Introduction to Geology

The word geology means 'Study of the Earth' ."Geo" means "earth" and "ology means "study of “.Also known as geoscience or earth science, Geology is the primary Earth science and looks at how the earth formed, its structure and composition, and the types of processes acting on it.

it is concerned with the history of the earth over the course of its 4.5-billion-year life. By studying the structures of the earth we can unlock its hidden past and anticipate its future. It is a complex science that encompasses many different subtopics. All of the diverse topics of geology have one thing in common, they have to do with the earth. Scientists who study geology learn about Earth's physical structures, processes, minerals, and history. Geologists study topics that include plate tectonics, earthquakes, rivers or streams, fossils, and even the formation of the Earth.

Geology looks at some of the most important issues in society today including energy sources and sustainability, climate change, the impacts of developments on the environment, water management, mineral resources and natural hazards.

By studying these issues, geologists, along with other scientists, can anticipate earth's future and examine any changes that may need to be made. A key example of this is the study of climate change and how society needs to change to improve the earth's future. By switching from fossils fuels to geothermal energy and other renewable sources, we can reduce our carbon emissions and the effects of global warming.

Understanding the mechanical properties of soils help us evaluate risks for landslides and identifying zones that are prone to risks. Studying the movement of groundwater underneath our feet supports drinking water protection from pollution.

Benefits of studying geology:

1- Predicting the behavior of Earth systems and the universe.

2- Finding adequate supplies of natural resources, such as ground water, petroleum, and metals.

3- Conserving soils and maintaining agricultural productivity.

4- Developing natural resources for safe environment.

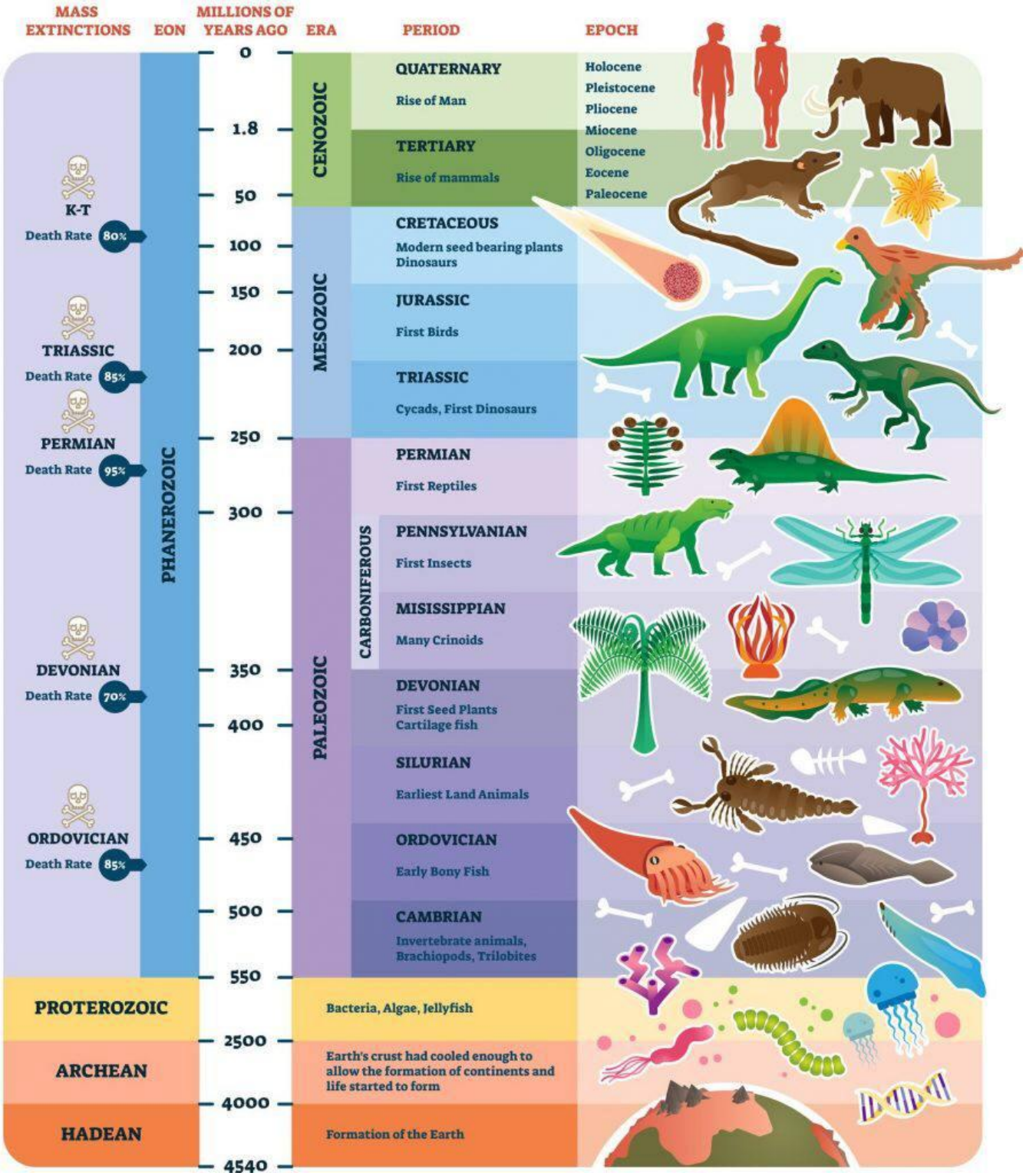
5- Reducing human suffering and property loss from natural hazards, such as volcanic eruptions, earthquakes, floods, landslides, hurricanes, and tsunamis.

