

## Lesson plan – The Volcanoes in Greece – Worksheet

### Introduction:

Recent - in geology terms - volcanic activity in the Hellenic Territory goes back approximately 40 million years and continues almost without interruption. Older manifestations of volcanic activity have been recorded in Eastern Macedonia and Thrace (Zarkadenia, Dipotama, Kalotyxo, Kirki - Aisympi and Feres - Dadia volcanic fields and **Samothraki**) between 35 to 23.6 Ma and in Samothraki reach up to 19 Ma.

Then, volcanic activity migrated to the south and vigorously emerged in the Northern Aegean Sea region (**Samothraki**, Imvros, Limnos, Agios Eustratios, and **Lesvos**) as well as at the nearby coast of Asia Minor. At the Northern Aegean Sea islands (Limnos, Ag. Eustratios, Lesvos) severe volcanic activity is observed, between 23.2 and 16.2 Ma.

Scattered volcanism at a small volume and extent is present in the Central Aegean region, between 17 and 13 Ma. It is only specific to small manifestations in **Skyros**, Psara and Chios, while larger formations are found in Central Euboia (**Oxylithos** and Orio). A series of granites are present in Cyclades and the Eastern Aegean; their age varies between 17 and 8.5 Ma. The oldest of them are located in Ikaria, Tinos, Mykonos, Dilos, Naxos and Keros.

Volcanic activity is then restricted to the eastern Aegean, between Samos and Kos, from 10.7 to 5.6 Ma. Only in **Patmos** volcanic activity reach up to 3.5 Ma.

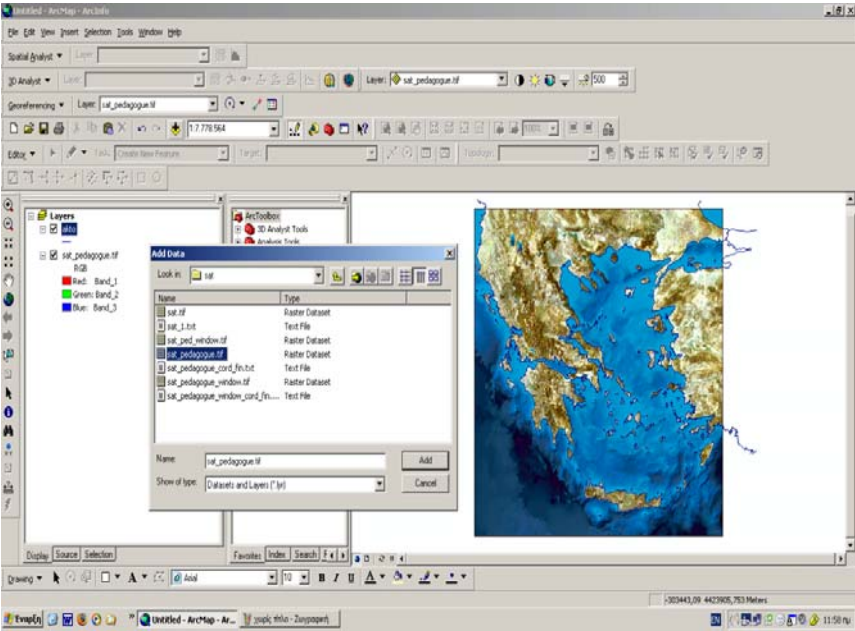
Scattered volcanic activity has been recorded in the Hellenic territory for a period between 6 and 0.5 million years. Such activity is concentrated at the western shores of Pagasitikos gulf and at the Northern Euboikos gulf (**Achilleio**, Porfyrio, **Mikrothives**, Lichades, Agios Ioannis), at the Voras massif (**Almopia**), at the Strymonikos region (Strymoniko, Didymoi Lofoi (Twin Hills), Gavra, Ankistro), **Antiparos** and at the rocky islet Psathoura.

