# Subsurface Water Distribution Mapping and Seasonal Fluctuation of Water Table Determination for Water Management at Ban Pa Sak Ngam, Luang Nuea Subdistrict, Doi Saket District, Chiang Mai Province

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# Contents



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# Introduction

- In the past, Ban Pa Sak Ngam, Luang Nuea Subdistrict, Doi Saket District, Chiang Mai Province was rich in forest resources.
- In 1978, the government announced the Government Forest Concession Policy leading to the reduction of forest resources.
- In 1992, Khun Mae Kuang Forest Area Royal Development Project was started. Ban Pa Sak Ngam was included in this Project.
- In 1999, the result of the Project continuously increased the forest area.
- However, over the past few years, Ban Pa Sak Ngam has continuously faced water shortages for consumption and agriculture. Water management is therefore important.


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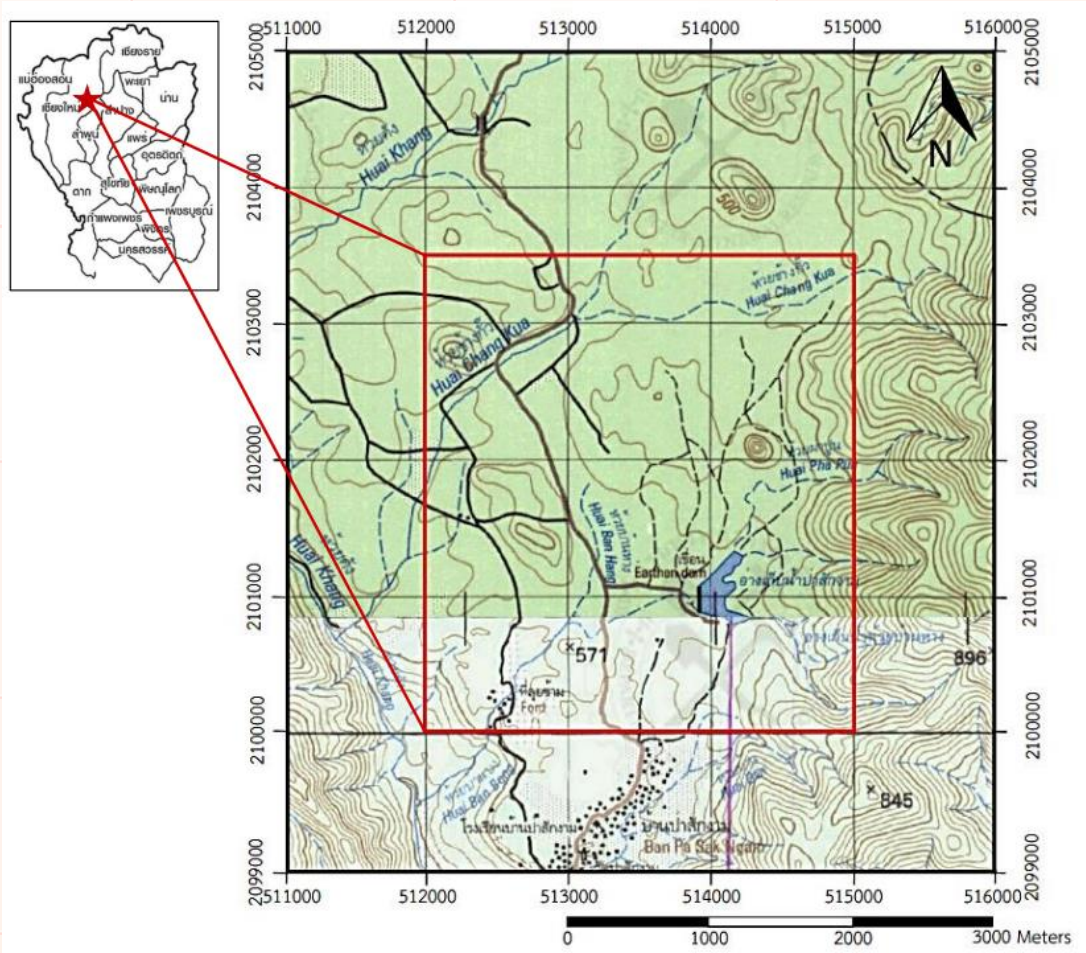
# Study area

- Ban Pa Sak Ngam is situated in the northeastern part of Chiang Mai Basin, Thailand.
- The study covers the area of about 10.5 sq. km.

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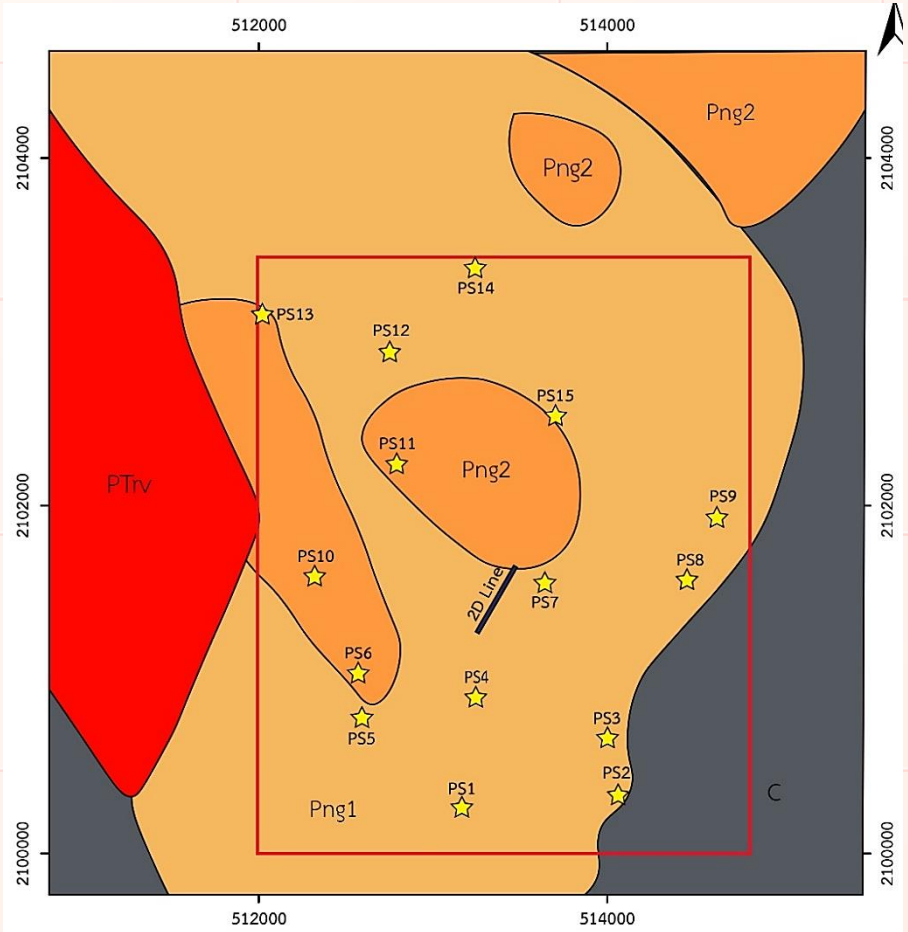
- **Lithology of the study area**

| | |
|---|---|
| Png1 | Tuffaceous sandstone, Sandstone, gray to greenish grey Shale, and Limestone |
| Png2 | Massive and laminated Limestone interbedded with Shale, Sandstone |
| C | Conglomerate, Sandstone, Sale, Slate, Chert, and Conglomeratic Limestone |
| Ptrv | Rhyolite, Andesite, flowed Tuff, Agglomerate Rhyolitic Tuff, and Andesitic Tuff |

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# Objectives

- Subsurface water distribution mapping
- Rock properties prediction using seasonal fluctuation of the subsurface water table

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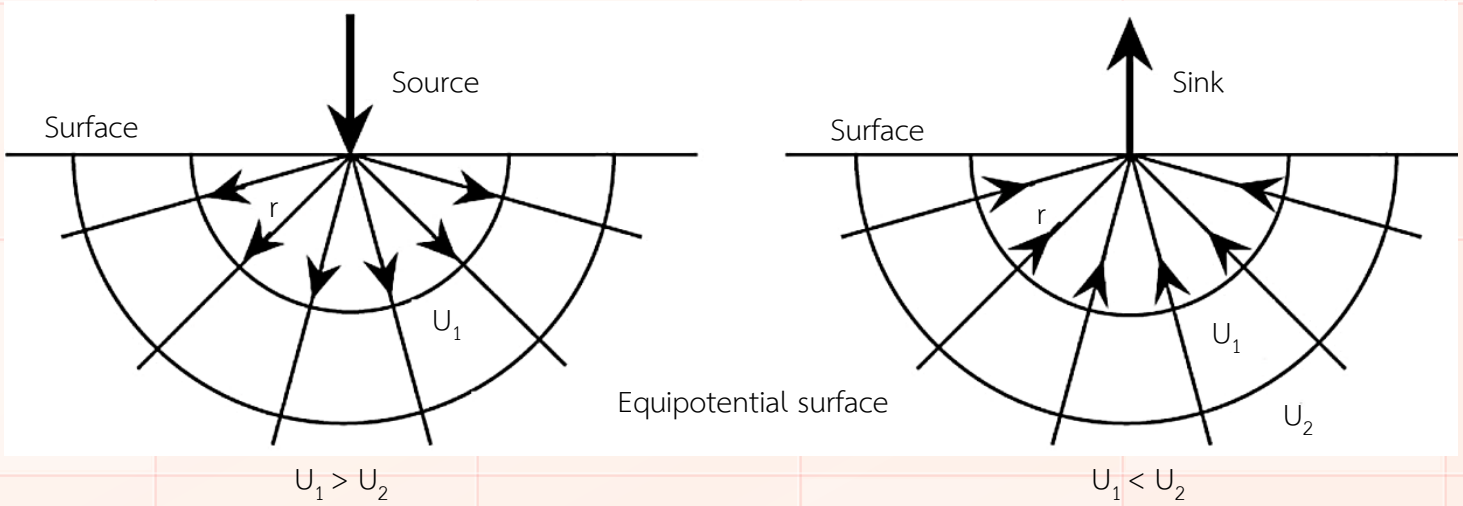
# Methodology and Result

- **Surface resistivity survey**
- Surface electrical resistivity surveying is based on the principle that the distribution of electrical potential in the ground around a current-carrying electrode depends on the electrical resistivities and distribution of the surrounding soils and rocks.

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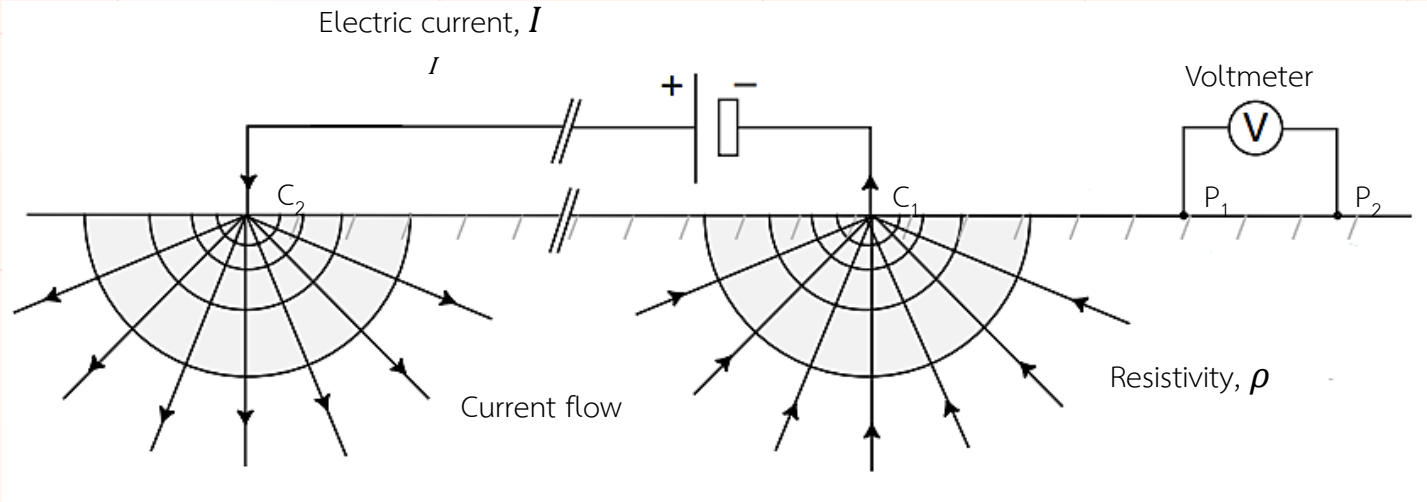
- **Surface resistivity survey**
- The usual practice in the field is to apply an electrical direct current (DC) between two electrodes implanted in the ground and to measure the difference of potential between two additional electrodes that do not carry current.

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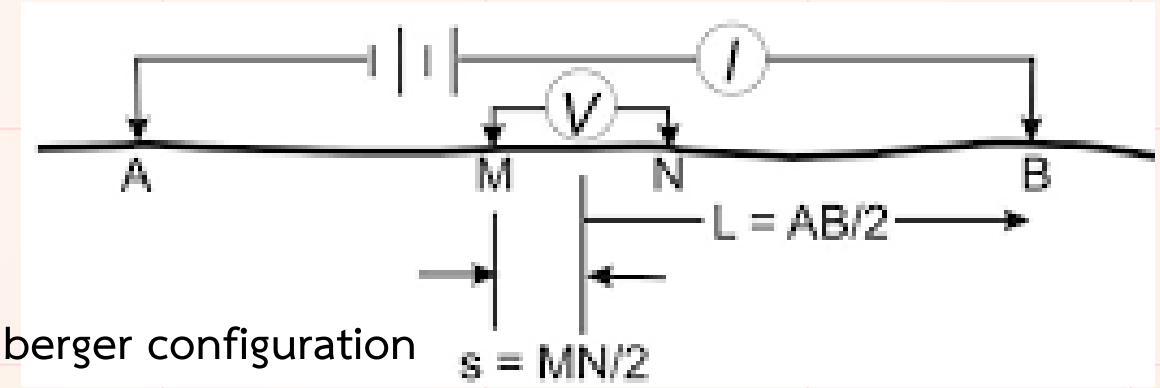
- **Schlumberger configuration**
- The Schlumberger configuration is an array where four electrodes are placed in-line around a common midpoint. The two outer electrodes,  A and B, are current electrodes, and the two inner electrodes, M and N, are potential electrodes placed close together.




Schlumberger configuration

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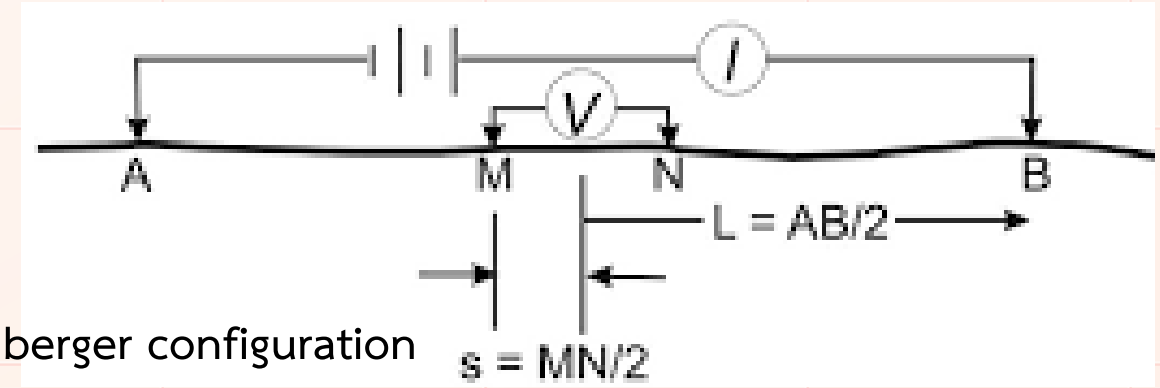
- **Schlumberger configuration**
- For each measurement, the current electrodes, A and B, are moved outward to a greater separation throughout the survey, while the potential electrodes M and N stay in the same position until the observed voltage becomes too small to measure. At this point, the potential electrodes M and N are moved outward to a new spacing. The reasonable distance between M and N should be equal to or less than one-fifth of the distance between A and B.




Schlumberger configuration

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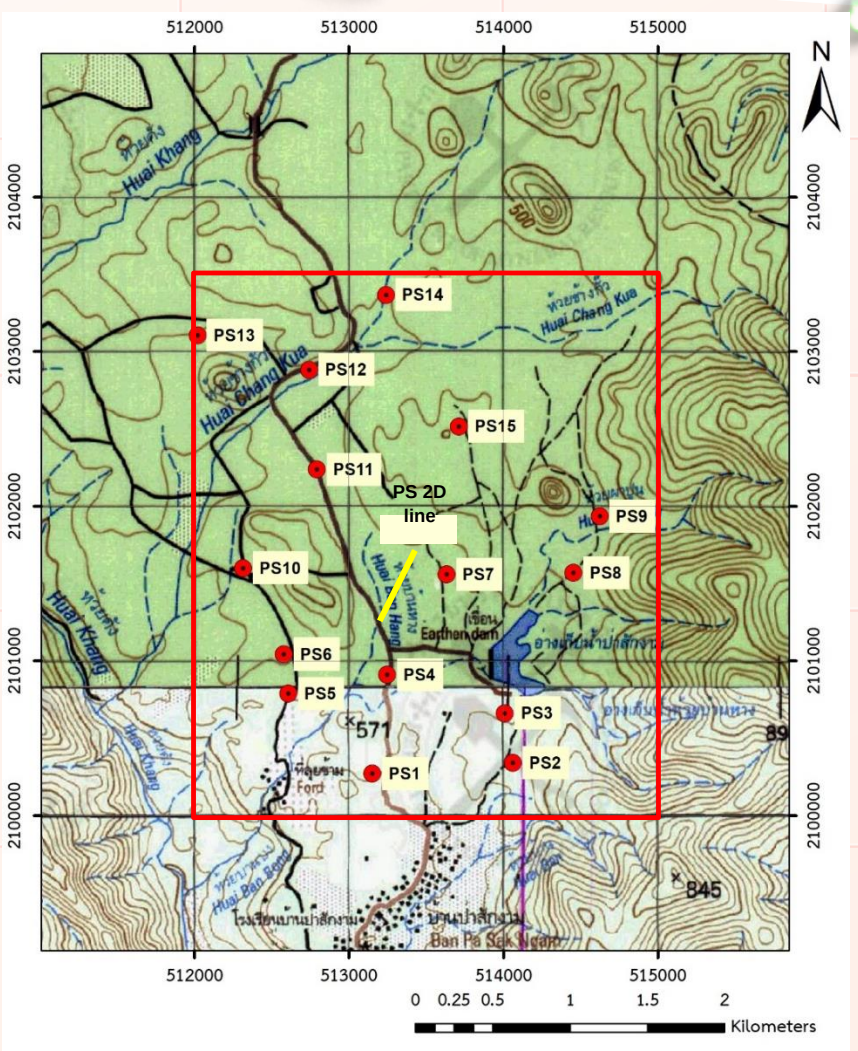
- Surface resistivity survey was the easy and suitable method to provide the information.
- 15 points (PS1-PS15) were assigned for 1D vertical electrical sounding in the study.
- Schlumberger electrode configuration was used in the study.
- The total length for each survey line was 200 m.
- The surveys were conducted twice in January and May 2022 to study the changes in subsurface water.

