MANGANESE IN THE SHELF SEDIMENTS OFF THE WEST COAST OF INDIA

P. S. N. MURTY
National Institute of Oceanography, CSIR, Rafi Marg, New Delhi-1

AND

CH. M. RAO AND C. V. G. REDDY
National Institute of Oceanography, Ernakulam

AS a part of the programme aimed at understanding the nature and distribution of different elements in the marine sediments fringing the west coast of India in relation to their source and environmental factors, the distribution pattern of manganese has been determined and the results of the same are presented in this short note. The locations of the stations from where the sediment samples were collected are given in Fig. 1.

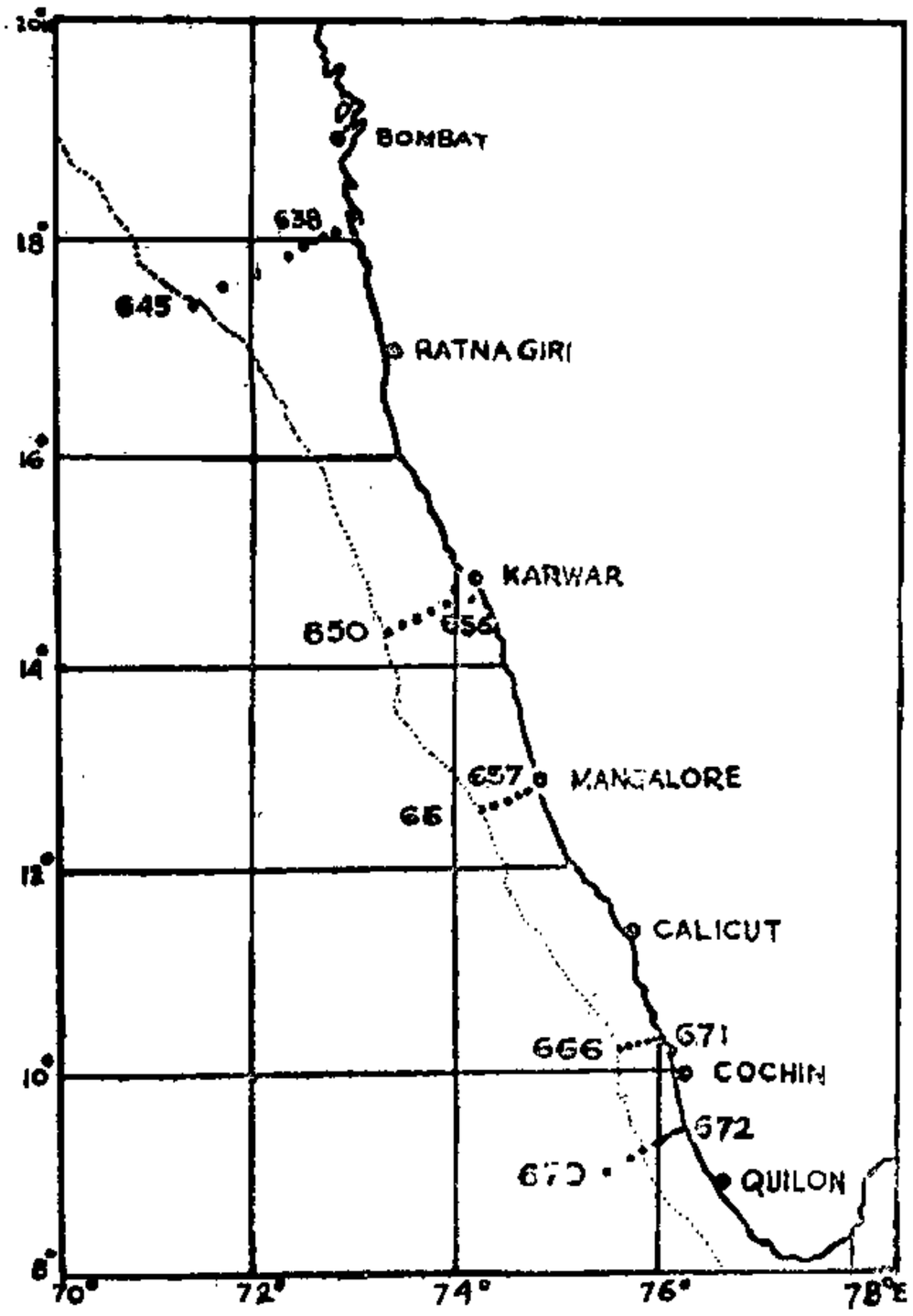
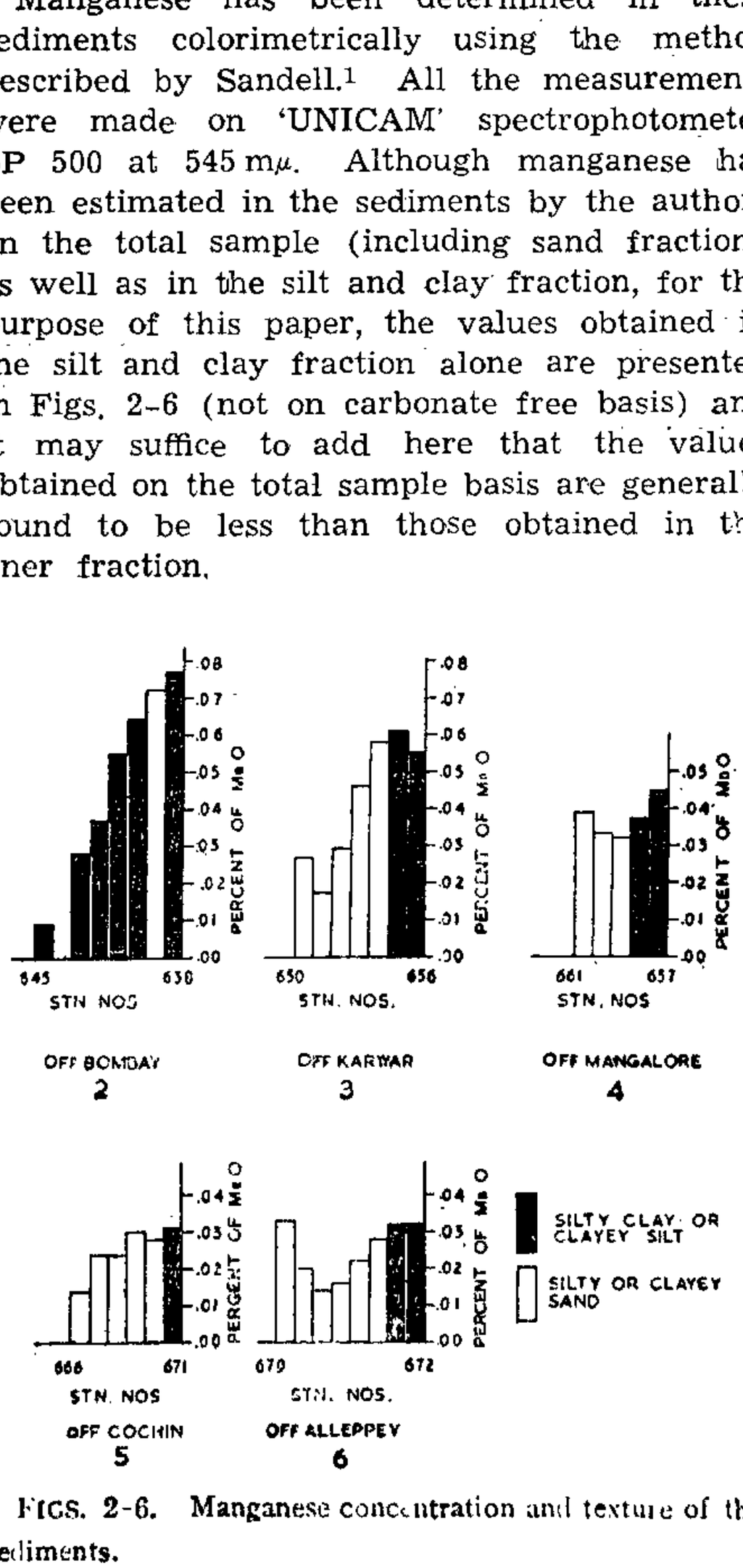


FIG. 1 Map showing the station locations.

