Deep Earth Academy
CONSORTIUM FOR OCEAN LEADERSHIP

Subduction Zone Conditions

Summary

Students investigate core samples obtained across a subduction zone off the east coast of Japan and compare the rock found in each drill hole.

Learning Objectives

Students will be able to:

- Use real data to compare depths where basement rock is found at three drilling sites.
- Form a hypothesis about the observations they make.

National Science Education Standards

Standard A: Science as Inquiry

Standard D: Earth and Space Sciences

Ocean Literacy Essential Principles

1. Earth has one big ocean with many features.
2. The ocean and life in the ocean shape the features of Earth.
7. The ocean is largely unexplored.

Target Age: Grades: 9 – 12

Time: 40 minutes

Background

Subduction zones are regions where two crustal plates come together and one is pulled or subducted beneath the other. Within this zone, rocks are subjected to high temperatures and pressures. As these rocks encounter such conditions, they change. The environment around the rock may exert or remove stresses and the rock attempts to adjust to these new conditions. Sometimes environmental forces bury the rock deeply where it is heated and placed under high pressure, while other times these forces bring the rock to the surface where there is less pressures and lower temperatures.

The *JOIDES Resolution* is an oceanographic research ship that goes on two-month voyages to collect samples of the ocean floor. The ship drills into the ocean floor and produces cores of sediments and the solid bedrock that lies beneath. Scientists then analyze these cores to learn about climactic and environmental conditions in Earth's past.

In this activity, you and your students will investigate three core samples collected from near a subduction zone off the coast of Japan and look at actual data provided by scientists who analyzed these cores. The cores were collected from separate legs (voyages) of the J*OIDES Resolution* (Legs 126, 185, and 129). You will study cores from holes 793, 1149, and 800. Figure 1 is a map showing the locations from which these cores were drilled. Figures 2 – 4 are the data sheets recorded by the scientists. (Notice that the data sheets are not uniform from leg to leg.)

The research vessel, JOIDES Resolution.

Activity submitted by Joe Monaco (School of Rock 2007), Redlands East Valley High School, Redlands, California.

What to do

(answer guides in orange):

1. Ask students to look to the map and describe the general trend of the drilling sites used in this investigation.

   The general trend of the drilling sites is northwestward.

2. Each data sheet shows the depth below sea floor (dbsf) in meters and the associated rock or sediments. Basement rock is the solid rock found beneath the sediments. Ask student to look carefully and explain what they notice about the depth of the basement rock as they compare these three drilling sites.

   The basement rock becomes shallower as you approach the ocean trench. The depth of the basement rock then becomes quite deep closer to the trench. This might be due to the ocean plate bending as it plunges into the trench. As the plate bends, it flexes upward.

3. Have your students think about their observations and develop a hypothesis to explain what they observed.

4. Ask students: Which type of rock forms the basement at all three sites?

   The basement rock at all three sites is basalt (igneous rock).

5. The age of the basement rock at site 800 is thought to be Late Jurassic/early Cretaceous, the age at site 1149 is Cretaceous, and that of site 793 is Oligocene. Ask students: If the oldest ocean floor is found near ocean trenches, how can the age of the rock at site 793 be explained?

   The rock at site 793 is rather deep. It would be subjected to high temperatures and pressures and the original rock may have melted and recrystallized. This would start the geologic clock over again.

6. Why do they think these three sites were used in this investigation? (Hint: plate tectonics).

   The three sites were chosen to investigate the environmental conditions that may be found in a subduction zone. Large pressures and high temperature, as well as friction, would alter the original rocks as they are subducted.

