GEO369 – Introduction to Geophysics

7 September, 2004
Bevill 266

<u>Class 4: Deriving, plotting, and interpreting earthquake fault plane solutions</u>

Today we have three tasks.

1. Create a Lambert equal area projection plot in GMT.
2. Use this plot to derive the fault plane solution of an earthquake (instructions are given on the handout).
3. Plot this earthquake in GMT.

As there was some confusion with the location of spaces etc. in the previous exercise I have typed each of the unix commands using a Courier font. I hope this helps. I have also added comments to the c-shells (text preceded by “#”) to help explain what the commands are doing.

1. Logon to your PC.
2. Double-click on your “imiloa dtterm” icon. A window should appear with the “imiloa” prompt.
3. Change directory to “GEO369”.
   ```
   cd GEO369
   ```
4. Make a new directory named “class4”.
   ```
   mkdir class4
   ```
5. Change directory to “class4”
   ```
   cd class4
   ```
6. Create a new file that we can edit in xemacs (and open it in the background).
   ```
   xemacs class4_1.csh &
   ```
7. In the editor window enter the following commands:
   ```
   #!/bin/csh
   #set the plot type to a flavor that illustrator likes
   gmtset PAPER_MEDIA letter+
   #set variables for projection, scale and map extent. The projection is
   #a lambert project, centered on the equator at the zero meridian.
   #the map is 6.5 inches along the x-axis and covers the a whole sphere.
   set J = -JA0/0/6.5i
   set R = -R0/360/-90/90
   set psname = class4_1.ps
   #plot grid lines every 2 degrees with a pen size of 0.1 points
   gmtset GRID_PEN 0.1p
   psbasemap $R $J –B2g2/2g2 -P -K >! $psname
   #plot grid lines every 10 degrees with a pen size of 1 point
   gmtset GRID_PEN 1p
   psbasemap $R $J -Ba10f10g10/a10f10g10 -O >> $psname
   #display the plot with ghostview
   ghostview $psname &
   ```
8. Start Illustrator and open your new file. As me for help if you cannot find it. Print the file to the HP4600 in Bevill 266.
9. Follow the instruction in the handout to plot your earthquake and derive the fault plane solution.
10. What sort of fault created this earthquake?

11. Create a new c-shell that we can edit in xemacs (and open it in the background)
```
xemacs class4_2.csh &
```
12. In the editor window enter the following commands:
```
#!/bin/csh
#set the bounds, tick marks and scale to match the exercise from
#class2
#Though we do not know the location of our earthquake, we are going
#pretend that it is in the center of this map.
set R = -R150/152/-11/-9
set B = -Ba1.0f10m
set J = -JM6.5
set psname = class4_2.ps
psbasemap $R $J $B –K –P >! $psname
#plot the coastline at full resolution with a line thickness of
#1 point
pscoast $R $J –Df –W1p –O –K >> $psname
#plot the earthquake solution. The format of the columns
#in the file is:
#1,2:   longitude, latitude of
#3:     depth of event in kilometers
#4,5,6: strike, dip, and slip direction of plane 1
#7,8,9: strike, dip, and slip direction of plane 2
#10,11: mantissa and exponent of moment in dyne-cm
# note that in our case the slip directions are –ve.
psmeca $R $J –Sc0.5 –O <<END>> $psname
151 -10 10 30 80 -78 294 60 -60 1.58 25
END
ghostview $psname
```
13. Open this map in illustrator and annotate it with a description of the earthquake. Print this out and hand it in at the end of the lab.
14. The actual earthquakes with fault plane solutions (from 1976-2004) are listed below. Plot these earthquakes using the script above. Open your plot in illustrator and annotate it, indicating the nature of each earthquake. Hand this in at the end of the lab.
```
151.80 -9.26 10 250 73 -178 160 88 -17 1.580 25
151.94 -9.1610 10 246 50 180 337 90 40 5.730 24
151.84 -10.14 10 64 72 -161 327 72 -19 6.950 24
151.24 -9.64 10 279 40 -70 73 53 -106 4.370 25
151.37 -9.94 10 74 50 -131 308 55 -52 8.810 23
151.91 -10.60 10 55 31 172 152 86 59 1.470 24
152.00 -9.63 10 150 82 -8 242 82 -171 2.070 24
151.77 -9.91 10 66 24 -109 267 67 -82 1.550 25
150.39 -9.25 10 69 50 -135 306 57 -50 11.970 23
151.53 -9.95 10 60 34 -136 292 67 -64 1.360 24
```