

28. REDEPOSITED AND/OR REWORKED LARGER BENTHIC FORAMINIFERA FROM MIOCENE DEBRIS FLOWS, BLAKE-BAHAMA BASIN (WESTERN NORTH ATLANTIC), DEEP SEA DRILLING PROJECT LEGS 44 (SITE 391) AND 76 (SITE 534)¹

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ABSTRACT

A detailed inventory is presented of the larger, shallow-water benthic Foraminifera incorporated in the calcareous allochthonous material that has been redeposited or reworked in the deep sediments of the Blake-Bahama Basin during the lower to middle Miocene.

INTRODUCTION

At Sites 391 and 534, located in the deep part of the Blake-Bahama Basin, drilling penetrated peculiar Miocene sediments; these rocks are mainly characterized by the occurrence of allochthonous, frequently calcareous, material, which has been introduced into a "background" pattern of sedimentation represented by siliceous mudstones thought to be deposited below the CCD (carbonate compensation depth).

Processes and possible mechanisms of this type of sedimentation (debris flows, turbidites) have been recently extensively investigated (Benson, Sheridan et al., 1978; Bliefnick et al., this volume). Among the calcareous allochthonous material, more or less abundant and medium to relatively well preserved planktonic and benthic Foraminifera have been depicted. Benthic forms appeared to be mostly represented by larger, shallow-water specimens. In Sites 391 and 534 reports, this neritic material has only been briefly mentioned. Using several hundred thin, nonoriented sections, our work attempts a more precise identification at the generic and, as often as possible, specific, level of a maximum of taxa. A comparative analysis of the resulting various stratigraphical ranges may enable us to better discriminate between the respective influences of the redeposition and reworking processes.

SITE 391

With samples from this Site we have investigated in more detail several levels containing the richest faunas of larger foraminifers, principally observed in Hole 391A, Core 12. According to Benson, Sheridan et al. (1978), this core belongs to the bottom part of their lithologic Subunit 2d, of the middle to lower Miocene.

Sample 391A-12-3, 19-23 cm This sample yielded *Lepidocyclina* (*Eulepidina*) *undosa*, *L. (Neolepidina)* cf.

pustulosa, *L. (Lepidocyclina)* cf. *miraflourensensis*, *Heterostegina* sp., *Amphistegina* sp. gr., *lessonii* and indet. *Miogypsinidae*. With the exception of *L. (Neolepidina)* *pustulosa* of the upper middle and upper Eocene, and therefore reworked, all the other macroforaminifers observed in this sample may have been contemporaneous with the *in situ* fauna, that is, they were probably redeposited.

Sample 391A-12-3, 66-69 cm yielded *Miogypsina* sp., *Heterostegina* sp., *Sphaerogypsina* sp., *Amphistegina* sp. gr. *lessonii*, all probably redeposited, and *Asterocyclina* sp. (middle and upper Eocene), reworked.

Sample 391A-12-5, 6-11 cm yielded *Lepidocyclina* (*Lepidocyclina*) *canellei*, *L. (Lepidocyclina)* *giraudi*, *Miogypsina* (*Miogypsina*) sp., *Amphistegina* sp., *Nummulites* (s.l.) sp., probably redeposited, and *Asterocyclina* sp. and *Fabiania cassis* (middle and upper Eocene), reworked.

Sample 391A-12-5, 41-46 cm yielded *Lepidocyclina* (*Lepidocyclina*) *canellei* and *Amphistegina* sp., probably redeposited.

Sample 391A-12-5, 48-51 cm yielded *L. (Lepidocyclina)* *canellei*, *Miogypsina* (*Miogypsina*) sp., *Amphistegina* sp., *Nummulites* sp., probably redeposited, and *L. (Neolepidina)* *macdonaldi* (upper Eocene) and *Vaughanina* sp. (upper Senonian), reworked.

