

**Problem Set III**  
**Mineral Weathering and Formation**

1. Give an example of the following reactions: hydration, hydrolysis, exchange, and oxidation.
2. Why do island (orthosilicates) and chain silicates (inosilicates) have faster dissolution rates in acidic solutions than framework (tectosilicates) or layer silicates (phyllosilicates).
3. Suggest mechanisms to explain the more rapid weathering of aluminosilicates at low and high pH.
4. You are conducting a weathering study and your solution analysis indicates that you have  $1.8 \times 10^{-3}$  M silica and a pH of 3. You plug this data into your chemical speciation computer program and indicates that quartz precipitates. Do you think this will happen? Justify your answer. Do you think you will have anything precipitate in this solution?
5. Is mica weathering best described by congruent or incongruent dissolution? Why?
6. Explain why Si is more readily leached from the soil than Fe or Al?
7. Mica weather by loss of  $K^+$  from the interlayer sites usually via replacement or exchange with a proton. However, in the presence of concentrated salts such as 1 M NaCl this reaction is not very pH sensitive. What is the mechanism of  $K^+$  replacement in salt solutions.
8. The following dissolution rates were calculated in the laboratory. Actual dissolution rates of these minerals in soil environments are often much slower than those listed below. Provide several reasons for these differences.

Quartz  $4.1 \times 10^{-14}$

K-feldspar  $1.7 \times 10^{-12}$

Ca-feldspar  $6.6 \times 10^{-9}$

9. Explain why trioctahedral micas release  $K^+$  more rapidly than dioctahedral micas.
10. Answer the following questions and provide complete justification for your answer.
  - a. You have two minerals with similar structures. One has ferric Fe ( $Fe^{3+}$ ) and one has ferrous Fe ( $Fe^{2+}$ ). In an oxygenated environment which mineral would you expect to weather faster?
  - b. In which environment would you expect a Ca-Feldspar to weather more rapidly (pH and temperature are equal)?

Sandy soil with little vegetation and organic matter

Sandy soil with abundant vegetation and high organic matter.

11. Growing plants can accelerate the weathering of  $K^+$  bearing minerals such as mica. How does this occur? What type of mica would be most and least susceptible to this form of weathering?