



United Nations  
Educational, Scientific and  
Cultural Organization



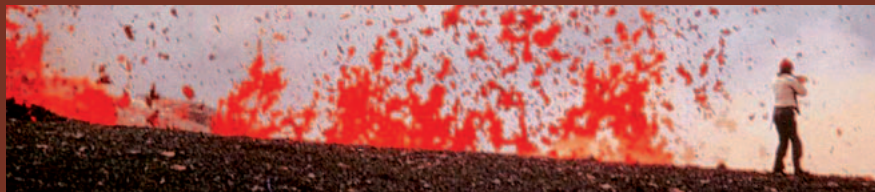
International  
Geoscience  
Programme



International  
Union of Geological  
Sciences

# INTERNATIONAL GEOSCIENCE PROGRAMME IGCP

IN THE SERVICE OF SOCIETY



Ecological and Earth Sciences in UNESCO

## What is this brochure for?

This brochure describes the International Geoscience Programme (IGCP), a joint operation by UNESCO and the International Union of Geological Sciences (IUGS). It describes the type of research we conduct under this Programme, including how to apply, and the conditions for funding. The brochure also explains to potential sponsor organizations why they should support IGCP, and what they will receive in return.

## Who should read it?

The brochure is aimed at potential research applicants, typically leading scientists working in the numerous fields of geoscientific research across the world. It also provides information for national committees of the IGCP, UNESCO's National Committees, national 'adhering organizations' to IUGS, and potential sponsors.

## Why sponsor the IGCP?

The IGCP is the oldest and most successful example of scientific cooperation between a non-governmental organization (NGO) - the IUGS - and an intergovernmental organization - UNESCO. The IGCP enjoys the highest reputation within the UN system as well as among the world's scientific organizations, and brings together junior and senior geoscientists from less and more developed nations. Over the past 35 years, tens of thousands of scientists have actively taken part in IGCP projects; for many of them the Programme has been the gateway to a successful career in and beyond geoscience. IGCP has also been responsible for some major geoscientific programmes of ground-breaking international standard.

Given that the IGCP's motto is **Geosciences in the Service of Society**, investing in this Programme will support applied scientific research directly designed to improve living conditions in modern societies that are heavily dependent upon their natural environment and local geological conditions.

Through rigorous selection and evaluation procedures only the very best scientific proposals receive funding. Moreover, the IGCP's long-held policy is to provide starter finance ('seed money') only, as a means of bringing together scientists from as great a number of nations as possible. The imprimatur of the IGCP then makes it easier for the scientists to raise matching funds from other sources.

If you choose to sponsor IGCP, your generosity will be acknowledged in all IGCP project reports, and on the IGCP website's home page. Your contribution will guarantee that top young scientists from developing countries actively interact with some of the world's leading scientists, thus contributing to capacity-building worldwide.

## What to do next ...

If you are a scientist wishing to register initial interest in bringing together a group of fellow scientists from a number of countries in order to generate a research proposal relevant to one of the described themes (see pages 5, 7, 9, 11, and 13) or one constituting a basic research topic (see page 15), please go to [www.unesco.org/science/earth](http://www.unesco.org/science/earth) and follow the instructions for submission of an IGCP project.

If you wish to sponsor IGCP, please contact the Secretariat in Paris - see inside back cover for details.

## What is IGCP?

The International Geoscience Programme (IGCP) fosters interdisciplinary geoscientific research among researchers internationally, through joint research work, meetings and workshops. Since its creation in 1972, IGCP has supported over 500 projects in about 150 countries.

IGCP brings together scientists from around the world, and provides them with seed money to devise and conduct joint international research and to collectively publish the results. High on the list of selection criteria are scientific quality and the extent of the international, multidisciplinary cooperation likely to be generated by a proposed project.

## Which are the main sponsors?

The initiators and main sponsors of the IGCP are UNESCO's Division of Ecological and Earth Sciences, and the International Union of Geological Sciences (IUGS). Other sponsors include UNESCO's Water Sciences Division.

