



מכון ויצמן למדע

Weizmann Institute of Science

רחובות 76100, ישראל

המחלקה להוראת המדעים

קבוצת מדעי כדור הארץ והסביבה

The Rock Cycle

A field trip to Makhtesh Hatira

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4th GOAL workshop

January 2020

Content:

Tectonic processes: a folding structure

The rocks' cycle

Rock and landscape

Rock and society

The learning stops and expected schedule

06:45 – leaving Rehovot

09:45 – Reaching the town Yeruham

10:00-13:00 – Stop1: Makhtesh Hatira

14:00 – 16:30 – Dead Sea

18:30 – Rehovot



Rock and Society: Looking over the industrial area of Yeruham

In the northern side of the road there are three industrial sites: Negev ceramic, Fenicia bottles and Ackerstein stones.

Please look at the yard of each industry and try to identify the product and the raw materials of each of them. Please write your observations in the table below.

The factory	The product	The raw materials
Negev ceramic		
Fenicia Bottles		
Ackerstein		

What is the common factor of all these tree factories? _____

What is the reason that theses factories were located here? _____

Stop 1: Mt. Avnon - The Makhtesh view



A. Orientation

Look around and with the help of the teacher identify the following sites: the cliff, the Hatira wadi, the quarry, the site where the Hatira wadi crosses the cliff to the south-east.

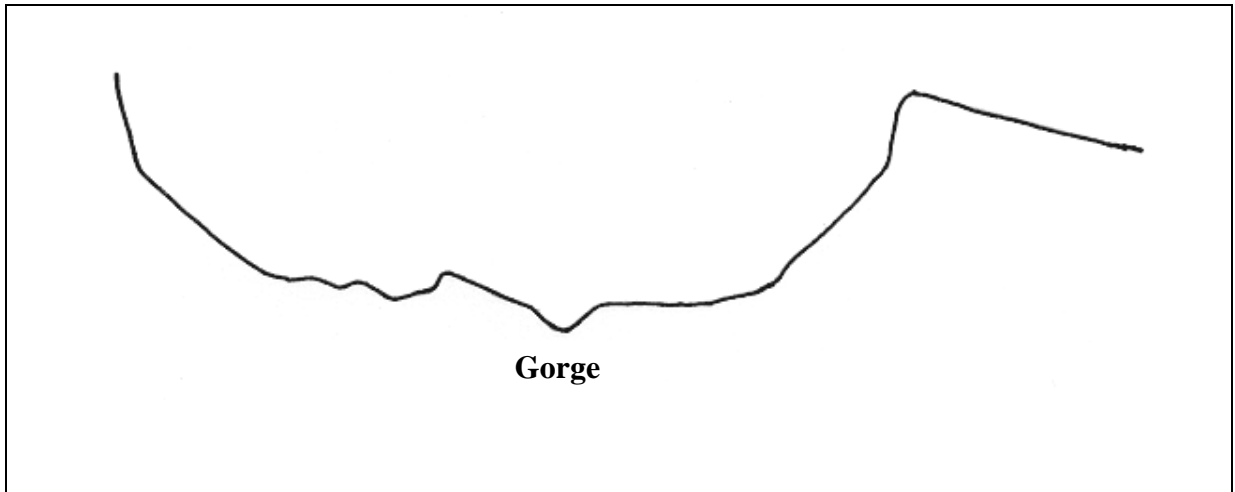
B. The topography

1. Below is a topographical cross section of the Makhtesh wall from Mt. Avnon to the Hatira gorge.

- Look to the south and try to recognize the following view formations: cliff, slope, wadi, gorge, Questa.
- Mark those formations on their right place on the topographical cross-section below.

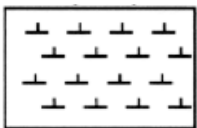
Southern east	Northern west
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Avnon Mt.

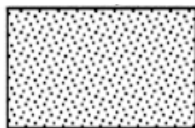


Legend

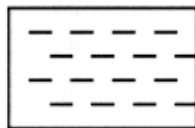
Chalk



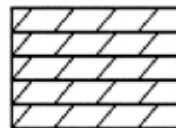
Sandstone



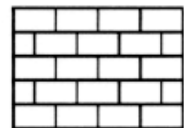
Clay



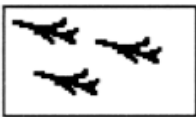
Dolomite



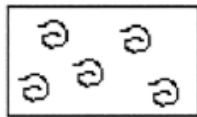
Limestone



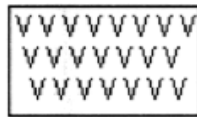
Continental fossils



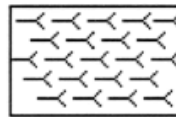
Marine fossils



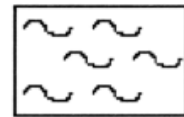
Volcanic



Gypsum



Marl



B. The geology



1. Observe the rock that builds the cliff

- What phenomenon can tell you that this rock belongs to the sedimentary rocks group? _____
- Are the rock's layers horizontal or tilted? _____
- What can you conclude from the above observation concerning the layers?

