Record of the Trace Fossils from Upper Gondwana Succession of Bairam and Adjoining Area, District Amravati, Maharashtra

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ABSTRACT

Nine ichnogenera have been recorded from non-marine Gondwana succession of Bairam and adjoining area. An attempt has been made to describe the trace fossils and classify them according to their behavioural patterns. The assemblage is dominated by burrows showing feeding activities of polychaetes followed by grazing and resting structures of (?) arthropod. A few comments on palaeoenvironment and palaeoecology have also been made.

INTRODUCTION

Well preserved trace fossils are recorded from arenaceous succession of Gondwana, exposed in Bairam (21° 22' 77° 37') and adjoining area of Belkher (21° 22' 77° 32'). The area constitutes a portion of Amravati district of Maharashtra and Betul district of Madhya Pradesh. The Deccan Trap is widely exposed lithounit followed down by the Gondwana and the Lameta (Fig. 1).

The Gondwana sediments are exposed in the form of isolated patches in basaltic terrain and are mainly represented by coarse to fine grained arenaceous horizons with interbedded shale. The clay occurs as pockets of lenticular body interbedded in sandstone. The arenaceous sediments show good development of sedimentary structures e.g., cross bedding, parallel bedding and ripple mark (Fig. 2C, D).

The area, however, has not been studied in details. A few comments on lithological settings and stratigraphical aspects have been made in past (Blanford, 1869; Pascoe, 1959). Recently, the clay deposits have drawn the attention because of its economic value (Arogysawamy, 1968; Bhusari, 1979). The age of the sequence is a matter of debate and most of the workers have correlated it with Upper Triassic (Pascoe, 1959; Bhusari 1979). Recently, Srivastava et al., (1994) have recorded plant fossils and assigned Upper Cretaceous age which is also supported by palynological evidences (Kumar, 1992).
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Fig. 1: Geological Map of the area (After Gadewar and Sukhtankar, 1990)

So far, trace fossils have rarely been reported from the Gondwana area. In the present paper, an attempt has been made to describe and discuss the significance of the ichnofauna recorded from the Gondwana deposits of Bairam-Belkher area. However, trace fossils from Gondwana succession of Hazaribagh have recently been reported by De (1990, 1993).

GEOLOGY AND LITHOLOGICAL SETTING

The Bairam area is a hilly terrain of low elevations. The sedimentary units represented by Gondwana and Lameta formations are exposed in the form of inliers in the widespread Deccan Trap with faulted contacts. The general stratigraphy of the area is as follows:

<table>
<thead>
<tr>
<th>Age</th>
<th>Formation</th>
<th>Rock Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quaternary</td>
<td>Unconformity</td>
<td>Soil and alluvium</td>
</tr>
<tr>
<td>Miocene (?)</td>
<td>Deccan</td>
<td>Non-porphyratic to porphyritic basalt</td>
</tr>
<tr>
<td>Up. Cretaceous</td>
<td>Trap</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unconformity</td>
<td></td>
</tr>
<tr>
<td>Upper Cretaceous</td>
<td>Lameta</td>
<td>Shale, limestone and sandstone</td>
</tr>
<tr>
<td></td>
<td>Disconformity</td>
<td></td>
</tr>
<tr>
<td>Lower Cretaceous</td>
<td>Upper</td>
<td>Clay, shale, sandstone and conglomerate</td>
</tr>
<tr>
<td>Formation</td>
<td>Gondwana</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unconformity</td>
<td></td>
</tr>
<tr>
<td>Archaean</td>
<td></td>
<td>Quartzo-feldspathic gneiss</td>
</tr>
</tbody>
</table>

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The Gondwana sediments unconformably overlies the Archaean Gneisses. The contact is exposed in the adjoining Suhardi area (22° 15′; 70° 00′). The Gondwana succession is about 100m thick (Fig. 3) with a general dip of 15° - 20° north. The lower 40-45m thick sequence is represented dominantly by medium grained sandstone which is ferruginous at places. The overlying 30-35m deposit is represented by alternations of medium grained sandstone and shale (Fig. 2A). The pinching of the strata can be noticed, forming lensoïd bodies (Fig. 2B). At some places, thick pockets of clay are exposed which are brown, black to grey in colour. The clay and shale are fossiliferous with plant remains. The upper part is about 10m thick, coarse grained arenaceous with pebbles of quartz and feldspar.

The upper contact of Gondwana is sharp with the Lameta. The Lameta rocks are represented by 40-50m thick, brecciated, chertified limestone mostly exposed at the top of hillocks in concordance with the Gondwana. It is overlain by the Trap.

**DESCRIPTION OF THE TRACE FOSSILS**

The trace fossils are mainly represented by burrows, trails and resting structures. The identification is based on Hantzschel (1975). Terminology used is as proposed by Schäfer (1964) and Martinsson (1970). A few of the unidentified taxa are described under separate head.

