

COUGAR MOUNTAIN FIELD TRIP

PREPARING to Go to Cougar Mountain

<http://www.kingcounty.gov/recreation/parks/inventory/cougar.aspx>
<http://www.issaquahalps.org> and <http://www.issaquahalps.org/schedule.html>
http://en.wikipedia.org/wiki/Cougar_Mountain

http://www.issaquahalps.org/images/maps/cougarmt_pg1.pdf
 and http://www.issaquahalps.org/images/maps/cougarmt_pg2.pdf
http://www.metrokc.gov/ftp/gis/Web/VMC/recreation/CM_0504.pdf
http://geomapnw.ess.washington.edu/services/publications/map/data/Issaquah_6-29-06.pdf
<http://www.seanet.com/~pfitech/I-90GeoTour.pdf>

- **Bring this handout, pencils, a clipboard or other hard surface, and (optional) a camera.**
 - **Wear sturdy shoes that can get muddy and clothes that might get wet.**
 - **Bring snacks and water, any medications you might need, etc.**
- **There are no bathroom facilities at either field-trip stop. No smoking on field trips.**

DIRECTIONS for Getting to Cougar Mountain

From Bellevue College:

To get to Stop 1:

1. Leave campus via the east (main) entrance onto 148th Ave SE.
2. Turn right and follow 148th under I-90.
3. Turn right onto ramp to I-90 East (toward Spokane).
4. Exit I-90 at Exit #13 (Newport Way).
5. Turn right at the bottom of the exit ramp, then take an immediate right onto SE Newport Way.
6. Drive about 0.5 miles and pull off on the right side of the road. The Stop 1 outcrop is along the left side of the road.

After completing the activities at Stop 1:

7. Return to the vehicles and continue along SE Newport Way to the intersection of 164th Ave. SE (the first traffic light).
8. Turn left and follow 164th Ave SE for 1.6 miles before bearing right onto Lakemont Boulevard SE.
9. Just before crossing Coal Creek, turn left into the Cougar Mountain Wildland Park parking lot (also known locally as the Red Town Trailhead). Note: This is not the Cougar Mountain zoo!
10. Cross the street and follow the path along the creek to the outcrops of Stop 2.

From Seattle via I-90 Eastbound (toward Spokane):

Follow the instructions for getting there from Bellevue College, *starting at #4*: "Exit I-90 at Exit #13 (Newport Way)".

From North Bend via I-90 Westbound (toward Seattle):

1. Take I-90 West to Exit #13 (Newport Way).
2. At the bottom of the exit ramp, take a left onto Lakemont Boulevard SE. *Be careful of traffic!*
3. Cross under I-90.
4. Take your first right-hand turn (at a traffic light) onto SE Newport Way.
5. Follow the rest of the instructions for getting there from Bellevue College, *starting at #6*: "Drive about 0.5 miles..."

Introduction to the Geologic History of Cougar Mountain

- GOAL:** By identifying the rock and sediment types, succession of layers, and structural features (e.g, a large fold) at two locations, we will try to reconstruct some of the geologic history of Cougar Mountain as recorded in its rocks and sediments.
- But:** Repeated glaciation of the Puget Sound area has left behind thick layers of glacial sediment in many locations. As a result, it is hard to find places where the underlying bedrock is exposed.
- Luckily:** An exception is Cougar Mountain. This long spur of bedrock protrudes into the Puget Lowland from the west side of the Cascade Mountains. Cougar Mountain has only a thin cover of glacial sediment, in contrast to the lowlands to the north, west, and south. Today, we will look at a portion of the old (pre-glacial) sedimentary bedrock and some newer glacial sediments.
- Uh-oh:** The northern margin of the mountain, which coincides roughly with I-90, is a segment of a major east-west fault that crosses the Puget Lowland – the Seattle-Bremerton Fault. This fault is a recent feature (geologically speaking), and is active. For example, it was the site of an extremely large earthquake 1,100 years ago.
- So...** *Geologic investigations of the rocks at Cougar Mountain, around King County, and near Mt. Rainier have led to the following interpretation of some of the geologic history of this area. Let's discuss it chronologically (from longest ago to most recently)...*

Middle Eocene epoch – about 50 million years (Myr) ago:

A large river system with its source far to the east emptied into the eastern margin of a large marine embayment east of the Olympic Mountains. The river formed an extensive **delta** where it flowed into the embayment. The Cascade Mountain Range was not a major topographic feature at the time. Between about 45 and 40 Myr, the deltaic deposition was punctuated by local **volcanic** activity (unrelated to modern Cascade volcanism) in the Issaquah area and also to the south, near Centralia. The resulting andesitic lava flows, lahars (volcanic mudflows), and other such rocks formed a unit up to 6,500 feet thick. This rock unit is known in the Issaquah area today as the **Tukwila Formation**. We won't see these rocks today, but they are nearby (e.g., in downtown Newcastle)!

