Assignments

Due: October 10, 2014

1. What is the isotropic material in seismology? Why is the isotropic assumption mostly valid in seismology? What kind of research in seismology forces us to consider other assumptions instead of the isotropic one?
2. Derive the isotropic wave equation (equation 1.22) from equations 1.8, 1.11, and 1.21. Also, explain what assumptions is the isotropic wave equation applied (e.g., material, dimension, elastic moduli)?
3. Give an example of a strain tensor for which there is 1) an increase in volume, b) a decrease in volume, c) shear strain but no volume change. Which of these strains could result from a P wave, and which could result from an S wave?
4. Figure I.4 is an observed waveforms of the Northridge earthquakes on January 17, 1994. When we assume that the incoming waves are $\mathbf{u} = (0, 0, A\sin(\omega(t - x/c)))$ (where A is the amplitude, ω the angular frequency, c the wave velocity), compute the maximum strain tensor given by the Northridge earthquake at the observation point. We know the wave velocity is $3.2 km/s$ from other data.
5. Figure I.5 shows a profile of a borehole. Draw the shear and bulk moduli in the entire borehole (0–100 m). You can use the densities (kg/m^3) following: granite 2.6, clay 1.6, sand 2.4, and quartz 2.65.

bonus

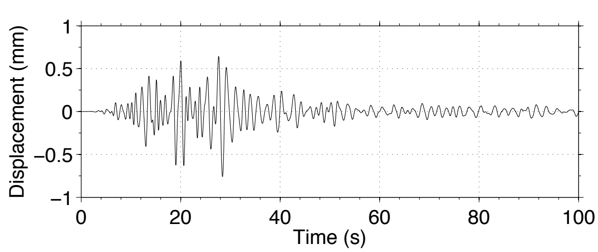
Show that we can reduce the components of the elastic moduli from 21 (general anisotropic) to 2 (isotropic) with isotropic assumptions.

no point

I (Nori) need some feedback from you. Write down to tell me about your opinion for the class. What are good and what are needing to be improved? What can I do in this class to better help you understand the material or improve your skills? What do you want to learn more? How about the speed of the class? My English?

(If you mind to put your name on this question, you can write down it on a scratch paper without your name and hand it to Clara. Then she can give me it as an anonymous.)

Figure 1.4: Vertical displacement of the Northridge earthquake (Jan 17, 1994). The frequency range is 0.5–1.5 Hz.



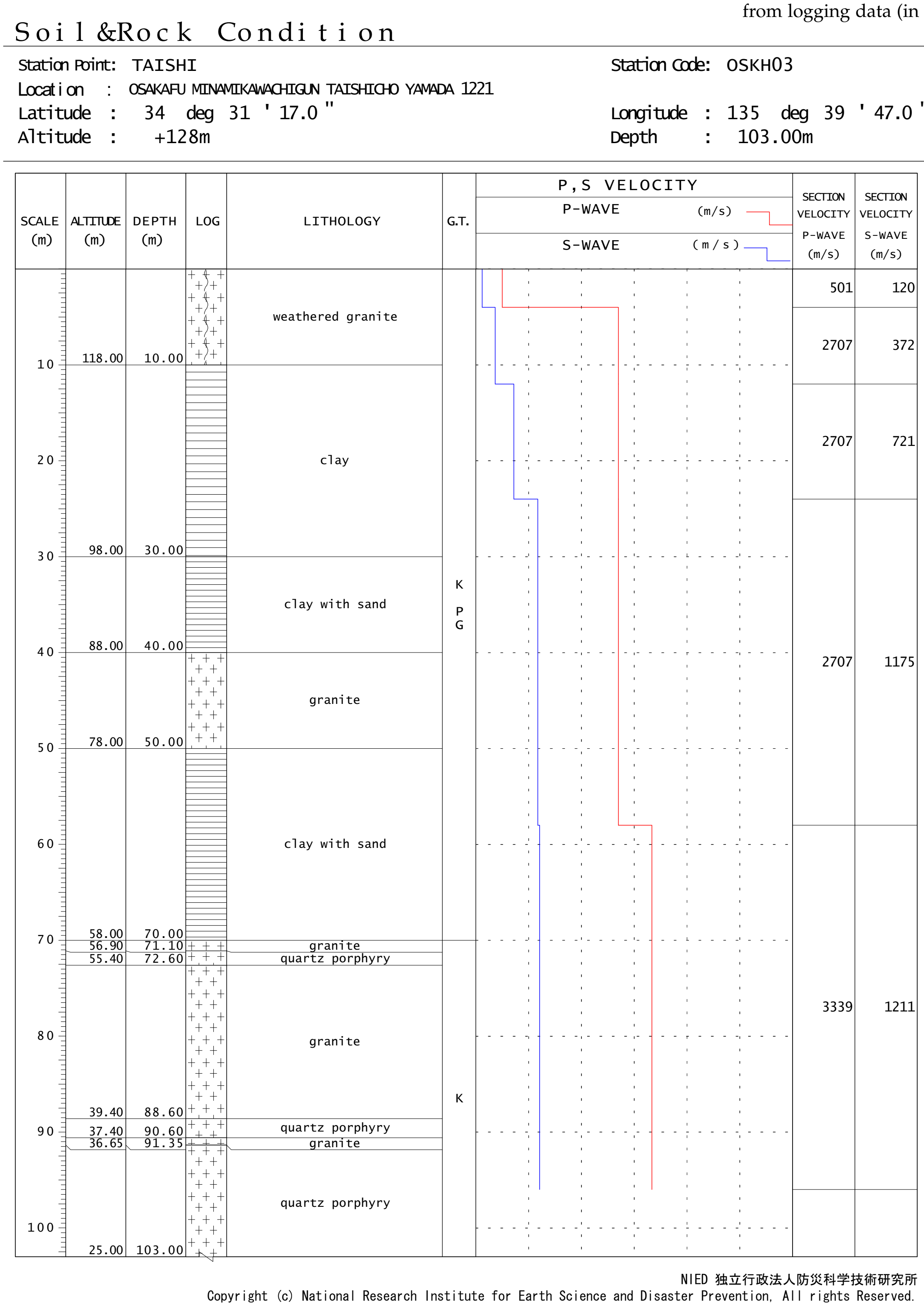


Figure 1.5: Borehole profile estimated from logging data (in Osaka, Japan).

Assignment 1 (addition)

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For simplicity, let us consider a 2D case. When a stress tensor is given by

$$\underline{\sigma} = \begin{pmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \sigma_{22} \end{pmatrix} = \begin{pmatrix} -30 & -12 \\ -12 & -50 \end{pmatrix} MPa,$$

and there is a fault oriented at 30° clockwise from x_1 axis, answer problems below.

1. compute the deviatoric stress of the given stress.
2. compute the normal and shear tractions on the fault.
3. explain why the normal and shear tractions on the fault is important for studies of earthquake.