

Density of Oceanic Crust

Background

Certain properties of a substance are both distinctive and relatively easy to determine. Density, the ratio between a sample's mass and volume at a specific temperature and pressure (like standard ambient temperature and pressure), is one such property. Regardless of the size of a sample, the density of a substance will always remain the same. The density of a rock sample can, therefore, be used in the identification process.

While density may vary only slightly from rock to rock, detailed sampling and correlation with other factors like depth may reveal important information about the history of a core, or may help to improve the use of seismic profiles. The average density of oceanic crust is 3.0 g/cm^3 , while continental crust has an average of 2.7 g/cm^3 .

Learning Objectives

Using prior knowledge and the formula for density, students will be able to:

- Calculate the density of samples from a single core;
- Determine the relationship between density and depth in a given core; and
- Measure, calculate, and compare continental rock samples.

National Science Education Standards

Standard D: Earth and Space Science

Standard G: History and Nature of Science for grades 9-12

Ocean Literacy 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, undergraduates

Time: One class period

Materials

- Balance or digital scale
- Graph paper
- Metric ruler
- Colored pencils

- 100 ml graduated cylinder
- Continental rock samples (see below)

Vocabulary

Use your textbook, the introductory material above, and/or geological dictionaries to define the following terms:

- density
- inverse relationship
- mass
- direct relationship
- volume
- isostasy

What To Do

Part 1

1. Complete Report Sheet 1 by calculating the missing densities. How will you deal with the differences in significant digits? Make sure to include units in your answers.
2. Using the depths and densities from your chart, plot a graph on your own paper (or use an electronic graphing tool) and title it Depth vs. Density. Hint: Think about independent and dependent variables. Using a blue colored pencil, draw a line of best fit from the XY-intercept through the plotted points.

Part 2

1. Find the mass and volume for each of the four continental samples as instructed by your teacher. How will you deal with error in the laboratory? How about significant digits? Record your answers in the space provided.
2. Calculate and record the density for each sample.

Analysis

1. Describe the procedure for determining the density of rock samples.
2. Does the shape of a sample affect its density?
3. What factors could lead to an error in your mass and volume measurements?
4. How do temperature and physical state affect density?
5. Explain the relationship between depth and density for the samples at Site/Hole 1256C.
6. How do the oceanic crust densities you calculated compare to the average density for oceanic crust?
7. Compare and contrast your oceanic crust results with the sedimentary and metamorphic rock samples.

Extensions

1. Compare your graph of density vs. depth during Leg 206 to the more detailed graph of bulk densities at depths of 750 to 1250 meters compiled in the Preliminary Report for Expedition 309 available through the Information by Expedition link at http://publications.iodp.org/preliminary_report/309.
2. Calculate the average densities for both the oceanic crust and the continental samples. How do these two averages relate to the theory of isostasy?

Report Sheet 1: Density vs. Depth at Site/Hole 1256C

Expedition 206 Site/Hole 1256C

Core #	Section #	Piece #	Rock Name	Depth (m)	Volume (cm ³)	Mass (g)	Density (g/cm ³)
5R	1	1	Aphyric basalt	252.5	8.0	19.384	
6R	3	5	Aphyric basalt	262.67	8.0	22.56	
7R	3	5	Aphyric basalt	271.44	8.0	23.08	
8R	3	6	Aphyric basalt	282.59	8.0	23.64	
9R	4	7	Aphyric basalt	294.27	8.0	23.264	
10R	3	4	Aphyric basalt	295.26	8.0	23.28	
11R	4	4	Aphyric basalt	308.61	8.0	23.368	
12R	1	4	Aphyric basalt	317.18	8.0	23.4208	
13R	1	1	Aphyric basalt	322.08	8.0	23.448	

Report Sheet 2: Density of Laboratory Samples

	Mass (g)	Volume (cm ³)	Density (g/cm ³)
<i>Sedimentary Rock</i>			
Limestone			
Sandstone			
<i>Metamorphic Rock</i>			
Gneiss			
Schist			