FNCA Study Panel

Project title: Research on climate change using nuclear and isotopic techniques

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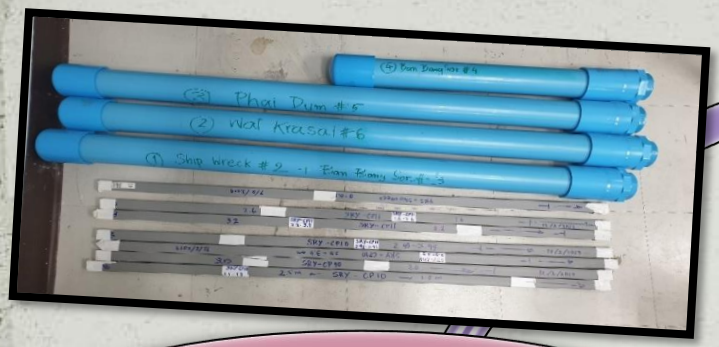
In cooperation with ANSTO, Chulalongkorn University, Fine Arts Department, Chulachomklao Royal Military Academy, and Princess Maha Chakri Sirindhorn Anthropology Centre

- Plan & Expectation
- Case Studies
- Related Projects & Conclusion

Plan & Expectation



Sediment

Oyster Shells

Paleo Climate?

3 Research questions
- The historical climate/record of archaeological sites?
- The past sea level variation?
- Ancient water management?

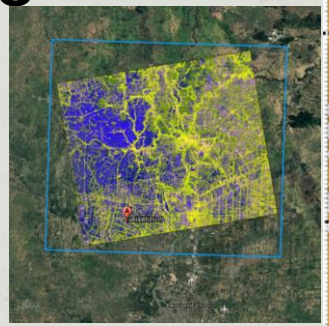
3 Information
- Seasonality (Climate variation)
- Date of site (5,500 years or 8 Ma?)
- Catastrophe/ Event of millions oysters' accumulation

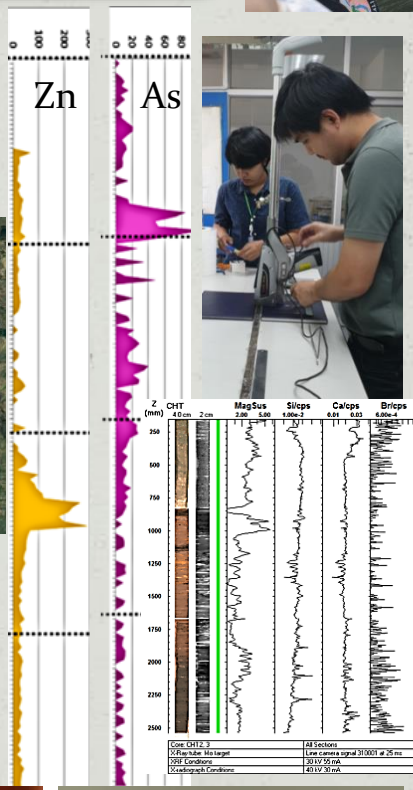
How To...

1) **Fieldworks (2018-2019)**

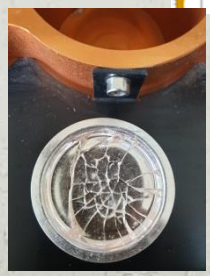
- ✓ 38 sediment cores
- ✓ 9 sites from 8 provinces of Thailand
- ✓ 20 days of fieldwork

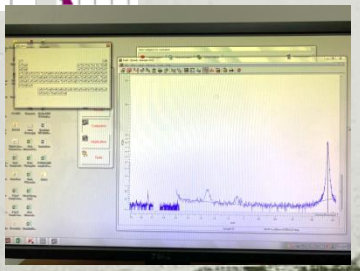
2) **Sediment analysis**
   - **HXRF**
   - **ITRAX & C-14 dating at ANSTO**

