

Diversity in the Lower Cretaceous flora of Dhrangadhra Formation, Gujarat

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Dhrangadhra Formation (Lower Cretaceous) is exposed in different parts of Surendranagar and Rajkot districts of Gujarat. The palaeobotanical investigations have revealed the presence of fairly rich mega- and microfloral assemblages. The occurrence of characteristic Wealden elements such as, *Gleichenia nordenskioldii*, *Onychiopsis psilotooides*, *Weichselia reticulata*, *Cladophlebis kathiawarensis* and presence of *Cicatricosisporites cooksonii*, *Appendicisporites* sp., *Impardecispora* sp., *Aequitriradites* sp., *Microcachryidites* sp. in the microflora support the Lower Cretaceous age for Dhrangadhra Formation.

Key-words-Dhrangadhra Formation, Lower Cretaceous, Megafloora, Mioflora.

INTRODUCTION

THE oldest exposed sedimentary sequence found in Saurashtra, Gujarat is known as Dhrangadhra Formation. Oldham (1893) and Fox (1931) informally referred this sequence as 'Kathiawar Bed', whereas Fedden (1884) designated it as 'Umias of Saurashtra'. The Dhrangadhra Formation is found in Surendranagar and Rajkot districts of Gujarat, covering an area of about 2500 sq. km and attaining a maximum thickness of 500 metres (Fedden, 1884). This formation is made up of fine to medium grained, often obliquely laminated sandstone along with intermittent beds of grey and weakly fissile shales. Fairly rich plant megafossils and comparatively less diversified plant microfossils have been reported from the shale beds of this formation.

Megafloora

Feistmantel (1880) and Fedden (1884) reported *Pecopteris* sp., *Taeniopteris* sp., *Alethopteris whitbyensis* Schimp. (Feistm.), *Ptilophyllum cutchense* Morris, *Palissya jabalpurensis* Feistm., *Taxites tennerimus* Feistm. and *Araucarites cutchensis* Feistm. from this formation. Rao and Vimal (1950) recorded *Sphenopteris* sp., *Cladophlebis whitbyensis*, *Cladophlebis* sp., *Brachyphyllum* sp., *Araucarites cutchensis* and *Elatocladus plana* from Tartar and *Cladophlebis indica* from Dhuli. Roy (1966, 1968), Varma and Rawat (1970), Kasat (1970), Borkar and Chiplonkar (1973), Bose and

Jana (1979). Jana and Bose (1981) Kumaran *et al.* (1984) also worked on the megafossil assemblages from the Dhrangadhra Formation. In all the megaflooral assemblages the dominance of conifer genera e.g. *Pagiophyllum*, *Brachyphyllum* or *Araucarites* is noticed.

Megafossils recorded from this formation are listed : *Equisetum rajmahalensis*, *Matonidium goeppertii*, ? *Phlebopteris* sp., *Hausmannia dichotoma*, *Hausmannia pachyderma*, *Dictyophyllum indicum*, *Gleichenia nordenskioldii*, *Cladophlebis kathiawarensis*, *Cladophlebis* sp., *Cladophlebis* sp. cf. *C. longipennis*, *Onychiopsis psilotooides*, *Weichselia reticulata*, *Sphenopteris* sp., *Ptilophyllum acutifolium*, *Pterophyllum princeps*, *Elatocladus longifolia*, *Elatocladus plana*, *Brachyphyllum expansum*, *Brachyphyllum regularis*, *Pagiophyllum* sp. cf. *P. divaricatum*, ? *Allocladus bansaensis*, cf. *Coniferocaulon rajmahalense*, *Araucarites cutchensis* and *Araucarites macropterus*.

Recently, *Thalites* sp. (Fig. 1) a bryophytic fossil and *in situ* preserved *Isoetes* sp. (Fig. 2) have been discovered from Sonagad and Thar localities.

Mioflora

Palynological assemblages from Dhrangadhra Formation are recorded by Varma and Rawat (1964), Venkatachala and Rawat (1970) and Kumaran *et al.*,



Fig. 1. *Thalites* sp. BSIP specimen no. 33/5253, x 3. Fig. 2. *Isoetes* sp. BSIP specimen no. 99/5522, x1.5.

