

## Multiscale dissolution rate investigation on the olivine (0 1 0) surface

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One of the most promising methods to reduce carbon emissions for the cement and concrete industry is the enhancement of belite ( $\text{Ca}_2\text{SiO}_4$ ) hydration. This reaction is a chemical analogue to the hydration of olivine ( $(\text{Mg,Fe})_2\text{SiO}_4$ ). One of the key processes of hydration is mineral dissolution. Therefore, the quantification of dissolution rates is relevant for understanding hydration kinetics and the development of the material properties.

In this work, the (0 1 0) surface of an olivine crystal ( $\text{Mg}_{1.808}\text{Fe}_{0.184}\text{Ni}_{0.007}\text{Cr}_{0.0006}\text{SiO}_4$ , identified by single crystal X-ray diffraction) was used for flow-through dissolution experiments. The crystal was embedded in epoxy and finely polished. A 0.1 M HCl solution (pH = 1) was used as solvent in the flow-through reactor. Two experiments performed at different hydraulic residence times (i.e., 4 and 30 seconds) were conducted. The topography changes of the crystal surface during the dissolution process were measured by ex-situ vertical scanning interferometry (VSI) and in-situ atomic force microscopy (AFM). Dissolution rate maps were calculated from surface normal retreat maps and described by rate spectra and statistical methods.

Sub-centimeter scale dissolution rate spectra, microscale pit growth habits, and nanoscale step-wave movement are discussed in this study. These results at various scales give insight into the mechanism of olivine dissolution, and eventually will provide clues for the understanding of cement hydration process.