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Study on the freezing-induced soil moisture redistribution under the applied high pressure

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Abstract: Soil water distribution induced by freezing has a significant influence on the mechanical response of the artificial frozen wall. To understand the effects of the high pressure on soil moisture redistribution is vital important for soil buried in deep underground since the soil to be frozen was often suffered from high ground pressure during its formation. This paper investigates the freezing-induced moisture redistribution in a fine-grained soil under the condition of applied high pressure. By using the specific freezing-thawing experimental equipment, the thermal state and the freezing front propagation of tested soil column are determined during its freezing, and the moisture content profile within the soil column is measured at the end of the freezing process, to determine the position of the stable freezing front and the characteristic of water redistribution. It is found that for all the soil columns under applied high pressure, the freezing front reaches a stable state when a certain temperature gradient has been applied to the soil column for about 14.5 h, whereas the stable position moving towards the warm side with the increment of temperature gradient. The moisture content of frozen zone is generally high compared with that of the unfrozen zone. The minimum moisture content in frozen fringe close to the freezing front relates to the applied pressure rather than the temperature gradient. On the contrary, the increment of the temperature gradient will cause an increase in the maximum moisture content in the ice lens area. This further confirms that for the soil column under applied high pressure condition, the water in unfrozen zone will go through the frozen fringe to ice

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