Geological Society of Africa

Newsletter

Volume 11 - Issue 2
(June/July 2021)

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GSAf Council election (October 2021)

Call for bids: BID for the 29th Colloquium of African Geology (CAG29)

CAG28 is approaching, are you ready for the largest geo-scientific event in Africa?
Fez, Morocco (9th-17th October, 2021)

Edited by
Tamer Abu-Alam
Editor of the GSAf Newsletter

http://gsafr.org/newsletter/

Welcome to Fez, Morocco

The 28th Colloquium of African Geology
(CAG 28)

9th-17th October, 2021

Join the largest geo-scientific event in Africa

http://www.fsdmfes.ac.ma/CAG28/

In the issue

Geological Society of Africa – Newsletter
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http://gsafr.org

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GSAf MATTERS

Geological Society of Africa – Council election (October 2021)

Announcement from the council

Due to the Covide-19 pandemic, the GSAf council decided to postpone the election of a new council from 2020 to the General assembly which will be held in person in Fez, Morocco – October 2021.

Rules of election according to GSAf´s constitution:

1- Candidates for election to the Council shall have been bonafide fully paid-up Ordinary or Life Members, active in Society affairs for at least four (4) years in order to become eligible.

2- If necessary and useful for the society, members of the council who have served the two-term periods can be re-elected to another council position.

3- All posts are open to competition by qualified members. Elections to the Council shall take place every four (4) years at a General Assembly of the Society. The elected officers are eligible and can be re-elected to serve for one further term of four (4) years in the same or a different position. The maximum period that shall be served by a member of the Society on the Council shall be eight (8) years except in the case of the President who may serve on the Council for two (2) consecutive four (4) year terms, followed by one term of two (2) years as the Immediate Past-President of the Society.

4- Eligible candidates seeking election to the Council shall be nominated by at least two (2) members of the Society. The nominations shall be received by the Secretary-General at least three (3) months before the General Assembly, circulated by him/her to the member countries through the Vice-Presidents and Councillors and posted on the Society website. Where there is more than one nomination for a position on the Council, the election of officers shall be by ballot of members present at the General Assembly, excluding Associate and Honorary Members, with the proviso that no more than one (1) representative from a country can be elected to or hold office on the Council at any one time. In the event that no nominations for individual posts are received, the current Council shall endeavor to identify suitable candidates to present to the General Assembly for approval.

5- The Council shall have the power to fill any vacancies that may arise on the Council by co-opting paid-up members of the Society.

6- According to these rules, the following table shows the eligibility of members of the current council:

Post	Name	Title	Eligibility
President	Olugbenga Okunlola	Prof	Eligible
Past President	Aberra Mogessie	Prof	Not Eligible
Secretary-General	Maideyi Meck	Dr	Not Eligible
Honorary Treasurer	Asfawossen Asrat Kassaye	Prof	Honorary position
Membership secretary	Prosper M. Nude	Prof	Eligible
Newsletter editor	Dr Tamer Abu Alam	Ass. Prof.	Eligible
Vice President West	Yao Agbossoumonde	Dr	Eligible
Vice President East	Beneah Odhiambo	Prof	Not Eligible
Vice President North	Youssef Driouch	Prof	Not Eligible
Vice President South	Wladyslaw Altermann	Prof	Not Eligible
Vice President Central	Léon Bora Uzima Bahavu	Mr	Eligible
Councillor East	Jean-Claude Ngaruye	Mr	Eligible
Councillor North	Khouloud Mohamed	Dr	Eligible

Councillor South	Anna- Karren Nguno	Ms	Eligible
Councillor Central	Pending		
Councillor West	Adama Sangare	Dr	Eligible

Call for nomination

ELECTIONS FOR THE GSAf COUNCIL During the next CAG28 in Fez, Morrocco, in October 2021, elections for the positions within the Council of GSAf will take place. According to decisions taken and approved during the last General Assembly in Dar es Salaam, some restrictions have been introduced, as follows.

1. The position of President must be filled by one of the members in office;

2. The position of Treasurer, since the accounts are in Ethiopia, must be filled by a member-based in Ethiopia;

3. The position of Editor is nominated by the Council. All other positions are open for election,

Please be advised that current serving members who would like to continue should apply through the Secretary-General (maideyimeck@yahoo.com) with a cc to the President (gbengaokunlola@yahoo.co.uk) and Newsletter Editor (tamerabualam@yahoo.com)

For transparency. Every GSAf paid member with his/her updated CV can run for the open positions or even to the other for which there is already one or more candidates. Interested members should follow the same procedure as above. A CV and a photo, as well as a motivation declaration, should be sent also to the Secretary-General with cc to the President and to the Newsletter Editor

The nominations shall be received by the Secretary-General at least three (3) months before the General Assembly, circulated by him/her to the member countries through the Vice-Presidents and Councillors and posted on the Society website.

DUE TO THE COVID-19 PANDEMIC, THE SECRETARY-GENERAL MAY RECEIVE THE NOMINATIONS UNTIL TWO MONTHS BEFORE THE GENERAL ASSEMBLY.

Geological Society of Africa

http://gsafr.org/

BID for the 29th Colloquium of African Geology (CAG29)

The next 28th Colloquium of African Geology (CAG28) will take place in Fez, Morrocco in October 2021. The Colloquium of African Geology (CAG) is a major biennial meeting organized under the auspices of the Geological Society of Africa (GSAf). Since the first colloquium in 1965, this Colloquium has been hosted by several European and African countries. The African countries that had a chance to organize this event are Swaziland, Zimbabwe, Morocco, Mozambique, Tunisia, South Africa, Ethiopia, Tanzania and Nigeria.

The GSAf General Assembly, to take place during CAG28, will vote for the next place to organize CAG29 which will take place in 2023/4. For that, the Council of the GSAf needs to receive proposals that will be analyzed and presented to the General Assembly. Statutes demand that bids should be submitted to the GSAf Council, through its President or Secretary-General. It is GSAf practice that CAG's will rotatively be organized by the 5 regions (North, South, East, West and Central).

In that sense, we urge Africa and European countries to submit their bids latest 30th September 2021 to:

Prof. Gbenga Okunlola, President of the GSAf, gbengaokunlola@yahoo.co.uk

Dr. Maideyi Mabvira-Meck, Secretary-General of GSAf, maideyimeck@yahoo.com

CC Dr. Tamer Abu-Alam, Newsletter editor GSAf, tamerabualam@yahoo.com

Communications to the GSAf

Nature Reviews Earth & Environment

Dr. Laura Zinke (Senior Editor, Nature Reviews Earth & Environment, Nature Research) sends the following message to the members of the GSAf.

Dear Dr. Abu-Alam (information officer of GSAf),

I am emailing from Nature Reviews Earth & Environment, a journal from the Nature Portfolio. The journal has an article type called 'Tools of the Trade', which is led by early career researchers (mainly PhD students), and we are hoping that as the newsletter editor/information officer for the Geological Society of Africa, you might be able to help us get the word out about them to students in your networks? I've included some example links below, but essentially, these short (~300 words) articles are written on a method/instrument for a general geoscience audience, and include a photo of the method 'in action'. We are looking for authors, and while we've had strong representation from European and North American students, we would be grateful if you could alert students in Geological Society of Africa of this opportunity. Interested students should email us at nree@nature.com with their name/affiliation, the method/instrument they use in their research, some of its applications (preferably related to their own work), and the photo they would like to us.

I've included a couple of examples here in case those are helpful, please let me know if you would like any more information.

Exploring mantle evolution with atom probe tomography by Hamed Gamal El Dien: https://www.nature.com/articles/s43017-021-00172-w

Untangling aerosols from the sky with sunphotometers by Yueming Dong: https://www.nature.com/articles/s43017-020-0086-2

Drone-based surveys of mineral deposits by Robert Jackisch: https://www.nature.com/articles/s43017-020-0042-1

Thank you for your help, please let me know if you have any questions.

Best wishes,

Dr. Laura Zinke

Senior Editor, Nature Reviews Earth & Environment

Nature Research

The GSAf encourages students and junior researchers to submit their communication to Nature Reviews Earth & Environment journal.

