

Supplementary Information for

Teaching Geology in higher education institutions under Covid-19 conditions

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Teaching Mineralogy

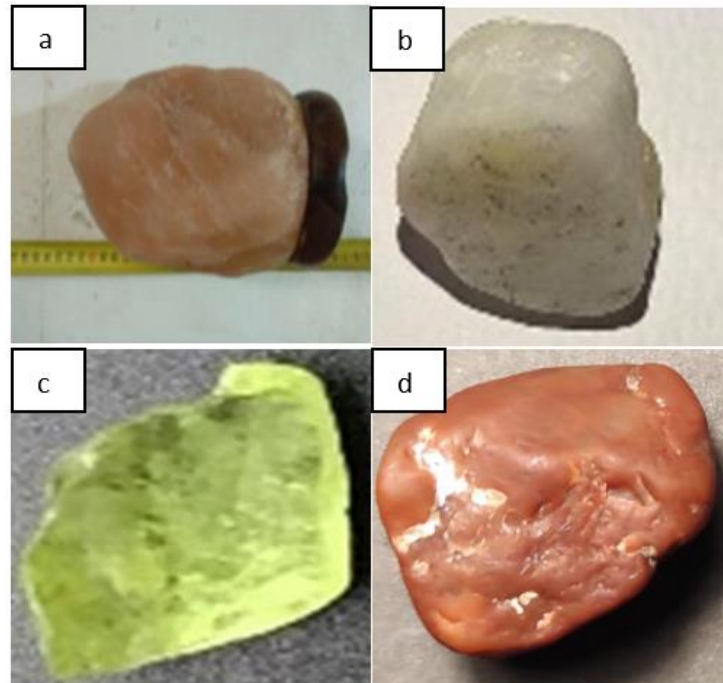


Figure S1: Sample photographs of the minerals the students found: (a) halite; (b) anhydrite; (c) beryl; (d) hematite.

Teaching Petrology

The project aimed not to evaluate students but to evaluate the research so it can be improved where needed to achieve better learning results when applied in the immediate future. The questionnaire consisted of 3 questions in a tree-like form, as shown below:

Rocks for eclass – Questionnaire

1. Igneous Rock
 - a. Plutonic
 - i. Granite
 - ii. Diorite
 - iii. Gabbro
 - iv. Peridotite
 - b. Volcanic
 - i. Rhyolite
 - ii. Basalt
2. Sedimentary Rock
 - a. Conglomerate – breccia
 - b. Sandstone
 - c. Fine-grained sedimentary rocks (clay - claystone - pelite -siltstone)
 - d. Carbonate (limestone - dolomite)
 - e. Silicate (chert)
 - f. Mineral coals
3. Metamorphic Rock
 - a. Phyllite
 - b. Slate
 - c. Gneiss

- d. Marble
- e. Quartzite

The questionnaire contained the following information in order to comprehend rock and rock category characteristics and differences and, as a result, better assimilate the corresponding teaching material.

Rocks for eclass with photos of rocks

Questionnaire

1. The rock(s) contains:

- A. Only crystals of minerals (plutonic)
- B. Mineral crystals and amorphous material (volcanic)
- C. Schistosity (metamorphic, phyllite, gneiss slate)
- D. Layering-stratification (sedimentary, sandstone, claystone, chert)
- E. Only crystals of a (hard) mineral with or without schistosity (marble, quartzite)

2. If A. was answered above, there are the following cases:

- A. Light-colored with a few dark crystals (granite).
- B. Approximately equal proportion of light-colored and dark-colored crystals (diorite).
- C. Mainly dark-colored crystals (gabbro).
- D. Only dark-colored crystals (peridotite).



Figure S2: Granite.

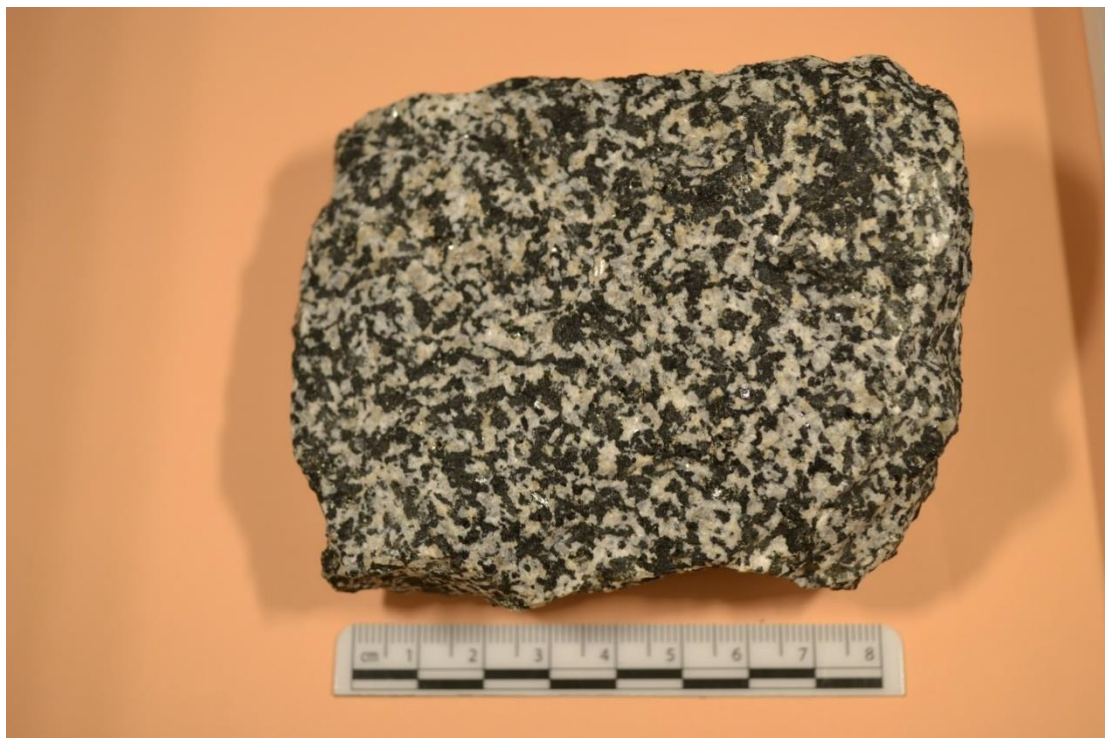


Figure S3: Diorite.

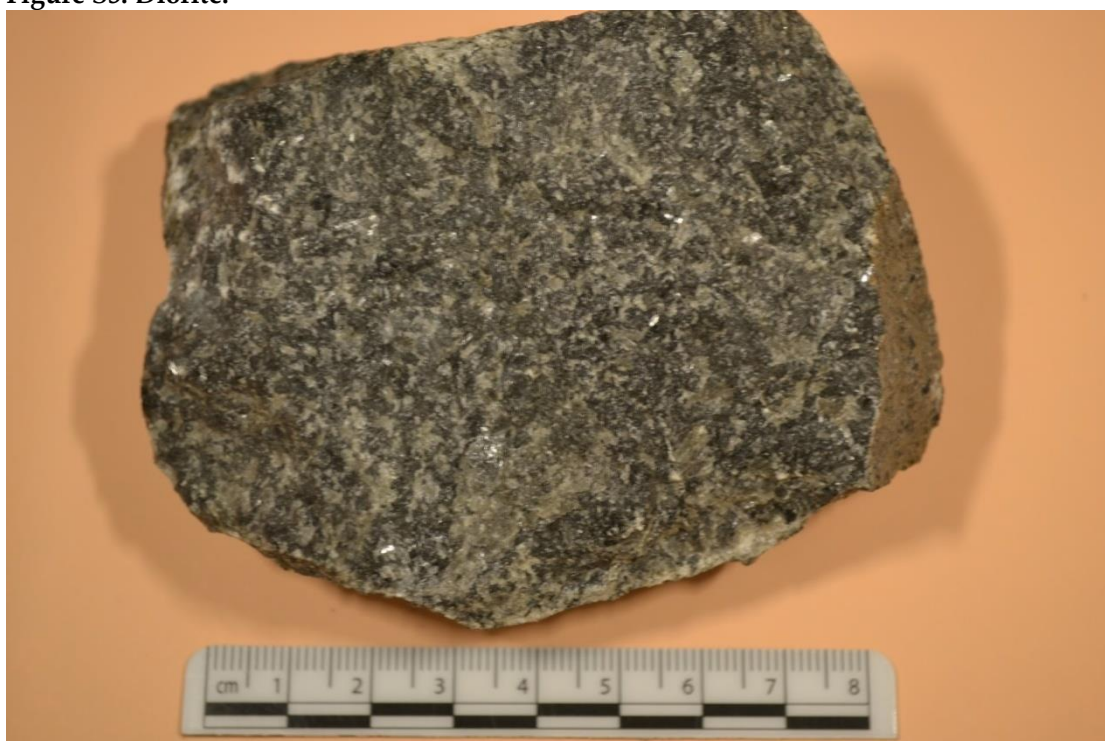


Figure S4: Gabbro.



Figure S5: Peridotite.

3. If B. was answered above, there are the following cases:

A. Light-colored or gray (rhyolite).

B. Dark-colored (basalt).



Figure S6: Rhyolite.



Figure S7: Basalt.

4. If C. was answered above, there are the following cases:

- A. Large grains greater than 1-2 mm (cobblestone or breccia).
- B. Grains (of sand) visible to the naked eye (sandstone).
- C. Very small grains (clay–claystone–pelite–siltstone).
- D. From grains of a single mineral not too hard (able to be scratched with a knife) with a layering–stratification (limestone–dolomite).
- E. From grains of a single and very hard mineral, unable to be carved with a knife (chert).
- F. From a gray to black color scale material (or coal colored) with or without plant residues (mineral coals).



Figure S8: Cobblestone or breccia.



Figure S9: Sandstone.

