phagocytic cells of blood were able to kill the bacteria. A number of studies[22–25] suggested that some humoral antibacterial factors normally present in the serum could influence phagocytosis and intracellular killing. In the control, serum became so diluted due to mixing with TC 199 media (Sigma) (used in phagocytosis experiment[18]) that it had no effect on the growth of *E. coli* and *S. typhi* as shown in Figures 2 and 3. In a separate year-long monitoring experiment it was observed that agglutination titer of Mrigal serum against *E. coli* and *S. typhi* were linearly correlated with the same bacterial concentration in their ambient environment (r value, *E. coli* = 0.741, *S. typhi* = 0.721). So presumably the natural antibody titer against *E. coli* and *S. typhi* which existed in Mrigal as observed in MIT and MBT was enough to promote the ingestion of bacteria as well as killing to a certain extent as has been seen in the case of mice[26]. Phagocytosis as well as killing of bacteria *in vitro* were also measured at 25° C, the optimum temperature for antibody production in carp[11].

The bacterial cells which escape phagocytosis in different sites especially in blood, reach the muscle[7] and may lead to hygienic problems for handlers and consumers. We have seen that the bacterial cells reached the muscle when their concentrations in the digestive tract exceeded a threshold value[10, 27].

Considering the problems of public health and fish health in pisciculture, bacterial concentration in water should be maintained within the limits of phagocytic and bactericidal ability of the fish. It is known that these bacteria are non-pathogenic for fish. But their presence would cause stress to the defence mechanism of the fish and it may become more prone to infection by fish pathogens[28].

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Late Quaternary turbidites of the Arabian Sea abyssal plain, west of Lakshadweep Ridge

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Sediment cores collected from the Arabian Sea abyssal plain representing late Quaternary column have intercepted deep sea turbidite sequences of composite origin. Based on the study of their coarse fraction, they are grouped into Indus Fan (IF) and calciclastic (CC) turbidites. IF-turbidites are dominated by distal terrigenous minerals and CC-turbidites are essentially composed of coral fragments, the source of which is proximal Lakshadweep Ridge.

Turbidites are sediment accumulations deposited by shortlived turbidity currents charged with particles in suspension and are characterized by graded bedding, laminations and other primary sedimentary structures. Gravity-driven underwater currents resulting from factors such as heavily charged rivers, oversteepening of depositional slope through sediment heaping, multiple drop in sea levels, quake-induced sediment slump, etc., are believed to yield turbiditic sediments in marine regime.

The northern and central part of the Arabian Sea extending a little over one million km^2 is regarded as the ultimate repository of Indus river sediments since about Oligocene–Miocene, coeval with the major uplift of Himalayas[1,2]. Kolla and Coumes[3] have given an account of the morphology and seismic stratigraphy of the Indus Fan ascribing the turbiditic sedimentation mainly to Indus influx. However, routine sedimentological studies of 35 piston and gravity cores (length ranging from 0.3 to 3.2 m) from the abyssal plain west of the Lakshadweep Ridge during R. V. Samudra Manthan (RVSM) cruises of Geological Survey of India during the years 1986–90, have shown that at least twelve of these cores indicate the presence of unconsolidated turbidites not only of Indus Fan (IF) origin but also of nearby Lakshadweep Ridge consisting of calciclastic[3] (CC) sediments (Figure 1). The present note is perhaps the first documentation of these two turbidites from the region and concerns briefly their mineralogy and internal sedimentary structures.

The abyssal plain is 4000–4500 m deep with a southerly gradient of 1/1000 and is draped with hemipelagic clay and calcareous (foraminiferal and nanno) ooze. Sediment cores have intercepted varying thicknesses of pale brown (10YR 6/3) to greyish brown (10YR 5/2) hemipelagic sediments and grey (5Y 6/1) to light olive grey (5Y 6/2) calcareous ooze. The distribution of radiolaria (biogenic silica) is less common, which indicates that the seafloor is still above carbonate compensation depth (CCD). The turbidites do not occur at any specific level in the cores but are seen between 0.25 and 1.8 m below the sea bed either as distinct individual units or intermixed with mainly hemipelagic clay in the south and calcareous ooze in the north.

