recorded microfossils from Bilara limestone of the Marwar Supergroup. Under the descriptions of age (p.455) they report, "most of the foraminifera genera in the assemblage range in age up to recent and most of these range through whole of the Tertiary". Further, they have stated on (p.475), "it is logical therefore, to conclude that the age of the recovered microfauna may not be older than Miocene or Middle Eocene. The general microfauna elements, freshness of their preservation and total composition of the assemblage is reminiscent of Neogene assemblage of Western Indian Tertiary basins".

From the above, anybody can guess that the Bilara limestone, the middle horizon of the Marwar Supergroup, belongs to Tertiary.

9. We have placed Pokaran Sandstone at *par* with Jodhpur sandstone (*see* Table 1). The term Pokaran sandstone was consciously used with a geographical connotation to enable one to comprehend the evolutionary history of Pokaran Boulder Bed.
10. We have not delineated the Pokaran Boulder Bed in Fig.1 because it does not form consistent horizon but occurs in far-flung spreadout patches. However, in our paper we have described the various localities where from we studied the boulder bed. They are shown in Fig.1.

### References

BHATT, D. K. and RAVINDRA KUMAR (2000) Record of marine microfauna younger than Palaeogene from Rajasthan. Jour. Geol. Soc. India, v.53, pp. 453-458.

BHATT, D. K. and RAVINDRA KUMAR (2001) Discussion. Jour. Geol. Soc. India, v.57, pp.379.

BHUSHAN, S.K. (1977) A note on the stratigraphic position of Pokaran Bed. Indian Minerals, v.31, pp.43-45.

GSI (1971). Code of Stratigraphic Nomenclature of India. Geol. Surv. India, Misc. Publ.

KNOLL, A.H. and WALTER, M.R. (1992) Latest Proterozoic Stratigraphy and Earth History. Nature, v.365, pp.675-678.

LA TOUCHE, T.H.D. (1902) Geology of western Rajputana. Mem. Geol. Surv. India, v.35, pt.1.

OLDHAM, R.D. (1886) Preliminary note on the Geology of northern Jaisalmer. Rec. Geol. Surv. India, v.19, no.3, pp.157-160.

PAREEK, H.S. (1981) Basin configuration and sedimentary stratigraphy of western Rajasthan. Jour. Geol. Soc. India, v.22, pp.517-527.

Pareek, H.S. (1984) Pre-Quaternary Geology and Mineral Resources of northwestern Rajasthan. Geol. Surv. India Mem., v.115, 99p.

PASCOE, E. H. (1975). A Manual of the Geology of India and Burma. Vol. II, Geol. Surv. India, pp.485-1343.

RAGHAV, K.S. (2000a) On discovery of middle Eocene larger foraminifera from a limestone bed in Churu district, Rajasthan. Jour. Geol. Soc. India, v.55, pp.269-274.

Raghav, K.S. (2000). Discovery of foraminifera from Bilara Group, Jodhpur District, Rajasthan. Jour. Geol. Soc. India, v.55, pp.395-397.

VIRENDRA KUMAR (1999) Evolution and geological set up of the Nagaur-Ganganagar basin, northwestern Rajasthan. *In:* B.S. Paliwal (Ed.), Geological Evolution of Northwestern India. Scientific Publishers, Jodhpur, pp.34-60.

## OUTCROP SEQUENCE STRATIGRAPHY OF THE MAASTRICHTIAN KALLANKURCHCHI FORMATION, ARIYALUR GROUP, TAMIL NADU by R. Nagendra, R. Raja, A. Nallapa Reddy, B.C. Jaiprakash, and R.J. Bhavani. Geol. Soc. India, v.59(3), pp.243-248.

**P. K. Kathal,** Centre of Advanced Study in Geology, Dr. H.S.G. University, Sagar - 470 003 (kathal@vsnl.com and pkkathal@rediffmail.com), comments:

The authors have attempted sequence startigraphy of the Maastrichtian (70-66 Ma) Kallankurchchi Formation, Ariyalur Gropu (Tamil Nadu) based on the field observations, occurrences of microfossils (benthic foraminifera) as well as megafossils (bivalves and bryozoans).

The study raises a few important questions:

(a) They seem to be unaware of the utility of smaller rotaliids in upper Cretaceous rocks as they identified only 5 of the 40 encountered foraminifera at species level. Although there are various genera of restricted ranges but application of smaller rotaliids in biostratigraphy of Upper Cretaceous rocks is mainly at species level (Haynes, 1981). The smaller rotaliids particularly the *Gavelinella-Lingulogavelinella* group, which occur in the studied sequence has immense utility of Cretaceous stratigraphiy, as most of their families were established by the late Upper Cretaceous. Seven rotaliids belonging to the group are valuable mainly in Lower Cretaceous from Hauterivian upward particularly in Albian (Scheibnerova, 1971a, 1971b; Price, 1976; Salaj, 1976).

