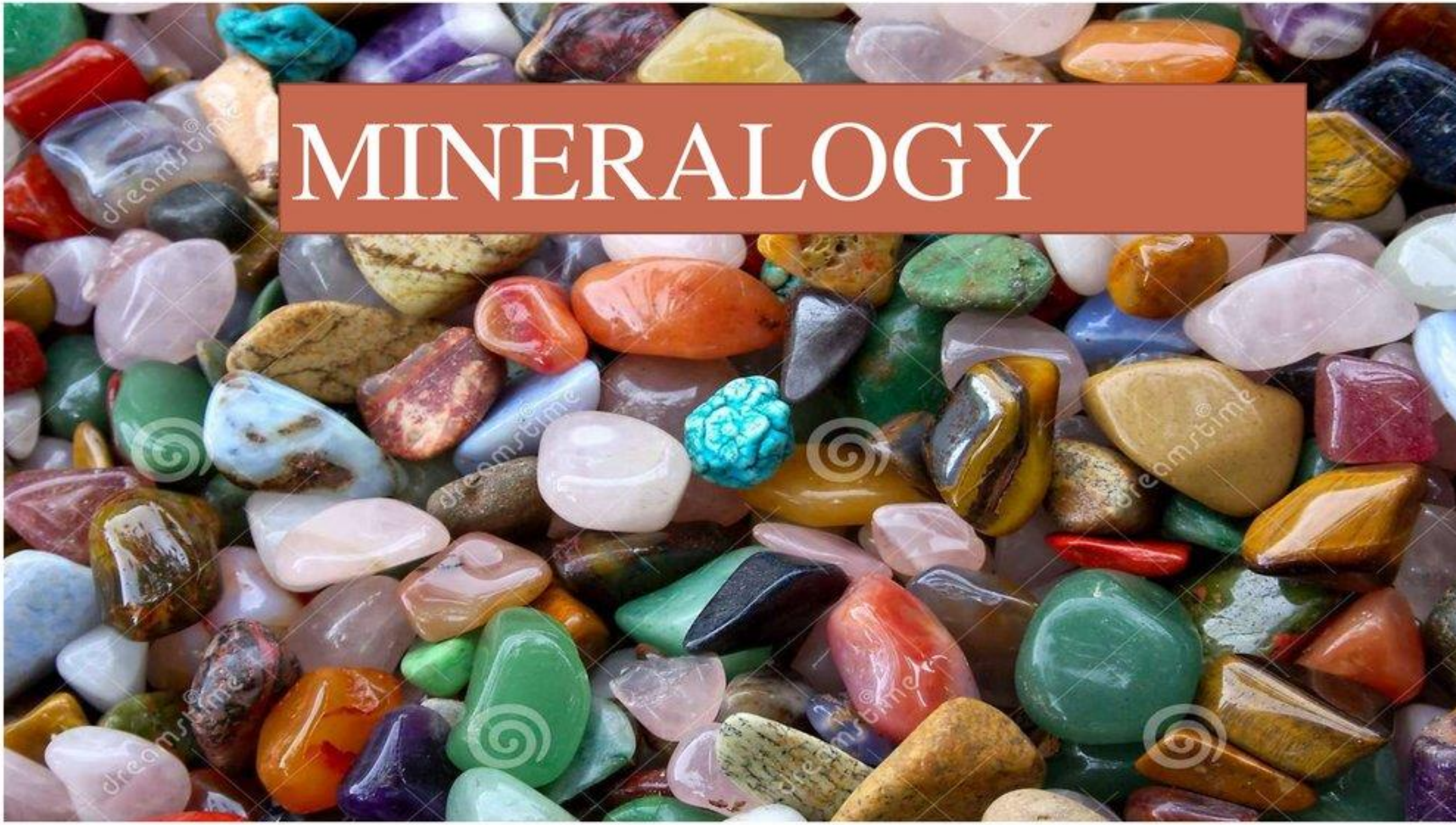
MINERALOGY



introduction

- Mineralogy is a subject of geology specializing in the scientific study of the chemistry, crystal structure, and physical (including optical) properties of minerals and mineralized artifacts. Specific studies within mineralogy include the processes of mineral origin and formation, classification of minerals, their geographical distribution, as well as their utilization.

Physical properties

- Physical properties An initial step in identifying a mineral is to examine its physical properties, many of which can be measured on a hand sample. These can be classified into density- measures of mechanical cohesion(hardness, tenacity, cleavage, fracture, parting); macroscopic visual properties (luster, color, streak, luminescence, diaphaneity); magnetic and electric properties; radioactivity and solubility in hydrogen chloride (HCl)

- **Hardness** is determined by comparison with other minerals. In the Mohs scale, a standard set of minerals are numbered in order of increasing hardness from 1 (talc) to 10 (diamond) A harder mineral will scratch a softer, Hardness can also be measured on an absolute scale using a sclerometer

Mohs' Hardness Scale

Soft:
Leaves mark or gets grooved

Hard:
Scratches other stuff

1	2	3	4	5	6	7	8	9	10
Talc	Gypsum	Calcite	Fluorite	Apatite	Orthoclase	Quartz	Topaz	Corundum	Diamond

