

Sulfur species in anthropogenic dust particles trapped in snow core

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Introduction

Mineral dusts in ice/snow cores represent a probe for precious environmental variations such as climatic change. Moreover, size distributions, compositions, and especially chemical states of dust particles are also much useful information related to dust transport. For the purpose of estimating the source areas of dusts, some studies on isotopic signatures of dusts, like an index of $^{87}\text{Sr}/^{86}\text{Sr}$ vs. $^{143}\text{Nd}/^{144}\text{Nd}$, have been performed on Vostok and Epica ice cores at Antarctica during the Holocene [1]. However, in order to evaluate anthropogenic materials with ice/snow cores, ice cores collected at Antarctica were insufficient for analysis because of too slow mean accumulation snowfall rate. It has been already indicated clearly that variations of chemical states of sulfur are very effective in evaluation of dust particles, like yellow dust (kosa). Therefore, we focus on the chemical states of sulfur in dusts trapped in shallow snow cores collected at the area where anthropogenic materials have been transported abundantly.

Experimental

The snow samples were collected about 1000g in 2007-2008 winter season at konsei-pass, where is a border between Tochigi and Gunma prefectures. Sampling sites were point A (Gunma-side, 139°23'10"E, 36°49'8"N) and point B (Tochigi-side, 139°24'1"E, 36°48'42"N) shown in figure. The most surface snow was removed from collected samples for analysis to prevent contaminations such as diesel emissions from snowplow. The snow samples were melted at room temperature, and divided into two aliquots and deposited on durapore[®] membrane filter under a simple clean chamber. Beam line was used at BL9A and BL12C, the spectra were collected in fluorescence mode using a Lytle type detector at room temperature.

Results and Discussion

Figure shows XANES spectra of sulfur K-edge of A and B snow samples. Two pre-edge peaks (1) and (2), and white peak (3) which located from 2472eV to 2480eV in spectra can belong to S^{2-} [-II](2472eV), SO_3^{2-} [+IV](2474eV), and SO_4^{2-} [+VI](2480eV), respectively. Although a difference is not remarkable at both points about the peak (3) which belongs to a sulfuric acid system, the chemical species of SO_3^{2-} and S^{2-} are hardly detected at Point B as compared with Point A. Since the fountainhead of the sulfur hot spring which might be an S^{2-} source approaches point B, the corrosions by H_2S have

been remarkable. When taking into consideration from above situation, it seemed reasonable to suppose that the S^{2-} peak (1) should be detected at spectrum of point B, however, the peak (1) was detected more clearly at point A.

The following story can be estimated as results and discussion. The source of sulfate (SO_4^{2-}) can be mainly explained by combustions of coal or oil fuel from an industrial area. Thus sulfate existed widely in the atmosphere. On the other hand, peak (1) indicating sulfide (S^{2-}) has obviously a difference in opposition to a situation. We were able to observe pyrite [FeS_2] in the snow samples collected at other points contained in flyash particles by SEM analysis. The flyash particles trapped by snow had more large diameter than other particles, and tended to fall at the area near its sources. In this region, the monsoon from northwest excels during winter season, thus snowfall begins from the northwest side, that is point A side. Particles including sulfide were carried by the monsoon, and may have been removed by snowfall out of the atmosphere before the konsei-pass.

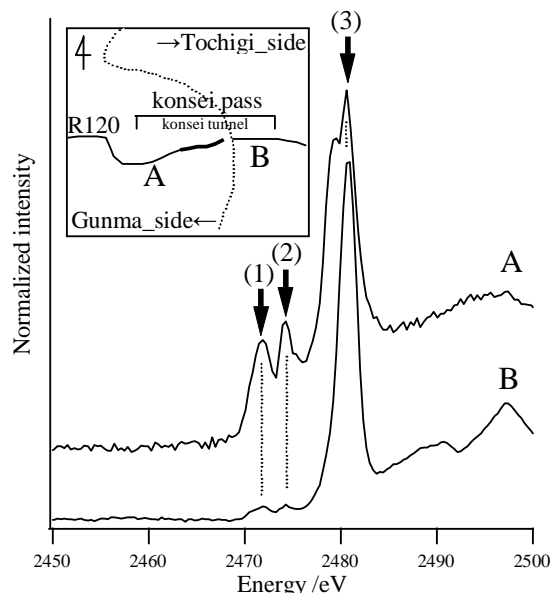


Figure. Sulfur K-edge XANES spectra of dusts trapped in snow in 2007-2008 winter season at konsei-pass. Top left square shows sampling sites around konsei-pass.

Reference

[1] B.Delmonte et al., *Earth Sci. Rev.*, 66, 63 (2004).

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