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The need for a geoscience education roadmap for Africa

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The African continent is a geological paradise for its geodiversity and richness of natural resources. Geoscience education is essential as it provides opportunities for social/cultural, academic, scientific and professional growth and development. Despite several initiatives that have been started recently on this subject, they have not yielded concrete actions, due to the complexity of the African scenario, and also to the lack of clear and tailor-made geoscientific guidelines. This article summarizes the main recommendations and declarations, which currently exist and have been adopted since 2006, involving partnership and capacity building on geodducation. The article highlights the launching of a new mid to long term, IUGS-based project named GEO-ERA: GEOscience Education Roadmap for Africa. Here we make a call upon all interested African and international institutions, organizations, societies and associations to collaborate and assist and be a part of the development and construction of the GEO-ERA, as well as in the execution of the geoeducational activites.

Introduction

Africa has a fast growing population of one billion people, yet 75% of the continent is sparsely inhabited. Africa’s population size is expected to double to nearly two billion by the year 2050 (Sippel et al. 2011). Africa is a rich continent in terms of mineral, oil, gas, water and energy resources such as wind and solar energy in addition to its potential for hydroelectric production. However, to harness these resources, and, what is more important, to progress in knowledge, learning from their geological situations, one needs capital and human capacity. Although the majority of the population is young and developing, there are political and economic factors that have hindered this advance. In a globalized world, this cannot continue as in the past. The need for the natural resources from Africa is attracting investors from more developed countries and especially from the emerging economies. The problem that Africa is facing now, is to be in a good position to cope with certain scientific as well as legal agreements, dealing with such large investments that can have lasting consequences for the sustainable development of the continent. But it is extremely important to educate the youth in the different fields of social as well as natural sciences. Thus, geoscience education is crucial.

The significance of geoscience education

Geoscience education is a key factor in the academic, scientific and professional progress of any modern society. Africa is a priority for UNESCO and education is crucial for the development of the whole continent. The International Union of Geological Science (IUGS) shares this view, and considers geoscience education in Africa as a focal point in mobilizing knowledge, information, skills, and initiatives. In order to advance in earth science education and research, a key factor will be to use all partnership resources (universities, research organizations and societies, geological surveys, policy makers (e.g. Ministry of Mines), and also private companies) which are involved in the respective African countries. King (2011) in his article entitled “In a trade war, would you rather have armies of lawyers or geologists?” stated several important points regarding this subject. We quote here just one paragraph:

“50,000 students are studying geology in China today. That number is well over 25 times the number of college students who are studying geology in the U.S. This is an important development. There is a revolution occurring in the scientific approach to understanding the Earth. The fields that make up geology, and related Earth and space sciences, are currently undergoing major advances that promote understanding of our planet as a number of interrelated systems. Many new realms of scientific investigation are emerging through the study of the connections and interactions between the atmosphere, hydrosphere, biosphere, cryosphere, solid Earth, and near space. Furthermore, geoscientists are playing critical roles in recognizing the extent and magnitude of human impact on the entire Earth system. And this understanding is gaining new context via the growth in knowledge of processes on other planets. So the more people who are out there and who understand at least the basics of geology (let alone the really hard stuff), the better for that nation.” (King, 2011)

Geoscience education is becoming very important, not only in developed and emerging economies but even more in continents like Africa where most of the areas are not explored, not mapped and many of the potential natural resources are not known. Those that are explored and some that are being mined might have been known or
explored during the colonial time and also have been easily accessible. At the moment, infrastructural facilities like the transportation, energy and telephone infrastructures are increasingly developing in Africa, paving the way for more geological mapping to be done, more exploration for mineral and energy resources to be conducted. The question is who is going to do this? Africans or the expensive expatriates who come with the investors? What happens when the companies leave? It is important to have a strategy to develop the earth sciences and the related research sector to train as many local geologists as possible, develop the educational and research infrastructures of universities, faculties and departments of natural sciences, and encourage the establishment of regional centres of excellence in Africa.

As previously stated, the African continent has a population of ca. 1 billion which is increasing every year. Developing a scientific research infrastructure for the earth sciences, which one can consider minimal, can make a difference in the development strategy of the continent. It is time to make priorities (knowledge is always a priority) and educate, investing in fields which will bring high return, and help the appropriate sustainable development of the natural resources sector of the African countries.

