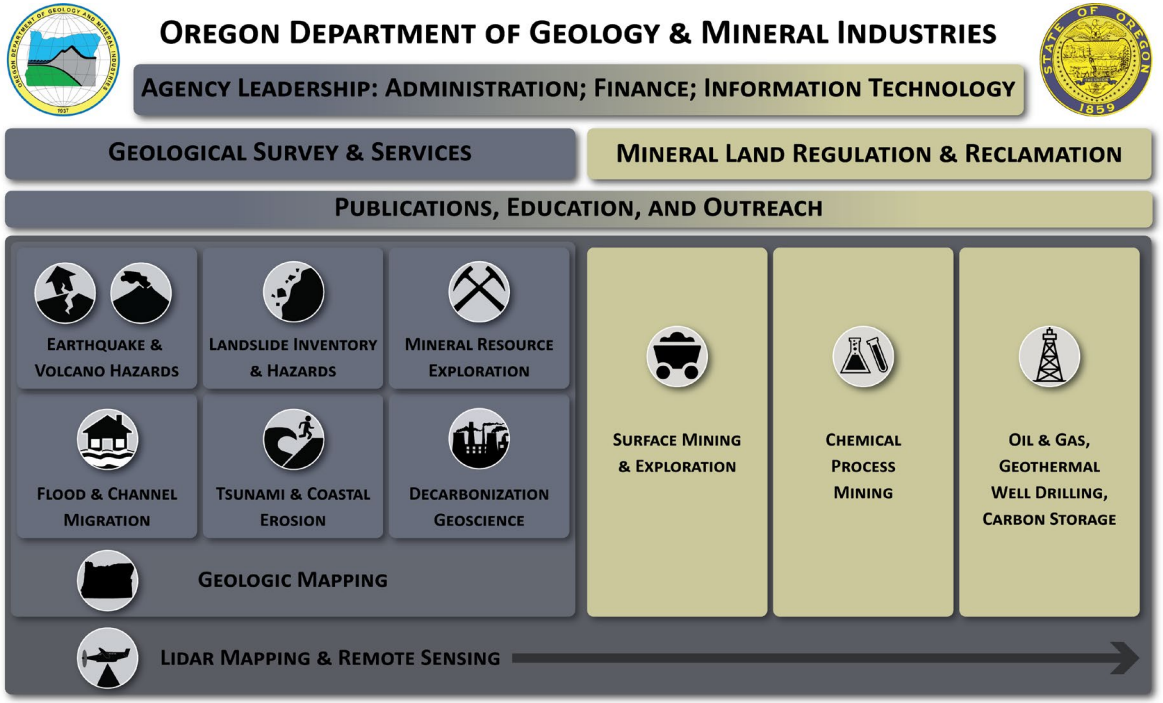
Geologic Carbon Sequestration in Oregon

Oregon Dept. of Geology and Mineral Industries
Decarbonization Projects Lead: Neyda Maymi

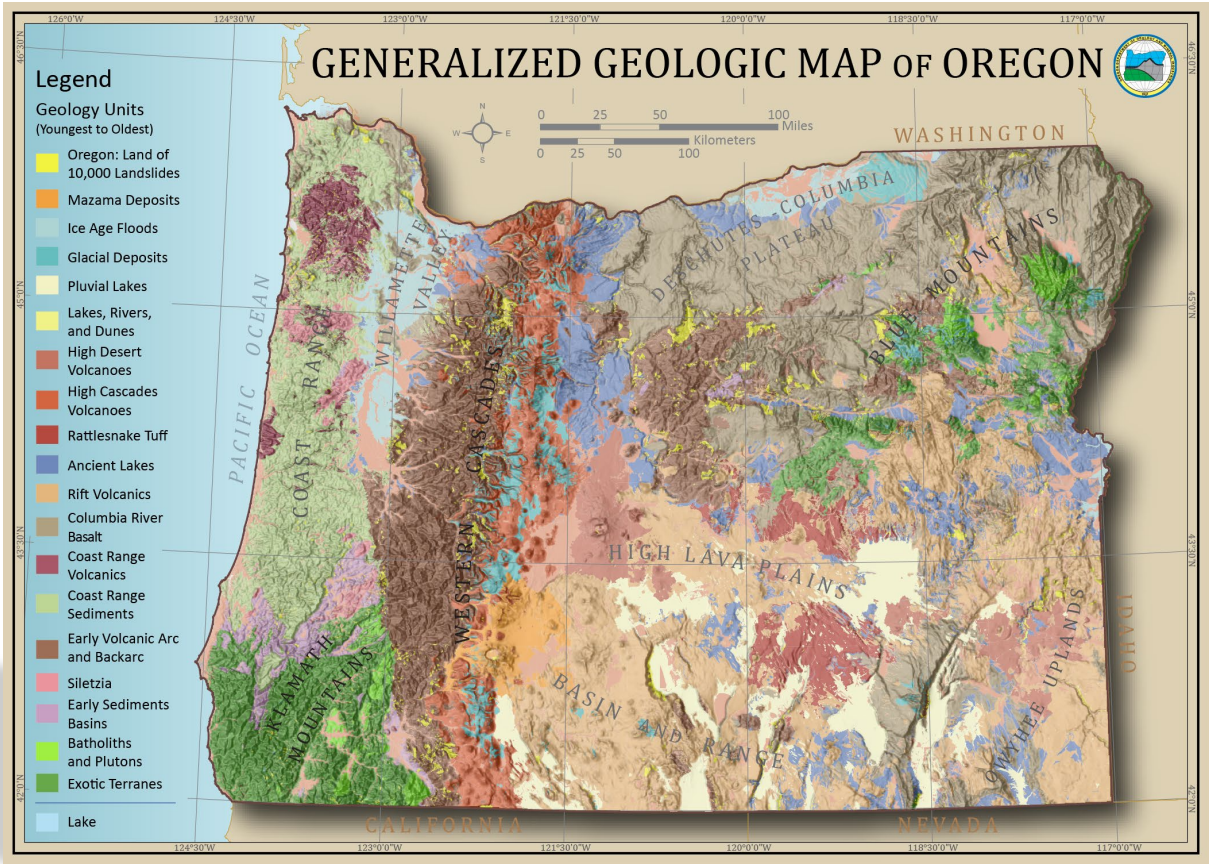
June 2026

An Introduction To DOGAMI



- Scientific excellence
- Public safety
- Responsible resource stewardship

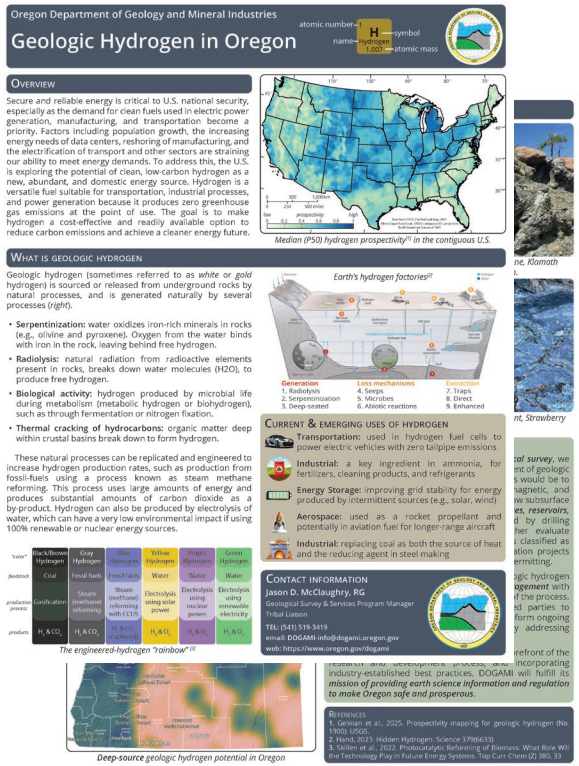
Our Mission:
Provide earth science information and regulation to make Oregon safe and prosperous



