Institute of Soil, Water & Environmental Sciences

Agricultural Research Organization Volcani Center

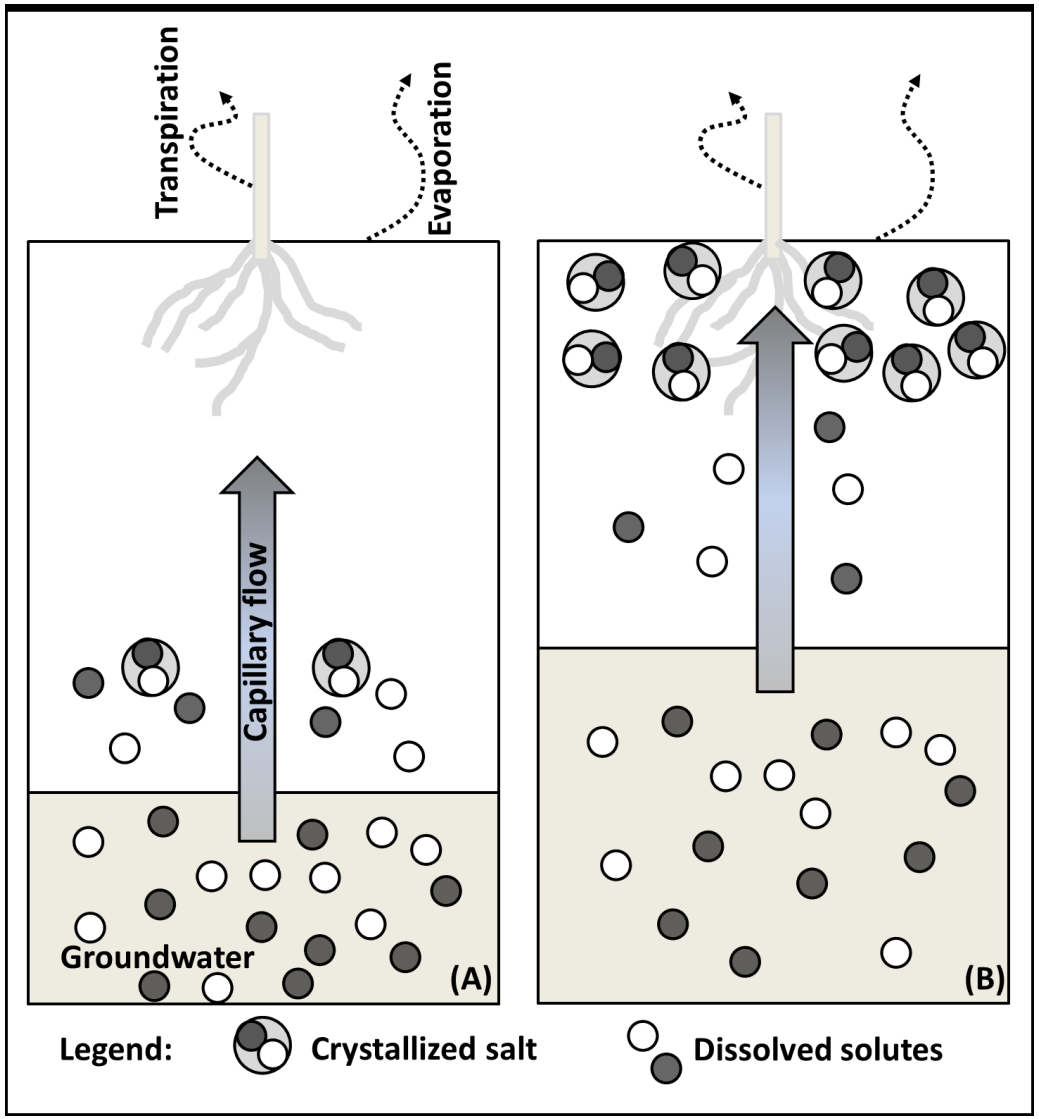
אוניברסיטת בן-גוריון בנגב Ben-Gurion University of the Negev

Salt Crusting Over Evaporating Soils - Three-Dimensional Insights

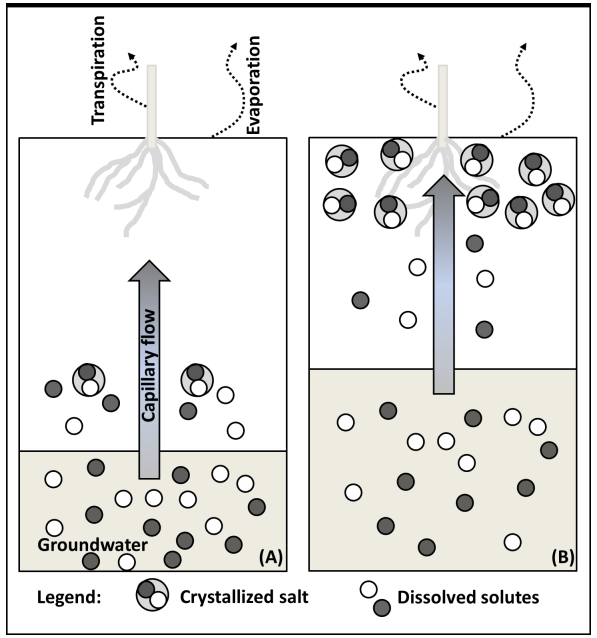
Uri Nachshon, Noam Weisbrod, Roee Katzir, Ahmed Nasser

- Salt crusting is a well known phenomenon in natural and agricultural environments.

- Salt accumulates at the evaporation front.



- When evaporation is at soil surface – efflorescence salt crust could be generated.



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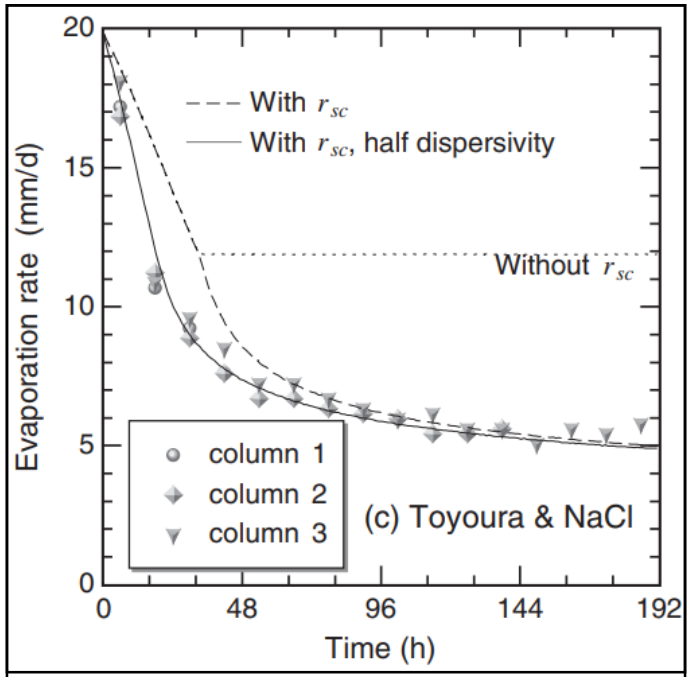
INTRODUCTION

- Works have shown that efflorescence salt crust reduces evaporation from bare soil.



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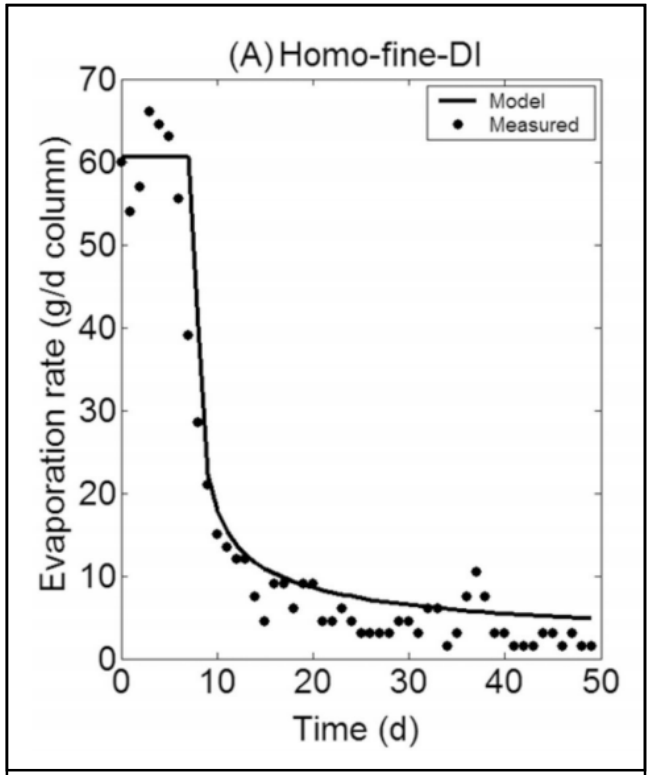
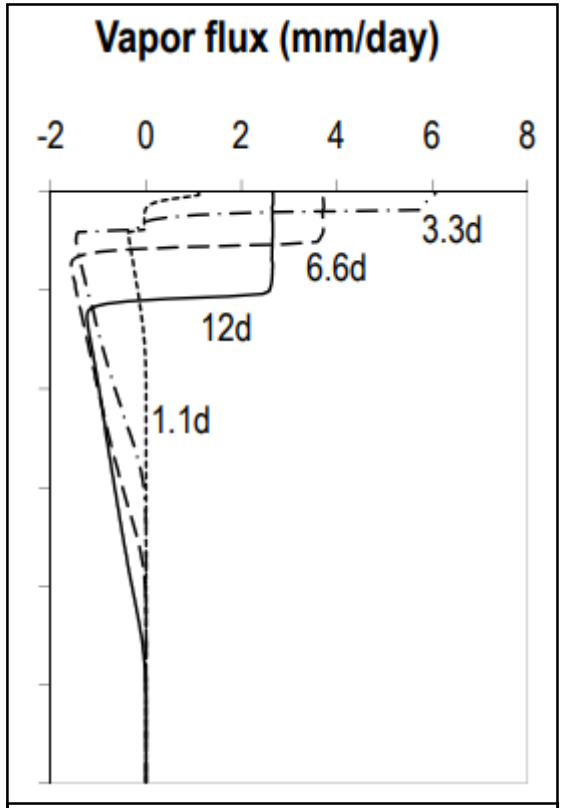


Nachshon, Uri, et al. "Combined evaporation and salt precipitation in homogeneous and heterogeneous porous media." Water Resources Research 47.3 (2011).