**Geoscience education in Africa: understanding the general panorama**

Despite several geoscience education plans and programs that have begun recently, they have not still materialized on the ground. Among them, probably the most significant one is the UNESCO initiative in Earth Sciences Education for Africa (UNESCO, 2009), which is mainly based on a set of previous cooperation meetings and “declarations”, these are: Maputo Declaration (2006); Arusha Declaration – Launch of the International Year of Planet Earth (IYPE), Tanzania (2008); Paris and Pretoria Declarations (2009). The most important recommendations are: (1) to strengthen scientific infrastructures and promote regional centers of excellence for the teaching of geosciences in Africa; (2) to improve access to geoscientific knowledge through a revision of the national educational systems; (3) to call upon the African Union to develop a Strategic Plan for a balanced development of Africa; (4) to support the AEGOS Initiative (African-European Georesources Observation System) (AEGOS, 2011) aiming at developing an information system to be distributed and shared; (5) to invite the African geoscientific community and civil society to actively show, through IYPE, the great potential of geosciences in the building of a more safe, healthy and wealthy Africa, and (5) to promote the creation of Geoparks (AGN, 2011) (Fig.1), biosphere reserves and African Sites of Geological Heritage, as an instrument of preservation and development.

Five workshops were conducted, related to the UNESCO initiative in 2009 and the beginning of 2010 in the different African regions. Their major Recommendations are the following: (1) Earth science community must engage in outreach exercises to educate the general public on the importance of earth sciences for society; (2) 21st century Earth System Science Education must transcend conventional view of geosciences and the teaching of Earth Sciences needs to be multidisciplinary in its approach; (3) Geology should be included in the school curriculum at primary and secondary levels; (4) it is important to build Industry and Academia connections; (5) reinvigorate old networks and build new ones between African researchers and the global research community; (6) counter the lack of adequate analytical facilities through exchange, sharing and procuring new equipment through novel funding mechanisms, and (7) improving earth science education requires addressing many elements of the status of earth science in Africa but must also focus on teaching. Further information can be found in the UNESCO website and the GSAF Newsletters (UNESCO, 2009, Vasconcelos, 2012).

In addition, three significant partnership and cooperation on African activities also deserve special attention: (1) the Colloquium of African Geology. It was the objective of the Geological Society of Africa to deal with earth science education and research by using its platform “The biannual colloquium of African Geology”. This Colloquium has significantly contributed to presenting research results on African Geology and provided a meeting place for exchanging ideas and establishing new networks and strengthening the existing ones. Till now, 23 biannual colloquium have been organized in Europe and Africa. The 24th Colloquium will take place in January 2013 in Addis Ababa, Ethiopia; (2) the cooperation with African-European Georesources Observation System (AEGOS) (AEGOS, 2011). The main objectives were: (a) to draw a panafriacan infrastructure of inter-changeable data and of services, user friendly, to strengthen the sustainable use of georesources in Africa; (b) to contribute to GEOSS (Global Earth Observation System of Systems) (GEOSS, 2011) through the installation in Africa of an observation system of the Solid Earth; (c) to elaborate common strategies for capacity building and training programs, and (d) to support geoscientific communities and institutional decision makers in the definition of sustainable development policies; and (3) the cooperation with Geoscience InfoRmation in...
The mission is to ensure that knowledge-based geosciences information contributes to improve the environmental and economic prosperity of people in Africa by: (a) building a pan-African geosciences information knowledge network of geological surveys, universities, research institutes and companies; (b) exchanging and sharing geosciences information and good practice; (c) bringing together relevant African authorities, national experts and stakeholders in geosciences information; (d) making Africa a more active component of the international geosciences information community, and (e) encouraging the contribution to and creation of cross-border and global geosciences information standards.

**GEO-ERA: GEOscience Education Roadmap for Africa**

The IUGS Commission on Geoscience Education, Training and Technology Transfer (IUGS-COGE) was established in 2004 to examine and develop programs to assist developed and developing countries to maintain, expand or introduce better Earth Science education, outreach and technology transfer within their own countries (IUGS-COGE, 2012). Despite the numerous science education activities focused on Africa, there is not yet a real “Geoscience Education Roadmap” for the whole continent, which takes into account not only that “Africa is one”, but also the diversity of its regions and the idiosyncrasies and specific needs of each African country. Thus, following the IUGS recommendation concerning Africa as a potential location for the development of IUGS-COGE activities, the need of launching a new, mid to long term (2012-2016) project, named GEO-ERA (GEOscience Education Roadmap for Africa) was proposed and advanced during the IUGS meeting in February 2011 in Paris, as a multi-institutional approach to chart the course ahead, learning and taking full advantage of other previous geoscience education initiatives (e.g. Earth Science Education Initiative in Africa) (UNESCO, 2009), and incorporating an additional geoethical approach (Martinez-Frias et al. 2011).