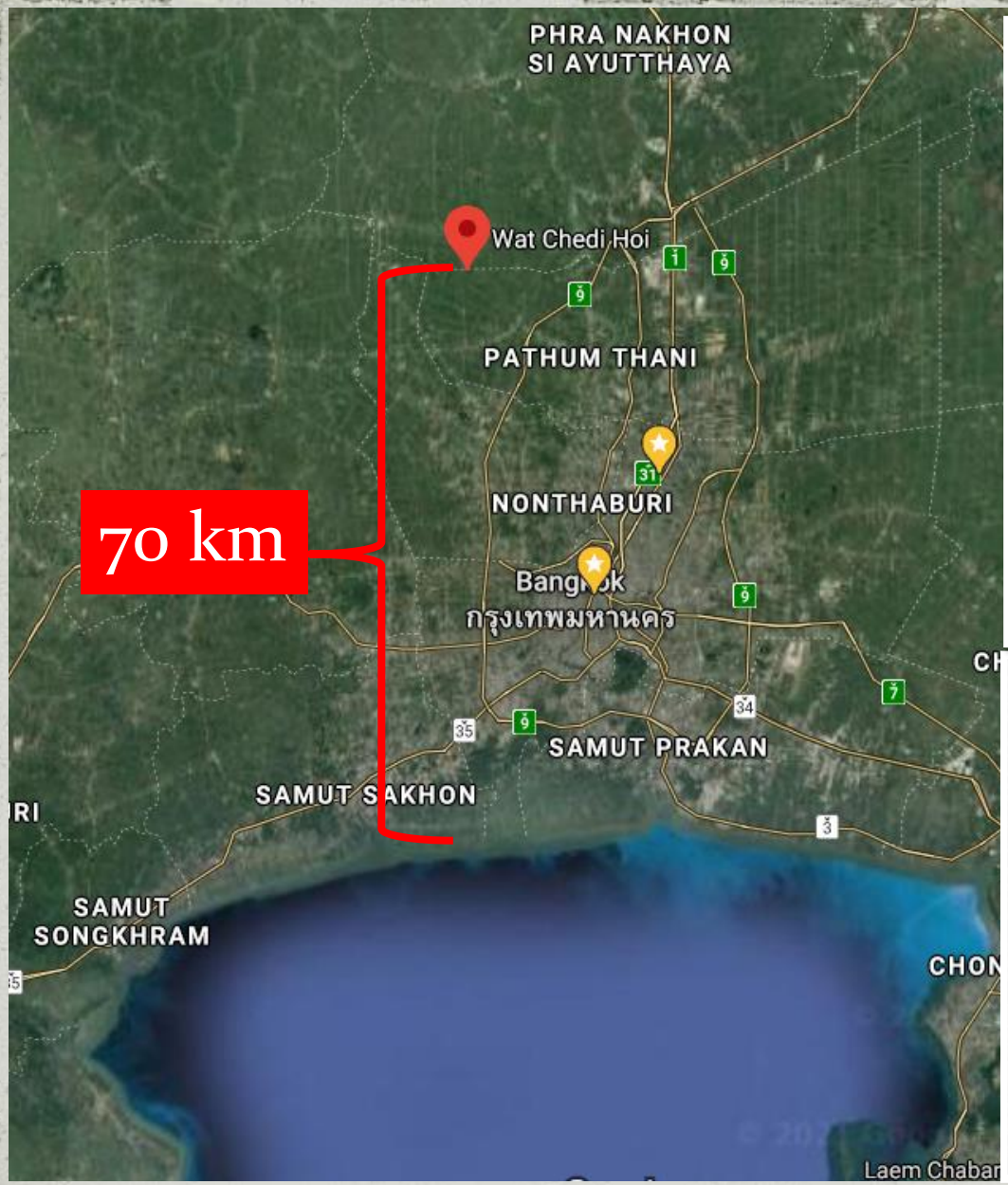


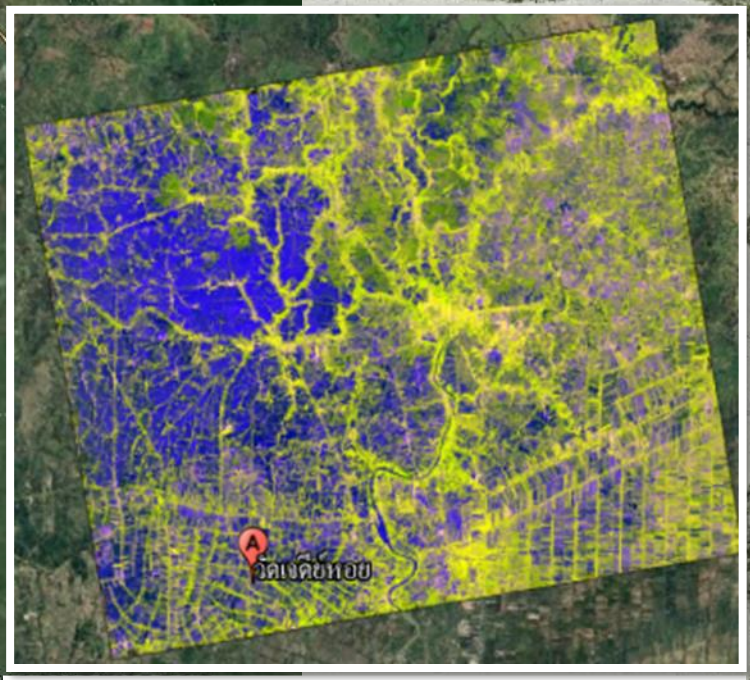


3) **Oyster shell analysis**
   - **WDXRF, NAA, ICPMS, Pb-210 dating at TINT**
   - **Seasonality study at CAS: Chinese Academy of Science**
   - **U-series dating at UQ (does not yet confirm)**

