INTEGRATED DSDP/ODP PALEONTOLOGIC DATABASES

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Summary

The paleontologic data collected by scientists using material from the Deep Sea Drilling Program (DSDP) and the Ocean Drilling Program (ODP) form one of the largest sets of information on the distribution of oceanic microfossils in time and space. Uniform distribution and range charts for major oceanic microfossil groups are available at the GEOMAR section of the Ocean Drilling Stratigraphic Network (ODSN) website (www.odsn.de). The homogenization involves synonymization of the taxa and expression of their abundances according to a standardized numerical format. The distribution charts show all of the occurrences of the fossils that were reported, by sample number and depth in section. The range charts show only the stratigraphic intervals within which the highest and lowest occurrences of the fossils must lie. The range charts are converted to graphic age-depth plots using age calibration of the fossil datums. The age-depth plots show the lowest and highest occurrence datums for species and the uncertainty of the datum's depth in the hole. The datum ages are according to the latest available compilation, but because these differ from older calibrations using older timescales there is also a module that allows the different timescales used over the history of the ocean drilling programs to be compared.
Paleobiogeographic distributions can be reconstructed from the databases. The distribution of a taxon or taxa in DSDP/ODP drill sites can be shown as present or absent, and the sites inserted into plate tectonic reconstructions.

Introduction

The paleontologic data sets for the DSDP have been available on CD-Rom from the U.S. National Geophysical Data Center in Boulder, Colorado. However, many paleontologists found the format in which they were presented (lists of species occurring in a given sample) to be inconvenient for research purposes. The data originally on CD-ROM have been converted into a format which is readily accessible and can easily be manipulated. Paleontologic data for the ODP, which have been available in the form of Excel sheets at the ODP website, have been converted into the same format. Stratigraphic distribution data are currently available for the following: calcareous nannoplankton, diatoms, planktic foraminifers, benthic foraminifers, radiolarians, and silicoflagellates.

During the 30+ years of DSDP and ODP taxonomic work has resulted in erection of new species and genera, synonymizing of described species, and many generic reassignments. Synonymy lists for species names and for generic assignments were compiled from monographs and other major publications on the paleontology and taxonomy of the planktic foraminifera and calcareous nannoplankton.

Distribution and range charts for paleontologic data

Charts which show the presence/absence or relative abundance of species in specific samples are available as "distribution charts." Relative abundance data were originally presented in a variety of ways. In addition to the original mode of presentation (Fig. 1), these have been unified into a simple numeric scheme (absent = 0, rare = 1, few = 2, common = 3, abundant = 4, very abundant = 5) to make data from different sites compatible. To eliminate outlier occurrences, the numeric stratigraphic distribution charts have been smoothed with a three-point rolling average to produce "smoothed distribution charts."

