

Data presented in tables indicate the agaroids obtained from both the species of red algae exhibit similarity in inorganic composition except for moisture, sulphate and crude protein content. However, a remarkable difference is observed in the physical properties of the two agaroids. Furthermore, the agaroid obtained from *H. musciformis* congeals only after the addition of inorganic electrolytes like KCl whereas the agaroid from *Faucheia* sp. congeals normally at room temperature without any addition of electrolytes. There are also considerable differences between the gel strength, setting and melting points of the two. It can, therefore, be said that the agaroid from *Faucheia* sp. is superior to that obtained from *H. musciformis* and it can probably be used as an alternative source for this phycocolloid.

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Vertical Distribution of the Degree of Calcium Carbonate Saturation in the Indian Ocean

S. W. A. NAQVI & C. V. G. REDDY

National Institute of Oceanography, Dona Paula 403004

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Degree of saturation of calcium carbonate as a function of depth has been studied at 3 locations in the Indian Ocean from alkalinity and pH measurements. Surface waters are 4-5 fold supersaturated with respect to calcite. Degree of saturation is maximum within the first 50 m. As the depth increases, the degree of saturation decreases and at about 1000 m the waters become either undersaturated or near-saturated.

SUPERSATURATION of surface waters with calcium carbonate in several areas of the oceans has been observed¹⁻⁶. The degree of saturation of water with this compound can be obtained either by satometry measurements^{5,7} or by dividing the concentration ionic product ($\text{Ca}_2^+ \text{CO}_3^{2-}$) (with the apparent solubility product (K_{sp}^1) under identical temperature, pressure and salinity conditions. Several authors have studied the apparent solubility product at 1 bar pressure as a function of temperature and chlorinity^{8,9} while the effect of pressure has been studied by others^{4,10}. Considerable information is available on the vertical distribution of the degree of saturation in the Pacific and Atlantic Oceans²⁻⁵.

However, no work has been reported from the Indian Ocean. Hence some studies have been made in this field from selected locations of the Indian Ocean.

The present data on alkalinity, pH, temperature and salinity were taken from the reports of MONEX I 1973 cruises in which four soviet research vessels *Priliv*, *Okean*, *Voeykov* and *Shokalaitsky* took part, and were used for the calculations of degree of saturation. Nansen type samplers were used for the collection of water samples during these cruises and the temperature was measured using deep sea reversing thermometers. Total alkalinity was determined by the titrimetric method of Gripenberg and salinity by Mohr-Knudsen titration technique.

Three deep stations were selected representing 3 different regions for which all the four required parameters were available at relatively short depth intervals.

Lyman's values¹¹ for the dissociation constants of carbonic and boric acids were used for the calculation of carbonate concentration. The effect of pressure was taken into consideration by using the equation:

$$\log (K_i^{(P)}/K_i^{(1)}) = -\Delta\bar{V}_i(P-1)/2.303RT \quad \dots(1)$$

where $\Delta\bar{V}_i$ is the change in partial molar volume for the reaction occurring in sea water, P the pressure, R the gas constant and T the absolute temperature. The superscript (P) indicates the pressure condition. Values of $\Delta\bar{V}_2$ and $\Delta\bar{V}_B$ were taken as $-10.7 \text{ cm}^3/\text{mole}$ and $-23.1 \text{ cm}^3/\text{mole}$ respectively¹².

For calculating the concentration of calcium, Wattenberg's equation was used

$$[\text{Ca}^{2+}] = 0.5 (\text{alk.}) + 0.000477 \text{ Cl}\%_0 \text{ (moles/litre)} \quad \dots(2)$$

Solubility product of calcite was calculated using the equation³:

$$K_{sp}^1 = (0.69 - 0.0063t) \frac{\text{Cl}\%_0}{19} \times 10^{-6} \text{ (moles}^2/\text{litre}^2) \quad \dots(3)$$

where t is the temperature and $\text{Cl}\%_0$ the chlorinity. Effect of pressure was calculated using Eq. 1 taking the value of $\Delta\bar{V}$ as $-29.7 \text{ cm}^3/\text{mole}$.

Degree of saturation is given by

$$DS = \frac{(\text{Ca}^{2+})(\text{CO}_3^{2-})}{K_{sp}^{1(P)}} \quad \dots(4)$$

The calculated values of the degree of saturation are estimated to be accurate to $\pm 10\%$.

