

Dear Referee,
Thank you very much for reviewing our manuscript.

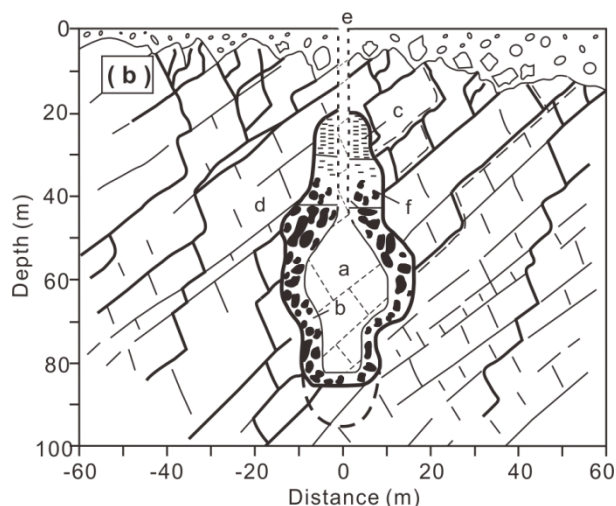
Response to the comments:

Referee comments are repeated in red.

1) The geometry of the cave

“..., but there is no data provided on the relationship of the passage beneath the cave to the 85 m vertical chamber. The cross-section provided in Figure 1b of Yang and Shi (2015) suggests that there is also a vertical entrance above the chamber to the outside, but no detailed information is provided about its dimensions, nor whether it is open throughout the year. Enlarging the diagram, the upper entrance appears to be about 4-5 m wide and cylindrical, i.e., it is large enough to allow large quantities of summer monsoon rain and winter snow to enter the top of the cave.”

As mentioned in page 4 line 14-15 of our manuscript, the ice cave has only one entrance, and has wooden spiral stairs leading to a bowling room. The following figure is the new version of Figure 1b of our manuscript. E in the figure is the entrance of Ningwu ice cave and the entrance is showed in Figure 1c of our manuscript. The entrance is open throughout the year. In Figure 1c, we can see the entrance is not very vertical. Limited quantities of summer monsoon rain and winter snow enter Ningwu ice cave through the entrance.



2) Mean annual air temperature

“The obvious solution to obtain reliable climate data for the site is to install a weather station at the Ningwa cave site in the natural vegetation cover at an undisturbed site close to the cave, on a similar slope and aspect. The ice cave represents a pocket of sporadic permafrost by definition, but the extent of the pocket needs to be determined. A deep borehole to a depth of about 100 m that is instrumented with thermistors and a data logger could determine whether the adjacent ground contains permafrost. It would also provide basic data for comparison with temperatures measured in the cave itself.”

Thank you very much for giving us these specific instructions. We are glad to perform these works. If we get further support, we will carry out these observations. The current results at least provide a first order approximation for us.

3) Some basic types of ice caves

“Yet another possible source of ice could be by condensation of water from warm air in a humid, subtropical climate (c.f., de Freitas and Schmekal, 2003). This is likely to occur at Ningwu ice cave if there is significant inflow of air into the cold cave in summer.”

Generally, ice caves are classified by their mass and energy exchange process. Section 3 of our manuscript detailed the energy exchange process of Ningwu ice cave. Mass (water and ice) is in dynamic equilibrium state. Water infiltrates into the cave throughout the year, and forms ice; Ice at the bottom of Ningwu ice cave is thawed under geothermal flow, and the water infiltrates into the deeper place. Ice stalactites, ice stalagmites (Fig. 1d of our paper) can be seen in all part of Ningwu ice cave. This can verify the former process; No directly observational evidences support the latter process.

4) Environmental history of the region

“This suggests that the ice in the Ningwu ice cave may only date back about 6 ka instead of 3 million years. The cave may also be a former mass of ice in the cavern that is currently suffering from thawing of the relict ice as a result of a warming climate.”

In this part, referee suggested that the ice in the Ningwu ice cave may only date back about 6ka instead of 3 million years. We agree with you on this point. But, we do not consider the ice cave is currently suffering from thawing of the relict ice. If there is no air convection heat transfer in winter, the ice body in Ningwu ice cave will melt rapidly. According to section 5.2 of our manuscript, to thaw the ice body completely only takes 37 years when the latent heat is considered.

Sincerely,
S. Yang and Y. Shi

References

De Freitas, C. R. and Schmekal, A., 2003. Condensation as a microclimatic process: Measurement, numerical simulation and prediction in the glowworm cave, New Zealand. *International Journal of Climatology* 23: 557-575.

Yang, S. and Shi, Y., 2015. Numerical simulation of formation and preservation of Ningwu ice cave, Shanxi, China. *The Cryosphere Discuss* 9: 2367-2395.