

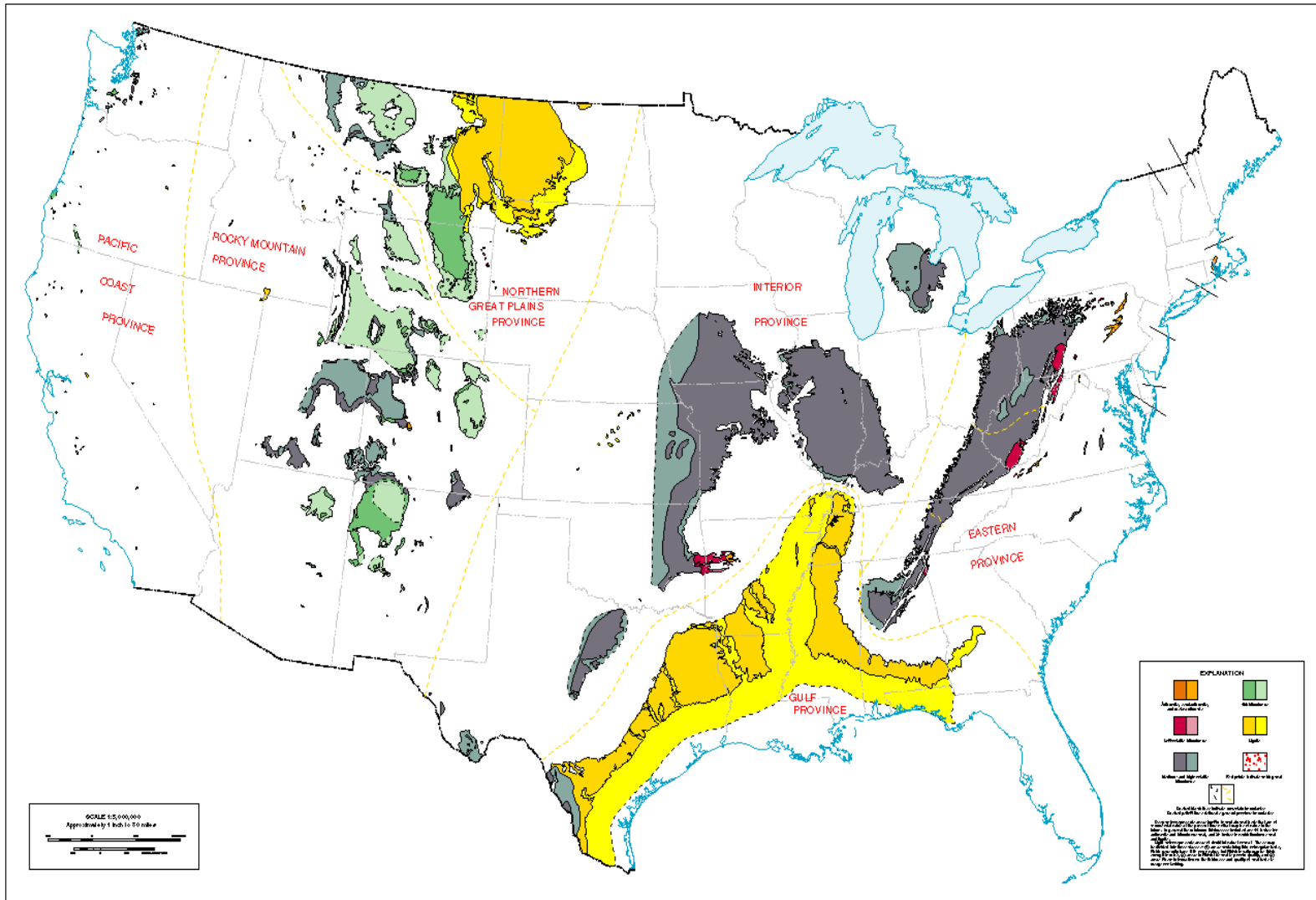
# Reinhold Environmental Ltd.



