CORAL REEFS AND DARWIN'S THEORY OF "REEF EVOLUTION"

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A Short Note on Reefs

- A prominent feature of shallow marine settings is the reef.
- Reefs are natural structures of rock formed by marine animals.
- Today's reefs are largely made by corals, but in the geological past, have been constructed by sponges and bizarre clams.
- Reef-building organisms build skeletons of calcium carbonate in the form of aragonite or calcite.

Great Barrier Reef
Australia

Conditions necessary for reef development

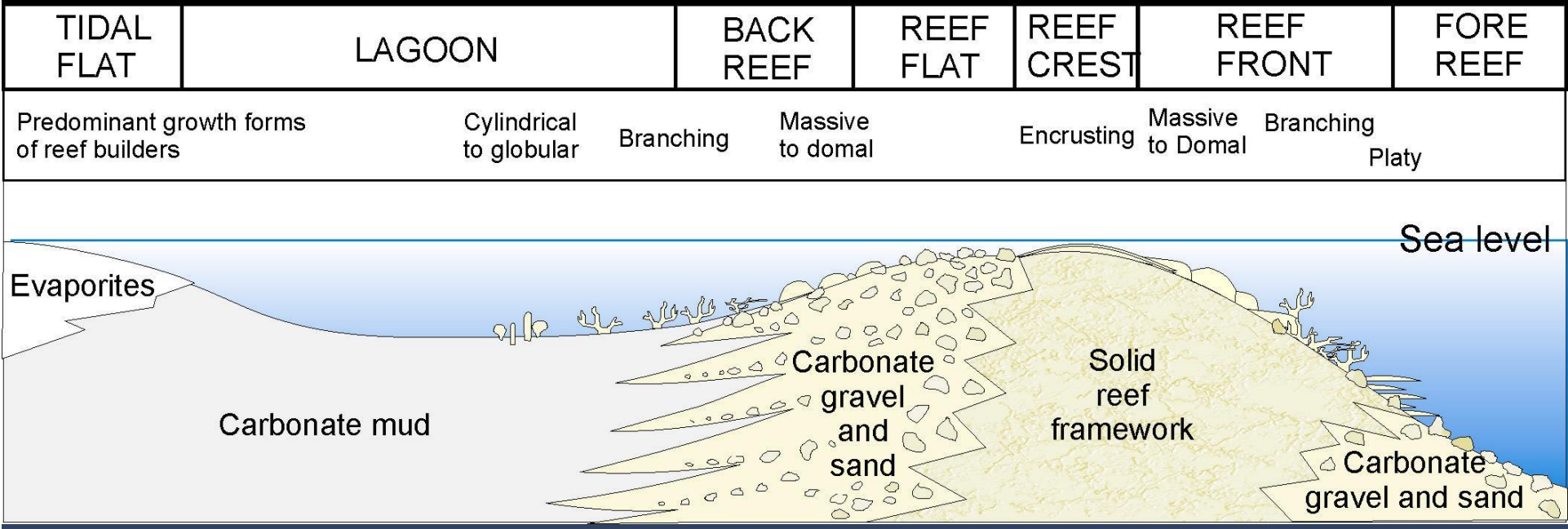
- Large reefs are limited to the warm seawater areas of the tropics.
- Calcium carbonate is easier to precipitate in warm water than in cold water.
- Secretion of calcium carbonate is aided by microscopic cells of algae that live in the tissues of reef builders (the algae remove carbon dioxide from the tissues, decreasing the acidity of the water).

Reefs also tend to preferentially form in areas where

1. Little clastic sediment occurs (such sediment particles smother reef builders).
2. Nutrient levels are low.
3. Water is shallow

Reef zones

Reef builders are zoned in a reef according to their form (encrusting forms tend to dominate the reef crest where wave action is strongest, while more delicate branching forms are confined to deeper water zones where water action is more gentle).



A lagoon can develop behind a reef, where it is protected from strong waves .

