CENTRAL PARK GEOLOGY FIELD TRIP

Author: Prof. Leveson, Brooklyn College.
Adapted for Hunter College by Shruti Philips

This is a self-guided field trip. There will be three stops on this field trip.

Please follow social distancing guidelines if you go to Central Park in person. You may also take a virtual tour using **Google Earth**. To take a Google Earth tour of this field trip, type in 'Central Park New York' in the search button and then zoom into the coordinates given below for each stop. Use the different features available including street view and familiarize yourself with the surroundings for each stop.

Map-1:

Enter CENTRAL PARK at 67th street and 5th Ave:

INSTRUCTIONS: As you enter Central Park you will see a small play area for children on your right. Continue walking straight (west) towards the statue of **Balto-**the heroic sled dog. Before you reach the statue you will see a large exposure of rock on your left. This is **rock exposure A .**

<u>Field Trip stop #1</u>: Google Earth coordinates: 40^0 46' 10.29" N, 73^0 58' 15.51" W

Rock Exposure A

Go to **the rock exposure A.** (Locations are shown on the Map above). When you arrive at the exposure, make the required observations, and answer the questions.

1. Examine the rock that you are standing on. Note that the **rock is layered**. Sketch a rough map of Stop#1 and Exposure A. In the area marked "exposure A", draw a series of parallel lines to indicate the direction of layering.

2. In the space below, make a sketch of any feature that suggests the layering in exposure A has been deformed.

3. Name one **mineral** present in the rock in abundance.

 Rock type in ‘Exposure A’ in outcrop and

hand specimen 

4. Classify this rock. Is it an Igneous, sedimentary, or metamorphic rock? Explain your reasoning. What is the name of the **major rock type** seen here?

5. Standing **on Exposure A,** if you look around in all directions, you will see that there are many similar exposures of rock cropping out of the grass. In loose boulders, features such as layering generally do not show any consistency from one boulder to the next. What is there that suggests that, underneath the soil and grass that separates them, rock exposures A and the ones around are joined, and are not just the tops of large, buried, loose boulders?

These rock exposures are actually '**outcrops'**, places where bedrock (the continuous crust of the earth) appears at the earth's surface.

The folding that you see in this area may be understood in terms of the **geologic history of the New York City region:**

About 500 million years ago, this region was **shallow sea floor, off the coast of the American Continent**, and was the site of deposition of great thicknesses of **sediment** derived from the erosion of the nearby land **(Fig. 1).** Sediments were deposited near the start of the Cambrian Period (542 million years ago) on the shores of the **Iapetus Ocean**.

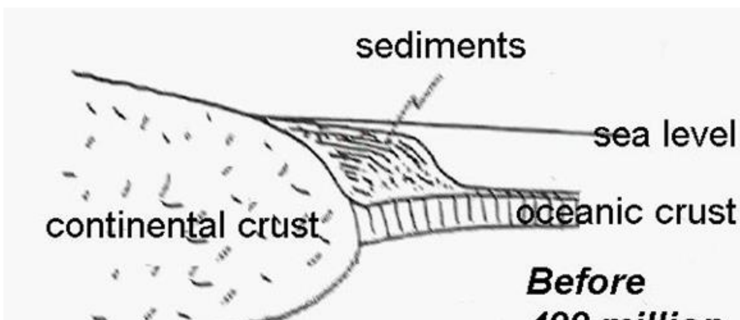

FIG. 1

During that time, the region was in the central part of the American plate. Later, a new**, convergent plate boundary** developed here, along which **ocean lithosphere was pushed under continental lithosphere** (forming a **subduction zone).**

Subduction of the **Iapetus ocean** led to its destruction and **the collision** of different **continental blocks** and **island arcs** onto the American continent. As a result, the region became subject to **compression,** and a **mountain range** formed **(Fig. 2).** From the subduction zone, **heat, magma,**

and chemically active fluids penetrated the core of the mountain range, deforming and metamorphosing the sedimentary layers.

Those collisions gave rise to **the Appalachian Mountain** belt that sutured together the continental blocks into a **supercontinent** that we call **'Pangea'**. The **three mountain building** events called **'orogenies'** that eventually built the lofty Applachian range are:

1. **the Taconic Orogeny** in the Middle Ordovician (about 472 million years ago);
2. **the Acadian Orogeny** in the Middle to Late Devonian (at 390 million to 370 million years); and
3. **the AlleghenianOrogeny** in the Late Carboniferous to Permian (300 million to 250 million years ago).