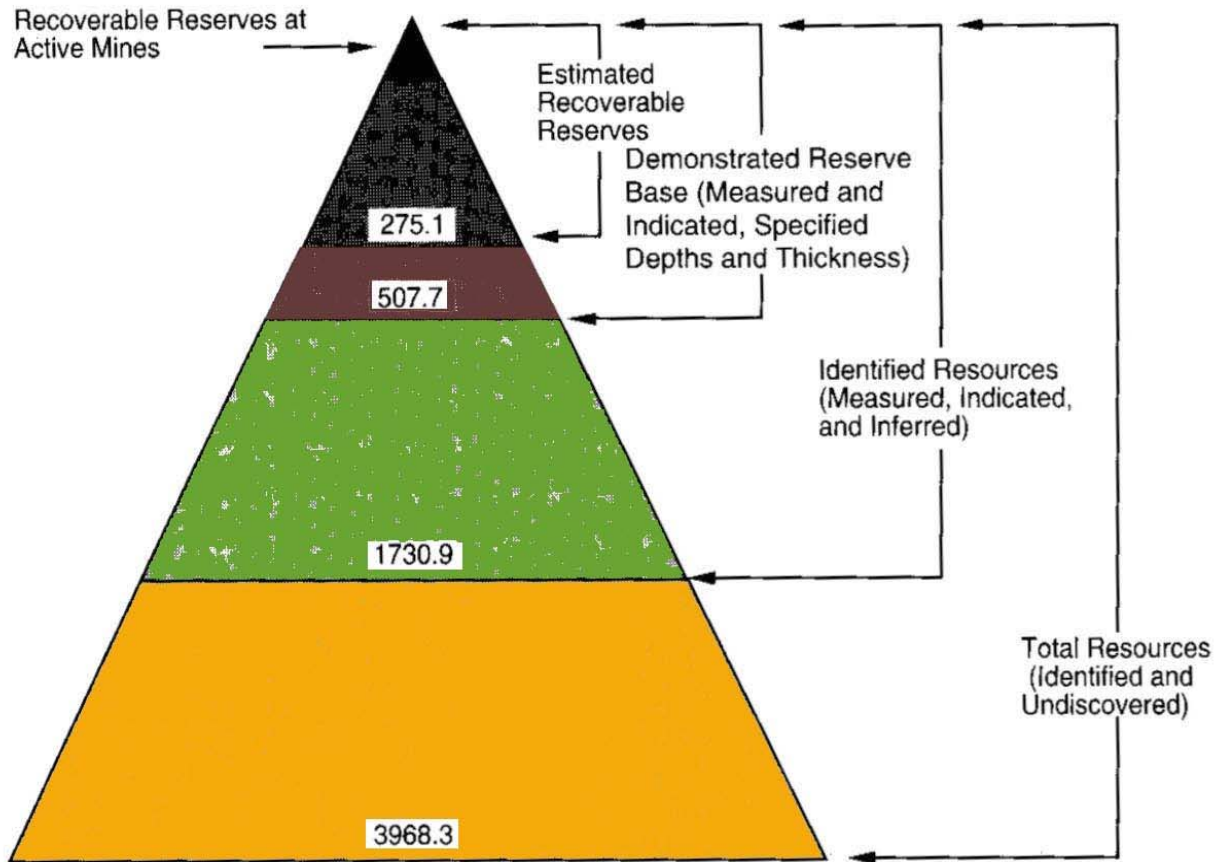
2008 APC Round Table  
& Expo Presentation

*July 13-15, 2008, in Savannah, GA*

# Coal Deposits in the USA



## US Coal Resources & Reserves



United States coal resources and reserves in billion short tons.  
(From EIA, *U.S. Coal Reserves: 1997 Update*, U.S. Department of Energy, Energy Information Administration, Washington, D.C., February 1999, p. 5, Appendix A.)

## Coal

Mechanical combination of coal + mineral matter

### Coal Maceral (bark, sap, leaves)

- Sorry, no dinosaurs
- Complex aromatic hydrocarbon
- Volatile & Fixed Carbon — energy sources
- Hydrophobic (rejects water)

