

ABSTRACT

Using data to explain difficult geologic concepts and to illustrate fundamental spatial relationships has long been an important aspect of geoscience education...

At the lower-division level (physical geology, environmental geology, and natural hazards), some specific online exercises include: 1) evaluating flooding recurrence intervals...

TEACHING OBJECTIVE

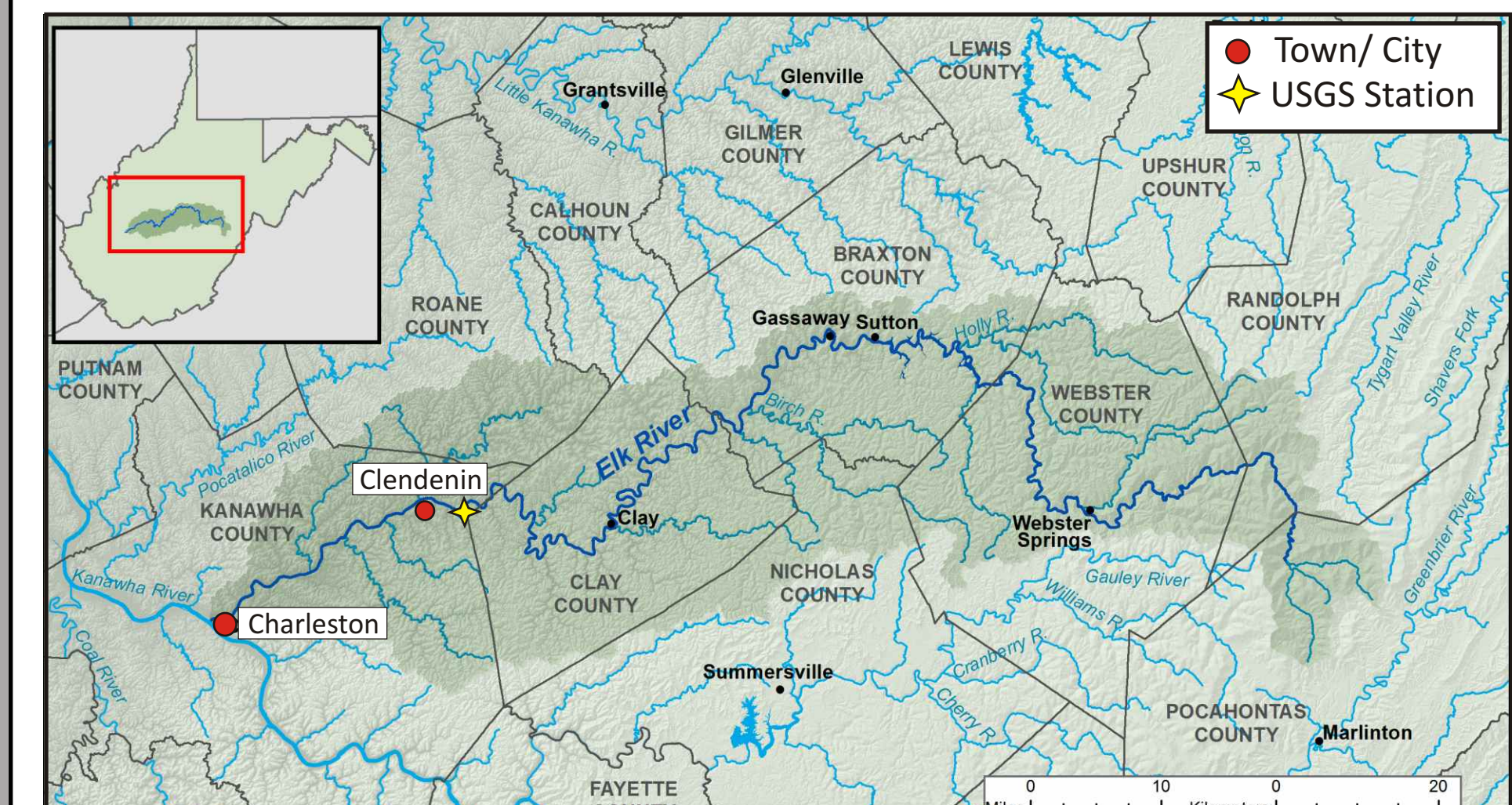
As educators, we are challenged with keeping students engaged and actively participating during class. Regardless of the approach we take, our efforts must resonate beyond the classroom...

- 1) Earth Scientists use repeatable observations and testable ideas to understand and explain our planet
2) The Earth is constantly changing and evolving through time
3) Water is an essential component of the Earth
4) Humans have the capability to significantly alter the Earth

LOWER-DIVISION EXERCISE

GEOHAZARDS EXERCISE

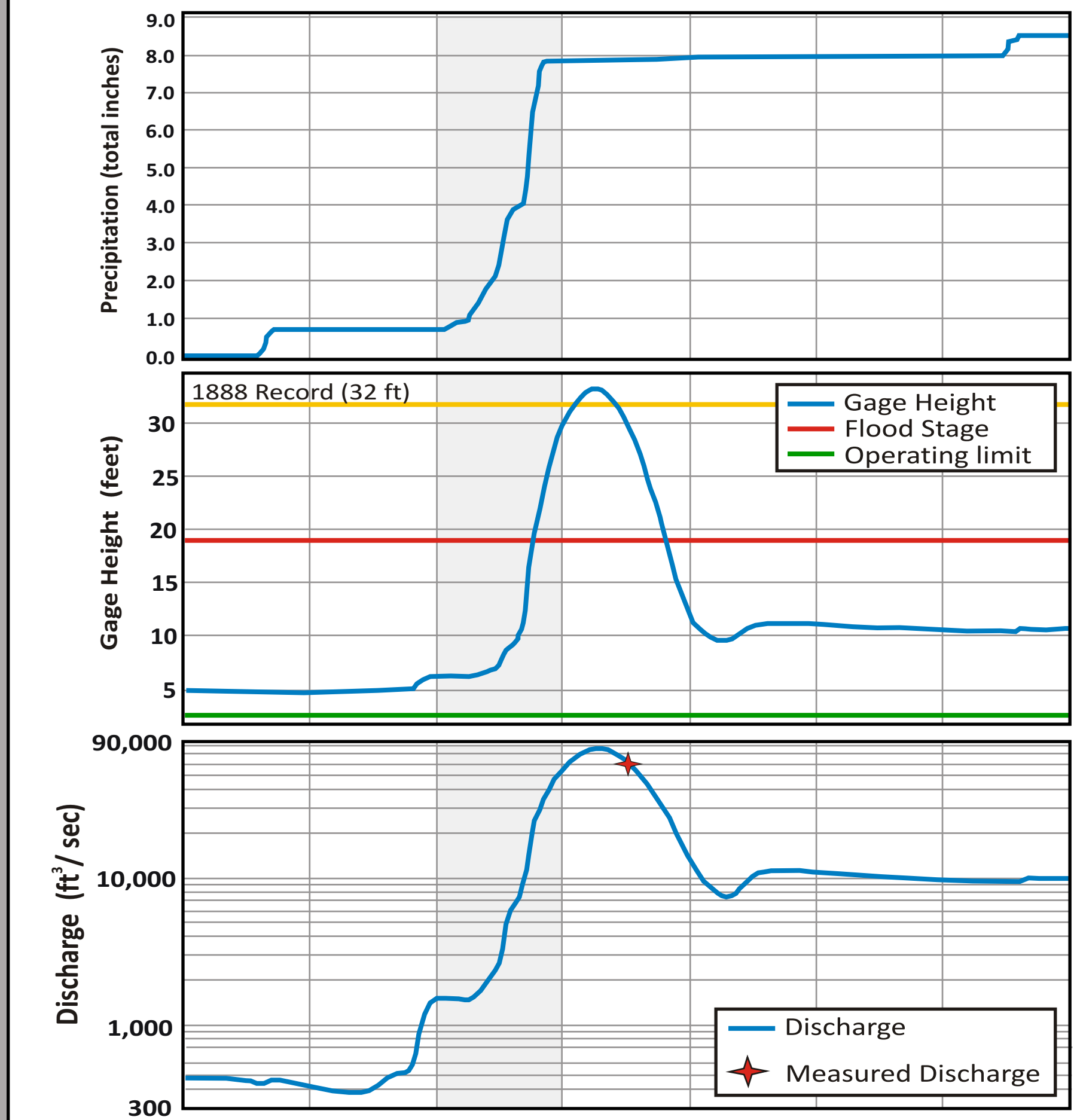
On June 23, 2016, torrential rainfall produced widespread flooding throughout much of West Virginia. Along the Elk River in Kanawha County, the small town of Clendenin, WV was especially hit hard...



PART 1: First, students must locate the Elk River and the town of Clendenin, WV (Image above - Elk River watershed, modified from www.wikipedia.org).

