SOIL PROPERTIES AND CARBON DIOXIDE EMISSION FROM SULFIHEMISTS IN THE KELANTAN PLAINS, PENINSULAR MALAYSIA

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Rise in Sea Level

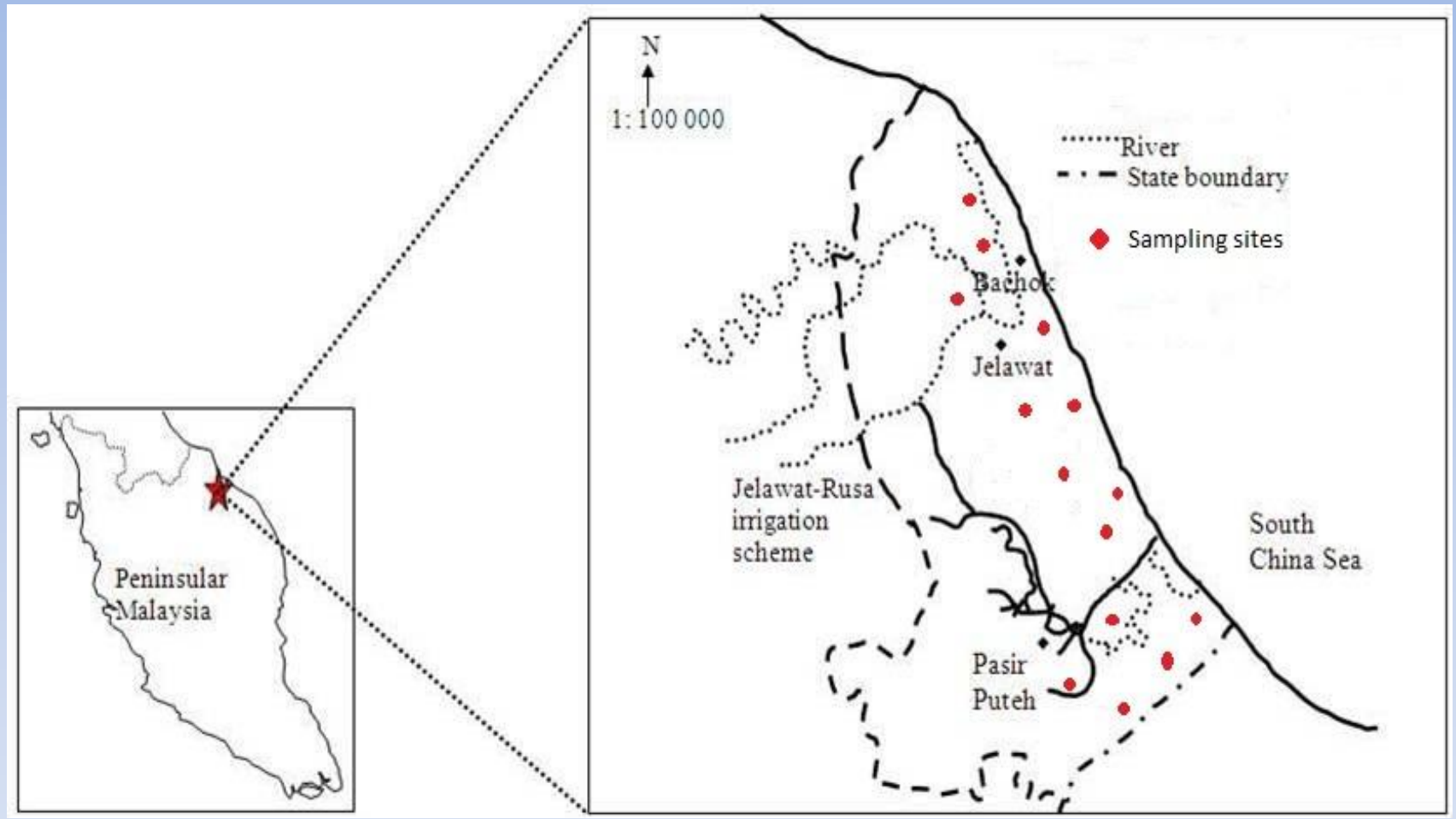
- The presence of sandy beach ridges in Kelantan Plains is an indication of the rise of sea level during the Holocene (<10,000 years ago)

(Haile, 1970)

