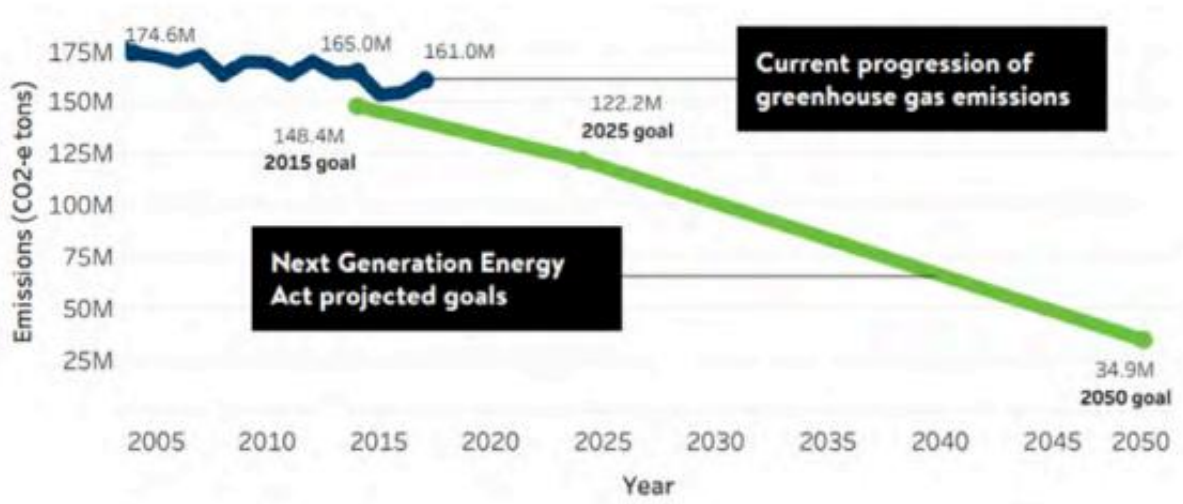
Minnesota's Climate Action Framework



Geologic Carbon Sequestration

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Difference between Geologic Carbon Storage vs Geologic Carbon Mineralization

