DEBREBRHAN UNIVERSITY

SCHOOL OF SOCIAL SCIENCE AND HUMANITIES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

Geography of Ethiopia and Horn of Africa

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CHAPTER ONE

Geography: Definition, Scope and Themes

- ***"Geography is the scientific study of the Earth that describes and analyses spatial and temporal variations of physical, biological and human phenomena, and their interrelationships and dynamism over the surface of the Earth."***

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The Scope, Approaches and Themes of Geography

- The major approaches of geography are:-

A. **Topical (systematic)** fields of Geography view particular categories of physical or human phenomena as distributed over the Earth.

B. **Regional geography** is concerned with the associations within regions of all or some of the elements and their interrelationships.

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- Geography has five basic themes:-

1. Location

- Location is defined as a particular place or position.

2. Place

- Place refers to the physical and human aspects of a location.
- It is associated with toponym, site (the description of the features of the place), and situation (the environmental conditions of the place).

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3. Movement

- **First,** physical movement of people allowed the human race to inhabit all the continents and islands of the world.
- **Second,** aspect of movement is transport of goods from one place on the Earth to another.
- **Third** dimension of movement is the flow of ideas that allows the unification of the human civilization and promotes its growth and prosperity.

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- The concept of “place” aids geographers to compare and contrast two places on Earth

4. Human-Environment Interaction

- Human-environment interaction involves three distinct aspects, dependency, adaptation, and modification.

- **Dependency** refers to the ways in which humans are dependent on nature for a living.
- **Adaptation** relates to how humans modify themselves, their lifestyles and their behavior to live in a new environment with new challenges.
- **Modification** allowed humans to “conquer” the world for their comfortable living.

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5. Region

- A region is a geographic area having distinctive characteristics that distinguishes itself from adjacent unit(s) of space.
- It could be:-

I. **Formal region: -** that is characterized by homogeneity in terms of a certain phenomenon.
II. **Functional or nodal region**:- Organized to function politically, socially or economically.
III. **Vernacular Region:-** this is a region, which is neither formal nor functional but perceived to exist by inhabitants.

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Location, Shape and Size of Ethiopia and the Horn

- The location of a country or a place on a map or a globe is expressed in two different way:-
- These are **astronomical and relative locations.**

A. Astronomical location:- also known as absolute or mathematical location using the lines of latitudes and longitudes.

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B. Relative location:- expresses the location of countries or places with reference to the location of other countries

Vicinal location/using compass points	In relation to water bodies & land masses
➲ **Sudan to the west and northwest** ➲ **South Sudan to southwest** ➲ **Djibouti to the east** ➲ **Somalia to the east and southeast** ➲ **Eritrea to the north**	➲ In the Horn of Africa ➲ Southwest of the Arabian Peninsula ➲ South of Europe ➲ Northwest of the Indian Ocean

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- The implications of the location of Ethiopia are described as follows:

a. Climate:

- The country has a tropical climate, though modified by its altitude.

b. Socio-cultural:

- Ethiopia is one of the earliest recipients of the major world religions namely Christianity, Islam and Judaism due to its proximity to the Middle East, which was the origin of these religions.

c. Political: The political history of Ethiopia has been considerably influenced by:

- Geopolitical considerations of superpowers.
- Adjacency to the Red Sea (a major global trade route).

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Size of Ethiopia

- Ethiopia with a total area of approximately 1,106,000 square kilometers is the 8th largest country in Africa and 25th in the World.
- It extends about 1,639 kilometers East-West, and 1,577 kilometers North-South. About 0.7% of the country is covered by water bodies.

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Advantages	**Disadvantages**
Possess diverse agro ecological zones	Demands greater capital to construct infrastructural facilities
Variety of natural resources	Requires large army to protect its territory
Own extensive arable land	Difficult for effective administration
Have larger population size	Difficult for socio-economic integration
Home for diverse cultures	
Greater depth in defense external invasion	

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The shape of Ethiopia and its Implication

