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S, H, O and Sr isotopic Study of precipitation in Chugoku district

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Monthly precipitations at 7 sampling points along Tottori-Okayama line in the Chugoku district have been collected in order to reveal regional impact, and seasonal and secular change of cross border pollution from mainland China. We report here the results during January 2011 and August 2014. Major dissolved species, hydrogen and oxygen isotope ratios of water, sulfur isotope ratios of sulfate ion, and strontium isotope ratios were measured after filtration by 0.45um membrane filter.

On the Sea of Japan side, sulfur isotope ratio of non-sea salt sulfate is high in winter and low in summer. High sulfur isotope ratio indicates the contribution of sulfate originated from northern China, cross border pollution. Constancy of this high sulfur isotope ratio in winters during study years suggests no change in the source of pollution. In summer of 2013, high sulfur isotope ratio of sulfate was found. It is probably due to the washout of sulfate of high sulfur isotope ratio by heavy rains in this summer, and is local phenomenon.

On the Seto Inland Sea side, no seasonal change in sulfur isotope ratio of sulfate was found and sulfur isotope ratio of non-sea salt sulfate is lower than that on the Sea of Japan side. This indicates that sulfate with high sulfur isotope ratio originated from mainland China is largely removed before crossing the Chugoku Mountains.

The deuterium excess in both of the Sea of Japan and the Seto Inland Sea sides is high in winter season and low in summer. It indicates that water vapor responsible for winter precipitation is provided from the Sea of Japan in both sides, and that the water vapor responsible for summer precipitation is from the Pacific Ocean. In winter at the Seto Inland Sea side, though water vapor from the Sea of Japan is responsible for precipitation, no signature of sulfate with high sulfur isotope ratio originated from main land China is found. This indicates that sulfate originated from mainland China is mainly removed in the process of the precipitation/snowfall in the Sea of Japan side.

Sr isotope ratio measured at Yurihama close to the Sea of Japan shows clear seasonal variation. In April, May, and June it is higher than that of seawater, and in July and August it is lower than that of seawater. It is almost equal to that of seawater in other months. High Sr isotope ratio in spring is due to the soluble component of yellow sand brought from mainland China and low Sr isotope ratio in autumn and winter is mainly influenced by sea salt. The timing of change in sulfur isotopic ratio of sulfate does not agree with that in Sr isotope ratio, indicating the transport process of sulfate and yellow sand are independent of each other.

Keywords: cross- border pollution, precipitation, sulfur isotope ratio, hydrogen isotope ratio, oxygen isotope ratio, strontium isotope ratio