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## Chapter -2


# The Geology of Ethiopia and the Horn

 ስለም ተማሪዎች እንዴት ናችሁ ? ዛሬ ደግሞ UNIT 2 (Geology of Ethiopia and the horn) የሚለውን Chapter እናያለን



Natural Students ምናልባትም Geography ከተማራችሁ ትንሽ ቆየት ስላላችሁ አዲስ ይሆንባችኋል ነገር ግን ምንም አታስቡ ከ U እስከ T  እያንዳንዱን ነገር አብረን እናያለን።

Geology ምንድነው  ከሚለው እንነሳ

➡ Geology is the study of the Earth's evolution, the materials that make it up, and the forces acting on it.

➡ Geology ሲባል Specifically ስለ መሬት Evolution እና አሰራር የሚያጠና ሳይንስ ነው 

 Scientists use clues from rocks and other landforms to learn about the Earth's history .


 Geology ከሌሎች የ Science Discipline ለየት የ ሚያደርገው Subject Deal የሚያረገው ማንም ሰው ያላያቸው እና የ አይን እማኝ  የሌለበት just በ Clue እና Inference ( ምክንያታዊ ግምት) ብቻ የተሰበሰቡ መረጃዎችን በመጠቀሙ ነው።

◆ There are many such clues not only the rocks & landforms which can observed & studied but also provided by indirect methods such as:-

➡ Geo physics(Earth quake waves)

➡ Geochemical analysis (Rock composition )

➡ Geo chronology (Radio active dating)

 Geophysics እና Geochemical analysis ቀላል ናቸው 😐 ግን Geochronology is a method of finding the ages of rock ወይም የ Fossilኦችን እድሜ Radioactive elements በመጠቀም Determine የ ምናደርግበት መንገድ ነው 😇

➡ እሺ ለ Introduction ይሄን ያህል ካልን ይበቃናል Next, ወደ ገደለው እንግባ

👉 Geology እንደሚያስረዳው ከሆነ ምድራችን በፊት Pangea የተባለች አንድ ትልቅ Surface ነበረች እናም ይህች Surface gradually ለ 2 split አድርጋ ወደ

Gondwana land (where Africa is a part) and Laurasia ተከፈለች 😬

➡ Then drifted apart to form the present arrangement of continents.

😊 Alfred Wegener የተባለው የ Australia Climatologist እንደሚያስረዳው ደግሞ According to his continental drift theory Pangea Split ስለመሆኗ 🤔 ለዚህም አራት ዋና ዋና Evidence አስቀምጧል

እስኪ እነዚህን የ Alfred Supporting evidences እንያቸው 👊

1. Fit of the continents:

🕊 The opposing coastlines of continents often fit together.

የ Continents Coastline (የባህር ዳርቻ) assemble ብናደርጋቸው ልክ እንደ Puzzle pieces fit ያደርጋሉ So ይሄ ደግሞ የ ሚያሳየን ሁሉም continents አንድ እንደነበሩና Split አድርጎ አሁን ያለንበት ደረጃ ላይ እንደደረሰ ነው 😊 ::

## 2☐. Match of mountain belts, rock types:

🕊️ If the continents are reassembled as Pangaea, mountains in West Africa, North America, Greenland, and Western Europe match up.

የ Mountain belts እና Rocks match or Align ማድረግ ደግሞ ሌላኛው የ Alfred Evidence ነበር 😇

## 3☐. Distribution of fossils:


■ The distribution of plants and animal fossils on separate

continents forms definite linked patterns if the continents are reassembled.

ይሄ ደግሞ የሚለን Similar fossils of plants & animals የተለያዩ Continents ላይ መገኘታቸው የ ሚያሳየው In the past all continents connected together እንደነበሩ ነው 🙄

## 4☐. Paleoclimates:

🕊️ Rocks formed 200 million years ago in India, Australia, South America, and southern Africa all exhibited evidence of continental glaciations.

 Rocks even though አሁን ካሉበት location ጋር Compatible ባይሆኑም 😊 የተለያዩ Continents ላይ ያሉ Rocks የ past Climateን ያሳያሉ So, ይሄ የ ሚያሳየው ከዚህ በፊት እዛ Position ላይ እንዳልነበሩ ነው, ገባችሁ? 😎

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 Age Dating Techniques

👉 There are two main techniques used to determine the age of rocks:

➡ Relative Dating and Absolute Dating.

