

U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

**A Compilation of Sulfur Dioxide and Carbon Dioxide
Emission-Rate Data from Mount St. Helens during 1980-88**

by

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INTRODUCTION

Airborne monitoring of Mount St. Helens by the USGS began in May 1980 for sulfur dioxide emissions and in July 1980 for carbon dioxide emissions. A correlation spectrometer, or COSPEC, was used to measure sulfur dioxide in Mount St. Helens' plume. The upward-looking COSPEC was mounted in a fixed-wing aircraft and flown below and at right angles to the plume. Typically, three to six traverses were made underneath the plume to determine the SO₂ burden (concentration x pathlength) within a cross-section of the plume. Knowing the burden along with the plume width and plume velocity (assumed to be the same as ambient wind speed), we could then calculate the emission rate of SO₂. The use of correlation spectroscopy for determining the sulfur dioxide output of volcanoes is well established and the technique has been discussed in detail by a number of investigators (Malinconico, 1979; Casadevall and others, 1981; Stoiber and others, 1983).

Carbon dioxide in the Mount St. Helens plume was measured by an infrared spectrometer tuned to the 4.26 μm CO₂ absorption band. An external sample tube was attached to the fuselage of a twin-engine aircraft to deliver outside air to the gas cell of the spectrometer. The aircraft was then flown at several different elevations through the plume at right angles to plume trajectory to define plume area and carbon dioxide concentration in a vertical cross-section of the plume. These two parameters along with the density of CO₂ for the altitude of the plume and the plume velocity (assumed as above to be equal to ambient wind speed) were then used to calculate the CO₂ emission rate (Harris and others, 1981).

DISCUSSION

From May 1980 to September 1988, more than 1000 fixed-wing aircraft flights were made by the U.S. Geological Survey in order to measure and characterize gas emissions from Mount St. Helens. Sulfur dioxide was detected on the majority of these flights. However, toward the end of this time period, and particularly during the final two years of measurements, the sulfur dioxide burden was often below the detection limit of the COSPEC. On those days, the sulfur dioxide emission rate was arbitrarily assigned a value of 3 tonnes/day in the database. Carbon dioxide was routinely measured starting in July 1980. These measurements were discontinued in August 1981 after CO₂ levels had declined to near background levels.

The data listing in this report contains all of the available daily SO₂ and CO₂ emission rates determined by the USGS from May 1980 through the end of the measurements in September 1988. On a few occasions, two gas-measurement flights were made in a single day. In those cases, two emission-rate values are listed for that day. Portions of this database have been presented earlier by Casadevall and others (1981, 1983), Harris and others (1981), McGee (1992a), and McGee and Sutton (in press). Other data pertaining these measurements such as plume dimensions and wind information were earlier listed in McGee (1992b).

ACKNOWLEDGMENTS

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REFERENCES CITED

- Casadevall, T.J., Johnston, D.A., Harris, D.M., Rose, W.I., Malinconico, L.L., Stoiber, R.E., Bornhorst, T.J., Williams, S.N., Woodruff, Laurel and Thompson, J.M., 1981, SO₂ emission rates at Mount St. Helens from March 29 through December, 1980, *in* Lipman, P.W. and Mullineaux, D.L., eds., The 1980 eruptions of Mount St. Helens, Washington: U.S. Geological Survey Professional Paper 1250, p. 193-200.
- Casadevall, T.J., Rose, W.I., Gerlach, T.M., Greenland, L.P., Ewert, J., Wunderman, R. and Symonds, R., 1983, Gas emissions and the eruptions of Mount St. Helens through 1982: *Science*, v. 221, p. 1383-1385.
- Harris, D.M., Sato, Motoaki, Casadevall, T.J., Rose, W.I. and Bornhorst, T.J., 1981, Emission rates of CO₂ from plume measurements, *in* Lipman, P.W. and Mullineaux, D.L., eds., The 1980 eruptions of Mount St. Helens, Washington: U.S. Geological Survey Professional Paper 1250, p. 201-207.
- Malinconico, L.L., 1979, Fluctuations in SO₂ emission during recent eruptions of Etna: *Nature*, v. 278, p. 43-45.
- McGee, K.A., 1992a, The structure, dynamics, and chemical composition of noneruptive plumes from Mount St. Helens, 1980-88: *Journal of Volcanology and Geothermal Research*, v. 51, p. 269-282.
- McGee, K.A., 1992b, Volcanic-plume data from Mount St. Helens during 1980-88: U.S. Geological Survey Open-File Report No. 92-361, 24 p.
- McGee, K.A. and Sutton, A.J., in press, Eruptive activity at Mount St. Helens, Washington, USA, 1984-1988: A gas geochemistry perspective: *Bulletin of Volcanology*.
- Stoiber, R.E., Malinconico, L.L. and Williams, S.N., 1983, Use of the correlation spectrometer at volcanoes, *in* Tazieff, H. and Sabroux, J.C., eds., *Forecasting Volcanic Events*: Amsterdam, Elsevier, p. 425-444.