Fingernail 2.4

Penny 3.0

Nail 5.0

Glass Plate 5.6

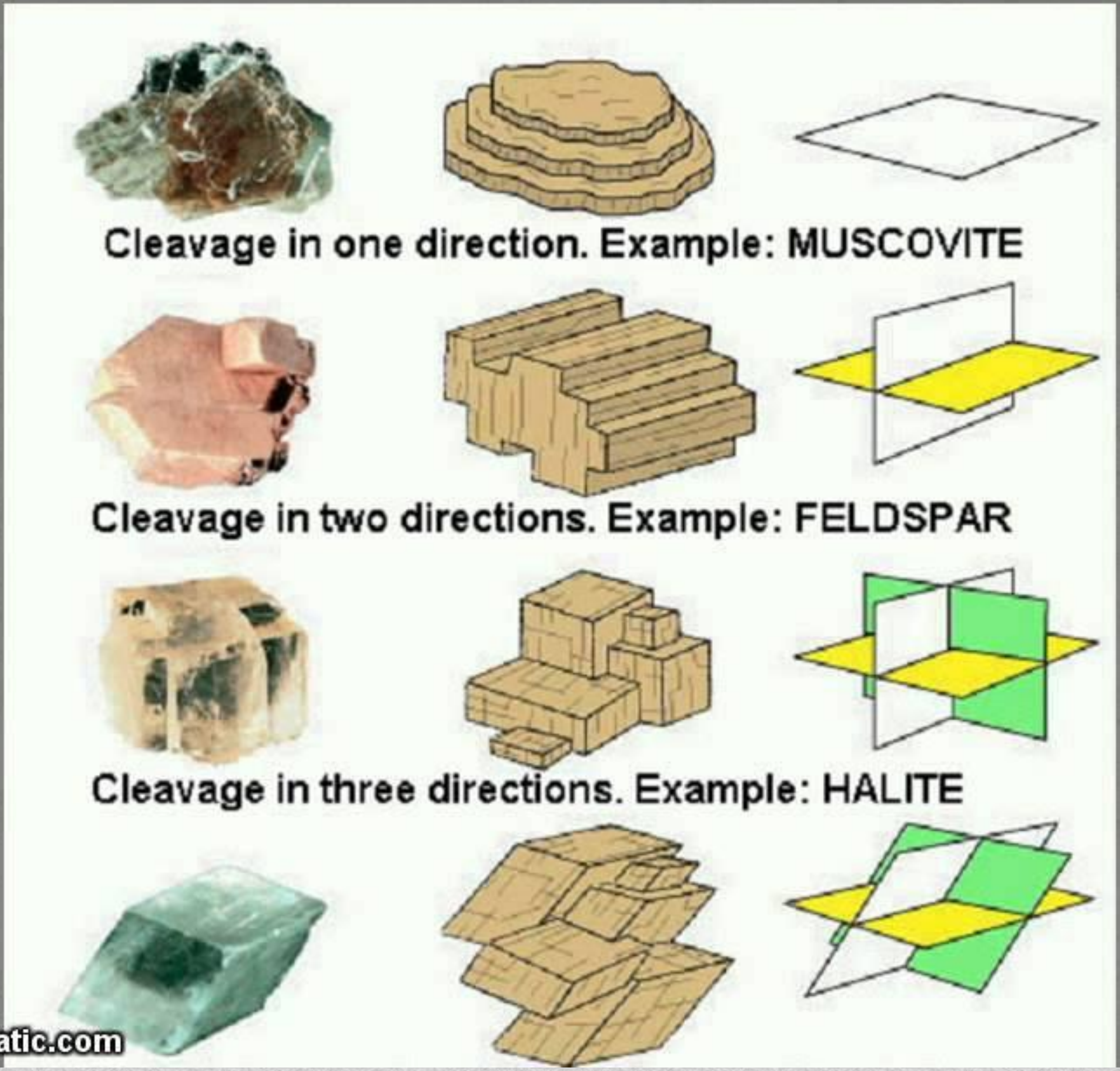
Streak Plate 7.5

The Harder one scratches the Softer one
(If your mineral scratches the other, the mineral is harder)
(If your mineral is scratched by the other, the mineral is softer)

Tenacity refers to the way a mineral behaves, when it is broken, crushed, bent or torn. A mineral can be brittle, malleable, sectile, ductile, flexible or elastic. An important influence on tenacity is the type of chemical bond (e.g., ionic or metallic)

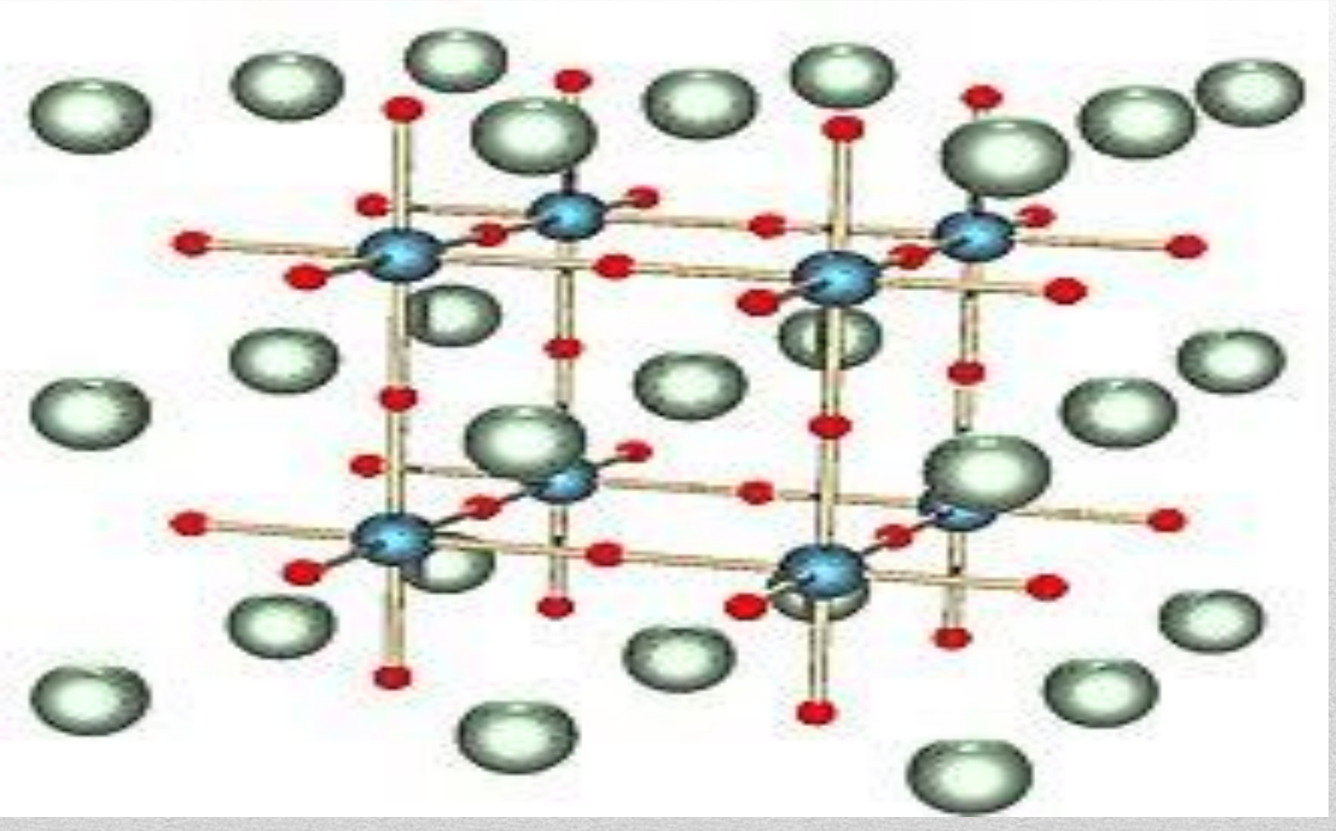
- **Cleavage**
- is the tendency to break along certain crystallographic planes. It is described by the quality (e.g., perfect or fair) and the orientation of the plane in crystallographic nomenclature.Parting is the tendency to break along planes of weakness due to pressure, twinning or exsolution
- .

Physical Properties of Minerals



- **Crystal structure**
- The crystal structure is the arrangement of atoms in a crystal. It is represented by a lattice of points which repeats a basic pattern, called a unit cell, in three dimensions. The lattice can be characterized by its symmetries and by the dimensions of the unit cell.

Crystal structure



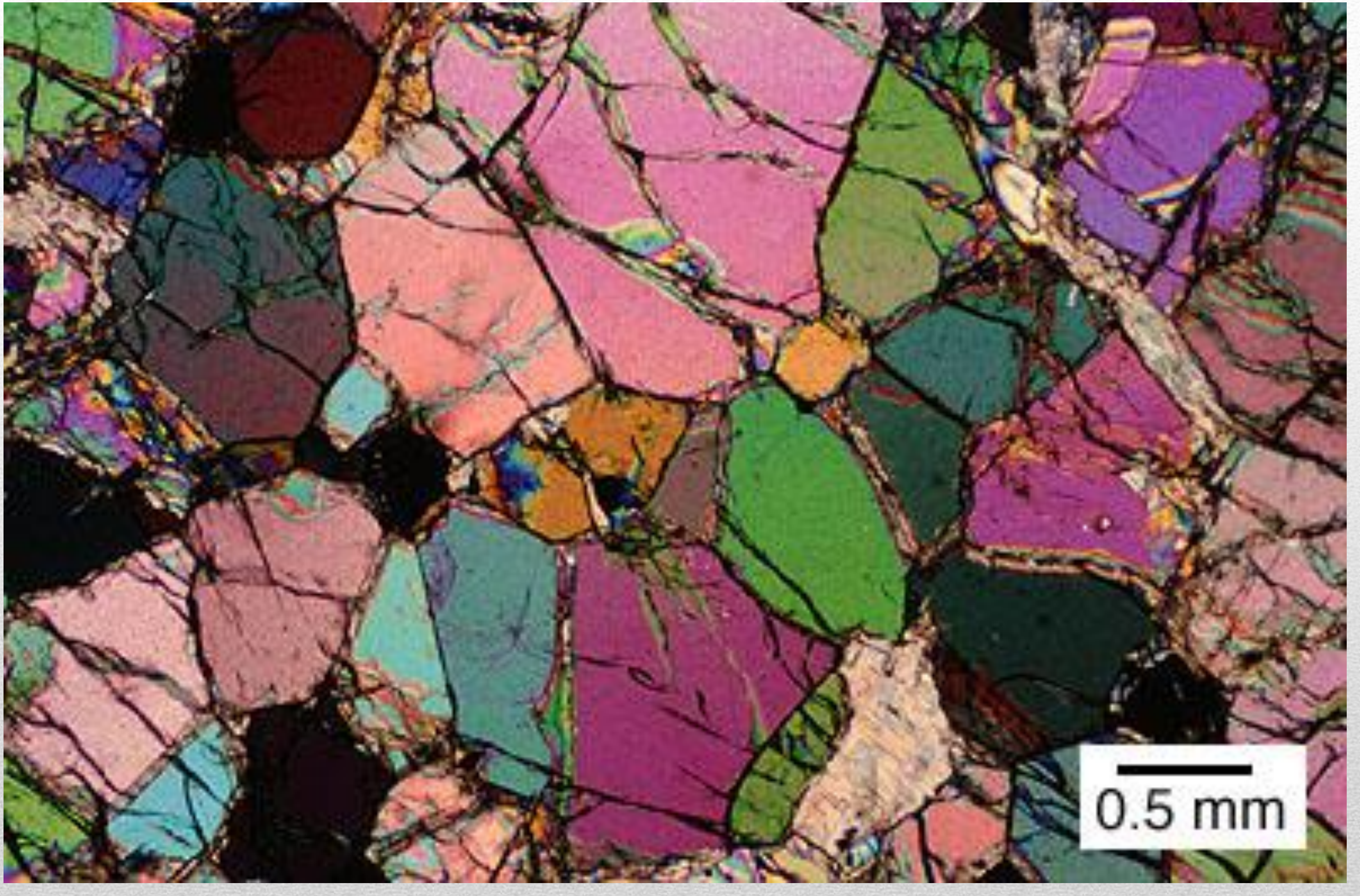
- **Chemical elements**
- A few minerals are chemical elements, including sulfur, copper, silver, and gold, but the vast majority are compounds. The classical method for identifying composition is wet chemical Analysis
- **Systematic**
- Systematic mineralogy is the identification and classification of minerals by their properties. Historically, mineralogy was heavily concerned with taxonomy of the rock-forming minerals. There are over 6,000 named and unnamed minerals, and about 100 are discovered each year

