences between assemblages on adjacent sides of a biostratigraphic boundary evolved in a widespread and instantaneous manner. Detailed sampling of conformable units should reveal a transitional fauna, which the worker may choose to affiliate with either unit, arbitrarily split among both, or designate as transitional. Stage boundaries characterized by either structural discontinuities or transitional faunules were apparent in the recent study of the Naples Beach section by DePaolo and Finger (1991).

Millions of barrels of oil have been discovered in the California Miocene using geologic correlations based on foraminiferal biostratigraphy. Even though Kleinpell's 1938 framework has flaws, conclusions drawn from it were often successful. Unpublished versions of this biostratigraphy can now be substantially refined with the information presented in this study. It is hoped that future applications in geologic exploration will benefit from the greater degree of precision and confidence afforded by this revised foraminiferal biostratigraphy and the unique collection of faunal plates included in this atlas.

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Graves Creek (GC) Section

Salinas Basin

Stratigraphy Studied

Sandholdt Member, Monterey Formation
Saucesian to Luisian Stages

Importance

- Site of one of the earliest papers on California Foraminifera (Bagg, 1905).
- Referred to by Kleinpell (1938) as classic upper Relizian.
- Includes base of Monterey Formation.

References

Foraminifera: Bagg (1905), Cushman and Kleinpell (1934), Kleinpell (1938), Lipps (1966), Lipps and Kalisky (1972), Weaver (1986), Finger and others (1990).
Calcareous Nannoplankton: Lipps and Kalisky (1972), Finger and others (1990).
Strontium Isotope Ratios: DePaolo and Finger (1991).
Geology: Bagg (1905), Hart (1976), Graham (1976, 1980), Mertz (1984, 1989).

Sample Collections

GC-1 to -15d: Eighteen samples collected in Graves Creek by J. H. Lipps, A. R. Loeblich, and H. Tappan in 1964 (Figs. 4-6); 18 good foraminiferal assemblages recovered (Table 2).
SL-1: Collected along Santa Lucia Ave. by K. L. Finger and D. J. DePaolo in 1988 (Figs. 4-6); this sample yields a good foraminiferal assemblage (Table 2).

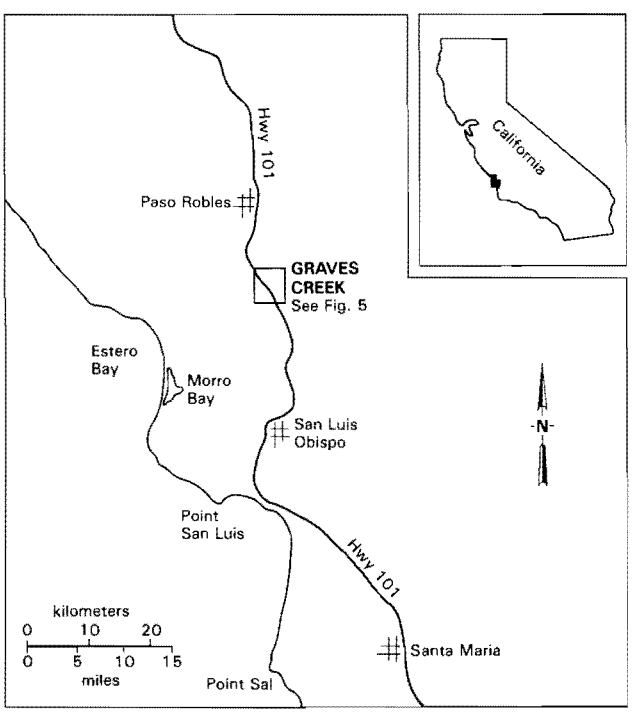

FIGURE 4. Location of the Graves Creek area, Atascadero, San Luis Obispo County.

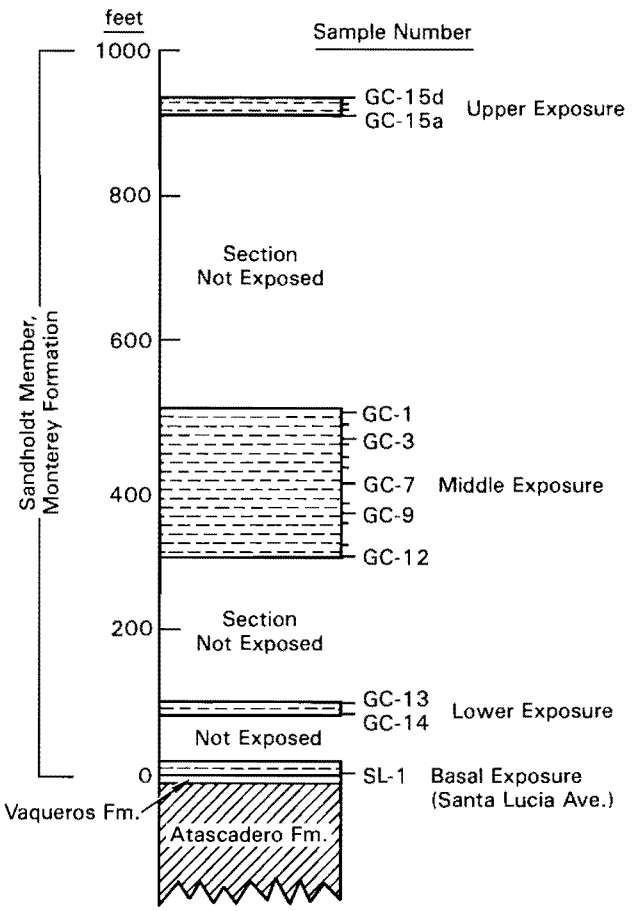

FIGURE 6. Stratigraphic column of the composite Graves Creek section denoting positions of collected samples.

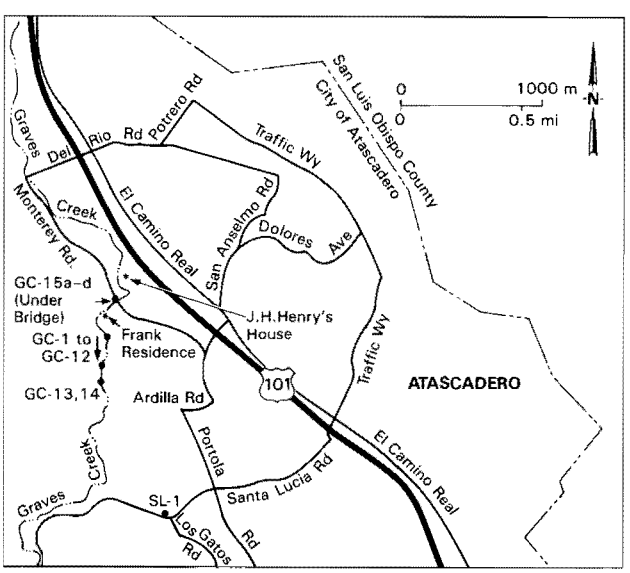

FIGURE 5. Sample locality map of the Graves Creek composite section.

TABLE 2. Species checklist for the Graves Creek composite section. (1 of 2)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

GRAVES CREEK SECTION	SAUCESIAN			REELFOOT											LUISIAN			
BENTHIC FORAMINIFERA	SL1	14	13	12	11	10	9	8	7	6	5	4	3	2	1	15a	15b	15c	15d
Ammobaculites? sp. B								VR											
Ammodiscus incertus																VR			
Amphimorphina amchitkaensis				VR	VR			A	VR										
Anomalinoides salinasensis		A	F			VR			F	A	F	A	C	C	A	A	R	R	R
Astacolus cf. A. cymboides	VR			VR			VR	R					VR						
Astacolus sp. B												VR		VR				R	R
Astacolus sp. C										VR									
Astacolus sp. F							VR					VR	F			VR			
Astacolus sp. H	VR																		
Baggina californica				A	C	VR	F	F	VR										VR
Bolivina advena	F	F	A	A	A	A	C			VR						VR	VR	A	A
Bolivina advena ornata										VR	F	A	VR			A	A	A	VR
Bolivina blakei					VR			R	F	A	A	R	C						
Bolivina brevior s.l.													R		R	A	F		
Bolivina californica		C	C	A	A	C	A	A	A	A	A	A	A	A	A	A	F	F	F
Bolivina churchi	VR			A	A	F	C	F	C	A		F	C	C	A				
Bolivina conica									A	C	A	A	A	A	A				
Bolivina granti										A	C	A	A	A			R		
Bolivina imbricata										VR	F		R			VR		A	A
Bolivina modeloensis											VR	F	R	F		VR	VR	VR	
Bolivina pseudospissa		VR			VR	VR	F	VR		VR		VR		R	F		VR		R
Bolivina salinasensis	A	A	F				F		F									R	
Bolivina tongi filacostata	VR	R	F					VR											
Bolivina tumida s.l.		VR	VR			VR		VR	C	A	A	A	A	F	F	F	A	A	A
Buccella oregonensis											R		VR		VR	R	VR	VR	VR
Bulimina cf. B. hebespinata													VR	VR	VR				
Bulimina subacuminata	F	A		F	R		VR	VR		VR				F	VR				
Bulimina subcalva		VR	C	VR				VR											
Buliminella elegantissima							VR	VR	VR							VR	R	VR	R
Buliminella subfusiformis	C	A	A	A	A	C	A	A	C	C	F	C	C	A	A	A	A	A	A
Cancris baggi													R	VR	R	C		VR	VR
Chilostomella ovoidea		F	F	R	VR	VR	R				R	F							
Chilostomina pustulosa													F						
Chyrsalogonium californiensis			VR	VR															
Cibicides pumilus			VR			VR			F	VR	F	F	R	R	F	R	VR	VR	VR
Cibicidoides cushmani	VR		R	VR	F	F	A	A											
Dentalina atascaderoensis							VR												
Dentalina communis				VR			VR					VR							
Dentalina lagoei			VR				VR												
Dentalina pseudoobliqua				R			VR	F	VR	F	R	F	C	F	F	C	VR	F	F
Dentalina roemeri		VR	VR	VR	VR				VR	VR									VR
Dentalina sp. F							VR												
Duplella baggi									VR	VR		VR					VR		
Duplella lacrima							VR												
Elphidium granti													R	VR	VR	R	VR		VR
Enantiodentalina murali	VR	VR	R	A	R		R	VR		VR	VR	VR	VR		R	VR	VR	VR	VR
Epistominella smithi	VR		VR	VR	R	C	VR	F							R		A	A	A
Fissurina gravesensis									VR							VR	VR		
Fissurina cf. F. laevigata labiata					VR		VR			VR						VR			
Fissurina longipunctata				VR	VR														
Fissurina natlandi	VR	VR	VR		VR	VR	VR	VR		R	VR	VR	VR			VR	VR		VR
Fissurina quasimarginata	VR		VR	VR				VR		R									
Fissurina sp. D			VR																
Fissurina sp. H											VR								
Frondicularia cf. F. bulbosa	VR				VR	VR		VR	VR			VR	R	R	R				
Frondicularia sp. A																		VR	VR
Fursenkoina sp. B		VR						VR				VR							
Gaudryina pliocenica	F																		
Gavelinopsis durhami											VR	VR							
Gavelinopsis holkas												R	VR	VR	R	VR			VR
Globocassidulina neomargareta	R	R	F	F	F	VR													
Globocassidulina neopulchella				F		F	F	R	C	A	C	A	A	A	C				
Guttulina sp.										VR		VR		VR					
Gyroidina healdi			VR		F				F			VR							
Gyroidina rosalormis	VR	F	C	C	C	R	A	A	C	A	F	A	A	VR	F	A	R	C	F
Hanseniaca rotundimargo				F	R				F			F	VR			C	VR	R	A
Hanzawaia cf. H. crassisepta	C	F														R	VR		
Hanzawaia depaoloi	F	C	F	VR	F	R	F	VR	VR	R	VR	VR	VR	VR	F	VR	VR	R	VR
Holmanella baggi	R			R					VR	F	R	F	F	F	F	F	VR	VR	VR
Hyalinonetrion "elongata"			VR																
Islandiella cannata	VR							R		VR				VR					
Islandiella modeloensis			VR	VR	F	VR	VR	VR	VR	F	F	F	F	F	C	R	R	R	F
Kleinpella californiensis	C	F	F	F	VR	VR	R	VR	F		R	F	R	VR		VR	R	F	F
Lagena apiopleura					VR	VR	R	VR		VR	VR	VR				VR			R
Lagena discrepans			VR																
Lagena laevis							VR												VR
Lagena lisbonensis		VR	VR	VR									VR						
Lagena mexicana			VR																
Lagena pacifica					VR														
Lagena cf. L. pliocenica	VR												VR						
Lagena timmsana			VR					VR				VR	R			VR			R
Lagena sp. C		VR																	
Lenticulina atascaderoensis	R	F	A	VR	VR	VR	VR					F	VR	F	F	F			
Lenticulina barroni			VR																
Lenticulina branneri																F	A	C	F
Lenticulina dubia					R			VR					VR	VR	VR		VR	VR	VR
Lenticulina cf. L. dubia				VR			VR		VR								VR		
Lenticulina hughesi				F	R	R	C	VR	F	F	F	C	C	F	F				
Lenticulina luciana				F	F	C	A	C	A	F	A	R	C	C	A		VR		
Lenticulina miocenica																F	VR	A	A
Lenticulina reedi								VR				VR				VR	VR		
Lenticulina sandholdtana			VR	F		VR	R	C									F		
Lenticulina smileyi	C	R	F				VR	VR		R		VR	R	VR	VR	VR	F	C	C
Lenticulina sp. C							F								VR				
Lenticulina sp. G													VR			VR			

TABLE 2. Species checklist for the Graves Creek composite section. (2 of 2)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

GRAVES CREEK SECTION	SAUCESIAN			RELIZIAN											LUISIAN			
BENTHIC FORAMINIFERA	SL1	14	13	12	11	10	9	8	7	6	5	4	3	2	1	15a	15b	15c	15d
Marginulina crouchi								VR		R	VR	VR	R		VR				
Marginulina sp.							VR	VR										VR	
Marginulinopsis beali										VR	R		F	VR	VR	F	F	F	C
Marginulinopsis sp.	VR																		
Megastomella capitanensis									F	F	F	F	VR		VR				
Megastomella purisima												F	VR						
Nodogenerina parexilis		F	R	F	VR	F	F	VR		R	VR	F	VR	VR	R				
Nodogenerina parkeri								VR											
Nodogenerina sagrinensis	VR	VR	C	F	VR	VR	VR	R	VR	VR	VR		VR	VR		VR	VR	VR	R
Nodogenerina tappani														F	F				
Nodosaria ewaldi	R	VR	VR	VR				VR								VR			
Nodosaria franki				VR	VR			VR											
Nodosaria irregularis			VR						VR									VR	
Nodosaria obispoensis				VR											VR	R	R		R
Nodosaria perversa		R	R	R	VR			VR	VR	VR	R	F	F	F	R		VR		
Nodosaria weaveri		VR	VR	VR	VR	VR	VR		VR			VR		VR	R				
Nonionella miocenica										VR		VR					VR		VR
Nonionellina millen			VR	R	R		VR	F	VR	F	F	F	F	R	R	F		F	F
Oolina cf. O. borealis			VR		VR		VR	VR		VR		VR	R	VR	VR	VR	VR		VR
Oolina elongata					VR					VR		VR					VR		
Oolina globosa setosa								VR											
Oolina hexagona			VR										VR		VR				
Oolina melo						VR						R					R	VR	
Oridorsalis subtenera			R						C	F	R		R						
Oridorsalis umbonata	VR		F		VR		VR	F											
Paracassidulina delicata												VR							
Parafissurina sp. B			VR																
Paralrondicularia miocenica	F					C	C	C	R	VR	VR		VR						
Planorbulina sp.													VR						
Plectofrondicularia californica				VR	R	R	F	C	VR	VR			R	C	C				
Praeglobobulimina spinifera			R	R	VR														
Protoglobobulimina pseudoturta	R	F	VR	A	R	F	A	A	R	VR	VR	C	VR	F	C				
Proxifrons advena	F	C	A	R	F	C	R	C	R	VR			VR						C
Pseudononion basispinatum		VR					F	R	R		VR	R	R	VR		VR	VR		VR
Pseudononion costiferum		VR	VR	VR	VR	VR		VR	VR	R	VR		R		R		F	C	A
Pseudoparrella subperuviana		VR	R	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Pullenia inglei									C	C	F	A	C	C	C				
Pullenia malkinae				R	R	F	F	VR	F	VR	VR		VR						
Pullenia miocenica																C	VR	C	A
Rectuvigerina brannen	F	F	F			R	A	F					VR	C	C	A	F	F	C
Rectuvigerina hughesi				A	A	F	VR		F	F	C	C	F	VR	VR	VR			
Rectuvigerina loeblichi				VR	F	VR			A	F	F	F	C	F	F				
Rectuvigerina transversa	A	A	A																
Reophax cf. R. excenticus												VR							
Reussoolina simplex			VR				VR	VR	VR			VR	VR						
Rosalina californica			VR									F							
Rutherfordoides californiensis			VR	R				R			VR							VR	VR
Siphonodosaria advena	C	C	A	F	F	F	C	F	F	A	C	C	C	C	F	C	R	F	F
Siphonodosaria monterreyana	F	F	VR	A	A				F	VR	R	F	VR						
Siphonodosaria quadrulata	F	VR	F	A	VR	R	A	R	R			VR	R	VR					
Siphonodosaria sp.										VR					VR				
Sphaeroidina chilostomata		VR			VR		VR	VR	VR	R									
Spirosigmoilina tenuis								VR											
Suggrunda inflata		VR		VR	VR	VR	VR	VR	VR	VR		R							
Suggrunda kleinpelli	VR	VR	A	F	VR			VR											
Trifarina fluens	VR	VR																	
Uvigerina cf. U. hannai									VR										
Uvigerina cf. U. hispidocostata					VR	VR		VR											
Uvigerina hootsi	F		VR				VR		R	F		C	VR			F	VR	F	F
Uvigerina subperegrina	C	A	A	VR	F	F	F	F	R	R	C	A	A				VR	VR	
Uvigerinella californica		A	VR	VR	F	A	A	A	A			VR	F	F		VR	VR	VR	F
Uvigerinella californica ornata					VR			VR	VR	VR	R		VR	VR	F	VR	F	C	
Vaginulina cf. V. dubia												VR							
Vaginulina cf. V. tenuis		VR	VR																
Valvulineria californica				VR	VR	R	F	VR	F	A	C	C	C	F	F	C	C	F	A
Valvulineria miocenica	A	A	A		VR	VR		F	F	VR	F	R	C	F	R	R	VR		
Valvulineria robusta	C	A	F	A	A	C	A	A	F	F	R	A	C	C	F	A	VR	C	F
PLANKTIC FORAMINIFERA	SL1	14	13	12	11	10	9	8	7	6	5	4	3	2	1	15a	15b	15c	15d
Catapsydrax stainforthi	VR	R	C																
Globigerina bulloides		A	A	A	F	A	A	F	A	A	A	A	A	A	A	A	R	C	A
Globigerina connecta?						VR													
Globigerina praebulloides	F	C	R	R	VR	VR			VR		VR		VR			VR			
Globigerina pseudociperoensis	A	F	A	A	F	F	F		R	A	C	A	C	C	A	F	R	R	F
Globigerina quinqueloba				F	R		F	F			C	A	A	F	C				
Globigerina cf. G. woodi	F					VR	VR				VR								
Globigerinella obesa	A	R	F	F			F		R	VR	VR	F	R						
Globigerinita glutinata	R		R	VR	VR				R							R		VR	
Globigerinita uvula																	VR		
Globigerinoides altiaperturus								VR			VR		VR						
Globigerinoides cf. G. primordius													VR						
Globigerinoides quadrilobatus	VR				VR											VR			
Globoquadrina baroemoenensis	F																		
Globoquadrina venezuelana		R	VR	VR			VR		R				VR		VR				
Globorotalia cf. G. acrostoma	VR																		
Globorotalia birnageae		VR																	
Globorotalia mayeri										VR	F	VR							
Globorotalia praescitula	VR			F		VR	VR				R	R	F		VR	F			VR
Globorotalia zealandica													VR			VR			
Globorotaloides suteri relizensis	F	F	R	R	VR														
Neogloboquadrina continuosa	VR	F	F	F	VR				VR		R								
Protentella prolixa?				VR															
Tenuitellinata angustiumbilicata	C	A	A	A	A	A	A	A	A	A	C	A	A	F	C	A	A	R	A
OSTRACODES	VR									VR		VR	VR						VR

Indian Creek (IC) Section

Salinas Basin

Stratigraphy Studied

Monterey Formation
Saucesian to Luisian Stages

Importance

- Type area of Luisian Stage.

References

Foraminifera: Cushman (1926), Kleinpell (1938, 1980), Lipps (1966), Lipps and Kalisky (1972), Addicott and others (1980), Billman and Hopkins (1980), Poore and others (1981).

Calcareous Nannoplankton: Lipps and Kalisky (1972), Addicott and others (1980), Poore and others (1981).

Diatoms: Addicott and others (1980), Poore and others (1981), Baldauf and Barron (1982).

Geology: Anderson and Martin (1914).

Sample Collection

IC-1 to -342 (CRC-42982-1 to -187): Collected by J. H. Lipps in 1962 (Figs. 7-9); 155 samples lost in storage fire; 38 good assemblages recovered (Table 3).

Comments

The Indian Creek section is located approximately six miles east of the type locality of the Luisian Stage along the northern margin of the La Panza Range, San Luis Obispo County. Only the middle Monterey Sandholdt Member yields abundant foraminifers. Although Kleinpell (1938) designated a type section for the Luisian Stage in the south limb of a syncline located about 8 km west of Wilson Corner, the foraminifers from that section were never studied until Billman and Hopkins (1980) published their species checklist for 21 samples collected in 1931. The faunal characterization of Kleinpell's Luisian Stage was based in part on foraminifers from exposures along Quailwater Creek (Cushman, 1926) about 3 km west of Wilson Corner, and the primary faunal data used to define and recognize the Luisian Stage were derived from the benthic foraminiferal assemblages of the type Luisian zones in Reliz Canyon, 140 km to the northwest.

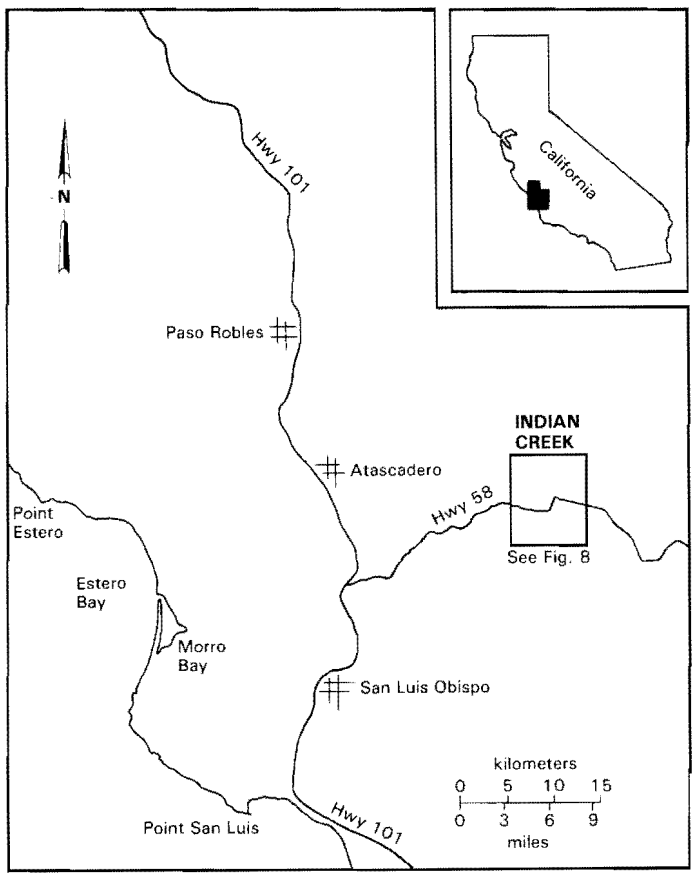

FIGURE 7. Location of the Indian Creek area, San Luis Obispo County.

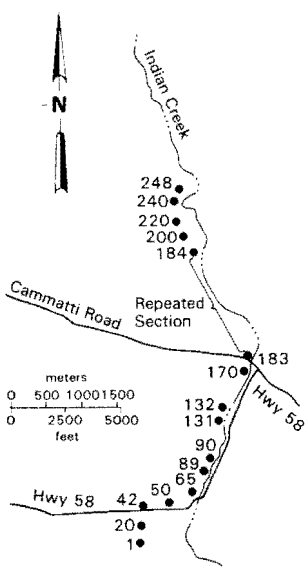

FIGURE 8. Sample locality map of the Indian Creek section.

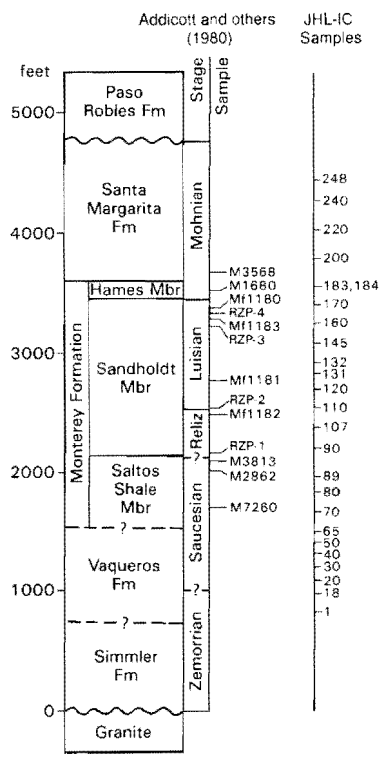

FIGURE 9. Stratigraphic column of the Indian Creek sample collection denoting positions of collected samples.

TABLE 3. Species checklist for the Indian Creek section. (1 of 2)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

INDIAN CREEK SECTION	SAUCESIAN					REJLZIAN										
BENTHICS JHL-IC SAMPLE:	83	91	92	100	102	108	109	111	112	114	115	116	117	118	119	120	122
Anomalinoides salinasensis																	
Astrononion goudkolli										VR	F						
Baggina californica																	
Bolivina advena						A		A				VR					R
Bolivina advena ornata	R						A	R	A	A	A	A	VR	A	A	A	A
Bolivina blakei				C				A	A	A	A		A	A	A	C	C
Bolivina brevior s.l.											C	A	A			F	F
Bolivina californica						VR	A	A	A	A	A		C	R	R	F	R
Bolivina churchi	VR	R		A	A												
Bolivina conica	VR																
Bolivina cf. B. euplectella		VR															
Bolivina foraminata	R						A										
Bolivina hughesi	R																
Bolivina imbricata		A					R										
Bolivina pseudospissa										R							
Bolivina spissa									R								
Bolivina tumida		F		R	R		C		A	A	A	C	A	A	A	A	
Bolivina sp. F															VR	VR	
Buliminella californica	VR																
Buliminella curta													F	R	R		R
Buliminella elegantissima		C	A														
Buliminella sublusitormis	VR	A	F	A	A		F	A	F	C	F		F	F	A	F	
Cancris baggi																	
Cancris lippsi		A	R	F	R												
Chilostomella ovoidea														R	VR		
Cibicides pumilus																	
Cibicides sp. D										VR							
Dentalina cf. D. baggi																	
Dentalina pseudooblique		R						R					VR	R			
Elphidium granti										VR							
Enantiodentalina muraii							F	C	R		R		VR	F	F		
Epistominella smithi																	
Fissurina sp. I				VR													
Fissurina sp. J																	
Gaudryina subglabrata		VR															
Gyroidina rosaformis							R	R	R					R	R	VR	
Hansenisca altiformis (reworked?)															VR		
Hanzawaia depaoloi		R		A	A					VR?							
Haplophragmoides? sp. A																	
Islandiella carinata		F		VR	F												
Islandiella modeloensis							R	R		R	VR		R			VR	VR
Kleinpella californiensis		R						C	F	A	F	R		F	R	F	
Lagena apiopleura		VR															
Lagena laevis		VR															
Lagena meridionalis		VR															
Lagena semilineata		R															
Lagena cf. L. striata		R															
Lagena sp. B									VR								
Lenticulina atascaderoensis														VR			
Lenticulina barroni				F													
Lenticulina indianensis								C									
Lenticulina luciana																VR	
Lenticulina miocenica																	
Lenticulina smileyi		R		A				VR	R	R			F			R	
Marginulina crouchi							VR	VR					R				
Marginulinopsis beali			VR?	F									R		VR?	VR	
Megastomella capitanensis								VR									
Megastomella punisima																	
Nodogenerina parkeri															VR		
Nodosaria ewaldi														R			
Nodosaria franki				VR													
Nonionella miocenica		A	A				F						VR				
Nonionellina milleri								F	C	C	A		R	A	A	F	F
Parafrondicularia miocenica		VR															
Protoglobobulimina pseudoturta	R	A					R	VR		VR	VR			C	F		
Proxitrons advena		F		A													
Pseudononion basispinatum		VR															
Pseudononion costiferum		A	A	A	A									VR		R	
Pseudoparrella subperuviana		A	A	A	R	VR	C	A	A	R	A	F	A	C	C	A	A
Pullenia miocenica																	
Rectuvigerina branneri																	
Rectuvigerina hughesi							F										
Rectuvigerina loeblichi							F										
Siphonodosaria advena							F	VR	R	R			R	F	F	R	
Suggrunda inflata		VR															
Suggrunda kleinpelli				VR	VR												
Trillarina fluens		A															
Uvigerina hannai															A		
Uvigerina hootsi															A		
Uvigerina segundoensis				A													
Uvigerina subperegrina	R					R	F	R	A	F	F	R	A	A	A	C	R
Uvigerinella californica				A													F
Uvigerinella californica ornata					A		VR			R	VR	VR					
Valvulineria californica	C	R		F				A	A	A	A	A	A	A	A	A	A
Valvulineria miocenica					R	A	A										
Valvulineria robusta							A	F						F	F	R	
PLANKTICS JHL-IC SAMPLE:	83	91	92	100	102	108	109	111	112	114	115	116	117	118	119	120	122
Globigerina bulloides	F			R		A	A	VR	A	A	A	A	A	A	A	A	F
Globigerina pseudociperoensis	VR	R		R		C	A		C	A	A	F	A	A	A	C	R
Globigerina quinqueloba							VR				R		F		F		
Globigerinella obesa														VR			
Globigerinita uvula																VR	
Globigerinoides immaturus						R					VR						
Globorotalia mayeri										F	R		F				
Globorotalia praescitula							F			VR	VR						
Tenuitellinata angustiumbilicata		R				A	A	R	A	A	A	A	A	A	A	A	F

TABLE 3. Species checklist for the Indian Creek section. (2 of 2)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

INDIAN CREEK SECTION									L U I S I A N											
BENTHICS JHL-IC SAMPLE:	124	126	127	129	130	131	135	136	138	140	141	142	143	146	147	151	153	155	156	162	168
Anomalinoides salinasensis	VR																				
Astrononion goudkoffi																					
Baggina californica																			VR	F	
Bolivina advena							A	A	A												A
Bolivina advena ornata	A	A	A	R	A	A			F		F		A	C		R	VR	A	C	A	
Bolivina blakei	A																				F
Bolivina brevior s.l.			A				C	F	C	C		VR		A?			F	A		F	
Bolivina californica	A					R															
Bolivina churchi											R										
Bolivina conica																					
Bolivina cf. B. euplectella																					
Bolivina foraminata																					
Bolivina hughesi																					
Bolivina imbricata	VR	F		A	A	A				F				A	A						
Bolivina pseudospissa																					
Bolivina spissa																					
Bolivina tumida	A	A	F	A	C	A		R			R		A	A		R					VR
Bolivina sp. F	F																				
Buliminella californica																					
Buliminella curta																		A			
Buliminella elegantissima														R	F						
Buliminella subfusiformis	F	F	R	A	A	A	A	A	A	R	R		R	A	A	R			VR	F	A
Cancris baggi	F			VR		R									VR						
Cancris lippsi																					
Chilostomella ovoidea																					
Cibicides pumilus																					VR
Cibicides sp. D																					
Dentalina cf. D. baggi	VR																				
Dentalina pseudoobliqua						R										R					
Elphidium grantii																					
Enantiodentalina murali		R		R		R															
Epistominella smithi																					F
Fissurina sp. I																					
Fissurina sp. J								VR													
Gaudryina subglabrata																					
Gyroidina rosaformis	R							VR													
Hansenisca altiformis (reworked?)																					
Hanzawaia depaoloi	VR								VR												VR?
Haplophragmoides? sp. A		VR?									VR										
Islandiella carinata																					
Islandiella modeloensis																			VR		
Kleinpella californiensis		A	VR	A	A	A	A	F	A	F	A		VR	A	F						R
Lagena apiopleura																					
Lagena laevis																					
Lagena meridionalis																					
Lagena semilineata																					
Lagena cf. L. striata																					
Lagena sp. B																					
Lenticulina itascaderoensis	VR																				
Lenticulina barroni																					
Lenticulina indianensis																					
Lenticulina luciana	F																				
Lenticulina miocenica									R												
Lenticulina smileyi	R																	R			
Marginulina crouchi	VR																				
Marginulinopsis beali	VR			VR	F	F			R	VR	F	VR	VR	VR	R			F	VR		
Megastomella capitanensis																					
Megastomella punisima	C																				
Nodogenerina parkeri																					
Nodosaria ewaldi																					
Nodosaria franki																					
Nonionella miocenica						R	A	C	R						F	R					R
Nonionellina miltari	A	A	F	VR																	
Parafrondicularia miocenica																					
Protoglobobulimina pseudotorta	A	VR																			
Proxifrons advena																					
Pseudononion basispinatum																					
Pseudononion costiferum	R			A	A	A	C	A	A	F	F		A	C	A		F	A	C	A	A
Pseudoparrella subperuviana		F	F	C	F	A			R		C	R	A			VR	VR	A		A	
Pullenia miocenica	R																			VR	
Rectuvigerina brannen	A			VR	VR				R									A	VR		
Rectuvigerina hughesi																					
Rectuvigerina loeblichi																					
Siphonodosaria advena	R																				
Suggrunda inflata		R																			
Suggrunda kleinpelli						VR															
Trifarina fluens																					
Uvigerina hannai																					
Uvigerina hootsi																					
Uvigerina segundoensis																					
Uvigerina subperegrina														A				A	R		
Uvigerinella californica	A					F							VR					VR			A
Uvigerinella californica ornata									F												
Valvulineria californica	A	A	A	A	A	A	A	F	C	A	A	F	A	A	C	A	A	A	A	A	
Valvulineria miocenica				VR				R				VR	A	A	A	F	A	A	A	A	A
Valvulineria robusta	A		A			R															
PLANKTICS JHL-IC SAMPLE:	124	126	127	129	130	131	135	136	138	140	141	142	143	146	147	151	153	155	156	162	168
Globigerina bulloides	A	A	VR	F	R	A								R				R			R
Globigerina pseudociperoensis	A	F		R	VR	C															
Globigerina quinqueloba						F															
Globigerinella obesa																					
Globigerinita uvula						R															
Globigerinoides immaturus																					
Globorotalia mayeri																					
Globorotalia praescitula																					
Tenuitellinata angustiumbilicata	F	A	A	R		A								R	VR			R			

Laguna Hills (LH) Section

Santa Ana Embayment, Los Angeles Basin

Stratigraphy Studied

Middle Monterey Formation
Luisian Stage

Importance

- Contains detailed evidence of initial basin subsidence.

References

Foraminifera: Not previously documented.
Ostracodes: Finger (1988).
Geology: Morton and others (1974), Getz (1982), Stadum (1982, 1984).

Sample Collections

MAR-254: Collected and provided by M. A. Roeder in 1983 (Figs. 10, 12); good foraminiferal assemblage recovered (Table 4).
LH-1 to -7: Collected by K. L. Finger and G. L. Armstrong in 1983 (Figs. 10-12); 5 good foraminiferal assemblages recovered (Table 4).

Comments

The MAR-254 and LH-5 to -7 sample localities are no longer exposed, having been collected during the early phase of the area's development for housing.

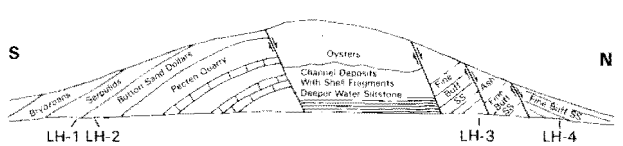

FIGURE 11. Cross-section of the Moulton Parkway roadcut denoting sample localities, Laguna Hills.

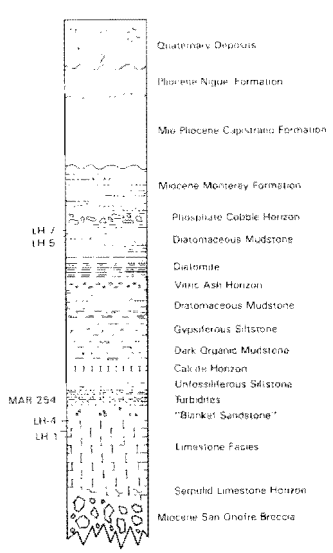

FIGURE 12. Generalized stratigraphic column of the Laguna Hills sample collection denoting positions of collected samples.

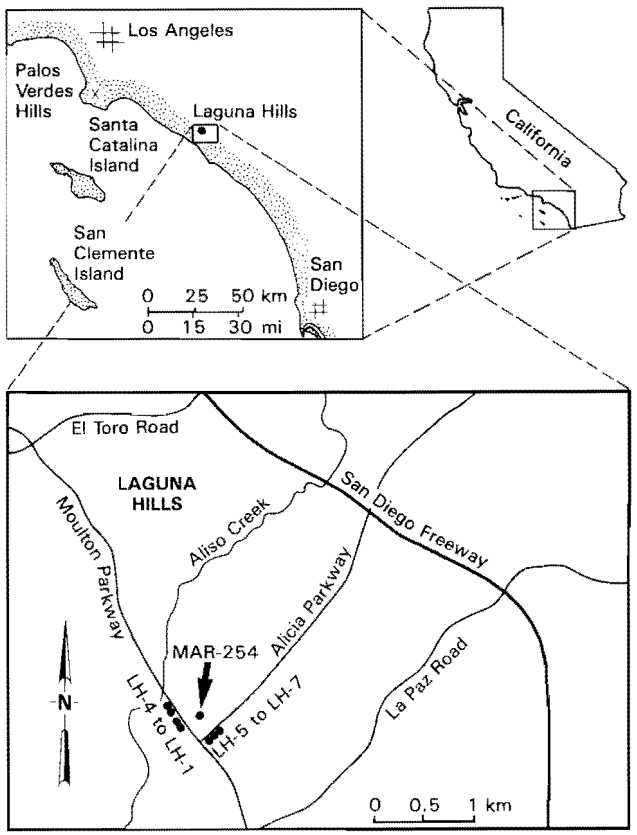

FIGURE 10. Location of the Laguna Hills area, Orange County, and sample locality map of the Laguna Hills section.

TABLE 4. Species checklist for the Laguna Hills section. [Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

SPECIES / SAMPLE:	LH-1	LH-3	LH-4	MAR254	LH-5	LH-7
Ammodiscus incertus			R			
Asiacolus sp. G				VR		
Baggina californica				VR	C	R
Bolivina advena ornata	C		A	R	A	R
Bolivina brevior s.l.	VR	R	F	F	R	C
Bolivina californica	VR				A	A
Bolivina cf. B hughesi var. A	VR			VR	VR	
Bolivina imbricata		A	C	C		VR
Bolivina lumida	F	A	C	A	C	C
Bolivina sp. J					R	
Buccella oregonensis		F	R			
Buliminella elegantissima	R	F	F	C		
Buliminella subfusiformis	VR	A	C	C	A	VR
Cancris baggi	R		R	VR		
Chilostomella ovoidea					VR	
Cibicides pumilus	VR	R	VR			
Cibicides sp. D		VR	R			
Cibicidina sp. A	F					
Dentalina pseudoobliqua				VR	F	F
Dentalina sp. D					R	R
Elphidium grantii	VR	VR	R	VR		
Fursenkoina sp. B				VR		
Gaudryina exilis				VR		
Gaudryina pliocanica	VR					
Gaudryina subglabrata			F			
Globigerina bulloides	VR		R	VR		
Globigerinella obesa			VR			
Hansenisca rotundimargo					F	R
Hanzawaia dapsoloi	C	F	C	F		
Islandiella modeloensis	A	C	C	VR	F	
Kleinpella californiensis	VR	F	F	C	C	C
Lagena apiopleura?	VR		R			
Lenticulina miocenica					R	R
Lenticulina smileyi			VR	VR	F	A
Lobatula lobatula				VR		
Marginulinopsis beali	VR?	VR		VR	C	R
Neoponides navarrotei			R	VR		
Nonionella miocenica	R	F	R	C		
Proteglobobulimina pseudoturta				VR	F	R
Pseudononion basispinatum	VR	F	R	VR		
Pseudononion costiferum	VR	VR	VR	VR	C	F
Pseudoparrella subperuviana	VR	R	R	F	F	
Pullenia miocenica					C	F
Quinqueloculina seminulum				VR		
Rectuvigerina brannani					A	A
Suggrunda kleinpelli						C
Tanuitaltinata angustiumbilicata			VR	VR		
Textularia sp.			R	VR		
Uvigerina hannai						F
Uvigerina subperegrina					C	
Uvigerinella californica ornata	VR		R	VR		
Valvulineria californica	R	A	A	R	A	C
Valvulineria miocenica	C	F	R	A	C	F
Virgulinella peritusa				VR		

Manville Quarry (MQ) Access Road Section

Santa Maria Basin

Stratigraphy Studied

Upper Monterey Formation
Mohnian Stage

Importance

- Yields the most continuous late Miocene-early Pliocene diatom sequence in California.

References

Foraminifera: Govean and Garrison (1981), Ingle (1985).
Diatoms: Barron (1975, 1976a).
Geology: Govean and Garrison (1981), Isaacs (1989).

Sample Collection

CRC-42107-1 to -40: Collected by K. L. Finger and G. L. Armstrong in 1983; 23 good foraminiferal assemblages recovered (Table 5).

Comments

The same Mohnian foraminiferal fauna was also recovered from nearby exposures along Miguelito Road. A collection of the quarry section was also made, but only siliceous microfossils are found in those younger sediments.

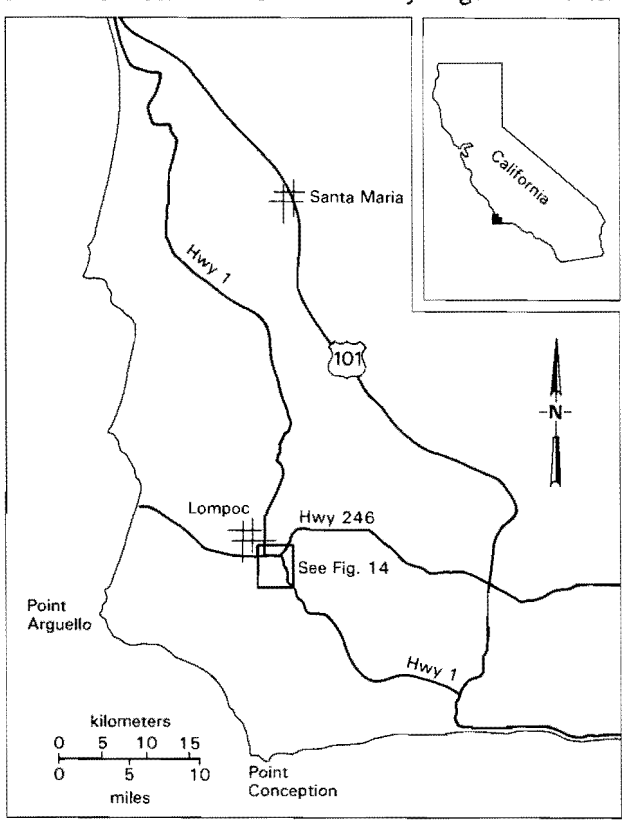

FIGURE 13. Location of the Manville Quarry area, Lompoc, San Luis Obispo County.

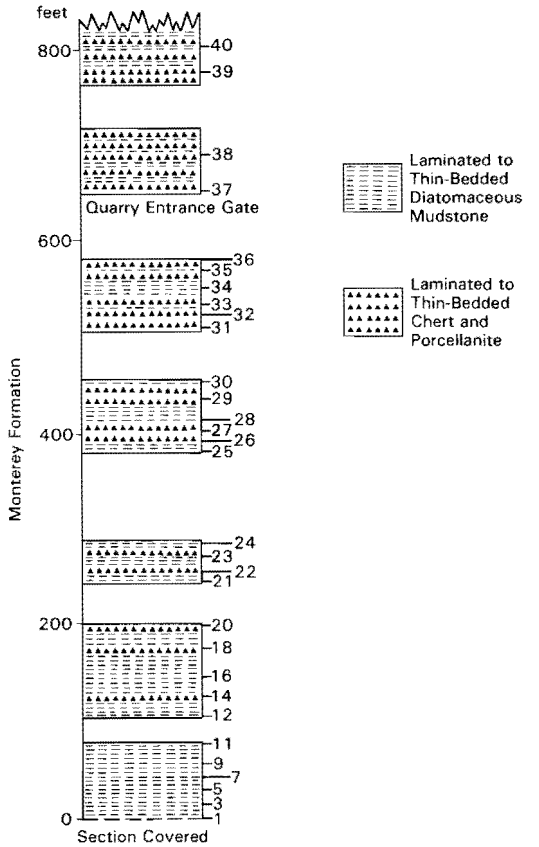

FIGURE 15. Stratigraphic column of the Manville Quarry access road sample collection denoting positions of collected samples.

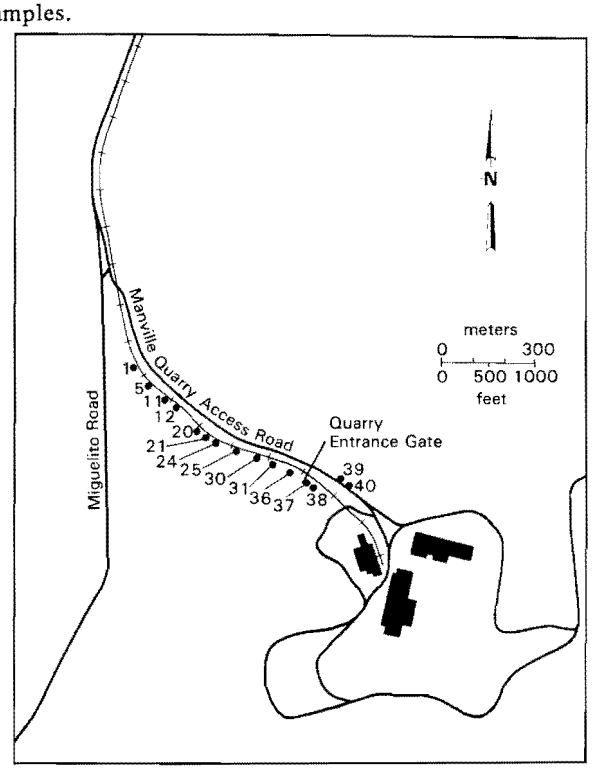

FIGURE 14. Sample locality map of the Manville Quarry access road section.

TABLE 5. Species checklist for the Manville Quarry access road section.
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

STRATIGRAPHIC FEET:	0	16.4	52.9	58.4	70.6	78	107	118	127	136	148	159	176	272	381	400	414	436	453	509	521	531	576
BENTHICS CRC42107 SAMPLE:	1	3	8	9	10	11	12	13	14	15	16	17	18	23	25	27	28	29	30	31	32	33	36
Ambitropus evax			VR	VR	VR	R			VR		R	R	R	VR	R	VR							
Astrononion goudkoffi			VR		R	R	F	F	R	R	F	F	C	R	VR	R	R	R		F			
Bolivina bramlettei		VR				VR		R							R	VR				VR			
Bolivina brevior	F	A	A	F	A	A	A	A	C	A	A	A	A	F	F	R	F	F		A	F	F	R
Bolivina californica		R		VR	F	R	R	A		C	C	A	F	F	R	F		VR	A			F	
Bolivina foraminata			F		F	R	R			R	F	R	F	F	C	R					F		VR
Bolivina girardensis		F	F		A	C	R	F	VR		R	F		F	F	F	F	F	F	C	F	A	F
Bolivina granti															VR	R	R	F		A			
Bolivina hughesi		F				R		R				C	A	R	R	R	VR					VR	
Bolivina interjuncta						R																	
Bolivina modeloensis											R		R				R		VR				
Bolivina pseudospissa		VR	F	R	F	C	F	F		R	F	A	C	VR?	F	A		F	F	C	F	R	VR
Bolivina salinasensis		C	F	VR	F	R	R	F	VR	R	F	F	F					R				F	
Bolivina ticensis								VR															
Bolivina tongi filacostata																						VR	
Bolivina tumida						R		A									A						
Bolivina woodringi		F	F	VR	C	A	F	A	R	F	A	R		C	C	F	R	C	R	F	R	A	C
Bolivina sp. E						R																	
Bolivina sp. F		F																					
Bolivina sp. G													R										
Bolivina sp. H													F										
Bulimina inflata		VR			VR	R	VR	R		R	F	VR		R	VR								
Buliminella brevior																				VR			
Buliminella curta		F			R	R		F		R		F	F	F	VR	VR							
Buliminella subfusiformis		VR	R	R	F	F	R	A		R	VR	VR	R	VR	R	F	C	F		F	F	C	A
Cassidulinella rerulinaformis			R		VR	VR					F			F		A	R	R				F	VR
Chilostomina pustulosa								VR															
Dentalina cf. ?D. antennula			VR		R	R	R	VR	R					VR									
Epistominella discorbisoides					VR	F	F																
Gavelinopsis sp. C													VR?										
Globocassidulina monicana					F	F	VR	R	VR	R	C		VR			VR				VR			
Gyroidina healdi		VR																					
Gyroidina rosaformis s.l.			R	R	F	R		F	R	R	R	A	R		VR	R		R					R
Hansenisca multicamerata			R		VR	F	F	F		R	F			R	VR	F						C	
Hansenisca rotundimargo		VR					VR				F	VR	R	VR				VR					R
Holmanella baggi			R					R	R									R		VR		VR	VR
Holmanella valmonteensis		R			F	C	C	F		R	F	C	A	R	F	F	R	VR	C		C	VR	R
Hopkinsina magnifica					R					F						VR		R				F	
Hopkinsina sp. A						VR	VR			VR				VR									
Islandiella modeloensis	VR		VR		R	F	F	R				F	C	F									
Kleinpella californiensis		C		R		R	R	A		C	F	A		R	F	VR	VR			R		C	
Nodogenerina cf. N. bradyi										VR													
Nodogenerina sagrinensis		VR						VR				VR			VR	VR	R			VR			
Nodosaria ewaldi		VR										VR				VR		VR					
Nodosaria irregularis		VR	VR		F	F										VR				R			
Nodosaria cf. N. ovalis								R															
Nodosaria "spinescens"								R															
Nodosaria sp. B														VR									
Nonionellina milleri																						VR	
Oolina melo															VR								
Paracassidulina delicata					R	F	F	R			VR	R			R	VR		R				R	VR
Praeglobobulimina galliheri																						VR	
Praeglobobulimina spinifera								R															
Protoglobobulimina pseudotorta							R	R	VR		R		R	VR	R?	R				R		F	
Pseudoparrella subperuviana	VR	VR	F	F	F	C	VR	F	R	R	F		VR		C	R	F	F		R	VR	C	A
Pullenia inglei					VR	R	F	F						R						VR	VR	F	
Pullenia malkinae		F																					
Siphonodosaria adversa														VR									
Sphaeroidina chilostomata		VR	VR			R	VR				F	VR	C			VR				VR			
Suggrunda kleinpelli						VR		VR	VR						R		F					VR	
Uvigerina hannai			R					R			R												
Uvigerina hootsi		C				VR	F	C			F	F		F			R	VR	R	VR		R	
Uvigerina segundoensis				VR	R																		
Uvigerina senticosa												VR											
Uvigerina subperegrina		C			A	A	A	C	VR	F	A	C	A	F						F	F	C	
Uvigerinella californica ornata											VR												
Valvulineria mcdougalli			R		VR		R	C		F	VR		R?										
Valvulineria robusta							VR									R						VR	
PLANKTICS CRC42107 SAMPLE:	1	3	8	9	10	11	12	13	14	15	16	17	18	23	25	27	28	29	30	31	32	33	36
Globigerina bulloides		VR	A	R	A	A	C	A	C	C	F	A	A	C	F	C	A	R		VR		A	A
Globigerina praebulloides								VR						VR									
Globigerina pseudociperoensis			F	F	F	F	F	F	VR	R		F	F	F	VR	F	R					F	
Globigerinella obesa							VR																
Globigerinella pseudobesa																VR							
Globigerinita uvula				F	VR	F	VR	F	F	F	VR	VR		F	VR			VR				F	R
Globorotalia cf. Glr. menardii						R																	
Globorotaloides trema			VR																				VR
Neogloboquadrina pachyderma						VR										VR	R	F				VR	
Orbulina suturalis										R					VR							VR	
Orbulina universa																							VR
Tenuitellinata angustiumbilicata			R	R		VR			R?	VR		VR	R		R							F?	C?
Indeterminate globigerinids		VR															R						
Prunopyle titan (radiolarian)		F					R	VR			R							VR		F	F		R

Monterey County (MC) Roadcut Sections

Salinas Basin

Stratigraphy and Depositional Basin Studied

Del Rey Canyon Diatomite Member, upper Monterey Formation
Mohnian Stage (includes old Delmontian Stage)

Importance

- Type area of Delmontian Stage.
- Type area of Monterey Formation.

References

Foraminifera: Kleinpell (1938), Wornardt (1972), Govean (1980), Smith-Evernden (1985), Smith and Buzas (1986).
Diatoms: Barron (1975, 1976a).

Sample Collections

CRC-41367-1 and -2: Toro Road samples collected by K. L. Finger in 1981 (Figs. 16, 18 and 19); one good foraminiferal assemblage recovered (Table 6).
CRC-41368-1: Olmstead road sample collected by K. L. Finger in 1981 (Figs. 16, 17); good foraminiferal assemblage recovered (Table 6).
CRC-42263-1 to -8: Toro Road samples collected by K. L. Finger and W. H. Akers in 1983 (Figs. 16, 18, and 19); three good foraminiferal assemblages recovered (Table 6).

Comments

Although this is the area of the type Delmontian Stage (Kleinpell, 1938), and these samples are coeval with those from the stratotype, studies by Pierce (1972), Ruth (1972), and Barron (1975, 1976a) indicate that these rocks are correlative with the late early Mohnian. The upper Delmontian *Bolivina obliqua* Zone, which has its type in the Topanga Canyon section, is younger than these strata and, hence, does not fall within a defined stage. Although Pierce (1972) suggested expanding the Mohnian Stage to the top of the Miocene, most workers have informally referred to this uppermost Miocene interval as "Delmontian".

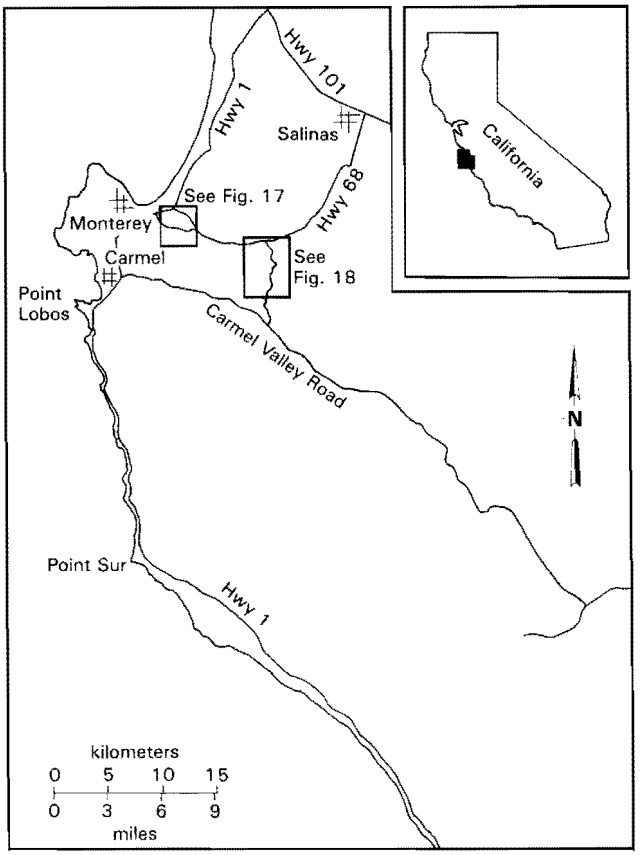

FIGURE 16. Locations of roadcut collection areas, Monterey County.

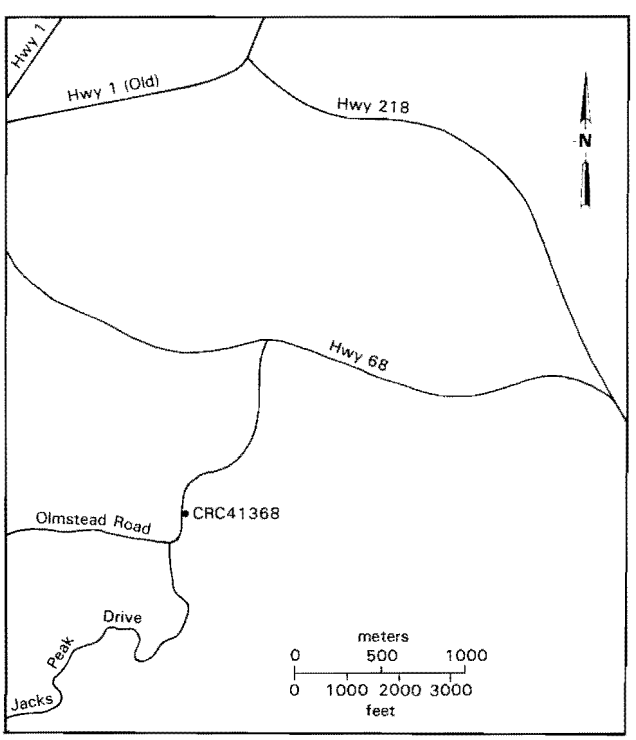

FIGURE 17. Locality map of the Olmstead Road sample.

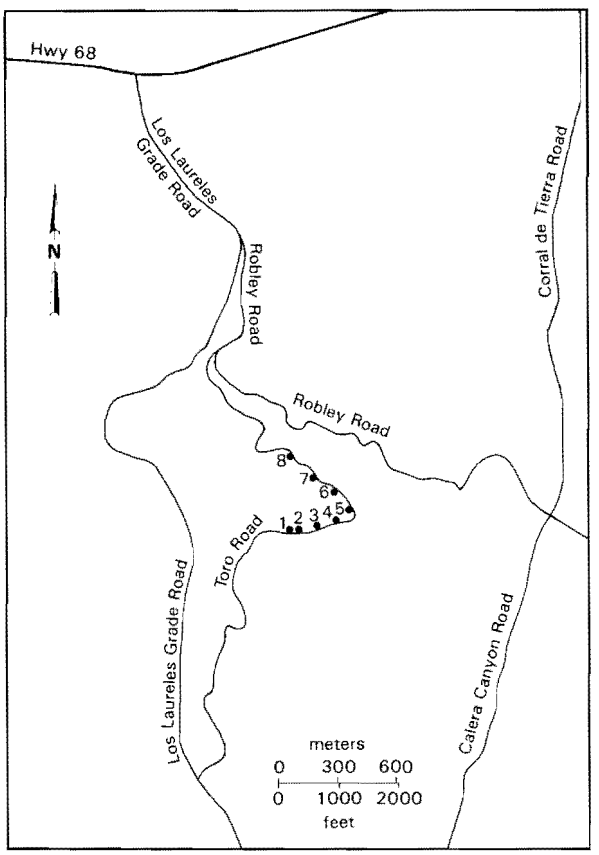

FIGURE 18. Sample locality map of the Toro Road sample.

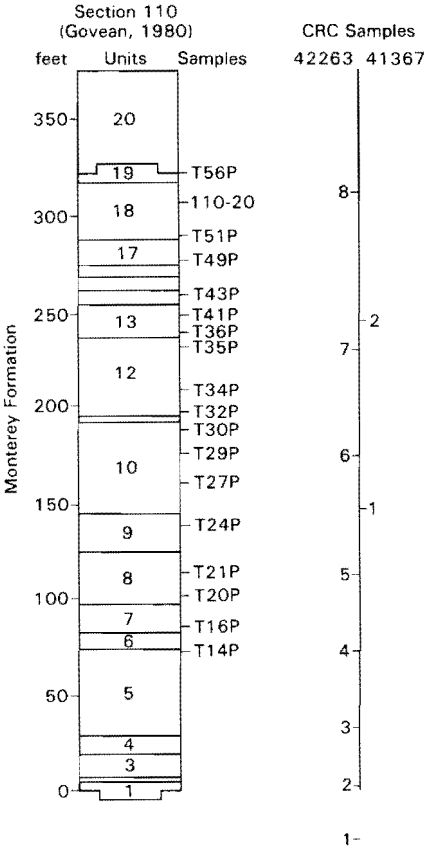

FIGURE 19. Stratigraphic column of the Toro Road section denoting positions of collected samples.

TABLE 6. Species checklist for the Monterey County roadcut sections.
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30; X = present (no quantitative count made)]

MONTEREY COUNTY	(Kleinpell's Delmontian Stage)				
SECTIONS:	Olmstead Rd	Toro Road			
SPECIES CRC SAMPLE:	41368-1	41367-2	42263-6	42263-7	42263-8
Bolivina brevior			F	F	
Bolivina foraminata		X	VR	A	VR
Bolivina multicostata					R
Bolivina pseudospissa		X			
Bolivina wissleri			F		
Bolivina woodringi					R
Buliminella curta	X	X	C	A	A
Buliminella elegantissima		X	F	A	A
Buliminella subfusiformis					R
Epistominella pacifica	X				
Nonionella miocenica					A
Praeglobobulimina galliheri		X			
Protoglobobulimina pseudotorta	X	X			
Pseudononion schencki	X	X	A	A	A
Pseudoparrella subperuviana				VR	
Uvigerina subperegrina	X	X			
Uvigerina sp. B					F

Naples Beach (NA) Section

Santa Barbara Embayment, Ventura Basin

Stratigraphy Studied

Monterey Formation
Saucesian through Mohnian Stages

Importance

- Condensed section spanning entire interval of "Monterey" time.
- Located adjacent to major oil fields.
- Focal point of many previous studies.

References

Foraminifera: Cushman and Kleinpell (1934), Kleinpell (1938, 1980), Lipps (1966), Wornardt (1972), Blake (1985), Arends and Blake (1986), DePaolo and Finger (1991).

Calcareous Nannoplankton: DePaolo and Finger (1991).

Diatoms: Arends and Blake (1986), Barron (1986a, b), DePaolo and Finger (1991).

Strontium Isotope Ratios: DePaolo and Finger (1991).

Geology: Dibblee (1987), Isaacs (1980a, b, 1981a-d, 1984, 1989), DePaolo and Finger (1991), Hornafius (1991).

Sample Collections

CRC-39842-1 to -108: Collected from the east bluff by J. H. Lipps, A. R. Loeblich, and H. Tappan in 1963, and from the west bluff and base of east bluff by J. H. Lipps and B. Akpati in 1964 (Figs. 20-22) ; 106 good foraminiferal assemblages recovered (Table 7).

CRC-40660-1 to -28: Collected by K. L. Finger and G. L. Armstrong in 1982 (Figs. 20-22). Although those of these samples yielding foraminifers have equivalents in the above collection, several specimens not seen elsewhere are illustrated from this collection in the plates of this atlas.

NA-89-1 to -11: Collected by K. L. Finger in 1989 from gully behind east bluff and condensed section at the Luisian-Mohnian transition (see DePaolo and Finger, 1991); four good foraminiferal assemblages recovered from condensed section (included in Table 7).

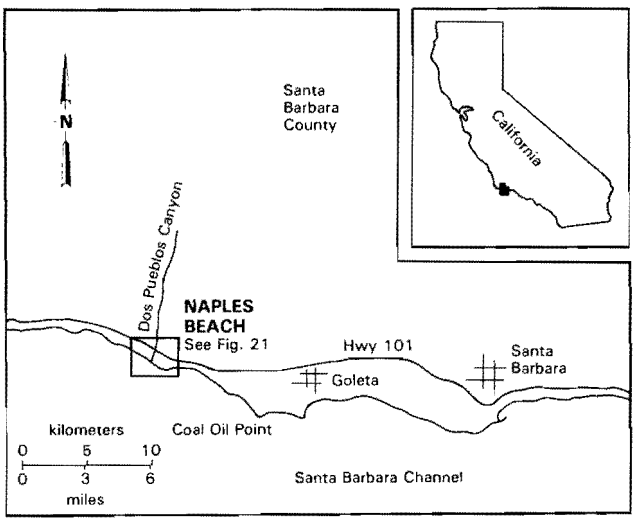

FIGURE 20. Location of the Naples Beach area, Santa Barbara County.

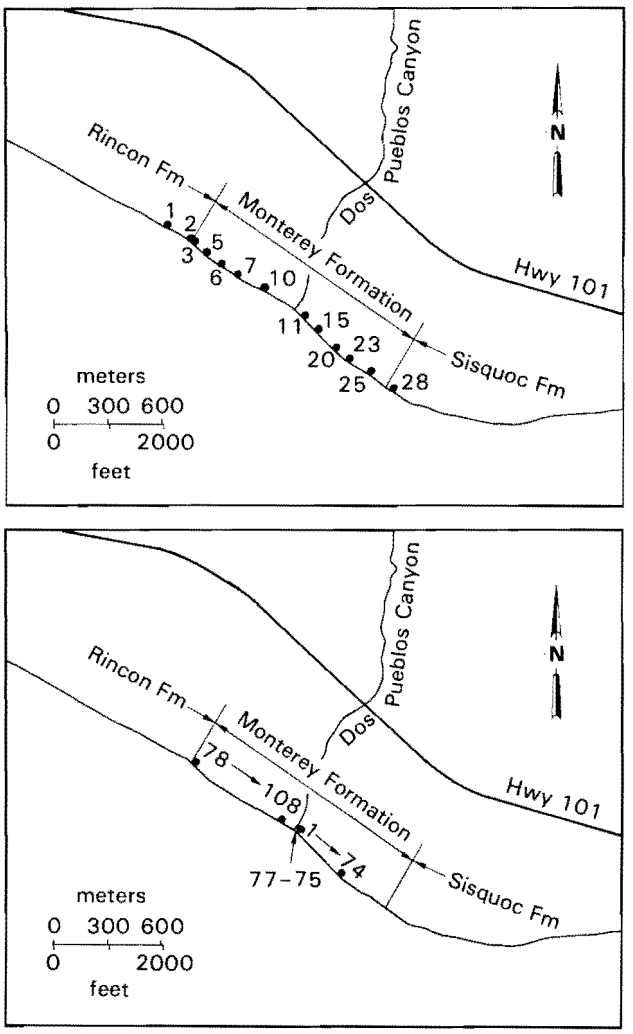

FIGURE 21. Sample locality map of the Naples Beach section. Top: CRC-40660 collection. Bottom: CRC-39842 collection (checklisted in Table 7).

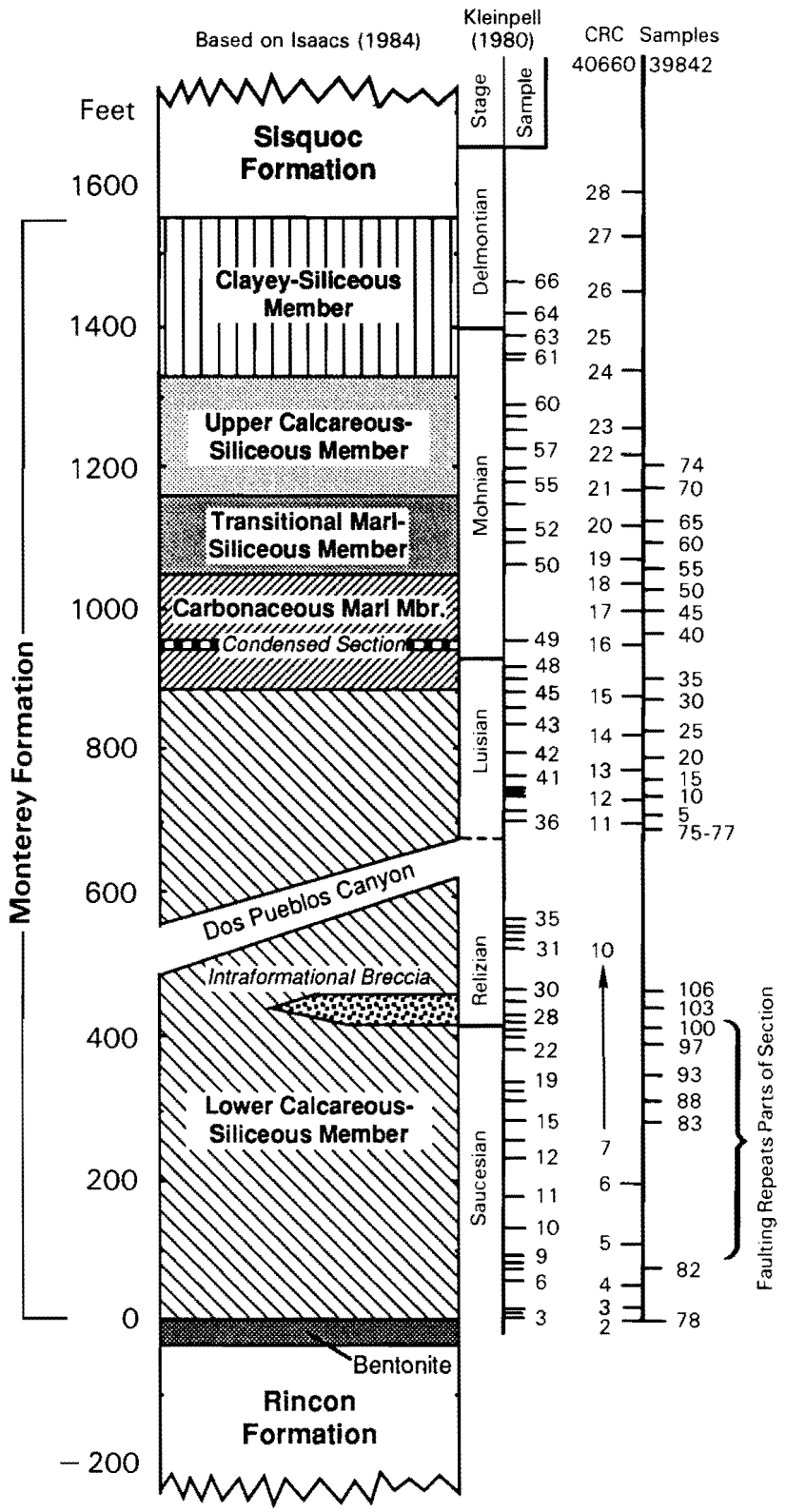

FIGURE 22. Stratigraphic column of the Naples Beach section denoting positions of collected samples.

