United States Interior Department
Minerals Management Service

**MMS**

# Biostratigraphic Chart of the Gulf of Mexico Offshore Region, Jurassic to Quaternary

## Recent through Oligocene

| Time (mya) (not to scale) | Chronostratigraphy: System | Subsystem | Series | Stage | Biostratigraphy: Foraminiferal planktic and benthic regional and local markers | Calcareous nannoplanktic regional and local markers | MMS Chronozone: Proposed | Current |
|---|---|---|---|---|---|---|---|---|
| | Quaternary | | Holocene | | Globorotalia inflata | | | |
| 0.20 | | | Pleistocene: Upper | Ionian | Globorotalia flexuosa<br>Sangamon fauna | Emiliania huxleyi (base of acme)<br>Pontosphaera indooceanica<br>Gephyrocapsa oceanica flood<br>Gephyrocapsa caribbeanica flood | PLU | UPL |
| 0.78 | | | Middle | | Globorotalia truncatulinoides coiling change, right-to-left<br>Trimosina "A" | Helicosphaera inversa<br>Pseudoemiliania lacunosa "A"<br>Pseudoemiliania lacunosa "B"<br>Gephyrocapsa caribbeanica increase<br>Gephyrocapsa omega<br>Gephyrocapsa parallela | PLM | |
| 1.77 | | | Lower | Calabrian | Siliostomella antillea<br>Globorotalia inciisa<br>Sphaeroidinella dehiscens acme "A"<br>Trimosina "A" acme<br>Angulogerina magna<br>Hyalinea balthica / Trimosina "B"<br>Globorotalia tosaensis tosaensis<br>Sphaeroidinella dehiscens acme "B"<br>Angulogerina "B"<br>Uvigerina hispida | Pseudoemiliania lacunosa "C" acme<br>Gephyrocapsa aperta acme<br>Scyphosphaera pulchermina<br>Gephyrocapsa sp. (large variety)<br>Helicosphaera sellii<br>Reticulofenestra pseudoumbilica<br>Calcidiscus macintyrei | PLL | |
| 2.60 | | Pliocene | Upper | Gelasian | Globorotalia crassula acme,<br>Globorotalia praehirsuta<br>Cristellaria "S"<br>Globorotalia menardii coiling change, left-to-right<br>Globorotalia exilis<br>Globorotalia miocenica<br>Globorotalia partenuia<br>Bolivina imporcata / "P"<br>Lenticulina 1<br>Textularia crassiseptа / "P" | Calcidiscus macintyrei increase<br>Discoaster brouweri<br>Discoaster brouweri "A"<br>Discoaster pentaradiatus<br>Discoaster surculus | MPL | MPL |
| 3.55 | | | | Piacenzian | Caratubulimina pacifica<br>Cassidulina laevigata carinata acme / "L"<br>Haplophragmoides emaciatum<br>Saracenaria "H"<br>Globorotalia multicamerata<br>Globoquadrina altispira = Valvulineria "H"<br>Cycloclypeus sp.<br>Arenaceous fauna<br>Cibicides grossaperforatus<br>Sphaeroidinellopsis seminulina<br>Textularia 1 | Discoaster asymmetricus<br>Cyclococcolithus cartae,<br>Discoaster tamalis | PU | LPL |
