ocean explorer
oceanexplorer.noaa.gov

Exploring Alaska's Seamounts

Volcanoes, Plates and Chains

Focus
Formation of seamounts in the Gulf of Alaska

Grade Level
5-6

Focus Question
How were seamounts in the Axial-Cobb-Eikelberg-Patton chain formed?

Learning Objectives
Students will be able to describe the processes that form seamounts.

Students will be able to describe the movement of tectonic plates in the Gulf of Alaska region, and explain the types of volcanic activity that might be associated with these movements.

Students will be able to describe how a combination of hotspot activity and tectonic plate movement could produce the arrangement of seamounts observed in the Axial-Cobb-Eikelberg-Patton chain.

Additional Information for Teachers of Deaf Students
In addition to the words listed as Key Words, the following words should be part of the list.

Magnets
Polarity
Latitude
Longitude
Magnetic North
Habitats
Tectonic
Hypothesis
Aligns
Expedition
Glaciers

The words listed as Key Words should be introduced prior to the activity. There are no formal signs in American Sign Language for many of these words and many are difficult to lip-read.

If some of this information has not already been covered in your class, you may need to add an additional class period to teach vocabulary and teach some of the Background Information to the students prior to the activity. The activity itself is very visual and is easily followed by most deaf students.

An additional assessment tool is to give a TV-style report about the events rather than a written report. This could be more like a report for the Discovery Channel so it could be a bit more in depth. They can hand in their notes as written work.

Materials
- ❒ Framed screen with outline map of the Gulf of Alaska (see instruction sheet)
- ❒ Small can of Great Stuff (from hardware store)
- ❒ Overhead transparency Gulf of Alaska Seamounts
- ❒ (Optional) Overhead transparency of Patton

seamount 3-D bathymetric model which can be downloaded from http://ridge.coas.oregonstate.edu/rkeller/seamounts.html

Audio/Visual Materials

- ❒ Overhead projector
- ❒ (Optional) Computer video of simulated fly-around of the Patton Seamount; download from http://ridge.coas.oregonstate.edu/rkeller/Fly_around.mov

Teaching Time

20 - 30 minutes

Seating Arrangement

Classroom style or in cooperative groups around tables

Maximum Number of Students

As many as are in the class

Key Words

Basalt
Rift
Subduction
Hotspot
Seamount
Magma

Background Information

Seamounts are undersea mountains that rise from the ocean floor, often with heights of 3,000 m (10,000 ft) or more. Compared to the surrounding ocean waters, seamounts have high biological productivity, and provide habitats for a variety of plant, animal, and microbial species. Numerous seamounts have been discovered in the Gulf of Alaska. Many of these seamounts occur in long chains that parallel the west coast of the U.S. and Canada. One of the longest chains, known as the Axial-Cobb-Eikelberg-Patton chain, is being intensively studied by the Ocean Exploration 2002 Gulf of Alaska Expedition. What formed these underwater mountains in the first place, and why are they arranged in chains? These are two of the questions that the Gulf of Alaska Expedition hopes to answer.

Seamounts are generally thought to be the remains of underwater volcanoes that can be formed in several ways. Many volcanoes are associated with the movement of the tectonic plates that make up the Earth's crust. Where these plates move apart (for example, along the mid-ocean ridge in the middle of the Atlantic Ocean) a rift is formed, which allows magma (molten rock) to escape from deep within the Earth and harden into solid rock known as basalt. Where tectonic plates come together, one plate may descend beneath the other in a process called subduction, which generates high temperatures and pressures that can lead to explosive volcanic eruptions (such as the Mount St. Helens eruption which resulted from subduction of the Juan de Fuca tectonic plate beneath the North American tectonic plate). Volcanoes can also be formed at hotspots, which are thought to be natural pipelines to reservoirs of magma in the upper portion of the Earth's mantle.