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INTRODUCTION

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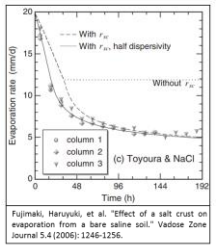
- The salt crust acts as a resistor for vapor flow between soil and atmosphere.



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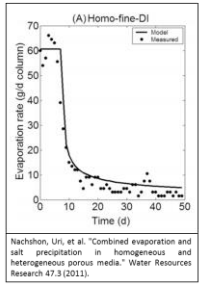

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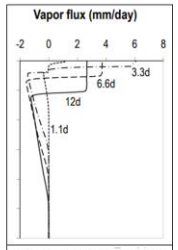

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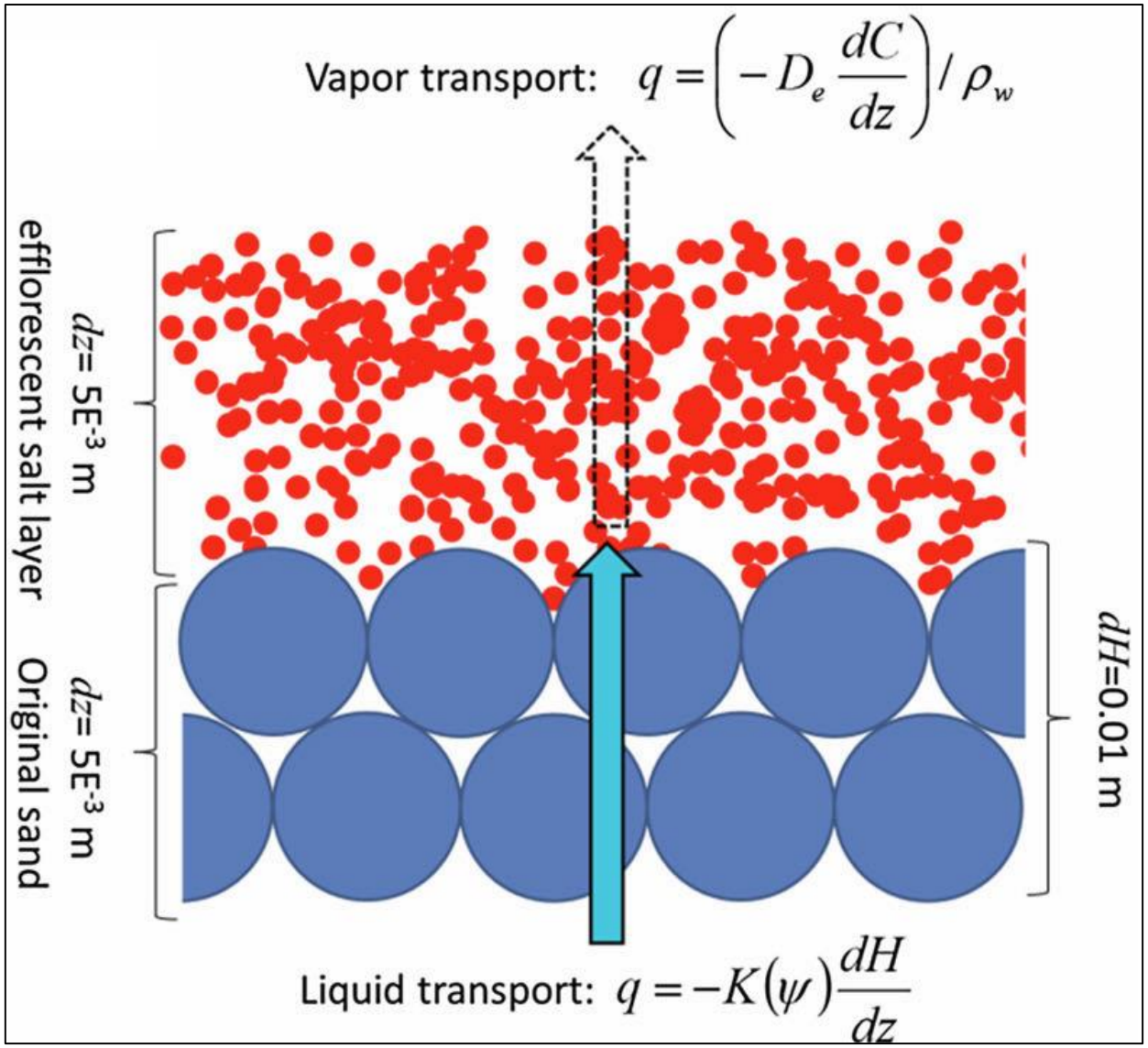
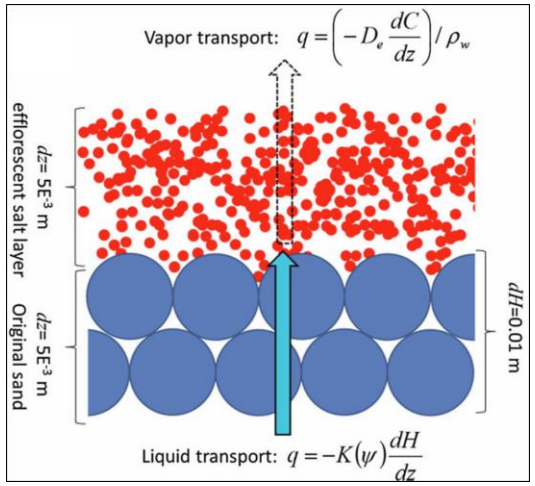
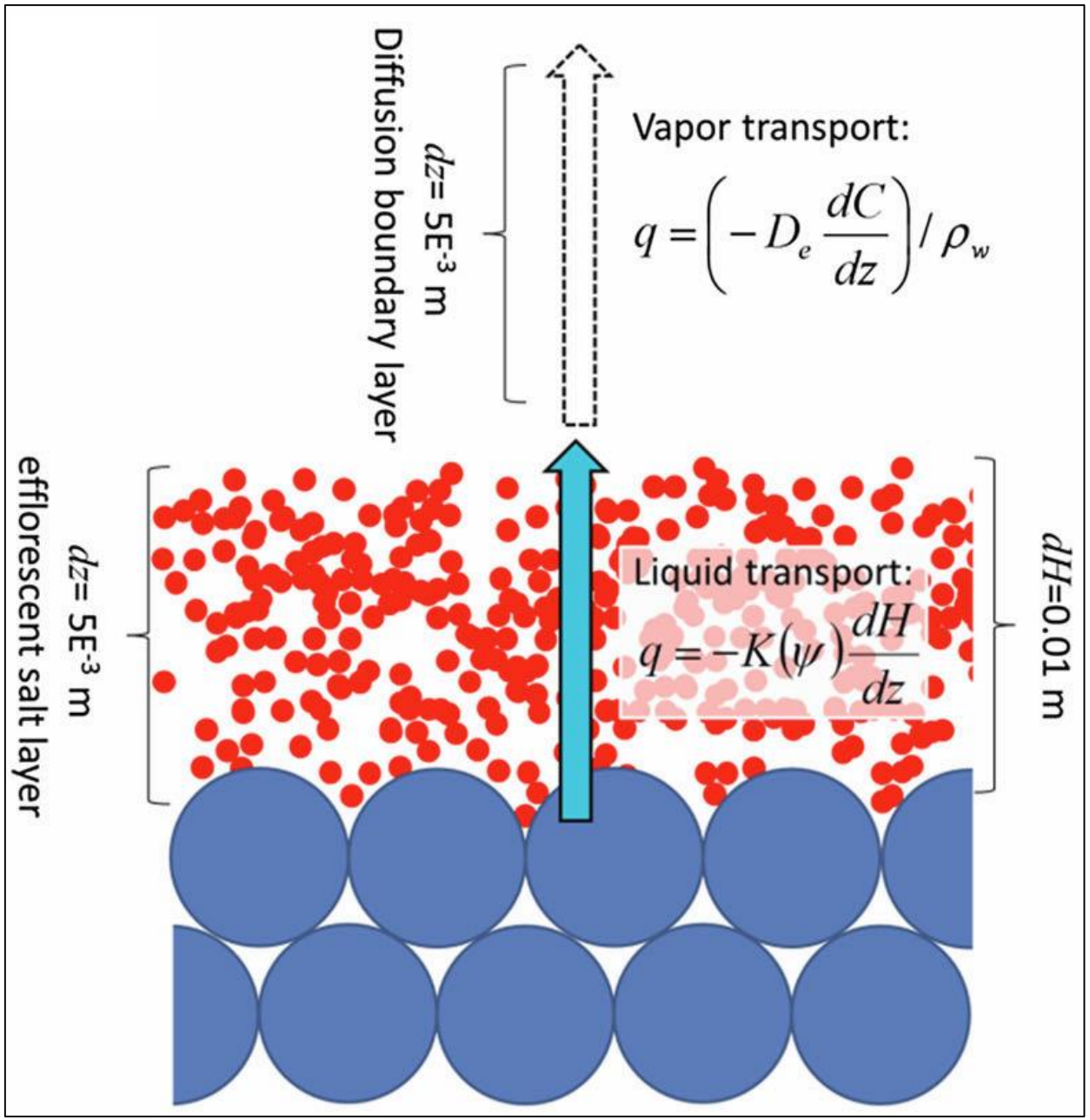


