## Geos 225 – Geophysics Prelab

## Lab 12 2007 Apr 6 **Due 4/10/07**

Day/Time_____________________________ Name_________________________

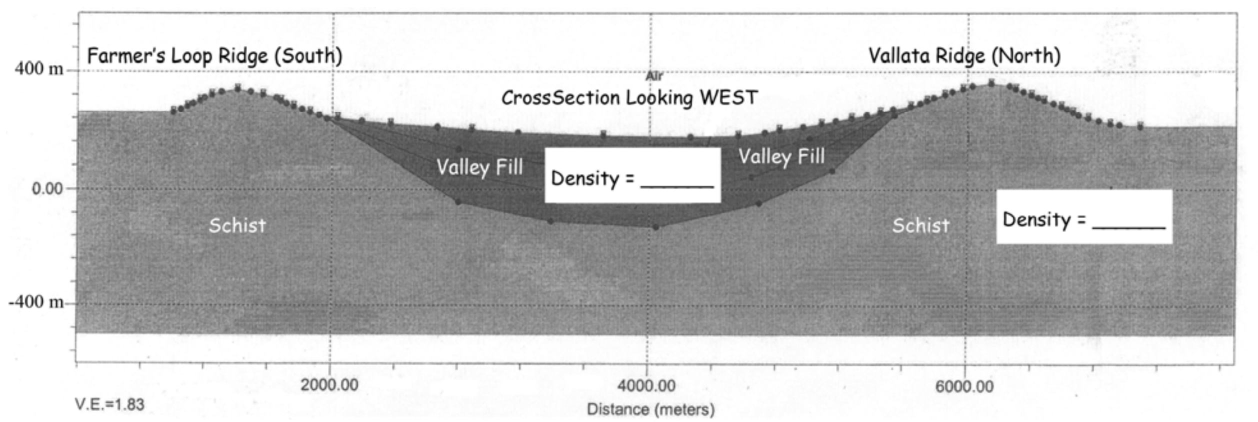
Instructions: Read pages 50 – 58 in the compendium.

1. Using the tables below the cross section, estimate and label the approximate density of the Valley Fill and Schist units in the cross section below. Estimate a value to 3 significant digits.

2. What is the Density Contrast between the Schist and the Valley Fill ? ____________ grams/cc

3. If we flew over the simple Goldstream Valley model below at a constant height would we weigh more or less over the center of the valley?

____________________________________________________________________________________________




| | Wet Density (grams/cc) | | Dry Density (grams/cc) | |
|---|---|---|---|---|
| **Rock Type** | **Range** | **Average** | **Range** | **Average** |
| **Alluvium** | 1.96 - 2.0 | 1.98 | 1.5 - 1.6 | 1.54 |
| **Clays** | 1.63 - 2.6 | 2.21 | 1.3 - 2.4 | 1.70 |
| **Glacial Drift** | --- | 1.8 | --- | --- |
| **Gravels** | 1.7 - 2.4 | 2.0 | 1.4 - 2.2 | 1.95 |
| **Loess** | 1.4 - 1.93 | 1.64 | 0.75 - 1.6 | 1.20 |
| **Sand** | 1.7 - 2.3 | 2.0 | 1.4 - 1.8 | 1.60 |
| **Sand and clays** | 1.7 - 2.5 | 2.1 | --- | --- |
| **Silt** | 1.8 - 2.2 | 1.93 | 1.2 - 1.8 | 1.43 |
| **Soils** | 1.2 - 2.4 | 1.92 | 1.0 - 2.0 | 1.46 |
| **Sandstone** | 1.61 - 2.76 | 2.35 | 1.6 - 2.68 | 2.24 |
| **Shales** | 1.77 - 3.2 | 2.4 | 1.56 - 3.2 | 2.10 |
| **Limestone** | 1.93 - 2.9 | 2.55 | 1.74 - 2.76 | 2.11 |
| **Dolomite** | 2.28 - 2.9 | 2.7 | 2.04 - 2.54 | 2.30 |

| Rock Type | Range | Average | Rock Type | Range | Average |
|---|---|---|---|---|---|
| **Quartzite** | 2.5 - 2.7 | 2.60 | **Serpentine** | 2.4 - 3.10 | 2.78 |
| **Schists** | 2.39 - 2.9 | 2.64 | **Slate** | 2.7 - 2.9 | 2.79 |
| **Graywacke** | 2.6 - 2.7 | 2.65 | **Gneiss** | 2.59 - 3.0 | 2.80 |
| **Granulite** | 2.52 - 2.73 | 2.65 | **Chloritic slate** | 2.75 - 2.98 | 2.87 |
| **Phyllite** | 2.68 - 2.80 | 2.74 | **Amphibolite** | 2.90 - 3.04 | 2.96 |
| **Marble** | 2.6 - 2.9 | 2.75 | **Eclogite** | 3.2 - 3.54 | 3.37 |
| **Quartzitic slate** | 2.63 - 2.91 | 2.77 | **Metamorphic - avg.** | 2.4 - 3.1 | 2.74 |