What produced the seamounts in the Axial-Cobb-Eikelberg-Patton chain? One hypothesis is that they were formed over the Cobb hotspot which is currently located off the coast of Oregon near the ridge between the Juan de Fuca and Pacific tectonic plates. As the Pacific plate moved away from the Juan de Fuca plate, different portions of the Pacific plate were exposed to the Cobb hotspot, causing volcanoes produced by the hotspot to be aligned in the same direction that the plate was moving.

Learning Procedure

1. Explain that seamounts are the remains of underwater volcanoes, and that they are islands of productivity compared to the surrounding ocean environment. You may want to use a color transparency of the 3-D bathymetric model of the Patton seamount, and/or the video of the simulated fly-around during this discussion. Describe

the general process of underwater volcano formation, and introduce the concept of hotspots. You may need to review the concept of plate tectonics, if students are unfamiliar with this idea and the relevant terms. Be sure to distinguish the type of volcanic activity at spreading ridges (typically a slow ooze of lava) from volcanoes near areas of subduction (often explosive eruptions such as Mt. St. Helens).

2. Demonstrate how periodic volcanic eruptions at a hotspot and movement of a tectonic plate could produce a chain of seamounts similar to that found in the Gulf of Alaska: Have one or two students hold the framed screen above the can of Great Stuff (which the teacher should control!). Position the can so that the starting point is near the 41 Ma mark. Have them very slowly move the screen in the direction shown by the Plate Movement arrow. As the screen moves, gently release a small squirt of Great Stuff to produce a small mound on top of the screen (you should practice this in advance to get a feel for the trigger!). Make a mound at the 41 Ma, 38 Ma, 9 Ma, and 0 Ma marks. Use the Gulf of Alaska Seamounts overhead transparency to explain that the framed screen represents the Pacific plate, the four mounds of Great Stuff represent the Patton, Murray, Warwick, and Axial Seamounts, and the can of Great Stuff represents the Cobb hotspot. Tell the students that Ma stands for millions of years, and discuss the significance of 0 Ma at the Axial Seamount (an age of 0 means that the seamount is still being formed).

The Bridge Connection

www.vims.edu/bridge/geology.html

The "Me" Connection

Have students write a first-hand account of an exploratory dive to investigate formation of the Axial Seamount. You may want to have them do library or internet research to back up their report.

Connections to Other Subjects

English/Language Arts, Geography, Mathematics

Evaluation

Have students write a newspaper style report about events happening on the Juan de Fuca ridge. Tell them it is OK to include events that are happening slowly (such as tectonic plate movement) as well as events happening more quickly (such as volcanic eruptions). Their reports should include subduction beneath the North American plate (and possibly associated volcanic activity), seafloor spreading, and events associated with the Cobb hotspot (such as formation of the Axial Seamount).

Extensions

Have students visit http://oceanexplorer.noaa.gov to keep up to date with the latest Gulf of Alaska Expedition discoveries.

Resources

http://oceanexplorer.noaa.gov - Follow the Gulf of Alaska Expedition daily as documentaries and discoveries are posted each day for your classroom use. A wealth of information can also be found at both of these sites.

http://ridge.coas.oregonstate.edu/rkeller/seamounts.html - Background on seamount exploration and research in the Gulf of Alaska

http://volcano.und.nodak.edu/vwdocs/vwlessons.atg.html - Teacher's guide on plate tectonics, hot spots, and volcanoes

http://newton.physics.wwu.edu:8082/jstewart/scied/earth.html - Earth science education resources

http://www.sciencegems.com/earth2.html - Science education resources

http://earth.leeds.ac.uk/dynamic earth - Background on plate tectonics

http://www-sci.lib.uci.edu/HSG/Ref.html - References on just about everything

National Science Education Standards

Content Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Content Standard D: Earth and Space Science

- Structure of the Earth system

For More Information

Paula Keener-Chavis, National Education Coordinator/Marine Biologist
NOAA Office of Exploration
Hollings Marine Laboratory
331 Fort Johnson Road, Charleston SC 29412
843.762.8818
843.762.8737 (fax)
paula.keener-chavis@noaa.gov

