cave air monitoring and oxygen isotopic variation in drip water at Inazumi Cave, Oita, Japan

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Variation in oxygen isotopic ratios of stalagmite has been used as useful proxy for reconstruction of rainfall amount and pattern since drip water forming the stalagmite is originated from meteoric water. The original value of isotopic ratios in the drip water is controlled by the meteoric water, however, the final isotopic composition of the drip water is determined by in-cave processes such as evaporation and CO_2 degassing. Therefore, it is important to understand how the initial $\delta^{18}O$ of the drip water is changed by the in-cave processes before it is imprinted in the stalagmite.

Here, we conducted 3 days and 2 nights cave air monitoring and sampling the drip water at Inazumi Cave, Oita, Japan from February to December, 2014. For the cave air monitoring, cave air temperature, relative humidity and cave air CO_2 were measured. For sampling the drip water, the drip water before and after hitting on the handrails was collected in daytime and midnight during the monitoring periods. The meteoric water was sampled outside and near Inazumi Cave monthly. $\delta^{18}O$ and δD were measured for both the drip water and the meteoric water and HCO_3^- was measured for the drip water.

As a result, while the cave air temperature and relative humidity were stable through a whole year, the cave air CO_2 showed distinct seasonal variation, indicating that the cave air CO_2 might be the key to control both CO_2 degassing and kinetic fractionation of $\delta^{18}O$ of the drip water. While HCO_3^- showed seasonal and sequential variation as the cave air CO_2 was lowered, $\delta^{18}O$ and δD did not show, indicating that CO_2 degassing does not strongly affect $\delta^{18}O$ of the drip water as kinetic fractionation or that CO_2 hydroxylation and hydration might dominate in the drip water to maintain isotopic equilibrium.

$\delta^{18}O$ and δD of the drip water was plotted on or close to meteoric water line made by the meteoric water sampled around Inazumi Cave, indicating that the drip water is originated from the meteoric water around Inazumi Cave and evaporation does not affect $\delta^{18}O$ and δD of the drip water. Plus, $\delta^{18}O$ and δD of the meteoric water showed wider variation (-4.69~-13.23‰, -23.12~-101.51‰, respectively) than the ones of the drip water (-7.8~-8.41‰, -54.28~-57.08‰, respectively), indicating that the meteoric water is mixed well in host carbonate rock and homogenized drip water is produced. The mean value of $\delta^{18}O$ and δD of the drip water was the closest to the one of MJJASO (from May to October) of precipitation, indicating that the $\delta^{18}O$ and δD of the drip water might be controlled by summer season precipitation, which dominates approximately 80% precipitation amount out of all precipitation around Inazumi Cave.

$CaCO_3$ farming is now in progress at Inazumi Cave and $\delta^{18}O$ of precipitated $CaCO_3$ and the feeding water will be compared hereafter to check if isotopic equilibrium is maintained between them or not.

Keywords: stalagmite, δD and δ18O, paleoclimatology, drip water, meteoric water, isotopic equilibrium

