Block Diagram Problems

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Objectives

To use block diagrams to visualize some simple geologic structures in three dimensions.

To determine the sequence of geologic events leading to the development of the structures and to learn the names of the structures.

Time required

Three class periods to complete 8 to 10 block diagram problems.

Materials

per student
Scissors
Soft-lead pencil
Eraser: cut at an angle to provide a narrow erasing edge (and to double the number of erasers available)
Ruler

Background

Note: Students should have a general knowledge of geologic structures.

Some of our most interesting scenery involves folded and faulted rock layers. It is not difficult to learn what various geologic structures look like from all sides. This investigation will guide you through a series of diagrams that become more and more complex. There are simple rules you must follow, and you will work with drawing techniques you might not have encountered elsewhere. When you follow these rules through every step of your work, you are assured of a correct solution. As you work on this activity, you will develop your eye-hand coordination and polish your logical, sequential thinking skills.

Procedure

In this investigation, block diagrams represent geologic structures. You will be given the pattern of one or more faces of a structure. Determine what the other faces will look like. Use information in Parts I to IV in the **Procedure** and the symbols shown in Figure 1 to help you figure out and draw the pattern on the unmarked faces.

Use a soft-lead pencil for all drawing (NO pens!); pencils must be kept sharp. Number all diagrams. Do the assigned diagrams in numerical order. Do not skip around.

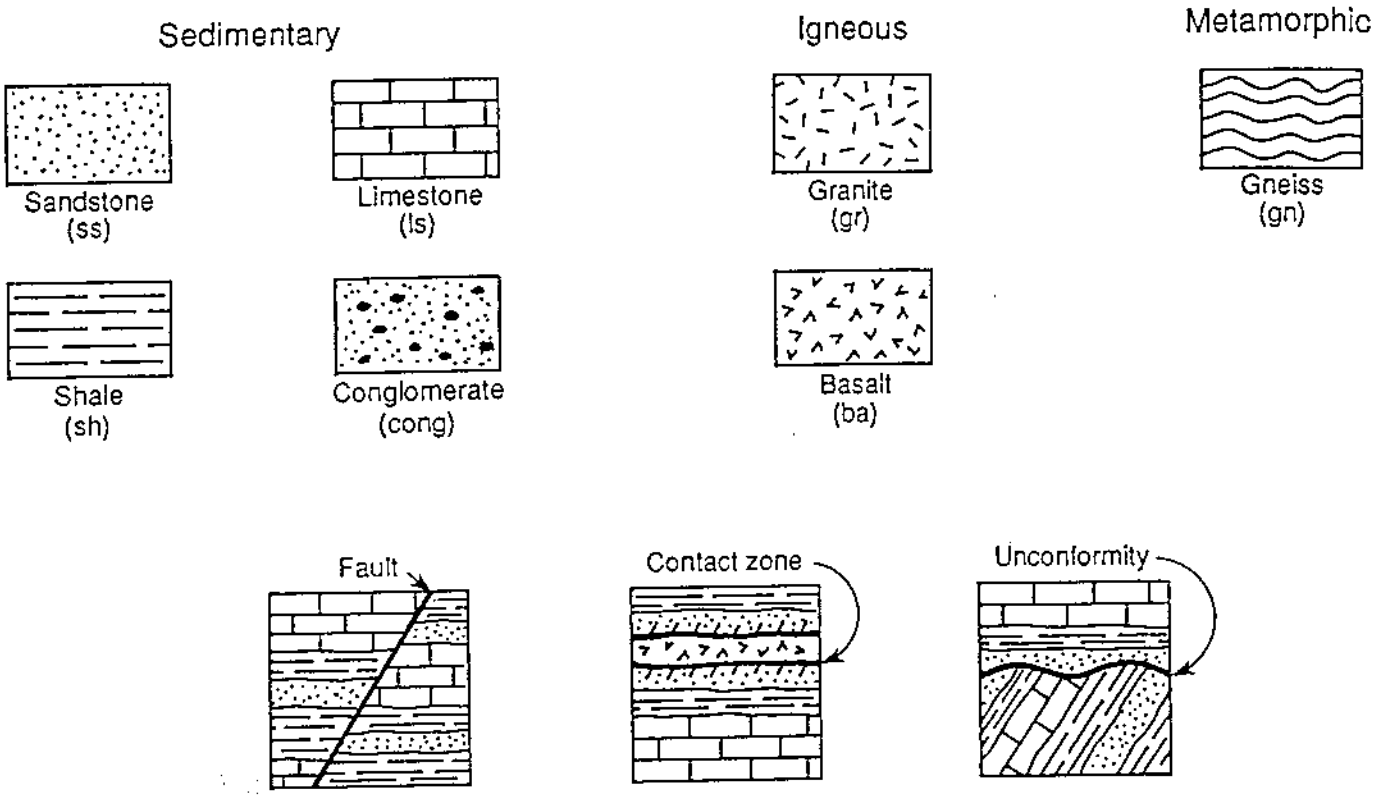

Figure 1. Symbols for rock types and structures.