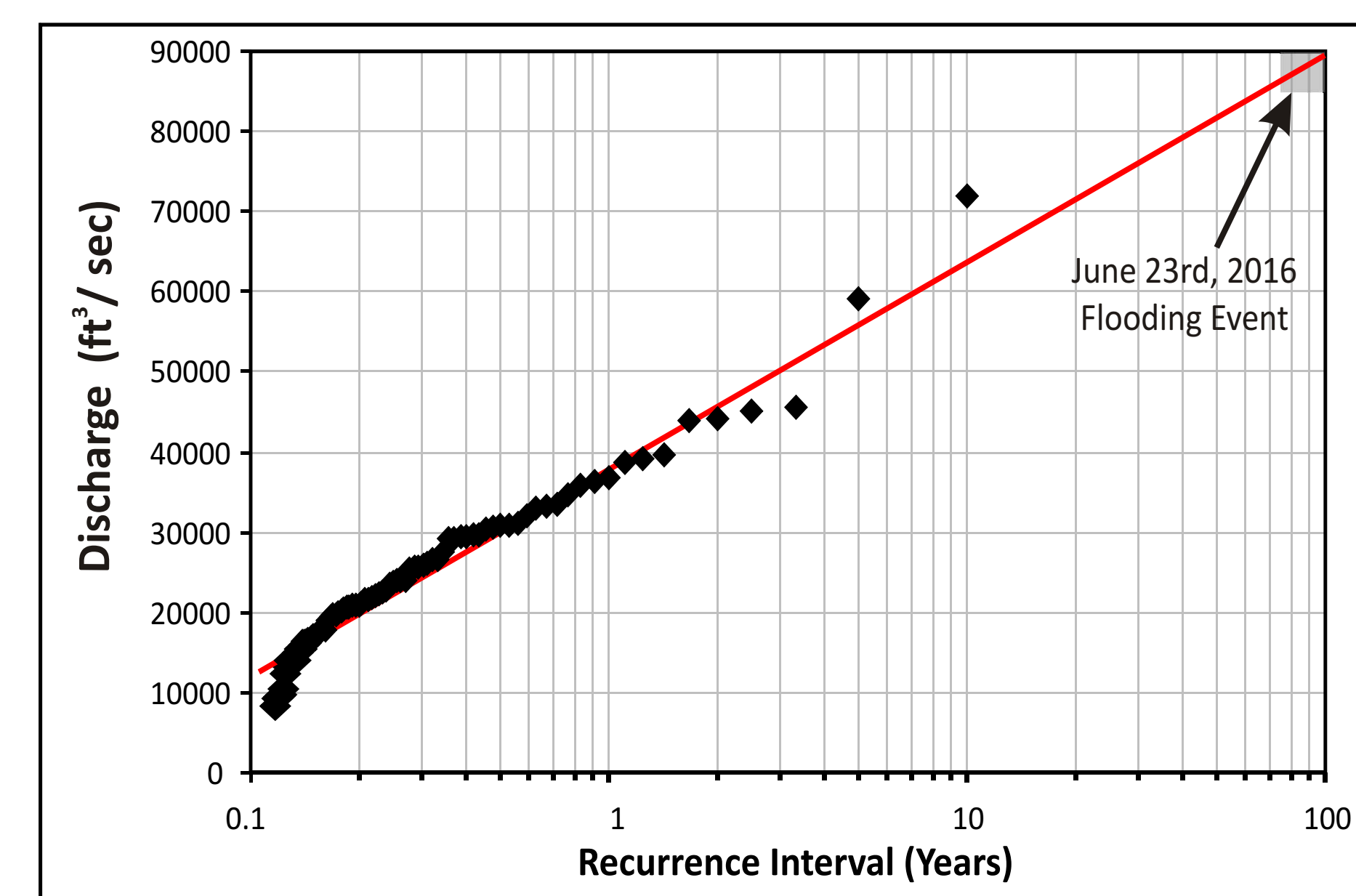
Table with 2 columns: Water Year, Date. Includes data for peak streamflow at Queen Shoals, WV.

USGS 03197000 Elk River at Queen Shoals, WV



PART 2: Using the NWIS website, students are instructed to create plots of the streamflow data. The plots above contain NWIS data for USGS station 03197000 (Elk River at Queen Shoals, WV from June 21, 2016 to June 27, 2016).

PART 3: Using the NWIS website, students are instructed to navigate to the annual peak streamflow data for the Elk River. The image above is a screen capture, showing the different types of output formats available...



PART 4: After importing the data, students analyze the Elk River peak streamflow events. Once they record their observations, students determine the recurrence interval of the 6/23/16 event. The image above illustrates the rating curve for the Elk River, showing annual peak streamflow data from Dec. 1st, 1928 to present...