Degree of saturation, calculated from the equation (4), has been plotted against depth. Values more than unity represent supersaturation while those less than unity represent undersaturation. Surface samples were 4-5 fold supersaturated with respect to calcite. Degree of saturation was invariably at maximum somewhere in the first 50 m depth. This may be attributed to a higher rate of photosynthetic activity in the subsurface layer resulting in an increase in pH and a decrease in dissolved CO_2 . A maximum in pH and a minimum in total CO_2 content were observed at this depth. As the depth increases, the degree of saturation decreases—first rapidly down to a depth of about 200 m and then gradually in deeper layers. In the near-surface waters, photosynthesis exceeds respiration and decomposition,

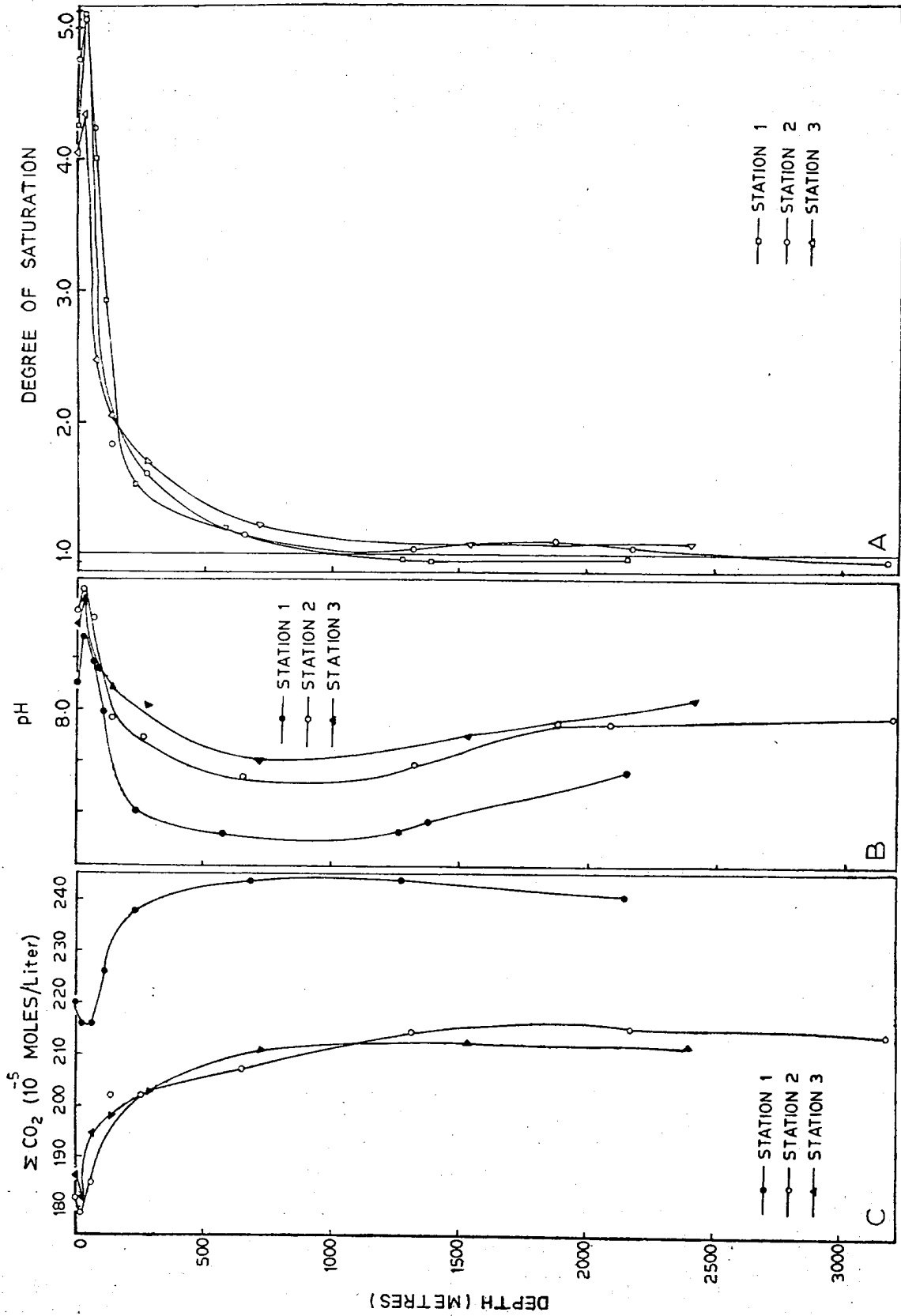


Fig. 1 — Depthwise distribution of (A) degree of saturation, (B) pH and (C) ΣCO_2 at stations 1 to 3

