Leg 129

Scientists discover remnants of ancient ocean

February 9, 1990 COLLEGE STATION, TX -- Oceanographers for the first time have recovered the oldest remaining remnants of the Pacific Ocean's original seafloor.

Scientists drilling in the far western Pacific on board *JOIDES Resolution*, drill ship for the Ocean Drilling Program (ODP), recovered 175-million year-old fragments of sediments and ocean crust. Geologists place the age of this rock in the Jurassic period, a time also known as the Age of Reptiles, when dinosaurs dominated the animal kingdom and climate conditions produced warmer global temperatures.

The layers of rocks recovered immediately above the Jurassic zone are also scientifically significant, because they document an episode of extreme volcanism that produced a climate far different from today's.

For scientists, recovery of such ancient rocks represents a major cornerstone in reconstructing Earth's geologic history, because ocean crust as old as Jurassic rarely escapes the inexorable processes of plate tectonics.

The concept of plate tectonics holds that Earth's outer shell, called the lithosphere, is made of large crustal plates, which move across Earth's surface. When a plate carrying dense ocean crust slams into a plate of more buoyant continental crust, the leading edge of the oceanic slab slides beneath, plunging deep into Earth's mantle. On this cruise, ODP drilled near the edge of a deep-sea trench, where ocean crust is consumed, to recover the remnants of the ancient Pacific seafloor. In a few million years, this same crust will plunge deep into Earth's mantle, where it will be regenerated and spewed up at a mid-ocean ridge as new ocean crust, thus continuing its endless cycle through time.

To obtain the sediment and rocks samples, scientists lowered a drill bit and pipe through 3.6 miles of seawater and penetrated almost one-half mile into the underlying Jurassic sediments and

volcanic rocks. When the material arrived on deck, paleontologists compared the fossils found in the rocks to fossils found elsewhere, and determined that these rocks belong to the Callovian Stage of the Middle Jurassic Period. Exact ages will be assigned to the crustal rocks after radiometric dating tests are completed.

These fossils tell a story, unknown until now, about climate, wind and ocean currents in the Pacific Ocean during the Jurassic. The scientists have reconstructed an environmental history based on the fossils in the recovered material. Single-celled organisms use either carbonate or silica to construct their shells. The only fossils found in the Jurassic oceanic sediments in this area are radiolaria, organisms that build their shells with silica. Scientists know that silica-generating organisms can better tolerate a nutrient-poor environment than their carbonate cousins.

A strong ocean circulation would have churned up an abundance of nutrients, yielding a wider variety of organisms. The lack of carbonate fossils in the sediments suggests a weak circulation driven by weak winds. Diminished winds and currents, scientists hypothesize, result from a generally warmer global climate with smaller temperature differences between the poles and the equator.

Scientists since 1969 have searched for this Jurassic material without success. Until now, they were only able to drill holes that bottomed in the next younger geologic period, the Cretaceous, which dated no older than 135 million years.

This time, ODP scientists used a geophysical survey technique called "seismic reflection profiling" to locate the best spot to drill for Jurassic material. This technique, similar to the ultrasound tests used in hospitals, penetrates the layers of rock and sediment with sound waves that produce images of the underlying topography. The scientists used this method to locate a site with a layer of Cretaceous rocks thin enough to drill through to get to the underlying Jurassic rocks.

In addition to the geologic record produced by the Jurassic-aged material, the overlying layer of Cretaceous rocks also contains

messages for scientists to ponder in the years to come. Cretaceous rocks blanket the western Pacific with a thick cover of lava flows and volcanic ash representing a huge outpouring of eruptions occurring between 90 to 120 million years ago. We now see these records of intense volcanic activity in the myriad of atolls and islands scattered throughout the western Pacific.

Volcanic activity as intense as that of the Cretaceous would probably create a climate far different from today. Scientists, however, have yet to agree on the climate implications of so much volcanism. One group contends that the dust clouds associated with volcanoes would have substantially lowered world temperatures, creating a "nuclear winter." Opponents believe the opposite: the released carbon dioxide captured in Earth's atmosphere would produce a greenhouse effect that would have significantly raised global temperatures.