GAS EMISSION RATES FROM MOUNT ST. HELENS, 1980-88 (tonnes per day)*

DATE	SO₂FLUX	n	S.D.	CO₂FLUX
01-May-80	10			
08-May-80	48			
14-May-80	15			
25-May-80	2600			
26-May-80	200			
31-May-80	130	3	35	
03-Jun-80	256	5	60	
06-Jun-80	858	4	200	
09-Jun-80	597	2	85	
11-Jun-80	1025	4	200	
14-Jun-80	1024	4	160	
18-Jun-80	1347	3	20	
22-Jun-80	1400	3	340	
05-Jul-80	2620	4	440	
06-Jul-80	1768	2	90	12300
08-Jul-80	2210	4	640	22000
09-Jul-80	1590	6	350	7000
13-Jul-80	1863	8	390	14000
16-Jul-80	878	3	160	8200
18-Jul-80	1215	4	450	8900
22-Jul-80	1780	5	350	4800
23-Jul-80	809	3	20	9400
25-Jul-80	1788	2	45	17700
28-Jul-80	700	3	150	
29-Jul-80	1125	4	170	14000
30-Jul-80	923	4	90	8800
03-Aug-80	1124	4	40	16000
04-Aug-80	925	4	110	7200
05-Aug-80	850	3	210	
06-Aug-80	780	3	165	3700
07-Aug-80	870	4	155	3700
08-Aug-80	901	2	5	3200
09-Aug-80	1812	4	640	5400
10-Aug-80	590	4	120	4800
11-Aug-80	940	4	120	8300
12-Aug-80	670	4	75	3600
13-Aug-80	3350	4	85	23100
14-Aug-80	1570	4	100	10400
15-Aug-80	760	4	65	2900

*Contact K.A. McGee for availability of data in electronic format.

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
16-Aug-80	1010	3	70	3600
17-Aug-80	1460	4	240	5000
18-Aug-80	780	4	70	1200
19-Aug-80	1290	3	30	4400
20-Aug-80	1870	4	350	3900
21-Aug-80	2585	2	340	8300
22-Aug-80	2034	5	490	13500
23-Aug-80	1838	4	330	6600
24-Aug-80	1245	4	120	8200
25-Aug-80	523	4	30	2500
26-Aug-80	1364	4	10	4700
29-Aug-80	1013	4	340	7900
03-Sep-80	1300	3	60	
05-Sep-80	610	3	45	3800
06-Sep-80	1300	3	30	15900
08-Sep-80	1800	2	10	6800
10-Sep-80	296	3	120	1112
15-Sep-80	434	4	140	1531
17-Sep-80	590	4	120	1645
22-Sep-80	1327	4	60	
23-Sep-80	720	3	200	3300
24-Sep-80	1450	4	260	6300
25-Sep-80	1430	3	400	2000
26-Sep-80	480	3	15	3000
27-Sep-80	1280	5	230	14700
29-Sep-80	960	4	270	
30-Sep-80	590	3	30	3800
01-Oct-80	1430	5	220	5200
03-Oct-80	600	4	160	4065
06-Oct-80	470	3	25	
07-Oct-80	800	4	120	5000
08-Oct-80	760	4	35	3200
09-Oct-80	805	3	80	5460
10-Oct-80	760	4	100	
15-Oct-80	1190	3	410	2200
16-Oct-80				3140
17-Oct-80				3800
18-Oct-80	1380	3	70	2000
19-Oct-80	1200	4	230	7400
21-Oct-80	1060	1		
22-Oct-80	840	3	20	7290
27-Oct-80	1010	3	20	
28-Oct-80	727	3	110	3300
29-Oct-80	468	3	75	6485
30-Oct-80	622	4	115	1250
04-Nov-80	335	4	50	3220