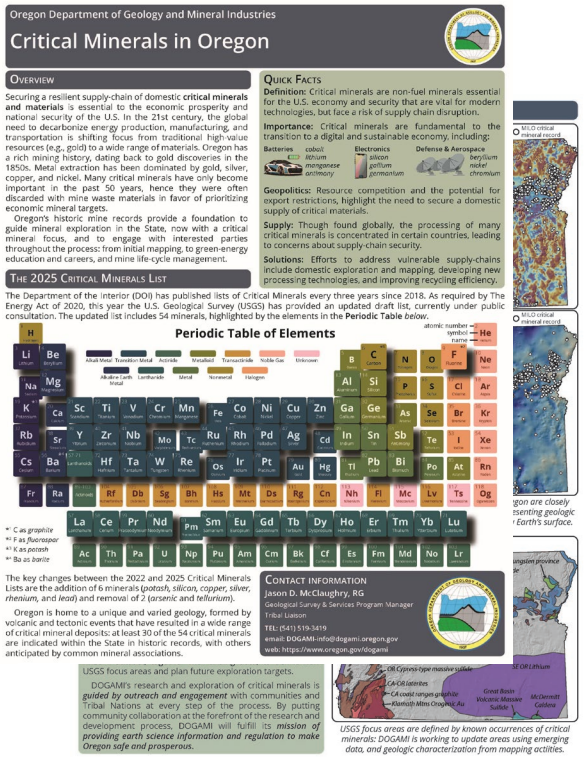
Decarbonization Geoscience in Oregon

Geologic Carbon Storage

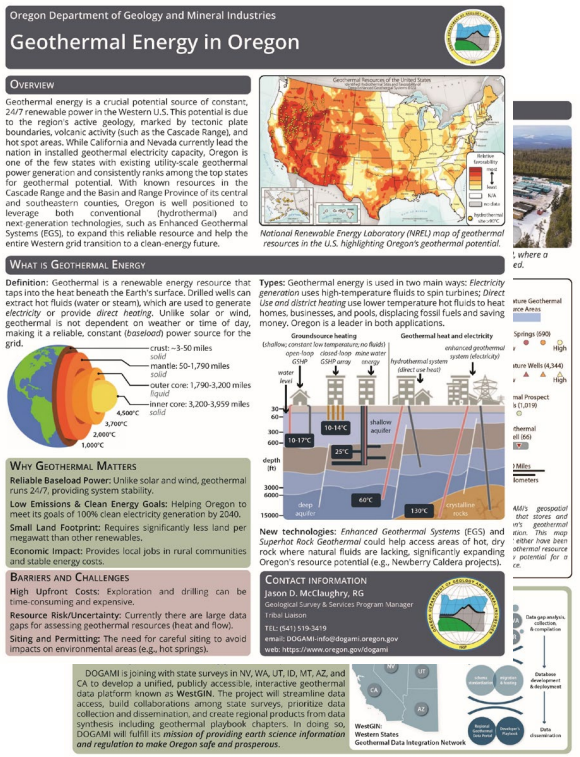
Geologic Hydrogen



Critical Minerals



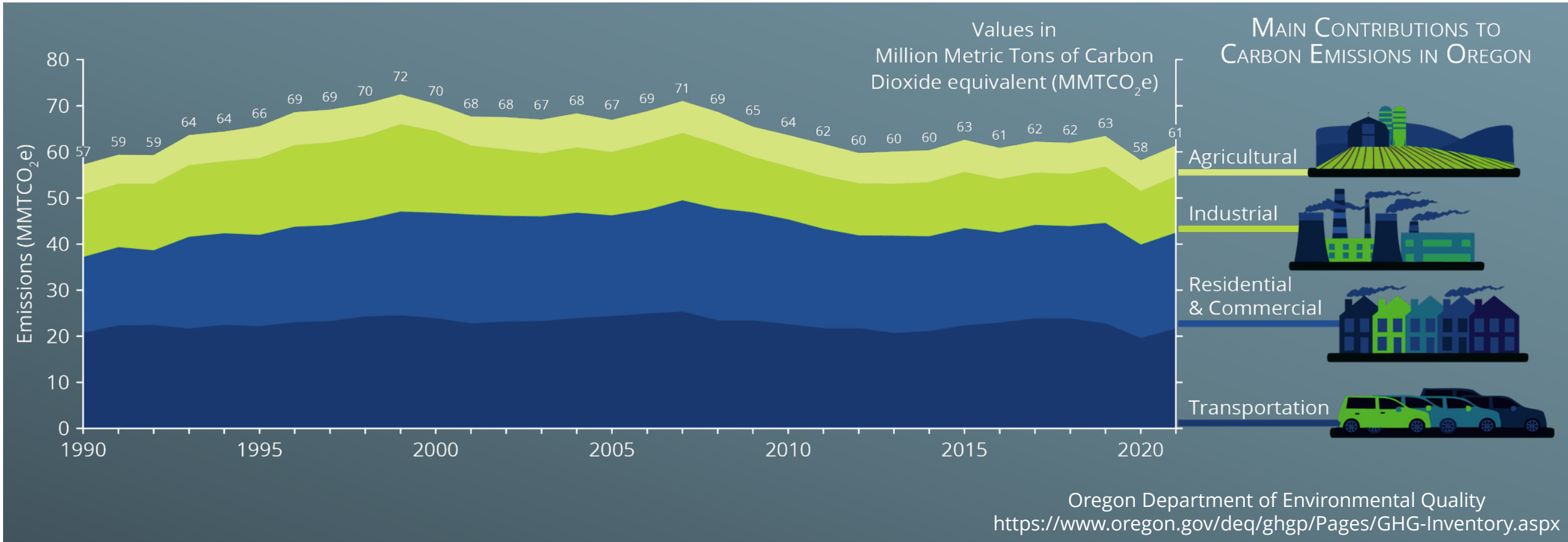
Geothermal Energy



Flyers developed for the *Decarbonization Geoscience Focus Area* to highlight DOGAMI's current and future roles in the State's decarbonization goals

Carbon Emissions in Oregon

Across DEQ, ODOE, ODOT, and Metro, over 35 coordinated initiatives are underway to advance Oregon's emissions-reduction goals. Carbon sequestration and storage provide additional opportunities to offset emissions.



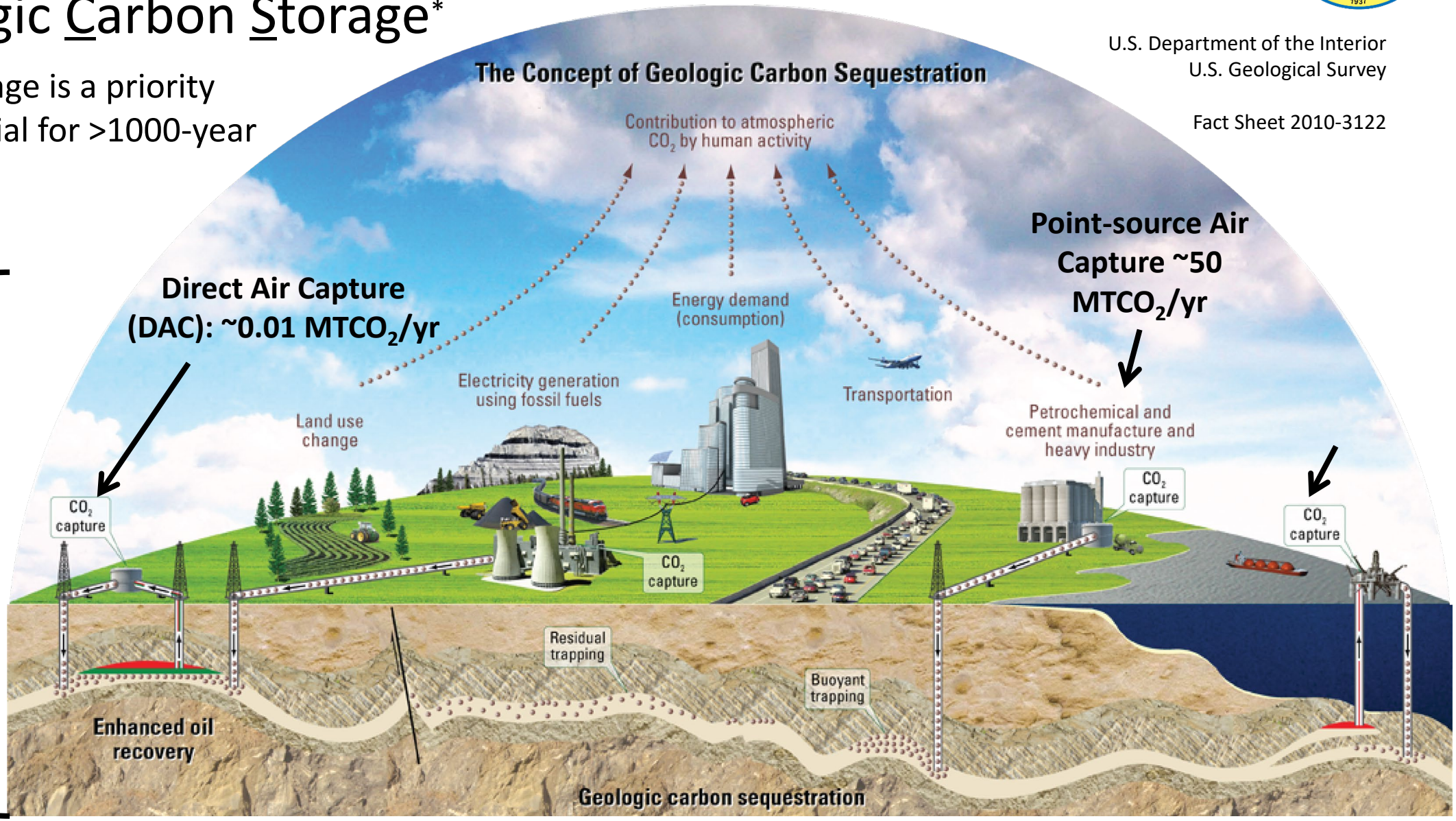
Oregon Department of Environmental Quality
https://www.oregon.gov/deq/ghgp/Pages/GHG-Inventory.aspx

