

# Changes over Time — Microfossils in Blake's Nose

## Summary

This activity allows students to access online data and generate graphs that illustrate distribution changes in marine microfossils preserved in ocean sediment cores. Students will retrieve data for several microfossils and generate a graph that illustrates the geologic period of time in which the organisms existed. After graphing the data, students will observe and compare their findings with the class.

## Learning Objectives

Students will be able to:

- Demonstrate computer skills to access online data from the ODP Database.
- Demonstrate spreadsheet skills to transfer and manipulate data from the ODP Database.
- Develop hypotheses related to microfossil distribution patterns.
- Identify evolution patterns and trends using microfossils.

- Interpret and analyze online data using tables and graphs.
- Communicate findings using PowerPoint software.

## National Science Education Standards

Standard A: Science as Inquiry

Standard C: Life Science

Standard D: Earth and Space Sciences

## Ocean Literacy Essential Principles

2. The ocean and life in the ocean shape the features of Earth.
5. The ocean supports a great diversity of life and ecosystems.

**Target Age:** Grades 5-8

**Time:** Three class periods

## Materials

Database information from Ocean Drilling Program

Computers with Internet access, spreadsheet software and presentation software

## Background

Scientists are interpreting Earth's past and projecting Earth's future by analyzing evidence from microfossils that have been buried in ocean sediments for millions of years. Microfossils are the remains left from microscopic, single-celled organisms with hard parts (shells), known as Protists. When they were living, they floated near the ocean surface with other plankton. Their empty shells have accumulated on the seafloor over time. Scientists retrieve these microfossils from ocean sediment cores that are drilled and cored using specially designed ships and equipment. Scientists study the chemistry, physics, and biology of these sediment cores to determine changes in climate and life throughout Earth's geologic history. Scientists have retrieved sediment core data dating back as far as the Cretaceous period (over 65 million years ago).

The following websites are accessed during this activity:

[http://www-odp.tamu.edu/publications/171B\\_IR/CHAP\\_03.PDF](http://www-odp.tamu.edu/publications/171B_IR/CHAP_03.PDF) (Initial Report)

[http://www-odp.tamu.edu/publications/171B\\_IR/CHAP\\_03.PDF](http://www-odp.tamu.edu/publications/171B_IR/CHAP_03.PDF) (Lithostratigraphy Data)

[http://www-odp.tamu.edu/publications/171B\\_IR/CHAP\\_03.PDF](http://www-odp.tamu.edu/publications/171B_IR/CHAP_03.PDF) (Biostratigraphy Data)

## Background (continued)

<http://iodp.tamu.edu/database/coreimages.html> (Photos of Core)

<http://iodp.tamu.edu/janusweb/general/dbtable.cgi?leg=171&site=1049> (Inventory of Core Data)

[www.chronos.org](http://www.chronos.org) (Microfossil Database)

<http://www.oceanleadership.org/education/deep-earth-academy/educators/classroom-activities/a-bit-of-engineering/> (Ocean Drilling Info)

<http://www.scotese.com/> (Paleogeographic Maps and Geologic Time Information)

<http://www.ucmp.berkeley.edu/exhibits/geologictime.php> (Geologic Time Information)