Sample 391A-12-5, 52-55 cm yielded *L. (Lepidocyclina)* *giraudi*, *L. (Lepidocyclina)* *miraflourensensis*, *Miogypsina* (*Heterosteginoides*) sp., *Nummulites* sp., *Heterostegina* sp., *Sphaerogypsina* sp., *Amphistegina* sp., probably redeposited, and *L. (Nephrolepidina)* *chaperi*, *L. (Neolepidina)* *macdonaldi*, *Fabiania cassis*, and *Asterocyclina* sp., (middle and upper Eocene), reworked.

SITE 534

At this Site, Cores 534A-7, 10, 13, and 17 particularly have shown levels containing rich and allochthonous faunas of macroforaminifers (Site 534 report, this volume). By lithological correlation, these cores have been attributed to the Great Abaco Member of the Blake Ridge For-

¹ Sheridan, R. E., Gradstein, F. M., et al., *Init. Repts. DSDP, 76*: Washington (U.S. Govt. Printing Office).

mation and are thought to be approximately equivalent to similar units, which had already been penetrated at Site 391 (and there referred as Subunits 2d and 2e, Benson, Sheridan, et al., 1978). As a result of a combined biostratigraphical analysis of Site 534 foraminifers and nanofossils (Site 534 report, this volume), the interval comprising Cores 534A-7 to 17 has been assigned to the lower Miocene.

Sample 534A-7-1, 54-59 cm yielded *Lepidocyclina* (*Lepidocyclina*) *canellei*, *L. (Lepidocyclina) miraflorensis*, *Amphistegina* sp. gr. *lessonii*, *Miogypsina* (*Miogypsina*) sp., *Sphaerogypsina* sp., probably redeposited, and *Helicolepidina nortoni* (middle and upper Eocene) and *Vaughanina* sp. (upper Senonian), reworked.

Sample 534A-7-1, 60-63 cm yielded *L. (Lepidocyclina) canellei*, *L. (Lepidocyclina) cf. yurnagunensis*, probably redeposited.

Sample 534-10-4, 66-71 cm yielded *L. (Lepidocyclina) canellei*, *Lepidocyclina* sp., *Amphistegina* sp. gr. *lessonii*, *Miogypsina* (*Miogypsina*) sp., *Heterostegina* sp., probably redeposited.

Sample 534A-13-1, 86-88 cm yielded *L. (Lepidocyclina) canellei*, *Miogypsina* sp., *Amphistegina* sp., probably redeposited.

Sample 534A-13-1, 137-141 cm yielded *L. (Lepidocyclina) canellei*, *Heterostegina* sp., probably redeposited, and *L. (Neolepidina) macdonaldi* (upper Eocene), reworked.

Sample 534A-13-2, 78-82 cm yielded *Heterostegina cf. antillea*, probably redeposited.

Sample 534A-17-7, 10-15 cm yielded *L. (Lepidocyclina) canellei*, *L. (Lepidocyclina) miraflorensis*, *L. (Lepidocyclina) waylandvaughani*, *L. (Lepidocyclina) giraudi*, *L. (Lepidocyclina) cf. yurnagunensis*, *L. (Eulepidina) undosa*, *Miogypsina* sp., *Nummulites* sp., probably redeposited, and indet. *Discocyclinidae* (Paleocene-Eocene), reworked.

Sample 534A-17-7, 16-18 cm yielded *L. (Lepidocyclina) canellei*, *L. (Lepidocyclina) giraudi*, *Amphistegina* sp. gr. *lessonii*, *Miogypsinoidea* sp., *Heterostegina* sp., probably redeposited, and *L. (Neolepidina) macdonaldi*, *L. (Neolepidina) pustulosa pustulosa*, *Dictyoconus floridanus*, and *Asterocyclina* sp., (middle and upper Eocene), reworked.

Sample 534A-17-7, 28-30 cm yielded *L. (Lepidocyclina) canellei*, *L. (Eulepidina) cf. undosa*, *Heterostegina cf. antillea*, indet. *Miogypsinidae*, probably redeposited.

