

South Valley University

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## 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).



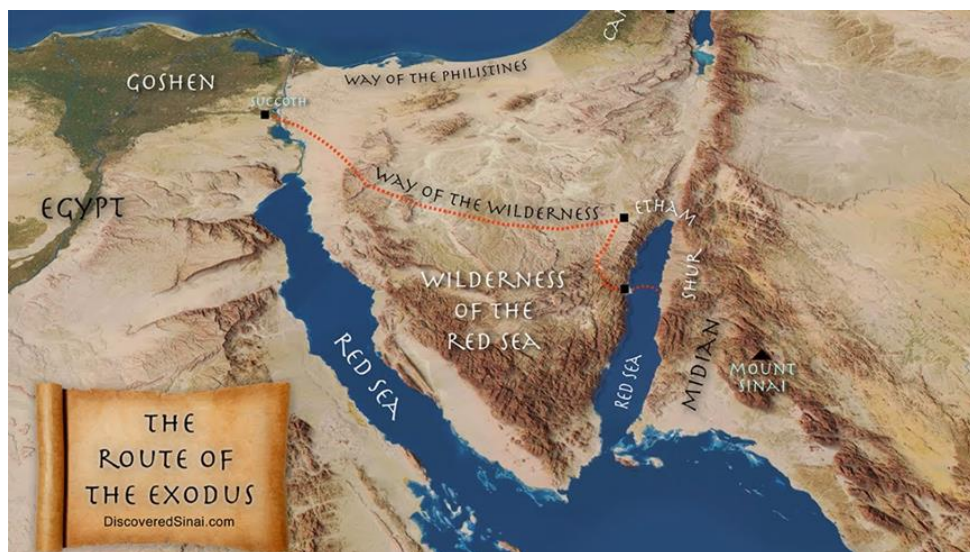
The Red Sea is a seawater inlet of the Indian Ocean, lying between Africa and Asia. Its connection to the ocean is in the south, through the Bab el Mandeb strait and the Gulf of Aden. To its north lie the Sinai Peninsula, the Gulf of Aqaba, and the Gulf of Suez (leading to the Suez Canal). It is underlain 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.