KNOW AFRICA (COVER STORY)

River Nile, Egypt

The Nile is a major north-flowing river in northeastern Africa. The longest river in Africa, it has historically been considered the longest river in the world, though this has been contested by research suggesting that the Amazon River is slightly longer, the Nile is amongst the smallest of the major world rivers by the measure of cubic meters flowing annually. About 6,650 km (4,130 mi)[a] long, its drainage basin covers eleven countries: Tanzania, Uganda, Rwanda, Burundi, the Democratic Republic of the Congo, Kenya, Ethiopia, Eritrea, South Sudan, Republic of Sudan, and Egypt. In particular, the Nile is the primary water source of Egypt and Sudan (i.e., 90% of available resources in both countries).

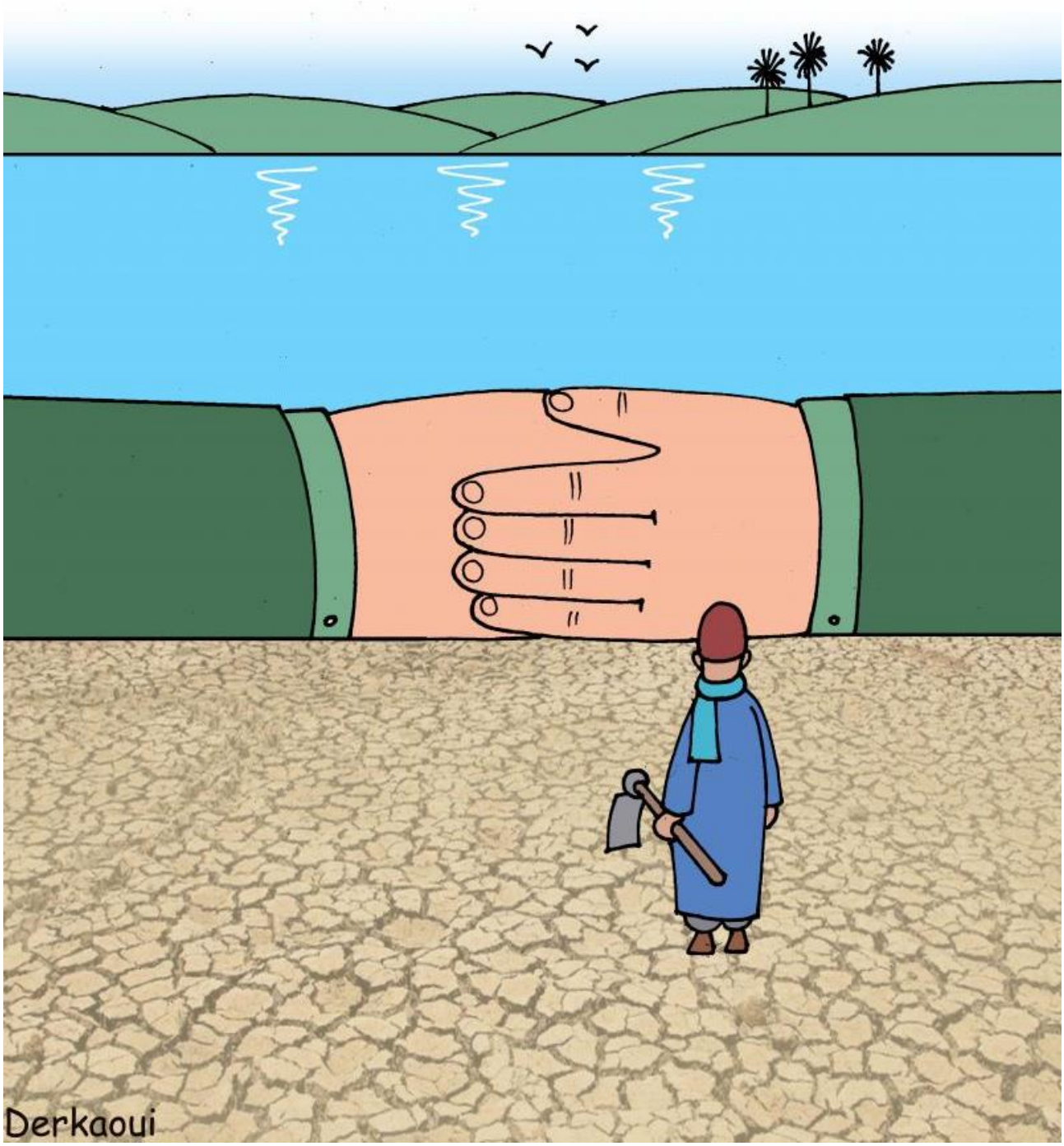
The Nile has two major tributaries – the White Nile and the Blue Nile. The White Nile is considered to be the headwaters and primary stream of the Nile itself. The Blue Nile, however, is the source of most of the water, containing 80% of the water and silt. The White Nile is longer and rises in the Great Lakes region of central Africa, with the most distant source still undetermined but located in either Rwanda or Burundi. It flows north through Tanzania, Lake Victoria, Uganda and South Sudan. The Blue Nile begins at Lake Tana in Ethiopia and flows into Sudan from the southeast. The two rivers meet just north of the Sudanese capital of Khartoum.