## Objectives

IGCP's scientific objectives include:

- Increasing our understanding of the geoscientific factors affecting the global environment in order to improve human living conditions.
- Developing more effective methods to find and sustainably exploit natural resources of minerals, energy and groundwater.
- Increasing our understanding of geological processes and concepts of global importance, including an emphasis on socially relevant issues.
- Improving standards, methods and techniques of carrying out geological research, including the transfer of geological and geotechnological knowledge between industrialized and developing countries.

## IGCP Secretariat

The IGCP Secretariat is based in UNESCO's Ecological and Earth Sciences Division. The Secretariat manages the Programme and communicates with the IGCP Bureau, project leaders, National Committees, members of the Scientific Board, Initiators (IUGS and UNESCO), UNESCO regional offices and with sponsors. It organizes regional meetings to stimulate interest and participation in IGCP activities, facilitates publication of IGCP documents, and is responsible for the IGCP website ([www.unesco.org/science/earth](http://www.unesco.org/science/earth)) as well as organising the annual IGCP meetings.



*World map showing countries involved in IGCP projects in brown*

## UNESCO's Division of Ecological & Earth Sciences

UNESCO promotes cooperation between nations on various topics in education, science and culture in order to advance peace and security. The Earth sciences programmes within UNESCO's Natural Sciences Sector are unique in the UN, as they give particular attention to understanding the Earth System. They address interdisciplinary research and capacity-building in the fields of geology and geophysics, including the sustainable management and development of the Earth's mineral and energy resources. They strongly contribute to the Global Earth Observation Systems of Systems (GEOSS) enhancing the ground-based and satellite observation of the planet. UNESCO assists in providing better information for decision-makers to plan for sustainable socio-economic development, hazard mitigation and safeguarding the environment and geological heritage.

In 2001 UNESCO was invited by its Executive Board to highlight the importance of territories or natural parks with special geological features. This initiative introduces a unique international framework linking socio-economic development and conservation. The Geopark Initiative works closely with UNESCO's World Heritage Centre, the Man and the Biosphere (MAB) World Network of Biosphere Reserves and national and international undertakings and non-governmental organizations active in geological heritage conservation.

the Division of Ecological and Earth Sciences supports the Geopark initiative and the International Year of Planet Earth because both of these initiatives promote international cooperation designed to improve our understanding of the Earth System, while sustaining local communities.

## The rise and Fall of the Vendian Biota (IGCP 493)

Some 600 million years ago, one of the most significant events in Earth history occurred - a sudden increase in biodiversity, culminating in a variety of hard skeleton species. This project is particularly interested in the precise timing of these events, the effects that changing environments, climates, global chemistry and palaeogeography had on the development and diversification of animals, culminating in the spectacular Ediacaran/Vendian faunas.

Researchers are investigating the most representative sections along the coasts of the White Sea in Russia, the Flinders Range of South Australia, the deserts of southern Namibia and the coastal outcrops of Newfoundland. Additional material (mainly from South America) is brought forward to compare its setting with the better-known faunas elsewhere in the world. Researchers from many disciplines gain experience with the Ediacaran assemblages worldwide, and involve students as well as non-scientists that include artists in particular.

The project is particularly active in public outreach projects, including a stamp issue and a childrens' book publication in association with Australia Post. A teachers' kit has been developed to accompany the stamp release, public exhibitions are being organized, as are symposia and classroom lessons for the public at large. Besides the research results and related discoveries, the aim is to educate and to bring front-line science to the public. In addition, a series of commercial jewellery depicting Ediacarans has been produced as well as a CD of music in memory of the Ediacarans.



## Theme: The Global Change and Evolution of Life: evidence from the geological record

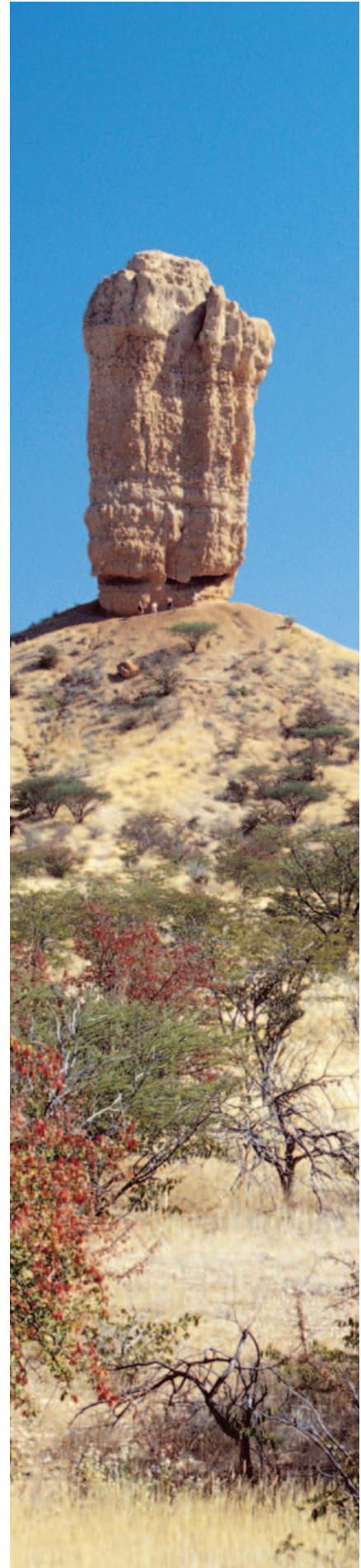
The biosphere is the 'living shell' of planet Earth. It is the unique characteristic of our planet. Life-forms affect the atmosphere, oceans, land surface and even the composition of rocks.

Although life began only a few hundred million years after the Earth was formed, life began to affect the Earth System significantly about 2.7 billion years ago when living organisms began to produce oxygen. Much more recently, the biosphere has been affected by human impact. It is the joint aim of palaeontologists and biologists worldwide to understand, through their research, the multiple factors controlling the processes of the biosphere. This research provides insights into the functioning and stability of past ecosystems in relation to climate change, understanding biodiversity dynamics over long time-scales, and predicting future biosphere vitality.

Changes in climate and life on Earth are preserved in the rock record. Ice and dust records, terrestrial and ocean sediments, and sequences of fossil plant and animal assemblages, are all part of this record. Five major and ten smaller mass extinctions have punctuated the history of life.

These extinctions were the result of dramatic environmental changes brought about by many factors, including plate tectonics, volcanism, sea-level fluctuation, changing biogeochemical cycles, and periodic cataclysmic impacts. Such extinctions also provide important clues as to how to tackle present-day environmental challenges, as well as ways of mitigating and managing environmental damage.

Through this theme, IGCP invites scientists around the world to submit proposals designed to advance understanding of climate change and the evolution of life from geological records.



### What is IUGS?

The International Union of Geological Sciences (IUGS) offers an international platform for co-operation among the approximately half a million practitioners of the fundamental and applied Earth sciences. With about 120 member countries and 40 affiliated bodies, the IUGS is one of the largest scientific NGOs in the world. Since its founding in 1961, IUGS has been a member of the International Council for Science (ICSU).

IUGS exists to unite the global geological community by promoting the geosciences through geoscientific studies relevant to the Earth system, and by applying the results to sustainable use of natural resources, sustaining the ecological environment, mitigating geohazards, improving prosperity, and preserving the quality of human life.

IUGS bodies are concerned with a wide range of geological research of direct interest to governments, industry and academic groups within Earth sciences. Many of IUGS's programmes are conducted in partnership with UNESCO, the oldest and largest of which is IGCP.

### Seismic micro-zoning of Latin American cities (IGCP 487)

The impact of earthquakes on cities is often catastrophic. This is particularly true for the many cities built in coastal zones, and on ancient lake-beds and river plains. Earthquake impact is significantly increased where seismic energy is amplified by thick, unconsolidated sediments that underlie such cities. To improve the protection of citizens we must find out where and when new earthquakes will occur and which parts of a city will be most seriously affected.