Part I. Assumptions

You will need to make the following assumptions to figure out how to complete each block diagram.

1. The pattern that appears along the edge of one face will also appear along the edge of the adjoining face unless otherwise indicated.
2. The pattern on one face will appear on the opposite face unless otherwise indicated.
3. Faults will extend through the block.
4. Folds will extend through the block.
5. Rock layers will extend through the block unless otherwise indicated.

Part II. Folding and drawing

Follow the steps below for each block diagram. See Figure 2.

1. Cut the diagram out. Make it into a box by folding each of the four flaps along the outside edge of the center square so that the patterned flap faces out (Figure 2A-C). Make very sharp creases. Do not tape or staple the flaps because you will need to have the paper flat later. Correct folding is essential.

2. Hold the box from the inside so that one blank flap (face) is next to the patterned face (Figure 2C).

3. On two blank faces that adjoin the patterned face (you are holding one blank face, and the other is the top face), draw short horizontal lines to mark the top and bottom of each of the layers shown on the patterned face (Figure 2D).

4. Use the assumptions in Part I to help you decide the direction the rock layers go, and draw lines to show the direction on the two faces (Figure 2E).

5. Draw the appropriate rock pattern for each layer (Figure 2F).

6. Fold, mark, and draw until all the faces have been patterned. The solution to each diagram is easier when you hold the box in one hand and view it from all angles. Check your work, making sure layers continue around corners and that no layer ends abruptly.

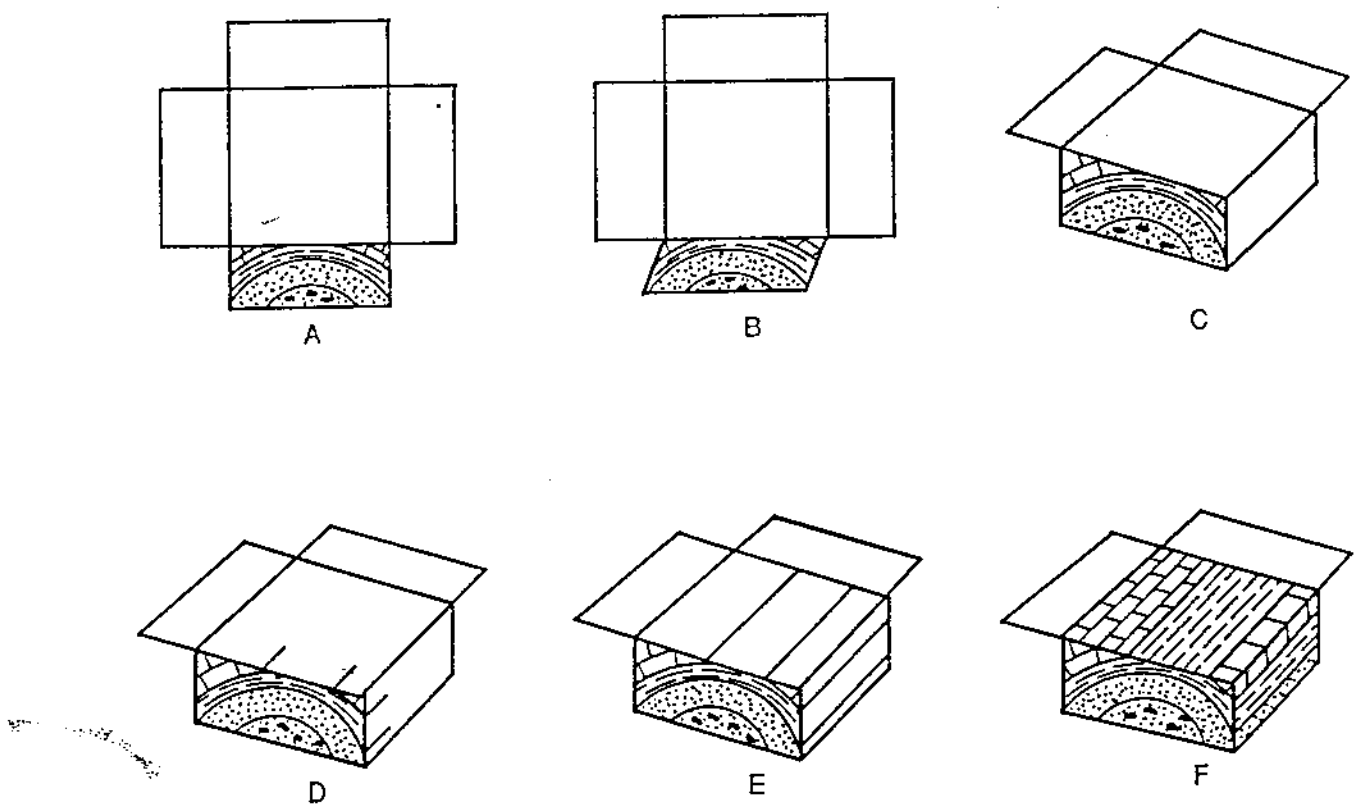

Figure 2. Folding and marking a block diagram.

