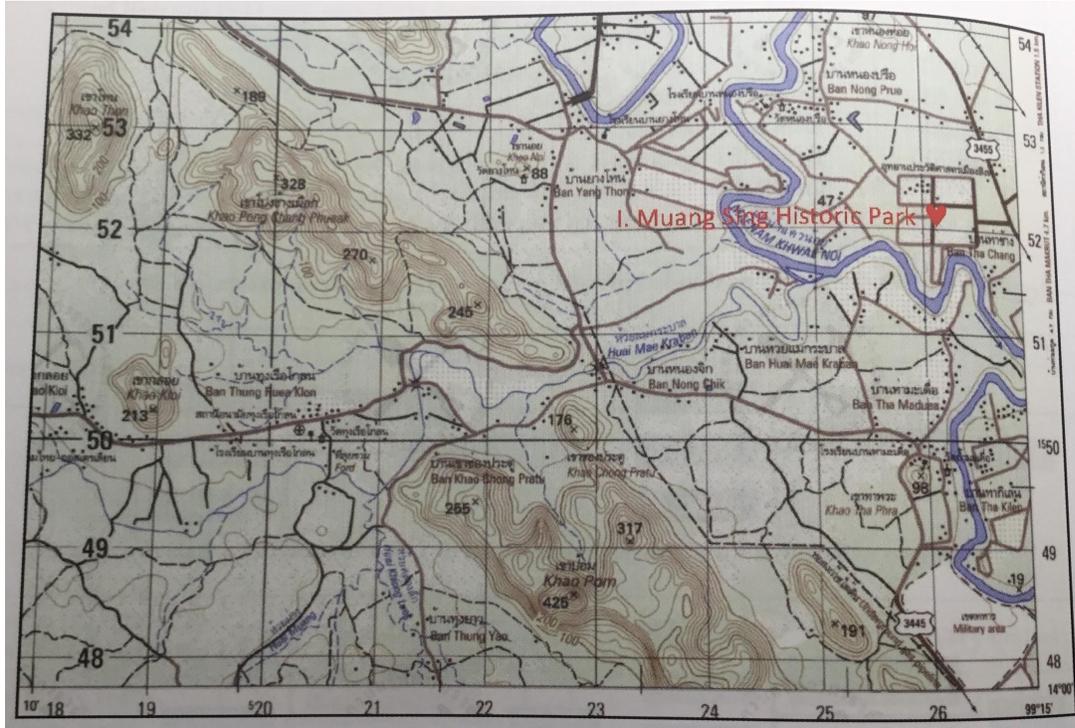


IESO 2018 Thailand: International Team Field Investigation (ITFI)

ITFI SITE 1 – The Mysterious Rocks

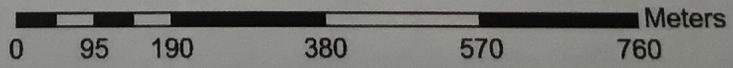
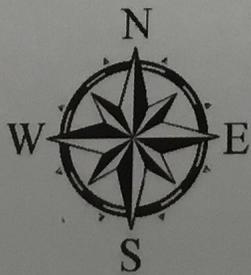
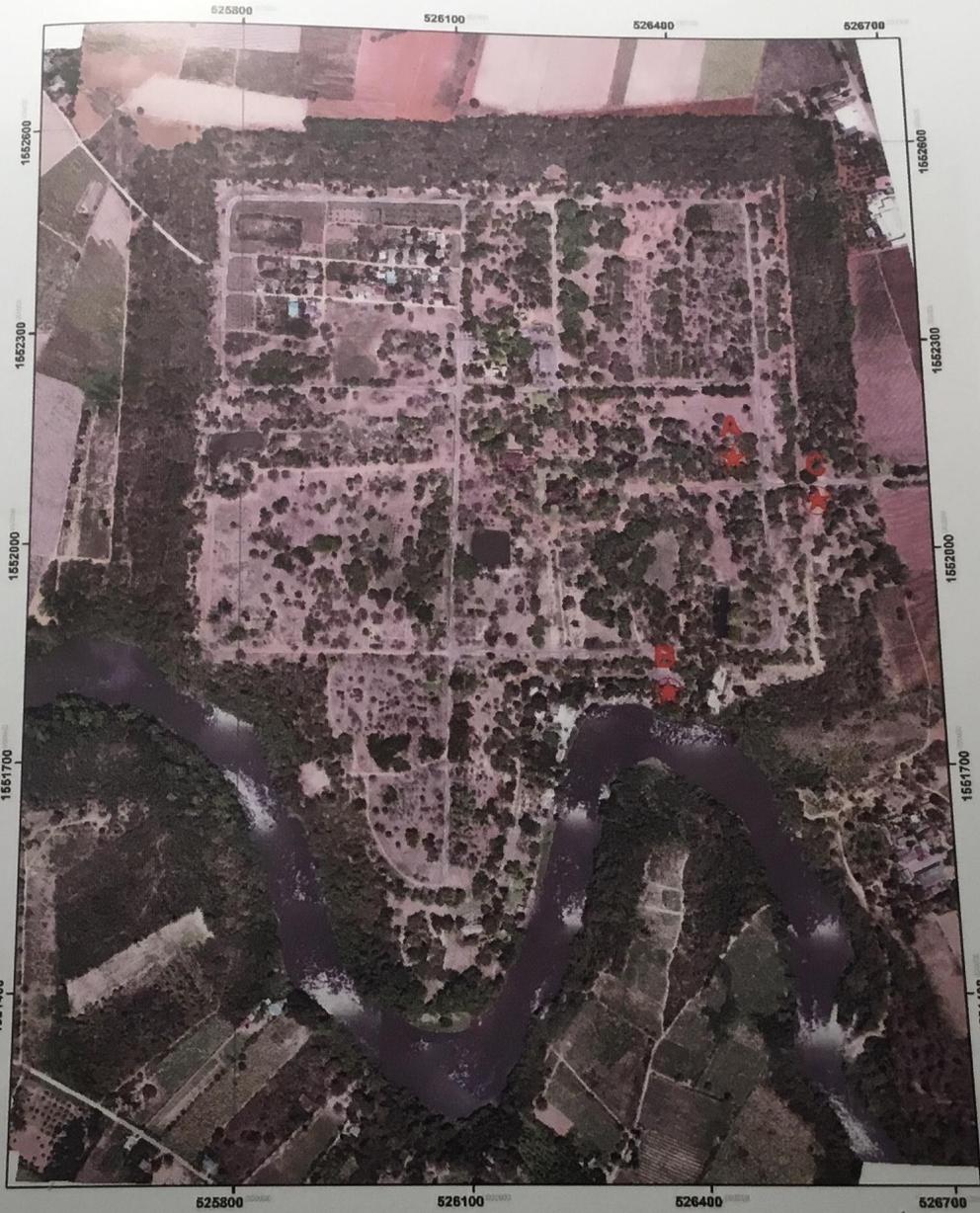
Location: Muang Sing Historic Park, Sai Yok District, Kanchanaburi Province (UTM Grid, 526329E/1552087N, 14°02'21.5"N/99°14'37.9"E)