but as the depth increases, respiration and decomposition become more important leading to the production of CO_2 and the utilization of oxygen. Hence the degree of saturation decreases. At station 1 (off the central west coast of India; $16^\circ 00' \text{N}$, $77^\circ 27' \text{E}$; date of sampling, 10 June 1973), a crossover from supersaturation to undersaturation was observed at approximately 1000 m (Fig. 1A) after which the degree of saturation became almost constant down to a depth of about 2100 m. pH increased after passing through a minimum at about 1000 m depth (Fig. 1B). Increase in carbonate concentration due to increase in pH is balanced by increase in solubility product of calcite. At station 2 (along the equator $0^\circ 07' \text{N}$, $59^\circ 43' \text{E}$; date of sampling, 2 June 1973), the water was near-saturated at about 1000 m. Degree of saturation at this depth reached a minimum corresponding to a minimum in pH . Beyond this depth, degree of saturation gradually increased down to a depth of about 1800 m to a maximum, associated with an increase in pH . At greater depths it again tended to decrease. This decrease in the degree of saturation with depth is largely due to the increase in the solubility product. A crossover from supersaturation to undersaturation was observed around 2600 m. This pattern is similar to the one reported by Ben-Yaakov and Kaplan⁵ for the Pacific Ocean with the exception of maximum in the subsurface layer. However, at the depth where a minimum occurs, the water was not found to be undersaturated as reported by these authors in the Pacific waters. At station 3 (off the Somali coast, along the equator; $0^\circ 0' \text{N}$, $48^\circ 0' \text{E}$; date of sampling 19 June 1973), no crossover was observed down to a depth of approximately 2400 m. However, the water showed only slight supersaturation at about 1000 m and continued to be so down to 2400 m. Since the calcium concentration at all stations particularly below 1000 m was found to be nearly constant ($\pm 1\%$), the difference in depths at which the crossover from supersaturation to undersaturation occurs, may be attributed largely to the differences in the total carbon dioxide (Fig. 1C) and the associated equilibria of the carbon dioxide system in the sea water determining the concentration of carbonate ion.

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Distribution of Phenolic Acids in Soils from Two Mangrove Areas of Goa

N. G. K. KARANTH, P. A. LOKABHARATHI & SHANTHA NAIR

Biological Oceanography Division, National Institute of Oceanography, Dona Paula 403004

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Mangrove soil samples from Agacaim (6 km from Zuari river mouth) contained *p*-hydroxy benzoic, *p*-coumaric, vanillic, phloretic, ferulic and syringic acids while samples from Banastarim (15 km from Zuari river mouth) contained all others except the last two. The origin and chemistry of these phenolics in the mangrove soil appears to be important and may provide a clue to the processes involved in the degradation of organic matter of the mangrove swamps.

SOME phenolic compounds which occur in soil as degradation products of lignins, humus and other polymeric materials are known to be toxic to plants^{1,2}. Although there are reports on the pattern of phenolics present in the orchards and agricultural soils³⁻⁵ very little information is available on the types of these compounds in the specialized environments such as mangroves. Therefore, it is desirable to look into the pattern of these phenolics in mangrove soils with a view to studying their microbial metabolism and the consequent effect on the plant growth. The present paper deals with the isolation and identification of phenolic acids in soils from 2 mangrove areas of Goa.

Standard phenolic acids were obtained from Sigma Chemical Co., St Louis, USA, and also from Koch-Light Laboratories Ltd, U.K. Other chemicals were of AnalaR grade. Distilled peroxide-free ether was used throughout the studies.

Soil samples were collected from 2 mangrove areas, (i) Agacaim about 6 km from the Zuari river mouth, and (ii) Banastarim in the Cambarjua canal, about 15 km from the Zuari river mouth. The samples were collected in January and March 1975 from the top 15 cm of the bottom soil. Undecomposed plant residues were removed and the soil analysed in duplicates.

Isolation and identification of phenolic acids — To approximately 2 kg of soil sample, ethanol (95%) was added immediately after the collection to suppress any alteration of phenolics by microbial activity. The suspension was adjusted to pH 11 by the addition of 10N NaOH. The sample was then mixed well and left for 24 hr with periodic stirring. At the end of this period, pH was checked again and readjusted to 11. The clear supernatant solution