CHEMICAL CHARACTERIZATION OF SOIL ORGANIC mTrER BY CURIE-POINT PYROLYSIS-GAs CHROMATOGRAPHY

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A rapid and reproducible chemical characterization of whole soils was carried out by Curie-point pyrolysis gas-chromatography (Py-GC). Samples can be analyzed directly after drying and grinding without further pretreatment. cluster analysis correctly classified the resulting pyrograms into each soil type.

Humic substances, the major organic constituents of soils and facent sediments. are widely distributed over the earth's surface. The classification of humic substances is based upon solubility differences in aqueous solutions at different pHs. There have been many reports on the methods of extraction and analysis of soil organic matters[1].

Pyrolysls-gas chromatography (Py-GC) has been shown to be Very useful as an analytical technique. Pyrograms of biomaterials arc very complex[2]. The patterns of variation are not easily discernible by visual 1nspcctlon. Multivariate analysis is needed to determine cluster patterns as a way or elucidating the chemical features that discriminate between clusters. Analysis or who]e soils by pyrolysls-gas chromatography is limited in use[3l. The major objective of this study was to cvaluate Py-GC pattern recognition as a method for the chemical characterization of whole soil.

Soil (approximately 10 mg/sample) was applied to a ferromagnetic foil and brought to a Curic temperature of 590℃ by a Curic-point pyrolyzer (Japan Analytical Industry Co.. LTD.. JIIP-3). The temperature rise time was approximately 0.2 s and the foil was held at the end temperature for 3 s. The pyrolyzer head was maintained at a constant temperature or 250℃. The resulting pyrolyzate components were solved on a DB-wax fused sillica capillary column (0.25 mm i.d. x 30 m long. film thickness 0.25 um). The capillary gas Chromatograph (Hitachi Manufacture L.td.. G 3000) was equipped with a flame ionization detector and helium was the carrier gas. Peak areas were obtained using automatic integrator (Hitachi Manufacture Ltd., D 2500).

The samples analyzed in this study were all obtained from the Osaka Prefecture (A.B.C and D) except the soil E sample(Ibaraki Prefecture). Each soil was analyzed three times by Py-GC.

Data summarizing the properties and sources of the soil samples analyzed in this study are shown in Table 1. Pyrolysls of whole soil at a Curie temperature of 590°C yields complex chromatograms(Fig. 1). The pyrograms of the whole soil samples could not be distinguished from one another by visual 1nspectlorl. Therefore. only the most prominent 50 peaks were selected in order to characterize the difference among these soils.

Table 1 Soil properties

Sample	Location	pH(H_2O)	C(%)	N(%)	C/N
A	Shakudo	6.59	1.97	0.25	7.9
B	Shakudo*	6.66	2.49	0.29	8.6
C	Kuroishi	6.99	1.83	0.16	11.4
D	Nakamozu	6.29	1.26	0.11	11.5
E	Ichige	5.66	5.65	0.42	13.5

*Soil amended with lime

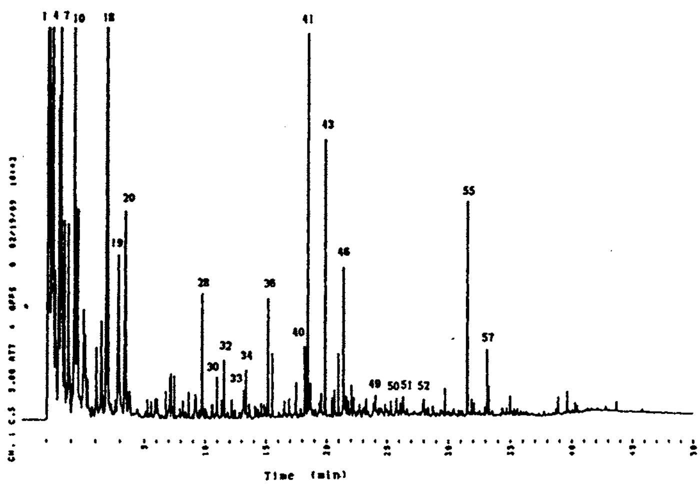

Fig. 1 Pyrogram of the soil E.

The identification of the pyrogram peaks was carried out by capillary GC-MS (Hitachi Manufacture Ltd.. M 2000). The peaks were identified as acetaldehyde(Peak No.4). aceton(Peak No.7). acetonitrile (Peak No.18). toluene(Peak No.20). pyridine(Peak No.28), 3-methyl furan(Peak No.36). acetic acid(Peak No.40). furfura1(Peak No.41), 5-methylfuran(Peak No.46), pheno1 (Peak No.55), and cresol(Peak No.57).

Pyrograms of the whole soil samples are very complex and overall patterns of variation are not easily discernible by visual inspection. Ohya and Komai[4] reported that cluster analysis of fatty acid composition was useful for the identification of relationships among isolated bacteria. and consequently, was helpful in the study of the qualitative effects of heavy metals on bacteria communities. Hence, we applied the cluster analysis to these pyrogram

Figure 2 shows a dendrogram obtained using multivariate analysis. The result straightforwardly gives relationships among the five soils. The soils of A and B are ident1cal except that soil B was treated with lime to amend the soil pH. These two soils and soil C are clearly distinguished from the other soils. The similarity of soil D shows a litt1e low value in comparison with this group(soils A.B and C).

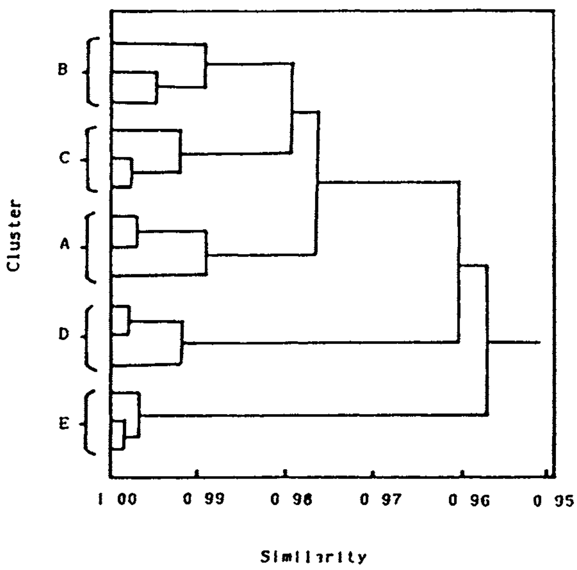

Fig 2 Dendrogram of the soils

Furthermore. the results in the dendrogram indicate that soil E. volcanic ash soil. is very different from the other soils. The dendrogram also indicates the similarity and dissimilarity between the groups of whole soil pyrograms. The soils A and C are the most similar each other. and the soils A and E the most dissimilar. It might reflect the chemical structure or soil organic matters. For example. the presence of furfural and methyl furan is consistent with a result of thermal decomposition or polysaccharide[5].

In this study the Py-GC profiles obtained from five kinds of soil were compared by cluster analysis. The cluster analysis classified the pyrograms into each soil group.

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キュリーポイントパイロリシスガスクロマトグラフィーによる土壌有機物の解析

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キュリーポイントパイロリシスカスクロマトグラフィーにより土壌有機物の解析を行った。土壌は化学的な前処理を必要とせず そのパイログラムは多数のピークを生した。多変量解析のクラスター分析法の適応は 土壌の分類が可能であることを示した。

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