5.2 The Results of Stress

The high pressures and temperatures caused by stress in the crust generally deform rocks. When stress is applied slowly, the deformed rock may return to its original shape as the force is removed. There is a limit, however, to the amount of force each type of rock can withstand and still retain its shape. If the force exceeds that limit, the shape of the rock changes permanently. In places of extreme stress, rock becomes so deformed that it may break.

Section Objectives

- **Compare folding and faulting as responses to stress.**
- **Describe four types of faults.**

Folding

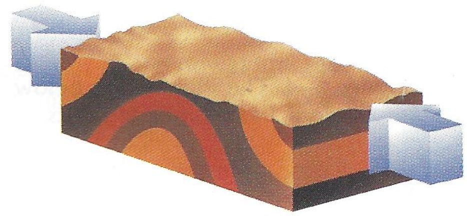
When rock responds to stress by becoming permanently deformed without breaking, the result is **folding.** Folding is most easily observed where flat layers of rock are under severe compression and are squeezed inward from the sides. The layers move into new, folded positions without breaking. Cracks may appear, but the rock layers remain intact.

Folds, which appear as wavelike structures in rock layers, vary greatly in size. Some folds are small enough to be contained in a hand-held rock specimen. Others cover thousands of square kilometers and can be viewed only from the air.

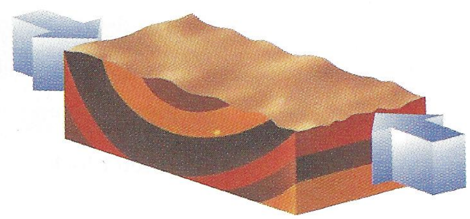
The three general types of folds—**anticline** (ANT-ih-kline), **syncline** (SIN-kline), and **monocline** (MON-uh-kline)—are shown in Figure 5–3. Anticlines are upcurved folds in the layers, and synclines are downcurved folds. Monoclines are gently dipping bends in horizontal rock layers.

Generally, wherever large folds occur, an anticline will form a ridge, and a syncline will form a valley. Landforms of this type are commonly found among the ridges and valleys of the Appalachian Mountains.

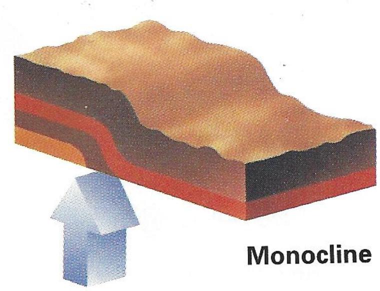
Figure 5–3. Study the rock fold shown in the photo below on the left. Compare it with the three types of rock folds illustrated below right. Which type of rock fold is shown in the photo?



Anticline



Syncline



Monocline

Faulting

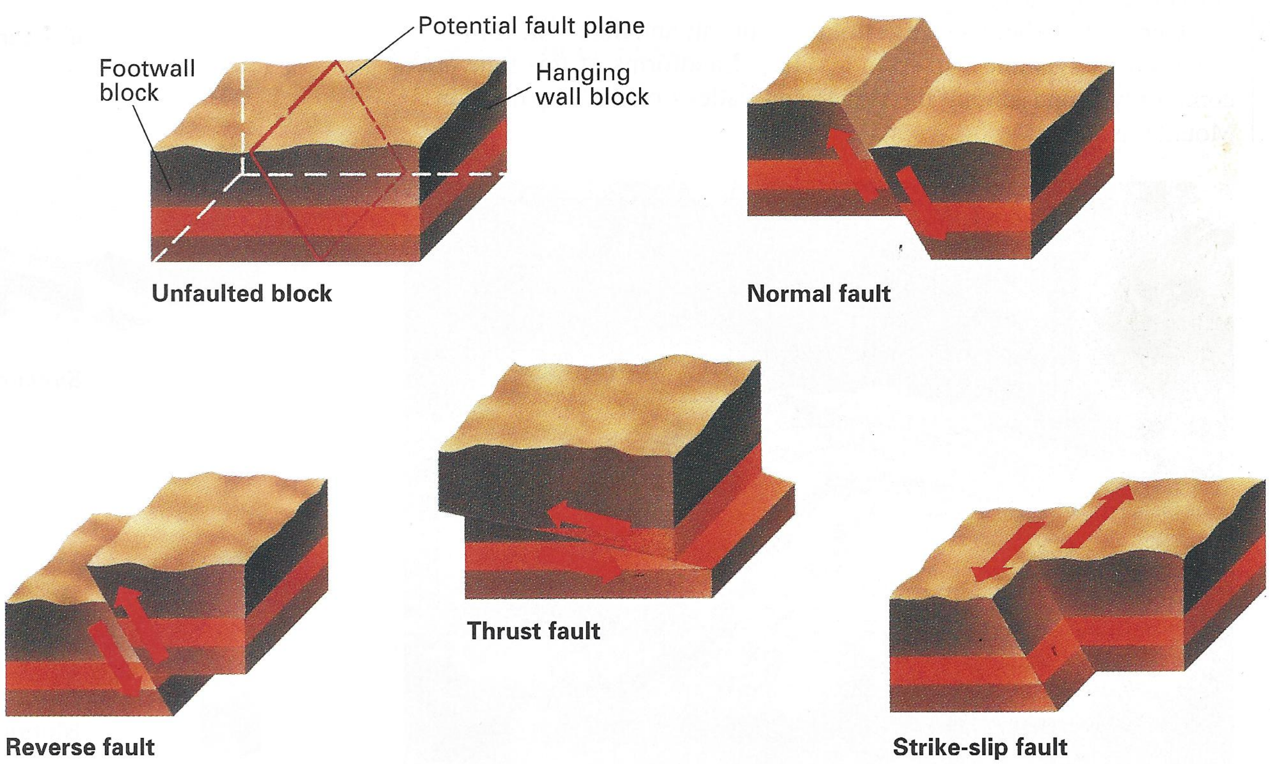
Rock does not always respond to stress by folding. Cooler temperatures and lower pressure near the earth's surface often cause rock to respond to stress by breaking. The difference in how rock near the earth's surface and rock deep inside the earth's crust respond to stress can be compared to the behavior of a heated glass rod. If the rod is heated until it is red hot, it can be bent easily. What would happen if you tried to bend the rod without heating it?

