Contribution ID: **322** Type: **Oral Presentation**

Gravity shapes permafrost melting after saline water invasion

Monday, 30 May 2022 14:40 (15 minutes)

Invasion and retention of seawater into surface caves and fractures in permafrost land induces melting, as salt lowers water freezing point. Melting of permafrost region changes surface energy balance by modifying sunlight reflection rate and adsorbing latent heat, which may finally impact the global climate mode. Therefore, it is of environmental significance to investigate ice melting in soil porous media with saline water invasion.

Visualized experiments are conducted in 3D-printed porous micromodel and bead-packs. A porous region saturated with ice is in contact with a vertical fracture/vug saturated with saline water. Dye is added into the saline water to characterize the melting front evolution as well as to visualize the concentration profile. Melting process is recorded by camera and microscope.

Surprisingly, we find that very little melting at the top –instead, a preferential melting region is observed at the bottom of the frozen porous media (shown in Fig.1). Strong upward convection along the inclined melting front is identified, implying the major role of gravitational force induced by the density contrast between just-melted pure water and original saline water.

Theoretical analysis demonstrates that this preferential melting emerges when the characteristic Peclet number Pe > 1, corresponding to pore size of > 0.1mm. When pore size is larger, gravity-driven convection dominates over diffusion that results in this preferential melting; when pore size is smaller, diffusion takes dominance and the melting front is relatively uniform. Analytical model of the preferential melting kinetics is derived that predicts experimental results well. As more than 70% particles in permafrost soil are larger than 0.1mm, this preferential melting should be highlighted in practice.

This preferential permafrost melting may lead to the formation of discrete permafrost islands floating on a melted mud layer. It alters (1) the heat transfer between the frozen surface and the environment, and (2) the mechanical performance of the permafrost surface. It thus should be seriously considered for accounting surface energy balance and evaluating civil construction at permafrost region.

Acceptance of the Terms & Conditions

Click here to agree

MDPI Energies Student Poster Award

No, do not submit my presenation for the student posters award.

Country

China

References

Time Block Preference

Time Block A (09:00-12:00 CET)

Participation

Online

Primary author: Ms WANG, Yumin (College of Engineering, Peking university)

Co-authors: Mr ZHANG, Yuheng (College of Engineering, Peking University); Prof. XU, Ke (Peking University)

Presenter: Ms WANG, Yumin (College of Engineering, Peking university)

Session Classification: MS08

Track Classification: (MS08) Mixing, dispersion and reaction processes across scales in heterogeneous and fractured media