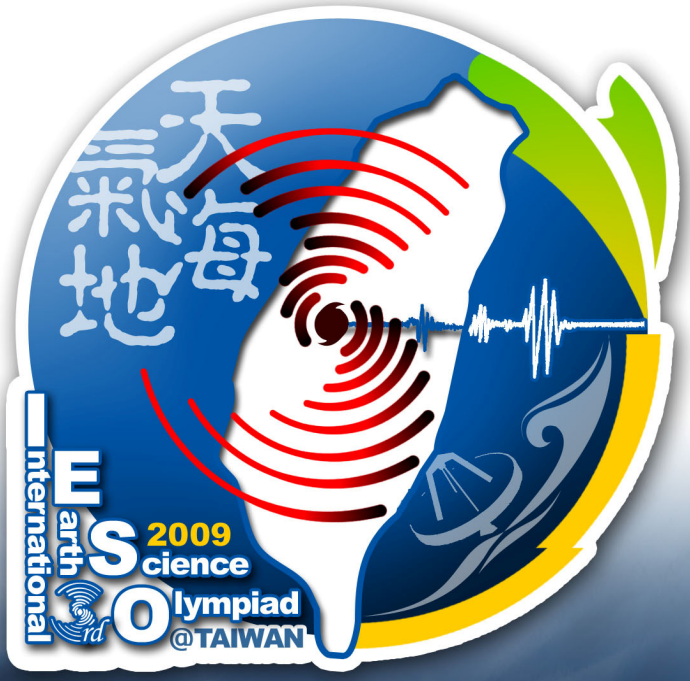
The 3rd International Earth Science Olympiad



Practical Test – Geosphere

18 September 2009

Taipei, Taiwan

Student Name:	Nationality:

Mentor's Signature:_____

希言自然，故飄風不終朝，驟雨不終日。孰爲此者？天地。
To seldom speak is the essence of nature. Why the winds and storm do not last whole day? Because the earth that manifests the winds and storm is constantly changing.

《老子道德經》第廿三章

Laozi Tao Te Chin 4th Century BC

南方有倚人焉曰黃繚，問天地所以不墜不陷，風雨雷霆之故。惠施不辭而應，不慮而對，遍爲萬物說。
In the south, there was a man of extraordinary views, named Huang Liao, who asked Shi how it was that the sky did not fall nor the earth sink, and what was the cause of wind, rain, and the thunder's roll and crash. Shi made no attempt to evade the questions, and answered him without any exercise of thought, talking about all things.

《莊子雜篇》天下第三十三

Zhuangzi Tian Xia 4th Century BC.

Field survey is one of the essential activities in geological and physical geographical studies. Depending upon research purposes, geologists and/or geographers would select field sites to investigate. After site selection, researchers would: sketch the topography, observe the sedimentary structures, classify the rocks consisted in the strata, identify the fossils they observed, measure the strike and dip of the strata, and the structures and label them on the geological map. They would use all these data to interpret and reconstruct the geological history.

Instructions:

1. Please follow the instructors' instruction when traveling between stops for your and others safety. **The rocks will be slippery and potentially dangerous. Please move with caution. Absolute No Running! Absolute No Reading while Walking!**
2. You will be visiting a geological sanctuary. We urge you not to damage or take away geological material during your field investigations
3. In this practical test, you will be a geologist and a geographer studying a small area.
4. There are six stops (1 to 6).The sequence of visit to the six stops is not important, as long as all six sites are visited.
5. You will have 15 minutes at each site for making your observations.
6. Please record your observations and answers on your test sheets.
7. No discussion among students.
8. Please keep your test sheets carefully. If you lose any of them, there will be no score will be granted for that section.
9. Hard hats are provided at STOPs 4 and 6 because possible injury. Please wear a hard hat at these stops and return it later.
10. **Please read questions 1 and 2 first. Do not answer them until you have visited all six stops. You will need to get a whole picture of this area to understand the geology and structure of the area.**

