INTRODUCTION TO ATMOSPHERE, HYDROSPHERE AND BIOSPHERE

B.SC. SEM-1

GE-1

DEPT. OF GEOLOGY

DSPMU, RANCHI

The Atmosphere

Atmosphere is a mixture of different gases and it envelopes the earth all round. It contains life giving gases like oxygen for humans and animals and carbon dioxide for plants.

In other words

The Earth is surrounded by a blanket of air, which we call the ***atmosphere***.

• The atmosphere consists of four unique layers (the troposphere, the stratosphere, the mesosphere, and the thermosphere).

•The atmosphere reaches over 350 miles up from the surface of the Earth.

COMPOSITION OF THE ATMOSPHERE

The atmosphere is composed of gases, water vapour and dust particles. The proportion of gases changes in the higher layers of the atmosphere in such a way that oxygen will be almost in negligible quantity at the height of 120 km. Similarly, carbon dioxide and water vapour are found only up to 90 km from the surface of the earth.

Constituent	*Formula*	*Percentage by Volume*
Nitrogen	N_2	78.08
Oxygen	O_2	20.95
Argon	Ar	0.93
Carbon dioxide	CO_2	0.036
Neon	Ne	0.002
Helium	He	0.0005
Krypto	Kr	0.001
Xenon	Xe	0.00009
Hydrogen	H_2	0.00005

Or

Composition of the Air

Nitrogen	78%
Oxygen	21%
Other gases	1%

*greenhouse gases: carbon dioxide, water vapor, methane, etc.

Study the above table showing the composition of the atmosphere and answer the following questions.

1. Which gas constitutes the highest % of atmosphere?

2. Name the gas which constitutes least % of atmosphere Gases

Carbon dioxide is meteorologically a very important gas as it is transparent to the Incoming solar radiation but opaque to the outgoing terrestrial radiation. It absorbs a part of terrestrial radiation and reflects back some part of it towards the earth‘s surface. It is largely responsible for the ***green house effect***.

The volume of carbon dioxide has been rising in the past few decades mainly because of the burning of fossil fuels. This has also increased the temperature of the air.

Ozone is another important component of the atmosphere found between 10 and 50 km above the earth‘s surface and acts as a filter and absorbs the ***ultra-violet rays*** radiating from the sun and prevents them from reaching the surface of the earth.

Water Vapour

Water vapour is also a variable gas in the atmosphere, which decreases with altitude. In the warm and wet tropics, it may account for four per cent of the air by volume, while in the dry and cold areas of desert and polar regions, it may be less than one per cent of the air. Water vapour also decreases from the equator towards the poles. It also absorbs parts of the insolation from the sun and preserves the earth's radiated heat. It thus, acts like a blanket allowing the earth neither to become too cold nor too hot. Water vapour also contributes to the stability and instability in the air.

Dust Particles

Atmosphere has a sufficient capacity to keep small solid particles, which may originate from different sources and include sea salts, fine soil, smoke-soot, ash, pollen, dust and disintegrated particles of meteors. Dust particles are generally concentrated in the lower layers of the atmosphere; yet, convectional air currents may transport them to great heights. The higher concentration of dust particles is found in subtropical and temperate regions due to dry winds in comparison to equatorial and polar regions.

Dust and salt particles act as hygroscopic nuclei around which water vapour condenses to produce clouds.