What Are Coral Reefs?

- Coral reefs are large underwater structures composed of the skeletons of colonial marine invertebrates called Coral.

- Each individual coral is referred to as a polyp. Coral polyps live on the calcium carbonate exoskeleton to the existing coral structure.

- Scientists have explored only about 20 percent of the ocean's floor, according to the National Oceanic and Atmospheric Administration (NOAA) . As such, ocean explorers continue to discover previously unknown coral reefs that have likely existed for hundred of years.

The Beauty of Coral Reefs

Coral polyps
(individual coral animals)

Coral reefs are often called the “rainforests of the sea” due to the great diversity of creatures that form them. Note that the brilliant colours apparent in corals are from the microscopic algae in the coral tissues (different colours absorb different wavelengths of light).

CORAL REEFS NEED: sunlight

Coral reefs have a symbiotic relationship with a type of microscopic algae, which require sunlight. Therefore, coral reefs must exist where sunlight penetrates so that they can thrive and grow.

CORAL REEFS NEED: wave action

waves bring in food, nutrients and oxygen to the reef

CORAL REEFS NEED: warm water

CORAL REEFS NEED: calcium

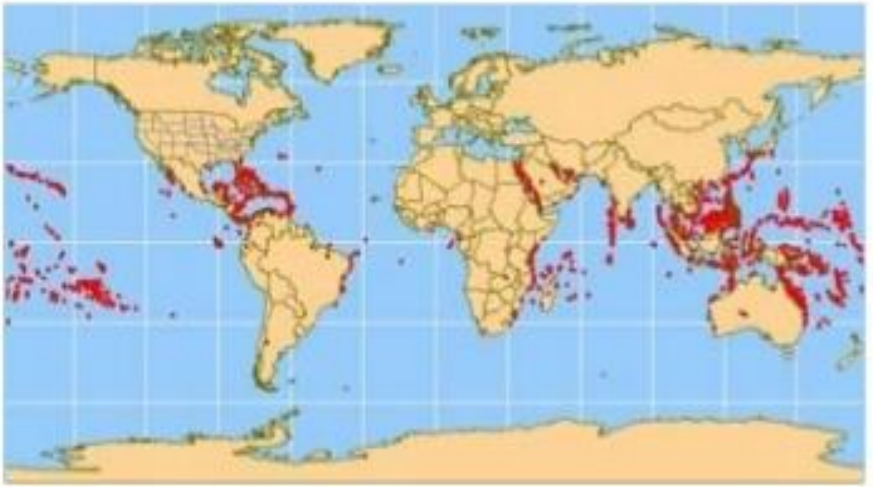
used to build their limestone skeletons
available in shallow waters

CORAL REEFS NEED: clear water

Clear water allows for sunlight to reach the algae

Where Can You Find Coral Reefs?

- Coral is found all over the world:
  - Tropical
  - Temperate
  - Polar
- Only tropical corals build reefs



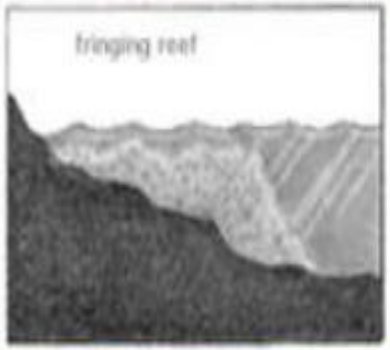
Coral reefs around the world

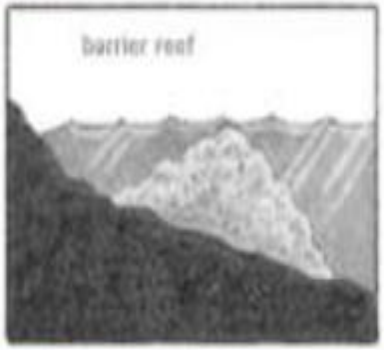
Coral Reefs cover 284,300 square kilometers of Earth's surface

