PeGn624 Homework # 7

- Assigned: 2009-01-29
- Due: 2009-02-09

Please derive the effective horizontal stress equation Eq. 1.

$$\sigma'_h = \frac{\nu}{1-\nu}\left(\sigma_v - \alpha_P P - 3\beta_T K(T - T_R)\right) \tag{1}$$

For both derivations, use the following assumptions, Eqs. 2–4.

$$\sigma_h = \sigma_{xx} = \sigma_{yy} \tag{2}$$

$$\sigma_v = \sigma_{zz} \tag{3}$$

$$\epsilon_{xx} = \epsilon_{yy} = 0 \tag{4}$$

The following relationships may be useful, Eqs. 5–7.

$$G = \frac{E}{2(1+\nu)} \tag{5}$$

$$\lambda = \frac{\nu E}{(1+\nu)(1-2\nu)} \tag{6}$$

$$K = \frac{E}{3(1-2\nu)} \tag{7}$$

1. Start with Hooke's Law, Eqs. 8–9.

$$\epsilon_{xx} = \frac{1}{E}\left(\sigma_x - \nu(\sigma_y + \sigma_z)\right) \tag{8}$$

$$\epsilon_{yy} = \frac{1}{E}\left(\sigma_y - \nu(\sigma_x + \sigma_z)\right) \tag{9}$$

2. Start with the general stress-strain relationship, Eq. 10.

$$\sigma_{ij} = 2G\epsilon_{ij} + \lambda\epsilon_b\delta_{ij} + \alpha_P P\delta_{ij} + 3\beta_{Tb}K_b(T - T_R)\delta_{ij} \tag{10}$$