12. CENOZOIC PLANKTONIC FORAMINIFERAL BIOSTRATIGRAPHY OF THE SOUTHWESTERN PACIFIC AND TASMAN SEA—DSDP LEG 29

D. Graham Jenkins, Geology Department, University of Canterbury, Christchurch, New Zealand

ABSTRACT

A description is given of the Cenozoic planktonic foraminifera obtained from 10 sites of DSDP Leg 29. The New Zealand Cenozoic planktonic foraminiferal zonal scheme was used with only slight modifications; these are discussed. Brief comments are made on selected taxa.

INTRODUCTION

Drilling operations by *Glomar Challenger* on Leg 29 of the Deep Sea Drilling Project, undertaken during March-April 1973, yielded 1181 meters of sediment from 16 holes at 10 sites (Figure 1). This report is concerned with the Cenozoic planktonic foraminifera obtained from the sites, with emphasis on the biostratigraphic zonation, and a comparison of some of the taxa with records published in Australia and New Zealand. An account of the planktonic foraminifera for each site is given in the Site Report chapters (this volume).

This study of samples was undertaken for the following purposes; (a) determination of the total planktonic foraminiferal fauna; (b) age resolution of the samples into the established New Zealand zonal scheme; and (c) accurate resolution of zonal boundaries.

Procedures

Samples were washed on a 230-mesh sieve, dried, and sieved into fine, medium, and coarse fractions. Normally, each core-catcher sample was examined. In order to determine the positions of the zonal boundaries, examination was also made of numerous intermediate samples until the boundary was resolved between the closest two samples. Two samples per core section were taken for examination to position the zonal boundaries. Once a boundary had been determined, only the faunas from the two samples approximating the boundary were normally recorded in addition to the core-catcher samples (Tables 1-6).

Most of the taxa encountered on Leg 29 have previously been recorded and illustrated from Australia (Jenkins, 1966) and New Zealand (Jenkins, 1971).

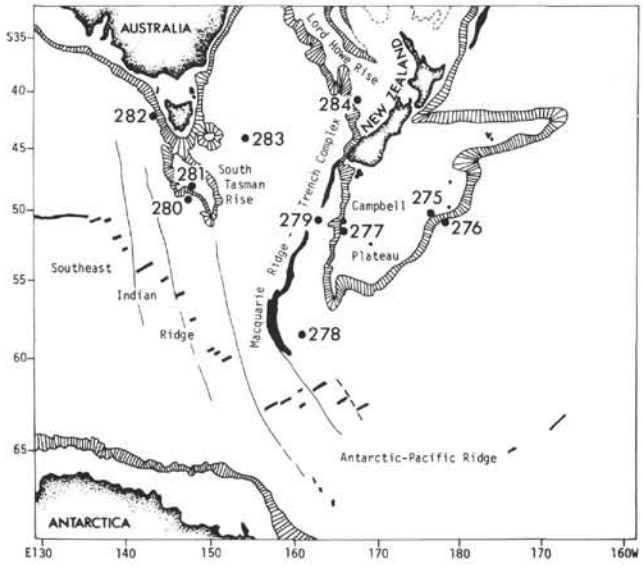


Figure 1. *Location of sites drilled during DSDP Leg 29.*

ZONAL SCHEME

It was apparent before Leg 29 began that the New Zealand Cenozoic planktonic foraminiferal zonal scheme would probably be workable to the south of New Zealand. The problem remained as to how far south the scheme would work before the faunas became radically changed. This working hypothesis remained true for all sites except at the southernmost Site 278 at 55°33′S. Unfortunately the water depth at Site 278 was so great during the Oligocene-Pleistocene, compared with the present depth of 3698 meters, that most of the planktonic foraminiferal tests had probably gone into solution. Thus, Site 278, because of extreme water depth, is not regarded as a true test for the zonal scheme at this latitude, and because of the dissolution of tests, three informal zones were used to cover the upper Oligocene-Miocene interval. These were based on the few solution-resistant taxa. The three informal zones, in ascending order, which were devised for Site 278 are: *Globigerina (G.) woodi, Globorotalia (T.) conica,* and *Globigerina (G.) bulloides* (Table 7).

The zonal scheme used on Leg 29 was based mainly on previous work by the writer in Australia and New Zealand. The middle Oligocene-upper Miocene sequence of the Lakes Entrance oil shaft, Victoria, Australia, was sub-divided into 11 zones (Jenkins, 1960). Most of these zones were incorporated into a subdivision of the New Zealand Cenozoic into 21 zones (Jenkins, 1966, 1967). The main addition to the Cenozoic zonal scheme has been the subdivision (in ascending order) of the Pliocene-Pleistocene *G. (T.) inflata* Zone into the *G. (T.) puncticulata, G. (T.) inflata,* and *G. (G.)*