 A. Relative Dating

👉 Uses geological evidence to assign comparative ages of fossils.

➡ Hence, we can use two ways to know the relative age of a rock: one way is to look at any fossils the rock may contain. If any of the fossils are unique to one of the geologic time periods, then the rock was formed during that particular time period.

➡ The second way is to use the "What is on top of the older rocks?" When you find layers of rocks in a cliff or hillside, younger rocks are on top of older rocks.



💻 But these two methods only give the relative age of rocks -which one is younger and which is older 😊

➡ በአጠቃላይ ይህ Aging Technique ምን መሰላችሁ የአለትቶችንን መነሳባባር እንደ እንድ Criteria በማየት የ Rock እድሜን የሚሰጥ ነው 😊

💡 B. Absolute Dating



➡ Also known as Radiometric Dating 🌍.

🔴 This technique relies on radioactivity discovered in 1896.


 Radioactive elements like uranium (U) and thorium (Th) decay over time, serving as natural clocks within rocks . Each radioactive element has a unique half-life

## 1☒Carbon-14 Technique :

 After an organism's death, carbon-14 decays at a known rate, with a half-life of 5730 years.

 This method is used for dating organic material  July 17 .  
(እንዳትረቡ)

## 2☒ Potassium-Argon Technique

 This method is commonly used to date rocks because potassium-40 is found in minerals like micas, feldspars, and hornblendes. However, exposure to high temperatures can alter the results .

▶▶These dating techniques allow scientists to explore the true age of rocks and understand Earth's geological history!

✈️ ለምን ይመስላችኋል ? 🤔 ምክንያቱም ረጅም Half life ስላለው ነው ::

🌄 Geological Processes and the Resulting Landforms of Ethiopia and the Horn.

🕒 The Precambrian Era (4.5 billion - 600 million years ago)

➡️ The Precambrian Era covers about 5/6 of Earth's history 🌍.

🔴 Since this period is very ancient, and fossils from this time are scarce, much of our knowledge is based on limited evidence.

👉 እንደምናውቀው በዚህ Era ሰው የለ እንሰሳ የለ 😄 ስለ Precambrian Era መረጃም ብዙ ለማግኘት አስቸጋሪ ነው 😊

➡️ However, we do know some important geological events from this era.

🏔️ Major Geologic Events :



## 1 ☐ Orogenesis (Mountain Formation)

➡ The most significant process of the Precambrian Era was orogenesis (የተራሮች መፈጠር) .

🕊 This involved intense folding of the Earth's crust, along with igneous intrusions beneath the surface 🌋. As a result, massive mountain ranges were formed.

2 ☐ After these mountains formed, long periods of denudation (erosion) flattened the peaks, leaving behind nearly level peneplains.

## 3 ☐ Metamorphic Rocks and Crystalline Structures

■ The rocks from this era were subjected to immense heat and pressure, transforming them into metamorphic rocks.

☢ This process also led to the formation of crystalline structures in many areas, making these rocks unique.

▶▶In Ethiopia, these ancient Precambrian rocks form the basement for most of the country's geology, lying beneath more recent layers of rock.

🔒 Even though these rocks are often buried, they are exposed in some areas, such as Tigray, Gambella, Benishangul-Gumuz.

➡ ምን መሰላችሁ ጠቅለል ስናደርገው የምትጠየቁት በPrecambrian Era ጊዜ Happen ያደረጉ ክስተቶች ምንድናቸው ተብላችሁ ነው ፤ ስለዚህ ከላይ የዘረዘርናቸውን መሸምደድ አለባችሁ ።

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The Paleozoic Era Geologic Processes

➡ It lasted for about 375 million years.

➡ The major geological process of this Era was denudation.

➡ The gigantic mountains that were formed by the Precambrian orogeny were subjected to intense & prolonged denudation.

🖱 በአጠቃላይ በዚህ Era Ethiopia ላይ That much የተከናወነ ክስተት ባይኖርም በPrecambrian Era የተፈጠረው ተራራ እየተሸረሸረ ወደ ሜዳነነት የተቀየረበት ዘመን ነበር 😊

✈ At the end, the gigantic mountain ranges were reduced to a 'peneplained' surface.

