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Observation of Cloud Water Chemistry in the Free Troposphere and the Atmospheric Boundary Layer on Mt. Fuji (5)

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Context/Purpose: Mt. Fuji is an isolated peak and its top is located at the free troposphere, so we could observe background concentration of various chemicals in the ambient air over Japan, background pollution due to the long-range transportation from Asian Continent to Japan, and aerosol-gas-cloud interaction. To make clear cloud water chemistry in the free troposphere, we studied acidic substances and trace metals at the top of Mt. Fuji.
Method: Observations of cloud water were conducted in July and August from 2007 to 2018 at the Mt. Fuji Research Station located at the summit (3776 m a.s.l.). Cloud water samples were manually collected by a passive string-type cloud water collector (Usui Co. Inc., FWP-500) at the top of Mt. Fuji (3776 m a.s.l.). Concentrations of major inorganic ions in cloud water were measured by ion chromatography. The pH and electric conductivity were measured after the filtration by 0.45 μm membrane filter. Major inorganic ions were measured by ion chromatography. Fifty-six trace metals were measured by ICP-MS, while Hg was measured by a reducing-vaporization mercury analyzer. The origin of air mass was determined by the backward trajectory. As rare earth metal production in China accounts for 80% of world production, they may be an indicator of the emissions from China.
Results/Interpretation: Volume weighted mean (VWM) pH of cloud water slightly increased from 3.75 in 2007 (n=1) to 4.73 in 2018 (n=27), although total major ion concentration was relatively low around 0.10 meq/L during the studied periods. The average of nitrate/nss sulfate equivalent ratio (N/S ratio) of cloud water increased from 0.67 in 2007 (n=1) to 1.14 in 2018 (n=27). The increase of pH and N/S ratio indicates that the acidification of cloud water at the top of Mt. Fuji is recovering. Backward trajectory analysis showed that cloud water at the top of Mt. Fuji was acidified with the decrease of N/S ratio, the increase of soluble As, Se, and Cd, and rare earth metals such as cerium and yttrium when air mass comes from the Continent.
Conclusion: The recovery of the acidification of cloud water collected at the top of Mt. Fuji was probably due to the reduction of transboundary air pollution from China.