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REVIEW

'GROWTH CONDITIONS OF MANGANESE NODULES, COMPARATIVE STUDIES OF GROWTH RATE, MAGNETIZATION, CHEMICAL COMPOSITION AND INTERNAL STRUCTURE' by Dietrich Heye in *Progress in Oceanography* (Ed.) Mary Swallow, Vol. 7, No. 5/6, 1978, pp. 163-239. Pergamon Press, Oxford, New York, Frankfurt. Annual Subscription \$ 48.40.

This is a detailed study of a collection of manganese nodules mainly from the Pacific (24 from the surface of the ocean floor and 15 buried) by 5 to 7 different methods (largely non-destructive analyses). The methods of preparation which prevent the whole nodule from being shattered has enabled a number of studies to be carried out on a single sample. After reviewing the methods of dating the nodules, the author has selected the α track method. He finds that continuous growth of the nodules is the norm and interruptions are exceptions. The growth rates for the whole nodules are 4–9 mm/10⁶ years, though rapid rates of 30 mm are also encountered.

The interesting part of the work is the treatment of sections with HCl vapour leading to the deposition of a layer of coloured chlorides on the surface. The colour difference strikingly depicts, though qualitatively, the distribution of Mn and Fe. This is corroborated by electron microprobe analyses. The layers in the treated sections show sharp boundaries which do not support migration of chemical components in the nodules. The results when correlated with growth rates indicate that during rapid growth, little Fe is deposited while more Fe is deposited when growth is slow. The studies in spite of improved techniques did not detect any magnetic reversals in the nodules and thus confirmed the observations of previous workers. A detailed study of cracks in the nodules based on a model of age dependent nodule shrinkage and cracking, indicates that the nodules break after a critical age of about 5×10^5 yrs and has an interesting implication that all nodules without cracks are younger than about 10⁶ yrs. Slower growth results in smaller size while faster growth, leads to larger size. Based on detailed studies of the microstructure, it is inferred that the nodule growth is less disturbed in the sediment than at the water side and the disturbances of the nodule growth caused by water do not reach the sediment side.

The Appendix at the end contains description of the texture and growth of each nodule and is useful in correlating the results from different studies.

In recent years a number of papers have appeared on manganese nodules from the ocean floor. These papers, however, deal largely, with a particular aspect only. In the present work, the author has correlated results of different studies carried out on a number of nodules.

The paper is a useful addition to the growing literature on ocean floor manganese nodules and forms a valuable reference work. The paper is printed in the high standards of the Pergamon Press and contains a number of excellent photos and micro-photos of nodules, some showing in colour the effect of HCl vapour.

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