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New nannofossil age-constraint for the Latest Tithonian index ammonite *Himalayaites*

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Abstract

Himalayites, a Latest Tithonian ammonite index recently recorded from the Jaisalmer Basin (western India) has yielded index nannofossil species *Ethmorhabdus gallicus* Noël (LAD) and *Helenea chiastia* Worseley (FAD) enabling calibration with NJ17B *Ethmorhabdus gallicus* subzone of early Late Tithonian age (141.5 to 142.5 Ma). This is the oldest startigraphic nannofossil age-constraint record for the genus from the southern Tethys which suggests that the Jaisalmer Basin may be the center of evolution for this genus.

Introduction

Nannofossil assemblage is reported from Latest Tithonian index ammonite *Himalayites* (1) from the upper part of the Rupsi Shale Member (Jaisalmer Formation) exposed near Rupsi village (27ºN , 70º49'E), northwest of Jaisalmer, western India. Genus *Himalayites* Uhlig, originally reported from the Tethys Himalaya, is considered as the index for Latest Tithonian sediments, globally (2. 3, 4, 5, 6, 7, 8, 1).

The recovery of age-diagnistic nannofossil assemblage from the matrix of *Himalayites* aff. *seideli* (Oppel) described by Jain and Garg (1) enables a reassessment of the startigraphic range of this genus and its paleobiogegraphy. The recovered nannofossil assemblage, the first Tithonian record from southern Tethys, is moderately preserved with low diversity (21 species) characterized by small sized *Nannoconus* species of distinct Tethyan affinity.

Geological setting

The Jaisalmer Basin is situated on the northwestern part of the Indian peninsula, where low dipping Mesozoic succession comprising of Lathi, Jaisalmer, Baisakhi, Bhadasar and Pariwar formations is exposed overlying the Pre-Cambrian basement. The Baisakhi Formation is divisible into three Members (Baisakhi, Ludharva and Rupsi in ascending order).

In the type section, the Rupsi Shale is represented by shale-sandstone intercalations with several thin ammonite rich hard sandy bands (Fig. 2). Garg et al. (9) recorded agglutinated foraminiferal assemblages from the Rupsi Shale Member and also noted three ammonite associations namely *Torquatisphinctes* (Kimmeridgian), *Torquatisphintes-Pachysphintes* (Kimmeridgian) and *Hildoglochiceras-Aulacosphintoides* (EarlyTithonian). Pandey and Krishna (10) constrained the Rupsi Shale Member to Early Tithonian and erected three ammonite biozones - Virgatosphinctoides, Natricoides and Communis from bottom to top. Recently Jain and Garg (1) from the uppermost part of the Rupsi Shale Member recorded the Late Tithonian index ammonite *Himalayites* aff. *seideli* (Oppel) [M] and revised the Rupsi Shale Member biozonation erecting four ammonite biozones – Alterniplicatus, Virgatosphinctoides, Kobelliforme and

Himalayites in ascending order. The topmost Himalayites Zone was correlated with the Latest Tithonian Tethyan Duragites spp. Zone (1).

The nannofossil assemblage

The assemblage recovered from sample number JR5c includes 21 species viz. *Cretarhabdus conicus, Cyclagelosphaera margerelii, Discorhabdus corollatus, Diazomatolithus lehmanii, Ethmorhabdus gallicus, Helenea chiastia, Lucianorhabdus* sp., *Lotharingius sigillatus, Lotharingius hauffii, Nannoconus compressus, N. erbae, Nannoconus infans, N. wintereri, Zeugrhabdotus embergerii, Rotelapillus radians, Zeugrhabdotus erectus, Zeugrhabdotus fluxus, Watznaueria barnesae, Watznaueria britannica, Watznaueria fossacincta,* and Gen et sp. indet. coccosphere.

Zonal assignment

The nannofossils assemblage is assigned to the *Conusphaera mexicana* Zone of Roth (11) of Middle Tithonian age. Small nannoconids of less than 8mm in length (represented here as *Nannoconus compressus* and *N. wintereri*) is taken to approximate the base of this Zone.

The occurrence of *Zeugrhabdotus embergeri* is helpful in approximating the lower boundary of the *Conusphaera mexicana* Zone. The close proximity of FAD of *Zeugrhabdotus embergeri* and *C. mexicana* is clearly shown in many DSDP sections in North Atlantic (Medd *in* 11) and is used here as evidence for our zonal assignment. The *C. mexicana* Zone is subdivided into two subzones; the older *Hexapodorhabdus cuvillieri* and the younger *Polycostella beckmannii* subzones.

