Field Exercise Handout
Geology 480

General

This handout is intended to provide you with some of the basic information that you will use in the next few weeks. The following pages contain suggestions concerning how and what you should observe in the field, what to record and how to record it, and a brief discussion on safety in the field. The information in this handout will be supplemented by your instructors.

Just as importantly, the following pages explain how to present your data, including standard presentation formats and standard geologic symbols. While it is understood that this is not a drafting class, it must also be understood that the presentation of your data must be neat, legible and in accordance with accepted standards so that others can properly understand, analyze and critique your work and interpretations.

Field Safety

It is appropriate at this point to consider some basic rules concerning field safety. A more complete set of field rules and regulations was presented to you as part of the orientation at the first meeting.

1. Always work with a field partner, and be mutually responsible for each other. If you get hurt by yourself, it may be a long time before anyone finds you.

2. Always wear eye protection when using rock hammers and chisels.

3. Always carry a copy of your field map, and know (or learn) how to interpret topography, and know your location at all times.

4. Always know (mark it on your map, if necessary) where you parked your vehicle, or where you are to be picked up.

5. Always carry an ample supply of water.


Field Equipment

The following section discusses the items that you will find beneficial in the field. Those marked with an (*) are considered essential to properly complete your assignments. Recommended items:

*Fieldbook  *Acid bottle  Extra pencils
*Compass  Appropriate clothing  Scales
*Rock hammer  Field boots  Reliable watch
*Hand lens  Hat/Sun glasses  Clipboard w/protective cover
*Grain size card  Sunblock/Lotion  Food/Lunch
*Safety glasses  Knapsack  *Water
*Protractor

Fieldbooks are an important part of a geologists field equipment. They should be bound, constructed of stiff, parallel-sided cardboard covers, and contain water-proof or water-resistant paper. The paper should be gridded on at least one side (so you can make your drawings to scale). Your fieldbook should also be of sufficient construction so that it can withstand a moderate amount of abuse and weathering.
Using an indelible marker, label the inside cover with the project or class name, locality and dates (beginning and end of project, or duration for which this particular fieldbook was used). Also add your name, address, phone number, and offer a reward for recovery. A brand new fieldbook is a minor loss, but one containing months or even years of field data is irreplaceable. Your locality should be defined as specifically as possible, so that others can easily find your field area, should the need arise.

Field Notes

Your field notes must be neat and legible, and accordingly, your choice of writing implement is also of importance. It is best to use a drafting pencil (4H or 5H) to record your data, in that it will not run in the rain or otherwise smear. Soft-leaded pencils (2B) and erasable inks will smear - and you can’t erase non-smear inks.

Always print or write legibly. Abbreviations are discouraged, but if you must use abbreviations be certain that they are appropriate, and use only commonly accepted and understood abbreviations. All abbreviations should be listed in your notebook so that they can be translated by others. Adopt an appropriate format for recording your field observations (generally one of your own design and one that is suitable to your specific field project) and maintain that format throughout. When recording data, all entries must be number-keyed to specific locations plotted on your field map. If you can’t locate/recall the exact spot where your data was observed, it’s useless to you or anyone else.

THE STRATIGRAPHIC SECTION

Measuring Section

In areas where the geology is not known, measuring and describing the stratigraphic section is one of the most important initial steps of a geological investigation. The obvious purpose behind measuring section is to familiarize the geologist with the local stratigraphy. Measuring a section also aids the geologist in recognizing structural complexities (duplication or omission of strata), interpreting the region’s tectonic history, and recognizing stratigraphic similarities (as well as differences) in other locales.

The purpose behind having you measure section is two-fold. Number one, it is intended to familiarize you with the local stratigraphy, so that you can learn to recognize a formation or unit based on its lithologic character or sequence for the upcoming mapping exercises. Number two, while measuring the section, you are to observe and record specific information concerning the lithologic and biologic content of all units. Doing so will aid you in the interpretation of the region’s geologic history. By the time you start measuring section, you should already be familiar with the usage of a Brunton compass and a Jacob staff.

Constructing the Stratigraphic Column

Forms will be provided upon which you can record your field observations. These forms should be filled out as shown in the example (Figure 2.1), using the appropriate symbols (Figure 2.2). The final drafted stratigraphic section must exactly follow the format shown in Figure 2.3, and include a detailed lithologic description (Discussed below).

