

Experiment

Boiling and Freezing

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**Vigorous
evaporation**

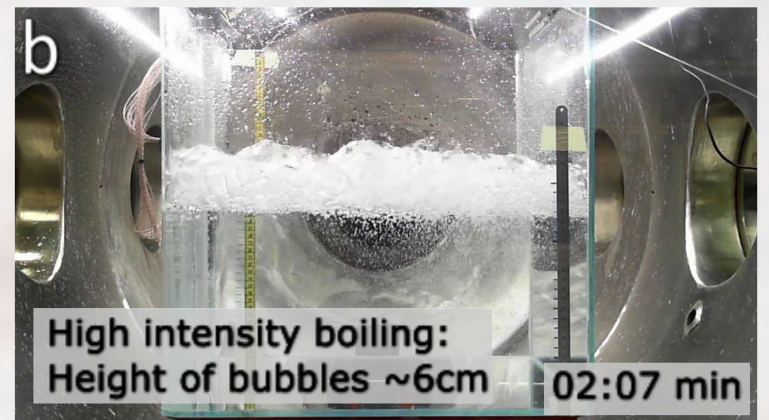
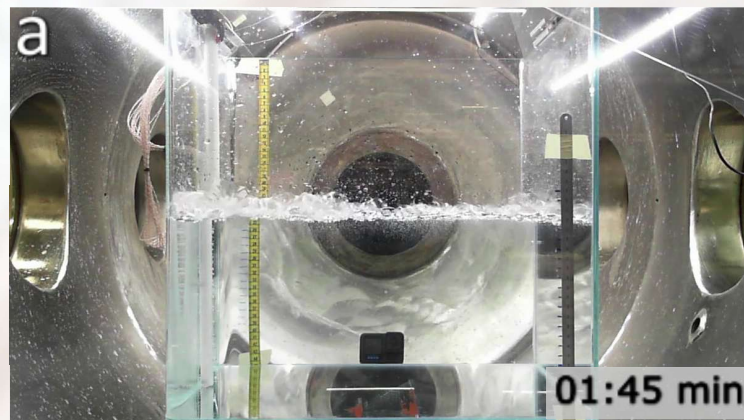
Freezing

**What happens
when you expose
volatiles to near-
vacuum
conditions?**

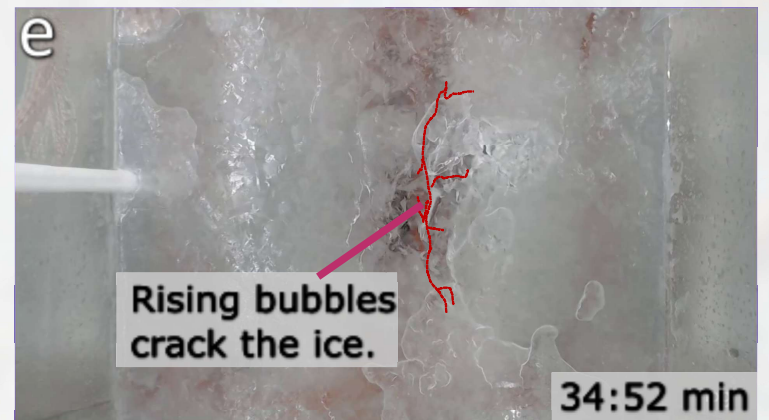
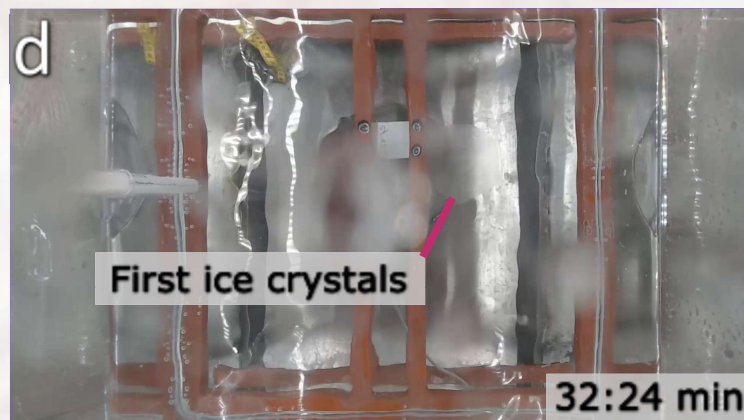
OBSERVATIONS

Angle of
Viewing

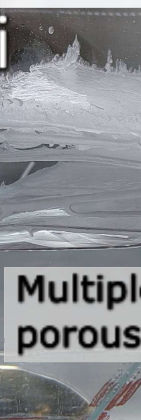
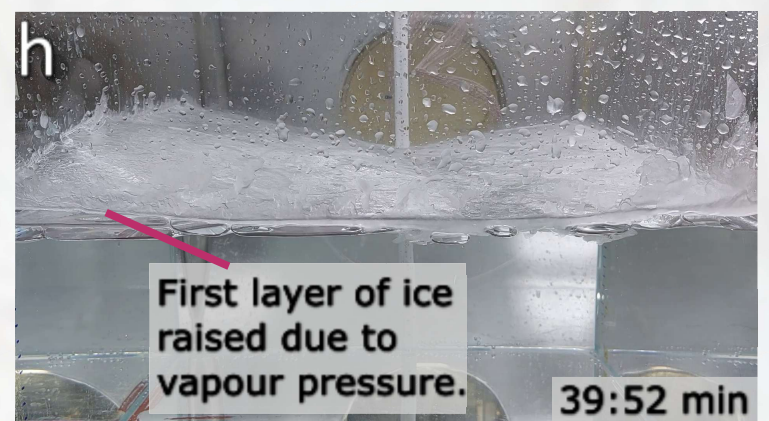
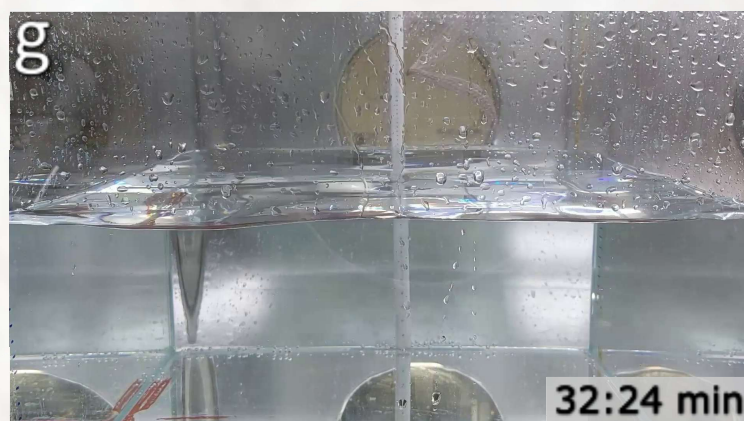
Front