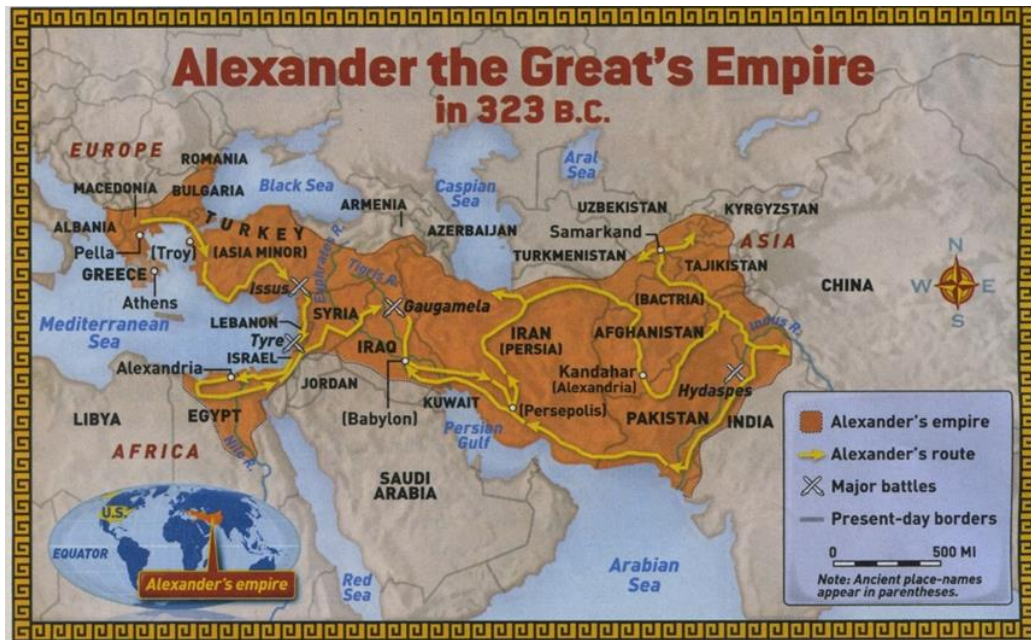
## History

### 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 Sinai, 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

## REFERENCES

1. Fernandez-Armesto, Felipe (2006). *Pathfinders: A Global History of Exploration*. W.W. Norton & Company. p. 24. ISBN 0-393-06259-7.
2. Fernandez-Armesto, Felipe (2006). *Pathfinders: A Global History of Exploration*. W.W. Norton & Company. pp. 32–33. ISBN 0-393-06259-7.
3. East, W. Gordon (1965). *The Geography behind History*. W.W. Norton & Company. pp. 174–175. ISBN 0-393-00419-8.
4. Sofianos, Sarantis S.; Johns, William E. (2002). "An Oceanic General Circulation Model (OGCM) investigation of the Red Sea circulation, 1. Exchange between the Red Sea and the Indian Ocean". *Journal of Geophysical Research: Oceans*. 107 (C11): 3196. Bibcode:2002JGRC..107.3196S. doi:10.1029/2001JC001184.
5. Por, F. D. (2012-12-06). *The Legacy of Tethys: An Aquatic Biogeography of the Levant*. Springer Science & Business Media. ISBN 9789400909373

6. Rose, Paul; Laking, Anne (2008). Oceans: Exploring the hidden depths of the underwater world. London: BBC Books. ISBN 978-1-84-607505-6
7. Lindquist, Sandra (1998). The Red Sea Province: Sudr-Nubia(!) and Maqna(!) Petroleum Systems, USGS Open File Report 99-50-A. US Dept. of the interior. Pp. 6-7, 9.
8. Froese, Ranier; Pauly, Daniel (2009). "FishBase". Retrieved 2009-03-12.
9. Siliotti, A. (2002). Verona, Geodia (ed.). Fishes of the red sea. ISBN 88-87177-42-2.
10. Lieske, E. and Myers, R.F. (2004) Coral reef guide; Red Sea London, HarperCollins ISBN 0-00-715986-2
11. "Scuba Diving in Egypt – Red Sea – Dive The World Vacations".  
[www.dive-the-world.com](http://www.dive-the-world.com)
12. Philippe Cousteau Jnr (23 April 2010). Jacques Cousteau's underworld village in the Red Sea. BBC Earth. Retrieved 11 December 2018.
13. M. Sultan, S. Sefry and M. AbuAbdallah, "Impacts of Climate Change on the Red Sea Region and its Watersheds, Saudi Arabia", *The Red Sea: The Formation, Morphology, Oceanography and Environment of a Young Oceanic Basin* (Springer, 2015), p. 364.
14. Bonnie M. Sampsell, *The Geology of Egypt: A Traveler's Handbook* (American University in Cairo Press, 2003), pp. 27–28.
15. Stevens, Chris J.; Nixon, Sam; Murray, Mary Anne; Fuller, Dorian Q. (July 2016). *Archaeology of African Plant Use*. Routledge. ISBN 978-1-315-43400-1.
16. David N. Edwards, *The Nubian Past: An Archaeology of the Sudan* (Routledge, 2004), pp. 64, 209, 251–52.
17. Leif Manger, *Managing pastoral adaptations in the Red Sea Hills of the Sudan: Challenges and Dilemmas* (IIED, 1994), p. 2.



