

Coal Ash Harvesting and the Future of SCMs

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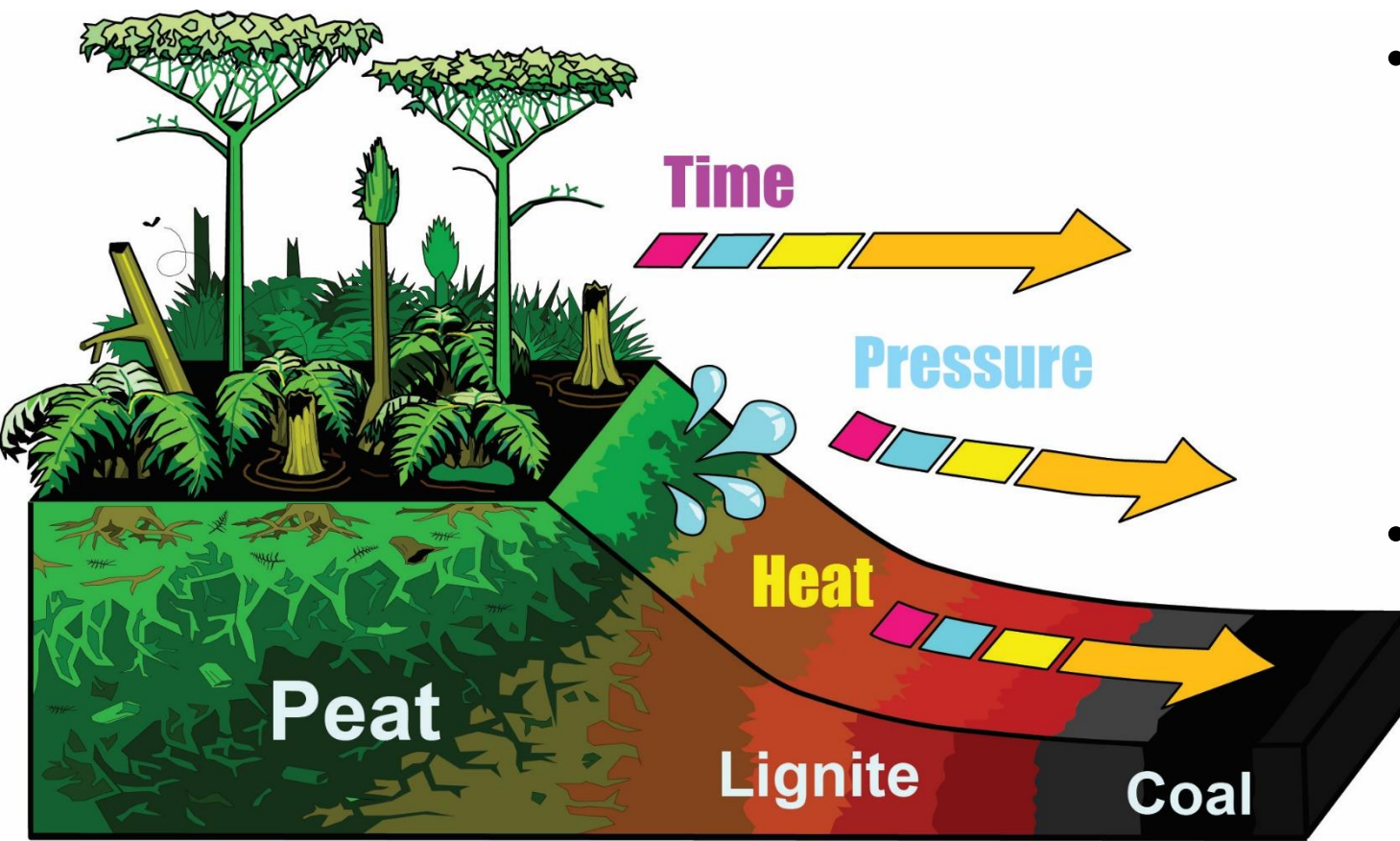


What is Harvested Coal Ash?

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What is Coal?



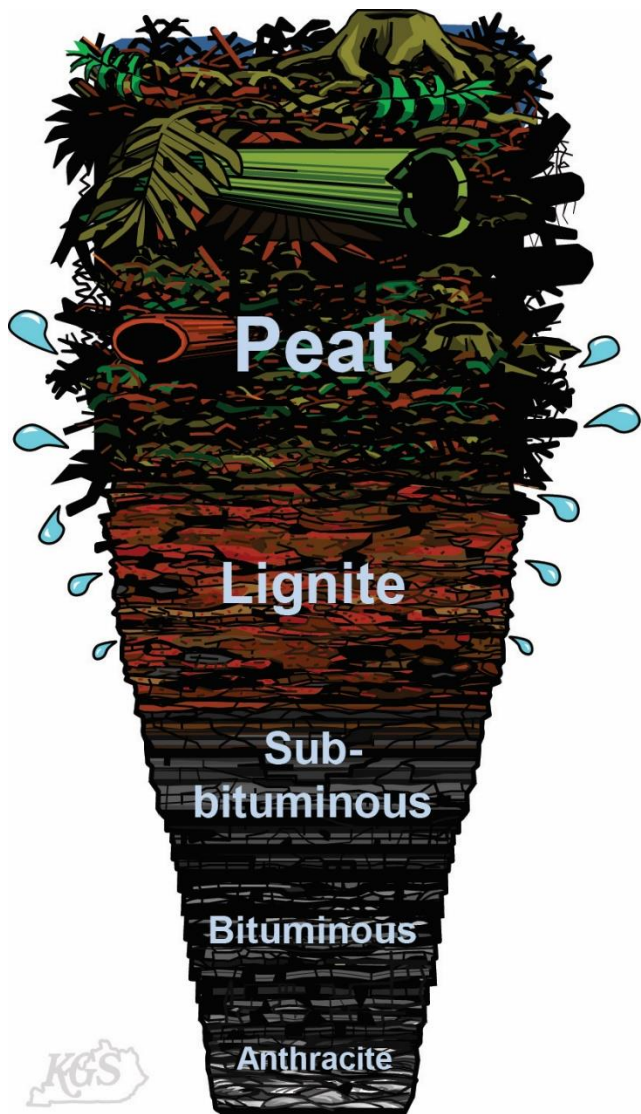
- Coal is a sedimentary rock derived from transformation of plant matter into a carbon rich mineral through compaction and heat
 - This process is called “**coalification**”
- Coalification is a continuous, transitional process that takes place over millions of years



