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Radiocarbon dating of stalagmites from the Ryugashi Cave, Shizuoka

KATO, Tomomi[1] ; MINAMI, Masayo[2*] ; HORIKAWA, Keiji[3] ; NAKAMURA, Toshio[2]

[1]Graduate School of Environmental Studies, Nagoya University, [2]Center for Chronological Research, Nagoya University, [3]Graduate School of Science and Engineering for Research, University of Toyama

Stalagmites are cave deposits precipitated from drip water. Drip water consists of carbon derived from soil CO_2, which has atmospheric ^{14}C values in isotopic equilibrium with atmosphere, and carbonate-dissolved CO_2, which has ^{14}C-free (dead) carbon through interaction with cave host bedrock. As a result, drip water contains a percentage of dead carbon, which will make the ^{14}C ages of the stalagmite older. Therefore, a correction of the dead carbon fraction is needed for ^{14}C dating of stalagmites. In recent years, young stalagmites of 10-20 ka have been ^{14}C dated by comparing the ^{14}C on samples of known calendar age with the tree ring record of atmospheric ^{14}C during a period of overlap (Hoffmann *et al*., 2010; Southon *et al*., 2012). This procedure involves the implicit assumption that dead carbon fraction in stalagmite remained constant through its growth time. In this study, therefore, we examined dead carbon fraction in two stalagmites from the Ryugashi Cave in Hamamatsu, Shizuoka by investigating seasonal variation in ^{14}C concentrations of drop water coupled with soil CO_2, atmospheric CO_2, and host limestone, in order to reveal possibility of accurate and precise ^{14}C dating on stalagmite in Japan.

The drip water samples showed ^{14}C of 1130 BP to 980 BP and $\delta^{13}C$ of -10.1 ‰ to -9.1 ‰, which are lower in fall and winter, and higher in spring and summer, and have the annual means of ^{14}C of 1025±140 BP and $\delta^{13}C$ of -9.4±0.4 ‰. The RYGS12 stalagmite of 7 cm in length showed 945±30 BP at its top and 2150±40 BP at its bottom, and had a growth rate of about 60 μm/yr. The calibrated age of RYGS12 was estimated by comparing the ^{14}C with the IntCal13 calibration curve, resulting that the stalagmite had a constant dead carbon fraction through its growth time and gives ^{14}C ages of 1050 years older than the true age. The carbon isotopic fractionation between drip water and stalagmite was negligible. The results indicate that high-resolution ^{14}C measurement can be performed on stalagmites in the Ryugashi Cave.

The RYGS12 sample showed rapid decrease of $\delta^{13}C$ from -8.3 ‰ to -11.8 ‰ at around AD1450 The decrease suggests an increase of soil input to the stalagmite, since soil CO_2 has low $\delta^{13}C$ of -22.0 ‰. It is reported that there was a great earthquake of magnitude 8.6 (Meio earthquake) accompanied by a catastrophic tsunami in this study area in AD1498. Therefore, the $\delta^{13}C$ decrease might be caused by the Meio earthquake. In the presentation, we will present ^{14}C result on another stalagmite sample RYG08 of 30 cm in length.

Keywords: stalagmite, radiocarbon age, carbon isotope ratio, oxygen isotope ratio