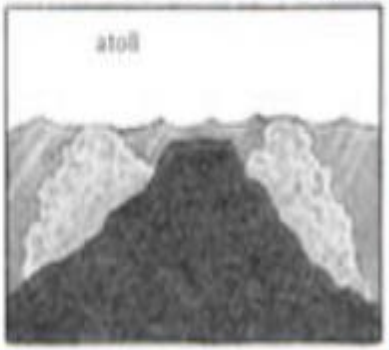
There aren't coral reefs on the west coasts of America and Africa because of upwelling and cold currents.

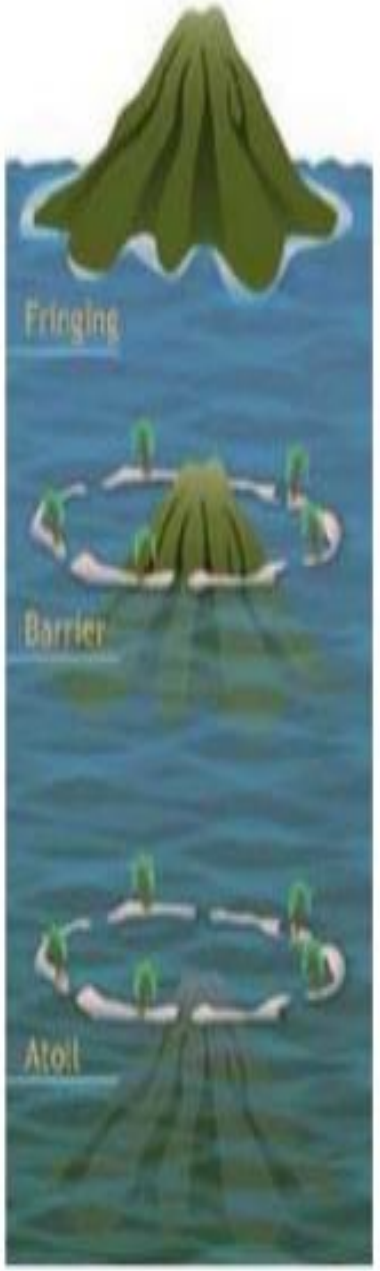
Types of Reefs

- The basic Coral Reef classification scheme was first proposed by Charles Darwin
- There are three main types of reefs:
  - Fringing
  - Barrier
  - Atolls
- There are two other reef types:
  - Patch reefs
  - Bank reefs









Fringing Reefs

- Occur adjacent to the land, with little or no separation from the shore
- They develop through upward growth of reef-forming corals on an area of continental shelf.
- May have a completely shallow lagoon in some areas, or no lagoon at all
- Most common reef in the Greater Caribbean and Red Sea

Barrier Reefs

- Broader and Separated from land by a lagoon that can be miles wide and at least a dozen yards deep
- Usually parallel the shore
- Parts of the reef structure often protrude above sea level as low-lying coral islands.
  - These develop as wave action deposits coral fragments broken off from the reef itself
- Largest reefs develop on the edges of continental shelves (called "shelf barrier reefs"
  - Great barrier reef, Belize barrier reef

