

Soil Organic Matter  
Its Characteristics and Roles in  
Agricultural Environments  
Part 1

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Wise-being in the forest told ....



# Homo ab Humo

- Human was born from a rich soil containing large amount of
- **Human – Humus – Humidity**  
There is a profound connection between human, humus, and humidity.
- Sleeping mind of human “Terra as the mother”

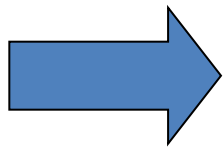
# Do you feel soil dirty?

Take a clod of soil  
into your hand,  
watch and smell it.



# We will be relieved by such soils:

- Black soil
- Soft soil
- Good smelling soil
- Soil in which small worms are living

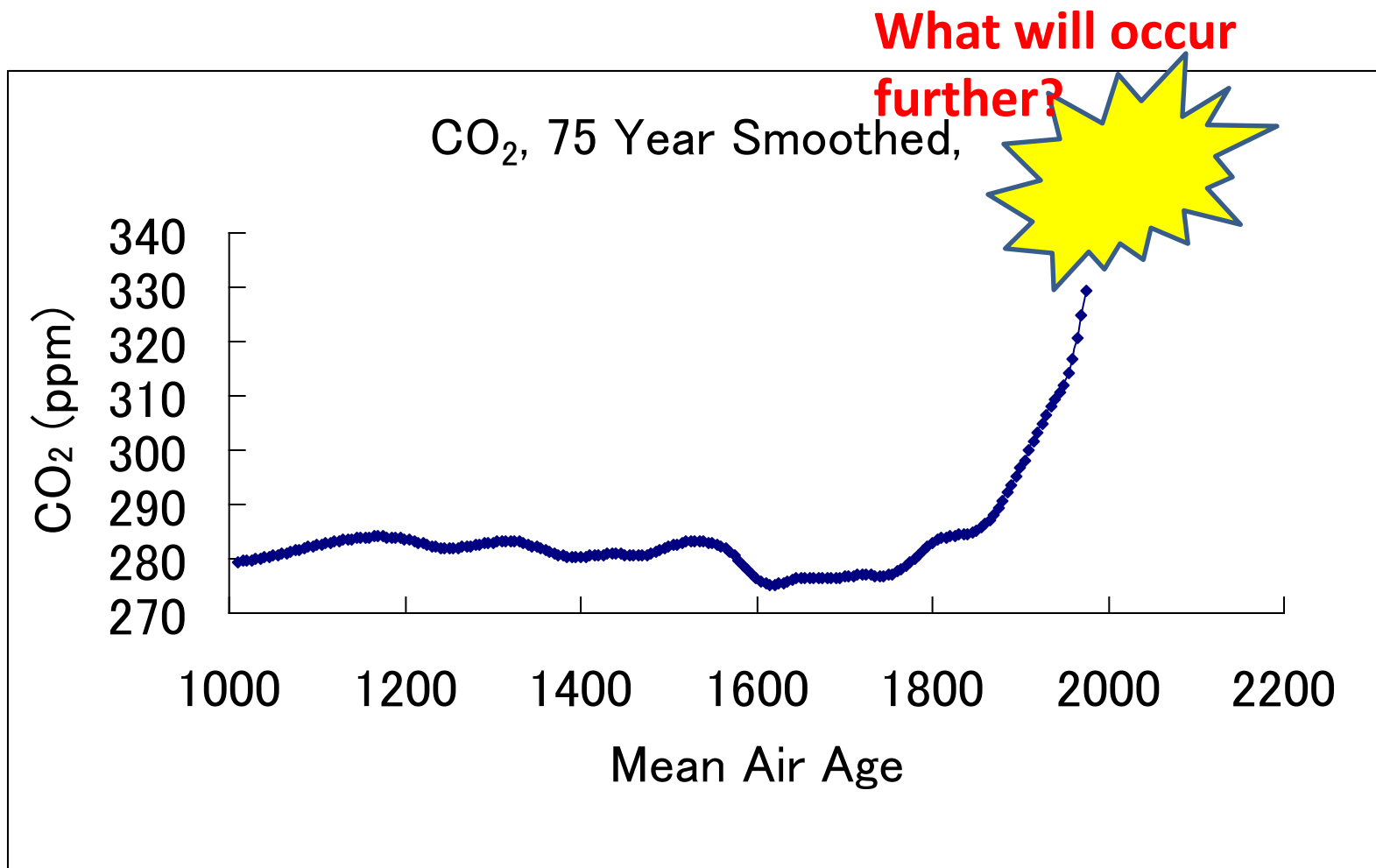


Such soils contain a suitable amount of organic matter.

Soil breeds life.

Evidence for this fact is

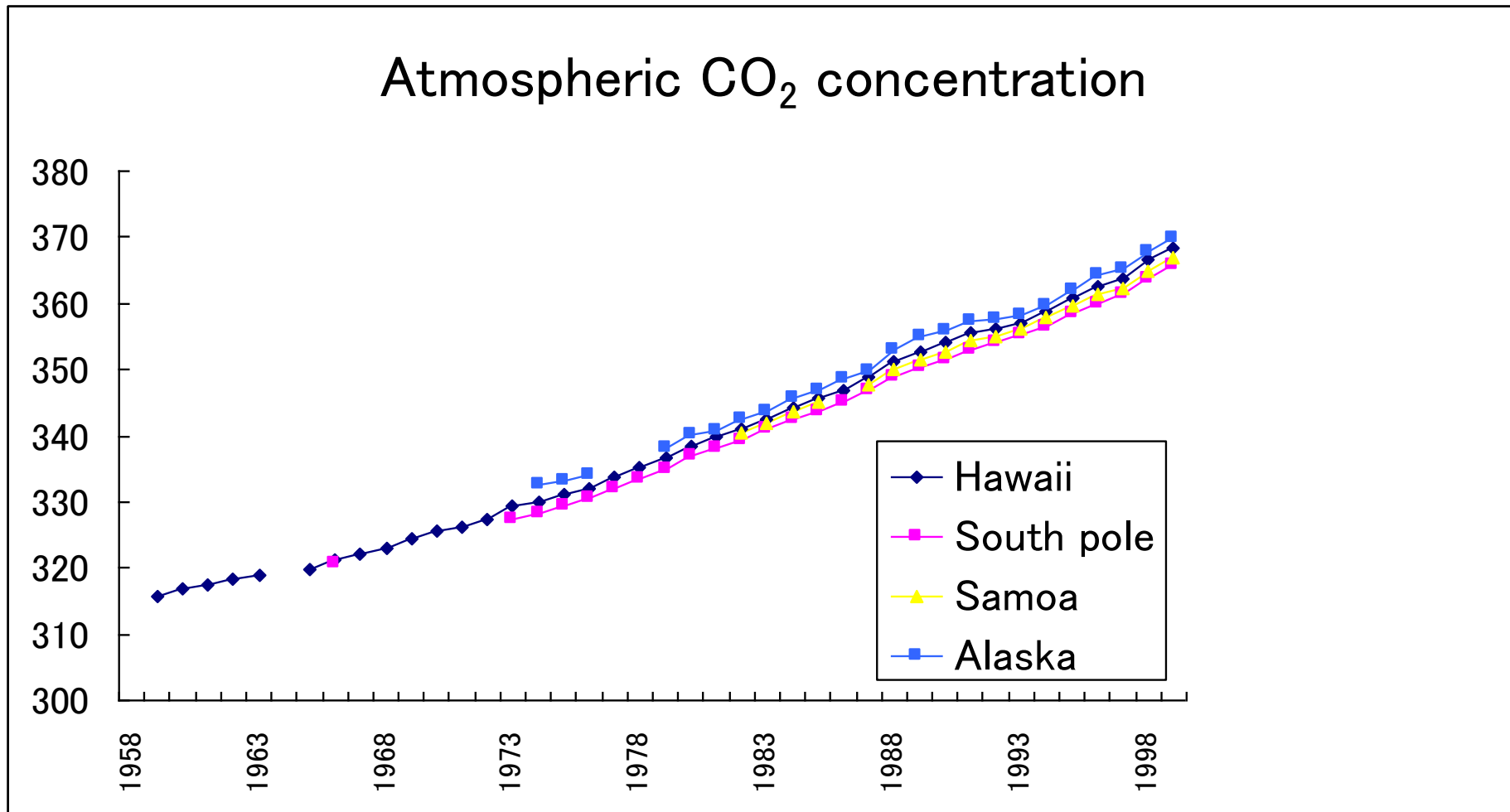
Soil Organic Matter.



