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Primary Productivity of Late Cretaceous Ocean: Nannofossil Records from Jaisalmer Basin, Western India and its Implications.

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Abstract

Late Cretaceous (Albian-Maastrichtian) is globally recorded as period of extensive global marine transgressions. During late Albian, Indian subcontinent was situated at ~35°S and moved northward upto 15°S during early Maastrichtian. In the present study, highly diversified (over 200 species) and well-preserved calcareous nannofossil assemblages from outcrop and the subsurface (Tanot #1) of late Albian-early Maastrichtian sequences are recorded from the Jaisalmer Basin, western India. Nannofossils are the most important pelagic calcifying organisms in the modern oceans. They have the ability to carry out photosynthesis which makes them an important group of primary producers. The recorded nannofossil assemblages at various depths display marked fluctuations in diversity and abundance. Five low productivity zones alternating with high productivity zones at different depth intervals have been recorded throughout the succession. These regressive intervals can be matched well with the global sea level curve. The high productivity zones contain various events of acme and size variation of particular species.

Introduction

Jaisalmer, a pericratonic basin is situated in the north-western part of Rajasthan, western India. It displays nearly flat topography covered with recent desertic alluvium and few prominent hillocks of marine Mesozoic-Tertiary rocks in the form of cuestas ranging in age from Lower - Middle Jurassic to Palaeogene. The subsurface Cretaceous succession provided micropalaeontological data based on planktic, smaller benthic foraminifera and ostracoda (1, 2) for dating purposes. However, calcareous nannofossils with better age resolution have for the first time been utilized from Cretaceous subsurface succession of Tanot well#1 (27° 46’ N and 70° 17’ E) dug by Oil India Limited from the Jaisalmer Basin.

Methodology

One hundred and fourteen samples (well cuttings) were studied for nannofossils between 1104 to 1899m depths. The Cretaceous succession represents Pariwar, Goru and Parh formations in ascending order from which well to moderately preserved, highly diversified nannofossil assemblages ranging in age from Late Albian to Early Maastrichtian have been recorded.

Results and Discussion

The study revealed that the nannofossil assemblages are exceptionally well preserved and highly diverse at certain levels but show low to moderate diversity in general with rare to abundant occurrences of selected number of species. Besides marker species of standard zonal schemes, several other substitute marker taxa have been utilized to facilitate biostratigraphic subdivision of the studied interval and their comparison with global zonation schemes. In the present study, an informal alpha-numeric zonal scheme has also been proposed for the Tanot well#1 which may prove useful for shallow shelf areas of low latitude. Seventeen nannofossil zones were assigned on the presence of last occurrence (LO) of zonal

markers (TA1-TA17) and compared with existing zonation schemes of Burnett, 1998 (3); Perch-Nielsen, 1985 (4); Bergen and Sikora, 1999 (5). Five subzones in basal most Zone (TA1) were demarcated on the basis of first occurrence (FO) of subzonal markers (3).

Calcareous Nannofossils are considered as one of the most important pelagic organisms which can biomineralise calcite and they are able to carry out photosynthesis which make them an important group of primary producers (8, 9) in the modern oceans (6, 7). The recorded nannofossil assemblages at various depths show striking fluctuation in diversity, numerical abundance and acme or size variation of specific taxa. Five low productivity zones have been demarcated throughout the succession alternating with high productivity zones at different depth intervals. These regressive intervals shows well correlation with the global sea level curves of Haq et al. 1987 (10). The high productivity zones contain various events of acme and particular species size variation.

The high diversity and high abundance of nannofossils during late Campanian-early Maastrichtian suggest stabilized marine conditions in warm tropical region. Santonian to early Maastrichtian age sediments are first time recorded in Jaisalmer Basin. In the adjoining Pakistan and Iran basins equivalent marine sediments are oil bearing so, possibility of getting rich organic sediments in Jaisalmer Basin cannot be ruled out.

