

# ISOSTASY

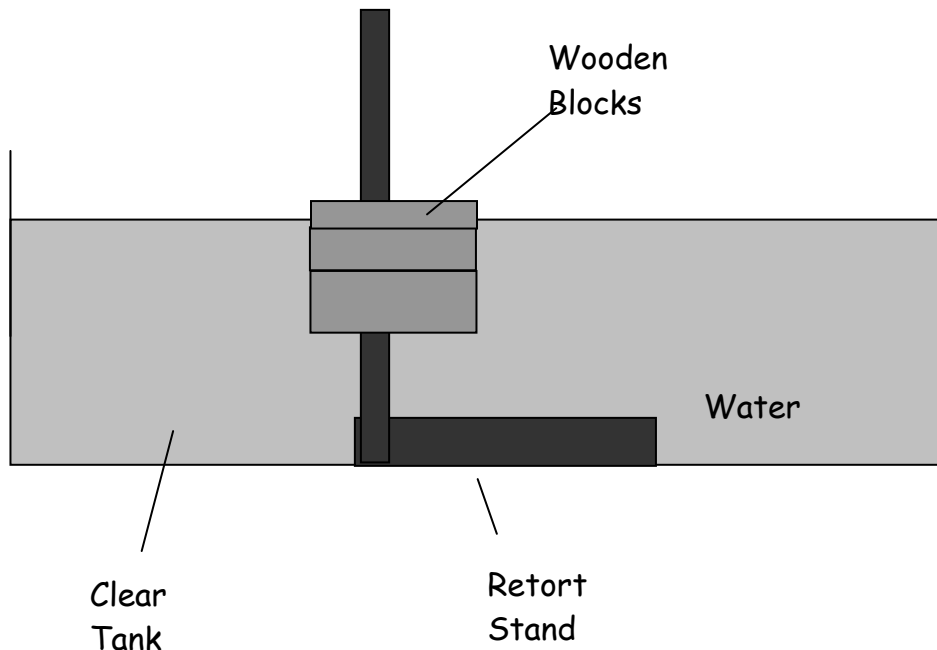
## Purpose

To determine the relationship between the amount of erosion and the amount of uplift of the crust and between the amount of deposition and the depression of the crust.

In these experiments the water represents the mantle, the blocks of dense wood the crust and the blocks of light wood the sediment or ice. The weight of the wood (crust or sediment) added must equal the weight of the water (mantle) displaced.

**Activity I** To determine the amount of uplift or depression caused by the thickening of the crust by mountain building and thinning by erosion

1 Place the retort stand in tank.



2 Measure the thickness of all the dense blocks (A to D) and then do the same for the light blocks (E to H). Record the data in the table below.

3 Copy and complete this table:

blocks	A	B	C	D	E	F	G	H
thickness added (t)								
Total thickness added (T)								
height of top of blocks above water = height of land (H)								
change in height of top of blocks (h)								
depth of bottom of lowest block = base of crust (D)								
change in depth (d)								

4 Place block A over the retort stand in the water and measure the height of the top above the water and the depth of the bottom below the water.

5 Place block B on top of block A. Measure the height of the top of the highest block above the water. Measure the depth of block A below the water.

6 Repeat instructions 4 until you have all the blocks of dense wood (A to D) on top of each other.

7 Now repeat the process adding the light blocks E to H.

8 Plot a bar graph with height above (H) and below water (D) and the total thickness added (T) on the vertical axis and the stages A to H on the horizontal axis. Your zero line should be about 1/3 up the page. It should look like a series of steps which gives you a good visual representation. Label your lines "level of land before isostatic adjustment", "level of land after isostatic adjustment", "base of crust after isostatic adjustment"

9 Plot a scatter graph of H and D on the vertical axis against T on the horizontal axis

10 Find from the graph or from the numerical data the relationship between the change in height and the thickness added or subtracted, the density of water and wood.

## Questions

1 Write an equation to show the relationship of uplift and erosion assuming the mantle has a density of 3.3 and crust 2.7.

How will the height of a plateau change if 500m of rock are eroded from its surface?

2 Likewise write an equation to show the relationship of depression and sedimentation assuming that sediments have density of 2.0.

100 m of sediment are deposited all over the bottom of a large deep lake. By how much will the depth of the lake change?

3 Write another equation to show the relationship between isostatic change in sea level and the thickness of ice added. Ice has a density of 0.9.

Parts of Scotland have raised beaches indicating an isostatic rise of the land of 10m. What thickness of ice must have melted to cause this amount of uplift?

## Teacher's Section

### Requirements

One transparent tank about 50cm by 30cm by 30cm deep filled with water 20cm deep. The lowest block should not touch the bottom when all blocks are in the tank.

Blocks of dense wood e.g oak and of light wood e.g. pine.

Retort stand (to hold all the blocks in place.)

Ruler and tape measure

### Making the equipment

Four of pieces of hard wood. All pieces of wood should be 10cm long by 7cm wide and of varying thicknesses, say 5cm, 3cm, 2cm, and 1cm. All pieces should have a hole drilled through the centre so that they fit easily over the retort stand and should be labelled A thickest to D thinnest. The wood should not have knots because these will make it float unevenly. Four pieces of soft wood 10cm by 7cm, 5cm, 3cm, 2cm, and 1cm thick, again with a hole in, labelled E to H.

### Notes

Unless you wish the students to calculate the density of the wood it should be worked out before and given to them. The density of any wood can easily be found by finding what proportion lies below the surface of the water.

With less bright students it is better to give them the equation and ask them to confirm it. It is easiest to measure the depth below water using a tape measure and the height above using a ruler.

### Results

The equation is  $t$  (thickness added)  $\times$   $d_{wd}$  (density of wood) =  $d$  (change in depth of bottom of crust)  $\times$   $d_{wt}$  (density of water.)

$$d = t \times \frac{d_{wd}}{d_{wt}}$$

$$h = t - \frac{t(d_{wd})}{d_{wt}} \quad h = \text{height of top above water}$$

### Time

About 40 minutes for the practical part



Isostasy; wooden blocks floating in tank