ITFI 1 site plots on topographic map.

ITFI: Groups 1-4 will conduct field work at this site. There are 3 stops and time allocation for each stop is 1 hour. Groups 1-2 will work at stop A, group 3 at stop B, and group 4 at stop C. After one hour of work, each group has to rotate as guided by our volunteer.

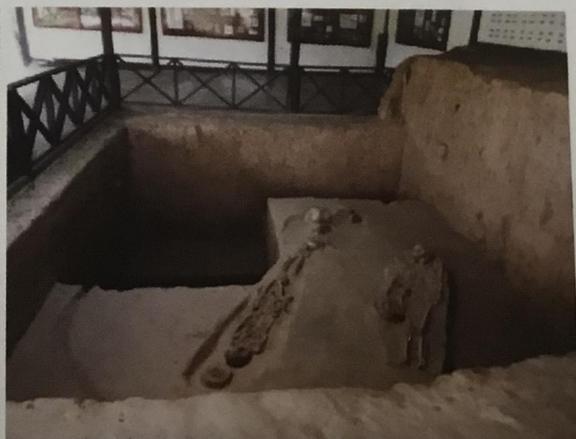
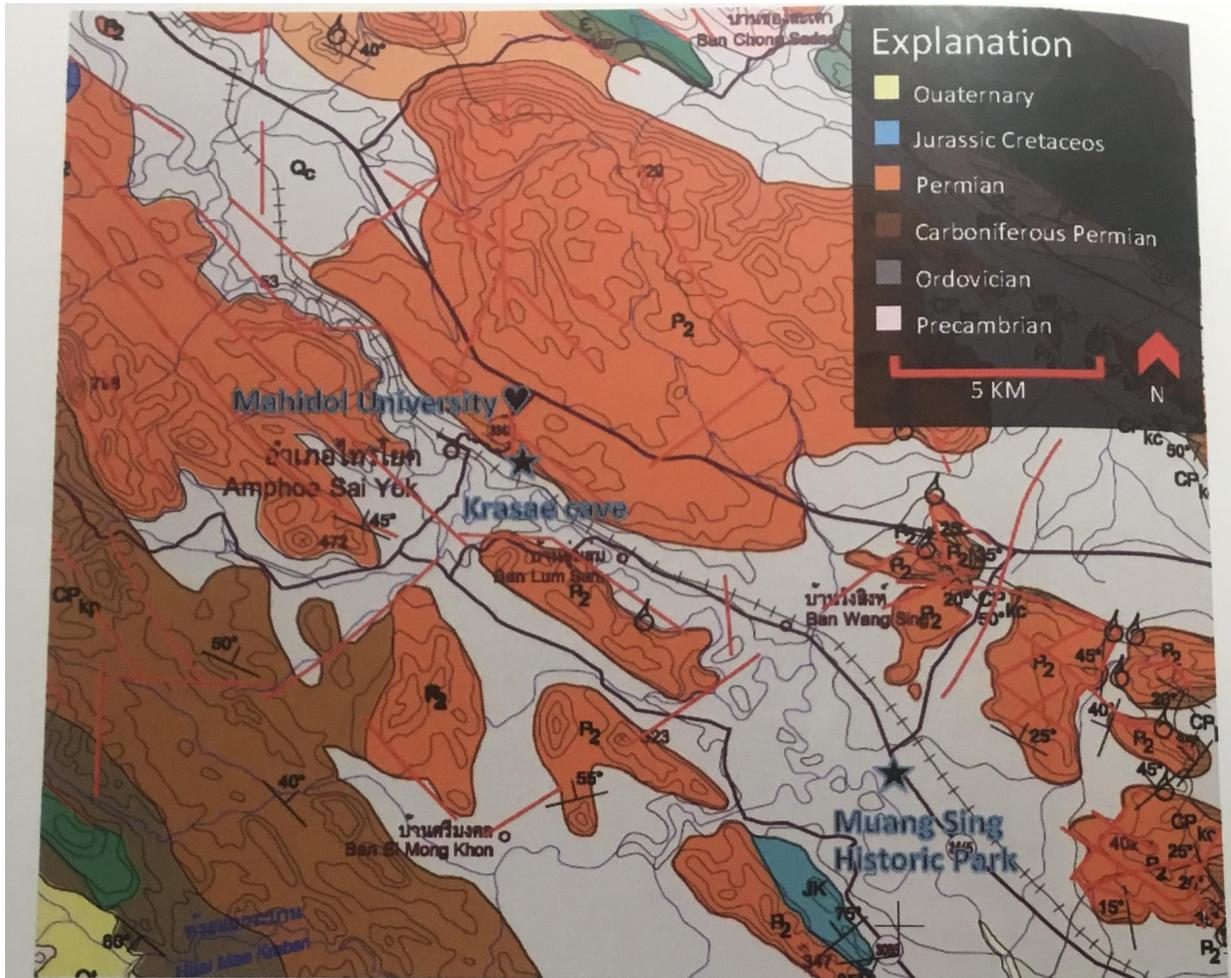
Background: The historical park was built on the floodplain of the Kwae Noi River. The Muang Sing / Prasat Muang Sing Temple is an ancient Khmer Bayon-style temple. The history of the site goes back to the period between 867 and 1157 A.D., a period when the Khmer Kingdom flourished. The area was declared as a historical site by the Fine Arts Department, Ministry of Culture, Government of Thailand in 1987 (**Figures 1 & 2**).



