

BORON IN THE MODERN DELTAIC SEDIMENTS OF THE KRISHNA RIVER AND ITS OFFSHORE REGION, EAST COAST OF INDIA

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ABSTRACT

Boron concentrations in the clay fraction of the sediments from different subenvironments of the Krishna Delta are estimated. The estuarine and marine sediments have higher content of boron relative to the sediments of the fresh water zone of the river channel. Variations in distribution pattern of boron in the delta are discussed in relation to salinity, sedimentation rate, clay minerals and organic carbon.

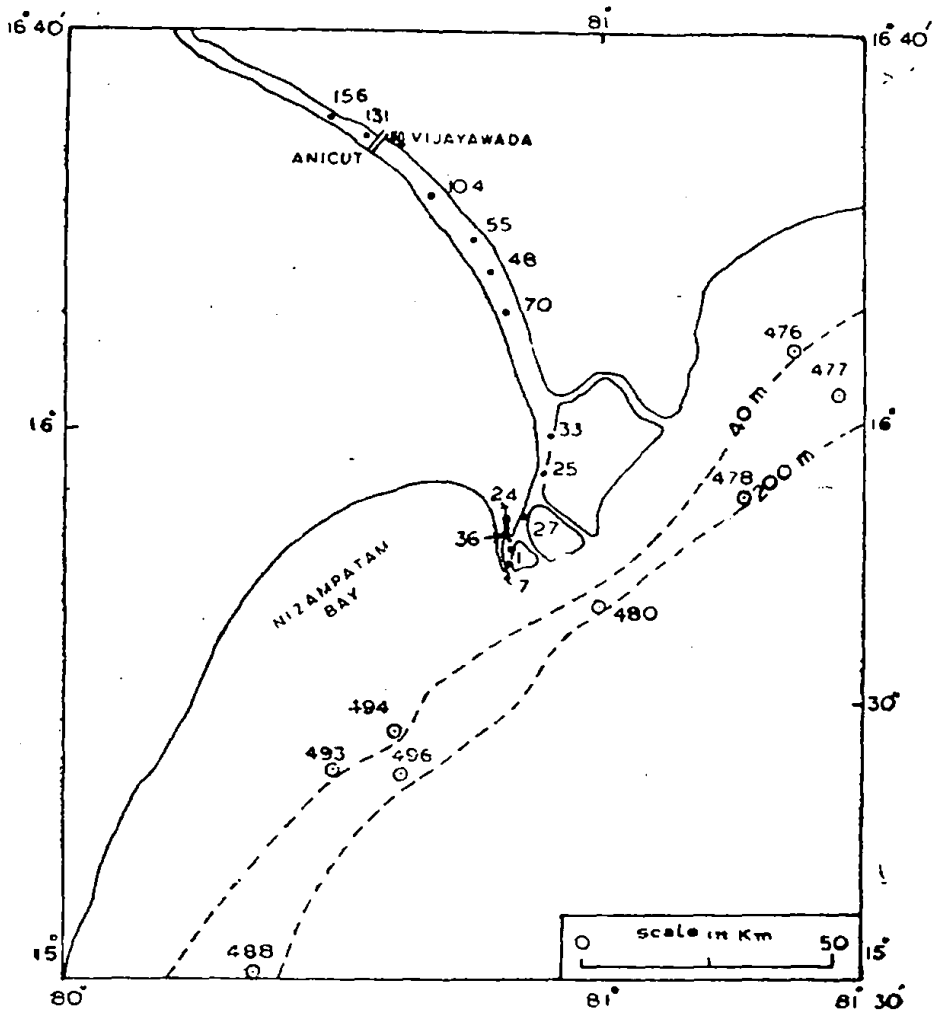


Fig. 1 Krishna river delta.

