

Two stalagmite records of the Holocene climate change in Japanese Islands

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A stalagmite is a potential paleoclimatic archive that recorded temperature and rainfall in its chemical proxies, and relatively easily dated. This study presents time-series of climatic proxies (e.g. oxygen isotope) of two stalagmites collected from Niigata (beside Japan Sea) and Hiroshima (circum-Setouchi Inland Sea), and discusses the Holocene climate change.

The stalagmite from Itoigawa (IT), Niigata Prefecture, is 16-cm-long specimen formed during the last 8 kyr. The oxygen isotopic values range from $\delta 4$ to $\delta 8$ permil and reveal the overall trend decreasing until 1.5 ka and increasing afterwards. This specimen also records several positive spikes with age-range of hundreds years. The uppermost 5.5 cm of the stalagmite from Jinsekikogen (JK), Hiroshima Prefecture, involves the record from 8.0 to 4.5 ka showing fluctuating oxygen isotopic values with the decreasing trend by 1.2 permil, in opposite to the IT records. Stalagmite oxygen isotope value changes with temperature and the dripwater value. If the temperature control was dominated, assumed range of the temperature change was 16 (in IT) and 5 degrees (in JK), which were unrealistic as the Holocene change. Thus, the value of dripwater (originally from meteoric water) must have controlled the stalagmite records. Because of low time-resolution of the measurement, the stalagmite records inherit the mean value of meteoric water, which was dominated by winter snowfall in IT, but by summer rainfall in JK.

The meteoric oxygen isotopic value, in general, is low in strong rainfall (snowfall) and high in weak rainfall. Thus, the two stalagmite records indicate the intensified winter monsoon and declined summer monsoon (SM) during a period from early to middle Holocene. The declined SM was supported by increasing trend in carbon isotopic value and Mg/Ca ratio in JK, and consistent to the oxygen isotope record from a stalagmite collected from Guilin, China (Dykoski et al., 2005). This suggests that Japanese Islands was within the Holocene climatic framework of the Northern Hemisphere (NH) characterized by the gradual southwards shift of the Intertropical Convergence Zone.

The Guilin stalagmite displays low-amplitude spikes that were correlated to the Bond Events. We could not determine whether the spikes of our two stalagmites correspond to the events. The amplitude of the spikes in the IT stalagmite is much larger than Guilin. This observation indicates that the snowfall beside the Japan Sea has been sensitive to the climatic perturbation in NH.

Dykoski, C.A. et al., 2005. A high-resolution, absolute-dated Holocene and deglacial Asian monsoon record from Dongge Cave, China. *Earth and Planetary Science Letters* 233, 71- 86.

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