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
05-Nov-80	264	4	55	1535
10-Nov-80	230	3	40	1885
11-Nov-80	480	3	20	3620
12-Nov-80	335	2	55	2380
13-Nov-80	515	3	75	8095
15-Nov-80	407	3	65	3825
20-Nov-80	350	3	30	
24-Nov-80	557	3	65	7275
26-Nov-80	633	3	90	3058
28-Nov-80	261	4	50	1328
01-Dec-80	567	1		4100
06-Dec-80	811	3	70	5800
07-Dec-80	1344	3	40	3840
08-Dec-80	470	3	40	3200
12-Dec-80	664	3	130	5110
13-Dec-80	874	2	260	
15-Dec-80	966	3	70	11870
16-Dec-80	831	3	50	5520
18-Dec-80	410	4	65	2440
19-Dec-80	1960	3	180	9110
01-Jan-81	547	5	150	
02-Jan-81	647	6	70	
04-Jan-81	670	5	205	
07-Jan-81	167	5	35	
08-Jan-81	223	3	65	
09-Jan-81	280	3	40	971
11-Jan-81	320	6	90	2097
12-Jan-81	552	3	30	1737
13-Jan-81	41	4	15	
14-Jan-81	154	1		
16-Jan-81	296	4	40	
19-Jan-81	141	5	40	
20-Jan-81	103	3	45	
25-Jan-81	544	4	40	1755
31-Jan-81	396	4	60	2350
02-Feb-81	216	4	35	
03-Feb-81	606	4	35	1650
04-Feb-81	162	6	15	
05-Feb-81	777	3	105	
06-Feb-81	497	4	80	1398
07-Feb-81	570	4	30	2775
21-Feb-81	505	5	70	
25-Feb-81	356	3	30	872
26-Feb-81	359	4	5	
02-Mar-81	374	4	30	2565
05-Mar-81	159	3	50	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
06-Mar-81	600	3	90	
09-Mar-81	489	4	10	
10-Mar-81	281	3	35	706
11-Mar-81	122	3	15	515
12-Mar-81	118	3	25	
13-Mar-81	384	4	50	1007
17-Mar-81	223	3	45	470
27-Mar-81	316	3	35	
28-Mar-81	121	3	15	
01-Apr-81	268	3	30	930
13-Apr-81	1435	4	145	5441
14-Apr-81	200	3	80	1440
15-Apr-81	154	4	25	
16-Apr-81	378	4	30	1194
18-Apr-81	230	3	30	
23-Apr-81	661	3	60	
29-Apr-81	145	3	40	
30-Apr-81	200	3	5	
01-May-81	311	3	55	
04-May-81	525	2	5	
08-May-81	345	3	25	696
09-May-81	228	3	10	1252
11-May-81	441	3	20	
12-May-81	197	4	10	1267
13-May-81	143	3	20	235
16-May-81	151	3	15	
22-May-81	220	4	45	832
23-May-81	342	3	120	1184
26-May-81	201	3	15	418
27-May-81	192	4	15	1088
28-May-81	340	3	70	1298
29-May-81	465	4	105	
01-Jun-81	263	4	35	6219
02-Jun-81	176	3	25	
05-Jun-81	554	4	195	978
06-Jun-81	365	2	35	
11-Jun-81	737	2	95	
14-Jun-81	292	2	30	
15-Jun-81	325	3	50	
17-Jun-81	695	3	130	
20-Jun-81	892	4	90	
25-Jun-81	152	3	20	1951
26-Jun-81	409	3	45	5055
27-Jun-81	242	3	10	4054
29-Jun-81	210	3	25	
01-Jul-81	292	3	20	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
03-Jul-81	322	4	30	1626
04-Jul-81	247	3	25	
10-Jul-81	795	3	100	
11-Jul-81	354	3	100	
14-Jul-81	185	3	20	351
15-Jul-81	304	4	71	
16-Jul-81	87	7	15	
17-Jul-81	150	3	20	830
18-Jul-81	280	4	15	
20-Jul-81	230	4	10	
21-Jul-81	165	4	15	
22-Jul-81	190	4	25	
23-Jul-81	530	5	95	4000
24-Jul-81	180	5	10	
25-Jul-81	226	5	40	
27-Jul-81	60	3	10	
28-Jul-81	177	4	25	
30-Jul-81	144	7	20	
31-Jul-81	143	3	25	1200
01-Aug-81	100	4	15	
03-Aug-81	110	3	10	
05-Aug-81	280	5	65	
06-Aug-81	97	4	25	
07-Aug-81	470	7	150	
08-Aug-81	30	5	5	
10-Aug-81	86	3	10	
12-Aug-81	40	1		
13-Aug-81	110	5	15	
14-Aug-81	68	3	10	767
15-Aug-81	38	3	1	
17-Aug-81	74	3	20	
18-Aug-81	38	3	10	
19-Aug-81	94	4	5	
20-Aug-81	240	3	30	
21-Aug-81	249	4	45	
22-Aug-81	240	3	50	
24-Aug-81	365	3	75	
26-Aug-81	57	5	15	
27-Aug-81	154	4	30	
28-Aug-81	63	4	20	262
31-Aug-81	185	4	30	
02-Sep-81	246	8	40	
03-Sep-81	69	5	10	
03-Sep-81	164	4	35	
04-Sep-81	210	4	20	
05-Sep-81	99	4	15	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
06-Sep-81	272	4	25	
06-Sep-81	663	4	70	
07-Sep-81	207	4	20	
08-Sep-81	197	4	55	
09-Sep-81	307	4	20	
10-Sep-81	188	4	40	
11-Sep-81	69	4	10	
12-Sep-81	171	3	5	
15-Sep-81	184	4	20	
16-Sep-81	246	3	10	
17-Sep-81	173	3	10	
18-Sep-81	190	4	15	
24-Sep-81	538	3	115	
25-Sep-81	340	4	75	
29-Sep-81	310	4	75	
30-Sep-81	240	3	100	
09-Oct-81	191	6	30	
10-Oct-81	122	4	20	
11-Oct-81	96	4	5	
12-Oct-81	151	3	30	
13-Oct-81	76	4	10	
14-Oct-81	95	4	25	
15-Oct-81	109	4	15	
17-Oct-81	66	5	10	
19-Oct-81	140	4	45	
20-Oct-81	95	2	25	
21-Oct-81	196	4	40	
22-Oct-81	122	4	25	
23-Oct-81	130	5	35	
24-Oct-81	145	4	20	
31-Oct-81	230	4	25	
01-Nov-81	200	5	30	
02-Nov-81	160	4	5	
04-Nov-81	160	4	25	
06-Nov-81	136	5	15	
07-Nov-81	642	4	145	
08-Nov-81	104	4	20	
09-Nov-81	80	6	10	
10-Nov-81	89	4	15	
16-Nov-81	134	5	20	
24-Nov-81	175	5	20	
25-Nov-81	190	7	20	
27-Nov-81	62	4	15	
01-Dec-81	110	3	10	
11-Dec-81	52	4	10	
12-Dec-81	130	4	30	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
16-Dec-81	100	6	40	
06-Jan-82	347	5	50	
07-Jan-82	120	4	25	
10-Jan-82	66	5	5	
13-Jan-82	141	4	50	
18-Jan-82	213	4	15	
24-Jan-82	83	4	15	
31-Jan-82	82	4	30	
04-Feb-82	60	4	10	
05-Feb-82	68	4	10	
06-Feb-82	95	5	20	
07-Feb-82	90	4	10	
08-Feb-82	97	5	15	
09-Feb-82	127	5	30	
10-Feb-82	238	6	20	
21-Feb-82	63	4	15	
24-Feb-82	98	4	5	
25-Feb-82	55	3	15	
04-Mar-82	89	4	10	
05-Mar-82	139	5	5	
06-Mar-82	83	4	5	
07-Mar-82	84	5	10	
15-Mar-82	121	6	5	
16-Mar-82	112	8	10	
17-Mar-82	130	5	5	
18-Mar-82	131	4	10	
19-Mar-82	233	4	20	
20-Mar-82	61	5	10	
20-Mar-82	115	4	20	
21-Mar-82	362	4	20	
21-Mar-82	380	4	15	
22-Mar-82	284	6	40	
23-Mar-82	313	3	50	
24-Mar-82	88	4	10	
28-Mar-82	334	6	100	
29-Mar-82	177	5	40	
05-Apr-82	650	14	195	
06-Apr-82	388	6	50	
06-Apr-82	194	4	20	
08-Apr-82	107	6	15	
09-Apr-82	135	5	15	
16-Apr-82	183	3	20	
19-Apr-82	247	5	15	
22-Apr-82	326	4	25	
24-Apr-82	221	4	30	
25-Apr-82	196	4	20	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
26-Apr-82	110	5	10	
27-Apr-82	71	5	5	
29-Apr-82	133	4	10	
30-Apr-82	73	5	5	
01-May-82	176	8	30	
04-May-82	186	5	40	
05-May-82	113	4	25	
06-May-82	219	8	25	
11-May-82	147	5	20	
12-May-82	557	4	50	
13-May-82	100	8	15	
14-May-82	327	5	35	
14-May-82	432	5	65	
15-May-82	317	5	50	
15-May-82	268	6	25	
16-May-82	149	4	30	
18-May-82	640	5	60	
19-May-82	340	5	40	
19-May-82	1840	5	300	
20-May-82	175	7	15	
21-May-82	65	7	10	
23-May-82	164	4	50	
24-May-82	219	4	30	
25-May-82	155	4	10	
26-May-82	318	4	35	
28-May-82	164	5	25	
29-May-82	209	6	20	
30-May-82	165	4	10	
02-Jun-82	298	5	35	
03-Jun-82	367	5	10	
07-Jun-82	414	5	80	
08-Jun-82	226	1		
09-Jun-82	147	6	15	
10-Jun-82	233	5	45	
11-Jun-82	57	5	10	
14-Jun-82	306	5	10	
15-Jun-82	314	5	35	
16-Jun-82	418	6	25	
17-Jun-82	222	3	50	
19-Jun-82	155	3	10	
20-Jun-82	37	5	5	
21-Jun-82	171	5	35	
22-Jun-82	73	4	15	
23-Jun-82	229	5	30	
24-Jun-82	74	4	10	
25-Jun-82	43	5	5	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
27-Jun-82	117	5	15	
28-Jun-82	106	2	15	
29-Jun-82	170	5	30	
30-Jun-82	222	4	25	
01-Jul-82	72	4	5	
04-Jul-82	164	5	25	
05-Jul-82	125	4	20	
06-Jul-82	43	4	10	
08-Jul-82	78	5	10	
09-Jul-82	231	4	40	
10-Jul-82	104	6	10	
11-Jul-82	264	4	45	
12-Jul-82	71	4	5	
13-Jul-82	130	4	40	
14-Jul-82	244	3	30	
16-Jul-82	126	4	15	
17-Jul-82	95	3	10	
18-Jul-82	182	4	25	
19-Jul-82	147	5	20	
20-Jul-82	214	2	30	
21-Jul-82	119	5	30	
22-Jul-82	41	5	5	
23-Jul-82	57	5	10	
25-Jul-82	44	5	10	
28-Jul-82	31	5	5	
29-Jul-82	107	6	10	
30-Jul-82	62	5	10	
31-Jul-82	85	4	10	
03-Aug-82	184	8	45	
04-Aug-82	61	7	10	
05-Aug-82	45	5	5	
06-Aug-82	58	5	15	
08-Aug-82	19	3	5	
09-Aug-82	138	4	55	
14-Aug-82	100	7	10	
15-Aug-82	60	6	15	
16-Aug-82	37	6	10	
17-Aug-82	100	7	15	
17-Aug-82	85	6	30	
18-Aug-82	489	9	105	
18-Aug-82	531	6	100	
19-Aug-82	353	6	50	
19-Aug-82	362	5	30	
21-Aug-82	263	5	35	
22-Aug-82	149	7	10	
23-Aug-82	161	5	15	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
24-Aug-82	141	5	25	
25-Aug-82	107	5	15	
26-Aug-82	185	5	10	
27-Aug-82	144	5	20	
28-Aug-82	147	5	20	
31-Aug-82	56	5	15	
01-Sep-82	111	5	10	
02-Sep-82	95	5	15	
03-Sep-82	67	5	10	
07-Sep-82	133	5	5	
08-Sep-82	88	5	10	
17-Sep-82	65	6	15	
18-Sep-82	72	5	15	
21-Sep-82	48	5	10	
22-Sep-82	130	5	20	
23-Sep-82	106	5	30	
27-Sep-82	95	5	20	
29-Sep-82	90	3	20	
30-Sep-82	105	5	10	
01-Oct-82	79	5	5	
05-Oct-82	88	5	20	
09-Oct-82	57	5	10	
12-Oct-82	58	5	15	
15-Oct-82	18	6	5	
29-Oct-82	21	6	10	
01-Nov-82	45	4	15	
07-Nov-82	3	5		
09-Nov-82	24	6	15	
21-Nov-82	40	5	5	
07-Dec-82	3	4		
09-Dec-82	35	4	5	
24-Dec-82	20	4	5	
27-Dec-82	25	2	5	
29-Dec-82	3	3		
31-Dec-82	23	4	5	
13-Jan-83	35	5	5	
15-Jan-83	80	6	20	
19-Jan-83	80	3	10	
20-Jan-83	100	9	25	
21-Jan-83	90	8	30	
30-Jan-83	25	5	5	
31-Jan-83	220	7	30	
01-Feb-83	30	6	5	
04-Feb-83	260	2	30	
05-Feb-83	185	7	25	
07-Feb-83	145	6	30	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
15-Feb-83	410	1		
21-Feb-83	105	3	15	
23-Feb-83	100	2	20	
28-Feb-83	145	6	10	
02-Mar-83	105	6	25	
03-Mar-83	65	6	20	
10-Mar-83	360	6	25	
11-Mar-83	190	6	20	
15-Mar-83	80	5	2	
17-Mar-83	50	4	5	
22-Mar-83	195	2	15	
24-Mar-83	120	6	30	
31-Mar-83	160	5	10	
04-Apr-83	90	6	15	
06-Apr-83	120	6	10	
11-Apr-83	175	3	15	
12-Apr-83	130	3	10	
14-Apr-83	105	5	10	
15-Apr-83	110	11	30	
18-Apr-83	180	6	5	
19-Apr-83	60	5	10	
21-Apr-83	65	7	10	
23-Apr-83	3	3		
25-Apr-83	180	6	40	
26-Apr-83	60	7	10	
27-Apr-83	70	6	5	
28-Apr-83	55	5	10	
30-Apr-83	70	3	5	
04-May-83	85	5	25	
11-May-83	90	6	15	
12-May-83	90	5	10	
13-May-83	25	6	5	
17-May-83	105	5	10	
19-May-83	120	5	25	
20-May-83	120	5	20	
21-May-83	145	6	20	
23-May-83	125	5	10	
24-May-83	65	5	5	
27-May-83	55	6	20	
03-Jun-83	45	6	15	
06-Jun-83	90	7	10	
08-Jun-83	40	5	5	
13-Jun-83	60	7	20	
16-Jun-83	90	3	5	
20-Jun-83	160	6	15	
21-Jun-83	140	8	25	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
22-Jun-83	250	4	15	
25-Jun-83	195	5	25	
27-Jun-83	290	5	20	
28-Jun-83	185	2	20	
04-Jul-83	80	5	5	
05-Jul-83	85	3	10	
06-Jul-83	105	5	15	
10-Jul-83	75	4	15	
11-Jul-83	3	5		
15-Jul-83	310	7	15	
17-Jul-83	180	6	10	
21-Jul-83	190	7	40	
22-Jul-83	30	5	10	
23-Jul-83	55	6	10	
28-Jul-83	150	7	35	
29-Jul-83	80	5	18	
01-Aug-83	55	7	5	
02-Aug-83	85	5	15	
04-Aug-83	45	5	10	
05-Aug-83	25	4	5	
08-Aug-83	50	5	15	
09-Aug-83	40	4	5	
12-Aug-83	225	5	10	
13-Aug-83	30	5	5	
15-Aug-83	45	2	10	
17-Aug-83	45	6	10	
18-Aug-83	180	5	25	
18-Aug-83	75	10	15	
20-Aug-83	175	4	20	
22-Aug-83	60	7	20	
24-Aug-83	30	5	5	
25-Aug-83	80	4	10	
27-Aug-83	60	4	15	
03-Sep-83	190	4	40	
05-Sep-83	95	5	5	
07-Sep-83	140	4	25	
09-Sep-83	115	4	5	
13-Sep-83	60	10	10	
14-Sep-83	205	6	10	
15-Sep-83	70	5	15	
17-Sep-83	70	3	35	
19-Sep-83	120	5	15	
22-Sep-83	55	5	15	
23-Sep-83	75	6	25	
26-Sep-83	70	4	20	
29-Sep-83	45	4	5	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
01-Oct-83	210	5	40	
04-Oct-83	115	6	30	
05-Oct-83	65	5	15	
06-Oct-83	70	4	10	
07-Oct-83	70	5	10	
08-Oct-83	140	5	40	
09-Oct-83	3	5		
10-Oct-83	50	4	10	
11-Oct-83	75	6	5	
12-Oct-83	60	5	5	
13-Oct-83	65	5	5	
15-Oct-83	30	5	1	
16-Oct-83	15	4	1	
18-Oct-83	60	5	5	
19-Oct-83	80	5	30	
20-Oct-83	65	4	5	
23-Oct-83	200	5	65	
24-Oct-83	85	5	30	
25-Oct-83	35	4	10	
26-Oct-83	80	4	15	
27-Oct-83	30	5	5	
31-Oct-83	200	5	20	
05-Nov-83	65	1		
08-Nov-83	25	4	10	
21-Nov-83	150	3	10	
28-Nov-83	50	3	1	
29-Nov-83	65	2	5	
01-Dec-83	20	4	5	
11-Dec-83	115	5	10	
13-Dec-83	100	4	10	
17-Dec-83	110	5	15	
21-Dec-83	100	5	15	
22-Dec-83	100	1		
28-Dec-83	85	6	15	
31-Dec-83	70	6	5	
05-Jan-84	115	2	35	
09-Jan-84	30	4	5	
12-Jan-84	105	4	25	
13-Jan-84	115	2	5	
14-Jan-84	3	2		
16-Jan-84	70	3	1	
17-Jan-84	55	5	5	
18-Jan-84	115	4	25	
19-Jan-84	55	5	10	
20-Jan-84	125	4	5	
26-Jan-84	120	4	45	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
29-Jan-84	35	6	10	
30-Jan-84	50	4	10	
31-Jan-84	15	3	5	
01-Feb-84	55	3	5	
02-Feb-84	75	5	10	
03-Feb-84	65	7	10	
05-Feb-84	45	6	10	
06-Feb-84	137	5	25	
06-Feb-84	125	7	10	
07-Feb-84	145	4	10	
07-Feb-84	170	5	15	
14-Feb-84	110	4	5	
15-Feb-84	105	4	5	
16-Feb-84	95	4	20	
26-Feb-84	95	2	5	
27-Feb-84	3	3		
03-Mar-84	80	4	25	
06-Mar-84	45	6	5	
15-Mar-84	165	4	30	
22-Mar-84	60	5	15	
27-Mar-84	45	4	10	
29-Mar-84	398	5	25	
30-Mar-84	402	5	45	
02-Apr-84	90	5	15	
13-Apr-84	3	1		
14-Apr-84	3	3		
16-Apr-84	150	4	25	
20-Apr-84	70	4	10	
26-Apr-84	35	6	10	
04-May-84	155	3	5	
07-May-84	15	1		
14-May-84	215	4	20	
27-May-84	62	6	10	
28-May-84	55	3	5	
01-Jun-84	20	4	1	
06-Jun-84	20	3	1	
12-Jun-84	15	4	5	
14-Jun-84	35	3	5	
18-Jun-84	105	4	10	
18-Jun-84	100	3	5	
19-Jun-84	110	4	5	
22-Jun-84	130	6	20	
23-Jun-84	60	3	5	
01-Jul-84	100	4	5	
06-Jul-84	40	3	10	
13-Jul-84	55	3	10	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
20-Jul-84	15	2	1	
27-Jul-84	12	5	1	
03-Aug-84	30	3	5	
10-Aug-84	12	3	1	
17-Aug-84	36	3	5	
24-Aug-84	37	4	1	
30-Aug-84	14	4	2	
04-Sep-84	54	4	10	
08-Sep-84	440	6	80	
10-Sep-84	786	4	30	
12-Sep-84	284	3	10	
13-Sep-84	211	5	15	
13-Sep-84	167	4	10	
15-Sep-84	95	4	10	
18-Sep-84	70	3	5	
23-Sep-84	190	5	30	
26-Sep-84	135	4	10	
28-Sep-84	148	4	10	
02-Oct-84	45	4	5	
08-Oct-84	215	1		
15-Oct-84	93	5	5	
22-Oct-84	98	4	5	
31-Oct-84	60	3	10	
14-Nov-84	25	3	5	
15-Nov-84	21	1		
21-Nov-84	38	5	5	
26-Nov-84	10	4	5	
03-Dec-84	3	4		
05-Dec-84	10	2	1	
02-Jan-85	50	4	10	
07-Jan-85	25	3	5	
22-Jan-85	76	3	5	
25-Jan-85	23	4	10	
04-Feb-85	3	3		
17-Feb-85	60	4	10	
18-Feb-85	40	5	5	
26-Feb-85	45	6	10	
02-Mar-85	65	5	15	
07-Mar-85	90	4	20	
09-Mar-85	30	7	10	
11-Mar-85	30	5	1	
13-Mar-85	75	5	10	
28-Mar-85	3	1		
29-Mar-85	25	6	5	
02-Apr-85	3	5		
05-Apr-85	3	3		