Hole 360

Investigator	Core	Section	Depth	Chiloguembelin: sp.	Globorotalia acostaensis	Globorotalia crassaformis	Globorotalia humerosa	Globorotalia margaritae	Globorotalia menardii	Globorotalia miozea miozea	Globorotalia puncticulata	Globorotalia scitula	Globigerinoides obliqus	Globigerinoides sacculifer	Globigerina bradyi	Globigerina bulloides	Globigerina falconensis	Globigerina nepenthes	Globigerina quinqueloba
JENKINS,D.G.	1	1	79.81	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
JENKINS,D.G.	1	0	87.1		P	P	P	P	P	P	P	P	P	P		P			
JENKINS,D.G.	2	1	90.28	P	P	P	P	P	P	P	P			P	P	P	P		P
JENKINS,D.G.	2	0	98.5		P	P		P	P				P	P		P			
JENKINS,D.G.	3	3	102.39	P	P	P			P			P	P	P	P	P		P	P
JENKINS,D.G.	3	0	107.6		P	P			P			P	P			P		P	
JENKINS,D.G.	4	3	111.9		P				P	P		P	P	P	P	P		P	P
JENKINS,D.G.	4	0	115.6		P	P			P	P			P					P	
JENKINS,D.G.	5	3	121.93		P				P	P		P	P	P	P	P			P
JENKINS,D.G.	5	0	126.95		P		P		P	P			P			P			
JENKINS,D.G.	6	3	131.14		P				P	P		P	P	P	P	P		P	
JENKINS,D.G.	6	0	136.35		P				P	P		P	P			P		P	
JENKINS,D.G.	7	3	140.6		P				P	P		P	P		P	P		P	P
JENKINS,D.G.	7	0	145.6		P				P	P		P	P	P		P		P	
JENKINS,D.G.	8	3	150.09		P				P	P		P				P		P	P
JENKINS,D.G.	8	0	150.6		P				P			P	P			P			
JENKINS,D.G.	9	3	159.77		P				P	P		P	P			P		P	
JENKINS,D.G.	10	3	169.07		P				P	P		P		P		P		P	
JENKINS,D.G.	10	0	169.6		P					P		P				P			
JENKINS,D.G.	11	3	178.1		P				P	P		P	P	P	P	P		P	P
JENKINS,D.G.	11	0	183.6		P				P					P				P	
JENKINS,D.G.	12	3	187.85		P				P	P		P	P		P	P		P	P
JENKINS,D.G.	12	0	191.6		P				P	P		P		P		P		P	
JENKINS,D.G.	13	3	197.39		P				P	P		P	P	P		P		P	P
JENKINS,D.G.	13	0	202.6		P				P							P		P	
JENKINS,D.G.	14	3	206.88		P				P	P		P	P	P	P	P		P	P
JENKINS,D.G.	14	0	210.6		P				P	P		P				P		P	
JENKINS,D.G.	15	1	213.32							P						P		P	P
JENKINS,D.G.	15	0	215.6							P								P	
JENKINS,D.G.	16	2	224.12		P				P	P						P		P	
JENKINS,D.G.	16	0	228.1						P	P		P	P			P		P	
JENKINS,D.G.	17	1	232.74						P			P			P	P		P	P
JENKINS,D.G.	17	0	236.1						P	P						P		P	
JENKINS,D.G.	18	1	242.28						P	P						P		P	P
JENKINS,D.G.	18	0	244.1							P						P			
JENKINS,D.G.	19	4	264.5							P		P				P		P	P
JENKINS,D.G.	19	0	266.1							P						P		P	

Fig. 1. Part of the distribution chart for planktic foraminifera from DSDP Hole 360 from the South Atlantic off South Africa. Species were noted only to be present. It is assumed that where the species was not noted as present, it was not found. For some investigators (but not Jenkins) this may be an unwarranted assumption, because we are aware that some investigators reported only stratigraphically important species. Depth is depth below the sea floor in meters.

The range of a fossil is from levels between the lowest sample in which it occurs and the next underlying sample, in which it does not occur, and the highest sample in which it occurs to the next overlying sample. The range charts have been constructed by interpolating between the samples defining the bases and tops of species occurrences (Fig. 2).

