Teachers Guide:
Marine Sediment Lab Activity

Objective: During this activity students will understand that scientists use microfossils present in sediments to study past climate.

Introduction
This activity is designed to introduce students to marine geology, and specifically the science behind using ocean sediment cores to study past climate. As you can see, many topics can be focused on, depending on your curriculum and how you structure the activity. We will mainly focus on the use of foraminifera as a proxy to discover information about past climate. This activity guide was developed by Angela Skeeles-Worley and Hélder Pereira during the Teachers at Sea program on the summer 2008 AMOCINT campaign on the R/V Marion Dufresne.

Background
There is an incredible diversity of marine microorganisms found in remains of ocean sediments. Some of the main groups that are found are coccolithophores (Fig. 1), diatoms (Fig. 2), dinoflagellates (Fig. 3), and foraminifera (Fig. 4), the latter representing both zooplankton as well benthic forms. Planktonic forms are much more abundant in deep-sea sediments. Planktonic organisms live in the water column, whereas benthic organisms live on the ocean floor. Benthic foraminifera have evolved a wide spectrum of architectures pending on their life style (in or on the sediment). They are often flat and have depressed chambers. The pelagic foraminifera generally have spherical chambers and today these organisms are represented by around 40 different species. When we analyze what types of organisms exist in different layers of sediment, we can draw conclusions about past climate conditions and circulation patterns. For instance, some foraminifera species are characteristic of colder water while others are characteristic of warmer water. Therefore, depending on the species assemblage in a given layer of sediment, we can draw conclusions about the climate during that time period. This has major implications for understanding past and present climate cycles, and what changes we might experience as a result of our current trend of rapid climate change.

Materials:
For each lab group:
- 2 sieves (150µm and 62µm)
- stereomicroscope
- Petri dish
- hair gel to pick-up microfossils more easily (optional)
- a small amount of sediment from each sampling site
- a small paintbrush, a pointer, and a scoop (or spatula)

Suggested Procedure:
1. Watch movie or presentation with introductory information about marine biota typically found in sediments. Students should take notes!

2. Observe and describe each sediment sample. Some visual properties you might have your students describe are texture, smell, and color.

3. Place one sample in a sieve, and run water over it in a lab sink until all of the mud has disappeared.

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You may request sediment samples from the AMOCINT (Atlantic Meridional Overturning Circulation during Interglacials) project or the IODP (Integrated Ocean Drilling Program)
4. Place the sediment that is left after sieving in the bottom of a Petri dish and observe the sediment under the dissecting microscope. The foraminifera will be easier to see if you use the dark background on the dissecting microscope.

Possible Topics of Exploration
1. Identifying different groups of organisms in the samples.
2. Distinguishing pelagic foraminifera species from benthic foraminifera species.
3. Comparing the characteristics of typical Northern foraminifera species and Southern foraminifera species.

Supporting Materials

Figures

Fig.1 - Coccolithophore
Fig.2 - Diatoms
Fig.3 - Dinoflagellate
Fig. 4 - Benthic foraminifer
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Fig. 5 - Major foraminifera groups (from Haq and Boersma, 1978)