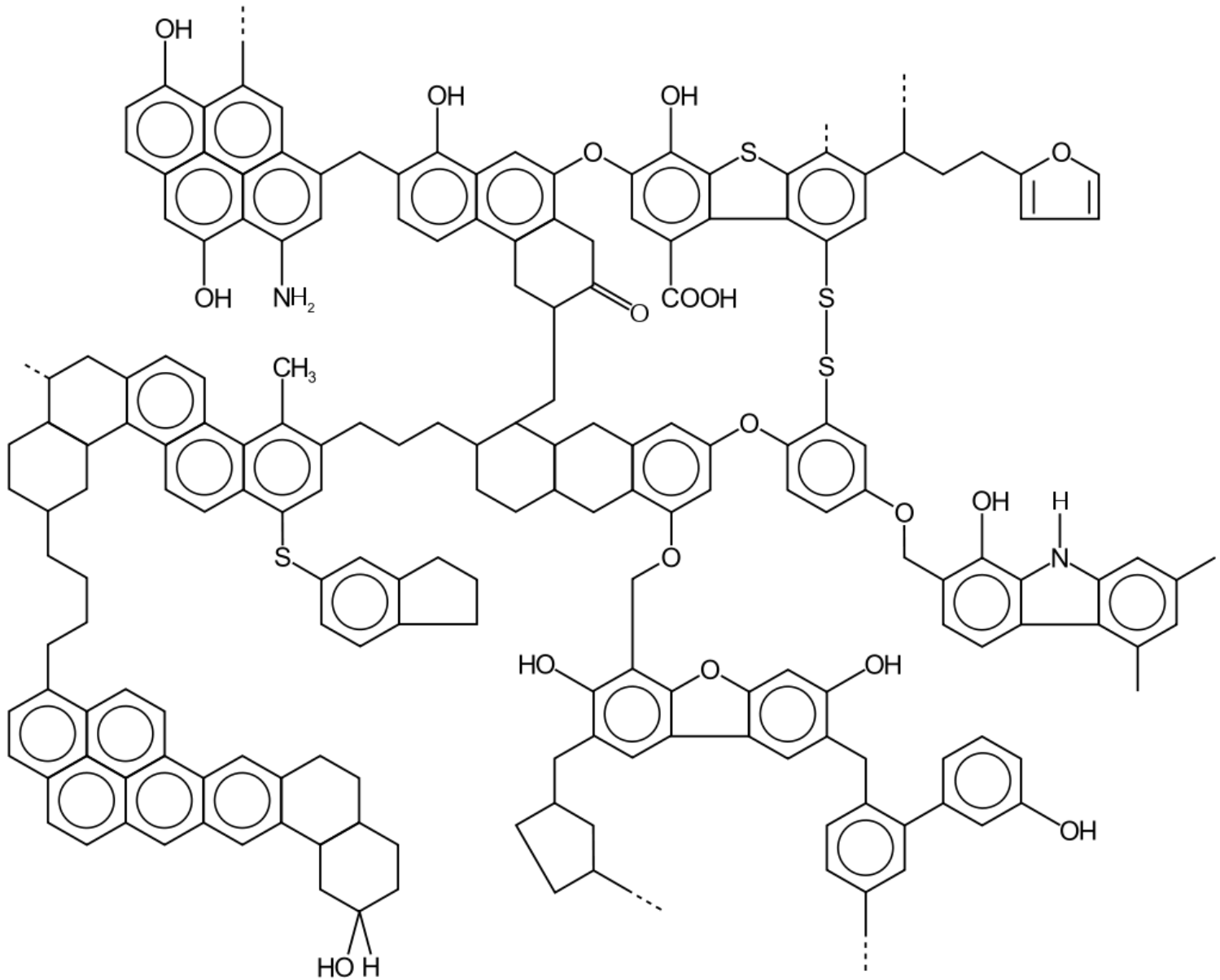
3. COAL

- Coal is a combustible rock that is composed primarily of carbon rich organic material.
- Coal is a heterogeneous sedimentary rock that reflects both the different sedimentological regimes within which peat forms and the varied vegetation types from which it is derived.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NH2
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COOH
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- Coal is a major source of energy in the production of electrical power using steam generation.