- **Biomineralogy**
- Biomineralogy is a cross-over field between mineralogy, paleontology and biology. It is the study of how plants and animals stabilize minerals under biological control, and the sequencing of mineral replacement of those minerals after deposition

- **Formation and Occurrence**
- The effects of provided by variables and catalysts such as pressure, temperature, and time allow for the process of the formation of minerals. This process can range from simple processes found in nature, to complex formations that take years or even centuries of time. The origin of certain minerals are certainly obvious, with those such as rock salt and gypsum from evaporating sea water. Various possible methods of formation include

- **sublimation from volcanic gases**
- deposition from aqueous solutions and hydrothermal brinescrystallization from an igneous magma or lavarecrystallization due to metamorphic processes and metasomatismcrystallization during diagenesis of sedimentsformation by oxidation and weathering of rocks exposed to the atmosphere or soil environment.

- **Optical mineralogy**
- Optical mineralogy is a specific focus of mineralogy that applies sources of light as a means to identify and classify minerals. All minerals which are not part of the cubic system are double refracting, where ordinary light passing through them is broken up into two plane polarized rays that travel at different velocities and refracted at different angles. Mineral substances belonging to the cubic system pertain only one index of refraction Hexagonal and tetragonal mineral substances have two indices, while orthorhombic, monoclinic, and triclinic substances have three indices of refraction. With opaque ore minerals, reflected light from a microscope is needed for identification


0.5 mm

Thank you

CRYSTALLIZATION

DEFINITION

Crystallography is the experimental science of determining the arrangement of atoms in crystalline solids.

Crystallography is a fundamental subject in the fields of materials science and solid-state physics.

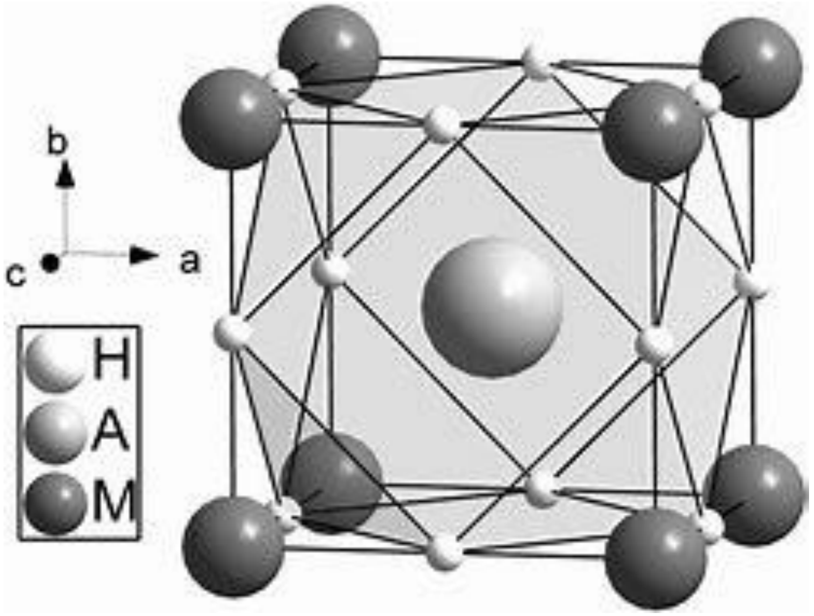
Once a crystal is obtained, data can be collected using a beam of radiation. Although many universities that engage in crystallographic research have their own X-ray producing equipment, synchrotrons are often used as X-ray sources, because of the purer and more complete patterns such sources can generate.

Synchrotron sources also have a much higher intensity of X-ray beams, so data collection takes a fraction of the time normally necessary at weaker sources. Complementary neutron crystallography techniques are used to identify the positions of hydrogen atoms, since X-rays only interact very weakly with light elements such as hydrogen.

Producing an image from a diffraction pattern requires sophisticated mathematics and often an iterative process of **modelling and refinement.**

Crystallography is used by materials scientists to characterize different materials. In single crystals, the effects of the crystalline arrangement of atoms is often easy to see macroscopically because the natural shapes of crystals reflect the atomic structure. In addition, physical properties are often controlled by crystalline defects.

A crystal structure (an arrangement of atoms in a crystal) is characterized by its **unit cell,** a small imaginary box containing one or more atoms in a specific spatial arrangement. The unit cells are stacked in three-dimensional space to form the crystal.



The definite ordered arrangement of the faces and edges of a crystal is known as crystal symmetry. A sense of symmetry is a powerful tool for the study of internal structure of crystals. It is a simplifying key to the endlessly various arrays of atoms which make-up crystalline solids, enabling us to think of them in terms of a familiar pattern.

Crystals possess different symmetries or symmetry elements. They are described by certain operations. A symmetry operation is one that leaves the crystal and its environment invariant. That is, after performing an operation on the body, if the body becomes indistinguishable from its initial configuration, the body is said to possess a symmetry element corresponding to that particular operation.

Symmetry operations performed about a point or a line are called point group symmetry operations.

SYMMETRY ELEMENTS IN A CUBIC CRYSTAL:

One of the noticeable features of many crystals, is a certain regularity of arrangement of faces. The next regular feature we must notice is the frequent occurrence of similar faces (of the same size and shape) in parallel pairs on opposite sides of the crystal.

A cube possesses three such pairs of parallel and opposite faces. Hence a cube is said to show a centre of symmetry, i.e., the body centre of the cube is a centre of symmetry. This centre lies at equal distances from various symmetrical positions. Centre of symmetry is also known as inversion centre.

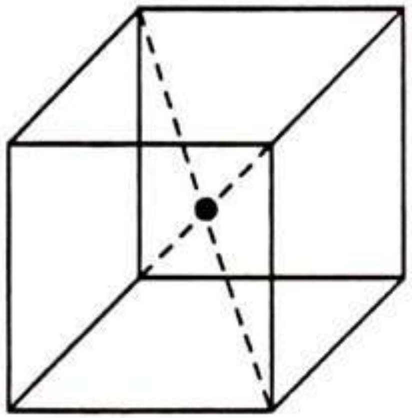


Fig. 2.13. Centre of inversion in a cubic crystal.

