EWCE 203

Geology and Geomorphology

Geologic Time Scale

Geologic Time

Geology: The science of the earth, an organized body knowledge about the globe on which we live.

Purpose of studying of geology:

- To **unlock the mysteries** of our environment.
- To **explore the earth** from the ocean floor to the mountain peak to discover the origin of our continents and encircling seas.
- Try to **explain a land surface** so varied from flood plains to mountains.
- To **search for the record of life** from the earliest one-celled organisms of ancient seas to the complex plants and animal of the planet.
- To **explain ever changing physical envir**onment of the earth.

Geologic Time Scale

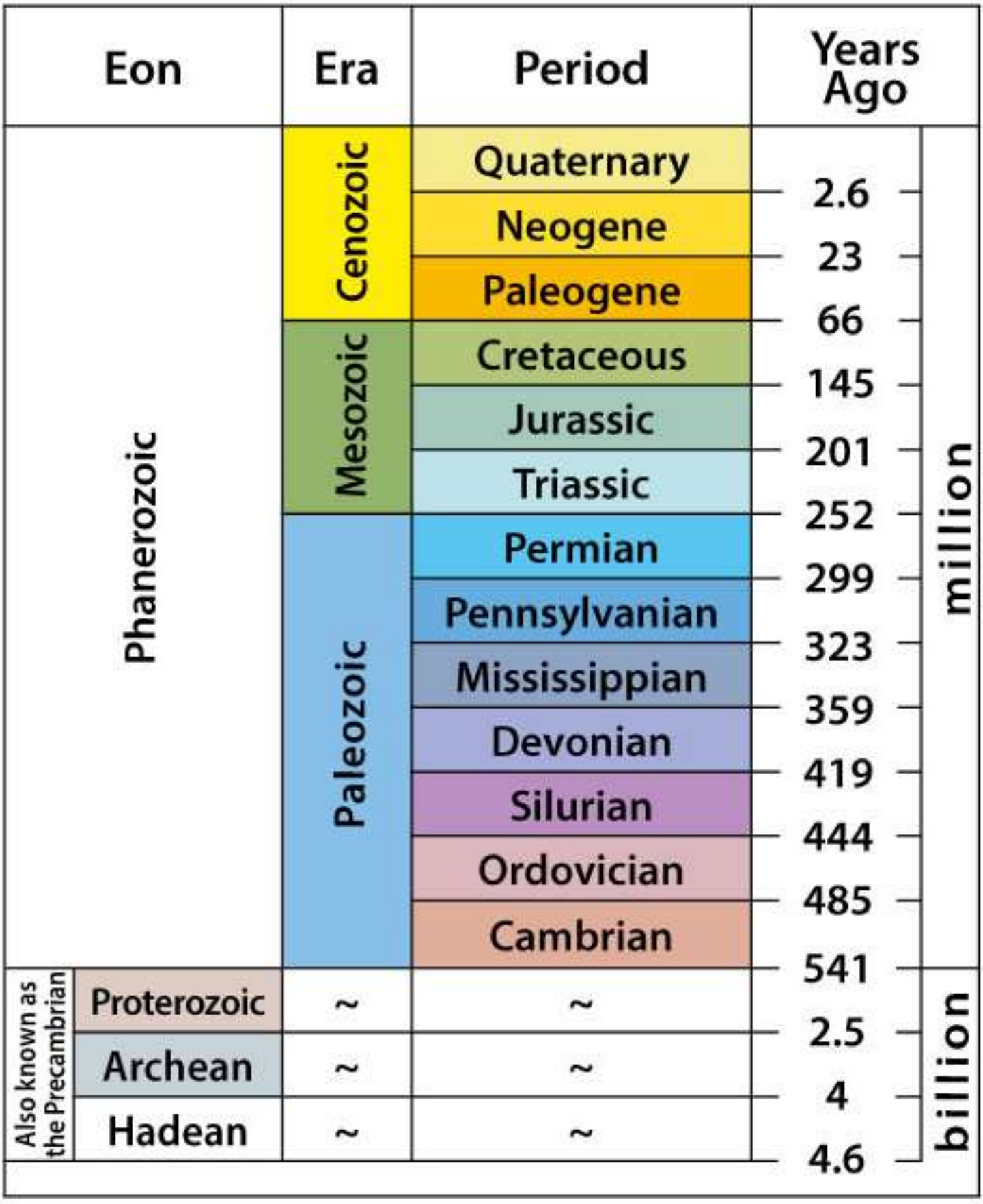
- Presents the **correct sequence of events** in Earth's history.

- **"Calendar" for events** in Earth history.

