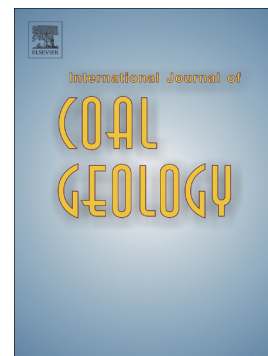


Accepted Manuscript

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PII: S0166-5162(17)30325-7

DOI: doi: [10.1016/j.coal.2017.09.003](https://doi.org/10.1016/j.coal.2017.09.003)

Reference: COGEL 2885

To appear in: *International Journal of Coal Geology*

Received date: 17 April 2017

Revised date: 1 September 2017

Accepted date: 7 September 2017

Please cite this article as: Cortland F. Eble, Stephen F. Greb , Geochemical, petrographic and palynologic characteristics of two late middle Pennsylvanian (Asturian) coal-to-shale sequences in the eastern Interior Basin, USA. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. *Cogel*(2017), doi: [10.1016/j.coal.2017.09.003](https://doi.org/10.1016/j.coal.2017.09.003)

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Geochemical, Petrographic and Palynologic Characteristics of two Late Middle Pennsylvanian (Asturian) Coal-to-Shale Sequences in the Eastern Interior Basin, USA

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Abstract

Two coal-to-shale sequences of late Middle Pennsylvanian (Asturian) age from the southern portion of the Eastern Interior (Illinois) Basin, USA were examined geochemically, petrographically and palynologically. The Springfield coal was found to be moderately low in ash yield and high in total sulfur content. Petrographically, the coal is high in vitrinite content and low in liptinite and inertinite. Palynologically, the bed is co-dominated by spores of arborescent lycopod and tree fern affinities. The examination of closely-spaced bench samples revealed vertical species variation within both of these plant groups. *Lycospora micropapillata* + *L. orbicula*, both of which were produced by *Paralycopodites*, are most abundant in basal coal benches, whereas *Lycospora granulata*, produced by *Lepidophloios* is the dominant arborescent lycopod spore throughout the rest of the bed. *Thymospora pseudothiessenii* is the dominant tree fern spore throughout most of the coal, with *Laevigatosporites globosus* becoming dominant in the top-most coal benches.

The Herrin coal bed is also moderately low in ash yield and high in total sulfur content. Unlike the Springfield coal, it contains two distinct inorganic partings that have regional extent. The Herrin coal also has several coal benches with increased ash and sulfur that were not present in the Springfield coal bed. Petrographically, it is dominated by vitrinite, with the partings and high ash coal benches containing more inertinite, and liptinite. Palynologically, the Herrin coal is dominated by arborescent lycopod spores with subdominant tree fern spores. As with the Springfield coal, *Lycospora micropapillata* + *L. orbicula* are the dominant arborescent lycopod spores at the base of the coal, with *Lycospora granulata* dominating the rest of the bed. *Granasporites medius*, which was produced by *Diaphorodendron* and *Synchysidendron*, occurs more frequently in the Herrin coal bed, and are most abundant in, and in proximity to, the two inorganic partings. Tree fern spores are less abundant in the Herrin coal, and do not display any discernable vertical species variation.

Collectively, both the Springfield and Herrin coal beds are interpreted to have formed in extensive planar, topogenous mires. Consistently saturated peat conditions throughout the development of both paleomires are indicated by the high vitrinite contents, and prevalence of arborescent lycopods. The deposition of widespread inorganic partings in the Herrin coal represent significant events in peat accumulation, with high ash coal benches representing smaller, more local events.

Both of the coals are overlain by black, very organic-rich (avg. TOC +/- 20 %) marine shales. The Turner Mine Shale, which directly overlies the Springfield coal, has layers at the coal/shale contact with fairly abundant vitrinite, primarily in the form of vitrodetrinite, near the base of the shale, but the majority of the shale is dominated by the liptinite macerals bituminite, lamalginite and amorphinite. Micrinite is a major organic component of the shale. The Anna Shale, which directly overlies the Herrin coal, is similar in overall maceral composition, but contains less vitrinite, and more solid bitumen and micrinite. Trace element ratios (Ni/Co, V/Cr, V/V + Ni), indicative of paleoredox conditions, indicate that both shales were deposited under mainly dysoxic to suboxic/anoxic conditions. The shales are interpreted to represent a progressively rising water table, caused by an increase in eustatic sea levels. Vitrinite reflectance values in the shales are lower than corresponding values measured from the coal, indicating some degree of vitrinite suppression occurring in the Turner Mine and Anna Shales.

Key Words: Geochemistry; Petrography; Palynology; Coal; Shale

1.0 Introduction

The Western Kentucky Coal Field is the southern tip of the Eastern Interior, or Illinois Basin (Fig. 1). It covers 16,576 km² and contains approximately 36 billion tons of remaining coal resources,

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