The most distinguishing feature of the turbidites of this region is the occurrence of a few centimetre thick graded or ungraded fine to coarse silt within silty clay usually showing strong colour contrast or discordance. This silt layer which commonly represents Bouma's[4] Ta type is of either greyish yellow green (5GY 7/2) or white colour (5Y 8/1) and comprises variable amounts of terrigenous and biogenous components. The non-turbiditic matrix is composed of coccoliths and clay minerals. The silt zone is under and overlain by silty clay horizons featuring Bouma's Tb, Tc and Td (parallel and wavy) laminations not necessarily in sequential order but with depleting detrital budget. These are illustrated by summarised sequences of RVSM cores 2/SM 39, 29/SM 49 and 2945/59 in Figure 2. Three layers of turbiditic deposition with an intervening pelagic clay are manifestly indicated in the sediment column. Cycles reflecting the glacial/interglacial events can also be discerned on the basis of clastic and planktonic contents of the sediments. The maximum thickness recorded for a single unit is about 70 cm.

Diagnostic IF-turbidites are documented from RVSM cores 2/SM39 and 29/SM49, (Figures 1 and 2), in which peak depositional features are indicated

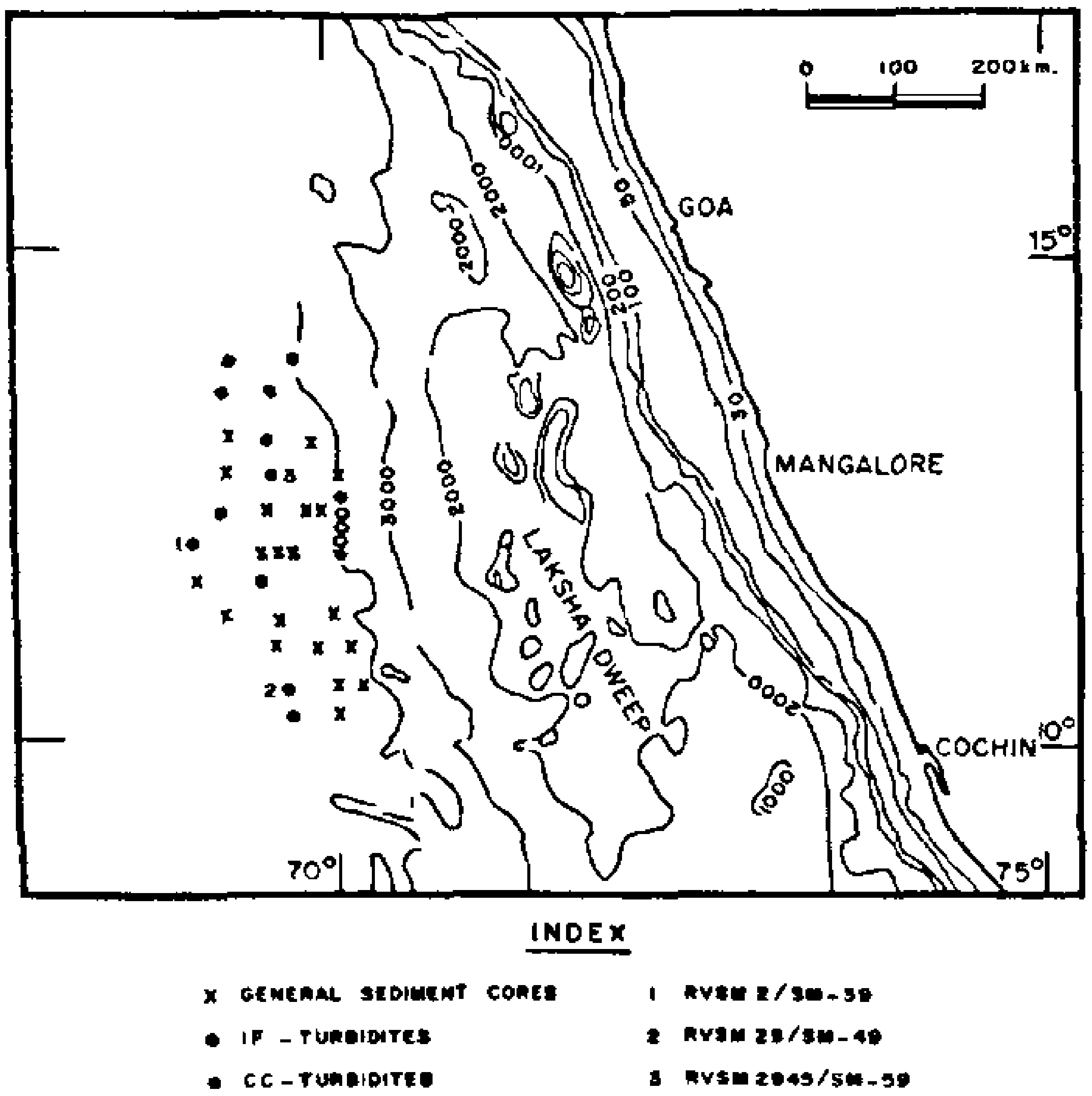

Figure 1. Map of the Arabian Sea abyssal plain showing the location of turbidites-bearing sediment cores.

