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Monitoring the microclimate of limestone caves close to the urban area – case study from Mt.Shoushan in Kaohsiung, southern Taiwan

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Located at the edge of Kaohsiung City, Mt. Shoushan is famous for numerous limestone caves created by mass wasting rather than water solution, and attract citizens to visit. In order to understand the cave environment and evaluate the impact from visitor to the caves, this study carried out a microclimate monitoring in five popular limestone caves (Xingxing cave, Tianyu cave, Jingguan cave, Beifeng cave, Jinggua cave) in the Mt.Shoushan. Mt. Shoushan is dominated by the primitive broadleafed forest with distinct dry and wet seasons, and its geology consists of limestone on the top and mudstone as basement.

Works of our projects include measuring and mapping the geomorphological features in the caves, and monitoring microclimate items such as carbon dioxide levels, temperature, humidity, atmospheric pressure, air velocity and direction in the caves. Five sets of monitoring station were set up in each of the five caves, and two meteorological station was set up outside the Xingxing cave and the Beifeng cave for monitoring the climate conditions outside the caves. Meanwhile, we also set up auto-operated time-lapse cameras at the entrances of the five caves to record the numbers of visitors, their entering time and the durations of staying in the caves. All these data were used to understand the natural environmental characteristics of the caves and the visitors' impact to them.

Compared with most other monitoring data of caves, our monitor recording interval is 5 minutes. Therefore, not only can we realize the annual, seasonal and month variations of the cave, but also we can analyze the daily and hour changes induced by visitors. In addition, ultrasonic anemometers are added in the monitoring stations to measure the wind velocity and direction. The data will help us to understand the air convection in different cave opening condition (single or double entrances) and how it effects the dissipation or accumulation of carbon dioxide in the cave.

As the level of carbon dioxide affects the development of speleothems, is there any regular fluctuations in CO_2 level? Or will the terrain and the number of cave entrance affect the exchange of the air in the cave? According to the current monitoring results, we distinguish the seasonal patterns of CO_2 level (dry and wet seasons). It seems that every cave has its own microclimate changing pattern. The positive correlation between carbon dioxide level in the cave and outside temperature can be preliminarily determined, and the carbon dioxide level in the single-entrance cave is 100 ppm higher than that in the double-entrance cave in normal conditions. These findings may contribute to the local cave management and the interpretation of the palaeo-climate proxy obtained from speleothems.