# Minimizing Exposure to Legacy Wells

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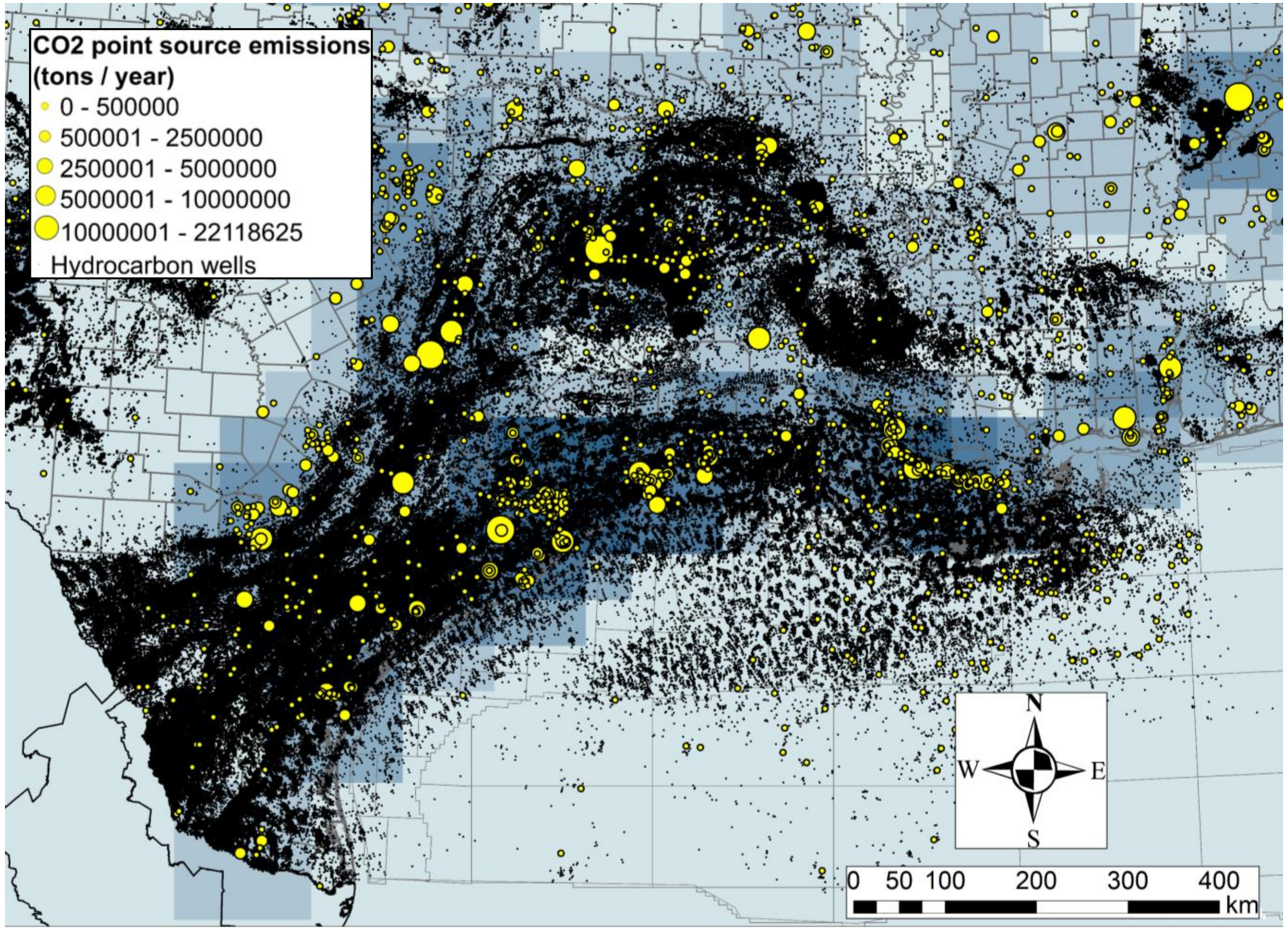
# Lots of wells and emissions




Data: US EPA FLIGHT database and IHS Enerdeq (2022)

- GoM is highly prospective for $CO_2$ storage
  - Large point-source emissions
  - Abundant subsurface data
  - Proven reservoirs and seals
  - Potentially re-usable infrastructure
- 1.1M legacy wells
  - Holes in confining system
  - Review and remediation add cost
- Lots of competing uses to accommodate
  - HC fields
  - SWD
  - CCS

