INVESTIGATION

2.11

What Is the Geologic History of Upheaval Dome?

A PERPLEXING GEOLOGIC FEATURE CALLED UPHEAVAL DOME forms a conspicuous feature within Canyonlands National Park of Utah. In most of Canyonlands, colorful sedimentary rocks are nearly horizontal, but around Upheaval Dome they are abruptly warped upward and eroded into a very unusual circular structure. The feature continues to puzzle geologists as to how and when it formed.

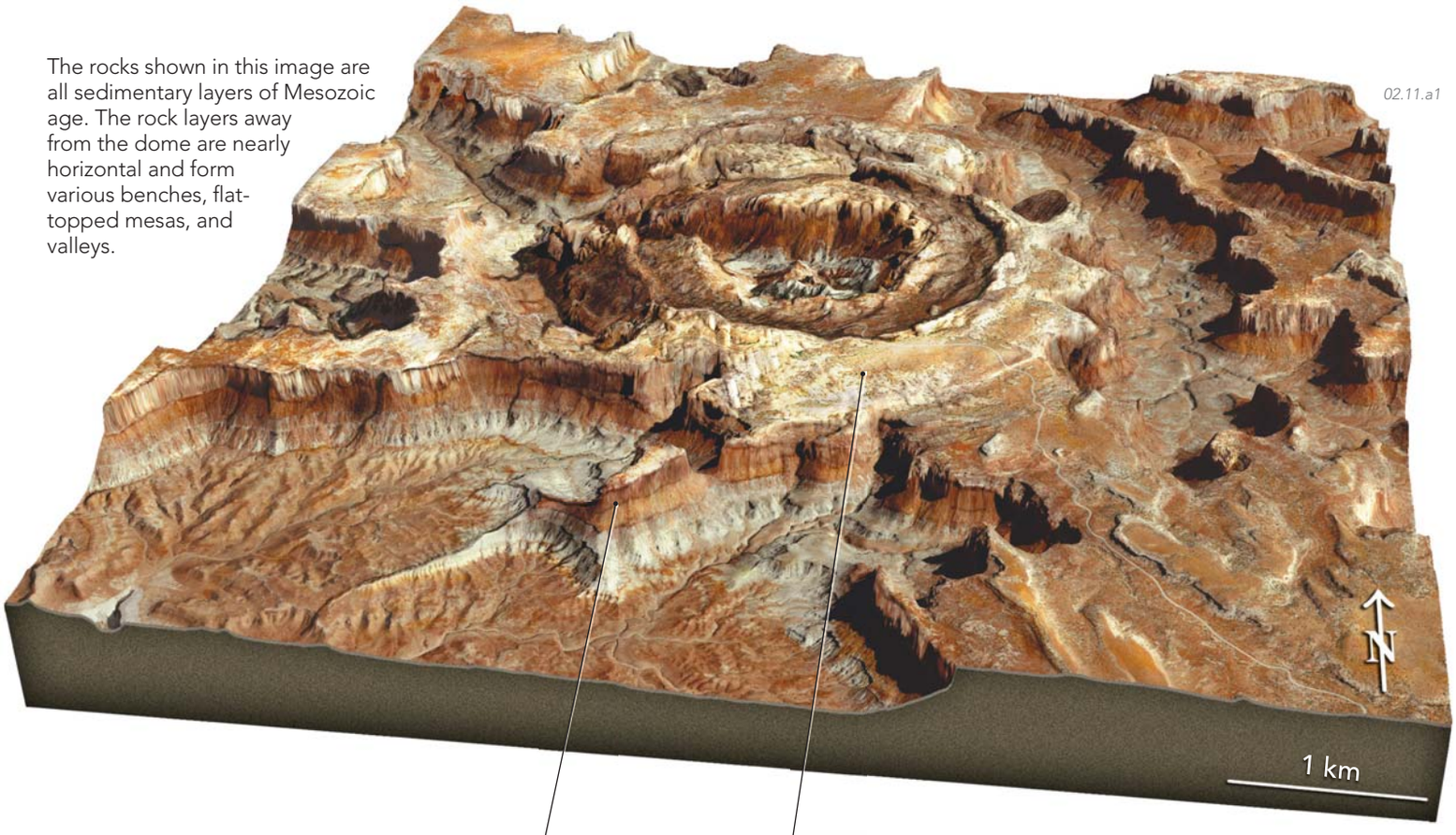
Goals of This Exercise:

- Make some observations and develop some questions about Upheaval Dome.
- Determine the sequence of geologic events that formed the rock layers in the dome.
- Suggest some ways to test possible explanations for the origin of the dome.

