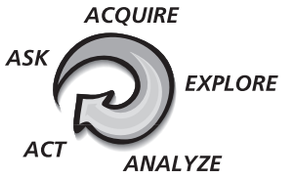
NAME _____ DATE _____

The Earth Moves

A GIS investigation



Answer all questions on the student answer sheet handout

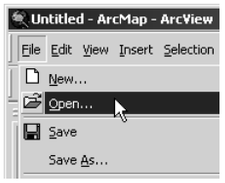
Step 1 Start ArcMap

a **Double-click the ArcMap icon on your computer's desktop.**

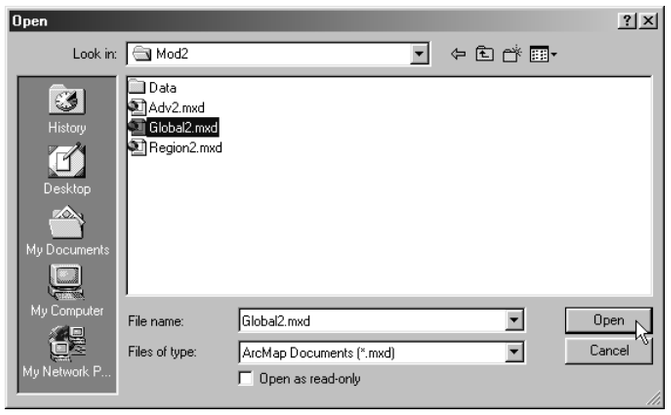
b **If the ArcMap start-up dialog appears, click An existing map and click OK. Then go to step 2b.**

Step 2 Open the Global2.mxd file

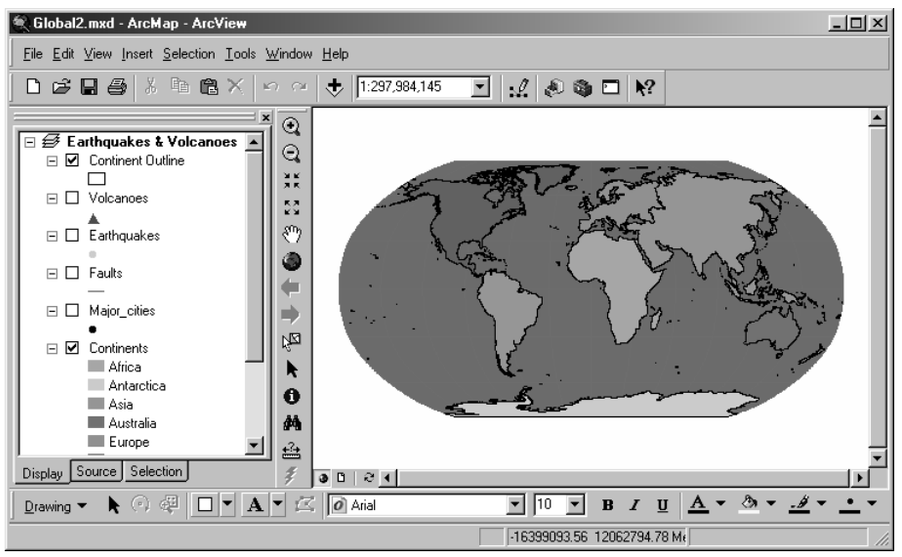
a **In this exercise, a map document has been created for you. To open it, go to the File menu and choose Open.**



b **Navigate to the module 2 folder (C:\MapWorld9\Mod2) and choose Global2.mxd (or Global2) from the list.**



c **Click Open.**



When the map document opens, you see a map with three layers turned on (Continent Outline, Continents, and Ocean). The check mark next to the layer name tells you the layer is turned on and visible in the map.

Step 3 Look at earthquake location data

In this step, you will compare your original theories about earthquake and volcano locations to actual data using GIS.

a **Turn on the Earthquakes layer by clicking the box to the left of the name in the table of contents.**

This places a check mark in the box and adds a layer of points showing the locations of earthquakes on the map.

b **Evaluate the map and write your answers to the following questions on the answer sheet:**

(1) Do earthquakes occur in the places you predicted? List the regions you predicted correctly for earthquake locations.

