GEOLOGY AND PALYNOSTRATIGRAPHY OF LOWER GONDWANA FORMATIONS IN MOHPANI COALFIELD, MADHYA PRADESH, INDIA

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ABSTRACT

The present paper deals with the geology and stratigraphical setting of the Lower Gondwana sequence comprised of Talchir sediments and Coal-bearing beds in the Mohpani Coalfield in the light of field observations and palynological data. The field studies reveal that the Coal-bearing beds form a part of a continuous sedimentary cycle in the succession. The palynological observations also confirm the Talchir affiliation of the Coal-bearing beds and hence, they have been grouped with the Talchir Series presumably homotaxial with the Rikba plant beds. A measured section showing the order of superposition of the beds and the position of the two cenozones based on the quantitative estimation of the palynofossils, has been given. In addition to this, a revised geological map along with sections of the area prepared on the basis of present studies, suggest that the rocks were locally folded and uplifted in the form of a dome due to the upward humping caused by the intrusion of a dolerite laccolith which was also the source for the intrusive dolerite dykes. The probability of the extension of coal deposits below the Bagras in the surrounding area has been indicated. Climatic cycles and the changes in the environment during the deposition of these rocks have also been discussed.

INTRODUCTION

Mohpani Coalfield lies (22° 45′:78° 50′) in the centre of Ranipura reserve forest in the district of Narsinghpur, Madhya Pradesh. The tract of Lower Gondwana rocks occurs about 22 kms. South of Gadarwara on Central Railway, near Mohpani and Gottitoria villages. The entire succession of Gondwana rocks is exposed in the cutting of Sitarewa River, East of Mohpani, and presents one of the best Gondwana exposures in the Satpura Basin. The Lower Gondwana formations are exposed within a distance of about 2 kms. from Nayakhera Village to the old Railway bridge. Tectonic disturbances have affected the area which are recorded in the form of structural features. The Lower Gondwana strata and Bagra conglomerate have been subjected to uplifting in the area between the old bridge and the Nayakhera Village in the form of a dome which was subjected to erosion, exposing the Talchir rocks. Talchir sediments, being the oldest, occupy the central portion of the dome, whereas, the younger rocks are placed on the margins. As regards the next formation in succession, the coal-bearing beds surround the Talchir rocks from North, South and East. In the West, these beds have been eroded and the area is covered by recent alluvium, excepting at one place near Gottitoria Village where the sandstones of the Coal-bearing beds are exposed and coal seams are known to be present underneath. Bagra conglomerate, Denwa shales, Jabalpur beds and Traps overlie the coal beds successively.

The interest in the Geology, Stratigraphy and the economic exploitation of Coal in Mohpani Coalfield dates long back with the discovery of coal in the Sitarewa River Cutting, East of Mohpani by Colonel Ousley in the year 1835 as cited by Fox (1934). Later MEDLICOTT (1860) studied this area and described it as one of the most important coal-bearing areas in the Narmada Valley. In 1870, MEDLICOTT (H.B.) surveyed this area in detail. Megaflora from this coalfield has been described by FEISTMANTEL (1879) who reported the presence of *Gangamopteris cyclopteroides*, *Glossopteris communis* and *Noeggerathiopsis hislopi*. On the basis of the plant megafossils, he considered these beds equivalent to the Karharbari Stage of the Talchir Series. Later, Fox (1931) placed the Karharbari Stage in the Damuda Series. Thus, the position of the Karharbari Stage in the Lower Gondwana stratigraphy became debatable.

Karharbari Stage is an important coal-bearing horizon in the Indian Lower Gondwana Sequence. The name has been given for the rocks exposed near the Karharbari Village in the Giridih Coalfield, Bihar. Previously these beds were grouped along with the Barakar Stage by HUGHES (1868). But after Feistmantel had studied the megafossils of this area BLANFORD (1878), considering the abundance of *Buriadia heterophylla* and *Gondwanidium validum*, significant, which were not reported from the true Damuda flora, suggested the separation of these beds from it. Later, after a re-examination of the type area, he found that the laminated structure which is characteristic of the Damuda coal was almost absent in the Giridih coal and that the Talchir rocks, supposed to be unfossiliferous, also contained some plant fossils of the kind known from Karharbari Stage. Therefore, on petro-palaeobotanical grounds he suggested finally a separation of the Karharbari beds from the Damuda Series and their inclusion in the Talchirs (*vide* FEISTMANTEL, 1879). He (BLANFORD, 1880) advocated the recognition of the upper part of the Talchir group as the Karharbari Stage. This was officially accepted by the Geological Survey of India for some time. Subsequently, Karharbari megafossils were also reported from Pali, Umaria, Mohpani, Shahpur (Betul), Deogarh, Karanpura, Hutar, and Daltonganj Coalfields.

However, Fox (1931) reconsidered the position of the Karharbari Stage and strongly recommended for the inclusion of this Stage with the overlying Damudas, as the basal member of the Barakar Series. His view was based mainly on the following facts:

(1) The occurrence of the marine strata at the base of the coal-measures in the Umaria Coalfield lying unconformably over the Talchirs, suggests for the separation of the Karharbari Stage from the Talchirs and its inclusion with the Damudas.

(2) The quality of the Giridih coal resembles with some of the coals of the higher coal seams of the Barakar Series in Jharia Coalfield.

(3) The lithological distinction between the Talchirs and the Karharbari beds is seen even in the type area.