The FAD of *P. beckmannii* and presence of less than 8µm long nannoconids help to determine the boundary of the two subzones. The extinction of both *Helenea chiastia* (= *Cruciellipsis* sp. cf. *chiastia*) and *Ethmorhabdus gallicus* provide Early to Late Tithonian age (Table-1) and both are present in JR5c sample of Rupsi section of Jaisalmer, western India.

Occurrence of *Z. embergeri* (FAD), *N. compressus* (FAD) and *E. gallicus* (LAD) in the assemblage is taken here as marker taxa for NJ 20 (T) *Conusphaera mexicana* Zone assignment of late Early Tithonian age (Table). NJ 20 (T) Zone of Bralower *et al.* (12) encapsulates Tethyan lower to middle Tithonian time slice (CM 22n – CM20). The present nannofossil assemblage can be correlated to NJ 20b (T) Middle Tithonian *Polycostella beckmanni* subzone. Occurrence of *Nannoconus* sp. marks the advent of Tithonian age. So far no nannofossil data is available from Ethiopian subprovince of Indo- Pacific Province. The assemblage is dominated by Tethyan nannoconids of less than 8µm in length. Nannoconnids are known from upper Tithonian of Italy, Tunisia and southeast Africa belonging to Tethyan realm (11).

Conclusions

1. This is the first nannofossil record from Jaisalmer Basin, western India of Tithonian age. The assemblage is moderately diversified and well preserved but limited to only one sample.
2. The ammonite genus *Himalayites* is a global Late Tithonian marker.
3. The calcareous nannofossil assemblage recovered from sample number JR5c containing *Himalayites* aff. *sideli* was assigned Late Early Tithonian.
4. Occurrence of *Z. embergeri* (FAD), *N. compressus* (FAD) and *E. gallicus* (LAD), *D. corollatus* (LAD) in the assemblage is taken here as marker taxa for NJ 20 (T) *Conusphaera mexicana* Zone assignment of late Early Tithonian age.

The introduction of *Himalayites* in western India (13, 14) parallels the rising Late Tithonian sea level (15, 16) which facilitated the opening of a new seaway connections among otherwise isolated or semi-isolated basins (see also 14).

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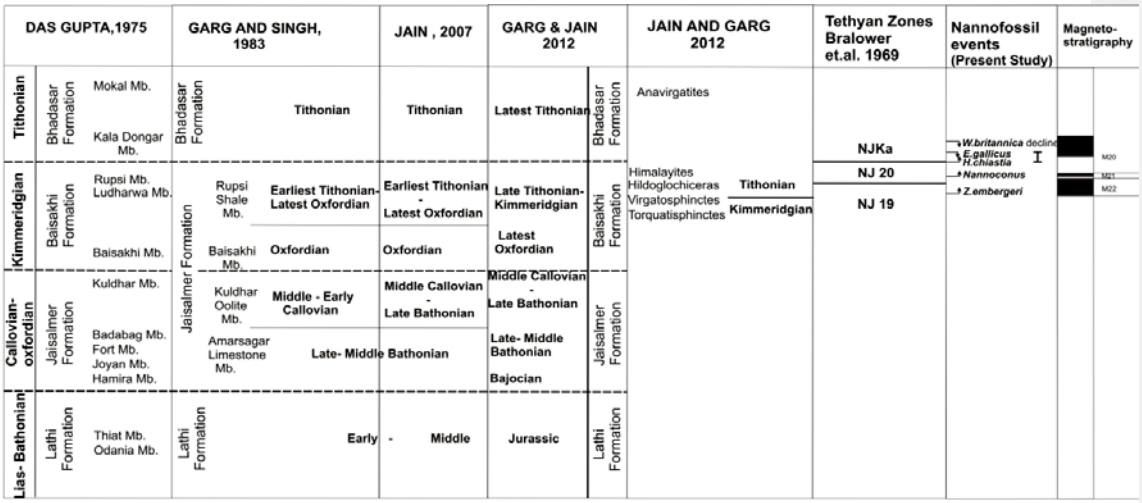

Table: Stratigraphic framework for the Jaisalmer Basin (After Das Gupta, 1975; Garg and Singh, 1983; Jain, 2007; Garg and Jain, 2012). The four Ammonite Zones based on acme, abundance of *Torquatisphinctes, Virgatosphinctes, Hildoglochiceras* and *Himalayites* (from bottom to top respectively) are shown. The nannofossil assemblage belongs to Tethyan lower NJKa NF Zone of Bralower et al., 1989 corresponding with NJ 17b of Boreal NF Zone of Bown et al. 1998 of Middle Tithonian age representing CM 20n.