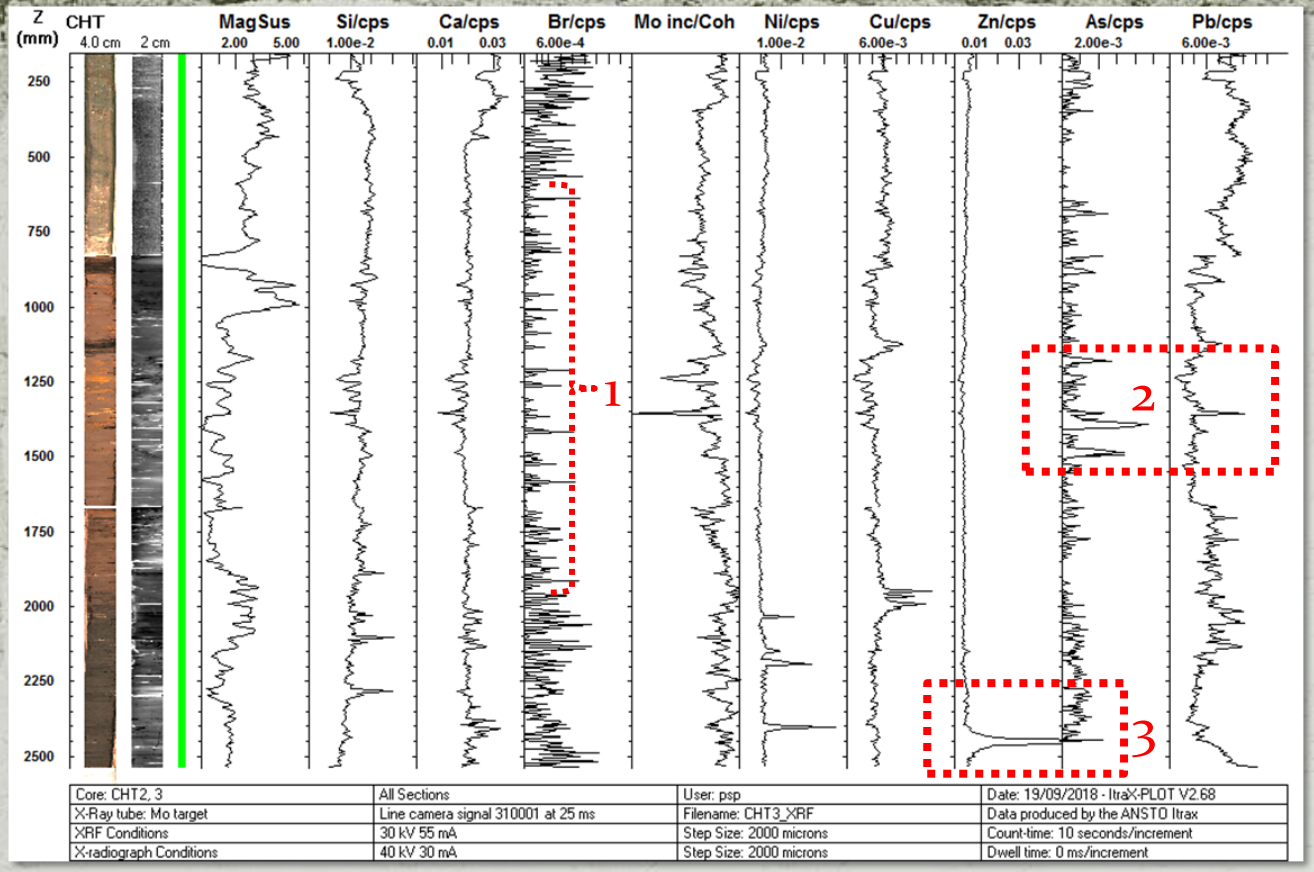








Case study 1: Wat Chedi Hoi or Giant Oyster Temple

