

Student Worksheet: Density of Lithosphere and Mantle Rocks Experiment

Aim: To determine the role of rock density and buoyancy in tectonic plate motion.

Materials: Rock samples (basalt, gabbro, blueschist, eclogite, andesite, granite, peridotite, serpentinite), scales (+/- 0.1 g), cotton thread, 500 mL beaker or plastic container, tap water, retort stand, boss head, clamp

Method:

1. A dry rock sample was placed on the scales and the mass recorded.
2. A length of cotton was securely tied to the rock.
3. The retort stand, boss head and clamp were set up so that the rock sample could be suspended from the clamp.
4. A half-full beaker of water was placed on the scales and the scales were zeroed.
5. The rock was suspended and wholly immersed in the water and the mass recorded (this mass will be equal to the volume of the displaced water in cm^3 because the density of fresh water = 1 g/cm^3).
6. The density was calculated using the formula:

$$\text{Density (in g/cm}^3\text{)} = \frac{\text{mass}}{\text{volume}} = \frac{\text{dry mass in air (g)}}{\text{volume of rock (cm}^3\text{)}}$$

7. The rock densities were plotted on the cross-section of a subduction zone (following page).

Diagram of set up

Results:

Rock type	Location	Dry mass in air (g)	Mass in water (g) = volume (cm^3)	Density (g/cm^3)
basalt	oceanic crust (upper 0.5 km)			
gabbro	oceanic crust (0.5-10 km)			
blueschist	subducting oceanic crust			
eclogite	subducting oceanic crust			
andesite	continental crust (volcanic arc)			
granite	continental crust			
peridotite	upper mantle (lithosphere + asthenosphere)			
serpentinite	hydrated mantle			

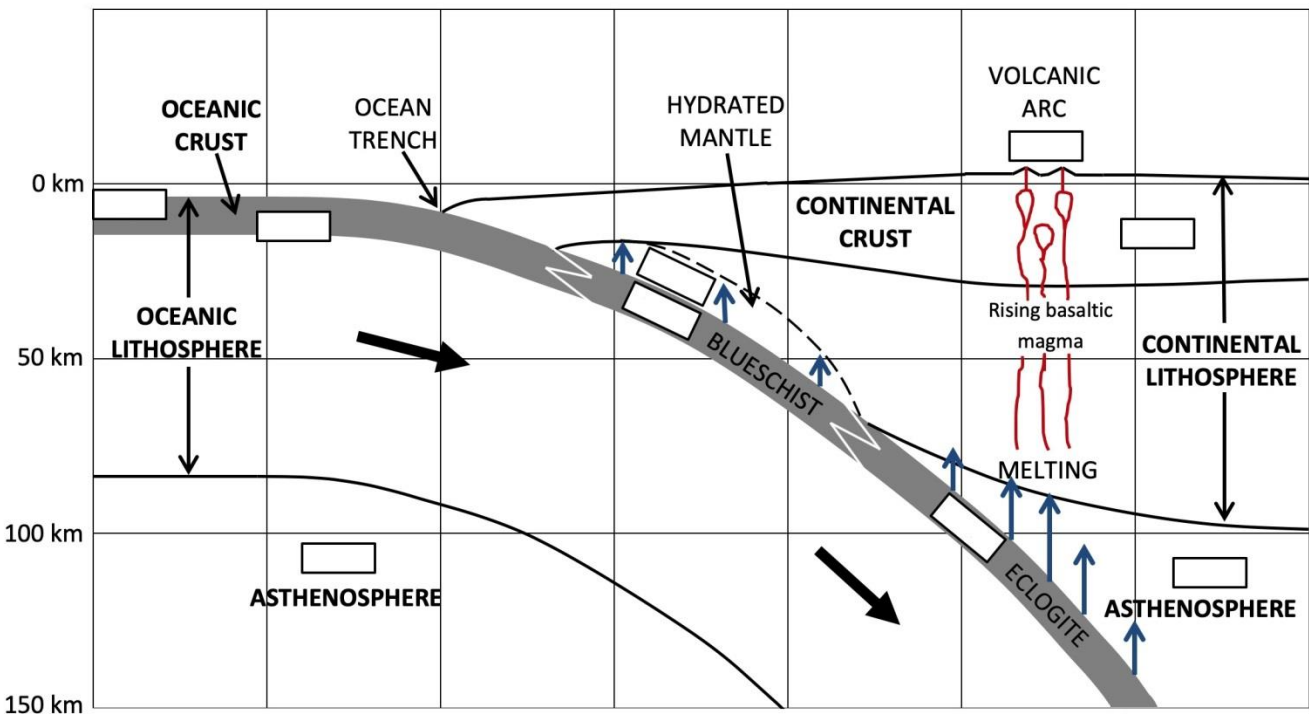


Figure 7: Cross section of a subduction zone with measured rock densities in g/cm^3

Questions:

1. Classify the eight rocks in this experiment as:

Volcanic igneous

Plutonic igneous

Metamorphic

2. Why does continental lithosphere float higher on the asthenosphere than oceanic lithosphere?

3. Explain why the metamorphism of basalt and gabbro to blueschist and then to eclogite is a possible cause for subducted plates being pulled down into the mantle (slab pull).

4. The metamorphism of blueschist to eclogite as the oceanic plate descends also releases a large amount of water. This water lowers the melting point of mantle peridotite causing the generation of mafic magma (called flux melting). Why does this magma rise?

Conclusion: