14. Prusinkiewicz, P., Lindenmayer, A., Hanan, J. S., Fracchia, F. D., Fowler, D. R., de Boer, M. J. M. and Mercer, L., *The Algorithmic Beauty of Plants*, Springer-Verlag, New York, 1990.

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Atlas of Carbonate Microfacies from the Reservoirs of Bombay Offshore Basin, India. K. Satyanarayana, R. R. Sharma, D . K. Dasgupta and K. K. Das. Regional Geology Laboratory, Exploration Business Group, Oil & Natural Gas Corporation Ltd., Mumbai, India. 1999. ISBN 81-7525-086-0. Price: US $290.

Oil exploration and exploitation are a technology- and money-intensive game that demand thorough in-depth analysis of all available geological and geophysical information. The game becomes more intricate while exploring a carbonate reservoir rock because of its mercurial susceptibility to diagenetic changes. These changes make it difficult to read correctly the depositional environment so essential in oil exploration and exploitation. Sedimentary environment controls the size, shape, composition, internal organization, position in a basin and bounding lithologies – be it either a carbonate or terrigenous sand bodies. Further, since diagenetic changes in carbonate rock occur at different stages of its evolution, the timing of such changes is important with respect to its structural changes and hydrocarbon migration.

Microfacies analysis of carbonate rock is essential in order to fully comprehend the composition, internal organization, post-depositional changes and evolution of porosity. The present book under review highlights these intricate microfacies changes in carbonate rocks of Bombay Offshore Basin in response to shift in depositional environment. The Oil & Natural Gas Corporation Limited (ONGC) has done a commendable service to the scientific community in publishing this atlas which will certainly help students and researchers engaged in the study of carbonate rock. Notwithstanding the fact that such an atlas is not new in the book market[1–2], what is new, however, is that (i) all illustrations are drawn from Indian sources, and (ii) ONGC has for the first time endeavoured to publish data that so long remained confined in their files. The price is, however, prohibitively high for anybody to procure a personal copy.

The atlas documents various microfacies and resultant porosity variations in carbonate reservoir rocks of various producing horizons of Bombay offshore oil basin. The illustrations are excellent. The authors have presented microfacies illustrations separately for various hydrocarbon bearing structures, e.g. Bombay High field, Deep continental shelf, Panna field, Bassein field, Mukta block, Neelam field, Heera field and Ratnagiri block. Illustrations of each field are preceded by a brief description of the salient geological features of the field, accompanied by generalized stratigraphic column and a map showing locations of wells drilled into the structure. It would have been instructive for the students if various log responses and structure contour and isopach maps had been presented for each field.

While providing a brief geological history of the Bombay Offshore Basin, the authors describe the basin as formed due to extensional tectonics. It is difficult to explain reverse fault in a pericratonic extensional basin (see p. 2). There are no evidences of it in the accompanying illustrations. It is also not clear how some homoclines and periclines are incorporated as 'basement structural elements' in the map.

The authors have thoughtfully included glossary of terms used in microfacies description and analysis. However, terminologies are not exhaustive and descriptions of those that are presented are very brief, casual and some are not correct. The term 'micrite' (acronym of microcrystalline calcite ooze) does not refer only to lithified carbonate mud (1–4 µm), but is used also as a synonym for modern carbonate mud. Further, in the glossary of 'micrite' and 'sparite' it should have been clearly mentioned that while the former can form a rock by itself with or without any association of allochems, it does not in case of sparite that forms cement in the pore spaces of allochems only. Sparite (if not neomorphic) does not exist independently. Authors have entered separate glossary for 'sparite' and 'sparry calcite'. What is the difference between the two? Why not simply define 'sparite' as a mosaic of crystals larger than those in micrite, formed either as cement or as neomorphic spar[3].

Again, since pellets cannot always be established as of fecal origin, it is better and safer to use a non-genetic term 'pelloid'. Keeping this in view, pelmicrite/pelsparite should be defined as a limestone composed of pelloids (allochem) in a matrix of micrite or sparry cement respectively.

The definitions of 'oomicrosparite', 'pelmicrudite' and 'pelsparrudite' in the glossary are misleading. Oomicrosparite means ooids set in a groundmass of homogeneous neomorphic spars, characterized by crystal sizes varying between 4 and 10 microns; it is not as given in the glossary. 'Oosparmicrite' may be a transitional type between oosparite and oomicrite where micrite from oomicrite may have been partially washed out with the resultant void spaces filled-in by calcite spar. In such cases, one has to be sure that calcite spars are not products of neomorphism. Again, since the size of the allochems is considered in determining the grain size name[4], it is not clear how pelloids can belong to rudite class (>1 mm).

The definition of 'packstone' has been defined casually as 'a limestone containing lime mud and particle supported'. It would have been better to define it as 'a grain-supported allochemical rock with carbonate mud matrix in the interstices'. The definition of 'pellet lime mud' is misleading and not clear. How could lime mud be 'shaped into sand-sized pellets'?

A mold, as defined in the glossary, cannot be natural impression but a pore formed by complete or selective removal by solution of a former individual constituent (allochem).

Coming to the illustrations in the atlas, none of them are numbered which is essential for reference and discussion purposes.

In legends of many of the illustrations, the word 'sparitization' has been interchangeably used both for neomorphic spars (microspars and pseudospars) and void-filling cements (see top and bottom photographs on page 48 and top photographs on page 49). The term normally means neomorphism of micrite to spar.

