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Mineral composition of clay fractions in some Quaternary deposits in the Chao Phraya Basin, central Thailand

by

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M. N. Alekseev and Y. Takaya classified stratigraphically the Quaternary deposits which revealed characteristic weathering patterns into four groups, e. g. Floodplain deposits with no iron-oxide concretions, Formation I with iron-oxide concretions, Formation II with pisolitic concretions and Formation III with a thin lateritic cap layer.[1] On the basis of their observations, the author anticipated the existence of some relationship between the weathering degree of the deposits and their stratigraphical positions. If such a relationship does exist, the variation in their weathering degree will be reflected in the kaolin minerals content of the deposits. This theory is based on the known fact that generaly kaolin minerals are the final weathering product of rocks and deposits under humid tropical and subtropical climatic conditions. Bearing this in mind, the author examined the relationship between the clay mineral composition and the stratigraphical horizon of Quaternary deposits.

I Materials

The specimens were collected from the left bank of the Yom River. The stratigraphical horizon of the specimens is shown in Table 1.

II Experimental result

Figs. 1a and 1b show X-ray diffraction patterns of oriented specimens which are Ca-saturated and air dried. Figs. 2a and 2b show part of the results of X-ray diffraction analysis on oriented specimens of variously treated specimens, i. e. Ca-saturated air dried, Ca-saturated glycerol solvated, K-saturated air dried, K-saturated 300°C

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Table 1 Locations of sampling sites and some remarks of samples

depth(m)	material	formation	sample number
Loc. 48 : Left bank of the Yom, Si Samrong			
	Very pale brown to brown massive loamy clay	I	
0.5			
	Fine sand	I	
0.7			
	Brown to dark brown massive loam	I	48-1
2.5			
	Fine sand	I	
2.7			
	Brown to dark brown massive loam	I	
4.2			
	Light brownish gray to grayish brown clay with many plant remains	I	48-2
5.7			
	Coarse sand with clay balls	I	
5.9			
	White to light brownish gray sandy clay with ferruginous concretions	?	48-3
6.2			
	Brown and very pale brown laminated loam with few manganese concretions	?	48-4
6.7			
	Dark yellowish brown, yellowish red and white reticulately mottled clay with common iron-oxide concretions	II	
7.3			
	Light yellowish brown clay with common white cloudy mottlings	II	
7.9			
	White clay with common brown mottlings	II	48-5
8.2			
Loc. 52 : Left bank of the Yom, Sukhothai			
	Yellowish brown massive loam	I or Fp	
1.8			
	Brown clay with common plant remains	I	52-1, 1b
2.6			
	Olive gray clay with common brown mottlings	II	52-2
3.3			
	Grayish brown clay with common strong brown and red mottlings and many iron-oxide concretions	III	52-3
4.2			

