

Geologic Carbon Sequestration in Oregon

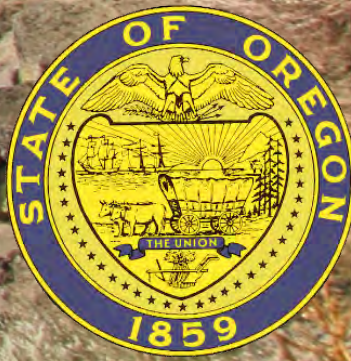
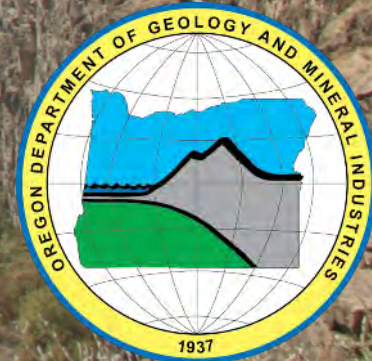
An Update on State Investigations: September 2025

Oregon Department of Geology and Mineral Industries

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One-minute overview

- In recognition of the severity of the climate crisis, the Oregon legislature has approved funding for DOGAMI to ***investigate carbon storage potential in the Columbia River Basalts in northern Oregon***
- This is ***not*** a carbon dioxide injection project.
- The study will include:
 - Listening to Tribal Nations and potentially affected communities to understand regional perspectives
 - Installation of at least one research well to investigate:
 - Columbia River Basalt properties deep below the ground
 - Water type, quality, and distribution within the basalt
 - An analysis of the potential impacts of carbon dioxide storage in northern Oregon
 - An investigation of the long-term environmental impact of geologic carbon storage
 - Regulatory framework investigation on the assurance of protection of communities and resources
- The technical, engagement, and regulatory framework results will be reported to the Legislature

What is DOGAMI?



OREGON DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES

AGENCY LEADERSHIP: ADMINISTRATION; FINANCE; INFORMATION TECHNOLOGY



GEOLOGICAL SURVEY & SERVICES



EARTHQUAKE
HAZARDS



LANDSLIDE INVENTORY
& HAZARDS



MINERAL RESOURCE
EXPLORATION



FLOOD & CHANNEL
MIGRATION



TSUNAMI & COASTAL
EROSION



DECARBONIZATION
GEOSCIENCE



GEOLOGIC MAPPING



LIDAR MAPPING & REMOTE SENSING

MINERAL LAND REGULATION & RECLAMATION



SURFACE MINING
& EXPLORATION



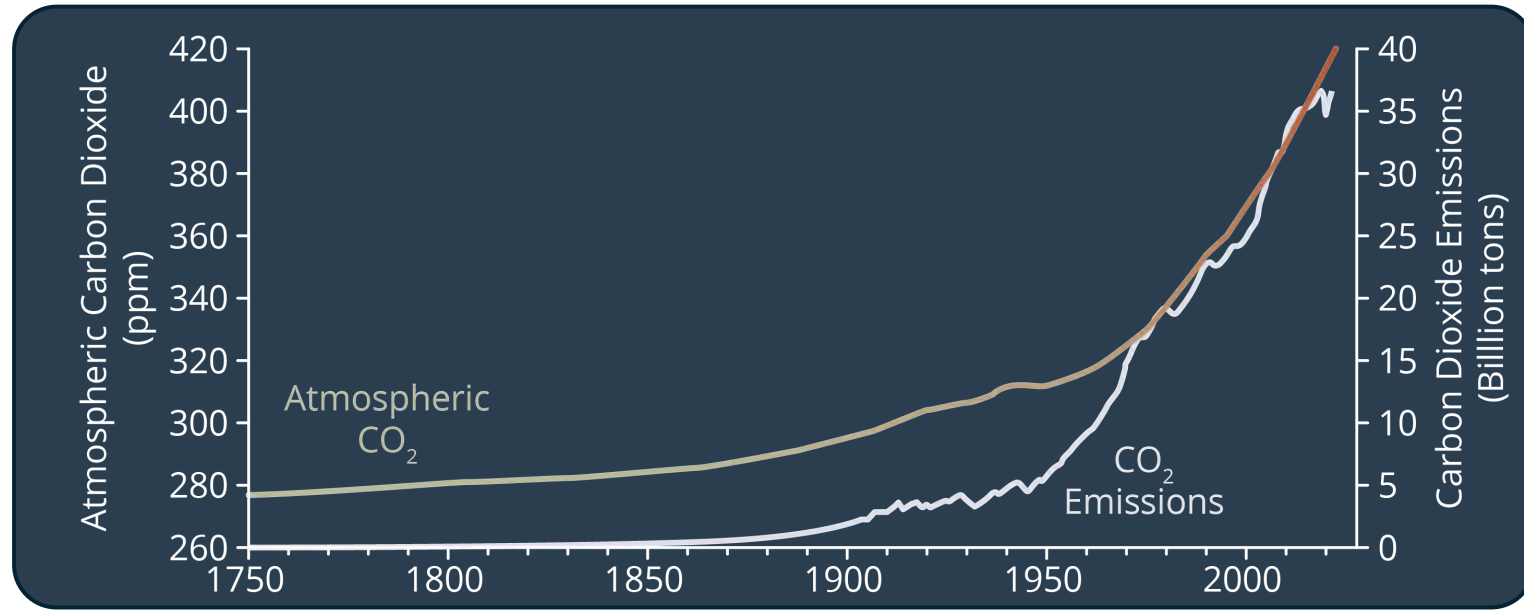
CHEMICAL
PROCESS
MINING



OIL & GAS,
GEOTHERMAL
WELL DRILLING,
CARBON STORAGE

Climate Change: The need for action

- Impacts of rising temperatures, changes in weather patterns, and wildfires
 - Impacts on plants and animals
 - Changes in growing seasons
 - Availability and quality of water resources
- Potential remedies
 - Industrial decarbonization
 - Carbon Capture
 - Point source
 - DAC
 - Carbon Sequestration
 - Organic systems
 - e.g., Elliot State research forest
 - Geologic systems
 - e.g., Columbia River Basalts



