DINOFLAGELLATES AND RADIOLARIANS FROM THE TETHYAN SEDIMENTS, MALLA JOHAR AREA, KUMAON HIMALAYA: A PRELIMINARY REPORT


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ABSTRACT

The paper reports the occurrence of dinoflagellate cysts from the Spiti Shale and radiolarians from the Giumal Sandstone, Jhangu Formation and Balcha Dhura Formation exposed in Malla Johar area, Pithoragarh district.

INTRODUCTION

In the Trans-Himalayan region there is an impressive succession of sedimentary rocks designated as Tethyan sediments. These show almost uninterrupted sequence from Pre-cambrian to Early Eocene (Kumar et al., 1977). The upper part of the Mesozoic succession of the Tethyan sediments is considered as geosynclinal in nature but due to lack of much needed detailed micropalaeontological and sedimentological data, the evolution of the Tethyan geosyncline, vis-a-vis the sedimentary tectonics is still not well understood.

The Tethyan succession of the Malla Johar area is exposed in a very unfriendly terrain showing juvenile landscape in which the height varies from 3,000m to 6,000m. The rocks of the area are highly disturbed and deformed. Their structure and stratigraphy were established by Heim and Gansser (1939). Recently Kumar et al. (1977) have presented a modified lithostratigraphic scheme for the Tethyan sequence of this area. The Sancha Malla Group which has been assigned Lower Jurassic to ? Lower Eocene age (Kumar et al., 1977), has been subdivided lithostratigraphically into four formations, viz., Spiti Shale, Giumal Sandstone, Jhangu Formation and Balcha Dhura Formation (Table-1).

Table-1—(Modified by Kumar et al., 1977, after Heim and Gansser, 1939)

<table>
<thead>
<tr>
<th>GROUP</th>
<th>FORMATION</th>
<th>LITHOLOGY</th>
<th>AGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXOTIC</td>
<td>FORMATION</td>
<td>White Oolitic Limestone</td>
<td></td>
</tr>
<tr>
<td>BALCHA DHURA</td>
<td>FORMATION</td>
<td>Basic volcanic rocks interbedded with reddish brown and greyish green</td>
<td>?Lower Eocene</td>
</tr>
<tr>
<td></td>
<td>90 M</td>
<td>shales and radiolarian chert.</td>
<td></td>
</tr>
<tr>
<td>JHANGU</td>
<td>FORMATION</td>
<td>Dark greyish green graywacke, shales, red foraminiferal limestone, calcareous</td>
<td>Upper-Cretaceous</td>
</tr>
<tr>
<td></td>
<td>400 M</td>
<td>sandstone, orthoquartzite and thin bands of radiolarian cherts.</td>
<td></td>
</tr>
<tr>
<td>Giumal Sandstone</td>
<td>400 M</td>
<td>Glaucolithic sandstone, siltstone, shales and radiolarian cherts.</td>
<td>Lower-Cretaceous</td>
</tr>
<tr>
<td>SPITI SHALE</td>
<td>200 M</td>
<td>Black friable shales and siltstone with abundant nodules containing</td>
<td>Oxfordian-Portlandian</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ammonites.</td>
<td></td>
</tr>
<tr>
<td>Rewali Bagar</td>
<td>FERRUGINOUS</td>
<td>Ferruginous oolitic limestone and shale with abundant ammonites.</td>
<td>Callovian</td>
</tr>
<tr>
<td>GROUP</td>
<td>OOLITE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FORMATION</td>
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</table>
The samples which have yielded the microplankton were collected along Laptal-Balcha Dhura and Laptal-Chajon La mule tracks during an expedition organised by the Department of Geology, Lucknow University in 1974. Dinoflagellates have been recorded from the Spiti Shale whereas sediments belonging to the Giumal Sandstone, Jhang Formation and Balcha Dhura Formation have yielded a rich radiolarian fauna.

**DINOFLAGELLATES**

The Spiti Shale sequence is about 200 metres thick. The samples from lower 50 metres did not yield any palynofossil except for some organic detritus. The palynoflora recorded from the Spiti shale samples are highly oxidised. The very friable nature of the palynomorphs might be due to the highly disturbed nature of the rocks, as the entire Tethyan sequence was subjected to intense tectonic disturbances during the uplift of the Himalaya. The preservation of the palynofossils is therefore, unsatisfactory. Attempts have been made to procure, as complete as possible, the individual specimens by following various variations during the chemical analysis.

The dinoflagellates and other palynofossils were recovered by the conventional acid/alkali method. However, the complete oxidation of the organic matter took a very long time and the final recovery of dinocysts and miospores was very poor due to heavy breakage. To avoid this, the material was therefore, treated comparatively for a lesser time. Only the under-macerated material furnished better results. Alkal treatment and acetylation were completely avoided.