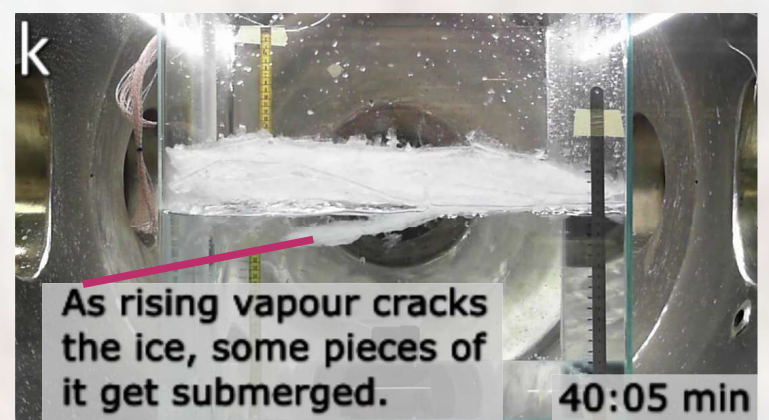
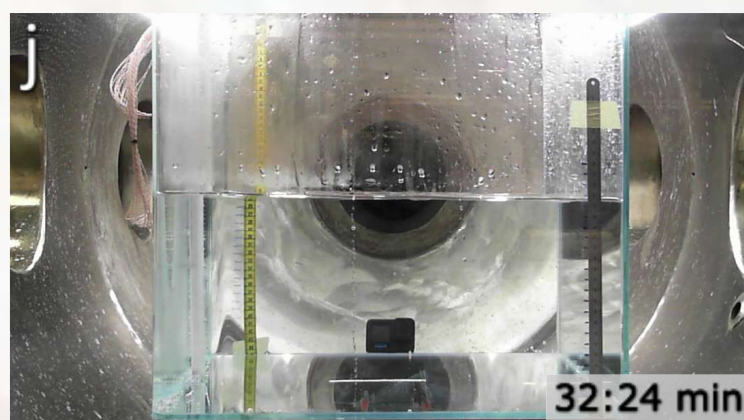
Top



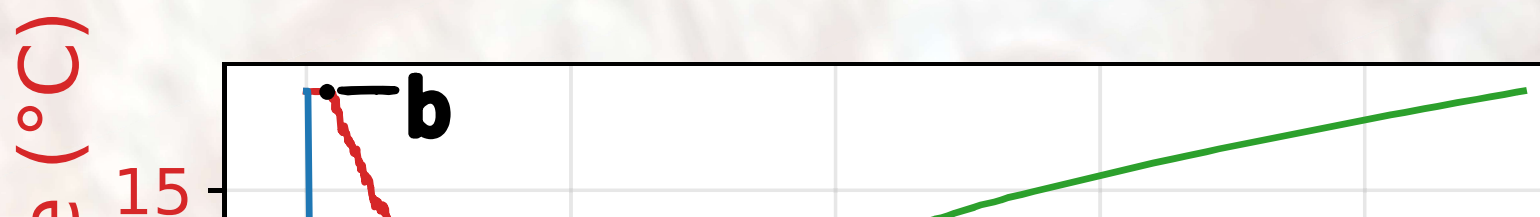
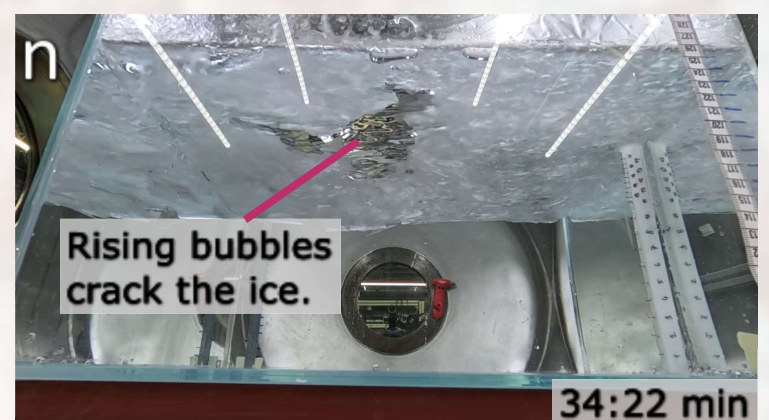
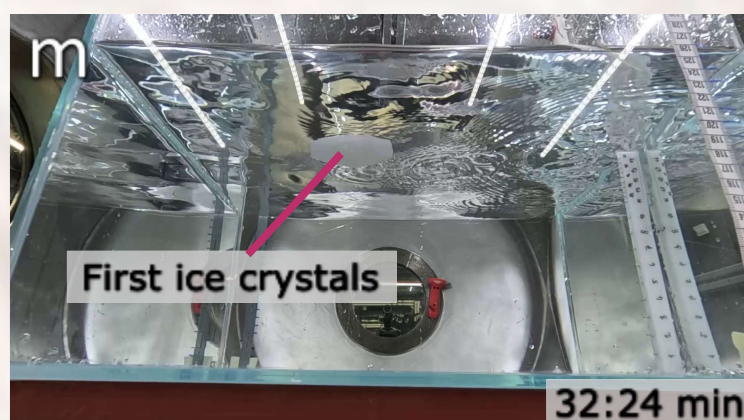
Side