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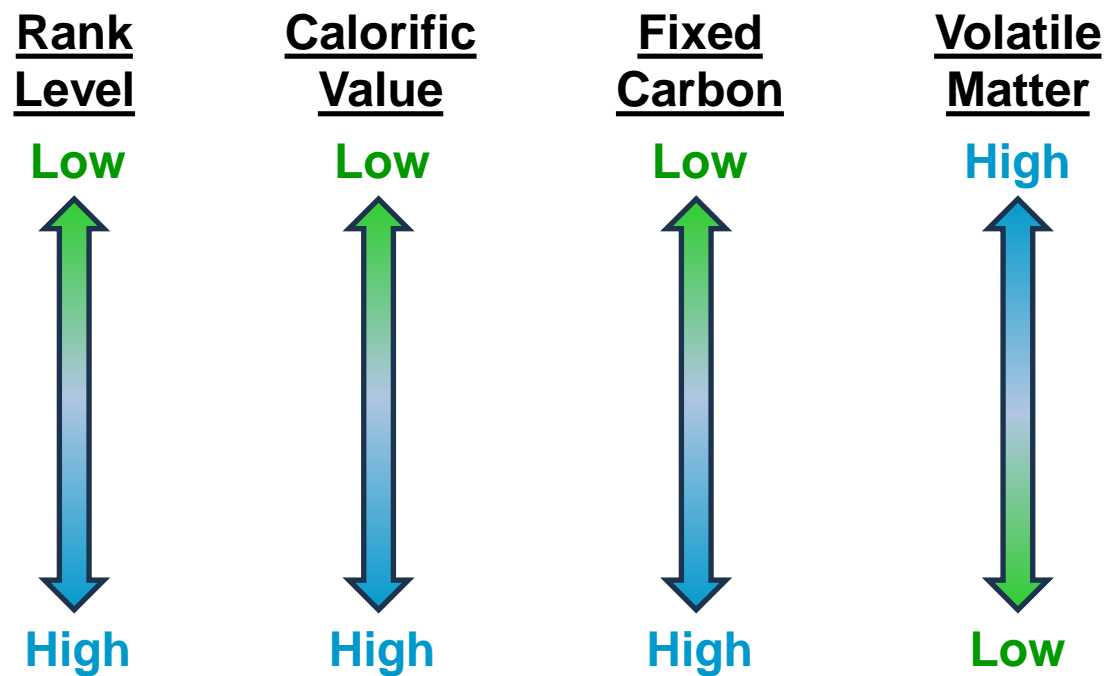
 Stephen Greb, Kentucky Geological Survey, University of Kentucky

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What is Coal Rank?

Coal is categorized into 4 different “ranks” based on its state in coalification process



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What is Coal Made of?

Coal is made of two types of material - organic macerals, and inorganic minerals

Macerals - Carbon

- Macerals are the carbon-rich grains in coal derived from the coalification of plant matter
- Fuel portion of coal
- Three categories based on source of plant matter
 - Vitrinites – Plant cell walls
 - Liptinites – Spores, plant outer coatings
 - Inertinites – Fungi, plant matter altered by other processes like fire

Minerals

- Minerals in coal are divided into to primary categories
 - Syngenetic – Minerals original to the peat bogs
 - Diagenetic – Secondary deposits
- **Coal ash is formed in power generation due to the mineral impurities in coal, and the type and concentration of minerals is what determines the final composition and Class of coal ash**

Why Does this Matter?

Lower Rank Coal

Lignite, Some Bituminous

Lower calorific value



Lower fixed carbon content



Higher volatile & mineral content



Produces Class C Ash

Higher Rank Coal

Some Bituminous, Anthracite

Higher calorific value



Higher fixed carbon content



Lower volatile & mineral content



Produces Class F Ash



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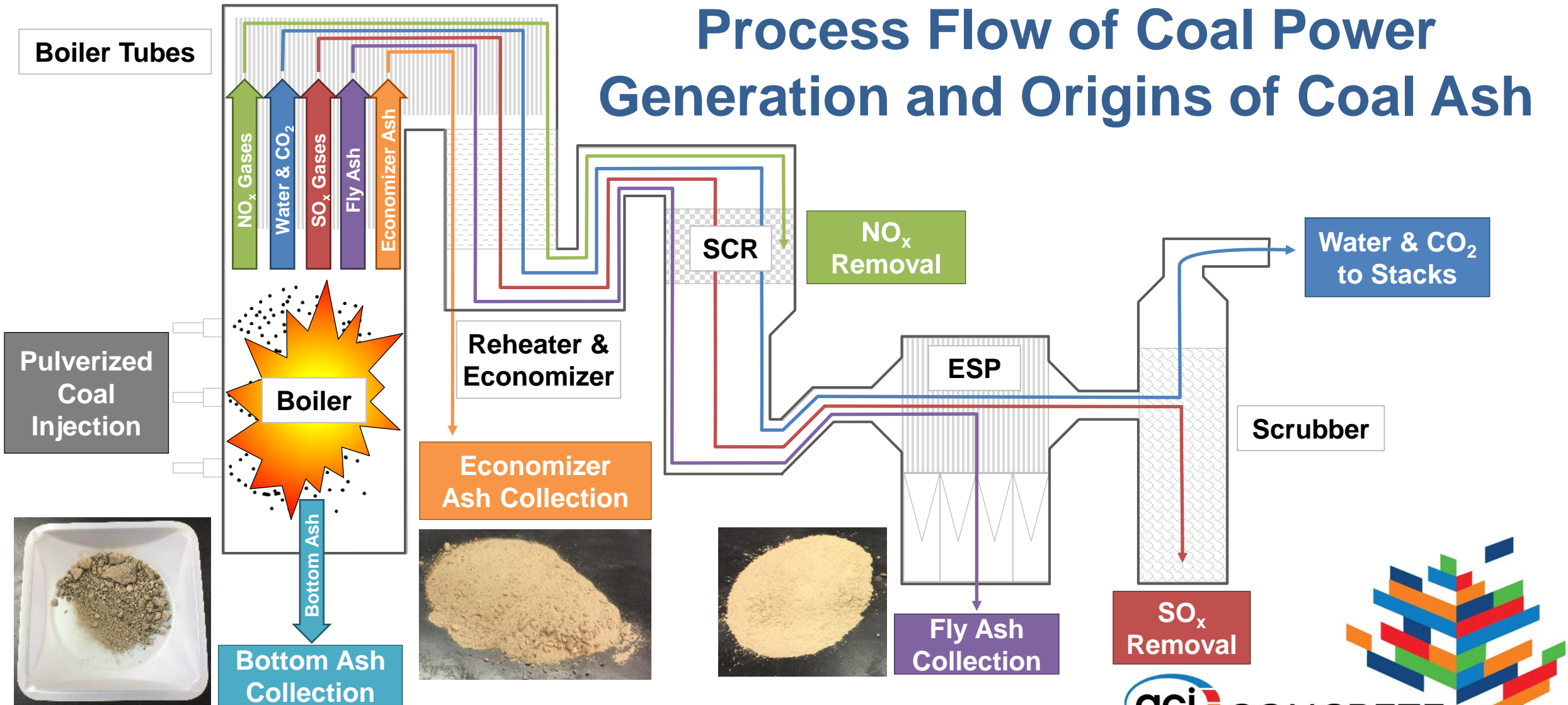


