# Geochemical Reactions in a Typical Williston Basin Reservoir Used for $CO_2$ and Acid Gas Storage

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*Abstract* - This work reports results which were obtained during a series of laboratory experiments and numerical modeling of geochemical reactions performed by the Plains $CO_2$ Reduction (PCOR) Partnership. Finely ground samples collected from various formations of the Williston Basin (North Dakota, USA) and magnesium silicate were exposed for a period of four weeks to pure supercritical carbon dioxide and a mixture of supercritical carbon dioxide (67.3 mole %) and hydrogen sulfide (32.7 mole %) at 2250 psi (155 bar) and 158°F (70°C) in dry, fresh water, and 10 wt. % NaCl brine conditions. Prior to exposure, XRD mineralogical analysis demonstrated the presence of anhydrite, calcite, dolomite, forsterite, halite, illite, magnetite, and quartz in the Williston Basin samples. After exposure, XRD analysis of reaction products was also performed. Most minerals displayed high reactivity with acid gas, including the conversion of anhydrite to gypsum. In contrast,
most samples showed low reactivity with exposure to pure $CO_2$, although the wet magnesium silicate was converted to magnesium carbonate and quartz, and the related dolomite was converted to calcite and magnesium carbonate. The results of the laboratory experiments were compared with the numerical modeling which was performed with the Geochemist's Workbench simulator and PHREEQC, where the thermodynamic database was adjusted with SUPRCRT92 code. The correspondence between the laboratory tests and modeling is discussed in the full scale paper.