TABLE 1
Ranges of Planktonic Foraminifera in Selected Samples of Site 277

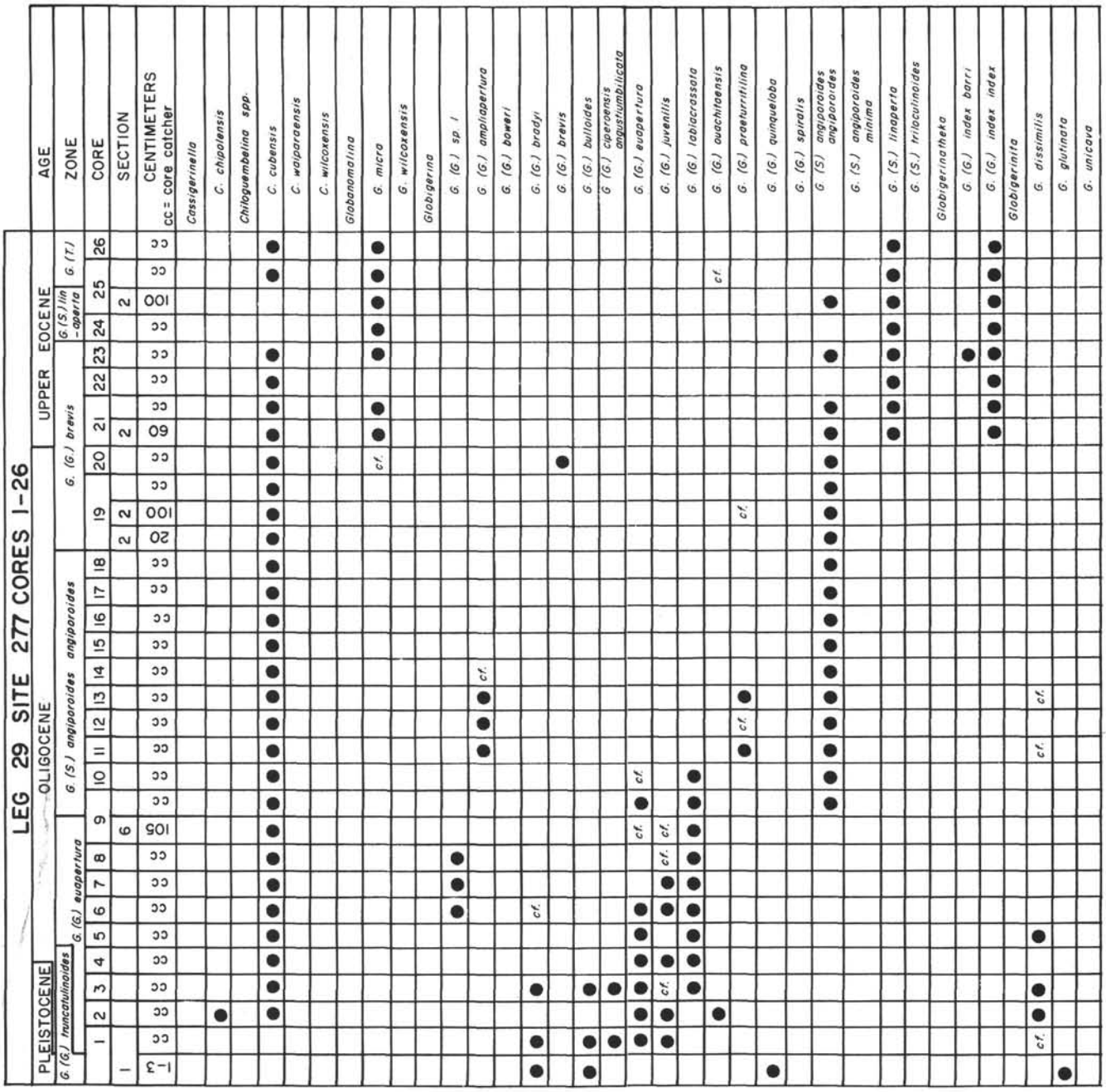


TABLE 1 – *Continued*

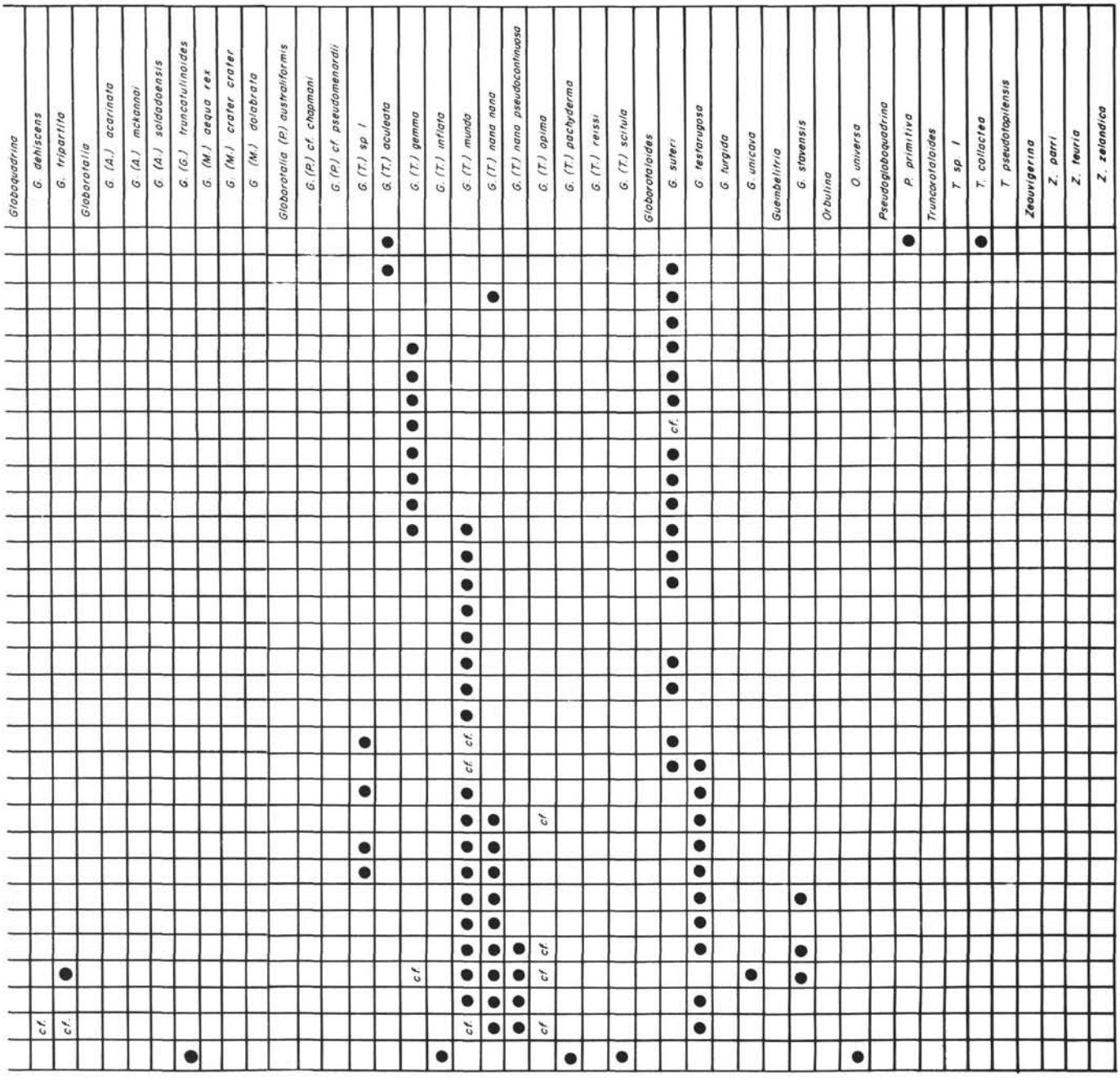


TABLE 1 – *Continued*

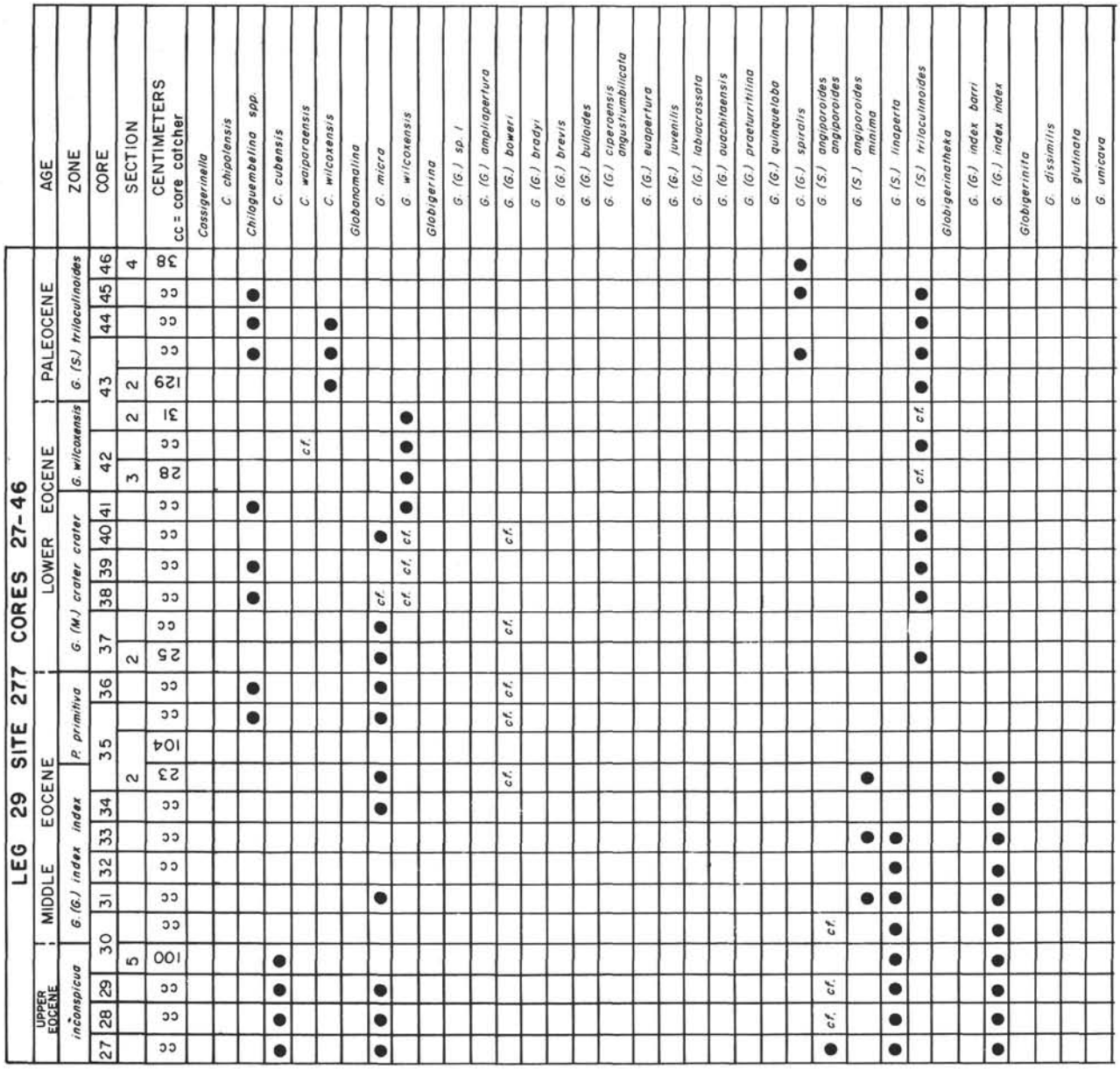


TABLE 1 – *Continued*

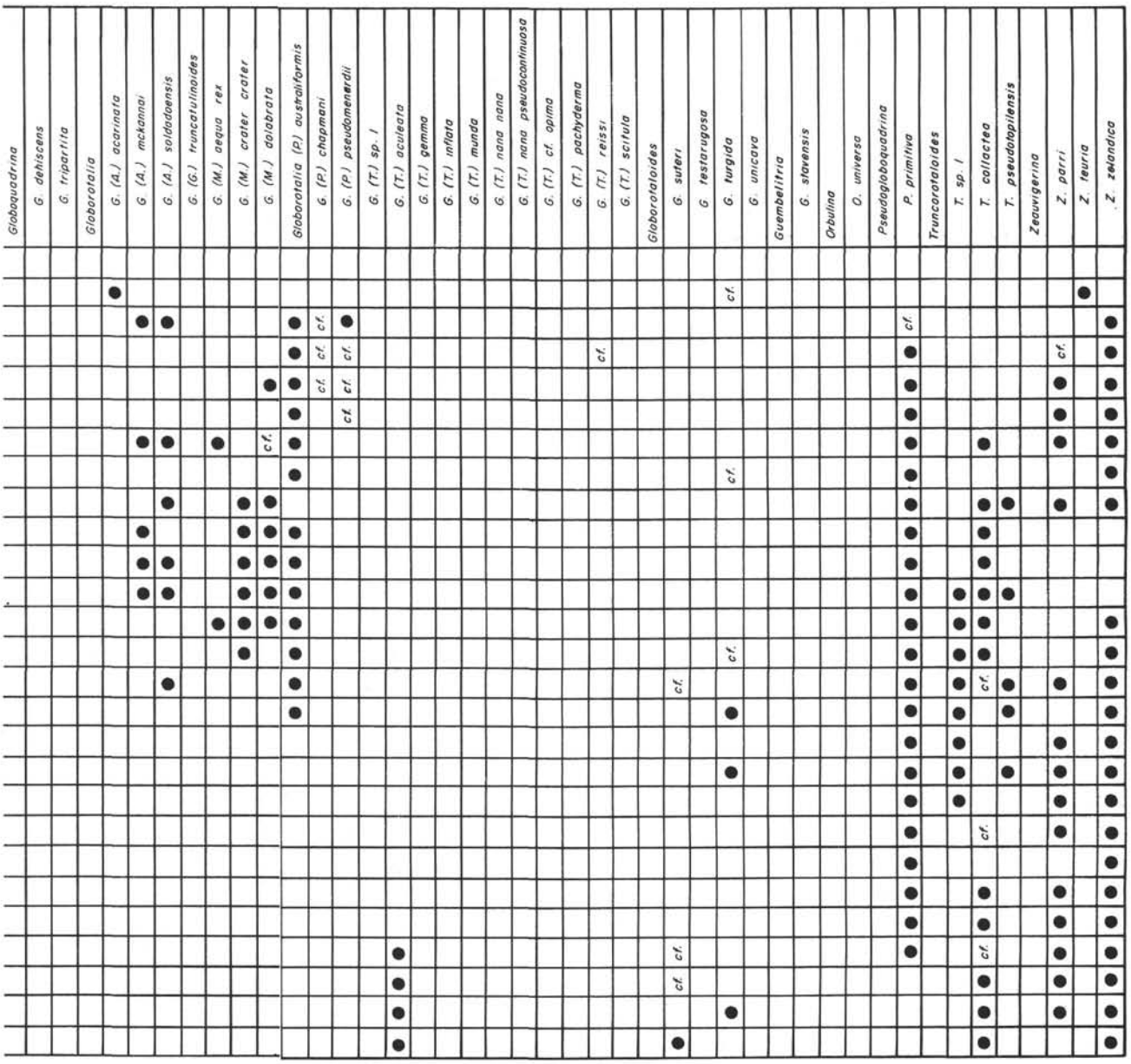
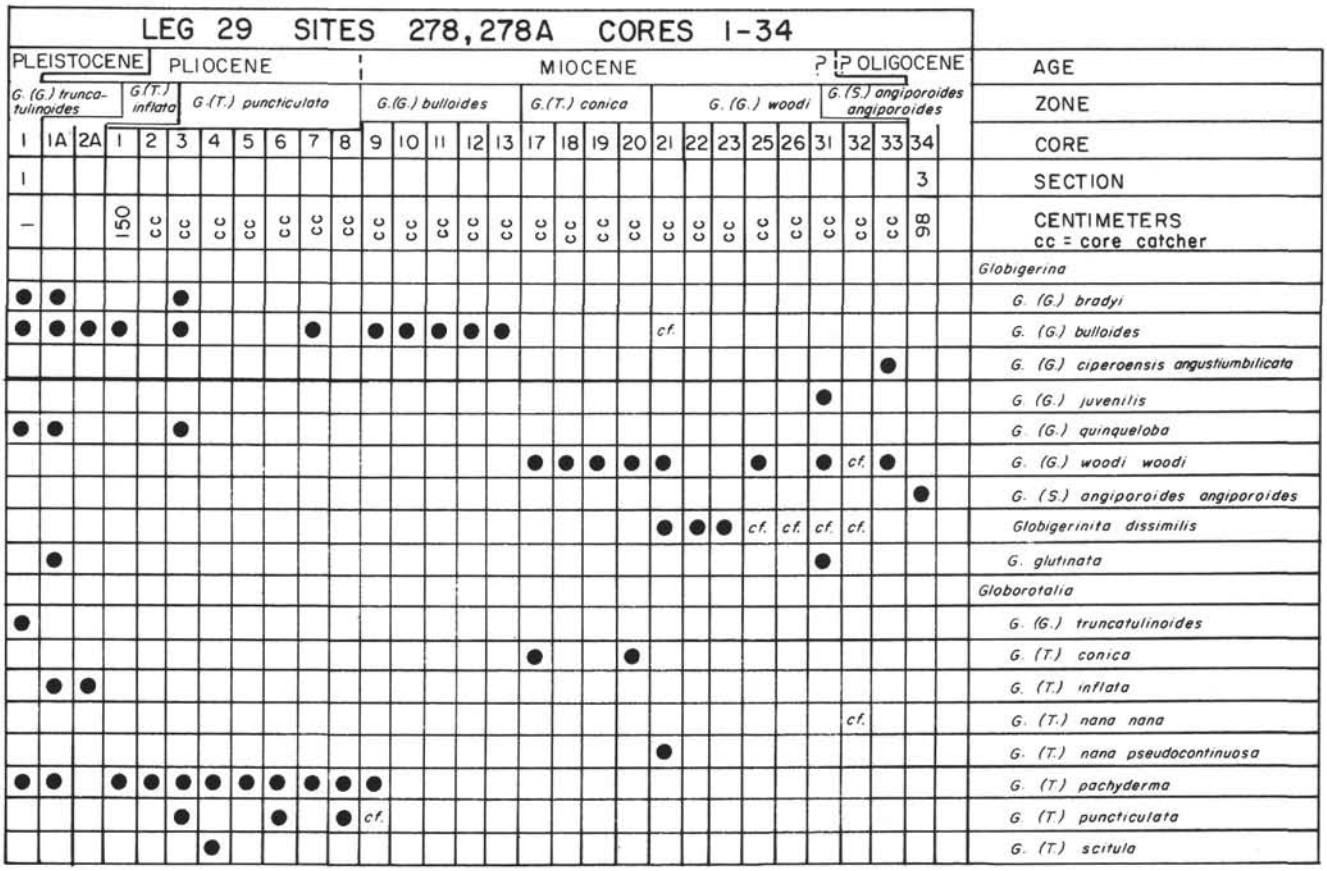