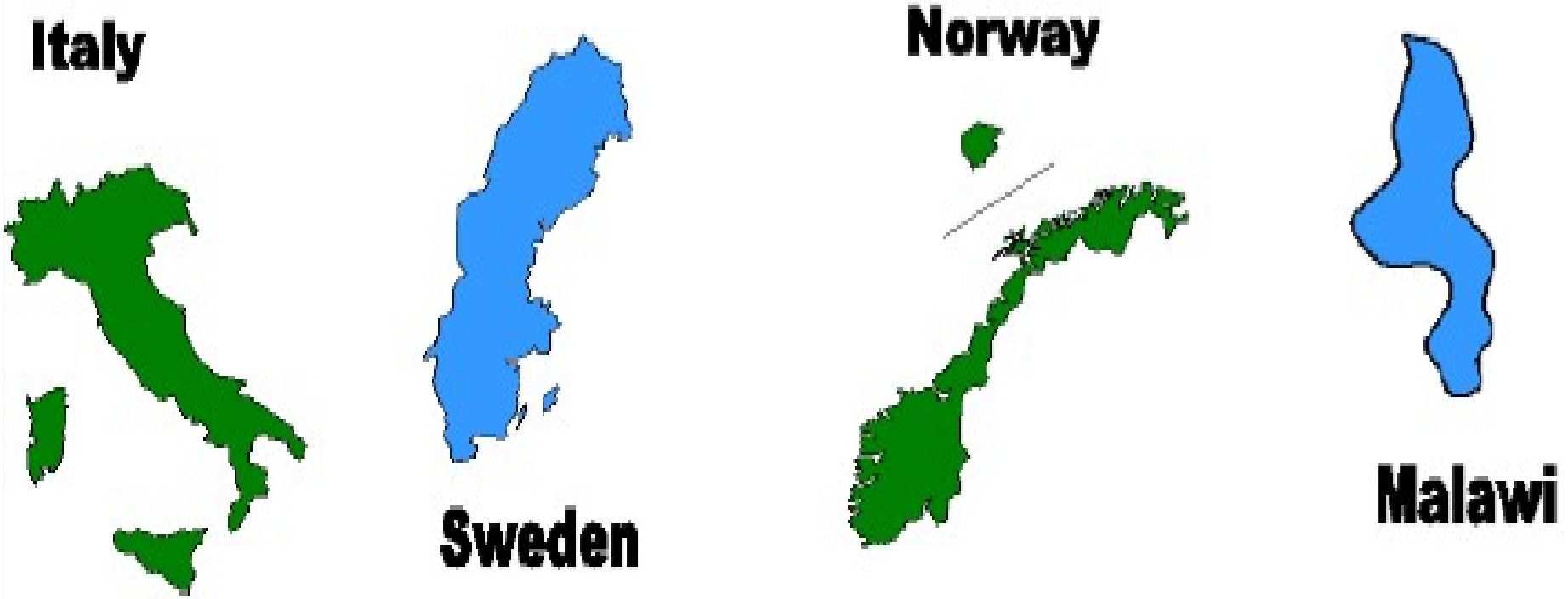
- Countries of the World have different kinds of shape that can be divided into five main categories:

1. Compact shape countries: The distance from the geographic center of the state to any of the borders does not vary greatly. It is easier for defense, socioeconomic and cultural integration.

2. Fragmented shape countries: They are divided from their other parts by either water, land or other countries.

3. Elongated shape countries: They are geographically long and relatively narrow like Chile, Italy, Norway, Malawi, Sweden etc.

Elongated shape countries



Perforated shape countries:





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5. **Protrude shape countries:** Countries that have one portion that is much more elongated than the rest of the country like Namibia, Thailand, Zaire, Myanmar, Eritrea etc…

- There are various ways of measuring shape of countries. These measures are known as the *indices of compactness*. It measure the deviation of the shape of a country from a circular shape, which is the most *compact shape.*
- There are four most commonly used measures of compactness. These are:

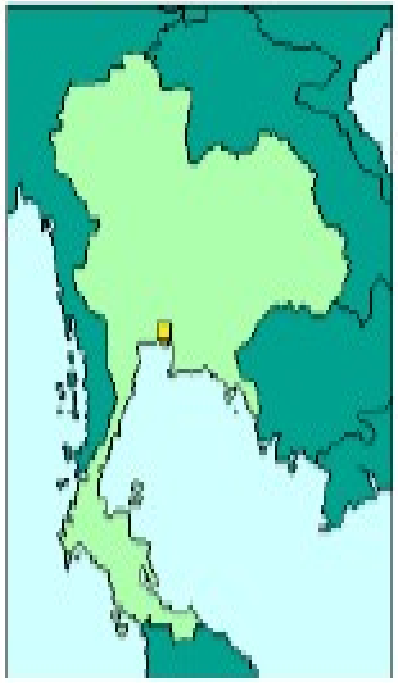
1. *Area-Boundary ratio.* The higher the A/B ratio, the greater the degree of compactness.