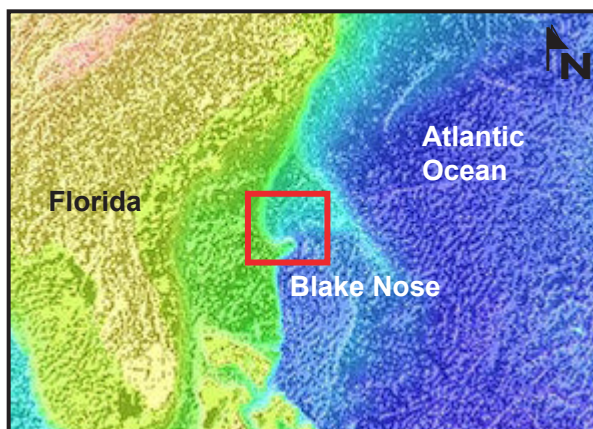
## What to do

### Prior to Day One

- Students should have an understanding of changes in landforms over time. Students should also have developed skills for accessing online data and transferring this data to a spreadsheet. A review of ocean sediment coring and drilling will also be helpful to students in understanding how the data presented in this activity is recovered. Information and videos describing this process can be found at the following website: <http://www.oceanleadership.org/education/deep-earth-academy/educators/classroom-activities/a-bit-of-engineering/>
- Display a list of planktonic foraminifera (shown below) for students to select one species.
  - Morozovella lehneri*
  - Morozovella aragonensis*
  - Morozovella formosa formosa*
  - Morozovella marginodentata*
  - Morozovella velascoensis*
  - Globanomalina pseudomenardii*
  - Acarinina soldadoensis*
  - Morozovella conicotruncata*
  - Parasubbotina varianta*
  - Parvularugoglobigerina eugubina*
  - Abathomphalus mayaroensis*
  - Contusotruncana contusa*
  - Racemiguembelina fructicosa*
  - Ticinella primula*
  - Note that other microfossils are listed in the document but the “forams” listed above have provided “time markers” for this core sample.

### Day One: Activity Introduction

- Introduce this activity by showing students the location of the Blake Nose drilling site on a world map.
  - Distribute Table 5: Planktonic Foraminifera Distribution in Hole 1049A (page 17 in the *Initial Report*) and use an example species to demonstrate how students should interpret the table to locate information about their species. Students should feel comfortable using the table and key before continuing the activity. (Providing a list of steps for generating a spreadsheet may also be helpful for students.)



Location map for the Blake Nose.

- Computer Lab:** Guide students to the ODP Database and instruct them to locate the Initial Report from Leg 171, Site 1049, Hole A of Blake Nose. Provide students with a rubric to assist them. The rubric should include the following:
  - Create a spreadsheet to record the different periods of geologic time (Age) in which your organism existed and the depth of the sediment (mbsf = meters below seafloor) where your organism was found.

- b. Generate a graph that illustrates the geologic time periods in which your organism lived and the depth of the sediment core where your organism was found. This is called an Age-Depth Plot.
- c. Print a copy of your graph to display during class.
- d. **Graphing Tips:** Select Format Y-axis and set all Y-axis values to reverse order and to the following coordinates: Min = 0; Max = 180; Major = 20; Minor = 4. Omit the Legend.
- e. Factors affecting depth of sediment:
  - i. Sedimentation rate
  - ii. Compaction of seafloor
  - iii. Disturbances to the seafloor sediment.

### Days Three to Five

1. **Research:** Have students research one species of planktonic foraminifera to test their hypothesis of the age of the microfossil and to determine the geologic time period in which their microfossil existed. Students will use the ODP Database and Internet research skills to identify and illustrate the following:
  - a. An illustration of the species.
  - b. A geologic time chart illustrating the correct time period in which the species lived (including eon, era, period, epoch, and age). The First Occurrence (FO) and Last Occurrence (LO) from the ODP Database should be noted. Some species do not have both occurrence intervals noted in the database.
  - c. An illustration of Earth's environment during the identified time frame.
  - d. An illustration of Earth's tectonic landscape during the identified time frame.
  - e. A graph illustrating coexistence with other microfossils explored during this activity.
  - f. The sources cited for this investigation.
2. **Communication:** Have students present their findings to the class using PowerPoint software. Encourage class discussion to clarify correlations and variances between findings from each research team.