1. What is the most likely depositional environment of the strata of this Bitou Cape area? (1 pt)
   (A) freshwater lake environment
   (B) desert and arid basin environment
   (C) fluvial environment
   (D) coastal environment
   (E) deep marine environment.
   Answer: _____

2. Please look at your map **on the last page**. Consider the strike and dip data provided along with your own measurements. Assuming that all the strikes and dips were measured on the same continuous plane, what is the most likely macro-scale geological structure of the Bitou Cape area? (1 pt)
   (A) anticline
   (B) syncline
   (C) volcanic crater
   (D) normal fault
   (E) reverse fault.
   Answer: _____

STOP 1

3. What is the most likely depositional environment for the sedimentary structure observed within the red frame at this outcrop? (1 pt)

   (A) riverine environment (B) lacustrine environment

   (C) deep sea with turbidity current (D) intertidal zone.

   Answer: _____

4. Please locate your current position using the GPS provided, and record it below at (i). Refer to the map (last page). Using the GPS position you obtain, select the correct spot from spots I to V. Record this answer at (ii) below.

   (i) GPS readout (1 pt): _____

   (ii) Circle the correct spot (1 pt): I, II, III, IV, V

5. Please measure the dip direction and dip angle of the assigned bedding surface at STOP 1 and plot them within the corresponding white circle on the map. Ticks around the white circles are 10° apart. Symbol " $\diagdown^{20}$ " indicates a stratum with a dip direction of 045° and a dip angle 20°.

   (i) dip direction: _____; dip angle: _____(2 pts)
   (strike = dip direction ± 090°)

   (ii) Label the dip direction and dip angle symbol in the corresponding white circle on the map **on the last page**. (1 pt)

STOP 2

6. What is the most dominant sedimentary structure that you see within the red frame at STOP 2? (1 pt)
   (A) ripple mark (B) cross bedding (C) slump structure
   (D) load structure (E) flame structure
   Answer: _____

7. What is the major sediment transport direction indicated according to this outcrop? Please answer by standing on the "X" mark, facing toward the outcrop. Please write down the correct answer using letters A to H. (2 pts)
   Answer: _____

8. Please identify the rock type you observed within the yellow frame. (1 pt)
   (A) granite (B) limestone (C) pillow lava
   (D) sandstone (E) shale
   Answer: _____

STOP 3

9. What is the structure within the red frame at STOP 3? (1 pt)
   (A) ripple mark　(B) cross bedding　(C) fault
   (D) plumose structure　(E) flame structure
   Answer: ________

10. Please observe the fossils from the assigned five sample locations (① to ⑤). Identify and match them with the pictures of fauna provided and circle the sample location numbers in the 2nd column. Then circle the name of the fauna corresponding to what you found. The names of fossils can be used more than once. You do not have to answer the third column (Name of fauna) if you don't find that kind of fossil. (total 4.5 pts; 0.5 pt each)

Pictures of fauna	Sample location	Name of fauna	
	① ② ③ ④ ⑤	Ans:	(A) bivalve (B) brachiopod (C) cephalopod (D) crustacean (E) gastropod (F) sea urchin
	① ② ③ ④ ⑤	Ans:	(A) bivalve (B) brachiopod (C) cephalopod (D) crustacean (E) gastropod (F) sea urchin
	① ② ③ ④ ⑤	Ans:	(A) bivalve (B) brachiopod (C) cephalopod (D) crustacean (E) gastropod (F) sea urchin

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	① ② ③ ④ ⑤	Ans:	(A) bivalve (B) brachiopod (C) cephalopod (D) crustacean (E) gastropod (F) sea urchin

STOP 4

11. At STOP4, you see a fallen rock. Identify what direction was “up” at the time of formation of the rock. (2 pts)
    Answer: _____