- About 6000 years ago, the sea level in Asian region was 3-5m above the present

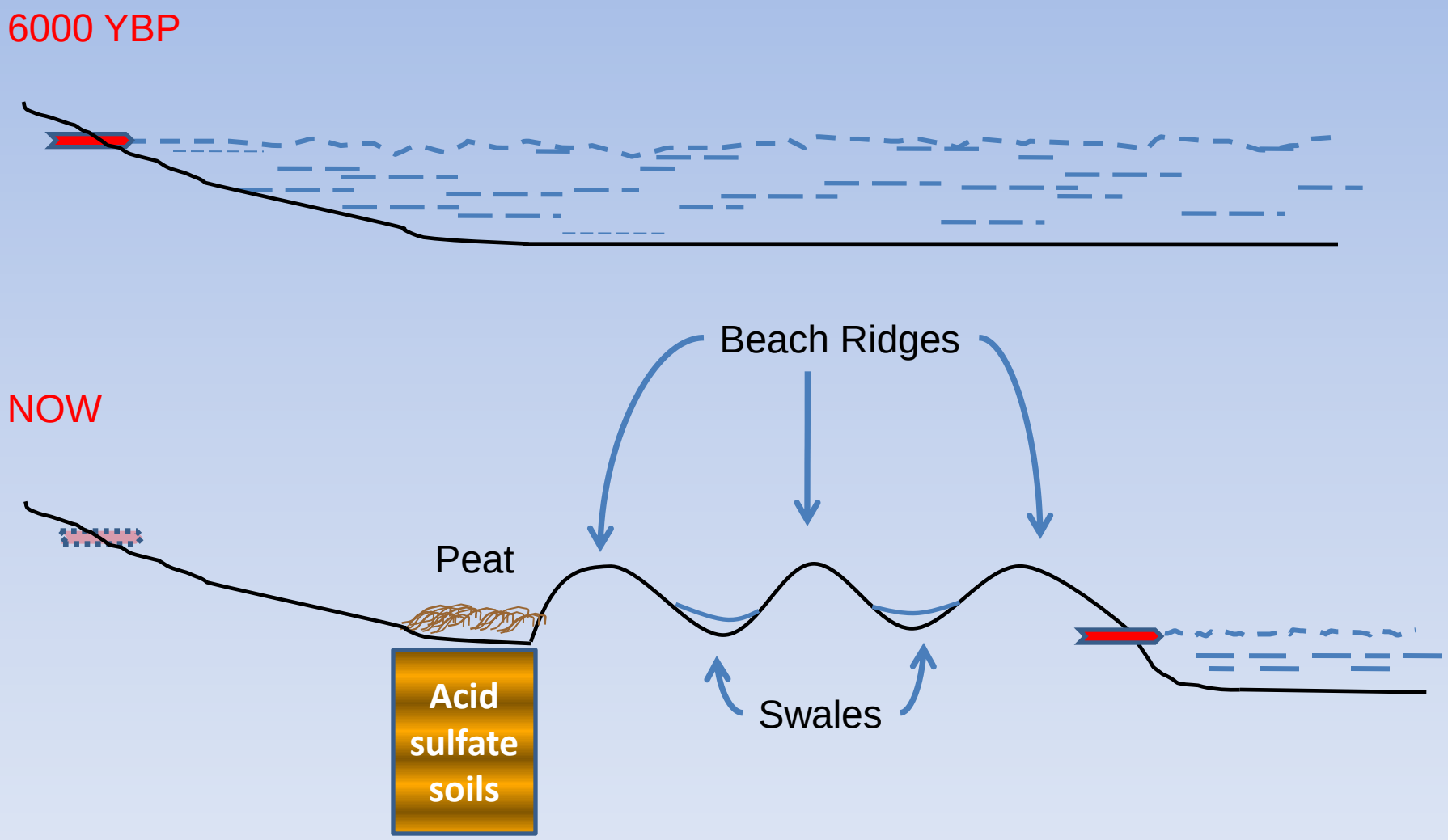
(Pons et.al., 1982)