1.3°C rise since pre-industrial era

2.0°C target set in Paris Climate Agreement

800 GtCO₂ remaining budget to exceed targets

40 GtCO₂/year in global emissions

20 years remain to meet targets



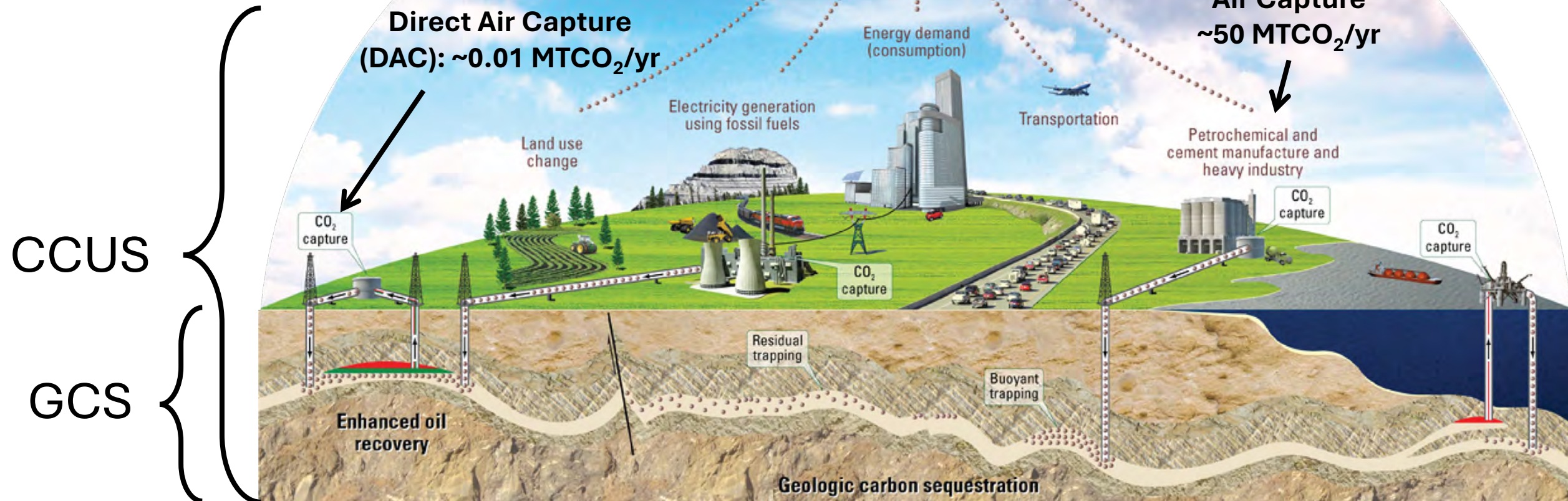
CCUS: Carbon Capture, Utilization, Storage*

GCS: Geologic Carbon Storage*

U.S. Department of the Interior
U.S. Geological Survey

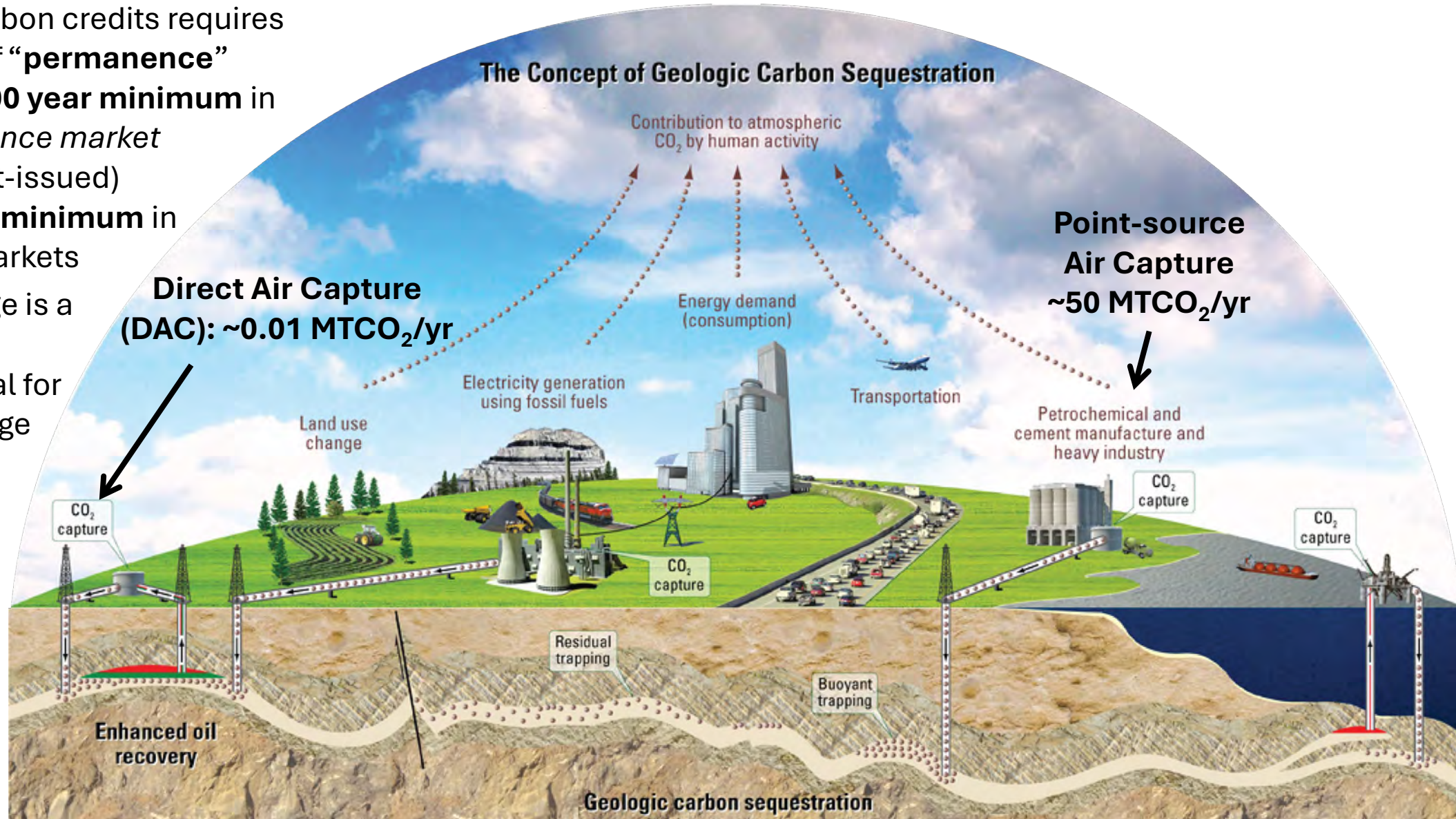
Fact Sheet 2010-3122

* Sometimes referred to as **sequestration**, the process of removal from the atmosphere, and storing in solid or liquid form



Fact Sheet 2010-3122

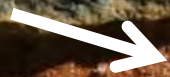
- # GCS



Turning carbon dioxide (CO₂) into stone

Basalt
lava

Siderite vein
Iron carbonate (FeCO₃)