12. Please identify the type of fallen rock at this location. (1 pt)
    (A) granite (B) limestone (C) pillow lava
    (D) sandstone (E) shale
    Answer: _____

STOP 5

13. What is the sedimentary structure within the red frame at STOP 5? (1 pt)
    (A) ripple mark (B) fold (C) slump structure
    (D) load structure (E) flame structure
    Answer: _____

14. Based on the sedimentary structure you identified in the previous question, what is the most likely flow direction of water during formation? (2 pts)
    Answer: _____

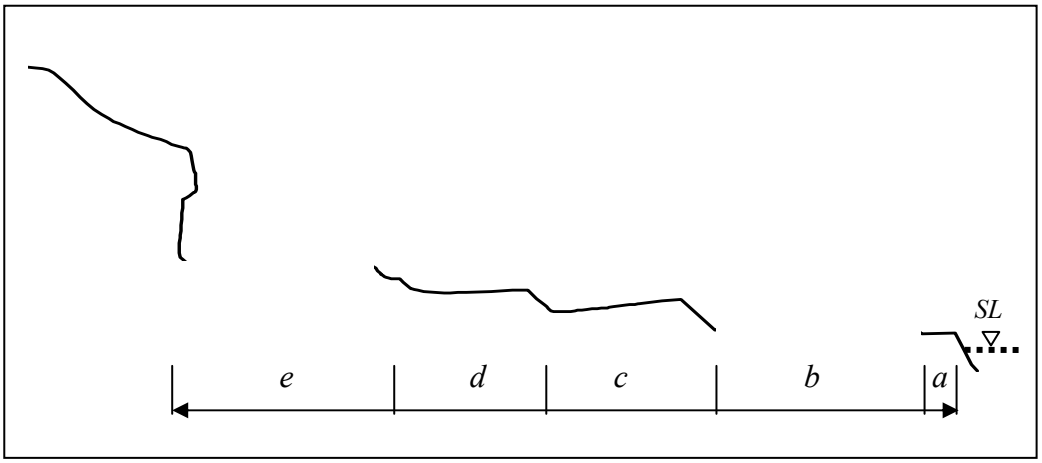
15. There are five surfaces in this outcrop labeled ① to ⑤. Please identify each surface and circle the correct options below. (2.5 pts)

Surface number	bedding plane	fault plane	joint plane	fold axial plane
①	bedding plane	fault plane	joint plane	fold axial plane
②	bedding plane	fault plane	joint plane	fold axial plane
③	bedding plane	fault plane	joint plane	fold axial plane
④	bedding plane	fault plane	joint plane	fold axial plane
⑤	bedding plane	fault plane	joint plane	fold axial plane

STOP 6

This stretch of coast is characterized by sea cliff, sea notch, wave abrasion platform (also known as shore platform) and some micro landforms. The figure below (not to scale) shows a cross section from the ridge of the headland to the sea though it is not quite completed yet. Its location is indicated by the arrows on the ground. Between the cliff toe and sea water, five segments can be readily identified (noted as segments a-e).

Please walk along the cross section before answering the following questions. **Be cautious on wet and slippery ground.**



Figure

16. Sketch the *segments b* and *e* to complete the cross section. (2 pts)

Please make use of observations within thirty meters on either side of the section line.

17. What major processes contributed to the landform development here? Check off or tick the four correct answers in the following list. (2 pts)

