10th International Congress on Sedimentology. Friedman, G.M (ed.) 1978
Vol. 2 p. 707

RADIOMETRIC GEOCHRONOLOGY OF PHOSPHORITES

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Attempts have been made in recent years to determine the absolute ages of phosphorites in which apatite is a major component, using uranium-series methods. In terms of the uranium series isotopic data, phosphorites analyzed so far can be grouped into 3 categories. One group of phosphorites, occurring on the sea floor off Peru, Chile and southwest Africa, contain virtually no Th-230, yet have appreciable uranium contents with U-234/U-238 ratios close to that of modern sea water, leaving little doubt that they are of Holocene age. To this can be added a phosphorite deposit on an atoll in the equatorial Pacific, where a Holocene age is independently confirmed by radiocarbon dating of the underlying reef limestone. A second group of phosphorites occurring off Peru, Chile and New South Wales, Australia, show various degrees of disequilibrium within the uranium decay series, yielding apparent Th-230 ages up to 150,000 years. Although confirmation of these ages must await cross checks by independent methods, close internal agreement between the Th-230 ages and U(IV)-234 ages of individual samples tend to support their validity. A third group of phosphorites, with a more general distribution, and comprising the majority of marine and insular phosphorite deposits have the uranium decay series in secular equilibrium, or show evidence of U-234 loss. These deposits are interpreted as being at least 800,000 years old, and a Tertiary age has been independently established in several cases.

The general distribution and age pattern of phosphorites indicates that contemporary phosphorite formation is restricted to areas with intense present day upwelling. The age pattern of phosphorites with 'finite ages', if confirmed, would imply that the deposition of phosphate on the sea floor was interrupted at times of maximum sea level lowering during the Quaternary. The great predominance and more widespread distribution of phosphorites with ages in excess of 800,000 years suggests that phosphorite formation was more extensive in pre-Quaternary time than at present. These data should provide new impetus for the study of environmental conditions required for the accummulation of phosphorite deposits.