| 5.32 | | | Lower | Zanclean | Succella (Eponides) hannai acme<br>Cibicides mansi<br>Globorotalia margaritae<br>Uvigerina nadica<br>Globigerina cruryi / neperthes "B"<br>Globigerina neperthes<br>Bulimmella 1<br>Siphonodularia jugosa / "J"<br>Signoilina "P" / cf. schlumbergeri<br>Sphaeroidinellopsis multilobata<br>Globigerinoides mitra<br>Globorotalia pleistocenica acme | Sphenolithus abies<br>Reticulofenestra pseudoumbilica,<br>Discoaster intercalaris,<br>Dictyococcites antarcticus<br>Pseudosphenolithus abies "B" acme<br>Sphenolithus abies "B"<br>Amaurolithus tricorniculatus<br>Ceratolithus acutus<br>Discoaster quinqueramus | PL | UP |
| 7.12 | | Neogene | Miocene: Upper | Messinian | Globorotalia menardii coiling change, right-to-left<br>Globorotalia margaritae primitiva<br>Globorotalia juanai<br>Textularia "X"<br>Textularia latumi<br>Bolivina denticulata | Discoaster quinqueramus<br>Discoaster berggrenii<br>Reticulofenestra rotaria<br>Discoaster berggrenii "A" | MUU | LP |
| 11.20 | | | | Tortonian | Textularia 6<br>Bigenerina irregularis / 6<br>Globorotalia acostaensis coiling change, right-to-left<br>Planulina renzi<br>Reophax davyoppei,<br>Robulus "E"<br>Bigenerina floridana / "A"<br>Cristellaria "K"<br>Malonia pompilioides increase<br>Cibicides trinchera esemis<br>Uvigerina carapitana<br>Amphistegina "E"<br>Cycloclypeus 3<br>Globorotalia lenguaensis,<br>Bolivina thalmanni<br>Discorbis 12<br>Bigenerina "B"<br>Eponides mansfieldi<br>Textularia "G"<br>Globoquadrina dehiscens<br>Robulus 15<br>Textularia "L"<br>Cibicides inflata<br>Cibicides carstensi,<br>Bigenerina 2<br>Globorotalia mayeri<br>Globorotalia siakensis<br>Uvigerina 3,<br>Cibicides carstensi increase | Discoaster neohamatus<br>Discoaster loeblichii<br>Minylithus convallis<br>Catinaster mexicanus<br>Discoaster bellus,<br>Discoaster calcaris<br>Discoaster prepentadiatus<br>Discoaster prepentaradiatus increase<br>Discoaster bollii,<br>Catinaster calyculus<br>Discoaster hamatus<br>Catinaster coalitus<br>Discoaster exilis<br>Helicosphaera walbersdorfensis<br>Coccolithus mopelagicus | MUU | UM3 |
| 14.80 | | | Middle | Serravallian | Globorotalia fohsi robusta<br>Robulus 5 / 55<br>Textularia "W"<br>Globorotalia fohsi lobata<br>Globorotalia fohsi praefohsi<br>Globorotalia fohsi fohsi<br>Globorotalia peripheroacuta<br>Bigenerina humblei<br>Cyrtostina miocenica<br>Globorotalia peripheroronda<br>Cristellaria "I"<br>Praeorbulina glomerosa<br>Cibicides opima | Discoaster kugleri<br>Discoaster kugleri acme<br>Calcidiscus premacintyrei<br>Cyclicargolithus floridanus<br>Discoaster sanmiguelensis<br>Sphenolithus heteromorphus<br>Sphenolithus heteromorphus acme | MLU<br>MUM<br>MMM | UM1<br>MM9<br>MM7 |
