PE8204 - Fundamentals of petroleum Geology:

Unit 2:

① Describe the Lithostratigraphy and Biostratigraphy

⇒ Lithostratigraphy: It is a sub-discipline a stratigraphy the geological science associated with the study of strata or rock layers.

⇒ Major focuses include geochronology, comparative geology and petrology.

⇒ In general a stratum will be primarily igneous or sedimentary relating to how the rock was formed.

⇒ Sedimentary layers are laid down by deposition of sediment associated with weathering processes, decaying organic matters.

⇒ These layers are distinguishable as having many fossils and are important for the study of biostratigraphy.

⇒ Igneous layers are either plutonic or volcanic in character depending upon the cooling rate of the rock.

⇒ These layers are generally devoid of fossils and represent intrusions and volcanic activity that occurred over the geologic history of the area.

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Stratotype : A designed type of unit consisting of accessible rocks that contain clear-cut characteristics that are characteristic for a particular lithostratigraphy unit.

Lithosome : Masses of rock of essentially uniform character and having interchanging relationships with adjacent masses of different lithology.
eg : Shale lithosome, lime stone lithosome.

Biostratigraphy : It is a branch of Stratigraphy which focuses on correlating and assigning relative ages of rock strata by using the fossil assemblages contained within them.

*Usually in one geological section represents the same period of time as another horizon at some other section.

*The fossils are useful because sediments of the same age can look completely different because of local variations in the sedimentary environment. For example, one section might have been made up of clay and marls while another has marls while another has more chalky limestones, but if the fossil spices recorded are similar, the two sediments are likely to have been laid down at the same time.

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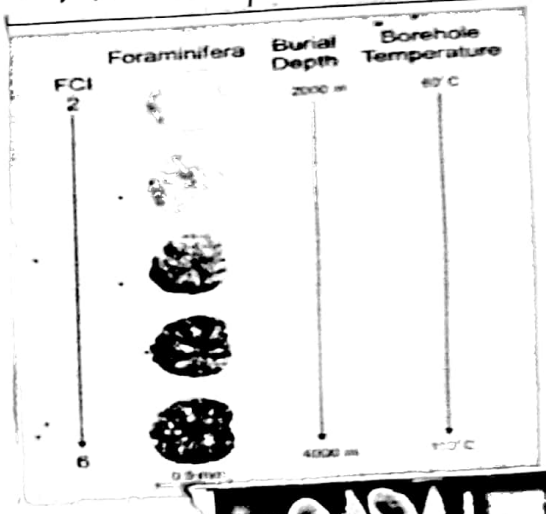
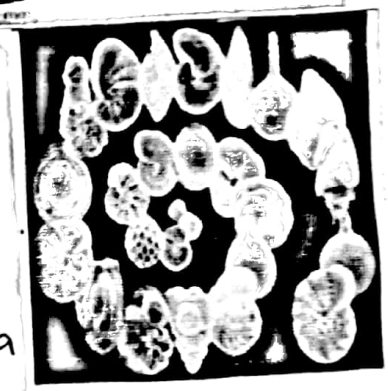
2. Give a detail account on the application of microfossils in hydrocarbon exploration.

* Microfossils have many application to petroleum Geology.

* Three microfossil which are of particular importance to hydrocarbon exploration are

* Foraminifera, calcareous, Nannofossils and palynomorphs.





Foraminifera:

* Foraminifera have many uses in petroleum exploration and are used to interpret the ages and paleoenvironments of sedimentary strata in oil wells.

* Agglutinated fossil foraminifera deeply in sedimentary basins can be used to estimate thermal maturity, which is a key factor for petroleum generation.