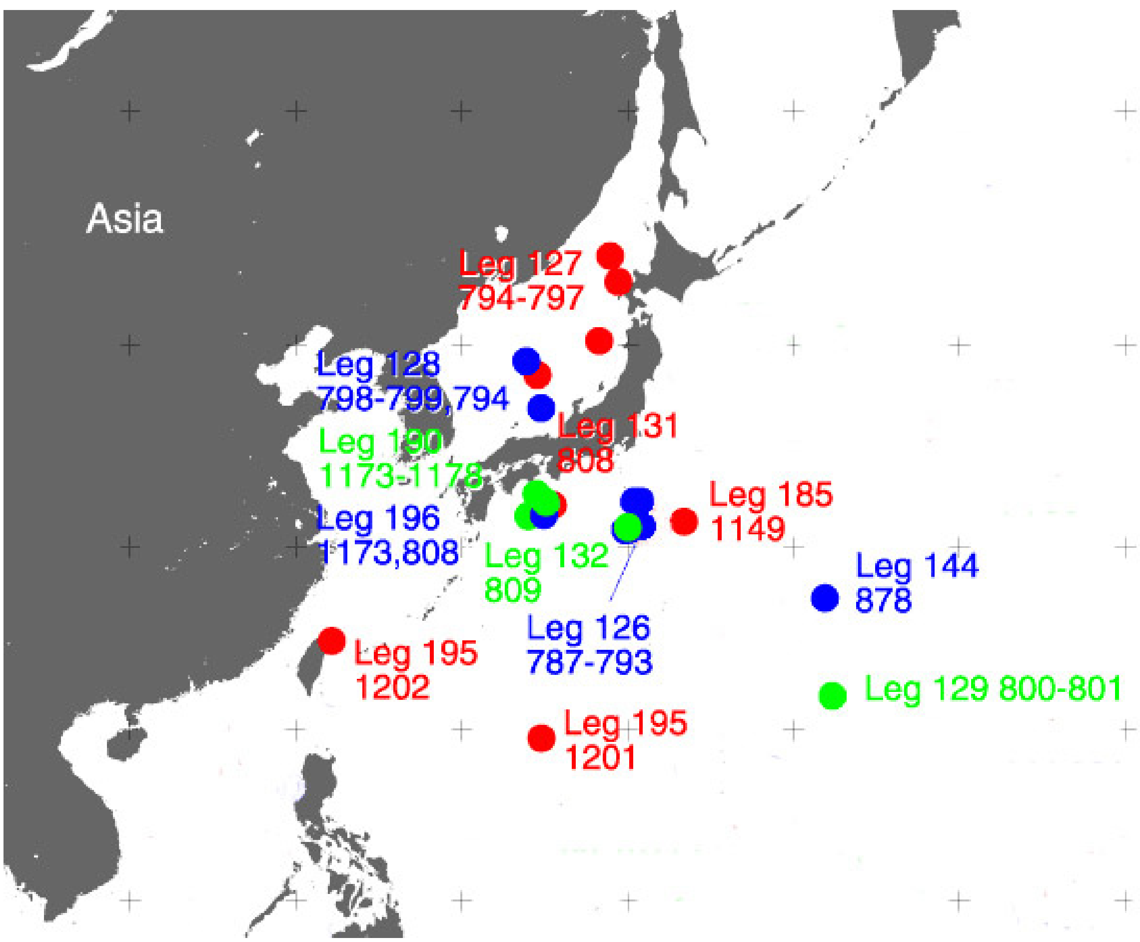

Figure 1: Portion of the Pacific Ocean showing Legs and drilling sites for selected voyages.