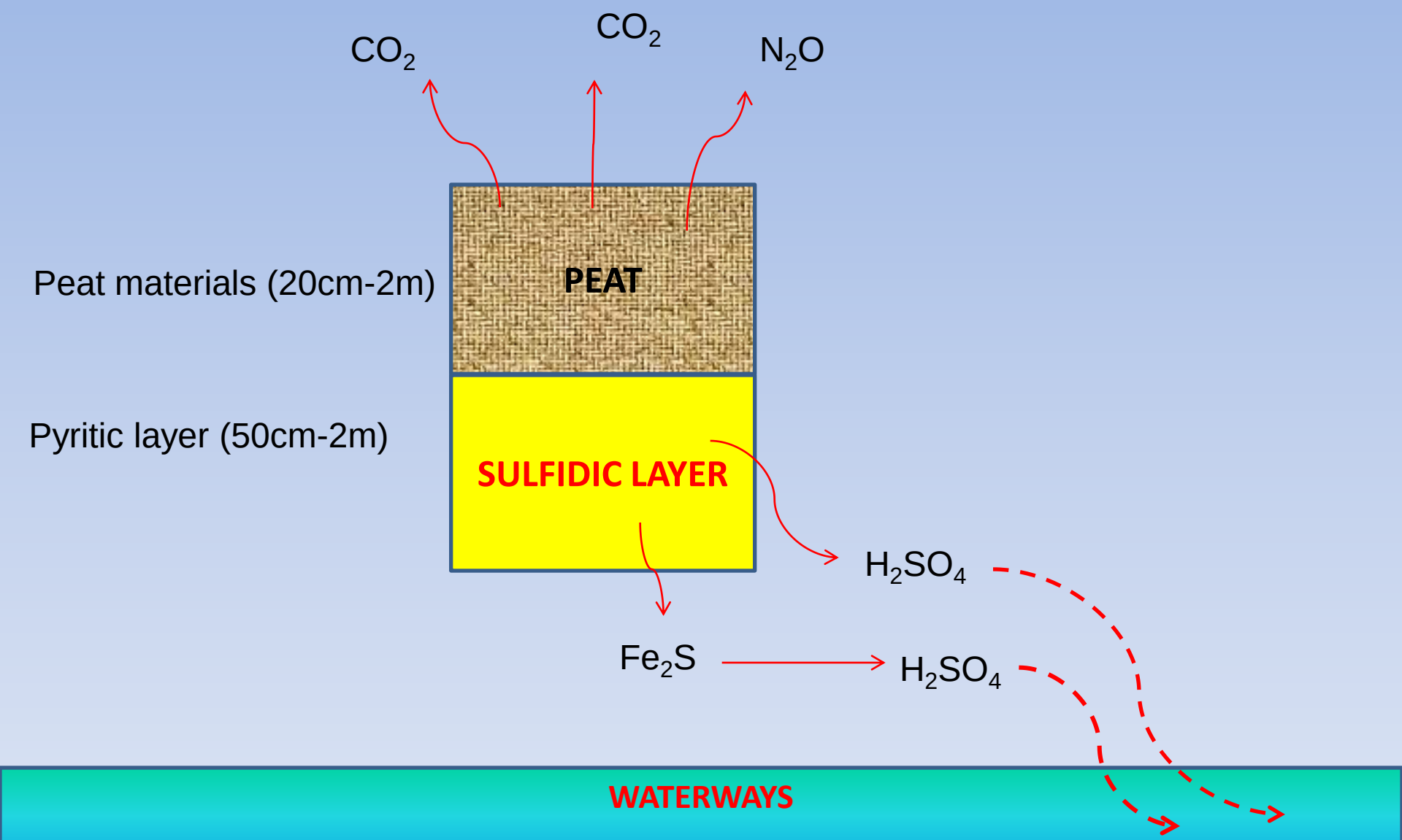
Study Background



Study site: Kelantan Plains

Formation of Peat Soil on Acid Sulfate




CO_2
CO_2
N_2O
Peat materials (20cm-2m)
PEAT
Pyritic layer (50cm-2m)
SULFIDIC LAYER
H_2SO_4
Fe_2S
H_2SO_4
WATERWAYS

- Carbon dioxide (CO_2) from soils with peat materials is proven to be a significant source of global warming

- Many studies had intensively measured CO_2 emission from peat soils

- However, the study on release of CO_2 from soils with peat materials mixed with sulfidic layer is uncommon

Objectives

- To determine the properties of soils having peaty materials on pyrite bearing sediments in the Kelantan Plains

