Weathering of feldspar – A FIB and TEM investigation

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Introduction

Previous investigations of laboratory weathered feldspar samples have revealed the presence of a nanometre scale, amorphous layer of silica-rich gel or 'leached layer' [1]. However, difficulties in producing electron transparent samples have hindered research into these layers using TEM. Additionally, the study of *naturally* weathered material has been limited to relatively low-resolution SEM investigations of pitted surfaces [2] or TEM investigations of interior portions [3]. We have instigated a pathfinder study to investigate leached layers on both natural and laboratory weathered alkali feldspars, using a combination of the innovative Focussed Ion Beam technique (FIB) [4] for sample preparation and nanoanalytical TEM for imaging and chemical analyses.

Samples and results

Weathered (pH1 buffer solution, 45˚C, 111 days) and unweathered control grains of perthitic alkali feldspars were prepared for TEM using the FIB.

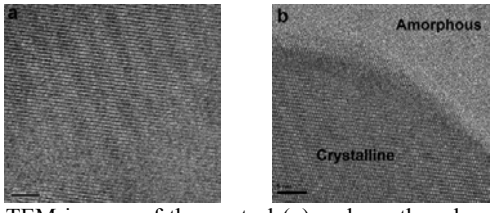

Fig. 1 TEM images of the control (**a**) and weathered samples (**b**). The weathered sample has a clear amorphous layer. Scale bar: 5 nm.

Although both samples were susceptible to beam damage, an obvious amorphous layer (~60nm) was observed in the weathered sample. Further investigations are required but these initial results suggest that FIB preparation of the surfaces of weathered feldspars may be successful in producing electron transparent samples with no observable damage to the delicate, amorphous layers. We are continuing with FIB preparations and nano-TEM analyses of more laboratory and naturally weathered feldspar samples.

References

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Molecular modeling of water exchange on aluminum clusters: Identifying reaction mechanisms in complex systems

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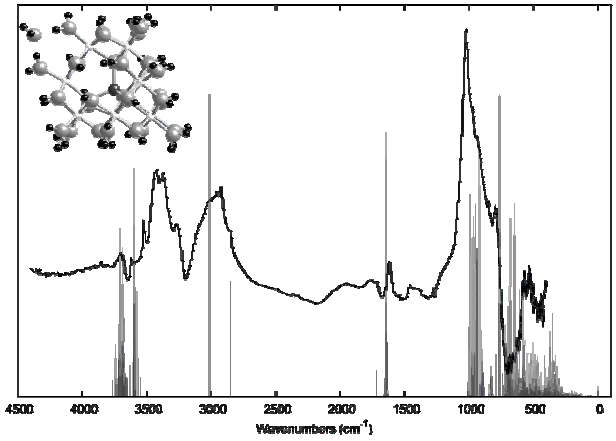
Small polyoxocations (Figure 1, inset) are useful models for the surfaces of oxide minerals. The rate of water exchange and the activation volume of the $GaAl_{12}$ keggin have been measured using ^{17}O-NMR.[1,2] We now want to understand the mechanism(s), and to compare experimental rate parameters with those calculated using both *ab initio* and molecular-dynamics techniques. To this end, vibrational frequencies of DFT-optimized $GaAl_{12}$ with, and without, second-shell water were calculated and measured experimentally (Figure 1). From the large number of vibrational frequencies that include an Al-O_w stretch (where O_w is an oxygen on a water), it is clear that there is more than one pathway for exchange. Furthermore, it is difficult to know which, if any, is dominant using simple cluster calculations.

Figure 1: Measured vs. calculated vibrational frequencies of the $GaAl_{12}$ keggin molecule (inset). The black curve is an FTIR spectrum, the vertical lines are calculated intensities.



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