It is pertinent to note that the palaeogeographical position of the Indian subcontinent after its break up from Madagascar-Sychelles from early-late Cretaceous time spanning from Albian to early Maastrichtian (ca. 112-68my) was from 40°- 15° in most reconstructions (11). The studied succession of Tanot Bore Well-1 in western Rajasthan therefore might have been laid in mid to low latitudes in the southern hemisphere during Albian to early Maastrichtian time slice and the nannofossil assemblage shows distinct changes with the rapidly changing palaebiogeographic position of Indian subcontinent. Record of cold water taxa (*Seribiscutum primitivium, Angulofenestrellithus snyderi, Broinsonia matalosa, Bukrylithus ambiguous, Eiffellithus monechiae, Eiffellithus pospichalii, Nephrolithus corystus, Nephrolithus frequens, Octolithus multiplus, Radiolithus hollandicus, Retecapsa ficula, Stoverius achylosus* and *Tortolithus hallii*) with Tethyan nannoconids and other warm water taxa (*Ceratolithoides pricei*, *Ceratolithoides ultimus*, *Micula murus*, *Micula praemurus*, *Nannoconus truitii frequens* and *Prolatipatella multicarinata*) suggests mixing of cold and warm water regimes via current system.

Conclusions

Record of more than 200 nannofossils species suggests that during Late Cretaceous time the ocean was highly conducive for nannofossil richness in Jaisalmer. Although some low productivity zones have also been recorded throughout the succession but these regressive intervals are well matched with the global sea level fluctuation. The high diversity and high abundance of nannofossils during the late Campanian-early Maastrichtian time suggests that stabilized marine conditions might have prevailed in warm tropical region.

References

1. N.P. Singh, “Mesozoic-Tertiary biostratigraphy and biogeochronological datum planes in Jaisalmer Basin, Rajasthan”, XVI Indian Colloquium on Micropalaeontology and Stratigraphy, 63-89, 1996. (1996).

2. A. Bhandari, “Phanerozoic stratigraphy of western Rajasthan Basin: A review. In: P. Kataria (ed.), Geology of Rajasthan status and prespective. Proceedings of the Seminar”, Mohan Lal Sukhadia University, Department of Geology, Udaipur, 126-174, 1999, (A. B. Roy Felicitation Volume).

3. J.A. Burnett, “Upper Cretaceous. In: P.R. Bown (ed.), Calcareous Nannofossil Biostratigraphy”, Chapman and Hall Ltd., Cambridge University Press, Cambridge, 132-165, 1998.

4. K. Perch-Nielsen, “Cenozoic calcareous nannofossils. In: H.M. Bolli, J.B. Saunders and K. Perch-Nielsen (eds.), Plankton stratigraphy”, Cambridge University Press, 329-554, 1985.

5. J.A Bergen and P.J. Sikora, “Microfossil diachronism in southern Norwegian North Sea chalks. In: R.W. Jones and M.D. Simmons (eds.), Valhall and Hod fields Biostratigraphy in production and development Geology”, Geological society special publication, 152, 85-111, 1999.

6. K.H. Baumann, B. Bockel and M. Frenz, “Coccolith contribution to South Atlantic carbonate sedimentation. In: H.R. Thierstein and J.R. Young (eds.), Coccolithophores: From molecular processes to global impact”, Springer, Berlin, 367-402, 2004.

7. W.W. Hay, “Carbonate fluxes and calcareous nannoplankton. In: H.R. Thierstein and J.R. Young (eds.): Coccolithophores: From molecular processes to global impact”, Springer, 509-528, 2004.

8. A. Winter and W.G. Siesser, “Coccolithophores”, Cambridge, Cambridge University Press, 242, 1994.

9. P.R. Bown and J. Young, “Introduction. In: P.R. Bown (ed.), Calcareous nannofossil Biostartigraphy”, Chapman and Hall Ltd, Cambridge University Press, Cambridge, 1-15, 1998.

10. B.U. Haq, J. Hardenbol and P.R. Vail, “Chronology of fluctuating sea levels since the Triassic, Science, 235, 1156-1167, 1987.

11. J. Lees, “Calcareous nannofossil biogeography illustrates paleoclimate change in the Late Cretaceous Indian Ocean”, Cretaceous Research, 23, 537-634, 2002.

