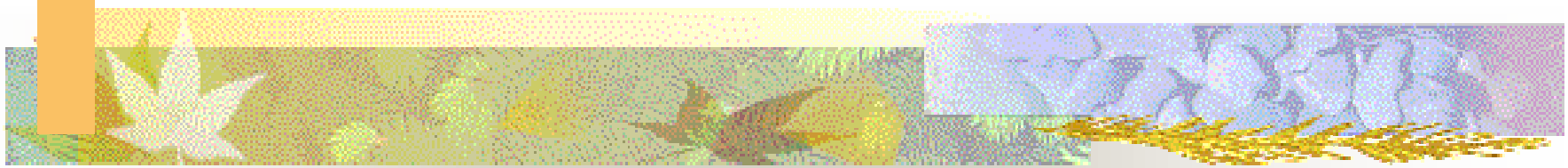
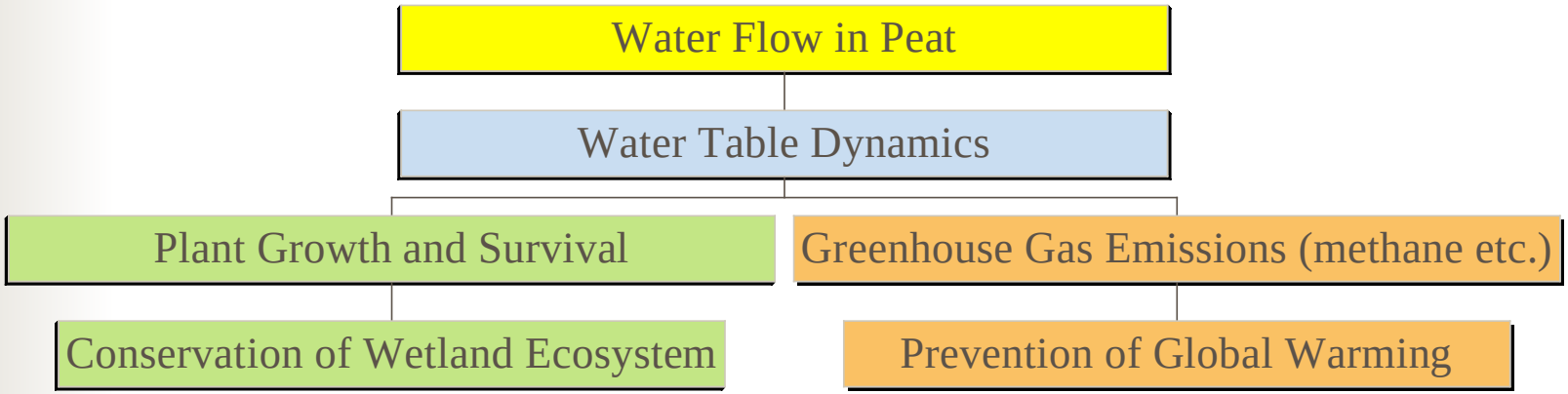
Bibai Report 25～27/Oct./2001



M. Mizoguchi, K. Seki, S. Mitsuishi, T. Tokida

Background of This Study



Water flow in peat controls water table dynamics, which, in turn, have been shown to affect plant growth and survival and rates of greenhouse gas emissions. It is important to investigate factors affecting water flow in peatland.

Past Studies 1 –Field Studies

- Dinel, H. et al. 1988. A field study of the effect of depth on methane production in peatland waters: Equipment and preliminary results. J. Ecol. 76:1083-1091
- Buttler, A. J. et. al. 1991. The relation between movement of subsurface water and gaseous methane in a basin bog with a novel instrument. Can. J. Soil Sci. 71:427-438.
- **Their studies indicate that methane is occluded in the gaseous phase in amounts significant enough to influence water movement.**

Past Studies 2 –Laboratory Studies

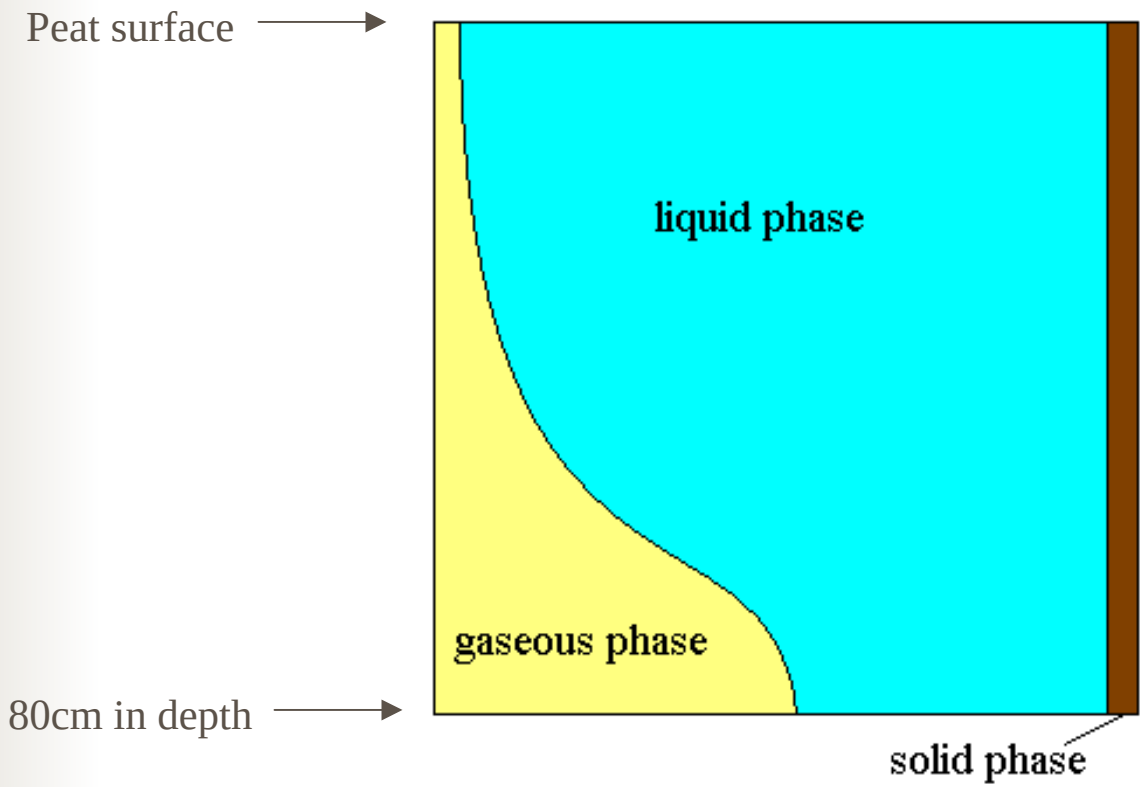
- Reynolds, W. D. 1992. Effect on in-situ gas accumulation on the hydraulic conductivity of peat. Soil science, 153:397-408.
- Clive, W. B. 2001. Effect of biogenic gas bubbles on water flow through poorly decomposed blanket peat. Water Resour. Res. 37:551-558.
- **They showed that presence of gas bubbles, especially methane, appeared to have a major effect on hydraulic conductivity.**

The Preceding Research 1

- Even the water table level is very close to the peat surface, the ratio of water to gases in the MGC-syringe suggested that there is a non-trivial amount of bubble gas in peat, and that volumetric gas content rose abruptly around 70cm in depth.
- Analyses of gases collected in MGC method have shown that the main constituent of gas bubbles in peat was methane.
- Considering the two observations described above, it appears that there can be formed a large gas hole in catotelm in *bibai* wetland.

The Preceding Research 2

An image of phase distributions based on the preceding research



Objectives

- To grasp distributions and quantities of bubble gas below the peat surface in *bibai* wetland.

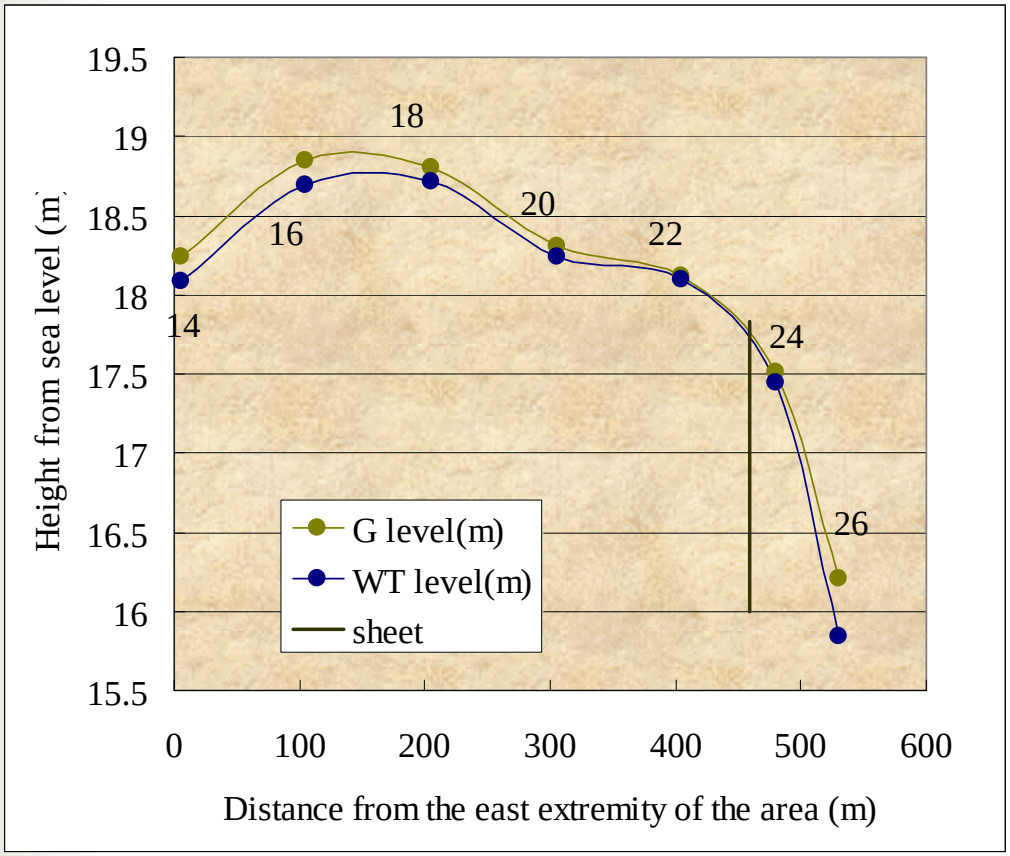
Materials and Methods

- Estimation of volumetric gas content in peat using the MGC method.
- Gas sampling with the MGC and analyses of sampled gas with gas chromatograph.
- Measurements of dielectric properties using the Profile Probe -type PR1 and conversion to soil water content.
- Pressure profile measurements by inserting the Diver connected metal pole into peat.