Student Page

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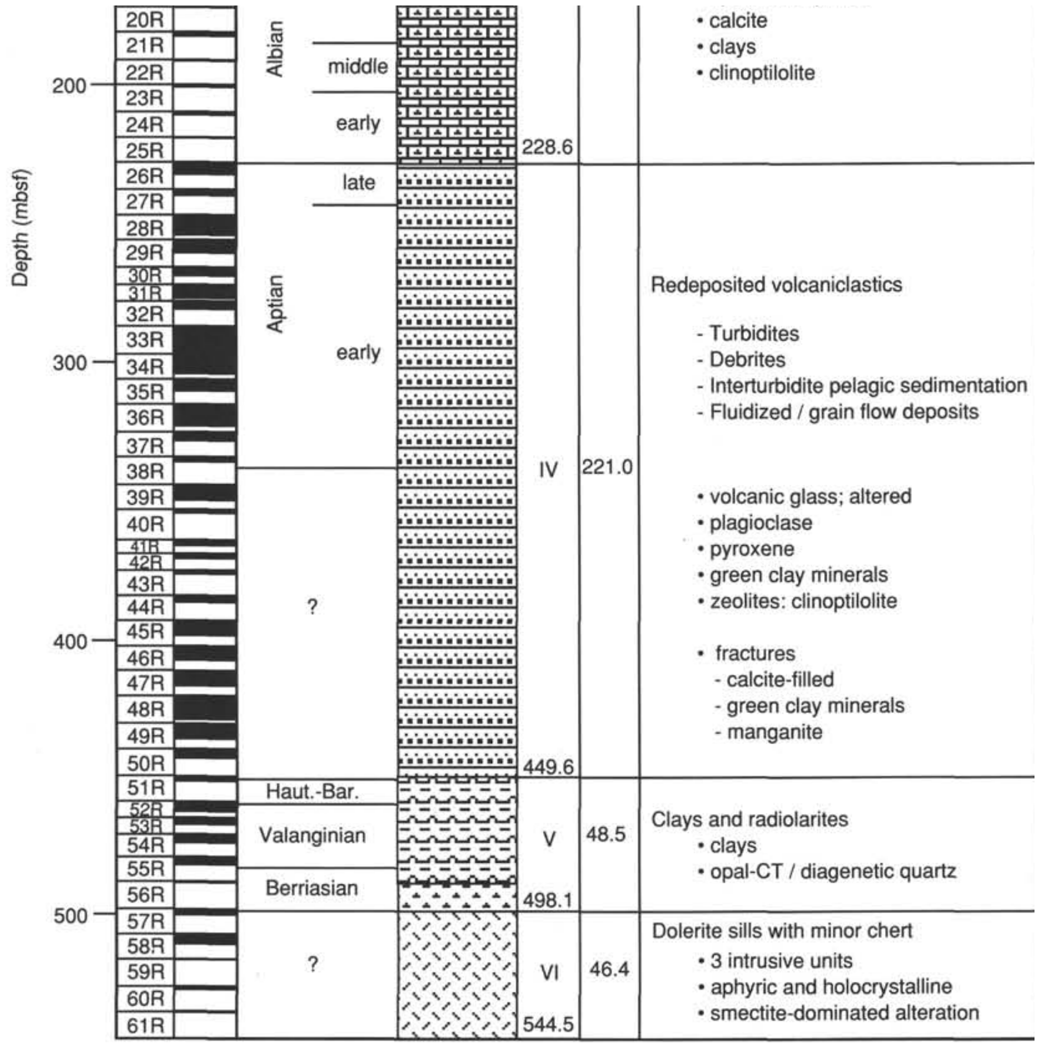
Refer to the figures and answer the following questions:

- Referring to the map, describe the general trend of the drilling sites used in this investigation.
- Each data sheet shows the depth below sea floor (dbsf) in meters and the associated rock or sediments. Basement rock is the solid rock found beneath the sediments. What do you notice about the depth of the basement rock as you compare the three drilling sites? Develop a hypothesis to explain what you observe.
- Which type of rock forms the basement at all three sites?
- The age of the basement rock at site 800 is thought to be Late Jurassic/early Cretaceous, the age at site 1149 is Cretaceous, and that of site 793 is Oligocene. If the oldest ocean floor is found near ocean trenches, how can the age of the rock at site 793 be explained?
- Why do you think these three sites were used in this investigation? (Hint: plate tectonics).