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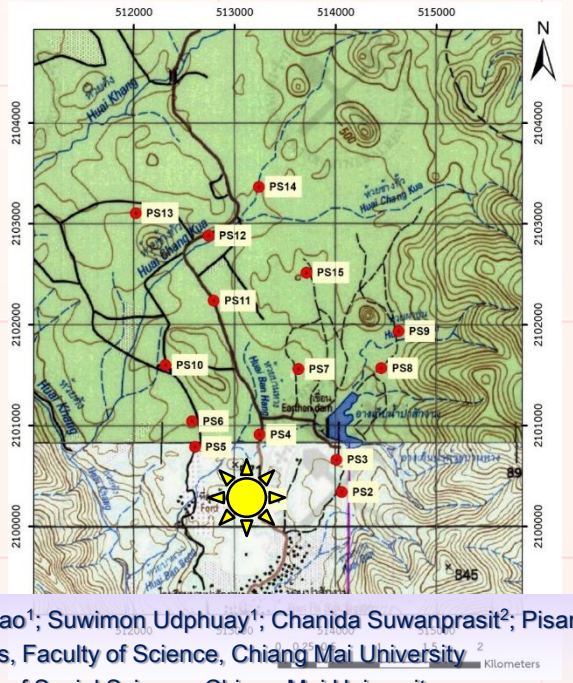
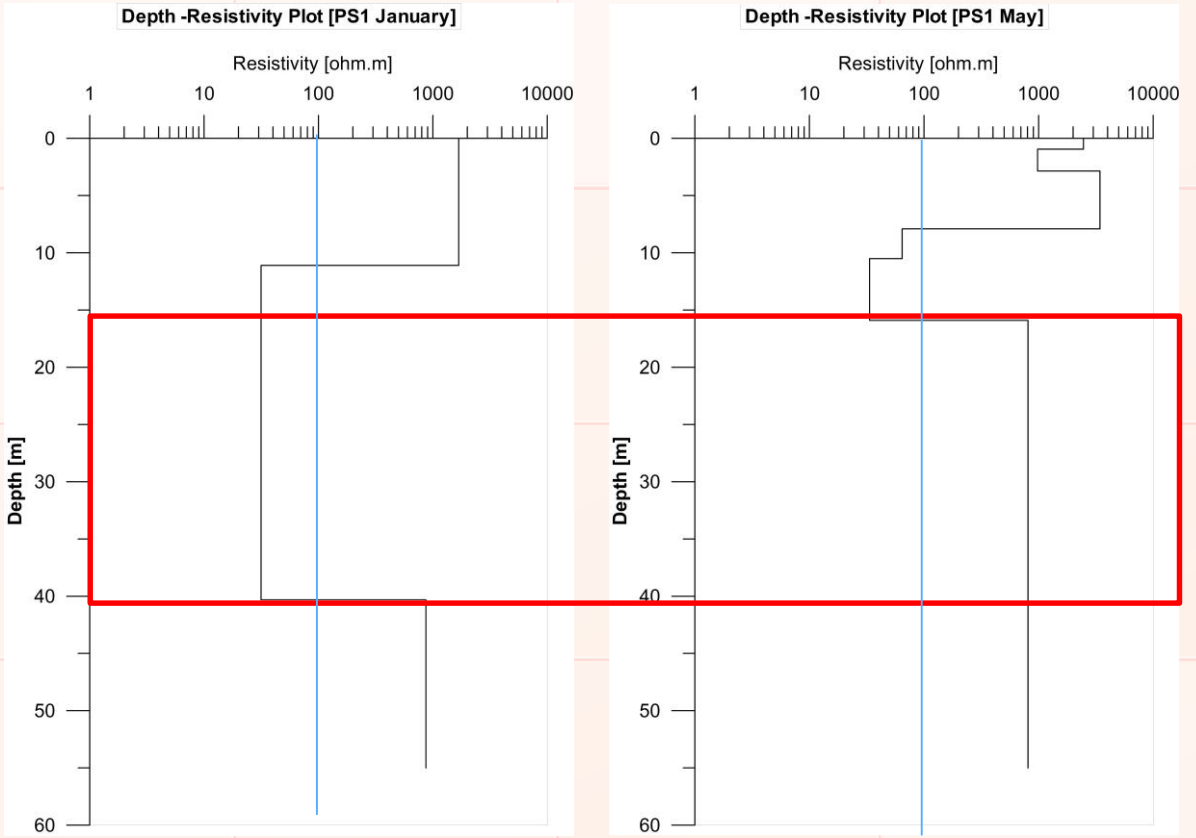
# Result

- Fracture rock can be distinguished at the depth between 15.90 m and 40.32 m
- Subsurface water level can be found at the depth of about 10 m.




PS1 in Png1 unit

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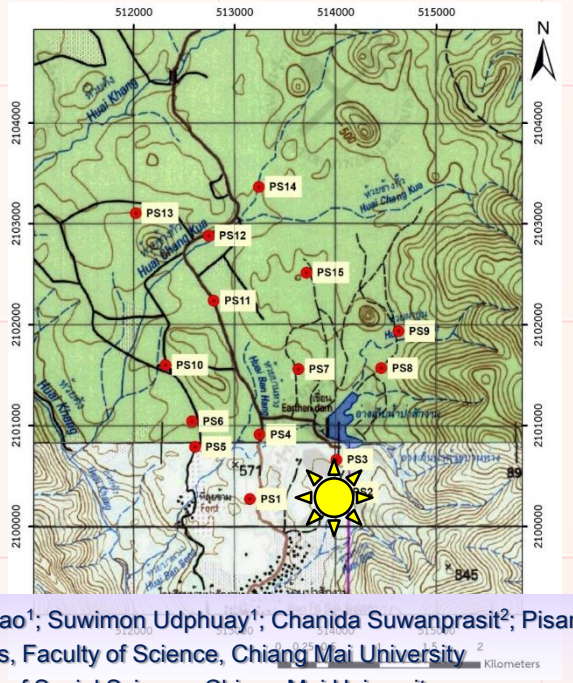
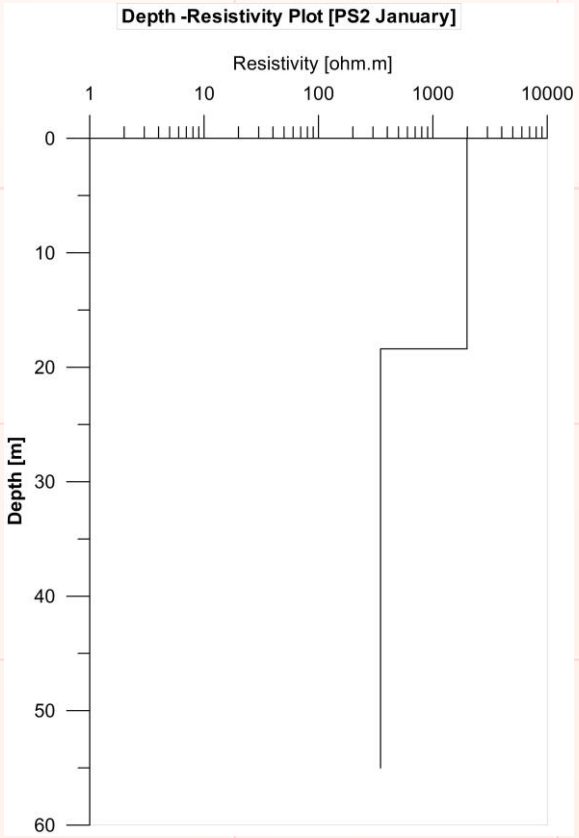
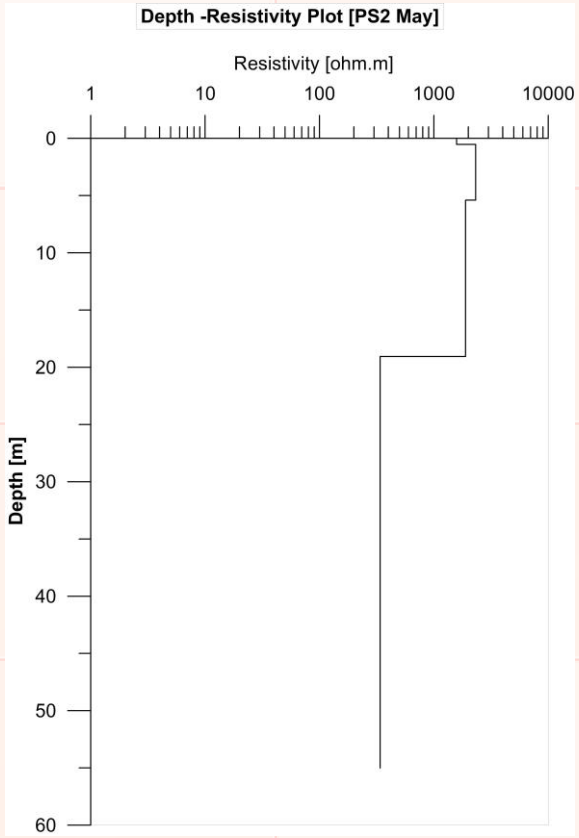
- Resistivity patterns are quite stable indicating no effect of rainfall on the subsurface water.




PS2 in Png1 unit

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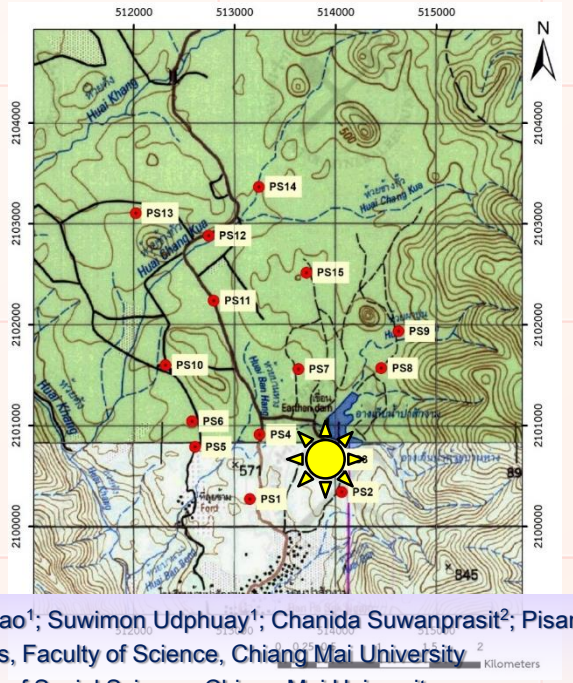
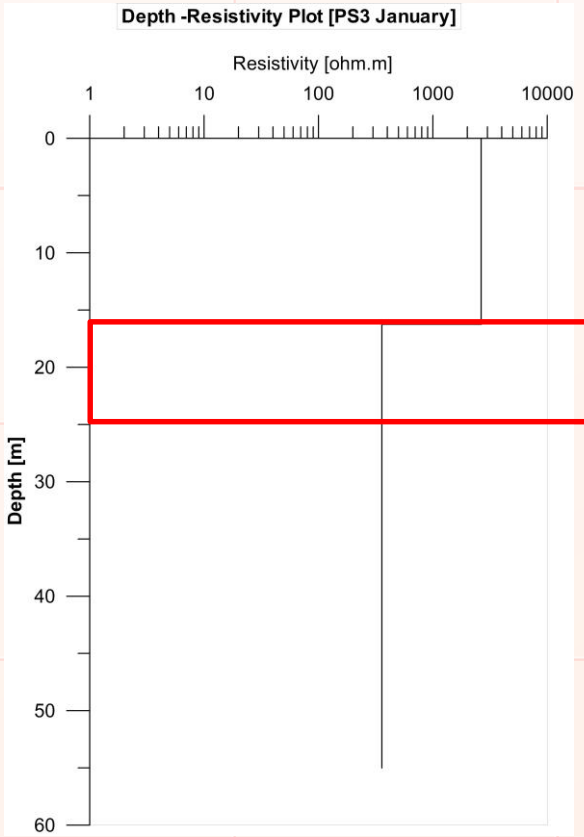
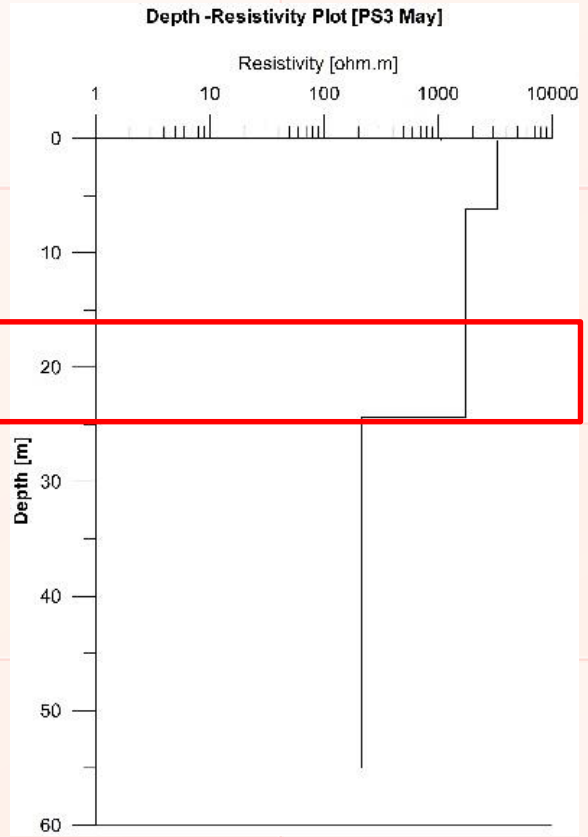
- AT the depth between 16.23 m and 24.36 m, fracture rock is indicated




PS3 in Png1 unit

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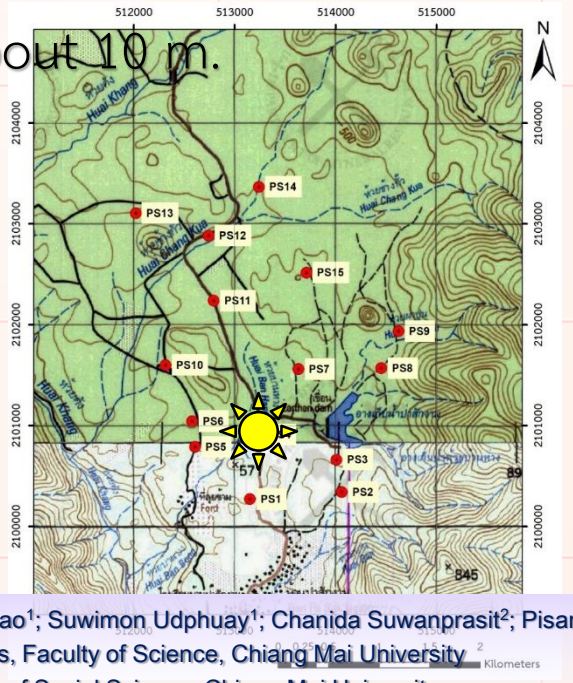
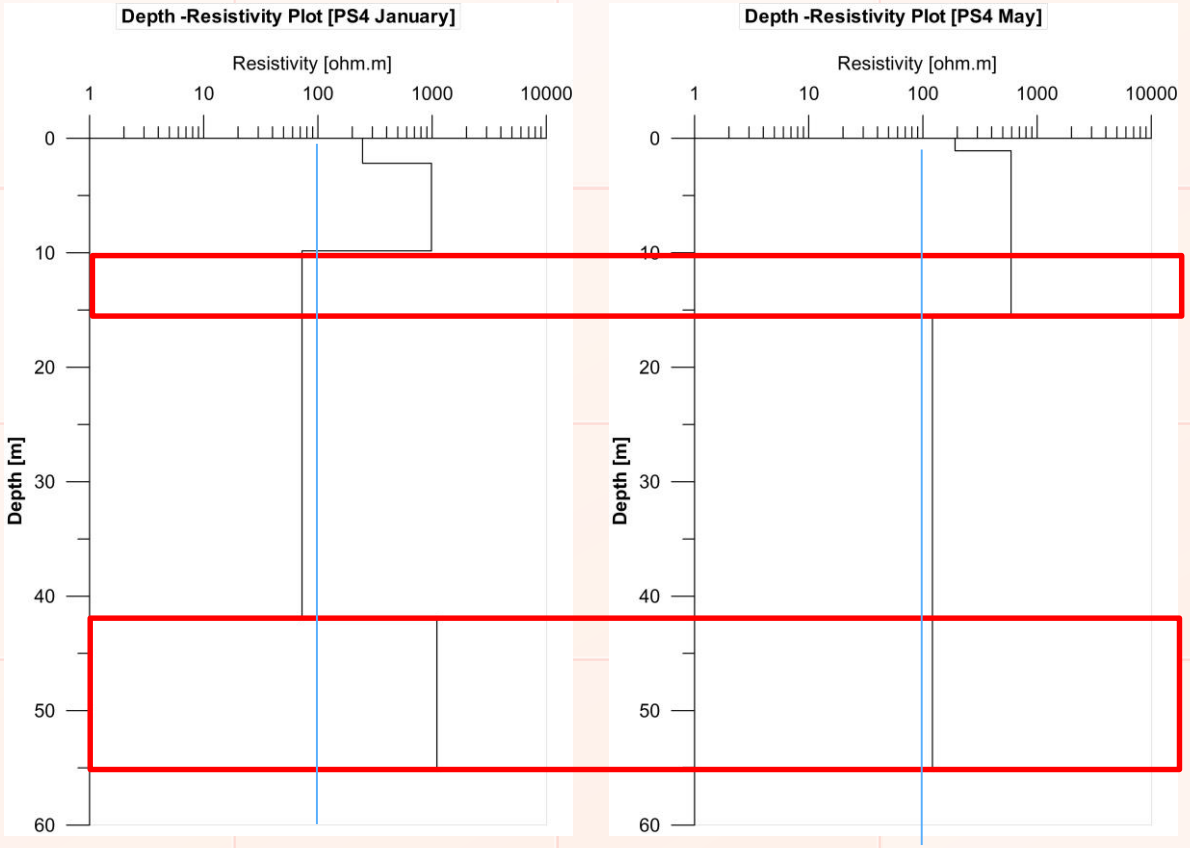
- AT the depth between 9.83 m and 15.43 m, and the depth greater than 41.97 m, fracture rock is indicated
- Subsurface water level can be found at the depth of about 10 m.




