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Monitoring of olivine weathering using 4D X-ray micro-computed tomography

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Olivine ($(Mg, Fe)_2SiO_4$) has received significant attention as a potential feedstock for enhanced silicate weathering (ESW), a technique to remove carbon dioxide (CO_2) from the atmosphere at ambient conditions[1]. However, assessing olivine dissolution solely via water chemistry may not be sufficient due to the slow dissolution kinetics of olivine at low temperatures, where it does not release sufficient Mg^{2+} and silica in detectable quantities especially in solutions such as seawater. Therefore, we present weathering investigations of an olivine grain using laboratory X-ray micro-computed tomography (XCT) located at UGCT (Ghent University, Belgium). The weathering experiment was conducted by subjecting olivine grains in acidic 1M HCl solution for 12.5 days while imaging at four-time steps. Qualitative investigation revealed shrinkage of the olivine grain while quantitative analysis presents a volume decrement, suggesting the occurrence of dissolution over time. XCT facilitated bulk dissolution rate calculation from volume and surface area evolution through dissolution process. Additionally, local dissolution rates over the olivine surface was computed from surface retreat due to dissolution, allowing the calculation of the reactivity map to compare surface reactivity before weathering[2]. Furthermore, we utilize the image processing workflow to measure olivine grain-pack dissolution during ESW application[3], which can be applied for measuring, reporting and verifying (MRV) of ocean alkalinization.

[1] Montserrat, F., Renforth, P., Hartmann, J., Leermakers, M., Knops, P., & Meysman, F. J. (2017).
Olivine dissolution in seawater: implications for CO2 sequestration through enhanced weathering
in coastal environments. Environmental Science & Technology, 51(7), 3960-3972.

[2] Winardhi, C. W., Godinho, J. R. D. A., & Gutzmer, J. (2023). The Effect of Macroscopic Particle
Features on Mineral Dissolution. Minerals, 13(2), 253.

[3] Kularatne, K., Fiers, G., Winardhi, C. W., Wallis, D., Meysman, F.J., & Cnudde, V. (2024). Long-term weathering of olivine in ambient seawater: Implications for ocean alkalinity enhancement in coastal environments. Geochimica et Cosmochimica Acta. (under review).

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