Working with data files

- One of the purposes of making maps is to be able to superimpose geographically referenced data.
- This data can be:
  - Discrete points that you want to plot with a given symbol (square, triangle, circle, etc)
  - Continuous lines or polygons
- This is commonly done with `psxy`

psxy for plotting symbols

- `psxy` uses argument `-S` to plot symbols
- For instance: `-Sc` will plot circles, `-St` triangles (type `man psxy` for the entire list of available symbols)
- `-S` is followed by the scale of the symbol (e.g., 0.1)
- Symbol color and outline are defined with `-G` and `-W` arguments, like in `pscoast`.

psxy for plotting symbols

- Log on to http://neic.usgs.gov/
- Click on *Earthquake Catalog Search*
- Choose *Global*
- Select *Screen File Format*, database *USGS/NEIC (PDE) 1973 - Present*
- Choose minimum magnitude 6 maximum magnitude 10 and submit search
- Save the resulting file in your working directory as a **text file (not html) and name it** `all_gt_6.neic`

psxy for plotting symbols

- To plot the earthquake catalog we just downloaded on a map, first extract the useful information (latitude, longitude) with awk:

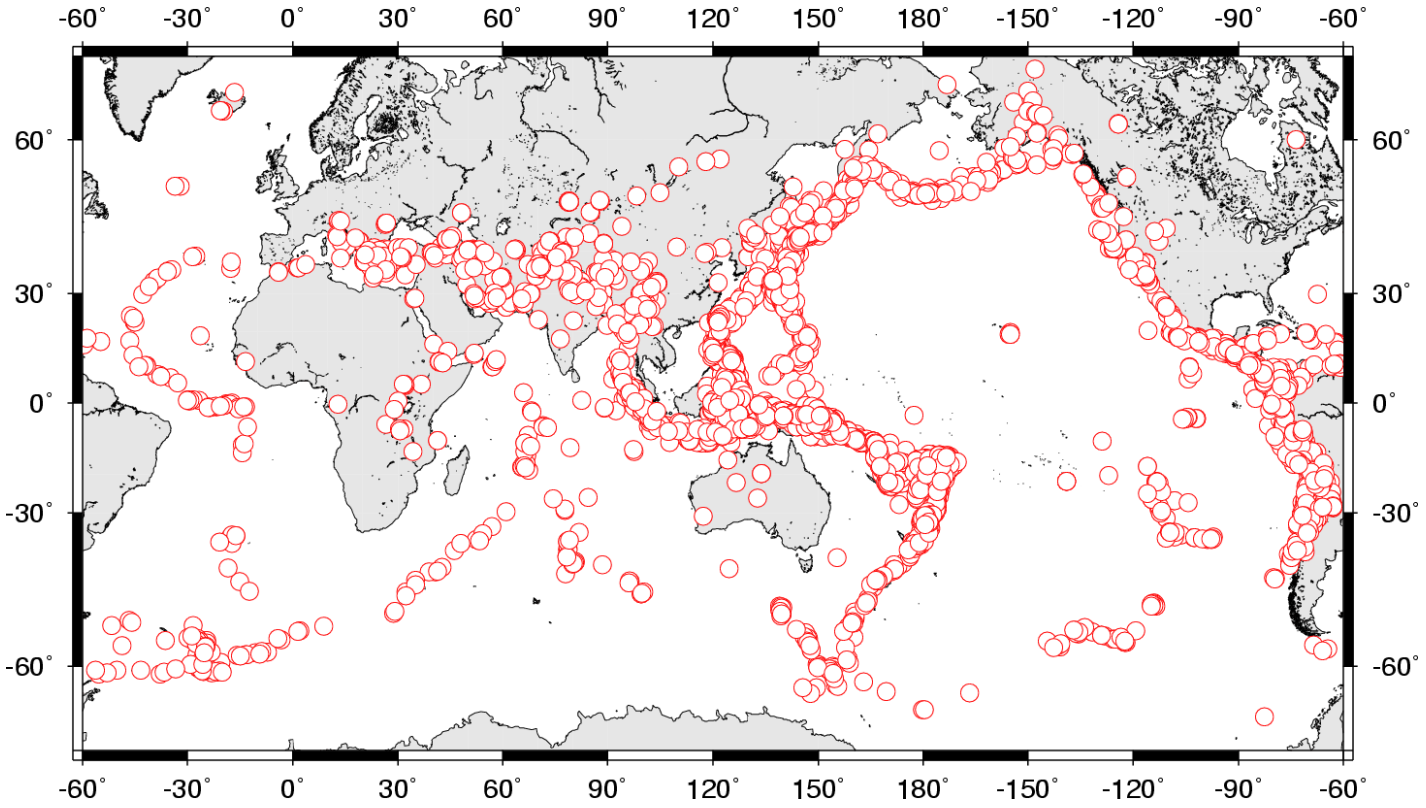
```
awk ’NR>24 {print $7,$6}’ all_gt_6.neic >! tmp.sis
```

- Then plot the map:

```
pscoast -R-60/300/-70/70 -Ba30 -G230 -W1/0 -JM9i -P -K > eq1.ps
```

- And add the seismicity in red circles:

```
psxy tmp.sis -R -JM -Sc0.09 -W1/255/0/0 -G255 -O >> eq1.ps
```


-60˚
-30˚
0˚
30˚
60˚
90˚
120˚
150˚
180˚
-150˚
-120˚
-90˚
-60˚
60˚
30˚
0˚
-30˚
-60˚

psxy for plotting symbols

- Note that the input data can also be specified as follows:

```
psxy << end -R -JM -Sc0.09 -W1/255/0/0 -G255 -O >> eq1.ps
166.50 -12.09
123.93 -0.12
-103.00 18.48
139.23 28.21
... etc
end
```

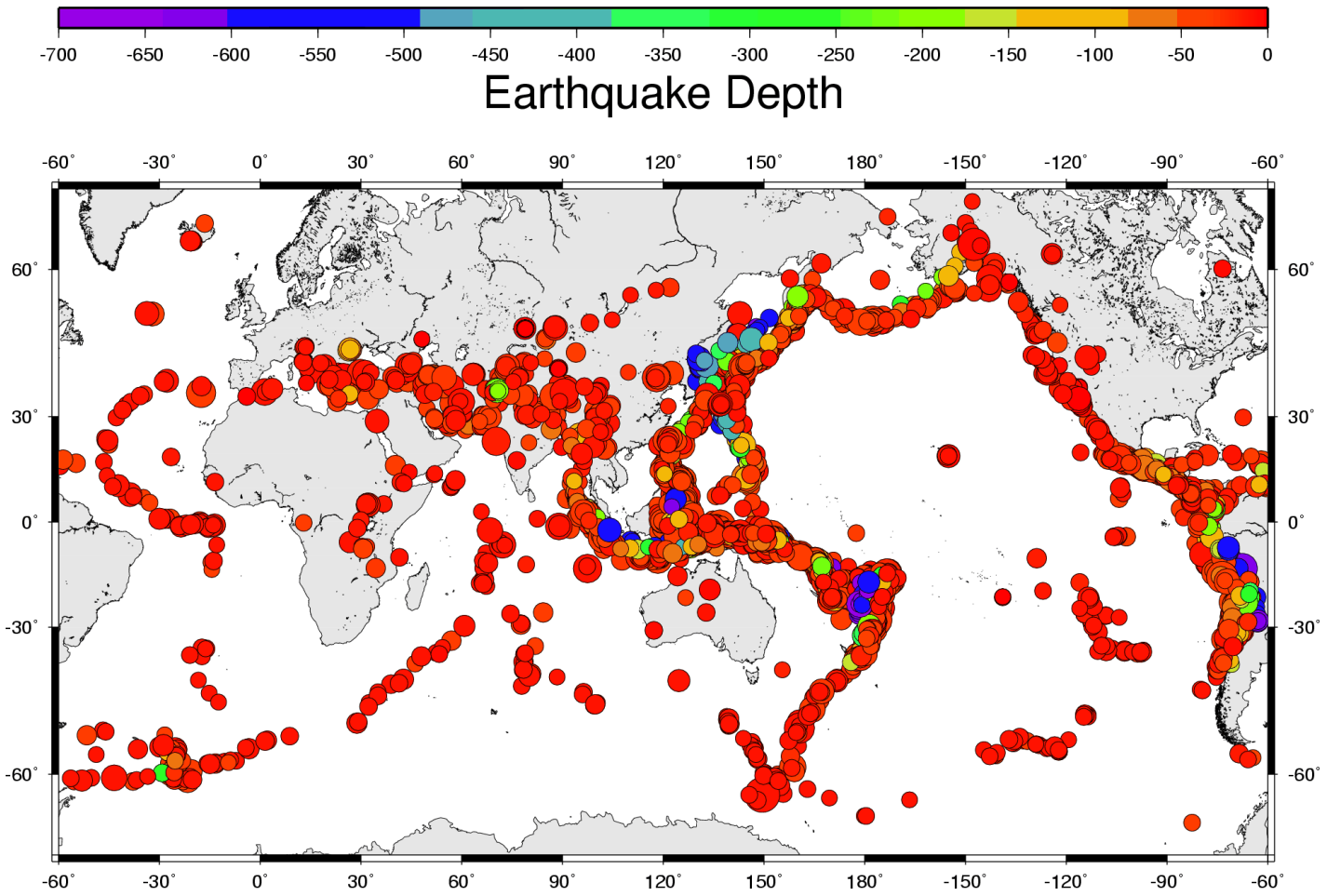
- Or you can also pipe awk into psxy:

```
awk 'NR>24 {print $7,$6}' all_gt_6.neic |
     psxy -R -JM -Sc0.09 -W1/255/0/0 -G255 -O >> eq1.ps
```

psxy for plotting symbols

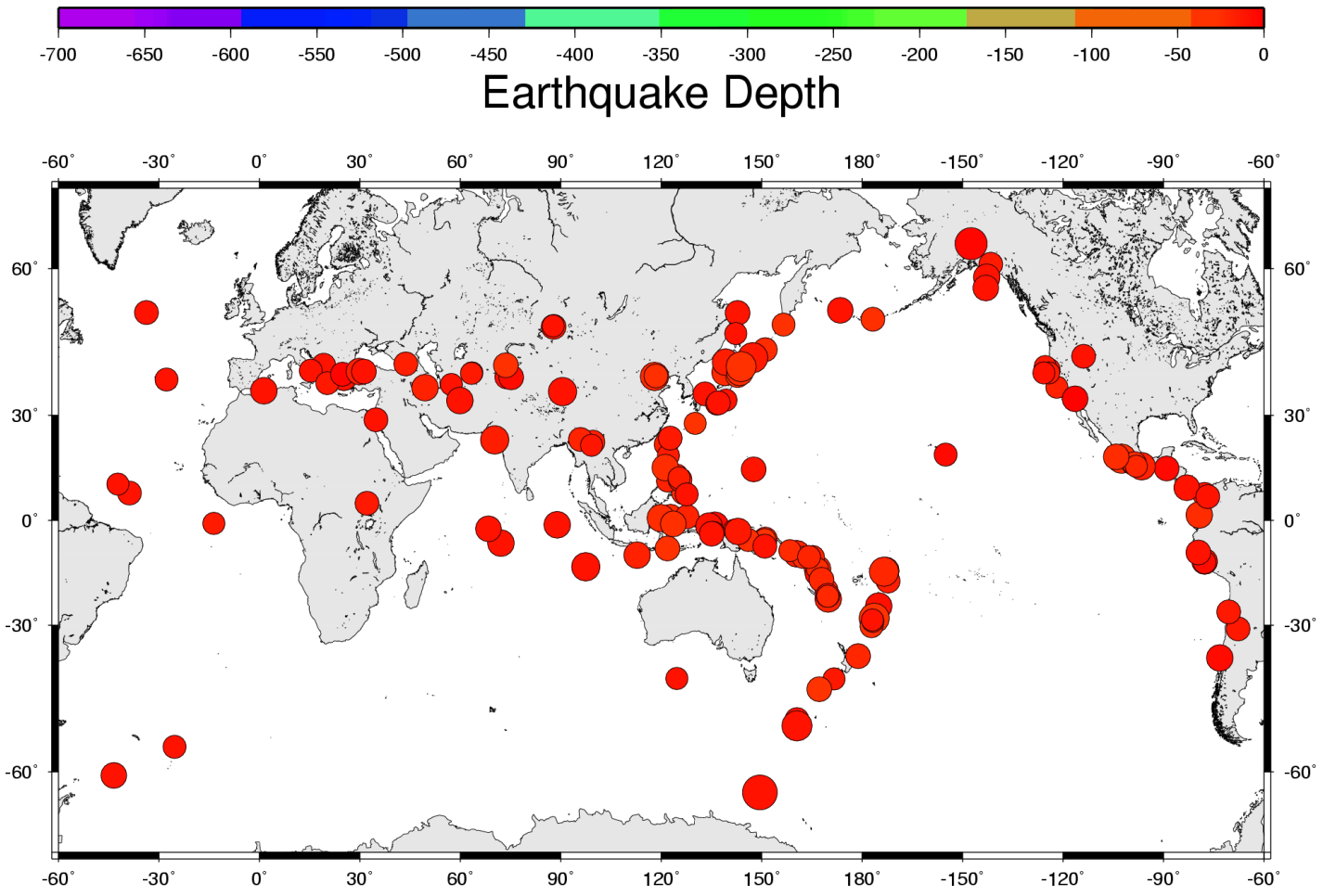
- `psxy` can also plot symbol color or size according to other information, for instance earthquake depth and magnitude
- Try this:

```
set mm = 0; set mM = 9; set dm = 0; set dM = 700
awk 'NR>24 {lon=$7; lat=$6; mag=$9; dep=$8; \
     if (dep>dm && dep<dM && mag>mm && mag<mM) \
     {print lon,lat,-dep,mag*mag/300}}' \
     dm=$dm dM=$dM mm=$mm mM=$mM all_gt_6.neic >! tmp.sis
makecpt -T-700/0/50 -Z -Crainbow >! depth.cpt
pscoast -R-60/300/-70/70 -G230 -Ba30 -W1/0 -JM9i -K > eq2.ps
psxy tmp.sis -R -JM -Sc -W1/0 -Cdepth.cpt -O -K >> eq2.ps
psscale -D4.5i/6.3i/9i/0.15ih -Ba50:"Earthquake Depth": \
        -Cdepth.cpt -L -O >> eq2.ps
```


-700 -650 -600 -550 -500 -450 -400 -350 -300 -250 -200 -150 -100 -50 0
Earthquake Depth
-60˚ -30˚ 0˚ 30˚ 60˚ 90˚ 120˚ 150˚ 180˚ -150˚ -120˚ -90˚ -60˚
60˚
30˚
0˚
-30˚
-60˚

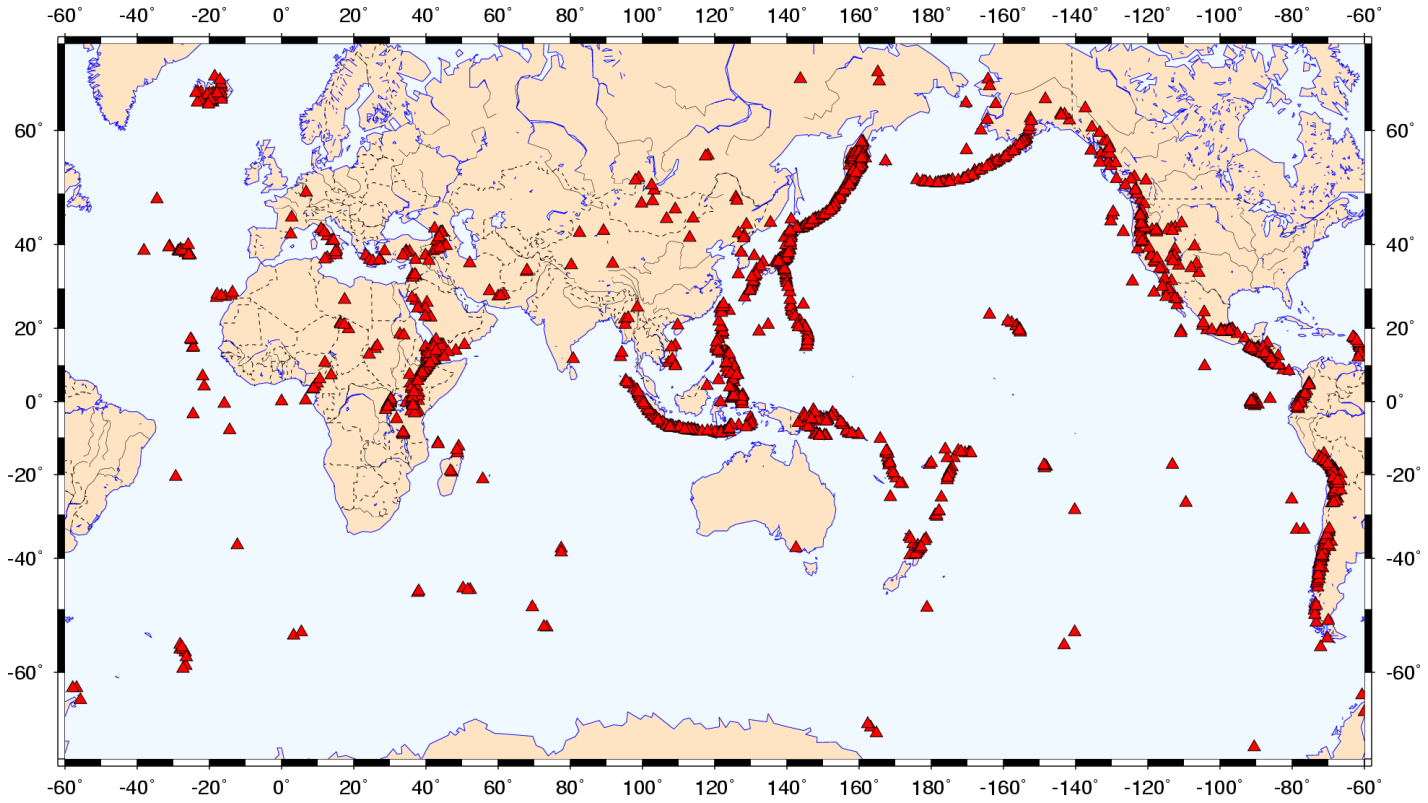
With:

```
set mm = 8; set mM = 9; set dm = 0; set dM = 30}
```



psxy for plotting symbols

- Now plot volcanoes!
- Find data at http://www.ngdc.noaa.gov/seg/hazard/vol_srch.shtml
- Select all volcanoes and save as `world_volcanoes`
- Plot volcanoes as red triangles


-60˚ -40˚ -20˚ 0˚ 20˚ 40˚ 60˚ 80˚ 100˚ 120˚ 140˚ 160˚ 180˚ -160˚ -140˚ -120˚ -100˚ -80˚ -60˚
60˚
40˚
20˚
0˚
-20˚
-40˚
-60˚

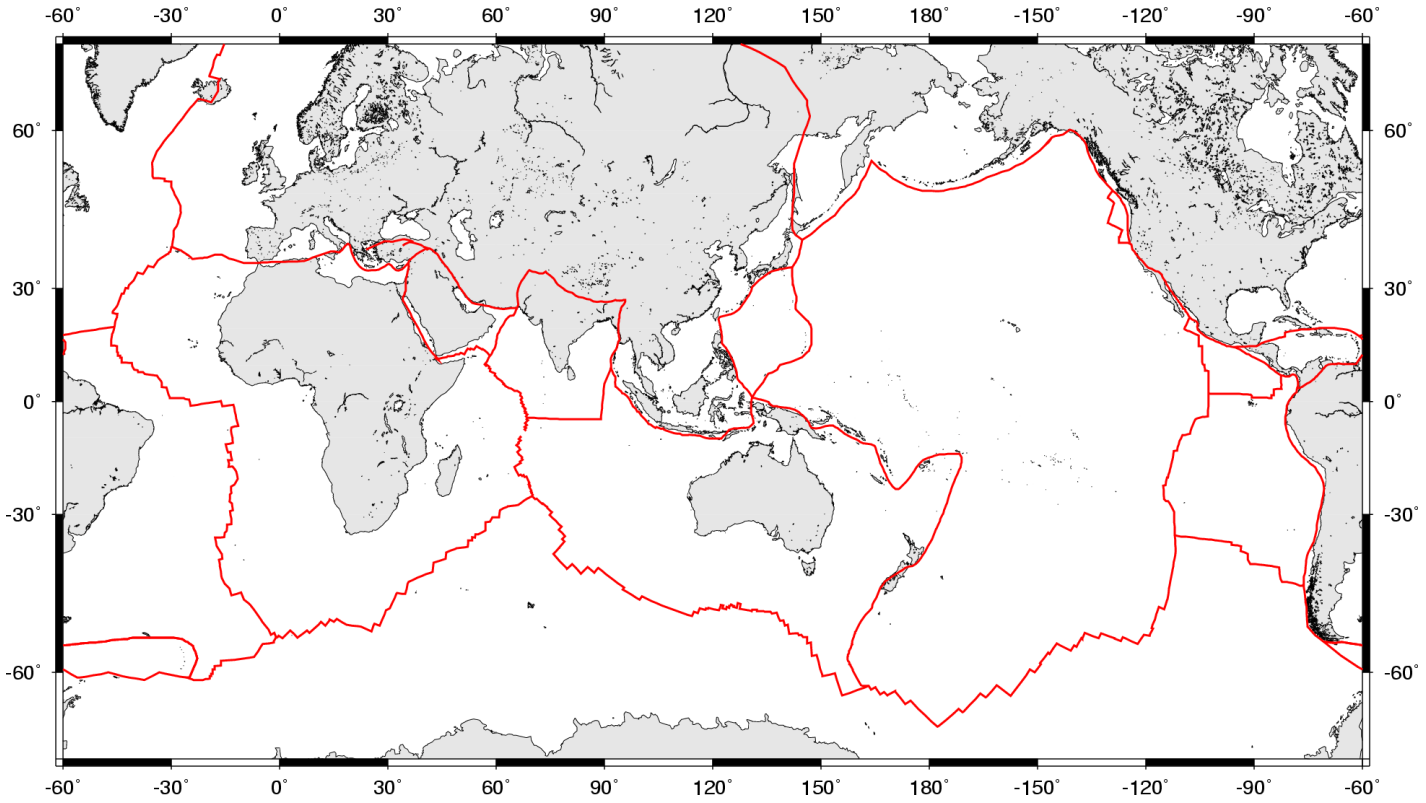
psxy for plotting lines

- `psxy` can also be used to plot lines or polygones
- The syntax is the same as for symbols, but you do not specify `-G`
- As usual, the color, width, and type of the line are given with `-W`
- `psxy` will draw continuous line until it reaches >
- > means *“pen up, start drawing a new line”*

psxy for plotting lines

- File `nuvel1_plates_mod` contains the trace of major plate boundary faults
- Plot map with plate boundary traces:

```
pscoast -R-60/300/-70/70 -Ba30 -G230 -W1/0 -JM9i -K > pbf.ps
psxy nuvel1_plates_mod -R -JM -: -M -W4/255/0/0 -O >> pbf.ps
```


-60˚
-30˚
0˚
30˚
60˚
90˚
120˚
150˚
180˚
-150˚
-120˚
-90˚
-60˚
60˚
30˚
0˚
-30˚
-60˚

psxy for plotting symbols

```
#!/bin/csh -f

set plot = global_seismicity.ps
set sis_file = 'all_gt_6.neic'
set vol_file = 'world_volcanoes'
set plt_file = 'nuvel1_plates_mod'
set latm = -70.0; set latM=70.0; set lonm=-60.0; set lonM=300.0
set mm = 5; set mM = 9; set dm = 0; set dM = 700
set proj = -JM9i
set grid = -B10a20::EWNS
set rivers = -I1/0/0/255; set resol = "-Dc -A4"
set LAND = -G255/228/196
set WET = -S240/248/255
set COAST = -W1/0/0/255

set frame=-R$lonm/$lonM/$latm/$latM

echo "Plotting basemap and coastlines..."
psbasemap $proj $frame $grid -K >! $plot
pscoast $frame $proj $resol $rivers -N1/1ta $COAST $LAND $WET -K -O >> $plot

echo "Sorting seismicity..."
# Symbol color according to depth, size according to magnitude
awk 'NR>24 { \
    lon=substr($0,38,7); lat=substr($0,31,6); \
    mag=substr($0,50,4); dep=substr($0,46,3); \
```

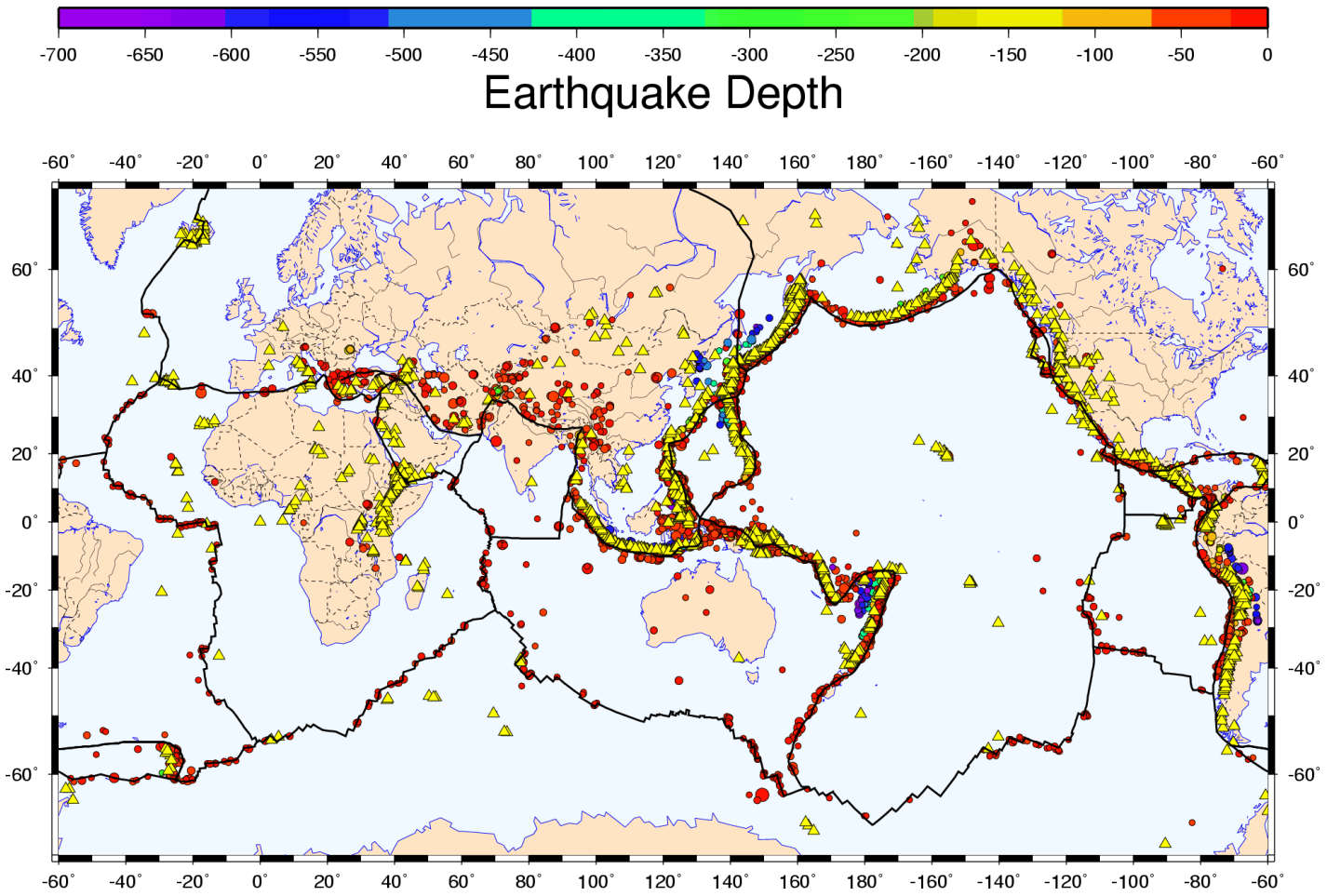
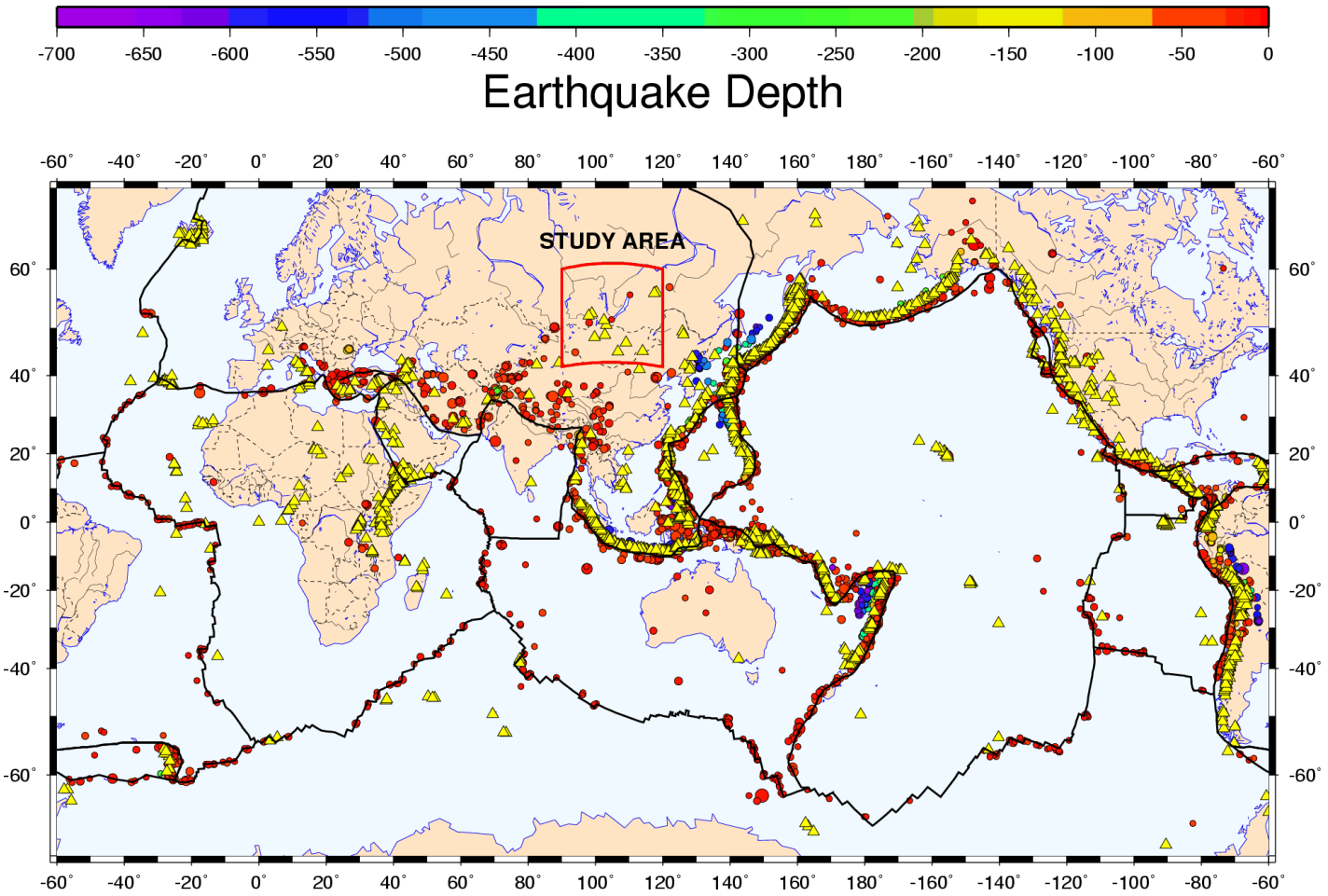
```
    lon=strtonum(lon); lat=strtonum(lat); mag=strtonum(mag); dep=strtonum(dep); \
    if (dep>dm && dep<dM && mag>mm && mag<mM) {print lon,lat,-dep,mag*mag/800}}' \
    dm=$dm dM=$dM mm=$mm mM=$mM $sis_file >! tmp.sis

echo "Plotting seismicity..."
makecpt -T-700/0/50 -Z -Crainbow >! depth.cpt
psxy tmp.sis $frame $proj -Sc -W1/0 -Cdepth.cpt -O -K >> $plot
psscale -D4.5/6.3/9/0.15h -Ba50:"Earthquake Depth": -Cdepth.cpt -L -O -K >> $plot

echo "Sorting volcanoes..."
awk 'NR>14 {lon=substr($0,70,8); lat=substr($0,62,7); \
     lon=strtonum(lon); lat=strtonum(lat); \
     print lon,lat}' $vol_file >! tmp.vol

echo "Plotting volcanoes..."
psxy tmp.vol $frame $proj -St0.10 -G255/255/0 -W1/0 -O -K >> $plot

echo "Plotting plate boundaries..."
psxy $plt_file -: $frame $proj -M -W4/0 -O >> $plot
```


-700 -650 -600 -550 -500 -450 -400 -350 -300 -250 -200 -150 -100 -50 0
Earthquake Depth
-60˚ -40˚ -20˚ 0˚ 20˚ 40˚ 60˚ 80˚ 100˚ 120˚ 140˚ 160˚ 180˚ -160˚ -140˚ -120˚ -100˚ -80˚ -60˚
60˚
40˚
20˚
0˚
-20˚
-40˚
-60˚

Shows your study area