TABLE 2
Ranges of Planktonic Foraminifera in Selected Samples of Site 278



truncatulinoides zones; these zones have been used informally by the writer in New Zealand (Table 7). The taxa used to delineate the zonal boundaries are shown in Table 8; the zones penetrated at the various sites are shown in Table 9.

The lack of certain taxa and paucity of others made it necessary to make a few minor amendments to the New Zealand zonal scheme:

1) Because of the total absence of *Globorotalia (T.) inconspicua* at Site 277, it was decided to follow the precedent of micropaleontologists from South Australia (Ludbrook and Lindsay, 1969), and refer the zone as *Globorotalia (T.) aculeata* Zone.

2) *Globigerina (G.) brevis* was found to be very rarrre at Site 277 and absent at Site 282. This led to the redefinition of the zone based on the total range of *Globorotalia (T.) gemma* which has the same range as *G. (G.) brevis* in New Zealand (Jenkins, 1966).

SYSTEMATIC PALEONTOLOGY

Cassigerinella chipolensis (Cushman and Ponton)

C. chipolensis was found to be very rare, and was only recorded in the *G. (G.) euapertura* Zone at Site 277. In New Zealand *C. chipolensis* occurs as far south as the Clifden section at about 46°S (Jenkins, 1971).

Chiloguembelina cubensis (Palmer)

C. cubensis was found generally in abundance in samples at Site 277 from the *G. (T.) aculeata* Zone to the lower *G. (G.) euapertura* Zone. *C. cubensis* is less abundant at its lower stratigraphic range.

C. wilcoxensis (Cushman and Ponton)

At Site 277 *C. wilcoxensis* was found to be a useful marker in the Paleocene *G. (S.) triloculinoides* Zone.

Globanomalina micra (Cole)

Specimens of *G. micra* were obtained at Site 277 from the lower part of the *G. (M.) crater crater* Zone to about the middle of the *G. (G.) brevis* Zone. *G. micra* was found to be very rare towards the upper Eocene-lower Oligocene.

G. wilcoxensis (Cushman and Ponton)

A few specimens of *G. wilcoxensis* were obtained from the *G. wilcoxensis* Zone, with transitional forms linking it to *G. micra* in the *G. (M.) crater crater* Zone.

Globigerina (G.) ciperoensis angustiumbilicata Bolli

Very rare specimens were found at Sites 277, 279, and 281, but were a little more common at Site 282. It is probable that its rarity in the southern sites was due to temperature control.

G. (G.) bradyi Weisner

G. (G.) bradyi was found to be fairly common at some sites such as 279 and 284, but rare at other sites.

G. (G.) bulloides d'Orbigny

G. (G.) bulloides was common at most sites examined and seems to have a relatively solution-resistant test at Site 278. It is fairly common at Site 279 where it seems to replace *G. (G.) woodi woodi* in the middle Miocene as the most common *Globigerina* within their size range.

G. (G.) eamesi Blow

The occurrence of *G. (G.) eamesi* at sites of Leg 29 is sporadic: absent at Sites 277 and 278; very rare at Sites 279 and 282; and fairly common in the *G. trilobus trilobus-G. (G.) woodi connecta* zones at Site 281. This distribution is hardly explained by assuming a temperature control, but, within its stratigraphic range, it is fairly common in continental shelf deposits in New Zealand.

G. (G.) labiacrassata Jenkins

At Site 277, *G. (G.) labiacrassata* found in the *G. (S.) angiporoides angiporoides-G. (G.) euapertura* zones resembles *G. (G.) woodi woodi*, but has a thicker apertural lip, and has less coarse wall ornamentation. A few specimens found at Site 282 in faunas of low diversity suggests that *G. (G.) labiacrassata* has a relatively solution-resistant test.

G. (G.) nepenthes Todd

It is probable that the paleogeographic distribution of *G. (G.) nepenthes* was temperature controlled. During Leg 29 it was found in only one sample from Site 282 and one doubtful specimen from Site 284. It is therefore concluded that sites drilled on Leg 29 were south of its original distribution.

G. (G.) ouachitaensis Howe and Wallace

G. (G.) ouachitaensis has a sporadic distribution in the area drilled: one specimen occurred in the *G. (G.) euapertura* Zone at Site 277; one specimen in the *G. (G.) woodi connecta* Zone at Site 279; and a few specimens in the *G. (G.) brevis-G. (S.) angiporoides angiporoides* zones at Site 282.

G. (G.) quinqueloba Natland

As expected from its Recent distribution, *G. (G.) quinqueloba* was found to be common in the Miocene-Pleistocene at Sites 279, 281, and 284.

G. (G.) woodi connecta Jenkins

Most of the specimens in the *G. trilobus trilobus* Zone at Site 279 are thick walled and approach the morphology of *Sphaeroidinella cellata* Subbotina. Also at Site 279 *G. (G.) woodi connecta* ranges into the upper part of *G. trilobus trilobus* Zone, well above its recorded range in New Zealand (Jenkins, 1971).

G. (G.) woodi woodi Jenkins

Well-preserved specimens of *G. (G.) woodi woodi* were obtained from the upper Oligocene-Miocene of Site 278 in a low-diversity fauna which had probably been caused by selective solution of tests. At Site 279 *G. (G.) woodi woodi* is well-developed in the lower Miocene with some of the thick-walled specimens resembling *Sphaeroidinella cellata* Subbotina. Also at Site 279 it is the commonest *Globigerina* in the *G. (G.) woodi connecta-G. trilobus trilobus* zones, but is replaced by *G. (G.) bulloides* as the dominant form in the middle Miocene. A similar change in dominance was also noted at Site 281.

G. (G.) woodi decoraperta Takayanagi and Saito

G. (G.) woodi decoraperta was found to be rare in the *G. (T.) mayeri mayeri* Zone at Site 279; one was recorded in the *G. (G.) miotumida miotumida* Zone at Site 282. It was found to be much more common in the lower latitude Site 284 (40°30'S) in the *G. (G.) miotumida miotumida-G. (T.) inflata* zones.

G. (S.) angiporoides angiporoides Hornibrook

Within its upper Eocene-middle Oligocene stratigraphic range *G. (S.) angiporoides angiporoides* is fairly common at Sites 277, 278, 281, and 282. It appears to have had a solution-resistant test.

G. (S.) linaperta Finlay

G. (S.) linaperta is present in the middle upper Eocene at Site 277. From its presence in the upper Eocene of Sites 281 and 282 it is postulated that it has a tough solution-resistant test.

G. (S.) triloculinoides Plummer

It is quite common within its stratigraphic range of *G. (S.) triloculinoides-G. (M.) crater crater* zones at Site 277.

Globoquadrina altispira (Cushman and Jarvis)

A few specimens were found in the *G. (G.) miozea conomiozea* and *G. (T.) inflata* zones at Site 284.

G. dehiscens (Chapman, Parr, and Collins)

Within the *G. (G.) woodi connecta* to *G. (T.) mayeri mayeri* zones at Site 279, *G. dehiscens* is fairly common, but the tests appear to be less quadrate than usual in New Zealand. At Site 282 it was also fairly common in the *G. (G.) woodi woodi-G. (G.) miotumida miotumida* zones. It is noteworthy that *G. dehiscens* was not recorded in the upper Miocene-Pliocene of Site 284.

G. tripartita (Koch)

From its paleogeographic distribution in New Zealand it has been assumed that *G. tripartita* was a warm-water form. If this postulate is true, then its occurrence in the *G. (G.) woodi connecta-G. trilobus trilobus* zones at Site 279 could indicate warmer water conditions.

