Clays and Clay Minerals, Vol. 22, pp. 369–371. Pergamon Press 1974. Printed in Great Britain

IMOGOLITE FROM NEW GUINEA

(*Received 29 December* 1973)

Imogolite is a hydrous aluminium silicate mineral (Cradwick *et al.*, 1973) with a fibrous morphology and low degree of structural order, which, since first described by Yoshinaga and Aomine (1962), has been reported to occur as a weathering product of pyroclastic materials in many localities. However, Wada *et al.* (1972) have recently drawn attention to the fact that imogolite occurs in gels derived from massive, though jointed, basalt in Hawaii. The purpose of the present note is to describe the identification of imogolite in some very young volcanic ash soils from New Guinea—a finding that has important genetic implications.

The soils have been described by Bleeker and Parfitt (1973) and some characteristics relevant to this study are given in Table 1. For electron-microscopic examination the clays were treated with hydrogen peroxide and subsequently by the sodium dithionite method of Mehra and Jackson (1960) to remove organic matter and free iron oxides, respectively. The material was dispersed ultrasonically and a drop of dilute suspension dried on a carbon support film mounted on an electron microscope grid. The instrument used was an AEI EM6 electron microscope.

Figure 1(a) shows imogolite fibres in Soil 1 together with amorphous silica. The electron diffraction pattern obtained from the bundle of fibres in the ringed area (Fig. 1b) is identical with that previously published for imogolite (cf. Russell *et al.*, 1969). Imogolite was similarly identified in the 0–14 cm horizon of Soil 16.

The clay from Soil 16 at depth 140–160 cm (Table 1), which is a buried A horizon, was shown by X-ray diffraction to contain halloysite, which, under the electron microscope, appears as small circular particles entangled in the imogolite threads (Fig. 1c). On an electron diffraction pattern (Fig. 1d) the first and fifth rings from the centre are the halloysite 02 and 20 reflections at 4·46 and 2·56 Å, respectively, while the other rings are characteristic of imogolite.

A surface soil from Tambul contained the vermicular features shown in Fig. 1(e) as well as imogolite. The electron diffraction pattern from one such vermicule (Fig. 1f) points conclusively to gibbsite in the form of long stacks of plates lying on edge. Although the micrograph in Fig. 1(e) was recorded from a sample prepared as described above, both imogolite and the vermicular gibbsite could be identified in specimens prepared from the untreated soil—despite the fact that there was some tendency for them to be obscured by the large amount of organic debris present.

Imogolite has thus been found in all the soils listed in Table 1, which include three surface horizons of varying age and a buried A horizon that contains halloysite. This contrasts with the findings of Aomine and Mizota (1972) for Japanese soils where imogolite is found only in older subsoils and never in the presence of halloysite. Weathering processes, however, are much more rapid under the humid tropical conditions prevalent in New Guinea and the two weathering sequences that produce imogolite and halloysite probably occur together.

The most significant occurrence of imogolite is in Soil 1 from Hoskins which, according to radiocarbon dating, is less than 800 yr-old and is in a relatively early stage of development. This observation supports the conclusion of Wada and Matsubara (1968) and Wada *et al.* (1972) that the formation of allophane and imogolite is parallel rather than sequential as originally thought.

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Table 1. Some relevant characteristics of the soils used in this study

Location	Soil	Depth (cm)	Alt. (m)	Ave. rainfall (mm)	Ave. temp. (°C)	Minerals other than imogolite	Age (yr)
Hoskins, New Britain	1	0–5	10	3400	25	Amorphous silica	<800*
Hoskins, New Britain	16	0–14	10	3400	25	Allophane	<2000*
	16	140–160	10	3400	25	Halloysite, allophane	<2000*
Tambul, New Guinea		0–10	2000	2500	18	Halloysite, allophane, gibbsite	<15,000†

* Radiocarbon dating from charcoal fragments by Dr. Kigoshi, Gaskushuiu University, Tokyo. The charcoal fragments are from trees that were fired during the eruption. Most of the charcoal was buried and is in non-humic horizons.