The second kind of symmetry element in a crystal is a plane of symmetry or reflection symmetry. A crystal is said to possess reflection symmetry about a plane if it is left unchanged in every way after being reflected by the plane. The two symmetry elements, namely, centre of inversion and plane of reflection, may easily be understood by saying that inversion is a symmetry operation similar to reflection, with the only difference that reflection occurs in a plane through the lattice point, while inversion is equivalent to reflection through a point. The three straight planes of symmetry in a cube are shown in

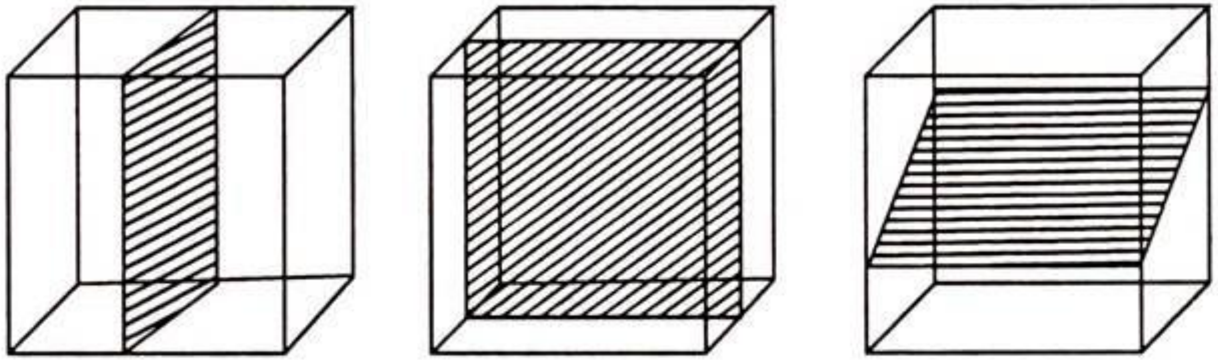


Fig. 2.14. The three planes of symmetry parallel to the faces of the cube.

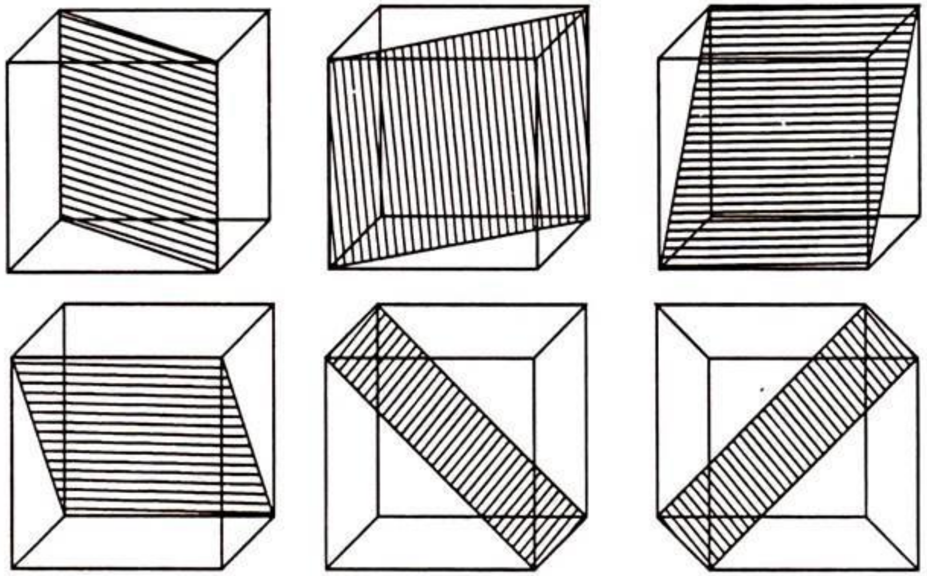


Fig. 2.15. The six diagonal planes of symmetry in a cube.

THE TOTAL NUMBER OF CRYSTALLOGRAPHIC SYMMETRY ELEMENTS OF THE CUBIC SYSTEM IS THUS GIVEN BY:

Centre of symmetry – 1

Straight planes – 3

Diagonal planes – 6 (9 planes)

Tetrad axes – 3

Triad axes – 4 (13 axes)

Diad axes – 6

crystal habit is the characteristic external shape of an individual crystal or crystal group. The habit of a crystal is dependent on its crystallographic form and growth conditions, which generally creates irregularities due to limited space in the crystallizing medium (commonly in rocks).

it is also important to describe the quality of the shape of a mineral specimen:

Euhedral: a crystal that is completely bounded by its characteristic faces, well-formed. Synonymous terms: idiomorphic, automorphic;

Subhedral: a crystal partially bounded by its characteristic faces and partially by irregular surfaces. Synonymous terms: hypidiomorphic, hypautomorphic;

Anhedral: a crystal that lacks any of its characteristic faces, completely malformed. Synonymous terms: allotriomorphic, xenomorphic.

ACICULAR/ NATROLITE

GLOBULAR/ MALACHITE

DENDRITIC/ PYROLUSITE

South Valley University

Hurghada Faculty of Education

Major Biology & Geology Department

GEOLOGY OF THE RED SEA

Introduction

The Red Sea presents a collection of just about everything of interest to scientists studying the rifting of our planet's lithosphere. The Red Sea has become a model to compare with more poorly exposed, or less accessible, rifts around the world and across geologic time.

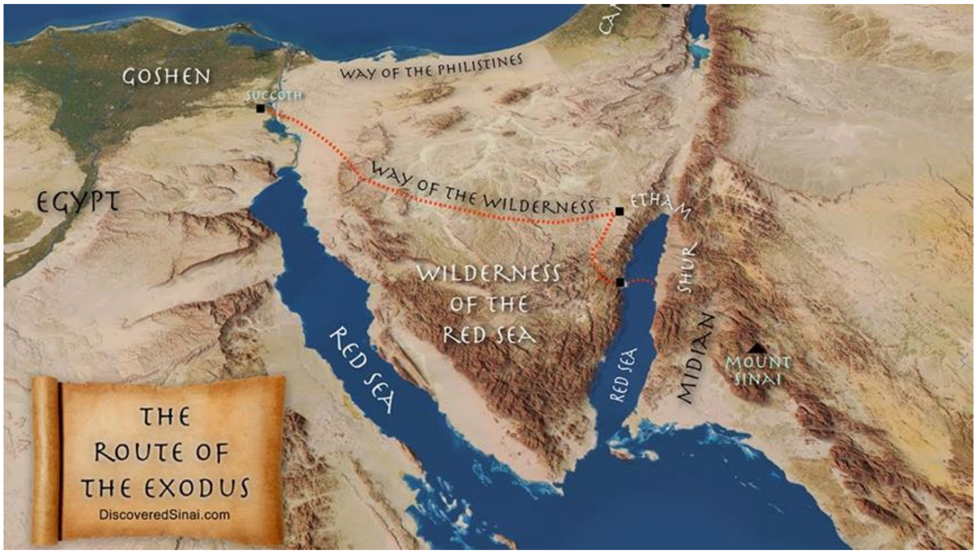
The Red Sea has long been recognized as one component of a continent scale rift system that reaches from the Dead Sea to Mozambique. This led to the popularization of the term "Afro-Arabian rift system" by geologists mapping its different segments (Baker 1970; Khan 1975; Kazmin 1977).

The Red Sea is a seawater inlet of the Indian Ocean, lying between Africa and Asia. Its connection to the ocean is in the south, through the Bab el Mandeb strait and the Gulf of Aden. To its north lie the Sinai Peninsula, the Gulf of Aqaba, and the Gulf of Suez (leading to the Suez Canal). It is underlain by the Red Sea Rift, which is part of the Great Rift Valley. The Red Sea also has extensive shallow shelves, noted for their marine life and corals.

