total alkali contents of the basalts of these three areas which amounts to 4.21, 4.49 and 4.91% respectively. The MgO, CaO and Al_2O_3 values are also quite similar. The Na_2O and K_2O values are similar to those reported for alkali basalts of different regions[5].

The M' values (100 $Mg^{2+}/Mg^{2+} + Fe^{2+}$, calculated with Fe^{3+}/Fe^{2+} ratio as 0.10) for the present alkali-olivine basalts are 47.23 indicating that the fractionation process has played an important role in the evolution of these basalts.

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FLUCTUATING MONSOONAL PRECIPITATION AS REVEALED BY FORAMINIFERAL VARIATIONS IN A CORE FROM SHELF REGIME OFF KARWAR (INDIA)

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Monsoons in India were poor in 1986 and similar reports for 1987 are now available. There was severe drought in various parts of the country affecting crops and in turn the economy and our economic plans. Drought years need not cause too much hardship if they can be anticipated. This requires long term weather forecasting—a very difficult and delicate task. In order to predict the future behaviour of monsoons with a fair degree of accuracy, the study of palaeomonsoons becomes very important.

Rivers are known to affect physical and chemical conditions and biological and geological processes of the continental shelf regions adjoining their mouths, giving rise to distinctive microenvironments in these areas. The areal extent of these microenvironments depends upon the amount of freshwater discharge from the rivers. Variation in the intensity of monsoons i.e. in the volume of precipitation, would cause fluctuations in the average discharge through the rivers. A transgression and regression of these microenvironments can therefore be expected in phase with pulsating monsoonal discharge.

Any variations and/or cyclicity in the monsoons during the last few centuries could be deduced by examination of the see-saw movements of river-mouth microenvironments using foraminiferal data from sediment cores taken from the adjoining continental shelf. Such an attempt has been made by the present author and preliminary results are presented here.

Based on the foraminiferal distribution in surface sediments from the Dabhol Bhatkal sector of the west coast of India[1–7], Nigam[8] selected the species, *Cavarotalia annectens*[9,10] (Parker and Jones) to monitor the effect of freshwater discharge (through estuaries) on inner shelf foraminiferal fauna. It was observed[8] that this species was absent/rare in front of river mouths and the abundance of this single species from closely spaced sub-samples of a sediment core at any river-mouth would be helpful in the study of palaeomonsoons.

A box core (cross-section 15 × 15 cm, length 1.16 m) was collected on board *R. V. Gaveshani* during its 156th cruise on 17 November 1985 (figure 1) from a water depth of 25 m, in the shelf region off Karwar, in front of the mouth of the Kalinadi river. The core site was selected as Kalinadi is by far the largest river (length 69 km; average annual discharge 207 m^3/s) in the central west coast of India. Subsamples at every 2 cm for the top 10 cm and at