Later Eocene epoch – about 40 Myr ago:

Deposition of sediments continued in the delta system between and during local volcanic events, eventually burying all the volcanic rocks with **river and delta** sediments. The sediments deposited on top of the volcanic rocks in this environment are up to 3,000 feet thick, and are known as the **Renton Formation**. We will see Renton Formation rocks at “Stop 2” today.

Oligocene epoch – about 35-25 Myr ago:

Sea level had risen slightly over the Renton Formation sediments, covering them with **shallow marine and beach** deposits. These near-shore sediments are up to 12,000 feet thick (over 2 miles!), and are known as the **Blakeley Formation**. Layers of volcanic **tuff and pumice** within the Blakeley Formation provide evidence of nearby volcanic activity, and in fact mark the beginning of Cascades volcanism to the east. We will see Blakeley Formation rocks at “Stop 1”.

Miocene epoch – about 25 Myr ago:

Starting about 25 Myr, tectonic forces folded and uplifted rocks in western Washington. Cougar Mountain is underlain by a flank of one of these giant folds, the **Newcastle Anticline**. We are able to study the formations mentioned above because they have been uplifted, tilted, and eroded.

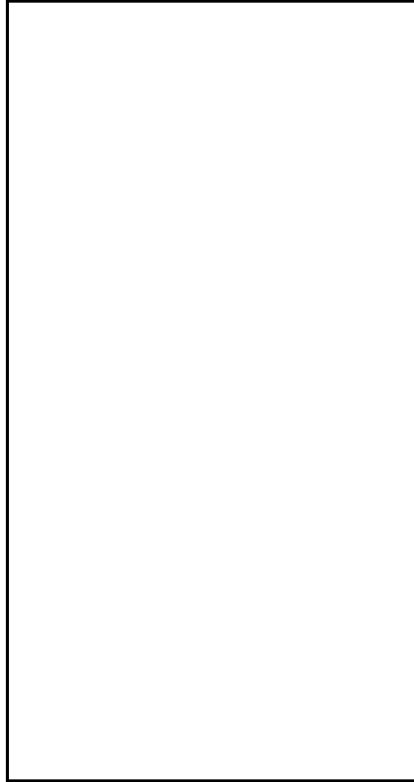
More recently:

There is abundant evidence of continental glaciation on and near Cougar Mountain, in glacial-ice, glacial-stream, and glacial-lake features. The thin layer (10-20 feet) of **Vashon Glacial Till** is capped in places with thin layers of sand and gravel. Cougar Mountain existed during the retreat of the Puget Lobe during the end of the last glaciation (15,000 years ago) as an island-like feature in a rapidly changing landscape of glacial-margin lakes and melt-water streams. Both the southern and northern valleys (May Valley) and the subtle valley of the Eastgate shopping area are melt-water channels. Glacial Lakes Sammamish and Washington once flooded the flanks of Cougar Mountain to elevations of about 400 feet above sea level. Although the shape of Cougar Mountain does not show the streamlining erosive power of glaciers, the lowlands north and south do show drumlinoid landscapes, as do the hills in and around Seattle.

Summary Questions

- 5. On the block diagram below, draw a **stratigraphic column** of the sedimentary units exposed at Cougar Mountain. Include the Blakeley Formation, the Vashon Formation, and the Renton Formation. Be sure to place the *oldest* unit at the *bottom* of the column and the youngest at the top. Place patterns in the column to help distinguish between each unit. Use a wavy line to represent unconformities. Use the standard geologic patterns below; feel free to make up other patterns as needed, e.g., to represent fossils.

