Journal of the Arkansas Academy of Science

Volume 30 Article 34

1976

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ABSTRACT

Dissolved Ca, Mg, Na, K, Fe, Mn, and Zn loads of the Buffalo River generally show trends along the river attributable to changes in geology and vary with the season because of concentration by evapotranspiration and dilution by rain. Suspended material element loads show neither seasonal trends nor trends along the river. The Fe load for the river is predominantly in the suspended material, the Mn load is divided approximately evenly between dissolved and suspended material, and Ca, Mg, Na, K, and Zn are predominantly in the dissolved load.

METHODS

Water samples were collected in March, May, June, August, and December 1974 and in March 1975 from seven stations (Steele et al. 1975) spanning 110 miles of the Buffalo River in northcentral Arkansas. For each collection the river was clear and in a nonflood condition. Atomic absorption spectrophotometric analyses were made for major elements (Ca, Mg, Na, and K) and minor elements (Fe, Mn, Zn) on the dissolved (<0.45 μm) and the suspended (>0.45 μm) material.

Approximately 500 ml of river water was filtered through a 0.45 μm filter. The filter containing the suspended material was treated with 2 ml of concentrated HC1 overnight and the extractant was diluted to 25 ml before analysis. The analyses are expressed in terms of milligrams or micrograms per liter of water filtered. Data for the minus 95 mesh fraction of bottom sediments indicate that approximately 70% of each of the elements is obtained by acid treatment (Steele and Wagner 1975). The major elements were analyzed directly by the methods of the Perkin-Elmer Handbook (1970). The minor elements also were determined directly on extracts of suspended samples, but for the dissolved material were determined by an organic extraction method modified from that of Nix and Goodwin (1970).

DISSOLVED MATERIAL

Water concentrations of elements along the Buffalo River (Fig. 1) generally reflect the geology. Calcium and Mg increase in concentration downstream where limestone and dolostone are present. Because of the presence of shale (clay) in the upstream region which tends to scavenge Na and K from the water and because of the presence of feldspar in sandstone downstream, the trend for Na and K is a slight increase in concentration downstream. A trend of decreasing Fe concentration downstream is observed because a major source of Fe is the shale in the upper part of the drainage basin, and the dissolved Fe is diluted and precipitated downstream. It is possible that colloidal iron may have passed through the 0.45 μm filter and that the iron trend represents the settling (removal) of colloidal iron downstream. Manganese concentrations are low and relatively constant (4-9 ppb). Zinc concentration is variable and may be related to zinc mineralization in the area.

These relationships are essentially those reported by Nix (1973, 1975) for detailed (about 50 samples) study of the river in late spring in 1973 and 1974. This observation confirms that the seven stations can be used to represent the river. Differences between the present data and Nix's 1974 sodium and potassium trends can be attributed to different flow rates at collection time and/or the fact that Nix analyzed unfiltered water samples. The maximum concentrations of major ions during the late summer (Fig. 2) correlate with low flow and high temperature of the river (Fig. 3). This correlation can be explained as the result of concentration of the elements by evapotranspiration during periods of least rainfall and the lack of dilution by rain. Iron and Zn variations are irregular (Fig. 2); there is no correlation with flow, temperature, dissolved oxygen, or pH. The Mn concentration of the river water is uniform (Fig. 2) and apparently not affected appreciably by the aforementioned factors.

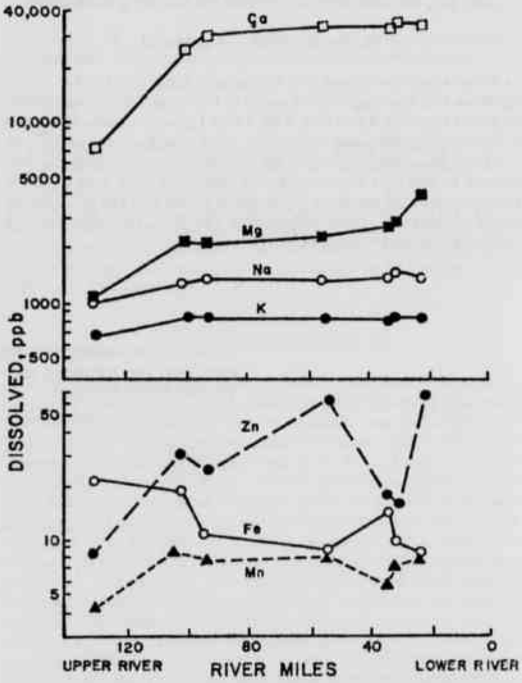

Figure 1. Dissolved river loads versus river miles. Points are average values for each station.