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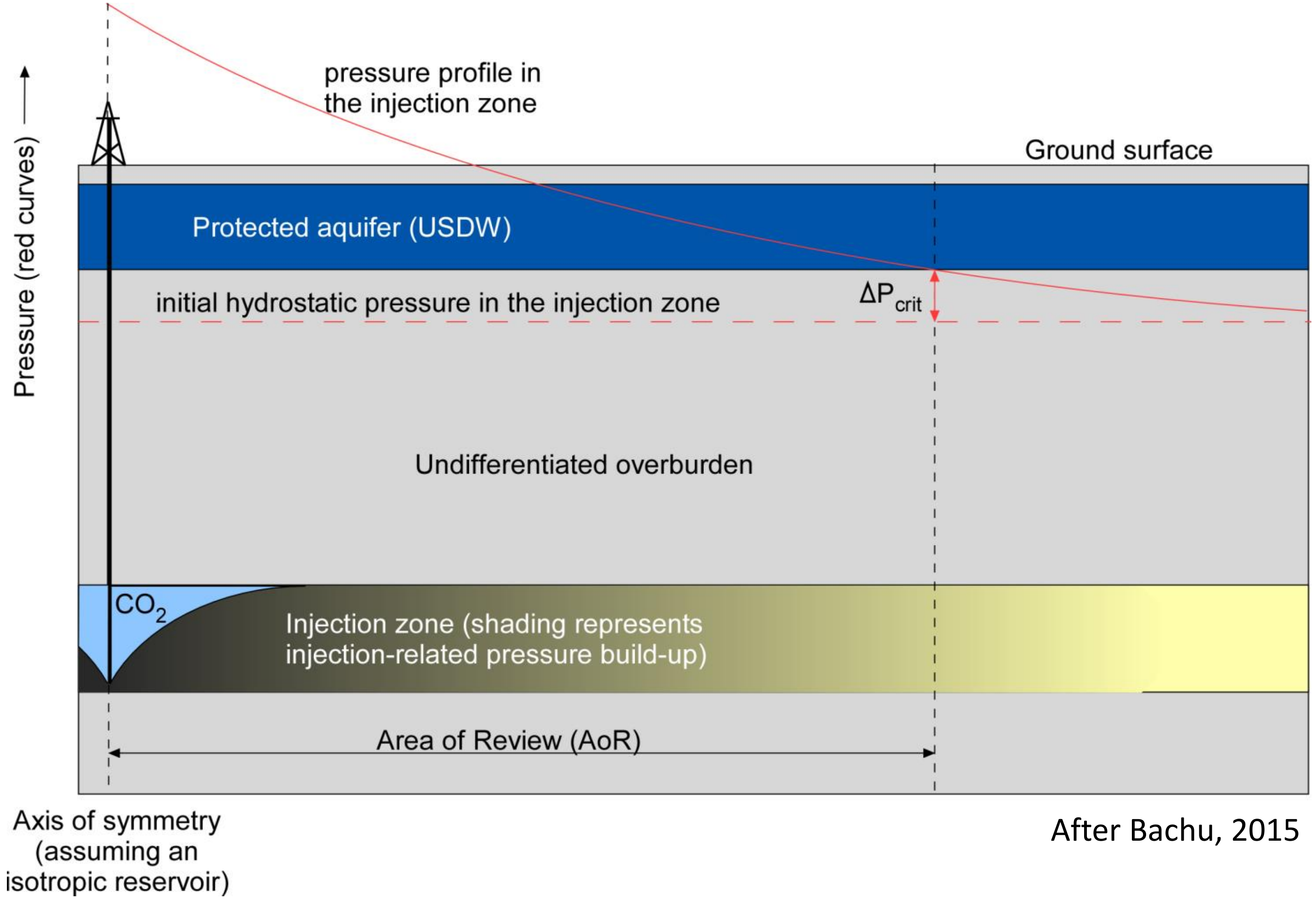
# Area of Review




After Bachu, 2015

AOR size depends on

- Injection rate/duration
- Reservoir properties
- $\Delta P_{crit}$

$\Delta P_{crit}$ depends on:

- Depth difference between injection zone and protected zone
- Density difference between injection zone brine and USDW
    - Function of temperature and salinity

