

Report of the AfricaArray Planning workshop held at Wits University, 13-14 July, 2004

Date: 17 July 2004



Principal Participating Institutions in the AfricaArray Programme (on 12 July 2004):

**University of the Witwatersrand (S.A.), School of Geosciences (Prof. Paul Dirks)
Penn State University (U.S.A.), College of Earth and Mineral Sciences (Prof. Andy Nyblade)
Council For Geoscience (S.A.) (Dr. Gerhard Graham)**

With respect to Wits, this report is relevant to:

**Schools: Geosciences (Department of Geophysics)
Research Thrust: Mineral Exploration, Mining and Processing
AESEDA: Alliance for Earth Sciences Engineering and Development in Africa
NRF: Centre of Excellence proposal in Economic Geology
Proposals: AfricaArray**

1. The AfricaArray programme

AfricaArray refers to networks in Africa embracing the full spirit of NEPAD. It refers to networks of scientists working on linked projects across the continent; to shared training programmes and shared infra-structural investments such as the array of seismic stations and other geophysical equipment to be installed across participating nations. Above all AfricaArray refers to a shared vision to assure that Africa will retain specialist capacity in the strategically vital research area of geophysics; fundamental to oil, gas and mineral exploration, thermal energy extraction and earthquake studies.

The AfricaArray programme seeks to establish a teaching and training platform in geophysics in Africa. AfricaArray is designed as a 20 year programme that intends to build on currently existing capacity. Seismology has been identified as one of the key areas to initiate the programme, but input from other branches of geophysics is deemed equally important in achieving the long-term objectives of AfricaArray. These objectives have been defined as follows:

- to maintain and further develop geophysical training programmes in Africa, to address Industry, Government and University requirements
- to promote geophysical research in Africa, by establishing an Africa-to-Africa support system
- Assist in assuring that specialist training facilities such as geophysics are not lost to the continent; i.e. retain specialist capacity in Africa.
- Obtain data to effectively study fundamental crustal and mantle processes shaping the African Continent (e.g. the African Super Plume; the extent and nature of mantle lithosphere roots; the formation of rift basins etc.)

2. INTRODUCTION

In October 2003 Penn State University, USA, launched the "Alliance for Earth Sciences, Engineering and Development in Africa". This alliance is aimed at "promoting the integration of physical sciences, engineering and social sciences in order to

develop human resources, promote economic vitality and enable effective stewardship of geo-resources [in this context oil, gas, minerals and water] in Africa". At the end of the October meeting at Penn State, an MOU was signed between Penn State University and the Universities of the Witwatersrand, UCT, Lagos, Ibadan and Agostinho Neto (Luanda, Angola).

The strategic objectives of AESEDA are complimentary to those defined by the Wits University research thrust "Mineral Exploration, Mining and Processing", and efforts to establish the research thrust have been combined with efforts to establish AESEDA initiatives at Wits.

As a direct outflow of the October meeting, and following discussions between Prof. Andy Nyblade (Penn State) and Prof. Paul Dirks (Wits, Geosciences), Prof. Nyblade developed a white paper entitled "AfricaArray" aimed at building geophysics capacity in Africa. This will be achieved through the establishment of a training platform by making use of the Wits, School of Geosciences as the southern African training and research hub. Wits will be backed by Penn State as the American training and research hub.

The training platform must be supported by international research projects in geophysics. In its initial stages, AfricaArray seeks to develop a continent-wide seismological array as an infrastructural investment in the region and as a research tool to the project. Further projects will be developed during later stages of the project to ensure a rounded geophysical training and research programme with an international character.

The AfricaArray project was endorsed by the AESEDA secretariat in November 2003 and launched in South Africa in February 2004 during a visit by Prof. Nyblade. After Prof. Nyblade's visit to South Africa (21-28 February 2004), a full AfricaArray proposal was prepared and submitted to USAID (Global Development Alliance programme for the development of Public-Private partnerships) on March 15, 2004. This proposal was declined in late June 2004, however, the preparation of the proposal catalyzed much interest in AfricaArray and helped focus the project objectives.

To consolidate existing contacts and develop concrete proposals, AESEDA at Penn State organized a workshop on 10-12 May 2004, which was attended by Prof. Dirks on behalf of Wits. Immediately following this workshop, Prof. Nyblade organized a meeting in Houston on 14 May 2004 with representatives from oil companies. The aim of the meeting was to introduce AfricaArray to oil and gas companies with activities in West Africa (mainly Angola, Congo Brazzaville, Gabon and Nigeria). The meeting was attended by representatives from ExxonMobil, SHELL, ChevronTexaco, Haliburton, ConocoPhillips and Marathon. Profs Dirks and Nyblade were accompanied by Mr John Dietz (Penn State, Director of Development, College of Earth and Mineral Sciences). The AfricaArray idea was well received in Houston and several companies indicated that specific proposals could be submitted to them.

During the May meeting Profs Nyblade and Dirks finalized the planning for the AfricaArray workshop to be held in July 2004 at Wits University. This workshop was scheduled in conjunction with Geoscience Africa 2004 conference to increase exposure of the project. NRF and NSF together supported the workshop with R110,000, which made it possible for a large number of delegates from across Africa to attend.

3. AIMS OF THE JULY WORKSHOP

The AfricaArray workshop at Wits University was convened with the following specific aims:

- Identify current facilities and endeavours with respect to geophysics training and research in Africa

- Define a teaching curriculum in geophysics centred around the existing facilities at AfricaArray partner institutions and aimed at building future capacity across participating countries. This curriculum must accommodate student and staff exchanges, and promote optimal use of available facilities.
- Define research projects that can be used to initiate and build the AfricaArray programme; and describe the required infrastructural and training requirements for such a programme.
- Identify funding opportunities and mechanisms in support of the AfricaArray programme. Investigate public vs private funding opportunities (e.g. NEPAD funding, funding by governmental organisations and Universities in participating countries and bilateral aid funding).
- Explore an administrative mechanism through which partner institutions in AfricaArray can gainfully participate (e.g. vetting of potential students; provision of scholarship funding; equipment exchange; equipment management structures etc.).
- Develop a strategy and a managerial structure to implement the programme.

In support of these aims the workshop was conducted as follows:

1. AfricaArray, its aims and objectives were introduced.
2. Delegates were divided into five working groups, specified below, which met for several hours to discuss the main goals set for each working group, and attempt to identify and answer some of the key questions posed to the group.
3. The group leaders presented results from their groups to the entire workshop.
4. Results of the group discussions were used to guide further planning.

4. REPORT OF ACTIVITIES, RESULTS AND ACTIONS REQUIRED

4.1 Workshop attendance

The workshop took place over two days (see programme; Appendix 1) and attracted a total of 53 delegates; 46 from Africa and 7 from Europe, USA and Australia (see Table 1) of which 21 received sponsorship. Considering the very limited lead time this turn-out was excellent.