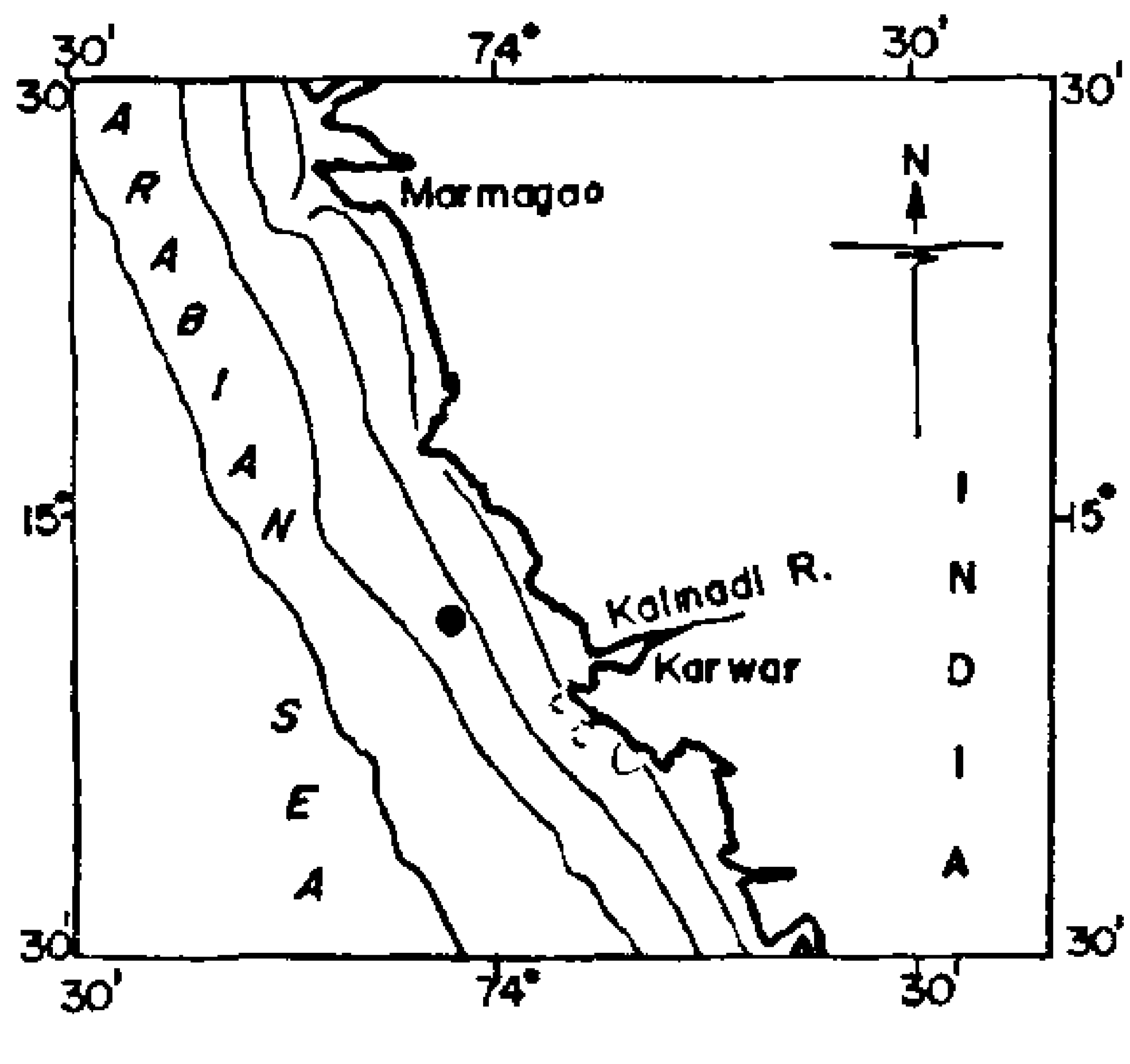

Figure 1. Map of the study area showing core location.

every 5 cm further down core were utilized for the present study.

Considering the rate of sedimentation (approx. 5 mm/year) in some nearby cores[11] from shelf, each sample represents a period of a few years. Therefore, the present sampling technique/intervals is expected to keep sediment mixing[12,13] to a minimum due to averaging. However, the annual monsoonal layering[14] cannot be studied and therefore is beyond the scope of the present work.

The percentage abundance of *C. annectens* in the total benthic foraminifera obtained for each sample and plotted against depth in core (figure 2) varied from 0 to 4.88%. In coastal areas, abundance of this species is inversely proportional to freshwater discharge; hence its low frequency should indicate higher discharge through rivers and thus better monsoons. If there is no change in monsoonal precipitation, the resultant distribution of *C. annectens* in core would remain constant. As this species shows considerable fluctuation in abundance, it would appear that monsoonal intensity had varied during the last few centuries. The dry and wet spells marked in figure 2 show that there is cyclicity in the intensity of time span equivalent to that required for the deposition of approximately 20 cm of sediment. It is also noticed that, after a very good monsoon some years ago (characterized by extremely rare *C. annectens* at a depth of 4 cm from the top), we are now going through a phase of higher salinity i.e. poor monsoons.

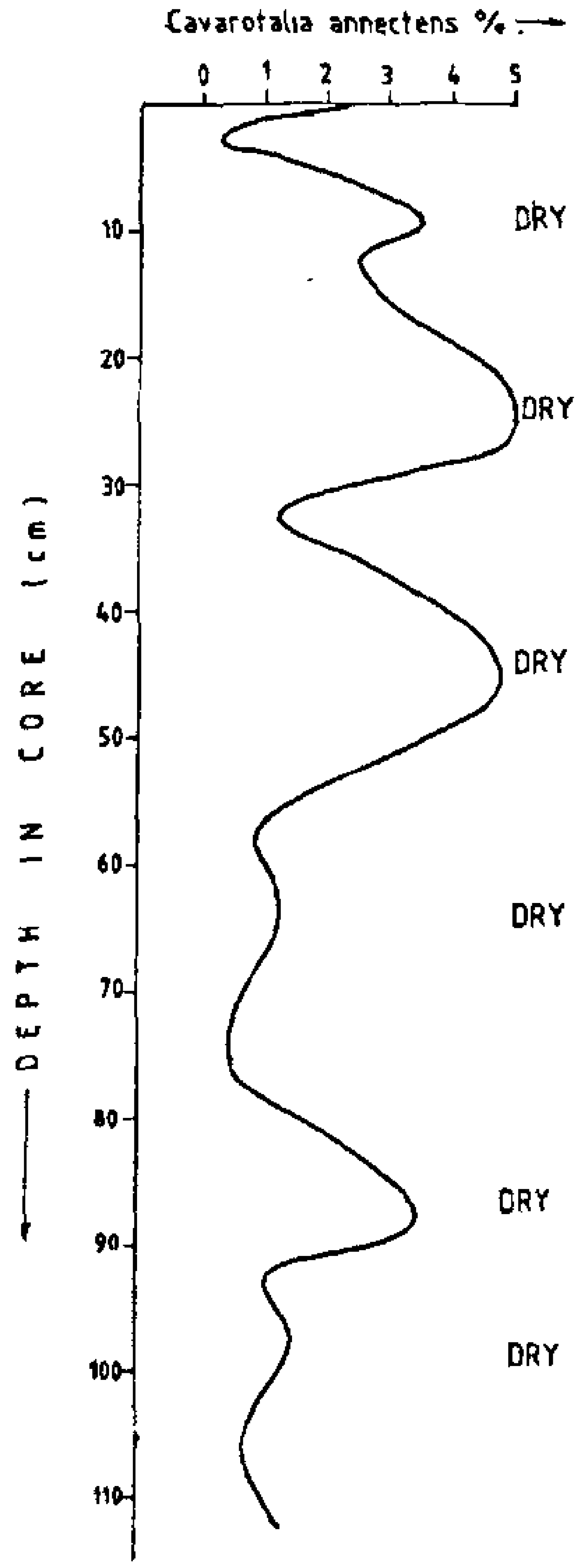

Figure 2. Variation in percentage frequency of *C. annectens* in core.

A detailed study involving dimorphic ratios, isotopic compositions of *C. annectens* and precise dating of the sediments to determine the exact timing of wet and dry spells and the nature of the cyclicity is in progress and will be published in due course.

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