EAR 419/619 – Aqueous Geochemistry

Lab #5

Dissolution Kinetics

**Summary and Objectives**

* This lab demonstration communicates the role of particle size, solvent temperature, and surface area in influencing mineral dissolution rates. A quickly dissolving mineral (halite) is used to demonstrate this concept. The specific conductance of the water that the halite dissolves into is used to measure dissolution over time. Determine dissolution rates by measuring the dissolution of a solid material over time.

**Materials**

* Coarse salt (~3-5 g)
* Mortar and pestle
* Weigh boats
* Balance
* Deionized (DI) water
* 2 L beakers
* Stir plate and stir bar
* Electrical conductivity meter

**Experimental procedure**

1. Grind half of the coarse salt into a fine powder using the mortar and pestle
2. Weigh 1.5 g of each coarse salt and fine salt
3. Fill the beaker with 1 L of deionized (DI) water
4. Measure the electrical conductivity of DI water in each beaker using an EC meter.
It should be ~0 μS/cm.
5. Place the beaker of water onto a stir plate and set the water to mix gently but thoroughly
6. Keeping the EC meter in the water, add the coarse salt to the water
7. Record electrical conductivity every 5 seconds (for 30 seconds) and then every 10 seconds until readings stay constant
8. Repeat the experiment for the other two set-ups: 1) 1.5 g finely ground salt in the DI water at room temperature; 2) 1.5 g coarse salt in the heated DI water (~50 °C).
9. Convert EC to TDS by using the equation below (TDS in mg/L and EC in μS/cm):

$$TDS=EC×0.50$$

By assuming all TDS represent Na+ and Cl- ions, you can derive the mass of dissolved NaCl.

1. Plot the results of the demonstration as mass of dissolved NaCl versus time to visualize the differences in dissolution.

**Report**

Provide **three tables** of the data your group collected (one table for each set-up), with columns for time (seconds), EC, mass of dissolved NaCl. Plot on one graph, for all set-ups, the mass of dissolved NaCl as a function of time. Differentiate each set-up using a different symbol and provide a legend. Then answer the following questions (Upload all tables, graphs, and responses to Blackboard in one single PDF file).

Q1: Briefly, describe how the slope of the curve changes over time. What does the slope represent? Discuss why the slope changes over time.

Q2: Calculate the rate of the reaction in the linear portion for each set-up.

Table 1. Dissolution of coarse salt in room-temperature DI water

|  |  |  |
| --- | --- | --- |
| Time (s) | EC (mS/cm) | TDS or NaCl (mg/L) |
| 0 |  |  |
| 5 |  |  |
| 10 |  |  |
| 15 |  |  |
| 20 |  |  |
| 25 |  |  |
| 30 |  |  |
| 40 |  |  |
| 50 |  |  |
| 60 |  |  |
| 70 |  |  |
| 80 |  |  |
| 90 |  |  |
| 100 |  |  |
| 110 |  |  |
| 120 |  |  |

Table 2. Dissolution of fine salt in room-temperature DI water (table format is similar to Table 1)

Table 3. Dissolution of coarse salt in heated DI water (table format is similar to Table 1)