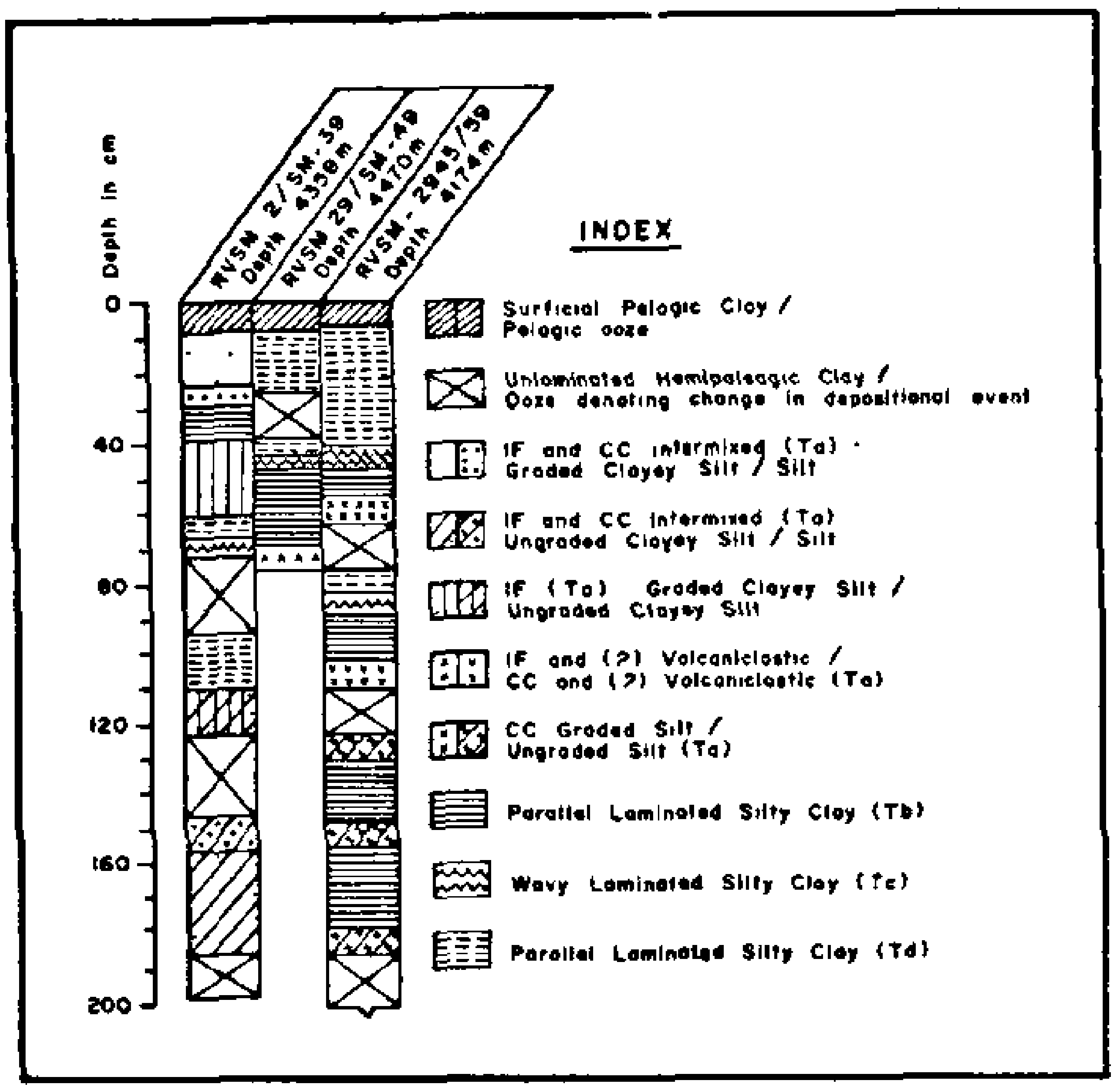

Figure 2. Vertical sequence of sediment cores indicating IF and CC turbidites.

between 25 and 156 cm below seafloor. Non-biogenic detrital minerals here constitute 40–45% of the coarse fraction (+4 phi size) and their amount generally increases at lower levels. Bulk of these minerals is distributed in silt-sized portion of the sediments.

The coarse fraction mainly comprises of anomalously isotrophic brown and green biotite (40–50%) and subangular to subrounded quartz (25 to 30%). Quartz sporadically contains crystallites and often displays strain shadows. Other minerals present are feldspar (10 to 15%), chlorite (5 to 10%), opaque minerals (1–2%), hornblende (1%) and less commonly glass shards, epidote, clinopyroxene and (?) glauconite. Among feldspars plagioclase is less than K-feldspar and is mostly altered. Zoned variety of plagioclase, microcline and perthite are not uncommon. Occurrence of feldspar may or may not be related to turbidites as it could also come from aeolian processes or submarine volcanism. Nevertheless alkali feldspar including microcline may indicate a continental provenance and these are relatively stable in marine regime when compared with plagioclase[5].

Bioclastic materials in the coarse fractions of IF-turbidites are mainly coral fragments (35 to 45%) followed by benthic foraminifers (2–5%), pteropods and miniscule bivalves (1–5%) and radiolarian tests (1–2%). Occurrence of varying amounts of coral fragments even in IF-turbidites might suggest inter-mixing of bio- and non-biogenic clastites from proximal and distal sources.

