

# International Continental Scientific Drilling Program

## ICDP

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### Annual Report 2013

#### Summary

Scientific drilling is an indispensable tool of modern Earth Science research, because it provides the only means of obtaining direct information on processes operating at depth. Drilling allows for determination of *in-situ* properties of solid materials and fluids and permits testing of hypotheses and models derived from surface observations. Drill holes may be used as a natural laboratory for experiments and as observatories for long-term monitoring of ongoing active processes. Earth drilling, therefore, plays a critical role in scientific research directed towards improved understanding of the workings of our planet and has a key role in solving urgent societal problems.

Multinational efforts in continental scientific drilling have been coordinated by ICDP since 1996. The concept for this program was developed in response to geosciences community's need for scientific drilling as an essential tool to enable a better understanding of fundamental Earth processes and structure. The program is based on commingled funding and international cost sharing, joint efforts of international science teams, as well as technology and knowledge sharing. The program concentrates on topics of high international priority, and drilling projects are conducted at locations of global geological significance. The organization is simple and flexible comprising an independent science review board, as well as an executive and an oversight committee. Administration assistance and substantial operational support are provided voluntarily by the German Research Centre for Geosciences – GFZ. Funding is provided by a growing number of member countries, usually through national funding agencies.

ICDP fosters proposals through international workshops that assist researchers in the development of a drilling proposal. To date, 59 of these workshops have been funded and have resulted in a total of 30 ICDP supported, successfully executed, drilling projects. Thematically the activities have focused on paleoclimate investigations, earthquake and volcano research, impact events, geodynamics, and potential energy resources (see below for current and future themes). Many scientific results from these drilling and Earth observation projects have been published in high-ranking scientific journals. Training of on-site scientists, engineering, on-site science and data management technologies are also important components of ICDP. The journal *Scientific Drilling*, jointly issued with the Integrated Ocean Drilling Program (now: International Ocean Discovery Program) IODP, serves to communicate developments from current projects as well as workshop reports and announcements for future scientific-drilling related activities.

#### Global Partners

ICDP currently (31.12.2013) has 24 members including 23 countries (Germany, USA, Japan, China, Canada, Austria, Norway, Poland, Czech Republic, Iceland, Finland, South Africa, Italy, South Korea, Spain, Sweden, Switzerland, New Zealand, France, Israel, India, the Netherlands, and the United Kingdom) and UNESCO as member organizations. Belgium will be ICDP member from 1.1.2014 on.

Expressions of interest in membership and/or negotiations are currently underway with Brazil, Russia, Turkey, Portugal, Denmark, among others. The German Research Centre for Geosciences - GFZ is the Executive Agency of the ICDP and acts on behalf of the ICDP members.

### **Support Level**

Drilling projects are an integral component of major geoscience research programs, including comprehensive pre-site investigations, accompanying laboratory studies, drilling (directly supported by ICDP), and measurements and tests in the drill hole. Drilling programs are costly and only realizable to a limited extent by any entity acting alone. International cost sharing, optimal utilization of all available resources, incorporation of international leading experts, and application of the existing knowledge combined with selection of optimal drilling locations (“World Geological Sites”), are all essential elements of the international continental scientific drilling program ICDP.

ICDP is financed through the annual contributions of its members. The membership fees vary and are based on a number of criteria that include economic factors, the scientific manpower and size of the respective country. The full or Category A members USA, Germany, and Japan provide \$700,000 and have the right to chair panels while China, Canada, France and India contribute \$200,000. The smaller European countries contribute according to their ESF share between amounts of \$20,000 and \$70,000 annually.

The ICDP funds are used, for the most part, for co-funding of the approved ICDP projects and for the execution of ICDP workshops and training courses. In addition, funds cover expenditures for the maintenance of the ICDP Equipment Pool and the ICDP Drilling Information System (DIS). The annual membership income to support ICDP activities is approximately \$3.5M.

The philosophy of ICDP support for projects is based on the “commingled funding” principle. This means that the ICDP is usually one of several funding partners in a joint drilling project. The financial contribution by ICDP to directly support a drilling project varies between about 5% to about 70% (in rare cases) of the total operational costs. Usually national funding agencies or other sources of support for scientific drilling provide the remainder of the funding for the drilling project.