6- Determining geological controls on natural environments and predicting the impact of human activities on them.

7- Understanding global climate patterns.

Geologic Time Scale

The Geologic Time Scale is a system used by scientists to describe the timing and relationships between events in Earth's history. It covers a vast expanse of time, from the formation of the planet nearly 4.6 billion years ago to the present day.



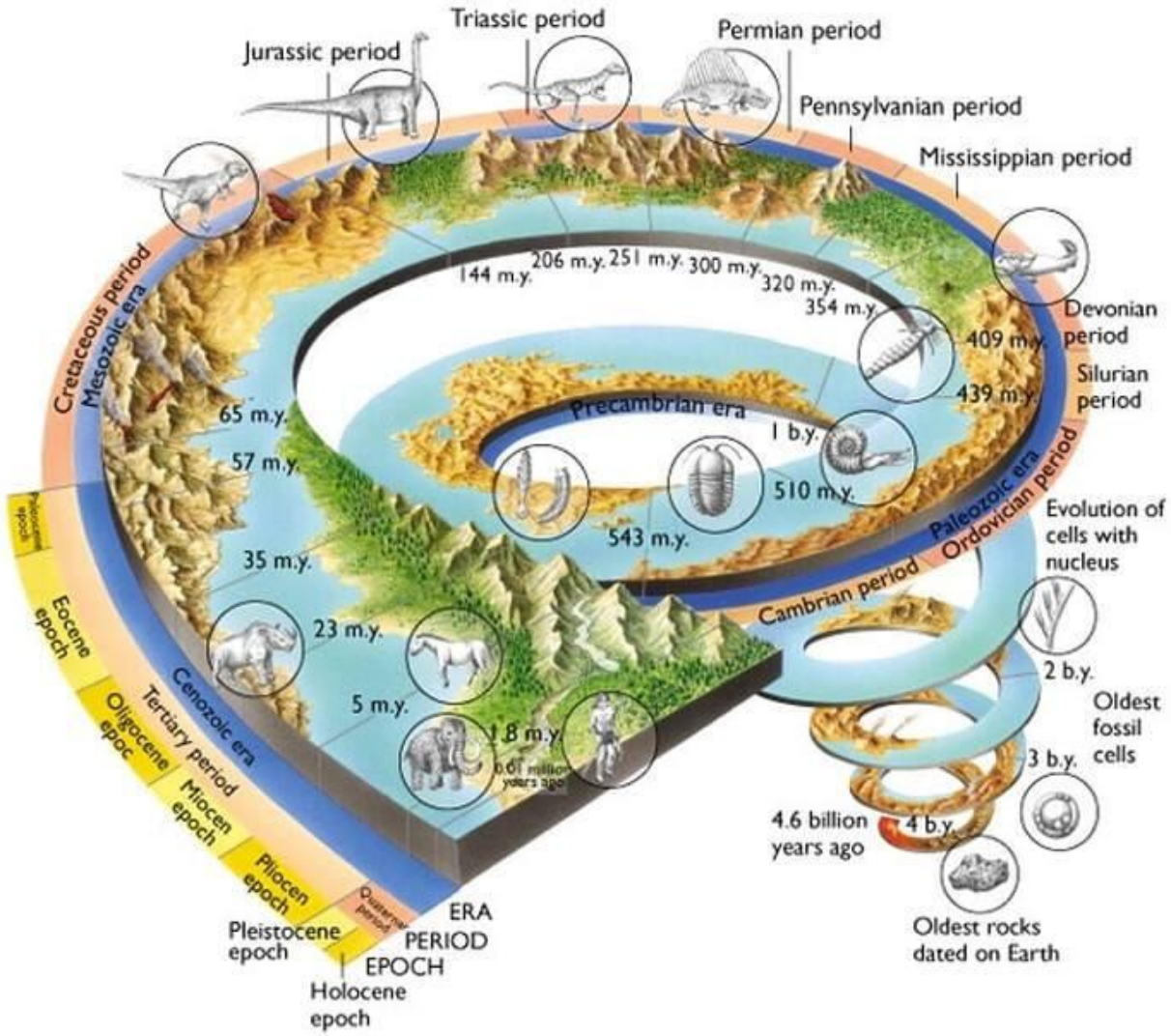
Geologic Time Scale

The Geological time units:

- Eons : The eon is the broadest category of geological time. Earth's history is characterized by four eons; in order from oldest to youngest.

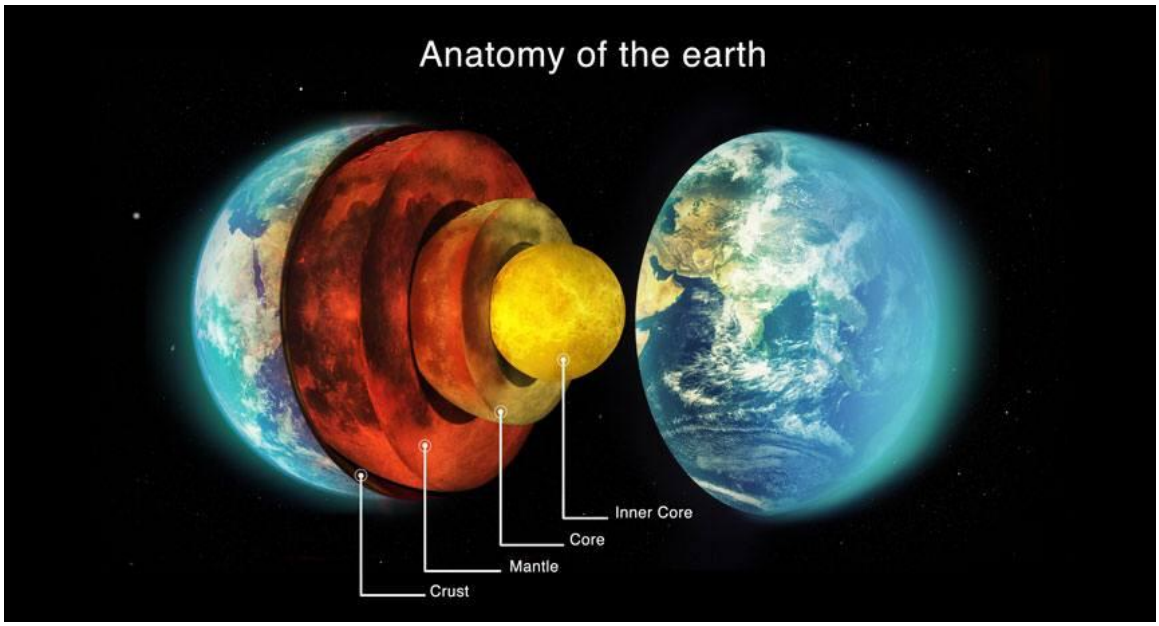
- Eras : Eons of geological time are subdivided into eras, which are the second-longest units of geological time.

