# Geomorphology Field Research Project

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San Gabriel Mountains, with Claremont, Pomona, and Ontario in the foreground
Photo by D.M. Morton, U.S. Geological Survey

## INTRODUCTION

The goal of our research project is to allow you to integrate and apply your geomorphic knowledge in a focused study of a local landscape system. In this project, you will investigate the origin and significance of a series of flat-topped mesas and isolated hills that rise above the gently sloping surface of alluvial fans along the San Gabriel Mountain foothills. To complete this study, you will work with other students as part of a research team of 3 or 4 members. Each team will be assigned a different field area and will conduct a comprehensive geomorphic investigation of landforms within that area.

Team members will be expected to work collaboratively to formulate a research plan, complete a background literature search, and conduct independent fieldwork outside of class time. Each team should divide up responsibilities among team members as they see fit. However, each individual student is expected to contribute an equivalent amount of time and effort toward project completion. At the end of the quarter, each team will present the results of their research in an oral presentation in front of the class, and in a professional written report submitted to the professor.

## FIELD SITES

Rapid Quaternary uplift along the frontal faults of the San Gabriel Mountains (Sierra Madre-Cucamonga fault system) has led to the deep incision of canyons and the production of large volumes of sediment. This eroded rock debris is transported by streams across the mountain front and deposited within broad *alluvial fans* that extend outward into the adjacent lowland basin. Quaternary fan deposits consist primarily of inter-fingered lobes of coarse gravel laid down by episodic stream flooding and debris flows. These massive gravel fans coalesce into a regionally extensive *bajada* formed along the base of the mountains.

For the most part, this landscape consists of a broad, low relief, gently sloping surface that extends outward from the San Gabriel Mountain front into the Pomona-Ontario basin. However, in several areas, remnant surfaces occur at higher elevations along the edges of the alluvial fans (e.g., mountain front at La Verne, Claremont, Upland). Also, in several locations, the alluvial fan surface is disrupted by small flat-topped hills such as Red Hill in Rancho Cucamonga, and Indian Hill in Claremont.

These hills have particular geomorphic and geologic characteristics that may shed light on their origin and significance. Your task as a geomorphologist is to study these anomalous landforms by making field observations, collecting data, generating maps and cross sections, and developing multiple working hypotheses about their origin. Be sure to consider all geomorphic processes operating in the landscape, and think about the significance of these landforms in both a local and regional context.

## ASSIGNMENT

**Due: __/__/__ (Friday - last week of classes)**

**1) Report:** Each team of students will submit a research report with at least 5 pages of text, plus illustrations, and a reference list. This report should follow standard research report format (see lab guidelines handout).

**2) Presentation:** Each research team will also give a class presentation on their results during the last week of class (*In Lab Period* – __/__). This presentation should include some form of visual aids (overheads, PowerPoint, photos, poster, etc)

## PROJECT DETAILS

### The investigation:

Your investigation should begin by familiarizing yourself with the field sites on maps, in aerial photos, and in person.

You should work with your group to develop a research plan, to schedule fieldwork, and to divide up responsibilities accordingly.

Spend some time viewing your field sites on air photos under the stereoscope. Take careful notes and make trace maps if appropriate.

Make use of library resources to conduct a background literature search. Look for papers/reports on your specific field areas, as well as general studies of alluvial fans and related landforms. You should reference these sources of information in your final report. I will provide you with some initial reference material to get you started.

Plan to visit your field sites several times with the goal of carrying out specific tasks (e.g. reconnaissance mapping, measuring section & describing units, completing soil profiles, etc.). One particular challenge is that these sites are in suburban areas and exposure will be limited. You will have to work with scant field data and make inferences about what you can't see. In some cases, data from one site may have to be extrapolated to another site.

Be sure to develop "multiple working hypotheses" about your landform. Your goal will be to choose one favored hypothesis by process of elimination.

### The report:

The final project report should be organized and formatted in a professional manner. All maps, illustrations, and plots should be neat, accurate, and drawn to scale.

The report should include the following sections: Introduction, Methods, Field Observations, Field Data & Results, Discussion, and Conclusions.

In addition to 5+ pages of text, your report should include:

- a geologic map, focusing on Quaternary deposits
- a stratigraphic column, with detailed lithologic descriptions
- two or more topographic profiles with cross sections of underlying units (these profiles should show the landform from several different perspectives)
- a soil profile (if possible)
- any other useful diagrams or photographs
- a reference list

## SOME REFERENCE MATERIAL TO GET YOU STARTED:

### Your text book:

Ritter, D.F., Kochel, R.C., and Miller, J.R., 2002, Process Geomorphology, Fourth Edition: New York, New York, McGraw-Hill Companies, Inc., 560 p.

### Research papers & reports:

Baird, A., 1956, Geology of a portion of San Antonio Canyon, San Gabriel Mountains, California [M.S. Thesis], Pomona College, Claremont, California, 91 p.

Eckis, R., 1928, Alluvial fans of the Cucamonga District, southern California: Journal of Geology, v. 36, no. 3, p. 224-247.

Morton, D.M., Matti, J.C., and Tinsley, J.C., 1987, Cucamonga fault zone scarps, Day Canyon alluvial fan, eastern San Gabriel Mountains, southern California, *in* Hill, M.L., *ed.,* Geological Society of America Centennial Field Guide, Volume 1, Cordilleran Section, p. 199-200.

Ritter, J.B., Miller, J.R., Enzel, Y. and Wells, S.G., 1995, Reconciling the roles of tectonism and climate in Quaternary alluvial fan evolution: Geology, v. 23, p. 245-248.

Schumm, S.A., Baker, V.R., Bowker, M.F., Dixon, J.R., Dunne, T., Hamilton, D., Hjalmarson, H.W., and Merritts, D., 1996, Alluvial Fan Flooding: Washington, D.C., National Research Council, National Academy Press, 172 p.

Shelton, J.S., 1955, Glendora volcanic rocks, Los Angeles basin, California: Geological Society of America Bulletin, v. 66, p. 45-90.

Tinsley, J.C., Matti, J.C., and McFadden, L.D., 1982, Late Quaternary pedogenesis and alluvial chronologies of the Los Angeles and San Gabriel Mountains areas, Southern California, and Holocene faulting and alluvial stratigraphy within the Cucamonga fault zone: A preliminary view: Geological Society of America Cordilleran Section Guidebook, Field Trip 12, 44 p.

Van Buskirk, M.C. and Brooks, D.A., 1994, Geology and Geophysics of the Sierra Madre – Cucamonga Fault Zone, San Gabriel Mountains, California, *in* McGill, S.F. and Ross, T.M., *eds.,* Geological Investigations of and Active Margin, 1994 Geological Society of America Cordilleran Section Guidebook, Trip 5, p. 82-93.

### A few useful web sites:

http://geomaps.wr.usgs.gov/socal/geology/inland_empire/index.html

http://www.nap.edu/books/0309055423/html/index.html

http://bfs.claremont.edu/environment/bfsgeo.html