Experimental Determination of Reaction Rates and Modeling of the Long-Term Fate of CO_2 in Deep Geological Formations, Peng Lu, Department of Geological Sciences, Indiana University, Bloomington, IN 47405, pelu@indiana.edu; Qi Fu, William E. Seyfried Jr., Department of Geology and Geophysics, University of Minnesota; Brian R. -Strazisar, Sheila W. Hedges, National Energy Technology Laboratory, U.S. Department of Energy; Zuoping Zheng, and Chen Zhu, Department of Geological Sciences, Indiana University, Bloomington, IN 47405

The injection of CO_2 into deep saline aquifers is a potential option for greenhouse gas mitigation. However, several key issues, such as underground storage time and the fate of the injected CO_2, must be studied before this option becomes economically and socially acceptable. In order to test the feasibility of CO_2 injection, we conducted feldspar dissolution experiments in CO_2 impregnated brines. Feldspars' dissolution rates were calculated based on temporal change in solution chemistry. Analysis of mineral reactants (SEM, TEM, and XPS) following the experiments confirmed the existence of abundant secondary mineralization associated with feldspar surfaces. The reaction path and secondary minerals precipitation kinetics were determined by reaction-path modeling. The slow kinetics of secondary minerals exert a strong control of feldspar dissolution. The experimental work was supplemented with one-dimensional reactive mass-transport modeling. The dissolution of the injected CO_2 into brine causes a sharp drop in pH, and consequently, the acidic brine aggressively reacts with aquifer minerals. Our model also predicts the dissolution of aluminosilicate minerals with the formation of secondary minerals and the precipitation and dissolution of carbonate minerals and is consistent with laboratory-scale CO_2 core-flooding experiments in the literature. The transport of carbon can be significantly retarded with respect to the flow of the brine itself, and a significant amount of injected CO_2 is immobilized because of mineral trapping. The carbon reactive transport is sensitive to the reaction rates used, illustrating the need for improved knowledge of reaction kinetics.