

## **Mapping and Interpretation of Fluvial Landforms: Alluvial Fans**

Your assignment is to prepare a preliminary report on the geology/geomorphology of the area imaged in a set of stereo aerial photographs. You should treat the assignment as if you either have been hired by a private consulting firm (or government agency: NRC, NASA, DOD) and charged with the duty of providing a preliminary analysis of the area. The task is to sort out, to the degree possible the Quaternary stratigraphy and make interpretations about possible influences of Quaternary climate change and tectonic activity.

We will work on the interpretation of this field site in small groups and as a class over the next two weeks. I will mix in some relevant lecture material when appropriate as we work through the plausible explanations and interpretations of observed field relationships. The deliverable at the end of this process is a report, the expected structure and content of which is described in detail below. We will all work together as you learn how to interpret aerial photographs and think about processes on alluvial fans (both depositional processes and post-deposition modification). However, everyone will prepare an individual report including their own maps, figures, and words. A brief “guide” to mapping and image interpretation is included below.

The essential requirements are: (1) to provide a relevant interpretive map of the area, complete with legend, cross-sections, and illustrative sketches, as required to convey the extent and limits of your understanding of the area; (2) to provide guidelines for further investigation of the site (usually including advice for directed field study); (3) to provide a full accounting of any limitations of the interpretive map and problems remaining; and (4) to provide full documentation of any outside resources or prior knowledge incorporated into the analysis.

### **Guidelines for Reports: preparing a clear and concise document**

Reports are limited to 4 pages, 1.5 spaced, 12-point font, with 1” margins (or equivalent). The 4 page limit is serious. I will only read the first 4 pages.

Make effective and efficient use of captions and appendices: place only the essentials in the report text. For instance, the “map unit definitions” or mapping criteria are best reported as a legend (or stratigraphic column) to the interpretive map. Beware: avoid “lazy” use of appendices -- do not overburden your boss (or instructor) with reams of poorly organized supplementary data. The report must be free of spelling errors and written in a crisp, clear, efficient style. Do not repeat yourself.

Consider the report as an extended abstract. The report must convey: what you are trying to do; what important conclusions you have reached; what limitations the interpretive map entails; what outside sources of information you have used; and what key

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recommendations you can make for further exploration of the area. The maps, cross-sections, illustrations, and processed images are the backbone of your report. They must be integrated effectively into the report. Each illustration must be used to **MAKE A POINT**. Maps or illustrations not directly referred to will be ignored. Illustrations must be clearly labeled and annotated such that a busy executive (like your instructor) can quickly breeze through your report and understand clearly what you did and both how and why you made the interpretations outlined in the report.

### **Recommendations for Report Structure**

1. Opening paragraph: State your claim – what is the goal of the report and what is your essential conclusion/ what is your fundamental interpretation presented in the map and cross-sections.
2. Review the bare essentials of your methods, materials, and approach (airphotos, defined units based on albedo, topography, geometry, etc) – max  $\frac{3}{4}$  page.
3. Present and discuss your interpretation (leveraging and explaining the map and cross-sections). ~ 1-1.5 pages.
4. Identify Further Research needs. Provide a useful guide to this further work. Identify critical areas – where to go to best resolve remaining uncertainties (ie. critical age relations, nature of critical contacts, etc). ~  $\frac{3}{4}$  page.

### **Deliverables**

1. A Geologic Map of the alluvial fan complex in the center of the color ASTER image of the study area (dv\_aster.jpg or dv\_aster.png, electronic version available on the course webpage). You may draw contacts on the Aster scene paper or electronic version (ideally in a separate layer) or on tracing paper or thin mylar. Readability, clear labeling of units, an accurately located contacts and geologic structures are essential. Include North Arrow, scale bar, caption.
2. A Stratigraphic Column with unit descriptions (your map's legend). Unit descriptions must be based on what you see in the images available – define how the unit was mapped: someone else should be able to use these criteria and produce a similar map.
3. Three Geologic Cross Sections are required. Additional cross-sections are encouraged, if they help you make the case for your interpretation (for instance you might want to include a regional cross-section across Death Valley to set the context, or you might want to include a cross-section illustrating a particularly important contact relationship or a particularly puzzling area). Required cross-sections A-A', B-B', and C-C' will be defined in class (exact location is flexible and projecting information into cross-sections is encouraged). Cross sections must be neat, readable and labeled with same units/colors as on the Geologic Map. Cross sections can be drawn by hand based on a reasonable cartoon representation of surface topography. A Geologic Cross section must show an

