

## The Major Discoveries of Scientific Ocean Drilling

**S**cientific ocean drilling's long history of discovery continues today with the Integrated Ocean Drilling Program (IODP). For more than 30 years, stretching over hundreds of scientific expeditions, and involving thousands of researchers, the outcomes of scientific ocean drilling have significantly advanced our understanding of the Earth. Reliable information about how our planet works—and has worked in the past—is recorded in great clarity in the sediments and rocks that compose the global ocean floor. The pristine samples of sub-seafloor sediments and rocks, brought to the surface by scientific ocean drilling, are indispensable to scientists expanding mankind's knowledge of environmental change, earthquake genesis, volcanic processes, the evolution of life on earth and more.

### SCIENTIFIC OCEAN DRILLING HAS:

#### I. Confirmed the basic tenets of plate tectonics and continental drift.

1. Confirmed that the age of ocean crust becomes progressively older away from spreading ridges.
2. Matched magnetic reversal stratigraphy with age of ocean sediments and crust away from spreading ridges.
3. Elucidated various plate motions and evolution of continental drift over the past 120 million years.
4. Demonstrated that hot spots—thought to be stationary—can migrate over long periods.
5. Confirmed that the oldest ocean crust is no older than Jurassic in age.
6. Quantified the amount of ocean sediments recycled into the Earth's mantle at subduction zones.

7. Confirmed the three-layer model (basalt-sheathed dikes-gabbro) of ocean crust, which explains the primary source of marine magnetic anomalies.

#### II. Established and quantified global environmental changes over the past 100 million years.

1. Documented and quantified global climatic change over the past 100 million years.
2. Discovered rapid (decadal) climate change as a global phenomenon.
3. Documented and quantified climate extremes over the last 100 million years.
4. Elucidated the details of the “hothouse” world 55 million years ago when subtropical climates prevailed at the Polar Regions.
5. Proposed the hypothesis that rapid (decadal) climate change was initiated by global decomposition of methane hydrates in ocean sediments.
6. Confirmed the timing of the gateway opening between Australia and Antarctica, the establishment of the Antarctic Circumpolar Current, which ended the “hothouse” era and began a 40 million year cooling of the Earth.
7. Established the hypothesis that uplift of the Himalaya enhanced global cooling.



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8. Confirmed the closing of the seaway between Central and South America circa five million years ago and implicated this change with the onset of the Pleistocene.
9. Documented the history of sea level rise and fall over the past 60 million years.
10. Discovered the global environmental impacts from the extrusion of large volumes of igneous rocks—so called large igneous provinces.
11. Demonstrated that the Mediterranean Sea had evaporated at least once leaving a nearly empty ocean basin for a time.
12. Discovered global anoxic events in the oceans.
13. Documented a shift to dryer climate in Central East Africa thought to have been the impetus for human migration from Africa starting about two million years ago.
14. Provided key samples to allow determination of sea surface temperatures of ancient oceans from the chemistry of the shells of organisms once living within surface waters but deposited in ocean sediments.

### III. Revolutionized understanding of the formation of mineral resources of copper and zinc.

1. Discovery of massive Cu and Zn deposits at spreading ridges caused international resource companies to revise their exploration strategies—annual impact of roughly \$500 million.

### IV. Changed our understanding of the nature and genesis of geologic hazards.

1. Evaluated fluid flow in the accretionary sediments in subduction zones and elucidated the role of water in subduction zone earthquakes.

2. Determined the significance of mud volcanoes in subduction zone dehydration and its connection to earthquakes and explosive volcanoes.
3. Discovered existence and cause of major undersea landslides of sufficient size to generate large tsunamis.

### V. Discovered methane hydrates in ocean sediments and confirmed their existence worldwide.

1. Determined the nature of chemosynthetic communities associated with methane hydrates in ocean sediments.

### VI. Confirmed the catastrophic impact of a meteorite with earth 65 million years ago.

### VII. Discovered evidence of a vast, active deep biosphere in ocean sediments and crust.

### VIII. Established ocean floor observatories to monitor earthquakes, tsunamis, and fluid flow in ocean sediments and crust.

### IX. Revolutionized the accuracy and precision of geomagnetic polarity and geologic time scales in concert with high-resolution age information on climatic cycles. ●