Sample 534A-17-7, 32-35 cm yielded *L. (Lepidocyclina) canellei*, *L. (Lepidocyclina) giraudi*, *Heterostegina antillea*, *H. panamensis*, *Nummulites* sp., *Miogypsina* sp., *Sphaerogypsina* sp., *Amphistegina* sp., probably redeposited, and *L. (Neolepidina) macdonaldi*, *L. (Neolepidina) pustulosa pustulosa*, *Fabiania cassis*, *Dictyoconus floridanus*, and *Asterocyclina* sp. (middle and upper Eocene), reworked.

Sample 534A-17, CC yielded *L. (Lepidocyclina) canellei*, *L. (Lepidocyclina) giraudi*, *L. (Lepidocyclina) miraflorensis*, *L. (Lepidocyclina) cf. yurnagunensis*, *L. (Eulepidina) undosa*, *L. (Polylepidina) antillea*, *Heterostegina antillea*, *H. panamensis*, *Miogypsina* sp., *Mio-*

gypsinoides sp., *Amphistegina parvula*, *A. sp. gr. lessonii*, *Amphistegina* sp., *Nummulites* sp., probably redeposited, and *L. (Neolepidina) pustulosa pustulosa*, *L. (Neolepidina) macdonaldi*, *L. (Nephrolepidina) chapleri*, *Asterocyclina minima*, *Asterocyclina* sp., *Fabiania cassis*, (middle and upper Eocene), reworked.

REDEPOSITION AND REWORKING: POSSIBLE ORIGIN OF THE ALLOCHTHONOUS SHALLOW-WATER BENTHIC MATERIAL

The most significant result derived from our observations is that an important part of the shallow-water macroforaminifers are of the early Miocene, that is, they are contemporaneous with the younger age given by the presumably "in situ" (or possibly also transported, see Benson, Sheridan, et al., 1978) accompanying pelagic microfauna.

This result may suggest that part of the neritic organisms have been transported from the inner continental shelf, for instance, by turbidite and/or combined turbidite-debris flow processes, and redeposited in the deep sediments of the Blake-Bahama Basin.

However, erosion and faunal reworking are also indicated by the simultaneous occurrence, in the studied material, of macroforaminifers of an older age, most often middle to upper Eocene, more rarely upper Senonian. There is no peculiar evidence that the amount of reworked specimens increases downward or upward. This parameter does appear to be better linked with the variations of intensity of the erosional processes.

Benson, Sheridan, et al., (1978) suggested the Bahama channels, where shallow marine Tertiary sediments crop out, as a possible source of the allochthonous shallow-water benthic forms. We may also note that assemblages of redeposited and reworked macroforaminifers, which have been observed in the lower Miocene sediments penetrated at Sites 391 and 534, are very similar to those described from neighboring areas, like Florida, Georgia, the Gulf Coast, and the Greater Antilles (particularly Cuba and Haiti) (Cole 1938, 1941-1945, 1964, 1967; Cole and Applin, 1961, 1964; Drooger, 1952; Akers and Drooger, 1957; Butterlin, 1981).

ACKNOWLEDGMENTS

The authors wish to express their gratitude to their colleagues Dr. Gérard Bignot, Dr. Alphonse Blondeau, and Dr. Claude Lorenz (University of Paris VI, France), who kindly reviewed this manuscript. Dr. Moullade thanks DSDP for inviting him to participate in Leg 76 and providing additional samples, and the Centre National pour l'Exploitation des Océans (CNEXO), which provided assistance for travel expenses. Financial support for this investigation was furnished by the Centre National de la Recherche Scientifique (CNRS) under Grant "A.T.P. Géologie-Géophysique des Océans" No. 096.