CCUS: Carbon Capture, Utilization, Storage
GCS: Geologic Carbon Storage*

- Long-term storage is a priority
- GCS has potential for >1000-year storage

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

Fact Sheet 2010-3122



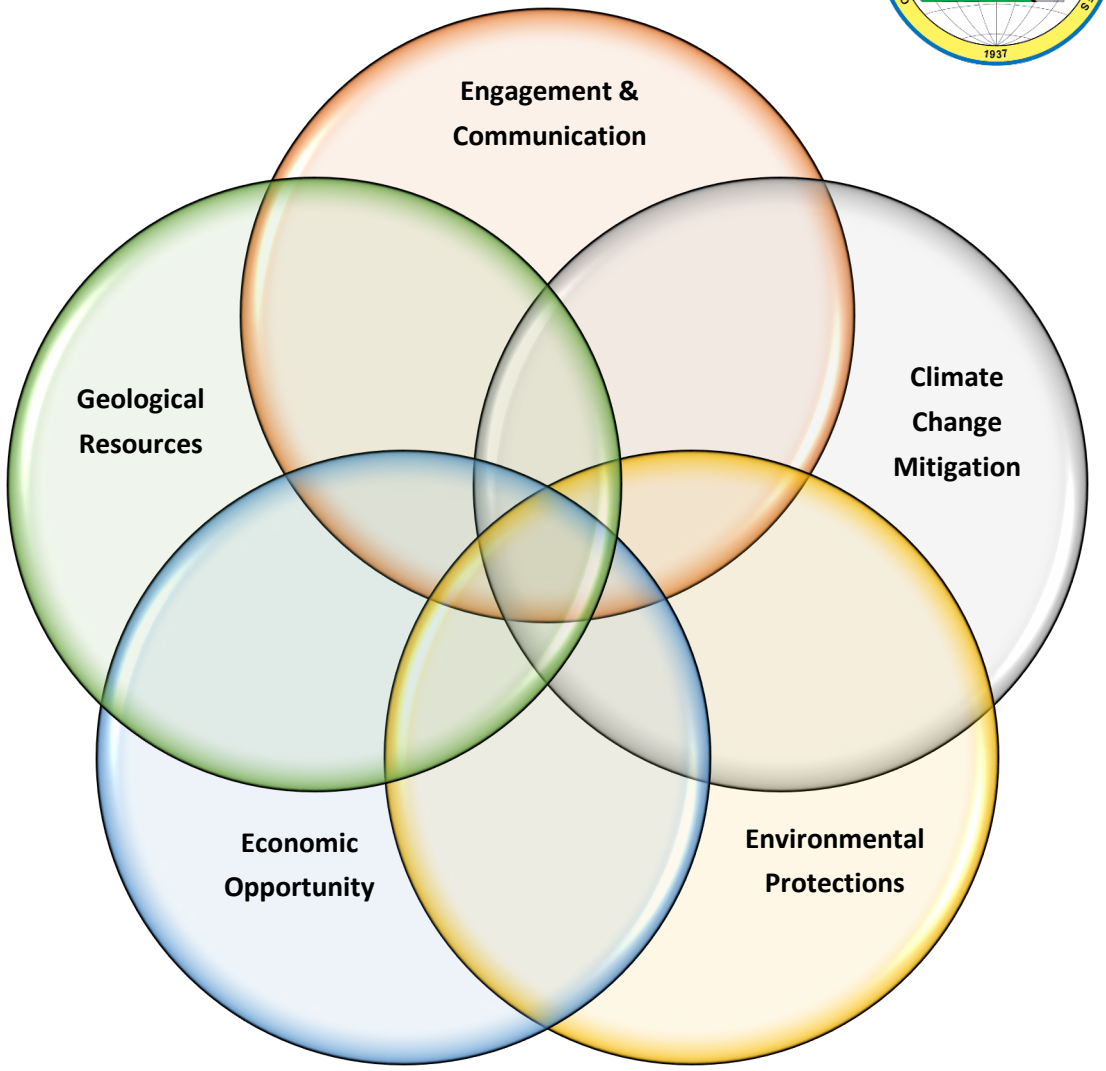
CCUS

GCS

Geologic Carbon Storage in Oregon

Considerations for Oregon:

- Examine all solutions to meet climate goals
- Geologic carbon storage is an established technology
- The technology can be assessed in Oregon
- Requires coordinated partnership amongst the state, interested parties, and Tribal governments and communities



The <u>first</u> and <u>most</u> important step is to understand the subsurface geology

Geologic Carbon Storage: The Columbia River Basalt Group (CRBG)

CRBG: ~81,000 sq. miles

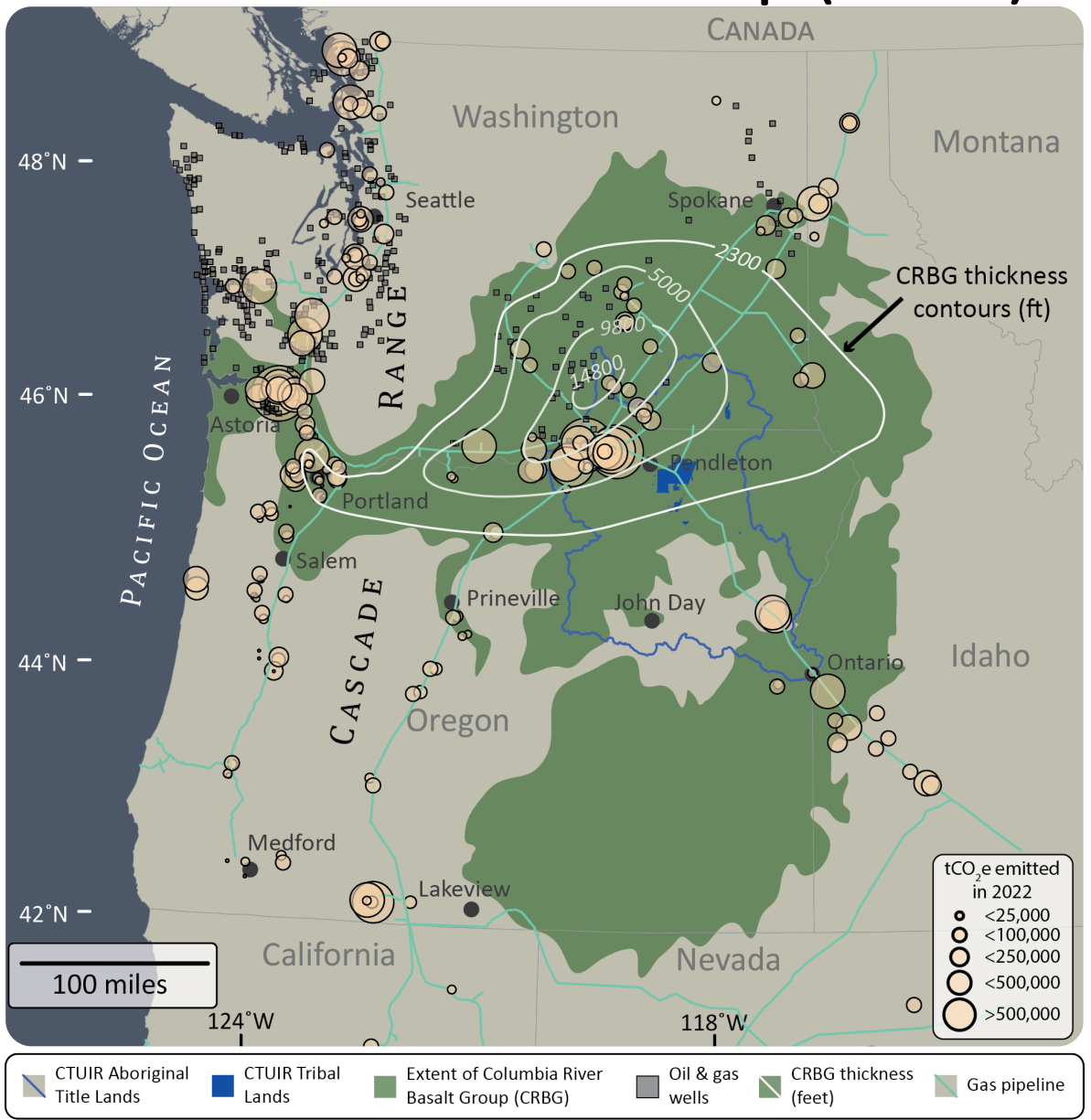
CRBG volume:

- Maximum thickness ~2.8 miles
- Total volume ~50,000 cubic miles

Estimated CO_2 storage capacity ranging from 40-100 billion metric tons (Gt)

-- aka --

1 - 2.5 years of the global CO2 emissions or >600 years of Oregon's current emissions!



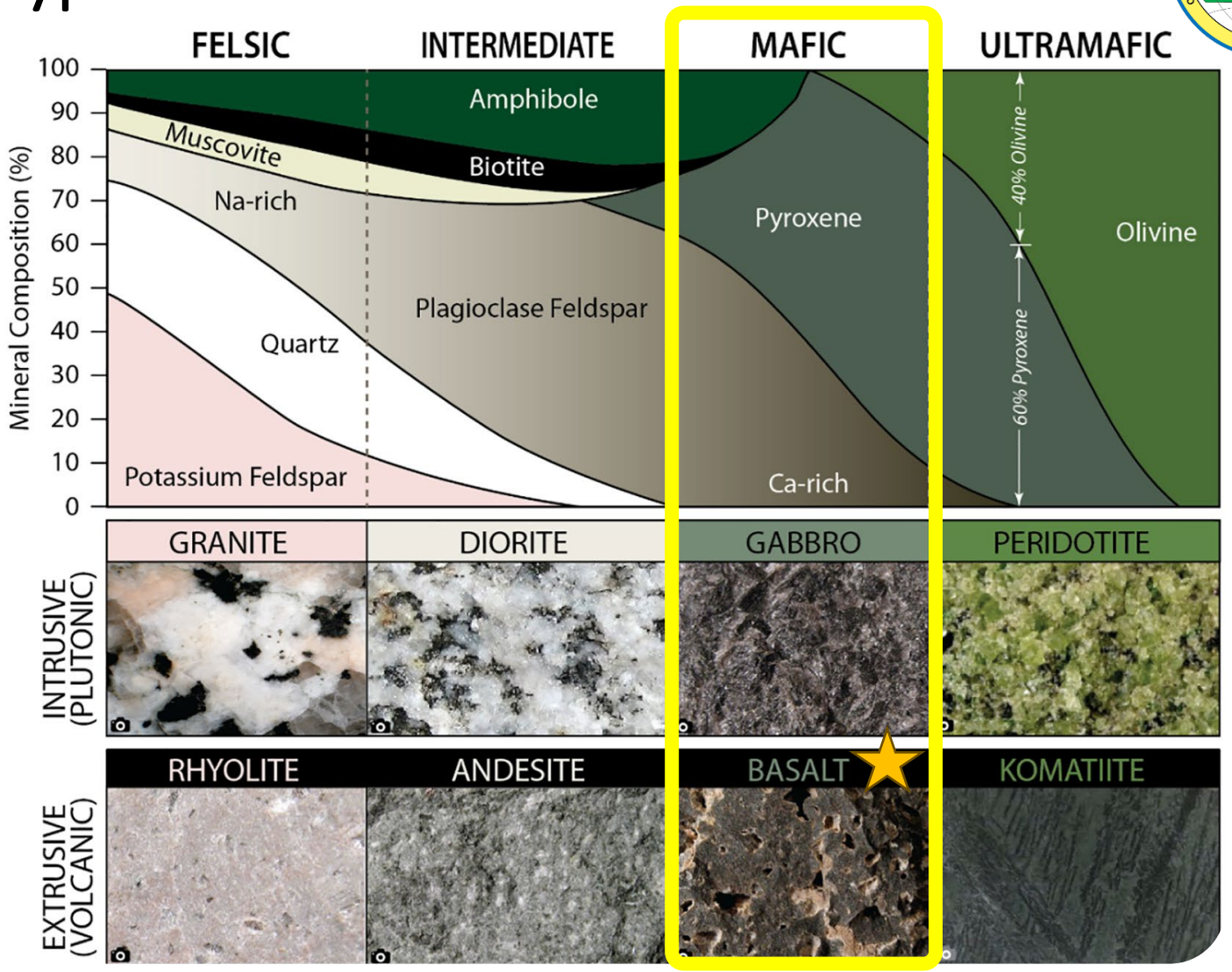
Mineral Carbonation - Rock Types

Highest potential in ultramafic / mafic rocks:

- High concentration of metal cations
- High reactivity
- Potentially large surface area

Process occurs in nature, with mineralization rates controlled by:

- Temperature
- Pressure
- CO_2 concentration
- Chemistry



Geologic Storage Mechanisms

1. Structural / stratigraphic trapping

- CO_2 is less dense than water and buoyantly rises after injection
- Rising CO_2 can become physically trapped under impermeable layers

2. Residual trapping

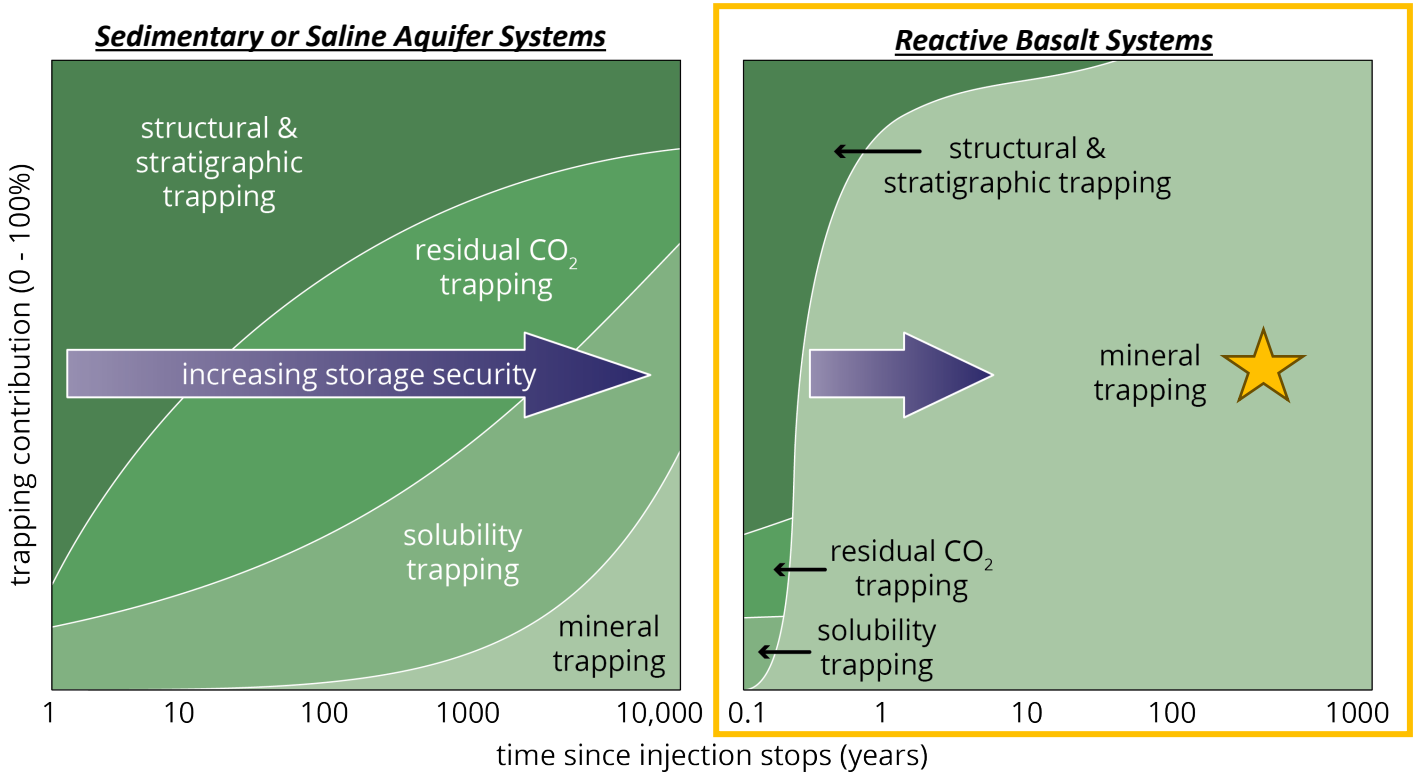
- As CO_2 moves through a porous rock, small droplets become stuck within the pore space
- This creates a *residual phase* of CO_2 that is immobile

3. Solubility trapping

- Over time, fluid CO_2 dissolves into the pore water
- This dissolved CO_2 can become trapped with formation waters

4. Mineral trapping ★

- Over time CO_2 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 CO_2 trapping



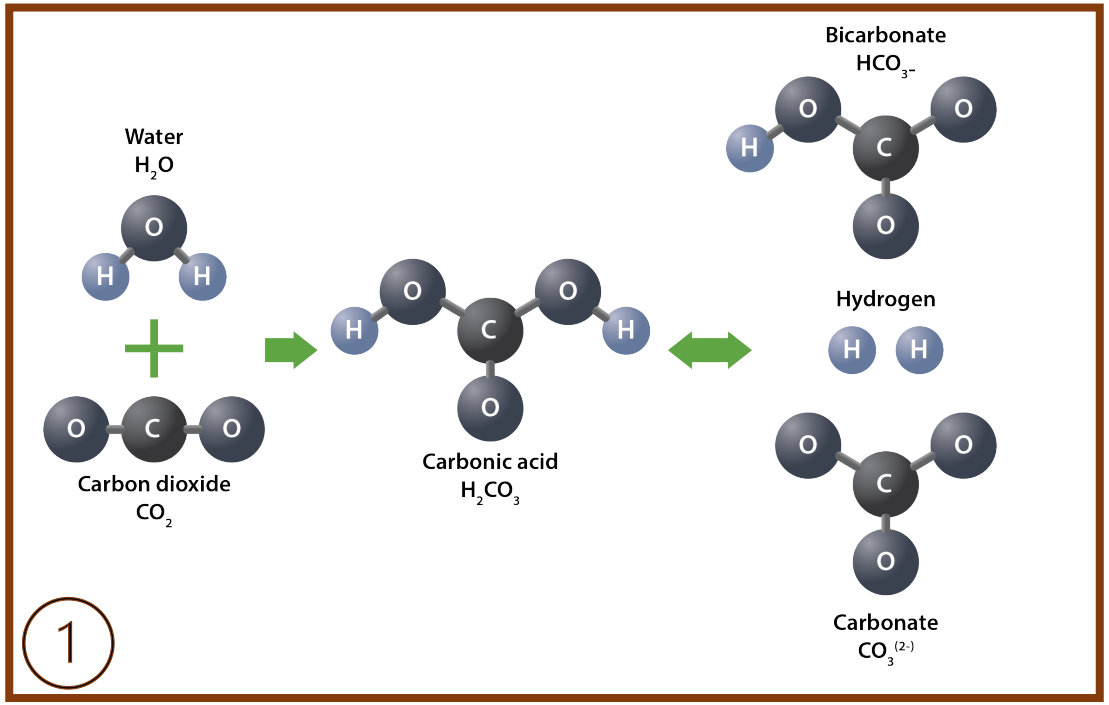
Kelemen et al., 2019, *Frontiers in Climate*

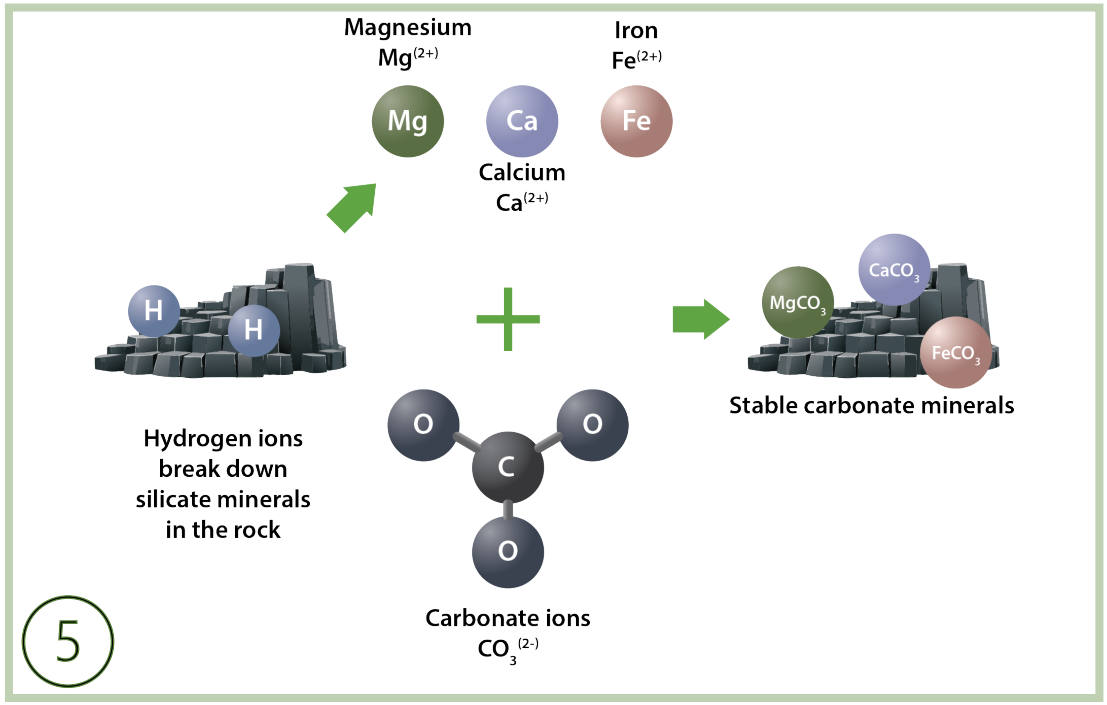
Carbonation Chemistry: Reactive Basalt Systems

Requires

1. **Acidic fluid conditions for dissolution**
2. Reactive host rock + dissolved CO_2 in fluids
3. High concentration of divalent cations: calcium, magnesium, iron (**Ca, Mg, Fe**)
4. Permeable rocks for fluid flow
5. **Alkaline fluid conditions for mineral precipitation**

4





From: Sikurajapathi et al., 2025, *Fuel, 395*

Turning carbon dioxide (CO_2) into stone

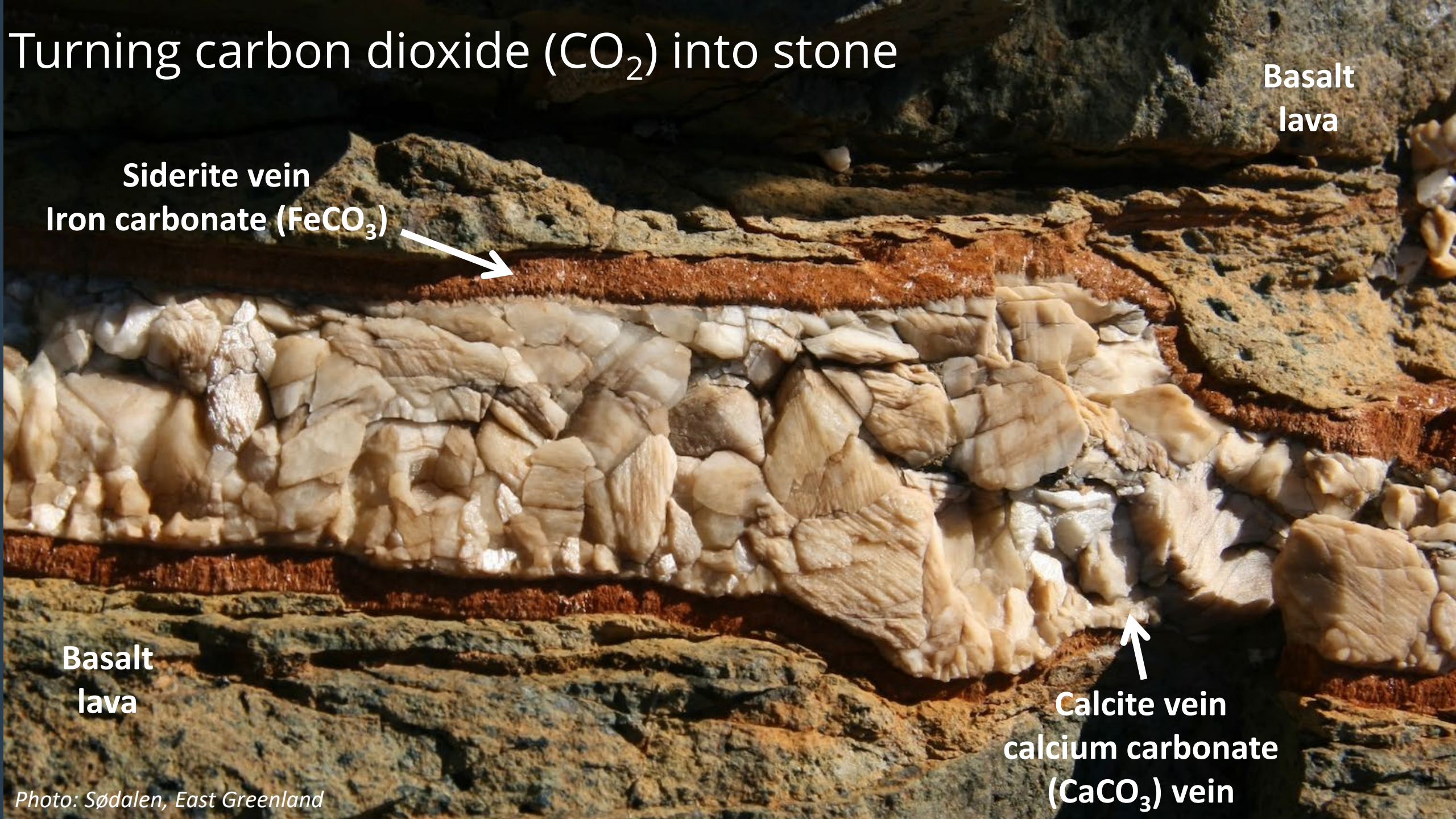


Photo: Sødalen, East Greenland

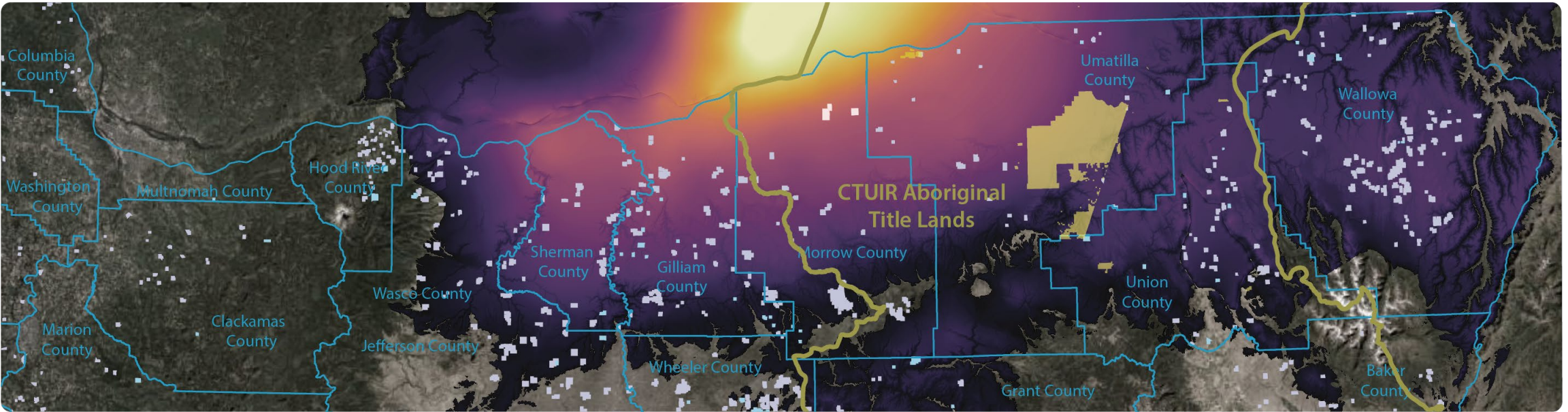
The Geologic Carbon Storage (GCS) Project

Recognizing the severity of the climate crisis, the Oregon legislature approved funding for DOGAMI to ***investigate Carbon Storage feasibility in the Columbia River Basalts in NE Oregon***

DOGAMI 2025-2027 Budget Bill HB 5010 provided a $10 million one-time other-funds limitation and four limited-duration positions to investigate geological carbon sequestration feasibility (funded in part by the Department of State Lands).