Country of origin	Number of delegates
Africa	44
Angola	3
Botswana	5
Cameroon	1
Ethiopia	1
Kenya	1
Malawi	1
Mozambique	1
Namibia	3
Nigeria	2
South Africa	21
Tanzania	2
Uganda	1
Zambia	1

Zimbabwe	3
Europe (Ireland, Germany, Netherlands, Sweden)	4
USA	1
Australia	2
Total	51

The delegates represented a large number of organizations active in Africa including: 4 oil and gas companies (BHPbilliton, Schlumberger, PetroSA, Tanzania Petroleum Dev. Corp.); 3 mining houses (AngloAmerican, deBeers, BHPbilltion), 3 consulting companies (1 Australian, 1 Namibian, 1 SA); 4 South African government and parastatal organisations (Department of Science and Technology; NRF; CSIR/Miningtek; HartRAO); 2 professional societies (GSSA, SAGA); 2 funding organisations (AMIRA and NRF); 8 geological survey organizations (Botswana; Malawi, Mozambique, Namibia, South Africa, Uganda, Zambia, Zimbabwe) and 16 Universities including UCT, Wits and RAU from South Africa.

Many more potentially interested parties had been invited. Several countries/organisations had planned to attend but could not make it due to logistical constraints (Cameroon Geological Survey; DRC). Many of the oil, gas and mining companies did express a firm interest in the outcomes of the workshop, but did not wish to actively participate in discussions at this stage. A number of South African Universities had been invited, but apologized citing a variety of reasons (Pretoria University, Western Cape, Fort Hare, Venda, U. North).

4.1 Workshop results

The results of the group discussions have been attached to this report as Appendix 3. A summary and analysis of these results as discussed with the entire group is provided below. The recommendations flowing from the discussions are intended to improve on the existing White Paper, and comments provided below have been structured accordingly (i.e. comments should be read in conjunction with the AfricaArray white paper)

1) Teaching/Training

- Purpose of training programmes must be made clear for academic institutions, industry, and government institutions
- Phase 1, focus on Wits; then expand
- Start developing centers of training in other places
- There is a need for information about geophysics teaching across Africa (curriculum, staff)
- Work towards a common curriculum, this could be between e.g. Wits, Unam and Ubots.
- Encourage dialog between geophysics faculty in Africa
- In developing the proposal further, emphasize all aspects and applications of geophysics
- Consider the inclusion of short courses (travelling training courses), refresher courses, field courses etc.

2) Geophysics Technology Array

- In developing AfricaArray it may be best to structure the programme around an education/training platform, and build a diverse technology array as a tool to support teaching
- The building of the technology array could start with seismic stations (build on existing network infrastructure) and upgrade where possible (resources)

- The continued growth of the Technology Array could include GPS, MT (other?)
- Obtain a database of available geophysics data sets (other than earthquakes), potential fields, reflection seismic, gamma ray spectrometry (IAEA)
- Clearly integrate a flexible array (seismic) for temporary deployments on specific targets/projects.
- It should become clear what countries can provide (entry to AA) vs. what do countries receive from AA

3) Research topics/projects

- AfricaArray should be linked to focussed and clearly defined, large-scale projects backed by strong scientific motivation. Examples could include:
 - Bushveld Roving Array (advantage: ready to go; disadvantage: not international in character, i.e. too focussed)
 - Understanding Cratons (Craton boundaries, Depth of cratonic roots, Craton growth, Craton evolution, implications to mineral exploration)
 - lithospheric structure (evolution)
 - Basins (Angola, elsewhere?), Continental margins
 - East African Rift – origin and evolution
 - projects relevant to industry
- Links with other projects in geophysics and geology must be made clear
- A very important ultimate aim of the AfricaArray project must be to understand the deep mantle structure below the African continent (the African Superplume)
- 3D/ swaths/ transects of specific targets

4) Fund Raising

- To maximize effectiveness, it will be important that all participants to AfricaArray lobby for support of geophysics using the AA programme as a common platform.
- In raising funding it may be expedient to split the effort between teaching and research (incl. student support etc) vs. Array operation (installation and operation of seismic stations etc.)
- For the training programme to develop it is vital to target funding for academic salaries
- It will be important to seek funding from diverse sources for all aspects of AA
- It will be important to seek partnerships with academic/ industry societies (SAGA, SEG, SGFA, GSSA, BGA, GSA, GSAf...)
- Target individuals to apply to well known (large and small) funding agencies (identify people with experience)
- Promote AfricaArray at meetings

5) Structure

- The management structure of AfricaArray must be flexible
- It will be important to review existing examples and learn from past successes (Kaaopvaal project) and failures.
- For AfricaArray to have a maximum chance of success it will be best to have the programme firmly embedded in existing structures (e.g. existing training programmes, existing seismic array) rather than creating a wholly new structure.
- A mechanism must be devised for setting up partnership/pledges to join AfricaArray
- An interim advisory board must be created (short term) (what is the best way to set up the board?)
- AfricaArray has to be an official entity for point of contact, bank accounts
- regional coordination

- set up web page – contact details of participants
 - fund raising (pledges, distribution of funds?)
 - promotion of AfricaArray
 - advise (suggestions) on station locations
 - advise on research objectives/projects
 - recommend longer term structure
 - regional representation (that is cost effective – email?)
- Careful not to stifle enthusiasm of individual successful fundraisers by imposing an overly beaurocratic or centralised system
- set up foundation for AfricaArray funding, contracts (bursaries, research projects)
- Executive officers (Andy Nyblade, Paul Dirks)

4.2 Conclusions and points of action

- In developing AfricaArray it is advisable to structure the programme around an education/training platform. A diverse technology array as a tool to support teaching and drive research can be built on this platform.
- AfricaArray should not be developed as only a seismological array, but should have a much broader focus: Geophysical Array; Array of cooperative linkages; Array of training programmes etc.
- The existing white paper must be rewritten to incorporate the various recommendations made during the workshop (Nyblade/Dirks).
- A database of on-going activities in geophysics on the continent must be compiled.
- Potential partners will be approached to provide specific information on training and research programmes and needs as well as the level of support each is willing to provide for AfricaArray.
- With regards the management structure it was agreed that Prof. Nyblade and Dirks would provided the executive leadership to drive AfricaArray forward. Actions needed include:
 - Initiate bank account/foundation account (Wits)
 - Rewrite white paper
 - Data collection
 - Prepare promotional materials (Wits) including logo and leaflets
 - Initiate the establishment of an advisory board.
 - Lobby
 - Initiate research proposals.

During the workshop and the parallel Geoscience Africa 2004 conference, a number of discussions and meetings were held between Profs Nyblade and Dirks and individual participants and/or representatives from a variety of organizations. Many of these discussions resulted in pledges of support to, or indications of interest in AfricaArray. Possible opportunities that could arise from these meetings have been listed below.

