AN ASSIGNMENT ON THE MORPHOLOGICAL CLASSIFICATION OF POLLEN AND SPORES

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QUESTION 1

Discuss the morphological classification of pollens and spores.

Spores and pollens are normally retrieved from their host sediments as disjunct entities, separate from the original parent plant. The free sporing plants including the Bryophyta e.g. mosses and liverworts, and the Pteridophytes which, although not a natural classification, encompassess all the seedless vascular plants, including the palaeontologicaly important ferns and fern allies, are primarily classified using the gross morphology, wall structure and the type of wall sculpture, if present. The important feature of homospory in terms of the fossil record is the four fold division involved in spore production, this takes the form of either a tetrahedra which gives a trilete spore or a tetragon which gives a monolete spore. The trilete and monolete marks imparted on the individual spores are the marks where each of the spore tetrad once abutted each other.

Spores can be classified in several ways:

By spore producing structure

- Fungi

In fungi and fungus-like organisms, spores are often classified by the structure in which meiosis and spore production occurs. Since fungi are often classified according to their spore-producing structures, these spores are often characteristic of a particular taxon of the fungi.

- Sporangiospores: spores produced by a sporangium in many fungi such as zygomycetes.
- **Zygospores**: spores produced by a zygosporangium, characteristic of zygomycetes.
- **Ascospores**: spores produced by an ascus, characteristic of ascomycetes.
- **Basidiospores**: spores produced by a basidium, characteristic of basidiomycetes..
- **Aeciospores**: spores produced by an aecium in some fungi such as rusts or smuts.
- **Urediniospores**: spores produced by a uredinium in some fungi such as rusts or smuts.
- **Teliospores**: spores produced by a telium in some fungi such as rusts or smuts.
- **Oospores**: spores produced by an oogonium, characteristic of oomycetes.

- Red Algae

- **Carpospores**: spores produced by a carposporophyte, characteristic of red algae.
- **Tetraspores**: spores produced by a tetrasporophyte characteristic of red algae.

By function

- **Chlamydospores**: thick-walled resting spores of fungi produced to survive unfavorable conditions.
- **Parasitic fungal spores** may be classified into internal spores, which germinate within the host, and external spores, also called environmental spores, released by the host to infest other hosts.

By origin during life cycle

- **Meiospores**: spores produced by meiosis; they are thus haploid, and give rise to a haploid daughter cell(s) or a haploid individual. Examples are the precursor cells of gametophytes of seed plants found in flowers (angiosperms) or cones (gymnosperms), and the zoospores produced from meiosis in the sporophytes of algae such as Ulva.
    - **Microspores**: meiospores that give rise to a male gametophyte, (pollen in seed plants).
    - **Megaspores** (or **macrospores**): meiospores that give rise to a female gametophyte, (in seed plants the gametophyte forms within the ovule).
- Mitospores (or conidia, conidiospores): spores produced by mitosis; they are characteristic of Ascomycetes. Fungi in which only mitospores are found are called "mitosporic fungi" or "anamorphic fungi", By mobility

Spores can be differentiated by whether they can move or not.

- **Zoospores**: mobile spores that move by means of one or more flagella, and can be found in some algae and
- **Aplanospores**: immobile spores that may nevertheless potentially grow flagella.
- **Autospores**: immobile spores that cannot develop flagella.
- **Ballistospores**: spores that are forcibly discharged or ejected from the fungal fruiting body as the result of an internal force, such as buildup of pressure.
- **Statismospores**: spores that are discharged from the fungal fruiting body as the result of an external force, such as raindrops or a passing animal. Examples are puffballs.

Classification of pollen, like that of spores is based on the morphological trends observed among various groups of fossils which may be primarily but not entirely reflections of evolution within the groups of plants which produced the pollen. It should also be remembered that higher plants have charcteristics of reproduction which permit them to utilise modes of evolution unavailable to animals. Because of their relatively simple genetic systems plants may utilise hybridisation and self fertilisation. The early gymnosperms produce prepollen, differentiated from true pollen by germination from the proximal rather than the distal side. Recent gymnosperms may produce very distinctive saccate pollen, i.e. pollen with one, two or rarely three air sacs attached to a central body (colpus) or monosulcate pollen as in the cycads and ginkgos. The angiosperms produce pollen with the greatest morphological variation, but typicaly with either a tricolpate or monosulcate form.

QUESTION 2

Explain and highlight the various applications of pollens and spores in geosciences.

APPLICATIONS

1. **Biostratigraphy and Geochronology**: Pollen and spores are used in biostratigraphy to correlate strata and determine the relative age of a given sequence, horizon, bed. While botanical information from them may be limited, fossil spores and pollen have proved exceptionally useful as biostratigraphic indices. They are particularly valuable in freshwater environments, in evaporitic deposits and situations where marine and freshwater facies interdigitate. Pollen and spores can also be used to gather additional information about ground ice origin.

2. **Paleoecology and Climate change**: Pollen and spores can be used to reconstruct past vegetation and marine and freshwater phytoplankton communities, and thus inferring paleoenvironmental and paleoclimatic conditions in the area.

3. **Organic palynofacies studies**; palynofacies; pollen and spores provide information on the depositional paleoenvironments of sedimentary rocks.

4. **Geothermal alteration studies**; examine the colour of palynomorphs extracted from rocks to give the thermal alteration and maturation of sedimentary sequences, which provides estimates of maximum palaeotemperatures.

5. **Limnology studies.** Freshwater palynomorphs and animal and plant fragments, including the prasinophytes and desmids (green algae) can be used to study past lake levels and long term climate change.

6. **Taxonomy and evolutionary studies**. Involving the use of pollen morphological characters as source of taxonomic data to delimit plant species under same family or genus. Pollen apertural status is frequently used for differential sorting or finding similarities between species of the same taxa. This is also called Palynotaxonomy.

QUESTION 3

Explain the stratigraphical and paleoenvironment applications and significance of pollens and spores in sedimentary and petroleum geology.

In petroleum geology, pollen and spores are used to determine the geologic ages and stratohorizons of petroleum source rocks as they are extracted from small samples of rock secured in drilling operations. Palynological analysis is a practical application in petroleum exploration. The fossil spores and pollen should be from the source bed, the carrier bed and the reservoir bed, thus forming a three- part assemblage. Correlation of fossil spores and pollens are used to judge petroleum source rocks. palynofacies; pollen and spores provide information on the depositional paleoenvironments of sedimentary rocks.

In sedimentary geology, pollens and spores fossils are recoverable in statistically significant assemblages in a wide variety of sedimentary rocks. Such microfossils are useful in determining geologic age and are especially important in sediments devoid of large fossil. Pollen and spores are used in biostratigraphy to correlate strata and determine the relative age of a given sequence, horizon, bed. While botanical information from them may be limited, fossil spores and pollen have proved exceptionally useful as biostratigraphic indices. Pollen and spores can be used to reconstruct past vegetation and marine and freshwater phytoplankton communities, and thus inferring paleoenvironmental and paleoclimatic conditions in the area. They are particularly valuable in freshwater environments, in evaporitic deposits and situations where marine and freshwater facies interdigitate. Pollen and spores can also be used to gather additional information about ground ice origin. palynofacies; pollen and spores provide information on the depositional paleoenvironments of sedimentary rocks.