New IGCP Projects Accepted and Starting in 2011

successive steps over the five-year duration of the project (2011-2015).

Project No. 594. Impact of Mining on the Environment in Africa

(Sponsored by the Swedish International Development Cooperation Agency)

Countries involved: Algeria, Belgium, Botswana, Croatia, Czech Republic, Denmark, Ethiopia, France, Italy, Mali, Morocco, Mozambique, Namibia, Niger, Poland, Romania, Senegal, South Africa, Togo, Zambia, Zimbabwe

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Duration: 2011-2014

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A large amount of information about the contamination of mining sites in different parts of the world has been gathered by carrying out systematic geochemical sampling and analysis. This has led to an improved understanding of the causes and effects, and has provided an impetus for new environmental legislation and strategies for remediation in many developed countries. In Africa, because of economic pressures and slower evolution of environmental awareness, local communities have been particularly exposed to the detrimental effects of mining contamination on public health, agriculture and the environment. During the last twenty years, environmental experts and organizations from Europe, Australia and North America increasingly co-operated with their counterparts in Africa on a number of projects in different countries. However, these geochemical investigations tended to be focused on the impacts of mining and mineral processing at a national level and in specific mining fields without taking account of the overall impact on larger hydrological and environmental domains across the continent. In environmental matters, trans-boundary cooperation and liaison between the African governments and institutions is limited. Consequently, there is a wide opportunity for sharing the knowledge of monitoring methods and for developing a common approach to the management and interpretation of geochemical data. With such

Project No.591. The Early to Middle Palaeozoic Revolution

Countries involved: Argentina, Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, France, Germany, Iran, Italy, Lithuania, New Zealand, Norway, People's Republic of China, Poland, Portugal, Russia, Saudi Arabia, Spain, Sweden, Turkey, United Kingdom, USA

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The presence of at least eight major perturbations to the global carbon cycle in roughly 40 million years demonstrates that the Late Ordovician to Early Devonian interval was among the climatically least stable episodes of Earth history. Following the Great Ordovician Biodiversification Event (GOBE) and prior to the Devonian Terrestrial Revolution, this interval represents a unique opportunity to study in detail the cause-and-effect relationships of significant global planetary change within a biologically fully populated ocean-atmosphere-biosphere system but prior to the development of a significant global terrestrial biosphere.

The Late Ordovician to Early Devonian interval contains several of the most severe paleoclimate and paleobiological events in Earth history including paleobiodiversity events and perturbations to the global carbon cycle near the base of the Katian, Ordovician-Silurian boundary, Llandovery-Wenlock boundary, middle Homerian, middle Ludfordian, and Silurian-Devonian boundary, among others. This interval of Earth history also contains the acme and amelioration of

the Early Paleozoic Ice Age, which provides an important historical analogue for researchers of modern climate change. Additionally, the Late Ordovician-Early Devonian interval contains the roots of the invasion of life onto land. The Earth did not go quietly into the Middle Paleozoic and the primary research objective of this project is to investigate this dynamic and important interval in the history and evolution of life and our planet.

Late Ordovician to Early Devonian strata are of global economic and environmental significance as source rocks, host rocks, targets, aquifers, and potential sites of sequestration and containment. Much of the North African and Arabian oil is either sourced from or housed in Late Ordovician to Early Devonian strata. Silurian carbonates are the host rocks of globally significant deposits of mineral resources such as gold, zinc, and lead. Two of the largest salt deposits on the planet were deposited during the Silurian Period, and the globally expansive Late Ordovician to Early Devonian carbonate platforms are utilized as a source of limestone for chemical, industrial, and architectural use worldwide. The broad epicontinental platforms common during this interval often act as local or regional aquifers for municipal and agriculture water use, and in some areas, are being targeted as potential sites for CO₂ sequestration and hazardous waste containment studies as well. Improved understanding of the temporal, geospatial, and ultimately causal relationships between these resources and Late Ordovician-Early Devonian global planetary change has direct economic and environmental significance, and additionally, is critical to understanding the Early to Middle Paleozoic Revolution.