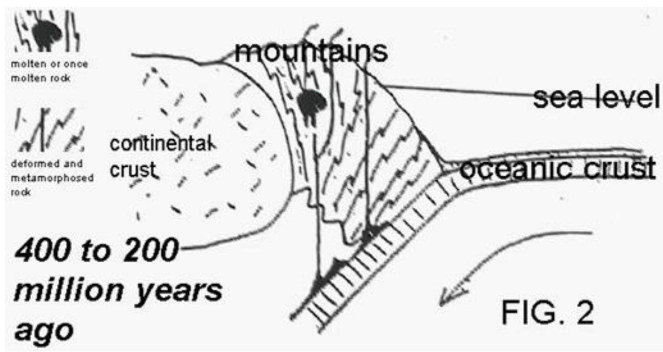

FIG. 2

About **200 million years ago,** the region **ceased being a convergent plate boundary,** and active mountain building processes **came to a halt.** Gradually the mountains were eroded away until the rocks which composed their **igneous** and **metamorphic roots** were exposed at the surface **(Fig. 3).** The deformed rocks at which you are now looking are the **roots** of that ancient mountain range.

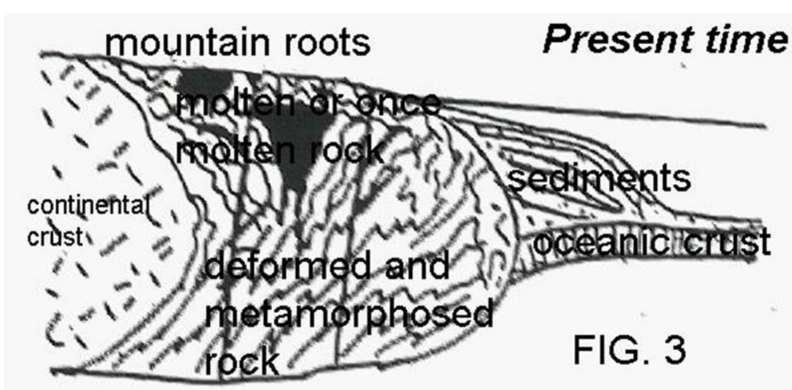

FIG. 3

In the roots of the mountain range where these rocks formed, **pockets of melt** developed which were then squeezed and forced (intruded) into the adjacent solid rock. When the melt cooled, it formed bodies of rock called **"intrusives**". Such intrusives may also be seen in this area.

6. Find the **intrusion**. Note its sharp contacts with the surrounding rock.

Next, leave **Rock Exposure A** and walk toward and past the statue of **Balto** the sled dog and under the small bridge and onto the other side.

Continue walking past **Shakespeare's statue** toward '**Sheep's Meadow'**.

Enter **Sheep's Meadow** through the small gate and walk toward the large outcrop of rock on your left with many boulders perched on top. This is stop #2.

<u>Field Trip stop #2</u> Google Earth coordinates: 40^0 46’ 14.21” N, 73^0 58’ 28.54” W

1. Stand on the wide mound of rock. This is **rock exposure B**. Observe that the rock is layered, and the layers appear **folded**. Is the rock exposure here an outcrop of **bedrock** like rock exposure A? Evidence?

2. What is the major rock type?

3. Look again at the layers in this area. Note the numerous **"grooves"** parallel to the layers that exist where some of the layers have been **worn (eroded) more deeply** than others. Why have they been worn more deeply?

4. Note the **complex folding** of the layers in part of this area.

Trace the course of an individual folded, contorted layer for as great a distance as possible. Note where you begin to follow the layer and where you finish following it. Now measure the length of that layer in terms of the length of your foot; that is, follow along the layer walking heel-to-toe, heel-to-toe. Write your answer below.

The length of the layer is ________________ foot lengths.

Next, walk **heel-to-toe** in a straight line from where you began your traverse along the layer to where you finished the traverse.

The straight-line distance is ________________ foot lengths.

If we assume that the layer you followed was originally straight, then the difference between the two measurements you made represent the amount of shortening that the deformation (folding) accomplished. **By approximately what percent of its original length was the layer shortened?**

Shortening percent = ________________

5. Step off **rock exposure B** on the west side, stand on the soil or grass, and look at the rock face that slopes gently down toward you. Locate the foot-or-so wide, **parallel grooves** that extend for ten yards or so up the outcrop.

   a. Are the grooves parallel to the layering in the rock?

   b. Could they be due to **differential erosion** of the layering in the rock?

   c. Did the grooves form **before or after** the folding of the rock layering?