(2) What patterns do you see in the map?

Step 4 Sort and analyze earthquake magnitudes

You can take a closer look at the data behind the dots by looking at the attribute table of the Earthquakes layer. An attribute table contains specific information about the features in a layer. In the Earthquakes layer, each point represents an earthquake with a magnitude of greater than 5.0 on the Richter scale. In this step, you will use the attribute table to focus on the 15 strongest earthquakes.

a **In the table of contents, right-click Earthquakes and click Open Attribute table.**

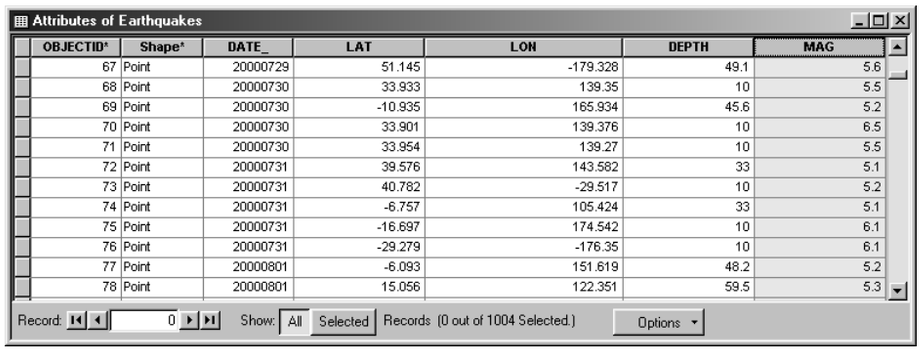
You see all the attribute data associated with the yellow earthquake points on the map.

Do not maximize this table. It will prevent you from viewing the map at the same time.

b **Look at the table. Scroll down to see more records.**

Remember: Each record in this table represents one point on the map.

c **Click the field (column heading) labeled MAG to select it.**



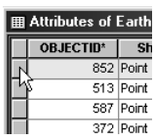
The heading appears depressed and the column is highlighted in blue when the field is selected. This field represents the magnitude of the earthquakes.

d **Scroll up to the top of the table. Now you will put the magnitudes in order from the largest magnitude to the smallest.**

e **Right-click the MAG field heading and click Sort Descending.**

The records have been rearranged from largest to smallest. Now you will select the 15 largest earthquakes.

f **Hold down the Ctrl key, click the small gray box to the left of the first record in the table, and drag your mouse until the first 15 records are highlighted in blue.**



To make sure you have highlighted 15 earthquakes, look at the status bar at the bottom of the table. It should display:

If you select too many records, click the Options button at the bottom of the table and click Clear Selection to clear the selections and try again.

When you select a record in the attribute table, its point on the map will be highlighted also.

g **Move the attribute table out of the way so you can see where the 15 strongest earthquakes are located on the map. At this point, selected earthquakes may overlap, causing some selected earthquakes to "disappear." If this occurs, zoom in until you can see all the selected earthquakes.**

Note: Refer to the ArcMap Toolbar Quick Reference for a brief explanation of the Zoom and Pan tools.

How do the 15 selected locations compare to your original paper map? List three ways.

h Click the Full Extent button to see the entire world on the map.

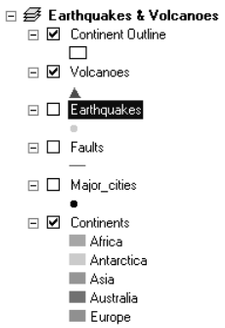
i At the bottom of the attribute table, click the Options button and click Clear Selection.

Note: If you don't see the Options button, your table window may be too narrow. Widen your table window until you can see the Options button on the bottom right portion of the table.

j Close the attribute table.

Step 5 Look at volcano data

a Turn off the Earthquakes layer and turn on the Volcanoes layer.



(1) How do the volcano locations compare with your original predictions? List the regions of volcanic activity you predicted correctly.

(2) What patterns do you see in the volcano points and how do they compare with the earthquake patterns? (Hint: Turn the Earthquakes layer on and off.)