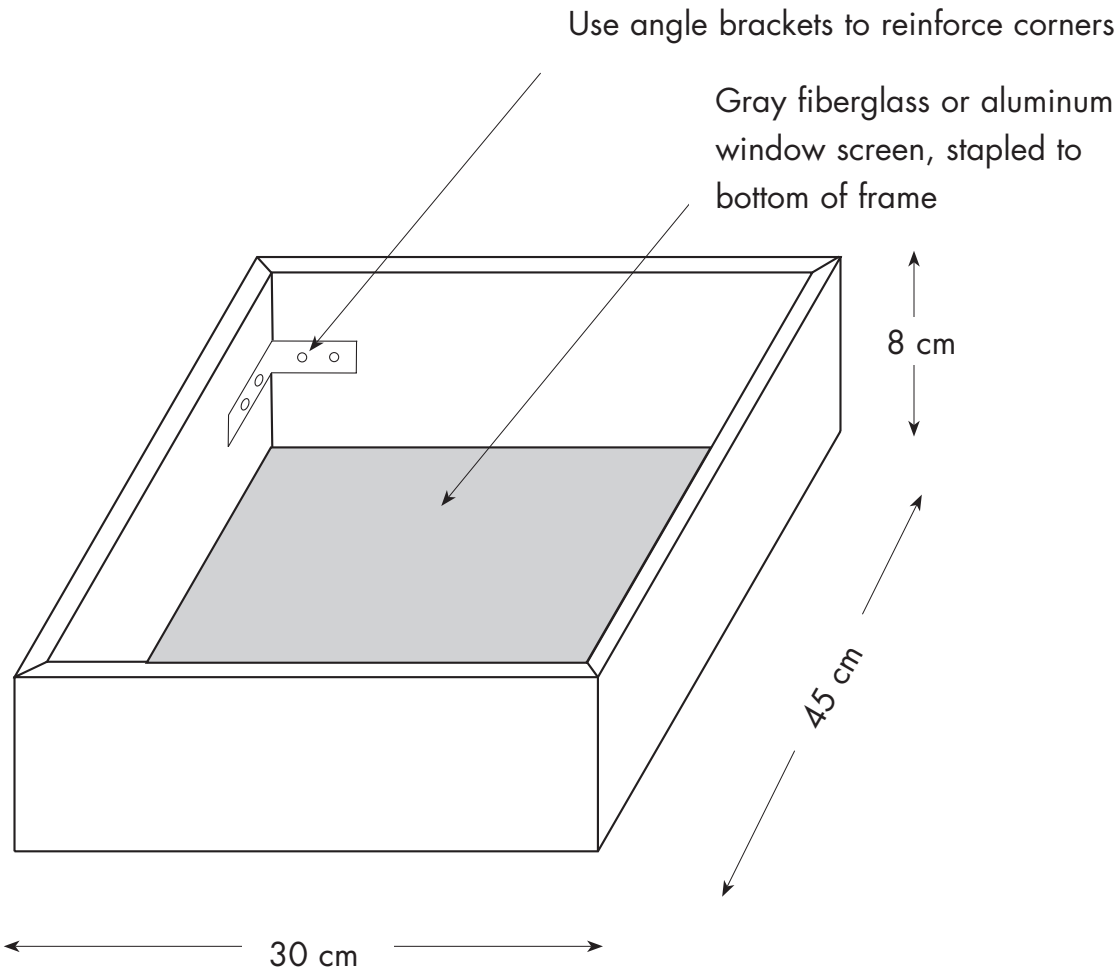
Acknowledgements

This lesson plan was produced by Mel Goodwin, PhD, The Harmony Project, Charleston, SC for the National Oceanic and Atmospheric Administration. If reproducing this lesson, please cite NOAA as the source, and provide the following URL:
http://oceanexplorer.noaa.gov