- But – the salt crust is porous.
- **How come capillary flow has no impact?**





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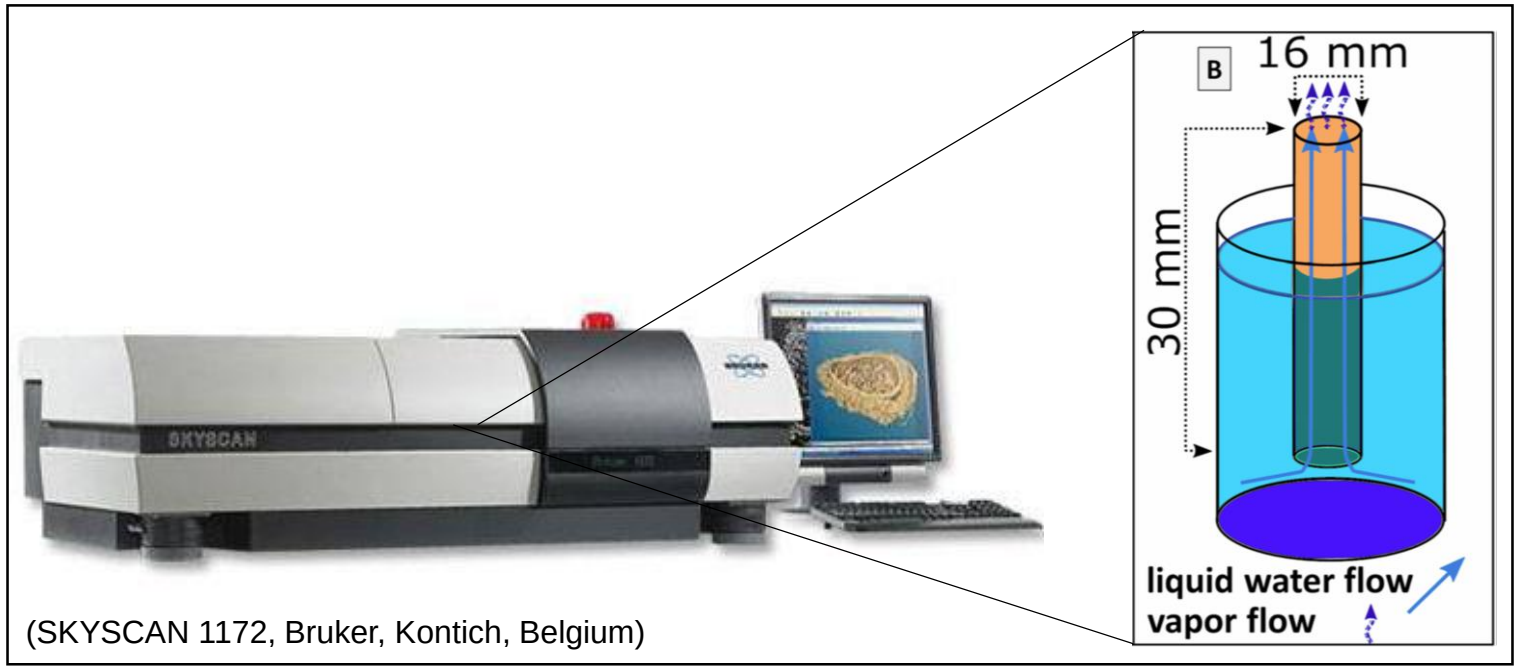
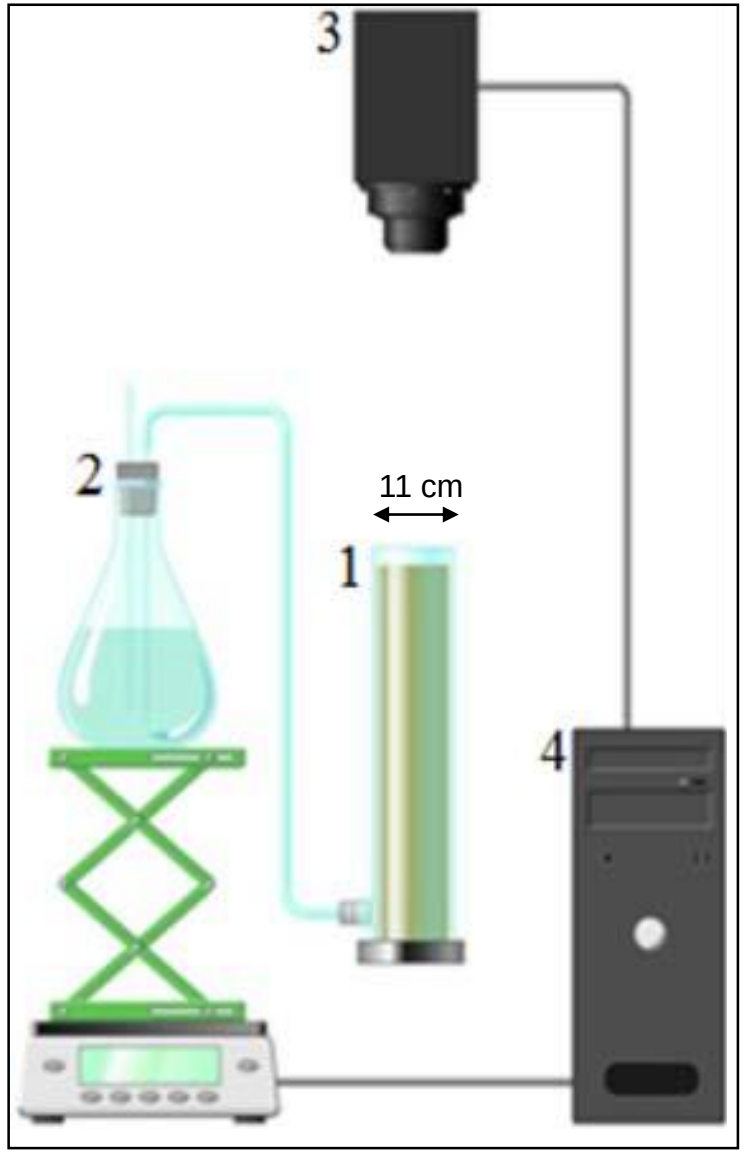
METHODS

- X-ray and visible light imagining of growing salt crusts (NaCl).



(SKYSCAN 1172, Bruker, Kontich, Belgium)



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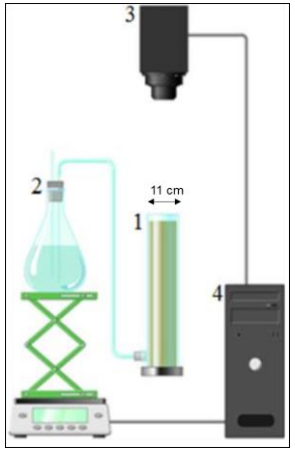
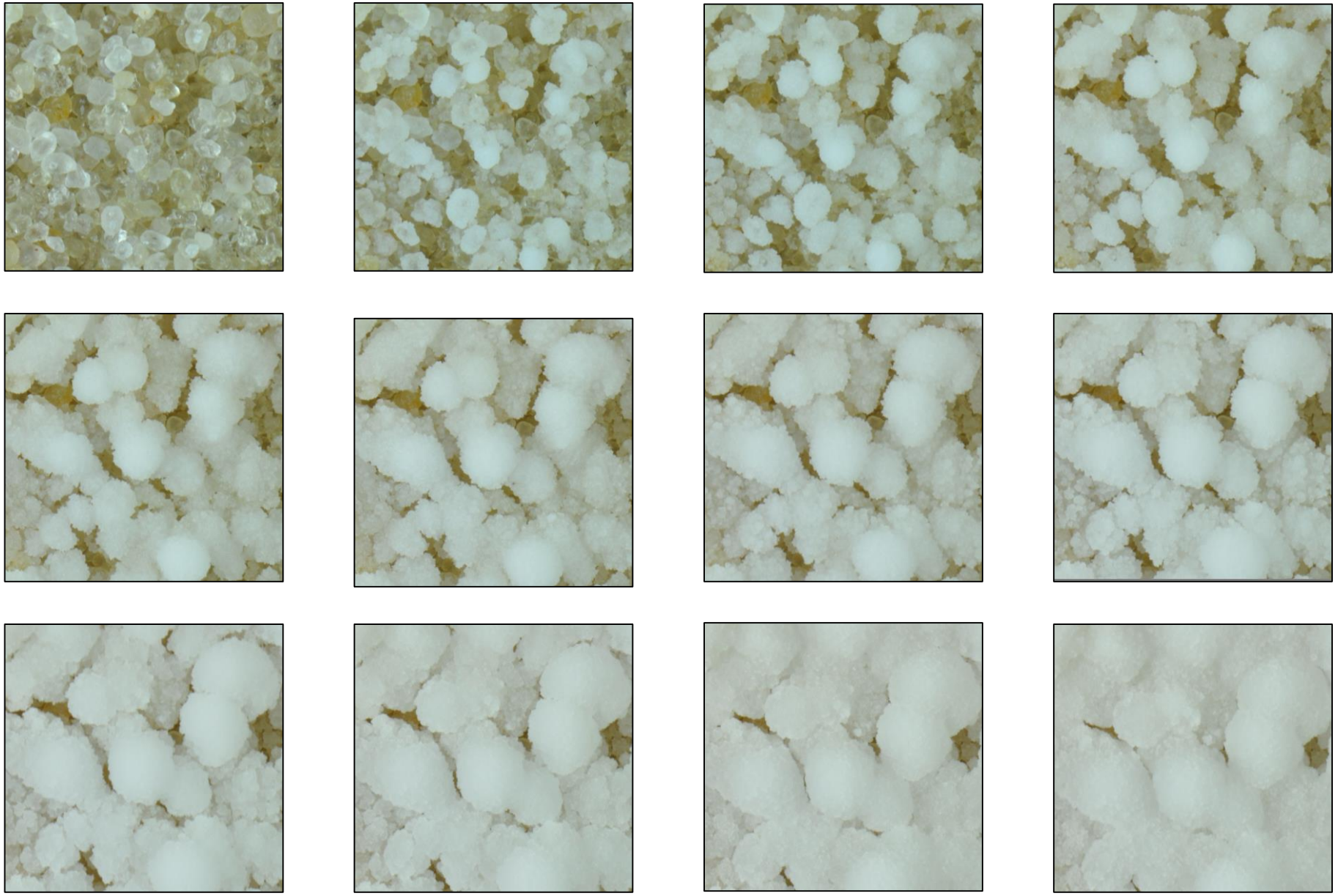
RESULTS

