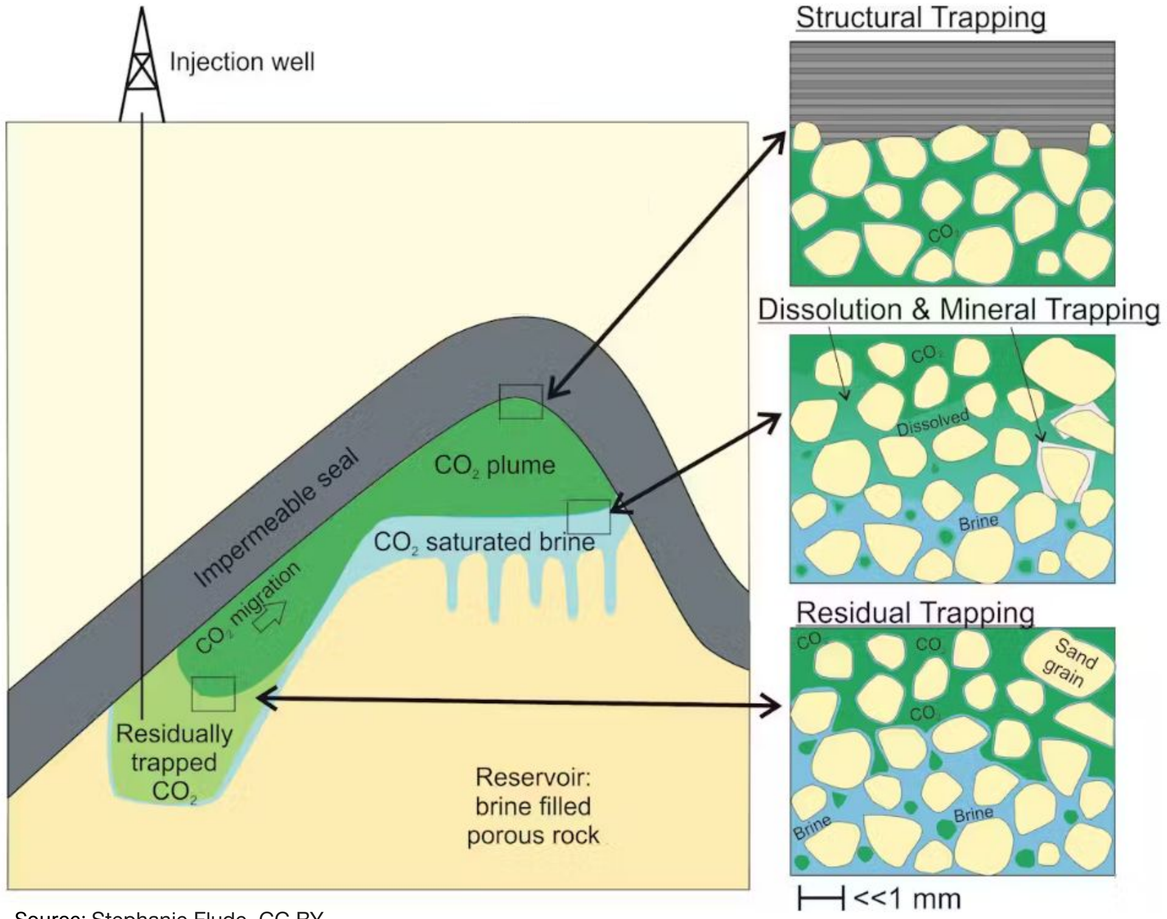
From Grids to Brines: Small Tweaks, Big Shifts in CO_2 Storage

Mark Lakos – Rock Flow Dynamics

SPE EuropEC 2025, Vienna
SPE-225574-MS
Numerical Investigation of Geological CO2 Storage
– Sensitivity Study on Saturation Functions

Trapping mechanisms



Source: Stephanie Flude, CC BY

Structural trapping

- Driven by geology

Dissolution and mineral trapping

- Driven by solubility
- Driven by mineralization

Residual trapping

- Driven by hysteresis

Time and Storage security!

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What to consider?

- **Numerical parameters**

How big is too big and how small is small enough?

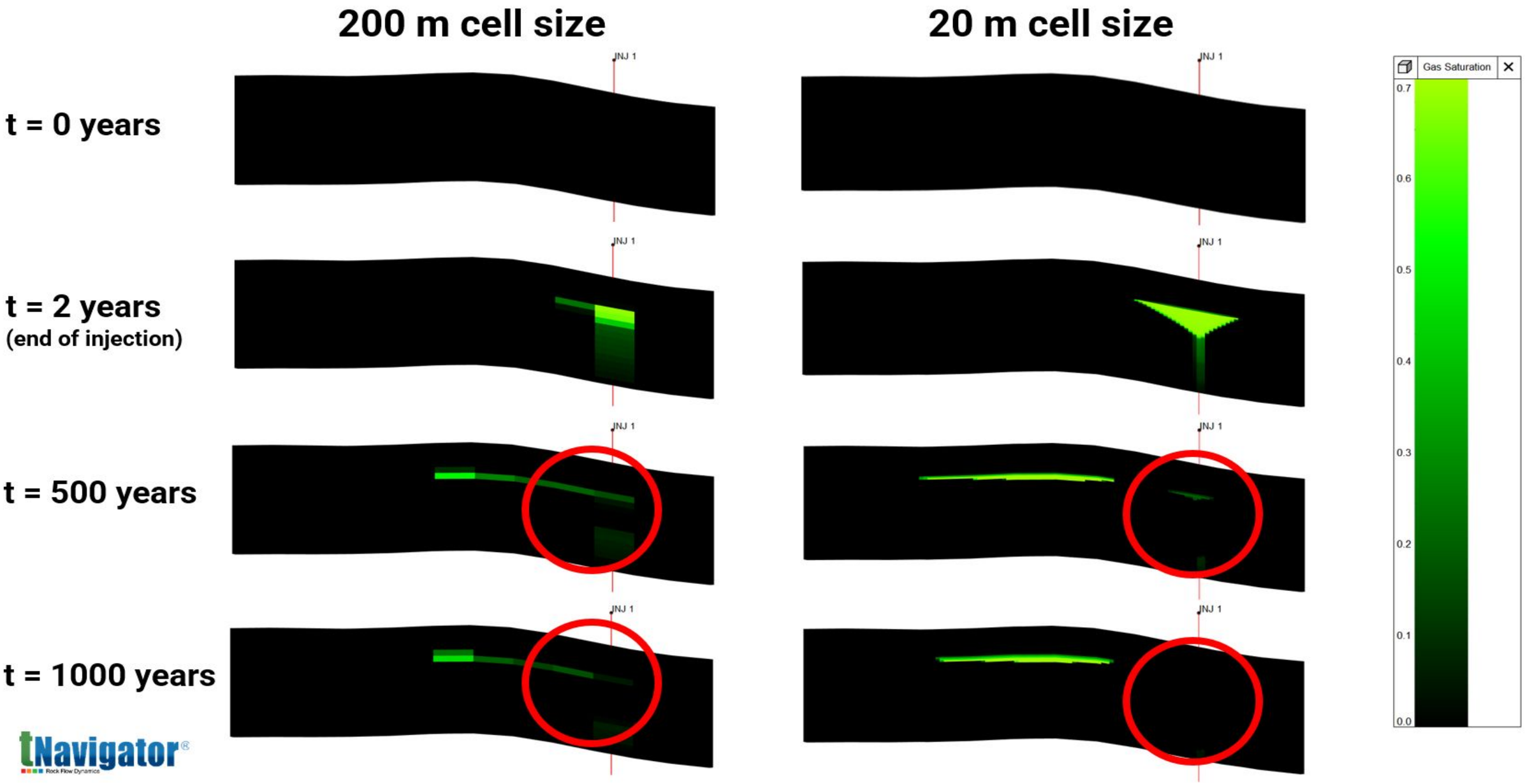
- **Reservoir characterization**

Where do we want to inject?
What fluids do we have? What are their properties?
What rocks do we have?