Globigerinatheka (G.) index index (Finlay)

The stratigraphically lowest, rare specimens in the *G. (G.) index index* Zone at Site 277 resemble New Zealand specimens of this zone, with only one aperture. Thereafter in the zone, it became more common with specimens having multiple apertures.

Deduced from its occurrence in upper Eocene sediments at Site 282, *G. (G.) index index* appears to have had a robust, solution-resistant test.

Globigerinella aequilateralis (Brady)

It occurs sporadically at Site 281, south of the subtropical convergence, in the *G. (T.) puncticulata-G. (G.) truncatulinoides* interval. The occurrence of *G. aequilateralis* at Site 281 without warm-water forms such as *Globigerinoides* tends to suggest that it is more tolerant of cooler water than the latter genus. Well within the subtropical belt at Site 284, *G. aequilateralis* is common in the *G. (G.) miotumida miotumida-G. (G.) truncatulinoides* zones.

Globigerinita dissimilis (Cushman and Bermudez)

G. dissimilis is rare in the *G. (G.) euapertura* Zone at Site 277, and in the *G. (G.) woodi woodi* Zone at Site 278. At both sites 279 and 281, *G. dissimilis* appears to have become extinct later than in New Zealand. This extinction is before the initial appearance of *G. (G.) miozea miozea*. Some of the specimens in the *G. (G.) woodi connecta* Zone at Site 279 have exceptionally thick tests, and its general occurrence at other sites suggests that it has a solution-resistant test.

Globigerinoides altiaperturus Bolli

At Sites 279 and 281 it is not present within its known lower Miocene New Zealand range of *G. (G.) woodi connecta-G. trilobus trilobus* zones, but there is one specimen in the *G. (G.) woodi connecta* Zone at the more northerly Site 282. It is concluded that its original paleogeographic distribution was probably temperature controlled.

G. trilobus bisphericus Todd

A few doubtful specimens of *G. trilobus bisphericus* were recorded at Site 279 in the *G. trilobus trilobus* Zone, but it was not present within its known range at Site 281.

G. ruber (d'Orbigny)

A single, doubtful, specimen was recorded in the *G. (T.) mayeri mayeri* Zone at Site 279. Rare specimens are present in the *G. (G.) truncatulinoides* Zone at Site 282, and it is fairly common in the *G. (G.) miozea conomiozea-G. (G.) truncatulinoides* zones at Site 284.

TABLE 3
Ranges of Planktonic Foraminifera in Selected Samples of Site 279

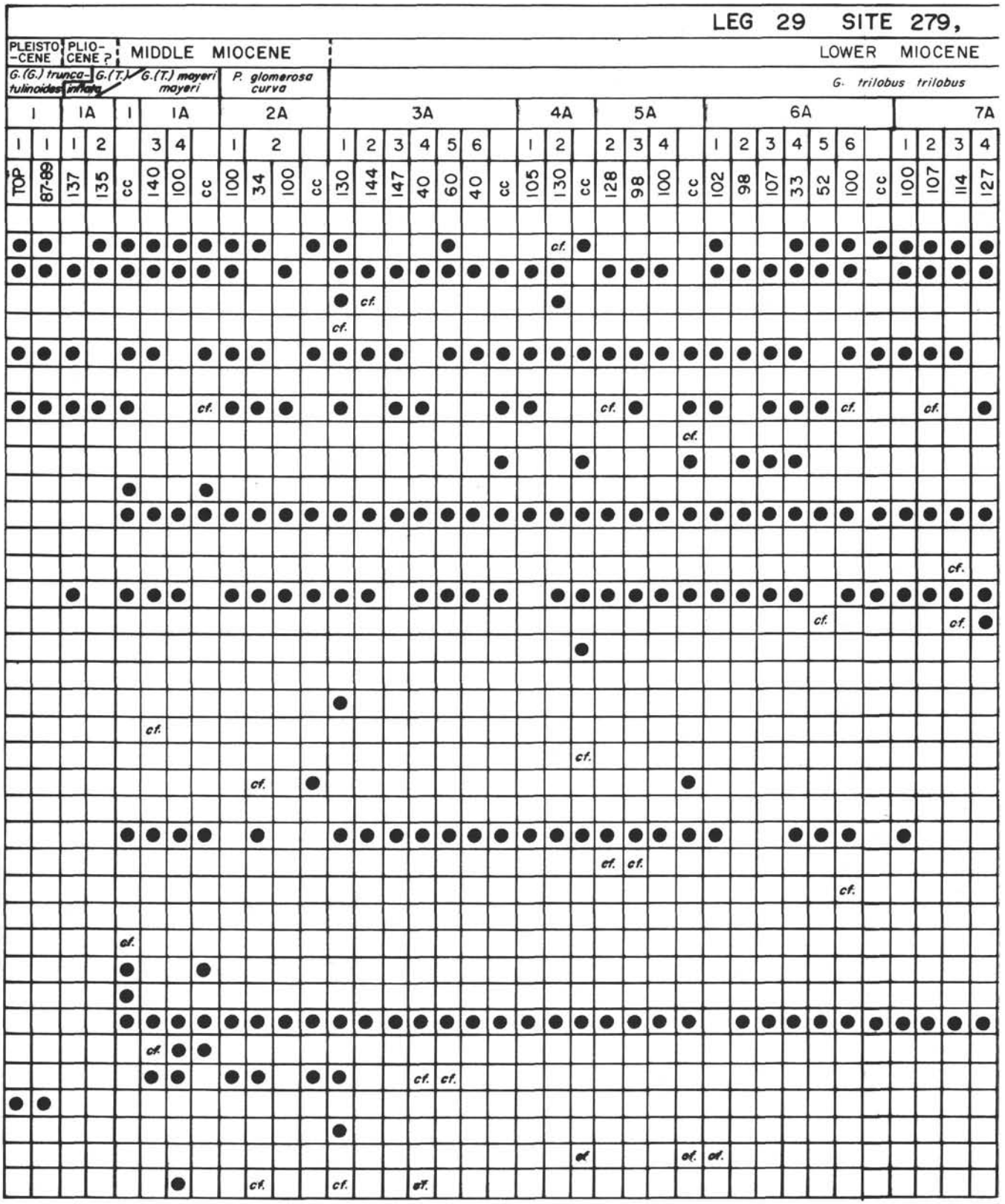
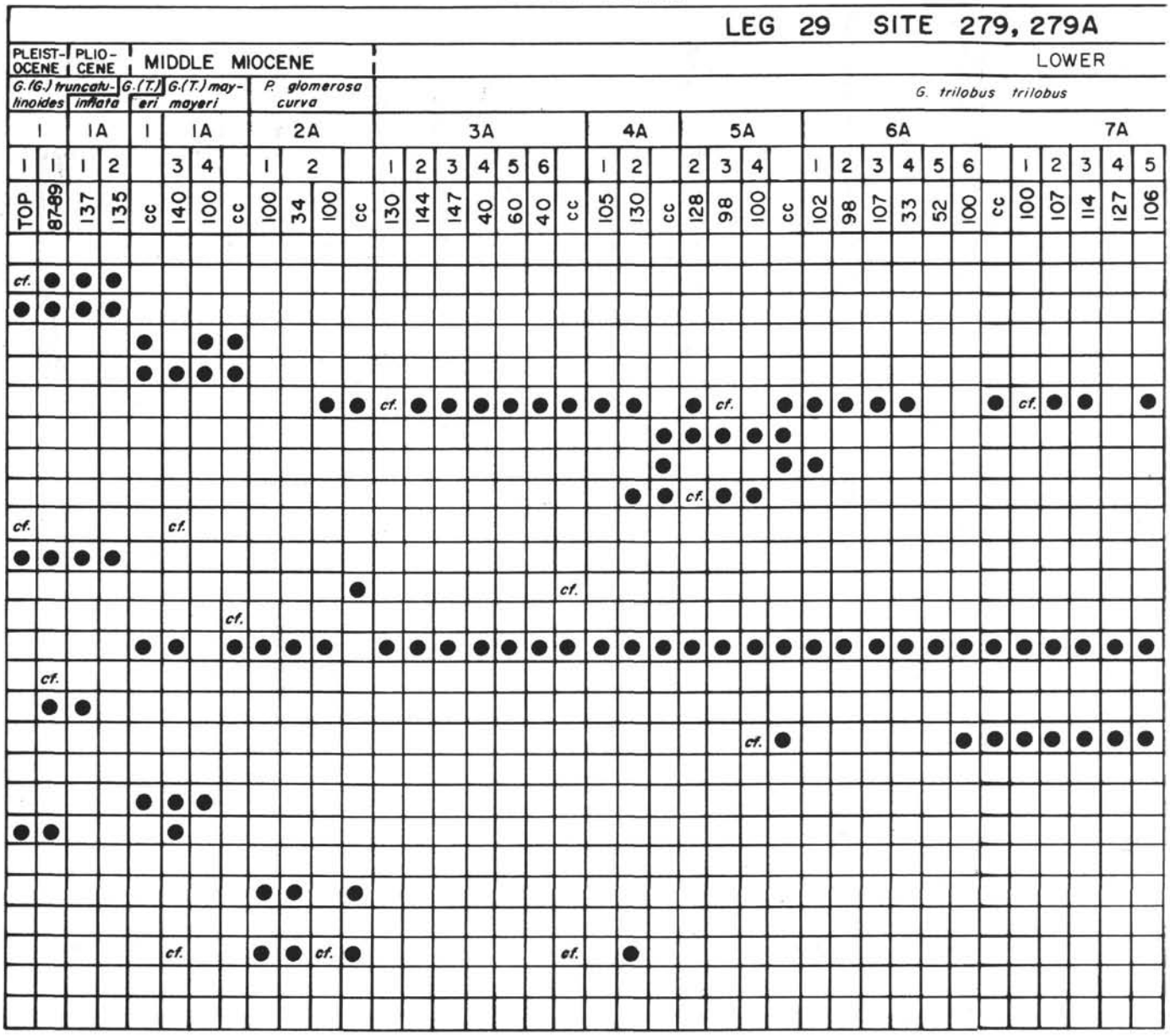


