AfricaArray: developing the continent's natural resources

Africa lacks the skilled manpower to meet the needs of the continent's energy industry. A new initiative aims to improve geophysics-training capabilities across Africa. By Paul Dirks, head, School of Geosciences, University of the Witwatersrand

GEOSCIENTISTS from across Africa are supporting a pan-African initiative, AfricaArray, designed to strengthen geophysics education and research and build a training and research (T&R) support system. T&R programmes at African universities will benefit from the establishment of multi-functional, geophysical observational networks that can be used in support of earthquake monitoring; natural hazard mitigation; and oil, gas and mineral exploration.

AfricaArray is a 20-year initiative developed to meet New Partnership for Africa's Development requirements for continent-wide co-operation in human-resources development and capacity building. The programme started in January 2005 with the intake of 10 honours students, from several African countries, at the University of the Witwatersrand (Wits), Johannesburg.

The project's name refers to an array of shared training programmes and scientific observatories, and scientists across the continent working on various shared projects and, above all, a vision that Africa will retain capacity in a range of scientific fields vital to the development of its natural resources.

Vision

Hydrocarbons, minerals and water are a major driving force for economic development. Africa is a primary source of strategic and base metals for world markets – hydrocarbons production from sub-Saharan Africa alone may provide 25% of US oil imports by 2015. Water resources are needed for supporting sustainable livelihoods throughout the continent – and in some countries, geothermal reservoirs provide an important energy source. In addition, natural disasters linked to earthquakes, volcanoes and tsunamis form a threat to large parts of the continent.

AfricaArray has been designed to address these demands, by creating a pool of highly trained African geophysical professionals to be employed in industry, government and universities, managing and developing the continent's natural resources.

The programme was established through a partnership of three founding organisations: Wits, the Council for Geoscience (CGS), in Pretoria, and the US' Pennsylvania State University. These institutions have made a range of teaching, research and data-acquisition facilities available. To store and manage the huge quantity of data generated, the programme has secured the support of the US' Incorporated Research Institutions for Seismology, which has made available its data-storage and -distribution facilities. Collectively, these organisations have pledged R13.2m of in-kind support for AfricaArray over the next three years and have committed their support beyond 2007.

In addition, a large number of public- and private-sector organisations, in Africa and internationally, have pledged their support for the programme, with in-kind contributions amounting to R3.26m and a further $0.5m pledged by the National Science Foundation in the US in support of research.

Implementation

AfricaArray will be implemented in four phases over a period of 20 years. During Phase 1, which started in January 2005 and will run to December 2007, the geophysics T&R programme at Wits will be enhanced. This project builds on the existing honours degree by expanding opportunities for MSc and PhD students to participate in sandwich training programmes with US and European partners.

The Practical Geophysics field course has been expanded and, from 2006, will include US participants who wish to gain practical exploration experience. Students will work with data from the geophysical recording network, including broadband seismometers, global positioning system (GPS) monitoring, magnetotelluric and other instruments. By linking several geophysical readings to one observatory, the likelihood of continued maintenance and participation is enhanced.

From 2007 to 2014, training opportunities and the network of shared scientific observatories will be expanded. Sustainable centres of excellence in geo-

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Students receive a broad range of geophysical training from mine seismology to global geophysics. These students are visiting a mine in Klerksdorp, South Africa, at a depth of around 3,000 metres

physics will be established at other African universities (for example, oil and gas exploration programmes in Luanda, Angola; natural-hazard studies in Dar es Salaam, Tanzania) and a secondary-school outreach programme will be set up focussing on natural hazards, oil, gas and mineral exploration, mine safety and career opportunities in the natural-resources sector.

The AfricaArray model of promoting capacity building through T&R activities will be propagated to other science fields vital to the development of Africa's natural resources and will add other monitoring equipment to the scientific observatories (for example, GPS, meteorological, hydrological and other environmental sensors). Many academic training programmes in Africa will be strengthened to the point where they can independently provide a sustainable pool of natural scientists including geologists, geophysicists and engineers.

