Sorption processes on small and dirty mineral particles – Do size and cleanliness matter?

GORDON E. BROWN, JR.[1,2]*, JUYOUNG HA[1,3], ALEXANDRE GÉLABERT[1,4], DAVID M. SINGER[1,5], YINGGE WANG[1], JOHN R. BARGAR[2], PETER ENG[6], Y. CHOI[6], TOM KENDELEWICZ[1] AND A.M. SPORMAN[7]

[1]Geological & Environmental Sciences, Stanford University, Stanford, CA 94305, USA (gordon.brown@stanford.edu)
[2]Stanford Synchrotron Radiation Lightsource, SLAC National Accelerator Lab, Menlo Park, CA 94025, USA
[3]Civil & Environmental Engineering, UC Berkeley, Berkeley, CA 94720, USA
[4]IMPMC, University of Paris 7, 75015 Paris, France
[5]Earth Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA
[6]GSECARS, University of Chicago, Chicago, IL 60637, USA
[7]Chemical Engineering, Stanford University, Stanford, CA 94305, USA

Most mineral particle surfaces in the natural environment are not perfectly clean and the particles are often in the nanoparticle size range (1-100 nm), which leads to the following question: Do particle size and surface cleanliness matter in sorption processes? Most surface geochemists have studied the sorption of aqueous cations and anions as well as small organic molecules on mineral surfaces that are not UHV-clean. Many have ignored the potential effects of surface coatings such as adventitious carbon on sorption processes, while others have focused explicitly on the effects of surface coatings of natural organic matter or microbial biofilms on mineral surface properties such as charge as a function of pH and on metal ion sorption. Some have carried out XAFS spectroscopy measurements intended to characterize the molecular details of sorbed species on mineral surfaces, including their modes of attachment. Still others have examined the interaction of water with mineral surfaces using x-ray photoelectron spectroscopy, and a few have studied the interaction of various aqueous sorbate species with mineral nanoparticle surfaces using XAFS spectroscopy. In an attempt to answer the above question, I will review some of these studies, including a number carried out in our labs, involving the effects of water, adventitious carbon, microbial biofilms, and particle size on sorption processes.

$^{40}Ar/^{39}Ar$ thermochronology from the Ecstall, Butedale, and Smith Island plutons: A thermal model for late Cretaceous British Columbia

S.J. BROWNLEE[1]* AND P.R. RENNE[1,2]

[1]UC Berkeley, Department of Earth and Planetary Science, 307 McCone Hall, Berkeley, CA. 94720-4767 (*correspondence: sbrownlee@berkeley.edu)
[2]Berkeley Geochronology Center, 2544 Ridge Rd. Berkeley, CA 94709 (prenne@bgc.org)

$^{40}Ar/^{39}Ar$ thermochronology has been applied to hornblende and biotite from three plutons in northern British Columbia, the Ecstall, Butedale, and Smith Island plutons. Most effort has been focused on the Ecstall pluton because of its relevance to the Baja-BC hypothesis. Spatially resolved trends in reset and partially reset cooling ages from the Ecstall can be mapped in relation to the younger Quottoon pluton, which represents a thermal boundary in this area. Partially reset cooling ages from biotite and hornblende extend up to 17, and 14 km from the themal boundary, respectively. These distances represent some of the largest reported from an intrusive contact aureole. The high spatial resolution of the Ecstall sampling, and consistency of the resetting trend, make this one of the most highly resolved thermal histories obtained using mainly $^{40}Ar/^{39}Ar$ thermochronology.

The trends in cooling ages are broadly consistent with a 2 dimensional, finite volume, numerical thermal model for the continental crust in this area. The best agreement is found when the thermal boundary remains above 500˚C for 4 Ma or more. We also explore the effects of advection of heat by fluids and possible tectonic influences on thermal history, such as uplift and tilting. Compositional variations, which may affect diffusion parameters in biotite, are also explored and taken into account in the model cooling ages.

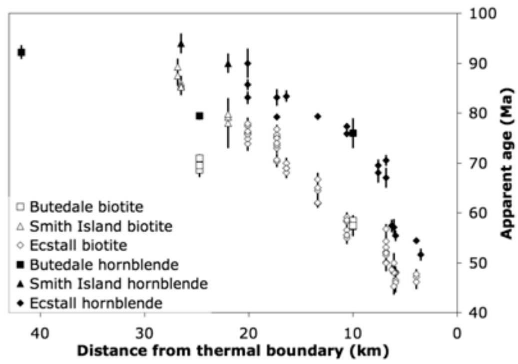

Figure 1: $^{40}Ar/^{39}Ar$ cooling ages plotted vs. distance from the thermal boundary.