What is Coal Ash?

Per ASTM C618-23 the Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete:

- **Coal ash, n** – fly ash and bottom ash resulting from the process of combustion of ground or powdered coal obtained either from current power plant production or harvested from landfills or impoundments.

Process Flow of Coal Power Generation and Origins of Coal Ash



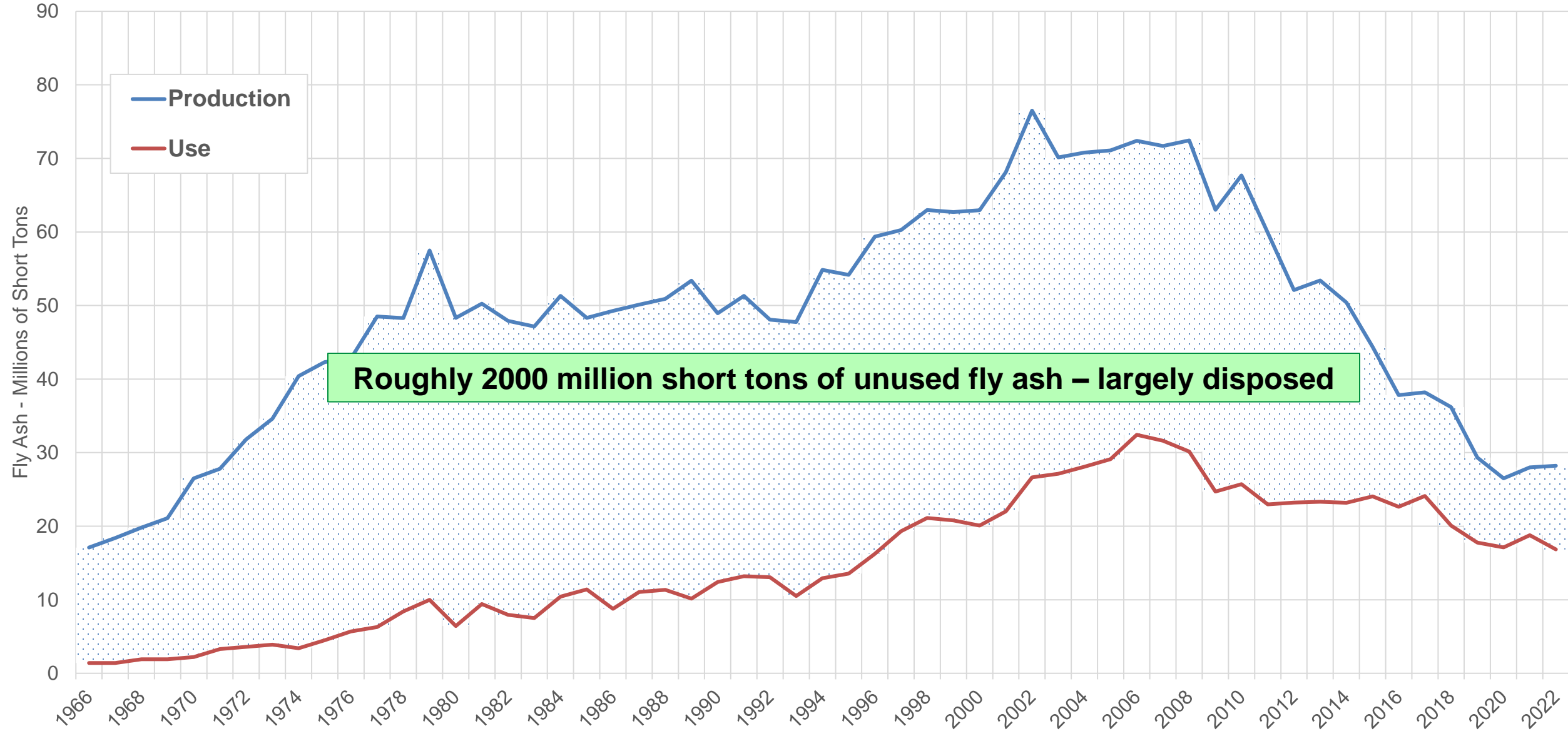
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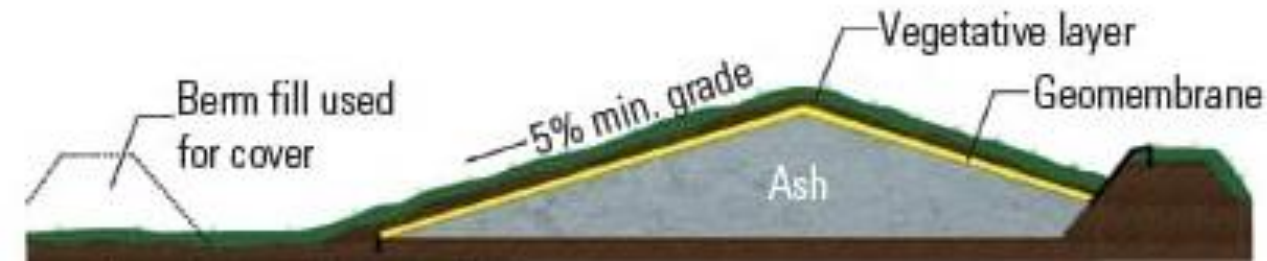
~~What is Harvested Coal Ash?~~

Fly Ash Production and Use – Courtesy of ACAA Survey



How is Ash Disposed?