Geologic Carbon Storage

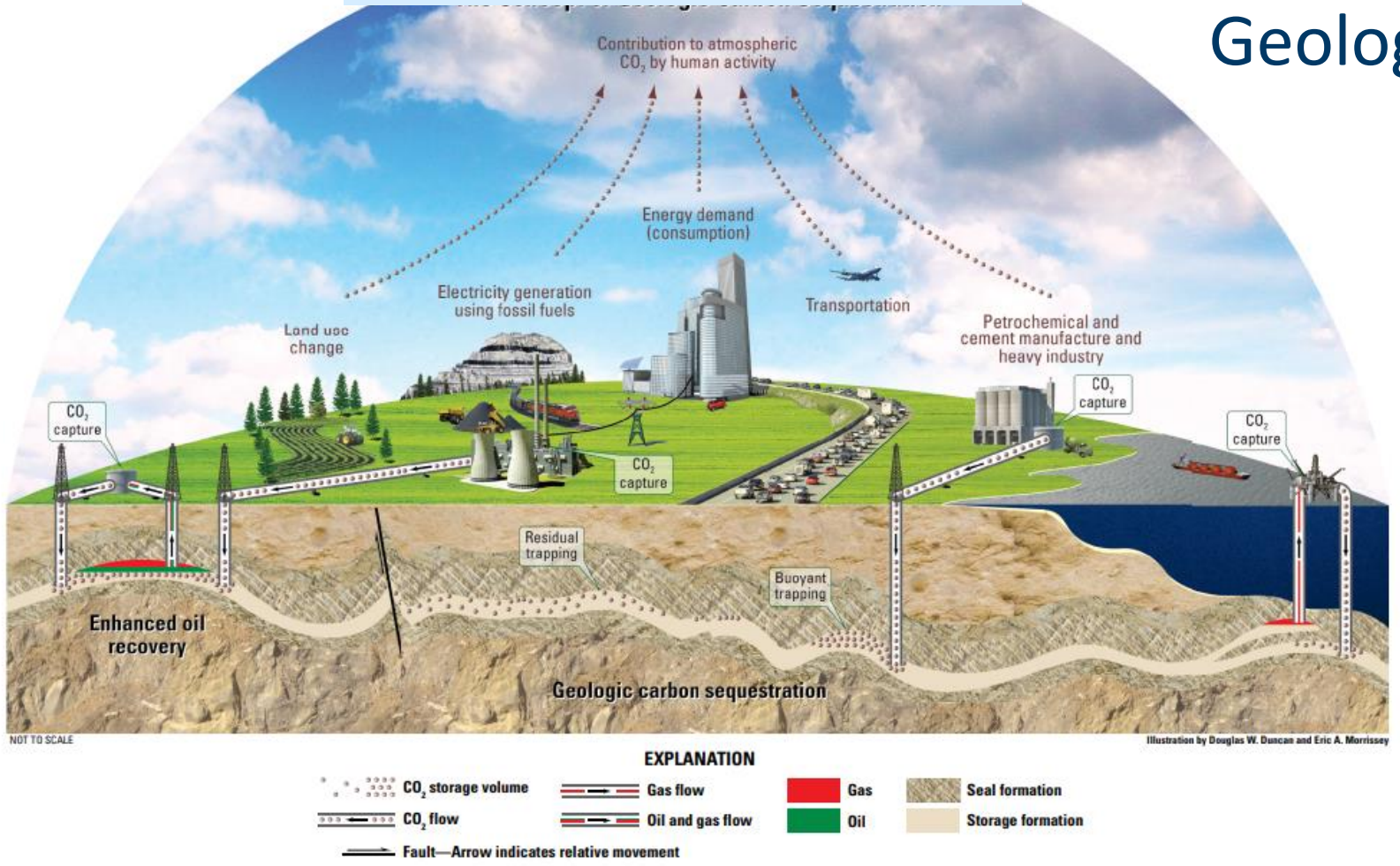


Figure 1. Figure illustrating the concept of geologic carbon sequestration. Figure composed by Douglas W. Duncan and illustrated by Eric A. Morrissey.

Capture CO2 from stationary industrial sources, like power and ethanol plants

Transport via truck or pipeline

Use porous geologic formations at least 1-2.5 km below the surface to store CO2. Formations are known because they also trap and store oil and gas.

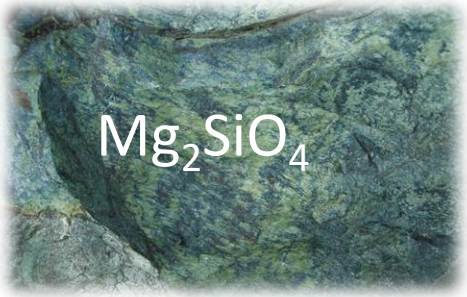
Inject CO2 into existing oil and gas wells

CO2 can be used to further enhance production of oil and gas

Estimated potential for 30Gt of CO2 storage @ $7 – 13 per metric ton

Geologic Carbon Sequestration – through Mineralization

Olivine



$+ 2CO_2 + 2H_2O$

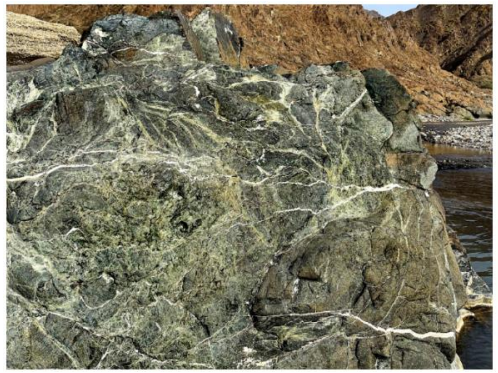
Carbonic Acid
(also known as carbonated water)