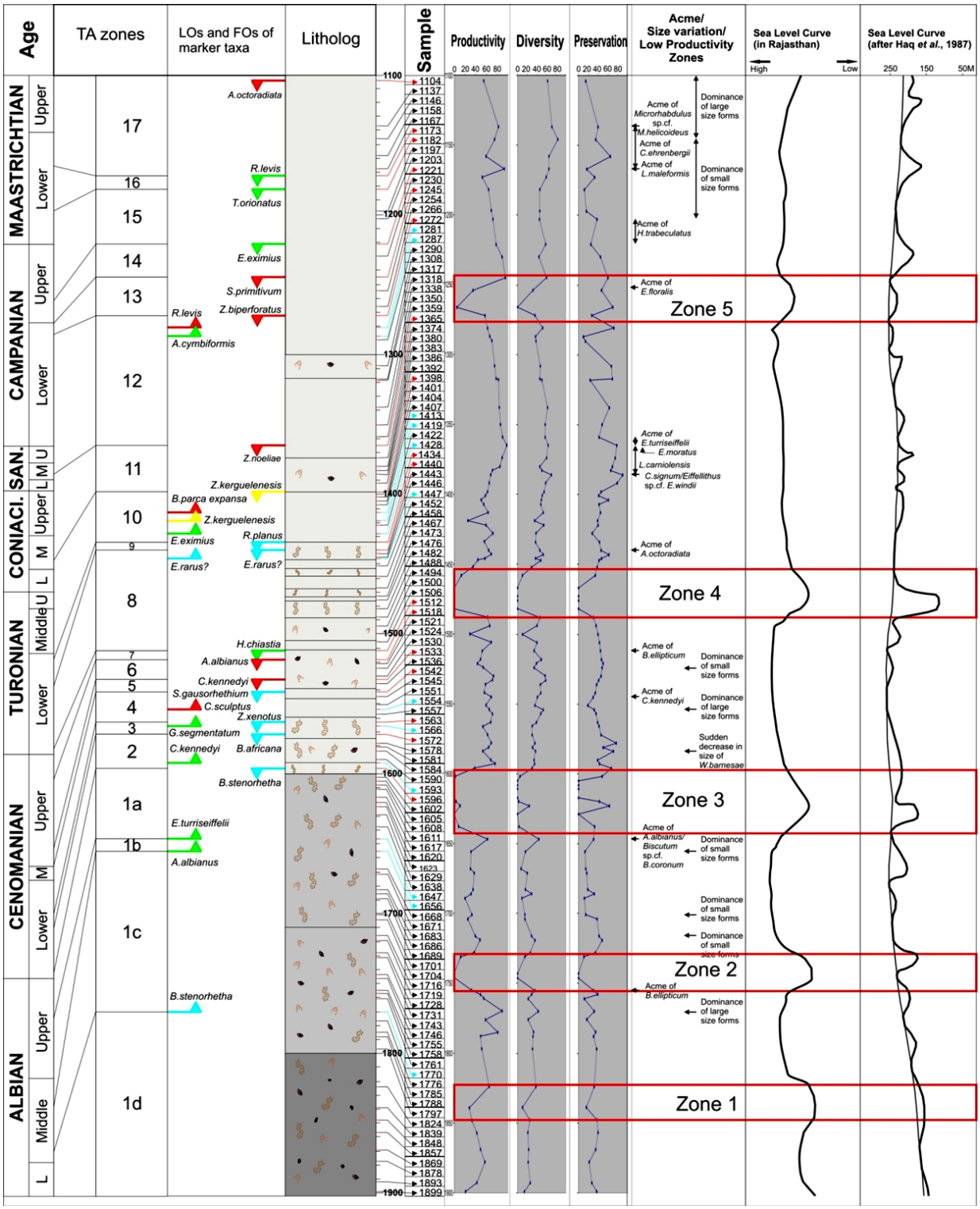

Chart showing the High and Low Productivity Zones with acme horizons, size variation and sea level curve.