Welcome!

Welcome to the third edition of the AfricaArray newsletter. This past year, AfricaArray reached a significant milestone with the successful completion of its first phase of development (January 2005 - December 2007) and the establishment of a formal administrative structure. To highlight the accomplishments of the past three years, as well as pave the way for future growth, the feature article in this newsletter recaps the major achievements of AfricaArray to date and describes some of the efforts underway as phase two of AfricaArray’s development begins.

Because AfricaArray is primarily an educational initiative to strengthen geoscience training and research programmes in support of Africa’s natural resource sector, we also highlight in this issue the students who are being or else have been supported by AfricaArray. And, as we look forward to expanding AfricaArray into new areas, both geographically and scientifically, we gratefully acknowledge the generous support from our sponsors.

Andy Nyblade and Paul Dirks,
Co-Directors, AfricaArray

In this Issue...

- AfricaArray: Developing a Geosciences Workforce for Africa’s Natural Resource Sector ........................................ 2
- AfricaArray helps to build a geochemical database for the Bushveld Complex ............................................. 5
- Funding opportunities to be posted on the AfricaArray website ................................................................. 5
- Seismic project in the Western Rift, Uganda and Tanzania .................................................................................. 6
- New AfricaArray Staff ................................................................. 7
- Our Sponsors ........................................................................ 7
- AfricaArray Students ............................................................. 8
- Funding obtained for upgrading the AfricaArray seismic network ................................................................. 9
- New permanent AfricaArray stations added during 2007-2008.................................................................. 9
- AfricaArray formalizes a governance structure .............. 10

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Council for Geoscience
AfricaArray: Developing a Geosciences Workforce for Africa’s Natural Resource Sector

AfricaArray is a 20-year initiative to meet the New Partnership for Africa's Development (NEPAD) requirements for continent-wide co-operation in human-resources development and capacity building through research and training networks. The AfricaArray initiative started in January 2005 with the intake of ten B.Sc. honours students, from several African countries, at the University of the Witwatersrand (Wits), Johannesburg. With support from both public and private partners, in just 3 years AfricaArray has become multi-faceted, promoting a range of educational and research activities. AfricaArray has grown quickly because of grassroots efforts from many people within a variety of African, U.S. and European institutions committed to the initiative's educational and research goals, and its underlying philosophy of building support networks across the African continent. Although the long-term vision for AfricaArray is to support training in many geoscience fields, efforts during the initial three years have been focused on geophysics, and seismology in particular, to:

- Maintain and develop existing geophysical training programmes;
- Promote geophysical research;
- Establish a network of geophysical observatories for obtaining data to investigate scientific targets of economic, societal and academic importance.

Central to the AfricaArray initiative is the network of scientific observatories across Africa designed to create an integrated geoscience capacity-building programme. Such a network, linked through common instrumentation, data access, and operation, can grow into a community facility and consequently underpin a broad-based training and research support system through data sharing and collaborative projects.

AfricaArray was established through a partnership of three organizations: the University of the Witwatersrand (Johannesburg, South Africa), the Council for Geoscience (Pretoria, South Africa; formerly known as the South African Geological Survey), and the Pennsylvania State University (University Park, PA, USA). These institutions have made a wide range of teaching, research and data acquisition facilities available to AfricaArray. In order to store and manage the large quantity of data generated by AfricaArray, the Incorporated Research Institutions for Seismology (IRIS) has made available its data management and distribution facilities. The partnership base for AfricaArray now includes 14 universities in Africa, 19 government institutions in Africa, 14 companies, as well as many organizations outside of Africa.

Implementation: Phase 1

AfricaArray is being implemented in four phases. During Phase I, which ran through December 2007, the geophysics programme at Wits was expanded and improved, a geophysics field course was expanded and formalized, a network of permanent seismic observatories was built, and a multi-project research programme was initiated.

