Strata Stories

Lava Canyon Trail Activity

Teacher Information:

Time Commitment: 45 minutes to 1 hour
Location: Stratigraphy Viewpoint

This is a challenging activity that will test your students' observational skills, and deductive capabilities. Students learn about the characteristics of three types of eruptive deposits at the stratigraphy area and gather data to determine which type of volcanic event would most likely occur here in the future. Teachers should review the "background information" section on the Teacher's Corner to become familiar with Mount St. Helens eruptive history.

Students will be better served if they have prior knowledge of the following vocabulary words:

1) Lahar: An Indonesian term for debris flows and mudflows. A flow of water-saturated volcanic debris down the slope of a volcano in response to gravity.
2) Mudflow: A flow of water-saturated earth material that moves like a fluid. A coarser flowing mass is often called a debris flow.
3) Pyroclastic Flow: A lateral flow of a violent mixture of hot gases and unsorted volcanic fragments, ash, pumice and glass fragments that can move at speeds of up to 100 miles an hour. They can be caused by an eruption or by the collapse of a lava dome.
4) Pyroclastic Surge: A violent mixture of gases and particles that flows above the ground surface at high velocities. It can develop from a pyroclastic flow and is highly mobile.
5) Air Fall: Volcanic ash, pumice and rock that has fallen through the air from an erupting cloud. These deposits are usually well sorted and layered.
6) Pumice: A lightweight frothy volcanic rock, usually high in silica content formed by the expansion of gas in erupting lava. This porous rock can sometimes float on water.
7) Ash: Fine particles of pulverized rock blown from an explosive vent. Volcanic ash does not result from combustion, rather from rapidly expanding gases in magma that shatter the rock into tiny particles.
8) Strata: Layers of earth.

Goal:

1) To discover how strata can be used as an aid in reconstructing the geologic history of an area and predicting future volcanic hazards.

Objectives:

1) Students will be able to describe and differentiate lahar, air fall and pyroclastic flow deposits.
2) Students will understand the principle of superposition—that new layers are laid down on top of old deposits.
3) Students will be able to reconstruct geological history by analyzing and interpreting strata.
4) Students will be able to forecast future volcanic hazards by reconstructing the geologic history at the Stratigraphy Viewpoint.

Strata Stories

Stratigraphy Viewpoint Activity

Your Mission: (purpose) To use your observation skills, and the "case facts" to determine what type of eruptive event will most likely impact this site in the future.

Possible Explanations: (hypothesis)

#1: A lahar is most likely to be deposited here in the future.
#2 A pyroclastic flow is most likely to be deposited here in the future.
#3 Air fall is most likely to be deposited here in the future.

Case Facts: (materials)

- Lahar layers contain mixtures of *different sized* boulders, gravel and sand. Lahar deposits also contain *different types* of boulders, gravel and sand, because old and new volcanic debris is carried down from the slopes of a volcano.
- Air fall layers tend to contain *well-sorted and layered* dust, sand and/or gravel sized rock. Many of the air fall deposits at the stratigraphy area, contain *pumice*.
- Pyroclastic flows usually contain one type of pumice in a variety of sizes. The ash layers from pyroclastic surges tend to look like *paintbrush strokes.* These deposits can contain *charred wood,* because pyroclastic flows contain superheated gases.
- Soil is usually *dark brown*, and may contain *holes* where the roots of trees once grew. The presence of soil indicates that the volcano was dormant for a long period of time.

Evidence Evaluation (procedure)

Observe the cliff face before you and use the case facts to identify eruptive deposits. Gather data to determine which type of volcanic event would most likely occur here in the future.

Observations: (record data)

1. How many different layers can you see? _____
2. Find the 1980 lahar layer and another lahar layer. Is the 1980 lahar larger or smaller?

   _____
3. How many layers could have been formed by air fall? _____
4. How many layers could have been formed by pyroclastic flows? _____

   How many of these layers contain burned wood? _____
5. Are there any soil layers? If so, what do they tell us about Mount St. Helens?

   _____

Conclusion:

a) I think that explanation # _____ is best. ; OR
b) I have reached a different conclusion

In complete sentences, explain the evidence you used to support your conclusion.

_____

_____

_____

Answer Sheet for Strata Stories

Stratigraphy Viewpoint Activity

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Evidence Evaluation (procedure)

Observe the cliff face before you and use the case facts to identify eruptive deposits. Gather data to determine which type of volcanic event would most likely occur here in the future.

