

TRACE ANALYSIS OF POLLUTANTS IN RAIN WATER AT GOA

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ABSTRACT

Two rain water samples were collected in the Goa region during the period June - July '77. Both the samples were analysed for traces of metals and one sample for petroleum hydrocarbons. The concentration of petroleum hydrocarbons was found to be 22 $\mu\text{g/l}$. Metal concentrations in rain water were compared with sea water and earth's crust.

Recently, much attention has been given to studies of the pattern of salt exchange between ocean and the atmosphere. The relative intensity of ion migration from the ocean surface to the atmosphere is of fundamental importance. A knowledge of this enables one to derive the salt content of the atmosphere.

It has been established that the chemical composition of the atmospheric moisture differs consistently from the composition of sea water (Korzh, 1971; Bruyevich and Korzh, 1969; Petrenchuk and Selezneva, 1970; Hoffman, Duce and Hoffman, 1972). The atmospheric aerosol is composed of a wide variety of inorganic and organic materials that originate from both natural and man-made sources. These materials include mineral dust from the continents, sea spray from the oceans, air pollution particles from combustion and various industrial processes and particles formed from the chemical reactions of atmospheric gases. The transfer of salt from the ocean to the atmosphere had until recently been linked exclusively to mechanical formation of spray (mechanical vaporisation) from the sea water under the action of the wind and on bursting of air bubbles at the ocean surface (Korzh, 1973). Study of mass balance of metals is very essential to understand their cycles, pollutant and otherwise, in nature. A preliminary report on this has formed the basis for the extension of the programme on International Hydrological Decade (Duce, Parker and Giam, 1974).

As a part of our ongoing study on 'Protection of the Marine Environment and Monitoring of Pollutants' in the seas around India, we are examining the different transfer processes. Petroleum hydrocarbons and metals which are supposed to be the main pollutants were chosen for the analysis. Preliminary data based on samples collected during June-July '77 are reported here.

Two locations were selected for the collection of rain water, one in an urban area (Rain water I) and the other near the sea, about 10 km away from the first (Rain water II). Samplings were carried out at heights of 75 m and 25 m above the mean sea level. Rain water was collected in 10 litre glass tanks during June-July, '77. A tank was placed on a platform on a terrace about one metre high. In the first case (Rain water I) the total rainfall was 563 mm and was collected from 18th June to 6th July (18 days) whereas in the second case (Rain water II) collection was from 29th July to 31st July (3 days) and total rainfall was 44 mm.

For determination of petroleum hydrocarbons, the water sample was first extracted with hexane and the hexane extract passed through a column of silica-gel. The absorption was read in a Beckman ACTA C-III Spectrophotometer in the UV range. The standard used was furnace oil from Indian Oil Corporation. Atomic Absorption Spectrophotometer (Hilger Watts Atomspek Model H 1550) was used to analyse the water samples for content of sodium, magnesium, potassium, calcium, iron, cobalt, nickel, copper, zinc and lead. The results of the analysis of rain water are presented in Table I.

Table I. Comparison of metal abundances in rain water with sea water and earth's crust

(Normalised to Na = 10,500 ppm)

Metal	Rain water ^a I ^d	Rain water ^a II ^e	Sea water ^b	Earth's crust ^c
Mg	1011.00	479.00	1350.00	7753.00
K	881.00	398.00	380.00	9700.00
Ca	74.00	—	400.00	13470.00
Fe	10.77	1.58	0.01	18700.00
Co	0.24	0.06	0.0005	9.40
Ni	0.29	0.05	0.002	27.84
Cu	17.05	2.55	0.003	21.00
Zn	33.00	5.00	0.01	26.00
Pb	68.50	4.10	0.00003	04.80

a This work,

b Goldberg (1963),

c Mason (1966),

d Na concentration (5.36 ppm),

e Na concentration (20.60 ppm).

Petroleum Hydrocarbons: Concentration of petroleum hydrocarbons was 22 µg/l in the rain water sample analysed. Recently, replacement of coal by petroleum products as an energy source instead of eliminating air pollution, has led to a new type of pollutants characterised by the presence of oxidising substances, chiefly ozone and the occurrence of eye irritation, damage to vegetation and reduction of visibility. It has also been shown that photochemical reactions involving hydrocarbons and nitrogen dioxide producing peroxy acetyl nitrate (PAN), in concentrations of a few parts per million can produce all these manifestations (Neiburger, 1959).

Metals: In recent years, extensive investigations of trace elements in natural waters have been carried out. However, precipitation, which is one of the sources of transfer of trace elements in surface waters, has so far received very little attention. Sources of microelements in precipitation may be soil erosion, rock weathering, sea spray, aerosols, industrial pollution and small particles of cosmic origin. The cosmic particles enter the earth's atmosphere in great quantities and contain iron, copper, manganese, etc. (Drozdova and Makhon'ko, 1970).

Table I gives the metal concentrations in rain water and in earth's crust (Mason, 1966) which have been normalised to a sodium content of sea water (10,500 ppm) and compared with sea water concentrations (Goldberg, 1963). The concentrations of sodium, magnesium and potassium were found to be more in Rain water II than in Rain water I (before normalisation). This may be because of the fact that these metals

are abundant in sea water and the location for Rain water II was close to the sea whereas the location for Rain water I was away from it. The concentrations of other metals, *i. e.*, calcium, iron, cobalt, nickel, copper, zinc and lead were found to be higher in Rain water I. The collection of this water being in an urban region, higher concentrations of these metals can be accounted by terrestrial sources. The higher concentration of lead may be due to lead tetraethyl which is mixed with petrol as antiknock additive for automobiles.

Zinc and lead appear to be more concentrated in Rain water I by several orders of magnitude over terrestrial abundance, whereas, magnesium, potassium, calcium, iron, cobalt, nickel and copper were found to be more in the earth's crust (Table I). Also, it can be seen that the concentration of most of the metals is more in Rain water II than in sea water. Since Rain water II was collected near the sea, the concentrations should have been more or less the same. But this is not the case which may be due to aerosols formed by air water interactions. This aerosol is a particle containing sodium along with other elements. Near the seashore it will come down along with the rain water thus adding to the concentration in rain water. The higher concentrations may also be influenced by dust particles containing certain elements.

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