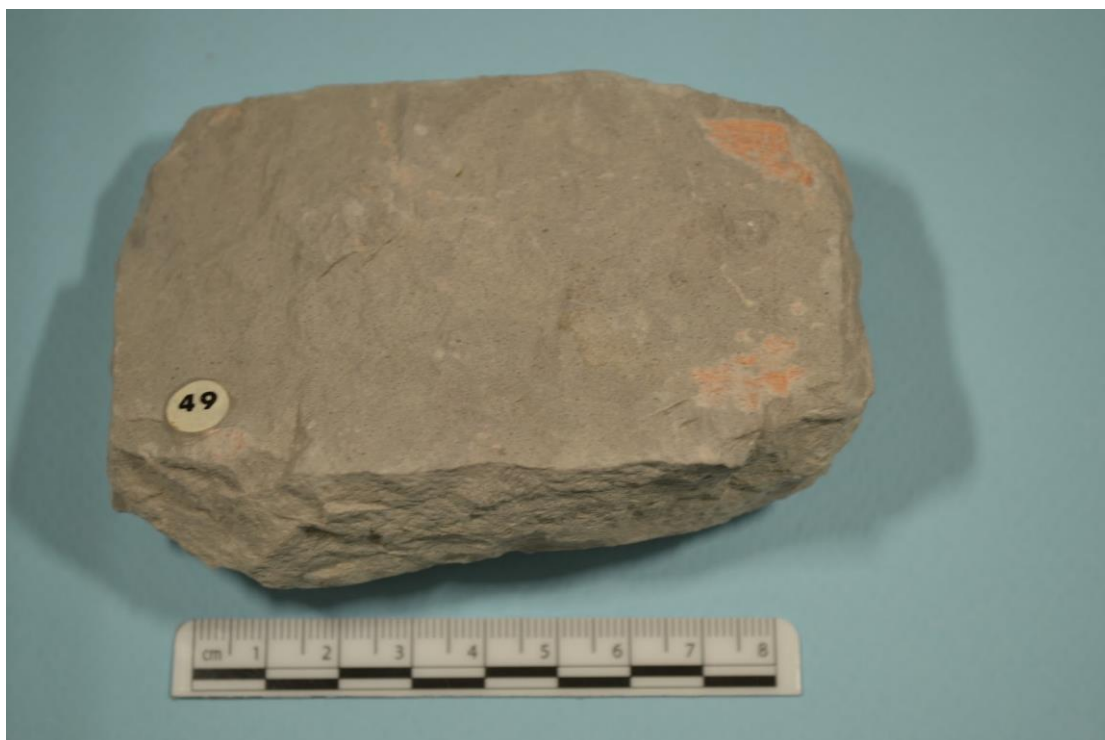


Figure S10: Clay-claystone-pelite-siltstone.



Figure S11: Limestone-Dolomite.



Figure S12: Chert.



Figure S13: Mineral coals.

5. If D. was answered above, there are the following cases:

- A. Well-formed schistosity and a very small size of minerals (phyllite).
- B. Very well-formed schistosity (slate).
- C. Not well-formed schistosity but a clear orientation of their mineral crystals (gneiss).



Figure S14: Phyllite.



Figure S15: Slate.

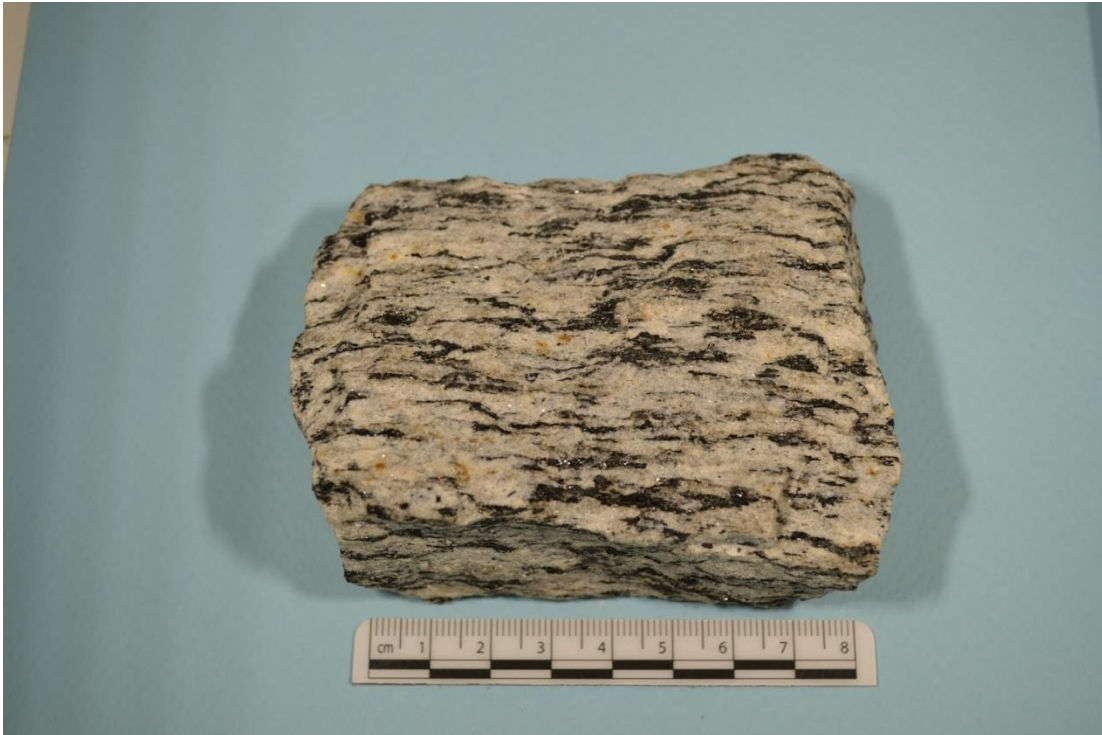


Figure S16: Gneiss.

6. If E. was answered above, there are the following cases:

- A. Only a well-crystallized mineral, usually white, and sometimes shows schistosity (marble).
- B. Only a well-crystallized mineral, hard with a variety of colors but usually in different shades of ash color (quartzite).



Figure S17: Marble.



Figure S18: Quartzite.

Faults/tectonic geology – Teaching faults



☐ **Choice 1**



☐ **Choice 2**



☐ **Choice 3**



☐ **Choice 4**

Figure S19: Choose the photograph that shows the correct fault. Only one paucity should be highlighted. The correct answer was the choice 3.



☐ **Choice 1**



☐ **Choice 2**



☐ **Choice 3**



☐ **Choice 4**

Figure S20: Choose the photograph that shows the correct fault. The correct answer was choice 1.

Match the pieces of the maps with the topographic sections.



☐ **Choice 1**



☐ **Choice 2**

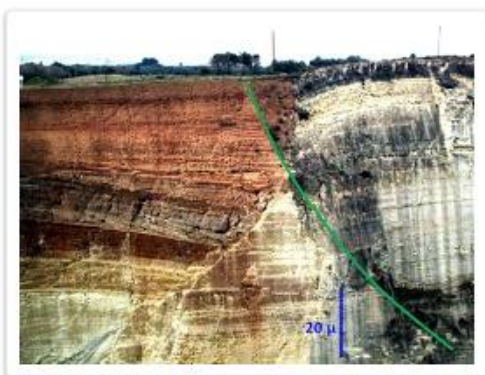


☐ **Choice 3**



☐ **Choice 4**

Figure S21: Choose the photograph that shows the correct fault. Only one paucity should be highlighted. The correct answer was choice 3.



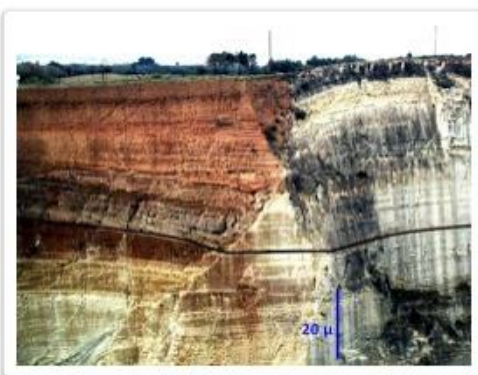
☐ **Choice 1**



☐ **Choice 2**



☐ **Choice 3**



☐ **Choice 4**

Figure S22: Choose the photograph that shows the correct fault. Only one paucity should be highlighted. The correct answer was choice 2.

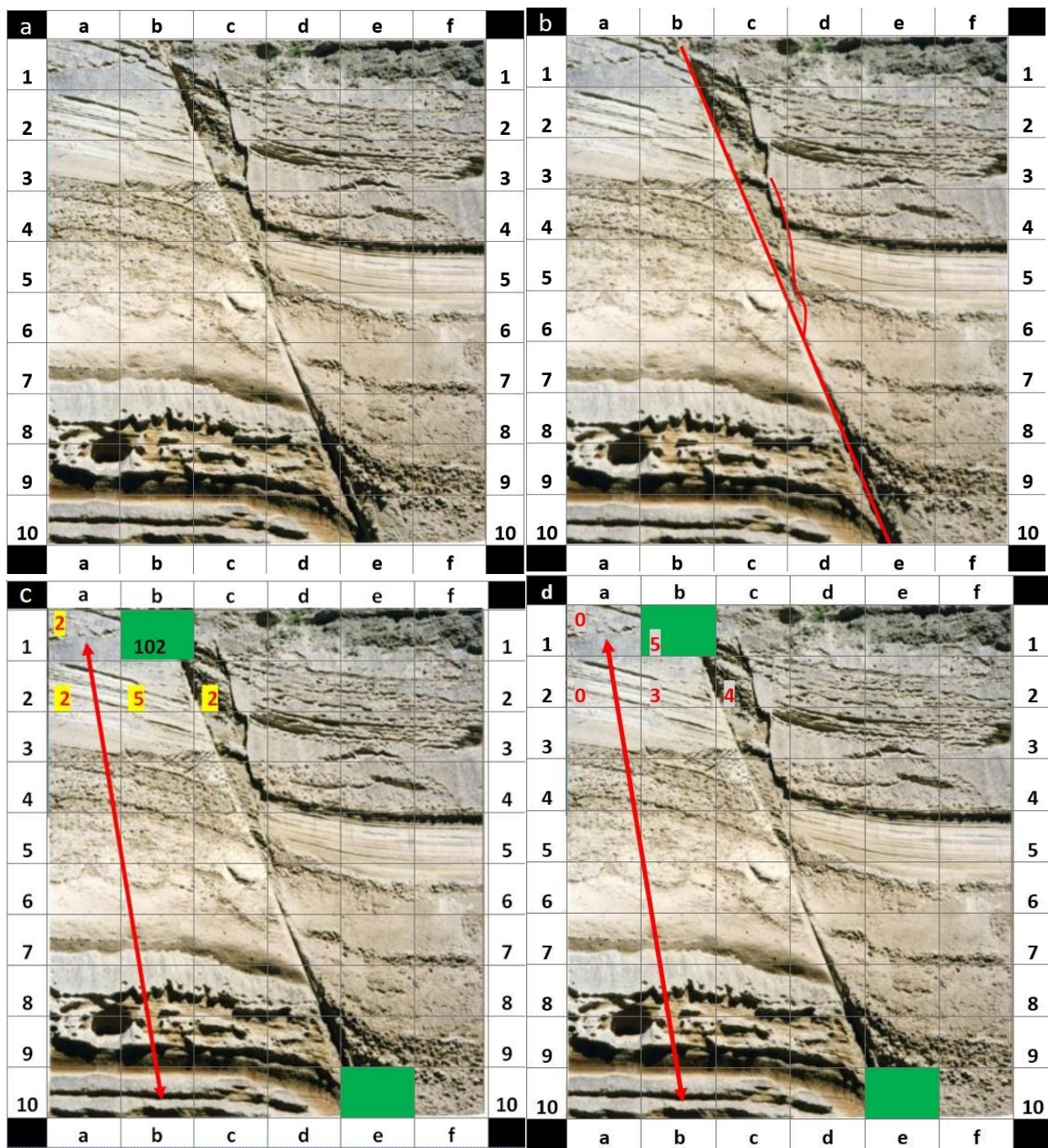


Figure S23: Exercise 1.