Hole 360

H/L	genus	species	depth 1	depth 2	avg depth	age
H	*Globigerinita*	*dissimilis*	339.94	342.1	341.02	-
L	*Globigerinita*	*dissimilis*	566.85	567.13	566.99	-
H	*Globigerina*	*woodi connecta*	356.63	358.1	357.37	-
L	*Globigerina*	*woodi connecta*	394.38	396.1	395.24	-
H	*Globigerina*	*venezuelana*	374.87	377.1	375.99	-
L	*Globigerina*	*venezuelana*	742.6	754.93	748.76	-
H	*Globorotalia*	*kugleri (q)*	377.1	394.38	385.74	21.5
L	*Globorotalia*	*kugleri (q)*	394.38	396.1	395.24	45.8
H	*Globigerinoides*	*primordius*	377.1	394.38	385.74	24.3
L	*Globigerinoides*	*primordius*	394.38	396.1	395.24	26.7
H	*Globigerina*	*binaiensis (q)*	396.1	412.59	404.35	19.1
L	*Globigerina*	*binaiensis (q)*	412.59	418.1	415.35	22.1
H	*Globigerina*	*ciperoensis angulisu*	396.1	412.59	404.35	-
L	*Globigerina*	*ciperoensis angulisu*	412.59	418.1	415.35	-
H	*Globigerina*	*ciperoensis ciperoe*	396.1	412.59	404.35	-
L	*Globigerina*	*ciperoensis ciperoe*	412.59	418.1	415.35	-
H	*Globigerina*	*juvenilis*	396.1	412.59	404.35	-
L	*Globigerina*	*juvenilis*	431.88	435.5	433.69	-
H	*Globigerina*	*praebulloides*	396.1	412.59	404.35	-
L	*Globigerina*	*praebulloides*	457.6	472.93	465.26	-
H	*Globoquadrina*	*altispira globosa*	396.1	412.59	404.35	-
L	*Globoquadrina*	*altispira globosa*	452.24	457.6	454.92	-
H	*Globoquadrina*	*globularis*	396.1	412.59	404.35	-
L	*Globoquadrina*	*globularis*	412.59	418.1	415.35	-
H	*Globorotaloides*	*testarugosus*	396.1	412.59	404.35	-
L	*Globorotaloides*	*testarugosus*	513.1	529.71	521.4	-
H	*Globorotalia*	*opima nana*	412.59	418.1	415.35	27.1
L	*Globorotalia*	*opima nana*	508.09	513.1	510.6	30.6
H	*Globigerina*	*euaperta*	412.59	418.1	415.35	-
L	*Globigerina*	*euaperta*	566.85	567.13	566.99	-
H	*Cassigerinella*	*chipolensis*	418.1	431.88	424.99	-
L	*Cassigerinella*	*chipolensis*	431.88	435.5	433.69	-
H	*Globorotalia*	*opima opima*	418.1	431.88	424.99	-
L	*Globorotalia*	*opima opima*	472.93	473.6	473.26	-
H	*Globorotalia*	*munda*	435.5	452.24	443.87	-
L	*Globorotalia*	*munda*	513.1	529.71	521.4	-
H	*Globigerina*	*labiacrassata*	435.5	452.24	443.87	-
L	*Globigerina*	*labiacrassata*	490.63	497.5	494.06	-

Fig. 2. Part of the range chart for planktic foraminifera from DSDP Hole 360. **H** = highest occurrence, **L** = lowest occurrence. **Depth 1** and **Depth 2** are the samples bracketing the highest or lowest occurrence of the taxon. **Avg. depth** is the mean of the two depths. **Age** is the age assignment given the datum by the Leg 165 Shipboard Scientific Party (1997). Ages of datums do not necessarily increase with depth.

There are now more than five thousand tables and charts stored on the server and ready for downloading. To maximize efficiency, all charts are available as ASCII-files, preformatted for use with spreadsheets or stratigraphic programs. The file names are transparent. For example: 360_p1.dch is the distribution chart for planktic foraminifera prepared by the first investigator for Site 360.

Age-depth plots

The stratigraphies of DSDP and ODP Holes have been based on the age model established at the time the hole was drilled or on subsequent updates. In the mean time the numerical ages of fossil and magnetic datums have changed. Even the revised stratigraphies are not always consistent with today's chronostratigraphy. Anyone who has attempted to produce a regional synthesis has discovered that it has become a major challenge to produce a consistent set of age-depth plots.

To produce homogenous age-depth plots reflecting the current state of knowledge, the ages assigned to marker datum levels must be updated as the chronostratigraphic scale is revised. To produce objective age-depth plots, the positions of the base (lowest occurrence datum = L) and top (highest occurrence datum = H) of each species were determined, using the range charts. These levels were compared with the most recent comprehensive list of datum ages (Leg 165 Shipboard Scientific Party, 1997). The synonymy lists were searched to insure that all variants of the species names were recognized. The sequence of datum ages versus depths was compiled and plotted as shown in Fig. 3. Some ages are contradictory, in that younger ages underlie older ages. Datum ages which are out of sequence may reflect regional differences in ranges, reworking or incorrect identifications. This re analysis of the datum-age data has made it possible to add many new ages to depth levels in the hole stratigraphies, but the results must still be interpreted carefully, especially where the species occurrences are based on older data. About 500 new age/depth diagrams are available.