Observations: (record data)

1. How many different layers can you see? *There are twelve layers, but some are hard to see.*

2. Find the 1980 lahar layer and another lahar layer. Is the 1980 lahar larger or smaller?
   The 1980 layer is smaller

3. How many layers could have been formed by air fall? *There are five air fall layers*

4. How many layers could have been formed by pyroclastic flows? *There are three layers*
   How many of these layers contain burned wood? *One layer contains charcoal*

5. Are there any soil layers? If so, what do they tell us about Mount St. Helens?
   There are two soil layers. One is located about 1-foot above the Ye-air fall layer. The other layer is located high up the cliff face and is difficult to see.

Conclusion:

a) I think that explanation # ___3___ is best. ; OR
b) I have reached a different conclusion
In complete sentences, explain the evidence you used to support your conclusion.

There are five air fall layers, but only three pyroclastic layers and two lahar layers. Air fall will most likely be deposited here in the future.

Instructional Sequence for "Strata Stories":

1. **Stage #1:** Walk to the interpretive sign at the end of the Stratigraphy viewpoint trail. At the interpretive sign explain:

   A. In order to appreciate the lahar, students must first understand the shoestring glacier story. If the volcano is visible point to the deep trough running down from the crater rim to the base of the volcano. Shoestring Glacier carved this trough. The glacier was much larger before the 1980 eruption. The glacier not only filled most of the trough, it also use to stretch another 1300 feet upward from the current summit.

   B. Explain that within seconds after the eruption began on May 18, 1980 an enormous, turbulent dark cloud surged down all sides of the volcano. The cloud reached the base of Shoestring Glacier in 90 seconds. This hot cloud melted 27 feet of ice from the glacier, creating a mudflow—a flow of mud, rock, trees and debris. This mudflow, called a lahar, looked and moved like wet flowing concrete.

   C. The lahar, traveling nearly 60 mph, grew as it surged down slope scouring away the forest. When the lahar reached the site where your school bus is parked it had slowed to 45 mph and was nearly 15 feet deep. You can see how deep it was by looking at standing dead trees along the edges of the lahar. The bark was removed when boulders inside the lahar bashed against the tree. Some trees on the hillside behind us also have these 'flow marks" on them, where the bark was removed by the abrasive flow. Large rocks like those scattered around you actually floated on the surface of the wet-concrete-like flow.

   D. Part of the lahar flowed down the Pine Creek drainage (the ridge line your left), but the rest of it was deflected down Lava Canyon behind you. The lahar scoured out the canyon—removing the forest, exposing a lava flow and an ancient rock formation.

   E. By 9:00 am, 17 million cubic yard of debris, enough to fit on a football field nearly 3,000' high, had entered Swift Reservoir--the large body of water your bus passed just outside of Cougar. This debris also raised the water level of the reservoir two and a half feet. This lahar was impressive, but it wasn't the largest mudflow on May 18th. A lahar that went down the North Fork of the Toutle River was four times larger in volume!

   F. Today the lahar deposits tell us about the May 18, 1980 event. Look around and you can see that it was composed of rocks of various sizes and kinds, mixed with ash. These are not new rocks; instead, these are old rocks from the former summit. Rocks the size of cars, and smaller ones like those scattered around us, floated on the surface of the Lahar. The Lahar actually carried away two large bridges! Look at the cliff face to our right. Notice that it is made up of layers of different colors and kinds of rocks and other material. The top layer is the 1980-lahar deposit. Its depth varies from a few inches to a couple of feet here, but is up to 27 feet deep in other locations.

2. **Transition:** Have the students walk in single file behind you (to protect plant communities) until you reach the base of the cliff face where students will complete the "Strata Stories" activity. Lead the students to a section of the cliff face where the strata layers are most clearly defined.

3. **Stage #2:** At the base of the cliff, ask students if they keep a diary to record their thoughts and feelings. Explain that the layers of earth are here are like entries in a diary that tell us about 13,000 years of Mount St. Helens 40,000 year history. That is equivalent to 1/3 of the volcano's life! Ask them to think about significant events during the last 1/3 of their lives and explain that they will be looking at some significant events in Mount St. Helens' life. Emphasize that we do not know the exact time that all of these events occurred, but we do know that they occurred within certain time frames.