Protrude shape countries

Namibia



Thailand



Zaire



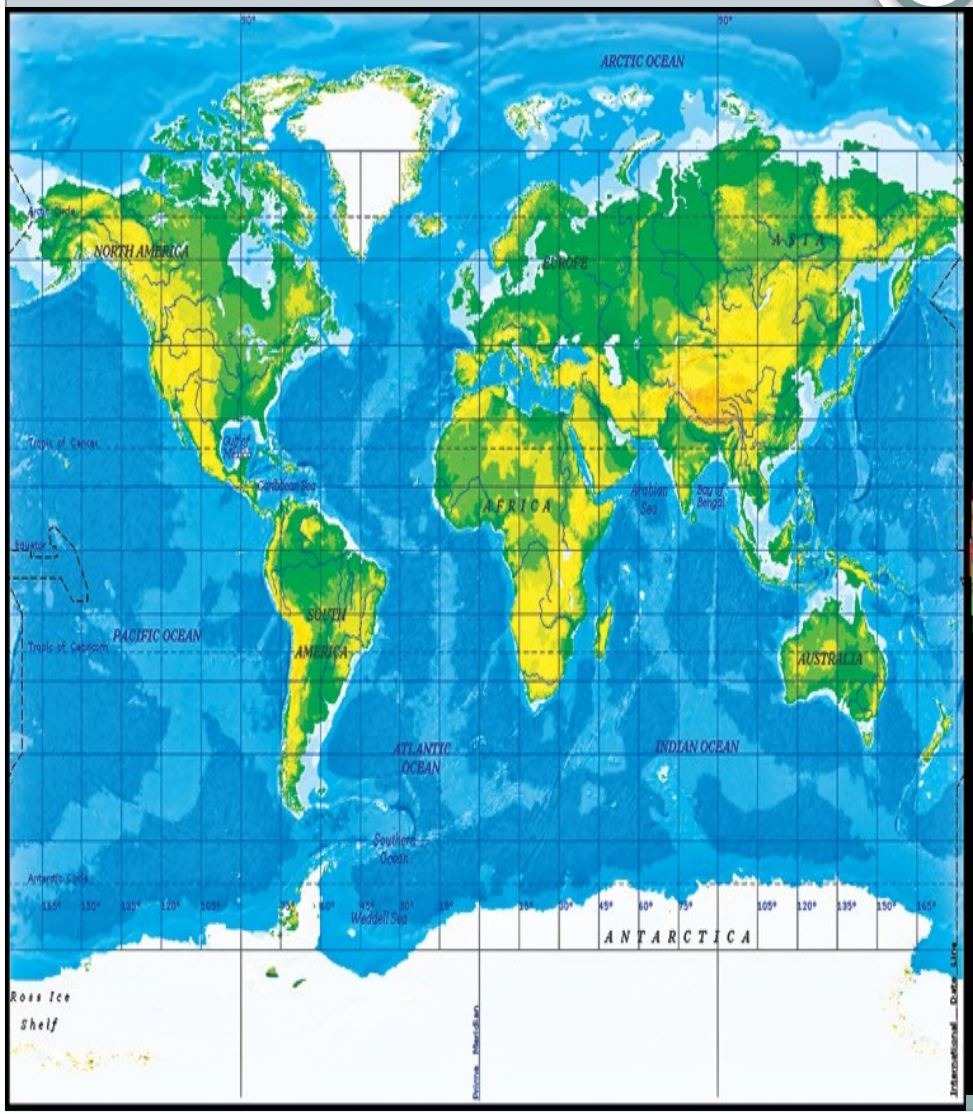
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2. Boundary-Circumference ratio. It measures how far the boundary of a country approximates the circumference of a circle of its own size. Therefore, the nearer the ratio to 1 the more compact the country is.

3. The ratio of the area of the country to the circumference of the smallest inscribing circle: *Area-Circumference ratio*. The higher the A/C ratio, the greater the degree of compactness.

4. The ratio of the actual area of a country to the smallest possible inscribing circle: *Area-Area (A/A') ratio*. The area of the inscribing circle is the area of the smallest possible circle whose circumference passes through the extreme points on the boundary.

What is the basic difference b/n Map & Glob?





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1. Basic Skills of Map Reading

- A map is a two-dimensional scaled representation of part or whole of the Earth surface on a flat body such as piece of paper, black board, wood or cloth.

Importance of maps

- Provide the basis for making geographical details such as relief, drainage, settlement etc.
- Maps are powerful tools for making spatial analysis of geographical facts of areas represented.

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- Maps are used on various disciplines like land use planning, military science, aviation, tourism, marine science, population studies, epidemiology, geology, economics, history, archaeology, agriculture etc.
- Maps are useful for giving location of geographical features by varied methods of grid reference, place naming etc.
- Maps are potentially used to measure area size, distance etc.

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Types of Map

I. Based on their purpose and functions.

a. Topographical maps:

- depict one or more natural and cultural features of an area.
- Contents of topographical maps depend on purpose of a map, scale of a map, date of compilation, and nature of the land represented.

