



AFRICAARRAY NEWSLETTER

Volume 8

Welcome!

Welcome to the second edition of the AfricaArray newsletter. AfricaArray has continued to grow in many ways this past year as support for the initiative has expanded, both from the public (government) and private (industry) sectors. The number of AfricaArray M.Sc. and Ph.D. students now stands at twelve, and another three students will start in the programme in September. A new AfricaArray research chair in seismology at Wits has been appointed, and several new research projects have been launched. The number of broadband seismic stations in the permanent "backbone" network has topped twenty, and by the end of 2007 the network should contain close to thirty stations. In addition, development of three project-specific networks is under way to provide new data sets for imaging the lithospheric structure of the Congo Craton and the Western Branch of the East African rift system, and for advancing our understanding of mining-related seismicity.

In this issue of the newsletter, we share a number of AfricaArray's achievements over the past year, provide an update on the development of the AfricaArray seismic network, and acknowledge the generous support that we have received from our sponsors.

Andy Nyblade and Paul Dirks,
Co-Directors, AfricaArray

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.

An AfricaArray listserv has also been set up to communicate time-sensitive announcements to the community. If you have not already done so, you can join the listserv by going to <http://www.africaarray.psu.edu/listserv.htm>. Messages can be posted on the listserv by sending them to Verity Lloyd, AfricaArray Administrative Assistant at lloydv@geosciences.wits.ac.za.

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PENNSTATE



Council for Geoscience



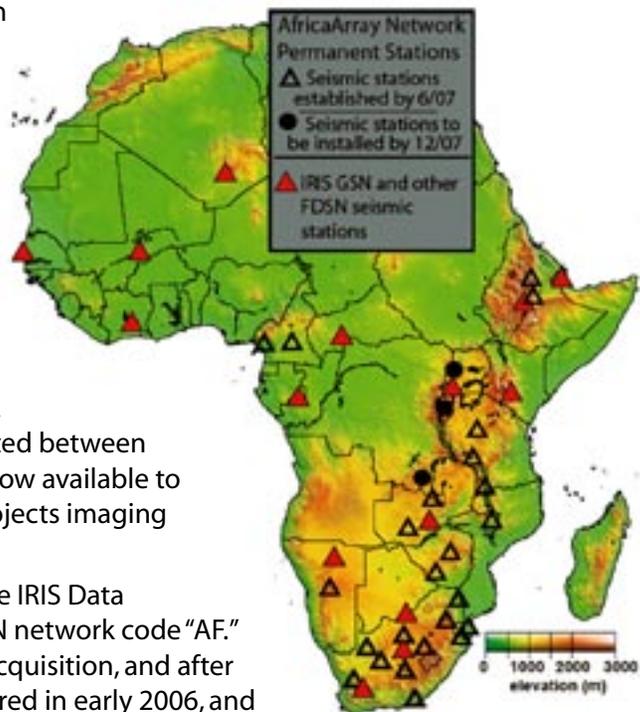
AfricaArray Permanent "Backbone" Network

There has been tremendous progress made over the past year in developing the network of permanent broadband seismic stations, or "backbone" network. There are now twenty-three stations established in eight countries, and another three stations are under construction and should be operational by the end of 2007 (see station map to the right). The stations now span much of eastern and southern Africa.

There has been generous support from many organizations that has made this rapid development possible, including access to existing vaults and equipment, support for installing and maintaining equipment, and assistance with archiving data. Over the past twelve months, the data recovery rate has fluctuated between seventy and eighty percent, and enough high-quality data are now available to permit AfricaArray students to make substantial progress on projects imaging crustal and mantle structure at a variety of scales.

Data from the network are being archived and distributed by the IRIS Data Management Center (www.iris.washington.edu) under the FDSN network code "AF." Data are restricted to AfricaArray partners for three years after acquisition, and after that the data become openly available. The first data were acquired in early 2006, and therefore the first open release will be in early 2009. In-country network operators can release data from their stations to anyone during the three year holding period, if they want to.

