Prospects for Carbon Dioxide Storage in Underground Geologic Formations

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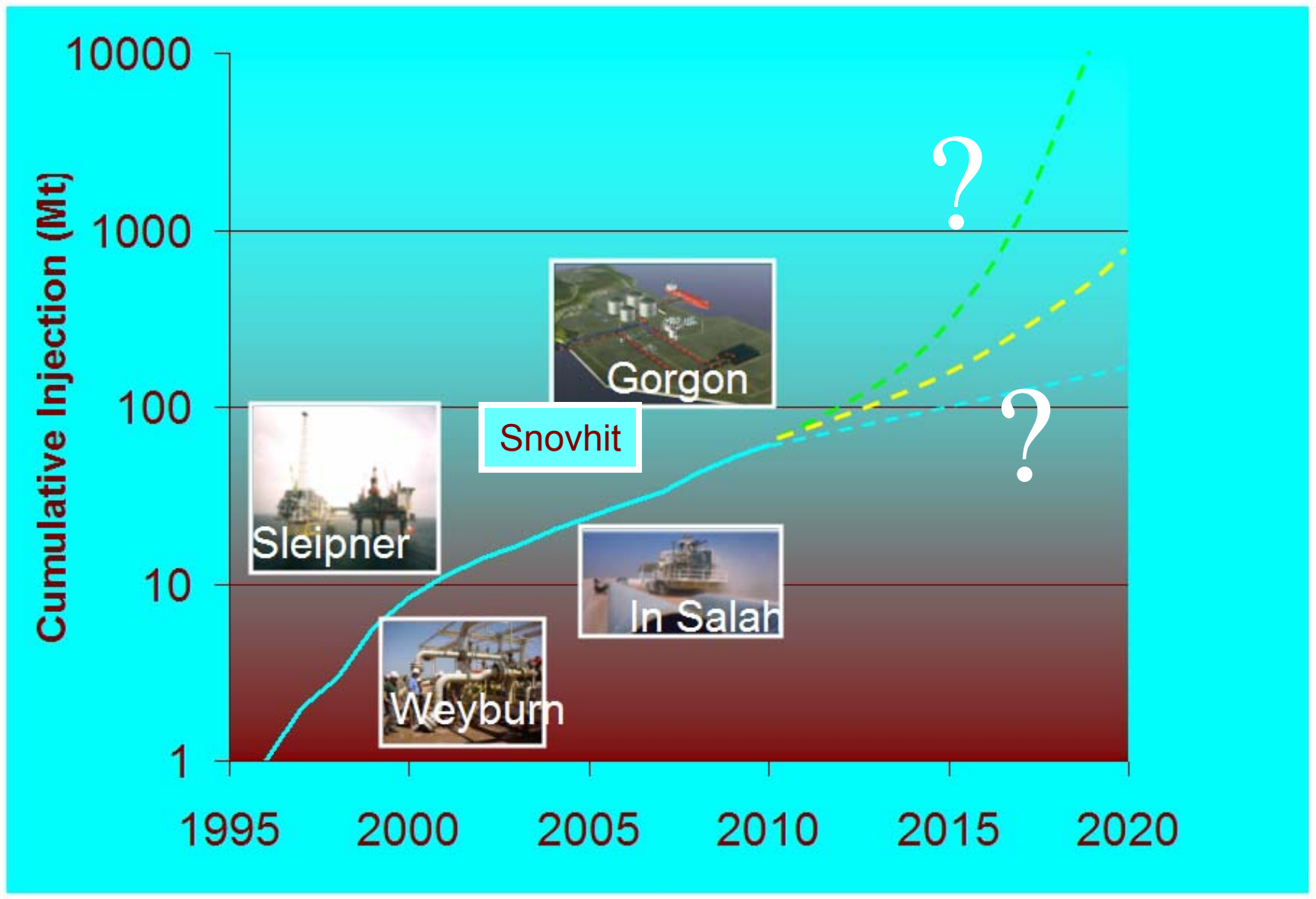
Current and Future Storage Projects



