

BOOK - REVIEWS

Quaternary Deltas of India

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The 'Quaternary Deltas of India' is published as a memoir of the Geological Society of India. The volume contains nineteen papers, including an introduction by the editor, presented and discussed at a workshop in 1990, at Andhra University. The papers in the volume fall under two categories : those that discuss the evolution and the landform units of individual deltas, and the others that have investigated the stratigraphy, sedimentation, delta building processes, hydrogeology and the soil and floral characteristics of the deltas, using established techniques of investigation and analysis. Thus, the volume presents the genesis, evolution and morphology of Bengal delta and the deltas of Subarnrekha, Mahanadi, Godavari, Krishna, Pennar, and Cauvery on the east coast and the Narmada and Tapti estuarine sedimentation on the Araliaan sea coast, with half a dozen studies centred on Godavari and Krishna deltas which appear to have been more intensively investigated. Most individual delta studies seem to have depended on a photo-geological approach making use of satellite data from Landsat, TM and IRS. The general evolution of the deltas based on palaeo strand lines and delta lobes, the identification of geomorphic units and lineaments has been the main preoccupation of the papers in this category. The study of the deltaic sediments of Mahanadi delta

(Rath and Sarma) presents a more comprehensive picture reconstructed from the evidences derived not only from Landsat, but equally from gravity aeromagnetic reflections and deep seismic sounding surveys. The recognition of three major fracture patterns, possibly related to mid-tertiary tectonics, and the building of stratigraphy have finally led to a conclusion that the Mahanadi delta represents a composite progradataula delta system.

In case of Godavari four stages of evolution have been recognized but many more important characteristics of the delta system emerge from the study (Krishna Rao and Swamy). The sedimentary facies either in terms of their texture or mineralogical composition reveal some interesting results. The excess of montmorillonite in Krishna delta as compared to Godavari, and a relatively higher percentage of sodium and calcium in the Krishna delta sediments as compared to Godavari, as opposed to higher concentration of iron in the latter reveal not only the impact of lithology, but also of the weathering environments of the two basins. A rate of progradation of 1.18m/year and sedimentation rate of 1.9mm/year in the delta of Godavari are some of the important findings, no doubt, to be ascertained by more field studies of the type. Another study of the waves, currents and as-

socaited physical processes in Godavari delta (Sastry, Vethamony and Swamy) further ameliorates our understanding of the dynamics of shore processes in delta formation. The offshore region of Godavari studied by shallow seismic profiling (T.C.S. Rao) records several major events during the pleistocene, witnessed in the complex series of three to four sedimentary layers separated by well defined unconformities. A similar situation exists in the Krishna delta thereby confirming the existence of phases that mark the sedimentation - erosion equilibrium or the absence of it. The Krishna delta (Reddy and Shah) developed in five stages has very distinct strandlines, representing a set of ancient beach ridges, tidal flats and delta lobes formed by sediment laden palaeo - distributaries. The quaternary geological and geomorphological map of Reddy and Shah not only gives the landform units but also the sequence of delta shifting in stages. There appears to be a remarkable similarity in the evolution of the Godavari and Krishna deltas, the former showing four and the later five stages in its evolution.

The Pennar delta study (K.K.Rao) looks beyond the delta and talks of a number of surfaces (not necessarily typical erosional surfaces except the Singarayakonda surface) in the delta plain. The delta is underlain by Mio-Pliocene cuddalore sandstones : the Mio-Pliocenes capped by laterite establish a stratigraphic boundary between the Quaternary and the Pliocene sediments. Divided between upper and lower, the Pennar delta is marked by three strandlines and five delta lobes.

The Cauvery delta, though studied earlier by several workers, has received inadequate attention in this volume. The only paper on Cauvery delta (Babu) is more concerned with geochronology and the reconstruction of early geological phases of sedimentation, the

palaeodeltas, from the late cretaceous to Micocene. The palaeo - deltas as suggested by Babu occur at different levels (fig. 1 - p. 94) ranging from 0 to 3000m. This besides being highly improbable, suggests a tectonic uplift of considerable magnitude, a sea-level change or the combined effect of the two. The late quaternary movements have disturbed the coastal configuration and the delta progradation is restrained. How does the late Quaternary movement conform to categorising the coromandel coast as an Atlantic passive type, as done by the author?