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answer b1-e10 or e10-b1); (b) schematic representation of the fault on previous image; (c) answers given numerically (the red line represents a partially correct answer); (d) answers given by the students marked from 1 to 5.

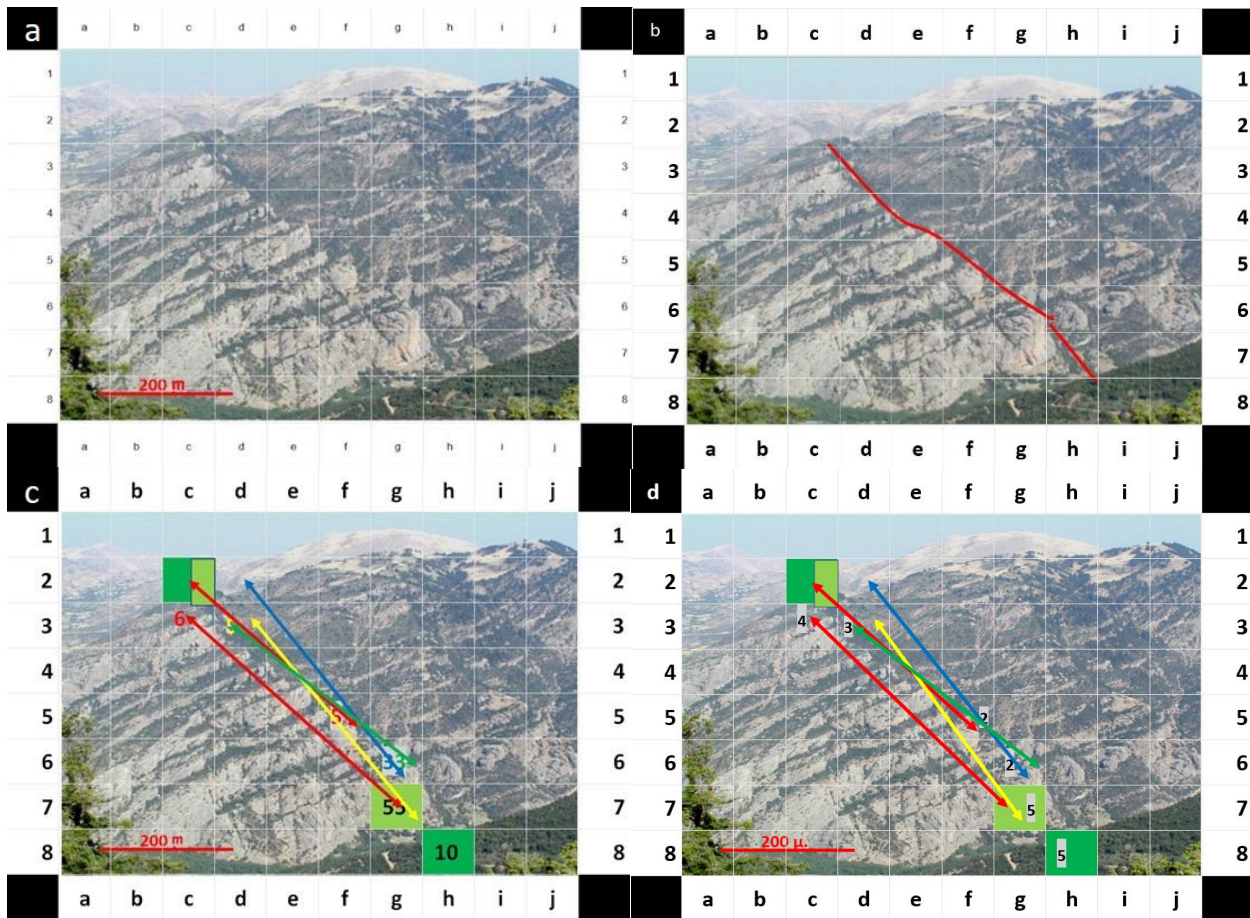


Figure S24: Exercise 2

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answers c2-h8, c2-g7, h8-c2, g7-c2); (b) schematic representation of the fault on previous image; (c) answers given numerically; (d) answers given by the students marked from 1 to 5.

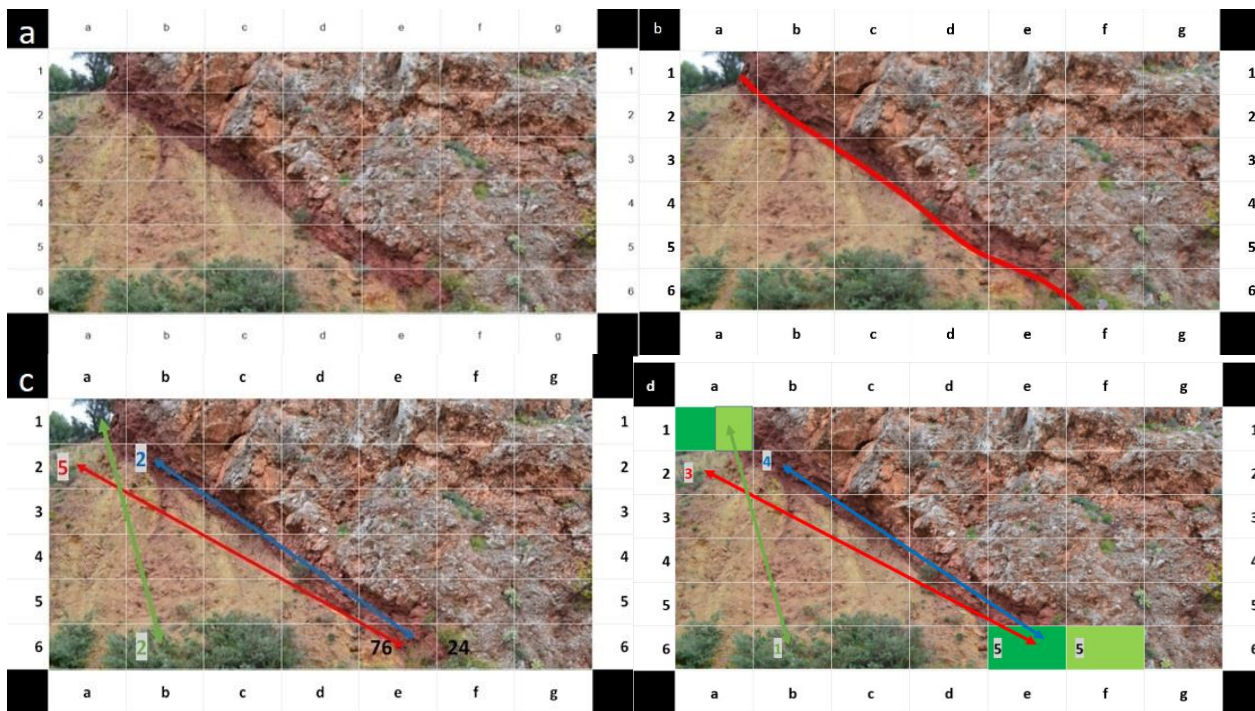


Figure S25: Exercise 3

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answers a1-e6, a1-f6, e6-a1, f6-a1); (b) schematic representation of the fault on previous image; (c) answers given numerically; (d) answers given by the students marked from 1 to 5.

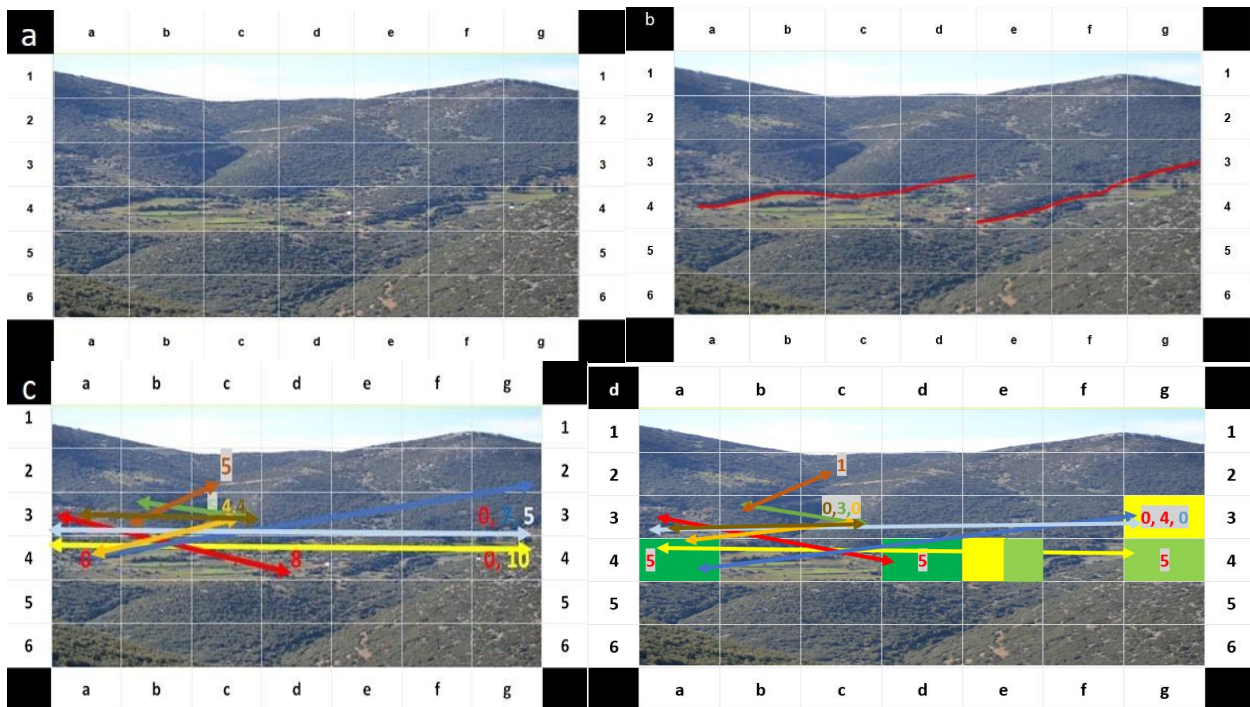


Figure S26: Exercise 4.

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answers a4-d4, e4-g3, e4-g4, d4-a4, g3-e4, g4-e4); (b) schematic representation of the faults on previous image; (c) answers given numerically; (d) answers given by the students marked from 1 to 5.

