

Boron, calcium and magnesium in Kavaratti lagoon water, Lakshadweep Archipelago

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Analysis of major elements in the water of Kavaratti lagoon show variations in the concentrations of boron from 4.08 to 4.25 mg kg⁻¹ (av. 4.15 mg kg⁻¹); calcium from 420.4 to 429.3 mg kg⁻¹ (av. 424.79 mg kg⁻¹); magnesium from 1228.8 to 1319.8 mg kg⁻¹ (av. 1280.19 mg kg⁻¹) and the salinity varied from 35.01 to 35.10 × 10⁻³ (av. 35.04 × 10⁻³). The ratios of boron, calcium and magnesium to chlorinity in the lagoon water showed wide variation and were very much lower than that of the surface seawater outside the lagoon indicating their removal. In the lagoon, the calcium and magnesium removal was attributed to their involvement in the biological precipitation of carbonates whereas the removal of boron was attributed to its co-precipitation with carbonates.

Various physical, chemical and biological studies of the Lakshadweep sea and Kavaratti lagoon carried out over the past two decades showed considerable variability in the physico-chemical and biological characteristics of these waters¹⁻⁴. The major element calcium has been well studied in the Lakshadweep sea as well as in the Kavaratti and Minicoy lagoon^{5,6}. However, no information is available on boron and magnesium in these waters. Hence, the present study was initiated on boron, calcium and magnesium in the Kavaratti lagoon with respect to one station outside the lagoon. The distribution and significance of these elements in the lagoon are also presented.

Kavaratti is an island of the Lakshadweep group of islands and is situated along 10°35'N lat. and 72°36'E long. It is a perfect atoll⁷ with an island situated on the east, occupying an area of 3.45 km (Fig.1) and a shallow lagoon² (4.5 km long and 1.2 km wide, with an average depth of 2 km). The transport of water from sea to the lagoon is always by waves which break across the reefs.

Surface and bottom water samples were collected from four selected stations (Fig.1), using Niskin sampler during the *ORV Sagarkanya* cruise No

105-A from 19th-24th Sept. 1995. The stations in the lagoon were fixed in such a way so as to cover the entire area.

The samples after collection were preserved in the deep freezer and were later analysed for salinity and major elements soon after they were brought to the shore laboratory. The salinity was measured by the argentometric titration method⁸ whereas,

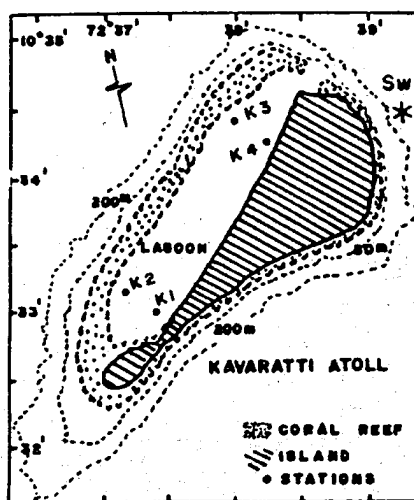


Fig.1—Map showing location stations

calcium and magnesium were estimated by the method of Culkin & Cox⁹. Magnesium values were corrected for strontium and for the end point overestimate as suggested by Carpenter & Manella¹⁰. Boron was determined by the Carminic acid method of Hatcher & Wilcox¹¹.

The major ions showed significant variability in the lagoon and indicated considerable difference in the surface and bottom values. However, the salinity of lagoon water which showed a narrow range of variation from 35.01 to 35.10×10^{-3} indicated no difference between the surface and bottom levels. Figure 2a shows that a fairly uniform salinity of 35.0×10^{-3} exists at three stations (Stn. K1 to K3) without any difference in the surface and bottom waters. However, at Stn. K4 a slightly higher

salinity of 35.10×10^{-3} is encountered. This increase in salinity at Stn K4 though small, indicates the effect of seawater transport to the lagoon due to its proximity to the entrance to lagoon.