We've Come a Long Way…

- Large estimated capacity – 100s of years
- Geographically widespread capacity
- Injection and reservoir engineering technology is mature
- Storage can be safe… if…
- CO_2 can be stored for 1000s of years or longer
- Hazards are known and risk can be low
- Monitoring technology is available at reasonable cost
- Mitigation and remediation techniques identified

Current Issues

Storage Security

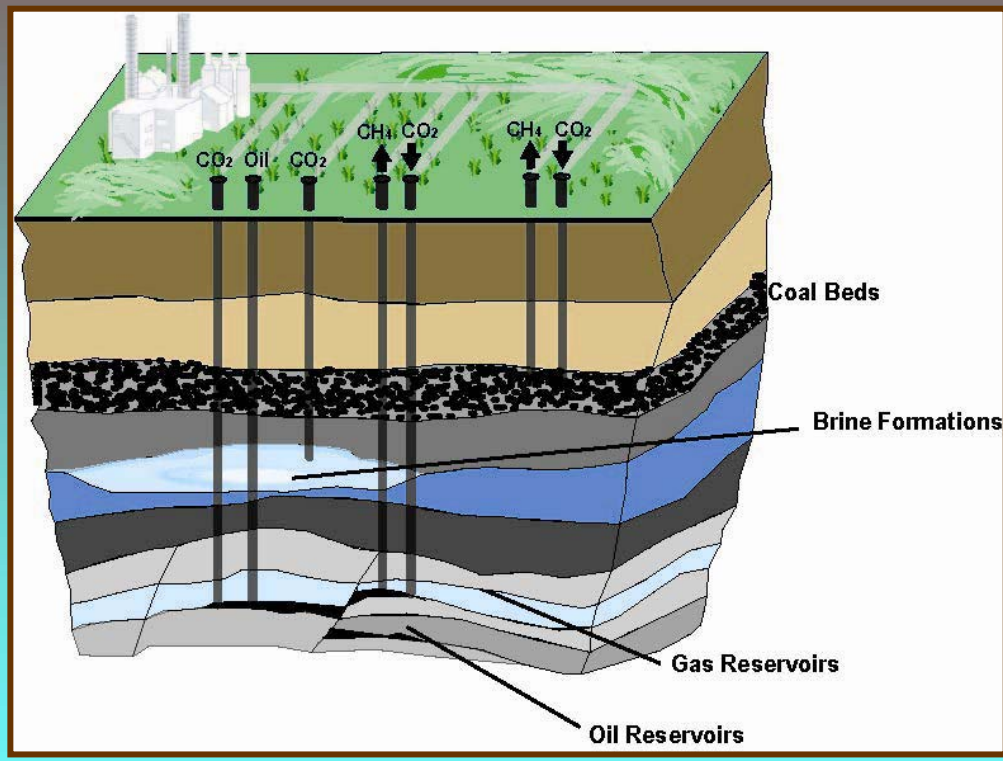
Proven Storage Reserves

Risk Management

Demonstration Projects

Many Lines of Evidence Indicate Effective Storage

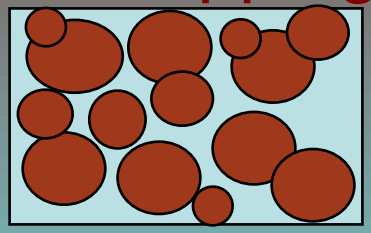
- Natural analogues
  - Oil and gas
  - CO_2 formations
- Industrial analogues
  - Natural gas storage
  - CO_2 EOR
  - Liquid waste disposal
- Fundamental physical and chemical processes
- Numerical simulation
- Monitoring existing projects
  - Sleipner
  - Weyburn



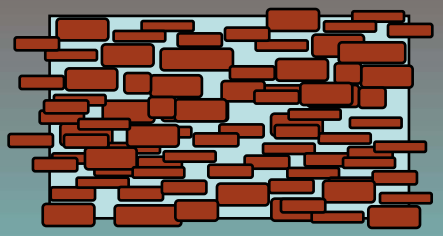
Schematic of a sedimentary basin with CCS