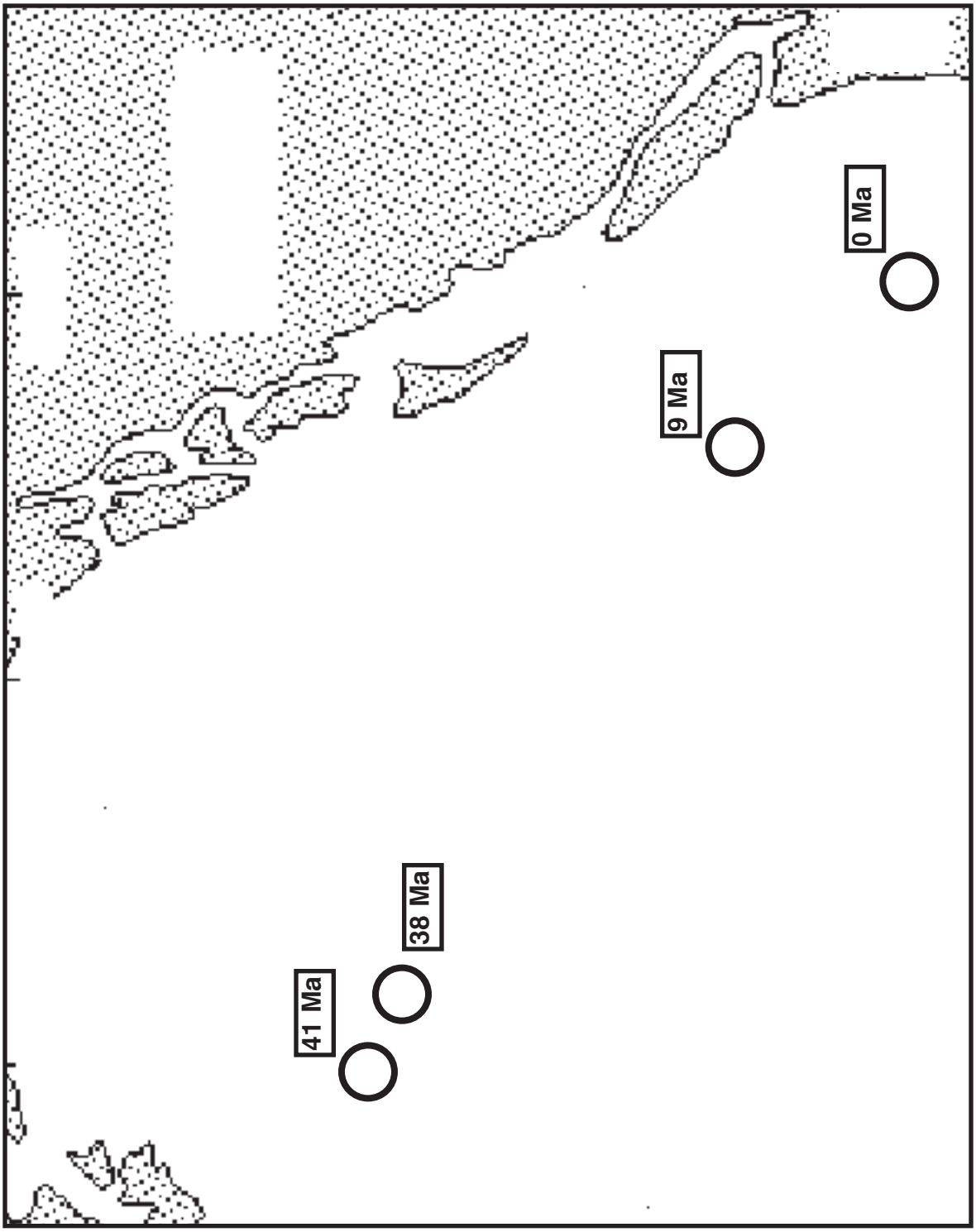
SCILINKS Selected by Science Educators from NSTA

Framed Screen Instruction Sheet

Make frame from 3/4" thick plywood or 1" x 3" pine lumber. Fasten corners with glue and screws, reinforce with angle brackets in corners. Staple window screen to bottom of frame. Enlarge the outline map of the Gulf of Alaska to 11" x 17" on a photocopier, then trace the map onto screen with black marking pen.