TABLE 3 – *Continued*

279A CORES 1-11

AGE																												
ZONE																			G. (G.) woodi connecta										
CORE			8A				9A							10A							11A								
SECTION	-5	6		1	4	5	1	2	3	4	5	6		1	2	3	4	5	6		1	2	3	4	5	6		
CENTIMETERS cc = core catcher	106	100	cc	105	100	117 150	100	109	102	102	115	40	cc	134	31	100	135	100	103	cc	50	50	35	75	40	100	cc	
Globigerina																												
G. (G.) bradyi	●	●	●	●	●	● ●	●		●	●	●	●	●				●	●	●	●	●	●		●		●	●	
G. (G.) bulloides	●		●	●	●	● ●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●		●	●	●		
G. (G.) ciperoensis angustiumbilicata				●																				●				
G. (G.) eamesi																												
G. (G.) juvenilis	●	●			●	● ●		●	●	●	●	●	●	●	●		●	●	●				●		●	●		
G. (G.) ouachitaensis																									cf.			
G. (G.) quinqueloba	●				cf.		cf.		cf.	cf.		cf.	cf.	cf.	cf.	cf.	cf.	cf.	cf.	cf.	cf.			●			cf.	
G. (G.) venezuelana			●																									
G. (G.) woodi connecta				●		●							●					●	●	●	●	●	●	●	●	●	●	
G. (G.) woodi decoraperta																												
G. (G.) woodi woodi	●	●	●	●	●	● ●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	
Globigerinita																												
G. dissimilis			●		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
G. glutinata	●	●	●	●	●	● ●	●	●		●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	
G. suteri	cf.																						cf.					
G. unicava																												
Globigerinoides																												
G. apertasuturalis															●													
G. ruber																												
G. trilobus bisphericus																												
G. trilobus trilobus	●			cf.	●	● ●			●	●	●	●	●		cf.	●												
Globoquadrina																												
G. dehiscens		●	●		●	● ●		●	●	●	●		●	●	●	●		●	●	●	●	●	●	●	●	●	●	
G. larmeui																												
G. tripartita						cf.				cf.	●	cf.	●		cf.	●	●					cf.			cf.			
Globorotalia																												
G. (G.) explicationis																												
G. (G.) miotumida miotumida																												
G. (G.) miozea conoidea																												
G. (G.) miozea miozea	●	●																										
G. (G.) panda																												
G. (G.) praemenardii																												
G. (G.) truncatulinoides																												
G. (T.) sp. nov.																												
G. (T.) bella																												
G. (T.) conica																												

TABLE 3 – *Continued*



G. trilobus trilobus (Reuss)

Generally, *G. trilobus trilobus* was found to be rare within the drilled area, but was commonest within its zone at Site 279.

Globorotalia (G.) miotumida explicationis Jenkins

It is very well developed in the *G. (G.) miotumida miotumida* Zone and lower part of the *G. (G.) miozea conomiozea* Zone at Site 284. In New Zealand, *G. (G.) miotumida explicationis* has been recorded from the top of the *G. (T.) mayeri mayeri* Zone to the top of the *G. (G.) miotumida miotumida* Zone (Jenkins, 1971).

G. (G.) miotumida miotumida Jenkins

At Site 284 it has a range from the *G. (G.) miotumida miotumida* Zone to the lower part of the *G. (T.) puncticulata* Zone. This is very similar to its range in New Zealand (Jenkins, 1971).

G. (G.) miozea conomiozea Kennett

There appears to be a transition in morphology between it and *G. (G.) miotumida miotumida* at Site 284 in Sample 284-17, CC.

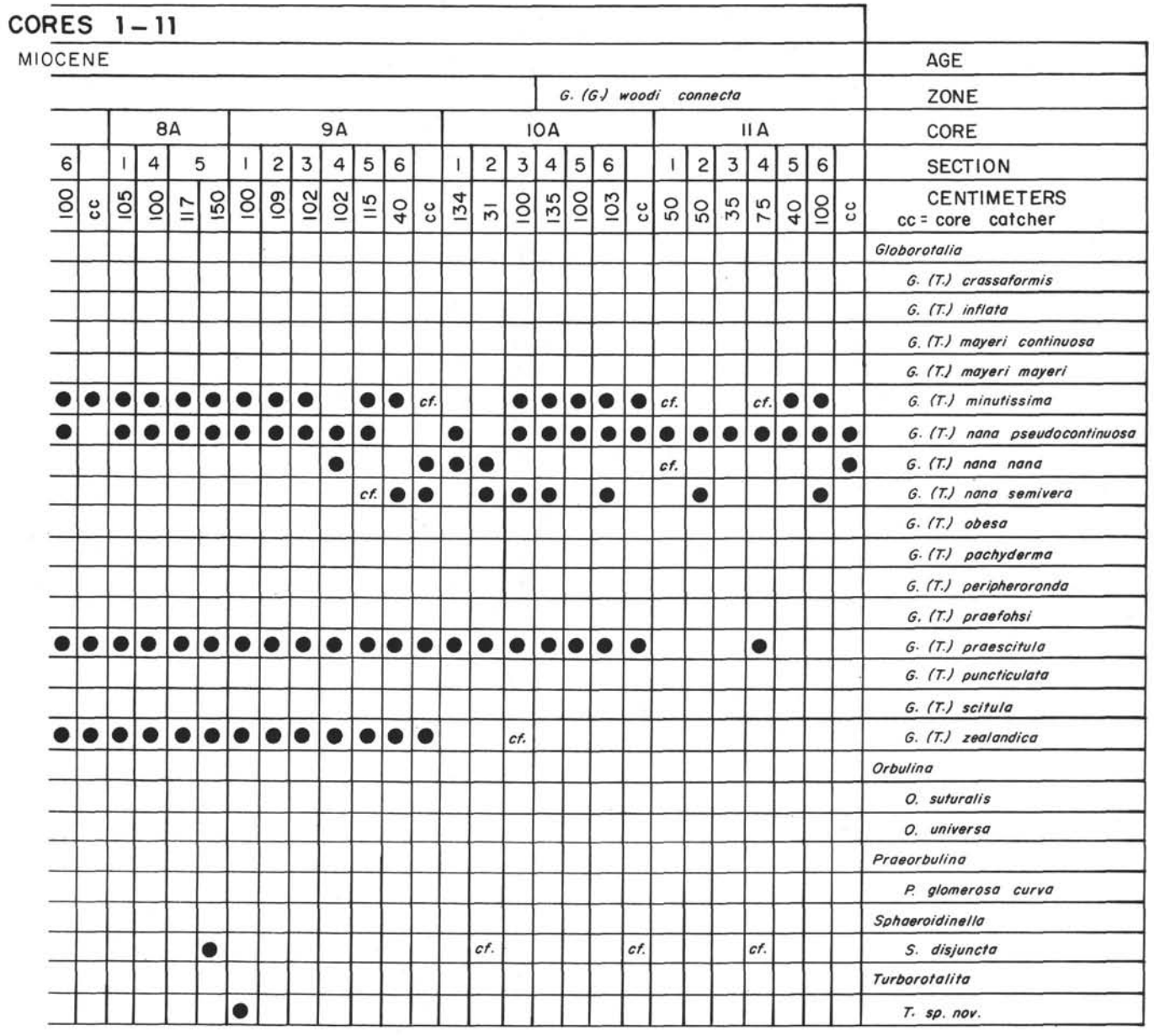
G (G.) miozea miozea Finlay

It is fairly common in the *G. (T.) mayeri mayeri* Zone at Site 279 where the populations are sinistrally coiled and specimens are thick walled. The evolutionary change from *G. (T.) praescitula* to *G. (G.) miozea miozea* may have occurred earlier at Site 279 compared to the transition in New Zealand. Consideration should be given to the possibility that *G. (G.) miozea miozea* is a deep-water ecophenotype and may therefore appear earlier in deep water deposits compared to the continental shelf deposits of New Zealand.

G. (G.) panda Jenkins

Rare specimens occur in the *G. (T.) mayeri mayeri* Zone at Site 279.

TABLE 3 – *Continued*



G. (G.) truncatulinoides (d'Orbigny)

Various morphological forms were found at the sites drilled on Leg 29 including morphotypes of *G. (T.) tosaensis* at Sites 275 and 284. Well-developed, keeled, sinistrally coiled specimens of *G. (G.) truncatulinoides* were found at Sites 280, 281, 282, and 284.

G. (M.) crater crater Finlay

Typical forms were found in its zone at Site 277, but the populations did not yield *G. (M.) crater caucasica* Glaessner with 6-7 chambers in the final whorl, which is found in New Zealand (Jenkins, 1971).

G. (T.) aculeata Jenkins

G. (T.) aculeata was found to be fairly common within its upper Eocene range at Site 277 where it appears to have had a later extinction, compared with this event in New Zealand (Jenkins, 1971).

G. (T.) conica Jenkins

It is much better developed at Sites 278, 279, and 281 compared with its records in Australia (Jenkins, 1960) and New Zealand (Jenkins, 1971). It is postulated that *G. (T.) conica* was possibly a cooler water taxon which made brief incursions into the Australian and New Zealand waters during the middle Miocene.

G. (T.) crassaformis (Galloway and Wissler)

Large specimens of *G. (T.) crassaformis* were obtained in Pleistocene-Recent sediments from Sites 279 and 284; some from Site 284 have well-developed keels.

G. (T.) gemma Jenkins

At Sites 277 and 282, *G. (T.) gemma* has been used as a zonal marker for the *G. (G.) brevis* Zone. There is evidence in the samples from Site 282 that *G. (T.) gemma* had a solution-resistant test.

G. (T.) inflata (d'Orbigny)

It normally formed a dominant part of the Pliocene(?)-Pleistocene planktonic foraminiferal faunas at most sites. *G. (T.) inflata*, the only species present at Site 283, appears to have a solution-resistant test.

