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Supplement of

The yearly amount and characteristics of deep-buried phreatic evaporation in hyper-arid areas

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The Dunhuang Mogao Grottoes are representative examples of cave-style Buddhist temples. These ancient caves remain well-preserved to the present day, and have become an important part of Buddhist heritage (Fig. 1).

Fig. 1. The Mogao Grottoes of Dunhuang.

Due to their long history, grand scale, rich content, and state of preservation, the Dunhuang Mogao Grottoes were listed in 1987 in their Directory of World Cultural Heritage by the United Nations Educational, Scientific, and Cultural Organization (UNESCO). However, a survey found that after ca. 1600 years since their creation, about 50% of the wall paintings have suffered deteriorating diseases (Fig. 2).

(a) Delaminating (Cave 387). (b) Mildew pollution (Cave 53).
Due to a lack of vegetation protection, aeolian desertification, gravel desertification, and frequent sandstorms are typical characteristics of Mogao surrounding. It is not advantageous to Mogao Grottoes protection. Thus, Prheatic water has very important scientific value with respect to recovering vegetation on desertified land and for re-evaluation of Phreatic water resources in hyper-arid areas. This study also facilitates preservation of the cultural relics.

In 2010-2015, we did this experiment in the greenhouse-air condition system, and same time used another greenhouse-air condition system to go on monitoring the basic phreatic evaporation (Fig. 3-5).

**Fig. 2.** Representative diseases on the mural paintings in the Mogao Grottoes.
In this paper, we measured and analyzed the yearly evaporation quality characteristics of deep-buried phreatic water in extremely arid area at the top of Mogao Grottoes in Dunhuang City, located in northwest China’s Gansu province, by using a closed greenhouse-air conditioner method from 2010 to 2015, and analyzed the new running mechanism through humidity and temperature of 50 to 500 cm soil layer, which represented the heterothermozone.

After 6 years monitoring of PE, we determined the annual evaporation is 4.52 mm in hyper-arid area. The PE has sinusoidal characteristics and changes along with soil yearly temperature variation. Accordingly, analysis of the monitoring temperature and
humidity in 50–500 cm soil shows that there exist conditions and migration mechanisms for PW in the heterothermozone and deeper soil.

We found that there exists phreatic evaporation, i.e., the groundwater-soil-plant-atmospheric continuum (GSPAC) water transports upward. This work break through the traditional conception of deep-buried phreatic evaporation does not exist. We found that the evaporation of phreatic water (4.52 mm) in this area is relatively larger for survival of drought-tolerant vegetation; it has very important scientific value with respect to recovering vegetation on desertified land and for re-evaluation of PW resources in hyper-arid areas.

We hope these pictures be useful.

Best wishes!

Sincerely

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