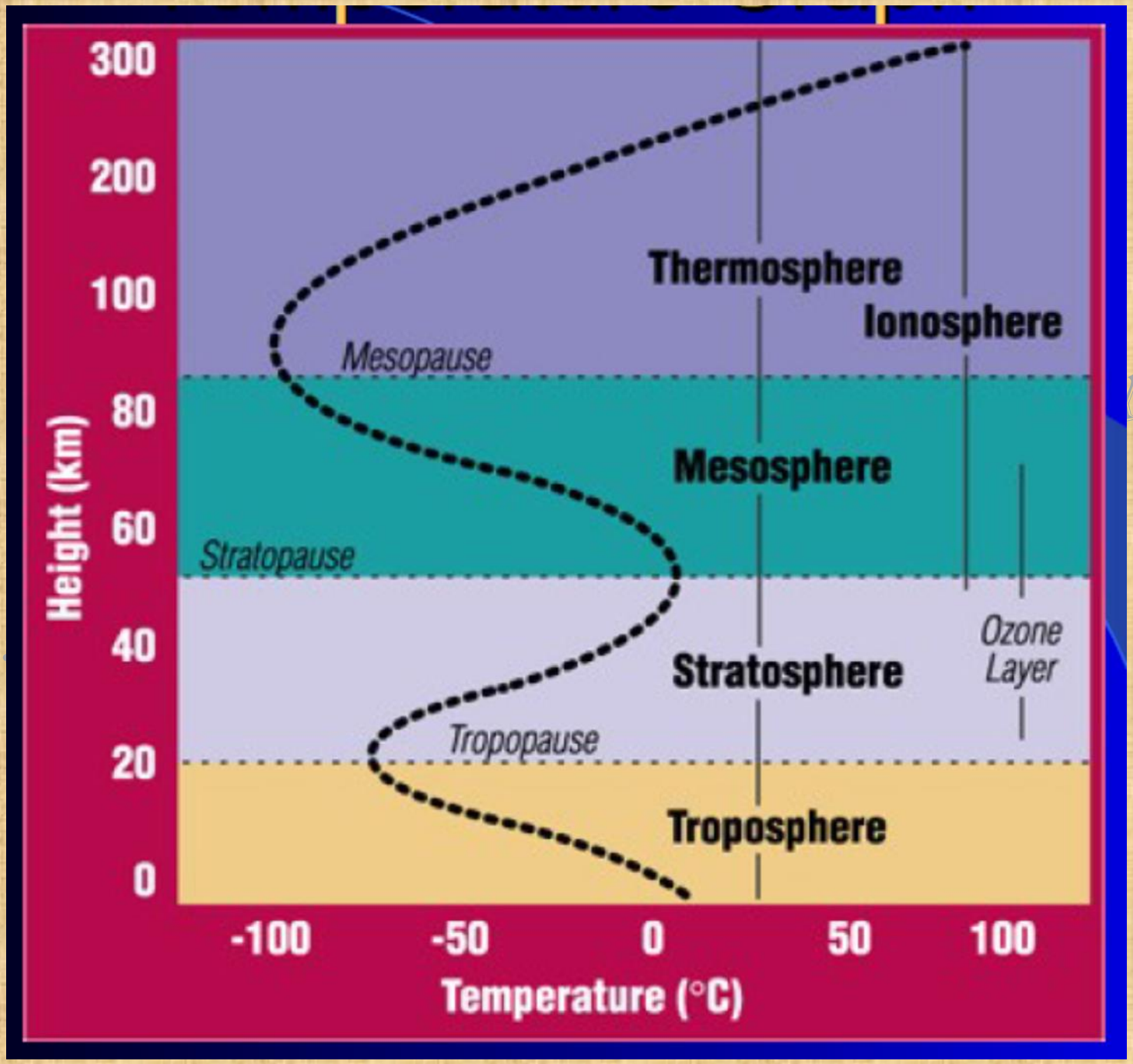
STRUCTURE OF THE ATMOSPHERE

1.The atmosphere consists of different layers with varying density and temperature. 2. Density is highest near the surface of the earth and decreases with increasing altitude.

3.The column of atmosphere is divided into five different layers depending upon the temperature condition.

Name the layers of atmosphere

They are: troposphere, stratosphere, mesosphere, thermosphere and exosphere.


300
200
100
80
60
40
20
0
Height (km)
Thermosphere
Ionosphere
Mesopause
Mesosphere
Stratopause
Ozone Layer
Stratosphere
Tropopause
Troposphere
-100
-50
0
50
100
Temperature (°C)

The troposphere

1.It is the lowermost layer of the atmosphere.

2. Its average height is 13 km

3. extends roughly to a height of 8 km near the poles and about 18 km at the equator.

4. Thickness of the troposphere is greatest at the equator because heat is transported to great heights by strong convectional currents.

5. This layer contains dust particles and water vapour.

6. All changes in climate and weather take place in this layer.

7. The temperature in this layer decreases at the rate of 1 °C for every 165 m of height.

8. This is the most important layer for all biological activity.

9. The zone separating the troposphere from stratosphere is known as the ***tropopause***.

The air temperature at the tropopause is about minus 800 °C over the equator and about minus 45°C over the poles.

The temperature here is nearly constant, and hence, it is called the tropopause.

The stratosphere

1. It is found above the tropopause and extends up to a height of 50 km.

2. One important feature of the stratosphere is that it contains the ***ozone layer***.

3. This layer absorbs ultra-violet radiation and shields life on the earth from intense, harmful form of energy.

The mesosphere

1. It lies above the stratosphere,

2. which extends up to a height of 80 km.

3. In this layer, once again, temperature starts decreasing with the increase in altitude and Up to minus 100°C at the height of 80 km.

4. The upper limit of mesosphere is known as the ***mesopause***.

The ionosphere

1 .It is located between 80 and 400 km above the mesopause.

