United States
Environmental Protection
Agency

Environmental Monitoring Systems
Laboratory
Research Triangle Park NC 27711

Research and Development

EPA-600/S4-83-053 Jan. 1984

EPA

Project Summary

Air Quality Data for Metals 1977 Through 1979 from The National Air Surveillance Networks

E. G. Evans, G. F. Evans, D. B. Ray, T. Risher, V. A. Wheeler, S. L. Cummings, J. E. Frazer, S. L. Harper, T. A. Hinners, W. A. Loseke, L. J. Pranger, and John C. Puzak

The National Air Surveillance Network, which has existed for over 20 years, provides air quality information for many urban and nonurban locations within the United States. The data in this publication were collected with the generous support of the many state and local air pollution control agencies that operate the National Air Surveillance Network stations. Also, the ten EPA Regional Offices have participated in this program since 1973 by sending weighted high volume filters to the centralized laboratory for analysis.

This report summarizes the network data for metals determined from high volume samples collected from 1977 through 1979. Concentration values are presented in the form of cumulative frequency distributions. Arithmetic and geometric sample statistics are also reported, as are measures of the precision associated with the analytical methods employed. This report is a continuation in a series of publications of network data.

This Project Summary was developed by EPA's Environmental Monitoring Systems Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The U.S. Environmental Protection Agency conducts a variety of air sampling activities to obtain information about air quality in the United States. Often this work is accomplished with the assistance and cooperation of state and local agencies. One such program consists of the National Air Surveillance Networks (NASN) which have existed for over 20 years. Although pollutant monitoring is decentralized, analysis and publication of trace pollutant data remain the responsibility of Environmental Monitoring Systems Laboratory, Research Triangle Park, NC (EMSL/RTP).

Air quality samples are collected at several urban and nonurban NASN sites located across the country. Urban sites are generally located within a city, town, or adjacent suburb. Nonurban sites were originally located in rural or remote areas, although many of these rural areas have become more heavily populated and were influenced by spreading urbanization.

Concentrations of metals in particulate matter form the National Air Surveillance Network are presented in this report. Measures of the analytical data quality are also included. This report is a continuation in a series of publications of network data.

Laboratory Procedures

High volume filters exposed in the field were returned to the laboratory by mail. During shipment, each filter was folded in half the long way with the soiled sides facing each other. A 2.5-cm-wide strip was cut from the edge of the filter to the fold at the center. This yielded a 2.5- x

20.3-cm strip which was folded with its soiled sides together.

New laboratory procedures were utilized beginning with the 1977 samples. This was done because use of a new optical emission spectrometer was begun (to replace an obsolete unit) and the desire for data on individual samples rather than quarterly composites required different approaches than had been utilized in the past. The 1977 sample strips, prepared as described above, were extracted by the lead reference method ultrasonic extraction technique using mixed nitric and hydrochloric acids with the hydrochloric acid present at the maximum concentrations allowed in that procedure. One deviation from that procedure was employed. All final solution volumes were 50 ml rather than 100 ml to bring more trace elements into the expected operating range of the new optical emission spectrometer. The change was first tested by analyzing strips with known high lead content; lead was recovered quantitatively.

Solutions obtained from this extraction procedure were analyzed by aspiration with the new Jarrell-Ash 975 Atomcomp Optical Emission Spectrometer. It is a direct-reading type spectrometer with inductively coupled argon-plasma excitation. The spectrometer was calibrated with multielement standards in solutions whose acid composition matched that of the extracted filters. Interelement effects were evaluated and corrections were applied.

Minicomputer readouts of spectrometer operation were transmitted to an associated PDP-11 data-accumulation computer for storage permitting further computations and efficient transmittal to ultimate data bank storage. The PDP-11 provided the final computations and real-time evaluation of two quality control standard solutions for the benefit of the analyst. Each solution contained all of the elements capable of being analyzed by the spectrometer. One solution contained the elements at a low concentration in the operating range of each element, and the other solution had a much higher concentration of the operating range of each element. The solutions were run alternately after every ninth sample. This real-time evaluation permitted the analyst to be certain of satisfactory spectrometer operation before continuing with the analyses.