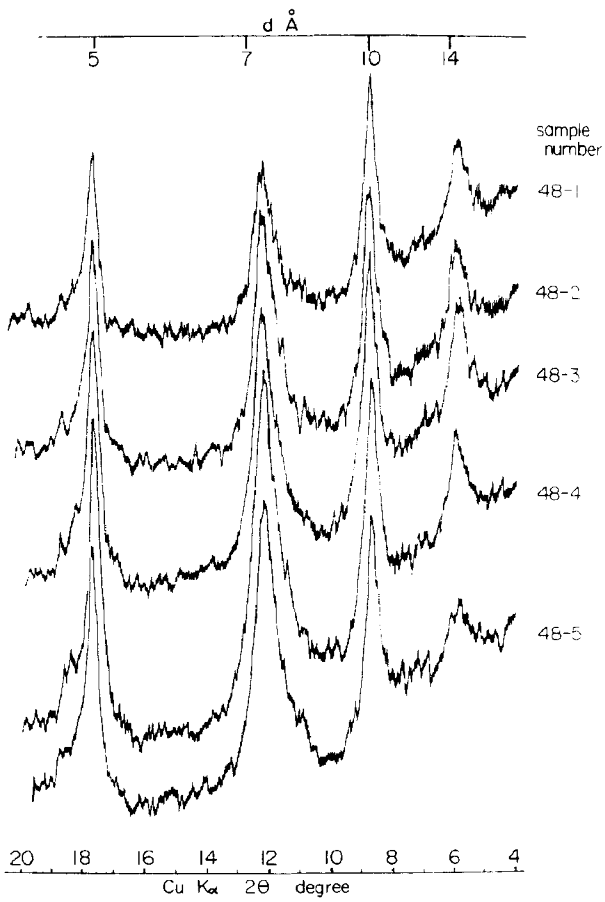


Fig. 1a X-ray diffraction patterns of oriented specimens of Ca-saturated air dried clays from samples of No. 48

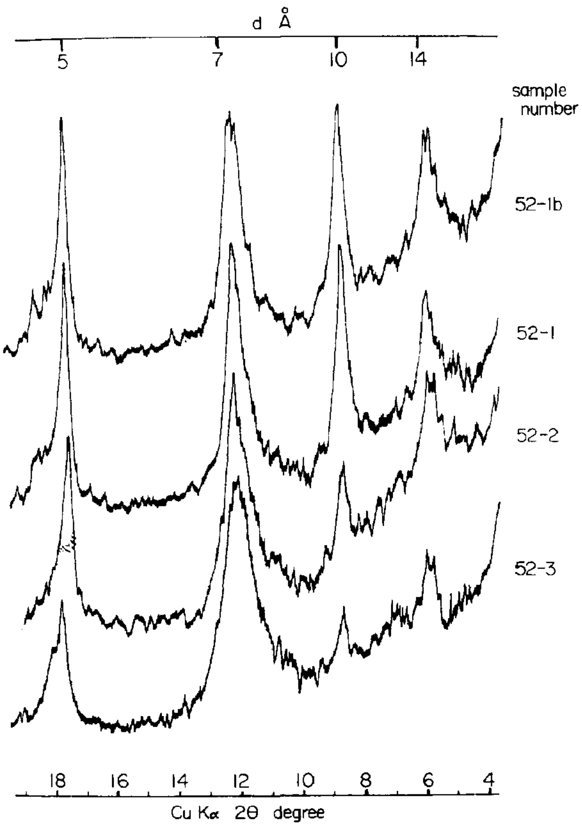


Fig. 1b X-ray diffraction patterns of oriented specimens of Ca-saturated air dried clays from samples of No. 52

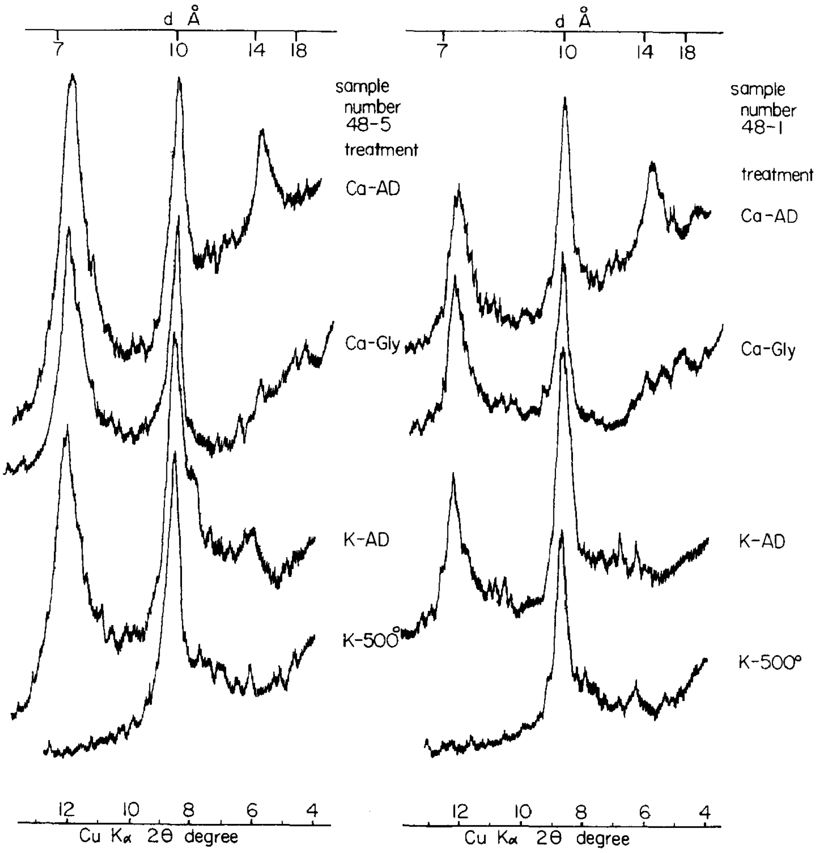
Table 2 Mineralogical characteristic of clay fractions