| 16.40 | | | | Langhian | Robulus 53<br>Amphistegina "B"<br>Globorotalia siakensis coiling change, left-to-right<br>Globigerinatella insueta<br>Robulus "L" / 43<br>Cibicides 35 | Helicosphaera ampliaperta<br>Discoaster defandreri acme<br>Discoaster calculosus | MLM | MM4 |
| 20.52 | | | Lower | Burdigalian | Cassigerina 1<br>Robulus 54b = Cristellaria 54<br>Saracenaria sp. / "D"<br>Gyroidina "K" / 9 / 4<br>Catapsydrax stainforthi<br>Catapsydrax dissimilis,<br>Robulus chambersi,<br>Discorbis bolivarensis / "B",<br>Cristellaria "A"<br>Marginulina ascensionensis / "A"<br>Globigerina binaensis<br>Gyroidina 8<br>Siphonodularia fredsmithi | Sphenolithus belemnos<br>Helicosphaera euratrisenta<br>Sphenolithus disbelemnos<br>Orthorhabdus serratus<br>Triquetrorhabdulus carinatus,<br>Triquetrorhabdulus challengeri<br>Discoaster calculosus increase | MUL<br>MML | LM4 |
| 23.80 | | Paleogene | Oligocene: Upper | Chattian | Siphonina davisi<br>Planulina palmerae<br>Globigerinoides primordius<br>Lenticulina harsanyi<br>Lenticulina jeffersonensis,<br>Cristellaria "R",<br>Globorotalia kugleri,<br>Globigerina angulisuturalis | Discoaster saundersi<br>Sphenolithus dissimilis<br>Cyclicargolithus abisectus<br>Helicosphaera recta | MLL | LM2<br>LM1 |
| 28.50 | | | Lower | Rupelian | Robulus "A"<br>Discorbis gravelli<br>Globigerina ciperoensis ciperoensis<br>Heterostegina texana<br>Cibicides jeffersonensis<br>Bolivina perca<br>Marginulina idiomorpha<br>Marginulina vaginata<br>Marginulina howei<br>Camerina "A"<br>Nisogoniatodes "A"<br>Cibicides haizardi<br>Globorotalia opima nana<br>Globorotalia opima opima<br>Cristellaria "H"<br>Marginulina texana<br>Bolivina mexicana<br>Nonion struma<br>Rodosaria blanpiedi<br>Discorbis "D"<br>Chiloguembelina cubensis<br>Textularia mississippiensis seligi<br>Anomalina bilateralis<br>Globigerina ampliapertura<br>Spiroplectammina mississippiensis<br>Globorotalia increbescens<br>Textularia warreni<br>Pseudohastigerina micra<br>Lacostomo "B"<br>Cibicides pippeni<br>Cibicides mississippiensis | Dictyococcites bisectus<br>Sphenolithus ciperoensis<br>Ericsonia fenestratra<br>Zygrhablithus bijugatus<br>Sphenolithus ciperoensis<br>Sphenolithus distentus<br>Sphenolithus predistentus<br>Sphenolithus pseudoradians,<br>Reticulofenestra hempdenensis<br>Reticulofenestra umbilica<br>Reticulofenestra hillae<br>Ericsonia formosa<br>Ericsonia subdisticha<br>Discoaster noeliae<br>Isensolithus recurvus | OU<br>MO<br>OL | UO<br>MO<br>LO |