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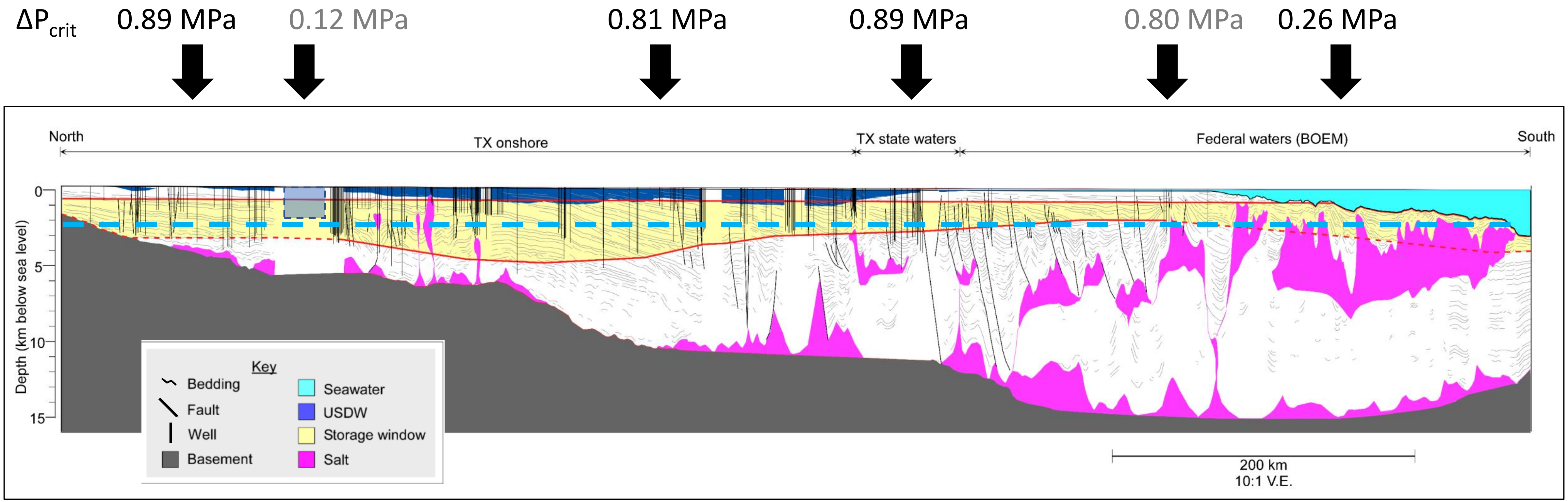
# Critical Pressure at 2500 m Depth

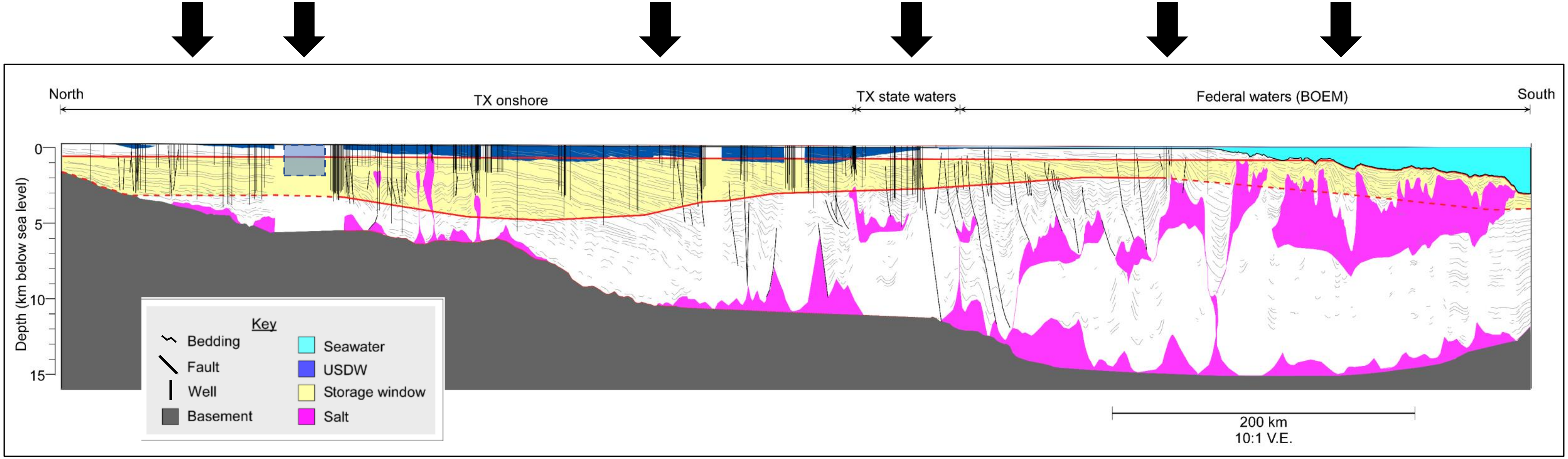



All cases: Injection at 2500 m depth into brine with 60Kppm TDS; USDW = 6Kppm TDS; Seawater = 35 Kppm TDS

1 MPa = 145 psi

# Critical Pressure at Base of Storage Window

| Depth | 3500 m | 3500 m | 4500 m | 3000 m | 1800 m | 3700 m |
|---|---|---|---|---|---|---|
| $\Delta P_{crit}$ | 2.67 MPa | 1.27 MPa | 3.31 MPa | 2.10 MPa | 0.73 MPa | 1.44 MPa |