The northern section of the river flows north almost entirely through the Sudanese desert to Egypt, where Cairo is located on its large delta and the river flows into the Mediterranean Sea at Alexandria. Egyptian civilization and Sudanese kingdoms have depended on the river since ancient times. Most of the population and cities of Egypt lie along those parts of the Nile valley north of Aswan. Nearly all the cultural and historical sites of Ancient Egypt developed and are found along river banks.

(the image is - Modified from https://www.cosmosplus.com/node/793

The text is from https://en.wikipedia.org/wiki/Nile)

GEOLOGY COMIC



This section of the newsletter should include a geology comic, but there is no fun if there is no water. The image is without comment, without a caption.

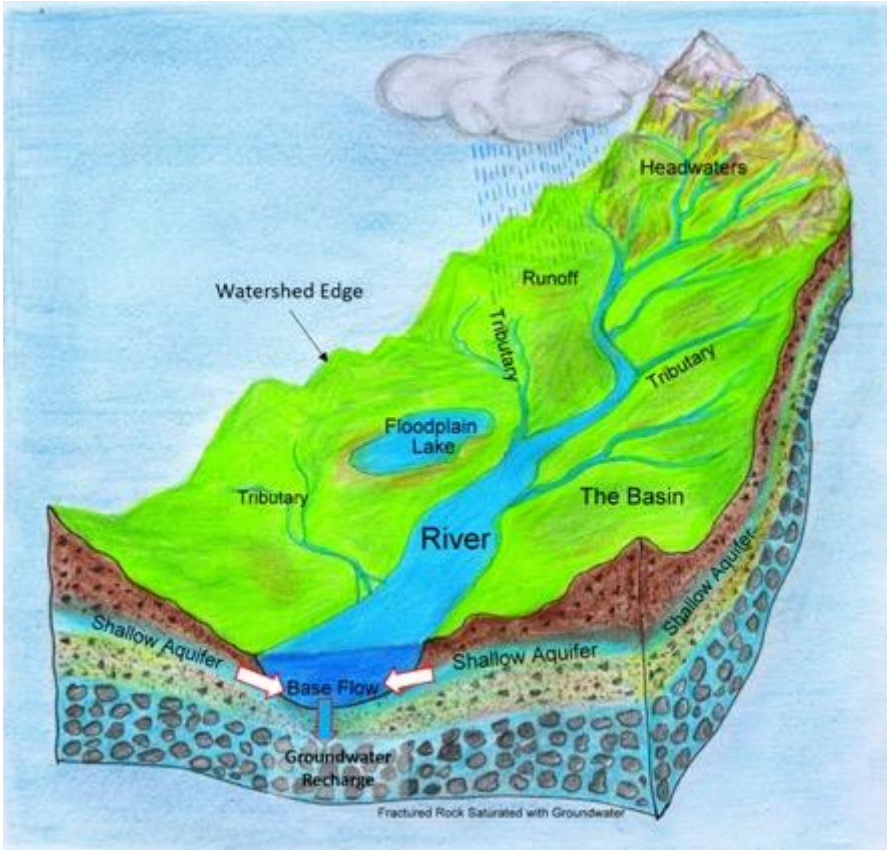
From: https://cartoonmovement.com/cartoon/nile-dam

