

Science News

Ocean Drilling Deep Into the Pacific Crust

ScienceDaily (Apr. 13, 2011) — From April 13 to June 3, an international team including four French researchers from CNRS and the Université Paul Sabatier in Toulouse (1) is setting off for the East Pacific to carry out an ocean drilling campaign off the coast of Costa Rica. The expedition's goal is to drill down for the first time next to a superfast-spreading mid-ocean ridge, to reach the gabbro that lies around 2 km beneath the ocean floor. Obtaining samples of these magmatic rocks, which result from slower cooling than the basalts found on the ocean floor, will enable scientists to better understand the structure of the crust and test models for its formation in the specific context of fast-spreading ridges.

The samples will shed light on the role of seawater in the evolution of the ocean crust, as well as on the contribution of the lower part of the crust to marine magnetic anomalies. The departure of the mission coincides with the 50th anniversary of the first drilling of the ocean crust in April 1961 (2).

The importance of drilling at fast-spreading ridges

Geologists long dreamed of directly studying the rocks that make up the ocean floor. Scientific ocean drilling, which started around fifty years ago, has now made this possible, even if the objective of sampling an entire section of the oceanic crust and drilling down to Earth's mantle, at a depth of 5-6 km, remains to be achieved. The scientists chose to focus on the oceanic crust formed at fast-spreading ridges (which is the case in the Pacific Ocean) because it is more uniform and homogeneous than the crust formed at slow-spreading mid-ocean ridges (such as those in the Atlantic for instance). Around 20% of existing mid-ocean ridges have fast spreading rates (> 8 cm/year). They have generated nearly half of today's oceanic crust, making up 30% of Earth's surface. Characterizing this type of crust is of utmost importance to better understand geochemical cycles (such as the carbon cycle) on the planetary scale.

Oceanic crust is formed along mid-ocean ridges by the cooling of magma produced by the partial melting of mantle rocks. If the magma reaches the surface of the ocean floor, it cools rapidly, forming the basalts that make up the vast majority of the upper oceanic crust. However, if the magma crystallizes more slowly at depth, the rock that is formed is a gabbro. The oceanic crust is therefore made up of a surface layer of basalt underlain by deeper gabbro.

Drilling deep into the oceanic crust jointly led by Damon Teagle, professor at Southampton University and Benoît Ildefonse, CNRS senior researcher, the IODP(3) 335 expedition will take place from 13 April to 3 June 2011 on the US ocean drilling research vessel JOIDES Resolution. Four of the 31 scientists taking part in the expedition are French: Benoît Ildefonse and Marguerite Godard from the Laboratoire " Géosciences Montpellier " (CNRS/Université Montpellier 2), Lydéric France from the Centre de Recherches Pétrographiques et Géochimiques (CNRS) and Bénédicte Abily, PhD student at the Laboratoire " Géosciences Environnement Toulouse " (CNRS/Université Paul Sabatier/IRD).

The scientists will be drilling in the East Pacific, into the crust of the Cocos plate, formed 15 million years ago at a very rapid rate (>20 cm/year), which is faster than at any existing active ridge. The 2011 campaign follows on from three expeditions to the same site in 2002 and 2005. In 2002, 500 meters of basalt was extracted from the drill hole. In 2005, drilling was carried out down to a depth of 1500 meters, finally obtaining the only existing sample of a complete, intact section of upper oceanic crust. With this new expedition the researchers intend to collect samples from as deep as possible and, for the first time next to a fast-spreading ridge, reach the gabbro in the lower oceanic crust. The samples collected will enable geologists to test models for the formation of these rocks and to characterize their cooling process, as well as the role of

hydrothermal circulation at such depths, by studying their alteration. The formation of oceanic crust, which covers around 70% of Earth's surface, is a key process in the dynamics of our planet, which this drilling project should help us to better understand.

1) The Laboratoire " Géosciences Montpellier " (CNRS/ Université Montpellier 2), the Centre de Recherches Pétrographiques et Géochimiques (CNRS) and the "Géosciences Environnement Toulouse " unit (CNRS/Université Paul Sabatier/IRD).

2) Teagle and Ildefonse, 2011. Journey to the mantle of the Earth. *Nature*, 471, 437-439. Doi: 10.1038/471437a. 3) The Integrated Ocean Drilling Program (IODP) is an ambitious international program: