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RECONSTRUCT EARTH'S KARST CAVES TO SIMULATE HUMAN LIVE IN EXTRATERRESTRIAL CAVE BASES

Abstract

Numerous studies have suggested that caves are widespread on the Moon, Mars, and even across the solar system. As compared to the ground, building bases in caves on these extraterrestrial bodies have notable advantages. For example, resistance to radiation and meteorites, sparse dust, and possibly mild temperatures. Several planetary comparative studies have been carried out to compare the differences between extraterrestrial cave systems with Earth. However, to assess whether an extraterrestrial lava tube can be converted into the base, a suitable cave on Earth needs to be found for testing first.

For this purpose, our team investigated dozens of caves with different types in Chongqing, China. Karst landforms are widely developed and complete in Chongqing, including skylights, ground seams, dark rivers, shafts, and other special landforms. Most of these caves are arched structures (like lava tubes) with a radius of a few meters to several tens of meters and a length of several thousand meters, or tens of thousands of meters (enough for simulation (meeting simulation needs). Caves stretch in a winding manner, with complex crisscross structures and isolated darkness inside. We suggest that karst caves on Earth can be used as testbeds for extraterrestrial cave bases under certain intentions, such as isolated dark environments, complex structures, and huge spaces that humans may face in future extraterrestrial lava tubes. Despite their differences in formation mechanisms and rock properties, unique gravity, and dimensional differences.

As further research, we attempted to build an integrated simulation base in a karst cave, containing a small to medium-sized cave artificial ecology system, laboratory, and training base. In detail: 1. A closed artificial ecosystem constructed inside the cave, with air directly contacting the rock wall, capable of supporting crew survival; 2. A testing platform for cave detection and automated construction technology in a realistic environment; 3. Crew training site connected to the base for Extravehicular Activity System (EVA) training. This simulation platform can also provide several unique research opportunities. For example, research on artificial ecosystem internal circulation containing soil and rocks, sealing techniques for caves, and attempts to introduce natural light from outside. Finally, we hope to promote the development of related research on extraterrestrial bases through simulation experiments.