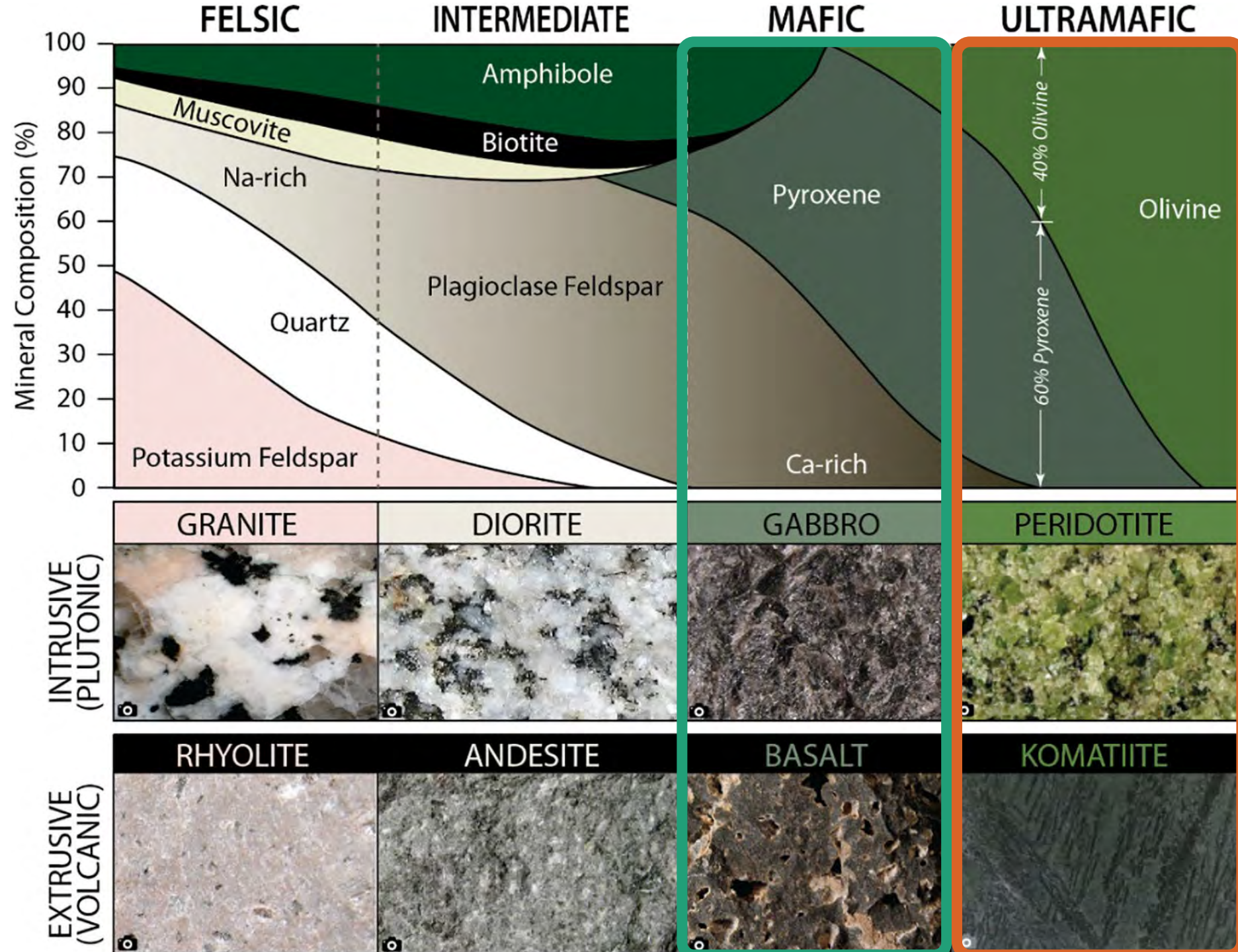
Basalt
lava



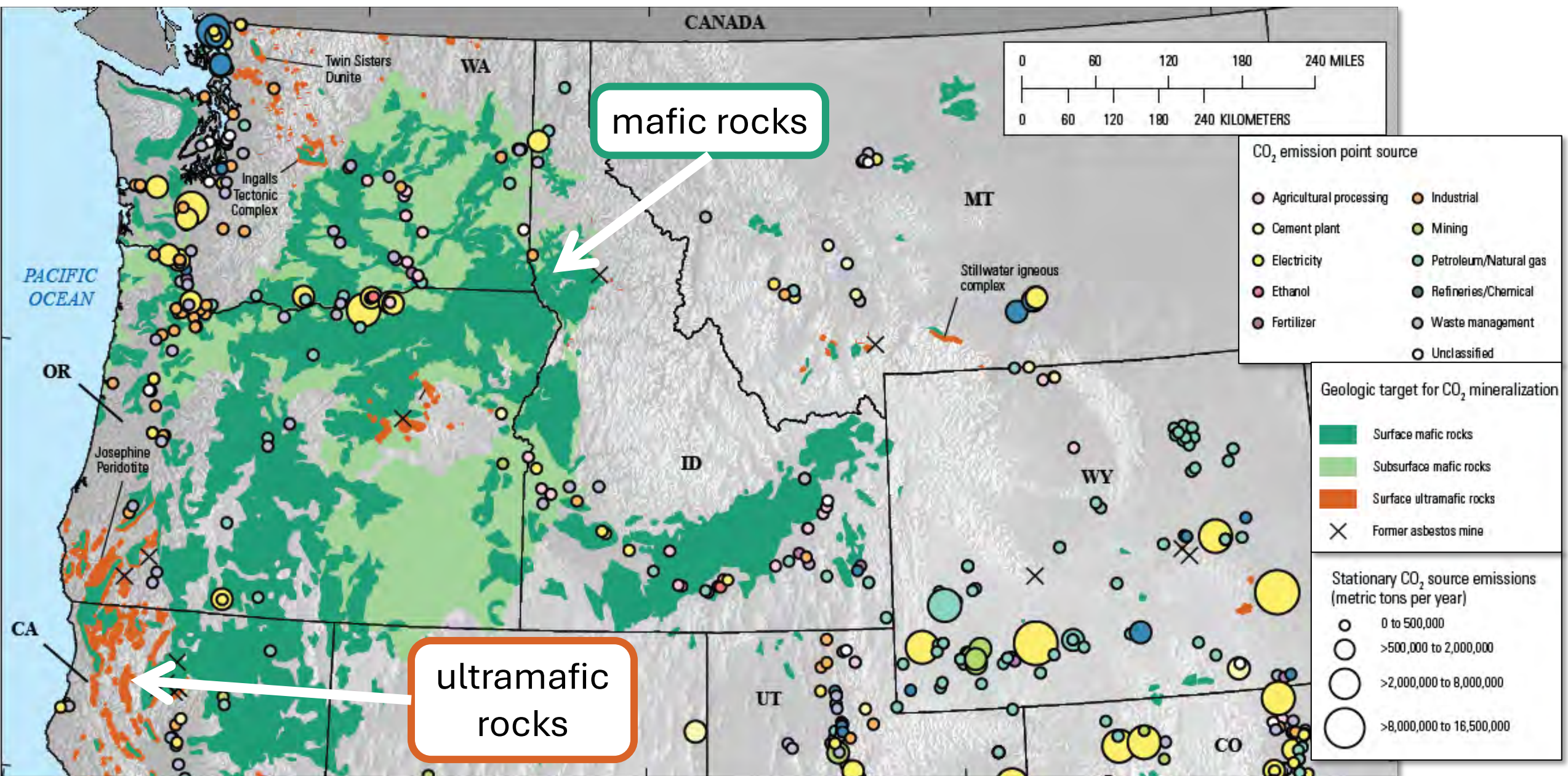
Calcite vein
calcium carbonate
(CaCO₃)

Mineral carbonation rock types

- Highest potential in **ultramafic / mafic** rocks:
 - High concentration of metal cations
 - High reactivity
 - Potentially large surface area
- Process occurs in nature, with rate controlled by:
 - Temperature
 - Pressure
 - CO₂ concentration
 - Mineralogy