- Visible light images.





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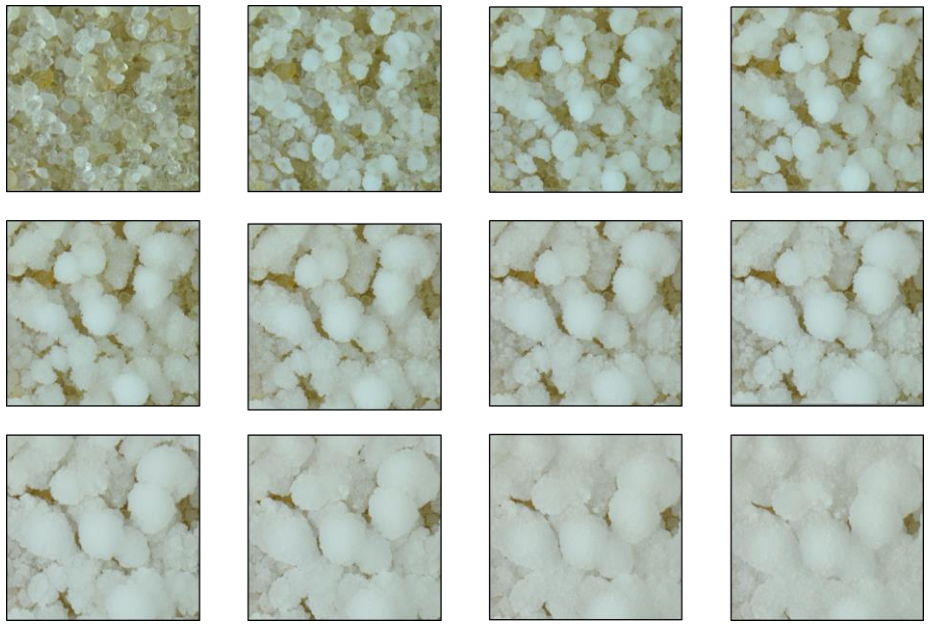
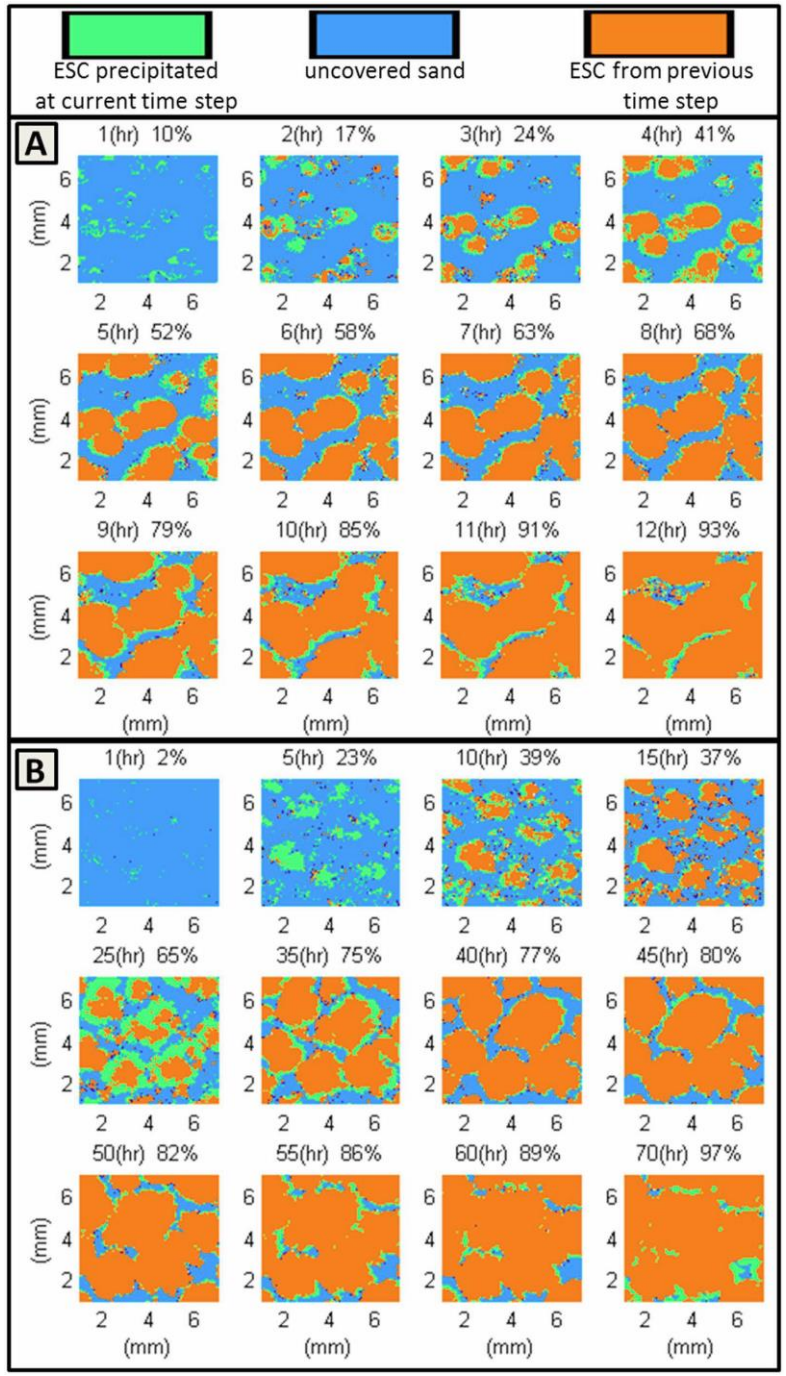
RESULTS

- Visible light images.
- Crystals grow out of specific nucleation centers.