Recently, MAITHY (1965) has described the mioflora from the Giridih Coalfield and suggested the dominance of the characteristic Talchir forms. BASU (1964) has indicated the petrological differences between the basal and the upper seams of most of the Lower Gondwana coalfields and hence, has placed the former in the Karharbari Stage. LELE and KULKARNI (1969) have described the mioflora from the shale of Argada 'S' coal seam of South Karanpura Coalfield and compared it with the Giridih mioflora.

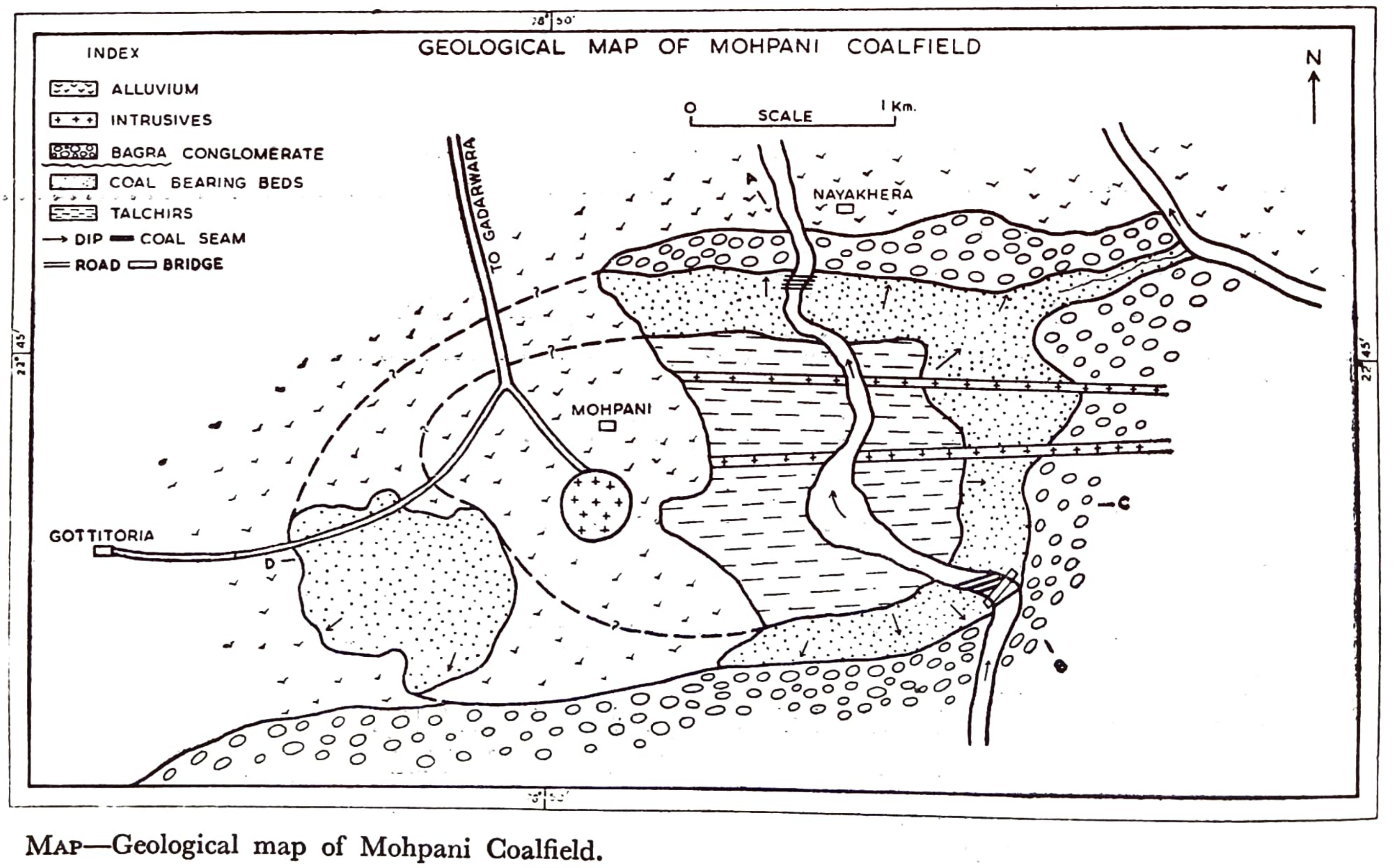
Evidently, the problem regarding the position of the Karharbari Stage in the Lower Gondwana stratigraphy is of much interest. It is not yet decided whether this stage should be included in the Talchir Series or in the Damuda Series. This led the authors to work out the palynology of the Coal-bearing beds of Mohpani Coalfield which are supposed to be of Karharbari Stage, according to FEISTMANTEL (1879). Moreover, the thickness of the Lower Gondwana strata is not much and the lithological distinction between the Talchirs and the Coal-bearing beds is also not distinct. They rather overlie the Talchirs conformably forming a part of a continuous sedimentary cycle. Therefore, considering it as the ideal place for the study of the Talchirs and their relation with Karharbari sediments, Mohpani Coalfield was selected for the present investigations.

In order to assign the actual stratigraphical position of the Coal-bearing beds and their relation with the underlying Talchir rocks, the entire succession of the Talchirs and the Coal-bearing beds has been studied palynologically in detail and the biostratigraphy of these sediments has been presented. A measured section of the area was studied and the position of the assemblage zones (cenozones) based on the quantitative estimation of the palynotaxa recovered from these rocks was determined. An attempt has also been made to explain the geology and the structure of the area. A revised geological map and a section have been prepared.

Material for the present investigation has been collected by us during the excursion in the area during the years 1967 and 1971. In all, 22 coal and shale samples were collected from the Talchir and the Coal-bearing beds. In the case of coal samples special care was taken to obtain representative samples of the entire coal seams. The samples were collected from the Sitarewa River Cutting as indicated in the details of the exposed section given in the paper elsewhere.