PS4 in Png1 unit

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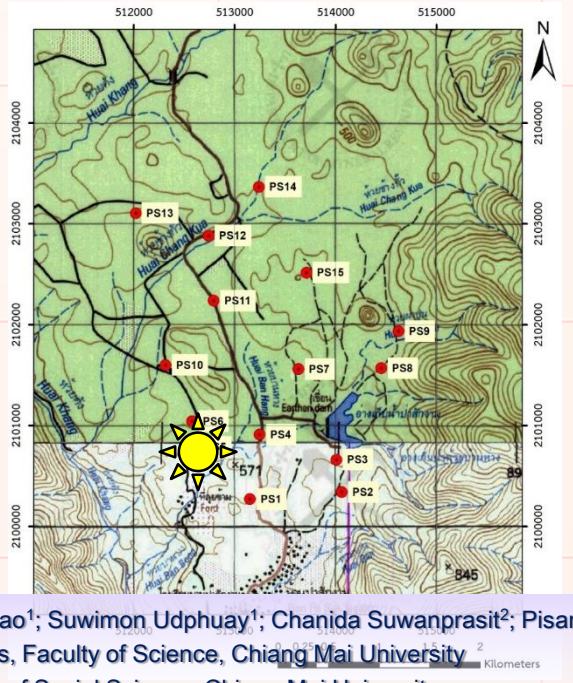
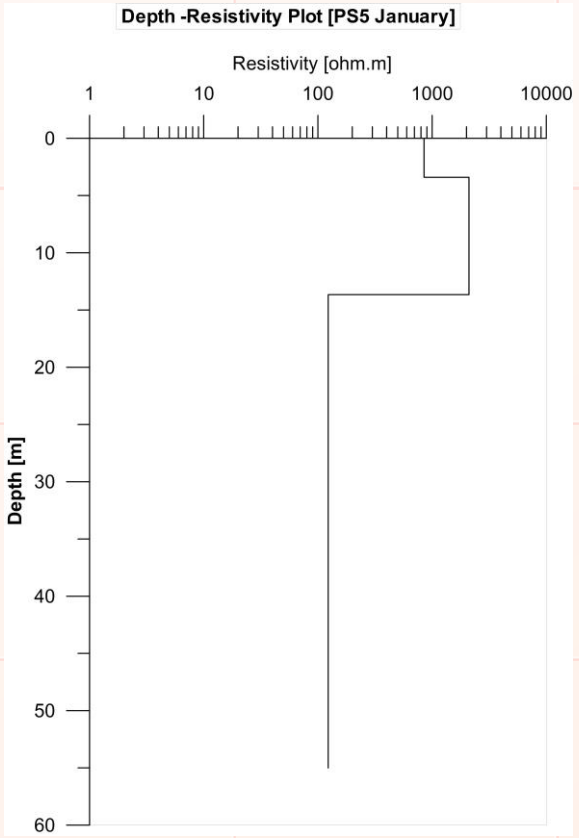
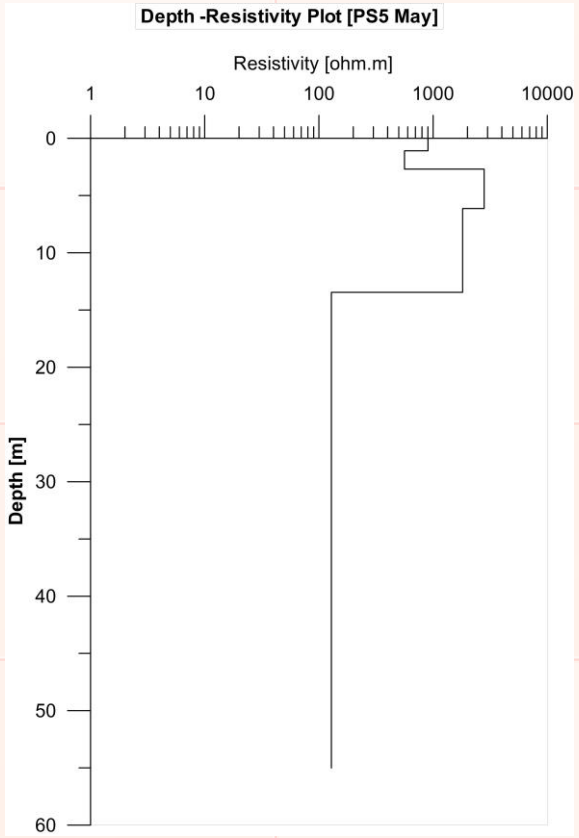
- Resistivity patterns are quite stable indicating no effect of rainfall on the subsurface water




PS5 in Png1 unit

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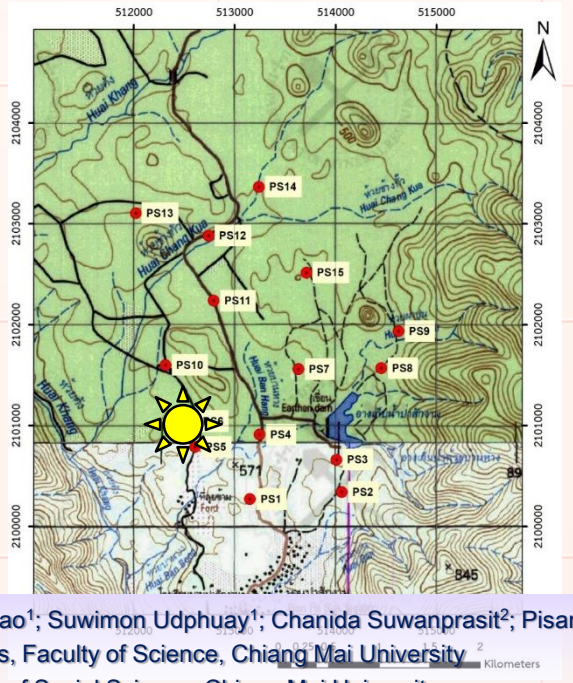


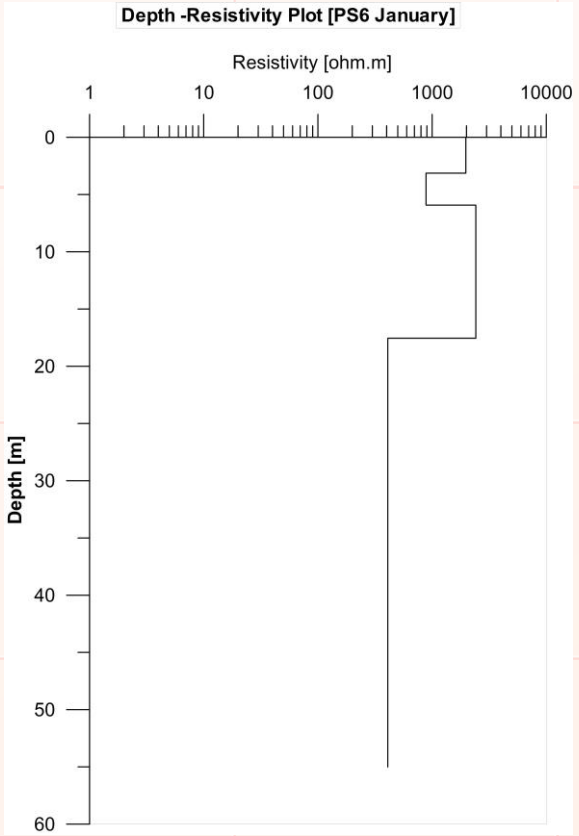


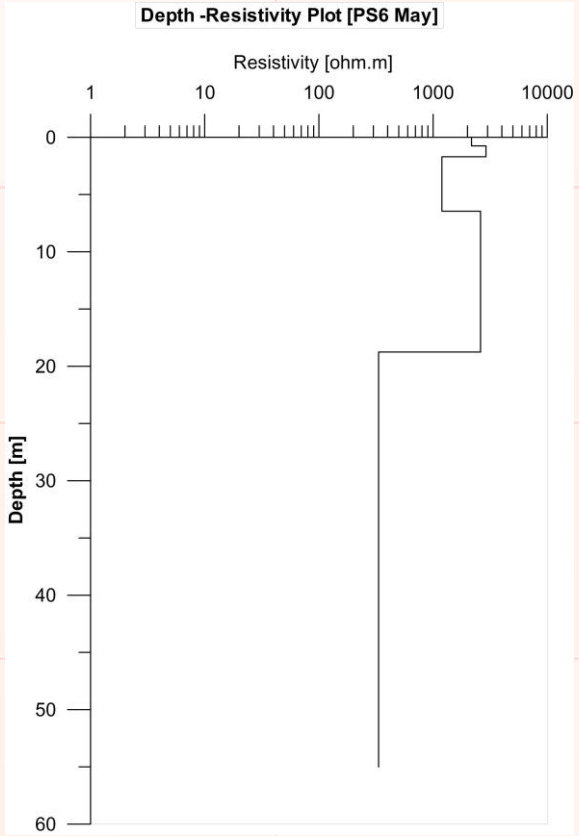


PS6 in Png2 unit

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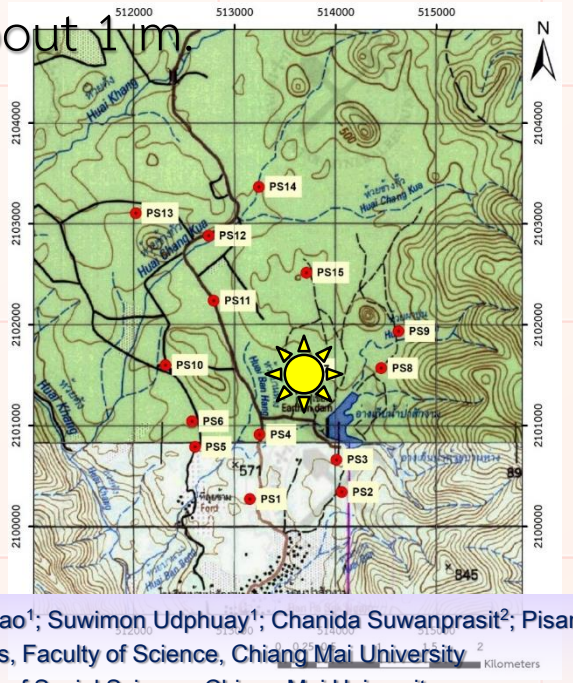
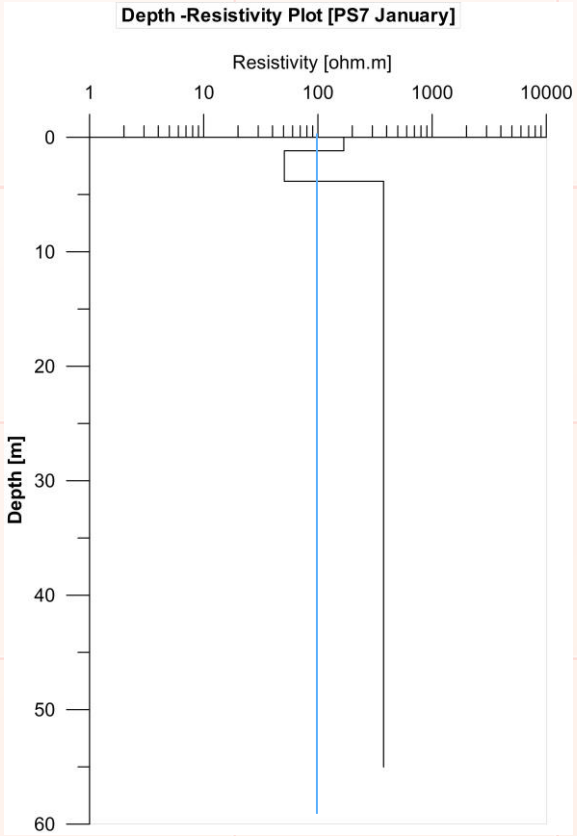
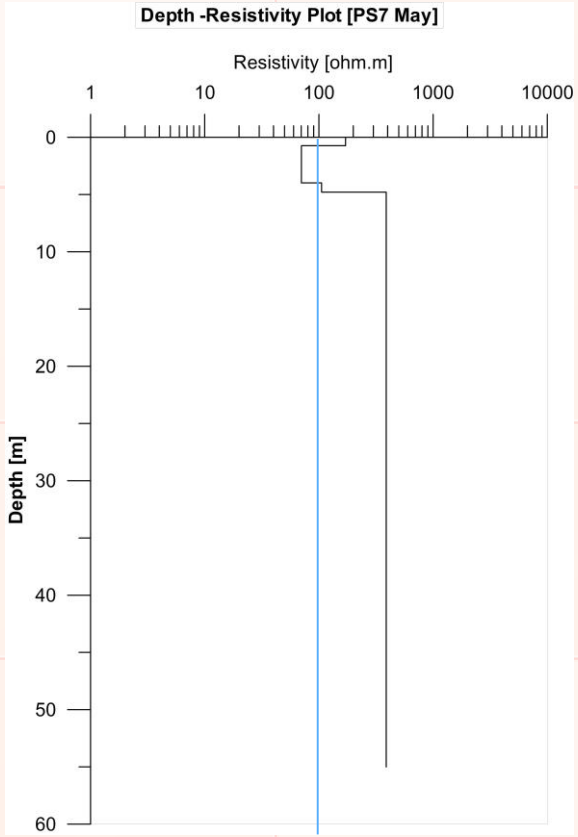
- Resistivity patterns are quite stable indicating no effect of rainfall on the subsurface water
- Subsurface water level can be found at the depth of about 1 m.