2. It contains electrically charged particles known as ions, and hence, it is known as ionosphere.

3. Radio waves transmitted from the earth are reflected back to the earth by this layer.

4. Temperature here starts increasing with height.

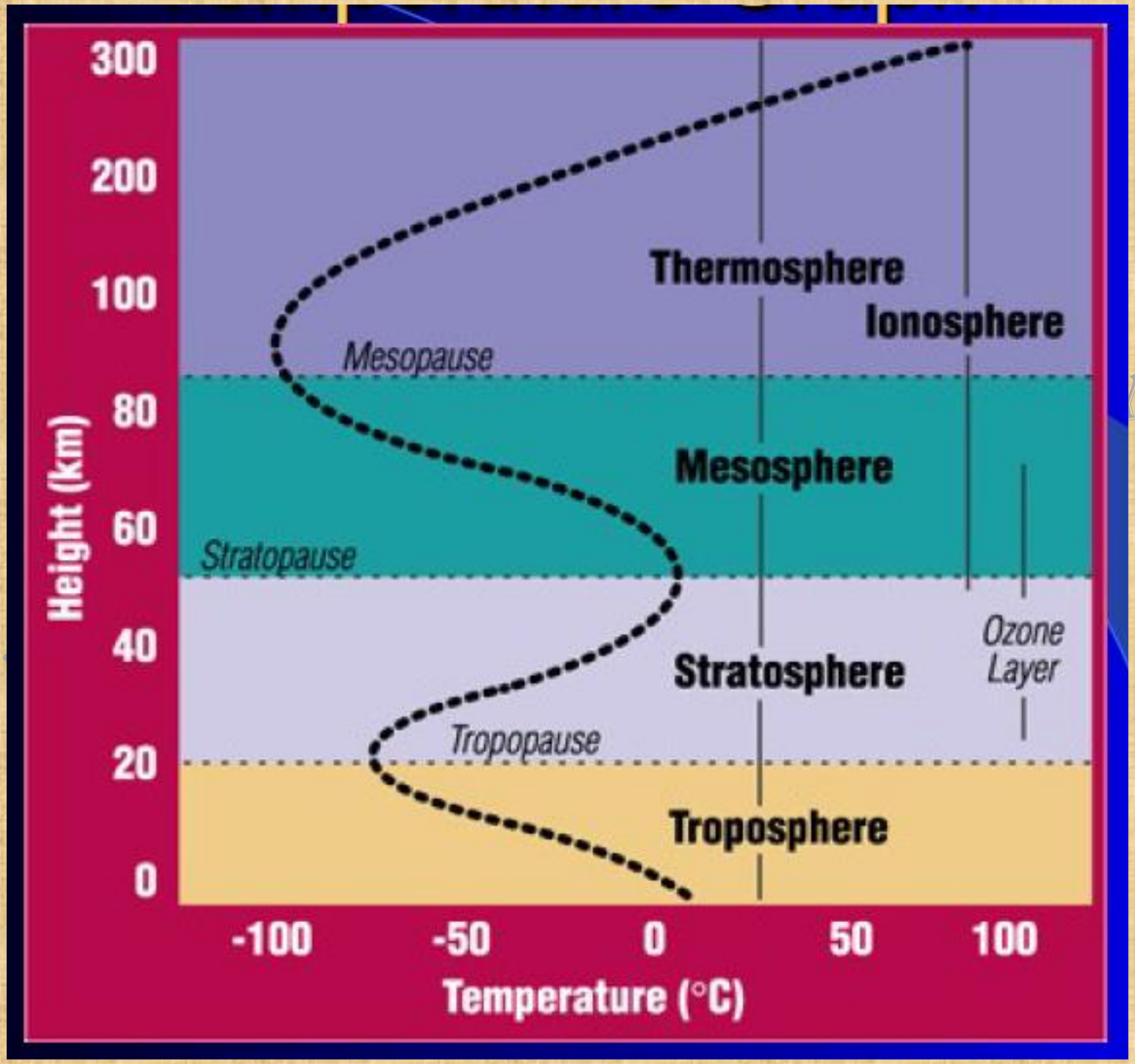
5. The uppermost layer of the atmosphere above reaches up to minus 100

Exosphere

1. the thermosphere is known as the ***exosphere***.

2. This is the highest layer but very little is known about it.

3. Whatever contents are there, these are extremely rarefied in this layer, and it gradually merges with the outer space.