Front

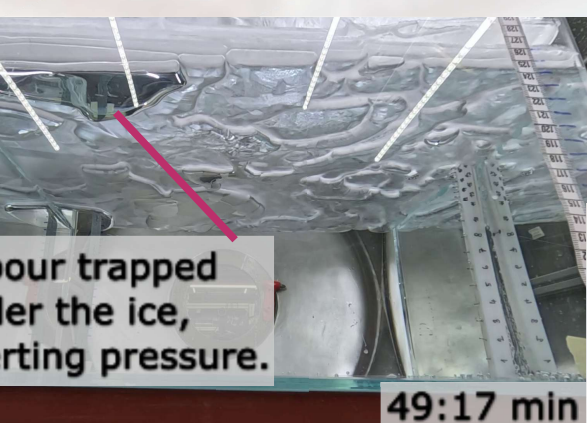
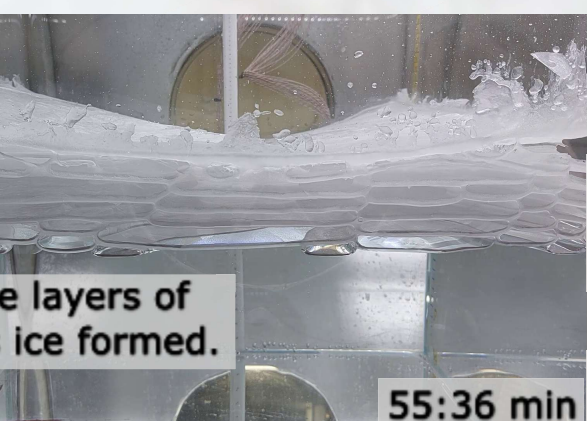
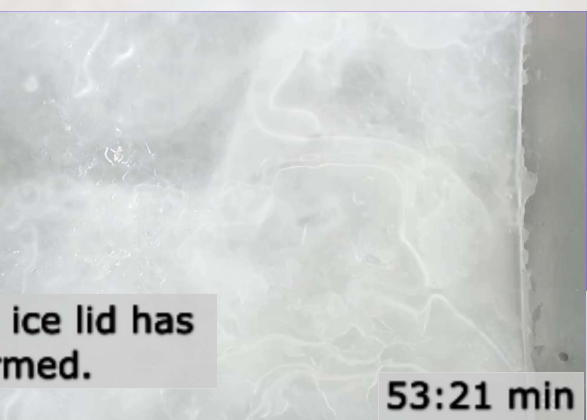
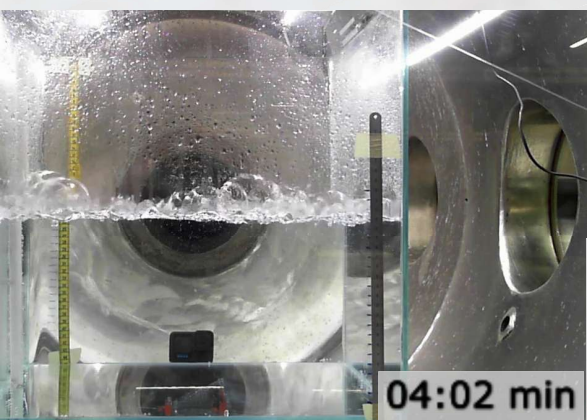


Bottom



S

30x speed



900 (bar) 1.8 (g)

2.5 wt.%

0.5 wt.%

NaCl

23.3 wt.%

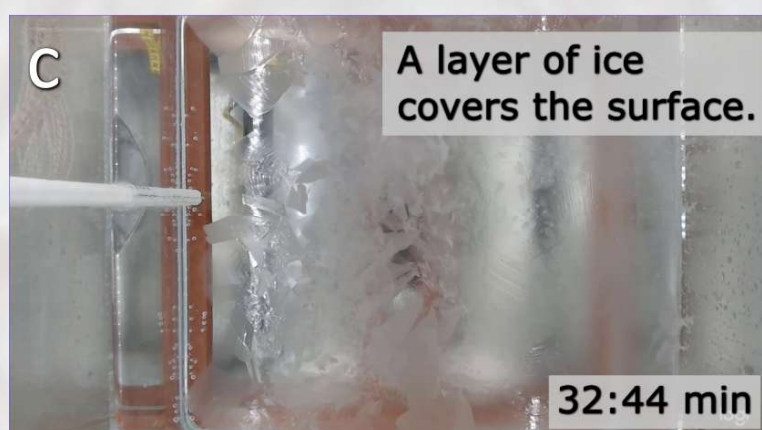
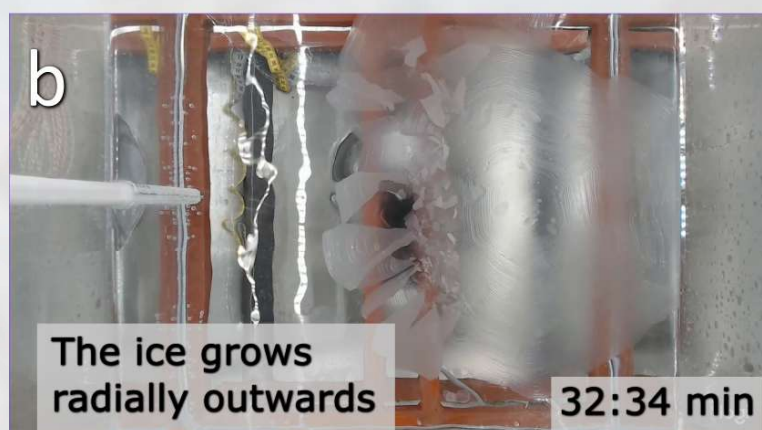
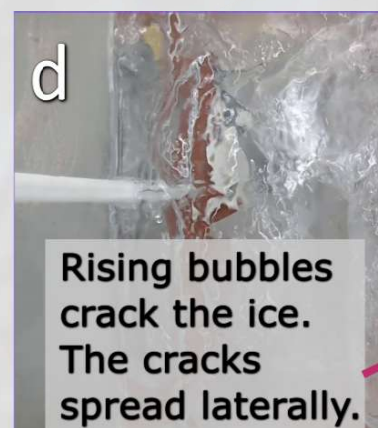
5.0 wt.%