The program is based on a reliable budget with regular financial contributions by the member institutions, strict expense policies including moderate project funding with no long-term financial commitments and very low program administration costs. This allows for attracting new Earth science communities through opportunities to get workshop and project proposals funded. ICDP’s organization, financing through commingled funding, and the bottom-up project policy relying on unsolicited proposals driving the program at large is serving as a model for other programs.

### **ICDP Organizational Structure and Management**

**The Assembly of Governors (AOG)** provides financial and scientific oversight of the ICDP. It determines the program policies, decides on EC-recommended full proposals and allocates the amount of commingled ICDP funding for each individual drilling project. In addition, the AOG decides on the annual program plan and the associated budget, and it discusses the long-range plans of the ICDP as prepared and proposed by the EC.

**The Executive Committee (EC)** is responsible for the operation and management of the program. It decides on workshop and technical proposals, reviews the operational, technical, managerial and financial feasibility of full proposals, recommends funding of full proposals to the AOG, assembles the scientifically prioritized projects into an annual program plan with an associated annual budget and prepares the long-range program plan that constitutes the ICDP program. The EC is made up of one appointee from each ICDP member nominated by the respective funding partners of the program. EC members typically are science managers with expertise in drilling and/or coordination of major research projects. The chair of the EC (executive chair) represents the ICDP internationally and has the executive responsibility for carrying out the program. The executive chair plays a key role as the international spokesperson and ambassador for the ICDP. Tireless efforts to attract membership of an increasing number of countries have resulted in a strong growth of the scientific community for drilling.

**The Science Advisory Group (SAG)** is an independent body of internationally renowned experts in the research fields covered by the program. It has the task of carrying out thorough scientific evaluations of all pre-proposals, full proposals and workshop proposals submitted to the ICDP and to assign priority based on their expected scientific impact and their outreach and educational potential. The SAG recommendations are the primary input to the EC as it develops projects for both annual and long-range programs. The SAG has developed the following set of evaluation criteria:

- Quality of Science
- Need for Drilling
- Qualifications of Proponent
- Societal Relevance
- Budget
- Responsiveness to previous recommendations
- Technical Feasibility
- Adequacy of Site Characterization
- Cost Effectiveness
- Project Organization

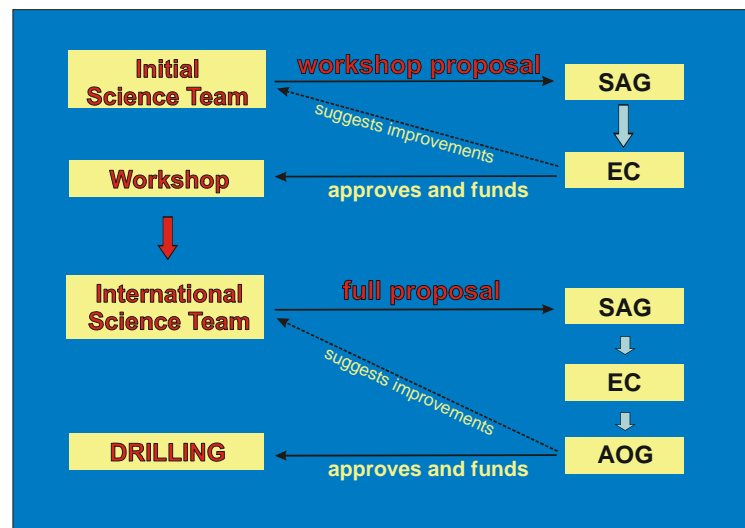
**The Operational Support Group (OSG)** plays a major role in supporting the management of the program and in providing expertise and stability to planning and operation of the overall program. The German Research Centre for Geosciences (GFZ) handles the administration of the program, including financial accounting and contractual support. Currently the GFZ finances from its own budget a group of six scientists, engineers and technicians who compose the core of the ICDP Operational Support Group and who are based at the GFZ. The OSG serves to support the following functions:

- Provide technical and scientific liaison to SAG and EC
- Develop Joint Research Ventures for each project authorized by EC
- Management and support of Secretariats for AOG and EC
- Assistance in contracting and permitting
- Support for scientific and engineering drill-site operations
- Support for field facility for core and sample description and management
- Provide all data collected during each project through a readily accessible data management system for ICDP projects, the Drilling Information System (DIS)

- Prepare - through this Drilling Information System - Initial Reports that describe drilling, engineering and sample and core description and procedures for each project
- Provide training courses in scientific drilling prior to and during drilling projects
- Organize outreach activities on major international geoconferences (AGU, EGU, IGC)
- Edit the IODP-ICDP journal 'Scientific Drilling'
- Develop, purchase, and maintain an ICDP Equipment Pool comprising scientific-technical instruments and tools for on-site use in ICDP projects
- Provide management support for individual ICDP projects
- Provide and operate ICDP equipment

Management of ICDP activities at the GFZ takes place in the Platform "Scientific Drilling" by the following personnel:

- Prof. Dr. Brian Horsfield
- Dr. Ulrich Harms (Executive Secretary and Head of the ICDP Operational Support Group).



