LABORATORY 3- PLATE ROTATION

OBJECTIVES:

Explore the fit of South America against Africa in a "Gondwanaland Reconstruction" and investigate whether their separation is consistent with a single pole of rotation.

BACKGROUND: We will utilize the following plate tectonic properties:

(a) The relative displacement of any rigid plate with respect to another can be described as a simple rotation about a ***rotation pole***

(b) Poles of rotation can be located by determining the intersection of great circles perpendicular to the small circles which describe plate motion (transform faults, fracture zones)

(c) Relative displacements may be described in terms of the total angle of rotation Ω, the angular velocity ω, or the linear velocity $v = \omega R \sin\Theta$ [R is radius of Earth, Θ is colatitude measured from the rotation pole]

EXERCISE: South America - Africa Relative Motion

1. Examine the bathymetry along coastlines of South America and Africa. Decide what depth contour is representative of the outline of these continents. You will need to digitize the edge of South America in order to fit it against Africa.
2. By examination of the maps and through trial and error, find an Euler Pole that rotates South America together with Africa.
3. Carefully examine your "best fit" to determine the nature of gaps and overlap. Also examine the geography of overlap and gap regions to see if there are any clues to explain the misfits.
4. Using your total rotation and the age of the breakup of Gondwannaland (check the location and age of magnetic anomalies) determine the angular velocity of the separation of South America and Africa. Compare this estimate with the spreading rates determined in lab 3.
5. Make a plot showing the position of South America at present, 40 Ma, 80 Ma, and 120 Ma and discuss your findings for continental drift.
6. Use the transform fault and fracture zone geometry in the South Atlantic to discuss whether the relative

motion of South America and Africa motion is consistent with a single pole of rotation.

POINTS TO CONSIDER IN YOUR DISCUSSION:

(1) Is it appropriate to consider a single rotation pole for the entire opening of the South Atlantic ?

(2) In your Gondwanaland reconstruction, can you develop reasons which account for regions of misfit (overlap and gaps) ?

(3) Are there other ways to determine the plate positions for the intermediate time periods (i.e. 40 Ma, 80 Ma) than the method you used in step 5?

(4) Uncertainties are needed for all quantitative results. Your method to recognize and describe uncertainties must be articulated (in methods section).

As always, make sure that all figures (plots, graphs, maps, etc.) are appropriately titled, labeled, and if necessary have keys and scales. In the case of the plate reconstructions, label the plates, and in your lab report make sure you indicate the criteria used to select pole positions, rotation angles, and continental outlines.

USEFUL MATLAB FUNCTIONS:

[lon,lat] = GreatCircle(lon_in,lat_in,azimuth,dist)
returns points on a great circle starting at lat_in long_in, proceeding in the direction azimuth. Dist is an optional input to specify how far out to construct the great circle (default is 150 degrees)

```
[long_out,lat_out]=Euler_Rotation(long_pole,lat_pole,rotang,long_in,lat_in);
```
specify a rotation pole and an amount of rotation to rotate your continent to an earlier position

```
[long_out,lat_out]=get_continent
```
make a map using m_map, then call this function which allows you to click on the map to outline the continents

```
[long_out,lat_out]=get_point_on_map
```
make a map using m_map, then call this function which allows you to click on the map to find the latitude and longitude of a single point. The point is plotted on the map.