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Climate variability in the Caribbean area during the last 12 ka reconstructed from speleothems from western Cuba

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To get more information about past climate variability in subtropical regions on inter-decadal to centennial timescales, Two stalagmites from the Dos Anas cave system in western Cuba were studied by precise ^{230}Th/U-dating (MC-ICPMS and TIMS) and high-resolution stable isotope (δ^{18}O and δ^{13}C) analyses.

Stalagmite Cuba Grande, CG, is 720 mm long and grew during the last 1.3 ka. MC-ICPMS measurements enabled the independent estimation of the ^{232}Th/^{238}U ratio of the detritus in this stalagmite sample (Fensterer et al., 2010). The δ^{18}O profile of CG has a resolution of about 3 years and shows high variability of up to 1.5 ‰ around a mean value of -5.2 ‰ . The recent seasonal pattern of the δ^{18}O value of precipitation shows a good agreement with the seasonal pattern of rainfall amount, with lower δ^{18}O values corresponding to higher precipitation. Assuming that the lowest δ^{18}O values correspond to periods of highest recharge of the karst aquifer, heavier oxygen isotope values can be ascribed to periods of less rainfall and/or stronger evaporation. Thus, we interpret the δ^{18}O variability observed in CG during the last 1,300 years as variations in past precipitation. Stalagmite CG exhibits higher than average δ^{18}O values during the last 130 a, from approximately 1550 – 1680 and between 1100 and 1300 years AD, suggesting periods of reduced recharge. The two younger periods coincide with periods of warm sea surface temperatures reconstructed from Bahamas corals (Saenger et al., 2009), the older one coincides with the Medieval Warm Period. There is an apparent relationship between the δ^{18}O signal of CG and the intensity of the sun during the last 250 a. A similar relationship between solar intensity and drought frequency was observed in the Maya Lowlands in Mexico (Hodell et al., 2001) for the past 2 ka. In addition, the frequency analysis of both the δ^{18}O and the δ^{13}C signal of stalagmite CG shows significant peaks at 200 and 80 a, which may also be ascribed to solar variability. Both observations suggest an influence of solar intensity on the variability of Cuban precipitation on decadal to centennial timescales.

Stalagmite CP, is 420 mm long and grew continuously during the last 12 ka. Stable isotopes were sampled at a resolution of approximately 4-10 a. The δ^{18}O values of CP are about 2 ‰ higher than those of CG. This is related to its aragonitic structure. The δ^{18}O signal shows a distinct transition from higher to lower values in the section between 9 and 7.5 ka that mimics the transition of surface ocean δ^{18}O. Superimposed on this long term trend, the δ^{18}O signal shows several shorter cycles within the last 12.5 ka, probably reflecting past variations in precipitation. This indicates that the δ^{18}O signal recorded in Cuban stalagmites reflects both changes in the moisture source (i.e., Caribbean surface ocean water) as well as local climate variability.

References

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