APPLICATION OF SPORE AND POLLENS

IN

CORRELATION OF COAL SEAMS

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Palynology is the microscopic study of fossil spores and pollens. Because plants evolved through time, and climates changed through time, the plants in coal-forming wetlands changed through time.

In many coal basins, groups of coals, and some times individual coals, can be correlated based on their spore and pollen content. Vertical and lateral changes in palynology are sometimes good indicators of likely changes in coal quality because they relate to the original coal-forming swamp plants and swamp conditions. Palynology can be used to determine what the ancient coal-forming wetlands that formed the coal looked like for comparison to modern peat-forming wetlands.

SPORES

- Spores are reproductive haploid structures that is adapted for dispersal and surviving for extended periods of time in unfavorable conditions.
- Spores form part of the life cycles of many plants, algae, fungi and some protozoans.
- A chief difference between spores and seeds as dispersal units is that spores have very little stored food resources compared with seeds.

- Spores are usually haploid and unicellular and are produced by meiosis in the sporophyte.
- Once conditions are favorable, the spore can develop into a new organism using mitotic division, producing a multicellular gametophyte, which eventually goes on to produce gametes.

POLLEN

- Pollens are produced from the microspore mother cells, but female spores are produced by the megaspore mother cells

- Pollen grains have two outer coats extine and intine and female spores do not have the extine or intine.

- Pollens are dispersed by various mechanisms, but female spores are retained within the ovary.

Pollens are found inside the pollen sac, and female spores are found inside the ovule.

- In other words, all pollens are spores, but not all spores are pollens.

Coal is formed from accumulations of plant matter in mire environments (the term “mire” includes swamps, marshes, moors, fens, and bogs). The kinds of plants inhabiting coal forming mires have changed through geologic time but can also differ with the diverse ecological settings of mires.

Different kinds of plants can form coal deposits with a variety of compositional characteristics. Understanding the kinds of plants that formed a particular coal deposit contributes to understanding the properties of the coal (other than rank) that may have economic significance in coal utilization

The coalification process involves the structural and chemical decomposition of plants. Consequently, the kinds of plants that formed a particular coal deposit cannot be directly identified by examination of the coal. However, spores and pollen produced by plants inhabiting ancient coal-forming mires are well preserved in all but the most highly altered coal deposits.

Therefore, study of the fossil spores and pollen preserved in coal can be the key to understanding the nature of the plant communities of ancient mires.

Knowledge of the vegetation of ancient mires leads to interpretations of their paleoecological settings and of paleoclimates, which are major factors affecting “coal systems” as defined elsewhere in this volume.

Palynological studies of coal also provide valuable data on age and correlation of coal beds and coal zones, which are important features of coal systems.

Warwick (this volume) explains that the development of a coal system from the initial deposition of peat to the ultimate utilization of a coal resource involves several phases, including accumulation, burial, and preservation, and diagenetic to epigenetic coalification.

The accumulation phase includes five fundamental components: plant type, peat mire type, climate, sedimentation style, and syngenetic processes.

Also important in studies of coal systems and the exploitation of coal deposits are the geologic age and stratigraphic correlation of coal beds or coal zones. The use of stratigraphic palynology in conjunction with the essentially paleoecologic investigations outlined above have a long history in coal geology.

This history is not reviewed here, but some complications and a successful methodology are briefly discussed.

EXAMPLES

A seminal palynological study of a coal deposit leading to an interpretation of the flora of the mire from which it was derived is that of Traverse (1955) on the Brandon lignite, a noncommercial coal of early Miocene age (Traverse, 1994).

In his 1955 study, Traverse documented the pollen and spore flora of the lignite and related it to modern plant genera and families to reconstruct the ancient mire flora.

The palynoflora of the Brandon mire is numerically dominated by pollen of flowering plants (angiosperms), especially fossil species referable to the living beech and cyrilla families.

The modern affinities of certain other fossil plants represented by pollen in the coal enabled Traverse (1955) to reach important conclusions about the subtropical to tropical paleoclimate of the Brandon deposit.

Although there were important floristic differences, Traverse (1955) found the closest modern analog to the Brandon lignite mire in the swamps of Florida.

Cohen and Spackman (1972) later studied the peat deposits of southern Florida with the goal of reconstructing the ancient environments in which they formed; these peat deposits were viewed as precursors to coal deposits.

Several distinctive types of peat were identified in this work, including those formed predominantly or largely of mangroves, saw grass, water lilies, and ferns or admixtures of these plants. The depositional environments of these peats ranged from marine (the mangroves) through brackish to freshwater (saw grass and water lilies).

Cohen and Spackman's (1972) analyses of peat types were primarily paleobotanical in nature but were supplemented by unpublished palynological data of Riegel (1965). Riegel's data could be used to distinguish the peats of marine and freshwater origin