# Mineral resources In red sea

4th year  
Major of biology

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**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\_:

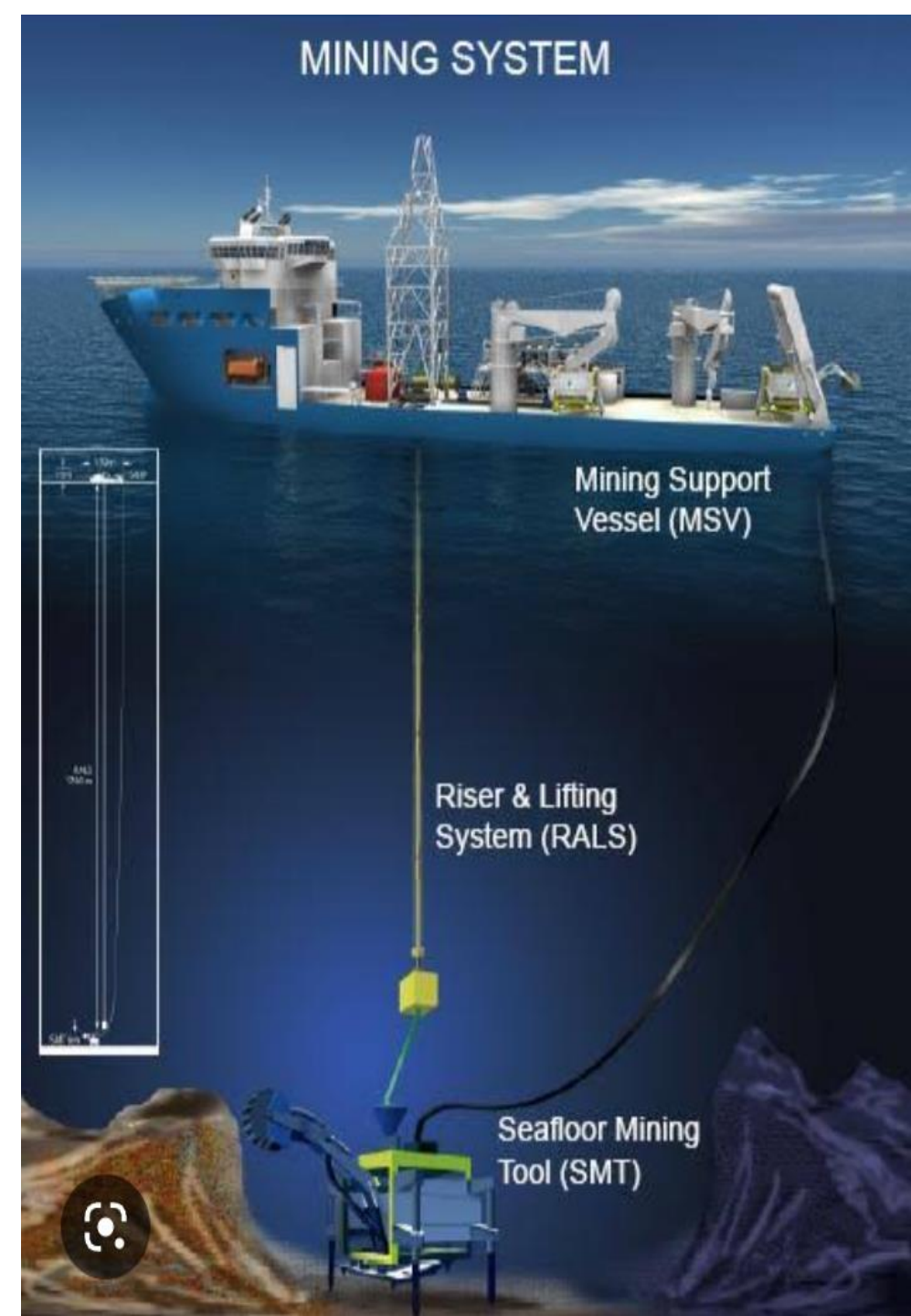
-1The first, which is the largest of them, is called a basin Atlantis 2

-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



A large, powerful blue wave is shown in the process of crashing, with white foam visible at its base. The wave dominates the left and center of the frame, sloping upwards towards the right. The sky above is a clear, pale blue. In the far distance on the right, a small cluster of buildings or a town is visible on the horizon.

