

# 102 Physical Geology Lab

## Ordering Geologic Events II and Interpreting Geologic History.

**Materials needed:** pencil, eraser, lab notebook, Grand Canyon geologic map and corresponding rocks (provided by instructor)

- Objectives:**
1. Review rock types. Review and be able to apply techniques for relative dating.
  2. Review and be able to apply techniques for relative dating.
  3. Be able to apply relative and absolute dating techniques to field sites and interpret geologic history.

**Answer the questions on the following pages about the Geologic Map of the Eastern part of the Grand Canyon National Park, Arizona**

Each rock unit found in the Grand Canyon can be identified on the map by its unique color and **map symbol** (a 2-3 letter code). Below is a list of a few of these map symbols (in bold), followed by a sample number that corresponds to a rock sample from the bins in front of you.

**r** = SED-N-1 (in jar of sediment)

**Pk** = S-F

**Pc** = S-C

**Ph** = S-A.

**Mr** = S-H

**PEn** = S-E

**PEc** = I-C

**PEg** = I-A and I-E

**PEi** = I-i

**PEs** = M-E

**PEv** = M-b

**PEbr** = M-c

**PEr** = M-d

1. Each of the sample names listed above is located in the bins on your tables. In order to answer the following questions, you need to look at these rock samples.
  - a. *i)* Unit “r” on the map is river sediment – please examine this sediment (in jar labeled SED-N-1). Identify *at least 2* minerals that you can see in this sediment.  
*ii)* Find the area on your map that is outlined by a red box. Locate the river sediment (unit r) in this area. Which rock units surround the river sediment (list the rock type AND the rock symbol)?  
*iii)* Could these rocks be the source for the sediment? (to answer this question: consider whether these rocks usually contain the minerals found in sediment “r”)
  - b. *i)* Rock units Ph (S-A), Pc (S-C), and PEn (S-E) are clastic sedimentary rocks. Identify each of these rocks using the corresponding rock samples  
*ii)* Describe the environment in which they were formed in terms of relative energy levels (low energy flow; moderate energy flow; high energy flow).
  - c. *i)* Unit PEn is a clastic sedimentary rock that **contains** pieces of a metamorphic rock. Name the type of metamorphic rock that makes up the pieces in unit PEn (see corresponding rock sample).  
*ii)* Look at the map legend: Is there a rock unit in the Grand Canyon that might be the source of these clasts (if so, name the unit)?  
*iii)* What is the **relative age** of rock PEn vs. the metamorphic rock found in PEn?

- d. Samples I-A and I-E are two different rock types – *however*, they are listed as the same unit (P€g) on the Grand Canyon map.
- i) Identify rocks I-A and I-E
  - ii) Why are they grouped together (i.e. how are they similar)?
  - iii) What is the main difference between them? (*HINT*: use figure 5.3 to answer the above questions)
2. i) What is the elevation at the top Cedar Mountain (in the very SE corner of the map)? ii) What are the “formation names” of the rock units that make up Cedar Mtn.? iii) What is the name of the geologic **period** during which they were deposited (ask someone if you don’t understand this question!)? iv) So, what is their maximum age (in millions of years)? v) What is the youngest they could be? vi) Speculate on why Cedar Mtn. sticks up above the surrounding rocks (*hint*: think about what process might have formed it.)
3. Which way is the Colorado River flowing? How do you know?
4. If you were to hike from the Ranger Station (on the North Rim of the canyon) all the way down to the Colorado River (near the Phantom Ranch), how many vertical feet would you have to hike down? **NOTE**: There are red arrows on the map indicating the points for which you need to calculate elevation.
5. Look at cross section G-G'. What kind of unconformity exists between the Cambrian sedimentary rocks (e.g. €t) and the Precambrian sedimentary rocks (e.g. P€d, P€s, etc)?
- For questions 6-9 look at cross section B-B'
6. What kind of unconformity exists between Pk and Pt?
  7. What kind of unconformity exists between the Cambrian Tapeats Sandstone (€t) and the Vishnu Schist (P€v)?
  8. i) Which is older, the Hermit Shale (Ph) or the Kaibab formation (Pk)?  
ii) What “geologic law” did you use to answer this question?
  9. i) Which are older, the Roaring Spring/Uncle Jim Faults or the Permian sedimentary rocks (which include all rock units starting with the letter P(not P€))?  
ii) How can you tell?
10. Throughout the map, P€g (granite) is found in contact with P€v (Vishnu schist). You can see this relationship in cross section A-A' i) Which of these two units is older? ii) What “geologic law” did you use to answer this question?
11. Look at the **right half** of cross section G-G' (*i.e. from Johnson Point to G'*). Put all of these units in chronological order; include folding, faulting, tilting and erosion in your geologic history. *Assume the two faults occurred at the same time.*
12. Use the graph in figure 8.16 to answer the following question: i) If the granite (P€g - in the question above) has 12.5% of its parent isotopes left, how many half-lives have elapsed? ii) If the half-life of the isotope in question (<sup>235</sup>U) is 713 million years, how old is the granite? iii) Cross section G-G' shows granite P€g in contact with the Tapeats Sandstone (€t). What is the oldest age possible for the Tapeats Sandstone?
13. i) What is the elevation of the top of the Redwall Limestone (purple unit Mr) in the northeastern corner of the map (a good spot to look is by the B near the northern edge of the map)? ii) What is the elevation of the top of the same unit on the western edge of the map (look by Dead Horse Mesa on the northwestern edge of the map)? iii) What is the difference in elevation and what might explain this difference?