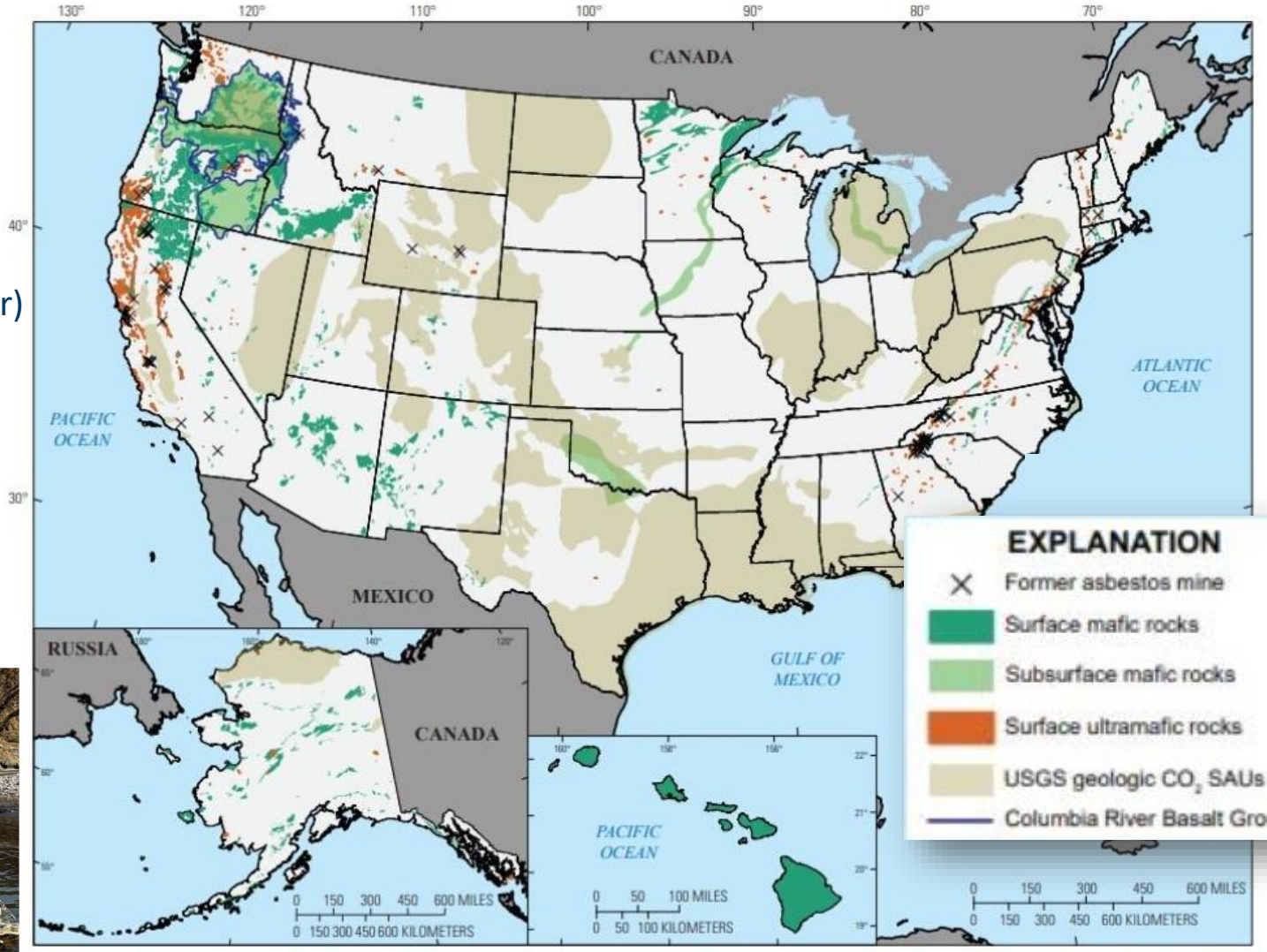
Magnesite

(Magnesium Carbonate)

$+ H_4SiO_4$

CO_2 mineralization occurs at the earth surface. White bands are CO_2 mineralized in a rock (peridotite) formation.





Source: US Geological Survey

Carbon Sequestration

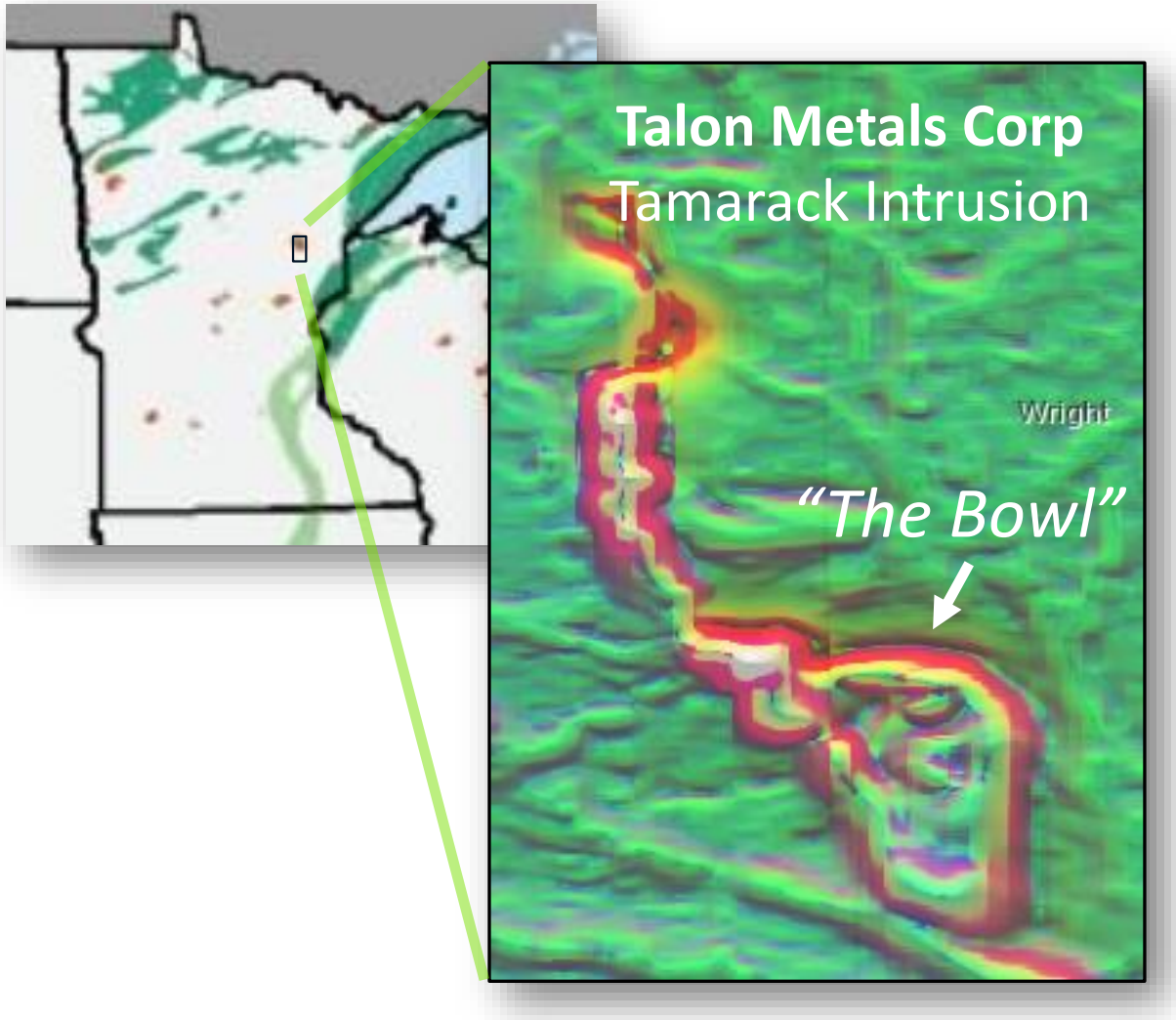
Atmosphere

Biosphere

Atmosphere
Biosphere
Oceans

Significant Potential for Carbon Mineralization

- A discovery in northern MN – within the **Tamarack Intrusion Complex** has significant potential for carbon sequestration through mineralization.
- A potentially 200-2000 feet of highly porous olivine minerals exist in a formation called the “bowl.”
- DOE speculatively calculates that the bowl may have the potential to permanently store ~16 Gt of CO2.



