Influences of soil dust, sea salt and anthropogenic activities on ionic and Sr isotopic compositions of wet deposition in Iran

*Yoriko Yokoo[1], Kosuke Asai[1], Sae Horii[1], Ryo Anma[2], Shiva Mehrabani[3], KiCheol Shin[4]

1. Faculty of Science and Engineering, Doshisha University, 2. Tokushima University, 3. Kurdistan University, 4. RIHN

We collected monthly wet deposition in four western cities (Hamedan, Ilam, Shiraz and Ahvaz) from January 2014 to May 2017 and in three eastern cities (Mashhad, Birjand and Zahedan) from January 2016 to May 2017 and in Rezvanshahr from May 2016 to May 2017 in Iran, and determined their pH values, electrical conductivity (EC), major ionic concentration (Na^+, Mg^{2+}, K^+, Ca^{2+}, Cl^-, NO_3^-, SO_4^{2-} and HCO_3^-) and Sr isotope ratios ($^{87}Sr/^{86}Sr$) in order to elucidate the influences of soil dust, sea salt and anthropogenic activities on wet deposition chemistry. In no-rainfall months, we rinsed the sampler with ultrapure water and collected it to understand the influence of aerosols. The climate in Iran is semiarid, and the dry and wet seasons are from June to September and from October to May, respectively.
The wet deposition and rinsed water samples in western and eastern Iran were neutral to slightly alkaline ranging from 6.26 to 9.04 and from 6.71 to 11.08 in pH, respectively. Those in Rezvanshahr were neutral to acidic ranging from 3.88 to 7.48 in pH. The ionic compositions of most precipitation samples were enriched in $Ca^{2+}$and HCO_3^-. Although the pH of natural rain in equilibrium state with atmospheric CO_2 is typically 5.6, precipitation in western Iran is not acidic because of neutralization by aeolian minerals such as calcite originating from arid areas. The $^{87}Sr/^{86}Sr$ of samples fell in a narrow range of 0.708±0.001. These values were most likely due to the dissolution of calcite. Small, but detectable seasonal variation was found in the $^{87}Sr/^{86}Sr$ ratio that suggests different provenances of calcite/gypsum controlled by changing wind direction.
The ionic compositions of several samples were abundant in NO_3^- and SO_4^{2-} in Hamedan, Ilam, Shiraz and Mashhad. These samples were collected during dry season and wet season immediately after the dry season. These results suggest that the samples dissolved NO_3^- and SO_4^{2-} derived from anthropogenic activities and/or soil dust such as sulfate minerals concentrated in atmosphere during the dry season. The ionic compositions of samples in Ahvaz, Rezvanshahr, Birjand and Zahedan were relatively enriched in Na^+ and Cl^-. Ahvaz and Rezvanshahr are closer to the Persian Gulf and the Caspian Sea, respectively. These indicate that the wet deposition samples in Ahvaz and Rezvanshahr are subject to salt from sea and salt lake.

Keywords: wet deposition, ionic composition, Sr isotope ratio, West Asia