🕊 The sediments were transported southward & eastward to form continental & marine deposits, respectively.

The Mesozoic Era Geologic Processes (225-70M years ago)

➡ The Mesozoic Era lasted about 155 million years, characterized by

1🔒Epeirogenesis (የመሬት እንቅስቃሴ), involving alternating sinking and rising of the land. This affected the Horn of Africa and Arabian landmass.

2🔒Land Subsidence and Sea Invasion:

🔒 Around 225 million years ago, the land began to sink, allowing the sea to invade from Somalia and Ogaden.

🔒 This process led to sand deposition over the older Precambrian rocks.

3🔒Formation of Sandstone and Limestone:

➡ Over time, sediments compacted into Adigrat sandstone and Hintalo limestone, named after regions in Tigray.

4🔒Uplift and Retreat of the Sea:

💻 The slow rise of land and the sea's retreat began in the Upper Jurassic and continued through the Cretaceous, leading to the deposition of clay, silt, and sand conglomerates, forming the Upper Sandstone layer.

→ #ትኩረት :- በMesozoic era ጊዜ ብዙ ነገሮች ስለተከናወኑ እያንዳንዱን መሸምደድ አለባችሁ ::

→ Major Formations:

🖥 By the end of the Mesozoic Era, three main sedimentary formations emerged:

1. Adigrat Sandstone

2. Hintalo Limestone

3. Upper Sandstone

→ The age and thickness of the sandstone layers vary in a Southeast-Northwest direction.

→ The Adigrat sandstone is older and thicker in the southeast, while the Upper Sandstone is younger and thicker in the southeast but older in the northwest. (ያዙ ፈተና ላይ እይቀርጥ )

→ Coverage of Mesozoic Sediments:

✦ Mesozoic sediments nearly covered all of Ethiopia, extending to central Tigray and the western highlands.

➡ Most Mesozoic rocks are found in the Southeast lowlands and are overlain by Cenozoic rocks.

🕊 Generally ስለ Mesozoic era በደንብ መያዝ አለባችሁ ፤ ብዙ Events Happen ያደረጉበት Era ነው ።

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The Cenozoic Era Geologic Processes

➡ The Cenozoic Era (🗿) is the most recent geological era, significantly shaping the present-day landmass of Ethiopia and the Horn of Africa.

➡ አሁን እኛ የምንገኝበት Era ነው 😊

🖱 It involves few major geological events along with other important processes:

1☒. Uplifting of the Arabo-Ethiopian landmass and extensive lava outpouring. 🌋

2☒. Formation of the Rift Valley.

3☒. Quaternary volcanism and deposition.

## **A.** Uplifting of the Arabo-Ethiopian Landmass and Lava Flood

📅 The uplifting of the Arabo-Ethiopian landmass began in the Upper Jurassic and Cretaceous periods, continuing into the Paleocene and Oligocene epochs.

✈️ Massive tectonic forces fractured the crust, resulting in enormous lava flows that covered the Mesozoic sedimentary layers, creating the Ethiopian plateau and the floor of the present-day Rift Valley.

➡️ The lava, known as Trappean lava or Trap Series lava, formed thick layers on the plateau, reaching heights of over 1,000 meters in the northern Central Highlands.

## **A.** Formation of the Rift Valley

 The Rift Valley's formation relates to the theory of plate tectonics.


➡ As tectonic plates moved apart, they created tensional forces that caused parallel fractures in the crust.

⬆ The central landmass collapsed, forming the Rift Valley

▼ Rifting began in the late Oligocene and Miocene epoch.


➡ Spatial Extent of the Rift Valley

😊 The Ethiopian Rift Valley is part of the Great East African Rift system, stretching about 7,200 kilometers, with 5,600 kilometers in Africa and 1,700 kilometers in Eritrea and Ethiopia.

 The Afar Triangle is the widest part of the Rift Valley, ranging from 200-300 km.




## A. Quaternary Volcanic Eruptions and Depositions


 Quaternary volcanic activities occurred during the Pliocene-Pleistocene epochs.


 Key Features of Recent Volcanism:

 Numerous active volcanic cones, including Erta Ale, the most active volcano in Ethiopia.