LOWER-DIVISION EXERCISES

GPS TIME SERIES EXERCISE

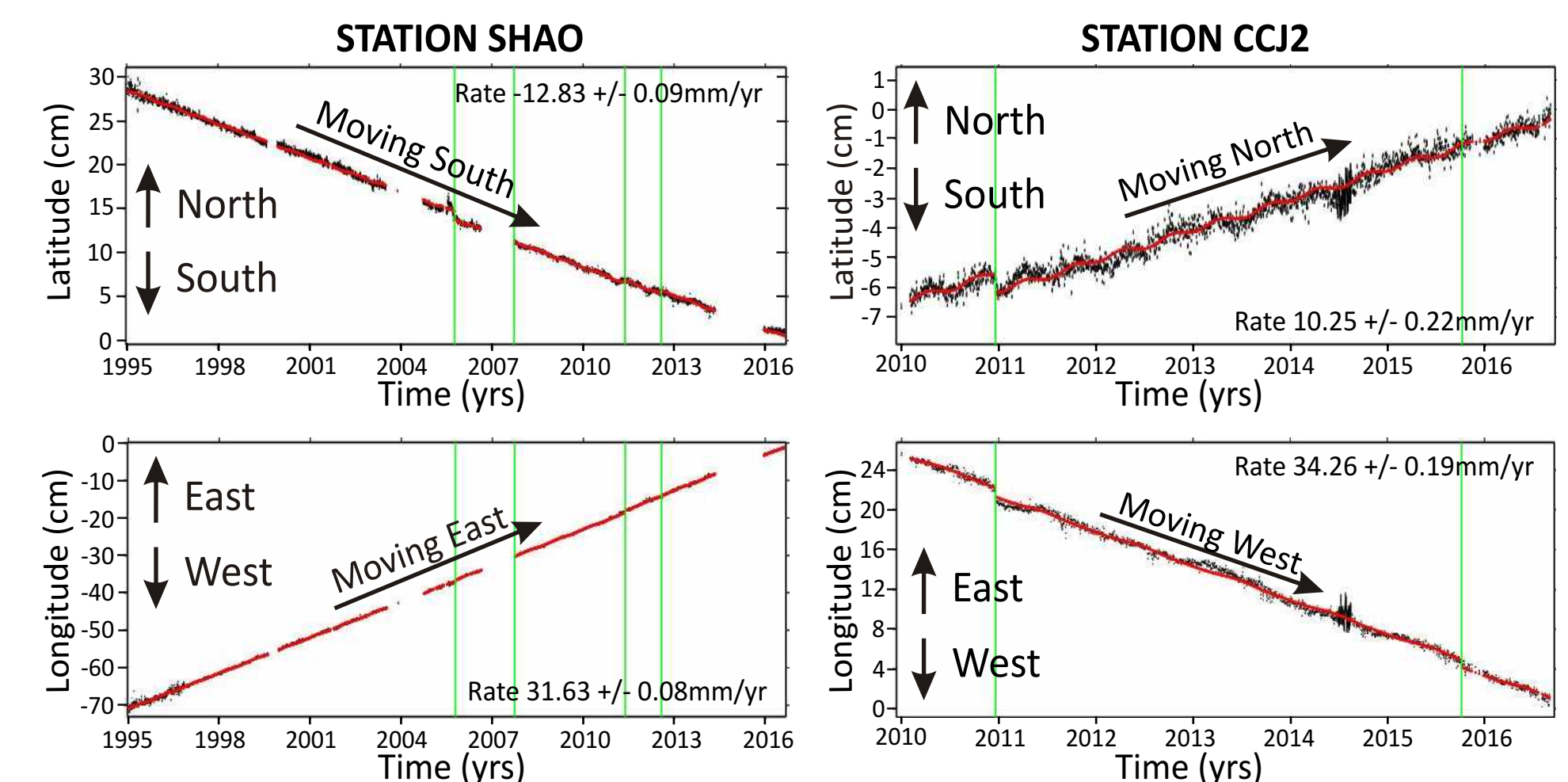
Following a brief introduction to plate tectonics, students are asked to complete an in-class exercise that is aimed at 1) helping students visualize the movements of tectonic plates...



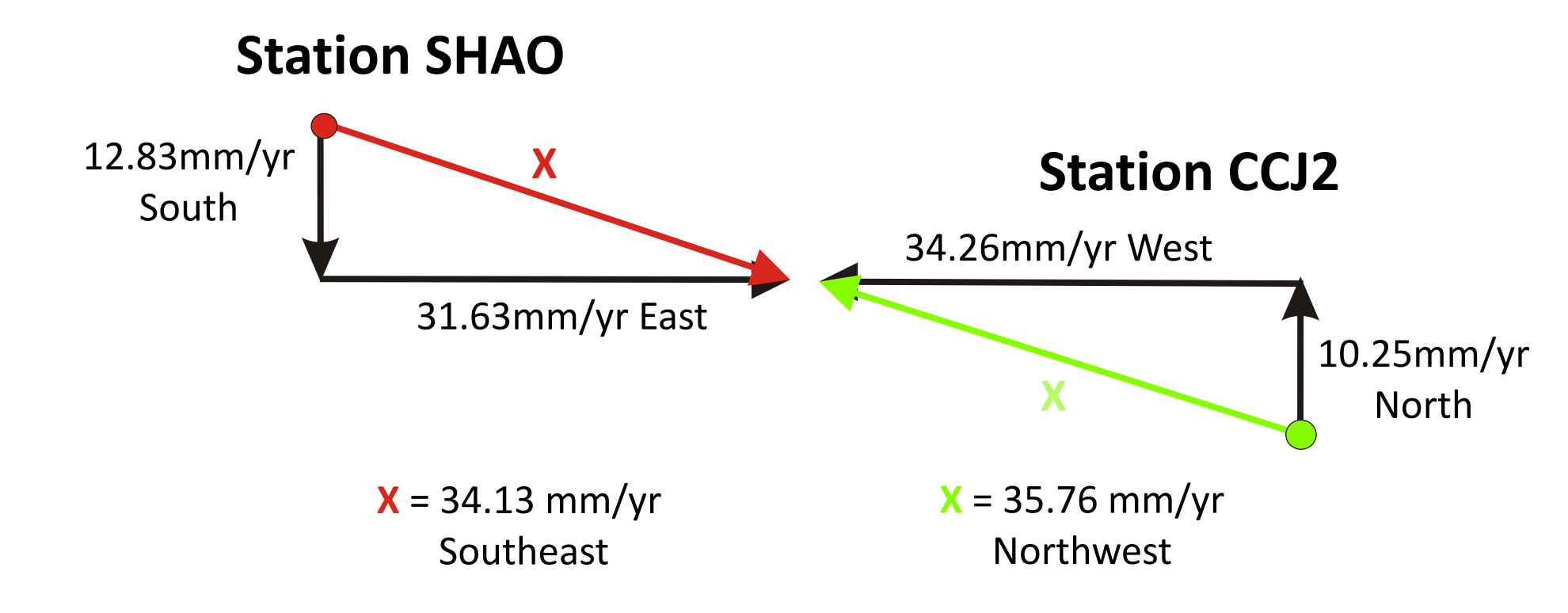
PART 1: Using the interactive Google map tool, students are instructed to locate specific GPS stations. (Image above - screen capture from NASA JPL website highlighting stations SHAO and CCJ2).



