

# The Geology of Pacific Northwest Streams, Lakes, & Deserts

## Lab 4: Rocks and Weathering

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Part I adapted from The University of California Museum of Paleontology, Berkeley. Part II adapted from (1) R. Teed and R. Teed from Carleton College and (2) G.S. Hancock and C.M. Bailey at the College of William and Mary

### Part I. Experimental Laboratory: Chemical and Mechanical Weathering (10 pts)

#### 1. How does water affect carbonate rocks?

We will investigate how water affects carbonate rocks. To model this we will use antacid tablets (Alka-Seltzer is one brand of antacid tablets) that contain carbonates.

#### Materials:

- 2 antacid tablets
- A small beaker
- Water
- Pair of tweezers to remove the tablet for observation
- Timer or clock

#### Procedure:

- 1) Take a look at the Alka-Seltzer tablet and record your careful observations.
  
- 2) Place one tablet in a small beaker and cover it with water.
- 3) Make careful observations for 3 minutes. Use the timer or a clock to watch the time.
  
- 4) After 3 minutes, use the tweezers to remove the tablet and then record your observations of the surface of the tablet. Compare the tablet to an unused one to make sure your observations are accurate.
  
- 5) Write down your thoughts about how water might alter carbonate rocks.
  
- 6) Record whether you think this exploration demonstrated chemical weathering, mechanical weathering, or erosion.
  
- 7) When you're all finished, make sure you rinse out the beaker and leave it ready for the next group to use.

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**2. How does water affect limestone rocks? How does acid rain affect limestone rocks?**

At this lab station you will investigate how water and acid rain affect limestone. To model limestone you will use chalk, which is a type of limestone. To model acid rain, you will use vinegar.

**Materials:**

- 2 pieces of chalk
- A mortar and pestle
- Water
- Vinegar
- 2 small beakers
- Pair of tweezers to remove the chalk for observation
- Tape and a marker to label the beakers

**Procedure:**

- 1) You need to have pebble-sized pieces of chalk for this experiment. If you need to, use a mortar and pestle to break the chalk into smaller pieces.
- 2) Record your observations of the chalk. How does it feel? What does its surface look like?
  
- 3) Place half of the chalk pieces in one beaker and label it "Acid Rain".
- 4) Place the other half of the chalk pieces in the other beaker and label it "Water".
- 5) In the beaker labeled "Acid rain" cover the chalk with vinegar.
- 6) In the beaker labeled "Water" cover the chalk with water.
- 7) Record your observations. After waiting about 3-5 minutes, you can try to take the chalk pieces out of the beakers if you want to make additional observations. Otherwise, record your final observations.
  
- 8) Write down your thoughts about how water and acid rain might affect limestone rocks.
  
  
- 9) In your lab notebook, record whether you think this exploration demonstrated chemical weathering, mechanical weathering, or erosion.
  
  
- 10) When you're all finished, make sure you rinse out the mortar and pestle and the beakers and leave the station ready for the next group to use.

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**3. How does shaking affect different types of rocks?**

At this lab station you will explore how rocks are altered by vigorous movement such as ocean waves, falling down a rocky mountain slope in a rock or snow avalanche, or tumbling down a turbulent river. To model rocks of different hardness you will use gravel (a harder rock) and sugar cubes (a softer rock). Shaking them will mimic the vigorous motion that occurs in ocean waves, rock avalanches, or riverbeds.

**Materials:**

- Sugar cubes (approximately 5-7)
- One jar with lid
- Gravel (a small handful)

**Procedure:**

- 1) Pick out 5-7 sugar cubes and record your observations of the sugar cubes.
  
- 2) Pick out a handful of gravel and record your observations of the gravel.
  
- 3) Put both the sugar cubes and gravel in a jar and close the lid tightly. Then shake the contents of the jar vigorously for about 5 minutes. You and your partner may need to take turns so you don't get tired.
- 4) After five minutes open the jar and look carefully at the sugar cubes and gravel. Record your observations.
  
  
  
  
  
  
  
  
  
  
- 5) Write down your thoughts on how abrasion (whether tumbling down a mountain, being tossed around in waves, or washed down a riverbed) might affect different types of rocks.
  
  
  
  
  
  
  
  
  
  
- 6) Record whether you think this exploration demonstrated chemical weathering, mechanical weathering, or erosion.
  
  
  
  
  
  
  
  
  
  
- 7) When you've finished, clean out the jar so that the station is ready for the next group.