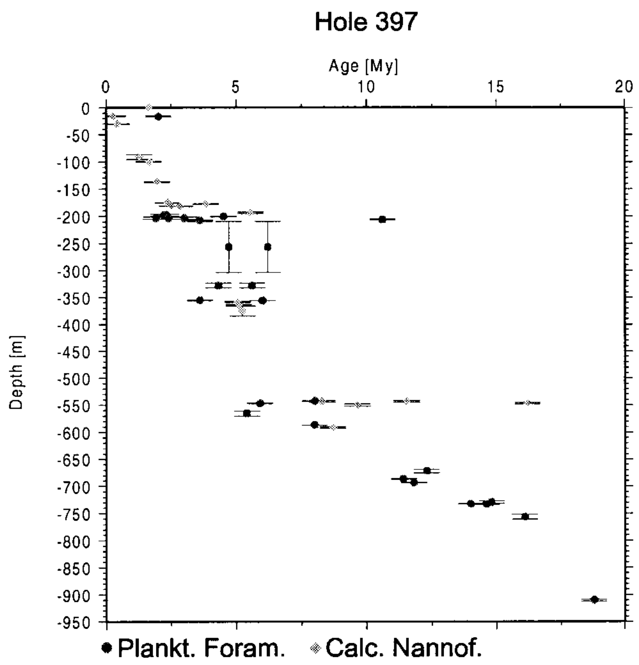

Fig. 3. Uninterpreted datum age-depth plot for DSDP Hole 397 from the Central Atlantic off West Africa showing datums (ages of highest, H, or lowest, L, occurrences) for planktic foraminifera and calcareous nannofossils. The horizontal lines show the depths of the samples bracketing the datum and the vertical lines show the uncertainty in depth of the datum. There are ambiguous data at depths of 200m and 550 m.

Another set of data, from DSDP Hole 36, is easier to interpret because there are fewer ambiguities. As shown in Fig. 4, the sedimentation rates appear to be almost constant through most of the Cenozoic.

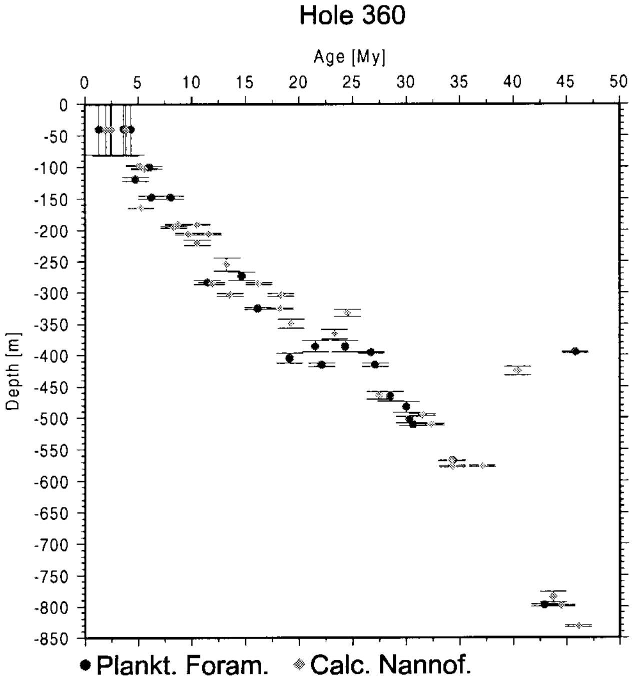

Fig. 4. Uninterpreted datum age-depth plot for DSDP Hole 360 from the South Atlantic off southern Africa. There are no biostratigraphic data for the top of the section. Below 80 m the stratigraphy shows a relatively even, consistent age increase with depth, with only two major outliers at 400-450 m depth. Some of the datums used in making this plot are shown in Fig. 2.

Plate tectonic reconstructions

The further one goes back into the geological past, the more distant the present day locations are from the place where the sediments were originally deposited. For this reason, an Internet-usable plate tectonic reconstruction tool was created, which allows plotting of plate-reconstructions of any age between present and approximately 150 Ma. This program includes extensive regional data-sets, which were reworked to include plate tectonic framework data, such as crustal-ages and plate affiliations. The data-sets used include: plate tectonic rotation files (Hay et al., in press); three latitudinal reference-frames: the paleomagnetic reference frame of Harrison and Lindh (1982), and two different hot spot reference frames (Cox and Hart, 1986, and Mueller et al., 1993); plate and fragment (continental block and terrane) boundaries; DSDP and ODP Site locations (Sites 1 - 997); present-day coastlines; and sea-floor magnetic lineations. Terranes are shown only if they exited at the time the reconstruction represents. Similarly, DSDP and ODP sites are shown only if they passed through material that could have the age of the reconstruction. The appearance of a DSDP or ODP Site on a reconstruction does not guarantee that material of that age was recovered; the interval may not have been cored, or the age might be represented by an hiatus. It is easy to include these data-sets in the reconstruction-plots. There are a variety of map projections available. The final maps are produced using the GMT (Generic Mapping Tools, Soest Hawaii) graphics package, which is available from their website (http://www.soest.hawaii.edu/soest/gmt.html) at no charge. The reconstructions may be downloaded from the server in Postscript or TIFF format for use in publications or for educational purposes. Examples are shown in Figs. 5-7.