The dinocysts and miospores have been recovered from different levels. The assemblages show marked differences suggesting the possibility of biozonation of Spiti Shale in this area.

The present preliminary report records some of the important dinocysts listed below and only a few have been illustrated (Pl. I—19).

*Oligospheridium anthophorum* (Cookson & Eisenack) Davey; *Oligosphereidium pulcherrimum* (Deflandre & Cookson) Davey and Williams; *Lithodinia* sp.; *Sentusidinium* sp.; *Sentusidinium* sp. ?; *Pareodinia ceraophora* Deflandre; *Prolizosphereidium* sp. cf. *torynum* (Cookson & Eisenack) Eisenack & Kjellström; *Gonyaulacysta jurassica* (Deflandre) Norris & Sarjeant; *Tubotuberella apatela* (Cookson & Eisenack) Ioannides et al., *Adnatosphaeridium aemulum* (Deflandre) Williams & Downie; *Oligosphereidium dictyophorum* (Cookson & Eisenack) Davey & Williams; *Omatia montgomeryi* Cookson & Eisenack.

Apart from these, the palynological assemblage also contains a few specimens of pteridophytic spores and acritarchs at particular levels. A perusal of the Upper Jurassic dinoflagellate assemblages described from different parts of the world reveals that the Spiti Shale dinocysts are comparable to those of Australia and New Guinea (Cookson & Eisenack, 1958), England, Scotland and France (Ioannides et al., 1970; Gitmez and Sarjeant, 1972). The dinocyst flora supports an Upper Jurassic age of the Spiti Shale.

**RADIOLARIANS**

The occurrence of radiolarians in the Tethyan sequence of Malla Johar was first made by Heim & Gansser (1939) followed by Mamgain & Sastry (1975), but no detailed taxonomic attempt was made. It has been noticed during the study of petrographic thin sections of the rocks of the Sancha Malla Group that the radiolarians are particularly abundant in three horizons, viz., (i) in the bedded cherts, at the gradational contact between Spiti Shale and Giumal Sandstone; (ii) greywacke and siltstones of the uppermost Jhang Formation (Upper Flysch of Heim & Gansser, 1939) and (iii) the bedded cherts of the Balcha Dhura Formation.

The radiolarians have been investigated in thin sections only, as attempts to extract them through chemical analysis were partially successful due to the fact that the radiolarian shells have undergone large-scale glauconitization. However, in several of the thin sections of the cherts and sandstones, well-preserved radiolarian shells are found allowing a more or less satisfactory generic identification.

The radiolarian assemblages show both qualitative and quantitative differences in composition within the three horizons. Some of the important and significant constituents of these assemblages are listed below and a few have been illustrated (Pl. I—10-19).

**GIUMAL SANDSTONE**

In general the radiolarian assemblage is dominated by cryptothoracic and multisegmented Theoperid Nassellaria and single shelled spherical spumellarians (*Cenoaphera*). A few forms referable to pseudoaulophacid and/or spongoidisc spumellarians also constitute a significant part of this assemblage. Glauconitization is very distinct.

Following Nassellaria genera have been identified: *Sethocapsa* spp., *Lithocampe* sp. cf. *L. elegantissima*, *Lithocampe* sp. *Eucyrtis* sp., *Zhamoidellum* et al. or (*Cryptamphorella*), *Holoeryptoca* sp. and *Williriedellum*.

This radiolarian assemblage resembles with the Upper Jurassic-Cretaceous assemblage recorded by Dumitrica (1970) from Romania in having common abundance of cryptothoracic nassellarians. Some of the forms (*Lithocampe* sp. cf. *L. elegantissima*, *Eucyrtis* sp. and *Sethocapsa* sp.) are similar to those recorded from the Lower Cretaceous of Rotti Island near Timor, Point Sal. California, DSDP Leg 26 (Riedel & Sanfilippo, 1974) and DSDP,
Leg 20 (Foreman, 1973). Therefore, an uppermost Jurassic-Lower Cretaceous age is tentatively suggested for the present radiolarian assemblage.

**JHANGU FORMATION**

The samples yielding Radiolaria belong to the greyish green graywackes in the upper part of this formation.

