5.2 WEATHERING: WATER VS. TEMPERATURE

Does water or temperature play a more essential role in the rock weathering process?

WEATHERING

The rate at which rocks begin to break down is a function of the rock types (mineralogy) resistance to weathering and the environment (temperature/rainfall) in which that rock is found. The rate of weathering of a hypothetical rock, in meters weathered per every thousand years, depends on both temperature, *T* (measured in Kelvin), and rainfall, *r* (measured in meters/year). We can use the formula $e^x(rT/300)$ to calculate the rate of weathering (measured in meters weathered away every thousand years) of a hypothetical rock exposed at or near the surface. The rate of weathering also depends on composition of the rock, but let's ignore that for the purpose of this exercise.

In order to find the rate of weathering we must first align our units of measure which we collected in the data table to the units required by the formula $e^x(rT/300)$ where *T* is the temperature (in Kelvin), and *r* is the rainfall (in meters/yr).

a. e^x is the exponential function on your calculator
   This is typically expressd as e^x on your scientific calculator.
b. Finding Temperture (T)
   Convert your temperatures in (°F) to Kelvin and record it in the table.
   $K = (0.56)(°F - 32) + 273$
c. Finding Rainfall (r)
   Convert the rainfall in (cm/day) to (meters/yr)
   #cm/day X 3.6525 = # m/yr

Use the formula $e^x(rT/300)$ to find the rate of weathering every thousand years.

MATERIALS

- 5.2 Student Worksheet (see next page)
- Calculator

ACTIVITY

1. Calculate the rate of weathering of a sample rock exposed in an environment with a mean annual temperature of 32°F and receives 0.26 centimeters of rainfall per day.
   First convert your units:
   a. Temperatures in (°F) to Kelvin
      Temperature in Kelvin = (0.56)(°F -32) +273
   b. Rainfall in (cm/day) to (meters/yr)
      Rainfall in meters/year = number of cm/day × 3.6525
   c. Enter values into calculator beginning with the exponential function
      $e^x(rT/300)$

   The calculated rate of weathering is _____ meters every thousand years.

2. Calculate the potential rates of weathering for each of the listed latitudes.
    a. Temperatures in (°F) to Kelvin
        Temperature in Kelvin = (0.56)(°F -32) +273
    b. Rainfall in (cm/day) to (meters/yr)
        Rainfall in meters/year = number of cm/day 3.6525
    c. Enter values into calculator beginning with the exponential function
        $e^x(rT/300)$

Latitude	Temperature (°F)	Temperature (K)	Rainfall (cm/day)	Rainfall (m/yr)	Rate of weathering (m/1000 yrs)
90° N	0		0.1		
60° N	20		0.15		
30° N	70		0.2		
0° Equator	85		0.5		
30° S	70		0.18		
60° S	20		0.3		
90° S	0		0.05		

5.2 WEATHERING: WATER VS. TEMPERATURE CONTINUED

REFLECTION

1. At what latitude will the greatest rate of weathering occur? _____

2. What two factors contribute to this high rate of weathering at this latitude?

3. Which two latitudes have the most similar rates of weathering? _____ _____

4. Explain how the latitudes share such closely related rates of weathering.

5. Compare the rates of weathering for 60° S and 60° N:

   a. 60° S: _____

   b. 60° N: _____

   c. Calculate the difference in these two rates of weathering: _____

6. Based on the data you have calculated for each of the specified latitudes discuss whether temperature or rainfall is a more important factor in weathering.

7. At what position (A, B, C, D, E, F, G, H, I, J) would you expect to see the greatest rate of weathering to occur? Explain.