
GEOLOGICAL SURVEY
WESTERN AUSTRALIA
OPEN DAY
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Mineral Carbonation

An option for CO_2 mitigation in Western Australia?

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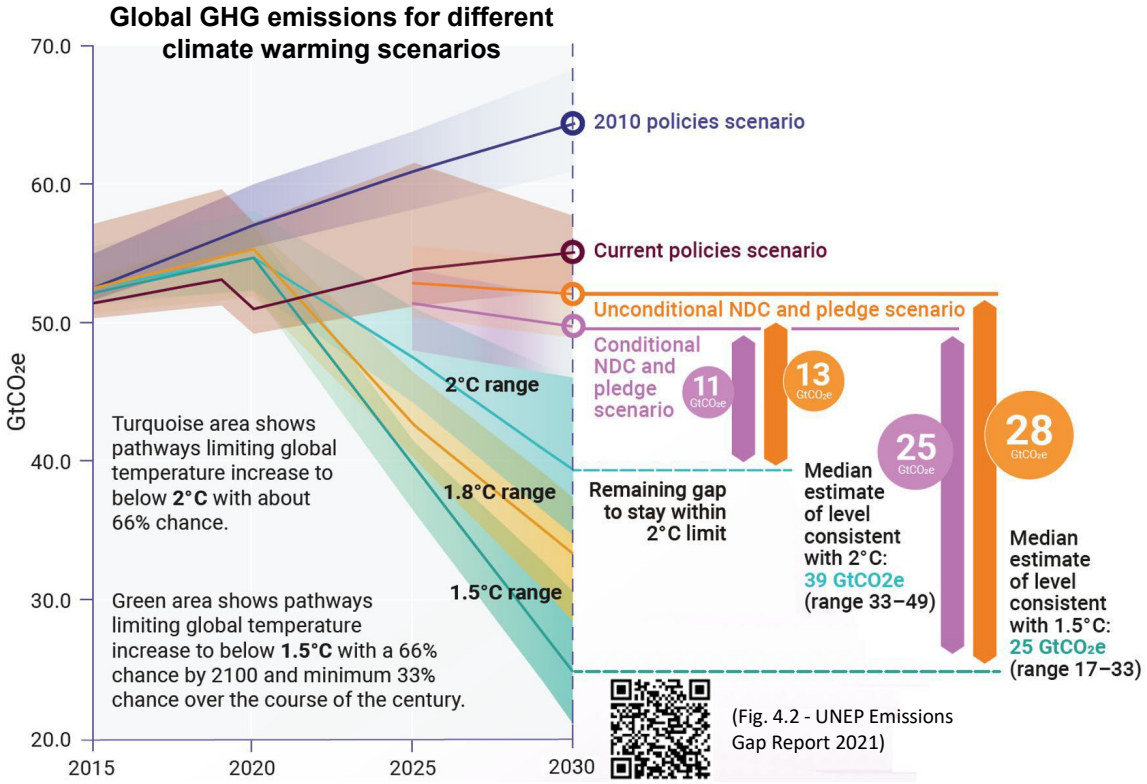
BACKGROUND IMAGE SOURCE – Royal Society

The New Energy Transition

Western Australia aspires to a prosperous and resilient low-carbon future, with net-zero greenhouse gas emissions by 2050

BACKGROUND IMAGE SOURCE - https://www.teriin.org/blog/why-battery-energy-storage-key-renewables-growth

Houston…we have a problem!



(Fig. 4.2 - UNEP Emissions Gap Report 2021)

Huge gap between aspirational and actual CO_2 emission reductions

The deficit must be captured using NETs*

* **NET** - Negative Emission Technology

Mineral Carbonation 101

- **One NET of many**
- **React CO_2 with Mg-, Ca- or Fe-rich silicate minerals**
- **Transform CO_2 into carbonates**
- **Permanent sequestration**

(Ca,Mg,Fe)-silicate + CO_2 + H_2O

(e.g. olivine, pyroxene, amphibole)