***b*. Special purpose/statistical maps:**

- show distribution of different aspects such as temperature, rainfall, settlement, vegetation etc.

II. Classification of map based on scale

Based on their scale map classified in to three:-

a. ***Large scale map***
b. ***Medium scale map***
c. ***Small scale map***

NB. Large scale map:-are better for showing small areas because large scale shows a great detail of an area where as small scale map shows a large area with less detail.

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Marginal Information on Maps (Elements of Maps)

a. **Title:** It is the heading of the given map which tells what the map is all about.

b. **Key (legend):** It is the list of all convectional symbols and signs shown on the map with their interpretation.

c. **Scale:** It is the ratio between the distance on the map and the actual ground distance. Scales enable the map user to interpret the ground measurement like road distance, areal sizes, gradient etc.

d. **North arrow:** It is indicated with the north direction on a map

e. **Margin:** Is the frame of the map. It is important for showing the end of the mapped area.

f. **Date of compilation:** It is a date of map publication.

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CHAPTER TWO

THE GEOLOGY OF ETHIOPIA AND THE HORN

Origin of the Universe: The Big Bang Theory

- Acc to Big Bang theory, the universe is the result of the 'explosion of matter' which has extremely high density and temperature.
- Some 10 to 20 billion year ago, all matter in the known

universe were once concentrated into a single point called cosmic egg.

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- The explosion destroyed the mass, and all the matter was thrown into space in all direction.
- The violence of the explosion was so great that matter of the cosmic (space) egg was reduced to subatomic particles, which soon reassembled to form only two elements **H & He.**
- Within these gas clouds, future Galaxies, gravity produced much denser and more localized concentrations of gas.
- When a temperature of approximately 11 million degree Celsius was reached, thermonuclear fusion (union) was spontaneously initiated, and **stars were born.**

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- About 12 billion years ago fire ball in which all matter and energy was concentrated then exploded (big banged) due to which matter and energy spread out ward in all directions, the materials cooled and condensed in to the present day galaxies.
- So that the origin of other solar system, including the Earth believed to be similar to that of galaxies.

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Theory of Continental Drift

- The movement of the Earth's continents relative to each other.
- The earth's continents were once bunched up together in to a single huge continent called *Pangaea*.
- Wegener's principal observations were:-
  - *Fit of the continents (coastline similarities)*
  - *Match of mountain belts, rock types (Rock similarities)*
  - *Distribution of fossils (fossil remain similarities)*
  - *Paleo climates*

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Geologic Processes: Endogenic and Exogenic Forces

A. Internal processes (endogenic):- tectonic processes (**folding, faulting, orogenesis** (mountain building), and **epeirogenesis** (**sinking** and **rising** of the landmass.

B. External (exogenic) processes:- are geomorphic processes.

- They include **weathering, mass transfer, erosion** and **deposition**. They act upon the volcanic and structural landforms by modifying, roughening and lowering them down.

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2.5.1. The Geological Time Scale and Age Dating Techniques

- The geological history is divided in to Eras. Each Era is divided into periods.
- The geological time scale measures time on a scale involving four main units:-

i. epoch
ii. periods.
iii. Era
iv. Eon

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- Paleozoic Era (ancient life) is the age of invertebrates
- Mesozoic Era (the middle life) is the age of reptiles
- Cenozoic Era (recent life) is the age of mammals
- These geological time divisions basically differ from each other in the following characteristics:-
  - The relative position of land and sea,
  - The kind of climate
  - Life forms

2.5.1. Age Dating Techniques

- There are two techniques of knowing the age of rocks: Relative and absolute age dating:-

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A. Relative dating technique

- Refers to sequence of time which events took place
- Dating time of events not measured in number, rather only order of occurrence of events

B. Absolute Dating/radio active dating/

- Numerical dating of geological events obtained by using Isotopic dating technique
- Isotopic dating determine age of rock or mineral through its radioactive elements
- Isotopes are an atom that has different numbers of neutrons but the same number of proton.

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- Radioactive means have unstable nuclei, instability cause an element to disintegrate or transform isotopes to create new another daughter element.
- **Half life:-** time takes for atom of original unstable parent element to decay to atoms of new more stable daughter element.
- ***Example:- Ur-238 half time 4.6 billion years to new daughter lid 206***
- ***Potassium 40- half life 4.3 billion years to new daughter Argon-40***
- ***C14- half life 5730 years to new daughter Nitrogen-14***

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Geological Processes and the Resulting Landforms of Ethiopia and the Horn

A. Precambrian Era Geologic Processes (4.5 billion - 600 million years ago)

- The major geologic event of the Precambrian Era was *Orogenesis*.
- The land was subjected to intense folding.
- Most parts of Covered by basement rocks

(*sedimentary* and *igneous*) **Heat** Metamorphic Rock

pressure (Basement/*crystalline rock*)

- Rich in metallic minerals

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- Out crops of old crystalline basement complex rocks covering 25% of the land mass of the country; they are found in the following areas: -

i. The northern part:

ii. In the western Part:

iii. In the southern Part:.

iv. In the eastern part.