(1984). Varma and Rawat (1964) reported some pollen grains having angiospermic affinity such as, *Granatricolporites* sp., *Punctatriporites* sp. and *Granatiporites* sp. along with spores and pollen of Lower Cretaceous age from Dhrangadhra-Morvi-Chotila and Surendranagar areas. Venkatachala and Rawat (1970) restudied the earlier assemblage and made fresh preparation from same samples to confirm the record of angiospermous pollen and they confirmed the presence of Lower Cretaceous assemblages but did not recover angiospermous pollen. Kumaran *et al.* (1984) reported some palynofossils from Tarnetar area also. In all these palynological contributions, unlike megafossils, the dominance of coniferous pollen has been noticed.

A check-list of palynofossils recorded from this formation is furnished below: *Cyathidites* sp., *Osmundacidites wellmannii*, *Lycopodiumsporites austroclavatidites*, *Lycopodiumsporites* sp., *Ceratosporites* sp., *Cicatricosisporites cooksonii*, *Neoraistrickia* sp., *Impardecispora* sp., *Klukisporites* sp., *Foveotriletes* sp., *Contignisporites* sp., *Cingulatisporites* sp., *Staplinisporites* sp., *Gleichniidites* sp., *Appendicisporites* sp., *Polycingulatisporites* sp., *Aequitriradites* sp., *Krauselisporites* sp., *Polypodiaceasporites speciosus*, *Callialasporites dampieri*, *Callialasporites discoidalis*, *Callialasporites segmentatus*, *Callialasporites trilobatus*, *Callialasporites triletus*, *Callialasporites* sp., *Podocarpidites* sp., *Pityosporites* sp.,

Microcachryidites sp., *Classopollis pflugii*, *Classopollis* sp., *Ginkgocycadophytus* sp., *Monosulcites* sp., *Araucariacites australis* and *Araucariacites* sp.

Besides Lower Cretaceous megafloral and palynological assemblages, Jana (1984) recorded an early Middle Jurassic subsurface palynological assemblage from a bore hole drilled near Pipli in Surendranagar District in Gujarat. The palynofossils recorded from this bore hole are as follows : *Cyathidites minor*, *Biretisporites potonieii*, *Todisporites major*, *Dictyophyllidites mortoni*, *Concavissimisporites verrucosus* and *Guttatisporites vischeri*

Kumar (1994) restudied the palynological assemblage and recorded *Cyathidites densus*, *Haradisporites mineri*, *H. scabratus*, *Lophotriletes* sp., *Impardecispora uralensis*, *Lygodiumsporites* sp., *Lycopodiacidites asperatus*, *Trilites fusus*, *Callispora potonieii*, *Matonisporites dubius*, *M. phlebopteroides*, *M. discoidalis*, *Ischyosporites haradensis*, *Densoisporites mesozoicus*, *Staplinisporites caminus*, *Lametatriletes mesozoicus*, *L. tenuis*, *Coptospora kutchensis*, *Cycadopites couperi*, *Araucariacites ghuneriensis*, *Callialasporites doringii*, *C. lametaensis*, *C. circumplectus*, *Pityosporites* sp., *Alisporites haradensis*, *Podosporites microsaccatus*, *Schizosporis laevigatus*, *S. parvus*, *S. sprigii* and *S. rugulatus*, however, most of these forms are not

available in slides, therefore authenticity of the assemblage can not be ascertained as such.

The dominance of *Dictyophyllidites mortoni* (35.5%) and *Guttatisporites vischeri* (10%) in the Pipli palynological assemblage (Jana 1984) is noteworthy. These forms are found in Rhaetic as well as in Jurassic strata. The total absence of *Contignisporites*, *Cicatricosisporites*, *Murospora florida* in Pipli palynological assemblage rules out Upper Jurassic age.

COMPARISON AND DISCUSSION

In overall composition and in the nature of dominant elements i.e., pteridophytes and conifers, Dhrangadhra megaflora closely resembles with megaflora known from Bansa, Chandia and Patparha localities of South Rewa Gondwana Basin. Sukh-Dev (1970, 1972a, 1972b) and Pant and Srivastava (1977) have recorded characteristic Wealden forms of pteridophytes e.g. *Gleichenia nordenskioldii*, *Weichselia reticulata*, *Onychiopsis psilotoides*, *Hausmannia pachyderma*, *Gleichenia rewahensis*, *Phlebopteris polypodioides* from above mentioned localities and from Dhrangadhra flora. The flora of Bansa compares in possessing common conifer genera e.g. *Pagiophyllum*, *Brachyphyllum* but differs in having *Allocladus*, *Harrisiophyllum*, *Yabiella hirsurta*, *Ginkgoites feistmantelii* (Bose & Sukh-Dev, 1959; Sukh-Dev & Zeba-Bano, 1979; Pant *et al.*, 1983 and Srivastava *et al.*, 1984). The bennettitalean remains in both the flora are meagrely represented (Bose & Sukh-Dev, 1958; Sukh-Dev & Zeba-Bano, 1977).