MUEANG SING HISTORICAL PARK - KANCHANABURI : IESO 2018

Research questions

1. Did the rocks here at stop A and stop C form *in situ*?
2. What earth systems interrelationships do these rocks present?



Stop A (left) and stop B (right) photography.

Guiding assignments:

Stop A:

1. Identify the rock: _____

2. Look around and describe at least three characteristics of the phenomenon:

3. Write down at least three different hypotheses to explain the appearance of the rocks here:

4. Stand at the point marked as “A” and examine the rocks beneath. What phenomenon do you observe, and does it support or reject the hypotheses you suggested? Please explain why.

5. With the help of a volunteer for your group, proceed to stop B, which is located a few hundred meters from here on the bank of the Kwae Noi River.

Stop B:

6. Look at the soil profile at the excavation site and closely observe the materials of this profile in a nearby exposure.
Mention below how it supports or rejects the hypotheses you proposed.

7. With the help of the volunteer for your group, proceed to Stop C located at the historic park entrance.

Stop C:

Observe and examine characteristics of the phenomenon.

8. Do the features you observed at Stop C support or reject the hypotheses you proposed earlier at Stop A? _____

ITFI 2 – The Krasae Cave and the Earth System

Location: Death Railway and Krasae Cave, Sai Yok District, Kanchanaburi Province (UTM Grid, 518079E/1559395N, 14°06'19.6"N/99°10'02.4"E)

The Krasae Cave is located on the western bank of the meandering Kwa Noi River, along a segment of the Three Pagodas Fault escarpment and the Death Railway in Sai Yok District.



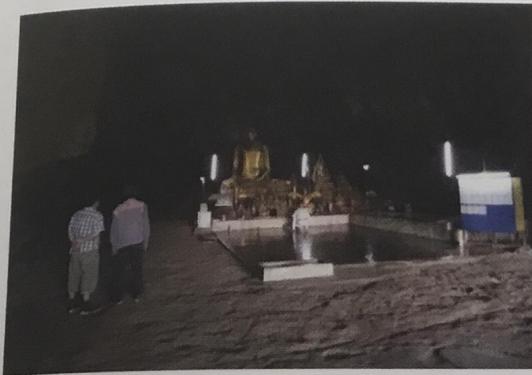
ITFI 2 site plots on topographic map.

ITFI: Groups 5-7 will conduct field work at this site. There are 2 stops and time allocation for each stop is 1 hour 30 minutes. Group 5 will work at stop A, and groups 6-7 at stop B. After one hour and a half of work, each group has to rotate as guided by our volunteer.

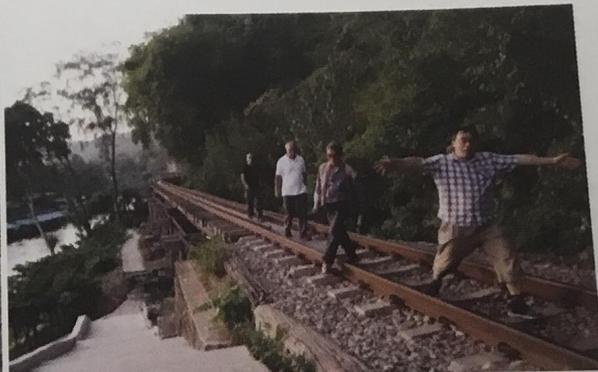
Background: Krasae Cave is a small one-sided open cave approximately 6-8 x 16-20 m in size. The Death Railway, situated southeast of the cave, was built during World War II (1939-1945) with the minimum supply of construction equipment but mainly by construction tools and human labor.



THAMKAR SAE - KANCHANBURI : IESO 2018



Krasae cave (Stop A)



Death Railway



Death Railway (Stop B)

Train passes the death railway where a segment of fault escarpment is the background.

Research question:

What kinds of earth system interrelationships are presented by this cave?