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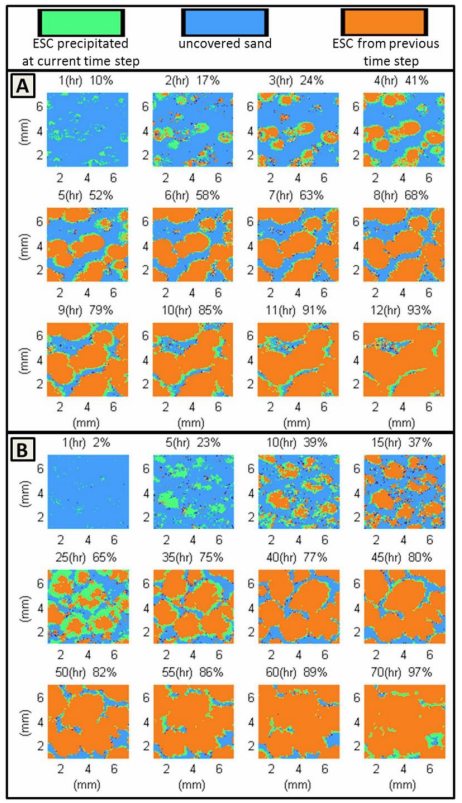
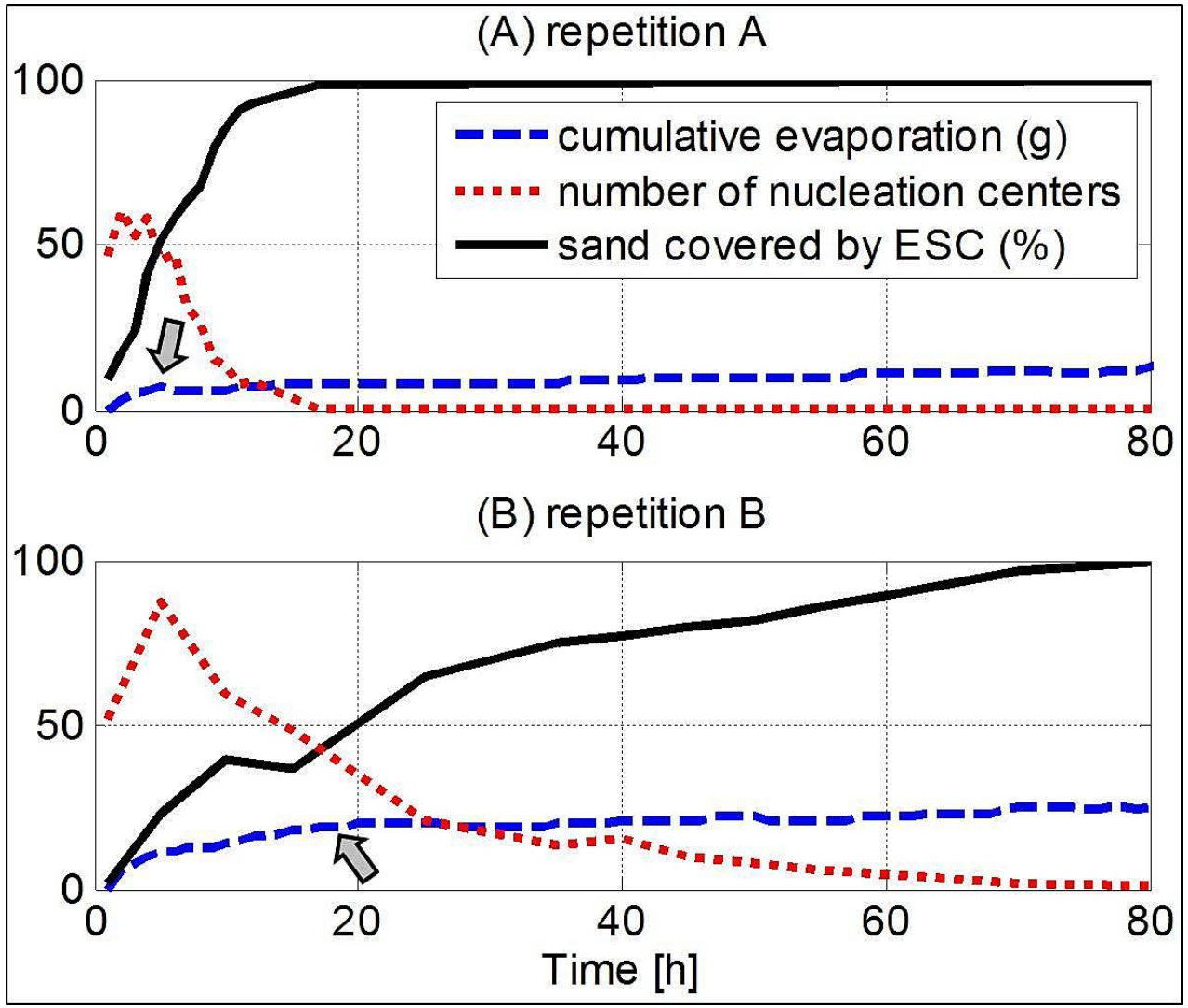
RESULTS

- Visible light images.
- Crystals grow out of specific nucleation centers.
- Reduction in number of nucleation centers.





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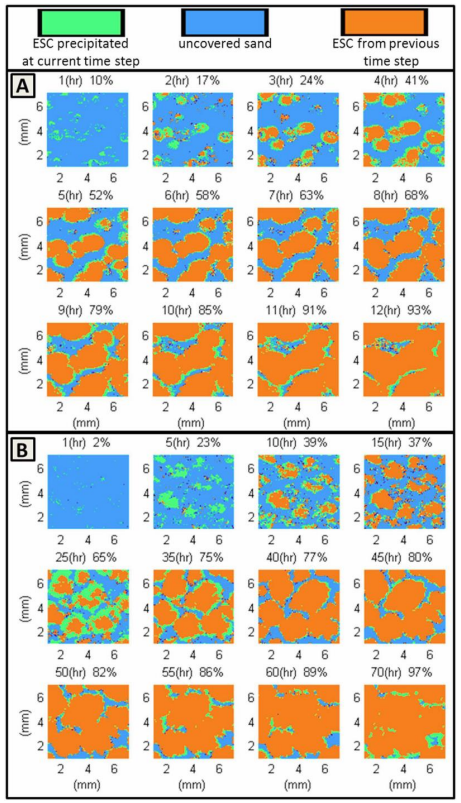
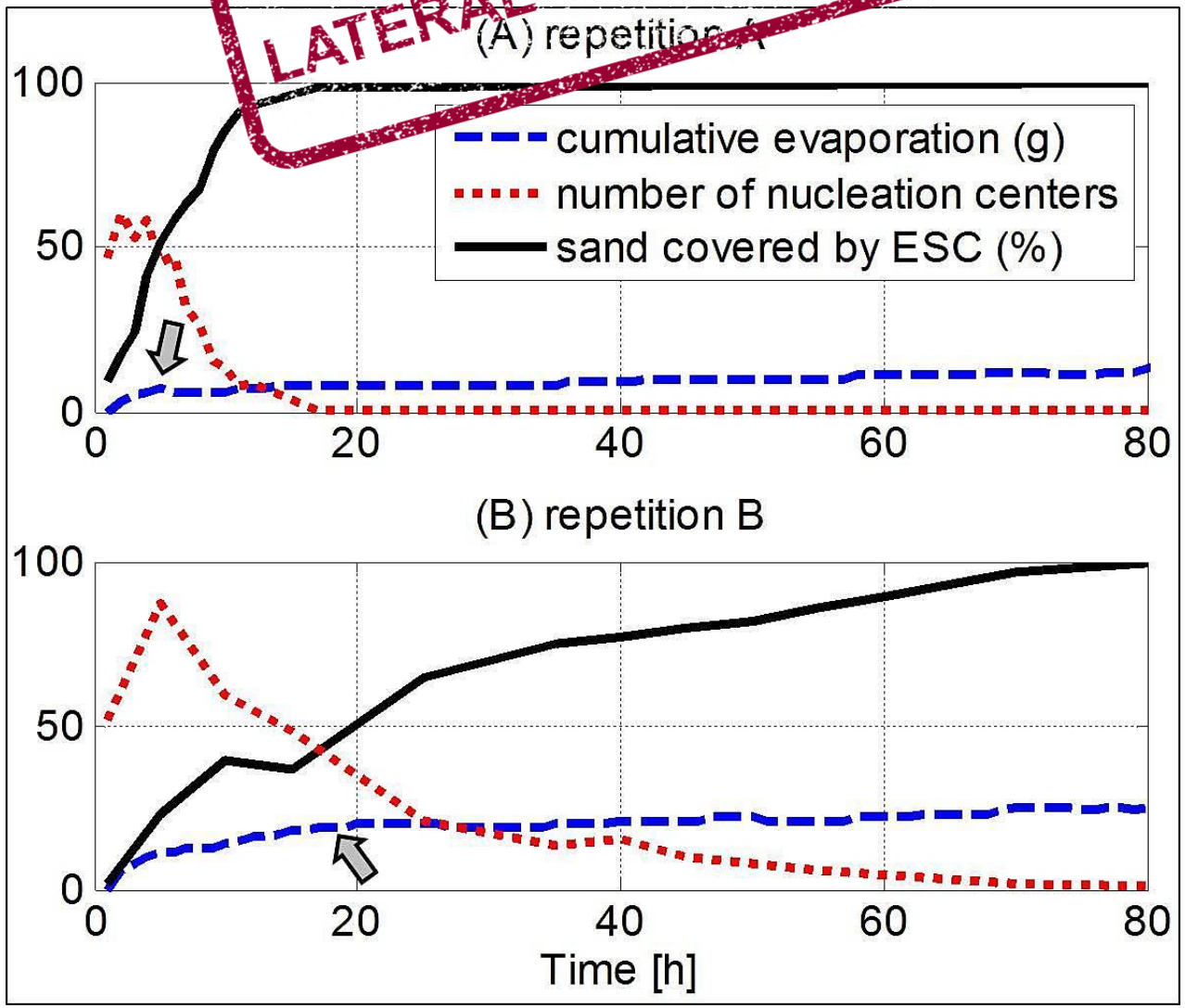