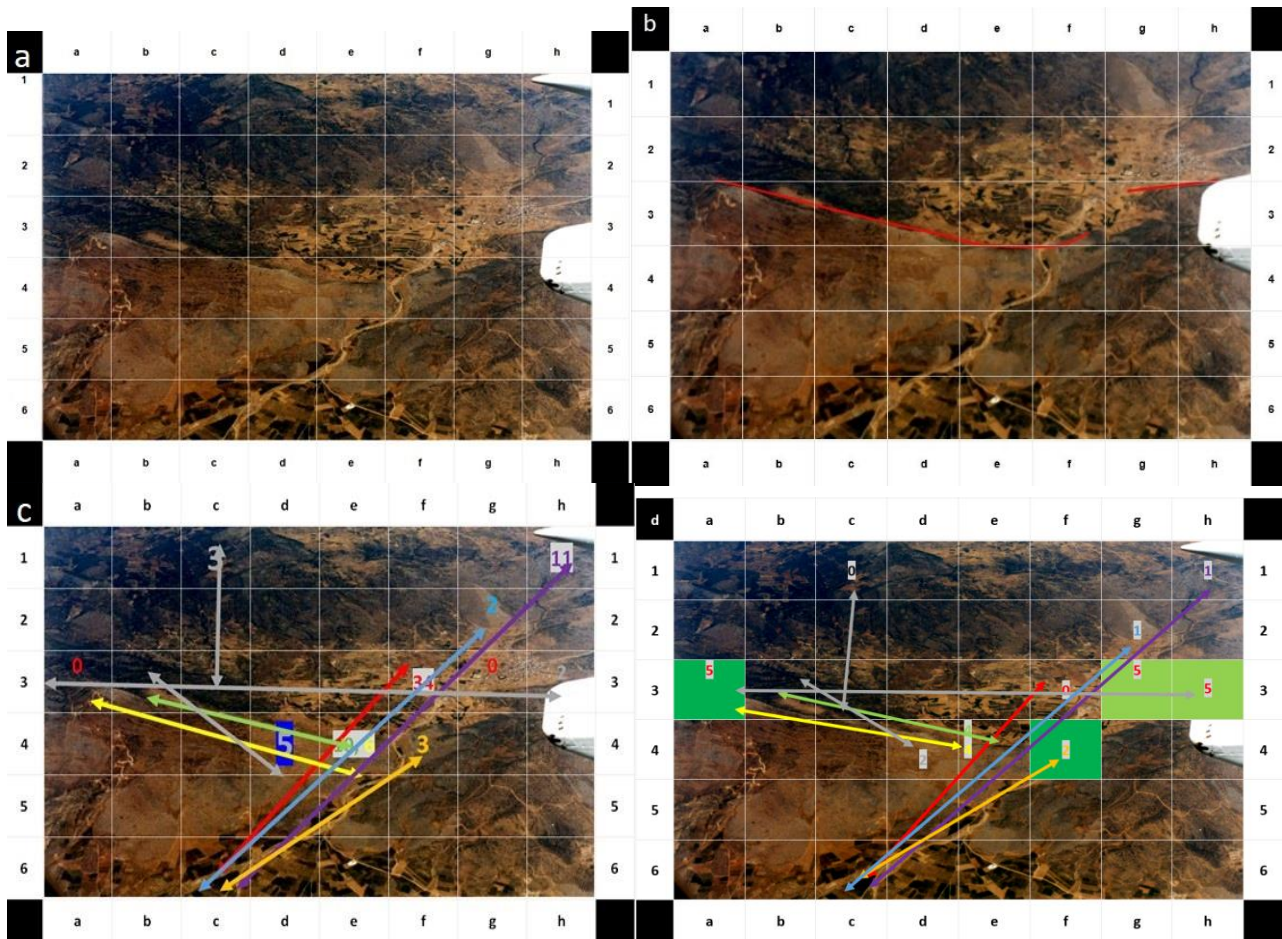


Figure S27: Exercise 5.

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answers a3-f4, g3-h3, f4-a3, h3-g3); (b) schematic representation of the faults on previous image; (c) answers given numerically; (d) answers given by the students marked from 1 to 5.

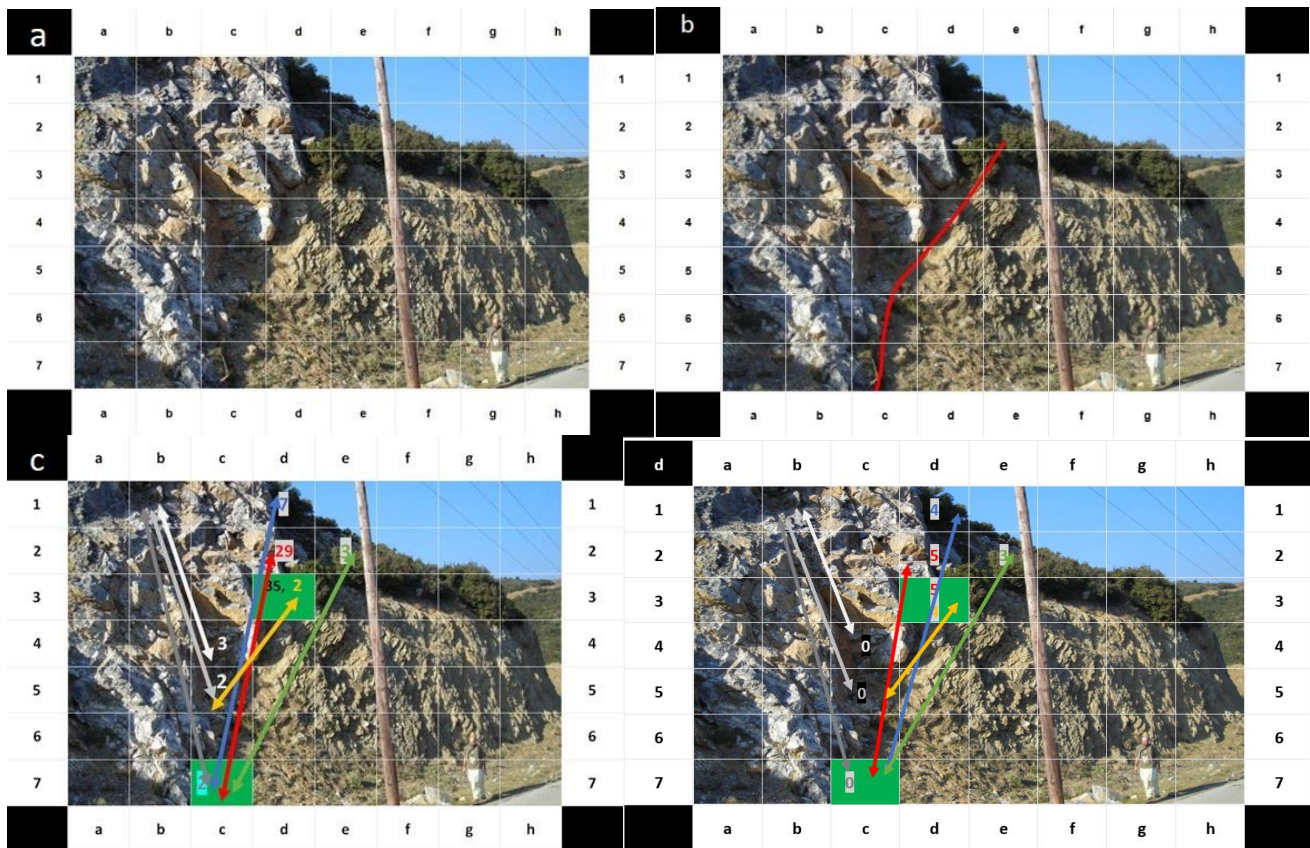


Figure S28: Exercise 6.

Sample photographs of the questionnaire that was given: (a) exercise given (correct answers c7-d3, d3-c7): (b) schematic representation of the fault on previous image; (c) answers given numerically; (d) answers given by the students marked from 1 to 5.

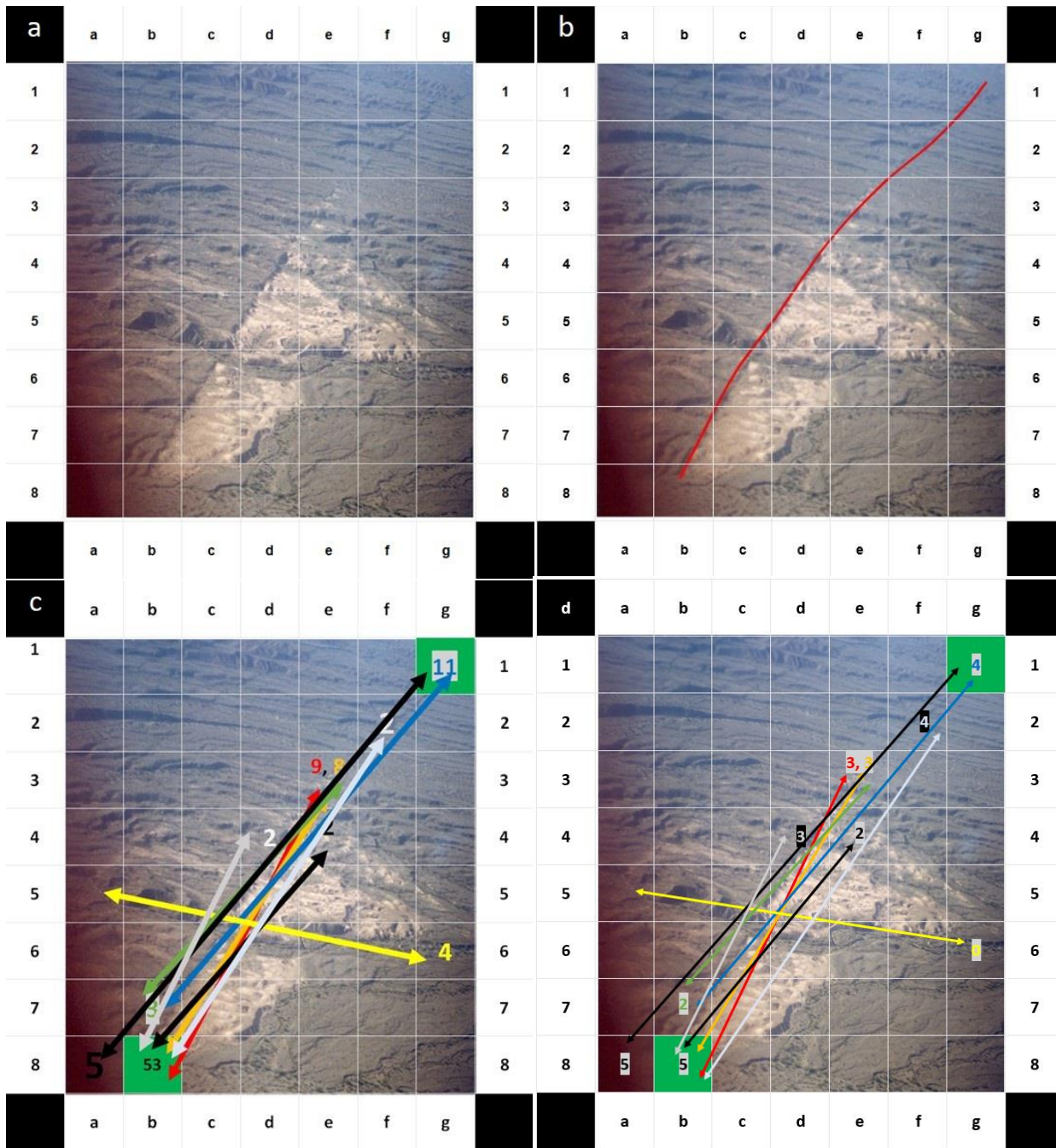


Figure S29: Exercise 7.