 Semi-dormant volcanic hills like Fantale and Boseti-Gouda.

 Quaternary Deposition

 During the Quaternary period, significant climatic changes resulted in alternating warm and dry periods and cooler, wetter periods, leading to the last Ice Age.

 Heavy rains eroded the Ethiopian plateau, depositing sediments in the Rift Valley lakes.

➡ The increased surface flow created large rivers and lakes, such as Lake Ziway, Lake Hawassa, and others.

➡ Types of Deposits: (ፈተና ላይ እይቀሩም ያዙ 😊)

1 ☐ Lacustrine deposits: Found in former lake beds. 🛶

2 ☐ Fluvial deposits: Along riverbanks and floodplains.

3 ☐ Glacio-fluvial deposits: On high mountains like Bale.

4 ☐ Aeolian deposits: Windblown materials.

5 ☐ Coastal and marine deposits: Found in areas previously covered by the sea.

በአጠቃላይ Cenozoic Era the recent Era ሲሆን ሰው የተፈጠረበት ፣ ስምጥ ሸለቆ የተፈጠረበት እንዲሁም ብዙ እሳተ ገሞራ የተከሰተበት ዘመን ነው ።

→ የምትጠየቁት እንዴት መሰላችሁ በ Quaternary period ምን ተከሰተ ..like 🙏



ይህ Chapter በአማርኛ ለማብራራትም አቻ የማታገኙላቸው  
Geological Words ስላሉት ብዙም በአማርኛ አልፃፍኩላችሁም ፤  
ቢሆንም እያንዳንዱን Event ልቅም አድርጋችሁ መሸምደድ አለባች

በቀጣይ ጥያቄዎችን አብረን እንሰራለን

→ Geography chapter 2

Choose The Best Answer from the Given alternatives

1. Which of the following is Not a clue used by geologists to understand the Earth's past?

A) Astronomical observations

- B) Rock and landform formations
- C) Geophysical data
- D) Geochemical analysis

2. What is the name of the supercontinent that existed before the continents drifted apart?

- A) Gondwanaland
- B) Laurasia
- C) Pangaea
- D) Pangella

3. Which of the following is Not a process that contributes to the building of landforms?

- A) Weathering
- B) Volcanic activity
- C) Faulting
- D) Orogenesis

4. What is the term for the slow rising and sinking of landmasses, often associated with the Mesozoic Era?

- A) Orogenesis
- B) Epeirogenesis
- C) Volcanism
- D) Plate tectonics

5. Which of the following is an example of an endogenic geologic process?

- A. Weathering
- B. Erosion
- C. Deposition
- D. Mountain building

6. What is the name of the geological feature that formed as a result of the uplifting of the Arabo-Ethiopian landmass?

- A) The Ethiopian Highlands
- B) The Rift Valley
- C) The Red Sea
- D) The Horn of Africa

7. Which of the following is a piece of evidence that supports the Continental Drift Theory?

- A) The distribution of earthquake epicenters
- B) The presence of similar fossils on different continents
- C) The existence of deep-sea trenches
- D) The formation of coral reefs

8. What is the significance of the Cenozoic Era in the geological history of Ethiopia?

- A) It was a period of intense erosion and deposition.
- B) It saw the formation of the Ethiopian Highlands.
- C) It marked the end of volcanic activity in the region.
- D) It was a period of significant climate change.

9. What is the primary driving force behind the movement of tectonic plates?

- A) Gravity
- B) The Earth's magnetic field

C) Convection currents in the mantle

D) The rotation of the Earth

10. Why is it important to understand both endogenic and exogenic geological processes?

A) To predict future earthquakes and volcanic eruptions

B) To develop strategies for managing natural resources

C) To understand the evolution of life on Earth

D) All of the above

11. The tilting of the Horn of Africa during the Mesozoic Era resulted in which of the following?

A. Higher elevation in the southeast and lower elevation in the northwest

B. Higher elevation in the northwest and lower elevation in the southeast

C. The formation of a large inland sea

D. The emergence of new volcanic islands

12. Which of the following geological time units is the largest?

- A) Epoch
- B) Period
- C) Era
- D) Eon

13. The Paleozoic Era is known as the age of:

- A) Mammals
- B) Reptiles
- C) Invertebrates
- D) Dinosaurs

14. Relative age dating relies primarily on:

- A) Stratification relationships
- B) Radiometric analysis
- C) The decay of radioactive isotopes
- D) Fossil index species