B. The Paleozoic Era Geologic Processes (600million - 225 million years ago)

- The Paleozoic Era lasted for about 375 million years.
- The major geological process of this Era was **denudation** and **peneplanetion.**

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- The sediments were transported southward and eastward to form continental (in Africa) and marine deposits, respectively.
- ***limited deposition within Ethiopia, rocks belonging to this Era are rare in the country.***

C. Mesozoic Era Geologic Processes (225-70 million years ago)

- It was an Era of alternate slows sinking and rising (epeirogenesis) of the landmass
- Affected the whole present-day Horn of Africa and Arabian landmass.

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- Subsidence of the land began about 225 million yrs ago.
- As the land sink slowly the sea invaded it starting from Somalia and Ogaden and slowly spreading NW ward in the late Triassic & continued up to Jurassic period.
- Mesozoic era sub divided in to 3 period:-
    1. Triassic (225 million)
    2. Jurassic (142 million)
    3. Cretaceous (70 million)

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- As the shallow sea spread towards the land, sands were deposited over the peneplained Precambrian rock surface.
- As the depth of the sea increased, mud (shale), gypsum and later lime were deposited.
- Through time, by cementing minerals, the sands and lime were compacted to form sandstone and limestone layers respectively.

i. **Triassic** period horn of Africa began to sink because of internal force and followed by **invasion(transgression)** of sea water from Indian ocean

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- Old sedimentary rock in Ethiopia known as ***Adigrat sand stone*** formed.

ii. **Jurassic period:-**land surface of Ethiopia remained under sea invasion. The *transgression of the sea continued into the mainland in the NW direction.*

- As result the dead bodies of various creatures formed second layer of sedimentary rock known as ***Hintalo limestone.***

iii. **Cretaceous period:-**With **retreated/regression/** of the sea, another third layer deposition of Gypsum, shale and at

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- The Mesozoic sedimentary rocks cover 25% of the land mass of the country.
- During the transgression and regression of the sea, and due to the direction of the invading and retreating sea, the age and thickness of the Sandstone layers vary in a SE - NE direction.

D. The Cenozoic Era Geologic Processes (70million years ago - Present)

- Tectonic and volcanic activities that took place in this Era have an important effect in the making of the present-day landmass of Ethiopia and the Horn of Africa

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- Very significant structural, climatic and biological events have occurred in the Horn.
- Geological events of this era divided into events of the Tertiary and Quaternary Periods.

I. Geological events of Tertiary Period (70 -1.6 million yr)

- These geologic activities are:

  a. Uplifting of the Arabo-Ethiopian landmass and outpouring of huge quantity of lava.

  b. Formation of the Rift Valley.

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a. Uplifting of the Arabo-Ethiopian landmass and outpouring of lava flood:-

- This huge uplift continued to the Paleocene and Oligocene epoch of the Tertiary period.
- This uplifting was of an epeirogenic character and found dominantly in central Ethiopia.
- As the uplifting continued through time, great cracks opened in the crust and resulted in the pouring out of extensive basaltic lava (known as the ***Trappean lava series***).

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- The lava resulted in the formation of:-
  - *North central highlands*
  - *Northwestern Highlands*
  - *Southeastern Highlands*
  - *Somali plateaus*
- As Cracking continued during the period, it formed the Great East African Rift Valley System/Ethiopian rift valley part of this.

b. The Formation of the Rift Valley

- The formation of the Rift Valley related with the theory of plate tectonics.

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- Lateral movement of the crust in opposite directions producing ***tensional forces.***
- Tension widened the fractures, the central part of the landmass collapsed to form an extensive structural depression known as the ***Rift Valley.***
- The Red Sea and the Gulf of Aden were connected as a result of the rifting and faulting of the land bridge that separated them.