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answers b8-g1, g1-b8); (b) schematic representation of the fault on previous image; (c) answers given numerically; (d) answers given by the students marked from 1 to 5.

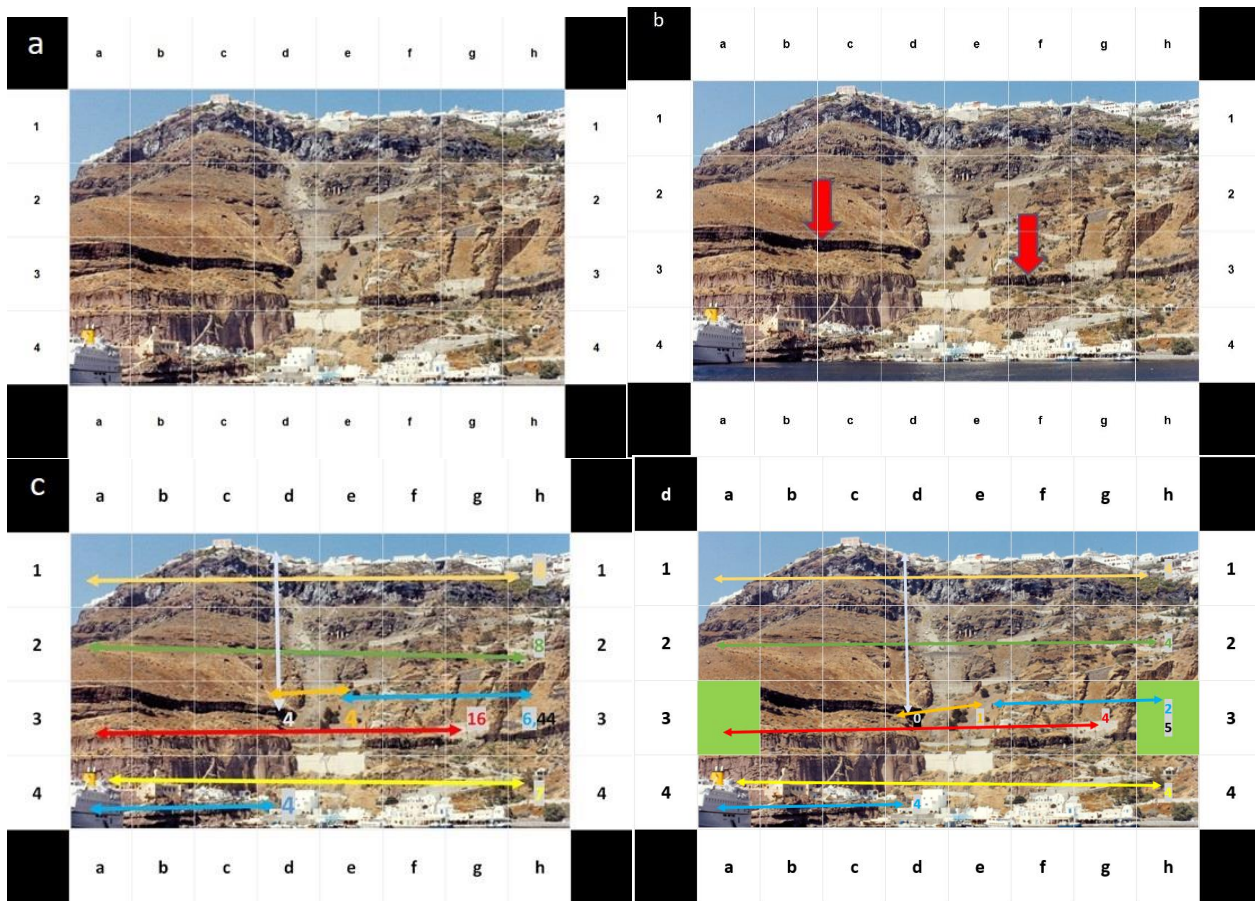


Figure S31: Exercise 9.

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answers a3-h3, h3-a3); (b) layers that shift; (c) answers given numerically; (d) answers given by the students marked from 1 to 5.

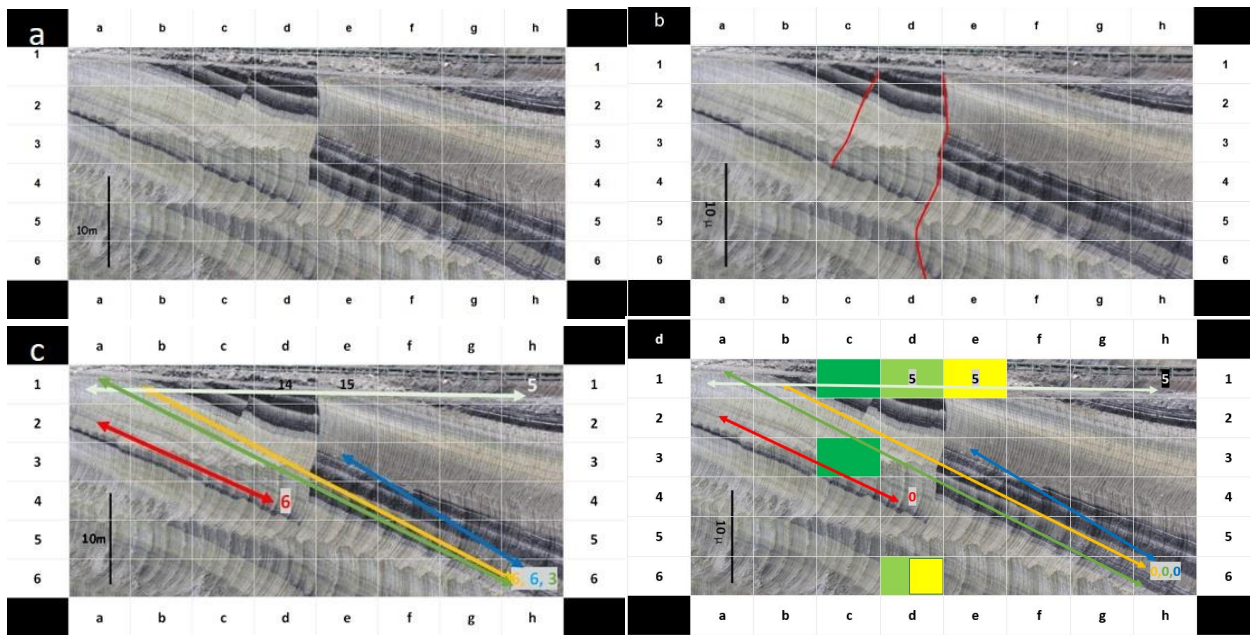


Figure S32: Exercise 10.

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answers e1-e3, d1-d6, e1-d6, e3-e1, d6-d1, d6-e1); (b) schematic representation of the faults on previous image; (c) answers given numerically; (d) answers given by the students marked from 1 to 5.

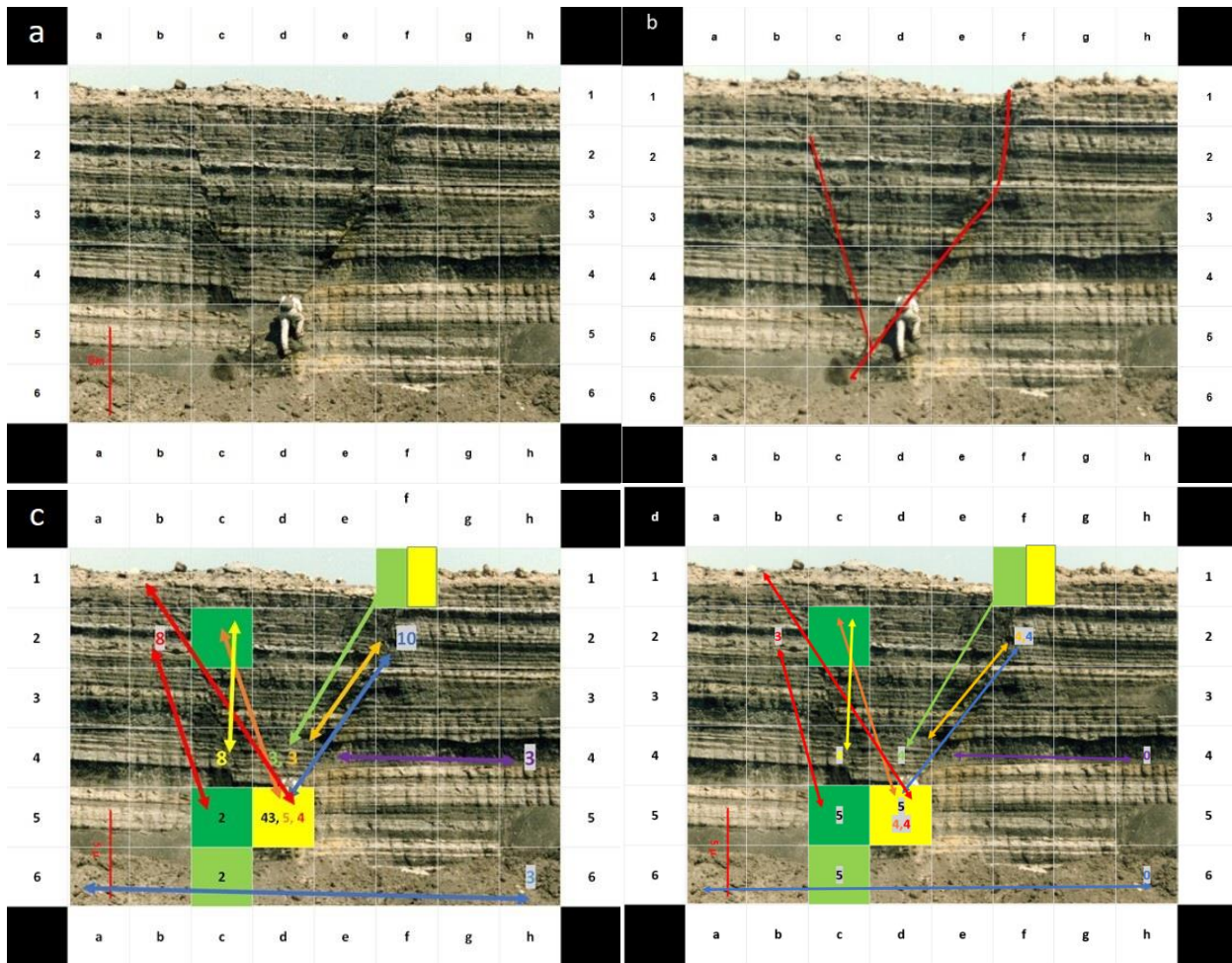


Figure S33: Exercise 11.