300
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Height (km)
Thermosphere
Ionosphere
Mesopause
Mesosphere
Stratopause
Ozone Layer
Stratosphere
Tropopause
Troposphere
-100
-50
0
50
100
Temperature (°C)

Hydrosphere

Hydrosphere

- The totality of water surrounding the Earth, comprising all the bodies of water, ice and water vapor in the atmosphere i.e. water held in oceans, rivers, lakes, glaciers, ground water, soil, and air.

Types of water

Types of water	Name	Volume, billion km³	Amount with respect to entire volume of the hydrosphere, %
Sea water	Sea	1370	94
Ground (except soil water) water	Ground	61,4	4
Ice and snow (Arctic, Greenland, mountain regions, ice regions)	Ice	24,0	2
Surface water: lakes, reservoirs, rivers, swamps, soil water	Fresh	0,5	0,4
Atmospheric water	Atmospheric	0,015	0,01
Water in living organisms	Bio-related	0,00005	0,0003

Ice distribution on the Earth (according to Reymes, 1990)

Ice type	Volume		Square of distribution	
	t	%	billiob km²	%
Ice caps	$2,4*10^{16}$	98,95	16,1	10,9 of land
Subsurface ice	$2*10^{15}$	0,83	21	14,1 of land
Sea ice	$3,5*10^{13}$	0,14	26	7,2 of ocean
Snow cover	$1*10^{13}$	0,04	7264	14,2 of Earth
Glaciers	$7,6*10^{12}$	0,03	63,5	18,7 of ocean, (sporadically)
Atmospheric ice	$1,7*10^{12}$	0,01	510,1	100 over the Earth

Snow-ice cap of African mountain top of Kilimanjaro melted during 11000 years

Arctic and Antarctic glaciers are gradually melting

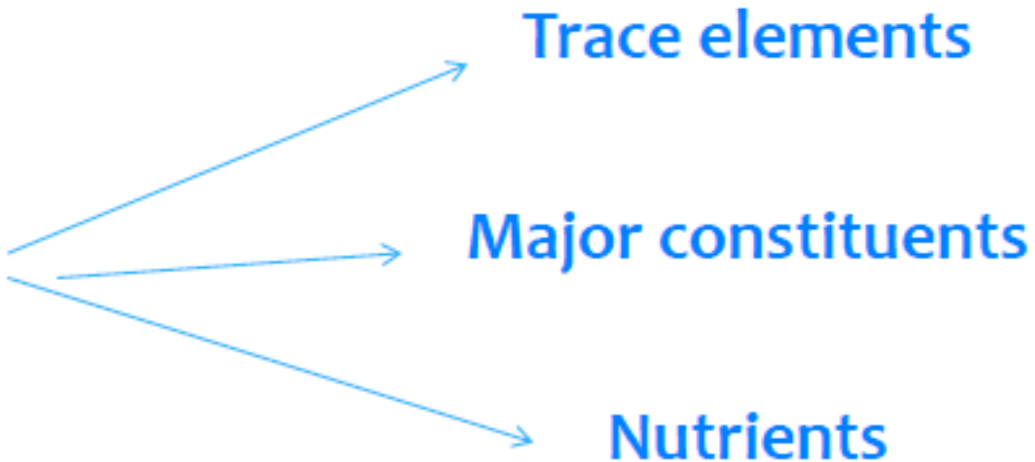
Nearly 94% of the whole water volume is concentrated in oceans and seas; 4 % are in ground waters; about 2 % - in ice and snow (mainly in Arctic, Antarctic, and Greenland); 0,4 % - in surface waters (rivers, lakes, swamps).

Insignificant amount of water is contained in atmosphere and organisms. All types of water are transformed from one form to another in circulation process (global cycle).

2. Chemical composition of water

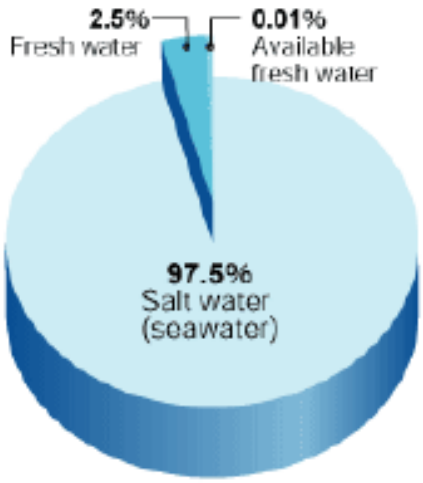
Classification of matter in sea water (according to Horn, 1972):