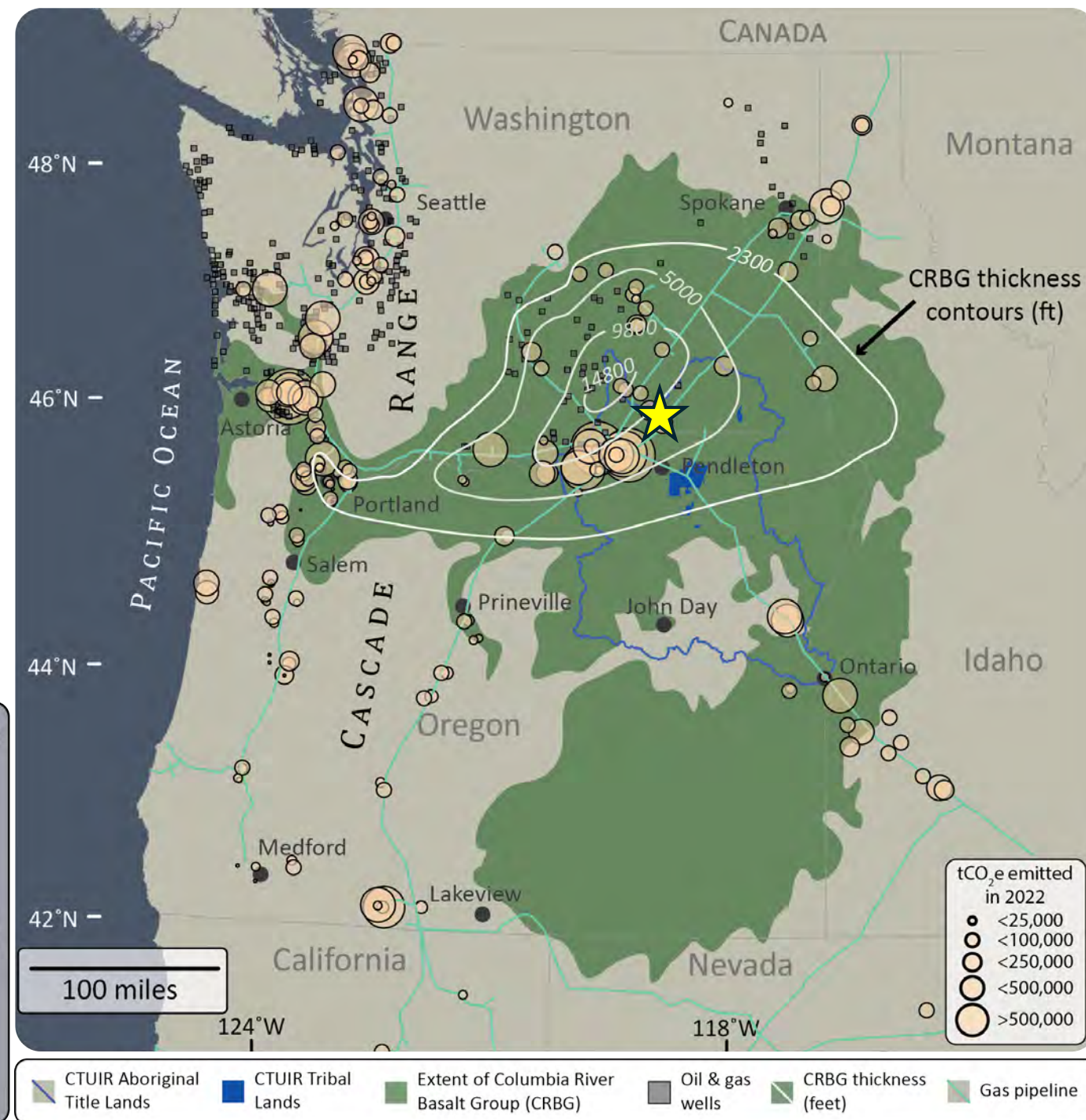
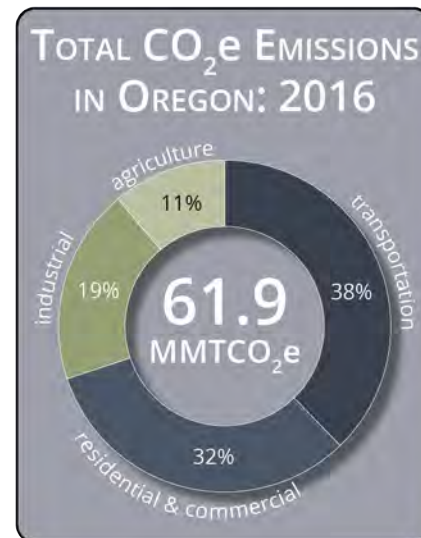
NW USA: Opportunities for CO₂ storage



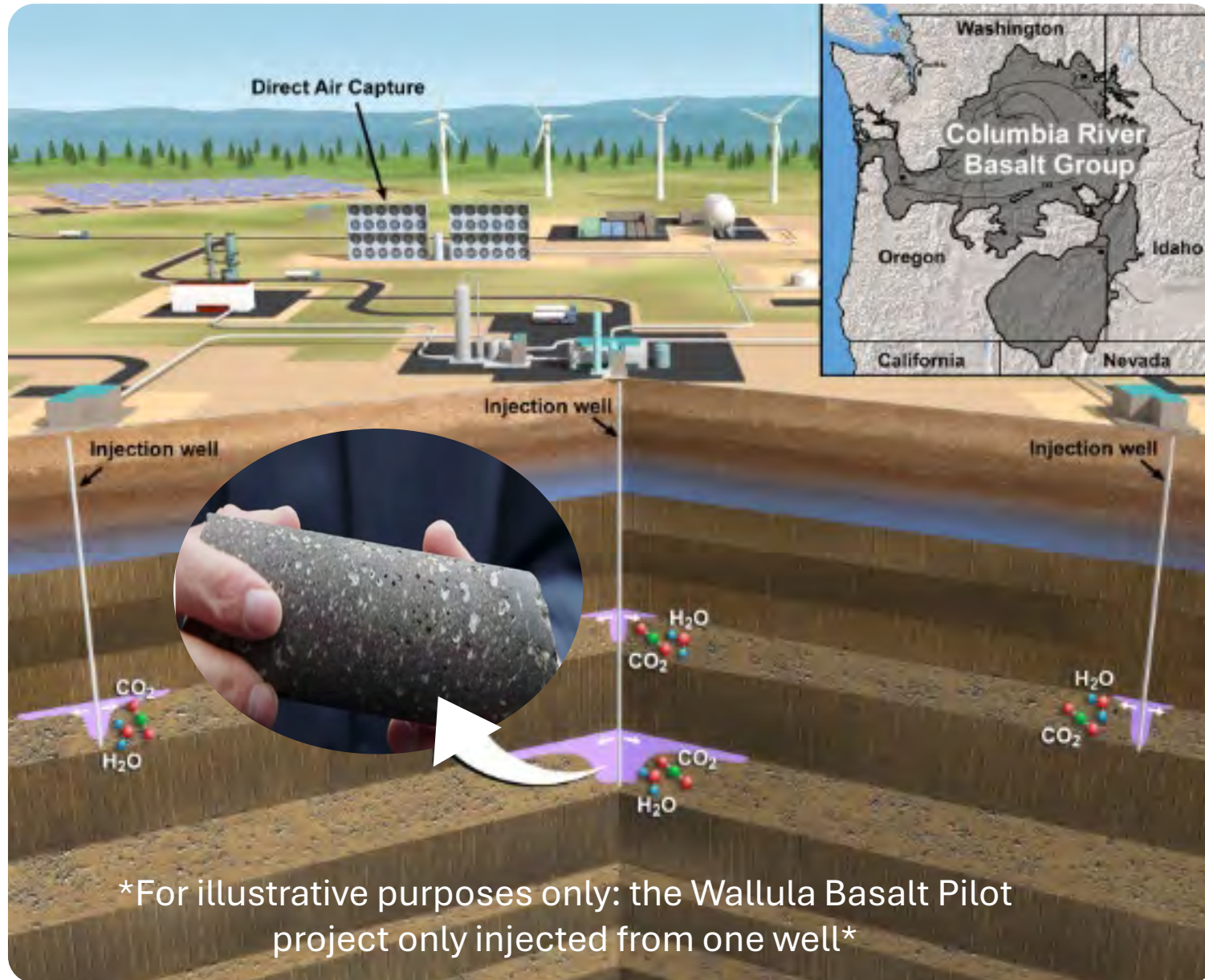
The Columbia River Basalt Group (CRBG)

