INVESTIGATION

12.18

Where Did This Earthquake Occur, and What Damage Might Be Expected?

THIS COASTAL REGION CONTAINS TWO FAULTS, an active volcano, and several steep-sided mountains prone to landslides. Any of these features could cause ground shaking. You will use seismic records from a recent earthquake to determine which feature caused the observed shaking. From this information, you will decide what hazards this earthquake poses to each of the small towns in the area.

Goals of This Exercise:

- Examine the large illustration and read the text boxes describing the types of features that are present.
- Use three seismograms to determine which feature is likely to have caused the earthquake.
- Consider potential earthquake hazards to determine what dangers each small town would face from the earthquake.
- Decide which town you think is the safest from earthquake-related hazards and justify your decision with supporting evidence.

Procedures

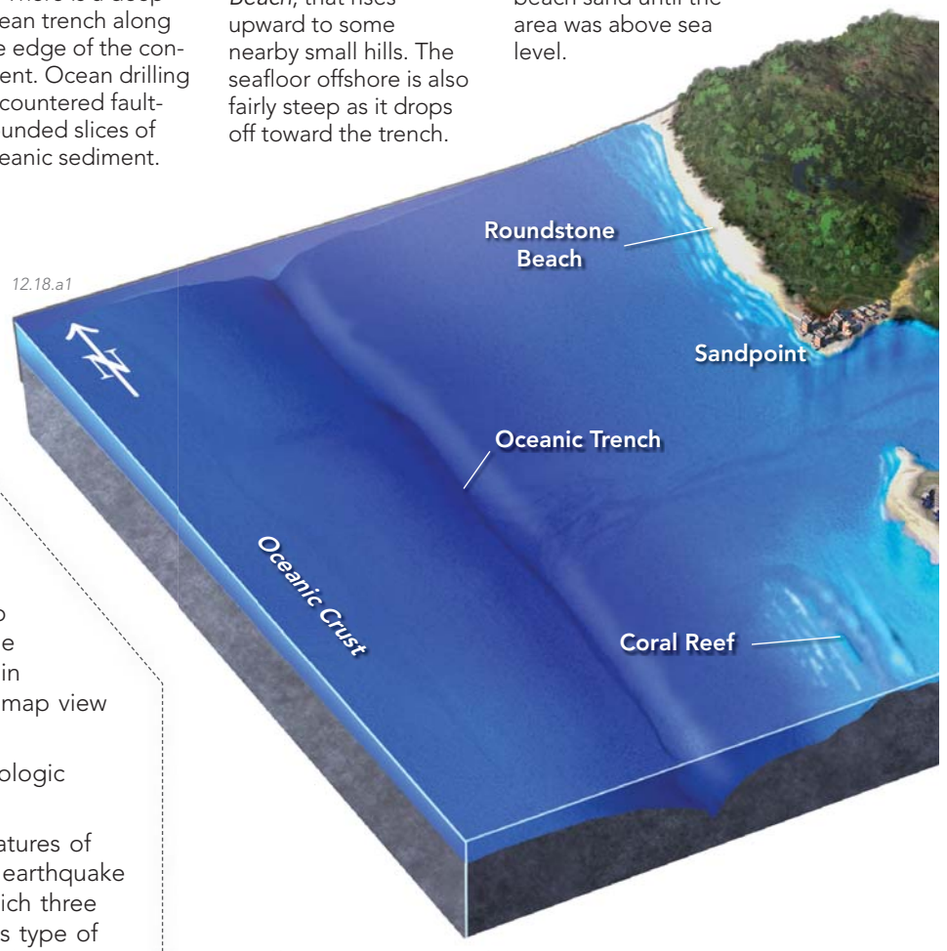
The area has several small towns and three seismometers, each named after the town which it is near. Seismograms recorded at each seismic station during a recent earthquake are shown at the top of the next page. Use the available information to complete the following steps and enter your answers in the appropriate places on the worksheet or online.