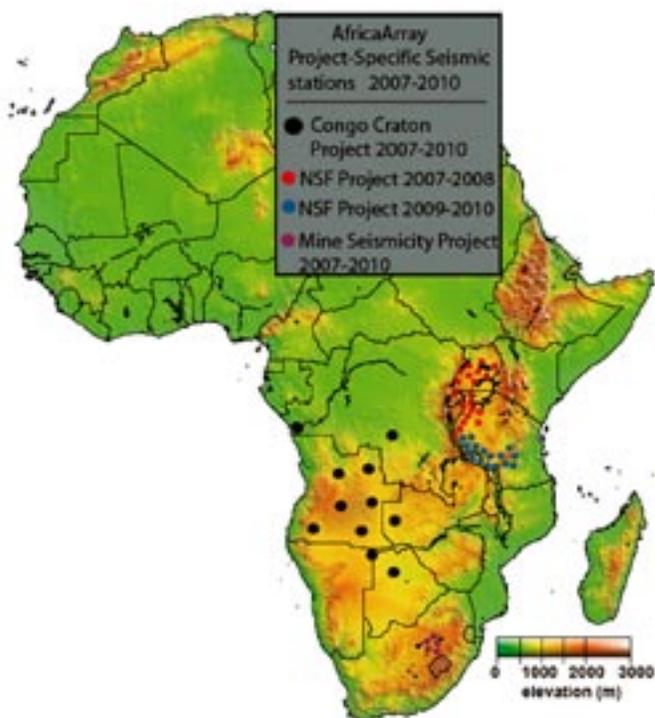
AfricaArray data archived at IRIS can be viewed at: <http://www.iris.edu/mda/AF>. Authorized users (i.e., in-country network operators and those working on AfricaArray projects) who need access to the archived data should contact Prof. Andy Nyblade by email at andy@geosc.psu.edu.



AfricaArray Project-Specific Networks

In addition to the backbone network, three project specific networks have been established. We hope that two of these networks, one in Angola and one in South Africa, will become part of the backbone network after the projects are completed. The map to the right shows the location of the three project-specific networks. Details of the Angola and Mine networks are provided in separate articles in this newsletter.

The network in Uganda and Tanzania is funded by the U.S. National Science Foundation and will consist of two phases. During the first eighteen months of the project, starting in August 2007, twenty broadband stations will be deployed in Uganda and northwestern Tanzania (red dots on map). In January 2009, the stations will be redeployed in southwestern Tanzania, and will remain there until August 2010. The data recorded by the network will fill a critical gap in data coverage along the Western Branch of the East African rift system and the western side of the Tanzania Craton.



Durrheim Appointed New Research Chair



In December 2006, the Minister of Science and Technology, Mosibudi Mangena, announced that Prof. Ray Durrheim had been selected one of nineteen first-round recipients of a Research Chair under the new and highly prestigious “South African Research Chair’s” programme, which seeks to promote research at South African Universities and research Institutes by putting in place 210 new Chairs by 2010. Ray Durrheim’s new title is “Research Chair in Exploration, Earthquake and Mining Seismology”, and he will split his time between the Department of Geophysics in the School of Geosciences at the University of the Witwatersrand to provide leadership to the “AfricaArray” programme and the Council for Scientific and Industrial Research to provide leadership to the “Minimizing the Rock burst risk” programme. Prof. Durrheim began this new appointment on April 1, 2007. Below is a brief biography and vision statement.

Biography

Dr. Ray Durrheim is a graduate of Stellenbosch University, University of Pretoria and Wits, and is married with a two teenage children. Ray started his career as an exploration geophysicist with Gencor. He was involved in gold, coal and base metal projects, gaining field and interpretation experience in ground and airborne magnetics, gravity, resistivity, CSAMT, IP, ground and airborne EM. Ray was appointed a lecturer in the Geophysics Department at Wits in 1983, where his research activities included investigations of the crust and upper mantle using both explosive and mine tremor energy sources, and the application of the reflection seismic method to gold and platinum exploration.

