Glaciers – Laboratory 11

_____

(name)

Part 1. The basics

A **glacier** is long living body of ice that moves under the influence of gravity and its own weight. It develops on land as compacted snow is transformed into ice. There are two main types of glaciers. Glaciers that are confined to valleys are called **valley or alpine glaciers**. Such glaciers are relatively common in the NW United States and in Alaska. Those glaciers that are not restricted to a valley but cover large areas of continents are called **continental glaciers**. *On a global basis, glaciers cover 1/10th of the Earth's surface, and store over 75% of the world's freshwater supply. If all of the global supply of land ice locked up in glaciers were to melt, then sea level would rise ~70 meters.*

All glaciers consist of two parts. The upper part is perennially covered with snow, and is referred to as the **zone of accumulation**. In contrast, in the lower part calving, melting, and evaporation occur. The lower part is called the **zone of wastage**. The boundary between the zone of accumulation and the zone of wastage is the **snow line**, a line marking the highest point at which the glacier's winter snow cover is lost during a melt season.

If, over a period of time, the amount of snow a glacier gains is greater than the amount of water and ice it loses, then the glacier will expand. If the amount of water and ice a glacier looses is greater than the amount of snow it gains, then the glacier will shrink.

Question

What do you think will happen to the snow line under these two different set of conditions?

An expanding glacier is said to have a **positive budget** and, as a result, is said to be **advancing**. A shrinking glacier is said to have a **negative budget** and, and as a result, is said to be **retreating**.

Throughout the 20th century most glaciers on a global basis have been retreating. Movement varies from a few millimeters a day to more than 15 meters a day.

Question

*Why do you think the glaciers retreating**?***

Basal sliding refers to the sliding motion of the whole glacier over underlying rock. Such sliding is facilitated by a thin film of melt water. **Plastic flow** occurs in a zone of variable thickness lying immediately above the interface between the glacier and the underlying rock. Here flow takes place by slippage along internal planes of individual crystals. The **rigid zone** overlies the zone of plastic flow and extends upward to the surface of the glacier. Ice within the rigid zone is brittle; it rides passively on the underlying zone of plastic flow.

Question

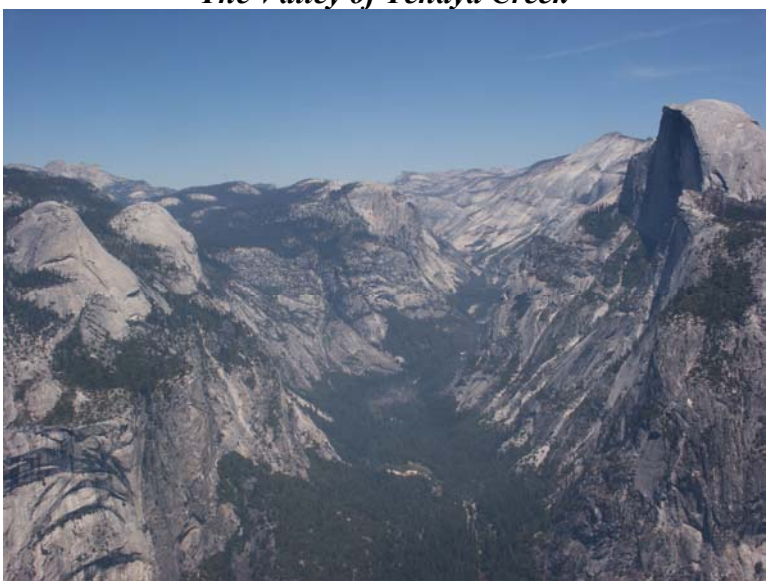
Cracks in glaciers occur only in the rigid zone and commonly form crevasses. Why would you not expect to find such structures in the zone of plastic flow?

Part 2. Landforms created by ancient glaciers

In the remaining parts of this lab we will learn that glaciers produce some of the most beautiful landscapes on the globe, and will focus on the glacial features of Yosemite National Park. If you have not visited the park, then you are encouraged to do so. I can almost guarantee you that you will not be disappointed!

Glacial Features of Yosemite National Park

The Valley of Tenaya Creek



Valley of Tenaya Creek, Yosemite National Park. Half Dome is on the right, and North Dome is on the left.

