BOOK REVIEWS

HISTORICAL EVOLUTION OF A MAJOR GEOLOGICAL CONCEPT

The volume "Eustasy: The Historical Ups and Downs of a Major Geological Concept" (Memoir 180: Geological Society of America, 1992) deals with the historical evolution of a major geological concept—eustasy since the 18th century and its recent upsurge. The concept of eustasy, a complex but significant one, has a long history starting from the Biblical concept of Noah's flood at the beginning of human civilization to the concept of neptunism to the 20th century concept of cyclothem; presently the concept of seismic stratigraphy has revolutionized geological thinking on stratigraphy. Since the cyclothem concept of twenties and thirties, the concept of eustasy went into hibernation for 30 long years. The concept has been revived through the activities of DSDP drilling project and seismic sequence stratigraphy.

The volume, under review, is an outgrowth of a symposium organized by the History Division of the Geological Society of America, held at Dallas, Texas, in the year 1990. The major theme of organizing such a symposium 'is to remind the geological community of its historical roots so as to avoid, insofar as possible, having each generation reinvent the wheel and repeat many of its ancestors' mistakes'.

The volume is divided into nine chapters. First chapter is on 'An introduction to the ups and downs of eustasy' by R. H. Dott. Dott provides an overview of evolution of the concept from the 18th century to the present.

The second chapter is on De Maillet's Telliamed (1748): The diminution of the sea or the fall portion of a complete cosmic eustatic cycle' by Albert V. Carozzi. Being a French diplomat and traveller, Maillet's concept of the diminution of the sea was a remarkable achievement considering the time he lived in. Carozzi observes that 'his ingenious approach to the history of the earth, according to which the sea—during thousands of millions of years of eustatic fall—was entirely responsible for all the physiographic, lithologic and structural features of the earth's crust, made him an unusual forerunner of eustasy....'

The third chapter is on 'Eduard Suess and European thought on Phanerozoic history' by A. Hallam. It is Suess who first coined the term 'eustasy' (a word of Greek derivation meaning truly balanced or level) in his book "Das Antlitz der Erde" published in 1888 (whose English translation 'The Face of the Earth' done by Sollas in 1906). Suess recognized two types of sea level movements—positive and negative—in his concept of eustasy. He envisaged eustatic movements as asymmetric in nature with negative movements being more temporarily irregular and rapid than the positive movements. He visualized further that the falls in sea level were in response to subsidence of the ocean floor as a consequence of the earth's contraction. Similarly, rises in sea level were due to upward displacement of water by sedimentation on the ocean floor.

The fourth chapter is on 'T.C. Chamberlin's hypothesis of diastrophic control of world-wide changes of sea level: A precursor of sequence stratigraphy' by R.H. Dott. Chamberlin's diastrophic control hypothesis, induced by global stress in response to shrinking of the earth, had a profound effect on American thinking on stratigraphy. Dott observes that 'Chamberlin's hypothesis of repetitive, synchronous world-wide changes of sea level with resulting universal unconformities punctuating the global stratigraphic record—"correlated pulsation"—was to have a profound effect upon subsequent workers, especially in North America, and was an important precursor of modern sequence stratigraphy'.
The fifth chapter is on A.W. Grabau's embryonic sequence stratigraphy and eustatic curve by Markes E. Johnson. The paper deals with the origin and evolution of Grabau's view on the pulsation theory and the interrelationships between what is now known as sequence stratigraphy and eustasy.

The sixth chapter is on 'The Cyclothemic concept in the Illinois basin: A review' by Ralph L. Langenheim, Jr., and W. John Nelson. The authors trace the history of development of a concept -- cyclothem -- as gradually evolved through the work of J.A. Udden, J. Marvin Weller and Harold Wanless in the Illinois basin (the birth place of the concept) between the years 1912-1932. The authors have nicely traced the ups and downs of the cyclothemic concept, and in their own words 'it still evokes controversy after nearly 80 years proves the subject to be lively and durable'.

The seventh chapter is on 'R.C. Moore and concepts of sea level change in the mid-continent' by Rex C. Buchanan and Christopher G. Maples. As the authors bring out, Moore was not a believer in glacial eustasy (though he ultimately yielded), but was a staunch supporter of tectonic and diastrophic changes that bring about sea level changes through time and space. Moore further believed that orogenic movement in one part of the globe could have a global effect on sea level. As the authors point out 'Moore was amongst many geologists who operated under an epistemological paradigm of their time -- if a single action could explain all results, they refused to complicate the issue by invoking multiple causes'.

The eighth chapter is on 'The evolution of seismic stratigraphy and the global sea level curve' by Peter R. Vail, a scientist who is one amongst the key persons in the development of the concept. The concept, at the present time, has revolutionized the total thinking of global stratigraphy and has amply demonstrated that a motivated group of scientists can achieve results that are capable to shake the earth. The reading of the paper, as it reveals the background story, is really thrilling. The author has rightly stated that 'sequence stratigraphy has the potential for providing a unifying concept for stratigraphy and basin evolution similar to what plate tectonics has done for most of geology'.

The ninth and final chapter is on 'A challenge: Is it possible to determine eustasy and does it matter?' by Christopher G. St.C. Kendall, Philip Moore, Gregory Whittle and Robert Cannon. The authors stress on the point that true eustatic change of sea level from ancient rock strata can not be unequivocally determined since sea level change is intertwined with other factors, e.g., tectonics and sediment supply, disentangling of which is not an easy proposition. At best, one can constrain the effects of eustasy, tectonics and sediment supply. The authors have proposed use of graphic simulations in order to unravel the history of basin development, geometry of the fill and facies pattern by recognizing the fact that 'sediment accommodation is the product of eustasy and tectonics, so that if one assumes the sea level behaviour, then the residual is tectonic behaviour'.

The book is well-printed and well-illustrated with some rare photographs that are usually not seen in any of the recent geology books. Indian students of Earth Sciences would do well to go through the book so as to avoid many of their ancestors' mistake while interpreting stratigraphy.

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