CORE SCANNER TECHNOLOGIES

TAKE EVERYTHING WITHOUT BREAKING

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Introduction

Modern core scanning technologies, such as hyperspectral Corescan™ and HyLogger™ or Itrax™ X-ray fluorescence (XRF) allow mineral and geochemical data acquisition without the necessity of breaking the core for speciality analysis. The applications are tremendous, from geological (lithology, mineralogy, fracture networking) and paleoenvironmental indicators, to coal processing (mineral liberation and breakage) and utilisation (characterisation of deleterious elements), and to coal seam gas (mineralised cleat systems).

Core Scanners

Three examples of core scanners are presented in this study. Below are described some of the characteristic of the instruments applied to the coal core:

Corescan™

Hyperspectral system operating, at the moment, only with VNIR and SWIR cameras. It works in grids of 0.5 mm pixels for a 30 mm swath.

Outputs:

- Optical photograph
- Spectral images
- Mineral class maps (colour-based)
- Mineral abundance maps
- Organic slopes and organic ratios

HyLogger™

A Hyperspectral Core Logging System, with cameras operating in the VNIR, SWIR and TIR range. It operates in a straight line, acquiring information at each 0.8 mm.

Outputs:

- Optical photograph
- Distribution of the main mineralogy through the core
- Bin of the mineral distribution

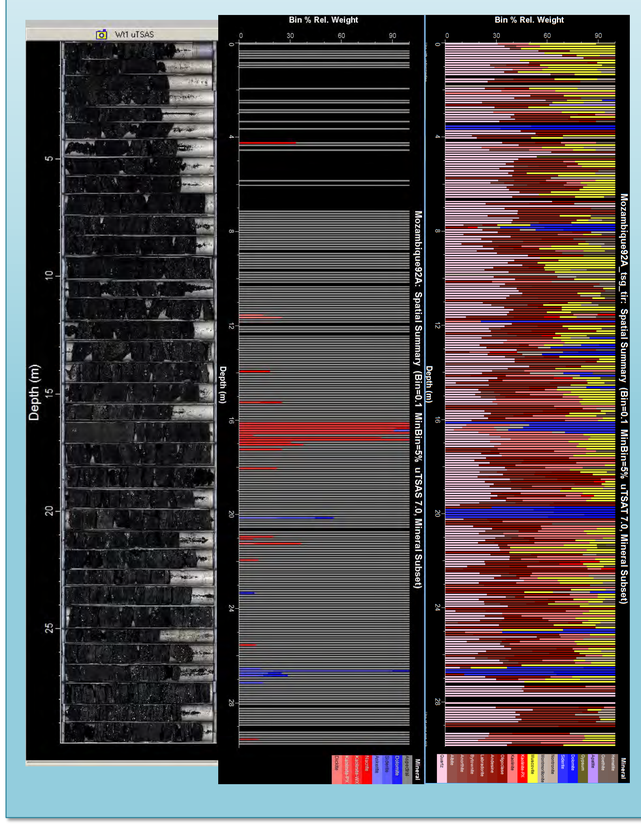
Itrax™ XRF

Automated core scanner with energy-dispersive X-ray fluorescence spectrometers. The resolution for data acquisition can go to very small spacing, in this work was used 0.5 mm.

Outputs:

- Optical photograph
- Radiograph image
- Elemental profile (major and trace elements distribution)

HyLogger™



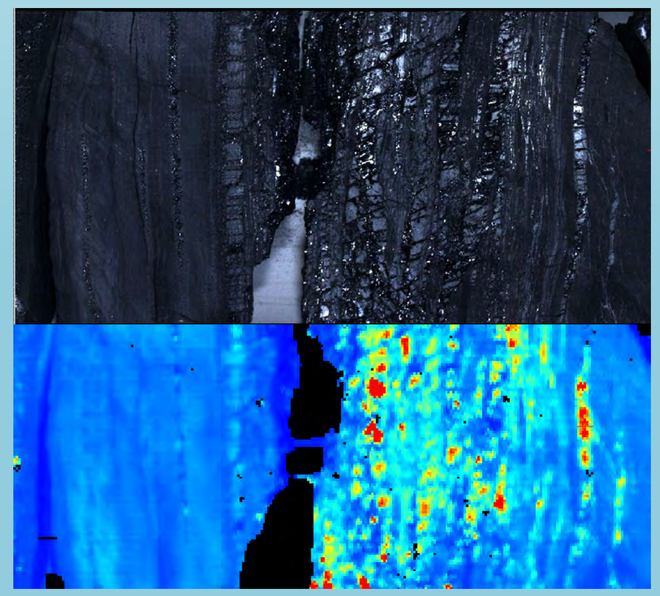
SWIR and TIR mineral distribution:

- Clays, mainly kaolinite, followed by dickite and some montmorillonite.
- Quartz is identified throughout the Chipanga Seam, but tend to increase in relative abundance to top of the seam.
- Carbonates occurs in localised parts of the seam, and are related to either as siderite cement partings or as infillings in fractures.
- Feldspar and mica are also detected by the HyLogger TIR, but these are yet to be verified.