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:

-1 Agriculture

It is used in the manufacture of fertilizers

-2 Industry

Chemical cleaners and pesticides used in homes

-3 Livestock food

Phosphate is one of the most important foods for livestock



A large, powerful blue wave is crashing over a rocky shore. The water is a deep, vibrant blue, and the sky above is a clear, light blue. The wave's crest is breaking, creating white foam and spray. The overall scene is dynamic and energetic.

**03**

**Iron**



### The definition 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

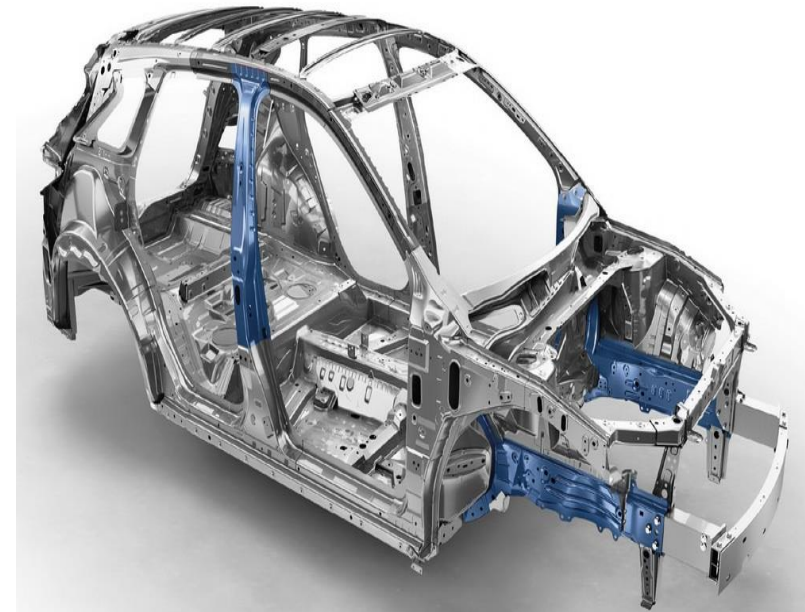


## The importance of iron:

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



A large, powerful blue wave is shown in motion, crashing against a clear, light blue sky. The water is a deep, vibrant blue, and the wave's crest is breaking, creating white foam. The perspective is from a low angle, looking up at the wave as it moves across the frame.

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:

- 1 density is high,
- 2 It is found in nature in the form of a metal with a yellowish-red color
- 3 it is ductile and malleable
- 4 it is not affected by most common acids
- 5 Gold 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.



