

MEASURING HYDROCARBON FEATURES IN COAL WITH HIGH RESOLUTION SPECTROSCOPY

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Spectral Evolution





SPECTRAL EVOLUTION

- Incorporated June, 2004
- Manufacturing facility in Lawrence, Massachusetts
- Full line supplier of UV-VIS-NIR spectrometers for field portable mineral identification, core logging, remote sensing, and general photonics applications

COAL INDUSTRY IN UNITED STATES PICKING UP

- Expected to play a leading role for many years to come
 - Coal mining in the U.S. rose by 19% last year - according to the U.S. Department of Energy data
 - #1 source of electricity production in the U.S. during 1st half of 2017 – according to the U.S. Energy Information Administration (EIA)
 - U.S. has 262 billion tons of recoverable coal reserves, according to EIA – that's a 235 year supply @ current rate of use
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NEED FOR NEW TECHNOLOGY AND CONCEPTS

- Demand has risen in U.S. and other countries such as China, India and Europe – new technology for exploration is needed for faster results, less financial burden
- Surface mining for coal has more advantages compared to underground mining – coal recovery for economic gain is ~85%-90%
- New concepts for classifying coal quality in field are needed
 - Coals in U.S. are classified by rank – defined as “the degree of metamorphism or progressive alteration the natural series from lignite to anthracite”
 - Major role in distinction of coal is hydrocarbon content as well as differing concentrations of the important elements such as Sulfur or Chlorine
 - Using technology in field to identify coal features such as hydrocarbon features and/or other signatures is needed for viable and fast results to compliment lab assay is important.

SR-6500 ULTRA HIGH RESOLUTION SPECTRORADIOMETER

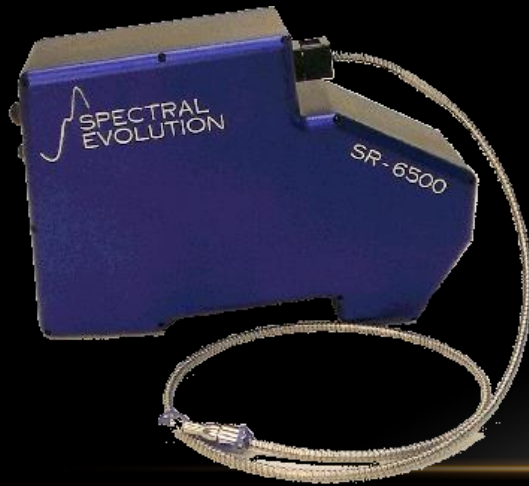
Spectral Range: 350-2500nm

Spectral Resolution:

1.5nm @ 700nm

3.0nm @ 1500nm

3.8nm @ 2100nm

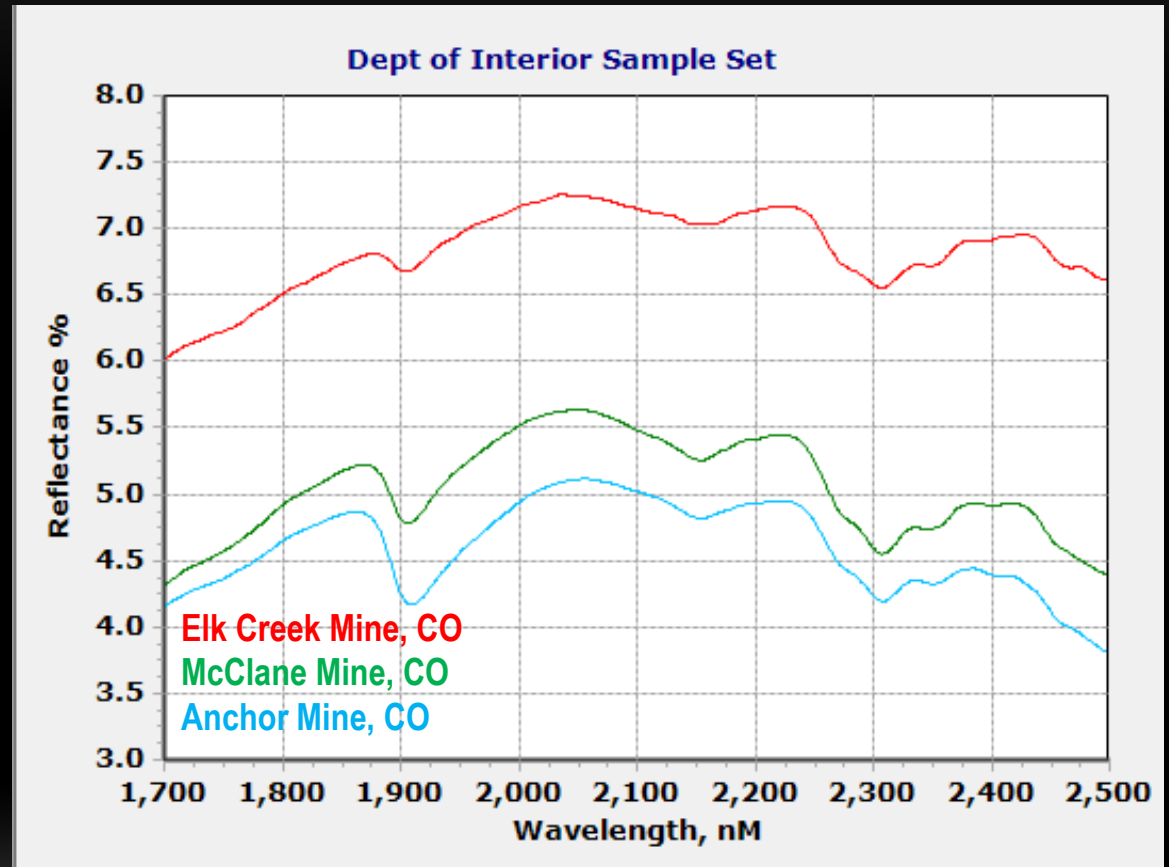


Sample provided by Tennessee Valley Authority – Paradise Fossil Stockpile in Kentucky, US