GENERAL GEOLOGY

Mohpani Coalfield is the northern most extension of the Satpura Gondwana Basin. Further North of Mohpani, the area is covered by alluvium and on the South by thick vegetation. The exposures of the Gondwana rocks are present mainly in the Sitarewa River Cutting, East of Mohpani Village. Local drainage of the area consists of Sitarewa and its tributaries having their flow towards North. General topography of the area is marked by flat topped hills which rise abruptly from the plains and a clear demarcation between the two regions can be made easily.



MAP—Geological map of Mohpani Coalfield.

GEOLOGICAL FEATURES

The entire section of rocks exposed between old Railway bridge and Nayakhera Village (Map) has been divided into northern and the southern parts (The change in the direction of dip has been taken as the line of division).

Southern portion (Section-I) running North to South.

T	22.5 meters	needle shales, more compact and sandy in the middle but bouldery in the
A		uppermost part.
L	70.0 meters	boulder bed with greenish tinge.
C	35.0 meters	shales with intercalated coubles.
H	2.5 meters	sandstone.
I	2.5 meters	needle shales (Sample No. 1)
R	2.5 meters	boulder bed.
	2.5 meters	boulder bed.
	1.5 meters	sandstone.
S	14.0 meters	needle shales, light green in colour.
E	4.0 meters	greenish pink needle shales.
D	14.0 meters	greenish sandstone.
I	17.0 meters	green needle shales.
M	7.0 meters	boulder bed with small pebbles.
E	24.0 meters	shales slightly carbonaceous (Sample No. 2).
N	10.0 meters	coarse grained sandstone with thin patches of needle shales (Sample
T		No. 3).
S	1.0 meters	boulder bed.
	8.0 meters	shaly sandstone.
	7.5 meters	hard sandstone with current bedding.
	3.5 meters	green needle shales.
	1.5 meters	white grey sandstone.
	1.7 meters	carbonaceous needle shale (Sample No. 4)
	1.5 meters	red shale (sample No. 5).
	5.0 meters	carbonaceous (sandy) shale (Sample No. 6).

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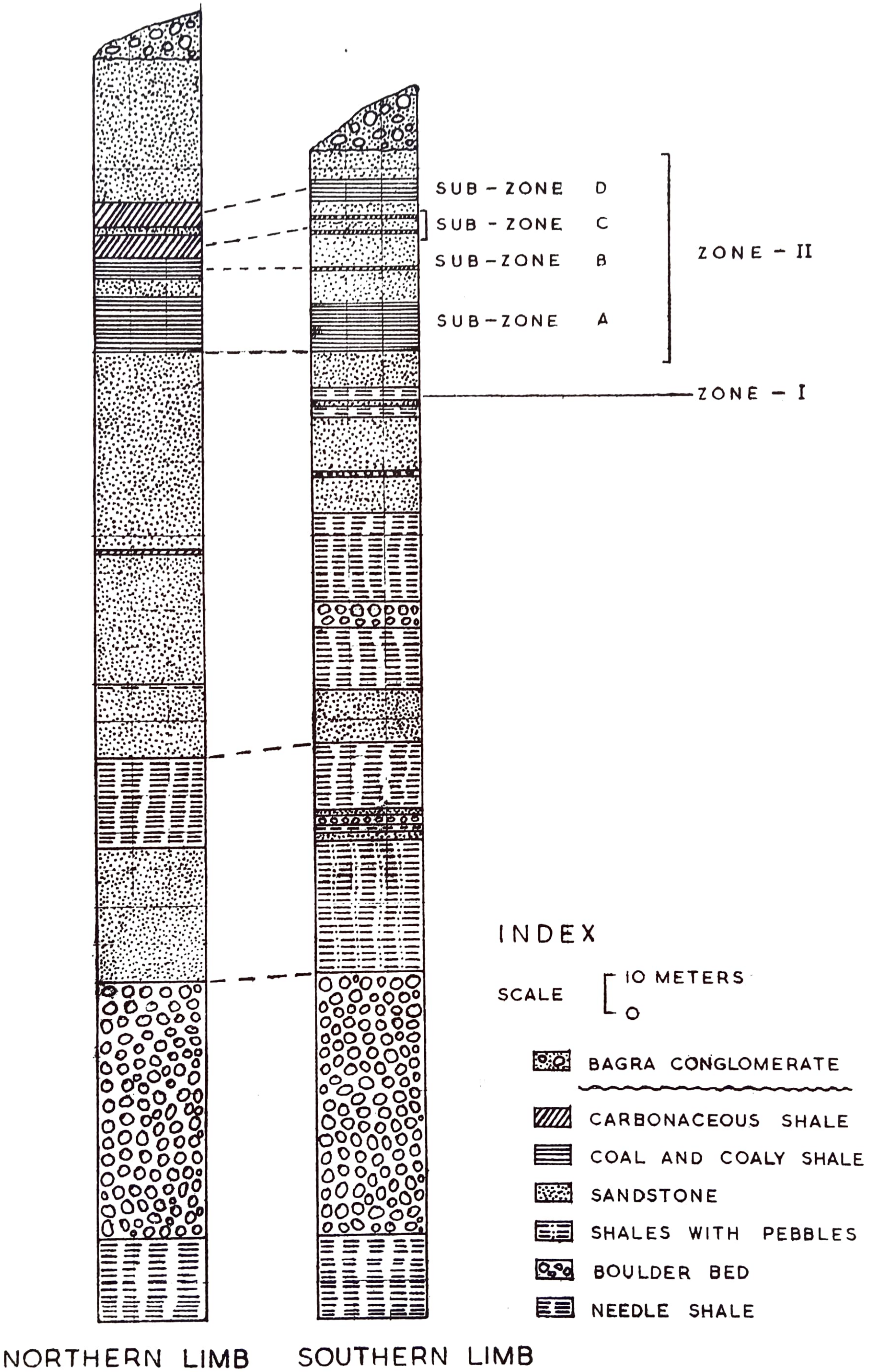
C	1.3 meters	sandstone.
O	1.25 meters	shaly sandstone (Sample No. 7).
A	8.0 meters	grey sandstone with fragmentary plant fossils.
L	14.0 meters	coal and coaly shale (Sample Nos. 8, 9 and 10).
	8.0 meters	sandstone.
B	0.8 meters	carbonaceous shale (Sample No. 11).
E	8.5 meters	sandstone.
D	0.5 meters	shaly coal (Sample No. 12).
S	3.0 meters	sandstone.
	3.0 meters	sandstone.
	0.8 meters	carbonaceous shale (Sample No. 13).
	4.0 meters	sandstone.
	6.5 meters	coal and coaly shale (sample Nos. 14 and 15).
	8.0 meters	sandstone whitish, compact and cross bedded.
		Unconformity
		Bagras