sample number	formation	clay mineral composition							ratios of each clay mineral content	
		kaolin content(I) %	illite content(II) %	content(III) %	others					
					Ver*	Mt*	Chl*	Mixed* layer	II+III/I	III/II
48-1	I	30	40	30	++	++	±	++	2.33	0.75
2	I	35	35	30	+++	++	±	+	1.86	0.86
3	?	35	35	30	+++	+	—	+	1.86	0.86
4	?	40	35	25	++	++	—	+	1.50	0.72
5	II	40	35	25	+++	+	—	+	1.50	0.72
52-1	I	35	35	30	+++	+	±	+	1.86	0.86
1b	I	35	35	30	++	++	±	++	1.86	0.86
2	II	45	25	30	+++	+	—	++	1.22	1.20
3	III	60	15	25	++	+	—	++	0.66	1.67

* Ver : vermiculite, Mt: montmorillonite, Chl: chlorite, Mixed layer : illite-vermiculite or illite-montmorillonite

+++ abandant, ++ common, + small, ± very small, —not detect heated, and K-saturated 500°C heated. Table 2 shows the clay mineral composition which is determined on the basis of the peak intensities appearing in X-ray diffraction patterns.

Judging from the X-ray diffraction pattern of the Ca-saturated air dried clays shown in Figs. la and lb, all the specimens are composed of four kinds of mineral component having such diffraction peaks as 14 to 15 Å, diffused 14 to 10 Å, 10 Å and 7 Å, of various intensities. Among them, most of the material showing a peak of 14 to 15 Å collapses its peak to a figure of 10 Å, and 12 to 13 Å by the air drying of K-saturated clay. This material, at least if not all of it, also expands its peak position to 18 or 19 Å by the glyserol solvation of Ca-saturated clay. From these changes in peak position and intensity, it can be deduced that those large parts of the material with 14 to 15 Å are vermiculite and montmorillonite. The 14 Å peak revealed in the K-saturated 500°C heated clays from 48-1, 48-2, 52-1 and 52-1b indicates the presence of



