Weathering and Soil

Disintegration of Rock

Rocks exposed to the elements break down into smaller particles called ________ which eventually breaks down further to form ________. This process is called weathering.

Definition of weathering: ______________________________________________________

Definition of erosion: __________________________________________________________

Definition of mass wasting: ____________________________________________________

Weathering takes place where the 4 earth systems lithosphere, atmosphere, hydrosphere, and biosphere can interact with each other. i.e., at the Earth’s surface.

How deep can weathering penetrate into the Earth? ____________________________

Descriptions of the two kinds of weathering:

• _____________: rock is physically broken down but the minerals don’t change

• _____________: rock is broken down by chemical or biochemical alteration of minerals, or by dissolving minerals and removing them in solution.

Mechanical Weathering

Any weathering that involves the physical breakdown of rock is called mechanical weathering. There are five main types:

1. _____________: when water freezes and expands, forcing rock to break apart.

   How much does water expand when it freezes? ________

   What is the process called where fractures in rock are forced apart by the water inside them freezing? ________________ (this is just another way of saying “frost wedging”)

   The chunks of rock that then fall off and collect on a slope are called ____________.

2. _____________: rocks under pressure deep inside the Earth’s crust get brought slowly to the surface over geologic time (e.g., by the effect of erosion or mountain building). At the surface, the rocks expand and break apart.

   The process whereby rocks get uplifted is called ________________.

   The rock breaks into thin slabs or sheets during uplift. The fractures between these slabs of rock are called _______________.

The process that produced these thin slabs or sheets is called _________________.

The large bodies of weathered rocks that are created at the Earth’s surface as a result are called ________________ (Example: ________________).

3. ________________: temperature extremes and sudden temperature changes may cause a rock to peel off in layers, like an onion. This is a type of exfoliation called _________________.

   In what type of environment is this likely to happen? ________________

   So are rocks good or poor conductors of heat?  GOOD  or  POOR ?

4. ________________: the forces of growing crystals can break bits off rocks. This is common where water containing dissolved minerals evaporates.

   What mineral commonly grows when water evaporates?: ________________

5. ________________: plant roots penetrate cracks and force rocks apart, whereas burrowing animals help break down rocks and soil into smaller particles.

**Chemical Weathering**

(1) One type of chemical weathering is when ions are removed from minerals in the rocks, causing them to dissolve completely. In this case, we say that the ions have been carried away in solution and the process itself is called _________________.

What two types of minerals frequently get dissolved and removed in solution?:

1. ________________  2. ________________

So what three types of rocks made up of these minerals can potentially dissolve?:

1. ________________  2. ________________  3. ________________

What types of ground collapse features in limestone are caused by dissolution? ________________

(2) Rainwater is actually a weak acid. Raindrops falling through the air dissolve CO$_2$, resulting in the formation of an acid compound called ________________ (H$_2$CO$_3$).

This acid facilitates rainwater's ability to chemically attack rock minerals. Also, water that seeps into the ground absorbs additional CO$_2$ from decaying organic matter, which causes it to become even more acidic.

Rainwater interacts with man-made atmospheric pollutants such as ________________ and ________________ compounds, resulting in an even stronger acid called ________________ which speeds up the weathering process.
The reason rain can cause weathering is because dissolved H⁺ ions displace larger cations in minerals in rocks, such as K⁺, Na⁺, and Mg²⁺.

This is a type of chemical weathering involving reactions with water, which we call _________________ reactions.

This is exactly how feldspar is able to break down into clay, and is why marble gravestones lose the inscriptions on them over time.

(3) A third type of chemical weathering is when oxygen is added to a metal to form an oxide. This is called _________________. Such chemical reactions are particularly common in areas affected by __________________ (i.e., waste water from mining operations).

   Example: iron pyrite oxidizes to form ________________ acid. This is commonly introduced into streams in regions near old ______________ mines.

Factors Influencing Weathering

How long does it take for a layer of topsoil to develop from the weathering of underlying rocks?

The main factors that control how susceptible a rock is to mechanical or chemical weathering are:

• ________________: some minerals are more susceptible to weathering than others.

   Example: ______________ is very resistant to weathering
   ______________ is not very resistant to weathering

In general, minerals get more resistant to weathering as we move down Bowen's Reaction Series (i.e., olivine and Ca-plagioclase are least resistant).

• ________________: if rocks contain lots of fractures, they are more susceptible to weathering such as through frost wedging. The greater the number of joints, the more surface area that's available for chemical weathering.

   Jointed rocks are weathered by having the corners rounded off to form smooth, rounded boulders. This process is called ________________ weathering.

• ________________:

What type of climate is best for chemical weathering? ______________________

Where is this most likely to occur? ______________________

What type of climate is best for mechanical weathering? ______________________

Where is this most likely to occur? ______________________
Soil

Soils can originate through one of two ways: they can either be:

_____________________ (formed in place), or
_____________________ (brought in from somewhere else).

Soil deposited during river floods are transported (e.g. along the Nile River each year).

Transported soils may also be deposited by the wind. For example, the soils in the Palouse region were blown in by winds about 10,000 years ago. We call this type of wind-blown soil ________________.

We recognize five different horizons in a soil profile that reflect the progressive downward migration of weathering action.

The horizons are (from the top down): ____________________________.

The O horizon is mostly decaying organic matter, called ________________.
The A horizon is a mix of organic matter and minerals, like clay.
The O and A horizons together are called ________________.

The E horizon is not always present- it contains very little organic matter or oxidized minerals, so it tends to be light colored. It is common in acidic soils.

The B horizon is predominantly brown or red, consisting of oxidized clay minerals.
The C horizon is mostly original rock that has started to oxidize and weather.

Do we always see each of these soil horizons in every soil profile?     YES   or    NO

We also distinguish three main families of soil types:

• __________________ : rich in clays and are common in areas of moderate rainfall and temperate climates, such as the eastern, central and NW United States. These soils are the best for agriculture.

• __________________ : are common in areas having dry climates, like the SW United States. They are rich in CaCO₃ and other soluble minerals like gypsum. Water evaporation precipitates these minerals forming a hard, light-colored layer called ________________. They are not very fertile unless highly irrigated.

• __________________ : are common in tropical and equatorial areas with high temperatures and high rainfall. The soils are red and strongly leached, meaning all the nutrients have been dissolved and carried away in solution. They can support tropical rainforests but cannot support agriculture if the forests are clear-cut.

Some types of soils expand when water gets added, which can result in a lot of disruption of surface structures. These types of soils are called ________________.

FINAL QUESTION:

By what percentage can expansive soils increase in volume when water gets added?

______________________