Soil Organic Matter
Its Characteristics and Roles in Agricultural Environments
Part 4

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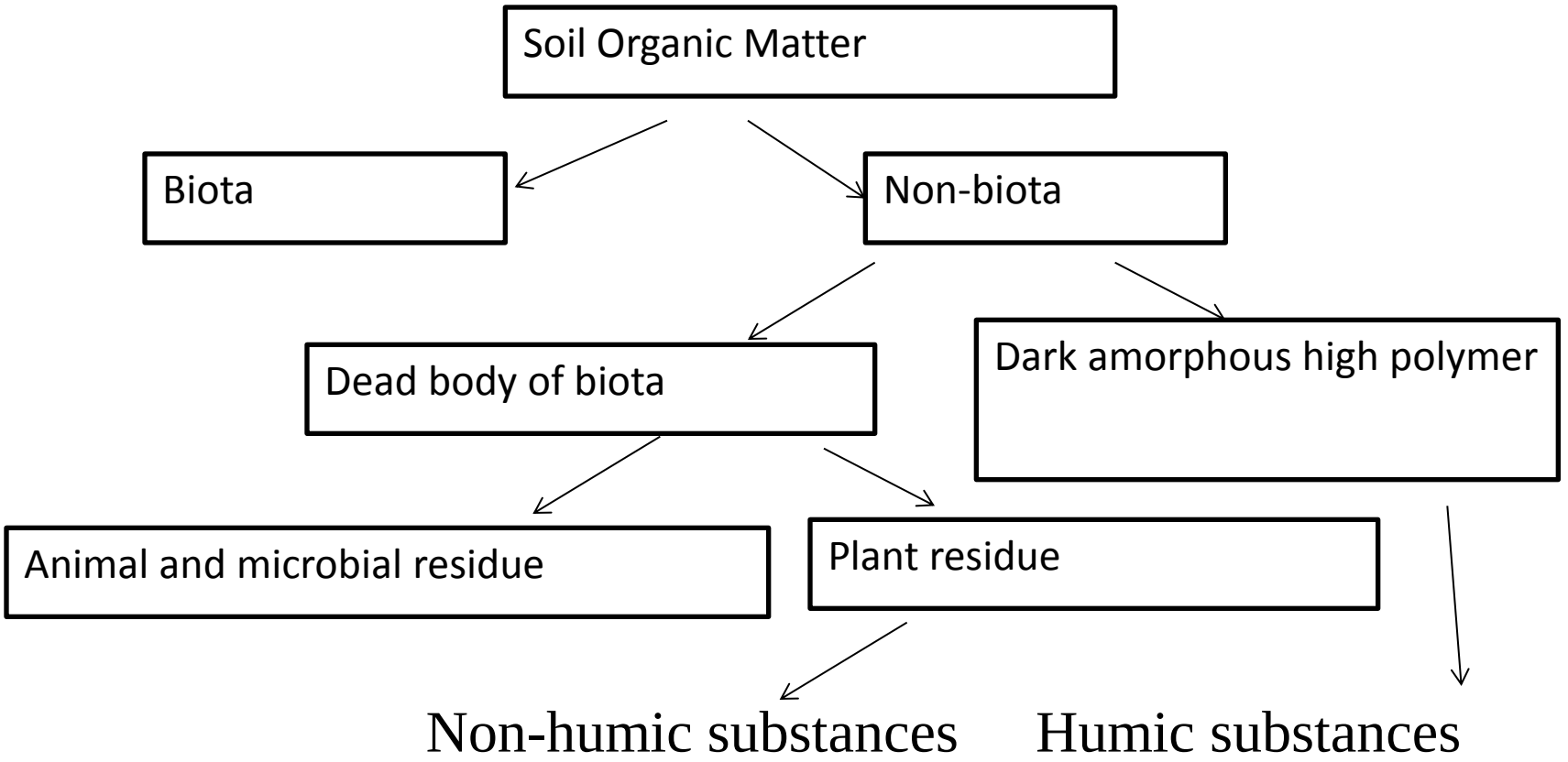
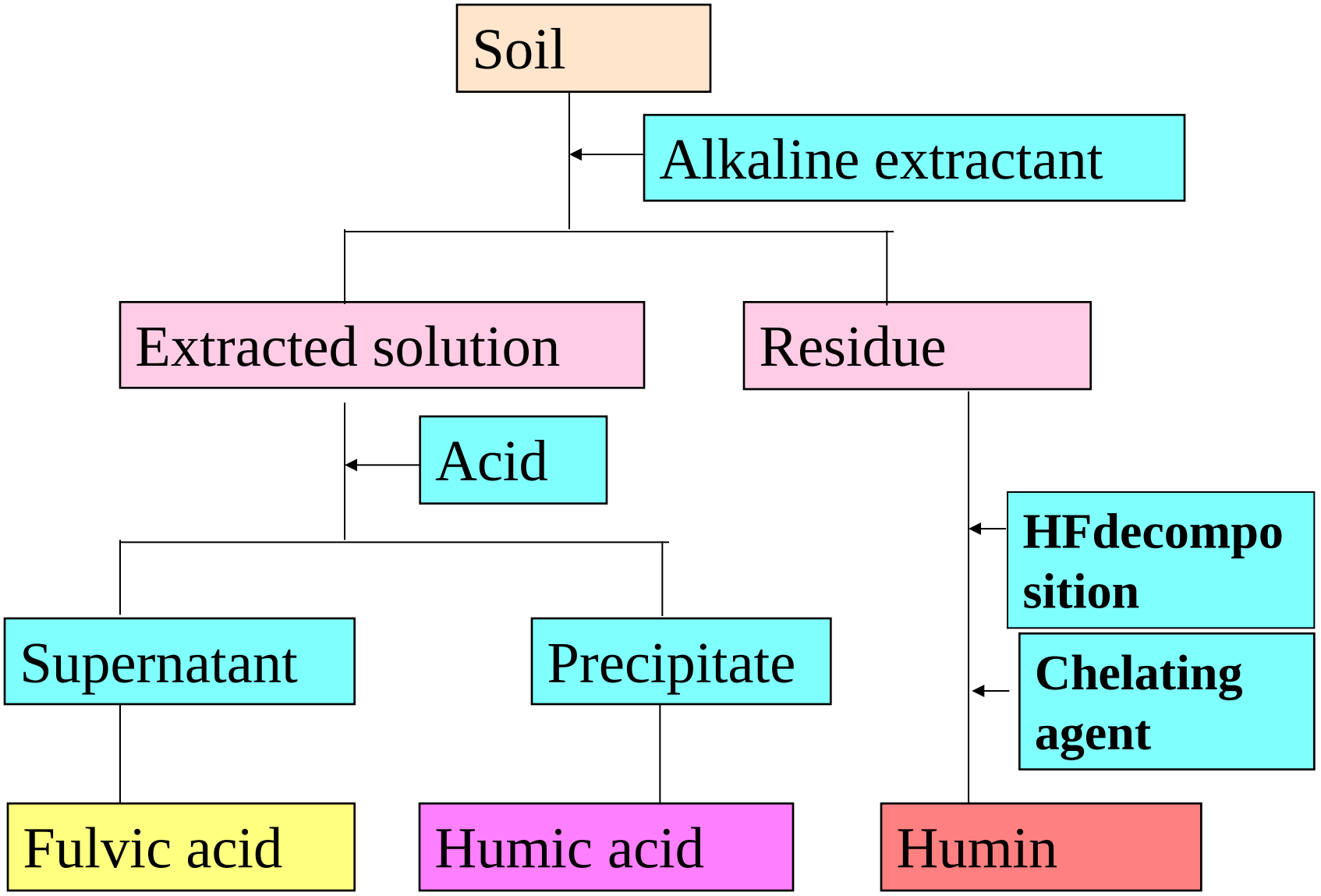
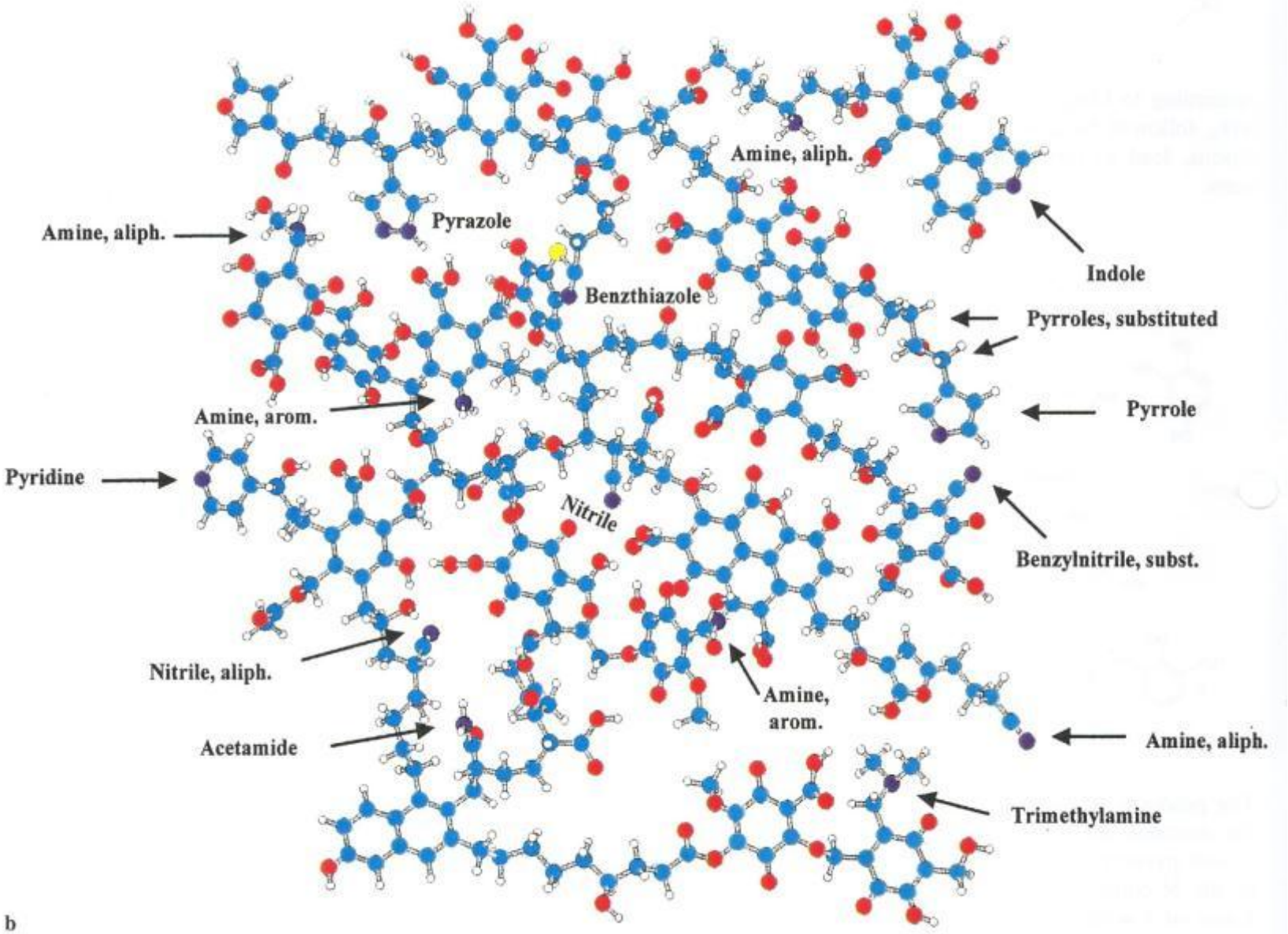
Characterization of soil organic matter