Specifically, this project will investigate the biological, chemical and physical evolution of the ocean-atmosphere-biosphere system during this dynamic interval of Earth history by addressing in detail the relationships between climate, sea level, tectonics, biology, oceanography, volcanism, and the stratigraphic record of Early to Middle Paleozoic global planetary change. This project will be conducted in collaboration with the International Subcommissions on Ordovician, Silurian, and Devonian Stratigraphy (SOS, SSS, SDS), and will be accomplished in

approach, natural anomalies can be assessed in relation to those caused by mining and related industrial activity, taking into account the geology, topography, climate, vegetation and hydrology in different regions of Africa. For many of these regions, basic information required to distinguish between natural and anthropogenic sources of metals in waters, soils and vegetation is sparse or completely lacking. Environmental baselines to enable an assessment of the degree of contamination of soils and agricultural crops by heavy metals have not been established in the majority of African countries. Therefore, the proposed project is designed (1) to correlate and integrate the results of multidisciplinary studies performed in contaminated areas using the best contemporary procedures for statistical analysis, management and compilation of geochemical data; (2) to strengthen the capacity of African institutions in environmental geochemistry by cooperation with foreign experts and organizations, (3) to raise public awareness about impacts of mining on the environment and human health, and (4) to facilitate cooperation among geoscientists and medical scientists.

The proposal for a new IGCP Project includes several interdependent and overlapping topics covering a range of environmental-geochemical studies in abandoned and active mining districts of Africa:

- Soil and surface contamination by metals and gaseous emissions in mining and ore processing areas
- Response of plants to heavy metal stress and bioremediation
- Contamination of wetlands, surface and ground waters
- Modelling of dispersion of dust and gaseous emissions from mining operations and smelters
- Geochemical modelling of the pollutant cycle in contaminated areas
- Standardization of procedures for the management and interpretation of geochemical data
- Evaluation of potential links between contamination and health in mining districts
- Training of African experts in environmental monitoring and assessment of the impact of mining on the environment and human health
- Raising of environmental awareness, particularly in small scale and artisanal mining areas

The results of the proposed project should contribute to improve capacity building in environmental monitoring, to assess the

extent of contamination in specific regions, to raise environmental awareness among local population and to improve or amend environmental legislation in African countries. The project results can also be used in land use planning, in establishing priorities in remediation activities, in the selection of the best available remediation technologies and in mitigation of environmental dangers in contaminated regions.

Project No. 596 Climate Change and Biodiversity Patterns in the Mid-Paleozoic

Countries involved: Australia, Austria, Belgium; Bulgaria, Canada; Czech Republic, Germany, Fiji Islands, France, Italy, Iran, Japan, Mongolia, People's Republic of China, Poland, Portugal, Russia, Spain, Tajikistan, Thailand, Turkey, Ukraine, Union of Myanmar, United Kingdom, USA, Vietnam

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The Mid-Paleozoic conforms to a time interval of dynamic long-term climate change, which was accompanied by substantial variations in biodiversity. Within the framework of this project we intend to increase and refine the documentation of biodiversity mainly in tropical realms during Early Devonian-Early Carboniferous times and identify links to climate change. Groups distinctive for different ecosystems, especially indicating terrestrial, neritic and pelagic marine environments, are land plants, phytoplankton, foraminifers, sponges, corals, arthropods, cephalopods, echinoderms, brachiopods, bryozoans, conodonts and fishes. In addition to general diversity patterns of different fossil groups, we will study three distinctive intervals in detail, which should document biodiversity and the intensity of evolutionary-pressure during (1) greenhouse (Givetian), (2) beginning climate change

(Early-Middle Frasnian; e.g. *punctata*-Zone) and (3) icehouse conditions (Late Famennian-Tournaisian).

The rapid rise of land plants during the Middle Devonian was coupled with strongly decreasing atmospheric CO₂ values from 4000 ppm to nearly present day values of about 350 ppm during the latest Devonian (compare Royer, 2006). This dynamic climate shift was followed by a complete reorganisation of ecosystems with tremendous consequences for marine communities at global scales. The interaction between developments on land, such as the formation of top-soil and its influence on the geochemical composition of marine environments are considered as important factor probably responsible for evolutionary trends in biodiversity. Therefore geochemical analysis of carbon, oxygen and strontium isotopes as well as the total organic content and sulfur of sedimentary rocks will be measured to reconstruct prevailing paleoenvironmental conditions. Additionally, geophysical data related to the magnetic susceptibility and the natural gamma radiation of sediments (in cooperation with IGCP 580) will be used as auxiliary methods for high resolution correlation of biostratigraphic well-documented units belonging to different bathymetric sequences within the tropical belt (Laurussia, Siberia, peri-Gondwana and N-Gondwana).

