

## Biotite dissolution in simulated Hanford tank waste

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Chromium and technetium have been identified in solutions that have leaked from single-shell storage tanks at the U.S. Department of Energy's Hanford site in Washington state. Dissolution of Fe(II)-bearing minerals such as biotite is a potential source of electrons for the reduction of the soluble chromate ( $\text{CrO}_4^{2-}$ ) and pertechnetate ( $\text{TcO}_4^-$ ) ions to less mobile reduced forms. Little is known, however, of biotite dissolution under the conditions found in Hanford waste: high pH, high Al and  $\text{NaNO}_3$  concentrations, high temperatures, and large amounts of organic compounds. In the current study, the effects of pH, Al, and  $\text{NaNO}_3$  were investigated using continuously-stirred flow-through reactors at room temperature (pH 14) and at 25 °C (pH 11-13).

Steady-state dissolution rates for Si, Al, Fe, and K increased with increasing pH, except for Si, Al, and Fe at pHs 11 and 12 where the rates for each element were nearly identical. Dissolution was incongruent at all pHs with rapid preferential release of K followed by near stoichiometric release of Si and Al. Release of the octahedral cations, Fe and Mg, was much slower. High concentrations of  $\text{NaNO}_3$  (2 M or 6 M) at pH 13 and pH 14 generally enhanced the release rates of all elements. Al-enriched solutions ( $0.055 \text{ Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ , both with and without 2 M  $\text{NaNO}_3$ ), suppressed the release rates of Si and Fe at pH 13 relative to dissolution in nitrate- and Al-free solutions whereas the release rates of K and Mg were enhanced. There were pH-dependent transients (i.e., initially rapid dissolution rates decaying to slower rates) in each experiment. The amounts of Si, Al, Fe, and K released in the non-steady-state interval were greatest at pH 14, followed by pH 13, 12 and 11.

Despite the fact that the solutions were supersaturated at all pHs with respect to the sparingly soluble iron oxides, detectable quantities of iron were present in all solutions except one. Therefore, if Fe oxidation and precipitation took place, they did not prevent continued Fe dissolution from biotite, suggesting that biotite may indeed be a source of reductive capacity within the Hanford sediments.

## Presolar/Interstellar Materials

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### Introduction and General Overview

This talk will review much of our current understanding of the origins, nature, and evolution of materials in circumstellar and interstellar space. The initial discussion will focus on familiarizing the audience with some of the nomenclature associated with the field, reviewing the lifecycle of dust in space, and pointing out where the speakers that follow will address portions of the lifecycle in greater detail. The different techniques used to study interstellar materials will then be addressed, paying particular attention to (i) telescopic remote sensing of the dust currently in interstellar space, (ii) laboratory studies of individual interstellar grains found in meteorites and other extraterrestrial materials, and (iii) laboratory simulation experiments.

### The Specific Case of Organics of Biological Interest

The final portions of the discussion will focus on the nature of interstellar organic compounds as a particular example of how these disparate techniques can be used to improve our understanding of interstellar matter. Interstellar organics will be briefly addressed in general, but particular attention will be paid to the possible connections between interstellar and meteoritic organics, especially those portions of the organic inventory that may play a role in the origin and evolution of life on planetary surfaces. The cases of aromatic ketones, amino acids, and amphiphiles will be specifically addressed.

### References

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