

TABLE 1. Chemical analyses of starting clay minerals

	1	2	3	4
SiO ₂	62.02%	47.24%	44.59%	62.74%
TiO ₂	—	0.38	0.33	tr.
Al ₂ O ₃	32.24	35.04	35.75	0.27
Fe ₂ O ₃	tr.	0.59) 0.20	—
FeO	tr.	tr.		—
MnO	none	tr.	—	tr.
MgO	0.18	0.21	0.04	29.95
CaO	0.40	0.16	2.75	tr.
Na ₂ O	—	1.37	0.60	0.75
K ₂ O	—	8.75	0.40	0.17
H ₂ O(+)	—	5.52	14.56	4.80
H ₂ O(-)	6.06	0.32	0.35	0.87
Total	100.90%	99.58%	99.57%	99.55%

1. Pyrophyllite from Yoji, Gunma Prefecture, Japan (Analyst: H. Kodama).
2. Sericite from Goto mine, Nagasaki Prefecture, Japan (Analyst: K. Tomita).
3. Kaolinite from Kanpaku mine, Tochigi Prefecture, Japan (Analyst: K. Tomita).
4. Talc from Haicheng, China (Analyst: K. Tomita).

the concentration of NaOH solution at 100°C. After reaction, each sample was washed with distilled water on filter paper for the removal of excess salt. The product was air-dried, and oriented specimens were made by smearing a clay paste onto a glass slide, and investigated by X-ray diffraction analysis. Total chemical analysis and scanning electron microscopy were carried out.

RESULTS

Reaction products from pyrophyllite

Experiments were carried out by changing the reaction time and amounts of starting

TABLE 2. Experimental conditions and reaction products from pyrophyllite

Run No.	Sample (g)	NaOH M	Solution (ml)	Reaction time (hrs)	Products
2299	0.03	3	100	30	Py
2077	0.03	3	100	68	Sm (1), Soda
2303	0.03	3	100	70	Sm (1), Mix (M/S)
2125	0.1	0.5	100	6	Sm (1), Py
2127	0.1	0.5	100	12	Sm (1), Py
2306	0.2	3	100	70	Sm (1), Py

Sm: smectite, Py: pyrophyllite, Soda: sodalite, Sm (1): smectite having one-layer of water molecule, Mix (M/S): mixed-layer mineral of mica/smectite.