PS7 in Png1 unit

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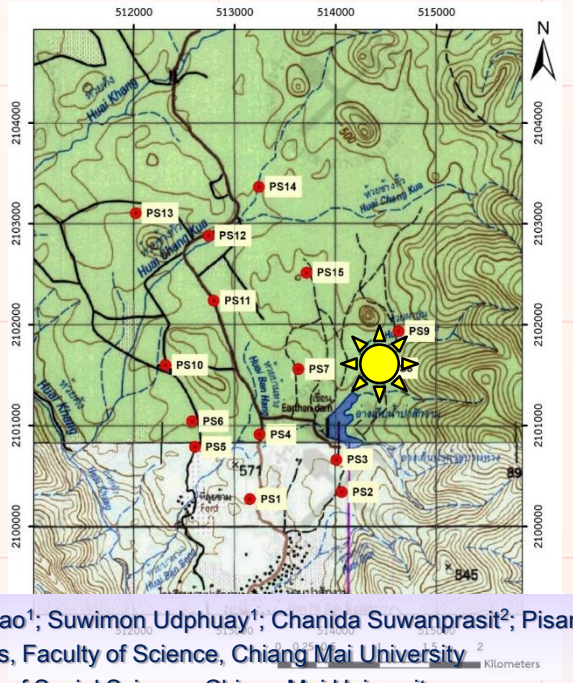
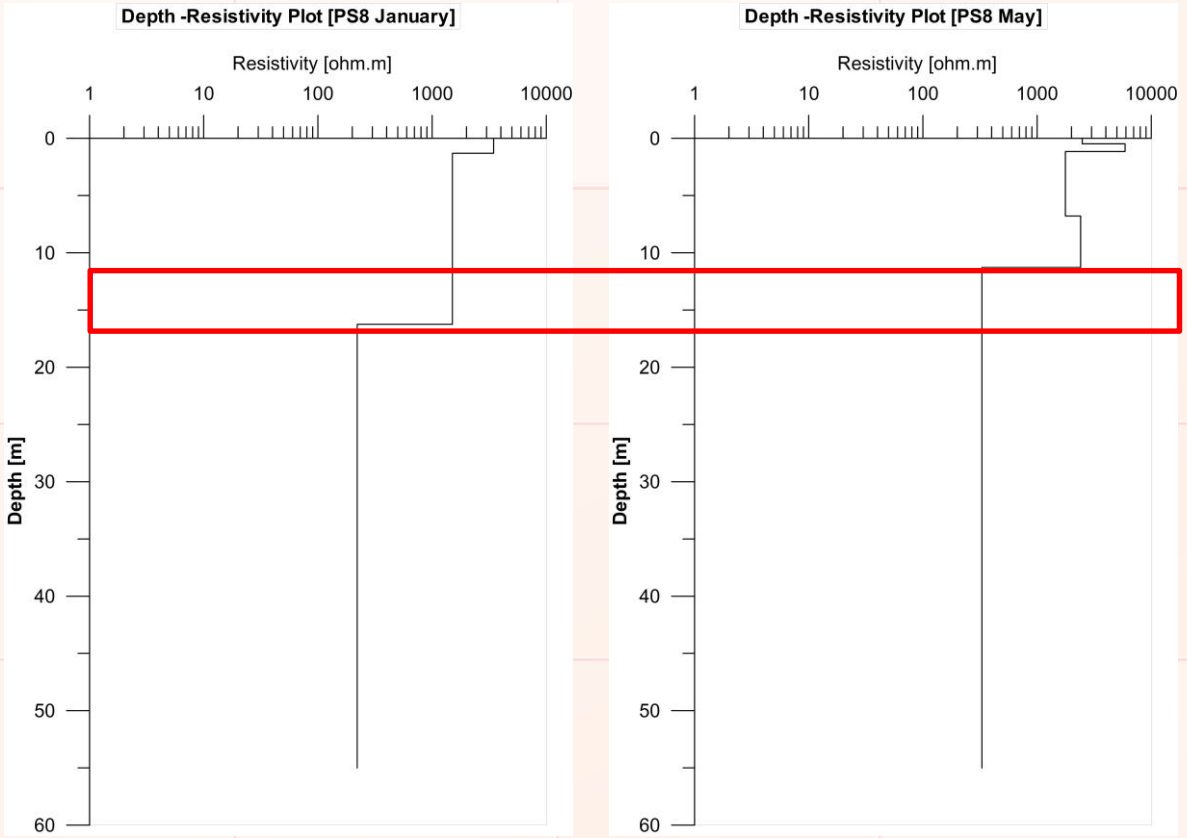
- AT the depth between 11.29 m and 16.25 m, fracture rock is indicated




PS8 in Png1 unit

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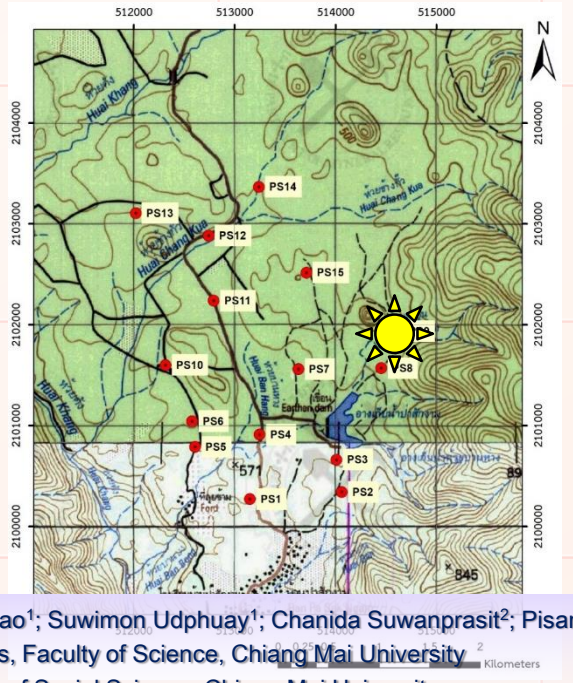
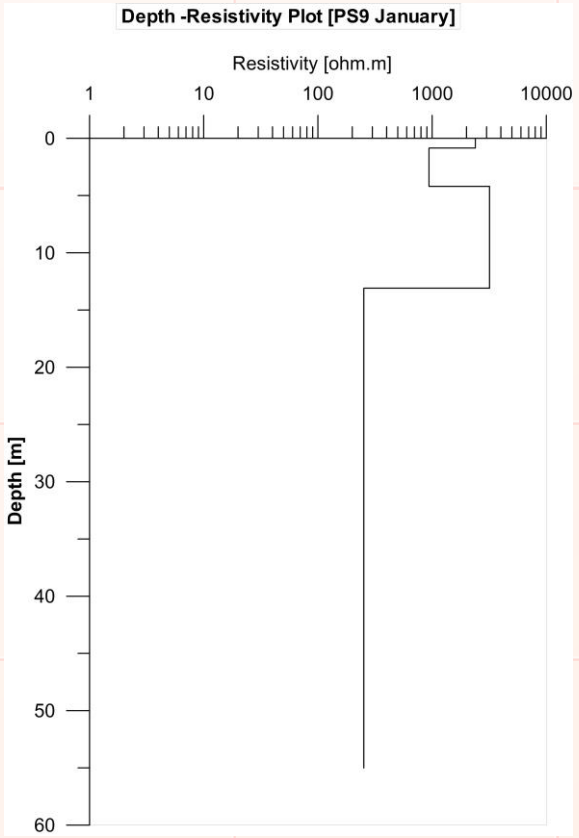
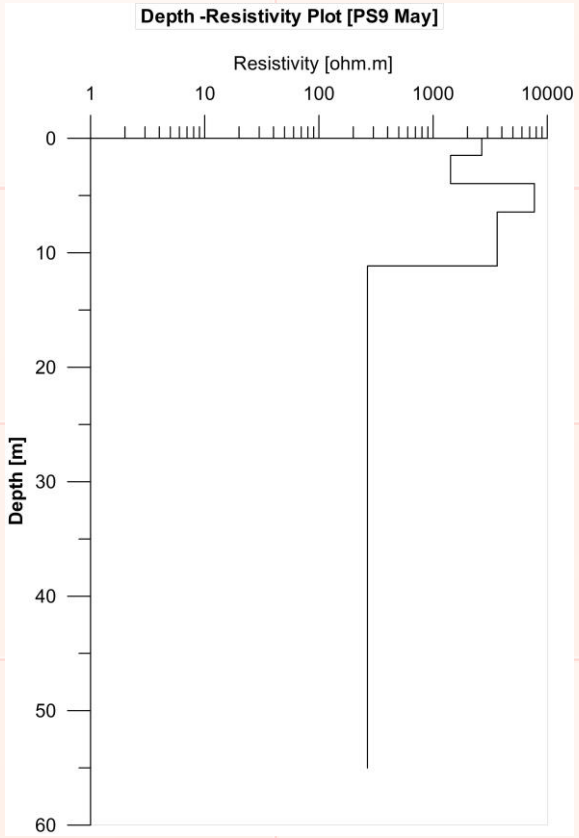
- Resistivity patterns are quite stable indicating no effect of rainfall on the subsurface water




PS9 in Png1 unit

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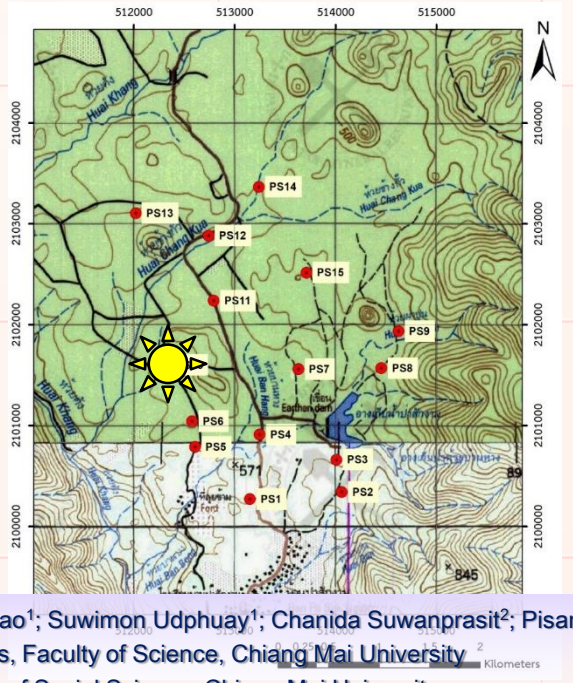
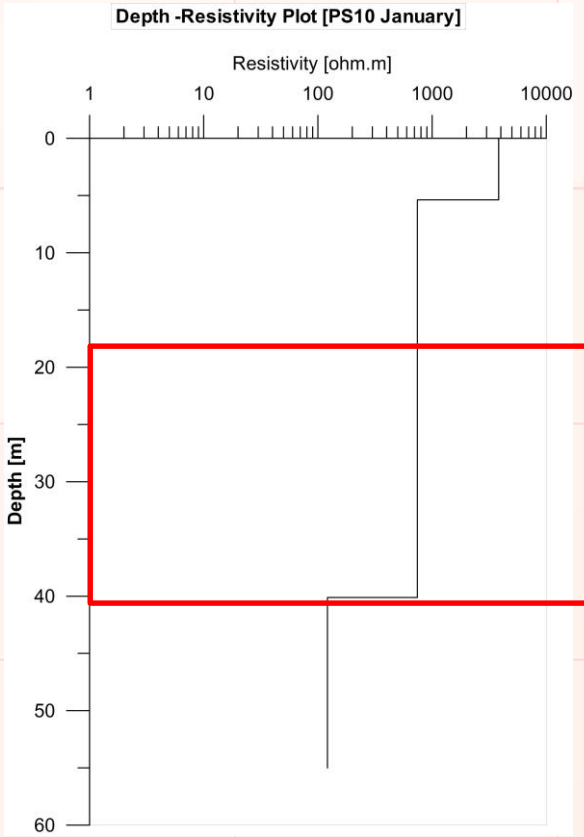
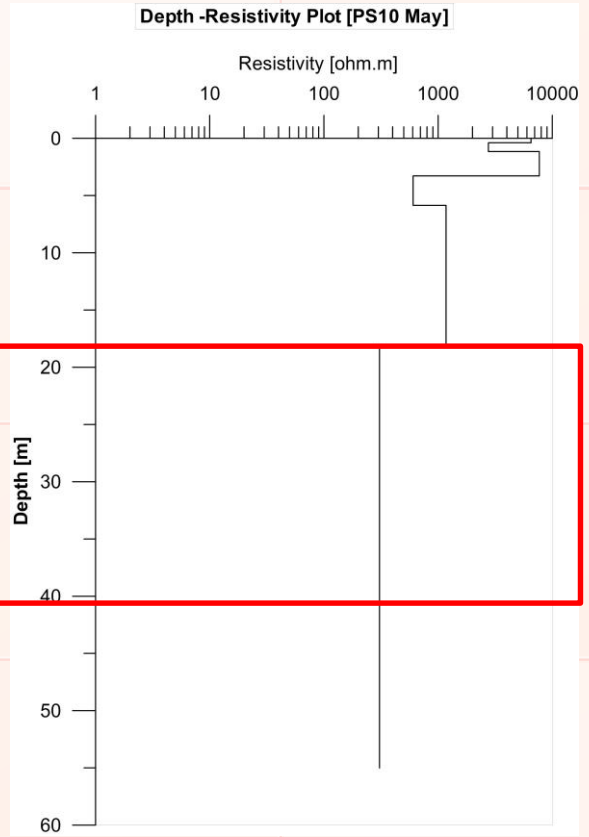
- AT the depth between 18.18 m and 40.11 m, fracture rock is indicated.




PS10 in Png2 unit

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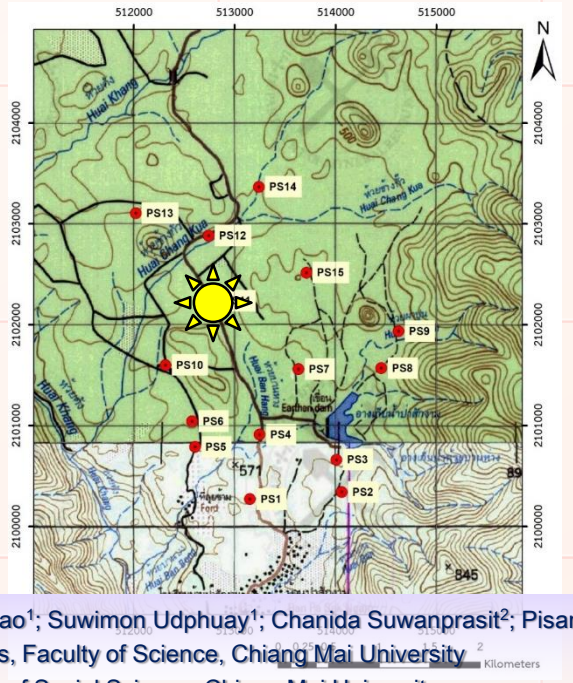
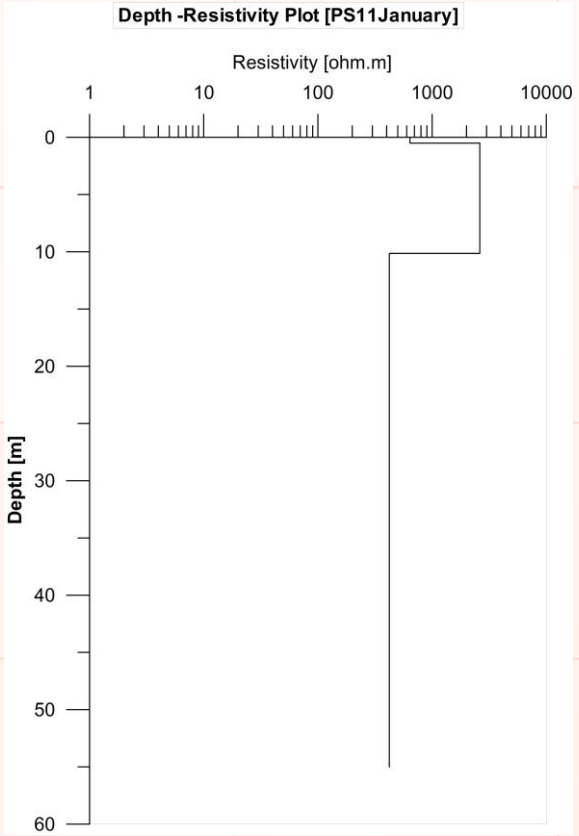
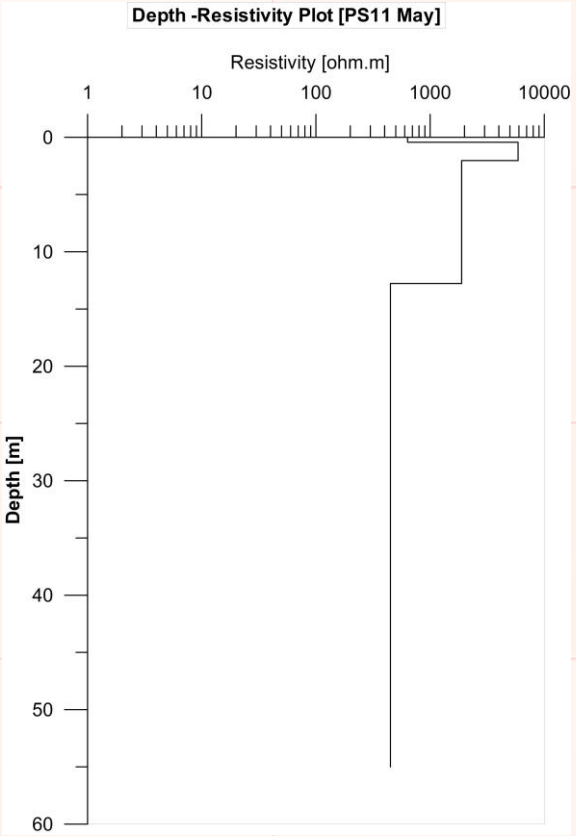
- Resistivity patterns are quite stable indicating no effect of rainfall on the subsurface water.




PS11 in Png2 unit

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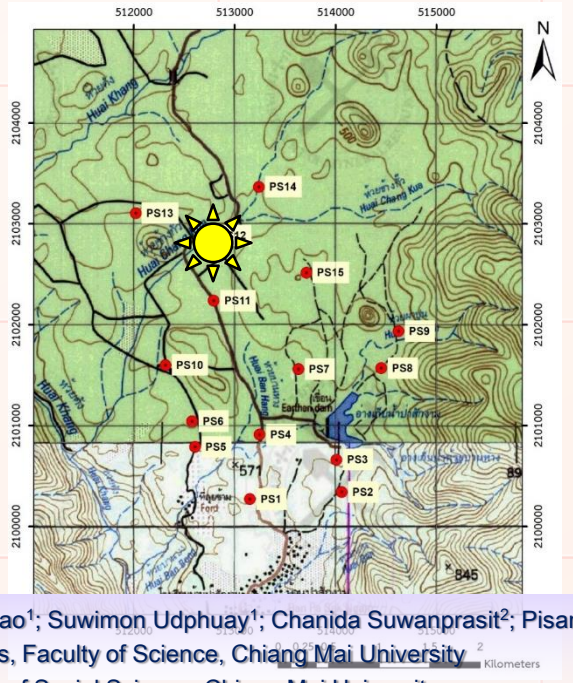
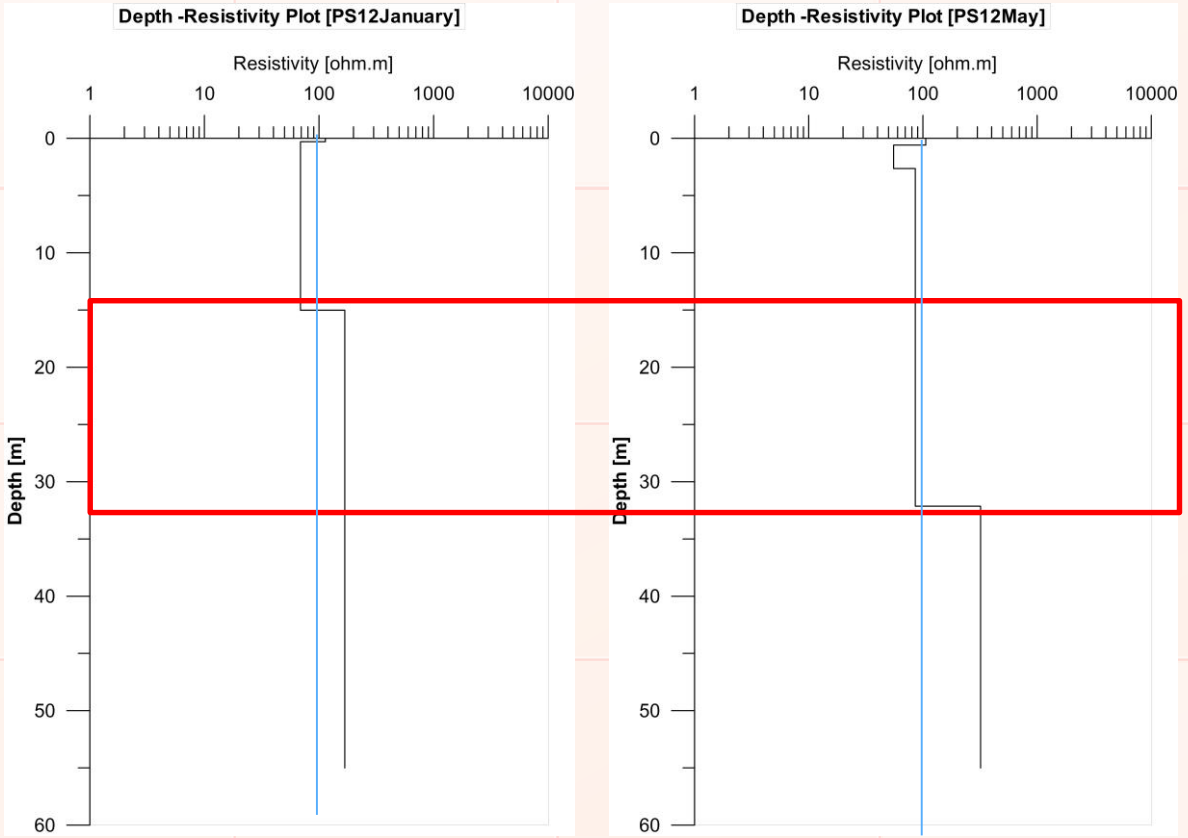
- AT the depth between 15.02 m and 32.14 m, fracture rock is indicated.
- Subsurface water level can be found at the depth of about 0.4 m.