- To measure the emission of CO_2 from the soils

MATERIALS AND METHODS

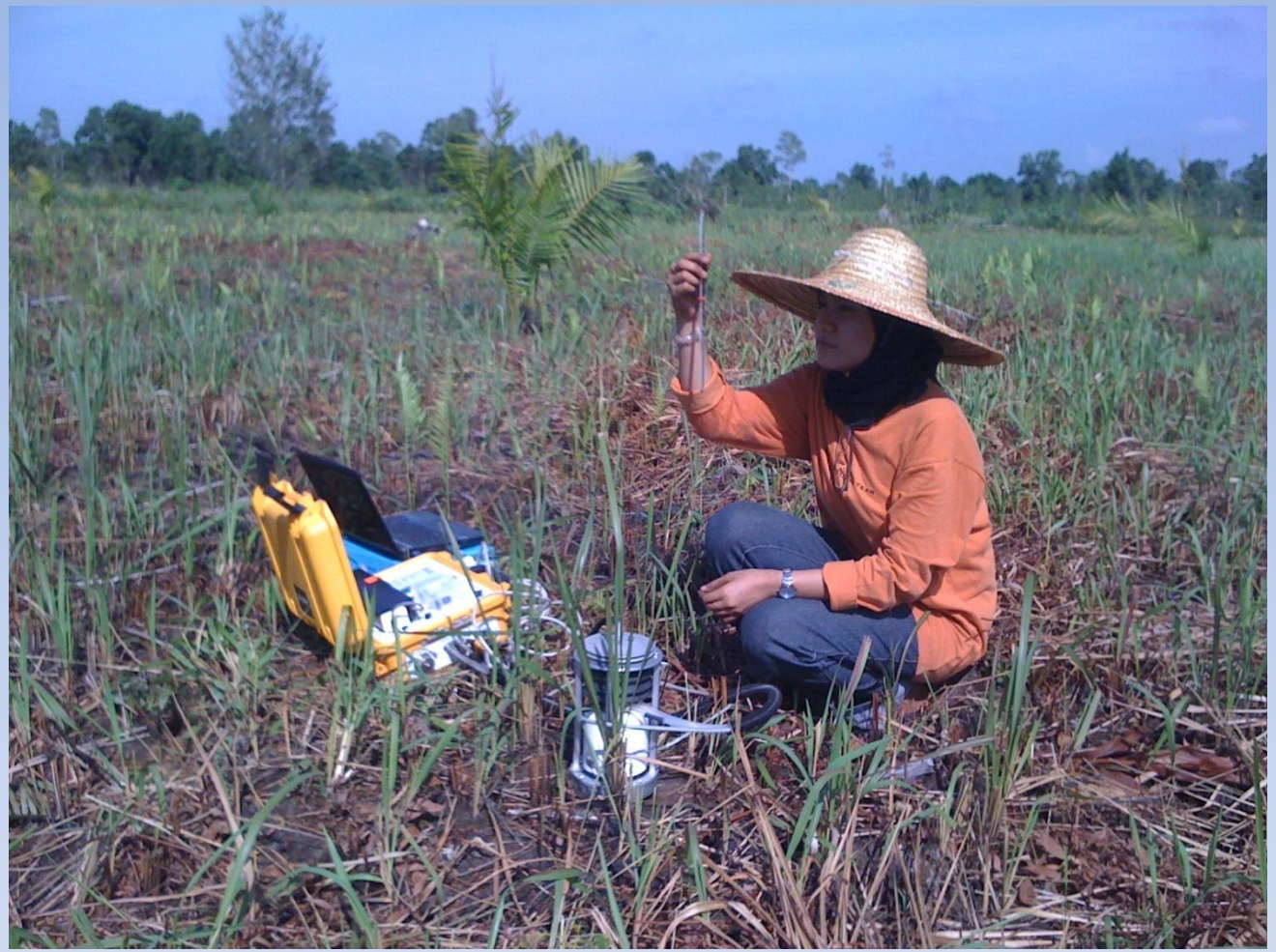
Oil palm was planted on the deep peat (2m)

Rubber trees were planted on the deep peat (2m)

Field Measurement

Collecting soil samples

CO2 flux was measured using LICOR infra red gas analyzer



Recording the soil temperature

Laboratory Analyses

- The soil samples was collected according to depth
  - 0-15cm
  - 15-30cm
  - 30-45cm
  - 45-60cm