33.70

## Eocene through Jurassic

| Time (mya) (not to scale) | Chronostratigraphy: System | Subsystem | Series | Stage | Biostratigraphy: Planktic and benthic foraminifera and ostracod (O) regional and local markers | Calcareous nannoplanktic regional and local markers | MMS Chronozone: Proposed | Current |
|---|---|---|---|---|---|---|---|---|
| 33.70 | Tertiary | Paleogene: Eocene | Upper | Priabonian | Globorotalia cerroazulensis cocoaensis,<br>Hantkenina alabamensis<br>Textularia hockleyensis<br>Globorotalia cerroazulensis pomerolii<br>Textularia dibolensis<br>Globigerinatheka tropicalis / mexicana<br>Globigerinatheka seminvoluta<br>Camerina moodybranchensis,<br>Camerina jacksonensis | Discoaster saipanensis,<br>Micrantholithus altus<br>Discoaster barbadiensis<br>Chiasmolithus consuetus<br>Crococentrum reticulatum<br>Sphenolithus obtusus | EU | UE |
| 37.00 | | | Middle | Bartonian | Nonionella cocklieldensis<br>Truncorotaloides rohri<br>Cibicides yeguaensis<br>Eponides yeguaensis<br>Nodosaria mexicana<br>Ceratobulimina eximia<br>Morozovella lehneri<br>Eponides gaselytensis<br>Globorotalia bullbrooki<br>Truncorotaloides topilensis<br>Clavulinoides guayabalensis<br>Operculinoides salinensis<br>Cibicinoides beckmanni<br>Subbotina frontosa<br>Acarinina broedermanni | Micrantholithus procerus,<br>Chiasmolithus grandis,<br>Perma papillatum<br>Perma basquensis<br>Perma stradneri<br>Perma balium<br>Chiasmolithus gigas | EM | ME |
| 41.30 | | | Lutetian | | Cyclammina canefriveriensis<br>Discocyclina advena<br>Morozovella aragonensis<br>Haplostylheridea stenzeli (O) | Discoaster sublodoensis,<br>Sphenolithus spiniger<br>Rhabdosphaera inflata<br>Discoaster lodoensis | | |
| 49.00 | | | Lower | Ypresian | Acarinina soldadoensis<br>Morozovella quetra<br>Acarinina angulosa<br>Morozovella nox / subbotinae<br>Morozovella formosa formosa<br>Morozovella wilcoxensis<br>Morozovella acuta | Chiasmolithus californicus<br>Tribrachiatus orthostylus<br>Toweius craassus<br>Tribrachiatus contortus<br>Discoaster multiradiatus | EL | LE |
| 54.50 | | Paleocene | Upper | Thanetian | Morozovella velascoensis<br>Cythereidea subinensis (O)<br>Discorbis washburni<br>Planulorotaliites pseudomenardii<br>Morozovella anguista<br>Planulorotaliites pusilla pusilla<br>Planulorotaliites compressa<br>Vaginulina longiforma,<br>Subbotina pseudobulloides<br>Morozovella uncinata | Fasciculithus tympaniformis<br>Heliolithus kleinpellii<br>Heliolithus reidelii<br>Toweius eminens<br>Chiasmolithus bidens<br>Discoaster diastypus | LU | UL |
| 57.90 | | | Selandian | | Vaginulina midwayana,<br>Globorotalia inconstans | | | |
| 60.90 | | | Lower | Danian | Globigerina triloculinoides<br>Globoconusa daubjergensis<br>Robulus pseudocostata<br>Globigerina eugubina | Chiasmolithus danicus<br>Markalius inversus astroporus | LL | LL |
| 65.00 | Cretaceous | | Upper | Maastrichtian | Aaathomphalus mayaroensis<br>Globotruncana contusa<br>Gansserina gansseri<br>Rosita fornicata<br>Globotruncana ventricosa<br>Globotruncana lapparenti | Micula decussata<br>Micula prinsii FAD<br>Micula murus FAD<br>Watznaueria barnesiae FAD<br>Nephrolithus frequens FAD<br>Reinhardtites levis<br>Tetralithus trifidus<br>Tranolithus phacelosus | KUU | UK4 |
| 71.30 | | | | Campanian | Globotruncana calcarata<br>Globotrolites michelieniana<br>Globotruncana elevata<br>Archaeoglobigerina bosquensis<br>Stensioina exsculpta exsculpta<br>Marginotruncana marginata<br>Marginotruncana coronata<br>Whitemella baltica<br>Planoglobulina taylorana | Aspidolithus parcus constrictus<br>Reinhardtites anthophorus "A"<br>Eiffellithus eximius<br>Aspidolithus parcus parcus<br>Reinhardtites anthophorus "B"<br>Lithastrinus grillii<br>Bukryaster hayi<br>Broinsonia enormis<br>Marthasterites furcatus | | |