GEOLOGICAL EXPRESSIONS

River basin

A river basin is the portion of land drained by a river and its tributaries. It encompasses all of the land surface dissected and drained by many streams and creeks that flow downhill into one another. As a bathtub catches all the water that falls within its sides, a river basin sends all the water falling on the surrounding land into the river.

As an artery connects the parts of a body to one another, so river threads together the creeks and streams, valleys and hills, lakes and underground springs that share a common assembly of water. Whatever happens to surface or groundwater in one part of the river basin will find its way to other parts. If water is diverted out of its downward course in one section, other parts will come to "know" of its absence. A river basin comes closer than any other defined area of land, with the exception of an isolated island, to meeting the definition of an ecosystem in which all things, living and non-living, are connected and interdependent.



modified from https://www.milwaukeeriverkeeper.org/whats-a-river-basin-whats-a-watershed/ and https://www.thethirdpole.net/en/regional-cooperation/opinion-an-equation-to-restore-river-basins-in-south-asia/

Welcome to Fez, Morocco

The 28th Colloquium of African Geology
(CAG 28)

9th-17th October, 2021

Third circular

English version: http://www.fsdmfes.ac.ma/CAG28/MDocs/files/CAG%2028%20Fez%20Third%20announcement%20I.pdf

French version: http://www.fsdmfes.ac.ma/CAG28/MDocs/files/CAG%2028%20Fez%20Troisieme%20Circulaire%20Fr.pdf

News from GSAf partners

The Geological Society of South Africa organizes several seminars and workshops in order to increase the competencies of African geoscientists. The following table shows some of these events organized during the following months. A full list of these activities is presented at the GSAf website (http://gsafr.org/seminars/).

Wednesday, July 28

1:00pm

Geoheritage Talks

Friday, July 30

1:00pm

Roskill talks about the outlook for electric vehicles, lithium-ion batteries and Africa's role in new energy applications

Wednesday, August 4

1:00pm

Career Pathways for Geoscientists - Resource Geologist and Mineralogist

Thursday, August 5

10:00am

Overberg Geoscientists & Roger Parsons

Friday, August 6

1:00pm

Dr Karen Smit - Diamonds from the central Kaapvaal document 2 billion years of lithosphere modification: ages from Voorspoed, Star and Bobbejaan

Tuesday, August 10

8:30am

ESG Inquisition

Wednesday, August 11
8:30am
ESG Inquisition

1:00pm
Career Pathways for Geoscientists - Hydrogeologist and Volcanologist

Thursday, August 12
10:00am
Overberg Geoscientists & Dylan Blake

Tuesday, August 17
8:30am
Precious Metals Day

Wednesday, August 18
1:00pm
Career Pathways for Geoscientists - Astrogeologist and more!

Thursday, August 19
10:00am
Overberg Geoscientists & John Compton

Saturday, August 21
Structural Geology Course with Prof Mike Watkeys

Sunday, August 22
Structural Geology Course with Prof Mike Watkeys

Wednesday, August 25
1:00pm
Geoheritage Talks

Thursday, August 26
10:00am
Overberg Geoscientists & Bruce Cairncross

Tuesday, August 31
8:30am
Practical Project Management Course for Exploration Geologists

Wednesday, September 1

Practical Project Management Course for Exploration Geologists

Thursday, September 2

Practical Project Management Course for Exploration Geologists

10:00am

Overberg Geoscientists & Jock Harmer

Friday, September 3

5:00pm

Practical Project Management Course for Exploration Geologists

Tuesday, September 7

10:00am

Drilling Methods and Techniques in Resource Exploration - Session 1

Thursday, September 9

10:00am

Overberg Geoscientists & Stephen Davey

Tuesday, September 14

10:00am

Drilling Methods and Techniques in Resource Exploration - Session 2

Tuesday, September 21

10:00am

Drilling Methods and Techniques in Resource Exploration - Session 3

Friday, September 24

1:00pm

Roskill talks about the copper outlook and the role of Africa

Tuesday, September 28

10:00am

Drilling Methods and Techniques in Resource Exploration - Session 4

News from GSAf partners

IUGS
International Union of Geological Sciences

The following are geosciences events supported and/or hosted by the IUGS for the coming months.