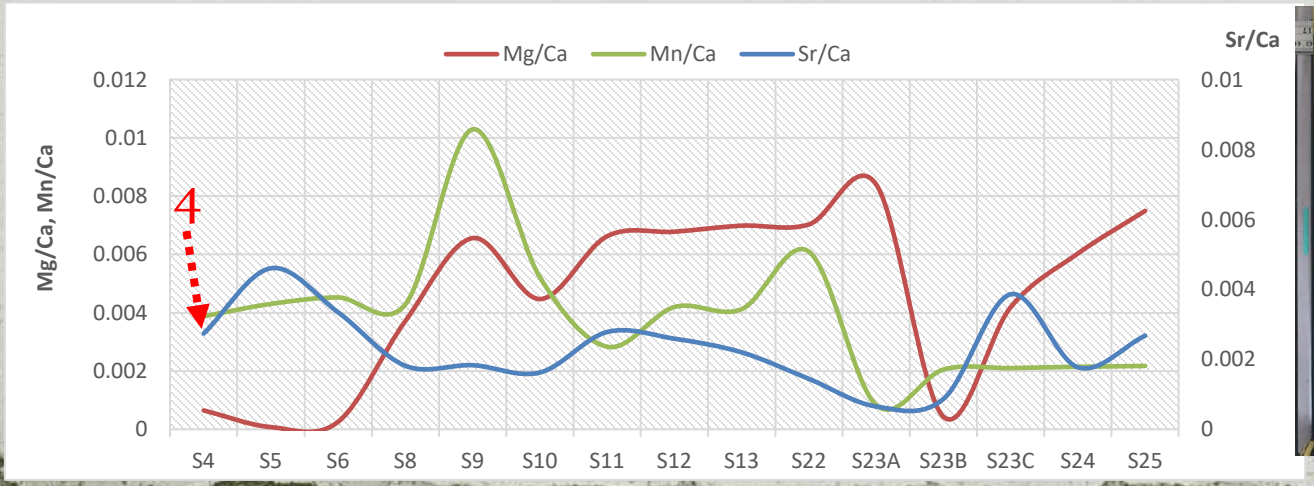


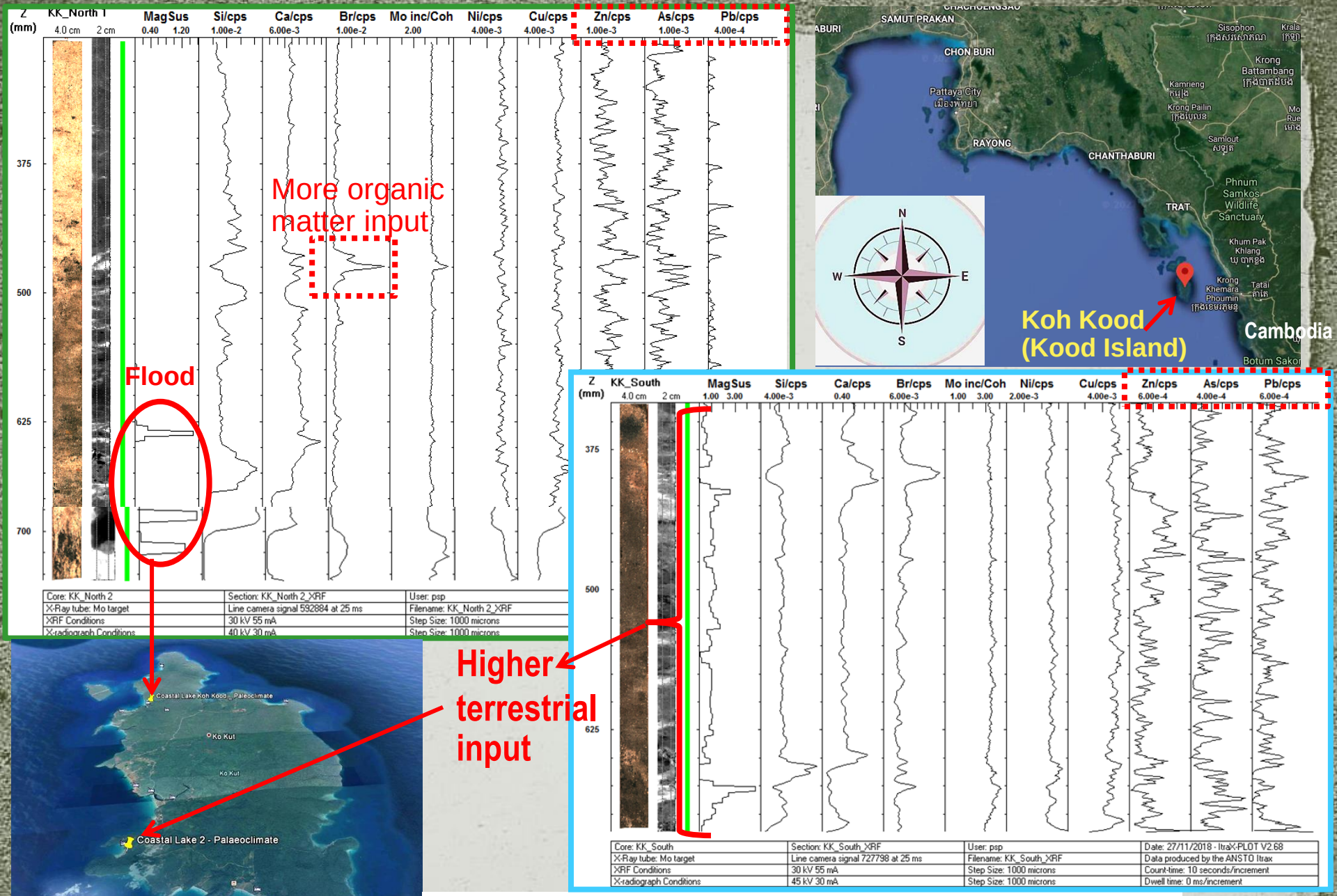
1. Br level low indicates period of decreased organic matter input. Fluvial supply was more active.