### Day Two

1. Paste each graph side-by-side in the classroom. Display graphs to encourage student observations for the following:
  - a. Changes in microfossils as depth below seafloor increased.
  - b. Reappearance of family groups (Genus), but different species.
  - c. Predictions:
    - i. Oldest fossils to most recent
    - ii. Age predictions based on core depth.
2. **Class Discussion:** Facilitate a class discussion using the graphs. Include the following in the discussion:
  - a. Coexistence and absence of different planktonic foraminifera species.
  - b. Beginning of species (First Occurrence = FO); life span of species; extinction of species (Last Occurrence = LO).
  - c. Changes in population diversity (number of species).
  - d. Age projections of microfossils; predictions based on Law of Superposition.

Data used in this activity are shown in the table below:

Species	Depth of Sediment (meters below below seafloor)	Depth of Sediment (meters below below seafloor)	Last Occurrence (millions of years ago)
<i>Morozovella lehneri</i>	40.09	43.5	40.1
<i>Morozovella aragonensis</i>	49.56	52.3	43.6
<i>Morozovella formosa formosa</i>	73.14	54.0	50.4
<i>Morozovella marginodentata</i>	89.11		52.5
<i>Morozovella velascoensis</i>	100.08	60.0	54.7
<i>Globanomalina pseudomenardii</i>	100.08	59.2	55.9
<i>Acarinina soldadoensis</i>	100.08	56.6	49.0
<i>Morozovella conicotruncata</i>	100.29	60.9	58.1
<i>Parasubbotina varianta</i>	105.93	63.0	59.2
<i>Parvularugoglobigerina eugbina</i>	125.71	64.97	64.7
<i>Abathomphalus mayaroensis</i>	137.95	68.3	65.0
<i>Contusotruncana contusa</i>	137.95	69.6	65.0
<i>Racemiguembelina fructicosa</i>	142.39	69.6	65.0
<i>Ticinella primula</i>	150.93	109.0	99.0

Table 5. Planktonic foraminifer distribution in Hole 1049A.

Age	Zone	Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation													
middle Eocene	P12	171B-1049A-3H-CC	30.60	A	G													
middle Eocene	P12	4H-3	33.75	A	G													
middle Eocene	P12	4H-5	36.75	A	G													
middle Eocene	P12	4H-CC	40.09	A	G													
middle Eocene	P12.P11	5H-CC	49.56	A	G													
middle Eocene	P11	6H-CC	59.06	A	G													
Eocene	P9-P10	7H-CC	60.04	A	M													
Eocene	P9-P10	8X-CC	60.83	A	M													
Eocene	P9-P10	9H-CC	69.40	A	G													
Eocene	P8-P7	10X-CC	73.14	A	G													
early Eocene	P6-P7	12X-CC	89.11	A	M													
late Paleocene	P4a-P4b	13H-CC	100.08	A	M													
late Paleocene	P3a	14X-CC	100.29	A	P													
early Paleocene	P1c	15X-CC	105.93	A	M													
early Paleocene	P1b	16X-CC	124.12	A	VG													
early Paleocene	P1a	17X-2, 3-10	125.34	A	VG													
early Paleocene	P1a	17X-2, 22-24	125.53	A	VG													
early Paleocene	P1a	17X-2, 40-42	125.71	A	VG													
Mastrichtian	A. myurensis	17X-CC	128.46	A	G													
Mastrichtian	R. fructicosa	18X-3, 65-67	137.95	A	VG													
Mastrichtian	R. fructicosa	18X-4, 10-12	138.90	A	G													
Mastrichtian	G. saussurei-G. falsostuarti	18X-4, 16-18	138.96	A	G													
Albian	T. primula	18X-CC	142.39	A	VG													
Albian	H. gobbachikae	19X-CC	150.93	A	VG													
Aptian	G. algerianus	20X-CC	161.49	A	G													
Aptian		21X-CC	167.70	A	G													

Notes: Abundance: A = abundant; R = rare; F = few; P = present. Preservation: G = good; M = moderate; P = poor; VG = very good.

