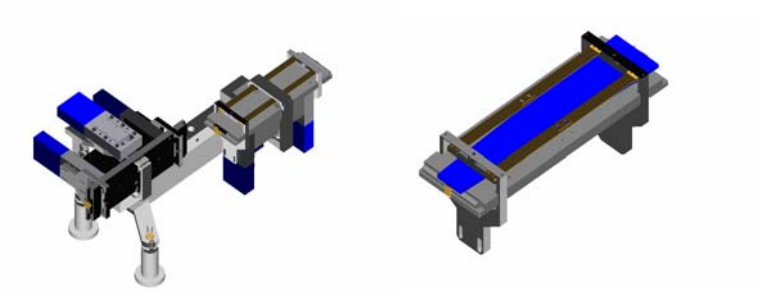
Microfocusing at the PNC-CAT

Kirkpatrick-Baez focusing mirrors

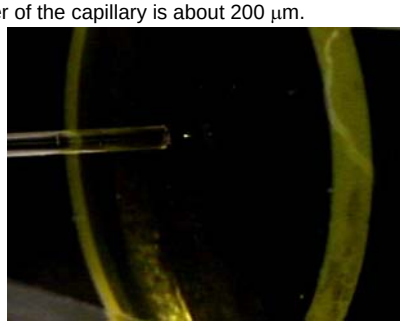
Two K-B mirror systems have been built. The long set shown below focuses to 3 μm. A shorter version focuses to about 1 μm. Both are based on a design developed by CARS-CAT. A combination of a trapezoidal mirror shape and unequal bending moments gives and accurate elliptical bend.



Bender assembly **Detail of trapezoidal mirror**

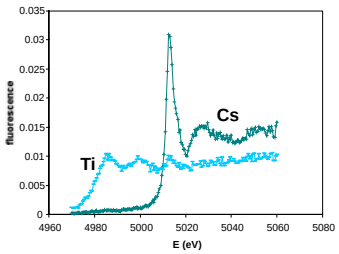
Tapered Capillaries

Tapered capillaries concentrate the x-ray beam by passing it through a gradually tapering glass capillary. Typical inlet dimensions are 150 μm, and the outlets vary from 0.5 to 2 μm depending on the application. The figure shows the capillary outlet striking a fluorescent screen. The outer diameter of the capillary is about 200 μm.



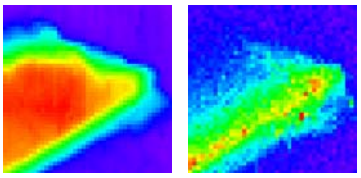
Cs absorption in weathered micas

These were taken using a Kirkpatrick-Baez mirror focusing to about a 6 micron spot. The flux in this spot was about 10^{11} at 5 keV. Both the transmission and fluorescence signals were detected. The data below is for the sectioned muscovite sample treated with 10^{-2} M Cs solution. The micas had many different elements present. The most troublesome was Ti which has its K edge about 30 eV below the Cs L_3 edge, and fluorescence lines on either side of the Cs line. Nevertheless, the detector resolution of about 150 eV could effectively separate the signals. Below is the near edge fluorescence spectra for Ti and Cs taken at the location of maximum Cs concentration in the sample.

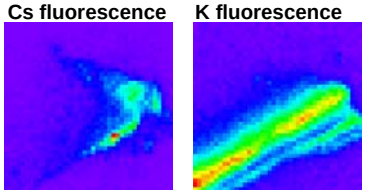


Below are images obtained while monitoring the transmission and Cs, Ti, and K fluorescence signals. The incident x-rays were at 5013 eV. This is the peak of the Cs white line and enhances its signal. All of the views are identical since they were obtained during a single scan. The image size is 500 microns square.

Sample absorption **Ti fluorescence**



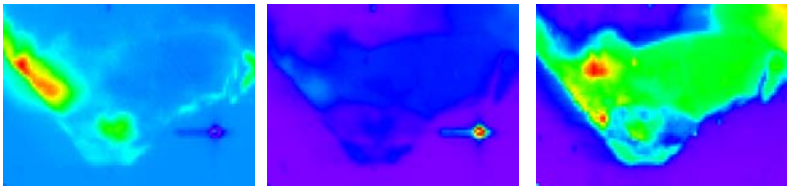
Cs fluorescence **K fluorescence**



Recent results with 1μm resolution using the small K-B mirror

(Image size 140x100μm)

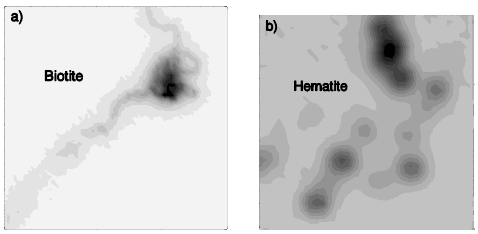
Cs Ti Mn

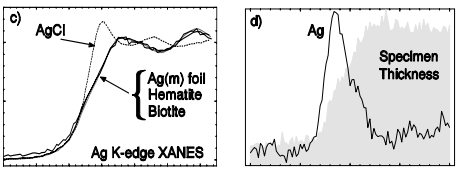


Microscopic Imaging of Reduced Zones on Surfaces*

Although one of the key parameters in any mineral-water reaction is the reactive surface area of the mineral, accurate measurements are difficult to obtain. The difficulty is further compounded when one attempts to measure the surface coverage of the reduced form of a bulk constituent such as Fe. Surficial Fe(II) is subject to oxidation by atmospheric oxygen and does not yield a spectroscopic signature significantly different from that of Fe(III) in the bulk. To overcome this difficulty we employed a reactive probe, Ag(I), to oxidize surface-accessible Fe(II) and precipitate Ag(m) in place, thereby preserving the spatial distribution of reactive surface sites in a form that is more stable to atmospheric oxidation and amenable to measurement.

The XRM analyses were performed using 25.6 KeV light focused with a glass capillary having a 0.7 μm diameter exit. Spot size on the specimen varied with distance from the capillary tip and was adjusted to be approximately equal to the step size of the scan (typically 2.5-5 μm). In addition to transmission measurements, a 13-element Ge detector was used to detect Ag fluorescence produced by the sample.





*J. E. Amonette, K. M. Russo, D. E. Brewe, S. M. Heald, and Y. A. Gorby