Ge161, Plate Tectonics. Fall 2010. Problem Set 6.

Structures visible in the ocean floor using gravity anomalies and seafloor ages.

1. Copy this file from the class web site into your own Linux directory:

gravmap_agemap.gmt

2. Change the permissions on the file in your own directory, so that you can execute it and edit it. (Type the command "chmod 777 gravmap_agemap.gmt".)

Note that to run this script you need to be connected to the seismo lab computers so that you can access the global gravity and global age grid data sets. These are in /home/datalib under Global_Gravity and Seafloor_Age directories. You can go there to read more details about the data sets and how they were constructed.

For steps 3-6, use the same map boundaries and approximately the same map scale that you used in Problem Set 5 (seismicity maps). .

3. Make a map of the gravity data for your study area. Note that the scale of the plot can be changed on the command line where you have to put –Jm0.1 (for example). Make this number smaller if the map is too big, and larger if the map is too small. Print out this map once you are happy with how it looks.

Here is a sample command line for this script, for the Hawaiian-Emperor seamount chain in the Pacific ocean:
./gravmap_agemap.gmt Hawaiian_Emperor 140 210 20 50 –Jm0.1 300
Here is the syntax of the command:
[*command title_prefix_for_files west east south north basemap_type_scale resolution]*

4. After you close the gravity map window on your screen, you will also get a colored map of the age of the seafloor in the same region. This is from a global data base so it may be missing details and it may not be completely correct for your map area. Print this map once you are happy with how it looks.

Note that if you want to run this program again with different parameters, you may have to either change the title (which in the above case is Hawaiian_Emperor) or remove all the files with names that start with the title. Depending on how your account is set up, the script may not over-write any existing files.

5. Put a piece of tracing paper on top of the map from #3. On this tracing paper draw another map, at the same scale, of the same region. Color the active plate boundaries on your map and label the plates with their names. Trace and label any other features visible in the gravity data, i.e. fracture zones, pseudofault traces, dead spreading centers, seamounts, hotspot traces, and the traces of triple junctions; maybe even the continent-ocean boundary. Pick out everything that looks interesting or important in the gravity data even if you don't know what it is. You can try to identify some features from other bathymetric maps or journal articles that you might have been reading.

6. Use the age map and the gravity map together to make an overlay on tracing paper with each seafloor province in a different color. (This refers to which spreading ridge formed the seafloor; e.g., at the Galapagos TJ you have 3 provinces: seafloor formed by Pac-Cocos spreading, seafloor formed by Cocos-Nazca spreading, and seafloor formed by Pac-Nazca spreading. These are bounded by the 3 triple junction traces.)

7. Write a ***one-page*** explanation (3 paragraphs) of the important features that are visible in the gravity data, on the whole map. You can use whatever references you would like for this. This explanation should include the following:

a) What age range of seafloor is present on the ocean floor in the map area? (You can determine this by looking at the map of the world magnetic anomalies and other more detailed references about your map area.) Does this agree with what is shown on the seafloor age map that you made? If you have any seafloor that shows up as black or gray in the seafloor age map (in other words that no age was assigned to it), how old do you think it could be, and why?

b) What are the principal events that occurred in the plate motion history to produce the features that you see in your map? (Give references if appropriate.)

8. Look at the active plate boundaries and rank them according to how visible they are in the gravity field data. Note the differences that you see, both general and specific (for example, if the ridge segments are more/less visible than the transform faults; if one transform fault has a much bigger gravity signature than others).

Turn in for this assignment the following items (maps should all be at the same scale):

- Printed copy of the gravity map for your area
- Printed copy of the age map for your area
- Tracing paper with your tectonic interpretation that you made as an overlay to the gravity map
- Tracing paper with map showing different seafloor provinces in different colors, as an overlay to the gravity map
- Discussion of the features (following points 7a, 7b, 8 listed above)

Several notes:

1) You need to have enough disk space to be able to make the gravity map. If you have a large study area and try to make your map at very high resolution, you might run out of disk space. If this happens to you, let us know ASAP so we can try to find a solution for you.
2) For your final report for Ge161, you will need to include these maps, so if you save the files then you won't have to make them again.