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Low permeability Cover-layer deformation behavior and collapse in Air-Water interaction in karst cave by model tests

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Low permeability Cover-layer has a certain effect on groundwater resistance and air resistance, a relatively closed space can be formed by the cover-layer and its underlying karst space. If the groundwater table is lower than the baseplate of the cover-layer, Vacuum suction erosion and air explosion are the mainly mechanism of collapse. The forming conditions, factors of collapse were considered and analyzed, and then the conceptual models of this type was established, and models in lab which used to study the cover-layer deformation behavior and collapse Mechanism in air-water interaction were carried out, due to embed study the vacuum suction erosion or air explosion that may plastically fail and may enlarge or collapse. Thickness, density of cover-layer, and rate of increase or decrease in water level in the cavity were considered, the conclusion are as follows:
With the decrease in water level in the cave, gravity and vacuum suction force may greater than the shear force of the cover, then collapse happened, so vacuum suction erosion is the mainly process; With the increasing in water level, the positive pressure in the cave add the gravity of the cover-layer is greater than the shear force, then collapse happened, so that air explosion is the mainly process.
If the same density of the cover-layer and the same rate of increase or decrease in water level in the cave, but the difference thickness of cover, The larger the thickness, the smaller the deformation, the more stable of the cover-layer. If the same thickness of the cover and the same rate of increase or decrease in water level, but the difference density, When the positive and negative pressure in the cavity is low, the looser cover-layer is more stable than the slightly dense one. As the density and thickness remain unchanged, while rate of decrease in water level is increasing, the vacuum value in the cave become greater, the deformation became greater, the cover would be more instable. While rate of increase in water level of the cave is reaching a critical value, air explosion that leads to collapse, then the structure of the cover-layer would be destroyed, and the cover soil sprayed out, with sound of blasting. Also Bolzmann equation were used to match the relation curve between positive pressure of cave and displacement, the matched curve Indicated that the critical positive value and the predicting critical vacuum value which can lead to collapse.
In our study, It's worth mentioning that there are some of assumptive boundary conditions were proposed of the physical and mathematical models.