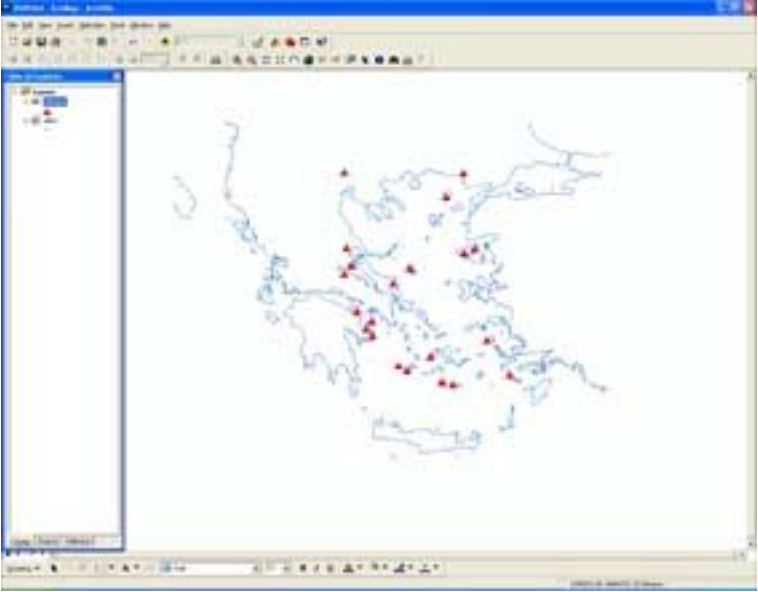
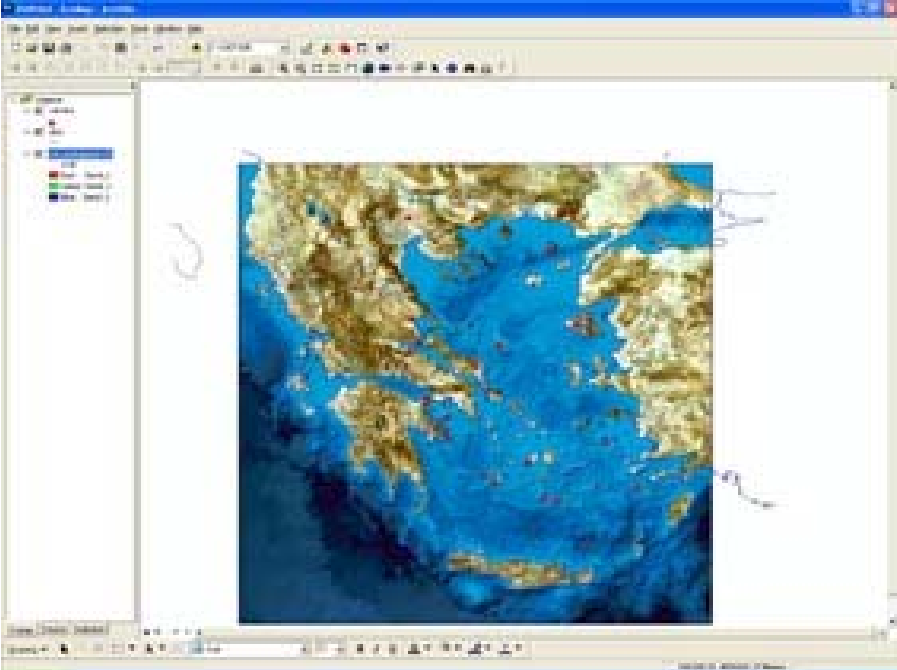
Intense volcanic activity occurs from Pliocene and up to the present age, in the Southern Aegean volcanic arc region. Volcanic activity age in **Sousaki**, **Aegina** and **Poros** spans in excess of 2 million years, while **Methana**, **Santorini** and **Nisyros** are volcanoes formed during the last 1 million years. **Milos** is host to both old and new volcanoes.