Current Research Activity

Tamarack Nickel Project Selected for Climate Innovation Funding By US Department of Energy

Minnesota to host $6.2 million R&D project exploring carbon storage potential in Aitkin County

Project led by RioTino, partners include:

- Talon Metals Inc.
- Pacific Northwest National Laboratory (PNNL)
- WA State – Columbia University
- CarbFix (a carbon mineralization company based in Iceland)
- Tribal outreach – future partnership with Red Lake Inc. and sponsorship to attend conferences with Mille Lacs Band

A 3-year project funded in 2022:

- $2.2M awarded by US Dept of Energy
- $4.0M funded by RioTinto
- Application for an additional $11M submitted to DOE
- Carbon sequestration has the potential to produce hydrogen.

Interest to the state of Minnesota

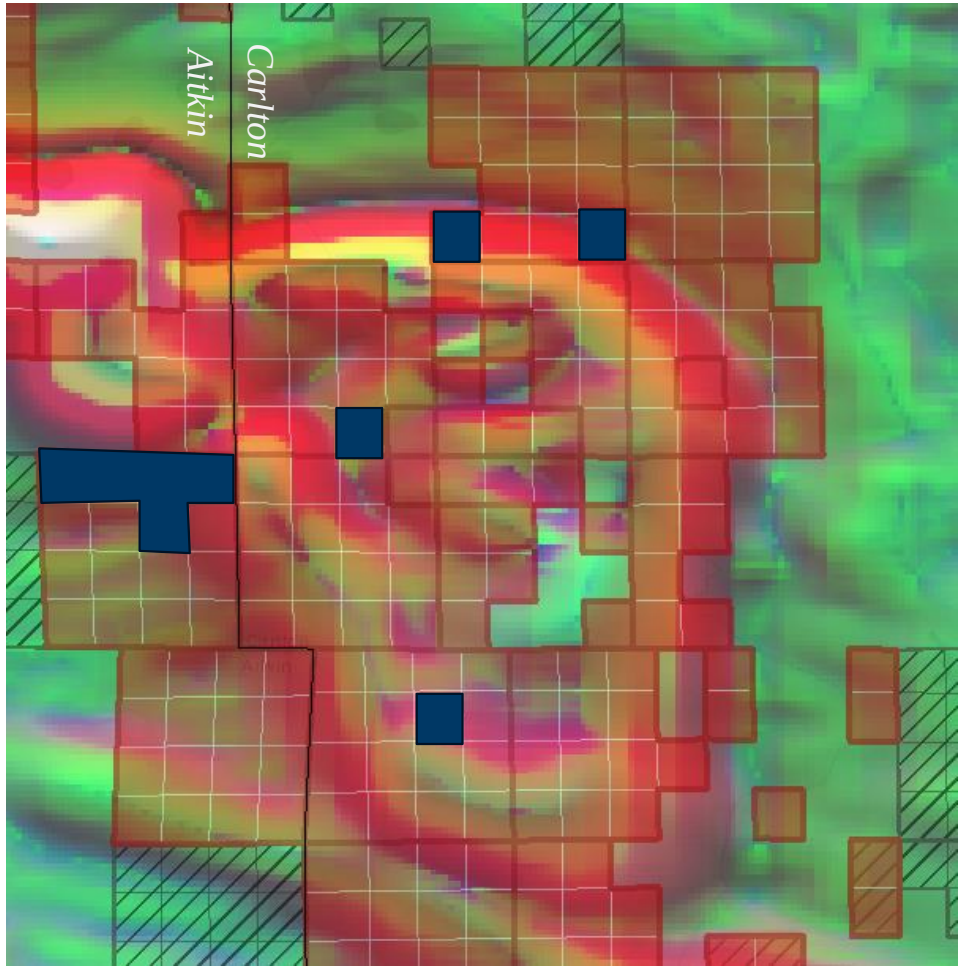
MN owns most of the minerals within the bowl:

- Red Squares indicate active state mineral leases on non-school trust lands (mostly tax forfeited lands).
- Blue squares indicated active state mineral leases on School Trust lands
- Ownership includes mixture of severed and non-severed surface with mineral estate

However, R&D into this method of CO2 is inhibited:

- DNR is not authorized to administer leases/negotiate royalties for carbon mineralization
- Ownership of the pore spaces (surface vs mineral estate) is not well understood
- MN laws prohibit injection wells

Legislation is needed to be able to develop leases to allow pilot and scaled up R&D into this emerging technology



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Thank You!