



International
Energy Agency

Principles of the Geological Storage of Carbon Dioxide

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Key Messages

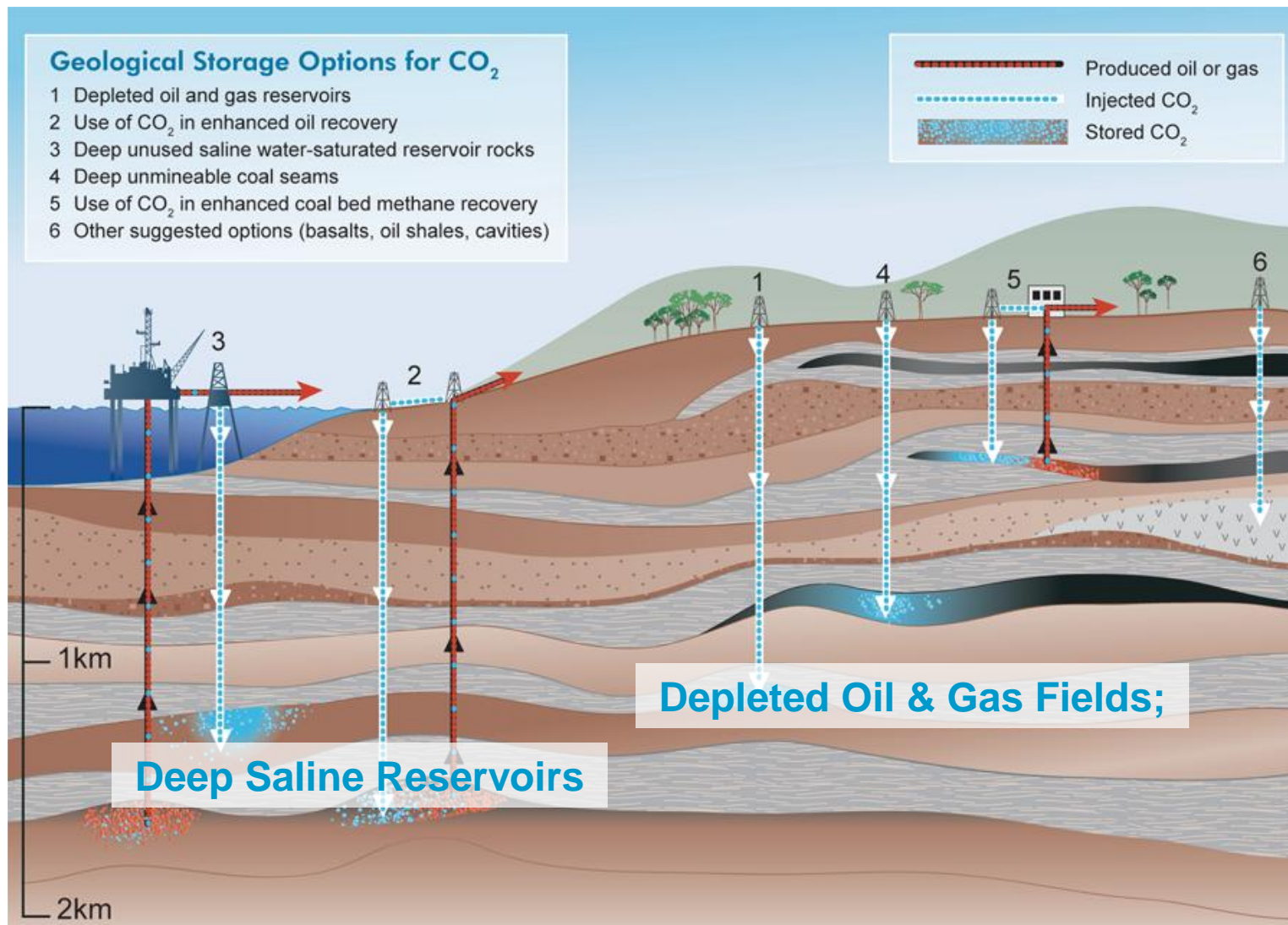
1. Evidence from petroleum studies show that oil, gas and CO₂ can be stored in the deep subsurface for geological time
2. CO₂ can be stored in depleted oil and gas fields and deep saline formations
3. CO₂ injected as a fluid into reservoirs (sandstones) is trapped by seals (mudstones)
4. The technology for the geological storage of CO₂ is mature

What is Geological Storage?

