CHAPTER 1

INTRODUCTION

Eduard Suess (1985) introduced the term ‘Gondwanaland’ for the hypothetical supercontinent \((\text{Pangaea})\). Alfred Wegener (1912), proposed the evidences for supercontinent \(\text{Pangaea}\), existed during Late Palaeozoic and all the continents were united into a single landmass surrounded by the great ocean \(\text{Panthalassa}\). Later, \(\text{Pangaea}\) fragmented into two land masses, the northern \(\text{Laurasia}\) and southern known as Gondwana. During Cretaceous Gondwana further fragmented into five parts viz. India, South Africa, Australia, South America and Antarctica. Wegener’s continental drift theory was supported by A. L. Toit (1937) in his book \textit{Our Wandering Continents} in which he has described the similarity in the geological formations of continents and has given the thoughts of its existence. The presence of \(\text{Glossopteris}\) flora and \(\text{Mesosaurus}\) fauna specially in Carboniferous and Permian rocks of Gondwana sequence in all the Gondwana continents supports the existence of Gondwana.

The term Gondwana was introduced by H. B. Medlicott in 1872. However, it was published by Ottokar Feistmantel in 1876. According to Fox (1931), the Gondwana system was applied to deposits of conglomerate, sandstone, shales and coal seams of fluviatile and lacustrine origin which occur in the Indian Peninsula and whose geological age ranges from Middle or Early Carboniferous to Upper Jurassic. The time span of the Gondwana deposits has been revised by further studies by Sastri et al. (1977) and several scientists and Upper Carboniferous to Lower Cretaceous age has been assigned to these freshwater or riverine deposits of conglomerates, sandstones, silts, shales and coal measures. The base of which is marked by the presence of tillite or glacial boulder bed. The Gondwana sediments are notable for the remarkable presence of fossil flora which are named as the \(\text{Glossopteris, Dicroidium}\) and \(\text{Ptilophyllum}\) floras. The Gondwana sediments are believed to be deposited only on the Gondwanaland within the prescribed time and ecological limits \textit{sensu} Fox (1931).

Palynology is the science that deals with the study of pollen and spores, their dispersal and application thereof. This definition was given by Hyde and Williams (1944) when they coined the term ‘palynology’. With the widening scope of palynology it started accommodating other organic-walled microfossils. Now palynology is the branch of Palaeobotany which deals with the study of organic-
walled microfossils, both extant and extinct. It includes the study of spores, pollen, megaspores, dinoflagellate cysts, foraminifers, acritarchs, radiolarians, chitinozoa, scolecodonts, conodonts, oligostegina, microscopic algae, nannoconus, fungi, ostracods, dermal appendages, cuticles, vascular elements, and various other organic-walled microfossils (Tschudy & Scott 1969; Traverse 1988; Agashe 2006).

Palaeopalynology is an interdisciplinary science focussed on the study of organic microfossils found in sedimentary rocks ranging from the Precambrian to the Holocene. Reinsch (1881) discovered Carboniferous, Permian and Triassic plant remains from the coal for the first time and suggested the extraction method of spores from the coal. He published the first photomicrograph of fossil spores. Bennie & Kidston (1886) exhibited the occurrence of spores in the coal.

The pioneer palaeopalynological studies in India were initiated by Professor Birbal Sahni. Virkki (1937) under the guidance of Professor Sahni undertook the palynological studies and described some bisaccate pollen grains belonging to Permian sediments. Sahni (1940, 1948) reported the significance of these palynomorphs in fossil fuel exploration and forced for the palaeobotanical studies of coal seams in India. Later on, the studies were carried out by different palaeopalynologists (Sen 1944; Mehta 1944; Ghosh & Sen 1948; Pant 1950; Mittre 1961; Srivastava & Pawde 1962). However, a systematic approach has been made by Bharadwaj (1962). Diverse aspects of the palaeopalynology have been discussed by different palynologists. Lots of researchers and scientists carried out palynological work in the various field of palaeopalynology in different parts of India and palynology became a fast growing science with various application possibilities to solve the geological problems. Since then a large number of palynological studies have been taken place in different areas spanning the great extent of time and covering large geographical space in India. Palynology contributed a significant role in a diverse range of applications, related to many scientific disciplines like Biostratigraphy, Geochronology, Palaeoecology (Palaeoenvironment), Climate change, Geothermal alteration, Taxonomy, Evolutionary studies and Archaeological palynology.