Study Site 1

Study Site 2

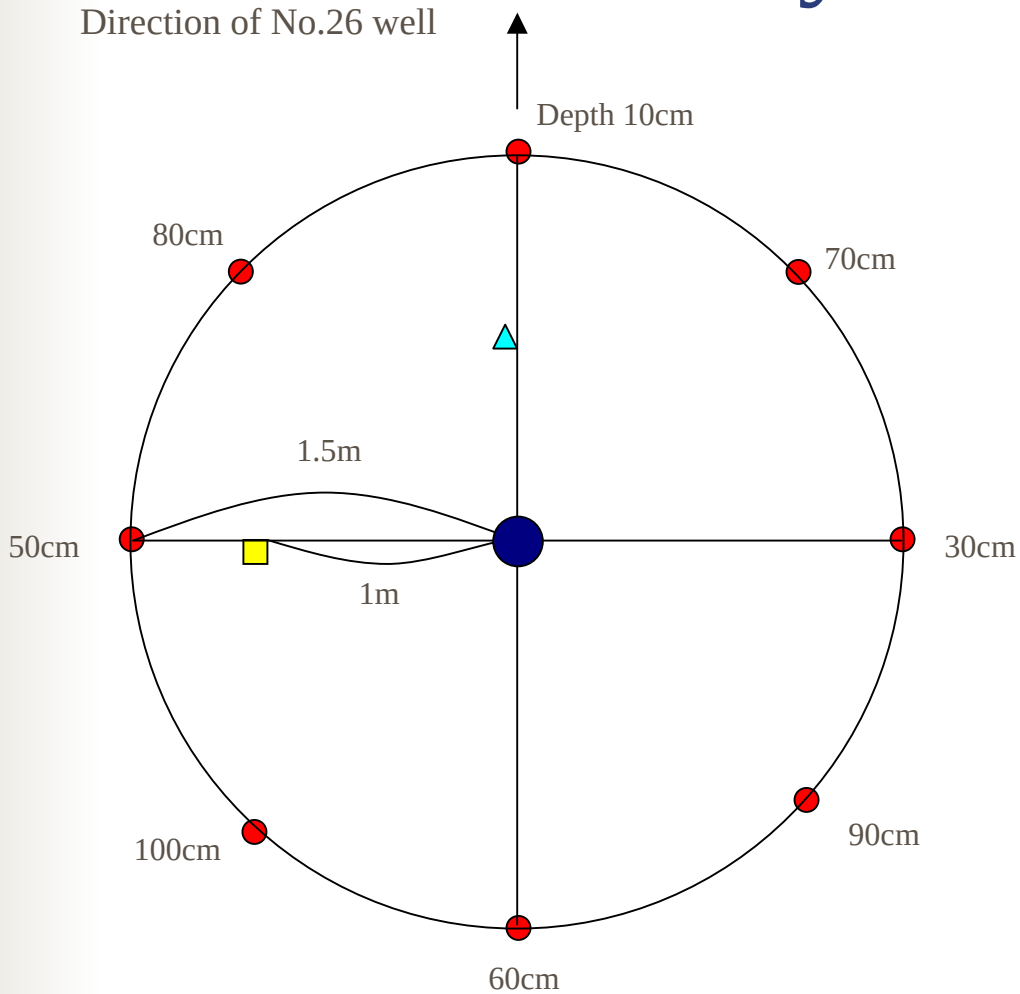
Study Site 3



Along the eastern and western extremity runs a drainage canal several-ly.

Conditions in the east-ern and western borders are, therefore, drier than the central part of this peatland.

Measurement Layout



A Well for water table level measurement

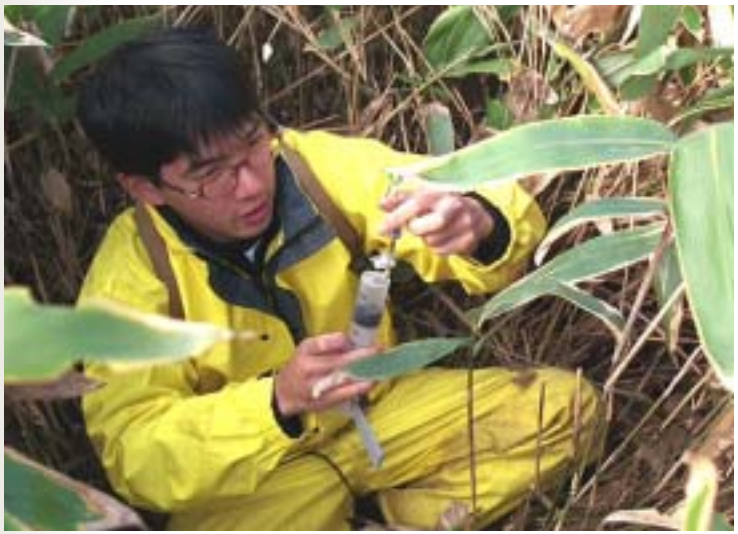
Gas collection (MGC)

Pressure measurement (Diver)

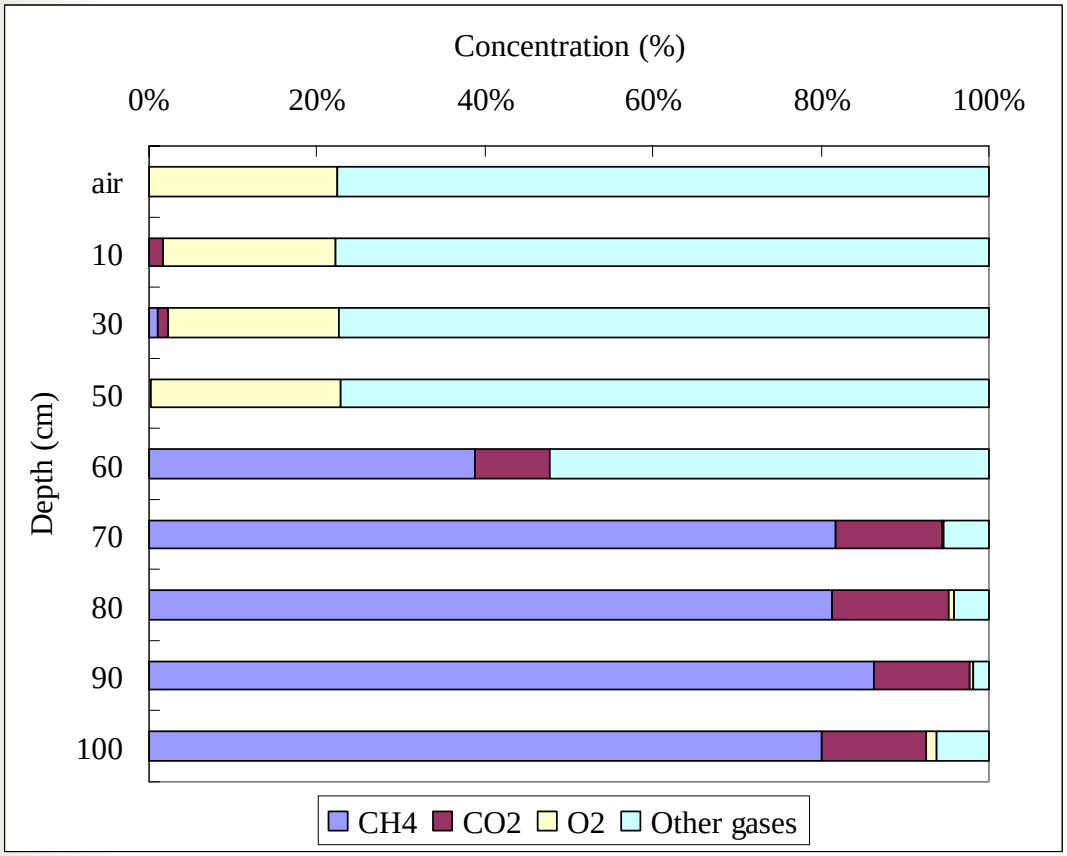
Profile Probe

Gas Sampling

Gas sampling 2



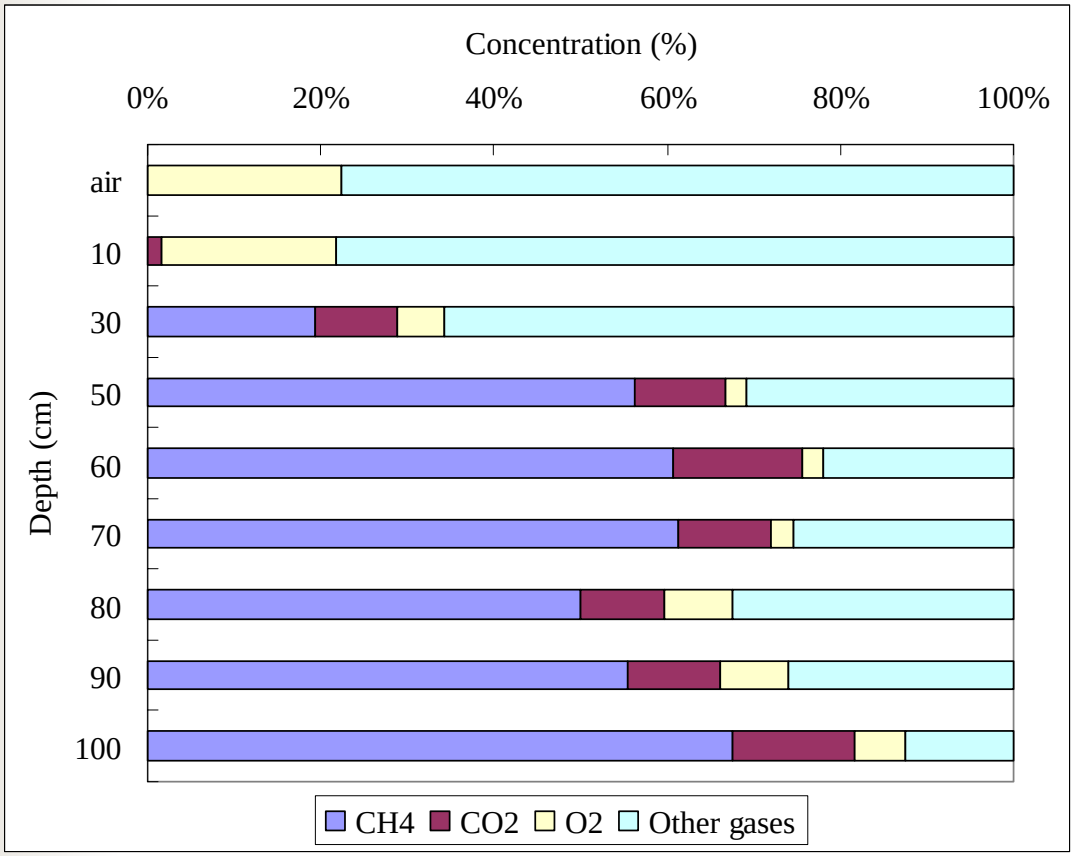
Depth Profile of Gas Concentrations at Location 14



Water Table Level: 16cm
Ground Vegetation: none
Shrub Vegetation: *Sasa palmata*

Very high methane concentration was detected below 60cm in depth and that was the highest concent-ration in all samples.