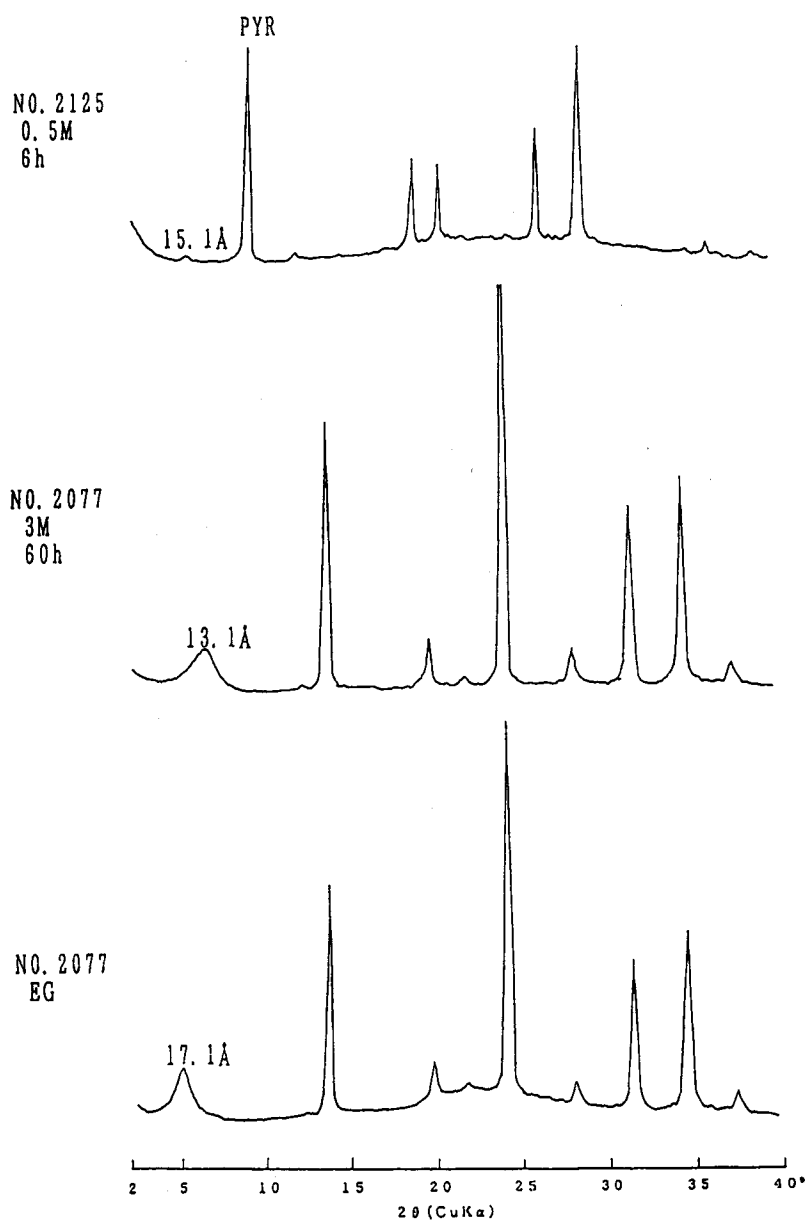


FIG. 1. X-ray powder diffraction patterns of the synthesized samples from pyrophyllite.
2125: reaction product after boiling 0.1 g of pyrophyllite in 100 ml of 0.5 M NaOH solution for 6 hours.
2077: reaction product after boiling 0.03 g of pyrophyllite in 100 ml of 3 M NaOH solution for 60 hours.
2077 EG: treated with ethylene glycol.



FIG. 3. Scanning electron micrographs of the synthesized smectites from some clays.

A. smectite synthesized from pyrophyllite, B. smectite synthesized from sericite, C. smectite synthesized from kaolinite, D. smectite synthesized from talc.

Smectite from sericite

Experimental conditions and reaction products are listed in Table 3. When 0.03 g of sericite was boiled in 100 ml of 3 M NaOH solution, smectite was formed together with Na-P zeolite after 60 hours. The (001) reflection showed 15.2 Å, and the d-value expanded

TABLE 3. Experimental conditions and reaction products from sericite

Run No.	Sample (g)	NaOH M	Solution (ml)	Reaction time (hrs)	Products
2071	0.03	3	100	3	Ser
2073	0.03	3	100	60	Sm, Na-P
2268	0.03	3	100	80	Sm, Na-P
2062	0.03	0.5	100	25	Sm, Ser
2067	0.03	0.75	100	16	Sm, Ser

Sm: smectite, Ser: sericite, Na-P: zeolite P.

