Trace Element Distribution in Waters of the Northern Catchment Area of Lake Kinneret, Northern Israel

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ABSTRACT / Waters of the northern watershed of Lake Kinneret, sampled during the period 1978–1983, were analyzed for their major and trace element contents. The trace element concentrations of the major water sources of the watershed (the Dan and Banias springs) represent background values. After emergence, the waters are subjected to human activity. In crossing the populated and cultivated Hula Basin in man-made canals, the major and trace element contents increase. In comparison to the trace element concentrations, those of the major elements have narrow ranges and small temporal fluctuations. Trace element concentrations varied by 3 orders of magnitude, and temporal variations were large but not necessarily seasonal. Point sources of trace elements were urban effluents, fish pond wastes, and peat soil drainage. The trace element concentrations decrease in the waters of the last segment of the Jordan River. All measured trace elements were below the criteria levels established by regulatory agencies. Several, however, were of the same order of magnitude. Addition of wastes from enhanced recycling, and morphologic modification of the final course of the Jordan River could result in increase in the trace element concentrations in the water.

Introduction

The sources of trace elements of environmental and geochemical significance in commodity watersheds is of concern, particularly in regions where water is intensively utilized. A knowledge of the source of trace elements allows a more efficient management of the surface and groundwaters of the area. In the present investigation, we chose the northern watershed of Lake Kinneret (Sea of Galilee) in northern Israel to evaluate the potential roles of urban, agricultural, and natural sources on the trace element distribution in the waters of this important watershed.

Lake Kinneret and its northern catchment area is located in northeastern Israel (Fig. 1), and is a segment of the Jordan–Dead Sea Rift System. Its surface area of 168 km² and volume of 4,300 × 10⁶ m³ make Lake Kinneret the major water reservoir of the country. A volume of 960 × 10⁶ m³/yr drains into the lake, of which approximately 300 × 10⁶ m³ is removed by evaporation. The Jordan River, the main water source, enters the lake in the north and exits in the south. The river drains an intake area of approximately 1,590 km², and its average annual influx to the lake is about 670 × 10⁶ m³. The substantial dimensions of the lake allow storage of winter precipitation and Jordan River floodwaters for use during dry years. The lake is also exploited for fisheries, recreation, and tourism. Since 1964, the National Water Carrier (NWC) has become the major outlet of the lake. About 350 × 10⁶ m³/yr are pumped from the lake and diverted by a pipe–canal network as far south as the arid Negev area. This quantity of water constitutes approximately 20 percent of the freshwater consumption of Israel. Because of the crucial role of the lake in the water supply system of Israel, considerable efforts are being made to control the quality and quantity of the lake’s water.

A compendium of papers summarizing the state of knowledge regarding Lake Kinneret was published recently by Serruya (1978). However, trace element data on the waters of the basin and the lake are scant. Cowgill (1980) determined 46 elements in unfiltered water samples of the Jordan sources, the Hula Reserve, and the river water. Arad and others (1984) determined the trace element contents of the groundwaters of Israel and included only single analyses of the groundwaters of the catchment area. Frevert (1983) and Frevert and others (1982) analyzed the Jordan River and compared the cadmium, copper, zinc, lead, and mercury contents with those from Lake Kinneret.

Geological and Hydrological Setting of the Jordan Drainage Basin

The watershed of Lake Kinneret can be divided into three hydrologically controlled regimes: replenishment areas and groundwater systems, the Hula Basin, and the Jordan River south of the Hula Basin.

Replenishment Areas and Groundwater Systems

The replenishment area of the main springs that feed the Jordan River is located in Mount Hermon and the Anti Lebanon Mountains and consists mainly