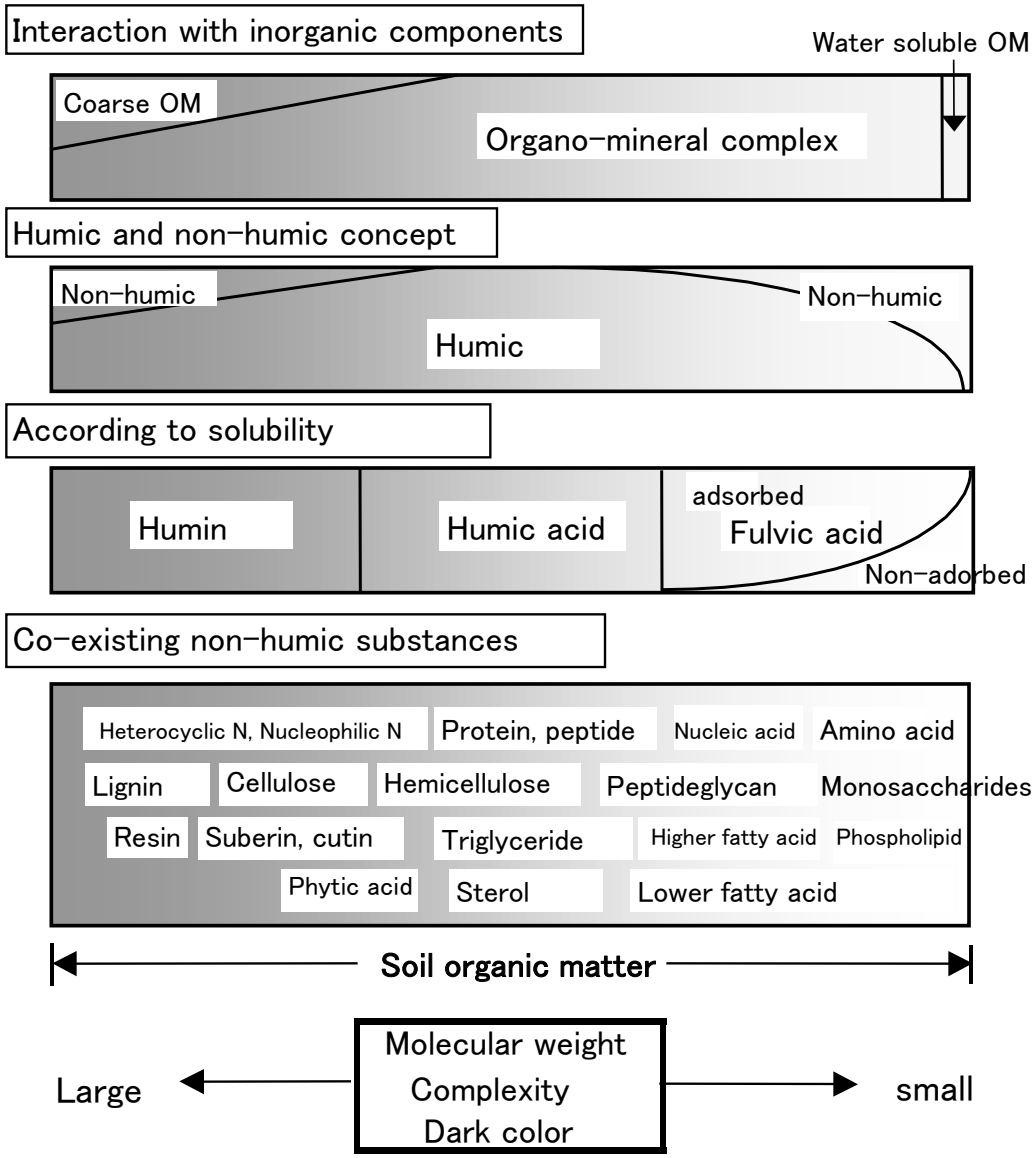
Division of soil organic matter（Takai, 1977）



