Unique properties of stalagmite oxygen isotopic records in Japan

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Stalagmite paleoclimatology has reconstructed climate conditions in the past mainly by oxygen isotopes. This is because O-isotopes of stalagmite calcite are principally controlled by two factors; temperature and O-isotope of drip water, which represent the mean air temperature and the mean isotopic value of meteoric water at the cave location. However, studies in south China have emphasized the control of meteoric O-isotopes because the temperature change cannot reasonably explain the large amplitude of change in the stalagmite O-isotopes (> 8‰) in the late Pleistocene-Holocene time window. Interpretation of the Chinese records relies on a model based on isotopic fractionation in a route from seawater evaporation to rainwater precipitation, which may changes with intensity of East Asian summer monsoon. We have been analyzed O-isotopes of the stalagmites collected from Hiroshima, Niigata, Gifu, and Mie Prefectures. Except for the material from Niigata indicating the intensity change of the East Asian winter monsoon, the stalagmites from other three caves generally indicate a similar patter of change with the Chinese stalagmites, but indicate much smaller amplitude of change. Another feature of these Japanese stalagmites is long-term trends that follow to the O-isotope record of seawater. Another model is required for these trends. The seawater O-isotope can explain 1/3 of the change in the stalagmites, and the remaining 2/3 likely associated with the temperature change. This model estimates that the range of warming from the LGM and mid-Holocene was 9 degree and that the maximum cooling during Heinrich event was -3 degree, and these estimates are consistent with some of the previous studies. We also suggest that the rainfall intensity and the water-vapor fractionation did not largely reflect on the Japanese stalagmite records. These unique features of the isotopic records of the Japanese stalagmites are due to the geographic position at the vicinity of the moisture source, Kuroshio warm current.

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