

**Fingerprinting  
captured CO<sub>2</sub> using  
natural tracers:  
Determining CO<sub>2</sub> fate  
and proving  
ownership**

Stephanie Flude, Stuart  
Gilfillan, Stuart Haszeldine,  
Fin Stuart



# Context



- Storage security is key to CCS success
- Need to monitor storage complex
- Adding tracers: Expensive? Environmental hazards? Contamination / elevate background?

# Can we use natural tracers in the CO<sub>2</sub>?

## Stable Isotopes



www.phenomenica.com

<b>12 C</b> 12.00000 98.89% Stable	<b>13 C</b> 13.00335 1.11% Stable	<b>14 C</b> 14.0 t <sub>1/2</sub> = 5715yrs Radioactive Cosmogenic/ anthropogenic
<b>16 O</b> 15.9949 99.76% Stable	<b>17 O</b> 16.9991 0.04% Stable	<b>18 O</b> 17.9991 0.20% Stable

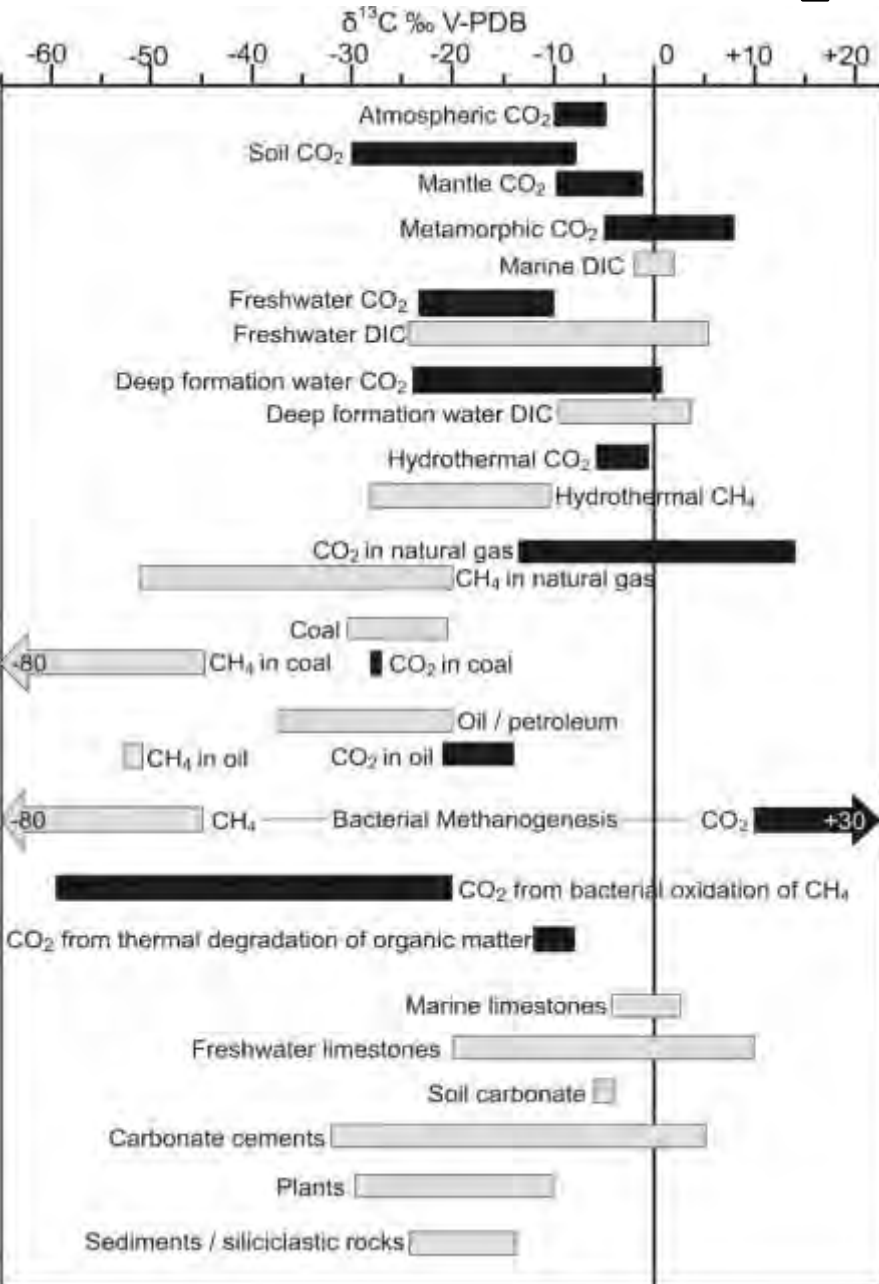
web.sahara.arizona.edu

- Use  $\delta^{13}\text{C}$  of the injected CO<sub>2</sub> or the HCO<sub>3</sub><sup>-</sup> formed by CO<sub>2</sub> dissolution.
- Use  $\delta^{18}\text{O}$  of injected CO<sub>2</sub> and its effect on reservoir H<sub>2</sub>O

Noble gases – Use the noble gas fingerprint in captured CO<sub>2</sub>



# Inherent CO<sub>2</sub> tracers in nature...



Understanding the baseline conditions



[www.phenomenica.com](http://www.phenomenica.com)

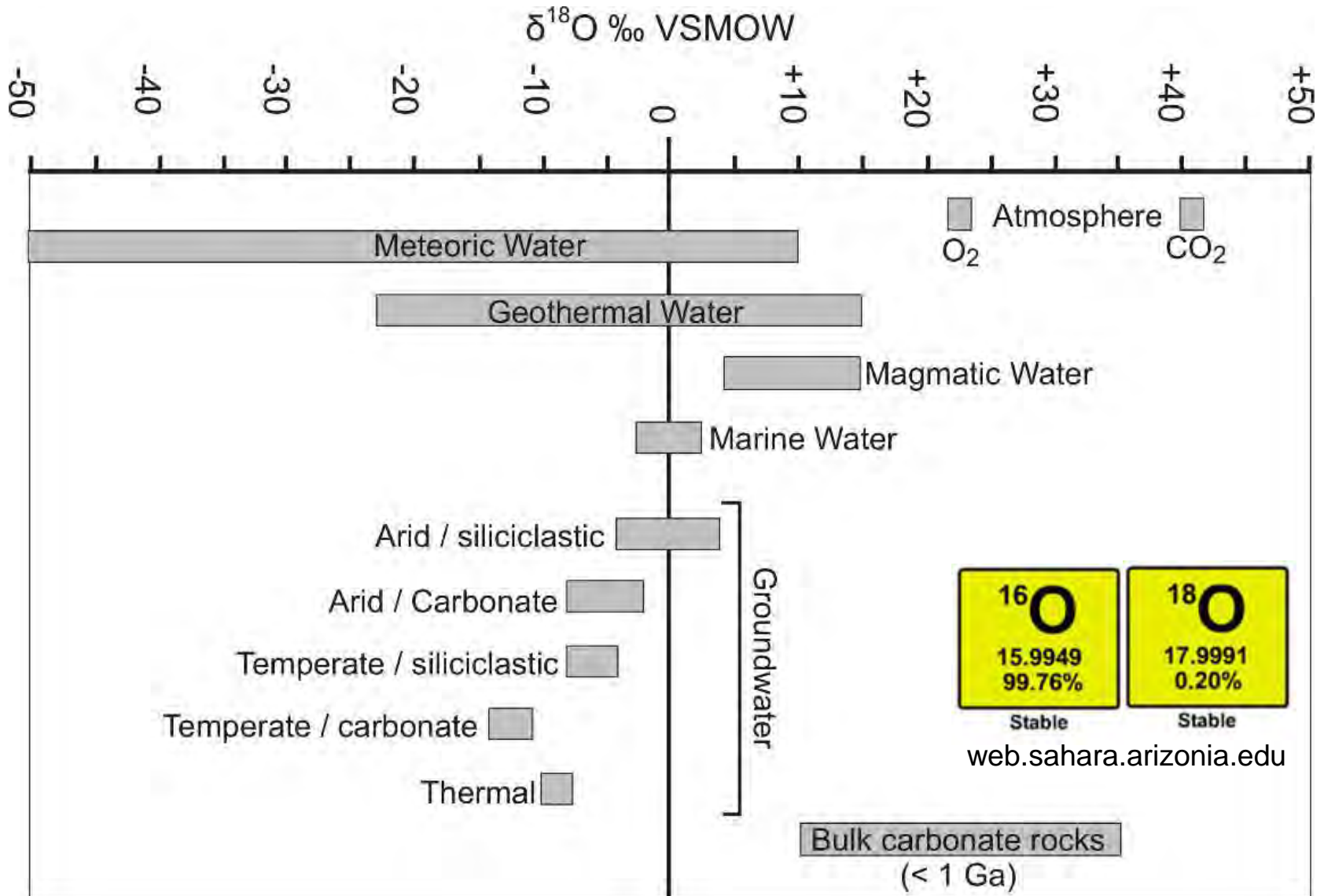
<b><sup>12</sup>C</b>	<b><sup>13</sup>C</b>
12.00000	13.00335
98.89%	1.11%

