

# **Reactivity of some silicate minerals under low pH and temperature conditions**

T. PARRA AND E. KOHLER

IFP, Geology/Geochemistry/Geophysic Division, 1-4 Av. de  
Bois-Préau, Rueil-Malmaison 92852, France;  
(teddy.parra@ifp.fr), (eric.kohler@ifp.fr)

During the past 50 years, metamorphic petrologist developed experiments aimed at estimating with a better precision, thermodynamic data of minerals. However, the bracketing experiment used in these type of studies are limited to temperature over 350°C, because of the low kinetic speed under this temperature.

A series of experiments were led to investigate the speeds variation to reach equilibrium of mineral mixtures according to the initial pH and temperature. Three different equilibria were tested using seven minerals supplied by the Muséum d'Histoire Naturelle de Paris (Albite, Analcime, Stilbite and Laumontite), the Clay Minerals Society (Kaolinite KGa-2), the Centre National de Recherche Scientifique (Pyrophyllite), or synthesized using silica gel prepared by the sol-gel method and heated to 700°C during 15 days (Quartz). For each equilibrium, two mixtures were prepared, one with a major proportion of reactants and the other with a major proportion of products. Three pH were tested: free pH of deionized water, pH close to 4.5 controlled by acetic acid, pH close to 2 controlled by hydrochloric acid. The experiments took place in soft golden tubes enclosed in stainless steel autoclaves. Depending on the equilibrium, we set pressures to 100 bars and temperatures varying between 70 and 285 °C, in order to place the mixtures in the vicinity but not on the equilibrium P,T mineral curve.

The hypothesis is that a weak pH is going to increase the rate of the unstable mineral dissolution in the deionized water and that the weak water/rocks ratio (10 weight percent) is going to increase the speed towards solution saturations. This should allow mineral precipitation on the germs present in the mixture with respect to the solution chemistry, the temperature and pressure conditions.

The characterization of final mixtures was realized with XRD analysis to verify that only the expected phases were formed, and their quantification was verified by infrared spectrometry. The experiments show that the global reactivity (dissolution then precipitation) was appreciably modified but additional experiments must be investigated to overcome experimental difficulties, validate the presented results and demonstrate the understanding on other minerals.