| 83.50 | | | | Santonian | Dicarinella asymetrica<br>Whitemella inornata<br>Marginotruncana sinuosa<br>Hedbergella delrioensis<br>Stensioina granulata granulata<br>Dicarinella concavata,<br>Marginotruncana renzi | Eprolithus floralis<br>Zeugrhabdotus noeliae<br>Lithastrinus moratus | | |
| 85.80 | | | | Coniacian | Dicarinella imbricata<br>Whitemella pseudobulla<br>Hedbergella simplelis | Quadrum gartneri<br>Slovenia echyiosus | | |
| 89.00 | | | | Turonian | Dicarinella hagni<br>Planulina eaglefordensis<br>Helvetoglobotruncana helvetica<br>Praeglobotruncana stephani,<br>Helvetoglobotruncana praehelvetica | Chiastozygus platylrethum<br>Parhabdolithus achlyosteurion<br>Calculites acsoutsiatis<br>Parhabdolithus asper | KLU | UK2 |
| 93.50 | | | | Cenomanian | Globigerinelloides bentonensis<br>Rotalipora cushmani<br>Rotalipora greenhornensis<br>Rotalipora appenninica<br>Rotalipora reichelí<br>Lenticulina gaulina,<br>Praeacrylthrellas tenuiensis (O),<br>Feruseella washitensis<br>Textularia ritoensis<br>Rotalipora gandolfi | Microstaurus chiastius<br>Axopodorhabdus albianus<br>Lithraphidites acutus<br>Lithraphidites praequadratus<br>Corollithion kennedyi | | LK8 |
| 99.60 | | | Lower | Albian | Planomalina buxtorfi<br>Rotalipora ticinensis<br>Ticinella roberti<br>Cythereis Hedericksburgensis (O), Cyth. brevis (O)<br>Cytheridea goodlandensis (O), C. olivensis (O)<br>Biticinella breggiensis<br>Ammobaculites goodlandensis<br>Dictyocoxus walnutensis<br>Eocytheropteron trinitiensis (O)<br>Orbitolina texana<br>Rehacythereis ? aff. R. glabrella (O) | Hayesites albiensis<br>Braarudosphaera africana<br>Braarudosphaera hockwoldensis<br>Predacosphaera columnata<br>Crucicribrum anglicum<br>Rucinolithus irregularis | KUL<br>KML | LK6 |
| 112.20 | | | | Aptian | Ticinella bejaouaensis<br>Planomalina cheniouensis<br>Epistomina sp.<br>Globigerinelloides algerianus<br>Globigerinelloides blowi<br>Schackoina cabri<br>Globigerina hoterivia<br>Hedbergella sigali<br>Chofatella decipiens | Eprolithus antiquus<br>Conusphaera mexicana,<br>Micrantholithus obtusus<br>Nannoconus kampneri<br>Micrantholithus hoschulzi<br>Nannoconus steinmanni<br>Conusphaera rothii | KLL | LK3 |
| 121.00 | | | Coahuilian | Barremian | Schulerideа lacustris (O)<br>Cheilheribergella escretacea | Nannoconus colomi<br>Nannoconus abundans<br>Calcicalathina oblongata<br>Lithraphidites bollii | | |
| 127.00 | | | | Hauter. | | Speetonia colligata | | |
| 132.00 | | | | Valang. | Eversticyclammina virginiulina<br>Schulerideа acuminata (O) | Crucibiglobus cuvillieri<br>Tubodiscus verenae<br>Rucinolithus wisei<br>Diadorhombus rectus | | |
| 137.00 | | | | Berriasian | Hubsonia vulgaris / callahani (O)<br>Pentaschulerideа pentagonalis (O) | Micrantholithus speetonensis<br>Polycostella senaria<br>Polycostella beckmanni | | |
| 144.20 | | Jurassic | Upper | Tithonian | Callaxycytheridea poahontunda (O)<br>Succicrenata italica increase | Hexalithus noelae | JU | UJ4 |
| 150.70 | | | | Kimmer. | Epistomina mosquensis<br>Alveoseptа jaccardi | Stephanolithion bigotii bigotii<br>Stephanolithion bigotii maximum | | |
| 154.10 | | | | Oxfordian | Globuligerina oxfordiana<br>Lenticulina quenstedti | Discorhabdus jungii | | |
| 159.40 | | | Middle | Callovian | Paalzowella feifeli<br>Reinholdella crebra<br>Epistomina regularis<br>Epistomina cornuta | Stephanolithion speciosum<br>Stephanolithion hexum<br>Watznaueria crucicentralis | JM | MJ |