* The Foraminiferal Colouration Index (FCI) is used to quantify colour changes and estimate burial temperature. FCI data is particularly useful in the early stage of petroleum generation (~100°C)

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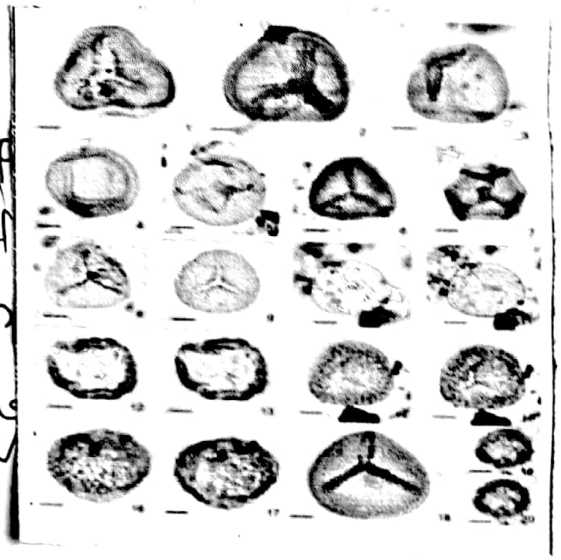
Calcareous nannofossils

* These are extremely small objects (Less than 25 microns) produced by planktonic unicellular algae
* Coccolithophores, planktonic golden brown algae that are very abundant in the world's oceans.
* The calcareous plates accumulate on the ocean floor become buried beneath later layers, and are preserved as Nannofossils.

palynomorphs:



* Spores and pollens are transported by wind and water and can travel long distance before final deposition
* organic chemicals comprising palynomorphs get darker with increased heat
* Helps to asses the temp. to which a rock sequence was heated during burial and thus it is useful in predicting whether oil or gas may have formed in the area under study.

1) OOZE is a pelagic - deep sea sediment of which at least 30% is composed of the skeletal remains of microscopic floating organisms.

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2) The different types of fossils fuels are coal, oil and natural gas and even CBM gas.

3) Some of the important microfossils involved in oil exploration are Deatoms, coccolithophores, Radiolaria, foraminifera, conodonts and palynomorphs.

4) The foraminiferal colouration index (FCI) is used to quantify colour changes and estimate burial temperature.

5) Sediment maturation is checked for hydro carbon Investigation before any exploration.

6) Oil exploration & production companies are in Asia, Africa, America, Australia, Oceania & Europe. In India the companies include Gujarat State petroleum corporation Oil and Natural Gas corporation, oil India etc.

7) ONGC currently exploring coal bed Methane in singrauli, Madhya pradesh and north of Godavari valley in Andhra pradesh.

3. What is Stratigraphy? Explain in detail about types of Stratigraphy.

The branch of geology that seeks to understand the geometric relationships between different rock layers (called strata), and to interpret the history

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represented by these rock layers.

* Stratigraphic studies deal primarily with sedimentary rocks but may also encompass layered igneous rocks or metamorphic rocks formed either from such extrusive igneous material or from sedimentary rocks.

Types of stratigraphy

1. Litho stratigraphy } refer Q.NO.①
2. Bio stratigraphy
3. Chemo stratigraphy
4. Chrono stratigraphy
5. Cyclo stratigraphy
6. Magneto stratigraphy.

3. Chemo stratigraphy :

* Chemostratigraphy or chemical stratigraphy is the study of the chemical variations within sedimentary sequences to determine stratigraphy relationships.

* The field is relatively young, having only come into common usage in the early 1980's, but the basic idea of chemostratigraphy is nearly as old as stratigraphy itself.

* Distinct chemical signatures can be useful as distinct fossil assemblages or distinct

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lithographies in establishing stratigraphy relationships between different rock layers.

4. chronostratigraphy:

* It is the branch of stratigraphy that studies the age of rock strata in relation to time.

* The ultimate aim is to arrange the sequence of deposition and the time of deposition of all rocks with in a geological region, and eventually, the time entire geologic record of the Earth.

* The standard stratigraphic nomenclature is a chronostratigraphic system based on palaeontological intervals of time defined by recognised fossil assemblages (biostratigraphy). The aim of chrono-stratigraphy is to give a meaningful age data to these fossil assemblage intervals and interfaces.

5. Cyclo stratigraphy:

* cyclo stratigraphy is the study of astronomically forced climate cycles with in sedimentary successions. Astronomical cycles are variations of the earth's orbit around the sun due to the gravitational interaction with other masses with in the solar system.