This IGCP project is addressing these questions by bringing together knowledge of earthquake hazards collected in Latin America. As an alternative to traditional, costly and time-consuming micro-zoning, the next step consists of 3D modelling of subsurface structures, based on precise geoscientific information and earthquake simulation. Such models predict impact of the earthquakes on the ground conditions and describe the ground motion generated from such simulated quakes. Software for this was developed by an earlier IGCP Project (414). The hardware consists of a powerful computer network located at the International Centre for Theoretical Physics in Trieste, Italy (ICTP). Training on the application of advanced computational techniques, together with seminars and regional meetings, forms an important component of this project.



## Theme: Geohazards: reducing risks

Geohazards can have a drastic effect upon society, as demonstrated by the 2004 Indian Ocean Tsunami and hurricane Katrina (2005). While more developed nations suffer mostly in financial terms, the human impact of geohazards is concentrated in the less developed world. As population increases, more and more people and businesses are exposed to geohazards.

Geoscience cannot *eliminate* geohazards, but it is increasingly able to reduce their impact and to mitigate associated risks. This has resulted in improved forecasting (where geohazards may occur, and how these may impact communities). The next challenge is to add spatial resolution and temporal precision.

Another challenge facing Earth scientists is how best to communicate information on risk reduction to governments and decision-makers. Improved communication with stakeholders will assist in formulating policies on risk management.



### What is the International Year of Planet Earth?

The International Year of Planet Earth is a joint initiative of IUGS and UNESCO to raise awareness of the benefits of the Earth sciences among the public and decision makers – who are urged to apply and translate such knowledge in their day-to-day policymaking. The International Year has been proclaimed by the United Nations General Assembly for 2008, but its activities span the triennium 2007 – 2009.

The International Year of Planet Earth has a science programme and an outreach programme of about equal size. The former focuses on 10 themes, including Groundwater, Hazards, Health, Earth & Life, Resources, Megacities, Soil, Ocean, Deep Earth and Climate. The outreach programme includes exciting and spectacular public events, such as balloon launches, geo-trains and geo-buses, stamps, excursions, public lectures, exhibitions, Geoparks and educational programmes – all suggested by participating individuals and groups locally.

Both programmes operate in this responsive ('bottom-up') mode, while international 'Top Conferences' in all continents address the political dimension by drawing attention to geo-solutions to societal problems.

Implementation of the 'Greatest Geo-Show on Earth' mainly takes place at national levels, National Committees of the International Year being active in many countries of the world.

### GIS Metallogeny of Central Asia (IGCP 473)

Central Asia is one of the world's richest mineral provinces. Despite its enormous potential, production has declined sharply in the past decade. No reliable geodynamic or metallogenic studies or maps based on modern plate-tectonic concepts and international standards exist for the region. State-of-the-art expertise on sustainable mining and investment is urgently needed to exploit these deposits and to boost Central Asian economies. This project aims to develop available expertise in the region and to bridge the current gap between, on the one hand, superseded knowledge and assessments incompatible with international standards, and on the other, modern expertise based on GIS techniques that have been developed for metallogenic mapping in the Ural and Altay mountain ranges.

This project correlates stages of crustal evolution, magmatism and ore formation across national borders, and integrates existing information with new data to link geotectonic units of Central Asia with their mineral inventories. Moreover, the project places metallogenic evolution within the context of crustal growth, and works towards a unified metallogenic-geodynamic model of Central Asia. It builds on an earlier IGCP Project (373) and has won the IGCP Young Scientists Project Award. Training facilities are provided through the EU; national funds provide scientists from more than 30 countries in Central Asia and beyond with opportunities to share expertise and to gain modern knowledge about mineral prospecting and sustainable exploitation.





## Theme: Earth Resources: sustaining society

Nearly everything we make or build, and nearly all the energy we use, comes out of the Earth. Modern society is, and will remain, heavily dependent on minerals and fossil energy sources.