Cell Size Sensitivity: How small is small enough?

20 m vs 200 m

CO2 Plume



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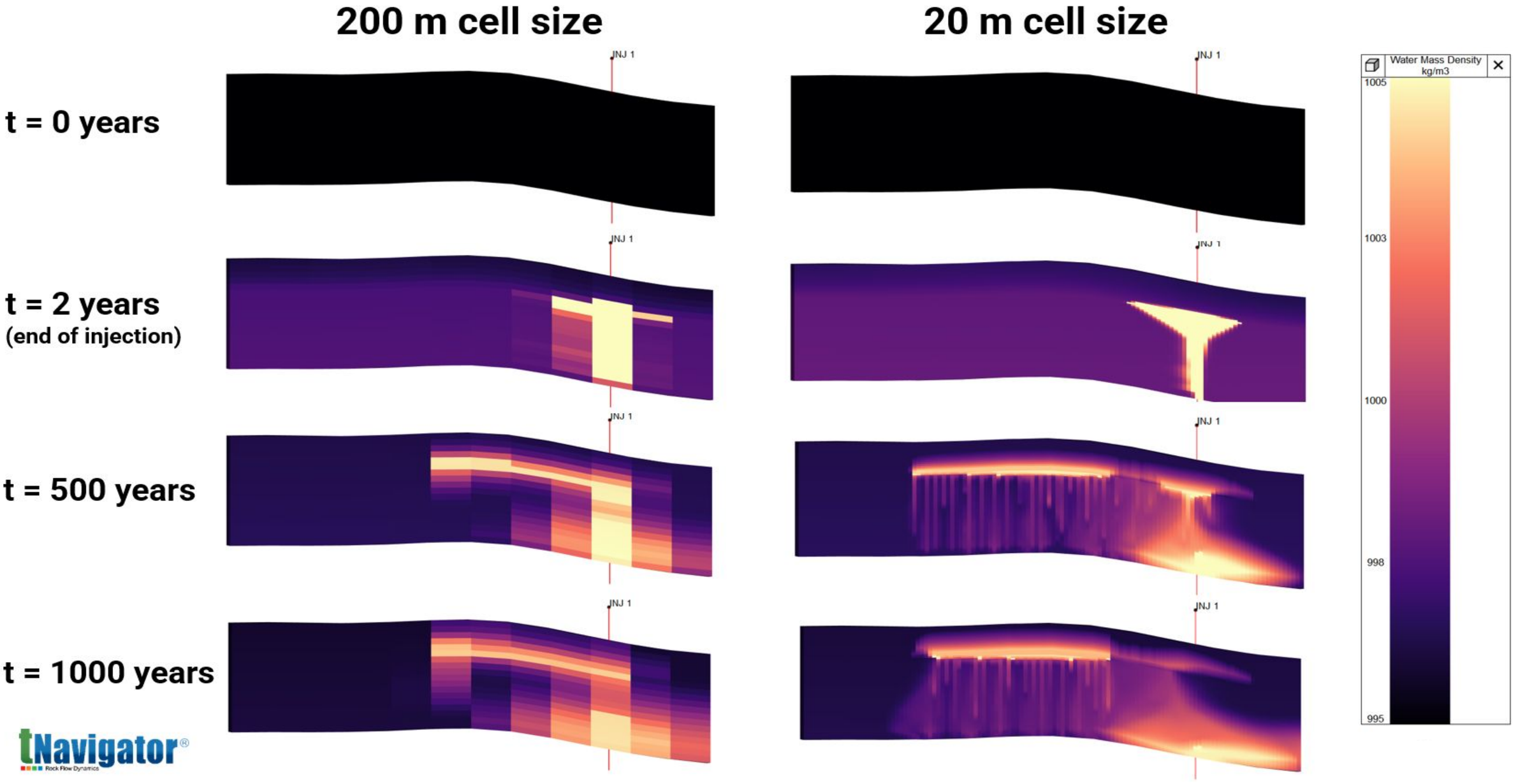
Water Density