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
09-Apr-85	10	4	5	
12-Apr-85	70	5	5	
14-Apr-85	3	6		
25-Apr-85	10	5	5	
29-Apr-85	3	4		
01-May-85	3	3		
07-May-85	45	5	10	
09-May-85	3	3		
13-May-85	45	2	5	
16-May-85	50	5	15	
17-May-85	5	8	2	
21-May-85	15	7	5	
23-May-85	40	3	15	
26-May-85	30	5	5	
30-May-85	90	4	10	
02-Jun-85	160	5	25	
03-Jun-85	45	6	15	
08-Jun-85	220	5	10	
10-Jun-85	165	5	10	
12-Jun-85	60	4	5	
18-Jun-85	45	5	5	
21-Jun-85	55	4	5	
26-Jun-85	45	3	5	
28-Jun-85	25	4	5	
02-Jul-85	25	4	5	
05-Jul-85	25	5	5	
08-Jul-85	25	5	5	
11-Jul-85	25	5	5	
15-Jul-85	25	5	5	
22-Jul-85	30	4	5	
23-Jul-85	25	6	5	
24-Jul-85	35	5	5	
25-Jul-85	40	22	10	
26-Jul-85	30	10	5	
31-Jul-85	3	4		
03-Aug-85	20	17	5	
12-Aug-85	40	6	5	
13-Aug-85	20	8	5	
16-Aug-85	3	4		
26-Aug-85	45	6	15	
29-Aug-85	20	5	1	
03-Sep-85	50	4	5	
18-Sep-85	10	7	5	
20-Sep-85	25	5	5	
24-Sep-85	3	3		
26-Sep-85	3	3		