Ray joined CSIR in 1993, where he is a Fellow in the CSIR Natural Resources and the Environment Unit. While at CSIR he has conducted mine seismology research, managed the DeepMine and FutureMine Collaborative Research Programs, was seconded to the Mining and Mineral Sciences Laboratories of Natural Resources Canada in Ottawa during 2003, and is now the leader of the project Minimising the Rockburst Risk, sponsored by the Mine Health and Safety Council.

Ray is a registered Professional Natural Scientist; a member of

the South African Geophysical Association (SAGA), Society of Exploration Geophysicists (SEG), the American Geophysical Union (AGU), the South African National Institute of Rock Engineering (SANIRE); and a Fellow of the South African Institute of Mining and Metallurgy (SAIMM). The honours he has received include the Salomon Prize (1998) for the best rock engineering paper authored by a member of SANIRE, the CSIR Outstanding Achiever Award (1999), and the SAIMM Silver Medal (2003) for the paper (co-authored by Fernando Vieira) entitled Probabilistic mine design methods to reduce rockburst risk.

Vision statement

The Chair in Exploration, Earthquake and Mining Seismology will strive to establish a world-class academic and research programme in seismology in South Africa. The academic program will produce graduates with a sound knowledge of seismology, which they will be able to apply to mineral and hydrocarbon exploration, seismic hazard assessment, and the mitigation of earthquake and rockburst risks. The research programme will have two major thrusts:

1. AfricaArray, a 20-year pan-African research and capacity building programme in geophysics launched in July 2004. Core partners are Wits, the Council for

Geoscience, and the Pennsylvania State University with participating institutions from across Africa, Europe and the USA. AfricaArray science is aimed at determining the lithospheric structure of the African Plate, and the chemical and dynamic causes of the African Superplume, the largest anomaly in the Earth’s mantle.

2. Minimizing the Rockburst Risk, a 5-year programme that commenced in April 2005, and is sponsored by the Mine Health & Safety Council. Core partners are CSIR, ISS International Ltd, and the Council for Geoscience. The programme encompasses both fundamental research on seismic source mechanisms, dynamics of fault zones and rock burst damage mechanisms, and applied research on methods to estimate seismic hazard and to integrate seismic observations and numerical modelling. The deep mines in South Africa are the only place in the world where ruptures related to earthquakes and seismic events can be viewed and studied in situ.

There are currently thirteen M.Sc. and Ph.D. candidates involved in seismological research at Wits.

The Chair will seek to develop partnerships with the exploration and production companies in the hydrocarbon and mineral

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Angola Craton Project

In the second half of 2007 AfricaArray will start a new project centred on the Angola Craton. The project is aimed at providing improved tomographic models of the P and S velocity structure of the crust and upper mantle beneath the southern Democratic Republic of Congo (DRC), the eastern half of Angola and neighboring parts of Zambia, Botswana and Namibia in an attempt to better define the edges of the cratonic lithosphere, as well as the extent of thick lithospheric root zones beneath the craton.

This project is a collaborative effort between AfricaArray, Agostinho Neto University (ANU) and the National Meteorological Institute of Angola (INAMET) in Luanda, and will involve participation from AfricaArray partners in Namibia (the Namibia Geological Survey), Zambia (The Zambia Geological Survey) and Botswana (The University of Botswana and Botswana Geological Survey). Because the project has possible implications for better delineating the diamond exploration potential of the Angola Craton, sponsorship for the project has been provided by DeBeers, RioTinto and BHP Billiton.

Currently few permanent seismic stations exist in Angola. After a



Jose Maria at INAMET office.



New seismic station in Porto Quipiri north of Luanda (August 2006)

series of earthquakes in 2002-04 the Angolan government decided to build a network of monitoring stations, placing eight broadband sensors purchased from Nanometrics across the country, which will stream data via satellite uplink to create a high quality facility directed by INAMET. Currently four stations have been built, and the remaining stations are expected to be put in place in the second half of 2007.