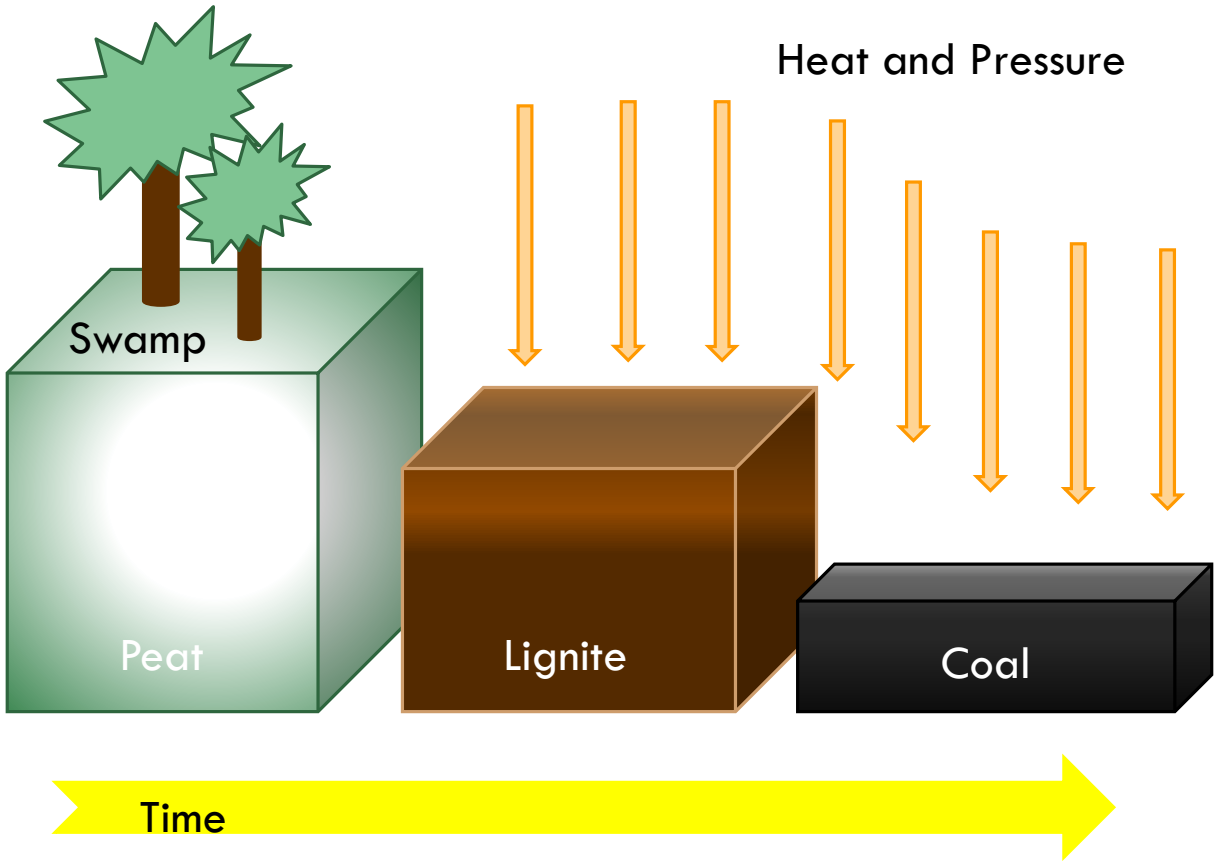
- Different varieties of coal arise because of differences in the kinds of plant material (coal type), degree of coalification (coal rank), and range of impurities (coal grade).