Results of this project should show whether climate change (e.g. interaction of CO₂ and temperature) from greenhouse conditions during the Early-Middle Devonian to icehouse conditions during the Late Devonian-Early Carboniferous represents a major trigger for variations in biodiversity or if a combination of multiple factors is responsible for such changes.

Related to this study, a network of taxonomic workers will be established, which will help to update the systematics of Mid-Paleozoic terrestrial and marine organisms. These datasets will be made available to the public by using existing e-infrastructures such as the *Paleobiology Database*.

The benefit of this project regards scientific as well as social purposes. On the one hand results of the project might help to understand our present day situation and climate change in future by documentation of Mid-Paleozoic climate change and its effect on biodiversity. On the other hand, our novel combination of global Earth system sciences and analytical paleobiology will help to integrate and educate young researchers responsible for the preservation of knowledge in future.

The proposed project makes a strong case for meeting the key criteria of IGCP: With three female project co-leader, many enthusiastic young scientists involved for research and training, and strong involvement of researchers from less developed countries (Russia, Thailand, Mongolia, Vietnam etc.), combined with a strong team of experienced research leaders on topic and region.

Project No: 597. Amalgamation and Breakup Pangaea: the Type Example of the Supercontinent Cycle

Countries involved: Argentina, Australia, Belgium, Brazil, Canada, Chile, Cuba, Czech Republic, France, Germany, India, Ireland, Italy, Japan, Korea, Mexico, Mongolia, Morocco, Namibia, Norway, People's Republic of China, Peru, Poland, Portugal, Romania, Russia, South Africa, Spain, Switzerland, Taiwan (of China), Turkey, United Kingdom, USA

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Duration: 2011-2015

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There is widespread acceptance that between 300 and 200 million years ago, all of the Earth's continental land masses were assembled into a giant supercontinent, Pangaea, surrounded by a superocean, Panthalassa. However, different configurations have been proposed, e.g. Pangaea A and B. The breakup of Pangaea over the last 200 million years resulted in the formation of new oceans (such as the Atlantic, Indian and Southern) between the dispersing continental fragments. For the past 25 years, however, evidence has been amassing that Pangaea was only the latest in a series of supercontinents that assembled and dispersed over the last 2.5 billion years. Although the mechanisms responsible are controversial, many geoscientists agree that repeated cycles of supercontinent amalgamation and dispersal have not just taken place, but have had a profound effect on the evolution of the Earth's crust, atmosphere, climate, and life.

The focus of the proposed research is to understand the mechanisms that led to the formation of the latest supercontinent,

Pangaea, and in so doing provide a template by which the origin of the older supercontinents can be evaluated. Although we know to a first-order where and when Pangaea formed, we do not know the locations and precise timing of assembly of the constituent pieces, and how or why Pangaea formed. The tectonic processes involved resulted in the creation and destruction of oceanic lithosphere, mountains, and by implication the mineral endowments that accompanied them. We will focus on the evolution of two types of Palaeozoic oceans whose contrasting fates were pivotal in the development of Pangaea; (a) interior oceans, such as the Rheic and Iapetus oceans which were located *between* converging continents and were consumed to produce Pangaea, and (b) exterior oceans which *surrounded* the continents during the entire Paleozoic, and became one superocean (Panthalassa) when Pangaea formed. Interior oceanic lithosphere originated between 600 and 500 million years ago and its closure produced a series of orogenic events culminating about 300 million years ago with terminal collision between Laurentia (North America), Baltica (western Europe) and Gondwana (South America-Africa), arguably the principal collisional event in the assembly of Pangaea. The evolution of the exterior ocean is primarily preserved in the 18,000 km long Terra Australis orogen, which was located along the periphery of Pangaea and records sem-continuous subduction between 570 Ma and 230 Ma.

