

II. GEOLOGIC STUDIES OF CORAL ATOLLS

Coral atolls are organic communities isolated from influences of continental landmasses. The organisms that build the reefs are responsive to their physical and chemical environment, and, as they build the reefs and islands, these in turn influence the physical and chemical environment so as to provide a variety of ecologic habitats. Geologic studies of reefs, islands, and lagoons should provide the biologist with a pattern of zones of growth, erosion, and sedimentation, and should indicate the relations of these zones to environmental factors. The biologist's studies of the organisms in each zone should in turn help the geologist in interpreting the geologic history and paleo-ecology of the atoll from drill cores.

At present there are fairly well-integrated studies of the physical and chemical environment, the biology, and the geology, from very few atolls. Work at Bikini and the northern Marshalls has shown some relations of the pattern of reef zones and lagoon sedimentation to the prevailing conditions of surf, tides, and currents, and to changes in temperature and chemistry of waters on the reefs. It has been shown by drilling that the rocks at Bikini down to 2556 feet include a relatively complete section of limestone, mostly unconsolidated, through the Miocene and possibly including Upper Oligocene.

The relations of reef structures to the environment found at Bikini may not hold at other latitudes or in other island groups, and further work on a number of atolls at different latitudes both north and south of the equator is necessary.

Future geologic work should include:

1. Drilling. A deep hole to the basement rock should be drilled on an atoll that has been well studied. At Bikini such a hole would probably be 4000-7000 feet deep.

Holes to depths of 2500 feet, such as the one drilled at Bikini, should be drilled on atolls in every major island group. Lines of shallower holes to 300 feet or less should be drilled across islands and reefs on both windward and leeward sides of several selected atolls to relate the subsurface rocks to the topography of the lagoon and offshore slopes.

2. Oceanographic work. The physical environment of a number of atolls must be studied. These studies should include wave and current studies over reefs, lagoon circulation and exchange with the ocean, and accurate gauging of tides.

The chemistry of sea water, especially of that over reefs, is very little known. Oxygen, salinity, and pH measurements carried out over the diurnal cycle, and under different seasonal conditions, should be made on selected atolls.

3. Adequate facilities should be provided for lagoon studies. These facilities should include large ships with both shallow and deep recording fathometers, winches for dredging, and bottom sampling and coring apparatus. Smaller craft such as landing or rearming boats should be available for near-shore studies or for shallow water diving. A trained deep-sea diver could add greatly to our knowledge of lagoons in the zone of photosynthetic action.

4. Adequate aerial photographs, preferably overlapping photos on a scale not less than 1:5,000, should be obtained of as many atolls as possible.

The problem of the origin of islands on reefs might well be attacked by a survey of one of the islandless atolls, such as Ngulu Atoll in the western Carolines, or by a comparative study of Kayangel and the adjacent Ngaruangel atolls north of Palau.

Whether an island can form and become stabilized by vegetation under present conditions might be determined by finding out how large a sand and gravel accumulation, such as a bar or "temporary" island, must be before it can hold a freshwater lens sufficient to permit the growth of vegetation.

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