Depth Profile of Gas Concentrations at Location 16



Water Table Level: 15cm

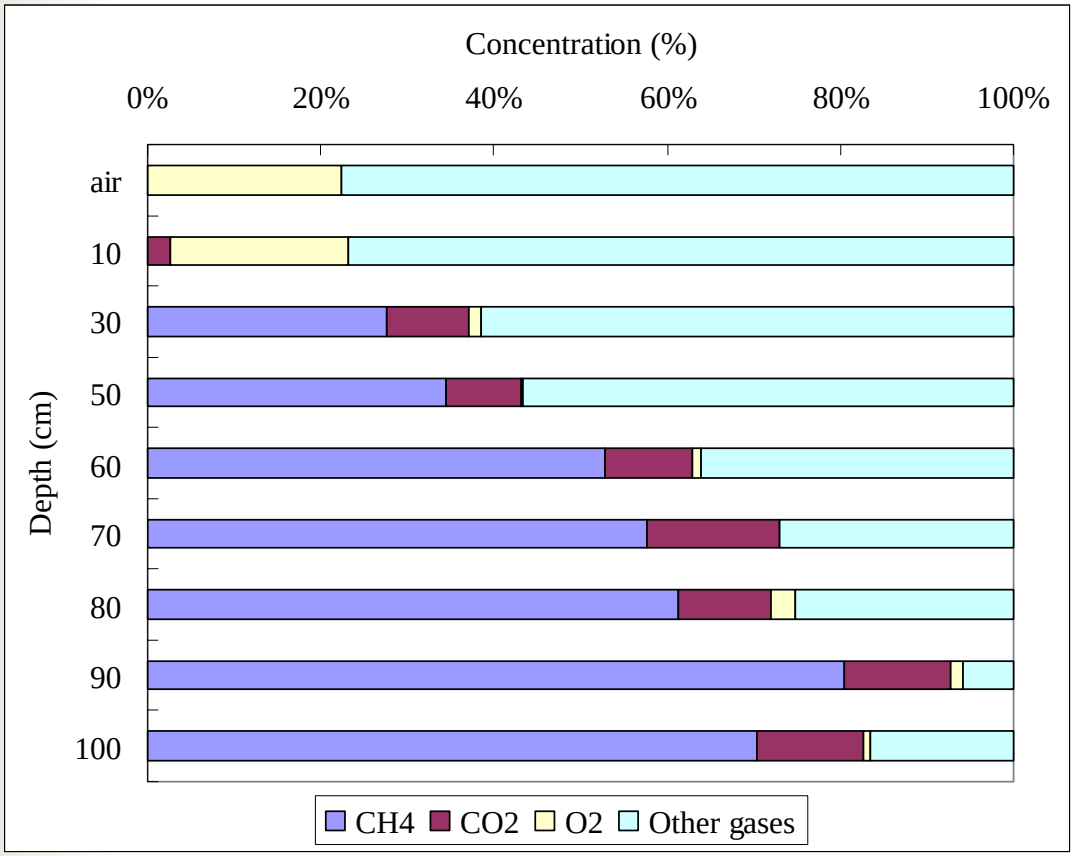
Ground Vegetation: none

Shrub Vegetation: *Sasa palmata*, *Vaccinium oxycoccus*

Oxygen was found in the depth where relatively high methane concentration was also detected.

☆It suggest that methane production may occur in spots.

Depth Profile of Gas Concentrations at Location 18



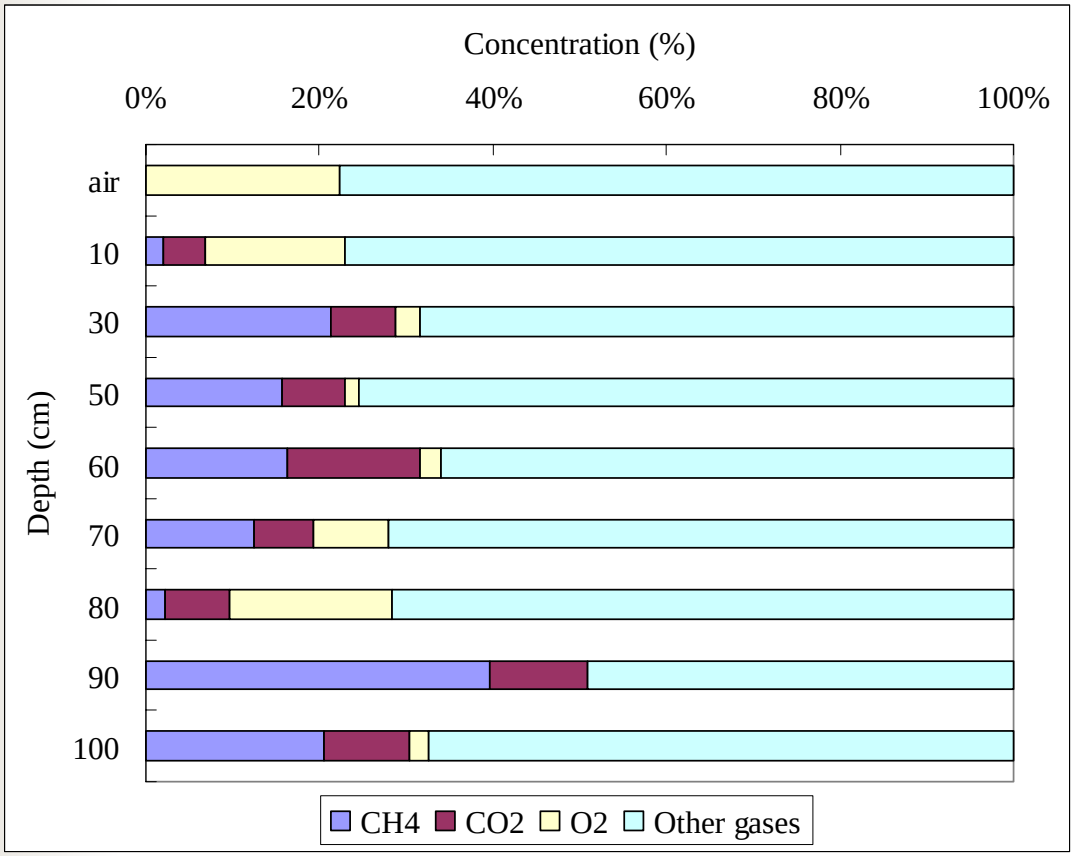
Water Table Level: 8.1cm

Ground Vegetation: *Sphagnum spp. Carex spp.*

Shrub Vegetation: *Sasa palmata*

In contrast to location 16, three was not much oxygen detected with methane.

Depth Profile of Gas Concentrations at Location 20



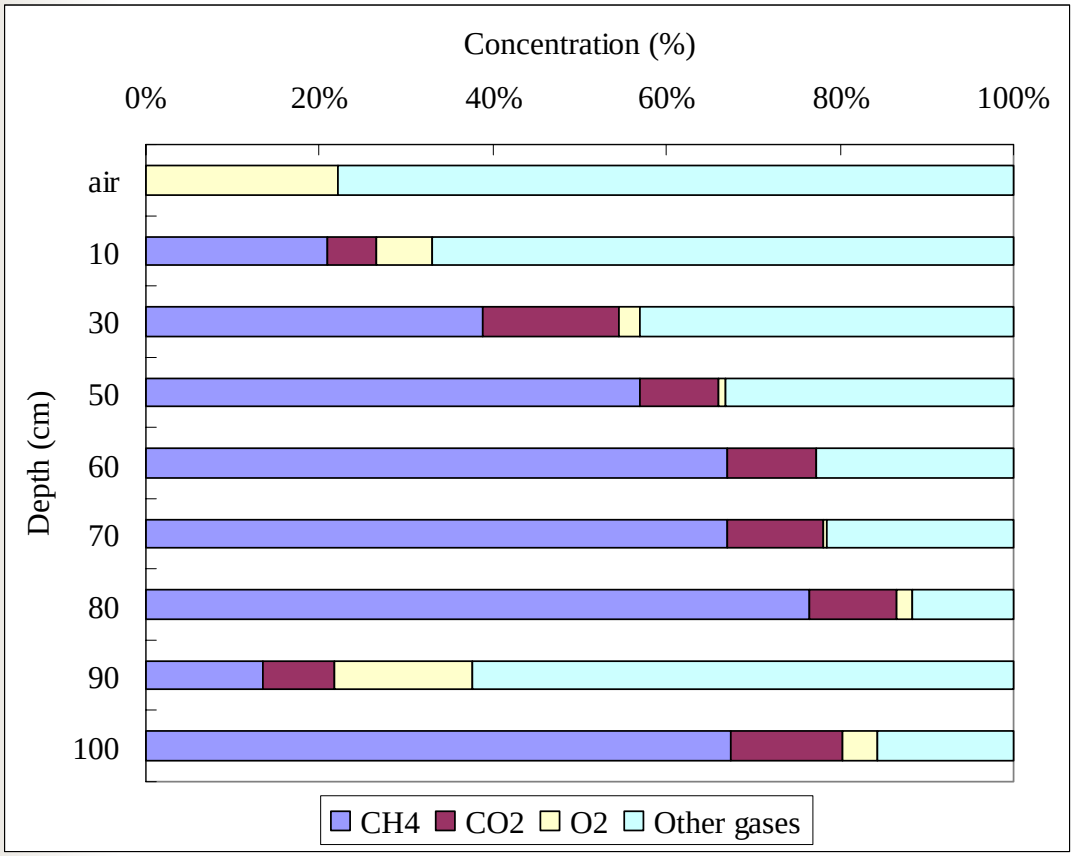
Water Table Level: 6.6cm

Ground Vegetation: *Sphagnum spp. Carex spp.*

Shrub Vegetation: none

Although water table was fairly high level, methane was far less detected compared to other locations.