Depth Core # Age Rock Type Rock Description



Key to symbols used in the graphic lithology column

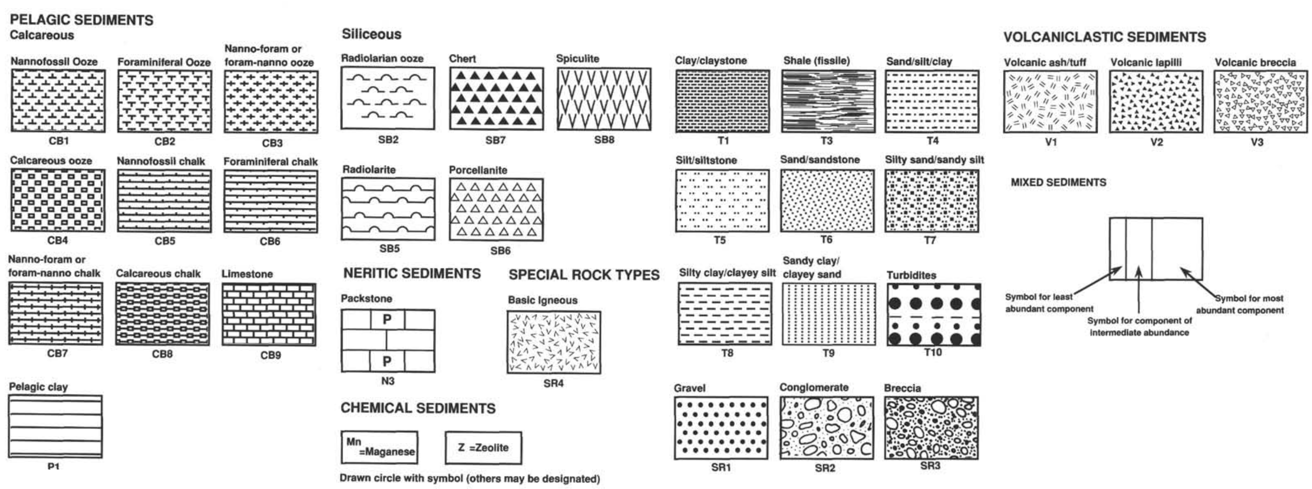


Figure 2: Leg 129, Site 800, Hole A
Figure taken from the Initial Reports *for Leg 129, Site 800 at:*
http://www-odp.tamu.edu/publications/129_IR/VOLUME/CHAPTERS/ir129_02.pdf