- Records of the earth's geologic History

Subdivides all time into named units of abstract time in descending order of duration:

- **Eon** – Longest span of one billion years and **three eons** are recognized.
- **Era** - Second longest portions of geological time and **three eras** are recognized by IUGS (International Union of Geological Science).
- **Periods -** basic unit of the GTS; during these spans of time specific systems of rocks were formed.
- **Epochs** - A subdivision of a geological period.
- **Ages** – Rest of the times till today.


Eon
Era
Period
Years Ago
Phanerozoic
Cenozoic
Mesozoic
Paleozoic
Quaternary
Neogene
Paleogene
Cretaceous
Jurassic
Triassic
Permian
Pennsylvanian
Mississippian
Devonian
Silurian
Ordovician
Cambrian
2.6
23
66
145
201
252
299
323
359
419
444
485
541
million
Also known as the Precambrian
Proterozoic
Archean
Hadean
2.5
4
4.6
billion

Basics of Geologic Time Scale

- Geologic time units is **based on stratigraphy,** which is the correlation and classification of rock strata.

- **Fossil forms** that occur in the rocks, provide the chief means of establishing a geologic time scale, with the timing of the emergence and disappearance of widespread species from the fossil records being used to delineate the beginnings and endings of ages, epochs, periods, and other intervals.

Geologic Time

Geologic Time from two points of view:

- **Relative time**
- **Absolute Time**

Relative time- that is whether one event in earth history came before or after another event disregarding of years.

Absolute Time -that is **whether a geologic event took place a thousand years ago**, a billion years ago or at some date, even further back in earth's history is reported as absolute time.

Importance of Geologic Time in the study of Geology:

- **To Relate the human history** with the Relative and Absolute time in earth history.

- To know **whether some event** (such a volcanic eruption) **occurred before or after another event** (such as rise in sea level) and **how these events are related** to another event (perhaps mountain building).

- To **determine the absolute time** of an event as near as possible.

- To **determine the approximate dates for many geologic events** ie dinosaurs became extinct about 63 million years ago.

Measuring Absolute Time

By **radio-activity of radio active elements** have provided the most efficient means of measuring absolute time

What is radio-active elements?

- Elements whose **nuclei spontaneously emits particles** to produce new elements.
- **Rate at which a given radio-active element decays** is **unaffected by changes in physical conditions or by time**.
- If one can know:

  -the **amount of radio active element** (the parent) material that remains,

  -the **rate of radio active decay**,

  -the **amount of new elements** (the daughter) that **has formed.**
- Then, **one can calculate the time elapsed since the radio-active decay began.**

Geological Time Scale:

- A **system of chronological dating** that relates geological **strata to time**.
- **Used by** the Geologist, Paleontologist and other Earth Scientists to **describe** the **timing** and **relationship of events** that have occurred during Earth's history.

Divisions of Geological Time:

- Eon: Primary division
- Era
- Period
- Epoch
- Age

Geologic Time

Precambrian Supereon: before 570 million of years

Eon: -**Proterozoic**

-Archean

-Hadean

After 570 million of years:

Era: -**Cenozoic**: 65 million of years to present date

-**Mesozoic**: 225 million of years to 65 million of years.

-**Paleozoic**: 225 million of years to 570 million of years.

Geologic Time

Era: **Cenozoic:** 65 million of years to present date

Period:

Quaternary: (Epoch)Holocene-0.01 million yrs to present date.

: **Pleistocene**

Tertiary : **Pliocene**

: **Miocene**

: **Oligocene**

: **Eocene**

: **Paleocene**

Era: **Mesozoic:** 225 million of years to 65 million of present.

Period: Cretaceous

: **Jurassic**

: **Triassic**

Geologic Time

Era: **Paleozoic:**

Period: **:Permian**

: Pennsylvanian

: Mississippian

Carboniferous

:Devonian

: Silurian

: Ordovician

: Cambrian

---

570 million of years

Precambrian

Aspects of Life Records:

- **Precambrian** -Primitive massive plants and invertebrates.

  -One-celled organisms.

- **Paleozoic Era**:

  -Cambrian: **First marine plants & invertebrates**.

  : 70 million of years

  -Ordovician: **Vertebrates first appeared (fish)**

  : 60-70 million of years

  -Silurian: **Fish**

  35-45 million of years

Geologic Time

-Devonian: **Spore bearing land plants**.

: 50 million of years

-Mississippian: **Spore bearing land plants**

: 20 million of years

-Pennsylvanian: **Spore bearing land plants**

:Coal forming swamps

:45 million of years

-Permian: **Amphibia**

: 55 million years

Aspects of Life Records (cont..):

- **Mesozoic Era**:

-Triassic: **Dinosaurs first appeared**.