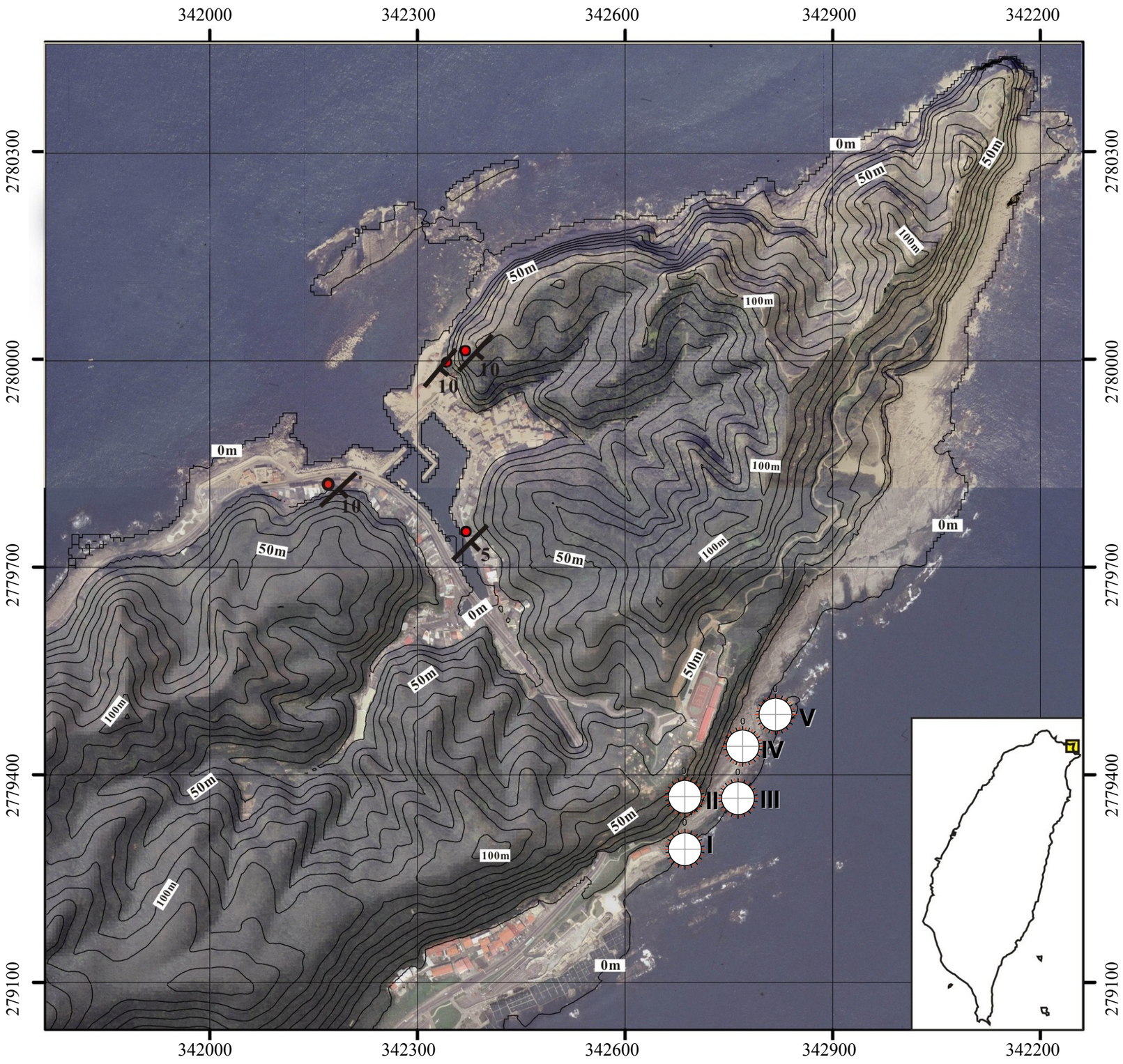
- ☐ uplift
- ☐ frost action
- ☐ salt weathering
- ☐ fluvial erosion
- ☐ subsidence
- ☐ wave erosion
- ☐ slope failure

Caption for the map on the last page

This is not a question!

Topographic map of the Bitou Cape region in Taipei County, northeast Taiwan. The latitudinal-longitudinal coordinates on the map are in the Taiwan Grid position format (TM2) coordinate system.

Map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342900
342200
2780300
2780000
2779700
2779400
279100
0m
50m
100m
10
10
10
5
V
IV
III
II
I