University of Liverpool Aerosol Sampling

Sampling

The aerosol samples were collected using the high-volume filter system described by Chester et al (1984). Trace metal samples were collected using acid washed Whatman GF/C filters in a plastic holder. Organic samples were collected using an anodised aluminium holder containing pre-ashed (450°C >4 hours) Whatman GF/C filters. Approximately 1000 cubic metres of air were filtered for each sample.

Sampling was only undertaken when the wind direction was such that there was no risk of contamination from the ship's exhaust system. The filters were located approximately 14m above the sea surface in the bow. Care was taken to protect the filters from rain, either by covering with specially constructed plates or, in the case of heavy or persistent rain, by removing the filter holder. The filter holder was also removed if there was a significant risk of contamination by sea spray.

Care was taken to prevent contamination of the filters by moving them around the ship in sealed containers and only handling them under a laminar flow hood. A number of blank filters were taken through the complete shipboard handling procedure, without switching on the pumps. These were analysed together with unhandled blanks from each batch of filters used. In no cases were the blanks high enough to warrant corrections to the sample data.

Trace metal analysis

Total atmospheric trace metals were determined by dissolving the filters in redistilled HNO_3 and Aristar HF. Trace metals were determined in the digest solutions using either flame or flameless (graphite furnace) atomic absorption techniques.

Organic analysis

The filters for organic analysis were wrapped in multiple layers of pre-ashed aluminium foil and stored in a closed metal container in a freezer. Samples were kept frozen until the hydrocarbons were extracted from the filters in a Soxhlet apparatus using dichloromethane.

Before extraction commenced, an internal standard (2,21 dimethyl docosane) was added to the extraction unit for the quantification of saturated hydrocarbons and unclassified material (UCM). Quantification of the polycyclic aromatic hydrocarbons (PAH) was achieved by the addition of d-8 napthalene and d-10 anthracene as internal standards.

After extraction, the extract was concentrated to ca. 1 ml by rotary evaporation and to dryness by blowing down under a gentle stream of nitrogen. The extract was then redissolved in dichloromethane for injection into the GC-MS.

All analyses were performed on a VG TS250 mass spectrometer, operated in selective ion monitoring mode, coupled to a Hewlett Packard Model 5908A gas chromatograph fitted with an on-column injector and a 25m HP-5 Ultra grade column. The temperature programme used was 40°C, 1 minute, 4°C per minute to 310°C then isothermal for 20 minutes. Because total extracts were injected into the system it was necessary to incorporate, and regularly replace, a 1m retention gap ahead of the analytical column to remove nonvolatiles.

All data processing, including peak area integration, was performed using software incorporated in the mass spectrometer operating system.

Air mass origins

The air mass origins included in the data set were assigned using 48 hour back trajectories at a height of 10m supplied by the Meteorological Office.

References

Chester, R., Sharples, E.J. and Murphy, K.J.T. (1984). The distribution of particulate M_o in the Atlantic aerosol. Oceanologica Acta 7, 441-450.