**Geophysics at Wits:** Geophysics degrees at Wits are offered at the B.Sc. Honours (a one-year specialized degree following a three-year B.Sc. degree), M.Sc. and Ph.D. levels. At the undergraduate level, students interested in geophysics enroll in the B.Sc. programme and take a concentration of courses in geology, physics and math.

To increase Wits’ training capacity at the M.Sc. and Ph.D. levels, an AfricaArray “sandwich” programme was set up that allows students to spend up to 6 months each year studying and conducting research with a professor at an affiliated university in the U.S. or Europe. The students are co-supervised by faculty at Wits and at the affiliated institution, but degrees are granted by Wits only. Since 2005, 35 B.Sc. Honours, 13 M.Sc., and 10 Ph.D. students, as well as 5 postdocs, have been supported in the programme. The M.Sc. and Ph.D. students have been co-supervised by professors at Penn State, the University of Texas-Austin, the Dublin Institute for Advanced Studies in Ireland, and the International Training Center at Enschede University in the Netherlands.

The geophysics programme at Wits has also been strengthened
through the addition of a research chair in seismology, IT and geophysics technicians, and by the procurement of seismic equipment (48 channel seismograph and 3 broadband seismometers) and computers, all supported by the South African National Research Foundation.

**Geophysics field course:** In 2006 the practical geophysics field course, patterned after the SAGE programme (http://www.sage.lanl.gov/), was expanded by opening participation to students from outside of Wits, including participants from companies. The 42 students who have participated in the field course during 2006-2008 have come from 12 different African countries and the U.S. Six of the African students have been supported by funding from the SEG Foundation. The three-week long course is part of the B.Sc. Honours curriculum at Wits and involves practical application of a variety of geophysical methods (differential GPS, gravity, magnetics, electrical resistivity, and seismic refraction) to image faults, dikes and overburden thickness at mining projects in the Bushveld Complex of northeastern South Africa. Support for the field school including accommodation and gravity meters has been provided by Anglo Platinum, Anglo American, and African Rainbow Minerals.

**Permanent seismic observatories:** The AfricaArray observatory network (Figure 1) consists of 26 broadband seismic stations in 11 countries, and the Council for Geoscience plays the lead role in maintaining the network. Six additional stations will be added to the network by the end of 2008. The various components of a station are illustrated in Figure 2. Some of the seismic stations belong to national networks, and others have been constructed using equipment provided by AfricaArray. Data from a number of stations are downloaded daily, while at other stations the data are retrieved every month or

![Figure 2. (Top) Permanent AfricaArray seismic observatory in Dodoma, Tanzania showing the security fence and metal lid covering a 4m deep vault (top) and (Bottom) inside the vault, looking downward from the top.](image-url)
two. Unrestricted access to the data is permitted 3 years after acquisition, giving AfricaArray students, postdocs and faculty time to use the data for thesis research and sponsored projects.

Research projects: Two research projects are highlighted to illustrate the linkage between the AfricaArray educational programmes and seismic observatory network. Descriptions of other projects can be found on the AfricaArray web site and in other parts of this newsletter.

In the first project, sponsored by INAMET (Meteorological Institute of Angola), BHP Billiton, De Beers, and Rio Tinto, seismic data from earthquakes are being used to image lithospheric structure across Angola, which covers the southwestern section of the Congo Craton. To accomplish this, data from the permanent seismic observatories are being combined with data from temporary seismic stations deployed in Angola, D. R. Congo, Zambia, Botswana and Namibia (Figure 2). Ph.D. and M.Sc. students supported by the project are using the data in a variety of ways to investigate the seismic velocity and attenuation structure of the crust and uppermost mantle beneath the western half of southern Africa, and establish the lithospheric structure of the SW Congo Craton. In addition, geophysicists and technicians at INAMET and Agostinho Neto University are being trained to operate the Angola network, and the seismic data are being used to compile the first ever, modern seismic hazard map for Angola.