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- The area between the Danakil Depression and the Red Sea was uplifted to form the Afar Block Mountain/Pleistocene

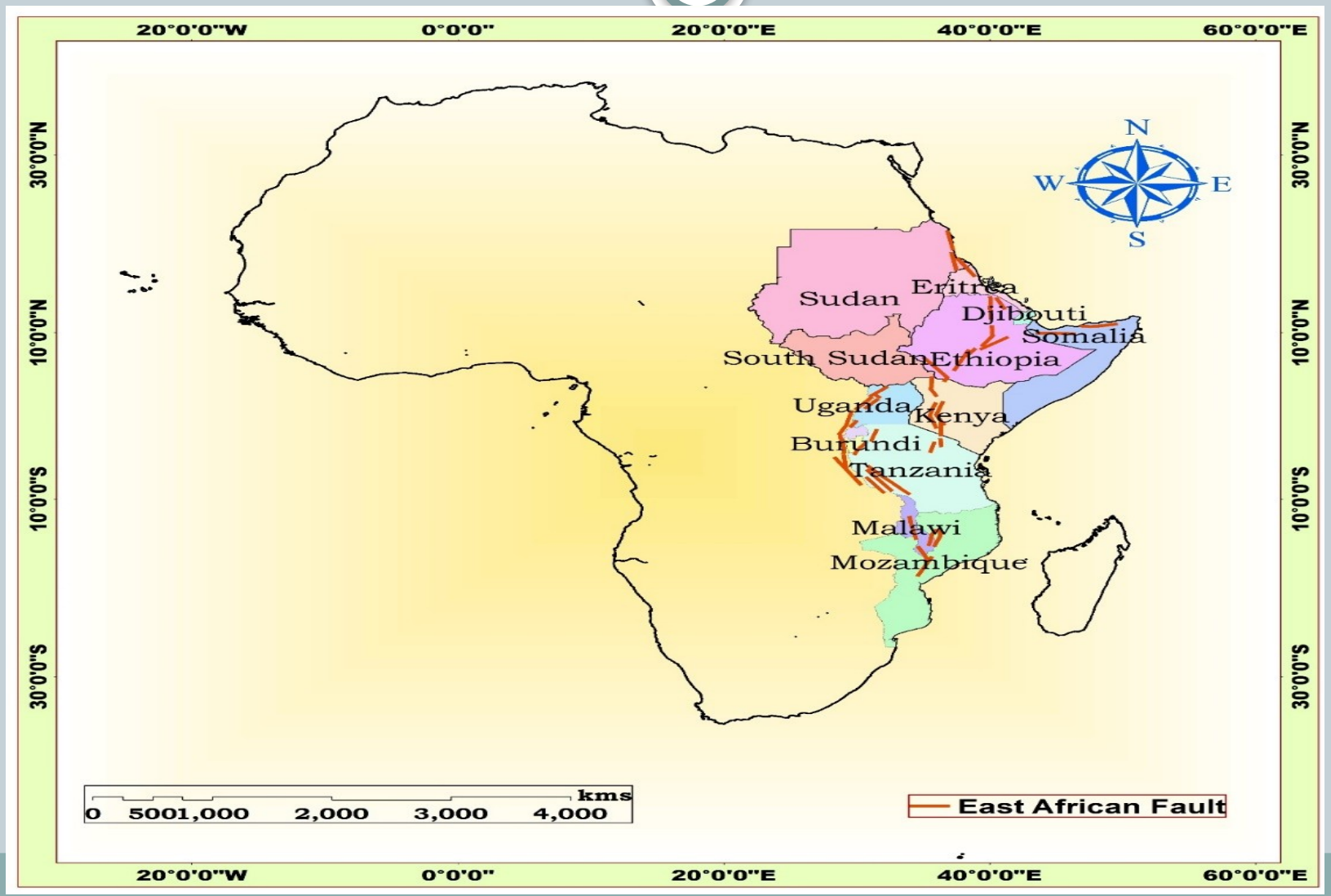
The Spatial Extent of the Rift Valley

- The Ethiopian Rift Valley is part of the Great East African Rift system that extends from Palestine-Jordan in the north to Malawi-Mozambique in the south, far a distance of about 7,200 kilometers.
- About 5,600 kilometers is in Africa, and 1,700

