

Holocene stalagmite growth and farming by Jomon Man in Japan

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Japanese Holocene stalagmites

Stalagmite study in Japanese caves based on U-Th dating has represented new aspects on the Late Pleistocene-Holocene paleo-moisture in Japanese Islands [1-3]. In turn, results of the U-Th dating imply that growth of many studied stalagmites slowed or stopped in 4000-6000 years ago although dripwater are still active on these stalagmites. This is clearly due to low Ca concentration of the dripwater, and only a few stalagmites are fed by enough Ca concentration for calcite precipitation. Thus, Ca concentration of dripwaters in Japan decreased in mid-Holocene.

Did Jomon Man kill the stalagmites?

Dripwater Ca concentration is primary controlled by $p\text{CO}_2$ at soil/limestone interface where limestone is dissolved. Then, temperature, moisture, and vegetation abundance are main factor for soil CO_2 produced by root respiration and microbial decomposition of organic matter. If the soil CO_2 in the limestone areas decreased in 4000-6000 years ago, at least one of the factors drastically changed at this period.

Considering relatively stable climate during Holocene, the most likely factor was declined vegetation. Inferring from the age of 4000-6000 years ago, cooling and drying were unlikely and not supported from the stalagmite data. Instead, more likely cause was farming by Jomon Man that had expanded in Honshu in mid-Holocene. In addition, it is well known that they preferred to live in limestone areas because they could hide from rain. Their burnt farming may have destroyed thick forest vegetation, resulted in decreasing soil $p\text{CO}_2$ and dripwater Ca, and ultimately declined the growth of the stalagmites. We have only little supporting evidence for this hypothesis, but the mid-Holocene peak of fine-grained charcoal in lake deposits implies active farming by Jomon Man. Another consequence from the farming could be wide distribution of black-colored soil (Kuroboku). Further examination is required to study detailed charcoal-pollen occurrence in lake deposits, as well to perform radiocarbon dating for Kuroboku and burnt wood from the Holocene soil and archeological sites in Japanese Islands.

[1] Shen *et al.* (2010) *Quatern. Sci. Rev.* **29**, 3327-3335. [2] Horii *et al.* (2013) *Chem. Geol.* **347**, 190-198. [3] Sone *et al.* (2013) *Quatern. Sci. Rev.* **75**, 150-160.