In the second project, funded by the U.S. National Science Foundation, seismic data from earthquakes are being used to image crust and mantle structure beneath eastern and southern Africa for improving our understanding of the largest seismic anomaly in Earth’s mantle, the so-called African Superplume. The African Superplume is best imaged in the lower mantle beneath southern Africa and appears to be a thermochemical structure extending upwards from the core mantle boundary well into the mid-mantle and perhaps even into the upper mantle beneath eastern Africa. There is no consensus on the interpretation of the African Superplume, what role it plays in large-scale mantle circulation, whether or not it extends to Earth’s surface beneath southern or eastern Africa, or how it may have influenced surface uplift and the development of Africa’s distinct topography and basin architecture.

To improve images at all depths, but particularly at mid-mantle depths where anomalous lower and upper mantle structure might connect, data from the permanent seismic observatories are being combined with data from a network of temporary seismic stations in Uganda and western Tanzania (Figure 2). Students (B.Sc. Honours, M.Sc. and Ph.D) are involved in field work and modeling the data to improve images of the Superplume.

Implementation: Phases 2-4

The goals for the second development phase (2008-2010) are three fold: 1) to establish a firm management structure for AfricaArray; 2) build regional centers of excellence in geophysics at several African universities, and 3) to expand into other geoscience fields, including the addition of new sensors to the observatory network for obtaining GPS, meteorological and hydrological data.

Progress has already been made towards achieving these goals. AfricaArray has established a partnership with the Geophysics Department at Agostinho Neto University (ANU) in Luanda, Angola, and is training ANU geophysics staff through the Congo Craton project. The development of a geophysics field course at ANU is underway, similar to the one taught at Wits, and research projects are being planned to image details of crustal structure beneath the coastal margin of Angola for evaluating models of extension and rift evolution. In a parallel effort, AfricaArray has established a partnership with the Geophysical Observatory at Addis Ababa University (AAU) in Ethiopia. AfricaArray is supporting the expansion of the seismic network run by AAU, and professors at affiliated universities in the U.S. have begun assisting students enrolled in a newly formed M.Sc. seismology programme at AAU.

The primary goal for phase 3 (2011-2013) is to expand the AfricaArray initiative into West and North Africa. The foundation for this expansion is now being laid. Several academic institutions in West Africa have become AfricaArray partners, and a number of seismic station
operators have expressed an interest in joining the AfricaArray observatory network. By phase 4 (2014), the AfricaArray initiative will be fully implemented, supporting education and research projects throughout Africa in many geoscience fields, all linked through a multi-functional observatory network that serves to strengthen the science community through data exchanges and collaborative projects. The challenge for phase 4 and beyond will be to maintain and support the multi-faceted AfricaArray programme.

AfricaArray and Industry Partners

Industry partners are providing support to AfricaArray in a variety of ways, including both direct and in-kind support. A few illustrative examples include:

- Schlumberger’s Faculty for the Future Programme, which has provided support for two African female postdoctoral scholars to advance their careers through research using AfricaArray data and from mentoring by faculty at Penn State and Wits;
- The Total Professors Association, an organization of retired professional employees from Total, which has provided short courses in 3-D seismics, basin analysis and well logging to geoscientists at Wits and ANU; and,
- Anglo Platinum and its partner African Rainbow Minerals, which have made available to AfricaArray the use of an exploration camp as a base for the geophysics field course and prepared suitable field sites over exploration target zones.

An example of a sponsored project that combines training of African students, research, and use of data from the observatory network is provided by the Congo Craton project described above.

Funding opportunities to be posted on the AfricaArray website

A new page on the AfricaArray website will be created for posting funding opportunities relevant to AfricaArray partners. Anyone wishing to contribute information on funding opportunities should forward them to the AfricaArray staff assistant (Dalena.Blitenthall@wits.ac.za) for posting on the website. Funding opportunities provided directly to the AfricaArray co-Directors from funding agencies also will be posted on the website.