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Date of Initial Receipt: October 27, 1982

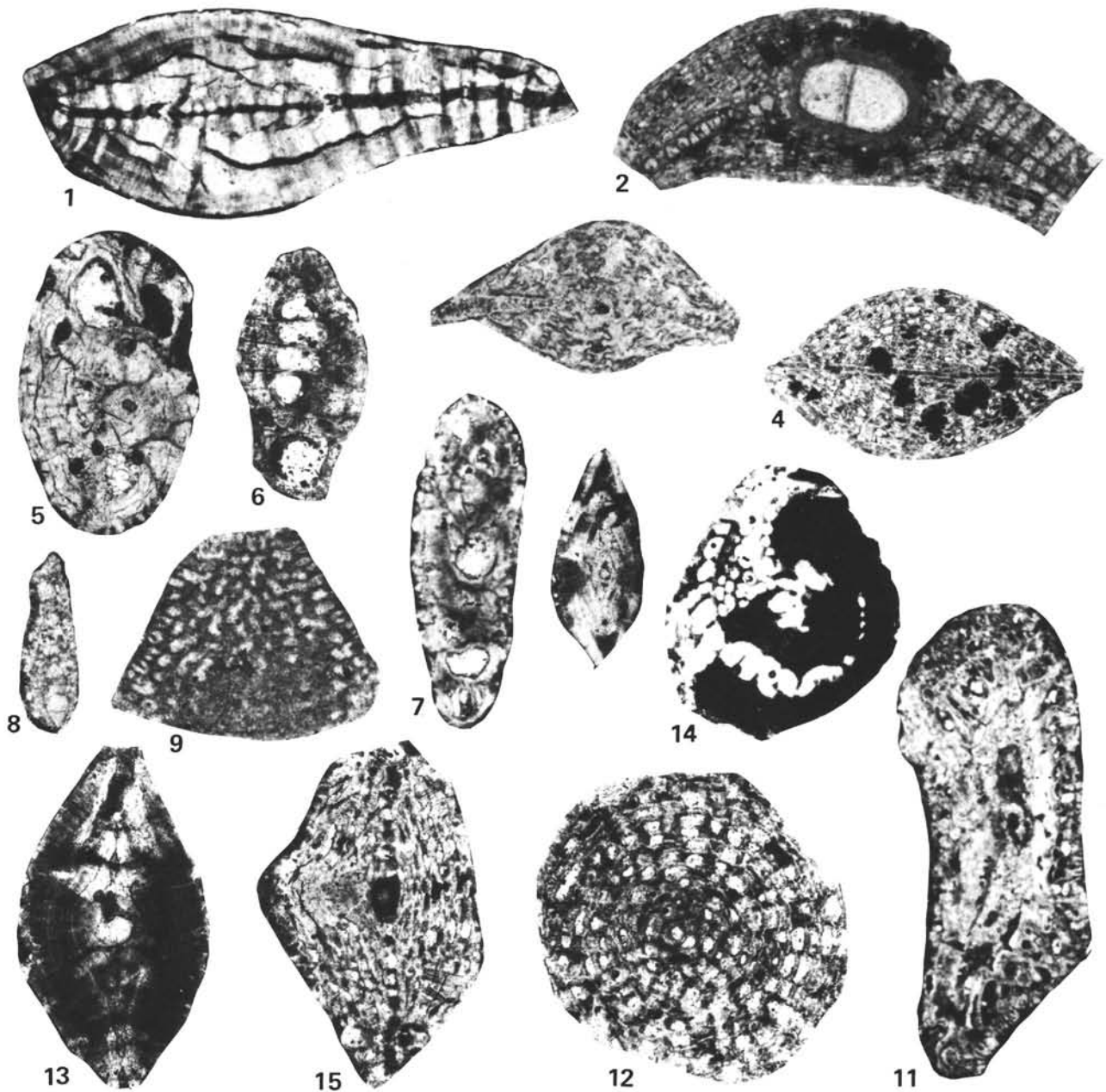


Plate 1. Larger benthic Foraminifera from Miocene debris flows. (All specimens with the exception of Figs. 1, 2, 8-11, and 14 are magnified $\times 40$.)
 1. *Heterostegina* cf. *antillea* Cushman, $\times 17$, subaxial section. Sample 534A-13-2, 78-82 cm. 2. *Lepidocyclina* (*Lepidocyclina*) *miraflorensis* Vaughan, $\times 26$, axial section. Sample 391A-12-5, 52-55 cm. 3. *Vaughanina* sp. subaxial section. Sample 391A-12-5, 48-51 cm. 4. *Asterocyclina* sp. subaxial section. Sample 391A-12-5, 52-55 cm. 5-7. *Miogypsinoides* sp. (5) subequatorial section. Sample 534A-17,CC. (6) Axial section. Sample 534A-17-7, 16-18 cm. (7) Axial section. Sample 534A-17,CC. 8. *Miogypsina* (*Miogypsina*) sp., $\times 17$, axial section. Sample 534A-17-7, 32-35 cm. 9. *Dictyoconus floridanus* (Cole), $\times 26$, subaxial section. Sample 534A-17-7, 32-35 cm. 10. *Amphistegina* sp., $\times 17$, axial section. Sample 534A-17-7, 32-35 cm. 11. *Fabiania cassis* (Oppenheim), $\times 26$, transverse section. Sample 534A-17,CC. 12. *Sphaerogypsina* sp., radial section. Sample 534A-7-1, 54-59 cm. 13. *Heterostegina panamensis* Gravell, axial section. Sample 534A-17-7, 32-35 cm. 14. *Heterostegina* cf. *antillea* Cushman, $\times 17$, subequatorial section. Sample 534A-17,CC. 15. *Helicolepidina nortoni* Vaughan, subaxial section. Sample 534A-7-1, 54-59 cm.