By examining the rocks and sediments from the Jurassic, scientists can learn more about global climatic history and the evolution of life in the sea. Material recovered from the Cretaceous layer will help scientists understand how unusual conditions alter Earth's climate, creating effects that may have far-reaching implications for human activity on today's planet.

Co-chief scientists for the cruise were Dr. Roger Larson, University of Rhode Island, Narragansett, and Dr. Yves Lancelot, Universite Pierre et Marie Curie, Paris, France. Dr. Andrew Fisher, Texas A&M University in College Station, was staff scientist.

JOIDES Resolution, registered as SEDCO/BP 471, is the research vessel for the ODP, which is funded by the United States National Science Foundation, Canada and Australia, the European Science Foundation Consortium for the Ocean Drilling Program, Federal Republic of Germany, France, Japan and the United Kingdom.

The 470-foot-long drill ship's derrick towers 200 feet above the waterline. A seven-story laboratory stack provides facilities for on board examination of sediment and hard-rock cores. Laboratories contain space and equipment for studies in chemical, gas and physical properties, paleontology, petrology,

paleomagnetics and sedimentology. Marine geophysics research is conducted while the ship is under way.

Texas A&M University, as science operator, operates and staffs the drill ship and retrieves cores from strategic sites around the world. The science operator also ensures that adequate scientific analyses are performed on the cores. To do this, Texas A&M maintains shipboard scientific labs and provides logistical and technical support for shipboard scientific teams. On shore,in the Texas ALM University Research Park, the science operator manages post-cruise activities, curates the cores and publishes the scientific results.

Lamont-Doherty Geological Observatory of Columbia University is responsible for downhole logging.

Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES), an international group of scientists, provides scientific planning and program advice. Joint Oceanographic Institutions (JOI, Inc.), a nonprofit consortium of 10 major U.S. oceanographic institutions, manages the program.

"The Ocean Drilling Program's Pacific expeditions will give us important information about the origin and evolution of ocean basins, global climatic conditions and the tectonic forces responsible for natural phenomenon such as the volcanoes and earthquakes common to this area," said Dr. Philip D. Rabinowitz, director of the ODP.

Note: JOIDES Institutions are: University of California at San Diego; Columbia University; University of Hawaii; University of Miami; Oregon State University; University of Rhode Island; Texas A&M University; University of Texas at Austin; University of Washington; and Woods Hole Oceanographic Institution.

Non-U.S. members are Canada and Australia Consortium for the ODP, European Science Foundation Consortium for the ODP: Belgium, Denmark, Finland, Iceland, Italy, Greece, the Netherlands, Norway, Spain, Sweden, Switzerland and Turkey; Federal Republic of Germany; France; Japan; and the United Kingdom.)

The scientific party for Leg 129 was: Yves Lancelot, co-chief scientist, Universite Pierre et Marie Curie, France; Roger Larson, co-chief scientist, University of Rhode Island, Narragansett; Andrew Fisher, staff scientist, Ocean Drilling Program, Texas A&M University, College Station; Lewis Abrams, University of Rhode Island; Richard Behl, University of California, Santa Cruz; William Busch, University of New Orleans; Gordon Cameron, Dartmouth, Nova Scotia, Canada; Paterno Castillo, University of Miami; Mitch Covington, Florida State University, Tallahassee; Gabi Durr, Universitat Tubingen, Federal Republic of Germany; Elisabetta Erba, Universit degli Studi di Milano, Italy; Peter Floyd, University of Keele, United Kingdom; Christian France-Lanord, Centre de Recherches Petrographiques et Geochimiques, Vandoeuvre, France; Ernst Hauser, Universitat Munchen, Federal Republic of Germany; Susan Karl, U.S. Geological Survey, Anchorage, Alaska; Anne Marie Karpoff, Institut de Geologie, Strasbourg, France; Atsushi Matsuoka, Niigata University, Japan; Alain Molinie, Lamont-Doherty Geological Observatory, Palisades, N.Y.; James Ogg, Purdue University, West Lafayette, Ind.; A.R.M. Salimullah, University of Southampton, United Kingdom; Maureen Steiner, University of Wyoming, Laramie; Brian Wallick, Purdue University; Winton Wightman, Dahousie University, Halifax, Nova Scotia, Canada.