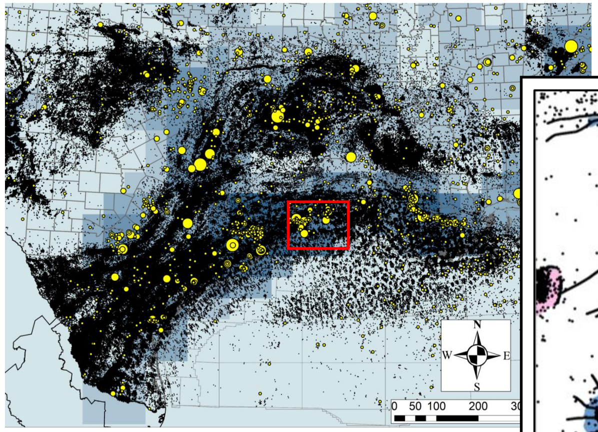


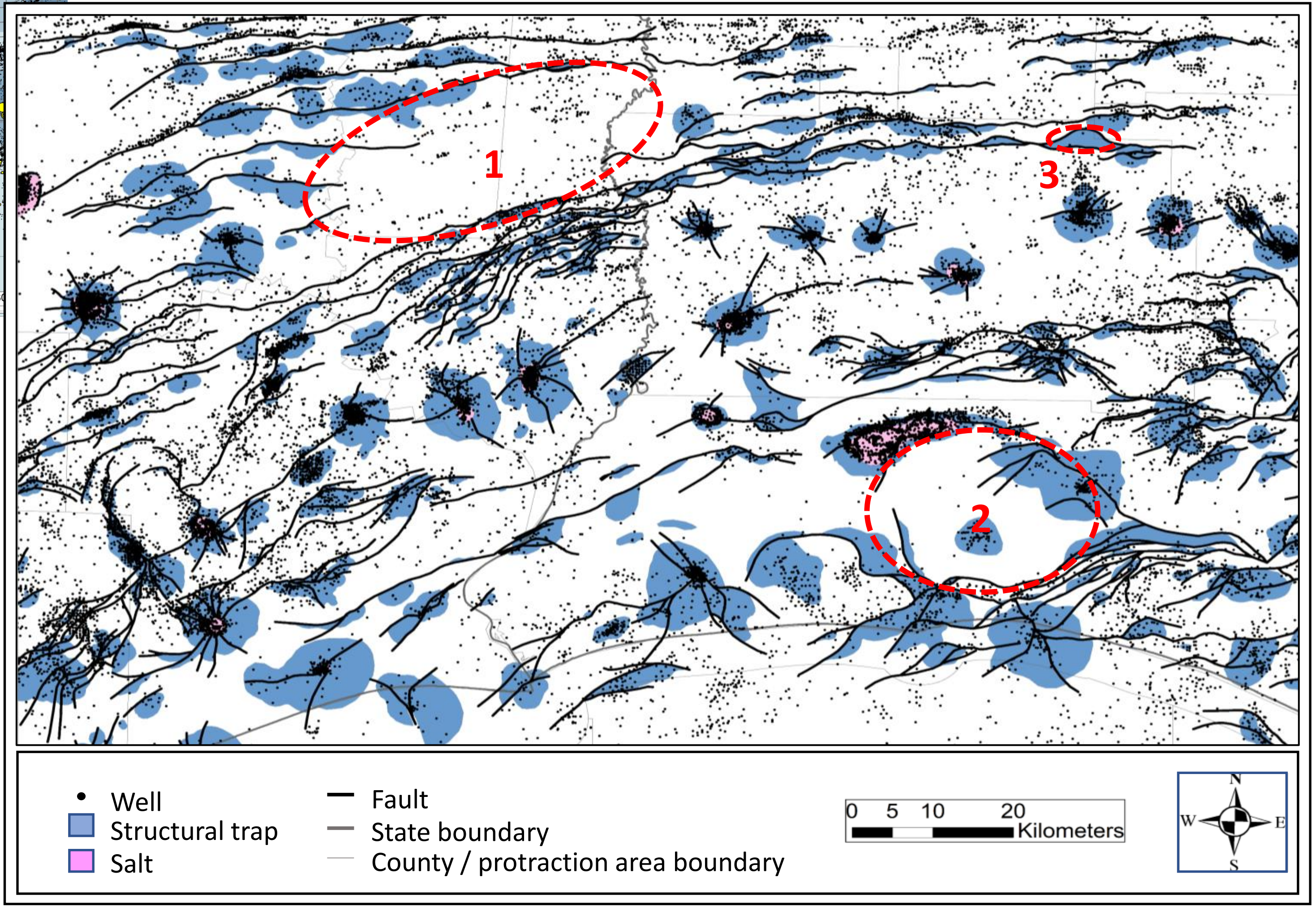

All cases: Injection into brine with 120K ppm TDS; USDW = 6K ppm TDS; Seawater = 35K ppm TDS