AfricaArray workshop: Tuesday 13 July and Wednesday 14 July, 2004

Person visited (others present)	Organization	Contact details	Outcomes
16/7/04 Prof. Belinda Bozzoli (DVC Research)	Wits University		<ol style="list-style-type: none"> 1. Wits will consider providing funding for a Post-Doctoral position 2. Wits will provide funding for promotional brochure (together with Wits Enterprise; PD to prepare budget) 3. Set-up a presentation by PD to SET (with focussed request; e.g. seismology post) 4. DVC will assist in arranging a meeting with NRF, DST, DME, MQA, CGS, USEmbassy to promote AfricaArray to potential high-level funders.
16/7/04 Mr Peter Bezuidenhout (Director Marketing)	Wits University		<ol style="list-style-type: none"> 1. Provide support in the preparation of an AfricaArray report and promotional brochure
16/7/04 Ms Heidi Voysey-Leunig (Director, Foreign Students office)	Wits University		<ol style="list-style-type: none"> 1. Can provide funding for regional travel to arrange alignment of teaching programmes between Wits and UNAM, Bots etc. 2. Will set up contact with NORAD representative to supply proposal to NORAD by Jan 2005.
13/7/04 Schlumberger			<ol style="list-style-type: none"> 1. Advertise a "Women in Science" scholarship plus other scholarships 2. Provide Schlumberger with staff development fellowship proposal
14/7/04 BHP			<ol style="list-style-type: none"> 1. Check with their HR office regarding support for two Zambian Students 2. Would be interested to receive a proposal for a Congo Craton project by mid-august (together with deBeers)
14/7/04 – 16/7/04 Dr. Mike de Wit, Regional Exploration Manager Africa Dr. David Hatch Senior technical manager, Geophysics Dr. Moctar Doucoure (Dr. Doucoure attended the AA workshop on behalf of deBeers; Dr de Wits and Dr Hatch attended GeoscienceAfrica 2004 and spoke to PD and AN)	DeBeers Exploration, Pretoria (Centurion)	Tel: 012- 6735200	<ol style="list-style-type: none"> 1. The possibility of providing in-kind support, especially with respect stations in Central Africa was reiterated. Keep in touch with Mike de Wit. DeBeers is interested in supporting programmes when permitting issues with countries of interest are completed. 2. Possible technical support of seismic station in Angola was mentioned 3. DeBeers would be interested to receive a proposal for a Congo Craton project by mid-august <p>Action:</p> <ul style="list-style-type: none"> • keep DeBeers informed
15/7/04 Michael Sears	AngloAmerican	011 638-2366, Gorette (admin) 011 638-9111 (Switchboard)	<ol style="list-style-type: none"> 1. Support for teaching position to be applied for through METF; Anglo Group representatives on METF are supportive.
15/7/04 Prof. Jay Barton (2004/5 Chairman)	Geological Society of South Africa, Rand Afrikaans University		<ol style="list-style-type: none"> 1. Will support the AA programme through the GSSA (lobbying)
14/7/04 Dave Hutchinson	Geological Survey Namibia		<ol style="list-style-type: none"> 1. Align teaching programmes at Wits and UNAM so that teaching programmes at UNAM and Wits can be interchanged. GSN is interested in co-ordinating this effort. 2. Provide full sponsorship for three students (possibly one MSc, two Hons) 3. Possibly pledge the three new short period seismic stations to the programme <p>Action:</p> <ul style="list-style-type: none"> • David Hutchinson to report on outcomes of local discussions at GSN •
14/7/04 Dr. Joaquim Boavida	Agostinho Neto University, Angola		<ol style="list-style-type: none"> 1. If support is available two MSc students could be sent as part of AA 2. (Set up a staff development fund for ANU in parallel with Wits) 3. Provide logistical support for seismic station installation 4. Possibly organise a AfricaArray workshop focussed on Angolan needs in November 2004.
Dr Gerhard Graham	Council for	Tel: 012 – 8411227 (graham)	<ol style="list-style-type: none"> 1. two PhD bursaries have been provided

Director, geophysics, data management	Geoscience, Pretoria	Gerhardg@geoscience.org.za	<ol style="list-style-type: none"> 2. equipment for one seismic station in Angola, plus installation costs 3. 10 or 11 broadband stations (see letters of support) 4. space and technical back-up
Mr Elias Daudi, National Director of Geology	Maputo, Mozambique		<ol style="list-style-type: none"> 1. will consider supporting students for training in geophysics
Prof. Alan Jones	Dublin Institute for Adv. Studies, Ireland		<ol style="list-style-type: none"> 1. Would be willing to contribute 1 MT short course a year 2. Could supervise one more MSc student
Dr Bjorn Lund International Programme for Physical Science	Uppsala University		<ol style="list-style-type: none"> 1. Interested in continuing to support East African network and seismological training in East African Countries. <p>Action Prof. Nyblade to contact programme director</p>
Dr. Oliver Ritter	Geoforschungszentr um Potsdam, Germany		<ol style="list-style-type: none"> 1. Will check whether broad-band stations can be obtained from GFZ to place them in Namibia 2. Improve ties with Inkaba ye Africa 3. Will consider placing an MT station at one site in Namibia
Dr Graham Stewart	Leeds University, UK		<ol style="list-style-type: none"> 1. Partnering with AfricaArray 2. Could possibly provide broad-band sensors to AfricaArray on a temporary basis
Prof. Colin Reeves	ITC, Netherlands		<ol style="list-style-type: none"> 1. would like to partner with AfricaArray
Prof. Henri Kampunzu	University of Botswana		<ol style="list-style-type: none"> 1. would like to work with Wits in a co-operative manner. 2.
14/7/04 Dr Rob Drennan (Director, Centres of Excellence)	NRF, Pretoria	Tel: 012 –	<ol style="list-style-type: none"> 1. Interest in AfricaArray was expressed. 2. The close alignment of the proposal with NEPAD objectives was commented on. 3. It was suggested that any AA proposals submitted to NRF be aligned with the 'Inkabe Ye Africa' project.

In addition to the above support, the School of Geosciences at Wits University is fully supportive of the AfricaArray project and is willing to pledge it's Honours Geophysics training program and its geophysics research facilities to the project. In addition the School can make available space, a field vehicle, bursary funding and its network of contacts.