*Barocochnites* Vyalov, 1971 (Fig. 4)

**Description.**

Densely populated, horizontal to inclined, U-shaped, curved, semicircular, closely meandering burrows preserved in epirelief. The surface of burrow is smooth and infilling is fine grained silty material. The burrow may overlap one another. The diameter of the burrow ranges 3-5mm, which tapers at the ends. The length of entire burrow may range 3-10 cm.

The structure is preserved in 5mm thick, fine, silty material forming the upper surface of six cm thick, medium to fine grained sandy horizon.

**Discussion**

The burrow may be considered as feeding structure of wormiform animal. It is reported from Upper Triassic of Central Asia (Panir) (Hantzschel, 1975).

*Cochlichnus* Hitchcock, 1858 (Fig. 4C)

**Description**

Epichnial, unbranched, solitary burrow forming a wavy structure which commonly follow the bedding plane. The burrow surface is smooth. The diameter of the burrow is mostly constant except for the terminals. The burrow fill is similar to the host rock i.e., fine to medium grained yellowish-brown sandstone. The length of the cuticle is 5mm and diameter range 4-5mm.

**Discussion**

The structure shows close resemblance with *Cochlichnus* of Hakes (1976) and Miller (1984) except for larger dimensions. Hakes (1976) reported it from Upper Pennsylvanian of Kansas and considered it epichnia and probably trophicha of small worm like animal. He
Fig. 2: A. Alterations of the medium grained sandstone and shale in upper part of the sequence, B. Lensoid body of the sandstone in clay, C. Ripple bedding, D. Cross-bedding.
made a generalised statement for *Cochlichnus* regarding facies i.e., intermediate environment between fresh water and well developed brackish condition.

Miller (1984) reported it from Channel fill sandstone of Rockcastle Conglomerate of Lower Pennsylvanian and considered it a structure of transition zone where the fresh water body was freely connected with sea water.

The structure may be considered as burrow of deposit feeding animal.
**Planolites** Nicholson, 1853 (Fig. 4H)

**Description**

Epichnial, unbranched, cylindrical to sub-cylindrical burrows preserved on the top surface of the bed. The fill is similar to that of the host rock i.e., medium to fine grained brownish red to greyish brown sandstone. Rarely, the colour of the burrows are noticed to be different to the host rock. The surface may be smooth or transversely striated. Occasionally the tapering of the burrow at one side has also been noticed. The diameter of the burrows ranges 2-5mm and is generally constant for an individual while the length is 1-2cm.

**Association**

The structure is associated with spindle shape burrows.

**Discussion**

The burrow may be considered as feeding structure of mobile deposit feeder worm. The *Planolites* as a feeding structure is widely reported from marine deposits of shallow to deep environments (Hantzsche, 1975). Kumar and Srivastava (1989) and Srivastava and Kumar (1992) reported it from the Cretaceous flysch succession and Muth Quartzite (Devonian) of Malla Jhohar area respectively. Frey (1976) has included certain forms of *Planolites* in Scoyenia Ichnofacies of non-marine environment.

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**Rutichnus D’ Alessandro, et. al., 1987**

(Fig. 4A)

**Description**

Poorly preserved, cylindrical to sub-cylindrical, branched burrow preserved in epirelief. The branching is frequent. Many branches can arise from single burrow and may run parallel for some distance. However, the length of branches varies widely. Branching is mostly of twig shape.

The surface of burrow is irregular and shows indistinct transverse striations giving an appearance of rugose or undulose structure. The burrow fill is medium to fine grained greyish brown silty material as of the host rock. The diameter of burrow may vary after branching and ranges 3-5mm.

**Discussion**

The burrow shows similarity with *Rutichnus rutilus* of D’ Alessandro et. al., (1987). They considered the possible mode of construction of the burrow of *R. rutilus* by outward and return journey of worm like animal.

The present structure may be considered as fodinichnia of mobile deposit feeder.

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**Skolithos Haldemann** (Fig. 4E-G)

**Description**

These are simple, inclined to vertical, isolated shaft/pipe-like structures. The burrow
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is infilled with the similar material as that of host rock but slightly darker in colour. The host rock is medium to fine grained arenaceous yellowish brown sandstone. A faint burrow line of darker colour is noticed. The diameter of the burrow is 1-3 mm while length ranges from 3-4 cm.

Discussion

The burrow may be considered as feeding-dwelling structure of suspensions feeder.

Bilobed Trail (Fig. 5D)

Description

The biogenic structure is endichinal, isolated, unbranched, elongated; curved bilobed trail preserved in agrillaceous material as convex to semicircular epirelief. The bilobed structure is because of surficial wavy furrow running longitudinally almost at the top median position. The structure is marked by parallel fine transverse striations on both the sides of burrow. The infilling material does not show any internal structure and is represented by the host rock i.e., fine grained greyish clayey material.