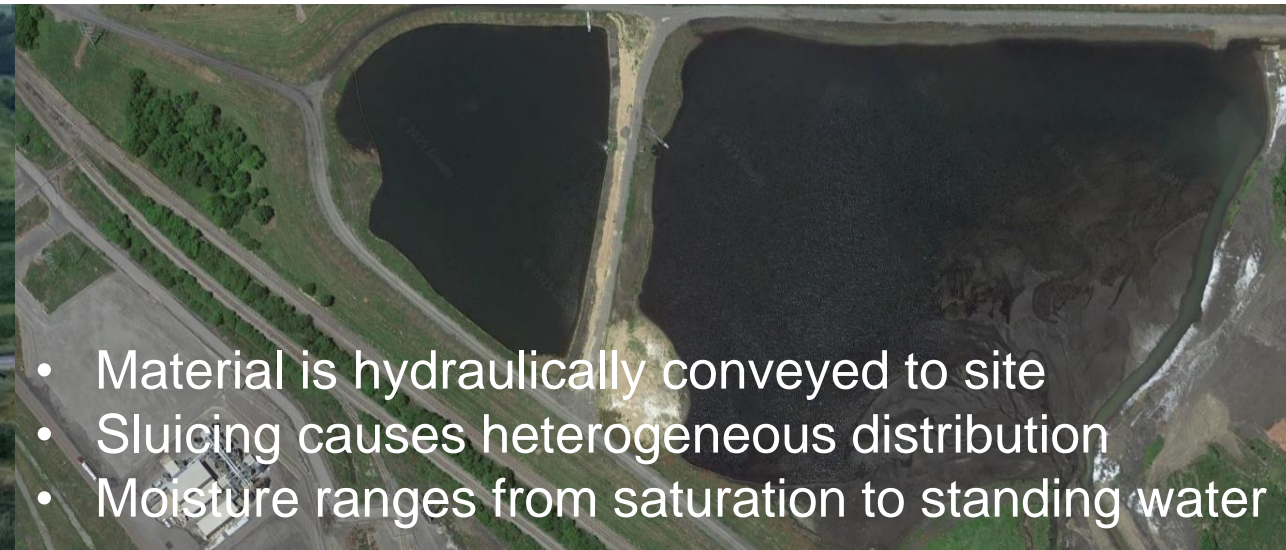
Stacks



Ponds



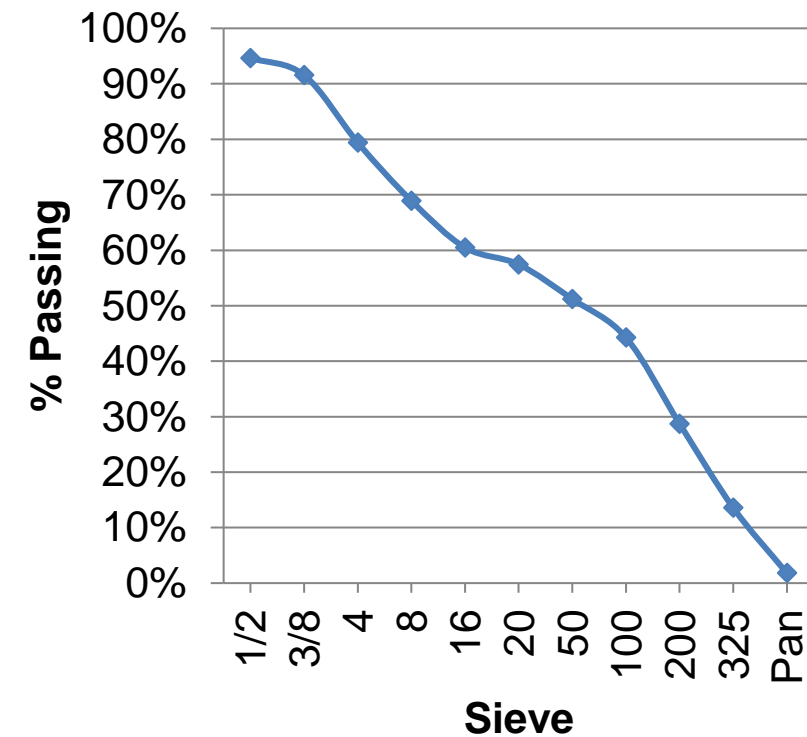
- Material transported to site by truck
- Deposited and compacted in lifts
- Conditioned to 12-20% moisture



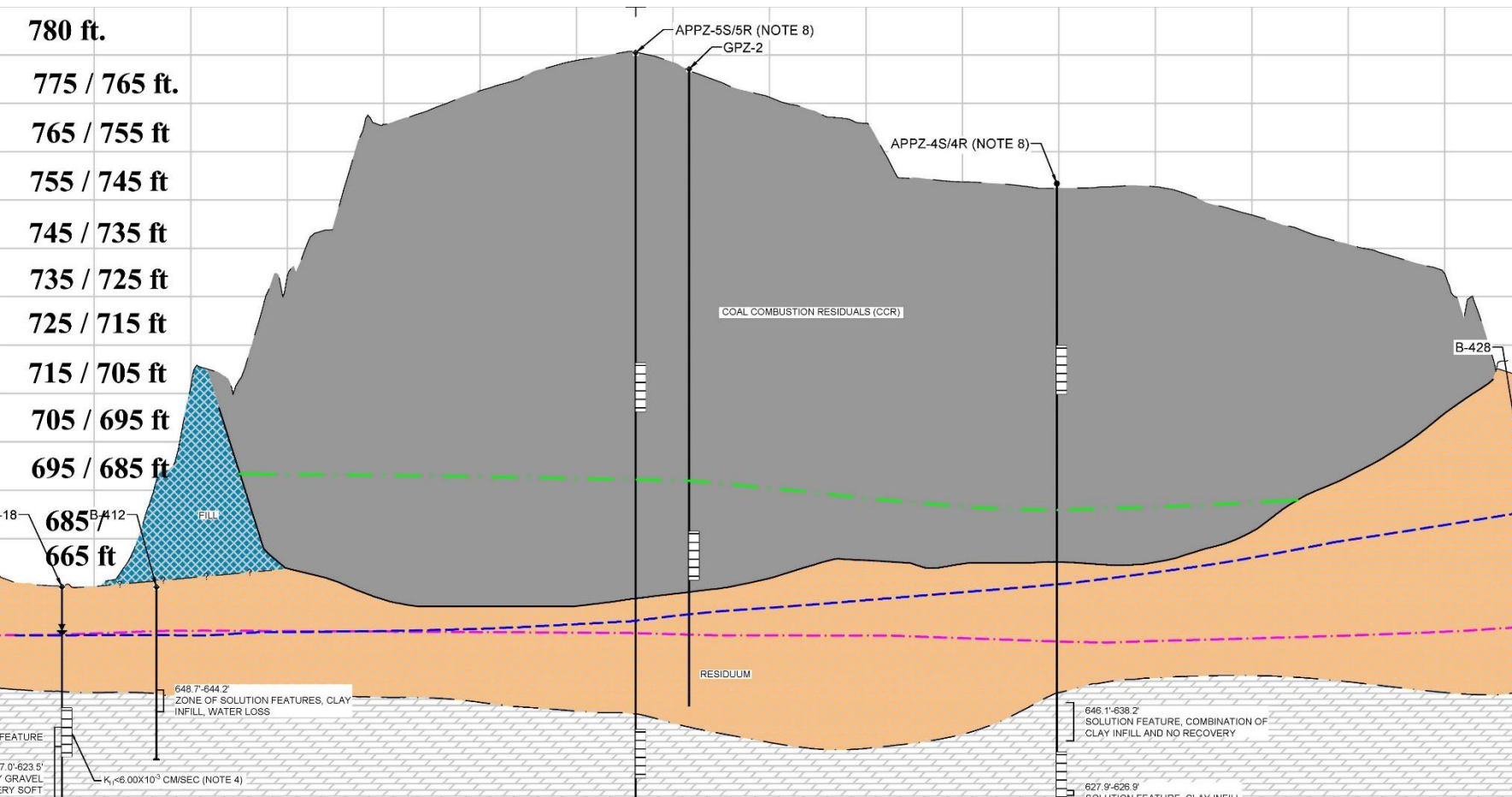
- Material is hydraulically conveyed to site
- Sluicing causes heterogeneous distribution
- Moisture ranges from saturation to standing water

