Fossil Pollen, Spores, Diatoms and Phytoliths

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TOPIC: Fossil Pollen, Spores, Diatoms and Phytoliths

THEME: Palynology

DEPARTMENT: Herpetology

Maize under the microscope
Source: NMK - Palynology

Lesson Objectives

1. The participants shall define palynology.
2. The participants shall pollen grains, spores, phytoliths and diatoms.
3. The participants shall appreciate the importance and application of the study of palynology.
4. The participants shall appreciate the role of Palynology Section within the Department of Earth Sciences at the National Museums of Kenya.

Learning resources

1. Text
2. Video
3. Photo

What is Palynology?

Palynology is the study of pollen grains and spores and other micro remains of organisms that are virtually indestructible, microscopic, but easily identifiable using their morphological characteristics. Such microorganisms and others can be found in wetlands, dry paleo lakes, and archaeological and geological exposures. These microscopic remains are used to study paleoclimates and paleoenvironments ranging from seasons to millennia.

Definition of terms

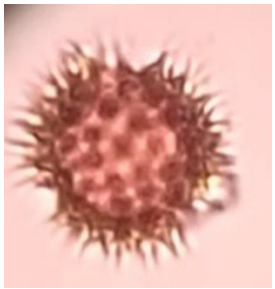
Pollen grains are defined as haploid micro gametophytes that transport male reproductive cells in a plant, while spores are single-celled reproductive units of nonflowering plants. Phytoliths are microscopic particles of silica that form in plant tissues, finally diatoms are unicellular eukaryotic alga characterised by having a siliceous covering and a symmetrical body.

Eucalyptus sp. (Exotic) as seen through a microscope
Source: NMK - Palynology

Fossilized Pollen and Spores

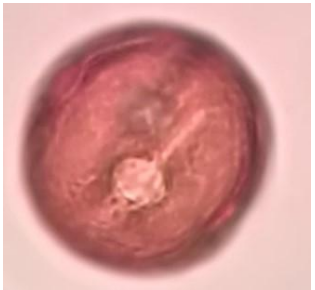
A fossil is any evidence of prehistoric life that can be used in the identification of stratigraphic units. They serve as index fossils and can be used to identify relative age and correlate sedimentary rocks at great distance.

Pollen and spores can be preserved under certain environmental conditions in the sediments, both ancient and recent times. They are used in the reconstruction of past vegetation changes. Pollen and spores have been proved invaluable as indicators of past environmental conditions. They have complex material called **sporopollenin** that does not easily support decay, making them easily preserved in abundance in wetlands and in paleo lakes. Due to their sizes, they are easily transported to a considerable distance, suggesting pollen and spores identified in the sediments can be from local or surrounding vegetation. Their structure and shaping help in the identification of the plants, and their abundance in the sediments help in quantitative counting of different types of pollen grains.



Biden pilosa (Black Jack) under microscope
Source: NMK - Palynology

Zea mays (Maize) under a microscope
Source: NMK - Palynology



Ricinus communis (Castor) under a microscope
Source: NMK - Palynology

Importance and application of studying pollen grains

Archaeology: The study of pollen in archaeology is used to reconstruct ancient environments and document environmental changes that had significant impact on human societies.

Exposure in archaeological site
Source: NMK - Palynology

Entomopalynology: This is the study of pollen and their interactions with insects, providing important information to their migration activities and feeding habits (Jansonius and MacGregor, 1996).

Insect identified in recovered sediments
Source: NMK - Palynology

Melissopalynology: This is the study of pollen grains in honey. This assists to combat fraud, inaccurate labelling of honey and trace geographical origin of a particular type of honey.

Paleopalynology: This is the study of fossil pollen and spores to reconstruct vegetation history. The reconstructed vegetation helps us to understand paleoclimates and palaeoenvironments.

Forensic palynology: The study is used to compare pollen content in samples collected from a suspect against the background at the scene of the crime and their alleged whereabouts at the time of crime. It can also be used to determine if a corpse has been moved by comparing the pollen on the corpse against the background at the scene of recovery (Faegri & Iversen, 1975; Jansonius & McGregor, 1996).

Medical Palynology: Many people are allergic to pollen by reacting to various types of modern pollen grains. This type of study aims to identify various pollen grains in the atmosphere susceptible to individuals causing serious allergic reactions.

Study of plant taxonomy: Pollen characters are useful in solving complicated problems of interrelationships between various taxa and their assessment of their status helps in the classification particularly with reference to the families, sub-families, species and subspecies.

Petroleum geology: Palynomorphs (microscopic fossils composed especially of pollen or spores) in petroleum can be used as indicators for correlation between oil and source in order to identify petroleum source rocks. As fossils, they can also indicate geological ages and ecological environments of petroleum source rocks.

Process of collecting and preserving fossilised pollen and spores

Sediment samples: Palynological research involves field work to recover sediments by carrying out coring using various methods that include:

- Russian coring method, commonly used in swamps, marshy areas, fens and bogs.
- Long core drilling is used for big holes in paleolakes and petroleum extraction, and other fields. For long core drilling, rotary drilling method is used for long records that cover hundreds of years to millions.
- Piston coring/Livingstone coring techniques is used in large water bodies such as lakes and seas

Preparing to recover sediments
Source: NMK - Palynology

Recovered core using Russian corer
Source: NMK - Palynology

Taking core length
Source: NMK - Palynology

Storage of pollen grains: Pollen grains can be preserved in viable conditions, in liquid nitrogen at the temperature of -196 degrees Celsius. This method is called cryopreservation. The lower temperature allows it to store for a longer period of time as it reduces the growth rate of the cells.

Pollen and other microfossils identification: The identification is done using light microscopes of different magnification objectives that range from x10 to x100. Oil immersion is used to increase the resolving power of a microscope. This is achieved by immersing both the objective lens and the specimen in a transparent oil of high refractive index, thereby increasing the numerical aperture of the objective lens.

Cold room/deep freezer: This is used to store cores recovered from wetlands for future research.

Core lithology
Source: NMK - Palynology

Role of National Museum of Kenya's Palynology Section

National Museums of Kenya (NMK) provide fundamental information about past climates changes and encompasses two main factors in environmental history: human interactions with landscapes, and plant cover changes. The museum is also a place where fossilised material is stored for study to be done by future generations helping to inform studies around climate change.

References

Jansonius J. and McGregor D. C. (eds). (1996). *Palynology: principles and applications*. American Association of Stratigraphic Palynologists Foundation.

Faegri , K. and Iversen , J. (1975). *Textbook of Pollen Analysis* (3rd ed.). Hafner Press.