The topographic map and grid for Question 1 can be found at the end of this pdf file

Question 1

Draw below the topographic profile along the transverse shown in the map labeled Valley of Tenaya Creek.

- *How would you describe the shape of the profile?*

- *How do you think this profile differs from one of a valley carved entirely by a river?*

Bridalveil Falls

View of Bridalveil Falls, Yosemite National Park. The falls emanate from Bridalveil Creek.

The topographic map and grid for question 2 can be found at the end of this pdf file

Question 2

Draw the topographic file for the transverse shown on them map labeled Bridalveil Falls.

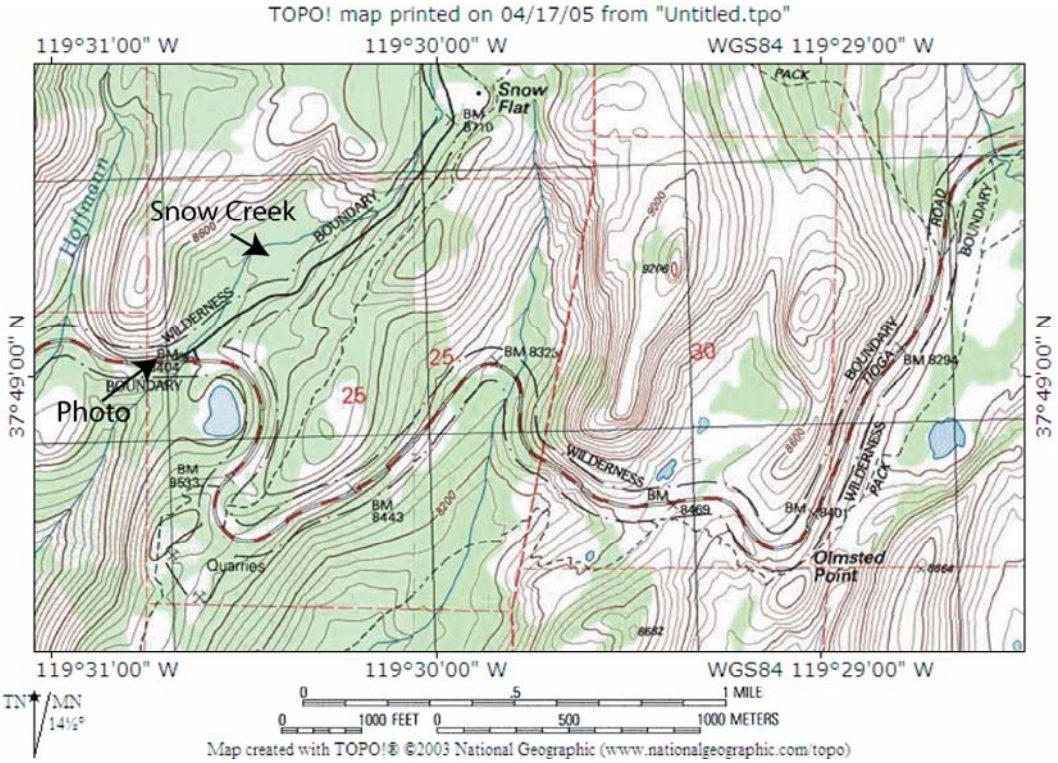
- *How high does Bridalveil Creek fall in reaching Yosemite Valley?*

- *Given that Yosemite Valley is an ancient glacial valley, how do you think Bridalveil Falls formed?*

- *What name would you apply to Bridalveil Creek?*

Snow Creek Glacier

Photo of debris deposited to the side of the glacier that moved down Snow Creek. The road in the foreground is Tioga Road (see illustration below).



Topographic map showing Tioga Road and Snow Creek.

