

FAULT-BOUNDED MOUNTAINS AND MORPHOMETRIC PROPERTIES

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This classroom activity is designed to help students see the utility of simple morphometric properties in fault-bounded mountain and piedmont environments. Rather than listing and describing commonly used properties in lecture, students develop their own properties by studying topographic maps of the Tobin Range in Nevada. The class later discusses the properties that the students develop and compares them to those used by geologists who worked in the region.

Geomorphic topics addressed in the activity/assignment:
Tectonic Geomorphology

Context:

- Designed for an undergraduate course in geomorphology.
- Addresses student fear of quantitative aspect and/or inadequate quantitative skills.
- This is a 15 to 20 minute stand-alone classroom exercise.

This exercise requires a basic understanding of common types of faults (i.e., normal faults) and major physiographic provinces (i.e., the Basin and Range province). It is included as part of a discussion of endogenic forces, following the introduction of epeirogenic and orogenic processes.

Content/concept goals:

Students who complete this exercise should develop an appreciation for the utility of simple morphometric properties.

They should also understand that they can develop and test their own morphometric properties; i.e., they are not restricted to those used by other geologists.

Higher order thinking skills goals:

Students who complete this exercise synthesize topographic and structural data using topographic maps and formulate hypotheses regarding potentially useful morphometric properties.

Other goals:

Students who complete this exercise gain experience in working in groups and with topographic maps.

Description:

This exercise is based on the information presented in following article:

Bull, W.B., 1984, Tectonic Geomorphology: Journal of Geological Education 32, pp.310-324.

To prepare for the classroom exercise, the instructor briefly presents the concept that measurable landform properties can reflect the intensity of tectonic activity. We discuss that certain landforms and settings are particularly useful in these types of analyses, for example, fault-bounded mountains and piedmonts. The class goes through a quick review of dip slip faults, fault scarps, and triangular facets, and the Tobin Range is introduced as a typical example of a fault-bounded range. We then ask the question, what are the useful characteristics of these settings in terms of inferring tectonic activity?

To address the question, students work in groups of 2 or 3. Each group is given a set of topographic maps chosen from the following (the region can also be printed from CDs of digital, seamless topo.s, but some quad. names are provided for reference):

7.5 minute quad.s: Home Station Ranch , Jersey Summit , Kennedy Canyon, Mount Tobin , Needle Peak

15-minute quad.s: Mt. Tobin, Buffalo Springs, Cain Mountain

On each map set, two lengths along the fault scarps are marked. One is marked in red and one in purple. Each student group has a map set of a slightly different region, but all map sets have a red fault scarp and a purple fault scarp marked. The red fault scarps in all of the sets are those that have experienced more recent displacement.

Each group is asked to do the following:

1. List physical characteristics of each of the two fault-bounded mountains/piedmonts that are marked on your quad.s with different colors.
2. Decide among yourselves which fault-bounded mountains/piedmont has experienced more recent displacement.
3. Suggest morphometric properties that could be used to differentiate between the more recent and less recent displacement, and explain why each of your properties makes sense. Morphometric properties must be measurable from the topographic maps.

After about 10 minutes, the class reconvenes and we go through the first two questions as a class. Then, each group presents at least one morphometric property and explains their reasoning. Once we have a list of properties that the class agrees on, the instructor presents and the class discusses the properties that Bull (1984) used in his research of the Tobin Range region, such as sinuosity, the ratio between the valley floor width and the total valley height, the development of triangular facets.

Evaluation:

Students are not formally evaluated in this exercise. However, the instructor can evaluate if the goals of the assignment have been met by the quality of the discussion that follows the group work. Students should be able to develop at least three or four morphometric properties on their own, and they should be able to justify why each property makes sense.

Supporting References:

Bull, W.B., 1984, Tectonic Geomorphology: Journal of Geological Education 32, pp.310-324.