Name:_____

Lab Exercise 3: Geology, Soils and Archaeological Site Settings of Rift Valleys

Objectives:

The objectives of this lab are to:

1. To reinforce through exercises the sedimentary and stratigraphic settings of archaeological sites in rift valleys.
2. To examine and interpret different site settings with respect to potentials for preservation of archaeological integrity (faunas, artifacts)
3. To give you experience in the description and interpretation of sediments and soils.

Grading

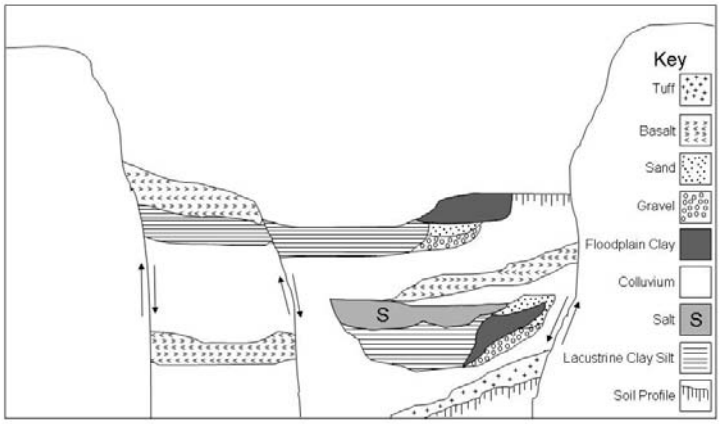
Your lab grade will be based on:	Completion of tasks	40 points
	Questions	35 points

Materials

1. Soils samples from forest and prairie settings
2. Munsell color charts
3. Dilute hydrochloric acid (HCl)
4. Plastic spoons, paper towels, etc.

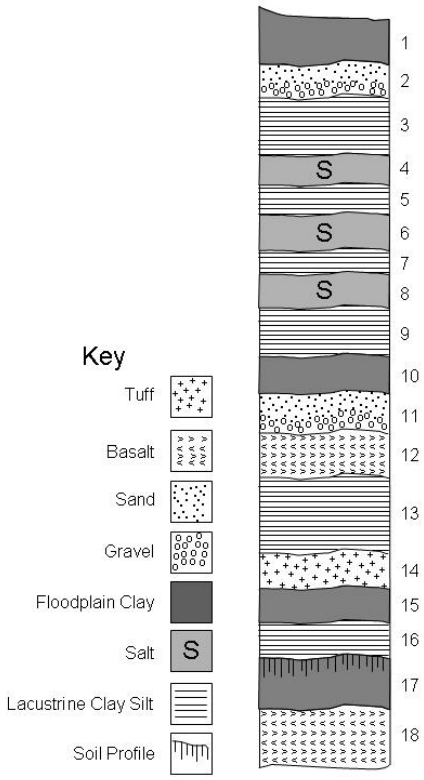
Geologic Cross Sections

A **geologic cross section** provides a representation of the rocks and sediments below the surface across a wide area. For example, the figure below represents a cross section across a rift valley. Note that the sides of the valley are uplifted areas bounded the valley floor at faults. The valley axis is underlain by the thick sediments of different types. The principle of superposition tells us that in cross sections that are undisturbed, the oldest rocks or sediments are at the bottom and are overlain by progressively younger materials.



Geologic cross section example

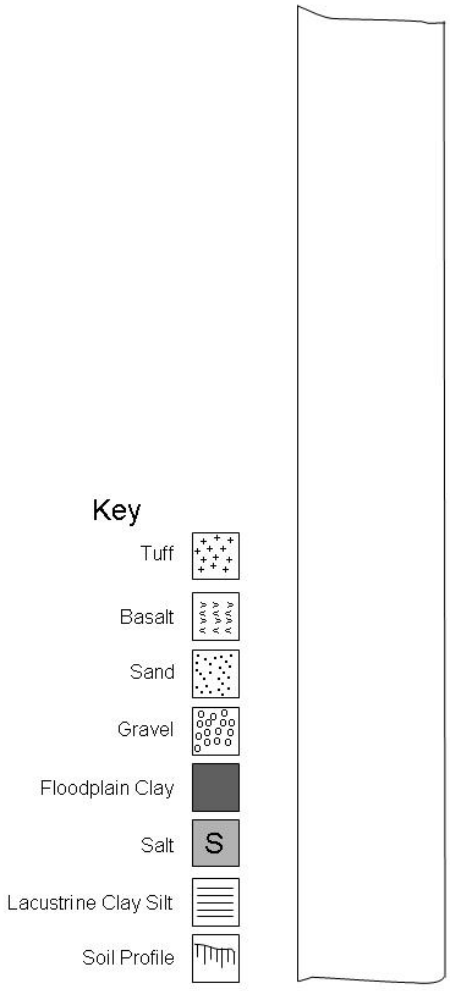
A **geologic profile**, shown below**,** is a representation of the vertical arrangements of rocks, sediments and soils below the surface. Unlike cross sections, geologic profiles describe the geology of a single place or 'locality' .