- The chemical properties of the soils were analyzed in laboratory

RESULTS

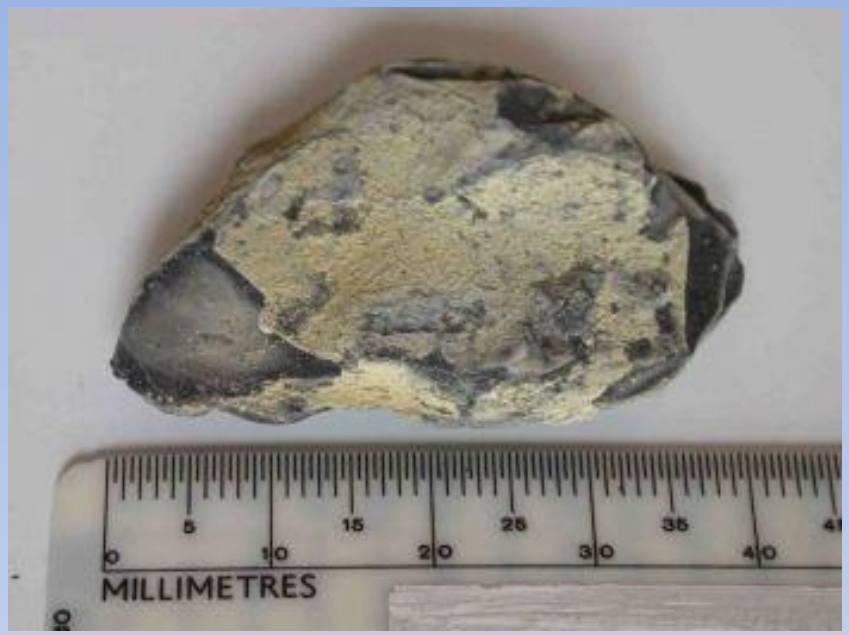
Site	Depth	pH	EC	K	Ca	Mg	Al	CEC	Ext. Fe	avail. P	Total N	Total C
	(cm)		(dS/m)	(cmolc/kg)						(mg/kg)	(%)	
OP	0-15	4.3	0.1	1.2	1.8	1.0	3.9	10.0	2.3	17.6	0.3	3.3
	15-30	4.3	0.1	0.7	2.3	1.1	4.0	9.0	1.5	19.1	0.2	1.4
	30-45	3.5	0.1	0.7	3.9	1.2	3.7	9.5	1.3	14.2	0.1	1.3
	45-60	3.6	0.1	0.8	3.2	1.2	4.2	12.4	1.9	75.1	0.2	4.2
R	0-15	3.5	0.1	0.6	0.7	0.3	6.2	14.2	0.8	10.0	0.2	4.4
	15-30	3.4	0.1	0.5	0.5	0.3	5.5	11.7	0.4	9.5	0.1	2.0
	30-45	3.7	0.1	0.5	0.5	0.3	3.8	9.3	0.1	10.1	0.8	0.9
	45-60	3.5	0.1	0.4	0.4	0.3	5.2	17.6	0.1	10.3	0.4	4.6
G	0-15	4.0	0.1	1.0	0.5	0.4	4.1	20.4	0.2	14.4	0.4	9.3
	15-30	3.5	0.2	0.8	0.5	0.3	6.2	14.3	0.1	14.6	0.2	5.3
	30-45	3.6	0.1	0.7	0.7	0.7	15.7	20.1	0.5	17.4	0.5	13.3
	45-60	3.2	0.2	0.5	1.2	0.8	32.1	10.7	0.3	17.0	0.3	15.1

Soil chemical properties of pyritic soils

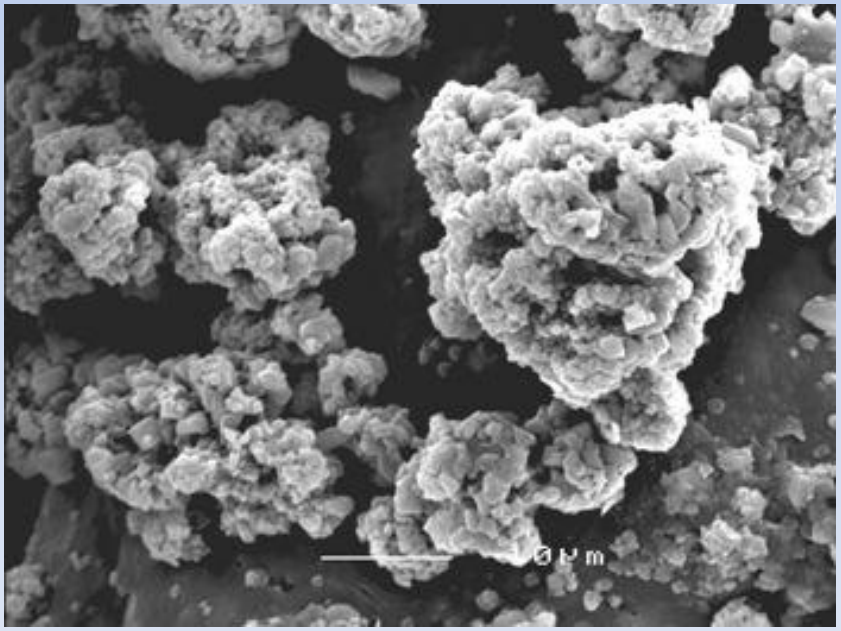
OP= Oil palm
R = Rubber
G = Secondary forest

