e-Journal Earth Science India: www.earthscienceindia.info
Popular Issue, April, 2008

# PALAEOPALYNOLOGY: The Wonderful Dating Tool

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*Quite astonishingly people frown upon the fact that how do the minuscule pollen and spores - the fundamental reproductive units of plants - indicate the age of rocks. A plant completes its life cycles in two stages – gametophytic and sporophytic generation. The number of chromosomes of an organism in each generation is definite: Haploid in gametophytic and diploid in sporophytic generation. In plant kingdom, the gametophytic generation is more pronounced in lower plants and sporophytic generation is more developed in higher plants. The science of pollen and spore study is known as palynology, while the study of fossil pollen and spores comes under the purview of palaeopalynology.*

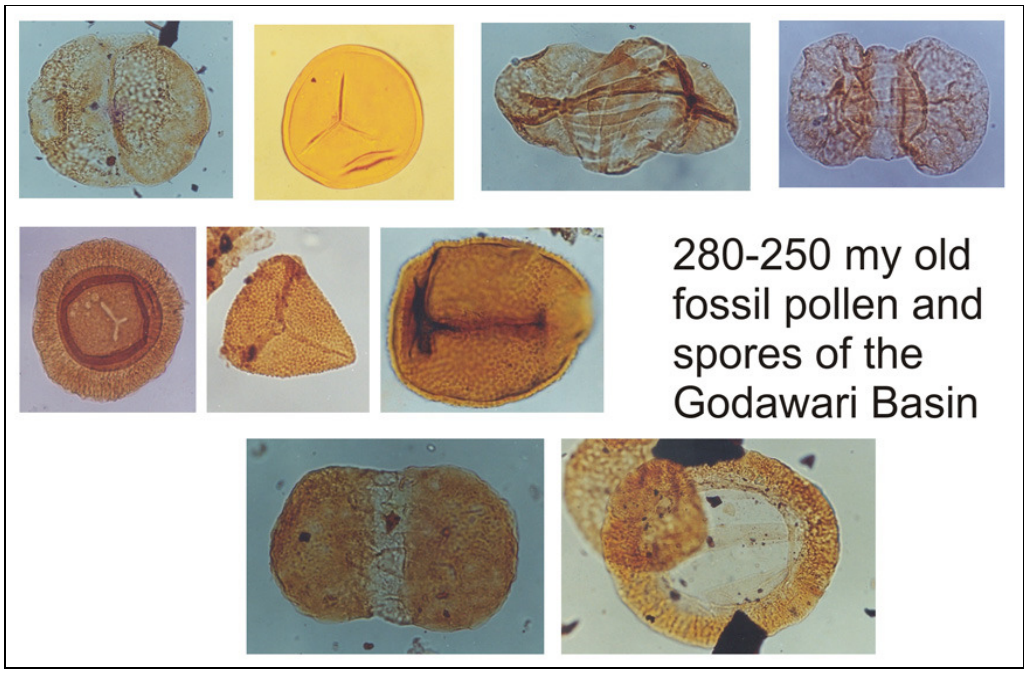
## Fossilisation

In nature, smaller forms are more readily fossilised – under conducive conditions - than gigantic ones, with better recognizable and identifiable features. This very characteristic makes palynology a ‘palaeobotanists's delight'. Pollen grains are produced by advanced vascular plants. They represent first unit of gametophytic generation. Spores are produced by many groups of primitive plants, they may be haploid or diploid. Pollen and spores are invisible to unaided eyes, but can be easily recognized under a microscope. They are produced in enormous number by the plants. The unique fossilising character of these microscopic forms is owing to the presence of a substance called ‘sporopollenin' in their outer wall called ‘exine', and hence, they cannot be easily changed or destroyed In nature, formation of rock is a continuous process. Over the millions of years during which sediments are deposited, pollen and spores, released by the plants and subsequently blown by the wind or water get deposited with the sediments, during sedimentation. During this process of deposition, plants and animals or their parts including pollen and spores representing that particular time under favorable fossilizing conditions, get preserved in the rocks as fossils and become the characteristic elements of that host rock unit. Because of well-preserved diagnostic characteristics, these are considered extremely helpful in rock dating and facies correlation.

## The Indian Scenario

In India palaeopalynological studies were started by the pioneer work of Virkki (1936). He carried out detailed work on the fossil-flora of Lower Gondwana . However, it was Prof. Birbal Sahni who later realized the importance of these microscopic objects, preserving the history of palaeoflora and carried out extensive study on Gondwana flora and laid the foundation of palaeopalynological studies in India . With the active guidance and support from renowned Prof. Seeward, he laid the foundation of palaeobotany in the Indian subcontinent. In India , ever since, in coal and oil exploration, palaeopalynology has become an important all-pervasive tool for dating and correlation of rocks. The laboratory he worked, later became the famous Birbal Sahni Institute of Palaeobotany, located at Lucknow . Being unique of its kind in India , this Institute is catering to the needs of various organisations – engaged in oil and coal exploration and also in academics.

In laboratory, these fossil ‘grains' (pollens and spores both) can be easily separated from the host rock by a method called maceration, in which the fossil-rich rocks are crushed and the material is treated with necessary amounts of concentrated acids and alkalies to remove the unwanted fraction and obtaining clean pollen and spores. These separated ‘grains' are then subjected to identification under microscope. With the help of treatise and other methods specific identifications are made for carrying out further desired investigation.




## The Geological Perspective

During the course of evolution in the geologic past and climate changes, many a plant species became extinct and new ones evolved. Hence, we find different pollen-spores or their groups in different strata with clear origin and extinction points i.e. appearance, dominance and disappearance of the same. Most importantly, different types of plants produce different types of pollen and spores, which are unique in their shape and morphological characteristic that can readily be identified. Some pollen grains have distinctive sculpturing. Many coniferous trees, such as pine and spruce, produce pollen with saccus. Several types of deciduous trees produce pollen grains with openings or pores. Not only the basic structure of pollen and spores vary, but so also do its surface ornamentation. This characteristic of pollen and spores helps in revealing differential distribution of fossil pollen and spores through time. Thus, pollen and spores in a rock of different time are quite different in their morphological and numerical characters and thus, presence of particular type of pollen and spores or their groups (palynoassemblage) characterize that particular horizon. Dating and correlation of rocks is performed by the qualitative and quantitative study of these pollen and spores and by comparing the palynoflora of one area with other, the rock strata are correlated.

Pollen and spores present in the rocks represent the parent plant of that particular time when the rock was formed. If we analyse the general distribution of pollen and spores through geologic time, we find that in Silurian time the spores were very few and simple trilete. In Early Devonian time they became slightly complex and ornamented. In Middle Devonian time heterospory (production of two kinds of spores- micro and megaspores)

originated. From the rocks of Carboniferous time fossils of seed megaspore *Lepidocarpon* has been recorded. First presence of pollen has been recorded in rocks of Carboniferous time. In Permian time (290-250 my) changes in structural complexities, shapes and type of pollen is evident. Saccate pollen grains are dominant in Permian rocks as gymnosperms were the dominant group of plants during this time. In early Permian, monosaccate pollens were dominant while disaccates were prevalent during late Permian. In rocks of Triassic and Jurrassic time different types of pollen and spores have been recorded. In Early Cretaceous time, angiosperms evolved, hence we get angiosperm pollens in the rocks of this time. Hence, researchers deduce the date by the studying detailed pollen morphology and their geologic distribution.

Besides telling the age of the rocks the study of pollen and spores is useful in stratigraphic correlation, palaeoclimate modeling, palaeoecological interpretations, forensic and medical sciences also.

## About the Author

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