PART 2: After examining the horizontal velocities, students record their observations, predict plate boundary types, and sketch the plate boundary on the map (Image above shows plate boundary sketch - pink line).



PART 3: Students then examine the online GPS time series data to determine the relative motions of each GPS station. As an example, station SHAO (above left) shows a decrease in latitude with time (moving south) and an increase in longitude with time (moving east)...



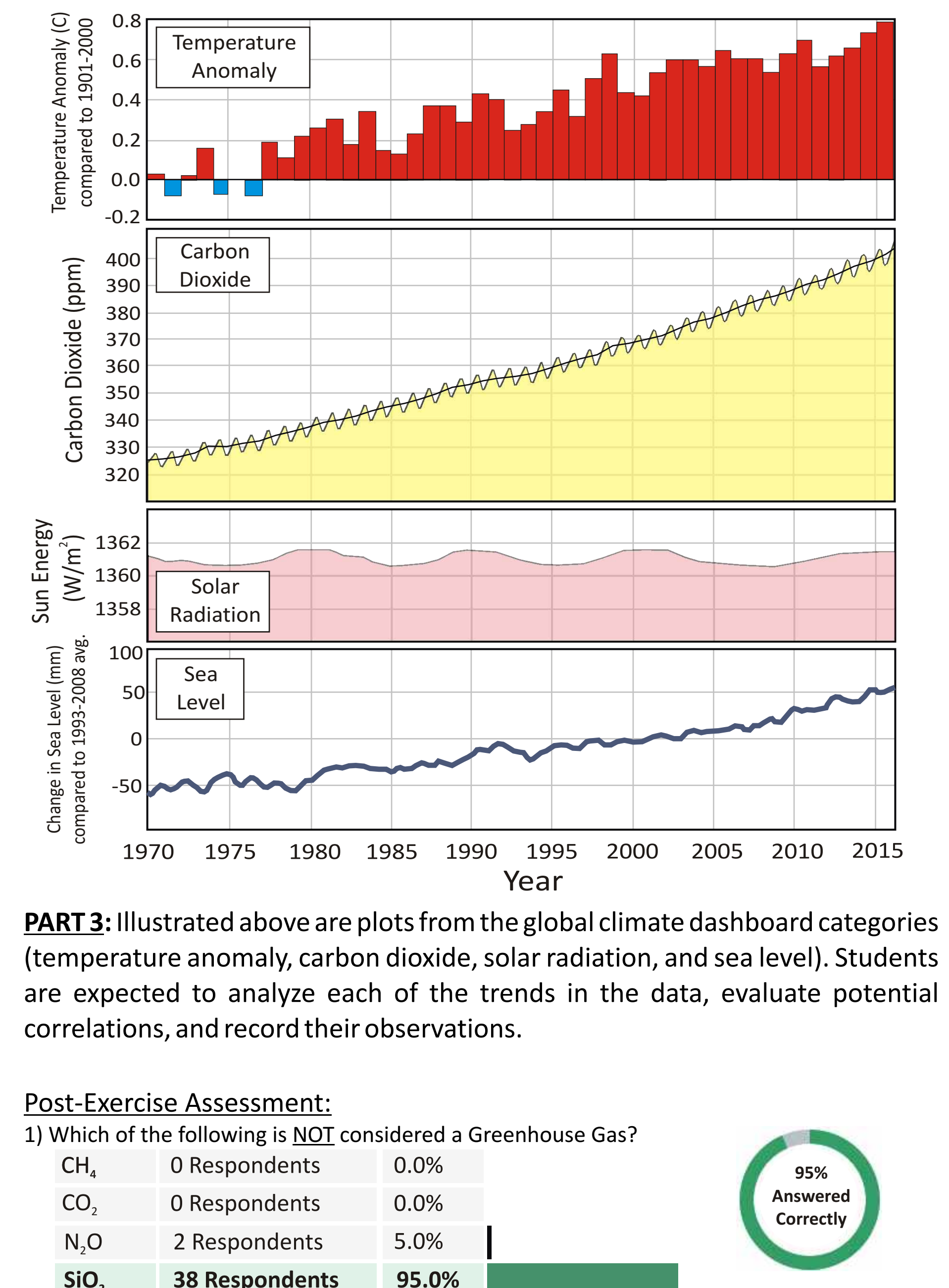
PART 4: Using the horizontal components for each station (illustrated in Part 3), students are then asked to create a simple sketch of the relative motions for both GPS stations (shown above). After making the sketch, the students calculate the final horizontal velocity for each station and determine the rate of plate motions.

