THE INFLUENCE OF A SULFUR DIOXIDE POINT SOURCE ON THE RAIN CHEMISTRY OF A SINGLE STORM IN THE PUGET SOUND REGION

TIMOTHY V. LARSON*, ROBERT J. CHARLSON*, ERIC J. KNUDSON**, GARY D. CHRISTIAN**, and HALSTEAD HARRISON*

Institute of Environmental Studies, University of Washington, Seattle, Wash. 98195, U.S.A.

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Abstract. Sampling and chemical analysis of a rainstorm were undertaken to determine the influence of a large source of SO2 on regional precipitation chemistry. A definite correlation was obtained between hydrogen ion, sulfate ion and As concentration increases downwind of the source. Estimated sulfate deposition in a 1500 km2 downwind area was compared to existing models.

1. Introduction

As part of the ongoing interest in rain chemistry at the University of Washington, an experiment was designed with the following objectives in mind:

(1) To examine the influence of a major SO2 point source on rain chemistry in this region; specifically, to study the areal and chemical extent of rain modification by a large non-ferrous smelter located in the area.

(2) To gain information on short term averages of rain chemistry by sampling a single rain occurrence.

(3) To examine the relationships between acidity and chemical composition of rainwater.

(4) To explore possible conservative tracer elements emitted by the smelter that could be used in the study of plume washout and rainout.

(5) To compare, if possible, measured plume deposition by rainout and washout to empirical and semi-empirical models.

Relatively few investigations (Mrose, 1966; Pearson and Fisher, 1971; Summers and Hitchon, 1971; Granat and Rodhe, 1973; Dana et al., 1973; Gatz, 1974) have been done on the chemistry of individual rain occurrences. In most of these studies, only a few of the major ionic constituents were evaluated (Na+, K+, Ca++, Mg++, H+, NH4+, Cl−, NO3, SO42−). In addition, relatively little work has been done on trace elements in precipitation (Lazrus et al., 1970; Drozdova and Makhon’ko, 1970; Gatz, 1974; Rattonetti, 1974). With these considerations in mind, we would like to report our results involving a single rain occurrence in the Puget Sound region in November 1973.

* Dept. of Civil Engineering and IES, University of Washington, Seattle, Wash. 98195, U.S.A.
** Dept. of Chemistry, University of Washington, Seattle, Wash. 98195, U.S.A.
† Dept. of Atmospheric Science and IES, University of Washington, Seattle, Wash. 98195, U.S.A.
2. Experimental

2.1. Sample Collection

Forty-three sampling sites were selected (see Figure 1) to give a representative picture of the influence of the smelter on the rain chemistry. At each site, two polyethylene buckets were placed, giving a combined rain collection area of about 0.1 m². The buckets were previously scrubbed, washed, and rinsed with deionized distilled water, and were covered before and after rain sample collection with a thin polyethylene sheet. The buckets were exposed for about 5 h at each site (1200 to 1700 Pacific Standard Time) and were brought directly back to the laboratory. The samples were then transferred to smaller (250 ml) polyethylene bottles that had also been washed and rinsed with deionized distilled water. The wash water from five of the collection buckets was mixed together to make up the 'blank'.

2.2. Analyses

The pH of each of the samples was determined with a pH meter at the time of transfer.