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Received 11 June 1993; accepted 15 June 1993

Marine aerospora of the Indian Ocean along the Kerala coast – A preliminary report

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Aeromonitoring along the sea route from Cochin to Theingapatnam along the coast of Kerala was carried out with the support of the Geological Survey of India (GSI) ship *Samudra Shaudhikama*, by various methods. The occurrence of a large number of pollen grains and fungal spores of which *Cocos nucifera* and grasses among pollen-bearing plants and *Alternaria*, *Helminthosporium* and *Curvularia* among fungal taxa were significant. The study shows that the pollen grains travel to a distance of at least 25 km into the sea, and maybe also far beyond. The various applications of marine aerospora studies have been suggested.

AEROBIOLOGICAL surveys for gaining knowledge on pollen grains and spores have been confined to terrestrial locations mainly because of their relevance in the diagnosis and treatment of allergic diseases in man. Scant attention has been paid to marine aerobiological surveys all over the world, but for a few reports. Darwin[1] reported the occurrence of pollen carpet formation on the deck of the ship *Beagle* when it was berthed along the coast of South America, while Erdtman[2] reported the presence of pollen grains in the Atlantic. Both reports relate to the pollen of pines travelling about 1000 km. All the same, the knowledge on aerospora of the ocean not only has relevance in establishing the distance of the pollen travel, but is also of potential importance in the human allergy problems related to maritime travel, including those of fishermen. Further, the marine aerospora should also project the spectra of the flora along the coastline and beyond overland, as also the islands. In spite of the multidirectional significance, the study of marine aerospora has not received the attention it deserves.

As a part of a research programme on the palynological assessment of the coastal environment of the west coast of India, sponsored by the Oil and Natural Gas Commission (ONGC), Dehra Dun, marine aerospora were collected on the research ship of Geological Survey of India, *Samudra Shaudhikama*. The ship cruised at an average distance of 25 km from the coast of Kerala, starting from Cochin in the north to Theingapatnam in the South, covering a total distance of 250 km during the period of 7 days from 30 January 1993 to 6 February 1993.

The methods used included the exposure of adhesive-coated petri dishes, as well as slides placed in the aeroscopes installed on the 'monkey island' (9 m) and 'boat deck' (3 m above the sea level) of the ship. The slides were changed after every 25 km covered, which took 2 h. By means of a regular vacuum cleaner, the bag of which was inlayed with a plastic lining, air was drawn all along the journey at no fixed intervals. The slide changes were made at places corresponding to the locations along the coast.

The present report is intended to notify the occurrence of a large number of pollen types and also fungal spores in the marine air space, a list of which is given in Table 1.

A total of 580 grains were counted from 124 slides, of which the maximum number was of Poaceae (250), followed closely by *Cocos* (191); the other types (represented by at least 26 taxa) were in smaller numbers. Similarly, a total number of 215 fungal spores were noted, of which *Alternaria* (62) was maximum, followed by *Helminthosporium* (43) and *Curvularia* (24). A good number of unidentified ones were also present. Apart from the pollen grains and fungal spores, fungal hyphae, plant scales, trichomes, fish scales, mites, insects, and other biological particulates were also observed. Among all the slides, the set from Theingapatnam contained the maximum number of Poaceae and *Cocos* pollen, reflecting the nearness of the ship to the coast, which was just 2 km, and the dense occurrence of the above taxa in the area. Comparing the aerospora collections on the slides with those made by the vacuum cleaner, it may be pointed out that the pollen grains of *Cocos* over-dominated the aerospora, eclipsing the presence of other types, although the grass pollen was noticed as being the most predominant in the slide exposures. The coconut trees cover a considerable area of the whole wetland ecosystems, and the 'pollen rain' may be contributing to the organic sediments of not only the ocean floor but also the backwaters, and such pollen together with the benthic

Table 1.