- Although most coals occur in stratified sedimentary deposits, the deposits may later be subjected to elevated temperatures and pressures caused by igneous intrusions or deformation during orogenesis (i.e., processes of mountain building), resulting in the development of anthracite and even graphite.

i. Origins of Coal

- Coal is especially worthy of the name fossil fuel, as it frequently bears visible traces of the geologic time period in which it has its origin. The journey from those ancient origins to the modern coke or reprocessing plant is hundreds of millions of years long.
- In swamps, the lignin accumulates under water, compacting into peat. Over the geological ages, the peat layers of the primeval swamps metamorphosed into coal. Depression and thrusting of earth's crust buried the deposits and subjected them to high pressures and tempratures for long periods of time.

- Under those conditions, the lignin gradually lost its oxygen atoms via the expulsion of water and carbon dioxide gas, and additional bonds formed among the aromatic groups, producing a hard, black, carbon-rich material, which we mine as coal.



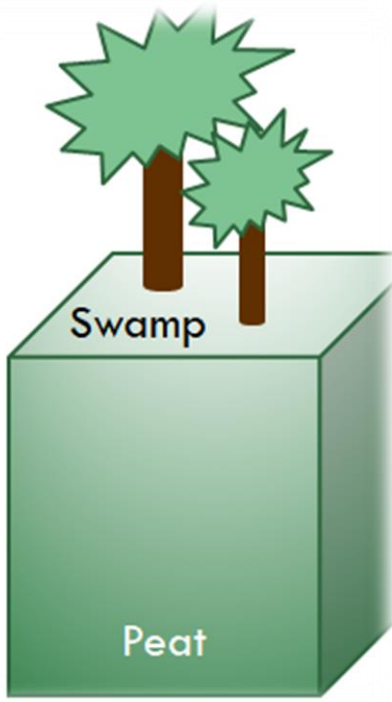
- Evidence that coal was derived from plants comes from three principal sources.

1. Lignites, the lowest coal rank, often contain recognizable plant remains.
2. Sedimentary rock layers above, below, and adjacent to coal seams contain plant fossils in the form of impressions and carbonized films (e.g., leaves and stems) and casts of larger parts such as roots, branches, and trunks.
3. Even coals of advanced rank may reveal the presence of precursor plant material. When examined microscopically in thin sections or polished blocks, cell walls, cuticles (the outer wall of leaves), spores, and other structures can still be recognized. Algal and fungal remains also may be present. (Algae are major components in boghead coal, a type of sapropelic coal.)

Formation Processes

1. Peat

Although peat is used as a source of energy, it is not usually considered a coal. It is the precursor material from which coals are derived, and the process by which peat is formed is studied in existing swamps in many parts of the World.



- The formation of peat is controlled by several factors including;

1. The evolutionary development of plant life,
2. The climatic conditions (warm enough to sustain plant growth and wet enough to permit the partial decomposition of the plant material and preserve the peat),
3. The physical conditions of the area (its geographic position relative to the sea or other bodies of water, rates of subsidence or uplift, and so forth).

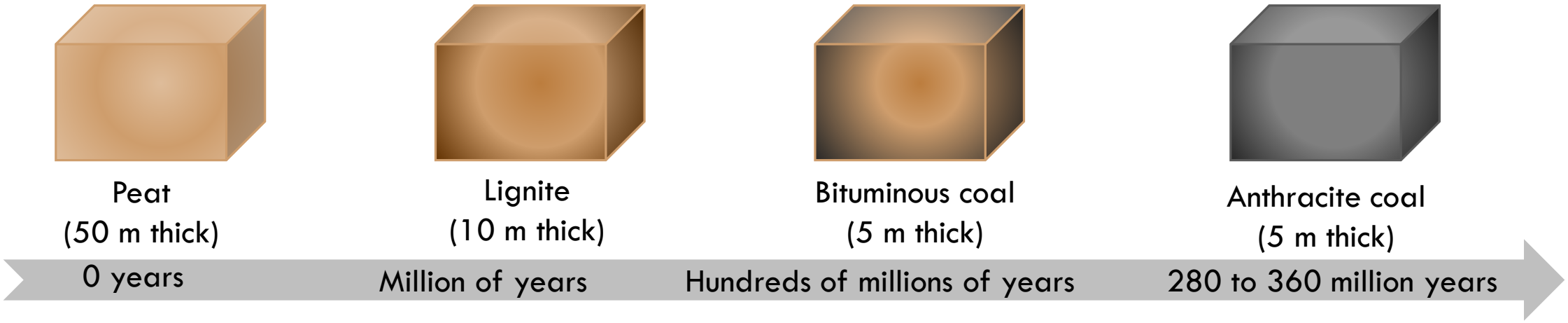
- Warm moist climates are thought to produce broad bands of bright coal. Cooler temperate climates, on the other hand, are thought to produce detrital coal with relatively little bright coal.