SECTION I—Measured section of Lower Gondwana Sequence exposed in Sitarewa River, Mohpani Coalfield.

Northern portion (section-I) running South to North:

T	22.5 meters	needle shales (Sample No. 16).
A	68.0 meters	sandstone (greenish yellow) interbedded with thin boulder beds having
L		chunks of needle shales (Sample No. 17).
C	36.0 meters	sandstone.
H	45.0 meters	sandstones and needle shales, the sandstones being indurated near the
I		dyke.
R		
S		

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C	35.0 meters	compact white sandstone with cross bedding.
O	0.5 meters	carbonaceous shale (Sample No 18).
A	55.0 meters	sandstone.
L	16.0 meters	shale and coal with minor sandstone partings (Sample No. 19).
	5.0 meters	white cross bedded sandstone.
B	6.0 meters	coal and shale (Sample No. 20).
E	7.0 meters	carbonaceous shale (Sample No. 21).
D	2.0 meters	red sandstone.
S	7.0 meters	carbonaceous shale (Sample No. 22).
	40.0 meters	white sandstone.
		Uncomformity
		Bagras

LITHOLOGY OF THE BEDS

Archaeans—According to Fox (1934), no rocks older than the Lower Gondwanas are seen in the area but Archaean siliceous limestones of the Bijawars are seen west of Tundni.

Talchirs—The Talchirs are represented by the boulder beds, needle shales, and sandstones. The boulder beds are composed of assorted boulders of different size and shape. Needle shales are fine grained, pale, to greenish grey in colour and can be recognized easily as they break along their joints typically forming needle like fragments. The Talchir sandstones are coarse grained, gritty in nature and copiously contain loosely packed fragments of felspars. These sandstones are mostly greenish yellow in colour. Some of these sandstones (Pl. 1, Fig. 1) are also compact in nature and are greyish white in colour. At places they are intercalated with carbonaceous shale bands which are upto 0.4 meters in thickness. Coal is not present in this stratum. The most interesting feature of the Talchir rocks in the area is their repetition. The entire Talchir sequence is composed of repeated beds of boulder beds, needle shales and sandstones. The oldest boulder bed exposed in the axis of the fold has not been found in contact with the basement rock. This is also the thickest amongst all the boulder beds and the size of the boulders present in it is also much larger. The glacial marks are rare and are seen only on some big sized boulders of this formation. The rest of these beds are mainly composed of the boulders of smaller size. Gradually these beds become less prominent and they range from bouldery to gritty beds of varying thicknesses. The lithology of these beds remains more or less constant but for the differences in the texture of the rock. Some of the younger boulder beds are very interesting as they are reworked showing inclusions of Talchir needle shales (Pl. 1, Fig. 2). Reworking seems to be a characteristic feature of the Talchir rocks of the area as some of the sandstones also show this nature.

Coal-bearing beds—The Coal-bearing beds are composed of sandstones, shale and coal seams. These rocks are best exposed in the Sitarewa River Cutting near the old Railway bridge (Pl. 1, Fig. 3). Four coal seams are exposed here, dipping about 30° due South. Just near the bridge, towards South, the Coal-bearing beds have been unconformably succeeded by the Bagra conglomerates (Pl. 1, Fig. 4).

The sandstones having cross beddings are hard, compact, whitish grey in colour. There are three main types of sandstones present in the area. At the base of the coal beds the sandstones are white, fine-grained and soft in nature gradually becoming hard and red due to the sudden increase in the ferruginous content. Near the contact with the Bagras the sandstones are creamish, light yellow in colour. These variations indicate change in the source materials and the conditions of deposition.

The coal, exposed in the seams, is usually of dull to semibright type and is composed of alternating bands of bright and dull coal. Durain seems to be its dominant component. The shales near the coal seams are very characteristic and some of them show current bedding and small ripple marks. The other exposure of Coal-bearing beds is about 2 kms. North of the bridge dipping very steeply due North near the Nayakhera Village, but here the seams are thinner and also of poor quality. Near Gottitoria, about a mile West of Mohpani, the Coal-bearing beds (sandstones) are exposed in a hillock which also bears the remnants of the old workings. The sandstones exposed here are fine grained, hard, compact and whitish in colour.