INAMET was willing to partner with AfricaArray by offering the data in return for training in seismology to staff at ANU and INAMET. AfricaArray has used this opportunity to leverage funding from mining houses to establish additional stations in western Zambia, northern Namibia, northern Botswana and SW Congo, to create a broadband seismic network that is sufficiently dense to allow us to model the craton down to a horizontal resolution of 250-300 km. With support for infrastructure, money has also been provided for M.Sc. and Ph.D. bursaries so that

people can be trained to use and research the data.

The Angola project will provide impetus to establish an AfricaArray centre at ANU in Luanda, which will be headed by Jose-Maria Wanassi, who will also be conducting an MSc as part of the project.



Durrheim
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sectors (BHP Billiton, De Beers, Rio Tinto, Schlumberger and Total are already actively involved in the AfricaArray programme), as well as science councils (CSIR, Council for Geoscience) and universities (e.g. University of Cape Town, Penn State University) in South Africa, Africa and beyond.

Mine Seismic Network Project

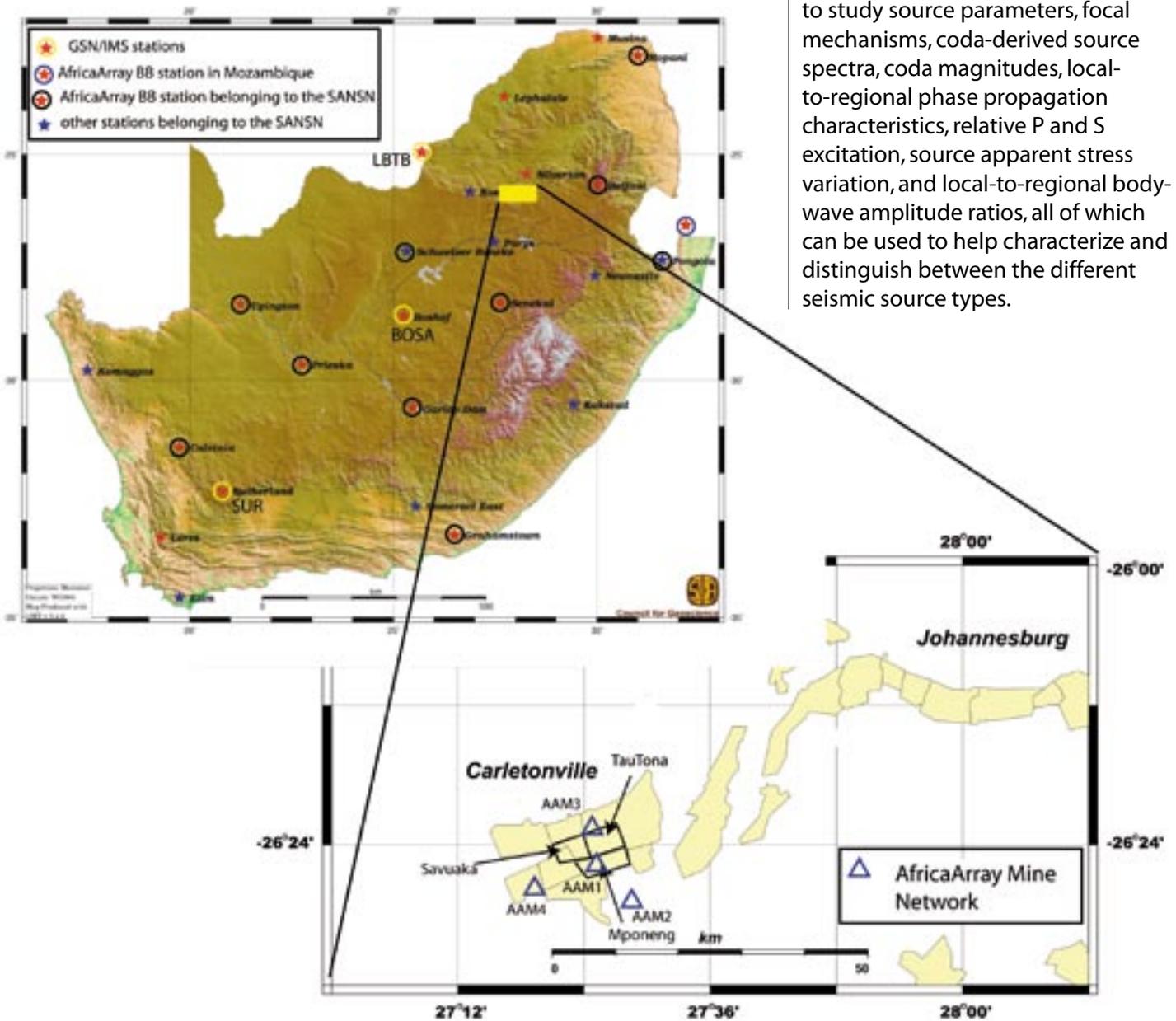
In this project, we are developing and exploiting a unique seismic data set to address the characteristics of small seismic events and the associated seismic signals observed at local (<200 km) and regional (<2000 km) distances. The dataset is being developed using events from three deep gold mines in South Africa recorded on in-mine networks (<1 km) comprised of hundreds of high-frequency sensors, a network of broadband seismic stations installed as part of this project at the surface around the mines, and the network of existing AfricaArray broadband

