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Global paleotemperature reconstruction since 600 AD from the calcite stalagmite in Yongcheon Cave, Jeju Island, Korea

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Yongcheon Cave is located on Jeju Island, the southernmost part of Korea. It is a typical lava tube cave that formed between 0.2∼0.4 Ma ago, and includes numerous carbonate speleothems. A 11cm-long stalagmite (YC-1) was collected from its growth position in 2005. ^{210}Pb dating results show that the top 0.9 cm of the YC-1 is less than 100 years old with the constant growth rate of 0.033 mm/yr. ^{230}Th/^{234}U and ^{14}C dating results indicate that the stalagmite is about 1,400 years old. Textural and stable isotopic analyses were carried out to infer the paleoclimatic variation during its growth. δ^{18}O and δ^{13}C values range from -8.1‰ to -5.5‰ and from -8.1‰ to -0.5‰ (PDB), respectively. Similar long-term trends of both isotopes indicate that both isotopes were affected by global climate changes even though fluctuations for short terms may well reflect local climatic conditions. It appears that oxygen isotopic compositions of the stalagmite reflect water-controlled process, that is, oxygen isotopic contents of drip-waters were more or less controlled by those of meteoric water. More intense summer monsoon in the past is characterized by more depleted oxygen isotope data. Changes of carbon isotope compositions were determined by the residence (buffering) time between meteoric water and overlying carbonate sediments and paleosols. Higher and more intense rainfall during more intense summer monsoon periods resulted in more depleted carbon isotope signals. Thus, stable isotope results of the YC-1 stalagmite reflect the intensity of East Asian Monsoon system which affected the Jeju Island since 600 AD. The overall trend shows previously reported the ‘Dark Age Cold Period’, ‘Medieval Warm Period’, and ‘Little Ice Age’ as well as recent global warming. This result suggests that paleoclimatic variations recorded in the stalagmite are closely connected with paleoclimatic changes in the North Atlantic and Europe. Especially, carbon isotope changes coincide well with the instrumental temperature records since 1850. Averaged annual temperature in northern hemisphere from 1961 to 1990 shows a linear relationship with carbon isotopic compositions (R^2=0.??). Coeval trends between carbon isotopes of the YC-1 and the intensity and amount of rainfall as well as abrupt temperature increase due to global warming may well suggest that they are closely inter-related. Based on the calculation, global averaged temperature during the Little Ice Age can be estimated to be lower than the present by about 0.8 to 1.1˚C.