The key variables are depths to base of protected zone and OP

1 MPa = 145 psi

# Pressure Propagation and AoR

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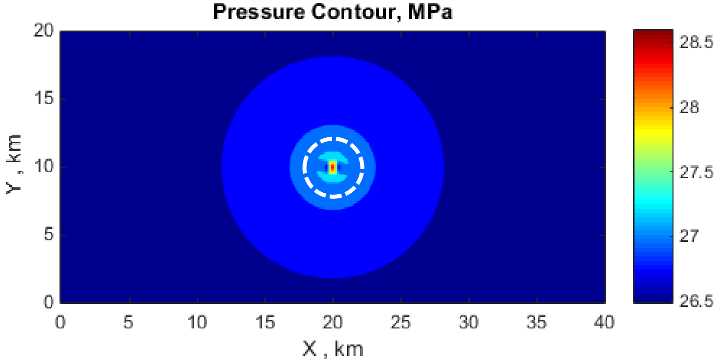
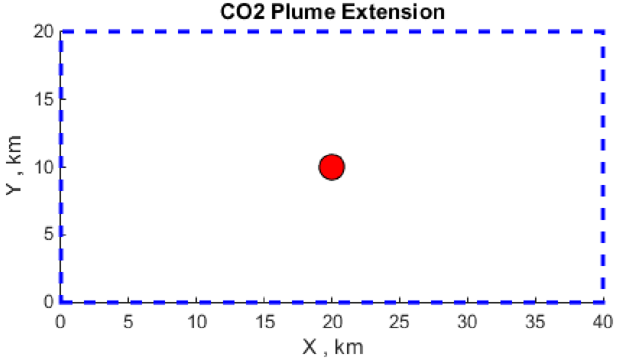
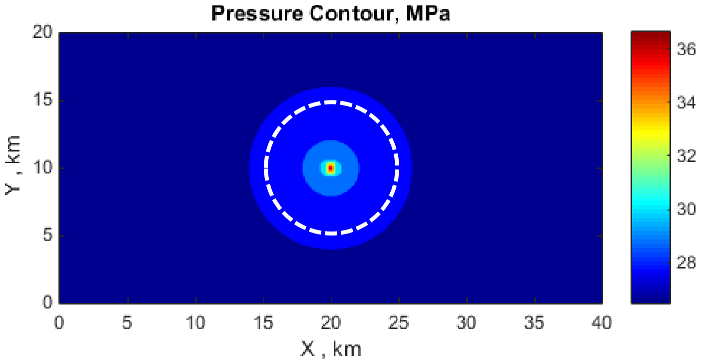
# Prospect 1: 400 km$^2$, Open Boundaries