### Mineral Matter (ash)

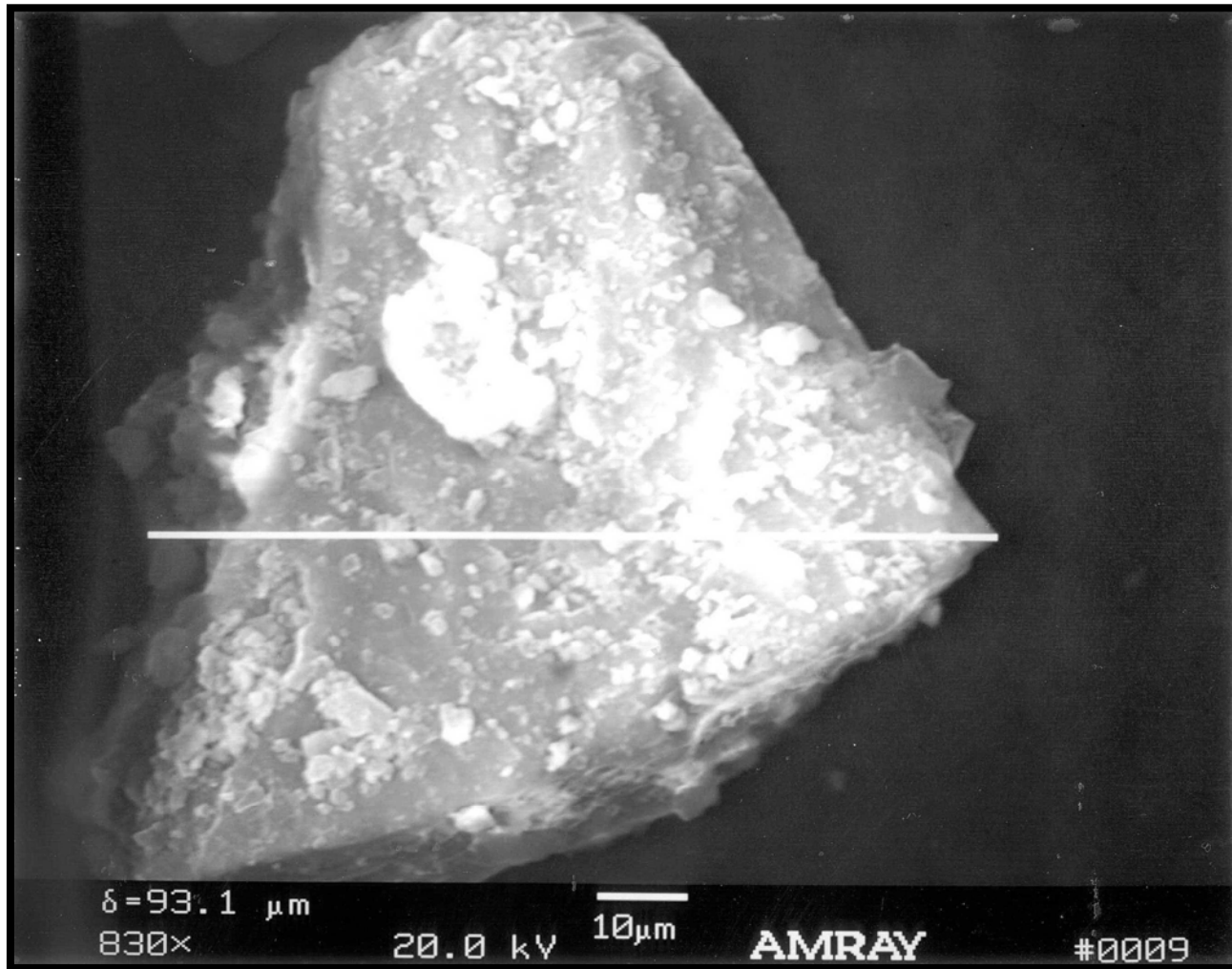
- Combustible & non-combustible minerals — energy sink
- Mostly minerals of the following oxides
  - Si, Al, Ti, Fe, Ca, Mg, K, Na, S, P, Ba, Sr, Mn, Cl, + ...
  - 76 of the first 92 elements
  - Where did most of it go?
- Hydrophilic (accepts water)