Precision

Table 1 presents precision estimates for the various analyses. Measures of precision are expressed as percentages of concentration level because precision is generally concentration dependent. Precision estimates are based upon the differences between analyses performed on two filter strips taken from the same filter. Thus, the measure of precision includes variation caused by cutting, extracting, and analytical processing, as well as any actual variability between filter strips. Precision measurements were made throughout the analysis period. Duplicate strips of every twentieth sample were analyzed, and precision estimates were obtained.

Table 1. Measures of Precision For 1977-1979 NASN Filters

	1977		1978		1979	
Metal	# Pairs	%CV	# Pairs	%CV	# Pairs	%CV
Barium	211	8	178	7	137	50
Beryllium	95	36	31	23	100	41
Cadmium	73	12	123	11	118	54
Copper	211	9	178	8	137	19
Iron	211	14	178	5	137	25
Lead	209	4	178	3	137	15
Manganese	211	12	178	6	137	27
Molybdenum	34	19	87	24	89	29
Nickel	104	18	130	21	109	17
Vanadium	132	8	149	8	124	15
Zinc	209	11	178	11	137	38

Precision was expressed as the percent coefficient of variation (%CV), computed as follows:

$$\%CV = \frac{(100)\, S_{x_1-x_2}}{100\ GM} \Big/ \sqrt{2} \qquad (1)$$

Where x_1, x_2 = concentration values of the analyses of duplicate filter strips, $\mu g/m^3$

$S_{x_1-x_2}$ = standard deviation of a set of differences between duplicate strips, x_1-x_2

GM = grand mean of a set of paired concentration values

Results

Data presented in Tables 2 and 3 are annual cumulative frequency distributions by metal of individual results for urban and nonurban locations, respectively. In the first line of Table 2, the number, 4648, is the number of valid 24-hour samples analyzed for beryllium in 1977. The minimum value detected that year follows and "LD" indicates the value was below the discrimination limit. The next seven entries are the 10 through 99-percentile values. For example, the 99-percentile value of 0.445 indicates that 99% of the 4648 values, i.e., 0.99 x 4648 = 4601, were equal to or less than 0.445 ng/m³. The next entry is the maximum annual value. Arithmetic means and standard deviation are presented in the last two columns in the table. With the exception of beryllium, all values ar expressed in micrograms per cubi meter. Some of the year-to-year variabilit in the national summary tables can b attributed to use of different sets of site in the summarization, depending upo the completeness criteria for valid dat and changes in state and local agenc participation in the networks over th years.