What is in Coal Ash Deposits?

Historic ash impoundments may potentially contain any combination of power plant operation residuals, including fly ash, bottom ash, coal rejects, and FGD materials



Coal Ash Deposit Characterization



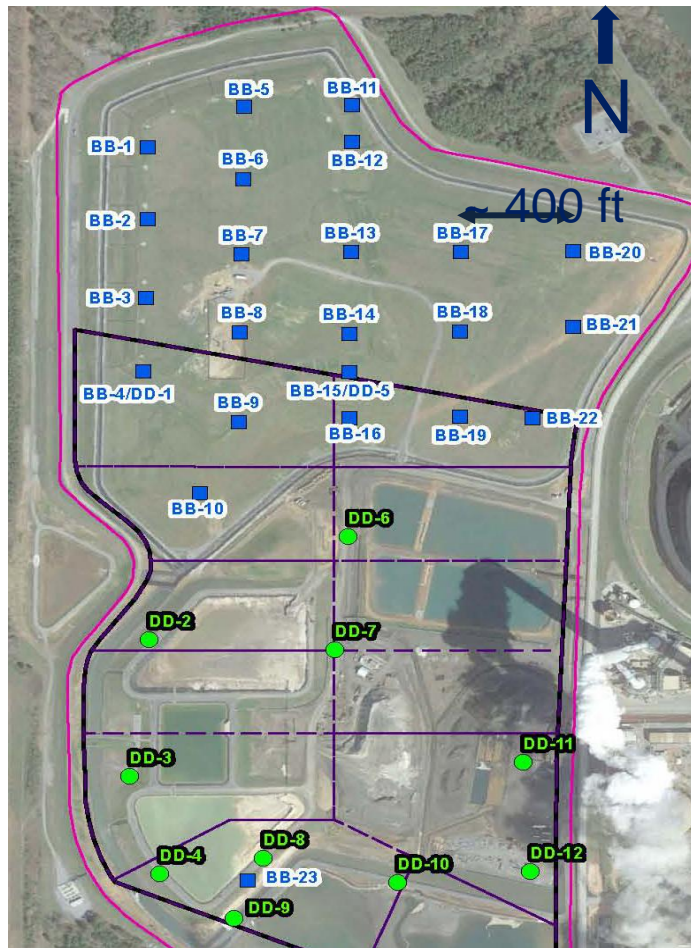
- Due to the variety of materials that can be present in coal ash impoundments, marketers need to perform due diligence in characterizing these deposits
- Such characterization can resemble mining projects



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Coal Ash Deposit Characterization



Sonic Drilling



- Sonic provides continuous, undisturbed core samples through any geological formation.
- Sonic- 4-inch ID sample is “extruded” into a plastic sleeve for sampling.

Direct Push Technology



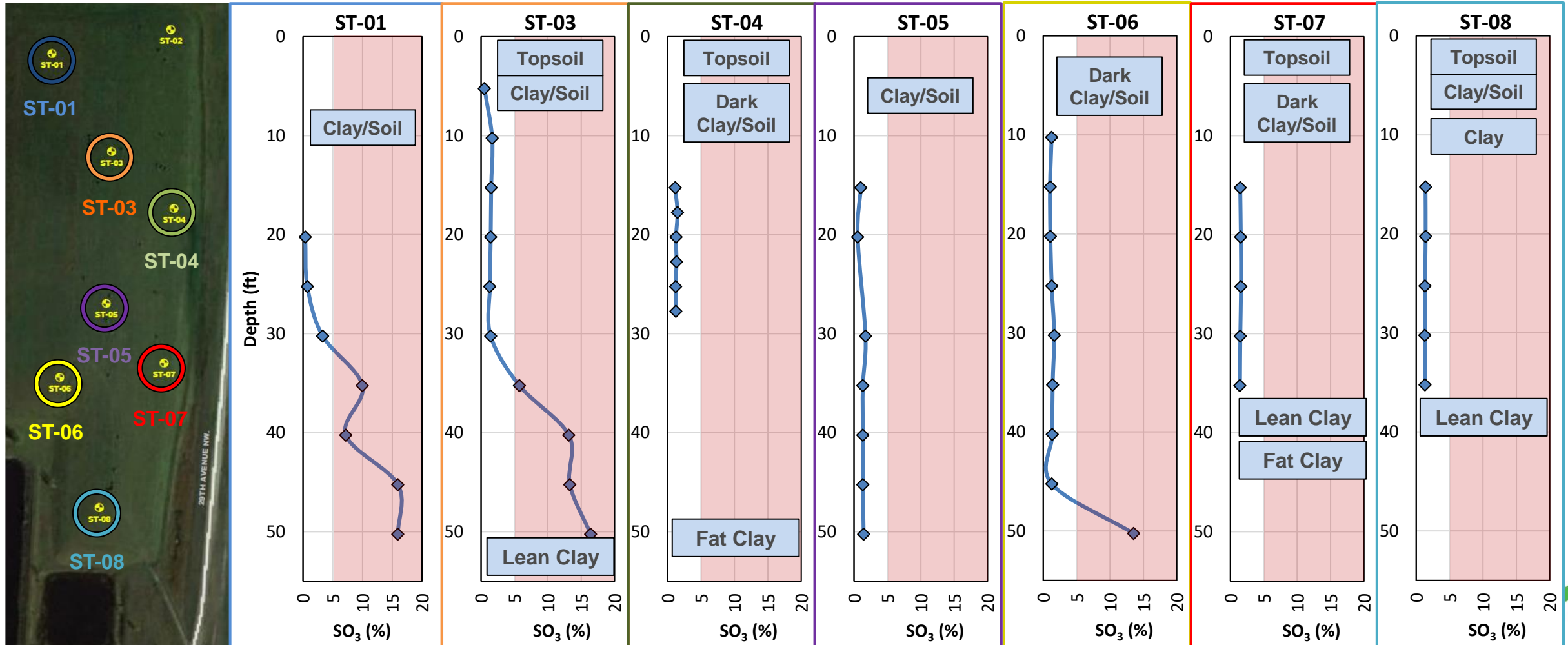
- DP machines use a percussion hammer
- Not for use in consolidated rock like limestone, granite or gneiss.
- DPT- 1.5 inch ID plastic tube is “sliced” open with specific tool

