Leg 128

Scientists reconstruct 20-million-year record probe earth's interior with space-age technology

November 30, 1989 COLLEGE STATION, TX -- Scientists for the Ocean Drilling Program (ODP) went back in time to piece together a marginal sea's ancient geologic record. They also used the latest technology to look into the future, probing far into the sea's crust to monitor contemporary activity caused by shifting crustal plates.

The Japan Sea, which separates the islands of Japan from mainland China, represents a body of water whose geologic history can be compared to the evolution of a living organism.

Like an organism, the Japan Sea originated and evolved in response to its environment; processes both on land and deep within Earth's mantle gave birth to and continue to affect the ongoing life of the sea.

The Japan Sea is the deepest and largest of a great chain of marginal seas that ring the Pacific Rim. Seas like the Japan, and the Philippine, Sula, Celebes, Banda and South China lie adjacent to deep-sea trenches, where old ocean crust descends into Earth's interior. As the crust melts, arcs of volcanoes form between the trenches and the marginal seas. The volcano studded islands of Japan and the numerous earthquakes associated with this region typify the kinds of formations associated with marginal seas.

Like other marginal seas, the Japan Sea originated when the ocean crust weakened and rifted apart as molten lava came to the surface. This same process creates the larger ocean basins of the world. Scientists are particularly interested in the evolution of marginal seas because they indicate that ocean crust is being consumed and new ocean floor is being created.

Evidence from the sites drilled shows that during the Ice Ages, beginning about 18,000 years ago, the Japan Sea was completely isolated from the Pacific Ocean. Cycles of climate and

sea-level changes resulting from ascending and receding polar ice at one time severely restricted circulation between the sea and the Pacific Ocean, turning the Japan Sea into a lago mar, or huge marine lake. During the time of isolation, the sea's oceanographic conditions varied greatly from those of today. Cores recovered from more than 1200 meters of sediment representing the past 20 million years record a period when the sea was extremely low in oxygen due to the isolation from the Pacific Ocean. In contrast, today's sea is rich in oxygen, caused by the free exchange of deep bottom water with the Pacific.

The scientists also recovered cores containing ash layers, which will provide a detailed record of periodic volcanic explosions in the region. The number of ash layers increases dramatically in sediments dating between 900,000 and 300,000 years ago, indicating a peak in explosive volcanism during this period.

Another drill site tested theories about the formation of metalliferous sulfide deposits known to occur in similar ancient marginals seas around the world. These deposits are commonly mined for zinc, lead and other metals.

Probing Earth's interior

In a unique series of experiments, the scientists on board ODP's drill ship *JOIDES Resolution* joined their colleagues on two ships from Tokyo's Oceanographic Research Institute to probe deep into Earth's interior.

In one experiment, scientists placed a newly designed seismometer into a hole 700 meters below the seafloor. The instrument records a broad range of seismic waves generated from large and small earthquakes.

Each seismic event that the seismometer collects is relayed to a special deep-sea recording device, which scientists will retrieve from the seafloor in about two months. Most earthquakes in this region are generated by the collision of crustal plates. The hundreds of seismic events recorded during the next two months will help scientists determine the structure beneath the Japan Sea, the Japanese islands and the Japan Trench.

In a second experiment, scientists placed a set of electrodes

down a hole drilled deep in the seafloor. A second ship sent electrical charges into the water, setting up currents that penetrated deep into the underlying crust. This activity allowed scientists to observe the electrical resistivity within this portion of Earth's interior. These measurements will help scientists learn more about the crustal structure, fluid temperature and presence of partially melted rocks.

These pioneering experiments provide basic research data that will help scientists better understand the collision of crustal plates and the structure of the crust and mantle boundary beneath this unusually dynamic region of the Pacific rim.

Co-chief scientists for Leg 128 were Dr. Jim Ingle of Stanford University at Stanford, California, and Dr. Kiyoshi Suyehiro of the Ocean Research Institute at the University of Tokyo, Japan. Dr. Marta von Breymann of Texas A&M University, College Station, was the staff scientist.

Twenty-seven scientists from the United States, Canada, Japan, Federal Republic of Germany, France, Switzerland and the United Kingdom participated on the cruise.

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 A&M 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 Institutions (JOI, Inc.), a nonprofit consortium of 10 major U.S. oceanographic institutions, manages the program.

"During the next two years, JOIDES Resolution will drill in the western Pacific," said Dr. Philip D. Rabinowitz, director of the ODP. "We will investigate the Pacific's complex tectonic zones, which comprise several oceanic and continental plates."

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.

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