TABLE 7. Species checklist for the Naples Beach section. (1 of 8)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

NAPLES BEACH SECTION	SAUCESIAN																			RELIZIAN					
BENTHICS CRC39842-	78	79	80	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
Ambitropus evax																										
Ammodiscus incertus																										
Anomalinoides salinasensis				F?	R		R	VR				R	F	R	F	A	R	F						R	R	
Astacolus crepidulus			VR																							
Astacolus naplesensis															C											
Astacolus sp. E																										
Astacolus sp. G																		R								
Astacolus sp. I																										
Astrononion goudkoffi																										
Baggina californica																										
Bolivina advena	A	A	A		A	F	A	A	A	A	F	A	A	A	A	A	A	A	A					A	F	C
Bolivina advena ornata																										
Bolivina benedictensis																										
Bolivina biakei																					A	A	A	A	A	
Bolivina brevior s.l.		R		C	A	R		F	A	A	A	R	F	A	F	F	A	A	A	A	A		R	A	C	
Bolivina californica				A	A	A	A	C	C		F	C	F	A	A	C	C	A	F	R	A	F	F	A	C	
Bolivina churchi																										
Bolivina conica																										
Bolivina cuneiformis																										
Bolivina foraminata																										
Bolivina girardensis																										
Bolivina granti																										
Bolivina hughesi																										
Bolivina imbricata																										
Bolivina isaacsi							C			R				R	R	C	A	A	A	A				A	R	
Bolivina modeloensis																										
Bolivina mulleri																										
Bolivina predecussata																										
Bolivina pseudospissa																							A	F	A	
Bolivina salinasensis s.l.			C																							
Bolivina spissa																					C	F				
Bolivina tongi filacostata				VR																						
Bolivina tumida s.l.				A	A		C		R			R		F		A	A	A	A	F	R		R	A	A	A
Bolivina tumida "seminuda"																										
Bolivina wissleri																										
Bolivina woodringi																										
Bolivina sp. A																										
Bolivina sp. J																										
Bolivina sp. O																										
Bolivina sp. R																										
Buccella oregonensis				VR																						
Bulimina alligata	R	VR	F																							
Bulimina inflata																										
Bulimina subacuminata																										
Bulimina subcalva																										
Buliminella curta				VR																						
Buliminella elegantissima					VR	VR		VR	VR		VR			R	VR						R				R	
Buliminella semihispida																										
Buliminella subfusiformis	A	A	A	A	A	A	A	A	A	A		A	F	A	A	A	A	A	A	A	A	A	A	C	A	C
Cancris baggi			R				R																			
Cancris planus	R	F	C			F																				
Cassidulinella renulinaformis																										
Cibicides pumilus				VR	VR						VR															
Cibicides sp. D																										
Cibicidoides cushmani			F									VR														
Dentalina cf. D. baggi																										
Dentalina grandis																										
Dentalina pseudoobliqua																										
Dentalina sp. A															VR	VR										
Dentalina sp. D															VR	R										
Dentalina sp. E																										
Enantiodentalina murali	VR		VR	VR											VR	R	VR	VR								
Epistominella discorbisoides																										
Epistominella smithi												C														
Fissurina nallandi																										
Fissurina sp. C																										
Fissurina sp. E																										
Fissurina sp. M																										
Frondicularia sp. B																										
Fursenkoina subplana																										
Fursenkoina sp. A																										
Gallinerina virgerinaformis																										
Gaudryina subglabrata			C																							
Gavelinopsis garveyensis																										
Globocassidulina monicana																										
Globocassidulina neamargareta	F	R		VR	F		F	R			C	F				VR	R	R	R	C	VR		F	F	R	C
Guttulina sp.																										
Gyroidina healdi																										
Gyroidina rosaformis s.l.				R		F									A	VR									VR?	
Hansenisca multicamerata																										
Hansenisca rotundimargo																										
Hanzawaia depaoloi													R	R		VR							VR	VR		
Haplophragmoides? sp. D	R	R	C																							
Holmanella baggi							R										R	F	VR?					R		
Holmanella valmonteensis																										
Hopkinsina magnifica																										
Islandiella californica																										
Islandiella carinata																										
Islandiella modeloensis								VR		VR			VR	VR				R								
Kleinpella californiensis	C	C	C	R	R	A	R		F	R	R	VR	R	F		C		A	A	F				R	VR	A
Lagena apiopleura																										
Lenticulina atascaderoensis						VR	R	VR										R				R				

TABLE 7. Species checklist for the Naples Beach section. (2 of 8)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

NAPLES BEACH SECTION	RELIZIAN					LUISIAN																	
BENTHICS CRC39842-	105	106	107	108	89-3	77	76	75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Ambitropus evax																										
Ammodiscus incertus										VR	VR	VR												VR		
Anomalinoides salinasensis							R	F	F	C	C	A	A	C		A	A	A	F	A	C	C	A	C	C	C
Astacolus crepidulus																										
Astacolus naplesensis																										
Astacolus sp. E																										
Astacolus sp. G												VR														
Astacolus sp. I											VR															
Astrononion goudkoffi																										
Baggina californica					C						VR	C	F	C		R	F	R	F	R	C	F	F	R	C	F
Bolivina advena	A	A		A	C	A	C	C				A	A	A		C	A	A	A	R	R	F	F	F	C	A
Bolivina advena ornata						A	A	A	A	A	A	C	A			A	A	A	A	A	R	VR	VR		VR	
Bolivina benedictensis																										
Bolivina blakei	A	A	A	A																						
Bolivina brevior s.l.	C		F	C			A		A	C	A	A	A	A		VR	A	A		F					F	
Bolivina californica	R	C	C	F			R	C	VR	R	A	A	C	F		A	R	F	F	R	A	F	F	R	R	F
Bolivina churchi		R												R		VR				VR			VR	R	R	F
Bolivina conica								F			F	R	R			R	F	R								
Bolivina cuneiformis																										
Bolivina foraminata																										
Bolivina girardensis																										
Bolivina granti																										
Bolivina hughesi																										
Bolivina imbricata										VR		F	R							VR						
Bolivina isaacsi	VR																									
Bolivina modeloensis																										
Bolivina mulleri								R	VR		VR															
Bolivina predecussata																										
Bolivina pseudospissa		A	A	A							VR		R			F	F		R	VR	R	VR	R	R		
Bolivina salinasensis s.l.																					A	A	A	A		
Bolivina spissa																										
Bolivina tongi filacostata																										
Bolivina tumida s.l.			A	F				R			R									VR		R		VR	C	C
Bolivina tumida "seminuda"						VR			C																	
Bolivina wissleri																										
Bolivina woodringi																										
Bolivina sp. A																		VR								
Bolivina sp. J																										
Bolivina sp. O																										
Bolivina sp. R											R			R		VR				VR	VR					R
Buccella oregonensis																										
Bulimina alligata																										
Bulimina inflata																										
Bulimina subacuminata																									R	
Bulimina subcalva																										
Buliminella curta																						F				
Buliminella elegantissima	VR			VR														R								
Buliminella semihispida																										
Buliminella subfusiformis	A	A	A	A	R	F	F	F	A	A	C	C	C	C		A	A	A	C	A	C	R	F	F	R	F
Cancris baggi			VR			VR		VR			F	R	R				VR	VR		VR						
Cancris planus																										
Cassidulinella renulinaformis																										
Cibicides pumilus						R	VR		R				R			R		VR		VR						
Cibicides sp. D																										
Cibicidoides cushmani																										
Dentalina cf. D. baggi										VR	VR	VR	R			F				VR						
Dentalina grandis																							R		F	R
Dentalina pseudoobliqua											R	F	F	R		F	R	VR	VR	R	F	R	C	F	VR	VR
Dentalina sp. A																										
Dentalina sp. D																										
Dentalina sp. E																										
Enantiodentalina murali																										
Epistominella discorbisoides																										
Epistominella smithi																										
Fissurina nellandi																	R									
Fissurina sp. C													VR													
Fissurina sp. E																										
Fissurina sp. M											VR															
Frondicularia sp. B																										
Fursenkoina subplana																										
Fursenkoina sp. A																										
Gallitherina uvigerinaformis																										
Gaudryina subglabrata																										
Gavelinopsis garveyensis																										
Globocassidulina monicana						F	F		F	F	A	F	A	R		F	R	F	F	A	VR	VR	VR	VR	VR	VR?
Globocassidulina neomargareta	R	F	C	R																						
Guttulina sp.											VR													VR		
Gyroidina healdi																										
Gyroidina rosaformis s.l.							R			F	A	F	A	A		A	A	A	C	A	A	F	C	A	F	C
Hansenisca multicamerata																				VR						
Hansenisca rotundimargo					VR	R	R	VR	F	F	VR	R	F	A			F	A		R		VR	R	R	VR	F
Hanzawaia depaoloi			VR?		VR	R	R		R	R				VR			R	VR		VR?		VR?		VR?		
Haplophragmoides? sp. D																										
Holmanella baggi						R	R	R		VR	R	R	F	F			F	C	R	F		R	VR			VR
Holmanella valmonteensis																										
Hopkinsina magnifica																										
Islandiella californica																										
Islandiella carinata					VR																					
Islandiella modeloensis					VR					R	C			A			C	VR			F	F	F	F	A	C
Kleinpella californiensis							VR	R	R		R						VR									VR
Lagena apiopleura												VR					VR									
Lenticulina atascaderoensis																										

TABLE 7. Species checklist for the Naples Beach section. (3 of 8)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

NAPLES BEACH SECTION	LUISIAN																	LOWER MOHNIAN						
BENTHICS CRC39842-	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	89-5	89-6	89-7	89-8	38	39	40
Ambitropus evax																									
Ammodiscus incertus											F														
Anomalinoides salinasensis	A	A	A	A	A	A	A	A	A	A	R?														
Astacolus crepidulus																									
Astacolus naplesensis																									
Astacolus sp. E			VR?																						
Astacolus sp. G																									
Astacolus sp. I																									
Astrononion goudkoffi													VR												
Baggina californica	F	A	C	C	C	C	A	F	C	F		A		R	R				C	F		F			
Bolivina advena	A	A	A	A	A	A	A	A	C	A		A	F	F	F		F	A	C	F	R	A	A	A	
Bolivina advena ornata		C			VR				R		F						F								
Bolivina benedictensis																						VR			
Bolivina blakei											A														
Bolivina brevior s.l.		A					VR	F	R	F	A	F		R	R	F	R	VR					R		R
Bolivina californica	R	F	F	F	C	F	A	F	F	R			VR						A	A	A		R	R	
Bolivina churchi	R	R	A	F										F	A			VR				A			
Bolivina conica											C														
Bolivina cuneiformis																C	F								
Bolivina foraminata												C				R									
Bolivina girardensis																									
Bolivina granti																									
Bolivina hughesi																			VR?	VR?					
Bolivina imbricata																									
Bolivina isaacsi																									
Bolivina modeloensis														VR	VR?				R	R					
Bolivina multeri																									
Bolivina predecussata																									
Bolivina pseudospisse				R	F	VR		C	A	A		F	R	VR	R		F						A	A	A
Bolivina salinasensis s.l.	C			VR	R		F	C				C	R		R	A							R		
Bolivina spisse																									
Bolivina tongi fitacostata							VR	C	C	A	VR												R	F	
Bolivina tumida s.l.			A		R	R		A			R		R	R	VR									F	
Bolivina tumida "seminuda"																									
Bolivina wissleri																									
Bolivina woodringi																									
Bolivina sp. A																									
Bolivina sp. J																									
Bolivina sp. Q																									
Bolivina sp. R										VR	VR														
Buccella oregonensis					VR						VR														
Bulimina alligata																									
Bulimina inflata																			VR						
Bulimina subacuminata							R																		
Bulimina subcalva																									
Buliminella curta																							A	A	R
Buliminella elegantissima																									
Buliminella semihispida																									
Buliminella subfusiformis	F	F	C	F	F	F	A	A	F	C	F	A	F	R	F	A	F	A	C	F	F	C			
Cancris baggi				R																					
Cancris planus																		R							
Cassidulinella renulinaformis																									
Cibicides pumilus																VR									
Cibicides sp. D	VR																								
Cibicidoides cushmani																									
Dentalina cf. D. baggi								F																	
Dentalina grandis	F		VR	VR	R		VR	F	R	VR															
Dentalina pseudoobliqua	C				F	F	F	F	F	C															
Dentalina sp. A																									
Dentalina sp. D	VR																								
Dentalina sp. E																									
Enantiodentalina murali																									
Epistominella discorbisoides																									
Epistominella smithi												R	VR						R	F	R	VR			
Fissurina natlendi																									
Fissurina sp. C																									
Fissurina sp. E																						VR			
Fissurina sp. M																									
Frondicularia sp. B																									
Fursenkoina subplana								VR																	
Fursenkoina sp. A																									
Gallitherina uvigerinaformis																							A	A	A
Gaudryina subglabrata																									
Gavelinopsis garveyensis												R						VR							
Globocassidulina monicana		A											R	F	R	F	R	F				C			R
Globocassidulina neomargareta																									
Guttulina sp.																									
Gyroidina healdi																		R	F	R		F			
Gyroidina rosaformis s.l.	A	A	A	C	A	A	A	R	A	A	F		F						C	VR	A	C	VR	A	F
Hansenisca multicamerata													VR?	VR											
Hansenisca rotundimargo	F	F	R	F	C	F		F	F	A	R	C				R		R							
Hanzawaia depaoli						VR										R			VR		F			F	
Haplophragmoides? sp. D																									
Holmanella baggi		VR	R	F	F		VR	R		F	R								VR						
Holmanella valmonteensis																									
Hopkinsina magnifica																							VR		
Islandiella californica																									
Islandiella carinata																									
Islandiella modeloensis	C	C	C	A			A	A	A		F	F	VR	VR					F	F	F				
Kleinpella californiensis											F	R	VR	VR								C		R	
Lagena apiopleura																			VR						
Lenticulina atascaderoensis																									

TABLE 7. Species checklist for the Naples Beach section. (4 of 8)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

NAPLES BEACH SECTION	LOWER MOHNIAN					UPPER MOHNIAN																								
BENTHICS CRC39842-	41	42	43	44	45	46	47	49	50	51	52	53	54	55	56	57	58	59	60	62	63	64	65	66	68	69	70	71	72	73	74
Ambitropus evax		R	R	R			VR	R	VR?	R			C	R																	
Ammodiscus incertus																															
Anomalinoides salinasensis																															
Astacolus crepidulus																															
Astacolus naplesensis																															
Astacolus sp. E																															
Astacolus sp. G																															
Astacolus sp. I																															
Astrononion goudkoffi							VR										VR				VR			VR						C	
Baggina californica																															
Bolivina advena																															
Bolivina advena ornata																															
Bolivina benedictensis	R?																				R										
Bolivina blakei																															
Bolivina brevior s.l.	F	R	R	F	C	A	A	F	A	C	C	A	C	A	A	F	C	C	F	C	F		A	C	A	A	A	F	F	C	A
Bolivina californica	C	R	VR	VR		F		F		R	F				F	VR															
Bolivina churchi							F																								
Bolivina conica																															
Bolivina cuneiformis																															
Bolivina foraminata										VR												R	F	F	F	R?	VR		C	
Bolivina girardensis		R		F	C	F	C	F		C	A	R	A	A	C	A	C	VR				R	C	F	F	R	A			F	R
Bolivina granti	F	A	F			VR				R			R	F	C	A	R	VR	VR												
Bolivina hughesi				A	C			A		F	F	F	C	VR	R	A		R	R	F		F			F	A	F			C	
Bolivina imbricata																															
Bolivina isaacsi																															
Bolivina modeloensis	F	VR?			VR			VR		R			R	R	R	R				R	VR?			F			VR				VR?
Bolivina mulleri																															
Bolivina predecussata																	VR			VR	A			F			R				
Bolivina pseudospissa	A	C		A	A	A	A	A	A	A	A	A	A	A	A	A	F	F		A	C	A	F	A	A	A	A	F	A	A	A
Bolivina salinasensis s.l.				F							VR		VR																		
Bolivina spissa																															
Bolivina tongi filacostata																	VR						VR			VR	R				
Bolivina tumida s.l.	C				R						VR																		R		
Bolivina tumida "seminuda"																															
Bolivina wissleri	VR																														
Bolivina woodringi											R		A		F	F	VR		R			R	R?				VR			VR	
Bolivina sp. A																															
Bolivina sp. J											R																				
Bolivina sp. Q									R	R																					
Bolivina sp. R																															
Buccella oregonensis																															
Bulimina alligata																															
Bulimina inflata				VR						R						R															
Bulimina subacuminata																															
Bulimina subcalva							VR																								
Buliminella curta	F	R	R	C	R	A	R		R	F	VR		VR																		
Buliminella elegantissima																								VR							
Buliminella semihispida															R	C								R							
Buliminella subfusiformis	R			F	R		R		VR?	VR	F	VR	F		R	F	R		F	F			R	R	F	R	C		VR		
Cancris baggi																															
Cancris planus																															
Cassidulinella renulinaformis											VR								R												
Cibicides pumilus																															
Cibicides sp. D																															
Cibicidoides cushmani																															
Dentalina cf. D. baggi								R		VR																					
Dentalina grandis		VR																													
Dentalina pseudoobliqua						R																									
Dentalina sp. A																															
Dentalina sp. D																															
Dentalina sp. E								R																							
Enantiodentalina murali																															
Epistominella discorbisoides						VR																									
Epistominella smithi																						R					F				
Fissurina nattandi																															
Fissurina sp. C																															
Fissurina sp. E																															
Fissurina sp. M																															
Frondicularia sp. B																VR															
Fursenkoina subplana																															
Fursenkoina sp. A							R																								
Galitherina uvigerinaformis	A	VR		VR	R																										
Gaudryina subglabrata																															
Gavelinopsis garveyensis																								VR?			C		VR		
Globocassidulina monicana	VR	VR			A	F	R	F	C	A	R	VR	R		R	A				VR	F	VR	R	R		F	F		VR	F	
Globocassidulina neomargareta																															
Guttulina sp.																															
Gyroidina heaidi																											R		R	A	R
Gyroidina rosalormis s.l.	A	F		A	F	F	F	R	R	R	A	F	C	F		VR			C	C	F?			R	R						
Hansenisca multicamerata													F			VR															
Hansenisca rotundimargo											R								R	F				VR					F		
Hanzawaia depaoloi																															
Haplophragmoides? sp. D																															
Holmanella baggi																															
Holmanella valmonteensis					C	A?	F?	R?	A	R	F	VR?	F	R		VR?	R		A		A			R			VR		R?		
Hopkinsina magnifica								A											A							C				
Islandiella californica							R?																								
Islandiella carinata																															
Islandiella modeloensis		VR?	F	A	A									F		F															
Kleinpella californiensis				VR		VR		VR?	R	C	A	VR	R	R	F	R		VR	C	F	R					R					
Lagena apiopleura																															
Lenticulina atascaderoensis																															

TABLE 7. Species checklist for the Naples Beach section. (5 of 8)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

NAPLES BEACH SECTION	SAUCESIAN																			RELIZIAN					
BENTHICS CRC39842-	78	79	80	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
Lenticulina douglasi																										
Lenticulina dubia																									VR	
Lenticulina cf. L. gerlandi																										
Lenticulina miocenica																										
Lenticulina reedi																					R	C	F		F	
Lenticulina smileyi	A	A	A	F	F	A	F	F	R			F		R	R	F	F	F	F	F				R	F	
Lenticulina sp. A																										
Lenticulina sp. B																								R		
Lenticulina sp. F																										
Marginulina crouchi																										
Marginulina sp.																										
Marginulinopsis beali																										R?
Megastomella capitanensis																										
Megastomella purisima																										
Neoeponides navarrettei																										
Nodogenerina bradyi																										
Nodogenerina parexilis							VR								R	VR										
Nodogenerina sagrinensis																						R			R	
Nodosaria ewaldi							VR																			
Nodosaria irregularis																										
Nodosaria perversa							R									R										
Nonionella miocenica																							R			C
Nonionellina milleri																										
Oolina cf. O. borealis																										
Oolina hexagona																										
Ondorsalis relizana																					VR	R	VR		R	
Paracassidulina delicata																										
Parafissurina sp. A																										
Paratrondicularia miocenica	C		F		F		R								R	F	R	R			R	R	R	R	R	
Praeglobobulimina galiheri																										
Protoglobobulimina pseudotorta			VR																		R				VR	
Proxitrons advena												R														
Pseudononion basispinatum																					R	VR	F		R	
Pseudononion costiferum			C			VR						R						VR		VR	R	F		VR	F	
Pseudononion multicameratum																										
Pseudoparrella californica																										
Pseudoparrella subperuviana	A	A			F		F	F				C	VR	VR	F		C	R	F	F	A		F	C	A	
Pullenia inglei																										
Pullenia malkinae														VR												
Pullenia miocenica																										
Rectuvigerina branneri														VR	C	F		R						VR		
Rectuvigerina transversa	R	A	A	A	R	A	C	A	A	R	R	A														
Rutherfordoides californiensis		R																								
Saracenaria schencki	R		VR																							
Siphonodosaria advena		R	R	F	A	F	C	F	R		R	F		R	F	A	F	C	R	F				C	R	
Siphonodosaria monterеyana																										
Siphonodosaria quadrulata																										
Sphaeroidina chilostomata																										
Suggrunda inflata												R				VR	VR									
Suggrunda kleinpelli	F	VR	A			C	F	R				F	VR	VR	F	C	F	C	A	C	F		VR	F	F	F
Uvigerina hannai														R	F											
Uvigerina hootsi																										
Uvigerina hootsi var.																										
Uvigerina segundoensis																										
Uvigerina senticosa																										
Uvigerina subperegrina																						C		C	C	
Uvigerina subperegrina f. impolita	A	C	R		A		C					A				A	A	C	A	A	C					
Uvigerina sp. C																										
Uvigerina sp. D																										
Uvigerinella californica				C		A	R					R?									C	F	R	R		
Uvigerinella californica ornata																										
Valvulineria californica	VR																									
Valvulineria malagaensis																										
Valvulineria miocenica				A	A	A	A	A	A					A	C	A	A	A	A	A	A	C	A	A	A	A
Valvulineria miocenica ornata										VR	A															
Valvulineria cf. V. miocenica ornata						C		VR				A														
Valvulineria robusta				R												VR								VR		
Valvulineria subinequalis																									F	
PLANKTICS CRC39842-	78	79	80	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
Globigerina bulloides	C	VR		A	C	C	A	R	F		F	R	A	A		A	A	A	A	C	F	C	C	A	A	C
Globigerina praebulloides			F	R			F			F			A													
Globigerina pseudociperoensis	A	R	R	C	F	F	F		A	A	F		F	R		A	A	A	R	R		VR	F	F	F	R
Globigerinella aequilateralis																										
Globigerinella obesa	F		R		VR	VR	R						R				VR	F				VR			R	C
Globigerinita glutinata																										
Globigerinita uvula																					VR					
Globigerinoides immaturus				F			VR?		R?	R																
Globigerinoides quadrilobatus																										
Globoquadrina baroemoensis																										
Globoquadrina venezuelana							R																			
Globorotalia mayeri																										
Globorotalia praescitula																	VR			VR						
Globorotalia cf. Glr. praescitula																										
Globorotaloides suteri relizensis						VR		VR?														VR				
Globorotaloides aff. G. suteri relizensis																										
Globorotaloides trema																										
Neogloboquadrina continuosa						R			VR	R																
Praeorbulina glomerosa circularis																										
Praeorbulina transitoria																										
Tenuitellinata angustiumbilicata	A	C	R	A	A	A	A	A	A	C	A	C	A	A	C	A	A	A	A	A	A	R	A	A	A	A
Prunopyle titan (radiolarian)																										

TABLE 7. Species checklist for the Naples Beach section. (6 of 8)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

NAPLES BEACH SECTION	RELIZIAN					LUISIAN																		
BENTHICS CRC39842-	105	106	107	108	89-3	77	76	75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Lenticulina douglasi																										
Lenticulina dubia											F			VR		VR	R				VR	VR	R	VR		VR
Lenticulina cf. L. gerlandi																										
Lenticulina miocenica																										
Lenticulina reedi			R					VR								R				VR						
Lenticulina smileyi	VR	VR		F		VR			R	R		VR	VR					VR	VR	VR?		VR		VR	VR	VR
Lenticulina sp. A													VR													
Lenticulina sp. B		F	F																							
Lenticulina sp. F																										
Marginulina crouchi																VR	R									
Marginulina sp.																									VR	
Marginulinopsis beali								VR		VR	F	R										VR	VR		R	VR
Megastomella capitanensis																		VR								
Megastomella purisima								VR																		
Neoeponides navarrettei											VR															
Nodogenerina bradyi																										
Nodogenerina parexilis								VR																		
Nodogenerina sagrinensis				VR																					VR	
Nodosaria ewaldi																									VR	
Nodosaria irregularis																										
Nodosaria perversa																										
Nonionella miocenica					VR																					
Nonionellina milleri						VR	VR	R																		
Oolina cf. O. borealis									VR																	
Oolina hexagona							VR																			
Oridorsalis reliana		VR																								
Paracassidulina delicata																										
Parafissurina sp. A									VR																	
Parafrondicularia miocenica	R	F	F	F																						
Praeglobobulimina gallineri																					R					
Protoglobobulimina pseudotorta		VR									F						A	A	VR	F						
Proxifrons advena																										
Pseudononion basispinatum	VR		R	F																						
Pseudononion costiferum		R		F																						VR
Pseudononion multicameratum																						VR				
Pseudoparrella californica																										
Pseudoparrella subperuviana	F		A	A	VR	A	F	R	F	C	C	C	C	A		C	A	C		VR	VR	F	F	R	R	F
Pullenia inglei																										
Pullenia malkinae																									VR	VR
Pullenia miocenica						F	F	C	C	A	A	A	A	A		C	A	A	A	A	C	A	A	C	A	A
Rectuvigerina branneri				VR		R	R	C	R	C	F	F	R	C	F		A	F	C	A	A	C	C	F	F	A
Rectuvigerina transversa		R																								
Rutherfordoides californiensis																										
Saracenaria schencki																										
Siphonodosaria advena		R			F									C						VR	R	VR?	VR	VR		F
Siphonodosaria montereyana																		VR					VR		VR	
Siphonodosaria quadrulata																							VR		VR	
Sphaeroidina chilostomata																									VR	
Suggrunda inflata			VR																							
Suggrunda kleinpelli	R		A	R																					VR	
Uvigerina hannai																	VR									
Uvigerina hootsi																										
Uvigerina hootsi var.																										
Uvigerina segundoensis																										
Uvigerina senticosa																										
Uvigerina subperegrina	R	A	VR	R						R	R	F	VR				R		VR						VR	
Uvigerina subperegrina f. impolita																										
Uvigerina sp. C																										
Uvigerina sp. D		VR																								
Uvigerinella californica	C	C	C	C								F	F												VR	
Uvigerinella californica ornata						F	F	R			VR	R	R				R			VR			R			
Valvulineria californica					VR	F	C	A	A	A	A	A	A	A		C	A	A	C	C	C	A	A	A	C	A
Valvulineria malagaensis													R													
Valvulineria miocenica	A	A	A	A		R			R		VR	VR				VR	VR									
Valvulineria miocenica ornata									VR	R			F	R								R				
Valvulineria cf. V. miocenica ornata																										
Valvulineria robusta		R			F		R	C		R	F		R			R	R	F								
Valvulineria subinequalis																										
PLANKTICS CRC39842-	105	106	107	108	89-3	77	76	75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Globigerina bulloides	A	A	A	A	A	A	A	A	A	A	C	A	A	F		R	A	A	VR	C	A	VR	R	C	C	A
Globigerina praebulloides					F							VR	R				R							R		
Globigerina pseudociperoensis	C	F	R	C	A	A	A	A	C	F		R	A	R			C	C		R	F			R	C	F
Globigerinella aequilateralis	VR																									
Globigerinella obesa	F				F		VR										R				A			R		VR
Globigerinita glutinata									R									R		R				R		
Globigerinita uvula										VR			R	VR										VR		VR
Globigerinoides immaturus																				R	R			VR		
Globigerinoides quadrilobatus												VR	F	VR			VR									
Globoquadrina baroemoensis																	VR									
Globoquadrina venezuelana																										
Globorotalia mayeri									F			VR	F													
Globorotalia praescitula						F	R	VR						VR			F			F						VR
Globorotalia cf. Glr. praescitula																				R						
Globorotaloides suteri relizensis		VR			R																					
Globorotaloides aff. G. suteri relizensis					R																					
Globorotaloides trema																								VR	VR	VR
Neogloboquadrina continuosa					R																					
Praeorbulina glomerosa circularis																				R	C					
Praeorbulina transitoria																				VR	R					
Tenuitellinata angustiumbilicata	A	A	A	A	A	A	A	A	A	A	A	A	A	A		A	A	A	VR	A		F	R	F	F	A
Prunopyle titan (radiolarian)																										

TABLE 7. Species checklist for the Naples Beach section. (7 of 8)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

NAPLES BEACH SECTION	L U I S I A N																	L O W E R M O H N I A N						
BENTHICS CRC39842-	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	89-5	89-6	89-7	89-8	38	39	40
Lenticulina douglasi																									
Lenticulina dubia		VR	VR		R	F		R	R																
Lenticulina cf. L. gerlandi																									
Lenticulina miocenica					R			VR																	
Lenticulina reedi																			VR	R	VR			R	
Lenticulina smileyi	R	F	R	R		F	R		R														VR		
Lenticulina sp. A																									
Lenticulina sp. B																									
Lenticulina sp. F																									
Marginulina crouchi																									
Marginulina sp.																									
Marginulinopsis beali		F	VR	R		F	VR	R	F	R															
Megastomella capitanensis																	VR	F				C			
Megastomella purisima											F														
Neoeponides navarrettei																									
Nodogenerina bradyi																									
Nodogenerina paresilis																		VR	C						
Nodogenerina sagrinensis		R			VR	VR				VR		R													
Nodosaria ewaldi							R						R	R					R	VR		R			
Nodosaria irregularis																									
Nodosaria perversa																									
Nonionella miocenica																									
Nonionellina milleri																									
Oolina cf. O. borealis																									
Oolina hexagona																									
Oridorsalis reliana																									
Paracassidulina delicata																								F	VR
Parafissurina sp. A																									
Parafrondicularia miocenica																									
Praeglobobulimina gallineri							R																		
Protoglobobulimina pseudoturta						VR																			
Proxifrons advena																									
Pseudononion basispinatum																									
Pseudononion costiferum																									
Pseudononion multicameratum																									
Pseudoparrella californica																									
Pseudoparrella subperuviana	C	A	A	C	F	F	F	A	F	F	C	F		VR		F	VR		R	R			R	C	A
Pullenia inglei																								VR	
Pullenia malkinae						VR													VR			R			
Pullenia miocenica	A	A	A	C	A	A	A	A	A	A															
Rectuvigerina branneri	C	A	A	A	A	A	A																		
Rectuvigerina transversa																									
Rutherfordoides californiensis							VR																		
Saracenaria schenoki																									
Siphonodosaria advena	VR	R	VR		R		F	R				A					R	R	F		F	F	VR	R	
Siphonodosaria monterеyana								R								R		R	F				R		
Siphonodosaria quadrulata		F				VR							R					R	F		R	F	C	R	
Sphaeroidina chilostomata						R	VR	C		VR	R	A	VR	R		VR	VR	R	A	C	A				
Suggrunda inflata																									
Suggrunda kleinpelli														VR											
Uvigerina hannai																							R		
Uvigerina hootsi																			F	C	F	C		VR	
Uvigerina hootsi var.																									
Uvigerina segundoensis				VR																					
Uvigerina senticosa																									
Uvigerina subperegrina					R									R					R	F		A	A	C	
Uvigerina subperegrina f. impolita																									
Uvigerina sp. C																									
Uvigerina sp. D																									
Uvigerinella californica				R				C	A	F						A	A	C			R				
Uvigerinella californica ornata			VR		R	F	R	C		F	F	A	F	A	A	C	C	A	R	F		VR			
Valvulineria californica	A	A	A	A	C	A	A	C	A	A													C	R	
Valvulineria malagaensis																									
Valvulineria miocenica												C	F	F	C	C	F	A							
Valvulineria miocenica ornata				VR	R																				
Valvulineria cf. V. miocenica ornata																									
Valvulineria robusta							F	R		VR	C								F	R		R			
Valvulineria subinequalis						VR																			
PLANKTICS CRC39842-	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	89-5	89-6	89-7	89-8	38	39	40
Globigerina bulloides	R	R	A	A					R		R	A	VR							VR					
Globigerina praebulloides																									
Globigerina pseudociperoensis			A	F			A																		
Globigerinella aequilateralis																									
Globigerinella obesa		F										VR													
Globigerinita glutinata																									
Globigerinita uvula																									
Globigerinoides immaturus																									
Globigerinoides quadrilobatus																									
Globoquadrina baroemoensis																									
Globoquadrina venezuelana		VR																							
Globorotalia mayeri																									
Globorotalia praescitula	R			R			VR																		
Globorotalia cf. Glr. praescitula																									
Globorotaloides suteri relizensis																									
Globorotaloides aff. G. suteri relizensis																									
Globorotaloides trema	R	R								F															
Neogloboquadrina continuosa																									
Praeorbulina glomerosa circularis			VR																						
Praeorbulina transitoria																									
Tenuitellinata angustiumbilicata	A	A	A	A	F	R	C	R	R	F	C	A	C		R			R				C			
Prunopyle titan (radiolarian)																									

TABLE 7. Species checklist for the Naples Beach section. (8 of 8)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

NAPLES BEACH SECTION	LOWER MOHNIAN					UPPER MOHNIAN																							
BENTHICS CRC39842-	41	42	43	44	45	46	47	49	50	51	52	53	54	55	56	57	58	59	60	62	63	64	65	66	68	69	70	71	72	73	74
Lenticulina douglasi																VR											R				
Lenticulina dubia																										VR?					
Lenticulina cf. L. gerlandi											F					VR														
Lenticulina miocenica																															
Lenticulina reedi								R		VR																					
Lenticulina smileyi																															
Lenticulina sp. A																															
Lenticulina sp. B																															
Lenticulina sp. F	VR?						VR			R											VR		F		R				R	
Marginulina crouchi																															
Marginulina sp.																															
Marginulinopsis beali																															
Megastomella capitanensis																															
Megastomella purisima																															
Neoeponides navarrettei																															
Nodogenerina bradyi																														R	
Nodogenerina parexilis																															
Nodogenerina sagrinensis																															
Nodosaria ewaldi				R			R	R		F	R		R		VR				R	VR		R	F	R		VR	R				
Nodosaria irregularis				F	VR								VR		VR		VR						R								
Nodosaria perversa																															
Nonionella miocenica																															
Nonionellina milleri																															
Ootina cf. O. borealis																															
Ootina hexagona																															
Oridorsalis relizana																															
Paracassidulina delicata	F	R				C					R		R			F	VR							R		R	R		R		
Parafissurina sp. A																															
Parafrondicularia miocenica																															
Praeglobobulimina galliheri				VR																											
Protoglobobulimina pseudotorta				VR		VR		A	F	F	R		F	VR	R	F			C	R		VR	R	R	R	R	F			R	
Proxifrons advena																															
Pseudononion basispinatum																															
Pseudononion costiferum																															
Pseudononion multicameratum																															
Pseudoparrella californica		F		A	A	A	A	C	F		F	F	F		VR	F		F										R			
Pseudoparrella subperuviana	C									A	C	R	C	F	F	A	R	A	F	A	R		A	A	A	F	F		C	F	
Pullenia inglei	VR					F														VR											
Pullenia malkinae																			VR?												
Pullenia miocenica																															
Rectuvigerina branneri																															
Rectuvigerina transversa																															
Rutherfordoides californiensis																															
Saracenaria schencki																															
Siphonodosaria advena																VR			VR	VR	VR								R		
Siphonodosaria montereyana																															
Siphonodosaria quadrulata																															
Sphaeroidina chilostomata			VR																							VR					
Suggrunda inflata																															
Suggrunda kleinpelli																															
Uvigerina hannai				F		F	A																								
Uvigerina hootsi						F	C		R	F	F	F	A		A	F															
Uvigerina hootsi var.														C																	R
Uvigerina segundoensis																															
Uvigerina senticosa										VR						VR													VR		
Uvigerina subperegrina	F?	F	F	A	A	F	A			A	R		VR		A	A			A	A	R	A	A	A	A	A	A		A	A	R
Uvigerina subperegrina f. impolita																															
Uvigerina sp. C					VR																										
Uvigerina sp. D					VR																										
Uvigerinella californica																															
Uvigerinella californica ornata							VR																								
Valvulineria californica				VR																											
Valvulineria malagaensis				VR							R																				
Valvulineria miocenica																															
Valvulineria miocenica ornata																															
Valvulineria cf. V. miocenica ornata																															
Valvulineria robusta	F			VR?						VR			R			R		VR		R		F		R		VR					
Valvulineria subinequalis						R		F											A												
PLANKTICS CRC39842-	41	42	43	44	45	46	47	49	50	51	52	53	54	55	56	57	58	59	60	62	63	64	65	66	68	69	70	71	72	73	74
Globigerina bulloides																															
Globigerina praebulloides																															
Globigerina pseudociperoensis																															
Globigerinella aequilateralis																															
Globigerinella obesa																															
Globigerinita glutinata																															
Globigerinita uvula																															
Globigerinoides immaturus																															
Globigerinoides quadrilobatus																															
Globoquadrina baroemoensis																															
Globoquadrina venezuelana																															
Globorotalia mayeri																															
Globorotalia praescitula																															
Globorotalia cf. Glr. praescitula																															
Globorotaloides suteri reilzensis																															
Globorotaloides aff. G. suteri reilzensis																															
Globorotaloides trema																															
Neogloboquadrina continuosa																															
Praeorbulina glomerosa circularis																															
Praeorbulina transitoria																															
Tenuitellinata angustiumbilicata																															
Prunopyle titan (radiolarian)																														X	

San Clemente Island (SC) Sections

Los Angeles Basin

Stratigraphy Studied

Middle part of Monterey Formation
Luisian and Mohnian Stages

Importance

- Among the southernmost exposures of the Monterey Formation.

References

Microfossils: Not previously documented; some age data in Vedder and Moore (1976).
Geology: Olmsted (1958), Mitchell and Lipps (1965), Vedder and Howell (1976), Vedder and Moore (1976).

Sample Collections

SCI-L76-1 to -53: Collected by J. H. Lipps and T. E. DeLaca in 1976 (Figs. 23-27; not all samples available); 22 good foraminiferal assemblages recovered (Table 8).
UCLA-6317: Sample of Susuki and Stadum (1978) provided by T. Susuki; good foraminiferal assemblage recovered (Table 8).
Although analyzed during the course of this study, the San Clemente Island collections made by Lipps in 1962 and 1963 are excluded from this report because of poor specimen recovery and preservation.

Comments

Exact stratigraphic positions of most samples are uncertain due to the discontinuous exposures and topographic relief of sections.

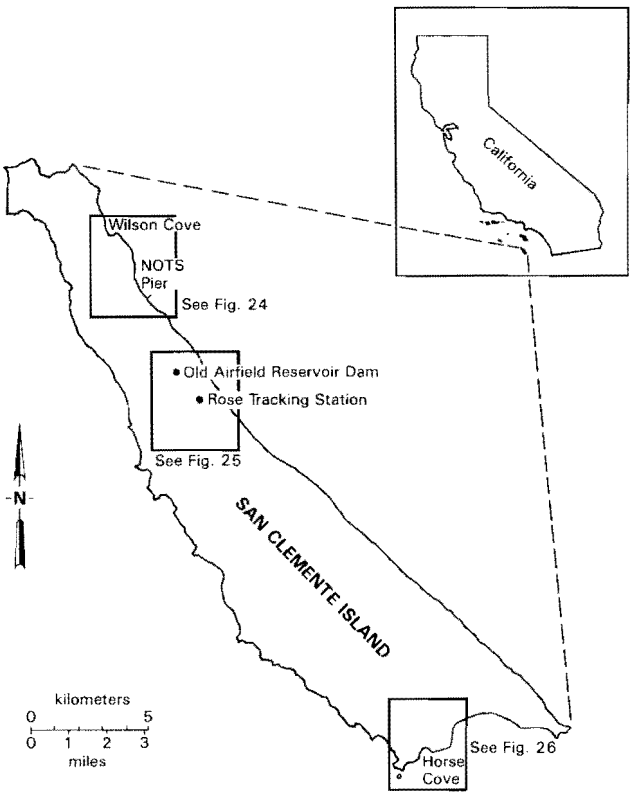

FIGURE 23. Locations of collection areas on San Clemente Island, Los Angeles County.

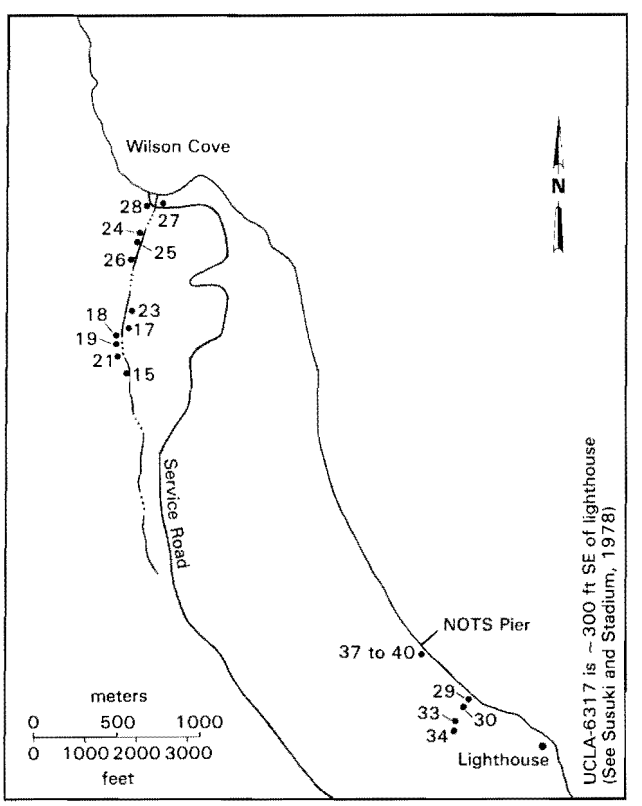

FIGURE 24. Sample locality map of the Wilson Cove and NOTS Pier sections, San Clemente Island.

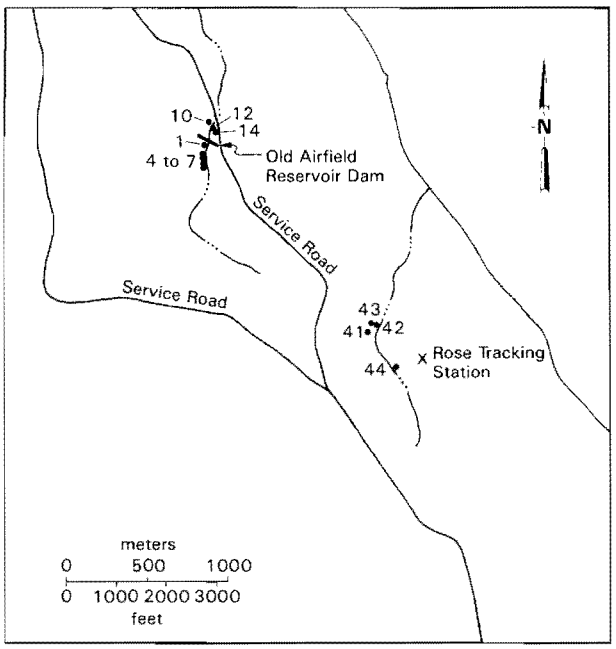

FIGURE 25. Sample locality map of the Old Airfield Reservoir Dam and Rose Tracking Station sections, San Clemente Island.

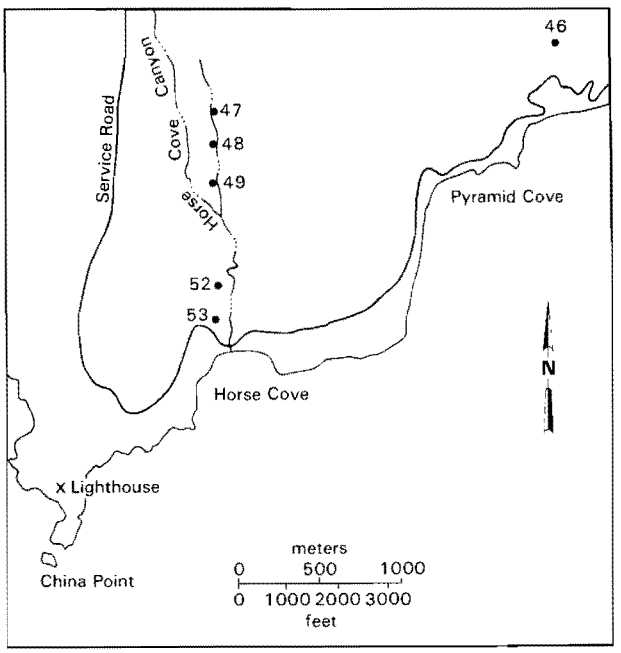

FIGURE 26. Sample locality map of the Horse Cove Canyon section, San Clemente Island.

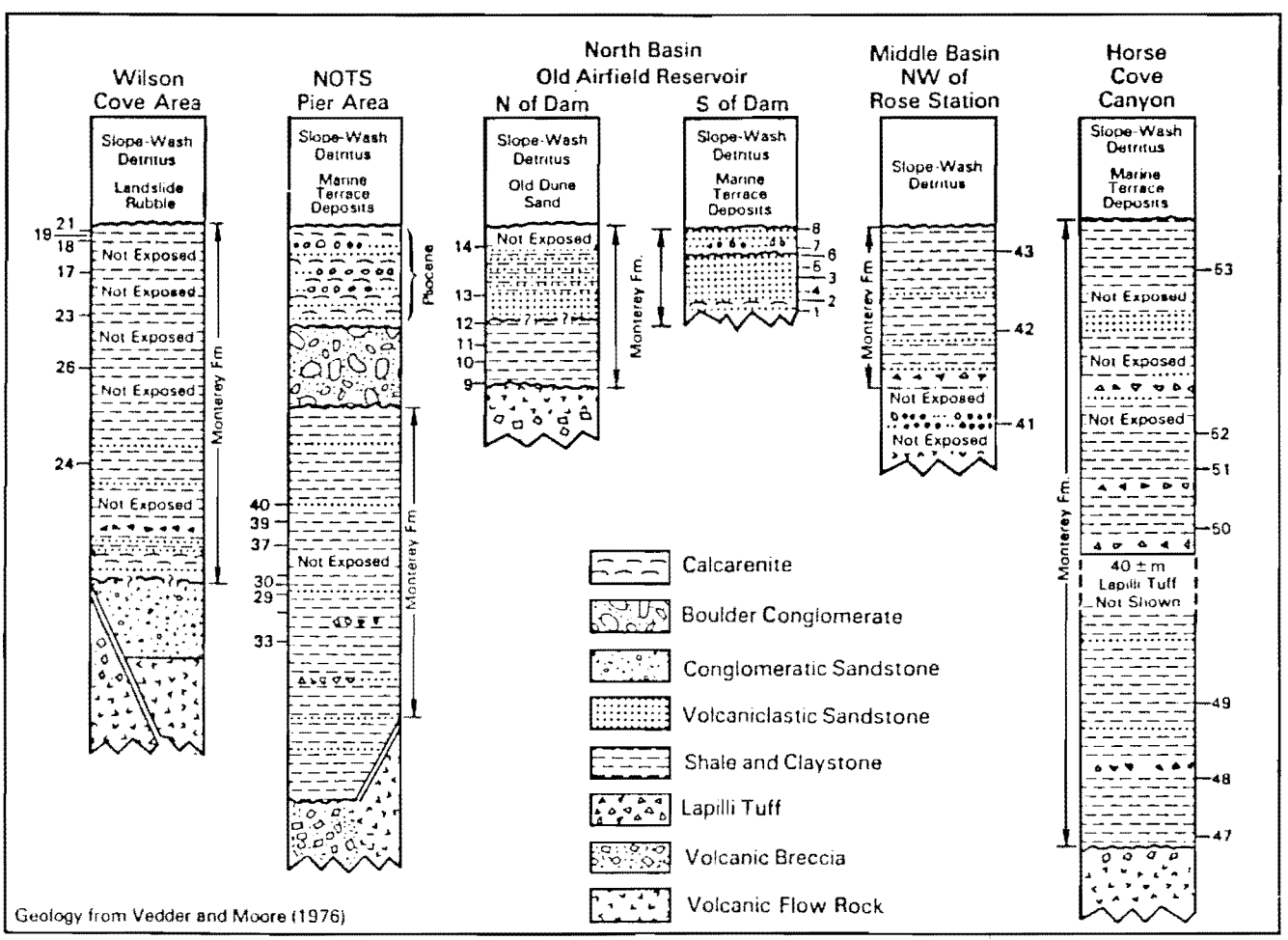

FIGURE 27. Stratigraphic columns of the five San Clemente Island sections denoting positions of collected samples.

TABLE 8. Species checklist for the San Clemente Island sections. (1 of 2)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

SAN CLEMENTE ISLAND	NORTH BASIN				WILSON COVE						NOTS PIER						NOTS PIER	MID BASIN	
BENTHIC FORAM AGE:	LUISIAN				LUISIAN						LUISIAN						LUISIAN	MOHNIAN	
BENTHICS L76 SAMPLES:	10	12	5	7	26	23	17	18	19	21	37	39	40	33	30	29	UCLA-6317	42	43
Ambitropus evax										VR									
Amphimorphina amchitkaensis														R		F			
Anomalinoides salinasensis					A	A	A	A	A	A	A	A	A	A	A	A			
Astacolus crepidulus																VR			
Astacolus sp. D														R					F
Baggina californica	F	F	R	C	A	A	C	A	A	A	F	A	C	A	C	A	F	A	A
Bolivina advena						VR							C		A	A	A	R	A
Bolivina advena ornata	R		A		A	A	A	C	F	C	A	C	A	A	A	F	R		
Bolivina blakei												F		A					
Bolivina brevior s.l.							A	A	A	A	C		C	F	A	R			
Bolivina brevior dunlapi					C														
Bolivina californica	C		R		C	A	A	A	A	A	C	A	A	A	A	C	VR	C	A
Bolivina churchi						A	R		F					A		F			
Bolivina conica					C							A							
Bolivina granti									C										
Bolivina imbricata					C		A	A	A	A			R				C		
Bolivina modeloensis					F										VR				
Bolivina pseudospissa					F	F	F		VR		C	A							
Bolivina salinasensis							A		A										
Bolivina tumida s.l.					A		A	A	F	A	R	F		A	A	A	F	F	A
Bolivina woodringi																			R
Bolivina sp. K																	F		
Buccella oregonensis					VR	VR					VR		VR				C		
Bulimina inflata									VR					A	A	R			
Bulimina subacuminata							R							A					
Buliminella elegantissima						VR													
Buliminella subfusiformis					A	A	A	A	A	A	A	A	A	A	A	A	C	R	A
Cancris baggi					A	R					C	F	A	F			VR		
Cancris planus															R	R			
Cibicides cf. C. farctus																	R		
Cibicides pumilus													R			VR			
Cibicides sp. D																	C		
Cibicidina sp. A																VR	F		
Concavella gyroidinaformis																		A	A
Dentalina pseudoinvolvens																	R		
Dentalina pseudoobliqua		F			R	F		F	F	F			F	F	C	C			
Dentalina roemeri															R	VR			
Dentalina sp. B														VR					
Ehrenbergina alata															VR				
Elphidium granti					VR												A		
Epistominella smithi					VR														
Fissurina cf. F. laevigata labiata																	F		
Fissurina natlandi																	F		
Fissurina quasimarginata									VR								VR		
Fissurina sp. G																	R		
Fursenkoina subplana										VR									
Gallitellina uvigerinaformis																		A	A
Gaudryina sp.																	F		
Gavelinopsis holkos																	F		
Globocassidulina monicana					A			C	C		F	F	F				A	R	A
Gyroidina rosaformis s.l.					A	A	A	A	A	A	F	C	F	A	A	A			
Hansenisca rotundimargo					C		F	F	C	R	F	R	F	A	A	A			R
Hanzawaia depaoloi							VR	VR	VR		F	F			F	VR	A	R	A
Holmanella baggi					A		R	R	F	R	A	F	F	C	A	F			
Hopkinsina magnifica																			A
Hopkinsina sp. B																VR			
Islandiella modeloensis			F	F	A	A	VR			F	F	VR		A	A	A	F	F	R
Kleinpella californiensis							VR	R	R					R					
Lagena apiopleura														VR	VR		F	VR	
Lagena meridionalis																			VR
Lagena cf. L. pliocenica																	R	VR	
Lagena timmsana					VR												VR		
Lagena sp. D										VR				VR					
Lagena sp. E																VR			
Lenticulina barroni														VR					
Lenticulina cf. L. gerlandi						VR							VR	F	F	R			
Lenticulina miocenica					C		VR				C	F		C	C	C	VR?		
Lenticulina reedi											R								C
Lenticulina smileyi	C	F	R	C	F						A	F	R	A	A	A	R	VR	

TABLE 8. Species checklist for the San Clemente Island sections. (2 of 2)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

SAN CLEMENTE ISLAND	NORTH BASIN				WILSON COVE						NOTS PIER						NOTS PIER	MID BASIN	
BENTHIC FORAM AGE:	LUISIAN				LUISIAN						LUISIAN						LUISIAN	MOHNIAN	
BENTHICS L76 SAMPLES:	10	12	5	7	26	23	17	18	19	21	37	39	40	33	30	29	UCLA-6317	42	43
Lenticulina sp. A													VR						
Lenticulina sp. E																VR			
Lenticulina sp. G														F	F	R			
Loxostomoides digitata					A		A	F	A	C	F	R						F	A
Marginulina sp.					VR														
Marginulinopsis beali		F		R			VR		R					C	C	F			
Megastomella capitanensis																		R	C
Neoeponides navarrettei																	A		
Nodogenerina cf. N. bradyi																VR			
Nodogenerina parexilis						F													
Nodogenerina parkeri									F										
Nodogenerina sagrinensis					C	F	R	F	A	C					R?				
Nodosaria cf. N. anomala					F														
Nodosaria ewaldi		R							R?										
Nodosaria irregularis							F	R											
Nodosaria obispoensis												F	R	C	F				
Nodosaria cf. N. perversa						F	R		R	VR						R			
Nodosaria weaveri																VR			
Nonionella miocenica									VR						R				
Nonionellina milleri					F	F													
Oolina borealis											R	VR	VR			VR	R		
Oolina cf. O. borealis					R														
Oolina hexagona																	VR		
Plectofrondicularia californica							VR	VR						F	F	F			
Praeglobobulimina galliheri																			VR
Protoglobobulimina pseudotorta					C		C	C	F	C	F	F	A	VR					VR
Proxifrons advena																			R
Proxifrons sp.														R					
Pseudononion basispinatum																	A		
Pseudononion costiferum					R	VR	VR			VR	C	F		F	R	F			
Pseudononion multicameratum										VR	VR	VR		R	R				
Pseudoparrella subperuviana					A	F	A	A	A	A	A	A	VR	A	A	A	VR	R	A
Pullenia miocenica				F	A	C	C	R	F	A	F	A	A	A	A	A			
Pullenia malkinae						F								VR					
Rectuvigerina branneri	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	R		
Rectuvigerina hughesi									R					R	VR	VR			
Siphonodosaria advena					R						VR	R	C	C	A	F		VR	
Siphonodosaria montereyana														F					
Siphonodosaria quadrulata						F	F		R	R				F	F	VR			VR
Textularia sp.																	F		
Trifarina fluens					A												A		
Uvigerina hootsi						F												A	A
Uvigerina subperegrina	F	A	A		A	F		VR		VR?	A	C	R	F	F			C	
Uvigerinella californica														F	F				
Uvigerinella californica ornata											C	F	F	R	F	VR	F	A	A
Valvulineria californica s.l.	A	A	R	F	A	A	A	A	A	A	A	A	A	A	A	A		F	C
Valvulineria miocenica		F	F							VR		R	VR						
Valvulineria miocenica ornata					VR						F			VR	F	R			
Valvulineria robusta					C	C	F	R	C	A		F	F					R	
Valvulineria subinequalis														F	F	R			C
PLANKTICS L76 SAMPLES:	10	12	5	7	26	23	17	18	19	21	37	39	40	33	30	29	UCLA-6317	42	43
Globigerina bulloides					C		A	A	A	A			A	F	A	A	F		
Globigerina pseudociperoensis			R		F		A	A	A	A			F	A	C	A	R		
Globigerina quinqueloba								R?	VR?						F				
Globigerinella obesa									VR					F	F	R			
Globigerinoides bulloideus					VR?														
Globigerinoides immaturus					VR														
Globorotalia praescitula														VR					
Globorotalia cf. Glr. praescitula									VR										
Tenuitellinata angustiumbilicata					A	C	A	A	A	A	C		A	A	A	A	C		

Topanga Canyon (TC) Section

Los Angeles Basin

Stratigraphy Studied

Modelo Formation
Mohnian Stage

Importance

- Type section for the Mohnian Stage.
- Type section for the *Bolivina obliqua* Zone of the Delmontian Stage.

References

Foraminifera: Hoots (1931), Cushman and Kleinpell (1934), Kleinpell (1938, 1980), Pierce (1956), Ford (1972), Wornardt (1972).
Diatoms: Hoots (1931), Barron (1976a).
Geology: Hoots (1931).

Sample Collections

TC-1 to -382 (CRC-42981-1 to -306): Collected by J. H. Lipps circa 1964 (Figs. 28-30); 76 samples lost in storage fire; 44 good assemblages recovered (Table 9).

Comments

The lower member of the Modelo Formation is mostly thin-bedded cherty siliceous shale interbedded with more massive coarse gray and brown sandstone, whereas the upper member is punky diatomaceous shale. W. D. Rankin (*in* Hoots, 1931) checklisted 66 species of foraminifera vs. 37 assemblages from a section collected along a road southeast of Girard, between Ventura Boulevard and Mohn Springs. The upper member of the Modelo Formation that was exposed north of Mulholland Drive and includes the type *Bolivina obliqua* Zone is currently obscured by a thoroughly landscaped community in what is now part of Woodland Hills. The lower member still exposed along the winding road (now the southern extension of Topanga Canyon Boulevard) is the interval analyzed in this study. It is referred to here as the Topanga Canyon section because of the boulevard name and the fact that the adjacent Garrapata Canyon and Old Topanga Canyon (just to the west) coalesce into Topanga Canyon just south of here.

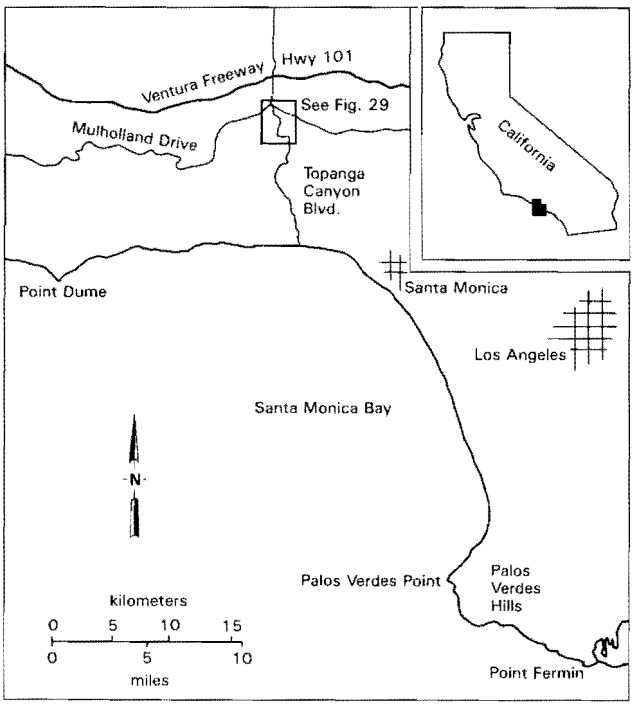

FIGURE 28. Location of the Topanga Canyon area, Los Angeles County.

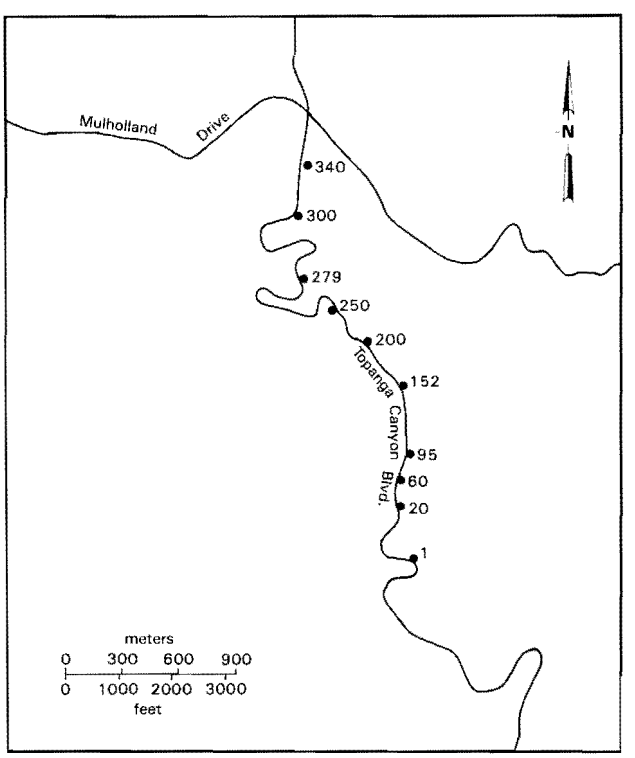

FIGURE 29. Sample locality map of the Topanga Canyon section.

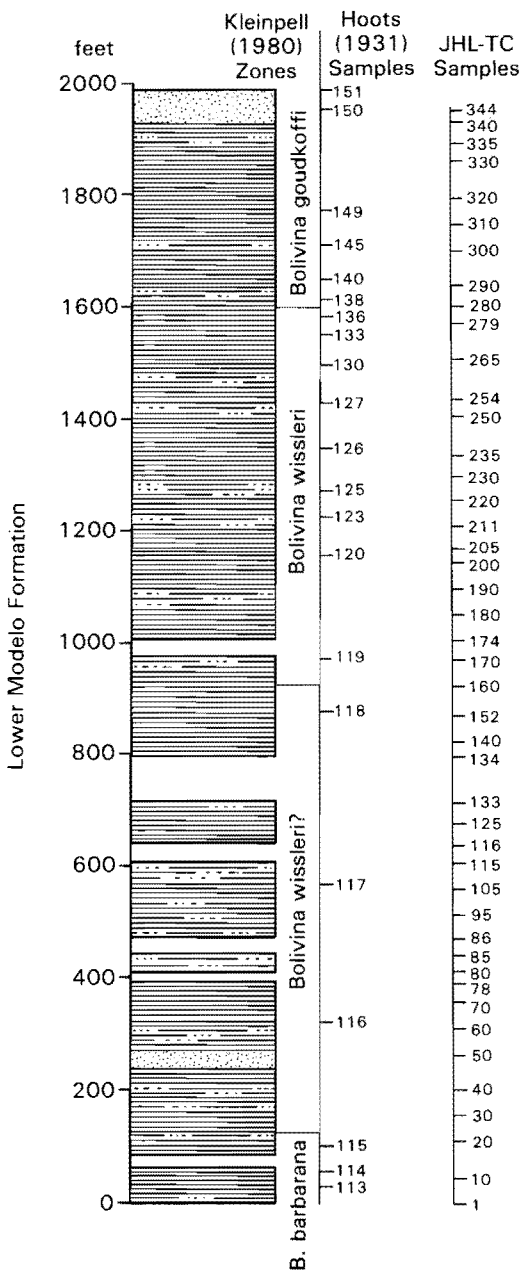

FIGURE 30. Stratigraphic position of samples in the Topanga Canyon collection.

TABLE 9. Species checklist for the Topanga Canyon section. (1 of 2)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

TOPANGA CANYON SECTION																					
BENTHICS JHL-TC SAMPLE:	14	20	22	24	28	71	77	78	92	99	118	123	125	130	141	143	154	158	159	160	165	169
Ambiitropus evax	VR																	F	R			
Ammobaculites? sp. A														R	VR							
Astrononion goudkoffi						VR?		R?										VR	VR	R	VR	
Bathysiphon sanctaecrucis															VR							
Bolivina advena ornata												C	A									
Bolivina benedictensis								C														
Bolivina brevior s.l.	A	A	A	A			C		F	A			R			R		F	C	A	R	F
Bolivina californica	R	C	R	R	VR	F	R	C			VR	VR	R									
Bolivina foraminata													C									R
Bolivina girardensis								VR?														
Bolivina granti						F																F
Bolivina hughesi							F	F			VR?	C	R				C	F	R		R	
Bolivina imbricata													R									
Bolivina madeloensis				R?			R	VR			VR								R			
Bolivina predecussata																						
Bolivina pseudospissa	F	A	C	R	R	F	C	C	VR	VR	VR					VR	F	C	F	F	F	R
Bolivina salinasensis		R						F											VR			
Bolivina spissa																						
Bolivina tumida s.l.						VR	F				VR	A			VR	R					R	
Bolivina woodringi								R?									R	R	R	F	F	
Buccella oregonensis																		R	R			
Buliminella brevior																				R		
Buliminella curta		R																				
Buliminella elegantissima																						
Buliminella subfusiformis	VR		VR					R		VR			R	R		VR		F	F	F	R	R
Cassidulinella nanulinaformis		F														VR				R		
Cibicides sp. A												VR										
Cibicides sp. B																		VR				
Cibicides sp. C																	VR		VR			
Cibicidina sp. B																						
Elphidium granti																		VR				
Epistominella discorbisoides																					F	
Epistominella smithi																						R
Fissurina sp. F																						
Gallitellia vivginiaformis					VR				R								VR	R	R			
Gallitellina sp.		R	F	VR				F														
Gavelinopsis garveyensis																						
Globocassidulina monicana																		R			F	VR
Gyroidina haidi		VR					C				VR							VR				
Gyroidina cf. G. keenani																						
Gyroidina roseformis s.l.	R	R						R														
Hansenisca altiformis																						
Hansenisca multicamerata																						
Hansenisca rotundimargo						VR		F				VR					R	R	A	C	R	R
Hanzawaia depaolai								VR														
Haplophragmoides? sp. A												R		F	F							
Haplophragmoides? sp. B														VR	VR							
Haplophragmoides? sp. C															VR	VR						
Holmanella baggi																VR	R?	F	R	VR	R	R
Holmanella valmonteensis																						
Hopkinsina magnifica																						
Islandiella madeloensis						VR	VR						VR									
Kleinpellis californiensis		R	R										R									
Lagena sp. D																						
Lenticulina smileyi					R																	
Lenticulina sp. D					VR																	
Martinottiella communis?																						
Megastomella capitanensis														R								
Nacoponides navarroai								VR									VR					
Nodosaria ewaldi					VR																	
Nodosaria irregularis																						
Nonionella miocenica								VR					F									
Nonionellina millari												VR	F									
Oolina borealis																						
Oolina melo																						
Oridorsalis umbonata																	VR					VR
Paracassidulina delicata							VR	VR		VR						VR				R		R
Planulina sp.			VR																			
Praeglobobulimina galliheri																						
Protoglobobulimina pseudoobtusa													VR									
Proxifrons advena																						
Pseudononion costiferum													R									
Pseudononion schencki												VR?										
Pseudoparrella californica												VR				R		A	F			
Pseudoparrella subperuviana	F		C			R	VR	VR		C			R							F	F	F
Pullenia inglei							R	R														
Pullenia malkinae																					VR	
Pullenia miocenica																					VR	
Reduvigerina brannani													R									
Siphonodosaria advena		R	R				R															
Sphaeroidina chilostomata					R		VR	VR										VR		VR	R	
Suggrunda kleinpelli																						
Textularia cf. T. warrenites																						
Tremachora arga																						
Uvigerina hannai						R												R		R	VR	F
Uvigerina hoorsi		R			A	F	R	F				R	R			VR		R	R	R		C
Uvigerina subperegrina			VR		C		F	A			R?		R				C	A	A	C	C	
Uvigerinella californica		VR																				
Uvigerinella californica ornata		VR																				
Valvulineria californica												A	A	R	VR	R						
Valvulineria malagaensis	VR															F	F	F	F	F	VR	F
Valvulineria robusta													R									
Valvulineria subinaequalis																						
Varneulinulla? sp. A												R										
Varneulinulla? sp. B												VR		R	R	VR						
PLANKTICS JHL-TC SAMPLE:	14	20	22	24	28	71	77	78	92	99	118	123	125	130	141	143	154	158	159	160	165	169
Globigerina bulloides		R	F		R		A	A	R			F	F				VR	F	F	A	R	R
Globigerina pseudociperoensis							R	F				R	VR						R	F		
Globigerinella obesa																				R		
Globigerinita glutinata																						
Globigerinita uvula																						
Tenuitellinata angustiumbilicata													VR						VR			

TABLE 9. Species checklist for the Topanga Canyon section. (2 of 2)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

TOPANGA CANYON SECTION																					
BENTHICS JHL-TC SAMPLE:	175	197	199	200	201	211	218	221	223	227	230	235	238	252	265	289	292	298	305	306	308	318
Ambitropus avax					R																	
Ammobaculites? sp. A																						
Astrononion goudkoffi		R	R	R	VR	R	R	VR	C	C	VR	VR		R	R			VR				
Bathysiphon sanctaecrucis																						
Bolivina advena ornata																						
Bolivina benedictensis																						
Bolivina brevior s.l.	VR	A	A	C	A		A	F	A	A	F	A	R	R	C	A	R	C	F	F	A	
Bolivina californica								VR	R													
Bolivina laraminata															C		F					
Bolivina girardensis			F		R			R	VR	R	R	R	R	A	VR	R	R		VR	F		
Bolivina granti		VR										A	A			A				VR?		
Bolivina hughesi	R				R				C	R			VR	A	R	F				R	R	
Bolivina imbricata																						
Bolivina modeloensis		C	F	R		R			VR				VR	C	R		C	R		VR	C	
Bolivina predecussata																		F				
Bolivina pseudospissa				VR		R	VR	A		C	A	F	F	A	F		A	R	VR			
Bolivina salinasensis			R												R							
Bolivina spissa	C	F	R	VR	R	VR																
Bolivina tumida s.l.																						
Bolivina woodringi		A	C	R	C	R	F	F	A	R		VR		VR	A		VR					
Buccella oregonensis		VR				VR	R		F													
Buliminella brevior		A					VR		VR													
Buliminella curta			VR	R		VR								VR		VR						
Buliminella elegantissima														VR	VR							
Buliminella subfusiformis			R		VR			C	A		F	VR		F	F			VR				
Cassidulinella renulinaformis			R									R	VR		A							
Cibicides sp. A										VR	VR	VR			VR							
Cibicides sp. B																						
Cibicides sp. C																						
Cibicidina sp. B	VR																					
Elphidium granti																						
Epistominella discorbisoides	R																					
Epistominella smithi		R																				
Fissurina sp. F												VR										
Galliherina uvigerinaformis																						
Galliherina sp.																						
Gavelinopsis garveyansis																VR					R	
Globocassidulina monicana	R	F		VR	R			VR	C	VR		VR	R									
Gyroidina healdi														F		C	R				VR	VR
Gyroidina cf. G. keenani										VR												
Gyroidina rosaformis s.l.		VR	F			VR			F	C	R	F	VR	A	F		R	VR	VR			
Hansenisca altiformis	VR																					
Hansenisca multicamerata									R					R	A		A					
Hansenisca rotundimargo	R	F		R		R	F	VR	C	A	VR	R	A		A	C	A		VR	VR	F	VR
Hanzawaia depaolai	R																					
Haplophragmoides? sp. A					VR																	C
Haplophragmoides? sp. B																						
Haplophragmoides? sp. C																						
Holmanella baggi	F				R					VR		VR		F	R	A	VR	R			A	
Holmanella valmonteensis		R		R		R	F						VR									
Hopkinsina magnifica														R	C	A	VR	R				
Islandiella modeloensis	R		VR		VR		VR	VR	F			VR			VR	F			R	R	A	
Kleinpella californiensis														C	R							
Lagena sp. D									VR													
Lenticulina smileyi	R																					
Lenticulina sp. D									VR													
Martinottiella communis?																						R
Megastomella capitanensis																						
Neoeponides navarretei																						
Nodosaria ewaldi		VR								VR				R			R	VR				
Nodosaria irregularis														R								
Nonionella miocenica																R					F	
Nonionellina milleri																						
Oolina borealis			VR						F	VR												
Oolina melo									F	VR		VR										
Oridorsalis umbonata	F																					
Paracassidulina delicata					VR			VR							R							
Planulina sp.																						
Praeglobobulimina galliheri									R													
Protoglobobulimina pseudoterta						VR							F	A			A					
Proxifrons advena																VR						
Pseudononion costiferum																						
Pseudononion schencki																						
Pseudoparrella californica																						
Pseudoparrella subperuviana		A	F		VR	F		R	C			F	C	A	A	C	C	F	F	VR	C	
Pullenia inglei									F													
Pullenia malkinae																VR						
Pullenia miocenica	VR													R								
Ractuvigerina brannari																						
Siphonodosaria advena																						
Sphaeroidina chilostomata	R			VR					R	VR						R	R				F	VR
Suggrunda kleinpelli					R				VR													
Textularia cf. T. warrenites	VR																					
Tremachora arga									VR													
Uvigerina hannai												F		A	R		C	R				
Uvigerina hootsi	F	F	R		VR		F		A	F	VR		F			R	F	R		R	A	
Uvigerina subperegrina	F			R	F	R	VR	F	C	R	R			A	R	R	A	R		C	F	
Uvigerinella californica							VR															
Uvigerinella californica ornata																						
Valvulineria californica																						
Valvulineria malagaensis	R	R					R		VR				VR		F	F	C				VR	
Valvulineria robusta																						
Valvulineria subinequalis														C								
Verneuilinulla? sp. A																						
Verneuilinulla? sp. B																						R
PLANKTICS JHL-TC SAMPLE:	175	197	199	200	201	211	218	221	223	227	230	235	238	252	265	289	292	298	305	306	308	318
Globigerina bulloides		A	VR		F	VR		R	C	A	A	R			A	VR						
Globigerina pseudociperoensis															VR							
Globigerinella obesa																						
Globigerinita glutinata		R	R																			
Globigerinita uvula		VR							F													
Tenuitellinata angustiumbilicata									R						VR							

Upper Newport Bay (UNB) Section

Santa Ana Embayment, Los Angeles Basin

Stratigraphy Studied

Middle to upper Monterey Formation,
and lower Capistrano Formation
Luisian to "Delmontian" Stages

Importance

- Yields some of the most diverse and best preserved Neogene foraminiferal assemblages in California.

References

Foraminifera: Ingle (1962, 1967, 1972, 1973a), Lipps (1964, 1966), Warren (1970, 1972, 1973), Lipps and Kalisky (1972), Wornardt (1973), Duncan (1979), Lustig (1984).

Calcareous Nannoplankton: Wilcoxon (1969), Lipps and Kalisky (1972), Wornardt (1973).

Diatoms: Wornardt (1970, 1973), Barron (1975, 1976a, b).

Radiolarians: Casey and Price (1973), Wornardt (1973), Weinheimer and others (1986).

Silicoflagellates: Wornardt (1970, 1973).

Geology: Ingle (1967), Sterling (1982).

Sample Collection

CRC-40267-1 to -16, and -29 to -50: Collected by W. R. Riedel, W. H. Akers, G. L. Armstrong, and R. J. Navarrette in 1982, and by K. L. Finger and G. L. Armstrong in subsequent years, totalling 58 samples (Figs. 31-33); numbers with letter suffices indicate resampling (i.e., -50 and -50a are samples collected on different dates from same locality); G. L. Armstrong collected -47a in 1971; 31 good foraminiferal assemblages recovered from the 38 sample localities of the Monterey Formation (Table 10). (CRC-40267-17 to -28 localities are Pliocene and Pleistocene exposures.)

Comments

Although there is much reference literature on the micropaleontology of this section, it is mostly confined to regional field guides, symposia, and graduate studies (unpublished and published).

Warren (1970, 1972, 1973) identified a sparse "Delmontian" fauna from the uppermost Monterey Formation, but my samples from this interval and the overlying Capistrano Formation were devoid of foraminifera.

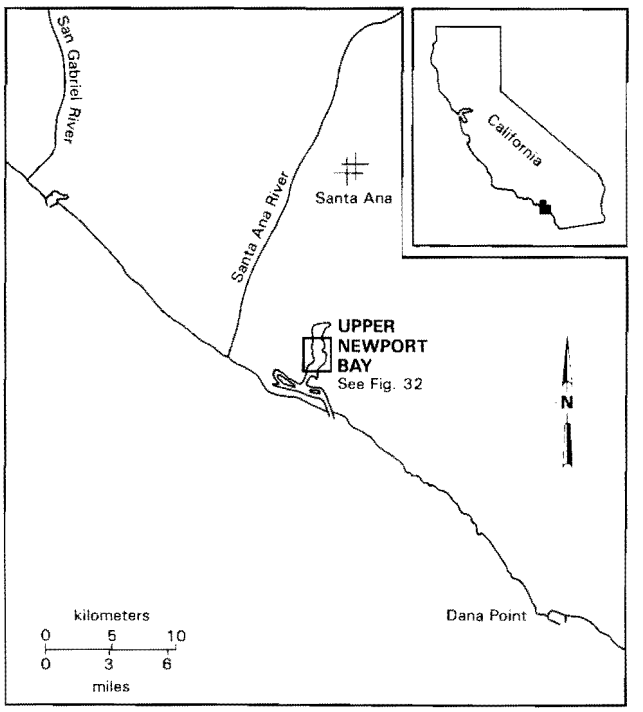

FIGURE 31. Location of the Upper Newport Bay area, Orange County.

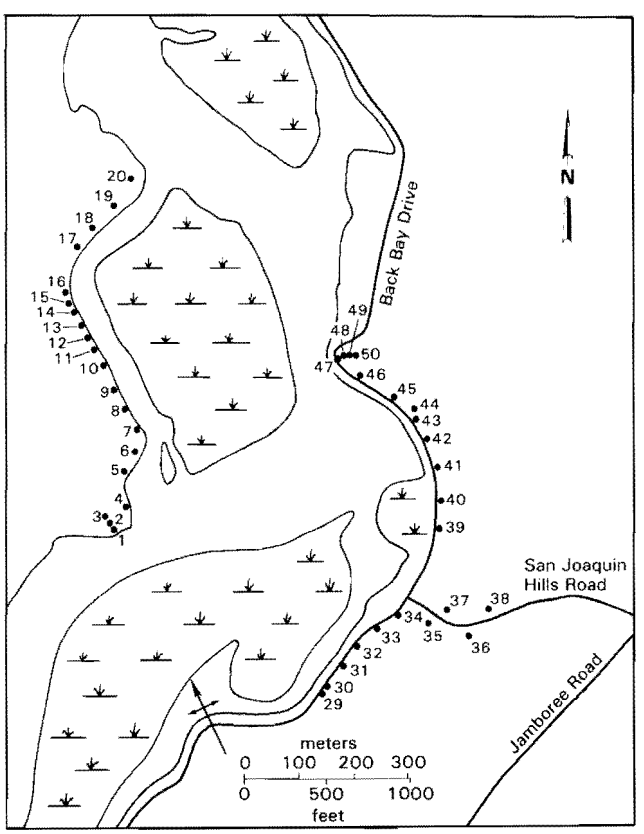

FIGURE 32. Sample locality map of the Upper Newport Bay section.

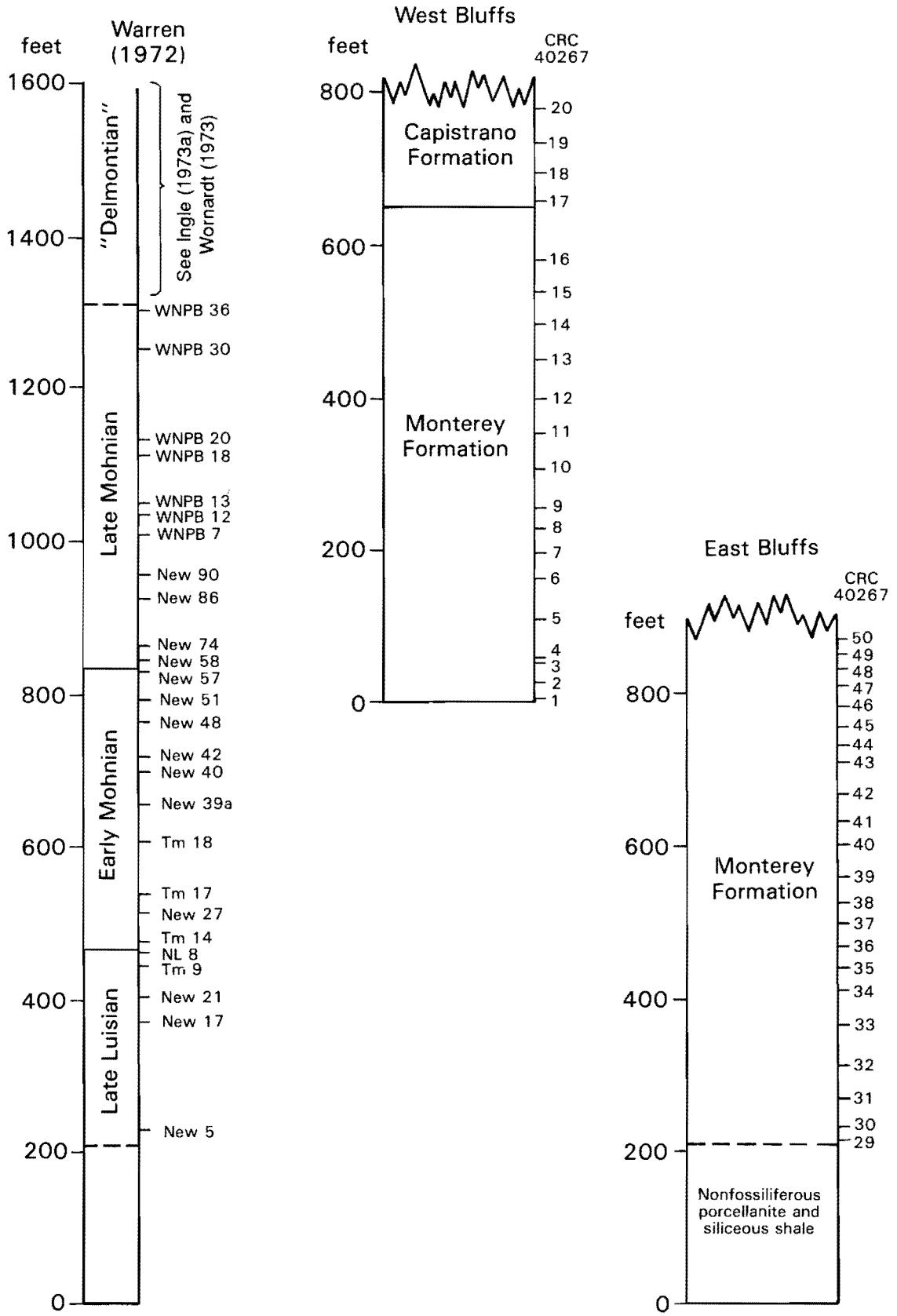

FIGURE 33. Stratigraphic position of samples in the Upper Newport Bay collection.

TABLE 10. Species checklist for the Upper Newport Bay section. (1 of 3)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

BENTHIC FORAM AGE:	LUISIAN										EARLY MOHNIAN												-	LATE MOHNIAN							
STRATIGRAPHIC FEET:	220	235	270	320	370	420	420	445	445	470	530	560	600	710	730	750	780	785	810	810	810	810	830	840	845	870	870	940	985	1040	1140
BENTHICS CRC40267 SAMPLE:	29	30	31	32	33	34	34a	35	35a	36	38	39	40	43	44	45a	46a	1	2	47a	47b	47c	48	3	4	50	50a	6	7	9	11
Ambitropus evax												VR		VR					R	A	A	R				C	VR				
Amphicoryna catesbyi								VR																							
Anomalinoides salinasensis							R	R	F																						
Astacolus crepidulus																				R		VR									
Astacolus mayi											R	R																			
Astacolus sp. D																						VR									
Astrononion goudkoffi																	VR	F				F		F	R	R	F	R			
Baggina californica						R	R	A	A		C		F	C	F	C	VR														
Bolivina advena					F	C		A	A		R		R		VR	A					F										
Bolivina advena ornata	A	A	A	A	A	A	C	R	A																						
Bolivina benedictensis													VR	VR										A		A		F			
Bolivina bramlettei					VR					A	A	A		C	A	A		F	C	A	R	F		F	A	A	C	C			
Bolivina brevior s.l.	A		A	A	A	A	A	A	A									A			A	F		A		A	C		A		
Bolivina brevior dunlapi	A		A	A	A			C																A							
Bolivina californica		VR		VR	A	A	A	A	C	R	C	F	R	A	A	A	R	A	A	A	A	R			A						
Bolivina churchi								VR				A	C	A	A	A															
Bolivina exilicostata																		A													
Bolivina foraminata																								A		A	C	F			
Bolivina girardensis																								VR		A		VR	R		
Bolivina granti																										R	F				
Bolivina hughesi																	A	R	VR	VR	C	F			F	F	R	VR			VR
Bolivina cf. B. hughesi var. A										VR																					
Bolivina humilis																				F		F									
Bolivina imbricata	VR	A	F	R	C																										
Bolivina modeloensis																												F	R		
Bolivina predecussata																													F		
Bolivina pseudobeyrichi								C	R									R													
Bolivina pseudospissa	VR				R		R			R							A	A	F	A	A	A		R	A		C		C		
Bolivina cf. B. sabahensis								VR																							
Bolivina salinasensis			R			VR					A	VR		R	F	A	VR	A	VR						A		C				
Bolivina santanaensis																				C											
Bolivina spissa																								A		A		A			
Bolivina tongi filacostata								R			A						C	R				C									
Bolivina tumida		A		VR	F	A	A	VR	A				R	A	A	A		A			F	C		VR		VR	C		R		
Bolivina tumida var. "seminuda"	A		VR	VR						A	A	A					A			A											VR
Bolivina tumida var. "striatocrenulata"	R																														
Bolivina wissleri																			F	A	R	F									
Bolivina woodringi																								F		R		F	R		
Bolivina woodruffi																			A						A						
Bolivina sp. A								R																							
Bolivina sp. B											VR																				
Bolivina sp. C																								R		VR			R		
Bolivina sp. D																									R						
Bolivina sp. E																								R							
Bolivina sp. H																									F						
Bolivina sp. I					VR		VR																								
Bolivina sp. L			VR																												
Buccella oregonensis						VR																						R	VR		
Bulimina inflata								VR			VR			R	F		VR			A	R	VR			R		R				
Buliminella californica																			F								?				
Buliminella curta											R													F				?			
Buliminella elegantissima									VR												VR										
Buliminella subfusiformis	A	A	A	A	F	A	C	A	A	A	A	A	C	A	A	A	A	F	F	A	A	F		A	F	A	F	A	F		R
Cancris planus	R								C																						
Cassidulinella renulinaformis																								A	VR						
Chilostomella ovoidea						R			A	R										F		VR									
Chilostomina pustulosa											VR			R						F						R	R				
Cibicides pumilus																													R		
Cibicides sp. C																											VR				
Cibicidoides mckannai						VR					R															VR					
Concavella gyroidinaformis											A	A		C	VR	A															
Dentalina cf. D. baggi															VR				F			VR	F				F				
Dentalina grandis								VR	R																						
Dentalina pseudoobliqua							R	F	F																						
Dentalina roemeri												VR																			
Dentalina sp. B									F																						
Dentalina sp. C											R				VR																
Dentalina sp. E																				VR	R										

TABLE 10. Species checklist for the Upper Newport Bay section. (2 of 3)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

BENTHIC FORAM AGE:	LUISIAN											EARLY					MOHNIAN							-	LATE MOHNIAN								
STRATIGRAPHIC FEET:	220	235	270	320	370	420	445	470	530	560	600	710	730	750	780	785	810	810	810	810	830	840	845	870	870	940	965	1040	1140
BENTHICS CRC40267 SAMPLE:	29	30	31	32	33	34	35	36	38	39	40	43	44	45a	46a	1	2	47a	47b	47c	48	3	4	50	50a	6	7	9	11
"Dentalina" sp.	R		VR		VR														F										
Elphidium grantl																													
Epistominella smithi								C	A	F	R		R		VR														
Evolutononion dumonti									A	A				A						F						VR			
Fissurina sp. A																									VR				
Fissurina sp. B																								VR					
Fissurina sp. G																	VR												
Fursenkoina subplana				VR																									
Fursenkoina sp. C							VR																						
Gallitherina uvigerinaformis												F	R																
Gallitherina uvigerinaformis doanei															C		F	A	A										
Gallitherina uvigerinaformis var. A																						VR							
Gavelinopsis holkos							VR													VR					VR		VR		
Gavelinopsis sp.																													
Glandulina sp.																									VR				
Globocassidulina monicana		VR						R	A	A	F	C	C	A	F			A	A			R			F	F			
Guttulina sp.														VR															
Gyroidina healdi						C	C	A	A	A		A	C	F				A		R				F					
Gyroidina rosaformis						C	C	A				A		C				A	R	R					F	VR		R	
Hansenisca multicamerata									R	F				F		VR		C		F		VR	F	C	F				
Hansenisca rotundimargo		R	R		F	C	F	A	C						C	F		R		VR			F		F	VR			
Hanzawaia depaoloi	F								F	F				R	C					VR									
Holmanella baggi	R				R		R	R	VR	A	A		VR	F	C		C		A		F	F		C			VR		
Holmanella valmonteensis																							C		F	C	F	R	
Hopkinsina magnifica																							VR	A	A	A	VR		
Hopkinsina sp. A																VR	R			R									
Hopkinsina sp. C																		VR											
Hyalinonetrion "elongata"	VR																	VR	VR										
Islandiella californica									F	VR	VR																		
Islandiella cannata																		VR		R									
Islandiella modelcoensis			VR			R		F		VR						VR	C			C	C			A			R		VR
Klampella californiensis	A	A	A	A	A	A	F	A	R			R	VR	VR	F	R	R	A	F	F		A	A	C	C	A		
Klampella sp. A												R	R																
Klampella sp. B																								R					
Lagena discrepans																									VR				
Lagena semilineata																VR											VR		
Lagena cf. L. striata									VR																				
Lagena timmsana		VR																											
Lagena sp. A																							VR						
Lagena sp. B																				VR									
Lenticulina cushmani?																	R	R											
Lenticulina douglasi									F	F	R			F			A	F	F										
Lenticulina dubia																													
Lenticulina miocenica		VR					R	R																					
Lenticulina reedi									A	F	F		F					F		F									
Lenticulina smileyi																	R												
Lemalia sp.																				F									
Loxostomoides digitata	VR		C	VR					A		F	A	VR	F								F		C	F				
Marginulina subbullata									R																				
Marginulinopsis beali						VR		R																					
Megastomella capitanensis												C	F																
Nodogenerina cf. N. bradyi																			R										
Nodogenerina sagrinensis									C	F				A	R										VR				
Nodogenerina sp.															VR														
Nodosaria ewaldi							F	F	R	R	VR	VR	F		R			A	F	F			R		R				
Nodosaria irregularis									VR															VR	VR				
Nodosaria perversa														R	R														
Nodosaria sp. A																	R												
Nonionella miocenica								VR						VR			VR	R									VR		A
Oolina borealis							VR									VR	VR		VR			VR			VR	VR			
Oolina melo																				R									
Ondorsalis umbonata																		F											
Paracassidulina? crescentaperta																									VR				
Paracassidulina delicata																	A			R		R		R	VR		R		
Praeglobobulimina gallineri							R	F	C	R				R	VR		R	A	R	R	R	R	C		F				
Praeglobobulimina spinifera																		F	R	R					VR				
Procerolagena sp.																									VR				
Protoglobobulimina pseudotorta	C	C	R		R	F	VR	A	C	F	F	F	R	F	A	R	F		R	C		F		VR	R	VR	A	VR	R

TABLE 10. Species checklist for the Upper Newport Bay section. (3 of 3)
[Relative abundance of a species is calculated on the number of specimens seen while picking the assemblage (N>300): VR = 1, R = 2-5, F = 6-15, C = 16-30, A = >30.]

BENTHIC FORAM AGE:	L U I S I A N										E A R L Y M O H N I A N												-	L A T E M O H N I A N							
STRATIGRAPHIC FEET:	220	235	270	320	370	420	420	445	445	470	530	560	600	710	730	750	780	785	810	810	810	810	830	840	845	870	870	940	985	1040	1140
BENTHICS CRC40267 SAMPLE:	**29**	**30**	**31**	**32**	**33**	**34**	**34a**	**35**	**35a**	**36**	**38**	**39**	**40**	**43**	**44**	**45a**	**46a**	**1**	**2**	**47a**	**47b**	**47c**	**48**	**3**	**4**	**50**	**50a**	**6**	**7**	**9**	**11**
Proxifrons advena											R	R	F		C		R			C	F	F									
Proxifrons vaughani											R	R																			
Proxifrons sp.																	VR														
Pseudonodosaria obtusissima												R				VR	VR														
Pseudononion basispinatum							VR																								
Pseudononion costiferum	F		R	R	VR	R		VR		A		VR	F		R	VR															
Pseudononion multicameratum	R	VR	R		VR						A		VR		A												VR				
Pseudoparrella californica																								A			F	R			
Pseudoparrella subperuviana	C		F			C	C		R	C	A	A	F		A	A	A	A		A	A	F		A		A	C	F	F		
Pullenia inglei																								R			A	R	VR		
Pullenia malkinae																				R		VR									
Pullenia miocenica		C			VR	A	A	A	A		VR							VR													
Pullenia salisburyi																								VR			VR				
Pullenia sp.																						VR									
Quadrimorphina sp.																				VR		R									
Rectuvigerina branneri						C	C	C	VR																						
Siphonodosaria advena					VR						C	C	R	F	C	R	A			F		R		VR							
Siphonodosaria montereyana											F					F				R	VR	VR					VR				
Siphonodosaria quadrulata								VR			R	R	VR	F		F	R			A	F	F									
Siphonodosaria sp.																											VR				
Sphaeroidina chilostomata								R												F	R				R	R	VR				
Stainforthia nodosa								F																							
Suggrunda inflata										VR							R														
Suggrunda kleinpelli					F				F		C			R	VR	A	R	C		R		R		R		F	R				
Tremachora arga																								VR		R					
Trifarina fluens																		VR						VR					VR		
Uvigerina hannai								A			C		A			C		F	C		C				A	C				R	A
Uvigerina hootsi	VR								R	A	A	A		A	C	A		A	A					R		F					
Uvigerina hootsi var.																	C			A	A	A									
Uvigerina segundoensis		R																					C	R	VR			R			
Uvigerina cf. U. segundoensis												VR																			
Uvigerina senticosa														VR																	
Uvigerina subperegrina	VR					F	VR					R	C	C	A	C	A	A	F	A	C	C			C		R		R	VR	
Uvigerinella californica			VR																												
Uvigerinella californica ornata			VR		R	VR		VR																VR							VR
Valvulineria californica	A	A	F	A	C	A	F	F	C		F					VR															
Valvulineria malagaensis													C		A						F	F	VR	R	F		F				
Valvulineria mcdougalli																		C				R				R	R				
Valvulineria miocenica	A							R																							
Valvulineria miocenica ornata		A	A	A	F	C	R		F																						
Valvulineria robusta								F	F	VR	A	C	F	R	F	A	R			C											
Valvulineria subinequalis														F			R			VR		F			VR	VR	VR				
Virgulinella pertusa										R										VR						VR	VR				
PLANKTICS CRC40267 SAMPLE:	**29**	**30**	**31**	**32**	**33**	**34**	**34a**	**35**	**35a**	**36**	**38**	**39**	**40**	**43**	**44**	**45a**	**46a**	**1**	**2**	**47a**	**47b**	**47c**	**48**	**3**	**4**	**50**	**50a**	**6**	**7**	**9**	**11**
Globigerina bulloides	F	A	A	A	A	A	A		A	F	VR	F				VR	A	A						A		A	A	A	A		
Globigerina praebulloides												VR																			
Globigerina pseudociperoensis			F	F	F	A	A	VR	A								A							C		A	A	A	R		
Globigerinella aequilateralis																											VR				
Globigerinella obesa							VR																								
Globigerinita glutinata																										R					
Globigerinita parkerae																											VR				
Globigerinoides bulloideus																											VR				
Globigerinoides subquadratus																											R				
Globorotalia conoidea																											VR				
Globorotaloides trema								A	C	F																					
Neogloboquadrina cf. N. acostaensis																											VR				
Neogloboquadrina continuosa																		VR													
Neogloboquadrina pachyderma																										C	F		R		
Orbulina cf. O. suturalis																											R				
Orbulina universa				VR																								VR	R		
Praeorbulina glomerosa circularis							VR																								
Praeorbulina glomerosa var. A																				VR											
Praeorbulina glomerosa var. B																	VR														
Protentella prolixa									A																						
Tenuitellinata angustiumbilicata	A	A	A		A	A	A	A	A	R																F	F				
Ostracodes						F			VR															VR		F	F	F			
Prunopyle titan (radiolarian)					X									X				X				X		X		X	X	X	X	X	X

TABLE 11. Checklist of benthic species vs. sections. (1 of 2)
Section key: GC = Graves Creek, IC = Indian Creek, LH = Laguna Hills, MQ = Manville Quarry access road, MC = Monterey County roadcuts, NA = Naples Beach, SCI = San Clemente Island, TC = Topanga Canyon, UNB = Upper Newport Bay.
Solid boxes denote presence of species.

SPECIES	SECTION:	GC	IC	LH	MQ	MC	NA	SCI	TC	UNB
Ambitropus evax					■		■	■	■	
Ammobaculites? sp. A									■	
Ammobaculites? sp. B		■								
Ammodiscus incertus				■			■			
Amphicoryna catesbyi										■
Amphimorphina amchitkaensis		■						■		
Anomalinoides salinasensis		■	■				■	■		■
Astacolus crepidulus								■		
Astacolus cf. A. cymboides		■								
Astacolus mayi										■
Astacolus naplesensis		(• Mussel Rock)					■			
Astacolus sp. A										
Astacolus sp. B		■								
Astacolus sp. C										
Astacolus sp. D								■		
Astacolus sp. E							■			
Astacolus sp. F		■								
Astacolus sp. G				■			■			
Astacolus sp. H		■					■			
Astrononion goudkoffi			■		■		■		■	■
Baggina californica		■	■				■	■		■
Bathysiphon sanctaecrucis									■	
Bolivina advena		■	■	■			■		■	■
Bolivina advena ornata		■	■	■			■	■	■	■
Bolivina benedictensis							■			
Bolivina blakei		■	■				■			
Bolivina bramlettei					■					■
Bolivina brevior s.l.		■	■	■	■	■	■	■	■	■
Bolivina brevior dunlapi				■				■		
Bolivina californica		■	■		■		■	■	■	■
Bolivina churchi		■	■				■			
Bolivina conica		■	■				■	■		
Bolivina cuneiformis							■			
Bolivina cf. B. eupiectella			■							
Bolivina exilicostata										■
Bolivina foraminata			■		■		■		■	■
Bolivina girardensis					■		■		■	■
Bolivina granti		■			■		■		■	■
Bolivina hughesi			■		■		■		■	■
Bolivina cf. B. hughesi var. A										■
Bolivina cf. B. hughesi var. B				■						
Bolivina humilis										■
Bolivina imbricata		■	■	■			■	■	■	■
Bolivina interjuncta					■					
Bolivina snyderi							■			
Bolivina modeloensis		■			■		■	■	■	■
Bolivina mulleri										
Bolivina multicostata						■				
Bolivina parva?			■				■	■		
Bolivina predecussata							■		■	■
Bolivina pseudobeyrichi										■
Bolivina pseudospissa		■	■	■	■	■	■	■	■	■
Bolivina cf. B. sabahensis							■			
Bolivina salinasensis		■			■				■	
Bolivina santanaensis									■	
Bolivina spissa			■				■		■	■
Bolivina ticensis					■					
Bolivina tongi filacostata		■			■					
Bolivina tumida s.l.		■			■		■			■
Bolivina wissleri							■			
Bolivina woodringi					■	?	■			
Bolivina woodruffi										
Bolivina sp. A										■
Bolivina sp. B										
Bolivina sp. C										
Bolivina sp. D										■
Bolivina sp. E										■
Bolivina sp. F			■							
Bolivina sp. G					■					
Bolivina sp. H										■
Bolivina sp. I										
Bolivina sp. J				■			■		■	
Bolivina sp. K								■		
Bolivina sp. L										■
Buccella oregonensis		■		■			■			
Bulimina alligata										
Bulimina cf. B. hebespinata		■								
Bulimina inflata					■		■	■	■	■
Bulimina subacuminata		■								
Bulimina subcalva							■			
Buliminella brevior					■				■	
Buliminella californica			■				■			■
Buliminella curta			■		■		■		■	■
Buliminella elegantissima		■	■			■	■	■	■	■
Buliminella semihispida							■			
Buliminella subfusiformis		■	■	■	■	■	■	■	■	■
Cancris baggi										
Cancris lippsi			■							

SPECIES	SECTION:	GC	IC	LH	MQ	MC	NA	SCI	TC	UNB
Chilostomella ovoidea		■		■			■			■
Chilostomina pustulosa		■			■					
Chrysalogonium californiensis		■								
Cibicides pumilus		■		■			■	■		■
Cibicides cf. C. farctus								■		
Cibicides sp. A									■	■
Cibicides sp. B										■
Cibicides sp. C										
Cibicidina sp. A				■				■		
Cibicidina sp. B								■	■	
Cibicides sp. D		■		■				■	■	
Cibicidoides cushmani		■					■	■		
Cibicidoides mckannai										
Concavella gyroidinaformis								■		
Cyclammina incisa		(• FJP-9)								
Dentalina? cf. D. antennula					■					
Dentalina atascaderoensis		■								
Dentalina cf. baggi			■				■			■
Dentalina communis		■								
Dentalina grandis							■			■
Dentalina lagoei		■								
Dentalina pseudoinvolvens								■		
Dentalina pseudoobliqua		■		■			■	■		■
Dentalina roemeri		■					■			
Dentalina sp. A							■			
Dentalina sp. B								■		■
Dentalina sp. C										■
Dentalina sp. D				■			■			
Dentalina sp. E										
Dentalina sp. F							■			
"Dentalina" sp.										■
Duplella baggi		■								
Duplella lacrima										
Ehrenbergina alata								■		
Elphidium granti										■
Enantiodentalina murali		■	■	■						
Epistominella discorbisoides					■		■		■	
Epistominella pacifica						■				
Epistominella smithi		■	■				■		■	■
Evolutonorion dumonti										■
Fissurina gravesensis		■								
Fissurina cf. F. laevigata labiata		■								
Fissurina longipunctata										
Fissurina natlandi		■						■		
Fissurina quasimarginata		■								
Fissurina sp. A										■
Fissurina sp. B										
Fissurina sp. C							■			
Fissurina sp. D		■								
Fissurina sp. E							■			
Fissurina sp. F									■	
Fissurina sp. G										
Fissurina sp. H		■						■		
Fissurina sp. I			■							
Fissurina sp. J										
Frondicularia cf. F. bulbosa		■								
Frondicularia sp. A										
Frondicularia sp. B							■			
Fursenkoina subplana							■	■		■
Fursenkoina sp. A							■			
Fursenkoina sp. B		■		■						
Fursenkoina sp. C										
Gallitellina vigerinaformis										■
Gallitellina sp.									■	
Gaudryina exilis				■						
Gaudryina pliocenica		■						■		
Gaudryina subglabrata			■	■			■			
Gavelinopsis durhami		■								
Gavelinopsis garveyensis							■		■	
Gavelinopsis hollos		■						■		■
Gavelinopsis sp.					■					■
Glandulina sp.										
Globocassidulina monicana					■		■	■	■	■
Globocassidulina neomargareta		■					■			
Globocassidulina neopulchella		■								
Guttulina sp.		■								■
Gyroidina healdi		■			■		■			
Gyroidina cf. G. keenani										■
Gyroidina rosaformis s.l.		■	■		■					
Hansenisca altiformis			■						■	■
Hansenisca multicamerata					■		■		■	■
Hansenisca rotundimargo		■		■	■		■		■	■
Hanzawaia cf. H. crassisepta										
Hanzawaia depaoloi		■		■	■		■		■	■
Haplophragmoides? sp. A									■	
Haplophragmoides? sp. B										
Haplophragmoides? sp. C									■	
Haplophragmoides? sp. D							■			

TABLE 11. Checklist of benthic species vs. sections. (2 of 2)
Section key: GC = Graves Creek, IC = Indian Creek, LH = Laguna Hills, MQ = Manville Quarry access road, MC = Monterey County roadcuts, NA = Naples Beach, SCI = San Clemente Island, TC = Topanga Canyon, UNB = Upper Newport Bay.
Solid boxes denote presence of species.

SPECIES	GC	IC	LH	MQ	MC	NA	SCI	TC	UNB
Cancris planus									
Cassidulinella renulinaformis									
Hopkinsina magnifica									
Hopkinsina sp. A									
Hopkinsina sp. B									
Hopkinsina sp. C									
Hyalinonetrion "elongata"									
Islandiella californica									
Islandiella carinata									
Islandiella modeloensis									
Islandiella spp. (indet. globose juv.)									
Kleinpella californiensis s.l.									
Kleinpella sp. A									
Kleinpella sp. B									
Lagena apiopleura									
Lagena apiopleura?									
Lagena discrepans									
Lagena laevis									
Lagena lisbonensis									
Lagena meridionalis									
Lagena mexicana									
Lagena pacifica									
Lagena cf. L. pliocenica									
Lagena semilineata									
Lagena cf. L. striata									
Lagena timmsana									
Lagena sp. A									
Lagena sp. B									
Lagena sp. C									
Lagena sp. D									
Lagena sp. E									
Lenticulina atascaderoensis									
Lenticulina barroni									
Lenticulina branneri									
Lenticulina cushmani?									
Lenticulina douglasi									
Lenticulina dubia									
Lenticulina cf. L. dubia									
Lenticulina cf. L. gerlandi									
Lenticulina hughesi									
Lenticulina indianensis									
Lenticulina luciana									
Lenticulina miocenica									
Lenticulina reedi									
Lenticulina sandholdtana									
Lenticulina smileyi s.l.									
Lenticulina sp. A									
Lenticulina sp. B									
Lenticulina sp. C									
Lenticulina sp. D									
Lenticulina sp. E									
Lenticulina sp. F									
Lenticulina sp. G									
Lernella sp.									
Lobatula lobatula									
Loxostomoides digitata									
Marginulina crouchi									
Marginulina subbullata									
Marginulina sp.									
Marginulinopsis beali									
Marginulinopsis sp.									
Martinottiella communis?									
Megastomella capitanensis									
Megastomella purisima									
Neoeponides navarrettei									
Nodogenerina cf. N. bradyi									
Nodogenerina parexilis									
Nodogenerina parkeri									
Nodogenerina sagrinensis									
Nodogenerina tappani									
Nodogenerina sp.									
Nodosaria cf. N. anomala									
Nodosaria ewaldi									
Nodosaria franki									
Nodosaria irregularis									
Nodosaria obispoensis									
Nodosaria cf. N. ovalis									
Nodosaria perversa									
Nodosaria "spinescens"									
Nodosaria weaveri									
Nodosaria sp. A									
Nodosaria sp. B									
Nonionella miocenica									
Nonionellina milleri									
Oolina borealis									
Oolina cf. O. borealis									
Ooliina elongata									
Oolina globosa setosa									
Holmanella baggi									
Holmanella valmonteensis									
Oolina hexagona									
Oolina melo									
Oridorsalis relizana									
Oridorsalis subtenera									
Oridorsalis umbonata									
Paracassidulina? crescentaperta									
Plectofrondicularia californica									
Paracassidulina delicata									
Parafissurina sp. A									
Parafissurina sp. B									
Paratrondicularia miocenica									
Planorbulina sp.									
Planulina sp.									
Praeglobobulimina gallitheri									
Praeglobobulimina spinifera									
Procerolagena sp.									
Protoglobobulimina pseudotorta									
Proxifons advena									
Proxifons vaughani									
Proxifons sp.									
Pseudonodosaria obtusissima									
Pseudononion basispinatum									
Pseudononion costiferum									
Pseudononion multicameratum									
Pseudononion schencki								?	
Pseudoparrella californica									
Pseudoparrella subperuviana									
Pullenia malkinae									
Pullenia inglei									
Pullenia miocenica									
Pullenia salisburyi									
Pullenia sp.									
Quadrimorphina sp.									
Quinqueloculina seminulum									
Rectuvigerina brannen									
Rectuvigerina hughesi									
Rectuvigerina loeblichi									
Rectuvigerina transversa									
Reophax cf. R. excenticus									
Reussolina simplex									
Rosalina californica									
Rutherfordoides californiensis									
Saracenaria schencki									
Siphonodosaria advena									
Siphonodosaria montereyana									
Siphonodosaria quadrulata									
Siphonodosaria sp.									
Sphaeroidina chilostomata									
Spirosigmoilina tenuis									
Stainforthia nodosa									
Suggrunda inflata									
Suggrunda kleinpelli									
Textularia cf. T. warrenites									
Textularia sp.									
Tremachora arga									
Trifarina fluens									
Uvigerina hannai									
Uvigerina cf. U. hannai									
Uvigerina cf. U. hispidocostata									
Uvigerina hootsi									
Uvigerina segundoensis									
Uvigerina cf. U. segundoensis									
Uvigerina senticosa									
Uvigerina subperegrina									
Uvigerina subperegrina f. impolita									
Uvigerina sp. A									
Uvigerina sp. B									
Uvigerina sp. C									
Uvigerina sp. D									
Uvigerinella californica									
Uvigerinella californica ornata									
Vaginulina cf. V. dubia									
Vaginulina cf. V. tenuis									
Valvulineria californica									
Valvulineria malagaensis									
Valvulineria mcdougalli									
Valvulineria miocenica									
Valvulineria miocenica ornata									
Valvulineria cf. V. miocenica ornata									
Valvulineria robusta									
Valvulineria subinequalis									
Verneuilinulla? sp. A									
Verneuilinulla? sp. B									
Virgulinella pertusa									
Bolboforma sp. (alga)									
Prunopyle titan (radiolarian)									

TABLE 12. Checklist of planktic species vs. sections.

Section key: GC = Graves Creek, IC = Indian Creek, LH = Laguna Hills, MQ = Manville Quarry access road, MC = Monterey County roadcuts, NA = Naples Beach, SCI = San Clemente Island, TC = Topanga Canyon, UNB = Upper Newport Bay.

*Zones restricted here to those concurrent within the "Monterey" time interval of N6-N17; based on Ingle (1973b), Kennett and Srinivasan (1983), Keller (1984), Bolli and Saunders (1985), and this study.

Solid boxes denote presence of species.

PLANKTIC FORAMINIFERA	ZONES*	GC	IC	LH	MQ	MC	NA	SCI	TC	UNB
Catapsydrax stainforthi	N6-N7	■								
Globigerina bulloides	N9-N17	■	■	■	■		■	■	■	■
Globigerina connecta?	N6-N7	■								
Globigerina praebulloides	all	■			■		■			■
Globigerina pseudociperoensis	all	■	■		■		■	■	■	■
Globigerina quinqueloba	all	■	■					■		
Globigerina cf. G. woodi	-	■								
Globigerinella aequilateralis	N12-N17						■			■
Globigerinella obesa	all	■	■		■		■	■	■	■
Globigerinella pseudobesa	N13-N17				■					
Globigerinita glutinata	all	■					■		■	■
Globigerinita parkerae	all									■
Globigerinita uvula	N13-N17	■	■		■		■		■	
Globigerinoides altiaperturus	N6-N7	■								
Globigerinoides bulloideus	N17							■		■
Globigerinoides immaturus	all		■				■	■		
Globigerinoides quadrilobatus	N7-N17	■					■			
Globigerinoides subquadratus	N6-N14						■			■
Globoquadrina baroemoenensis	all	■								
Globoquadrina venezuelana	all	■					■			
Globorotalia acrostoma	N4b-N11	■								
Globorotalia birnageae	N6-N8	■								
Globorotalia conoidea	N9-N17									■
Globorotalia mayeri	N6-N14	■	■				■			
Globorotalia cf. Glr. menardii	-				■					
Globorotalia praescitula	N6-N9	■	■				■	■		
Globorotalia cf. Glr. praescitula	-	■					■	■		
Globorotalia zealandica	N6-N8	■								
Globorotaloides suteri relizensis	N6-N8	■					■			
Globorotaloides trema	all				■		■			■
Neogloboquadrina acostaensis	N15-N17									■
Neogloboquadrina continuosa	N6-N16	■								■
Neogloboquadrina pachyderma	N16-N17				■			■		
Orbulina suturalis	N9-N17				■		■			■
Orbulina universa	N9-N17				■					
Praeorbulina glomerosa circularis	N8-N9						■			■
Praeorbulina glomerosa var. A	-									■
Praeorbulina glomerosa var. B	-									■
Praeorbulina transitoria	N7-N9						■			
Protentella prolixa	N7?, N10-N14	■								■
Tenuitellinata angustiumbilicata	all	■	■	■	■		■	■	■	■

TABLE 13. Checklist of maximum relative abundance of benthic species vs. section/age. (1 of 5)
Section key: LH = Laguna Hills, MQ = Manville Quarry access road, MC = Monterey County roadcuts, SCI = San Clemente Island, TC = Topanga Canyon, UNB = Upper Newport Bay.
Stage key: S = Saucesian, R = Relizian, L = Luisian, M = Mohnian.
Abundance key: A = abundant, C = common, F = few, R = rare, VR = very rare.

SECTION:	Graves Creek			Indian Creek			LH	MQ	MC	Naples Beach				SCI		TC	UNB		COMPOSITE			
STAGE:	S	R	L	S	R	L	L	M	M	S	R	L	M	L	M	M	L	M	S	R	L	M
BENTHICS NO. ASSEMBL:	3	12	4	5	12	21	6	23	5	20	11	39	40	17	2	44	10	21	28	35	97	135
Ambitropus evax		VR						R					C	VR		VR		A		VR	VR	A
Ammobaculites? sp. A																R						R
Ammobaculites? sp. B		VR																		VR		
Ammodiscus incertus			VR				R					F									F	
Amphicoryna catesbyi																	VR				VR	
Amphimorphina amchitkaensis		A												F						A	F	
Anomalinoides salinasensis	A	A	A			VR				A	R	A		A			F		A	A	A	
Astacolus crepidulus										VR				VR				R	VR		VR	R
Astacolus cf. A. cymboides	VR	R											X						VR	R		
Astacolus mayi																		R				R
Astacolus naplesensis										C									C			
Astacolus sp. A																						VR
Astacolus sp. B		VR	R																	VR	R	
Astacolus sp. C		VR																		VR		
Astacolus sp. D														R	F			VR			R	F
Astacolus sp. E												VR									VR	
Astacolus sp. F		F	VR									VR?								F	VR	
Astacolus sp. G							VR			R		VR							R		VR	
Astacolus sp. H	VR																		VR			
Astrononion goudkoffi					F			C				VR	C			C		F		F	VR	C
Baggina californica		A	VR			F	C				C	A	C	A	A		A	C		A	A	A
Bathysiphon sanctaecrucis																VR						VR
Bolivina advena	A	A	A		A	A				A	A	A	A	A	A		A	A	A	A	A	A
Bolivina advena ornata		A	A	R	A	A	A					A		A		A	A		R	A	A	A
Bolivina benedictensis													R			C		A				A
Bolivina blakei		A		C	A	A					A	A		A					C	A	A	
Bolivina bramlettei								R									A	A			A	A
Bolivina brevior s.l.		R	A		A	A	C	A	F	A	A	A	A	A		A	A	A	A	A	A	A
Bolivina brevior dunlapi														C			A	A			A	A
Bolivina californica	C	A	A		A	A	A	A		A	A	A	A	A	A	C	A	A	A	A	A	A
Bolivina churchi	VR	A		A		R					R	A	A	A			VR	A	A	A	A	A
Bolivina conica		A		VR								C		A					VR	A	C	
Bolivina cuneiformis												C									C	
Bolivina cf. B. euplectella				VR															VR			
Bolivina exilicostata																		A				A
Bolivina foraminata				R	A			F	A			C	C			C		A	R	A	C	A
Bolivina girardensis								A					A			A		A				A
Bolivina granti		A	R					A					A	C		A		F		A	C	A
Bolivina hughesi				R				A					A			A		A	R			A
Bolivina cf. B. hughesi var. A																	VR				VR	
Bolivina cf. B. hughesi var. B							VR														VR	
Bolivina humilis																		F				F
Bolivina imbricata		F	A	A	R	A	A					F		A		R	A		F	A	A	R
Bolivina interjuncta								R														R
Bolivina isaacsi										A	A								A	A		
Bolivina modeloensis		F	VR					R				VR	F	F		C		F		F	F	C
Bolivina mulleri												R									R	
Bolivina mullicostata									R													R
Bolivina parva?													X									VR
Bolivina predecussata													A			F		F				A
Bolivina pseudobeyrichi																	C	R			C	R
Bolivina pseudospissa	VR	F	R		R			A	X		A	A	A	A		A	R	A	VR	A	A	A
Bolivina cf. B. sabahensis																	VR				VR	
Bolivina salinasensis	A	F	R					C		C		A	F	A		F	R	A	A	F	A	A
Bolivina santanaensis																		C				C
Bolivina spissa					R						C					C		A		C		A
Bolivina ticensis								VR														VR
Bolivina tongi filacostata	F	VR						VR		VR		A	F				R	C	F	VR	A	C
Bolivina tumida s.l.	VR	A	A	F	A	A	A	A		A	A	A	C	A	A	A	A	A	A	A	A	A
Bolivina wissleri									F				VR					A				A
Bolivina woodringi								A	R				A		R	A		F				A
Bolivina woodruffi								F										A				A
Bolivina sp. A												VR					R				R	
Bolivina sp. B																		VR				VR
Bolivina sp. C																		R				R
Bolivina sp. D																		R				R
Bolivina sp. E																		R				R
Bolivina sp. F					VR	F														VR	F	
Bolivina sp. G								R														R
Bolivina sp. H								F										F				F

TABLE 13. Checklist of maximum relative abundance of benthic species vs. section/age. (2 of 5)
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SECTION:	Graves Creek			Indian Creek			LH	MQ	MC	Naples Beach				SCI		TC	UNB		COMPOSITE			
STAGE:	S	R	L	S	R	L	L	M	M	S	R	L	M	L	M	M	L	M	S	R	L	M
BENTHICS NO. ASSEMBL:	3	12	4	5	12	21	6	23	5	20	11	39	40	17	2	44	10	21	28	35	97	135
Bolivina sp. I												R					VR				R	
Bolivina sp. J							R						R								R	R
Bolivina sp. K														F							F	
Bolivina sp. L																	VR				VR	
Buccella oregonensis		R	R				F			VR		VR		C		F	VR	R	R	F	C	R
Bulimina alligata										F									F			
Bulimina cf. B. hebespinata		VR																		VR		
Bulimina inflata								F					R	A			VR	A			A	A
Bulimina subacuminata	A	F										R		A					A	F	A	
Bulimina subcalva	C	VR											VR						C	VR		VR
Buliminella brevior								VR								A						A
Buliminella californica				VR														F	VR			
Buliminella curta					F	A		F	A	VR		F	A			R		F	VR	F	A	A
Buliminella elegantissima		VR	R	A		F	C		A	R	R	R	VR	VR		VR	VR	VR	R	R	C	A
Buliminella semihispida									R				C									C
Buliminella subfusiformis	A	A	A	A	A	A	A	A	R	A	A	A	C	A	A	A	A	A	A	A	A	A
Cancris baggi		R	C			F	R			R	VR	F		A					R	R	A	
Cancris lippsi				A															A			
Cancris planus										C		R		R			C		C		C	
Cassidulinella renulinaformis								A					R			A		A				A
Chilostomella ovoidea	F	F			R		VR										A	F	F	F	A	F
Chilostomina pustulosa		F						VR										F		F		F
Chrysalogonium californiensis	VR	VR																	VR	VR		
Cibicides cf. C. farctus														R							R	
Cibicides pumilus	VR	F	R			VR	R			VR		R		R				R	VR	F	R	R
Cibicides sp. A																VR						VR
Cibicides sp. B																VR						VR
Cibicides sp. C																VR		VR				VR
Cibicides sp. D					VR		R					VR		C						VR	C	
Cibicidina sp. A							F							F							F	
Cibicidina sp. B																VR						VR
Cibicidoides cushmani	R	A								F									F	A		
Cibicidoides mckannai																	VR	R			VR	R
Concavella gyroidinaformis															A			A				A
Cyclammina incisa																			X			
Dentalina cf. ?D. antennula								R														R
Dentalina atascaderoensis		VR																		VR		
Dentalina cf. D. baggi						VR						F	R					F			F	F
Dentalina communis		VR																		VR		
Dentalina grandis												F	VR				R				F	R
Dentalina lagoei	VR	VR																	VR	VR		
Dentalina pseudoinvolvens														R							R	
Dentalina pseudoobliqua		C	C	R	R	R	F					C	R	C			F		R	C	C	R
Dentalina roemeri	VR	VR	VR											R				VR	VR	VR	VR	VR
Dentalina sp. A										VR									VR			
Dentalina sp. B														VR			F				F	
Dentalina sp. C																		R				R
Dentalina sp. D							R			R		VR							R		VR	
Dentalina sp. E													R					R				R
Dentalina sp. F		VR																		R		
"Dentalina" sp.																		F				F
Duplella baggi		VR	VR																	VR	VR	
Duplella lacrima		VR																		VR		
Ehrenbergina alata														VR							VR	
Elphidium granti		R	R		VR		R							A		VR	R			R	A	VR
Enantiodentalina murail	R	A	VR		C	R				R									R	A	R	
Epistominella discorbisoides								F								F						F
Epistominella pacifica	VR	C	A						X				VR									X
Epistominella smithi	VR	C	A			F				C		R	F	VR		R	C	A	C	C	A	A
Evolutononion dumonti																		A				A
Fissurina gravesensis		VR	VR																	VR	VR	
Fissurina cf. F. laevigata labiata		VR	VR											F						VR	F	
Fissurina longipunctata		VR																		VR		
Fissurina natlandi	VR	R	VR									R		F					VR	R	F	
Fissurina quasimarginata	VR	R												VR					VR	R	VR	
Fissurina sp. A																		VR				VR
Fissurina sp. B																		VR				VR
Fissurina sp. C												VR									VR	
Fissurina sp. D	VR												VR						VR			VR
Fissurina sp. E												VR									VR	

TABLE 13. Checklist of maximum relative abundance of benthic species vs. section/age. (3 of 5)
Section key: LH = Laguna Hills, MQ = Manville Quarry access road, MC = Monterey County roadcuts, SCI = San Clemente Island, TC = Topanga Canyon, UNB = Upper Newport Bay.
Stage key: S = Saucesian, R = Relizian, L = Luisian, M = Mohnian.
Abundance key: A = abundant, C = common, F = few, R = rare, VR = very rare.

SECTION:	Graves Creek			Indian Creek			LH	MQ	MC	Naples Beach				SCI		TC	UNB		COMPOSITE			
STAGE:	S	R	L	S	R	L	L	M	M	S	R	L	M	L	M	M	L	M	S	R	L	M
BENTHICS NO. ASSEMBL:	3	12	4	5	12	21	6	23	5	20	11	39	40	17	2	44	10	21	28	35	97	135
Fissurina sp. F																VR						VR
Fissurina sp. G														VR				VR			VR	VR
Fissurina sp. H		VR																		VR		
Fissurina sp. I				VR															VR			
Fissurina sp. J						VR															VR	
Frondicularia cf. F. bulbosa	VR	R																	VR	R		
Frondicularia sp. A			VR																		VR	
Frondicularia sp. B													VR									VR
Fursenkoina subplana												VR		VR			VR				VR	
Fursenkoina sp. A													R									R
Fursenkoina sp. B	VR	VR					VR												VR	VR	VR	
Fursenkoina sp. C																	VR				VR	
Galliherina uvigerinaformis s.l.													A		A	R		A				A
Galliherina sp.																F						F
Gaudryina exilis							VR														VR	
Gaudryina pliocenica	F						VR												F		VR	
Gaudryina subglabrata				VR			F			C									C		F	
Gavelinopsis durhami		VR																		VR		
Gavelinopsis garveyensis												R	C			R					R	C
Gavelinopsis hoikos		R	VR											F			VR	VR		R	F	VR
Gavelinopsis sp.								VR?										VR				VR
Glandulina sp.																		VR				VR
Globocassidulina monicana								C				A	A	A	A	C	R	A			A	A
Globocassidulina neomargareta	F	F								C	C								C	C		
Globocassidulina neopulchella		A																		A		
Guttulina sp.		VR									VR							VR		VR		
Gyroidina healdi	VR	F						VR				R	A			C		A	VR	F	R	A
Gyroidina cf. G. keenani																VR						VR
Gyroidina rosaformis s.l.	C	A	A		R	R		A		A	VR?	A	A	A		A	A	A	C	A	A	A
Hansenisca altiformis					VR											VR				VR		VR
Hansenisca multicamerata								C				VR	F			A		C			VR	A
Hansenisca rotundimargo		F	A				F	F			VR	A	F	A	R	A	A	C		F	A	A
Hanzawaia cf. H. crassiseptа	C		R																C		R	
Hanzawaia depaoloi	C	F	R	A	VR?	VR	C			R	VR	R	F	A	A	R	F	C	C	F	A	A
Haplophragmoides? sp. A						VR										C					VR	C
Haplophragmoides? sp. B																VR						VR
Haplophragmoides? sp. C																VR						VR
Haplophragmoides? sp. D										C									C			
Holmanella baggi	R	F	F					R		F	R	C	VR	A		A	R	A	R	F	A	A
Holmanella valmonteensis								A					A			F		C				A
Hopkinsina magnifica								F					A		A	A		A				A
Hopkinsina sp. A								VR										R				R
Hopkinsina sp. B														VR							VR	
Hopkinsina sp. C																		VR				VR
Hyalinonetrion "elongata"	VR																VR	VR	VR		VR	VR
Islandiella californica																		F				F
Islandiella carinata	VR	R		F							VR							R		VR		R
Islandiella modeloensis	VR	C	R		R	VR	A	C		R	VR	A	A	A	F	A	F	A	R	C	A	A
Islandiella spp. (indet. globose juv.)								R														R
Kleinpella californiensis s.l.	C	F	F	R	A	A	C	A		A	A	F	A	R		C	A	A	A	A	A	A
Kleinpella sp. A																		R				R
Kleinpella sp. B																		R				R
Lagena apiopleura		R	R	VR								VR	VR	F	VR				VR	R	F	VR
Lagena apiopleura?							R														R	
Lagena discrepans	VR																	VR	VR			VR
Lagena laevis		VR	VR	VR															VR	VR	VR	
Lagena lisbonensis	VR	VR																	VR	VR		
Lagena meridionalis				VR											VR				VR			VR
Lagena mexicana	VR																		VR			
Lagena pacifica		VR																		VR		
Lagena cf. L. pliocenica	VR	VR												R	VR				VR	VR	R	VR
Lagena semilineata				R														VR	R			VR
Lagena cf. L. striata																		VR				VR
Lagena timmsana	VR	R	R											VR			VR		VR	R	R	
Lagena sp. A																		VR				VR
Lagena sp. B					VR													VR		VR		VR
Lagena sp. C	VR																		VR			
Lagena sp. D														VR		VR					VR	VR
Lagena sp. E														VR							VR	
Lenticulina atascaderoensis	A	F	F		VR	VR				R	R								A	F	F	

TABLE 13. Checklist of maximum relative abundance of benthic species vs. section/age. (4 of 5)
Section key: LH = Laguna Hills, MQ = Manville Quarry access road, MC = Monterey County roadcuts, SCI = San Clemente Island, TC = Topanga Canyon, UNB = Upper Newport Bay.
Stage key: S = Saucesian, R = Relizian, L = Luisian, M = Mohnian.
Abundance key: A = abundant, C = common, F = few, R = rare, VR = very rare.

SECTION:	Graves Creek			Indian Creek			LH	MQ	MC	Naples Beach				SCI		TC	UNB		COMPOSITE			
STAGE:	S	R	L	S	R	L	L	M	M	S	R	L	M	L	M	M	L	M	S	R	L	M
BENTHICS NO. ASSEMBL:	3	12	4	5	12	21	6	23	5	20	11	39	40	17	2	44	10	21	28	35	97	135
Lenticulina barroni	VR			F										VR					F		VR	
Lenticulina branneri			A															R			A	
Lenticulina cushmani?																						R
Lenticulina douglasi													R					A				A
Lenticulina dubia		R	VR								VR	F					R			R	F	
Lenticulina cf. L. dubia		VR	VR																	VR	VR	
Lenticulina cf. L. gerlandi													F	F							F	F
Lenticulina hughesi		C																		C		
Lenticulina indianensis					C															C		
Lenticulina luciana		A	VR		VR	F														A	F	
Lenticulina miocenica			A			R	R					R		C			VR				A	
Lenticulina reedi		VR	VR								C	R	R	R	C			A		C	R	A
Lenticulina sandholdtana	VR	C	F																VR	C	F	
Lenticulina smileyi s.l.	C	R	C	A	F	R	A			A	F	F	VR	A	VR	R		F	A	F	A	A
Lenticulina sp. A												VR		VR							VR	
Lenticulina sp. B											F									F		
Lenticulina sp. C		F																		F		
Lenticulina sp. D																VR						VR
Lenticulina sp. E														VR							VR	
Lenticulina sp. F													F									F
Lenticulina sp. G		VR	VR											F						VR	F	
Lernella sp.																		F				F
Lobatula lobatula							VR														VR	
Loxostomoides digitata														A	A		C	A			A	A
Marginulina crouchi		R			R	VR						R								R	R	
Marginulina subbullata																		R				R
Marginulina sp.		VR	VR									VR		VR						VR	VR	
Marginulinopsis beali		F	C	F	R	F	C				R?	F		C			R		F	F	C	
Marginulinopsis sp.	VR																		VR			
Martinottiella communis?																R						R
Megastomella capitanensis		F			VR							F	C		C	R		C		F	C	C
Megastomella purisima		F				C						F								F	C	
Neoeponides navarrettei							R					VR		A		VR					A	VR
Nodogenerina cf. N. bradyi								VR						VR				R			VR	R
Nodogenerina parexilis	F	F								R			C	F					F	F	F	C
Nodogenerina parkeri		VR			VR									F						VR	F	
Nodogenerina sagrinensis	C	F	R					R			R	R		A				A	C	F	A	A
Nodogenerina tappani		F																F		F		
Nodogenerina sp.																		VR				VR
Nodosaria cf. N. anomala														F							F	
Nodosaria ewaldi	R	VR	VR		R			VR		VR		R	F	R		R	F	A	R	R	F	A
Nodosaria franki		VR		VR															VR	VR		
Nodosaria irregularis	VR	VR	VR					F					F	F		R		VR	VR	VR	F	F
Nodosaria obispoensis		VR	R											C						VR	C	
Nodosaria cf. N. ovalis								R														R
Nodosaria perversa	R	F	VR							R				F				R	R	F	F	A
Nodosaria "spinescens"								R														R
Nodosaria weaveri	VR	R												VR					VR	R	VR	
Nodosaria sp. A																		R				R
Nodosaria sp. B								VR														VR
Nonionella miocenica		VR	VR	A	F	A	C		A		C			R		F	VR	A	A	C	A	A
Nonionellina milleri	VR	F	F		A	A		VR				R		F		F			VR	A	A	F
Oolina borealis														R		F	VR				R	F
Oolina cf. O. borealis	VR	R	VR									VR		R					VR	R	R	
Oolina elongata		VR	VR																	VR	VR	
Oolina globosa setosa		VR																		VR		
Oolina hexagona	VR	VR										VR		VR					VR	VR	VR	
Oolina melo		R	R					VR								F		VR		R	R	F
Oridorsalis relizana											R									R		
Oridorsalis subtenera	R	C																	R	C		
Oridorsalis umbonata	F	F														F		F	F	F		F
Paracassidulina? crescentaperta																		VR				VR
Paracassidulina delicata		VR						F					C			R		A		VR		A
Parafissurina sp. A												VR									VR	
Parafissurina sp. B	VR																		VR			
Parafrondicularia miocenica	F	C		VR						C	F								C	C		
Planorbulina sp.		VR																		VR		
Planulina sp.																VR						VR
Plectofrondicularia californica		C												F						C	F	
Praeglobobulimina galliheri								VR	X			R	VR		VR	R	F	A			F	A

TABLE 13. Checklist of maximum relative abundance of benthic species vs. section/age. (5 of 5)
Section key: LH = Laguna Hills, MQ = Manville Quarry access road, MC = Monterey County roadcuts, SCI = San Clemente Island, TC = Topanga Canyon, UNB = Upper Newport Bay.
Stage key: S = Saucesian, R = Relizian, L = Luisian, M = Mohnian.
Abundance key: A = abundant, C = common, F = few, R = rare, VR = very rare.

SECTION:	Gravea Creek			Indian Creek			LH	MQ	MC	Naples Beach				SCI		TC	UNB		COMPOSITE			
STAGE:	S	R	L	S	R	L	L	M	M	S	R	L	M	L	M	M	L	M	S	R	L	M
BENTHICS NO. ASSEMBL:	3	12	4	5	12	21	6	23	5	20	11	39	40	17	2	44	10	21	28	35	97	135
Praeglobobulimina spinifera	R	R						R										F	R	R		F
Procerolagena sp.																		VR				VR
Protoglobobulimina pseudotorta	F	A		A	C	A	F	F	X	VR	R	A	A	A	VR	A	A	A	A	A	A	A
Proxifons advena	A	C	C	A				R							R	VR		C	A	C	C	C
Proxifons vaughani																		R				R
Proxifons sp.														R				VR			R	VR
Pseudonodosaria obtusissima																		R				R
Pseudononion basispinatum	VR	F	VR	VR			F				F			A			VR		VR	F	A	
Pseudononion cosliferum	VR	R	A	A	R	A	C			C	F	VR		C		R	A	F	A	F	A	F
Pseudononion multicameratum												VR		R			R	A			R	A
Pseudononion schencki									A							VR?						A
Pseudoparrella californica													F			A		A				A
Pseudoparrella subperuviana	R	A	A	A	A	A	F	A	VR	A	A	A	A	A	A	A	C	A	A	A	A	A
Pullenia inglei		A						F					F			F		A		A		A
Pullenia malkinae		F						F		VR		VR	R	F		VR		R	VR	F	F	R
Pullenia miocenica			A			R	C					A		A		R	A	VR			A	R
Pullenia salisburyi																		VR				VR
Pullenia sp.																		VR				VR
Quadrimorphina sp.																		R				R
Quinqueloculina seminulum							VR														VR	
Rectuvigerina branneri	F	A	A			A	A			C	VR	A		A		R	C		C	A	A	R
Rectuvigerina hughesi		A	VR		F									R						A	F	
Rectuvigerina loeblichi		A			F															A		
Rectuvigerina transversa	A									A	R								A	R		
Reophax cf. R. excenlicus		VR																		VR		
Reussolina simplex	VR	VR																	VR	VR		
Rosalina californica	VR	F																	VR	F		
Rutherfordoides californiensis	VR	R	VR							R		VR							R	R	VR	
Saracenaria schencki										R									R			
Siphonodosaria advena	A	A	C		F	R		VR		A	C	A	F	A	VR	R	VR	A	A	A	A	A
Siphonodosaria montereyana	F	A										R	F	F				F	F	A	F	F
Siphonodosaria quadrulata	F	A										F	C	F	VR		VR	A	F	A	F	A
Siphonodosaria sp.		VR																VR		VR		VR
Sphaeroidina chilostomata	VR	R						C				A	A			F	R	F	VR	R	A	A
Spirosigmoilina tenuis		VR																		VR		
Stainforthia nodosa																	F				F	
Suggrunda inflata	VR	R		VR		R				R	VR						VR	R	R	R	R	R
Suggrunda kleinpelli	A	F		VR		VR	C	VR		A	A	VR				R	F	A	A	A	C	A
Textularia cf. T. warrenites																VR						VR
Textularia sp.							R							F							F	
Tremachora arga																VR		R				R
Trifarina fluens	VR			A										A				VR	A		A	VR
Uvigerina hannai					A		F	R		F		VR	A			A	A	A	F	A	A	A
Uvigerina cf. U. hannai		VR																		VR		
Uvigerina cf. U. hispidocostata		VR																		VR		
Uvigerina hootsi	F	C	F		A			C					A	F	A	A	A	A	F	A	A	A
Uvigerina segundoensis				A				R				VR					R	C	A		R	C
Uvigerina cf. U. segundoensis																		VR				VR
Uvigerina senticosa								VR					VR					VR				VR
Uvigerina subperegrina	A	A	VR	R	A	A	C	A	X		A	F	A	A	C	A	F	A	A	A	A	A
Uvigerina subperegrina f. impolita										A	C								A	C		
Uvigerina sp. A										VR									VR			
Uvigerina sp. B									F													F
Uvigerina sp. C													VR									VR
Uvigerina sp. D											VR		VR							VR		VR
Uvigerinella californica	A	A	F	A	F	A				A	C	A	R	F		VR	VR		A	A	A	R
Uvigerinella californica ornata		F	C	A	R	F	R	VR				A	F	C	A	VR	R	VR	A	F	A	A
Vaginulina cf. V. dubia		VR																		VR		
Vaginulina cf. V. tenuis	VR																		VR			
Valvulineria californica		A	A	C	A	A	A			VR	VR	A	C	A	C	A	A	F	C	A	A	A
Valvulineria malagaensis												R	R			C		C			R	C
Valvulineria mcdougalli								C										C				C
Valvulineria miocenica	A	C	R	R	A	A	A			A	A	C		F			A		A	A	A	
Valvulineria miocenica ornata										A		R		F			A		A		A	
Valvulineria cf. V. miocenica ornata										A									A			
Valvulineria robusta	A	A	A		A	A		R		R	F	C	F	A	R	R	F	A	A	A	A	A
Valvulineria subinequalis											F	VR	A	F	C	C		F		F	F	A
Verneuilinulla? sp. A																R						R
Verneuilinulla? sp. B																R						R
Virgulinella pertusa							VR										R	VR			R	VR

TABLE 14. Checklist of number of occurrences of benthic species vs. section/age. (1 of 4)
Section key: LH = Laguna Hills, MQ = Manville Quarry access road, MC = Monterey County roadcuts, SCI = San Clemente Island, TC = Topanga Canyon, UNB = Upper Newport Bay.
Stage key: S = Saucesian, R = Relizian, L = Luisian, M = Mohnian.

SECTION:	Graves Creek			Indian Creek			LH	MQ	MC	Naples Beach				SCI		TC	UNB		COMPOSITE (%)			
STAGE:	S	R	L	S	R	L	L	M	M	S	R	L	M	L	M	M	L	M	S	R	L	M
BENTHICS NO. ASSEMBL:	3	12	4	5	12	21	6	23	5	20	11	39	40	17	2	44	10	21	28	35	97	135
Ambitropus ovax		1						11					8	1		4		8	0	3	1	23
Ammobaculites? sp. A																2			0	0	0	1
Ammobaculites? sp. B		1																	0	3	0	0
Ammodiscus incertus			1				1					4							0	0	6	0
Amphicoryna catesbyi																	1		0	0	1	0
Amphimorphina arnchitkaensis		4												2					0	11	2	0
Anomalinoides salinasensis	2	8	4			1				10	2	29		12			3		43	29	51	0
Astacolus crepidulus										1				1				2	4	0	1	1
Astacolus cf. A. cymboides	1	4																	4	11	0	0
Astacolus mayi																		2	0	0	0	1
Astacolus naplesensis										1									4	0	0	0
Astacolus sp. A													1						0	0	0	1
Astacolus sp. B		2	2																0	6	2	0
Astacolus sp. C		1																	0	3	0	0
Astacolus sp. D														1	1			1	0	0	1	1
Astacolus sp. E		3	1																0	9	1	0
Astacolus sp. F												1							0	0	1	0
Astacolus sp. G							1			1		1							4	0	2	0
Astacolus sp. H	1																		4	0	0	0
Astrononion goudkoffi					2			16				1	5			18		8	0	6	1	35
Baggina californica		6	1			2	3				1	28	3	17	2		4	6	0	20	57	8
Bathysiphon sanctaecrucis																1			0	0	0	1
Bolivina advena	3	5	4		4	4				18	7	33	8	5	2		4	5	75	46	52	11
Bolivina advena ornata		4	4	1	11	15	5					22		15		2	9		4	43	72	1
Bolivina benedictensis													2			1		5	0	0	0	6
Bolivina blakei		7		1	9	2					9	1		2					4	71	5	0
Bolivina bramlettei								6									2	16	0	0	2	16
Bolivina brevior s.l.		2	2		5	10	6	22	2	17	7	24	33	9		34	8	7	61	40	61	73
Bolivina brevior dunlapi														1			5	1	0	0	6	1
Bolivina californica	2	12	4		11	2	3	16		16	9	30	17	15	2	13	8	13	64	91	64	45
Bolivina churchi	1	11		4		1					1	14	2	5			1	5	18	34	22	5
Bolivina conica		7		1								8		2					4	20	10	0
Bolivina cuneiformis												2							0	0	2	0
Bolivina cf. B. euplectella				1															4	0	0	0
Bolivina exilicostata																		1	0	0	0	1
Bolivina foraminata				1	1			13	4			2	7			4		4	4	3	2	24
Bolivina girardensis								19					23			14		4	0	0	0	44
Bolivina granti		5	1					5					12	1		6		2	0	14	2	19
Bolivina hughesi				1				10					18			18		11	4	0	0	42
Bolivina cf. B. hughesi var. A																	1		0	0	1	0
Bolivina cf. B. hughesi var. B							3												0	0	3	0
Bolivina humilis																		2	0	0	0	1
Bolivina imbricata		3	3	1	1	8	4					4		7		1	5		4	11	32	1
Bolivina interjuncta								1											0	0	0	1
Bolivina isaacsi										9	3								32	9	0	0
Bolivina modeloensis		4	3					4				1	13	2		16		2	0	11	6	26
Bolivina mullen												3							0	0	3	0
Bolivina multicostata									1										0	0	0	1
Bolivina parva?													1						0	0	0	1
Bolivina predecussata													5			1		1	0	0	0	5
Bolivina pseudobeyrichi																	2	1	0	0	2	1
Bolivina pseudospissa	1	8	2		1			20	1		6	21	34	6		31	4	10	4	43	34	71
Bolivina cf. B. sabahensis																	1		0	0	1	0
Bolivina salinasensis	3	2	1					13		1		13	5	2		5	2	10	14	6	19	24
Bolivina santanaensis																		1	0	0	0	1
Bolivina spissa					1						2					6		4	0	9	0	7
Bolivina ticensis								1											0	0	0	1
Bolivina tongi fitacostata	3	1						1		1		5	8				1	3	14	3	6	9
Bolivina tumida s.l.	2	9	4	3	9	12	6	3		11	7	17	6	11	2	7	10	16	57	71	62	25
Bolivina wissleri									1				1					4	0	0	0	4
Bolivina woodringi								21	1				9		1	18		4	0	0	0	40
Bolivina woodruffi																		2	0	0	0	1
Bolivina sp. A												1					1		0	0	2	0
Bolivina sp. B																		1	0	0	0	1
Bolivina sp. C																		3	0	0	0	2
Bolivina sp. D																		1	0	0	0	1
Bolivina sp. E																		1	0	0	0	1
Bolivina sp. F					2	1													0	6	1	0
Bolivina sp. G								1											0	0	0	1
Bolivina sp. H								1										1	0	0	0	1
Bolivina sp. I												8					2		0	0	10	0
Bolivina sp. J							1						1						0	0	1	1
Bolivina sp. K														1					0	0	1	0
Bolivina sp. L																	1		0	0	1	0
Buccella oregonensis		3	4				2			1		2		5		6	1	2	4	9	14	6
Bulimina alligata										3									11	0	0	0
Bulimina cf. B. hebespinata		3																	0	9	0	0
Bulimina inflata								10					4	4			1	9	0	0	5	17
Bulimina subacuminata	2	7										2		2					7	20	4	0
Bulimina subcalva	2	2											1						7	6	0	1
Buliminella brevior								1								4			0	0	0	4
Buliminella californica				1														1	4	0	0	1
Buliminella curta					4	1		10	5	1		1	16			6		2	4	11	2	29
Buliminella elegantissima		3	4	2		2	4		4	7	4	1	1	1		2	1	1	32	20	13	6
Buliminella semihispida													3						0	0	0	2
Buliminella subfusiformis	3	12	4	5	9	18	6	20	1	19	11	38	23	13	2	21	10	19	96	91	92	64
Cancris baggi		3	3			4	3			2	1	9		7					7	11	27	0
Cancris lippsi				4															14	0	0	0

TABLE 14. Checklist of number of occurrences of benthic species vs. section/age. (2 of 4)
Section key: LH = Laguna Hills, MQ = Manville Quarry access road, MC = Monterey County roadcuts, SCI = San Clemente Island, TC = Topanga Canyon, UNB = Upper Newport Bay.
Stage key: S = Saucesian, R = Relizian, L = Luisian, M = Mohnian.

SECTION:	Graves Creek			Indian Creek			LH	MQ	MC	Naples Beach				SCI		TC	UNB		COMPOSITE (%)			
STAGE:	S	R	L	S	R	L	L	M	M	S	R	L	M	L	M	M	L	M	S	R	L	M
BENTHICS NO. ASSEMBL:	3	12	4	5	12	21	6	23	5	20	11	39	40	17	2	44	10	21	28	35	97	135
Cancris planus										4		1		2			2		14	0	5	0
Cassidulinella renulinaformis								10					2			7		2	0	0	0	16
Chilostomella ovoidea	2	6			2		1										3	2	7	23	4	1
Chilostomina pustulosa		1						1										5	0	3	0	4
Chrysalogonium californiensis	1	1																	4	3	0	0
Cibicides cf. C. fletus														1					0	0	1	0
Cibicides pumilus	1	8	4			1	3			3		8		2				1	14	23	19	1
Cibicides sp. A																5			0	0	0	4
Cibicides sp. B																1			0	0	0	1
Cibicides sp. C																2		1	0	0	0	2
Cibicides sp. D					1		2					1		1					0	3	4	0
Cibicidina sp. A							1							2					0	0	3	0
Cibicidina sp. B																1			0	0	0	1
Cibicidoides cushmani	2	5								2									14	14	0	0
Cibicidoides mckannai																	1	2	0	0	1	1
Concavella gyroidinaformis															2			5	0	0	0	5
Cyclammina incisa																			0	0	0	0
Dentalina cf. ?D. antennula								7											0	0	0	5
Dentalina atascaderoensis		1																	0	3	0	0
Dentalina cf. D. baggi						1						7	2					5	0	0	8	5
Dentalina communis		3																	0	9	0	0
Dentalina grandis												11	1				2		0	0	13	1
Dentalina lagoei	1	1																	4	3	0	0
Dentalina pseudoinvolvens														1					0	0	1	0
Dentalina pseudoobliqua		10	4	1	3	2	3					22	1	10			3		4	37	45	1
Dentalina roemeri	1	5	1											2				1	4	14	3	1
Dentalina sp. A										2									7	0	0	0
Dentalina sp. B														1			1		0	0	2	0
Dentalina sp. C																		2	0	0	0	1
Dentalina sp. D							2			2		1							7	0	3	0
Dentalina sp. E													1					2	0	0	0	2
Dentalina sp. F		1																	0	3	0	0
"Dentalina" sp.																		1	0	0	0	1
Duplella baggi		3	1																0	9	1	0
Duplella lacrima		1																	0	3	0	0
Ehrenbergina alata														1					0	0	1	0
Elphidium granti		3	3		1		4							2		1	3		0	11	12	1
Enantiodentalina murali	3	9	4		7	3				7									36	46	7	0
Epistominella discorbisoides								3					1			2			0	0	0	4
Epistominella pacifica									1										0	0	0	1
Epistominella smithi	2	6	3			1				1		2	6	1		2	1	6	11	17	8	10
Evolutononion dumonti													1					5	0	0	0	4
Fissurina gravesensis		1	2																0	3	2	0
Fissurina cf. F. laevigata labiata		3	1											1					0	9	2	0
Fissurina longipunctata		2																	0	6	0	0
Fissurina nellandi	3	8	3									1		1					11	23	5	0
Fissurina quasimarginata	2	3												2					7	9	2	0
Fissurina sp. A																		1	0	0	0	1
Fissurina sp. B																		1	0	0	0	1
Fissurina sp. C												1							0	0	1	0
Fissurina sp. D	1												1						4	0	0	1
Fissurina sp. E												1							0	0	1	0
Fissurina sp. F																1			0	0	0	1
Fissurina sp. G														1				1	0	0	1	1
Fissurina sp. H		1																	0	3	0	0
Fissurina sp. I				1															4	0	0	0
Fissurina sp. J						1													0	0	1	0
Frondicularia cf. F. bulbosa	1	8																	4	23	0	0
Frondicularia sp. A			2																0	0	2	0
Frondicularia sp. B													1						0	0	0	1
Fursenkoina subplana												1		1			1		0	0	3	0
Fursenkoina sp. A													1						0	0	0	1
Fursenkoina sp. B	1	2					1												4	6	1	0
Fursenkoina sp. C																	1		0	0	1	0
Galliherina uvigerinaformis s.l.													9		2	5		6	0	0	0	16
Galliherina sp.																4			0	0	0	3
Gaudryina exilis							1												0	0	1	0
Gaudryina pliocenica	1						1												4	0	1	0
Gaudryina subglabrata				1			1			1									7	0	1	0
Gavelinopsis durhami		2																	0	6	0	0
Gavelinopsis garveyensis												2	2			2			0	0	2	3
Gavelinopsis hokos		4	2											1			1	2	0	11	4	1
Gavelinopsis sp.																		1	0	0	0	1
Glandulina sp.																		1	0	0	0	1
Globocassidulina monicana								10				25	24	7	2	12	2	12	0	0	35	44
Globocassidulina neomargareta	3	3								13	9								57	34	0	0
Globocassidulina neopulchella		11																	0	31	0	0
Guttulina sp.		3										2						1	0	9	2	1
Gyroidina heaidi	1	3						1				1	7			9		8	4	9	1	19
Gyroidina cf. G. keenani																1			0	0	0	1
Gyroidina rosaformis s.l.	3	12	4		6	2		14		4		29	22	12		8	4	8	25	51	53	39
Hansenisca altiformis					1											1			0	3	0	1
Hansenisca multicamerata								11				2	2			4		10	0	0	2	20
Hansenisca rotundimarga		5	4				2	8			1	30	5	11	1	24	7	7	0	17	56	33
Hanzawaia cf. H. crassiseptа	2		2																7	0	2	0
Hanzawaia depaolai	3	12	4	3		3	4			3	3	9	4	8	2	2	1	5	32	43	30	10
Haplophragmoides? sp. A						1										5			0	0	1	4
Haplophragmoides? sp. B																2			0	0	0	1

TABLE 14. Checklist of number of occurrences of benthic species vs. section/age. (3 of 4)
Section key: LH = Laguna Hills, MQ = Manville Quarry access road, MC = Monterey County roadcuts, SCI = San Clemente Island, TC = Topanga Canyon, UNB = Upper Newport Bay.
Stage key: S = Saucesian, R = Relizian, L = Luisian, M = Mohnian.

SECTION:	Graves Creek			Indian Creek			LH	MQ	MC	Naples Beach				SCI		TC	UNB		COMPOSITE (%)			
STAGE:	S	R	L	S	R	L	L	M	M	S	R	L	M	L	M	M	L	M	S	R	L	M
BENTHICS NO. ASSEMBL:	3	12	4	5	12	21	6	23	5	20	11	39	40	17	2	44	10	21	28	35	97	135
Haplophragmoides? sp. C																2			0	0	0	1
Haplophragmoides? sp. D										3									11	0	0	0
Holmanella baggi	1	8	4					7		3	1	23	1	11		16	6	11	14	26	45	26
Holmanella valmonteensis								18					11			5		5	0	0	0	29
Hopkinsina magnifica								5					5		1	5		5	0	0	0	16
Hopkinsina sp. A								4										3	0	0	0	5
Hopkinsina sp. B														1					0	0	1	0
Hopkinsina sp. C																		1	0	0	0	1
Hyalinonetrion "elongata"	1																1	2	4	0	1	1
Islandiella californica																		3	0	0	0	2
Islandiella carinata	1	3		3							1							2	14	11	0	1
Islandiella modeloensis	1	12	4		7	1	5	10		5	1	22	8	12	2	15	4	8	21	57	49	32
Islandiella spp. (indet. globose juv.)								1											0	0	0	1
Kleinpella californiensis s.l.	3	10	4	1	8	14	6	14		17	3	10	18	4		5	9	15	75	60	48	39
Kleinpella sp. A																		2	0	0	0	1
Kleinpella sp. B																		1	0	0	0	1
Lagena apiopleura		7	2	1								2	1	3	1				4	20	7	1
Lagena apiopleura?							2												0	0	2	0
Lagena discrepans	1																	1	4	0	0	1
Lagena laevis		1	1	1															4	3	1	0
Lagena lisbonensis	2	2																	7	6	0	0
Lagena meridionalis				1											1				4	0	0	1
Lagena mexicana	1																		4	0	0	0
Lagena pacifica		1																	0	3	0	0
Lagena cf. L. pliocenica	1	1												1	1				4	3	1	1
Lagena semilineata				1														2	4	0	0	1
Lagena cf. L. striata				1														1	4	0	0	1
Lagena timmsana	1	3	2											2			1		4	9	5	0
Lagena sp. A																		1	0	0	0	1
Lagena sp. B					1													1	0	3	0	1
Lagena sp. C	1																		4	0	0	0
Lagena sp. D														2		1			0	0	2	1
Lagena sp. E														1					0	0	1	0
Lenticulina atascaderoensis	3	8	1		1	1				4	1								25	29	2	0
Lenticulina barroni	1			1										1					7	0	1	0
Lenticulina branneri			4																0	0	4	0
Lenticulina cushmani?																		2	0	0	0	1
Lenticulina douglasi													2					7	0	0	0	7
Lenticulina dubia		5	3								1	15					2		0	17	21	0
Lenticulina cf. L. dubia		3	1																0	9	1	0
Lenticulina cf. L. gerlandi													1	5					0	0	5	1
Lenticulina hughesi		12																	0	34	0	0
Lenticulina indianensis					1														0	3	0	0
Lenticulina luciana		12	1		1	1													0	37	2	0
Lenticulina miocenica			4			1	2					2		7			1		0	0	18	0
Lenticulina reedi		2	2								5	3	7	1	1			5	0	20	6	10
Lenticulina sandholdtana	1	4	1																4	11	1	0
Lenticulina smileyi s.l.	3	7	4	2	5	2	4			17	5	18	2	12	1	2		2	79	49	41	5
Lenticulina sp. A												1		1					0	0	2	0
Lenticulina sp. B											3								0	9	0	0
Lenticulina sp. C		2																	0	6	0	0
Lenticulina sp. D																2			0	0	0	1
Lenticulina sp. E														1					0	0	1	0
Lenticulina sp. F													6						0	0	0	4
Lenticulina sp. G		1	1											3					0	3	4	0
Lemella sp.																		1	0	0	0	1
Lobatula lobatula							1												0	0	1	0
Loxostomoides digitata														7	2		3	8	0	0	10	7
Marginulina crouchi		6			3	1						2							0	26	3	0
Marginulina subbullata																		1	0	0	0	1
Marginulina sp.		2	1									1		1					0	6	3	0
Marginulinopsis beali		5	4	1	2	13	4					16		7			2		4	20	47	0
Marginulinopsis sp.	1																		4	0	0	0
Martinottiella communis?																1			0	0	0	1
Megastomella capitanensis		6			1							3	1		2	1		2	0	20	3	4
Megastomella purisima		2				1						2							0	6	3	0
Neoeponides navarrettei							2					1		1		2			0	0	4	1
Nodogenerina cf. N. bradyi								1					1	1				1	0	0	1	2
Nodogenerina paroxilis	2	11								3		2	1	1					18	31	3	1
Nodogenerina parkeri		1			1									1					0	6	1	0
Nodogenerina sagrinensis	3	10	4					7			3	6		6				5	11	37	16	9
Nodogenerina tappani		2																	0	6	0	0
Nodogenerina sp.																		1	0	0	0	1
Nodosaria cf. N. anomala														1					0	0	1	0
Nodosaria ewaldi	3	2	1		1			4		1		4	17	1		6	2	11	14	9	8	28
Nodosaria franki		3		1															4	9	0	0
Nodosaria irregularis	1	1	1					6					6	2		1		3	4	3	3	12
Nodosaria obispoensis		2	3											4					0	6	7	0
Nodosaria cf. N. ovalis								1											0	0	0	1
Nodosaria perversa	2	10	1							2				5				2	14	29	6	1
Nodosaria "spinescens"								1											0	0	0	1
Nodosaria weaveri	2	8												1					7	23	1	0
Nodosaria sp. A																		1	0	0	0	1
Nodosaria sp. B								1											0	0	0	1
Nonionella miocenica		2	2	2	2	7	4		1		3			2		4	1	5	7	20	16	7
Nonionellina milleri	1	11	3		9	4	4	1				3		2		2			4	57	16	2
Oolina borealis														5		3	1		0	0	6	2
Oolina cf. O. borealis	1	8	3									1		1					4	23	5	0
Oolina elongata		3	1																0	9	1	0

TABLE 14. Checklist of number of occurrences of benthic species vs. section/age. (4 of 4)
Section key: LH = Laguna Hills, MQ = Manville Quarry access road, MC = Monterey County roadcuts, SCI = San Clemente Island, TC = Topanga Canyon, UNB = Upper Newport Bay.
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SECTION:	Graves Creek			Indian Creek			LH	MQ	MC	Naples Beach				SCI		TC	UNB		COMPOSITE (%)			
STAGE:	S	R	L	S	R	L	L	M	M	S	R	L	M	L	M	M	L	M	S	R	L	M
BENTHICS NO. ASSEMBL:	3	12	4	5	12	21	6	23	5	20	11	39	40	17	2	44	10	21	28	35	97	135
Oolina globosa setosa		1																	0	3	0	0
Oolina hexagona	1	2										1		1					4	6	2	0
Oolina melo		2	2					1								3		6	0	6	2	7
Oridorsalis relizana											5								0	14	0	0
Oridorsalis subtenera	1	4																	4	11	0	0
Oridorsalis umbonata	2	3														3		2	7	9	0	4
Paracassidulina? crescentaperta																		1	0	0	0	1
Paracassidulina delicata		1						11					14			9		6	0	3	0	30
Parafissurina sp. A												1							0	0	1	0
Parafissurina sp. B	1																		4	0	0	0
Parafrondicularia miocenica	1	7		1						8	9								36	46	0	0
Planorbulina sp.		1																	0	3	0	0
Planulina sp.																1			0	0	0	1
Plectofrondicularia californica		10												5					0	29	5	0
Praeglobobulimina gallineri								1	1			2	1		1	1	2	12	0	0	4	13
Praeglobobulimina spinifera	1	2						1										4	4	6	0	4
Proceroiagena sp.																		1	0	0	0	1
Protoglobobulimina pseudotorta	3	12		2	6	2	3	9	2	1	3	6	19	9	1	5	9	16	21	60	30	39
Proxifons advena	3	8	1	2						1					1	1		8	21	23	1	7
Proxifons vaughani																		2	0	0	0	1
Proxifons sp.														1				1	0	0	1	1
Pseudonodosaria obtusissima																		3	0	0	0	2
Pseudononion basispinatum	1	7	3	1			4				7			1			1		7	40	9	0
Pseudononion costiferum	2	9	3	4	2	17	6			5	6	1		9		1	7	4	39	49	44	4
Pseudononion multicameratum												1		5			4	4	0	0	10	3
Pseudononion schencki									5										0	0	0	4
Pseudoparrella californica													14			4		3	0	0	0	16
Pseudoparrella subperuviana	2	12	4	4	12	13	5	20	1	13	8	34	27	13	2	26	6	15	68	91	77	67
Pullenia inglei		7						8					5			3		4	0	20	0	15
Pullenia malkinae		9						1		1		3	2	2		2		2	4	26	5	5
Pullenia miocenica			4			2	2					29		13		3	7	2	0	0	59	4
Pullenia salisburyi																		2	0	0	0	1
Pullenia sp.																		1	0	0	0	1
Quadrimorphina sp.																		2	0	0	0	1
Quinqueloculina seminulum							1												0	0	1	0
Rectuvigerina branneri	3	6	4			6	2			4	2	26		17		1	4		25	23	61	1
Rectuvigerina hughesi		11	1		1									4					0	34	5	0
Rectuvigerina loeblichi		10			1														0	31	0	0
Rectuvigerina transversa	3									12	1								54	3	0	0
Reophax cf. R. excenticus		1																	0	3	0	0
Reussolina simplex	1	5																	4	14	0	0
Rosalina californica	1	1																	4	3	0	0
Rutherfordoides californiensis	1	3	2							1		1							7	9	3	0
Saracenaria schencki										2									7	0	0	0
Siphonodosaria advena	3	12	4		8	1		1		17	4	15	12	7	1	3	1	10	71	69	29	20
Siphonodosaria montereyana	3	7										6	3	1				6	11	20	7	7
Siphonodosaria quadrulata	3	9										6	7	7	1		1	9	11	26	14	13
Siphonodosaria sp.		2																1	0	6	0	1
Sphaeroidina chilostomata	1	5						9				12	5			14	1	5	4	14	13	24
Spirosigmoilina tenuis		1																	0	3	0	0
Stainforthia nodosa																	1		0	0	1	0
Suggrunda inflata	1	8		1		1				3	1						1	1	18	26	2	1
Suggrunda kleinpelli	3	3		2		1	1	6		15	8	2				2	2	11	71	31	6	14
Textularia cf. T. warrenites																1			0	0	0	1
Textularia sp.							2							1					0	0	3	0
Tremachora arga																1		2	0	0	0	2
Triforina fluens	2			1										2				3	11	0	2	2
Uvigerina hannai					1		1	3		2		1	5			10	1	10	7	3	3	21
Uvigerina cf. U. hannai		1																	0	3	0	0
Uvigerina cf. U. hispidocostata		3																	0	9	0	0
Uvigerina hootsi	2	5	4		1			12					17	1	2	26	3	13	7	17	8	52
Uvigerina segundoensis				1				2				1					1	4	4	0	2	4
Uvigerina cf. U. segundoensis																		1	0	0	0	1
Uvigerina senticosa								1					3					1	0	0	0	4
Uvigerina subperegrina	3	10	2	1	12	3	1	14	2		7	9	30	11	1	26	3	15	14	83	30	65
Uvigerina subperegrina f. impolita										11	1								39	3	0	0
Uvigerina sp. A										1									4	0	0	0
Uvigerina sp. B									1										0	0	0	1
Uvigerina sp. C													1						0	0	0	1
Uvigerina sp. D											1		1						0	3	0	1
Uvigerinella californica	2	9	4	1	1	5				3	8	10	1	2		2	1		21	51	23	2
Uvigerinella californica ornata		8	3	1	4	1	3	1				23	4	7	2	1	4	2	4	34	42	7
Vaginulina cf. V. dubia		1																	0	3	0	0
Vaginulina cf. V. tenuis	2																		7	0	0	0
Valvulineria californica		12	4	3	10	20	6			1	1	31	5	16	2	5	9	2	14	66	89	10
Valvulineria malagasensis												1	2			17		8	0	0	1	20
Valvulineria mcdougalli								6										4	0	0	0	7
Valvulineria miocenica	3	10	2	1	2	12	6			13	10	13		3			2		61	63	39	0
Valvulinera miocenica ornata										2		7		5			7		7	0	20	0
Valvulineria cf. V. miocenica ornata										3									11	0	0	0
Valvulineria robusta	3	12	4		5	3		3		2	3	12	12	8	1	1	3	8	18	57	31	19
Valvulineria subinequalis											1	1	3	3	1	1		7	0	3	4	9
Verneuilinulla? sp. A																1			0	0	0	1
Verneuilinulla? sp. B																5			0	0	0	4
Virgulinella pertusa							1										1	3	0	0	2	2

TABLE 15. Checklist of benthic species vs. occurrences and maximum abundance. (1 of 2)
Stage key: S = Saucesian, R = Relizian, L = Luisian, M = Mohnian.
Abundance key: A = abundant, C = common, F = few, R = rare, VR = very rare.

	OCCURRENCE				MAX. ABUNDANCE			
BENTHICS STAGE:	S	R	L	M	S	R	L	M
Ambitropus avax		R	VR	F		VR	VR	A
Ammobaculites? sp. A				VR				R
Ammobaculites? sp. B		R				VR		
Ammodiscus incertus			F				F	
Amphicoryna catesbyi			VR				VR	
Amphimorphina amchitkaensis		F	R			A	F	
Anomalinoides salinasensis	F	F	C		A	A	A	
Astacolus crepidulus	VR		VR	VR	VR		VR	R
Astacolus cf. A. cymboides	R	F			VR	R		
Astacolus mayi				VR				R
Astacolus naplesensis	R				C			
Astacolus sp. A				VR				VR
Astacolus sp. B		F	R			VR	R	
Astacolus sp. C		R				VR		
Astacolus sp. D			VR	VR			R	F
Astacolus sp. E			VR			F	VR	
Astacolus sp. F		R	VR				VR	
Astacolus sp. G	R		R		R		VR	
Astacolus sp. H	R				VR			
Astrononion gouldkoffi		F	VR	C		F	VR	C
Baggina californica		F	C	F		A	A	A
Bathysiphon sanctaecrucis				VR				VR
Bolivina advena	A	C	C	F	A	A	A	A
Bolivina advena ornata	R	C	A	VR	R	A	A	A
Bolivina benedictensis				F				A
Bolivina blakei	R	A	R		C	A	A	
Bolivina bramlettei			R	F			A	A
Bolivina brevior s.l.	C	C	C	A	A	A	A	A
Bolivina brevior dunlapi			F	VR			A	A
Bolivina californica	C	A	C	C	A	A	A	A
Bolivina churchi	F	C	F	R	A	A	A	A
Bolivina conica	R	F	F		VR	A	C	
Bolivina cuneiformis			R				C	
Bolivina cf. B. euplectella	R				VR			
Bolivina exilicostata				VR				A
Bolivina foraminata	R	R	R	F	R	A	C	A
Bolivina girardensis				C				A
Bolivina grantı		F	R	F		A	C	A
Bolivina hughesi	R			C	R			A
Bolivina cf. B. hughesi var. A			VR				VR	
Bolivina cf. B. hughesi var. B			R				VR	
Bolivina humilis				VR				F
Bolivina imbricata	R	F	F	VR	F	A	A	R
Bolivina interjuncta				VR				R
Bolivina isaacsi	C	F			A	A		
Bolivina modeloensis		F	F	F		F	F	C
Bolivina mullen			R				R	
Bolivina multicostata				VR				R
Bolivina parva?				VR				VR
Bolivina predecussata				R				A
Bolivina pseudobeyrichi			R	VR			C	R
Bolivina pseudospissa	R	C	C	A	VR	A	A	A
Bolivina cf. B. sabahensis			VR				VR	
Bolivina salinasensis	F	F	F	F	A	F	A	A
Bolivina santanaensis				VR				C
Bolivina spissa		F		F		C		A
Bolivina ticensis				VR				VR
Bolivina tongi filacostata	F	R	F	F	F	VR	A	C
Bolivina turnida s.l.	C	A	C	F	A	A	A	A
Bolivina wissleri				R				A
Bolivina woodringi				C				A
Bolivina woodruffi				VR				A
Bolivina sp. A			R				R	
Bolivina sp. B				VR				VR
Bolivina sp. C				R				R
Bolivina sp. D				VR				R
Bolivina sp. E				VR				R
Bolivina sp. F		F	VR			VR	F	
Bolivina sp. G				VR				R
Bolivina sp. H				R				F
Bolivina sp. I			F				R	
Bolivina sp. J			VR	VR			R	R
Bolivina sp. K			VR				F	
Bolivina sp. L			VR				VR	
Buccella oregonensis	R	F	F	F	R	F	C	R
Bulimina aligata	F				F			
Bulimina cf. B. hebespinata		F				VR		
Bulimina inflata			R	F			A	A
Bulimina subacuminata	F	F	R		A	F	A	
Bulimina subcalva	F	F		VR	C	VR		VR
Bulimina brevior				R				A
Bulimina californica	R			VR	VR			F
Bulimina curta	R	F	R	F	VR	F	A	A
Bulimina elegantissima	F	F	F	F	R	R	C	A
Bulimina semihispida				R				C
Bulimina subfusiformis	A	A	A	C	A	A	A	A
Cancris baggi	F	F	F		R	R	A	
Cancris planus	F		R		C		C	

	OCCURRENCE				MAX. ABUNDANCE			
BENTHICS STAGE:	S	R	L	M	S	R	L	M
Cancris sp.	F				A			
Cassidulinella renulinaformis				F				A
Chilostomella ovoidea	F	F	R	VR	F	F	A	F
Chilostomina pustulosa		R		R		F		F
Chrysalogonium californiensis	R	R			VR	VR		
Cibicides cf. C. farctus			VR				R	
Cibicides pumilus	F	F	F	VR	VR	F	R	R
Cibicides sp. A				R				VR
Cibicides sp. B				VR				VR
Cibicides sp. C				R				VR
Cibicides sp. D		R	R			VR	C	
Cibicidina sp. A			R				F	
Cibicidina sp. B				VR				VR
Cibicidoides cushmani	F	F			F	A		
Cibicidoides mckannai			VR	VR			VR	R
Concavella gyroidinaformis				R				A
Cyclammina incisa	X				X			
Dentalina cf. ?D. antennula				R				R
Dentalina atascaderoensis		R				VR		
Dentalina cf. D. baggi			F	R			F	F
Dentalina communis		F				VR		
Dentalina grandis			F	VR			F	R
Dentalina lagoei	R	R			VR	VR		
Dentalina pseudoinvolvens			VR				R	
Dentalina pseudoobliqua	R	C	C	VR	R	C	C	R
Dentalina roemeri	R	F	R	VR	VR	VR	VR	VR
Dentalina sp. A	F				VR			
Dentalina sp. B			R				F	
Dentalina sp. C				VR				R
Dentalina sp. D	F		R		R		VR	
Dentalina sp. E				R				R
Dentalina sp. F		R				R		
"Dentalina" sp.				VR				F
Duplella baggi		F	VR			VR	VR	
Duplella lacrima		R				VR		
Ehrenbergina alata			VR				VR	
Elphidium grantı		F	F	VR		R	A	VR
Enantiodentalina murani	C	C	F		R	A	R	
Epistominella discorbisoides				R				F
Epistominella pacifica				VR				X
Epistominella smithi	F	F	F	F	C	C	A	A
Evolutinonion dumonti				F				A
Fissurina gravesensis		R	R			VR	VR	
Fissurina cf. F. laevigata labiata		F	R			VR	F	
Fissurina longipunctata		F				VR		
Fissurina natlandi	F	F	R		VR	R	F	
Fissurina quasimarginata	F	F	R		VR	R	VR	
Fissurina sp. A				VR				VR
Fissurina sp. B				VR				VR
Fissurina sp. C			VR				VR	
Fissurina sp. D	R			VR	VR			VR
Fissurina sp. E			VR				VR	
Fissurina sp. F				VR				VR
Fissurina sp. G			VR	VR			VR	VR
Fissurina sp. H		R				VR		
Fissurina sp. I	R				VR			
Fissurina sp. J			VR				VR	
Frondiculana cf. F. bulbosa	R	F			VR	R		
Frondiculana sp. A			R				VR	
Frondiculana sp. B				VR				VR
Fursenkoina subplana			R				VR	
Fursenkoina sp. A				VR				R
Fursenkoina sp. B	R	F	VR		VR	VR	VR	
Fursenkoina sp. C			VR				VR	
Gallitellina uvigerinaformis s.l.				F				A
Gallitellina sp.				R				F
Gaudryina exilis			VR				VR	
Gaudryina pliocenica	R		VR		F		VR	
Gaudryina subglabrata	F		VR		C		F	
Gavelinopsis durhami		F				VR		
Gavelinopsis garveyensis			R	R			R	C
Gavelinopsis hokos		F	R	VR		R	F	VR
Gavelinopsis sp.				VR				VR
Glandulina sp.				VR				VR
Globocassidulina monicana			C	C			A	A
Globocassidulina neomargareta	C	C			C	C		
Globocassidulina neopulchella		C				A		
Guttulina sp.		F				VR		
Gyroidina healdi	R	F	VR	F	VR	F	R	A
Gyroidina cf. G. keenani				VR				VR
Gyroidina rosaformis s.l.	F	C	C	C	C	A	A	A
Hansenisca altiformis		R		VR		VR		VR
Hansenisca multicamerata			R	F			VR	A
Hansenisca rotundimargo		F	C	C		F	A	A
Hanzawaia cf. H. crassisepta	F		R		C		R	
Hanzawaia depaoloi	F	C	F	F	C	F	A	A
Haplophragmoides? sp. A			VR	R			VR	C
Haplophragmoides? sp. B				VR				VR

TABLE 15. Checklist of benthic species vs. occurrences and maximum abundance. (2 of 2)
Stage key: S = Saucesian, R = Relizian, L = Luisian, M = Mohnian.
Abundance key: A = abundant, C = common, F = few, R = rare, VR = very rare.

	OCCURRENCE				MAX. ABUNDANCE					OCCURRENCE				MAX. ABUNDANCE			
BENTHICS STAGE:	S	R	L	M	S	R	L	M	BENTHICS STAGE:	S	R	L	M	S	R	L	M
Haplophragmoides? sp. C				VR				VR	*Oolina cf. O. borealis*	R	F	R		VR	R	R	
Haplophragmoides? sp. D	F				C				*Oolina elongata*		F	VR			VR	VR	
Holmanella baggi	F	F	C	F	R	F	A	A	*Oolina globosa setosa*		R				VR		
Holmanella valmonteensis				F				A	*Oolina hexagona*	R	F	R		VR	VR	VR	
Hopkinsina magnifica				F				A	*Oolina melo*		F	R	F		R	R	F
Hopkinsina sp. A				R				R	*Oridorsalis relizana*		F				R		
Hopkinsina sp. B			VR				VR		*Oridorsalis subtenera*	R	F			R	C		
Hopkinsina sp. C				VR				VR	*Oridorsalis umbonata*	F	F		R	F	F		F
Hyalinonetrion "elongata"	R		VR	VR	VR		VR	VR	*Paracassidulina? crescentaperta*				VR				VR
Islandiella californica				R				F	*Paracassidulina delicata*		R		F		VR		A
Islandiella carinata	F	F		VR	F	R		R	*Parafissurina sp. A*			VR				VR	
Islandiella modeloensis	F	C	C	F	R	C	A	A	*Parafissurina sp. B*	R				VR			
Islandiella spp. (indet. globosa juv.)				VR				R	*Parafrondiculana miocenica*	C	C			C	C		
Kleinpella californiensis s.l.	A	C	C	C	A	A	A	A	*Planorbulina sp.*		R				VR		
Kleinpella sp. A				VR				R	*Planulina sp.*				VR				VR
Kleinpella sp. B				VR				R	*Plectofrondicularia californica*		F	R			C	F	
Lagena apiopleura	R	F	F	VR	VR	R	F	VR	*Praeglobobulimina gallineri*			R	F			F	A
Lagena apiopleura?			R				R		*Praeglobobulimina spinifera*	R	F		R	R	R		F
Lagena discrepans	R			VR	VR			VR	*Procerolagena sp.*				VR				VR
Lagena laevis	R	R	VR		VR	VR	VR		*Protoglobobulimina pseudotorta*	F	C	C	C	A	A	A	A
Lagena lisbonensis	F	F			VR	VR			*Proxifons advena*	F	F	VR	R	A	C	C	C
Lagena meridionalis	VR			VR	VR			VR	*Proxifons vaughani*				VR				R
Lagena mexicana	R				VR				*Proxifons sp.*			VR	VR			R	VR
Lagena pacifica		R				VR			*Pseudonodosaria obtusissima*				R				R
Lagena cf. L. pliocenica	R	R			VR	VR	R	VR	*Pseudononion basispinatum*	F	C	F		VR	F	A	
Lagena semilineata	R			VR	R			VR	*Pseudononion costiferum*	C	C	C	R	A	F	A	F
Lagena cf. L. striata	VR			VR	R			VR	*Pseudononion multicameratum*			F	R			R	A
Lagena timmsana	R	F	R		VR	R	R		*Pseudononion schencki*				R				A
Lagena sp. A				VR				VR	*Pseudoparrella californica*				F				A
Lagena sp. B		R		VR		VR		VR	*Pseudoparrella subperuviana*	A	A	A	A	A	A	A	A
Lagena sp. C	R				VR				*Pullenia inglei*		F		F		A		A
Lagena sp. D			R	VR			VR	VR	*Pullenia malkinae*	R	F	R	R	VR	F	F	R
Lagena sp. E			VR				VR		*Pullenia miocenica*			C	R			A	R
Lenticulina atascaderoensis	F	F	R		A	F	F		*Pullenia salisburyi*				VR				VR
Lenticulina barroni	F		VR		F		VR		*Pullenia sp.*				VR				VR
Lenticulina branneri			R				A		*Quadrimorphina sp.*				VR				R
Lenticulina cushmani?				VR				R	*Quinqueloculina seminulum*			VR				VR	
Lenticulina douglasi				F				A	*Rectuvigerina branneri*	F	F	C	VR	C	A	A	R
Lenticulina dubia		F	F			R	F		*Rectuvigerina hughesi*		C	R			A	F	
Lenticulina cf. L. dubia		F	VR			VR	VR		*Rectuvigerina loeblichi*		F				A		
Lenticulina cf. L. gerlandi			R	VR			F	F	*Rectuvigerina transversa*	C	VR			A	R		
Lenticulina hughesi		C				C			*Reophax cf. R. excenticus*		R				VR		
Lenticulina indianensis		R				C			*Reussolina simplex*	R	F			VR	VR		
Lenticulina luciana		C	R			A	F		*Rosalina californica*	R	R			VR	F		
Lenticulina miocenica			F				A		*Rutherfordoides californiensis*	F	F	R		R	R	VR	
Lenticulina reedi		F	F	F		C	R	A	*Saracenaria schencki*	F				R			
Lenticulina sandholdtana	R	F	VR		VR	C	F		*Siphonodosaria advena*	A	A	F	F	A	A	A	A
Lenticulina smileyi s.l.	A	C	C	R	A	F	A	A	*Siphonodosaria montereyana*	F	F	F	F	F	A	F	F
Lenticulina sp. A			R				VR		*Siphonodosaria quadrulata*	F	F	F	F	F	A	F	A
Lenticulina sp. B		F				F			*Siphonodosaria sp.*		F		VR		VR		VR
Lenticulina sp. C		F				F			*Sphaeroidina chilostomata*	R	F	F	F	VR	R	A	A
Lenticulina sp. D				VR				VR	*Spirosigmoilina tenuis*		R				VR		
Lenticulina sp. E			R				VR		*Stainforthia nodosa*			VR				F	
Lenticulina sp. F				R				F	*Suggrunda inflata*	F	F	R	VR	R	R	R	R
Lenticulina sp. G		R	R			VR	F		*Suggrunda kleinpelli*	A	F	F	F	A	A	C	A
Lernella sp.				VR				F	*Textularia cf. T. warreniles*				VR				VR
Lobatula lobatula			VR				VR		*Textularia sp.*			R				F	
Loxostomoides digitata			F	F			A	A	*Tremachora arga*				R				R
Marginulina crouchi		F	R			R	R		*Trifarina fluens*	F		R	R	A		A	VR
Marginulina subbullata				VR				R	*Uvigerina hannai*	F	R	R	F	F	A	A	A
Marginulina sp.		F	R			VR	VR		*Uvigerina cf. U. hannai*		R				VR		
Marginulinopsis beali	R	F	C		F	F	C		*Uvigerina cf. U. hispidocostata*		F				VR		
Marginulinopsis sp.	R				VR				*Uvigerina hootsi*	F	F	F	C	F	A	A	A
Martinottiella communis?				VR				R	*Uvigerina segundoensis*	R		R	R	A		R	C
Megastomella capitanensis		F	R	R		F	C	C	*Uvigerina cf. U. segundoensis*				VR				VR
Megastomella purisima		F	R			F	C		*Uvigerina senticosa*				R				VR
Neosponides navarrettei			R	VR			A	VR	*Uvigerina subperegrina*	F	A	F	C	A	A	A	A
Nodogenerina cf. N. bradyi			VR	R			VR	R	*Uvigerina subperegrina f. impolita*	C	R			A	C		
Nodogenerina paresilis	F	F	R	VR	F	F	F	C	*Uvigerina sp. A*	R				VR			
Nodogenerina parkeri		F	VR			VR	F		*Uvigerina sp. B*				VR				F
Nodogenerina sagrinensis	F	C	F	F	C	F	A	A	*Uvigerina sp. C*				VR				VR
Nodogenerina tappani		F				F			*Uvigerina sp. D*		R		VR		VR		VR
Nodogenerina sp.				VR				VR	*Uvigerinella californica*	F	C	F	R	A	A	A	R
Nodosaria cf. N. anomala			VR				F		*Uvigerinella californica ornata*	R	C	C	F	A	F	A	A
Nodosaria ewaldi	F	F	F	F	R	R	F	A	*Vaginulina cf. V. dubia*		R				VR		
Nodosaria franki	R	F			VR	VR			*Vaginulina cf. V. tenuis*	F				VR			
Nodosaria irregularis	R	R	R	F	VR	VR	F	F	*Valvulineria californica*	F	C	A	F	C	A	A	A
Nodosaria obispoensis		F	F			VR	C		*Valvulineria malagaensis*			VR	F			R	C
Nodosaria cf. N. ovalis				VR				R	*Valvulineria mcdougalli*				F				C
Nodosaria perversa	F	F	F	VR	R	F	F	A	*Valvulineria miocenica*	C	C	C		A	A	A	
Nodosaria "spinescens"				VR				R	*Valvulineria miocenica ornata*	F		F		A		A	
Nodosaria weaveri	F	F	VR		VR	R	VR		*Valvulineria cf. V. miocenica ornata*	F				A			
Nodosaria sp. A				VR				R	*Valvulineria robusta*	F	C	F	F	A	A	A	A
Nodosaria sp. B				VR				VR	*Valvulineria subinequalis*		R	R	F		F	F	A
Nonionella miocenica	F	F	F	F	A	C	A	A	*Verneuilinulla? sp. A*				VR				R
Nonionellina milleri	R	F	F	R	VR	A	A	F	*Verneuilinulla? sp. B*				R				R
Oolina borealis			F	R			R	F	*Virgulinella pertusa*			R	R			R	VR

SYSTEMATICS

Suborder TEXTULARIINA Delage and Hérouard, 1896
Superfamily ASTRORHIZACEA Brady, 1881
Family BATHYSIPHONIDAE Avnimelech, 1952
BATHYSIPHON M. Sars, 1872
Type species: *Bathysiphon filiformis* M. Sars, 1872.
Bathysiphon sanctaecrucis Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 1, pl. 1, figs. 1, 2.
Plate 1, fig. 1.

Superfamily AMMODISCACEA Reuss, 1862
Family AMMODISCIDAE Reuss, 1862
Subfamily AMMODISCINAE Reuss, 1862
AMMODISCUS Reuss, 1862
Type species: *Ammodiscus infimus* L. G. Bornemann, 1874.
Ammodiscus incertus (d'Orbigny) = *Operculina incerta* d'Orbigny, 1839, Hist. Phys. Nat. Cuba, p. 49; v. 8, pl. 6, figs. 16, 17.
Plate 1, figs. 2-5.

Superfamily HORMOSINACEA Haeckel, 1894
Family HORMOSINIDAE Haeckel, 1894
Subfamily REOPHACINAE Cushman, 1910
REOPHAX de Montfort, 1808
Type species: *Reophax scorpiurus* de Montfort, 1808.
Reophax* cf. *R. excenticus Cushman, 1910, U. S. Natl. Mus., Bull., no. 71, pt. 1, p. 92, fig. 134.
Plate 1, fig. 6.
Remarks: Cushman's species, described from the Holocene of the Bering Sea, has more rapidly enlarging chambers. Rarity precludes designation of new species.

Superfamily LITUOLACEA de Blainville, 1827
Family LITUOLIDAE de Blainville, 1827
Subfamily AMMOMARGINULININAE Podobina, 1978
AMMOBACULITES Cushman, 1910
***Ammobaculites*? sp. A**
Plate 1, fig. 7.
Remarks: Test more rectilinear than *Ammobaculites*? sp. B. Rarity precludes designation of new species.
***Ammobaculites*? sp. B**
Plate 1, fig. 8.
Remarks: Test more curvilinear than *Ammobaculites*? sp. A. Rarity and poor preservation preclude designation of new species.

Family HAPLOPHRAGMOIDIDAE Maync, 1952
HAPLOPHRAGMOIDES Cushman, 1910
Type species: *Nonionina canariensis* d'Orbigny, 1839.
***Haplophragmoides*? sp. A**
Plate 1, figs. 9, 10.
Remarks: Coarser grained and less robust than *Haplophragmoides*? sp. B, more robust than *H.*? spp. C and D. Poor preservation precludes certainty of generic assignment and designation of new species.
***Haplophragmoides*? sp. B**
Plate 1, figs. 11, 12.
Remarks: Much more robust than other regional *Haplophragmoides*? spp. Rarity and poor preservation preclude certainty of generic assignment and designation of new species.
***Haplophragmoides*? sp. C**
Plate 1, figs. 13, 14.
Remarks: Much more compressed than other regional *Haplophragmoides*? spp. Rarity and poor preservation preclude certainty of generic assignment and designation of new species.
***Haplophragmoides*? sp. D**
Plate 1, figs. 15, 16.
Remarks: Much smaller than other regional *Haplophragmoides*? spp. Poor preservation precludes certainty of generic assignment and designation of new species.

Superfamily LOFTUSIACEA Brady, 1884
Family CYCLAMMINIDAE Marie, 1941
Subfamily CYCLAMMININAE Marie, 1941
CYCLAMMINA Brady, 1879
Type species: *Cyclammina cancellata* Brady, 1879.
Cyclammina incisa (Stache) = *Haplophragmium incisum* Stache, 1864, *Novara* Exped., Geol. Theil, v. 1, pt. 2, p. 165.
Plate 1, figs. 17, 18.
Remarks: As noted in Finger (1990), this probably is not the commonly assigned species of Stache, but its rarity and poor preservation in the available material preclude assignment elsewhere.

Superfamily VERNEUILINACEA Cushman, 1911
Family VERNEUILINIDAE Cushman, 1911
Subfamily VERNEUILININAE Cushman, 1911
GAUDRYINA d'Orbigny, 1839
Type species: *Gaudryina rugosa* d'Orbigny, 1840.
Gaudryina exilis Cushman and Brönnimann, 1948. Contr. Cushman Lab. Foram. Res., v. 24, p. 40, pl. 7, figs. 15a-16.
Plate 1, fig. 19.
Gaudryina pliocenica Cushman, Stewart, and Stewart, 1949, Oregon Dept. Geol. Min. Indust., Bull., no. 36, pt. 7, p. 150, pl. 17, figs. 2a., b.
Plate 1, figs. 20-22.
Gaudryina subglabrata Cushman and McCulloch, 1939, Allan Hancock Pac. Exped., v. 6, no. 1, p. 92, pl. 8, figs. 5-7b.
Plate 1, fig. 23.

Superfamily ATAXOPHRAGMIACEA Schwager, 1877
Family GLOBOTEXTULARIIDAE Cushman, 1927
Subfamily GLOBOTEXTULARIINAE Cushman, 1927
VERNEUILINULLA Saidova, 1975
Type species: *Verneuilinulla tessera* Saidova, 1975.
***Verneuilinulla*? sp. A**
Plate 1, fig. 24.
Remarks: Much more robust and with fewer whorls than *Verneuilinulla*? sp. B. Rarity precludes designation of new species.
***Verneuilinulla*? sp. B**

Plate 1, fig. 25.
Remarks: Much less robust and with more whorls than *Verneuilinulla*? sp. B. Rarity precludes designation of new species.

Superfamily TEXTULARIACEA Ehrenberg, 1838
Family EGGERELLIIDAE Cushman, 1937
Subfamily EGGERELLIINAE Cushman, 1937
MARTINOTTIELLA Cushman, 1933
Type species: *Clavulina communis* d'Orbigny, 1826.
Martinottiella communis? (d'Orbigny) = *Clavulina communis* d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 196, pl. 12, figs. 1, 2.
Plate 1, fig. 26.
Remarks: Although generic assignment is fairly certain, specific name cannot be verified on basis of two very fine-grained uniserial portions recovered.

Family TEXTULARIIDAE Ehrenberg, 1838
Subfamily TEXTULARIINAE Ehrenberg, 1838
TEXTULARIA Defrance, 1824
Type species: *Textularia sagittula* Defrance, in de Blainville, 1824.
Textularia* cf. *T. warrenites Coryell and Rivero, 1940, Jour. Paleont., v. 14, p. 325, pl. 41, fig. 4.
Plate 1, fig. 27.
Remarks: This species resembles *Textularia warrenites* (Miocene, Haiti) in its median ridge, but differs by its test flaring at a greater angle (45°) and having more curved sutures. Unlike *T. warreni* Cushman and Ellisor, 1931, this species is not as compressed, nor are its sutures raised. Rarity and poor preservation preclude designation of new species.
***Textularia* sp.**
Plate 1, fig. 28.
Remarks: Test triangular in front view, rapidly increasing in size, rather thick; chambers nine pair, low and broad, later chambers relatively inflated; sutures curved and incised. More robust and less flaring than *Textularia* cf. *T. warrenites*. Rarity and poor preservation preclude designation of new species.

Suborder MILIOLINA Delage and Hérouard, 1896
Superfamily MILIOLACEA Ehrenberg, 1839
Family HAUERINIDAE Schwager, 1876
Subfamily HAUERININAE Schwager, 1876
QUINQUELOCULINA d'Orbigny, 1826
Type species: *Serpula seminulum* Linné, 1758.
Quinqueloculina seminulum (Linné) = *Serpula seminulum* Linné, 1758, Systema Naturae, ed. 10. v. 1, p. 786. (See neotype figured in Loeblich and Tappan, 1964, Treat. Invert. Paleont., Pt. C, Protista 2, v. 1, p. 459, fig. 349-1a-c.)
Plate 1, fig. 29.

Subfamily SIGMOILINITINAE Luczkowska, 1974
SPIROSIGMOILINA Parr, 1942
Type species: *Spirosigmoilina tateana* Howchin, 1889.
Spirosigmoilina tenuis (Czjzek) = *Quinqueloculina tenuis* Czjzek, 1848, Naturw. Abh., v. 2, pt. 1, p. 149, pl. 13, figs. 31-34.
Plate 1, fig. 30.

Suborder LAGENINA Delage and Hérouard, 1896
Superfamily NODOSARIACEA Ehrenberg, 1838
Family NODOSARIIDAE Ehrenberg, 1838
Subfamily NODOSARIINAE Ehrenberg, 1838
CHRYSALOGONIUM Schubert, 1908
Type species: *Nodosaria polystoma* Schwager, 1866.
Chrysalogonium californiensis Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 22, pl. 1, figs. 6, 7.
Plate 2, figs. 1, 2.

DENTALINA Risso, 1826
Type species: *Nodosaria cuvieri* d'Orbigny, 1826.
Dentalina* cf. *?D. antennula d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 53, pl. 2, figs. 29, 30.
Plate 2, fig. 3.
Remarks: Differs from other regional *Dentalina* in symmetrical barrel-shaped chambers and well-constricted sutures. Middle fragments insufficient for specific designation.
Dentalina atascaderoensis Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 24, pl. 1, fig. 12.
Plate 2, fig. 4.
Dentalina* cf. *D. baggi Galloway and Wissler, 1927, Jour. Paleont., v. 1, no. 1, p. 49, pl. 8, figs., 14, 15.
Plate 2, figs. 5-8.
Remarks: Initial chamber of *Dentalina baggi* (Pliocene, California) is spherical, whereas that characterizing this species is fusiform with a small apical spine.
Dentalina communis d'Orbigny = *Nodosaria* (*Dentaline*) *communis* d'Orbigny, 1826, Ann. Sci. Nat., Paris, sér. 1, v. 7, p. 254.
Plate 2, fig. 9.
Dentalina grandis Reuss = *Nodosaria (Dentalina) grandis* Reuss, 1866, K. Akad. Wiss. Wien, Math.-Naturw. Cl., Denkschr., Wien, v. 25, pt. 1, p. 131, pl. 1, figs. 26-28.
Plate 2, figs. 10-12.
Remarks: The California species is remarkably similar to the form Reuss described from the Oligocene of Germany. *Dentalina* cf. *D. baggi* has less globular chambers; *D. pseudoobliqua* is curvilinear and has a small nonglobular proloculus.
Dentalina lagoei Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 24, pl. 1, fig. 11.
Plate 2, fig. 13.
Dentalina pseudoinvolvens Cushman and McGlamery, 1939, Contr. Cushman Lab. Foram. Res., v. 15, pt. 3, p. 45, pl. 9. figs. 1, 2.
Plate 2, fig. 14.
Remarks: The sole specimen recovered from the Luisian of San Clemente Island is remarkably similar to the primary types from the Alabama Oligocene.
Dentalina pseudoobliqua Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 26, pl. 1, fig. 10 (= *Dentalina obliqua* sensu Kleinpell, 1938, Mio. Strat. Calif., pl. 11, fig. 7, not *Nautilus obliquus* Linné, 1758, Systema Naturae, Ed. 10, v. 1, p. 710).

Plate 2, figs. 15-18.

Dentalina roemeri Neugeboren, 1856, K. Akad. Wiss., Math.-Naturw. Cl., Denkschr., Wien, v. 12, pt. 2, p. 82.

Plate 2, figs. 19-22.

Remarks: The slight apical spine characteristic of the California species is not apparent in the primary types from the Rumanian Neogene.

***Dentalina* sp. A**

Plate 2, fig. 23.

Remarks: Test less slender and chambers less distinct than *Dentalina roemeri*. Rarity precludes designation of new species.

***Dentalina* sp. B**

Plate 2, figs. 24, 25.

Remarks: Elongate urn-shaped chambers widest below midpoint and very constricted sutures differentiate species from comparative forms such as *Dentalina* cf. *D.*? *antennula* and *D.* cf. *D. baggi*. Rarity and fragmentation preclude designation of new species.

***Dentalina* sp. C**

Plate 2, fig. 26.

Remarks: Distinguished primarily by irregular uniseries of chambers widest below midpoint. Possibly aberrant form, but affinity uncertain. Rarity and fragmentation preclude designation of new species.

***Dentalina* sp. D**

Plate 2, figs. 27-29.

Remarks: Differs from *Dentalina roemeri* by its more compact and flaring test. Rarity precludes designation of new species.

***Dentalina* sp. E**

Plate 2, figs. 30, 31.

Remarks: Differs from *Dentalina roemeri* in its prominent apical spine. Rarity and fragmentation preclude designation of new species.

***Dentalina* sp. F**

Plate 2, fig. 32.

Remarks: Distinguished from *Dentalina roemeri* and *D.* sp. E by its bulbous, but not globular, proloculus. Rarity and fragmentation preclude designation of new species.

***"Dentalina"* sp.**

Plate 2, fig. 33.

Remarks: Has less-oblique, nearly flush sutures unlike those of *Dentalina roemeri, D.* sp. E, and *D.* sp. F. Its compressed flange-like apertural neck suggests a new genus, but two specimens recovered may be aberrant. Rarity precludes designation of new genus and species.

ENANTIODENTALINA Marie, 1941

Type species: *Enantiodentalina communis* Marie, 1941.

Enantiodentalina muraii Uchio, 1953, Jap. Jour. Geol. Geogr., Trans., v. 23, p. 152, pl. 14, figs. 1, 2.

Plate 2, figs. 34-47.

Remarks: As described by Uchio, this species is highly variable in test dimensions.

NODOSARIA Lamarck, 1812

Type species: *Nautilus radicula* Linné, 1758.

Nodosaria anomala Reuss, 1866, K. Akad. Wiss., Math.-Naturw. Cl., Denkschr., Wien, v. 25, pt. 1, p. 129, pl. 1, figs. 20-22.

Plate 2, figs. 48, 49.

Nodosaria ewaldi Reuss, 1851, Deutsch. Geol. Ges., Zeitschr., v. 3, p. 58, pl. 3, figs. 2a, b.

Plate 2, figs. 50-53.

Nodosaria franki Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 26, pl. 1, fig. 18.

Plate 2, fig. 54.

Nodosaria irregularis (Kleinpell) = *Nodogenerina irregularis* Kleinpell, 1938, Mio. Strat. Calif., p. 245, pl. 17, fig. 12.

Plate 2, figs. 55-61.

Nodosaria obispoensis Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 28, pl. 1, fig. 17.

Plate 2, figs. 62, 63.

Nodosaria* cf. *N. ovalis Schmid, 1867, Neues Jahrb. Min. Geol. Pal., Stuttgart, p. 585, pl. 6, figs. 50, 51.

Plate 2, fig. 64.

Remarks: Schmid's species (Permian, Germany) has more ovoid chambers separated by more incised and narrower sutures. Differs from all other regional *Nodosaria* in its rapid enlargement of chambers. Rarity and fragmentation preclude designation of new species.

Nodosaria perversa (Neugeboren) = *Dentalina perversa* Neugeboren, 1856, K. Akad. Wiss., Math.-Naturw. Cl., Denkschr., Wien, v. 12, pt. 2, p. 80.

Plate 2, figs. 65, 66.

Nodosaria "spinescens" ≠ *Dentalina spinescens* Reuss, 1851, Deutsch. Geol. Ges., Zeitschr., Berlin, v. 3, p. 62, pl. 3, fig. 10.

Plate 2, fig. 67.

Remarks: Among regional *Nodosaria, Nodogenerina, and Siphonodosaria,* prominent marginal spines are found only on this taxon. Reuss's *Dentalina* species (Eocene, Germany) has nearly identical later chambers, but its early chambers are unornamented and oblique. Rarity and fragmentation preclude designation of new species.

Nodosaria weaveri Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 28, pl. 1, figs. 19, 20.

Plate 2, figs. 68-72.

***Nodosaria* sp. A**

Plate 2, fig. 73.

Remarks: More slender test with thin, elongate neck differentiate this species from *Nodosaria irregularis*. Rarity precludes designation of new species.

***Nodosaria* sp. B**

Plate 2, fig. 74.

Remarks: *N. franki*, the only other costate *Nodosaria* in the regional fauna, has oblique sutures, whereas this species has horizontal sutures, fewer in number and finer in form. Rarity precludes designation of new species.

PSEUDONODOSARIA Boomgaart, 1949

Type species: *Glandulina discreta* Reuss, 1850.

Pseudonodosaria obtusissima (Reuss) = *Glandulina obtusissima* Reuss, 1863, K. Akad. Wiss., Math.-Naturw. Cl., Sitzber., Wien, v. 48, pt. 1, p. 66, pl. 8, figs. 92, 93.

Plate 2, fig. 75.

Subfamily FRONDICULARIINAE Reuss, 1860
FRONDICULARIA Defrance, 1826
Type species: *Renulina complanata* Defrance, in de Blainville, 1824.
Frondicularia* cf. *F. bulbosa Coryell and Rivero, 1940, Jour. Paleont., v. 14, p. 327, pl. 41, fig. 18.
Plate 3, fig. 1.
Remarks: Differs from Coryell and Rivero's species in its more tapering test and presence of some peripheral serration.
***Frondicularia* sp. A**
Plate 3, figs. 2, 3.
Remarks: Differs from *Frondicularia* cf. *F. bulbosa* in less-robust prolocular bulb positioned at the aboral edge. *F.* sp. B differs by its much thicker test with flush surface. Rarity and fragmentation preclude designation of new species.
***Frondicularia* sp. B**
Plate 3, fig. 4.
Remarks: Characterized by thick test with planular surface (due to flush sutures), smooth edges tapering at about 45° from median axis, apical spine, and inset prolocular bulb. Rarity and fragmentation preclude designation of new species.

Subfamily PLECTOFRONDICULARIINAE Cushman, 1927
AMPHIMORPHINA Neugeboren, 1850
Type species: *Amphimorphina haueriana* Neugeboren, 1850.
Amphimorphina amchitkaensis (Todd) = *Dentalina? amchitkaensis* Todd, 1953, Contr. Cushman Found. Foram. Res., v. 4, pt. 1, p. 3, pl. 1, figs. 12-19.
Plate 3, figs. 5-12.

PARAFRONDICULARIA Asano, 1938
Type species: *Parafrondicularia japonica* Asano, 1938.
Parafrondicularia miocenica (Cushman) = *Plectofrondicularia miocenica* Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 58, pl. 7, figs. 10, 11; pl. 8, figs. 11, 12.
Plate 3, figs. 13-17.

PLECTOFRONDICULARIA Liebus, 1902
Type species: *Plectofrondicularia concava* Liebus, 1902.
Plectofrondicularia californica Cushman and R. E. Stewart, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 2, p. 39, pl. 6, figs. 9-11.
Plate 3, figs. 18, 19.

PROXIFRONS Vella, 1963
Type species: *Frondicularia advena* Cushman.
Proxifrons advena (Cushman) = *Frondicularia advena* Cushman, 1923, U.S. Nat. Mus., Bull., no. 104, p. 141, pl. 20, figs. 1, 2.
Plate 3, figs. 20-22.
Proxifrons vaughani (Cushman) = *Plectofrondicularia vaughani* Cushman, 1927, Contr. Cushman Lab. Foram. Res, v. 3, pt. 2, p. 112, pl. 23, fig. 3.
Plate 3, fig. 23.
***Proxifrons* sp.**
Plate 3, figs. 24, 25.
Remarks: Nonflaring, very compressed test with a few median costae extending briefly from proloculus differentiate this species from other *Proxifrons*. Rarity and fragmentation preclude designation of new species.

Family VAGINULINIDAE Reuss, 1860
Subfamily LENTICULININAE Chapman, Parr, and Collins, 1934
LENTICULINA Lamarck, 1804
Type species: *Lenticulites rotulatus* Lamarck, 1804.
Lenticulina atascaderoensis Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 30, pl. 3, figs. 35-37.
Plate 3, figs. 26, 32.
***Lenticulina barroni* n. sp.**
Plate 5, figs. 7, 8.
Synonymy: *Lenticulina* sp. G in Finger and others (1990).
Type figures: Finger and others (1990), pl. 3, figs. 39, 40 (same as Pl. 5 figs. shown here).
Description: Test planispiral with slight asymmetry toward trochospiral; periphery slightly lobate; edge subacute, noncarinate. Chambers 12, maximum width about half the length. Sutures thickly limbate, slightly curved inward. Aperture radiate at end of short, oblique, peripheral extension of ultimate chamber.
Holotype: UCMP type number 38302.
Type locality: Locality GC-13, Saucesian, Graves Creek, San Luis Obispo County, California. Collected by J. H. Lipps, H. Tappan, and A. R. Loeblich, Jr., 1964.
Discussion: Not all specimens of the species display the slight coiling deviation. *L. barroni* is readily distinguished from most other regional *Lenticulina* by its limbate sutures.
Occurrence: Saucesian of Graves Creek and Indian Creek sections; Luisian of San Clemente Island.
Etymology: Named in honor of Dr. John A. Barron of the U.S. Geological Survey for his contributions on West Coast Neogene diatom biostratigraphy.
Lenticulina branneri (Cushman and Kleinpell) = *Robulus branneri* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 2, pl. 1, figs. 4a, b.
Plate 3, figs. 33, 34.
Lenticulina cushmani? (Galloway and Wissler) = *Robulus cushmani* Galloway and Wissler, 1927, Jour. Paleont., v. 1, p. 51, pl. 8, figs. 11a, b.
Plate 5, figs. 26, 27.
Remarks: Differs from *Lenticulina cushmani* (Pleistocene, California) by lacking both large umbonal boss and raised sutures in early part of whorl. Also resembles *L. dubia* (Kleinpell), but is more inflated. Rarity precludes designation of new species.
Lenticulina douglasi Finger, **n. sp.**
Plate 4, figs. 32-39.
Description: Test planispiral, thick-walled, robust; subcircular in side view, slightly to moderately inflated and biconvex in edge view. Periphery slightly lobate, moderately carinate, with short marginal spines. Chambers 7 in final whorl, maximum width about twice the height. Sutures curved inward and flush. Aperture radiate, at top of apertural face. Surface smooth. Wall calcareous, finely perforate.

Holotype: UCMP type number 38766.
Type locality: Locality CRC-40267-47a, lower Mohnian, Upper Newport Bay, Orange County, California. Collected by G. L. Armstrong, 1971.
Discussion: Differs from *L. smileyi* (Kleinpell) by its less-circular shape and its tendency to develop short peripheral spines. *L. douglasi* is a phenotypically diverse species, as populations display variations in suture incision/raising, keel development, and the presence/absence of marginal spines.
Occurrence: Upper Newport Bay and Naples Beach, restricted to the Mohnian.
Etymology: Named in honor of Prof. Robert G. Douglas of the University of Southern California for his contributions on the foraminiferal ecology of the California borderland.

Lenticulina dubia (Kleinpell) = *Planularia dubia* Kleinpell, 1938, Mio. Strat. Calif., p. 207, pl. 13, fig. 4.
Plate 3, figs. 35-42.

Lenticulina* cf. *L. dubia
Plate 3, figs. 43, 44.
Remarks: Larger than *L. dubia*. Eroded test has suggestion of peripheral spines. Rarity and fragmentation preclude designation of new species.

Lenticulina* cf. *L. gerlandi (Andreae) = *Cristellaria* (*Robulina*) *gerlandi* Andreae, 1884, Geol. Spezialk.-Karte Elsass-Loth. Abh., Strassburg, v. 2, no. 3, p. 116, pl. 9, figs. 25a, b.
Plate 5, figs. 9, 10.
Remarks: *L. gerlandi* (Oligocene, France) has a much narrower keel than does the California species; otherwise, they are remarkably similar. Rarity and fragmentation preclude designation of new species.

Lenticulina hughesi (Kleinpell) = *Robulus hughesi* Kleinpell, 1938, Mio. Strat. Calif., p. 198, pl. 7, figs. 18a, b.
Plate 3, figs. 45, 46.

Lenticulina indianensis Finger, **n. sp.**
Plate 5, figs. 24, 25.
Description: Test planispiral; ovate in side view, moderately biconvex in edge view; more compressed in later stage; narrow and bluntly carinate. Chambers 9 in final whorl, elongate, maximum width about twice the height; later chambers nearly evolute. Umbonal boss prominent. Sutures slightly thickened and raised in early portion, flush to incised in later portion, slightly curved inward. Aperture radiate, produced as blunt projection oriented obliquely outward from the periphery. Surface smooth. Wall calcareous, finely perforate.
Holotype: UCMP type number 38778.
Type locality: Locality IC-111, Relizian, Indian Creek section, San Luis Obispo County, California. Collected by J. H. Lipps, 1962.
Discussion: Test similar to *L. smileyi* (Kleinpell), but differs in later part of whorl, where it is more compressed and elongate. It also resembles *Lentinculina* sp. D, except for the forementioned nature of later chambers.
Occurrence: This species occurs only in a single Relizian locality in the Indian Creek section, where it is a common component of the assemblage.
Etymology: Named derived from Indian Creek, its type locality area.

Lenticulina luciana (Kleinpell) = *Robulus luciana* Kleinpell, 1938, Mio. Strat. Calif., p. 207, pl. 9, figs. 25a, b.
Plate 3, figs. 47, 48.

Lenticulina miocenica (Chapman) = *Cristellaria miocenica* Chapman, 1900, Calif. Acad. Sci., Proc., Ser. 3, v. 1 (1897-1904), no. 8, p. 250, pl. 30, figs. 1, 1a.
Plate 3, figs. 49-57.

Lenticulina miocenica?
Plate 4, fig. 1.
Remarks: Small specimen missing later chambers. Questionably assigned because its rapidly flaring test does not typify juveniles of the species.

Lenticulina reedi (Kleinpell) = *Robulus reedi* Kleinpell, 1938, Mio. Strat. Calif., p. 201, pl. 7, figs. 5, 23a, b.
Plate 4, figs. 2-9.

Lenticulina sandholdtana Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 30, pl. 3, figs. 41, 42.
Plate 4, figs. 10, 11.

Lenticulina smileyi (Kleinpell) = *Robulus smileyi* Kleinpell, 1938, Mio. Strat. Calif., p. 202, pl. 15, figs. 14a, b.
Plate 4, figs. 12-31.
Remarks: Plexus includes several species described from the California Miocene, morphotypically ranging from specimens with flush sutures (*Robulus mohnensis* Kleinpell, 1938) to those with slightly limbate sutures (*R. smileyi*), to those with distinctly limbate sutures (*R. laimingi* Bandy and Arnal, 1957, or *R. simplex* of many authors). Sutural thickening in this group is gradational and taxonomic distinction on this basis has no biostratigraphic justification. The preponderance of *R. simplex* in the Saucesian may be related to an observed predominance of forms with sutures "raised" by test erosion.

***Lenticulina* sp. A**
Plate 5, figs. 1, 2.
Remarks: Test relatively small; strongly keeled; chambers 6, inflated; sutures depressed. Rarity and fragmentation preclude designation of new species.

***Lenticulina* sp. B**
Plate 5, figs. 20, 21.
Remarks: Test robust, ovate in edge view; surface flush. Rarity and fragmentation preclude designation of new species.

***Lenticulina* sp. C**
Plate 5, figs. 3, 4.
Remarks: Test very compressed with slightly lobate periphery and subrounded edge; chambers 10; sutures incised, strongly curved inward. Rarity and fragmentation preclude designation of new species.

***Lenticulina* sp. D**
Plate 5, figs. 22, 23.
Remarks: Test very compressed, slightly wider across coiling axis, slightly keeled; chambers 12, narrow and crescentic; sutures incised, strongly curved inward. Rarity and fragmentation preclude designation of new species.

***Lenticulina* sp. E**
Plate 5, figs. 5, 6.
Remarks: Test moderately compressed, surface smooth, keel

robust. Rarity and fragmentation preclude designation of new species.

***Lenticulina* sp. F**

Plate 5, figs. 11-19.

Remarks: Test very compressed, keeled, and variably ornamented with very limbate sutures or thick irregularly concentric ridges somewhat similar to those described for *Robulus interrruptus* Asano and *Planularia ecuadorana* Cushman and Stevenson. This rare and highly variable ornamentation among the California Miocene lenticulinines suggests that variants recovered from a brief interval of the Naples Beach section are conspecific. Further population study would benefit designation of new species.

***Lenticulina* sp. G**

Plate 4, figs. 40, 41.

Synonymy: *Lenticulina* sp. I in Finger and others, 1990.

Remarks: Differs from *L. douglasi* in its less-fusiform edge view and more asymmetrically shaped peripheral spines. Rarity precludes designation of new species.

MARGINULINOPSIS A. Silvestri, 1904

Type species: *Cristellaria bradyi* Goës, 1894.

Remarks: Although the type species has longitudinal costae, I do not believe that species devoid of ornamentation obligate erecting a new genus.

Marginulinopsis beali (Cushman) = *Cristellaria beali* Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, no. 7, p. 25, pl. 4, figs. 6-13.

Plate 5, figs. 28-33.

***Marginulinopsis* sp.**

Plate 5, figs. 34, 35.

Remarks: Differs from *Marginulinopsis beali* in its less-robust and less-inflated form, more acutely edged spiral stage, and more chambers. Rarity precludes designation of new species.

SARACENARIA Defrance, 1824

Type species: *Saracenaria italica* Defrance, 1824.

Saracenaria schencki Cushman and Hobson, 1935, Contr. Cushman Lab. Foram. Res., v. 11, pt. 3, p. 57, pl. 8, figs. 11a, b.

Plate 5, figs. 36-38.

Subfamily MARGINULININAE Wedekind, 1937

AMPHICORYNA Schlumberger, 1881

Type species: *Marginulina falx* Jones and Parker, 1860.

Amphicoryna catesbyi (d'Orbigny) = *Nodosaria catesbyi* d'Orbigny, 1839, Hist. Phys. Nat. Cuba, p. 16, pl. 1, figs. 8-10.

Plate 6, fig. 1.

ASTACOLUS de Montfort, 1808

Type species: *Astacolus crepidulatus* de Montfort, 1808.

Astacolus crepidulus (Fichtel and Moll) = *Nautilus crepidula* Fichtel and Moll, 1798, Testacea Microscopica, p. 107, pl. 19, figs. g-i. Also see Rögl and Hansen, 1984, p. 66, textfig. 27, pl. 26, figs. 1, 2.

Plate 6, figs. 2, 3.

Remarks: *Astacolus californicus* Galloway and Wissler (Pliocene, California) is more compressed and less loosely enrolled.

Astacolus* cf. *A. cymboides (d'Orbigny) = *Cristellaria cymboides* d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 85, pl. 3, figs. 30, 31.

Plate 6, figs. 14, 15.

Remarks: D'Orbigny's species (Tertiary, Germany) is slightly arcuate, whereas this form is not. Rarity and fragmentation preclude designation of new species.

Astacolus mayi (Cushman and Parker) = *Robulus mayi* Cushman and Parker, 1931, Contr. Cushman Lab. Foram. Res., v. 7, pt. 1, p. 2, pl. 1, figs. 3a, b, 4, 5.

Plate 6, figs. 4, 5.

Astacolus naplesensis Finger, **n. sp.**

Plate 6, figs. 16-19.

Description: Test slightly ovate in side view, very compressed, narrowly carinate. Chambers 9 to 10, elongate and lunate. Sutures curved, early ones slightly raised, later ones slightly depressed. Aperture radiate. Surface smooth. Wall calcareous, very finely perforate.

Holotype: UCMP type number 38789.

Type Locality: Locality CRC-39842-93, Saucesian, Naples Beach, Santa Barbara County, California. Collected by J. H. Lipps and B. Akpati, 1964.

Discussion: Distinguished from other regional *Astacolus* by its compressed and carinate test of relatively numerous chambers.

Occurrence: Recorded from the west bluff of Naples Beach, where it was recovered from one locality; it is common in that assemblage. A worn specimen (pl. 6, figs. 16, 17) was also collected from the Luisian of the Mussel Rock section in San Luis Obispo County.

Etymology: Named for its type locality, Naples Beach.

***Astacolus* sp. A**

Plate 6, figs. 6, 7.

Remarks: Test not compressed, with elongate and arcuate uniserial stage. Coil more developed and inner edge broader than those of *Astacolus* sp. D. Rarity precludes designation of new species.

***Astacolus* sp. B**

Plate 6, figs. 8, 9.

Remarks: Test robust, coil weak, with elongate uniserial stage. Rarity and fragmentation preclude designation of new species.

***Astacolus* sp. C**

Plate 6, figs. 10, 11.

Remarks: Test shape lenticular, elongate, compressed; well-developed keel; chambers broader and fewer than *Astacolus* sp. G; sutures incised, nearly flush. Rarity and fragmentation preclude designation of new species.

***Astacolus* sp. D**

Plate 6, figs. 12, 13.

Remarks: Test compressed, coil weak, elongate and arcuate uniserial stage. See comparative comments under *Astacolus* sp. A. Rarity precludes designation of new species.

***Astacolus* sp. E**

Plate 6, figs. 30, 31.

Remarks: Test shape lenticular, elongate, less compressed than other regional *Astacolus*; periphery slightly lobate, edge subrounded; coil moderately developed; chambers inflated; sutures flush. More compressed than immature form of *Marginulina beali* (Pl. 6, figs. 34, 35). Rarity

precludes designation of new species.

***Astacolus* sp. F**

Plate 6, figs. 24-27.

Synonymy: *Astocolus* sp. I in Finger and others (1990).

Remarks: Test shape elongate and uncoiling, moderately compressed; coil weak; subrounded edge; sutures slightly incised to flush. Rarity and fragmentation preclude designation of new species.

***Astacolus* sp. G**

Plate 6, figs. 20-23.

Remarks: Test shape lenticular, elongate, very compressed; coil moderately developed; carinate; chambers narrower and more numerous than *Astacolus* sp. C; sutures slightly incised to flush. Rarity precludes designation of new species.

***Astacolus* sp. H**

Plate 6, figs. 28, 29.

Remarks: Test shape nearly rectilinear, slightly compressed; coil weak, uniserial stage well-developed; sutures flush. Rarity and fragmentation preclude designation of new species.

MARGINULINA d'Orbigny, 1826

Type species: *Marginulina raphanus* d'Orbigny, 1826.

Remarks: *Hemirobulina* Stache, 1864, is differentiated by its smooth surface, but I do not believe this warrants generic distinction.

Marginulina crouchi Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 32, pl. 5, figs. 28-31.

Plate 6, figs. 34-37.

Marginulina subbullata Hantken, 1875, Hungary, K. Ungar. Geol. Anst., Mitt. Jahrb., Budapest, v. 4, no. 1, p. 46, pl. 4, figs. 9, 10; pl. 5, fig. 9.

Plate 6, figs. 32, 33.

***Marginulina* sp.**

Plate 6, figs. 38, 39.

Remarks: Test less robust and more tapering than *Marginulina crouchi* and *M. subbullata*. Rarity precludes designation of new species.

Subfamily VAGINULININAE Reuss, 1860

VAGINULINA d'Orbigny, 1826

Type species: *Nautilus legumen* Linné, 1758.

Remarks: Unlike superficially similar species assigned herein to *Astacolus*, these two species are uniserial and arcuate; hence, their assignment to *Vaginulina*.

Vaginulina* cf. *V. dubia (Neugeboren) = *Marginulina dubia* Neugeboren, 1851, Siebenb. Ver. Naturw. Hermannstadt, Verh. Mitt., 1851, Jahrg. 2, no. 7, p. 120, pl. 4, fig. 1.

Plate 6, figs. 40, 41.

Remarks: *Vaginulina dubia* (Tertiary, Rumania) is less arcuate and has narrower chambers and a much smaller proloculus. Rarity precludes designation of new species.

Vaginulina* cf. *V. tenuis (Deecke) = *Cristellaria montis calvi* Deecke var. *tenuis* Deecke, 1886, Soc. Émul. Montebéliard, Mém., v. 16 (sér. 3, v. 6), p. 322, pl. 2, fig. 23.

Plate 6, figs. 42, 43.

Remarks: *Vaginulina tenuis* (Jurassic, Europe) has more lobate chambers. Rarity precludes designation of new species.

Family LAGENIDAE Reuss, 1862

HYALINONETRION Patterson and Richardson, 1987

Hyalinonetrion "elongata" (Ehrenberg) = *Miliolina elongata* Ehrenberg, 1844, K. Preuss. Akad. Wiss. Berlin, 1844, p. 274; type figure not given.

Plate 8, figs. 1-4.

Remarks: This commonly cited cosmopolitan species is in quotations because its lack of a type figure renders it an invalid nomen (Jones, 1984).

LAGENA Walker and Jacob, 1798

Type species: *Serpula (Lagena) sulcata* Walker and Jacob, in Kanmacher, 1798.

Lagena apiopleura Loeblich and Tappan, 1953, Smithson. Misc. Coll., v. 121, no. 7, p. 59, pl. 10, figs. 14, 15.

Plate 7, figs. 1-4.

Remarks: Differs from *Lagena alcocki* White (Pliocene, California), which has more costae and a reticulate neck, and from *L. acuticosta* Reuss (Maastrichtian, The Netherlands) which is more spherical and lacks the oral shoulder.

***Lagena apiopleura*?**

Plate 7, fig. 5.

Remarks: Specimens have less distinct (eroded?) and more numerous costae than described for the species.

Lagena discrepans Cushman and Gray = *L. pliocenica* var. *discrepans* Cushman and Gray, 1946, Contr. Cushman Lab. Foram. Res., p. 19, pl. 3, figs. 35-38.

Plate 7, figs. 6, 7.

Remarks: Patterson & Richardson (1988) erected *Exculpina* for species with incised basal sculpturing. However, longitudinal extension of such sculpturing ranges too greatly among lagenids to warrant generic distinction.

Lagena laevis (Montagu) = *Vermiculum laeve* Montagu, 1803, Testacea Britannica, p. 524.

Plate 7, fig. 8.

Lagena lisbonensis Cushman and Todd, 1948, Contr. Cushman Lab. Foram. Res., v. 24, p. 30, pl. 5, fig. 22.

Plate 7, figs. 9-11.

Lagena meridionalis Wiesner = *Lagena gracilis* Williamson var. *meridionalis* Wiesner, 1931, Deutsche Südpolar-Exped. 1901-1903, v. 20 (Zool. v. 12), p. 117, pl. 18, fig. 211.

Plate 7, fig. 12.

Lagena mexicana Andersen, 1961, Louisiana, Geol. Surv., Bull., no. 35, p. 76, pl. 16, fig. 11.

Plate 7, fig. 13.

Lagena pacifica Sidebottom, 1912, Quekett Micr. Club, Jour., ser. 2, v. 11 (1910-1912), no. 70, p. 398, pl. 16, fig. 29.

Plate 7, fig. 14.

Lagena* cf. *L. pliocenica Cushman and Gray, 1946, Contr. Cushman Lab. Foram. Res., v. 22, p. 68, pl. 12, figs. 22-25.

Plate 7, figs. 15, 16, 37, 38.

Remarks: Test tear-shaped with elongate neck; octagonal-shaped in oral or aboral view due to costae on lower part

of chamber. *Lagena pliocenica* (Pliocene, California) has a more hemispherical chamber and its costae are restricted to its flat base. *L. timmsana* has a more spherical chamber with more extensive costae. Rarity precludes designation of new species.

Lagena semilineata Wright, 1886, Belfast Nat. Field Club, Proc., n.s., v. 1, appendix 9, p. 320, pl. 26, fig. 7.

Plate 7, figs. 17, 18.

Lagena* cf. *L. striata (d'Orbigny) = *Oolina striata* d'Orbigny, 1839, Voy. Am. Mérid., Foram., v. 5, pt. 5, p. 21, pl. 5, fig. 12.

Plate 7, figs. 19, 20.

Remarks: *Lagena striata* (Recent, Falkland Islands) has a spherical chamber without an oral shoulder. *L. sulcata* (Walker and Jacob; Recent, England) has about half the number of costae. *L. haidingeri* (Czjzek) (Tertiary, Germany) has similar ornamentation but possesses a wide and flat aboral projection. Rarity precludes designation of new species.

Lagena timmsana Cushman and Gray = *L. pliocenica* var. *timmsana* Cushman and Gray, 1946, Contr. Cushman Lab. Foram. Res., v. 22, p. 68, pl. 12, figs. 15-17.

Plate 7, figs. 21-27; variants, figs. 28-31.

***Lagena* sp. A**

Plate 7, figs. 32, 33.

Remarks: Chamber globular; irregularly and sparsely ornamented with discontinuous costae; neck elongate, unornamented. Rarity precludes designation of new species.

***Lagena* sp. B**

Plate 7, figs. 34, 35.

Remarks: Chamber globular; neck very elongate; chamber ornamented with ~40 thin, slightly discontinuous or undulating costae, some extend onto neck about which they spiral slightly, those at aboral end break up into short spines. Rarity precludes designation of new species.

***Lagena* sp. C**

Plate 7, fig. 36.

Remarks: Chamber narrow-fusiform, tapering at oral end into apertural neck; surface smooth except for small eccentric aboral spine, and 6 costae extending from upper part of chamber and along neck. Rarity precludes designation of new species.

***Lagena* sp. D**

Plate 7, figs. 41-43.

Remarks: Chamber ovoid, ornamented with 25 slightly irregular, thick costae. Less globose than *Lagena sulcata* (Walker and Jacob). Specimens may be aberrant due to damage during growth, but "normal" forms not recovered. Rarity precludes designation of new species.

***Lagena* sp. E**

Plate 7, figs. 39, 40.

Remarks: Chamber globular with aboral knob and 12 weak latitudinal costae extending down neck and entire length of chamber. *Lagena sulcata* (Walker and Jacob) has more robust costae. Rarity precludes designation of new species.

PROCEROLAGENA Puri, 1954

***Procerolagena* sp.**

Plate 8, fig. 5.

Remarks: Chamber elongate-ovate tapering into long neck with apertural lip. Ornamented with 6 longitudinal costae. Rarity and loss of sole specimen preclude designation of new species.

REUSSOOLINA Colom, 1956

Type species: *Oolina apiculata* Reuss, 1851.

Reussoolina simplex (Reuss) = *Oolina simplex* Reuss, 1851, Naturw. Abh., Wien, v. 4, pt. 1, p. 22, pl. 2, figs. 2a, b.

Plate 8, figs. 6, 7.

Family POLYMORPHINIDAE d'Orbigny, 1839

Subfamily POLYMORPHININAE d'Orbigny, 1839

GUTTULINA d'Orbigny, 1839

Type species: *Polymorphina communis* d'Orbigny, 1826.

***Guttulina* sp.**

Plate 8, figs. 10-12.

Remarks: It is possible that more than one species is represented here, but the ontogenetic and intraspecific variability typical of the genus, and its rarity in this fauna, preclude designation of any new species.

Family ELLIPSOLAGENIDAE A. Silvestri, 1923

Subfamily OOLININAE Loeblich and Tappan, 1961

OOLINA d'Orbigny, 1839

Type species: *Oolina laevigata* d'Orbigny, 1839.

Note: Patterson and Richardson (1988) erected *Favulina* for species with polygonal ornamentation and *Homalohedra* for species with longitudinal ornamentation. However, some species display both kinds of ornamentation on the same test (e.g., *Oolina scalariformesulcata* (Wiesner)).

Oolina borealis Loeblich and Tappan, 1954, Washington Acad. Sci., Jour., v. 44, no. 12, p. 384.

Plate 8, figs. 13, 14.

Oolina* cf. *O. borealis

Plate 8, figs. 15-18.

Remarks: Differs from *Oolina borealis* in its fusiform shape with fewer costae. Rarity precludes designation of new species.

Oolina elongata (Dunikowski) = *Lagena elongata* Dunikowski, 1879, Kosmos, v. 4, p. 105, fig. 2.

Plate 8, figs. 19, 20.

Oolina globosa setosa (Earland) = *Lagena globosa* var. *setosa* Earland, 1934, *Discovery* Repts., v. 10, p. 150, pl. 6, fig. 52.

Plate 8, figs. 21, 22.

Oolina hexagona (Williamson) = *Entosolenia squamosa* var. *hexagona* Williamson, 1848, Ann. Mag. Nat. Hist., ser. 2, v. 1, p. 20, pl. 2, fig. 23.

Plate 8, figs. 23-25.

Oolina melo d'Orbigny, 1839, Voy. Am. Mérid. Foram., v. 5, pt. 5, p. 20. pl. 5, fig. 9.

Plate 8, figs. 26-31.

Subfamily ELLIPSOLAGENINAE A. Silvestri, 1923

DUPLELLA Patterson and Richardson, 1987

Type species: *Duplella apexadina* Patterson and Richardson, 1987.

Duplella baggi Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 32, pl. 2, figs. 30, 31.

Plate 8, figs. 32, 33.
Duplella lacrima Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 34, pl. 2, figs. 32, 33.
Plate 8, figs. 34, 35.

FISSURINA Reuss, 1850
Type species: *Fissurina laevigata* Reuss, 1850.
Fissurina gravesensis Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 34, pl. 2, figs. 5, 6.
Plate 9, figs. 13-16.
Fissurina* cf. *F. laevigata labiata (Buchner) = *Lagena laevigata* var. *labiata* Buchner, 1940, K. Leopold.- Carol. Deutsch. Akad Naturf., Abh., v. 9, no. 62, p. 467, pl. 12, figs. 201-207.
Plate 9, figs. 7-10.
Remarks: Differs from Buchner's species (Recent, Mediterranean) by being slightly pear-shaped.
Fissurina longipunctata Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 36, pl. 2, figs. 13, 14.
Plate 9, figs. 17-20.
Fissurina natlandi Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 36, pl. 2, figs. 1, 2.
Plate 9, figs. 1-6.
Fissurina quasimarginata Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 36, pl. 2, figs. 7, 8.
Plate 9, figs. 11, 12.
***Fissurina* sp. A**
Plate 9, figs. 21, 22.
Remarks: Test with a few very coarse punctae restricted to central area of chamber face and outer edge where there is a single keel. Rarity precludes designation of new species.
***Fissurina* sp. B**
Plate 9, figs. 23, 24.
Remarks: Test with very coarse punctae somewhat longitudinally aligned across entire chamber face. Rarity precludes designation of new species.
***Fissurina* sp. C**
Plate 9, figs. 25, 26.
Remarks: Test smooth-surfaced and with three well-developed and acute keels. Rarity precludes designation of new species.
***Fissurina* sp. D**
Plate 9, figs. 31, 32.
Synonymy: *Fissurina* sp. M in Finger and others, 1990.
Remarks: Test subcircular in side view, fusiform in apertural view; acutely carinate; entire surface coarsely punctate. Rarity and fragmentation preclude designation of new species.
***Fissurina* sp. E**
Plate 9, figs. 27, 28.
Remarks: Test ovoid in apertural view, noncarinate, surface smooth, broad apertural lip. Rarity precludes designation of new species.
***Fissurina* sp. F**
Plate 9, figs. 35, 36.
Remarks: Test smooth-surfaced and with three very thick keels. Rarity precludes designation of new species.
***Fissurina* sp. G**
Plate 9, figs. 33, 34.
Remarks: Test shape an elongate tear-drop, surface covered with punctae, noncarinate. Rarity precludes designation of new species.
***Fissurina* sp. H**
Plate 9, figs. 29, 30.
Remarks: Test with broad nonperforate keel, surface bearing several coarse punctae(?). Rarity and poor preservation preclude designation of new species.
***Fissurina* sp. I**
Plate 9, figs. 37, 38.
Remarks: Test almost pear-shaped, broadly ovoid in apertural view, noncarinate and unornamented. Possibly an internal mold. Rarity and poor preservation preclude designation of new species.
***Fissurina* sp. J**
Plate 9, figs. 39, 40.
Remarks: Test subcircular in side view, ovoid-fusiform in apertural view. Possibly an internal mold. Rarity and poor preservation preclude designation of new species.

Subfamily PARAFISSURININAE R. W. Jones, 1984
PARAFISSURINA Parr, 1947
Type species: *Lagena ventricosa* A. Silvestri, 1904.
***Parafissurina* sp. A**
Plate 8, figs. 36, 37.
Remarks: Test tear-shaped in side view, carinate; surface smooth; aperture buckled open; entosolenian tube extends 3/4 down one side. Rarity precludes designation of new species.
***Parafissurina* sp. B**
Plate 8, figs. 38, 39.
Remarks: Differs from *Parafissurina* sp. A in being more elongate and slightly more compressed, and in having a narrower keel; entosolenian tube not visible. Rarity precludes designation of new species.

Family GLANDULINIDAE Reuss, 1860
Subfamily GLANDULININAE Reuss, 1860
GLANDULINA d'Orbigny, 1839
Type species: *Nodosaria laevigata* d'Orbigny, 1826.
***Glandulina* sp.**
Plate 8, figs. 8, 9.
Remarks: Test shape slightly sinusoidal - possibly an immature form. Rarity precludes specific designation.

Suborder GLOBIGERININA Delage and Hérouard, 1896
Superfamily GLOBOROTALIACEA Cushman, 1927
Family GLOBOROTALIIDAE Cushman, 1927
GLOBOROTALIA Cushman, 1927
Type species: *Pulvinulina menardii* (d'Orbigny) var. *tumida* Brady, 1877.
Globorotalia acrostoma Wezel, 1966, Riv. Ital. Paleont., v. 72, no. 4, p. 1298, figs. 1-12.
Plate 10, figs. 7-9.
Globorotalia birnageae Blow, 1959, Bull. Am. Paleont., v. 39, no. 178, p. 210, pl. 17, figs. 108a-c.
Plate 10, figs. 1-3.
Globorotalia conoidea Walters, 1965, N.Z. Jour. Geol.

Geophys., v. 8, pt. 1, p. 124, figs. 8i-m.
Plate 10, figs. 28-30.

Globorotalia praescitula Blow = *Globorotalia scitula praescitula* Blow, 1959, Bull. Amer. Paleont., v. 39, no. 178, p. 221, pl. 19, figs. 128a-c.
Plate 10, figs. 10-18.

Globorotalia mayeri Cushman and Ellisor, 1939, Cushman Lab. Foram. Res., v. 15, pt. 1, p. 11, pl. 2, figs. 4a-c.
Plate 10, figs. 4-6.
Remarks: Some specimens grade into *Globorotalia zealandica* (see below) in what appears to be a variable plexus.

Globorotalia* cf. *Glr. menardii (Parker, Jones, and Brady) = *Rotalia menardii* Parker, Jones, and Brady, 1865, Ann. Mag. Nat. Hist., London, ser. 3, v. 16, p. 20, pl. 3, fig. 81.
Plate 10, figs. 31-33.
Remarks: Test small, nearly biconvex, weakly carinate, five-chambered. Sole specimen, possibly an immature form, precludes specific identification.

Globorotalia zealandica Hornibrook, 1958, N.Z. Jour. Geol. Geophys., v. 1, no. 4, p. 667, pl. 673, figs. 18, 19, 30.
Plate 10, figs. 25-27.
Remarks: Some specimens grade into *Glr. mayeri* in what appears to be a variable plexus.

***Globorotalia zealandica*?**
Plate 10, figs. 22-24.
Remarks: Differs from *Globorotalia zealandica* in being more inflated and lacking the wide open aperture (due to damage?).

Globorotalia zealandica-praescitula **transitional form**
Plate 10, figs. 19-21.
Remarks: Rounding of peripheral edge is transitional between the two species.

NEOGLOBOQUADRINA Bandy, Frerichs, and Vincent, 1967
Type species: *Globigerina dutertrei* d'Orbigny, 1839.

Neogloboquadrina acostaensis (Blow) = *Globorotalia acostaensis* Blow, 1959, Bull. Am. Paleont., v. 39, no. 178, p. 208, pl. 17, figs. 106a-c.
Plate 10, figs. 34-36.

Neogloboquadrina continuosa (Blow) = *Globorotalia opima continuosa* Blow, 1959, Bull. Am. Paleont., v. 39, no. 178, p. 218, pl. 19, figs. 125a-c.
Plate 11, figs. 4-6.

Neogloboquadrina pachyderma (Ehrenberg) = *Aristospira pachyderma* Ehrenberg, 1861, K. Preuss. Akad. Wiss. Berlin, Monatsber, p. 276, 277, 303. Lectotype figured in Banner and Blow, 1960, Contr. Cush. Found. Foram. Res., v. 11, pt. 4, pl. 3, figs. 4a-c.
Plate 11, figs. 1-3.

Family CANDEINIDAE Cushman, 1927.
Subfamily GLOBIGERINITINAE Bermúdez, 1961.
GLOBIGERINITA Brönnimann, 1951.
Type species: *Globigerinita naparimaensis* Brönnimann, 1951.

Globigerinita glutinata (Egger) = *Globigerina glutinata* Egger, 1895, K. Bayer. Akad. Wiss., München, Math.-Physik. Cl., Abh., v. 18, pt. 2 (1893), p. 371, pl. 13, figs. 19-21. Type figure in Ehrenberg, 1893, K. Akad. Wiss. Berlin, Abh., Jahrg. 1872, pl. 2, figs. 24, 25.
Plate 11, figs. 7-10.

Globigerinita parkerae (Bermúdez) = *Globigerinoides parkerae* Bermúdez, 1961, Dir. Geol. Bol. Geol., Publ. Espec. 3 (Congr. Geol. Venez. III, 1960, Mem.), v. 3, p. 1232, pl. 10, figs. 10, 11.
Plate 11, figs. 15, 16.

Globigerinita uvula (Ehrenberg) = *Pylodexia uvula* Ehrenberg, 1861, K. Preuss. Akad. Wiss., Berlin, Monatsber., p. 276, 277, 308.
Plate 11, figs. 11-14.

TENUITELLINATA Li Qianyu, 1987
Type species: *Globigerina angustiumbilicata* Bolli, 1957.

Tenuitellinata angustiumbilicata (Bolli) = *Globigerina ciperoensis angustiumbilicata* Bolli, 1957, U.S. Natl. Mus., Bull., no. 215, p. 109, pl. 22, figs. 12a-c, 13a-c.
Plate 11, figs. 17-19.

Family CATAPSYDRACIDAE Bolli, Loeblich, and Tappan, 1957
CATAPSYDRAX Bolli, Loeblich, and Tappan, 1957
Type species: *Globigerina dissimilis* Cushman and Bermúdez, 1937.

Catapsydrax stainforthi Bolli, Loeblich, and Tappan, 1957, U.S. Natl. Mus., Bull., no. 215, p. 37, pl. 7, figs. 11a-c.
Plate 11, figs. 20-22.

GLOBOQUADRINA Finlay, 1947
Type species: *Globorotalia dehiscens* Chapman, Parr, and Collins, 1934.