Corescan™

SWIR mineral distribution:

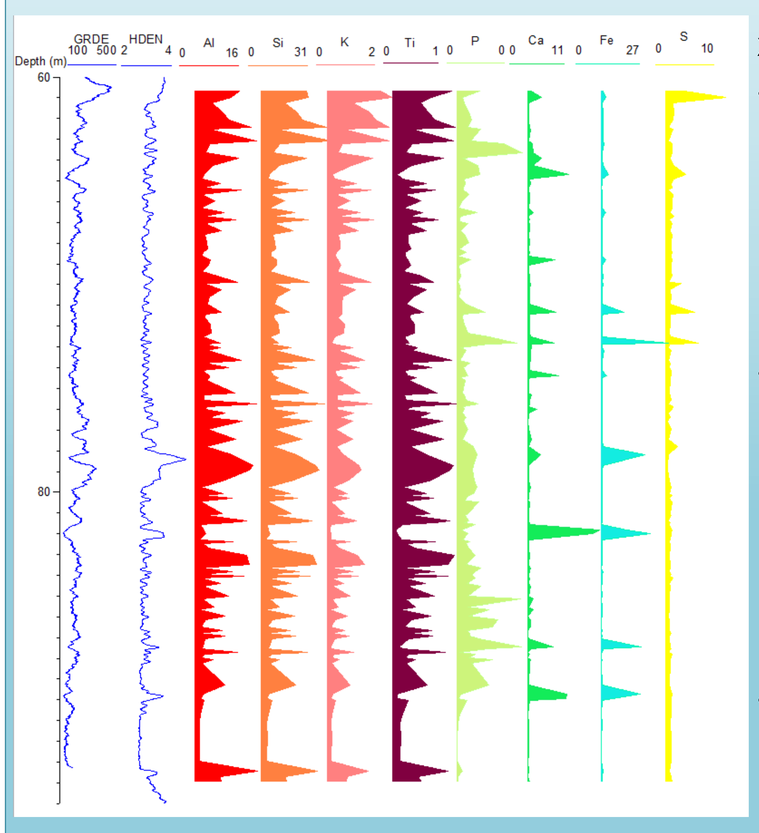
- The mineral class map created shows that the main clay is kaolinite, with minor occurrences of dickite and chlorite.
- Carbonates, such as siderite and carbonates (undifferentiated) are also mapped; they occur in specific locations that may be associated with cement partings.
- The absence of mineral recognition to the top of the seam points out for minerals that are not able to be identified by SWIR spectrometer, such as quartz (identified by the HyLogger).



Organic ratios:

- Corescan creates maps of the coal itself using organic ratios, which are a combination of distinct curves in the spectra which can be related to C and O bond stretching, such as the coal combined ratio in the figure. This ratio seems to be related with changes in the reflectance, that is, the upper part of the Chipanga Seam shows high reflectance (Rr= 2.5%) and coke microstructure (fine mosaic) when observed at the optical microscope, which are not observed in the lower part of the seam with lower reflectance (Rr=1.2%).
- The albedo at 550 nm from the Corescan™ also distinguishes between the different coal lithotypes (bright vs dull), based on their reflectivity.

Itrax™ XRF



XRF elemental distribution:

- Peaks of P combine with Ca indicating the occurrence of apatite in the Chipanga Seam, with higher concentrations in the lower part of the seam.
- Peaks of S occur associated with Fe indicating the presence of pyrite. However, S is a constant in seam, which can be related to organic sulphur.
- Higher amounts of Al, Si and K coincide with higher abundance of quartz and muscovite in the HyLogger
- Peaks of Ca and Fe correspond to the higher concentrations of carbonates, such as siderite cement partings.

Conclusion

- HyLogger™ TIR provided the “missing” mineralogy that cannot be acquired the lower wavelengths spectrometers (SWIR).
- Corescan™ with higher resolution provided information regarding coal properties that seem to be associated with rank and organic composition, in addition to mineral matter.
- The two systems are complementary and provide rapid methods for characterising the core at different scales.
- Itrax™ XRF is set up for a high resolution profiling of elements that are detrimental for coal utilisation, which cannot be evaluated by the hyperspectral technologies herein presented.

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