Storage Security: Trapping Mechanisms

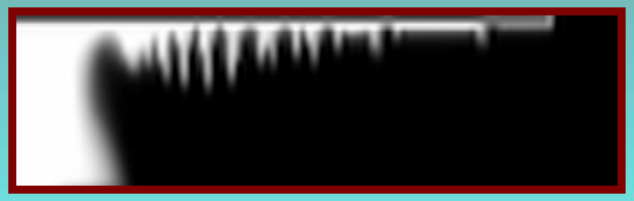
- Structural and stratigraphic trapping
  - Permeability barrier
  - Capillary barrier
- Solubility trapping



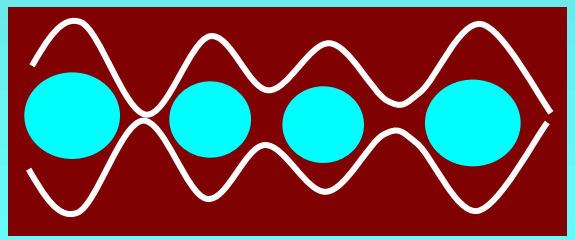
Sandstone



Shale



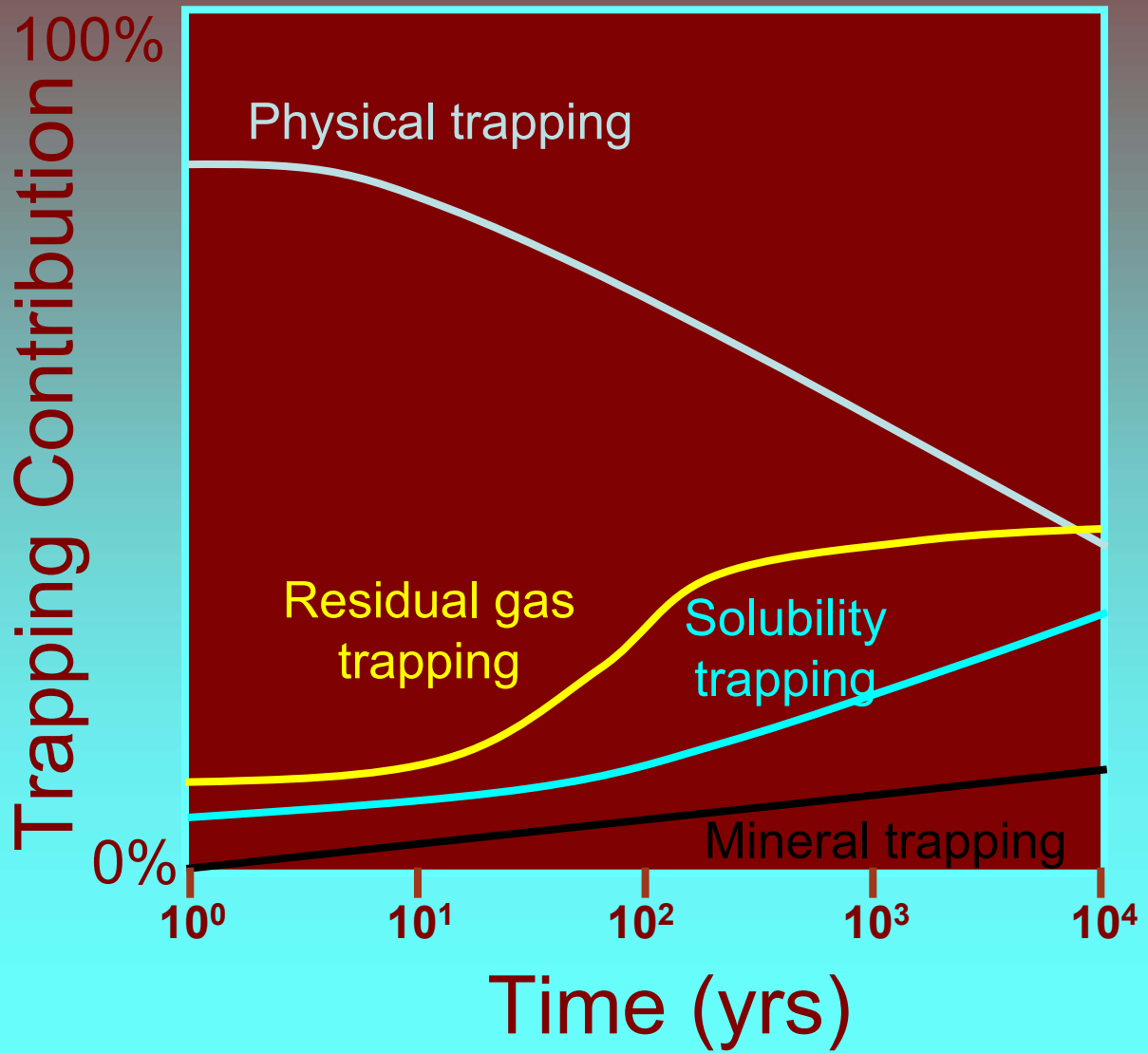
- Residual gas trapping



- Mineral trapping

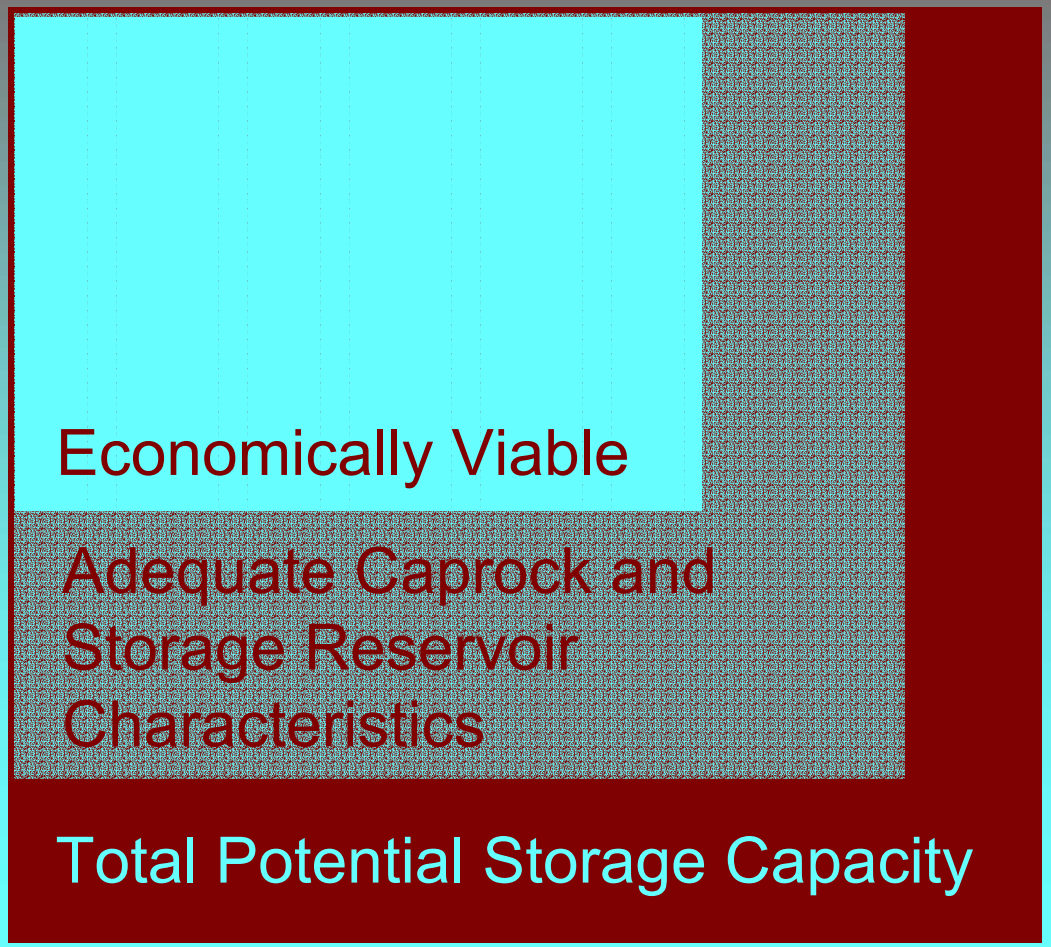
Temporal Evolution of Trapping Mechanisms

Storage security should increase with time at an effective storage site.



