Applied Magnetics, Spring 2009 – due 3/11

1. Here's a table (from an Excel file) of average Precambrian paleopole positions for North America. They are not a particularly refined or filtered set but they'll show you how we do tectonic calculations. To get these data I downloaded a bunch of poles and calculated a 5-pole running average:

AGE (ma)	Ave Lat	Ave Long
501	2	163
525	8	162
547	11	161
577	12	160
622	10	159
663	11	161
694	12	156
722	10	153
748	14	153
769	16	151
790	13	155
802	7	151
841	8	149
875	4	149
920	8	156
974	14	158
1028	19	171
1053	24	178
1079	29	181
1088	31	184
1088	33	185
1092	38	185
1098	43	187
1101	46	192
1098	39	186
1099	37	184
1101	39	184
1100	37	184

   a. Plot the data.
   b. Assume the data are representative of one major tectonic configuration and calculate the Euler pole for North America for ~ 500 Ma – 1100 Ma.
   c. Calculate the average angular velocity for North America over the full time interval.
   d. Given your results, how do Precambrian tectonic rates compare to present?

One thing to keep in mind is the geometry of an Euler pole – you'll want to find the point that is equidistant from each of the observed poles. Of course these are real data so they are not perfect, you'll have to find the point that is the "best" choice. One way to accomplish this would be to set up a spreadsheet that, when you change the location of the Euler pole, updates the distances from the new (guessed) Euler pole to the observed apparent pole positions. In an adjacent column you can calculate the difference between each distance and the mean distance – you want the sum of these differences to approach zero. That is, minimize:

$$\sqrt{\sum_i (dist_i - dist_{mean})^2}$$

where $dist_i$ is the distance from the Euler pole to the i^{th} apparent pole, and $dist_{mean}$ is the mean distance from the Euler pole to the apparent poles.

2. A good estimate for North America's apparent pole position for the Eocene - Oligocene boundary (~40 ma) is at 84° north, 168° east. The Goble volcanics of southwestern Washington (46° north, 237.5° east) are about the same age. Calculate the magnetic direction you would expect for the area at (46° N, 237.5° E) from the Eocene pole at 84° N, 168° E; this is known as the expected direction.

Beck and Burr (1979 - *Geology* v7, p 175-179) determined that the mean primary magnetization for the volcanic field, after cleaning, averaging, statistics, etc., was declination = 18.5°, inclination = 57.5°. Use the expected direction you calculated and, assuming Beck and Burr's field work was good, interpret the results in terms of rotation and transport of the terrane carrying the Goble volcanic rocks. Write a short, explanatory paragraph discussing your tectonic interpretation of their results.