At this level multisegmented Theoperid Nassellaria dominate the assemblage, though Cryptothoracic nassellarians and single-shelled spherical spumellarians (Cenosphera) are also fairly well represented. A few unidentified spumellarians are also present in good number. Glaucolithicum of the radiolarian shells is also very clearly marked in these rocks, though the forms are better preserved here than in the cherts of the basal Gwaim sandstone. The radiolarian taxa identified are listed below:


**BALCHA DHURA FORMATION**

The hard brownish red radiolarian cherts occur in association with basic volcanic rocks and minor shales, Heim & Gansser (1939) included these rocks with the thursted blocks of the Exotic Formation.

The radiolarian assemblage at this level differs from the assemblages encountered at lower levels, in that the spherical single-shelled spumellarians profusely dominate the assemblage. These forms could not be satisfactorily assigned to any genus. In contrast, a few nassellarians present in the assemblage, though significantly outnumbered by the spumellarians, are somewhat better preserved. The radiolarian shells at this level show no effect of glauconitization. The nassellarians encountered in these cherts have been referred to the following genera:


The presence of Coelocithophorids belonging to the Tetrakhtus triquis Zone in the lowermost member of the underlying Jhangu Formation, indicating latest Cenomanian-Maastrichtian age for the formation, has led Kumar et al. (1977) to assign doubtfully a Palaeocene or even Lower Eocene age to the Balcha Dhura Formation on stratigraphical grounds. Present radiolarian assemblage recovered from the upper part of the Balcha Dhura Formation, however, suggests a Cretaceous affinity.

**CONCLUSION**

1. The Spiti Shale sequence shows a number of palynologically productive horizons. Palynomorphs suggest an Upper Jurassic age.
2. The Gwaim Sandstone, Jhangu Formation and Balcha Dhura Formation show moderately well preserved radiolarian fauna. All the three formations have a characteristic assemblage.
3. The radiolarian fauna of the Balcha Dhura Formation suggests Cretaceous affinity.
4. Present study indicates that the dinoflagellates can be significantly used in deciphering the precise zonation of the Spiti Shale formation.

**ACKNOWLEDGEMENT**

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**REFERENCES**


DINOFLAGELLATES AND RADIOLARIANS FROM THE TETHYAN SEDIMENTS

EXPLANATION OF PLATE

PLATE I

1. Oligosphaeridium anthophorum (Cookson & Eisenack) Davey, 1969; Slide no. BSIP 6040; coordinates 129.7 x 6.7; x 500.
2. Lithodinia sp., Slide no. BSIP 5913; coordinates 108.9 x 10.0; x 500.
3. Oligosphaeridium pulcherrimum (Dellandre & Cookson) Davey & Williams 1966; Slide no. BSIP 5913; coordinate 112.5 x 10.3; x 500.
4. Sentudinium sp., Slide no. BSIP 6041; coordinates 104.5 x 3.7; x 500.
5. ?Setudinium sp., Slide no. BSIP 5912; coordinates 114.5 x 3.7; x 500.
6. Pareslavia eratophora Dellandre emend. Gocht, 1970; Slide no. BSIP 6042; coordinates 96.8 x 13.2; x 500.
7. Prolevephastidium cf. toryanum; Slide no. BSIP 5912; coordinates 121.8 x 16.5; x 500.
8. Gonystictypholyta jurassica (Dellandre) Norris & Sarjeant 1965; Slide no. BSIP 6043; coordinates 121.9 x 13; x 500.
9. Tabuliberella opatela (Cookson & Eisenack) Ioannides et al. 1977; Slide no. BSIP 5911; coordinates 112.2 x 8.8; x 500.
10. Spumellaria indet; Slide no. BSIP 5914; coordinates 107.0 x 8.0; x 300.
11. Sellicapsa sp., Slide No. BSIP 5917; coordinates 104.5 x 13.5; x 300.
12. Eucyrtis sp., Slide No. BSIP 5916; coordinates 101.5 x 12.8; x 300.
13. Lithocampe sp., Slide no. BSIP 5914; coordinates 104.5 x 10.6; x 250
14. cf. Encyrtidium sp., Slide no. BSIP 6044; coordinates 98.7 x 13.2; x 250
15. Dictymitra sp. cf. D. pseudobaculiformis; Slide no. BSIP 6044; coordinates 109.7 x 18.5; x 250.
16. Williedelldium sp., Slide No. BSIP 5914; coordinates 105.2 x 11.4; x 300.
17. ?Hansudia (or ? Cryphalapilia) sp.; Slide No. BSIP 5916; coordinates 107.0 x 13.0; x 300.
18. Eucyrtis sp. cf. E. truncata (?); Slide no. BSIP 6046; coordinates 116.6 x 12; x 250.
19. Lithocampe sp. cf. L. elongatus Ranz (in Riedel & Sanfilippo, 1974); Slide no. BSIP 6046; coordinates 102.3 x 10.1; x 250.