Name _____ Earth Science
Notes: Topic 6 Weathering

Weathering (Ch. 5 pg. 124 in text)

A. **Weathering**: Weathering is the breakdown of rock material by **chemical** or **physical** processes. **It is not erosion**, but weathering is the preparation for erosion because rocks must be small enough before they can be moved. The movement of the rocks or sediments is called erosion.

1. Physical Weathering - (AKA mechanical) During physical weathering the rock is broken into smaller pieces called **sediments**, but the chemical composition of the sediments **does not** change. The result of physical weathering is smaller pieces of the same type of rock.

Types of Physical Weathering:

a) Frost Action – liquid water runs into cracks in rocks, freezes and expands, which breaks the rock.

- Repeating of this freeze and thaw of water will cause rocks to crumble.
- Frost action is most important in climates where the temperature varies above and below 0°C (32°F) frequently, like in New York.

b) Abrasion – the wearing down of rocks as they rub or bounce against each other **in streams** and on the bottom of **glaciers**. During stream abrasion, the "corners" of rocks are broken off and the result is a **more rounded rock** and the longer the rock is in the stream the more round it will be.

- As glaciers move, rocks are dragged along the bottom scratching the surface.

c) Biologic Activity - Plant roots and burrowing animals can break rocks apart. The roots grow into the cracks and split the rocks as they grow. Worms can breakdown soil.

2. Chemical Weathering - During chemical weathering, the rock is broken down by **changing the chemical composition** of the rock, which means a new substance is formed.

- Some rocks are stable within the Earth, but when uplift occurs and they are exposed at the surface, they come in contact with weathering agents like water, oxygen, CO_2 and acids.

Types of Chemical Weathering:

a) Oxidation – If a rock contains minerals that have the element iron, it can react chemically with oxygen in the air or water. When this occurs, an new substance forms called iron oxide (RUST) and the larger rock may begin to crumble due parts of it changing.

b) Hydrolysis – When water combines with some minerals, it can dissolve them and create clay. It happens most frequently Carbonate and Silicate minerals.

c) Carbonation – Rainfall is slightly acidic and in more polluted regions of the world (like NY), it's even more acidic. When acid rain comes in contact with calcite-containing rocks like limestone, it can dissolve the rock substantially.

Example: Sink holes can form on the surface above such caverns.

3. Soil - Soil is the uppermost part of the lithosphere that is loose and can support plant life.

How does physical and chemical weathering form soil?

b) Soils Horizons - In this context, horizon just means layers of soil.

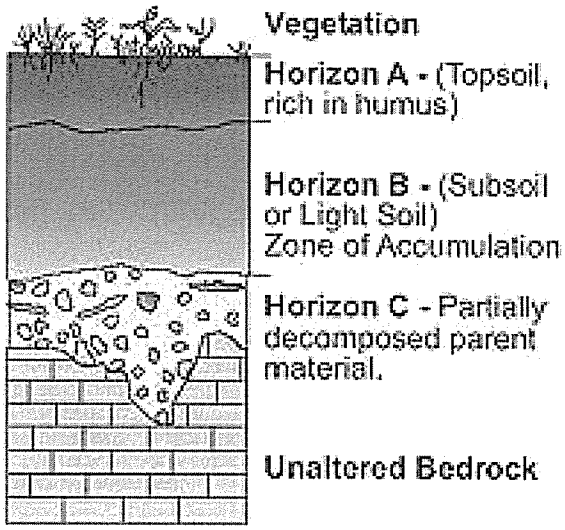
- As time passes, more weathering occurs which produces more defined horizons. Mature soils are easy to identify because they have thicker and well-defined horizons.
- **Soil profiles** are side views that allow us to study the soil horizons.

Types of soil horizons:

⇒ **A-Horizon** - (AKA Top soil) this horizon is usually dark in color from decaying **organic matter** like leaves, sticks and dead animals. This horizon has the most fully weathered rock material and is the **best for growing plants**.