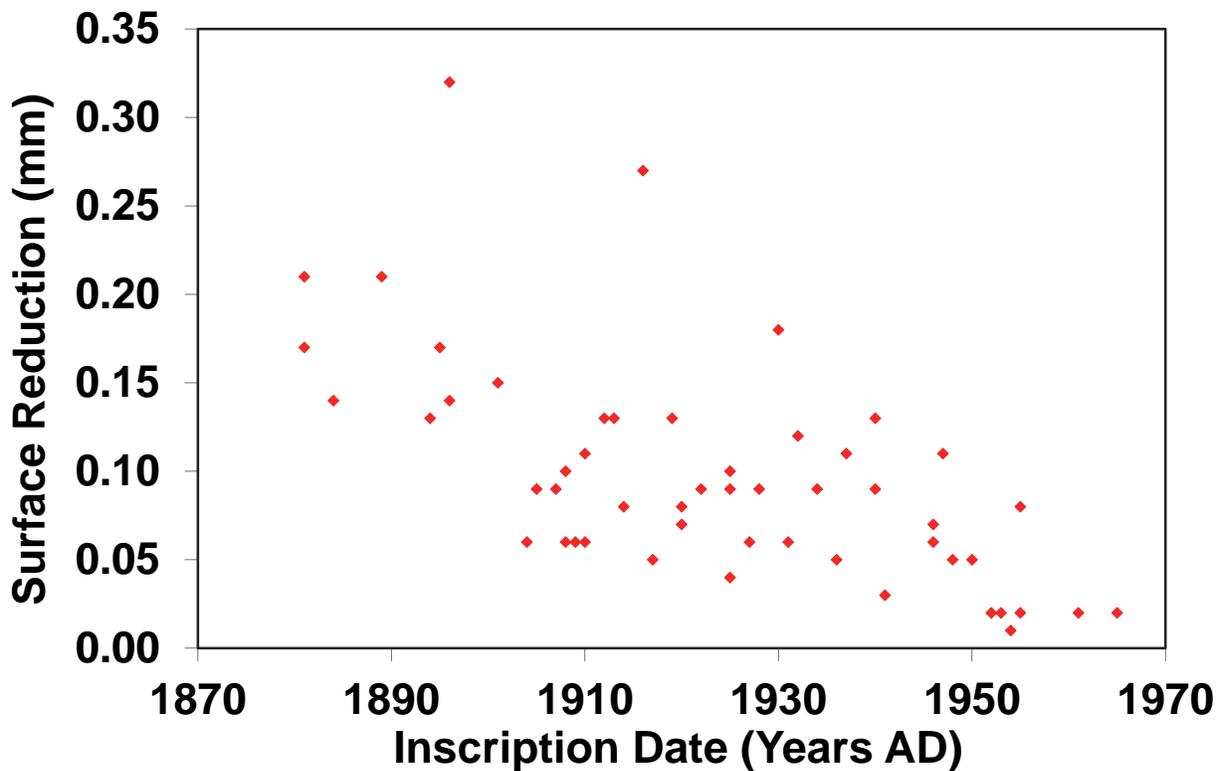
## Part II. Laboratory Analyses: Chemical Weathering of Tombstones (10 pts)

1. Determination of erosion rates.

Below is a plot showing measurements of the decrease in the level of the surface of tombstones over time. The vertical axis is distance in mm and the horizontal axis is time in calendar years. As the rock erodes, the surface lowers, resulting in lower distance measurements. The surfaces are higher in 1880 and lower in 1970. Therefore the distance measurements are larger on the right and smaller on the left.

A regression line is a line that represents the relations between a dependent variable (typically on the vertical axis, sometimes referred to as “y”) and an independent variable (typically on the horizontal axis, sometimes referred to as “x”). One may use this regression line to use a value on the horizontal axis to predict what the vertical axis would be (e.g.  $y = \text{some function of } x$ ). Your regression line will allow one to state a given time (years) and determine what the surface level would be (mm). The line represents the average of all data points in the plot. Each data point contributes to the average value as it changes through time.

- a. Draw a regression line through the data points. Place your line so that it has a larger value on the left and a smaller value on the right.



- b. We can use the slope of the line to determine the average rate of erosion of the tombstones in Sydney, Australia. The slope is the rise divided by the run, or the difference in minimum and maximum vertical values divided by the difference in min and max horizontal values. Calculate the slope of your regression line to determine the erosion rate for these tombstones and show your work. Use this formula:  $(\text{max distance} - \text{min distance}) / (\text{max year} - \text{min year}) =$