AfricaArray helps to build a geochemical database for the Bushveld Complex

In recent years there has been tremendous advancement in the development and availability of digital data sets for geosciences applications. Research in these areas is led by the developed world, where governments are increasingly pushing towards placing as much data as possible in the public domain to stimulate use for development. The developing world and especially Africa are lagging far behind in data-management technology in spite of the obvious potential for research and development.

AfricaArray promotes the establishment of public data sets in Africa for research and training and has engaged in a new initiative to develop a comprehensive geochemistry data base for the Bushveld Complex, which is economically the most important, and scientifically one of the best researched layered igneous complexes in the world. The initiative was launched by the “Geoinformatics for Geochemistry Programme” at the Lamont-Doherty Earth Observatory (USA), in collaboration with Anglo Platinum, the University of the Witwatersrand and the Council for Geoscience under the auspices of AfricaArray.

The “BushveldDB” is the starting application of the collaboration between the Lamont-Doherty Earth Observatory and AfricaArray. In the future it is hoped that concepts, designs, and expertise of the Geoinformatics for Geochemistry Programme will be applied to build geochemical data management systems for AfricaArray across a range of geological terrains. Training of skilled personnel, including students, will be a central activity of this initiative.
Seismic project in the Western Rift, Uganda and Tanzania

An AfricaArray project supported by the U.S. National Science Foundation is collecting seismic data from Uganda and western Tanzania to image crust and mantle structure beneath the western branch of the East African rift system.

Twenty broadband seismic stations were deployed in August 2007 by personnel from the Geological Survey and Mine Department of Uganda, the University of Dar es Salaam, Tanzania, the Geological Survey of Tanzania, and the Pennsylvania State University. In November, 2008 the stations will be redeployed to southwestern Tanzania for an additional 18 months.

Data from the project are being used in a number of ways by AfricaArray students and postdocs to learn about earth structure and processes beneath the western side of the East African Plateau.

Data from the temporary stations will be combined with data from the permanent AfricaArray network to image details of mid-mantle structure under eastern and central Africa where it has been hypothesized that the anomalous lower mantle structure of the African Superplume connects with anomalous upper mantle structure under East Africa.

Installing a temporary seismic station in Uganda (solar panels, seismometer, and burying the station once all the equipment has been installed).

Location of seismic stations in Uganda and Tanzania.
New AfricaArray Staff

Dalena Blitenthall
In September 2007 the AfricaArray team at Wits was joined by Dalena Blitenthall. She took over from Verity Lloyd after spending 5 years as the Senior Administrative Secretary for the School of Geosciences and assistant to the Head of School, Prof. Paul Dirks. She obtained valuable administrative experience dealing with all the undergraduate and postgraduate students and all related teaching aspects. She is responsible for all the administrative and financial tasks at Wits, as well as all the logistical arrangements of the Annual Africa Array Workshop.

Zibusiso Gumede
Zibusiso Gumede joined the AfricaArray technical team at Wits in April 2008. He will mainly be responsible for the installation and maintenance of AfricaArray seismic stations deployed across the African Continent, as well as providing IT support at Wits for the geophysics programme. He is a former employee of De Beers Group Services with experience in developing geophysical technology for supporting mining operations, and is currently working on his Ph.D. in geophysics at Wits. He has a Higher Diploma in Education (HDE), and B.Sc. (Hons) and M.Sc. degrees in Physics from the University of KwaZulu-Natal.