**Change in ambient CO<sub>2</sub>**

**(Ice-core data of antarctics)**

# Increase in atmospheric CO<sub>2</sub> concentration



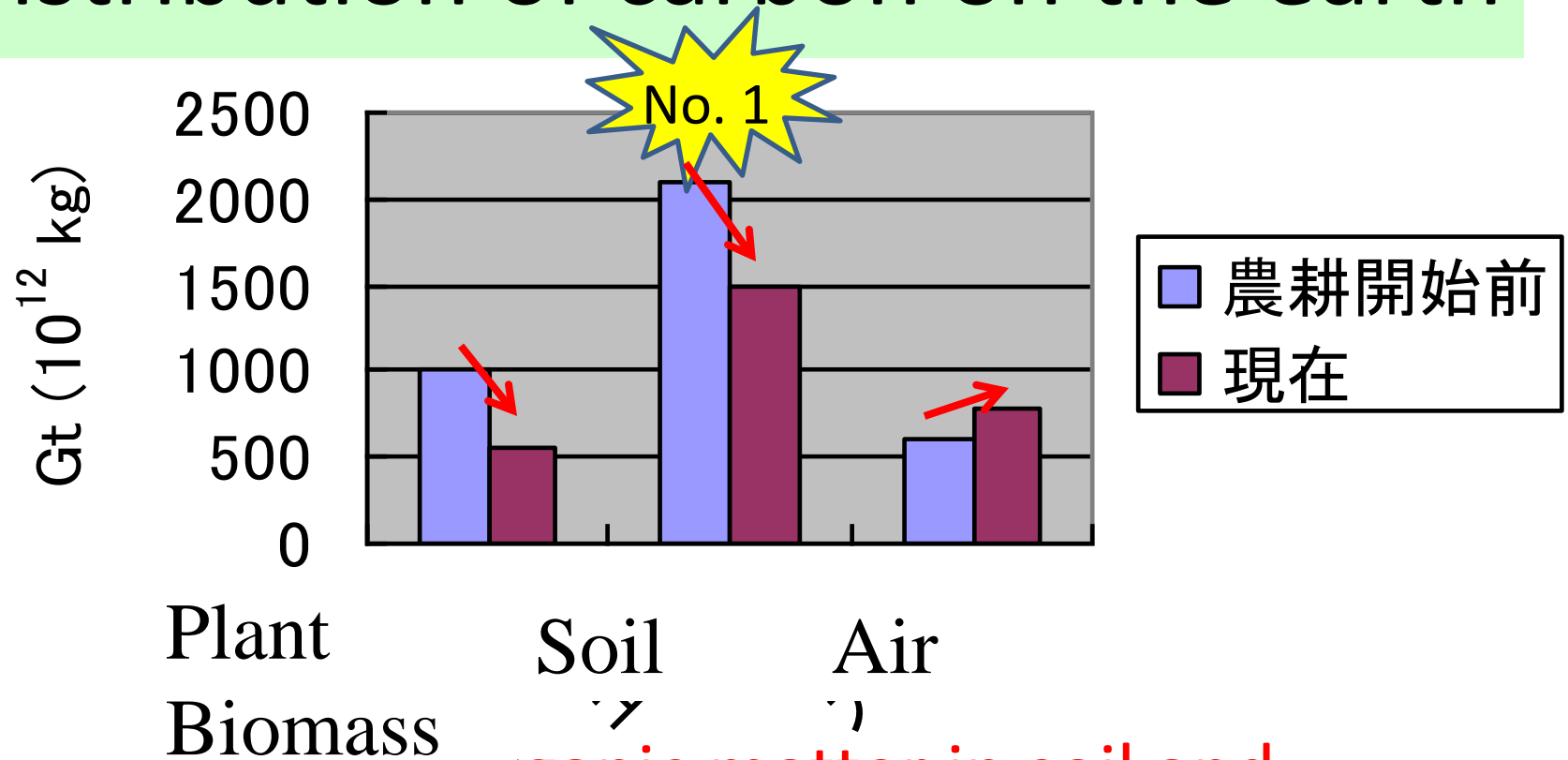


# Stocks of carbon on the surface of earth

Stock pools		Stored amount
		10 <sup>12</sup> kg
Earth		
Plant biomass		550
Soil humus		1500
Atmosphere	1850 (CO <sub>2</sub> 260 ppm)	560
	1890 (CO <sub>2</sub> 290 ppm)	630
	2000 (CO <sub>2</sub> 390 ppm)	820
Ocean		
Carbonate salts		20x10 <sup>6</sup>
Dissolved organic matter		600
Solid suspension and sediments		3000
Earth crust (fossil fuel)		4000
<b>Total amount</b>		<b>44800</b>

Hunt(1972), Paul and Clark(1989), Eswaran et al.(1993)  
 CO<sub>2</sub> concentration was calculated from ice-core data  
 in Law Dome Antartics.

# Distribution of carbon on the earth



植物バイオマス

Organic matter in soil and vegetation decreased remarkably due to civilization.

# Humic substance is

- The most abundant organic matter on the earth surface. As carbon amount

1500 Gt ( $10^9$  t,  $10^{12}$  kg)

- 3 times more abundant than plant biomass
- 2 times more abundant than  $\text{CO}_2$

2100 Gt of humus carbon in pre-historic age.

# Biomass production and respiration/ combustion on the earth ( $10^9$ t/year)

	Biomass production	CO <sub>2</sub> formation
Plant	500	34.5
Animal	0.5	4.1
Human	0.1	0.7
Microbes	1.0	112
Wild fire		6.9
Volcano		0.15
Factory		15
Total	502	173.5

## Emission of CO<sub>2</sub> due to human activity

Factors	Increase rare of CO <sub>2</sub> carbon
	Gt (10 <sup>9</sup> t)/year
<b>Fossil fuel combustion</b>	7
<b>Land use change</b>	2.2

# Land-use change

Forest clearing

Slash and burn

Grassland to upland field



# Large amount of gas is emitted from soil surface



# World energy consumption (2003)

Source	Consumption (petroleum equivalent $10^8$ tons)	
Petroleum	36.4	85.5
Natural gas	23.3	
Coal	25.8	
Atomic	6.0	12.0
Hydraulic	6.0	