⇒ **B-Horizon** - (AKA Sub soil) Infiltration through the A-Horizon leaches (brings) minerals into this layer. This horizon contains little or no organic matter.

⇒ **C-Horizon**- This horizon is located beneath the B-Horizon and consists of partially weathered bedrock. Beneath all layers is the **unweathered bedrock**.



4. Climate - Describe how climate affects weathering.

Use page 132 in textbook

What type of climate creates the most chemical weathering

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Notes/worksheet: Topic 6A – Erosion

B. Erosion

What is the definition of **Erosion**? _____

_____

_____

Use pages 160-165

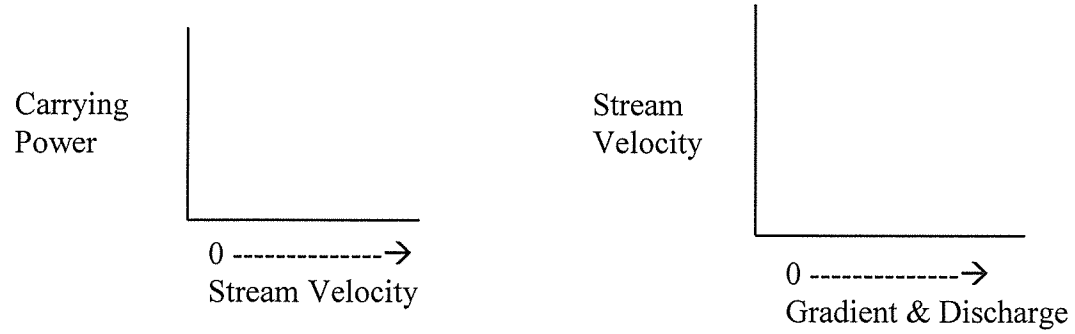
Agents of Erosion (things that move sediments)

1. Running Water - More sediments are transported by running water than any other erosional agent. Streams and rivers are the places that this erosion takes place. The amount of sediment a stream or river can transport is **directly** related to the velocity of the stream and is called **carrying power**.

a. **Stream velocity** is **directly** related to the stream discharge and the gradient (or slope) of the stream.

⇒ Discharge (definition) - _____

Draw a line on each of these graphs to represent each relationship:



b) **List** the **four ways** sediments are transported by running water:

_____ _____

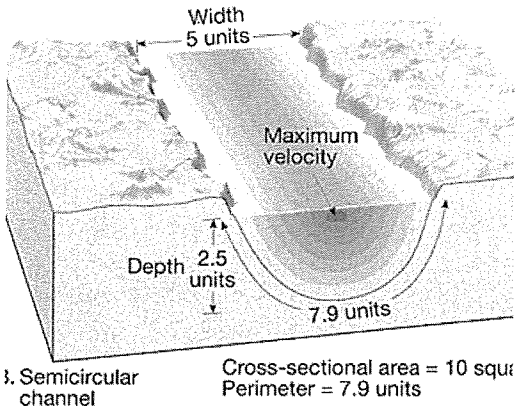
_____ _____

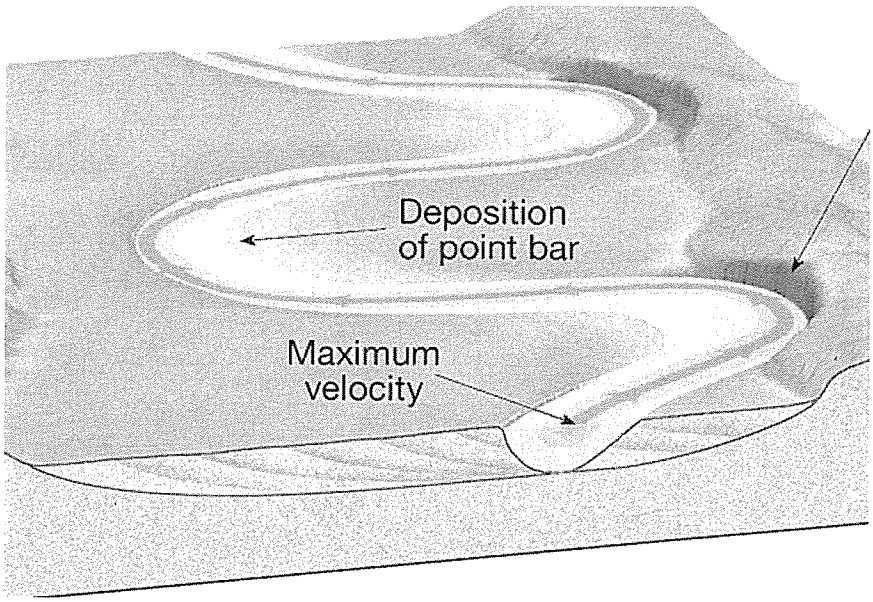
c) Stream Channels normally have (or will create) a V-shaped valley.

⇒ In a straight channel, the stream's velocity is greatest beneath the surface and near the center of the channel because there is less friction there.

⇒ In a curved channel, water near the outside of the stream has greater velocity than water near the inside of the curve. So, erosion is greater on the outside of the curved channel and deposition takes place on the inside.

SEE DIAGRAMS ON NEXT SIDE.





Q1. Why is stream velocity greatest on the outside of a stream meander (turn)?

Q2. Which stream will have the greatest velocity? _____

Q3. Which stream could move the largest sized sediment? _____

Q4. According to your ESRT, what size sediments can a stream transport if it has a velocity of 200 cm/sec? _____

Q5. How fast must a stream travel in order to erode all sediments the size of cobbles?

Use pages 203-207 in textbook.

Agents of Erosion (continued)

2) **Wind** – The stronger the wind velocity, the larger the particles it can transport and the longer distance it can be transported. Usually, sand is the largest size that can be moved and it only is carried 2 or 3 feet above the ground.

3) **Ice (glaciers)** - Glaciers carry sediments of all sizes, from boulders to silt. Basically, the sediments become stuck in the ice as the glacier moves across an area and then are dropped elsewhere.

Use pages 188-1198 in textbook.

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Notes/worksheet: Topic 6A – Erosion

⇒ Most erosional agents drop their sediments as well-sorted, **but glaciers are one agent of erosion that can leave UNSORTED SEDIMENTS.**

⇒ Glaciers create **U-SHAPED VALLEYS** as they grind through terrain.

Glacier (definition) - _____

_____

Describe how glaciers form. _____

_____

_____

Some glacier vocabulary:

a) Erratics – a term used to describe large boulders that glaciers transport.

b) Till- describes sediment that is directly dropped by the glacier and is usually **unsorted.**

c) outwash- describes the sediment that is deposited from the water (meltwater) that flows from the glacier as it melts.

d) Striations (glacial) - _____

_____

_____

e) Glacial polish – When glaciers move over bedrock, the ice grinds the rock and it appears polished. Many rock surfaces on the Shawangunk Ridge show this feature.

4) Gravity- Gravity is the primary force behind most erosion because its gravity that causes water and glaciers to move. It also transports sediments by itself. Rocks that fall from a cliff, which are called talus are transported to their new location by gravity.

Review Questions

Q1. What is the general appearance of sediments that have been eroded in a stream?

_____

Q2. Describe the type of weathering that takes place in streams and beneath glaciers.

_____

Q3. The size of the sediment that can be carried in a stream depends on the stream's _____, which is directly related to the _____ and _____ of the stream.

C. Deposition

Definition: _____

_____

Examples: Wind dropping sand; glaciers dropping erratics; water dropping clay.

1. **When and where does deposition occur?**

When an agent of erosion looses its carrying power, deposition (a.k.a. sedimentation) occurs. **Water is the dominant agent of erosion on Earth** and when water's velocity decreases (slows down), it looses its carrying power and it deposits (drops) the sediments it was transporting.