Bagra Conglomerates—These overlie the Coal-bearing beds unconformably. The conglomerate is very hard and compact being mainly composed of boulders of quartzite and jasper. The formation is exposed in a very large area extending from the South of the old Railway bridge to Bichla Village and beyond, all along the river bed. These conglomerates are again exposed in the North, near Nayakhera Village. There is a slight difference in the nature of Bagra rocks exposed at the two ends, such as in the southern end of the area the boulders are rounded in shape, whereas in the North they are angular (Pl. 1, Fig. 5).

Denwa Shales—Denwa shales are fine grained, reddish brown in colour. The best exposures of the rocks are seen about 3 km. South from the old Railway bridge, overlying the Bagra conglomerates, on the banks of the river.

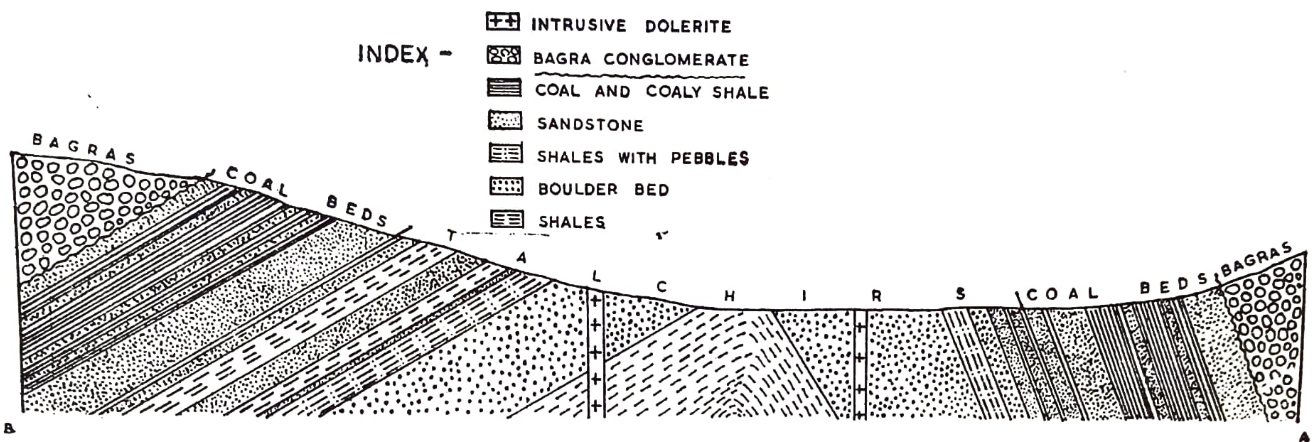
Jabalpur rocks—This group is mostly composed of hard and compact sandstones clay and siliceous limestones. At some places the clay is of good quality and is also extracted. Coal seams have also been recorded in the Jabalpur beds near Bichla on the eastern flanks of the hills forming the scarp. The coal is of very poor quality.

Traps—Traps are mostly eroded in the area and are present only in the form of small boulders on the hill tops.

Intrusives—Basic intrusive (Dolerite) dykes are significant at two places where they have aquired large dimensions and are being worked for the road building material (Pl. 1, Fig. 6).

ORIENTATION OF THE BEDS

The orientation of the Lower Gondwana beds seems complicated without a careful examination of the area. A major portion of the strata is eroded and is exposed in the Sitarewa River Cutting. Some patches of sandstones are also seen at a place near Gottitoria Village in the West and beyond the river in the East (Map). In the river section South of Gadarwara the first exposure is that of Bagra conglomerate near Nayakhera village about 2 kms. North-East of Mohpani. Further South, the Coal-bearing beds are exposed dipping towards North at a very high angle (Section-II). At the contact with the Bagras the Coal-bearing beds have become nearly vertical. The coal seams are crushed having fragile shaly coal. After the coal beds, Talchir rocks are exposed over a considerable distance, ending only 50 meters prior to the old Railway bridge. These are also intruded by two dolerite dykes. The beds show characteristic change of dip direction from North, North-East, East, South-East and finally South, near the old Railway bridge (Map). Just before the bridge the Talchirs are succeeded by the Coal-bearing beds again. The coal seams are exposed, having better coal in comparison to the first outcrop near Nayakhera Village. Here the dip is also less being about 30° South. The Coal-bearing beds are directly succeeded by the Bagras. These must have been deposited after a long interval of time as they are a much younger formation as compared to the coal beds.



SECTION II—Diagramatic (N-S) Geological section, vertical scale exaggerated.

Deeply beyond the eastern bank of the river the sandstones of the Coal-bearing beds are traceable at a height of 381 m. (1250 ft.) above sea level, connecting their exposures towards North and South in the river cutting. Similar sandstones are exposed near Gottitoria having the ruins of the past mining structures. This sandstone, also occurring at a height of 381 m. (1250 ft.) above sea level, is surrounded by the alluvium from North, East and West. The southern margin approaches the hills of the Bagras. The coal beds dip towards South and South-West in this part.

STRUCTURE OF THE AREA

The dip, changing from North to South through East, the presence of Coal-bearing beds (sandstone) in the East connecting their northern and southern exposures in the river cutting and the occurrence of Coal-bearing beds 1½ km. West of the river near Gottitoria at a similar height as in the East, suggest the occurrence of a dome, a doubly pitching anticline rather than a simple, pitching anticline with its axis dipping eastwards, as stated by Fox (1934).