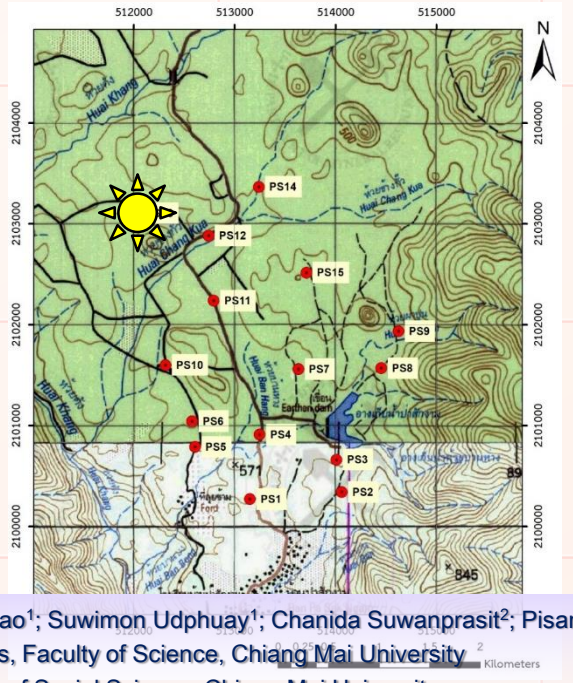


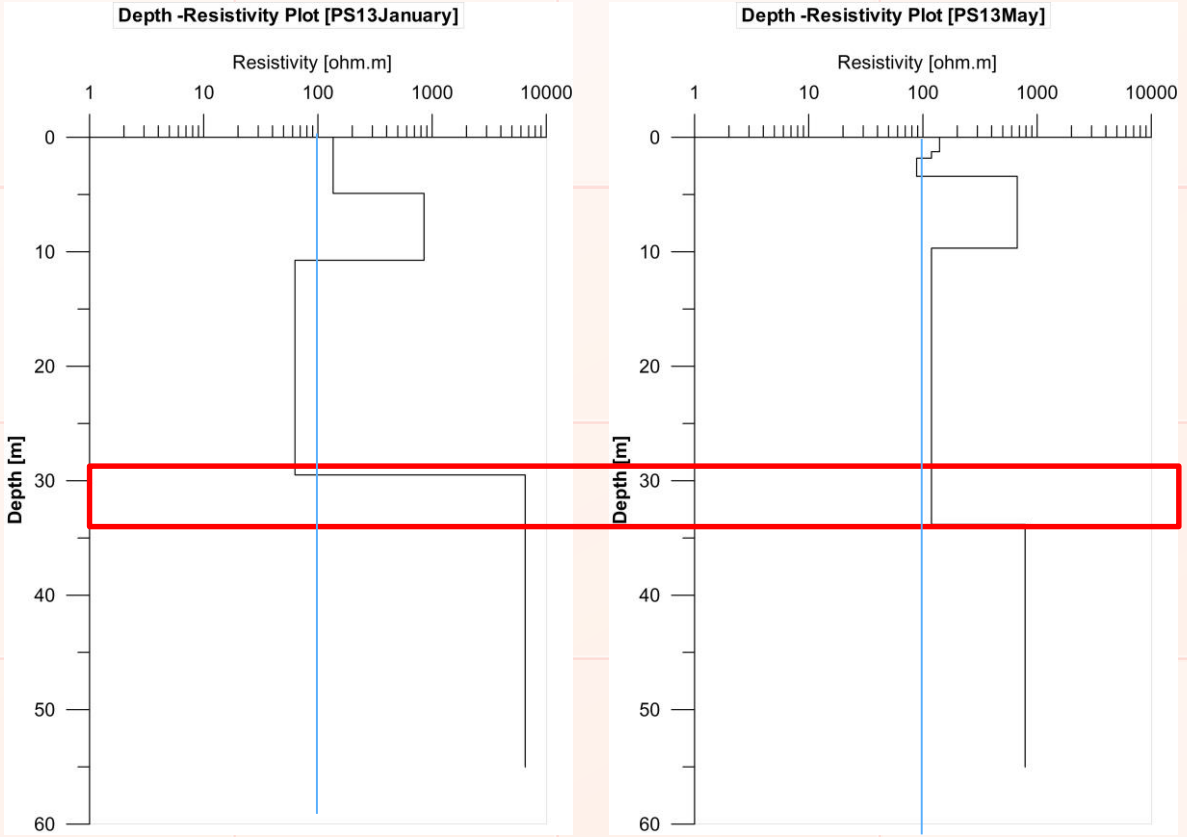




PS12 in Png1 unit

Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- AT the depth between 29.49 m and 33.84 m, fracture rock is indicated.
- Subsurface water level can be found at the depth of about 10 m.

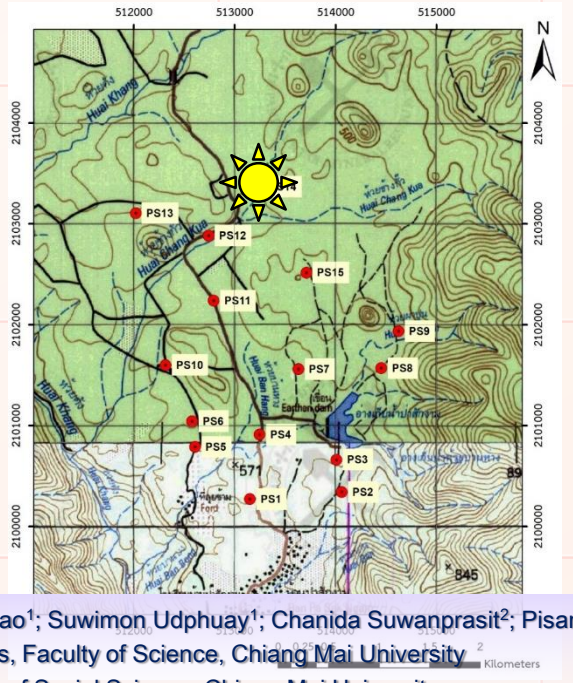


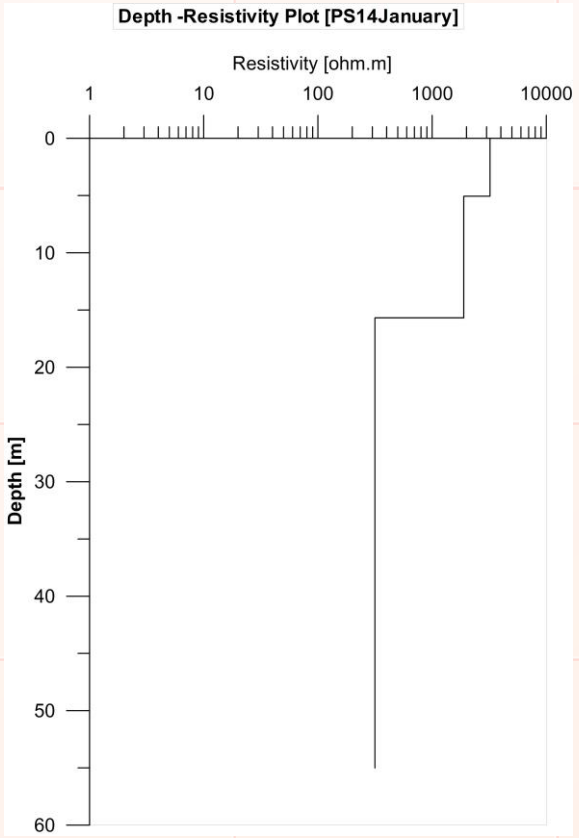



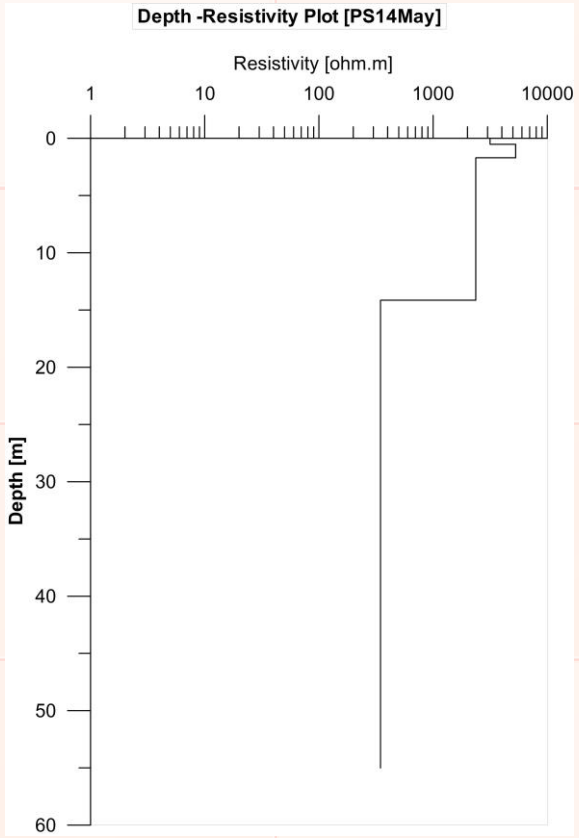

PS13 in Png2 unit

Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- Resistivity patterns are quite stable indicating no effect of rainfall on the subsurface water



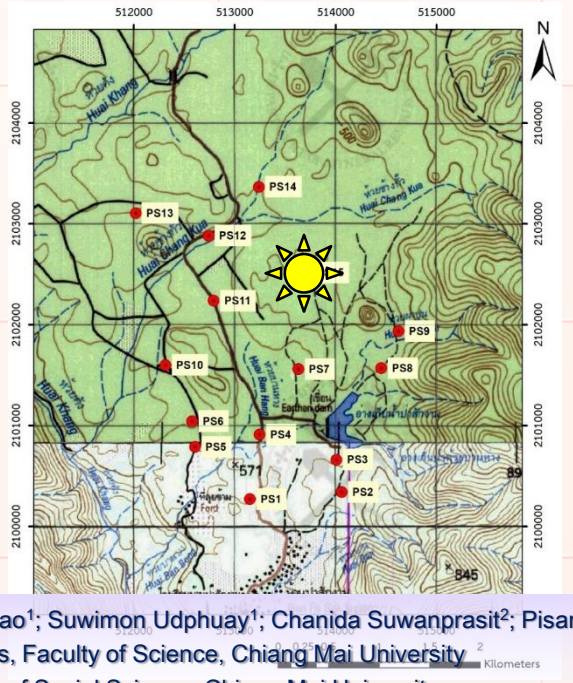



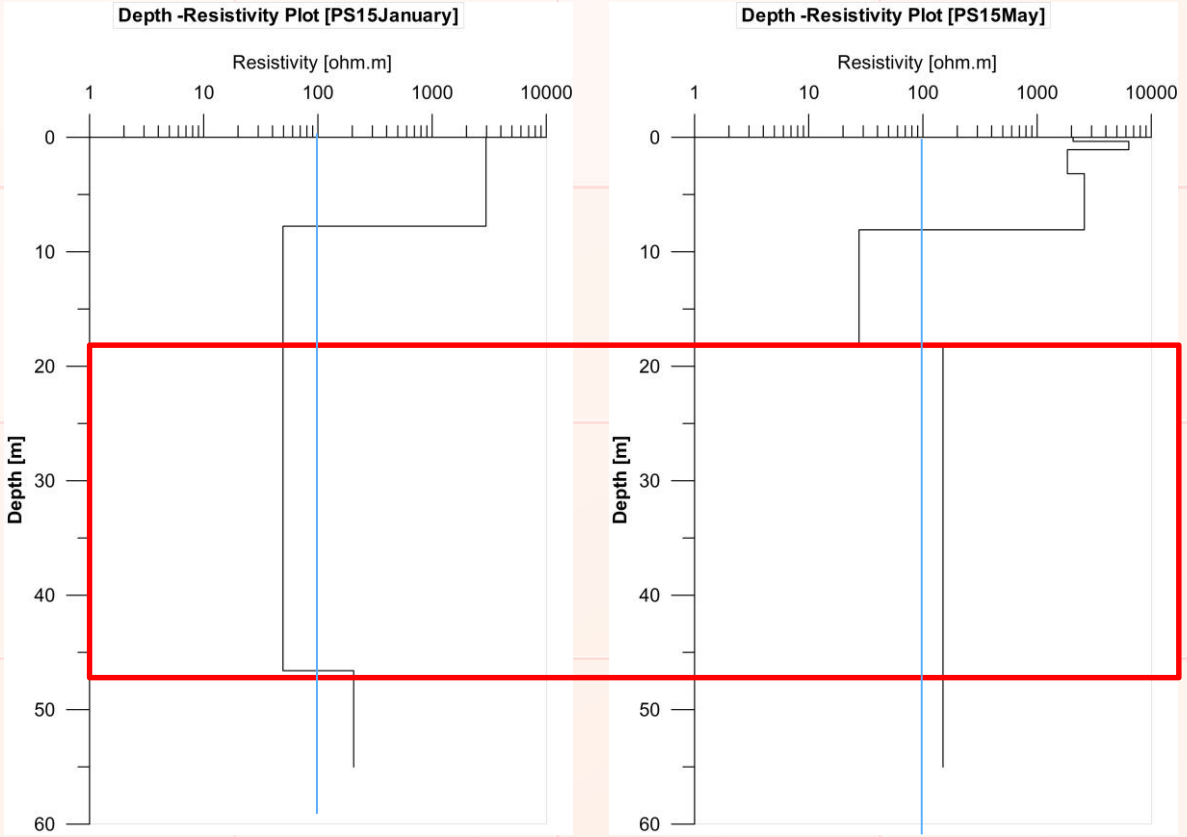




PS14 in Png1 unit

Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- AT the depth between 18.22 m and 46.6 m, fracture rock is indicated
- Subsurface water level can be found at the depth of about 9 m.