Calcium in lagoon water showed variation from 420.4 to 429.3 mg kg^{-1} with an average of $424.79 \text{ mg kg}^{-1}$ (Fig.2b) whereas in the surface seawater around the island, its concentration is 435.6 mg kg^{-1} . Both the values agree fairly well with those reported by Naqvi & Reddy⁶ for Kavaratti lagoon and Lakshadweep seawater. The Ca/Cl ratio showed variation from 0.0217 - 0.0221 with an average of 0.0219 . These ratios are lower than those for the open seawater which is observed to be 0.0224 . The lower ratios are probably due to a decrease in calcium content in the lagoon water. This decrease

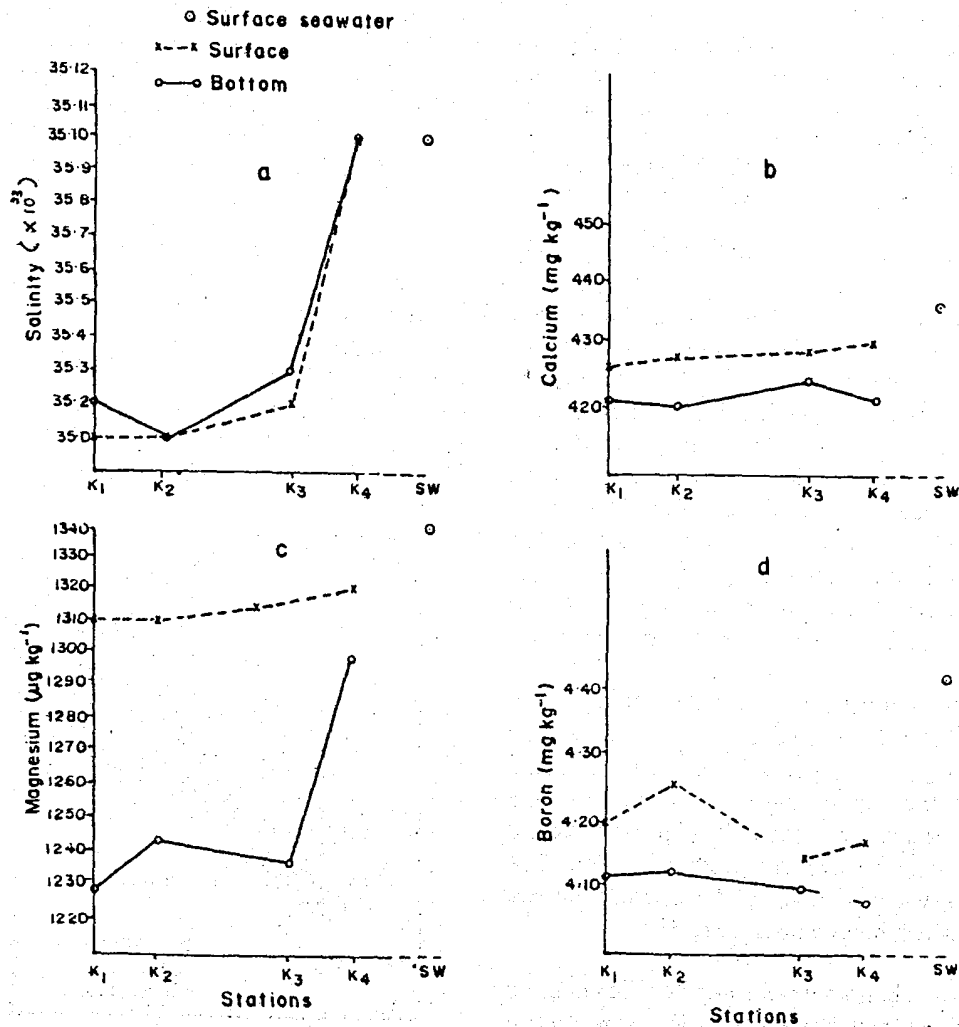


Fig.2—Map showing the distribution of salinity, calcium, magnesium and boron in Kavaratti lagoon water

is more evident in the bottom layer relative to surface (Fig.3a).

Earlier studies^{3,4,6} have shown that the coral reef surrounding the island as well as the coral growth within the lagoon utilises dissolved calcium from the water. The observed decrease of calcium in lagoon water therefore indicates its incorporation in the precipitation of carbonates.