- Carbon dioxide captured from industrial processes is transported to a storage site
- Injection via a well bore into a deep geological formation as a dense (supercritical) fluid
- Monitoring the migration of the fluid under buoyancy away from the injection point
- Eventually the CO₂ is permanently trapping – structural (buoyancy), dissolution, residual and geochemical

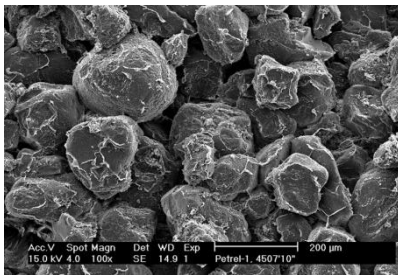


Options for Geological Storage

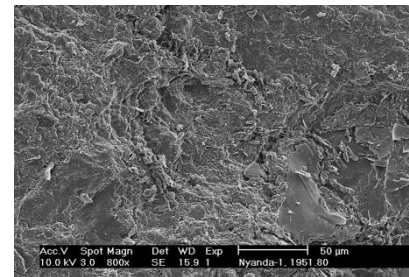


Reservoirs and Seals

- Reservoir rocks have spaces (pores) between the grains which can hold fluids and connections between the pores which can allow the fluids to flow through them (permeability). Sandstones and limestones.
- Sealing rocks are very fine grained with no practical permeability. Mudstones or shales.



~1
millimetre



~1/4
millimetre

How can you store anything in rock?

The geological characteristics of the subsurface can be seen exposed in coastal outcrops

*Adapted from
CO2CRC*



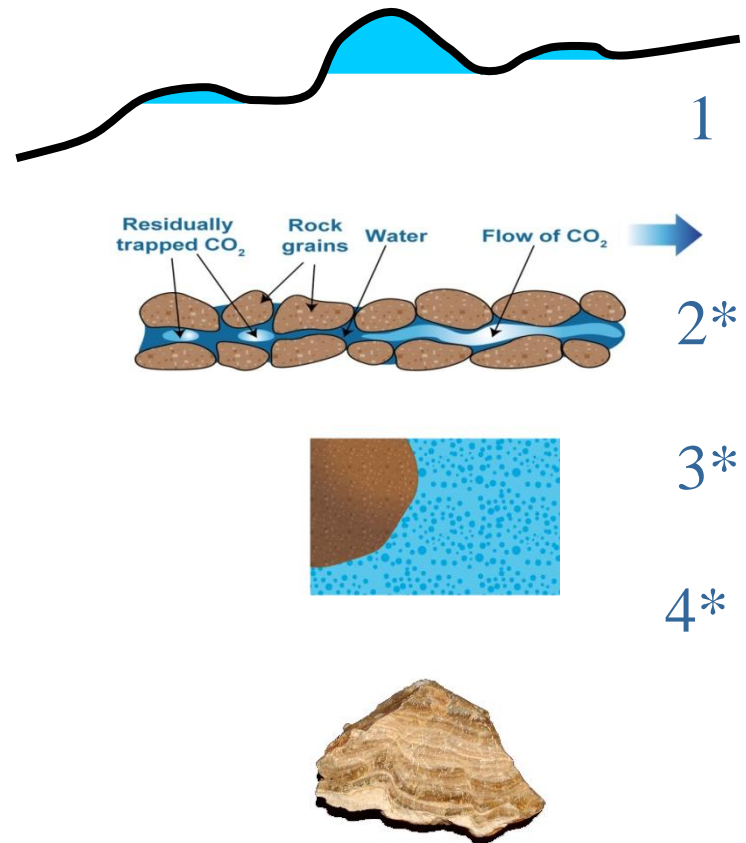


CO₂ trapping mechanisms in porous rocks

When CO₂ is injected into the subsurface, it will rise under buoyancy until it becomes immobilised by a combination of factors:

1. Structural and stratigraphic trapping
2. Residual trapping
3. Solubility trapping
4. Mineral trapping

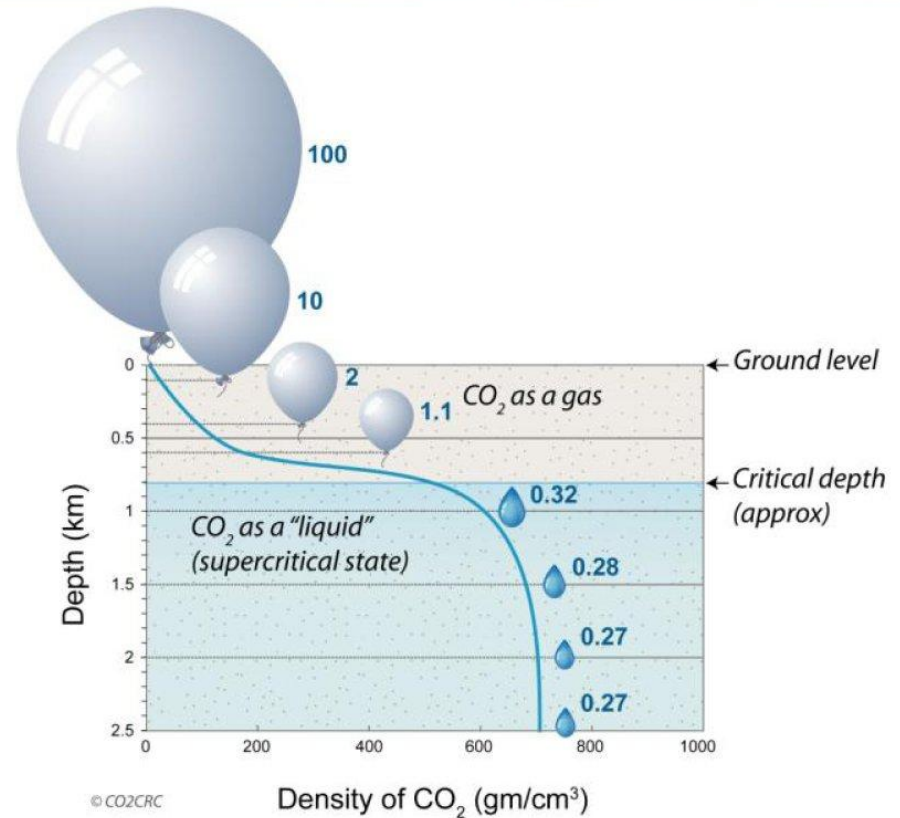
Unless residual storage occurs, the buoyant free phase CO₂ will ultimately rise to accumulate under the top seal of the reservoir.