- Substantial area: ~81,000 sq. miles
- Substantial volume
 - Maximum thickness ~2.8 miles
 - Total volume ~50,000 cubic miles
 - Enough material to cover Oregon to a thickness of ~2,250 ft... double the height of the Empire State building

- Estimated CO₂ storage capacity ranging from 40-100 billion metric tons (Gt)

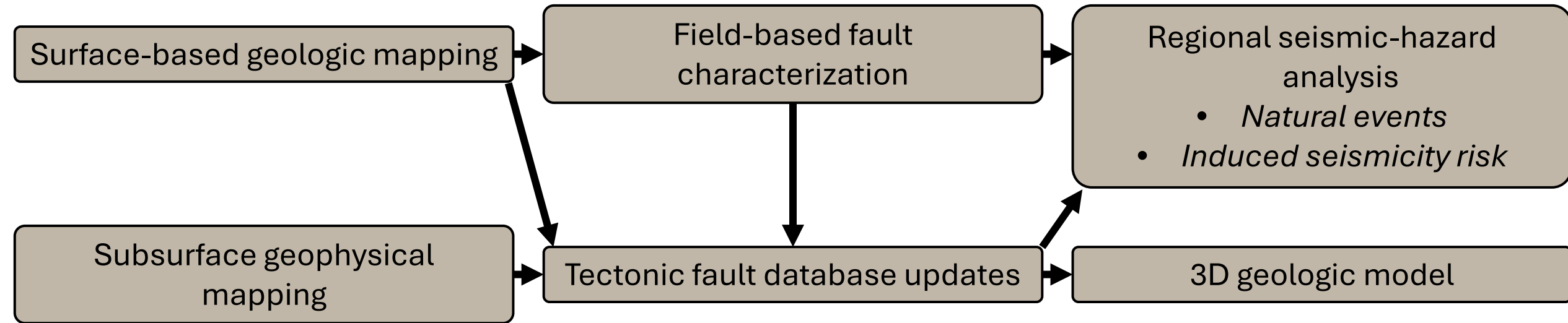


Wallula Basalt Pilot Project (2013-2015)

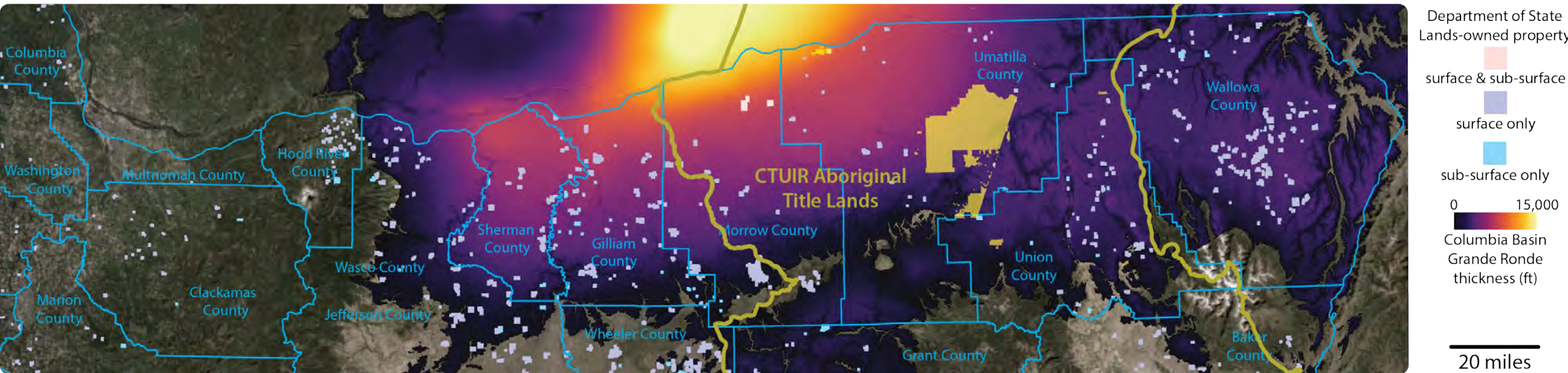
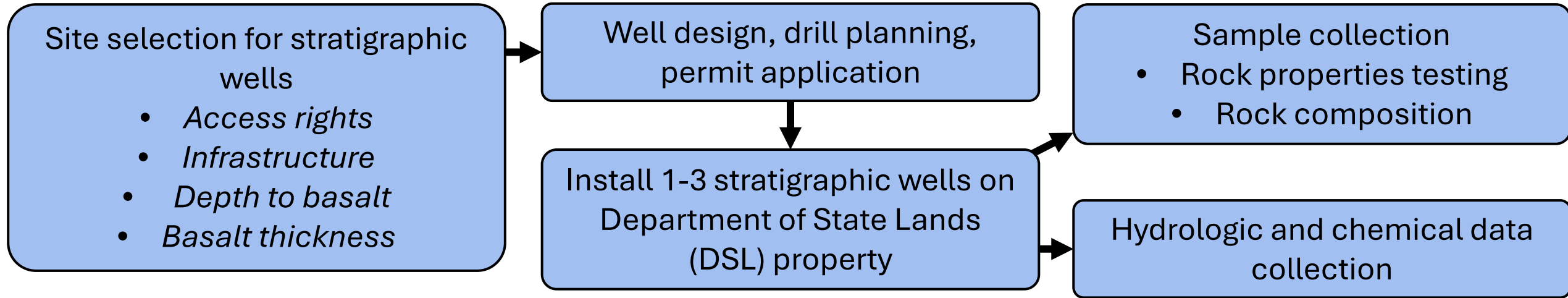


- Injection of 1,000 tons of *supercritical* CO₂ at ~850 m depth (2,600 ft) over 25 days
- No evidence for vertical migration of CO₂
- Horizontal migration limited to ~40 m from injection
- Post-injection drilling indicates mineralization within 2 years