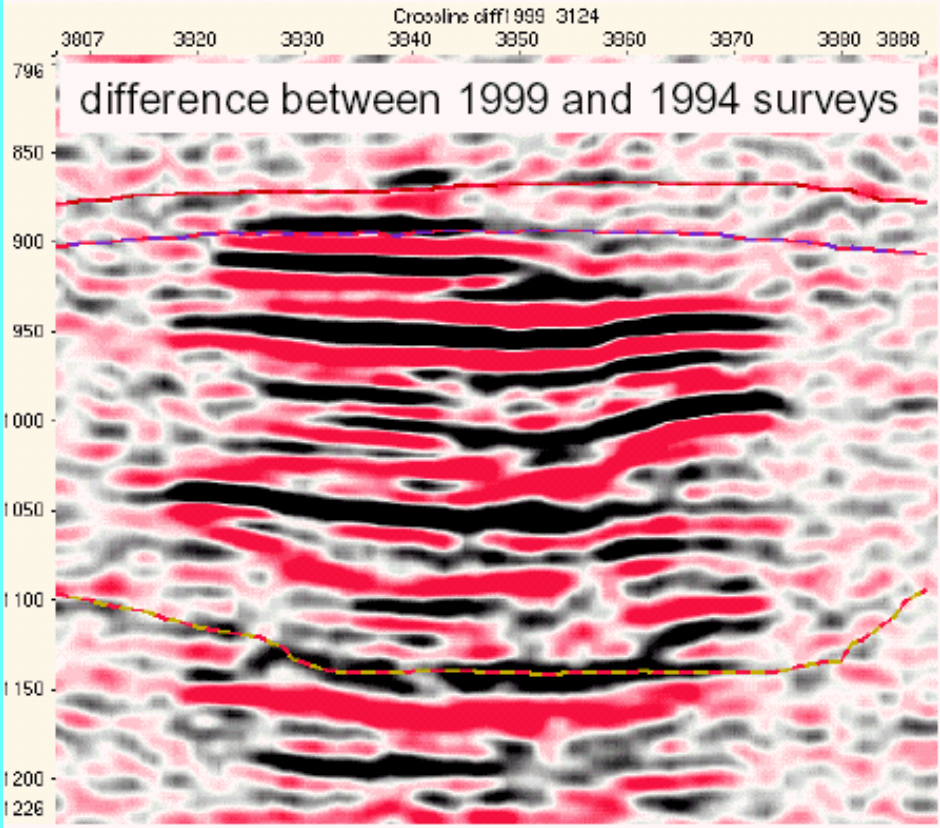
Establish Proven Storage Potential

- Large estimated capacity
- Geographically distributed
- Need to establish proven potential
  - Regional
  - National
  - Global



Risk Management

- The biggest risks have been identified
  - Leakage through injection or abandoned wells
  - Poor site selection
  - Inconsistent or inadequate monitoring
- To prevent such risks
  - Careful site selection
  - Monitoring
  - Remediation of leaking wells
  - Effective regulatory oversight



From Zwiegel et al., 2003

Seismic Survey Showing the Location CO_2 Injected at the Sleipner Project

Near Term Actions Needed

Research and Development
- Storage security
- Monitoring technology
- EOR and EGR

Risk Management
-Site selection criteria
- Monitoring protocols
- Remediation

Capacity Assessment
"Proven storage reserves"
- Regional
- National
- Global

Demonstration Projects
-Geologic storage at 4 to 6 additional sites
-International cooperation to reduce costs and share information

Conclusions

- Geologic storage is very promising as a GHG mitigation technology
- More demonstration projects are needed now
- Pipeline of viable projects needed to sustain deployment