- Periods : Just as eons are subdivided into eras, eras are subdivided into units of time called periods.



Internal of structure of the earth

Earth is composed of four distinct layers starting at the center,. They are, from deepest to shallowest, the inner core, the outer core, the mantle and the crust.



The inner core

This solid metal ball has a radius of 1,220 kilometers , or about three-quarters that of the moon. It's located 5,180 kilometers under Earth's surface. it's made mostly of iron and nickel. It's also intensely hot: Temperatures sizzle at 5,400° Celsius .

The outer core

This part of the core is also made from iron and nickel, just in liquid form. It sits some 5,180 kilometers below the surface. Heated by the radioactive decay of the elements uranium and thorium, this liquid move in huge,

turbulent currents. That motion generates electrical currents. They, in turn, generate Earth's magnetic field.

The mantle

At close to 3,000 kilometers thick, this is Earth's thickest layer. It starts 30 kilometers beneath the surface. Made mostly of iron, magnesium and silicon, it is dense, hot and semi-solid . Like the layer below it, this one also circulates slowly.

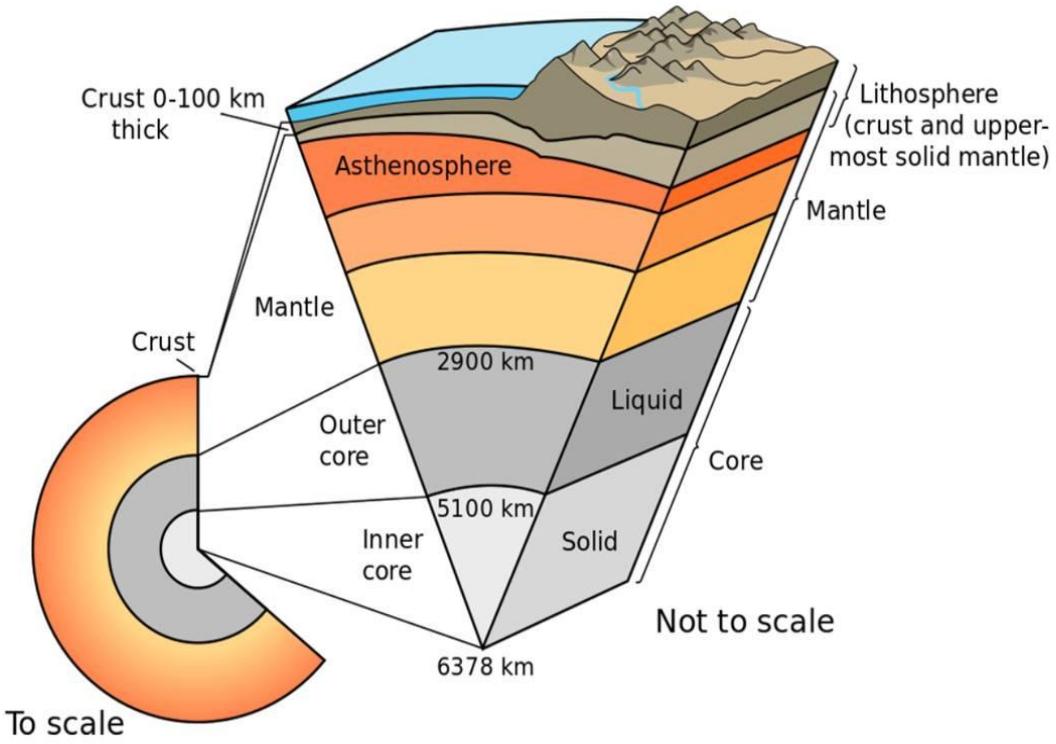


Plate Tectonics

Plate Tectonics: is a scientific theory that explains how major landforms are created as a result of Earth's subterranean movements.

The earth's crust is broken into separate pieces called tectonic plates . It is composed of two different types of material: the continental crust and the oceanic crust. Both types of crust rest atop solid upper mantle material. The upper mantle, in turn, floats on a denser layer of lower mantle that is much like thick molten tar.Each tectonic plate is free-floating and can move independently. Earthquakes and volcanoes are the direct result of the movement of tectonic plates at fault lines. The term fault is used to describe the boundary between tectonic plates.

* Plates move at rates of centimeters per year.

*Plates may be composed of continental and/or oceanic lithosphere.

The theory of plate tectonics proposes that the lithosphere is divided into eight major plates (North American, South American, Pacific, Nazca, Eurasian, African, Antarctic, and Indian-Australian) and several smaller plates(Arabian, Scotia, Juan de Fuca) that fit together like the pieces of a jigsaw puzzle . The largest plate is the Pacific plate. These plates are mobile, moving in constant, slow motion measured in rates of centimeters per year. The movements of plates over millions of years resulted in the opening and closure of oceans and the formation and disassembly of continents. The theory links Earth's internal processes to the distribution of continents and oceans.

