GEOLOGY

DEFINITION

The word *GEOLOGY* has been derived from the Greek words *GEO* meaning the Earth and *LOGOS* meaning discourse (*gagia* or *ge*, the ancestral Earth-goddess of Greek mythology, *logy*, a suffix denoting 'knowledge of').

Geology is therefore the science of the earth.

The science of geology includes the study of the earth as a whole. The study includes its origin, structure, composition, and history (including the development of life) and the nature of the processes which have given rise to its present state.

Recently, *GEOLOGY* has been defined as approximately synonymous with *SOLID EARTH SCIENCES*
Earth Sciences are those sciences that deal with the earth: They include:

GEOLOGY
GEOPHYSICS
METEOROLOGY, AND
PARTS OF OCEANOGRAPHY

MAJOR DIVISION OF SCIENCES

EARTH SCIENCES	
Geology	**Study of lithosphere**
Geophysics	**Study of physical properties of the earth**
Oceanography	**Study of oceans**
Meteorology and Climatology	**Study of atmosphere**
SPACE SCIENCE	**Study of space**
ASTRONOMY	**Study of interstellar space**
LIFE SCIENCE	**Zoology and Botany**
PHYSICAL SCIENCE	**Physics and Chemistry**

BRANCHES OF GEOLOGY

Physical or Dynamic Geology
Structural Geology
Mineralogy
Crystallography
Petrology
Historical Geology
- **Stratigraphy**
- **Paleontology**

Economic Geology
Engineering Geology
Geophysics
Geochemistry
Hydrogeology
Engineering Geology

IMPORTANCE OF GEOLOGY

Mining and Development of Mineral Resources
Civil Engineering (dam, tunnel, bridge, road etc.)
Water resources development
Environment
Agriculture
Forestry
Mitigation of Natural Hazards (Earthquakes, volcanoes, landslides,
Outer space research

PHYSICAL GEOLOGY

PHYSICAL GEOLOGY **is the study of the dynamics of the planet Earth.**
It is concerned with all the terrestrial agents and processes of change and with the effects brought about by them

The objectives of studying Physical Geology are to:

1. **Learn about the major interior and exterior features of the earth and how these features respond to the sources of available energy,**
2. **How human activities have affected the earth,**
3. **How geology must be applied to the searches of new supplies of natural resources**
4. **How geologic features record the passage of time**
5. **How principles of geology learned with examples on the earth can be applied to other planetary bodies.**

MAJOR CONCEPTS IN GEOLOGY

1. THE EARTH IS A DYNAMIC BODY EVOLVING THROUGH TIME

The idea that the earth is dynamic implies that it is supplied with sources of energy which can drive chemical reactions and physical reactions

The earth is subjected both to

a. External supplies of energy and forces (from the Sun)
b. Internal supplies of energy (outflow of earth's internal heat)

2. GEOLOGIC CYCLE

The concept was developed by James Hutton (1726-1797) in 1785

Hutton's doctrine 'Present is the key to the past' was expounded and illustrated by Charles Lyell as the 'Principles of uniformitarianism'

Hydrologic cycle
Rock cycle

GEOLOGY

The word geology has been derived from the Greek words *Geo* meaning the earth and *logos* meaning discourse. Geology is therefore the science of the earth.
This word was used in its proper sense in 1778 by Jean Andre de Luc (1727-1817), a Swiss - born scientist.
The science of geology includes the study of the earth as a whole, its

Origin
Structure
Composition, and
History (including the development of life), and
Nature of the processes which have given rise to its present state.

More recently, Geology has been defined as approximately synonymous with *solid earth sciences*. Earth sciences are those sciences that deal with the earth: they include

geology
geophysics
meteorology and
parts of oceanography.

The geologist is concerned primarily with the solid part of the earth.

What are earth sciences ? One approach to understand the scope of the subject matter within the earthsciences is to consider the geographic regions which the phenomena occupy.

Thus, we have the solid earth, or lithosphere, with which the geological sciences are traditionally concerned; the oceans, obviously the subject of a group of oceanographic sciences; an inner layer of the atmosphere with which meteorology and climatology deal; and finally, an outer atmosphere grading imperceptibly into interplanetary space, with which the space science and planetary sciences are concerned.

The domain of molecules and smaller, elementary particles of matter is assumed to be studied elsewhere, in the physical sciences of modern chemistry and physics. The world of vast interstellar dimensions, is the science of astronomy which deals with the universe of stars and nebula primarily concerned with the distribution and movement s of matter in space on a celestial scale. Moreover, the world of existing plant and animal life is largely left to be treated in the broad fields of life sciences or Biology (the science of living matter), including zoology and botany.

Solid earth sciences: are those that investigate the

Physical and chemical characteristics and processes of the earth and Astrobodies,
Origin , distribution, development, and utilization of earth materials and the land and as a whole.

The interaction between the solid earth and the hydrosphere and atmosphere.