CC-turbidites contain abundant bioclastic materials viz. coral fragments, transparent pteropod tests, benthic foraminifers and a small amount of bryozoans, It is recorded from RVSM core 2945/59 (Figures 1 and 2) between 40 and 179 cm level. Acid insolubles comprise mica, quartz, glass shards and iron oxides.

The main components detected under microscope are subrounded to rounded coral fragments (50–70%), fragmented pteropod tests (5–8%), suspected volcaniclastite (4%), juvenile molluscs (2–3%), benthic foraminifers which are mainly biserial types and milliolites (2–3%), bryozoa (1–2%), ostracod (1%) and biogenic siliceous tests ~1%. Comminutized and juvenile planktonic foraminifers unrelated to turbidites constitute 15–20%. These bioclastites are chemically $CaCO_3$-rich and hence called calciclastites[6]. The calciclastic substance is periodically contributed by the carbonate platforms of Lakshadweep Ridge where hermatypic corals are colonized on an enormous scale.

Turbiditic sediments found in the sub-bottom sediments of the Arabian Sea abyssal plain adjoining the Lakshadweep Ridge are heterogeneous in origin and composition. This phenomenon could be due to admixing of laterally transported clastites from distal Indus and proximal ridge sources during late Quaternary. Dominant clastic fractions — coral fragments along with other bioclastic material on the one hand and mica, quartz and ferromagnesian minerals on the other determine whether they are essentially CC- or IF-turbidites in so far as this region is concerned.

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