The active volcanoes of Greece are part of the Hellenic volcanic arc, a curved-line of volcanoes stretching from **Sousaki** in the east to **Kos** in the west. The volcanoes are the result of the subduction of the north-moving Africa plate under the Aegean microplate (part of the Eurasian plate). The historic record for eruptions in Greece dates back 2000 years. The first observation was the eruption at Methana in 258 BC that formed a lava dome and flows. The eruption at Santorini in 197 BC was the first record of the formation of a new volcanic island; there are also numerous surviving witnesses to the latest eruptions of the Santorini volcano (1925-1928, 1939-1941, 1950).

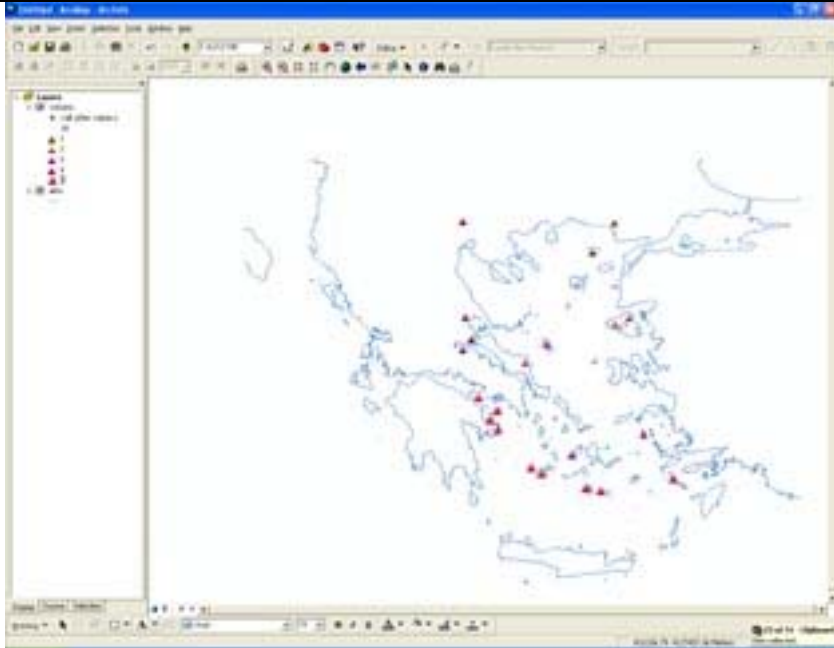
### Description of the exercise:

In this exercise, students will visually present the spatial distribution of volcanoes that occurred in the area of Greece. They'll locate zones with significant extinct and active volcanoes of Greece and make correlation of volcanic arc to tectonic plates boundaries as well as active faults and seismic activity. Furthermore they could identify the volcanic islands of Greece.

no	instruction	iNotes	Teachers' / Trainers' activity	Pupils' / participants' activity
1	<p><b>Step 1</b> Open ArcMap, click <b>A</b> new empty map and click OK.</p>		<input type="checkbox"/>	<b>X</b>
2	<p><b>Step 2</b> Add the datalayer “<i>sat_pedagogue.tif</i>” to show the satellite image of Greece (see screenshot).</p>  <p>Observe carefully the image and answer the following questions:</p> <ol style="list-style-type: none"> <li>1. <i>Mark (write down) some locations where you think volcanic activity or volcanoes exist.</i> ..... ..... .....</li> <li>2. <i>How did you choose these locations?</i> ..... ..... .....</li> <li>3. <i>What major cities are close to these locations?</i> ..... ..... .....</li> </ol>	1	<input type="checkbox"/>	<b>X</b>
3	<p><b>Step 3</b> You will now compare the predictions you made about volcanoes</p>		<input type="checkbox"/>	<b>X</b>