Hollow Stem/Split Spoon

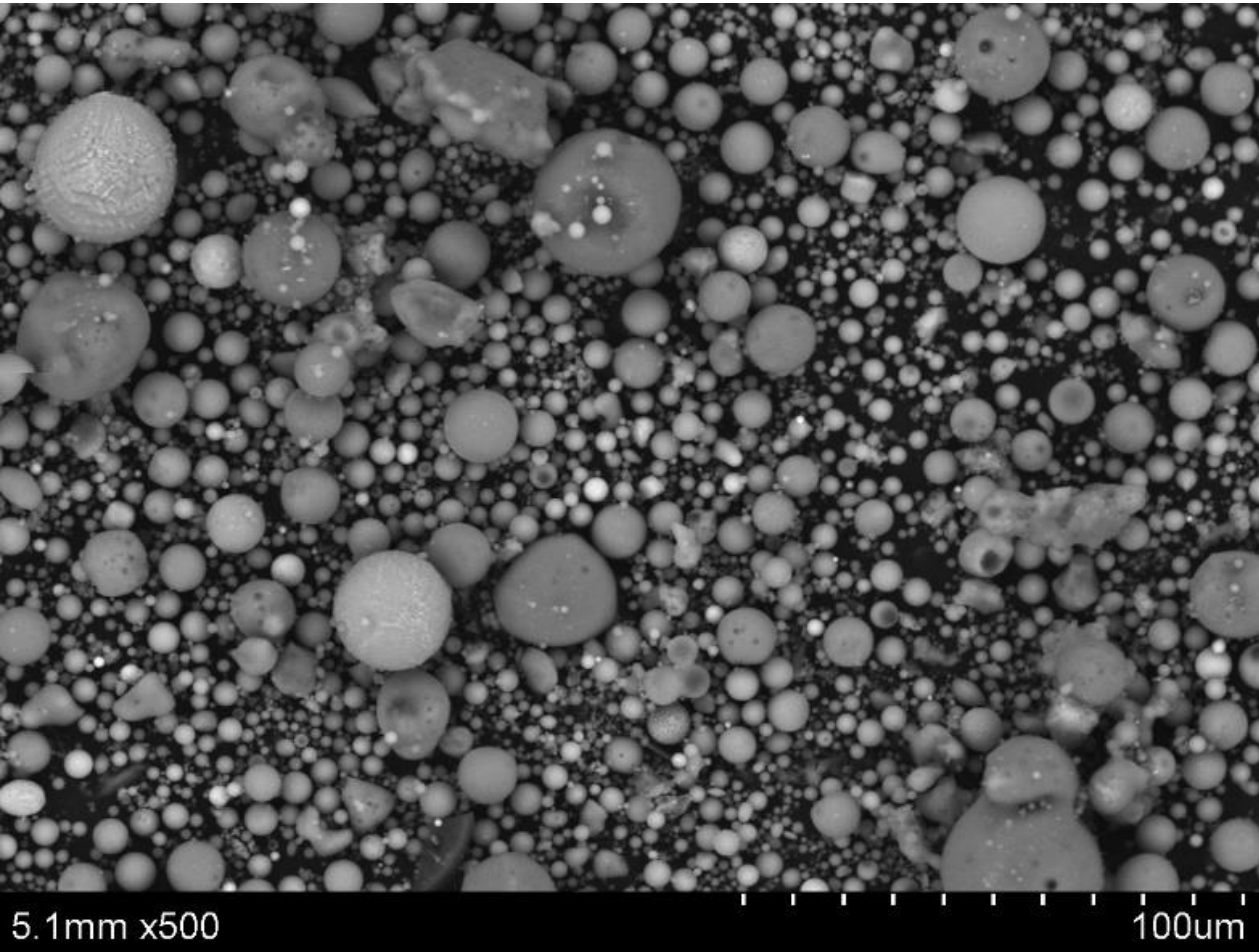


- Hollow stem auger drilling is ideal for advancing shallow boreholes in unconsolidated formations
- Split Spoon- sample is in a galvanized “Shelby” tube. This is extracted with hydraulic press.