Guiding assignments:

1. Identify the rocks in front and inside the cave and at the escarpment along the Death Railway.
2. Observe, describe, and take pictures of phenomena that might explain the history of this cave.
3. Read the map; you may find some useful information to answer the research questions.

Stop A:

1. Identify the rock in front and inside the cave: _____

2. Look around and describe at least three characteristics of the phenomenon:

3. Observe, describe, and take pictures of phenomena that might explain the history of this cave.

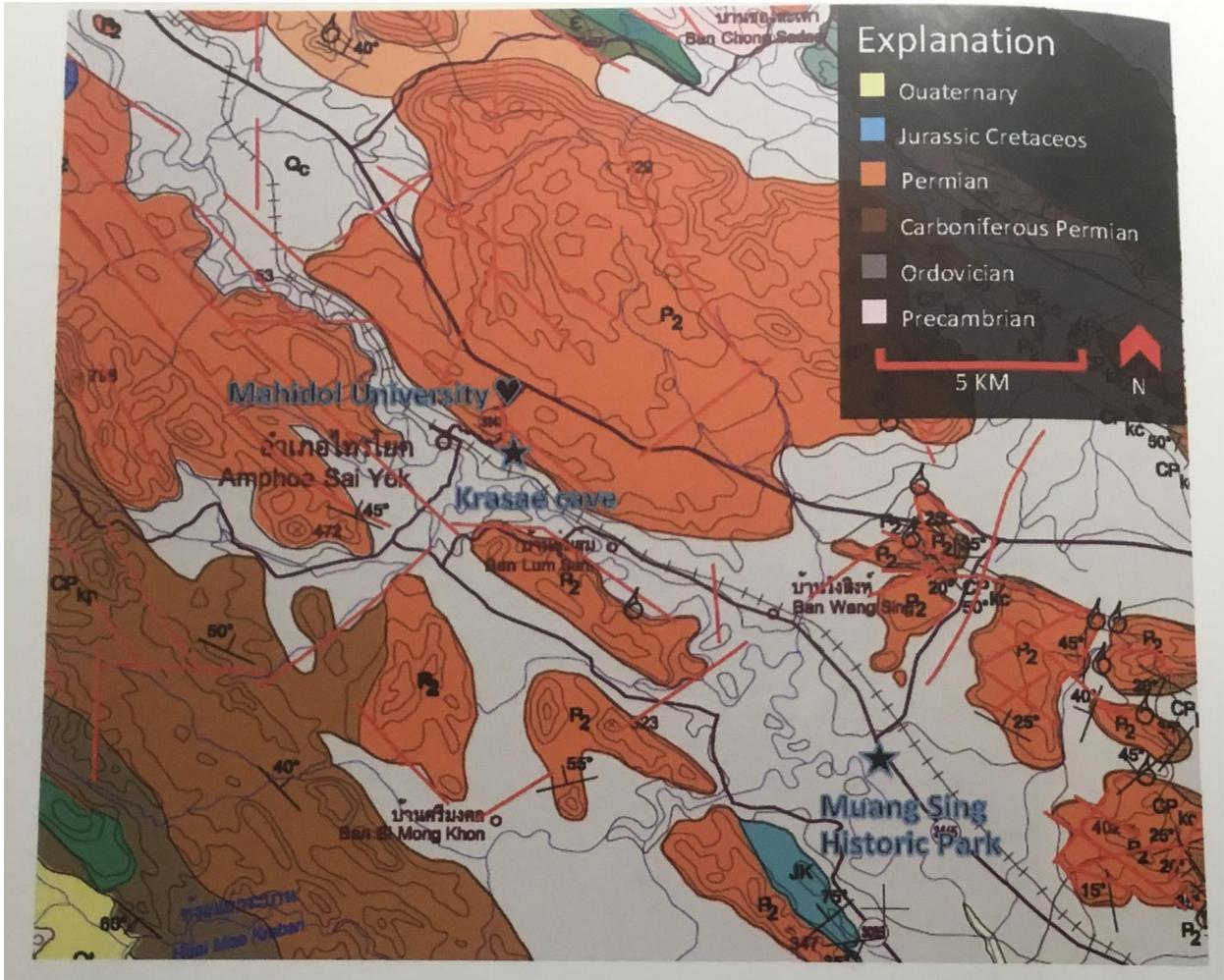
4. With the help of the volunteer for your group, proceed to Stop B, which is located about a hundred meters from the cave along the death railway.

Stop B:

5. Identify the rock at the escarpment along the death railway: _____

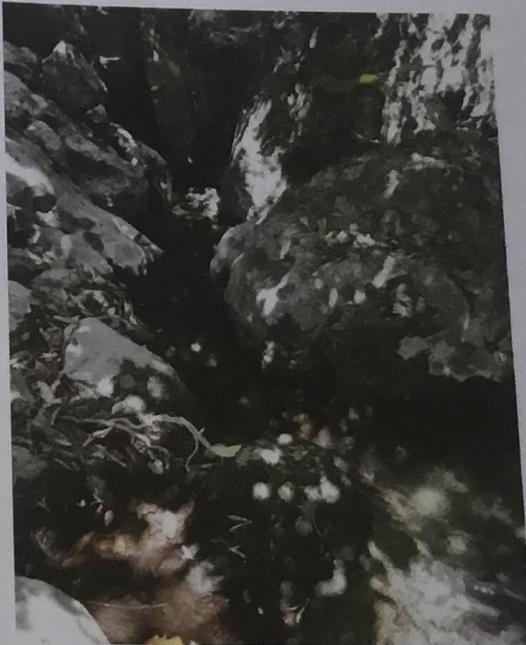
6. Look around and describe at least three characteristics of the phenomenon. Mention below how it supports or rejects the hypotheses you proposed.