Part III. Vocabulary

You will need to understand the following vocabulary.

anticline Upturned fold. See "fold" (Figure 4).

contact metamorphism The alteration of rock by heating due to contact or proximity to molten rock. New minerals are commonly formed, and the texture of the rock is changed.

contact zone The area around an igneous rock, which shows the effects of contact metamorphism.

deposition The natural process of laying down rock-forming material.

discontinuity A break or time gap in the deposition of layers.

erosion The natural process of moving rock material by water, wind, ice, or gravity.

fault A fracture along which the rocks on one side of the break have moved with respect to the rocks on the other side of the break. Two types of faults are shown in Figure 3.

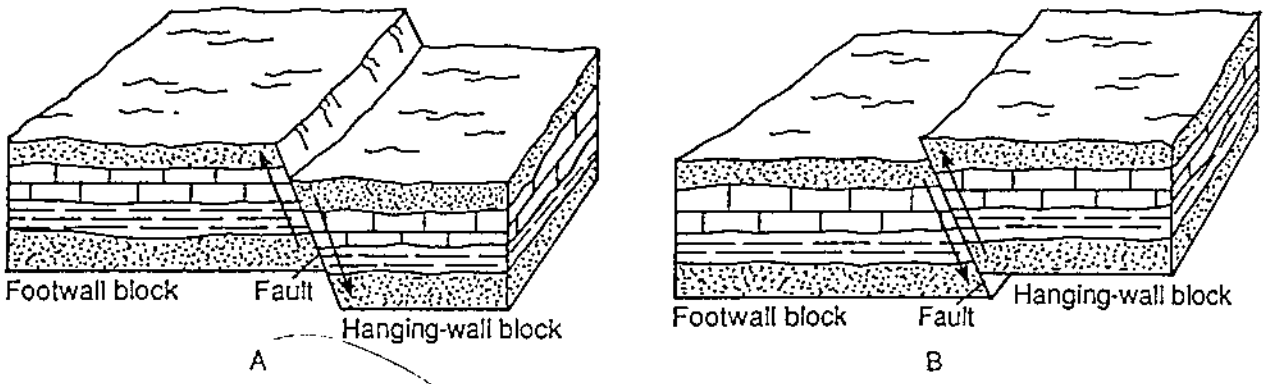

Figure 3. Two types of faults. Footwall refers to the underlying side of the fault. Hanging wall refers to the overlying side of the fault. Direction of the arrows indicates the relative movement of the blocks. (A) Normal fault, the hanging-wall block has moved downward relative to the footwall block. (B) Reverse fault, the hanging-wall block has moved upward relative to the footwall block.

fold A wave-like bend in rock layers that were originally horizontal, or nearly so. Folding results from compressional forces in the Earth's crust (Figure 4).

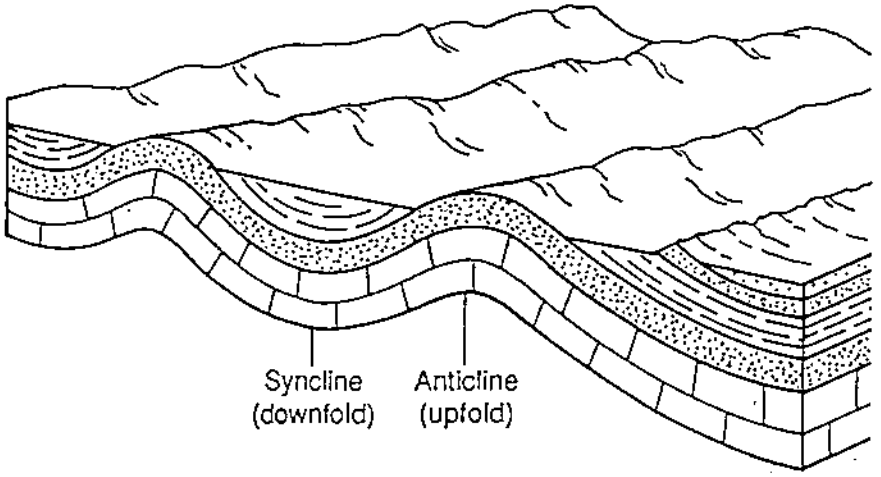

Figure 4. Two types of folds. Syncline, youngest rocks are in the core; anticline, oldest rocks are in the core.