0.5 wt.%

MgSO₄

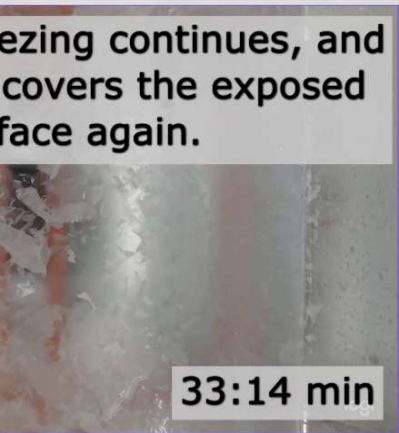
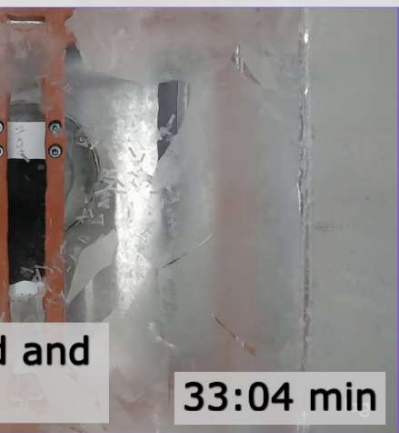
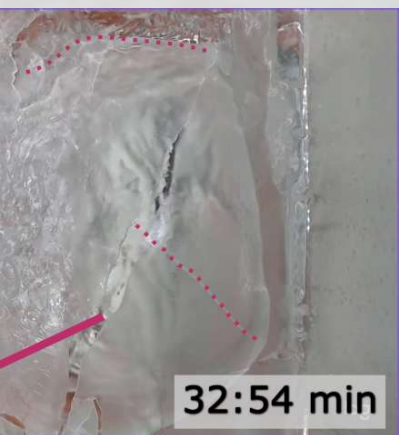
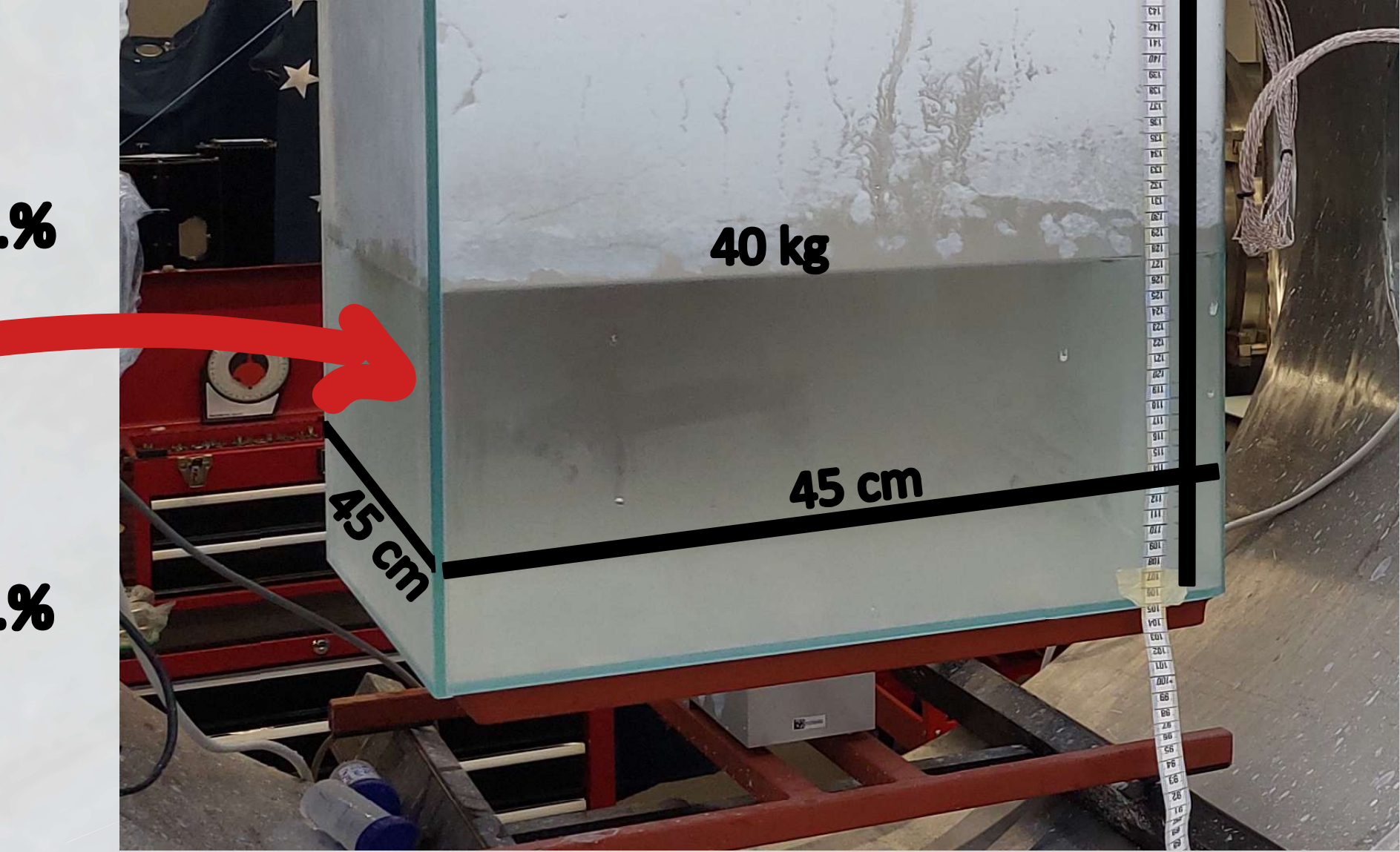
17.4 wt.%