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
01-Oct-85	35	5	5	
03-Oct-85	90	5	30	
07-Oct-85	20	5	10	
08-Oct-85	15	4	5	
15-Oct-85	20	4	5	
18-Oct-85	3	3		
25-Oct-85	35	5	10	
28-Oct-85	20	4	10	
12-Nov-85	10	5	5	
18-Nov-85	120	5	10	
22-Nov-85	5	4	2	
10-Dec-85	3	2		
11-Dec-85	3	3		
18-Dec-85	30	5	5	
27-Dec-85	3	3		
06-Jan-86	80	5	20	
24-Jan-86	55	5	25	
08-Feb-86	3	2		
10-Feb-86	45	5	10	
18-Feb-86	3	2		
26-Feb-86	3	2		
16-Mar-86	25	5	5	
19-Mar-86	10	4	5	
31-Mar-86	20	5	5	
07-Apr-86	5	4	2	
18-Apr-86	35	5	15	
21-Apr-86	3	3		
23-Apr-86	3	3		
30-Apr-86	3	2		
08-May-86	700	4	20	
14-May-86	35	5	5	
16-May-86	90	5	15	
19-May-86	40	5	5	
28-May-86	15	5	5	
09-Jun-86	25	4	5	
19-Jun-86	15	5	5	
25-Jun-86	25	5	10	
07-Jul-86	10	2	5	
18-Jul-86	35	4	5	
25-Jul-86	25	4	5	
28-Jul-86	40	4	10	
04-Aug-86	3	2		
07-Aug-86	3	2		
13-Aug-86	55	5	15	
19-Aug-86	35	5	5	
27-Aug-86	3	3		