Palynomorphs represent a reproductive phase of life-cycle in various plants that have at time evolved quite rapidly, therefore palynomorphs are characteristic and support narrow time span and hence useful for age understanding. Geochronology
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deals with the dating of rocks. On the other hand, the other aspect of palynology i.e. biostratigraphy is economically important and related to the study and correlation of rocks. Well identified, stratigraphically significant palynomorphs and palynoassemblages are helpful in identifying the oil, coal, and gas deposits. As fossil spores and pollen are constituents of coal and present in associated sediments, these can be executed for dating and correlation of coal and associated horizons. The source area of fossil pollen and spores may be terrestrial, freshwater, saltwater or estuary and they get deposited in sedimentary rocks in depositional site. Palynomorphs preserved easily in enormous number in the sediments because their sexine contains a chemical called ‘sporopollenin’ which is an oxidative copolymer of carotene and carotenoid esters. Sporopollenin is highly resistant to acetaldehydes and has high stability against anaerobic biological and non-oxidative chemical action due to the presence of phenolic and polyaromatic type of compounds. Thus, morphological characters of sexine remain preserved during the process of fossilization as well as the chemical process of maceration. Stratigraphic applications of palynomorphs are evident for age estimates of sedimentary rocks.

Plants have evolved through the ages. During the course of time they have changed their morphological characters by the continuous process of evolution, therefore also the pollen and spores produced by these plants changed their morphological organization and structures. Spores and pollen preserved in the sedimentary rocks represent the contemporaneous parent vegetation which was growing during the deposition of sediments. Thus, the kind and quantitative appearance of pollen and spores in the rocks of different times are quite different in their morphological and numerical characters and hence, the presence of particular types of pollen and spores or their groups (=Palynoassemblages) characterizes that particular horizon of rock. Dating and correlation of coal and associated sediments is practiced by the quantitative and qualitative study of pollen and spores and by comparing the palynoflora and its components of one area with the other rock strata. Palynology has evolved as an important parameter in prospecting and economic utilization of fossil fuel because palynofloras can be used to show correlation of a section of rocks from one place with another section of rocks from a different locality and of perhaps quite different thickness and lithology. Palaeopalynology is well applied for correlation since palynomorphs of one kind or different are found in
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Sedimentary rocks of various ages. Pollen and spores are produced by plants in enormous number, they retain their characteristic morphological features after various physical and chemical processes during preservation or fossilization due to the presence of sporopollenin in their outer wall called sexine, and hence they cannot be easily changed or destroyed. In the laboratory they can easily be recovered from the rock samples by maceration and can be identified feasibly by the presence of taxonomic morphological characters. Due to such virtual reasons, palynological studies are very useful in dating, stratigraphic correlation of coal seams and associated sediments because of their differential and characteristic distribution in time and space.

Godavari Graben is not only one amongst the five major Gondwana basins in India but also having the efficient coal potential. Barakar is the biggest coal producing stratigraphic unit because most of the coal production come from this formation. Exploratory drilling for coal in Ramagundem-mantheni area (Ramanamurthy 1979) revealed that the Barakar Formation is succeeded by Barren Measures and Kamthi Formation. Till late 20th century, Barakar was supposed to be the main coal-bearing horizon in this Graben. Later with the discovery of additional younger coal horizon equivalent to Raniganj Formation is also taken into consideration for the workable coal. The identification and locating the hydrocarbon potential in the younger sequences in newer areas, biostratigraphy and correlation of sediments of the area are the prime tasks of stratigraphic study. Singareni Collieries Company Limited (SCCL) and Mineral Exploration Corporation Limited (MECL) are engaged in the coal and other mineral exploration work in this Sub-basin. Prospecting for additional coal reserves is continued by these organizations. In the present investigation, four bore core sequences designated as MJR-11, MJR-13, MJR-14, MJR-16 have been studied palynologically in order to determine the geological age for palynostratigraphic and environment of deposition in Jangareddygudem area. The palynological inferences have been considered along with the lithostratigraphic attributes. This integrated study provided an insight into the age of sediments and palaeoenvironmental understanding of the area in individual subsurface lithostratigraphic units. A taxonomic study for all of the recorded taxa, with emphasis on the regional and global stratigraphic distribution of stratigraphically significant forms, has been attempted. For the robust
understanding of palaeoclimatic conditions, integrated studies of Dispersed Organic Matter (DOM) in corporation with palynological studies have been attempted.

Gauridevipet-Beddadanuru-Jangareddygudem coal belt will be analyzed for this purpose and its correlation with other sub-basins in the Godavari Graben and other Gondwana basins in India and Gondwana basins in other countries will be studied.