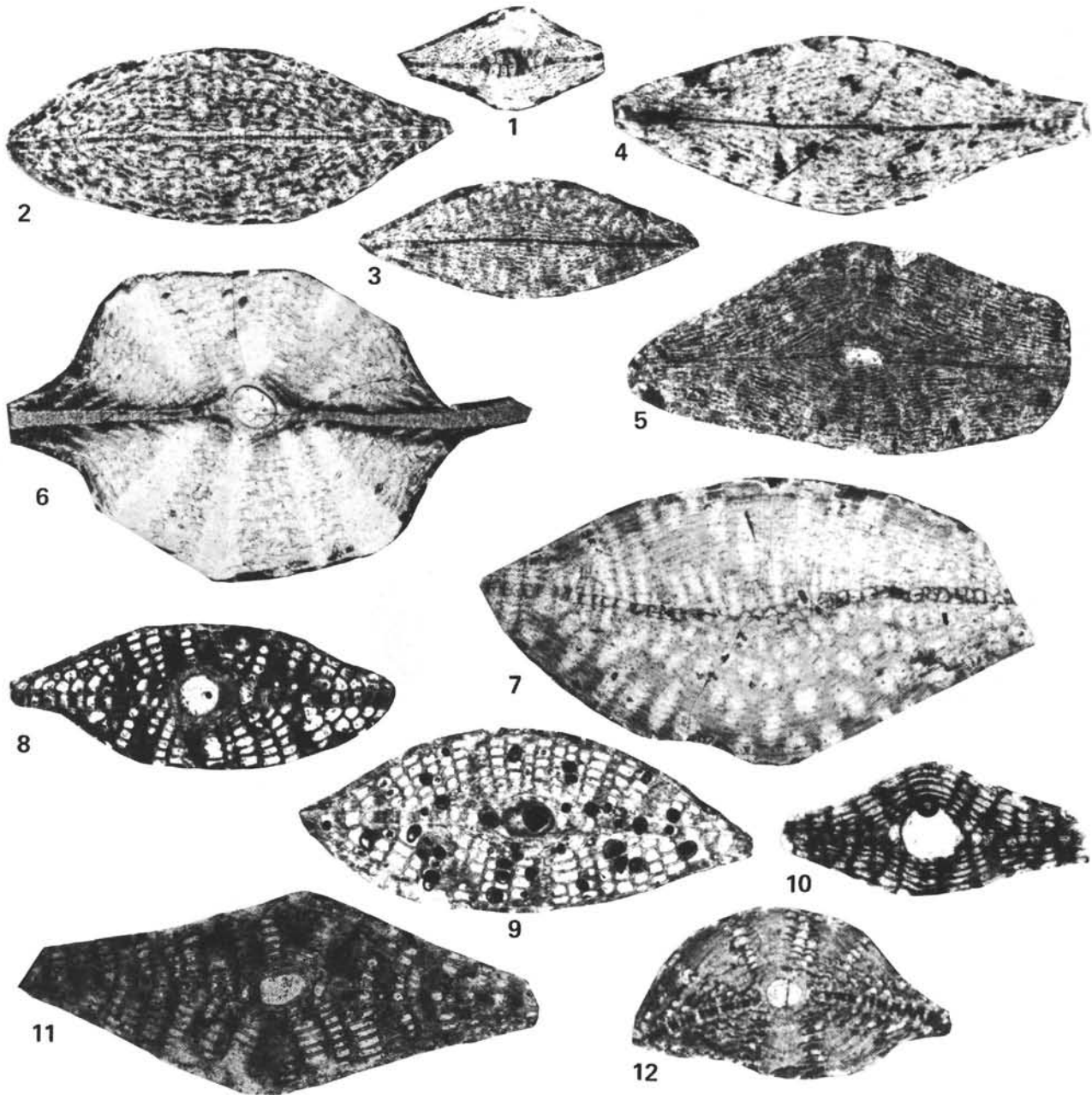


Plate 2. Larger benthic Foraminifera from Miocene debris flows. (All specimens with the exception of Figs. 3, 6-7, 10, and 12 are magnified $\times 40$.) 1-4, ?5. *Asterocyclina* sp., subaxial sections. (1-3) Sample 534A-17-7, 32-35 cm (Fig. 3, $\times 26$). (4) Sample 534A-17-7, 16-18 cm. (5) Sample 534A-17,CC. 6-7. *Lepidocyclina* (*Eulepidina*) *undosa* Cushman, $\times 17$, subaxial sections. Sample 534A-17,CC. 8-9. *Lepidocyclina* (*Lepidocyclina*) *canellei* Lemoine and Douvill , axial sections (8) Sample 534A-17-7, 10-15 cm. (9) Sample 534A-17,CC. 10-11. *Lepidocyclina* (*Lepidocyclina*) cf. *yurnagunensis* Cushman, axial sections. Sample 534A-17,CC. (Fig. 10, $\times 26$). 12. *Lepidocyclina* (*Lepidocyclina*) *giraudi* Douvill , subaxial section, $\times 26$. Sample 534A-17-7, 32-35 cm.