The volcano data includes information on the status of each volcano (active, inactive, and potentially active). You will focus on the active volcanoes.

Step 6 Select all active volcanoes

a In the table of contents, right-click Volcanoes and click Open Attribute Table.

The Type field of the table tells you if each volcano is Active, Potentially active, or Solfatara (emits gases, but is otherwise inactive).

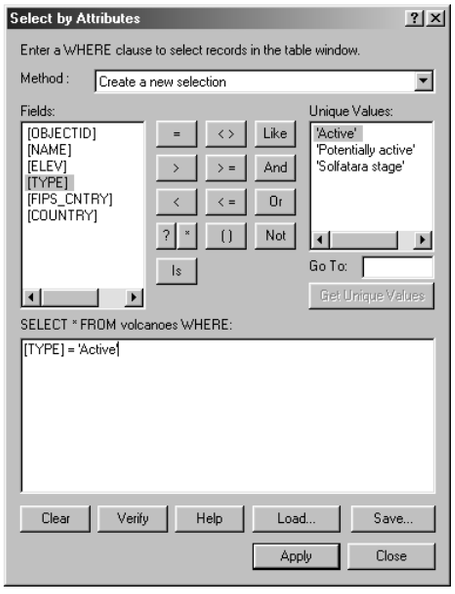
b Click on the Type field heading.

c Right-click the Type field heading and click Sort Ascending. Scroll down and you will notice that there are many active volcanoes.

It would not be fun to highlight all of these as you did with the Earthquakes layer. This is a smart database—we can ask it to select all of the active volcanoes by using Select by Attributes.

d At the bottom of the attribute table, click the Options button and click Select By Attributes.

e In the Select by Attributes dialog, make sure Method is set to "Create a new selection." In the left-hand Fields list, double-click Type. Single-click the equals sign (=). On the right-hand side, click the Get Unique Values button. Three values appear in the Unique Values list. Double-click "Active" in this list.



f Near the bottom of the dialog, click Verify. If the expression is successfully verified, click OK.

Hint: If you receive a syntax error, check that your equation is exactly like the one in the graphic above. If it isn't, click Clear and try again.

g At the bottom of the dialog, click Apply. All the active volcanoes are selected and highlighted blue.

h Close the Select by Attributes dialog and close the attribute table to see the map. Use the Zoom and Pan tools to explore where the active volcanoes are located.

(1) Does this data provide any patterns that were not evident before? Identify those patterns.

(2) Create a hypothesis as to why volcanoes and earthquakes happen where they do.

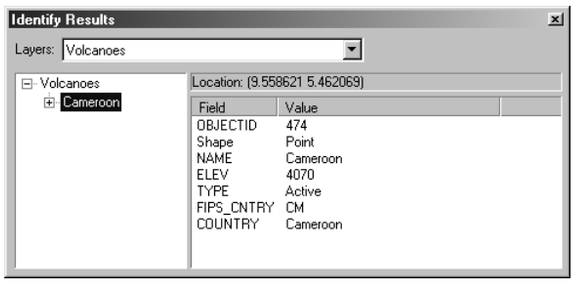
Step 7 Identify the active volcanoes on different continents

In order to learn more about the active volcanoes, you can use the Identify tool.

a Click the Identify tool. The Identify Results dialog displays. Click the Layers drop-down arrow and select Volcanoes in the list.

b Move your cursor over the map display. Notice how the cursor has a small "i" next to it.

c Click on an active volcano on the map. The Identify Results dialog shows you the name of the volcano, its elevation, type, and country location. For example:



d Close the Identify Results window and zoom in to the continent of your choice.

e Use the Identify tool to find the name, elevation, activity level, and country location of three volcanoes.

Write that information on the answer sheet.

f Close the Identify Results dialog.

g In the table of contents, right-click Volcanoes, point to Selection, and click Clear Selected Features to unselect all of the active volcanoes.

h Click the Full Extent button to see the entire world on the map.

Step 8 Add the plate boundaries layer

The earth is always changing. The crust of the earth is composed of several tectonic plates that are always on the move. Movement occurs at the boundaries between the plates and on the surface of the plates themselves.