Most deposition occurs in lakes and oceans because when streams enter lakes and oceans, the velocity of the water will decrease drastically or stop completely.

⇒ What agents of erosion will deposit sediments on land? _____

_____

1. **Settling time vs. settling rate –** When a sediment is deposited, we say that it settles to the bottom and how fast or slow it settles can be important. As the settling time **increases**, the settling rate or speed will **decrease.**

3. Factors that affect Deposition:

a) Particle size- The larger sediments are normally the first to be deposited (they have faster settling rates). Remember this relationship: **The greater the velocity of a stream, the larger the sediment it can carry**. When a stream's velocity decreases, the first particles to be deposited are the large particles, then progressively smaller sediments will be deposited if the velocity continues to decrease.

b) Particle shape – A **round** particle will settle faster than a flat or angular shaped sediment.

c) Particle Density – If other factors (size and shape) are equal, then the sediment that is the **densest** will settle out faster.

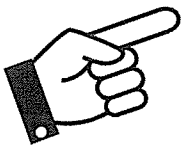
4. **Types of Deposition:**

a) Horizontal Sorting – As a stream enters a lake or ocean, its velocity will decrease. The farther from the mouth of the stream the lower the velocity.

This decreasing speed of the water will cause **larger particles** like cobbles & gravel to be **deposited first**. Next, the sand will settle out and then the silt. Finally, the clay will be deposited and eventually salt will precipitate from the evaporation of the water.

⇒ This will produce a **horizontal pattern** of deposited sediments ranging from **largest to smallest in size**.

⇒ It is important to note that the larger particles are deposited near the shore of the ocean or lake and the clays and precipitates are deposited much farther out.



Draw horizontal sorting here or attach another sheet.

b) Vertical sorting – In calm water, sediments will sort into **layers** of similar sizes. The **largest particles** are on the **bottom** and each layer above are progressively smaller. Each layer is called a depositional bed.

When does vertical sorting occur? _____

_____

_____

c) Graded bedding – This depositional pattern shows vertical sorting within several layers, which means several depositional events occurred.

d) Cross bedding – Sediments are deposited at an angle to the horizontal. This occurs with wind making sand dunes or sometimes with fast moving rivers that decrease velocity rapidly.

5. Agents of Deposition and features: In complete sentences, describe the following agents of deposition and the features and structures of those sediments after deposition. Please include any key words that I have already outlined for you. In some cases, the R.B. and Text will be sufficient, but in other cases you may need additional resources.

a) **Stream Deposition** - _____

_____

_____

Delta - _____

_____

_____

Flood Plain – (What is meant by 50 & 100 year old flood plain?) _____

_____

_____

_____

b) **Wind Deposition** - _____

_____

_____

c) **Deposition by Gravity** - _____

_____

_____

d) **Deposition by Glaciers** – Glaciers deposit sediments much differently than water and wind. One way is for large boulders to be randomly broken off during the **abrasion** of ice and bedrock. These are called **erratics**, but they don't represent a large percentage of the total sediment that glaciers deposit.

Two Main Types of Glacial deposits:

⇒ **Till** is **unsorted** rock that is directly deposited by the glacier, which normally happens as the glacier is receding (ice is melting).

⇒ **Outwash** is sediment that is deposited by the **melt-water**. As the glacier melts, a stream will flow out from under the ice and carry sediments. Outwash can have horizontal sorting.

⇒ Long Island is entirely a glacial deposit. It consists of both till and outwash.

Name _____ Earth Science

Notes/worksheet: Topic 6A – Erosion

Review Questions

1. What will happen to a river's velocity as it enters an ocean?

_____

_____

2. Describe the depositional "pattern" that will occur in the situation in question #1.

_____

_____

3. A clear tube of mixed sediment sizes is shaken vigorously and then set down. Draw what it would like after 5 minutes.