164.40

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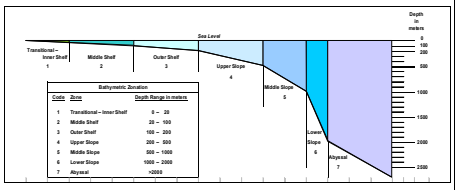
*For public release May 1, 2003*








## References used for Mesozoic and Cenozoic age determination and stratigraphic units


Armentrout, J. M., 1996, High resolution sequence biostratigraphy: examples from the Gulf of Mexico Plio-Pleistocene, in J. A. Howell and J. F. Aitken, eds., High-resolution sequence stratigraphy: innovations and applications: Geological Society Special Publication 104, p. 65–86.

Ascoli, P., 1984, Epistominid biostratigraphy across the Jurassic-Cretaceous boundary on the northwestern Atlantic shelf: Benthos 83, International Symposium on Benthic Foraminifera, Pau, p. 27-34.

Ascoli, P., C. W. Poag, and J. Remane, 1984, Microfossil zonation across the Jurassic-Cretaceous boundary on the Atlantic margin of North America, in G. E. Westermann, ed., Jurassic-Cretaceous biochronology and paleogeography of North America: Geological Association of Canada Special Paper 27, p. 31-48.

Bergen, J. A., and P. J. Sikora, 1999, Microfossil diachronism in southern Norwegian North Sea chalks: Valhall and Hod fields, in R. W. Jones and M. D. Simmons, eds., Biostratigraphy in production and development geology: Geological Society Special Publication 152, p. 85-111.

Berggren, W. A., D. V. Kent, C. C. Swisher III, and M.-P. Aubry, 1995, A revised Cenozoic geochronology and chronostratigraphy, in W. A. Berggren, D. V. Kent, M.-P. Aubry, and J. Hardenbol, eds., Geochronology, time scales and global stratigraphic correlation: Society of Economic Paleontologists and Mineralogists Special Publication 54, p. 129-212.

Bolli, H. M., J. B. Saunders, and K. Perch-Nielsen, eds., 1985, Plankton stratigraphy, volume 1: planktic foraminifera, calcareous nannofossils and calpionellids: Cambridge, Cambridge University Press, 509 p.

Bolli, H. M., J.-P. Beckmann, and J. B. Saunders, 1994, Benthic foraminiferal biostratigraphy of the south Caribbean region: Cambridge, Cambridge University Press, 408 p.

Bralower, T. J., R. M. Leckie, W. V. Sliter, and H. R. Thierstein, 1995, An integrated Cretaceous microfossil biostratigraphy, in W. A. Berggren, D. V. Kent, M.-P. Aubry, and J. Hardenbol, eds., Geochronology, time scales and global stratigraphic correlation: Society of Economic Paleontologists and Mineralogists Special Publication 54, p. 65-79.

Breard, S. Q., M. Nault, and A. D. Callender, 1994, Biostratigraphy and paleoecologic tolerances of Oligocene Paleocene foraminiferal assemblages of the Gulf Coast basin: Gulf Coast Association of Geological Societies Transactions, v. 44, p. 111-116.

Breard, S. Q., A. D. Callender, and M. Nault, 1997, Application of bathyal foraminiferal events to the Neogene through Pleistocene biostratigraphic framework of the Gulf of Mexico basin: Gulf Coast Association of Geological Societies Transactions, v. 47, p. 65-73.

Breard, S. Q., A. D. Callender, and M. Nault, 2000, Gulf of Mexico basin Late Tertiary deep-water biostratigraphic zonation: relationship to standard shelf foraminiferal and calcareous nannofossil marker terminology: Gulf Coast Section Society of Economic Paleontologists and Mineralogists Foundation Twentieth Annual Research Conference Deep-water Reservoirs of the World, December 3-6, 2000, Houston.

Brenchley, P. J., and D. A. T. Harper, 1998, Palaeoecology: ecosystems, environments and evolution: London, Chapman and Hall, 402 p.

Catalano, R. E., E. Di Stefano, A. Sulli, F. P. Vitale, S. Infuso, and P. R. Vail, 1998, Sequences and system tracts calibrated by high-resolution bio–chronostratigraphy: the central Mediterranean Plio-Pleistocene record, in P.-C. de Graciansky, J. Hardenbol, T. Jacquin, and P. R. Vail, eds., Mesozoic and Cenozoic sequence stratigraphy of European basins: Society of Economic Paleontologists and Mineralogists Special Publication 60, p. 155-177.

Frizzell, D. L., 1954, Handbook of Cretaceous foraminifera of Texas: Bureau of Economic Geology Report of Investigations 22, 232 p.

Gradstein, F. M., 1976, Biostratigraphy and biogeography of Jurassic Grand Banks foraminifera: Maritime Sediments Special Publication, v. 16, p. 557-583.

Gradstein, F. M., F. P. Agterberg, and M. A. D'Iorio, 1990, Time in quantitative stratigraphy, in T. A. Cross, ed., Quantitative dynamic stratigraphy, p. 519-542.