**CO<sub>2</sub> emission**

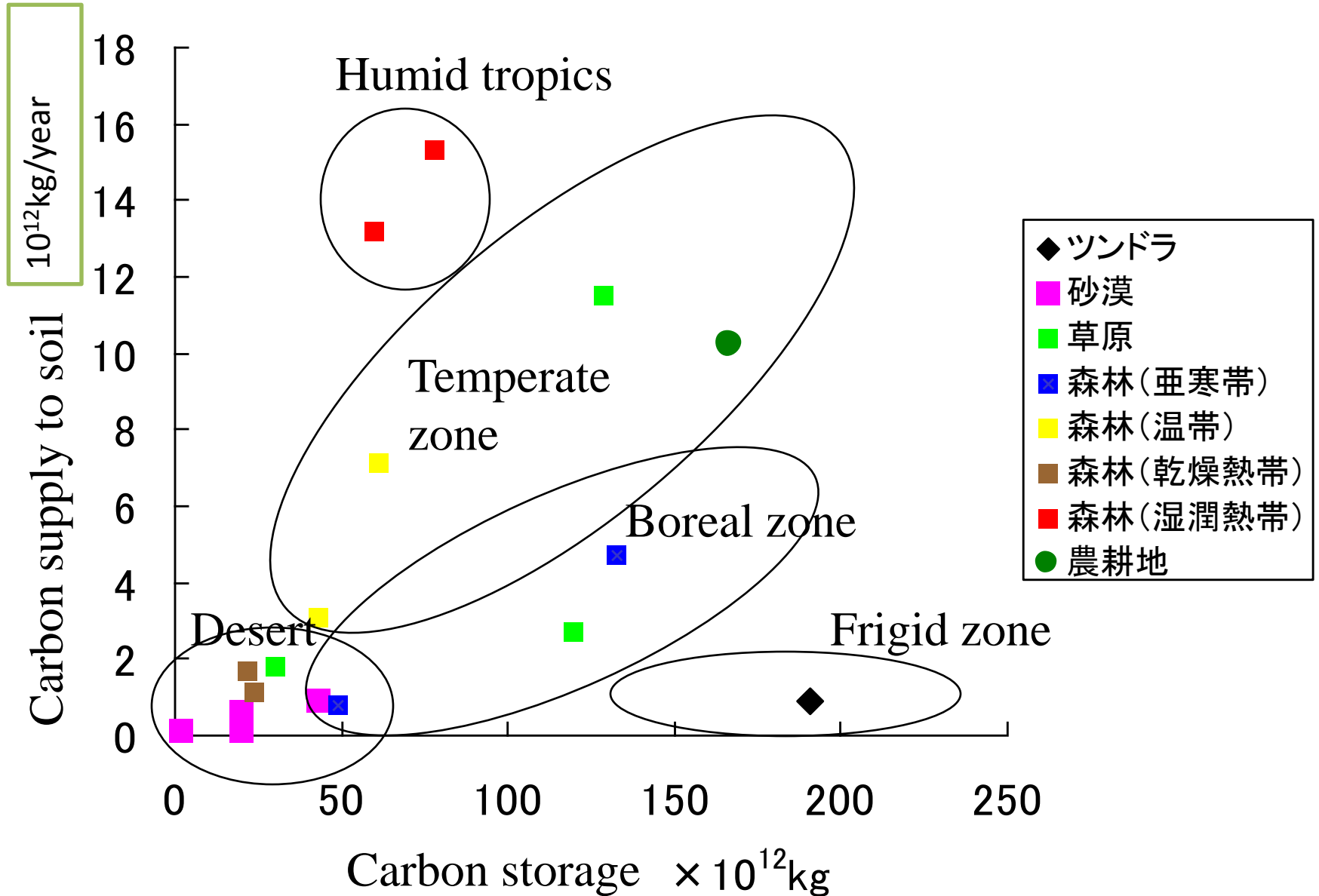
**heat emission**



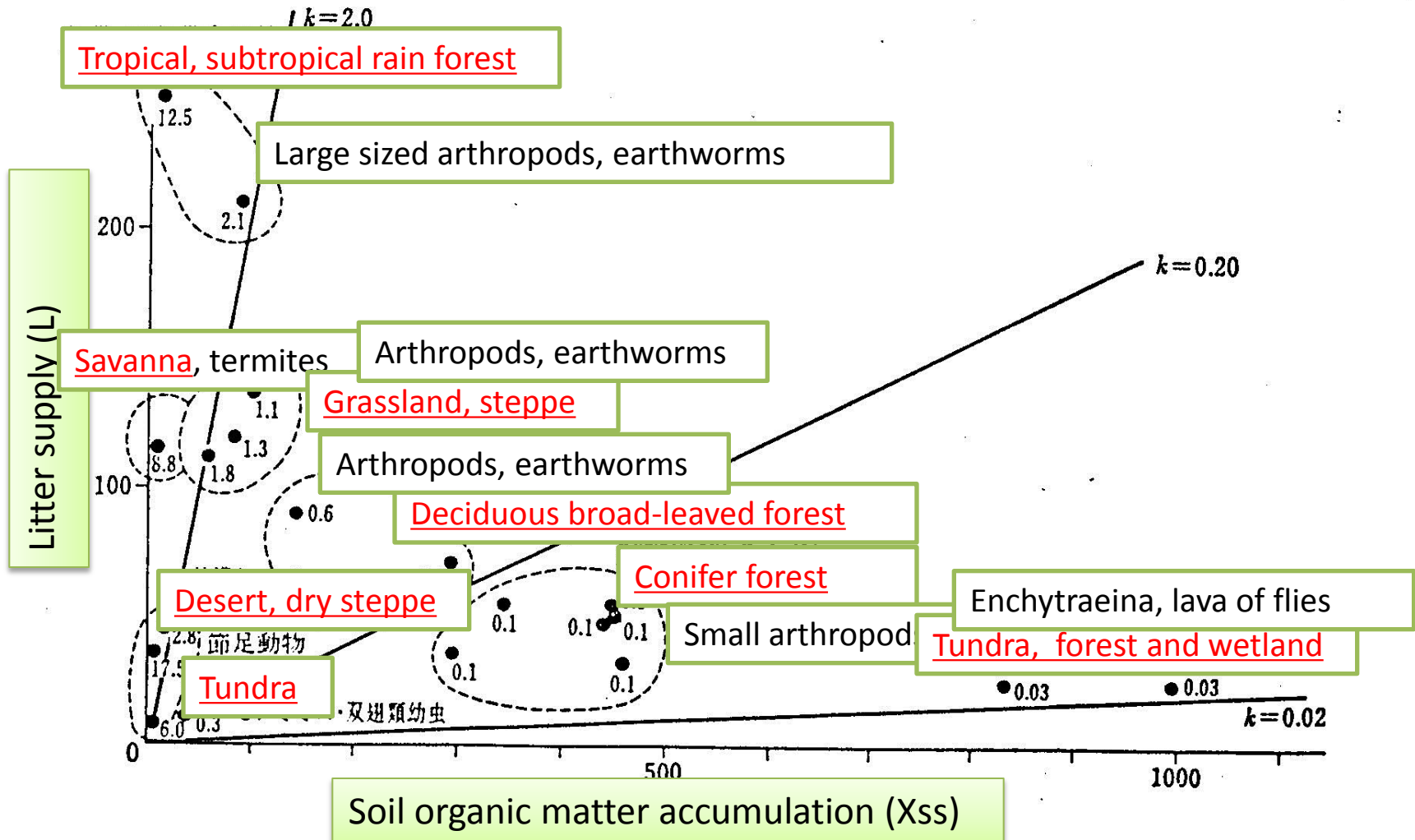
# Energy consumption per capita

- World 1.7 ton annually  
(petroleum equivalent)
- Japan 4.1 ton annually
- USA 8.0 ton annually
- Human activity causes the increase in atmospheric CO<sub>2</sub> concentration.
- Plant and soil absorb CO<sub>2</sub>.