Globoquadrina baroemoenensis (LeRoy) = *Globigerina baroemoenensis* LeRoy, 1939, Nat. K. Tijdsch. Ned. Indie, v. 99, no. 6, p. 263. pl. 6, figs. 1, 2.
Plate 11, figs. 23-25.

Globoquadrina venezuelana (Hedberg) = *Globigerina venezuelana* Hedberg, Jour. Paleont., v. 11, no. 8, p. 681, pl. 92, figs. 7a, b.
Plate 12, figs. 1-3.

GLOBOROTALOIDES Bolli, 1957
Type species: *Globorotaloides variabilis* Bolli, 1957.

Globorotaloides suteri relizensis Bandy, Ingle, and Wright, 1971, Jour. Foram. Res., v. 1, no. 1, p. 15, Pl. 1, figs. 1-4.
Plate 12, figs. 10-12.

Globorotaloides* aff. *G. suteri relizensis
Plate 12, figs. 7-9.
Remarks: Resembles *Globorotaloides variabilis* Bolli *sensu* Kennett and Srinivasan, 1983, pl. 53 (not Bolli 1957), which is probably an immature *G. suteri* Bolli.

Globorotaloides trema Lipps, 1964, Tulane Stud. Geol., v. 2, no. 4, p. 128, pl. 4, figs. 3a-c
Plate 12, figs. 4-6.

PROTENTELLA Lipps, 1964
Type species: *Protentella prolixa* Lipps, 1964.

Protentella prolixa Lipps, 1964, Tulane Stud. Geol., v. 2, no. 4, p. 124, pl. 2, figs. 8a-9c.
Plate 12, figs. 16-18.
Protentella prolixa?
Plate 12, figs. 13-15.
Remarks: Sole specimen is planispiral remnant with fifth chamber broken off. Rarity, poor preservation, and occurrence below documented range of species preclude specific identification.

Superfamily GLOBIGERINACEA Carpenter, Parker, and Jones, 1862
Family GLOBIGERINIDAE Carpenter, Parker, and Jones, 1862
Subfamily GLOBIGERININAE Carpenter, Parker, and Jones, 1862
GLOBIGERINA d'Orbigny, 1826
Type species: *Globigerina bulloides* d'Orbigny, 1826.
Globigerina bulloides d'Orbigny, 1826, Ann. Sci. Nat., sér. 1, v. 7, p. 277; modèles no. 17 and 76.
Plate 13, figs. 4-12.
Globigerina connecta? Jenkins, 1964, Micropaleontology, v. 10, no. 1, p. 72, text-figs. 1a-c.
Plate 12, figs. 22-24.
Remarks: Very small specimen with obscure aperture precludes specific identification.
Globigerina praebulloides Blow, 1959, Bull. Am. Paleont., v. 39, no. 178, p. 180, pl. 8, figs. 47a-c; pl. 9, fig. 48.
Plate 12, figs. 28-30; plate 13, figs. 1-3.
Globigerina pseudociperoensis Blow = *Globigerina praebulloides pseudociperoensis* Blow, in Brönnimann and Renz (eds.), 1969, Proc. First Intl. Conf. Plankt. Microfossils, v. 1, p. 381, 382, pl. 17, figs. 8, 9.
Plate 13, figs. 13-21.
Globigerina quinqueloba Natland, 1938, Scripps Inst. Oceanogr., Bull., Tech. Ser., v. 4, no. 5, p. 149, pl. 6, figs. 7a-c.
Plate 12, figs. 19-21.
Globigerina* cf. *G. woodi Jenkins, 1960, Micropaleontology, v. 6, no. 4, p. 352, pl. 2, figs. 2a-c.
Plate 12, figs. 25-27.
Remarks: Very small specimen with obscure aperture precludes specific identification.

GLOBIGERINELLA Cushman, 1927
Type species: *Globigerina aequilateralis* Brady, 1879.
Globigerinella aequilateralis (Brady) = *Globigerina aequilateralis* Brady, 1879, Rept. Voy. *Challenger*, Zool., v. 9, pl. 80, figs. 18-21.
Plate 13, figs. 28-30.
Globigerinella obesa (Bolli) = *Globorotalia obesa* Bolli, 1957, U.S. Natl. Mus., Bull., no. 215, p. 119, pl. 29, figs. 2-3.
Plate 13, figs. 25-27.
Globigerinella pseudobesa (Salvatorini) = *Turborotalia pseudobesa* Salvatorini, 1966, Atti Soc. Tosc. Sci. Nat., v. 73, p. 10, pl. 2, figs. 6a-15.
Plate 13, figs. 22-24.

GLOBIGERINOIDES Cushman, 1927.
Type species: *Globigerina rubra* d'Orbigny, 1839.
Globigerinoides altiaperturus Bolli = *Globigerinoides triloba altiapertura* Bolli, 1957, U.S. Natl. Mus., Bull., no. 215, p. 113, pl. 25, figs. 7a-c.
Plate 14, figs. 1-3.
Globigerinoides bulloideus Crescenti, 1966, Geol. Rom., v. 5, p. 43, text-fig. 8, no. 3, 3a; text fig. 9.
Plate 14, figs. 4-6.
Globigerinoides immaturus LeRoy = *Globigerinoides sacculiferus* (Brady) var. *immatura* LeRoy, 1939, Natuurk. Tijdschr. Nederl. Indie, v. 99, pt. 6, p. 263, pl. 3, figs. 19-21.
Plate 14, figs. 7-12.
Globigerinoides quadrilobatus (d'Orbigny) = *Globigerina quadrilobata* d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 164, pl. 9, figs. 7-10.
Plate 14, figs. 16-20.
Globigerinoides subquadratus Brönnimann = *Globigerinoides subquadrata* Brönnimann, 1954, Am. Jour. Sci., v. 252, no. 11, p. 680, pl. 1, figs. 8a-c.
Plate 14, figs. 13-15.

Subfamily ORBULININAE Schultze, 1854
ORBULINA d'Orbigny, 1839
Type species: *Orbulina universa* d'Orbigny, 1839.
Orbulina suturalis Brönnimann, 1951, Contr. Cushman Found. Foram. Res., v. 2, pt. 4, p. 135, pl. 2, figs. 1-15; pl. 3, figs. 3-8, 11, 13-16, 18, 20-22; pl. 4, figs. 2-4, 7-12, 15-16, 19-22; pl. 5. (figs. not numbered).
Plate 14, figs. 21, 22.
Orbulina universa d'Orbigny, in de la Sagra, 1839, Hist. Phys. Nat. Cuba, v. 8, p. 3, pl. 1, fig. 1.
Plate 14, figs. 23.

PRAEORBULINA Olsson, 1964
Type species: *Globigerinoides glomerosa* subsp. *glomerosa* Blow, 1956.
Praeorbulina glomerosa circularis (Blow) = *Globigerinoides glomerosa circularis* Blow, 1956, Micropaleontol., v. 2, pt. 1, p. 65, text-fig. 2, nos. 3, 4.
Plate 14, figs. 26, 27.
***Praeorbulina glomerosa* var. A**
Plate 14, figs. 28, 29.
Remarks: Test with early chamber stage development as in *Praeorbulina glomerosa curva*, but sutural apertures fewer and circular.
***Praeorbulina glomerosa* var. B**
Plate 14, figs. 30, 31.
Remarks: Test with early chamber stage development as in *Praeorbulina glomerosa sicana*, but slit-like apertures tangential, not parallel, to sutures.
Praeorbulina transitoria (Blow) = *Globigerinoides transitoria* Blow, 1956, Micropaleontology, v. 2, pt. 1, p. 65, text-fig. 2, nos. 12, 13.
Plate 14, figs. 24, 25.

Suborder ROTALIINA Delage and Hérouard, 1896
Superfamily BOLIVINACEA Glaessner, 1937
Family BOLIVINIDAE Glaessner, 1937
BOLIVINA d'Orbigny, 1839
Type species: *Bolivina plicata* d'Orbigny, 1839.
Bolivina advena Cushman, 1925, Contr. Cushman Lab.

Foram. Res., v. 1, pt. 2, p. 29, pl. 5, figs. 1a, b.
Plate 15, figs. 2-6; plate 17, fig. 48.
Remarks: Some variants (pl. 15, fig. 6) approach *Bolivina blakei*, suggesting the species may be closely related.

Bolivina advena ornata Cushman = *Bolivina advena* var. *ornata* Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 29, pl. 5, figs. 2a, b.
Plate 15, figs. 7-11.

Bolivina benedictensis Pierce, 1956, Jour. Paleont., v. 30, no. 6, p. 1307, pl. 142, figs. 9a, b.
Plate 15, figs. 12-14.

Bolivina blakei Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 38, pl. 4, fig. 12. (= *Bolivina floridana* Cushman *sensu* Kleinpell, 1938, Mio. Strat. Calif., pl. 12, fig. 1).
Plate 16, figs. 2-4.

Bolivina bramlettei Kleinpell, 1938, Mio. Strat. Calif., p. 267, pl. 21, figs. 9-11.
Plate 15, figs. 15-21.

Bolivina brevior Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 31, pl. 5, figs. 8a, b.
Plate 15, figs. 22-28.

Bolivina brevior dunlapi Kleinpell = *Bolivina dunlapi* Kleinpell, 1938, Mio. Strat. Calif., p. 271, pl. 15, fig. 2.
Plate 15, figs. 29-31.

Bolivina californica Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 32, pl. 5, figs. 10a, b.
Plate 15, figs. 32-38.

Bolivina churchi Kleinpell and Tipton, in Kleinpell, 1980, Mio. Strat. Calif. Rev., p. 72, pl. 9, figs. 11, 12.
Plate 15, figs. 1, 39-49.
Remarks: Commonly develops a serrate margin, but not as pronounced as that of *Bolivina acuminata* Natland.

Bolivina conica Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 30, pl. 5, figs. 4a, b.
Plate 15, figs. 50-53.

Bolivina cuneiformis Kleinpell, 1938, Mio. Strat. Calif., p. 270, pl. 9, fig. 3.
Plate 16, fig. 1.

Bolivina* cf. *B. euplectella Yokoyama, 1890, Palaeontographica, v. 36 (1889-90), pt. 4, p. 191, pl. 24, figs. 13, 13a, 14, 14a.
Plate 17, fig. 59.
Remarks: Test very compressed and twisted in early portion; chambers 6 pairs, narrow, angled ~45°; sutures incised and slightly curved sutures. Yokoyama's species (Cretaceous, Japan) is less twisted and has more elongate chambers. Rarity precludes designation of new species.

Bolivina exilicostata Finger, **n. sp.**
Plate 16, figs. 24, 25.
Description: Test biserial, lanceolate in side view, moderately compressed, edges subacute. Chambers 8 pair, narrow, angled at ~45°. Sutures incised, slightly curved. Ornamented with a few sub-longitudinal weak costae partially extending along lower half of test. Aperture a narrow slightly curved slit with slight lip extending almost half-way across apertural face. Surface smooth. Wall calcareous, very finely perforate.
Holotype: UCMP type number 38920.
Type locality: Locality CRC-40267-1, lower Mohnian, Upper Newport Bay, Orange County, California. Collected by W. R. Riedel, W. H. Akers, G. L. Armstrong, and R. J. Navarrette, 1982.
Discussion: Costae fewer and weaker than on *Bolivina interjuncta*. Test less compressed and with more extensive costae than *B. spissa*. Differs from *B. malagaensis* Kleinpell in having a more flaring and costate test.
Occurrence: Recovered only from its type locality.
Etymology: Derived from the Latin terms *exilis* (poor) + *costatus* (ribbed) in reference to its poorly developed costae.

Bolivina foraminata R. E. and K. C. Stewart = *Bolivina seminuda* Cushman var. *foraminata* R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 66, pl. 8, figs. 5a, b.
Plate 16, figs. 5-7.

Bolivina girardensis Rankin, in Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 17, pl. 3, figs. 7a, b.
Plate 16, figs. 8-10.

Bolivina granti Rankin, in Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 21, pl. 4, figs. 2a-3b.
Plate 16, figs. 13-18.

Bolivina hughesi Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 2, p. 43, pl. 6, figs. 4a, b.
Plate 16, figs. 19-21.
Remarks: See Finger (1990).

***Bolivina hughesi* var. A**
Plate 16, fig. 22.
Remarks: Less crenulate than typical *Bolivina hughesi*.

***Bolivina hughesi* var. B**
Plate 16, fig. 23.
Remarks: Less twisted and less crenulate than typical *Bolivina hughesi*.

Bolivina humilus Cushman and McCulloch = *Bolivina seminuda* Cushman var. *humilus* Cushman and McCulloch, 1942, Allan Hancock Pac. Exped., v. 6, no. 4, p. 211, pl. 26, figs. 1a-6.
Plate 16, figs. 11, 12.

Bolivina imbricata Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 31, pl. 5, figs. 7a-b.
Plate 16, figs. 28-33.

Bolivina interjuncta Cushman = *Bolivina costata* d'Orbigny var. *interjuncta* Cushman, 1926, Contr. Cush. Lab. Foram. Res., v. 2, pt. 2, p. 41, pl. 6, fig. 3.
Plate 16, figs. 26, 27.

Bolivina isaacsi Finger, **n. sp.**
Plate 17, figs. 57, 58.
Description: Test biserial, tightly twisted into a spindle, round in apertural view. Chambers 5 pair, slightly crenulate. Sutures incised, somewhat indistinct at crenulations. Aperture a narrow loop. Wall moderately perforate.
Holotype: UCMP type number UCMP38985.
Type locality: Locality CRC-39842-94, Saucesian, Naples Beach, Santa Barbara County, California. Collected by J. H. Lipps and B. Akpati, 1962.
Occurrence: Abundant in Saucesian and Relizian of Naples Beach section.
Discussion: Superficially similar to *Kleinpella californica*, but smaller, biserial, and crenulate.

Etymology: Named in honor of Dr. Caroline M. Isaacs of the U.S. Geological Survey in recognition of her contributions on the lithostratigraphy of the Monterey Formation.

Bolivina modeloensis Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 10, pl. 2, figs. 4a-b.

Plate 16, figs. 36-39.

Bolivina mulleri Kleinpell and Tipton, 1980, Mio. Strat. Calif. Revisited, p. 74, pl. 6, figs. 6a-7b.

Plate 16, fig. 35.

Bolivina multicostata Cushman = *Bolivina aenariensis* (Costa) var. *multicostata* Cushman, 1918, U.S. Geol. Surv., Bull., no. 676, p. 48, pl. 10, fig. 2.

Plate 17, fig. 56.

Bolivina parva? Cushman and Galliher = *Bolivina hughesi* Cushman var. *parva* Cushman and Galliher, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 25, pl. 4, figs. 10a, b.

Plate 16, figs. 41-44.

Remarks: Sutures oblique, not perpendicular to median axis as on Cushman and Galliher's species.

Bolivina predecussata Arnal, 1984, Jour. Foram. Res., v. 14, no. 1, p. 5, pl. 1, figs. 9-12, 14-21.

Plate 16, figs. 48-50.

Bolivina pseudobeyrichi Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 2, p. 45. Nom subst. pro *Bolivina beyrichi* Reuss var. *alata* Cushman (not Seguenza, 1862), U.S. Natl. Mus., Bull., no. 71, p. 35, figs. 57a, b.

Plate 16, fig. 40.

Bolivina pseudospissa Kleinpell, 1938, Mio. Strat. Calif., p. 279, pl. 21, fig. 6.

Plate 16, figs. 51-58; plate 17, fig. 49.

Bolivina* cf. *B. sabahensis Whittaker and Hodgkinson, 1979, Brit. Mus. (Nat. Hist.), Bull., Geol., v. 31, no. 1, p. 54, 55, pl. 4, fig. 4; p. 54, text-figs. 52-53c.

Plate 17, figs. 39, 40.

Remarks: Test densely ornamented with striae, particularly on lower two-thirds. Probably an ecophenotype of one or more other bolivinids, but affiliations are neither obvious nor consistent. Rarity precludes designation of new species.

Bolivina salinasensis Kleinpell, 1938, Mio. Strat. Calif., p. 280, pl. 9, fig. 6; pl. 15, fig. 3.

Plate 17, figs. 1-4.

Bolivina santanaensis Finger, 1990, Cushman Special Publ. No. 28, p. 48, p. 49 pl.-fig. 1.

Plate 17, figs. 41, 42.

Bolivina spissa Cushman = *Bolivina subadvena* Cushman var. *spissa* Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 2, p. 45, pl. 6, figs. 8a, b.

Plate 16, figs. 45-47.

Bolivina ticensis Kleinpell, 1938, Mio. Strat Calif., p. 284, pl. 18, figs. 6, 7.

Plate 16, figs. 59.

Bolivina tongi filacostata Cushman and McCulloch = *Bolivina tongi* var. *filacostata* Cushman and McCulloch, 1942, Allan Hancock Pac. Exped., v. 6, no. 4, p. 214, pl. 27, figs. 7-11.

Plate 17, figs. 6-8.

Bolivina tumida Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 32, pl. 5, figs. 9a-b.

Plate 17, figs. 9-20, 37.

***Bolivina tumida* vars.**

Plate 17, figs. 21-26.

Remarks: Variants are "seminude" and "striatocrenulate" ecophenotypes.

Bolivina wissleri Kleinpell and Tipton, 1980, Mio. Strat. Calif. Revisited, p. 74, 75, pl. 8, figs. 14a-16.

Plate 17, figs. 27, 28.

Bolivina woodringi Kleinpell, 1938, Mio. Strat. Calif., p. 285, pl. 21, figs. 4, 5.

Plate 17, figs. 29-36.

Bolivina woodruffi Finger, **n. sp.**

Plate 17, figs. 51, 52.

Description: Test biserial, lanceolate in side view, compressed, periphery lobate, edge subrounded. Chambers 9 pair, ranging from thrice as wide as high in early portion, to twice as wide as high in middle portion, to slightly higher than wide in ultimate pair. Sutures oblique, incised, and slightly curved. Aperture loop-shaped, slightly elevated on flange-like extension of ultimate chamber.

Holotype: UCMP type number 38980.

Type locality: CRC-40267-4, upper Mohnian, Upper Newport Bay, Orange County, California. Collected by W. R. Riedel, W. H. Akers, G. L. Armstrong, and R. J. Navarrette, 1982.

Discussion: Differs from *B. granti* in having more oblique sutures and being more compressed. Specimens range from 8 to 13 pairs of chambers and may be slightly twisted.

Occurrence: Recovered only from the upper Mohnian at Upper Newport Bay.

Etymology: Named in honor of Dr. Fay Woodruff of the University of Southern California, in recognition of her contributions on the foraminiferal paleoceanography of the Pacific Neogene.

***Bolivina* sp. A**

Plate 17, fig. 46.

Remarks: Test relatively small, very elongate and nearly rectilinear, very slightly curved and twisted, slightly compressed, edges subrounded; chambers 12 pair, perforate along the base of each chamber; sutures inclined, slightly incised; aperture loop-shaped with slight lip. Rarity precludes designation of new species.

***Bolivina* sp. B**

Plate 17, fig. 47.

Remarks: Test slightly compressed, very twisted; periphery lobate; chambers 8 pair; sutures incised, nearly horizontal; wall finely perforate. Lacks the crenulations of *Bolivina hughesi*. Possibly an aberrant *Bolivina granti*. Rarity precludes designation of new species.

***Bolivina* sp. C**

Plate 17, fig. 38.

Remarks: Test compressed, lanceolate in side view, ovate in apertural view; edge acute in early stage, rounded in later stage; chambers 12-15 pair; sutures incised, concave downward, slightly crenulate; wall finely perforate. Rarity precludes designation of new species.

***Bolivina* sp. D**

Plate 17, fig. 44.
Remarks: Test lower half flaring and upper half rectilinear, ovate in apertural view, moderately compressed; chambers 9 pair; sutures slightly incised and inclined; surface smooth. Rarity precludes designation of new species.

***Bolivina* sp. E**
Plate 17, fig. 50.
Remarks: Test small and narrow, nearly rectilinear, compressed; edge subacute; chambers ≥10 pair, perforate at their bases; sutures nearly flush, inclined. Rarity precludes designation of new species.

***Bolivina* sp. F**
Plate 17, fig. 60.
Remarks: Test relatively large, lanceolate in side view, moderately compressed with median ridge; chambers chevron-shaped, slightly crenulate, early ones indistinct; surface smooth. Similar to *Bolivina woodringi* but lacks costae on early chambers. Rarity precludes designation of new species.

***Bolivina* sp. G**
Plate 17, fig. 61.
Remarks: Test relatively small, lanceolate but narrow in side view, moderately compressed, lower half slightly twisted; periphery slightly lobate; edge rounded; chambers ~10 pair, low and wide except for ultimate chamber, which is nearly equidimensional and slightly inflated; sutures nearly flush and slightly inclined; wall finely perforate on lower two-thirds of each chamber. Rarity precludes designation of new species.

***Bolivina* sp. H**
Plate 17, figs. 5, 53.
Remarks: Test moderately compressed; periphery slightly lobate; edge rounded; chambers 11 pair, low and wide; wall very coarsely perforate except along uppermost edges of chambers and apertural face; most perforations longitudinally elongate due to their coalescence (dissolution effect?). Rarity precludes designation of new species.

***Bolivina* sp. I**
Plate 17, fig. 45.
Remarks: Test lanceolate, somewhat flaring, slightly compressed; periphery lobate; edge rounded; chambers 7 pair, slightly inflated; sutures deeply incised, concave downward; wall densely perforate. Differs from *Bolivina modeloensis* in being more inflated and lacking a serrate margin. Rarity precludes designation of new species.

***Bolivina* sp. J**
Plate 17, fig. 54.
Remarks: Test compressed; chambers 9 pair, about thrice as wide as high, bases very jagged; periphery serrate; edge acute; wall finely perforate. Population suggests this is an aberrant form which grades into typical *Bolivina tumida*. Rarity precludes designation of new species.

***Bolivina* sp. K**
Plate 17, fig. 55.
Remarks: Test slightly arcuate and flaring, moderately compressed, edge subacute; chambers indistinct, crenulate; two median ridges; wall moderately perforate. Differs from immature *Bolivina modeloensis* in being more compressed and in having median ridges. Rarity precludes designation of new species.

***Bolivina* sp. L**
Plate 17, fig. 43.
Remarks: Test very compressed, nonflaring; edge acute; chambers 9 pair, width nearly thrice the height; sutures oblique, nearly flush; wall very finely perforate. Rarity precludes designation of new species.

LOXOSTOMOIDES Reiss, 1957
Type species: *Bolivina applinae* Plummer, 1927.
Loxostomoides digitata (Arnal) = *Bolivina digitata* Arnal, 1984, Jour. Foram. Res., v. 14, no. 1, p. 3, pl. 1, figs. 1-8.
Plate 18, figs. 1-12.

Superfamily CASSIDULINACEA d'Orbigny, 1839
Family CASSIDULINIDAE d'Orbigny, 1839
Subfamily CASSIDULININAE d'Orbigny, 1839
CASSIDULINELLA Natland, 1940
Type species: *Cassidulinella pliocenica* Natland, 1940.
Cassidulinella renulinaformis Natland, 1940, Jour. Paleont., v. 14, p. 571, pl. 69, figs. 1-4, 7.
Plate 18, fig. 13.

GLOBOCASSIDULINA Voloshinova, 1960
Type species: *Cassidulina globosa* Hantken, 1876.
Globocassidulina monicana (Cushman and Kleinpell) = *Cassidulina monicana* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res, v. 10, pt. 1, p. 16, pl. 3, figs. 4a, b.
Plate 18, figs. 19-33.
Remarks: Immature specimens are identical to *Cassidulina barbarana* Cushman and Kleinpell; CRC-39842-70 specimen (pl. 5, figs. 23, 24) is its topotype.
Globocassidulina neomargareta Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 38, pl. 8, figs. 26, 27.(= *Cassidulina margareta* sensu Kleinpell, 1938, Mio. Strat. Calif., pl. 7, fig. 20(?), pl. 8, fig. 10).
Plate 18, figs. 14-18.
Globocassidulina neopulchella Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 40, pl. 8, figs. 22-25 (= *Cassidulina pulchella* sensu Kleinpell, 1938, Mio. Strat. Calif., pl. 10, fig. 9).
Plate 18, figs. 34-37.

ISLANDIELLA Nørvang, 1959
Type species: *Cassidulina islandica* Nørvang, 1945.
Islandiella californica (Cushman and Hughes) = *Cassidulina californica* Cushman and Hughes, 1925, Contr. Cushman Lab. Foram. Res., v. 1, no. 5, p. 12, pl. 2, figs. 1a-c.
Plate 18, figs. 19, 20.
Islandiella carinata (Silvestri) = *Cassidulina laevigata* var. *carinata* Silvestri, 1896, Accad. Pont. Nuovi Lincei, Mem., v. 12, p. 104, pl. 2, figs. 10a-c.
Plate 19, figs. 14-18.
Islandiella modeloensis (Rankin) = *Cassidulina modeloensis* Rankin, in Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 23, pl. 3, figs. 12a, b.
Plate 19, figs. 1-13.

LERNELLA Saidova, 1975
Type species: *Lernella auri* Saidova, 1975.
***Lernella* sp.**
Plate 19, figs. 21, 22.
Remarks: Differs from other *Lernella* in overall test shape and unusually large aperture. Rarity precludes designation of new species.

PARACASSIDULINA Nomura, 1983
Type species: *Globocassidulina nipponensis* Eade, 1969.
Paracassidulina crescentaperta (Arnal) = *Cassidulina crescentaperta* Arnal, 1984, Jour. Foram. Res., v. 14, no. 1, p. 12, pl. 3, figs. 22-25.
Plate 19, figs. 23-26.
Paracassidulina delicata (Cushman) = *Cassidulina delicata* Cushman, 1927, Scripps Inst. Oceanogr., Bull., Tech. Ser., v. 1, p. 168, pl. 6, fig. 5.
Plate 19, figs. 27-37.

Subfamily EHRENBERGININAE Cushman, 1927
EHRENBERGINA Reuss, 1850
Type species: *Ehrenbergina serrata* Reuss, 1850.
***Ehrenbergina* sp.**
Plate 19, figs. 38, 39.
Remarks: Differentiated from other *Ehrenbergina* by its relatively high, curved, chambers with subacute edges, and its two ventral ridges characterized by downward projecting spines which tend to coalesce into costae. Rarity precludes designation of new species.

Superfamily TURRILINACEA Cushman, 1927
Family STAINFORTHIIDAE Reiss, 1963
GALLIHERINA Kleinpell and Tipton, 1980
Type species: *Bulimina uvigerinaformis* Cushman and Kleinpell, 1934.
Galliherina uvigerinaformis (Cushman and Kleinpell) = *Bulimina uvigerinaformis* Cushman and Kleinpell, 1934, Contr.Cushman Lab. Foram. Res., v. 10, pt. 1, p. 5, figs. 14a, b.
Plate 20, figs. 1-5.
Remarks: Development of costae appears to be variable within populations of this species (Finger, 1990); *G. uvigerinaformis doanei* Kleinpell and Tipton, the weakly costate form (Pl. 20, figs. 4, 5), is considered here to be unworthy of taxonomic distinction.
***Galliherina* sp.**
Plate 20, fig. 6.
Remarks: Unlike *Galliherina uvigerinaformis*, this form is completely devoid of costate. Specimens were recovered only from the Topanga Canyon section, where they alternate with populations of *G. uvigerinaformis* rather than occurring in association with them. However, it is uncertain whether or not this relatively rare form warrants designation as a new taxon distinct from the *G. uvigerinaformis* grade.

HOPKINSINA Howe and Wallace, 1932
Type species: *Hopkinsina danvillensis* Howe and Wallace, 1932.
Hopkinsina magnifica Bramlette, in Woodring and Bramlette, 1951, U.S. Geol. Surv., Prof. Pap., no. 222 (1950), p. 59, pl. 22, figs. 1-3, 5.
Plate 20, fig. 7.
***Hopkinsina* sp. A**
Plate 20, fig. 8.
Remarks: Wall costate on lower two-thirds of test, smooth on half of penultimate chamber and all of ultimate chamber. Rarity precludes designation of new species.
***Hopkinsina* sp. B**
Plate 20, fig. 9.
Remarks: Moderately sparse costae irregularly distributed over entire test. Rarity precludes designation of new species.
***Hopkinsina* sp. C**
Plate 20, fig. 10.
Remarks: Twisted and unornamented, as in *Hopkinsina magnifica*, but test smaller, chambers higher and fewer, and neck longer. Rarity precludes designation of new species.

STAINFORTHIA Hofker, 1956
Type species: *Virgulina concava* Höglund, 1947.
Stainforthia nodosa (R. E. and K. C. Stewart) = *Virgulina nodosa* R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 64, pl. 8, figs. 4a-c.
Plate 20, fig. 11.

Superfamily BULIMINACEA Jones, 1875
Family SIPHOGENERINOIDIDAE Saidova, 1981
Subfamily TUBULOGENERININAE Saidova, 1981
RECTUVIGERINA Mathews, 1945
Type species: *Siphogenerina multicostata* Cushman and Jarvis, 1929.
Rectuvigerina branneri (Bagg) = *Sagrina branneri* Bagg, 1905, U.S. Geol. Surv., Bull., no. 268, p. 40, pl. 7, fig. 4.
Plate 21, figs. 7-56.
***Rectuvigerina branneri* var. A**
Plate 21, figs. 77, 78.
Remarks: Unusual costate-striate ornamentation is found on rare forms in association with *Rectuvigerina branneri* in the upper Luisian of the Upper Newport Bay section; these are aberrant specimens or unusual ecophenotypes of the species. They are not differentiated in the checklists from *R. branneri*.
***Rectuvigerina branneri* var. B**
Plate 21, figs. 79, 80.
Remarks: Resembles *Rectuvigerina hughesi*, but more crenulate at sutures and with very few discontinuous striae. Affiliated with *R. branneri* because it occurs in association with its variable populations in the upper Luisian of the Upper Newport Bay section. Because they are probably aberrant specimens or extreme ecophenotypes of *R. branneri*, they are not differentiated in the checklists.
Rectuvigerina hughesi (Cushman) = *Siphogenerina hughesi* Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 36, pl. 7, figs. 4a, b.
Plate 21, figs. 57-62.
Rectuvigerina loeblichi Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 40, pl. 4, figs. 37-42.
Plate 21, figs. 63-76.

Rectuvigerina transversa (Cushman) = *Siphogenerina raphanus* var. *transversus* Cushman, 1918, U.S. Natl. Mus., Bull., no. 103, p. 64, pl. 22, fig. 8.
Plate 21, figs. 1-6.

Family BULIMINIDAE Jones, 1875
BULIMINA d'Orbigny, 1826
Type species: *Bulimina marginata* d'Orbigny, 1826.
Bulimina alligata Cushman and Laiming = *Bulimina inflata* Seguenza var. *alligata* Cushman and Laiming, 1931, Jour. Paleont., v. 5, no. 2, p. 107, pl. 11, figs. 17a, b.
Plate 20, fig. 12.
Bulimina* cf. *B. hebespinata R. E. and K. C. Stewart = *Bulimina pagoda* var. *hebespinata* R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 63, pl 8, figs. 3a, b.
Plate 20, fig. 13.
Remarks: Differs from *Bulimina hebespinata* by its chambers with less-pronounced basal margins bearing shorter and more downward-projecting spines.
Bulimina inflata Seguenza, 1862, Accad. Gioenia Sci. Nat. Catania, Atti, Ser. 2, v. 18, p. 109, pl. 1, fig. 10.
Plate 20, figs. 14-16.
Bulimina subacuminata Cushman and R. E. Stewart, 1930, San Diego Soc. Nat. Hist., Trans., v. 6, no. 2, p. 65, pl. 5, figs. 2, 3a, b.
Plate 20, figs. 17, 18.
Bulimina subcalva Cushman and K. C. Stewart, 1930, San Diego Soc. Nat. Hist., Trans., v. 6, no. 2, p. 65, pl. 5, figs. 11a, b.
Plate 20, fig. 19.

PRAEGLOBOBULIMINA Hofker, 1951
Type species: *Bulimina pyrula* d'Orbigny var. *spinescens* Brady, 1884.
Praeglobobulimina galliheri (Kleinpell) = *Bulimina galliheri* Kleinpell, 1938, Mio. Strat. Calif., p. 253, pl. 17, figs. 2, 5.
Plate 20, figs. 24, 25.
Praeglobobulimina spinifera (Cushman) = *Bulimina spinifera* Cushman, 1927, Scripps Inst. Oceanogr., Bull., Tech. Ser., v. 1, p. 151, pl. 2, fig. 15.
Plate 20, figs. 20-23.

PROTOGLOBOBULIMINA Hofker, 1951
Type species: *Bulimina pupoides* d'Orbigny, 1846.
Protoglobobulimina pseudotorta (Cushman) = *Bulimina pseudotorta* Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 55, pl. 7, fig. 3.
Plate 20, figs. 26-33.

Family BULIMINELLIDAE Hofker, 1951
BULIMINELLA Cushman, 1911
Type species: *Bulimina elegantissima* d'Orbigny, 1839.
Buliminella brevior Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 33, pl. 5, fig. 14.
Plate 20, figs. 34, 35.
Buliminella elegantissima (d'Orbigny) = *Bulimina elegantissima* d'Orbigny, 1839, Voy. Am. Mér. Foram., v. 5, pt. 5, p. 51, pl. 7, figs. 13, 14.
Plate 20, figs. 48-50.
Buliminella curta Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 33, pl. 5, fig. 13.
Plate 20, figs. 36-38.
Buliminella semihispida Kleinpell, 1938, Mio. Strat. Calif., p. 250, pl. 20, figs. 8, 15, 16.
Plate 20, figs. 46, 47.
Buliminella subfusiformis Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 33, pl. 5, fig. 12.
Plate 20, figs. 39-45.

Family UVIGERINIDAE Haeckel, 1894
Subfamily UVIGERININAE Haeckel, 1894
UVIGERINA d'Orbigny, 1826
Type species: *Uvigerina pygmaea* d'Orbigny, 1826.
Uvigerina hannai Kleinpell, 1938, Mio. Strat. Calif., p. 294, not figured.
Plate 22, figs. 7-9.
Uvigerina* cf. *U. hispidocostata Cushman and Todd, 1945, Cushman Lab. Foram, Res., Spec. Publ., no. 15, p. 51, pl. 7, figs. 27, 31.
Plate 22, figs. 10, 11.
Remarks: Differs from *Uvigerina hispidocostata* by its very weakly hispid later chambers. Rarity precludes designation of new species.
Uvigerina hootsi Rankin, in Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram., Res., v. 10, pt. 1, p. 22, pl. 3, figs. 8, 9.
Plate 22, figs. 1-6.
Uvigerina segundoensis Cushman and Galliher, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 26, pl. 4, figs. 11a, b.
Plate 22, figs. 25, 26.
Uvigerina cf. U. segundoensis
Plate 22, fig. 24.
Remarks: Costae resembling those of *Uvigerina segundoensis*, but weaker and discontinuous. Rarity precludes designation of new species.
Uvigerina senticosa Cushman, 1927, Scripps Inst. Oceanogr., Bull., Tech. Ser., v. 1, p. 159, pl. 3, fig. 14.
Plate 22, fig. 23.
Uvigerina subperegrina Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram., Res., v. 10, pt. 1, p. 12, pl. 2, figs. 9-11.
Plate 22, figs. 12-22.
***Uvigerina* sp. A**
Plate 22, fig. 27.
Remarks: Costae few in number, very weakly developed, evenly spaced. Rarity precludes designation of new species.
***Uvigerina* sp. B**
Plate 22, fig. 28.
Remarks: Costae moderately strong as in *Uvigerina subperegrina*, but test long and slender with denser ornamentation. Rarity precludes designation of new species.
***Uvigerina* sp. C**
Plate 22, fig. 29.
Remarks: Similar to *Uvigerina subperegrina* but with more blade-like costae. Rarity precludes designation of new species.
***Uvigerina* sp. D**

Plate 22, fig. 30.
Remarks: Test inflated and consisting of 2+ whorls; wall smooth. Resembles immature *Uvigerina hootsi*, but disproportionately larger with more globose chambers. Rarity precludes designation of new species.

UVIGERINELLA Cushman, 1926
Type species: *Uvigerina (Uvigerinella) californica* Cushman, 1926.
Uvigerinella californica Cushman = *Uvigerina (Uvigerinella) californica* Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 58, pl. 8, figs. 2, 5.
Plate 22, figs. 31-35.
Uvigerinella californica ornata Cushman = *Uvigerina (Uvigerinella) californica* var. *ornata* Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 59, pl. 8, figs. 1, 6.
Plate 22, figs. 36-43.

Subfamily ANGULOGENERININAE Galloway, 1933
TRIFARINA Cushman, 1923
Type species: *Trifarina bradyi* Cushman, 1923.
Trifarina fluens (Todd) = *Angulogerina fluens* Todd, in Cushman and McCulloch, 1948, Allan Hancock Pac. Exped., v. 6, no. 5, p. 288, pl. 36, figs. 1a-f.
Plate 22, figs. 44-46.

Superfamily FURSENKOINACEA Loeblich and Tappan, 1961
Family FURSENKOINIDAE Loeblich and Tappan, 1961
FURSENKOINA Loeblich and Tappan, 1961
Type species: *Virgulina squammosa* d'Orbigny, 1826.
Fursenkoina subplana (Barbat and Johnson) = *Virgulina subplana* Barbat and Johnson, 1934, Jour. Paleont., v. 8, p. 14, pl. 1, figs. 16, 17.
Plate 23, fig. 1.
Fursenkoina **sp. A**
Plate 23, fig. 2.
Remarks: Differs from *Fursenkoina subplana* in its rectilinear and nontwisted test; chambers 3 pair, slightly higher than wide. Rarity precludes designation of new species.
Fursenkoina **sp. B**
Plate 23, figs. 6-8.
Synonymy: *Fursenkoina* sp. E in Finger and others, 1991.
Remarks: Test relatively planar compared to other *Fursenkoina*; chambers 3 pair, slightly higher than wide. Rarity precludes designation of new species.
Fursenkoina **sp. C**
Plate 23, fig. 4.
Remarks: Differs from *Fursenkoina subplana* in having its last two chambers comprising <50% of its test; chambers 3 pair, slightly higher than wide. Rarity precludes designation of new species.

RUTHERFORDOIDES McCulloch, 1981
Type species: *Rutherfordia rotundiformis* McCulloch, 1977.
Rutherfordoides californiensis (Bramlette) = *Cassidulinoides californiensis* Bramlette, in Woodring and Bramlette, 1951, U.S. Geol. Surv., Prof. Pap., no. 222 (1950), p. 61, pl. 22, fig. 7.
Plate 23, figs. 17-22.
SUGGRUNDA Hoffmeister and Berry, 1937
Type species: *Suggrunda porosa* Hoffmeister and Berry, 1937.
Suggrunda inflata Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 40, pl. 4, figs. 26-29.
Plate 23, figs. 29-36.
Suggrunda kleinpelli Bramlette, in Woodring and Bramlette, 1951, U.S. Geol. Surv., Prof. Pap., no. 222 (1950), p. 59, pl. 23, figs. 4, 5, 9.
Plate 23, figs. 23-28

Family KLEINPELLIDAE Finger and Lipps, 1990
KLEINPELLA Finger and Lipps, 1990
Type species: *Virgulina californiensis* Cushman, 1925.
Kleinpella californiensis (Cushman) = *Virgulina californiensis* Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 32, pl. 5, figs. 11a-c.
Plate 23, figs. 9-14.
Kleinpella californiensis ticensis (Cushman and Kleinpell) = *Virgulina californiensis* Cushman var. *ticensis* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 10, pl. 1, figs. 17a, b.
Plate 23, fig. 15.
Kleinpella californiensis **var.**
Plate 23, fig. 16.
Remarks: A single aberrant specimen ornamented with a few short irregular costae spanning sutures. Rarity precludes designation of new species.
Kleinpella **sp. A**
Plate 23, fig. 3.
Remarks: Test initially trochospiral, then biserial and slightly twisted for more than 3/4 the length; biserial chambers progressively higher than wide; short apical spine. Differs from *Kleinpella californiensis* by its high chambers, and from *K.* sp. B by its outline and compression. Rarity precludes designation of new species.
Kleinpella **sp. B**
Plate 23, fig. 5.
Remarks: Test initially trochospiral, then biserially untwisted and slightly compressed for more than 3/4 the length; widest 1/4 from aboral end, then tapering toward aperture with chambers twice as high as wide. Differs from *Kleinpella californiensis* by its high chambers, and from *K.* sp. A by its outline and compression. Rarity precludes designation of new species.

Superfamily VIRGULINELLACEA Loeblich & Tappan, 1984
Family VIRGULINELLIDAE Loeblich and Tappan, 1984
VIRGULINELLA Cushman, 1932
Type species: *Virgulina pertusa* Reuss, 1861.
Virgulinella pertusa (Reuss) = *Virgulina pertusa* Reuss, 1861, K. Akad. Wiss. Wien, Math.-Naturw. Cl., Sitzber., Wien, v. 42, no. 24 (Jahrg. 1860), p. 362, pl. 2, figs. 16a, b.
Plate 23, figs. 37, 38

Superfamily STILOSTOMELLACEA Finlay, 1947
Family STILOSTOMELLIDAE Finlay, 1947
NODOGENERINA Cushman, 1927
Type species: *Nodogenerina bradyi* Cushman, 1927.
Nodogenerina **cf. *N. bradyi*** Cushman, 1927, Contr.

Cushman Lab. Foram. Res., v. 2, pt. 4, p. 79.
Plate 24, figs. 1, 2.
Remarks: Cushman's species (Recent, South Pacific) have higher, more bell-shaped chambers. Rarity precludes designation of new species.
Nodogenerina parexilis (Cushman and K. C. Stewart) = *Nodosaria parexilis* Cushman and K. C. Stewart, in Cushman, Stewart, and Stewart, 1930, San Diego Soc. Nat. Hist., Trans., v. 6, p. 55, pl. 2, figs. 13-15.
Plate 24, figs. 3-7.
Nodogenerina parkeri Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 41, pl. 1, fig. 28.
Plate 24, fig. 17.
Nodogenerina sagrinensis (Bagg) = *Nodosaria sagrinensis* Bagg, 1912, U.S. Geol. Surv., Bull., no. 513, p. 58, pl. 16, fig. 4.
Plate 24, figs. 10-16.
Nodogenerina tappani Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 41, pl. 1, figs. 29-31.
Plate 24, figs. 18-20.
***Nodogenerina* sp.**
Plate 24, figs. 8, 9.
Remarks: Test uniserial, conical; chambers rapidly increasing in size; nearly four times as wide as high, later chambers with very short marginal spines; aperture indented. Conical shape distinguishes this from other species of *Nodogenerina*. Rarity precludes designation of new species.

SIPHONODOSARIA A. Silvestri, 1924
Type species: *Nodosaria abyssorum* Brady, 1881.
Siphonodosaria advena (Cushman and Laiming) = *Nodogenerina advena* Cushman and Laiming, 1931, Jour. Paleont., v. 5, no. 2, p. 106, pl. 11, figs. 19a, b.
Remarks: Irregular forms illustrated from Upper Newport Bay sample CRC-40267-50a are also present in Naples Beach sample CRC-39842-20.
Plate 24, figs. 21-35.
Siphonodosaria montereyana Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 41, pl. 1, figs. 22, 23.
Plate 24, figs. 45-51.
Siphonodosaria quadrulata (Cushman and Parker) = *Dentalina quadrulata* Cushman and Parker, 1931, Contr. Cushman Lab. Foram. Res., v. 7, pt. 1, no. 99, p. 3, pl. 1, figs. 9-11.
Plate 24, figs. 36-44.
***Siphonodosaria* sp.**
Plate 24, figs. 52, 53.
Remarks: Later segment uniserial; chambers slightly wider than high, barrel-shaped, barely increasing in size toward aperture; surface smooth. Fragmentation and rarity preclude designation of new species.

Superfamily DISCORBACEA Ehrenberg, 1838
Family BAGGINIDAE Cushman, 1927
Subfamily BAGGININAE Cushman, 1927
BAGGINA Cushman, 1926
Type species: *Baggina californica* Cushman, 1926.
Baggina californica Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 64, pl. 9, figs. 8a-c.
Plate 25, figs. 1-9.

CANCRIS de Montfort, 1808
Type species: *Cancris auriculatus* de Montfort, 1808.
Cancris baggi Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 15, pl. 3, figs. 2a-c.
Plate 25, figs. 10-18.
Cancris lippsi Finger, **n. sp.**
Plate 25, figs. 28-30.
Description: Test trochospiral, ovate in side view, periphery slightly lobate, biconvex in edge view, edge acute, almost carinate. Chambers seven in last whorl, lunate on spiral side, subtriangular on umbilical side, with imbricated umbilical flanges extending from chambers of final whorl. Sutures on spiral side limbate and raised in early portion of whorl, slightly incised between later chambers; sutures on umbilical side deeply incised. Aperture extra-umbilical, low. Surface smooth. Surface smooth. Wall calcareous, very finely perforate.
Holotype: UCMP type number 39195.
Type Locality: Locality IC-100, Saucesian, Indian Creek, San Luis Obispo County, California. Collected by J. H. Lipps, 1962.
Discussion: Test compressed as in *Cancris planus*, but chambers less elongate, sutures of early chambers thickened and raised, and with umbilical flanges rather than a prominent flap extending from ultimate chamber.
Occurrence: Restricted to several Saucesian localities in the Indian Creek section.
Etymology: Named in honor of Prof. Jere H. Lipps of the University of California in recognition of his contributions on California Miocene foraminifera.
Cancris planus Cushman and Todd = *Cancris baggi* Cushman and Kleinpell var. *planus* Cushman and Todd, 1942, Contr. Cushman Lab. Foram. Res., v. 18, p. 84, pl. 21, figs. 11a-c.
Plate 25, figs. 19-27, 31-33.
Remarks: *Nautilus auricula* Fichtel and Moll, 1798 (see Rögl and Hansen, 1984, p. 67 textfig. 28, pl. 26, figs. 3-8) is more elongate and its ultimate chamber is much more acutely edged. There is no comparison with this species in the type description of *Cancris planus*.

VALVULINERIA Cushman, 1926
Type species: *Valvulineria californica* Cushman, 1926.
Valvulineria californica Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 60, pl. 9, figs. 1a-c.
Plate 27, figs. 1-21.
Valvulineria malagaensis Kleinpell = *Valvulineria araucana* (d'Orbigny) var. *malagaensis* Kleinpell, 1938, Mio. Strat. Calif., p. 308, pl. 22, figs. 10-12.
Plate 25, figs. 34-36.
Valvulineria mcdougalli Finger, **n. sp.**
Plate 27, figs. 31-36.
Description: Test trochospiral, ovate in side view, periphery very lobate, edge rounded. Chambers 8-9 in final whorl, narrowly wedge-shaped, inflated, rapidly expanding in

edge view. Sutures radiate, deeply incised. Aperture extra-umbilical, obscured by broad flap-like extension of ultimate chamber. Surface smooth. Wall calcareous, finely perforate.
Holotype: UCMP type number 39218.
Type locality: Locality CRC-40267-47c, lower Mohnian, Upper Newport Bay, Orange County, California. Collected by K. L. Finger and G. L. Armstrong, 1983.
Discussion: Differs from *Valvulineria subinequalis* in having a less-compressed test with deeply incised sutures and a very lobate periphery.
Occurrence: Recovered from the lower and upper Mohnian at Upper Newport Bay, the upper Mohnian along the Manville Quarry access road, and the lower Mohnian at Naples Beach (CRC-40660 collection).
Etymology: Named in honor of Dr. Kristin McDougall of the U.S. Geological Survey in recognition of her contributions on West Coast Cenozoic foraminifers.
Valvulineria miocenica Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 61, pl. 8, figs. 9, 10; pl. 9, figs. 3a-c.
Plate 26, figs. 1-9, 19-30.
Valvulineria miocenica ornata Cushman = *Valvulineria miocenica* Cushman var. *ornata* Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 61, pl. 8, figs. 4a-c.
Plate 26, figs. 31-36.
Valvulineria* cf. *V. miocenica ornata
Plate 26, figs. 10-18.
Remarks: Differs from *Valvulineria miocenica ornata* by its variable and somewhat irregular development of thickened and raised sutures on both spiral and umbilical sides. Probably ecophenotypic variants.
Valvulineria robusta (Kleinpell) = *Baggina robusta* Kleinpell, 1938, Mio. Strat. Calif., p. 325, pl. 11, figs. 8a-c.
Plate 27, figs. 22-27.
Valvulineria subinequalis (Kleinpell) = *Valvulineria subinequalis* Kleinpell, 1938, Mio. Strat. Calif., p. 326, pl. 19, figs. 6, 9, 12.
Plate 27, figs. 28-30.

Family DISCORBIDAE Ehrenberg, 1838
NEOEPONIDES Reiss, 1960
Type species: *Rotalina schreibersii* d'Orbigny, 1846.
Neoeponides navarrettei Finger, **n. sp.**
Plate 24, figs. 59-64.
Synonym: *Neoeponides* cf. *N. parantillarum* (Galloway and Heminway) of Finger, 1990.
Description: Test trochospiral, subcircular in side view, biconvex in edge view, with thick keel. Chambers 7 in final whorl, crescentic on spiral side, subtriangular on umbilical side. Spiral sutures oblique, early ones slightly thickened and raised, later ones slightly incised; umbilical sutures slightly curved, nearly radiate, slightly incised. Aperture an extra-umbilical slit with elongate narrow lip extending from edge of ultimate chamber. Surface smooth. Wall calcareous, very finely perforate.
Holotype: UCMP type number 39187.
Type locality: Locality UCLA-6317, Luisian, SE of NOTS Pier, San Clemente Island, Los Angeles County, California. Collected by T. Susuki and C. J. Stadum, 1975 (locality of Susuki and Stadum, 1978).
Discussion: Differs from *Neoeponides parantillarum* (Galloway and Heminway) by its lower spire and lack of thickened umbilical sutures.
Occurrence: Luisian at Naples Beach, Laguna Hills, and San Clemente Island; Mohnian at Topanga Canyon.
Etymology: Named in honor of Ronald J. Navarrette of Chevron Oil Field Research Company, who processed samples for this study and analyzed many of the associated diatom assemblages for their biostratigraphic correlation.

Family ROSALINIDAE Reiss, 1963
GAVELINOPSIS Hofker, 1951
Type species: *Discorbina praegeri* Heron-Allen and Earland, 1913.
Gavelinopsis durhami Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 42, pl. 6, figs. 7-9.
Plate 28, figs. 10-12.
Gavelinopsis garveyensis (Natland) = *Rotalia garveyensis* Natland, 1938, Scripps Inst. Oceanogr., Bull., Tech. Ser., v. 4, no. 5, p. 147, pl. 6, figs. 6a-c.
Plate 28, figs. 1-3.
Gavelinopsis holkos Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 42, pl. 6, figs. 4-6.
Plate 28, figs. 4-9.
***Gavelinopsis* sp.**
Plate 28, figs. 13-15.
Remarks: Distinguished from other regional *Gavelinopsis* primarily by the shape of its chambers in spiral view. More robust with more subquadrate (vs. crescentic) chambers on spiral side than *G. durhami*, higher spired with fewer chambers than *G. garveyensis*; lower spired with more subquadrate (vs. subtriangular chambers) on spiral side than *G. holkos*. Rarity precludes designation of new species.

ROSALINA d'Orbigny, 1826
Type species: *Rosalina globularis* d'Orbigny, 1826.
Rosalina californica Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 42, pl. 28, figs. 16-18.

Family SPHAEROIDINIDAE Cushman, 1927
SPHAEROIDINA d'Orbigny, 1826
Type species: *Sphaeroidina bulloides* d'Orbigny, 1826.
Sphaeroidina chilostomata Galloway and Morrey = *Sphaeroidina bulloides* var. *chilostomata* Galloway and Morrey, 1924, Bull. Amer. Paleont., v. 15, no. 55, p. 32, pl. 5, figs. 1a, b.
Plate 24, figs. 54-58.

Superfamily DISCORBINELLACEA Sigal, 1952
Family PARRELLOIDIDAE Hofker, 1956
CIBICIDOIDES Thalmann, 1939
Type species: *Truncatulina mundula* Brady, Parker, and Jones, 1890.
Cibicidoides cushmani (Barbat and von Estorff) = *Cibicides floridanus* var. *cushmani* Barbat and von Estorff,

1933, Jour. Paleont., v. 7, no. 2, p. 173, pl. 23, figs. 21a-c.
Plate 28, figs. 26-28.
Cibicidoides mckannai Galloway and Wissler, 1927, Jour. Paleont., v. 1, p. 65, pl. 10, figs. 5a-6c.
Plate 28, figs. 19-25.

Family PSEUDOPARRELLIDAE Voloshinova, 1952
Subfamily PSEUDOPARRELLINAE Voloshinova, 1952
AMBITROPUS Lipps, 1965
Type species: *Epistominella evax* Bandy, 1953.
Ambitropus evax (Bandy) = *Epistominella evax* Bandy, 1953, Jour. Paleont., v. 27, no. 2, p. 179, pl. 23, figs. 1a-c.
Plate 28, figs. 29-34.

EPISTOMINELLA Husezima and Maruhasi, 1944
Type species: *Epistominella pulchella* Husezima and Maruhasi, 1944.
Epistominella discorbisoides Pierce, 1956, Jour. Paleont., v. 30, no. 6, pl. 139, figs. 13a-c.
Plate 28, figs. 35-37.
Epistominella pacifica (Cushman) = *Pulvinulinella pacifica* Cushman, 1927, Scripps Inst. Oceanogr., Tech. Ser., Bull., v. 1, p. 165, pl. 5, figs. 14, 15.
Plate 29, figs. 16-18.
Epistominella smithi (R. E. and K. C. Stewart) = *Pulvinulinella smithi* R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 70, pl. 9, figs. 4a-c.
Plate 29, figs. 1-15.

MEGASTOMELLA Faulkner, de Klasz, and Rérat, 1963
Type species: *Megastomella africana* Faulkner, de Klasz, and Rérat, 1963.
Megastomella capitanensis (Cushman and Kleinpell) = *Pulvinulinella capitanensis* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 16, pl. 3, figs. 3a-c.
Plate 29, figs. 19-27.
Megastomella purisima (Bramlette) = *Pulvinulinella purisima* Bramlette, in Woodring and Bramlette, 1951, U.S. Geol. Surv., Prof. Pap., no. 222 (1950), p. 60, pl. 23, figs. 10-15.
Plate 29, figs. 28-33.

PSEUDOPARRELLA Cushman and ten Dam, 1948
Type species: *Pulvinulinella subperuviana* Cushman, 1926.
Pseudoparrella californica (White) = *Epistominella pontoni* var. *californica* White, 1956, Jour. Paleont., v. 30, no. 2, p. 257, pl. 31, figs. 9a-c.
Plate 29, figs. 34-36; plate 30, figs. 1-3.
Pseudoparrella subperuviana (Cushman) = *Pulvinulinella subperuviana* Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 63, pl. 9, figs. 9a-c.
Plate 30, figs. 4-24.
Subfamily CONCAVELLINAE Saidova, 1981
CONCAVELLA Lipps, 1965
Type species: *Pulvinulinella gyroidinaformis* Cushman and Goudkoff, 1938.
Concavella gyroidinaformis (Cushman and Goudkoff) = *Pulvinulinella gyroidinaformis* Cushman and Goudkoff, 1938, Contr. Cushman Lab. Foram. Res., v. 14, pt. 1, p. 2, pl. 1, figs. 1a-2c.
Plate 30, figs. 25-36.

Superfamily PLANORBULINACEA Schwager, 1877
Family PLANULINIDAE Bermúdez, 1952
PLANULINA d'Orbigny, 1826
Type species: *Planulina ariminensis* d'Orbigny, 1826.
***Planulina* sp.**
Plate 31, figs. 1-3.
Remarks: Test planispiral, subovate in side view, nearly equally biconvex in edge view, edge subrounded; chambers somewhat indistinct, latter chambers slightly overlapping umbilical boss on both sides. Rarity and poor preservation preclude designation of new species.

Family CIBICIDIDAE Cushman, 1927
Subfamily CIBICIDINAE Cushman, 1927
CIBICIDES de Montfort, 1808
Type species: *Cibicides refulgens* de Montfort, 1808.
Cibicides* cf. *C. farctus (Fichtel and Moll) = *Nautilus farctus* Fichtel and Moll, 1798, Testacea Microscopica, p. 64, pl. 9, figs. g-i. Lectotype in Rögl and Hansen, 1984, N. Denk-Schrift. Naturhist. Mus. Wien, v. 3, p. 47, text-figs. 17a-c, pl. 13, figs. 1-3.
Plate 31, figs. 13-15.
Remarks: Fichtel and Moll's species (Pliocene, Italy) is planoconvex with 8 chambers, whereas this form is slightly biconvex with 6 chambers and a slightly coarser surface texture.
Cibicides pumilus Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 42, pl. 8, figs. 4-6.
Plate 31, figs. 4-12.
***Cibicides* sp. A**
Plate 31, figs. 19-21.
Remarks: Test planoconvex, subrounded in side view; distinguished on spiral side by thickened and raised peripheral rims and sutures of inner and outer whorls. Rarity precludes designation of new species.
***Cibicides* sp. B**
Plate 31, figs. 22-24.
Remarks: Represented by a single broken specimen distinguished by its concavoconvex shape and surface of anastomosing pustules and coarse punctae. Differs from *Cibicides* cf. *C. farctus* by its smaller size, coarser surface texture on the umbilical side, and its smoother concave spiral side with very coarse punctae. Rarity precludes designation of new species.
***Cibicides* sp. C**
Plate 31, figs. 25-30.
Remarks: Test concavoconvex to planoconvex, moderately compressed, subovate in side view, edge subacute; chambers lunate; sutures limbate; spiral side chamber faces coarsely perforate; sutures, peripheral rim, apertural face, and umbilicus imperforate. Distinguished from *Cibicides pumilis* in having coarsely perforate chambers and imperforate limbate sutures on its spiral side. Rarity precludes designation of new species.
***Cibicides* sp. D**
Plate 31, figs. 16-18.

Remarks: Test concavoconvex, moderately compressed, subovate in side view; periphery lobate; edge subacute; chambers lunate; sutures incised on umbilical side, nearly flush on spiral side; surface finely perforate. Variable test shape indicative of attachment. Differs from *Cibicides pumilis* in its concavoconvexity and having more elongate chambers. Test variability precludes specific identification.

CIBICIDINA Bandy, 1949
Type species: *Cibicidina walli* Bandy, 1949.
***Cibicidina* sp. A**
Plate 31, figs. 31-33.
Remarks: Test concavoconvex, moderately compressed, subovate in side view; edge subacute; chambers lunate; sutures slightly incised on umbilical side, flush on spiral side; surface smooth; aperture marginal with lip. Differs from *Cibicidina* sp. B in its subovate shape and incised sutures. Rarity precludes designation of new species.
***Cibicidina* sp. B**
Plate 31, figs. 34-36.
Remarks: Test slightly biconvex to concavoconvex, moderately compressed; nearly round in side view; edge subacute; chambers lunate; sutures slightly limbate and raised; wall finely perforate except for imperforate sutures; aperture marginal with lip. Differs from *Cibicidina* sp. A in its round shape and limbate sutures. Superficially resembles *Hanzawaia crassisepta* (Cushman and Laiming) from the regional Saucesian, but its sutures are less prominent and it is devoid of umbilical flaps. Rarity precludes designation of new species.

LOBATULA Fleming, 1828
Type species: *Lobatula vulgaris* Fleming, 1828.
Lobatula lobatula (Walker and Jacob) = *Nautilus lobatulus* Walker and Jacob, in Kanmacher, 1798, Adam's Essays on the Microscope, Ed. 2, p. 642, pl. 14, fig. 36.
Plate 32, figs. 1-3.

Family PLANORBULINIDAE Schwager, 1877
Subfamily PLANORBULININAE Schwager, 1877
PLANORBULINA d'Orbigny, 1826
Type species: *Planorbulina mediterranensis* d'Orbigny, 1826.
***Planorbulina* sp.**
Plate 32, figs. 4-7.
Remarks: Specimens are small fragments unsuitable for comparison with known species.

Superfamily NONIONACEA Schultze, 1854
Family NONIONIDAE Schultze, 1854
Subfamily NONIONINAE Schultze, 1854
EVOLUTONONION N. W. Wang, 1964
Evolutononion dumonti **Finger, n. sp.**
Plate 35, figs. 24-26.
Description: Test relatively small, planoconvex to nearly planispiral, partially involute on both sides, round in side view, ovate in edge view; periphery lobate; edge rounded; chambers 9, triangular to subquadrate; sutures incised; umbilicus depressed, without granular deposits; aperture an elongate interiomarginal slit with narrow lip. Surface smooth. Wall calcareous, finely perforate.
Holotype: UCMP type number 39302.
Type locality: Locality CRC-40267-38, lower Mohnian, Upper Newport Bay, Orange County, California. Collected by W. R. Riedel, W. H. Akers, G. L. Armstrong, and R. J. Navarrette, 1982.
Discussion: The lack of umbonal granular material is atypical of the genus. Assemblages include low-trochospiral morphotypes with 7-9 similarly shaped chambers (Pl. 35, figs. 27-29); although assigned herein to *Gyroidina rosaformis* s.l. on the basis of coiling, these transitional forms are part of an evolutionary grade between the two taxa.
Occurrence: Specimens within the *G. rosaformis-E. dumonti* grade are abundant in many Mohnian assemblages, but only a few specimens of the latter end member were recovered from several Upper Newport Bay samples.
Etymology: Named in honor of Mr. Michael P. Dumont of ARCO, a specialist on California diatoms and foraminifera.

NONIONELLA Cushman, 1926
Type species: *Nonionella miocenica* Cushman, 1926.
Nonionella miocenica Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 64.
Plate 32, figs. 8-16.

NONIONELLINA Voloshinova, 1958
Type species: *Nonionina labradorica* J. W. Dawson, 1860.
Nonionellina milleri Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 43, pl. 7, figs. 7, 8.
Plate 32, figs. 41-45; plate 33, figs. 1-12.

PSEUDONONION Asano, 1936
Type species: *Pseudononion japonicum* Asano, 1936.
Pseudononion basispinatum (Cushman and Moyer) = *Nonion pizarrensis* var. *basispinata* Cushman and Moyer, 1930, Contr. Cushman Lab. Foram. Res., v. 6, pt. 3, p. 54, pl. 7, figs. 18a, b.
Plate 32, figs. 17-23.
Pseudononion costiferum (Cushman) = *Nonionina costifera* Cushman, 1926, Contr. Cushman Lab. Foram. Res., v. 1, pt. 4, p. 90, pl. 13, figs. 2a-c.
Plate 32, figs. 24-32.
Pseudononion multicameratum (Cushman and Kleinpell) = *Nonion pizarrensis* W. Berry var. *multicameratum* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 4, pl. 1, figs. 10a, b.
Plate 32, figs. 33-37.
Pseudononion schencki (Kleinpell) = *Nonion schencki* Kleinpell, Mio. Strat. Calif., p. 235, pl. 16, figs. 11a, b.
Plate 32, figs. 38-40.

Subfamily ASTRONONIONINAE Saidova, 1981
ASTRONONION Cushman and Edwards, 1937
Type species: *Nonionina stelligera* d'Orbigny, 1839.
Astrononion goudkoffi (Kleinpell) = *Nonion goudkoffi* Kleinpell, 1938, Mio. Strat. Calif., p. 231, pl. 20, figs. 2, 5.
Remarks: The large specimen figured from Manville Quarry

access road sample CRC-42107-27 (Pl. 33, figs. 2, 3) is in a population with typical forms.
Plate 33, figs. 13-29.

PULLENIA Parker and Jones, 1862
Type species: *Nonionina bulloides* d'Orbigny, 1846.
Pullenia inglei Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 43, pl. 9, figs. 31, 32.
Plate 34, figs. 1-6.
Pullenia malkinae Coryell and Mossman, 1942, Jour. Paleont., v. 16, p. 234, pl. 36, figs. 3, 4.
Plate 34, figs. 13-16.
Pullenia miocenica Kleinpell, 1938, Mio. Strat. Calif., p. 338, pl. 14, fig. 6.
Plate 34, figs. 7-10.
Pullenia salisburyi R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 72, pl. 8, figs. 2a, b.
Plate 34, figs. 11, 12.
***Pullenia* sp.**
Plate 34, figs. 17, 18.
Remarks: Test planispiral, moderately compressed; subovate in side view; periphery lobate; edge rounded; chambers 4, rapidly increasing in size. Rarity precludes designation of new species.

Superfamily CHILOSTOMELLACEA Brady, 1881
Family CHILOSTOMELLIDAE Brady, 1881
Subfamily CHILOSTOMELLINAE Brady, 1881
CHILOSTOMELLA Reuss, 1849
Type species: *Chilostomella ovoidea* Reuss, 1850.
Chilostomella ovoidea Reuss, 1850, K. Akad. Wiss. Wien., Math.-Naturw. Cl., Denkschr., v. 1, p. 380, pl. 48, figs. 12a-e.
Plate 34, figs. 19-28.

Subfamily CHILOSTOMININAE Finger and Gaponoff, 1986
CHILOSTOMINA Finger and Gaponoff, 1986
Type species: *Chilostomina pustulosa* Finger and Gaponoff, 1986.
Chilostomina pustulosa Finger and Gaponoff, 1986, Jour. Foram. Res., v. 16, no. 1, p. 37, pl. 1, figs. 1-15; pl. 2, figs. 1-12; pl. 3, figs. 1-11.
Plate 34, figs. 29-35.

Family QUADRIMORPHINIDAE Saidova, 1981
QUADRIMORPHINA Finlay, 1939
Type species: *Valvulina allomorphinoides* Reuss, 1860.
***Quadrimorphina* sp.**
Plate 35, figs. 1-6.
Remarks: Test trochospiral, biconvex, subrounded in side view; 3 whorls visible on spiral side, each with 4.5 chambers; chambers crescentic to lunate on spiral side, triangular on umbilical side, moderately increasing in size; sutures incised; aperture extra-umbilical with broad umbilical flap extending from penultimate chamber. Rarity precludes designation of new species.

Family ORIDORSALIDAE Loeblich and Tappan, 1984
ORIDORSALIS Andersen, 1961
Type species: *Oridorsalis westi* Andersen, 1961.
Oridorsalis relizanus (Kleinpell) = *Gyroidina relizana* Kleinpell, 1938, Mio. Strat. Calif., p. 315, pl. 10, figs. 11a, b.
Plate 35, figs. 18-23.
Oridorsalis subtener (Galloway and Wissler) = *Rotalia subtenera* Galloway and Wissler, 1927, Jour. Paleont., v. 1, p. 60, pl. 10, figs. 4a-c.
Plate 35, figs. 7-11.
Oridorsalis umbonatus (Reuss) = *Rotalina umbonata* Reuss, 1851, Deutsch. Geol. Ges., Zeitschr., v. 3, p. 75, pl. 5, figs. 35a-c.
Plate 35, figs. 12-17.

Family HETEROLEPIDAE Gonzáles-Donosa, 1969
ANOMALINOIDES Brotzen, 1942
Type species: *Anomalinoides plummerae* Brotzen, 1942.
Anomalinoides salinasensis (Kleinpell) = *Anomalina salinasensis* Kleinpell, 1938, Mio. Strat. Calif., p. 347, pl. 13, figs. 1a-c.
Plate 35, figs. 30-35.

Family GAVELINELLIDAE Hofker, 1956
Subfamily GAVELINELLINAE Hofker, 1956
GYROIDINA d'Orbigny, 1826
Type species: *Gyroidina orbicularis* d'Orbigny, 1826.
Gyroidina healdi (R. E. and K. C. Stewart) = *Eponides healdi* R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 70, pl. 8, figs. 8a-c.
Plate 36, figs. 1-6.
Gyroidina cf. G. keenani (Cushman and Kleinpell) = *Eponides keenani* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 14, pl. 3, figs. 10a-11c.
Plate 36, figs. 7-9.
Remarks: Single specimen has long chambers characteristic of *Gyroidina keenani*, but that species is larger and has a flat spire. Its trochospire is higher than that of typical *G. rosaformis*, but variability in that species does not exclude the possibility that this is an aberrant form or extreme variation, as suggested by the possible grade illustrated on Plate 36, figs. 7-18.
Gyroidina rosaformis (Cushman and Kleinpell) = *Eponides rosaformis* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 14, pl. 2, figs. 18a-c.
Plate 35, figs. 27-29; plate 36, figs. 10-21.
Gyroidina* aff. *G. rosaformis
Plate 36, figs. 22-29.
Synonymy: *Gyroidina* cf. *G. rosaformis* of Finger (1990).
Remarks: Differs from *Gyroidina rosaformis* by its generally smaller size and oblique spiral sutures. This is probably an immature *G. rosaformis*, but these two morphotypes often occur independently of each other, with this one predominant in the Mohnian; some thin-sectioned adult *G. rosaformis* have early whorls resembling those of this form (see Finger, 1990).

HANSENISCA Loeblich and Tappan, 1987
Type species: *Gyroidina soldanii* d'Orbigny, 1826.
Hansenisca altiformis (R. E. and K. C. Stewart) = *Gyroidina soldanii* var. *altiformis* R. E. and K. C. Stewart,

1930, Jour. Paleont., v. 4, no. 1, p. 67, pl. 9, figs. 2a-c.
Plate 37, figs. 1-3.

Hansenisca multicamerata (Kleinpell) = *Eponides multicameratus* Kleinpell, Mio. Strat. Calif., p. 329, pl. 19, figs. 2, 3, 7.
Plate 37, figs. 4-9.

Hansenisca rotundimargo (R. E. and K. C. Stewart) = *Gyroidina soldanii* var. *rotundimargo* R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 68, pl. 9, figs. 3a-c.
Plate 37, figs. 10-24.

HANZAWAIA Asano, 1944
Type species: *Hanzawaia nipponica* Asano, 1944.

Hanzawaia* cf. *H. crassisepta (Cushman and Laiming) = *Cibicides americanus* var. *crassiseptus* Cushman and Laiming, 1931, Jour. Paleont., v. 5, no. 2, p. 119, pl. 14, figs. 7a-c.
Plate 38, figs. 5-7.
Remarks: Test more compressed than either *Hanzawaia crassisepta* or *H. depaoloi*. Sutures limbate as on *H. crassisepta* and typical of most *H. depaoloi*, but not raised. Many specimens can easily be misidentified as *Cibicidina* because weakly developed umbilical flanges are difficult to recognize.

Hanzawaia depaoloi Finger and Lipps, in Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 43, pl. 8, figs. 15-18.
Plate 37, figs. 25-38; plate 38, figs. 1-4.

HOLMANELLA Loeblich and Tappan, 1962
Type species: *Discorbinella valmonteensis* Kleinpell, 1938.

Holmanella baggi (Kleinpell) = *Planulina baggi* Kleinpell, 1938, Mio. Strat. Calif., p. 349, pl. 8, figs. 14a-c.
Plate 38, figs. 8-28.

Holmanella valmonteensis (Kleinpell) = *Discorbinella valmonteensis* Kleinpell, 1938, Mio. Strat. Calif., p. 350, pl. 21, figs. 14-16.
Plate 38, figs. 29-36.

Family TRICHOHYALIDAE Saidova, 1981
BUCCELLA Andersen, 1952
Type species: *Eponides hannai* Phleger and F. L. Parker, 1951.

Buccella oregonensis (Cushman, Stewart, and Stewart) = *Eponides mansfieldi* var. *oregonensis* Cushman, Stewart, and Stewart, 1948, Oregon Dept. Geol. Min. Indust., Bull., no. 36 (1947), pt. 2, p. 48, pl. 6, figs. a-c.
Plate 39, figs. 1-24.

Superfamily ROTALIACEA Ehrenberg, 1839
Family ELPHIDIIDAE Galloway, 1933
Subfamily ELPHIDIINAE Galloway, 1933
ELPHIDIUM de Montfort, 1808
Type species: *Nautilus macellus* var. ß Fichtel and Moll, 1798.

Elphidium granti Kleinpell, 1938, Mio. Strat. Calif., p. 938, pl. 19, figs. 1, 11.
Plate 39, figs. 25-31.

Suborder DELOSININA Revets, 1989
Family TREMACHORIDAE J. H. Lipps and K. L. Lipps, 1967
TREMACHORA J. H. Lipps and K. L. Lipps, 1967
Type species: *Tremachora arga* J. H. Lipps and K. L. Lipps, 1967.

Tremachora arga J. H. and K. L. Lipps, 1967, Jour. Paleont., v. 41, no. 2, p. 497, 499, figs. 1A-C.
Plate 23, figs. 39-45.
Remarks: Assignment of *Tremachora* to this new suborder is based on Revets' (1991) examination of the ultra-structure of *T. arga* topotypes.

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*Asterisks denote publications in which foraminifera are well-illustrated.

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Plate Index 1: Morphotypes

Plate Index 2: Systematics

Plate Index 3: Genera

Plate Index 4: Species

Plates 1-39

Key to Sections

CRC-39842 = Naples Beach

CRC-40267 = Upper Newport Bay

CRC-40398 = Mussel Rock

CRC-40660 = Naples Beach

CRC-41367 = Toro Road

CRC-41368 = Olmstead Road

CRC-42107 = Manville Quarry Road

CRC-42263 = Toro Road

CW-34975 = Los Sauces Creek

FJP-9 = Morales Canyon

GC = Graves Creek

IC = Indian Creek

LH = Laguna Hills

MAR = Laguna Hills

NA = Naples Beach

SCI-L76 = San Clemente Island

SL = Santa Lucia Ave. (Graves Creek section)

TC = Topanga Canyon

UCLA-6317 = San Clemente Island

Depositories and type numbers of illustrated specimens:

UCMP = University of California Museum of Paleontology

UCMP38218 to -38474 were previously assigned by Finger (1990) and Finger and others (1990).

UCMP38668 to -39335 are new type numbers.

USNM = U.S. National Museum

USNM388205 and -388213 were previously assigned by Finger and Gaponoff (1986).

PLATE 1

Textulariina, Miliolina

1 *Bathysiphon sanctaecrucis*, segment, TC-141, UCMP38668, side view, X50.

2-5 *Ammodiscus incertus*: **2**, CRC-39842-3, UCMP38669, side view, X97. **3**, GC-15a, UCMP38330, side view, X69. **4**, LH-4, UCMP38670, side view, X114. **5**, LH-4, UCMP38671, side view, X84.

6 *Reophax* cf. *R. excenticus*, specimen missing early segment, GC-4, UCMP38332, side view, X10.

7 *Ammobaculites?* sp. A, TC-130, UCMP38672, side view, X30.

8 *Ammobaculites?* sp. B, early segment, GC-8, UCMP38331, side view, X40.

9, 10 *Haplophragmoides?* sp. A, TC-123, UCMP38673, X60: 9, edge view; 10, side view.

11, 12 *Haplophragmoides?* sp. B, TC-130, UCMP38674, X30: 11, side view; 12, edge view.

13, 14 *Haplophragmoides?* sp. C, TC-141, UCMP38675, X40: 13, edge view; 14, side view.

15, 16 *Haplophragmoides?* sp. D, CRC-39842-80, UCMP38676, X150: 15, edge view; 16, side view.

17, 18 *Cyclammina incisa*, FJP-9, UCMP38677, X35: 17, edge view; 18, side view.

19 *Gaudryina exilis*, MAR-254, UCMP38678, side view, X41.

20-22 *Gaudryina pliocenica*: **20**, LH-1, UCMP38679, side view, X55. **21**, SL-1, UCMP38440, side view, X40. **22**, UCLA-6317, UCMP38680, side view, X65.

23 *Gaudryina subglabrata*, LH-4, UCMP38681, side view, X55.

24 *Verneuilinulla?* sp. A, TC-123, UCMP38682, side view, X35.

25 *Verneuilinulla?* sp. B, TC-123, UCMP38683, side view, X55.

26 *Martinottiella communis*?, late segment, TC-318, UCMP38684, side view, X70.

27 *Textularia* cf. *T. warrenites*, TC-175, UCMP38685, side view, X100.

28 *Textularia* sp., MAR-254, UCMP38686, side view, X47.

29 *Quinqueloculina seminulum*, MAR-254, UCMP38687, side view, X55.

30 *Spirosigmoilina tenuis*, GC-8, UCMP38334, side view, X100.

