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The significance of coral reef growth and sedimentation as a driving force in the subsidence of the enclosed volcanic island

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Charles Darwin in the year 1842, published a book on the formation of coral reefs based on his observations on the Beagle. According to his theory, coral reefs follow a sequence of geological changes from fringing reefs to atolls (DARWIN, 1842). Darwin explains in his writings that coral reefs grow vertically upward due to the cooling and subsidence of the island in order to remain within the surface waters (DARWIN, 1842). Later, wave action was found to be another key factor in controlling the growth of the windward side of the coral reef (ADEY, 1978). The present study throws light on the coral reef as being a newly formed landmass of considerable dimensions, capable of exerting a large amount of pressure on the shallow submerged rim of the island. The addition of load attributed to the growth of the coral reef around the island and the transport of reef sediment into the lagoon is considered here as one of the key driving forces leading to subsidence of the associated volcanic island.

Methodology and Theoretical Orientation:

- Measurement of 2-dimensional ground coverage area of the shallow reef and enclosed lagoon and calculating the mass of a 1m thick layer of the reef for a basic understanding of the sediment deposit around the island
- Comparing the area and shape of the reef to the area and visible depth of the lagoon for three fully formed atolls and one barrier reef
- Studying the bathymetry of the whole seamount bearing the coral reef with the help of available bathymetry data. The seamounts used here are the same as those used in comparing the reef and lagoon.

Findings: The measurements of ground cover of coral reef and lagoon in all four cases (**Figure 1**) show a strong relationship between the coral reef and the lagoon enclosed by the reef. Broad reef crests with gradual slopes were associated with shallow lagoons while narrower reef crests with steep slopes enclosed deeper lagoons. However, bathymetry studies on the whole seamount show that the slope of the seamount outside the reef remains intact, descending from ~25m to a depth of ~2500m below sea level. On the other hand, the portion of the seamount enclosed by the coral reef is completely drowned and submerged under a layer of reef sediment in all three of the fully formed atolls chosen for the study. This characteristic of an atoll holds good, regardless of the varying height of the coral reef from the base of the seamount showing that internal cooling and collapse alone are not the only determinants of the size and portion of the volcanic cone that collapses. The barrier reef in Figure 1.c also shows the presence of a prominent summit that has descended in height and remains intact during the formation of the barrier reef.

Conclusion and Significance: The form and structure of the reef crest and lagoon depend greatly on the rate of subsidence of the seamount (DARWIN, 1842). A more pliable seamount prone to collapse would allow a greater degree of sinking and deformation as seen in Figure 1.a, when compared to a more stable seamount like those found along the Great Barrier Reef. This finding can be supported by the density range of volcanic rock which is 1000 kg m^{-3} to 3000 kg m^{-3} (WOHLETZ & HEIKEN, 1992). To be able to sink a portion of the seamount, the density of the reef should either exceed or fall within the density range of volcanic rock. Calcite shows a density of 2710.kg.m^{-3} (HUDSON INSTITUTE OF MINERALOGY, 2002), while aragonite has a density of 2930.kg.m^{-3} (HUDSON INSTITUTE OF MINERALOGY, 2002), which can explain the varying sinking rates and intensities of islands surrounded by coral reefs. Moreover, the results of the bathymetry study show that the collapsed or sunken portion of the seamount is dependent on the position of the coral reef and not merely on the internal collapse of the seamount itself. The growth of the coral reef and associated sedimentation therefore play a significant role in the subsidence and eventual disappearance of the exposed volcanic island during the formation of an atoll. These are the findings of an ongoing study, the finer details of which shall be published shortly.

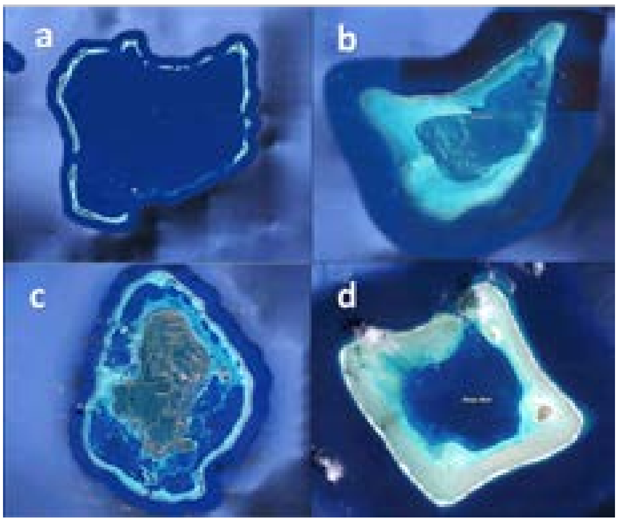

Figure 1:
a: narrow reef crest and deep lagoon of a fully formed atoll;
b: broad reef crest and shallow lagoon;
c: narrow reef crest and deep lagoon of a barrier reef;
d: broad reef crest and deep portion of the lagoon at its center

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Recent Publications

1. Darwin, C. (1874). The Structure and Distribution of Coral Reefs. London: Smith, Elder and Co., 15, Waterloo Place.
2. Adey, W. H. (1978). Coral Reef Morphogenesis: A Multidimensional Model. Science, 831-837.
3. Collins, L. (2002). Tertiary foundations and Quaternary evolution of coral reef systems of Australia's North West Shelf. In The sedimentary basins of Western Australia 3: Proceedings of the Petroleum Exploration Society of Australia Symposium, Perth, WA, 2002 (pp. 129-152). Petroleum Exploration Society of Australia.
4. Montaggioni, L. F. (2005). History of Indo-Pacific coral reef systems since the last glaciation: development patterns and controlling factors. Earth-Science Reviews, 71(1-2), 1-75
5. Frank, N., Turpin, L., Cabioch, G., Blamart, D., Tressens-Fedou, M., Colin, C., & Jean-Baptiste, P. (2006). Open system U-series ages of corals from a subsiding reef in New Caledonia: implications for sea level changes, and subsidence rate. Earth and Planetary Science Letters, 249(3-4), 274-289.

Biography

Dominique Frances Hoover has her experience in Marine Biology and Oceanography, with special interest in coral health and coral reef formation. Her work on coral reef growth and island subsidence is based on the findings of Charles Darwin, published in the year 1842, along with significant recent findings that support the new theory. She has arrived at this result after eight years of independent research in the field without the help of a research grant. She is now in the process of obtaining a research grant from the Department of Science and Technology, Government of India, to aid in her proof study. The proof obtained will then lead to the formulation of a theory based on the ability of a coral reef to cause increased subsidence of the attached landmass, due to its own weight.

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