Depth Profile of Gas Concentrations at Location 22



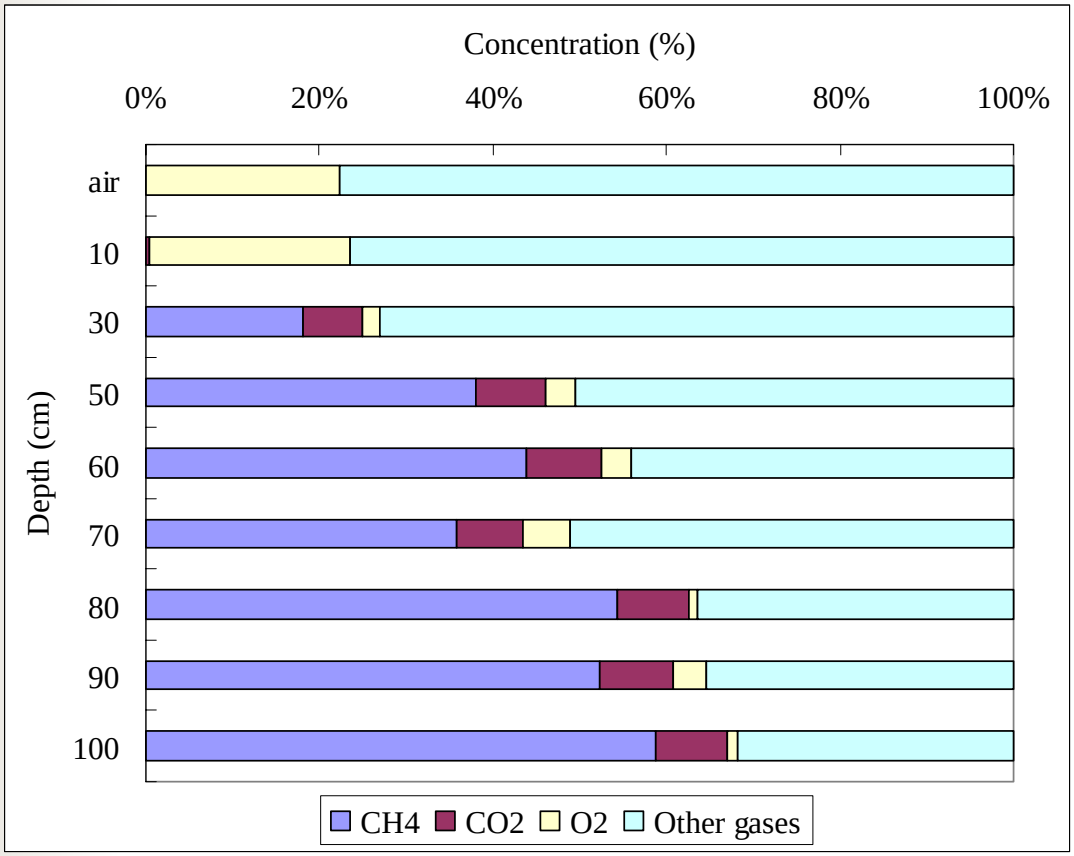
Water Table Level: 2.3cm

Ground Vegetation: *Sphagnum spp. Carex spp.*

Shrub Vegetation: none

The data from 90cm seems unreliable.

Depth Profile of Gas Concentrations at Location 24

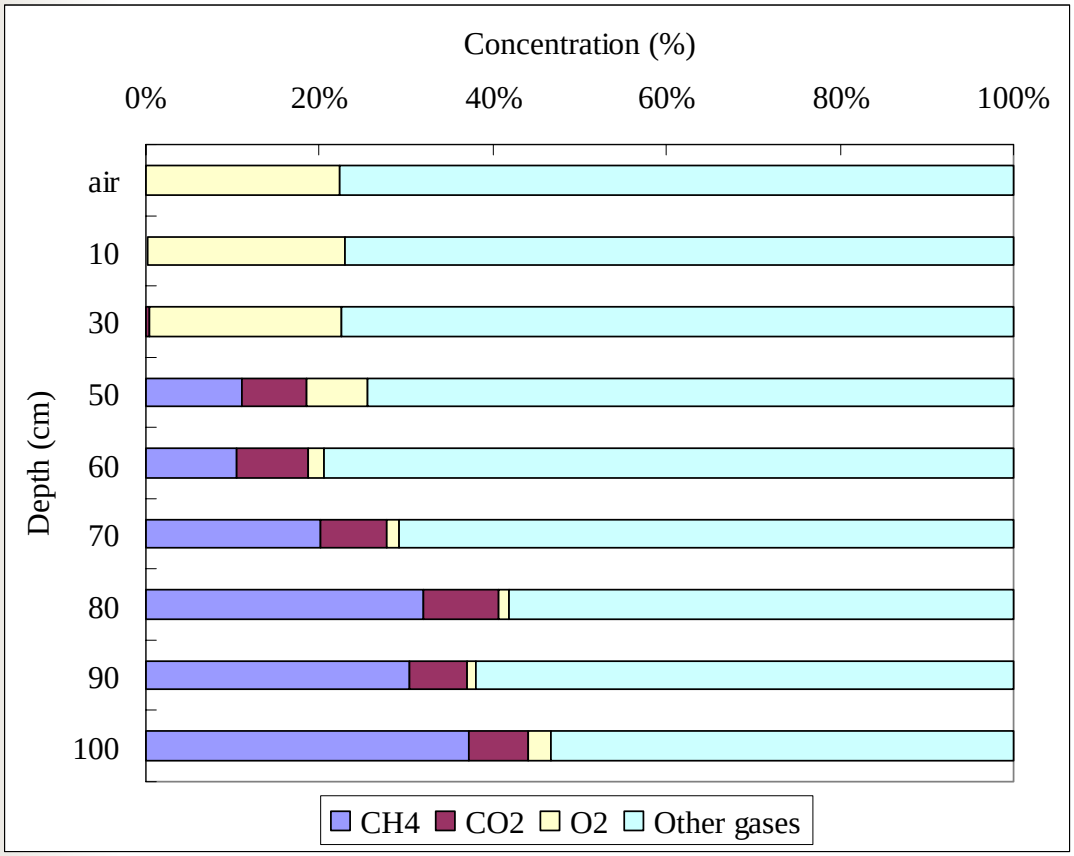


Water Table Level: 6.8cm

Ground Vegetation: *Sphagnum spp.*

Shrub Vegetation: *Vaccinium oxycoccus, Myrica gale var. tomentosa, Rhus trichocarpa*