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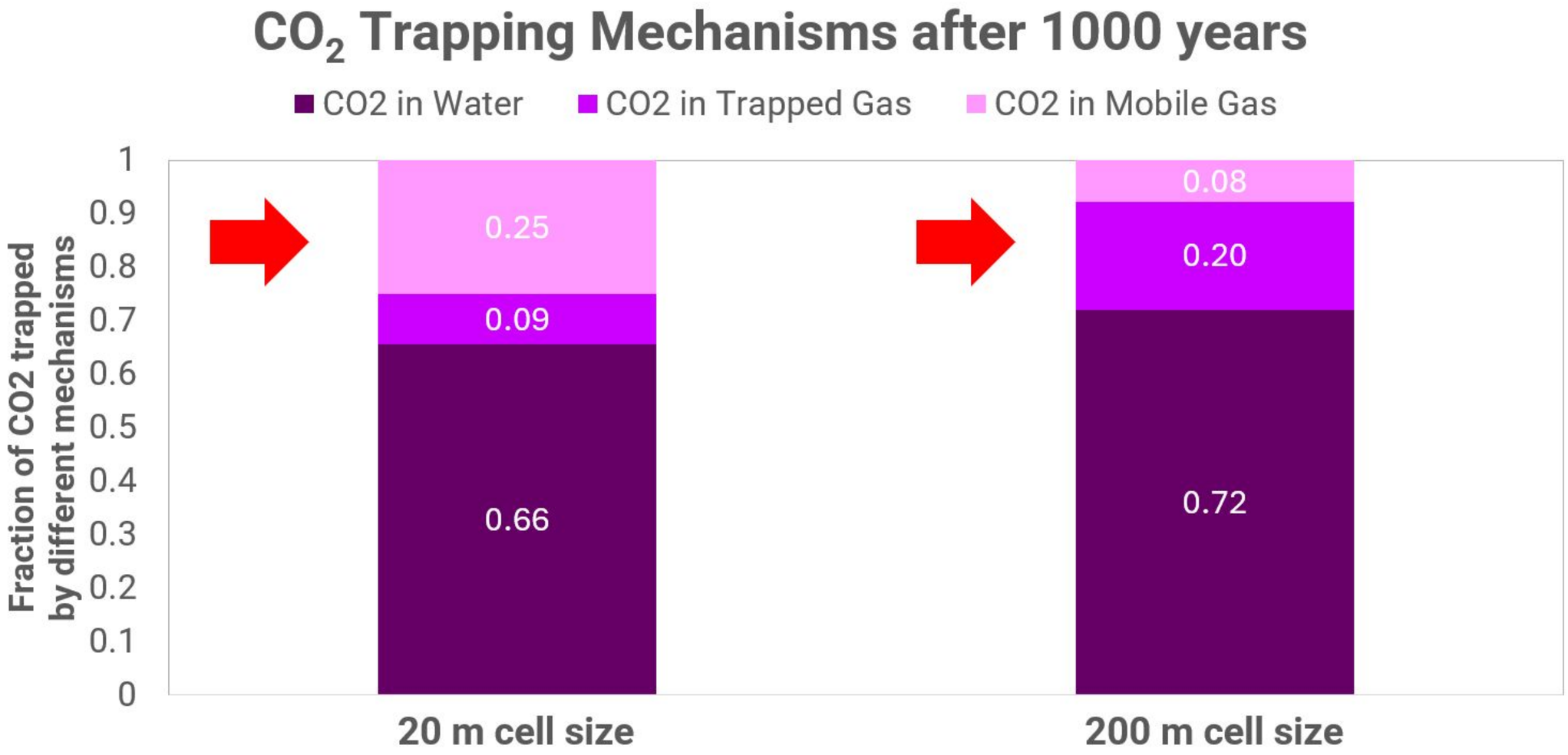