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answers c2-c5, f1-f6, f1-d5, c5-c2, f6-f1, d5-f1), (b) Schematic representation of the fault on previous image, (c) Answers given numerically, (d) Answers given by the students marked from 1 to 5.

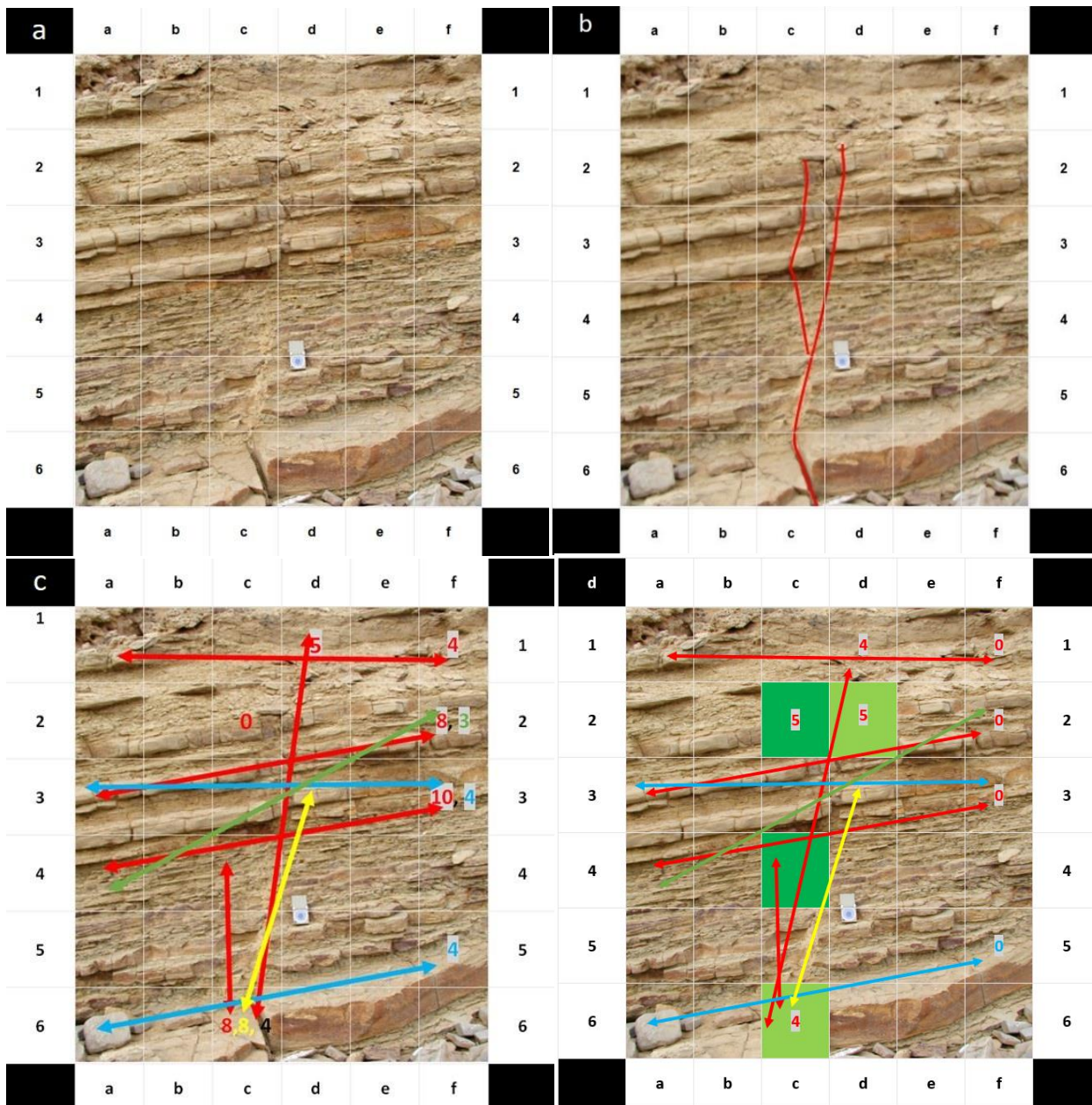


Figure S34: Exercise 12.

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answers c2-c4, c6-d2, c4-c2, d2-c6); (b) Schematic representation of the faults on previous image; (c) Answers given numerically; (d) Answers given by the students marked from 1 to 5.

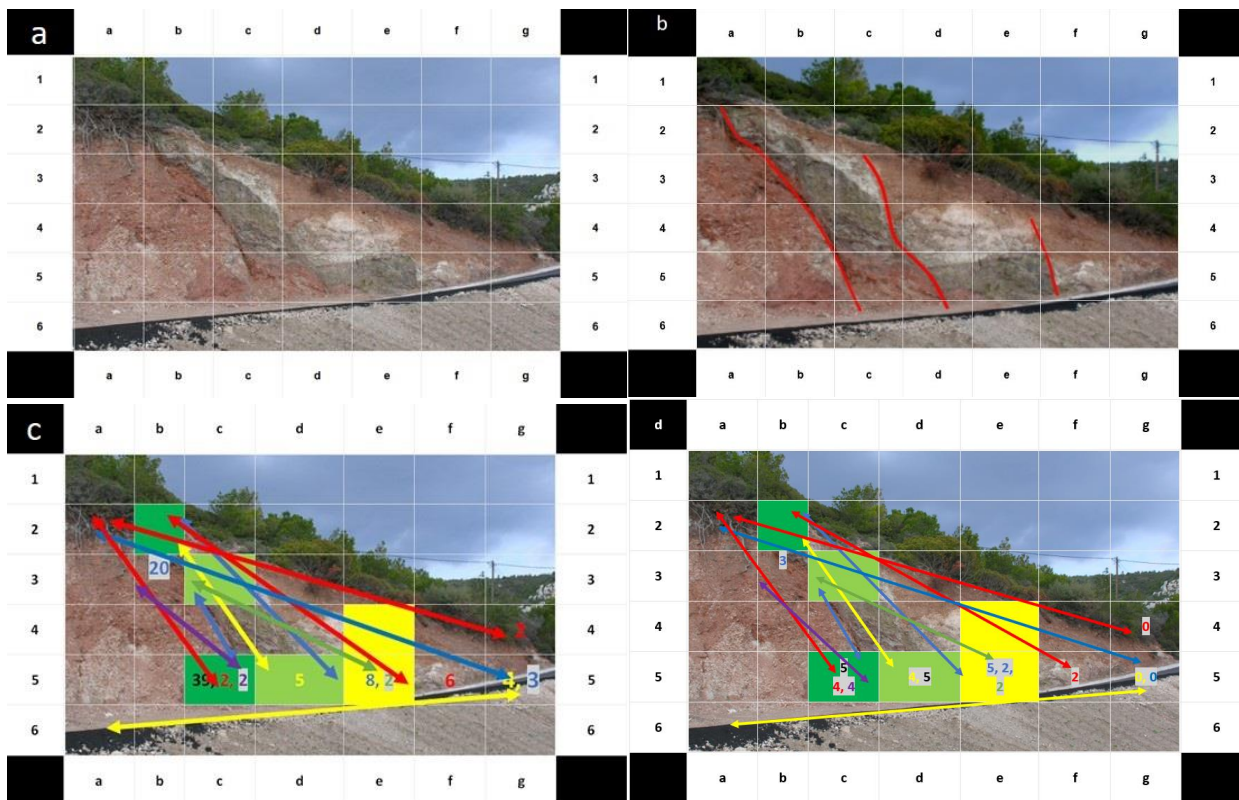


Figure S35: Exercise 13.

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answers b2-c5, c3-d5, e4-e5, c5-b2, d5-c3, e5-e4); (b) schematic representation of the faults on previous image; (c) answers given numerically; (d) answers given by the students marked from 1 to 5.

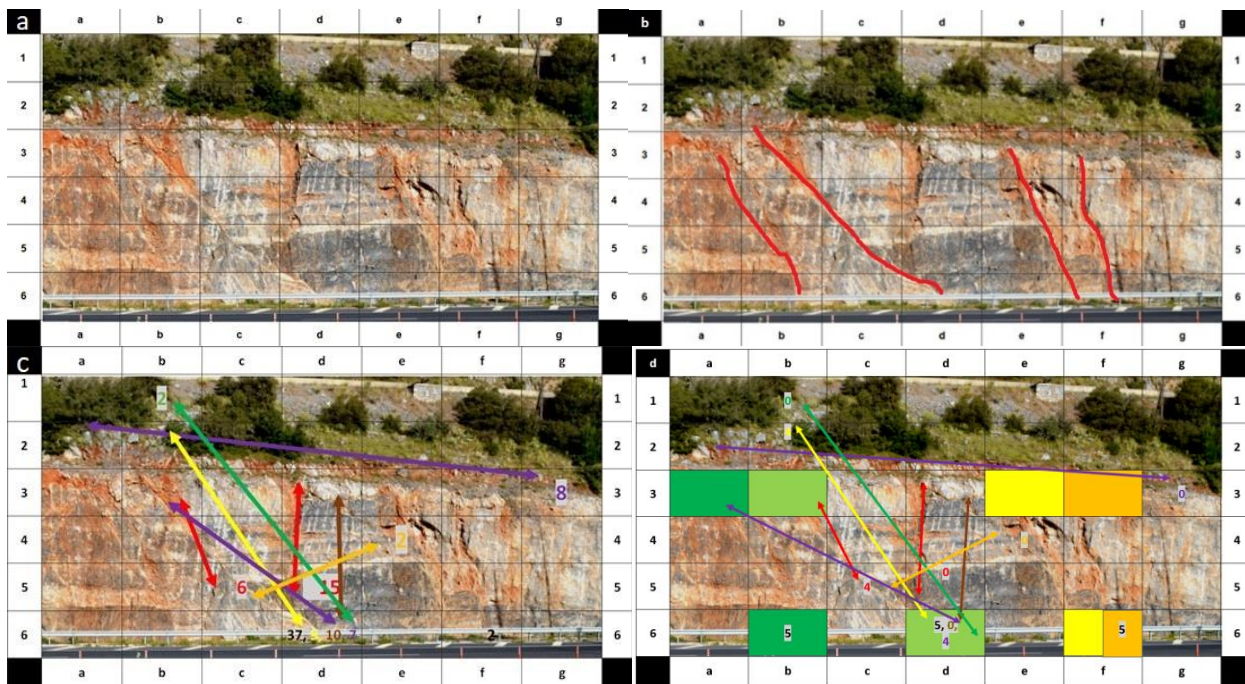


Figure S36: Exercise 14.

