Reading 9.1 – How Well Do Scientists Understand Plate Tectonics?

Getting Ready

You have learned that Earth's plates move on the surface of the earth, as they glide on a softened layer of hot mantle rock. Many scientists agree that this slow movement of the mantle rock is responsible for the movement of plates. In 1968, J. Tuzo Wilson declared, "The Earth, instead of appearing as an inert statue, is a living, mobile thing." Not only do the outer and visible parts of the earth move, but the interior of the earth also moves.

What evidence have you gathered in this unit that the outer Earth moves? What evidence do you have that the interior portion of the earth is in motion?

What are the interrelationships between the movement of different parts of the earth (plate tectonics) and the rock cycle?

In class, you used Silly Putty® to represent how solid rock can deform over time and at higher temperatures. You also looked at rock samples that showed evidence of past deformation. The appearance of metamorphic rock is one piece of evidence that solid rock can flow when it has been subjected to very high temperatures and large amounts of pressure in the interior of the earth over millions of years.

Although it may seem that the theory of plate tectonics is a fact and that scientists know all there is to know about this topic, this is not the case. Scientists examine existing knowledge and understanding about a theory and then look for alternative explanations. They also pursue unanswered questions, or they ask new questions.

One question that scientists have and that you may have raised in class is "How does mantle convection really work?" Scientists have a good sense of the characteristics of how hot and cold matter behaves in the earth's interior. Some of this understanding comes from experiments, such as those you did in Lesson 2, but scientists are still unsure of how mantle convection might look in the earth. Since no one can actually see it occurring, scientists must make hypotheses based on evidence. They also use computers to help estimate what might be happening in places that are inaccessible, like deep inside the earth. Scientists do not yet agree on how exactly mantle convection works within the earth's interior. Additional evidence is needed to deepen scientists' understanding of the theory of plate tectonics.

Another unanswered question is "Why do hotspots form?" This question may have also been raised in class. You have studied how a hotspot leads to the formation of a chain of volcanoes, but why are there not hotspots everywhere? Rather, they are only in certain locations. This is a puzzle for scientists. Some believe that hotspots originate very deep in the mantle, at the boundary between the mantle and the earth's core. These super-heated plumes (sections of the mantle that are much hotter than the surrounding area) are then thought to rise up through the mantle, leading to the features visible on Earth's surface. Others believe that hotspots are not as fixed as we think they are based on gathered evidence, but they can migrate slowly over time.

We may never fully understand all of the details associated with the existing theory of plate tectonics. This is why scientists continue studying these concepts. Earth science deals with many phenomena that are difficult to observe, such as those taking place within the interior of the earth. Not all aspects of the theory of plate tectonics can be tested, and experiments are hard to design, given the large scale of these processes. We know that plates have moved in the past and that they continue to move today. The exact methods of movement and the cause of this motion are still puzzling to scientists today. What unanswered questions do you have about plate tectonics? Why do you think Earth scientists continue to study plate tectonics?