DOGAMI is the Technical and Operational Lead

No CO_2 injection will occur during the feasibility study



The Geologic Carbon Storage (GCS) Project

The GCS project includes:

- 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 chemistry, 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.

Geologic Carbon Storage: Success Criteria

Category		Criterion	Specific Target / Requirement	Why it Matters
Geology	☑	**Basalt Thickness**	Minimum 400-800 m total thickness	Minimum 400 m depth for dilute injection and 800 m for supercritical. Maximize separation from USDWs.
		Mineral Chemistry	High Ca^{2+}, Mg^{2+}, Fe^{2+} content	Metal cations required to turn CO_2 into rock.
		Caprock Integrity	Formations with thick lavas that include low-permeability flow cores	Prevents buoyant CO_2 from migrating upward before it mineralizes.
		Structural Setting	Simple horizontal bedding; >5 miles from major or active faults.	Reduces risk of leakage and minimizes potential for induced seismicity.
Hydrology		**Water Salinity (TDS)**	Target formation fluids with >10,000 ppm total dissolved solids.	Regulatory compliance (EPA Class VI); avoids contamination of Protected Underground Sources of Drinking Water.
		Injectivity Potential	High transmissivity in interflow zones (rubbly flow tops).	Ensures the rock can take fluid at a high enough rate to be economically viable.
Logistics	☑	**Proximity to Source**	Within 5–10 miles of a CO_2 source or transport hub.	Even if the test well is not used, a future pilot or commercial site must be near the CO_2 source, or potential source.

Community engagement is essential to our success.
Building trust, transparency, and meaningful relationships is just as important as the technical work.

COMMUNITY ENGAGEMENT

Approach

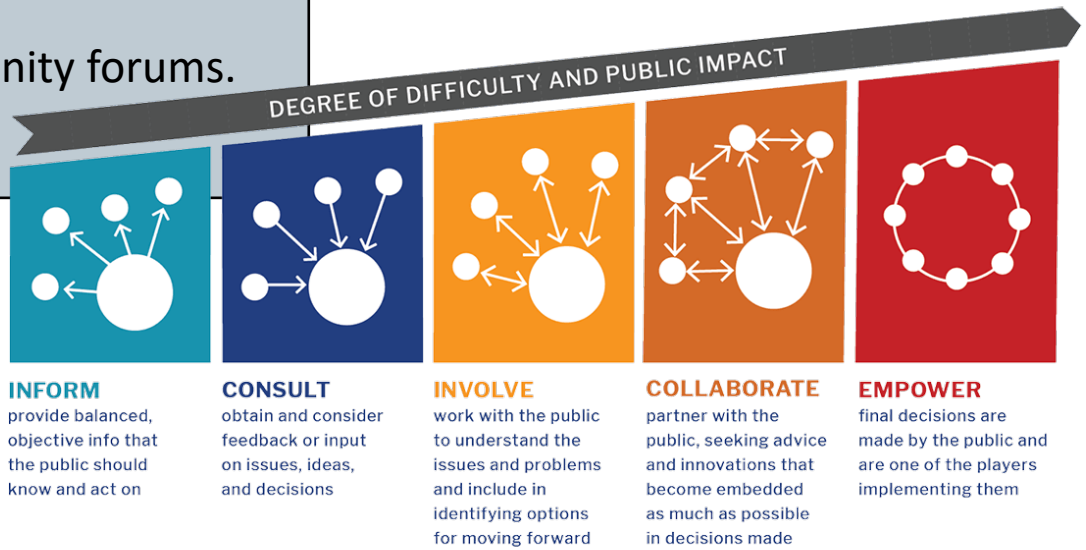
- **Communicate** early and often.
- **Coordinate** with DSL and other state agencies.
- **Listen** to Tribes and communities – ideas, traditional ecological knowledge, data needs, perspectives, and concerns.
- **Respond** and incorporate feedback.
- **Integrate** engagement into all project phases.
- **Communicate** ideas, perspectives, concerns to decision-makers.

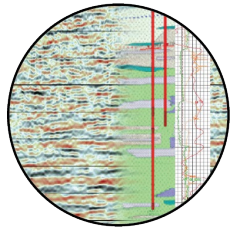
Methods

- **Conduct** in-person and virtual listening sessions.
- **Facilitate** community capacity building by providing resources for informed decision making.
- **Share** information through local and statewide media.
- **Release** surveys and project newsletters.
- **Plan** educational programs: schools, colleges, museums, community forums.
- **Create** internship opportunities.

Goals

- **Strengthen** *Trust* with Tribal and community partners.
- **Learn** community perspectives.
- **Provide** community benefits.
- **Inform** decision-makers.
- **Facilitate** decision-making.





Key technical aspects of the GCS project

TECHNICAL FEASIBILITY

Build the research team:
3 positions

Site selection for stratigraphic information well(s)
- Access rights
- Infrastructure
- Geologic criteria

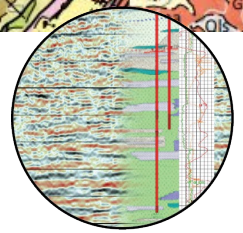
Well design, drill planning, permit applications

Exploration permit from *DOGAMI's Mineral Land Regulation and Reclamation* program

Install an information well on DSL property

Hydrologic and chemical data
- Water type and quality: **Extract water** for chemistry and dissolved solids content
- Water distribution: **Inject clean water** to identify reservoirs and seals

Rock analysis
- Sampling of rock (cuttings and core) for laboratory engineering and chemical composition
- Optical and geophysical imaging methods



Data, report, and formal publications: 25-27 GCS project

TECHNICAL FEASIBILITY

COMMUNITY ENGAGEMENT

REGULATORY STRUCTURE

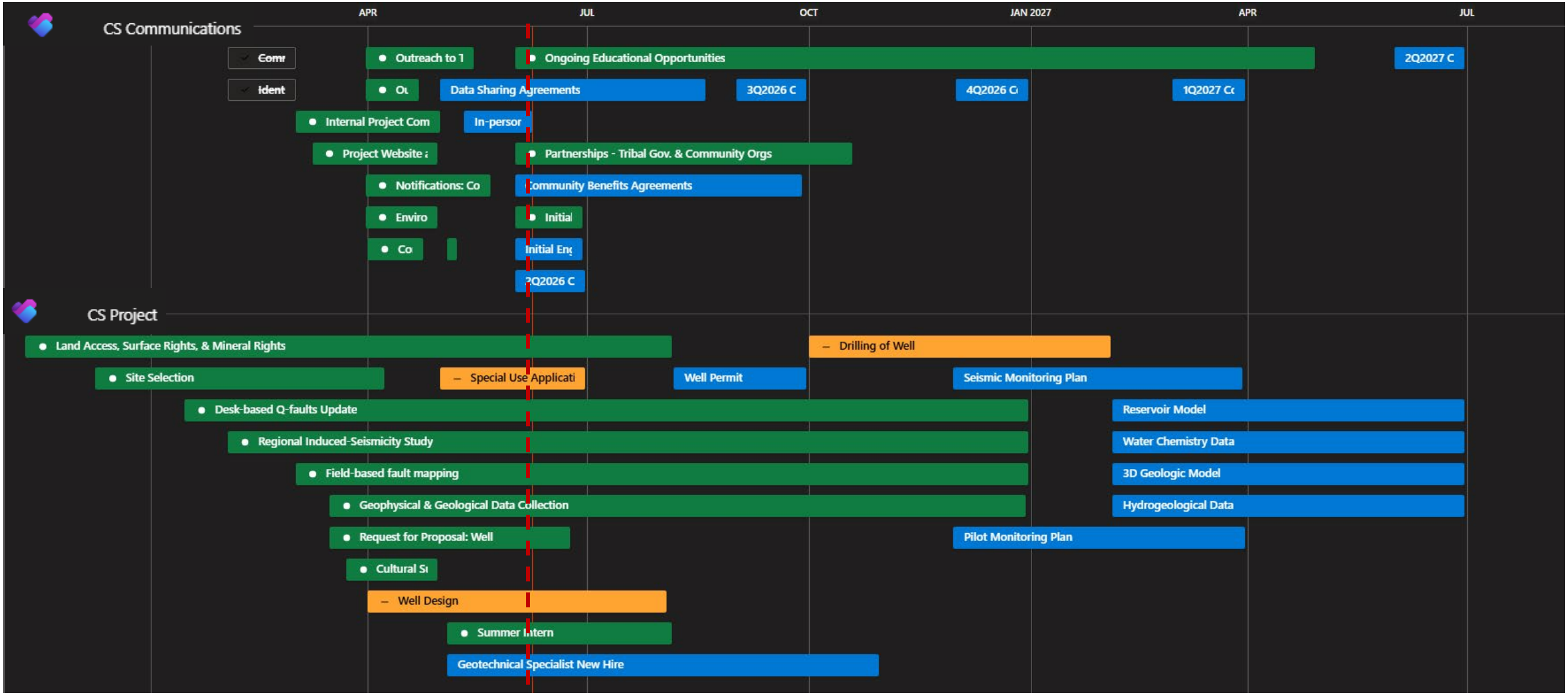
The project will **collect and synthesize geologic and hydrologic data**, at the surface and below

Key areas include:

- New geologic mapping to **recognize active and inactive faults** in the region: update Tectonic fault database
- **Regional seismic-hazard analysis**
- New 3D geologic model
- Basalt rock properties measurement, including **rock strength and fluid flow properties**
- **Subsurface conditions**: forces acting on the rocks, the pressure of water below the surface, and the temperature gradient
- Rock and water chemistry at depth: water quality, temperature, and **source of water**.
- Pilot-scale **techno-economic assessment** of geologic carbon storage from source to sink.
- **Community and Tribal Engagement** results.
- Regulatory framework investigation on the **assurance of protection of communities and resources**.