The mioflora of Dhrangadhra Formation resembles with Bansa mioflora in overall composition and in the dominance of coniferous genera. The Lower Cretaceous age assigned to Bansa mioflora by Maheshwari (1974) also suggests similar age for Dhrangadhra Formation.

The megaflora from the Gardeshwar Formation has been studied by Borkar and Phadke (1973, 1974) and Bose *et al.* (1984). The flora resembles with Dhrangadhra megaflora in the dominance of conifer genera *Pagiophyllum* and *Brachyphyllum*, and in the absence of bennettitalean remains but former has comparatively less number of pteridophytic elements

than the latter.

Composition wise, the Dhrangadhra megaflora resembles with the megaflora recovered from Bhuj Formation of Kachchh Basin; but the former is distinct in the absence of pteridospermous element and rare occurrence of bennettitalean remains such as *Ptilophyllum* and *Pterophyllum*. The dominant elements in most of the megafloral assemblages recovered from different localities of Dhrangadhra Formation are conifer genera such as, *Pagiophyllum*, *Brachyphyllum* or *Araucarites*. Whereas in Bhuj Formation the megafloral assemblages of some localities such as, Kakadbhit and Kurbi, are dominated by pteridosperm genus *Pachypteris* and in other areas, the species of *Ptilophyllum*, *Allocladus*, *Brachyphyllum* or *Araucarites* dominate (Bose & Banerji, 1984; Bose, *et al.*, 1992).

The fossil flora from Gangapur Formation, though apparently resembles with the megaflora of Dhrangadhra in general composition but differs in having *Pagiophyllum*, *Brachyphyllum* or *Araucarites* in Dhrangadhra Formation whereas *Elatocladus*, rare in Dhrangadhra is dominant in Gangapur (Bose *et al.*, 1982; Sukh-Dev & Rajanikanth, 1988). Though the mioflora of both the basins have several common elements but the Gangapur mioflora is qualitatively richer than Dhrangadhra mioflora.

The megaflora known from Rajmahal Hills, Jharkhand is very rich and varied in composition. On the basis of overall composition of the flora, characteristic occurrence of different index taxa and the dominance of different plant group Banerji (2000) recognised the occurrence of four types of plant assemblages. Of these four plant assemblages, the Dhrangadhra megaflora resembles with Assemblage 3 known from Nipania and Assemblage 4 known from Sonajori in having conifers as dominant elements but Assemblage 3 is distinct in having co-dominance of pentoxyleae with cycadophytes. The Pentoxyleae are absent and cycadophytes are rare in Dhrangadhra megaflora. The Assemblage 4 from Sonajori is distinguishable from the present megaflora in possessing probable angiospermous remains i.e., *Buteacarpon* and *Sonajoripushpam*.

Analysis of palaeobotanical information suggests that the Dhrangadhra megaflora contains definite

Wealden elements such as *Gleichenia nordenskioldii*, *Weichselia reticulata*, *Onychiopsis psilotoides* and *Cladophlebis kathiawarensis* along with other plant elements which are commonly encountered in the Upper Jurassic and Lower Cretaceous horizons and dominance of different conifer genera e.g., *Pagiophyllum*, *Brachyphyllum* and *Araucarites* show definite pre-Aptian age. Characteristic occurrence of definite pre-Aptian elements such as, *Cicatricosisporites cooksonii*, *Staplinisporites* sp., *Appendicisporites* sp., *Aequitriradites* sp. supports the Lower Cretaceous age (pre-Aptian) for the Dhrangadhra Formation. Comparison with Upper Gondwana flora indicates that the Dhrangadhra megafloora is comparable with the flora of Bansa, Chandia and Patparha localities of South Rewa Gondwana Basin in Madhya Pradesh and Gardeshwar Formation of Gujarat.

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