Pollen grains		Fungal spores
Acanthaceae		*Alternaria*
Amaranthaceae		*Bilpolaris*
Annonaceae		*Bispora*
Azadirachta	(Meliaceae)	*Curvularia*
Bignoniaceae		*Cercospora*
Cassia sp	(Legumminosae)	*Dendriphiopsis*
Casuarina sp	(Casuarinaceae)	*Dreschlera*
Cructferae		*Fusarium*
Cucurbitaceae		*Helminthosporium*
Compositae		*Humicola*
Cyperaceae		*Nigrospora*
Cocos nucifera	(Palmae)	*Pithomyces*
Dalbergia sp	(Leguminosae)	*Spondylocladiella*
Eucalyptus sp	(Myrtaceae)	*Sporidesmium*
Euphorbiaceae		*Tetraploa*
Loranthus sp	(Loranthaceae)	Unidentified fungal spores
Liliaceae		Fern spores
Leguminosae		
Malvaceae		
Moringa sp	(Moringaceae)	
Mimoseae		
Papilionaceae		
Poaceae		
Ricinus sp	(Euphorbiaceae)	
Salmalia sp	(Bombacaceae)	
Solanaceae		
Umbelliferae		
Urticaceae		
Unidentified types		

biomass may in all probability be the source of food for the fishes. Thus, aerospora studies of the entire marine ecosystems are potent with newer directions of applications.

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ACKNOWLEDGEMENTS. We acknowledge the support and co-operation given by the Geological Survey of India and also by Captain A. M. Joseph and Mr A. R. Nambiar, Chief Scientist of the ship *Samudra Shaudhikama.*

Received 26 April 1993, accepted 17 May 1993

Evidences of climatic variations during Late Pleistocene–Holocene in the eastern Bay of Bengal

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Based upon the variations of clay minerals, sediment texture, heavy mineral assemblage and ^{230}Th excess in the Late Pleistocene sediments of a hemipelagic core from the eastern Bay of Bengal (2713 m water depth), 35 cm and 73–78 cm levels are assigned as Holocene–Pleistocene Boundary and Last Glacial Maxima (LGM) respectively.

Two dominant arid phases and weak monsoon around LGM (73–110 cm) and at Holocene–Pleistocene boundary are identified from high concentration of chlorite, C/I ratio maxima (aridity reflector), decrease in characteristic clay mineral suites of humid climate, i.e. smectite and illite and a low K/C ratio. The intensity of monsoon between LGM and 15 ky^{-1} has been cyclic, and enhanced thereafter until the beginning of Holocene as deduced from high smectite, reduced chlorite and higher K/C ratio of sediments in 40–73 cm section (LGM–Early Holocene). Between 35 and 40 cm, at the beginning of Holocene, a significant reversal in the climate from humid to arid, and associated decrease in the monsoon intensity is interpreted. Clay mineral assemblage (high content of smectite, low chlorite) and their ratios, sediment texture and absence of heavy minerals between 0 and 35 cm, reflect the prevalence of stronger monsoon since 10 ky^{-1} BP. Angularity of quartz, characteristics of heavy and clay mineral suites and presence of glass shards have been utilized to determine the source of the sediments to this part of the Bay of Bengal.

THE Bay of Bengal has witnessed sedimentation since Early Eocene, and is a unique site which has archived the signature of palaeoclimatic fluctuations witnessed in the catchment area of different fluvial sources, i.e. Himalayas, peninsular India, Andaman Island group and Burma. Studies of palaeoclimatic changes in the Bay of Bengal are very few[1–4], and are mostly confined to the isotopic variations and sedimentology of selective sections of a few cores. As such, detailed palaeoclimatic studies in the Bay of Bengal are still in a state of infancy.

Liberation of the sediments and formation of clay suites depend upon climate, characteristics of source rocks and relief of the area[5]. If the geology and relief of the area has not altered significantly, the variations in the clay suites produced from a source will be climatic-dependent, i.e. formation of kaolinite and gibsite under a very humid climate, illite and smectite during moderate–humid climate and chlorite by physical weathering under arid cold climate[6–8]. The variations