GEO-ERA basically attempts to complement all preceding geeducational actions, providing the entire African continent with a geeducational roadmap, as a basis for executing concrete and practical actions. These actions will be coordinated by the Geological Society of Africa (GSAf), the main partner, with other international institutions and organizations (e.g. UNESCO, Association of Geoscientists for International Development - AGID, Center International pour la Formation et les Echanges en Géosciences - CIFEG), with two principal essential prerequisites: (1) GEO-ERA will be developed by Africans, and (2) GEO-ERA will enhance the visibility of the contributions linking “Geoscience Education” and “Africa” through the production of basic publications and thematic contributions in prestigious journals (e.g. Episodes, Journal of African Earth Sciences) (Martinez-Frias, 2012a). It is planned to build the initiative through the following steps: (1) arrangement of first contacts/meetings; (2) definition of the main goals; (3) selection of African teachers/experts; (4) coordination by regions/countries and also by subjects/priorities; (5) design, definition and identification of partial roadmaps; (6) development of theoretical and practical (laboratory and field) activities; (7) production of essential publications and organization of public outreach activities, and (8) workshops and thematic meetings. Figure 2 shows a schematic diagram plan to describe the different steps involved in the construction of GEO-ERA.

GEO-ERA has been unanimously agreed by all members of the IUGS-COGE and also was evaluated positively by the IUGS Ad-Hoc Review Committee at its meeting held in Madrid (September, 2011).

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**Figure 2. Schematic diagram plan of GEO-ERA for the period 2012-2016**

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**Figure 3. During the 63rd IUGS Meeting held in San Sebastian, Basque Country (Spain), in which GEO-ERA was officially approved, there was a special geological fieldtrip to the area of Zumaia. The spectacular Zumaia outcrops exemplify very well the significance of the field studies (e.g. geosites, geoparks) in geoscience education.**
GEO-ERA was officially approved in the framework of the 63rd IUGS Executive Committee meeting (San Sebastian, Spain, 2012) (Fig.3). This project was also presented, in Paris (Martinez-Frias, 2012b), in the workshop organized by UNESCO and the International Geoscience Programme - IGCP’s 40th Anniversary, entitled “Earth Science Education globally – connections between research and education”. A first significant initiative, which is already set within the context of GEO-ERA, is named “Promoting school-level Geoscience Education across Africa”. Basically, this is a joint proposal by UNESCO, IUGS-COGE and IGEO (International Geoscience Education Organization), which involves the following elements: (1) a week-long ‘launch pad’ symposium hosted in an African country, to which teams are invited from other African countries/regions, to develop local strategies to promote school-level geoscience education and to prepare a ‘school-level geoscience education plan’ specifically for their situations; (2) ongoing post-symposium support, from UNESCO, IUGS-COGE and IGEO to monitor progress on the geoscience school-level education plans, and (3) a further symposium, at a time in the future to be determined, to review progress on the plans and to develop enhanced support mechanisms. A key part of the plan involves the African teams developing school-level geoscience educational solutions for their own countries, based on their own experience and expertise, with support provided by members of the three organisations who have experience of such initiatives. Further information can be found in the IUGS COGE website (www.iugscoge.com).

Final remarks

A strategic roadmap is a plan that recommends objectives, strategies and pathways for the future of an organization or group. We geoscientists, are very clear of significance of “having a map”, discerning how each role and task matches with the process toward accomplishing the goals in the most efficient manner. It involves defining a vision identifying the goals, analyzing the gaps, being aware of the appropriate human and material resources, developing a tactical plan, and reviewing and finalizing the roadmap. In the framework of the Fifth Ordinary Session of the Conference of Ministers of Education of the African Union (COMEDAF V, http://www.comedafv.com/), a recent discussion (April, 2012) involved how to: (a) implement the Plan of Action for the Second Decade of Education for Africa; (b) make recommendations concerning the Commission’s education programme, and (c) consider reports on the performance of member states and related agencies in education. It is our duty and responsibility as earth scientists to be able to integrate our geosciences education roadmap such more general contexts, resulting in concrete and practical results.

We feel that Episodes is the perfect place to call upon all interested African and international institutions, organizations, societies and associations to collaborate and assist and be a part of the development and construction of the GEO-ERA, as well as in the execution of the geoscientific activities.

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