Gradstein, F. M., F. P. Agterberg, J. G. Ogg, J. Hardenbol, P. van Veen, J. Thierry, and Z. Huang, 1995, A Triassic, Jurassic and Cretaceous time scale, in W. A. Berggren, D. V. Kent, M.-P. Aubry, and J. Hardenbol, eds., Geochronology, time scales and global stratigraphic correlation: Society of Economic Paleontologists and Mineralogists Special Publication 54, p. 95-126.

Jones, R. W., 1996, Micropaleontology in petroleum exploration: Oxford, Oxford University Press, 432 p.

Jones, R. W., and M. D. Simmons, eds., 1999, Biostratigraphy in production and development geology, Geological Society of London Special Publication 152, 318 p.

Lawless, P. N., R. H. Fillon, and R. G. Lillon III, 1997, Gulf of Mexico Cenozoic biostratigraphic, lithostratigraphic, and sequence stratigraphic event chronology: Gulf Coast Association of Geological Societies Transactions, v. 47, p. 271-282.

Lord, A. R., ed., 1982, A stratigraphic index of calcareous nannofossils: Chichester, British Micropaleontological Society, 192 p.

Picou, E. B., Jr., B. F. Perkins, N. C. Rosen, and M. J. Nault, eds., 1999, Gulf of Mexico basin biostratigraphic index microfossils - a geoscientist's guide: foraminifera and nannofossils, parts I and II, Oligocene through Pleistocene foraminifera: Gulf Coast Society of Economic Paleontologists and Mineralogists Foundation, 215 p., 3 charts, 2 tables of synonyms (Text and CD-ROM).

Prothero, D. R., 2001, Magnetostratigraphic tests of sequence stratigraphic correlations from the southern California Paleogene, Journal of Sedimentary Research, v. 71, p. 526-536.

Simmons, M. D., W. D. Berggren, R. O. Krakhardy, B. J. O'Neill, R. W. Scott, and W. Ziegler, 1997, Biostratigraphy and geochronology in the 21st century: Paleontology in the 21st century, an International Senckenberg Conference and Workshop, reports and recommendations. http://www.nhm.ac.uk/hosted_sites/paleonet/paleo21/paleo21.html

Stainforth, R. M., J. L. Lamb, H. Luterbacher, J. H. Beard, and R. M. Jeffords, 1975, Cenozoic planktonic foraminiferal zonation and characteristics of index forms: University of Kansas Paleontological Institute, Art. 62, 162 p.

Styzen, M. J., 1996, Late Cenozoic chronostratigraphy of the Gulf of Mexico: Gulf Coast Society of Economic Paleontologists and Mineralogists Foundation, chart, 2 sheets.

Total Biostratigraphic Services, 1994, Miocene/Oligocene biostratigraphic chart (Gulf of Mexico): Total Biostratigraphic Services, Inc., New Orleans.

Waterman, A. S., 1999, Biostratigraphic chart, Gulf of Mexico Neogene (version 9909): Paleo-Data, Inc., New Orleans.

Wood, L. J., 2000, Chronostratigraphy and lectonostratigraphy of the Columbus basin, eastern offshore Trinidad: American Association of Petroleum Geologists Bulletin, v. 84, p. 1905-1928.


## LEGEND

All foraminiferal markers are extinction points (LADs) unless otherwise indicated.
**(O)** indicates an ostracode species.
The calcareous nannoplanktic markers are mainly coccolith species LADs. Dinoflagellates and palynomorphs (pollen) are occasionally used.
**LAD:** *Last Appearance Datum*
**FAD:** *First Appearance Datum*
Species LADs separated by a virgule (the diagonal mark "/") indicates either synonymous species or synchronous species.
Species LADs separated by "+" indicates symmetrical species.
Two or more species LADs separated by a comma indicate synchronous species LADs.
(for example, Discoaster bollii, Catinaster calyculus are two separate but time-equivalent coccolith extinction points).
**MMS Chronozone:** A body of rock formed during the same time span, bounded by biostratigraphic or correlative seismic markers.

References to this chart should be as follows:
Wilrock, R. B., A. R. Friedmann, J. J. Galluzzo, L. D. Nixon, P. J. Post, and K. M. Ross, 2003, Biostratigraphic chart of the Gulf of Mexico offshore region, Jurassic to Quaternary, U. S. Department of the Interior, Minerals Management Service, New Orleans.