Mineral deposits are diverse in nature and composition, reflecting their origins. Processes that form these deposits range from intrusions from the Earth's mantle, to sedimentary processes at the Earth's surface and even (in the case of some nickel deposits) meteorite impacts. To assess their occurrence and prospectivity, Earth scientists need to understand the processes and interactions that distinguish them from ordinary rock formations.

The Earth is not 'running out' of critical mineral deposits, at least not in the short term. The ability to find and produce those resources is being restricted in many regions by competing land-use, and political/environmental issues. The 'mineral resource problem' is mainly a matter of developing resources in a socially and environmentally responsible manner. Sustainable mining demands that potentially disruptive impacts of the mine life-cycle (exploration, development, site rehabilitation etc.) are taken fully into account. The geosciences can contribute to all these.

The same applies to energy resources, where environmental and social challenges have proved manageable. Natural gas is becoming an increasingly attractive fuel, but petroleum can also be used in a more sustainable way. Underused energy resources such as oil sands, oil shales, coal-bed methane and gas hydrates, often await effective exploitation. Sustainable use of such resources, however, requires research, mainly in geoscience. The IGCP provides opportunities for geoscientific communities all over the world to address these challenges.



### UNESCO Water Science Division and IHP cooperation

UNESCO's Water Sciences Division contributes to the implementation of IGCP projects related to groundwater resources. The Division also contributes actively to UNESCO's midterm strategy which 'gives priority to water and associated ecosystems', to realising UN Millennium Development Goals, and to UNESCO's Decade for Education for Sustainable Development. This is achieved through projects of the International Hydrological Programme (IHP), and by building partnerships with scientific NGOs. The Division is involved in developing measures to reduce the vulnerability of water resource systems and to promote integrated catchment approaches for water management. Like IGCP, IHP is one of UNESCO's five intergovernmental and international scientific cooperative programmes. IHP addresses hydrology and has the global ambition to formulate strategies for the sustainable management of water resources. IHP provides the framework for scientific research into the World's freshwater problems. It builds on partnerships, for example with the International Association of Hydrogeologists (IAH) and the Commission for the Geological Map of the World (CGMW), both of which are also affiliated to IUGS in the development of the Hydrogeological Map of the World.

### Karst aquifers and water resources (IGCP 513)

Large volumes of fresh groundwater are stored in subsurface cavities caused by underground dissolution of soluble rocks (karstification). About 25% of the world's population relies on drinking water supplies from karst aquifers, and karst waters are extremely vulnerable to contamination from land-use (urban, agricultural etc.). Karst water transport is rapid, with the result that the natural filtration provided by other types of aquifer do not occur.

Karst terrains pose a number of threats to the quantity and quality of water supplies. Moreover, difficult access from the surface may seriously hamper the study of karst waters and their underground environment.

This IGCP project aims to improve our understanding through theoretical and applied research, sharing global experience and resources, and finding solutions to karst water resource challenges. Theoretical research is crucial to ameliorating the hardships that karst terrain and hydrology exert. Applied research is also important for understanding water supply problems and related environmental issues.



## Theme: Geoscience of the Water Cycle

The distribution of water on Earth is controlled by the Water Cycle, which links hydrosphere, atmosphere, biosphere and geosphere. Groundwater constitutes the underground portion of the Cycle, and is primarily controlled by geological processes. Groundwater is fundamentally important, for drinking water and irrigation and for its role in ecosystems.

Locally and regionally, fresh groundwater resources are at risk - for example by contamination and saltwater invasion ('salinization'). Geological conditions in the subsurface largely determine whether such risks can be solved naturally or by intervention. As the population grows and global warming gathers pace, proper management of groundwater resources is becoming important for an increasing proportion of the world's population.

Understanding the water cycle involves contributions from geology, geophysics, soil sciences, environmental geosciences, engineering geology, geochemistry, biochemistry, hydrology and atmospheric sciences. There are significant geographical differences in groundwater characteristics and composition in different parts of the world, making the kind of cooperation provided by IGCP absolutely vital.