BRANCHES OF GEOLOGY

Geology is such a large subject that it has inevitably been subdivided into many branches. But these subdivisions are arbitrary and overlap with each other. The major branches are:

1. Physical Geology
2. Crystallography and Mineralogy
3. Petrology
4. Structural Geology
5. Historical Geology
   Stratigraphy
   Paleontology.
6. Economic Geology
7. Geophysics
9. Geochemistry
10. Hydrogeology

Engineering Geology: The knowledge of geology has also been utilized in cases of Engineering problems and this branch of geology is known as Engineering Geology.

Here, the principles and methods of geology for the purpose of civil engineering has been applied.

Broadly speaking there are two main divisions:

The study of raw materials e.g. aggregates etc.

The study of the geological characteristics of the immediate area where engineering operations are to be carries out e.g. ground-water characteristics, the load bearing capacity, the stability of slope, the excavation problems etc. (Rock mechanics).

PHYSICAL GEOLOGY

Physical Geology is the study of the dynamics of the planet earth.

The objective of studying physical geology are to:

a) Learn about the major interior and exterior features of the earth and how these features respond to the sources of available energy,
b) How human activities have affected the earth,
c) How geology must be applied to the searches of new supplies of natural resources,
d) How geologic features record the passage of time,
e) How principles of geology learned with examples on the earth can be applied to other planetary bodies.

Major concepts (The science dealing with time)

The most fundamental principle of geology is that the earth is a dynamic body evolving through time.

The earth undergoes important reactions driven by various energy sources.

The concept of the geologic cycle developed in the late eighteenth and early nineteenth century, became the basis of one of geology's greatest triumph, the proof of enormous age of the earth.

Development of concept of Plate Tectonics (development in mid 20th century)
The Dynamic Earth Evolving Through time:
The idea that the earth is dynamic implies that it is supplied with sources of energy which can drive chemical reactions and physical reactions
The earth is subjected both to:

1) External supplies of energy and forces
2) Internal supplies of energy

1. The sun is our most important external supply of energy. It is responsible for much what happens on earth including the continuation of life.
We are beginning to realize from space age research that the solar system behaves as a unit.
Not only does the sun send out energy that influences the surfaces on the planets in solar system,
but the planets exert a force on the sun that seems to affect the suns output of energy .The force is gravitational attraction.
2. The interior of the earth is the source of internal supplies of energy in the form of an outflow of heat.
In fact, the earth can be compared to a gigantic heat machine or heat engine.
The interior broadly consists of two parts

a) a dense, presumably metallic core, and
b) its thick rocky surrounding layer the mantle

Geologic theory suggests that at one time the entire core was liquid but through time the inner part has become solid, whereas the outer part remains liquid.
The slow movements of the liquid part of the core are thought to be the cause of the magnetic field that surrounds the earth.
Earth's magnetic field has become enormously important for geology.
The effects of the incoming solar energy and the out flowing heat are many and varied.
One of the first effects to be appreciated was what are now know as the
Geologic Cycle (James Hutton,1785)

Rock cycle,
Hydrologic cycle

THE GEOLOGIC CYCLE AND THE GEOLOGIC RECORD

The idea that were put together into what became known as the geologic cycle represent one of the greatest intellectual achievements of all time.
They were the work of one man-James Hutton (1726-1797).
Hutton was a farmer who set about attempting to apply the latest scientific methods in agriculture to his farm in Scotland.
He began to study the rocks and the surface features of the earth.
About 1768 he left the farm and began to do geologic research up to the rest of the life.
Hulton proposed a whole new way of looking at the world, which he named a " theory of the earth".
Hutton saw what was happening in the related activities we now know as the water cycle or hydrologic cycle

bed rock- regolith-sediment-strata or layer.

What Hutton did was to point out that the geologic cycle operates and important subcycle that became known as rock cycle

THREE GREAT GROUPS OF ROCKS AND THE ROCK CYCLE

Geologic record (Tape record)

a) the bed rock
b) the regolith
c) shape of the earth's surface

Geologic record reflects the passage of time.

The concept of rock cycle is that materials from inside the earth comes up to the surface and reacts with the atmosphere and water to become broke into pieces which form regolith or sediment.

The sediments accumulate where parts of the earth's surface are subsiding, becomes buried to greater and greater depths and thus is returned to the interior.

At depth the sediments may be compressed into sedimentary rocks, altered to metamorphic rocks or melted into magma to form igneous rocks.

JAMES HUTTON AND THE UNIFORMITARIAN PRINCIPLE

Fundamental to the interpretation of geological phenomena is a principle first proposed and abundantly illustrated by James Hutton.

Hutton (1785) attributed all geologic phenomena- mountain ranges such as the Alps, deep canyons and integrated river valleys system, the soil, the very rock themselves- to natural observable processes such as those seen in operation today.

Hutton's doctrine that the " present is the key to the past" was expounded and illustrated by Charles Lyell as the 'principles of uniformitarianism'.