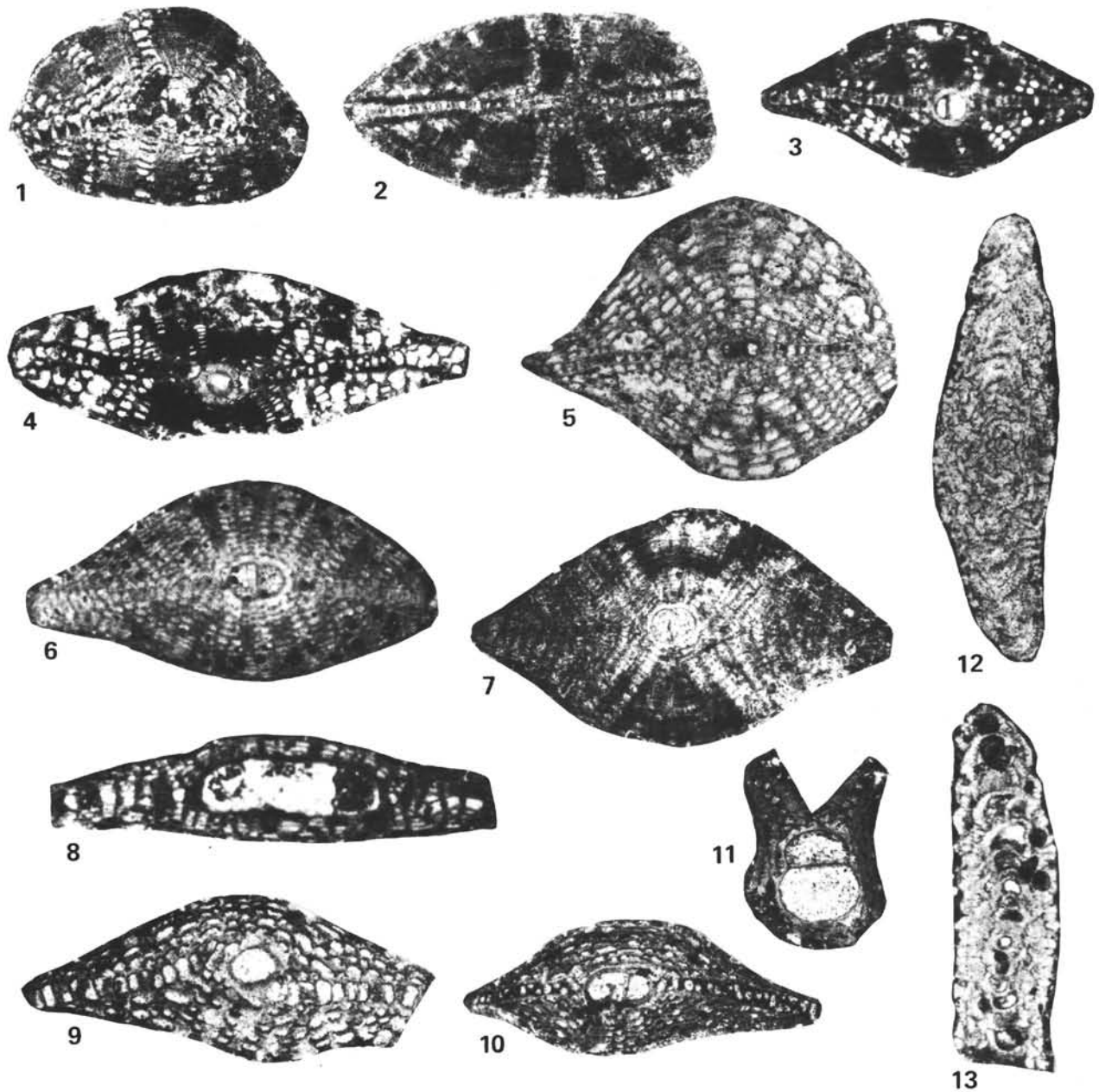


Plate 3. Larger benthic Foraminifera from Miocene debris flows. (All specimens with the exception of Figs. 8 and 11-13 are magnified $\times 26$.)
 1-3. *Lepidocyclina* (*Lepidocyclina*) *giraudi* Douvillé (1-2) subaxial sections. Sample 534A-17-7, 32-35 cm. (3) Axial section. Sample 534A-17-7, 16-18 cm. 4. *Lepidocyclina* (*Lepidocyclina*) *miraflorensis* Vaughan, subaxial section. Sample 534A-7-1, 54-59 cm. 5-7. *Lepidocyclina* (*Neolepidina*) *pustulosa pustulosa* Douvillé (5) axial section. Sample 534A-17-7, 16-18 cm. (6) Axial section. Sample 534A-17,CC. (7) Axial section. Sample 534A-17-7, 32-35 cm. 8. *Lepidocyclina* (*Nephrolepidina*) *chaperi* Lemoine and Douvillé, $\times 17$, axial section. Sample 534A-17,CC. 9-11. *Lepidocyclina* (*Neolepidina*) *macdonaldi* Cushman (9-10) axial sections. Sample 534A-17-7, 32-35 cm. (11) Embryonic zone, $\times 17$. Sample 534A-17-7, 16-18 cm. 12-13. *Gypsina vesicularis* (Parker and Jones), $\times 40$, axial sections. (12) Sample 534A-17-7, 32-35 cm. (13) Sample 534A-17,CC.