Name: Date:

Sedimentary Layers: Stories Told By Rocks

What are sedimentary layers?[1]

Sedimentary layers are layers of sedimentary rock. Sedimentary rocks are rocks made of what is called sediment. What is sediment? **Sediment** is the name for smaller pieces of broken-down rock or organic matter (a dead organism).

Sedimentary rock forms when sediment settles out of quiet waters such as a lake, swamp, or ocean. Sediment can be formed there or formed in another place and then washed in by erosion. The process in which sediments accumulate or pile up at the bottom of a body of water is called deposition.

After deposition, sediments slowly turn into rock. How does this happen? The weight of the layers slowly squeezes the sediments at the bottom. Minerals in the water "glue" the particles together. After many years, layers of sediment have turned to rock. The layers of rock build up over time.

What can sedimentary layers tell us about how environments and living things have changed in an area?

Our planet Earth is always changing. The movement of plates, large pieces of the crust or surface of the Earth, causes the continents to move. Land that is now at the equator may once have been at a pole! In addition, the climate has changed over time. Sedimentary layers preserve a record of changes in temperature, rainfall, and location over millions of years of Earth's history. If we find fossils of seashells in a layer of rock, we know that it was once an ocean. If we find fossils of trees, we know there was land when the layer formed. If we find fossils of organisms that need warm temperatures to survive, we know that the climate was warm in the past. Sometimes chemicals in the rocks give us clues about past climates.

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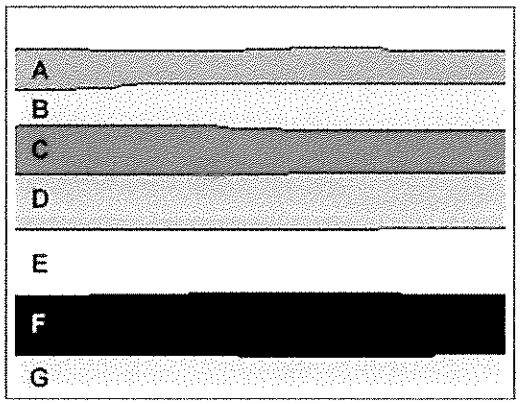
[1] Colorful layers of sedimentary rock in Makhtesh Ramon, Israel.Author: Rhododendrites, Creative Commons Attribution-Share Alike 4.0 International license. Layer diagram author: Kurt Rosenkrantz, CC Attribution-Share Alike 3.0 Unported license.

We can also learn about past life by studying sedimentary layers. Living things have existed on Earth for more than three billion years. During this time, the variety and type of organisms has changed. Fossils in sedimentary rock preserve the history of those changes. **Fossils** are the preserved remains of living things or traces of living things such as footprints. Fossils in sedimentary layers have helped us learn things such as how birds evolved from reptiles and when dinosaurs became extinct..

A special type of fossil called an index fossil can help scientists compare the ages of rock layers. An **index fossil** is a fossil of an organism that was widespread or present in many areas. As the Earth's environment changed, the organism became extinct. When an index fossil is present in a layer of rock, we know that that layer was formed before the organism became extinct. This helps us learn the age of the layers.

Interpreting sedimentary layer diagrams

In the same way that scientists learn about the history of Earth by looking at layers of sedimentary rocks, you can learn about Earth's history by looking at diagrams of sedimentary layers! You can always tell which layers are oldest because they are laid down first. After the first layer is deposited, a new one forms on top of it. This can go on and on for many millions of years. In the diagram to the right, see if you can tell which letter represents the oldest layer and which letter represents the youngest. Did you decide that A is the most recent, and G is the oldest? You're right!



Check your understanding by answering these questions in compete sentences:

1. What are sedimentary layers? How do they form?

2. How can we learn about past environments by studying sedimentary rocks?

3. What is a fossil? What are some things we have learned from fossils?

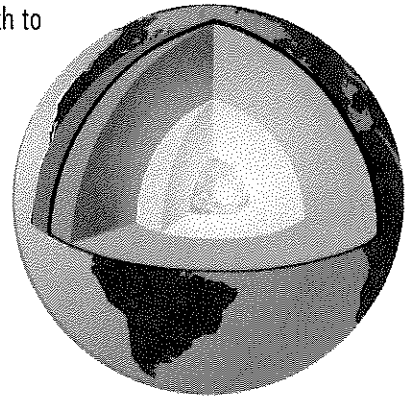
4. In a diagram of sedimentary layers, how can you tell which layers are older and which are more recent?

Name: Date:

The Layers of the Earth and Their Density

Words to know:

composition/composed: what something is made of, the materials in it.
density: how much mass/weight there is in a certain amount of volume.
material: a kind of substance such as metal, wood, or rock.



You probably know that if you could dig a hole from the surface of the Earth to its center, you would find that Earth is not the same all the way through. Earth has layers. The ones you hear about the most are the crust (where we live), the mantle, and the core. The main reason Earth has these layers is (drumroll please) … DENSITY!

Density is the amount of matter ("stuff") in a certain amount of space. Things that are dense are heavy for their size. Things that are not dense are very light for their size. So that means that different layers of the Earth must have matter more closely packed than others.

More dense things sink, just as a marble will sink in a tub full of water. Less dense things float, just as a rubber ducky will float in a tub of water. Earth has layers because denser materials sank to Earth's center billions of years ago, when Earth was so hot that it was liquid. The less dense materials are on the outside - the crust and mantle. More dense materials are in the deeper layers - the inner and outer core.

In the table below, you can see the density and composition of the layers of the Earth. To help you compare these densities to something you are familiar with, remember that the density of water is 1 g/cm^3.

LAYER	DENSITY	COMPOSITION
crust	2.2 - 2.9 g/cm^3	silicate rocks
mantle	3.4 - 5.6 g/cm^3.	silicate rock and oxide rock
core	9.9 - 12.2 g/cm^3. (outer), 12.8 - 13.1 g/cm^3. (inner)	mostly iron metal, some nickel and sulfur

[1] Earth cutaway credit: Jordens_inre.svg: Original Mats Halldin Vectorization: Chabacano. GNU Free Documentation License

What causes the density of the layers to be different? Two things! First, density is determined by composition - what each layer is made of. The rocky materials of the crust are less dense than the iron in the core. The atoms and molecules are different in the two types of materials, and that makes their densities different. Density is determined by the size of the particles in a material and how they are arranged.

Pressure is the other reason the layers are different in density. Pressure is a pushing or squeezing force. The weight of all of the Earth above each layer pushes down on the layers below it. The deeper you go into the Earth, the more pressure there is. That changes the arrangement of the particles. When there is more pressure, the particles are closer together. That makes them more dense. That is why, when you look at the table on the previous page, the density of each layer has both a low and a high number. The higher density is at the bottom of the layer, closer to the center of the Earth.

So there you have it! Earth has layers because of density. Dense materials such as iron sank to the middle of the Earth, the center of its gravity. Less dense materials stayed at the top. This all happened when the Earth was so hot that it was completely liquid, billions of years ago. Pressure also makes the lower layers more dense. That is because the tremendous weight of all the Earth above squeezes the particles below, making them closer together and more dense.

Check your understanding by answering these questions:

1. What is the definition of density?

2. If you took the same amount (the exact same volume), of a piece of crust and compared it to a piece of the core, which one would be heavier for its size? Why?

3. What was the state of matter of Earth (solid, liquid, or gas) when the denser materials sank to the center billions of years ago?

4. List Earth's layers in order of density, from the least to the most dense layer.

5. How does composition affect the density of the layers of the Earth?

6. What causes the pressure to be greater deeper in the Earth? How does pressure affect the density of the deeper layers?