1. Observe the features shown on the three-dimensional perspective. Read the text associated with each location, and think about what each statement implies about earthquake hazards.
2. Inspect the seismograms for the three seismic stations to determine where the earthquake probably occurred. You can get an idea from simply comparing the time intervals between the arrivals of P-waves and S-waves for each station.
3. Your instructor may have you use the graph next to the seismograms to determine the distance from each station to the epicenter. This will allow you to more precisely locate the epicenter. Detailed instructions for this procedure are listed in topic 12.6 earlier in this chapter. For plotting your results, a map view of the area is included with the worksheet.
4. From the general location of the earthquake, infer which geologic feature is likely to have caused the earthquake.
5. Use the information about the topographic and geologic features of the landscape to interpret what types of hazards the recent earthquake posed for each town. From these considerations, decide which three towns are the least safe and which two are the safest for this type of earthquake. There is not necessarily one right answer, so explain and justify your logic on the worksheet, if asked to do so by your instructor.

1. There is a deep ocean trench along the edge of the continent. Ocean drilling encountered fault-bounded slices of oceanic sediment.

2. Along one part of the coastline, there is a thin, steep beach, called *Roundstone Beach*, that rises upward to some nearby small hills. The seafloor offshore is also fairly steep as it drops off toward the trench.

3. The town of *Sandpoint* is built upon land that was reclaimed from the sea by piling up loose rocks and beach sand until the area was above sea level.

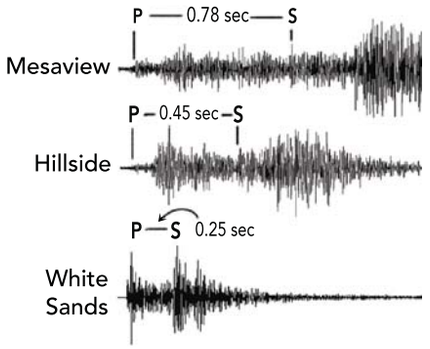


12. Offshore is a coral reef that blocks larger waves, creating a quiet lagoon between the reef and the shore.

Seismograms

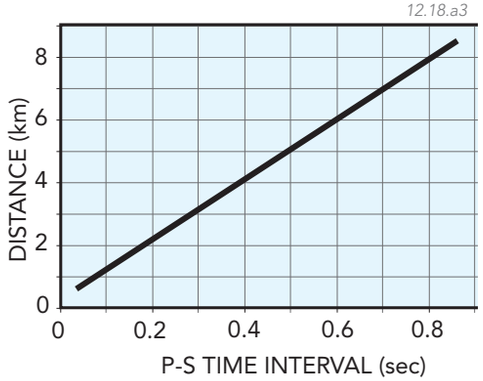
▶ These seismograms represent the time period from just before the earthquake to 1.5 seconds after it occurred. The first arrivals of P-waves and S-waves are labeled for each graph, along with the P-S time intervals.

12.18.a2



▶ If instructed to, use this graph to determine the distance from each seismic station to the earthquake's epicenter. Find the appropriate time on the horizontal axis, follow it upward to the line, and read off the corresponding distance on the vertical axis.