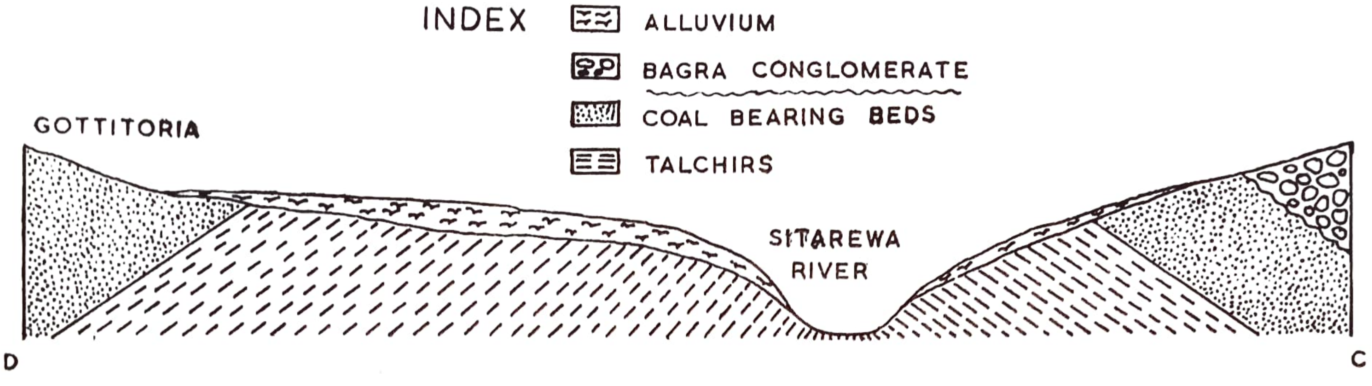
The exposure of a dolerite mass and the dolerite dykes suggest that the formation of the dome could have been due to the intrusion of an interformational laccolith occupying the plane of unconformity over the basement rocks below the Talchirs. This seems to have arched the overlying strata.

A major portion of the dome towards the West and the East has been eroded but for the sandstone of the Coal-bearing beds outcropping near Gottitoria and in the East, the rest of the area having been filled by the alluvium (Section-III). The nature and the sequence of the rocks forming the dome is revealed in the river cutting.

In view of the above conclusion regarding the geological structure of the Mohpani Coalfield, coal should be occurring along the fringe of the dome all round and also beyond the dome, below the Bagras of the surrounding hills. Coal has been mined so far only in the western and the south-eastern parts of the dome fringe.

BIOSTRATIGRAPHY AND PALYNOLOGICAL ZONATION

The stratigraphy of the Lower Gondwana sediments of the Mohpani Coalfield proposed here is based on the occurrence of spores and pollen grains in them. Two main



SECTION III—Diagramatic section (E-W) through Mohpani Coalfied.

miofloral zones, one each corresponding to the Talchir and the Coal-bearing beds, have been recognised. The older zone characterised by the dominance of radial monosaccates (*Parasaccites*, *Cannanoropollis* and *Plicatipollenites*) is based on the microfossils recovered from the slightly carbonaceous Talchir needle shales (sample No. 4). The upper zone characterised mainly by the dominance of *Sulcatisporites*, *Indotriradites* and *Brevitriletes* is based on the miospores recovered from the coal and associated shales of the coal seems. This zone has been further divided into four (A, B, C, and D.) sub-zones. Sub-division of the zone is based on the quantitative estimation of the palynotaxa represented in each sub-zone and mainly on the behaviour pattern of the dominant genera represented in the entire zone. Each sub-zone represents the miospore assemblage of an entire coal seam and the associated sediments, mainly carbonaceous shales.

Assemblage Zone—I (Histogram)

Quantitatively dominant genera	Percentage
Parasaccites	39.5
Cannanoropollis	25.5
Plicatipollenites	7.0
Less prominant genera	
Callumispora	5.0
Pilasporites	5.0
Sulcatisporites	4.5
Potonieisporites	3.5

Assemblage Zone—II (Histogram)