ICDP proposal handling workflow

## ICDP activities 2013

### ICDP Science Conference and the new ICDP Science Plan

An important outcome of the ICDP evaluation in May 2011 was the invitation to develop a new ICDP Science Plan. To lay down the structure of a new ICDP Science Plan, the ICDP Science Conference "Imaging the past to Imagine the future" was held in Potsdam from November 11-14, 2013.

160 project PIs, leading scientists, representatives from ICDP funding organizations, partner programs and industry, science outreach organizations, and early career scientists from 23 countries came together to discuss ICDP achievements and the current status of ICDP and pave the way for the new ICDP Science Plan. In addition, the meeting was streamed live in the internet to provide easy access for all interested parties.



*160 attendees of the ICDP Science Conference “Imaging the past to Imagine the future”*

The new ICDP Science Plan will emphasize the societal impact of continental scientific drilling through a targeted understanding of geoprocesses tackled by ICDP funded projects and will suggest measures to improve the visibility of ICDP and to strengthen the cooperation with partner programs (IODP, Andriill) and the industry.

**Socio-economic themes**

	Climate and Ecosystems	Sustainable Georesources	Geohazards
<b>Geoprocesses</b>	Deep Life	🏠	
	Paleoclimate	🏠	
	Volcanoes	🏠	🏠
	Element Cycles		🏠
	Plate Margins		🏠
	Impact Structures	🏠	🏠
	Fault Zones		🏠

*The new ICDP Science Plan towards a targeted understanding of geoprocesses*

**ICDP Workshops**

ICDP funds workshops to support a group of international scientists with an outstanding scientific theme of socio-economic relevance that requires drilling. The workshops serve to form a broad and competent Science Team and to develop full drilling proposals to ICDP and other co-funding agencies or industry. Over the past years, ICDP supported the conduction of workshops with a broad topical spectrum addressing either future drilling projects or thematic issues.



Workshop Title	Date and Venue	Participation	Countries
Japan Beyond-Brittle Project (JBBP): Scientific drilling to demonstrate the feasibility of engineered geothermal systems in ductile zones	March 12–16, 2013 Sendai, Japan,	102	12 (incl. Swiss)
Mochras revisited: a new global standard for Early Jurassic Earth history	March 20 –21, 2013 Oxford, UK	32	10 (incl. Swiss)
Drilling Overdeepened Alpine Valleys	April 3-5, 2013 Como, Italy	46	10 (incl. Swiss)
2 <sup>nd</sup> Eger Rift Workshop	June 4-5, 2013 Potsdam, Germany	50	5
<b>Forthcoming Workshops</b>			
Drilling the Bushveld Complex	September 7-9, 2014 Johannesburg, South Africa	-	-
Accelerating Neoproterozoic Research through Scientific Drilling (MagellanPlus)	March 17-19, 2014 Nottingham, UK	-	-

*Summary of ICDP workshops conducted 2013 and planned for 2014*

### ICDP Projects accomplished in 2013

#### Scientific Collaboration On Past Speciation Conditions in Ohrid (SCOPSCO)

Lake Ohrid is a transboundary lake between the Republics of Macedonia and Albania. With more than 200 endemic species described, the lake is a unique aquatic ecosystem of worldwide importance. This importance was emphasized, when the lake was declared UNESCO World Heritage Site in 1979, and included as a target area of the International Continental Scientific Drilling Program (ICDP) already in 1993. Though the lake is considered to be the oldest, continuously existing lake in Europe, age and origin of Lake Ohrid are not unravelled to date. Age estimations vary between one and ten million years



