

# Iron oxides

*Shannon and Ian Jacobs*

We have a rock that's smooth, mostly black, and very heavy, with a mass of 5.29 kg. I have trouble lifting it.

## Mekong Iron

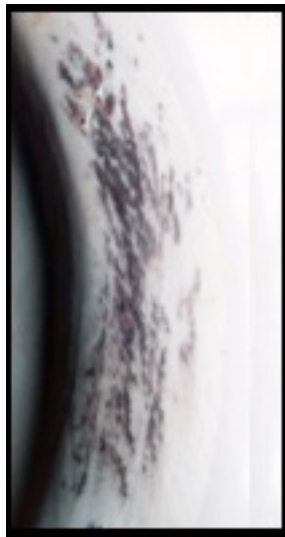
The local people along the Mekong river (where the rock was found) call it *Mekong Iron*. It's clearly not iron, but it could be iron ore, Magnetite or Hematite. There are simple tests for both of these.

When rubbed on unglazed white porcelain Magnetite leaves a black streak and Hematite leaves a red streak that looks like dry blood, hence the name "Hematite". Magnetite attracts a magnet but not iron filings.



A small magnet sticks firmly to the black sides of the rock but will not stick to the brownish parts. The black parts could be Magnetite, but the other parts are something else.

Rubbing the unglazed under surface of the plate shown below on different parts of the rock has different effects.



Streaks left by the black parts of the rock are black and by the slightly brownish regions are red.

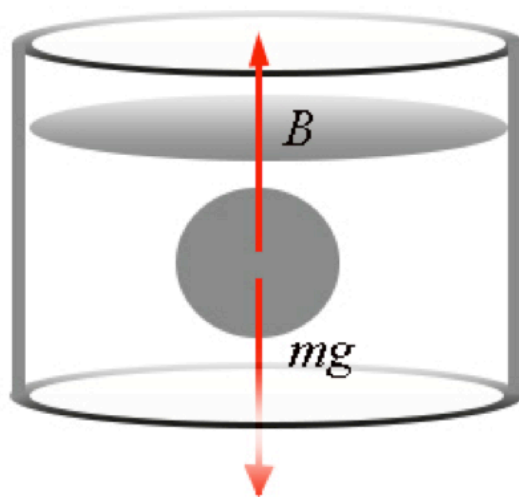
Our rock is a mixed specimen of magnetite with extensive regions of Hematite. Both have about the same density (5 g/cc) and both are common ores of iron. The density of the rock is close to this value (by dividing an estimated volume by the mass) but to make sure we weighed the rock under water.

## Measuring density

The mass of the rock is measured with scales is 5290 grams.



To find the volume of the rock it was hung on the scales in a bucket of water. That sounds silly, but it's clever.



When the rock is under water there is an upwards force called *buoyancy* that helps to balance its weight  $mg$ . That is true: I can lift the rock more easily when it's under water in a swimming pool.

*The buoyancy force on any object under water is equal to the weight of water that has the volume of the object.*

## The weight of the rock under water

When the rock is out of water the balance reads 5290 g.



When the rock is under water the balance reads 4180 g.



The loss of weight under water is 1110 g, meaning that the mass of water with the volume of the rock is 1110 g. The density of water is 1g/cc.

The density of the rock is  $5290/1110 = 4.8$  g/cc.

The densities of Magnetite (5.0 g/cc) and Hematite (5.2 g/cc) are slightly higher than this average density. Our “Mekong Iron” is a mixture of the two most common iron ores: Magnetite, which is  $\text{Fe}_3\text{O}_4$  and Hematite, which is  $\text{Fe}_2\text{O}_3$ . The rock apparently includes some impurities, possibly quartzite and other lighter rocks.