Depth Profile of Gas Concentrations at Location 26



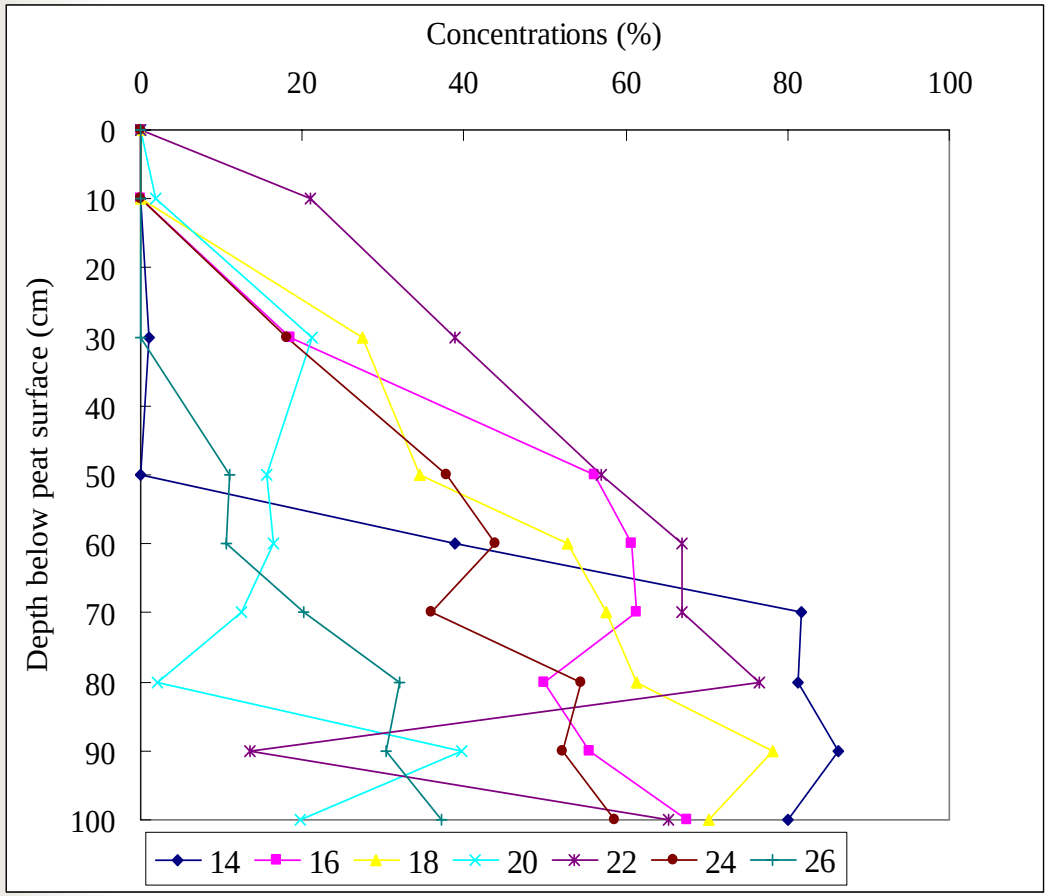
Water Table Level: 36.3cm

Ground Vegetation: *none*

Shrub Vegetation: *Sasa palmata*

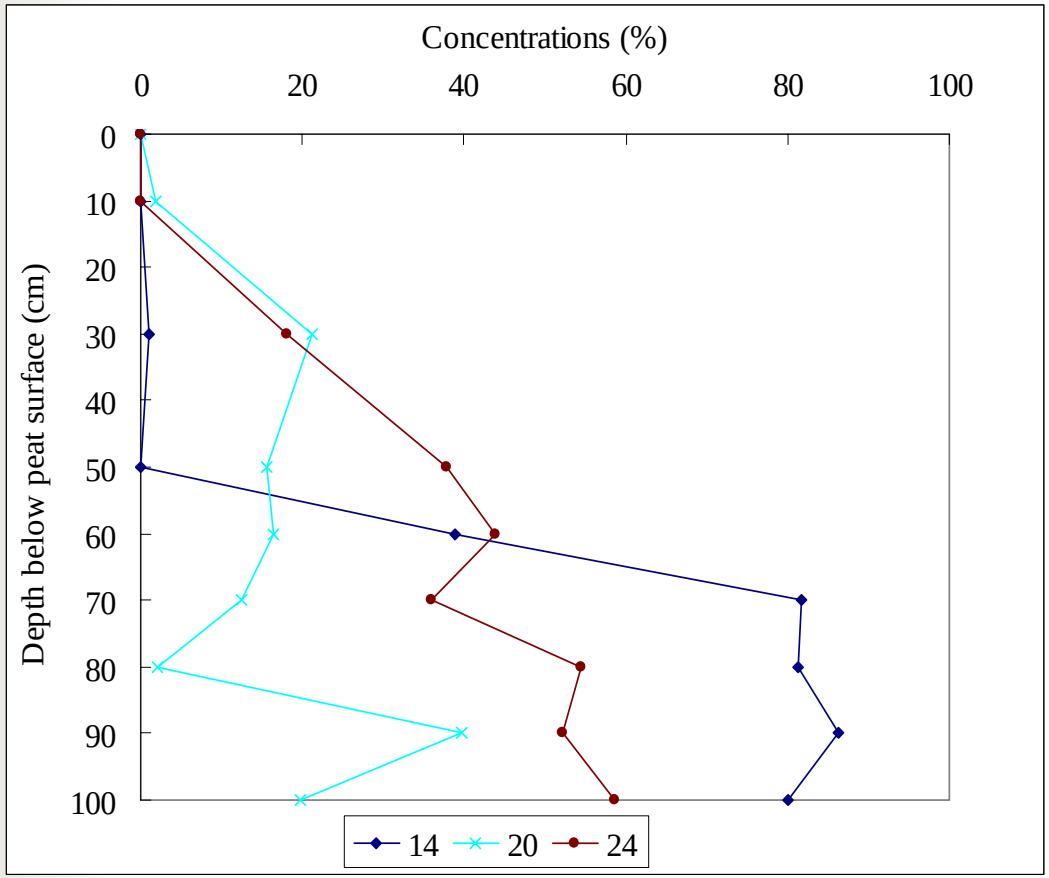
The driest condition of all locations.

Depth Profile of CH_4 Concentrations 1



There seem an upward tendency in methane with increasing depth.

Depth Profile of CH_4 Concentrations 2

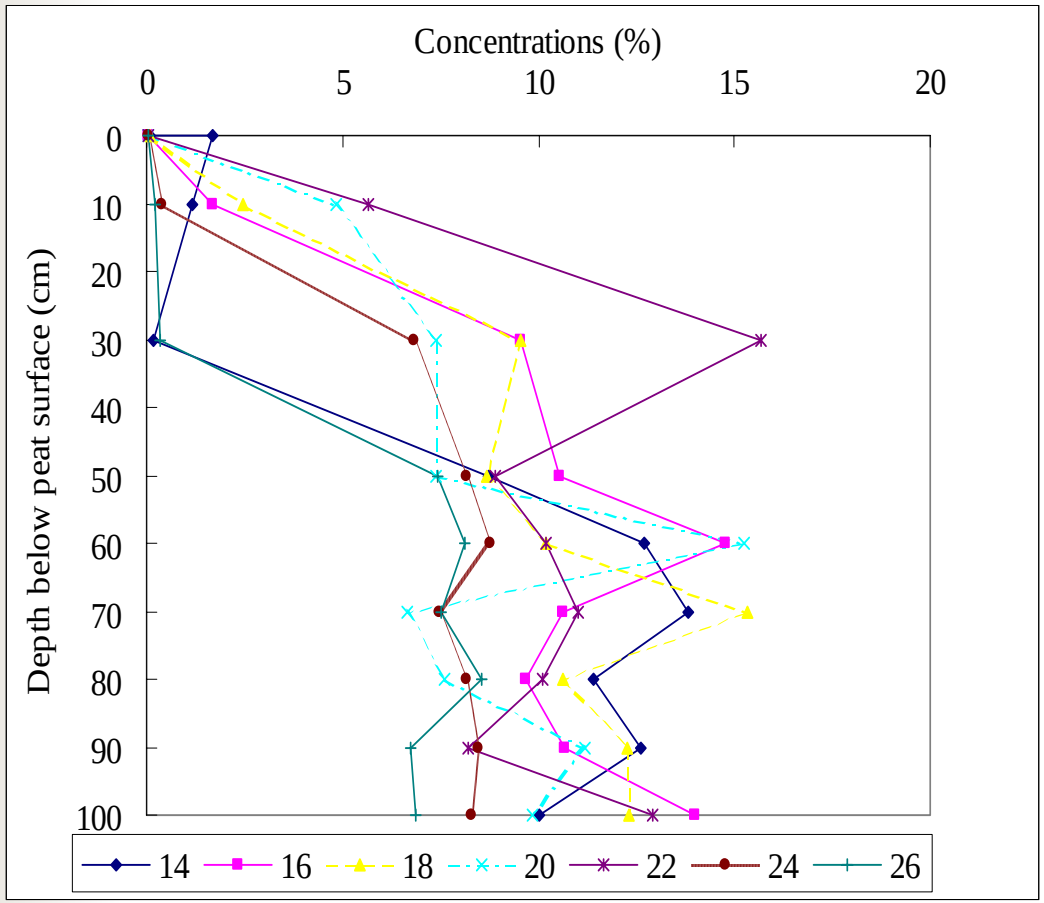


Location 14: A rapid increase in methane concentration was observed.

Location 20: Concentration of methane was low level among others.

Location 24: Methane concentration increased with increasing depth

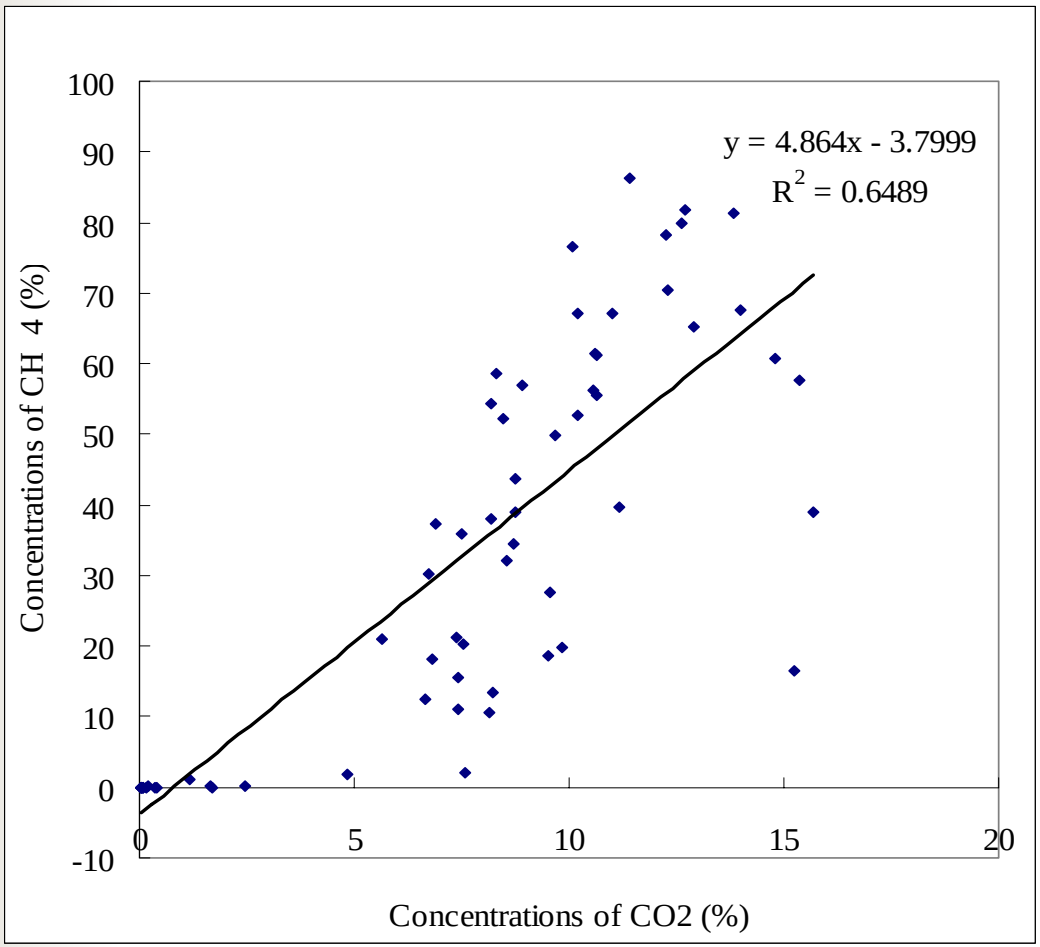
Depth Profile of CO_2 Concentrations



Variations in CO2 below 50cm from the surface of this peatland was less than in methane.

CO2 was detected regardless of the existence of methane.

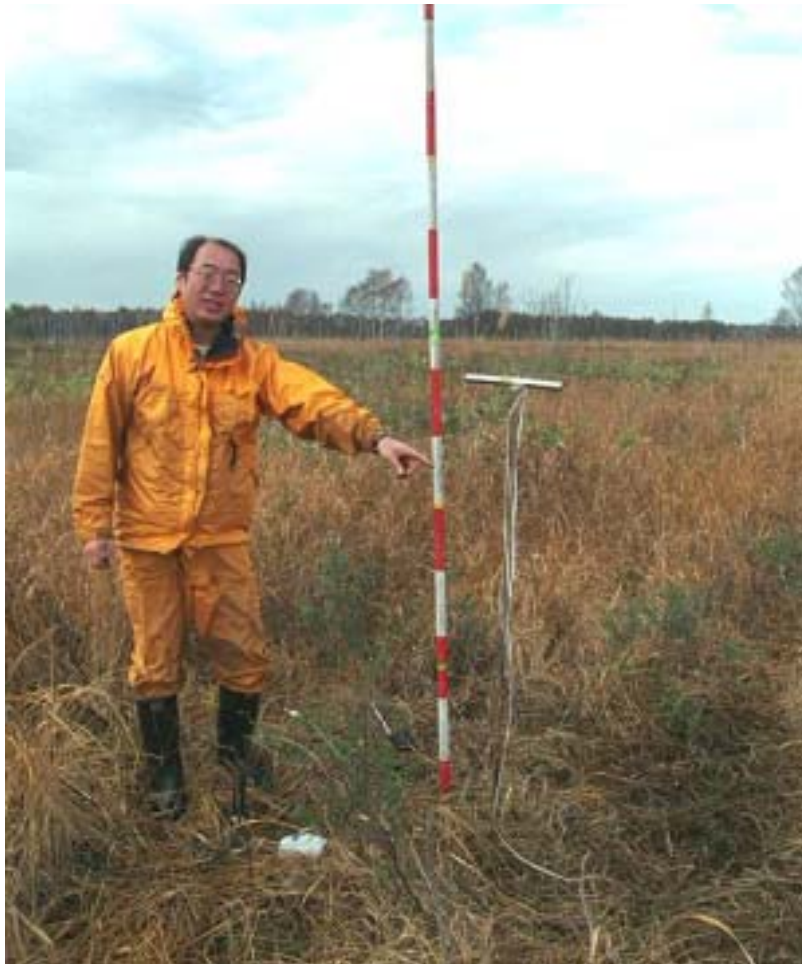
The Relationship between Concentrations of CH_4 and CO_2



