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Subtropical Northwest Pacific Climate Reconstruction from Speleothem Records from Gyokusen-do Cave in Okinawa Island

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A number of Quaternary paleoclimate records have been extracted from various kinds of geological materials such as deep-sea sediments (e.g., Imbrie et al., 1984), ice sheets (e.g., Dansgaard et al., 1993), trees (e.g., Briffa, 2000), speleothems (e.g., Wang et al., 2001), and corals (e.g., Bard et al., 1990). However, high-resolution, accurately dated hydrologic records from the lower latitudes are relatively scarce. Speleothems can have continuous deposition of calcium carbonate over long periods of time and well-chosen speleothems are datable with high precision using U/Th dating methods. Since the 1960s, oxygen isotope signatures in speleothem carbonates have been used as a paleoclimate proxy (e.g., Broecker et al., 1960) because the isotopic values can be controlled by the drip water and the cave temperature (e.g., Hendy, 1971). Recently, speleothem-derived oxygen isotope time series have been widely used to reconstruct hydrologic variations during the Quaternary (e.g., Wang et al., 2001). However, most of previously published archives from speleothems are restricted to China and Europe.

Here, we present oxygen isotope time series of speleothems in Gyoku-sen-do Cave, located at the southern Okinawa Island, Japan. The Hendy test performed in this study suggests that the oxygen isotope profile is primarily of environmental origin without effects of kinetic fractionation. Since December of 2009, we have observed cave environments using loggers and collected water samples. Using the established relationship between oxygen isotope compositions of drip water and precipitation, we provide a speleothem-based reconstruction of hydrologic changes around the Ryukyus for selected time windows during the Quaternary. Coupled with speleothem records from China (e.g., Wang et al., 2001) and Japan (Shen et al., 2010), the present study can allow a better understanding of spatial variations in precipitation associated with East Asian Monsoon for the past.

Keywords: limestone cave, speleothem, oxygen isotope composition, Okinawa, subtropical environment