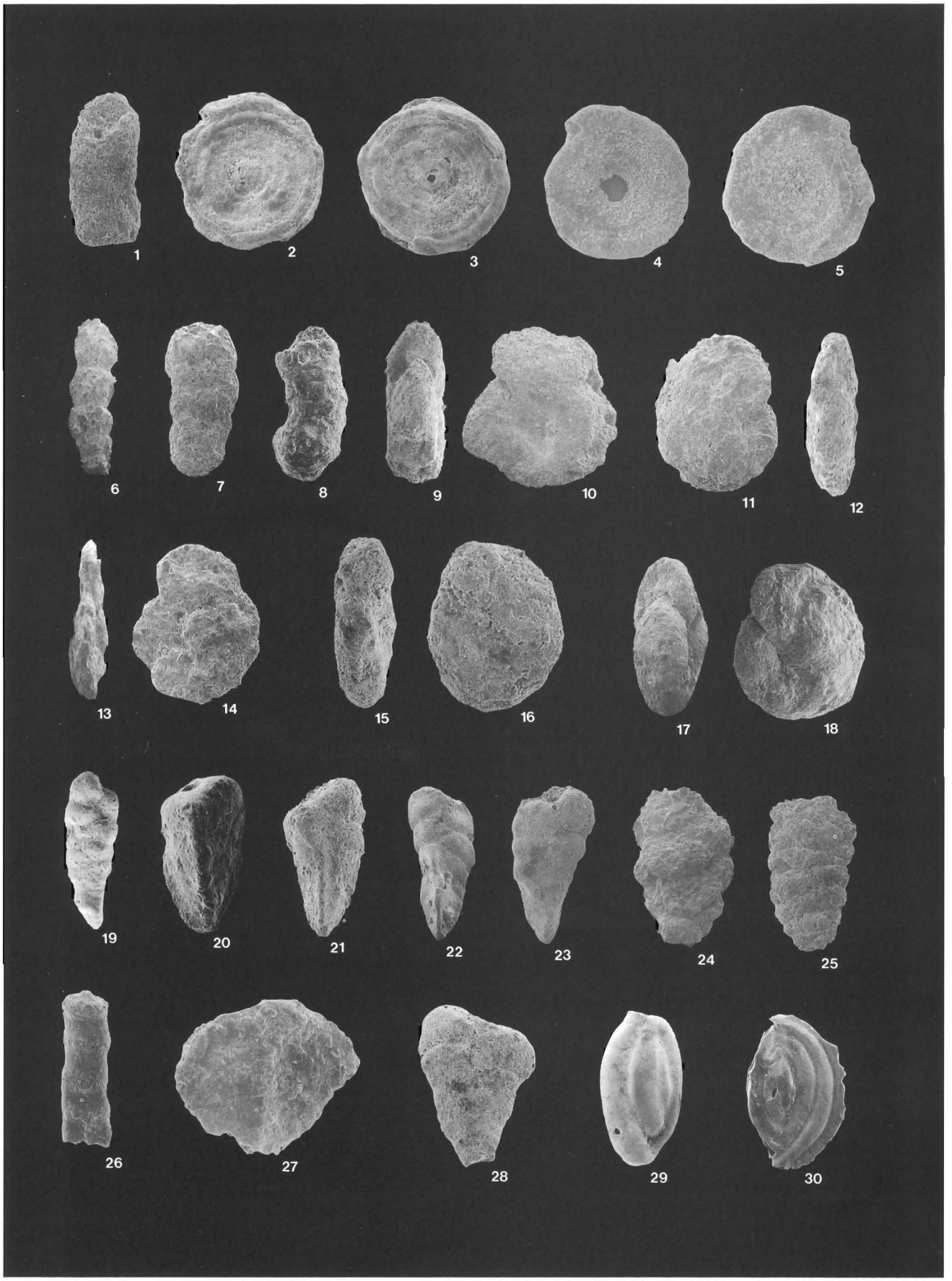
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PLATE 2

Chrysalogonium, Dentalina, Enantiodentalina, Nodosaria, Pseudonodosaria

1, 2 *Chrysalogonium californiensis*, GC-12, holotype, UCMP38221: 1, side view of aperture, x150; 2, side view, x45.
3 *Dentalina* cf. *?D. antennula*, middle segment, CRC-42107-13, UCMP38688, side view, x28.
4 *Dentalina atascaderoensis*, GC-9, holotype, middle segment, UCMP38226, side view, x20.
5-8 *Dentalina* cf. *D. baggi*: **5**, CRC-40267-48, UCMP38689, side view, x30. **6**, early segment, CRC-40267-44, UCMP-38690, side view, x35. **7**, early segment, CRC-40267-48, UCMP38691, side view, x20. **8**, early segment, CRC-39842-12, UCMP38692, side view, x35.
9 *Dentalina communis*, GC-4, UCMP38222, side view, x22.
10-12 *Dentalina grandis*: **10**, early segment, CRC-40267-35, UCMP38693, side view, x20. **11**, CRC-39842-26, UCMP-38694, side view, x20. **12**, CRC-40267-35a, UCMP38695, side view, x33.
13 *Dentalina lagoei*, holotype, GC-13, UCMP38225, side view, x100.
14 *Dentalina pseudoinvolvens*, late segment, UCLA-6317, UCMP38696, side view, x31.
15-18 *Dentalina pseudoobliqua*: **15**, CRC-40660-14, UCMP38697, side view, x40. **16**, MAR-254, middle segment, UCMP-38698, side view, x43. **17**, CRC-40267-35, UCMP38699, side view, x25. **18**, GC-15a, UCMP38700, side view, x31.
19-22 *Dentalina roemeri*: **19**, GC-8, UCMP38701, side view, x46. **20**, GC-11, UCMP38223, side view, x50. **21**, GC-14, UCMP38702, side view, x35. **22**, CRC-40267-39, UCMP38703, side view, x23.
23 *Dentalina* sp. A, CRC-39842-94, UCMP38704, side view, x35.
24, 25 *Dentalina* sp. B: **24**, middle segment, CRC-40267-35a, UCMP38705, side view, x25. **25**, late segment, CRC-40267-35a, UCMP38706, side view, x19.
26 *Dentalina* sp. C, middle segment, CRC-40267-38, UCMP38707, side view, x40.
27-29 *Dentalina* sp. D: **27**, early segment, CRC-39842-20, UCMP38708, side view, x45. **28, 29**, late segment, LH-5, UCMP38709, side views, x20: fig. 29 is 90° clockwise from fig. 28.
30, 31 *Dentalina* sp. E, early segment, CRC-40267-47a, UCMP38710, x33: 30, side view; 31, side view 90° counterclockwise from fig. 30.
32 *Dentalina* sp. F, early segment, GC-9, UCMP38227, side view, x43.
33 "*Dentalina*" sp., CRC-40267-47b, UCMP38711, side view, x17.
34-47 *Enantiodentalina muraii*: **34, 35**, IC-111, UCMP38712, side views, x40: fig. 35 is 90° clockwise from fig. 34. **36, 37**, IC-126, UCMP38713, side views, x43: fig. 37 is 90° clockwise from fig. 36. **38, 39**, GC-1, UCMP38379, side views, x35: fig. 39 is 90° counterclockwise from fig. 38. **40, 41**, GC-4, UCMP38381, side views, x40: fig. 41 is 90° clockwise from fig. 40. **42, 43**, GC-11, UCMP38380, side views, x35: fig. 43 is 90° clockwise from fig. 42. **44, 45**, GC-12, UCMP38383, side views, x25: fig. 45 is 90° clockwise from fig. 44. **46, 47**, GC-14, UCMP-38382, side views, x55: fig. 47 is 90° clockwise from fig. 46.
48, 49 *Nodosaria anomala*, early segment, SCI-L76-26, UCMP38714, x35: 48, apertural view; 49, side view.
50-53 *Nodosaria ewaldi*: **50**, late segment, GC-12, UCMP38228, side view, x27. **51**, late segment, CRC-40267-47a, lost specimen, side view, x34. **52**, CRC-40267-35a, UCMP38716, side view, x15. **53**, CRC-40267-47a, UCMP38717, side view, x10.
54 *Nodosaria franki*, holotype, middle segment, GC-8, UCMP38232, side view, x65.
55-61 *Nodosaria irregularis*: **55, 56**, megaspheric early segment, CRC-42107-11, UCMP38718: 55, apertural view, x62; 56, side view, x31. **57**, megaspheric specimen, CRC-40267-50a, UCMP38719, side view, x35. **58**, megaspheric early segment, GC-7, UCMP38230, side view, x45. **59**, megaspheric early segment, CRC-40267-50a, UCMP38720, side view, x24. **60**, microspheric early segment, CRC-42107-11, UCMP38721, side view, x38. **61**, megaspheric early segment, CRC-40660-21, UCMP38722, side view, x46.
62, 63 *Nodosaria obispoensis*: **62**, SCI-L76-30, UCMP38723, side view, x40. **63**, holotype, GC-15a, UCMP38231, side view, x30.
64 *Nodosaria* cf. *N. ovalis*, middle segment, CRC-42107-13, UCMP38724, side view, x26.
65, 66 *Nodosaria perversa*: **65**, early segment, CRC-40267-46a, UCMP38725, side view, x45. **66**, early segment of lost specimen, GC-12, side view, x50.
67 *Nodosaria "spinescens"*, CRC-42107-13, UCMP38726, side view, x35.
68-72 *Nodosaria weaveri*: **68, 69**, early segment, GC-1, UCMP38727, x60: 68, apertural view; 69, side view. **70, 71**, holotype, GC-12, UCMP38233: 70, apertural view, x56; 71, side view, x31. **72**, early segment, GC-9, UCMP-38728, side view, x36.
73 *Nodosaria* sp. A, CRC-40267-47a, UCMP38729, side view, x30.
74 *Nodosaria* sp. B, CRC-42107-23, UCMP38730, side view, x45.
75 *Pseudonodosaria obtusissima*, CRC-40267-39, UCMP38731, side view, x69.

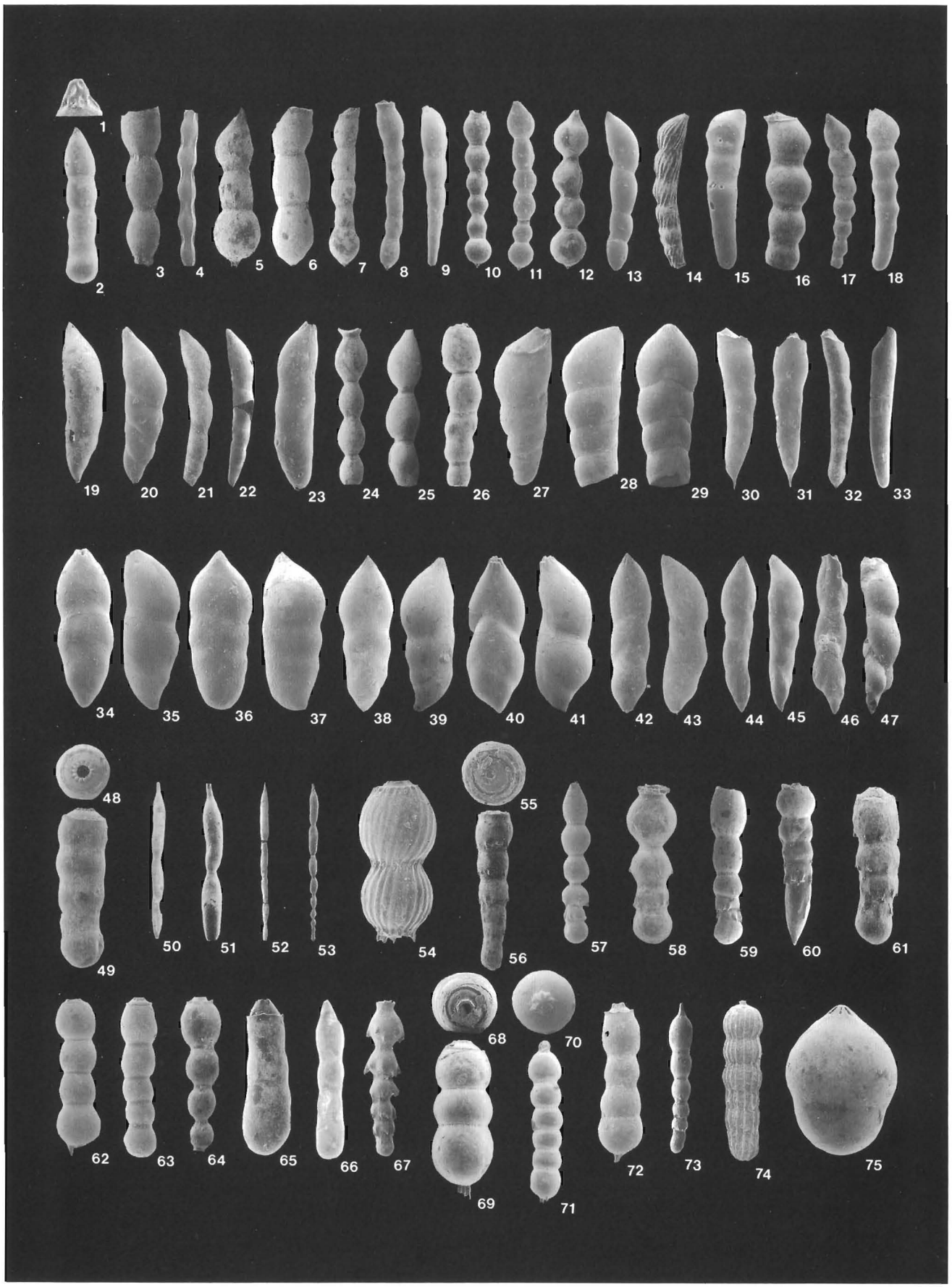
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PLATE 3

Frondicularia, Amphimorphina, Parafrondicularia, Plectofrondicularia, Proxifrons, Lenticulina

1 *Frondicularia* cf. *F. bulbosa*, GC-1, UCMP38431, side view, X57.

2, 3 *Frondicularia* sp. A, side views: **2**, GC-1, UCMP38732, X60; **3**, lost specimen, GC-15d, X48.

4 *Frondicularia* sp. B, CRC-39842-57, UCMP38733, side view, X45.

5-12 *Amphimorphina amchitkaensis*: **5, 6**, late segment, GC-8, UCMP38219: 5, side view, X54; 6, oblique apertural view, X83. **7**, middle segment, SCI-L76-29, UCMP38734, median apertural view, X50. **8**, middle segment, GC-8, UCMP38220, median apertural view, X26. **9**, megaspheric early segment, SCI-L76-29, lost specimen, side view, X31. **10**, megaspheric early segment, GC-8, UCMP38218, side view, X36. **11, 12**, lost microspheric early segment, GC-8, side view: 11, scanning electron micrograph, X41; 12, light photomicrograph revealing early biserial stage, X50.

13-17 *Parafrondicularia miocenica*, side views: **13**, CRC-40660-3, UCMP38736, X39. **14**, lost specimen, GC-9, X35. **15**, CRC-40660-3, UCMP38737, X47. **16**, GC-3, UCMP38435, X40. **17**, GC-9, UCMP38434, X30.

18, 19 *Plectofrondicularia californica*, side views: **18**, GC-1, UCMP38433, X40. **19**, SCI-L76-33, UCMP38738, X20.

20-22 *Proxifrons advena*, side views: **20**, GC-8, UCMP38432, X35. **21**, CRC-40267-44, UCMP38739, X35. **22**, CRC-40267-39, UCMP38740, X33.

23 *Proxifrons vaughani*, CRC-40267-39, UCMP38741, side view, X38.

24, 25 *Proxifrons* sp., CRC-40267-46a, UCMP38742, side view, X40: 24, SEM; 25, light photomicrograph revealing early biserial stage.

26-32 *Lenticulina atascaderoensis*: **26**, GC-13, UCMP38300, side view, X59. **27, 28**, holotype, GC-13, UCMP-38299, X60: 27, edge view; 28, side view. **29, 30**, GC-4, UCMP38743, X50: 29, edge view; 30, side view. **31, 32**, GC-4, UCMP38744, X50: 31, edge view; 32, side view.

33, 34 *Lenticulina branneri*, GC-15a, UCMP38287, X50: 33, edge view; 34, side view.

35-42 *Lenticulina dubia*: **35, 36**, CRC-40267-35, UCMP38745, X61: 35, side view; 36, edge view. **37, 38**, GC-8, UCMP38288, X70: 37, edge view; 38, side view. **39, 40**, GC-11, UCMP38289, X30: 39, edge view; 40, side view. **41, 42**, CRC-40660-14, UCMP38746, X57: 41, edge view; 42, side view.

43, 44 *Lenticulina* cf. *L. dubia*, GC-7, UCMP38290, X35: 43, edge view; 44, side view.

45, 46 *Lenticulina hughesi*, GC-3, UCMP38291, X38: 45, edge view; 46, side view.

47, 48 *Lenticulina luciana*, GC-2, UCMP38293, X48: 47, edge view; 48, side view.

49-57 *Lenticulina miocenica*: **49, 50**, LH-7, UCMP38747, X50: 49, edge view; 50, side view. **51, 52**, GC-15b, UCMP38294, X55: 51, edge view; 52, side view. **53**, SCI-L76-33, UCMP38748, side view, X40. **54**, SCI-L76-33, UCMP38749, side view, X45. **55**, SCI-L76-29, UCMP39350, side view, X55. **56, 57**, CRC-40267-30, UCMP38751, X60: 56, edge view; 57, side view.

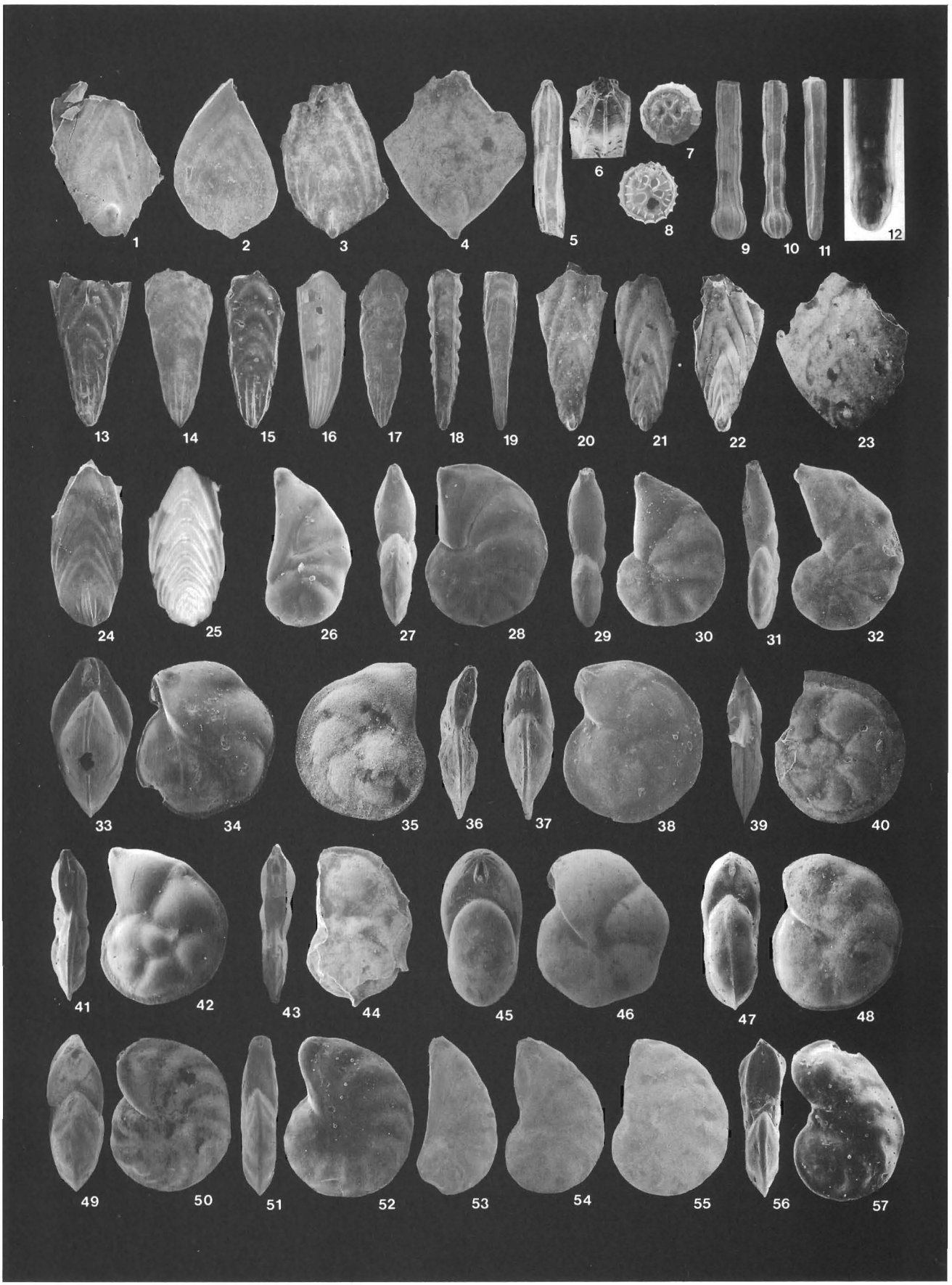
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PLATE 4

Lenticulina

1 *Lenticulina miocenica*?, CRC-40660-5, lost specimen, side view, X85.

2-9 *Lenticulina reedi*: **2, 3**, GC-8, UCMP38295, X60: 2, edge view; 3, side view. **4, 5**, CRC-40267-38, UCMP-38753, X36: 4, edge view; 5, side view. **6, 7**, CRC-40267-38, UCMP38754, X45: 6, edge view; 7, side view. **8, 9**, CRC-40267-39, UCMP38755, X25: 8, edge view; 9, side view.

10, 11 *Lenticulina sandholdtana*, lost holotype, GC-8, X63: 10, edge view; 11, side view.

12-25 *Lenticulina smileyi*: **12, 13**, IC-100, UCMP38756, X45: 12, edge view; 13, side view. **14, 15**, GC-6, UCMP38297, X54: 14, edge view; 15, side view. **16, 17**, CRC-40267-47a, UCMP38757, X62: 16, edge view; 17, side view. **18, 19**, LH-5, UCMP38758, X43: 18, edge view; 19, side view. **20, 21**, CRC-40660-14, UCMP38759, X59: 20, edge view; 21, side view. **22, 23**, GC-8, UCMP38760, X50: 22, edge view; 23, side view. **24, 25**, GC-15d, UCMP38761, X40: 24, edge view; 25, side view.

26-31 *Lenticulina smileyi* (forma "*simplex*"): **26, 27**, GC-13, UCMP38292, X40: 26, edge view; 27, side view. **28, 29**, GC-13, UCMP38296, X35: 28, edge view; 29, side view. **30, 31**, CRC-39842-78, UCMP38762, X40: 30, side view; 31, edge view.

32-39 *Lenticulina douglasi*, n. sp.: **32**, CRC-40267-38, lost specimen, edge view, X35. **33, 34**, CRC-40267-47a, lost specimen, X25: 33, edge view; 34, side view. **35**, CRC-40267-38, paratype, UCMP38765, side view, X55. **36, 37**, CRC-40267-47a, holotype, UCMP38766, X25: 36, edge view; 37, side view. **38, 39**, CRC-40267-38, paratype, UCMP38767, X50: 38, edge view; 39, side view.

40, 41 *Lenticulina* sp. G, GC-3, UCMP38301, X28: 40, side view; 41, edge view.

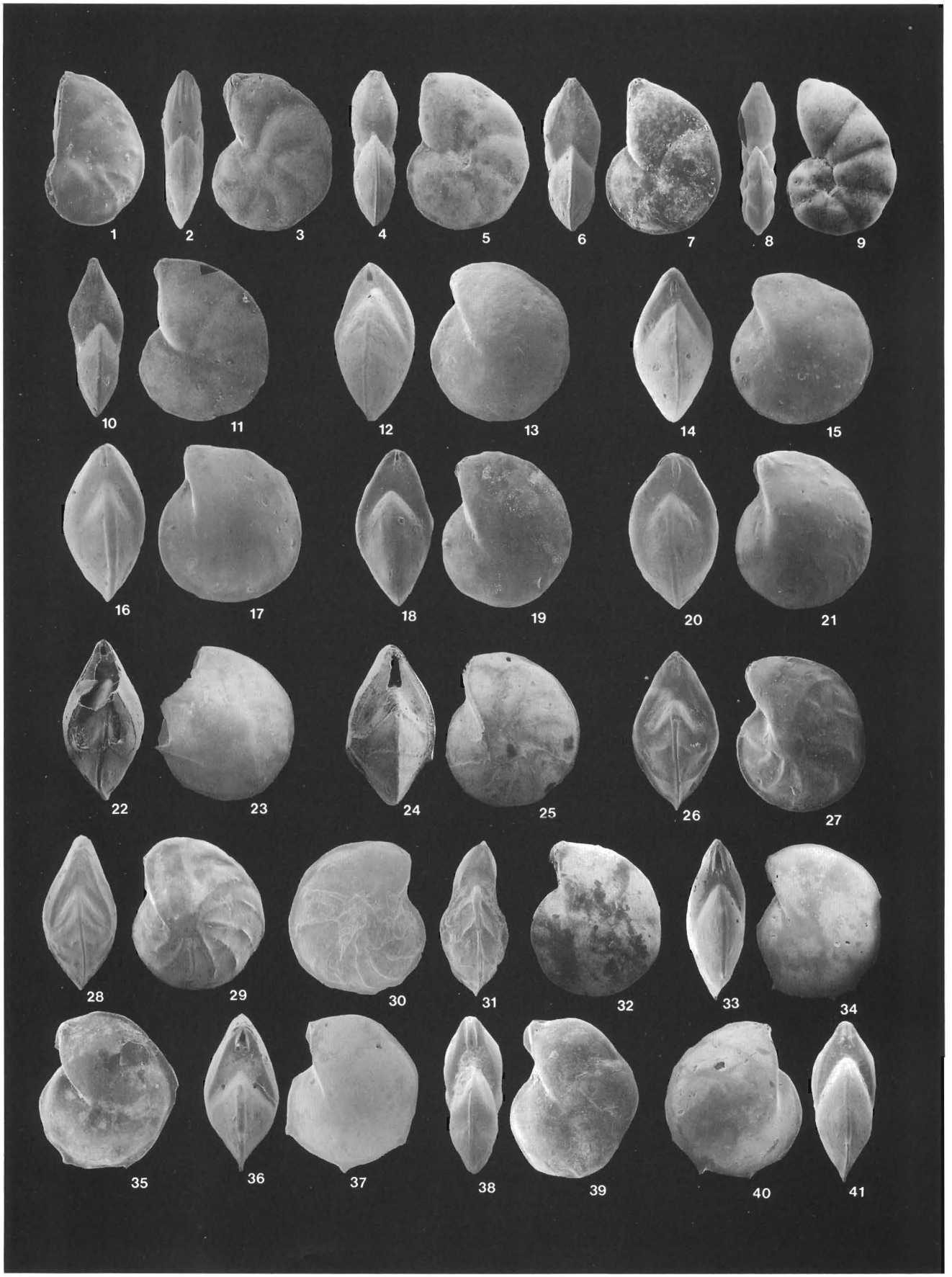
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PLATE 5

Lenticulina, Marginulinopsis, Saracenaria

1, 2 *Lenticulina* sp. A, CRC-39842-5, UCMP38768, X85: 1, edge view; 2, side view.

3, 4 *Lenticulina* sp. C, GC-9, UCMP38298. X30: 3, side view; 4, edge view.

5, 6 *Lenticulina* sp. E, SCI-L76-29, UCMP38769, X50: 5, edge view; 6, side view.

7, 8 *Lenticulina barroni*, n. sp., GC-13, holotype, UCMP38302, X30: 7, edge view; 8, side view.

9, 10 *Lenticulina* cf. *L. gerlandi*, SCI-L76-29, UCMP38770, X30: 9, edge view; 10, side view.

11-19 *Lenticulina* sp. F: **11, 12**, CRC-39842-65, UCMP38771, X37: 11, edge view; 12, side view. **13, 14**, CRC-39842-65, UCMP38772, X35: 13, side view; 14, edge view. **15, 16**, CRC-39842-51, UCMP38773, X38: 15, side view; 16, edge view. **17, 18**, CRC-39842-51, UCMP38774, X50: 17, edge view; 18, side view. **19**, CRC-39842-65, UCMP38775, side view, X30.

20, 21 *Lenticulina* sp. B, CRC-39842-103, UCMP38776, X80: 20, edge view; 21, side view.

22, 23 *Lenticulina* sp. D, TC-28, UCMP38777, X35: 22, edge view; 23, side view.

24, 25 *Lenticulina indianensis*, n. sp., IC-111, holotype, UCMP38778, X60: 24, edge view; 25, side view.

26, 27 *Lenticulina cushmani*?, CRC-40267-47a, UCMP38779, X45: 26, edge view; 27, side view.

28-33 *Marginulinopsis beali*: **28, 29**, microspheric, MAR-254, UCMP38780, X25: 28, edge view; 29, side view. **30, 31**, microspheric, GC-15d, UCMP38378, X20: 30, edge view; 31, side view; **32, 33**, megaspheric, LH-7, UCMP38781, X30: 32, edge view; 33, side view.

34, 35 *Marginulinopsis* sp., SL-1, UCMP38445, X25: 34, edge view; 35, side view.

36-38 *Saracenaria schencki*, CRC-39842-78, UCMP38782, X70: 36, edge view; 37, oblique side view; 38, opposite edge view.

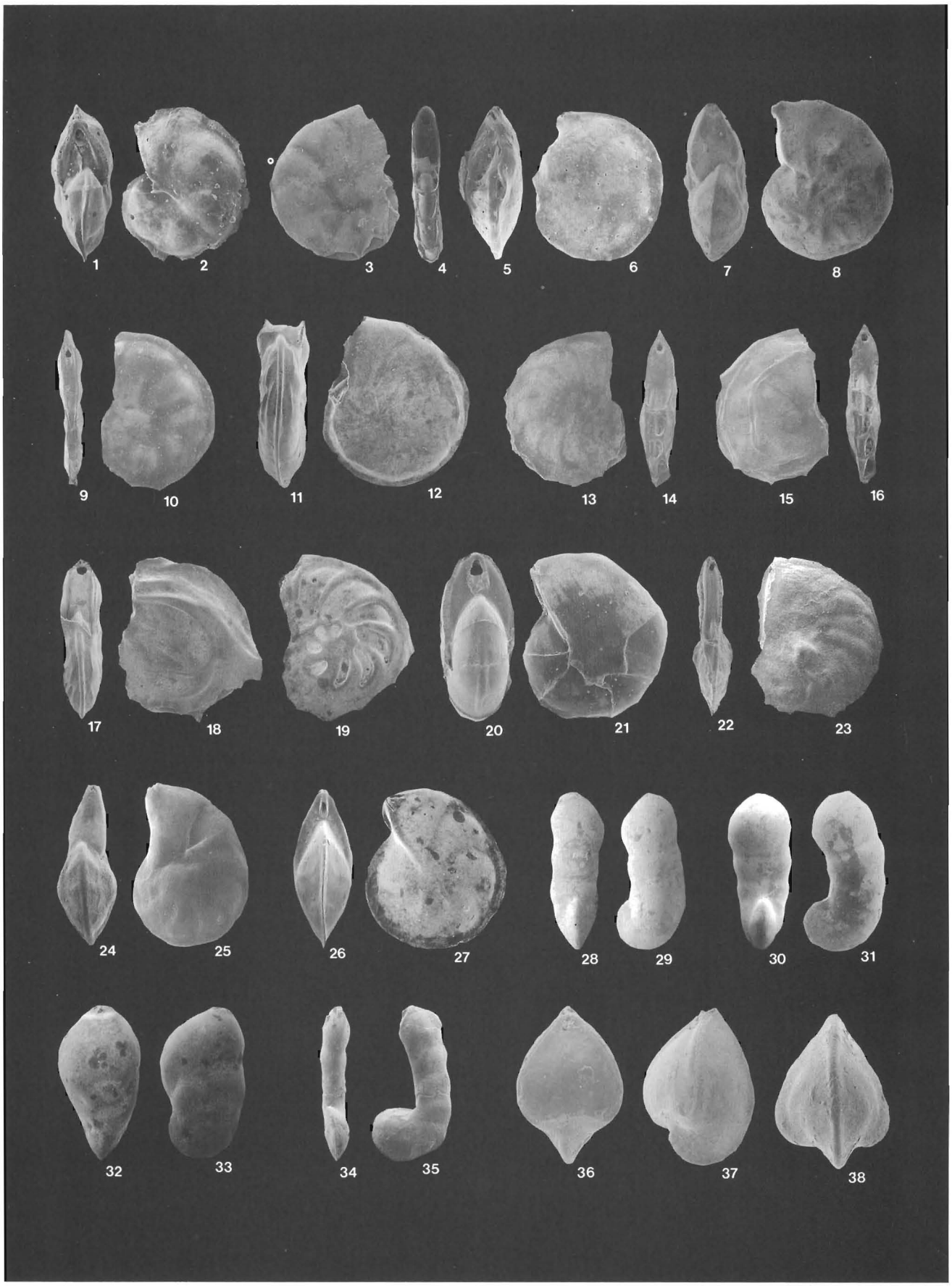
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PLATE 6

Amphicoryna, Astacolus, Marginulina, Vaginulina

1 *Amphicoryna catesbyi*, CRC-40267-35, UCMP38783, side view, X57.

2, 3 *Astacolus crepidulus*, SCI-L76-43, UCMP38784, X40: 2, edge view; 3, side view.

4, 5 *Astacolus mayi*, CRC-40267-39, UCMP38785, X43: 4, edge view; 5, side view.

6, 7 *Astacolus* sp. A, CRC-40660-15, UCMP38786, X40: 6, edge view; 7, side view.

8, 9 *Astacolus* sp. B, GC-2, UCMP38282, X67: 8, edge view; 9, side view.

10, 11 *Astacolus* sp. C, GC-6, UCMP38283, X53: 10, side view; 11, edge view.

12, 13 *Astacolus* sp. D, SCI-L76-29, UCMP38787, X33: 12, edge view; 13, side view.

14, 15 *Astacolus* cf. *A. cymboides*, GC-8, UCMP38284, X55: 14, edge view; 15, side view.

16-19 *Astacolus naplesensis*, n. sp.: **16, 17**, CRC-40398-3, UCMP38788, X42: 16, edge view; 17, side view. **18, 19**, CRC-39842-93, holotype, UCMP38789, X40: 18, edge view; 19, side view.

20-23 *Astacolus* sp. G: **20, 21**, CRC-39842-4, UCMP38790, X48: 20, edge view; 21, side view. **22, 23**, MAR-254, UCMP38791, X35: 22, edge view; 23, side view.

24-27 *Astacolus* sp. F: **24, 25**, GC-3, UCMP38285 (= *Astacolus* sp. I), X50: 24, edge view; 25 side view. **26, 27**, GC-4, UCMP38286, X35: 26, edge view; 27, side view.

28, 29 *Astacolus* sp. H, SL-1, UCMP38446, X40: 28, side view; 29, edge view.

30, 31 *Astacolus* sp. E, CRC-39842-3, UCMP38792, X60: 30, edge view; 31, side view.

32, 33 *Marginulina subbullata*, CRC-40267-38, UCMP38793, X50: 32, side view; 33, edge view.

34-37 *Marginulina crouchi*: **34, 35**, paratype, immature microspheric specimen, GC-1, UCMP38375, X45: 34, edge view; 35, side view. **36, 37**, holotype, microspheric, GC-5, UCMP38376, X35: 36, edge view; 37, side view.

38, 39 *Marginulina* sp., GC-9, UCMP38377, X55: 38, side view; 39, edge view.

40, 41 *Vaginulina* cf. *V. dubia*, GC-4, UCMP38374, X70: 40, edge view; 41, side view.

42, 43 *Vaginulina* cf. *V. tenuis*, GC-14, UCMP38373, X40: 42, side view; 43, edge view.

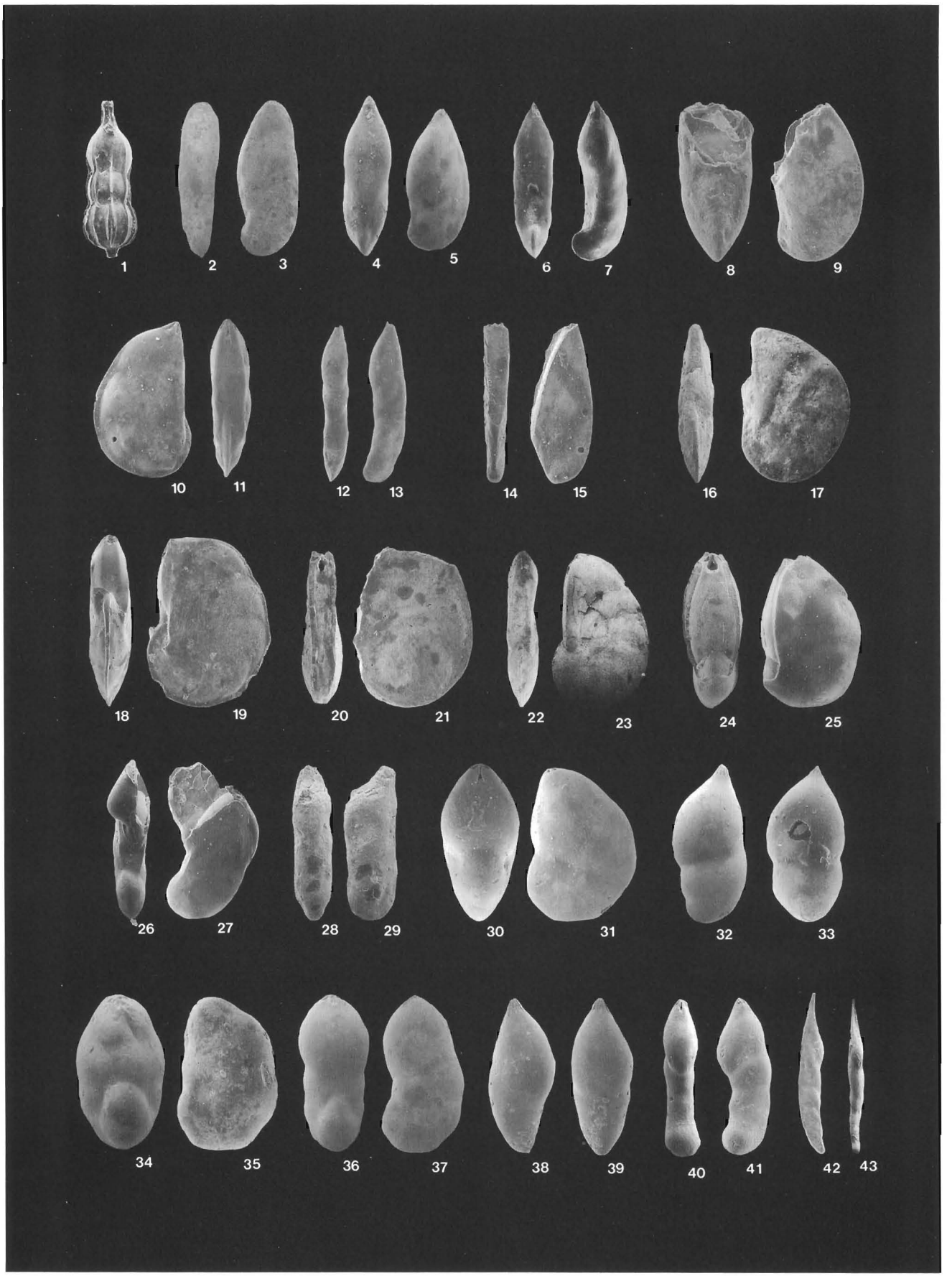
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PLATE 7

Lagena

1-4 *Lagena apiopleura*: **1, 2**, SCI-L76-42, UCMP38794, X98: 1, apertural view; 2, side view. **3**, GC-9, UCMP38265, side view, X200. **4**, GC-15d, destroyed specimen, side view, X110.

5 *Lagena apiopleura*?, LH-4, UCMP38796, side view, X125.

6, 7 *Lagena discrepans*, CRC-40267-50a, UCMP38797, X91: 6, apertural view; 7, side view.

8 *Lagena laevis*, GC-9, UCMP38253, side view, X200.

9-11 *Lagena lisbonensis*: **9, 10**, GC-3, UCMP38255, X95: 9, apertural view; 10, side view. **11**, GC-13, lost specimen, side view, X104.

12 *Lagena meridionalis*, IC-91, UCMP38798, side view, X200.

13 *Lagena mexicana*, GC-13, lost specimen, side view, X202.

14 *Lagena pacifica*, GC-11, lost specimen, side view, X173.

15, 16 *Lagena* cf. *L. pliocenica*: **15**, SL-1, UCMP38441, side view, X150. **16**, GC-3, UCMP38259, side view, X150.

17, 18 *Lagena semilineata*, CRC-40267-1, UCMP38799, X100: 17, apertural view; 18, side view.

19, 20 *Lagena* cf. *L. striata*, CRC-40267-38, UCMP38800, X71: 19, apertural view; 20, side view.

21-27 *Lagena timmsana*: **21**, GC-3, UCMP38261. side view, X106. **22, 23**, GC-3, UCMP38260, X122: 22, apertural view; 23, side view. **24, 25**, UCLA-6317, UCMP38801, X103: 24, apertural view; 25, side view. **26, 27**, CRC-40267-29, UCMP38802, X100: 26, apertural view; 27, side view.

28-31 *Lagena timmsana* variants: **28, 29**, var. A, GC-15a, UCMP38262, X103: 28, apertural view; 29, side view. **30, 31**, var. B, GC-3, UCMP38263, X89: 30, apertural view; 31, side view.

32, 33 *Lagena* sp. A, CRC-40267-4, UCMP38803, X98: 32, apertural view; 33, side view.

34, 35 *Lagena* sp. B, CRC-40267-47c, UCMP38804, X70: 34, apertural view; 35, side view.

36 *Lagena* sp. C, GC-14, lost specimen, side view, X157.

37, 38 *Lagena* cf. *L. pliocenica*, UCLA-6317, UCMP38805, X111: 37, apertural view; 38, side view.

39, 40 *Lagena* sp. E, SCI-L76-29, UCMP38806, X124: 39, apertural view; 40, side view.

41-43 *Lagena* sp. D: **40, 41**, SCI-L76-33, UCMP38807, X68: 41, apertural view; 42, side view. **43**, TC-223, UCMP38808, side view, X85.

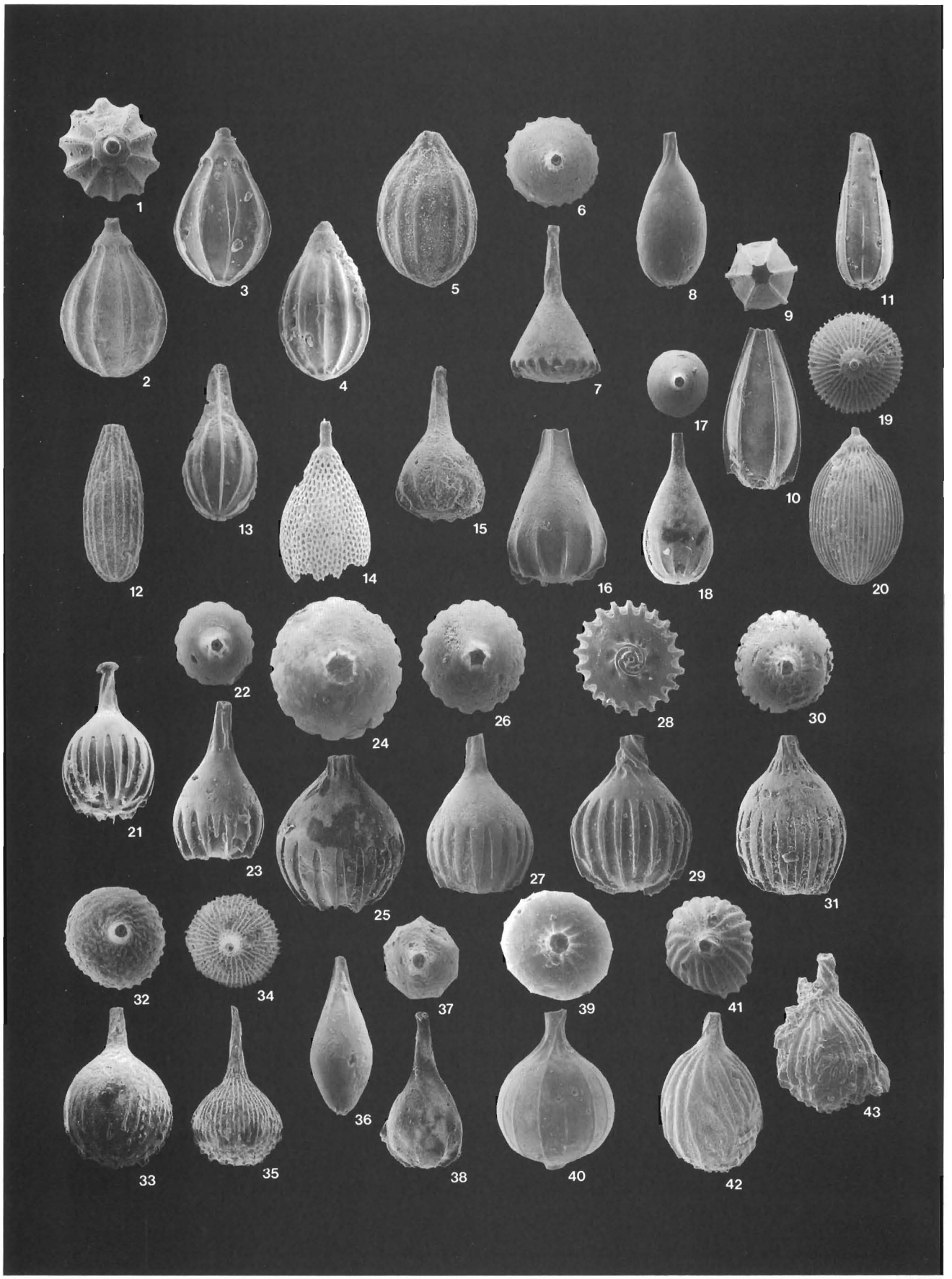
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PLATE 8

Hyalinonetrion, Procerolagena, Reussoolina, Glandulina, Guttulina, Oolina, Duplella, Parafissurina

1-4 *Hyalinonetrion "elongata"*: **1, 2**, CRC-40267-2, UCMP38809: 1, apertural view, X110; 2, side view, X35. **3**, GC-13, UCMP38258, side view, X50. **4**, CRC-40267-47a, UCMP38810, side view, X25.

5 *Procerolagena* sp., CRC-40267-50a, lost specimen, side view, X100.

6, 7 *Reussoolina simplex*, GC-7, UCMP38277, X65: 6, apertural view; 7, side view.

8, 9 *Glandulina* sp., CRC-40267-50a, UCMP38812, X45: 8, apertural view; 9, side view.

10-12 *Guttulina* sp.: **10**, crushed specimen, GC-4, UCMP38813, side view, X65. **11**, CRC-40267-45a, UCMP-38814, side view, X77. **12**, GC-2, lost specimen, side view, X83.

13, 14 *Oolina borealis*, UCLA-6317, UCMP38815, X116: 13, apertural view; 14, side view.

15-18 *Oolina* cf. *O. borealis*: **15, 16**, CRC-39842-1, UCMP38816, X230: 15, apertural view; 16, side view. **17, 18**, GC-1, UCMP38274, X130: 17, apertural view; 18, side view.

19, 20 *Oolina elongata*, GC-4, UCMP38278, X150: 19, apertural view; 20, side view.

21, 22 *Oolina globosa setosa*, GC-8, UCMP38279, X100: 21, apertural view; 22, side view.

23-25 *Oolina hexagona*: **23, 24**, UCMP38817, GC-3, X211: 23, apertural view; 24, side view. **25**, GC-13, lost specimen, side view, X200.

26-31 *Oolina melo*: **26, 27**, GC-10, UCMP38275, X200: 26, apertural view; 27, side view. **28, 29**, CRC-40267-1, UCMP38818, X113: 28, apertural view; 29, side view. **30, 31**, GC-4, UCMP38276, X193: 30, apertural view; 31, side view.

32, 33 *Duplella baggi*, GC-15b, holotype, UCMP38280, X200: 32, apertural view; 33, side view.

34, 35 *Duplella lacrima*, GC-9, holotype, UCMP38281, X235: 34, apertural view; 35, side view.

36, 37 *Parafissurina* sp. A, CRC-39842-1, UCMP38819, X228: 36, apertural view; 37, side view.

38, 39 *Parafissurina* sp. B, GC-13, UCMP38273, X200: 38, apertural view; 39, side view.

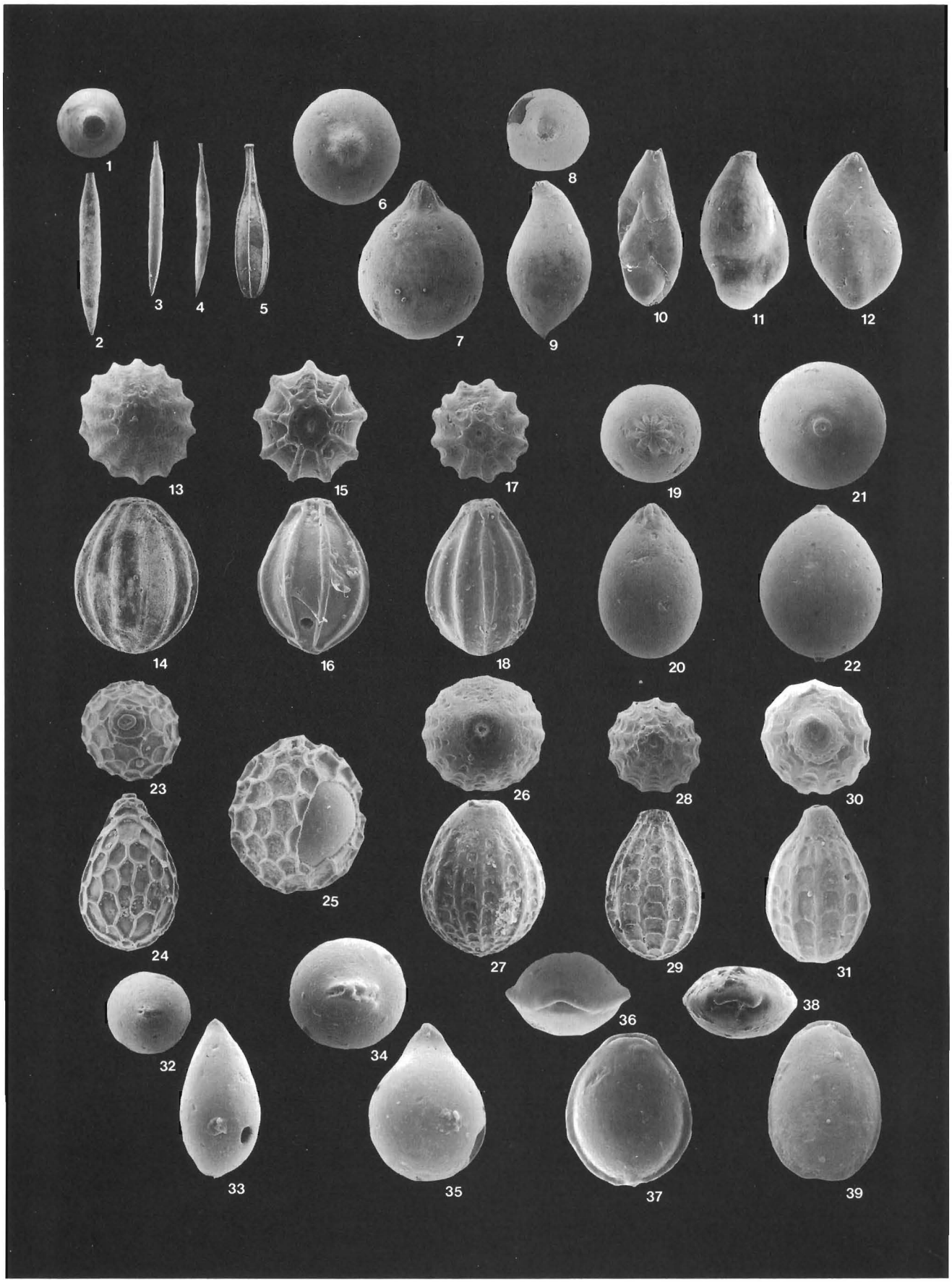
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PLATE 9

Fissurina

All specimens are illustrated in apertural and side views.

1-6 *Fissurina natlandi*: **1, 2**, GC-5, UCMP38820, X210. **3, 4**, GC-6, UCMP38821, X210. **5, 6**, GC-4, holotype, UCMP38266, X250.

7-10 *Fissurina* cf. *F. laevigata labiata*: **7, 8**, GC-6, UCMP38267, X150. **9, 10**, GC-6, UCMP38822, X223.

11, 12 *Fissurina quasimarginata*, holotype, GC-8, UCMP38269, X160.

13-16 *Fissurina gravesensis*: **13, 14**, GC-7, lost specimen, X260. **15, 16**, GC-15b, holotype, UCMP38268, X250.

17-20 *Fissurina longipunctata*: **17, 18**, GC-12, lost specimen, X210. **19, 20**, GC-11, holotype, UCMP38272, X212.

21, 22 *Fissurina* sp. A, CRC-40267-50a, UCMP38825, X205.

23, 24 *Fissurina* sp. B, CRC-40267-50, UCMP38826, X187.

25, 26 *Fissurina* sp. C, CRC-39842-5, UCMP38827, X215.

27, 28 *Fissurina* sp. E, CRC-39842-3, UCMP38828, X132.

29, 30 *Fissurina* sp. H, GC-5, UCMP38270, X210.

31, 32 *Fissurina* sp. D, GC-13, UCMP38271 (= *Fissurina* sp. M), X215.

33, 34 *Fissurina* sp. G, CRC-40267-47b, UCMP38829, X210.

35, 36 *Fissurina* sp. F, TC-235, UCMP38830, X260.

37, 38 *Fissurina* sp. I, IC-100, UCMP38831, X127.

39, 40 *Fissurina* sp. J, IC-136, UCMP38832, X210.


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PLATE 10

Globorotalia, Neogloboquadrina

1-3 *Globorotalia birnageae*, GC-14, UCMP38453, X150: 1, umbilical view; 2, edge view; 3, spiral view.

4-6 *Globorotalia mayeri*, GC-6, UCMP38471, X100: 4, umbilical view; 5, edge view; 6, spiral view.

7-9 *Globorotalia acrostoma*, SL-1, UCMP38452, X150: 7, umbilical view; 8, edge view; 9, spiral view.

10-18 *Globorotalia praescitula*: **10-12**, GC-3, UCMP38473, X150: 10, spiral view; 11, edge view; 12, umbilical view. **13-15**, CRC-39842-9, UCMP38833, X139: 13, umbilical view; 14, edge view; 15, spiral view. **16-18**, CRC-39842-12, UCMP38834, X150: 16, umbilical view; 17, edge view; 18, spiral view.

19-21 *Globorotalia zealandica-Glr. praescitula* transitional form, GC-15a, UCMP38835, X185: 19, umbilical view; 20, edge view; 21, spiral view.

22-24 *Globorotalia zealandica*?, lost specimen, GC-15a, UCMP38836, X117: 22, spiral view; 23, edge view; 24, umbilical view.

25-27 *Globorotalia zealandica*, GC-1, UCMP38470, X125: 25, spiral view; 26, edge view; 27, umbilical view.

28-30 *Globorotalia conoidea*, CRC-40267-50a, UCMP38837. X89: 28, umbilical view; 29, edge view; 30, spiral view.

31-33 *Globorotalia* cf. *Glr. menardii*, CRC-42107-11, UCMP38838, X80: 31, umbilical view; 32, edge view; 33, spiral view.

34-36 *Neogloboquadrina acostaensis*, CRC-40267-50a, UCMP38839, X95: 34, umbilical view; 35, edge view; 36, spiral view.

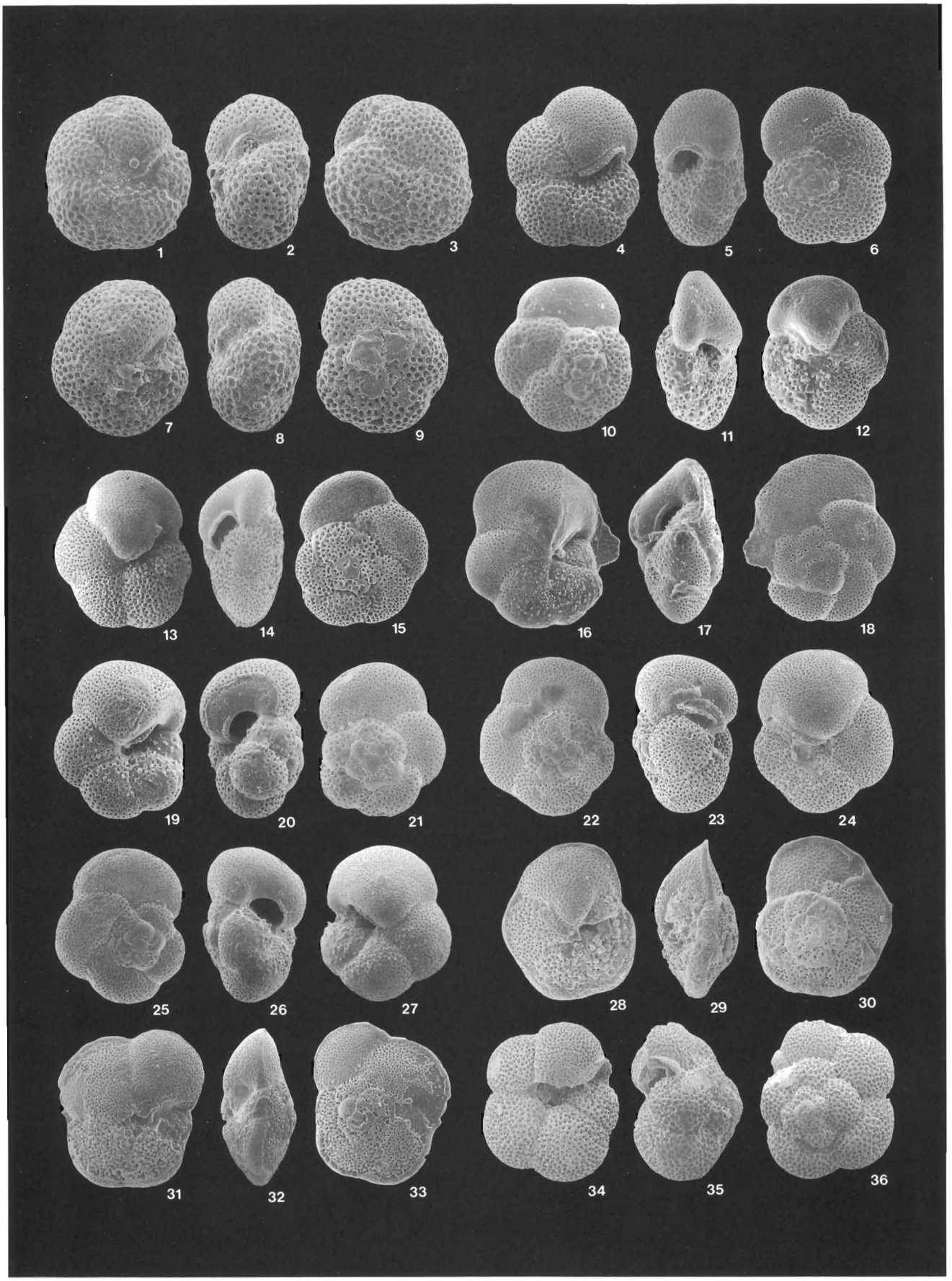
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PLATE 11

Neogloboquadrina, Globigerinita, Tenuitellinata, Catapsydrax, Globoquadrina

1-3 *Neogloboquadrina pachyderma*, CRC-42107-33, UCMP38840, X115: 1, umbilical view; 2, edge view; 3, spiral view.

4-6 *Neogloboquadrina continuosa*, CRC40267-1, UCMP38841, X108: 4, spiral view; 5, edge view; 6, umbilical view.

7-10 *Globigerinita glutinata*: **7, 8**, GC-7, UCMP38464, X200: 7, spiral view; 8, umbilical view. **9, 10**, GC-15a, UCMP38462, X175: 9, spiral view; 10, umbilical view.

11-14 *Globigerinita uvula*: **11**, TC-223, UCMP38842, umbilical view, X250. **12**, CRC-42107-13, UCMP38843, oblique umbilical view, X200. **13, 14**, GC-15b, UCMP38460, X300: 13, oblique umbilical view; 14, spiral view.

15, 16 *Globigerinita parkerae*, CRC-40267-50a, UCMP38844, X250: 15, umbilical view; 16, spiral view.

17-19 *Tenuitellinata angustiumbilicata*, CRC-39842-9, UCMP38845, X217: 17, spiral view; 18, edge view; 19, umbilical view.

20-22 *Catapsydrax stainforthi*, GC-13, UCMP38455, X150: 20, umbilical view; 21, edge view; 22, spiral view.

23-25 *Globoquadrina baroemoenensis*, SL-1, UCMP38451, X80: 23, umbilical view; 24, edge view; 25, spiral view.

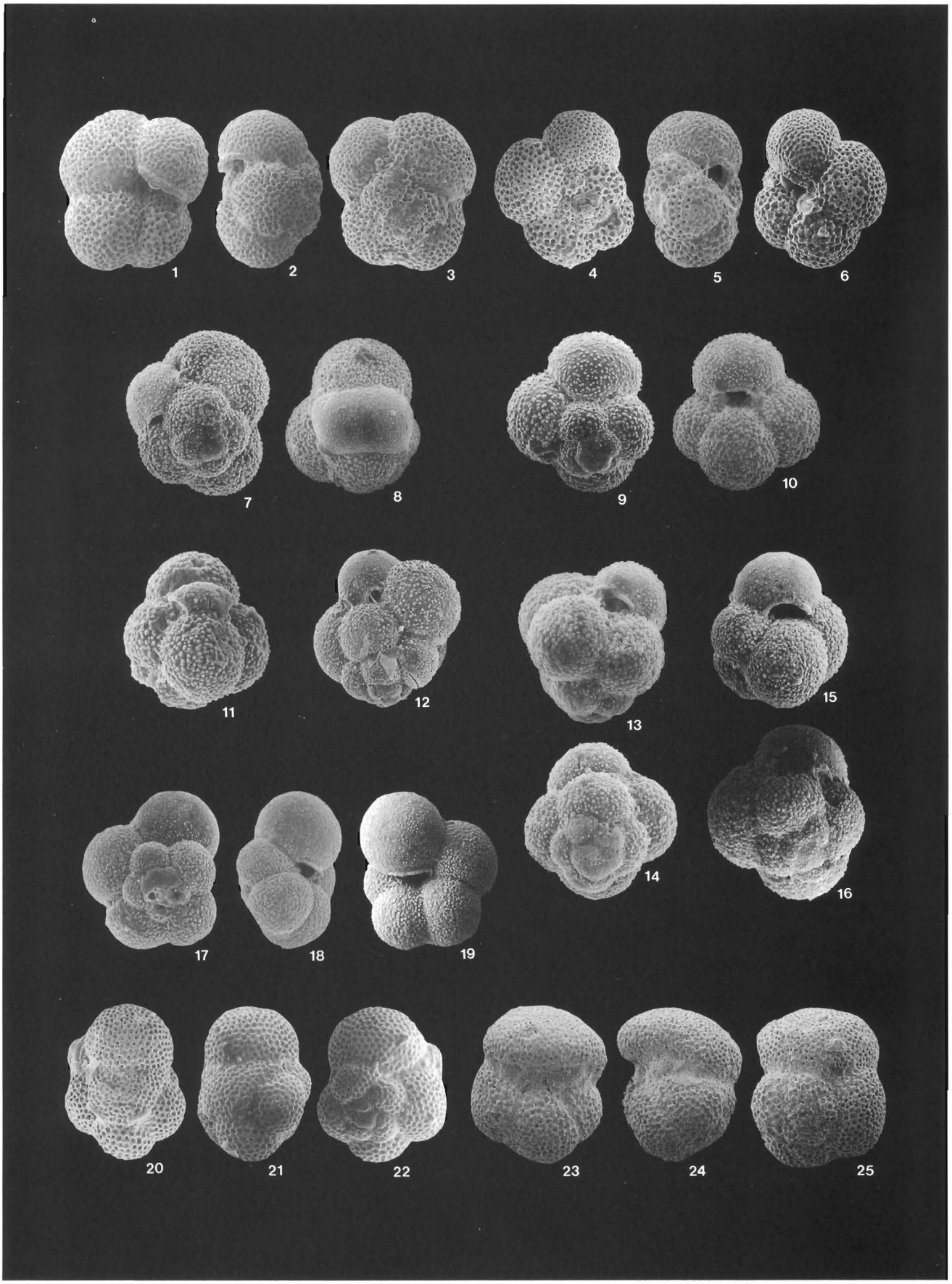
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PLATE 12

Globoquadrina, Globorotaloides, Protentella, Globigerina

1-3 *Globoquadrina venezuelana*, GC-1, UCMP38468, X100: 1, spiral view; 2, edge view; 3, umbilical view.

4-6 *Globorotaloides trema*, topotype, CRC-40267-35, UCMP38846, X200: 4, umbilical view; 5, edge view; 6, spiral view.

7-9 *Globorotaloides* aff. *G. suteri relizensis*, NA-89-3, UCMP38847, X300: 7, spiral view; 8, edge view; 9, umbilical view.

10-12 *Globorotaloides suteri relizensis*, GC-11, UCMP38474, X150: 10, umbilical view; 11, edge view; 12, spiral view.

13-15 *Protentella prolixa*?, GC-12, UCMP38454, X150: 13, side view; 14 edge view; 15, opposite side view.

16-18 *Protentella prolixa*, CRC-40267-35a, UCMP38848, X100: 16, side view; 17, edge view; 18, opposite side view.

19-21 *Globigerina quinqueloba*, GC-3, UCMP38461, X215: 19, spiral view; 20, edge view; 21, umbilical view.

22-24 *Globigerina connecta*?, GC-10, UCMP38447, X150: 22, umbilical view; 23, edge view; 24, spiral view.

25-27 *Globigerina* cf. *G. woodi*, SL-1, UCMP38448, X150: 25, umbilical view; 26, edge view; 27, spiral view.

28-30 *Globigerina praebulloides*, CRC-42107-13, UCMP38849, X120: 28, spiral view; 29, edge view; 30, umbilical view.

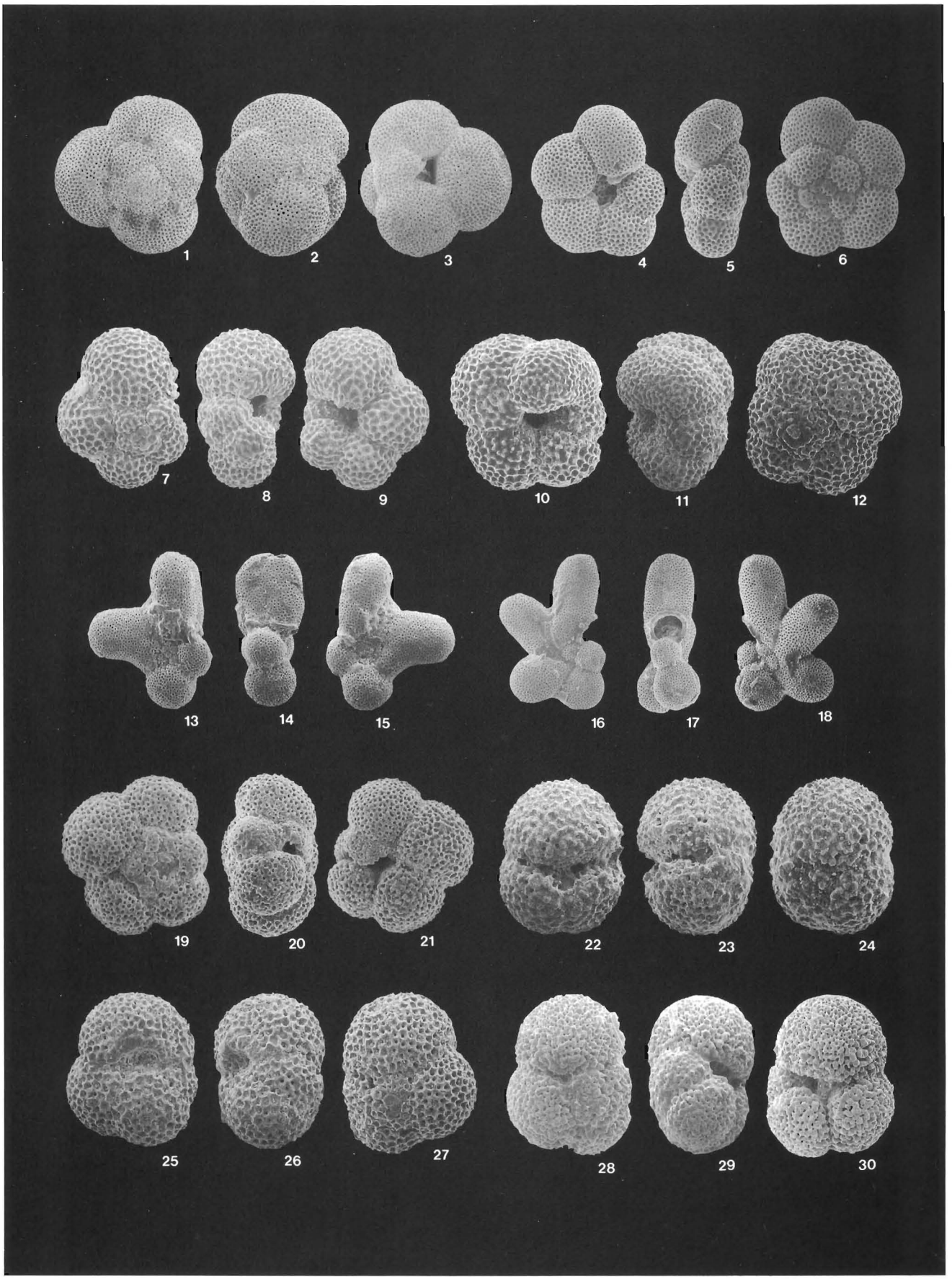
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PLATE 13

Globigerina, Globigerinella

1-3 *Globigerina praebulloides*, GC-7, UCMP38458, X150: 1, spiral view; 2, edge view; 3, umbilical view.

4-12 *Globigerina bulloides*: **4-6**, CRC-40267-3, UCMP38850, X92: 4, spiral view; 5, edge view; 6, umbilical view. **7-9**, GC-15a, UCMP38456, X100: 7, spiral view; 8, edge view; 9, umbilical view. **10, 11**, CRC-40267-47a, UCMP38851, X123: 10, umbilical view; 11, spiral view. **12**, CRC-40267-1, UCMP38852, umbilical view, X91.

13-21 *Globigerina pseudociperoensis*: **13-15**, GC-6, UCMP38459, X100: 13, umbilical view; 14, edge view; 15, spiral view. **16-18**, CRC-40267-6, UCMP38853, X62: 16, spiral view; 17, edge view; 18, umbilical view. **19-21**, CRC-40267-34, UCMP38854, X65: 19, umbilical view; 20, edge view; 21, spiral view.

22-24 *Globigerinella pseudobesa*, CRC-42107-27, UCMP38855, X90: 22, umbilical view; 23, edge view; 24, spiral view.

25-27 *Globigerinella obesa*, GC-7, UCMP38449, X100: 25, umbilical view; 26, edge view; 27, spiral view.

28-30 *Globigerinella aequilateralis*, CRC-40267-50a, UCMP38856, X79: 28, umbilical view; 29, edge view; 30, spiral view.

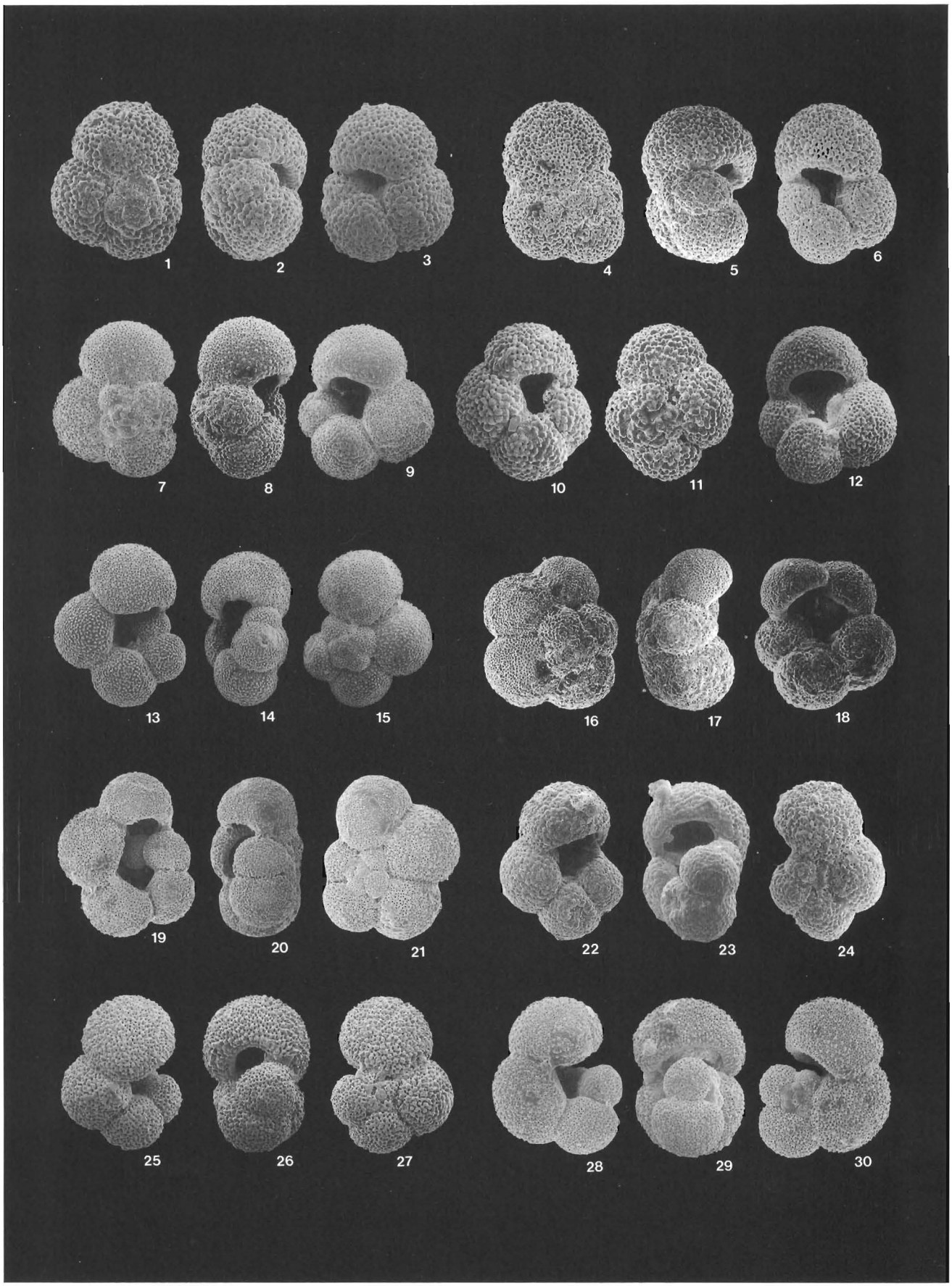
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PLATE 14

Globigerinoides, Orbulina, Praeorbulina

1-3 *Globigerinoides altiaperturus*, GC-5, UCMP38449, X100: 1, umbilical view; 2, edge view; 3, spiral view.

4-6 *Globigerinoides bulloideus*, CRC-40267-50a, UCMP38857, X67: 4, spiral view; 5, edge view; 6, umbilical view.

7-12 *Globigerinoides immaturus*: **7-9**, SCI-L76-26, UCMP38858, X65: 7, spiral view; 8, edge view; 9, umbilical view. **10-12**, CRC-39842-12, UCMP38859, X100: 10, umbilical view; 11, edge view; 12, spiral view.

13-15 *Globigerinoides subquadratus*, CRC-40267-50a, UCMP38860, X69: 13, spiral view; 14, edge view; 15, umbilical view.

16-20 *Globigerinoides quadrilobatus*: **16-18**, CRC-39842-12, UCMP38861, X100: 16, umbilical view; 17, edge view; 18, spiral view. **19, 20**, GC-15a, UCMP38467, X130: 19, umbilical view; 20, spiral view.

21, 22 *Orbulina suturalis*, CRC-39842-4, UCMP38862, X130: 21, side view; 22, spiral view.

23 *Orbulina universa*, CRC-42107-36, UCMP38863, X150.

24, 25 *Praeorbulina transitoria*, CRC-39842-13, UCMP38864, X55: 24, spiral view; 25, edge view.

26, 27 *Praeorbulina glomerosa circularis*, CRC-39842-13, UCMP38865, X125: 26, side view; 27, spiral view.

28, 29 *Praeorbulina glomerosa* var. A, CRC-40267-47a, UCMP38866, X96: 28, side view; 29, spiral view.

30, 31 *Praeorbulina glomerosa* var. B, CRC-40267-46a, UCMP38867, X100: 30, side view; 31, spiral view.