(b) Members of *Gavelinella-Lingulogavelinella* group namely, *Gavelinella, Gavelinopsis, Gyroidinoides, Osangularia, Lingulogavelinella, Praestorrsella* (misspelled in the text as *Praestorresella*), and *Gaupillaudina* (misspelled *Gaupilladina*) occur frequently in the Kallankurchchi Formation (Fig.2 of the authors). The authors could have utilized their presence by identifying them at specific levels in order to develop a 'higher resolution stratigraphy'.

(c) The authors have assigned Maastrichtian (70-66 Ma) age to the entire formation. However, chances of Maastrichtian-Danian boundary lying in the upper part of the formation may not be ruled out as *Cibicides*, which appeared in Danian (65 Ma) *Praestorresella*, which disappeared by the end of Maastrichtian (before 65 Ma) occur within 7.3 to 6.8 m levels (between Lower Arenaceous Limestone and *Gryphea* Limestone, Fig. 2).

(d) Table 1 shows that if *Gavelinella*, which occurs throughout the sequence is identified at species level, the possibility of demarcating Maastrichtian-Danian boundary is very much there.

**Table 1.** Age ranges of species of Gavelinella (Haynes, 1981)

| Species | Age range |
|---|---|
| *Gavelinella bullata* | Danian |
| *Gavelinella persuta* and *Gavelinella nelsoni* | Masstrichtian |
| *Gavelinella coastata, Gavelinella cretacea* and *Gavelinella tunida* | Santonian |
| *Gavelinella ammonoides, Gavelinella moniliformis* and *Gavelinella balthica* | Albian to Turonian |

(e) The occurrence of Cibicides at level below 7.3 m may be due to sample contamination, as evident further by:

(i) The respective age ranges of the following genera do not conform the stratigraphic levels where they occur in the studied section (Table 2).

(ii) When Lingulogavelinella disappeared by the close of Turonian (88.5Ma, Loeblich and Tappan, 1988, p. 627; and Gowda, 1987), question of its occurrence in Maastrichtian (70-66Ma) does not arise.

**Table 2.** Reported genera, their age ranges and depth in the sequence (Fig.2 of the authors)

| Genus | Age range (Ma) | Level occurrence in Fig. 2 |
|---|---|---|
| *Cibicides* | 65 to 0 | Throughout the succession |
| *Praestorresella* | 87.5 to 0 | at 3.7 m |
| *Lingulogavelinella* | 97.5 to 88.5 | at 20.1 m |
| *Osangularia* | 65 to 0 | at 26.8 m |
| *Alabamina* | 87.5 to 0 | at 37.3 m |

**R. Nagendra, R. Raja, A. Nallapa Reddy*, B.C. Jayaprakash**** and **R. Bhavani**, Centre for Geoscience and Engineering, Anna University, Chennai - 600 025; *Regional Geology Laboratory, Oil and Natural Gas Corporation Ltd., Chennai - 600 034; **Geology Divsion, ONGC, Tripura Project, Badarghat Complex, Agartala - 799 014, reply:

The authors would like to thank Dr. Kathal for his interest in our paper.

The main aim of our paper was sequence stratigraphy analysis of Kallankurichchi Formation and therefore much emphasis could not be given to foraminiferal studies. However, as a part of our ongoing DST project, a detailed study on the foraminifera and geochemistry is being undertaken, and the results will be published in due course. Thus, with respect to our present paper, we consider Dr. Kathal's remarks/comments (from a to e) are not relevant to the present paper since it is on the recognition of sequence stratigraphic parameters mainly by field observations.

The age of Kallankurichchi Formation is studied in detail and assigned as Maastrichtian by Raju et al. (1993) and Hart et al (2001).

The occurrence of species of *Cibicides*, (*bemontianus, harperi, subcarinatus, ribbingi*), *Gavelinopsis* (*bembix, tourainensis*), *Osangularia* (*carideriana, texana, navarroana*) are widely reported from Cretaceous sections (Rasheed and Govindan, 1968; Chidambaram, 2001; Banerjee, 1968; Widmark and Malmgren, 1992; Belford, 1960).

However, the appearance of *Lingulogavelinella* sp. in Fig.2 has occurred inadvertently. It should have appeared in Fig.5 of our other paper on "Kallakudi" (*JGSI*, v.59, pp.249-258). Both papers were simultaneously finalised by us and thereby this mistake had crept in. We profusely regret for this mistake.

## References

Banerjee, R.K. (1968) Late Cretaceous foraminiferal biostratigraphy of Pondicherry area, South India. *In:* Cretaceous -Tertiary Formations of South India. Mem. Geol. Soc. India, no.2, pp.30-49.

