



Variations on seepage water geochemistry induced by natural and anthropogenic microclimatic changes: Implications for the speleothems growth conditions

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During an annual cycle the effect of microclimatic changes (natural and anthropogenic origin) on the geochemical characteristics of seepage water and mineral precipitation rates was analyzed, for two karstic caves under opposing environmental stability and energy exchange with exterior. On the one hand Castañar cave (Caceres, Spain), an extremely controlled show cave with limited visitation showing a minimum exchange rate of energy with the outer atmosphere and, secondly, Canelobre cave (Alicante, Spain), a widely visited cave where the anthropogenic impact generates both high-speed and high-energy environmental changes. Microclimatic variations play a key role in CO₂-dissolving caused by the imbalance of pCO₂ between the karstic water and the cave air, favoring the slow processes of mineral precipitation. Thus, a pCO₂-range of seepage water have been detected for each cave (from 10-2.30/-2.35 to 10-2.47/-2.52 bar for Castañar cave, and from 10-2.8/-2.85 to 10-2.95/-3.0 bar for Canelobre cave) where the mineral oversaturation prevails, determining the type and rate of mineral precipitation in each cave. Finally, it analyzes how the changes on the oversaturation/ precipitation states are controlled by microclimatic variations, such as: 1) natural underground air renewal through the porous system of upper soil and the network of host-rock fissures (isolating membranes), or else through the cave entrance, 2) cumulative disruptions in the pCO₂ levels of cave air due to the presence of visitors, and 3) forced ventilation of the subterranean atmosphere due to the uncontrolled opening of cave entrances. The obtained results reinforce the significance of the microclimatic fluctuations on short time scales in the dynamic and evolution of the subterranean karst system, in terms of rates of mineral precipitation and growth of speleothems. Likewise the interpretations are useful in order to ensure the constant climate required for the conservation of caves.