Tectonophysics, November 26 2015 13:15-15:15

1. *Switch off your smartphone and put it out of sight*
2. *Head- or earphones are not allowed*
3. *Graphical calculator is allowed*
4. *Answer every question (and just the questions)*
5. *You are allowed to leave the room after one hour after the test has started (late comers will be allowed in during the first hour).*

Assignment 1 (6 pt). Plate model for cooling of oceanic lithosphere

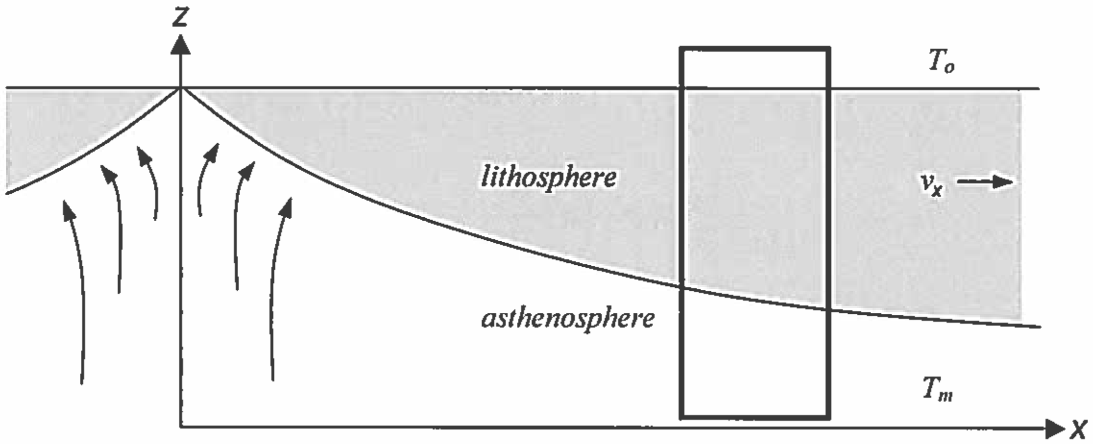

Figure 1. Geometry for derivation of advection-diffusion equation for oceanic lithosphere.

Figure 1 shows a schematic vertical cross section through a cooling oceanic lithosphere. The ridge is located at $x=0$. We consider the plate model with $T(z=0)=T_m$ and $T(z=L)=0$ (i.e., $T_0=0$). The lithosphere moves at with uniform velocity $\vec{v}=(v_x,0,0)$. Derive the non-dimensional version of the 2D advection-diffusion equation for the oceanic lithosphere. Assume that the box stays at a constant distance from the ridge (Eulerian frame). Also derive the non-dimensional boundary conditions and the initial condition. The starting point of your derivation is the diffusion equation

$$\rho C_p \frac{\mathrm{d}T}{\mathrm{d}t} = \nabla \cdot (k \nabla T)$$

where ρ is mass density, C_p is specific heat at constant pressure, T is temperature, t is time, and k is the (scalar) conductivity.

Assignment 2 (12 pt). Flexure of a broken elastic lithosphere.
The elastic flexure equation for a uniform plate with zero in-plane force is given by

$$D\frac{\mathrm{d}^4 w}{\mathrm{d}x^4} + (\rho_a - \rho_i) g w = q(x) \qquad (1)$$

(a) What is the meaning and physical dimension of D, w, x, ρ_a, ρ_i, g, and q?

(b) What is the physical dimension of $\mathrm{d}^4 w / \mathrm{d}x^4$?