Fractionation of humic substances



Proposed molecular structure of humic acid



Chemical composition of soil organic matter

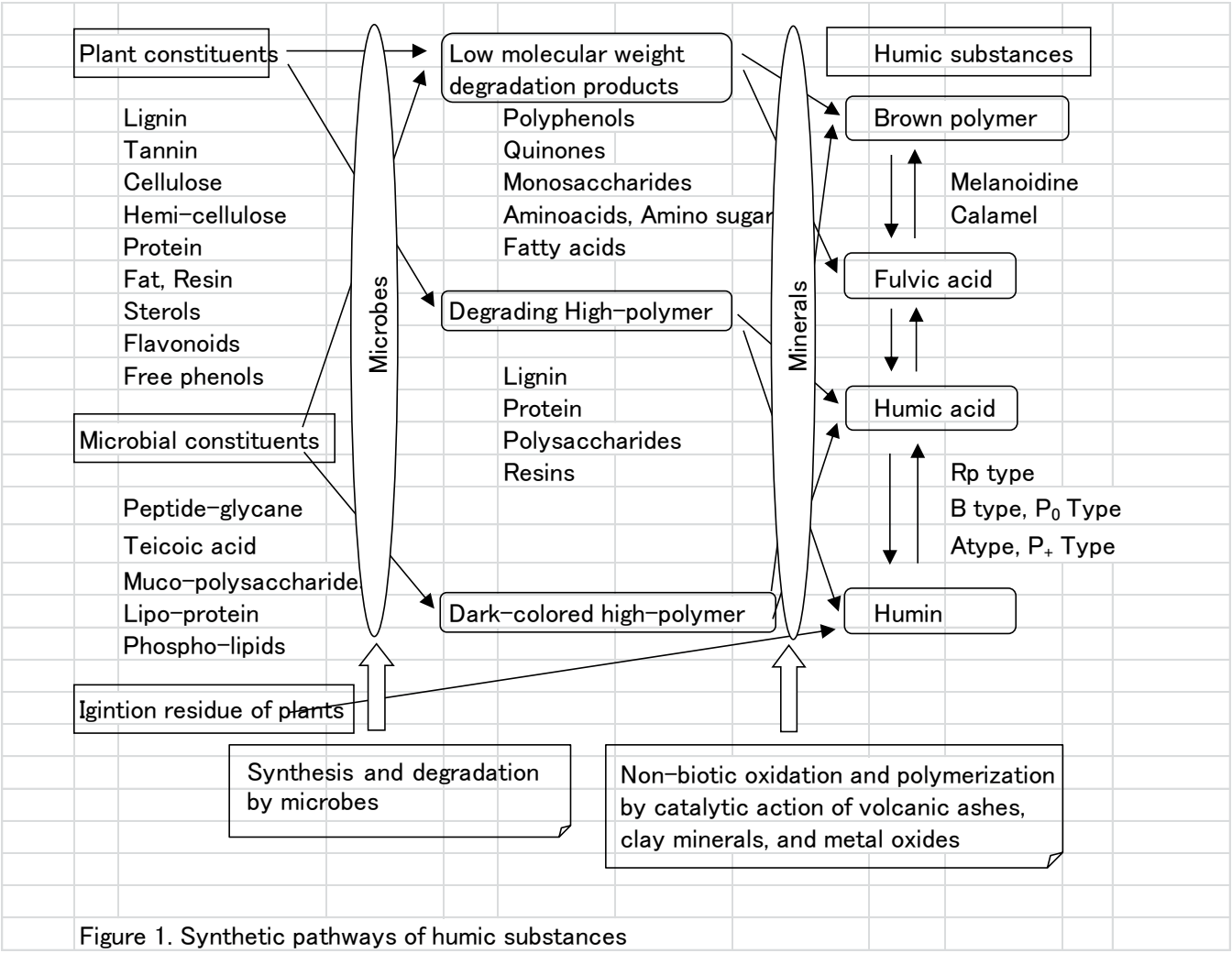


Figure 1. Synthetic pathways of humic substances

Free form OM

Not bound with minerals

Water soluble OM

Soluble in water

Fulvic acid

Soluble in acid and alkaline

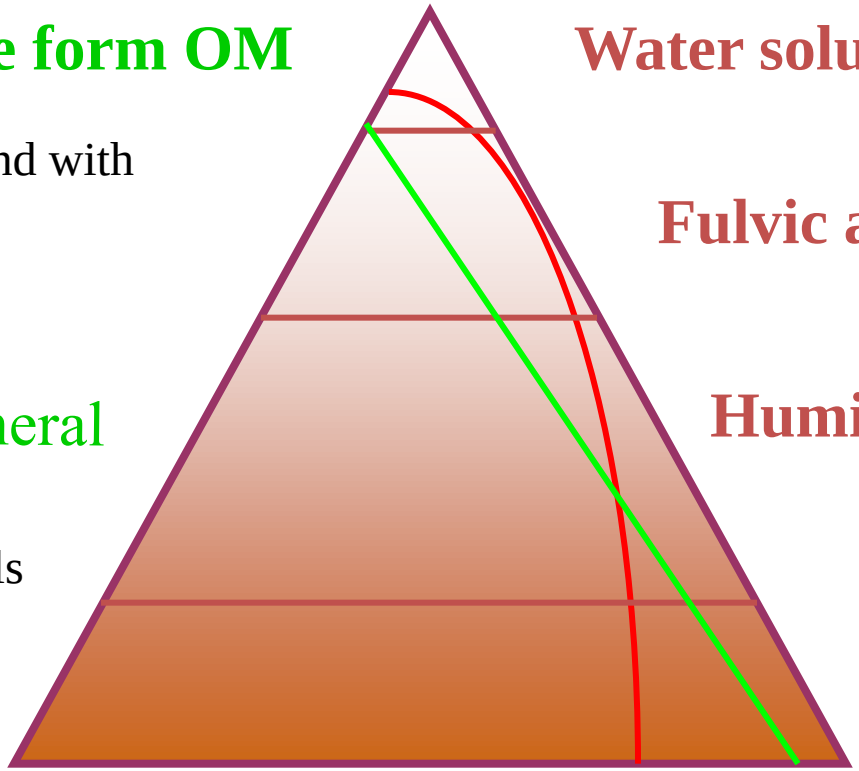
Humic acid Precipitate with acid

Organo-mineral complexes

Bound with minerals

Humin

Not soluble in alkali or acid



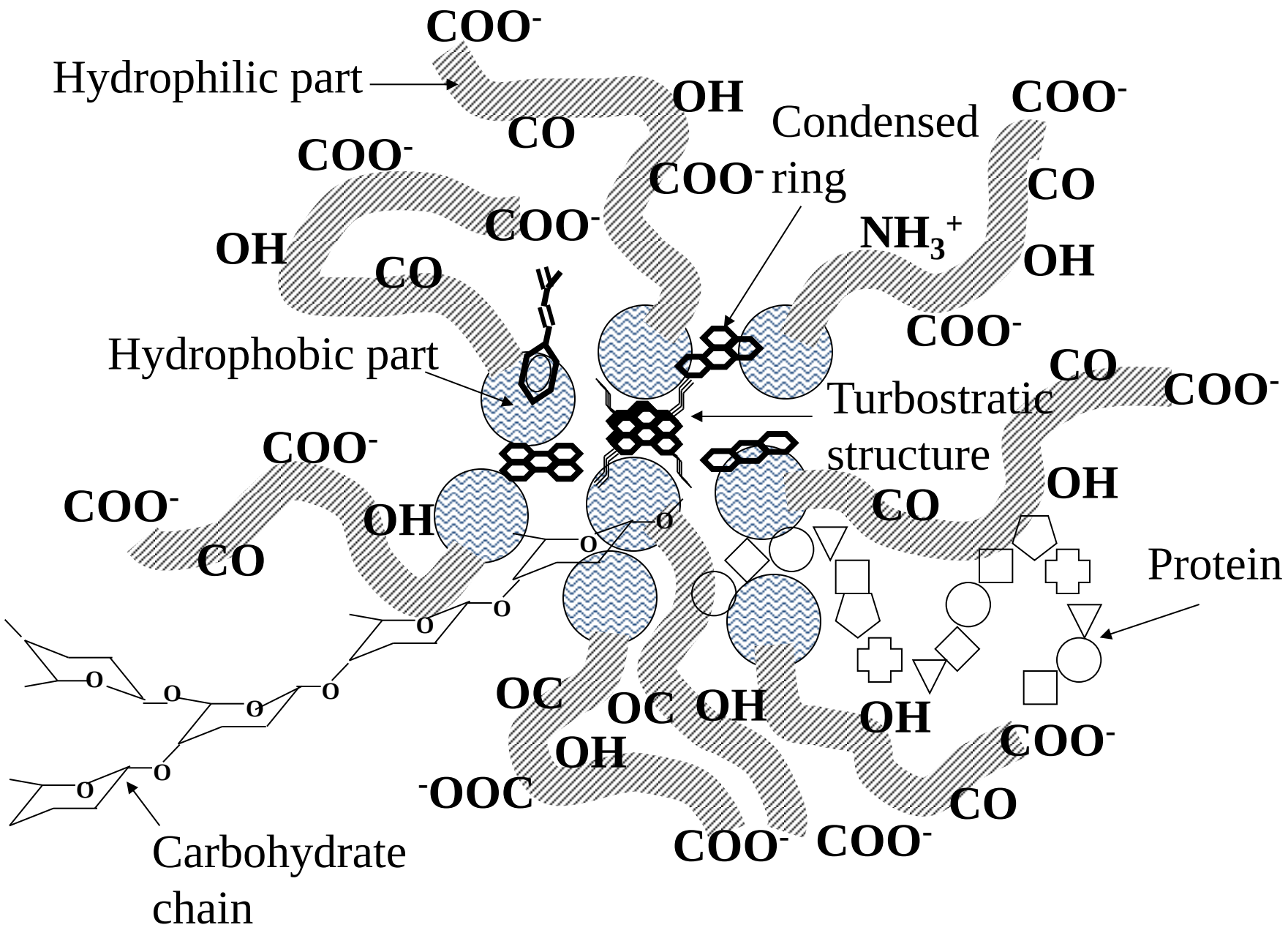
Humic substance

Dark colored, amorphous high polymer

Non-humic

OM with known structure

Concept on soil organic matter