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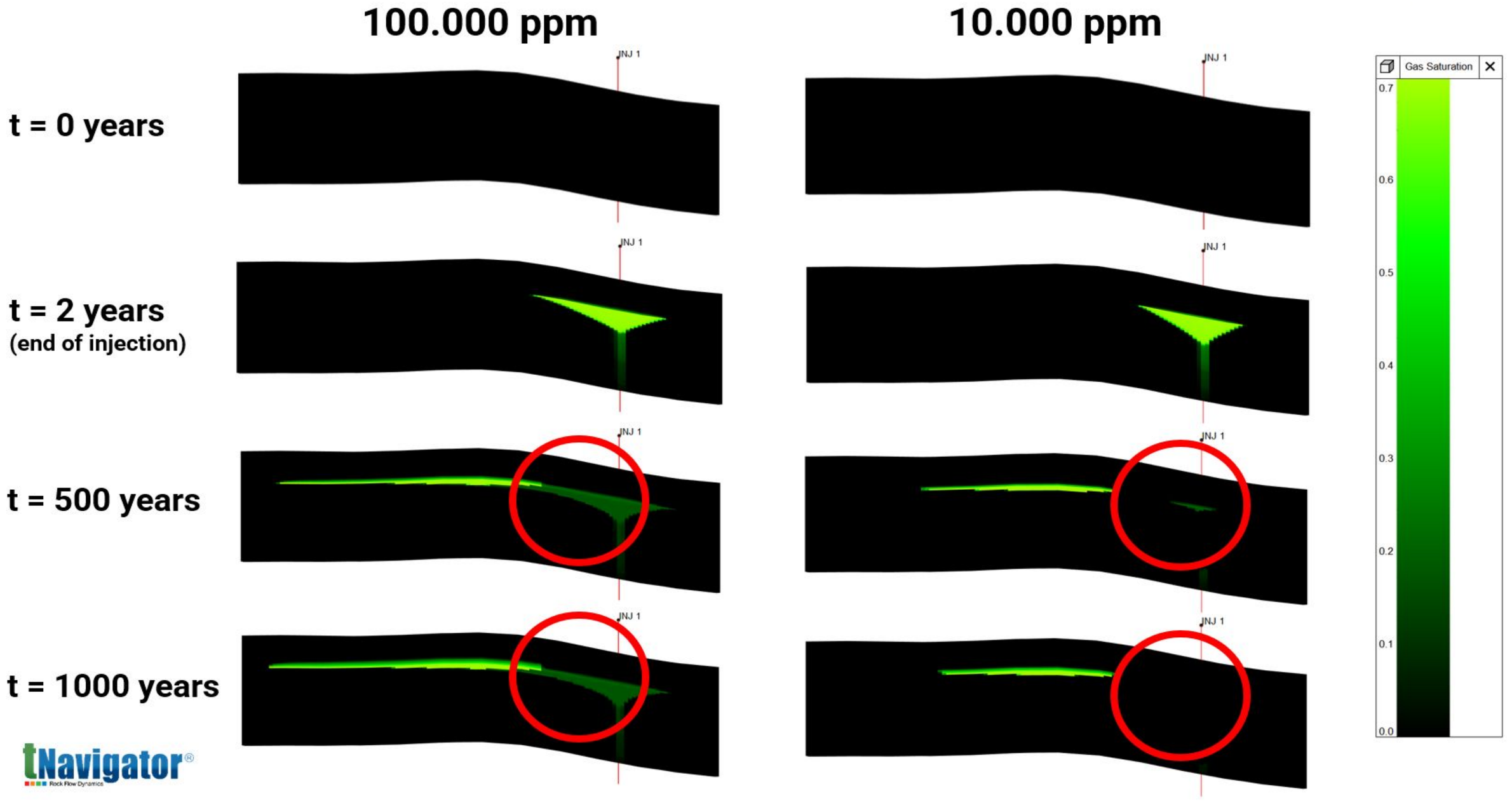
Salinity