Lithologic Field Descriptions

Lithologic descriptions must be as detailed as possible. Assigning rock names is to be done in accordance with the classification schemes of Dunham (1962) for carbonates and Dott (1964) for clastics which are appended on a later page in this handout. Individual, distinct rock types should be treated separately. Where units are thin, repetitive (either rhythmic or cyclic) and of similar rock type, it is appropriate and simplest to treat these units as one interbedded unit (e.g., see sample description 58 below). For each lithologic unit, you are to determine, record (in your fieldbooks) and present (in your stratigraphic column), each of the following lithologic features, and in the following order:
Figure 2.3 - Final stratigraphic column

LOCATION: The Beltway
NAME/PARTNER: Dave Johnson/Andrew Campbell
DATE: 5/15/96

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>FORMATION</th>
<th>MEMBER</th>
<th>METRES ABOVE BASE</th>
<th>GRAPHIC REPRESENTATION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERM</td>
<td>Clinton Fm.</td>
<td>Gorge Mbr.</td>
<td>1.0</td>
<td>Weathering resistance</td>
<td>Less than more</td>
</tr>
<tr>
<td>PERM</td>
<td>Clinton Fm.</td>
<td>Nile Mbr.</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERM</td>
<td>Dole Fm.</td>
<td>Quays Mbr.</td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. Shale, dark grey, weathered to light grey, thinly laminated (place parallel), non-fossiliferous, no sedimentary structures, sharp basal contact, some weathering.
9. Silty sandstone, light grey, very well stratified, finely laminated, lower part parallel, upper part cross-bedded, sharp basal contact, off-setting, trace fossils in basal part, no weathering.
8. Shale, light grey to olive, dolomitic, medium grey to light grey, very well stratified, cross-bedded, sharp basal contact, traces of weathering, no fossils.
7. Light sandstone, grey, weathered red-brown, containing cross-strata (N-S), moderately to poorly sorted, reoriented, jasper beds, brown sandstone (top), well stratified, interbedded with medium grey shale and siltstone, sharp basal contact, traces of weathering, no fossils.
6. Shale, light grey to olive, dolomitic, medium grey to light grey, very well stratified, cross-bedded, sharp basal contact, traces of weathering, no fossils.
5. Shale, dark grey, weathered to light grey, thinly laminated (place parallel), non-fossiliferous, no sedimentary structures, sharp basal contact, some weathering.
4. Mudstone, grey, weathered red-brown, containing cross-strata (N-S), moderately to poorly sorted, reoriented, jasper beds, brown sandstone (top), well stratified, interbedded with medium grey shale and siltstone, sharp basal contact, traces of weathering, no fossils.
3. Sandstone, grey, weathered red-brown, containing cross-strata (N-S), moderately to poorly sorted, reoriented, jasper beds, brown sandstone (top), well stratified, interbedded with medium grey shale and siltstone, sharp basal contact, traces of weathering, no fossils.
2. Mudstone, grey, weathered red-brown, containing cross-strata (N-S), moderately to poorly sorted, reoriented, jasper beds, brown sandstone (top), well stratified, interbedded with medium grey shale and siltstone, sharp basal contact, traces of weathering, no fossils.
1. Mudstone, grey, weathered red-brown, containing cross-strata (N-S), moderately to poorly sorted, reoriented, jasper beds, brown sandstone (top), well stratified, interbedded with medium grey shale and siltstone, sharp basal contact, traces of weathering, no fossils.
Fig. 7-6. A: classification of terrigenous sandstones (modified from Dott, 1964, Jour. Sed. Petrology, v. 34, Fig. 3); B: subdivision of lithic arenites (after Folk, 1968, p. 124).
### Table 6.3: Size limits of common grade and rock terms of sedimentary or igneous rocks

<table>
<thead>
<tr>
<th>Size</th>
<th>Aggregate</th>
<th>Angular</th>
<th>Fragment</th>
<th>Boulder</th>
<th>Cobble</th>
<th>Gravel</th>
<th>Pebble</th>
<th>Gravel</th>
<th>Breccia</th>
<th>Granule</th>
<th>Gravel</th>
<th>Sandstone</th>
<th>Silt</th>
<th>Siltstone</th>
<th>Clay</th>
<th>Shale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>256 mm</td>
<td>Boulder</td>
<td>Block</td>
<td>Cobble</td>
<td>Pebble</td>
<td>Pebble</td>
<td>Pebble</td>
<td>Pebble</td>
<td>Pebble</td>
<td>Pebble</td>
<td>Pebble</td>
<td>Pebble</td>
<td>Sand</td>
<td>Silt</td>
<td>Siltstone</td>
<td>Clay</td>
<td>Shale</td>
</tr>
<tr>
<td>2 mm</td>
<td>Granule</td>
<td>Sand</td>
<td>Sand</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Siltstone</td>
<td>Clay</td>
<td>Shale</td>
</tr>
<tr>
<td>¥2/8 mm</td>
<td>Sand</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Siltstone</td>
<td>Clay</td>
<td>Shale</td>
</tr>
<tr>
<td>¥2/32 mm</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Silt</td>
<td>Siltstone</td>
<td>Clay</td>
<td>Shale</td>
</tr>
</tbody>
</table>