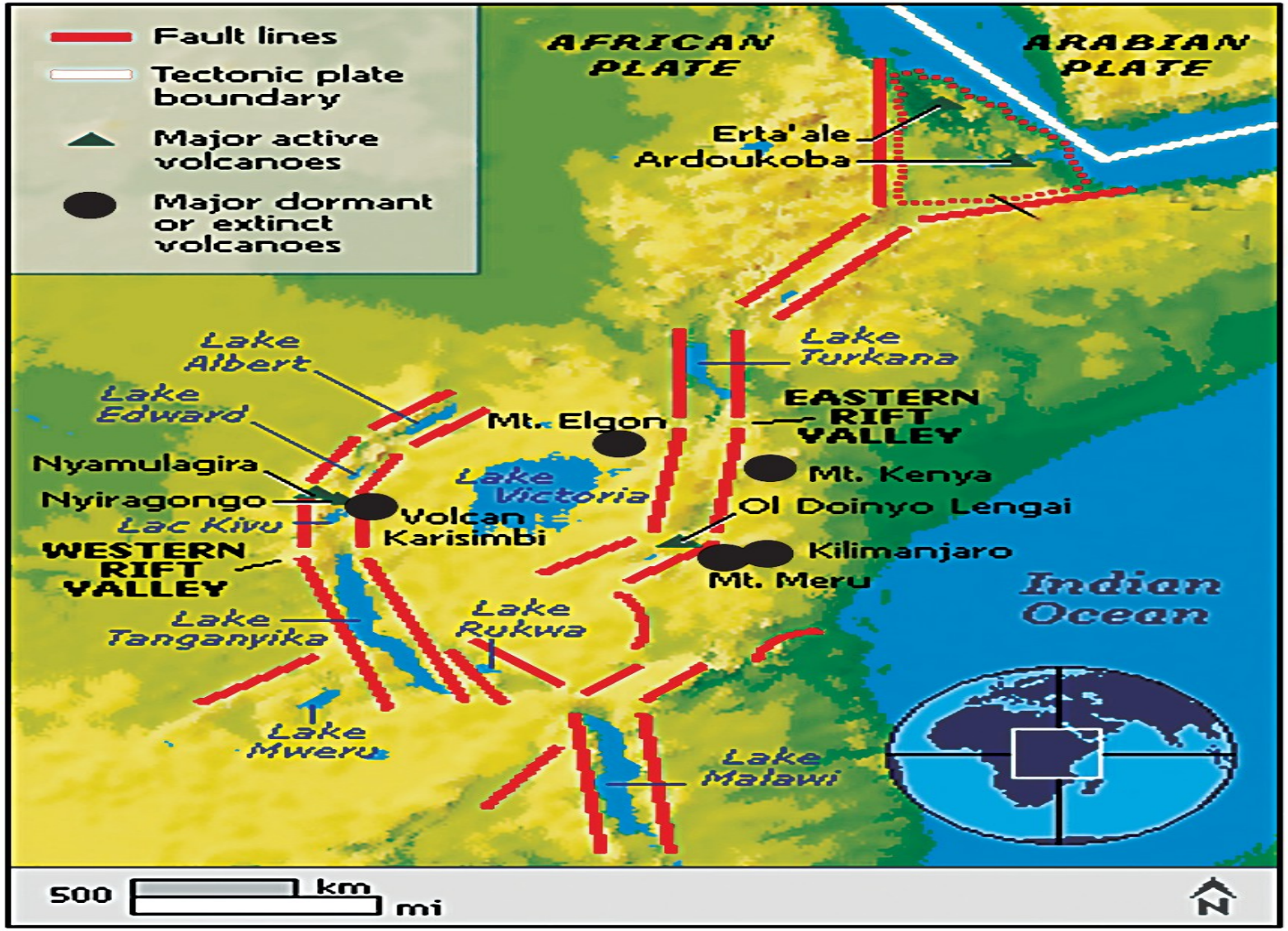
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- Red Sea, the Gulf of Aden, and the East African System meet and form the triangular depression of the Afar Kobar Sink lies about 125 m bsl.
- Formation of the Rift Valley has the following **structural/ physiographic effects**:
  - Division of Ethiopian Plateau into two.
  - Separates the Arabian landmass from African landmass.
  - It causes the formation of the Dead Sea, Red Sea and the Gulf of Aden troughs.
  - It creates basins and fault depressions on which the Rift Valley lakes are formed.

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20°0'0"E
40°0'0"E
60°0'0"E
30°0'0"N
10°0'0"N
10°0'0"S
30°0'0"S
N
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S
Sudan
Eritrea
Djibouti
Somalia
South Sudan
Ethiopia
Uganda
Kenya
Burundi
Tanzania
Malawi
Mozambique
0 500 1,000 2,000 3,000 4,000
kms
East African Fault

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Fault lines
Tectonic plate boundary
Major active volcanoes
Major dormant or extinct volcanoes
AFRICAN PLATE
ARABIAN PLATE
Erta'ale
Ardoukoba
Lake Albert
Lake Edward
Lake Turkana
EASTERN RIFT VALLEY
Mt. Elgon
Nyamulagira
Nyiragongo
Lac Kivu
Volcan Karisimbi
Lake Victoria
Mt. Kenya
Ol Doinyo Lengai
Kilimanjaro
Mt. Meru
WESTERN RIFT VALLEY
Lake Tanganyika
Lake Rukwa
Indian Ocean
Lake Mweru
Lake Malawi
500
km
mi
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II. Geologic Events of Quaternary period(1.6 million-present)

- Aden volcanism and recent faulting are more extensively developed in the Afar region.
- The basic volcanic features of the ***Aden series*** include the following:-
- Numerous and freshly preserved volcanic cones, many of which have explosive craters. Some of these are active Dubi, Erta Ale, Afrera etc. Of these, Erta Ale is the most active volcano in Ethiopia.