* Gases
* Organic compounds
* Particulate matter



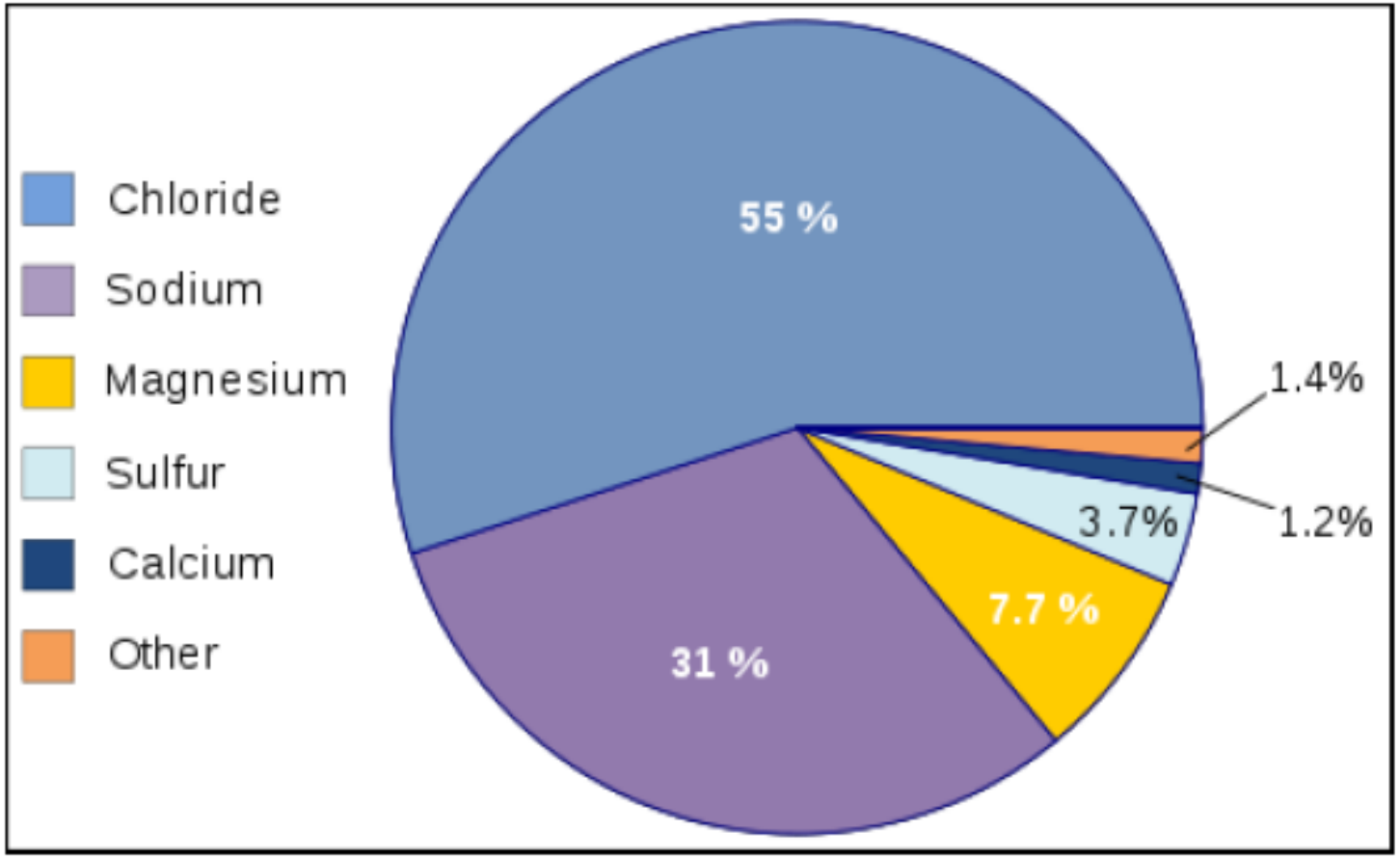
Chemical composition of the hydrosphere

* Chemical composition of the hydrosphere approximates to the average composition of sea water, where hydrogen, oxygen, chlorine, and sodium prevail.
* In land water carbonates prevail. Content of mineral substances in land water (salinity) fluctuates greatly depending on local conditions and, first of all, climate. Usually land water is weakly mineralized – fresh ***(river and fresh lake salinity ranges from 50 to 1000 mg/kg).***
* Average salinity of Oceanic water is around 35 g/kg (35 %), sea water salinity ranges from ***1-2 % (Gulf of Finland, Baltic Sea) to 41,5 % (Red Sea).*** The maximum salt concentration is in salty lakes ***(Dead Sea up to 260 %)***



Composition of the earth's water supply

Chemical composition of oceans



DEFINITION OF BIOSPHERE

The **biosphere**: is the global sum of all ecosystems. It can also be termed the zone of life on Earth, a closed system (apart from solar and cosmic radiation and heat from the interior of the Earth), and largely self-regulating