Sub-zone—A

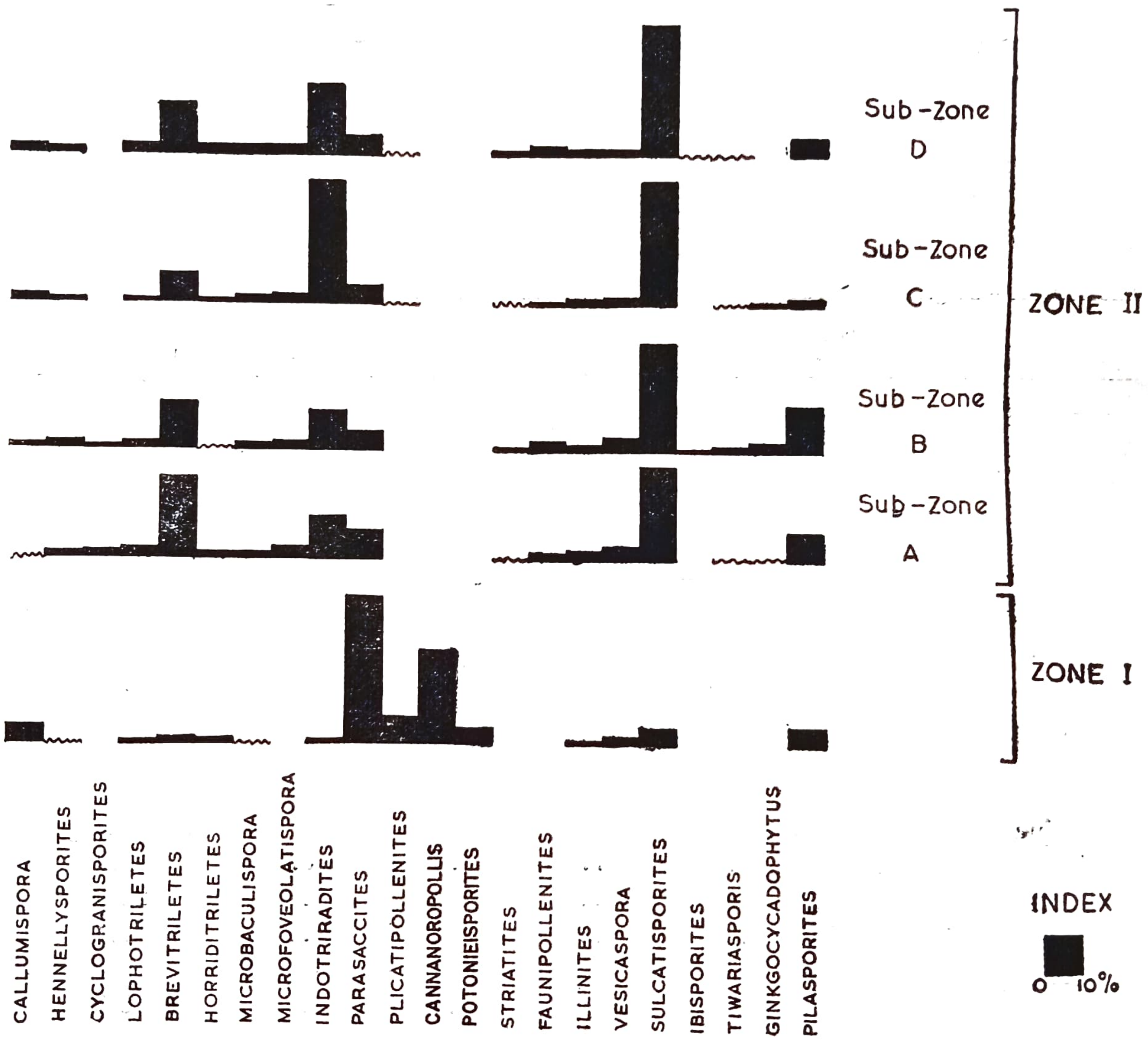
Quantitatively dominant genera	
Sulcatisporites	26.0
Brevitriletes	22.5

Indotriradites	..	..	..	..	12.0
Parasaccites	..	..	..	..	8.0

Sub-zone—B

Quantitatively dominant genera

Sulcatisporites	..	..	..	..	30.0
Brevitriletes	..	..	..	..	13.0
Indotriradites	..	..	..	..	11.0
Parasaccites	..	..	..	..	5.5



HISTOGRAM—Percentage frequency histogram of miospore genera, Mohpani Coalfield.

Sub-zone—C

Quantitatively dominant genera

Sulcatisporites	..	..	..	..	33.5
Indotriradites	..	..	..	..	33.5
Brevitriletes	..	..	..	..	8.0
Parasaccites	..	..	..	..	5.0

Sub-zone—D

Quantitatively dominant genera

Sulcatisporites	35.0
Indotriradites	19.0
Brevitriletes	14.0
Parasaccites	5.5

The miospore assemblage in the Assemblage zone-II exhibits homogeneity in general, although each sub-zone is also individualistic in character. Out of the above noted genera, *Sulcatisporites* is the dominant genus in all the seams. However, in seam No. 1. *Brevitriletes* is also well represented and in seam No. 3 *Indotriradites* is equally dominating as *Sulcatisporites*. Due to the change in the subdominant genera the pattern in each case has changed and a characteristic assemblage is recognisable. This clearly indicates that miofloristically, these four successive sub-zones are individually separable from one another and hence, all the four coal seams are also separable palynologically, as the sub-zones are the representatives of the individual coal seams though, the partings between the seams are not much wide (section-I).

The representation of the individual spore genera in all the seams show certain cohesive tendencies of variation, e.g. *Sulcatisporites*, the most important genus, shows small variation increasing progressively from the bottom to the top (25%, 30%, 33% and 35%). *Parasaccites*, a very significant genus for the Talchir Stage, on the other hand, gradually decreases in the succession (8%, 5.5%, 5%, 4.5%). However, *Indotriradites* is less in seam No. 1 and in seam No. 2, but attains maximum in seam No. 3 (33%) ultimately to fall again in the top seam. *Brevitriletes* is highest in the bottom seam, is less in the second and third seams but rises again in the uppermost seam.

Therefore, it is concluded that quantitatively the miofloral succession in the coal beds of Mohpani Coalfield is broadly speaking homogeneous, but for the variations in time, so that each seam also exhibits diagnostic miofloral association of its own and hence, it is divided into four sub-zones (Histogram).

As regards the position of the Mohpani mioflora in the chronostratigraphy, the Assemblage zone-I can be easily grouped with the Talchir Stage. It is closely comparable with the other known assemblages of this stage described by Potonié and Lele (1961) from S. Rewa Gondwana Basin and by Lele and Makada (1972) from Jainti Coalfield. However, the mioflora of Assemblage zone-II which is known from the Coal-bearing beds occurring only slightly above Assemblage zone-I in a conformable sequence and yet is so different, represents a change after the mioflora of the Talchir Stage.