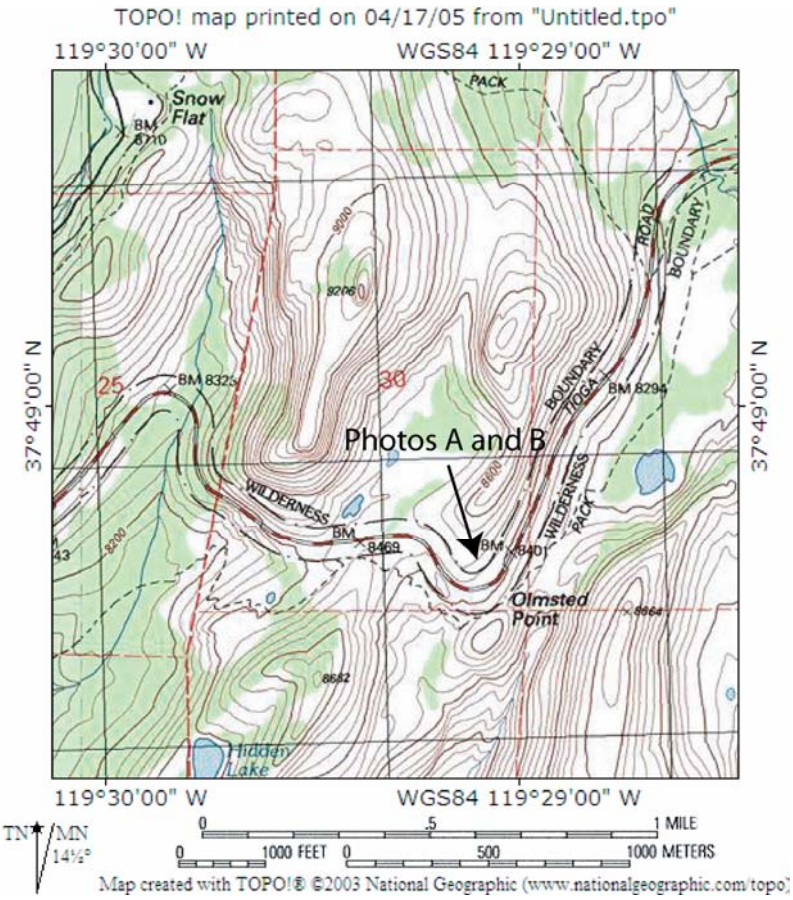
Question 3

Review the topographic map showing the location of Tioga Road and Snow Creek.

- *After reviewing the above topographic map, which way do you think the glacier was flowing that once filled up Snow Creek?*

- *What is a more technical term for the glacial material that was deposited laterally relative to the ancient glacier in Snow Creek?*

Olmsted Point lies off of Tioga Road and just before Tenaya Lake. It contains a variety of glacial features a few of which are shown in the next two photographs.



Topographic map showing the location of Olmsted Point and photos A and B.

Photo A. At the base of glaciers a fine powder composed of ground up rock material acts as a polishing agent. As the overlying ice moves slowly up or down a valley the fine powder under the pressure exerted by the overlying ice polishes the rock beneath the ice. When this polished surface is later exposed after the glacier has melted it is slowly worn away via abrasion and weathering. Can you pick out the polished versus the weathered surface? The bedrock in the photo is granite.

Photo B. The ridge above Olmsted Point is in places highly polished and sitting above this surface are large boulders of rock that appear to be completely out of place. These are believed to be boulders that were carried in the glacial ice, and then when it melted the boulders came to rest on the polished surface.

Question 4

Please review the map showing the location of Photos A and B, and then study the figures and their captions.

- *In Photo A what part of the photograph is glacial polish and what part is exposed granite? Briefly explain your answer.*

- *In Photo B how do we know that the boulders were deposited after the glacier melted and before the modern day topography was developed?*

Glacial features of Mount Whitney – the highest mountain in the continental United States

