

of calcium carbonate carried by slowly percolating water, before the often-enormous weight of strata above were added.

MODERN CORAL ATOLLS IN THE PACIFIC

In the Pacific Ocean a number of very thick coral atolls grow on extinct volcanic cones (seamounts). These have left us a record of their growth through long periods of time. The most useful of these atolls for time calculations is the Eniwetok atoll in the Marshall Islands. This structure was thoroughly studied by deep core drillings and other studies from 1946 through 1952, before the atomic bomb tests were carried out on it. The Eniwetok atoll was found to be a living, active reef which exhibits growth over its surface by various lime-secreting organisms, including corals, snails, and calcareous algae. It also exhibits the active processes of dissolution, cement precipitation, and other phases of fossilization just beneath the living growth layer which appears at the surface (Schlanger, 1963).

The Eniwetok atoll rests on a roughly-circular, extinct volcanic cone which rises to approximately two miles above the surrounding ocean floor. The reef cap resting on this seamount is nearly one mile thick. The deepest drill hole put down by the U. S. Geological Survey penetrated 4,610 feet of coral-algal reef material before striking the basalt of the volcanic base. This drilling not only encountered the expected reef materials and cemented limestone layers, but also penetrated three very definite, extensively-weathered unconformity levels, at depths of 300 ft., 1,000 ft., and 2,780 ft. respectively. The limestone just beneath these unconformities shows not only the marks of weathering, but also the kind of calcite cementation which typically occurs when limestone lies for many years above the salt water level, exposed to fresh water from rains. Further evidence of the length and extent of these unconformities is found in the presence of large amounts of pollen from seed-bearing trees and shrubs which grew on the reef during the periods of exposure (Leopold, 1969, p. 1138 & 1145-59).

The organically-produced components retrieved by the Eniwetok drilling project, together with descriptions of the unconformities, are listed in extensive detail in Ladd (1960), which is readily available in most university libraries. A considerable amount of this material has also been summarized in Wonderly (1977, p. 23-47).

The exact length of time required for the growth and formation of the Eniwetok reef is of course unknown. The U. S. Geological Survey team which did the research on it made estimates of the age of the various stratigraphic levels which they encountered in drilling. These estimates were based on traditional methods of fossil dating and on radiometric calculations. The oldest level of the reef was dated as Eocene; but, for the purposes of this paper, we prefer to think in terms of how much time would be required, at the fastest known growth rates for reefs in the Pacific, to produce the amount of sediment which is contained in the Eniwetok atoll. This amount of time is of course far less than the actual formation time, because one must allow for the periods of no growth (unconformities) mentioned above. These were periods when the top of the atoll "stood hundreds of feet above the sea. Eniwetok atoll was a high island, and bore a high-island fauna and flora, not once but several times" (Ladd, 1961, p. 711). We must add to these long periods of exposure and erosion the various shorter periods of growth retardation