   A. Explain that understanding strata layers around a volcano help geologists understand the geologic hazards a volcano presents. Understanding volcanic hazards saves lives. Prior to the eruption, geologists Rocky Crandell and Dwight Mulleniux studied the volcanic strata around Mount St. Helens. They recommended that the water level behind Swift Dam be lowered, because lahars had gone down several creeks that enter the reservoir. The water level was lowered prior to the 1980 eruption, which prevented this lahar from causing water to overtop the dam. Subsequent flooding could have devastated the communities of Cougar, Ariel and Woodland that lay below Swift Dam.

4. **Stage #3:** Explain that they will be studying soil layers and three different kinds of volcanic deposits --lahars, pyroclastic flows and ash fall. Set a clear expectation that identifying strata is **hard**—the thickness varies, sometimes there are no clear boundaries, and some layers are hard to categorize. Point to a clearly visible layer and show how its thickness and clarity vary across the cliff face. Then have **students answer question #1 on the student worksheet "*Strata Stories*"** regarding how many different layers they can see in the cliff face. Review characteristics of each type of volcanic event and their deposit. Start with lahars:

   A. Lahars: a fast moving flow of mud, rock, trees and debris that looks and moves like wet flowing concrete. Point to the boulder-strewn landscape around you and explain that Lahar layers contain mixtures of *different sized* boulders, gravel and sand. Lahar deposits also contain *different types* of boulders, gravel and sand, because old and new volcanic debris is carried down from the slopes of a volcano.

   Ask students to find the 1980 lahar deposit in the cliff face (top most layer). Then have the students locate another lahar deposit in the cliff face and **answer question #2.** NOTE: The only other lahar deposit is at the very bottom of the cliff face. This 3 to 8-foot deep layer of unsorted boulders, gravel, and sand was deposited by a lahar 12,000 years ago. Point out the Swift Eruptive Period lahar layer after students have answered the question.

   B. **Air fall:** Volcanic ash, pumice and rock that have fallen through the air from an erupting cloud. These deposits are usually well sorted and layered. Air fall layers tend to contain *well-sorted and layered* dust, sand and/or gravel sized rock. Many of the air fall deposits at the stratigraphy area contain *pumice*. Geologists at Mount St. Helens assigned a random letter to the ash fall layers in order to categorize them.

   There are two air fall layers directly above the Swift Eruptive Period Lahar deposit. The tan-yellow "J-Layer" is 6 inches to 1-foot thick, and directly above it the "Ye-Layer. Use the Ye-layer as an example of an air fall deposit. This orange-yellow pumice layer is three to four-feet deep. Explain that the eruption that produced this layer 3900 years ago was

twice as large as the 1980 eruption. Then have the students locate other air fall deposits in the cliff face and **answer question #3.**