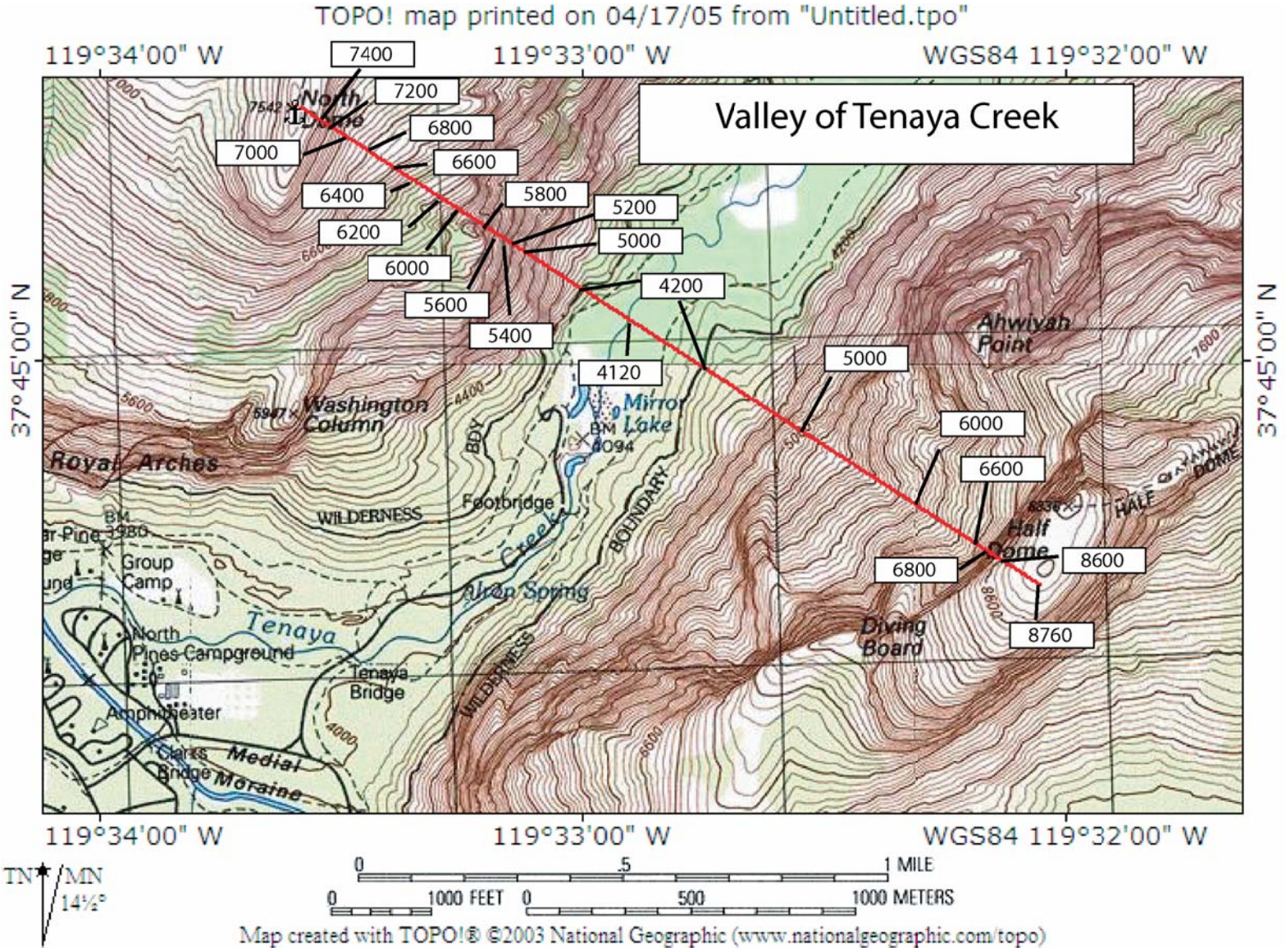
The topographic map and grids for questions 5 and 6 can be found at the end of this pdf file