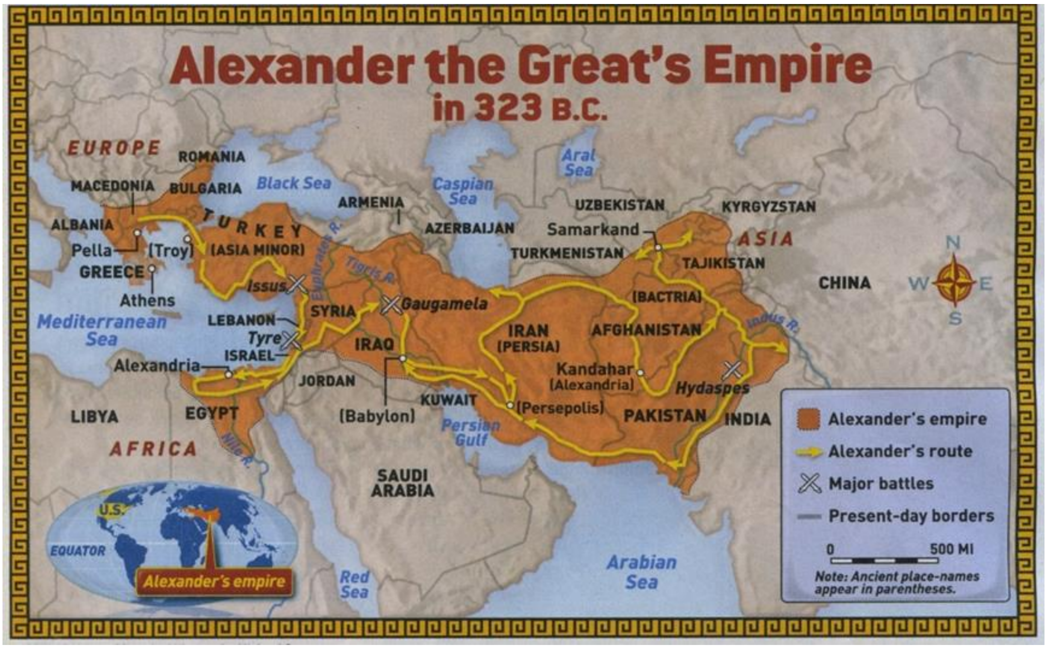
History

Ancient Era

The earliest known exploration of the Red Sea was conducted by ancient Egyptians, as they attempted to establish commercial routes to Punt. One such expedition took place around 2500 BC, and another around 1500 BC (by Hatshepsut). Both involved long voyages down the Red Sea. [1]



In the 6th century BC, Darius the Great of Persia sent reconnaissance missions to the Red Sea, improving and extending navigation by locating many hazardous rocks and currents. In the late 4th century BC, Alexander the Great sent Greek naval expeditions down the Red Sea to the Indian Ocean. Greek navigators continued to explore and compile data on the Red Sea. [2]



The Red Sea was favored for Roman trade with India starting with the reign of Augustus, when the Roman Empire gained control over the Mediterranean, Egypt, and the northern Red Sea. The route had been used by previous states but grew in the volume of traffic under the Romans. From Indian ports goods from China were introduced to the Roman world. [3]

Oceanography

The Red Sea is between arid land, desert and semi-desert. Reef systems are better developed along the Red Sea mainly because of its greater depths and an efficient water circulation pattern. The Red Sea water mass-exchanges its water with the Arabian Sea, Indian Ocean via the Gulf of Aden. These physical factors reduce the effect of high salinity caused by evaporation in the north and relatively hot water in the south. [4]

Salinity

The Red Sea is one of the saltiest bodies of water in the world, owing to high evaporation and low precipitation; no significant rivers or streams drain into the sea, and its southern connection to the Gulf of Aden, an arm of the Indian Ocean, is narrow. [5]

Geology

The Red Sea was formed by the Arabian Peninsula being split from the Horn of Africa by movement of the Red Sea Rift. This split started in the Eocene and accelerated during the Oligocene. The sea is still widening (in 2005, following a three-week period of tectonic activity it had grown by 8 m), [6] and it is considered that it will become an ocean in time (as proposed in the model of John Tuzo Wilson). In 1949, a deep-water survey reported anomalously hot brines in the central portion of the Red Sea.

Mineral resources

In terms of mineral resources, the major constituents of the Red Sea sediments are as follows:

- **Terrigenous constituents:**

Quartz, feldspars, rock fragments, mica, heavy minerals, clay minerals

- **Evaporite minerals**:

Magnesite, gypsum, anhydrite, halite

- **Authigenic minerals:**

Sulfide minerals, calcite, dolomite, quartz.

Ecosystem

The Red Sea is a rich and diverse ecosystem. More than 1200 species of fish [8] have been recorded in the Red Sea, and around 10% of these are found nowhere else.[9] This also includes 42 species of Deepwater fish.[8]

Hawksbill sea turtle in the Elphinstone Reef

The special biodiversity of the area is recognized by the Egyptian government, who set up the Ras Mohammed National Park in 1983. The rules and regulations governing this area protect local marine life, which has become a major draw for diving enthusiasts.

Nudibranch egg ribbon at Shaab Mahmoud

Divers and snorkelers should be aware that although most Red Sea species are innocuous, a few are hazardous to humans.[10]

Red Sea coral and marine fish

Tourism

The sea is known for its recreational diving sites, such as Ras Mohammed, SS Thistlegorm (shipwreck), Elphinstone Reef, The Brothers, Daedalus Reef, St. John's Reef, Rocky Island in Egypt [11].

The Red Sea became a popular destination for diving after the expeditions of Hans Hass in the 1950s, and later by Jacques-Yves Cousteau.[12] Popular tourist resorts include El Gouna, Hurghada, Safaga, Marsa Alam, on the west shore of the Red Sea, and Sharm-el-Sheikh, Dahab, and Taba on the Egyptian side of Sinaï, as well as Aqaba in Jordan and Eilat in palestine in an area known as the Red Sea Riviera. [13]

Bordering countries

The Red Sea may be geographically divided into three sections: the Red Sea proper, and in the north, the Gulf of Aqaba and the Gulf of Suez. The six countries bordering the Red Sea proper are:

- Eastern shore:
    - Saudi Arabia
    - Yemen
- Western shore:
    - Egypt
    - Sudan
    - Eritrea
    - Djibouti

The Gulf of Suez is entirely bordered by Egypt. The Gulf of Aqaba borders Egypt, Palestine, Jordan and Saudi Arabia.

A four-color map of the Red Sea and its bordering countries

Towns and cities on the Red Sea coast (including the coasts of the Gulfs of Aqaba and Suez) include:

- Al-Qusair, Egypt.
- Dahab, Egypt.
- ElGouna, Egypt.
- Suiz, Egypt.
- Hala'IB, Egypt.
- Hurghada, Egypt.
- Jeddah, Saudi Arabia
- Marsa Alam, Egypt
- Nuweiba, Egypt.
- Safaga, Egypt.
- Sharm Al-Sheikh, Egypt.
- Soma bay, Egypt.

Red Sea Hills

Geology

The Red Sea Hills are composed of the exposed Neoproterozoic volcano-sedimentary rock of the Arabian-Nubian Shield. Although the rock itself is 550–900 million years old, the mountains were created by uplift when the Red Sea itself was formed in the Oligocene, only some 23–34 million years ago. The Red Sea Hills are thus part of the same formation as the Sarawat Mountains of Saudi Arabia and the mountains of the Sinai Peninsula.[14] The Red Sea Hills rise almost to 3,000 metres (9,800 ft) today, but in the past were much higher. The Oligocene uplift caused the rejuvenation of their streams and the increased erosion removed most of the limestone and sandstone to expose the basement layer.[15]

History

In prehistoric times, the Red Sea Hills were likely the area where the Proto-Cushitic language was spoken.[15]

The Red Sea Hills are a source of porphyry, which was being mined as early as the fourth millennium BC.[16]

The Red Sea Hills are inhabited by the Beja people who speak a Cushitic language and practice pastoralism. They mainly live near the dry riverbeds, that flow seasonally into the sea and the Nile, where there is limited vegetation.[17] In antiquity, the Beja were known as the Blemmyes and their presence in the hills is detected archaeologically by the presence of Eastern Desert Ware from the fourth century AD. The material culture of the hills places it firmly within ancient Egypt's sphere of influence. Extensive mining settlements have been found in the Wadi Allaqi and the Wadi Gabgaba. The early Blemmyes built platform tumuli (flat-topped burial mounds), and the appearance of cairns to mark burials in the late Middle Ages may be linked to Islamization.[16]