[http://www-icdp.icdp-online.org/sites/ohrid/news/iod/2013\\_05\\_30.htm](http://www-icdp.icdp-online.org/sites/ohrid/news/iod/2013_05_30.htm)

and concentrate around three to five million years, and both marine and limnic origin is proposed. Extant sedimentary records from Lake Ohrid cover the last glacial/interglacial cycle and reveal that Lake Ohrid is a valuable archive of volcanic ash dispersal and climate change in the central northern Mediterranean region. These records, however, are too short to provide information about age and origin of the lake and to unravel the mechanisms controlling the evolutionary development leading to the extraordinary high

degree of endemism. Concurrent genetic brakes in several invertebrate groups indicate that major

geological and/or environmental events must have shaped the evolutionary history of endemic faunal elements in Lake Ohrid. Lake deep drilling was scheduled for 2012, but drilling became postponed due to logistical problems (the cargo ship with the drilling equipment caught fire). In April/May 2013 the drilling of Lake Ohrid was finally undertaken, retrieving 2201 m of sedimentary core (93.5% recovery) from four sites ranging from 80 to 260 m target depths. From the deepest site, situated in the centre of the lake, 579 m core from a sediment fill of ca. 700 m were recovered. Coarse-grained gravel and pebbles underlying clay and shallow water facies hampered deeper penetration. Three additional sites at more lateral parts of Lake Ohrid were drilled to unravel lake level fluctuations, catchment dynamics, biodiversity and evolution processes, active tectonics and spring dynamics, and the early development of the Ohrid Basin. The cores are now stored at the University of Cologne, Germany, where core opening, core description and documentation, and first analyses such as Multi-Sensor Core Logging (MSCL) and X-ray fluorescence (XRF) scanning is currently taking place.

### **Colorado Plateau Coring Project (CPCP)**

Despite a long and distinguished history of study of the Colorado Plateau region, particularly of the Chinle and Moenkopi formations, striking ambiguities in temporal duration and resolution, major uncertainties in global correlations, and significant doubts about paleolatitudinal position hamper incorporation of the huge amount of information from the region into larger tests of major competing



Photo by Randall Irmis/Colorado Plateau Coring Project

climatic, biotic, and tectonic hypotheses of global importance for Earth system processes. The Colorado Plateau Coring Project (CPCP) was launched to address these questions and drilled continuous cores from two sites (Site 1: 520 m, Site 2: 81 m and 253 m) through nearly the entire Triassic age section at Petrified Forest National Park (PFNP), Arizona, USA, one of the most famous and best studied successions of the continental Triassic in the World. The borehole at Site 1 drilled through the Chinle formation, reached the Moenkopi formation at m 503 m and run into

Coconino Sandstone at 512 m. The drill cores provide a quantitatively sound reference section in which magnetostratigraphic, geochronological, environmental, and paleontologic data are registered to a common thickness scale with unquestioned superposition. With such a reference section in hand the entire massive assemblage of outcrop data from the PFNP and the surrounding region can be integrated into the global framework.

### **Ongoing projects**

#### **Hominid Sites and Paleolakes Drilling Project (HSPDP)**

HSPDP (Hominid Sites and Paleolakes Drilling Project) aims to obtain sediment cores from several of the most important fossil hominid and early Paleolithic artifact sites in the world, located in Kenya and Ethiopia for understanding hominid phylogeny, covering key time intervals for addressing questions about the role of environmental forcing in shaping human evolution. Drill cores of lacustrine strata, with their continuity and excellent preservation of organic matter, fossils and other archives that are frequently degraded in outcrops, will provide a vast improvement in our understanding of environmental history in the places and times where various species of hominids lived over currently available outcrop records. Obtaining such core records from the continental interiors will provide a spatially resolved record at the landscape scale, much more localized and temporally resolved than the



regional/global climate signals preserved in deep sea core records, and in much closer proximity to the hominid sites than the current African deep lake records. The five proposed sites (Tugen Hills, West Turkana, Lake Magadi (Kenya), Chew Bahir, Northern Awash (Ethiopia) are all currently on-land and consist of thick lacustrine sedimentary sequences with high deposition rates. Therefore, the sites combine the attributes of

relatively low cost targets (in comparison with open water, deep lake sites) and the potential for long, highly continuous and informative paleoenvironmental records obtainable from lake beds. The Tugen Hills drilling (Kenya) finished up on June 11<sup>th</sup> and reached a depth of 228 m, just shy of the original 250 m target depth. Drilling in West Turkana (Kenya) reached 175 m. Downhole logging was carried out at both sites by the logging team of ICDP's Operational Support Group, the initial description of the Tugen Hills and West Turkana core took place at LacCore. Drilling activities in Ethiopia and at Lake Magadi are scheduled for 2014.