4.3 Exposure and publicity surrounding the workshop

During the Geoscience Africa 2004 conference, public support for AfricaArray was given in the following manner:

- During the opening session of the conference, the minister of Minerals and Energy, Ms. Pumzile Mlambo Nhcuka, mentioned AfricaArray as an example of a collaborative project worthy of support.
- During the official opening party of the Geoscience Africa 2004 conference on Monday 12 July, Prof. Belinda Bozzoli, Deputy Vice-Chancellor (Research) of the University of the Witwatersrand, referred to the AfricaArray project in very positive terms.
- During the Geological Society of South Africa, Annual General Meeting, on Thursday 15 July, the incoming Chairman of the Society, Prof. Jay Barton, pledged the Society's support for AfricaArray, and invited Prof. Dirks to work with the GSSA to help make AfricaArray a success.
- SAFM, the national radio broadcasting organisation, flighted an interview with Prof. Dirks on Friday 16 July (8.00 pm, "future watch" programme), about the Geoscience Africa 2004 conference during which AfricaArray was discussed.

Appendix 1

Programme

AfricaArray Workshop

Date: 13-14 August 2004.

Venue: GLT lecture theatre basement floor Geosciences Building

July 13

8:00-8:30 Introductory remarks about Wits geophysics and AfricaArray – Paul Dirks

8:30-9:15 AfricaArray overview, current state of project structure and fund raising – Andy Nyblade

9:15-9:35 Overview of geophysics training at Wits – Mike Jones

9:35 – 9:55 Overview of seismic networks in southern African countries (Gerhard Graham)

10:25-10:45 Overview of seismic networks in eastern Africa (Richard Ferdinand and Atalay Ayele)

10:45-11:15 Assignment to working groups and charge (Paul Dirks and Andy Nyblade)

11:15-12:00 Working groups deliberate

1:30- 3:30 Working groups deliberate and put together 15 min. presentation

3:30-4:00 break (tea)

4:00-5:30 Reports from working groups (5 x 15 min)

July 14

8:00-10:00 Recap of working group to reach consensus on key issues (Andy Nyblade moderate)

10:00-10:30 break (tea)

10:30-12:00 Workshop participants outline a preliminary workshop report.

Appendix 2

Programme: Working Groups and Tasks

AfricaArray Workshop

Date: 13-14 August 2004.

Venue: Geosciences Building

Group 1. Geophysical Research

Goals: to establish

- Who is conducting geophysical research in each country
- what geophysical research is being conducted and what are future research requirements
- what facilities are available, who maintains these facilities and how might these facilities be shared
- what data are available and how they may be shared

With regards seismology:

- What existing seismological facilities are available and can they be used for Africa Array
- What data are available and can they be used for the project
- What personnel are available
- What future research should be done

Key questions:

- What are the main research activities in different countries
- Who is doing this research
- What collaborative programmes are already in progress
- Who are the overseas collaborators
- What equipment is available for research
- Can this equipment be used for collaborative research in other countries
- What data bases are available
- Can these data bases be shared
- How do we see the future of geophysical research
- Can research be funded locally
- What are local research requirements in Industry

With regards seismology:

- Who is doing seismological research, what is their expertise
- What collaborative programmes are already in progress and who are the overseas collaborators
- What equipment is available (number of quality stations, centres for data collection, etc) and what methods are used to retrieve data from stations and forward them to data collection centres
- Can equipment be used for collaborative research in other countries
- What should be the minimum requirements for participation in the AfricaArray network
- What data bases are available, can they be shared with other participants
- What logistical support is available with respect to training of technicians, ensuring security of stations, and supply of electricity
- How do we see the future of seismological research

Group 2. Teaching and Training of Geophysics

Goals: to establish

- What geophysical teaching capacity is currently available
- What are the needs for future training
- How can these be developed in the short and long term

Key questions

- What good quality geophysics training programmes exist in Africa, and where
- What feeder programmes exist (e.g. physics or geology programmes)
- What teaching equipment do these departments have
- How can we co-ordinate these training programmes
- How do we develop geophysics training in Africa in the short and long term
- How do we identify and recruit suitable students; can we define a common standard
- Are participants prepared to identify suitable projects and undertake supervision
- Can we find funding for bursaries/scholarships for students
- Can teaching be funded sustainably

Group 3. Funding Opportunities

Goals: to establish

- What local funding sources are available
- What other sources can be tapped
- What is the ideal funding mechanism in support of AfricaArray in participating countries

Key questions

- What sort of government funding can be expected in participating institutions
- What logistical etc support can be expected in participating institutions
- What overseas funding can be attracted and how sustainable is this sort of funding
- What major mining or oil companies are operating where, and would they be willing to support the programme.
- What are company interests in geophysical training and how can these companies be persuaded to buy in.
- What other opportunities are there for fund raising

Group 4. Administrative Mechanism

Goals: to establish

- A mechanism for promoting and controlling collaborative research and teaching
- Promoting international interaction between Universities and government organisations such as geological surveys
- Establish a mechanism through which geophysical programmes can be build up on a regional basis.

Key questions

- What organizational model should be used?

- How would members of the organizational structure be chosen?
- What would be the terms of service?
- How would the organizational structure be funded/supported?
- How would students wanting to participate in AFRICAARRAY be selected and how student exchanges be organised?
- How do we take the current process forward without overloading a limited number of individuals; i.e. without unduly expanding on existing work loads?

Group 5. Strategic Planning

Goals: to establish

- How to maintain viable geophysics training programmes in Africa, and expand these programmes to address local needs.
- How to apportion responsibility
- How to build international bridges
- How to give geophysics in Africa a high profile

Key questions

- How many geophysicists do we need in Africa?
- How do we set up an advisory board, and who should be on it ?
- What would be the responsibilities of an advisory board?
- What would be the membership of the advisory board
- How do we build bridges with industry
- How do we identify the key needs of industry, Academia and Government Organisations

Appendix 3: Report-back by Working Group leaders

Working Group 1: Geophysical Research

Representation and Facilities

- Kenya
2bb,5SP,NDC,5 mobile stations (digital), 1 accelerometer, 7 GPS stations, EM,gravity,resistivity, infrasound stations
- South Africa
National network, geophysical equipment (airborne and terrestrial), laboratories
- Botswana,
National network (current SP), various geophysical equipment, laboratories,
- Uganda
2 bb, 3 SP, geophysical equipment, 1 GPS station, MT array (planned), mobile network (planned)
- Cameroon
12 bb, shallow and deep MT, geophysical equipment
- Tanzania
geophysical equipment, laboratories
- Ethiopia
1bb (running),2bb sensors(near future), 3sp (digitals), 4 GPS, 3 Accelerographs and one magnetic station, 5 mobile stations (SP-digital)

Minimum Requirements for Joining AfricaArray

- Different requirements for different phases
- Phase 1 restricted in accordance to current capability in the various countries
- Contribute data (earthquake data, reflection seismology, gravity, etc)
- Sponsored workforce (individuals for training – to be deployed in the AfricaArray, existing expertise)
- Scholarship linked to AfricaArray
- Provision of facilities for the installation of seismic equipment

Withdrawal from AfricaArray and Defaulting

- Equipment deployed under the agreement must fall back to within the project for re-deployment
- Training programme to be completed