<p>locations to actual data using ArcGIS</p> <p>Remove the satellite image from the screen and now Add the datalayer of <i>volcano.shp</i>. Then add the shape file "<i>akto.shp</i>"</p> <p>You can change the point symbol for volcanoes (choose shape triangle and red color) (see screenshot).</p> 	<p>1</p> <p>13</p>		
<p>Volcanoes points are drawn on the map. The points show the locations of all volcanoes of Greece (active, potential active and extinct).</p> <p>Add the datalayer "<i>sat_pedagogue.tif</i>".</p> 	<p>1</p>		

	<p><i>Note: the organisation of thematic layers!</i>  <i>Thematic layers are saved in a top down order: first points, then lines and in lastly polygons (or sat photo). To move a thematic layer, check (click) on the layer and drag up or down.</i></p> <p><i>Q4: Do volcanoes occur in the places you predicted? List the regions you predicted correctly for volcanoes locations.</i></p> <p>.....                  .....                  .....                  .....</p> <p><i>Q5: What patterns do you see in the volcano locations, and how do they compare with the earthquake patterns? (Turn the earthquakes layer on and off as needed)</i></p> <p>.....                  .....                  .....                  .....                  .....</p>			
4	<p><b>Step 4</b></p> <p>You can take a closer look at the data behind the dots by looking at the attribute table of the volcano layer.</p> <p>The field <b>Id</b> represents, in categories (5 for more recent and active volcanoes to 1 for the oldest and extinct volcanoes), the geological epoch (from Upper Eocene to Pliocene and Quaternary) that greek volcanoes were created. Now you will put the categories in order from the oldest to current ones.</p> <p>Now you will categorize the volcanoes according the geological epoch and show on the map volcano categories with different colors. The data includes extinct, dormant and active volcanoes.</p>	28  31  34	<input type="checkbox"/>	X



Based on the locations of different categories of volcanoes can you answer to the following questions?

*Q6: What patterns do you see in the locations of volcanoes categories (according to geological epoch)? Could you explain your answers?*

.....  
 .....  
 .....

*Q7: Where in Greece do you think that may be happen the next volcanic eruptions?*

.....  
 .....  
 .....

Search to the following internet site to find information about volcanoes in Greece:

[http://85.72.53.43:1956/nisyros\\_en/index.php?option=com\\_content&task=view&id=86&Itemid=109](http://85.72.53.43:1956/nisyros_en/index.php?option=com_content&task=view&id=86&Itemid=109)

<http://vulcan.wr.usgs.gov/Volcanoes/Greece/framework.html>

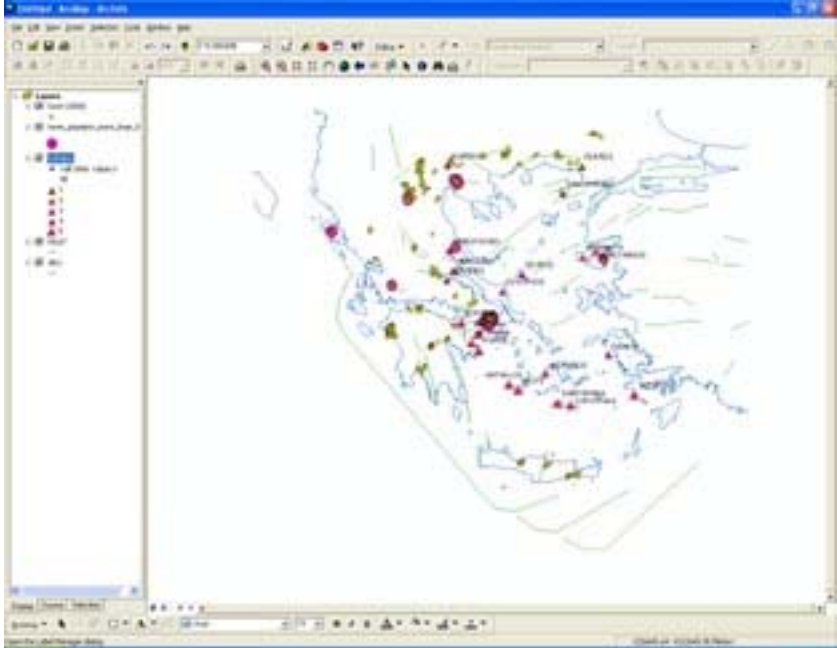
<http://www.volcanolive.com/greece.html>

