Stratigraphy Lab

Stratigraphy is the study of layered, or stratified rocks. It includes study of their type, age, distribution and the environments in which they formed. Sedimentary rocks are common subjects of stratigraphy, but, in fact, any layered or stratiform rock body, regardless of origin, may be analyzed stratigraphically.

In this lab, we will investigate the basic unit of stratigraphy, the formation. A formation is: (1) a rock mass, which is distinguishable from rocks above and below it, and (2) thick enough to be shown on the map. The boundaries between formations are referred to as contacts. Contacts may reflect a halt and restart in sedimentation, or even a period of time when some of the sediments were eroded, then more sediments were deposited on top. A contact representing an erosional event is called an unconformity. Formations may be lumped together in groups or sequences. Formations may be subdivided into members. The rank of a rock mass (group, formation, member) is "up to the discretion of the geologist who described it" (Prothero and Schwab, 1996) and is partly a function of the map scale.

Since sedimentary rocks reflect the environments in which they form, a systematic study of the changes seen in any stack of sedimentary rocks tells us about environments through time. Environments include: beach, deep sea floor, lake bottom, dune, and mudflat; in short, any place where sediment accumulates.

Environments can shift over time. For example, as sea level rises, beaches shift inland (transgressive sequence). If there is a marsh or mudflat back of the beach, it moves inland too. If sea level falls, the beach moves seaward (regressive sequence). Since sea level is never constant, beach and other shoreline features must move around, too. In any stack of sedimentary rocks, we can expect representation of many kinds of environments.

The purpose of this lab is to determine the stratigraphic record as it is seen in the sedimentary rocks near Geneva. In other words, you will be taking initial steps towards reading the rock record of past environments.

Materials and Preparation

During this lab, we will be outside most of the time, regardless of weather. Please dress appropriately for light hiking near a creek. Wear shoes that you won’t mind getting wet; sneakers or boots work best. Read through this handout before lab. You will need a notebook, a pencil and a ruler.

Background

The rocks in and around New York detail a fascinating slice of earth history, from a massive rise in sea level about 600 million years (MY) ago, accompanied by an explosion of marine organisms, to the infilling of this large continental sea with the eroded remnants of a giant mountain range to the east. We’re going to examine a distinctive pile of rocks deposited in this shallow sea, starting from an eroded, formerly exposed surface (the lower contact of this rock unit) to a point where a dramatic shift in rock type (the upper contact) signals what was a dramatic shift in the environment of deposition in this ancient sea.

This stack of rock, called the Edgecliff member of the Onandaga Formation, represents what Geneva and the area around it looked like for about two million years during the Middle Devonian period, which lasted from about 409 to 354 MY.

Methods

We will make three stops on our field trip, two of which include multiple outcrops. At each site, you will need to

1) Locate the stop on your topographic map

2) Prepare a description of the rock exposed at this site*

3) Draw in any contacts on the map

   * A rock description consists of everything you can observe about the rock at any particular outcrop, including type of rock, grain size and makeup, evident layering, sedimentary structures, fossils, presence and nature of any contacts, evidence of erosion, and any other features that might be relevant.

   After the field trip is over, you will need to

4) Calculate the thickness of the formation.

5) Draw a geologic column representing the rock unit we traversed.

6) Turn your finished column in to your instructor in lecture.

Thickness Calculation

Rock outcrops rarely provide perfectly horizontal exposures. Instead, layers of sedimentary rocks are often tilted up or down. That means that measuring the thickness of a rock formation is not as easy as stretching a tape measure or measuring distance on a map. We often need to use some elementary trigonometry to calculate the true thickness.