Stable

Stable

[web.sahara.arizona.edu](http://web.sahara.arizona.edu)

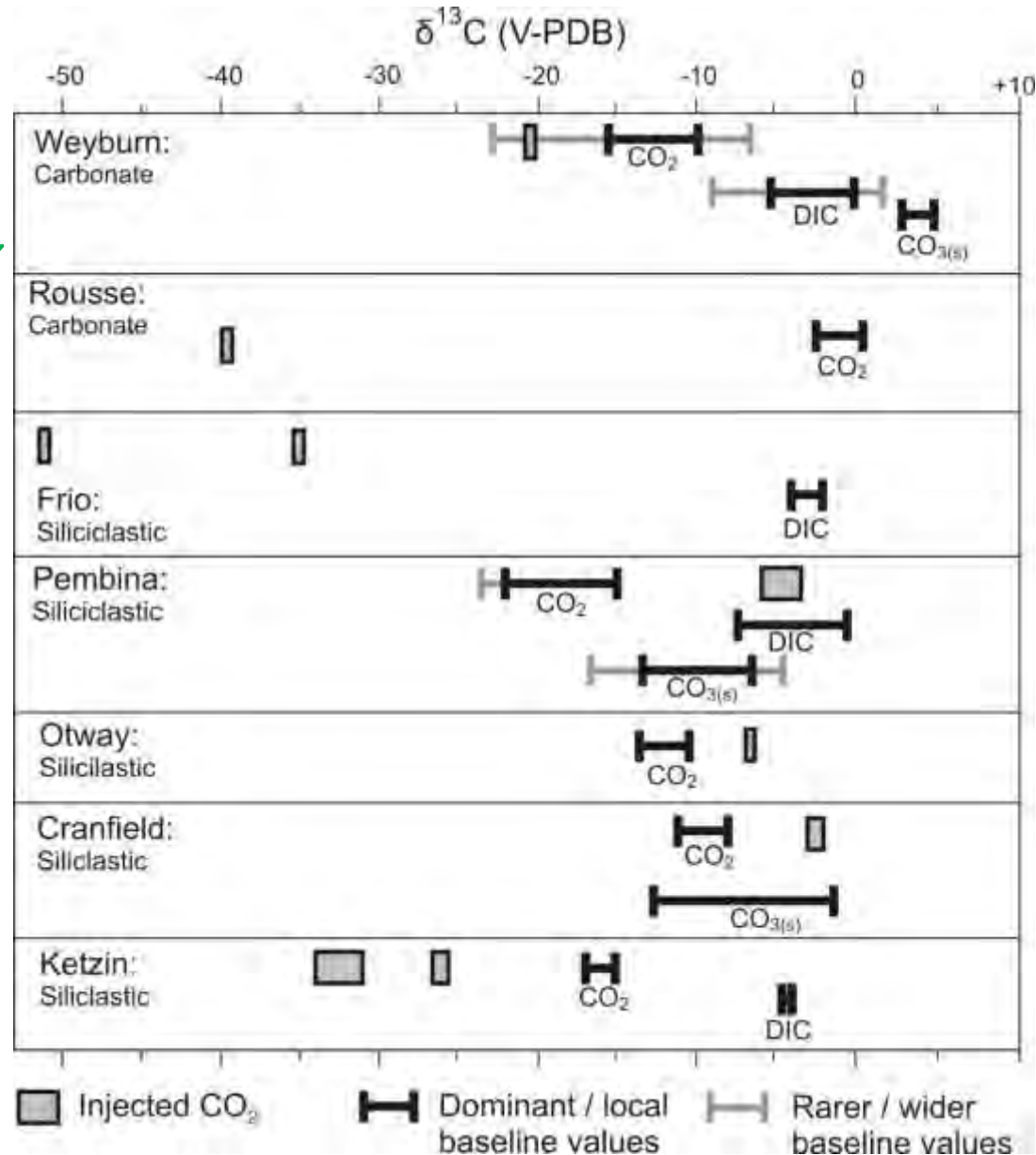
# Inherent CO<sub>2</sub> tracers in nature...