Geologic profile

An example of a geologic profile for a fictitious site, Locality A.

Fill in the stratigraphic column in the figure below, using the symbols indicated to show the following history. (**NOTE: A is the oldest and event J is the youngest!**): (***10 points***)



J expansion of a freshwater lake

I basaltic lava flow

H pyroclastic ash fall

G expansion and building of floodplain deposits

F long term exposure of former lake floor to weathering

E rapid shrinking and desiccation of the lake with evaporitic deposition

D expansion of a freshwater lake with clastic deposition

C stream channel then flood plain deposition

B stability and weathering

A basalt flow

Soils and Archaeology

In this section of the lab you will study, describe and interpret soils from two archaeological sites, one in a forest setting and the other from a prairie setting. Both soils formed along a stream valley in alluvial stream deposits. Your goal is to see the differences in the soils that are related to their environmental setting, and then relate the soil properties (including the original parent material, the organic content and the acid-alkaline chemistry of the soil). In the next lab, we'll investigate the archaeological content and patterns of preservation in these two sites.

Your samples come from:

The Acorn Site (Forest)

> This soil formed in a humid forested environment. You have samples from the A, B and C horizons.

The Antelope Site (Prairie)

> This soil formed in a semi-arid grassland setting. You have two samples from the thick A horizon, and one from the C horizon.

Your lab instructor will get you started by helping you to describe the samples in terms of color, texture and reaction to dilute hydrochloric acid (HCl). Then, in teams, collect your own samples from the bulk sample provided for each of the horizons in both soils.

Procedure for Describing Soil Samples

1. Place about a teaspoon of soil in a plastic spoon

2. Put a drop of dilute HCl on the sample and record the reaction:

   none - no reaction
   weak – very small bubbles form
   strong – froths visibly
   violent – froths violently

[NOTE: the reaction to HCl is the acid dissolving calcium carbonate ($CaCO_3$) which produces CO_2 gas if carbonates are present. The strength of the reaction is proportionate to the carbonate content.]

   Record the reaction on your data chart below

3. Drop just enough water on the sample to make it moist but not wet- this means there is no standing water or clear water film on the sample.

4. Determine the **Munsell Color**:

   Recall from the text for this lab that colors of the soil horizons indicate different kinds and degrees of soil development. For example **melanization** (darkening) is an indicator of organic matter, common in the upper (A) horizon. Melanization is indicated by low value and chroma, but can be expressed independently from hue. For example, both 7.5YR2/1 and 10YR2/1 would be considered melanized. **Rubification** (reddening), on the other hand, is an indicator of accumulation of iron and aluminum oxides in the B horizon, which is an indicator of the age of the soil. Rubification is indicated by the redder hues, and is

accompanied by higher value and chroma. For example, 5YR4/4 is a color indicating rubification.

Hold the sample behind the color chart. Check the sample against different pages of **HUE** until you are in the right color range, then move your sample between color chips on that page until you get the match that best fits your color.

Determine the soil color as follows:

HUE = the balance of red and yellow. Your samples will be found on the on the following two hue pages:

7.5 YR 10 YR

VALUE = the intensity of the hue
CHROMA = the darkness of the color

Record the color of your sample with the following notation (example):

10YR 4/3 [this is **HUE Value/Chroma**]