-
- What is the geological principle that your above conclusion is based on?
-

2. A closer look

- Approach the rock's exposure and collect a specimen of this rock.

Use the following table to identify the rock composing this outcrop.

Properties	Observations (circle)	Conclusions
Layers	Exist/not exist If exist: Horizontal/tilted	
Color		
Crumbling	Crumble / non crumble	
Hardness (Only for a non-crumble rock!)	Can be scratched by: fingernail/ only by iron /not even by iron	
Crushing by teeth (Only for a crumble rock!)	Ground / non ground	
Mouldability (while wet)	can be moulded/cannot be moulded	
Reaction to HCl (6%)	Very bubbly /slightly bubbly/ no reaction	
Additional observations		

Rock's name: _____

Don't forget to collect a specimen of rock and to take pictures of meaningful phenomena for your report

5. To which direction the layers that build the cliff are tilted (circle)? East / West
6. In order to turn the topographical cross-section of page 2 to a geological cross-section, please add to it the layers that you observed here: their direction and type of rock.



c. The quarry

1. Look around you. What do you feel while looking at this unique landscape? _____

2. Makhtesh Hatira is a nature park and a worldwide unique phenomenon. Look at the quarry. This quarry is the source of quartz sand for the glass industry.

- What is your opinion about the operation of this quarry inside this unique geological phenomenon? _____

3. What do you think is a more profitable industry, the quartz sand or the tourism? Explain: _____

D. The environment of formation

In order to reconstruct the environment of formation of the rocks that build the cliff, we'll go back and look for a guiding phenomenon on the slope behind the parking lot.

1. The phenomenon is: _____

2. How can this phenomenon tell us about the environment of formation of the rock? _____

- Geo-ethics

3. How many stages of the rock cycle, these fossils went through, until they were exposed here (circle)? Melting / crystallization / uplifting / exposure / erosion / weathering / transportation / crystallization of minerals to build skeletons / dissolution / crystallization of minerals from seawater / marine sedimentation / river sedimentation / lake sedimentation / cementation / burial

4. There are geologists who encourage their students to collect fossils. What is your attitude about fossils' collection? _____

Don't forget to take pictures of meaningful phenomena for your report

E. Earth systems

- Which relationships between the earth systems: geosphere, hydrosphere, atmosphere and biosphere (including man) might be identified in this stop (including all its four sections)? _____



Questions that were raised following the activity

Remarks and comments



Stop 2: The rock at the bottom of the Makhtesh wall



A. Rock and landscape

1. Are the rocks' layers that appear here younger or older than the layers that we observed in the upper part of the cliff? _____

2. On what geological principle is your answer based? _____

- Approach the rock's exposure and collect a specimen of this rock.

Use the following table to identify the rocks composing this outcrop.

Properties	Observations (circle)	Conclusions
Layers	Exist/not exist If exist: Horizontal/tilted	
Color		
Crumbling	Crumble / non crumble	
Hardness (Only for a non-crumble rock!)	Can be scratched by: fingernail/ only by iron /not even by iron	
Crushing by teeth (Only for a crumble rock!)	Ground / non ground	
Mouldability (while wet)	can be moulded/cannot be moulded	
Reaction to HCl (6%)	Very bubbly /slightly bubbly/ no reaction	
Additional observations		

Rock's name: _____

Go back to the geological cross-section of page 2 and add to it the layers that you observed here: their direction and type of rock.

B. The environment of formation

1. Observe the exposure. Which phenomena can lead you to reconstruct the environment of formation of this rock?

a) _____

b) _____

c) _____

2. Which stages of the rock cycle might be identified through the observations you made here (circle)? Melting / fast crystallization of a magma / slow crystallization of a magma / uplifting / exposure / erosion / weathering / transportation by wind / transportation by the sea / transportation by river / river sedimentation / dune sedimentation / marine sedimentation / lake sedimentation / cementation / burial /

Don't forget to take pictures of meaningful phenomena for your report

C. Earth systems

- Which relationships between the earth systems: geosphere, hydrosphere, atmosphere and biosphere (including man) might be identified in this stop (including all its four sections)? _____

D. Geo-ethic

1. The quarry utilizes only the white sandstone and gets rid of a huge volume of the unique colored sandstone. What do you think about this procedure?