### Moisture

- Inherent (Equilibrium, Bed) & Surface — energy sink



SEM Photomicrograph of Coal Particle



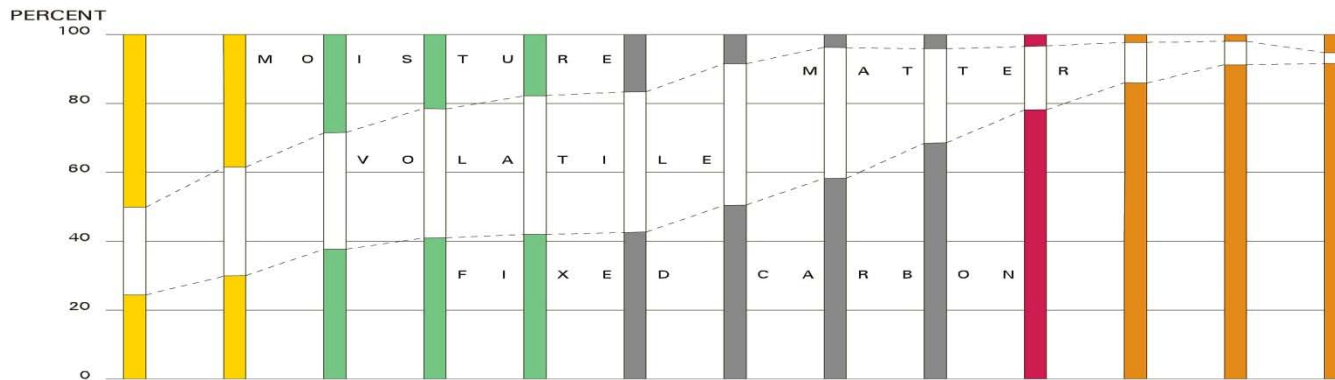
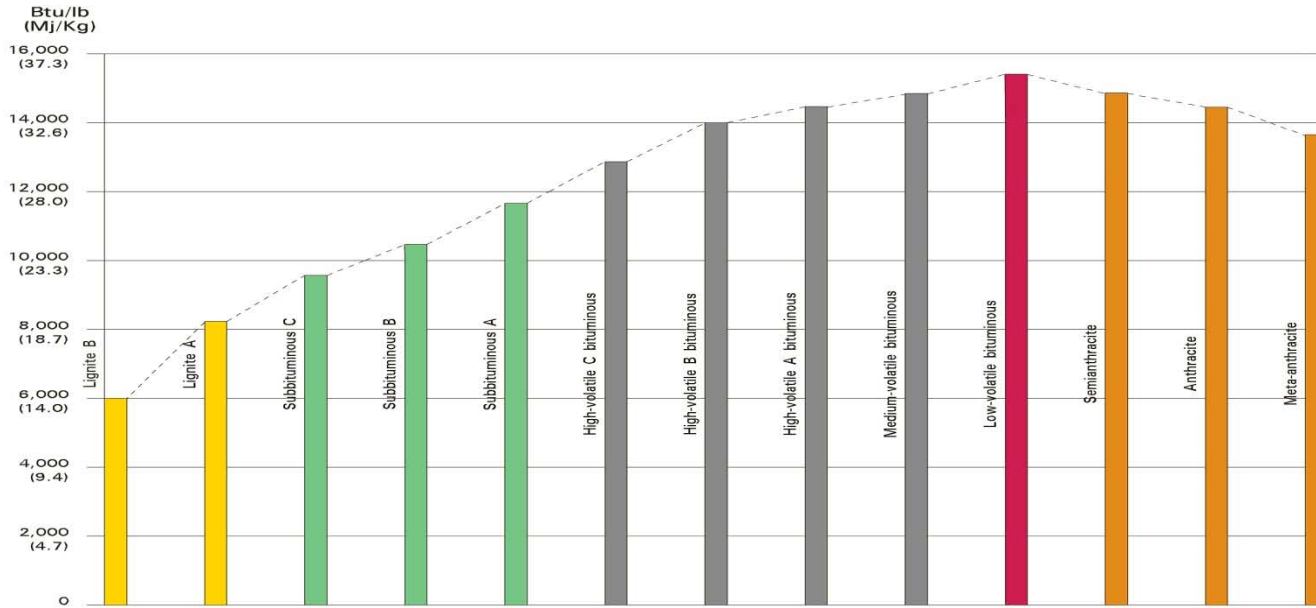
Sub-bituminous coal particle, about 93- $\mu\text{m}$  across.  
Note the defined edges, the shape and texture of the particle



Coal Seam — Pittsburgh (Northern Appalachia)