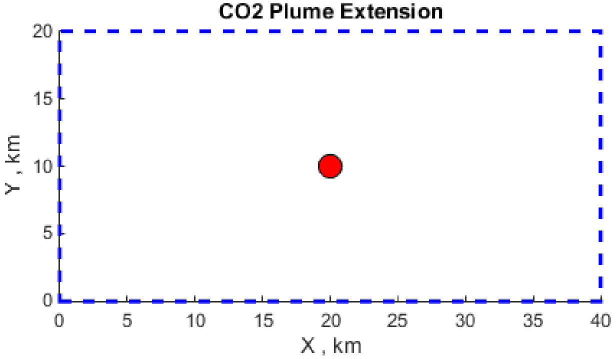
A. 100 mD permeability



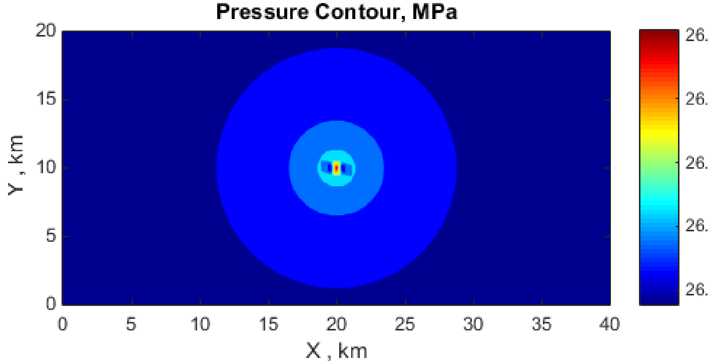



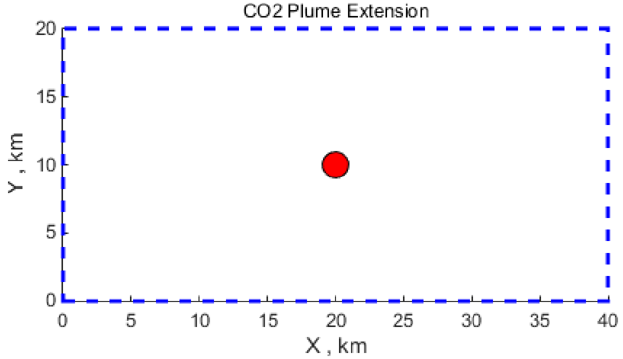

B. 20 mD permeability




C. 500 mD permeability

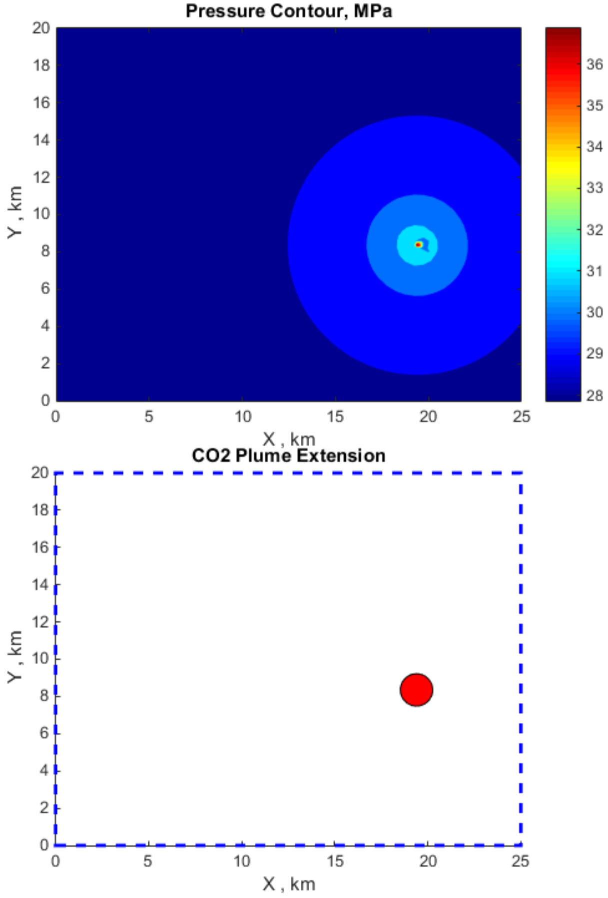


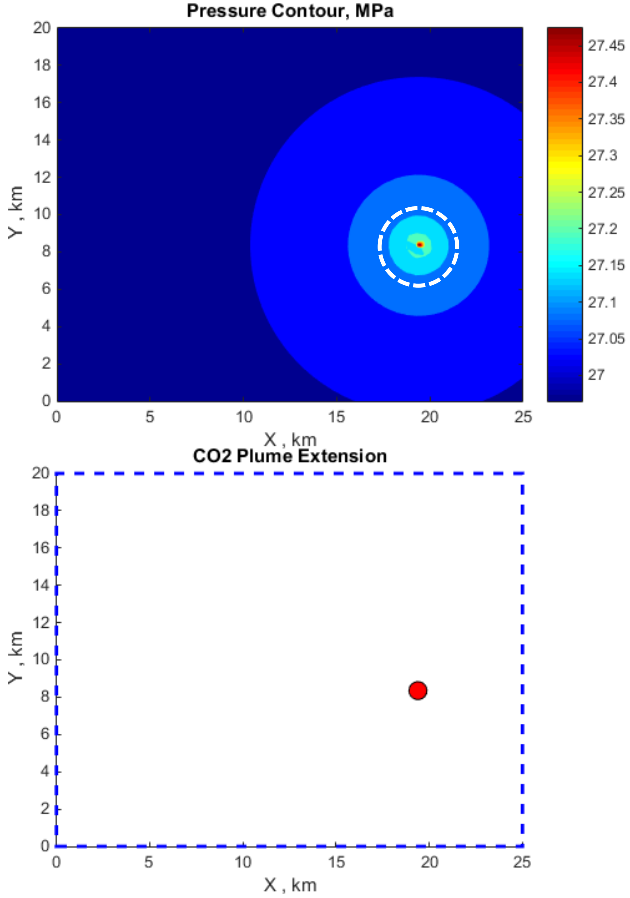

All models: 100 m net reservoir, 25% porosity, injecting 1 Mtpa for 20 years at 2.5 km depth