The length of structure ranges up to 12 cm while the diameter is almost constant and ranges up to 2 cm.

Discussion

The structure might have been produced by the animals having appendages by which excavation in fine grained sediment was possible during locomotion. However, It shows close resemblance with *Cruziana*.

Though the *Cruziana* is normally considered a structure produced by trilobites of marine Palaeozoic (Hantzschel, 1975), the record of similar structures have also been reported from different ages and environments e.g., freshwater Triassic of Carlsberg Fjord (Bromley and Asgaard, 1972) and freshwater Carboniferous deposits of Bolivia (Helwig, 1972 in Hakes, 1976).

However, the present structure may be considered as crawling/grazing trace of (?) arthropod.

Resting Marks (Fig. 5A-C)

Description

Isolated markings represented by flat, elliptical, lensoid, elongated or circular structures. The lensoid structures are bilobate marked by a deep furrow. The furrow or depression may be straight or curved which may or may not divide the structure into two equal halves. Both the halves show fine, parallel, transverse striations mostly perpendicular to the furrow (a cast of ill-preserved marking show poor radial striations arising from centre). Probably the lateroventral morphology of trace-makers are preserved in fine grained argillaceous material.

The structure is made up of fine grained greyish-black clayey material. The length ranges 3-6 cm., while width 2-4 cm.

Discussion

The structure may be considered as resting mark made by epibenthonic animal of dorso-ventrally elongated nature. The trace-maker
Fig. 5: A - C. Resting marks showing circular, lensoid to elliptical structure having fine striation.
D. Bilobed trail showing deep median furrow and fine transverse striations.
was probably the same which formed the bilobed trail. During the resting period, the animal probably used to contract its body in coil or circular patterns.

Spindle Shape Burrow (Fig. 4F)

Description

Epichnial, spindle-shape burrows preserved on the top surface of the bed. The burrow occurs mostly in solitary position. The surface of the burrow is smooth, while the fill is structureless which consists of fine grained yellowish-grey sandstone similar to the host rock.

The length of the burrow is up to 4 cm. The diameter of the burrow is maximum at middle portion and ranges from 4 to 5 mm.

Association

It is associated with simple burrows of Planolites.

Discussion

The structure may be considered as fodinichnia of deposit feeding animal probably of worm.

Indistinct Structures/Coprolites (Fig. 4D)

Description

These are isolated small, circular, semicircular to slightly elongated, elevated markings on the surface of the bed. The structure is present in fine grained sandy material. The complete structure is made up of homogeneous material, i.e., fine grained argillaceous or silty material depending upon host rock lithology. The diameter of the structure ranges from 3 to 5 mm. A few markings are connected with very indistinct trail like structures.

Discussion

The structure may be considered as excretal remains of lower group animals.

DISCUSSION AND CONCLUSION

1. A total of nine ichnotaxa have been recorded from arenic-argillaceous, non-marine Upper Gondwana succession of Bairam and adjoining areas viz., Barococnites, Cochlichnus, Planolites, Rutichnus, (?) Skolithos, bilobed trails, resting marks, spindle shape burrows and indistinct structures/coprolites.

2. Considering the behavioural patterns, the assemblage is dominated by feeding habitat followed by resting and grazing.

3. Taxonomically, the diversity of fauna making trace fossils was very limited and was mainly represented by polychaetes and (?) arthropods.

4. A few horizons are thickly populated with simple burrows i.e., Planolites, Barococnites showing high density of trace fossil making community.

5. Regarding palaeoenvironment, a generalised conclusion can be made in support of low to medium energy environ-
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ment of deposition where mostly benthonic community of lower group animals were present. However, the assemblage shows colonisation with change in local environments. This colonised assemblage can be categorised into the following:

i) Restricted to fine grained argillaceous clayey sediments of low energy environment and are mainly represented by grazing trails and resting marks.

ii) The rest of the assemblage is restricted to medium to high energy arenaceous sediments and are represented by mainly feeding structures.

The first category shows the presence of larger animals, probably arthropods, whereas the second one by lower group invertebrates, mostly polychaetes. The availability of food material was enough in clayey horizons, whereas comparatively less at the time of deposition of arenaceous sequence as the trace fossils are mostly represented by simple, branched, meandering and curved structures.

6. It has been observed that though trace fossils are being reported from non-marine sequence, it is very difficult to conclude precisely the environment of deposition only on the basis of trace fossil assemblage. Considering the overall characteristics of the sequence, its non-marine origin is beyond doubt because of the presence of typical leaf remains of Upper Gondwana i.e., Pilophyllum, Taeniopteris, Elatocladus, Matonidium, Pagiophyllum, etc. (Srivastava et. al., 1994). However, the present trace fossil assemblage includes Planolites, Cochlichnus and (?) Skolithos which are normally not reported from nonmarine sequences.

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