Structural concept of humic substances

Synthetic expression of elementary composition of humic substances

- As indices for expressing elementary composition synthetically, following ratios are calculated. Elementary number is used in the calculation.

Combustion Quotient

- Combustion quotient (CQ) is a theoretical value for respiration quotient as proposed by Tamiya [5)]
- $CQ = 4C / (4C + H - 3N - 2O)$ ------ (1)

Degree of Unsaturation

- Degree of unsaturation (DU) shows the number of unsaturated bonds and ring bonds per 100 carbon atoms.
- DUH = (2C + N—H) / 2C ×100 ------ (2)

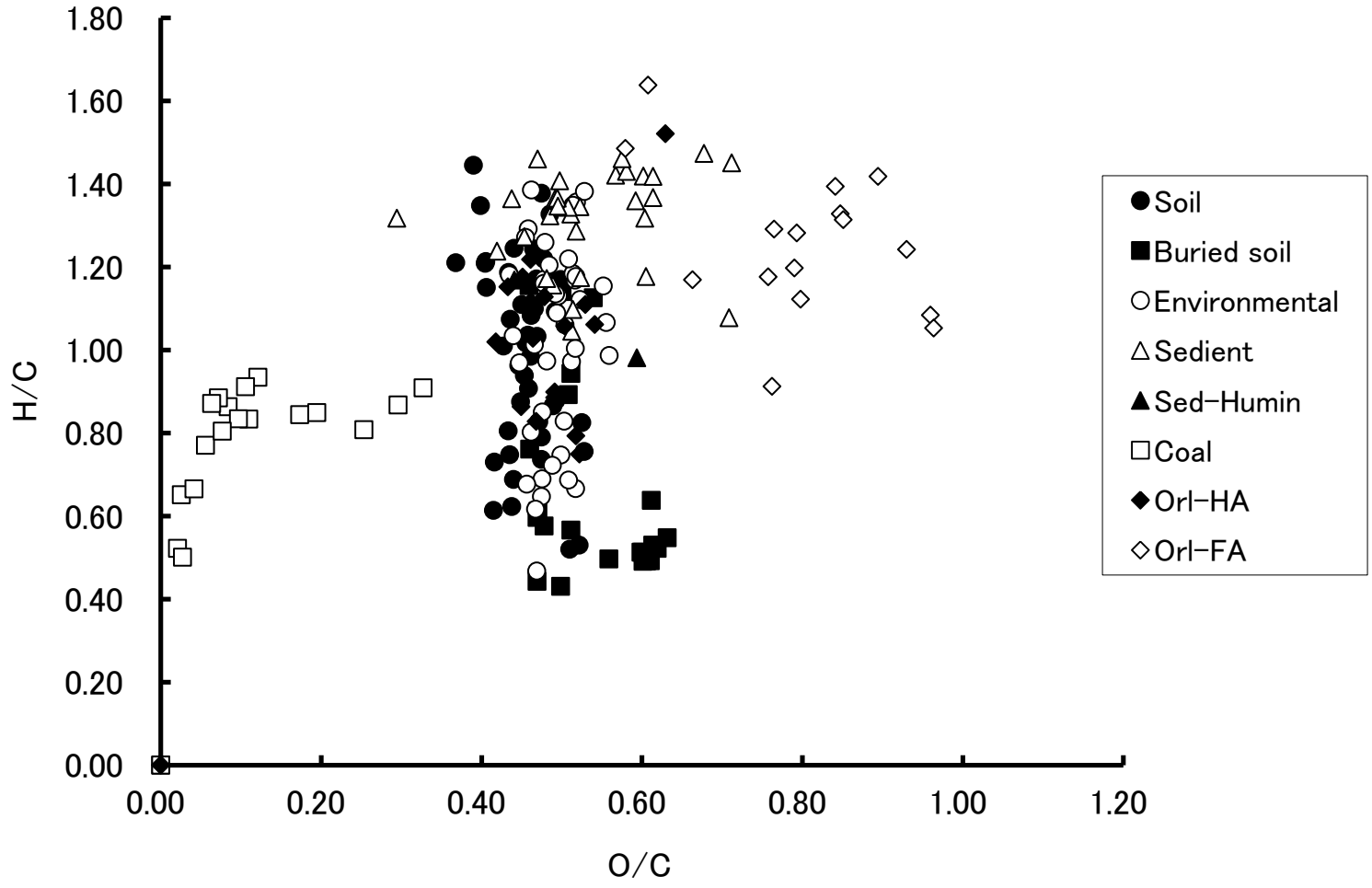
Degree of Oxidation (ω)