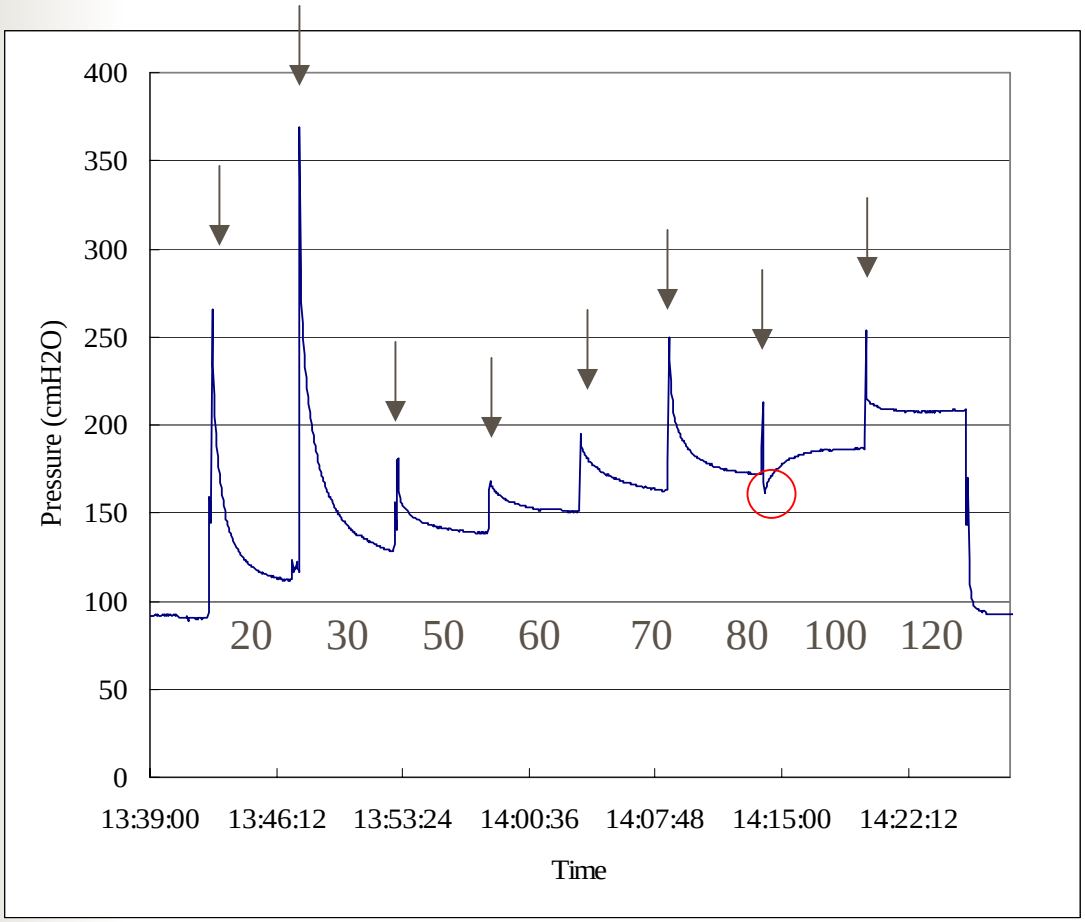
This figure shows a significant relation-ship between CO2 and methane.

☆This relationship suggest that methane fermentation may occur.

A Metal Pole Connecting to the Diver



Time Series of Total Pressure with Gradual Insertion of the Diver into Peat Layers -location 18



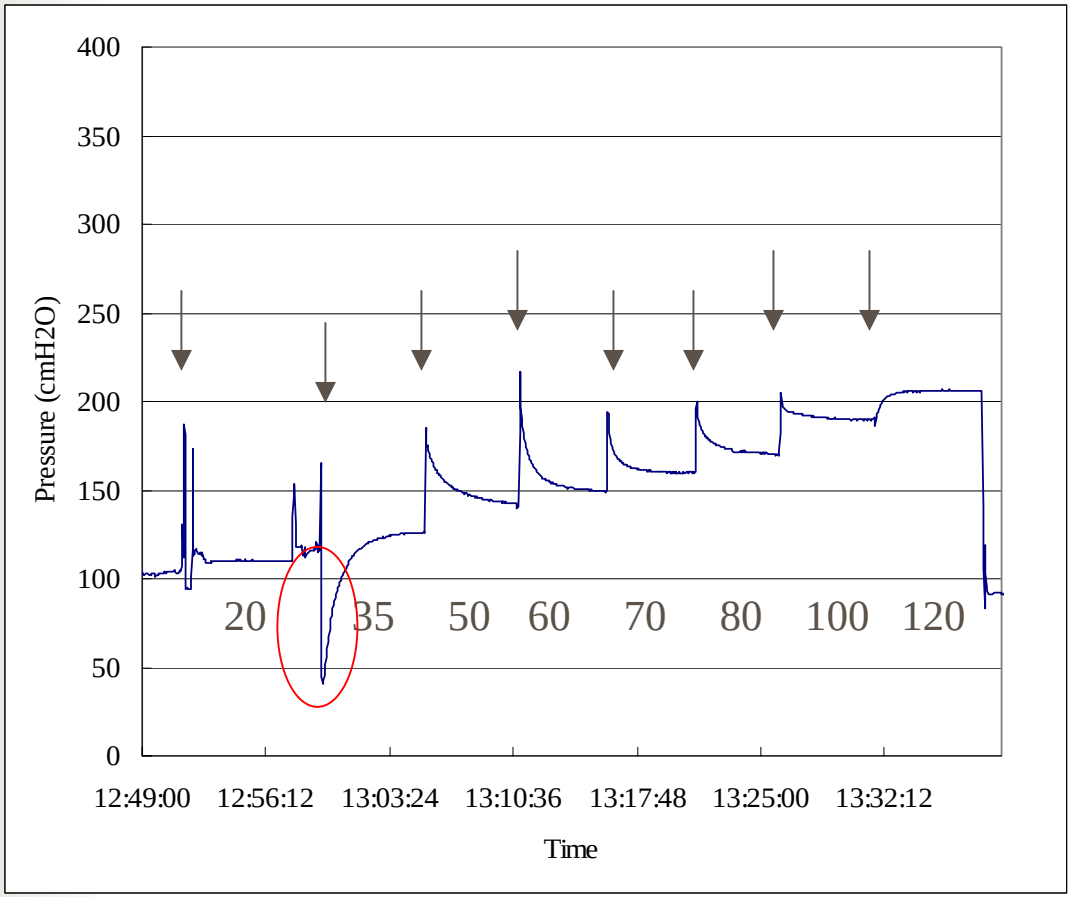
Water Table Level: 8.1cm

Ground Vegetation: *Sphagnum spp. Carex spp.*

Shrub Vegetation: *Sasa palmata*

Inserted depth	Equilibrated pressure
0	90.4
20	101.2
30	108.83
50	134.93
60	148.65
70	153.9
80	166.39
100	186.39
120	207.67

Time Series of Total Pressure with Gradual Insertion of the Diver into Peat Layers -location 20



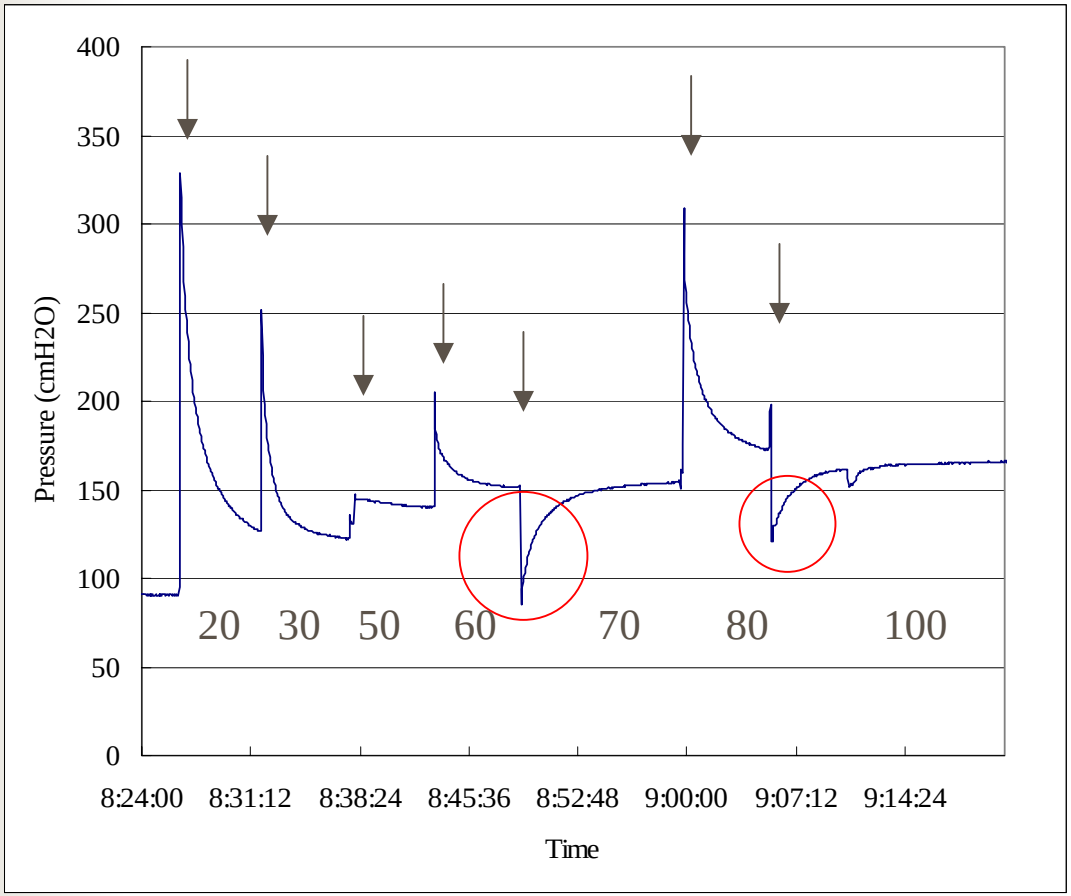
Water Table Level: 6.6cm

Ground Vegetation: *Sphagnum spp. Carex spp.*

Shrub Vegetation: none

Inserted depth	Equilibrated pressure
0	91.5
20	110.16
35	125.68
50	136.02
60	148.27
70	159.46
80	169.59
100	188.91
120	206.08

