Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12861

The importance of Ca-bearing zeolites for mineral carbonation

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Mineralization of CO_2 in mafic and ultramafic rocks offers one of the ways to limit carbon from the atmosphere. These rocks proved to be highly reactive in the acidic CO_2 waters, providing divalent cations to the solution while fixing CO_2 into stable carbonates, such as calcite, for its permanent storage. However, this process can be affected by the presence of Ca-bearing secondary phases, such as zeolites, that form under similar conditions as calcite. Notably, zeolites are the most common Ca-bearing silicate mineral in basalts at temperatures less than 200 ^{o}C. At the same time, little is known about their potential role during CO_2 mineralization despite their common occurrence in basaltic systems. To bridge this gap, we measured the overall dissolution rates of natural Icelandic zeolites during laboratory experiments at temperatures up to 150°C and various aqueous solution pH. Experiments were performed in both closed and open system mixed-flow rectors. Preliminary findings show that CO_2 mineralization in zeolites occurs through the preferential release of calcium from the zeolite structure. The preferential release of Ca depends on time, temperature, and aqueous solution composition. Mainly, preferential Ca release from zeolites decreases with time and increasing pH. In contrast, increasing aqueous NaCl concentration and increasing temperature increases the preferential release of Ca from zeolites. These findings suggest that the presence of zeolites in altered basalts can significantly enhance CO_2 mineralization if present during subsurface mineral carbonation efforts.