In the area under study, the sediments exhibit a well-marked zonation in regard to their distribution in that the inner shelf (upto a depth of about 20 fthm.) is covered by silty clays or clayey silts and this is followed by a zone of silty or clayey sands in the rest of the shelf and slope regions. This is particularly so between Alleppey and Karwar while off the Bombay coast, the shelf, for the greater part, is covered by fine-grained sediments.

Manganese has been determined in these sediments colorimetrically using the method described by Sandell.[1] All the measurements were made on 'UNICAM' spectrophotometer SP 500 at 545 mμ. Although manganese has been estimated in the sediments by the authors on the total sample (including sand fraction) as well as in the silt and clay fraction, for the purpose of this paper, the values obtained in the silt and clay fraction alone are presented in Figs. 2-6 (not on carbonate free basis) and it may suffice to add here that the values obtained on the total sample basis are generally found to be less than those obtained in the finer fraction.



FIGS. 2-6. Manganese concentration and texture of the sediments.

An examination of data presented in

Fgis. 2-6 reveals the following distribution pattern for the manganese in these sediments :

(i) There is a progressive increase in the manganese content of the sediments from south to north.

(ii) Along any given section, there is a progressive decrease in the manganese content in a direction seaward and away from the coast and

(iii) Along all the sections except off the Bombay coast, the sediments in the slope region are slightly more enriched in their manganese content than the immediately adjoining sediments in the shelf region.

The manganese content of the deep sea deposits has been attributed to different agencies : volcanic eruption, submarine weathering, chemical precipitation, biological extraction, etc. But in the case of the shelf deposits forming not far away from the land, the source must be found in the adjacent land mass itself. Manganese is carried to the sea both in solution and as a constituent of sedimentary debris (Murata, 1939).[2]

During weathering manganese is dissolved mainly as bicarbonate. Divalent manganese is readily oxidised to quadrivalent state when the waters bearing the manganese come into contact with the atmospheric or dissolved oxygen in the lake waters or the shallow near-shore waters. pH is another important factor controlling the migration of manganese and the colloidal hydroxides of manganese precipitate at pH 6. According to Rankama and Sahama[3] this precipitation takes place mostly in the river waters itself, while some manganese is precipitated in the brackish water areas. Thus what little manganese that is supplied to the sea will be preserved in the sediments as long as they are in contact with oxygenated waters.

The progressive decrease in the manganese content of the sediments in the seaward direction shows that the contribution is practically from land. A consideration of the distribution pattern of the sediments (particularly between Alleppey and Karwar) shows that the inner shelf is characterised by high rates of sedimentation. The sediments in the outer shelf have been described as relict sediments by Nair *et al.*[4] which are characterised by a high content of carbonate. The favourable hydrographic conditions for the deposition of fine-grained sediments in the inner shelf and the adsorption of manganese by these colloidal particles may account for the relatively high manganese observed in the inshore sediments along all the sections. While this is so in any given section, the manganese distribution shows a definite trend in the north-south direction also in that it decreases progressively from north to south. The climatic conditions on land and the hydrographic conditions in the shelf region being similar along the different parts of the west coast of India, the decreasing trend towards the south may have to be attributed to the differences in the rock types present along the different parts of the west coast of India (Deccan traps along the Bombay coast, Granitic rocks along the Mysore coast and the Tertiary and Sub-Recent formations, Peninsular gneissic complex and the Charnockitic rocks along the Kerala coast). The low values of manganese observed in the sediments of the 'Vembanad Lake' in Kerala State and the associated rivers by one of the authors (Murty, unpublished) confirms this surmise.

The sediments in the slope region are slightly enriched in their manganese content than the immediately adjoining sediments in the shelf region, along all the sections except off Bombay. Murty *et al.*[5] have reported high organic matter content in the slope sediments of the area under study and attributed the same to its preservation under a reducing environment. While the low manganese content off the Bombay coast is understandable in view of the fact that part of the manganese precipitated may be redissolved at the bottom under reducing conditions, it is difficult to explain enrichment in the slope sediments of other regions, particularly in view of their similarity in texture as well as composition to the immediately adjoining shelf sediments (silty or clayey sands characterised by high carbonate content). The only possible reason which can be offered is that these slope sediments are characterised by a high content of foraminiferal tests and perhaps manganese has been extracted from the waters by the planktonic foraminifera and preserved in their tests. The possibility of biological extraction of manganese from solution in sea-water involving the ingestion of this element by planktonic foraminifera and retention in their shells has been suggested by Correns[6] and confirmed by Goldberg *et al.*[7] as a mechanism contributing to the process of bringing manganese to the sediments.