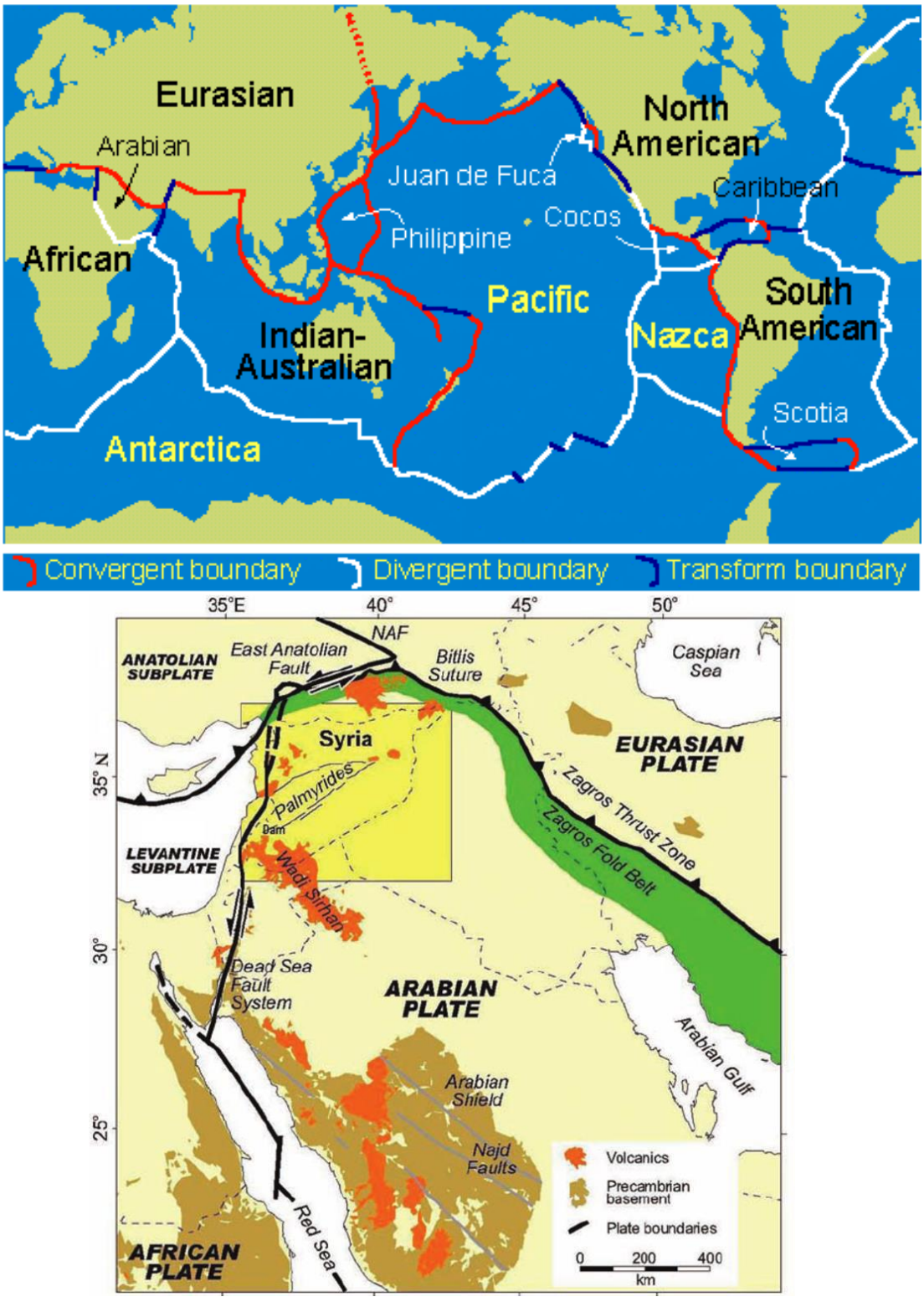
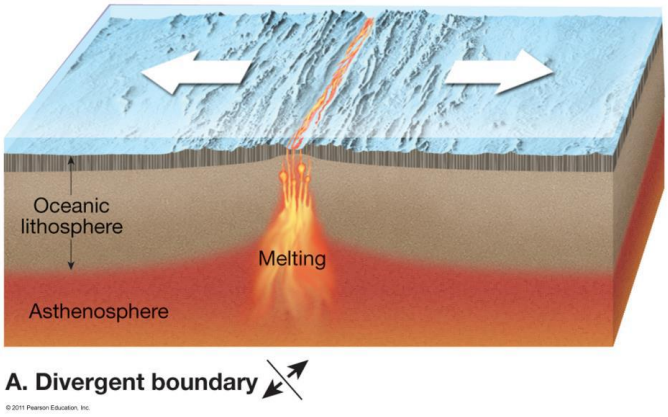


Figure : Distribution of tectonic plates with type of plate boundary

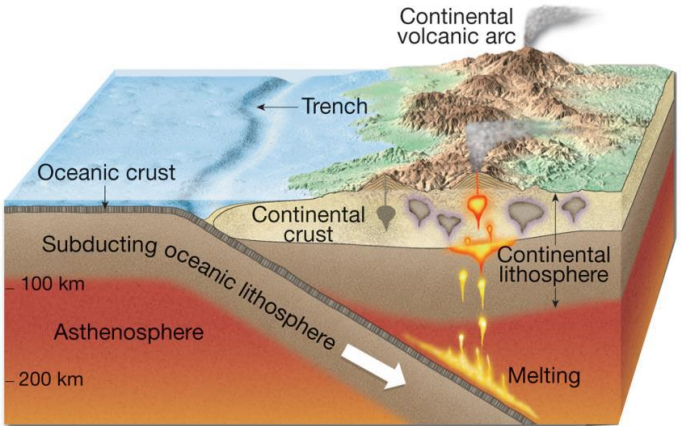
Types of plate boundaries:

1. Divergent plate boundaries .

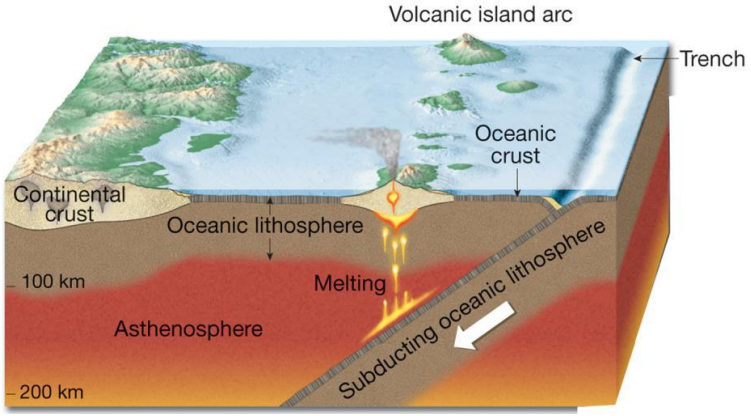


2. Convergent plate boundaries:

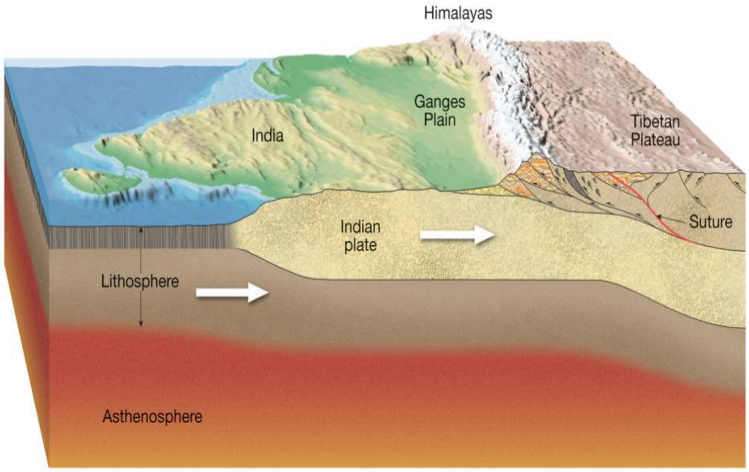
a- Oceanic–continental convergence .



b- Oceanic–oceanic convergence.

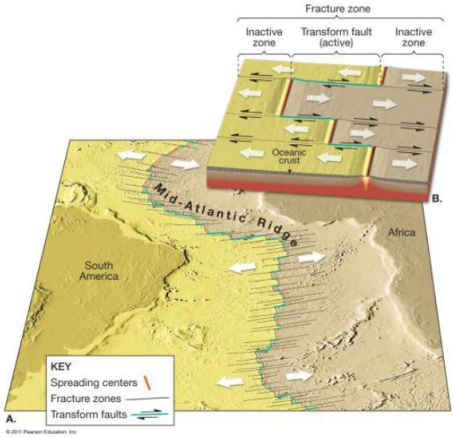


c- Continental–
continental convergence .



3. Transform fault boundaries.

TRANSFORM FAULT BOUNDARIES



MID-OCEANIC RIDGE

SAN ANDREAS FAULT

Importance of plate tectonics

The theory provides explanations for:

1. Earth's major surface processes
2. Distribution of earthquakes, volcanoes, and mountains
3. Distribution of ancient organisms and mineral deposits

Plate tectonics and environmental geology

scientists couldn't explain many natural phenomena, such as why earthquakes are common in certain areas and extremely rare in others, why volcanoes occasionally form in chains, and why fossils of the same species turn up in continents thousands of kilometers apart.With time, scientists have also realized that tectonics is the driving force behind most of the climate changes that our planet has endured over geological time.At a rate of millimeters per year, continents drift, break into smaller pieces, and crash into each other. This motion opens and closes seaways and builds mountain ranges and, in so doing, changes winds and ocean currents across the globe.