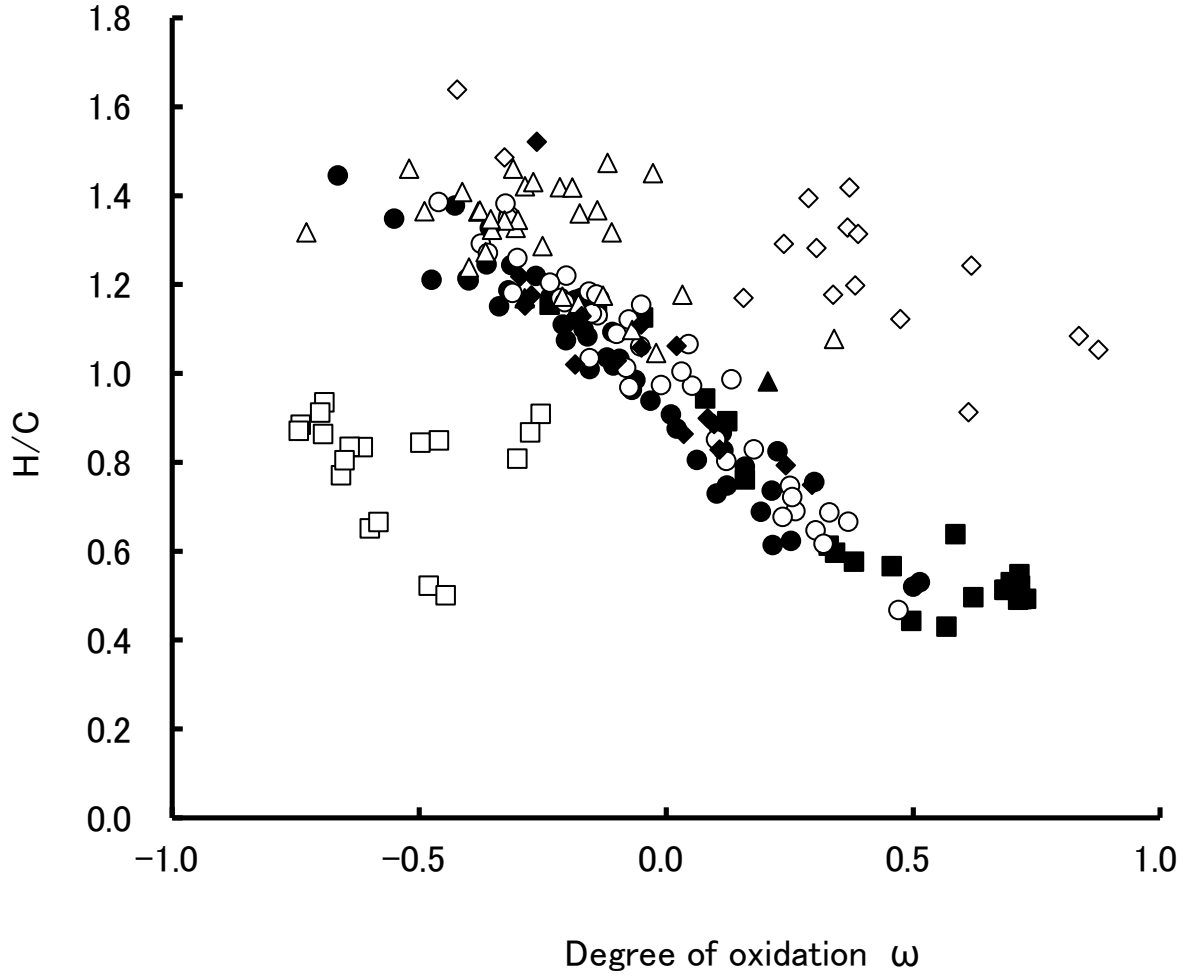
$\omega = (2O - H) / C$ ------ (3)

shows the excess or deficit of oxygen and hydrogen in comparison with $C_n(H_2O)_n$

- This value is distributed between −0.8 and +0.9 for humic substances.