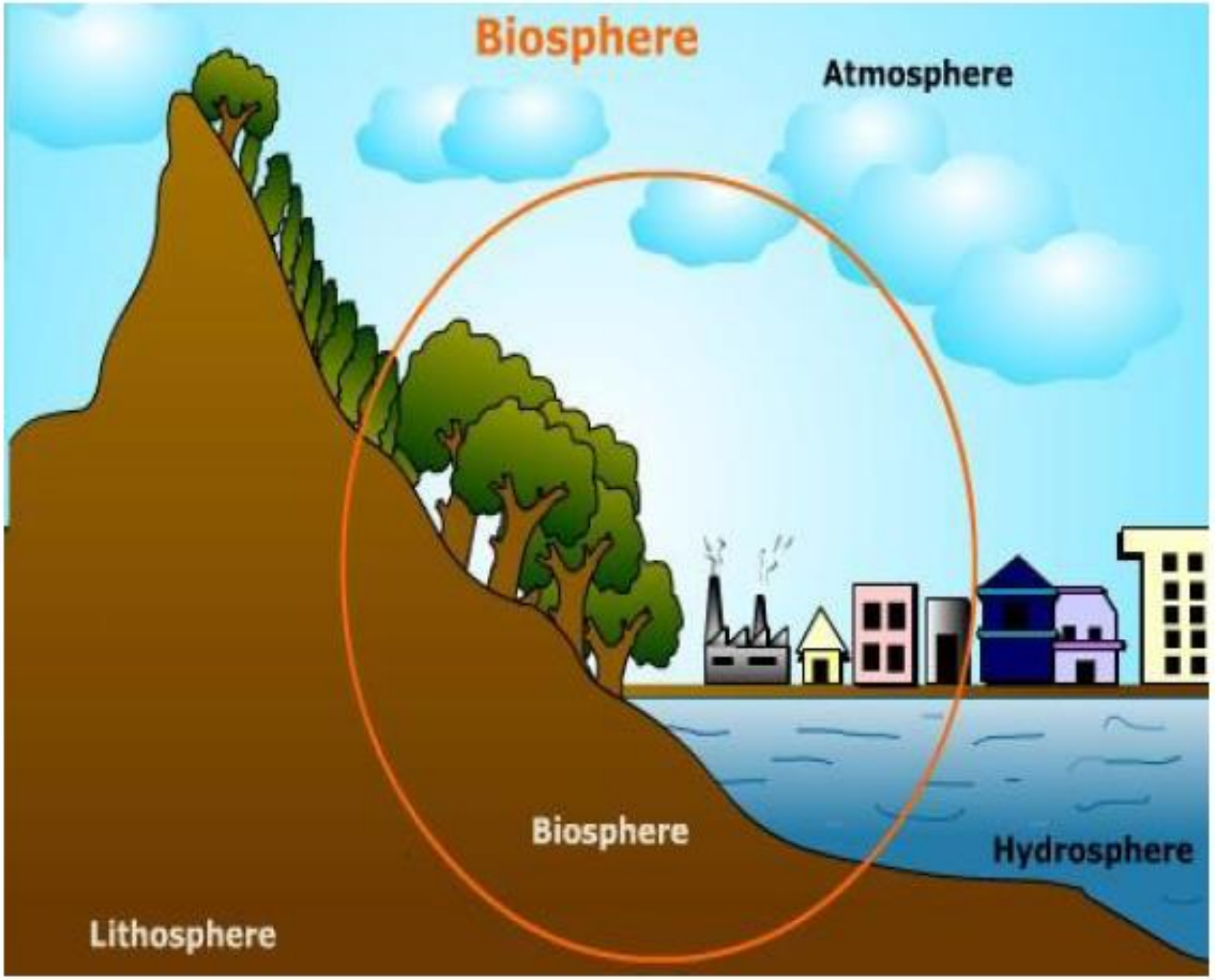
ORIGIN OF BIOSPHERE

Biosphere has a geological origin, it is an indication of the effect of both Charles Darwin and Matthew F. Maury on the Earth sciences. The biosphere's ecological context comes from the 1920s, preceding the 1935 introduction of the term "ecosystem" by Sir Arthur Tansley. Vernadsky defined ecology as the science of the biosphere. It is an interdisciplinary concept for integrating astronomy, geophysics, meteorology, biogeography, evolution, geology, geochemistry, hydrology and, generally speaking, all life and Earth sciences.