Sample photographs of the questionnaire that was given. (a) Exercise given (correct answers a3-b6, b3-d6, e3-f6, f3-f6, b6-a3, d6-b3, f6-e3, f6-f3); (b) schematic representation of the faults on previous image; (c) answers given numerically; (d) answers given by the students marked from 1 to 5.

Table S1: Absolutely correct answers given by the students.

Questions	Answers Given			
	Fault 1	Fault 2	Fault 3	Fault 4
1	102			
2	65			
3	100			
4	0	0		
5	0	0		
6	35			
7	53			
8	0			
9	44			
10	0	29		
11	2	45		
12	0	4		
13	35	0	0	
14	0	37	0	2

Teaching Maps

The given questionnaire to the students was:

Example: Reading a topographic map

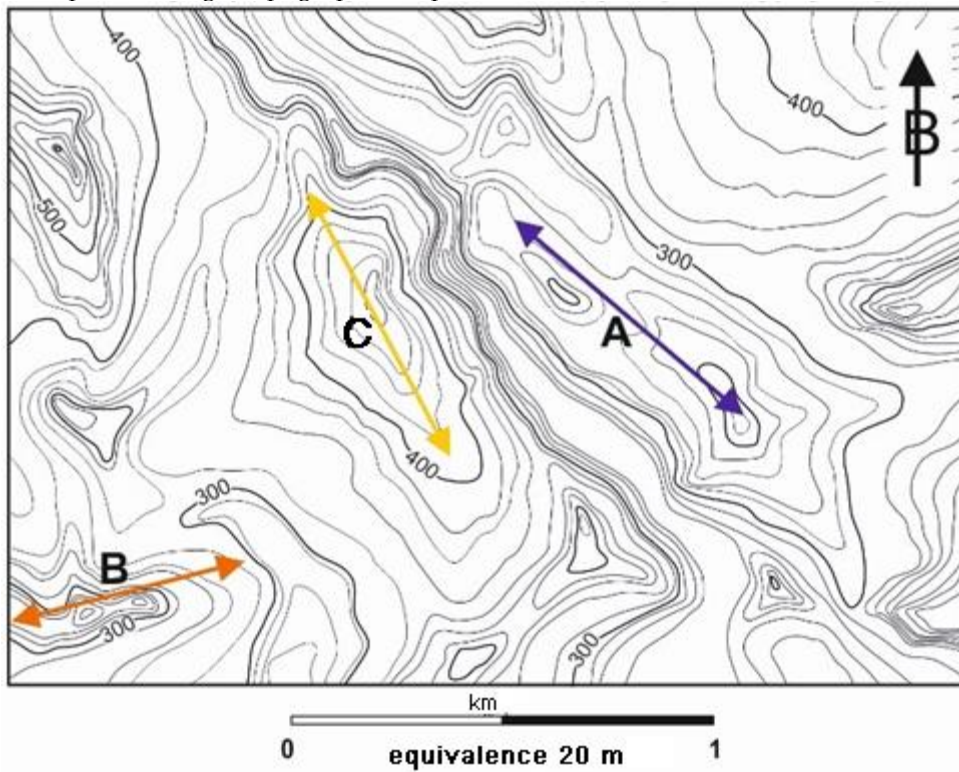


Figure S37: Example on how to fill out the questionnaire.

1. Line (A) on the map shows two hills of which the direction is NW-SE.
2. Line (B) on the map shows a hill with a double peak and a NE-SW direction.
3. Line (C) on the map shows a hill with a long peak and a NW-SE direction.

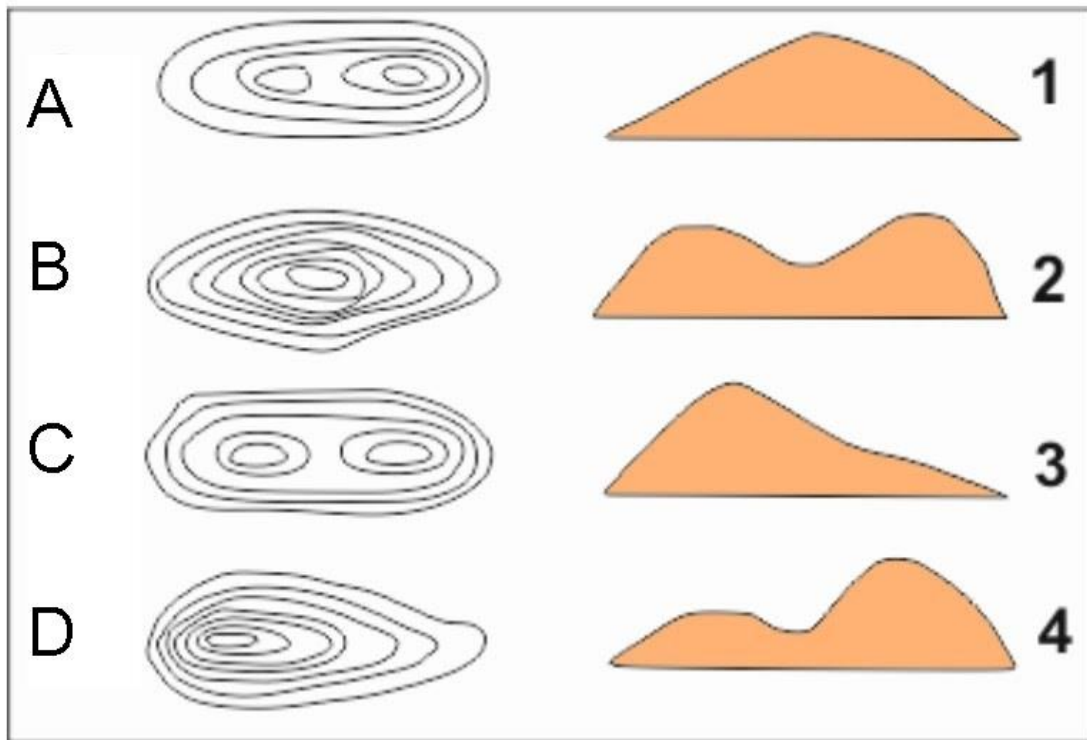


Figure S38: Exercise 1: Match the pieces of the maps with the topographic sections. The correct answer was A4, B1, C2, and D3.

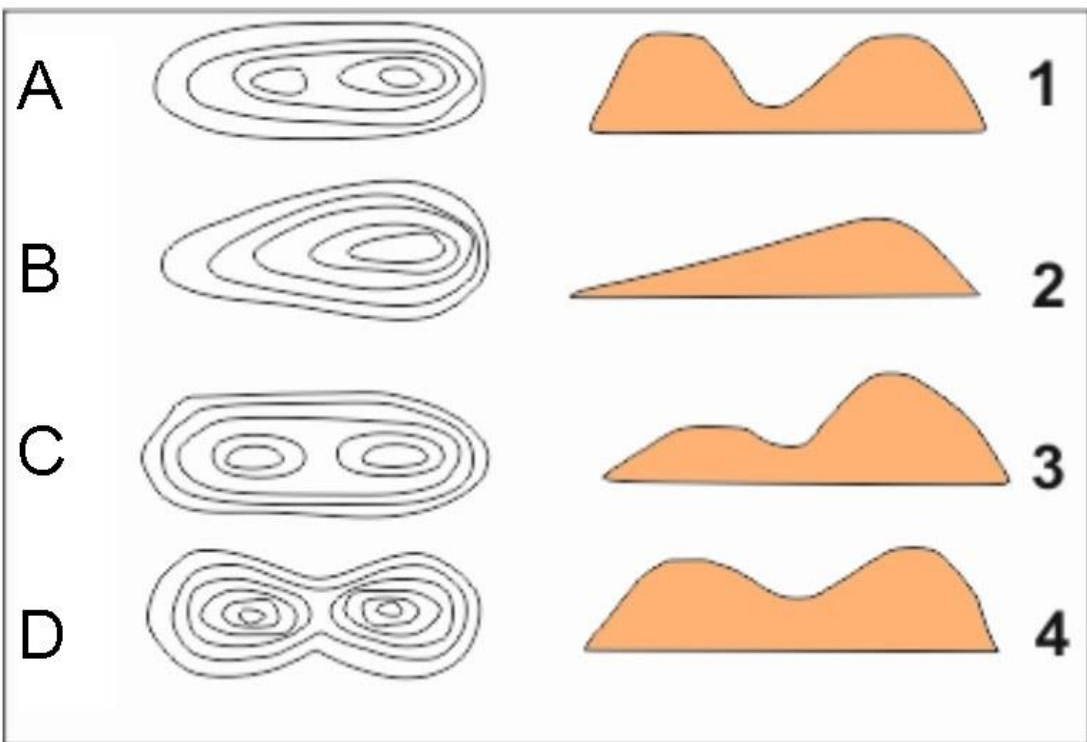


Figure S39: Exercise 2: Match the pieces of the maps with the topographic sections. The correct answer was A3, B2, C1, and D4.

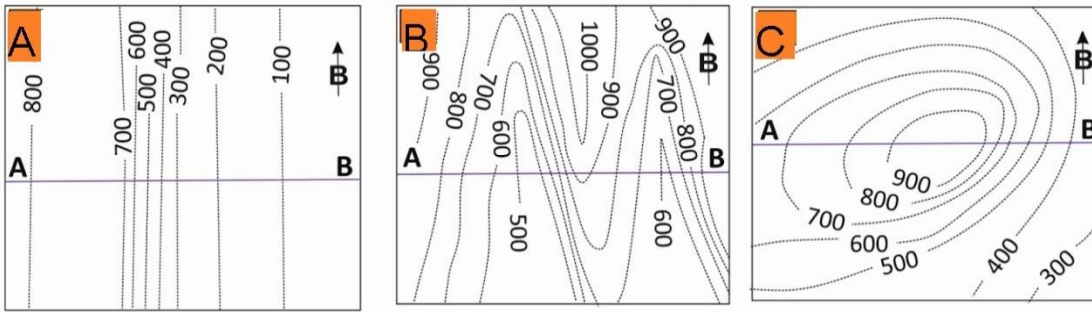


Figure S40: Exercise 3: One or more pieces of the topographical maps show a hill. Choose the correct answer.

- Map A
- Map B
- Map C
- Maps A and B

The correct answer was Map C.