### **UNESCO and the Decade of Education for Sustainable Development**

One of United Nations' responses to sustainable development was its participation in the Decade of Education for Sustainable Development (DESD), adopted in 2002 by the UN General Assembly for 2005 to 2014. UNESCO was charged with promoting the Decade, which aims to stimulate sustainable skills and behaviour, inspired by creative and critical ways of thinking, to encourage management of problems that may hamper sustainable development.

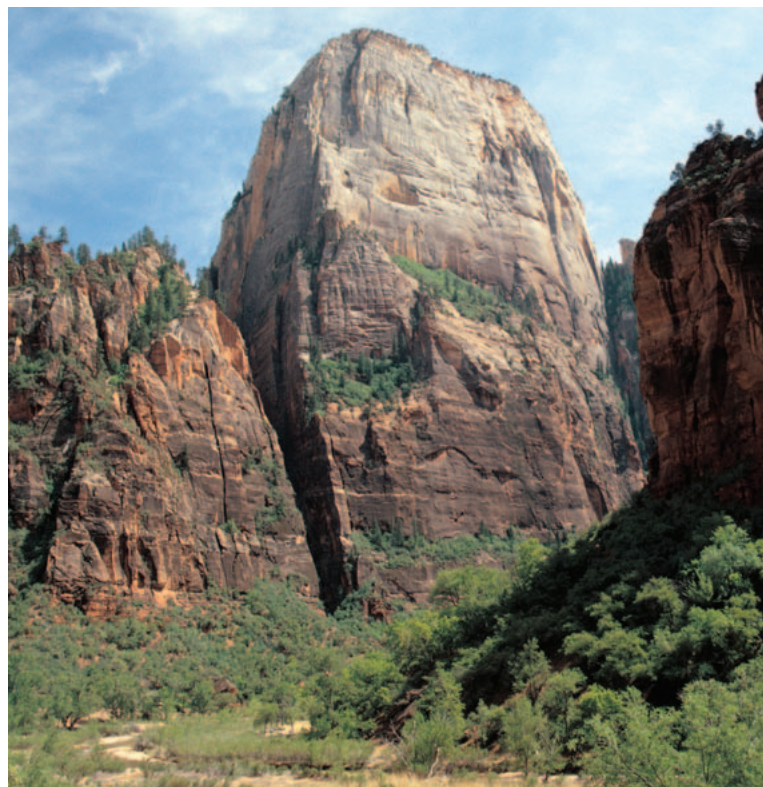
UNESCO's Natural Sciences Sector were among the first intergovernmental bodies to demonstrate concern for sustainable development. Today, sustainable development occurs in all UNESCO's fields of competence – education, science, culture and communication – in particular in the projects through UNESCO's field offices. In this respect, UNESCO has a dual role to play. First, it must integrate education for sustainable development within national policies and educational systems. Beyond that, however, it must aim to make all actors in civil society, including the private sector and the media, aware of the importance of the goals of sustainable development.

One of UNESCO's core activities in Earth science is IGCP, which is an excellent example of how UNESCO and its programmes can contribute to the development of improved concepts and methods bearing upon policy decisions based on the criteria of sustainable development.

### **Images of the Earth's crust (IGCP 474)**

Since the 1960s, the quantity and quality of seismic images of the Earth's crust have improved dramatically. These images provide detailed insight into the geological structures and tectonic processes that shape the Planet. Therefore, they are relevant to natural resources (including groundwater) and natural hazards, such as earthquakes. They also define processes that control the evolution of landscape and soils.

Most current seismic images come from more developed nations. This project aims to convert the results of separate regional deep seismic programmes into a global scientific framework by making seismic images across representative orogenic belts, rifts, and continental margins globally available. In doing so, such images become meaningful for researchers and educators in developing nations who have no easy access to the results of this technology. The results bridge the gap between scientific research and the public interest and provide real insight into the nature of the major geological processes in the uppermost 50 - 70 km of the crust that directly affect human life.

