Large seasonal variations in fine-aerosol precipitation rates revealed using cosmogenic Be-7 tracer

JUNG-SEOK CHAE[1,2] AND GUEBUEM KIM[1]

[1]School of Earth and Environmental Sciences, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea (*correspondence: gkim@snu.ac.kr)

[2]Korea Institute of Nuclear Safety, 62 Gwahak-ro, Yuseong-gu, Daejeon, 34142, Republic of Korea (jschae@kins.re.kr)

We analyzed Be-7 data collected for surface air and precipitation over 20 years in Korea. The Be-7 concentrations in the surface air were relatively higher in spring (March, April, May) owing to tropopause folding. However, they were relatively lower in summer (June, July, August) in association with efficient removal by precipitation. The monthly averages of Be-7 activities decreased as the amount of precipitation increased. In general, Be-7 is rapidly adsorbed onto fine aerosol particles following which it participates in the formation and growth of the accumulation mode aerosols (0.07-2 μm diameter). The previous study suggests that the concentrations of Be-7 and PM2.5 are mainly controlled by the same washout effect, although the sources are different. The mean depositional velocities of fine aerosols, based on the Be-7 mass balance model, showed a large seasonal variation, with its maximum value (1.9 cm s^{-1}) in July and minimum value (0.22 cm s^{-1}) in March. Our results imply that concentrations as high as six-fold for PM2.5 can occur in the dry season (winter; December, January, February) if the input terms remain the same, since the Be-7 depositional velocity reflects the net deposition of fine aerosols excluding moisture effects. Thus, precipitation seems to play a critical role in the seasonal changes of fine aerosol concentrations, providing much cleaner air during the summer monsoon season in the Northeast Asia.