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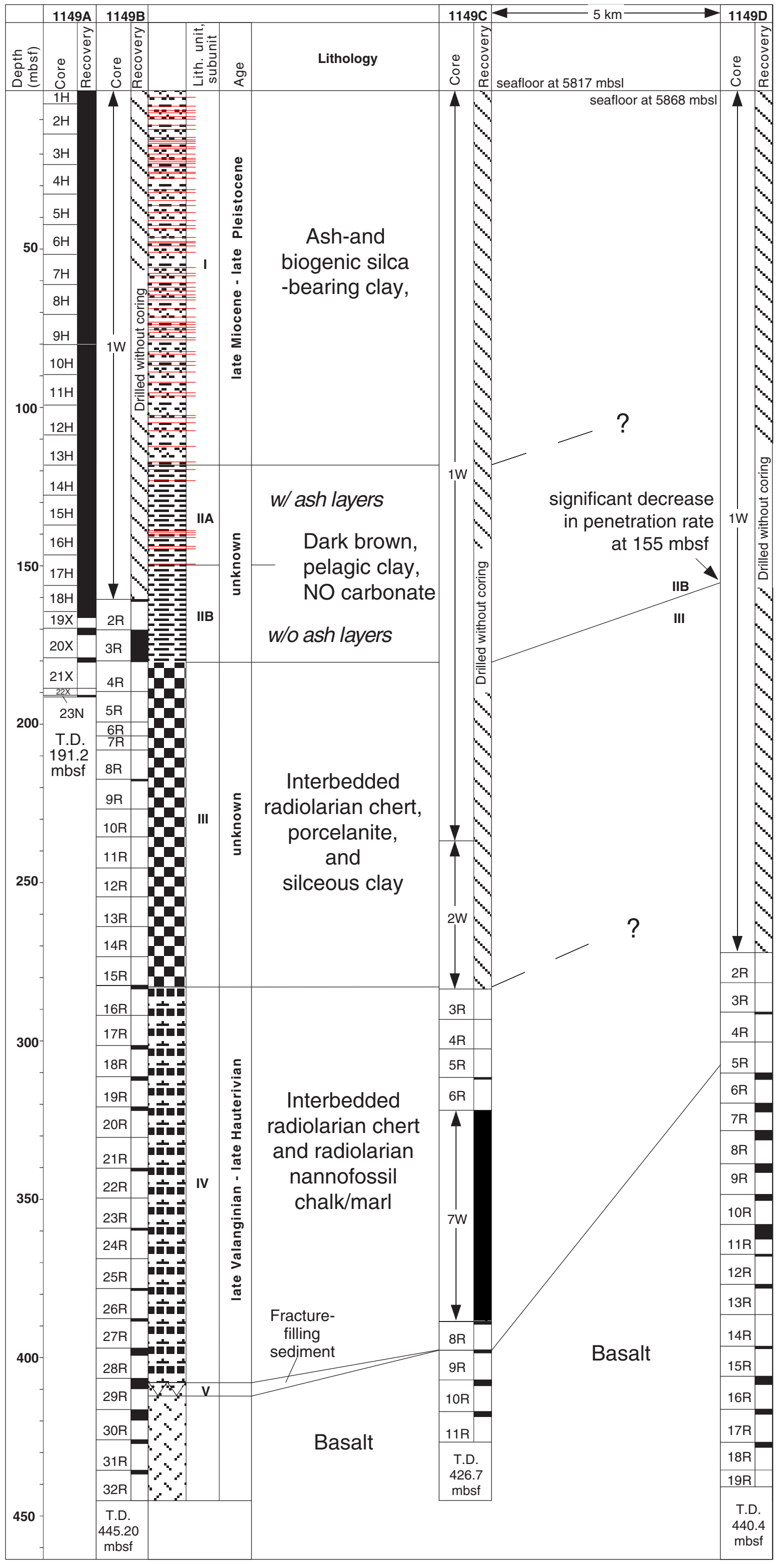
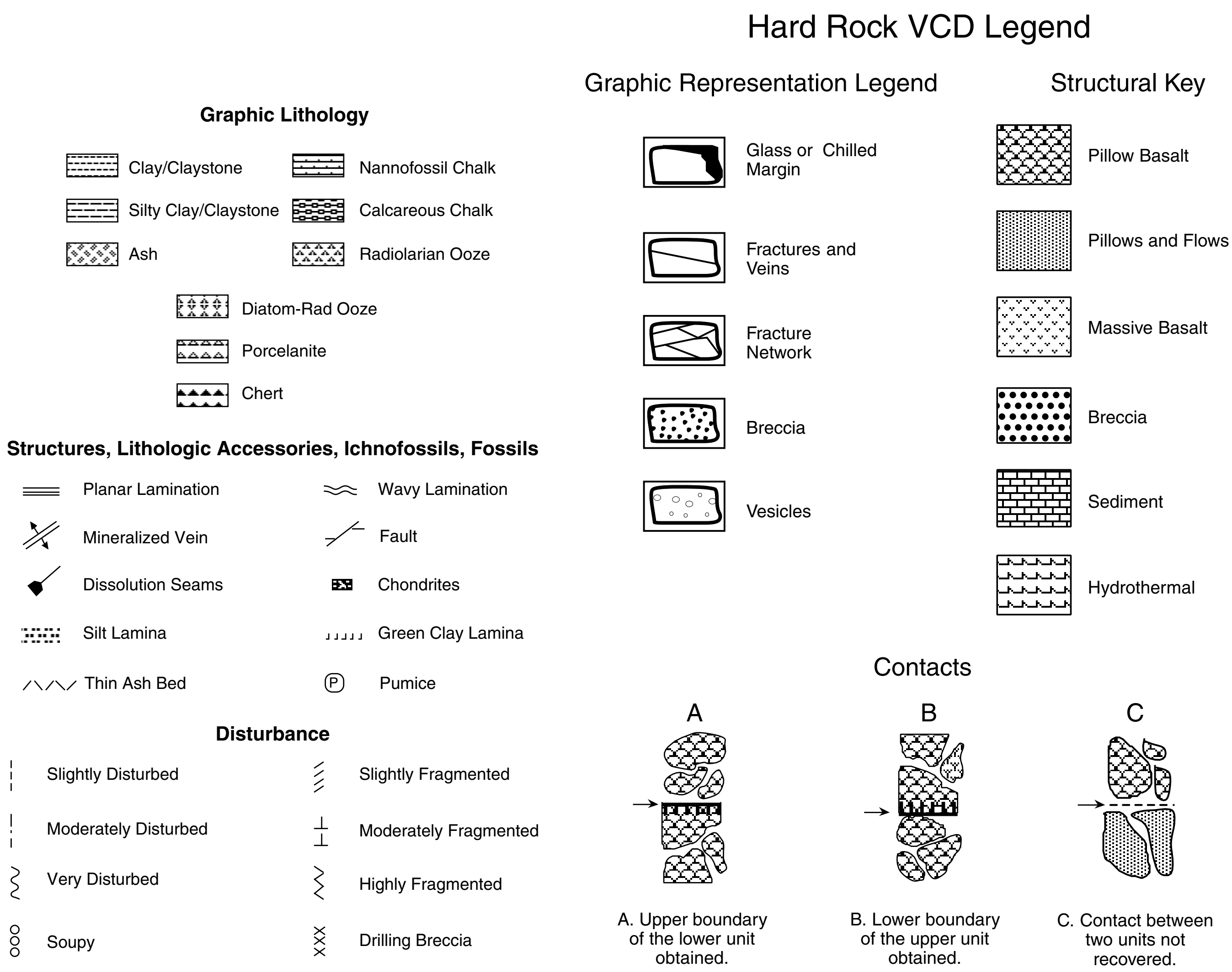