Age	Zone	Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation												
middle Eocene	P12	171B-1049A-	30,60	A	G	<i>Woodringina hornerstownensis</i>											
middle Eocene	P12	3H-CC	33,75	A	G	<i>Globanomalina archeocompressa</i>											
middle Eocene	P12	4H-3	36,75	A	G	<i>Parvularugoglobigerina alabamensis</i>											
middle Eocene	P12	4H-5	40,09	A	G	<i>Chiloguembelina crinita</i>											
middle Eocene	P12-P11	5H-CC	49,56	A	G	<i>Praemurica taurica</i>											
middle Eocene	P11	6H-CC	59,06	A	G	<i>Chiloguembelina morsei</i>											
Eocene	P9-P10	7H-CC	60,04	A	M	<i>Globanomalina planocompressa</i>											
Eocene	P9-P10	8X-CC	60,83	A	M	<i>Parasubbotina varianta</i>											
Eocene	P8-P7	9H-CC	69,40	A	M	<i>Praemurica inconstans</i>											
early Eocene	P6-P7	10X-CC	73,14	A	M	<i>Subbotina triloculinoides</i>											
late Paleocene	P4a-P4b	12X-CC	89,11	A	M	<i>Morozovella angulata</i>											
late Paleocene	P3a	13H-CC	100,08	A	M	<i>Morozovella conicotruncata</i>											
early Paleocene	P1c	14X-CC	100,29	A	M	<i>Praemurica uncinata</i>											
early Paleocene	P1b	15X-CC	105,93	A	M	<i>Subbotina triangularis</i>											
early Paleocene	P1a	16X-CC	124,12	A	VG	<i>Acarinina mckannai</i>											
early Paleocene	P1a	17X-2, 3-10	125,34	A	VG	<i>Acarinina soldadoensis</i>											
early Paleocene	P1a	17X-2, 22-24	125,53	A	VG	<i>Globanomalina pseudomenardii</i>											
early Paleocene	P1a	17X-2, 40-42	125,71	A	VG	<i>Morozovella apantesma</i>											
Maastrichtian	A. mayuroensis	17X-CC	128,46	A	VG	<i>Morozovella velascoensis</i>											
Maastrichtian	A. mayuroensis	18X-3, 65-67	137,95	A	VG	<i>Pseudohastigerina wilcoxensis</i>											
Maastrichtian	R. fructicosa	18X-4, 10-12	138,90	A	G	<i>Subbotina hornibrooki</i>											
Maastrichtian	R. fructicosa	18X-4, 16-18	138,96	A	G	<i>Subbotina patagonica</i>											
Maastrichtian	G. gansseri-G. falsosauarti	18X-CC	142,39	A	G	<i>Subbotina velascoensis</i>											
Albian	T. prinula	19X-CC	150,93	A	VG	<i>Globigerinatheka senni</i>											
Aptian	H. gorbachikae	20X-CC	161,49	A	G	<i>Morozovella gracilis</i>											
Aptian	G. algerianus	21X-CC	167,70	A	G	<i>Morozovella marginodentata</i>											
						<i>Morozovella subbotinae</i>											
						<i>Acarinina primitiva</i>											
						<i>Morozovella aragonensis</i>											
						<i>Morozovella formosa formosa</i>											
						<i>Acarinina bullbrooki</i>											
						<i>Globigerina senni</i>											
						<i>Morozovella caucasica</i>											
						<i>Subbotina inaequispira</i>											
						<i>Truncorotaloides rohri</i>											
						<i>Hantkenina mexicana</i>											
						<i>Globigerinatheka index</i>											
						<i>Globigerinatheka mexicana</i>											
						<i>Hantkenina dumblei</i>											
						<i>Morozovella lehneri</i>											
						<i>Morozovella spinulosa</i>											
						<i>Pseudohastigerina micra</i>											
						<i>Guembeltrioides higginsii</i>											
						<i>Acarinina coaligensis</i>											
						<i>Globigerapsis index</i>											

Table 5 (continued).