ACKNOWLEDGEMENT

The authors wish to thank Dr. N. K. Panikkar, Director, National Institute of Oceanography,

CSIR, for his keen interest and encouragement in the present investigations and Shri R. Jayaraman, National Institute of Oceanography, CSIR, for his helpful suggestions in the preparation of this paper.

1. Sandell, E. B., *Colorimetric Determination of Traces of Metals*, Interscience, New York, 1950.
2. Murata, K. J., *Amer. Jour. Sci.*, 1939, **237**.
3. Rankama, K. and Sahama, Th G., *Geochemistry*, The University of Chicago Press, Chicago, 1950.
4. Nair, R. R. and Abraham Pylee, *Abstracts of Papers, NISI/INCOR Symposium on Indian Ocean*, March 2-4, 1967.
5. Murty, P. S. N., Reddy, C. V. G. and Varadachari, V. V. R., *Proc. Nat. Inst. Sci. India* (In press).
6. Correns, C. W., *Nachr. Akad. Wiss. Gottingen, Math., Phys.*, Kl., 1941, **5**.
7. Goldberg, E. D. and Arrhenius, G. O. S., *Geochim. et Cosmoch. Acta*, 1958, **13**.

INFLUENCE OF HEAT ON SOIL STRUCTURE

G. KASI VISWANATH AND S. C. PILLAI
Department of Biochemistry, Indian Institute of Science, Bangalore-12

IT has been known from time immemorial in India that heating a soil, either by lightly burning it or by burning stubble on it, will increase the yield of the following crop.[1] A similar practice in areas having intense dry season is to leave the bare soil exposed to the sun, so it gets baked out. This is again practised in India and in Egypt.[1] However, the scientific basis for this age-old practice is not fully understood.

Early Experiments

In 1888 Franke[2] gave some experimental evidence on the effect of heat on soil: he obtained larger crops of oats and of yellow lupines on heated than on unheated soil; and he showed also that heating increased the solubility of the mineral and of the organic matter in the soil. Five years later Liebscher[2] stated that the sterilisation of soil by steam increased the availability of the phosphates and nitrogen compounds.

Russell and his co-workers,[2-5] who investigated the influence of partial sterilisation of soil on the production of plant food in the early years of this century, reported that when a soil had been heated to 95° C. it produced two, three, or sometimes four times as much crop (*e.g.*, spinach, tomato, turnips, lettuce and tobacco plant) as a portion of the soil which had not been heated.[3] They obtained such results not only with fertile soils but with an exhausted Rothamsted soil. They stated that the heat treatment had in some way brought about a considerable increase in the amount of nitrogen, phosphorus, and potassium obtainable by the plant.[3]

Experiments with "Sick" Soils

Russell and Petherbridge studied the effect of temperature and of antiseptics, such as toluene and carbon disulphide, on "sick" soils from glass-house (sick soils occur in different parts of the world, *e.g.*, beet sickness on the Continent,[4] the flax and corn-sick soils of Dakota,[4] U.S.A.: sewage-sick soils at Kegworth,[6] U.K., Baroda[7] and Bangalore,[8] India) and reported that "exposure to a temperature of 96°–98° C. for two hours has proved the most effective because it not only kills destructive and parasitic organisms, including *Heterodera*, but also effects a certain amount of decomposition, thus lightening the subsequent work of bacteria and bringing about certain secondary results, notably a great development of fibrous root".[4] Russell and Golding,[6,9] who studied sewage-sickness in soil and its amelioration by partial sterilisation, also reported that heating the soil or treating it with antiseptics was effective. Russell and his co-workers believed that the sickness in glass-house soils and sewage-sickness in soil are, in part, due to an abnormal development of a factor always present in ordinary soils and detrimental to bacteria.[6] This harmful factor, which was identified as the protozoa such as *Colpoda cucullus*,[3] *amœbæ*,[9] *Euglena*[9] and *Vorticella putrina*,[9] was put out of action by heat or by antiseptics. The soils thus treated produced more crops.

For over three decades the effect of sewage as a manure as well as irrigation water on soil conditions and plant growth has been under continuous study in this Department. The