Key technical aspects of the current project

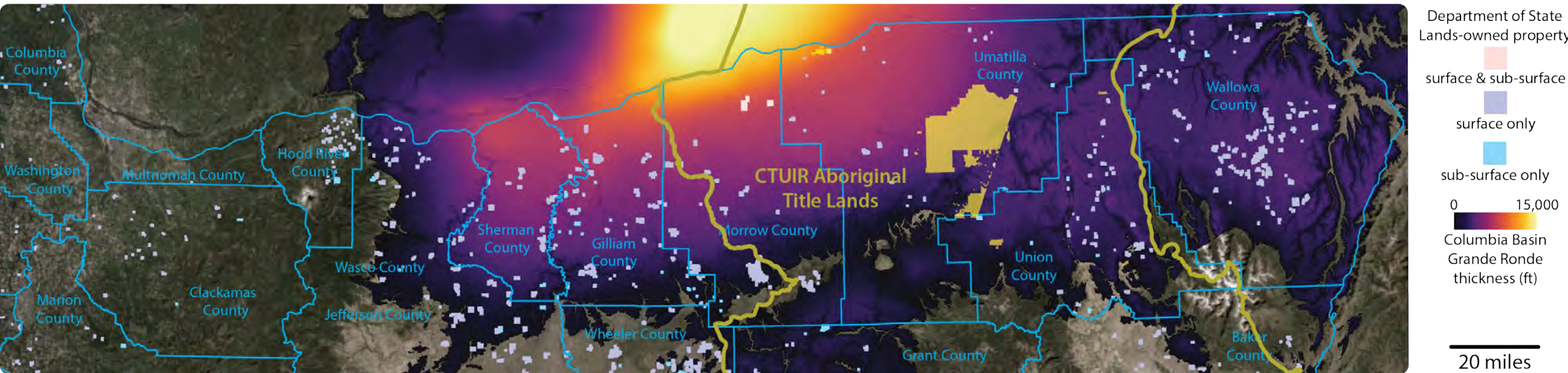


Key technical aspects of the current project



Community Engagement: Tribal Nations

- **Listening to and engaging with Tribal Nations is a top priority, particularly given the location of the Columbia River Basalt Group with respect to CTUIR lands**
- This presentation is an update to the 2023 CTUIR presentation on Carbon Sequestration
- Funding has been secured, but **work on this project has not yet started**
- Engagement with Tribal Nations, specifically CTUIR, will remain a priority through the life of the project



Community Engagement: Regional Stakeholders

- Initiating engagement activities as soon as possible
- Engagement will be coordinated with the Department of State Lands and other state agencies
- Engagement will include media, both local and statewide
- As a State of Oregon agency DOGAMI's role in this project is unique

Approach

- *Listen to Tribal perspectives*
- *Integrate engagement into all project phases*
 - *Incorporate Tribal Nation feedback*
 - *Relay concerns to decision-makers*

Methods

- *In-person and virtual listening sessions*
 - *Surveys and project newsletters*
- *Educational programs in schools, colleges, museums, and community forums*
 - *Internship opportunities*

Goals

- *Establish trust*
- *Learn community perspectives*
- *Create workforce development & education program plans*
 - *Inform decision-makers*

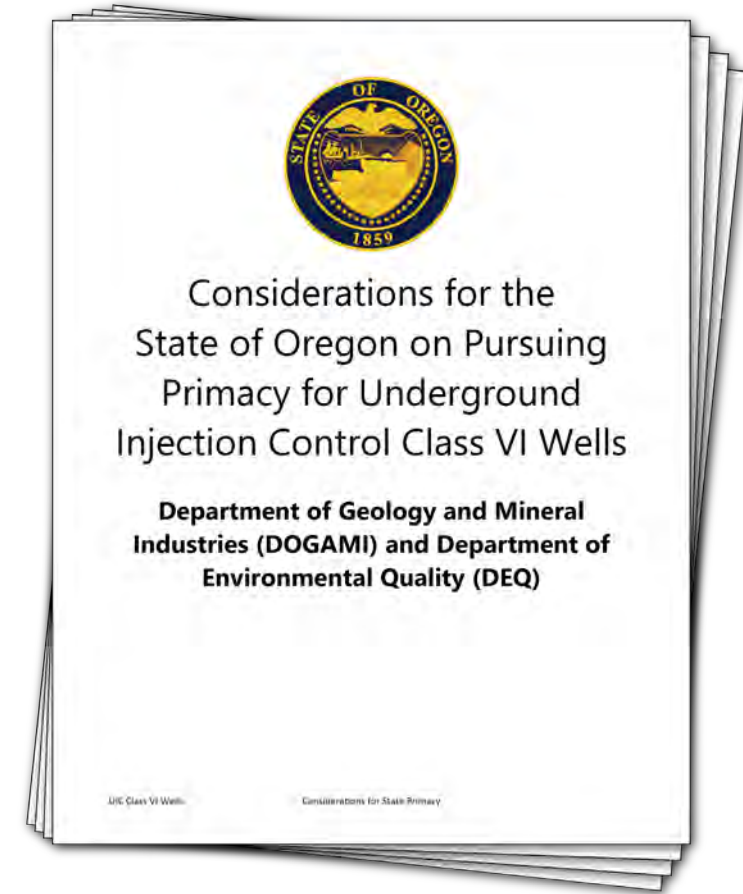
Regulatory Framework

Stratigraphic Research Well

- **No injection of CO₂**
- Gather geologic and hydrologic data:
 - **Extract water** for chemistry & dissolved solids
 - **Inject clean water** to identify reservoirs & seals
 - Sampling of rock for laboratory tests
 - Optical and geophysical imaging methods
- Dept. of State Lands will seek an exploration permit from DOGAMI's Mineral Land Regulation and Reclamation program: **Class V UIC well**

Primacy

- **DOGAMI and DEQ** are exploring the potential to apply to the EPA to **transfer Class VI permitting to the State**
 - Ensures permits conform to Oregon's stringent regulatory structures but...
 - Increases workload for DEQ & MLRR



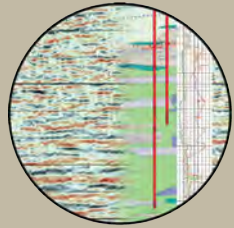
The geologic carbon storage project: 2025-2027



COMMUNITY ENGAGEMENT

- Listening to Tribal Nations, regional stakeholders, and nearby property owners
- Educational program development
- Assessment of community workforce and economic needs

Is there social license for geologic carbon storage in Oregon?



TECHNICAL FEASIBILITY

- Install 1-3 stratigraphic wells on Department of State Lands (DSL) property
- Surface-based geologic mapping
- Subsurface geophysical mapping
- Hydrologic and chemical data collection
- Seismic-hazard analysis

Is there a viable, safe, storage system in Oregon's Columbia River Basalt Group in Oregon?

