IODP

Tahiti Sea-Level Expedition

What is IODP?

The Integrated Ocean Drilling Program (IODP) is an international marine research drilling program dedicated to advancing scientific understanding of the Earth by monitoring and sampling sub-seafloor environments. Through multiple platforms — a feature unique to IODP — the world's pre-eminent scientists explore the deep biosphere, environmental change, and solid earth cycles.

IODP INTEGRATED OCEAN DRILLING PROGRAM

Mission-specific operations are conducted for IODP by the European Consortium for Ocean Research Drilling (ECORD) which represents the ocean-drilling efforts of most of Western Europe as well as Canada. Operations are undertaken by the ECORD Science Operator comprising the: British Geological Survey, the University of Bremen and the European Petrophysical Consortium.

ECORD European Consortium for Ocean Research Drilling

Further Information

www.iodp.org, www.ecord.org.

Updates will be posted during the expedition on www.iodp.de

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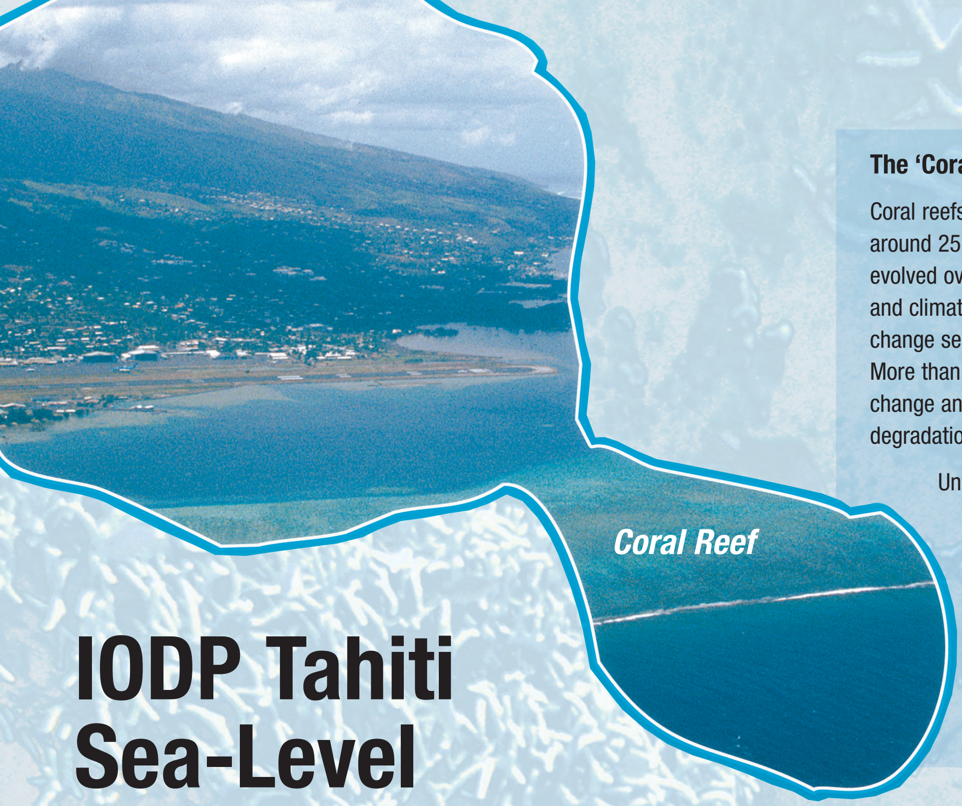

IODP Tahiti Sea-Level Expedition

Understanding the history and effect of sea-level fluctuations and climate changes is a primary objective of marine science. The Integrated Ocean Drilling Program's 'Tahiti Sea-Level Expedition' aims to investigate these effects for a critical period of global climate change that occurred at the end of the last ice age by studying cores from the coral reefs of the tropical island of Tahiti.

The major **scientific objectives** of the Tahiti Sea-Level Expedition are:

- to reconstruct the sea-level rise following the Last Glacial Maximum, 23 000 years ago, when half of North America and most of Northern Europe were covered by thick ice sheets and sea-level had fallen by more than 120 metres.
- to reconstruct associated changes in sea-surface temperatures.
- to analyze the effects of climatic and sea-level changes on reef building.

Finding past temperatures and past environments

The composition of calcium carbonate in coral skeletons can provide information on sea-surface temperatures and sea-surface salinities of the waters within which the corals lived.

Oxygen commonly occurs in two stable isotopes, ^{16}O and ^{18}O, of which ^{16}O is much more abundant. There is a correlation between the $^{18}O/^{16}O$ ratio of the carbonate in the coral and past environments, as relatively less ^{18}O is incorporated into the skeleton at higher temperatures and lower salinities. In addition, minor amounts of metallic elements are contained in corals less magnesium and more strontium are incorporated into the skeletal carbonate at lower temperatures. By integrating these records of past salinities and temperatures in coral skeletons from various ages and locations, scientists can reconstruct the palaeoceanographic evolution of the tropics.

The 'Coral Reef Crisis'

Coral reefs are one of Earth's most diverse ecosystems, hosting around 25 percent of all marine species. Reef communities have evolved over millions of years to face recurring natural environmental and climatic changes. However, over recent decades the rate of change seems to have overtaken the rate at which they can adapt. More than 10 percent of reefs have already been lost; climate change and human induced damage may mean that others will face degradation in the coming decades.

Understanding the effects of past rapid changes will help inform scientists and the public of possible future events, earth cycles, and climate change. Conditions during the last deglaciation, 23 000 to 6 000 years ago, when sea-levels rose rapidly at times and the polar ice-sheets melted are analogous to those that Earth now faces. By studying coral reef records from this period we may be able to better understand the potential impact of such changes in the future.

Studying past climates

Humankind has been making detailed instrumental observations of climate only for the past few decades. Before we can begin to understand the impact that human activity might be having on the present-day environment, such as increasing temperatures and rising sea-levels, we must have a clear understanding of the natural variability of climate and sea-level over the last few thousand years.

Since the onset of major glaciations in the Northern Hemisphere about three million years ago, Earth's climate has, on average, slowly cooled, though the process was neither steady nor gradual. There is evidence of relatively rapid fluctuations from cold (glacial) to warm (interglacial) intervals during which the ice sheets grew and melted. By looking at the changes in sea-level for these intervals, scientists can accurately estimate the amount of fresh water in the form of ice that has transferred between the continents and oceans during these cycles.

Why study coral reefs?

Coral reefs are extremely sensitive to environmental changes. As they grow through time they accurately record the detail of sea-level and climatic changes, whether natural or human-induced. High-resolution records of past global changes are stored in the geochemical and physical parameters of coral skeletons and reef sequences; these form 'archives' that may be used to understand the long-term behaviour of the tropical ocean–atmosphere system.

Corals have strict ecological requirements; they live only in a narrow water-depth range so they can be used as absolute indicators of past sea-levels. Radiometric dating methods also allow them to be used as 'chronometers' so that we can say not only what past sea-levels were but also how quickly sea-level changed.

Coral records represent an outstanding opportunity to extend sea-surface records beyond historical data and to define natural environmental and climatic variability on time scales ranging from individual seasons to thousands of years. Such records include tropical monsoons and the South Pacific 'El Nino' event which causes extreme weather around the globe.