Collaborative Programmes

- Uganda – IPPS for equipment and support, Univ of California (San Diego) for IRIS station, CTBTO (station), Icelandic international aid (geophysical equipment), BGR (geophysical equipment)
- Cameroon – Strasburgh Univ (equipment and support), Washington Univ (St Louis), Penn State, CTBTO
- South Africa – AFTAC, CTBTO (BOSA station, infrasound), BGR (Antarctica station), IRIS (Sutherland station), MT (various groups), SADC eg Malawi, Mozambique
- Botswana – AFTAC, CTBTO (Lobatse station), Hermanus Observatory (magnetics)
- Tanzania - ??
- Ethiopia – IRIS/USGS (FURI station), IPGP (magnetic station), CTBTO (planned)
- Kenya – IRIS/USGS, CTBTO, JICA, IPPS, Woodhouse (australia), DAAD, GFZ, National Oil Corporation of Kenya, Univ Karlsruhe (Germany)

Data Access

- Free and immediate access required in some countries, can be waived if only a limited number of stations is pledged.
- In general, agreement that three years' delay in the release of the data is acceptable
- Concern about slow Internet in Africa. Will make data access at IRIS difficult. Need to investigate an alternative

Working Group 2: Teaching

Need to be clear on what is included in "Geophysics"

- Seismology?
- All fields of solid earth geophysics? Practical!
- Should it include geophysics of oceans and atmosphere?
- Africa Array not "THE" vehicle to solve ALL geophysics problems in Africa

Division on expectations

- Generate a centre for excellence in seismology
- Where
- Develop well balanced geophysics programme with all core fields
- balance between theory and practical
- balance academic and applied

Existing facilities

- Need to collect data from countries not present
- Geophysics reasonably OK in countries represented
 - Nigeria
 - Tanzania

RSA
Namibia
Zimbabwe
Angola
Other Pockets

- Reasonable in terms of equipment, feeder courses

Future Needs

- Divergent
 - Particular need for seismology (Angola)
 - Improve quality of students, local staff
 - Most sustainable as is, but have needs for development
 - staff
 - funding
 - equipment
 - partnership
 - Ways of retaining trained geophysicists
 - Students
- Most are confident that good number of suitable students are available
- Bursary money variable, but available
- Projects available

Programme co-ordination

- Too difficult on a continent-wide scale – stick to research collaboration
- May be possible on regional scale depending on the needs in the region
- Closer co-operation within countries

Working Group 3: funding

Participants in the discussions:

Sue Webb, Wits; Tongesai Kapondo, Zimbabwe Geological Survey; Mike Sears, Anglo American; Richard Beck, Amira; Candice Levroux, NRF; Rob Drennan, NRF; Asbjorn Christensen, BHP

Discussion

- Geophysics – Geology relationship
- Different aspects different sources (NSF basic research etc)
- Specify oil companies to target

Advertising/promoting geophysics

- if country needs geophysicists, then needs to fund training (versus importing people)
- basic funding vs. research funding

Research vs Teaching needs

- funding for academic posts (exploration vs EQ and EM methods) WHY seismology?
- Support for proposal writing (Amira, Research Office, NRF)
- Technical support (servicing seismometers; computer support)
- Post docs, MSc, PhD and other student bursaries

Research funding mechanisms

- BYOB
- Company interest (oil and diamond companies)
- Links to Inkaba ye Africa (SA)
- Center of Excellence (SA)
- METF (Mineral Education Trust Fund (SA)
- Upstream Training Trust (SA)
- Anglo American Chairman's Funds
- NEPAD – channeling funding – aware of opportunities
- NRF: Student grants, THRIP (Salary), Innovation fund
- Bushveld Roving Array – strong company support – Amira interest
- Etc.

Teaching funding mechanisms

- Overheads on bursaries – companies would support
- METF(SA)
- Physics Review (SA)
- PetroSA lobby (SA)
- Dept of Minerals and Energy (SA)
- Etc.

Lobbying for Geophysics

- How to take case forward to METF for specific geophysics support?

- Within company support
- Support from professional societies
- Geophysics as a requirement for stock exchange, evaluations etc – ideas

Potential proposals

- USAID
- NEPAD
- JICA – Japanese
- CTBTO
- Global Mine seismology / EQ community
- World Bank (Angola other countries)
- UN/European Aid/Aid Programs
- Foundations: Carnegie, Kellogg etc – need successful contacts – specific aims

Working Group 4: Administrative structures

Past experiences

What has prevented collaboration to flourish in the past
1. Isolation: Individually we may not have the capacity to carry out the research in terms of expertise, resources.
2. Continuity of research is lost as a result of mobility (brain drain)
1. Visibility; poor advertising; too little research is done
2. In many places no primary capacity exists full-stop. No academics, no technicians.
3. Lack of dedicated funding from government. Insufficient money is made available to maintain programmes that have been started.
4. Relevance to the community must be demonstrated. Relevance of research conducted has not been always clear. (the importance of curiosity-driven research must not be under-estimated)
5. Desire for individual countries or institutions to get the lion share; realistic target setting must be done

Organizational structure

Other structures must be investigated as examples: IRIS; Waternet; East and Southern Africa seismological working group; SEAMIC etc.

Management parameters

AFRICAARRAY

- Must be a vehicle to bring Universities together.
- Must be an umbrella structure that makes it possible through agreements that certain research/teaching can be carried out selectively at other institutions on a per need basis.
- Will start small and grow from a nucleus of committed people. It must be modest and realistic in its initial objectives.
- We must not overload the people involved. The programme must build on the existing mechanisms, infrastructure and funding schemes.
- Financial structures must be based on real costs.
- Must not be overly bureaucratic or prescriptive.
- AfricaArray as a group of like-minded institutions, which will be used as a flag to raise the plight of geophysics.
- It must be supported by the institutions that want the success for their own benefit.

Additional suggestions

- Lesser economies can fall by the way-side and need to supported by stronger groups because they do not have the resources. Their seismic stations must be paid for etc.
- It must have a continental mandate.
- The training component of the East Africa Project was similar to what is proposed here and could be a good model that may work here.

Working Group 5: Strategic planning

How many geophysicists do we need?

- At least 20/yr (Probably more like 50/yr)
 - 10/yr in SA alone sponsored
 - Oil companies: 15-20/yr
 - Schlumberger: 12/yr
 - ITC: 20 African applicants/yr
 - ANU Luanda: approx 20/yr

Suggestions for Management structures

- Advisory board

- Interim board
 - 2 year term
 - Composition: 11 seats
 - Operations
 - Directory
 - Deputy: network
 - Deputy: training
 - Industry
 - Diamonds
 - Minerals
 - Oil
 - Environmental
 - Funding
 - Government?
 - World Bank?
 - Array experts
 - East African Array?
 - CGS
 - Observer seats for big funders

Possible additional criteria to be considered: Diverse geographically (4 regions); Good enthusiastic people; **Can pay own way?**; Just interim!

