Petrology
Spring 2006

Problem Set #4: Geothermal gradients

The expressions below can be used to calculate a conductive geothermal gradient for the lithosphere.

$T(z) = Qz/K + A_o z(b - z/2)/K + T_s$ $\quad z < b$

$T(z) = Qz/K + A_o b^2/(2K) + T_s$ $\quad b \le z \le L$ $\quad$ where L=100 km

		typical values
where:	T_s = surface temperature (°C)	15
	Q = mantle heat flow (mW/m^2)	30
	K = thermal conductivity (W/m/deg)	2.5
	$A_o = \rho H_s$ = heat production ($\mu W/m^3$)	2.0
	b = characteristic depth of A_o (km)	10
	z = depth (km)	

Using a spreadsheet (e.g., Excel), plot temperature (°C) vs. depth (km) for

a) the entire lithosphere (100 km), and

b) the upper 35 km. Plot depth as the y-axis and "negative" (i.e., going down the page from 0 km).

Answer the following questions:

1. What is the temperature at the base of the lithosphere? _____ at 35 km? _____.

2. Play around with some of the parameters. What do you need to do to get 700°C at 35 km? Is there a unique solution? Which parameters do you think we know best? the least?

3. The equations given above assume that heat flow in the lithosphere is by conduction only. Is this a reasonable assumption? Why or why not?