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Fundamentals of carbon dioxide storage by mineralisation to carbonate minerals

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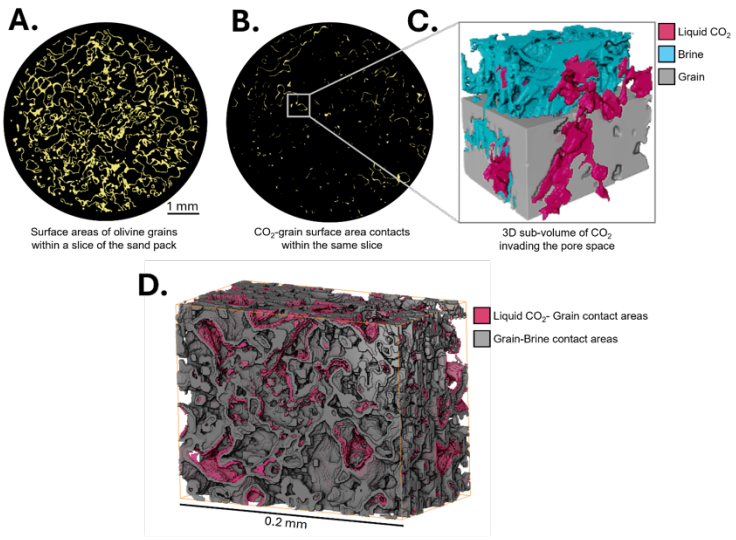
In this project we develop and carry out laboratory measurements of the rates of chemical reactions with minerals and under conditions relevant to underground CO_2 storage. The reactions underpinning carbon sequestration by mineralisation using basalt have been observed to be vigorous when occurring in liquid or supercritical CO_2 medium, with a stabilised water film. Industrial demonstration projects in Iceland and the USA have variously injected free CO_2 or CO_2 dissolved in water into subsurface basalt formations to induce mineralisation. However, the dissolution of CO_2 into water incurs major expense and twenty times as much fluid injection as compared with the injection of pure CO_2. Thus, determining whether and in which direction mineralisation reaction kinetics will be affected through the injection of free phase CO_2 as compared with carbonated water will have major implications for the design of industrial carbon mineralisation projects. Our aims are to characterise the kinetics of reactions that take place between basaltic minerals and a water saturated free supercritical or liquid CO_2 phase. These questions are fundamental in nature but the answers may have immediate and profound consequences for both engineered carbon storage and the fundamental physics of subsurface multiphase reactive transport.



The figure shows X-ray images of CO_2 and water moving through a sandpack of olivine, Saleh et al., 2024.

References:

Saleh, M. A., Shiel, H., Ryan, M. P., Trusler, J. M., & Krevor, S. (2024). Enhanced olivine reactivity in wet supercritical CO2 for engineered mineral carbon sequestration. *Energy & Fuels*, *38*(21), 21028-21041

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