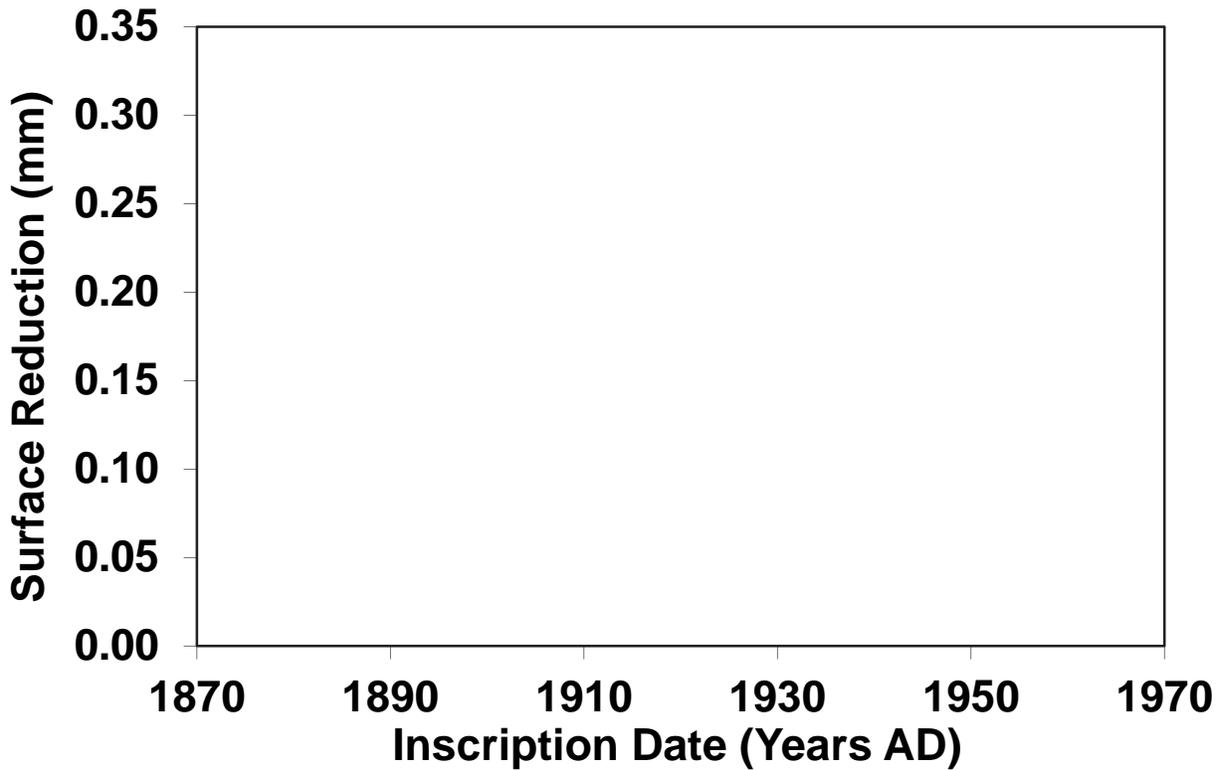
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c. Describe the relation between Surface Elevation (weathering depth) and Time.

2. Comparison between urban and rural settings

We will now plot the data from a different, more rural cemetery. We will then use a regression line through those data and compare the erosion rates between the two sites. Finally we will conclude if there is a significant difference between these two sites and hypothesize about what may be the cause for this difference, if there is a difference.

- a. In Tables further down in this lab, there are data for measurements at Tombstones in Wollongong, Australia. Plot these data points in the graph below.
- b. Plot a regression line through your data points.
- c. Determine the erosion rate based upon your regression line.



Erosion Rate (mm/yr) =

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- d. Sydney Erosion Rate: \_\_\_\_\_  
 Wollongong Erosion Rate: \_\_\_\_\_

Are these rates different? If so, why do you think they are? If not, why don't you think that they are different?

- e. Compare your rate estimates with two other people. Write the estimates from one of your class mates here:

Sydney Erosion Rate: \_\_\_\_\_  
 Wollongong Erosion Rate: \_\_\_\_\_  
 Are they close to or different than your rates?

Why do you think this is so?

3. Predictive value of these relations  
 Now, we will use these regression lines to predict what the surface level at a given time for each location. Use the regression line to estimate this value.

- d. What is the surface level in 1910?  
 Sydney:

Wollongong:

- e. What is the surface level in 1950?  
 Sydney:

Wollongong:

Inscription Date (Years AD)	Surface Reduction (mm)
1893	0.21
1902	0.16
1903	0.1
1904	0.08
1904	0.11
1905	0.18
1907	0.14
1907	0.17
1908	0.14
1909	0.13
1916	0.18
1917	0.13
1918	0.15
1919	0.12
1919	0.18
1922	0.23
1924	0.18
1930	0.27
1936	0.19
1936	0.2
1937	0.15
1940	0.13
1942	0.15
1954	0.14

Data taken from Dragovitch, D., 1986, Weathering rates of marble in urban environments, eastern Australia, Zeitschrift für Geomorphologie, v. 30, p. 203-214.