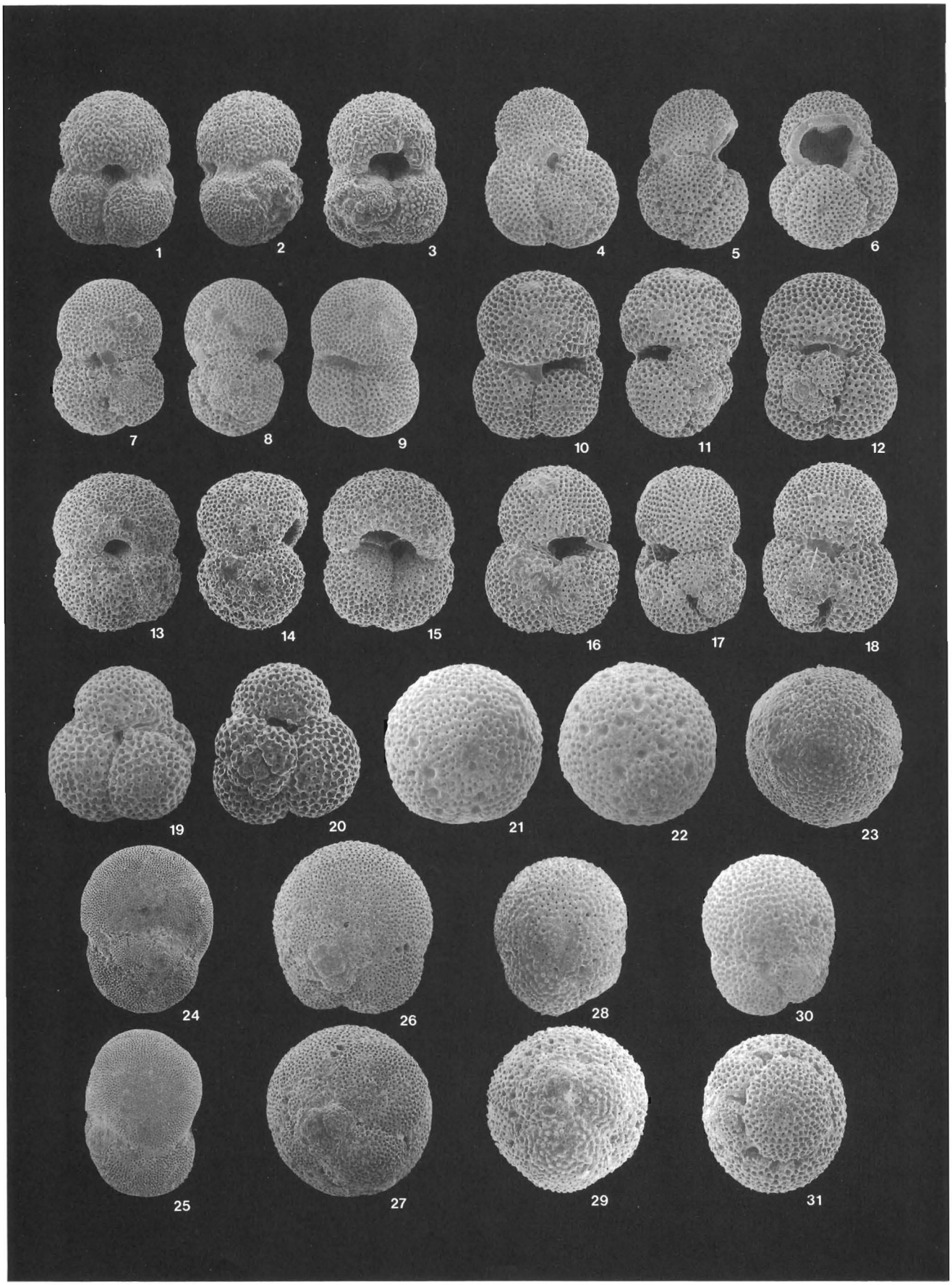
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PLATE 15

Bolivina

1 *Bolivina churchi*, CRC-40267-35, UCMP38868, side view, X66.

2-6 *Bolivina advena*: **2, 3**, CRC-40660-8, UCMP38869, X50: 2, apertural view; 3, side view. **4**, GC-15a, lost specimen, side view, X48. **5**, CRC-40267-38, UCMP38870, side view, X53. **6**, CRC-40267-35, UCMP-38871, side view, X59.

7-11 *Bolivina advena ornata*: **7**, GC-15a, UCMP38305, side view, X46. **8, 9**, CRC-40660-12, UCMP38872, X51: 8, apertural view; 9, side view. **10**, LH-5, UCMP38873, side view, X46. **11**, MAR-254, UCMP38874, side view, X51.

12-14 *Bolivina benedictensis*: **12, 13**, CRC-40267-3, UCMP38875, X45: 12, apertural view; 13, side view. **14**, CRC-40267-3, UCMP38876, side view, X50.

15-21 *Bolivina bramlettei*: **15**, CRC-40267-39, UCMP38877, side view, X40. **16, 17**, CRC-40267-39, UCMP-38878, X35: 16, apertural view; 17, side view. **18**, CRC-40267-36, UCMP38879, side view, X46. **19**, CRC-40267-50a, UCMP38880, side view, X41. **20**, CRC-40267-50a, UCMP38881, side view, X45. **21**, CRC-40267-50a, UCMP38882, side view, X42.

22-28 *Bolivina brevior* (forma *vaughani*): **22**, GC-15a, UCMP38306, side view, X110. **23**, CRC-40267-3, UCMP-38883, side view, X101. **24, 25**, CRC-40660-22, UCMP38884, X101: 24, apertural view; 25, side view. **26**, CRC-40267-32, UCMP38885, X160. **27**, MAR-254, UCMP38886, side view, X106. **28**, CRC-39842-38, UCMP38887, side view, X110.

29-31 *Bolivina brevior dunlapi*: **29**, CRC-40267-32, UCMP38888, side view, X160. **30**, CRC-40267-32, UCMP-38889, side view, X120. **31**, CRC-40267-32, UCMP38890, side view, X160.

32-38 *Bolivina californica*: **32**, GC-15a, UCMP38307, side view, X100. **33, 34**, CRC-40267-33, UCMP38891, X76: 33, apertural view; 34 side view. **35**, LH-5, UCMP38892, side view, X76. **36**, CRC-40660-18, UCMP38893, side view, X77. **37**, CRC-42107-27, UCMP38894, side view, X90. **38**, CRC-42107-11, UCMP38895, side view, X85.

39-49 *Bolivina churchi*: **39**, GC-6, UCMP38309, side view, X36. **40**, GC-6, UCMP38310, side view, X50. **41**, CRC-40267-39, UCMP38896, side view, X37. **42**, CRC-40267-39, UCMP38897, side view, X34. **43**, GC-6, UCMP38311, side view, X46. **44**, GC-1, UCMP38312, side view, X45. **45**, CRC-40267-44, UCMP-38898, side view, X41. **46, 47**, CRC-40267-39, UCMP38899, X35: 46, apertural view; 47, side view. **48**, GC-1, UCMP38313, side view, X47. **49**, CRC-40267-44, UCMP38900, side view, X45.

50-53 *Bolivina conica*: **50**, SCI-L76-26, UCMP38901, side view, X74. **51**, CRC-39842-8, UCMP38902, side view, X82. **52, 53**, GC-2, UCMP38308, X50: 52, apertural view; 53, side view.

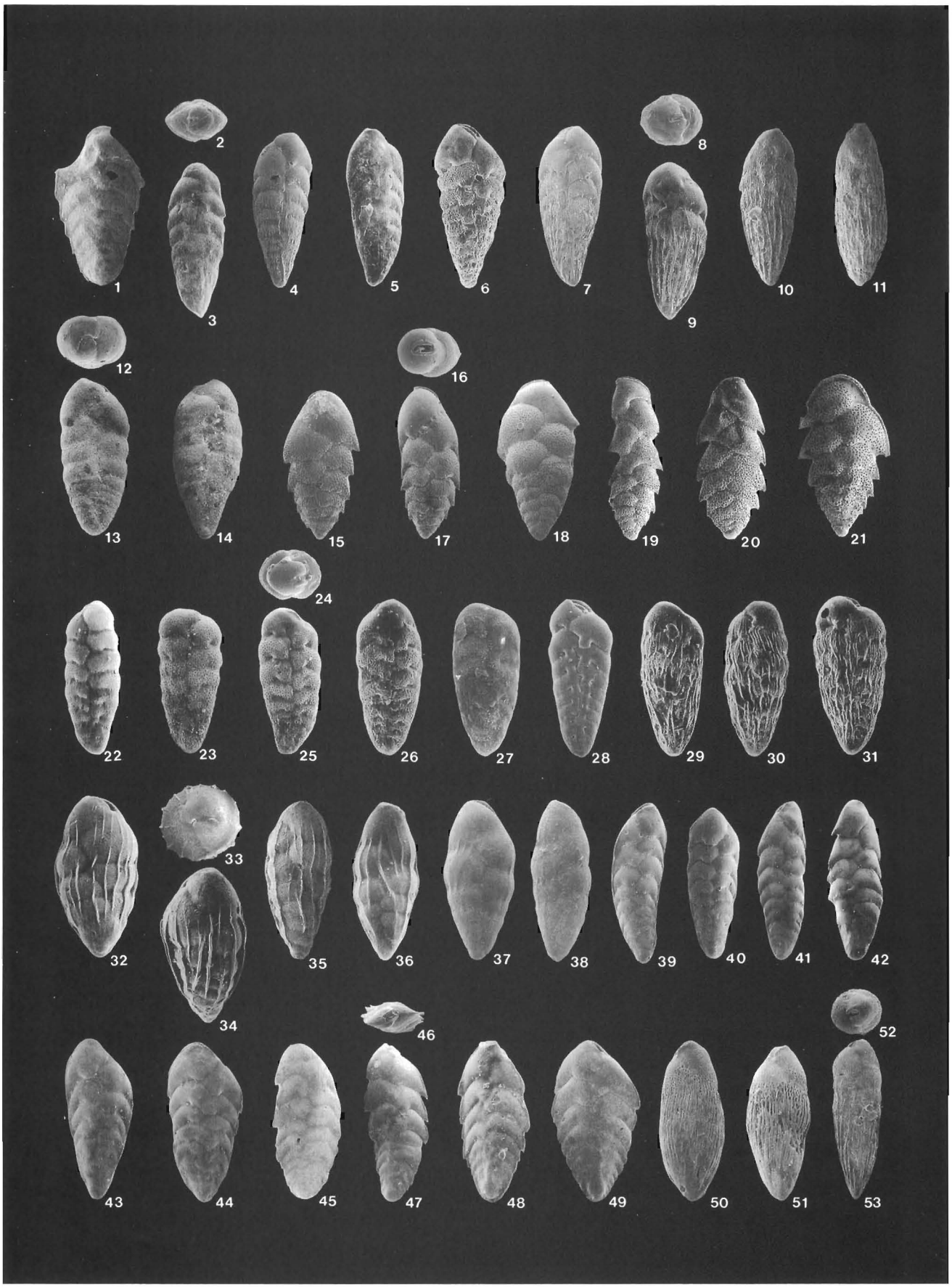
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PLATE 16

Bolivina

1 *Bolivina cuneiformis*, CRC-39842-34, UCMP38903, side view, x64.

2-4 *Bolivina blakei*: **2**, holotype, GC-3, UCMP38314, side view, x50. **3**, CRC-39842-103, UCMP38904, side view, x45. **4**, IC-109, UCMP38905, side view, x45.

5-7 *Bolivina foraminata*: **5, 6**, CRC-40267-3, UCMP38906, x50: 5, apertural view; 6, side view. **7**, CRC-40267-3, UCMP38907, side view, x50.

8-10 *Bolivina girardensis*: **8**, CRC-40267-50, UCMP38908, side view, x62. **9, 10**, CRC-40660-19, UCMP38909, x76: 9, apertural view; 10, side view.

11, 12 *Bolivina humilis*: **11**, CRC-40267-47a, UCMP38910, side view, x66; **12**, CRC-40267-47a, UCMP38911, side view, x45.

13-18 *Bolivina granti*: **13**, CRC-40267-50, UCMP38912, side view, x40. **14**, GC-3, UCMP38315, side view, x41. **15, 16**, CRC-40267-50, UCMP38913, x39: 15, apertural view; 16, side view. **17**, CRC-42107-31, UCMP38914, side view, x40. **18**, CRC-40267-50, lost specimen, side view, x35.

19-23 *Bolivina hughesi*: **19, 20**, CRC-40660-22, UCMP38916, x24: 19, apertural view; 20, side view. **21**, CRC-40267-50, UCMP38917, side view, x37. **22**, var. A, CRC-40267-36, UCMP38918, side view, x40. **23**, var. B, LH-5, UCMP38919, side view, x60.

24, 25 *Bolivina exilicostata*, n. sp., CRC-40267-1, holotype, UCMP38920, x46: 24, apertural view; 25, side view.

26, 27 *Bolivina interjuncta*: **26**, early segment, CRC-42107-11, UCMP38921, side view, x84. **27**, CRC-41397-10 (Pliocene, OCS-P-450 #1, offshore Pt. Arguello), UCMP38922, side view, x37 (shown for comparison).

28-33 *Bolivina imbricata*: **28**, IC-91, UCMP38923, side view, x46. **29, 30**, CRC-40267-32, UCMP38924, x44: 29, apertural view; 30, side view. **31**, GC-6, UCMP38316, side view, x72. **32**, MAR-254, UCMP38925, side view, x26. **33**, GC-15d, UCMP38317, side view, x45.

34 *Bolivina imbricata* (forma *marginata*), GC-3, UCMP38318, side view, x76.

35 *Bolivina mulleri*, topotype, CRC-39842-1, UCMP38926, side view, x46.

36-39 *Bolivina modeloensis*: **36**, immature specimen, CRC-42107-28, UCMP38927, side view, x79. **37**, immature specimen, CRC-39842-56, UCMP38928, side view, x100. **38**, GC-4, UCMP38319, side view, x75. **39**, GC-4, UCMP38929, side view, x60.

40 *Bolivina pseudobeyrichi*, CRC-40267-35, UCMP38930, side view, x50.

41-44 *Bolivina parva*?: **41, 42**, CRC-40660-16, UCMP38931, x112: 41, apertural view; 42, side view. **43, 44**, CRC-40660-16, UCMP38932, x112: 43, apertural view; 44, side view.

45-47 *Bolivina spissa*: **45**, CRC-39842-100, UCMP38933, side view, x55. **46, 47**, CRC-40267-3, UCMP38934, x40: 46, apertural view; 47, side view.

48-50 *Bolivina predecussata*: **48**, CRC-40267-7, UCMP38935, side view, x85. **49**, CRC-40267-7, UCMP38936, side view, x86. **50**, CRC-39842-63, UCMP38937, side view, x88.

51-58 *Bolivina pseudospissa*: **51**, GC-8, lost specimen, side view, x75. **52, 53**, CRC-40267-1, UCMP38938, x51: 52, apertural view; 53, side view. **54**, CRC-40267-29, UCMP38939, side view, x44. **55**, CRC-40267-47a, UCMP-38940, side view, x40. **56, 57**, CRC-40267-47a, UCMP38941, x35: 56, apertural view; 57, side view. **58**, CRC-39842-39, UCMP38942, side view, x41.

59 *Bolivina ticensis*, CRC-42107-13, UCMP38943, side view, x110.


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PLATE 17

Bolivina

1-4 *Bolivina salinasensis*: **1**, GC-7, UCMP38442, side view, x100. **2**, CRC-40267-45a, UCMP38944, side view, x56. **3**, CRC-40267-1, UCMP38945, side view, x51. **4**, CRC-40267-1, UCMP38946, side view, x74.

5, 53 *Bolivina* sp. H, partially decalcified *B. salinasensis*?: **5**, CRC-40267-4, UCMP38947, side view, x62. **53**, CRC-42107-18, UCMP38948, side view, x85.

6-8 *Bolivina tongi filacostata*: **6**, CRC-40267-46a, UCMP38949, side view, x80. **7**, GC-8, UCMP38321, side view, x100. **8**, CRC-39842-26, UCMP38950, side view, x150.

9-20, 37 *Bolivina tumida*: **9**, MAR-254, UCMP38951, side view, x52. **10**, GC-3, UCMP38322, side view, x131. **11**, CRC-40267-34, UCMP38952, side view, x70. **12**, CRC-39842-103, UCMP38953, side view, x150. **13**, CRC-40267-33, UCMP38954, side view, x65. **14**, CRC-40267-34, UCMP38955, side view, x100. **15**, CRC-40267-31, UCMP-38956, side view, x90. **16**, CRC-40267-30, UCMP38957, side view, x65. **17, 18**, CRC-40267-39, UCMP38958, x70: 17, apertural view; 18, side view. **19, 20**, CRC-40267-43, UCMP38959, x55: 19, apertural view; 20, side view. **37**, CRC-40267-7, UCMP38960, side view, x32.

21-26 *Bolivina tumida* var.: **21**, CRC-40267-3, lost specimen, side view, x80. **22**, GC-5, UCMP38324, side view, x60. **23**, GC-5, UCMP38323, side view, x70. **24, 25**, CRC-40267-29, UCMP38962, x85: 24, apertural view; 25, side view. **26**, GC-10, UCMP38325, side view, x60.

27, 28 *Bolivina wissleri*, CRC-40267-47a, UCMP38963, x35: 27, apertural view; 28, side view.

29-36 *Bolivina woodringi*: **29, 30**, CRC-40267-50a, UCMP38964, x40: 29, apertural view; 30, side view. **31**, CRC-40267-50a, UCMP38965, side view, x30. **32, 33**, CRC-40267-3, UCMP38966, x45: 32, apertural view; 33, side view. **34, 35**, CRC-40660-21, UCMP38967, x35: 34, apertural view; 35, side view. **36**, CRC-42107-11, UCMP-38968, side view, x31.

38 *Bolivina* sp. C, CRC-40267-3, UCMP38969, side view, x65.

39, 40 *Bolivina* cf. *B. sabahensis*, CRC-40660-14: **39**, UCMP38970, side view, x51. **40**, UCMP38971, side view, x65.

41, 42 *Bolivina santanaensis*, CRC-40267-47a, holotype, UCMP38337, x45: 41, apertural view; 42, side view.

43 *Bolivina* sp. L, CRC-40267-31, UCMP38972, side view, x85.

44 *Bolivina* sp. D, CRC-40267-4, UCMP38973, side view, x49.

45 *Bolivina* sp. I, CRC-40267-33, UCMP38974, side view, x90.

46 *Bolivina* sp. A, CRC-40267-35, UCMP38975, side view, x72.

47 *Bolivina* sp. B, CRC-40267-38, UCMP38976, side view, x53.

48 *Bolivina advena*, CRC-40267-40, UCMP38977, side view, x63.

49 *Bolivina pseudospissa*, CRC-40267-47a, UCMP38978, side view, x57.

50 *Bolivina* sp. E, CRC-40267-3, UCMP38979, side view, x93.

51, 52 *Bolivina woodruffi*, n. sp.: **51**, CRC-40267-4, holotype, UCMP38980, side view, x55; **52**, CRC-40267-6, paratype, UCMP38981, side view, x64.

54 *Bolivina* sp. J, MAR-254, lost specimen, side view, x37.

55 *Bolivina* sp. K, UCLA-6317, UCMP38982, side view, x95.

56 *Bolivina multicostata*, CRC-42263-8, UCMP38983, side view, x75.

57, 58 *Bolivina isaacsi*, n. sp.: **57**, CRC-39842-94, paratype, UCMP38984, side view, x85; **58**, CRC-39842-94, holotype, UCMP38985, side view, x100.

59 *Bolivina* cf. *B. euplectella*, IC-91, UCMP38986, side view, x55.

60 *Bolivina* sp. F, IC-124, UCMP38987, side view, x55.

61 *Bolivina* sp. G, CRC-42107-18, UCMP38988, side view, x105.

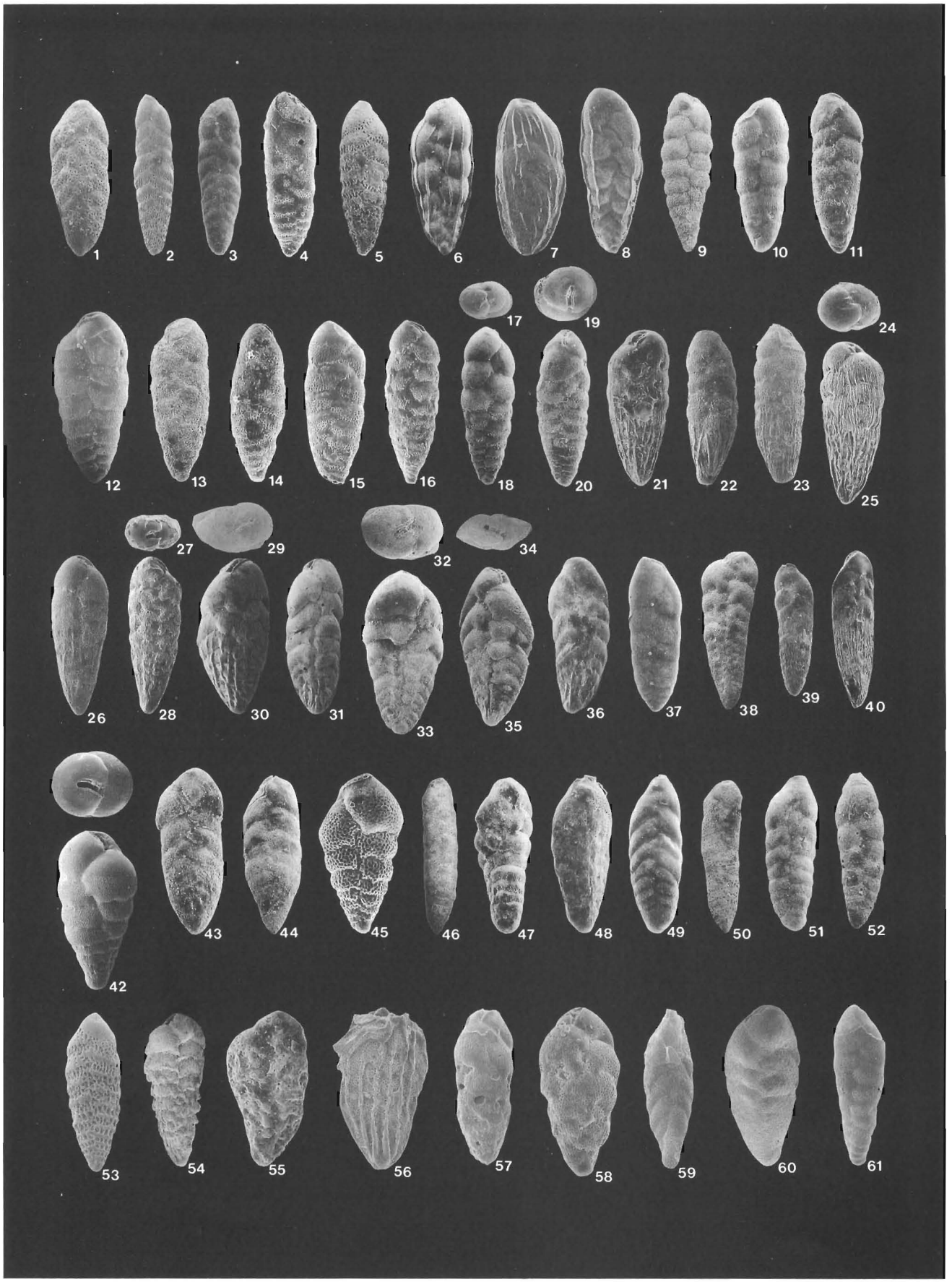
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PLATE 18

Loxostomoides, Cassidulinella, Globocassidulina

1-12 *Loxostomoides digitata*: **1**, CRC-40267-38, side view, UCMP38989, X50. **2**, CRC-40267-38, side view, UCMP38990, X45. **3**, CRC-40267-38, side view, UCMP38991, X40. **4**, CRC-40267-38, side view, UCMP38992, X40. **5**, SCI-L76-42, side view, UCMP38993, X35. **6**, SCI-L76-42, side view, UCMP38994, X45. **7**, SCI-L76-17, side view, UCMP38995, X65. **8**, SCI-L76-17, side view, UCMP38996, X65. **9**, SCI-L76-19, UCMP38997, side view, X55. **10**, SCI-L76-21, UCMP38998, side view, X70. **11**, CRC-40267-43, UCMP38999, side view, X45. **12**, CRC-40267-45a, UCMP39000, side view, X30.

13 *Cassidulinella renuliniformis*, crushed specimen, CRC-40267-3, UCMP39001, side view, X46.

14-18 *Globocassidulina neomargareta:* **14, 15**, GC-13, holotype, UCMP38419, X135: 14, edge view; 15, apertural side view. **16**, CRC-40660-5, UCMP39002, apertural side view, X150. **17, 18**, CRC-39842-98, UCMP-39003, X200: 17, edge view; 18, apertural side view.

19-33 *Globocassidulina monicana*: **19, 20**, CRC-40267-39, UCMP39004, X40: 19, apertural side view; 20, edge view. **21, 22**, immature specimen, CRC-39842-20, UCMP39005, X80: 21, edge view; 22, apertural side view. **23, 24**, immature specimen, CRC-39842-70, UCMP39006, X75: 23, edge view; 24, apertural side view. **25, 26**, CRC-39842-12, UCMP39007, X100: 25, oblique apertural side view; 26, edge view. **27, 28**, CRC-40267-46a, UCMP39008, X100: 27, edge view; 28, apertural side view. **29, 30**, CRC-40267-47a, UCMP39009, X40: 29, edge view; 30, apertural side view. **31, 32**, CRC-40267-47a, UCMP39010, X38: 31, edge view; 32, apertural side view. **33**, CRC-40267-39, UCMP39011, side view, X45.

34-37 *Globocassidulina neopulchella*: **34, 35**, GC-9, paratype, UCMP38417, X75: 34, edge view; 35, apertural side view. **36, 37**, GC-1, holotype, UCMP38418, X90: 36, edge view; 37, apertural side view.

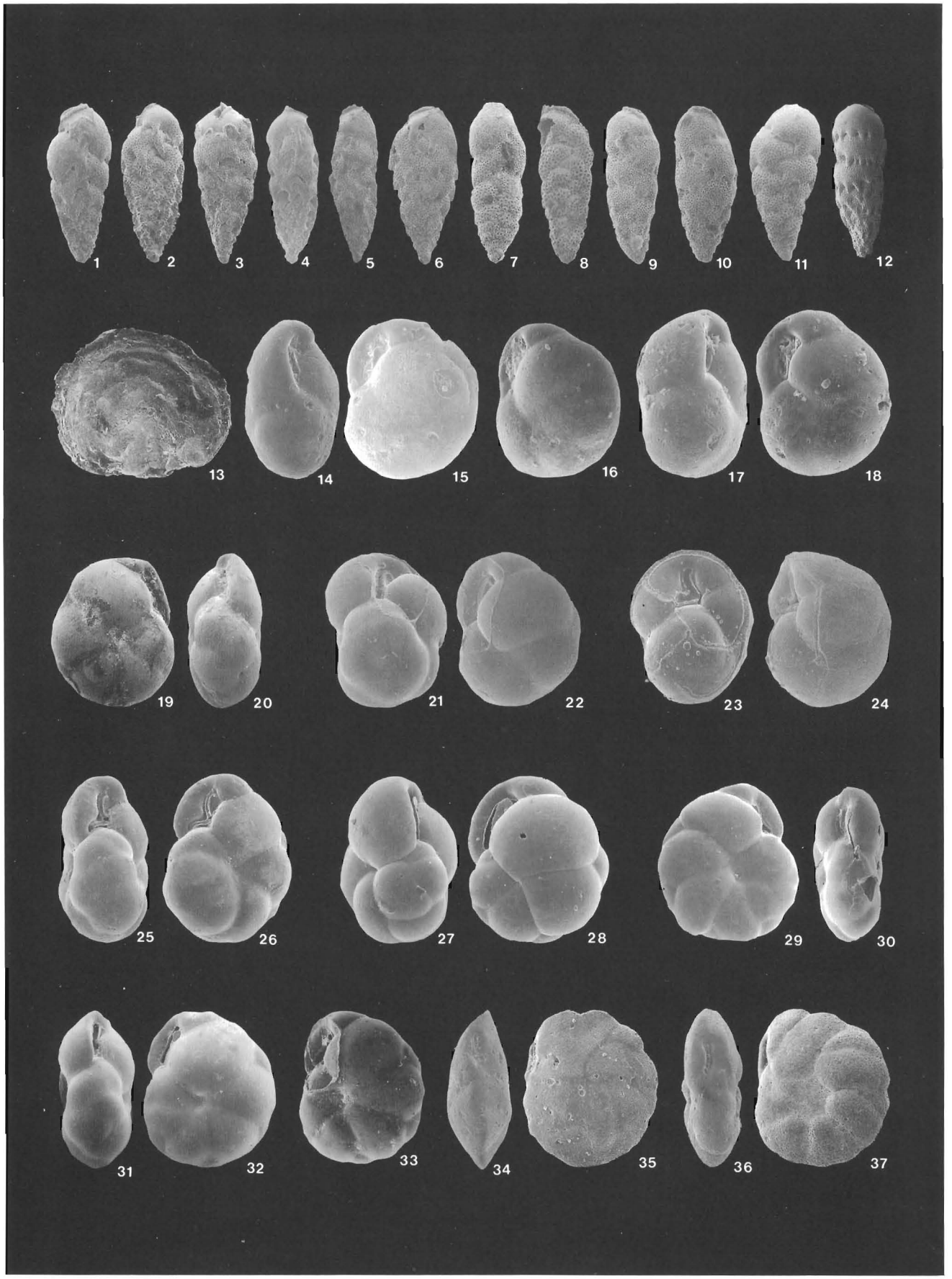
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PLATE 19

Islandiella, Lernella, Paracassidulina, Ehrenbergina

1-13 *Islandiella modeloensis*: **1**, **2**, MAR-254, UCMP39012, X75: 1, edge view; 2, apertural side view. **3**, **4**, GC-3, UCMP38422, X60: 3, apertural side view; 4, edge view. **5**, **6**, CRC-40267-4, UCMP39013, X50: 5, edge view; 6, apertural side view, X75. **7**, SCI-L76-29, UCMP39014, X65, apertural side view, X110. **8**, **9**, CRC-40267-35a, UCMP39015, X67: 8, apertural side view; 9, edge view. **10**, **11**, CRC-40267-50a, UCMP39016, X59: 10, edge view; 11, apertural side view. **12**, CRC-40660-14, UCMP39017, apertural side view, X70. **13**, SCI-L76-29, UCMP39018, apertural side view, X70.

14-18 *Islandiella carinata:* **14-16**, CRC-40267-47a, UCMP39019, X65: 14, apertural side view; 15, oblique side view; 16, edge view. **17**, **18**, GC-8, UCMP38421, X85: 17, edge view; 18, apertural side view.

19, 20 *Islandiella californica*, CRC-40267-38, UCMP39020, X40: 19, edge view; 20, side view.

21, 22 *Lernella* sp., CRC-40267-47c, UCMP39021, X200: 21, apertural side view; 22, edge view.

23-26 *Paracassidulina crescentaperta*: **23**, **24**, CRC-40267-50a, UCMP39022, X43: 23, apertural side view; 24, edge view. **25**, CRC-40267-50a, UCMP39023, apertural side view, X55. **26**, CRC-40267-50a, UCMP39024, apertural side view, X75.

27-32 *Paracassidulina delicata*: **27**, **28**, GC-4, UCMP39025, X110: 27, edge view; 28, apertural side view. **29**, **30**, CRC-40267-47a, UCMP39026, X85: 29, apertural side view; 30, edge view. **31**, **32**, CRC-40267-47a, UCMP39027, X140: 31, edge view; 32, apertural side view.

33-37 *Paracassidulina delicata* (forma *cushmani*): **33**, **34**, CRC-42107-11, UCMP39028, X200: 33, apertural side view; 34, edge view. **35**, CRC-40660-19, UCMP39029, apertural side view, X190. **36**, **37**, CRC-40267-3, UCMP39030, X120: 36, apertural side view; 37, edge view.

38, 39 *Ehrenbergina* sp., SCI-L76-30, UCMP39031, X60: 38, outer edge view; 39, inner edge view.

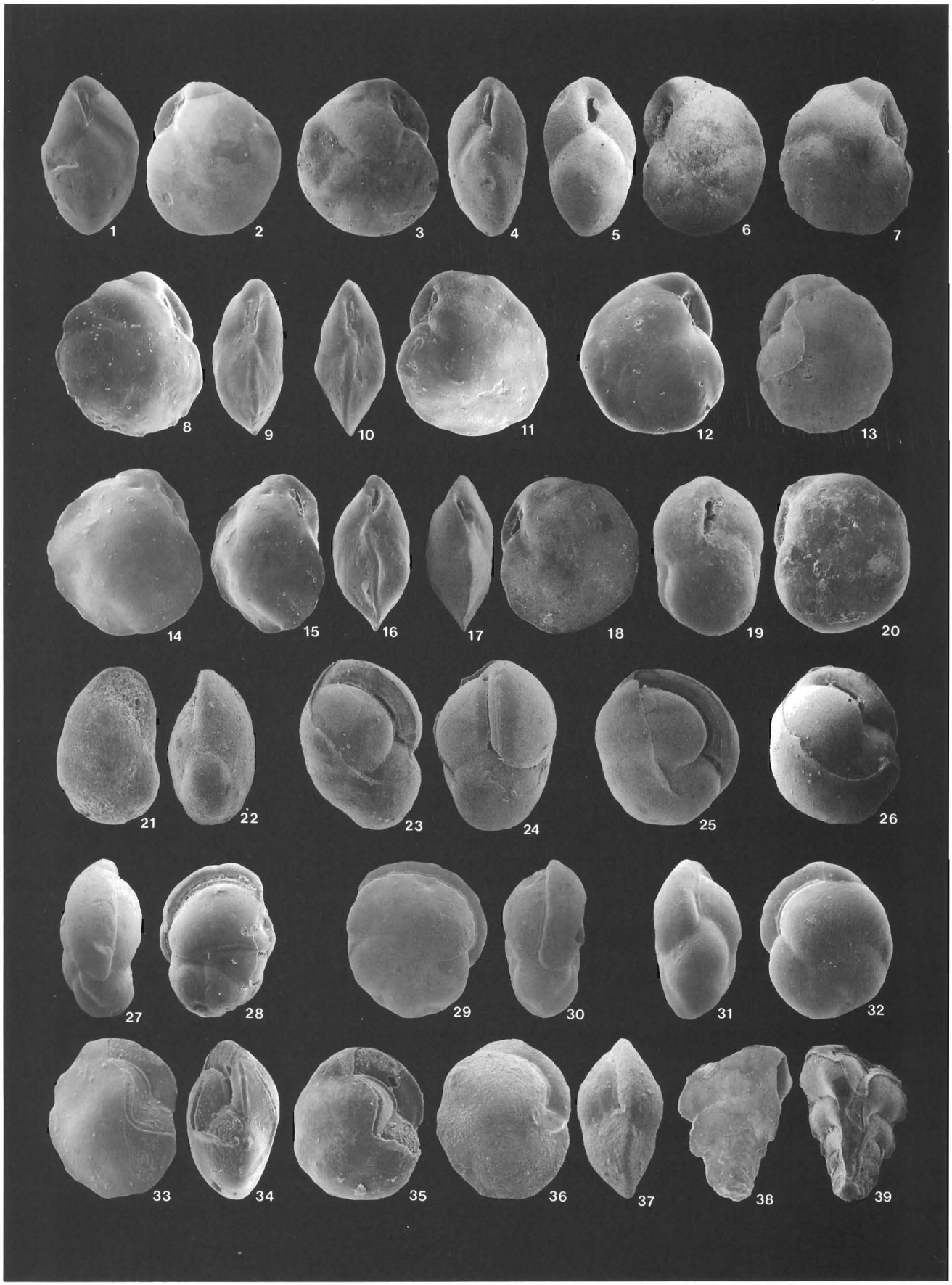
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PLATE 20

Galliherina, Hopkinsina, Stainforthia, Bulimina, Protoglobobulimina, Praeglobobulimina, Buliminella

All specimens are illustrated in side view.

1-5 *Galliherina uvigerinaformis*: **1**, SCI-L76-42, UCMP39032, X40. **2**, CRC-40267-47a, UCMP39033, X41. **3**, SCI-L76-42, UCMP39034, X40. **4**, forma *doanei*, CRC-40267-47a, UCMP39035, X33. **5**, forma *doanei*, early portion, CRC-40267-3, UCMP39036, X63.

6 *Galliherina* sp., early portion, TC-78, UCMP39037, X50.

7 *Hopkinsina magnifica*, CRC-40267-50a, UCMP39038, X20.

8-10 *Hopkinsina* spp. A-C: **8**, *H.* sp. A, CRC-40267-1, UCMP39039, X75. **9**, *H.* sp. B, SCI-L76-29, UCMP39040, X50. **10**, *H.* sp. C, CRC-40267-47a, UCMP39041, X40.

11 *Stainforthia nodosa*, CRC-40267-35, UCMP39042, X127.

12 *Bulimina alligata*, CRC-39842-80, UCMP39043, X75.

13 *Bulimina* cf. *B. hebespinata*, GC-2, UCMP38344, X75.

14-16 *Bulimina inflata*: **14**, CRC-40267-47a, UCMP39044, X35. **15**, CRC-40267-47a, UCMP39045, X49. **16**, CRC-42107-15, UCMP39046, X70.

17, 18 *Bulimina subacuminata*: **17**, GC-11, UCMP39047, X64. **18**, GC-9, UCMP38351, X97.

19 *Bulimina subcalva*, GC-13, UCMP38352, X60.

20-23 *Praeglobobulimina spinifera*: **20**, GC-13, UCMP38359, X100. **21**, CRC-40267-50a, UCMP39048, X56. **22**, CRC-40267-47a, UCMP39049, X65. **23**, CRC-40267-47a, UCMP39050, X85.

24, 25 *Praeglobobulimina galliheri*: **24**, eroded specimen, CRC-40267-2, UCMP39051, X35. **25**, CRC-40267-47a, UCMP39052, X63.

26-33 *Protoglobobulimina pseudotorta*: **26**, forma *pseudoaffinis*, GC-1, UCMP38358, X70. **27**, CRC-40267-47a, UCMP39053, X50. **28**, LH-7, UCMP39054, X60. **29**, CRC-40267-30, UCMP39055, X55. **30**, CRC-40267-39, UCMP39056, X55. **31**, CRC-40267-34, UCMP39057, X58. **32**, IC-115, UCMP39058, X45. **33**, CRC-41367-2, UCMP39059, X35.

34, 35 *Buliminella brevior*: **34**, CRC-42107-31, UCMP39060, X110. **35**, TC-197, UCMP39061, X200.

36-38 *Buliminella curta*: **36**, CRC-40267-3, UCMP39062, X70. **37**, CRC-39842-39, UCMP39063, X65. **38**, CRC-39842-39, UCMP39064, side view (note *Buliminita*-type aperture), X70.

39-45 *Buliminella subfusiformis*: **39**, GC-3, UCMP38357, X106. **40**, CRC-40660-6, UCMP39065, X86. **41**, GC-8, UCMP38355, X106; **42**, MAR-254, UCMP39066, X43. **43**, CRC-40267-36, UCMP39067, X45. **44**, CRC-40660-14, UCMP-39068, X80. **45**, forma *californica*, GC-3, UCMP38356, X93.

46, 47 *Buliminella semihispida*, topotypes, CRC-39842-57: 46, UCMP39069, X70; 47, UCMP39070, X75.

48-50 *Buliminella elegantissima*: **48**, GC-15b, UCMP38353, X200. **49**, CRC-41367-2, UCMP39071, X115. **50**, MAR-254, UCMP39072, X70.

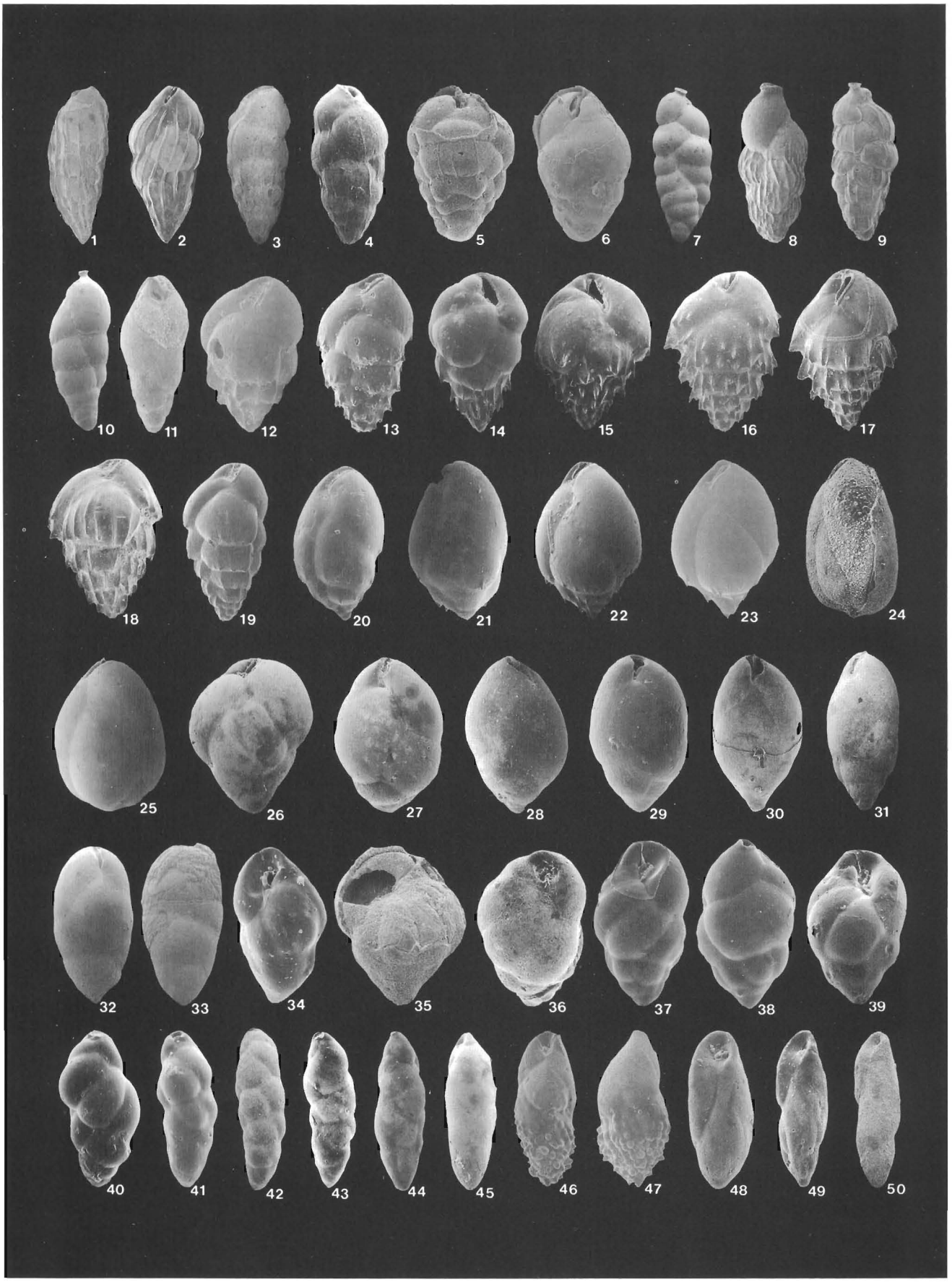
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PLATE 21

Rectuvigerina

All specimens are illustrated in side and aboral views.

1-6 *Rectuvigerina transversa*: **1, 2**, megaspheric specimen, GC-14, UCMP38348, X35. **3, 4**, microspheric specimen, GC-14, UCMP38349, X35. **5, 6**, microspheric specimen, CRC-40660-3, UCMP39073, X26.

7-56 *Rectuvigerina branneri*: **7, 8**, megaspheric specimen (destroyed), CRC-39842-22, X26. **9, 10**, megaspheric specimen, CRC-39842-12, UCMP39075, X26. **11, 12**, microspheric specimen, CRC-39842-2, UCMP-39076, X36. **13, 14**, microspheric specimen, CRC-39842-12, UCMP39077, X26. **15, 16**, megaspheric specimen (lost), CRC-39842-2, X45. **17, 18**, megaspheric specimen, SCI-L76-30, UCMP39079, X22. **19, 20**, microspheric specimen, CRC-39842-24, UCMP39080, X30. **21, 22**, megaspheric specimen, CRC-40267-35, UCMP39081, X17. **23, 24**, microspheric specimen, CRC-40267-35, UCMP39082, X17. **25, 26**, microspheric specimen, GC-13, UCMP38347, X31. **27, 28**, megaspheric specimen, GC-1, UCMP-38346, X30. **29, 30**, megaspheric specimen, LH-7, UCMP39083, X22. **31, 32**, megaspheric specimen, SCI-L76-39, UCMP39084, X26. **33, 34**, megaspheric specimen, SCI-L76-30, UCMP39085, X22. **35, 36**, megaspheric specimen, CRC-39842-1, UCMP39086, X27. **37, 38**, microspheric specimen, SCI-L76-39, UCMP39087, X26. **39, 40**, microspheric specimen, CRC-39842-24, UCMP39088, X51. **41, 42**, microspheric specimen, CRC-40267-35, UCMP39089, X22. **43, 44**, megaspheric specimen, CRC-39842-24, UCMP39090, X35. **45, 46**, megaspheric specimen, CRC-39842-24, UCMP39091, X35. **47, 48**, megaspheric specimen, CRC-39842-9, UCMP39092, X36. **49, 50**, microspheric specimen, GC-1, UCMP38343, X31; **51, 52**, megaspheric specimen, GC-1, UCMP38344, X31. **53, 54**, megaspheric topotype specimen, GC-15a, UCMP38345, X25. **55, 56**, megaspheric variant, SCI-L76-29, UCMP39093, X26.

57-62 *Rectuvigerina hughesi*: **57, 58**, megaspheric specimen (destroyed), SCI-L76-33, UCMP39094, X26. **59, 60**, microspheric specimen, GC-4, UCMP38335, X25. **61, 62**, megaspheric specimen, GC-4, UCMP38336, X30.

63-76 *Rectuvigerina loeblichi*: **63, 64**, megaspheric paratype, GC-4, UCMP38340, X26. **65, 66**, megaspheric specimen, GC-3, UCMP39095, X28. **67, 68**, microspheric paratype, GC-3, UCMP38339, X26. **69, 70**, microspheric specimen, GC-3, UCMP39096, X26. **71, 72**, megaspheric specimen, GC-3, UCMP39097, X29. **73, 74**, megaspheric specimen, GC-3, UCMP39098, X31. **75, 76**, megaspheric variant, CRC-40267-35, UCMP39099, X15.

77, 78 *Rectuvigerina* cf. *R. branneri*, megaspheric specimen, CRC-40267-35, UCMP39100, X17.

79, 80 *Rectuvigerina* cf. *R. hughesi*, megaspheric specimen, CRC-40267-35, UCMP39101, X28.

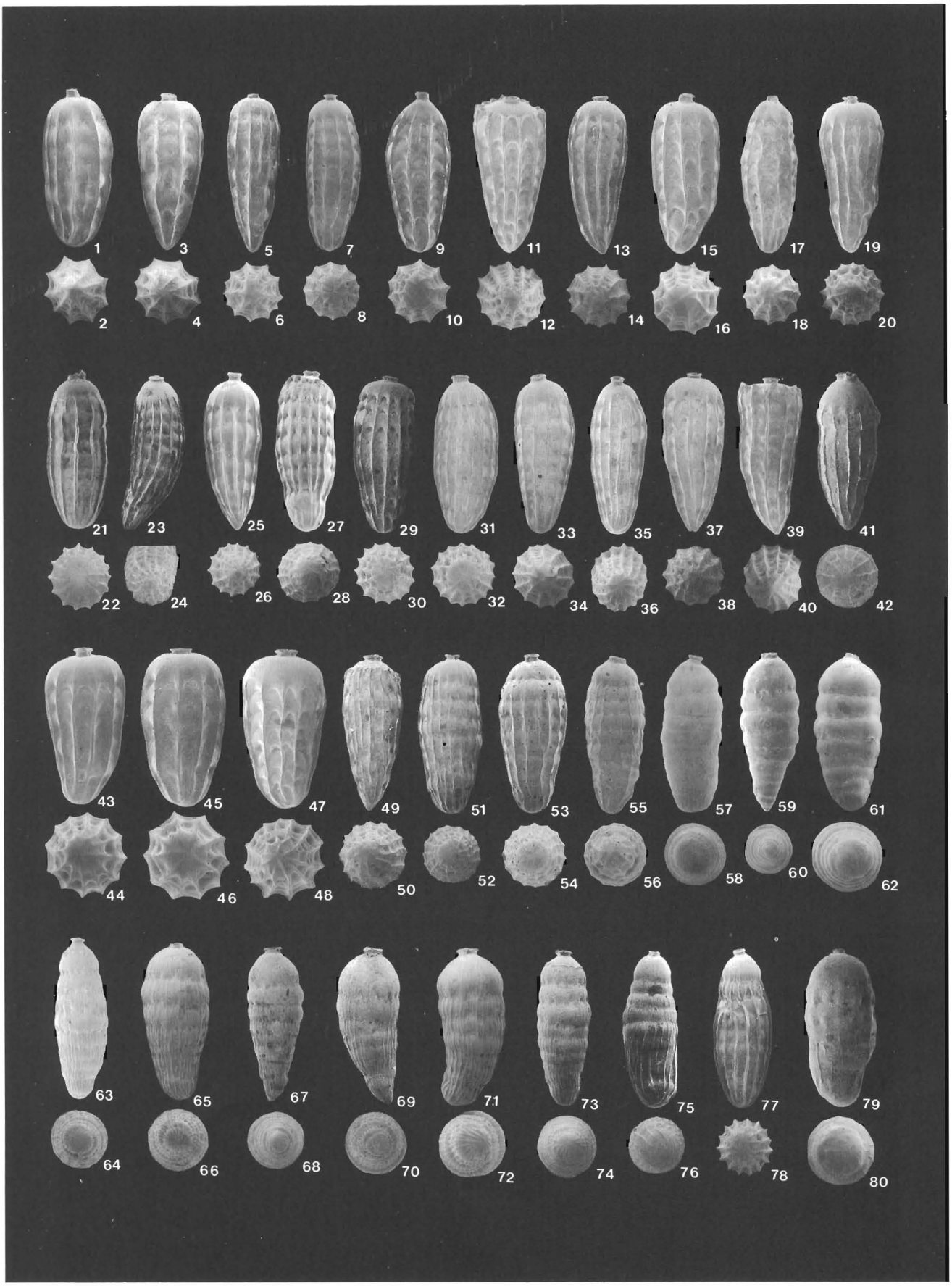
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PLATE 22

Uvigerina, Trifarina

All specimens are illustrated in side view.

1-6 *Uvigerina hootsi*: **1**, megaspheric specimen, CRC-40267-38, UCMP39102, X48. **2**, megaspheric specimen, CRC-40267-43, UCMP39103, X45. **3**, microspheric specimen, CRC-40267-43, UCMP39104, X35. **4**, microspheric specimen, CRC-40267-1, UCMP39105, X34. **5**, megaspheric specimen, GC-15a, UCMP38364, X70. **6**, megaspheric variant, CRC-40267-47a, UCMP39106, X44.

7-9 *Uvigerina hannai*: **7**, LH-7, UCMP39107, X50. **8**, GC-7, UCMP38357, X70. **9**, CRC-40267-35, UCMP-39108, X34.

10, 11 *Uvigerina* cf. *U. hispidocostata*: **10**, GC-10, lost specimen, X70. **11**, GC-10, UCMP39109, X67.

12-19 *Uvigerina subperegrina*: **12**, CRC-40267-44, UCMP39110, X55. **13**, LH-5, UCMP39111, X50. **14**, CRC-40267-34, UCMP39112, X55. **15**, CRC-41368-1, UCMP39113, X60. **16**, CRC-39842-68, UCMP39114, X45. **17**, GC-3, lost specimen, X60. **18**, CRC-42107-13, UCMP39116, X42. **19**, GC-3, UCMP38367, X66.

20-22 *Uvigerina subperegrina* (forma *impolita*): **20**, CW-34975-6b, *U. impolita* topotype, UCMP39117, X55. **21**, CRC-39842-96, UCMP39118, X60. **22**, CRC-39842-78, UCMP39119, X65.

23 *Uvigerina senticosa*, CRC-40267-43, UCMP39120, X45.

24 *Uvigerina* cf. *U. segundoensis*, CRC-40267-39, UCMP39121, X45.

25, 26 *Uvigerina segundoensis*: **25**, CRC-40267-6, UCMP39122, X40. **26**, CRC-40267-30, UCMP39123, X40.

27 *Uvigerina* sp. A, CRC-40660-3, UCMP39124, X58.

28 *Uvigerina* sp. B, CRC-42263-8, UCMP39125, X45.

29 *Uvigerina* sp. C, CRC-39842-45, UCMP39126, X30.

30 *Uvigerina* sp. D, CRC-39842-106, UCMP39127, X75.

31-35 *Uvigerinella californica*: **31**, CRC-39842-84, UCMP39128, X85. **32**, GC-2, UCMP38370, X62. **33**, GC-2, UCMP38369, X50. **34**, GC-9, UCMP38368, X50. **35**, CRC-40660-6, UCMP39129, X100.

36-43 *Uvigerinella californica ornata*: **36**, LH-4, UCMP39130, X60. **37**, GC-7, UCMP38372, X66. **38**, CRC-40267-31, UCMP39131, X55. **39**, MAR-254, UCMP39132, X60. **40**, CRC-40267-35, UCMP39133, X70. **41**, GC-15c, UCMP38371, X70. **42**, CRC-40267-33, UCMP39134, X70. **43**, CRC-40267-33, UCMP-39135, X75.

44-46 *Trifarina fluens*: **44**, CRC-40267-1, UCMP39136, X100. **45**, UCLA-6317, UCMP39137, X69. **46**, SL-1, UCMP38444, X150.

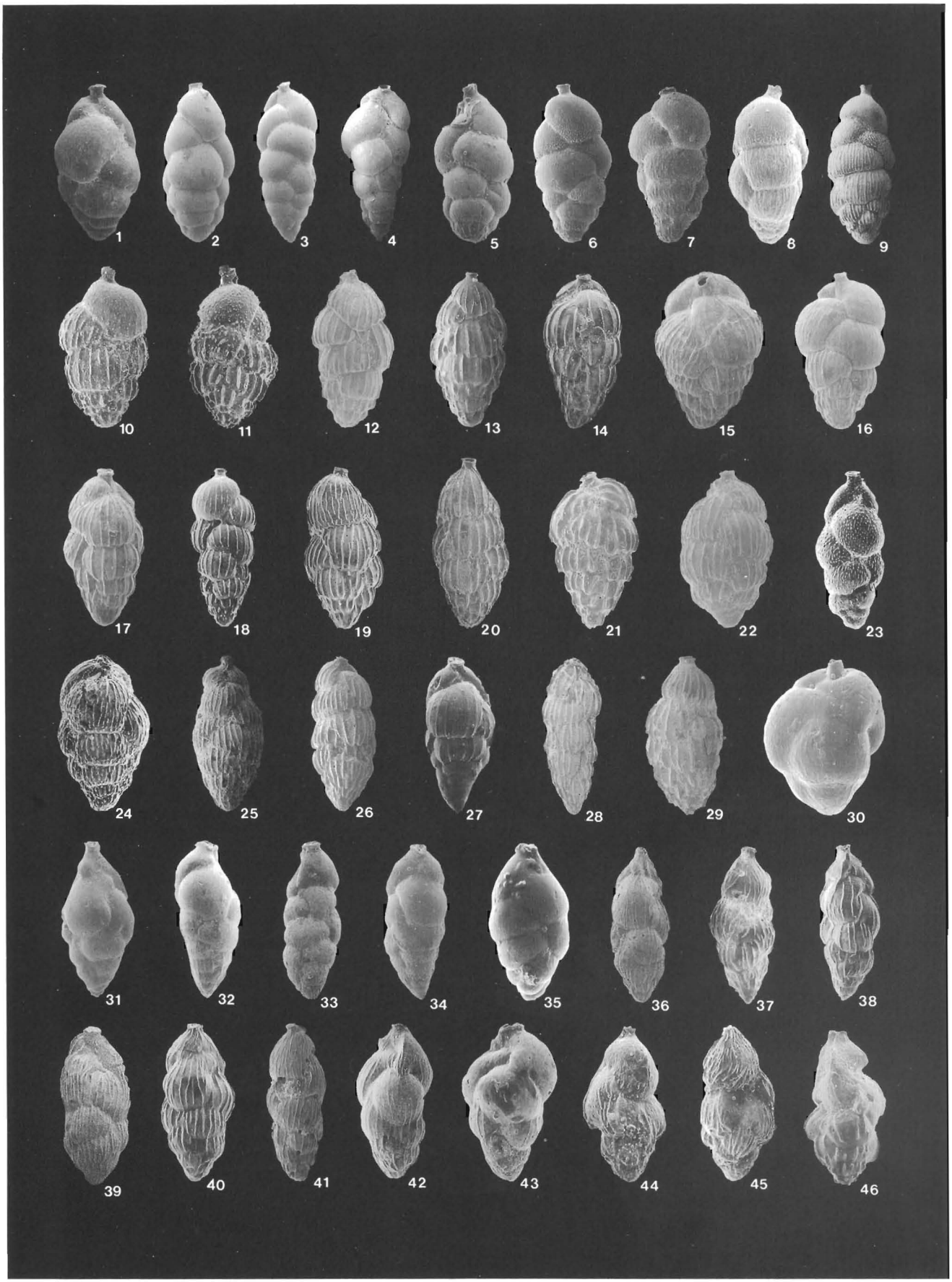
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PLATE 23

Fursenkoina, Kleinpella, Buliminella, Rutherfordoides, Suggrunda, Virgulinella, Tremachora

1 *Fursenkoina subplana*, CRC-40267-34, UCMP39138, side view, X86.

2 *Fursenkoina* sp. A, CRC-39842-47, UCMP39139, side view, X60.

3 *Kleinpella* sp. A, CRC-40267-43, UCMP39140, side view, X45.

4 *Fursenkoina* sp. C, CRC-40267-35, UCMP39141, side view, X80.

5 *Kleinpella* sp. B, CRC-40267-50, UCMP39142, side view, X60.

6-8 *Fursenkoina* sp. B: **6**, MAR-254, UCMP39143, side view, X66. **7**, GC-14, UCMP39144, side view, X100. **8**, GC-4, UCMP38443 (= *Fursenkoina* sp. E), side view, X150.

9-14 *Kleinpella californiensis*: **9**, GC-15d, UCMP38363, side view, X66. **10**, GC-4, UCMP38360, side view, X60. **11**, GC-14, lost specimen, side view, X140. **12**, CRC-40267-29, UCMP39145, side view, X72. **13**, forma *grandis*, CRC-40267-3, UCMP39146, side view, X30. **14**, MAR-254, UCMP39147, side view, X67.

15 *Kleinpella californiensis ticensis*, CRC-40267-47a, UCMP39148, side view, X60.

16 *Kleinpella californiensis* variant, CRC-40267-44, UCMP39149, side view, X73.

17-22 *Rutherfordoides californiensis*: **17-19**, GC-12, UCMP38420, X90: 17, outer edge view; 18, apertural side view; 19, inner edge view. **20-22**, GC-5, lost specimen, X77: 20, inner edge view; 21, apertural side view; 22, outer edge view.

23-28 *Suggrunda kleinpelli*: **23, 24**, GC-13, UCMP38326, X150: 23, apertural view; 24, side view. **25, 26**, CRC-40267-45a, UCMP39151, X55: 25, apertural view; 26, side view. **27, 28**, LH-7, UCMP39152, X100: 27, apertural view; 28, side view.

29-36 *Suggrunda inflata*: **29, 30**, IC-126, UCMP39153, X85: 29, apertural view; 30, side view. **31-33**, GC-4, holotype, UCMP38329, X175: 31, side view; 32, apertural view; 33, side view 90° clockwise from fig. 31. **34**, paratype, GC-6, UCMP38327, apertural view, X130. **35**, GC-6, lost specimen, apertural view, X192. **36**, paratype, GC-6, UCMP38328, side view, X152.

37, 38 *Virgulinella pertusa*: **37**, CRC-40267-50a, UCMP39155, side view, X75. **38**, MAR-254, UCMP39156, side view, X49.

39-45 *Tremachora arga*: **39, 40**, CRC-40267-50, topotype, UCMP39157, X107: 39, umbilical view; 40, spiral view. **41, 42**, CRC-40267-50b, topotype, UCMP39158, X85: 41, side view; 42, spiral view. **43, 44**, TC-223, UCMP39159, X133: 43, umbilical view; 44, side view. **45**, CRC-40267-3, UCMP39160, side view, X100.

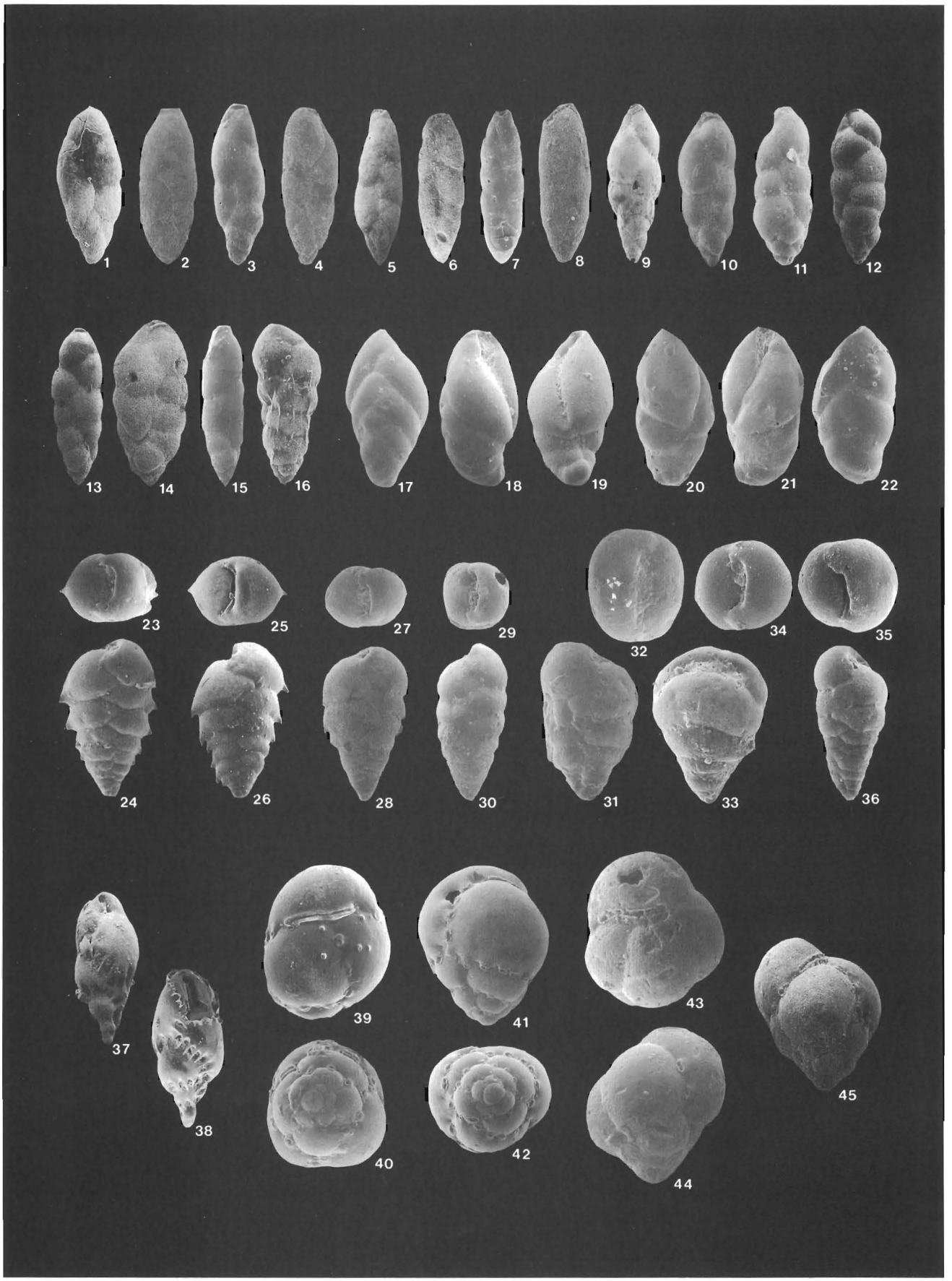
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PLATE 24

Nodogenerina, Siphonodosaria, Sphaeroidina, Neoeponides

1, 2 *Nodogenerina* cf. *N. bradyi*, CRC-42107-15, UCMP39161: **1**, median apertural view, X50. **2**, side view, X31.

3-7 *Nodogenerina parexilis*: **3**, early segment, SCI-L76-23, UCMP39162, side view, X30. **4**, middle segment, CRC-40660-6, lost specimen, side view, X120. **5, 6**, early segment, GC-3, UCMP38242: 5, median apertural view, X100. **6**, side view, X30. **7**, early segment, GC-3, UCMP38241, X20.

8, 9 *Nodogenerina* sp., early segment, CRC-40267-46a, UCMP39164, X45: 8, median apertural view; 9, side view.

10-16 *Nodogenerina sagrinensis*: **10, 11**, CRC-40267-38, UCMP39165: 10, apertural view, X72; 11, side view, X29. **12, 13**, GC-7, UCMP38250: 12, apertural view, X100; 13, side view, X63. **14**, lost specimen, GC-6, side view, X55. **15, 16**, CRC-39842-24, UCMP39166: 15, apertural view, X200; 16, side view, X100.

17 *Nodogenerina parkeri*, GC-8, holotype, UCMP38238, side view, X50.

18-20 *Nodogenerina tappani*: **18, 19**, GC-1, holotype, UCMP38239: 18, apertural view, X65; 19, side view, X34. **20**, GC-2, paratype, UCMP38240, side view, X25.

21-35 *Siphonodosaria advena*: **21, 22**, megaspheric specimen, CRC-40267-39, UCMP39167: 21, apertural view, X64; 22, side view, X32. **23**, megaspheric specimen, GC-6, UCMP39168, X40. **24, 25**, megaspheric specimen, CRC-40267-47a, UCMP39169: 24, apertural view, X78; 25, side view, X35. **26, 27**, megaspheric specimen, CRC-40267-47a, UCMP39170: 26, apertural view, X74; 27, side view, X26. **28**, microspheric specimen, SCI-L76-29, UCMP39171, side view, X30. **29**, megaspheric specimen, SCI-L76-29, UCMP39172, side view, X30. **30, 31**, microspheric specimen, GC-15a, UCMP38237: 30, apertural view, X43; 31, side view, X21. **32**, microspheric specimen, SCI-L76-33, UCMP39173, X25. **33, 34**, megaspheric specimen, SCI-L76-33, UCMP39174: 33, apertural view, X50; 34, side view, X25. **35**, aberrant late segment, CRC-40267-50a, UCMP39175, side view, X45.

36-44 *Siphonodosaria quadrulata*: **36**, CRC-40267-47a, UCMP39176, side view, X25. **37, 38**, CRC-40267-47a, UCMP39177: 37, apertural view, X78; 38, side view, X30. **39**, CRC-40267-38, UCMP39178, side view, X16. **40**, early segment, side view, GC-2, UCMP38245, X35. **41**, early segment, GC-3, UCMP38246, side view, X30. **42, 43**, GC-9, UCMP38248: 42, apertural view, X53; 43, side view, X35. **44**, GC-9, UCMP-38247, side view, X20.

45-51 *Siphonodosaria montereyana*: **45**, GC-11, UCMP39179, side view, X21. **46, 47**, GC-7, holotype, UCMP-38235: 46, apertural view, X56; 47, side view, X28. **48, 49**, CRC-40267-50a, UCMP39180: 48, apertural view, X82; 49, side view, X37. **50**, middle segment, CRC-40267-47a, UCMP39181, side view, X20. **51**, CRC-40267-38, UCMP39182, side view, X15.

52, 53 *Siphonodosaria* sp., late segment, GC-6, UCMP38236: 52, apertural view, X66; 53, side view, X45.

54-58 *Sphaeroidina chilostomata*: **54**, CRC-40267-35, UCMP39183, apertural side view, X70. **55**, CRC-40660-14, UCMP39184, apertural side view, X80. **56**, GC-6, UCMP38401, apertural side view, X150. **57**, CRC-42107-18, UCMP39185, apertural side view, X85. **58**, CRC-40267-50, aberrant immature form, UCMP-39186, apertural side view, X110.

59-64 *Neoeponides navarrettei*, n. sp.: **59-61**, UCLA-6317, holotype, UCMP39187, X50: 59, spiral view; 60, edge view; 61, umbilical view. **62-64**, LH-4, lost specimen, X55: 62, spiral view; 63, edge view; 64, umbilical view.

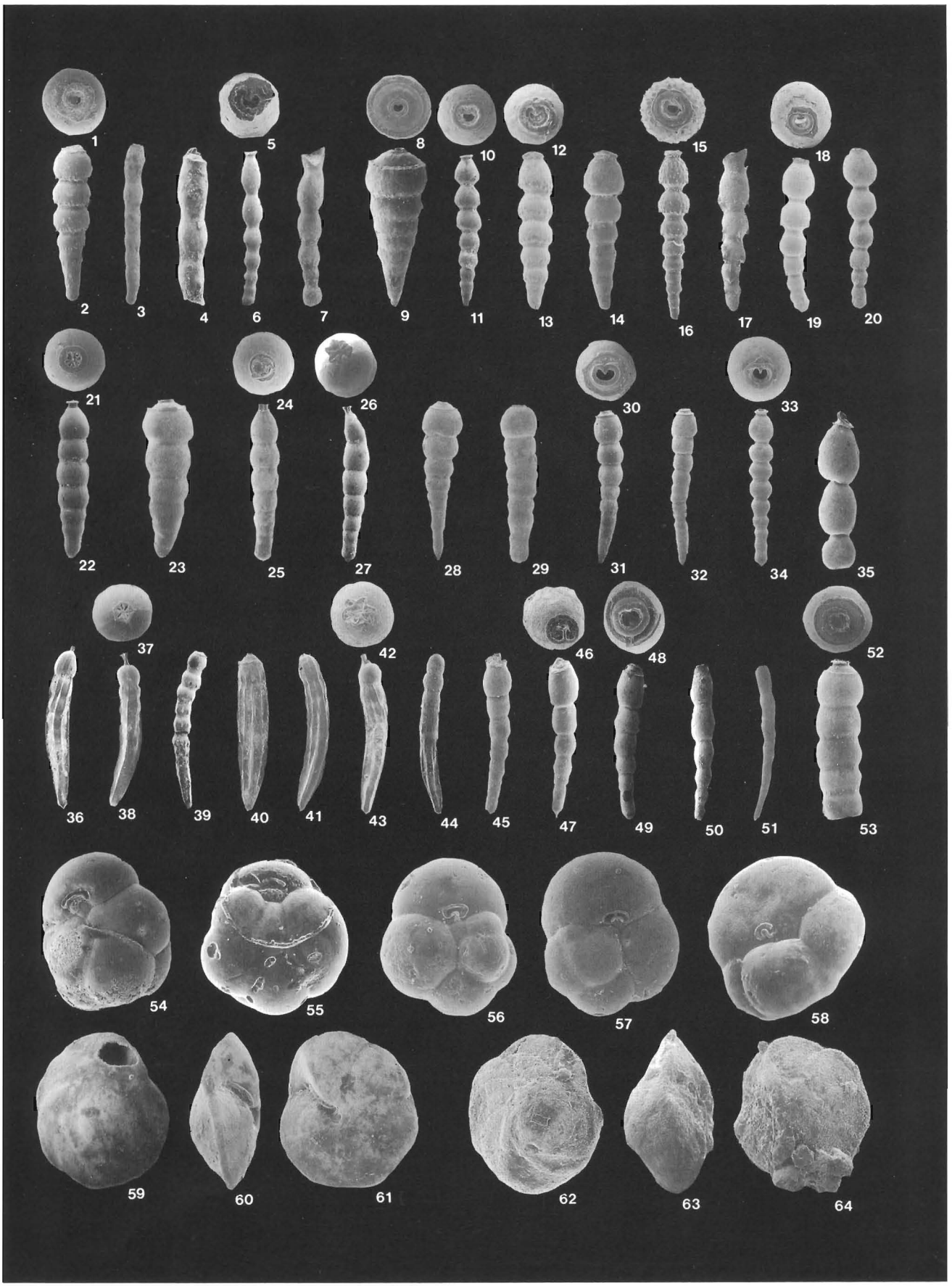
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PLATE 25

Baggina, Cancris, Valvulineria

1-9 *Baggina californica*: **1-3**, MAR-254, UCMP39189, X45: 1, umbilical view; 2, edge view; 3, spiral view. **4-6**, GC-9, UCMP38402, X45: 4, umbilical view; 5, edge view; 6, spiral view. **7-9**, CRC-40660-14, UCMP-39190, X45: 7, umbilical view; 8, edge view; 9, spiral view.

10-18 *Cancris baggi*: **10-12**, MAR-254, lost specimen, X29: 10, spiral view; 11, edge view; 12, umbilical view. **13-15**, GC-15a, topotype, UCMP38403, X42: 13, spiral view; 14, edge view; 15, umbilical view. **16-18**, CRC-39842-3, UCMP39192, X62: 16, spiral view; 17, edge view; 18, umbilical view.

19-27, 31-33 *Cancris planus*: **19-21**, CRC-40267-35a, UCMP39193, X54: 19, spiral view; 20, edge view; 21, umbilical view. **22-24**, SCI-L76-33, UCMP39194, X54: 22, umbilical view; 23, edge view; 24, spiral view. **25-27**, CRC-39842-80, UCMP39195, X74: 25, spiral view; 26, edge view; 27, umbilical view. **31-33**, CRC-40660-5, UCMP39196, X61: 31, spiral view; 32, edge view; 33, umbilical view.

28-30 *Cancris lippsi*, IC-100, holotype, UCMP39197, X65: 28, umbilical view; 29, edge view; 30, spiral view.

34-36 *Valvulineria malagaensis*, CRC-40267-44, UCMP39198, X65: 34, spiral view; 35, edge view; 36, umbilical view.

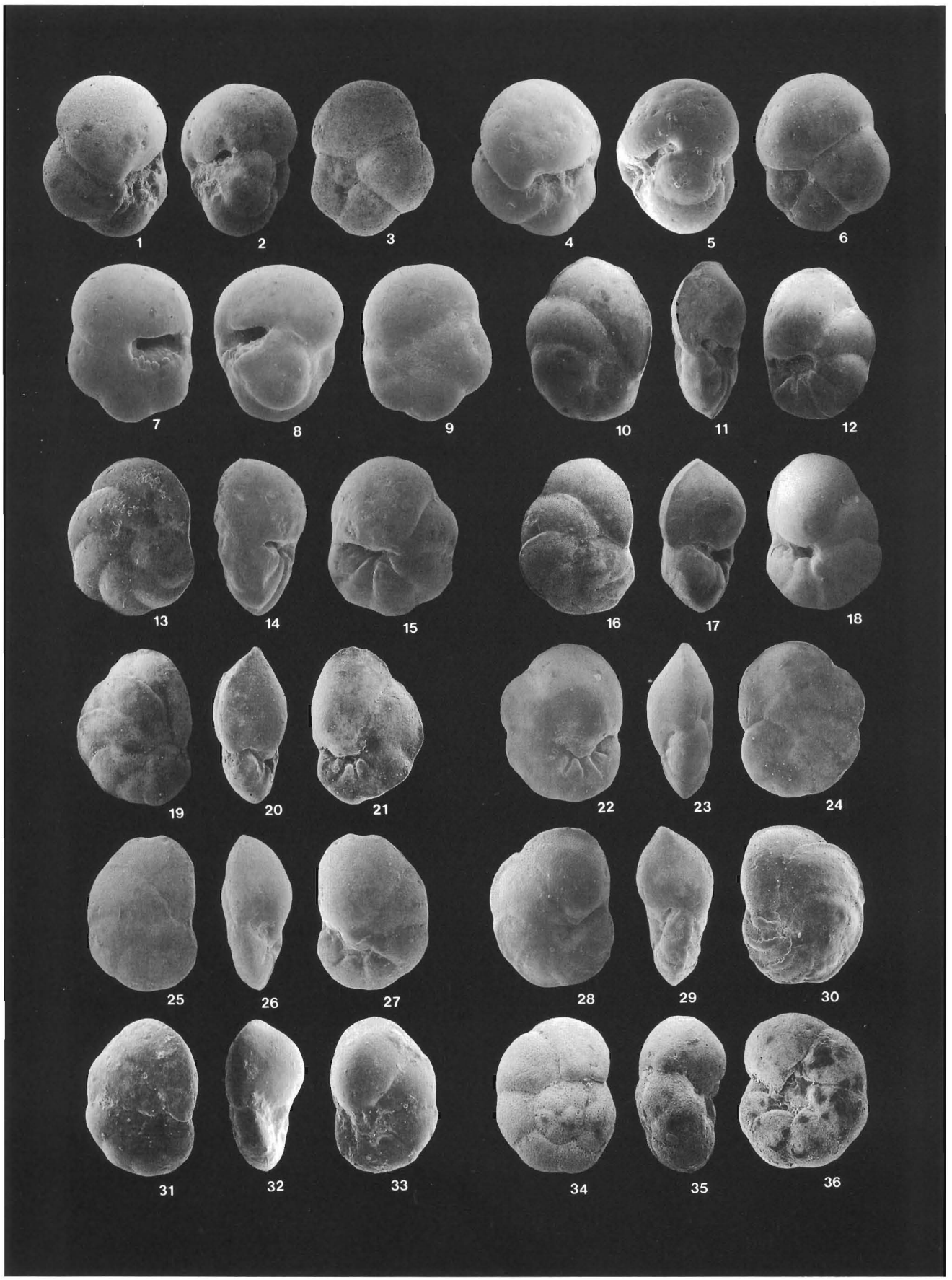
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PLATE 26

Valvulineria

1-9 *Valvulineria miocenica*: **1-3**, CRC-40660-8, UCMP39199, X59: 1, spiral view; 2, edge view; 3, umbilical view. **4-6**, CRC-39842-30, UCMP39200, X60: 4, umbilical view; 5, edge view; 6, spiral view. **7-9**, CRC-39842-103, UCMP39201, X60: 7, umbilical view; 8, edge view; 9, spiral view.