Figure 3: Leg 185, Site 1149, Hole B
Figure taken from the Initial Reports *for Leg 185, Site 1149 at:*
http://www-odp.tamu.edu/publications/185_IR/chap_04/c4_f9.htm#573094

Key to symbols used in Figure 3



Depth Age Rock Type

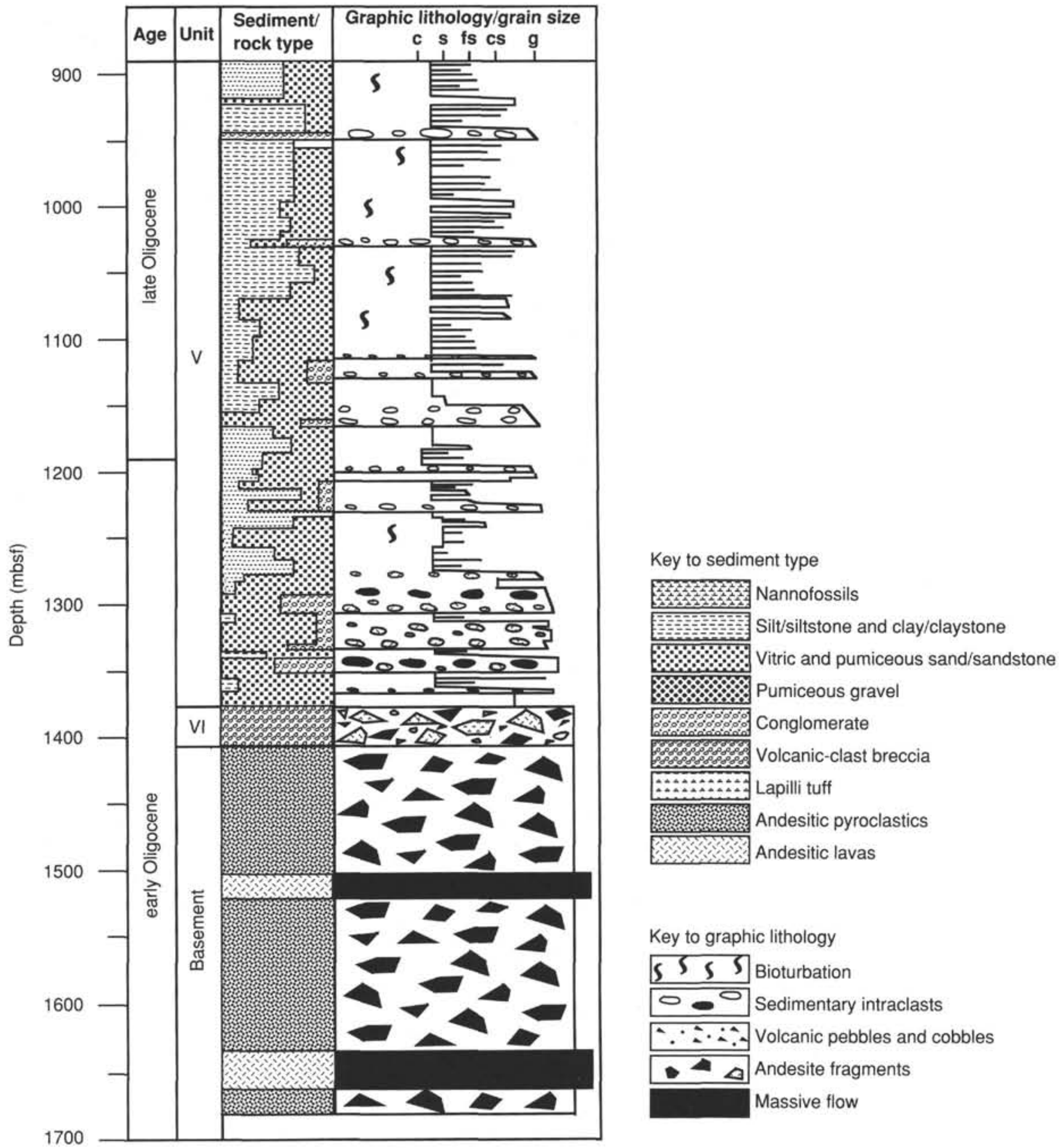


Figure 4: Leg 126, Site 793, Hole B
Figure taken from the Initial Reports *for Leg 126 at:*
http://www-odp.tamu.edu/publications/126_IR/VOLUME/CHAPTERS/ir126_10.pdf