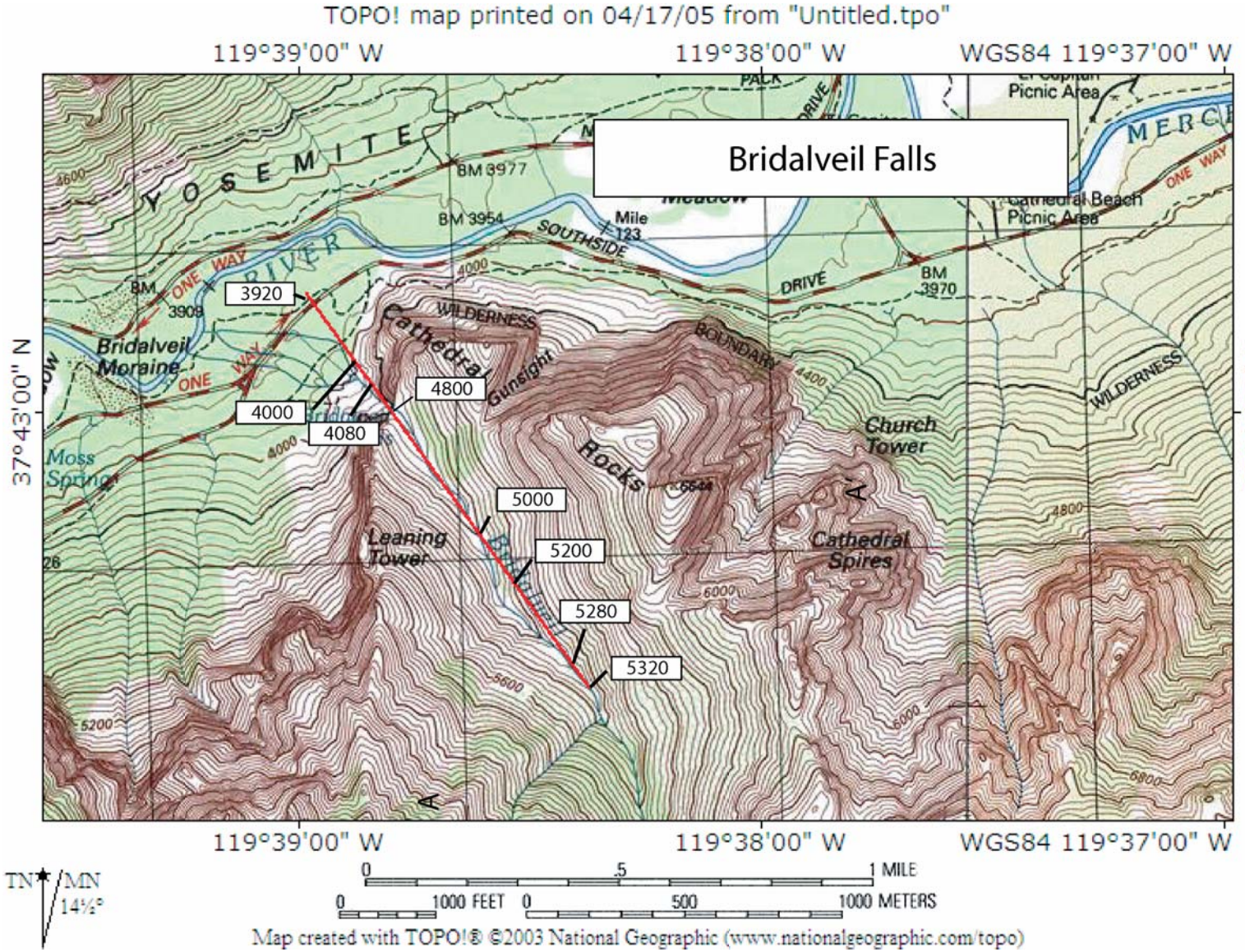
Question 5

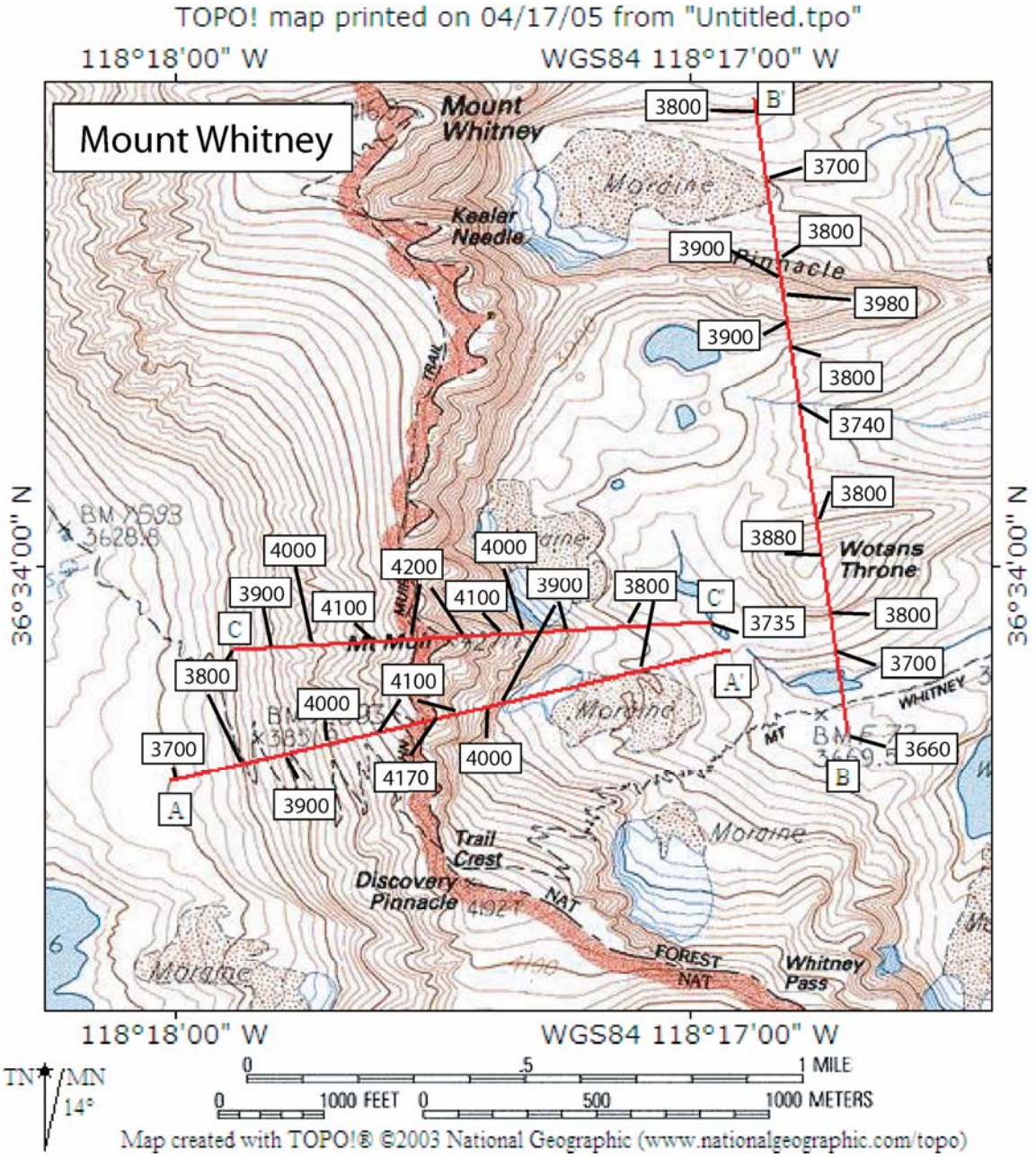
Aretes are knife-like ridges that separate adjacent glacially carved valleys. After reviewing the topographic map labeled Mount Whitney please draw the topographic profile of the ridge that extends from Discovery Pinnacle to Mount Whitney. The required profile is labeled A-A' and a grid is provided to aid you in your drawing. In addition, draw the profile for the traverse labeled C-C' on the grid that is provided for you. How would you describe the high ridged peak that occurs on both profiles?