Based on the location of the earthquakes and volcanoes, where do you think the plate boundaries are? Draw them on your paper map.

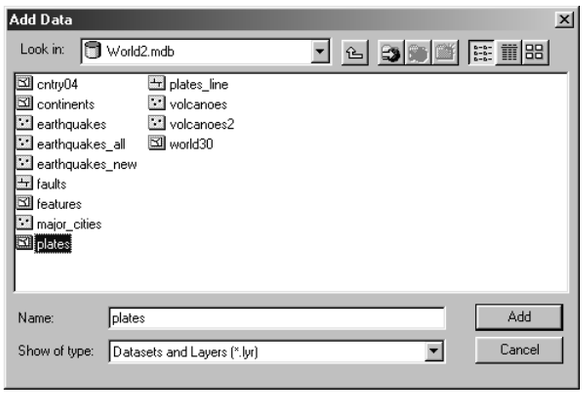
There are four basic types of plate boundaries. In this part of the GIS activity, you will investigate where these boundaries exist and how they affect the landforms close to them. Here's a quick review of the different types of plate boundaries:

- *Divergent boundary.* One or two plates are splitting apart. New crust is being formed from the center of the earth, causing the plate to spread. Rift valleys are one example of this type of plate movement.
- *Convergent boundary.* Two plates are colliding, forcing one plate to dip down underneath another one. The plate that is folding under has old crust that is being destroyed, while the plate on top has mountains and volcanoes being formed. In the ocean, these appear as trenches.
- *Transform boundary.* Plates are sliding against each other, causing large faultlines and mountains to form. Here, the crust is neither created nor destroyed.
- *Plate boundary zones.* Plate boundaries appear erratic (zigzagged). Scientists believe there are actually microplates in these areas, but it is unclear what effect these zones have on the physical environment.

a Turn off the Volcanoes layer.

b Click the Add Data button.

c Navigate to the module 2 data folder (**C:\MapWorld9\Mod2\Data**). Double-click **World2.mdb** to open it. Click **plates**.



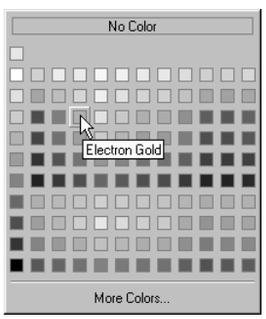
d Click Add.

The plates layer is added to your table of contents.

e In the table of contents, click the symbol beneath plates. The Symbol Selector opens.

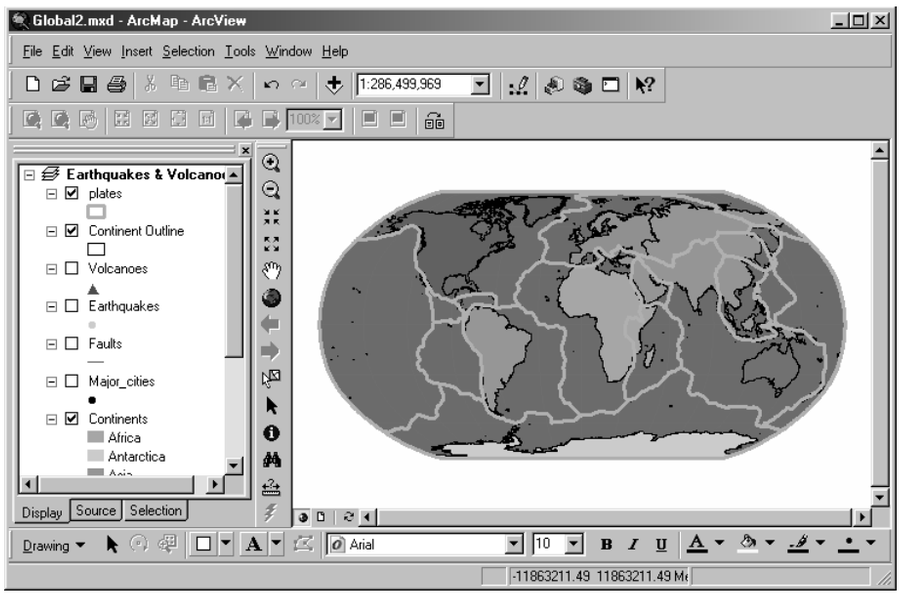
f On the right side, click the Fill Color down arrow and click No Color. This will create an outline of the plate boundaries.

g Click the Outline Color down arrow. Pause your mouse over a color to see its name. Click the Electron Gold color.



h Increase the Outline Width to **2**.

i Click OK. The gold outline symbol appears in the table of contents and on the map.