↓

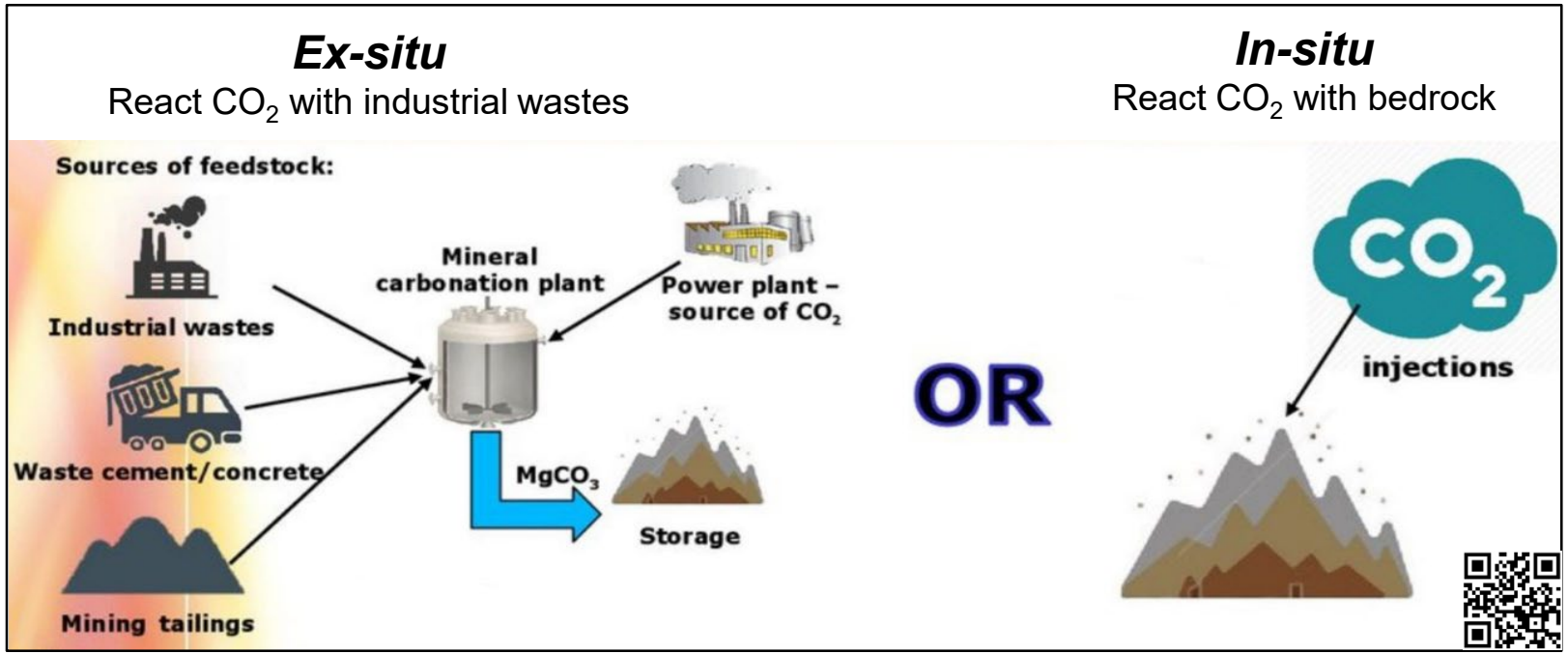
(Ca,Mg,Fe)-carbonate + SiO_2(aq) + heat

(e.g. magnesite, calcite, siderite)

Carbonate-filled fractures in the Samail Ophiolite, Oman
(Credit: University of Colorado, Boulder)

Mineral Carbonation 101

Two processing routes:

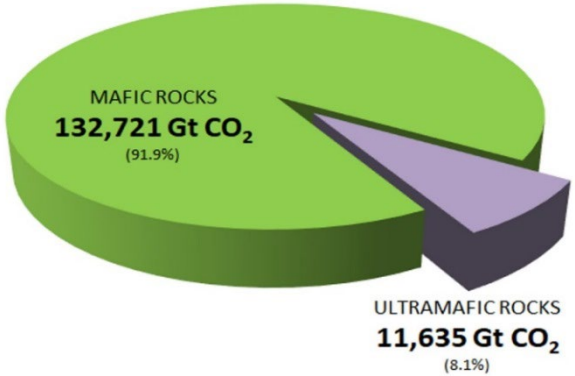


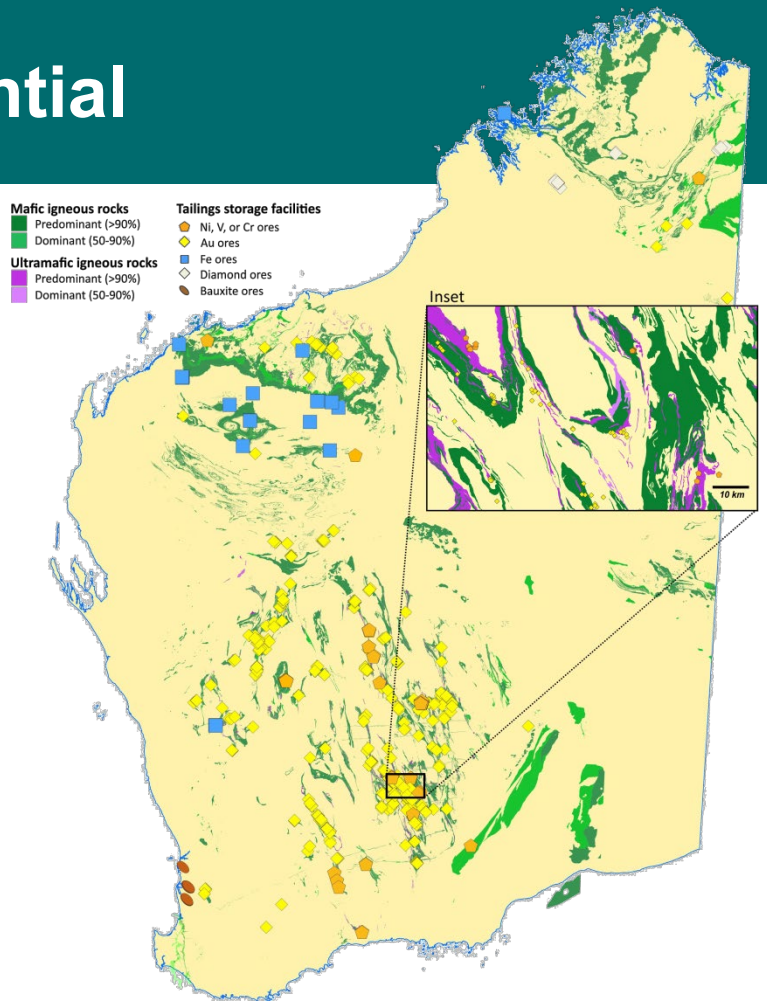
Slide 6 @ https://ppt-online.org/54206

WA mineral carbonation potential

- **Abundant (Ca-,Mg-rich) mafic and ultramafic rocks**
- **Favourable for CO_2 sequestration**
- **Many mines are in or near such rocks (sources of rock and CO_2 feedstocks)**

Theoretical maximum CO_2 sequestration by WA bedrock





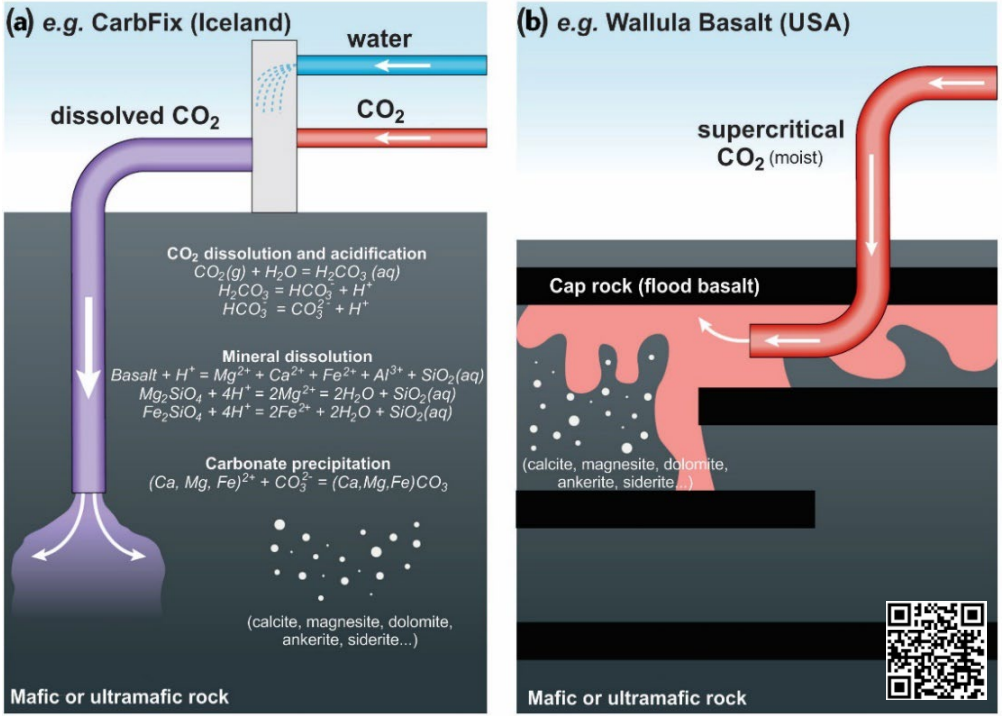
How viable is mineral carbonation?

Technically feasible

Many laboratory studies

Few demo and pilot-scale projects:

- ***In situ***
  (Carbfix, Iceland; Wallula Basalt, USA)
- ***Ex situ***
  (MCi Carbon, Australia)



(modified from Fig 4 in Snæbjörnsdóttir et al., 2020)

The Carbonation Challenge

Not yet economically viable

- **low values of CO_2 and carbonation products**
- **inadequately characterized feedstock resources**
  (e.g. distribution, abundance, chemical & physical properties)
- **lagging government policies**

Tailings storage facility at the Mt Keith nickel mine, WA (Google Earth image)

Making it real (in WA)

Mineral Carbonation Roadmap
(Curtin University & MRIWA Project M10462)