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
28-Aug-86	3	4		
03-Sep-86	25	5	5	
11-Sep-86	20	5	5	
12-Sep-86	3	4		
22-Sep-86	30	5	5	
06-Oct-86	65	5	5	
08-Oct-86	45	5	5	
14-Oct-86	25	5	5	
16-Oct-86	15	5	5	
18-Oct-86	20	5	5	
20-Oct-86	50	5	5	
21-Oct-86	550	5	50	
21-Oct-86	375	5	20	
22-Oct-86	675	5	50	
23-Oct-86	260	5	50	
24-Oct-86	160	3	15	
03-Nov-86	60	5	20	
13-Nov-86	3	3		
25-Nov-86	3	2		
02-Dec-86	35	5	5	
09-Dec-86	80	4	15	
11-Dec-86	3	4		
15-Dec-86	3	3		
16-Dec-86	15	5	5	
30-Dec-86	15	3	5	
06-Jan-87	3	5		
08-Jan-87	35	5	10	
15-Jan-87	30	5	5	
20-Jan-87	3	1		
21-Jan-87	15	5	5	
07-Feb-87	3	2		
10-Feb-87	3	5		
20-Feb-87	3	3		
25-Feb-87	3	5		
22-Mar-87	3	5		
24-Mar-87	10	5	5	
25-Mar-87	3	1		
27-Mar-87	3	4		
30-Mar-87	3	5		
01-Apr-87	3	5		
13-Apr-87	3	5		
20-Apr-87	15	4	5	
23-Apr-87	3	6		
27-Apr-87	15	2	5	
28-Apr-87	35	3	5	
04-May-87	3	5		

