Reading 1.2 – Volcanoes and Earthquakes

Getting Ready

Even if you do not experience volcanoes or earthquakes where you live, you probably know something about them. When volcanoes erupt or earthquakes occur, you see reports in the news. This photograph shows the destruction that can happen. Homes, cars, and everything else people own can be destroyed, but you are learning that these events do not just change the buildings and roads people have built; they change the surface of the earth itself.

The Driving Question for this unit is How Is the Earth Changing? It refers to the kinds of changes that affect the earth underneath everything you see in the photo. Under the pile of rubble and under the sidewalk, the earth changes when volcanoes erupt or earthquakes occur. To study these and other changes, you will talk not only about how the earth changes in ways you can see but also how the earth changes deep under oceans and deep under the land you see. This reading will help you think about predicting changes in the earth that will happen in the future.

How Do Scientists Know Where the Earth Will Change?

Scientists have ideas about where earthquakes and volcanoes will occur—and will change the earth—based on data. In class, your data showed the past location of these events on maps. Different colored dots and triangles showed where volcanoes had erupted and earthquakes had occurred on the earth over several years. A map that shows volcanic activity shows where volcanoes have erupted. A map that shows seismic activity shows where earthquakes have occurred. For now, you do not need to study words like *seismic*, *seismograph*, or *seismology*. However, it is useful to know that when you hear or see the prefix *seism-*, you know that the word is related to earthquakes.

Earthquake Destruction in Pakistan

Earth science often uses maps and visualizations of data that can be placed on maps. Data—put on top of a map—can help you make predictions about phenomena. If you were trying to predict where volcanoes or earthquakes would occur, the maps you looked at in class would be helpful. In fact, maps are an important kind of model that scientists use to represent phenomena and to predict phenomena.

Look at the maps you used in class. If you did not want to live where volcanoes or earthquakes could occur, where would you choose to live?

Predicting Where and When Events Will Happen

Scientists use maps like the ones you used in class to help them think about where earthquakes might occur. Meteorologists watch for changes in weather conditions to help them be more precise and to help them make predictions about what the weather will be like in the near future. The same is true with earthquakes. Scientists do not know exactly when an earthquake will occur. They use data to help them predict, but they cannot be very precise. For example, scientists know that earthquakes are more likely to occur in certain areas, and they are more likely to happen in places if it has been a long time since an earthquake occurred. They are less likely to occur in areas where an earthquake has happened more recently, and earthquakes are not very likely to happen in certain areas. You have already begun to think about locations of earthquakes and volcanoes by looking at patterns in class. How well do you think scientists can predict where a volcano will erupt? How well do you think scientists can predict when a volcano will erupt? Explain.

Do you think it is ever possible for an earthquake to occur or for a volcano to erupt in a place that is unexpected? Explain.

In this reading, you will learn some of the methods scientists use to help them make predictions. You do not need to know the names of these methods, but you should focus on the kind of information scientists use to make predictions.

Volcano Alert

Adapted from Karen Lurie

ScienCentral Archive, July 11, 2003


U.S. Geological Survey Department of the Interior/USGS
U.S. Geological Survey/photo by Robert Krimmel, May 18, 1980

Volcanoes may seem exotic, but there are plenty of them in the United States. According to the U.S. Geological Survey (USGS), 67 active or potentially active volcanoes are in the U.S. The best known is Mount St. Helens, which erupted in 1980. It sent a rolling column of hot ash and gas more than fifteen miles into the air. "[The blast] essentially killed every living thing within an area of 230 square miles," says C. Dan Miller, chief of the Volcano Disaster Assistance Program at the USGS Cascades Volcano Observatory. "It destroyed hundreds of acres of an old growth forest. It was an incredibly spectacular event."

It changed the face of volcano forecasting. "Since the 1980 eruptions we have refined our hazard assessment techniques," Miller says. "We much better understand hazardous volcanic events, like directed blasts and debris avalanches and how to lessen their damaging effects." A volcano erupts when hot gas and magma—molten rock that flows into a volcano through the Earth's crust—rise to the surface. If the volcano's top is sealed, the gas and magma have nowhere to go. Pressure builds, and the volcano blows. Every volcano is different, so eruptions are hard to predict, but some volcanoes do give off telltale warnings,

and today there is technology to help detect them. "We have developed some very exciting new monitoring tools that allow us to do a much better job of forecasting the onset of explosive eruptive activity," says Miller.

When a volcano is just about to erupt, there may be hundreds, possibly thousands, of small earthquakes, and they are detected by seismic activity. Samples of gases gathered on site reveal changes in volcanoes—for example, sulfur dioxide emissions increase during an eruption. Satellites and radar can detect even minute changes in the volcano's shape, and a technique called *interferometry* can highlight shifts in elevation of the volcano over time. Researchers are also working on a technique called *seismic tomography*, which provides them with essentially an x-ray of the inside of a volcano. More than 20 years after Mount St. Helens erupted, scientists still cannot predict eruptions precisely, but they are better equipped to help determine when it is time to evacuate an area in a way that is safer for the scientists, too. "Our strategy now is to take out a bunch of monitor equipment, install these stations all over the volcano, and then go back to a safe place and watch these data come in, in real time," says Miller.

"When one looks at these kinds of natural phenomena, [such as] volcanic eruption, you always think of the impact on human lives," said Bernard Chouet, a seismologist at the USGS. "The ultimate quest is to understand enough about the activity in that volcano to be in a position to make a prediction, predict the occurrence of an eruption."

What data do scientists use to determine when a volcano might erupt?