seismic stations at local/regional distances (50-1000 km) from the mines (see Map below). The final data set will contain: (1) events spanning 5 orders of magnitude (M from \sim -1 to 3) well recorded at a wide range of local and regional distances, (2) events from a range of source depths (0-4 km), and (3) events from a variety of source types correlated with in-mine information such as pillar collapse and shear failure.

The project is sponsored by the U.S. Department of Energy. Project partners include the Council for Scientific and Industrial Research,

the Council for Geoscience, the University of the Witwatersrand, the Pennsylvania State University, Lawrence Livermore National Laboratory, ISS International, and Anglo Gold Ashanti. Over the past six months, a network of four surface mine stations has been installed around the Mponeng, Savuaka and Tau Tona mines near Carletonville by the CGS (see Map below). The in-mine data set is being assembled by Linday Linzer (CSIR) with help from ISS International, and AfricaArray post-graduate student Ayodeji Ali.

Seismic event data are being used to study source parameters, focal mechanisms, coda-derived source spectra, coda magnitudes, local-to-regional phase propagation characteristics, relative P and S excitation, source apparent stress variation, and local-to-regional body-wave amplitude ratios, all of which can be used to help characterize and distinguish between the different seismic source types.



2007 AfricaArray Field School

The 2007 AfricaArray field school, organized by Sue Webb and Verity Lloyd at Wits University as part of the Geophysics Honours training programme, was once again hosted by Modikwa Platinum Mine, a joint venture between Anglo Platinum and African Rainbow Minerals, located near Steelpoort in South Africa. This year, students and staff investigated a region where mining for platinum will commence in about two years time. The area hosts several dykes and faults that cause loss of ground in mining operations, and the task of the field school was to locate and characterize these features. We are excited to have a "real world" task and environment in which to train our students.

This year we were able to expand our participant profile through generous support from our sponsors. Anglo Platinum and African Rainbow Minerals prepared and made available the research site, and Anglo American continued to support the field school by providing equipment (the CG3 gravimeter) and accommodation at the Driekop

exploration offices.

Penn State University supported the field school by sending Dr. Audrey Huerta, a research associate, returning for a second year to assist with the refraction seismic component. She was joined by two students and math professor Guoqing Tang from North Carolina Agricultural and Technical State University and one student from Fort Valley State University. The students were selected to participate in the field school as part of the Partnerships for International Research and Education (PIRE), a National Science Foundation (NSF) grant to Prof. Andy Nyblade.

The Dublin Institute of Advanced Study (DIAS) sent Marion Miensopust, who hails from Germany, to instruct the resistivity method. Marion is currently working on her Ph.D. in magnetotellurics at DIAS with Prof. Alan Jones, who has been a long term supporter of AfricaArray.