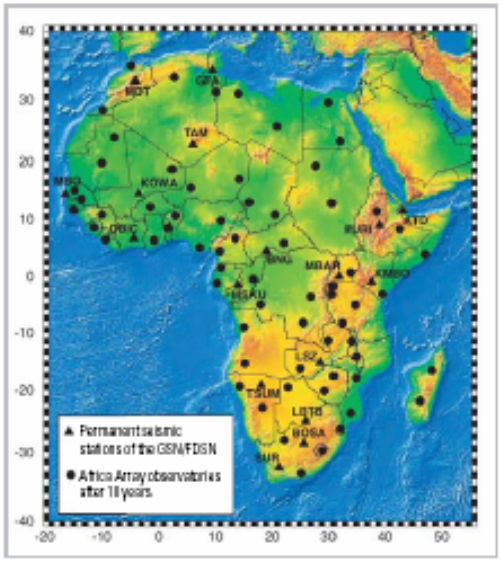
The degree programme

Initially, the geophysics training programme will be based in the School of Geosciences at Wits. Geophysics degrees are offered at BSc, MSc and PhD levels. There is a bridging year for students entering the programme who need extra course work in English, mathematics, physics and geology. At BSc level, students interested in geophysics enrol in the geology, or physics BSc programme and take a concentration of courses in geology, physics and mathematics.

To increase AfricaArray's training capacity at MSc and PhD levels, a sandwich programme has been set up through which students will spend up to six months a year studying and conducting research with a professor at one of the affiliated universities in the US or Europe. Students will be co-supervised by the faculty at Wits and at the affiliated institution, but degrees will be granted by Wits only. Several students have already enrolled in this programme and are being sandwiched by Penn State University and University of Texas.

The geophysics theme for AfricaArray is 4-D imaging of the African crust and mantle. Within the continent, there are many geological targets of economic, academic and societal interest – ranging from extremely old (Achaean) to very recent (active) faults; from very large (sub-continental scale) to very small (individual faults within a basin, or intrusive complex); and from very deep (lower mantle and core) to very shallow (near-surface aquifers). AfricaArray will investigate a range of targets spanning much of geologic time and many spatial scales using data from its observatories, plus geophysical, geochemical and geological data.

The programme's science will be conducted through a series of projects focused on the needs of its partners. This means private-sector partners interested in aspects of the programme can focus on their own specific needs and scientific objectives.



Current seismic stations and proposed AfricaArray geophysical observatories. Installation of new sites in Mozambique and Malawi is in progress

Observatories

A network of shared scientific observatories across Africa will be linked through common instrumentation, data access and operation, and form a shared facility. It will provide an important means of building a science community through common ownership. Data from the observatories underpins much of the science supported by AfricaArray. Some observatories will be permanent, while others will be temporary.

The observatories are built around a network of broadband seismic stations for recording earthquakes. This is because the initial focus of AfricaArray is on geophysics and because a significant amount of seismic-monitoring equipment operating in various parts of Africa has been pledged to the project. The observatories will be equipped with additional monitoring equipment over time, such as GPS, meteorological, hydrological and other environmental sensors.

The goal of the first phase of AfricaArray is to establish a network of 20-30 permanent observatories across southern and eastern Africa. During Phase 2 (2008-2010), this network will expand to other parts of the continent. To date, CGS has dedicated data from 11 broadband seismic stations within the South African National Seismograph Network and stations are being installed in Malawi, Mozambique, Namibia and Democratic Republic of Congo. This network will expand as funds become available and the network of partner institutions grows.

Technical training programme

Technical training of personnel to operate and maintain geophysical equipment will be provided by CGS, both in Pretoria and in the field. CGS has been training seismic-station operators from many African countries over the past few years. Certificates are issued when station operators complete the training course. This has been a highly successful programme and is integral to the maintenance and expansion of AfricaArray.

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