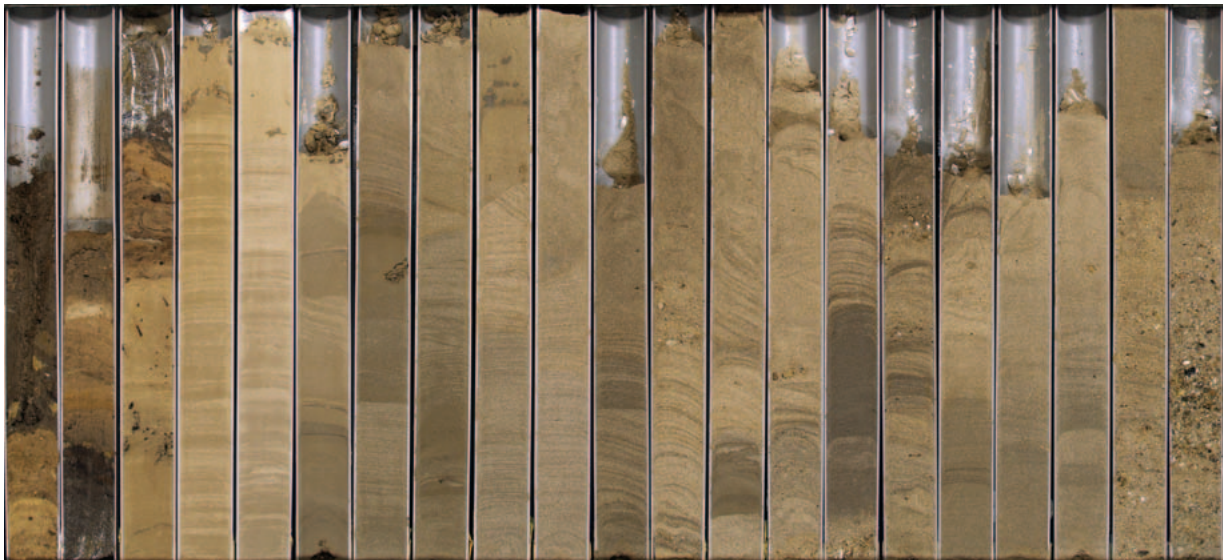


## Theme: The Deep Earth: how it controls our environment

Earth's surface, including our habitable environment, is controlled by processes deep within the planet. During the past few decades our understanding of the deep Earth has rapidly improved. We can now produce scientific models that help us to reconstruct the past and to forecast the future behaviour of geological systems and patterns within the solid Earth. Deep Earth processes also impact upon the shallow subsurface, controlling water supply, natural resources and natural hazards.

Earth scientists use a wide variety of techniques to investigate deep Earth processes. Improved seismic methods have provided a much greater understanding of the 3D structure of the Earth's mantle and, in much more detail, the overlying lithosphere. We can now describe how the deep Earth system works and how rocks deform under pressure from the movements of the Earth's lithospheric plates in space and time. Combined with progressively improving dating techniques, sometimes collected from great depths, geoscientists are now able to determine the rate of progression of tectonic and surface processes.

Scientists can now use satellites to monitor vertical and horizontal movements of the Earth's crust with great accuracy. Despite considerable progress during the past few decades, society continues to demand ever more detailed information on the distribution of natural resources and hazards. Therefore, IGCP invites geoscientists working on deep Earth problems and those concerned with the shallow subsurface to submit collaborative research proposals.



## The Neoproterozoic Pan-African belt of Central Africa: Sedimentation, deformation history, magmatism, metamorphism and geotectonic evolution (IGCP 470)

About half-way through Neoproterozoic time (1000 - 540 million years ago), the landmasses concentrated in a supercontinent called Rodinia began to break up. One of these, the Atlantica block, comprised today's Brazil and Northwest and Central Africa. Towards the end of the Neoproterozoic, continents began to merge again and fragments of Atlantica collided to form the West Gondwana continent.