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INTRODUCTION

Much attention has been paid to the geochemistry of boron in recent sediments since Landergren (1945) has pointed out its utility as a salinity indicator. In the present paper an attempt has been made to understand the distribution pattern of boron in the deltaic sediments and its utility in differentiating various subenvironments of the delta. The Krishna River stretching over a length of about 1280 km is one of the large rivers in India with a drainage area of 2,52,500 sq. km and a maximum discharge of about 1,193,901 sec³ (Khosla, 1951). The river traverses through a number of geological formations (mostly Deccan Traps and Unclassified Crystallines) before debouching into the Bay of Bengal. The material carried in suspension by the river at Anicut (Vijayawada) is computed to be

4,221 cubic feet/year (Anonymous, 1957). The sediment samples were collected during pre-flood season (March-May) in the deltaic part of the Krishna River (Fig. 1). Marine core samples of the delta were obtained in the 18th cruise of INS *Kistna* during the International Indian Ocean Expedition. The estimation of boron in the clay fraction of the sediments has been carried out by spectrophotometric method using caraminic acid (Hatcher and Wilcox, 1950). Potassium was determined by the flame photometer (Jenkins, 1954). The procedure given by Allison (1935) was adopted in estimating organic carbon.

The contents boron, potassium and organic carbon in the Krishna deltaic sediments are given in Table I. Scatter plot diagrams of boron versus river distance from Anicut, potassium and organic carbon are shown in Fig. 2.

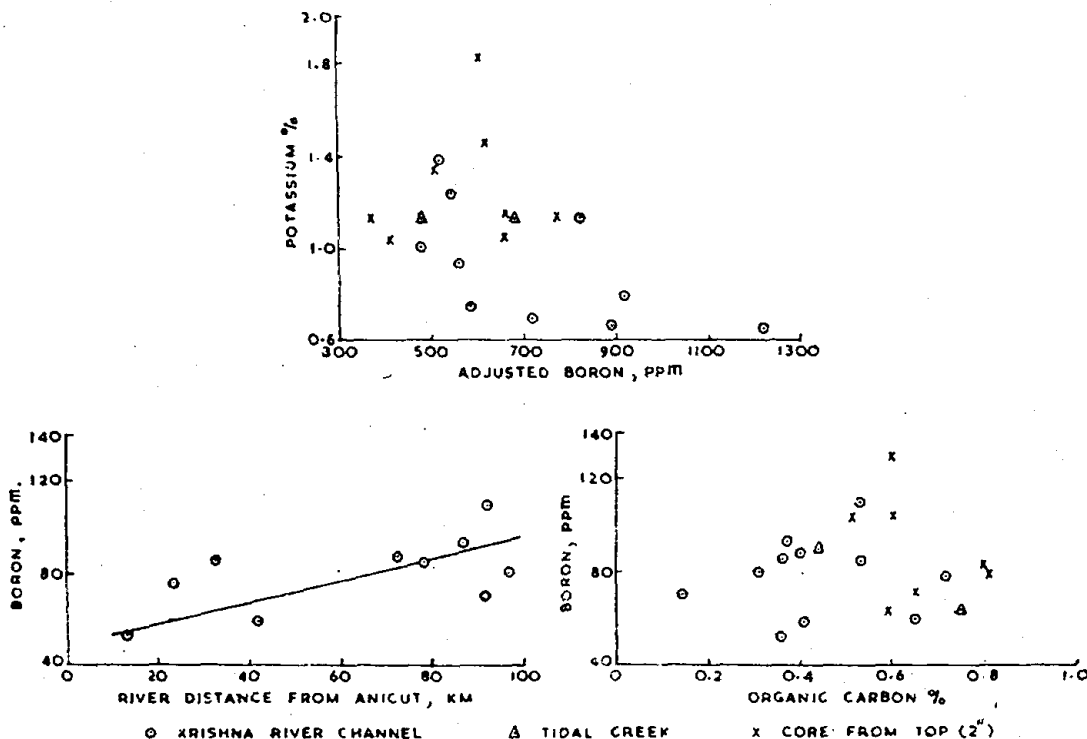


FIG. 2. SCATTER PLOTS OF BORON VS. RIVER DISTANCE ORGANIC MATTER AND POTASSIUM.