LATERAL GROW OF CRUST



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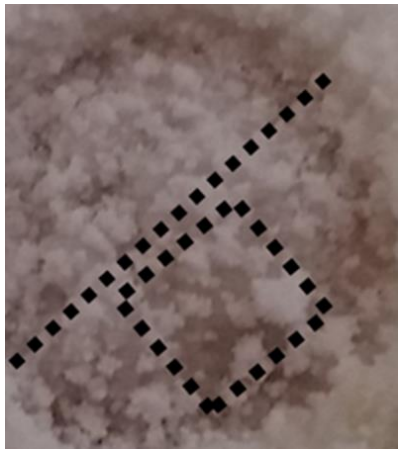
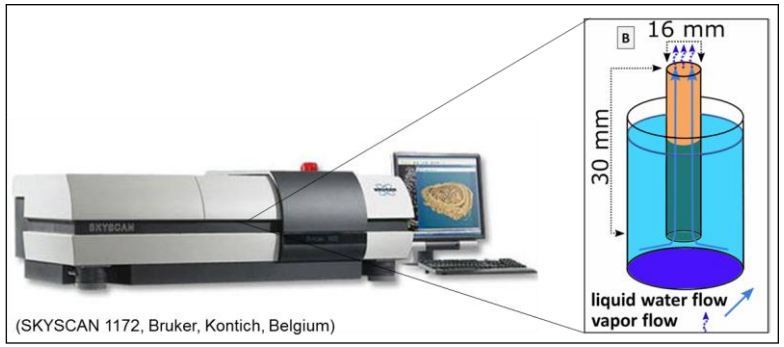
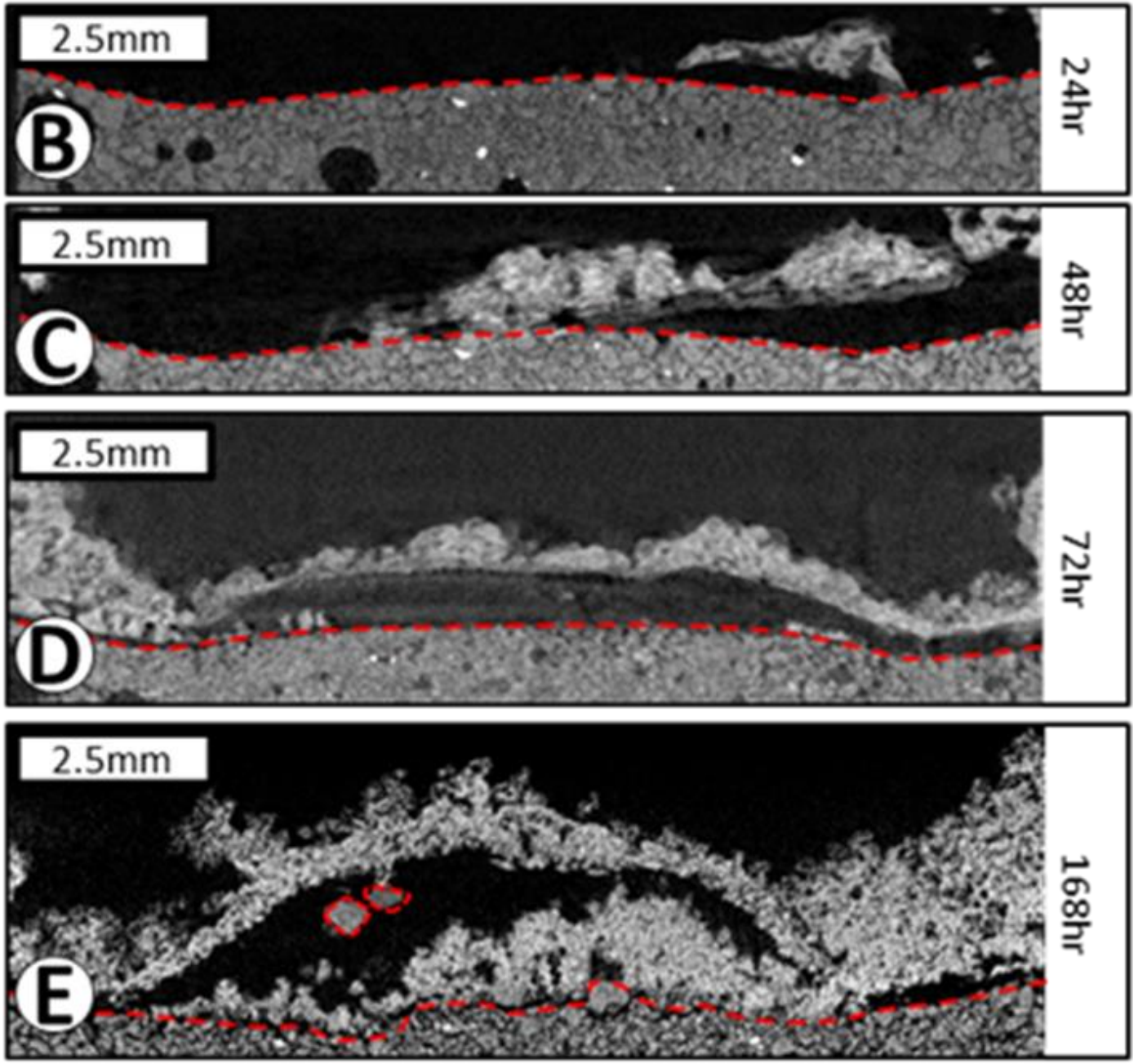
R E S U L T S

- X-ray images.
- 2D profiles.
- A “floating” crust.







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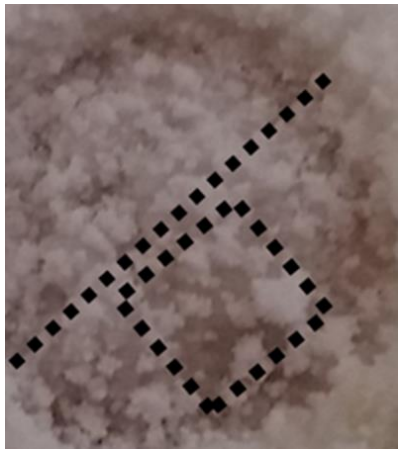
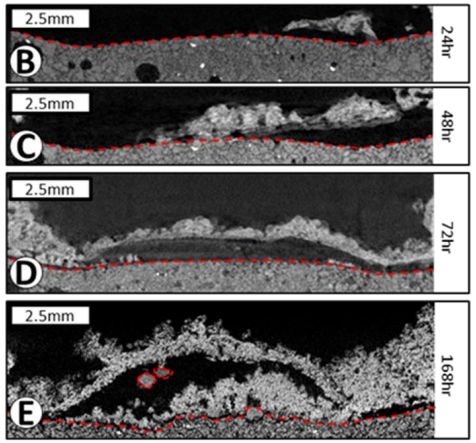
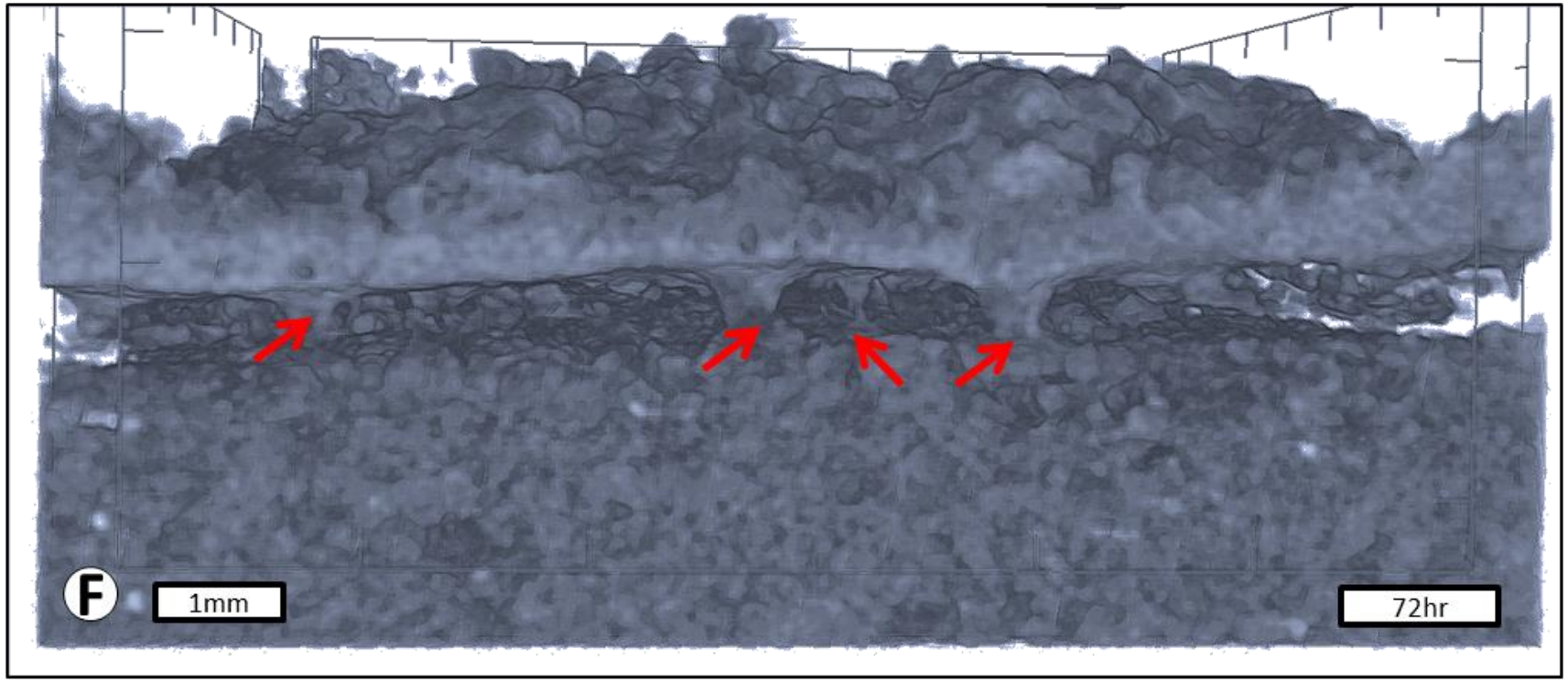
RESULTS

- X-ray images.
- 3D images.
- More than 90% of crust is “floating”.







