

## The origin of acid contaminants recorded in snow cover on Mt. Nishi-Hodaka-Dake, The Northern Japan Alps for three winters

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Vertical profiles of chemical components in snow cover at Mt. Nishi-Hodaka-dake, the Northern Japan Alps, were obtained over three consecutive winters (2001/02, 2002/03 and 2003/04) for the investigation of long-range transportation of chemical substances from the Asian continent to high mountainous areas in Japan. The sulphur isotope ratio of non sea-salt (nss-) sulphate in 2002/03 snow was also measured. Concentrations of anthropogenic components such as nss-sulphate and nitrate in snow range from almost 0 to over 100 ueq / L. The nss-sulphate / nitrate (S/N) ratio in snow typically ranges from 0.3 to 6.3. A considerable number of samples had higher S/N ratios than those found in Japan (about 2), while some samples had a much higher ratio (about 4-6), more akin to values found in China (about 4). Snowfalls at Mt. Nishi-Hodaka-Dake are considered to include acid contaminants transported from both the Asian continent and the industrial areas of Japan, with a variable proportion depending on weather conditions. High S/N ratios seem to be caused by severe winter pressure patterns. The sulphur isotope ratio values range from +3.1 permillage to +6.8 permillage. These ratios are evidently higher than that afforded by petroleum usage in Japan (-2 to 0 permillage), and is in accord with that of coal used in both northern China (+7.4 permillage) and the Russian Far East (+3.4 permillage). These sulphur isotope ratio values also suggest the occurrence of long-range transportation of nss-sulphate from the Asian continent, independent of chemical composition.