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Palynological studies and ^{14}C dating of a gravity core from the sea-bed west of Narcondam Island in the Andaman Sea

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The carbonate in sediments from a 1.38-m-long gravity core collected off Narcondam Island at a depth of 1134 m has been dated by the radiocarbon method. The age of the topmost sediment is 4500 ± 150 years BP and that of the base at 1.38 m, 20,100 ± 480 years BP. The sedimentation rate is rather uniform and has been calculated to be 9.3 cm per 100 years. Spores and pollen grains in the sediments are scanty, but phytoplankton are in abundance. The spores are mostly represented by *Lycopodium*, *Lygodium* and *Polypodium*, whereas the pollen belong to different taxa of coastal palms and mangroves. Peltate scales of mangrove plants are also occasionally found. Fragments of fusinite found in abundance from 1.18 m to 1.38 m of the core representing a time span of 2000 years between 18,000 years and 20,000 years BP, testify to intermittent volcanic activity at Narcondam Island during this period.

NARCONDAM is one of the two volcanic islands in the Andaman Sea (Figure 1). A 1.38-m-long gravity core collected 12 km west of Narcondam Island in the Andaman Sea at a depth of 1134 m by *RV Samudra Manthan* cruise 61 of the Geological Survey of India was dated by the radiocarbon method at the Birbal Sahni Institute of Palaeobotany and studied for palynological interpretations. The core collected in PVC Core Lines was transversely cut into two parts (0.00–0.70 cm and 0.70–1.38 m) on board immediately after collection and tightly sealed with blue and red caps. These were despatched to BSIP, Lucknow, within 30 days of collection. The sediment consists of clay and silty clay.

Method

At BSIP the core was cut longitudinally and from the sliced core, samples were carefully scooped out from measured depths (Table 1). Top 20 cm of the core was not studied because it was not compact and contained abundant water.

For the ^{14}C measurements, the sediment samples were not given any pretreatment. The hydrolysis of the

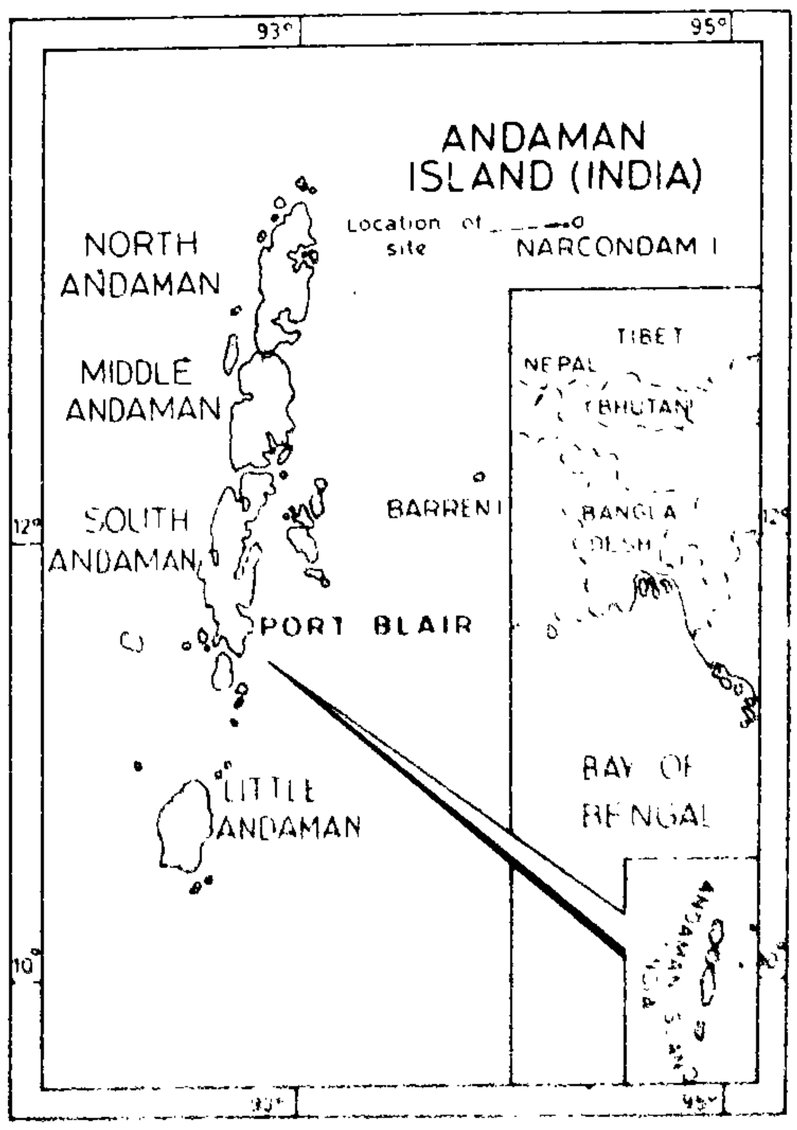

Figure 1. Location site of the sample

Table 1. Measured depth of the samples, their dry weight and age.