2. Anthropogenic indicators of possible metal working

3. Major peak of Zn indicates a single event of unusual deposit

4. Season of death (lower Sr/Ca) corresponds to higher sea surface temperature (SST)





Case study 2: Koh Kood or Kood/Kut Island

Wat Phu Khao Thong

Wat Dusidaram

Wat Senasanaram Ratworawihan

Wat Tha Sai

Wat Maheyong

Wat Ratchaburana

Ayothaya Floating Market

Wat Phra Si Sanphet
วัดพระศรีสรรเพชญ์

Wat Kasattrathirat Worawihan

Wat Suwandarum

วัดส้ม

Wat Phanan Choeng Worawihan
วัดพนัญเชิงวรวิหาร

Wat Chai Watthanaram
วัดไชยวัฒนาราม

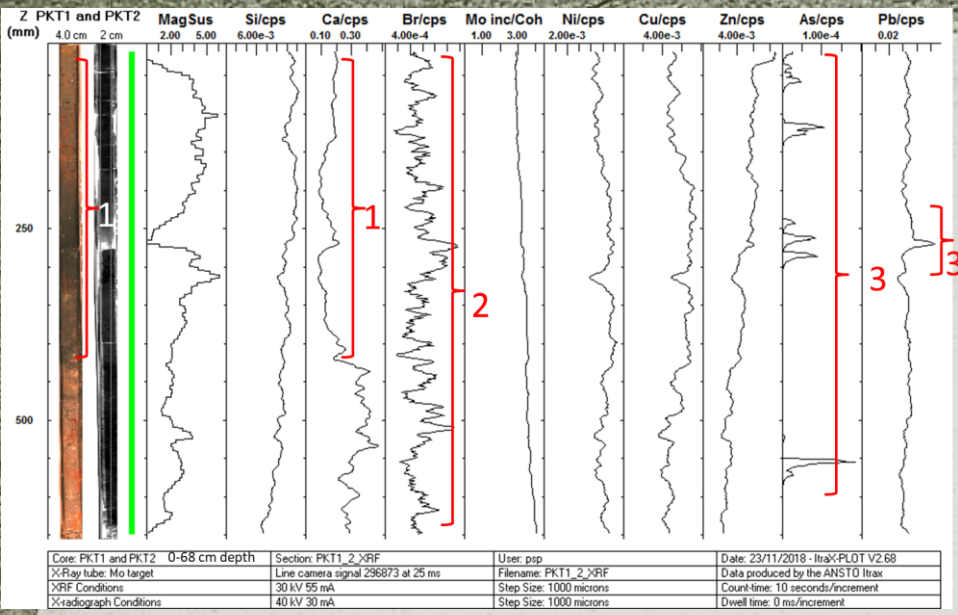
Wat Phutthai Sawan
วัดพุทไธศวรรย์

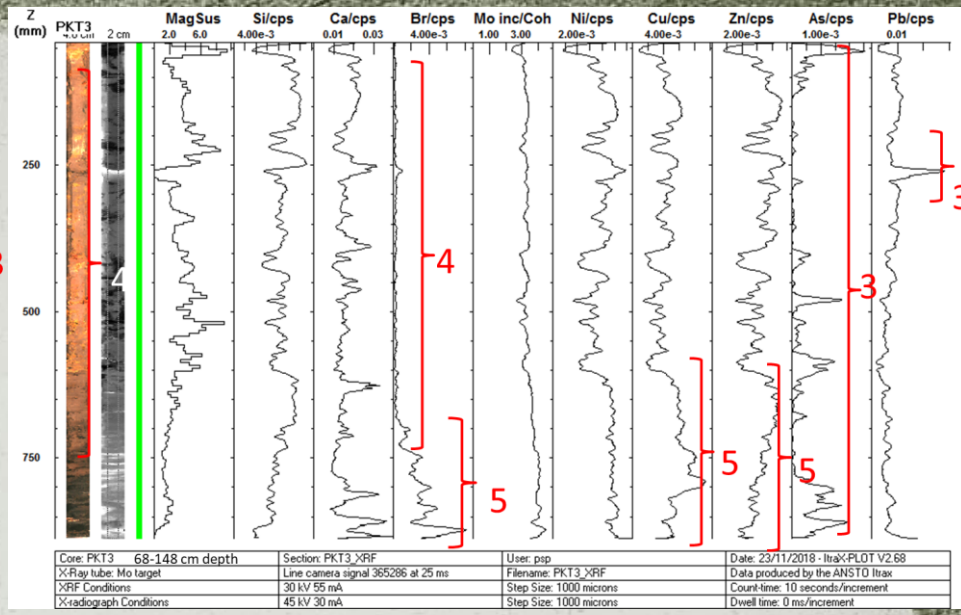
Japanese Village Museum
หมู่บ้านญี่ปุ่น

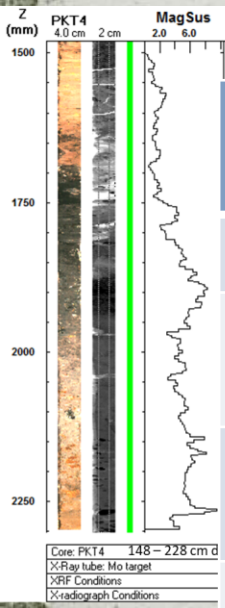
Chao Phraya River

Wat Krasai

Case study 3: Wat Phu Khao Thong







Depth (mm)	Significant character
0-400	Current cultivation
0-700	Fluvial supply more active
700-850	Fluvial supply less active
1500-2500	Swamp
3000-3500	No habitation, too active river

1. Low Calcium – current cultivation level and more organic matter (dark colours in optical image).
2. Br levels fluctuate – indicating period of increased/ decreased organic matter input.
3. Anthropogenic indicators of possible metal working or habitation of Arsenic and Pb levels higher than background
4. Br levels low – indicating period of decreased organic matter input. Fluvial supply more active.
5. Br levels higher – indicating period of more organic matter input. Fluvial supply less active, mag sus also low
6. Br levels higher – indicating period of more organic matter input. Fluvial supply less active, Ca also low. Possible more acidic soil conditions with local vegetation, swamp conditions (X-radiograph shows organic macrofossils).

2021-2022 Work Plan

Approved Projects	Samples & Techniques	Budget (THB)	Collaborations
1)Investigation of the past sea level variation 2)The historical record of archaeological sites 3)Understanding the Sediment profile for the investigation of ancient water management	✓ 3 fieldworks scheduled in 2021 for sediment core sampling by new auger (procurement is in process) ✓ Pollen/ Microfossil analysis ✓ HXRF ✓ OSL dating+^{210}Pb dating ✓ IRMS ($\delta^{18}O$) ✓ ^{3}H dating	2017-2019: 200,000THB 2021: 600,000 +200,000 THB 2022 : TBA	5 organizations • ANSTO • Fine Arts Dept. • Chulalongkorn University • Princess Maha Chakri Sirindhorn Anthropology Centre • Chulachomklao Royal Military Academy