USE OF THE TERM BIOSPHERE

The term "**biosphere**" was coined by geologist Eduard Suess in 1875, which he defined as:

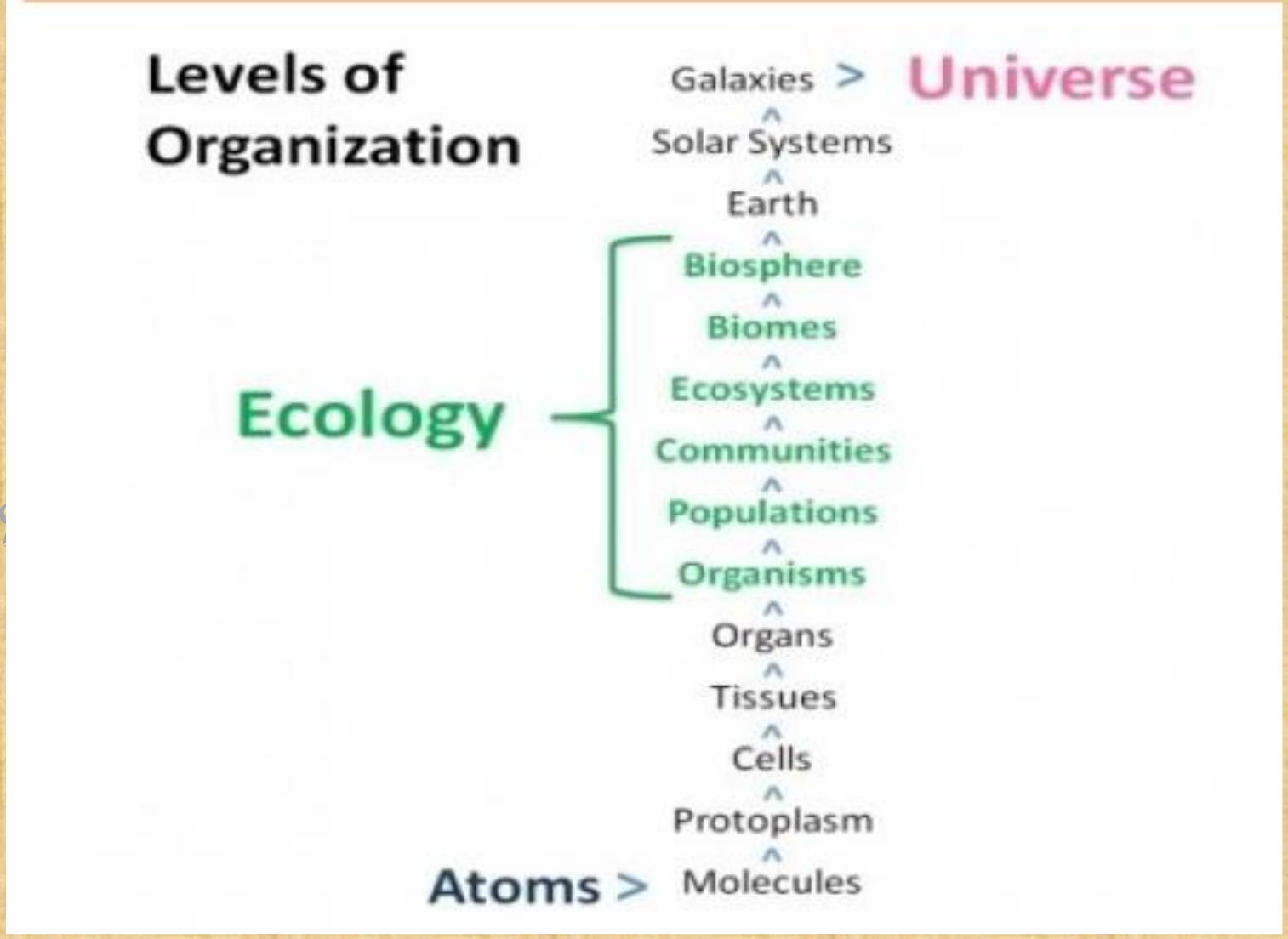
The place on Earth's surface where life dwells.