CLIMATE CHANGE EXERCISE

Climate change is becoming an increasingly more important topic to society. Thus, giving students an opportunity to examine climate-related data allows them to reach their own conclusions about the changes occurring to our planet...

EXAMPLE SURVEY QUESTIONS:

- 1) Which of the following is NOT considered a Greenhouse Gas?
2) (T/F) Climate Change will affect the entire globe equally.



PART 1: Before the exercise, students are asked to complete an anonymous survey regarding climate change. This survey helps to assess student perceptions and their current understanding of key information about climate change...

Global Climate Dashboard interface showing various climate data points and survey results.

PART 2: Following the survey, students are asked to explore the range of data available on the website. This allows them to become familiar with the website and to explore their curiosity. The image above is a screen capture of the 'Global Climate Dashboard' on the NOAA Climate.gov website...

PART 3: Illustrated above are plots from the global climate dashboard categories (temperature anomaly, carbon dioxide, solar radiation, and sea level). Students are expected to analyze each of the trends in the data, evaluate potential correlations, and record their observations.

Post-Exercise Assessment results for the climate change exercise survey.

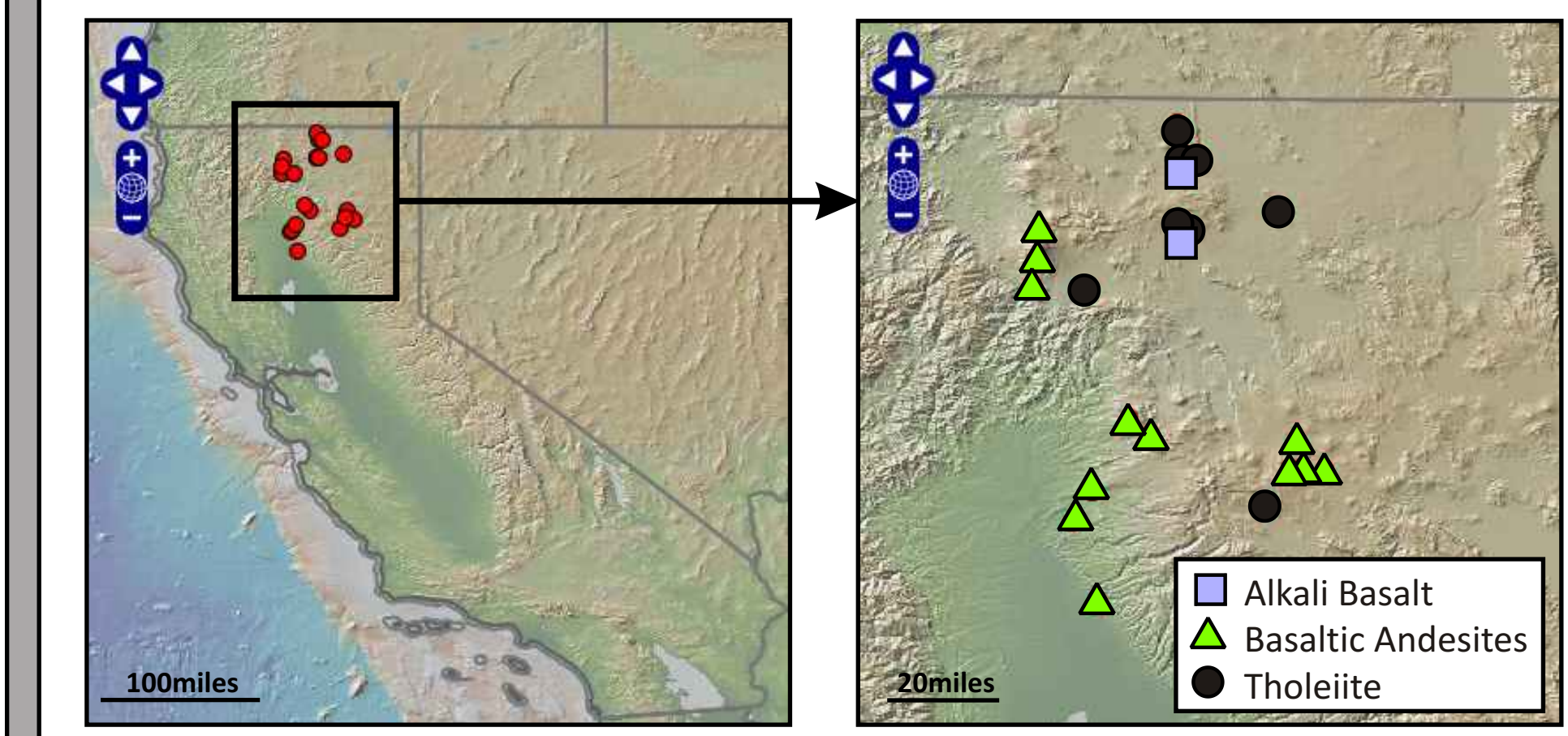
UPPER-DIVISION EXERCISE

PETROLOGY-GEOCHEMISTRY EXERCISE

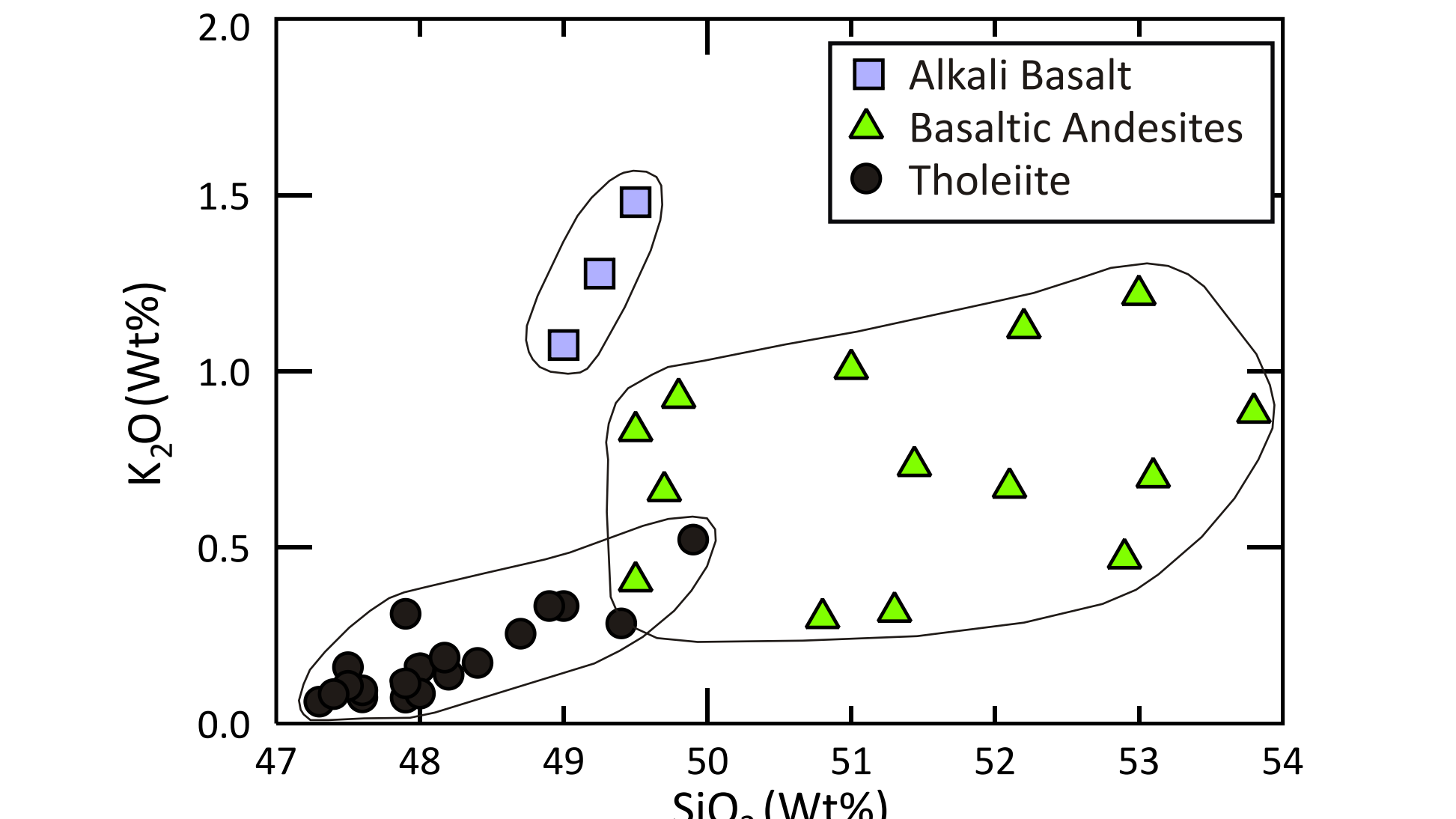
In this exercise, students use whole-rock major- and trace-element compositions of igneous rocks from the southern Cascade Volcanic Arc in the Western U.S. to evaluate the compositional diversity of volcanic fields...

NAV DAT database interface screenshot showing search options and filters.

PART 1: Students are asked to navigate to the NAVDAT database to locate a specific dataset. The image above is a screen capture of the NAVDAT website, showing the range of search options that students can explore.