Sample BS No.	Depth (cm)	Sample dry weight (g)	Carbonate content (%)	^{14}C age ± 1 σ (years) ($T_{1/2}$ = 5730 ± 40 years)
892	21–27	95	16.0	5890 ± 130
890	40.5–48	110	11.3	10190 ± 180
888	62–67	110	15.3	13070 ± 200
893	83–90	100	11.7	14410 ± 360
889	100–107	100	13.4	16480 ± 360
887	110–115	--	--	15140 ± 640
891	130–138	110	10.7	20090 ± 480

samples was carried out by reacting with 10% HCl in a round-bottomed flask connected to the vacuum system. The carbon dioxide gas evolved by the reaction of HCl on carbonates present in the sample was collected after purification in glass traps immersed in liquid nitrogen (−196° C). CH_4 was synthesized from the sample CO_2 and tritium-free tank H_2 in a SS reaction vessel using ruthenium catalyst (E-Catalyst) at 480°C. The methane gas was filled into an Oeschger–Houtermann ^{14}C proportional counter and assayed for ~ 2500 minutes during the first counting. After a waiting period of nearly 30 days, to allow for the decay of radon if any, the samples were counted again for more than 1000 minutes. ^{14}C ages were calculated only if the counting rates of the first and second counting were within the 2σ range. In none of these sediment samples, radon was present. For modern sample ^{14}C counting rate, the contemporary radiocarbon standard of NBS oxalic acid RM-49 (74.59% of RM-49 counting rate) was used. Background measurements were made with coals of Tertiary period. Details of equipment and calculation of age and error from the counting rates are given in our earlier studies[1,2]. Table 1 gives the depth of the sample, dry weight of sample used for hydrolysis, quantity of carbonate calculated on the basis of CO_2 evolved and age with 1 σ error. Figure 2 is a plot of the ^{14}C ages against depth of the sample. The line passing through the points is the best fit line by least square method. The Y-intercept corresponding to the age of surface sediment is calculated as 4500 years. The rate of sedimentation given by the slope of the line is 9.3 cm/1000 years (Figure 2).

Samples for palynological studies were treated with HCl, HF and HNO_3 followed by a wash in 5% KOH. Slides were prepared with polyvinyl alcohol and mounted in Canada balsam. For organic matter investigation samples were macerated with HCl and HF only and no alkali treatment was given.

Palynological assemblage

The spores and pollen grains were scanty in the assemblage, while phytoplankton, radiolaria, silicoflagellates and diatoms are comparatively abundant. Spores of *Lycopodium*, *Lygodium* and *Polypodium* are present in some samples. Palm and *Calamus* pollen are occasionally met with; besides, peltate scales generally associated with leaves of mangrove trees are also recorded. Fungal elements are seldom found except for the sporadic presence of microthyriaceous ascostromata, some spores, e.g. *Tetraploa*.

Palynodebris

The distribution of organic matter in the studied sequence is shown in Figure 3. The organic matter is classified into structured terrestrial, pollen/spore, fusinite, amorphous (terrestrial and marine) and structured marine components. Fusinite, amorphous (terrestrial and marine) and structured marine organic matter are well represented. Fusinite and amorphous (terrestrial and marine) organic matter are inversely proportional in distribution in the sediments; in sediments at 1.18–1.38 m where fusinite is found in abundance, amorphous palynodebris is hardly encountered. Fusinite is also found in good percentage between 0.98 and 1.01 m but its character varies considerably from the material studied at 1.18–1.38 m. Fusinite found at 1.18–1.38 m

