This work was supported in part by National Science Foundation grant DPP 81-18562. Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36.

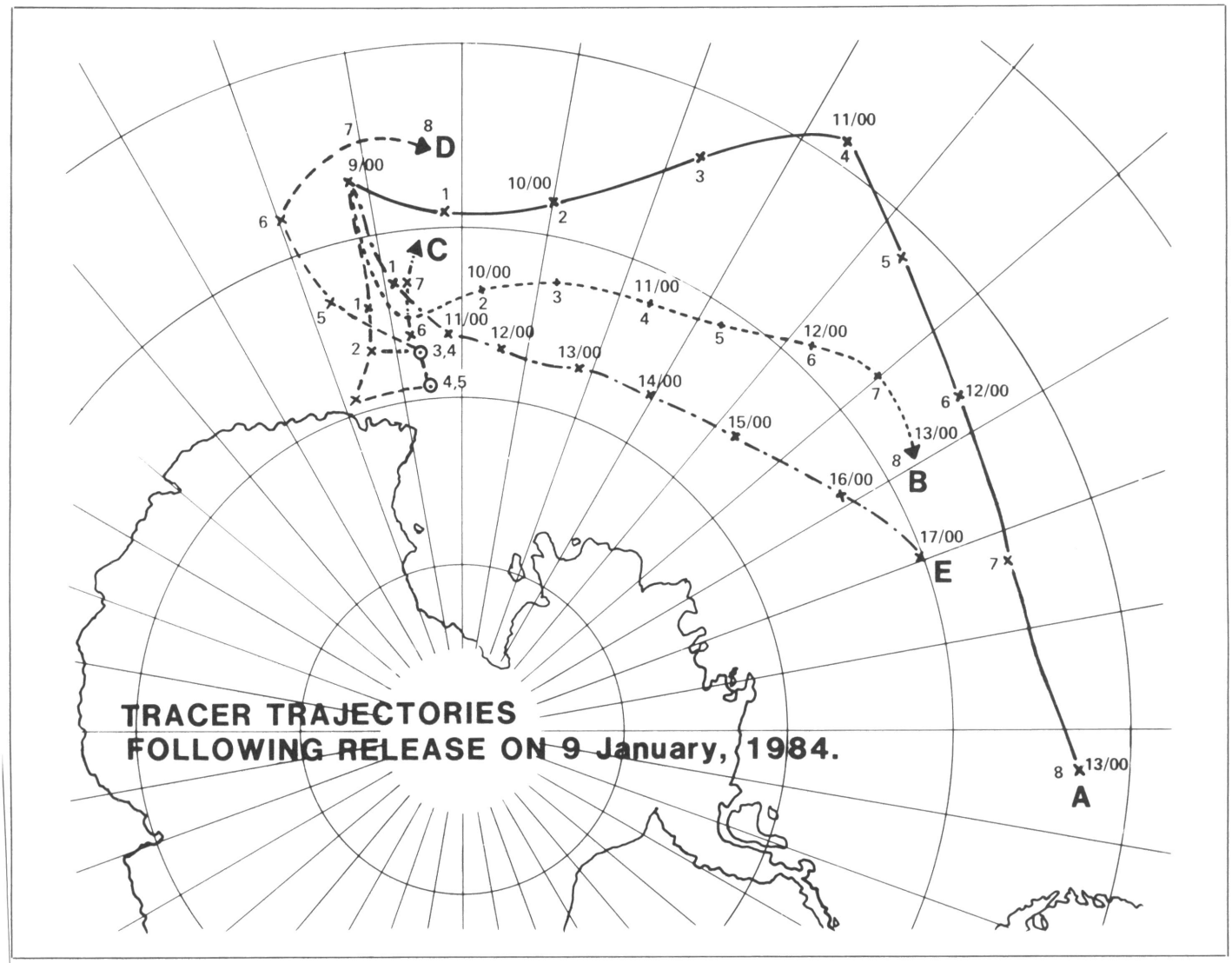

Figure 2. Forecast tracer trajectories following the release on 9 January 1984.

Determination of sulfur gases in the antarctic atmosphere

S.B. DILTS *and* D.R. CRONN

Laboratory for Atmospheric Research
Washington State University
Pullman, Washington 99164

A research program was conducted during austral summer 1985 to survey the ground-level concentration of atmospheric sulfur gases in Antarctica. The source of most of these gases is presumed to be natural biogenic emissions from productive marine waters (Andreae and Raemdonck 1983). They are subsequently transformed in the atmosphere to sulfate aerosol particles, transported across the Antarctic Continent, and eventually deposited to the ice sheet.

The measurements were made by metal foil collection/flash vaporization/flame photometric detection (MFC/FV/FPD). This is a relatively new method developed by S.O. Farwell, R.A. Kagel, and coworkers at the University of Idaho (Kagel 1983). Sample air is passed over a palladium foil strip which adsorbs the sulfur gases. The loaded foil is flash heated by an electric current, and the desorbed gases are carried to a flame photometric detector which is sensitive to sulfur molecules.

The foils are mounted in teflon blocks which can be taken into the field, sampled with portable pumps, and returned to the laboratory for analysis. The samples remain stable for up to several days if they are carefully sealed. This method gives total sulfur concentrations without speciation. Some error is introduced because the collection efficiency is slightly different for different sulfur gases and changes somewhat with use of the foils. Any response to sulfur-containing aerosols has not been characterized.

The field sampling team, consisting of S.B. Dilts, F.A. Menzia, and D.R. Cronn, arrived at McMurdo Station on 8 January 1985. Unfortunately, the MFC/FV/FPD instrumentation was damaged in transit. Repairs were started immediately, but it was 15 January before sampling commenced. Cronn returned to the United States on 25 January while Dilts and Menzia remained until sampling terminated near the end of the field season on 7 February due to instrument failure.

Samples were collected at Cape Royds, Lake Vanda, Upstream field camp on the Siple Coast, on helicopter flights over open water, on the Ross Ice Shelf (Meely automatic weather station), and at the South Pole. Samples also were collected at least once weekly at Arrival Heights (First Crater), Ross Island, which is usually upwind of nearby McMurdo Station. The number of samples collected at each site are listed in the table. Sampling times ranged from 1 to 3 hours. Dilts and Menzia traveled to Amundsen-Scott Station to set up a sampling program and train J. Sampson of the State University of New York at Albany in the sampling procedure. Sampling blocks were flown to South Pole Station, sampled, and then returned to the McMurdo laboratory for analysis.

Locations and numbers of samples collected for atmospheric sulfur trace gas analysis

Site	Location	Number of samples
Arrival Heights	77°50′S 166°39′E	13
South Pole	90°S	9
Cape Royds	77°33′S 166°09′E	5
Meely automatic weather station	78°30′S 170°08′E	3
Upstream field camp	83°28′S 138°03′W	3
Lake Vanda	77°32′S 161°33′E	3
Open water (McMurdo Sound)	77°30′S 165°00′E	2

Preliminary results from the MFC/FV/FPD analyses show total sulfur gas concentrations in the low parts-per-trillion range which is much less than expected, based on other investigators' results for remote areas (Torres et al. 1980; Jones, Cox, and Penkett 1983; Chatfield and Crutzen 1984). Testing of the repaired MFC/FV/FPD system and statistical analysis of the results are continuing to check the validity of the measurements.

A small number of whole-air samples, collected in stainless steel flasks, were shipped back to the Washington State University laboratories for gas chromatographic analysis for some of the individual sulfur-containing compounds. However, the stability of sulfur gases in such containers has been questioned based on experiences in our laboratory and elsewhere (Jones, Cox, and Penkett 1983). Gas chromatographic analysis of the flask samples shows high sulfur concentrations more consistent with polluted atmospheres than with the clean Antarctic. It is likely, therefore, that these samples were compromised in some way.

This work was supported by National Science Foundation grant DPP 82-16204.

References

Andreae, M.O., and H. Raemdonck. 1983. Dimethyl sulfide in the surface ocean and the marine atmosphere: A global view. *Science*, 221, 744.

Chatfield, R.B., and P.J. Crutzen. 1984. Sulfur dioxide in remote oceanic air: Cloud transport of reactive precursors. *Journal of Geophysical Research*, 89(D5), 7111.

Jones, B.M.R., R.A. Cox, and S.A. Penkett. 1983. Atmospheric chemistry of carbon disulphide. *Journal of Atmospheric Chemistry*, 1(1), 65.

Kagel, R.A. 1983. Development, characterization and application of measurement systems for low and sub-part-per-billion gaseous sulfur compounds. (Doctoral thesis, University of Idaho.)

Torres, A.L., P.J. Maroulis, A.J. Goldberg, and A.R. Bandy. 1980. Atmospheric OCS measurements on Project Gametag. *Journal of Geophysical Research*, 85(C12), 7357.