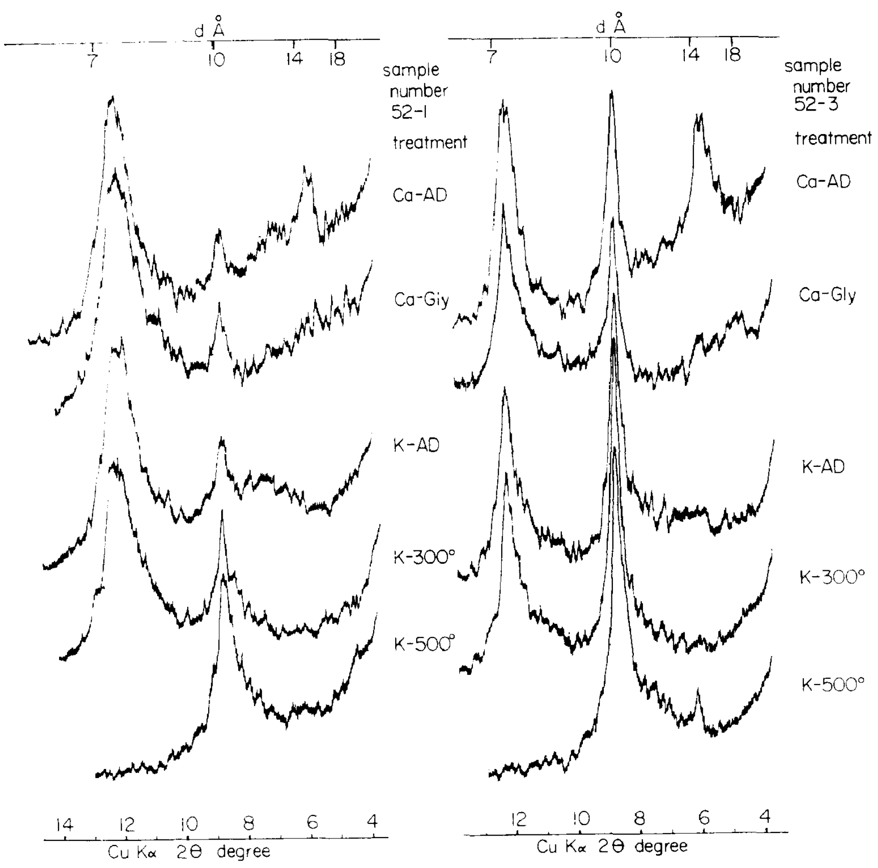
(A)　　(B)

Ca-AD : Ca-saturated air dried　　Ca-Gly : Ca-saturated glycerol solvated
K-AD : K-saturated air dried　　K-500 : K-saturated 500°C heated

Fig. 2a X-ray diffraction patterns of oriented specimens of variously treated clays from samples of No. 48-1 and 48-5 chloritic clays. 10 Å and 7 Å peaks shown in the Ca-saturated air dried clays indicate the existence of illite and kaolin minerals respectively. The diffuse peak of 14 to 10 Å shifts its peak position to various positions according to the treatment used. This implies that the clay is composed of interstratified mixed layer minerals of illite-vermiculite and illite-montmorillonite.

Based on the results of experiments, it is quite safe to say that the clay of Formation III is extremely rich in kaolin minerals, whereas that of Formation I is rich in illite and other 2:1 type clay minerals, and that Formation II falls between the two. Again it is very interesting to notice that samples 48-3 and 48-4, whose stratigraphical positions lie between Formation I and II, demonstrate their character intemediate between I and II in their mineral composition.

This seems to suggest that the behavior of clay mineral assemblage is consistent



(A) (B)

Ca-AD : Ca-saturated air dried Ca-Gly : Ca-saturated glycerol solvated
K-AD : K-saturated air dried K-300 : K-saturated 300°C heated
K-500 : K-saturated 500°C heated

Fig. 2b X-ray diffraction patterns of oriented specimens of variously treated clays from samples of No. 52-1 and 3 with the weathering degree of the deposits and consequently is closely related to the stratigraphical sequence, as demonstrated by the ratio of kaolin minerals to illite plus other 2:1 type clay minerals.

A more accurate determination of clay mineral composition, and a more extensive examination of the relationship with geographical features will contribute to the clarification of geo-history and soil formation of the Quaternary period in Central Plain.

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Literature Cited

1) Alekseev, M. N. and Y. Takaya "An outline of the Upper Cenozoic deposits in the Chao Phraya Basin, Central Thailand," *The Southeast Asian Studies* Vol 5, No. 2, pp. 106-124 (1967)