Study of Macroscopic and Microscopic Constituents of coals:

Macroscopic Constituents of Coal:

Coals are divisible into two main groups: Humic coal and Sapropelic coal (Stach et. al 1982). Humic coals are generally banded whereas Sapropelic coals are non-banded.

Non banded (Sapropelic) coals include Cannel or boghead coals. Both the Coals have dull lustre and yield Conchoidal fracture. They are generally massive and hard. Cannel coals are composed of spores and are blackish in colour, whereas boghead coal consists mainly of algal matter and are brown in colour.

The bituminous coals (Humic coals) are composed of well-defined bright and dull bands. They are found to differ in their appearance as well as texture. In general, Coals are hard, dull and semi bright to bright in nature.

The macroscopic (observable to the unaided eye) Components of Coal are termed as lithotypes. The banded bituminous coal lithotype is classified as Vitrain, Clarain, Durain and fusain.

1) Vitrain :- (VITRAIN).

- Bright Component of Coal having jet black colour.
- Very thin band of lamelli less than quarter inch in thickness.
- Coherent with uniform texture.
- Concoidal fracture, break in cubical block.
- They doesnot soils the finger.
- Upto 5% dull band 95% bright band.

2) Clarain — (CLARAIN)

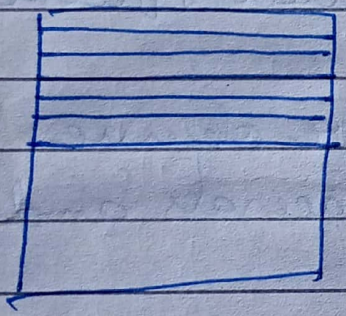
- Bright to less bright than Vitrain.
- Bands are of invariable thickness and parallel to bedding plane
- Silky lustre with smooth line
- Dull band ranging to 5-40%. Whereas bright band upto 60%.

3) Durain

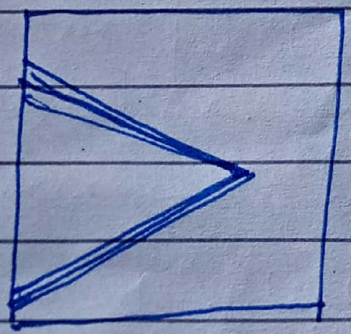
- Dull appearance with dull grey or black in colour
- Occuring as thick bands.
- Breaks with irregular fracture or splintery in nature.
- Bright bands upto 40% and dull bands upto 60%.

Fusain: (FUSAIN)

- Known as mineral Charcoal.
- breaks in powdery nature.
- occurs in patches or flat ways, wedges arranged irregularly in bedding plane.
- Fibrous in nature
- Very friable material like as Charcoal.
- Dull band 95% and bright band upto 5%.



VITRAIN



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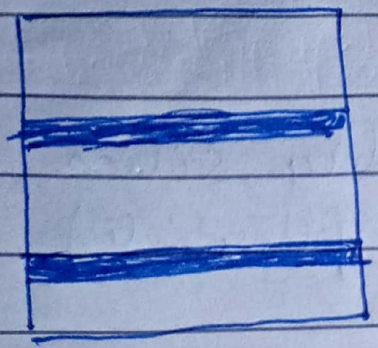

CLARAIN.

MICROSCOPIC CONSTITUENTS OF COAL

Coals are heterogenous in nature and are composed of inorganic, organic and mineral matter.

Inorganic (Al, Mg, Mn, Fe etc)
Organic (Maceral)
Mineral Matter (SiO_2, MnO, Mg_2O)

Microscopic study of coal consist of mineral and macerals.

The visible organic substances observed under microscope is called Macerals.

Under the microscope we observe two different types of macerals and minerals.

Macerals are of 3 types :-

1. Vitrinite
2. Exinite (Liptinite)
3. Inertinite.

Minerals types

Oxide minerals
Carbonation
Sulphide minerals (Clay, Silica, Carbonates, pyrite, Sphenolite)

Vitrinite :- (VITRINITE) :-

Vitrinite group of macerals are the most common and most important maceral group in Bituminous coal.

They are derieved from cell-wall material or woody tissue of the plants (Parenchymatus).

- Shallow water environment oxidative environment
- Reducing environment or Deep nature Condition.