Reptiles

Conifer and cycad plants.

30-35 million of years

-Jurassic: **Birds first appeared**

: 54-59 million of years

-Cretaceous: **Extinction of dinosaurs**

:71 million of years

Geologic Time

Aspects of Life Records:

- **Cenozoic Era**:

-Tertiary: **Horses first appeared**.

: **Grasses became abundant**

: **Mammals.**

: **Flowering Plants**

: 30-35 million of years

-Quaternary: **Appearance of Homosapien**

: 1.5 million of years

Rock and Rock Cycle

What is Rock?

- Rock is the most common of all the materials on the earth.
- We can **recognize rocks** as:

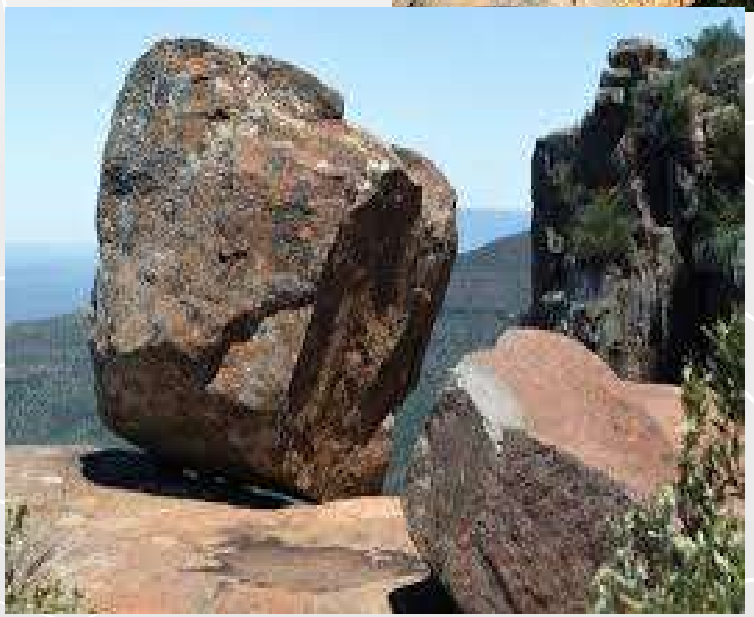
  -gravel in a driveway,

  -boulders in a streams,

  -Cliffs along a ridge.







- Firm **bed-rock is exposed** at earth surface or lies beneath a thin layer of soils or loose debris.

- **Rocks and soils & debris** above are **made up of minerals.**

- About a **dozen or less, out of about 2000 different minerals**, made up the bulk of materials that we see in the upper layer of the earth.

A mineral -a solid chemical compound that occurs naturally in pure form

Soil is the material found on the **surface of the earth that is composed of organic and inorganic material.**

Debris-loose natural material consisting especially of **broken pieces of rock**.

Cl of Rocks

Geologists divide the earth's rocks into **three main groups based on the mode of origin:**

- **Igneous**
- **Sedimentary**
- **Metamorphic**

Igneous Rocks: Name origin from the latin 'ignis' ie fire

Formation:

- 'Fire' formed rocks were once a hot, molten mass known **magma/lava,** which subsequently cooled into firm, hard rocks.

Igneous Rocks

- Lava flowing across the **earth's surface** from an erupting volcano, soon cools and hardened into igneous rocks.

- Some igneous rocks are also formed by cooling lava at some distance **beneath the surface**.





Sedimentary Rocks

- Meanings of Latin, **settling**
- Rocks are **made up of particles** **derived from the break-down of pre-existing rocks.**
- Usually these **particles are transported** by gravity, water, wind or glaciers to a new locations, where they are deposited to new arrangements.



Metamorphic Rocks

- Greek '**meta' means 'Change**' and '**morphe' means 'form'.**
- Original rocks have been changed **from its primary form to a new form.**
- Earth **pressure, heat, and chemically active fluids** beneath the surface, all these may be involved in changing an originally sedimentary rocks or igneous rocks into a metamorphic rock.

