MIT CLIMATE GRAND CHALLENGES

Massachusetts Institute of Technology

The Advanced Carbon Mineralization Initiative

The **Advanced Carbon Mineralization Initiative (ACMI)** will address the climate grand challenge by developing and translating the science, technology, and economic framework necessary to accomplish safe, permanent storage of CO_2 at global scale.

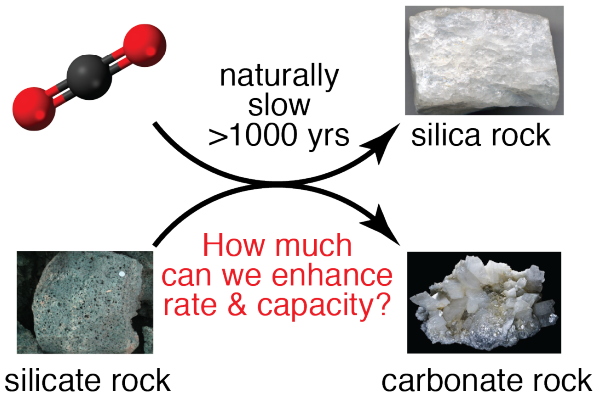
Carbon removal and storage from point sources and the atmosphere are key to meeting <2°C warming targets. We must develop technology to capture and store 10s of Gt CO_2e/year from point sources and the atmosphere within the next three decades, even if we succeed in transitioning to renewable energy and advancing other decarbonization technologies as fast as possible.

Carbon mineralization is the largest possible carbon storage method currently known:

- >100,000 Gt capacity
- High capacity in rapidly industrializing regions (India, China, Sub-Saharan Africa)
- Subsurface resources for storage of CO_2 streams
- Surface resources for atmospheric carbon removal
- Available near population centers and remote locations

Advanced carbon mineralization technologies to improve reaction efficiency are required to unlock this potential:

- Permanent conversion of CO_2 into rock
- Natural carbonate-silicate cycle occurs on geologic timescales
- Technology to increase reaction efficiency will enable scaled storage of CO_2 by mineralization
- Chemicals can catalyze this reaction
- Organisms have evolved to rapidly weather rock in search of nutrients
- Research integrating geology, chemistry, and biology can transform these mechanisms into robust engineering tools to build carbon mineralization technologies at scale

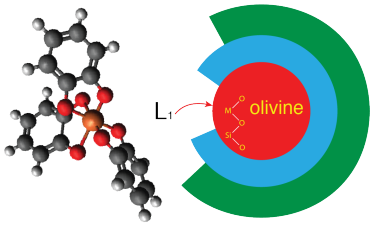


OBJECTIVES

ACMI targets the following key impediments to mineralization.

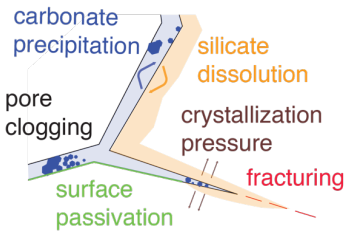
Thrust 1.
Molecular control of feedbacks

Designer chelators to inhibit passivation and catalyze carbonation



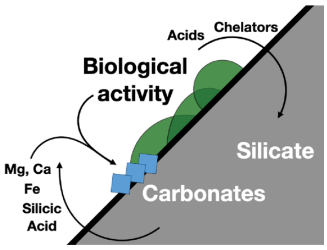
Thrust 2.
Chemo-mechanical coupling

Promoting reactive fracturing and inhibiting pore clogging



Thrust 3.
Biological control of mineralization

Discovering, optimizing, and controlling mechanisms for biomineralization



EXPECTED OUTCOMES

- Mechanistic models and catalysts for efficient carbonation of basalts
- Methods for tuning mineralization microbiome
- (Bio)chemical screening platforms for discovering and optimizing mechanisms for enhancing carbon mineralization
- Predictive models of bio-chemo-geo-mechanical feedbacks
- Methods for promoting reactive rock fracturing
- Techno-economic models for assessing mineralization costs
- Engineering tools for developing carbon mineralization technologies at scale

ACMI LEVERAGES CROSS-DISCIPLINARY SYNERGIES