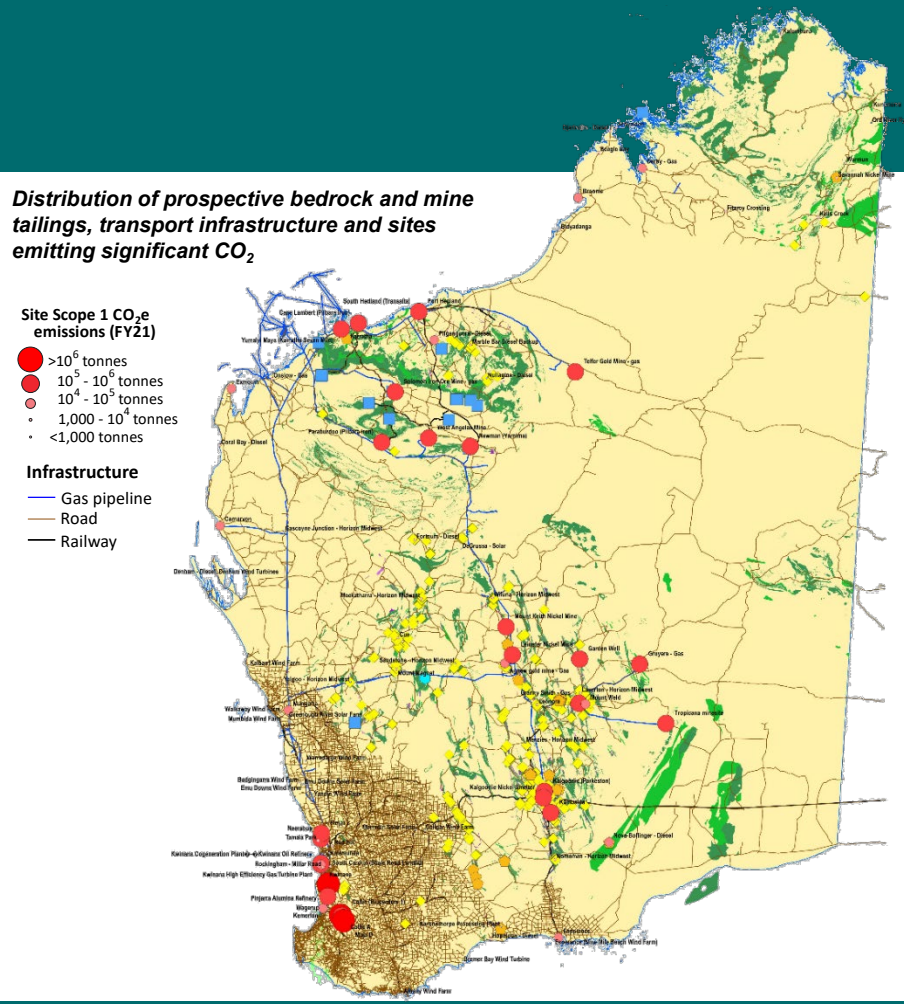
Technical & economic feasibility studies
(CSIRO CarbonLock program)

Petrophysical properties of bedrock resources
(CSIRO & Edith Cowan University)

GSWA is:

- **characterizing feedstock resources**
- **contributing data & advice to government & other projects**

Distribution of prospective bedrock and mine tailings, transport infrastructure and sites emitting significant CO_2



Other opportunities

Potential co-products may influence economics

- **Construction materials**
- **Critical minerals**

Contents lists available at ScienceDirect

Waste Management

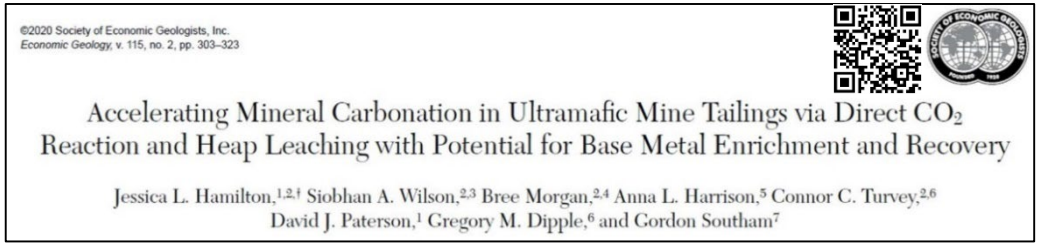
v.29 p.2722-2728 (2009)

journal homepage: www.elsevier.com/locate/wasman

ELSEVIER

Production of lightweight aggregate from industrial waste and carbon dioxide

Peter J. Gunning*, Colin D. Hills, Paula J. Carey



Economic Geology, v. 115, no. 2, pp. 303–323

Accelerating Mineral Carbonation in Ultramafic Mine Tailings via Direct CO_2 Reaction and Heap Leaching with Potential for Base Metal Enrichment and Recovery

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