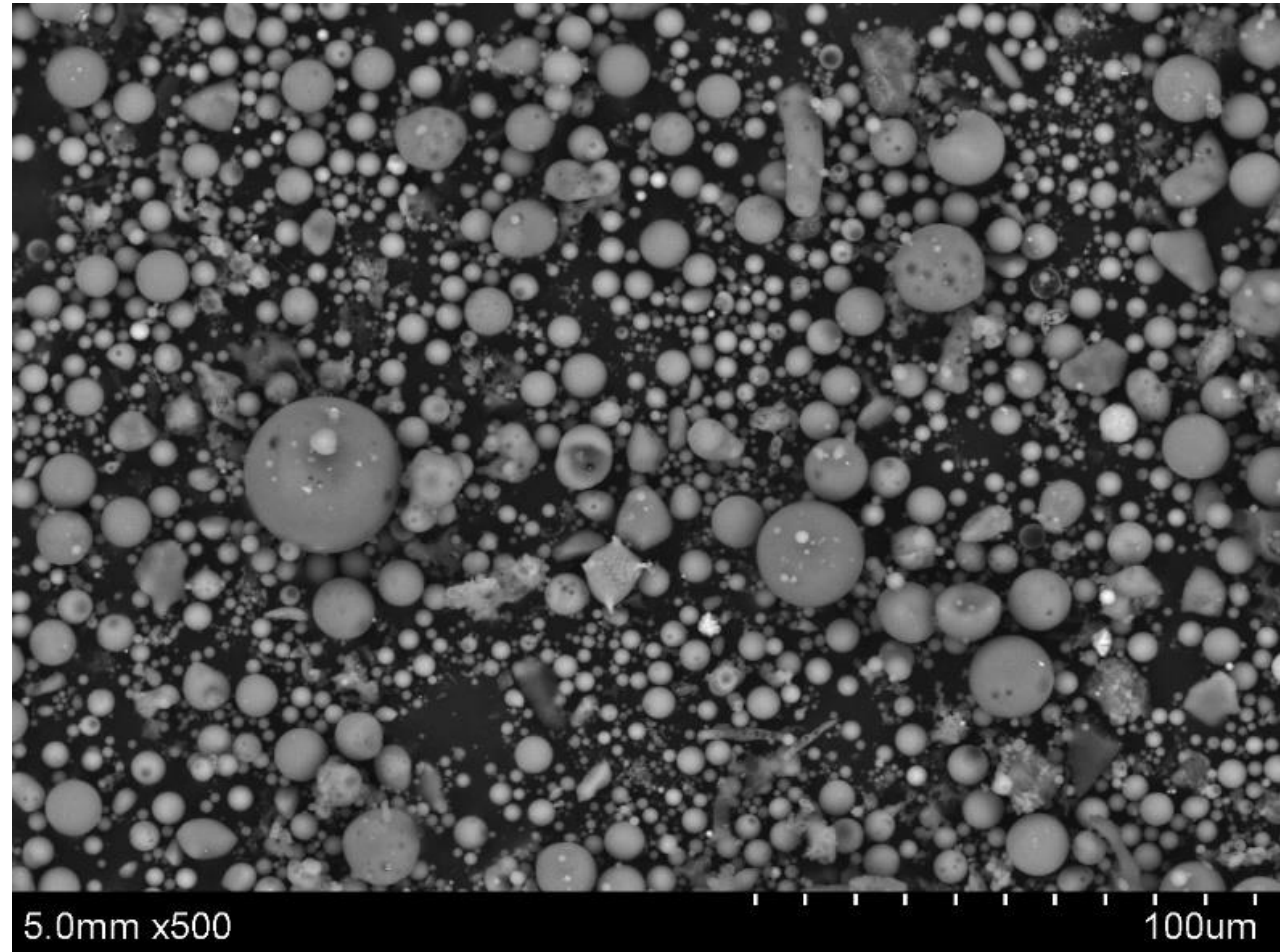
Coal Ash Deposit Characterization



Current Production Fly Ash

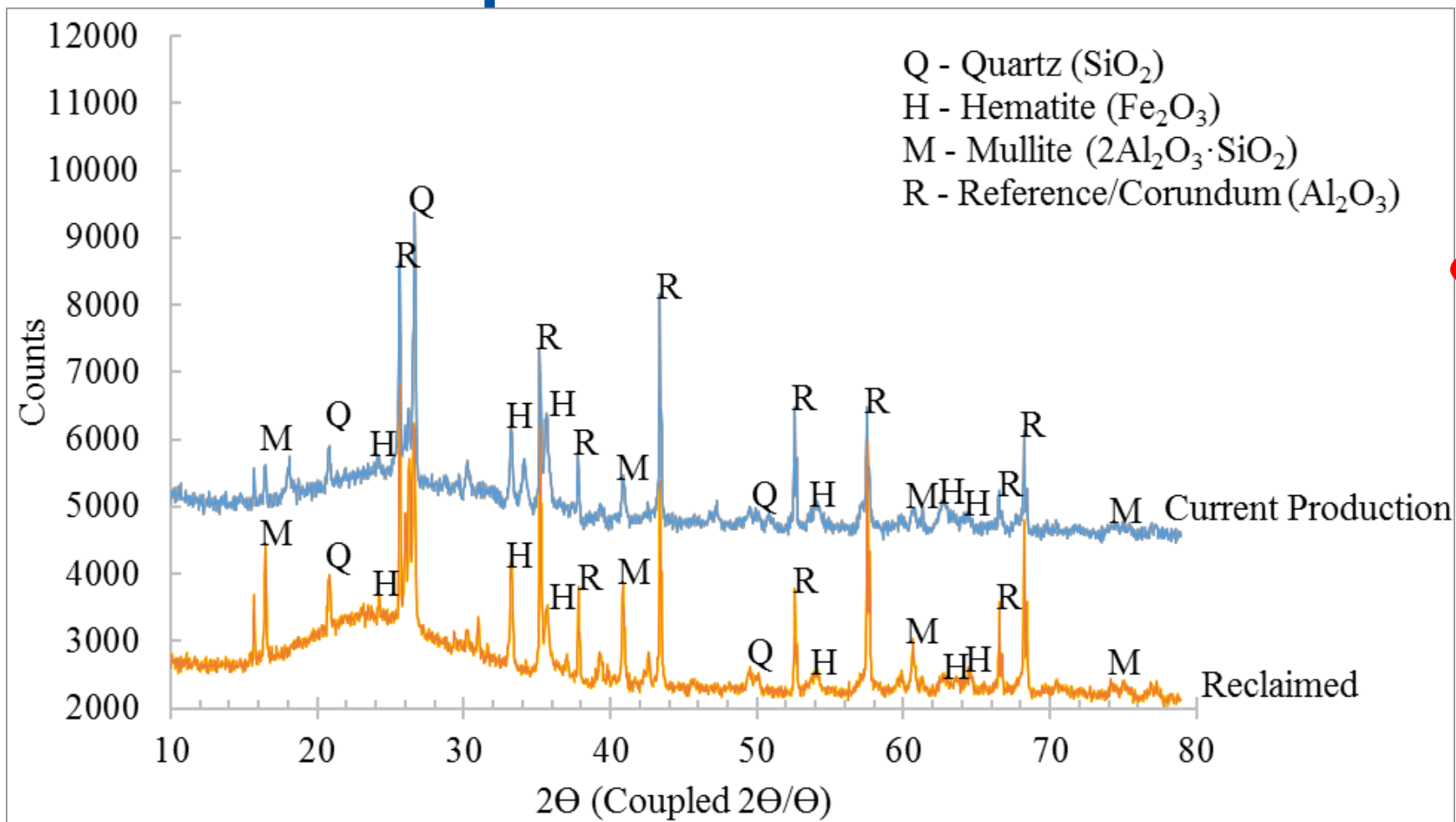


Beneficiated Harvested Ash



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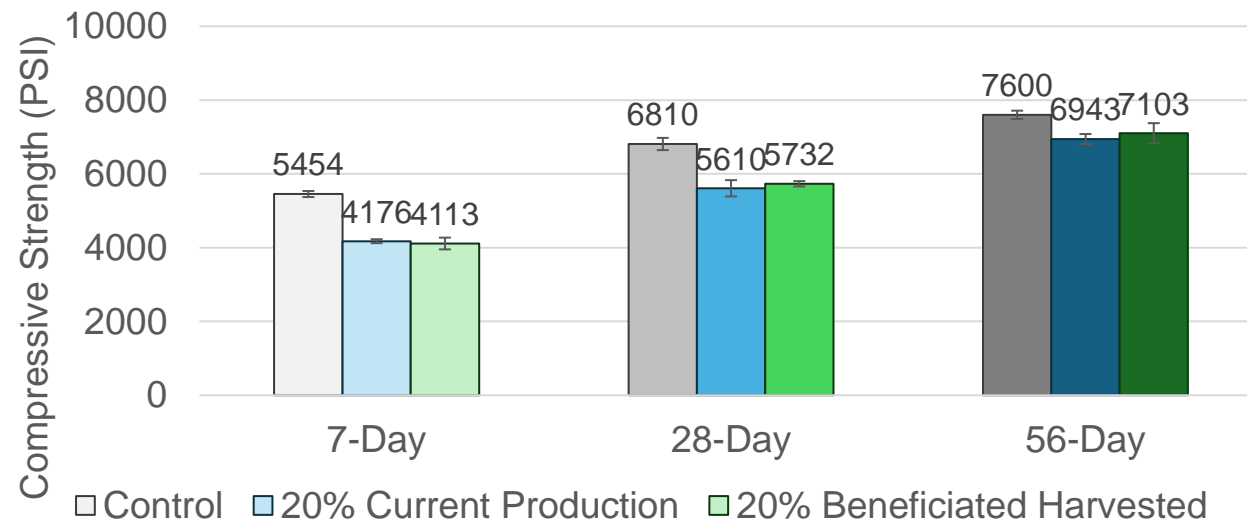
Ash Composition - Current Production vs Harvested



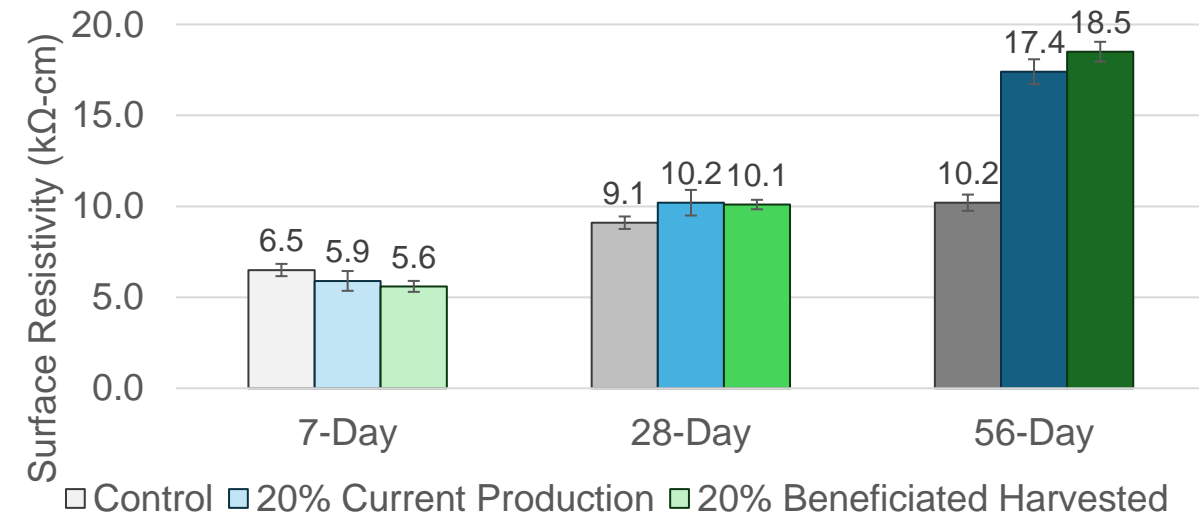
PHASES OBSERVED	Current Production	Beneficiated Harvested
Amorphous	77.02	78.61
Quartz	6.94	7.78
Hematite	3.94	3.67
Magnetite	2.76	-
Periclase	1.20	1.70
Diopside	1.98	2.69
Mullite	2.27	4.13

Ash Performance – Current Production vs Harvested

6-Sack Concrete Compressive Strength



6-Sack Concrete Surface Resistivity



ASTM C618 Performance

	SO ₃	CaO	Moisture	LOI	Fineness	SAI 7 d	SAI 28 d	Water Req'
Current Production	1.7	3.9	0.2	1.9	15	87	89	98
Beneficiated Reclaimed	0.8	1.7	**	4.4	23	88	89	98
ASTM C618 Type F	5.0% max	<18.0%	3.0% max	6.0% max	34% max	75% min	75% min	105% max

What is Harvested Ash? - Conclusions

- The mineral impurities in coal are the origin of all coal ash, and determine the chemical composition of the ash
- Coal ash is the collective term used to describe fly ash and bottom ash produced as a byproduct of electric power generation
- Coal ash that was not utilized was disposed, typically in stacks and ponds
- Coal ash deposits contain unique combinations of coal combustion byproducts, and therefore require site-specific planning and beneficiation strategies
- Once appropriately beneficiated, harvested coal ash can demonstrate performance equivalent to current production fly ash

Thank You! Questions?

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