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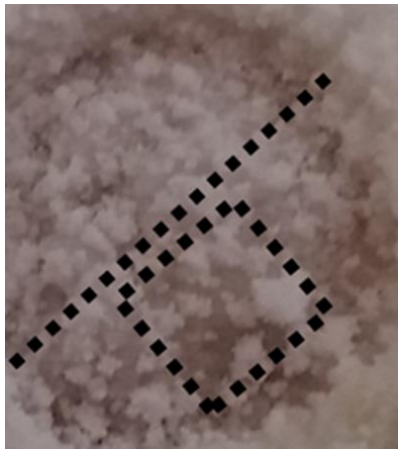

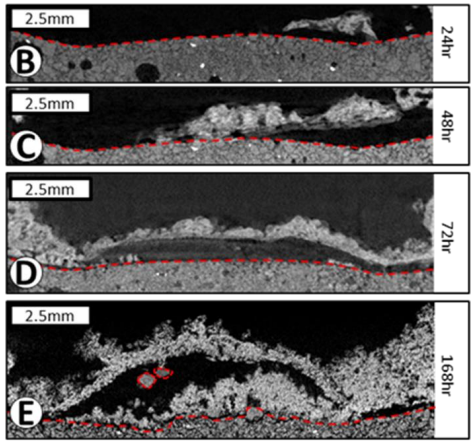

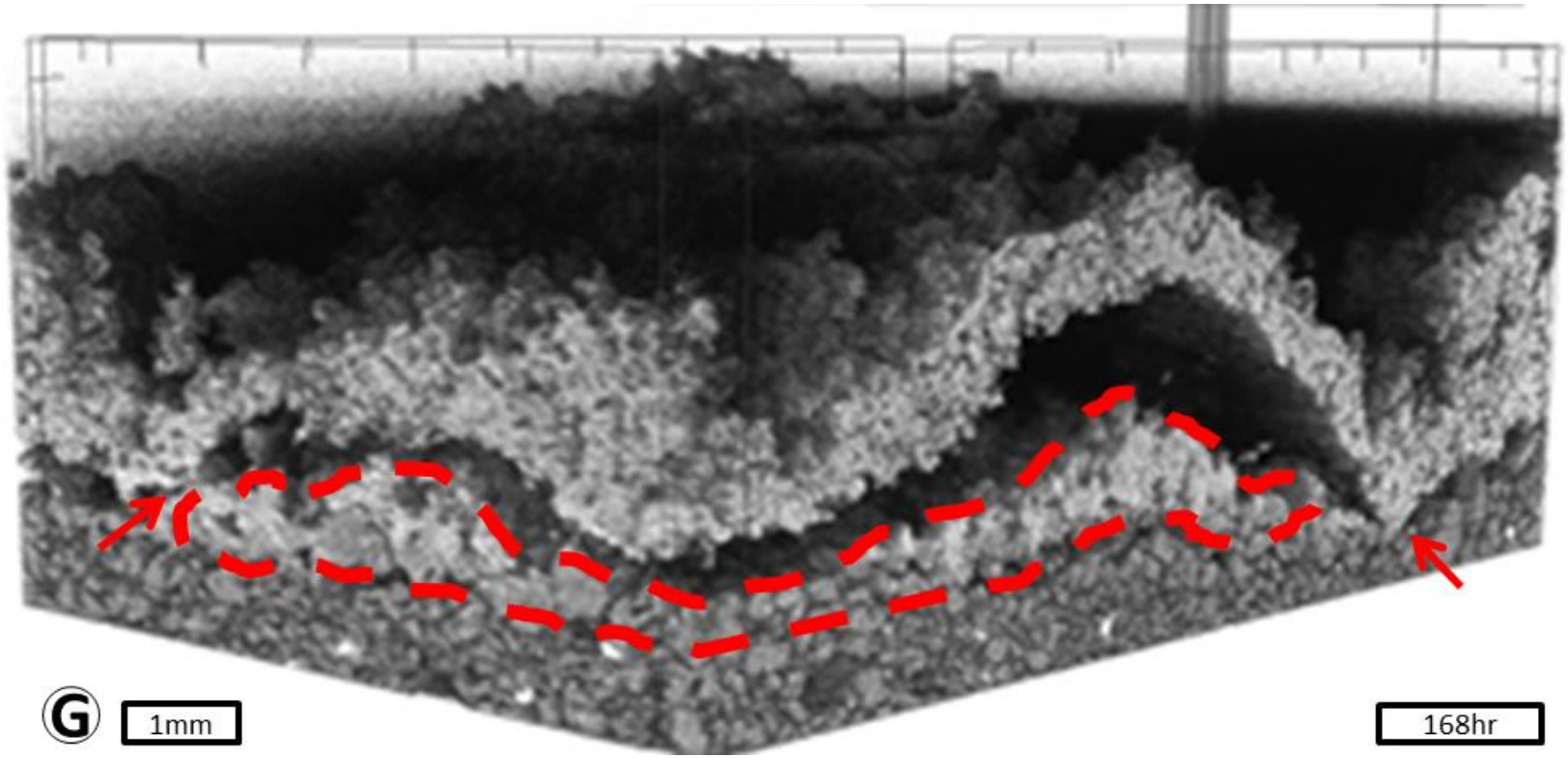

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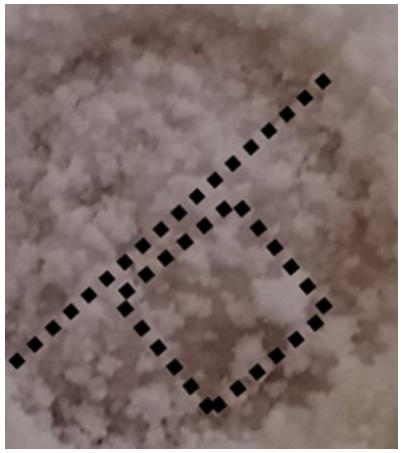
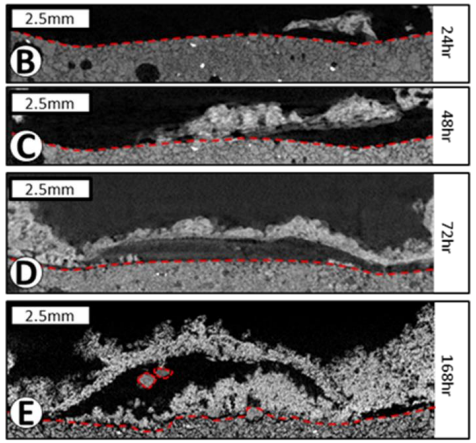
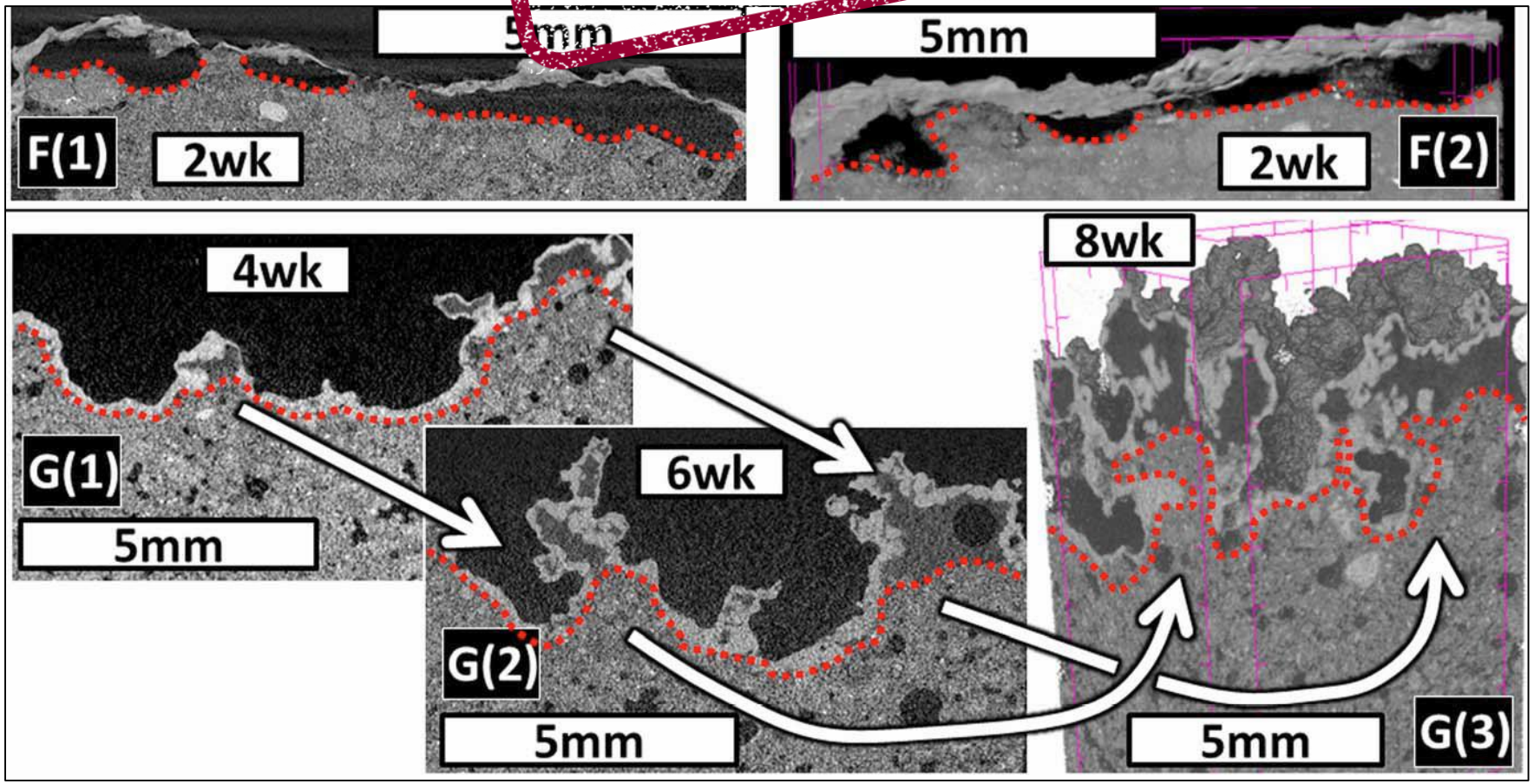
R E S U L T S

- X-ray images.
- Consisted at various soils.
- More than 90% of crust is “floating”.