Unit Name



 Sandstone

 Siltstone

 Shale

 Conglomerate

 Coal

 Till

Structural Geological History of Cougar Mountain

Please read and fully study sections in a geology book that cover folds and faults, geologic time, and topographic maps. This section will make much more sense! ☺

Geologic maps summarize the types and relationships of rocks in a given geographic area. Often, this information is superimposed on a **topographic map**. Different colors and patterns are used to distinguish rock types and the **legend (or explanation)** is the key to decoding the meaning of the colors.

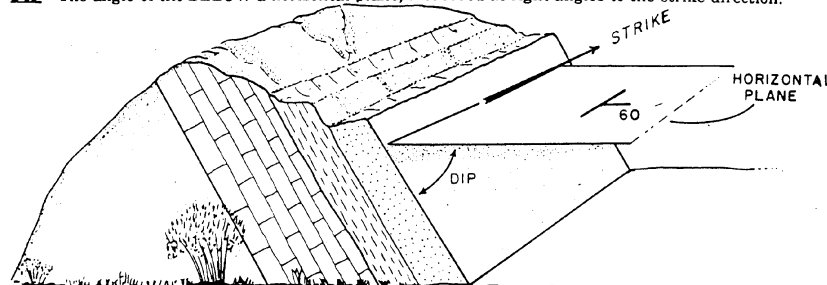
At the end of this handout, you will find a simplified geologic map of the Newport Way area of Cougar Mountain (near Issaquah) and a blank **cross-section** of the area along the line A-A' indicated on the map. Notice that the "top" of the cross-section is the **topographic profile** of the surface along that line. The word "**formation**" simply means an area or layer of similar rocks.

Making a geologic cross-section from a geologic map allows you to interpret where rocks and **geologic structures** (folds, faults, etc) are beneath the surface. Geologic cross-sections are made by first creating a topographic cross-section, then superimposing the geologic information (rock types, strikes & dips, etc) onto it. **You can thus create a "virtual road cut"**.

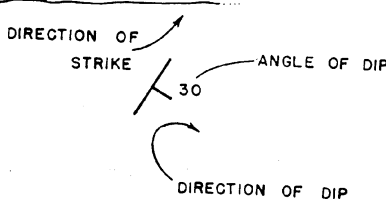
When rocks are deformed from their original position, Geologic Structures are formed. The orientation of tilted rock layers in geologic structures can be defined:

STRIKE - The compass direction of a line formed by the intersection of a layer and a horizontal plane.

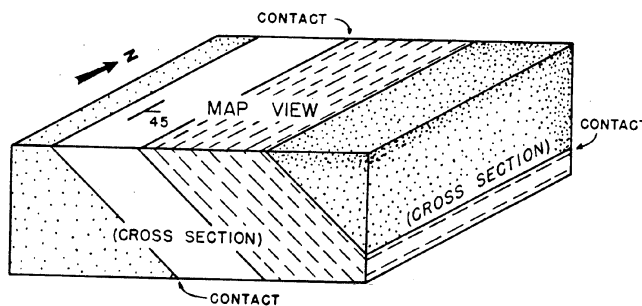
DIP - The angle of tilt BELOW a horizontal plane, measured at right angles to the strike direction.



