

# Pole position

**Dr Fabio Florindo**, one of the partners of EuroANDRILL, outlines the aims of the project, the legacy of ANDRILL on which it builds, and its potential impact for future generations

**THE ANTARCTIC ICE** Sheet has undergone many changes through the Cenozoic Era (the past 65.5 million years) and has varied in size considerably, influencing sea levels, atmospheric composition and dynamics, and ocean circulation. According to the latest Intergovernmental Panel on Climate Change (IPCC) worst-case scenario projections (i.e. continued greenhouse gas emissions at or above current rates), by 2100, global annual mean temperatures are likely to exceed those that were last experienced on Earth some 34 million years ago. During this last 'greenhouse' period, the Antarctic Ice Sheets were small to absent, and as Antarctica is the major driver of Earth's climate and sea level, much effort has been expended in deriving models of its behaviour. Understanding Antarctic climate evolution requires continent-wide as well as continent-to-deep-sea studies of past climate records, to decipher their separate but related histories. It is to this need that projects such as ANDRILL (ANtarctic geological DRILLing; [www.andrill.org](http://www.andrill.org)) and EuroANDRILL ([www.euroandrill.com](http://www.euroandrill.com)) are responding, as latter project coordinator Dr Fabio Florindo, from the Istituto Nazionale di Geofisica e Vulcanologia (INGV), Rome, explains: "Over the next few years, our research communities must work to integrate geoscience data provided by sediment cores (like ANDRILL/EuroANDRILL) and ice cores with new generation climate models".

## WHAT LIES BENEATH

ANDRILL is a multinational collaboration comprising more than 200 scientists, students, and educators from five nations (Germany,

Italy, New Zealand, the United Kingdom and the United States) to recover stratigraphic records from the Antarctic margin using Cape Roberts Project (CRP) drill core technology. Its chief objective is to drill back in time to recover a history of paleoenvironmental changes that will guide understanding of how fast, how large, and how frequent glacial and interglacial changes have been in the Antarctica region. This critical geological archive – especially data from key time periods in the distant past when global temperature was several degrees warmer than it is today – is invaluable in informing and guiding future scenarios of global warming which may reveal potential timing frequency and sites of future changes.

Up until now, European participation in the ANDRILL project has been limited. But under the auspices of the European Polar Board, EuroANDRILL has been formed to expand European participation in ANDRILL, involving partners from Italy, Germany and United Kingdom (already members of ANDRILL consortium) and seven additional European countries: Spain, Belgium, Finland, France,

Poland, Sweden, and The Netherlands. The United States, New Zealand, and Russia are non-EU collaborating partners of EuroANDRILL. EuroANDRILL seeks to expand on the legacy of ANDRILL and make the contributions of Antarctic geological drilling sustainable within the European Research Area. Its primary goal is to create a network of European paleoclimate scientists that can coordinate their shared research objectives and planning efforts and establish Europe as a key player in future Antarctic sediment and rock coring projects. With increased opportunities for European scientists to study the geologic history of Antarctica and to better understand the role of the high southern latitudes in past and future climate change, EuroANDRILL provides a coherent, integrated platform to support European leadership and involvement in the international ANDRILL Programme.

## A UNIQUE RIG

The ANDRILL drilling system is based around a drilling rig constructed by Universal Drill Rigs (UDR) in Brisbane. A type of rig commonly used in mineral drilling, it has been customised

PHOTOGRAPH OF A SPLIT CORE SECTION RECOVERED IN THE SMS PROJECT DRILL CORE  
(photo from SMS digital data files)



# Digging deep for answers

Led by **Dr Fabio Florindo**, EuroANDRILL is an exciting initiative that seeks to use advanced drill core technology to collect data about historical climate evolution in the Antarctic, to guide modelling and understanding of future climate change



**Could you elaborate on the background and the aims and objectives of the EuroANDRILL programme?**

The EuroANDRILL programme aims to investigate Antarctica's role in Cenozoic global environmental change through European participation in the international ANDRILL programme, which provides access to critical geological archives via a state-of-the-art drilling system.

**What kind of interest has there been in the ANDRILL programme from European countries? Does it offer significant benefit to European nations?**

To date, there is a lot of interest around ANDRILL. After the success of the programme's inaugural drilling seasons in 2006 and 2007, additional European countries are keen to get involved. Being part of ANDRILL allows scientists unique access to extraordinarily long, high-quality sedimentary archives from beneath high latitude ice-covered areas that are currently inaccessible to other drilling programmes. These archives provide critical data from which past climatic, geological, and environmental conditions in the southern high latitudes can be reconstructed.

