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Advanced Transmission Electron Microscopy for High-Resolution Imaging of Fluid-Solid Interfacial Reactions of Carbon Mineralization in Mafic and Ultramafic Rocks

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The investigation of fluid-solid interfacial processes is critical to unraveling the rate-controlling mechanisms governing carbon mineralization kinetics in mafic and ultramafic systems. We employed high-resolution transmission electron microscopy (HRTEM) and scanning transmission electron microscopy (STEM) to study the evolution of typical minerals in mafic and ultramafic rocks at the atomic scale and nanoscale. The reactions of CO2-H2O-mineral at different pressures and temperatures are investigated. The results demonstrate that these advanced TEM methods provide critical insights into mineral morphological evolution and elemental redistribution and migration, which are pivotal to elucidating the dynamic process in carbon mineralization. This study highlights the significance of advanced TEM techniques as a powerful tool for the detailed analysis of minerals, offering valuable guidance for understanding the reaction pathways and improving carbon mineralization efficiency.