BACKGROUND CONCENTRATION RANGES OF HEAVY METALS IN SWEDISH GROUNDWATERS FROM CRYSTALLINE ROCKS: A REVIEW

A. LEDIN, C. PETTERSSON, B. ALLARD

Department of Water and Environmental Studies, Linköping University, S-581 83 Linköping, Sweden

and

M. AASTRUP

Swedish Geological Co, Box 1424, S-751 44 Uppsala, Sweden

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Abstract. Concentration levels of heavy metals (Cr, Cu, Zn, Cd, and Pb) in groundwaters, primarily from igneous crystalline bedrock, are summarized. The groundwaters were sampled from 126 stations in Sweden during 1985-87 (1-6 times per year). The observed groundwater concentrations are generally at least qualitatively related to concentration levels in the bedrock as well as to pH of the water. Background concentration ranges for unpolluted groundwaters from the present bedrock environment are suggested.

1. Introduction

Trace components in the environment are continuously redistributed in hydrological/hydrochemical as well as biological cycles and pathways. The distribution and concentration levels of e.g. heavy metals have, however, changed drastically during the last decades due to human activities. A regional as well as global spreading of heavy metals is taking place as air borne and water borne emission. The progressing acidification in surface waters and soils in areas with low buffering capacity would increase the weathering rate of mineralized phases as well as enhance solubility and mobility of hydrolyzable metals.

Pollution of soil and surface waters due to metal releases from point sources and diffuse sources have been reported in numerous cases (see e.g. reviews in Förstner and Wittman, 1979; Salomons and Förstner, 1984; Adriano, 1986). There are, however, few studies of the composition of truly 'undisturbed' groundwaters, and 'normal' background levels of trace elements in various groundwaters from various geological environments can not generally be assessed. Moreover, it is likely that many of the early reported high background levels of heavy metals in natural waters reflect poor handling procedures and contamination control. Thus, the heavy metal contribution from anthropogenic sources, including sample contamination, can not always be distinguished from background levels originating from natural sources.

The objectives of the present study on the occurrence of some heavy metals (Cr, Cu, Zn, Cd, Pb) in groundwaters primarily from igneous crystalline granite...
bedrock are assessment of background concentration ranges and discussion of some of the processes that would affect these levels. The paper summarizes a more general review on heavy metals in groundwaters which was prepared as a background document for a workshop on the effects of metals on forest ecosystems (Ledin et al., 1988). Some of the conclusions have previously been presented elsewhere (Allard et al., 1989).

2. Heavy Metal Occurrence in Groundwater

2.1. Concentration levels in the ground

The elements Cr, Cu and Zn are all fairly common in the earth's crust. The average concentration levels are estimated to be 125 (Cr), 50 (Cu) and 65 (Zn) μg g⁻¹, while Cd and Pb are less abundant with average concentrations of 0.15 and 15 μg g⁻¹ respectively (Adriano, 1986). The abundance and distribution in rocks as well as in soils and sediments etc. vary, however, within a broad range. For granitic igneous rocks the ranges 2 to 90 (Cr), 4 to 30 (Cu), 5 to 140 (Zn), 0.003 to 0.18 (Cd) and 6 to 30 (Pb) μg g⁻¹ have been assessed (Cannon, 1978). Also for individual minerals in e.g. the granitic rocks and related soil types the variation in composition

![Cumulative frequency plot (%) of heavy metal concentrations (Cw, μg L⁻¹) in groundwaters (data from Aastrup and Ek, 1988).](image)