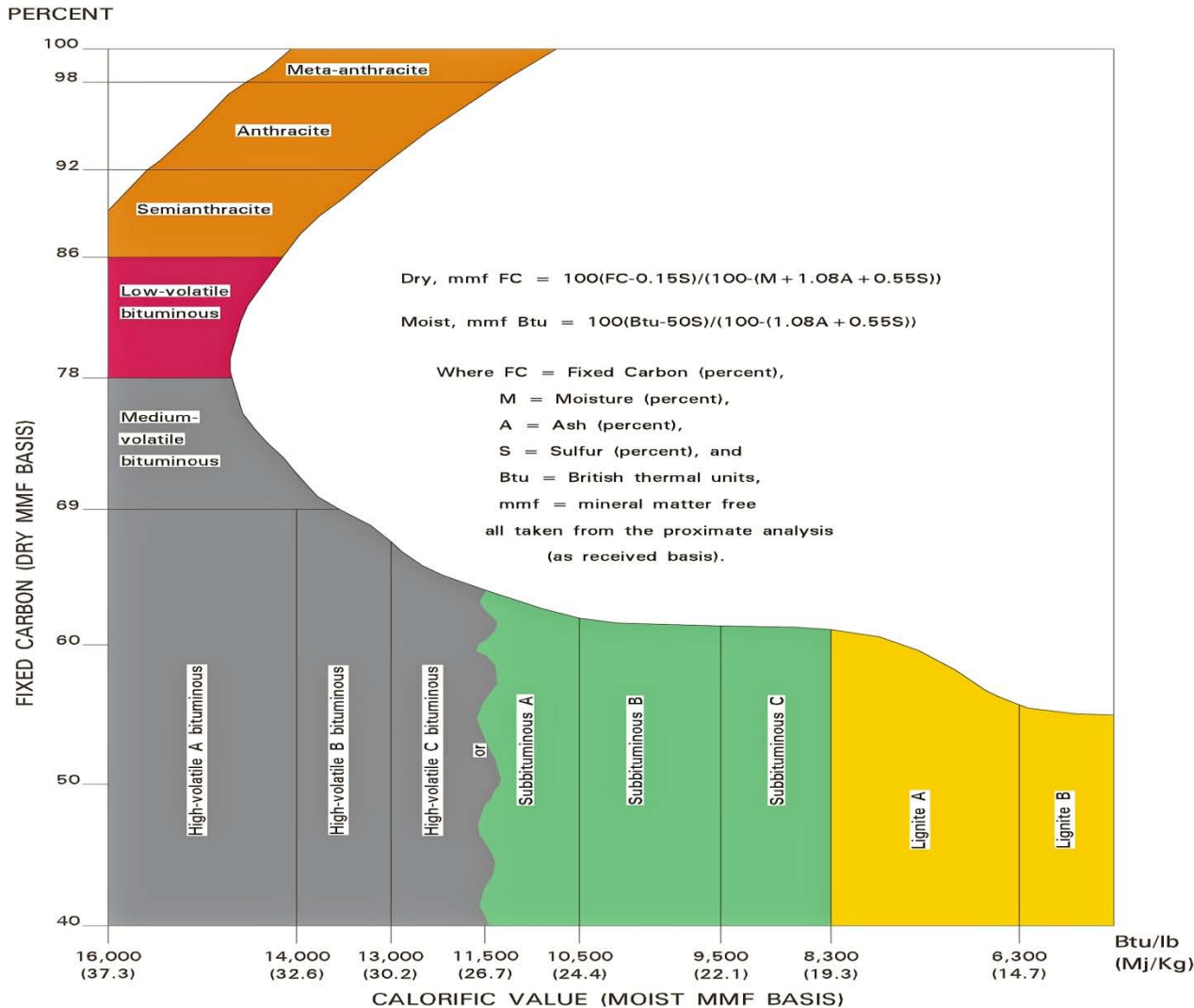
# Coal Quality by Rank



MAXIMUM CALORIFIC VALUES OF COALS OF DIFFERENT RANKS COMPARED TO PROXIMATE ANALYSIS DATA



# Basis of Rank Classification of US Coals



BASIS OF RANK CLASSIFICATION OF COALS IN THE UNITED STATES, AND THE FORMULA USED IN MAKING APPROXIMATE RANK DETERMINATIONS

