Chapter 13
Heavy Metal Levels in Sediment of the Turkish Black Sea Coast

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ABSTRACT

Sediments are an important repository for various pollutants such as pesticides and heavy metals and also play a significant role as sensitive indicators for monitoring contaminants in aquatic systems. Heavy metals which are regarded as serious pollutants of aquatic ecosystems are a major environmental problem in the Black Sea. Contamination by heavy metals has not been extensively studied in the Black Sea coast of Turkey, even though these are subjected to intense discharges of pollutants. It is important, therefore, that sediment by heavy metals be assessed in order to facilitate better management and protection of these valuable coastal ecosystems. This is especially the case, since Turkish Black Sea coast represents a prominent area for fishing, industrial development and urban extension and tourism activities. In view of the economic importance of the Black Sea coastal region of Turkey, this review aims to analyses the distribution and concentrations of heavy metals in bottom sediment in the coastal sediment along the Black Sea.

INTRODUCTION

Clark (1986) described the marine pollution as "the introduction by man, directly or indirectly, of substances or energy to the marine environment resulting in such deleterious effect as harm to living resources; hazards to human health; hindrance of marine activities including fishing; impairment of the quality for use of seawater; and reduction of amenities".

Most marine pollution is caused by domestic wastes, industrial wastes, oil wastes, pesticides, insecticides, radioactive wastes and metals (Laws, 1981; Phillips & Rainbow, 1994). Generally, Fe in sediment originates from geological sources whereas other metals Zn, Cr, etc. enter the rivers from industrial and domestic effluents and Pb from motor vehicle exhaust emissions. Cairns and Mount (1990) pointed out that over nine million chemicals are listed in the Chemical Abstract

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Service's Registry of Chemicals, although only an estimated 76,000 are in daily use. Especially coastal waters are increasingly affected by such dangerous substances (Bryan, 1984), one of the most important of which are metals (Phillips, 1980). These heavy metals bind preferentially to suspended particulate material and bottom sediments of rivers, estuaries and coastal waters. As a result, many toxic and persistent metals can be found at high concentrations in the sediment. This can lead to deleterious effects on benthic and pelagic communities, fisheries and potentially human health, through direct contact of organisms or re-suspension into the overlying water. All metals are taken up by aquatic organisms from solution and from food or particles (Luoma & Bryan, 1982; Rainbow, 1990; Rainbow & Phillips, 1993; Phillips & Rainbow, 1994), and can be accumulated at high concentrations (Rainbow, 1988; Rainbow, 1990; Rainbow & Phillips, 1993) when, whether essential or not, they may be potentially toxic to living aquatic organisms (Bryan, 1976a; Rainbow, 1985; Rainbow, Phillips & Depledge, 1990; Rainbow, 1995). Consequently, understanding heavy metal bioavailability from sediments is especially important.

SOURCES OF METALS IN THE MARINE ENVIRONMENT

Heavy metals found in seawater (Clark, 1986, 1992; Rainbow, 1993) are continuously released into the marine environment by both natural and artificial processes (Turekian, 1971; Bryan, 1976b; Depledge, Weeks & Bjerregard, 1994; Phillips & Rainbow, 1994). The natural sources of metals in sea are reviewed by Turekian (1971) and categorized by Bryan (1976b) as follows:

1. Coastal supply, which includes input from rivers and from erosion produced by wave action and glaciers;
2. Deep sea supply, which includes metals released from particles or sediments by chemical processes;
3. Supply which by-passes the near-shore environment and includes metals transported in the atmosphere as dust particles or as aerosols and also material which is produced by glacial erosion in polar regions and is transported by floating ice. Domestic effluents, urban storm water run-off (Förstner & Wittmann, 1983; Depledge, Weeks & Bjerregard, 1994), forest fires and vegetation (Clark, 1992) are also sources of heavy metals to the marine coast.

Anthropogenic sources include:

1. Atmospheric input from the burning of fossil fuels, the smelting and refining of metals, the use of leaded petrol in motor vehicles, fly ash from power stations and the use of seawater for cooling at electrical power stations with potential for corrosion of metal piping;. For some metals, inputs to the atmosphere as a result of human activities are greater than natural inputs and the sea acts as a sink for atmospheric contamination (Clark, 1992);
2. Mining activities, such as tailings;
3. Industrial processing of ores and the use of metal components, such as electroplating, pigments, electrical wirings, batteries, galvanizing, fertilisers;
4. The release of sewage (Depledge, Weeks & Bjerregard, 1994), which was dumped at sea in considerable quantities by Britain and it has a high organic content with heavy metals (Clark, 1986);
5. Contamination from ships in docks and harbours from the use of metals such as copper, tin and mercury in antifouling points and other metals such as lead, chromium and zinc in preservative paints (Bellinger & Benham, 1978; Young, Alexander & McDermott-Ehrlich, 1979);