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- *Volcanic hills and mountains,* some of which are semi-dormant (Fantale, Boseti-Gouda near Adama, Aletu north of Lake Ziway, Chebbi north of Lake Hawassa etc.)
- Extensive lava fields and lava sheets some of which are very recent.
- Lava ridges.
- Thermal springs, fumaroles etc.

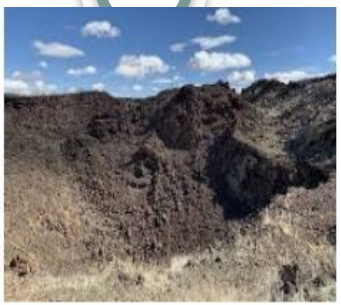
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Aden Lava Flow Wilderness Study Area ...
thearmchairexplorer.com



volcanic cone cluster ...
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Aden Crater and Lava Flow: Rugged ...
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Aden Lava Flow Wilderness - Wikipedia
en.wikipedia.org



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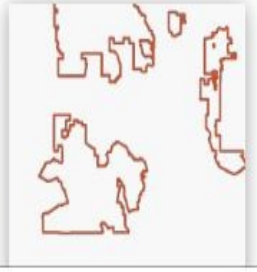


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Volcanic Landforms: Types & Formation ...
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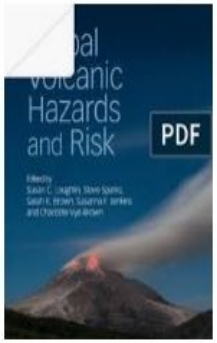
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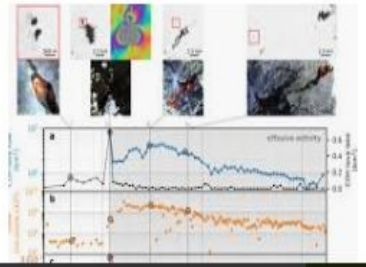


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Quaternary Deposition

- Earth experienced a marked ***climatic change.***
- Warmer and dry periods were alternating with cooler and wet periods. 'Ice Age''
- The heavy Pluvial Rains eroded the Ethiopian plateau & eroded materials were deposited in the Rift Valley lakes.
- The excessive rain resulted in an excessive surface flow; rivers were many and large.
- They carried a lot of water and sediments. Lake and marshy areas became numerous and deep.

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- For example:- Ziway-Langano-Shalla; Hawasa-Shallo; Chamo-Abaya
- After the ''Pluvial Rains'' the Earth's climate became warmer and drier.
- It increased the rate of evaporation that diminished the sizes of the rift valley lakes. Ex:- Afar rift valley lakes
- The major quaternary deposits are:-

a. Lacustrine deposits: Deposits on former lakebeds, and swampy depressions.

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b. Fluvial deposits: Deposits on the banks of rivers, flood plains both in plateau, foothills etc.

c. Glacio-fluvial deposits and erosional features: These are occurred on high mountains, such as Bale and Kaka Mountains.

d. Aeolian deposits: are **w**indblown deposits.

e. Coastal and marine deposits: Deposits on sea invaded and sea-covered places.

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- Quaternary deposits are mainly found in the Rift Valley (Afar and Lakes Region).
- The Cenozoic rocks cover 50% of the land mass of the country

Rock and Mineral Resources of Ethiopia

- The occurrence of metallic minerals in Ethiopia is associated with the Precambrian rocks.

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- Presently mineral production from Ethiopia has been negligible by World standards.

Brief Facts and Current State of Main Minerals in Ethiopia

- Ethiopia has abundant mineral resources of metals and precious metals, coal, and industrial minerals.

Gold **Gemstones and tourmaline**

Platinum **Potash**

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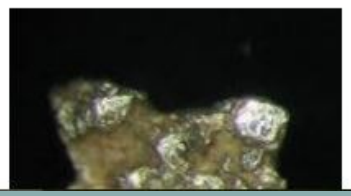


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The major mineral deposition zones or belts of Ethiopia are:-

1. ***The Western and South-western-greenstone belt:***
2. ***The Southern greenstone belt***
3. ***The Northern greenstone belt (Tigray):***