The coal formed is reducing environment will give leetter coal and rich in carbon dioxide.

The formation of coal depends upon
- Types of plants
- Types of Environment
- Types of Basin.

Types of Plants :-

- Hard plants always gives good coal due to increase in CO_2, as soft coal consists of insufficient CO_2

Vitrinite

Types of environment :-

There are two types of environment for the formation of coal -

1. Reducing Environment
2. Oxidising Environment

The Vitrinite group are always derived from harder part of the plant and it is always formed in reducing environment.

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Vitrinite:

Macerals of this group are characterized by their grey to white colour and structures. Reflectance are highly variable depending upon the rank of coal. They are considered as a reactive macerals, burning readily during combustion and becoming fluid during carbonization

The new system of subdivision of the Vitrinite maceral group differs substantially from the Stopes Heerlen System. Sub groups have been introduced, based upon the following Criteria:

Maceral group: defined by level of reflectance
Maceral subgroup: defined by degree of destruction.
Maceral: defined by morphology and/or degree of gelification.

Subdivision of the Maceral group Vitrinite According to ICCP system, 1994.

Sub group	Maceral
Telovitrinite	Telinite
	Collotelinite
Detrovitrinite	Vitrodetrinite
	Collodetrinite
Gelovitrinite	Corpogelinite
	Gelinite.

Liptinite :-

This group of macerals are derived from waxy and resinous parts of plants such as spores, cuticles and resins, which are resistant to weathering and diagnesis.

- They show higher H/C ratio as compared to other macerals.

They are dark grey to black colour (Lignite to medium volatile bituminous coals) in incident white light and give strong fluorescence under blue light excitation. The spectrum ranges from yellow, orange to brown colour depending upon maturation of coal. In general, the fluorescence intensity the liptinite / exinite macerals decreases with increasing rank.

Characteristics of submacerals of liptinite Group

Group Maceral	Maceral	Characteristics
Liptinite	Sporinite	Sporinite are lens shaped bodies in section perpendicular to the bedding.

Group maceral	Submaceral	Characteristics
		Submaceral are Characterized based on thickness of cell walls. In reflected light it appears darks to medium grey and becomes light grey at higher ranks. Under fluorescent light it appears green yellow, orange or brown.
	Cutinite	Long thread like structure with one end serrated. In reflected light it appears black to light grey and in fluorescent light it appears green yellow-Orange-brown.
	Resinite	Occur as cell fillings and as circular, oval shaped of variable size. In reflected light it appear black and resinite gives blue or blue-green, yellow-Orange brown fluorescence
	Alginite	Pila exhibit fan like shape
	Liptodetrinite	Detritus of macerals of Liptinite.

Submaceral	Characteristics
Suberinite	It is derived from suberin of the corkified cell walls which occurs mainly in tree barks. It also occur at the surface of the roots or stems and fruits. In reflected light it is dark and characterised by flourscence of variable intensity. In sub-bituminous coal it shows weak reddish flourscence.
Fluorinite	It is essentially plant oil. In fluorescent light it gives strong green or greenish-yellow colour.

Inertinite:

It is formed from harder part of plant in presence of oxidation i.e in oxidising environment. The coal is dominated by inertinite low grade coal.

It gives the whitish or sometimes yellowish to white colour under reflected microscope. Macerals of this group contain the highest Carbon and lowest hydrogen content of three groups.

Although inertinite maceral donot have significant role in Carbonization process, however, they do serve a very important function as a filler phase for the other reactive macerals of Coal.

Characteristics of submaceral of Inertinite Group.

Group Macerał	Maceral	Characteristics
Inertinite	Fusinite	High reflectance. Fusinite are partly formed from charring of plant material of peat, due to fires in coal swamps showing Cellular structure
	Semifusinite	Similar to fusinite but of reflectance intermediate between that of Vitrinite and fusinite. May be partly of forest fire origin but much Semifusinite is thought to be the result of bio-Chemical process.

Group Maceral	Maceral	Characteristics
	Sclerotinite	Moderate to high reflecting material of fungal origin.
	Macrinite	It is more or less amorphous gel like constituent of high reflectance showing round structure.
	Micrinite	It is fine grained with granular texture showing high reflectance
Inertodetrinite		This term is used for smaller particle of inertinite. These inertinite are derived from breakdown of fusinite and semifusinite