7. Observe the river level before and after dam construction. Look around and describe at least three characteristics of the phenomenon including geohazards. Mention below how it supports or rejects the hypotheses you proposed.

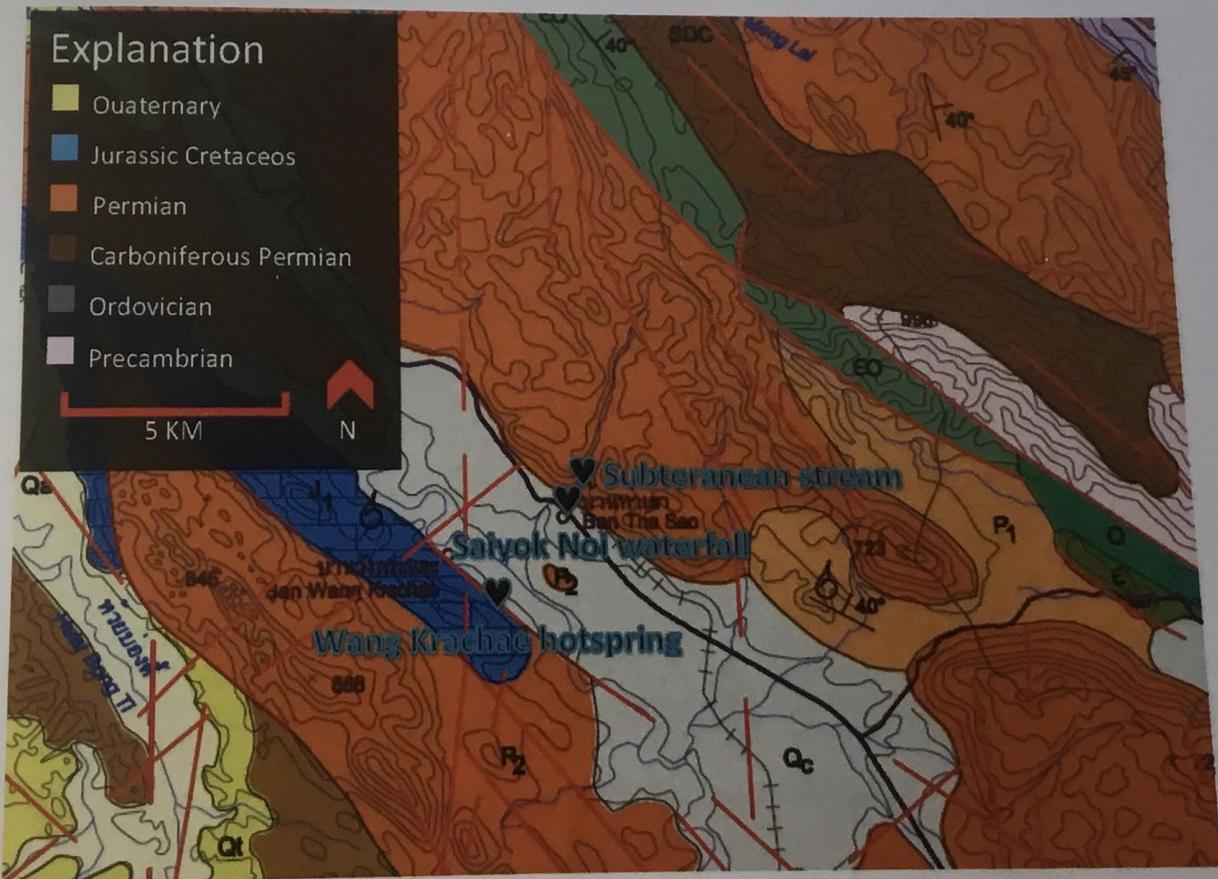




Sai Yok Noi water fall (STOP A)



Spring (Subterranean steam, STOP B)



ITFI 3 and ITFI 4 sites plot on geologic map

ITFI: Groups 8-11 will conduct field work at this site. There are 2 stops and time allocation for each stop is 1 hour plus moving from Stop A to Stop B and vice versa for 30 minutes. Groups 8-9 work at stop A while groups 10-11 work at stop B. After one hour of work, each group has to rotate as guided by our volunteer.

Research question

1. What kinds of earth system interrelationships are presented by this waterfall?

Guiding assignments:

Stop A — Under the waterfall

1. Identify the rock at the cliff: _____
2. Observe, describe, and take pictures of phenomena that might explain the history of this waterfall.
3. Collect a water sample from the river and measure the following parameters:
 - a. Temperature (T) _____
 - b. pH _____
 - c. Salinity _____
 - d. Carbonate _____
 - e. Bicarbonate _____
 - f. Nitrate _____
 - g. DO (dissolved oxygen) _____