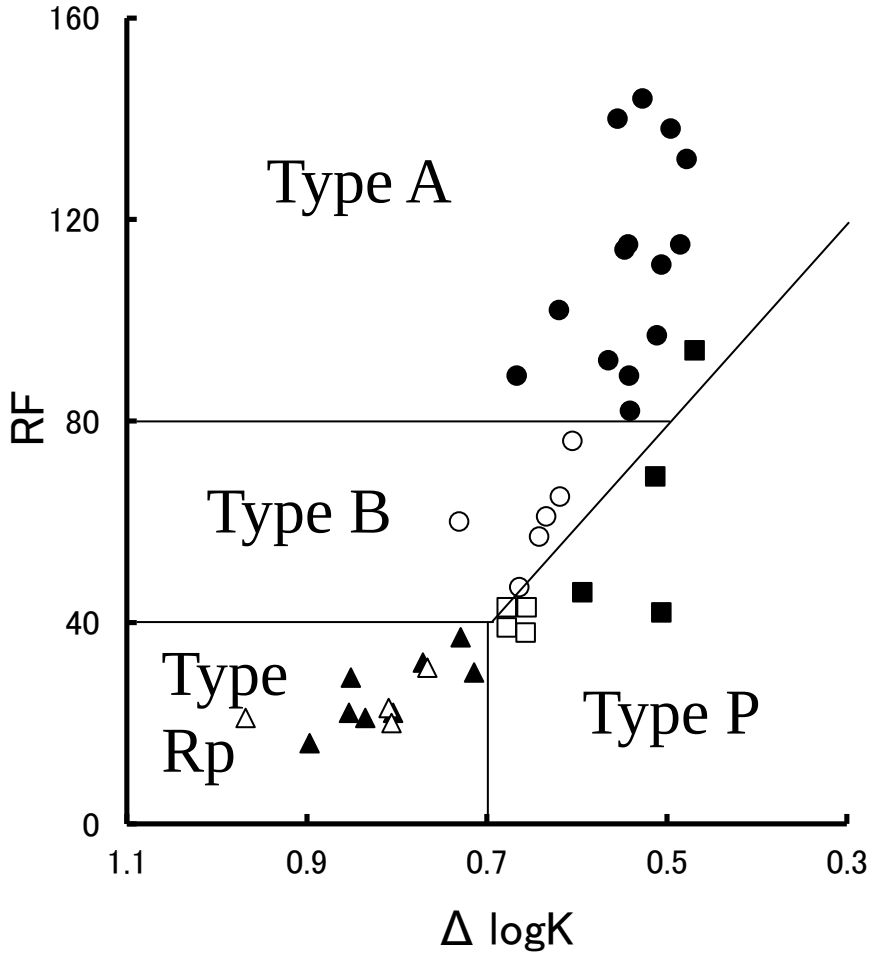
Elementary composition of humic substances H/C and O/C





Degree of oxidation(ω) and H/C

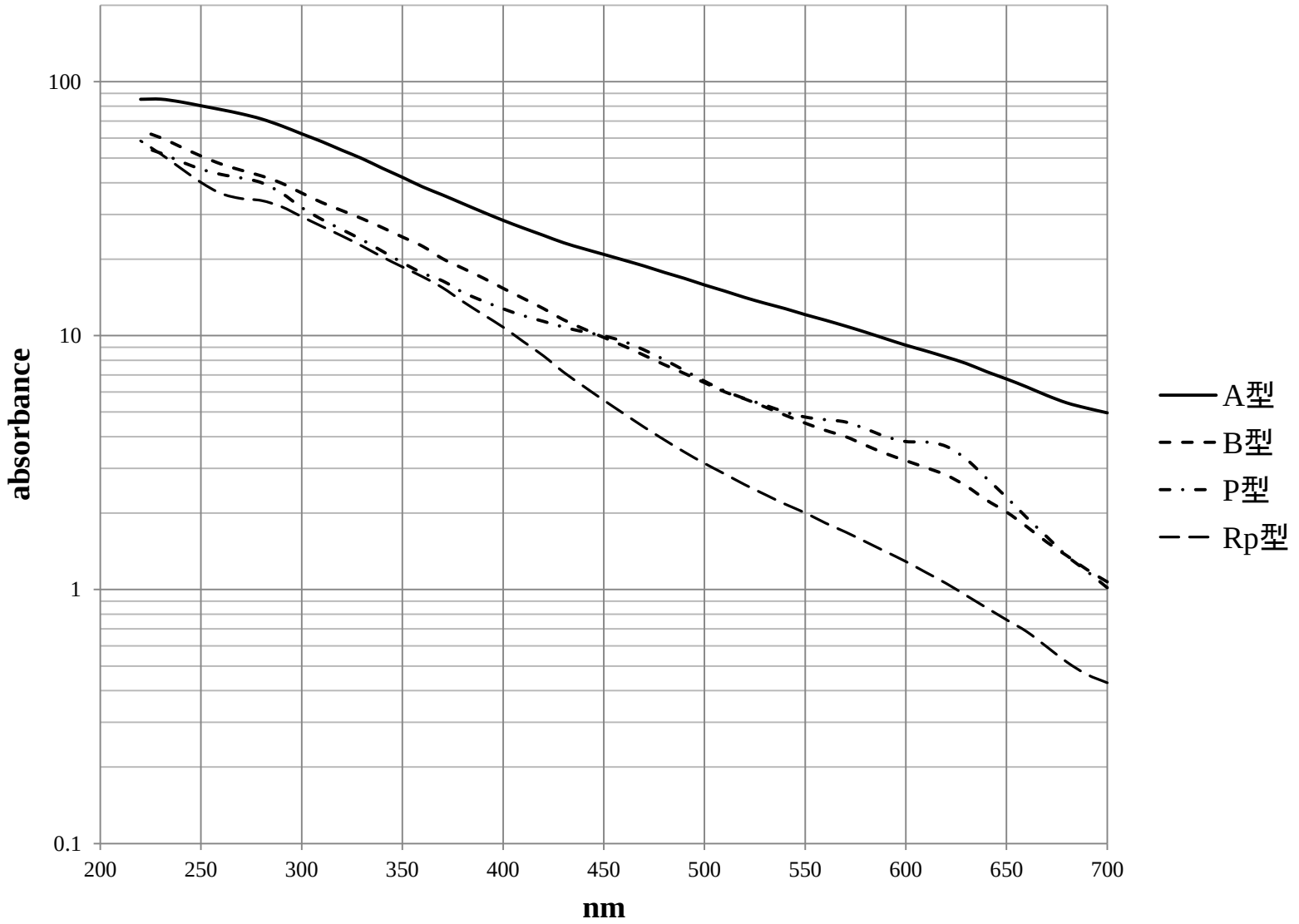
● soil humic acids from literature 3 ■ humic acids from buried volcanic ash sois、○ humic asids from literature 7, △ humic acids from sea and lake sediments, ▲ humin from sediments, □ coal, ◆ humic acids from Russian soils in literature 6 ◇fulvic acids from Russian soils.