## Hypothesized Coal Structures

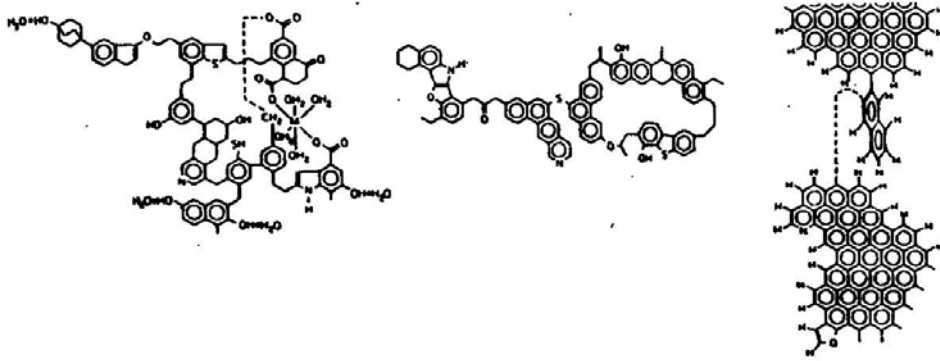


Figure 13. Spiro and Kosky (1982) models for a low-, intermediate-, and high-rank coal.

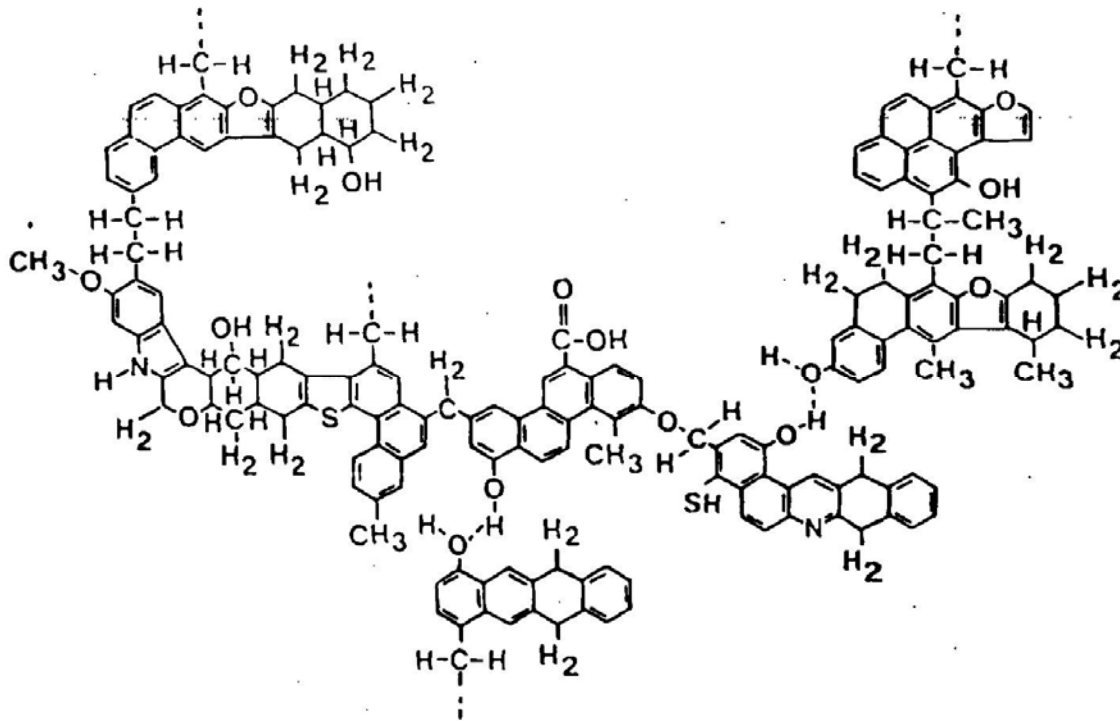
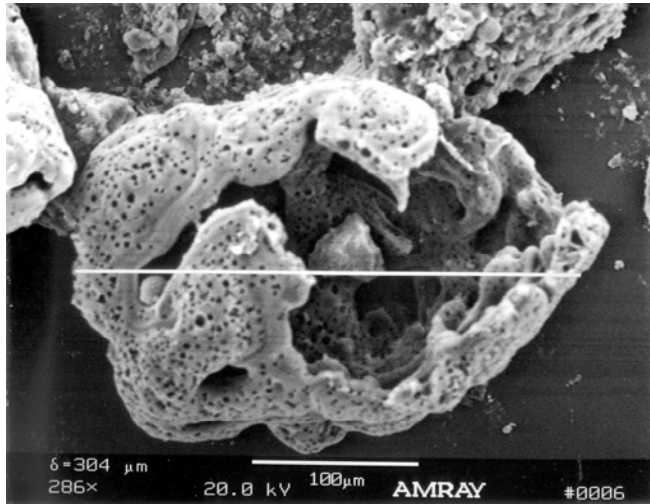
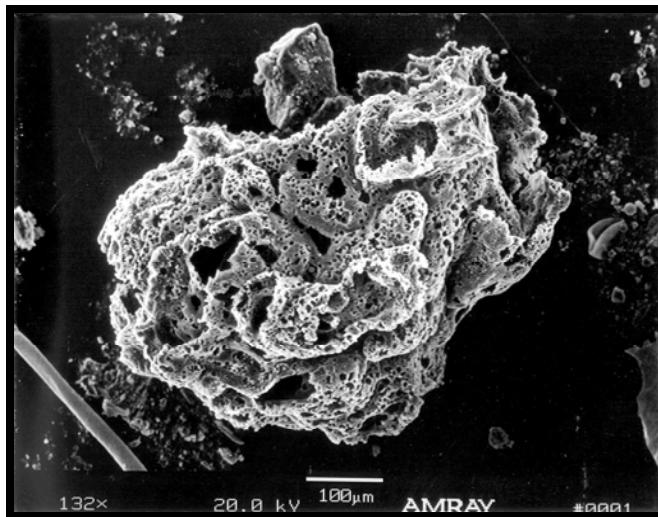