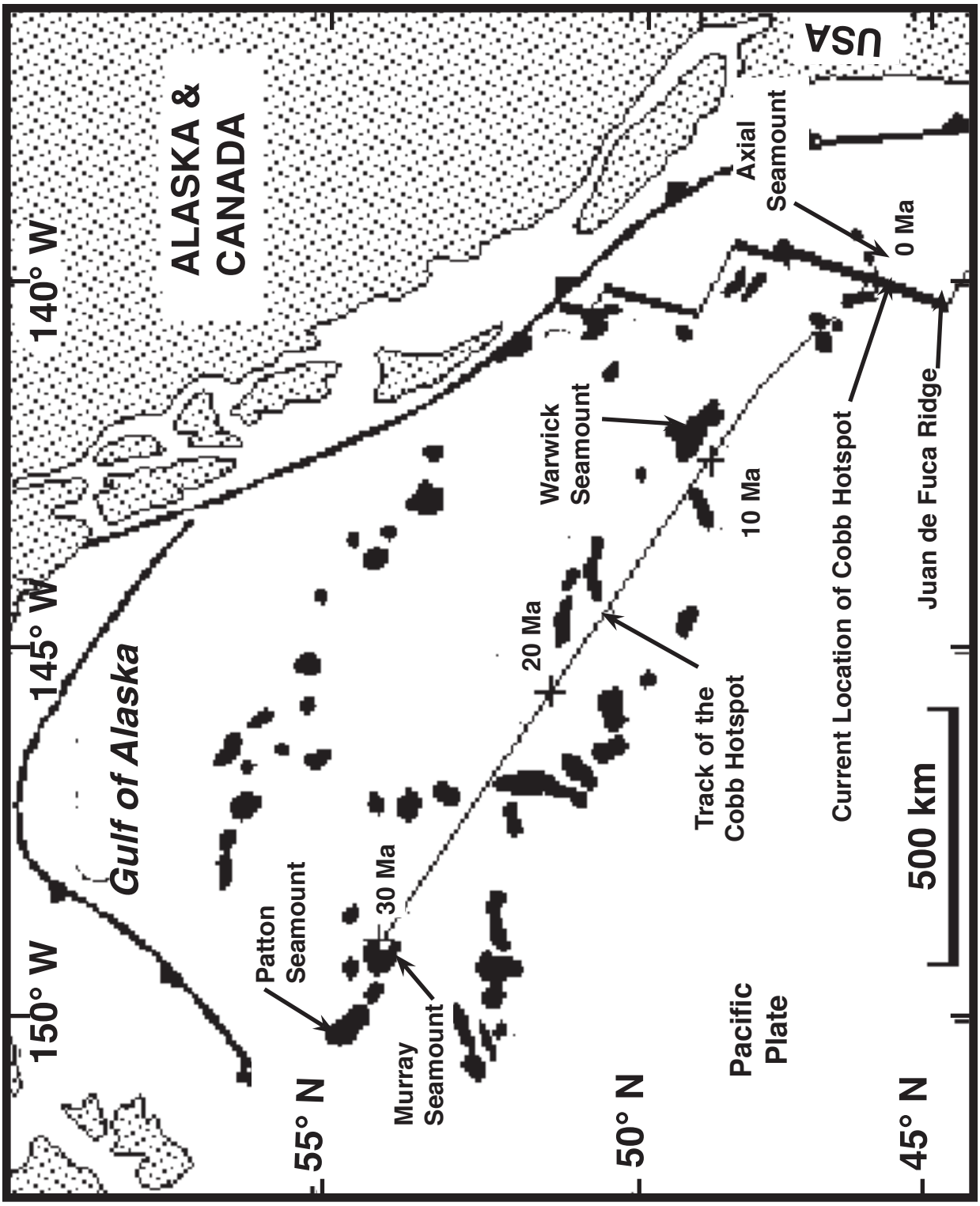


Map for use with framed screen and Great Stuff
(enlarge it to fit on an 11 x 17 sheet)



Gulf of Alaska Seamounts Map

(for overhead)



http://ridge.coas.oregonstate.edu/rkeller/seamounts.html

College of Oceanic and Atmospheric Sciences, Oregon State University