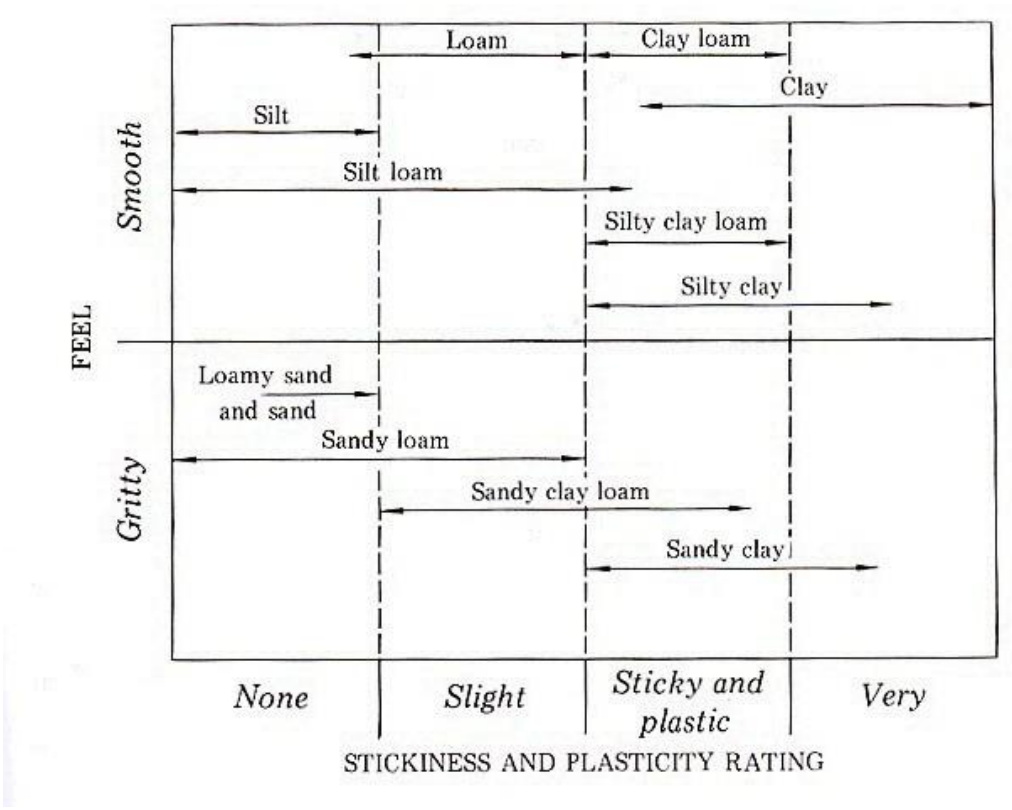
5. Now determine your **TEXTURE** on the same sample. Recall from your lab materials that soil texture is a balance of sand, silt and clay. Each of these fractions contributes to soil texture and to its "feel" in the field. First, we use soil texture to infer the original depositional environment (sandy suggests channels, clayey suggests flood plains). Second, we use texture to record soil development, particularly the movement of clay from the A horizon to the B horizon, which indicates the environment and age of the soil.

   (For this procedure you also want your sample to be moist, not wet)

   Using the chart below, rub the sample slowly back and forth between your fingers

   First, check for **grittiness** (that is the sand fraction) versus **smoothness** (silt fraction)
   Next feel for **stickiness/plasticity** (this is the clay fraction)
   Pinch the sample between your finger tips and pull them apart slowly
   None - Does not stick to your fingers.
   Slight – Adheres to your fingers a bit.
   Sticky and plastic – Can be easily rolled into a rod.
   Very- Rod can be easily bent into a ring. Holds a fingerprint easily (like potters clay).

   Find the place on the chart that combines your best estimate for grittiness, stickiness and smoothness, and select a **texture name**.



Add your soil texture to complete your tables (***30 points***).

Profile 1 - Forest

Horizon	**Color**	**Reaction HCl**	**Texture**
A			
B			
C			

Profile 2 – Prairie

Horizon	**Color**	**Reaction HCl**	**Texture**
A1			
A2			
C			

Questions:

Congratulations! You just received a large grant to go survey for Oldowan sites in the East African Rift. The grant requires you to compare Oldowan folk's use of game animals in forested and prairie environments. How will you apply your knowledge of rift valley geology to achieve the following two goals?

1. Your first goal is to focus your survey on sediments that are most likely to contain archaeological sites. Which environments of deposition, their sediments, and other distinguishing properties will you target in your survey and why? **(10 points)**

2. Your second goal is to prepare your crew to recognize both forest and prairie soils in the field. Indicate the key horizons and their properties you will give the crew that will enable them to distinguish between these kinds of soils: **(10 points)**

Forest Soils	Prairie Soils

3. Having found several important Oldowan sites on your survey, you now must write a new grant proposal to excavate key sites and analyze both the archaeological materials as well as reconstruct the environments of the occupations. Why would adding a geologist-soil scientist to your team strengthen your proposal as well as help you achieve your objectives? **(10 points)**

4. The longer a forest soil forms through weathering, the greater the loss of bone and other organic materials in an archaeological site. Recall that when a soil is buried by renewed deposition on the formerly stable surface, the soil stops forming. How can you use your field determination of color and texture to compare buried forest soils regarding how long they formed before they were buried? **(5 points)**