SAMPLE SET: UNITED STATES DEPT OF INTERIOR – BUREAU OF LAND MANAGEMENT



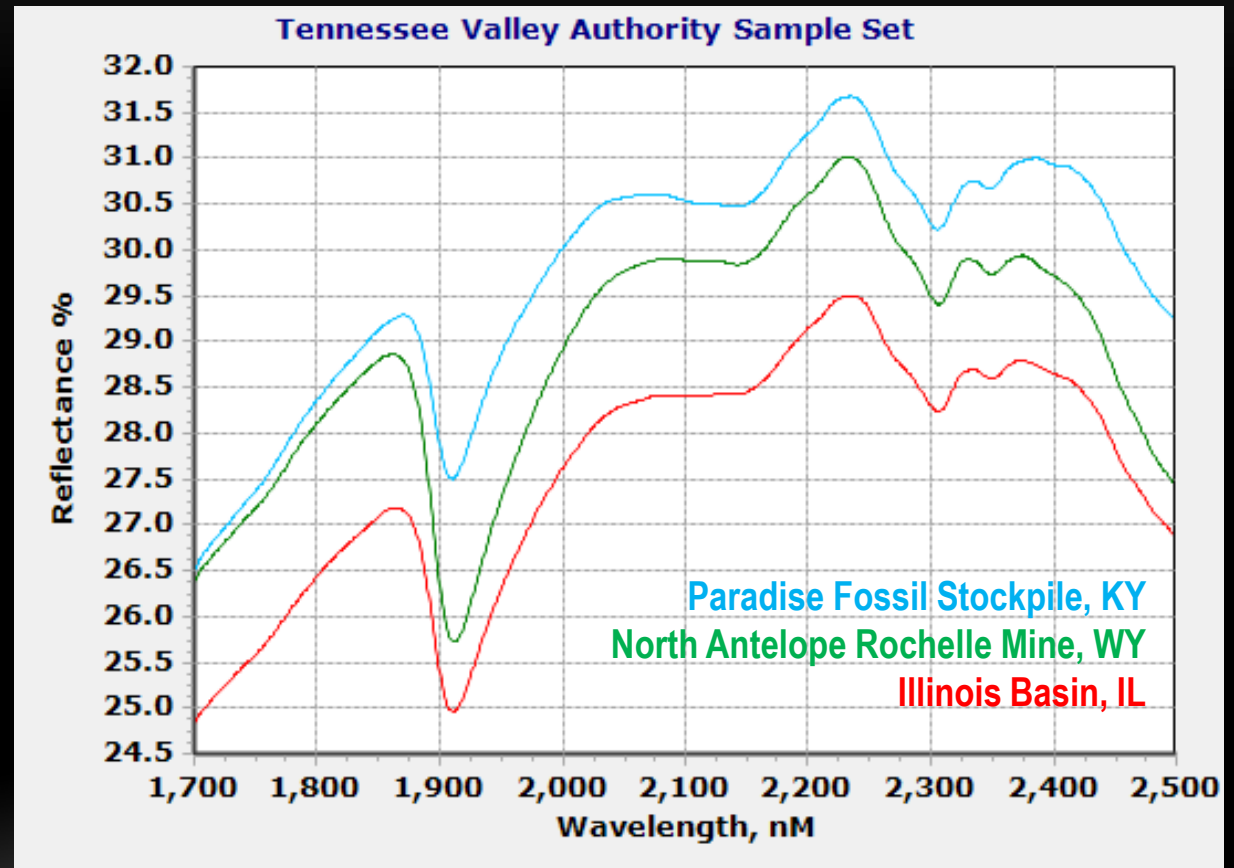
- Administer mining on federal land
- Samples locations from Colorado, USA



SAMPLE SET: TENNESSEE VALLEY AUTHORITY



- Provide electricity from different resources, including coal.
- Samples locations from Kentucky, Wyoming, and Illinois



CASE STUDY FROM PLOTLOGIC



- Based in Brisbane, Australia
- Develop and implement high quality ore characterization systems for the mining industry
- Australia's coal industry is also seeing an increase in demand, 4th highest coal exporter in the world
- Plotlogic using SR-6500 to build a quantification model for classifying different grades of coal based on features found within coal
- Apply new concept of classifying coal in the field for exploration and analysis
- Research is ongoing in the commercial mining industry in Australia

CONCLUSION

- Using a high resolution spectrometer to identify hydrocarbon features yields promising results for the coal industry:
 - Clearly pick out hydrocarbon features
 - Difference in shape and depth of features based on grade
- Further research is needed and is in process:
 - Create a quantification to depict where/why certain features occur within different grades of coal, create a standard for widespread use amongst industry worldwide
 - Use of the information for more accurate results in the field and to improve lab analysis efficiency