Peat

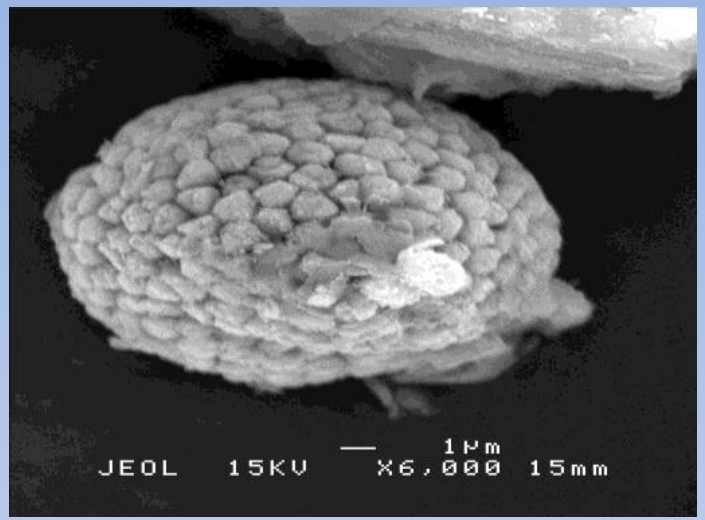
Sulfidic layer

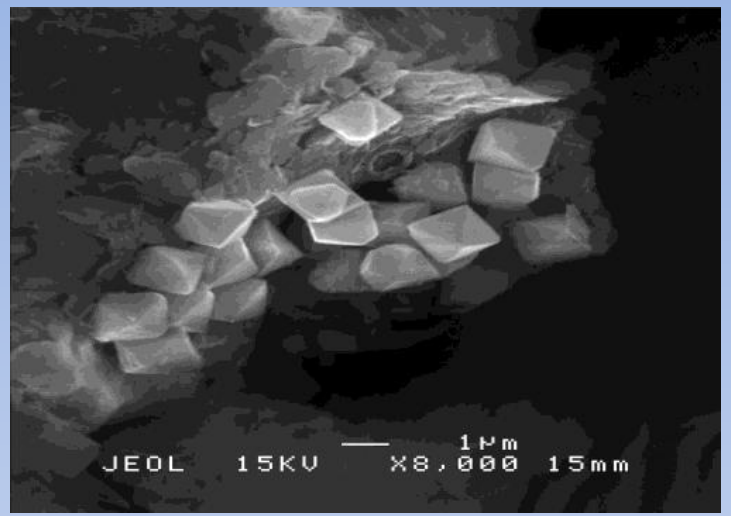


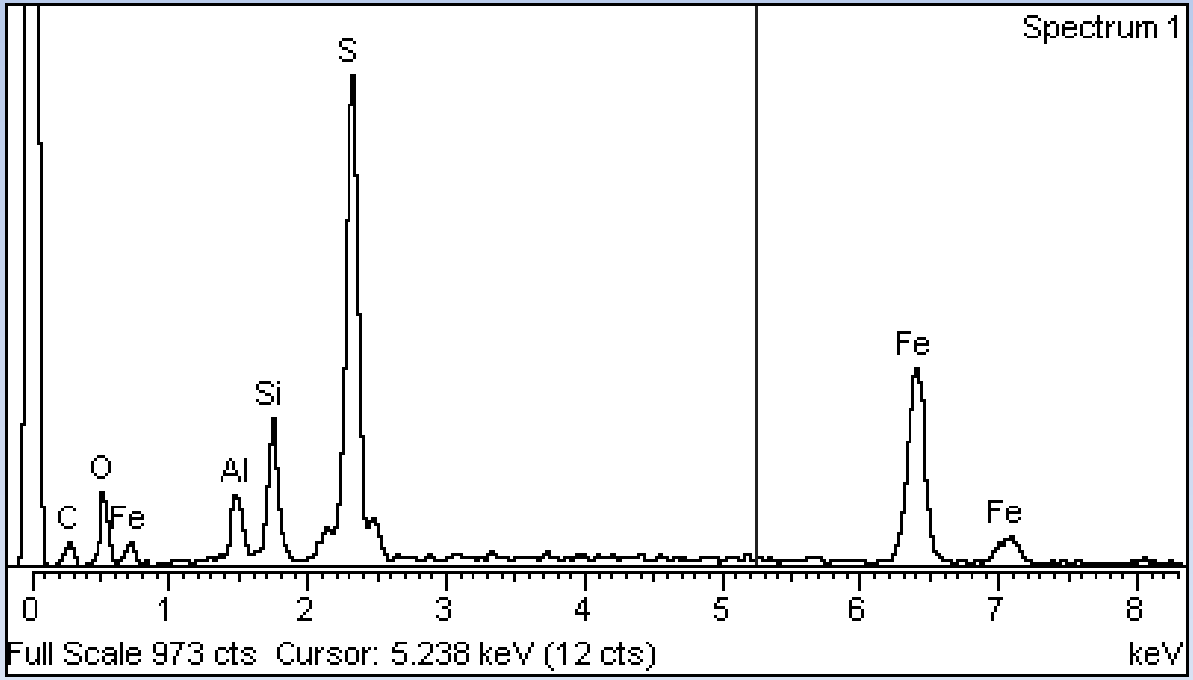
Soils coated with jarosite



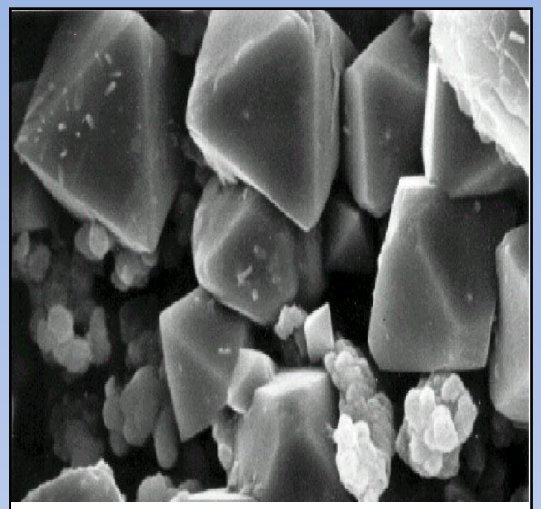
Jarosite under SEM



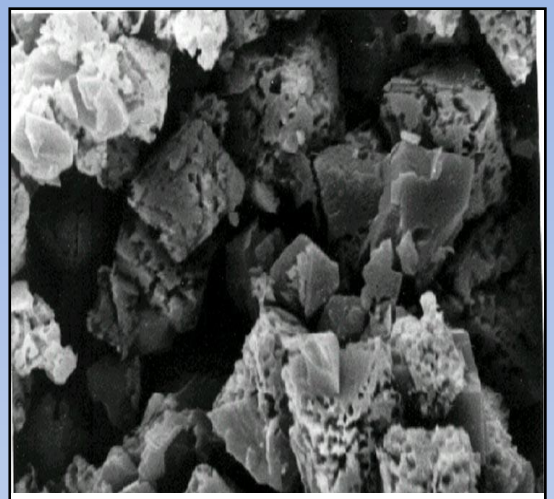




Pyrite under SEM-edX



SEM of pyrite



SEM of pyrite transformation

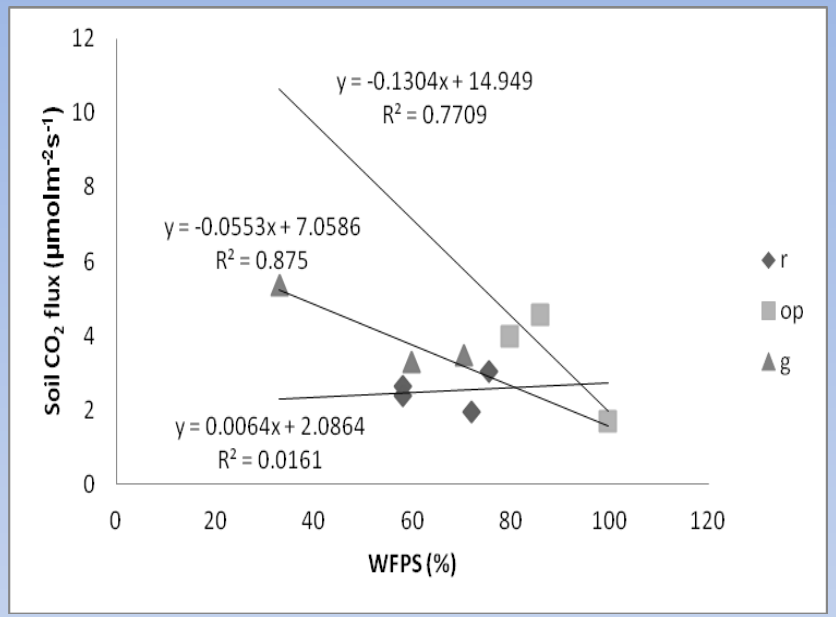
SEM of jarosite

Samples from rubber site

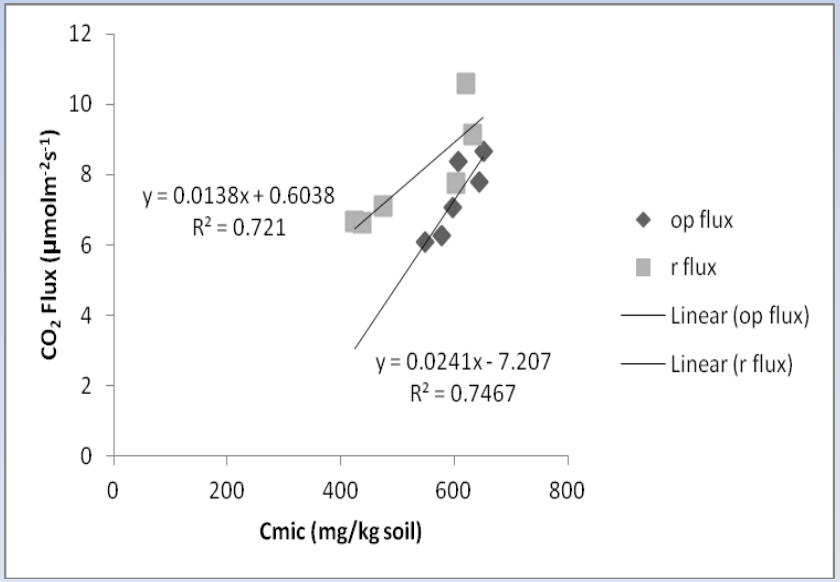
Properties of the topsoil at the time of flux measurement

	Rubber	Oil Palm	Secondary forest
pH	3.6	4.3	3.0
