Cave air monitoring and chemical analysis of drip water at Inazumi cave, Oita, Japan

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10 month cave air monitoring and chemical analysis of drip water were conducted at Inazumi underwater cave, Oita, Japan, from February to December, 2014, to understand the processes and mechanism of recording paleoclimate in stalagmite. Cave air CO2 was measured for the cave monitoring, and EC, pH, HCO3− and Ca2+ were measured for chemical analysis of drip water.

Special sampling techniques were designed for two sampling sites, SS2 and SS3, to highlight the relationship between cave air CO2 and drip water chemistry. At SS2, the drip waters, before and after hitting on three handrails arranged in tandem in limestone cave (SS2-U, -M2, -M3 and -L, respectively), were sampled. At SS3, the drip waters, before contacting with the cave air (BCWA) and after hitting on the artificial stalagmite, were sampled (BCWA, SS3-U, -M, -L, respectively).

At SS2, as the drip water hit on the handrails, HCO3−, Ca2+ and EC showed decreasing trend respectively and this trend became significant during winter when the cave air CO2 was low. Only pH was negatively correlated with other drip water parameters the above. This suggests that the two conditions, 1) the cave air CO2 is lower and 2) water film gets thinner as the drip water hits on the handrails, promote more CO2 degassing and CaCO3 precipitation.

At SS3, HCO3− and Ca2+ between BCWA and the drip water after contacted with the cave air showed almost the same concentration during summer, high cave air CO2 season, however, marked significant margin between them during winter, low cave air CO2 season. This result suggests that once drip water contacts with lower cave air CO2, more CO2 degassing and CaCO3 precipitation are promoted.

S.I.cc, standing for Saturation Index of Calcium Carbonate, and ΔpCO2, the difference of partial pressure of drip water (pCO2−dripwater) and of cave air (pCO2−caveair), were calculated if CO2 degassing and CaCO3 precipitation takes place or not. S.I.cc showed positive value at SS2 and SS3 during almost all monitoring periods, indicating CaCO3 is produced almost all the time. However, ΔpCO2 showed frequently negative value at SS2 and SS3, indicating that CO2 is not degassed from the drip water and the following CaCO3 precipitation is not taken place and most of drip water sampled already degassed CO2.

This research implied that CO2 variation is a main forcing factor to control HCO3− and Ca2+, main components in drip water to form CaCO3-made-laminae used for reconstructing paleoclimate; however, the calculation of ΔpCO2 showed that CaCO3 would not be produced from drip water. To solve the contradiction, another approach such as development of new sampling method will be necessary.

Keywords: Paleoclimatology, Stalagmite, drip water, cave air monitoring