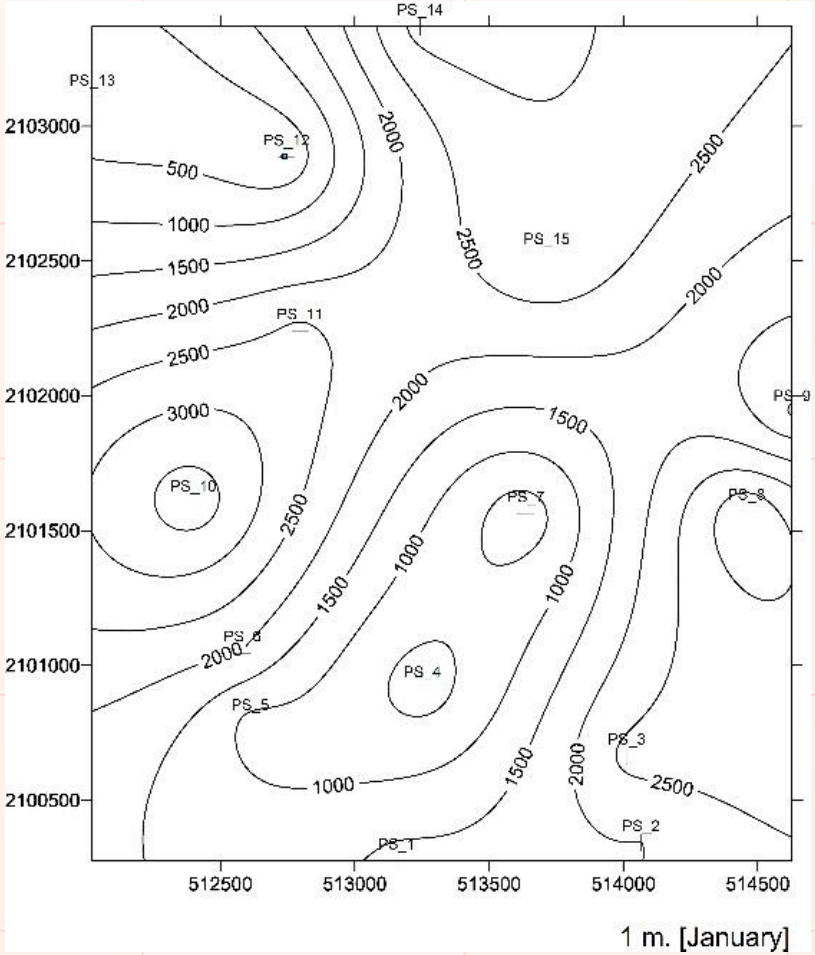



PS15 in Png1 unit

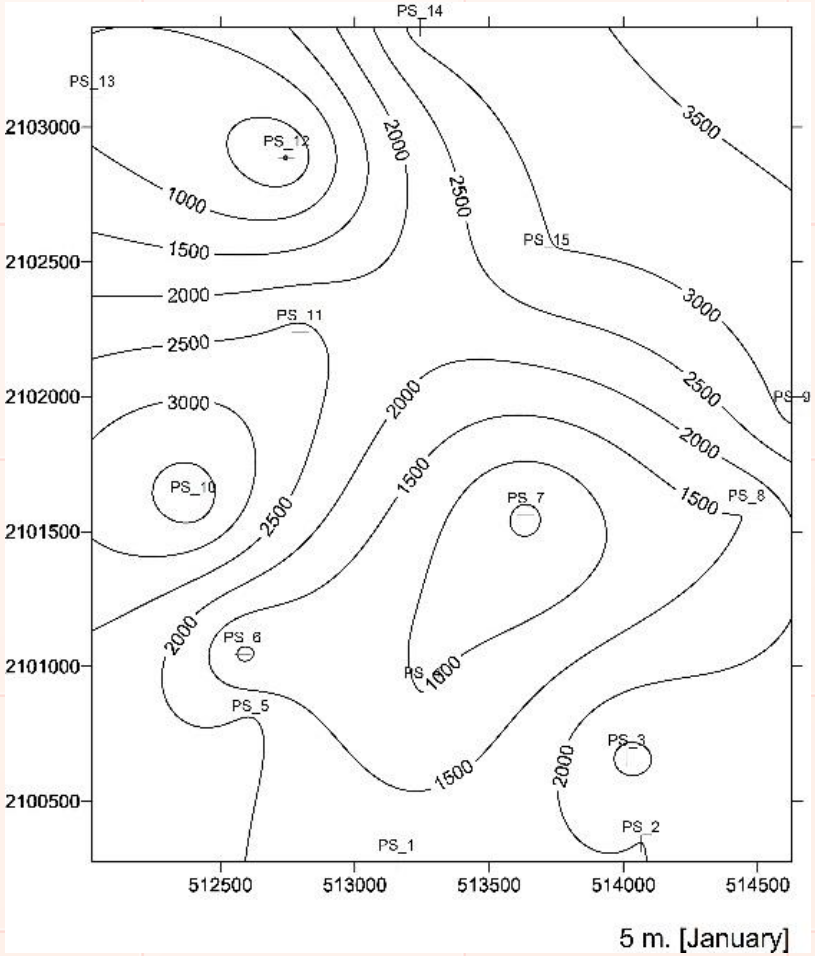
Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **1 m [January]**
- Resistivity contour map at the depth of 1 m., one small area (PS12) shows resistivity value less than 100 ohm.m.



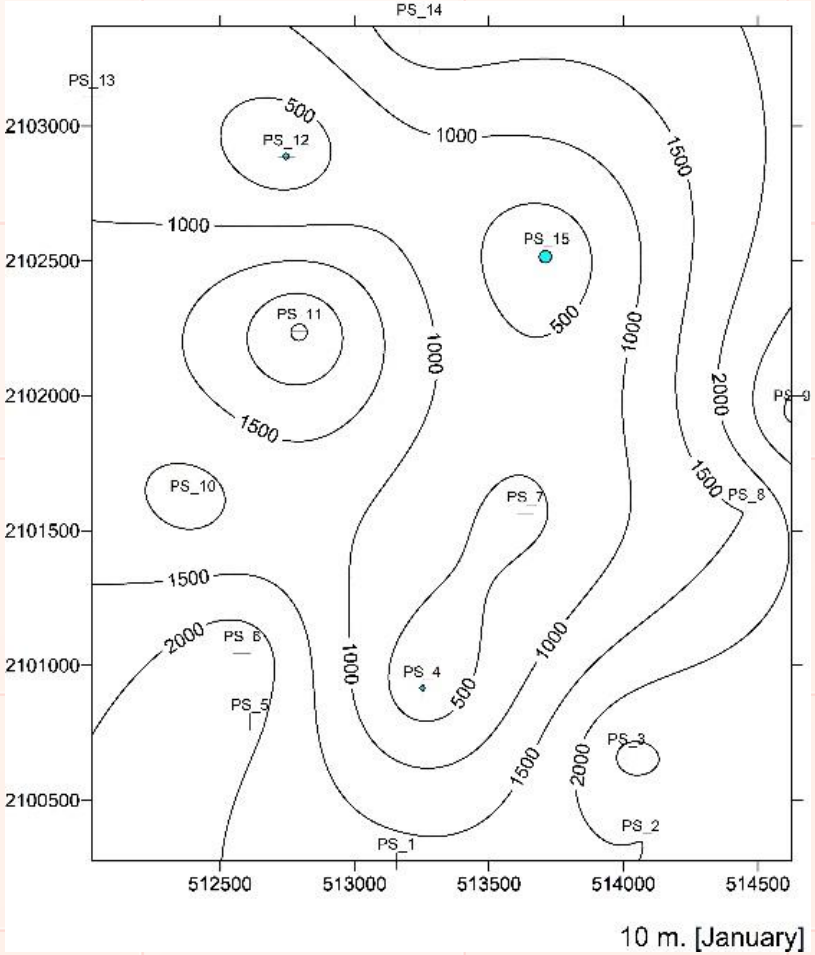

Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **5 m [January]**
- Resistivity contour map at the depth of 5 m one small area (PS12) shows resistivity value less than 100 ohm.m.



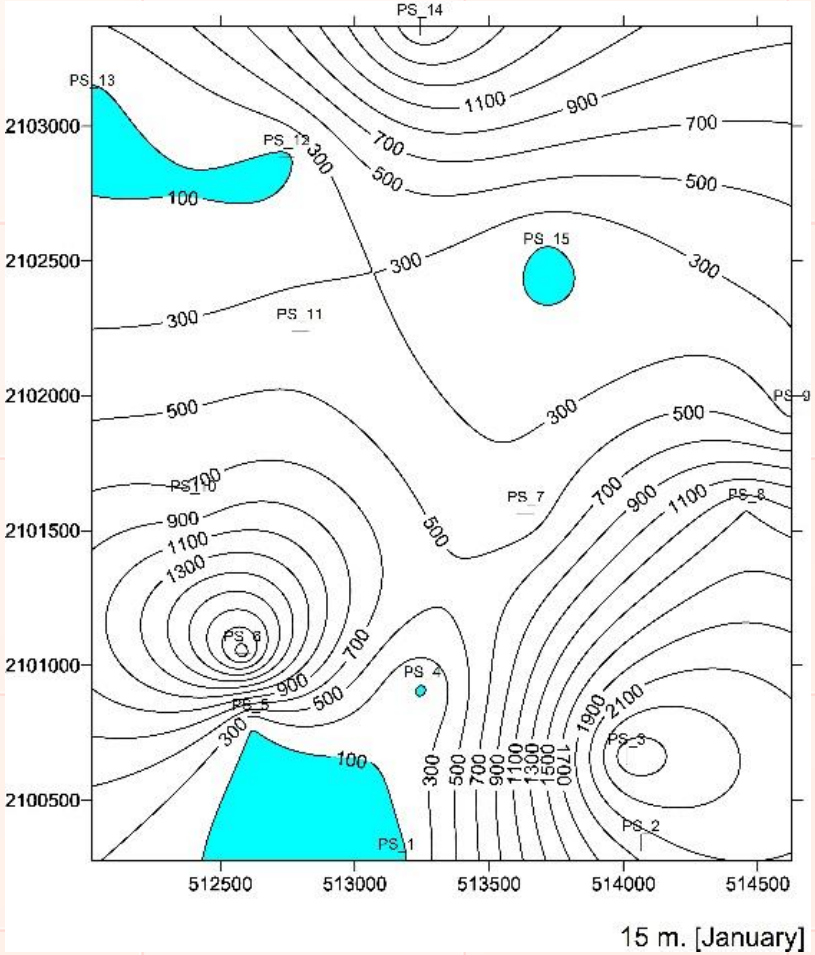

Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **10 m [January]**
- Resistivity contour map at the depth of 10 m., three small areas (around PS4, PS12 and PS15) show resistivity value less than 100 ohm.m.



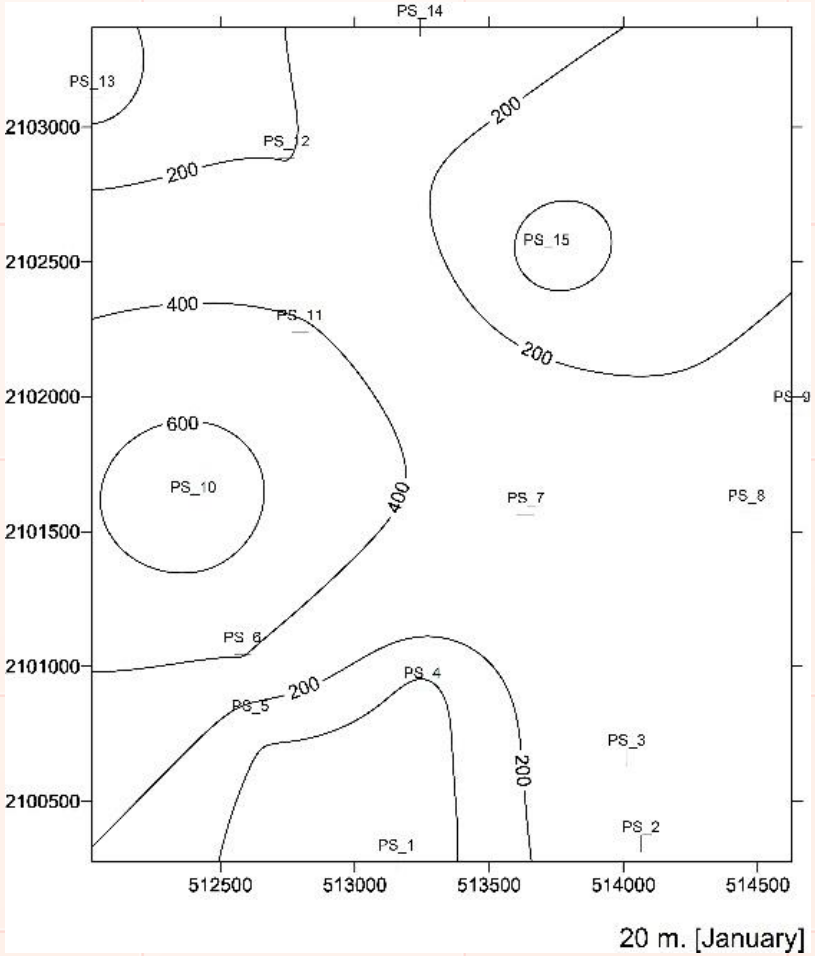

Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **15 m [January]**
- Resistivity contour map at the depth of 15 m., one small area (PS4) and three areas show the resistivity value equal or less than 100 ohm.m.



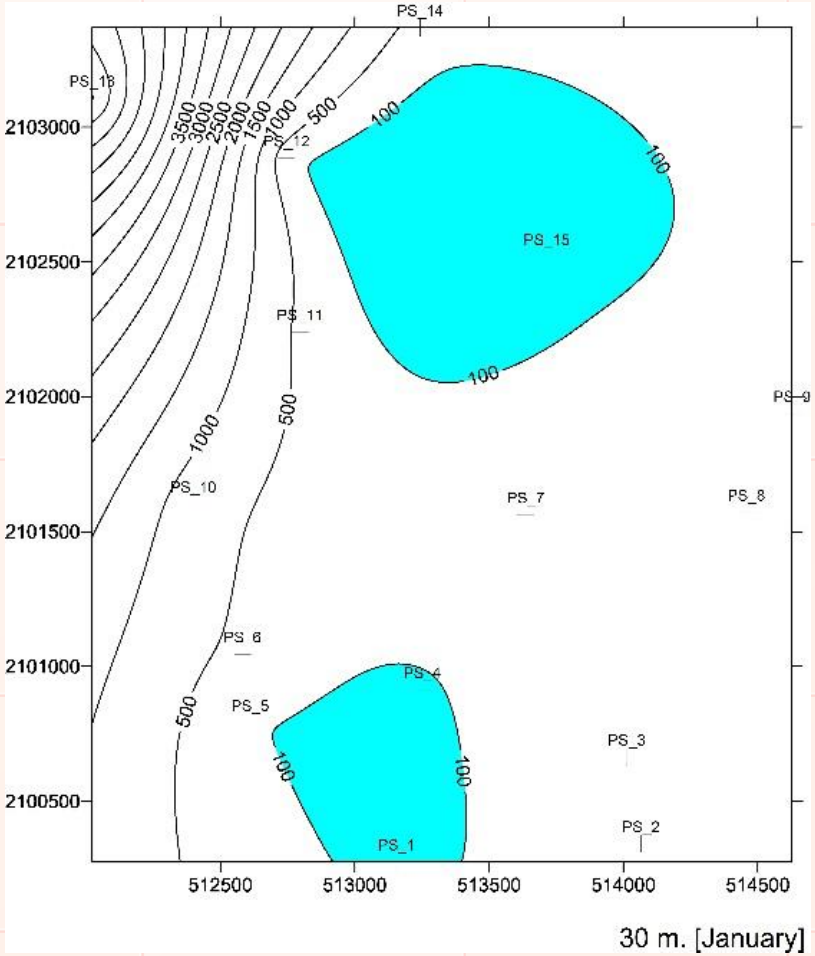

Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **20 m [January]**
- Resistivity contour map at the depth of 20 m., area showing resistivity value less than 100 ohm.m was not found.



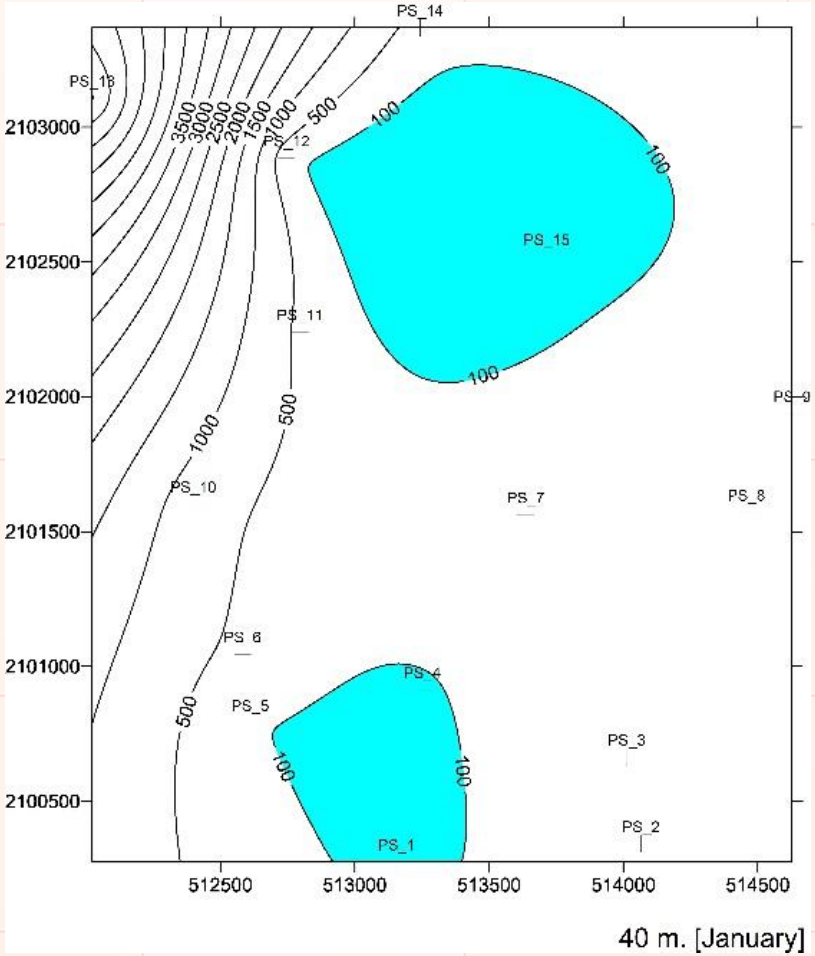

Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **30 m [January]**
- Resistivity contour map at the depth of 30 m., two areas show the resistivity value equal or less than 100 ohm.m.




Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **40 m [January]**
- Resistivity contour map at the depth of 40 m., two areas show the resistivity value equal or less than 100 ohm.m.