10.000 ppm vs 100.000 ppm

CO2 Plume



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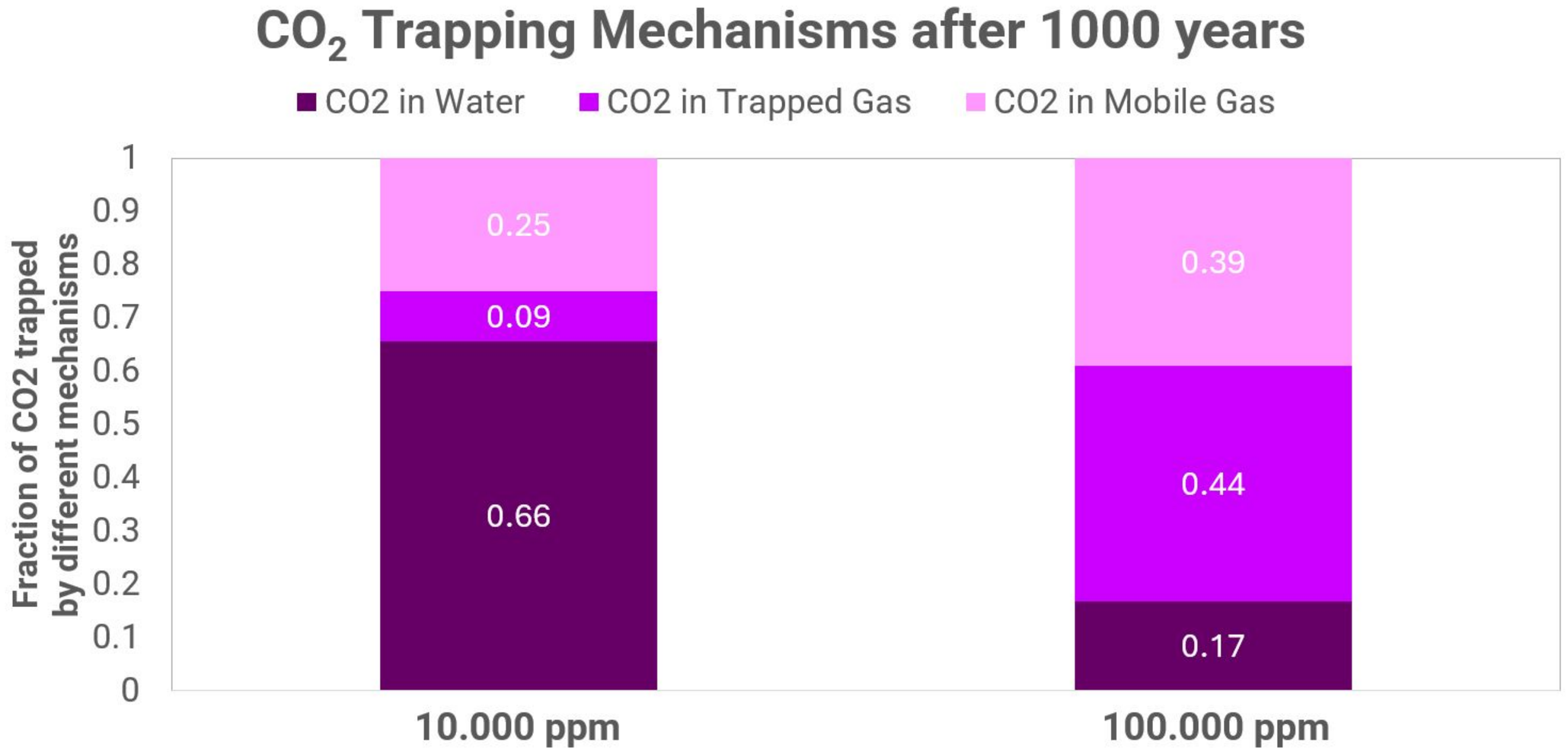

