

Using Natural ^7Be to Evaluate Upper-Air Transport of Aerosols and Gases in the Troposphere

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Natural radionuclides have been proposed for use in assessing the transport of ozone and aerosols in the troposphere (1-2). For example, ^7Be is known to be produced in the upper troposphere and lower stratosphere by interactions with cosmogenic particles. Beryllium-7 has a 53.28-day half-life and is a gamma emitter that attaches itself to fine particles in the atmosphere once it is formed. Indeed, in tropospheric aerosol samples ^7Be is typically found in association with aerosol particles that are 0.3 μm in diameter. Some investigators have asserted that ozone from aloft can be transported into rural and urban regions during stratospheric/tropospheric folding events, leading to increased background levels of ozone. Reported here are measurements of ^7Be taken at two sites near Pittsburgh, PA in the summer of 2001.

Samples were collected at two sites to examine the apparent residence times by using Sierra impactors and the number 4 plate for a submicron cut-off (aim particle size cut-off, D_{50} between 0.95 μm at a flow rate of 40 $\text{ft}^3 \text{min}^{-1}$ and 1.10 μm at a flow rate of 30 $\text{ft}^3 \text{min}^{-1}$). The first site was located approximately 5 km east of downtown Pittsburgh on a building rooftop adjacent to Schenley Park (40.4395° N latitude and 79.9405° W longitude, at an altitude of approximately 310 m). At this site the

wind was predominantly from the south and the west. The second site was located at the U.S. Department of Energy National Energy Technology Laboratory (NETL) Ambient Air Monitoring Station. This site is approximately 15 km south of downtown Pittsburgh (40.30655° N latitude and 79.9794° W longitude, at an elevation of 325 m above sea level). The wind at this site is predominantly from the south and southwest. At the sites, 24 hour samples were collected from July 22 to July 30, 2001 on quartz and cellulose filters. Air sample volumes ranged from 1320 to 1600 m³ of air. Nine samples were taken at the NETL site, and six were taken at the Schenley Park site.

Beryllium-7 was determined by direct gamma counting of the filter membranes with a high purity germanium (HPGe) crystal detection analyzer. This system allows for the direct measurement of ⁷Be attached to fine aerosol particles. Sample counting rates are corrected for geometry, detector response factors, and the relative decay rates of the gamma radiation versus total decay processes. The data are presented and compared to data obtained at Phoenix, AZ, in the summer of 2001 and in Houston, TX, in the summer of 2000. Reasonably good agreement between the three sites was observed for the ⁷Be levels. Concentrations of ⁷Be in dpm m⁻³ in Pittsburgh were observed range from 0.08 to 0.31 during this period. This is very comparable to levels we observed in Houston during much of the study in 2000, and lower by a factor of 3-7 than values observed in the Phoenix area. The data do not indicate any significant "events" that would be interpreted as upper air mass transport into the Pittsburgh area during the sampling period.

References

1. J.S. Gaffney, K.A. Orlandini, N.A. Marley, and C.J. Popp, "Measurement of ⁷Be and ²¹⁰Pb in Rain, Snow, and Hail." *J. Appl. Meteorol.* **33** 869-873 (1994), and references therein.
2. J.S. Gaffney, K.A. Orlandini, N.A. Marley, and C.J. Popp, "Reply to Comments on 'Measurement of ⁷Be and ²¹⁰Pb in Rain, Snow, and Hail.'" *J. Appl. Meteorol.* **34** 2106-2109 (1995).