Time Series of Total Pressure with Gradual Insertion of the Diver into Peat Layers -location 22



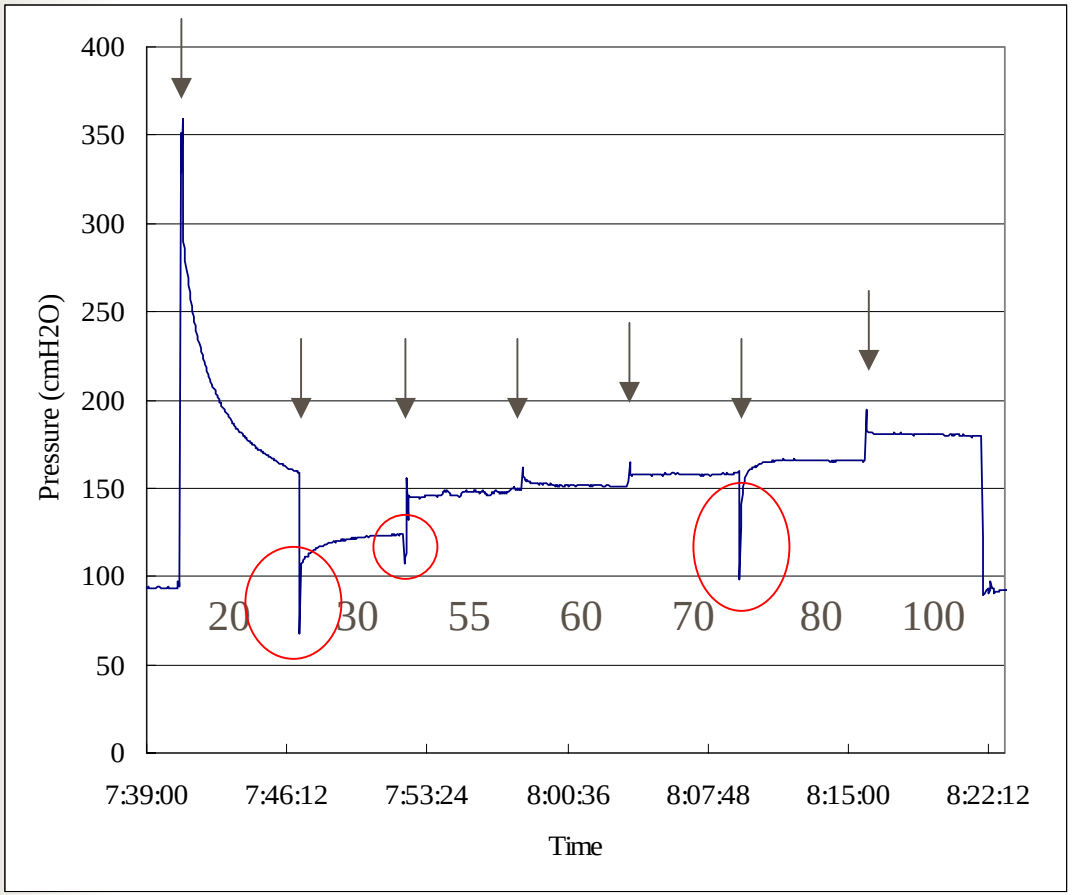
Water Table Level: 2.3cm

Ground Vegetation: *Sphagnum spp. Carex spp.*

Shrub Vegetation: none

Inserted depth	Equilibrated pressure
0	90.5
20	111.36
30	120.776
50	140.3
60	149.55
70	159.61
80	165.58
100	165.8

Time Series of Total Pressure with Gradual Insertion of the Diver into Peat Layers -location 24



Water Table Level: 6.8cm

Ground Vegetation: *Sphagnum spp.*

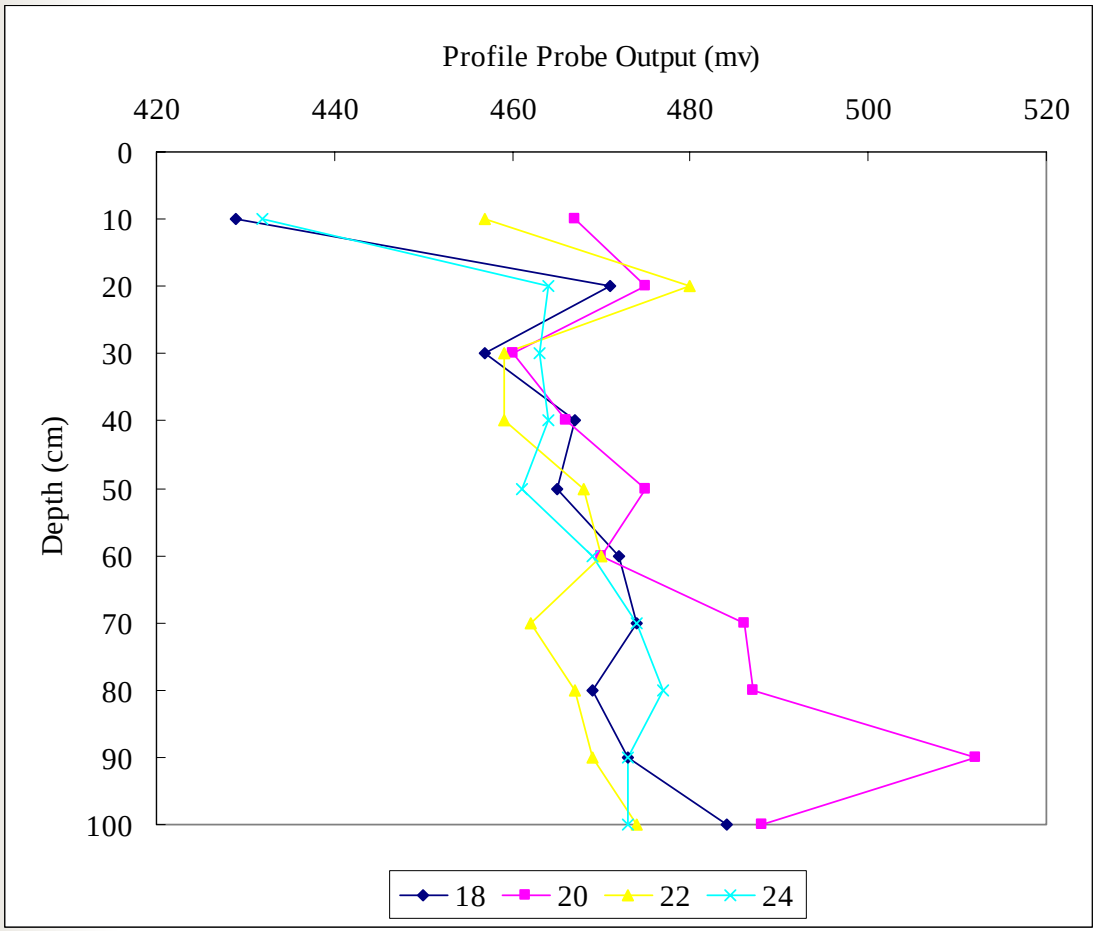
Shrub Vegetation: *Vaccinium oxycoccus, Myrica gale var. tomentosa, Rhus trichocarpa*

Inserted depth	Equilibrated pressure
0	93.5
20	-
30	126.93
55	149.3
60	150.9
70	158.1
80	165.4
100	179.7

Profile Probe

Profile Probe

Original Outputs

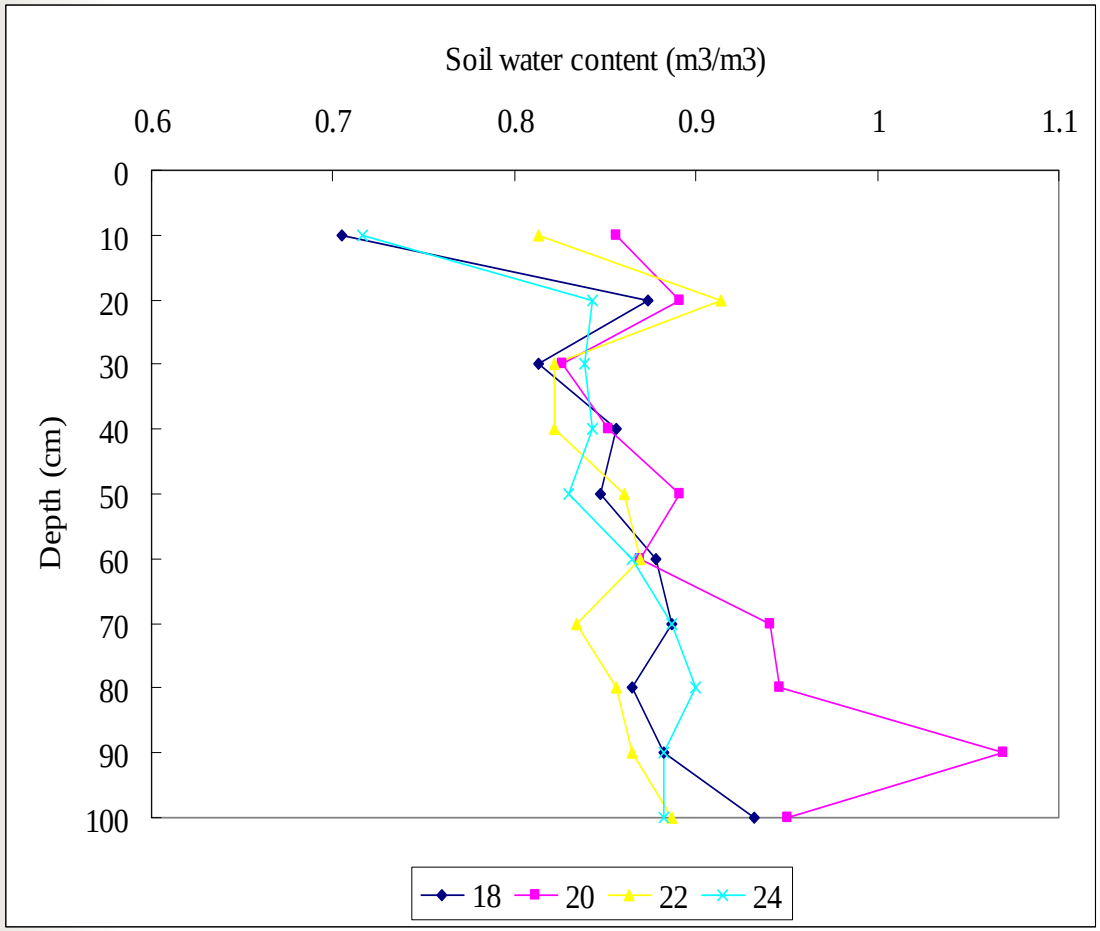


Values measured at location 20 appeared to be larger than those at other measuring points.