Primary responsibilities

- Operational and Advisory
- Funding
- Setting up structure of permanent programme and permanent board
- Increasing number of training centres
- Oversee station placement
- Scientific
- Funding
- Resolving operational conflicts

Secondary responsibilities

- Making geophysics more visible
- Support operational efforts to get government support (Government leverage on commercial operations)

Practical issues

- Meet in Johannesburg initially
 - Council for Geoscience
 - Wits

Management parameters

- Meet twice a year
- Administrative support eventually must have links to industry, government, academia, have a continental structures and Emphasize integration. A bottom up approach may well work best.

AfricaArray needs to be restructured to reduce the prominence of seismology and better facilitate:

array of organisations
Integration
Practical skills

Arising

- AA Funding route clear for array (not so clear for training within AA; other funding well defined in SA)
- Link between array and capacity building is weak
- Advisory board should be non-prescriptive
- Europe: Integrated Technology Platforms, EuroArray being sold as integrated geophysical array: GPS, MT, Oceanographic as well as seismic **Suggestion: structure around education, build array as tool to support teaching**
- Seismology as guide to later addition of other disciplines
- Links to Inkaba ye Africa
- Passive seismology missing
- Focussed on South Africa (due to funding)
- Premature to get involved?
- Integration

Appendix 4: list of participants to the AfricaArray workshop

	Company/University/ Organization	First name	Surname	Email address
1	Addis Ababa University	Atalay	Ayele	atalay@geobs.aau.edu.et
2	Agostinho Neto University	Joaquim	Boavida	calema@netangola.com
3	Amira Africa	Richard	Beck	richard.beck@amira.com.au
4	Anglo American	Mike	Sears	msears@angloamerican.co.za
5	BHP	Asbjorn	Christensen	asbjorn.n.christensen@bhpbilliton.com
6	Corner Geophysics, Namibia	Branko	Corner	branko@iafrica.com.na
7	Council for Geoscience	Gerhard	Graham	gerhardg@geoscience.org.za
8	Council for Geoscience	Eldridge	Kgaswane	ekgaswane@geoscience.org.za
9	Council for Geoscience	Martin	Brandt	martinb@geoscience.org.za
10	Council for GeoScience	Michelle	Smith	michelle@geoscience.org.za
11	Council for Geoscience	Johan	Steyn	jsteyn@geoscience.org.za
12	Council for Geoscience	Ian	Saunders	ians@geoscience.org.za
13	CSIR Miningtek	Ray	Durrheim	rdurrhei@csir.co.za
14	CSIR Miningtek / SAGA	Declan	Vogt	dvogt@csir.co.za
15	Cube Geophysics	Mark	Muller	mark@cube-geophysics.com
16	De Beers	Moctar	Doucoure	Moctar.Doucoure@debeersgroup.com
17	Department of Science and Technology	Anati	Canca	
18	Dublin Institute for Adv. Studies	Alan	Jones	alan@cp.dias.ie
19	Geoforschungszentrum Potsdam, Germany	Oliver	Ritter	oritter@gfz-potsdam.co.za
20	Geol Survey Malawi	Lostina	Chapola	Lostinachapola@yahoo.com
21	Geol Survey of Namibia	Dave	Hutchins	dhutchins@mme.gov.na
22	Geol. Surv. Botswana	Tarzan	Kwadiba	tarzan_kwadiba@yahoo.com
23	Geol. Surv. Botswana	T.H.	Ngwisanyi	tngwisanyi@gov.bw
24	HartRAO	Sakia	Madiseng	ludwig@ludwig.hartrao.ac.za
25	ITC Netherlands	Colin	Reeves	reeves.earth@planet.nl
26	National Director of Geology - Maputo	Elias	Daudi	exfdaudi@teledata.mz
27	NRF	Rob	Drennan	robd@nrf.ac.za
28	NRF	Candice	Levieux	candice@nrf.ac.za
29	Penn State University	Andy	Nyblade	andy@geosc.psu.edu
30	PetroSA	Abdullan	Jawoodien	abdullah.jawoodien@petrosa.co.za
31	RAU	Jay	Barton	jmb@na.rau.ac.za
32	Schlumberger Luanda	Silke	Sheppard	ssheppard@luanda.oilfield.slb.com
33	Schlumberger Luanda	David	Seabrook	dseabrook@slb.com
34	Tanzani Petrol Dev. Corporation	Elias	Kilembe	ekilembe.tpd@raha.com
35	Tanzani Petrol Dev. Corporation	Kelvin	Komba	komba.tpd@raha.com
36	Uganda Geological Survey	Fred	Tugume	seismo@afsat.com
37	Univ. Botswana	Henri	Kampunzu	Kampunzu@mopipi.ub.bw
38	University DAR	Richard	Ferdinand	rf@uccmail.co.tz
39	University of Botswana	Kebabonye	Laletsang	Laletsante@mopipi.ub.bw
40	University of Cape Town	George	Smith	gsmith@geology.uct.ac.za
41	University of Ibadan	A	Olayinka	idoure.olayinka@mail.ui.edu.ng
42	University of Lagos, Nigeria	Elijah	Ayolabi	eojelabi@yahoo.com
43	University of Nairobi	Gladys	Kianji	kianji@yahoo.com
44	University of Namibia	David	Robertson	djr@unam.na
45	University of the Witwatersrand	Gordon	Cooper	cooperg@geosciences.wits.ac.za
46	University of the Witwatersrand	Paul	Dirks	dirksp@geosciences.wits.ac.za
47	University of the Witwatersrand	Mike	Jones	jonesm@geosciences.wits.ac.za
48	University of the Witwatersrand	Sue	Webb	webbs@geosciences.wits.ac.za
49	University of Yaounde	Charles	Tabod	ctabod@uycdc.uninet.cm
50	University of Zimbabwe	Teddy	Zengeni	zengeni@science.uz.ac.zw
51	University of Zimbabwe	Jane	Gore	jgore@science.uz.ac.zw

52	Uppsala University	Björn	Lund	bjorn.lund@geo.uu.se
53	Zambian Geol Survey	Daniel	Lombe	seismic@coppernet.zm
54	Zim Geol Survey	Tongesai	Kapondo	tkapondo@bornagain.com, zgs@mweb.co.zw

Appendix 5: Explanation of Roles and Resources pledged by the Principal Partners in AfricaArray (situation on 14/07/2004).

