Geologic Maps and Groundwater

You can find out a great deal of information from geologic maps — from the types of rocks that make up a rock unit to the age of those rocks and the angle at which the rock bed is tilted. By identifying fractures and fracture zones in rock, geologic maps can even tell you where known faults are located.

Geologic maps are very colorful, and each color is linked to the types and ages of rock units. The legend included with each geologic map tells you what each color means. The legend also tells you, with the use of lines and arrows, where faults are located and, for strike-slip faults, in which relative direction they are moving.

This activity is designed to give you practice using a geologic map to understand how awter shapes the land - nad is stored within the land - in part of the Grand Canyon.

Materials

- Bright Angel Canyon geologic map
- Map key
- Geologic Time Scale
- Notebook and pen

Procedure:

1. Discss: Contained within the Grand Canyon is Bright Angel Canyon, a smaller, fault-controlled canyon. A fault is a fracture in the Earth's crust where both sides of therock have been displaced by movement. You can see a geologic map of Bright Angel Canyon in the .pdf file above.
2. Look carefully at the geologic map of Bright Angel Canyon. Use the key and geologic timescale to understand the information about rocks and faults on the map. Where are the oldest rocks located? Where are the younger rocks located? Notice the largest main canyon, and the smaller, shorter side canyons. What types of rock units are in the deepest sections? How do you know? Record your observations in your notebook.
3. When stresses build up between rock layers enough, the layers suddenly slip along a fault. Notice the pattern of fault lines on the map. Are the faults randomly distributed throughout the area, or do they appear to be grouped in some ways? Do the faults seem to be located in areas where particular types of rock are evident? If so, how might you explain that?
4. Bright Angel Canyon contains Roaring Springs. Groundwater — or water located under the earth’s surface in porous, permeable rock — springs forth from the earth here. How do you think the presence of groundwater reaching Earth’s surface change the rocks that surround it? Observe the position of Roaring Springs Fault on the geologic map. Which do you think came first — the fault or the springs?
5. Look at the geologic timescale again. What relationships do you observe between the locations of faults and the ages of rock layers? Where are the younger, more recently formed rock layers? Where are the comparatively older rock layers?
6. The Grand Canyon can be a hot and dangerous place if hikers are not prepared with plenty of fresh drinking water. Roaring Springs, in fact, is the primary source of drinkable water for Grand Canyon National Park, which hosts some five million visitors a year. Wells are used to pump the water to higher places, such as the North Rim Visitors Center. In addition, the Trans-Canyon Pipeline carries water across the Colorado River to the South Rim Visitors Center. Why do you think water is drawn from the ground rather than from the Colorado River? What, for example, would be some possible side-effects of damming the river?
7. Based on what you see here, how do you think canyons such as Bright Angel Canyon and the Grand Canyon form? How does water move underground? How does water move over the surface of the earth? How does water availability affects human presence in areas such as this one? How might that change if water were to become a more scarce resource in the future, as scientists predict?
8. Investigate geologic mapping in your state by going online to http://www.stategeologists.org/. Click on your state, which will send you to your state's geologic survey website. Find you state's local geologic map. Study the map's geologic patterns and the key and note what features are identified. Are there faults? Folds? Rivers? Valleys? Other features?