A What Are Some Observations and Questions About the Dome?

The three-dimensional perspective below shows an unusual circular feature called *Upheaval Dome*. Make some observations about this landscape, and record your observations on a sheet of paper or on the worksheet. As you study this landscape, record any questions or ideas that you have.

The rocks shown in this image are all sedimentary layers of Mesozoic age. The rock layers away from the dome are nearly horizontal and form various benches, flat-topped mesas, and valleys.



Some layers are resistant to erosion and form cliffs, whereas others are less resistant and erode into slopes. In some areas, erosion of the layers has formed buttes and rounded hills.

The rock layers in the dome form a large ring-shaped feature and are tilted outward in all directions, as shown in the geologic cross section on the next page.

B What Sequence of Geologic Events Formed the Rocks and the Dome?

Shown below are a stratigraphic section with the sequence of rock layers, and a geologic cross section across the dome. Using these two figures and the strategies in Section 2.2, determine the order in which the layers were formed, and write your answers on the worksheet.

Stratigraphic Section

Unit A: upper sandstone

Unit B: mudstone with thin sandstone layers

Unit C: middle sandstone

Unit D: mudstone with pebble-rich layers

Unit E: lower mudstone

Unit F: lower sandstone

Unit G: sandstone with abundant pebbles

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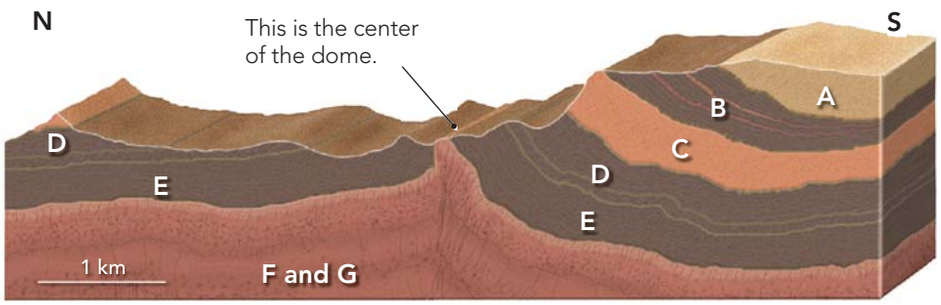
Units A, B, and C have a Jurassic age, whereas units D and E are Triassic. Units F and G are Permian (see timescale in section 2.6).

Cross Section

The letters A–G mark the units shown in the stratigraphic section to the left. The letters are assigned in order from top to bottom, not in the order in which the units formed. Some units, such as B and D, contain a series of related sedimentary rock layers rather than just a single type of rock.



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It is uncertain what types of rocks lie at depth below the dome (i.e., below units F and G).

All of the rock units have been folded into the dome. Any layers deposited after the dome was formed have been eroded away.

Many faults and folds (not shown here) have thickened the rock layers in some places and thinned them in others.

C How Would You Test Possible Explanations for the Origin of the Dome?

The origin of Upheaval Dome is controversial, and geologists currently debate three competing explanations. No single explanation has yet gained widespread acceptance by the geologic community.

1. A rising mass of salt warped the rock layers upward. A thick salt layer is known to be present beneath much of the Canyonlands region, and the salt may have risen upward because it is less dense than the surrounding rocks.
2. The dome formed as a result of rising magma. Igneous rocks formed from magma are common elsewhere in the region, where they have bowed up and baked the surrounding rock layers.
3. The dome is part of a larger, circular crater formed by a meteoroid impact. Many of the larger meteoroid-impact craters on the Moon and elsewhere contain a central peak or dome, which is interpreted to form by converging shock waves. In this case, Upheaval Dome only represents the center of a larger crater.

The age of the dome is poorly constrained. The dome must be younger than all of the rock layers in the vicinity because all of the layers are warped by the dome. When the dome formed, the currently exposed rocks were several kilometers deep, buried beneath overlying rock layers that have since eroded away. This erosion, therefore, removed some key evidence for the origin of the dome.

Procedures for Possible Explanations of the Dome

1. For each of the three explanations, draw a simple sketch on the worksheet illustrating which types of rocks you predict to find at depth.
2. List a prediction that follows from each explanation. Then, explain how that prediction could be tested.
3. List the types of information you would like to know about this location to further constrain the origin of the dome.