**TEACHING NOTES AND TIPS**

**BATHYMETRY OF RIFTED MARGINS LAB**

**I. INTRODUCTION**

**The RCL sedimentary module is planned as a 3-part sequence:**

(1) The very short powerpoint “Rupturing Continental Lithosphere: Introduction (from Dorsey 2013)” is the starting point\*. It will give students a preview of the scientific goals and findings of the RCL Initiative and a context for their study of the role of sediments in the evolution of rifts.

(2) **The lab exercise (“Bathymetry of rifted margins” lab)** is designed as the first activity in the “Rupturing Continental Lithosphere” mini-lesson sequence\*. In this exercise, each student investigates the geometry of the Red Sea (a cratonic rift) and of the Gulf of California (an orogenic rift) by creating a contoured bathymetric map and one or more topographic profiles of each area using GeoMapApp. Each student examines the geometry of the Gulf of California in detail by constructing a series of topographic profiles across successive extensional basins, compiling the profiles on a single graph, and calculating average depth for each profile using Excel.

(3) The final part, a powerpoint lecture and accompanying problem set (“Role of Sedimentation in Rifting”), asks students to investigate the role of isostasy and the role of sedimentation in the development of rifted margins. Students will use their observations of Gulf of California bathymetry to estimate the depth of basin fill. Students will examine the relationship between sedimentation in extensional basins and thinning of crust and mantle lithosphere.

\* The other modules in the Rupturing Continental Lithosphere mini-lesson series are also designed to follow both the “RCL Introduction” powerpoint lecture and the “bathymetry of rifted margins” lab investigation.

**II. BATHYMETRY OF RIFTED MARGINS LAB**

**Prerequisite knowledge (students)**

 1) Basic understanding of plate motion at spreading centers (i.e. plate motion is parallel to transform faults, and is not required to be perpendicular to the spreading ridge).

2) Familiarity with Excel. Step-by-step instructions for compiling, analyzing and plotting measurements are included as an appendix, but some prior experience using Excel is very useful.

**Description of lab exercise**

The “Bathymetry of Rifted Margins” lab begins with an introduction to the morphology, relative plate motions, and bathymetry of the Red Sea rift. Students will use GeoMapApp to create a topographic and bathymetric contour map, and to draw a bathymetric profile across the Red Sea. Students are asked to work in pairs with each partner creating his/her own map and bathymetric profile, and to describe the morphology of the Red Sea rift based on similarities and differences between the bathymetric profiles drawn by both partners. Step-by-step instructions for using GeoMapApp are given in an Appendix.

The main part of the “Bathymetry of Rifted Margins” lab is a more detailed study of the morphology, relative plate motions, and bathymetry of the Salton Trough – Gulf of California region. Each student will work with a partner to identify transform faults, interpret relative plate motion direction, and draw bathymetric profiles across a half dozen different sedimentary basins in the Salton Trough and Gulf of California (partners need not study all of the same basins). Students are asked to compile and analyze data by importing their bathymetric profiles into Excel, plotting all profiles on a single graph, and calculating average depth of each basin. Step-by-step instructions for using Excel are given in an Appendix. At the conclusion of the lab, students are asked to discuss north-to-south changes in the shape and depth of Gulf of California basins, and to propose a hypothesis to explain the observed variation.

**Tips for instructor**

Show students GeoMapApp at the beginning of class, and show them the link to MARGINS Focus Sites, and the data sets that are available. These sites were chosen because they were important globally.

[GeoMapApp](http://www.geomapapp.org/) takes a lot of time to learn. Becoming familiar with this tool is one of the learning objectives for this exercise. If you don't have time to devote a full lab class to learning GeoMapApp, you can skip this exercise, and use one or more of the other exercises without doing this module first.

The layout of this lab exercise places all of the specific instructions for how to use GeoMapApp in an appendix. Consequently, students will have to keep going to this appendix to get instructions for the next step. This layout is intended to separate the basic concepts and thought questions from the "nuts and bolts" instructions. Some instructors may choose to let students practice using GeoMapApp before the lab or at the beginning of the lab (for example, do the Red Sea profiles in class, as a group) to help students pick up basic GeoMapApp skills before undertaking the main lab activity, the Gulf of California profiles. Other instructors may chose to restructure the lab hand-out by moving instructions from the appendix into the text.

Student selection of lines for their bathymetric profiles is critical. **It is essential for students to identify the opening direction correctly, and to choose profiles that are perpendicular to the opening direction for each basin**. The instructor may decide to define assigned profiles in advance, both to avoid errors in profile orientation and to simplify comparison of students' answers. Or the instructor may choose to lead students through the first profile or two as a group, to make sure they have the right idea before allowing them to proceed independently with the rest of the lab.

Draw profiles from shore to shore.

Start drawing profiles in the southernmost part of the Gulf, where the strike of transform plate boundary segments is the most obvious, and work northward.

Students should answer the questions as they work through the lab (i.e. think about their results as they go along).

Make this a fully in-class exercise, so students interact with the instructor and with each other. Follow through in class to make sure students grasp the key principles: opening/extension direction vs. plate boundary; continental crust vs. oceanic crust and influence on bathymetry; sediment thickness variation. Students interpret, with one-on-one guidance, and then review as a group and compare to classmates' interpretations and to published interpretations. Allow individual write-ups so students can demonstrate their comprehension.