

is required to elucidate the formation of villi and their significance.

I am thankful to Prof. G. Krishnan for his interest in the work.

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1. Barrington, E. J. W., *Phil. Trans. Roy. Soc. Lond. B*, 1937, 228, 269.
2. Azariah, J., *J. Mar. biol. Ass. India*, 1967 (In press).
3. —. *Ibid.*, 1966, 8, 159.

CLAY MINERALOGY OF THE MUD BANKS OF COCHIN

THE deposition of mud on the beaches of Kerala is a recurring feature. This phenomenon is particularly common between Calicut and Quilon and is most frequent during the monsoon season. The formation of offshore bars of mud as well as the deposition of mud on the beaches have been collectively termed "mud banks". Bristow¹ gives a comprehensive account of mud banks, particularly their occurrence at various places, their so-called movement, the calming effect they have on the waves and speculations regarding their origin. A subsequent report by the Special Committee on the Movement of Mud Banks (DuCane²) is more instructive in so far as some work on the physical and chemical aspects of the mud is concerned. Results of the studies on some other aspects of the muds have been given by Nair *et al.*³

This paper is a report of the mineralogy of the sediment constituting the mud-banks formed off Cochin (Fig. 1). The results obtained particularly the clay mineral composition are used as a means of understanding the nature and source of origin of the muds. An investigation along the same lines is that of Favajee (quoted by Carroll in Milner).⁴

The fine fraction of the mud samples were analysed X-ray diffractometrically for their clay mineralogy. The results are given in Table I. The minerals detected are kaolinite, montmorillonite, illite, chlorite with some calcite and quartz in all samples. The presence of gypsum and hydrous phosphate was also noted.

Kaolinite.—Dominating the clay minerals in the muds are the kaolinites being 60–65% of the total. As the doublet at 4.13 Å and 4.18 Å is not resolved it is inferred that these kaolinites are poorly crystallised. In view of the

fact that lateritic soils are principally kaolinitic, it is not surprising that kaolinite is the dominating clay mineral in these muds. Apart from the contributions from the weathering of primary source rocks like acid igneous rocks, it is also possible that a certain amount is derived directly from secondary sources such as kaolinite deposits occurring in parts of the State, *viz.*, the Miocene Varkala deposits outcropping near the coast and its offshore extensions.

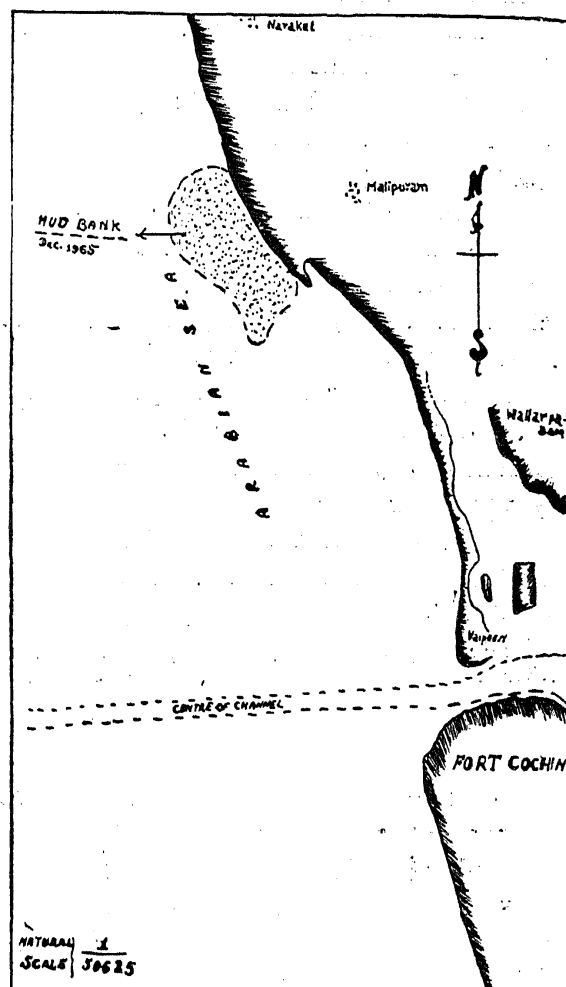


FIG. 1

TABLE I
Mineralogy of the mud banks

	M-2	M-4	M-8	M-17
Kaolinite	60-65%	60-65%	60%	55-60%
Montmorillonite	15-20%	15%	15-20%	15-20%
Illite	15%	15-20%	15-20%	20%
Chlorite	Trace	Trace	—	—
Quartz	2-5%	2-5%	2-5%	2-5%
Calcite	Trace	Trace	1-2%	1-2%
Gypsum	=	++	+	+
Hydrous phosphate	+	++	+	+

Note: Percentages are on Gypsum and Hydrous phosphate free basis.