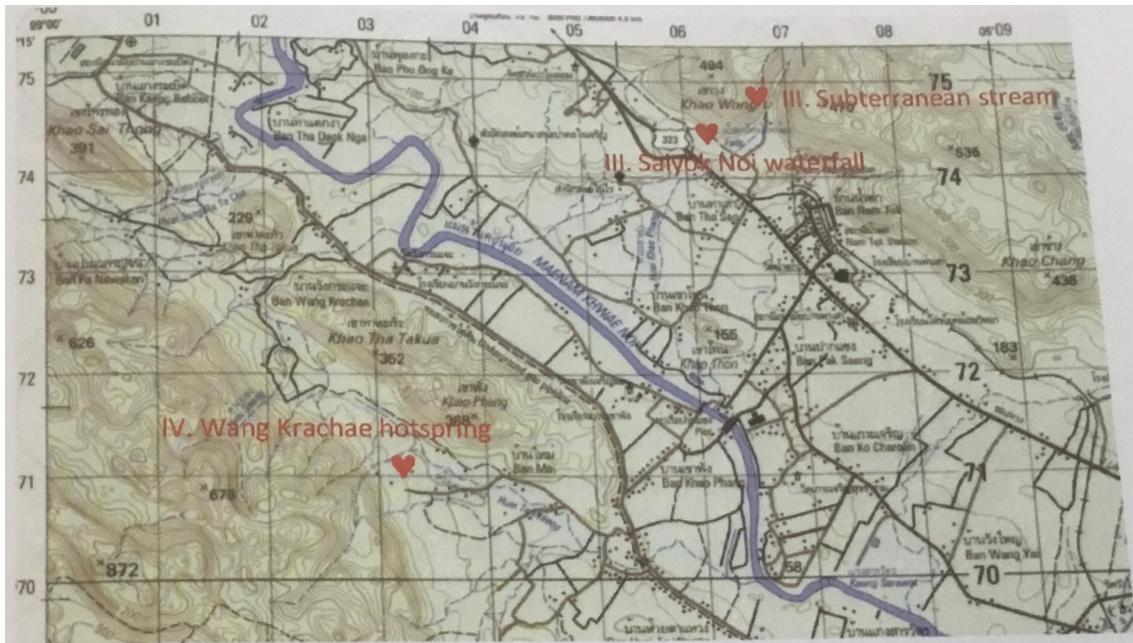
Stop B — The spring (the source of the waterfall) (UTM Grid. 506799E/1574561N)

1. Collect a water sample from the river and measure the following parameters
 - a. Temperature (T) _____
 - b. pH _____
 - c. Salinity _____
 - d. Carbonate _____
 - e. Bicarbonate _____
 - f. Nitrate _____
 - g. DO (dissolved oxygen) _____
2. Read the map; you may find some useful information to answer the research question.

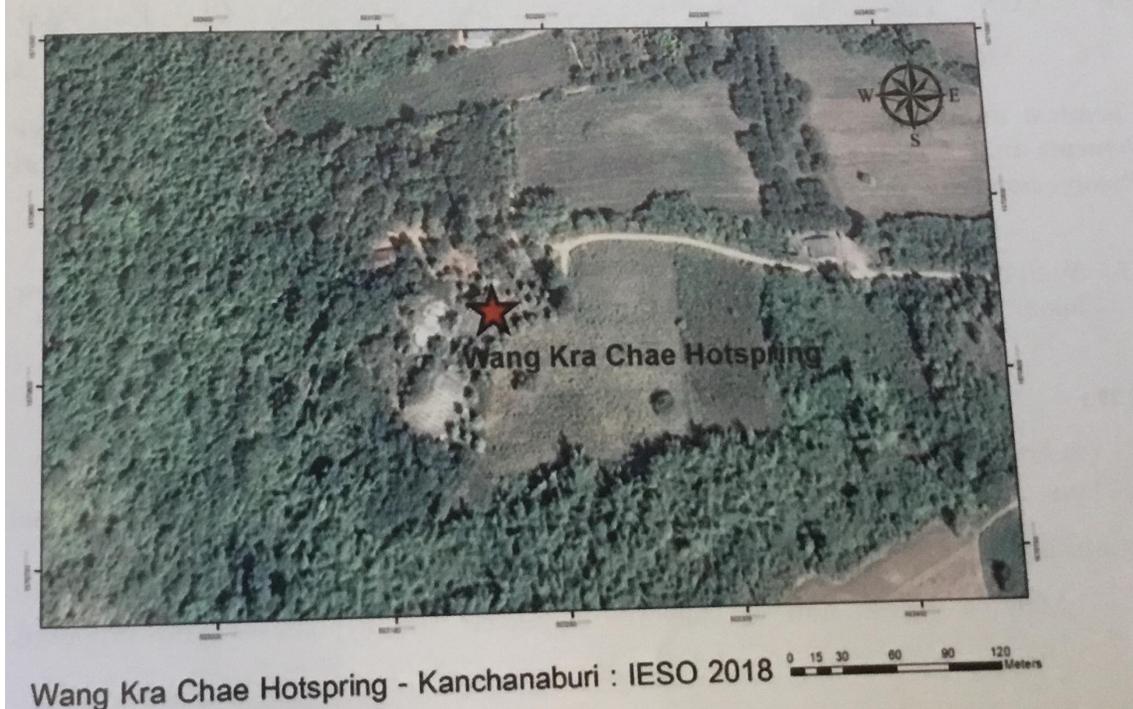
Remarks: Each group has to let at least 1 person to conduct chemical analysis which will be supervised by chemists.

ITFI 4 – The Hot Spring and the Earth System

Location: Wang Krachae hot spring is located at Wang Krachae subdistrict, Sai Yok District, Kanchanaburi Province. (UTM Grid, 503185E/1570861N)



Background: Hot springs are manifested commonly along the Kwae Noi River.