The geology that records the evolution of these ancient oceans was widely dispersed by the breakup of Pangaea, and is now widely distributed. There are major uncertainties in the identification of the ancient margins of these oceans, the mechanisms and timing of initial rifting and opening, and the geodynamics of their closure. Key areas have been identified for field workshops and conferences that shed light on the origin of Pangaea.

By definition, any study of Pangaea is global in scope. Many countries and every continent have pieces of the puzzle and only by bringing geoscientists together from many nations can we obtain a comprehensive understanding of its origin. Our project will bring together scientists from at least thirty countries, from different geological disciplines with expertise in different regions, and from academia, government, and industry, with the goal of understanding the processes that resulted in the amalgamation of Pangaea will provide natural constraints for future geodynamic models of supercontinents.

Project No.598. Environmental Change and Sustainability in Karst Systems

(Sponsored by the Swedish International Development Cooperation Agency)

Countries involved: Albania, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Croatia, Czech Republic, Cuba, Egypt, France, Germany, Greece, Hungary, Indonesia, Iran, Ireland, Italy, Japan, Lebanon, Lithuania, Malaysia, Mexico, Netherlands, New Zealand, People's Republic of China, Philippines, Poland, Puerto Rico, Romania, Russia, Serbia and Montenegro, Slovenia, South Africa, South Korea, Spain, Switzerland, Tasmania, Turkey, Ukraine, United Kingdom, USA, Venezuela, Vietnam

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Karst landscape/aquifer systems cover some 15% of the Earth's land surface and are estimated to supply drinking water to some 25% of the world's population. A critical scientific and development gap concerns the fact that the evolution and dynamics of these systems remain incompletely understood while they present serious challenges to human development with regard to water access and quality, agriculture, and landscape stability, especially in the face of climate change. Four successful karst-related IGCP projects have been undertaken since 1990, and in 2008 the UNESCO Category II 'International Research Centre on Karst' was established. Following these successful projects, which have involved hundreds of scientists from some 40+ countries including many developing countries and leveraged hundreds of thousands of dollars to support research, training, and capacity building, we propose a successor IGCP project 'Environmental Change and Sustainability in Karst Systems.'

Major initiatives proposed for the new Project are tied by the fact that present and

future environmental change will impact, and past environmental change is recorded in, karst systems at a range of time scales from hours to millions of years. Proposed topics of collaboration in research and education within karst systems include, for example 1) research to better understand how to protect key karst watersheds from changes in human land use that can catastrophically contaminate water supplies, guided both by hydrogeologic sophistication and participatory approaches that engage local, impacted communities; 2) studies to clarify processes by and quantify rates at which geologic interactions with carbonate rocks influence carbon cycling and in turn climate change; 3) better understanding methods for sustainable ecological and cultural resource protection within fragile karst systems spread across an awesome range of geologic, climatic and cultural landscapes and faced with a complex range of environmental challenges; and 4) quantification of environmental records that wait to be analyzed and interpreted within water, sediments, speleothems, and cultural records over these same timescales. Communication among scientists across these specialties, but bound by common and overlapping interests and experiences cannot help but richly fertilize ideas and nurture opportunities for the widely diverse group of international scientists engaged in this work that include geologists, geochemists, biologists and ecologists, chemists and geographers.

Specific objectives of the proposed Project include:

- 1 High quality, multi- and interdisciplinary basic and applied scientific research to advance the understanding of how environmental change over a variety of timescales impacts functions of karst systems, where appropriate to inform sound decision making;
- 2 Research into concepts associated with sustainability of karst systems, both with regard to human activities and health, and ecological protection. To support this project has in place a strong program of academic capacity building.
- 3 Careful tracking of leveraging to quantify an example of how IGCP projects have engaged associated efforts that have added enormous financial, technical, and human resources. Enormous financial leveraging is perhaps the greatest single strength of the IGCP programme, but in many cases the specific results are anecdotal. In this project we will ask participants to as accurately as possible quantify and report amounts of non-IGCP funding that was

brought to projects reported under the auspices of the programme.