Compare the actual plate boundaries to the ones you drew on your paper map. Record all similarities and differences.

Step 9 Add a layer file and an image

In order to get a closer look at landforms and boundaries, you will add two more layers:

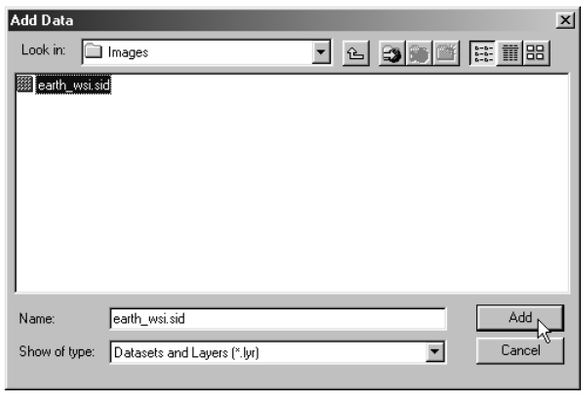
- *Major Landforms.lyr:* a layer file containing major physical features of the planet.
- *earth_wsi.sid:* a color-shaded relief map of the earth, made from a satellite image.

a Click the Add Data button, then click the Up One Level button to navigate to the Data folder. Double-click the LayerFiles folder to open it.

b Double-click **Major Landforms.lyr** to add it to your map.

c Click the Add Data button, then click the Up One Level button to navigate to the Data folder. Double-click the Images folder to open it.

d Click **earth_wsi.sid** and click Add.



Any file with a .sid extension is a compressed image file. Please note that images do not have tables attached to them. Because earth_wsi.sid is an image file, the Identify tool will not call up data for the image.

e In the table of contents, click earth_wsi.sid and drag it above the Continents layer.

f Look at the map. Are there any areas where major landforms, plate boundaries, and seismic activity (earthquakes and volcanoes) overlap?

g Use MapTips to find out the names of all major landforms formed at plate boundaries. Move the mouse pointer over a landform feature to see the MapTip. Write the names in the table on the answer sheet and label them on your paper map.

Predict how these features were formed by using your knowledge of plate boundaries (see the beginning of step 8 for a quick review).

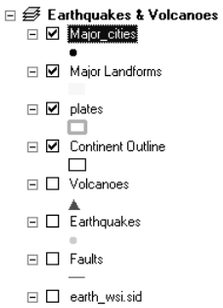
First, you will identify the plates by labeling them in ArcMap.

h In the table of contents, right-click on plates and click Label Features. Now, next to the name of each landform in the table on the answer sheet, write how you think the landform was created. The first one is completed for you.

Step 10 Identify major cities at high and low risk for seismic activity

Next, you will find cities with a high and low risk of earthquake and volcanic activity.

a **Turn off earth_wsi.sid. Move the Major_cities layer to the top of the table of contents and turn it on.**



b **Use the Zoom, Pan and Identify tools to find the names of specific cities that are high-risk or low-risk for a seismic event. Write those names in the table on the answer sheet.**

Hint: Remember to turn layers on and off as needed and to move the layers around in the table of contents.

Step 11 Exit ArcMap

In this GIS investigation, you used different layers to determine where earthquake and volcanic activity is located around the world. From this information, you were able to determine cities at high or low risk for these natural disasters.

a **Ask your teacher for instructions on where to save this ArcMap document and on how to rename the map document.**

b **If you are not going to save the map document, exit ArcMap by choosing Exit from the File menu. Click No when you are asked if you want to save changes to Global2.mxd (or Global2).**