The origin of the grooves may be explained in terms of **the Glacial Theory**. About **15 thousand years** ago, a giant body of flowing ice (a glacier) covered this area. **Embedded in the ice** at the bottom of the glacier **were large boulders**. As the ice pressed down on these boulders and dragged them over the underlying bedrock, **grooves were carved in the bedrock**. Smaller particles of rock that were dragged along created smaller grooves called **"striations".**

d. Find some striations. What is their orientation with respect to the grooves?

e. What are the possible **directions** from which the glaciers may have come to this area? (See map for true north.)

Direction 1 _________________ Direction 2 _________________

At a later outcrop we shall determine which of these two possible directions is most likely.

6. Notice the many **boulders** that lie scattered on the surface of the **rock exposure B**. Walk to the large **boulder perched on the rock**. There is a similar large boulder in the distance to the right of the carousel. These boulders are called **'erratics'.**




Examine the boulders.

a. What is the general grain size?

b. Name three minerals present in the largest boulder.

________________________ ____________________ ______________________

c. What **rock type** is the boulder?

d. What is the rock type upon which the boulder rests?

e. Explain how the boulder got to its present position. (It was <u>not</u> placed there by people)

Leave Sheep's meadow through the small gate near the boulders. Turn left and walk downhill towards the Carousel.

FIELD TRIP STOP #3: Google Earth coordinates: 40^0 46’ 9.01” N, 73^0 58’ 28.08” W

Go through the **underpass to the left of the carousel**. Upon emerging from the underpass, follow the path a short distance **to outcrop C** on the right. The outcrop is just below the red brick octagonal building. Stand so that beyond the outcrop, on the horizon, you can see the sign for the Essex Hotel.

1. Note the **glacial grooves** that run from right to left across the outcrop.

2. Look at the right end of the outcrop where it slopes down to the soil and grass. Now look at the left end of the outcrop. In profile, which end, the right or the left, looks steep and **abruptly "cut off"?** Which ends looks more **"streamlined"?**

   Steep ________________________ Streamlined _______________________

The asymmetry of this outcrop provides an ambiguous answer to the question "from which direction did the glacial ice advance?" As glacial ice moves over bedrock that is hilly, it tends to carve the "upstream" end of the hill into a smooth, streamlined shape. At the same time, as the ice flows over and then leaves the hill, it tends to "grab" at any loose, fractured parts of the bedrock and remove them, causing that end of the hill to have a steep, cliff-like profile (see Fig. 4). The resulting asymmetric hill is called **a ‘roche moutonnee’.**

3. From your examination of the **roche moutonnee** before you, from which direction did the glacial ice advance?

4. In Fig. 4, note the piece of detached bedrock embedded in the ice. What other erosional glacial feature that you have seen might be caused by such fragments?

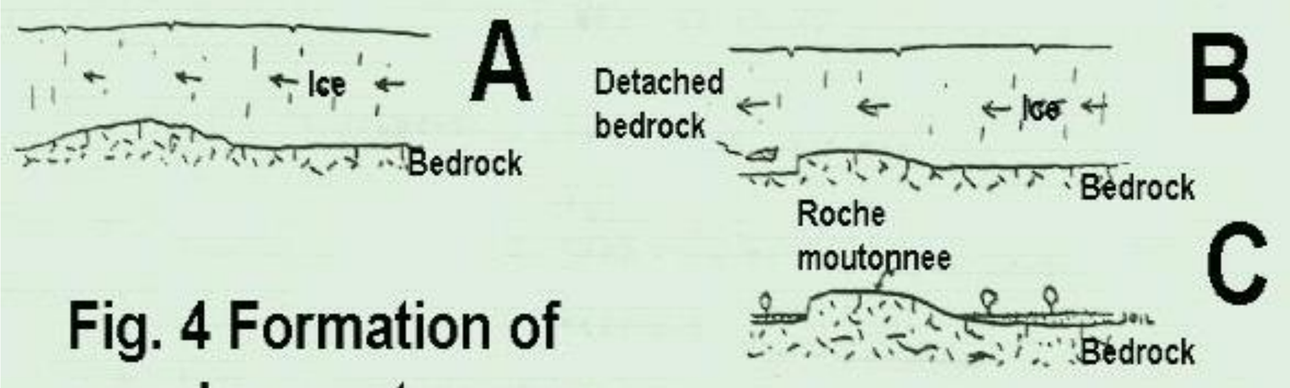

Fig. 4 Formation of a roche moutonnee

5. What effect does this have on the angularity of the fragment?

   If the fragment is not destroyed, what feature that you have observed might it become when the ice ultimately melts?

6. To verify the direction of glacial movement indicated by the **roche mountonee**, where would you go and what would you look for? (Hint: Consider your hypothesis concerning the origin of the erratic boulders.)