Name:_____ Course Section:_____

EARTH SCIENCE LAB ACTIVITY - DENSITY OF THE EARTH'S CRUST

Name:	Course ID:

During this lab you are required to estimate the density of the earth's continental crust. In order to do so, you must collect rocked samples from the crust and perform density valuations. Remember, the continental crust is composed of 3 rock types (sedimentary, igneous, metamorphic) and you will need to collect at least one sample of each. In the Lab you will measure their individual densities using a modified pycnometer method. The average of the densities of three different crustal rocks should approximate the density of the earth's continental crust.

Remember, the density or specific gravity (S.G.) is defined as Mass per unit Volume or: $\rho = \frac{m(grams)}{V(cm^3)}$

Prerequisites

Collecting Crustal Rock samples: You must take a self guided, self motivated field-trip to collect crustal rocks. Colorado is an ideal place to do so. Here are general collecting localities:

1. Sedimentary Rocks: Frontrange or Foothills: e.g. Dinosaur Ridge, Red Rocks Park.
2. Metamorphic Rocks: In the canyons toward the mountain areas: e.g. Lookout Mountain (Buffalo Bills Grave)
3. Igneous Rocks: Intrusive Granite: e.g. Estes Park; Extrusive Basalt: e.g. top of Table Mountain in Golden

What is a pycnometer & how does it work? A pycnometer for single mineral specimen testing consists of a glass vessel of known weight and volume. A special glass stopper assures that the volume in the bottle is constant when refilled and filled again. Excess liquid will just drain off. While other liquids may be used, distilled water is preferred since readily available. Before you start, make sure your mineral specimen fits through the opening of the bottle. Also measure the temperature of the distilled water you will be using. Weigh the dry mineral first (W_m) and then weigh the water filled pycnometer bottle (W_{bw}). Make sure there are no air bubbles inside. Place the mineral sample in the bottle, excess water will spill, and replace the stopper. Again, avoid air bubbles. Wipe the outside of the vessel dry and weigh the pycnometer vessel with the mineral specimen and water (W). Now you can calculate the weight of the water displaced by specimen (W_d) with the equation:

$$W_d = W_{bw} + W_m - W$$

The weight of the displaced water is directly related to the volume of the mineral specimen. Since 1g of distilled water is exactly equal to 1ml or 1cm^3 of volume at 4°C. This volume changes slightly at elevated temperatures and can be corrected by multiplying your results by a correction factor given in table 1.

Table 1 - Water temperature volume correction factors for distilled water

H_2O Temp °C	Volume multiplier	H_2O Temp °C	Volume multiplier	H_2O Temp °C	Volume multiplier
15	0.999099	19	0.998405	23	0.997538
16	0.998943	20	0.998203	24	0.997296
17	0.998774	21	0.997992	25	0.997044
18	0.998595	22	0.997770	26	0.996783

After you have such obtained the displaced volume of the water and the weight of the mineral, the S.G. can be calculated using the general formula given above in the introduction to this lab.

Materials needed:

- Triple Beam Balance or electronic balance
- Pycnometer or erlenmeyer flask with rubber stopper with hole
- beakers, cups, paper towels
- Rock Samples
- distilled water or tap water
- thermometer

Procedure:

1. Use the procedural description for the PYCNOMETER above. Since our lab is not equipped with standard

pycnometers, we will use a make-shift pycnometer consisting of an erlenmeyer flask with rubber stopper with hole.

2. Use multiple sample chips per measurement. Greater amount increases accuracy. Make sure sample chips fit through vessel opening.
3. Be careful to remove all air bubbles from flask and specimen before replacing the stopper. Gentle tapping might be helpful.
4. When using the make-shift pycnometer, be sure to place rubber stopper carefully down to the same depth into the flask every time you replace it. DO THIS SLOWLY! Excess water should spill out the hole!
5. After obtaining the weight for the displaced water, do not forget to adjust the displaced volume according to table 1.4.
6. Show ALL your calculations!

Measurements:

You will measure the density or specific gravity for your 3rock specimens, one sample from each of the three rock categories. Fill in the table below with your results:

Specimen Name	Measurements & Calculations t = _____ °C	S.G.
Igneous Rock Sample Name:	W_m = _____ = m W_{bw} = _____ W = _____ W_d = _____ x _____ = _____ = V *correction factor*	
Metamorphic Rock Sample Name:	W_m = _____ = m W_{bw} = _____ W = _____ W_d = _____ x _____ = _____ = V *correction factor*	
Sedimentary Rock Sample Name:	W_m = _____ = m W_{bw} = _____ W = _____ W_d = _____ x _____ = _____ = V *correction factor*	
	AVERAGE DENSITY or SPECIFIC GRAVITY from your three rock samples	

What is the percent error of your measurement?

You should be below ±6%. Compare your AVERAGE DENSITY to the ACCEPTED DENSITY for the continental crust using the formula below:

$$\%error_{CrustalDensity} = 100\% - \left(\frac{S.G._{yourmeasurement}}{2.7 g/cm^3} x100\right)$$

If your error is greater than ±6%, you MUST REPEAT the part of the experiment that introduced your error until your error margin is acceptable.

Water Volume Correction Factor for average tap water (TDS 100mg/l)

Temperature °C	Temperature °F	Multiply water volume by
15.0	59.0	x 0.9992
16.0	60.8	x 0.9990
17.0	62.6	x 0.9989
18.0	64.4	x 0.9987
19.0	66.2	x 0.9985
20.0	68.0	x 0.9983
21.0	69.8	x 0.9981
22.0	71.6	x 0.9979
23.0	73.4	x 0.9976
24.0	75.2	x 0.9974
25.0	77.0	x 0.9972
26.0	78.8	x 0.9969
27.0	80.6	x 0.9966
28.0	82.4	x 0.9963