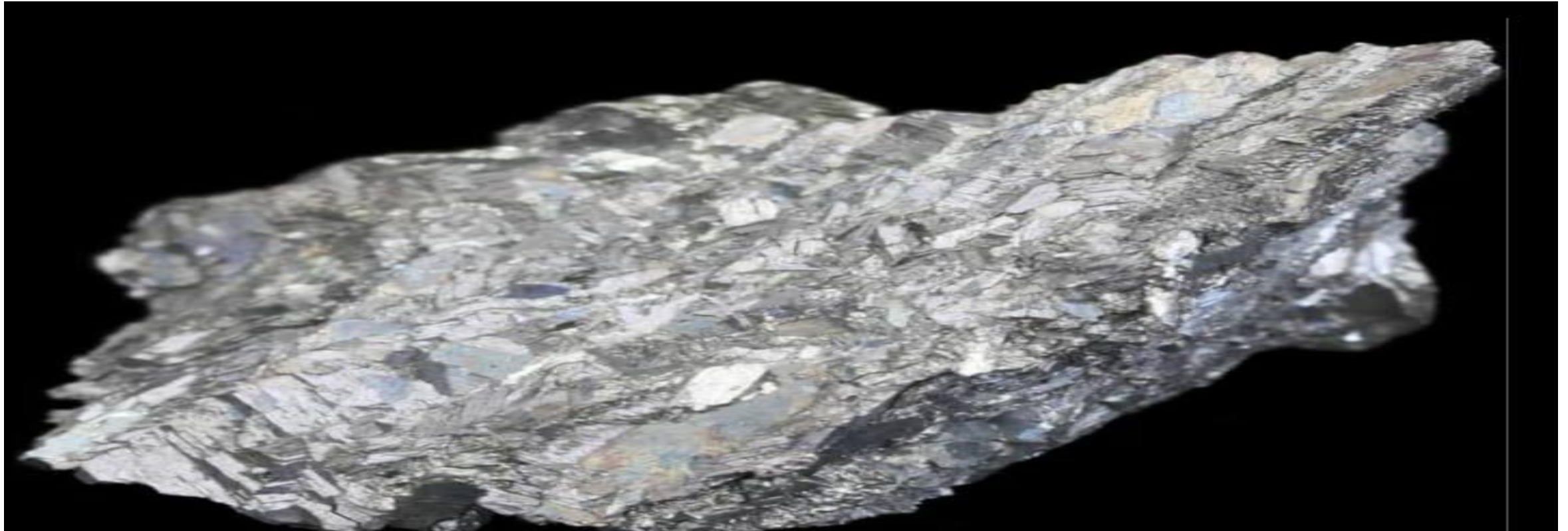


05

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,  $\text{Ag}_2\text{S}$ --

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  $\text{Ag}_2\text{S}$



$\text{AgCl}$

A large, powerful blue wave is shown crashing against a clear, light blue sky. The water is a deep, vibrant blue, and the wave's crest is breaking, creating white foam. The sky is a pale, clear blue, suggesting a bright, sunny day. The overall scene is dynamic and energetic.

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:

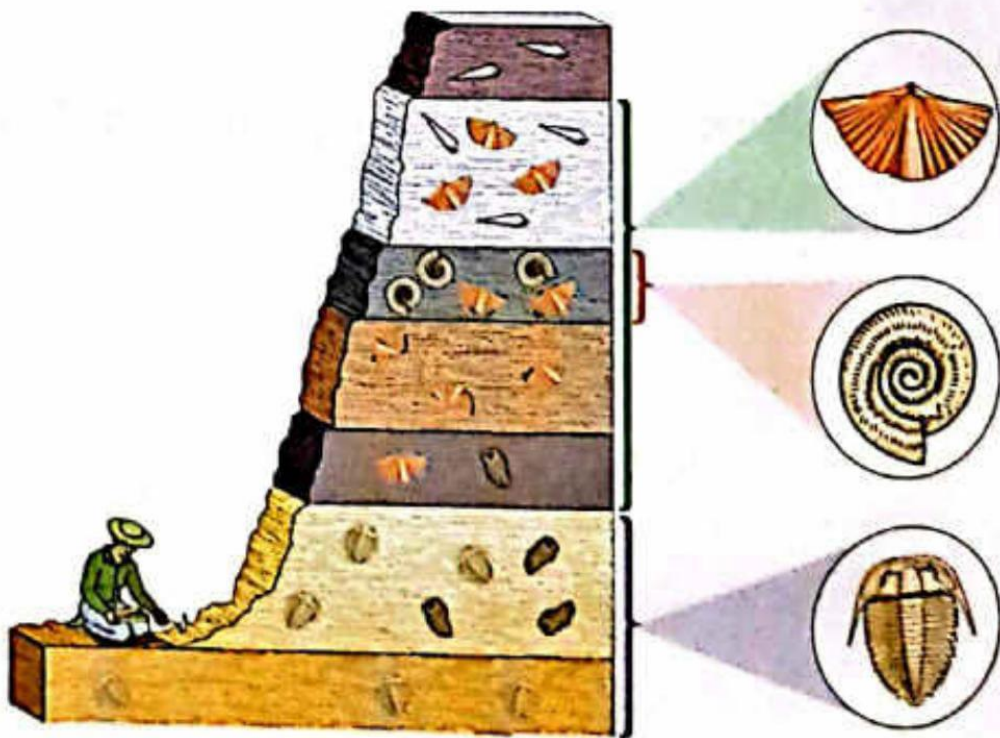
They are fossils of organisms that had lived for a short period of time in the past and had a wide geographical range distribution, then became extinct.

## 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.

اعداد:

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