Leg 180

Understanding deep ocean earthquakes

8 June 1998 What causes large faults in the Earth's crust &endash; the ones that cause big earthquakes &endash; to move so easily?

Twenty-six scientists representing 10 countries will address this question during the next research expedition of the Ocean Drilling Program (ODP). Dr. Brian Taylor of the University of Hawaii and Dr. Philippe Huchon of the École Normale Supérieure in Paris head the scientific team that will examine the mysteries of large faults.

Faults, cracks in the Earth's crust, produce earthquakes when they move or slip. Most faults respond to applied stresses by moving predictably: for example, the greater the perpendicular force that is applied to a fault, the greater is the resistance of the fault to slip. The movement of larger faults, such as those that accommodate plate motions, is much harder for scientists to predict. They can move and slip with little resistance to large normal stresses. The large earthquakes produced by these faults remain unpredictable in origin and timing.

To investigate this puzzle, the scientific team will penetrate and sample an active fault in the Woodlark Basin near Papua New Guinea using the technology aboard ODP's research vessel, *JOIDES Resolution*. The ship is capable of drilling and recovering core samples from beneath the seafloor. She can also deploy a re-entry cone on the sea floor, which enables the crew to make multiple re-entries into the hole, change drill bits and thus achieve deeper penetration into the formation.

In the Woodlark Basin, the seafloor is spreading apart at rates of 3 cm to 6 cm annually to form new oceanic crust. The scientists and crew will drill at the western end of the basin where extensional faults associated with the basin opening reach into the continental crust of Papua New Guinea. "To understand what's different about the shallowly dipping (25 - 30 degrees) fault zone that enables it to slip, we have to sample the rocks

and fluid and measure the conditions in the place where it is slipping," says Taylor.

The primary drillhole is intended to intersect the fault at 900 meters below the seafloor and may continue as far down as 1200 meters below the seafloor. A total of three drill sites are planned, the first directly into the fault zone, and the other two on either side of the fault. One of the many critical experiments will be to measure the formation fluid pressures and fracture stresses in and on both sides of the fault zone.

"Drilling down to and through the fault zone will be no easy task," says Huchon. "This is a hostile environment for recovering geologic samples and for making measurements because of the tremendous forces at work in this area, where the crust is rapidly pulling apart."

The *JOIDES Resolution* will depart Darwin, Australia, on June 12 and return to Sydney on August 11.

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 180 Scientific Prospectus) and will carry weekly reports on progress as the leg proceeds.