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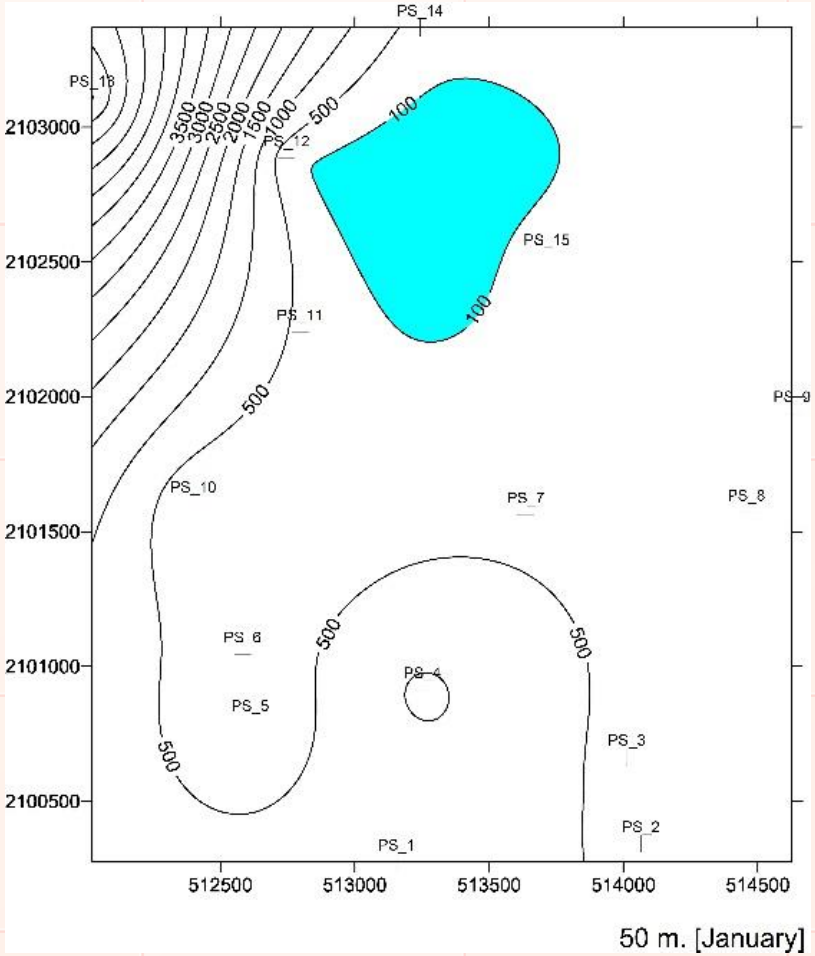
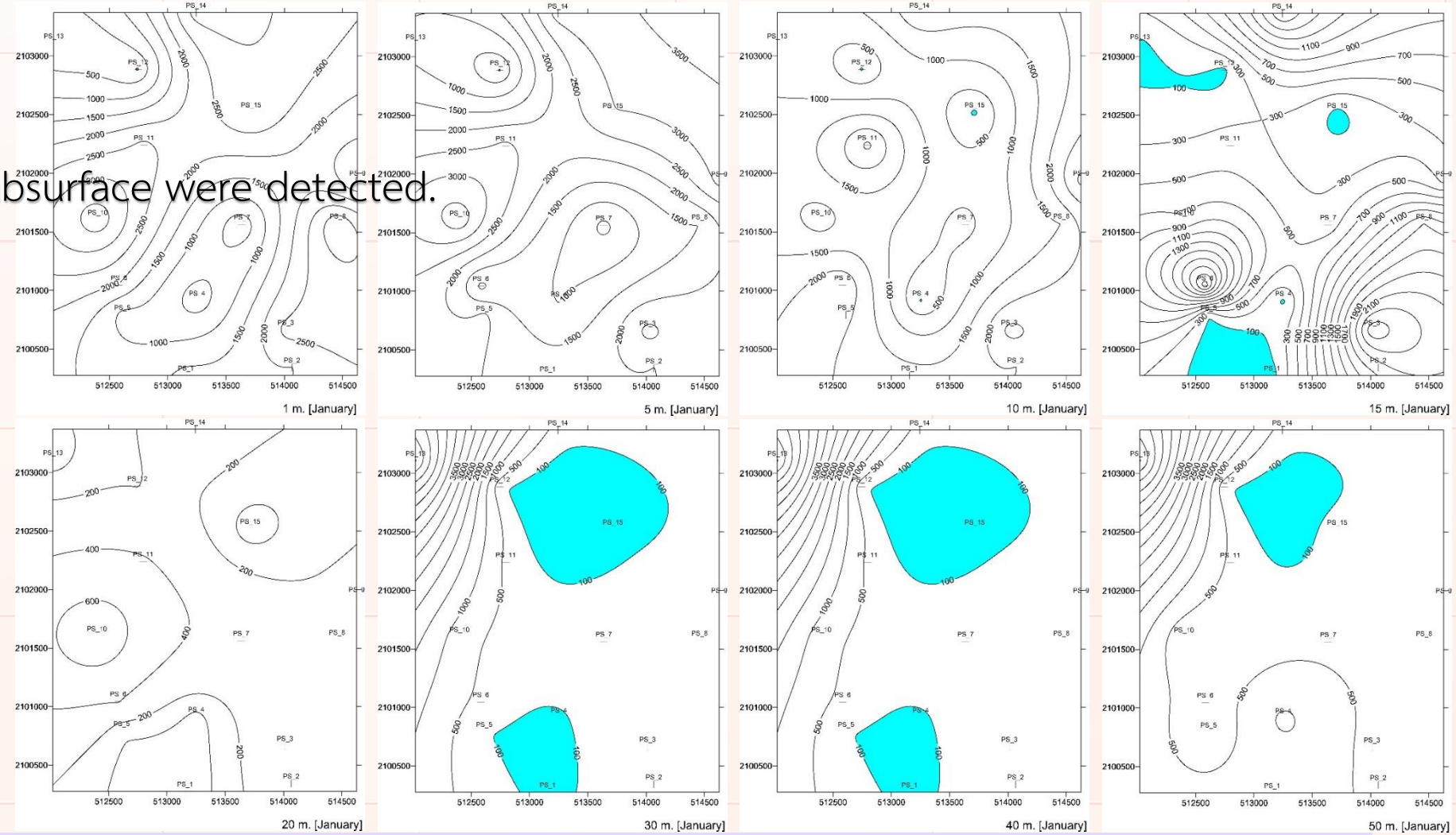
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **50 m [January]**
- Resistivity contour map at the depth of 50 m., one area shows the resistivity value equal or less than 100 ohm.m.




Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- [January]
- Two levels of subsurface were detected.

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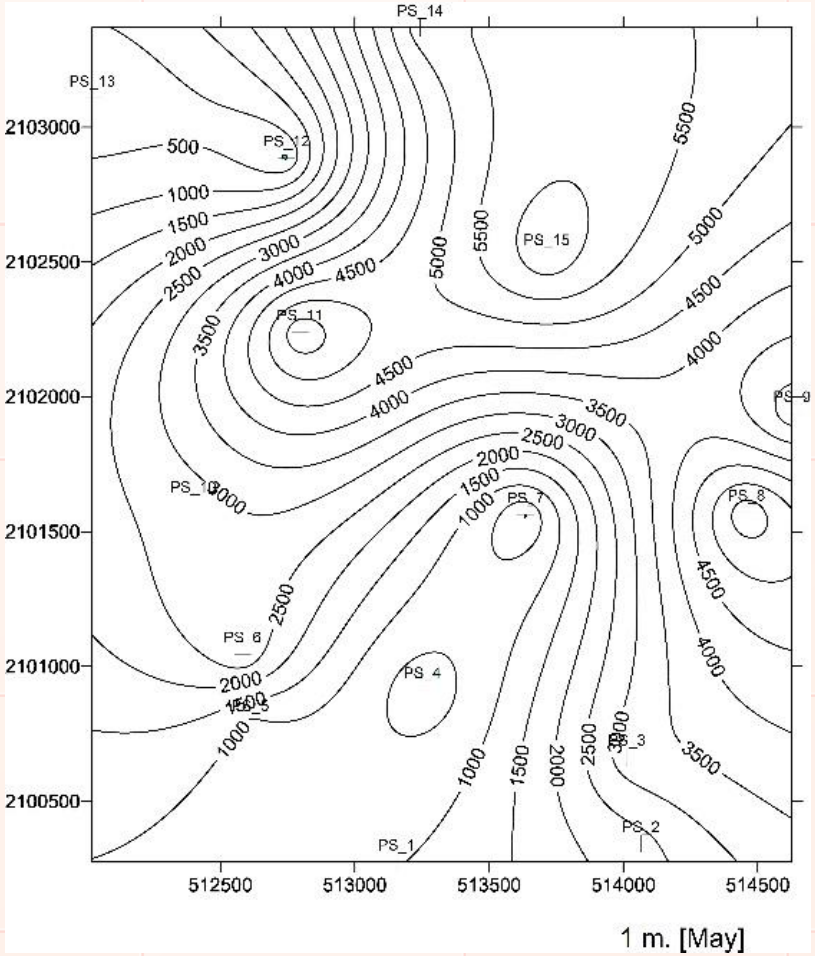
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **1 m [May]**
- Resistivity contour map at the depth of 1 m., one small area (PS12) shows resistivity value less than 100 ohm.m.

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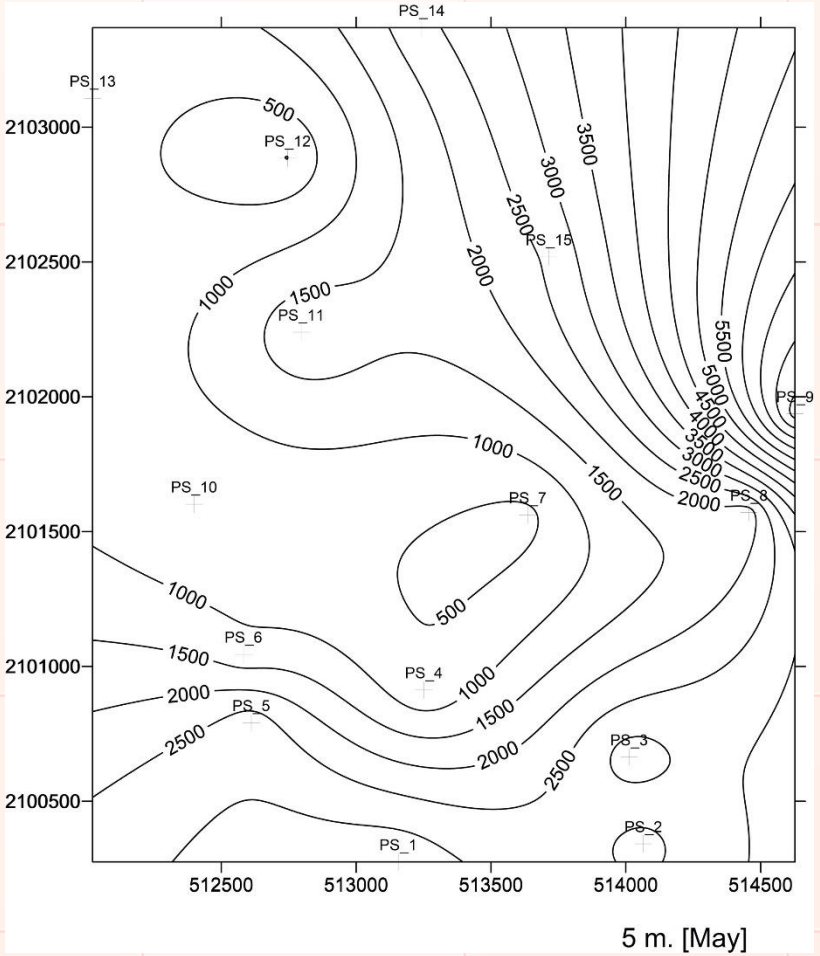
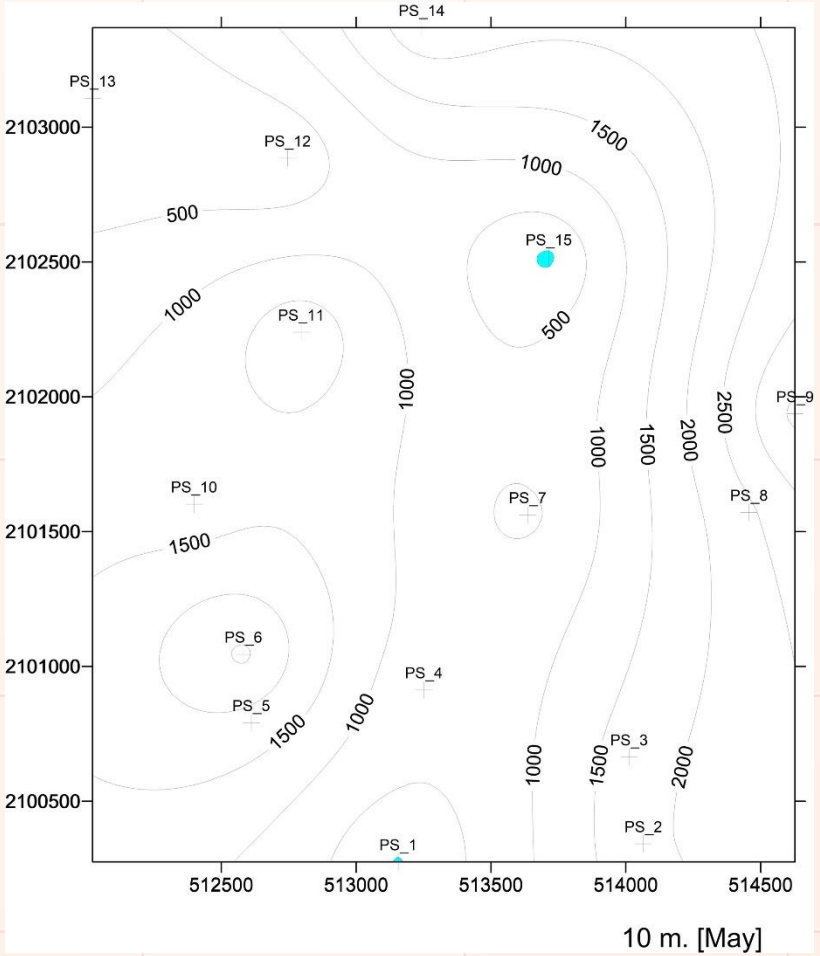
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **5 m [May]**
- Resistivity contour map at the depth of 5 m., one small area (PS12) shows resistivity value less than 100 ohm.m.



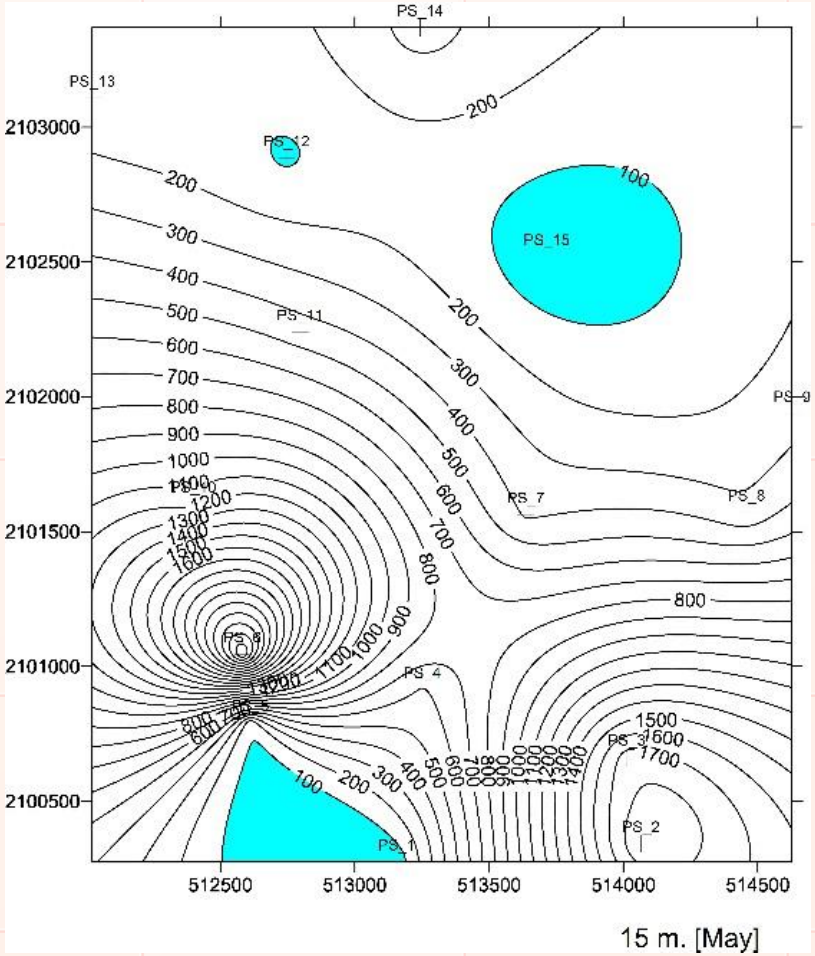

Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **10 m [May]**
- Resistivity contour map at the depth of 10 m., two small (PS1 and PS15) areas show the resistivity value equal or less than 100 ohm.m.




Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **15 m [May]**
- Resistivity contour map at the depth of 15 m., one small area (PS12) and two areas show the resistivity value equal or less than 100 ohm.m.

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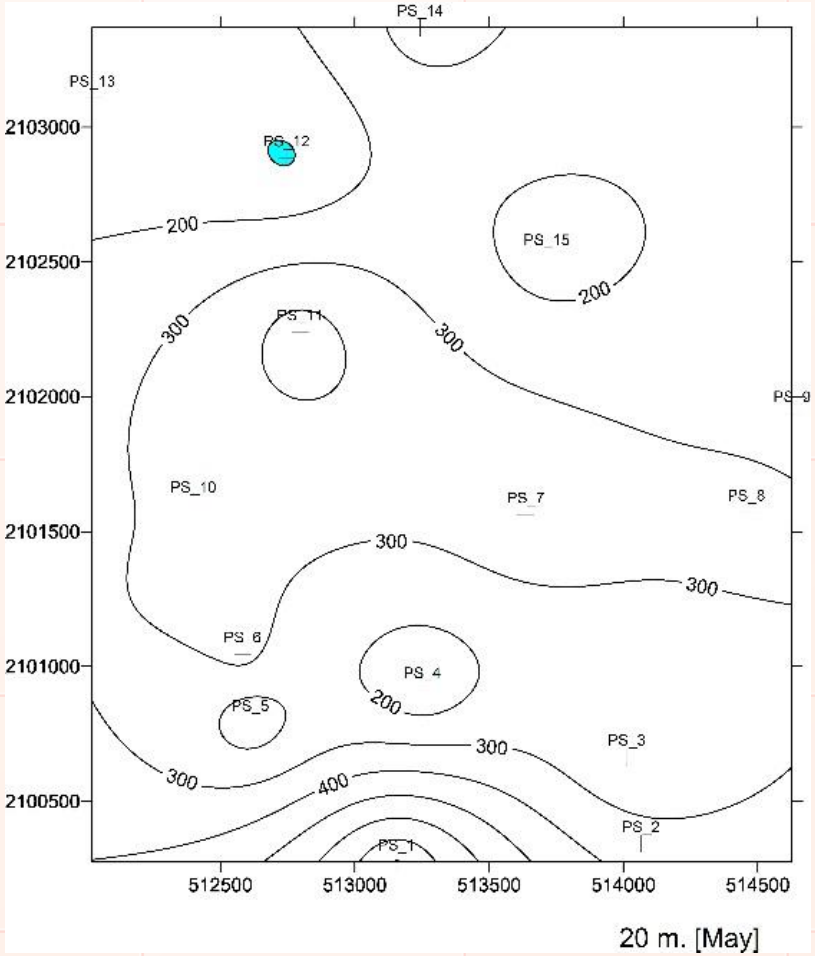
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **20 m [May]**
- Resistivity contour map at the depth of 20 m., one small area (PS12) shows the resistivity value equal or less than 100 ohm.m.