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
05-May-87	3	5		
07-May-87	3	4		
08-May-87	3	5		
11-May-87	3	5		
13-May-87	3	4		
22-May-87	3	2		
02-Jun-87	3	4		
09-Jun-87	3	5		
11-Jun-87	3	4		
23-Jun-87	3	4		
29-Jun-87	3	4		
06-Jul-87	3	5		
14-Jul-87	3	5		
27-Jul-87	3	3		
29-Jul-87	3	4		
05-Aug-87	3	4		
06-Aug-87	3	4		
10-Aug-87	15	5	2	
15-Aug-87	3	3		
18-Aug-87	45	7	5	
20-Aug-87	3	8		
22-Aug-87	3	6		
24-Aug-87	3	5		
26-Aug-87	3	7		
28-Aug-87	3	6		
31-Aug-87	15	6	2	
04-Sep-87	3	4		
08-Sep-87	10	5	5	
10-Sep-87	3	5		
11-Sep-87	3	5		
16-Sep-87	3	5		
17-Sep-87	3	5		
18-Sep-87	20	6	5	
21-Sep-87	5	5	1	
24-Sep-87	3	5		
28-Sep-87	25	5	5	
30-Sep-87	3	5		
14-Oct-87	3	5		
19-Oct-87	3	2		
20-Oct-87	10	5	5	
22-Oct-87	15	5	2	
26-Oct-87	15	5	5	
28-Oct-87	17	2	2	
02-Nov-87	3	4		
04-Nov-87	25	5	5	
17-Nov-87	30	5	5	