* Courtesy of the CO2CRC

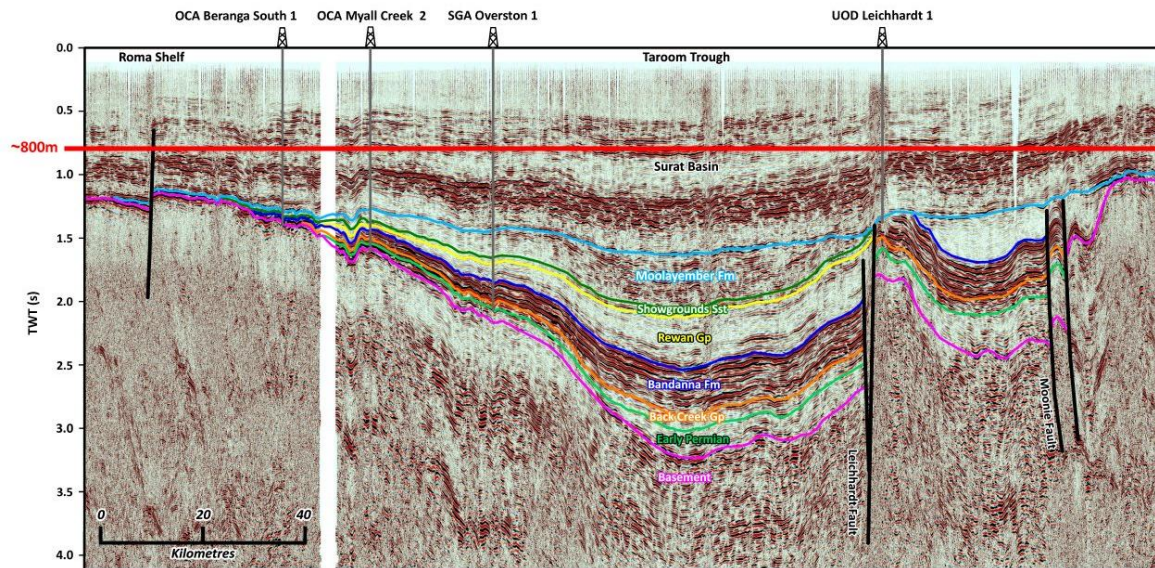
Why Supercritical CO₂

- At Pressures higher than 7.39 MPa and Temperatures higher than 31.1°C, CO₂ becomes a supercritical fluid: gas like but with 400x the density.
- Generally these conditions are found below about 800m in the subsurface



Sedimentary basins and geological storage

- ❖ Saline aquifers suitable for storage occur almost exclusively in sedimentary basins
- ❖ These are depressions in the crust of the earth in which sediments have accumulated over millions of years and which have not experienced significant uplift and folding
- ❖ They may be tens of kilometres thick and occur both on the continents and under shallow seas
- ❖ All oil and gas accumulations occur in sedimentary basins.

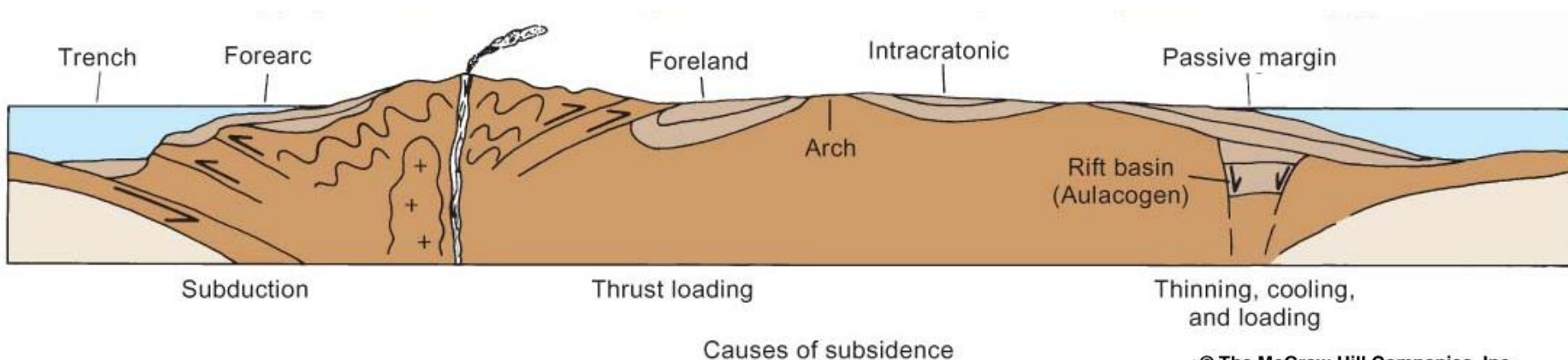


GSQ/GGSS Queensland Carbon Dioxide Geological Storage Atlas 2009.

- ❖ Oil and gas accumulations in a basin help demonstrate that the necessary trapping conditions exist there