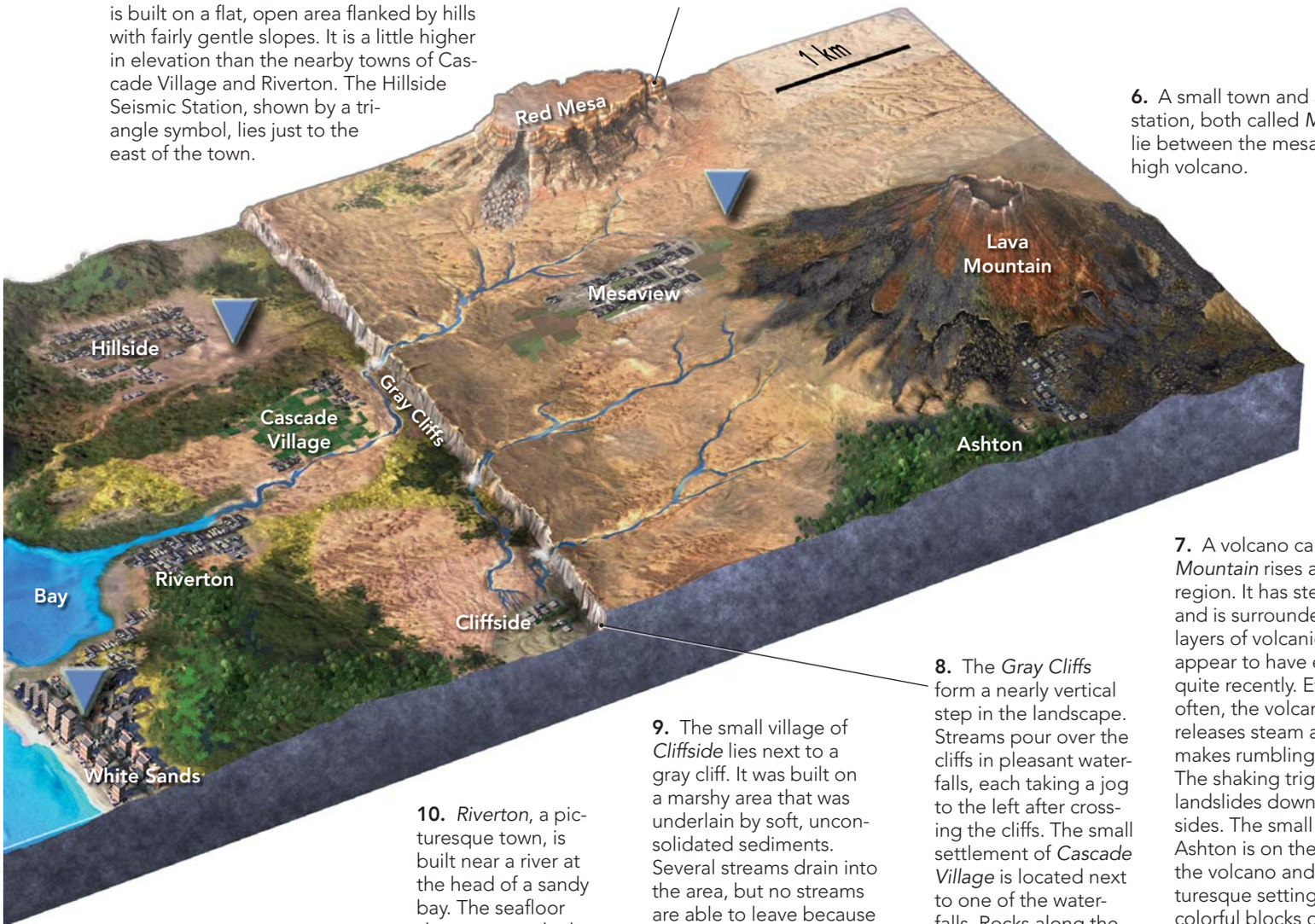
12.18.a3



4. A picturesque town, called *Hillside*, lies inland of some small mountains. The town is built on a flat, open area flanked by hills with fairly gentle slopes. It is a little higher in elevation than the nearby towns of Cascade Village and Riverton. The Hillside Seismic Station, shown by a triangle symbol, lies just to the east of the town.

5. In the northern part of the area, there is a flat-topped mountain, known as *Red Mesa*, surrounded by steep cliffs. A new landslide lies along the southern flank of the mountain.

6. A small town and a seismic station, both called *Mesaview*, lie between the mesa and a high volcano.



7. A volcano called *Lava Mountain* rises above the region. It has steep slopes and is surrounded by layers of volcanic ash that appear to have erupted quite recently. Every so often, the volcano releases steam and makes rumbling noises. The shaking triggers landslides down the hillsides. The small town of Ashton is on the flanks of the volcano and has a picturesque setting with huge, colorful blocks of volcanic rocks near the town.

8. The *Gray Cliffs* form a nearly vertical step in the landscape. Streams pour over the cliffs in pleasant waterfalls, each taking a jog to the left after crossing the cliffs. The small settlement of *Cascade Village* is located next to one of the waterfalls. Rocks along the cliffs are fractured and shattered.

9. The small village of *Cliffside* lies next to a gray cliff. It was built on a marshy area that was underlain by soft, unconsolidated sediments. Several streams drain into the area, but no streams are able to leave because the area is lower than the surrounding landscape. As a result, the soil is commonly very soft and people sink in as they walk.

10. *Riverton*, a picturesque town, is built near a river at the head of a sandy bay. The seafloor slopes out to the bay at a gentle angle. Muddy waters from the river prevent reefs from growing offshore in front of the bay.

11. *White Sands* is a resort town along a white, sandy beach. The sand comes from the offshore coral reef. There is a seismic station, shown by a triangle symbol, with the same name as the town.