# Prospect 2: 400 km$^2$, Closed Boundaries

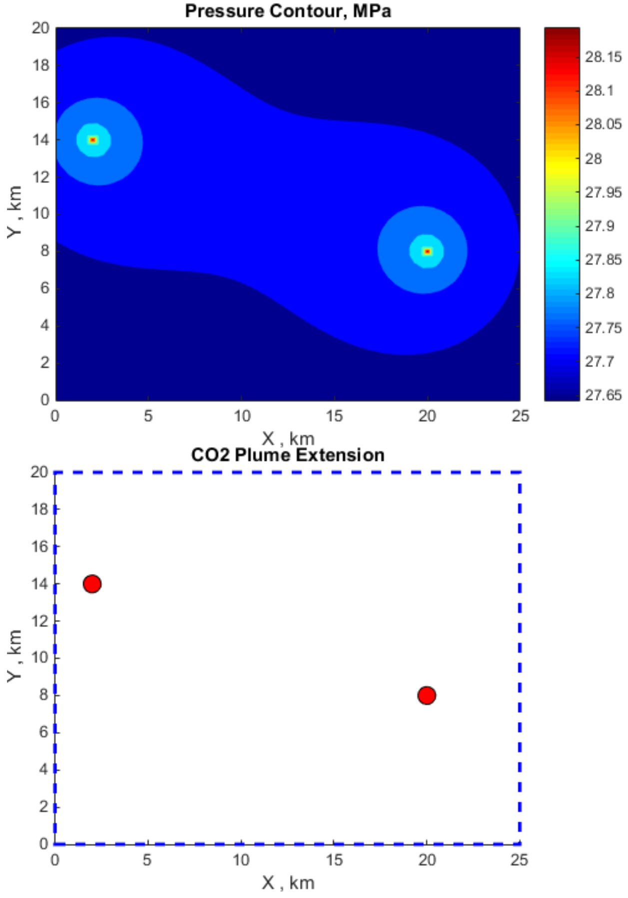
A. 100 m net reservoir




B. 400 m net reservoir




C. 400 m net reservoir, 2 wells

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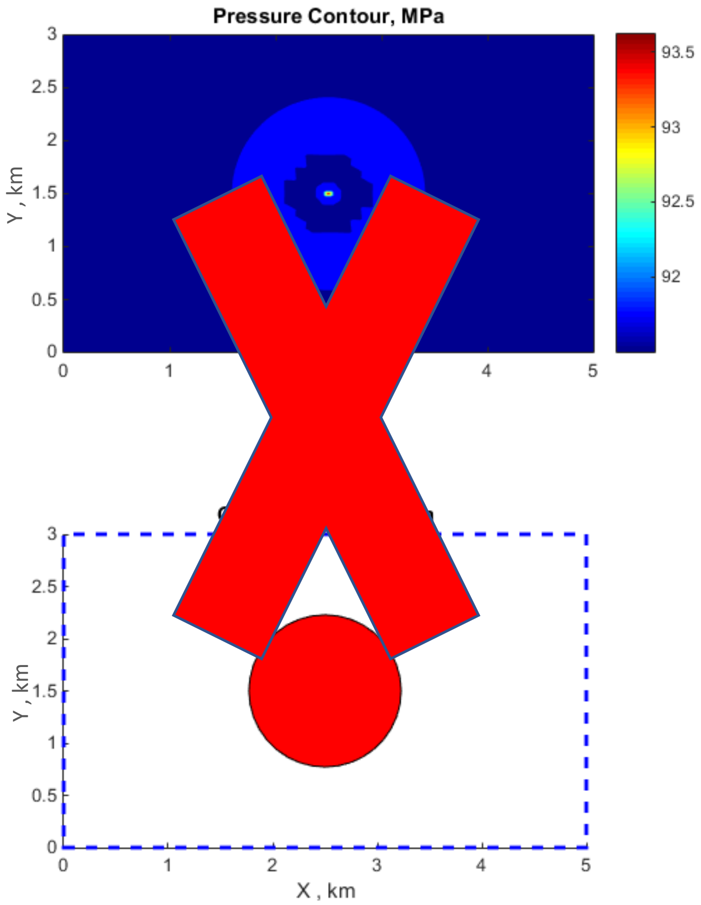
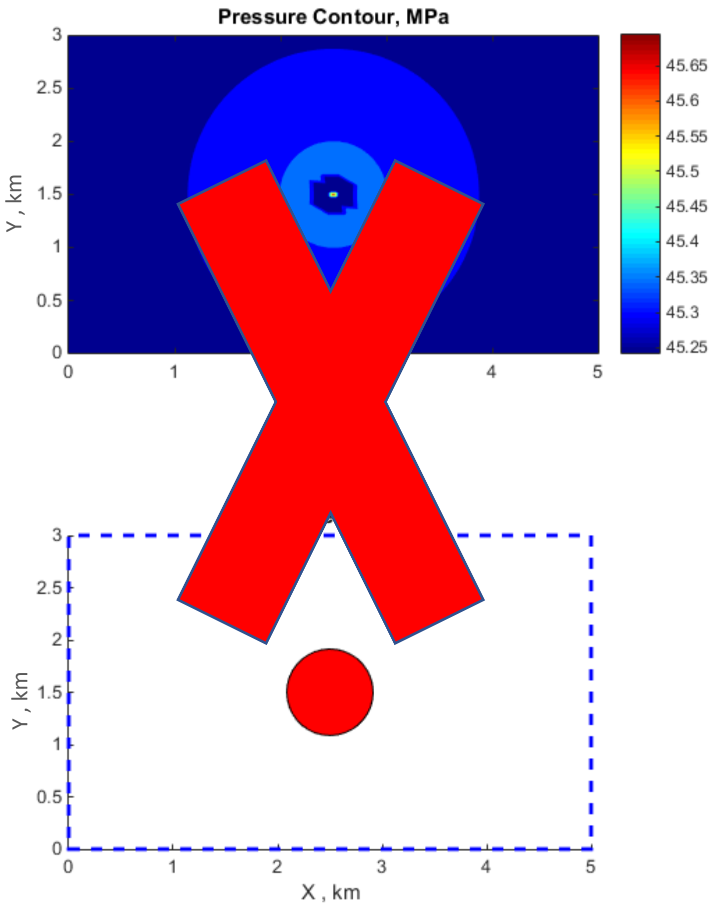
All models: 25% porosity, 100 mD, injecting 1 Mtpa for 20 years at 2.5 km depth