Stop 4: The rock that build the center of the Makhtesh



A. The rock

1. Are the rocks' layers that appear here younger or older than the layers of the Makhtesh wall? _____

2. On what geological principle is your answer based? _____

- Approach the rock's exposure and collect a specimen of this rock.

Use the following table to identify the rock composing this outcrop.

Properties	Observations (circle)	Conclusions
Layers	Exist/not exist If exist: Horizontal/tilted	
Color		
Crumbling	Crumble / non crumble	
Hardness (Only for a non-crumble rock!)	Can be scratched by: fingernail/ only by iron /not even by iron	
Crushing by teeth (Only for a crumble rock!)	Ground / non ground	
Mouldability (while wet)	can be moulded/cannot be moulded	
Reaction to HCl (6%)	Very bubbly /slightly bubbly/ no reaction	
Additional observations		

Rock's name: _____

Don't forget to collect a specimen of rock and to take pictures of meaningful phenomena for your report

Go back to the geological cross-section of page 2 and add to it the layers that you observed here: their direction and type of rock.

B. The environment of formation

- Look for a guiding phenomenon that will help you to reconstruct the environment of formation of this rock. **Hint: which of the fossils that appears in the next page you found here?**

1. The phenomenon is: _____

2. The environment formation of the rock is (explain): _____

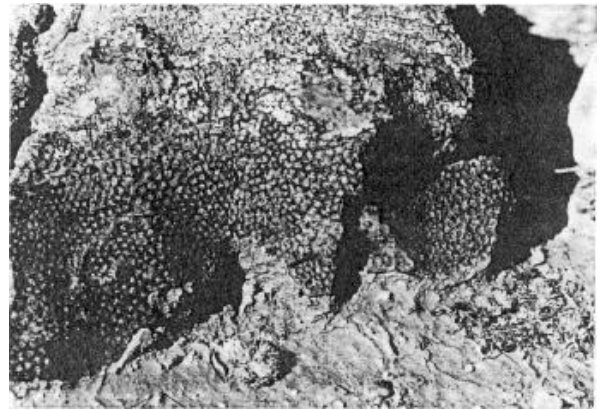
3. Which stages of the rock cycle might be identified through the observations you made here? _____

Don't forget to take pictures of meaningful phenomena for your report

אלמוגים

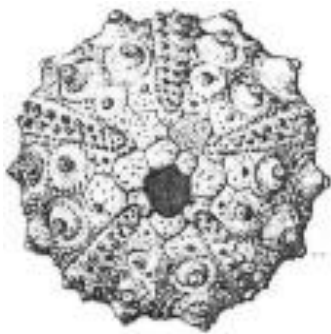


אלמוג בודד

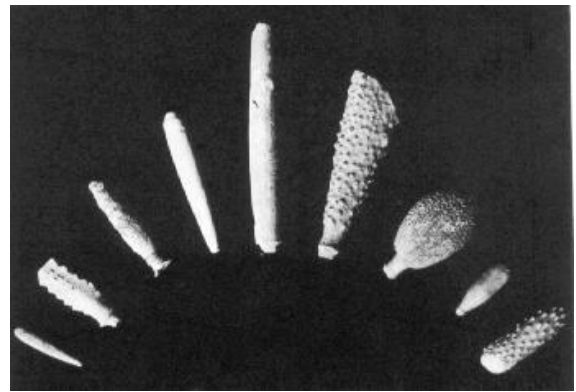


מושבה של אלמוגים (אין סיטו)

קיפודיים



גוף קיפודיים



דרבנות שונים של קיפודיים מתור היורא מכתש-
חתירה

חבצלתיים



תרשים של חבצלת-ים



חלקי גבעול של חבצלת-ים

C. Earth systems

- Which relationships between the earth systems: geosphere, hydrosphere, atmosphere and biosphere (including man) might be identified in this stop (including all its four sections)? _____