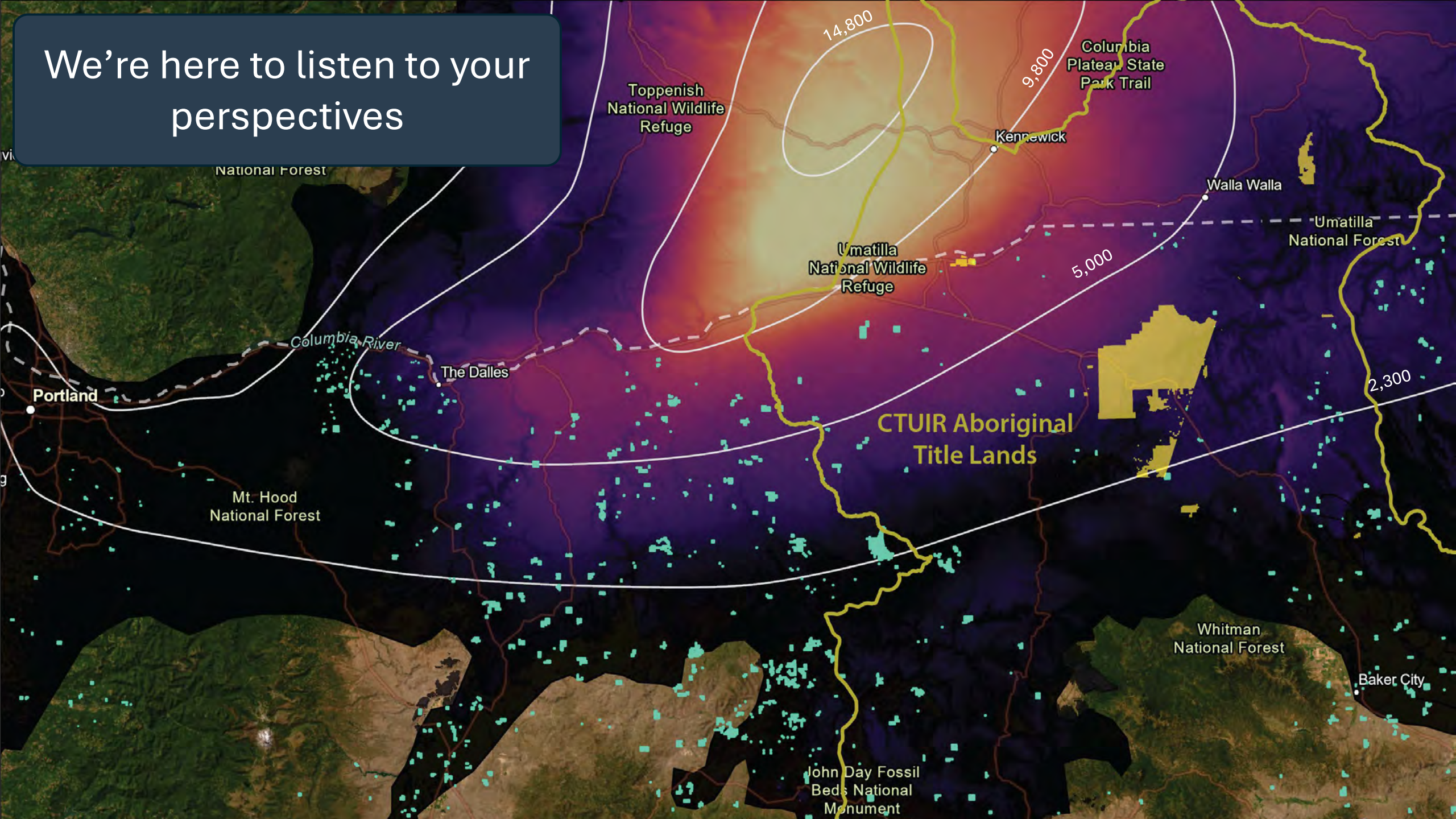


REGULATORY STRUCTURE

- Investigation of Class VI underground injection well (UIC) regulatory primacy
- Development of permitting pathways for carbon sequestration and geothermal exploration.

Should the State of Oregon seek primacy for Class VI UIC wells, to ensure and enhance environmental protections?

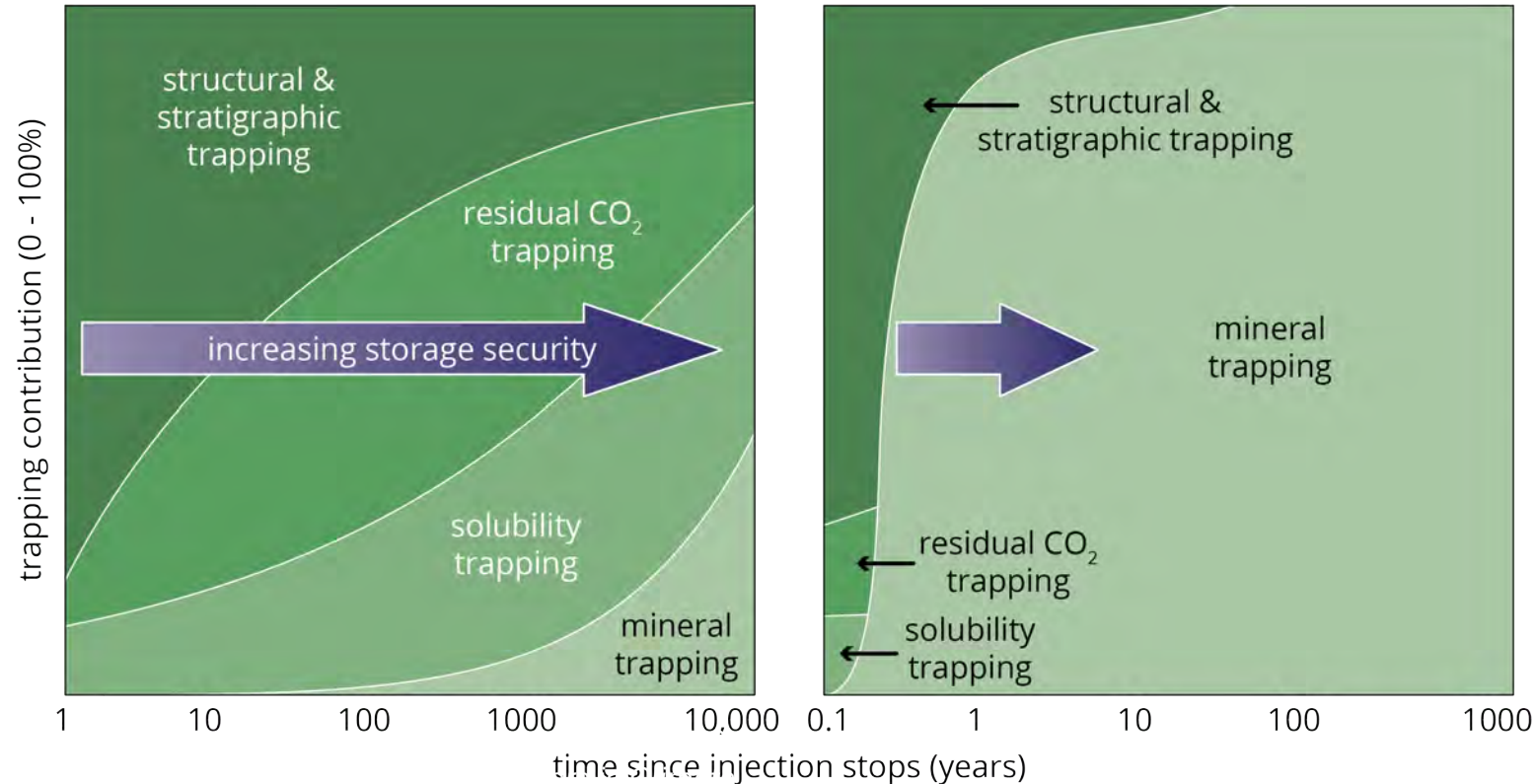
We're here to listen to your perspectives