Our Sponsors
Support from a diverse number of public and private partners is gratefully acknowledged, including:

- Anglo American
- African Rainbow Minerals
- Anglo Gold Ashanti
- Anglo Platinum
- Belgium Technical Cooperation Agency
- BHP Billiton
- BP
- Council for Geoscience (South Africa)
- Council for Scientific and Industrial Research (South Africa)
- De Beers
- Department of Energy (U.S.)
- Department of Minerals and Energy (South Africa)
- Department of Science and Technology (South Africa)
- ExxonMobil
- Geosoft
- Great Northern
- ISS International
- London Bullion Market Association
- Mineral Education Trust Fund (South Africa)
- National Science Foundation (U.S.)
- National Research Foundation (South Africa)
- Pennsylvania State University
- Rio Tinto
- Royal Museum for Central Africa (Belgium)
- Schlumberger
- SEG Foundation
- Sonangol
- Total, and Total Professors Association
- University of the Witwatersrand
- University of Texas

A complete listing of partners can be found on the AfricaArray web site (www.africaarray.psu.edu).
**AfricaArray Students**

**B.Sc. (Honours) students**

**2005**
- Richard Masetue
- Banzi Olorunju
- Stephanie Scheiber
- Uaapi Utjavari
- Ben Young

**2006**
- Zibusisu Gumede
  - Joel Mutatavikwa
  - Kanda Mutombo
- Ivor Kahimise
  - Martin Negonga
- Thabang Kgarume
  - Ntope Sedibeng
- Bathandwa Mabedla
  - Michelo Shalwindi
- Thuto Mkgato
- John-Paul Mubita
  - Isaiah Tumwikirize
- Issac Mulamba

**2007**
- Vuyokazi Bangani
  - Kenneth Mathibela
- Ralf Hansen
  - Rodney Segage
- Lebogang Ledwaba
  - Pieter-Ewald Share

**2008**
- Wonderboy Gubela
  - Brian Zulu
- Musa Manzi
  - George Uwha
- Takalani Ndanduleni

**M.Sc. students**

**Mayshree Bejaichund**, Wits
*Sponsor*: National Research Foundation and Council for Geoscience  
*Country*: South Africa  
*Thesis*: Assessing the potential for earthquake generated ground motion  
*Thesis Advisor*: Arthur Cichowicz, Ray Durrheim

**Stephan Coomber**, Wits
*Sponsor*: Anglo Platinum, National Research Foundation, Wits, and SEG Foundation  
*Country*: South Africa  
*Thesis*: Gravity modeling in the western Bushveld Complex, South Africa, using integrated geophysical data  
*Thesis Advisor*: Sue Webb

**Michelle Grobbelaar**, Wits
*Sponsor*: National Research Foundation and Council for Geoscience  
*Country*: South Africa  
*Thesis*: Blast measurements and Interpretation  
*Thesis Advisor*: Arthur Cichowicz, Ray Durrheim

**Marinda Havenga**, Wits
*Sponsor*: Council for Geoscience  
*Country*: South Africa  
*Thesis*: Geophysical interpretation over an area between the Venetia Diamond mine and the Limpopo river, South Africa  
*Thesis advisor*: Sue Webb

**Thabang Kgarume**, Wits
*Sponsor*: Council for Scientific and Industrial Research and National Research Foundation  
*Country*: South Africa  
*Thesis*: Hazard posed by aftershocks of mine tremors  
*Advisor*: Steve Spottiswoode (CSIR), Ray Durrheim

**Letticia Loots**, Wits
*Sponsor*: Council for Geoscience and Inkaba Ye Afrika  
*Country*: South Africa  
*Thesis*: Processing and interpretation of a reflection seismic profile across the Cape Fold Belt  
*Thesis advisor*: Michael Weber (GFZ, Germany), Ray Durrheim

**Lesiba Ledwaba**, Wits
*Sponsor*: Impala Platinum  
*Country*: South Africa  
*Thesis*: Seismic damage mechanism at Impala Platinum Mines  
*Thesis advisor*: Steve Spottiswoode (CSIR), Ray Durrheim

**Richard Munyai**, Wits
*Sponsor*: National Research Foundation  
*Country*: South Africa  
*Thesis*: Structural controls and 3-D geometry of gold mineralization at Consort Gold Mine and along the northern margin of the Archaean Barberton Greenstone Belt, Barberton  
*Thesis Advisor*: Paul Dirks