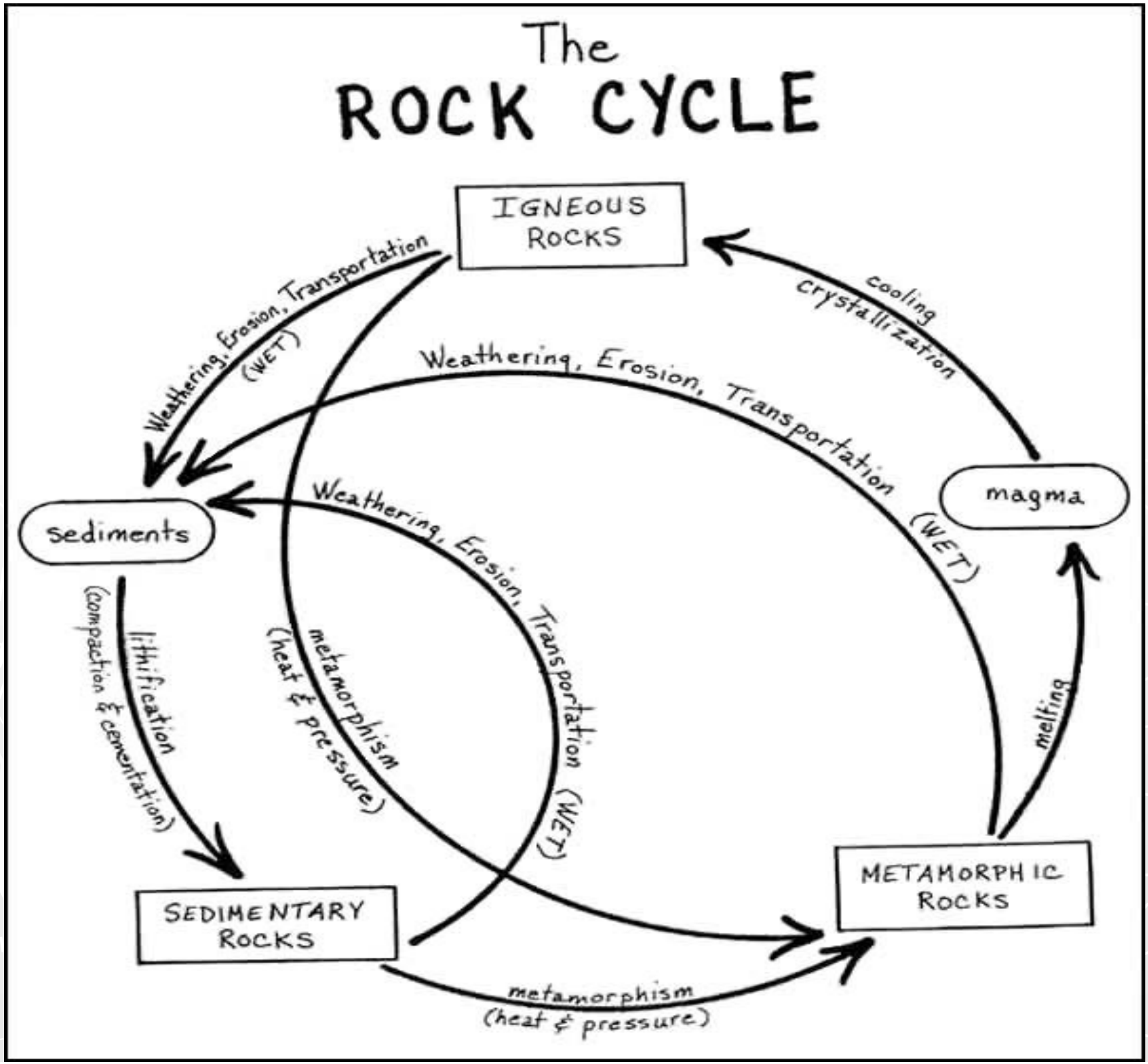


What is Rock Cycle?

- There are **definite relationship among formation** of sedimentary, igneous and metamorphic rocks.

- With **time and changing conditions**, **any one of the rock types may be changed** into other forms.

- These **relationships form a cycle**, which is **simply a way of tracking out the various paths that the earths material** follows.


The
ROCK CYCLE
IGNEOUS ROCKS
Weathering, Erosion, Transportation (WET)
cooling crystallization
Weathering, Erosion, Transportation (WET)
magma
sediments
Weathering, Erosion, Transportation (WET)
lithification (compaction & cementation)
metamorphism (heat & pressure)
melting
METAMORPHIC ROCKS
SEDIMENTARY ROCKS
metamorphism (heat & pressure)

Rock cycle

- **Metamorphic rocks** have to be molten, then to cool to became Igneous rocks.
- **Igneous rocks, metamorphic rocks and sedimentary rocks** have to have weathering affects to become sediments to form sedimentary rocks.
- **Igneous rocks and sedimentary rocks** under heat and pressure change to metamorphic rocks.

What is interruption of Rocks Cycle

- In some case the complete rock cycle may be interrupted, called Interruption.
- **Example:** An igneous rock may never be exposed at the earth's surface, and hence never be converted into sediments by weathering.

Thanks

N
NE
E
SE
S
SW
W
NW