How to be a field geologist: an in-class exercise to introduce students to basic outcrop analysis

Submitted to Cutting Edge activity collection, *Teaching Geoscience in the Field in the 21st Century*

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Name_____ Date_____
GEOL 8L: Earth science laboratory

Preparation for field geology lab

In preparation for your next lab, take about 20 minutes and complete the following. **You will be turning this in during the next class meeting.**

Pretty soon, you will be going on a field trip, during which time you will be analyzing geologic **outcrops.** An outcrop is an exposure of rock. (For example, if you were rock climbing on some cliffs, you would be climbing on an outcrop.) I want you to watch a short video of a couple of Mt. SAC students to get a better idea of how to analyze an outcrop.

- Go to www.youtube.com
- In the search window, type "Yosemite preview"
- The first hit should be a 5-ish minute video called ""Yosemite Preview—Making a Field Notebook". Watch the video and briefly answer the following questions:

(1) What does "fresh face" mean with respect to a rock, and how do you get a fresh face?

(2) What is the difference between a rock description and an interpretation?

(3) List the steps that you should take when you analyze an outcrop. Provide a brief (a few words max) explanation of each step.

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How to be a field geologist

Geologists spend time in the field (in other words, outdoors in a particular field area) making observations. Then, they use their observations to determine the geologic history of an area. As you've learned during the last several labs, different rocks form in different environments. Identifying the rock types present in your field area will allow you to formulate ideas about what type of environment used to exist there in the past.

When you are studying an outcrop (exposure of rock), it is important to have a systematic (in other words, step-by-step) way of completing the analysis. Typically, the procedure for analyzing an outcrop is:

#1: Outcrop-scale observations
These are your large-scale observations—looking at the outcrop from a distance and describing it.

#2: Detailed rock description
These are your small-scale observations—looking at a hand sample, describing the rock in detail using appropriate terminology, and identifying the rock's name.

#3: Interpretations
Based on your outcrop-scale observations and rock descriptions, tell a story of how the rock formed and what the environment in the area was like in the past when the rock formed.

Instructions:
Each table has been provided with a picture of an outcrop and a representative hand sample from that outcrop. (Please note that some of these outcrops are located in protected areas in which no rock collecting is allowed. Therefore, some of the hand samples are the same rock type that would be found at the site but are not from the actual site.)

(1) First, come up with a checklist of items that you should include in your field notes for any outcrop. In other words, which details do you think should be included in a field notebook entry?

- Which characteristics of the outcrop should be included in an outcrop-scale observation?
- Which details should be included in:
  - An igneous rock description?
  - A sedimentary rock description?
  - A metamorphic rock description?
- Which details should be included in an interpretation?

[Record your answers in the space on the next page.]

(1) Checklist of items that you should include in your field notes for any outcrop:

Outcrop-scale observations

Igneous rock description

Sedimentary rock description

Metamorphic rock description

Interpretation

(2) In the space below, complete a field notebook entry for your outcrop, following the checklist that you developed.

(3) Now, you will receive three yellow cards—one for igneous rocks, one for sedimentary rocks, and one for metamorphic rocks. These yellow cards are checklists that I give people before they go on a field trip like the one you will take shortly. Which items did you include in your checklist that I didn't include on mine? Which items did I include in my checklist that you didn't include on yours?

Items that you included in your checklist that I did not include in mine:

Items that I included in my checklist that you didn't include in yours:

(4) Finally, use the appropriate yellow card to complete a field notebook entry for your outcrop.

FIELD NOTE FORMAT FOR IGNEOUS ROCKS

- Name of stop
- Outcrop-scale (large-scale) observations: thickness; outcrop character (cliff former, slope former, or valley former); type(s) of weathering present
- Detailed igneous rock descriptions using a fresh face of a hand sample
    - Texture
    - % groundmass vs. % phenocrysts
    - composition
    - color
    - names of visible minerals
    - approximate sizes of minerals
    - rock name
- Interpretations (detailed story of how the rock/field site formed)
- Labeled sketch(es), including scale
- Answers to questions (if applicable)

Common minerals in igneous rocks

- plagioclase feldspar
- olivine
- pyroxene family (augite)
- amphibole family (hornblende)
- biotite (mica family)
- orthoclase feldspar
- muscovite (mica family)
- quartz

Igneous rock ID chart

	felsic	**intermediate**	**mafic**	**ultramafic**
phaneritic	granite	diorite	gabbro	peridotite
aphanitic	rhyolite	andesite	basalt	komatiite
porphyritic	porphyritic rhyolite	porphyritic andesite	porphyritic basalt	----------
pyroclastic	rhyolite tuff	andesite tuff	----------	----------
glassy	obsidian	obsidian	obsidian	obsidian
vesicular	pumice OR vesicular rhyolite	pumice OR vesicular andesite	scoria OR vesicular basalt	----------

FIELD NOTE FORMAT FOR SEDIMENTARY ROCKS

- Name of stop
- Outcrop-scale (large scale) observations: thickness; outcrop character (cliff former, slope former, or valley former); type(s) of weathering present
- Detailed sedimentary rock descriptions using a fresh face of a hand sample
    - Family (clastic, chemical, carbonate, or organic)
    - For clastic rocks only:
        - Clast size (use grain size card—silt, sand, granules, pebbles, cobbles, boulders)
        - Clast shape (rounded, angular)
        - Sorting (well-sorted, moderately sorted, poorly sorted)
    - Bedding (if applicable): thickness of layers, are the layers flat or tilted?
    - Induration (how well the rock is cemented. Indurated = well-cemented—hammer is required to break it. Moderately indurated = can be broken easily with a hammer. Poorly indurated = hammer will stick in the rock; kicking the rock will damage it. Non-indurated = unconsolidated sediment.)
    - Rock name
- Interpretations (detailed story of how the rock/field site formed)
- Labeled sketch(es), including scale
- Answers to questions (if applicable)

Clastics: conglomerate, breccia, quartz arenite sandstone, arkose sandstone, greywacke sandstone, mudstone, shale. Use the word "fossiliferous" in front of the rock name if fossils are present.
Carbonates: limestone, coquina, chalk, travertine. Use "fossiliferous" if fossils are present.
Chemical sedimentary rocks: rock gypsum, rock salt, chert
Organic sedimentary rocks: coal

FIELD NOTE FORMAT FOR METAMORPHIC ROCKS

- Name of stop
- Outcrop-scale (large scale) observations: thickness, outcrop character (cliff former, slope former, or valley former); type(s) of weathering present
- Detailed metamorphic rock description using a fresh face of a hand sample
    - Foliated or nonfoliated
    - Foliation type, if applicable (slaty cleavage, phyllitic texture, schistosity, gneissic banding)
    - Visible minerals, if any
    - Possible protolith (parent rock)
    - Rock name
- Interpretations (detailed story of how the rock/field site formed)
- Labeled sketch(es), including scale
- Answers to questions (if applicable)

Metamorphic rock ID chart

Foliated/nonfoliated	Foliation type	Rock name	Possible protolith
foliated	slaty cleavage	slate	shale, mudstone
foliated	phyllitic texture	phyllite	shale, mudstone
foliated	schistosity	schist	shale, mudstone
foliated	gneissic banding	gneiss	diorite, granite
nonfoliated		marble	limestone
nonfoliated		quartzite	sandstone
nonfoliated		serpentinite	gabbro, basalt, peridotite

Joshua Tree National Park

Crystal Cove State Park