☆Lower values at depths of 10cm may result from the effect of closer water table.

Profile Probe –Conversion to Soil Water Content

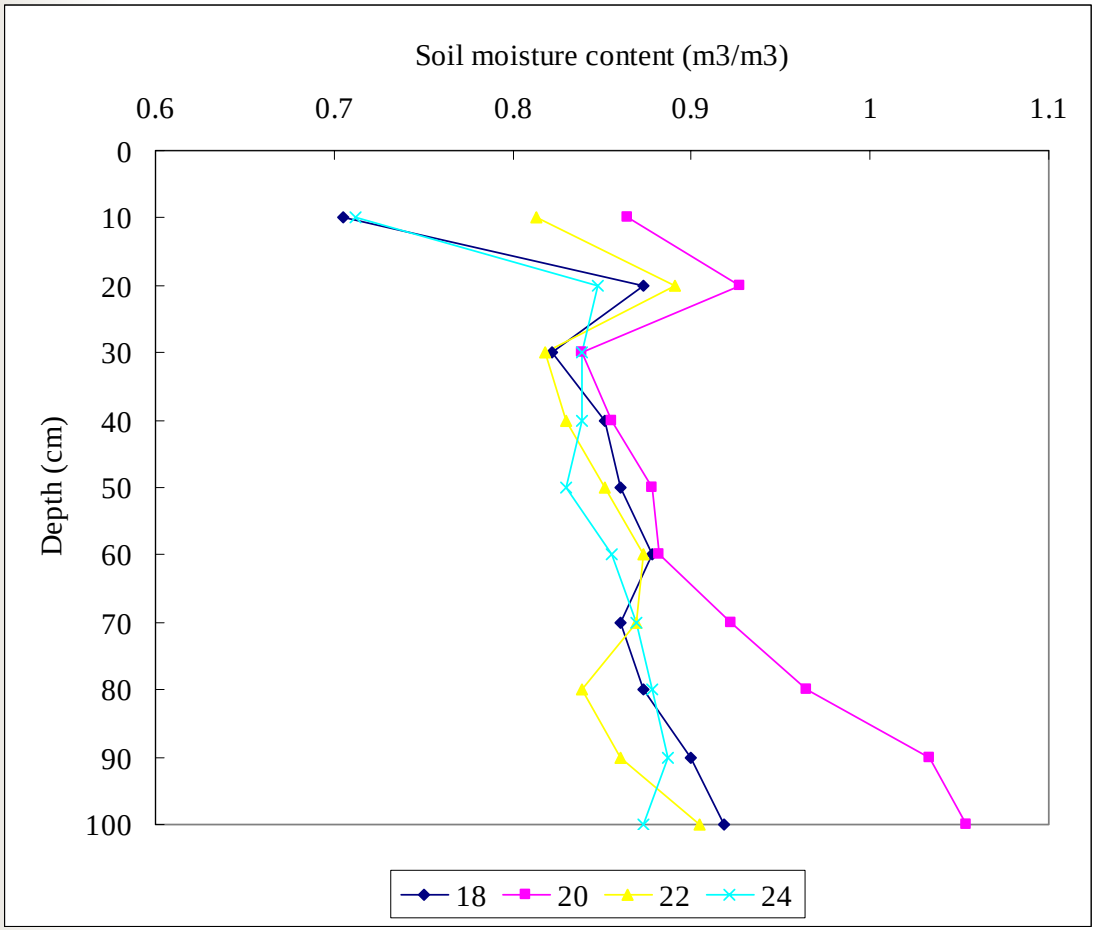
Water Content –the first measurement



☆Values of more than 1 (100%) in volumetric water content indicates that the general conversion equation described in the user manual for the Profile Probe can not be applied to this peat .

Profile Probe –Conversion to Soil Water Content

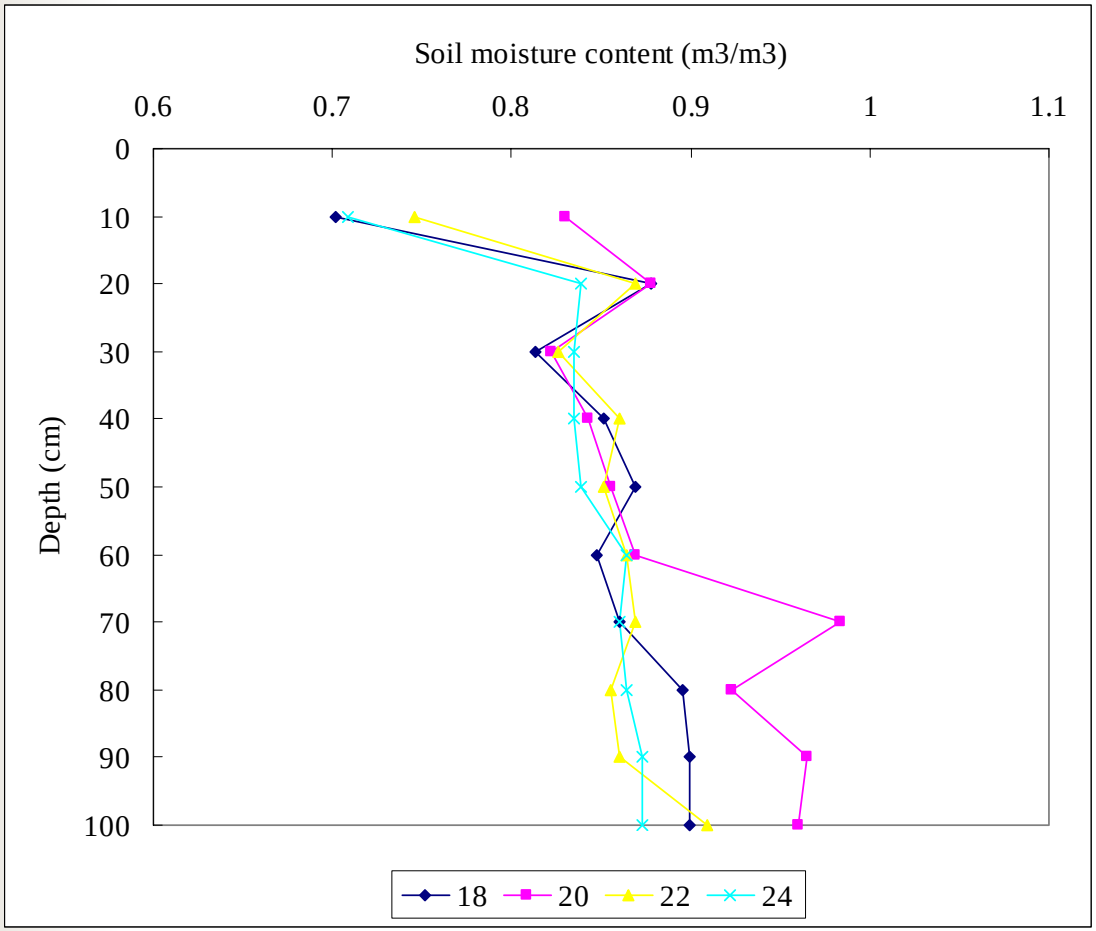
Water Content –the second measurement



Significant differences are observed between the first measurement and the second measurement at location 20.

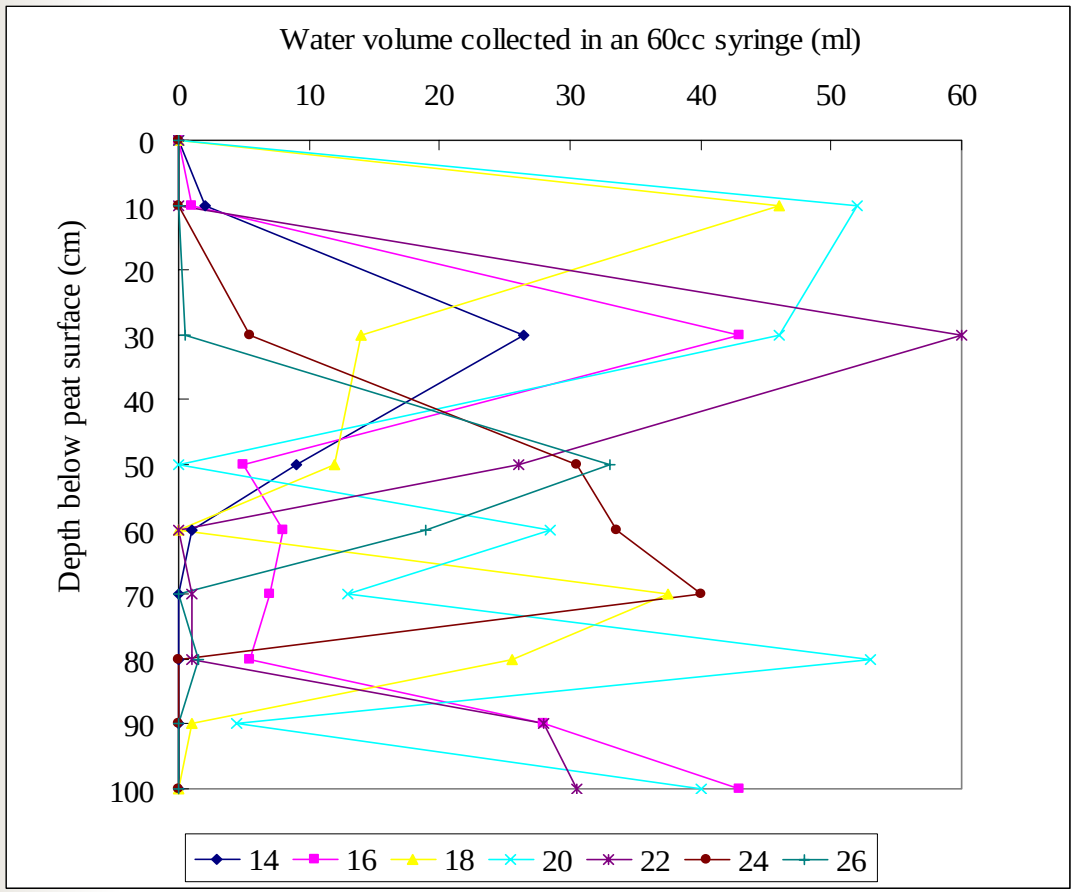
Profile Probe –Conversion to Soil Water Content

Water Content –the third measurement



Significant differences are observed between the second measurement and the third measurement at location 20.

Volume of Water Collected in MGC 1



Depth variations in water volume in MGC were extremely wider compared to depth variations in Profile Probe outputs.

Relative high ratio of water to gases at location 20 seems to be consistent with the observations in Profile Probe.

Volume of Water Collected in MGC 2