THE FLOATING CRUST CONCEPT







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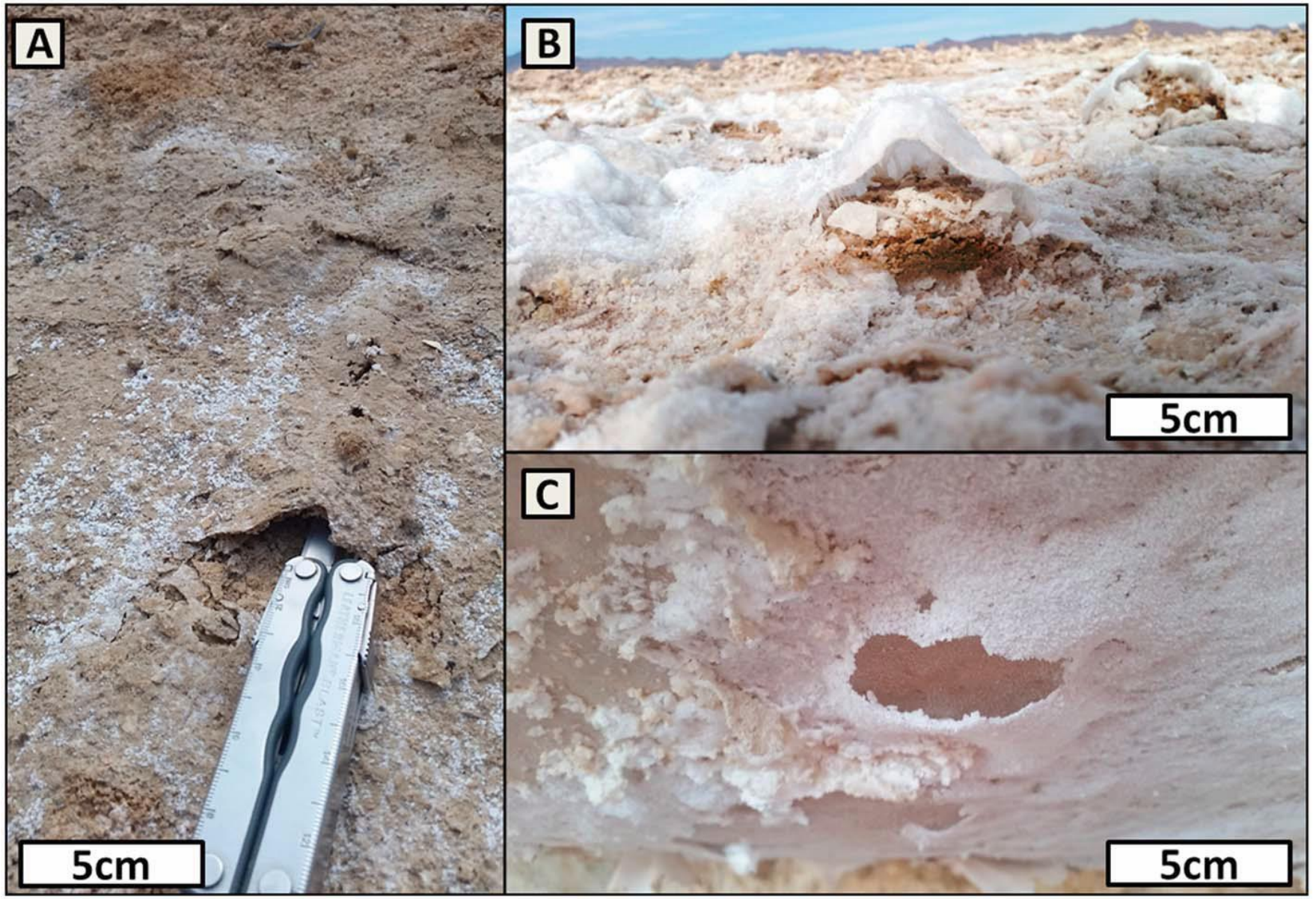
RESULTS

- Consisted with field observations.



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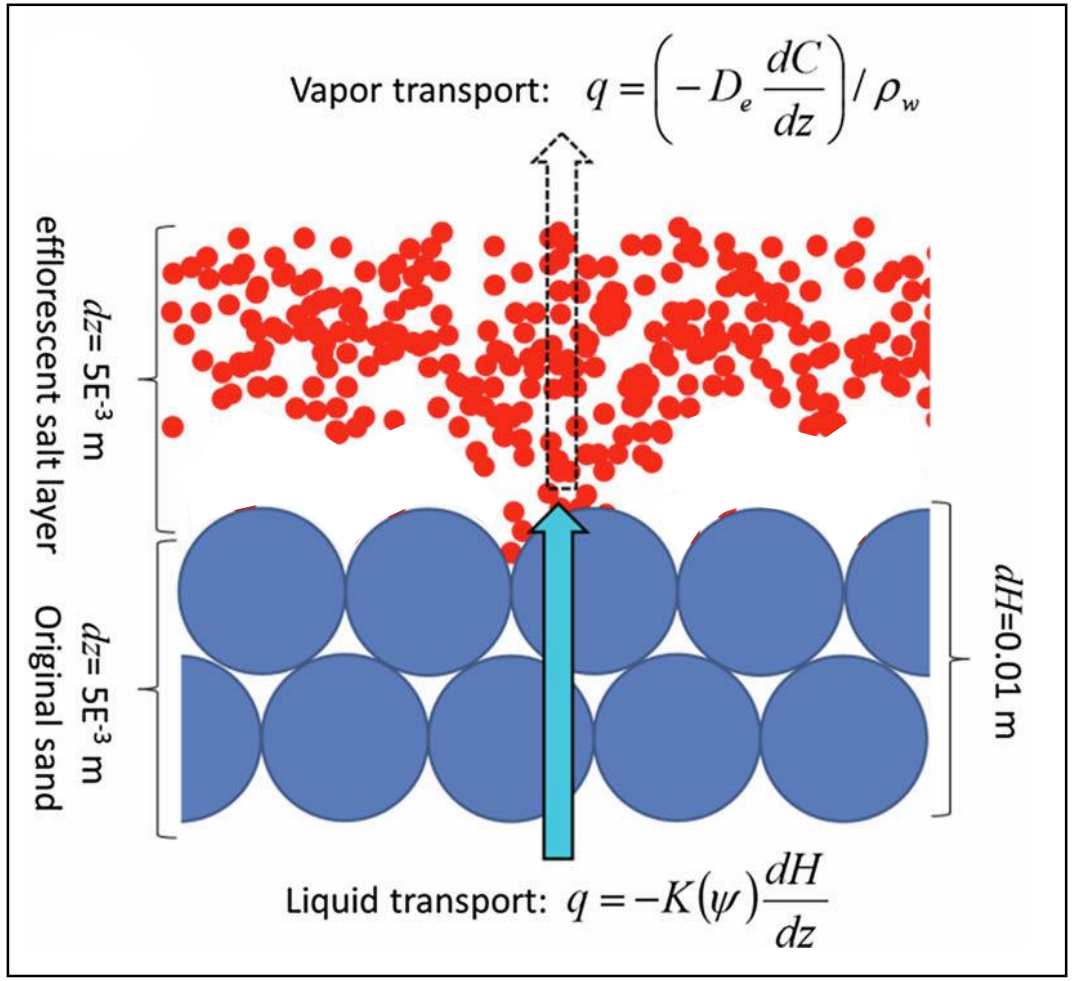
SUMMARY

- NaCl tend to be precipitated as an efflorescence salt crust.
- Water flow through the crust by capillarity is negligible in most cases.
- This is due to the “floating” crust which has minimal contact to soil surface.
- The crust is growing upward and laterally out of a limited number of nucleation centers.



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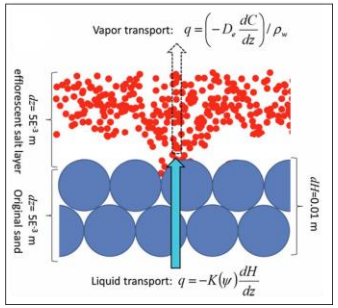

THANK YOU

Beyond the salt crust: on combined evaporation and subflorescent salt precipitation in porous media. U Nachshon, N Weisbrod - Transport in Porous Media, 2015

NaCl Crust Architecture and Its Impact on Evaporation: Three-Dimensional Insights U Nachshon, N Weisbrod, R Katzir, A Nasser - Geophysical Research Letters, 2018