Question 6

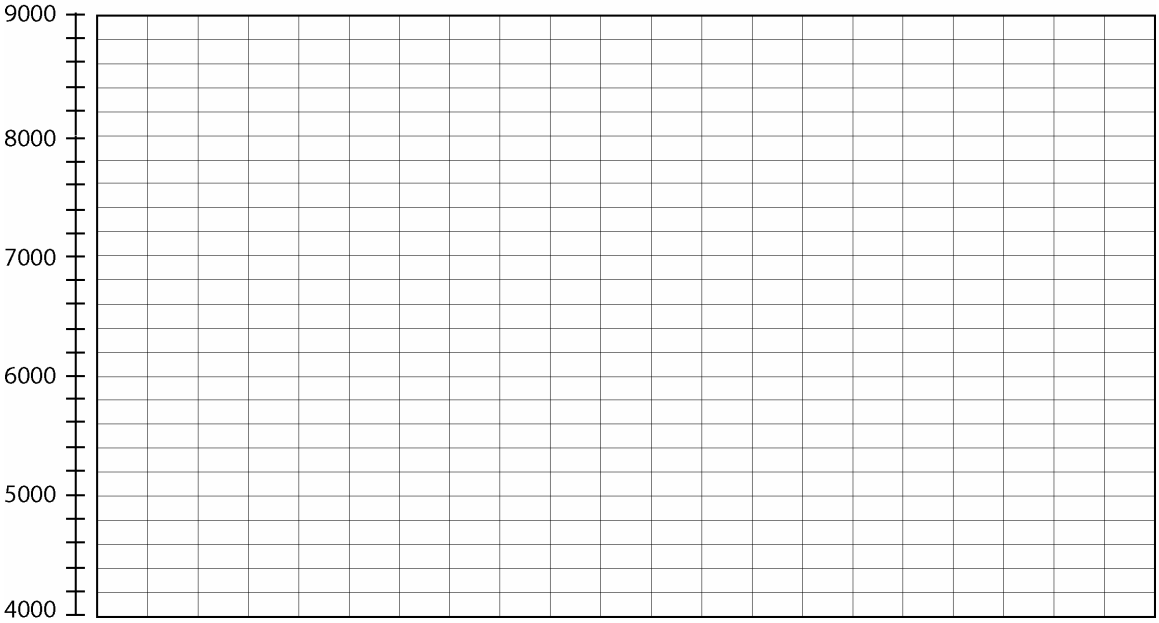
Many valley glaciers cut back into the central parts of mountains and flow outward toward adjacent valleys. Such valleys after the glaciers have melted are U-shaped. Please draw the topographic profile across the series of glacial valleys descending eastward from the high ridge extending southward from Mount Whitney. The required profile is labeled B-B' and a grid is provided to aid you in your drawing.


TOPO! map printed on 04/17/05 from "Untitled.tpo"
119°34'00" W
119°33'00" W
WGS84 119°32'00" W
37°45'00" N
Valley of Tenaya Creek
7400
7200
6800
7000
6600
6400
5800
5200
6200
5000
6000
4200
5600
5400
4120
5000
6000
6600
6800
8600
8760
North Dome
Washington Column
Royal Arches
Mirror Lake
Ahwiyah Point
Half Dome
Diving Board
Footbridge
WILDERNESS
BOUNDARY
Group Camp
North Pines Campground
Tenaya Creek
Alder Spring
Tenaya Bridge
Amphitheater
Clarks Bridge
Medial Moraine
TN
MN
14½°
0 .5 1 MILE
0 1000 FEET 0 500 1000 METERS
Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