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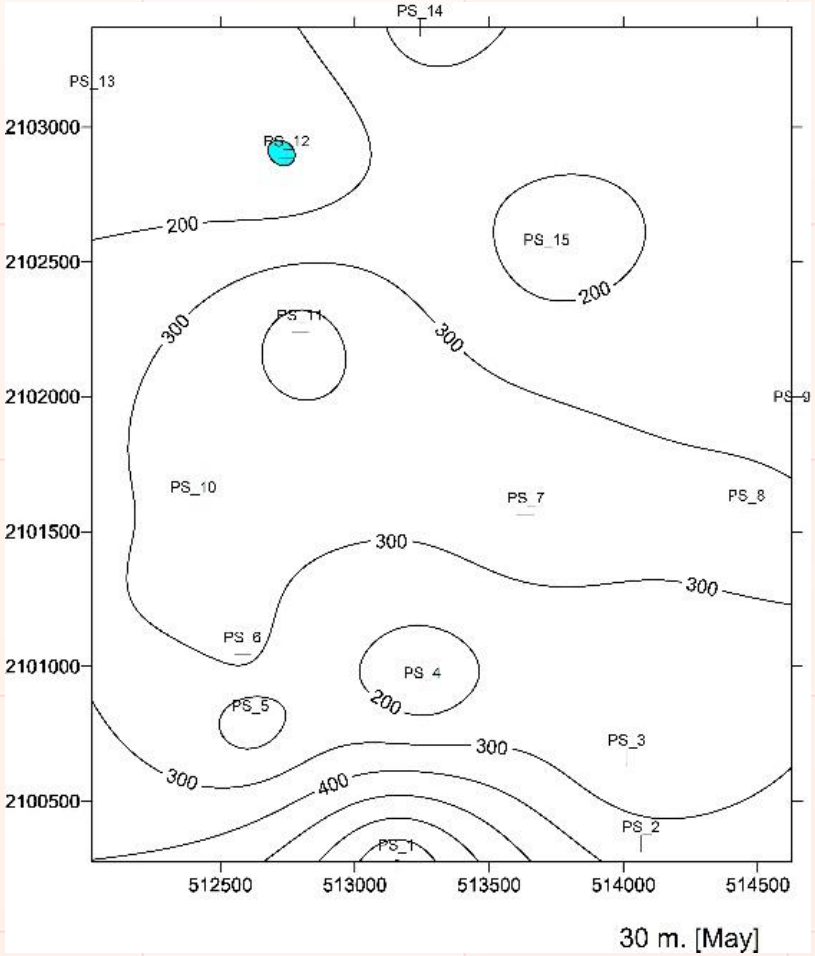
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **30 m [May]**
- Resistivity contour map at the depth of 30 m., one small area (PS12) shows the resistivity value equal or less than 100 ohm.m.

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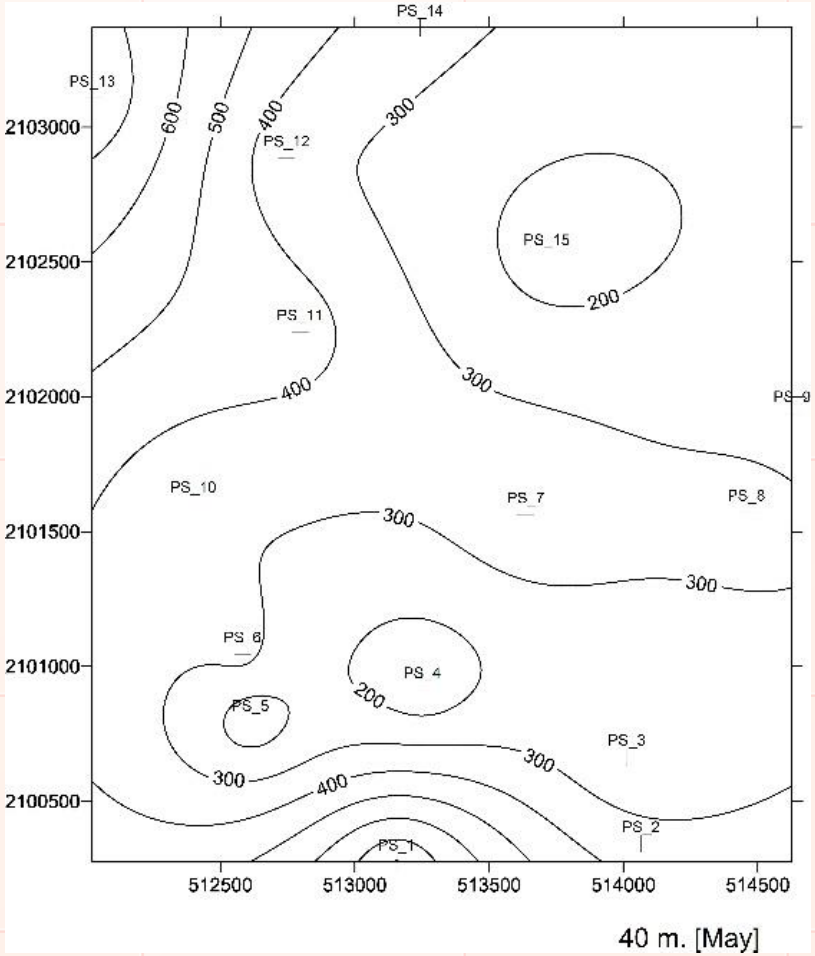
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **40 m [May]**
- Resistivity contour map at the depth of 40 m., area showing resistivity value less than 100 ohm.m was not found.

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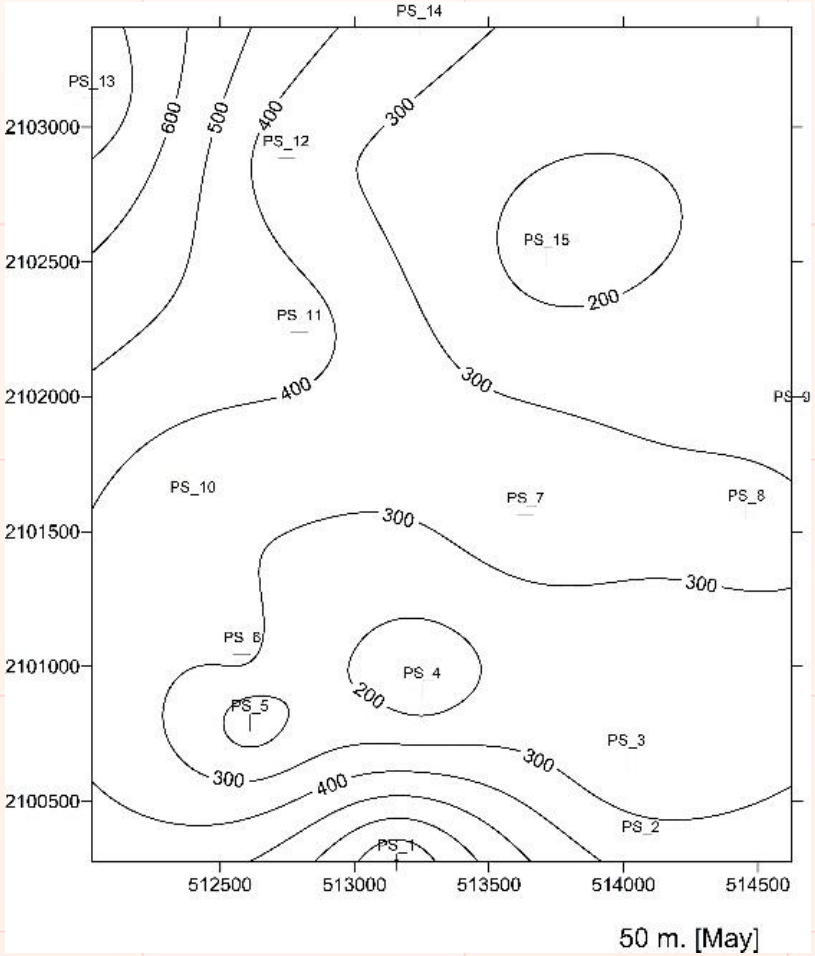
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- **50 m [May]**
- Resistivity contour map at the depth of 50 m., area showing resistivity value less than 100 ohm.m was not found.

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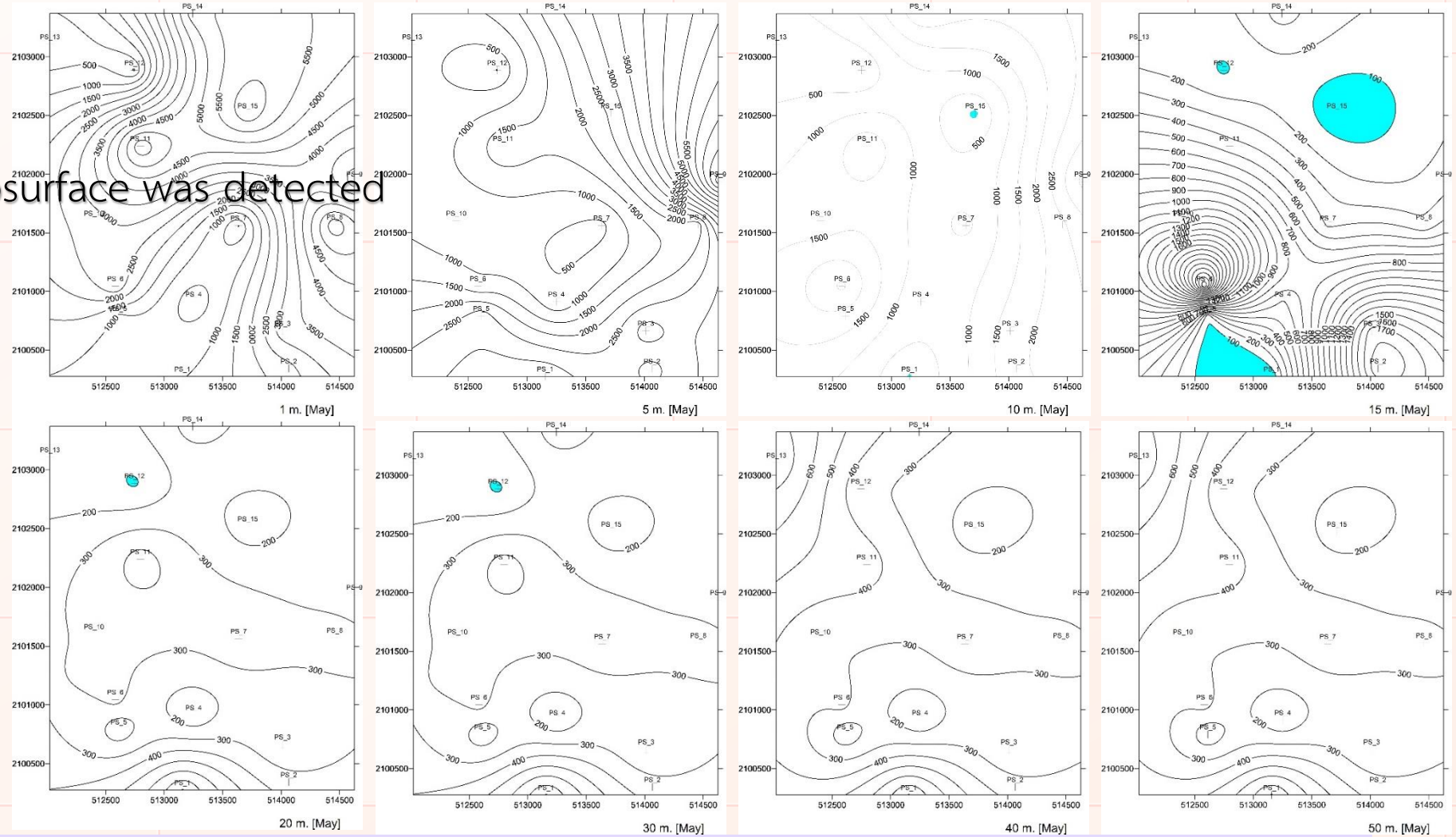
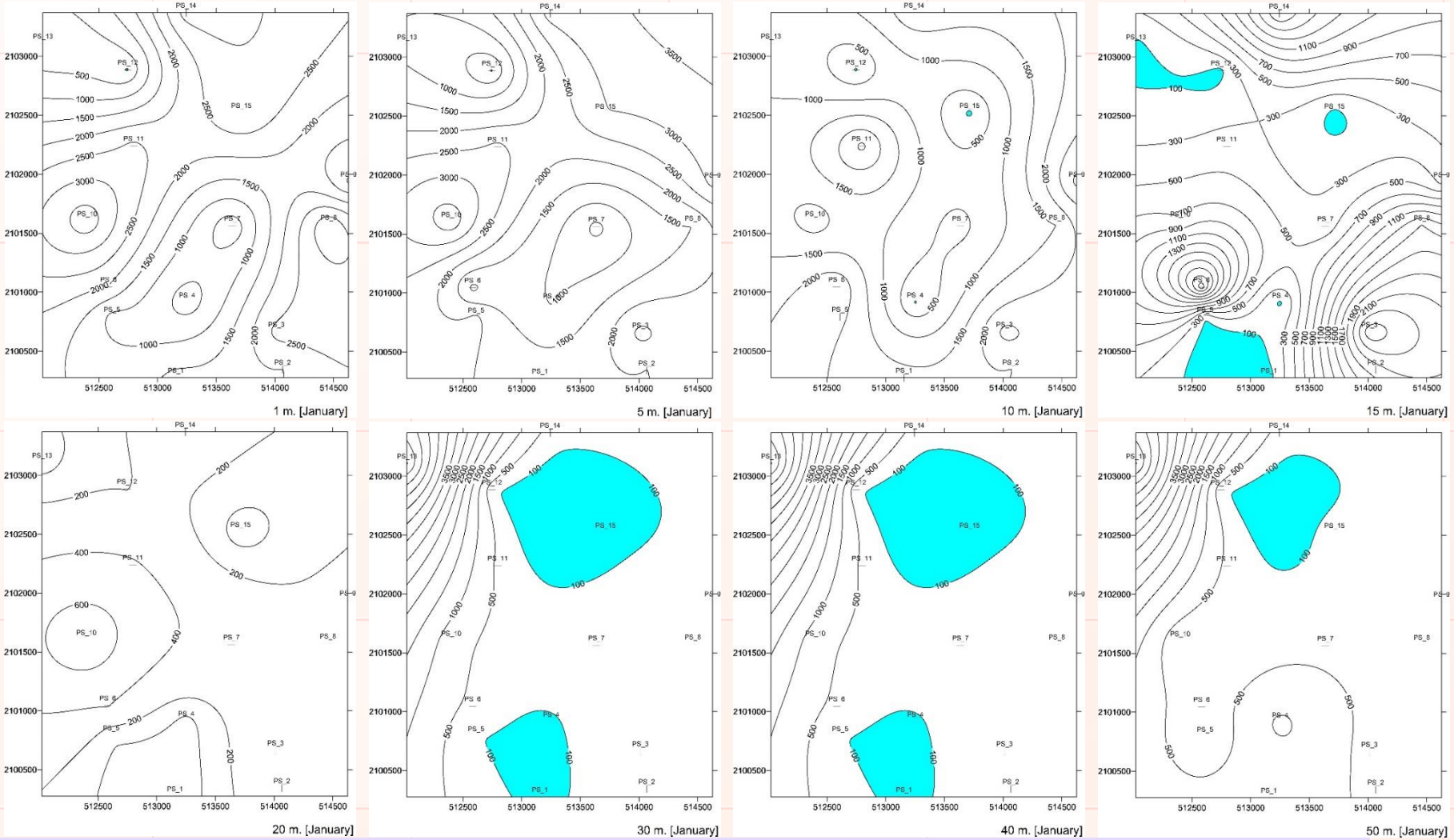
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- [May]
- One level of subsurface was detected




Sathirada Phahurat[1]; Arisara Chansao[1]; Suwimon Udphuay[1]; Chanida Suwanprasit[2]; Pisanu Wongpornchai[1]
[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University
[2] Department of Geography, Faculty of Social Science, Chiang Mai University

- [January]

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# Conclusion

- Fracture rocks can be found in both Png1 and Png2 units
- Data collected in January showed the subsurface water at one level of the shallow depth (15 m) in the north-western, north-eastern, and southern parts of the study area, and one level of the deep depth (> 30 m) in the northern and southern parts of the study area.
- Data collected in May showed the subsurface water at one level at the shallow depth (15 m) in the north-western, north-eastern, and southern parts of the study area.

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# Acknowledgement


- National Research Council of Thailand (NRCT) supports research funding.
- Headman and villagers of Ban Pa Sak Ngam support survey team.
- Adul Yawichai, Chanin Saengthip, Panyawat Suriyapor, Chaninthon Rattanavetchasit, Atcharawan Supaka support the field work.


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# Thank You!

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