Table 2. *Urban National Cumulative Frequency Distributions*

Element	Year	No	Min	Percentiles							Max	Arithmetic	
				10	30	50	70	90	95	99		Mean	SD
Beryllium[a]	1977	4648	LD[b]	LD	LD	LD	LD	LD	LD	0 445	1 775	0 0451	0 0702
	1978	3614	LD	LD	LD	LD	LD	0 171	0.234	0.397	1 512	0 0749	0 0895
	1979	2507	LD	LD	LD	LD	LD	LD	0 244	0 401	0 985	0 0538	0 0758
Barium	1977	4648	LD	0 010	0 015	0 021	0 031	0 053	0.071	0 176	2 130	0.0316	0 0631
	1978	3614	LD	LD	0 007	0 013	0 021	0 047	0 077	0 170	2.807	0 0265	0 0827
	1979	2507	LD	LD	LD	LD	LD	LD	LD	LD	1 853	0 0048	0 0681
Cadmium	1977	4648	LD	LD	LD	LD	0.002	0 004	0 007	0.021	0 350	0.0022	0 0073
	1978	3614	LD	LD	LD	LD	0 002	0 004	0.007	0 028	0 196	0 0024	0 0083
	1979	2507	LD	LD	LD	LD	0 002	0 004	0 006	0 015	0 178	0 0019	0.0051
Copper	1977	4648	LD	0 051	0 088	0 133	0 212	0 433	0 625	1 156	3.296	0 2075	0 2417
	1978	3614	LD	0 042	0 086	0 138	0 225	0 430	0 556	0 975	4.625	0 2008	0 2109
	1979	2507	LD	0 031	0 061	0 096	0 162	0 363	0 519	0 843	1 627	0 2593	0 1785
Iron	1977	4648	LD	0 34	0 64	0 98	1 46	2 64	3 50	5 95	19 41	1.308	1 191
	1978	3614	0 04	0 35	0 66	0 43	1 37	2 45	3 29	5 77	22 52	1 273	1 272
	1979	2507	LD	0 19	0 46	0 73	1 13	2 12	2 94	5 00	14 41	1 018	1 049
Lead	1977	4648	0 02	0 27	0 48	0 69	0 96	1 70	2 36	4 12	7 48	0 889	0 759
	1978	3614	LD	0.21	0 39	0 57	0 86	1 50	1 97	3 41	8 41	0 765	0 688
	1979	2507	LD	0 15	0 28	0 43	0 65	1 15	1 54	2 72	9 68	0 584	0 560
Manganese	1977	4648	LD	LD	LD	LD	0 04	0 08	0 12	0 29	2 20	0 043	0 068
	1978	3614	LD	LD	LD	LD	0 04	0 09	0 12	0 25	1 06	0 042	0 052
	1979	2507	LD	LD	LD	LD	LD	0 07	0 11	0 26	1 94	0 038	0 062
Molybdenum	1977	4648	LD	LD	LD	LD	LD	0 004	0 007	0 023	0 213	0 0022	0 0056
	1978	3614	LD	LD	LD	LD	LD	0 005	0 008	0 018	0 120	0 0021	0 0049
	1979	2507	LD	LD	LD	LD	LD	LD	0 004	0 015	0 275	0 0015	0 0065
Nickel	1977	4648	LD	LD	LD	LD	0 010	0 024	0 033	0 062	0 645	0 0100	0 0209
	1978	3614	LD	LD	LD	0 006	0 011	0 024	0 032	0 068	0 917	0 0110	0 0232
	1979	2507	LD	LD	LD	LD	0 010	0 022	0 030	0 058	0 207	0 0096	0 0128
Vanadium	1977	4648	LD	LD	LD	LD	0 013	0.040	0 065	0 137	0 339	0 0165	0.0274
	1978	3614	LD	LD	LD	LD	0 015	0 048	0 078	0 153	0 608	0 0191	0 0335
	1979	2507	LD	LD	LD	LD	0 016	0 053	0 085	0 170	0 425	0 0208	0 0352
Zinc	1977	4648	LD	0 037	0 063	0 094	0 151	0 322	0.488	1 176	6 237	0 1611	0.2599
	1978	3614	LD	0 029	0 054	0 085	0 141	0 333	0.529	1 366	6 199	0.1637	0.3026
	1979	2507	LD	LD	LD	LD	LD	LD	LD	0 563	9.051	0 0263	0 2379