D. Geo-ethic

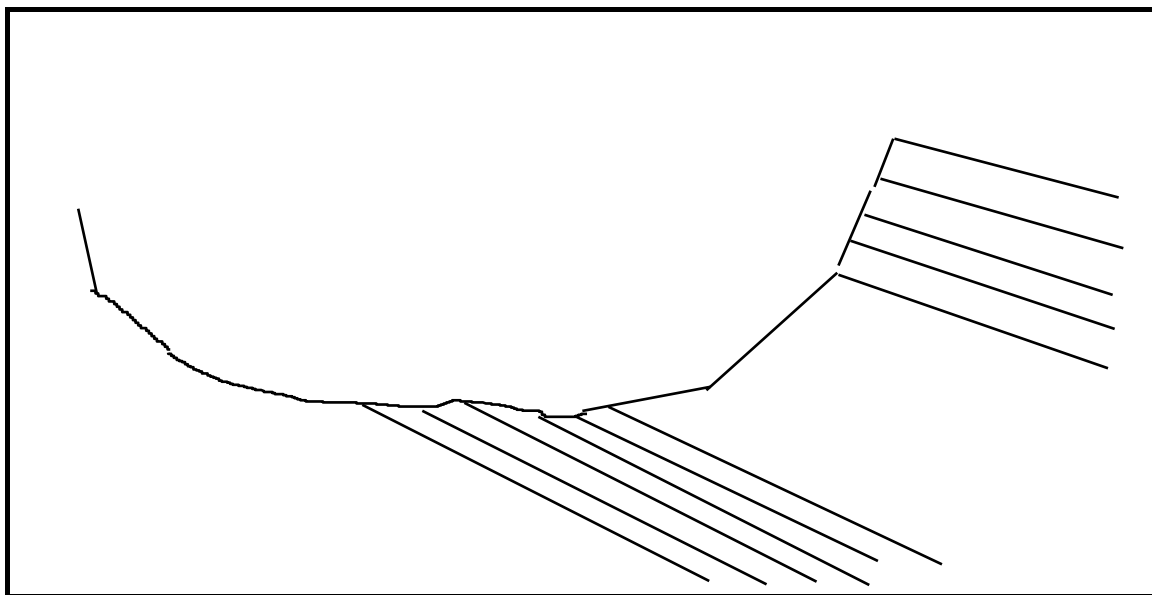
1. The Authority for Protection the Nature, which is responsible to this natural reserve, decided not to open this site for visitors. What is your opinion about it?

Stop 5: The southern east wall of the Makhtesh



A. Rock and landscape

1. Look at the rocks that build the wall of the Makhtesh here. To which group of rocks do they belong? Explain your answer: _____
2. Are they in their original position? Please explain your answer: _____
3. To which direction the layers are declined here (circle)? East / West
4. Add to drawing below the part of the topographical cross-section that we could not see from Mt. Avnon.



B. The Rocks of the southern east wall

1. Use the following table to identify the rock of the upper part of the cliff.

Properties	Observations (circle)	Conclusions
Layers	Exist/not exist If exist: Horizontal/tilted	
Color		
Crumbling	Crumble / non crumble	
Hardness (Only for a non-crumble rock!)	Can be scratched by: fingernail/ only by iron /not even by iron	
Crushing by teeth (Only for a crumble rock!)	Ground / non ground	
Mouldability (while wet)	can be moulded/cannot be moulded	
Reaction to HCl (6%)	Very bubbly /slightly bubbly/ no reaction	
Additional observations		

Rock's name: _____

Go back to the geological cross-section of page 2 and add to it the layers that you observed here: their direction and type of rock.

2. Use the following table to identify the rock of the bottom of the cliff.

Properties	Observations (circle)	Conclusions
Layers	Exist/not exist If exist: Horizontal/tilted	
Color		
Crumbling	Crumble / non crumble	
Hardness (Only for a non-crumble rock!)	Can be scratched by: fingernail/ only by iron /not even by iron	
Crushing by teeth (Only for a crumble rock!)	Ground / non ground	
Mouldability (while wet)	can be moulded/cannot be moulded	
Reaction to HCl (6%)	Very bubbly /slightly bubbly/ no reaction	
Additional observations		

Rock's name: _____

Go back to the geological cross-section of page 2 and add to it the layers that you observed here: their direction and type of rock.

Now you have a complete geological cross-section of Makhtesh Hatira!

5. Please use the following table to compare between the rocks' strata of northern-west wall (Mt. Avnon) and the southern east wall.

	The south-eastern wall	The north-western wall
Similar		
Different		

Don't forget to collect a specimen of rock and to take pictures of meaningful phenomena for your report

C. Reconstruction of the geological history of the Makhtesh

1. Reconstruct the geological structure of the Makhtesh: Go to the cross-section that you prepared and continue the inclination of the upper layer from both side with a dashed line till the two lines meet in the middle.
2. What a type of a geological structure was created (circle)? Anticline / Syncline
3. Connect the other layers with dashed lines as well.

4. Which geological process took place in order to change the structure that is drawn by the dashed lines to the landscape that appears today?

5. How many stages of the rock cycle you might identify following your observations in this stop?

Don't forget to take pictures of meaningful phenomena for your report

D. Earth systems

- Which relationships between the earth systems: geosphere, hydrosphere, atmosphere and biosphere (including man) might be identified in this stop (including all its four sections)? _____

Questions that were raised following the activity



Remarks and comments



Summary question:

In what university courses would you include these field trip stops, to cover the geo-ethical issues touched upon here?