# Supply and storage of carbon in soil



# Litter supply and SOM accumulation



主要な生態系型の落葉供給量, (L), 土壌有機物の蓄積 ( $X_{ss}$ ), 分解率  $k=L/X_{ss}$ , および主要な分解動物群 図中の数字はそれぞれの地点での k の値を示す。

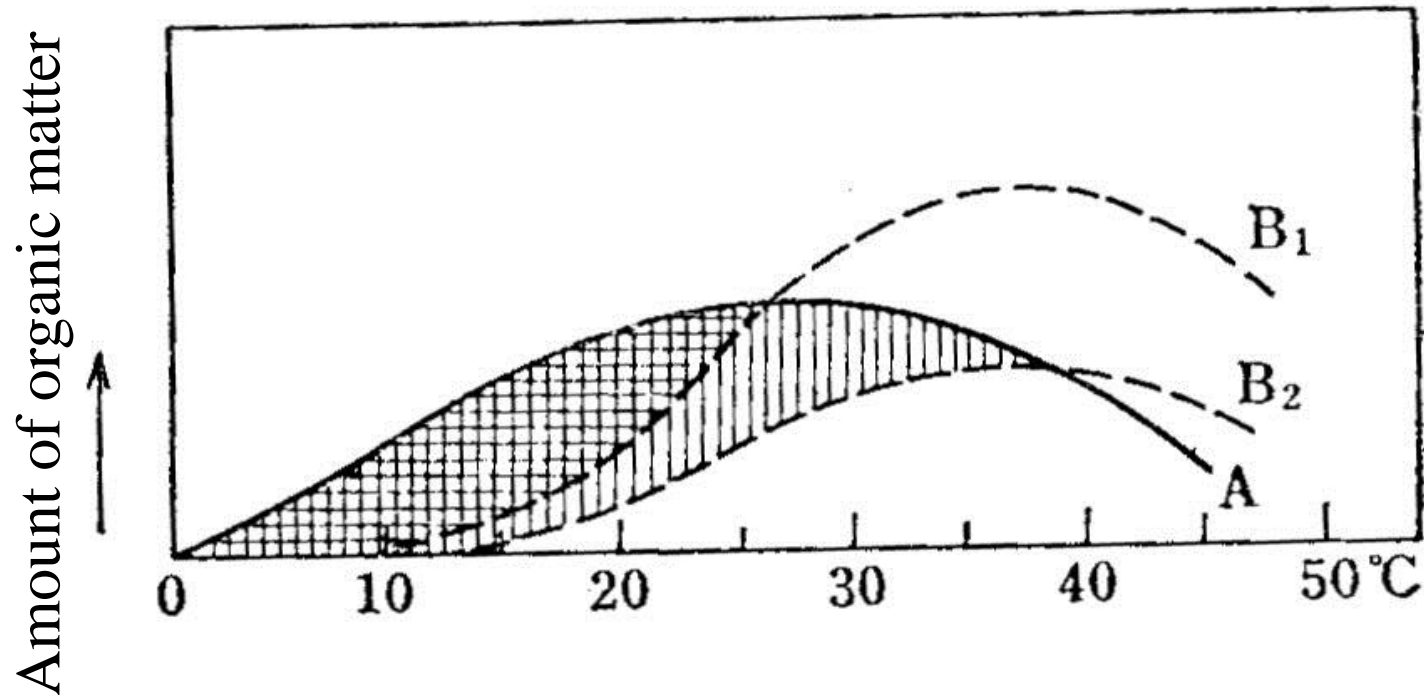
# Primary forest in Baybay, Leyte



# Primary forest soil profile in Baybay, Leyte



# Factors affecting SOM accumulation: temperature and moisture content of soil



 Aerobic upland soil

 Anaerobic flooded soil

**A** Organic matter production by plant

**B<sub>1</sub>** Organic matter decomposition in aerobic soil

**B<sub>2</sub>** Organic matter decomposition in anaerobic soil

## Amounts and Turnover Rates of C and N in the Microbial Biomass for Cultivated Soils for Three Locations

Soil and Location	Microbial C kg/ha	Microbial N kg/ha	C Inputs Mg/ha/yr	Nitrogen Flux through Microbial Biomass kg/ha/yr	Microbial Turnover Time yr
<b>Temperate</b>					
England	570	95	1.2	34	2.5
Canada	1600	300	1.6	53	6.8
<b>Tropical</b>					
Brazil	460	84	13	350	0.24