15. Absolute age dating techniques are primarily based on:



- A) The rate of sedimentation
- B) The principle of superposition
- C) The known decay rates of radioactive isotopes
- D) Fossil correlation

16. The Precambrian Era is characterized by:

- A) Abundant well-preserved fossils
- B) Widespread glaciation events
- C) Extensive orogenesis (mountain building)
- D) The diversification of mammals

17. Precambrian rocks are predominantly classified as:

- A) Sedimentary
- B) Metamorphic
- C) Igneous
- D) Crystalline

18. The Great East African Rift System's approximate length is:

- A) 1700 km
- B) 5600 km
- C) 7200 km
- D) 125 km

19. The lowest point in the Afar Triangle is approximately:

- A) 200 meters below sea level
- B) 125 meters below sea level
- C) 300 meters below sea level
- D) At sea level

20. A major structural effect of the Rift Valley's formation is:

- A) The unification of the Ethiopian Plateau
- B) The connection of the Arabian and African landmasses
- C) The formation of basins and fault depressions where lakes form.

D) The disappearance of hot springs and volcanoes

21. Which of the following is Not a feature commonly associated with the Rift Valley region in Ethiopia?

A) Hot springs

B) Active volcanoes

C) Frequent earthquakes

D) Extensive forests

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22. What was the primary geological process that shaped Ethiopia during the Paleozoic Era, contributing to the formation of undulating plains and inselbergs?

A) Extensive volcanic activity and the formation of new continents

B) Intense and prolonged denudation followed by peneplanation

C) The uplift of the Himalayas and the formation of the Rift Valley

D) Epeirogenesis

23. Which of the following geological periods saw the initial invasion of the sea into Ethiopia, beginning from Somalia and Ogaden?

A) Triassic

B) Jurassic

C) Cretaceous

D) Quaternary

24. The deposition of which rock type is considered to have the greatest potential for oil and gas deposits in Ethiopia?

A) Precambrian crystalline rocks

B) Mesozoic sedimentary rocks

C) Quaternary volcanic rocks

D) Aeolian deposits

25. What is the primary geological process that led to the formation of lacustrine deposits in Ethiopia during the Quaternary period?

- A) Volcanic eruptions
- B) Glacial erosion
- C) Pluvial rains and erosion
- D) Coastal and marine deposition

➡ Answer key 🙏

1. A

2. C

3. A

4. B

5. D

~~~~~

6. A

7. B

8. B

9. C

~~~~~

10. D

11. B

12. D

13. C

14. A

15. C



16. C

17. D

18. C

19. B

20. C



21. D

22. B

23. A

24. B

25. C



22. What was the primary geological process that shaped Ethiopia during the Paleozoic Era, contributing to the formation of undulating plains and inselbergs?

- A) Extensive volcanic activity and the formation of new continents
- B) Intense and prolonged denudation followed by peneplanation
- C) The uplift of the Himalayas and the formation of the Rift Valley
- D) Epeirogenesis

23. Which of the following geological periods saw the initial invasion of the sea into Ethiopia, beginning from Somalia and Ogaden?

- A) Triassic
- B) Jurassic
- C) Cretaceous
- D) Quaternary

24. The deposition of which rock type is considered to have the greatest potential for oil and gas deposits in

Ethiopia?

- A) Precambrian crystalline rocks
- B) Mesozoic sedimentary rocks
- C) Quaternary volcanic rocks
- D) Aeolian deposits

25. What is the primary geological process that led to the formation of lacustrine deposits in Ethiopia during the Quaternary period?

- A) Volcanic eruptions
- B) Glacial erosion
- C) Pluvial rains and erosion
- D) Coastal and marine deposition

➡ Answer key 🙏

- 1. A
- 2. C
- 3. A
- 4. B



5. D



6. A

7. B

8. B

9. C



10. D

11. B

12. D

13. C

14. A

15. C



16. C

17. D

18. C

19. B

20. C



21. D

22. B

23. A

24. B

25. C