† Pain (1973).

https://doi.org/10.1346/CCMN.1974.0220409 Published online by Cambridge University Press

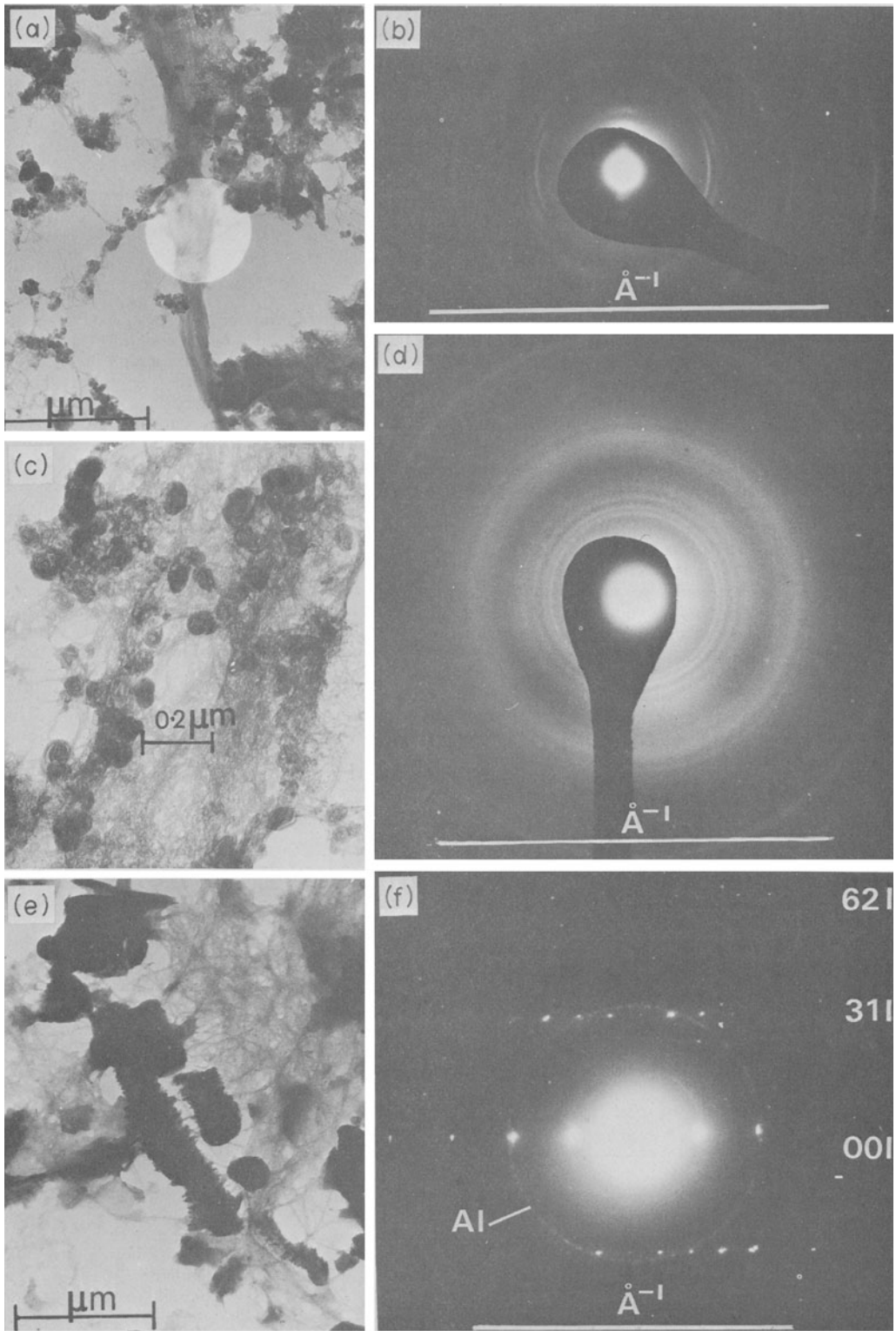


Fig. 1. Electron micrographs of clay from (a) Soil 1 after hydrogen peroxide and sodium dithionite treatment; (c) Soil 16, 140–60 cm, untreated; (e) Tambul soil after hydrogen peroxide and sodium dithionite treatment. Electron diffraction patterns from; (b) bundle of fibres in ringed area in (a); (d) material in (c); (f) vermicular gibbsite in Tambul soil. The rings are from evaporated Al used as a diffraction spacing calibration.

https://doi.org/10.1346/CCMN.1974.0220409 Published online by Cambridge University Press

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https://doi.org/10.1346/CCMN.1974.0220409 Published online by Cambridge University Press