While many important results have followed the previous four projects, and necessarily some of the interdisciplinary concerns of them shared certain themes in common with the new proposed project, its focus on the impacts of environmental change on karst systems and the enormous number of people who rely on them has become increasingly critical as understanding the rates and impacts of climate change (and the impacts themselves) enter a completely new paradigm, and as pressure on karst water resources from population growth rapidly accelerates.

Project No.599. The Changing Early Earth
(Sponsored by the Swedish International Development Cooperation Agency)

Countries involved: Australia, Belgium, Brazil, Cameroon, Finland, Denmark, India, Japan, Madagascar, New Zealand, Norway, People's Republic of China, Poland, South Africa, Spain, Sweden, Switzerland, Taiwan (of China), Tanzania, United Kingdom, Ukraine USA

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For two billions years after its formation at ca. 4.6 Ga, the early Earth was very different from the Earth we know today. During this period, which includes the Hadean and Archean Eras, the Earth changed drastically. The differentiated continents grew from a more primitive crust and the atmosphere and oceans evolved towards the modern, oxidized compositions. Gold, iron and other ores were deposited in greater volumes than at any other time in Earth's history. The identification and linking of the mechanisms that transformed the restless hotter, reducing early Earth with ambiguous tectonics and simple microbial life to a cooler planet with large, rigid plates and more complex life to a balanced planet

sustaining life is one of the most significant challenges in the Earth Sciences and a key to understanding our future on this planet. The early evolution of the interacting system of continents, oceans, atmosphere and biosphere is stored in the rock records of Archean cratons, the stable parts of continents that formed 3.9-2.5 billion years ago. Fragments of Archean cratons are dispersed in all present continents around the world. Thus the only way to study the early Earth as a whole is by a global interdisciplinary collaboration through joint multidisciplinary activities, electronic networking, and efficient information management. This project aims to create standards for data reporting and to compile geochemical, geochronological and geophysical information on the Archean cratons into a global database. This database will provide a free access archive for present and future researchers to track, correlate and model the changes reflected in the rock records from craton to craton.

A growing group of committed researchers (84 at this initial stage) from different disciplines, institutions and continents but with complimentary expertise will focus on resolving the cause-and-effect relationships of changes in continental growth and Earth's surface environments that provided the prerequisites for life and its early habitats. We will add a global and interdisciplinary perspective to previous research by integrating worldwide real data analyses and numerical geodynamic modeling tools. The currently active research of developing countries (South Africa, Cameroon, Tanzania, Brazil, India, China, and Russia) on the Archean cratons will play a crucial role in this project. Especially, we aim to strengthen cooperation with researchers working on Archean cratons in India, South America, China and Africa (Democratic Republic of Congo, Zimbabwe, Tanzania, Cameroon, Congo, Burkina Faso, and Madagascar).

This project will develop a global database of the Archean rock records from individual cratons for the scientific community, and will produce international papers and books, and a map series on the world's Archean cratons. We will generate a comprehensive multidisciplinary knowledge based on the history of our home planet through popular publications and exhibitions for the general public, produced in collaboration with Natural History museums and educational institutes. This research will benefit society by disseminating knowledge regarding the cause-and-effect relationships of the feedback mechanisms that balanced early Earth

conditions to our modern environments. In the long term, we anticipate that our results will help in predicting future long-time changes to planet Earth for sustainable human living conditions and evaluating the effects of climate change. In the short-term, we expect to promote conservation and sustainable use of the unique and non-renewable mineral resources, oceans and atmosphere by media appearances.

Project No. 600. Metallogenesis of Collisional Orogens

(Sponsored by the Swedish International Development Cooperation Agency)

Countries involved: Australia, Canada, Iran, Japan, Pakistan, People's Republic of China, Spain, USA

Project leaders: Zenqian Hou (China), David Leach (USA), Jeremy Richards (Canada), Richard Goldfarb (USA)

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Earth scientists have recently clearly established that most of the world's metallic ore deposits were formed during interactions between the tectonic plates that make up the Earth's surface. Furthermore, scientific investigations suggest that the different styles of crustal plate interaction lead to different processes of ore formation, and thus economic concentration of different commodities in different regions. Understanding these relationships is important because it allows for the formulation of models of ore genesis that form the basis for exploration and discovery of new mineral resources. Perhaps the best studied connection between plate interaction and ore genesis is where small crustal blocks (terrane), typically volcanic arcs or micro-continents, are welded onto older crustal blocks, such as in western North America or central Asia. This style of plate interaction, called 'accretionary orogenesis' has produced giant deposits of gold, silver, copper, lead, zinc, and cobalt, which are generally well understood. In contrast, the formation and distribution of ore deposits related to continent-continent collisions and associated mountain belts are less understood, although such deposits may

also contain large mineral resources.