2.5 wt.%



Simultaneous boiling and

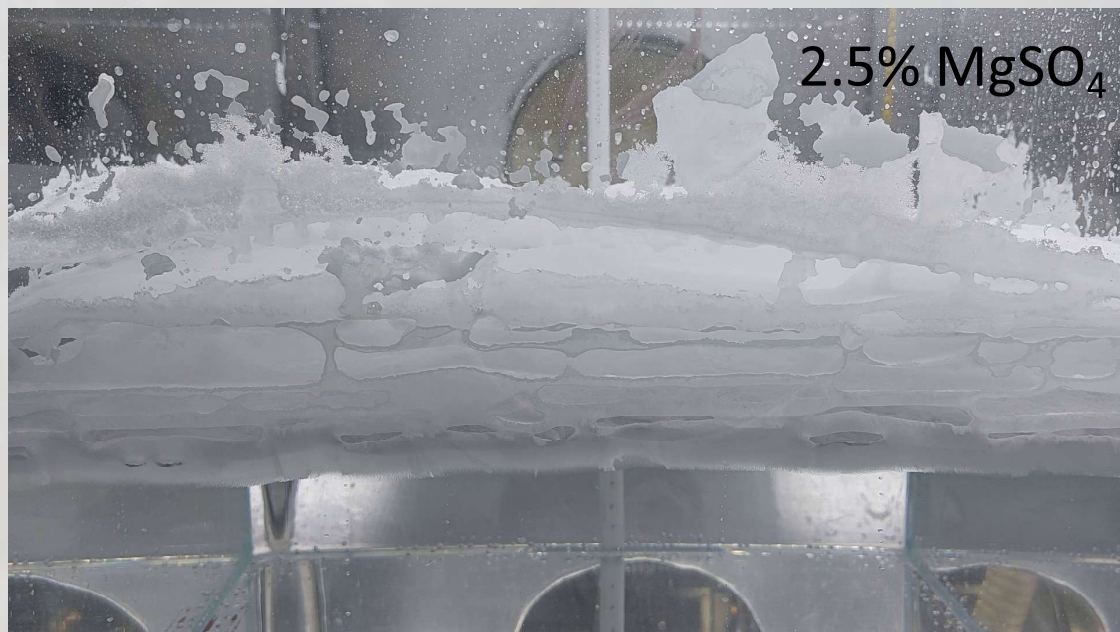
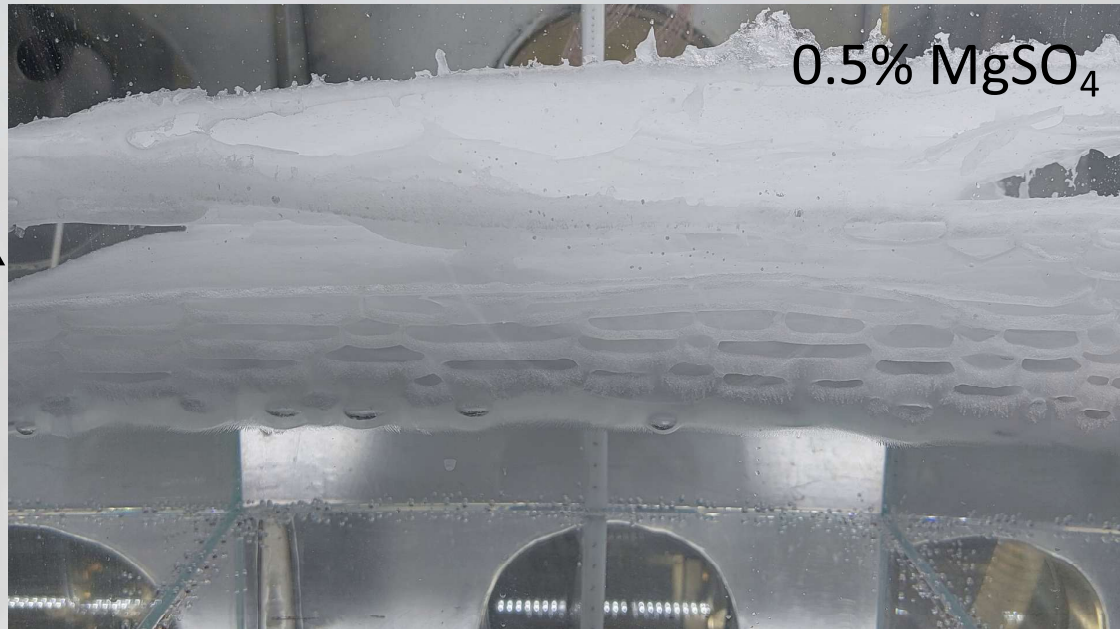
SALINITY AFFECTS