Montmorillonite.—Next in order of abundance are the montmorillonites ranging between

15–20%. These again are poorly crystallised and trioctahedral. Furthermore most of the montmorillonites are of the saponite variety. Saponites are considered to result from complete substitution of aluminium by magnesium in the octahedral sheet (Grim).⁵ The formation of montmorillonite is generally favoured where basic igneous rocks are subject to weathering in hot and moist climates, with the provision that the process of leaching, particularly the magnesium ion be none too rapid. These conditions are ideally met with in the interior of the State and it may therefore be reasoned that one of the possible ultimate sources of the saponites are the magnesium-rich pyroxene granulites found in the hinterland of Kerala (Krishnan).⁶

Illite.—Illite occurs in quantities comparable to montmorillonite (15–20%). The illite is dioctahedral and poorly crystallised. These are probably related to the weathered muscovites which was observed to be present in the coarse fraction of the sediments.

Chlorite.—Only trace quantities of this mineral were recorded in the muds. Quartz, calcite and gypsum were detected in small amounts in all the samples. Some of the samples showed a hydrous phosphate peak, which could be apatite. It is, however, not known whether this apatite is biogenic or inorganically precipitated.

From these observations, we conclude that the clay minerals of the mud banks show decided affinities to the parent rocks and are considered to result under conditions of tropical weathering of a variety of rocks. The essentially terrestrial nature of the clays is confirmed by the predominance of kaolinite over the montmorillonites and illites, the latter two being more typical of sediments found in the marine environment.

This further leads to the conclusion that little or no contribution to the sediment is made from the open sea and that the sediments constituting the muds are largely contributed to the near-shore region by the present-day rivers, either directly to the inner shelf or indirectly by way of the lagoons. Redistribution of such sediments by the waves and currents would result in the formation of mud banks and mud flats.

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1. Bristow, R. C., *Cochin Harbour Development—History of Mud Banks*, Cochin Govt. Press, Ernakulam, 1938, 1 & 2.
2. DuCane, C. G., *Report of the Special Committee on the Movement of Mud Banks*, Cochin, 1938.
3. Nair, R. R., Murty, P. S. N. and Varadachari, V. V. R., "Abstracts of Papers," *INCOR/NIO Symposium on "Coastal and Nearshore Oceanography"*, Ernakulam, November 3–4, 1966.
4. Carroll, D. *Sedimentary Petrography*, George Allen and Unwin Ltd, London, 1962, 2.
5. Grim, R., *Clay Mineralogy*, McGraw-Hill and Company, 1953.
6. Krishnan, M. S., *Geology of India and Burma*, Higginbothams, Madras, 1964.

OVIPAROUS MORPHS OF *LIPAPHIS ERYSIMI* (KALTENBACH) IN INDIA* (HOMOPTERA: APHIDIDAE)

Lipaphis erysimi (Kaltenbach), a cosmopolitan aphid infesting crucifers, is generally known to build up populations parthenogenetically in tropical countries. Sexual morphs of this aphid have been recorded and are well known from temperate zones in Europe and elsewhere (Hille Ris Lambers, 1949; Bodenheimer and Swirski, 1957). There is no published record of the occurrence of oviparæ from India even from the temperate regions at higher altitudes in the north though Verma and Mathur (1966) recorded male morphs of *L. erysimi* in Jammu. The present author noticed the prevalence of apterous oviparæ on *Brassica campestris* at 4,000–4,500 ft. in widely separated areas of Kalimpong and Mirik in Darjeeling District, West Bengal, during the first fortnight of March 1967 when the mean temperature was 17°C. However, no male morphs were encountered. The oviparæ are morphologically differentiated from alate and apterous virginoparæ by their swollen hind tibiae with pseudo-sensoria (Fig. A) and slight differences in the proportion of various antennal segments (Fig. B). Cottier (1953) described the oviparous morph from a single specimen collected on Shepherd's purse [*Capsella bursa-pastoris* (L.) Medik.] at Auckland (New Zealand), early in October 1945.

Dissection of oviparous females showed 7–11 eggs but none laid more than 8. The egg (Fig. C) was ovoid, shiny, greyish-green with