TABLE 4A
Ranges of Planktonic Foraminifera in Selected Samples of Site 281

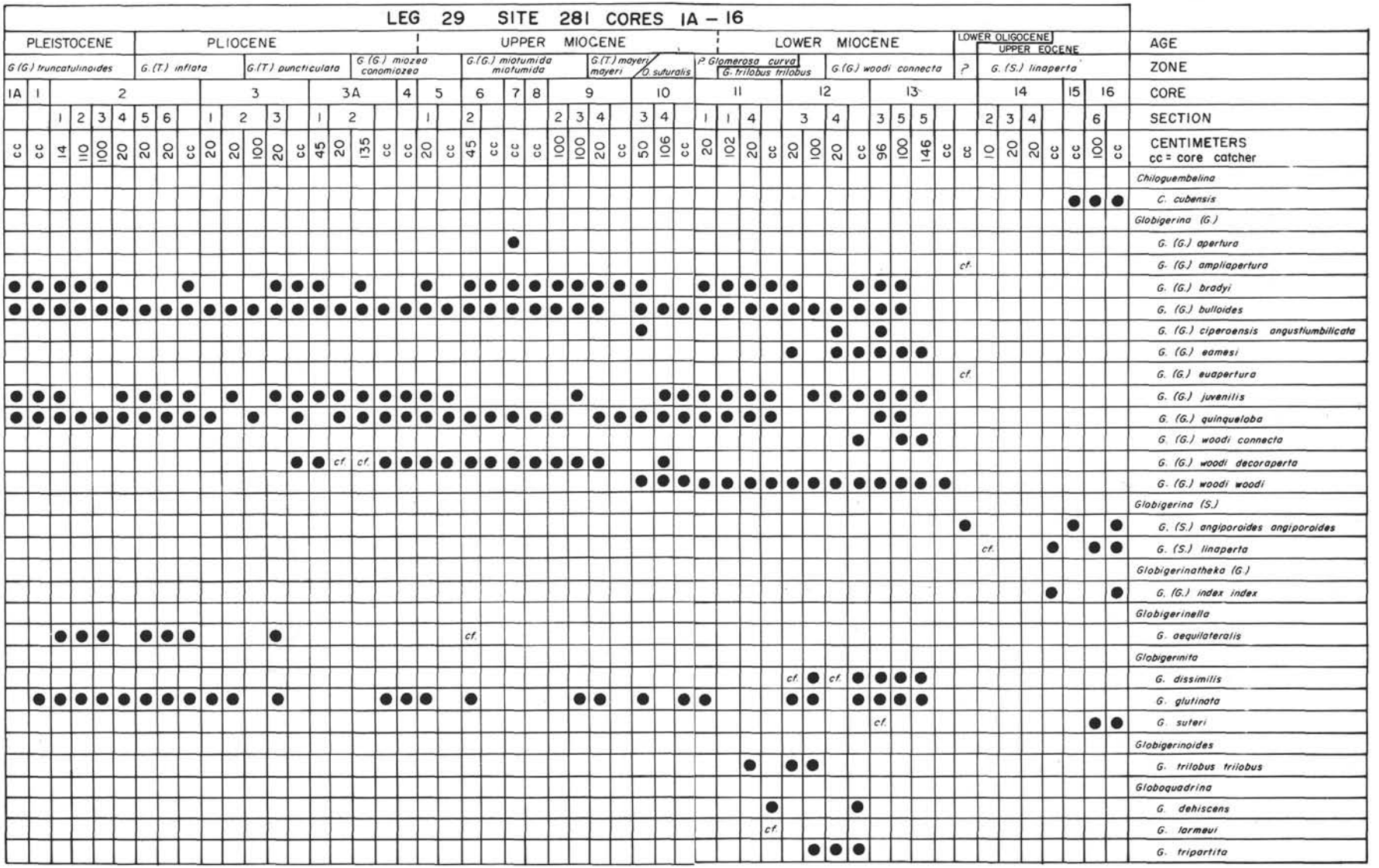


TABLE 4A – *Continued*

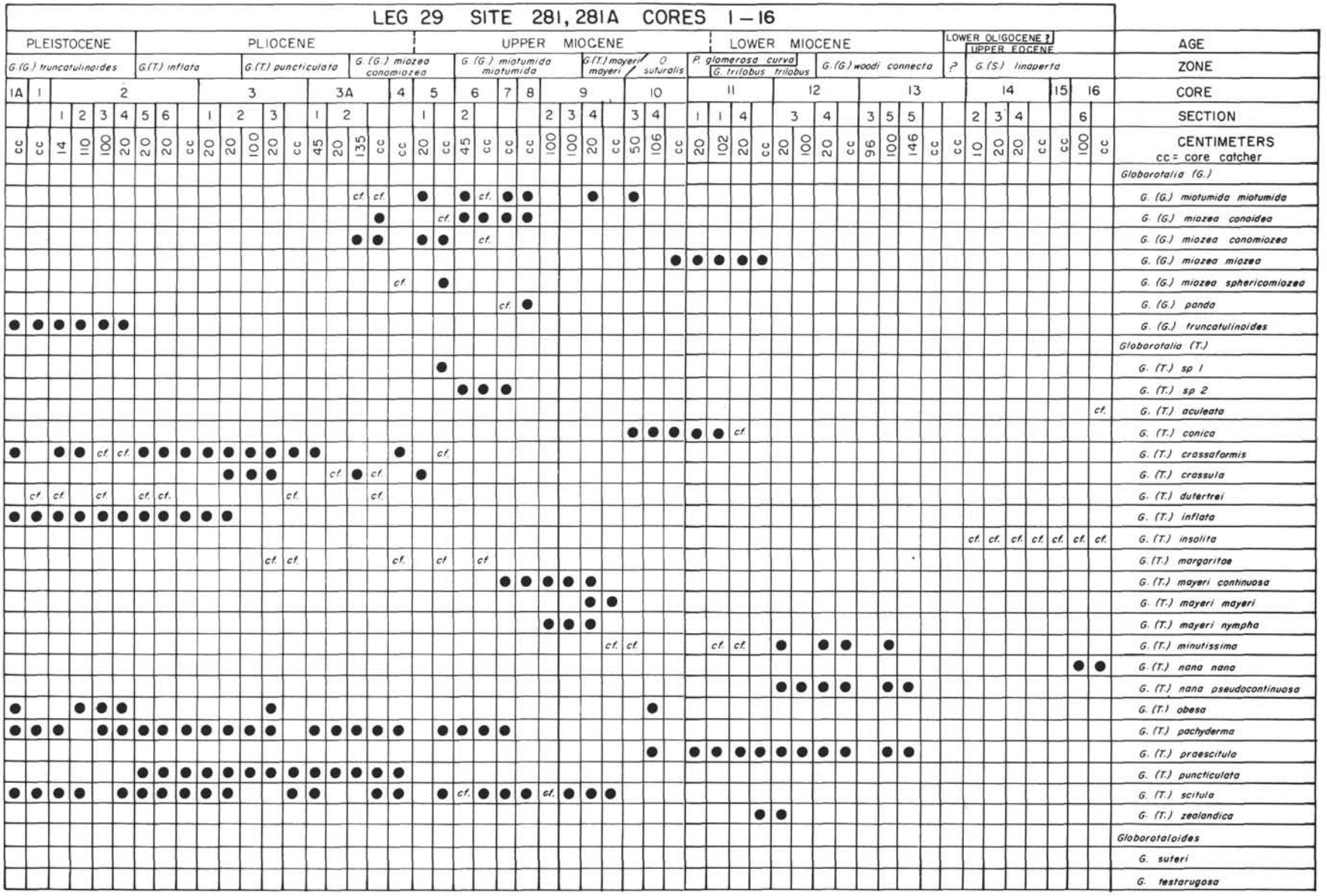
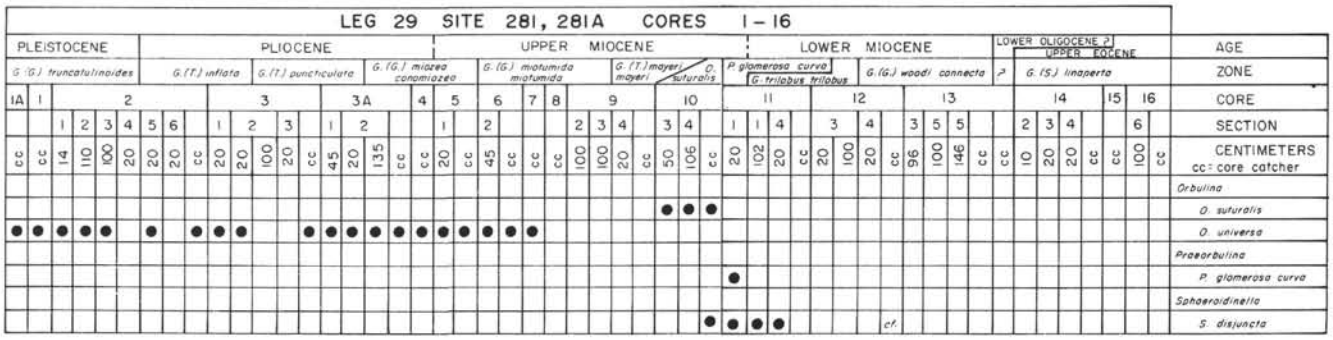


TABLE 4B
Ranges of Planktonic Foraminifera in Selected Samples of Hole 281A



G. (T.) mayeri continuosa Blow

It is present at Sites 279, 280, 281, and 284, and at Sites 279, 280 and 281, it is clearly related to *G. (T.) mayeri mayeri*. A transitional form between *G. (T.) mayeri continuosa* and *G. (T.) pachyderma* exists at Site 281 in the *G. (G.) miotumida miotumida* Zone, as previously reported from New Zealand (Jenkins, 1971).

G. (T.) mayeri mayeri Cushman and Ellisor

It is a common species within its zone at Sites 279, 280, and 281, and at Sites 279 and 281, *G. (T.) mayeri mayeri* is cryptogenic, appearing without its immediate ancestor *G. (T.) mayeri peripheroronda*. *G. (T.) mayeri mayeri* appears to have a tough, solution-resistant test.

G. (T.) mayeri nympha Jenkins

In New Zealand it became extinct in the upper part of the *G. (T.) mayeri mayeri* Zone, but at Site 281 it survived into the lower part of the succeeding *G. (G.) miotumida miotumida* Zone.

G. (T.) minutissima Bolli

It is a common form in the *G. (G.) woodi connecta-G. trilobus trilobus* zones at Site 279 where specimens have an aperture which is slightly larger than illustrated for the holotype from Trinidad.

G. (T.) munda Jenkins

At Site 277 there is some evidence that it may have evolved from *G. (T.) gemma*. *G. (T.) munda* has a juvenile form with regular chambers, but with a higher arched aperture than *G. (T.) gemma*. It is possible that *G. (T.) gemma* evolved into *G. (T.) munda* by increasing the test size, with a concomitant increase in the height of the aperture.

G. (T.) nana nana Bolli

It is fairly rare at Sites 277 and 279, but was found to be a useful marker in the upper Eocene at Site 282.

G. (T.) nana pseudocontinuosa Jenkins

It is fairly common at certain intervals in the *G. (G.) woodi connecta-G. trilobus trilobus* zones at Site 279; it is much more common at Sites 281 and 282.

G. (T.) nana semivera (Hornibrook)

It is fairly rare in the *G. (G.) woodi connecta-G. trilobus trilobus* zones at Site 279, with only a few specimens at Site 281.