horizontal Parallel to the horizon. ←——→

igneous rocks Rocks that are formed from the solidification of magma.

intrusion Magma that pushes into, through, or between existing rock layers or sediments beneath the Earth's surface and solidifies to form igneous rock (Figure 5).

lava flow Magma that flows onto the surface of the Earth as a result of volcanic activity and solidifies.

magma Molten or partly molten rock material.

metamorphic rocks Rocks that are changed by heat, pressure, the presence of chemically active fluids, or a combination of the three, without melting.

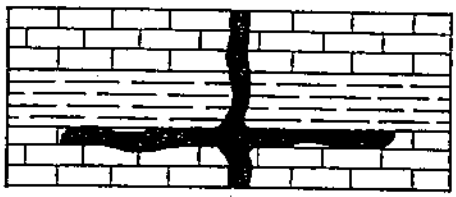

Figure 5. This type of intrusion is called a sill.

sedimentary rocks Layered rocks that are formed by the accumulation and consolidation of rock particles or debris. Some sedimentary rocks are formed from chemical precipitates.

sill A tabular igneous intrusion that is parallel to the rock layers surrounding it (Figure 5).

subsidence The sinking or downward settling of the Earth's surface.

syncline Downturned fold. See "fold" (Figure 4).

tabular A shape that is similar to that of a table in which the thickness is small relative to the length and width.

tilted Displaced from the horizontal; at an angle.

unconformity A buried surface of erosion or nondeposition that separates younger from older rock. An unconformity usually results when rock layers have undergone a sequence of uplift, erosion, subsidence, then deposition.

uplift A structurally high area in the Earth's crust, produced by movements that raised the rocks, as in a broad dome or arch.

vertical Upright; straight up and down. ↕

Part IV. Transferring angles

Follow the steps below to transfer an angle from one face to the opposite face. Figure 6 shows how to transfer a fault angle.

1. Place one edge of a ruler at the point where the fault line on the patterned face meets the top edge of the block. Make sure the ruler is parallel to the left edge of the top of the block. Mark the top edge of the opposite face with a light pencil mark (Figure 6B).

2. Move the ruler to the point where the fault line meets the lower edge of the face. Again, keep the ruler parallel to the left edge of the top of the block. Mark the point on the bottom edge of the opposite face (Figure 6C).

3. Draw a line to connect the two points (Figure 6D). You have constructed a fault line that has the correct angle but is of opposite inclination from the angle on the opposite face. When the diagram is folded, the fault line will look as if it goes through the block. Other points can be transferred across the diagram using this method.

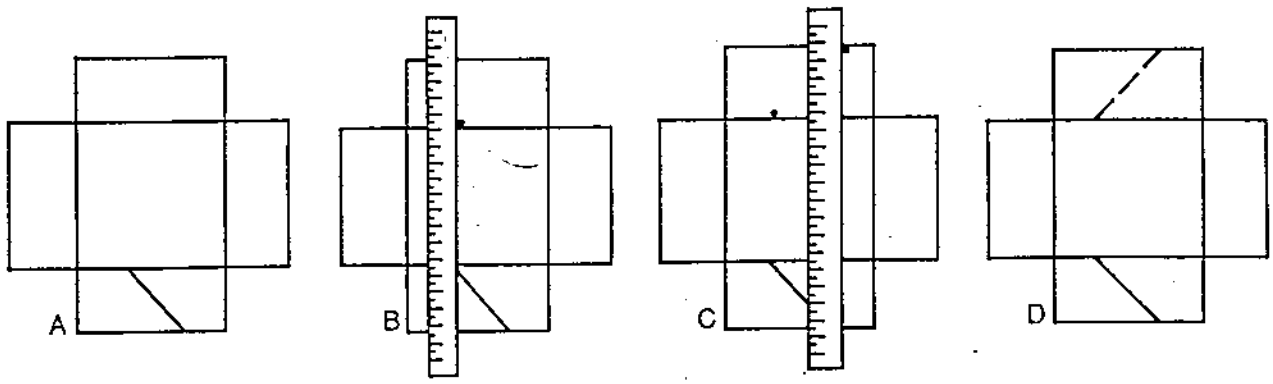

Figure 6. Transferring a fault angle to the opposite face.

Additional resources

Judson, Sheldon, and Kauffman, Marvin E. *Physical Geology.* 8th ed. Englewood Cliffs, N.J.: Prentice Hall, 1990.

Press, Frank, and Siever, Raymond. *Earth.* 4th ed. New York: W.H. Freeman and Co., 1986.