Leg 181

Massive Ocean Current May Provide Clues to Global Warming

3 August 1998 In the depths of the remote southwest Pacific Ocean there flows a cold-water current that today is 100 times the size of the mighty Amazon River.

Racing at depths between 2,000 and 5,500 meters this Deep Western Boundary Current (DWBC) forms part of a global system of ocean circulation, which distributes heat around the planet, and may play a key role in controlling climate change. This current channels 40 percent of the world's newly formed, cold deep water to the oceans.

The Earth has undergone global warming many times before. During the last 2.5 million years, Earth has been subjected to 50 cycles of glaciation followed by deglaciation, the last glacial period ending only 15,000 years ago. DWBC role in controlling these climatic changes will be studied by a team of 26 scientists representing nine countries during the next research expedition of the Ocean Drilling Program (ODP). Professors Bob Carter of James Cook University (Australia) and Nick McCave of Cambridge University (UK) will head the scientific team that will study the history of the world's largest deep ocean current where it flows into the Pacific Ocean east of New Zealand.

These scientists will seek to resolve their questions about climate change by analyzing samples of deep-sea mud, which are shaped by the deep currents to form great mounds on the sea floor. Core samples will be collected deep below the sea floor using the world's largest scientific drill ship, *JOIDES Resolution*.

As the DWBC passes from the Southern Ocean into the Pacific, it runs adjacent to the landmass of New Zealand. Mountains associated with the active faults and volcanoes of New Zealand provide an abundant source of eroded rock detritus. This sand and mud is fed into the path of the DWBC along several large deep-sea channels. Under the influence of the current, the fine-grained muds are then molded into huge deep-sea sediment

drifts. Some of these drifts are several hundred kilometers long, and their sedimentary layers preserve a unique archive of the changes, which have occurred in climate and current strength.

"Previous ODP studies of deep-sea sediment drifts in the North Atlantic have contributed enormously to our understanding of climate change in the northern hemisphere," explains McCave. "I anticipate that southern hemisphere drilling will result in exciting advances in knowledge, and enable a truly global picture to be ascertained. The area east of New Zealand is essentially unexplored territory for the drilling project. There are only three deep sea drill holes in this area, which is equivalent to the size of the North American Basin of the North Atlantic Ocean, where nearly 100 holes have been drilled. This is pioneering work."

To investigate the history of the DWBC and its sediment drifts, the scientific team will take core samples as deep as 500 m below the seafloor, using advanced drilling technology aboard the *JOIDES Resolution*. A hydraulic piston corer pushes directly into the upper layers of sediment, enabling scientists to recover the delicately layered deep-sea muds in an almost undisturbed state.

Subsequent studies of the core materials, both aboard the ship and in land-based laboratories, will allow the scientists to reconstruct the climate changes which have occurred in the southern Pacific ocean, and changes in the strength of the DWBC and associated oceanic fronts such as the subtropical convergence. Scientists will continue to study whether global warming changes the strength of the current. They also want to know if climatic feedback resulting from changes in the strength of the current would cause further warming still (super-greenhouse), or might it rather trigger a cooling and the onset of the next glaciation.

"Computer models are an important aid to understanding global climate change," states Carter. "To be useful they must be based on an understanding of the experiments in climate change that have been undertaken already by planet Earth. The results of our expedition will undoubtedly contribute greatly to our understanding of such past climatic experiments by providing hard data to constrain computer-based speculation."

The *JOIDES Resolution* is scheduled to depart Sydney, Australia on 16 Aug. and arrive in Wellington, New Zealand, 8 Oct. at the conclusion of the expedition. Wellington is home to New Zealand's National Institute for Water and Air Research (NIWA). NIWA scientists have provided most of the site survey data for this expedition, thus enabling scientists to pin-point the spots to be drilled with no chance of hitting pockets of oil or gas.

The Ocean Drilling Program, an international partnership of scientific institutions and governments, explores the history and evolution of Earth's crust. The Ocean Drilling Program is funded principally by the National Science Foundation, with substantial contributions from its international partners. These include the Federal Republic of Germany, France, Japan, the United Kingdom, the Australia/ Canada/ Chinese Taipei/ Korea Consortium for Ocean Drilling, the European Science Foundation Consortium for Ocean Drilling (Belgium, Denmark, Finland, Iceland, Italy, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and Turkey) and the People's Republic of China. The program is managed by Joint Oceanographic Institutions, a consortium of 10 U.S. institutions, with Texas A&M University responsible for science operations. Lamont-Doherty Earth Observatory is the operator for downhole logging.

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In addition, the ODP Web Site includes much additional information on this leg (Leg 181 Scientific Prospectus) and will carry weekly reports on progress as the leg proceeds.