**How can a better understanding of past ice sheet history help to improve our understanding of its future behaviour?**

It is certain that looking back to times in Earth's past when climate was warmer can provide us with a guide to the future. We know, for example, that during the early to mid Pliocene (3-5 million years ago) planetary temperatures were up to 3°C warmer than today and that atmospheric CO<sub>2</sub> concentrations not much higher than present. With average global temperatures projected to increase by 3°C by the end of the 21<sup>st</sup> Century we can examine the early to mid Pliocene as an analogue for future environmental conditions around the world. Specifically, we can study rock and sediment cores from Antarctica, to study the behaviour of the Antarctic Ice Sheets and their contribution to changes in global sea level.

**And has the ANDRILL programme managed to do this so far?**

Absolutely. During the first ANDRILL drilling season (McMurdo Ice Shelf Project) we recovered an impressive sediment core from beneath the sea-floor below the Ross Ice Shelf. This core encompassed much from the Pliocene and provides direct evidence that the entire West Antarctic ice sheet has waxed and waned in size under climate conditions that Earth will experience again within the next few hundred years.

**How can climate modelling systems help to analyse the stability of the cryosphere in the face of rising CO<sub>2</sub> levels?**

Numerical climate and ice sheet models provide us with a mechanism to emulate the complex physical and biological systems on Earth. We can use these models to conduct experiments to test how these systems will respond to changing conditions including oceanic temperature and sea-level. Furthermore, we can use coupled numerical ice sheet and climate models to evaluate the response of ice sheets and ice shelves to varying levels of atmospheric CO<sub>2</sub>. While these models are powerful, they are still evolving. Paleoclimate data obtained from geologic records provide environmental constraints and can be used to inform the models. Together,

paleoclimate archives and numerical models provide a robust approach to evaluate future response of the cryosphere to rising CO<sub>2</sub> levels.

**Education is an important part of EuroANDRILL's remit. Could you elaborate on the Educational and Public Outreach Programme?**

ANDRILL has implemented a comprehensive Educational and Public Outreach Programme ([www.andrill.org/education](http://www.andrill.org/education)). One of the major components was designed to engage a group of selected educators in every phase of the drilling projects, from on-ice research activities in Antarctica to discussion of results at our science integration meetings. Our approach has produced the important outcomes we desired. The educators that worked with our scientists have produced high quality outreach initiatives and educational material, which has been highly effective and scientifically precise. As a result, several hundred schools around the world have been involved and engaged in real paleoclimate science, and we have created an international network of highly motivated polar geo-science educators. Our educational programme is still growing, even years after the first phase of drilling has ended.

**How crucial a component to your work is the dissemination of research?**

In the same way the dissemination of our research in the scientific arena is integral to EuroANDRILL's work, so too is our educational initiative born within the context of ANDRILL's innovative approaches to geoscience education. We aim to expand the cohort of motivated teachers already engaged in ANDRILL and provide them with an inside view of the research we do. These teachers are key to ensuring that the knowledge we gain through our research is effectively passed on to our children as it is to our international colleagues and collaborators.



## EUROANDRILL

### OBJECTIVES

EuroANDRILL aims to investigate Antarctica's role in Cenozoic global environmental change using an international data-collection platform, the ANDRILL rig and drilling system.

### PARTNERS

- **Dr Fabio Florindo**, Coordinator  
Istituto Nazionale di Geofisica e Vulcanologia (INGV), Italy
- **Dr Carlota Escutia**, Instituto Andaluz de Ciencias de la Tierra  
University of Granada, Spain
- **Professor Marc De Batist**, Renard Centre of Marine Geology, Belgium
- **Dr Gerhard Kuhn**, Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
- **Professor Jan Backman**, Faculty of Science  
Stockholm University, Sweden
- **Professor Henk Brinkhuis**, Faculty of Sciences  
Utrecht University, Netherlands
- **Professor Jane Francis**, School of Earth & Environment  
University of Leeds, UK
- **Professor Andrzej Gazdzicki**, Institute of Paleobiology  
Polish Academy of Sciences, Poland
- **Dr Ritz Catherine**, LGGE – Laboratory of Glaciology and Geophysical Environment, France
- **Dr Kari Strand**, Thule Institute University of Oulu, Finland

### ASSOCIATED PARTNERS

#### Dr Frank Rack

University of Nebraska-Lincoln, U.S.