Breaks in rocks are divided into two categories. When there is no movement in the rocks along either side of a break, it is called a **fracture.** When the rocks do move, it is called a **fault.** A **normal fault** is one where the **fault plane**—the surface of a fault—is at a steep angle or almost vertical. The rocks above the normal fault plane, called the **hanging wall,** move down relative to the rocks below the fault plane, called the **footwall.** Normal faults occur along divergent boundaries, where the crust is being pulled apart due to tensional stress. Normal faults usually occur in a series of parallel fault lines, forming steep steplike landforms. The Great Rift Valley of East Africa is an area of large-scale normal faulting.

Another type of steep or nearly vertical fault is called a **reverse fault.** A reverse fault occurs when compression causes the hanging wall to move up relative to the footwall, as shown in Figure 5–4.

A **thrust fault** is a special type of reverse fault. The fault plane of a thrust fault is at a low angle or nearly horizontal. Because of

Figure 5–4. The illustration below shows four basic types of faults.



SMALL-SCALE INVESTIGATION

Folds and Fractures

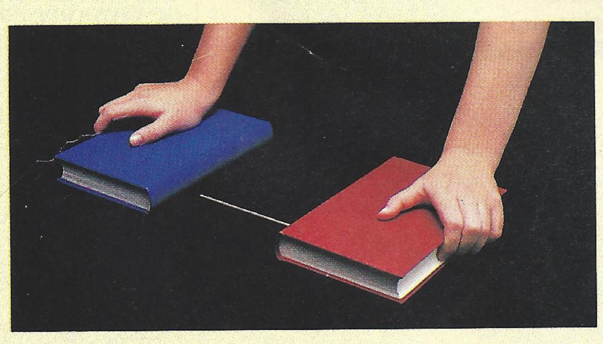
You can use some common objects to demonstrate the factors that govern the ways rock responds to stress from plate movements.

Materials

safety goggles; soft wood dowel, 2 mm × 15 cm; 2 books; plastic play putty

Procedure

1. **Put on the safety goggles.** Lay the dowel on a table. Place a book at each end of the dowel.
2. Place one hand on each book and gently and slowly slide the books against the ends of the dowel until the dowel bends slightly.
3. Move the books back to their original position. Observe and record what happens to the dowel as the books are moved.
4. Again move the books toward each other with the dowel between them. This time move the books quickly and forcefully. Record what happens to the dowel. Remove the safety goggles.
5. Roll a piece of play putty into a cylinder about 15 cm long and about the same diameter as the dowel.



6. Repeat Steps 1 through 3, using the putty in place of the dowel.
7. Re-form the putty into a cylinder. Grasp one end of the cylinder in each hand and pull quickly and sharply on both ends of the putty.

Analysis and Conclusions

1. Compare the responses of the dowel and the putty in Step 3. What two responses of rock to stress are represented?
2. Compare the response of the dowel in Step 4 with the response of the putty in Step 7.
3. What two factors influence the way the items respond to stress in this investigation? How do these factors influence the way rock responds to stress? Explain your answer.

the low angle of the fault plane, the rocks in the hanging wall are pushed up and over the rocks in the footwall. Reverse and thrust faults are common in steep mountains such as the Rockies and Alps.

Along a **strike-slip fault,** the rock on either side of the fault plane slides horizontally. Strike-slip faults often occur at transform fault boundaries. The San Andreas Fault, which runs through California, is the best known example of a strike-slip fault.

Section 5.2 Review

1. What results when rock responds to stress by permanently deforming without breaking?
2. Why is faulting more likely to occur near the surface than deep within the earth?
3. Describe four types of faults.