Online Exercise: Isostasy

Starting Point:

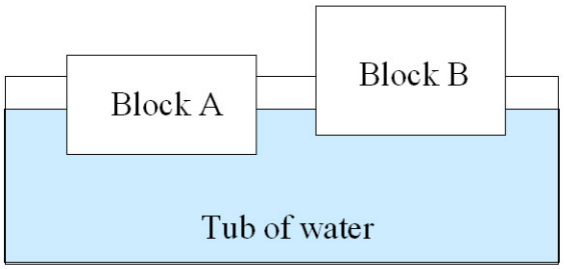
Note: These first two questions could be topics for discussion/chat for a couple of days that would then lead to the exercise that follows.

A. In your own words, can you explain the principle of isostasy? Please keep your answer simple without reference to the specifics of Airy or Pratt isostasy.

B. Use the principle of isostasy to explain why continental crust underlies areas of higher elevation than oceanic crust?

Online Exercise: Isostasy

1. Refer to the diagram below. There are two different blocks of wood, Block A and Block B, which are floating in a tub of water.



a. Which of the two blocks of wood is less dense?

a. Block A

b. Block B

b. Explain your reasoning behind your choice in part 1a.

a. Block A is less dense because it is thinner than Block B.

b. Block A is less dense because it sits lower in the tub of water.

c. Block B is less dense because it sits higher in the tub of water.

d. Block B is less dense because it is thicker than Block A.

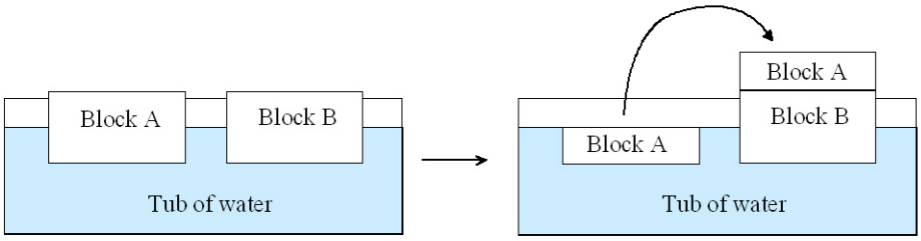
c. In terms of density, how are Blocks A and B analogous to oceanic and continental crust?

a. Block A is analogous to oceanic crust and Block B is analogous to continental crust.

b. Block A is analogous to continental crust and Block B is analogous to oceanic crust

2. Refer to the diagram below. There are two blocks of wood, Block A and Block B, which are floating in a tub of water (left diagram). The two blocks are made of the same type of wood and

are the same size and shape. Half of each block rises above the water line. You remove the blocks from the tub of water. You slice off the top half of Block A and put the sliced half onto the top of Block B as illustrated on the right diagram.



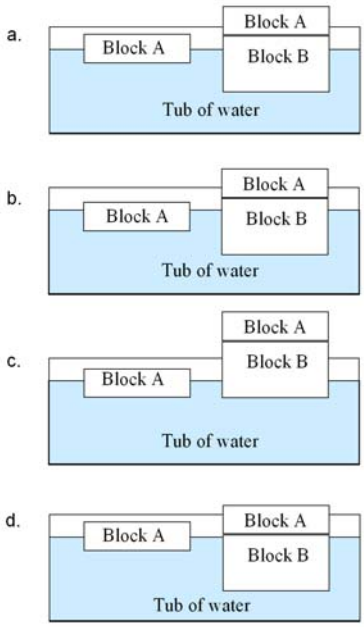
a. Predict what will happen to *both* blocks as you place them back into the tub of water. Will the blocks rise or sink isostatically compared to their original positions?

a. A will rise, B will sink; This is because half of A must rise above the water line and B will sink from the additional weight of A added on top of it.
b. A will rise, B will rise; This is because half of A must rise above the water line and B will rise from the added thickness of A.
c. A will sink, B will rise; This is because A is now half as thick and it will need to sink and B will rise because of the added thickness of A.
d. A will sink, B will sink; This is because A is now half as thick and it will need to sink and B will sink because of the added weight of A added on top of it.

b. If you have removed half of Block A, how much of the remaining block will be exposed above water?

a. 25% because half of the original amount is 25%
b. 35% because it is now less dense, so it rises up a bit more
c. 50% because it was 50% exposed before it was cut
d. 75% because making the block thinner makes it rise and float more

c. How would your tub and blocks look like after you sliced off half of Block A and added the sliced half to Block B.



