ESS 403
Global Tectonics
Laboratory Reports

Prepare your Laboratory Reports in electronic form (Word preferred) and submit them through the course electronic "drop box" by the listed due date. A scanner is available in JHN 366 should you need to add a visual that is not already in electronic form. An evaluation and suggested revisions will be posted within one week and you have one week to submit a revised version. Your final grade for each lab will be based on the revised lab. If no revision is received, the first grade will stand for the lab.

Format: The following sections must be present in every report: (Note that an important concept in communication is T^3 – (1) Tell them what you are going to say. (2) Tell them, (3) Tell them what you told them.)

1. Title

2. (20 pts) Abstract. An abstract is a summary (< 250 words) of information in a longer document or is a concise version of information to be presented later. In this course, it is a summary of everything associated with the lab. It has a format that must be followed rigorously:

    A. Principal objectives and scope of the investigation.
    B. Theory and methodology. What is the conceptual basis for the lab? What are the data? How were they analyzed?
    C. Concise summary of the results. What are the specific products of the lab? A number? – must include uncertainty. An interpretation of a map? – use concrete language. How do observations and theory come together?
    D. State the principal conclusions and any further speculation.

    The skill for you to develop is in choosing the words needed to encapsulate all important points while stripping away all extraneous details. Keep it to one paragraph. Work is often judged by its abstract. Examine every word with care; remove all that are unnecessary. Omit all experimental details, references, and lengthy expositions of your detailed knowledge. If it can be said in 100 words rather than 250, do so.

3. (10 pts) Introduction: Give a clear statement of the conceptual basis for the report and the theoretical background - equations are secondary and may need only a citation to where they are given.

4. (10 pts) Methodology: Where did you get the data? What did you do? How was uncertainty quantified? What data products (calculations, maps, tables,

figures) are created? (Specifically mention all). Do **NOT** discuss the results and the implications in this section.

5. (40 pts) Discussion: What was observed? How did the data and the theory compare? How does your work compare with material discussed in the text? What inferences were made? All labs come with a set of questions to guide the interpretation. Clearly identify the questions asked and the answers based on your work. Extra credit will be given for interpretations that extend beyond the questions. Text should refer to figures and tables by number. Features in the figures should be specifically noted and labeled.

   An excellent way to begin the discussion section is to refer to a figure or table. Here is an example from a report discussing earthquake locations in California: " In figure 1 earthquakes are clearly concentrated along a trend that is coincident with the mapped location of the San Andreas fault. …"

6. (5 pts) Conclusions: This is a summary of what was accomplished. Per T^3 – tell them what you told them. No new ideas should be included in this section.

7. (5 pts) A list of resources cited or used in preparation of the report. Use a standard science reference citation format:
   (authors, title, journal, volume, pages, year)
   Brown, J. M., Equation of state of iron, Geophys. Res. Lett., 75, 1005-1007, 2001
   It is expected that your textbook will be cited since information there is important in nearly all labs. But every item in the reference list must have an in-line citation in the text. In-line citations should be in the form: (Brown 2009) if citing a paper written by Brown in 2009, (Brown and Smith 2008) for a dual authored paper, and (Brown et al. 2007) if there are three or more authors.

8. (10 pts) Figures and tables. Figures, graphs, and tables must be numbered and labeled (x-axis, y-axis – quantity and units) with a title, legend, and arrows or circles as needed to highlight critical features. Error bars must be included in figures. A caption is required and should give necessary information to understand the content. Think about the necessary precision of numbers reported. If a quantity is only good to 3 significant figures (a 1% uncertainty), do not list 10 significant figures in your table

Report Length: No hard requirement is placed on the length of your report. It may be as short as several pages. Example: one paragraph each for the abstract, introduction, and methodology, a page or so of discussion, followed by a paragraph of conclusions and the references. Figures and tables can be embedded in the text or placed at the end. Creating many pages based on poorly organized and fuzzy thoughts is easy. The challenge is to write just enough to clearly articulate the key ideas.

Grading: Half of the total points are awarded for following the format – you are guaranteed 50 pts if I can find all elements discussed above. I may give no points at all for a section if required elements are missing. The remaining 50 points will be awarded based on how well you accomplish and communicate the work.

Notes on "Uncertainties"

All scientific measurements and observations are subject to uncertainty. It is your job not only to make the observation but also to determine its uncertainty. You will be given **no credit** for work that does not include an estimate of uncertainty. This applies to **every** quantitative result in **every** report all quarter. You will experience difficulty in identifying ways to describe or analyze uncertainty. It is your responsibility to discuss this with the instructor. Here are several examples of common sources of uncertainty:

1. Uncertainty in the primary measurement. Example: measure a distance on a printed map using a ruler. The ruler has a smallest gradation of millimeters. It may be possible for you to estimate the ruler distance to the nearest 0.1 millimeter. If, based on the map legend, a millimeter is equivalent to 5 km, the distance uncertainty on the map will be 0.5 km. Thus, you could report a map location to +/- 0.5 km. Misfit of the data to the theory can be a guide to the uncertainty in the data (scatter about a prediction if the theory is correct) or can indicate that the theory is incomplete or incorrect.
2. Uncertainty in an analyzed quantity (a model result). **Error propagation** is used to determine the uncertainty in a quantity that results from calculations based on primary measurements and some quantitative model. For example, one can determine the speed of a car by measuring the time it takes to go by a series of marker posts. The velocity is determined from the slope through time-distance data (each point has some uncertainty in the time and in the location). The accuracy of the velocity determined depends on the propagated uncertainties of each of the measurements.

During the quarter each lab will challenge you with different kinds of uncertainties in both data and model fits. You are expected to include a credible statement about how uncertainties were established for every lab. Some key terms in quantifying uncertainty include the "standard deviation", the "standard error", and "95% confidence intervals". The instructor and external sources (like Wikipedia) can be an excellent resource if you have questions about these terms.

Writing examples:

Report language that would receive a high grade:

> Seismicity of the Nasca Plate – South America subduction zone was examined. Earthquake locations and depths for events larger than magnitude 5 were found in the ANSS database for South America

between 1975 and 2007 in a latitude range from 9°S and 10°S and longitude range from 130°W to 90°W. A nearly linear trend in the depth to events (shallow at the coast and becoming as deep as 700 km at a distance 150 km inland of the coast) may indicate the location of the subducting Nazca plate. The dip angle of the trend is X+/-Y degrees. These observations are consistent with expectations based on the concept of Plate Tectonics with the shallow, cold subducting lithosphere being seismogenic.

Report language that would receive a low grade:

> Dr. Brown gave us some earthquake data from South America and we made a bunch of plots. We used a pencil and paper to make the plots and we pasted them into our notebooks. The plot of eq. vs depth showed some funny stuff that you can see like earthquakes going down inside the earth under South America. This is proof that plate tectonics exists.

The textbook

Reading is assigned in the text in support of lecture coverage. This will not always match perfectly with laboratory projects. You are expected to use the table of contents and the index to locate material in the text that is useful for the labs.