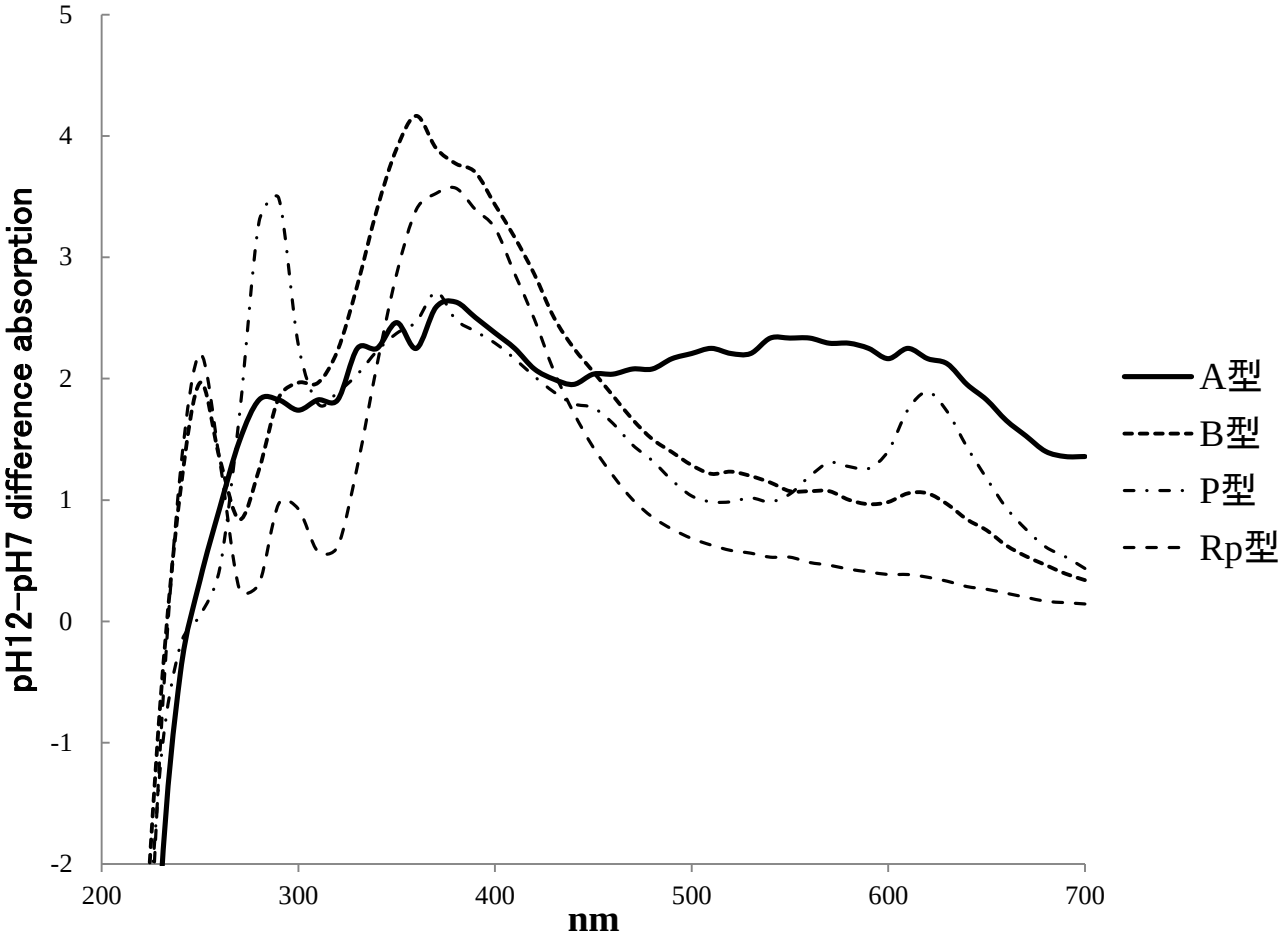
Classification of humic substances by RF and ΔlogK

● Type A, ○ Type B, ■ Type P with obvious Pg absorption, □ Type P without Pg absorption

▲ Type Rp from mineral soil, △ Type Rp from O layer



UV-vis. Absorption spectra of humic acis in different types
Type A　Inogashira (volcanic ash soil), Type B Higashiyama (brown forest soil),
Type P Tsubame (Pg of buried soil), Type Rp Anjo (paddy soil)
Concentrations are adjusted to 1mgC mL^{-1}



pH12-pH7 difference absorption spectra of different types of humic acids.
（Same humic acids as in the previous figure）