**Azangi Mangongolo**, Wits
*Sponsor*: AA Congo Craton Project; BHP Billiton, De Beers, Rio Tinto  
*Country*: D.R. Congo  
*Thesis*: 3-D surface wave tomography of the SW block of the Congo Craton  
*Thesis Advisor*: Andy Nyblade and Ray Durrheim

**Stewart Rouse**, Penn State
*Sponsor*: National Science Foundation and Penn State  
*Country*: U.S.  
*Thesis*: Sn and Pn velocity structure of the Ethiopian upper mantle  
*Thesis advisor*: Andy Nyblade

**Stephanie Scheiber**, Wits
*Sponsor*: National Research Foundation, SEG, and Wits  
*Country*: South Africa  
*Thesis*: Geodetic investigation of Torfajokull Volcano, Iceland  
*Thesis advisors*: Peter LaFemina, Sue Webb, Paul Dirks

**Pieter-Ewald Share**, Wits
*Sponsor*: National Research Foundation and CSIR
Funding obtained for upgrading the AfricaArray seismic network

Funding has recently been obtained from the U.S. National Science Foundation, the Pennsylvania State University and the University of Texas, Austin for upgrading seismic sensors and data loggers used in AfricaArray seismic stations across Africa. The funding will be made available over a four year period, starting July 2008, to replace data loggers as they wear out and fail and to upgrade a number of band-limited sensors. Funding has also been obtained to expand the network into West Africa with a number of new stations.

New permanent AfricaArray stations added during 2007-2008

Several new seismic stations have been added to the network during 2007-2008. These include stations at the University of Lubumbashi, D. R. Congo, the Geological Survey and Mines Department, Entebbe, Uganda, and the Tanzania Geological Survey, Dodoma, Tanzania. Permanent stations scheduled for installation later in 2008 include one in Rwanda, two in Ghana, and three in Ethiopia.
As AfricaArray begins its second phase of development, the successes attained during the first phase of development have led to the need for a formalized governance structure. Since the inception of AfricaArray, the governance of the initiative has been fairly informal, with Andy Nyblade and Paul Dirks acting as co-Directors, but with no formal legal backing to the initiative. With the expansion of the seismic network and the acquisition of financial assets (equipment and data, in particular) through sponsored projects, it has become necessary to create an administrative structure that is recognized legally by the founding partners (The University of the Witwatersrand, the Council for Geoscience, and the Pennsylvania State University).

After lengthy discussions at our AfricaArray meetings in 2006 and 2007, and between the AfricaArray partners, and review of several administrative models, a decision was reached by the founding partners to put in place a formal governance structure for AfricaArray that consists of four parts; 1) AfricaArray centers at each founding partner, administered under the rules and regulations of the individual partner institution, 2) Center directors, who run the Centers and who form an executive committee that manages all aspects of AfricaArray, 3) a single advisory board overseeing all centres, consisting initially of 11 members, and 4) a Memorandum of Agreement, which provides the legal basis for the governance structure. The MoA was signed by the founding partners on February 22, 2008.

The governance structure is flexible in that it allows for new partners to join AfricaArray at the same organizational level as the founding partners, if a new partner provides support to AfricaArray at a level comparable to the founding partners, and agrees to the goals and aims of AfricaArray. In the advisory board, each founding partner is represented by 2 members. Regional partners will be represented by three board members, and industry partners by two board members. If new partners join AfricaArray at the same level as the founding partners, and an AfricaArray Center is established within the new partner institution, then the advisory board will be expanded to include two new board members.

**About this Newsletter**

The purpose of this newsletter is to provide a forum for AfricaArray partners to communicate noteworthy achievements, progress on educational and research activities, and other news that is of broad interest to the community. Andy Nyblade and Paul Dirks serve as editors for the newsletter, and articles for inclusion in future issues of the newsletter should be directed to them. General inquiries about AfricaArray can be directed to admin.africaarray@wits.ac.za.