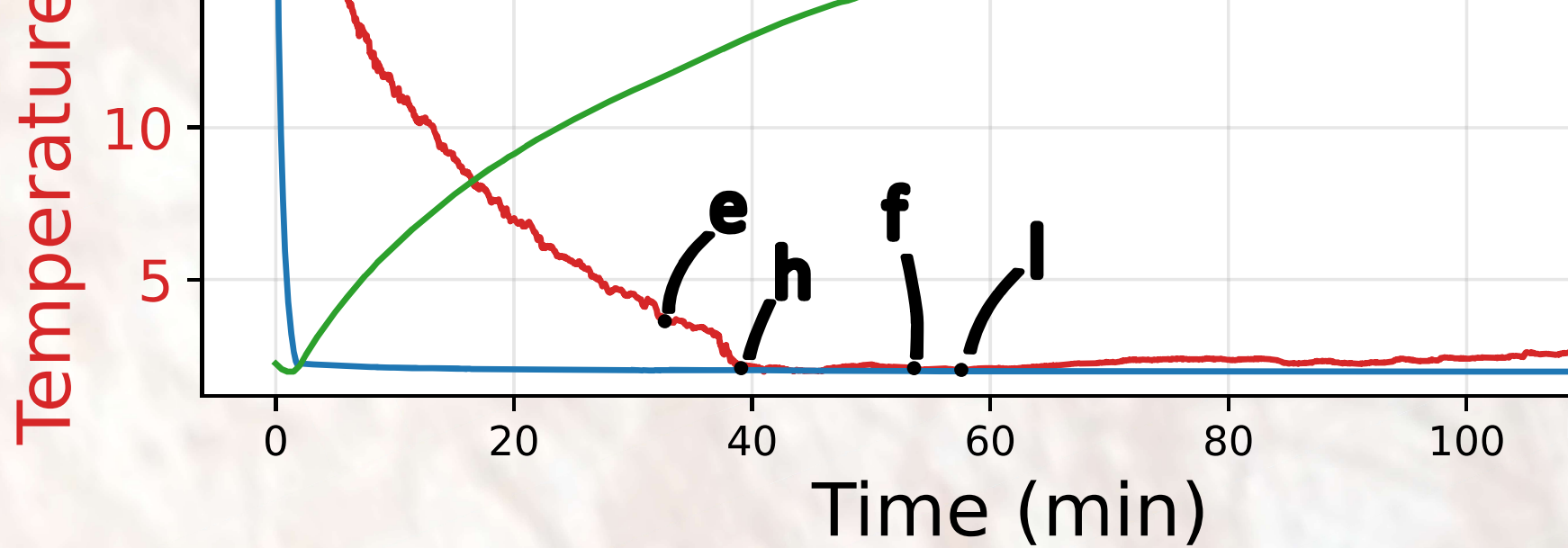
freeing

EFFECTS

P
O
R
O
S
I

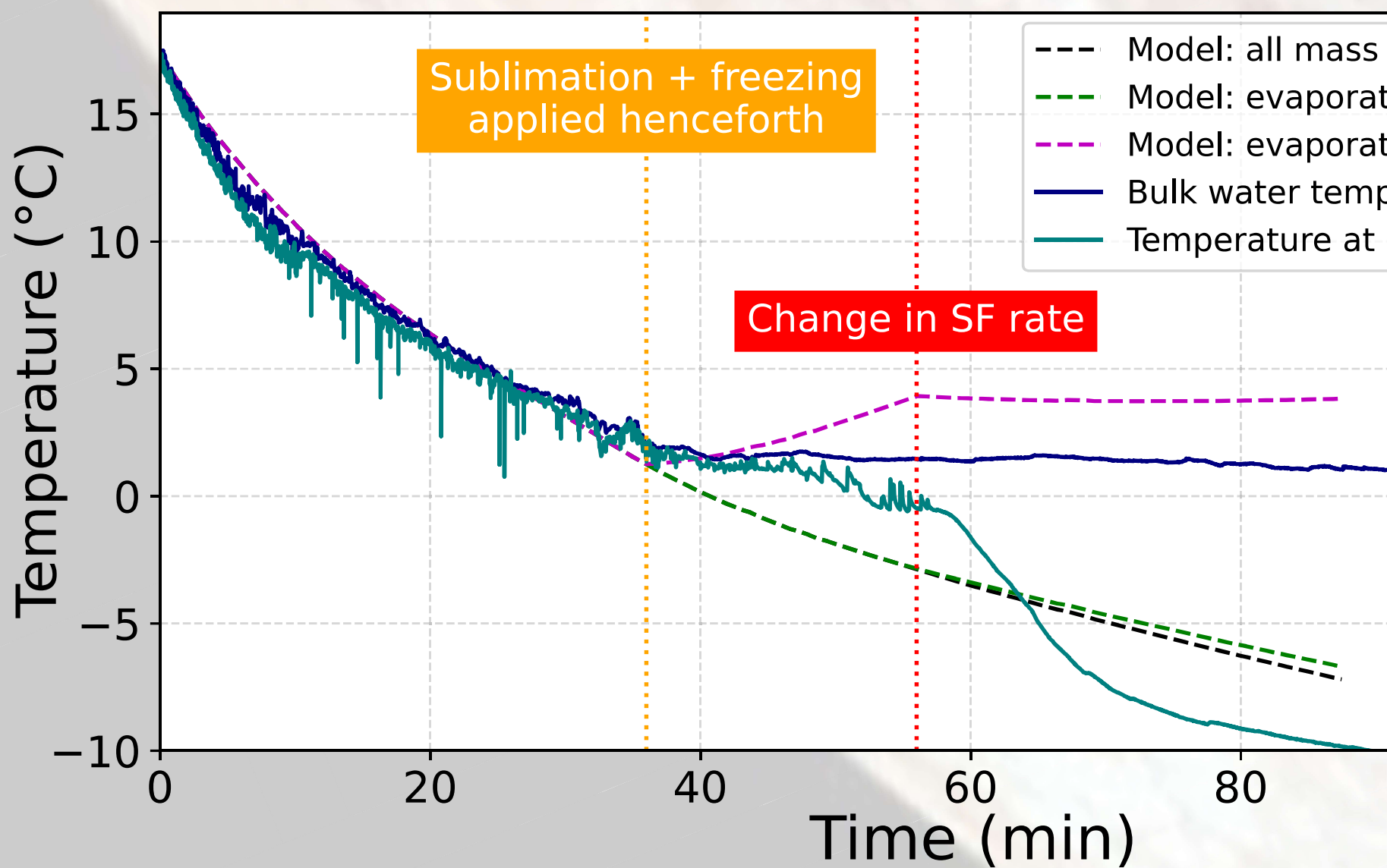


S
A
L
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N
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T

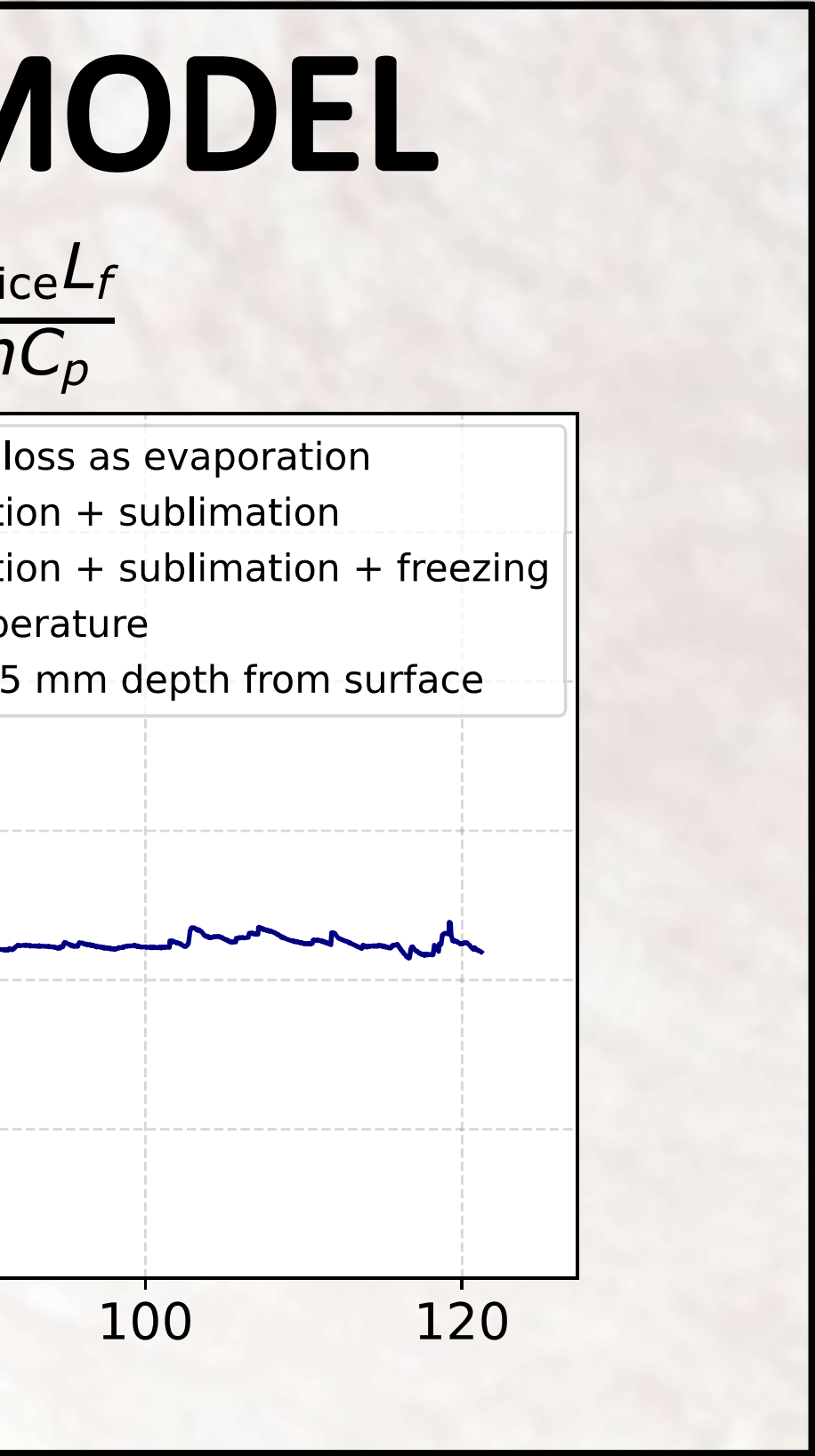
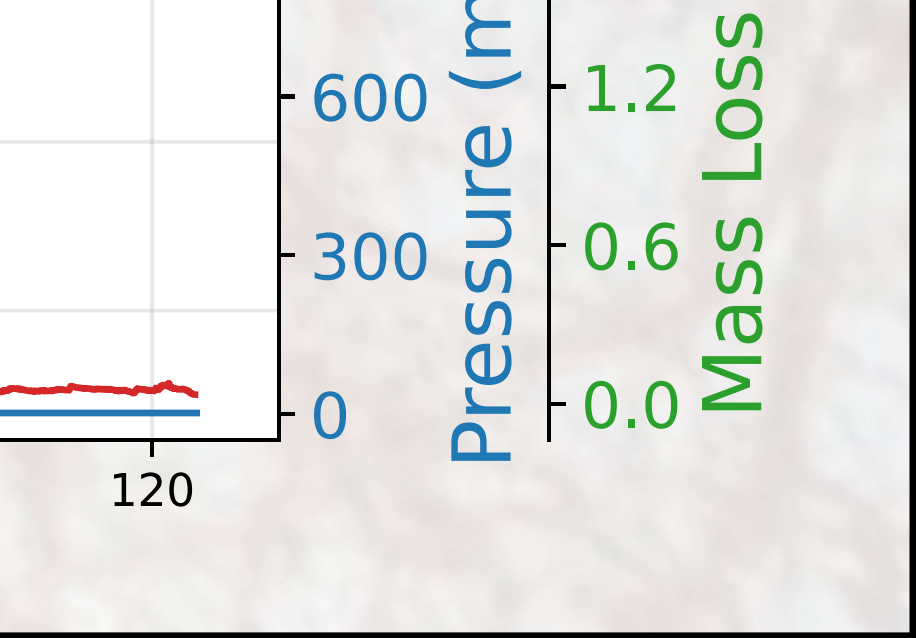