-- From Telford et al.,1976

# GEOS 225 A Geophysical Survey of the Goldstream Valley Area

Name:___________________________

## Introduction

Today's lab is an experiment—collecting real data. Anyway, it beats mapping plywood. We've talked about being able to use geophysical data to supplement surface geological information and to get clues into the subsurface. But how exactly does one do so? What special preparation, equipment, planning, and calculations are involved? What does one really get out of it all in the end? This is what today's lab exercise is all about.

## Preparation

"What geophysical tool would be best for my area?" is a question that you must settle well in advance. "How big of an geophysical response ("anomaly') can I expect?" and "How sensitive is the instruments which I have available?" are some other questions. Once you've convinced yourself that your exploration target will produce an anomaly significantly large to measure with the equipment available you design your data acquisition.

Generally, you'll be making a linear traverse or traverses, with the aim of producing a geophysical cross-section or cross sections. Or (more expensively) you might decide on the goal of to producing a raster of points that you'll be contouring. In either case the most productive strategy for designing a survey is to have an hypothesis of what the geology looks like in the sub surface. Generally your lines will run perpendicular to regional strike. Based upon your hypothetical model of the local geology you can Plan how far apart your stations should be to resolve the geology in the sub surface.

Obviously you'll want to make the stations in places where you can get to relatively easily. In most cases you'll want at least a dozen stations that cross the expected area of expected anomaly — with stations extending on either side of the anomaly approximately as far from the anomaly as the anomaly width.

In the case of the Goldstream Valley, we're attempting to model/better understand the thickness of the valley fill, so we want our traverse to extend well beyond Goldstream Valley per se. "How many stations should I make?" can be thought of as essentially a cost-benefit analysis: the more data the better, but one reaches a point where an additional data points cost more than the benefits.

Most geophysical surveys involve occupying a base station at the start and end of the survey to correct for whatever changes happen (in the measuring device and in the Earth's ambient field) during the time between the start and finish, so that the maximum number of points for a survey will be the maximum number of stations that can be occupied in a day, including the time needed to start and finish at the base station.

## Execution

We've laid out a string of stations 300-500 meters apart in a roughly linear array, approximately perpendicular to the Goldstream Valley. We have physically marked the points with a nail and orange flagging and physically located the points (UTMs or lat/longs and ELEVATION). Commonly this is done by an advance team (person), who marks and locates stations, so that the team (person) doing the actual geophysical measurements can concentrate on that part. In this case, the points are accurately marked and located and we will have two vans measuring gravity simultaneously. At the same time we will also be measuring the points by hand held GPS and estimating the elevation from the topo map.

## Geophysical measurements

For gravity, the precise lat/long and especially elevation (to within cm's!!) are critical to the data reduction. In this case, we'll have a team in the same van as the gravity team who will be using a special GPS device that will give the PRECISE locations and elevations. For a variety of reasons, they'll be recording locations as lat/longs in WGS 84. HOWEVER, the topographic maps of Alaska are in NAD27, so to make sure we are where we think we are, we'll be using recreation-grade GPS units to determine UTMs in the NAD27 datum as well.

## Geophysical Survey Jobs

To make sure all the stuff gets done at each station we'll assign people to do each of these tasks at each station. About half way through we'll switch jobs, so everyone gets to do a bit of everything.

1) **Master Recorder –** makes sure everything gets recorded, neatly, in the right place. After lab we'll collect these sheets and get a copy to everyone.
2) **Meter Reader 1 –** levels and reads the gravimeter and keeps an eye on Meter Reader 2.
3) **Meter Reader 2 –** levels and reads the gravimeter and keeps an eye on Meter Reader 1.
4) **Map Elev. Plotter 1 –** plots a precise map position, using whatever methods are available and estimates elevation from topo map, and keeps an eye on Map Elev. Plotter 2.
5) **Map Elev. Plotter 2 –** plots a precise map position, using whatever methods are available and estimates elevation from topo map, and keeps an eye on Map Elev. Plotter 1.
6) **NAD 27 GPS reader –** Reads a precise GPS map position for each station in NAD 27.
7) **NAD 83 GPS reader** – Reads a precise GPS map position for each station in NAD 83.
8) **RTK GPS reader –** Reads an ultra-precise position for each point **–** only one RTK device is available which we'll trade between vans.

## Data reduction and calculation of models

We'll be doing this as a homework assignment and discussing the result next Tuesday. DON'T SKIP THIS CLASS!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

## Prelude to modeling

The expected anomaly for two different Valley Fill thicknesses is shown below.