

Reliance of the rate of dissolution of the SON68 glass on $\text{SiO}_2(\text{aq})$: New quantification using interferometry

JONATHAN P. ICENHOWER,*¹ CARL I. STEEFEL,¹
ANDREAS LUTTGE,² JOE RYAN³ AND ERIC M. PIERCE⁴

¹Lawrence Berkeley National Laboratory, Berkeley, CA
94720 USA (*correspondence: jpicenhower@lbl.gov,
cisteeffel@lbl.gov)

²Rice University, Houston, TX 77005 USA (aluttge@rice.edu)

³Pacific Northwest National Laboratory, Richland, WA 99352
USA (joe.ryan@pnl.gov)

⁴Oak Ridge National Laboratory, Oak Ridge, TN 37831 USA
(piercem@ornl.gov)

At present, one of the most vexing problems confronting experimentalists and modelers alike is how nuclear waste glasses will react long-term in the repository environment. Many of the experiments that underpin modeling efforts have been conducted at conditions that are not germane to answering these questions. One of the most important constituents in natural subsurface waters is dissolved silica [$\text{SiO}_2(\text{aq})$], and efforts are underway to understand the dependence of the dissolution rate on this component. A method to determine rates accurately in solutions containing high concentrations of $\text{SiO}_2(\text{aq})$ is needed.

We present evidence that rates of glass dissolution can be quantified by using a Vertical Scanning Interferometer (VSI) over a range of $\text{SiO}_2(\text{aq})$ concentrations. Polished glass monoliths (SON68) were exposed to solutions containing 0 to 5.46×10^{-3} mol/L $\text{SiO}_2(\text{aq})$ at 90°C and pH = 9. Both batch (static) and flow-through reactor systems were employed. In the former, the surface area of glass to volume of solution ratio (SA/V) was kept at a low value, ensuring that the system maintained a constant chemical affinity. In the flow-through systems, the SA/V ratio was higher and the release of elements into solution was monitored to ensure steady-state values. Dissolution rates by VSI were determined by comparing the height of the reacted surface to that of a pristine reference surface, and these rates were compared against those determined by assaying the effluent solutions from the flow-through experiments. The results revealed a close correspondence between the two methods for determining rates, and both methods indicated a linear dependence of the rates upon the concentration of $\text{SiO}_2(\text{aq})$ in solution [$\log R = -1.37 \times 10^{-2}(\text{Si}) - 5.41$]. This linear dependence shows that the rate can be quantified at conditions pertinent to the disposal environment and that a mechanistic basis for predicting rates can be realized.

Smoke aerosol emission source analysis from satellite and airborne measurements

CHARLES ICHOKU^{1*}, CHARLES GATEBE^{1,2} AND
RALPH KAHN¹

¹Climate and Radiation Branch, NASA Goddard Space Flight
Center, Greenbelt, MD 20771, USA

(*correspondence: Charles.Ichoku@nasa.gov)

²GEST, University of Maryland Baltimore County, MD, USA

Accurate estimation of smoke emission source strength from active fires is essential for modeling smoke emission fluxes, transport, atmospheric interactions, and impacts on air quality and climate. For several decades, researchers have made efforts to estimate smoke emissions from ground-based measurements, but the spatial and temporal coverage is severely limited. The rapid growth of satellite measurement capability during the last decade has provided the potential to overcome these limitations by covering the entire globe for long periods of time. However, satellite remote-sensing methods are faced with new challenges as they attempt to use instantaneous observational snapshots to address continuous and highly variable processes such as fires and their emissions. The result is that, although the satellite enables more ground to be covered, uncertainties in quantifying emissions still remain, and may be even greater, compared to the ground-based methods. One of the promising ways to address this issue is the use of airborne measurements to bridge the spatial and temporal scales between the regional-scale satellite snapshots and landscape-scale, longer-duration processes of fire behavior and emissions. The ARCTAS summer campaign that was conducted in Canada in June–July 2008 provides a unique opportunity to demonstrate this approach with regard to closely exploring improved understanding of smoke emission mechanisms by remote sensing. In this talk, we will show preliminary results of using the vertical scans of plumes from the Cloud Absorption Radiometer (CAR) instrument aboard the NASA P-3 aircraft to complement the analysis of fire radiative power (FRP) and aerosol optical depth (AOD) measurements from MODIS aboard the Terra and Aqua satellites, and near-source plume-height measurements from MISR aboard Terra, to better understand the relationships between them, and elaborate the emission rates, spatial characteristics, and injection processes of smoke particulate matter.