10-18 *Valvulineria* cf. *V. miocenica ornata*: **10-12**, CRC-39842-90, UCMP39202, X75: 10, spiral view; 11, edge view; 12, umbilical view. **13-15**, CRC-39842-90, UCMP39203, X69: 13, spiral view; 14, edge view; 15, umbilical view. **16-18**, CRC-39842-90, UCMP39204, X69: 16, spiral view; 17, edge view; 18, umbilical view.

19-30 *Valvulineria miocenica*: **19-21**, MAR-254, UCMP39205, X50: 19, spiral view; 20, edge view; 21, umbilical view. **22-24**, CRC-40267-29, UCMP39206, X75: 22, spiral view; 23, edge view; 24, umbilical view. **25-27**, GC-1, UCMP39207, X63: 25, umbilical view; 26, edge view; 27, spiral view. **28-30**, GC-13, UCMP-38404, X65: 28, spiral view; 29, edge view; 30, umbilical view.

31-36 *Valvulineria miocenica ornata*: **31-33**, SCI-L76-30, UCMP39208, X54: 31, umbilical view; 32, edge view; 33, spiral view. **34-36**, CRC-40267-32, UCMP39209, X65: 34, umbilical view; 35, edge view; 36, spiral view.

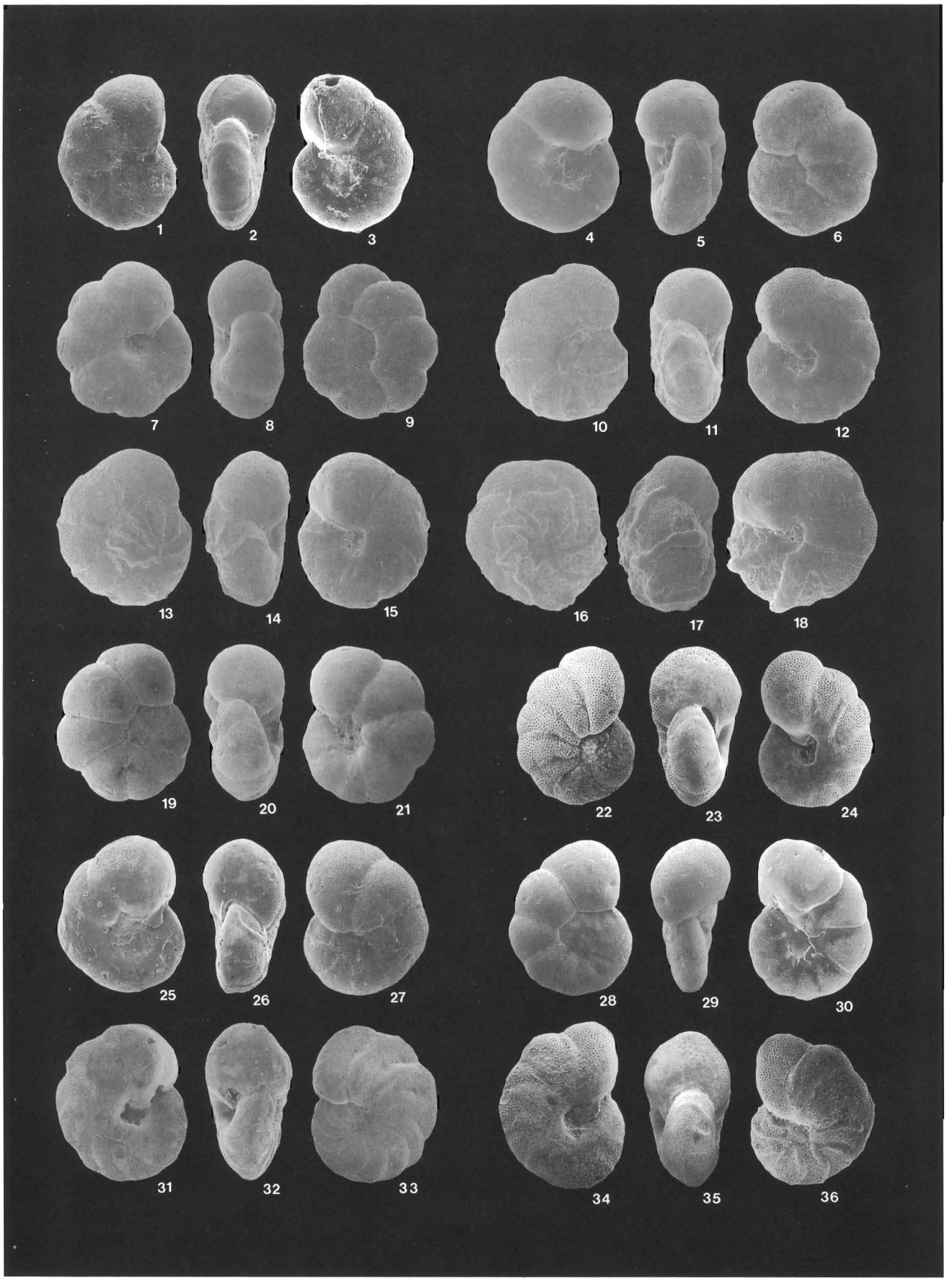
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PLATE 27

Valvulineria

1-6 *Valvulineria californica*: **1-3**, GC-15d, UCMP38405, X47: 1, umbilical view; 2, edge view; 3, spiral view. **4-6**, LH-7, UCMP39210, X35: 4, umbilical view; 5, edge view; 6, spiral view.

7-18 *Valvulineria californica* (forma *appressa*): **7-9**, CRC-40267-30, UCMP39211, X45: 7, spiral view; 8, edge view; 9, umbilical view. **10-12**, CRC-40267-30, UCMP39212, X34: 10, umbilical view; 11, edge view; 12, spiral view. **13-15**: GC-15d, UCMP38406, X65: 13, spiral view; 14, edge view; 15, umbilical view. **16-18**, CRC40660-14, UCMP39213, X55: 16, umbilical view; 17, edge view; 18, spiral view.

19-21 *Valvulineria californica* (forma *obesa*), CRC40660-14, UCMP39214, X50: 19, spiral view; 20, edge view; 21, umbilical view.

22-27 *Valvulineria robusta*: **22-24**, GC-2, UCMP38407, X52: 22, spiral view; 23, edge view; 24, umbilical view. **25-27**, CRC-40267-39, UCMP39215, X40: 25, umbilical view; 26, edge view; 27, spiral view.

28-30 *Valvulineria subinequalis*, CRC-40267-43, UCMP39216, X40: 28, umbilical view; 29, edge view; 30, spiral view.

31-36 *Valvulineria mcdougalli*, n. sp.: **31-33**, CRC-40267-1, paratype, UCMP39217, X50: 31, spiral view; 32, edge view; 33, umbilical view. **34-36**, CRC-40267-47c, holotype, UCMP39218, X40: 34, umbilical view; 35, edge view; 36, spiral view.

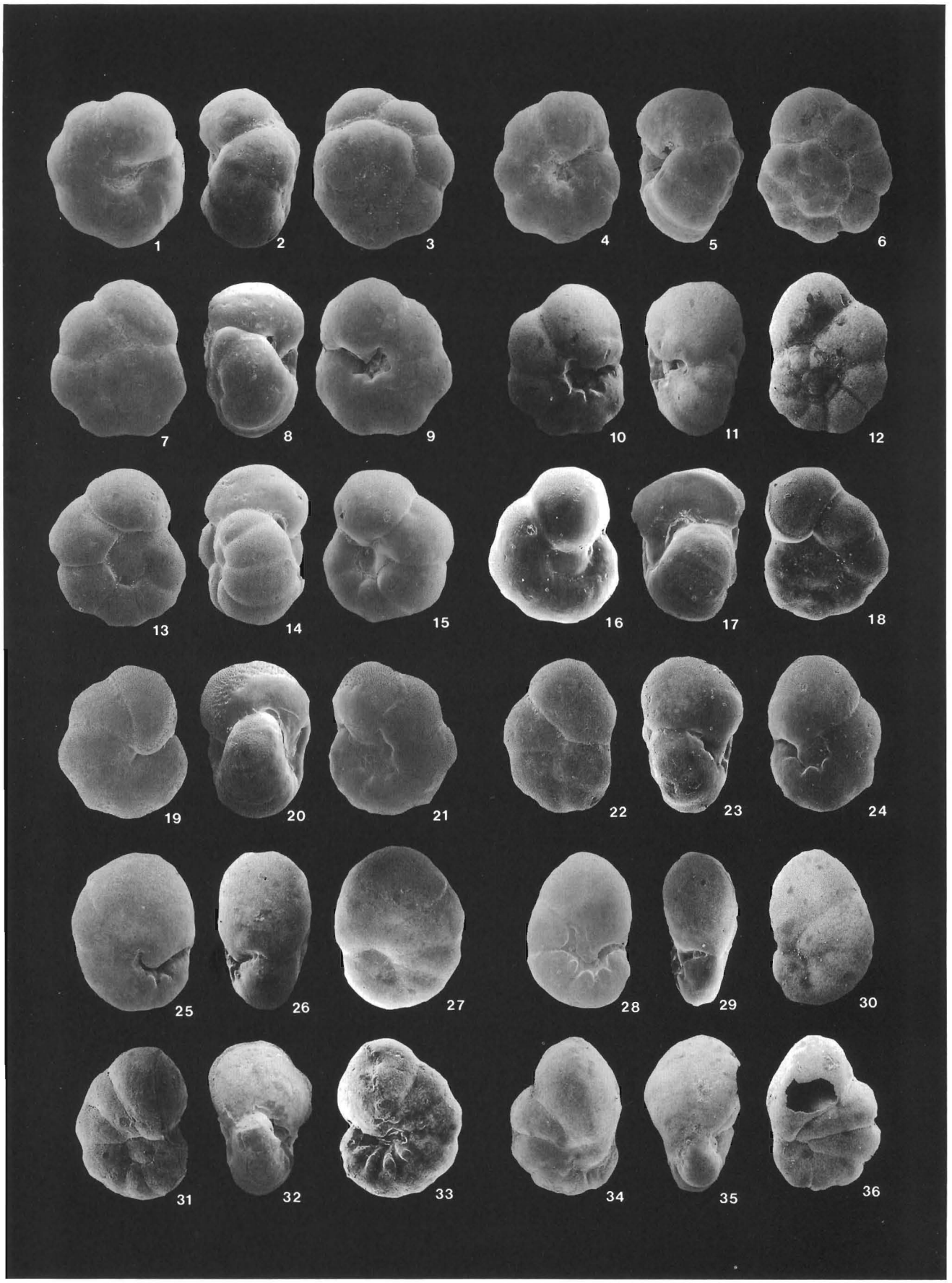
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PLATE 28

Gavelinopsis, Rosalina, Cibicidoides, Ambitropus, Epistominella

1-3 *Gavelinopsis garveyensis*, CRC-39842-70, UCMP39219, X85: 1, spiral view; 2, edge view; 3, umbilical view.

4-9 *Gavelinopsis holkos*: **4-6**, UCLA-6317, UCMP39220, X80: 4, umbilical view; 5, edge view; 6, spiral view. **7-9**, GC-4, holotype, UCMP38385, X200: 7, spiral view; 8, edge view; 9, umbilical view.

10-12 *Gavelinopsis durhami*, GC-4, holotype, UCMP38386, X105: 10, umbilical view; 11, edge view; 12, spiral view.

13-15 *Gavelinopsis* sp., CRC-42107-18, UCMP39221, X200: 13, spiral view; 14, edge view; 15 umbilical view.

16-18 *Rosalina californica*, GC-4, holotype, UCMP38387, X102: 16, umbilical view; 17, edge view; 18, spiral view.

19-25 *Cibicidoides mckannai* (forma *suppressa*): **19-21**, CRC-40267-50, UCMP39222, X150: 19, umbilical view; 20, edge view; 21, spiral view. **22-24**, CRC-40267-38, UCMP39223, X50: 22, umbilical view; 23, edge view; 24, spiral view. **25**, aberrant specimen, CRC-40267-34, UCMP39224, side view, X75.

26-28 *Cibicidoides cushmani*, GC-8, UCMP38410, X62: 26, umbilical view; 27, edge view; 28, spiral view.

29-34 *Ambitropus evax*: **29-31**, CRC-40267-39, UCMP39225, X52: 29, side view; 30, edge view; 31, opposite side view. **32-34**, CRC-40267-47a, UCMP39226, X63: 32, side view; 33, edge view; 34, opposite side view.

35-37 *Epistominella discorbisoides*, CRC-42107-11, UCMP39227, X100: 35, spiral view; 36, edge view; 37, umbilical view.

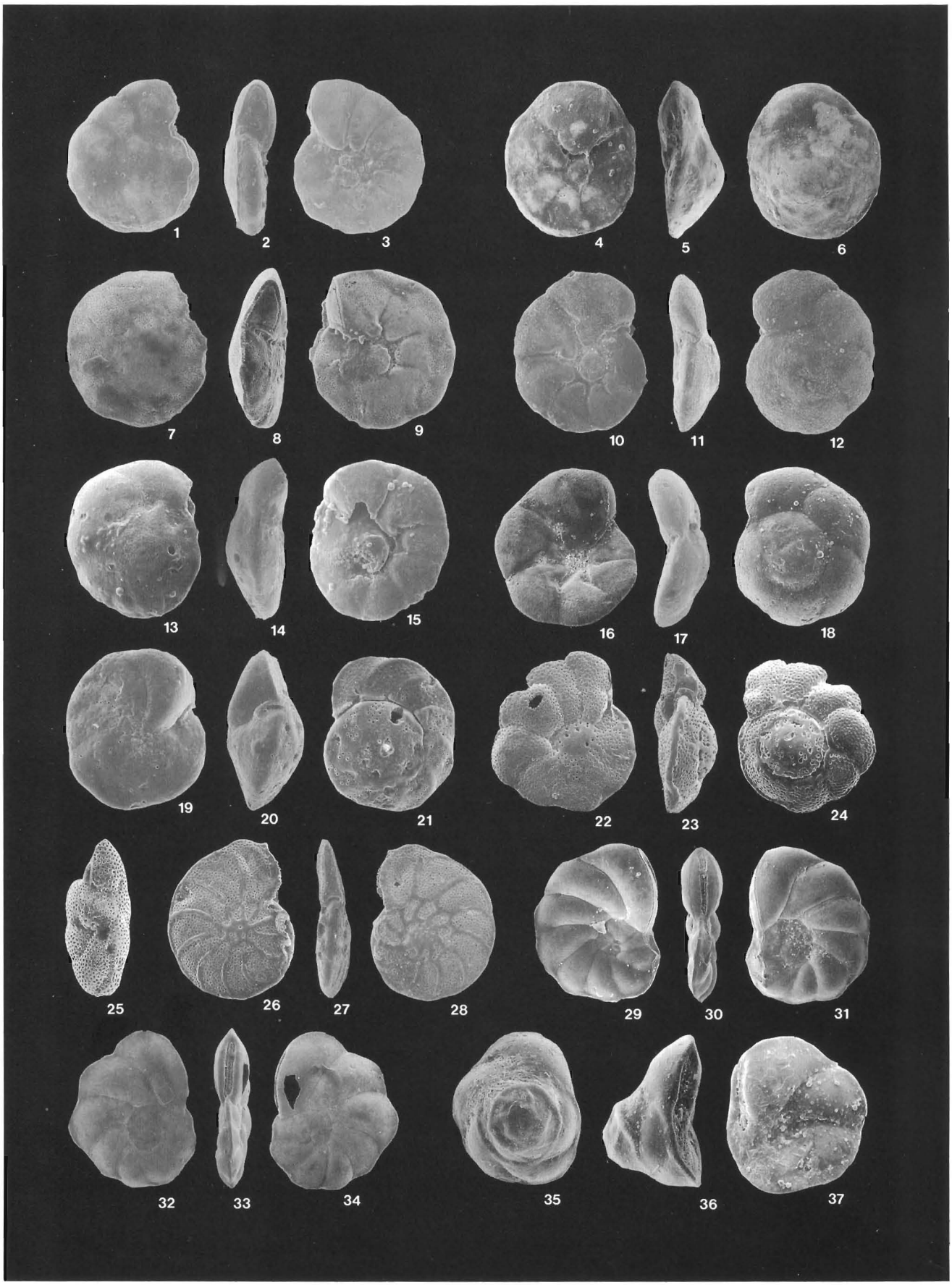
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PLATE 29

Epistominella, Megastomella, Pseudoparrella

1-15 *Epistominella smithi*: **1-3**, GC-8, UCMP38388, X88: 1, umbilical view; 2, edge view; 3, spiral view. **4-6**, GC-15c, UCMP39228, X83: 4, umbilical view; 5, edge view; 6, spiral view. **7-9**, CRC-40267-39, UCMP-39229, X63: 7, umbilical view; 8, edge view; 9, spiral view. **10-12**, CRC-40267-39, UCMP39230, X75: 10, umbilical view; 11, edge view; 12, spiral view. **13-15**, GC-10, UCMP39231, X96: 13, umbilical view; 14, edge view; 15, spiral view.

16-18 *Epistominella pacifica*, CRC-41368-1, UCMP39232, X115: 16, spiral view; 17, edge view; 18, umbilical view.

19-27 *Megastomella capitanensis*: **19-21**, CRC-40267-44, UCMP39233, X80: 19, side view; 20, edge view; 21, opposite side view. **22-24**, GC-4, UCMP38389, X70: 22, side view; 23, edge view; 24, opposite side view. **25-27**, CRC-40660-12, UCMP39234, X130: 25, side view; 26, edge view; 27, opposite side view.

28-33 *Megastomella purisima*: **28-30**, GC-4, UCMP38390, X180: 28, side view; 29, edge view; 30, opposite side view. **31-33**, GC-4, UCMP39235, X120: 31, side view; 32, edge view; 33, opposite side view.

34-36 *Pseudoparrella californica*, immature specimen, TC-158, UCMP39236, X250: 34, spiral view; 35 edge view; 36, umbilical view.

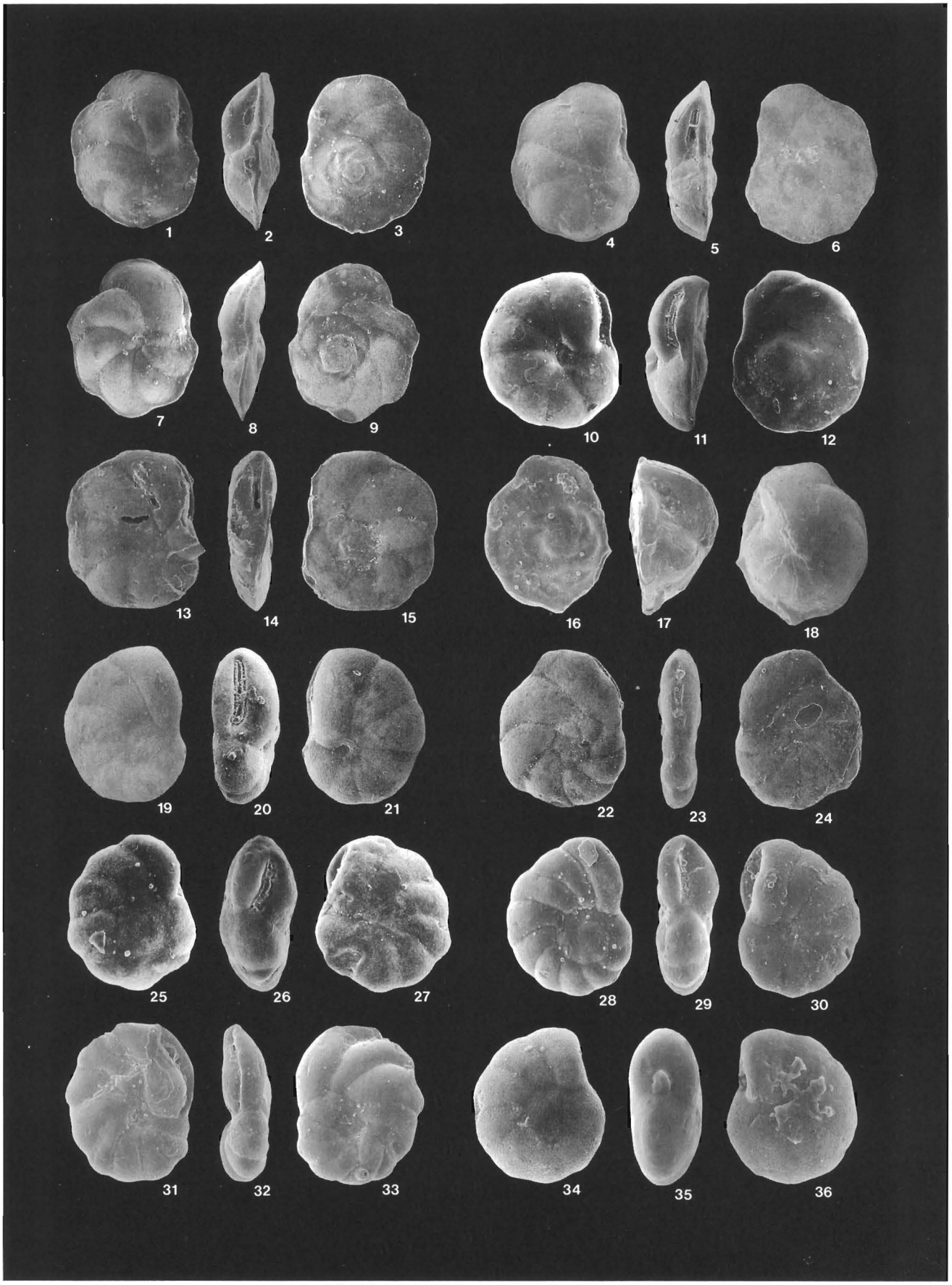
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PLATE 30

Pseudoparrella, Concavella

1-3 *Pseudoparrella californica*, CRC-40267-3, UCMP39237, X100: 1, spiral view; 2, edge view; 3, umbilical view.

4-24 *Pseudoparrella subperuviana*: **4-6**, CRC-40267-3, UCMP39238, X110: 4, spiral view; 5, edge view; 6, umbilical view. **7-9**, CRC-40267-50a, UCMP39239, X102: 7, spiral view; 8, edge view; 9, umbilical view. **10-12**, CRC-40267-38, UCMP39240, X90: 10, spiral view; 11, edge view; 12, umbilical view. **13-15**, GC-15d, UCMP38391, X180: 13, umbilical view; 14, edge view; 15, spiral view. **16-18**, LH-5, UCMP-39241, X120: 16, umbilical view; 17, edge view; 18, spiral view. **19-21**, aberrant specimen, CRC-39842-77, UCMP39242, X150: 19, umbilical view, X201; 20, edge view; 21, spiral view. **22-24**, aberrant specimen, GC-2, UCMP39243, X125: 22, umbilical view; 23, edge view; 24, spiral view.

25-36 *Concavella gyroidinaformis*: **25-27**, immature specimen, CRC-40267-39, UCMP39244, X102: 25, spiral view; 26, edge view; 27, umbilical view. **28-30**, CRC-40267-39, UCMP39245, X55: 28, umbilical view; 29, edge view; 30, spiral view. **31-33**, CRC-40267-39, UCMP39246, X87: 31, umbilical view; 32, edge view; 33, spiral view. **34-36**, CRC-40267-39, UCMP39247, X79: 34, spiral view; 35, edge view; 36, umbilical view.

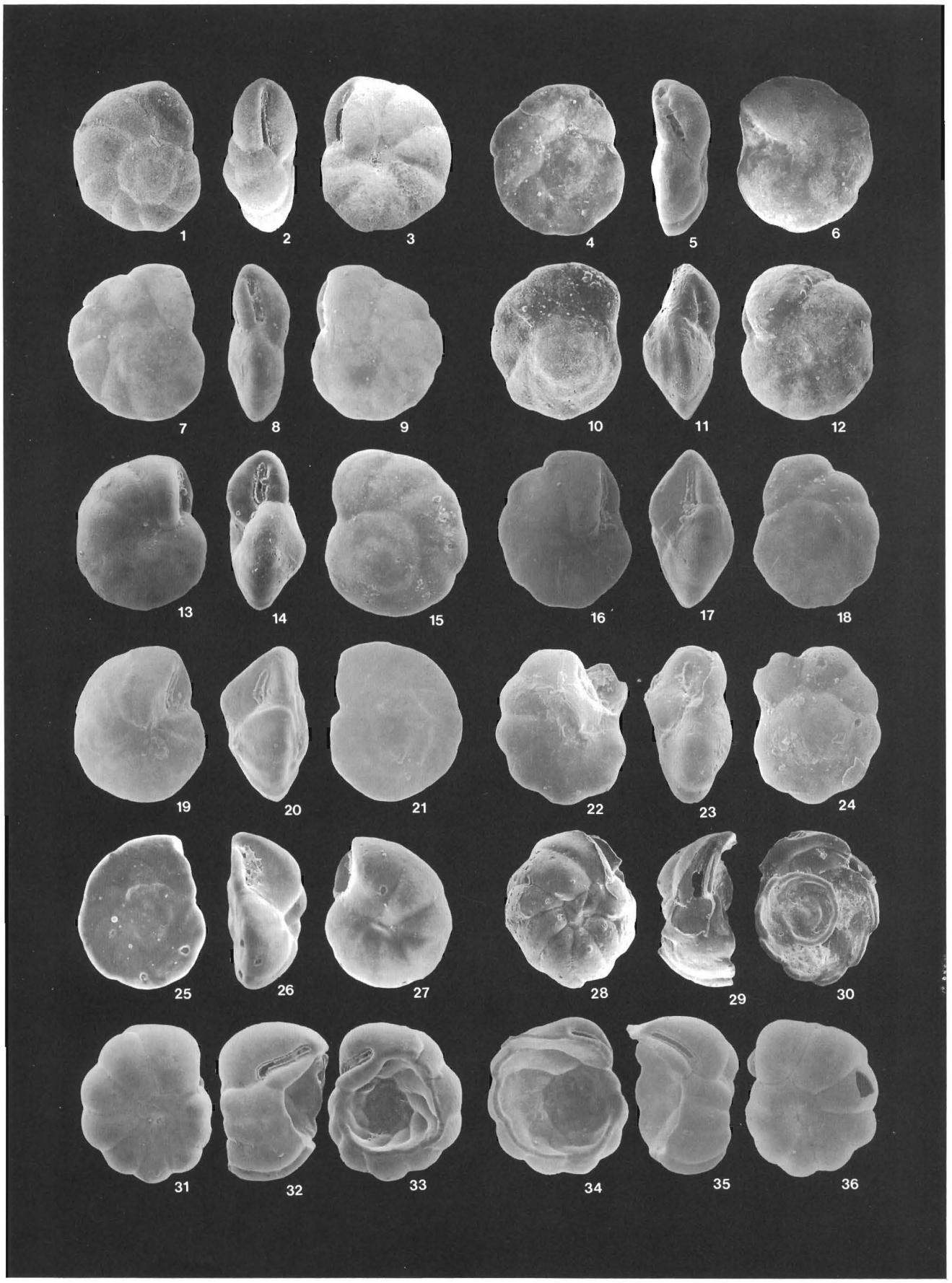
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PLATE 31

Planulina, Cibicides, Cibicidina

1-3 *Planulina* sp., TC-22, UCMP39248, X200: 1, side view; 2, edge view, 3, opposite side view.

4-12 *Cibicides pumilus*: **4-6**, UCLA-6317, UCMP39249, X59: 4, umbilical view; 5, edge view; 6, spiral view. **7-9**, LH-1, UCMP39250, X88: 7, spiral view; 8, edge view; 9, umbilical view. **10-12**, GC-5, UCMP39251, X87: 10, spiral view; 11, edge view; 12, umbilical view.

13-15 *Cibicides* cf. *C. farctus*, UCLA-6317, UCMP39252, X56: 13, spiral view; 14, edge view; 15, umbilical view.

16-18 *Cibicides* sp. D, LH-4, UCMP39253, X62: 16, umbilical view; 17, edge view; 18, spiral view.

19-21 *Cibicides* sp. A, TC-123, UCMP39254, X85: 19, spiral view; 20, edge view; 21, umbilical view.

22-24 *Cibicides* sp. B, TC-158, UCMP39255, X153: 22, umbilical view; 23, edge view; 24, spiral view.

25-30 *Cibicides* sp. C: **25-27**, CRC-40267-50a, UCMP39256, X79: 25, umbilical view; 26, edge view; 27, spiral view. **28-30**, TC-159, UCMP39257, X110: 28, spiral view; 29, edge view; 30, umbilical view.

31-33 *Cibicidina* sp. A, UCLA-6317, UCMP39258, X72: 31, umbilical view; 32, edge view; 33, spiral view.

34-36 *Cibicidina* sp. B, TC-175, UCMP39259, X70: 34, spiral view; 35, edge view; 36, umbilical view.

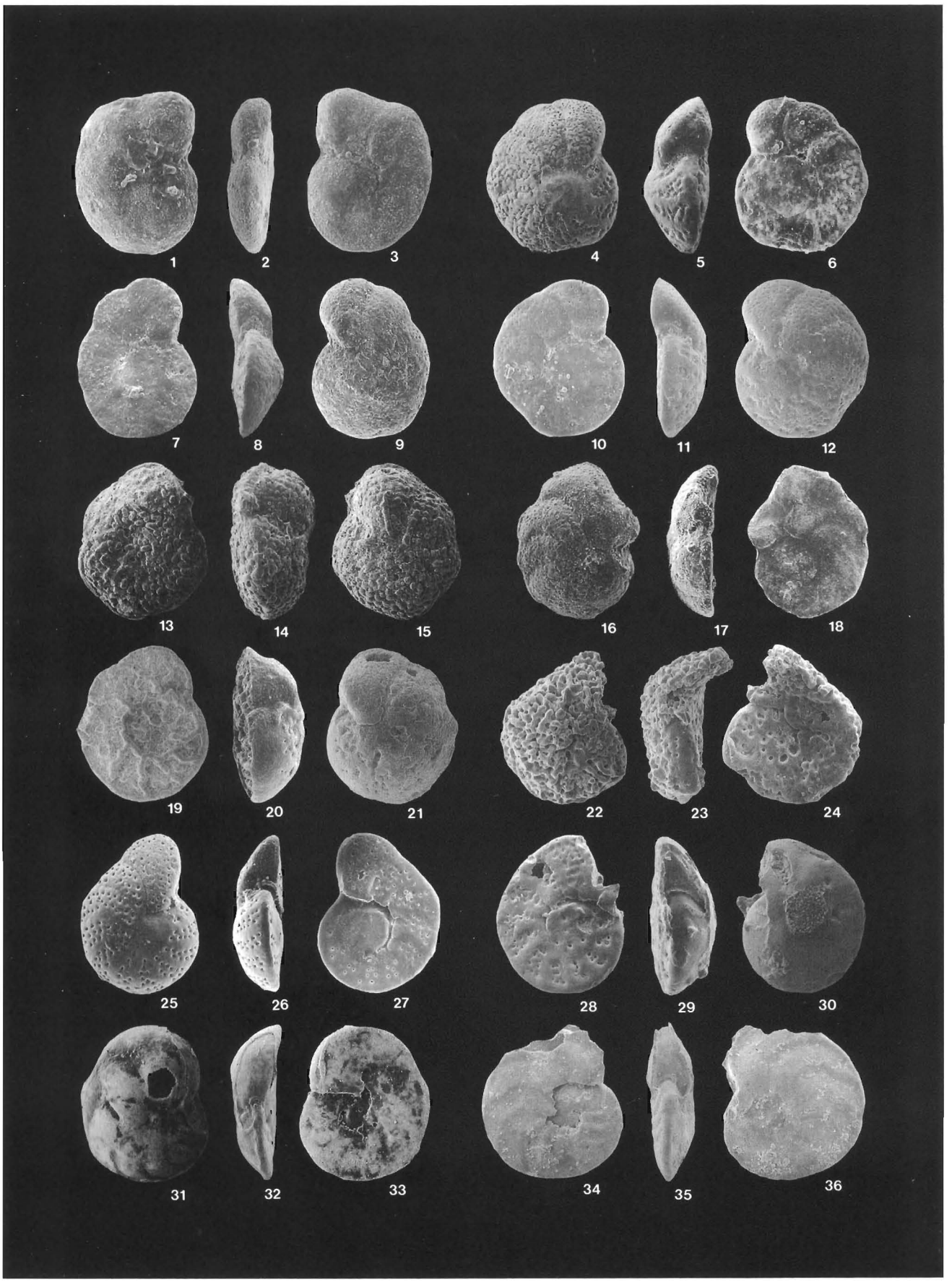
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PLATE 32

Lobatula, Planorbulina, Nonionella, Pseudononion, Nonionellina

1-3 *Lobatula lobatula*, MAR-254, UCMP39260, X65: 1, umbilical view; 2, edge view; 3, spiral view.

4-7 *Planorbulina* sp., fragmented specimens: **4, 5**, GC-3, UCMP38394, X114: 4, spiral view (outer chambers further damaged after taking fig. 5); 5, umbilical view. **6, 7**, GC-3, UCMP39261, X69: 6, spiral view; 7, umbilical view.

8-16 *Nonionella miocenica*: **8-10**, CRC-40267-11, UCMP39262, X85: 8, spiral view; 9, edge view; 10, umbilical view. **11-13**, CRC-42263-8, UCMP39263, X90: 11, umbilical view; 12, edge view; 13, spiral view. **14-16**, GC-15b, lost specimen, X150: 14, spiral view; 15, edge view; 16, umbilical view.

17-23 *Pseudononion basispinatum*: **17, 18**, GC-4, UCMP39264, X95: 17, side view; 18, edge view. **19-21**, MAR-254, UCMP39265, X38: 19, side view; 20, edge view; 21, opposite edge view. **22, 23**, GC-2, UCMP38399, X85: 22, edge view; 23, side view.

24-32 *Pseudononion costiferum*: **24-26**, CRC-40267-33, UCMP39266, X70: 24, umbilical view; 25, edge view. 26, spiral view. **27-29**, MAR-254, UCMP39267, X45: 27, umbilical view; 28, edge view, 29, spiral view. **30**, CRC-40267-36, UCMP39268, spiral view, X50. **31, 32**, GC-15d, UCMP39269, X60: 31, edge view; 32, spiral view.

33-37 *Pseudononion multicameratum*: **33, 34**, immature specimen, CRC-40267-50a, UCMP39270, X112: 33, side view; 34, edge view. **35-37**, CRC-40267-39, UCMP39271, X65: 35, side view; 36, edge view; 37, opposite side view.

38-40 *Pseudononion schencki*, CRC-41367-2, UCMP39272, X75: 38, side view; 39, edge view; 40, opposite side view.

41-45 *Nonionellina milleri*: **41-43**, CRC-40660-4, lost specimen, X90: 41, side view; 42, edge view; 43, opposite side view. **44, 45**, GC-15c, holotype, UCMP38398, X85: 44, edge view; 45, side view.

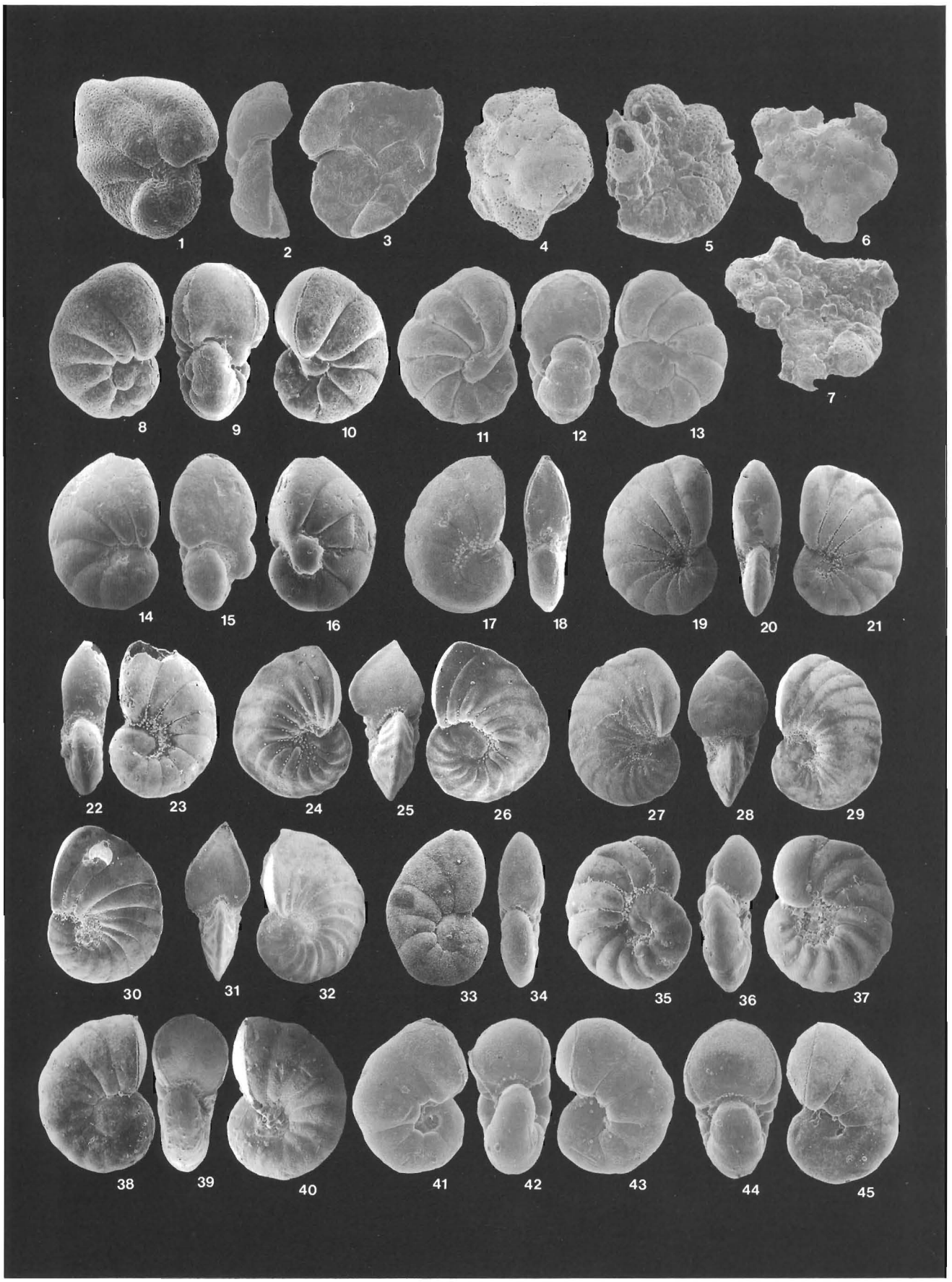
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PLATE 33

Nonionellina, Astrononion

1-12 *Nonionellina milleri*: **1-3**, CRC-40660-4, UCMP39274, X90: 1, side view; 2, edge view; 3, opposite side view. **4-6**, IC-119, UCMP39275, X80: 4, side view; 5, edge view; 6, opposite side view. **7-9**, IC-124, UCMP39276, X80: 7, side view; 8, edge view; 9, opposite side view. **10-12**, IC-124, UCMP39277, X74: 10, side view; 11, edge view; 12, opposite side view.

13-29 *Astrononion goudkoffi*: **13-15**, CRC-40267-50a, UCMP39278, X79: 13, side view; 14, edge view; 15, opposite side view. **16-18**, CRC-40267-3, UCMP39279, X88: 16, side view; 17, edge view; 18, opposite side view. **19-21**, CRC-40267-4, UCMP39280, X85: 19, side view; 20, edge view; 21, opposite side view. **22**, CRC-40267-6, UCMP39281, X79, side view, X201. **23**, CRC-42107-27, UCMP39282, side view, X60. **24, 25**, TC-158, UCMP39283, X175: 24, edge view; 25, side view. **26, 27**, CRC-42107-25, UCMP-39284, X200: 26, edge view; 27, side view. **28, 29**, CRC-39842-54, UCMP39285, X200: 28, edge view; 29, side view.

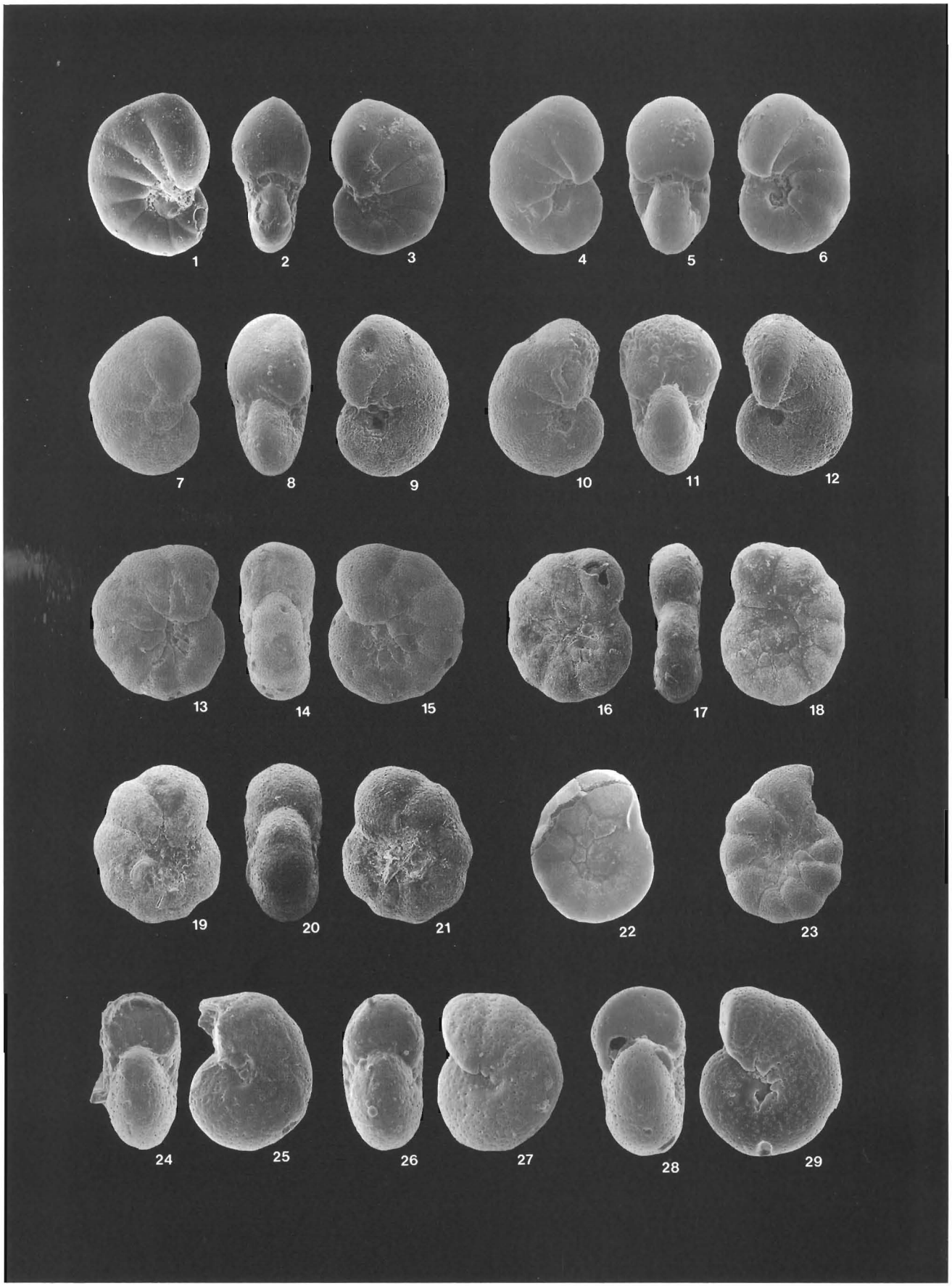
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PLATE 34

Pullenia, Chilostomella, Chilostomina

1-6 *Pullenia inglei*: **1, 2**, CRC-40267-50a, UCMP39286, X150: 1, edge view; 2, side view. **3, 4**, GC-4, holotype, UCMP38439, X65: 3, side view; 4, edge view. **5, 6**, GC-3, UCMP39287, X58: 5, edge view; 6, side view.

7-10 *Pullenia miocenica*: **7, 8**, LH-7, UCMP39288, X55: 7, edge view; 8, side view. **9, 10**, CRC-40267-35, UCMP39289, X69: 9, edge view; 10, side view.

11, 12 *Pullenia salisburyi*, CRC-40267-3, UCMP39290, X94: 11, side view; 12, edge view.

13-16 *Pullenia malkinae*: **13, 14**, CRC-40267-47a, UCMP39291, X45: 13, edge view; 14, side view. **15, 16**, GC-3, UCMP39438, X50: 15, edge view; 16, side view.

17, 18 *Pullenia* sp., CRC-40267-47c, UCMP39292, X50: 17, edge view; 18, side view.

19-28 *Chilostomella ovoidea*: **19**, CRC-40660-4, UCMP39293, side view, X90. **20-22**, CRC40267-47a, UCMP-39294, X50: 20, side view; 21, edge view; 22, side view at 45° to fig. 20. **23-25**, GC-13, lost specimen, X90: 23, side view; 24, edge view; 25, side view at 45° to fig. 23. **26-28**, CRC-40267-35a, UCMP39296, X75: 26, side view; 27, edge view; 28, side view at 45° to fig. 26.

29-35 *Chilostomina pustulosa*: **29-31**, CRC-40267-47a, holotype, USNM388205, X56: 29, umbilical view; 30, spiral view; 31, edge view. **32**, broken specimen, GC-3, UCMP38396, sagittal view, X90. **33-35**, CRC-40267-47a, paratype, USNM388213, X65: 33, spiral view; 34, edge view; 35, umbilical view.

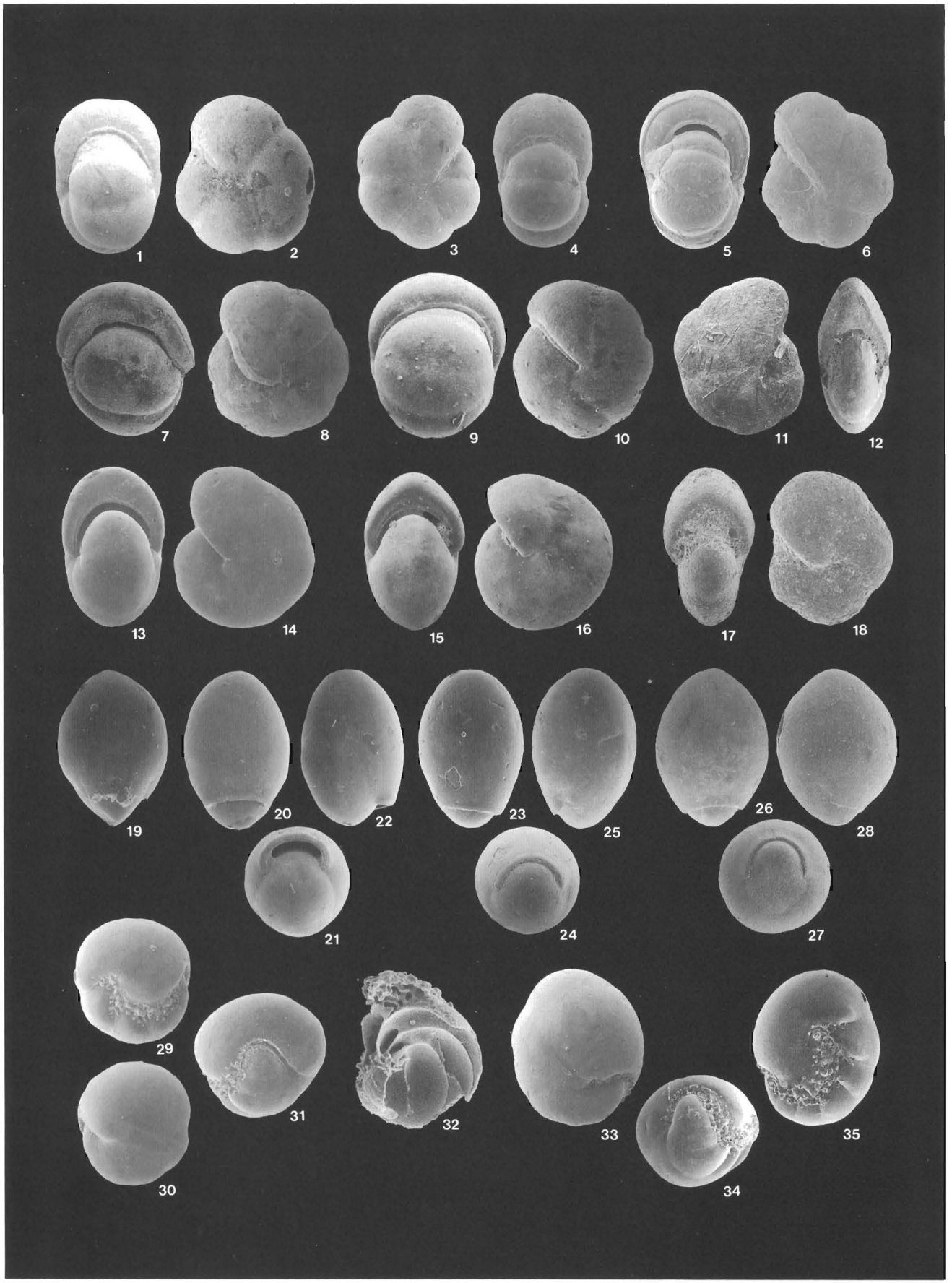
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PLATE 35

Quadrimorphina, Oridorsalis, Evolutononion, Gyroidina, Anomalinoides

1-6 *Quadrimorphina* sp.: **1-3**, CRC-40267-47a, UCMP39297, X75: 1, umbilical view; 2, edge view; 3, spiral view. **4-6**, CRC-40267-47c, UCMP39298, X135: 4, spiral view; 5, edge view; 6, umbilical view.

7-11 *Oridorsalis subtener*: **7, 8**, GC-6, UCMP38428: 7, supplementary aperture, X1500; 8, spiral view, X100. **9-11**, GC-6, UCMP38427, X90: 9, spiral view; 10, edge view; 11, umbilical view.

12-17 *Oridorsalis umbonatus*: **12-14**, CRC-40267-47a, UCMP39299, X78: 12, spiral view; 13, edge view; 14, umbilical view. **15-17**, GC-8, UCMP38429, X113: 15, spiral view; 16, edge view; 17, umbilical view.

18-23 *Oridorsalis relizanus*: **18-20**, CRC-39842-107, UCMP39300, X95: 18, spiral view; 19, edge view; 20, umbilical view. **21-23**, CRC-39842-100, UCMP39301, X117: 21, umbilical view; 22, edge view; 23, spiral view.

24-26 *Evolutononion dumonti*, n. sp., CRC-40267-45a, holotype, UCMP39302, X120: 24, umbilical view; 25, edge view; 26, spiral view.

27-29 *Gyroidina rosaformis*, transitional form grading into *Evolutononion dumonti*, CRC-40267-38, UCMP39303, X98: 27, umbilical view; 28, edge view; 29, spiral view.

30-35 *Anomalinoides salinasensis*: **30-32**, GC-15a, UCMP38408, X62: 30, umbilical view; 31, edge view; 32, spiral view. **33-35**, CRC-40660-14, UCMP39304, X68: 33, umbilical view; 34, edge view; 35, spiral view.

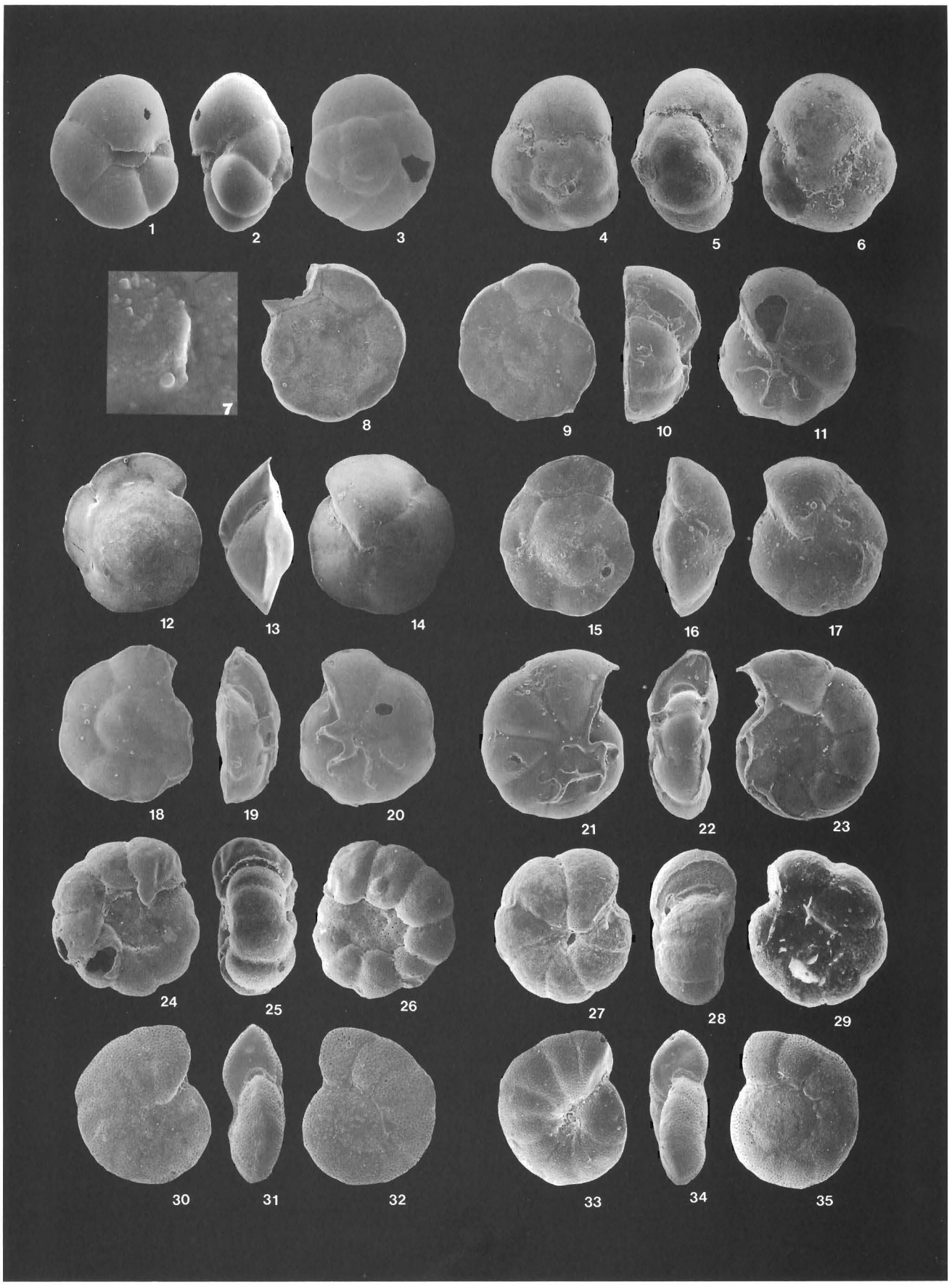
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PLATE 36

Gyroidina

1-6 *Gyroidina healdi*: **1-3**, CRC-40267-39, UCMP39305, X65: 1, umbilical view; 2, edge view; 3, spiral view. **4-6**, GC-11, UCMP38423, X95: 4, umbilical view; 5, edge view; 6, spiral view.

7-9 *Gyroidina* cf. *G. keenani*, TC-227, UCMP39306, X100: 7, spiral view; 8, edge view; 9, umbilical view.

10-21 *Gyroidina rosaformis*: **10-12**, GC-15a, UCMP38424, X150: 10, umbilical view; 11, edge view; 12, spiral view. **13-15**, CRC-40267-35, UCMP39307, X105: 13, umbilical view; 14, edge view; 15, spiral view. **16-18**, CRC-40267-35, UCMP39308, X95: 16, spiral view, X201; 17, edge view; 18, umbilical view. **19-21**, CRC-39842-41, UCMP39309, X125: 19, umbilical view; 20, edge view; 21, spiral view.

22-29 *Gyroidina* aff. *G. rosaformis*: **22-24**, CRC-40267-50a, UCMP39310, X125: 22, umbilical view; 23, edge view; 24, spiral view. **25, 26**, TC-252, UCMP39311, X225: 25, umbilical view; 26, spiral view. **27**, CRC-40660-19, UCMP39312, spiral view, X200. **28, 29**, CRC-40267-47b, UCMP39313, X198: 28, umbilical view; 29, spiral view.

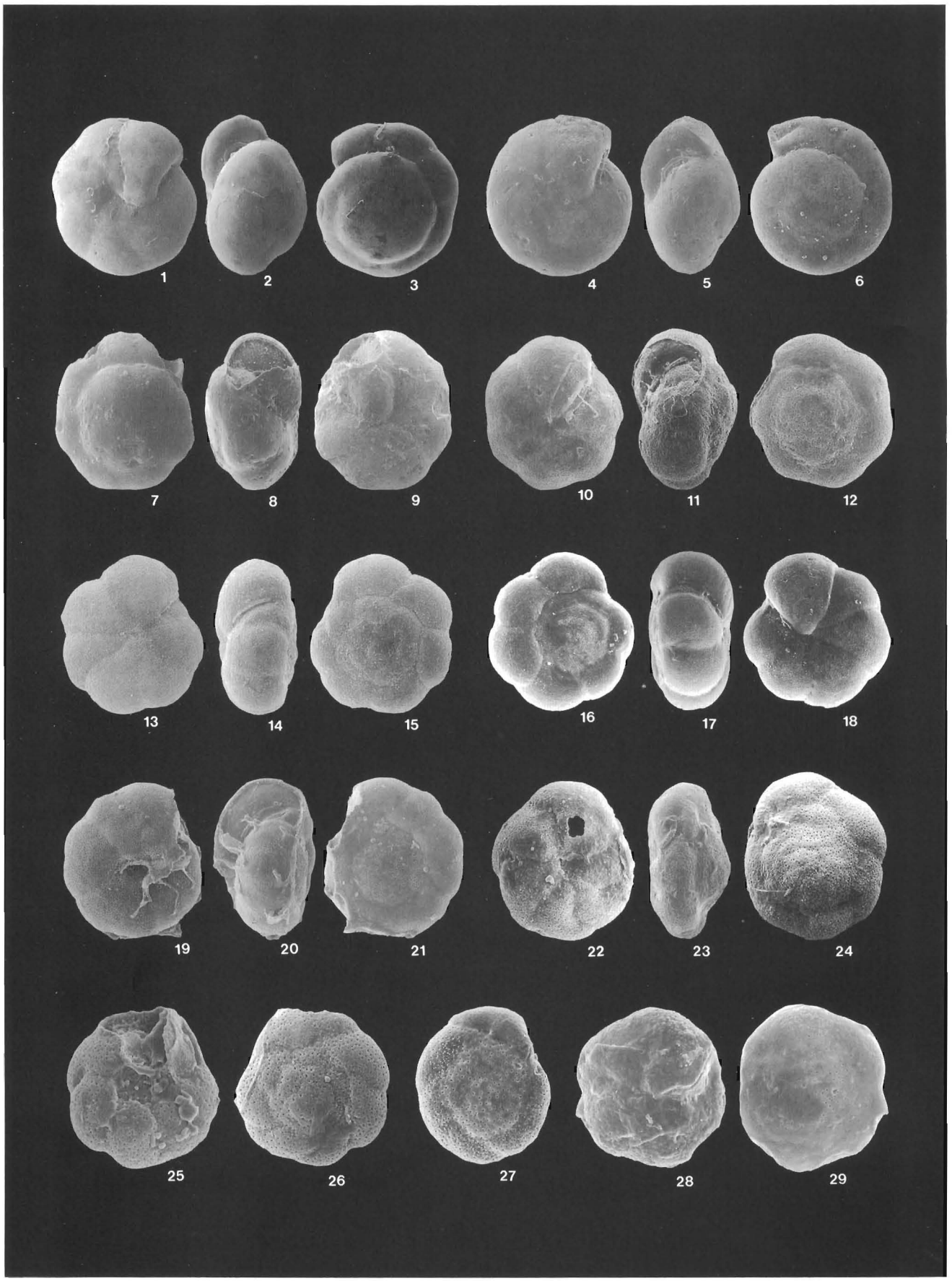
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PLATE 37

Hansenisca, Hanzawaia

1-3 *Hansenisca altiformis*, IC-119, UCMP39314, X60: 1, spiral view; 2, edge view; 3, umbilical view.

4-9 *Hansenisca multicamerata*: **4-6**, CRC-40267-47a, UCMP39315, X70: 4, umbilical view; 5, edge view; 6, spiral view. **7-9**, CRC-40267-50a, UCMP39316, X65: 7, umbilical view; 8, edge view; 9, spiral view.

10-24 *Hansenisca rotundimargo*: **10-12**, CRC-40267-35, UCMP39317, X80: 10, umbilical view; 11, edge view; 12, spiral view. **13-15**, LH-7, UCMP39318, X90: 13, spiral view; 14, edge view; 15, umbilical view. **16-18**, GC-12, lost specimen, X90: 16, spiral view; 17, edge view; 18, umbilical view. **19-21**, diagenetically compressed internal mold, GC-12, UCMP39320, X85: 19, spiral view; 20, edge view; 21, umbilical view. **22-24**, diagenetically compressed internal mold, GC-15a, UCMP38425, X75: 22, spiral view, X201; 23, edge view; 24, umbilical view.

25-38 *Hanzawaia depaoloi*: **25-27**, MAR-254, UCMP39321, X40: 25, spiral view; 26, edge view; 27, umbilical view. **28-30**, GC-9, holotype, UCMP38414, X60: 28, umbilical view; 29, edge view; 30, spiral view. **31**, SCI-L76-43, UCMP39322, spiral view, X33. **32-34**, CRC-40267-46a, UCMP39323, X40: 32, umbilical view; 33, edge view; 34, spiral view. **35-37**, IC-100, UCMP39324, X65: 35, umbilical view; 36, edge view; 37, spiral view. **38**, SCI-L76-43, UCMP39325, spiral view, X33.

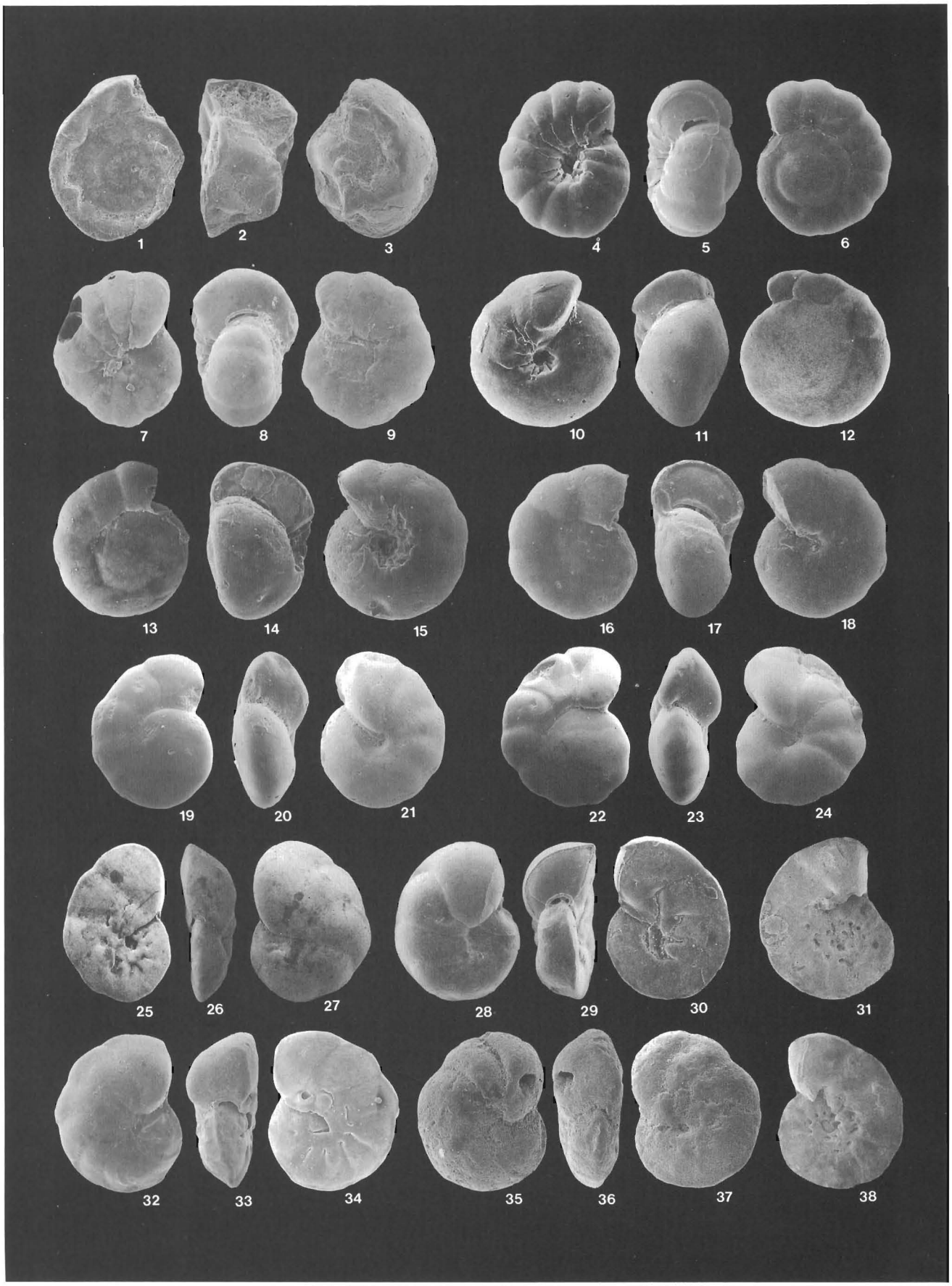
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PLATE 38

Hanzawaia, Holmanella

1-4 *Hanzawaia depaoloi*: **1-3**, CRC-40267-39, UCMP39326, X40: 1, spiral view; 2, edge view; 3, umbilical view. **4**, GC-3, lost specimen, spiral view, X133.

5-7 *Hanzawaia* cf. *H. crassisepta*, GC-14, UCMP38416, X59: 5, umbilical view; 6, edge view; 7, spiral view.

8-28 *Holmanella baggi*: **8, 9**, CRC-40267-6, lost specimen, X53: 8, edge view; 9, side view. **10, 11**, CRC-40267-47a, UCMP39327, X25: 10, side view; 11, edge view. **12, 13**, CRC-40267-39, UCMP39328, X38: 12, side view; 13, opposite side view. **14**, GC-3, UCMP38413, edge view, X97. **15**, GC-3, UCMP38412, edge view, X110. **16, 17**, CRC-40660-14, UCMP39329, X56: 16, side view; 17, opposite side view. **18-20**, GC-4, UCMP38411, X57: 18, side view; 19, edge view; 20, opposite side view. **21**, CRC-40267-6, UCMP39330, side view, X53. **22, 23**, SCI-L76-43, UCMP39331, X40: 22, side view; 23, edge view. **24-26**, immature specimen, CRC-40267-39, UCMP39332, X61: 24, side view; 25, edge view; 26, other side view. **27**, immature specimen, CRC-40267-43, UCMP39333, side view, X150. **28**, immature specimen (lost), CRC-40267-35, side view, X116.

29-36 *Holmanella valmonteensis*: **29-31**, immature specimen, CRC-40267-50, UCMP39334, X82: 29, side view; 30, edge view; 31, opposite side view. **32, 33**, CRC-40267-50a, UCMP39335, X45: 32, edge view; 33, side view. **34-36**, CRC-40267-50a, UCMP38795, X30: 34, side view; 35, edge view; 36, opposite side view.

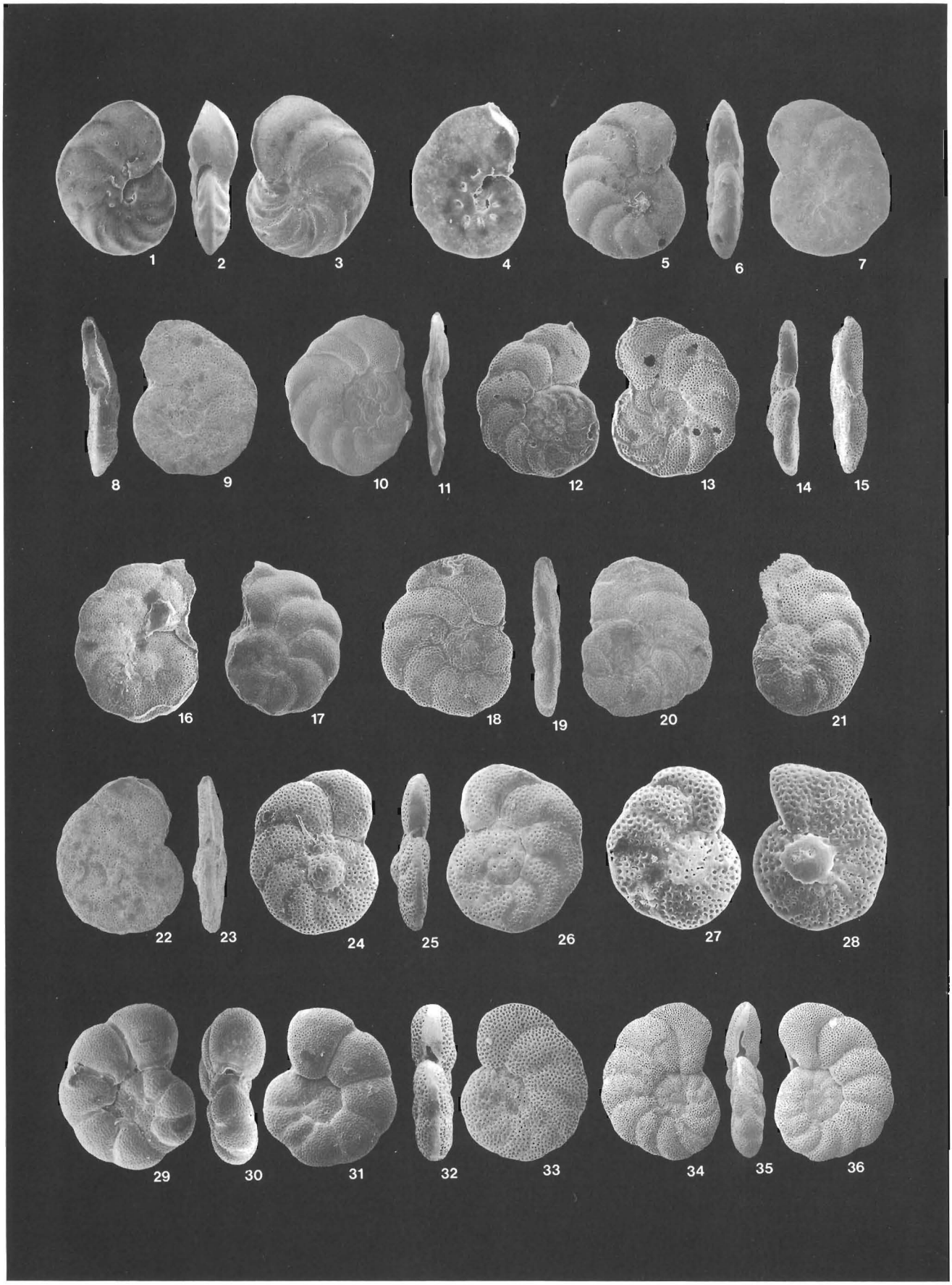
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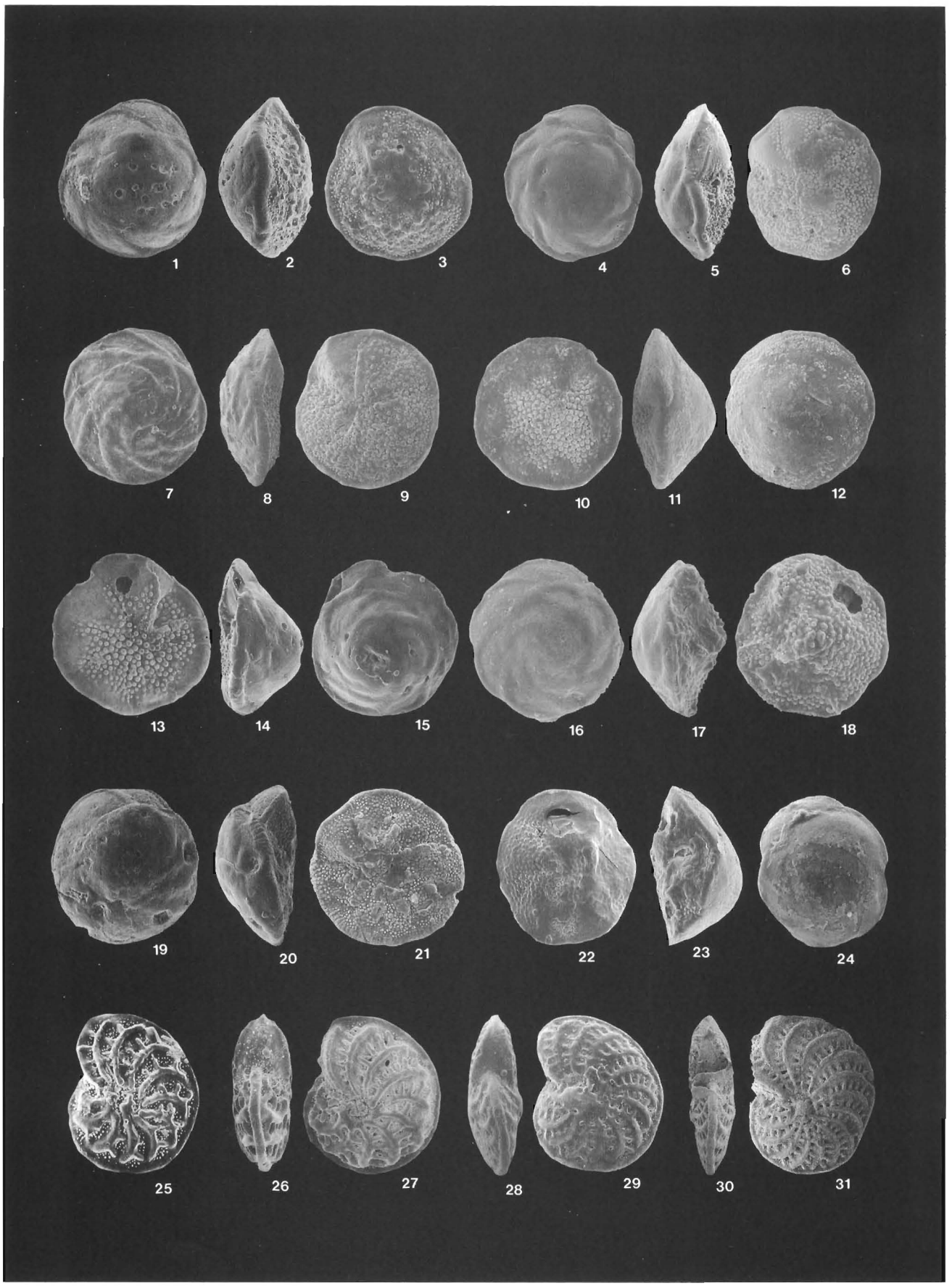
PLATE 39

Buccella, Elphidium

1-24 *Buccella oregonensis*: **1-3**, GC-5, UCMP38384, X115: 1, spiral view; 2, edge view; 3, umbilical view. **4-6**, CRC-40267-34, UCMP38823, X133: 4, spiral view; 5, edge view; 6, umbilical view. **7-9**, UCLA-6317, UCMP38824, X85: 7, spiral view; 8, edge view; 9, umbilical view. **10-12**, LH-4, UCMP38836, X175: 10, umbilical view; 11, edge view; 12, spiral view. **13-15**, SCI-L76-40, UCMP39109, X150: 13, umbilical view; 14, edge view; 15, spiral view. **16-18**, GC-15d, UCMP39115, X210: 16, spiral view; 17, edge view; 18, umbilical view. **19-21**, TC-223, UCMP39150, X133: 19, spiral view; 20, edge view; 21, umbilical view. **22-24**, CRC-40267-7, UCMP39154, X144: 22, umbilical view; 23, edge view; 24 spiral view.

25-31 *Elphidium granti*: **25**, immature specimen, CRC-42107-31, UCMP39264, side view, X120. **26, 27**, GC-15a, UCMP38393, X190: 26, edge view; 27, side view. **28, 29**, UCLA-6317, UCMP39295, X70: 28, edge view; 29, side view. **30, 31**, MAR-254, UCMP39319, X55: 30, edge view; 31, side view.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