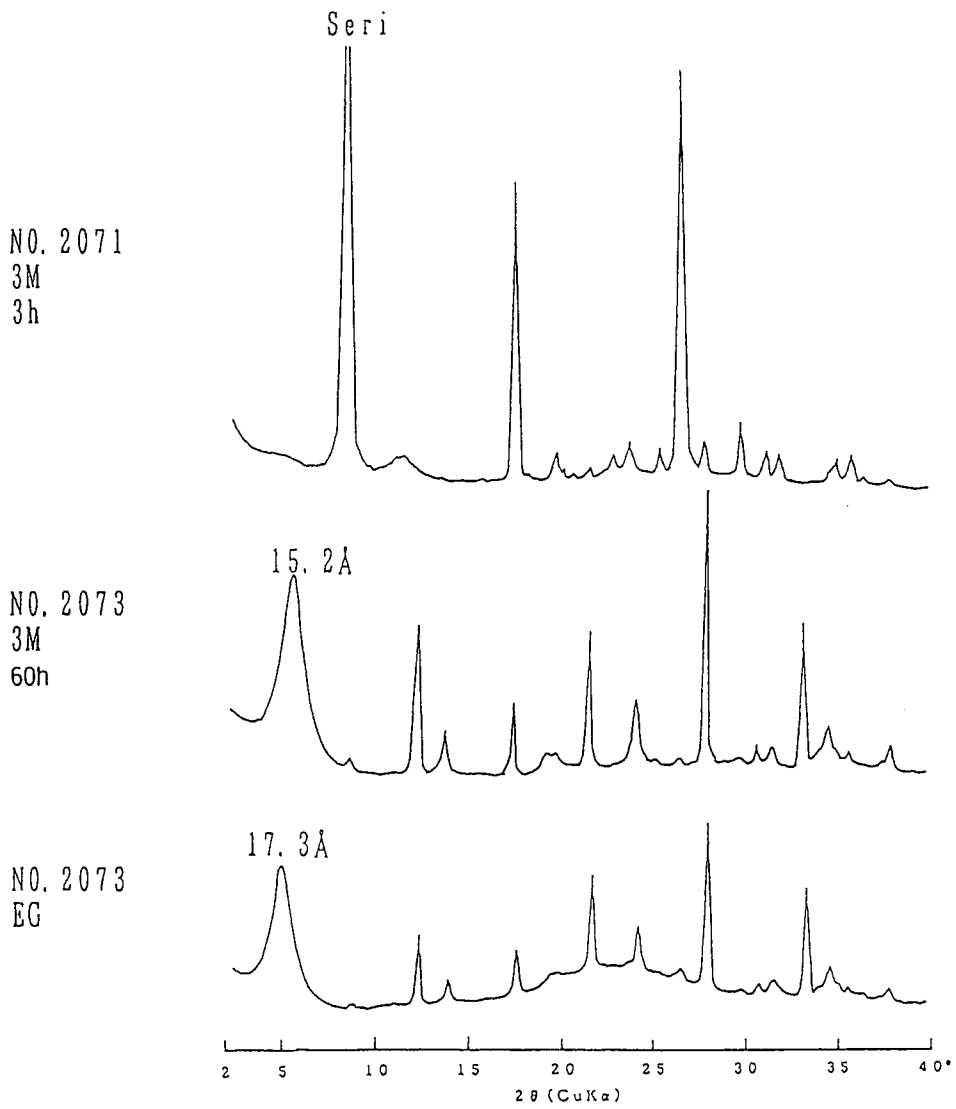


FIG. 4. X-ray powder diffraction patterns of the synthesized samples from sericite.

2071: reaction product after boiling 0.03 g of sericite in 100 ml of 3 M NaOH solution for 3 hours.

2073: reaction product after boiling 0.03 g of sericite in 100 ml of 3 M NaOH solution for 60 hours.

2073 EG: treated with ethylene glycol.

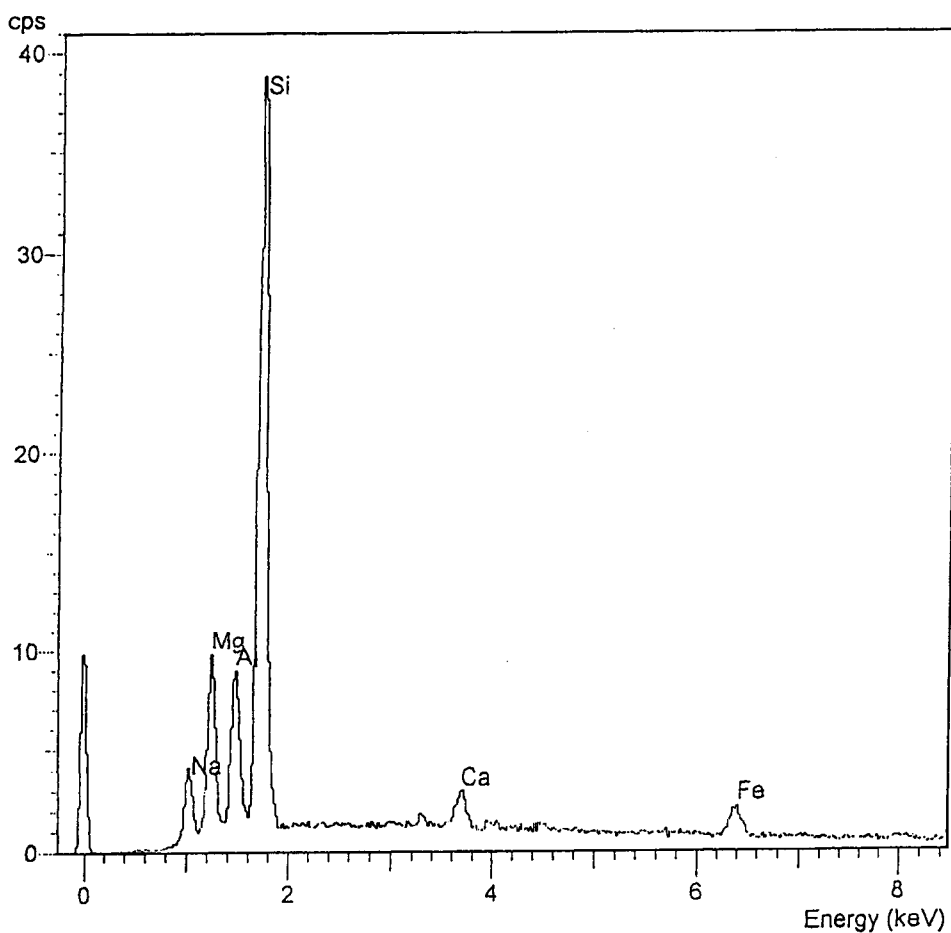


FIG. 5. EDX spectrum of smectite synthesized from sericite after boiling 0.03 g of sericite in 100 ml of 3 M NaOH solution for 60 hours.

to 17.3 Å by treatment with ethylene glycol (Fig. 4). This peak contracted to about 10 Å after heating at 500°C. Scanning electron microphotograph of the specimen is shown in Fig. 3B. Typical curving flakes of smectite are observed. Energy dispersive X-ray spectrum of the sample is shown in Fig. 5.

