### Earth 103 Module 1

#### Lab 1: PETM

#### Global warming during the Paleocene-Eocene Thermal Maximum

In this lab, we explore the magnitude of the warming that took place during the PETM based on proxy data. We compare PETM temperatures with current temperatures as well as warming predicted for the year 2100. We will look at Mg/Ca, oxygen isotope and TEX-86 proxy temperatures from a number of cores of marine PETM sediments drilled in the oceans and on land, as well as margin analysis of leaves from land sections, to determine the temperature change. If you have not read the relevant material on proxies and the PETM in this module, please go back and do this before you begin the lab.

Please Note: The data are provided in Google Earth file.

The goals of this lab are:

1. To compare the magnitude and rate of warming at the PETM with that of today.
2. To get comfortable with Google Earth, especially turning maps on and off.

If you have not worked through the [Google Earth Tutorial in the Orientation](http://e-education.psu.edu/earth103/orientation/googleearth), you must do so now.

#### ****Files to Download (Please download from the course website)****

1. [PETM Data](https://www.e-education.psu.edu/earth103/sites/www.e-education.psu.edu.earth103/files/module01/PETM%20Data.kmz)
2. [PETM Paleogeography](https://www.e-education.psu.edu/earth103/sites/www.e-education.psu.edu.earth103/files/module01/PETM%20Paleogeography.kmz)
3. [Modern SST](https://www.e-education.psu.edu/earth103/sites/www.e-education.psu.edu.earth103/files/module01/Modern%20SST.kmz)
4. [Projected Temperature](https://www.e-education.psu.edu/earth103/sites/www.e-education.psu.edu.earth103/files/module01/Projected%20Temperature.kmz)

#### ****Instructions****

Load [the PETM Data kmz file](http://www.e-education.psu.edu.earth103/files/module01/PETM%20Data.kmz) into Google Earth. The map shows continental positions and the extent of the ocean during the PETM. The red markers show the site positions that you will use for this lab. If you click on them you will get several pieces of information:

(1) the proxy used to determine temperature;

(2) the temperature just before the PETM (pre-event) and

(3) the PETM temperature.

I recommend you make a table similar to the example on the next page, that shows all of the data, as well as your calculated temperature change.

| **Site Positions** | **Proxy** | **Pre-event Temperature** | **PETM Temperature** | **Temperature Change** |
| --- | --- | --- | --- | --- |
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Next, practice turning on the modern sea surface temperature (SST) map in the [Modern SST kmz file](http://www.e-education.psu.edu.earth103/files/module01/Modern%20SST.kmz) as well as the map that shows SST projections for 2100 in the [Projected Temperature kmz file](http://www.e-education.psu.edu.earth103/files/module01/Projected%20Temperature.kmz) (this file shows temperature anomalies, meaning increases in temperatures in degrees C). Please note that you can only have one of the Modern and Projected Temperature files turned on at any time, but you can have the PETM data kmz file turned on with them to compare the PETM temperatures with those of today and those projected for 2100.

Note that since the continents have moved a long way in 55 million years since the PETM, there are places in the PETM ocean which now lie in the position of the modern continents and thus don’t have equivalent modern temperatures (you will see some PETM sites in the dark blue area of the modern continents).

After you have made the table from the data that you collected and feel comfortable comparing the data with temperatures read from the temperature kmz maps, please answer the **practice** questions below. Once you feel good about your answers, go to Lab 1 in Module 1 in Canvas. There will be two labs available to you, Module 1 Lab 1 (Practice) and Module 1 Lab 1 (Graded). You will have a chance to answer practice questions and get the correct answers before answering the Module 1 Lab 1 (Graded) questions for credit. Please make sure you fully understand the practice questions **before you start the graded questions** for credit. You may want to review some of the content in Module 1 to help prepare. Keep in mind that **you will only get one chance to complete the graded labs**.

#### ****Practice Questions****

1. What is the temperature increase at Bass River during the PETM (give your answer in degrees centigrade)?
2. Which oceanic site (i.e. only site with numbers located in the ocean basins) has the smallest temperature change?

**Now turn on the Modern temperature map and answer the following questions:**

1. Compared to modern temperatures, is the location of Site 277 warmer or colder during the PETM?
2. Which oceanic site (i.e. only sites with numbers located in the ocean basins) has the smallest temperature difference between PETM and modern?

Now turn off the Modern temperature map and turn on the Projected 2100 map and answer the following questions.
3. Is the most significant warming in the projection at high latitudes (meaning above 60 degrees latitude North and South of the equator? Yes or No
4. Comparing this to the PETM where there is no general pattern of warming with latitude, does the 2100 projection have a latitudinal pattern? Yes or No