interpretation of sub-surface structure and geometry and must be consistent with relationships implied by your Geologic Map. Internal consistency is at a premium. You are encouraged to present alternate versions of cross-sections – alternate plausible interpretations of the structure and stratigraphy at depth if you are unable to rule out multiple plausible interpretations. If you take this path be sure to discuss both alternates in your report and present a plan for further investigation that could resolve remaining uncertainty.

4. Written Report. Maximum 4 pages, 1.5 spaced, 12-point font, with 1” margins (or equivalent). The 4 page limit is serious. I will only read the first 4 pages. See Guidelines for Reports above.

## **Mapping / Image Interpretation Guidelines**

The Interpreter’s job: interpreter organizes and synthesizes information on the image, utilizing knowledge of processes to make inferences and pose testable hypotheses.

1. define objective, define assumptions
2. at all stages entertain multiple working hypotheses: force yourself to explore every possibility (your first idea may be your favorite, but may not be right)
3. use shade / shadow to discern topography
4. define working units (description, type area)
5. prepare unit map
6. carefully evaluate unit boundaries
  - superposition / relative age
  - depositional, fault, unconformity
7. define working chronology
8. explore interpretations, plausible explanations of unit map --> draw cross sections
9. consider processes (draw on external knowledge, experience, intuition, analogs), seek to explain:
  - original surface morphology
  - sequence of events
  - define predictable consequences of each plausible hypothesis --> test, narrow the field of plausible solutions
10. iterate any and all steps as appropriate
11. at all steps challenge yourself with what you don’t understand, cannot explain

The end result is a “most plausible” interpretation(s) represented by a unit map(s) and interpretative cross sections. Most importantly, implausible interpretations have been ruled out, a list of focused questions for further work have been defined, and a set of “critical areas” where solutions to remaining problems can potentially be resolved with further research, usually including field mapping.

## **Project Grading Criteria**

The Project Write up will be graded out of 50 points distributed as follows:

### **Presentation (15)**

- Clear statement of objectives, hypothesis(es) (5)
- Clarity (writing, illustrations, integration of text and figures) (10)

### **Analysis (25)**

- Data / interpretations clearly separated (10)
  - unit definitions / criteria
  - relative age criteria
- Internal consistency of interpretation (15)
  - cogent synthesis of data
  - pro and con evidence presented
  - appropriate mapping considering focus of report
  - alternate models recognized and considered

### **Further Work (10)**

- Define problem areas (specific) and alternate hypotheses (5)
- Suggest future work and solutions (specific / feasible) (5)

**Important:** I will grade based on internal consistency, logic, clarity of writing and figures. I will not grade based on whether you have come up with the “right” answer. There is in fact no known “right” answer.

### **Summary**

#### ***Deliverables***

- Map Hanaupah Fan -> units of ~equal age (Figure)
- Provide Detailed Unit Descriptions (mapping criteria) (Figure/Table/Appendix)
  - Color, texture, roughness, relief, relative elevation, composition
- Stratigraphic Column – Relative ages (Figure)
  - Admit uncertainty, identify critical areas/info needed to resolve
- Three Cross Sections (2 cross-fan, 1 down-fan) (Figure)
  - Relative Ages & Interpreted sequence of events must be expressed in cross-sections

#### ***Report Text:***

- Explain how relative ages are determined, admit uncertainties
- Interpret the sequence of events and likely drivers (uncertainties)
- Discuss evidence for climate, tectonics, both?
- ID critical areas and specific tasks to resolve uncertainties