Data for 1975-1976 (Steele et al. 1976) show the same seasonal trends. Both Parker (1975) and Meyer (1975) have presented data which also suggest seasonal variations similar to those described.

COMPARISON OF DISSOLVED AND SUSPENDED LOAD

The load of elements in the suspended sediments is low in comparison with their dissolved loads except in the case of Fe. As expected, the Fe content increases with river flow rate. The other element values show no systematic variation with river miles or season. Elemental load ratios of dissolved material to suspended material show no seasonal patterns or trends with river miles. Table I shows that the Fe load for the Buffalo River is predominantly in the suspended material, the Mn load is divided approximately evenly between dissolved and suspended material, and Ca, Mg, Na, K, and Zn are predominantly in the dissolved load.

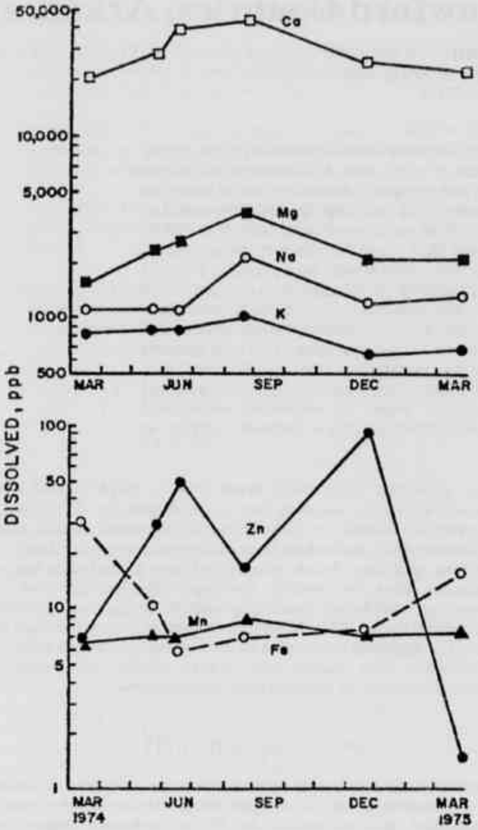

Figure 2. Dissolved river load versus month of collection. Points are average values for the seven stations.

Table I. Ratios of Dissolved Load to Acid Extractable Suspended Load

	Ca	Mg	Fe	Mn	Zn	Na	K
Buffalo River	800-2000	250-750	0.03-0.15	0.5-1.7	3.5-100	21-560	30-846

ACKNOWLEDGEMENT

This study was supported in part by funds provided by the National Park Service and the Office of Water Resources, U.S. Department of the Interior, as authorized under the Water Resources Research Act 1964, Public Law 88-379, and administered through the Water Resources Research Institute of Arkansas.

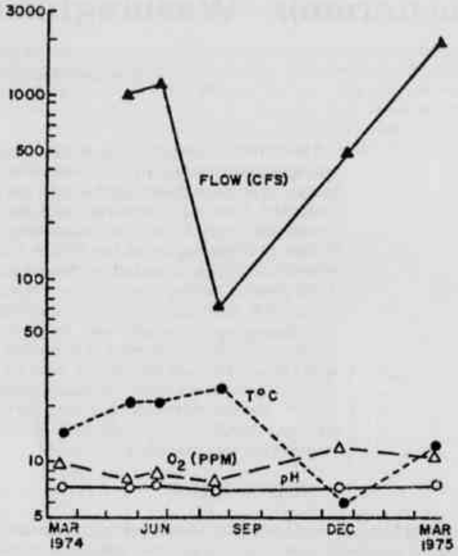

Figure 3. River water properties. Each point is an average value for the seven stations except flow, which is for a station near the midpoint along the river (55 river miles).

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