Geology 437 – Problems for 12/1/99

1. Start with some continental crust in isostatic equilibrium. It is 35 km thick, the surface at 500 meters above sea level, 2700 kg/m^3, and floating in 3200 kg/m^3 mantle above a compensation depth of 100 km below sea level. Suppose we magically erode (or blast away) 20% of the crust. What is the new elevation (assume constant temperature, isostatic equilibrium)? Suppose 4 km of basalt (3000 kg/m^3) floods into the hole - what is the new elevation of the surface of the basalt?

2. Here's a situation like the Bolivian Altiplano: assume 4km of elevation above sea level (2670 kg/m^3), 52 km of 2670 kg/m^3 crust, 15 km of 2819 kg/m^3 lower crust, and mantle (3200 kg/m^3) down to a compensation level 125 km below sea level. Assume 100% Airy compensation and calculate how much erosion will be needed to erode the surface to sea level.

Here are two problems to do using **GRAVCADW**, an MS-Windows gravity modeling program on the MS/Intel computers in SC 305. If you want your own copy to mess with:

- do an anonymous ftp login to spectre.geol.umt.edu
- click through to the pub/software directory
- get GravcadW32.zip
- uncompress and install on your maching
- now get GravcadW32.exe and copy it over the one you get from the above.

Now, if your plots print funny it is probably my fault – the print routine is still a little funky; don't worry about it. However, you can avoid almost any printing problem by making sure you do not have two vertices stacked (vertically) on top of each other. For example two consecutive points at (23,34.3) and (23, 29.3) will cause the program to crash – try it.

First, **GRAVCADW** has a built in demo data set - mess with that for a bit to figure out how the program works; see me if you need help. Next select **File/New Model** off the Menu Bar to start the next problems.

3. Imagine you are working in a groundwater system where the general depth to bedrock (2.75 g/cm^3) is 150 meters. The average density of the sediments in the basin is 2.1 g/cm^3. Suppose a divide in groundwater flow causes you to suspect a local bedrock high in the basin. The bedrock high is 500 meters wide, very long, and sticks up into the sediments. What distance below the surface must the bedrock high be to be able to see it with 0.5 mgal contours?

4. At one time the USGS had a big argument going about the nature of the Boulder batholith near Butte; the arguments went something like this: One group thought the contacts around the batholith were nearly vertical for at least 15 kilometers. The other side argued that the contacts might be near vertical for two kilometers but below that they dipped inward, beneath the batholith, at at least 40^o making a rather thin batholith. It all seems a little curious in that the Boulder batholith, surrounded by thrust faults, is allochthonous. Anyhow, if the batholith is 60 km wide and the density contrast of the batholith is -0.25 g/cm^3, can you discriminate between these two hypotheses using a gravity model? How and why? Use Gravcad's "add data graphically feature" to aid comparison.