Atolls

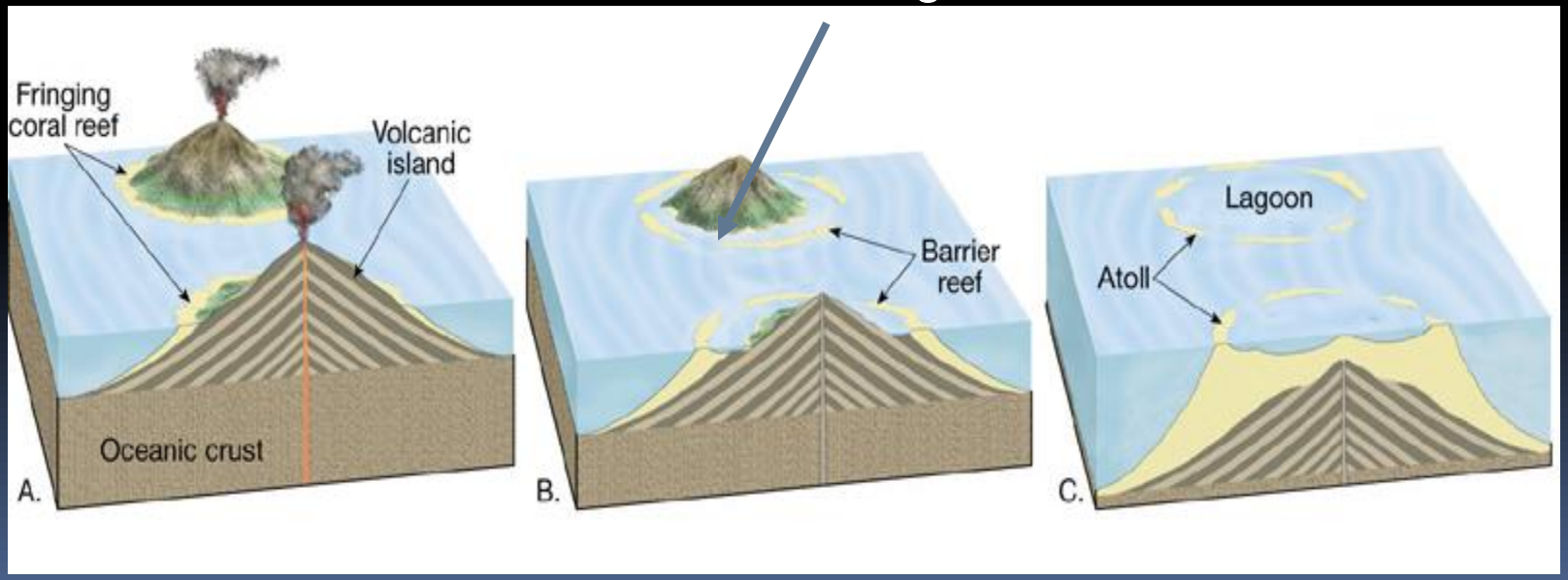
- Large, ring-shaped reefs, surrounding a central lagoon
- found well away from large landmasses, such as in the South Pacific
- Usually circular or horseshoe-shaped
- parts of atolls may protrude above the surface forming coral islands as well.

How an Atoll Forms ?

- An atoll is formed first as a reef that fringes a volcanic island.

- As the island sinks (after volcanic activity has ceased and the crust has cooled, becoming denser), the reef continues to build upward, eventually ending up as a ring-shaped structure.

Gilligan's Island ?