Smectite from kaolinite

Experimental conditions and reaction products are listed in Table 4. When 0.03 g of kaolinite was boiled in 100 ml of 0.0175 M NaOH solution, small amount of smectite was formed after 25 hours. The (001) reflection of the formed smectite showed 16 Å. When 0.03 g of kaolinite was boiled in 100 ml of 0.1 M NaOH solution for 80 hours, smectite

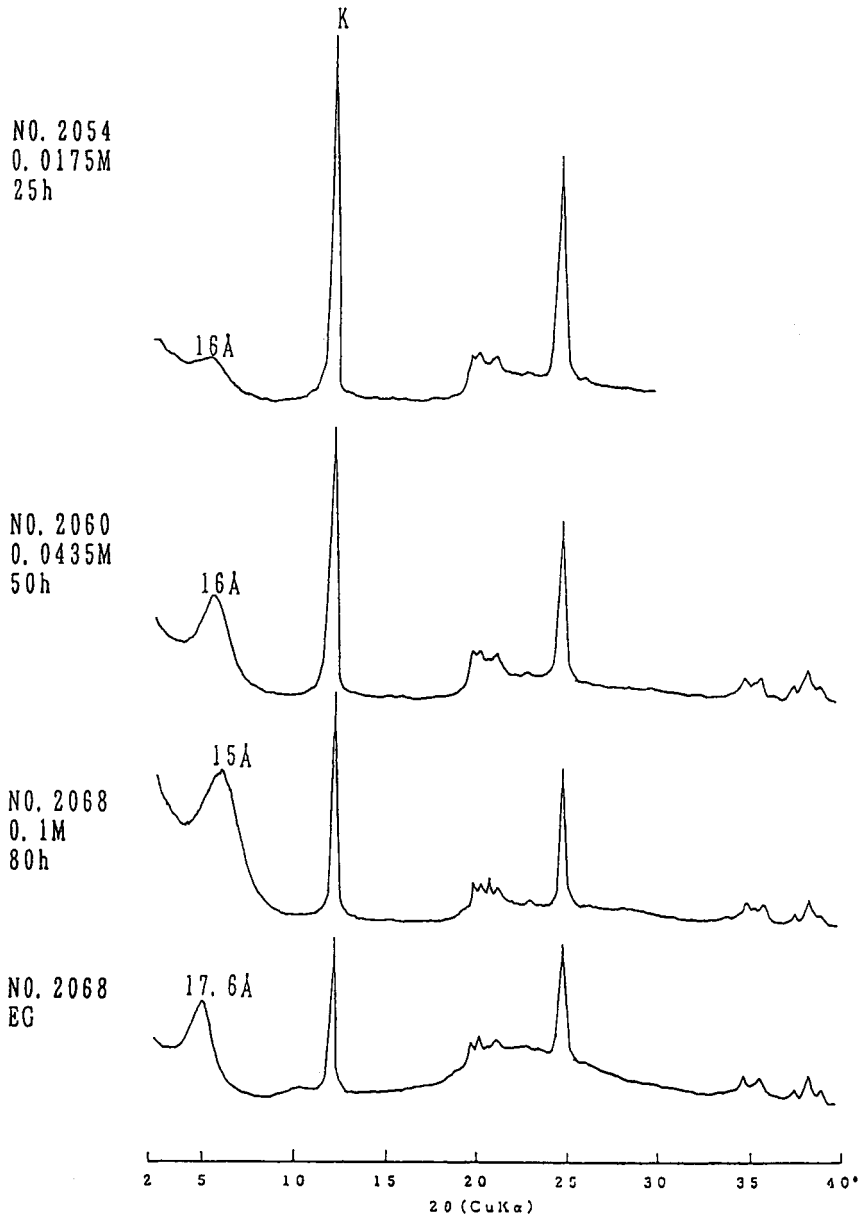


FIG. 6. X-ray powder diffraction patterns of the synthesized samples from kaolinite.
 2054: reaction product after boiling 0.03 g of kaolinite in 100 ml of 0.0175 M NaOH solution for 25 hours.
 2060: reaction product after boiling 0.03 g of kaolinite in 100 ml of 0.0435 M NaOH solution for 50 hours.
 2068: reaction product after boiling 0.03 g of kaolinite in 100 ml of 0.1 M NaOH solution for 80 hours.
 2068 EG: treated with ethylene glycol.