All Basins Are Not Equal

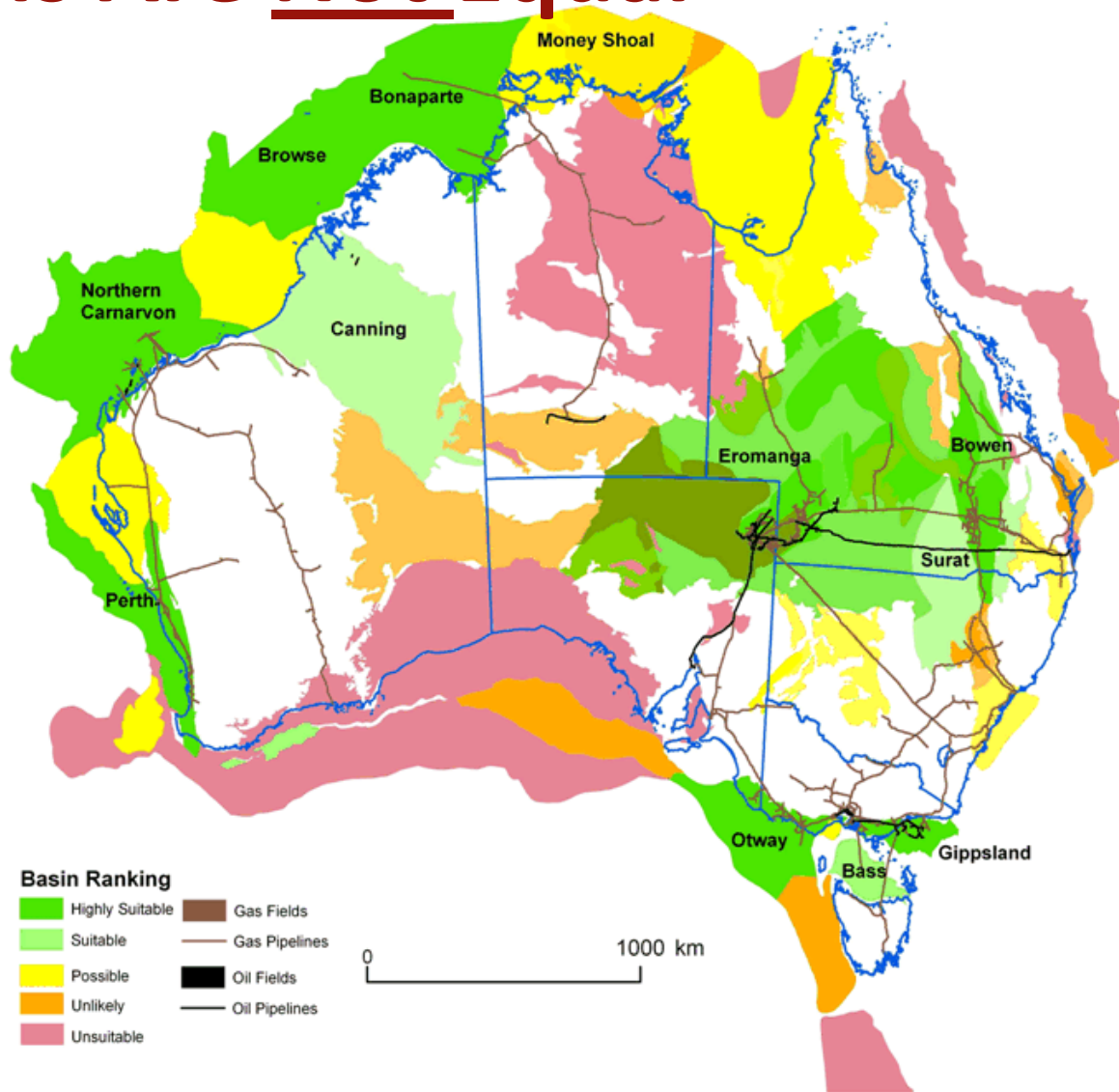
- Sedimentary basins are the regions that offer the opportunity for geological storage of CO₂.
- But all sedimentary basins do not have the same potential for storage
- We need to consider the tectonic settings and reservoir characteristics of each basin un assessing storage