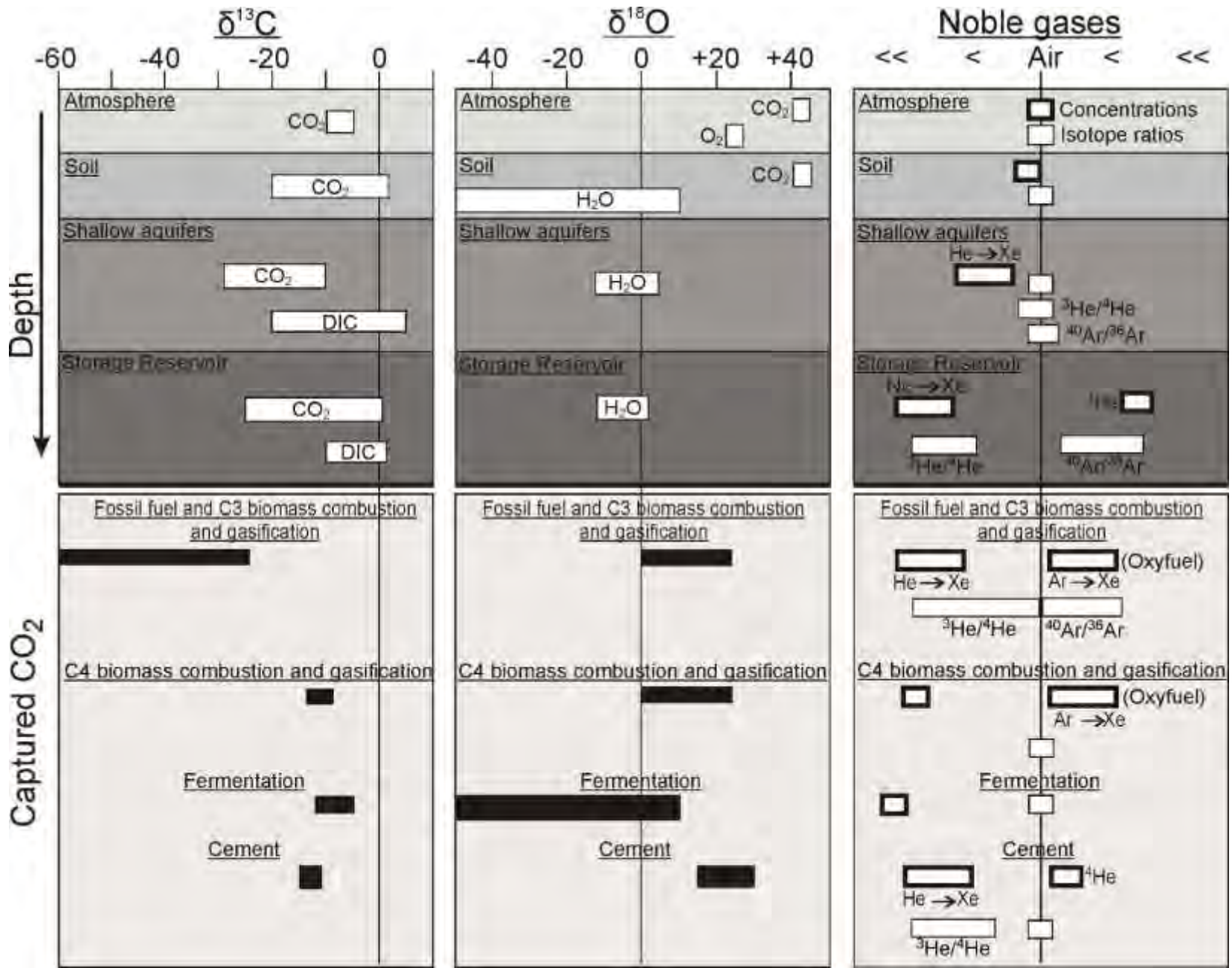
# Progress to date

What is the composition of captured CO<sub>2</sub>?

- Review paper ✓
  - Need more data for captured CO<sub>2</sub>
  - Don't assume no fractionation
- Sample Niederaussem ✓
- Sample Ferrybridge ✓
- Sample Callide ✓
- Sample PACT ... ⌚
- Sample Boundary Dam... ⌚ ✓
- Any other samples?
- **Stable isotope analyses**
- **Noble gas analyses**



# Where are inherent tracers likely to work?



# Sampled from variety of capture technology and feedstocks:

Feedstock:

Coal

Lignite

Gas

Biomass

Capture technology:

Amine capture

Ferrybridge ✓  
Boundary Dam ✓  
?PACT? ⌚

Niederaussem ✓

PACT ⌚

PACT ⌚

Oxyfuel

Callide ✓

Any offers? 😊

?PACT? ⌚

?PACT? ⌚  
Any offers?  
😊

Pre-combustion

Any offers? 😊

Any offers? 😊

Any offers?  
😊

Any offers?  
😊

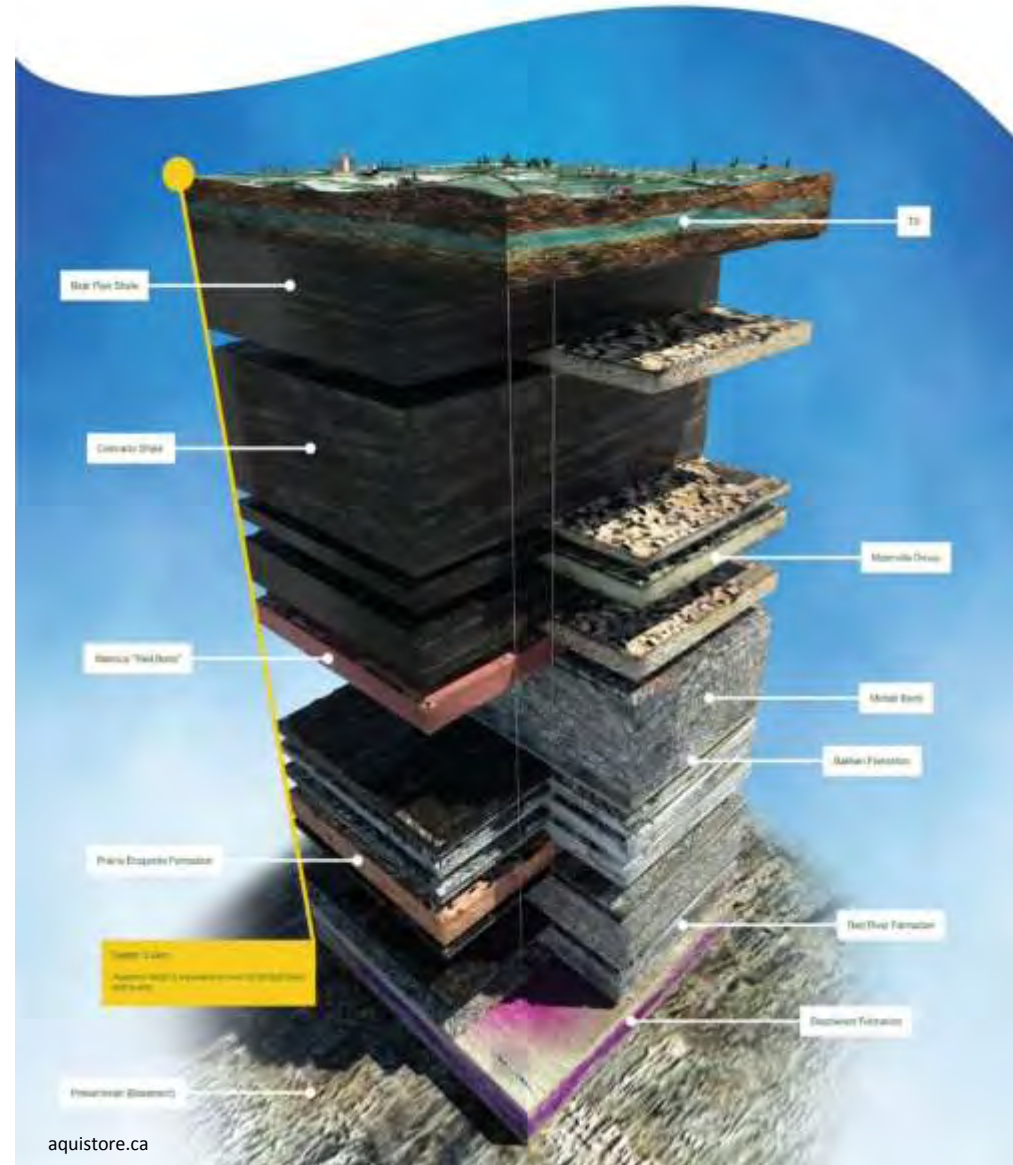
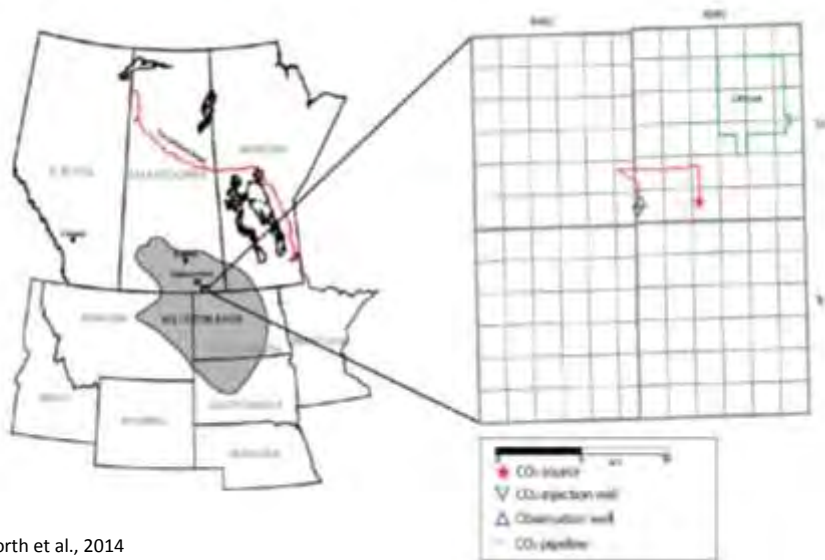


# RWE's Niederaussem, Lignite Plant, Germany



# Fingerprinting Captured CO<sub>2</sub> at Aquistore

- Is the signature retained in the subsurface?
  - Aquistore, Canada
  - Baseline samples ... ✓
  - Injected CO<sub>2</sub> ... ✓
  - Reservoir samples, ~ 6 months later



# Sampling at Aquistore

