# THE ORIGIN OF PEAT AND COAL

# CLIMATE AND ENVIRONMENTAL CONDITIONS

Peat and coal originate from **deltaic sequences** with the key requirements being: **terrestrial vegetation**, an anoxic **environment** and **rapid burial**.

- Anaerobic = an environment lacking oxygen. This is usually to describe conditions within a sediment. More generally it means total absence of free oxygen and bound oxygen (e.g. NO<sub>2</sub>)
- Anoxic = water without oxygen where standard decomposing bacteria cannot survive without oxygen. More
  generally it means no free oxygen in to form of O2. Note that there may still be oxygen stored in other forms
  like NO<sub>2</sub> or H<sub>2</sub>O.
- Sedimentary environment = a distinct area on the Earth surface characterized by particular rock types, sedimentary structures and fossils.
- **Climate** = the **long-term weather** conditions affecting an area.
- A coal seam = a layer of coal, usually 1-2m thick.
- Rank = a measure of maturity of coal OR the percentage of carbon
- Coals series = sequence of increasing rank from peat to anthracite.

Terrestrial vegetation (land plants) are found from the Silurian Period and onwards (~ 425Ma), although, most coal formed during the **Carboniferous period (~360 Ma)**. This is because **hot humid climates** encourage the rapid and abundant growth of trees and plants and these were the conditions present for certain regions of Pangea that were **near the equator**. A swampy or boggy environment contains stagnant water which ensures conditions are **anoxic**, thus preventing the decay of plant matter. **Anaerobic bacteria slowly change** the pl**ant matter into peat**, which is preserved provided it is **rapidly buried**.



The rapid burial must occur by a fine sediment. It is only conditions resulting from **deltas** that allow for economic quantities of **coal seams** to form; with rapid burial by a fine grained sediment **(silt, mud or clay)** and **sufficient subsidence** to build up the large thicknesses of **peat** required.

Sedimentation and subsidence rates must be high = delta top environments (topsets)

### COALIFICATION

**Coalification =** the process by which **peat is converted to coal** as it is **buried** though the effects of **heat** and **pressure** during **diagenesis.** 

Peat undergoes **thermal maturation** and compaction due to the weight of overlying sediment. This results in **water** and **other volatiles** (oxygen in the form of carbon dioxide, nitrogen, hydrogen in the form of methane gas). The methane may migrate away to form a natural gas reserve if it accumulates elsewhere in significant quantities.

The **woody material (lignin), resins and waxes** are preserved. As the water and volatile content decreases, carbon content increases and the volume reduces.

It is the reduction in thickness but concentration in carbon that results in economic coal seams being formed. **10m of peat**  $\rightarrow$  **1m coal seam**.

An increase in carob content, increases the grade and energy content (quality) of the coal.

Worst is Peat (NOT COAL) < Lignite < Bituminous coal < Anthracite



Hardness →increases

Decreasing sulfur and other impurities, smoke and ash on burning  $\rightarrow$ 

LEARN the red boxes and the general trend of properties

#### RESERVES OF COAL AND ITS USES

Coal is the **most abundant** of fossil fuels and the **most widely distributed** (at the time of the OCR GCE textbook). Nearly all of the cola is from reserves in is from USA, China, India and Russia. While it is estimated reserves will last for another 180 years, this does not factor in **discovery of new deposits** and **improvements in extraction technology. Economic and environmental security** factors may also affect this. With oil and natural gas reserves declining, coal is expected to fill the gap.

Coal is primarily combusted and produces **75% of generated electricity** annually – world consumption ~ 5.3 billion tonnes a year.

**Bituminous coal** is the mainstream choice but some power stations use lignite which is more pollutive and has a lower calorific value. Some bituminous coal is **baked to form coke** which is baked in the **blast furnace** to produce iron and steel. **Coke and anthracite** are combusted as **`smokeless fuels'**.

#### Methane can also be recovered from coal

- Method 1: Using chemical and thermal gasification processes on pre-extracted coal
- Method 2: Extracting **natural gas** that has migrated up and become trapped from **coal measures**.

Coal can also be used to **create liquid fuels such as petrol** and **diese**l but such processes release large volumes of **carbon dioxide**. **By-products** form coal processing are used to produce **plastics**, **synthetic fibers**, **dyes**, **soaps** and **pharmaceuticals**. This reduces the environmental impact.



## SOME BRIEF HISTORY

The first half of the Twentieth Century saw a huge need for coal mining. It was mined throughout both world wars as an energy supply for industry, military and travel. Coal miners were in fact exempt from having to be drawn to the armed forces.

Then, in the 1980s the coal industry went into decline for a number of economic and political reasons:

- The exploitation of cheap North Sea Oil, which is also a cleaner and a more efficient alternative, began
- It was cheaper to import coal from abroad than continue the mining industry.
- In the British Isles the geology is complex and the coal seams are thin so less economic.
- Coal gained a bad reputation as a dirty fuel.