G. (T.) pachyderma (Ehrenberg)

Dominantly sinistrally coiled specimens were found in a foraminiferal sand injected into (?)Upper Cretaceous-Paleocene sediment at Site 275. Also sinistrally coiled forms were found at Site 278 in the upper Miocene-Pleistocene, where the robust tests have survived solution effects, resulting in depleted faunas. *G. (T.) pachyderma* occurs in fairly large numbers in the Pleistocene-Recent at Site 279, but is rare at Site 280. A good record of the taxon occurs in the upper Miocene-Pleistocene at Site 281 where the populations are mainly sinistral, but there are both sinistral and dextral populations at Site 284.

G. (T.) praescitula Blow

There is a good record of *G. (T.) praescitula* at Site 279 from the *G. (G.) woodi connecta* Zone through to the *G. (T.) mayeri mayeri* Zone, but it is very rare at its cryptogenic initial appearance.

G. (T.) puncticulata (Deshayes)

A sample at Site 276 yielded specimens of *G. (T.) puncticulata* with distinctly angled peripheral margins. Its presence at Site 278 in very deep-water sediments suggests that it has a relatively strong solution-resistant test. Good faunas of *G. (T.) puncticulata* were obtained from Sites 281 and 284. At Site 284 there could be a transition between it and *G. (G.) miozea sphericomiozea* in the *G. (G.) miozea conomiozea* Zone.

G. (T.) scitula (Brady)

Very rare specimens were recorded in the *G. (T.) puncticulata* Zone at Site 278 and in the *G. (G.) truncatulinoides* zone at Site 279. *G. (T.) scitula* is much more common in the Miocene-Pleistocene *G. (T.) mayeri mayeri-G. (G.) truncatulinoides* zones at Sites 281 and 284.

G. (T.) tosaensis Takayanagi and Saito

Morphotypes of *G. (T.) tosaensis* exist in the Pleistocene *G. (G.) truncatulinoides* populations at Site 284.

G. (T.) zealandica Hornibrook

It is very rare in the lower Miocene *G. trilobus trilobus* Zone at Site 279 but numbers increase in the middle of the zone where it is quite common. From its range in southeast Australia (Jenkins, 1960) and New Zealand (Jenkins, 1971) *G. (T.) zealandica* is considered to be a good marker for the *G. trilobus trilobus* Zone.

Globorotaloides extans (Jenkins)

Typical specimens were obtained from the *G. (G.) euapertura* Zone at Site 282.

G. turgida (Finlay)

At Site 277 *G. turgida* was very rare in the *P. primitiva-G. (T.) aculeata* zones compared with its normal relative abundance in the Paleocene-Eocene of New Zealand.

G. testarugosa (Jenkins)

It was found to be common in the upper *G. (S.) angiporoides angiporoides-G. (G.) euapertura* zones at Site 277.

G. suteri Bolli

At Site 277 *G. suteri* appears to evolve into the coarser walled *G. testarugosa* in the upper part of the *G. (S.) angiporoides angiporoides* Zone.

TABLE 5
Ranges of Planktonic Foraminifera in Selected Samples of Site 282

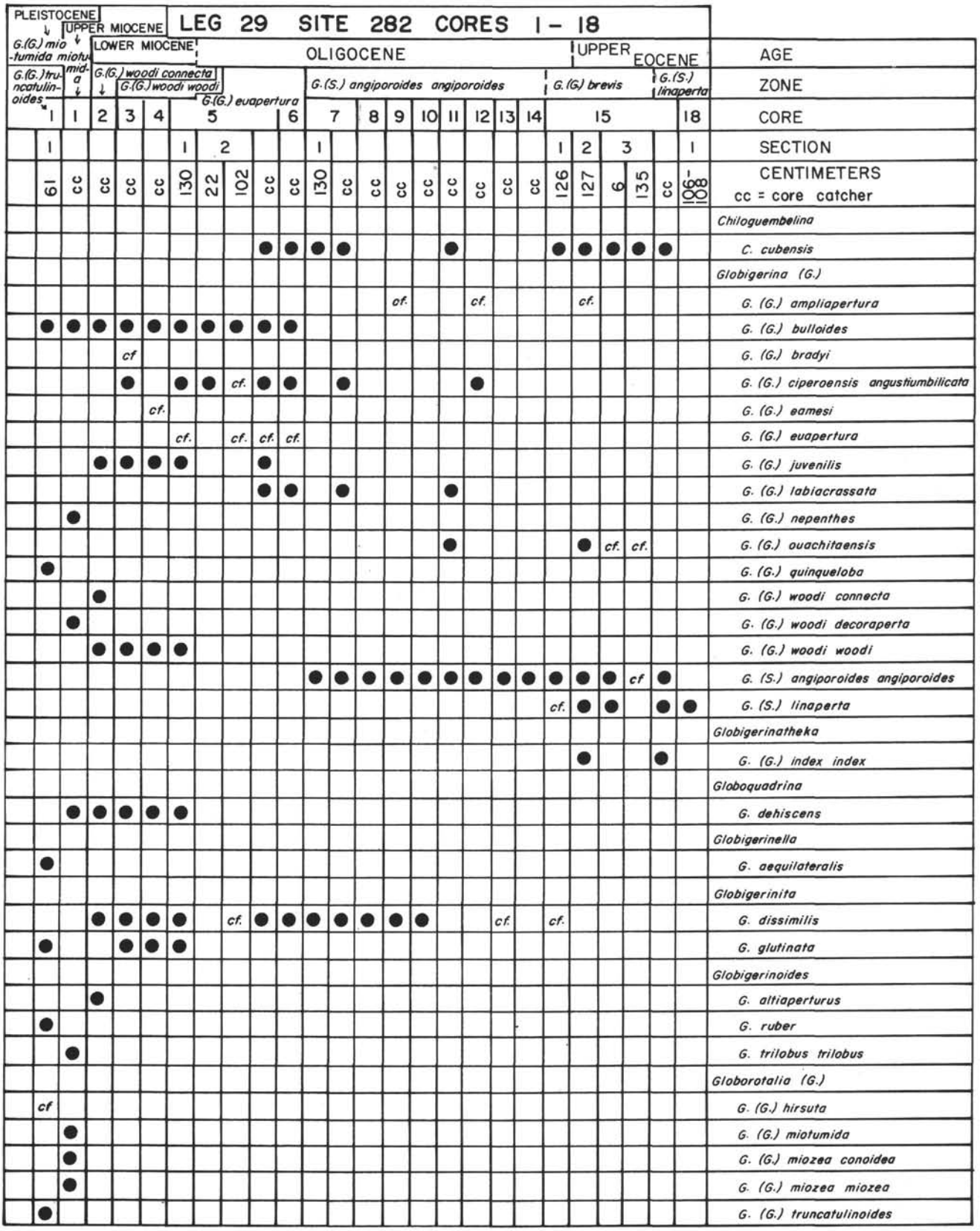
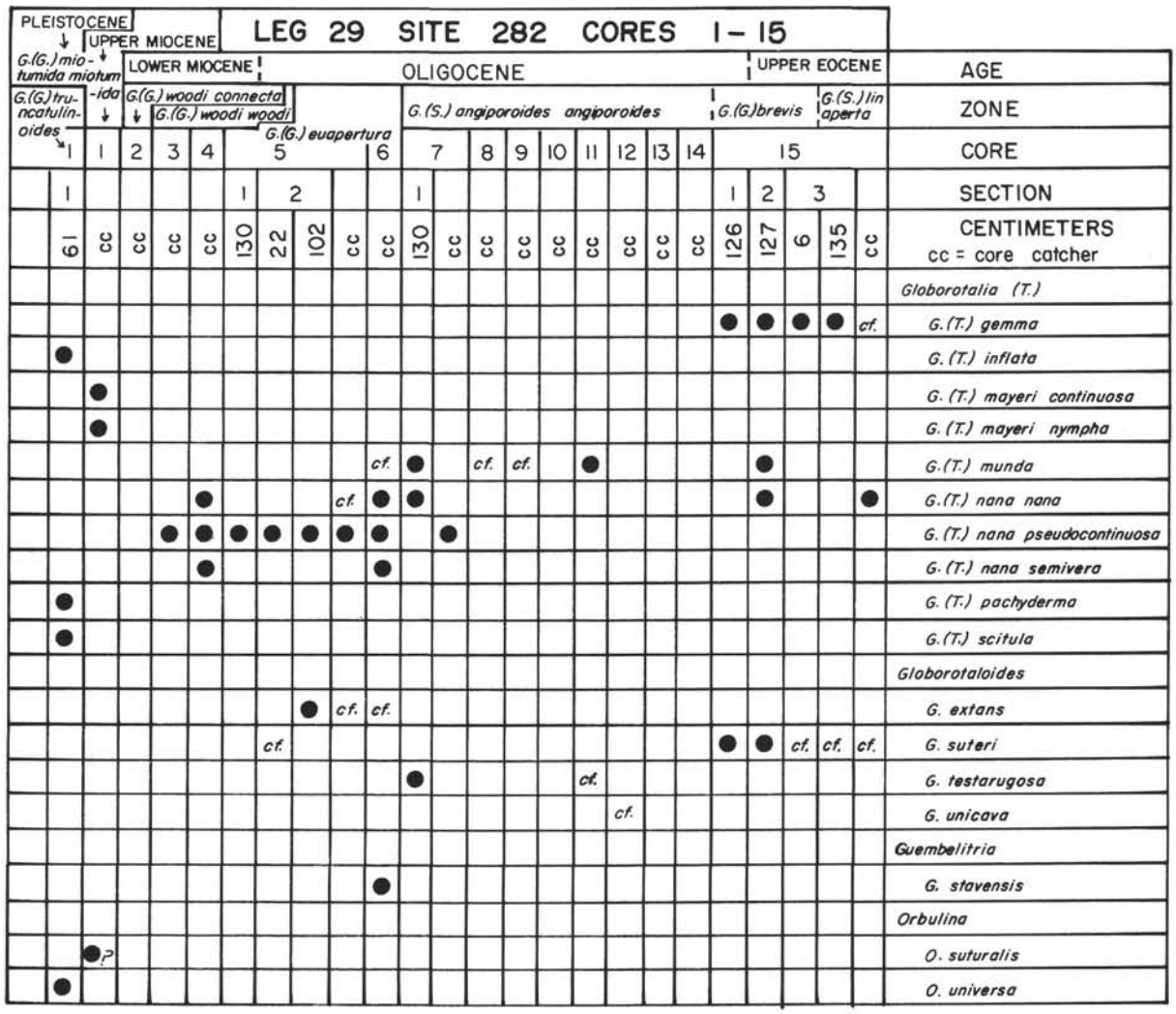


TABLE 5 – *Continued*



Guembelitria stavensis Bandy

At both Sites 277 and 282 *G. stavensis* was found in well-developed faunas of the *G. (G.) euapertura* Zone. It is also suggested that a bit-sample obtained from Site 276 with a few specimens of *G. stavensis* is also from the *G. (G.) euapertura* zone.