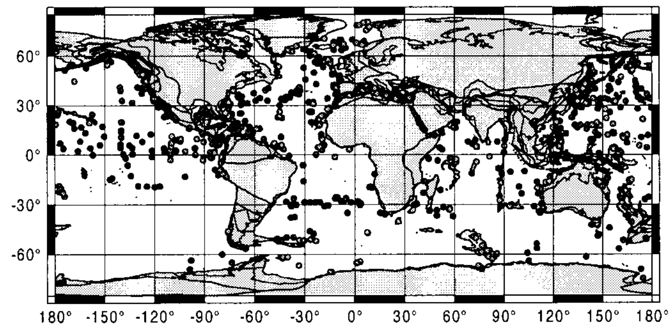

Fig. 5. The worldwide distribution of DSDP and ODP Sites shown on a Cylindrical Equidistant projection.

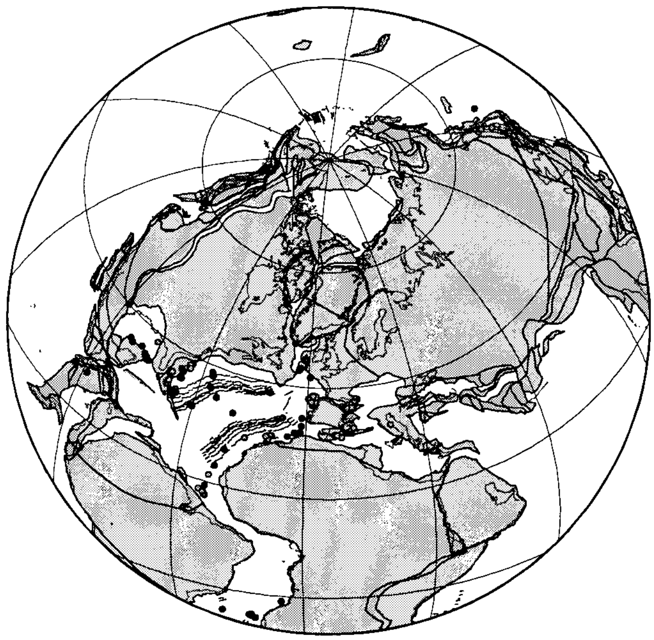

Fig. 6. Plate tectonic reconstruction for 100 Ma as a Lambert Azimuthal projection showing continental blocks, terranes, present-day shorelines and magnetic lineations. DSDP and ODP Sites where rocks 100 my old may have been penetrated and cores recovered are also shown. The only region in which existing magnetic lineations form a significant array is the North Atlantic.

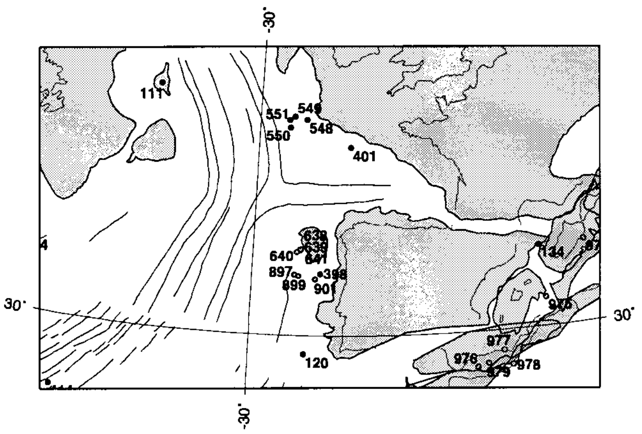

Fig. 7. Plate tectonic reconstruction of the North Atlantic at 65 Ma on a Lambert Azimuthal projection. The map shows continental blocks and terranes, present-day shorelines, magnetic lineations, DSDP and ODP Sites where rocks up to 65 my old may have been penetrated are also shown.

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