

Formation process of spatial and temporal distribution of stable isotopic composition in precipitation on slope of Mt. Tsukuba

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In order to investigate the spatial and temporal variation of stable isotopic composition in precipitation on the mountain slope, rain water samplers with a high temporal resolution are installed at four different altitudes (40 m, 215 m, 450 m, 870 m) on a southern slope of Mt. Tsukuba which has two peaks on its crest; 876 m (Nyotai-san) and 871 m (Nantai-san), Ibaraki prefecture, central Japan. Rain sample is collected at interval of every 1 mm from the beginning of the rainfall event to the amount of 7 mm, and of every 3.5 mm up to the amount of 35 mm. The samples were collected from August through November of 2004.

Based on one event gross rainfall samples, the deuterium and oxygen-18 isotopic ratios of rain samples fallen at higher elevations were lower than those at lower elevations, thus an altitude effect was estimated to be from -0.44 per mil/100m to -0.10 per mil/100m for oxygen-18.

The altitudes of the cloud base at all rainfall events were estimated, and there were possibility of the difference of the rain drop falling distance between sampling elevations. However, the effect of evaporation of rain drops and isotope exchange between rain drops and atmosphere during falling process might be small because the isotope compositions of the precipitation of S3, S2, and S1 are almost the same.

Estimation of isotopic composition in atmospheric water vapor before rain drops coagulation based on the Rayleigh process showed that the isotopic compositions of atmospheric water vapor would already have altitude effect before coagulation in the cloud. Therefore isotopic vertical profile in vapor would be almost constant in lower part of Mt. Tsukuba, and decrease in the higher part.

The altitude effect showed the temporal change that the effect is clear at the onset of the event, and gradually becomes unclear around the rainfall peak. Then it becomes clear again after the rainfall peak.

The temporal change of altitude effect might proceed by the temporal change of ascending current in the cloud caused by the latent heat's of the rain drop coagulation. It is possible that a superior ascending current would be caused by a large amount of drop coagulating in the cloud during the rainfall peak, consequently an ascending current might decrease isotopic gradient in the atmospheric water vapor, and altitude effect gets weakened.