3. Putting the sliced block of wood from Block A to Block B is analogous to what geologic processes? In other words: What does removing the wood from one block represent? What does adding the wood slice to the other block represent?

a. The sliced block of wood from Block A represents subduction, adding the wood slice to Block B represents mountain building.

b. The sliced block of wood from Block A represents tension, adding the wood slice to Block B represents compression.

c. The sliced block of wood from Block A represents erosion, adding the wood slice to Block B represents deposition.

d. The sliced block of wood from Block A represents tectonic uplift, adding the wood slice to Block B represents tectonic sinking.

4. Consider that the wood blocks represent the "crust" and the part of each block below the surface of the water represents the "root of the mountains" that extends downward into the "mantle" (the water). Use this analogy to explain how removing wood from the top of Block A explains exposure of metamorphic rocks that are found at the core of mountains.

a. As the top of the mountain is weathered and eroded, the root rises isostatically, eventually exposing the metamorphic rocks formed at depth.

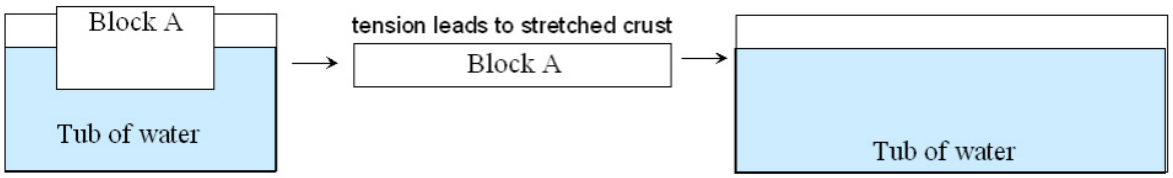
b. As the top of the mountain is removed, the metamorphic rocks slowly convect their way to the top.

c. As the top of the mountain is eroded, the root spreads out laterally, which exposes the metamorphic rocks.

d. As the top of the mountain is removed, this lowers the density of the mountain and causes the metamorphic rock to rise and get exposed.

e. As the top of the mountain is removed, the now exposed rock is metamorphosed because of the resulting change in temperature and pressure.

5. Using the diagram below, what would happen to Block A if we did not cut off half of the block, as in question #2, but instead stretched it? (a) Would Block A isostatically rise or sink? (b) What will happen to the elevation of Block A? (c) What happens to the "root" of Block A?



a. Block A will sink, the surface elevation will decrease, and the root will become thicker.

b. Block A will rise, the surface elevation will increase, and the root will become thinner.

c. Block A will sink, the elevation will increase, and the root will become thicker.

d. Block A will rise, the elevation will decrease, and the root will become thinner.

e. Block A will rise, the elevation will decrease, and the root will become thicker.

6. Mountains stand high compared to nearby plains. Which region, high mountains or low plains, do you predict will have the thicker crustal root?

a. The mountains would have a thicker crustal root.

b. The plains would have a thicker crustal root.

Note: These could be topics for discussion/chat for a couple of days AFTER the exercise.

Follow Up Discussion:

C. Why is oceanic crust always covered up by sea water? Another way to ask the same question, why is oceanic crust always found under water?

D. What is flexural isostasy and why is it a more realistic view of geologic processes than blocks of wood floating in a tub of water?

Assignment adopted from Instructor's Resource Guide for *How Does Earth Work?* 2e, Smith & Pun, Pearson, 2010