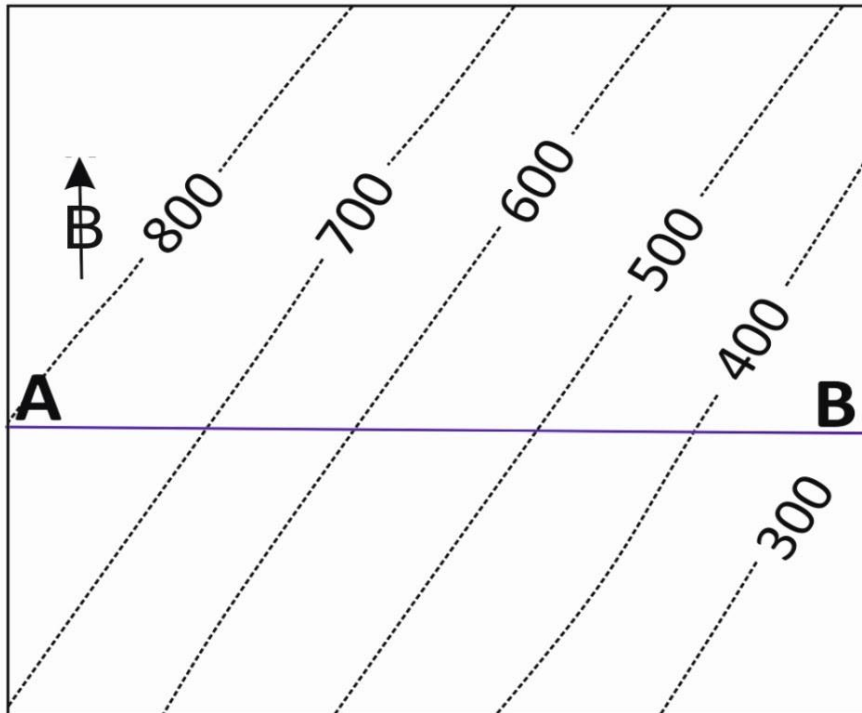


Figure S41: Exercise 4: A slope is shown on the piece of the topographical map. Choose the correct answer regarding where it inclines.

- to the south
- to the north
- to NW
- to SE

The correct answer was to SE.

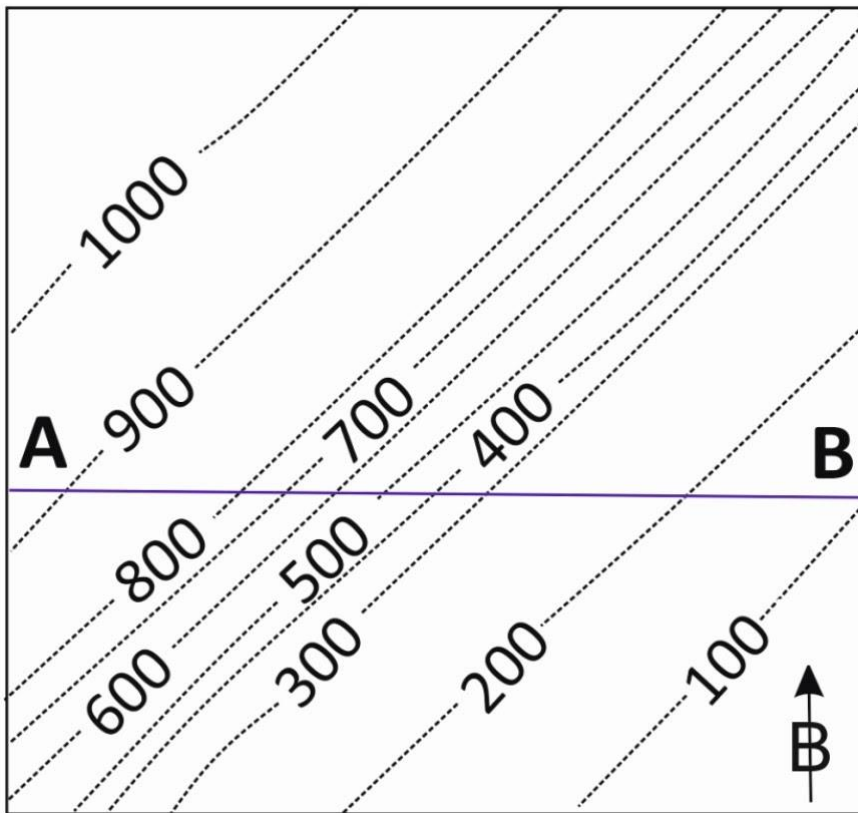


Figure S42: Exercise 5: A precipice is shown on the piece of the topographic map. Choose the correct answer regarding towards where it inclines.

- to SE
- to the north
- to NW
- to the south

The correct answer was to SE.

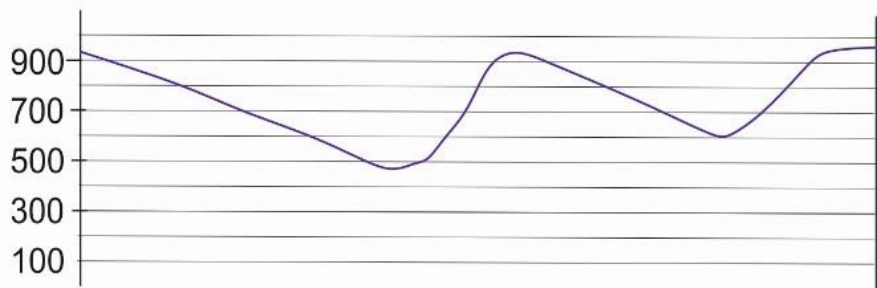
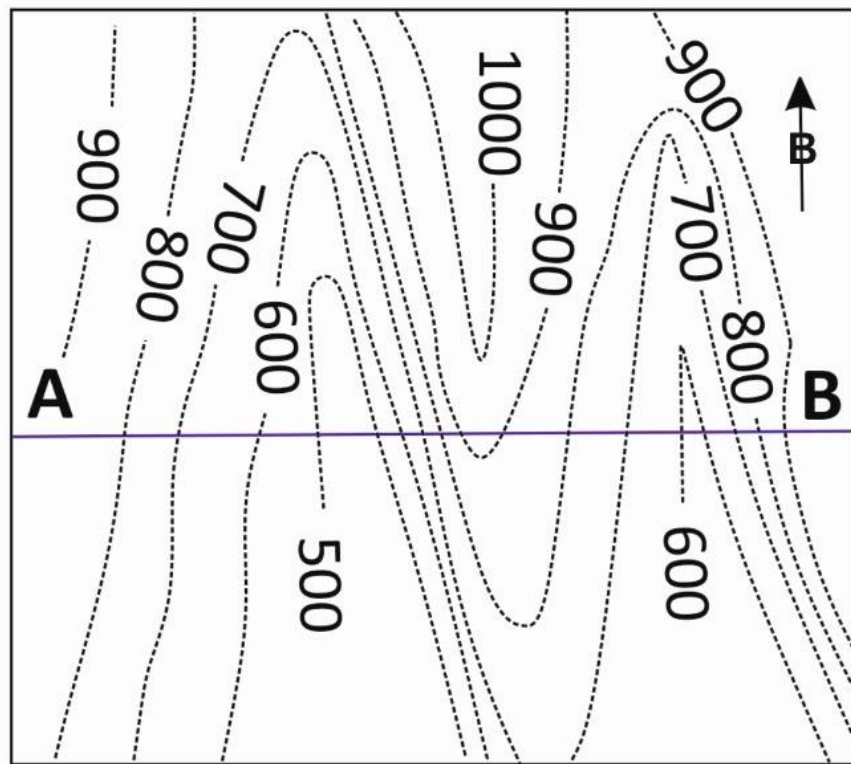


Figure S43: Exercise 6: The piece of the topographic map and the topographic section show a series of valleys and hills. Choose the correct answer regarding the orientation of the valleys on the map.

- N-S
- E-W
- NW-SE
- NE-SW

The correct answer was N-S.

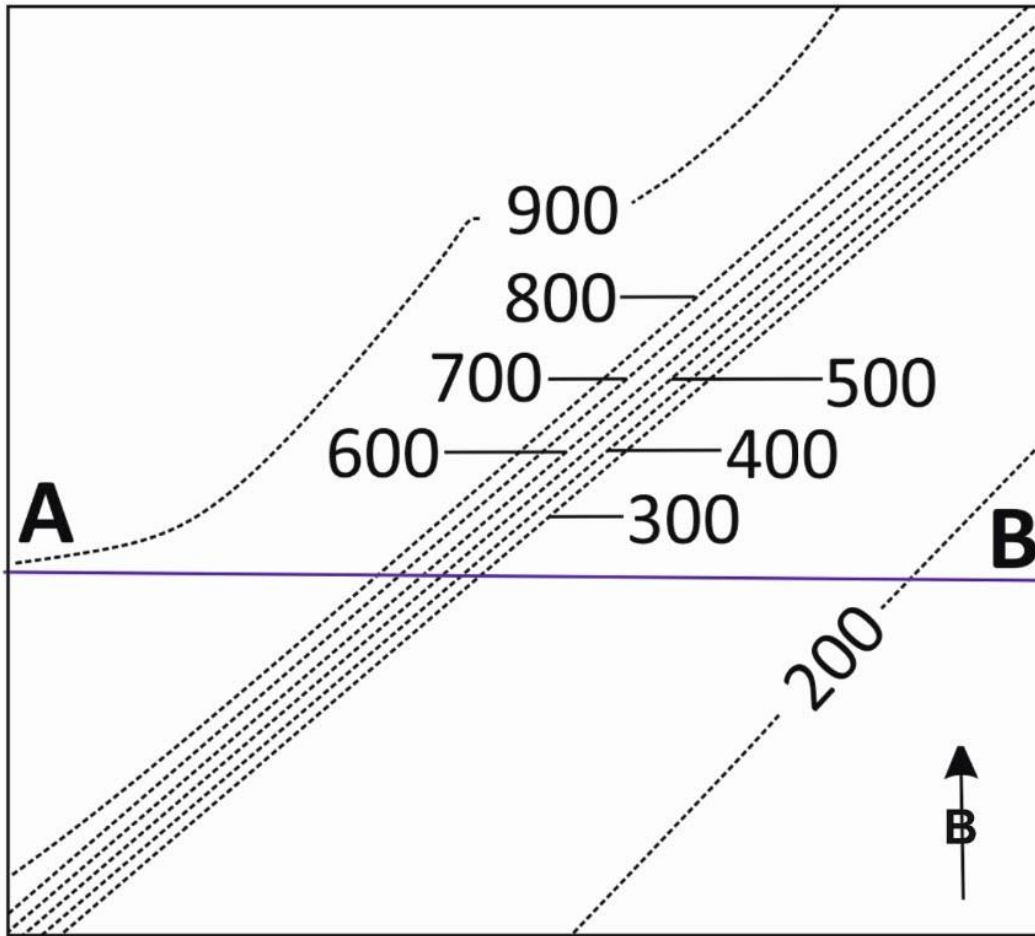


Figure S44: Exercise 7: A precipice is shown on the piece of the topographic map. Choose the correct answer regarding its orientation on the map.

- N-S
- E-W
- NW-SA
- NE-SW

The correct answer was NE-SW.