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TABLE - I
Distribution of boron, adjusted boron, potassium and organic carbon in the modern deltaic sediments of the Krishna River.

Sample No.	Boron ppm	Adjusted boron Observed Boron $\times 8.5$ $K_2O\%$	Potassium K%	Organic Carbon %
<i>River channel :</i>				
156	70	908.4	0.655	0.139
131	59	716.4	0.700	0.413
104	52	589.2	0.750	0.359
55	78	701.7	0.945	0.720
48	86	913.7	0.800	0.358
70	59	479.9	1.045	0.652
<i>Estuary :</i>				
33	88	656.1	1.140	0.400
25	85	519.8	1.390	0.537
27	93	1216.0	0.650	0.375
1	110	820.2	1.140	0.534
7	80	548.4	1.240	0.315
<i>Tidal creek :</i>				
24	65	484.6	1.140	0.746
36	91	678.4	1.140	0.443
<i>Marine :</i>				
476	80	507.5	1.340	0.809
477	89	663.6	1.140	0.949
478	63	512.4	1.045	0.589
480	71	370.2	1.630	0.646
494	104	775.4	1.140	0.519
496	130	605.3	1.825	0.603
493	104	613.8	1.440	0.604
488	80	650.7	1.045	0.814

The concentration of boron ranges from a minimum of 52 ppm to a maximum of 130 ppm with an average of 78.2 ppm in the deltaic clays. This value is comparatively lower than the boron content of deltaic clays (82 ppm) mentioned by Hirst (1962). There is a general down-

stream increase in the boron content of the deltaic clays with lowest concentrations (average 64 ppm) in the fresh water zone of the river channel upstream of the Anicut and somewhat enriched boron in the estuarine (average 91.2 ppm) and marine (average 90.1 ppm) environ-

ments. Though the salinity values at each of the sample locations are not available, it may be considered that boron exhibits an almost direct relationship with salinity, since the profile of salinity shows an increasing trend downstream (Swamy, 1970). Such an affinity has been observed by Landergren (1945), who noted that boron content of hydrolyzate sediments varies with salinity of water in which they were deposited. Further, Kukal (1971) has stated that in Recent sediments a direct relation between salinity of waters and the content of boron in sediments has been proved to exist. However, in the marine environment of the Krishna Delta, where there are no marked salinity variations, the northern part shows significantly low boron content compared to the southern part. This may be due to high sedimentation rates in the northern part where there will be insufficient time for adsorption process to operate to any appreciable extent.

It is unlikely that variation in the distribution on boron is dependent on variation of clay minerals in the Krishna deltaic sediments. The clay mineral composition of the deltaic sediments comprises of abundant montmorillonite with minor amounts of kaolinite and illite (Swamy, 1970). Montmorillonite content is more or less uniform throughout the deltaic sediments. Harder (1961) demonstrated that illite adsorbs consi-

derably more boron than either montmorillonite or kaolinite. But, in view of the very low illite content in the deltaic sediments and the antipathic relationship between adjusted boron and potassium (Fig. 2), it is considered that boron is not concentrated in illite. Borate ions in solution may be adsorbed into the montmorillonite because of their similarity in size and geometry to silicon and aluminum (Goldberg and Arrhenius, 1958; Hawkins and Roy, 1963).

A slight covariance of boron with organic carbon (Fig. 2) has been observed in the deltaic sediments. Such relationship between organic carbon and boron has been noticed by Boon and Mac Intyre (1968) in the estuarine sediments. Eager (1962) has pointed out that the organic content and boron are intimately related. Further, he has shown that the presence of soluble organic matter in the depositional environment will control the effective geochemical affinity of dissolved boron.

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