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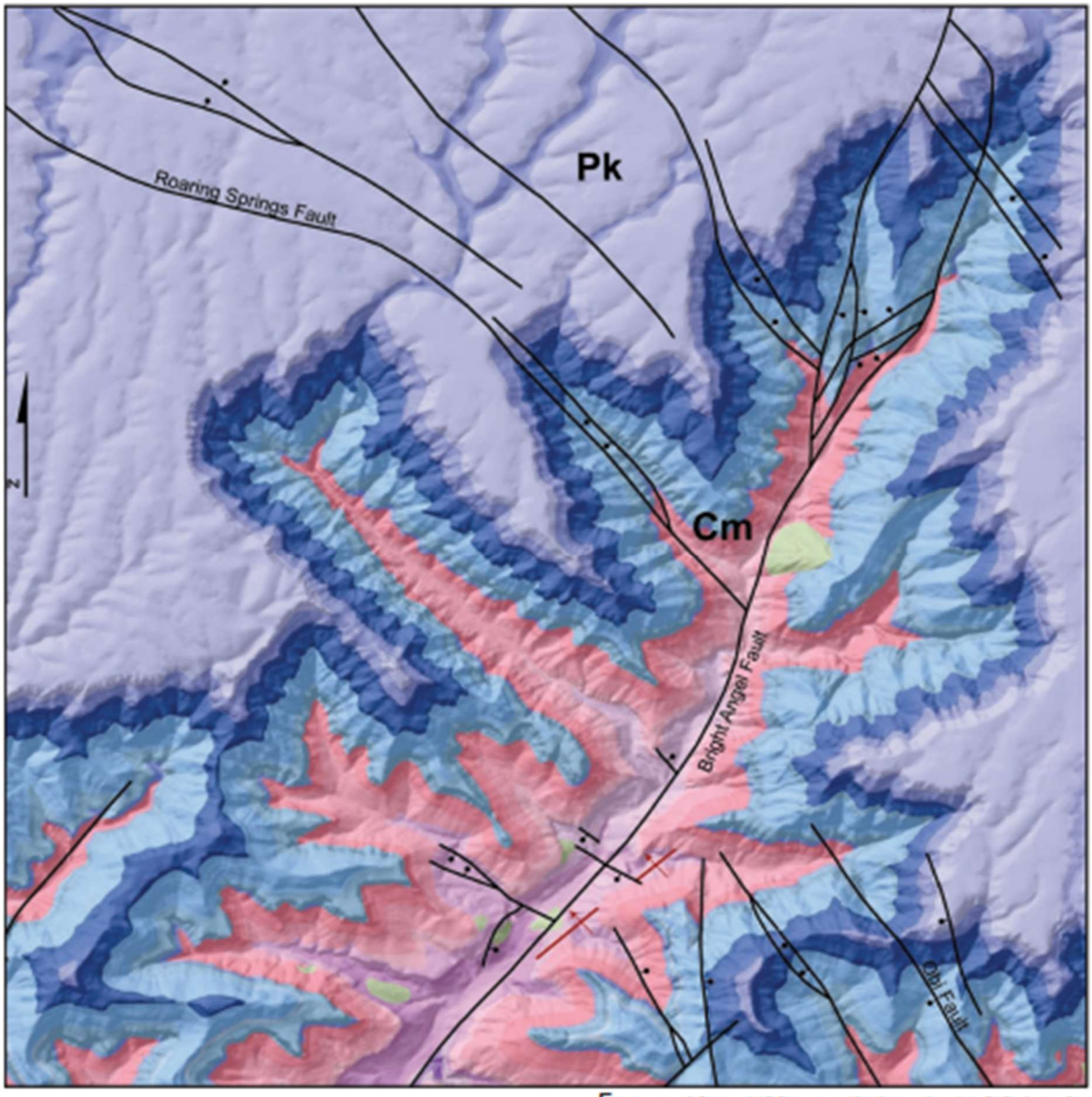
For more maps of the Grand Canyon Nationa Park, visit this interactive map of the area from the USGS and AASG or the National Geologic Map Database.

Geology of Bright Angel Canyon near the North Rim of Grand Canyon National Park



Extracted from NPS-compiled geologic-GIS data for Grand Canyon National Park by USGS geologist George Billingsley

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Map Key

Faults

reverse fault or high-angle fault

normal fault - bar and ball on downthrown side

Folds

monocline

Geologic Units

Ql	Landslide deposits (Holocene and Pleistocene)
Pk	Kaibab Formation, undivided (Lower Permian)
Pt	Toroweap Formation, undivided (Lower Permian)
Pc	Coconino Sandstone (Lower Permian)
Ph	Hermit Formation (Lower Permian)
Pe	Esplanade Sandstone (Lower Permian)
PNMs	Wescogame Formation, Manakacha Formation, and Watahomigi Formation, undivided (Pennsylvanian and Upper Mississippian)
Mr	Redwall Limestone, undivided (Mississippian)
Cm	Muav Limestone (Middle Cambrian)
Cba	Bright Angel Shale (Middle Cambrian)
Ct	Tapeats Sandstone (Middle and Lower(?) Cambrian)
Yu	Grand Canyon Super Group of Formations (Mesoproterozoic)