Red Sea Hills in Egypt

Closer view of the arid, rocky Red Sea Hills

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Mineral resources
In red sea

4th year
Major of biology

CONTENTS

01

Introduction about mineral resources in Red Sea

The investigations undertaken by the (Chen ship) centered on the area of hot salt water and mineral deposits surrounding the central part of the Red Sea. The study aimed to distinguish between three basins containing hot salty water, and they are_:

There are mineral deposits surrounding the central part of the Red Sea. There are four basins containing hot salty water, and they are_:

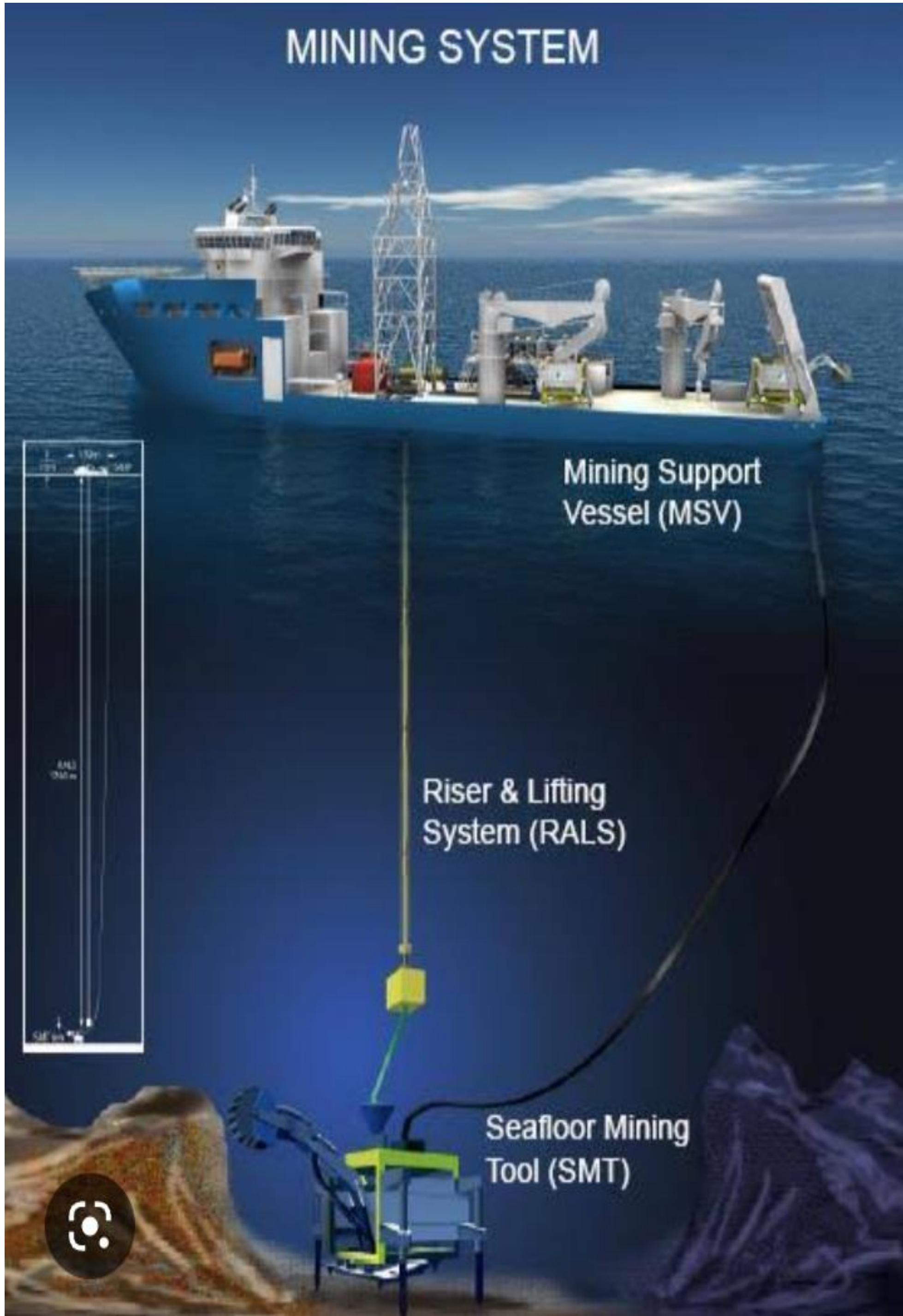
-1The first, which is the largest of them, is called a basin Atlantis 2

-2To the south of Atlantis 2 lies the second basin, the "Qin Basin."

-3The third basin is “Discovery”

-4The fourth basin is called "Oceanographic "

In addition to these natural resources found in the deep waters, there are other economic resources in the Red Sea



02

Phosphate

Phosphate

The definition of phosphate: Phosphate is a sedimentary rock formed millions of years ago, due to the accumulation of organic matter at the bottom of the seas and oceans, and phosphorus is extracted from it for use in agriculture and industry.

Places of phosphate in Egypt:
in three main localities, namely Nile Valley, New Valley in Western Desert, and the Eastern Desert along the Red Sea Coast

Apatite

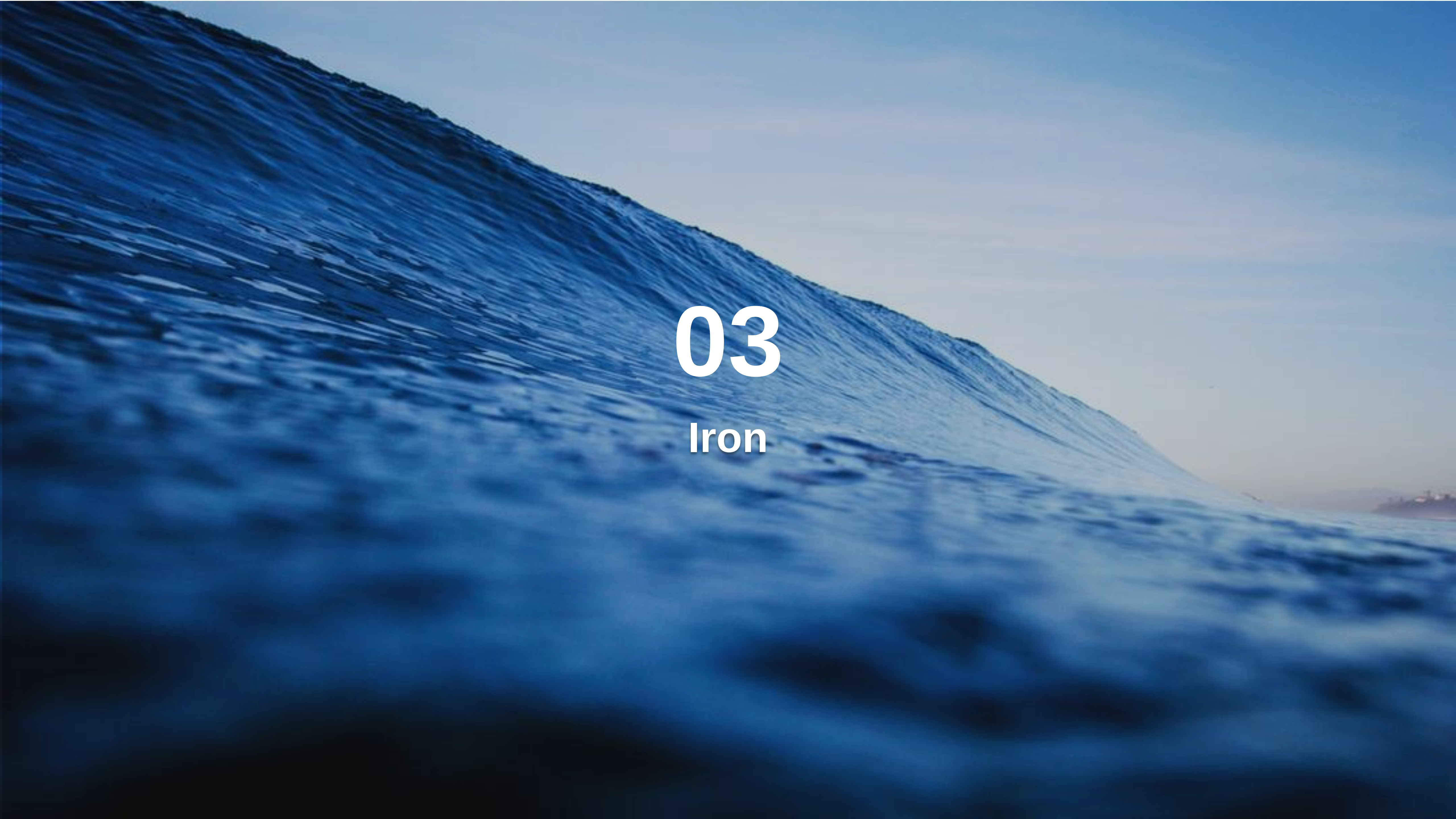
Types of phosphates :
A) hydroxyl apatite
B) Octa-calcium phosphate
C) Anhydrous monocalcium phosphate