Orbulina suturalis Bronnimann

Rare specimens were obtained from the *G. (T.) mayeri mayeri* Zone at Sites 279 and 280, and typical specimens from the *O. suturalis* Zone at Site 281.

O. universa d'Orbigny

Only a few small specimens were recovered from the Pleistocene of the southern Sites 275, 279, 281, and 282, but it is quite common in the *G. (G.) miotumida miotumida-G. (G.) truncatulinoides* zones of Site 284.

Praeorbulina glomerosa curva (Blow)

A few specimens were obtained from the zone of the same name at Sites 279 and 281. The lack of its descendant taxa *P. glomerosa glomerosa* and *P. glomerosa circularis* at these sites suggests that it penetrated further south than its descendants.

Pseudogloboquadrina primitiva (Finlay)

At Site 277 it was recorded from the Paleocene *G. (S.) triloculinoides* Zone to the upper Eocene *G. (T.) aculeata* Zone.

Truncorotaloides collactea (Finlay)

It was found to be fairly common at Site 277 from the *G. wilcoxensis* Zone to the *G. (T.) aculeata* Zone.

Zeauvigerina Finlay

The three New Zealand species, *Z. parri, Z. teuria,* and *Z. zelandica*, were recorded in the Paleocene-Eocene rocks at Site 277.

REFERENCES

Jenkins, D. G., 1960. Planktonic foraminifera from the Lakes Entrance oil shaft, Victoria, Australia: Micropaleontology, v. 6, p. 345.

———, 1966. Planktonic foraminiferal zones and new taxa from the Danian to Lower Miocene of New Zealand: New Zealand J. Geol. Geophys., v. 8, p. 1088.

———, 1967. Planktonic foraminiferal zones and new taxa from the lower Miocene to the Pleistocene: New Zealand J. Geol. Geophys., v. 10, p. 1064.

———, 1971. New Zealand Cenozoic planktonic foraminifera: New Zealand Geol. Surv. Paleontol. Bull. 42, p. 1-278.

Ludbrook, N. and Lindsay, J. M., 1969. Tertiary foraminiferal zones in South Australia: Plankt. Conf. Microfossils, First, Geneva, 1967, Proc., v. 2, p. 366.

TABLE 6
Ranges of Planktonic Foraminifera in Selected Samples of Site 284

LEG 29 SITE 284 CORES 1-22; 284A: 2																								
PLEISTOCENE			PLIOCENE													UPPER MIOCENE								AGE
G.(G.) trunca – tulinoides			G.(T.) inflata					G.(T.) puncti – culata				G.(G.) miozea conomiozea				G.(G.) miotumida miotumida								ZONE
1	2	3	2A	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			CORE
			3	4				6				1				6								SECTION
cc	cc	cc	100	20	cc	cc	cc	100	cc	cc	cc	110	cc	cc	cc	20	cc	cc	cc	cc	cc			CENTIMETERS cc = core catcher
																								Globigerina
		●		●		●	●		●	●	cf.	●	●				●	●			●		●	*G. (G.) bradyi*
●	●	●		●	●	●	●	●	●	●			●	●	●	●	●		●	●	●	●	●	*G. (G.) bulloides*
				●																				*G. (G.) digitata*
●				●	●	●	●		●			●	●				●			●				*G. (G.) juvenilis*
													cf.											*G. (G.) nepenthes*
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	*G. (G.) quinqueloba*
					●		●	●	cf.	●	●	●	●			●	●	●	●	●	●	●	●	*G. (G.) woodi decoraperta*
																								Globigerinella
●	●	●	●	●	●	●	●	●	●	●		●						●		●	●			*G. aequilateralis*
																								Globigerinita
		●	●		●		●	●	●		●		●	●	●		●	●			●		●	*G. glutinata*
																								Globigerinoides
				●																				*G. conglobatus*
			●						cf.	●			●	cf.										*G. obliquus*
●	●		●	●	●	●	●		cf.				●							cf.				*G. ruber*
									cf.															*G. sacculifer*
																	●							*G. trilobus*
																								Globoquadrina
						●							●											*G. altispira*
																								Globorotalia
										cf.														*G. (G.) hirsuta*
									cf.	cf.	●	●	cf.	●	●		cf.		●	●	●	●	●	*G. (G.) miotumida miotumida*
																●	●		●	●	●	●	●	*G. (G.) miotumida explicationis*
																●	●	●	●	●	●	●	●	*G. (G.) miozea conoidea*
												●	●	●	●	●	●	cf.						*G. (G.) miozea conomiozea*
														cf.	●									*G. (G.) miozea sphericomiozea*
●	●	●	●																					*G. (G.) truncatulinoides*
●	●	●	●	●	●	●	●	cf.	●	●	●	●	●		cf.									*G. (T.) crassaformis*
													cf.											*G. (T.) humerosa*
●	●	●	●	●	●	●	●	●																*G. (T.) inflata*
																cf.		cf.	●		●			*G. (T.) mayeri continuosa*
●	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●	cf.		*G. (T.) pachyderma*
					●	●	●	●	●	●	●	●	●	●											*G. (T.) puncticulata*
●	●	●	●	●	●	●	●	●	●	●	●	●	●	cf.	●	●	●	●	●	●	●			*G. (T.) scitula*
																								Hastigerina
								●									●							*H. pelagica*
																								Orbulina
															●							●		*O. bilobata*
●		●	●		●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●		*O. universa*
																								Sphaeroidinella
	●																							*S. dehiscens*

TABLE 7
Correlation of New Zealand Planktonic Foraminiferal Zones and Zones Used on Leg 29

INTERNATIONAL UNITS	NEW ZEALAND PLANKTONIC FORAMINIFERAL ZONES	LEG 29 ZONES AT SITES 275 277, 279 282, 284	INFORMAL ZONES AT SITE 278
PLEISTOCENE	*G. (G.) truncatulinoides*	? *G. (G.) truncatulinoides* ?	
PLIOCENE	*G. (T.) inflata*	*G. (T.) inflata*	
	G. (T.) puncticulata	*G. (T.) puncticulata*	
—?— —?—	*G. (G.) miozea sphericomiozea*	*G. (G.) miozea conomiozea*	
U	*G. (G.) miotumida miotumida*	*G. (G.) miotumida miotumida*	*G. (G.) bulloides*
	G. (T.) mayeri mayeri	*G. (T.) mayeri mayeri*	
M	*O. suturalis*	*O. suturalis*	*G. (T.) conica*
MIOCENE	*P. glomerosa curva*	*P. glomerosa curva*	
	G. trilobus trilobus	*G. trilobus trilobus*	
L	*G. (G.) woodi connecta*	*G. (G.) woodi connecta*	*G. (G.) woodi*
	G. (G.) woodi woodi	*G. (G.) woodi woodi*	
	G. dehiscens		
	G. (G.) eupertura	*G. (G.) eupertura*	
OLIGOCENE	*G. (S.) angiporoides angiporoides*	*G. (S.) angiporoides angiporoides*	
	G. (G.) brevis	*G. (G.) brevis*	
U	*G. (S.) linaperta*	? *G. (S.) linaperta*	
	G. (T.) inconspicua	*G. (T.) aculeata*	
	G. (G.) index index	*G. (G.) index index*	
M	*P. primitiva*	*P. primitiva*	
EOCENE	*G. (M.) crater crater*	*G. (M.) crater crater*	
L	*G. wilcoxensis*	*G. wilcoxensis*	
PALEOCENE	*G. (S.) triloculinoides*	*G. (S.) triloculinoides*	

TABLE 8
Planktonic Foraminiferal Zones Used on Leg 29 and Taxa Used to Delineate the Zonal Boundaries

INTERNATIONAL UNITS	PLANKTONIC FORAMINIFERAL ZONES USED ON LEG 29	TAXA USED TO DELINEATE ZONES
PLEISTOCENE	*Globorotalia (G.) truncatulinoides*	← INITIAL APPEARANCE OF *G. (G.) truncatulinoides*
	Globorotalia (T.) inflata	← INITIAL APPEARANCE OF *G. (T.) inflata*
PLIOCENE	*Globorotalia (T.) puncticulata*	← EXTINCTION OF *G. (G.) miozea conomiozea*
—?— —?—	*Globorotalia (G.) miozea conomiozea*	← INITIAL APPEARANCE OF *G. (G.) miozea conomiozea*
U	*Globorotalia (G.) miotumida miotumida*	← EXTINCTION OF *G. (T.) mayeri mayeri*
	Globorotalia (T.) mayeri mayeri	← INITIAL APPEARANCE OF *G. (T.) mayeri mayeri*
M	*Orbulina suturalis*	← INITIAL APPEARANCE OF *O. suturalis*
MIOCENE	*Praecrbulina glomerosa curva*	← INITIAL APPEARANCE OF *P. glomerosa curva*
	Globigerinoides trilobus trilobus	← INITIAL APPEARANCE OF *G. trilobus trilobus*
L	*Globigerina (G.) woodi connecta*	← INITIAL APPEARANCE OF *G. (G.) woodi connecta*
	Globigerina (G.) woodi woodi	← INITIAL APPEARANCE OF *G. (G.) woodi woodi*
		← INITIAL APPEARANCE OF *G. dehiscens*
	Globigerina (G.) eupertura	← EXTINCTION OF *G. (G.) angiporoides angiporoides*
OLIGOCENE	*Globigerina (S.) angiporoides angiporoides*	← EXTINCTION OF *G. (T.) gemma*
	Globigerina (G.) brevis	← INITIAL APPEARANCE OF *G. (T.) gemma*
U	*Globigerina (S.) linaperta*	← EXTINCTION OF *G. (T.) aculeata*
	Globorotalia (T.) aculeata	← INITIAL APPEARANCE OF *C. cubensis*
	Globigerinatheka (G.) index index	← INITIAL APPEARANCE OF *G. (G.) index index*
M	*Pseudoglobaquadrina primitiva*	← EXTINCTION OF *G. (M.) crater crater*
EOCENE	*Globorotalia (M.) crater crater*	← INITIAL APPEARANCE OF *G. (M.) crater crater*
L	*Globanomalina wilcoxensis*	← INITIAL APPEARANCE OF *G. wilcoxensis*
PALEOCENE	*Globigerina (S.) triloculinoides*	

TABLE 9
Planktonic Foraminiferal Zones Penetrated at Sites Drilled on Leg 29