Biosphere
Atmosphere
Biosphere
Hydrosphere
Lithosphere

CONCEPTS OF BIOSPHERE

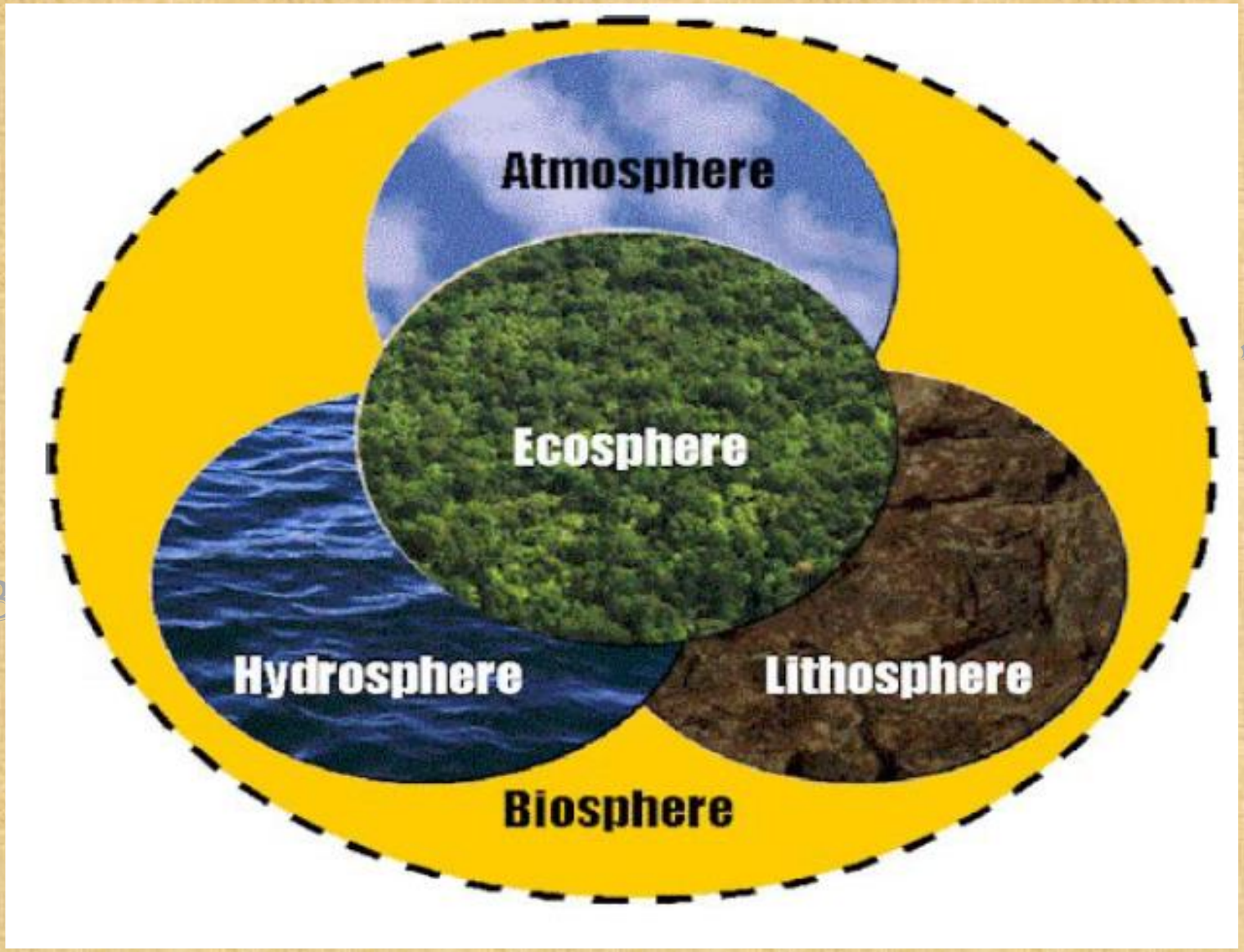
The **biosphere concept**: is common to many scientific disciplines including astronomy, geophysics, geology, hydrology, biogeography and evolution, and is a core concept in **ecology**, earth science and physical geography.

LEVELS OF ORGANIZATION



PHYSICAL PROPERTIES OF BIOSPHERE

The physical properties of the **biosphere** in terms of its surface reflectance (**albedo**) and exchange of heat and moisture with the atmosphere are also critical for understanding global circulation of heat and moisture and therefore climate. Alterations in both the physics (albedo, heat exchange) and chemistry (carbon dioxide, methane, etc.) of earth systems by the biosphere are fundamental in understanding anthropogenic **global warming.**


Atmosphere
Ecosphere
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Biosphere

FACTORS EFFECTS ON BIOSPHERE

- Distance between the earth and the sun.
- Seasons and seasonal climate changes are direct results of the tilt of the Earth towards or away from the Sun. Summer months allow half of the planet to warm while the other half cools. Six months later, the temperatures shift in the opposite direction.
- **Chemical erosion** is a great example of a landscape changing one molecule at a time.
- **Oxidation** and **reduction** reactions change the composition of rocks and organic materials. There is also **biological erosion**. Tiny organisms, such as bacteria and fungi, are constantly working to break down organic and inorganic materials.

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