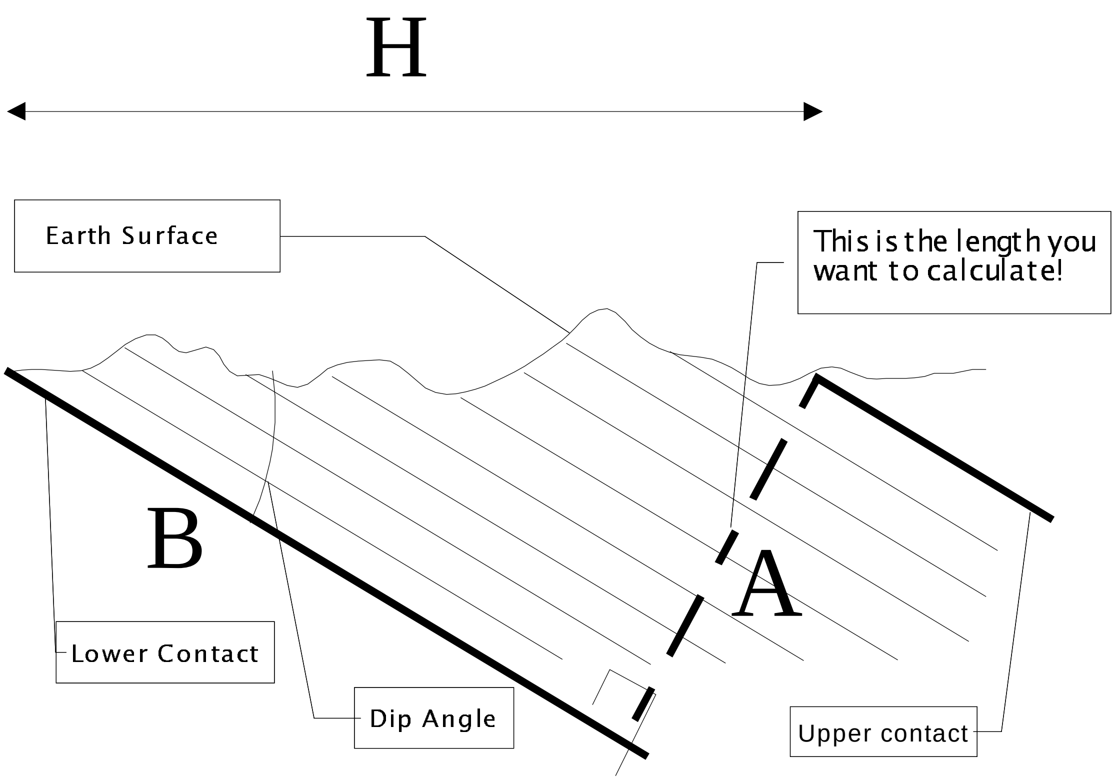
The figure below represents some tilted sedimentary strata. The angle these strata make with the surface of the earth, labeled "Dip Angle" and the thickness we want to calculate are shown in the figure. Referring to high school trigonometry, we know that the sin of the angle equals the length of triangle leg A divided by the length of the hypotenuse H, or

$$\sin(\text{Dip Angle}) = A / H$$

From this, we can solve for A, the thickness of the unit:

$$A = \sin(\text{Dip Angle}) \times H$$

Your lab instructor will measure the dip angle for you; you can use the topographic map to get the distance H. The map scale is 1:24000, so 1 unit measured on the map will equal 24000 units in the real world. For example, 1 inch on the topographic map represents 24000 inches in the real world. Use the metric system for your calculations. Give the thickness in meters.



Making the Geologic Column

A geologic column is a graphical representation of the section you examined during the field trip. As the name suggests, it's a column, drawn on paper, where the vertical scale is matched to the thickness of the rock you calculated in the step above. For example, if you calculated a thickness of 10 meters (which is not the correct answer, by the way), you'd draw a vertical column where perhaps two centimeters represent 1 meter of actual rock. You'd end up with a column 20 centimeters tall. The bottom of the column would represent the contact at the bottom of the formation; the top of the column would show the upper contact of the rock formation. At each point in the column where we stopped to look at the rocks (and you know where that is in the column because you located yourself on the map each time), you will write beside the column the rock descriptions you made in the field.

What to turn in

You won't have time to complete everything during lab period, so you'll need to turn in your lab materials in lecture the following Monday. Make sure to turn in (1) your topographic map with your localities and contacts mapped and (2) your geologic column with neatly written rock descriptions in the appropriate places, along with your thickness calculations. Make sure to put your name on each piece.

Example Geologic Column