ENERGY BALANCE M

$$\frac{dT}{dt} = -\frac{\dot{m}_{\text{evap}}L_v}{mC_p} - \frac{\dot{m}_{\text{sub}}L_s}{mC_{p,\text{ice}}} + \frac{\dot{m}_{\text{ice}}}{m}$$



Brož et al., EPSL 668 (2025): 119531, Patočka et al., EPSL 685 (2026): 488-506.; Morrison et al. JGR: Planets 128.1



SALINITY AFFECTS ICE PROPERTIES

RHEOLOGY

TIME

0.5% $MgSO_4$

40:46 min

40:46 min

Cracks grow laterally

40:47 min

Brittle Ice

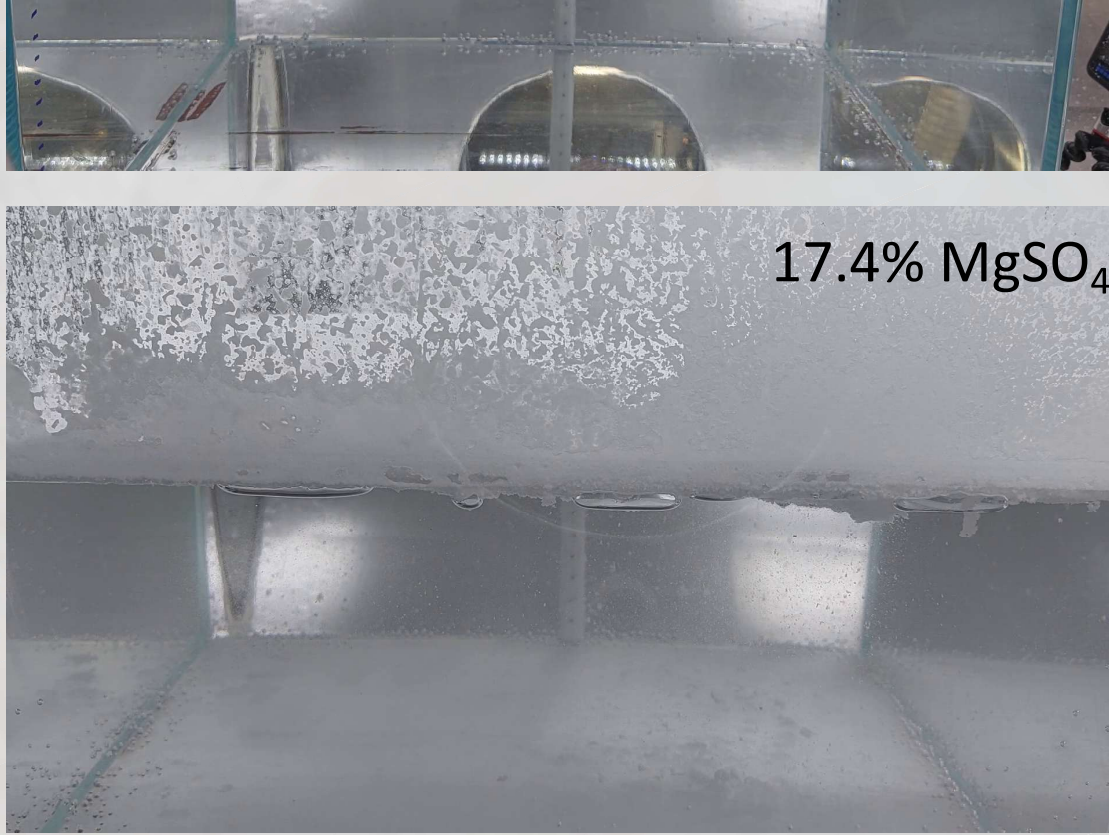
The figure shows a sequence of six images (a-f) of ice over time. A large black arrow labeled 'TIME' points downwards. The images show the formation and growth of cracks in ice. Image (c) has a text label 'Cracks grow laterally' with a red dashed line indicating the crack path. The images are labeled with timestamps: 40:46 min for (a), (b), and (d); and 40:47 min for (c), (e), and (f). The text 'Brittle Ice' is at the bottom left of the sequence.