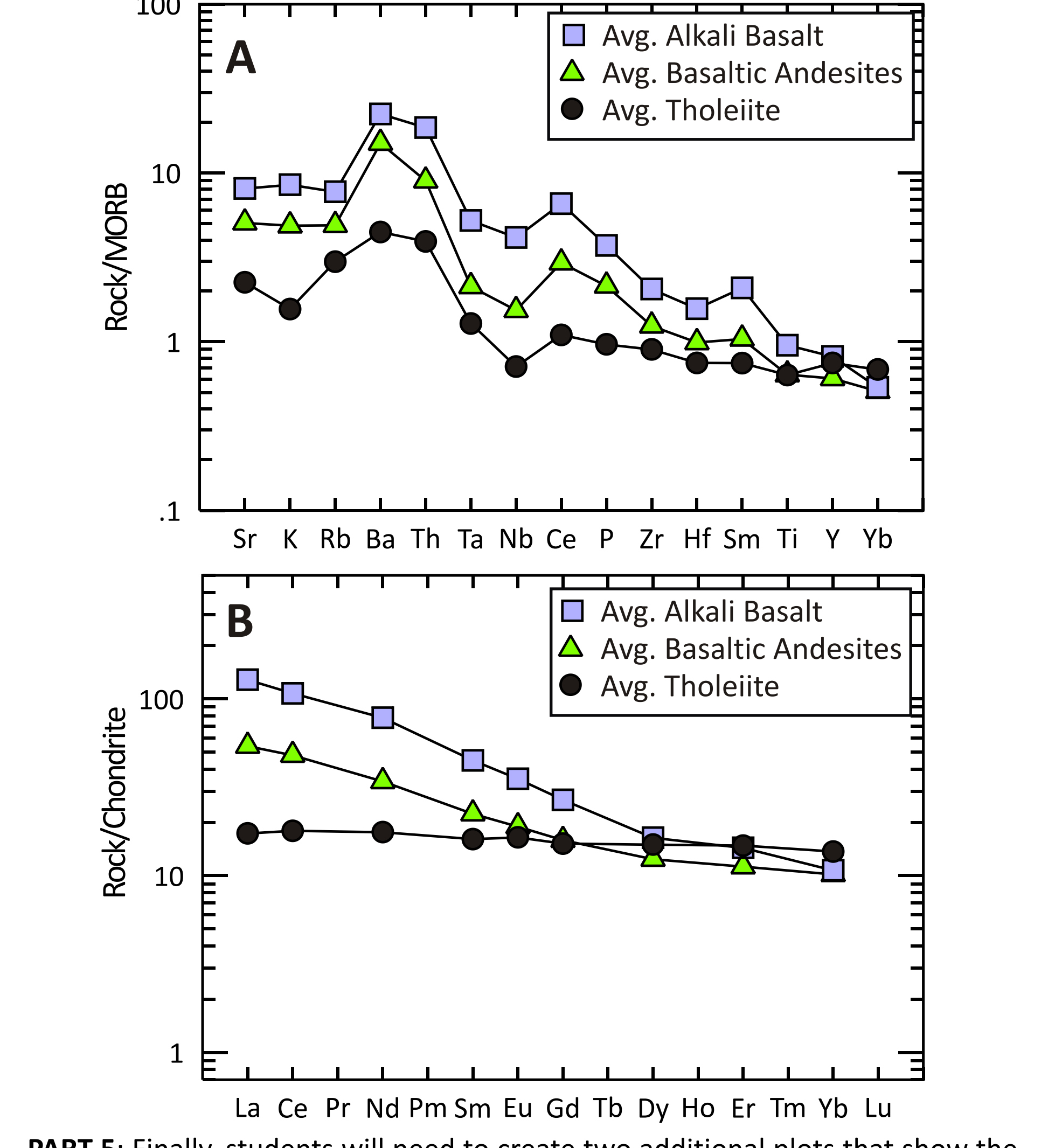


PART 2: Using the NAVDAT website, students will need to document the spatial distribution of each sample. This places the samples into a geologic context and helps the students look for spatial patterns that may help explain the geochemical diversity...



PART 4: One of the main objectives of this exercise is to have students explore the data, make geochemical plots (Harker Plots), and record their observations. In the plot above, for example, the alkali basalts have much higher alkali content than tholeiitic samples...

Table of geochemical data for various rock samples, including concentrations of Sr, K, Rb, Ba, Th, Ta, Nb, Ce, P, Zr, Hf, Sm, Ti, Y, and Yb.



PART 5: Finally, students will need to create two additional plots that show the variability of trace element concentrations (MORB-normalized and Chondrite-normalized REE plots - shown above). For this portion, students are given the normalizing data (MORB - Pearce, 1983; Chondrites - Sun and McDonough, 1989)...

DISCUSSION AND FUTURE DIRECTIONS

Online databases and repositories are excellent resources for geoscience educators. Because these resources are readily accessible, they can be used to develop activities appropriate for any course (major and non-major)...

- 1) The activities can be a lot of fun!
2) Promotes exploration and curiosity
3) Fosters open discussions among peers
4) Develops quantitative literacy and verbal reasoning skills
5) Promotes new ideas while reinforcing previously obtained knowledge
6) Provides an opportunity to analyze real data and draw valid conclusions about current geologic issues
7) Encourages the formulation of new hypotheses
8) Exercises can be easily assessed

Although these activities have already been tested in various classroom settings, ongoing work will focus on the assessment of these activities to better document the quality of student learning.