* Due to this cyclicity solar irradiation differs through time on different hemispheres and seasonality is affected. These insolation

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variations have influence on earth's climate and so on the deposition of sedimentary rocks.

6. Magnetostratigraphy: is a geophysical correlation technique used to date sedimentary and volcanic sequences.

*The method works by collecting oriented samples at measured intervals throughout the section.

*The samples are analyzed to determined their characteristic remanent magnetization (ChRM), that is, the polarity of Earth's magnetic field at the time a stratum was deposited. This is possible because Volcanic flows acquire a thermoremanent magnetization and sediments acquire a depositional remanent magnetization, both of which reflect the direction of the Earth's field at the time of formation.

4. Explain in detail about geological timescale:

*The geologic timescale is constructed through scientific methods and calculations as well as from the interrelationships of geological features as observed in the field.

*The principle of uniformitarianism is helpful in that we can accurately measures the rates of geologic processes.

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✓ Geologist recognize two different kinds of time.

* Relative time
* Absolute age.

Relative time concerns the sequence of geologic events, and absolute age measurements concern the actual age of a rock or mineral.

Relative time:

Basic principle:

* The law of superposition states that in an undisturbed sequence of sedimentary rocks or lava flows the overlying rock.
* The law of original horizontality states that most sediment rocks (an exception is cross-bedded sediment) formed as nearly horizontal layers. Any layered sequences that are now tilted were moved by later geologic processes.
* Any rock that cross-cuts another rock is younger than the rock cross-cuts. This rule applies also to mass wasting and erosion; whatever is eroded had to exist prior to the beginning of erosion.
* The law of faunal succession states that fossil species succeed one another in undisturbed rock in a definite and recognizable order around the world.

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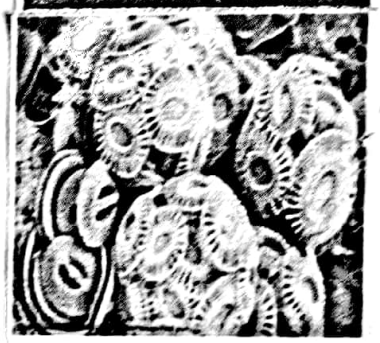
5. What is microfossils? Discuss about the types and importance of microfossils.

* Microfossil comprise the remains of once living bacteria, protists, plants and animals and in some cases fragments of larger organisms. eg conodonts.

* Some of the important microfossil involved in oil exploration are

Diatoms

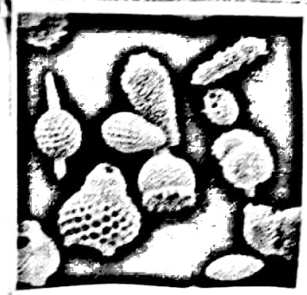
Diatoms : Unicellular algae which are characterised by an external skeleton comprising two valves, one overlapping the other like the lid of a pill box.



Coccolithophores : They are uni-cellular and predominantly autotrophic nannoplankton (Commonly - 5 - 60 milli micron in size) The cell is surrounded by protective armour of tiny calcareous scales called coccolith

Conodonts : Tooth-like fossils typically less than a millimeter long.

Radiolaria : They are marine protozoans. The fossil forms are made of opaline silica. The more advance form of radiolaria have lattice skeleton with complex geometry.



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Foraminifera :

ref. Q.no. (5).

*Spores and pollens : They are produced in large numbers and can be carried over long distances by wind or water before they settle down and get deposited.

Dict' ref Q.no.(2)

*Source for hydro carbon also navigates for exploration

Importance of microfossils :

*These are very importance source in determination of the age of sediments.

*The collected sedimentary specimen is dated to determine the age of rock.

* These are helps in bioZonation.

* Helps in reconstructing the palaeoecology or other elements of the past condition.

*These can be used in the Study of palaeo currents of sea.

* These are good indicators of the depositional environmental and hence they help in determination of the nature and age

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of palaeo current.

* It is help ful to study eustatic Sea level.

* Study of MF has been helpful in the evaluation of the condition in which petroleum deposits have been formed also important for petroleum prospecting.

* It is helpful in the study of hydro - thermal accumulation and to study high resolution biostratigraphy.

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