TC (%)	43	39	14
TN (%)	0.95	0.97	0.56
C:N %	45	40	25
Cmic (mg kg^{-1})	586	645	547
Nmic (mg kg^{-1})	538	540	442
Soil temperature	25	24	21
Bulk density (g cm^{-3})	0.22	0.31	0.42

Site	WFPS (%)			Corr. of WFPS and flux		
	Feb 2010	May 2010	Sept 2010	Feb 2010	May 2010	Sept 2010
1	58.04	55.43	52.26	0.13	0.05	0.22
2	79.73	78.26	77.73	-0.88	-0.88	-0.82
3	33.02	34.75	30.20	-0.94	-0.93	-0.95



Site	Mean of CO_2 Flux (mg C $m^{-2}h^{-1}$)			Annual CO_2 flux (kg C m^{-2} yr^{-1})
	Feb[a]	May[a]	Sept[b]	
1	103**	149	332	1.7
2	153	237	307	2.0
3	187	215	661**	3.1**



- Rough estimated CO_2 flux per year is about 4 kg CO_2 $m^{-2}y^{-1}$ for oil palm and 3.2 kg CO_2 $m^{-2}y^{-1}$ for rubber

- This result is higher than the other findings by Lulie (2010) (1.5 kg CO2 $m^{-2}y^{-1}$) that only consists of peat layer

- This noted that the peat soil mixed with sulfidic layer is releasing higher amount of CO_2compared to the area of only peat soils

- Factors affecting the CO_2 flux:
  - Root respiration
  - Soil bulk density
  - Soil microorganisms

- In future studies, need to define the interaction between peat soil and acid sulfate

Thank You

Any questions,