	✓ ITRAX (15-30 meters) ✓ At least 15 AMS dating }	➢ **FNCA** ➢ **ANSTO/TINT MOU (2019-2023)**	
4) Reconstruction of Paleo climate variability	✓ Fossil oyster shells ✓ Sr/Ca and Mg/Ca by NAA, WDXRF, ICP-MS ✓ $\delta^{18}O$ by IRMS ✓ U-series dating?	2019-2020: 200,000	Institute of Earth Environment; Chinese Academy of Science & Chedi Hoi Temple

The progress against the objectives

Archive 1: Fossil oyster

- A shell sample was delivered to Dr. Yan Hong at CAS's Lab in May2020, the analysis is on-going.
- In Thailand, the analysis methods (WDXRF, NAA, ICPMS) has been applied for determining of Ca, Sr, Mg concentration in shell.

Archive 2: Sediment

- ITRAX scanning results of 3 sites was done, the data interpretation is on-going.
- Two proposals of sediment core analysis were submitted to ANSTO 2020-2 round but they have been postponed to 2021-2 as of Covid-19.
- New research project hosted by Chulachomklao Royal Military Academy has aims to reconstruct the sediment profile in ancient water storage to better understand the past water flow and water management system following the best practice to recover water resource in drought prone area in the eastern Thailand.

Conclusion

The project outcomes evidence our strong **collaboration** among scientists, geologists and archaeologists. In addition, the conventional C-14 dating, OSL dating, Pb-210 dating, stable isotope analysis by IRMS and elemental analysis by HXRF, WDXRF, NAA and ICPMS are the promising technology available for environmental research in Thailand.

Besides, ANSTO's ITRAX scanning provides **the best resolution sediment profile** of Thai archaeological sites that has never been demonstrated elsewhere.

Due to the past environmental records will be soon retrieved; the data can be further applied to address various questions such as **the variation of paleoclimate, the possible cause of oyster accumulation and death** as well as **the past sea level variation and coastal pollution accumulation.**