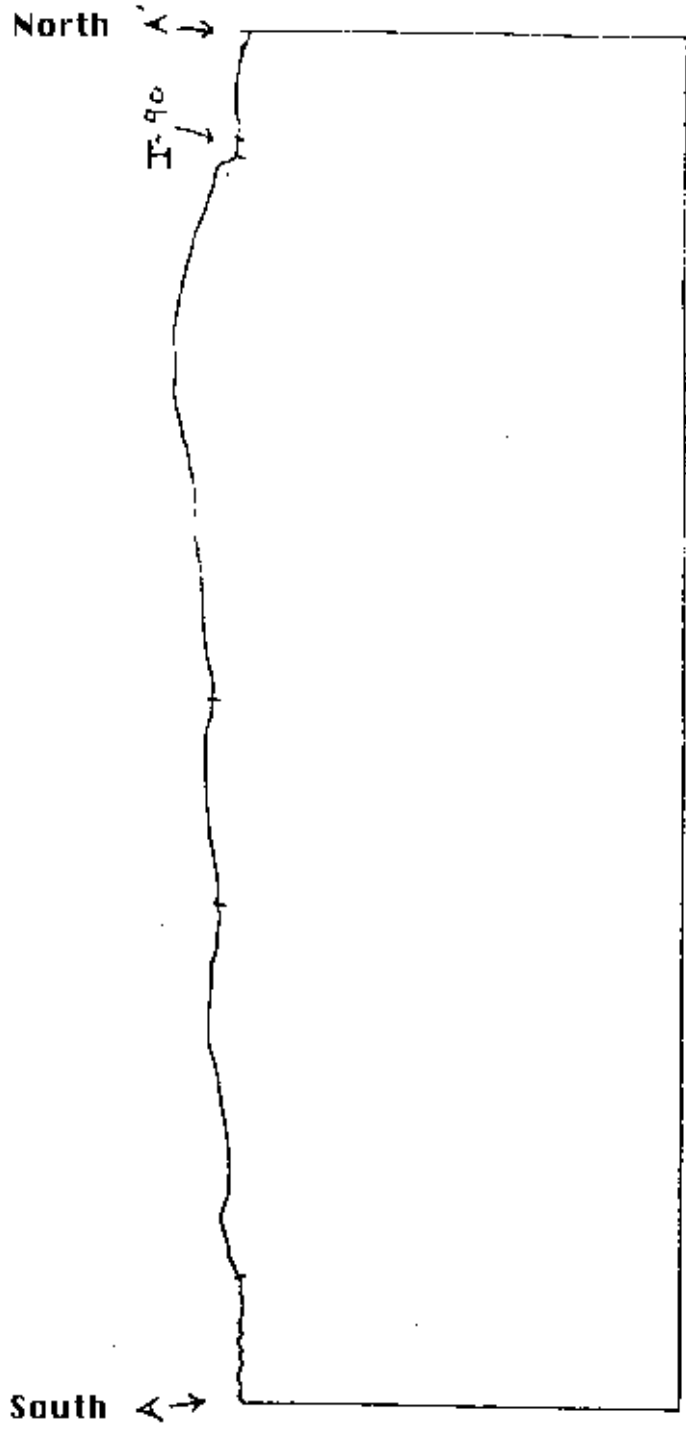
Strike/Dip symbols are written on maps to show the subsurface orientation of tilted layers. The long line represents the Strike direction. The short line represents the dip direction and is usually accompanied with a number that indicates the dip angle. In this example (if North is towards the top of the page) this rock layer strikes Southwest-Northeast, and dips to the Southeast at 30° below horizontal.



In the Block Diagram below, a series of tilted layers is exposed at the surface. The boundaries between each layer are called **CONTACTS**. **CROSS SECTIONS** view the rock units from the side. Note that Cross Sections viewed from the South and East are completely different because of the orientation of the tilted layers. A Strike/Dip symbol on the **MAP VIEW** of the surface shows the orientation of the rock layers: They strike North-South and dip at 45° to the east. Note that the strike line runs parallel to the Contact lines.



Below are a simplified **geologic map** of the Newport Way area of Cougar Mountain (near Issaquah) and a **blank cross-section** of the area along the line A-A' indicated on the map. Notice that the "top" of the cross-section is the topographic profile of the surface along that line.



Cross-section of the Newport Way area of Cougar Mountain (near Issaquah). Complete this cross-section using the **geologic map** of the Newport Way area.

6. a. Complete the **cross-section** along the line A-A', using the **attitudes** (strikes, dips, and directions) given for all of the layers. Assume uniform thickness for each layer. One important note: Quaternary sediments like the Vashon Till are very young and so *are not folded* (which makes the southern part of the cross-section a bit tricky).
- b. Which is the **oldest** rock unit?
- c. Which is the **youngest** unit (excluding Quaternary sediments)?
- d. What is the major **structure** shown on your map and cross-section?
- e. What kind of **stress** created that major structure? Along what compass direction was it oriented?
- f. Do the answers to parts a.-e. make sense in light of what you saw on the **Cougar Mountain field trip**? Explain.

7. **On a separate sheet of paper (typed, single-spaced, 1-2 pages):**

Based on your observations and interpretations on the field trip and afterwards, describe the geologic history of Cougar Mountain over the last 40 million years. Explain it chronologically (through *geologic* time—not fieldwork time), and cite your lines of evidence. Staple it to this handout. Be sure your name is on every page.