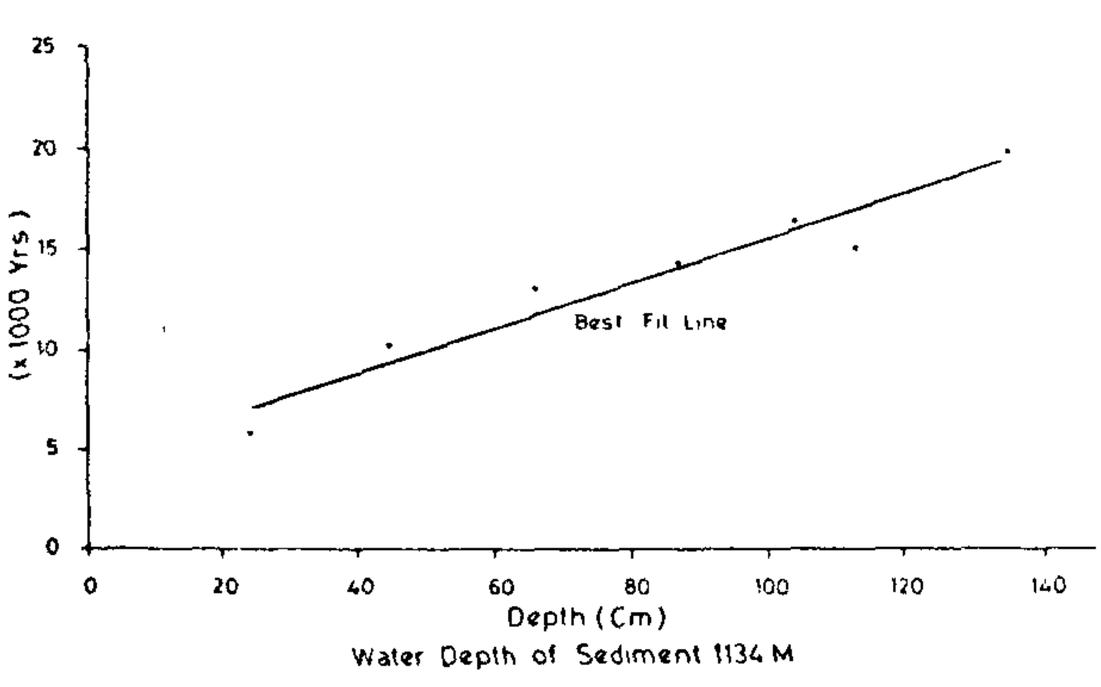

Figure 2. ^{14}C ages of the different samples studied.

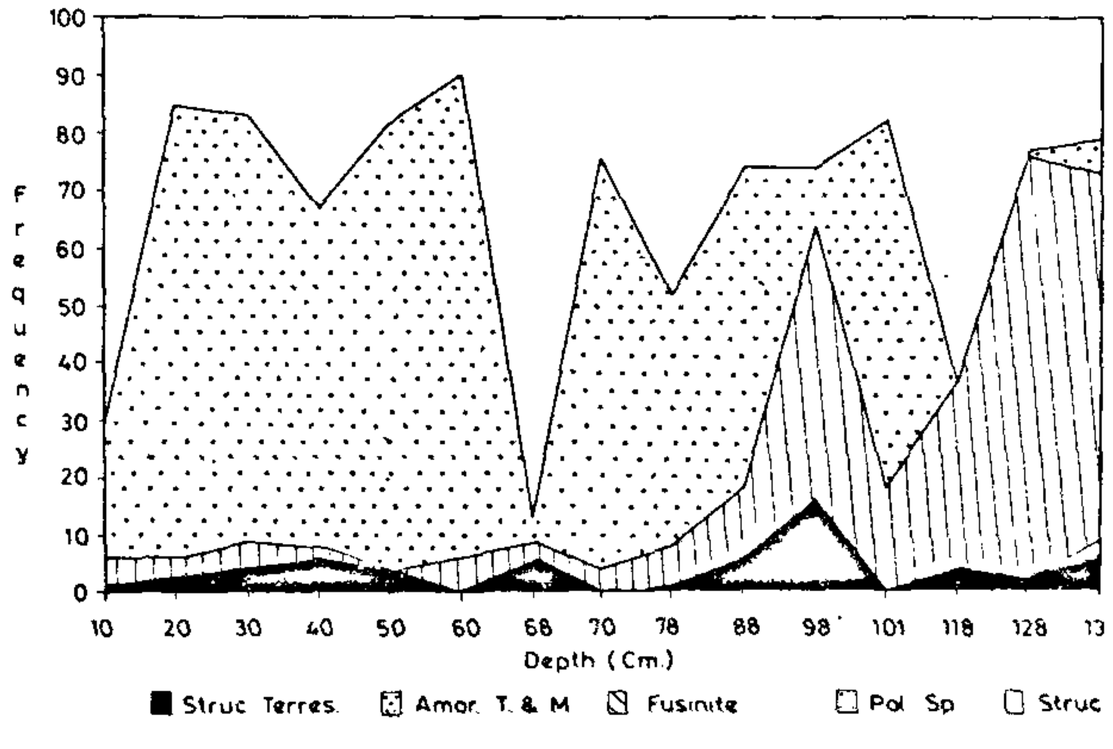

Figure 3. Frequency of the different dispersed organic matter.

exhibits distinguishable structure while that at 0.98–1.01 m does not show any bacterial degradation. Amorphous organic matter at 0.98–1.01 m is mostly biodegraded. The type of fusinite showing distinct structure which is also brittle and angular is the result of high temperature combustion of the woody organic matter[3]. The other type of fusinite showing biodegradation is formed at normal depositional condition and is found in abundance in many depositional environments.

Cope[4] and Prior and Alvin[5] observed that the middle lamella is not preserved and destroyed in fusinites affected by temperature greater than 280°C. Fusinites occurring in the Narcondam samples were studied under the SEM. It is observed that the middle lamellae are not preserved in the samples from 1.18 to 1.38 m interval, indicating the influence of fire on the woody material. This could be due to either normal forest fire or the result of volcanic eruption. The occurrence of forest fire in Narcondam Island seems to be remote as the conditions necessary for forest fire are not expected in a tropical and moist habitat. Since Narcondam is a volcanic island it is plausible that during 18 years BP (represented by 1.18–1.38 m) volca caused burning of forest, resulting in the pr pyro-fusinite which got deposited in the around the island.

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