#### Professor Timothy Naish

Antarctic Research Centre, Victoria University of Wellington  
New Zealand

#### Dr German Leitchenkov

Department of Antarctic Geoscience, Research Institute for Geology and Mineral Resources of the World Ocean, Russia

### CONTACT

#### Dr Fabio Florindo

INGV Istituto Nazionale di Geofisica e Vulcanologia  
Via di Vigna Murata 605, 00143-Roma, Italy

T +39 0651860 383 office / 238 lab F +39 0651860 397

E fabio.florindo@ingv.it

[www.euroandrift.com](http://www.euroandrift.com), [www.ingv.it](http://www.ingv.it)

**FABIO FLORINDO**, Principal Investigator of EUROANDRILL, has embarked upon six scientific expeditions to Antarctica. He has been a member of the steering committee of SCAR Scientific Research Programme "Antarctic Climate Evolution (ACE)", and a member of the ANDRILL steering committee and Co-Chief Scientist of the Southern McMurdo Sound Project. Amongst his other achievements, he is a member of Antarctic Science (Cambridge University Press) Editorial Advisory Board, and Editor of Reviews of Geophysics (AGU). His research interests include palaeomagnetism and environmental magnetism with applications to palaeoclimate and palaeoceanography.

► for ANDRILL's scientific requirements and for Antarctic conditions, both climatic and practical - the whole system can be broken down into components to be transported on sledges or by aeroplane. The drill system has the capacity to operate on both shore-fast-ice, and ice shelf platforms, and to recover continuous long stratigraphic records (up to 1,500 m) from water depths of up to 1,000 m.

In addition to the drilling system, ANDRILL has developed software packages like PSICAT (Paleontological-Stratigraphic Interval Construction and Analysis Tool), a Java-based program for creating stratigraphic diagrams of drill cores and CORELYZER, a visualisation tool that enabled ANDRILL's scientists to greatly enlarge images of the cores, integrate data sets, make annotations, and share information between their various working locations around the world.

### BREAKING RECORDS AS WELL AS ICE

During ANDRILL's first two drilling seasons, the drilling technology allowed scientists to obtain ca. 2,400 m of sediment and rock core with 98 per cent core recovery. It also achieved remarkable success in recovering two long rock and sediment cores from record-setting depths beneath ice-shelf and sea-ice platforms, drilling in 2006 to a depth of 1,000 m below the seafloor from the ANDRILL site on the Ross Ice Shelf. Key results from the projects have been published in over 40 papers including several in high-profile science journals such as Nature, Geology, and GSA Bulletin.

### EXPANDING THE LEGACY

In Europe, the International Polar Year (IPY) (March 2007-March 2009) has been highly visible and well promoted, and ANDRILL has been a highly visible and successful part of it. The EuroANDRILL study seeks to expand on the scientific legacy established during the fourth IPY and to ensure that the contribution of Antarctic drilling is sustainable in the European Research Area through networking of research projects and future planning efforts. In 2009, the importance of EuroANDRILL was recognised by the European Polar Board, and the EPB granted a small budget for travel and meetings of the EuroANDRILL steering committee during these initial phases. The first of the meetings of the steering committee, with representatives of each of the partner countries, took place during the First Antarctic Climate Evolution (ACE) Symposium in Granada in September 2009. EuroANDRILL is now working at both national and European level to get the necessary funds to ensure the development and continuation of the project.

### LOOKING FORWARD

EuroANDRILL will provide the opportunity for European scientists to participate in forthcoming ANDRILL projects in the Ross Sea Region. The first of these is the Coulman High project, which steps outside the reasonably well-understood Victoria Land Basin to target a Cretaceous to middle Miocene geological sequence at two sites beneath the Ross Ice Shelf. The Coulman High Project will address fundamental questions of global climate evolution and regional tectonics. In addition, EuroANDRILL plans to provide leadership in other areas of research on the Antarctic continent where stratigraphic sequences have the potential to provide paleoclimate/ice sheet records and boundary conditions for ice-sheet models (e.g., sites amongst the Ronne/Filchner Ice Shelves, and the James Ross Basin (Seymour/Snow Hill/James Ross Islands)).

There is also the possibility of EuroANDRILL developing a long-term polar drilling strategy for the Arctic region, in parallel to its studies in the Antarctic. Such possibilities will take much time and planning to realise, but what is certain is that EuroANDRILL's collaborative approach already promises to open up opportunities for scientists and institutions in Europe, and to ensure that their vital research on climate evolution is achieved and recognised on a global stage.