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**Figure 6.3**
Classification of conglomerates on the basis of clast lithology and type of fabric support.
1. Rock name (in accordance with Dunham or Dott)
2. Fresh color
3. Weathered color
4. Dominant grain size (Wentworth size scale - use your grain size card)
5. Degree of sorting (range in grain size and see below)
6. Degree of rounding (see below)
7. Degree of induration (see below)
8. Bedding thickness (see below)
9. Bedding shape (planar parallel, wedge, lens)
10. Type of cement
11. Fossil content (non-, moderately-, or richly fossiliferous; identify major phyla)
12. Sedimentary structures
13. Basal contact relationships (gradational, sharp, erosive, unconformable)
14. Weatherability (slope-forming (erodable), cliff-forming (resistant))
15. Other pertinent features

Do not omit items, e.g., if there are no fossils, don't ignore it, call it non-fossiliferous. For a more complete presentation on field notes see Compton (1985, p. 27-32).

Use the following charts and diagrams for their respective features:

**Bedding Thickness**
- thinly laminated = less than 3 mm
- thickly laminated = 3 mm to 1 cm
- very thin-bedded = 1 cm to 3 cm
- thin-bedded = 3 cm to 10 cm
- medium-bedded = 10 cm to 30 cm
- thick-bedded = 30 cm to 1 m
- very thick-bedded = greater than 1 m

**Degree of Sorting:**
- Very well sorted
- Well sorted
- Moderately sorted
- Poorly sorted
Degree of Rounding:

FIG. 3.24. Roundness classes. A: angular; B: subangular; C: sub-rounded; D: rounded; E: well rounded.

Induration: Break open a hand specimen of the lithology in question and examine a fresh surface with your hand lens, and determine:

#1. Did the rock break through the majority of grains or did it break around them?

#2. Rub the fresh surface with the pad of your thumb (not your thumbnail) and note whether:

a. only 1 or 2 grains were released.
b. between 3 and 10 grains were released.
c. more than 10 grains were released.

Then use the following chart:

<table>
<thead>
<tr>
<th>Degree of induration</th>
<th>Breaks</th>
<th>Number of grains released</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very well indurated</td>
<td>through grains</td>
<td>0, 1, 2</td>
</tr>
<tr>
<td>Well indurated</td>
<td>around grains</td>
<td>0, 1, 2</td>
</tr>
<tr>
<td>Poorly indurated</td>
<td>around grains</td>
<td>between 3 and 10</td>
</tr>
<tr>
<td>Friable</td>
<td>around grains</td>
<td>greater than 10</td>
</tr>
</tbody>
</table>

Geologic Mapping

During the field camp you will produce several geologic maps. Your instructors will supply you with enlarged photocopies of topographic maps that you will use as base maps. One copy is for use in the field. Retain at least one clean copy for use in preparing your formal geologic map. When the projects are turned in, you may be asked to submit your field maps and notes as well as the final copy of your map.

You are expected to adequately cover all areas of the map. Some areas of your map will be geologically simple, others are somewhat more complex, and will correspondingly require a bit more investigation. In general, your assignments will include plotting on your map the location and orientation of the different formations, and more specifically, the contacts between them, as well as the location and extent of faults and folds. The wide variety of map symbols that you will use are illustrated in the pages that follow.

The Geologic Map

Unless instructed otherwise our geologic map should contain the following:

1. Contacts between the mapped units.
   a. Thin solid line where known.
   b. Dashed line where inferred or approximately located.
   c. Dotted line where buried by recent (e.g., Quaternary Alluvium) sediments.
2. Faults (with appropriate symbols to show displacement).
   a. Thick solid line where known.
   b. Dashed line where inferred or appropriately located.
   c. Dotted line where buried by recent sediments.
3. Folds (with appropriate anticline, syncline and plunge symbols).
4. Strike and dip symbols.
5. Bar scale.
6. North arrow.
7. Key showing all symbols used in your geologic map and cross section, formation symbols and corresponding colors.
8. Map boundaries and line of cross section.

The Cross Section

On a separate sheet (plain white or tracing paper), construct a cross section to graphically illustrate the vertical dimension of your map area. Transfer this line of section onto your basemap accurately.

When constructing your section, do not use vertical exaggeration, i.e., your horizontal scale and your vertical scale are to be the same. If you exaggerate, you create problems with respect to dip values that must be correspondingly adjusted to properly represent your data. These conversions are a pain and give a false impression of the local geology. If you find it difficult to draw the section at the same scale as your geologic map (i.e., hard to show all pertinent data at that scale) you must expand both the horizontal and vertical scales accordingly. Be sure you make note of the factor by which you enlarged (2x, 3x, etc.) your section. Your instructors will specify when enlarged cross sections may be employed. Remember that when a line of cross section intersects planes (bedding or fault) at an angle, it is the apparent dip that is to be depicted. Sections must include:

1. Vertical scales marked at each end of the section.
2. Appropriate section (A-A’) and direction (NE-SW) indicators.
3. Colors that correspond to map unit colors.
4. Formation and fault symbols.
5. Project surface data into the subsurface on your section using the dip values recorded at the surface.
6. Make sure that you maintain the proper thickness for all formations in the cross section.

The Geologic History

Your write-up on geologic history is to be based solely on your observations in the field and the information provided in this handout. Making reference to your stratigraphic column, geologic map, and/or cross section (the data), discuss the sequence of geologic events, including depositional settings, transgressions or regressions, unconformities, and structural deformation (types of faults and folds, and whether they were formed by extension or compression). Your discussion is expected to be explanatory, i.e., do not formulate a mere list of events: Describe and interpret the area’s geologic history based on your observations. This write-up should be brief (approximately 2 pages) but it should also be complete.
APPENDIX 5. LITHOLOGIC SYMBOLS FOR CROSS SECTIONS AND COLUMNAR SECTIONS

1. Breccia
2. Conglomerate
3. Massive sandstone, coarse-grained
4. Massive sandstone, fine-grained
5. Calcareous sandstone
6. Bedded sandstone
7. Cross-bedded sandstone
8. Sandstone beds with shale partings
9. Sandstone lenses in shale
10. Siltstone
11. Mudstone or massive claystone
12. Shale
13. Oil shale
14. Carbonaceous shale with coal bed
15. Calcareous shale
16. Massive limestone
17. Bedded limestone
18. Dolomite
19. Argillaceous limestone
20. Sandy limestone
21. Oolitic limestone
22. Shelly limestone
23. Cherty limestone
24. Bedded chert
25. Gypsum
26. Anhydrite
27. Salt
28. Tuff and tuff-breccia
29. Basic lava flows
30. Other lava flows
31. Porphyryic igneous rock
32. Granitic rock
33. Serpentine
34. Massive igneous rock
35. Massive igneous rock
36. Schist
37. Folded schist
38. Gneiss
39. Marble
40. Quartzite
<table>
<thead>
<tr>
<th>ERA</th>
<th>PERIOD</th>
<th>EPOCH</th>
<th>MAP ABBREV.</th>
<th>COMMON MAP COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quaternary</td>
<td>Holocene Pleistocene</td>
<td>Q or Q</td>
<td>Various shades of gray and yellow</td>
</tr>
<tr>
<td>CENOZOIC</td>
<td>Tertiary</td>
<td>Pliocene Miocene Oligocene Eocene Paleocene</td>
<td>P or Tpl or Tpl M or Tm or Tm Q or To or To E or To or To Tp</td>
<td>Various shades of orange, yellow orange, and yellow</td>
</tr>
<tr>
<td>Mesozoic</td>
<td>Cretaceous</td>
<td>K</td>
<td></td>
<td>Various shades of green</td>
</tr>
<tr>
<td></td>
<td>Jurassic</td>
<td>J</td>
<td></td>
<td>Various shades of blue green</td>
</tr>
<tr>
<td></td>
<td>Triassic</td>
<td>Tt</td>
<td></td>
<td>Various shades of blue</td>
</tr>
<tr>
<td>Paleozoic</td>
<td>Permian</td>
<td>P or Cpm</td>
<td></td>
<td>Commonly blue, green, purple, pink, lavender</td>
</tr>
<tr>
<td></td>
<td>Pennsylvanian</td>
<td>P or Cm</td>
<td></td>
<td>purple gray</td>
</tr>
<tr>
<td></td>
<td>Mississippian</td>
<td>M or Cm</td>
<td></td>
<td>Various shades of purple</td>
</tr>
<tr>
<td></td>
<td>Devonian</td>
<td>D</td>
<td></td>
<td>pink, lavender, tan</td>
</tr>
<tr>
<td></td>
<td>Silurian</td>
<td>S</td>
<td></td>
<td>brown, red brown, red</td>
</tr>
<tr>
<td></td>
<td>Ordovician</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precambrian</td>
<td>Cambrian</td>
<td>E</td>
<td></td>
<td>No standard color</td>
</tr>
<tr>
<td></td>
<td>570 million years</td>
<td></td>
<td></td>
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</table>