ITFI: Groups 12-15 will conduct field work at this site. There are 3 stops and time allocation for each stop is 1 hour. Groups 12-13 work at stop A, group 14 works at stop B, and group 15 works at stop C. After one hour of work, each group has to rotate as guided by our volunteer.

Research question

1. What kinds of earth system interrelationships are presented by this waterfall?

Guiding assignments:

Stop A:

1. Observe, describe, and take pictures of phenomena that might explain the history of this hot spring.
2. Measure the flow rate of the hot spring.
3. Look around and describe at least three characteristics of this phenomenon.
4. Collect a water sample from the hot spring pool and measure the following parameters:
 - a. Temperature (T) _____
 - b. pH _____
 - c. Salinity _____
 - d. Carbonate _____
 - e. Bicarbonate _____
 - f. Nitrate _____
 - g. DO (dissolved oxygen) _____
5. Calculate the reservoir temperature applying geothermometer equations from the websites using the analytical data below.

pH	CON	TDS	ALK	Na	K	Ca	Mg	Fe	SiO ₂	Cl	F	SO ₄ ⁻²
7.6	536	290	260	6.7	1.85	46.6	30.2	0.01	24.4	7.1	0.	33
											2	

Chemical analysis of the Wang Krachae Hot Spring (pH has no unit, the other elements analysis unit is in parts per million or ppm, CON = conductivity, TDS = total dissolved solids, ALK = Alkaline HCO₃⁻).

6. With the help of a volunteer for your group, proceed to stop B, which is located a few hundred meters from here on the bank of the Kwae Noi River.

Stop B:

7. Observe and identify the rock nearby.
8. Look at the soil and describe the interrelationships between the geosphere and biosphere. Mention below how it supports or rejects the hypotheses you proposed.

9. With the help of the volunteer for your group, proceed to stop C located at the hot spring spa.

Stop C:

10. Observe, describe, and take pictures of the abandoned hot spring spa pool.

11. Examine and describe the phenomena that might explain why the pool became abandoned.

- What should be the best practice to prevent the pool from being abandoned?

12. Collect a water sample from the abandoned hot spring spa pool and measure the following parameters:

- a. Temperature (T) _____
- b. pH _____
- c. Salinity _____
- d. Carbonate _____
- e. Bicarbonate _____
- f. Nitrate _____
- g. DO (dissolved oxygen) _____

13. Compare the quality of the hot spring versus the abandoned pool and explain.

Remarks: Each group has to let at least 1 person to conduct chemical analysis which will be supervised by chemists.

ITFI: Groups 16-18 will conduct field work at this site. There are 2 stops and time allocation for each stop is 1 hour 30 minutes. Groups 16-17 work at stop A, and group 18 works at stop B. After one hour and twenty minutes of work, each group has to rotate as guided by our volunteer.

Research question

1. What kinds of earth system interrelationships are presented by the data of the Kwae Noi River that were collected (directly and indirectly)?

Guiding assignments:

Stop A: at the eastern side of the riverbank

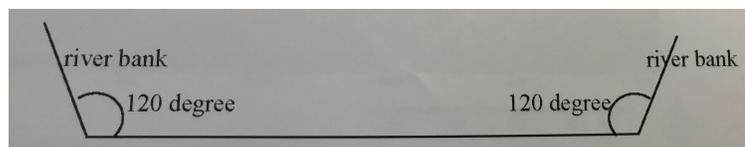
1. Identify characteristics of the river bank sediments.
2. Look around and describe at least three characteristics of the phenomenon of the river bank sediments and surrounding rocks:

3. Examine the sediments and rocks surrounding the river. What phenomenon do you observe that may cause geohazards? Provide hypotheses and explain whether phenomena supported or rejected your suggestions.

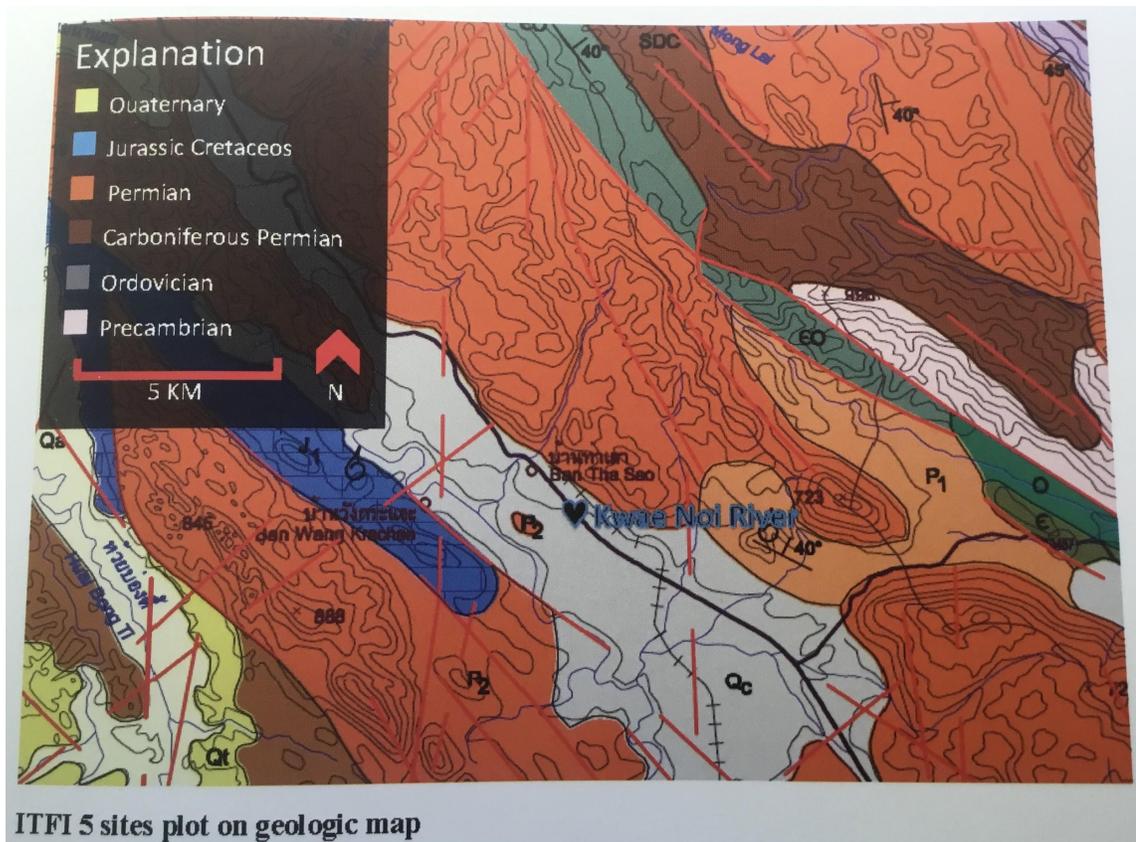
4. With the help of a volunteer for your group, proceed to stop B located at the middle of the bridge crossing the Kwae Noi River.