BELFORD, D.J. (1960) Upper Cretaceous Foraminifera from the Toolonga Calcilutite and Gingin chalk, Western Australia, Bureau of Mineral Resource, Geology and Geophysics, Bulletin, no.57, pp.1-190.

CHIDAMBARAM, L. (2000) Middle Turonian-Santonian Foraminiferal Biostratigraphy of Trichinopoly Group, South India. Cretaceous Stratigraphy - An Update. Mem. Geol. Soc. India, no.46, pp.173-204.

HART, M.B., BHASKAR, A. and WATKINSON, M.P. (2000) Larger Foraminifera from the upper Cretaceous of the Cauvery Basin, S.E. India. *In:* Cretaceous Stratigraphy - An Update. Mem. Geol. Soc. India no.46, pp.159-171.

GOWDA, S.S. (1987) A new genus of foraminifera from the Cretaceous rocks of South India. *In:* Proc. Indian Acad. Sci., Animal Sci., v.87(B), pp.1-15.

HAYNES, J. R. (1981) Foraminifera. MacMillan Publ. Ltd., London, 242p.

LOEBLICH, A.R., JR., and TAPPAN, H. (1988) Foraminiferal genera and their classification Van Nostand Reinhold, New York, v.1, 970p. and v.2, 847pls.

PRICE, R.J. (1976) Paleoenvironmental interpretations of the Albian of western and southern Europe, as shown by distribution of selected foraminifera. Mart. Sedi., Spl. Publ. no.1(B), pp.625-648.

RAJU, D.S.N., RAVINDRAN, C.N. and KALYANASUNDARAM, R. (1993) Cretaceous cycles of sea-level changes in the Cauvery Basin, India - A first revision. Bull. Oil Natural Gas Commission, v.30, pp.101-113.

RASHEED, D.A. and GOVINDAN, A. (1968) Upper Cretaceous Foraminifera from Vridhachalam, South India. *In:* Cretaceous-Tertiary Formations of South India. Mem. Geol. Soc. India, no.2, pp.66-84.

SALAJ, J. (1976) Benthonic zonation in the Lower Cretaceous in the Djebel Zaghouan region. Mar. Sed., Spl. Publ. v.1(B), pp.501-507.

SCHEIBNEROVA, V. (1971a) *Lingulogavelinella* (Foraminifera) in the Cretaceous of the Great Artesian Basin, Australia, Micropal., v.17(1), pp.109-116.

SCHEIBNEROVA, V. (1971b) Foraminifera and their Mesozoic Biogeoprovinces. Res. Geol. Surv. NSW, v.13(3), pp.135-174.

WIDMARK, J.G.V. and MALMGREN, B. (1992) Benthic Foraminifera changes across the Cretaceous-Tertiary Boundary in the Deep Sea; DSDP Sites 525, 527 and 465. Jour. Foraminiferal Res., v.22, no.2, pp.81-113

# CORRESPONDENCE

## COMPUTER BASED MODELLING AND GEOSTATISTICAL METHODS IN MINERAL EXPLORATION

We read with interest the article by A.K. Talapatra et al. (*JGSI*, v.57, pp.231-237) entitled "A scheme of Computer Based Mineral Deposit Modelling and Resource Evaluation of Precambrian Terrains". The author opined that at times continuous exposures of fresh *in situ* rock are generally very difficult to find. Therefore it is equally very difficult to draw inference on the occurrence of ore deposits. It is also possible that the likely occurrences of concealed ore deposits do not show any surface signatures of mineralisation. In such conditions non-conventional methods of exploration based on multivariate statistical analysis may be of help in establishing the characteristic interrelationships between various geological, geochemical and geophysical parameters to enable prediction of new exploration targets at low cost. Certainly, Geographic Information System is an useful tool facilitating integration of input data layers to generate thematic maps of different mineralized belts. However, the author should have forced his arguments by quoting real examples.

This paper attracted criticism by Mr. J.V. Subbaraman (*JGSI*, v.57, p.84). Mr. Subbaraman in a sweeping remark dismissed the applicability/utility of computer based modelling/geostatistical techniques in ore body assessment and prediction. In Mr. Subbaraman's opinion any study conducted in isolation of geological inputs *viz.*, lithology, structure, variation of grades is bound to be sterile.

It is common knowledge that when we are applying some techniques to mineral resource assessment/orebody modelling, we should also consider the geology of the area. This does not mean that geology alone is the panacea for all problems. An integrated approach involving a study of geology of the area, pattern recognition/geostatistical techniques is worth trying. In support of his apathy for the applications of these types of techniques, Mr. Subbaraman