GEOL 595-GD/L - Geodynamics
Lab Assignment # 2- Feb 1, 2010 (Due Feb 10, 2010)

Name:

Thermal Conductivity

This Green River Shale outcrop is 2000 ft thick. Found in Desolation Canyon, Utah. This formation was deposited long after the sedimentary layers of the Grand Canyon.

1. Temperatures at the interfaces between sedimentary layers of different rock types as determined from a well log are given in Table 1 below. The measured thermal conductivity of each layer is also given. Determine 1) the heat flow through each layer and 2) the mean value of the heat flow.

Table 1: Temperatures between Layers of Rock Types

Depth (m)	Temp (°C)	Rock Type	k ($Wm^{-1}K^{-1}$)
380	18.362		
		sandstone	3.2
402	18.871		
		shale	1.7
412	19.330		
		sandstone	5.3
465	20.446		
		salt	6.1
475	20.580		
		sandstone	3.4
510	21.331		
		shale	1.9
515	21.510		

2a. Determine the thermal conductivity (k) for granite and for gabbro. Before you begin make a guess as to which you think has a higher value of k .....? The value for thermal conductivity (k) can be determined from the equation below. The thermal resistance of the contacts are accounted for by associating a thermal conductivity (k_c) and a thickness δ with each contact. Show by algebraic manipulation and a rough sketch on a graph that you can determine k by plotting (T_1 - T_2)/(T_H - T_1) versus d without knowing k_c or δ.

$$\frac{T_1 - T_2}{T_H - T_1} = \frac{k_b d}{k_r l} + \frac{2\delta k_b}{l k_c} \tag{1}$$

2b. Build a model as shown in the figure below using the samples provided. Allow the system to reach equilibrium (let the rocks to heat up) and use the thermocouples or thermometers provided to measure T_1, T_2, T_H, and T_C (make a table listing each sample and measured values) for your system. You will also need to measure the thickness of each rock sample (d) as well as the thickness of your metal plates (l). Plot your measured values on a graph of (T_1 - T_2)/(T_H - T_1) versus d using each sample as a data point. You will have 2 graphs, one for granite and the other for gabbro. (If you only have time to measure 1 or 2 samples, you may need to collaborate results and share your data values. See page 132-134 of *Geodynamics* by Turcotte and Schubert for further discussion).