The importance of phosphate in Egypt:

-1Agriculture
It is used in the manufacture of fertilizers

-2Industry
Chemical cleaners and pesticides used in homes

-3 Livestock food
Phosphate is one of the most important foods for livestock



03

Iron

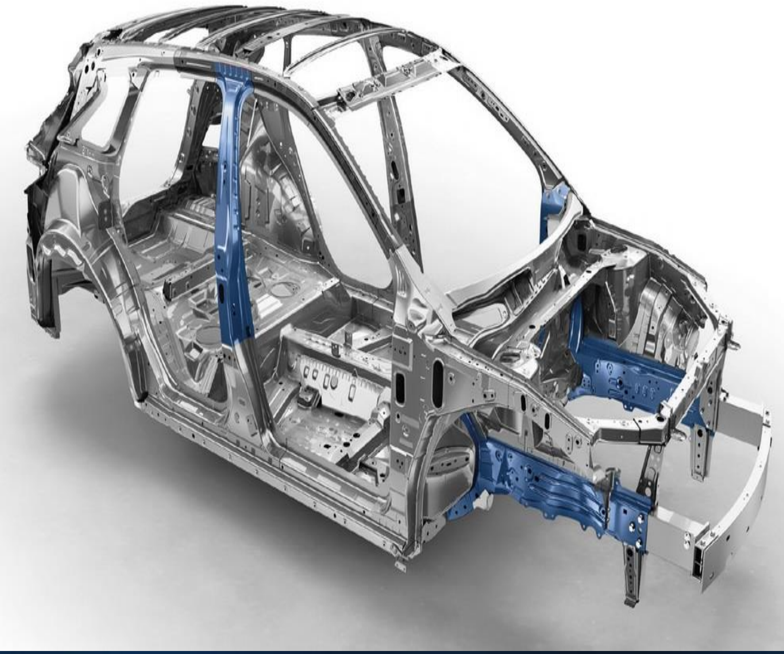
The defination of iron:

This element is the fourth most abundant on the Earth’s surface, and can be easily found in quarries and mines, for example. It oxidises (or rusts) when it comes into contact with oxygen, so we rarely see it in its pure form because of it; it is also a brittle and hard substance.and the most widely used metal.

Places of iron in red sea:

in the area of Abu Marwat / Ras Ghareb - Al-Qusayr –Marsa Alam

The importance of iron:



If properly heated, iron is also relatively easy to shape into various forms.

Uses of iron in daily life include machinery and tools, as well as vehicles, hulls of ships, structural elements for buildings, bridges and aircraft.it’s also used for hospital equipment.

The metal is used a lot because it is strong and cheap.

PROPERTIES OF IRON:
-1 Ferromagnetic ability
-3 Low cost
-4 Malleability
-2 Softness
-5 Dissolvable
-6 Conductivity


04
Gold

What is gold ?

gold is an element (Au) and a mineral –one of the few single-element minerals. Gold on Earth is rare, and valued having originated from prodigious star explosions and possibly brought to gold has been concentrated in the Earth’s crust by a variety of geological, physical, chemical and biological processes,
can be defined as either primary ore deposits or secondary ore deposits.

What are the types of gold rocks?

-1quartz
-2silt
-3subterranean rocks

Importance of gold:

-1density is high,

-2It is found in nature in the form of a metal with a yellowish-red color

-3it is ductile and malleable

-4it is not affected by most common acids

-5Gold is a precious metal that has been used in minting currencies and making jewelry

*Where is gold located in red sea:

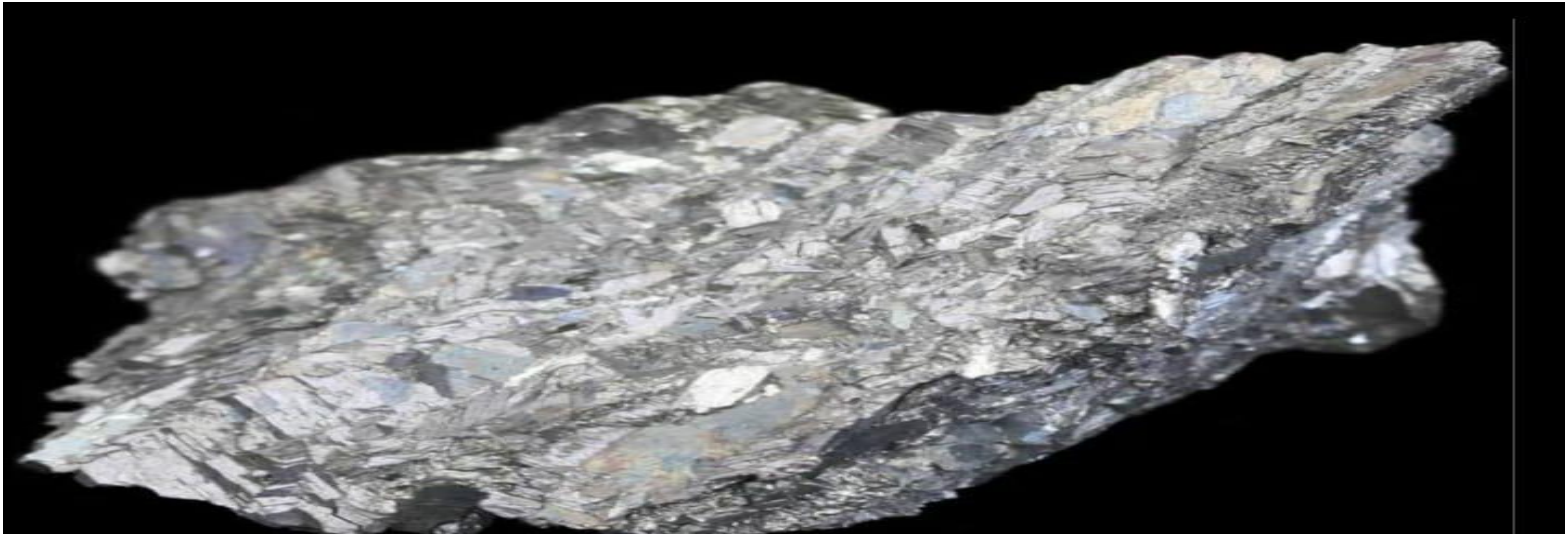
golden triangle
There are 94 gold sites in the Golden Triangle region, which is located in the Red Sea Governorate, between Safaga and Al-Qusayr.

05

Silver

Silver :

A white metal that can be ductile, malleable, and polished. It is one of the most conductive materials for heat and electricity. It is one of the precious gems that are used in minting money. Its salts are also used in photography.