Figure 12. The Solomon (1981) model of a Pittsburgh high-volatile bituminous coal.



286X, SEM-photomicrograph  
Partially Burned Coal Particle

Partially burned coal. Note the "popcorn" appearance. Particle is about 304- $\mu\text{m}$  across. Note the small seed-like ash particle in the center. Holes on the surface are made by escaping gases during combustion.



132X, SEM-photomicrograph  
Partially Burned Coal Particle

Partially burned coal. Particle is about 580- $\mu\text{m}$  across, very porous and hollow. Initial combustion likely occurred at the right end where there is a large hole. Smaller holes on the surface were made by escaping gases during combustion.



**Knowing just a coal's  
short prox  
is no longer sufficient**

**Does not contain enough  
information to make  
informed decisions**



# What does the traditional Short Proximate tell you?

- Moisture
- Ash
- Sulfur
- Heating Value



# What does the Proximate tell you?

- Moisture
- Ash
- Volatile
- Fixed Carbon
- Sulfur
- Heating Value
- MAF Heating Value
- Moisture Load
- Ash Load
- SO<sub>2</sub>
- Volatile/Fixed Carbon



## Coal Comparisons

	Bituminous		Sub-Bituminous	
<u>Proximate</u>	Pitt (S<1.7)	Pitt (S>1.7)	PRB (Na<4)	PRB (Na>4)
Moisture (%)	6.24	4.52	23.13	24.60
Ash (%)	6.70	6.78	4.22	3.60
Volatile (%)	31.89	34.31	32.97	31.57
Fixed Carbon (%)	54.75	54.39	39.68	40.23
Sulfur (%)	1.42	2.05	0.29	0.25
HHV (Btu/lb)	13,061	13,376	9,554	9,507
<b>MAF (Btu/lb)</b>	<b>15,002</b>	<b>15,080</b>	<b>13,152</b>	<b>13,241</b>
Moisture Load (lbs/MBtu)	4.78	3.38	24.21	25.88
Ash Load (lbs/MBtu)	5.13	5.04	4.41	3.79
SO <sub>2</sub> (lbs/MBtu)	2.17	3.07	0.62	0.53
V/FC (%/%)	0.58	0.63	0.83	0.78



## Moisture

- ◆ Laboratory characteristic
  - ◆ **Residual + Air-Dry Loss (ADL)  $\approx$  Total**
  - ◆ Every lab should report (Certificate of Analysis)
  
- ◆ Physical characteristic
  - ◆ **Equilibrium (Inherent, Bed) + Surface  $\approx$  Total**
  - ◆ Difficult & infrequently determined
  - ◆ Valuable reference value



Moisture Components