There are shortcomings in the bibliography too. In the first place, unpublished ONGC reports should not have been cited since these are not normally available to the general readers other than ONGC scientists. Many of the citations do not contain page numbers. Peter Scholle's book was not published in 1998 but 1978.

It appears that the authors were in a hurry for its publication without giving much thought and care that publication of a book deserves. On the whole, the book is useful and instructive for students in their practical classes on carbonate petrography and the teachers too will find it handy for classroom instructions and illustrations.

1. Horowitz, D. H. and Potter, P. E., *Introductory Petrography of Fossils*, Springer-Verlag, New York, 1971, p. 302.
2. Scholle, P. A., *A Color Illustrated Guide to Carbonate Rock Constituents, Textures, Cements, and Porosities*, Am. Assoc. Petrol. Geologists, 1978, Memoir 27, p. 241.
3. Bathurst, R. G. C., *Carbonate Sediments and Their Diagenesis*, 2nd edition, Elsevier, Amsterdam, 1975, p. 658.
4. Folk, R. L., *Petrology of Sedimentary Rocks*, Hemphill's, Texas, 1968, p. 170.

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Annual Review of Microbiology 1998. Nicholas Ornston (ed.), Annual Reviews Inc., 4139, El Camino Way, P.O. Box 10139, Palo Alto, California. Volume 52. Price: Individuals $75; Institutions $150, 847 pp.

Modern biology is multidisciplinary by necessity. The *Annual Review of Microbiology* are an excellent resource series for readers interested not only in microbiology but also in genetics, molecular biology, cell biology and biochemistry. Since micro-organisms serve as excellent experimental organisms to understand basic biological phenomena, this review series occupies an important place. The current volume contains 21 wide-ranging reviews prefaced by Adelberg.

Living cells face varying environmental and nutritional conditions during their life cycle and for nutrient absorption, cell–cell interactions, etc. they form polarized cell structures. The yeast, *Saccharomyces cerevisiae* also exhibits polarized growth during starvation or mating and, therefore, serves as an excellent model system to understand these phenomena. It grows mainly as rounded cells but its pseudohyphal form allows yeast to adopt an invasive growth pathway in search of food under starvation conditions. The molecules involved in establishment of polarity and projections in response to pheromones, coordination of these events with cell cycle and cell fate determination by mother cell-specific expression of HO endonuclease mediated by specific localization of the *HO* gene repressor ASH1, are fascinating examples of differentiation mechanisms reviewed by Madden and Snyder.

Similarly, in the important area of aging research, yeast has shown the way. The mother cell buds to produce a smaller daughter cell but a given cell divides only for a finite number of times (25–30) before dying, exhibiting an age-related slowdown of cell cycle, onset of sterility and breakdown of nucleoli. Mutations that impart longevity to yeast are involved in cAMP metabolism, epigenetic silencing and genome stability. The common denominator in aging has been identified as accumulation of circular rDNA molecules. An understanding of the molecular basis may help in devising strategies to delay aging in humans. The advancements in this field are reviewed by Sinclair, Mills and Guarente.

Lantibiotics are the antimicrobial peptides made from modified building blocks like thioesters and thiazoles or unsaturated and stereoinverted amino acids and their post-translational modifications. The genes involved in their biosyntheses are organized in clusters. Sahl and Bierbaum describe how these novel antibiotics have dual functions of cell–cell signalling and immunity as well as antimicrobial activity. The last effect is exerted mainly through pore formation. Their properties can lend themselves to important applications.

The general view that bacteria exist solely as unicellular organisms needs revision as recent studies show that they do form highly differentiated multicellular structures through highly sophisticated signal transduction networks. Integration of intercellular signals leads to decisions about gene expression and cellular differentiation, in a manner similar to multicellular organisms. In three reviews the authors (Shapiro; Andrews; and Jacob, Cohen and Gutnick) discuss how the unicellular organisms can also adopt the multicellular state coupled with division of labour and harnessing of resources that cannot be effectively utilized by single cells, and for defense.

How cells adapt to environmental conditions is best exemplified by the glyoxylate bypass mechanism in enteric bacteria like *Escherichia coli*. This pathway is used to divert isocitrate from the TCA cycle when bacteria are grown in acetate rather than glucose to prevent the quantitative loss of acetate carbon as carbohydrate. It is governed by regulation of activity of isocitrate dehydrogenase by phosphorylation/deposphorylation reactions, which helps to channel isocitrate through TCA cycle or glyoxylate bypass. This important mechanism is well reviewed by Cozzone.

A similar paradigm emerges from metabolic regulatory mechanisms of *B. subtilis*. Earlier considered a strict anaerobe, this soil organism is now known to adapt to anaerobic conditions, like water-logged soil, by turning on regulatory cascades (modifying a two-component signal transduction system) that allow the use of nitrate and nitrite as terminal electron acceptors. This is achieved by inducing the expression of fnr which, in turn, activates the genes involved in anaerobic metabolism. This interesting metabolic adaptation system is reviewed by Nakano and Zuber.

Most plants fix CO_2 by photosynthesis with the help of chlorophyll. However, the chemoautotrophic bacteria (mostly found under extreme environments and utilize sulphur, nitrogen, metals or carbon as electron donors) utilize the Calvin cycle for carbon fixation, in which one of the 13 main enzymes, ribulose 1,5-bisphosphate carboxylase/oxygenase (RuBiSCO), is found in unique polygonal organelles called