Principal Participating Institutions in the AfricaArray Programme (on 12 July 2004):

University of the Witwatersrand (S.A.), School of Geosciences (Prof. Paul Dirks)
Penn State University (U.S.A.), College of Earth and Mineral Sciences (Prof. Andy Nyblade)
Council For Geoscience (S.A.) (Dr. Gerhard Graham)

Others are invited to partner

At this stage there are two major South African partners in the *AfricaArray* project, the School of Geosciences, University of the Witwatersrand and the Council for Geoscience. The School of Geosciences, through its training of B.Sc., M.Sc. and Ph.D. geophysicists in Africa, brings a functioning training program to the project. The Council for Geosciences brings both a technical training program and an extensive array of working seismometers including database facilities. The US partner institution is Penn State University. The Department of Geosciences at Penn State University has a highly regarded geophysics faculty (6 faculty in geophysics, including 4 seismologists) and will provide technical support for training and seismic station operation to the South African partner institutions. These contributions are detailed below and the breakdown of the institutional match is as follows:

	Total US\$
University of the Witwatersrand	\$945,450
Council for Geoscience	\$684,106
Penn State University	\$96,926
Total	\$1,726,482

School of Geosciences (SOG), Wits University

Wits University is one of South Africa's premier Universities positioned in the country's economic heartland in the center of Johannesburg. The School of Geosciences is the largest grouping of Geoscience Academics in Africa, and has a long and close relationship with South Africa's mineral resource industry. It is a leading Geoscience teaching and research institution in South Africa in the fields of Applied and Mining Geology, Economic Geology, Geology, Palaeontology, Palaeoanthropology and Geophysics. Academic and technical personnel amount to 75 people with an additional supplement of 12 post-doctorate fellows. The School enrolls 470 undergraduate, and 99 M.Sc. and Ph.D. students that originate from across Africa and the world. The Geophysics department enrolls 12 B.Sc.(Hons) and 9 M.Sc. and Ph.D students.

The School of Geosciences and Wits University maintain the following equipment and facilities that are available for the duration of the AfricaArray programme:

- Geological, geochemical, geophysical training facilities and laboratories
- Training programme in geophysics at undergraduate, B.Sc.(Hons) and post-graduate levels.
- A wide range of analytical facilities
- International e-mail and Internet access
- Map production facilities
- Science libraries including a wide range of Geo-scientific books, magazines and articles
- National and international collections of geological information and maps
- A wide range of student facilities
- Teaching and research computer laboratories, both PC and Unix based.

Geophysics in the SOG is taught at B.Sc.(Hons) (i.e. 4th year) and post graduate levels (M.Sc. and PhD by research).

Geophysics service courses are provided to undergraduates (B.Sc.) in Geology and Physics. The current Faculty include three lecturers supplemented by two Honorary Research Associates and consultants hired on a needs basis.

The SOG is willing to make its teaching facilities available to accommodate geophysics training as envisaged within the *AfricaArray* project. For the next three years, starting from January 2005, this will include the provision of training facilities to five B.Sc. general students, 15 B.Sc. Honors students in Geophysics and five M.Sc. students from participating countries including South Africa, under the provision that they will meet the normal entry requirements set by the University.

An estimate of the in-kind value of this support is provided below. Registration and tuition costs cannot be provided free of charge, and have not been included.

Item	note	Year 1	Year 2	Year 3	TOTAL
SALARIES	1, 2	US\$	US\$	US\$	US\$
Teaching staff Geophysics (70%)	3	79,000	84,000	90,000	253,000
Administrator (10%)	4	2,800	2,900	3,100	8,800
Technical support (10%)	4	2,800	2,900	3,100	8,800
Teaching Geology I to Geophysics Hons	5	2,600	2,800	3,000	8,400
Teaching 5 B.Sc. general students	6	133,000	143,000	153,000	429,000
INFRASTRUCTURE					
Space allocation	7	36,250	38,900	41,500	116,650
Toyota Hilux (4WD-pick-up)	8	12,000	0	0	12,000
Computers	9	12,800	0	0	12,800
Computer/network maintenance	10	1,000	1,000	1,000	3,000
Running expenses Geophysics		16,000	16,000	16,000	48,000
Bursary funding (cash)	11	15000	15,000	15000	45,000
TOTAL		313,250	306,500	325,700	945,450

Notes

- Annual inflation correction: 7%
- Exchange rate: 1 US\$ = 6.6 Rand
- Total salary bill for three staff (2004 figures): R742,850 = US\$112,553. 70% of staff time has been allocated to teaching and supervision as part of AfricaArray.
- Administrator/technical assistance, School of Geosciences: Salary (2004 figures): R180,000 = US\$ 27,273. 10% of staff time has been allocated to support AfricaArray.
- Geology I is a prerequisite for all Geophysics Honours students. Geology 1 represents a work load = 50% senior lecture load @ 50 students. For 5 Honours Geophysics per year a lecture load of 5%. Senior lecturer salary: R280,000 = US\$ 42500 (5% = US\$ 2125). In addition student assistant time has been estimated @ US\$ 500.
- Cost has been calculated for 5 B.Sc. general students graduating with a B.Sc. in Geology and Physics. Total salary bill Geology (2004 figures): R5,499,000 = US\$833,000. Undergraduate teaching load: 40%, average number of B.Sc. graduates 25/year. Thus, 8% of total salary budget has been allocated to Africa Array. The resultant amount has been doubled to reflect a similar contribution made by the School of Physics at Wits.
- Space allocation: US\$36,250/year Rate: R900/sqm (= US\$135/sqm). Space allocated 268.5 sqm made up as follows:
Geosciences building: room #215 (staff room Jones: 22 sqm); #219b (student room: 25 sqm); #219-221-223 (postgraduate student rooms @ 10.5 sqm /room); #223 (staff room Webb: 10.5 sqm); #224 (computer room & Unix server: 36 sqm); #226 (staff room Cooper: 17.5 sqm); #120 Geophysics Honours lecture room: 36 sqm ; room allocation for 1 extra lecturer and 2 post-doctorates: 40 sqm; storage space 50 sqm.
- Toyota Hilux (FPX 797GP), 1998 fully serviced, 4WD vehicle.
- Computers: 8 computers, one-off contribution to the project @ US\$1600/computer
- Maintenance fee for computer lab; software upgrades, network service etc.
- Through its BHPBilliton staff development bursary funds, the School can make available funding to South African students in Geosciences that are part of AfricaArray.

Council for Geoscience (CGS)

The **Council for Geoscience** is a South African para-statal organization based in Pretoria. It specializes in all geosciences viz. regional geological mapping, mineralogy, geochemistry, palaeontology, geophysics, seismology, geohydrology and economic geology. The professional and technical personnel amount to 200 geoscientists and geotechnicians who are supported by the latest in-house technology.

The Council for Geoscience maintains the following equipment and facilities and these are available for the duration of the AfricaArray programme:

- International e-mail and Internet networking
- Map production facilities - ARC INFO GIS
- Bibliographic database (SAGEOLIT) containing bibliographic references to geoscience journal articles, books and maps
- Aerial photo database for South Africa
- National and international collection of geological information and maps
- International library of geosciences books, magazines and articles
- Extensive collection of LANDSAT imagery
- Fully equipped geological, geochemical, geophysical, seismological and geotechnical laboratories
- National databases for soils and engineering geology, exploration borehole logs, South African mineral resources, airborne geophysics
- Seismological network of stations throughout Southern Africa for seismic monitoring and hazard assessment

The CGS has a seismology section with eight seismologists/seismic analysts, one mathematician, four electronics technicians and one software and database support staff. Scientists and technical staff can be drawn from the pool of resources from the Seismology Unit as required.