The mioflora of Assemblage Zone-II is fairly comparable to the mioflora from the coal of Argada 'S' seam in South Karanpura Coalfield where *Sulcatisporites* is 33%, *Brevitriletes* is 16% and *Parasaccites* is 4% (Bharadwaj & Anand-Prakash, 1972). According to these authors, Argada 'S' seam is considered to be dated palynologically as Lower Karaharbari Stage because lying 70' above this seam, a carbonaceous shale has yielded, according to Lele and Kulkarni (1969), *Parastriopollenites* (a radial monosaccate) 33%, *Sulcatisporites* 14%, *Crucisaccites* 11% and *Cannanoropollis* (another radial monosaccate) 12%. Bharadwaj and Anand-Prakash (1972) consider the above mioflora to be much similar to the type Karharbari mioflora from Giridih Coalfield described by Maithy (1965). The only difference between these assemblages is the occurrence of *Parastriopollenites* and *Cannanoropollis* in South Karanpura Coalfield in the places of *Parasaccites* and *Plicatipollenites* of the Giridih

Coalfield. Such a difference is considered by BHARADWAJ and ANAND-PRAKASH (1972) to be insignificant because in their opinion, different genera belonging to the same morphological spore group could be dominant in different coal basins at the same geological time. This correlation is also supported by the occurrence of the Karharbari index spore genus *Crucisaccites* in similar quantities in both.

Regarding the status of the Karharbari Stage, it is evident that miofloristically it starts with the dominance of *Sulcatisporites* (a non-striated bisaccate), a gymnospermous miospore, suggestive of warmer climate during the early parts of the Karharbari Stage and hence, the luxuriant growth of the plants, ultimately forming the coal seems. In comparison to this, the Talchir Stage which represents much colder climate and thus, less plant life and no coal, shows the abundance of radial monosaccate spores. These climatic cycles appear to have been repeated again though, not with the same intensity and we get the radial monosaccates-rich mioflora again in the younger parts of the Karharbari Stage. The Gondwana sediments are represented by cyclic deposits and this fact also supports the possibility for the occurrence of the Talchir Stage mioflora again in the upper parts of the Karharbari Stage if preceded by a second glaciation (BHARADWAJ, 1971).

In view of its position immediately following the Talchir Stage, the Lower Karharbari coal measures form a part of the sedimentary cycle commencing from Talchir Boulder Bed and thus, should be considered a part of the Talchir Series. Moreover, the interglacial aspect as indicated by the nature of the mioflora contained in the Lower Karharbari coal measures and their position at the top of the Talchir sediments, further suggests that they are similar in stratigraphic position to the Rikba plant beds which are regarded as a part of the Talchir Stage rather than the Karharbari Stage. It may probably be preferable ultimately to assign the coal-bearing beds of Mohpani Coalfield and Argada T, S etc., coal seams, which contain *Sulcatisporites* rich assemblage to a separate, new stage within Talchir Series and retaining the use of Karharbari Stage for only the strata containing the radial monosaccates and *Crucisaccites* rich mioflora as described from its type area. Following stratigraphical succession is envisaged to be occurring in Mohpani Coalfield.

STRATIGRAPHICAL SUCCESSION

		(Old and recent alluvium of Narmada Valley (Basaltic lavas	
Upper Gondwanas		Jabalpur beds Denwa red shales Bagra conglomerate	
		..... unconformity	
Lower Gondwanas	Talchir Series	Lower Karaharbari Stage	(coal with inter-bedded shales and sandstones)
		Talchir Stage	Sandstones Needle shales Boulder Bed
		..... unconformity ..... Archaeans (?)	

CONCLUSIONS

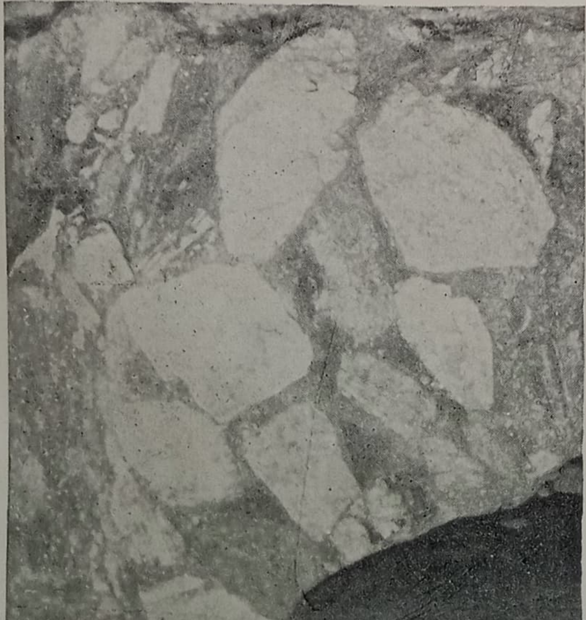
The field studies in Mohpani Coalfield suggest the Gondwana deposits to be occurring as remnants of a double pitching anticline (dome) formed by an interformational laccolith.

1

2

3

4



5

6

The Coal-bearing beds appear to be occurring along the fringe of the dome in the basin. The Talchir beds and the Coal-bearing beds lie in a conformable succession.

Palynological studies of the shale and coal beds of the Lower Gondwana sequence reveal two distinct spore assemblages restricted and corresponding to the Talchir and Lower Karharbari Stages. Biostratigraphically Lower Karharbari Stage tends to be a part of the Talchir Series and represents an interglacial phase similar to that represented by the Rikba plant beds. It is opined that ultimately the strata containing *Sulcatisporites* rich mioflora should be recognized as a new Stage.

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EXPLANATION OF PLATE 1

1. Talchir sandstones.
2. Reworked Talchir sandstones having flakes of needle shales.
3. Steeply dipping Coal-bearing beds.
4. Contact between the sandstones of the Coal-bearing beds and the Bagra conglomerate.
5. Bagra conglomerate having angular boulders.
6. Dolerite dyke intruded in the Talchir needle shales.