# Prospect 3: 15 km$^2$, Isolated Fault Block

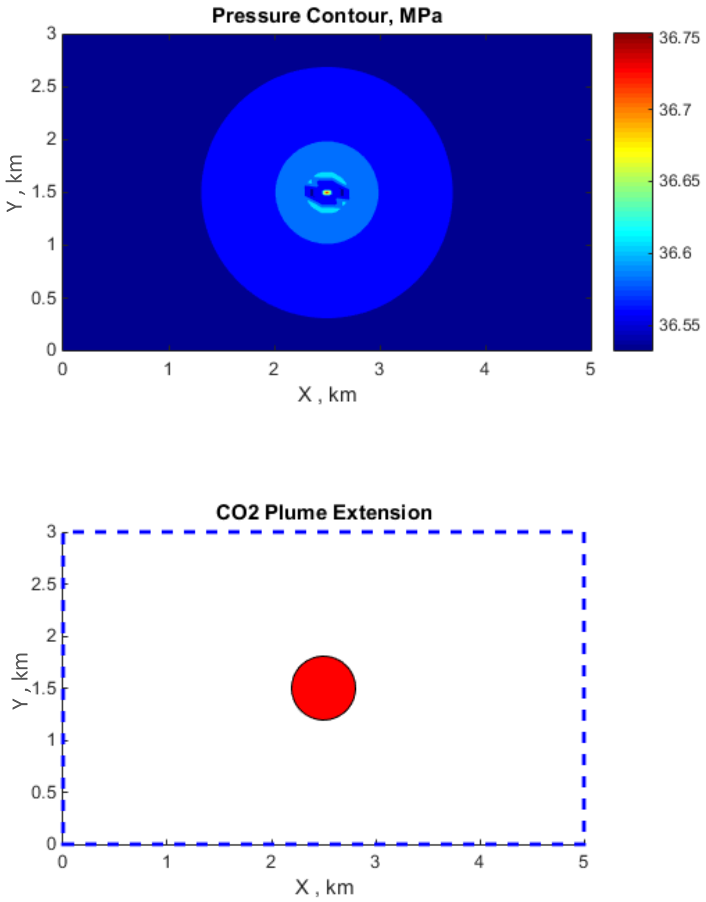
A. 100 m net reservoir, 1 Mtpa




B. 400 m net reservoir, 1 Mtpa




C. 400 m net reservoir, 0.5 Mtpa




All models: 25% porosity, injecting 1 Mtpa for 20 years at 2.5 km depth

# Minimizing Conflict

- Rules of thumb to minimize AoR
  - Choose deep injection zones
  - Stack multiple injection zones
  - Look for giant compartments
  - Consider isolated pressure compartments
- Minimizing conflict
  - Look for the big gaps in legacy wells
    - Down-dip fetch areas are often most favorable
  - First movers have a real advantage
  - Beware the effect of later, nearby injection
- Two wild cards
  - This does not consider the role of non-net reservoir—that may soak up significant pressure
  - Water production can mitigate pressure but adds cost and creates a new problem