Important continental collision zones with significant ore deposits and additional resource potential include the Himalayan-Tibetan and the Qinling-Dabie orogens in China, and the Variscan orogen of western and central Europe. Of these, the Tibetan-Himalayan belt and its continuation into the Alpine-Tethyan orogenic belt of Pakistan and Iran is the youngest and the most extensive continental collision belt on the planet. The belt contains a variety of geologically young, world-class mineral deposits with variable mineralization styles and commodities, formed in what are relatively clear geodynamic settings. It can, therefore, be regarded as the best natural laboratory on Earth for studying collisional orogeny and formation of related ore deposits.

The main objective of this international research proposal is to establish genetic links between the geodynamic processes that form large collisional orogenic belts and the specific controls on the most important ore deposits. To accomplish this objective, we propose carrying out large-scale syntheses of ore deposits in the Tibetan-Himalayan and Alpine-Tethyan orogenic belts, including comparative studies of key mineral deposits. A main focus of the project is to identify the primary ore controls and processes of ore formation in some of the youngest parts of these belts, where tectonic events can be most easily defined.

This project will propose a new conceptual framework for ore formation in continental collision belts and will provide useful tools for the exploration for new mineral resources in geologically similar, but older, collisional belts elsewhere in the world. In order to accomplish the goals of this proposal, the study will bring together world experts from several countries to work together to build a better understanding of ore-forming processes in a large geographical region with a challenging political diversity.

Societal benefits of the proposal include:

- a) The project will involve leading researchers on tectonics and economic geology from at least seven different developed and developing countries. This will contribute to the cross fertilization of social understanding and cultivate cooperation for many years to come.
- b) The exchange of research ideas, methods, and knowledge of scientists from diverse social and political environments will promote and encourage future co-operation and collaboration on Earth systems. These areas of cooperation will

contribute to a better understanding of fundamental Earth systems, such as continental assembly, processes of ore generation, and Earth evolution.

- c) This project will enhance the training of graduate students and young scientists in the cooperating countries.
- d) The results of this study will provide better ore deposit models and increased efficiency in the search for new resources in a world of diminishing natural resources.

Project No. 601. Seismotectonics and Seismic Hazards in Africa

(Sponsored by the Swedish International Development Cooperation Agency)

Countries involved: Algeria, Austria, Belgium, Cameroon, Ethiopia, France, Italy, Morocco, Mozambique, Nigeria, Norway, Portugal, South Africa, USA

Project leaders: Mustapha Meghraoui (France), Vunganai Midzi (South Africa), Atalay Ayele (Ethiopia), Djillali Benouar (Algeria)

Duration: 2011-2014

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The African continent includes seismically active zones with significant late Pleistocene and Holocene tectonics (last 100 ka) that characterize the continental deformation and its permanent background seismicity. The realistic assessment at a regional scale of geological and geophysical hazards requires the building of a databank.

The seismic hazards being among the major threats of the continent, seismotectonic studies and maps are a necessary step for the mitigation of earthquake disasters in Africa. In this project, the preparation of thematic maps in earthquake hazards constitutes an important objective necessary for the social and economic development of Africa.

