

Kosa to volcanic-ash ratio in soil layers estimated by $\delta^{18}\text{O}$ value and K-Ar dating

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The proportion of Kosa-dust and volcanic-ash as a parent material of soil was estimated by using stable isotopic analysis and radiometric dating method. This proportion is important to predict radiocesium mobility in the soil. Micaceous minerals, which can immobilize radiocesium by forming an inner-sphere complex, are abundant in Kosa-dust, while not in volcanic-ash.

Fifteen soils were collected from stacking layers of volcanic ash and Kosa-dust in an outcrop about 20 km north-east from Mt. Sanbe. These soils include four key tephra layers (Sanbe-Ikeda; 0.04 Ma, Sanbe-Sunahara; 0.05 Ma, Sanbe-Unnann; 0.07 Ma, Sanbe-Kisuki; 0.11 Ma) with rhyolitic or dacitic composition. The 2-20 μm particles were fractionated from these soils by using sieving and sedimentation methods after decomposing organic matters. SiO_2 minerals (mainly quartz) were isolated from a portion of the 2-20 μm particles to determine their $\delta^{18}\text{O}$ values. Potassium (K) content in the 2-20 μm particles was determined with atomic absorption spectrophotometry after they were digested with HF-HNO_3 solution. Percentage of ^{40}K in total K was calculated by the stable isotopic ratio. Amount of ^{40}Ar remaining in K-bearing minerals was determined by mass spectrometry. Then K-Ar age was determined by using these values.

The $\delta^{18}\text{O}$ values ranged from 8.64 to 15.14‰. The minimum value was similar to those of SiO_2 in rhyolite or dacite, whereas the maximum value was in the range of those previously obtained from Kosa-dust. The K-Ar ages ranged from 33 to 400 Ma. Except for the oldest one, these ages were similar or younger than those of Kosa-dust previously investigated (180-200 Ma), whereas much older than those of the key tephra layers (i.e. from 0.04 to 0.11 Ma). Interestingly, the $\delta^{18}\text{O}$ values and the K-Ar values showed a proportional relationship. Linear regression analysis obtained the following relationship; $y = 0.034x + 7.93$ ($R^2 = 0.88$) by putting $y = \delta^{18}\text{O}$ and $x = \text{K-Ar age}$. This linear relationship suggests that the soil layers in this study may be a mixture of volcanic-ash and Kosa-dust, both of which have a fixed or at least narrow range of $\delta^{18}\text{O}$ and the K-Ar values. The proportion of Kosa-dust in the 2-20 μm particles may take a wide range of value from 15 to 95%.

Keywords: Kosa-dust, K-Ar dating, $\delta^{18}\text{O}$, volcanic-ash