- The process of peat formation —biochemical coalification— is most active in the upper few metres of a peat deposit. Fungi are not found below about 0.5 metre, and most forms of microbial life are eliminated at depths below about 10 metres.

- If either the rate of subsidence or the rate of influx of new sediment increases, the peat will be buried and soon thereafter the coalification process —geochemical coalification— begins.

2. Coalification

- The general sequence of coalification is from lignite to subbituminous to bituminous to anthracite. Since microbial activity ceases within a few metres of the Earth's surface, the coalification process must be controlled primarily by changes in physical conditions that take place with depth.



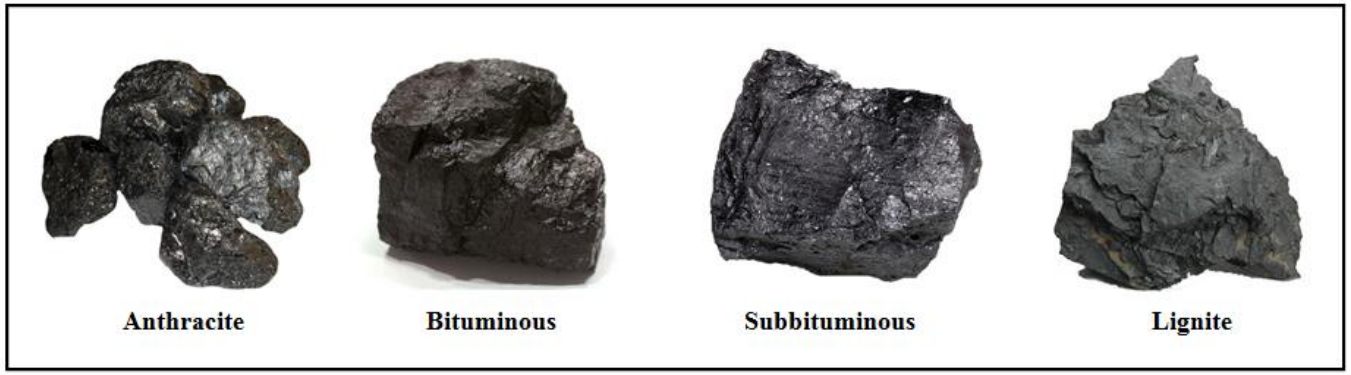
- Some coal characteristics are determined by events that occur during peat formation—e.g., charcoal-like material in coal is attributed to fires that occurred during dry periods while peat was still forming.

- Three major physical factors —duration, increasing temperature, and increasing pressure— may influence the coalification process.

- The formation of coal from organic debris is by a process of coalification. When some types of organic materials are heated and compressed over time, they can form water, gas, and coal. In some cases, a high-molecular weight, waxy oil is also formed.

