Lab #6: Bending of the elastic lithosphere

Introduction

The lithosphere can be bent, much like bending diving board when a diver stands on the end.

How much the diving board (or the Earth's lithosphere) bends is a function of a couple of things: the weight of the diver, and how rigid the diving board is.

On the Earth, when the lithosphere becomes bent, or flexed, it forms a basin. These basins typically fill with sediments, and these sediments often are the source of hydrocarbons. Thus, lots of money has (and is) being spent trying to figure out how flexing of the earth works.

Examples of flexing the lithosphere include the flexing of the down-going slab in the subduction regime, the deflection of the pacific plate under the load of the Hawaiian island, the flexing of the continental lithosphere in front of fold and thrust belts.
Note that flexure not only depresses the lithosphere, it also forms flexural bulges. As you know, the location and height of these bulges depends on how rigid the lithosphere is, and how large the load is.

So, as geodynamicists, we use our understanding of how flexure works to try and figure out things about the earth, like: the relative rigidity of the lithosphere, and how does rigidity vary in space and time?
Assignment:
1) Estimate the elastic plate thickness
   a) of the Pacific Plate near the Mariana Trench.

Supplies:
1) an m-script: PlateFlex.m
2) a data file of the bathymetry of the subducting plate near the Mariana Trench
   mariana.mat

Procedure:
1) write an m-script to load and plot the profile of the mariana
2) Next, there are 3 key pieces of information that you will need to pick from the data to define the shape of the flexed plate:
   i) the height of the bulge
   ii) the location of the bulge
   iii) the location of the “end of the plate”

   The m-script, PlateFlex.m uses these locations and heights to estimate the shape of a flexed plate, and thus the rigidity and elastic plate thickness of the plate.
   You will run this script, entering
   - the elevations and locations that you picked off of the data, and
   - your estimate of the elastic plate thickness
   The script will calculate and plot a flexure profile.

   If the calculated flexural profile does not match the data, re-estimate the elastic plate thickness until you can match the profile of the Mariana Trench.

To hand in:
1) Your M-File that loads and plots the data
2) Your flexure plot,
   • annotating the 3 inputs from the map, and
   • your preferred elastic plate thickness in the title
3) Discuss how increasing the rigidity of the lithosphere would affect the shape of the flexed plate.
4) Discuss how decreasing the load would affect the shape of the flexed plate.