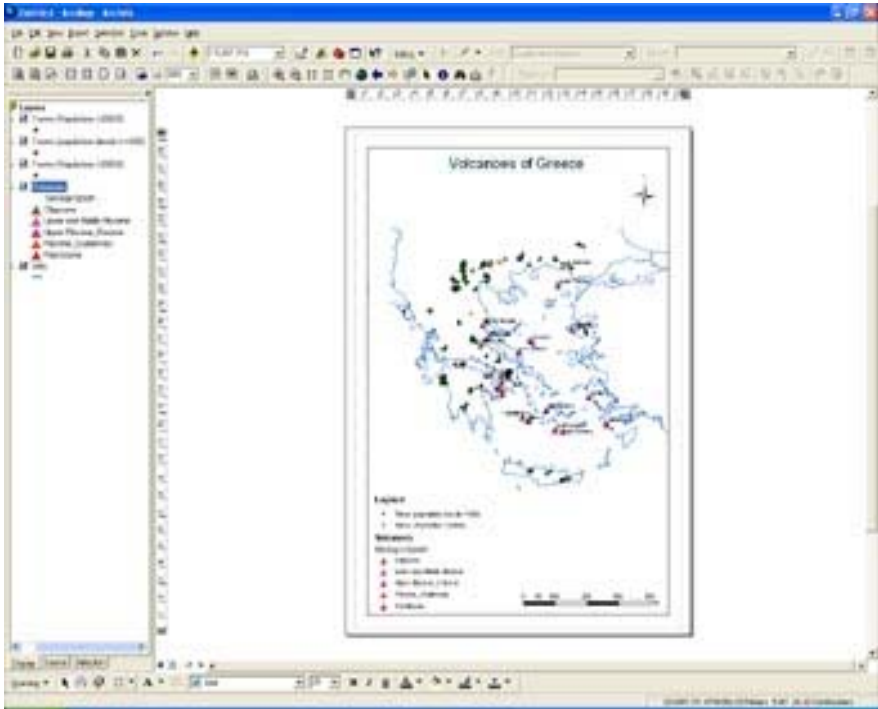
Save the map that you have created as volcano.mxd.

21





<p>7</p>	<p><b>Step 7</b>                  Identify major cities at high or low risk for volcanic activity.                  Measure the distance between active volcanoes and nearby big cities.                  Choose a city that's located near an active volcano.                  Click the Zoom in tool and then click the city's dot on the map (now you can see all the information about this city).                  Use the Measure tool to determine the distance from other cities to nearby active volcanoes.</p>  <p><i>Q10: What is the closest distance you found between a volcano and a city? Record that city, the volcano, and the distance between them. (Use the identify tool as needed)</i></p> <p>.....                  .....                  .....                  .....                  .....</p> <p><i>Q11: Are there many active volcanoes located close to cities?</i></p> <p>.....                  .....                  .....</p>	<p>16</p> <p>11</p>	<p><input type="checkbox"/></p>	<p>X</p>
----------	--	---------------------	---------------------------------	----------

8	<p><b>Step 8</b></p> <p>Create a geographical map (active volcanoes in Greece where included also the major cities), with a north arrow, a legend and a scale bar.</p> <p>Your map might look like this.</p>  <p>And now you can print your map!</p>	22	□	x
9	<p>Export your map as <code>Volcanoesyourname.pdf</code> and save it in your portfolio on Moodle.</p>	19	□	x
<b>Congratulations!</b>				

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information