Its presence in nature is in several forms, including pure metal in Norway, Canada - and Peru in the form of argentite, Ag_2S--
In the form of silver chloride, it is usually found mixed with some other metals such as gold and copper

Exploration was taking place in offshore areas along the coast of the Kingdom of Saudi Arabia in the Red Sea under an agreement with the Kingdom of Saudi Arabia. This coastal area also contains minerals of economic importance. On the Saudi side of the Red Sea, there are many types of minerals such as iron, gold, silver, brass, tin and barite.

And in the middle of the Red Sea at an intermediate point between Saudi Arabia and Sudan. Finally, it was confirmed that these areas contain zinc, brass, silver, cadmium, manganese, iron, lead, and some other minerals

Silver sulphide Ag2s

Agcl


THANKS

"Fossils"

Definition of fossils:

Fossil are the remains or traces of organisms that lived in the geologic past (older than the last 10,000 years), now preserved in the Earth's crust. Paleontologists use fossils as a record of the history of life. They tell us that an incredible multitude of organisms lived prior to the species that we see on Earth today; that most species that ever lived have become extinct; and that living things have changed through evolution over time, from one species into another, and adapted to changing environments.

Most organisms never become fossils, but instead decompose after death, and any hard parts are broken into tiny fragments. In order to fossilize, an organism must be buried quickly before it is destroyed by weathering, decomposed, or eaten by other organisms. This is why fossils are found almost exclusively in sediment and sedimentary rocks.

Igneous rocks, which form from cooling magma or lava, and metamorphic rocks, which have been altered by heat and pressure, are unlikely to contain fossils (but maybe, under special circumstances).

The importance of studying fossils:

(1) Determining the age of the rock layers that contain the fossil and knowing the era in which it lived..

(2)Through it, geologists depend on making a complete history of the earth…

(3) By studying it, it is possible to infer(الاستدلال) the climatic conditions and the geographical environment In which they used to live, for example, palm trees indicate the prevalence (شيوع) of a hot climate...

(4) through which we were able to infer the development of living organisms until the present era.

Standards and conditions of index fossils:

Index fossils is based on the principle that there are fossils of ancient organisms that lived in a region and then became extinct, and when we find the fossils of those organisms in the sedimentary layers, we can know the age of those sedimentary rocks, the inclusion of previous geological life types, and the climate in ancient times

Index fossils:

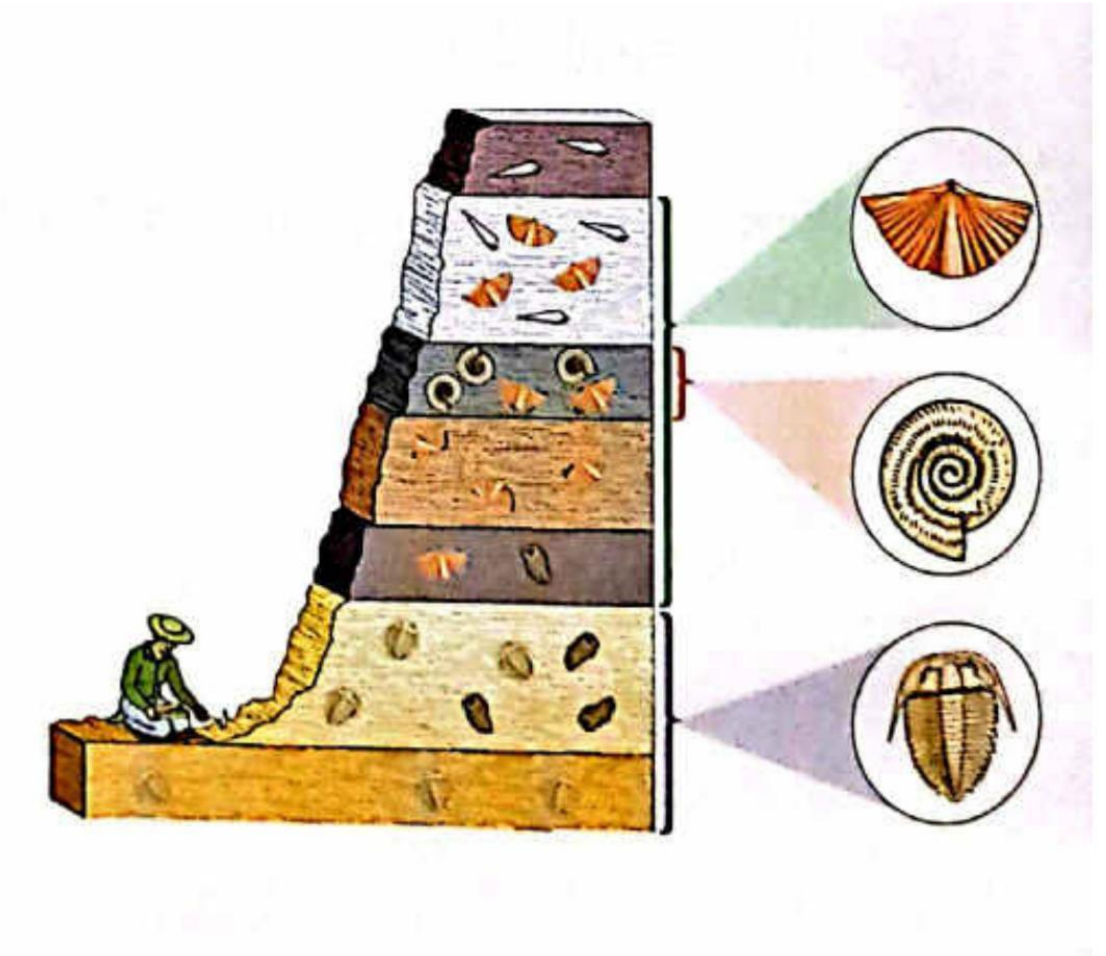
They are fossils of organisms that had lived for a short period of time in the past and had a wide geographical range distribution, then became extinct.

Characteristics of the index fossil:

-It has a wide geographical extent

-It has a short time range

-It retains its properties and shape



Factors that help the fossilization process:

It is clear that the largest number of organisms that lived throughout geological time died and decomposed without leaving behind a trace of their existence, and that a very small percentage of these organisms allowed the conditions to leave a trace in the form of a fossil.

The conditions that facilitate the fossilization process are attributed to biological factors related to the composition of the organism itself and environmental factors related to the way in which the organism is buried in the rock that contains it.

Environmental Conditions

1. **Anoxic environment**: low oxygen conditions repel scavengers while slowing the rate of bacterial decay.
2. **No scavengers**: scavengers scatter and destroy remains, stopping fossilization before it starts.

3. **No bacteria**: bacteria can completely decompose remains, leaving nothing behind to fossilize.
4. **High deposition rate**: this allows the organism to be buried before scavengers, bacteria, or the environment can take their toll, allowing the fossilization process to begin.

Organism Features

1. **Hard skeleton**: soft bodies decay rapidly (on the order of hours to days), leaving nothing behind.
2. **Simple skeleton**: complex, articulated skeletal parts tend to separate, making reconstruction difficult.
3. **High population numbers**: the more organisms of a species that exist, the greater the chances that one of them will be fossilized.
4. **Benthic infaunal lifestyle**: this means the organism lives in the sediment, so it's already buried.

Fossils preservation methods:

(1) Confinement in the snow : the ice stops the action of bacteria and fungi completely, and therefore the ice preserves the sample in a very good condition, to the extent that the fossils of the mammoth elephant and the rhinoceros that were found buried in the snows of Siberia showed what the animal was eating before its death.

(2) Preservation in amber : Amber is one of the materials that remain for a long time, and it arises from the freezing of the resinous substances secreted by amber pine trees.

(3) Preservation in tar and oily substances : In the asphalt taken from southern California, teeth and bones of some animals were found in good condition, but the soft parts of the animal's body were not.

Fossil skeletons of the saber-toothed tiger and several wolves have been recovered from this area.

(4) preservation in acidic swamps:

The acidic state of the swamps prevents the decomposition of some solid parts of organic matter.

Fossils of woody plants and skeletons of some animals such as the Irish deer were found in southern Europe.

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