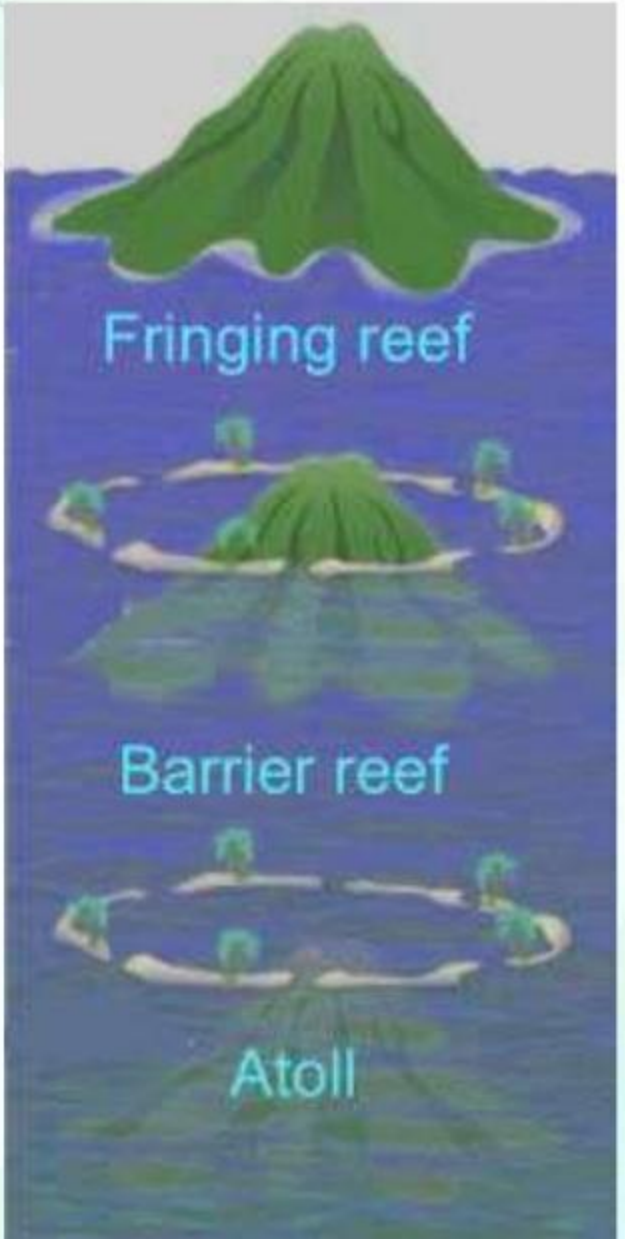
Evolution of the Three Main Reef Types

- As first proposed by Charles Darwin:

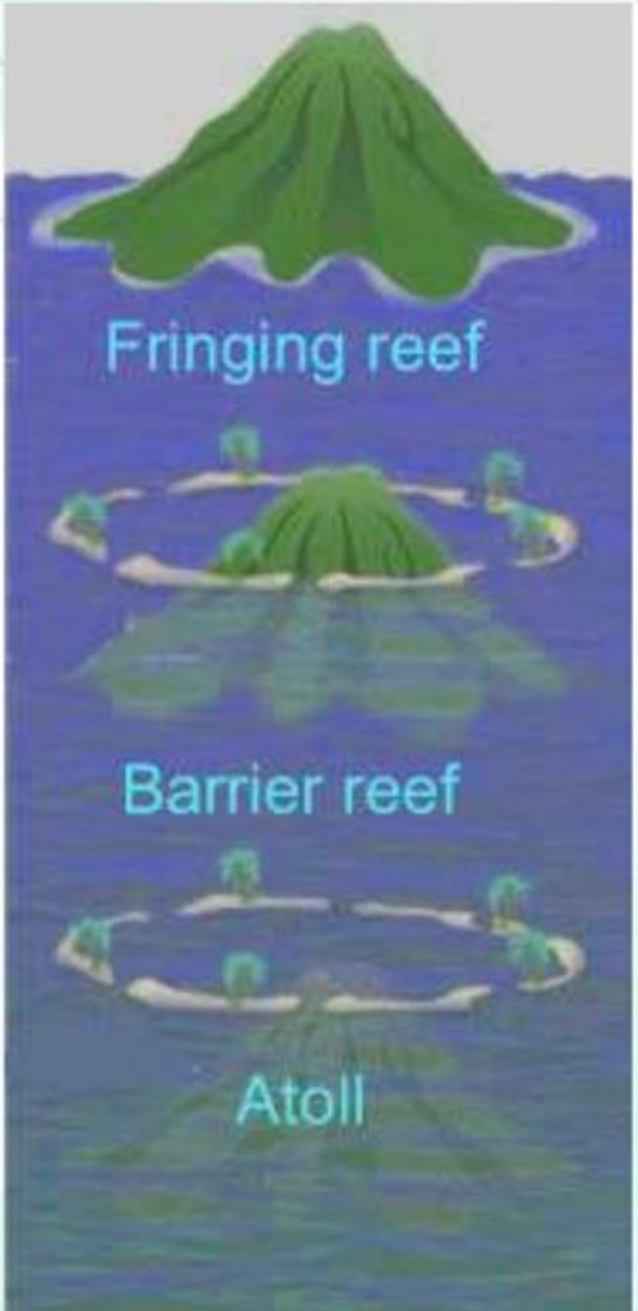
- Darwin proposed the three main reef types are simply different stages in the geological ‘evolution” of Pacific oceanic islands.

Darwin's Theory

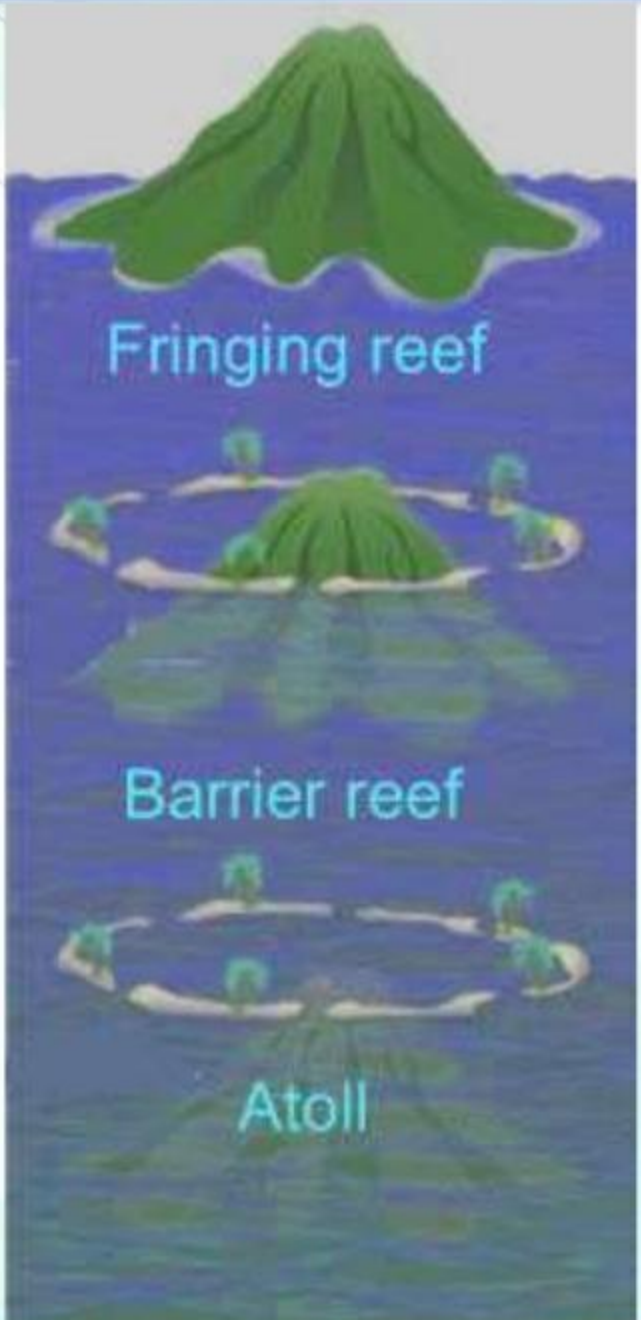
- Fringing reefs began to grow near the shorelines of new islands when conditions for growth were ideal



- As the island began to gradually subside into the sea, the coral was able to grow at the same rate, and remained in place at the sea surface, but farther from shore.
- It was now a barrier reef



- Eventually, the island disappeared below the sea surface, leaving only the ring of coral surrounding it
- It was now an atoll



- Darwin's theory of "reef evolution" was verified for the Indo-Pacific reefs in the early 1950's
  - After analyses of deep core drilling at Bikini and Eniwetok Atolls
  - We now know, however, that in some cases, the three types can be formed by different processes as well