Seismology Lab (07/04/2017)

1. Using a shell script, calculate equilibrium geotherm (at 10, 20 and 30 km depth) for a layered continental crust with a 30 km thick upper layer with heat generation of 0.4 μWm^{-3} overlying a 10-km thick layer with heat generation of 2.5 μWm^{-3}. Assume a surface temperature of zero, heat flow from the mantle is 20×10^{-3} Wm^{-2}, and thermal conductivity is 2.5 $Wm^{-1}{}^{\circ}C^{-1}$.

$$T = -\frac{A_1}{2k}z^2 + \left[\frac{Q_2}{k} + \frac{A_2}{k}(z_2 - z_1) + \frac{A_1 z_1}{k}\right]z, \ 0 \le z \le z_1$$

$$T = -\frac{A_2}{2k}z^2 + \left[\frac{Q_2}{k} + \frac{A_2 z_2}{k}\right]z + \frac{A_1 - A_2}{2k}z_1^2, \ z_1 \le z \le z_2$$

2. Using an asthenosphere temperature of 1300 °C (T_0) and assuming a temperature of 1150 °C (T) for the base of the lithosphere, calculate the thickness of 20, 40, 60, 80 and 100 Ma old oceanic lithosphere using a shell script (Given, $K = 10^{-6}$ m^2/s) (**T = T_0erf{z/(2*sqrt(Kt))}**)

x	1.01	1.05	1.09	1.11	1.15
erf(x)	0.8468	0.8624	0.8768	0.8835	0.8961

3. Make a shell script to fit a straight line in Least squares through (1, 1), (4, 2) and (5, 5).
   (Find m_1 and m_2 from $m_1 + m_2 z_i = d_i$)

$$\begin{pmatrix} N & \sum z_i \\ \sum z_i & \sum z_i^2 \end{pmatrix}\begin{pmatrix} m_1 \\ m_2 \end{pmatrix} = \begin{pmatrix} \sum d_i \\ \sum z_i d_i \end{pmatrix}$$