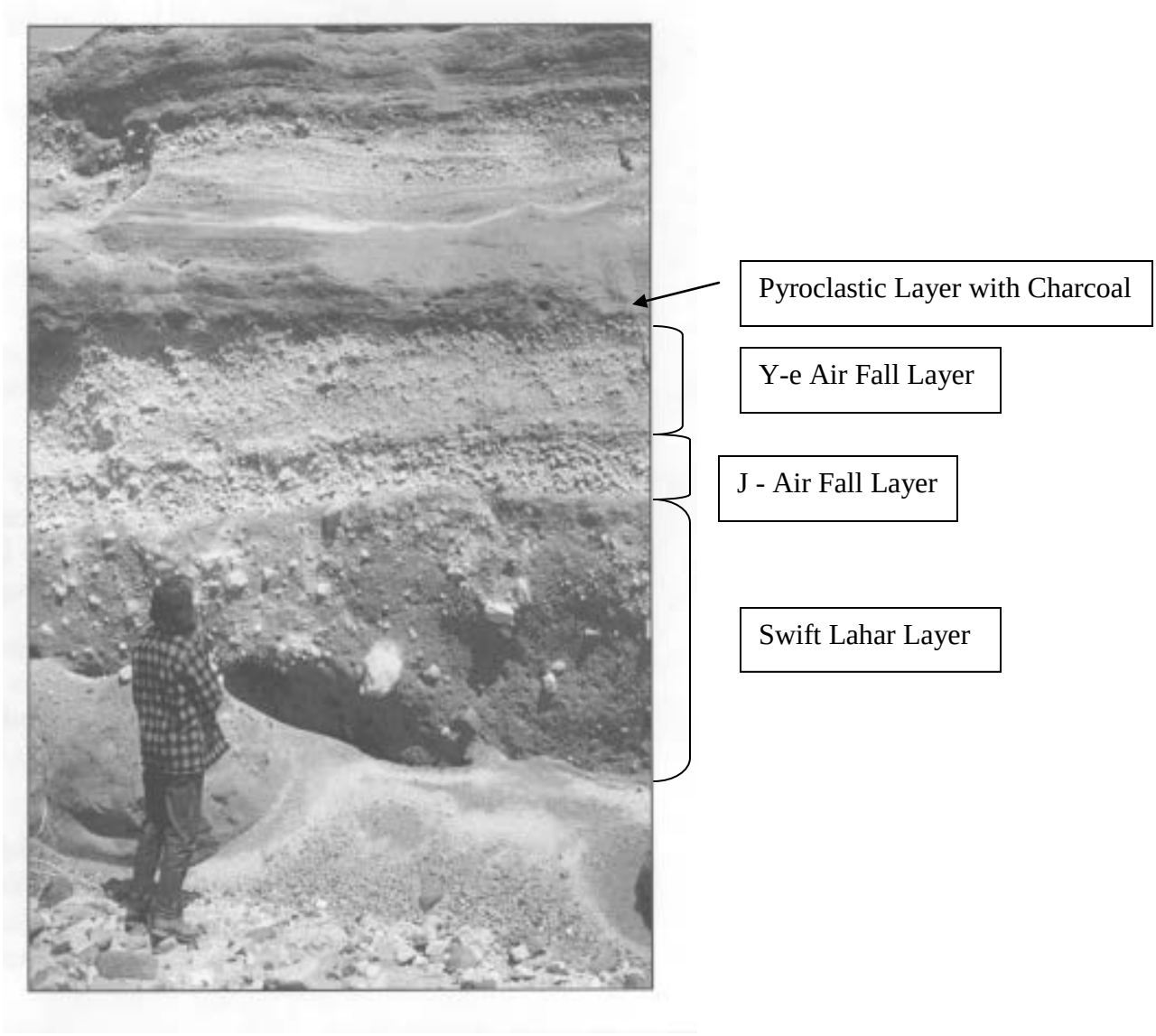
C. **Pyroclastic Flows**: A lateral flow of a violent mixture of hot gases and unsorted volcanic fragments, ash, pumice and glass fragments that can move at speeds of up to 100 miles an hour. They can be caused by an eruption or by the collapse of a lava dome. Sometimes pyroclastic flows can develop into a pyroclastic surge-- A violent mixture of gases and particles that flows above the ground surface at high velocities. Pyroclastic flows usually contain one type of pumice in a variety of sizes. The ash layers from pyroclastic surges tend to look like *paintbrush strokes.* These deposits can contain *charred wood,* because pyroclastic flows contain superheated gases.

   There is a pyroclastic surge deposit directly above the Ye-layer. If you scrape away the harder crust on the surface of this six to eight whitish-gray layer of ash you can often find an inch thick layer of charcoal. This eruption occurred about 2900 years ago. Then have the students locate other pyroclastic flow or surge deposits in the cliff face and **answer question #4.**

D. **Soil:** Soil is usually *dark brown* and may contain *holes* where the roots of trees once grew. The presence of soil indicates that the volcano was dormant for a long period of time. Look higher up the cliff for a layer with these characteristics. (NOTE: Cliff Swallows have excavated numerous holes in the entire cliff face—holes in thin brown layers are most likely from roots!) Then have the students locate other soil layers in the cliff face and **answer question #5**.

5. **Summarize**: Review the answers to the worksheet as a large group. Explanation #3 is best. There are five air fall layers, but only three pyroclastic layers and two lahar layers. Discuss problems encountered in identifying bands (thickness varies, no clear boundaries, hard to categorize). Explain that geologists encounter the same types of problems, and that sometimes pieces of the story are missing. Point to the lava flow just down stream that is not seen in stratagraphic layers to illustrate this point.

   Prior to May 18, 1980, geologists didn't fully understand that large landslides or lateral blasts occurred on volcanoes. After studying the May 18, 1980 landslide and lateral blast deposits on Mount St. Helens, geologist discovered similar deposits worldwide. In fact over 200 landslide deposits have been identified since 1980, including three which have fallen from Mount St. Helens. Explain that one of the great challenges of tracing the geologic history of an area to learn its potential volcanic hazards is that geologists must look at deposits in many areas to gain a true understanding of it. Return to your bus.



View of Stratigraphy