The magnesium content of lagoon water varied from 1228.8 to 1319.8 mg kg⁻¹ (av. 1280.19 mg kg⁻¹; Fig.2c). This is also lower than the magnesium value for seawater surrounding the island (1342.2 mg kg⁻¹). The observed seawater value, however, is high compared to the magnesium content of standard seawater^{12,13} which is given as 1294 mg kg⁻¹ at a salinity of 35 × 10⁻³. Such high values of magnesium (1339 ± 6 mg kg⁻¹) in the Lakshadweep sea and in lagoon water (1335 ± mg l⁻¹) were also observed by Sen Gupta *et al.*¹⁴.

The Mg/Cl ratio varied from 0.0634-0.0679 with an average of 0.0660. These ratios are lower than that of the average value for surface seawater (0.0690) outside the lagoon and indicated removal

of magnesium. This feature is clearly evident from Fig.3c, wherein the bottom values are lower than the surface. Investigations have shown that during the precipitation of carbonates, some magnesium is also precipitated along with calcium¹³ leading to a decrease in its concentration. So, the observed decrease in magnesium content in the lagoon water suggests incorporation of magnesium in the precipitation phase.

The lagoon water showed low values of boron ranging from 4.08 to 4.25 mg kg⁻¹ with an average of 4.15 mg kg⁻¹ (Fig.2d) relative to the surrounding seawater boron which has been observed to be 4.45 mg kg⁻¹. This observed seawater value of boron is very close to the standard seawater value of boron¹⁴.

The B/Cl ratio however showed variation from 0.210 to 0.219 with an average of 0.214. These ratios are significantly lower than that of the surrounding seawater ratio of 0.230 and indicate removal of boron from the lagoon water. This can be seen from the horizontal profiles of B/Cl ratio (Fig.3c) which shows distinctly lower values of boron at bottom compared to that of the surface.

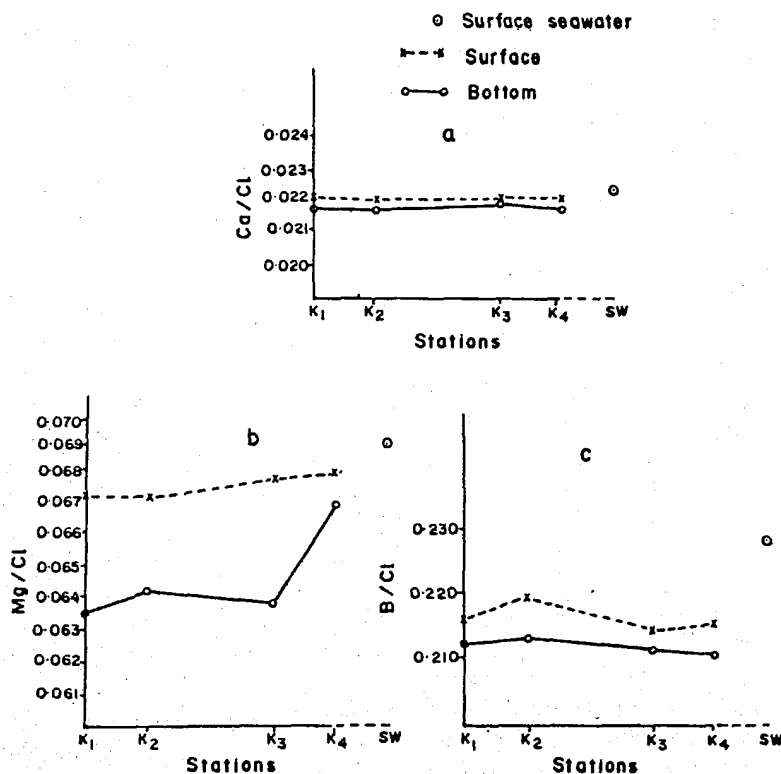


Fig.3—Map showing the variations of Ca/Cl, Mg/Cl and B/Cl ratios in Kavaratti lagoon water

Recent studies^{15,16} have shown that dissolved boron from seawater is coprecipitated with carbonates. As the lagoon system consists of only calcium carbonate bed and is surrounded by coral reefs around 400 m wide, the only possibility of the decrease of boron in lagoon water is its removal through coprecipitation with carbonates.

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