Name: Key **Homework 1, GEL 161**

Ch. 2 and Ch. 20 [30 pts]

1. **Plate Boundaries.** Use the plate motions shown in Figure 20.34 to identify the type of plate boundaries (convergent, divergent, conservative) corresponding to each of the following plate margins.

   (a) Pacific – Nazca plate margin.
   Divergent (spreading ridge)

   (b) Pacific – Australia plate margin.
   Convergent (subduction zone), with maybe some strike-slip in the south.

   (c) Nazca – South America plate margin.
   Convergent (subduction zone).

   (d) Australia – Antarctica plate margin.
   Divergent (spreading ridge): Australia is moving north faster than Antarctica.

   (e) North America – South America plate margin.
   Conservative (strike-slip).

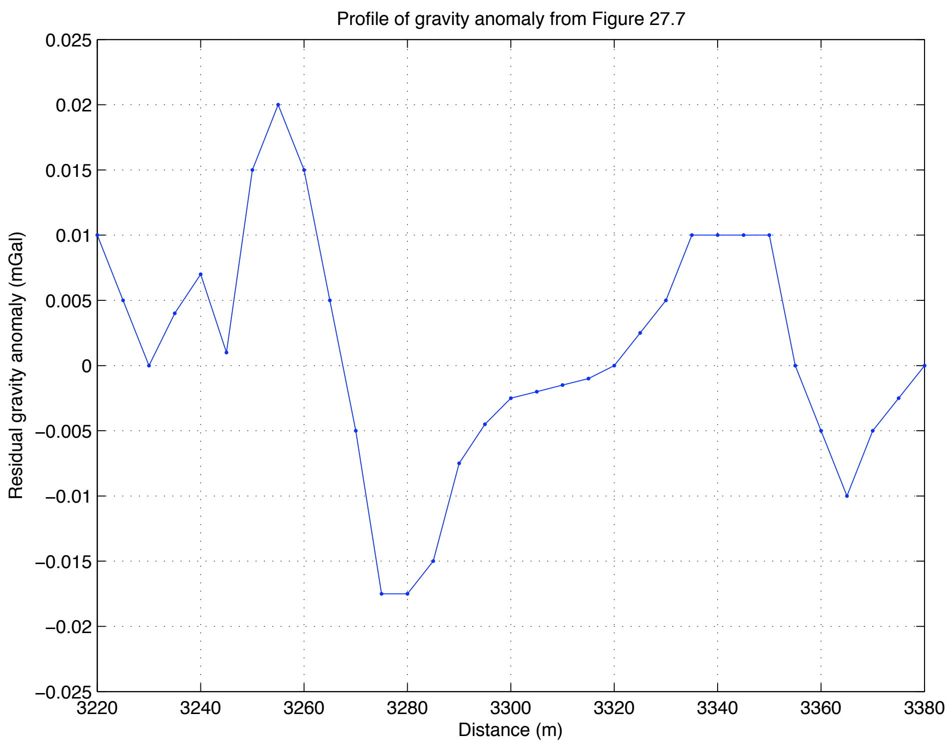
   Note that some margins may have more than one type of boundary. In this case, please specify which parts of the margin have each boundary type. [5 pts]

2. **Crustal Structure.** Make a sketch of the oceanic crustal structure listing each of the layers, the rock type, the density range, and the P-wave velocity (see Figure 20.27). What are the discontinuities (jumps) in the P-wave seismic velocity between each of the layers? [10 pts]

Layer	Rock Type	Thickness (km)	Density (kg/m^3)	P-wave Velocity (km/s)	Jump (km/s)
1	sediments	0–1.0	1400-2400	2.0	0.5
2a	pillow lavas	0.5–1.0	2700–2900	4.5-5.1	2.5
2b	dykes	0.5–1.0	2700–2900	5.1–6.0	0.5 (gradient)
3	gabbros	3.0–4.5	2700–2900	6.5–7.2 0.5	
4	mantle	–	3300	8.0	0.8

3. **Data Profiles.** Figure 27.7 shows the results of a microgravity survey: part (a) shows the full signal including the regional slope, while part (b) shows the residual anomaly after removing the regional slope. Create (by hand on graph paper or on a computer) a profile across the residual anomaly at 9850 m on the vertical (y) axis, going from 3220 m to 3390 m on the horizontal (x) axis. [5 pts]

Sampled data at every 5 m along contour plot, but still profile appears to be somewhat undersampled.



4. **Forward and Inverse Methods.** Assume you have a set of gravity measurements along a profile that you would like to interpret in terms of the subsurface structure. You can do this interpretation using either a forward or inverse method. List the steps you would need to take to interpret the data using a forward method approach and make separate list of the steps needed using an inverse method approach. Each step will be somewhat generic (e.g., make a simple model), the important point is the order of the steps and difference in the steps used in each approach. [10 pts]

   Forward method:

   (a) Choose a model to describe data (physical model or equation). This includes defining the parameters of the model but not there values.
   (b) Choose initial values for the parameters, and calculate a prediction.
   (c) Compare the prediction to the data and identify misfits.
   (d) Based on misfits, adjust model parameters (one parameter at a time).
   (e) Recalculate prediction, and iterate by trial-and-error until a good match to the data is found.
   (f) Vary model parameters to determine sensitivity of data fit to model parameters.

   Inverse method:

   (a) Choose a model to describe data (physical model or equation). This includes defining the parameters of the model but do not define there values.
   (b) Set up a system of equation for each *data point*.
   (c) Minimize error between the model prediction and the data (e.g., weighted least squares). Formal way to do this is to actually minimize with respect to each model parameters and sum the errors.
   (d) Directly *solve* for the best-fitting parameters (no trial and error).
   (e) Vary model parameters to determine sensitivity of data fit to model parameters.