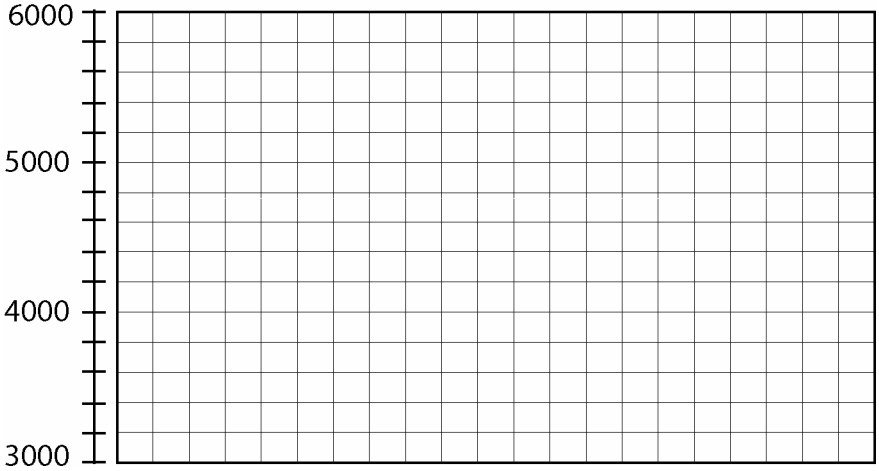

TOPO! map printed on 04/17/05 from "Untitled.tpo"
119°39'00" W
119°38'00" W
WGS84 119°37'00" W
37°43'00" N
Bridalveil Falls
3920
4000
4080
4800
5000
5200
5280
5320
Bridalveil Moraine
Moss Spring
Leaning Tower
Cathedral Rocks
Gunsight
Church Tower
Cathedral Spires
WILDERNESS BOUNDARY
SOUTHSIDE DRIVE
Mile 123
BM 3977
BM 3954
BM 3909
BM 3970
El Capitan Picnic Area
Cathedral Beach Picnic Area
ONE WAY
TN 14½° MN
0 .5 1 MILE
0 1000 FEET 0 500 1000 METERS
Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)


TOPO! map printed on 04/17/05 from "Untitled.tpo"
118°18'00" W
WGS84 118°17'00" W
Mount Whitney
Mount Whitney
Keeler Needle
Moraine
Pinnacle
Wotans Throne
Trail Crest
Discovery Pinnacle
Whitney Pass
FOREST
NAT
TRAIL
WHITNEY
BM 7593
3628.8
A
A'
B
B'
C
C'
3800
3700
3900
3800
3980
3900
3800
3740
3800
3880
3735
3800
3700
3660
4000
4200
4000
3900
3800
4100
4100
4000
4100
4000
4170
4000
3900
3700
36°34'00" N
36°34'00" N
118°18'00" W
WGS84 118°17'00" W
TN
MN
14°
0
.5
1 MILE
0
1000 FEET
0
500
1000 METERS
Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

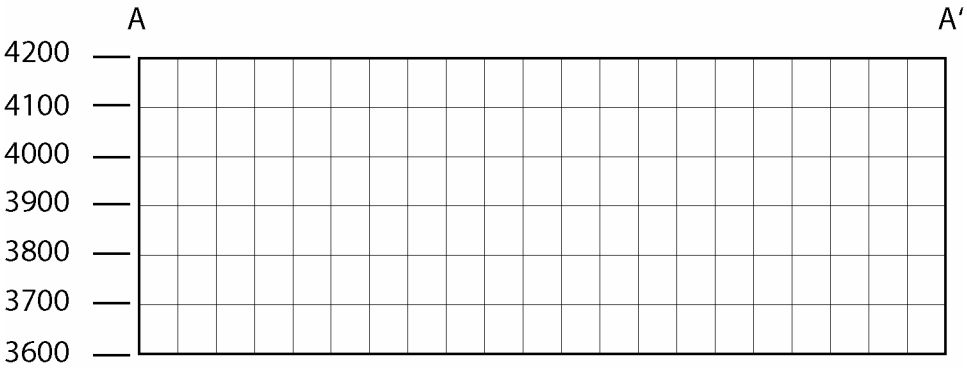
Tenaya Creek Profile



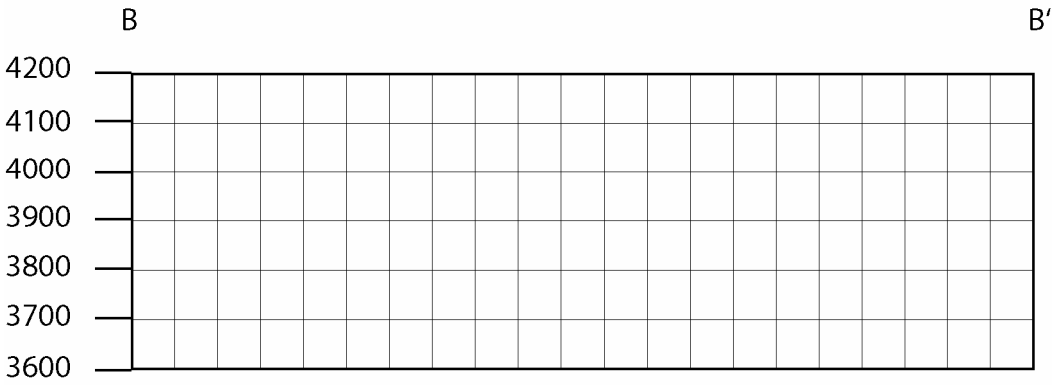
Bridalveil Falls



Mount Whitney



Mount Whitney



Mount Whitney