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All Basins Are Not Equal

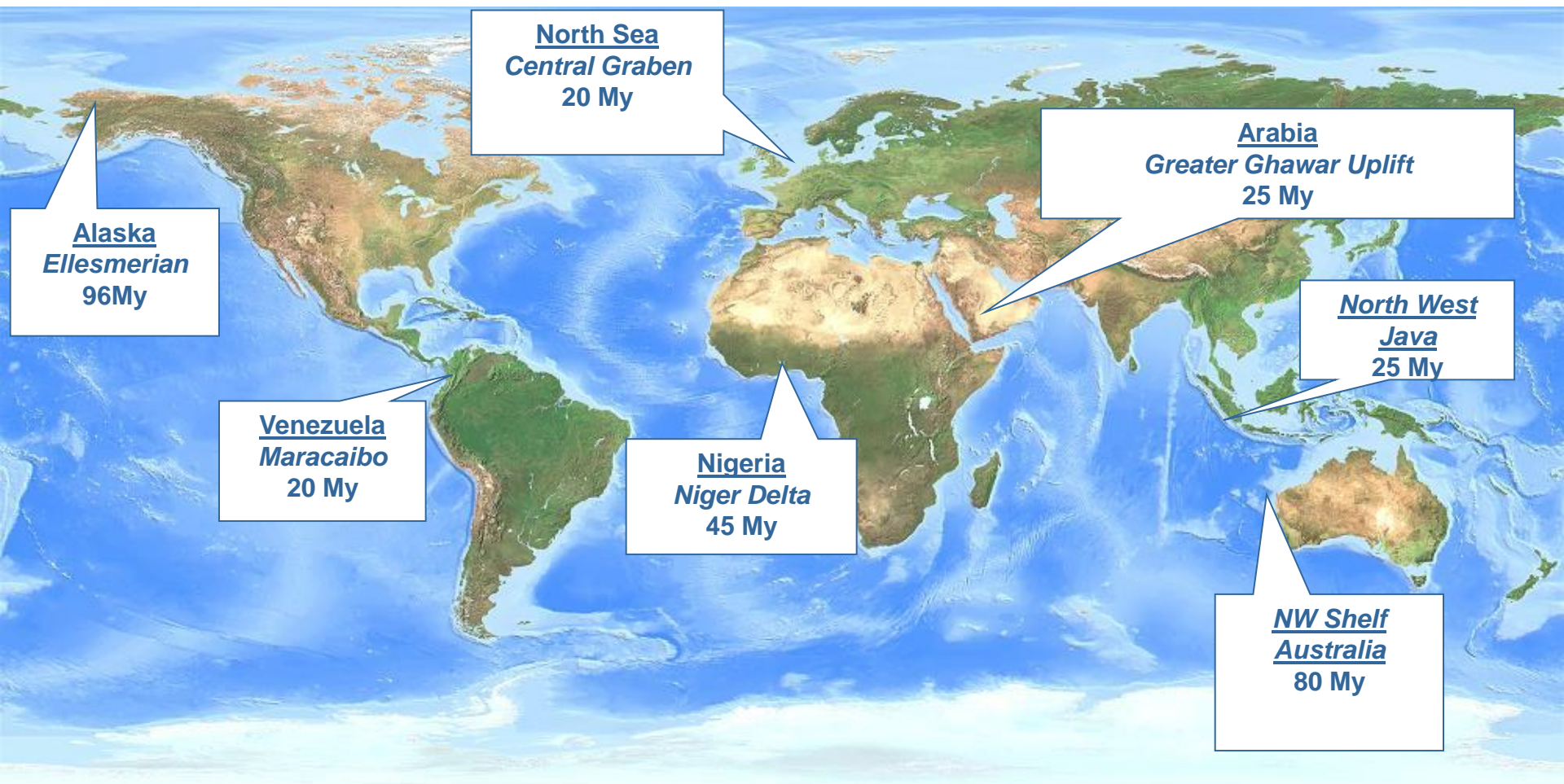
An example of the ranking of basins for carbon dioxide storage from a recent Australian Government Study conducted by Geoscience Australia



How long will it stay there?

- Naturally occurring fluids have been trapped underground for many millions of years
- Oil, natural gas and CO₂
- This can be shown by the study of petroleum systems.

Time Of Petroleum Charge Into Traps



Is This New Or Unproven Technology?

- The critical components of the CCS process are currently in use within the Oil & Gas Industry.
- **Capture:** Natural gas processing, ammonia plants other industrial processes.
- **Transport:** 5650 km of CO₂ pipeline in the USA.
- **Injection:** EOR – 70 projects in West Texas. Acid gas disposal
- **Storage:** Subsurface storage of natural gas for 100yr
storage of CO₂ since mid 1990s
- CO₂ storage in the North Sea since 1996



Source IPCC



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Thank You For Your Attention

Pores not Caverns