DATE	SO ₂ FLUX	n	S.D.	CO ₂ FLUX
18-Nov-87	3	5		
15-Dec-87	3	4		
17-Dec-87	3	5		
04-Jan-88	25	4	5	
12-Jan-88	3	3		
19-Jan-88	3	5		
21-Jan-88	3	5		
01-Feb-88	3	5		
02-Feb-88	3	4		
04-Feb-88	3	5		
19-Feb-88	3	4		
22-Feb-88	3	5		
24-Feb-88	3	5		
08-Mar-88	15	5	5	
11-Mar-88	10	5	5	
15-Mar-88	3	5		
17-Mar-88	10	5	5	
31-Mar-88	3	5		
01-Apr-88	3	6		
11-Apr-88	3	6		
13-Apr-88	3	5		
18-Apr-88	11	6	5	
25-Apr-88	3	5		
10-May-88	3	5		
11-May-88	3	5		
24-May-88	20	5	5	
26-May-88	3	1		
13-Jun-88	3	5		
08-Jul-88	8	2	1	
18-Jul-88	3	5		
20-Jul-88	3	5		
27-Jul-88	3	5		
02-Aug-88	3	5		
04-Aug-88	3	5		
09-Aug-88	3	1		
10-Aug-88	3	5		
15-Aug-88	3	5		
17-Aug-88	3	5		
24-Aug-88	3	4		
29-Aug-88	3	3		
31-Aug-88	21	5	5	
06-Sep-88	3	4		