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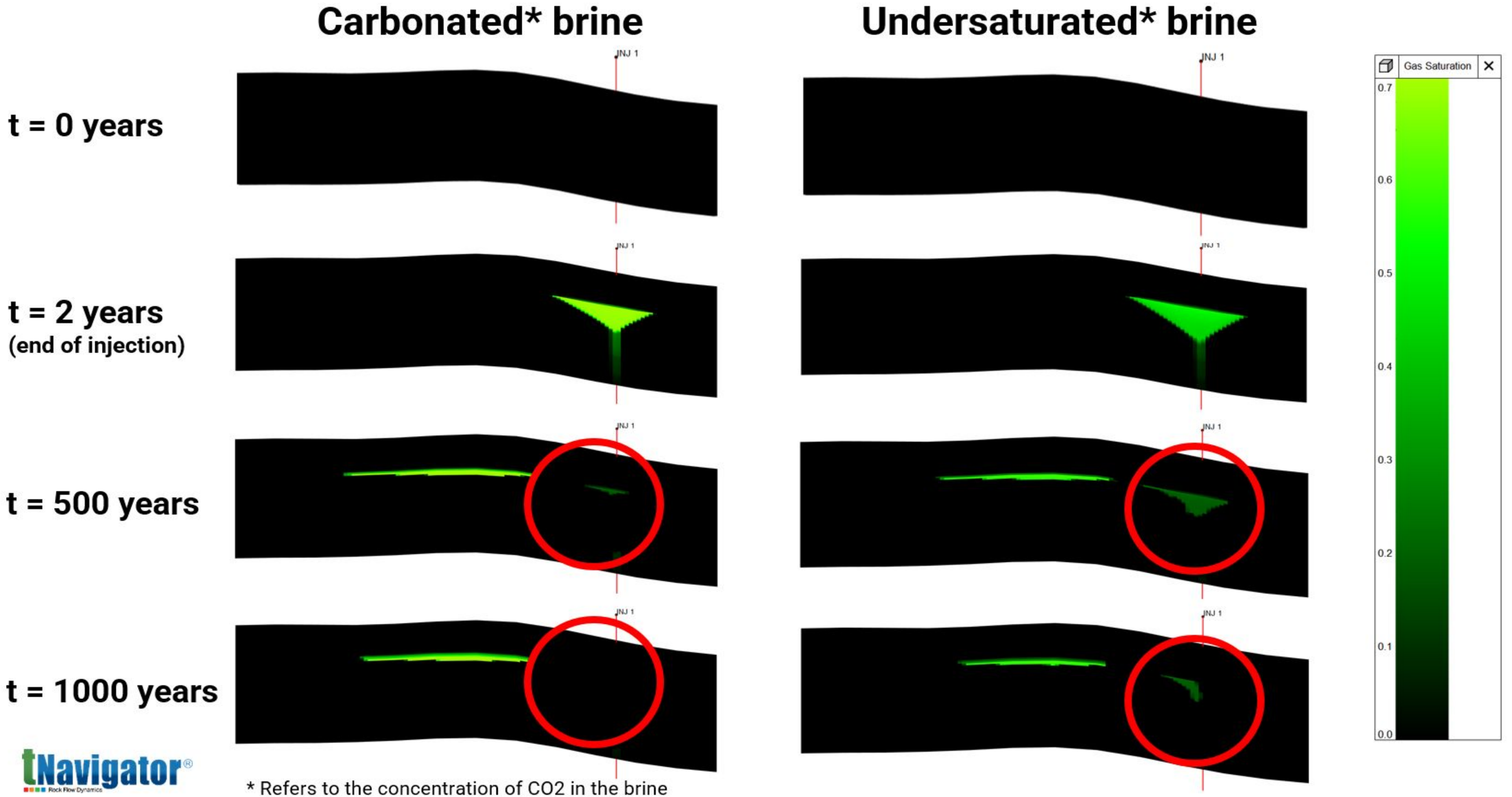
Relative Permeability