Key Point – All data will become available to the public following completion of the project at https://www.oregon.gov/dogami/

Carbon Storage Project: Roadmap



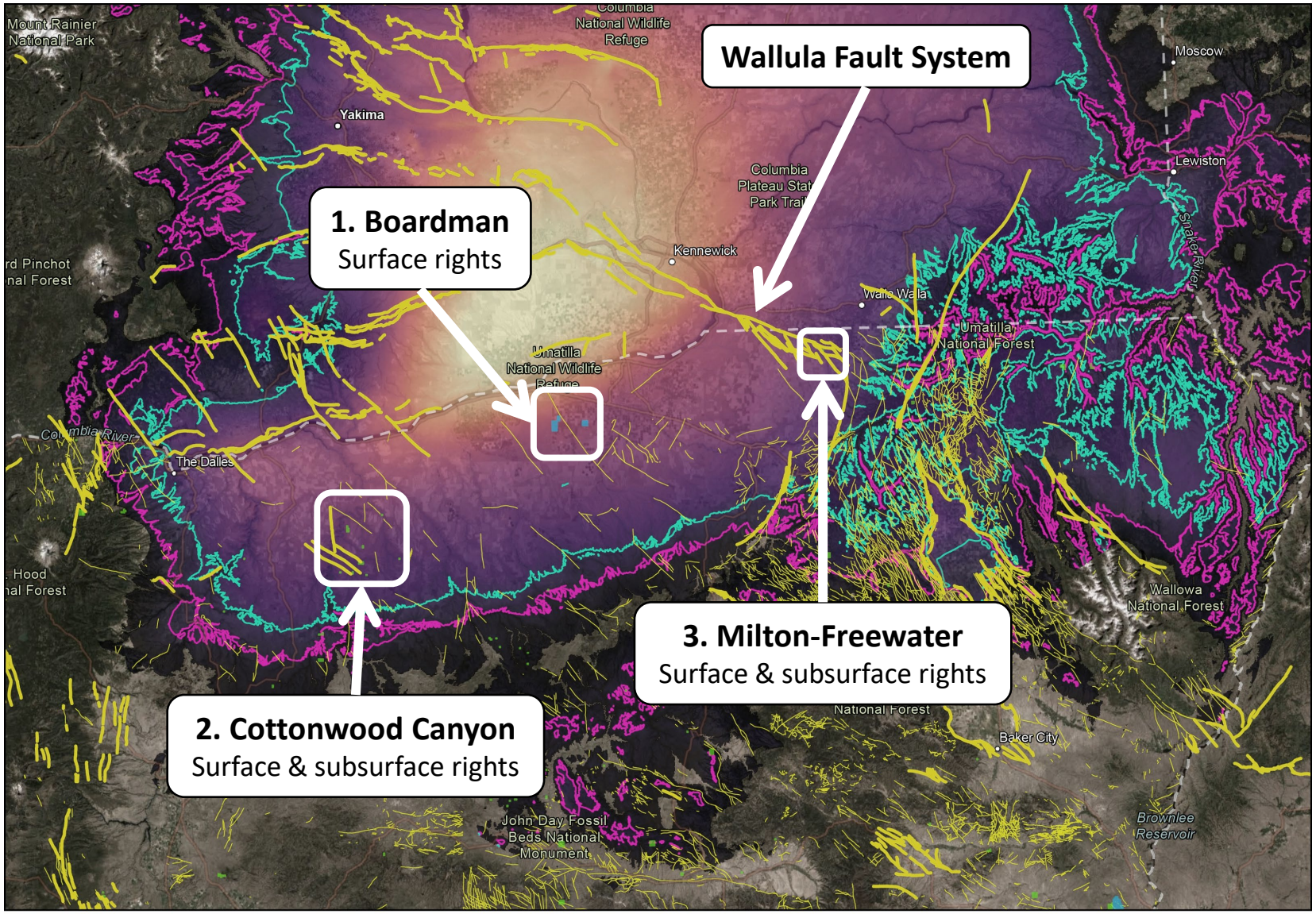
Site Selection Criteria

- An exploration well is critical in validating a basalt CO_2 storage site

- Siting is strategically chosen to provide the most representative data across the key criteria:
  - Safety
  - Mineralization Potential
  - Storage Capacity
  - Injectivity & Operational Feasibility

- Decision criteria on where to drill are focused on maximizing information about the flow path and reactivity of the target reservoir

Category	Criterion
Geology	Basalt Thickness
	Mineral Chemistry
	Caprock Integrity
	Structural Setting
Data Gaps	Legacy Subsurface Data
	Borehole Ground Truth
Logistics	Proximity to Source
	Distance to Utilities
Surface Ownership & Access	Rights & access
	Footprint & Slope
	Road Infrastructure



Faults
Quaternary (recent)
All other ages

Thickness Contour
400 m
800 m

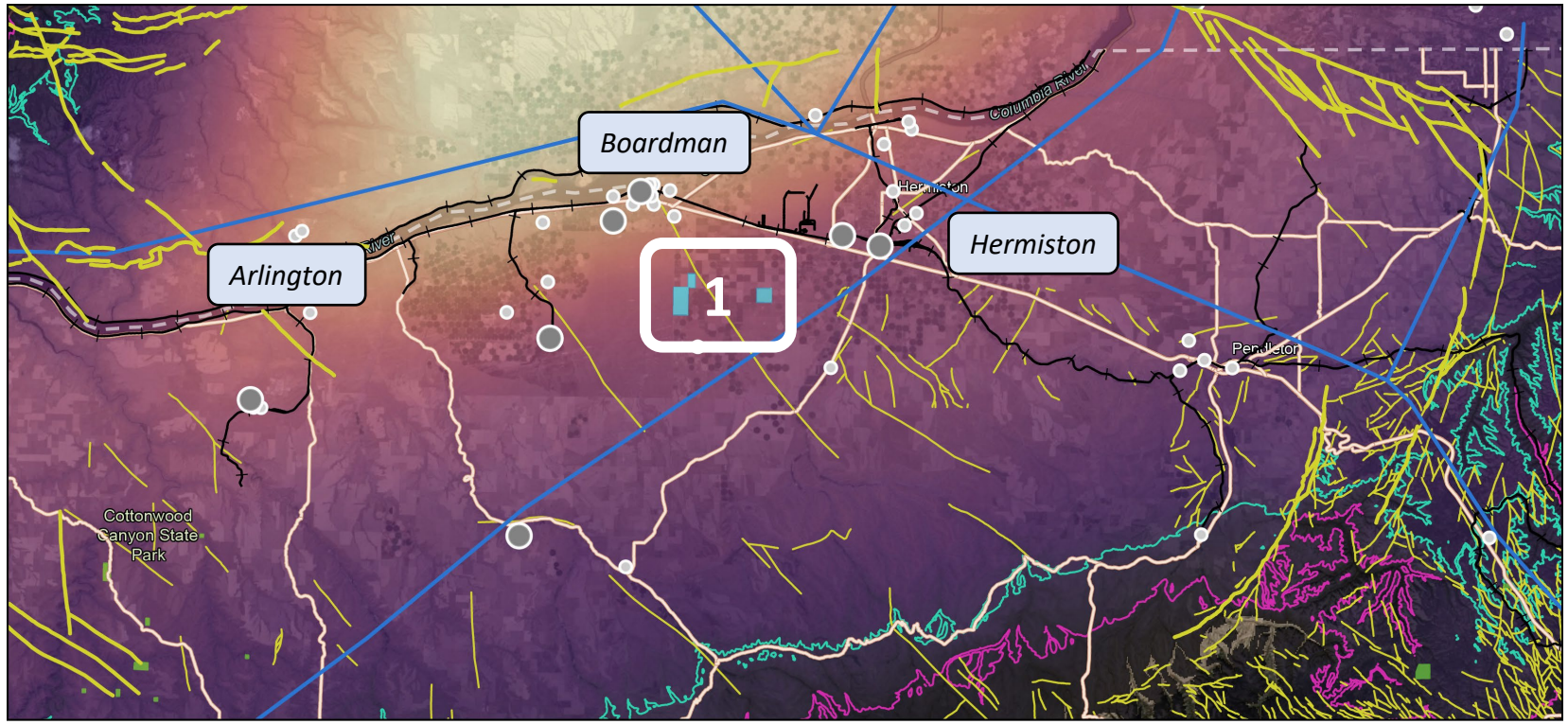
Columbia River Basalt modelled thickness (Columbia Basin)
0
17,000 ft
5,250 m