The CGS has extensive data gathering and data analyses capabilities that can be used during AfricaArray, including:

- 1) The South African National Seismograph Network (SANSN): Eleven stations have the required infrastructure (vaults, power and communication) in place. The CGS will collect and make the data available at its premises in Pretoria. The station locations can be seen in Figure 2 (Phase 1).
- 2) The Seismological Network of Malawi: For a number of years, the CGS has assisted in the maintenance and upgrading of the seismograph network of the Geological Survey Department of Malawi (GSDM). The four stations seem to provide a good coverage of Malawi. The data of these stations will be made available to *AfricaArray*. Data quality would have to be improved, and it will be necessary to install broadband seismometers at the stations. A map of the station locations is provided in the CGS letter of intent.
- 3) Other Seismological Stations in Eastern and Southern Africa: Apart from the seismological stations in Malawi, the Council for Geoscience has also installed and is operating one station in Kigali and five in Mozambique. The data from the station in Kigali will also be available to the *AfricaArray*, but only from the second year as the CGS would have to refurbish the entire station. Data from the five stations in Mozambique could be secured through discussion with the National Directorate of Geology in Maputo, and hence could also become available to *AfricaArray* during the course of Phase 1. A map of the station locations is provided in the CGS letter of intent.

An estimate of the in-kind support provided by the CGS to *AfricaArray* is provided below.

Item	note	Year 1	Year 2	Year 3	TOTAL
SALARIES (CGS)	1, 2	US\$	US\$	US\$	US\$
Operation (20%)	3	15,491	16,576	17,736	49,803
Administration (5%)	4	1,212	1,297	1,388	3,897
Technical support (25%)	5	11,770	12,594	13,475	37,839
Maintenance (30%)	6	12,390	13,257	14,185	39,832
Training and supervision (8%)	7	16,883	18,065	19,329	54,277
INFRASTRUCTURE					
Seismic equipment	8	293,465	0	0	293,465
Vehicle allocation (32,000km)	9	7,273	7,273	7,273	21,819
Space allocation	10	4,058	4,058	4,058	12,174
Training material	11	5,000	5,000	5,000	15,000
Running expenses of seismic network (15 stations)		35,000	35,000	35,000	105,000
Kigali station	8	0	28,500	0	28,500
Bursary funding	12	7,500	7,500	7,500	22,500
TOTAL		410,042	149,120	124,944	684,106

Notes

- Annual inflation correction: 7%
- Exchange rate: 1 US\$ = 6.6 Rand
- Total salary bill for three staff (2004 figures): R511,219 = US\$77,457. 20% of staff time has been allocated to the operation of the stations as part of AfricaArray.
- Administrator: Salary (2004 figures): R160,000 = US\$ 24,242. 5% of staff time has been allocated to support AfricaArray.
- Total salary bill for two staff (2004 figures): R310,731 = US\$47,080. 25% of staff time has been allocated to technical support as part of AfricaArray.
- Total salary bill for two staff (2004 figures): R272,573 = US\$41,299. 30% of staff time has been allocated to maintenance of stations as part of AfricaArray.
- Total salary bill for four staff (2004 figures): R1,392,836 = US\$211,036. 8% of staff time has been allocated to supervision and training as part of AfricaArray.
- Seismic equipment available to AfricaArray. Four systems with KS2000, R140 000 each; One system with Akashi seismometer, R190 000; Five systems with Guralp CMG 40T, R125 000 each; One Nanometrics system with STS2, R421,870. Malawi systems, R35 000 each (seismometers excluded). Total = R 1,936,870 = US\$ 293,465. Upgrade of station in Kigali, Rwanda, with new equipment. US\$ 28,500. AfricaArray to provide broadband seismometer (Year 2).
- Vehicle costs for maintenance trips. Provision for 32,000km @ R3/km per annum, 50% for support as part of AfricaArray. Total = R96,000*1/2 = US\$7,273
- Space allocation: Rate: R30/sqm/month. Space allocated 248 sqm made up as follows: Seismology Unit computer room: room 50 sqm; electronics laboratory 198 sqm. Total R30 *248*12 = R 89,280 = US\$ 13,527. 30% support to AfricaArray = US\$ 4,058
- Provision made for training material for students from African countries.
- Staff development bursary funds.

Penn State University

The Department of Geosciences at Penn State University is a nationally ranked department with 33 faculty representing many fields within the geosciences. The graduate program in geophysics offers MSc and Ph.D. degrees with specialization in seismology, rock mechanics, geodynamics, and heat flow. Affiliated with the geophysics program are active research groups in tectonics, structural geology, basin analysis, and geomorphology. There are six faculty in geophysics, about 20 geophysics graduate students (MSc and Ph.D.), and course offerings at the graduate level cover a wide range of topics. The teaching and research facilities within the geophysics program at Penn State will be made available to this project. They include a state-of-the-art computational facility (Unix-based workstations and compute-servers), plus a large library of software for manipulating and interpreting geophysical data.

The major role for Penn State will be to provide technical support for teaching geophysics courses at the University of the Witwatersrand and for operating and maintaining the seismic equipment. Faculty at Penn State will also assist in supervising the research projects of the MSc students trained as part of AfricaArray. Prof. Andrew Nyblade, the project leader at Penn State, was born and raised in Tanzania and has conducted geophysical research in eastern Africa for almost 20 years. He brings years of experience working in Africa to this project. An estimate of the in-kind support (match) provided by Penn State to AfricaArray is provided below.

Item	note	Year 1	Year 2	Year 3	TOTAL
SALARIES		US\$	US\$	US\$	US\$
Nyblade – teaching 1 month	1	6,000	6,000	6,000	18,000
Nyblade – release time from teaching	2	10,000	10,000	10,000	30,000
Fringe benefits on salaries	3	4,755	4,770	4,785	14,310
INFRASTRUCTURE					
Computer usage by students	4	1,611	1,668	1,721	5,000
Indirect Cost Recovery	5	9,841	9,872	9,903	29,616
TOTAL		32,207	32,310	32,409	96,926

Notes

1. Nyblade will spend 1 month each year teaching AfricaArray students or assisting Univ. of Wits faculty on course design and implementation.
2. Nyblade will received a 1 course reduction from the Department of Geosciences for his participation in AfricaArray.
3. PSU fringe rate is 27% on faculty salaries
4. AfricaArray students will use the geophysics computing lab at Penn State.
5. PSU indirect cost rate is 44%