Appendix: Background information

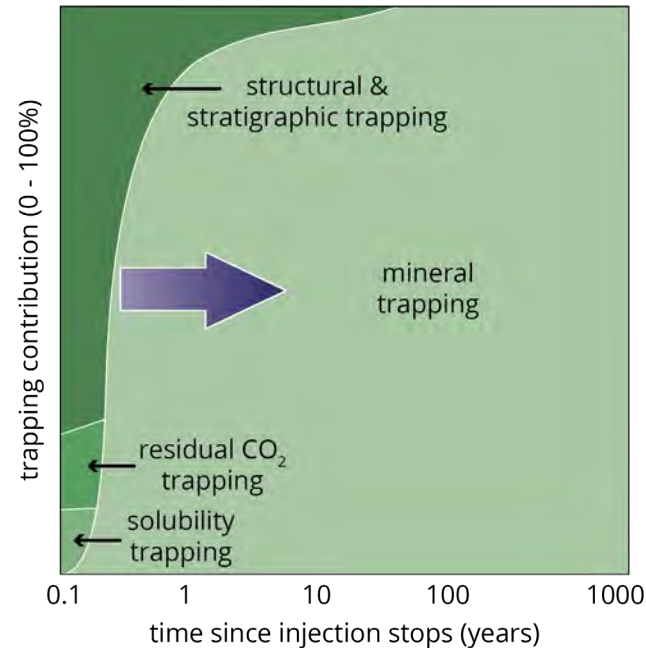
Geologic Storage Mechanisms

- **Structural / stratigraphic trapping**
 - CO₂ is less dense than water and buoyantly rises after injection
 - Rising CO₂ can become physically trapped under impermeable layers
- **Residual trapping**
 - As CO₂ moves through a porous rock, small droplets become stuck within the pore space
 - This creates a *residual phase* of CO₂ that is immobile
- **Solubility trapping**
 - Over time, fluid CO₂ dissolves into the pore water
 - This dissolved CO₂ can become trapped with formation waters



- **Mineral trapping**
 - Over time CO₂ binds with minerals in the host rock and dissolved metals in the pore waters
 - This creates new solid carbonate minerals that grow on rock surfaces
 - This is the most secure form of CO₂ trapping

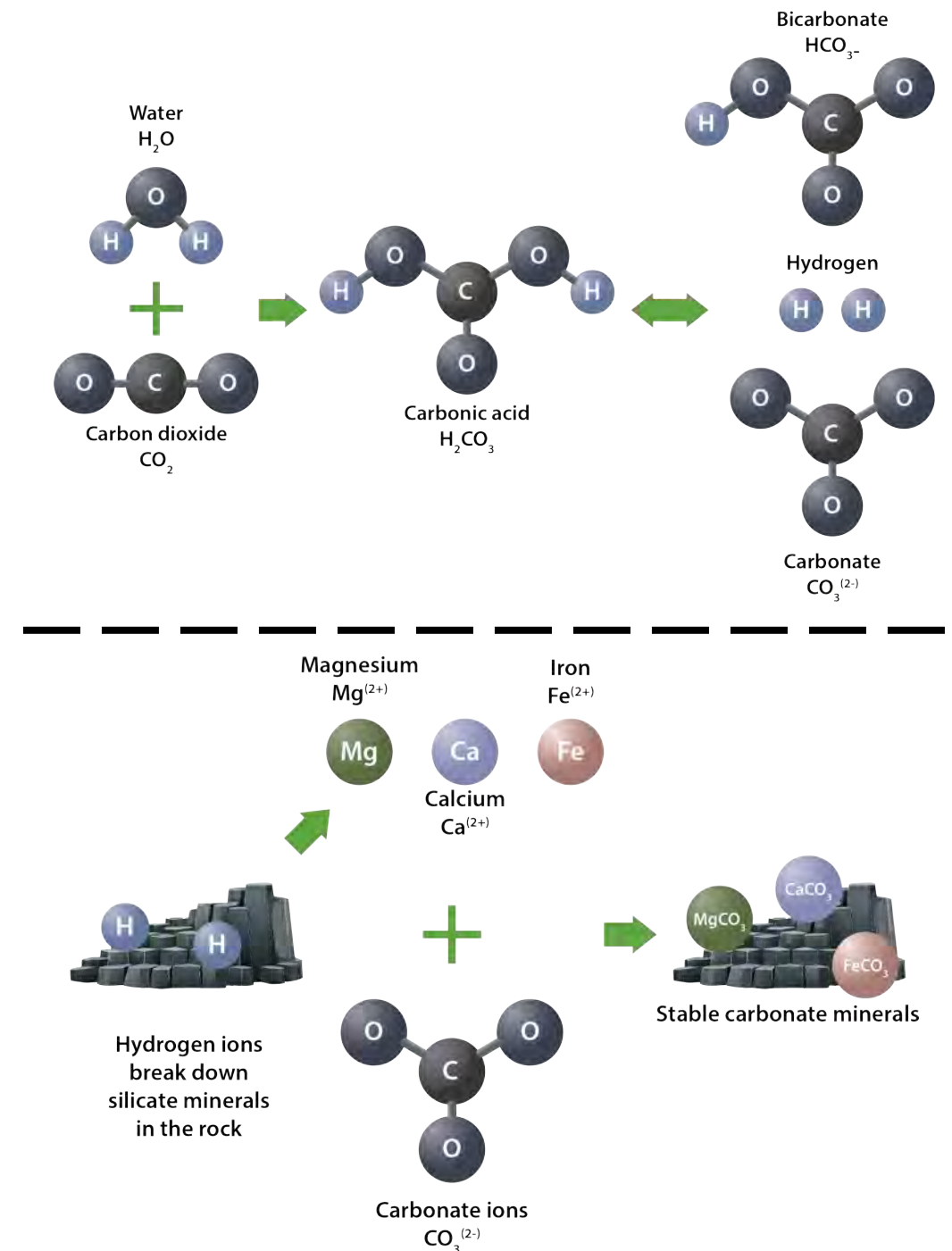
Carbonation Chemistry



Kelemen et al., 2019, *Frontiers in Climate*

Requires

- **Acidic fluid conditions for dissolution**
- Reactive host rock + dissolved CO₂ in fluids
- High concentration of divalent cations: calcium, magnesium, iron (**Ca, Mg, Fe**)
- Permeable rocks for fluid flow
- **Alkaline fluid conditions for precipitation**



Possible CRBG CO₂ reservoirs