Stop B:

5. Look around and describe at least three characteristics of the phenomenon along river flow and the river bank that may cause geohazards. Mention below how it supports or rejects the hypotheses you proposed.
-
6. Calculate the river flow velocity assuming that a ball is dropped 300 meters upstream first at the middle of the river and takes 200 seconds to reach the bridge, while a ball dropped near the river bank takes 250 seconds to reach the bridge. Assume average river velocity equals the average of both velocities.
 7. Assume the river bottom and river bank shale is a trapezoid with both side of the river banks dipping 60 degrees and river depth is 6 meters (figure below). Calculate the rate of river flow at the bridge.



8. Collect two water samples from the river, one at the middle and the other close to the river bank and measure the following parameters:
 - a. Temperature (T) _____
 - b. pH _____
 - c. Salinity _____
 - d. Carbonate _____
 - e. Bicarbonate _____
 - f. Nitrate _____
 - g. DO (dissolved oxygen) _____
9. Read the map; you may find some useful information to answer the research question.



Remarks: Each group has to let at least 1 person to conduct chemical analysis which will be supervised by chemists.

Rubric for Evaluation of ITFI Project Presentation (point values in parentheses)

- I. Content
 - A. The depth of the project (10)
 1. Was knowledge and information content beyond that provided by the field guide?
 - B. Use of geological principles (10)
 - C. Complete connection of the Earth systems (10)
 - D. Originality and creativity (5)
 1. Presenting original ideas and perspectives which were not presented by the field leader.
- II. Structure
 - A. Clarity of subject and purpose (10)
 - B. A clear connection among presentations' parts (flow of the presentation) (20)
- III. The use of tools
 - A. Concretization level of the subjects (10)
 - B. Minimal text and clear fonts (10)
 - C. Was the presentation dynamic to serve the content? (10)
 - D. Contextual use of scientific terms (10)
 - E. Aesthetics (10)
- IV. Oral presentation
 - A. Synchronization between oral and powerpoint presentations (10)
 - B. Fluency (10)
 - C. Time management (10)
- V. International cooperation (to be evaluated on site by a volunteer incognito)
 - A. How many team members were involved in the investigation? (10)
 - B. Quality of discussion amongst members (10)
 - C. Were they open to learning from one another? (10)
 - D. Did members respect others and give them an opportunity to contribute and speak up? (10)

IESO 2018 Thailand: Earth Systems Project (ESP)

The Problem of Land Subsidence in Bangkok

The Bangkok metropolis area has an estimated population of close to 20 million due to its geographic location on the lower Chao Phraya River Plain as well as its political location as the capital city of Thailand. Geologically, however, the city is located on very thick deposits of soft Bangkok clay and interbedded with river sand beds and hard clay of > 2 km thickness before reaching the bedrocks of granites and metamorphic rocks. Overpumping of the groundwater for domestic consumption from more than 8 sand aquifers within the Bangkok Metropolis and surrounding areas, namely, Samut Prakarn, Samut Sakorn, Nonthaburi, Pathum Thani, and Ayutthaya has resulted in extensive land subsidence in the lower central plain. The maximum subsidence of >2 m was measured for the southern part of Bangkok in early 2002 to 2005 and large areas of Bangkok and Samutprakarn were below mean sea level already. Drastic measures had been taken, including prohibition of groundwater pumping in Bangkok, Samutprakarn, Nonthaburi, and Pathum Thani. But by that time, a large chunk of the Bangkok Metropolis had already subsided below mean sea level. Bangkok Metropolis and Nonthaburi had to build concrete embankments on both sides of the river to protect the city from perpetual flooding. At the same time, the Bangkok Municipality Office has enacted regulations that required all new houses in the Metropolis to raise the land above mean sea level before construction permits were issued. Furthermore, salt water intrusion into the first two aquifers beneath the city has occurred. Fortunately, by that time the groundwater level in the depleted aquifer was gradually rising; thus groundwater recharge was unwarranted.

Students of each team are asked to research this problem. At least four aspects related to soil subsidence needs to be presented. Also, propose methods to mitigate this problem.