### **Geophysical Observatory at the North Anatolian Fault (GONAF)**

The GONAF plate boundary observatory (Geophysical Observatory at the North Anatolian Fault) was set up to determine and monitor the seismic hazard of the region and the processes occurring in the fault zone beneath the Marmara Sea off Istanbul with cutting edge earthquake monitoring technology. Specially designed seismic sensors in eight boreholes on the outskirts of Istanbul and around the eastern Marmara Sea will monitor the seismic activity of the region with high precision. In each of the respective 300 meter deep holes several borehole seismometers will be permanently installed at various depths. These detect even barely perceptible earthquakes with very small magnitudes at a high resolution and can thus provide information about the earthquake rupture processes associated with these. The first of eight ~300m deep holes was drilled in late 2012. In 2013, two holes were drilled. Drilling and completion of holes will be ongoing in 2014.



## Upcoming projects

ICDP drilling activities scheduled for 2014 comprise drilling 1) in the Scandinavian Caledonides in Sweden, 2) the Alpine Fault in New Zealand, and 3) the Songliao Basin in China.

1) The COSC project (Collisional Orogeny in the Scandinavian Caledonides) focuses on the mid Paleozoic Caledonide Orogen in Scandinavia in order to better understand orogenic processes, both in the past and in today's active mountain belts. The Caledonides in Scandinavia provide unique opportunities for understanding Himalayan-type orogeny and the Himalayan Orogen itself, thanks to the deep level of erosion (mid to lower crustal) and the paucity of superimposed post-Paleozoic deformation. This project targets both the Caledonian nappes ("hot" allochthon) and the underlying basement, with two c. 2.5 km drillholes, located near Åre and Järpen in western Jämtland. Drilling was scheduled for 2013, but due to permit issues which meanwhile have been solved drilling is now anticipated for mid 2014.

2) The DFDP project proposes to drill, sample, and monitor the Alpine Fault at depth, to take advantage of excellent surface exposures and the relatively shallow depths of geological transitions, and hence to better understand fundamental processes of rock deformation, seismogenesis, and earthquake deformation. The first phase of DFDP was completed in February 2011 with the successful construction of two shallow boreholes intersecting the Alpine Fault at Gaunt Creek, South Westland. Planning is now underway for the next phase of drilling, which is scheduled to start late 2014.

3) The principle target of drilling in the Chinese Songliao Basin is the recovery of a nearly complete Cretaceous terrestrial sedimentary record from a 5 km deep corehole in order to determine the basin-filling history and understand the response of terrestrial environment to geological events related to the carbon cycle and greenhouse gas triggered climate change. "Crust I", a newly designed drill rig with 10 km depth capacity, is currently on its way to Daqing to drill in the Songliao Basin.

## Education and Outreach Activities

- ICDP outreach actions were executed at the 2013 EGU meeting in Vienna, the Goldschmidt Conference in Florence and the 2013 AGU meeting in San Francisco, including Town Hall meetings, booths, and scientific sessions.
- A new ICDP website (<http://www.icdp-online.org>) was launched in October 2013 to increase the visibility of ICDP and to improve access to information for particular groups, including media representatives, politics, representatives from funding agencies, and the interested public.
- A new Best Practice brochure (ICDP Primer) was designed for scientists and engineers of upcoming drilling projects to explain the key steps and important challenges in planning and executing continental scientific drilling. The brochure can be downloaded from the new ICDP website (<http://www.icdp-online.org/media/icdp-best-practice-brochure-primer>).
- Up to May 2013, the IODP-ICDP program journal SCIENTIFIC DRILLING was produced and published by IODP-MI through the Tokyo office. Due to the current major reorganization of IODP, ICDP took over the responsibility for the journal and teamed up with Copernicus Publications as publishing partner to continue SCIENTIFIC DRILLING as Open Access journal. Due to financial support from ICDP, publications will be free of fees for authors. Past and upcoming volumes of SD can be downloaded from the new SCIENTIFIC DRILLING website and will also be available on ICDP and IODP websites. SCIENTIFIC DRILLING Volume 16 was published by Copernicus Publications in November 2013, including four Science Reports, four Workshop Reports, one Progress Report and one report on Technical Developments.