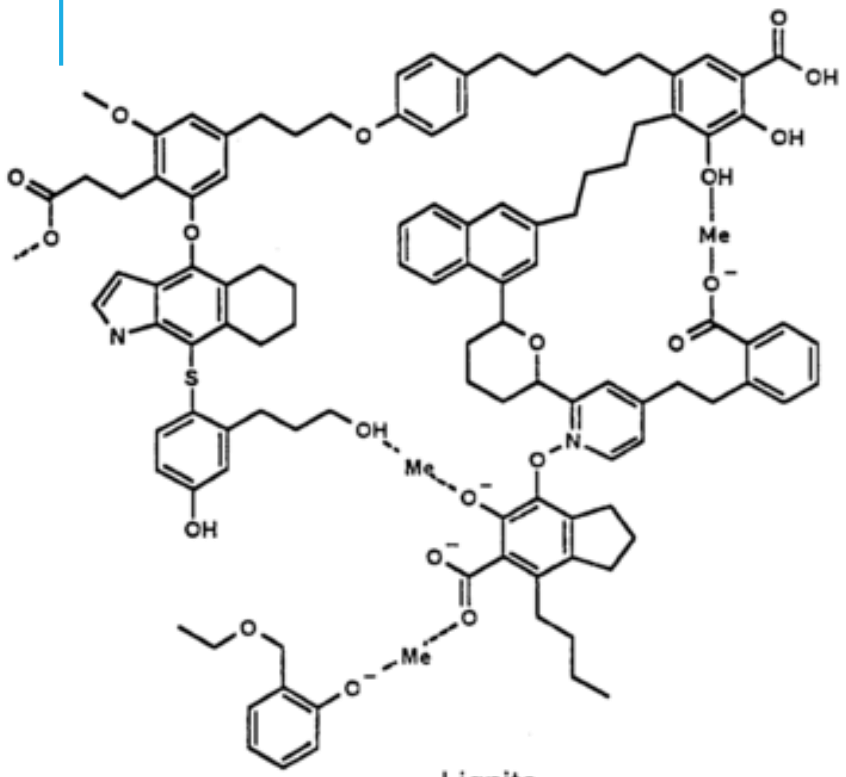
ii. Types of Coal

- There are four major types (or "ranks") of coal. Coals are classified by rank and rank is a measure of the degree of coalification or maturation of carbonaceous material.
- By coalification, buried plant matter changes into an ever denser, drier, more carbon rich, and harder material.

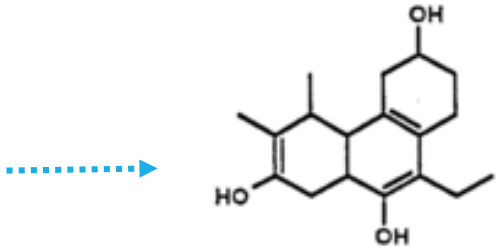


- The four ranks are:

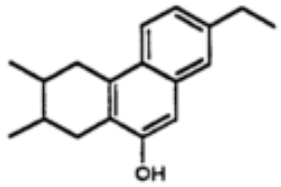
1. Lignite: Lignite coal, aka brown coal, is the lowest grade coal with the least concentration of carbon.
2. Subbituminous: Subbituminous coal is black in color and dull (not shiny), and has a higher heating value than lignite.
3. Bituminous: Bituminous coal is a middle rank coal between subbituminous and anthracite. Bituminous usually has a high heating value and is the most common type of coal used in electricity generation. Bituminous coal appears shiny and smooth when you first see it, but look closer and you may see it has layers.
4. Anthracite: The highest rank of coal. It is a hard, brittle, and black lustrous coal, often referred to as hard coal, containing a high percentage of fixed carbon and a low percentage of volatile matter.

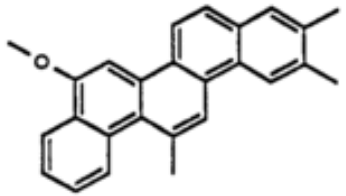


Lignite



Sub-bituminous coal
(high rank lignite)





High volatile bituminous (hard) coal

Low volatile

High volatile bituminous (hard) coal

Low volatile coal

Anthracite (hard coal)

Coal type	Approximate age, years	Approximate carbon content, %	Calorific Value (MJ/kg)
Lignites	60,000,000	65-72	5.5–14.3
Subbituminous coals	100,000,000	72-76	8.3–25
Bituminous coals	300,000,000	76-90	18.8–29.3
Anthracites	350,000,000	90-95	30

COAL	
Advantages	**Disadvantages**
It is easy to burn and is highly reliable.	It leaves a large carbon footprint.
It is affordable	It is highly exhaustible.
It produces high levels of energy.	It is not a renewable resource.
It is highly accessible and transportable.	It is hazardous to health and safety.
It can be used in a range of activities.	
It reduces dependence on other fossil fuels.	