0 12.5 25 50 Miles
0 12.5 25 50 Kilometers

Site selection
Category 1: Geology

- DSL school lands
- Columbia River Basalt modeled thickness
- Minimum thickness for injection technologies
- Proximity to *recent* faults
- Proximity to *other* faults

Site selection Category 2: Logistics



- Proximity to CO_2 sources
- Existing infrastructure

- Next and Ongoing:
  - Required access rights for drilling
    - In consultation with DOJ
    - Site specific potential for cultural significance
  - Assess and fill data gaps
  - Well planning
  - DSL special-use application

1: Boardman sites: *surface rights only*
2: Cottonwood Canyon sites: *surface & subsurface rights*
3: Milton-Freewater site: *surface & subsurface rights*

Carbon Storage Project: Test Well Update

We are here

- Land Access — In Progress
- Surveys — In Progress
- RFP — Awardee: Jul. 2026
- Well Design

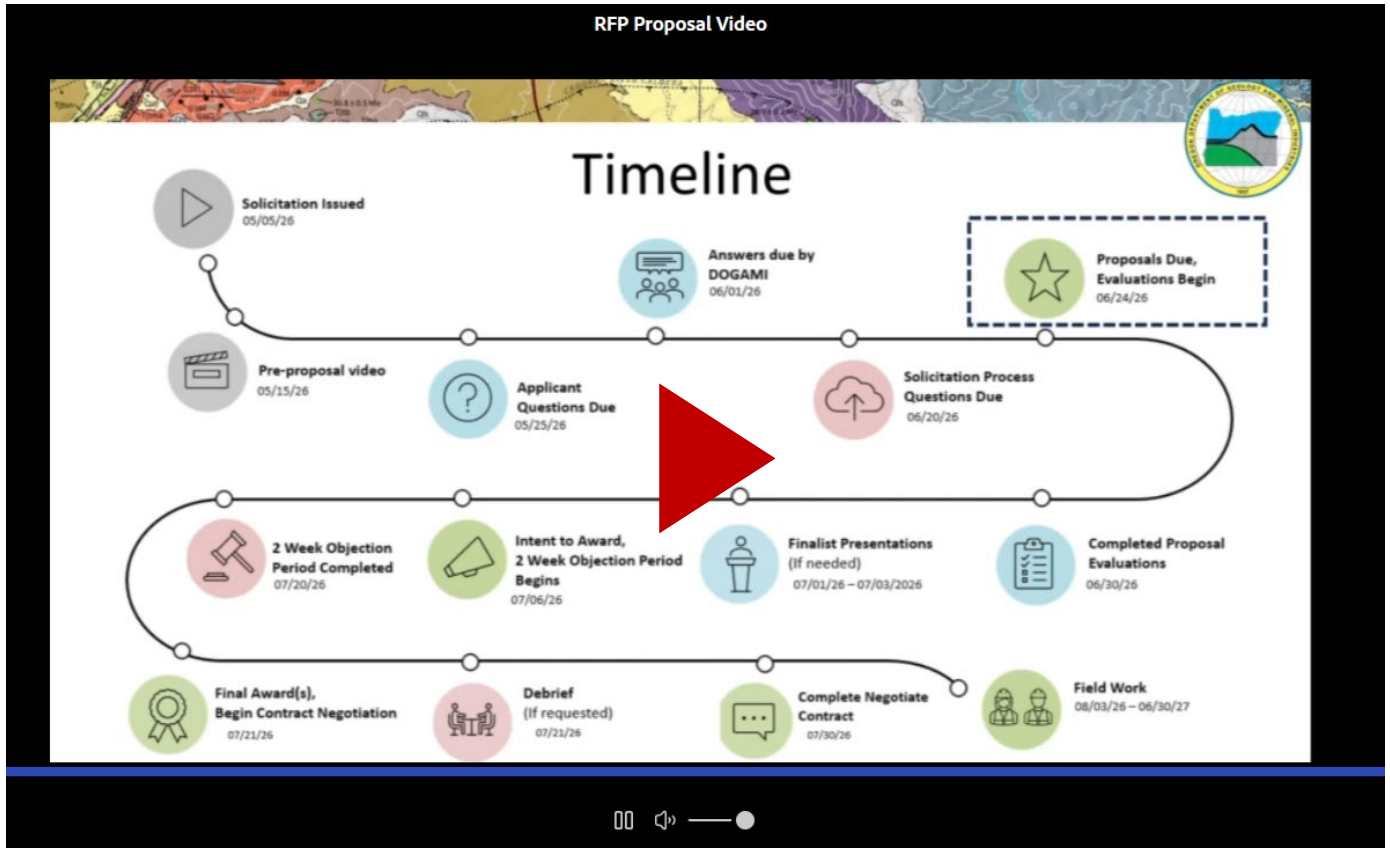
→ Well Permit — ETA: Aug. 2026 → Drilling Well — ETA: Sept. 2026 →

- Hydrogeological Data
- Water Chemistry Data
- 3D Geologic Model
- Reservoir Model

ETA: Jan. 2027

Request for Proposals (RFP)

- [State of Oregon - Bid Solicitation - S-63200-00016863]
  - Solicitation Timeline (Closes June 24th at 3:00pm PST)
  - Proposal
  - Video link and references
  - Q&A from proposers



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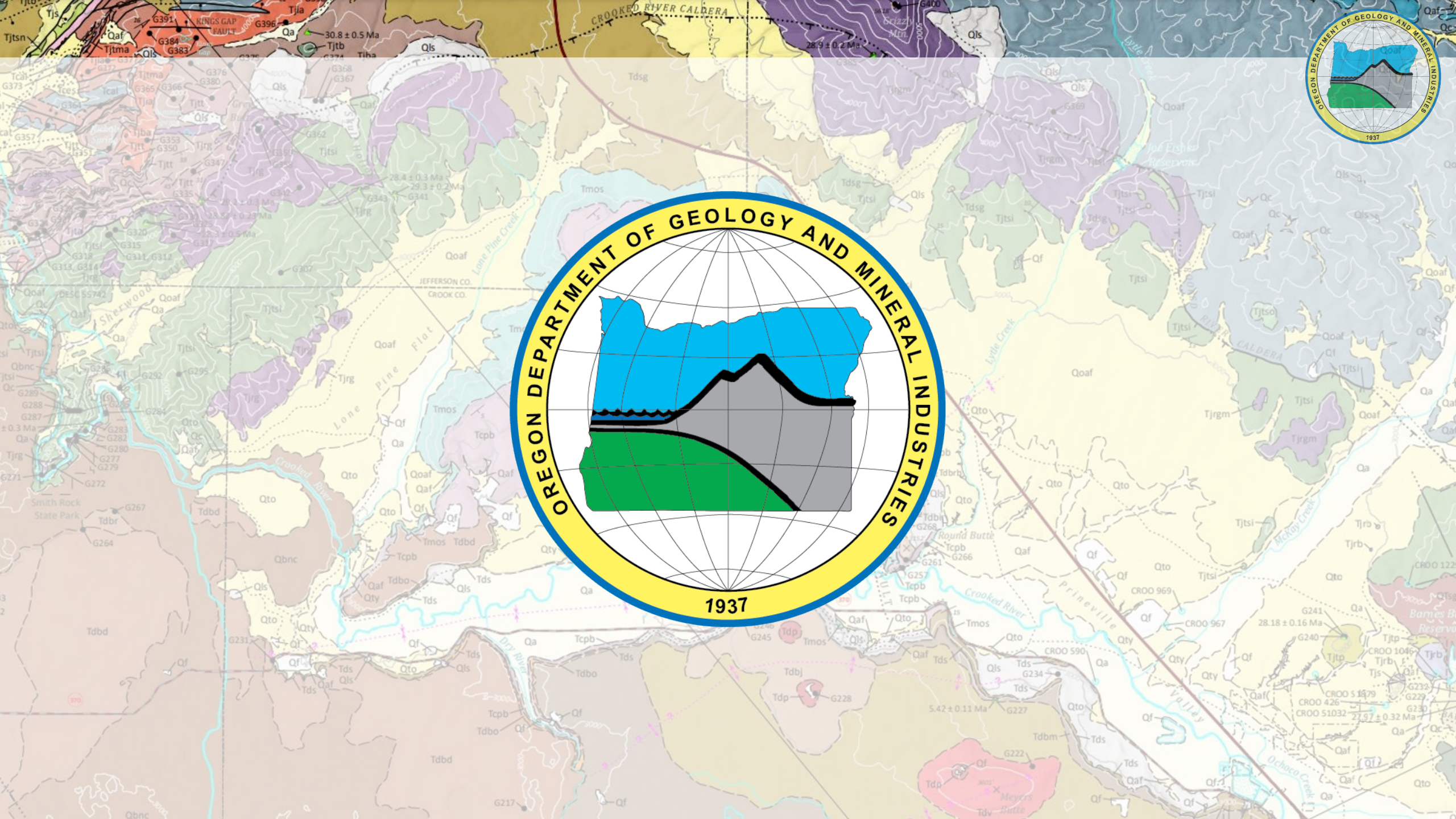
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Continuous Data Aggregation

OWRD Water Well Database & Data Share