We would also like to acknowledge the newest supporter of the field school: the Society of Exploration Geophysicists (SEG). Through the SEG Foundation, we received \$10,000 to support African participants in the field school. The selected participants were: Jose Marie Wanasi (Angola), Annie Mulowezi (Zambia) and Binyam Beyene (Ethiopia), all

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Field School continued from page 6

of whom are actively involved with other AfricaArray activities.

We were very excited that Prof. Ray Durrheim was able to join us in the field this year, to help with the seismic refraction method. The rest of the Wits team included: Susan Webb, coordinator; Dr. Mike Jones, Stephanie Scheiber, Stephen Coomber, and Bathandwa Mabedla, and of course this years honours class: Pieter-Ewald Share, Lebogang Ledwaba, Ralf Hansen, Vuyokazi (Vovo) Bangani, Kenneth Mathibela and Rodney Segage. Without the support of staff and students we couldn't run the field school.

The Council for Geoscience, a founding partner of AfricaArray, supported the field school by sending one of their recently appointed staff members, Letticia Loots, and finally we welcomed our first company sponsored participant from BHP-Billiton. Medard Kubanza, who hails from the DRC, but has spent a number of years in Japan, joined us to learn more about applying geophysics to mineral exploration.

During this year's field school we used for the first time our brand-new Geometrics 48-channel Geode seismograph, which was obtained from a special NRF grant in support of AfricaArray activities to Prof. Paul Dirks (see inset box to the right)

All in all, we had an exciting and truly international field school with participants originating from over nine different countries (South Africa, Togo, Ethiopia, Zambia, Angola, DRC, Germany, China and the USA)!

New Geometrics Geode Seismograph

In May 2007, through sponsorship from the NRF (National Research Foundation) in South Africa, the Geophysics Department at Wits University has acquired a 48-channel seismic system consisting of two Geode ultra-light exploration seismographs controlled by a Dell ATG D620 laptop computer. It is an extremely versatile system that can be used for refraction, reflection, VSP and tomography surveys, as well as earthquake, blast and vibration monitoring. It has a 24-bit dynamic range, and a 20kHz sampling bandwidth suitable for either high-resolution reflection seismic surveys or earthquake monitoring. The system will be used for teaching and research. Its first outing was on the AfricaArray Field School, held at Modikwa Mine in Mpumalanga in July 2007.



48-channel Geode seismograph being delivered by Terry Odgers (right) from Red Dog Scientific Services to Ray Durrheim (left).

We thank the following sponsors for their support:

Government agencies and other organizations:

Belgium Technical Cooperation (Belgium)
Council for Scientific and Industrial Research (South Africa)
Department of Energy (USA)
Department of Science and Technology (South Africa)
Incorporated Research Institutions for Seismology (USA)
National Research Foundation (South Africa)
National Science Foundation (USA)
Royal Museum for Central Africa (Belgium)
Society of Exploration Geophysicists

Companies:

Anglo American	Great Northern
African Rainbow Minerals	ISS International
Anglo Gold Ashanti	London Bullion Market Association
Anglo Platinum	Mineral Education Trust Fund (South Africa)
BHP Billiton	Rio Tinto
BP	Schlumberger
De Beers	TOTAL
ExxonMobil	

We also thank many other government and academic institutions in Africa, Europe, and the United States that are actively participating in and contributing to AfricaArray. See <http://africaarray.psu.edu/participants/participants.htm> for the full list of participants.

Current AfricaArray M.Sc. and Ph.D. Students



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Gabriel Daudi Mulibo
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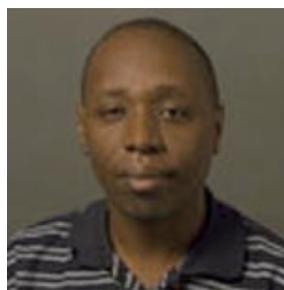
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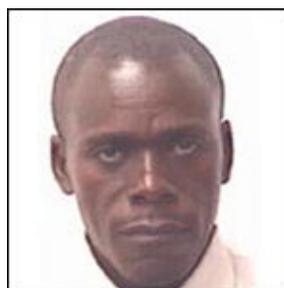
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Country: Democratic Republic of Congo