[a] *Expressed in ng/m³*
[b] *Less than detectable*

Table 3. *Nonurban National Cumulative Frequency Distributions*

Element	Year	No	Min	Percentiles							Max.	Arithmetic	
				10	30	50	70	90	95	99		Mean	SD
Beryllium[a]	1977	709	LD[b]	LD	LD	LD	LD	LD	LD	LD	0.568	0 0389	0.0387
	1978	458	LD	LD	LD	LD	LD	0.089	0 134	0 217	0.292	0.0474	0 0379
	1979	235	LD	LD	LD	LD	LD	LD	LD	0 173	0.173	0.0386	0 0199
Barium	1977	709	LD	LD	0 004	0 007	0 010	0 017	0 023	0 040	0.137	0 0089	0 0094
	1978	458	LD	LD	LD	LD	LD	0.014	0 024	0.057	0.096	0.0057	0.0118
	1979	235	LD	LD	LD	LD	LD	LD	LD	0.485	0.485	0 0118	0 0700
Cadmium	1977	709	LD	LD	LD	LD	LD	LD	0 002	0.005	0.037	0.0008	0.0016
	1978	458	LD	LD	LD	LD	LD	0 001	0.002	0.005	0.011	0.0008	0.0010
	1979	235	LD	LD	LD	LD	LD	0 001	0 006	0.031	0 0008	0 0051	
Copper	1977	709	LD	0.038	0 069	0 120	0 192	0 450	0.673	1 065	1.670	0 1932	0 2194
	1978	458	LD	0 040	0 095	0 179	0 290	0 607	0.845	1 396	2 104	0 2657	0 2895
	1979	235	LD	0 012	0 035	0 076	0 132	0 322	0 476	0.645	4 003	0.1417	0 2899
Iron	1977	709	LD	LD	0 05	0 10	0 24	0 52	0.72	1 79	3.03	0 218	0.326
	1978	458	LD	0.05	0 12	0.21	0 34	0 60	0 82	1 33	6.44	0 307	0 433
	1979	235	LD	LD	LD	0 11	0 19	0 35	0 46	0.93	2.29	0 162	0.230
Lead	1977	709	LD	LD	0 029	0 065	0 107	0 214	0 269	0 439	0.951	0.0920	0 1035
	1978	458	LD	LD	0 026	0 056	0 093	0 191	0 261	0.520	1.037	0 0843	0 1100
	1979	235	LD	LD	0 024	0 054	0 090	0.216	0 308	0 459	0 647	0.0842	0.1019
Manganese	1977	709	LD	LD	LD	LD	LD	LD	LD	0 08	0.24	0 022	0 013
	1978	458	LD	LD	LD	LD	LD	LD	LD	0 05	0.08	0.021	0 005
	1979	235	LD	LD	LD	LD	LD	LD	LD	LD	0.06	0 021	0 003
Molybdenum	1977	709	LD	LD	LD	LD	LD	LD	0 003	0 006	0.016	0 0011	0.0011
	1978	458	LD	LD	LD	LD	LD	LD	0 004	0.007	0.011	0 0011	0 0013
	1979	235	LD	LD	LD	LD	LD	LD	LD	0 002	0.004	0.0008	0 0004
Nickel	1977	709	LD	LD	LD	LD	LD	LD	0 010	0 052	0 238	0 0048	0 0143
	1978	458	LD	LD	LD	LD	LD	0 007	0 010	0.020	0.030	0 0039	0 0035
	1979	235	LD	LD	LD	LD	LD	LD	0.006	0 013	0 018	0 0032	0 0019
Vanadium	1977	709	LD	LD	LD	LD	LD	0 010	0.018	0 045	0 137	0.0069	0.0082
	1978	458	LD	LD	LD	LD	LD	0 018	0 027	0 059	0 089	0 0085	0 0104
	1979	235	LD	LD	LD	LD	LD	0 016	0 024	0 052	0 083	0 0079	0 0085
Zinc	1977	709	LD	LD	LD	0 023	0 038	0 076	0 116	0 323	5 623	0 0466	0 2316
	1978	458	LD	LD	LD	LD	0 040	0 102	0 142	0 242	1 738	0 0424	0 1101
	1979	235	LD	LD	LD	LD	LD	LD	LD	0 326	0 326	0 0134	0 0462

[a] *Expressed in ng/m³*
[b] *Less than detectable*

The EPA author ***E. G. Evans*** *(also the EPA Project Officer, see below) is with the Environmental Monitoring Systems Laboratory, Research Triangle Park, NC 27711.*

The complete report, entitled "Air Quality Data for Metals 1977 Through 1979 From the National Air Surveillance Networks," (Order No. PB 84-110 535; Cost: $25.00, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

The EPA Project Officer can be contacted at:

Environmental Monitoring Systems Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

☆U S GOVERNMENT PRINTING OFFICE 1984—759-015/7281

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

Official Business
Penalty for Private Use $300