References and Acknowledgements

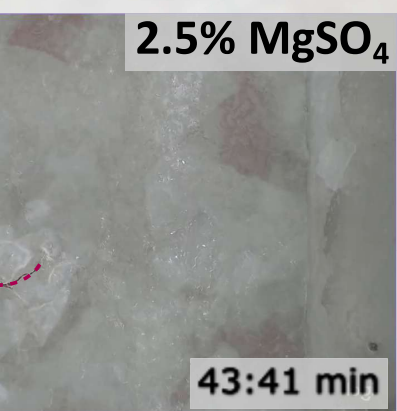
119999.; Lesage et al., Nature Communications 16.1 (2025): 1886.; Allison and Clifford., J: Solid Earth (2023): e2022JE007383.; Fox-Powell et al. (under prep.) 2026. This work was funded by the

EFFECTS OF POROSITY

T
Y

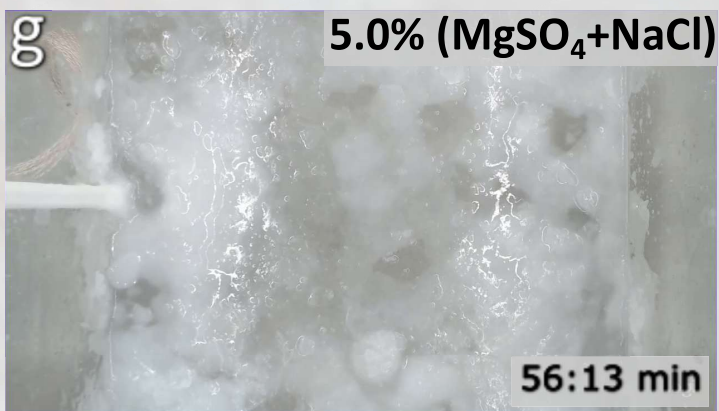


17.4% MgSO_4



2.5% MgSO_4

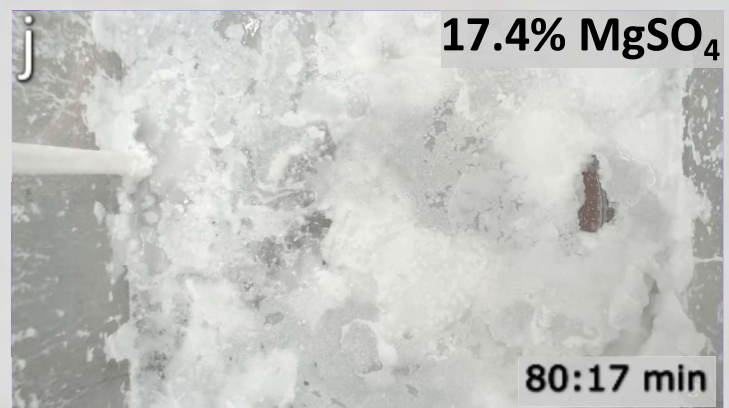
43:41 min



g

5.0% ($\text{MgSO}_4 + \text{NaCl}$)

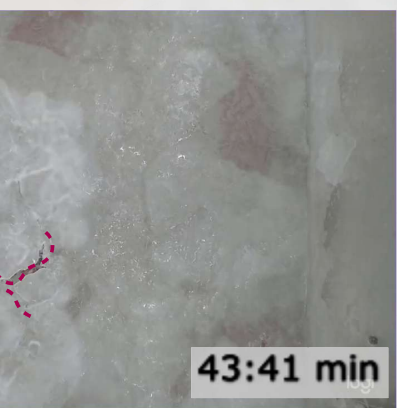
56:13 min



j

17.4% MgSO_4

80:17 min



43:41 min



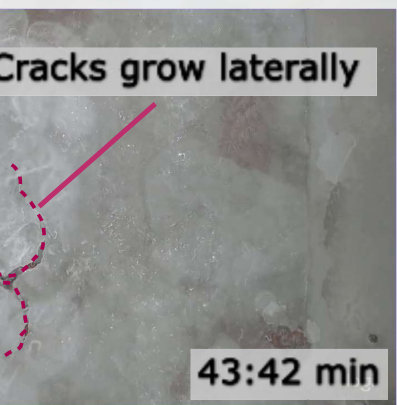
h

56:13 min



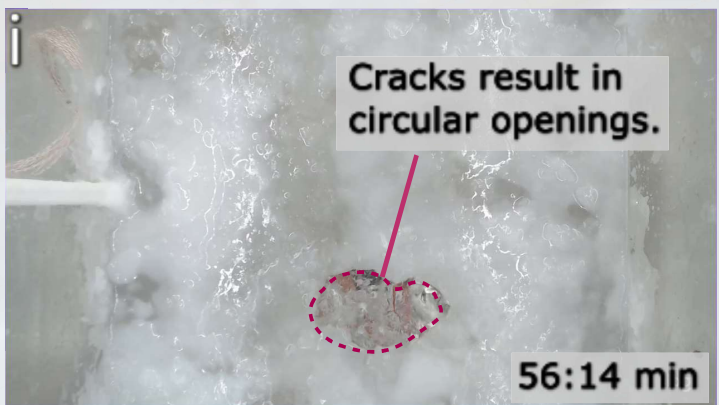
k

80:17 min



Cracks grow laterally

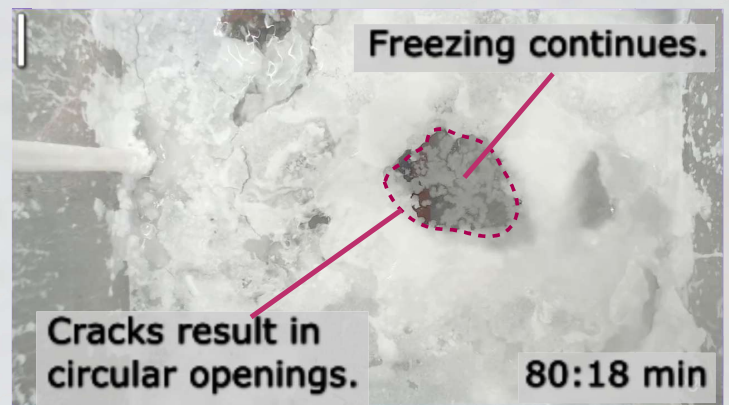
43:42 min



i

Cracks result in circular openings.

56:14 min



Freezing continues.

Cracks result in circular openings.

80:18 min

SALINITY

Ductile Ice

Earth 92.B8 (1987): 7865-7876.; Bargery et al., Icarus 210.1 (2010):
Czech Grant Agency grant No. 25- 15473S.