Project No. 604. Groundwater and Wetlands in Ibero-America

Countries involved: Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Peru, Portugal, Spain, Uruguay

Project leaders: Emilia Bocanegra (Argentina), Gerdon Cardoso (Brazil), Emilio Custodio (Spain), Teresita Betancur (Colombia), Marisol Manzano (Spain)

Duration: 2011-2015

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Wetlands are among the world's most productive ecosystems that not only support important ecological and biophysical processes, but also constitute a key source of goods and services for communities. They also have a natural purification capability that plays a fundamental role in Earth's ecosystems maintaining. However, current and predicted environmental and land use changes are expected to impact the natural dynamics of these ecosystems, particularly in response to the dynamics of their interactions with other elements of the hydrological systems, such as groundwater bodies. Many wetlands depend closely on their interactions with groundwater sources, which include a wide range of interactive processes associated with both water quantity and quality. Both aquifer and wetland degradation processes and/or subsequent recovery actions may produce significant impacts in the dynamics and interactions between these two resources, as well as in the goods and services that they provide. However, an integrated conceptual framework that synthesizes current knowledge from aquifer-wetland systems is lacking. Such conceptual framework should integrate existing and new knowledge around critical aspects such as hydrological, hydrogeological, hydrogeochemical (including environmental isotopes), numerical modeling of flow and mass transport, and socio-economic dynamics of the wetland interface. Additionally, the conceptual framework should be general enough to include wetland-aquifer systems representative of a range of geologic, climatic, hydrologic and biogeochemical conditions, as well as different histories of management and use. Ultimately, this framework will allow effective management and preservation of wetlands and groundwater resources when the different technical, economical and social goals are put together to get optimized benefits, reduce direct, indirect, and environmental

costs, and share responsibilities.

In this project we propose a scientific cooperation program between institutions and researchers that have a recognized experience in the study of wetland-aquifer interfaces a wide range of physical, ecological and social conditions. Each of these experiences, when considered individually, appear to only address specific aspects of the interface, and therefore cannot be used to respond to the grand challenge of understanding and managing these fragile yet important systems. Researchers in this collaboration represent diverse countries in the Ibero-American nations, who have worked and are currently working on the wetland-aquifer interfaces in tropical, subtropical and temperate regions of South America and the Iberian Peninsula. More specifically, our proposed cooperation consists in a cluster of groups, each represented by one of their leaders, who share good experience of collaboration and cooperation, with common backgrounds, yet experienced in a wide set of technical and cultural conditions. Such common history and diversity guarantees the potential success of this group. All participants will contribute their experience from past and ongoing projects, as well as their involvement in other projects and studies in the area, to define generalities and challenges not only in terms of basic scientific research but in how to involve public administrations and stakeholders, and how to communicate the results to the public. Notably, this cooperation will not only produce an integrated conceptual framework for understanding the hydrological dynamics of the wetland-aquifer interphase, but also will broaden the breadth and depth of the projects that the associated researchers have been conducting in their particular systems. At the end of this cooperation, it is expected that the group will produce a body of work that addresses important scientific questions, as well as some other products that include guidelines to stakeholders

Project No.606. Addressing Environmental and Health Impacts of Major and Abandoned Mines in Sub-Saharan Africa

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Countries involved: Belgium, Botswana, Burkina Faso, Cameroon, Central Africa Republic, Chad, Democratic Republic of Congo, France, Ghana, Mali, Namibia, Nigeria, Senegal, Sierra Leone, South Africa, Tanzania, United Kingdom, USA, Zambia, Zimbabwe

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Duration: 2011-2014

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Mining operations contribute more than 20 percent of the economy of sub-Saharan Africa, making mining one of the principal drivers of economic activity in the region. Sub-Saharan Africa also has some of the richest agricultural areas in the continent, making the agricultural industry a vital arm of the region's economy. The two industries of mining and agriculture are not only complementary but inextricably linked, in a way that negative impacts arising from the development of mining, may impinge on the development of agriculture. Indeed, several decades of metal mining has considerably altered the background levels of toxic metal species in the various environmental media, adversely affecting surface and groundwater resources, soil and food crops, with potential negative effects on the food chain and consequently, the health of man and animals. For example, the public health and environmental impacts of abandoned mines have become so critical in South Africa that the Government is facing a liability of about \$4.23 billion to rehabilitate about 6150 abandoned mines distributed in the country. In many other sub-Saharan African countries, the situation is worsened by the lack of a precise inventory of abandoned and derelict mines. Indeed, systematic surveys and impact assessment need to be carried out over the entire region to be able to determine the true extent of the detrimental effects of metal pollutants and their impact on human and animal health, as well as on the environment and its ecosystems. This is a pre-requisite for appropriate legislation development and enforcement.

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