The Central African region (Cameroon, Chad, Central African Republic, Gabon, Congo, West of Democratic Republic of Congo and NW Angola) is one in which the Neoproterozoic is least understood, despite the vast number of research projects directed toward mineral exploration in the rich Pan-African-Brasiliano belt system. The region is unevenly surveyed; geological research in different countries is fragmented and cross-border correlation of rock units is poor.

This project, which builds on the results of IGCP 440, brings together Earth scientists from the entire region to exchange information and jointly produce regional maps of the whole orogenic belt system in a series of workshops and regional conferences.



## Basic research in the IGCP

Although the IGCP has as its motto **Geoscience in the Service of Society**, and although the project evaluation criteria include societal relevance, the IGCP may also provide support for fundamental science. Sound applied science needs sound fundamental science, and in reality no clear-cut distinction exists between them.

In the course of IGCP's long history, numerous 'pure' science projects have led to greatly improved understanding of the origin and evolution of former and buried mountain belts; such knowledge has been readily applied during successful mineral prospecting programmes. In fact, this holds true for all of IGCP's themes, especially given that projects must be multidisciplinary. Such teams frequently create innovative research that leads to new basic science concepts, subsequently giving rise to novel applied knowledge. This is why it is important that Earth scientists of all specialities should submit proposals for multidisciplinary 'blue skies' research.



### How do I propose a project?

IGCP welcomes project proposals on the following topics:

- topics of particular interest to IGCP (as outlined in this document);
- topics defined annually by UNESCO and IUGS (see websites listed on the inside back cover);
- other relevant topics in fundamental and applied geoscience.

Project proposals may be submitted by individuals or groups.

Project proposals (application forms: [www.unesco.org/science/earth](http://www.unesco.org/science/earth)) should be submitted to the IGCP Secretariat before the deadline (normally before mid-October). These forms should be accompanied by a letter of endorsement from the IGCP or IUGS National Committee representing the project leader's home country. The IGCP Secretariat in Paris is ready to advise project leaders on all aspects of IGCP projects.

Proposals are evaluated according to scientific excellence, feasibility, societal relevance, education and training capacities, interdisciplinary and international cooperation potential, quality of the team and project leader(s), outreach potential (e.g. through publications), and the participation of women, young scientists, and ethnic minorities.

If granted, funding will be provided on a 'seed money' basis, typically between US\$ 5000 and 10,000 per year for a maximum duration of five years. IGCP funds should be used for organizing and managing research, meetings, and workshops related to the project, as well as to facilitate participation by scientists from developing countries. Additional resources are usually needed to ensure that research goals are reached, and scientists are strongly encouraged to raise such funds.

### Web sites for further reading

- UNESCO’s Ecological and Earth science Division:  
[www.unesco.org/science/earth](http://www.unesco.org/science/earth)
- IUGS: [www.iugs.org](http://www.iugs.org)
- UNESCO: [www.unesco.org](http://www.unesco.org)
- UNESCO’s Water Science Division: [www.unesco.org/water](http://www.unesco.org/water)
- International Year of Planet Earth: [www.yearofplanetearth.org](http://www.yearofplanetearth.org)
- Decade on Education for Sustainable Development:  
[www.unesco.org/education/desd](http://www.unesco.org/education/desd)
- International Hydrological Programme (IHP):  
[www.unesco.org/water/ihp](http://www.unesco.org/water/ihp)

Texts: Eduardo de Mulder, Edward Derbyshire  
and Ted Nield

Lay-out: Jos Rietstap

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### International Geoscience Programme (IGCP)

#### IGCP Secretariat

Division of Ecological and Earth Sciences

UNESCO

1, Rue Miollis

75732 Paris Cedex 15

France

T +33 1 45 68 84 17/18

F +33 1 45 68 58 22

E [igcp@unesco.org](mailto:igcp@unesco.org)

[www.unesco.org/science/earth](http://www.unesco.org/science/earth)