CO2 Plume



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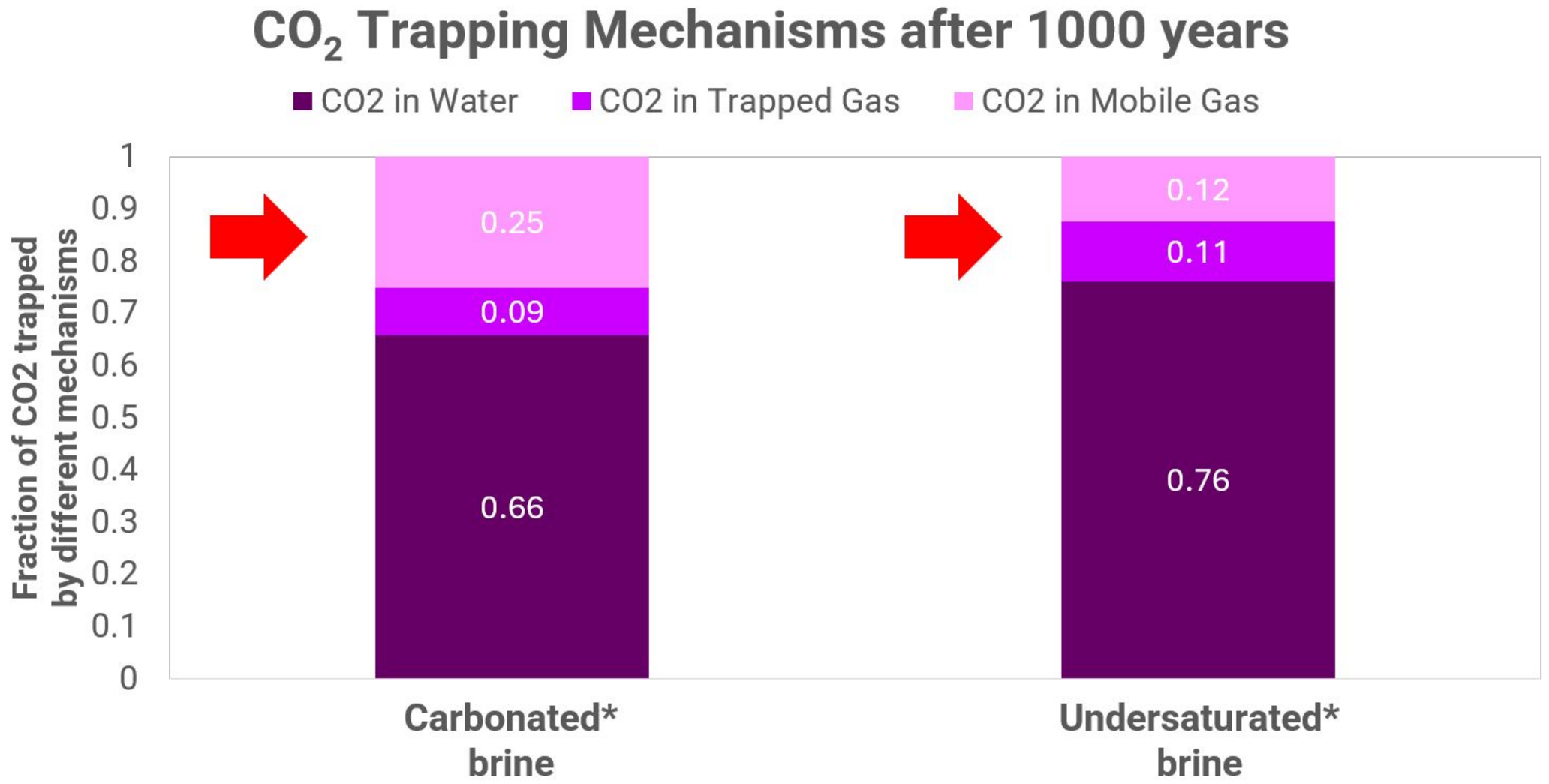
* Refers to the concentration of CO2 in the brine

Trapping Mechanisms



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Conclusions

1. Too large grid cells can mask the physics and may lead to misinterpretation of CO_2 solubility and trapping mechanisms.

2. Understanding your reservoir water – especially salinity – is key to assess how dissolution trapping will be contributing to the overall trapping.

3. Relative permeability curves – both drainage and imbibition – drive the path of the plume and impact where, and how the injected CO_2 is stored.