The Narmada and Tapti estuarine deltas (Ganpathi and Pandey) are really non-existent but the study discusses the river islands, and geomorphic features associated with the estuaries like marshes and terraces. The Quaternary landforms in Narmada - Tapti estuarine deltas reveal three sea-level changes. There is an active costal accretion seen in river islands, typified by Aliabet in Narmada. The terraces at two levels suggest the post Flandrian degradational - aggradational phases.

The dynamics of coastal processes studied over a time sequence in what is presented as a process - response system (Chakrabarti) in the coastal plain of eastern India, by repeated survey profiling has clearly demonstrated the changes in the relief even in a short span of time. The seasonal geomorphic mapping has brought out clearly the effect of processes as they vary, in a very concrete way. A way outstanding paper that has processed and interpreted a mass of data relates to the hydrological features of the deltas and estuarine tracts of India (S. Das). Starting with salt and fresh water interface and hydrology, the paper presents the sub-surface geology of a number of deltas, notably Ganga, Subarnsekha, Mahanadi, Godavari and Krishna, not ignoring at the same time the west coast estuarine delta of Narmada. According to the author, in Ganga, Mahanadi and Subarnrekha

deltas, the ground water potentials are high and the potentials are limited in Godavari, Krishna and Pennar delta, and moderate in Narmada and Cauvery delta. There is no uniformity in the quality variation of ground water, both laterally and vertically. A brief reference to ground water management practices is the applied aspect of the scientific exploration. The 'soils of the deltas of India (Pofali, Vadivelu and Swaminathan) presents a textural and chemical analysis of the soils of Hooghly, Mahanadi, Godavari, Krishna and Cauvery deltas. 'How representative the samples are'? is what one may enquire. These are soil profiles from a single specific location in each case. All the deltas show a high cation exchange capacity and richness in organic carbon content, due to intensive cultivation and accumulation of plant residues. A striking difference between Hooghly and Mahanadi deltas on the one hand and the Godavari and Krishna on the other lies in the pH of their soils. While the soils in the Hooghly and Mahanadi deltas show an acid reaction, the soils in Godavari and Krishna deltas have a pH above seven. This shows how faithfully the climate of the basins, particularly the rainfall, exhibits its effect in the deltas.

The floristic composition of the deltaic regions of India (Untawale and Jagtap) examines the mangrove eco-system in the deltas. Much of the mangrove forests of India (about 80%) is concentrated on the east coast of India, proving infallibly the association between deltaic sedimentation and the growth of mangroves. Occupying an area of a quarter of a million hectares, the mangroves in India have 47 species. Apparently showing climax growth in the spring tide coastal zone, the mangroves are a stabilizing factor in the delta dynamics.

A comparative study of the petroleum geology of Niger and Godavari deltas (V. Raghavendra Rao) closes the book. There is a remarkable similarity in the thickness of sediments - 9 km in Niger delta and 7 km. in case of

Godavari - and the extent of the shelf. The block faulted nature of the basement is common to both the deltas and the tertiary sedimentary sequences in both the deltas show marine, transitional and continental facies. This suggests that like Niger, Godavari delta could prove a valuable source of petroleum.

The book, very meticulously edited and thoughtfully organized, contains a wealth of information on the deltaic areas of India. The publication of the book has brought together the contributions of the scholars working on different themes and in different academic and research institutions. Yet, after reading all the papers, one feels the void of a comprehensive paper discussing the geological and the eustatic history of the East coast of India, since invariably in most deltaic studies, the exposed as well as the buried tectonic features, sometimes extending down to faults and grabens in the basement are mentioned. Obviously, the geological history of the coast is not as simple and straight as suggested by the configuration of the deltas. Also, nowhere in the book one finds a complete Quaternary history of any of the deltas, showing the balance between sediment accumulation and erosion, the tectonics, the changes in sea-level and the fluxes of climatic change that may have influenced the delta building processes.

These personal observations notwithstanding, both the Geological society of India and the editor of the volume, Prof. R. Vaidyanadhan, deserve appreciation for bringing out this volume which fulfills the longfelt gap in the study of coastal evolution of India. All those interested in coastal geomorphology, delta building, sedimentation and geohydrology of the coast, will find the book valuable. This reviewer is certain that the book will earn a niche on the shelves of the earth-service libraries as well as in the thinking of those working on the problems of Indian coasts in general and deltas in particular.

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