2 - 9 August 2021

Joint Conference of ISEH 2020 (5th International Symposium on Environment and Health), ICEPH 2020 (6th International Conference on Environmental Pollution and Health) & G16 2020 (7th International Conference on Research Frontiers on Chalcogen Cycle Science and Technology), Galway, Ireland

Website: http://www.nuigalway.ie/iseh2020/

16 - 20 August 2021

12th International Kimberlite Conference, Yellowknife NT, Canada

Website: https://12ikc.ca/

16 - 20 August 2021

34th International Geographical Congress, Istanbul, Turkey

Website: https://www.igc2020.org/en/

22 - 27 August 2021

47th Congress of the IAH - International Association of Hydrogeologists, São Paulo, Brazil

Website: https://iah2021brazil.org/en/

28 August - 4 September 2021

19th International Symposium on Vulcanospeleology, Catania, Italy

Website: http://www.19isvetna.com/

29 August - 2 September 2021

EMC2020 - 3rd European Mineralogical Conference, Cracow, Poland

Website: https://emc2020.ptmin.eu

5 - 9 September 2021

RawMat2021 - International Conference on Raw Materials and Circular Economy, Athens, Greece

"Technological Developments and Future Challenges"

Website: https://www.rawmat2021.gr/congress/

6 - 10 September 2021

48th Congress of the IAH - International Association of Hydrogeologists, Brussels, Belgium

Website: https://iah2021belgium.org/

6 - 10 September 2021

1st IAEG South American Regional Conference and 2nd Argentine Congress of Geology Applied to Engineering and the Environment, Córdoba, Argentina

Website: https://iaegsa2021.org/en/

6 - 10 September 2021

10th IAG International Conference on Geomorphology, Coimbra, Portugal

Website: http://www.geomorph.org/2020/04/1st-announcement-for-10th-iag-international-conference-on-geomorphology-6-10-sept-2021/

6 - 10 September 2021

WMESS 2021 - 7th World Multidisciplinary Earth Sciences Symposium, Prague, Czech Republic

Website: http://mess-earth.org/index.html

14 - 17 September 2021

SEG 100 Conference, Virtual

Website: https://www.seg100.org/index.html

19 - 24 September 2021

ESC 2021 - 37th General Assembly of the European Seismological Commission, Virtual

Website: https://www.escgreece2020.eu/

20 - 21 September 2021

EGCCC 2021 - Euro-Global Climate Change Conference, Paris, France

Website: https://magnusconferences.com/climate-change/

20 - 22 September 2021

NATHAZARDS2021 - Third AOGS-EGU Joint Conference on New Dimensions for Natural Hazards in Asia, Virtual Conference

Website: https://www.nathazards.org/

20 - 25 September 2021
EUROCK 2021 - Mechanics and Rock Engineering from theory to practice, Turin, Italy
Website: https://eurock2021.com

9 - 17 October 2021
CAG28 - 28th Colloquium of African Geology, 18th Conference of the Geological Society of Africa, Fez, Morocco
Website: http://www.fsdmfes.ac.ma/CAG28/

26 - 31 October 2021
DEEP-2021 - International Symposium on Deep Earth Exploration and Practices
Website: http://2021.sinoprobe.org/

31 October - 12 November 2021
COP26 - UN Climate Change Conference, Glasgow, United Kingdom
Website: https://ukcop26.org/

Contributions from GSAf partners

The following article appears at the blog of the IAPG

Meteorological or anthropogenic drought? A recent study illustrates the environmental, social and economic risks

By: by Silvia Peppoloni

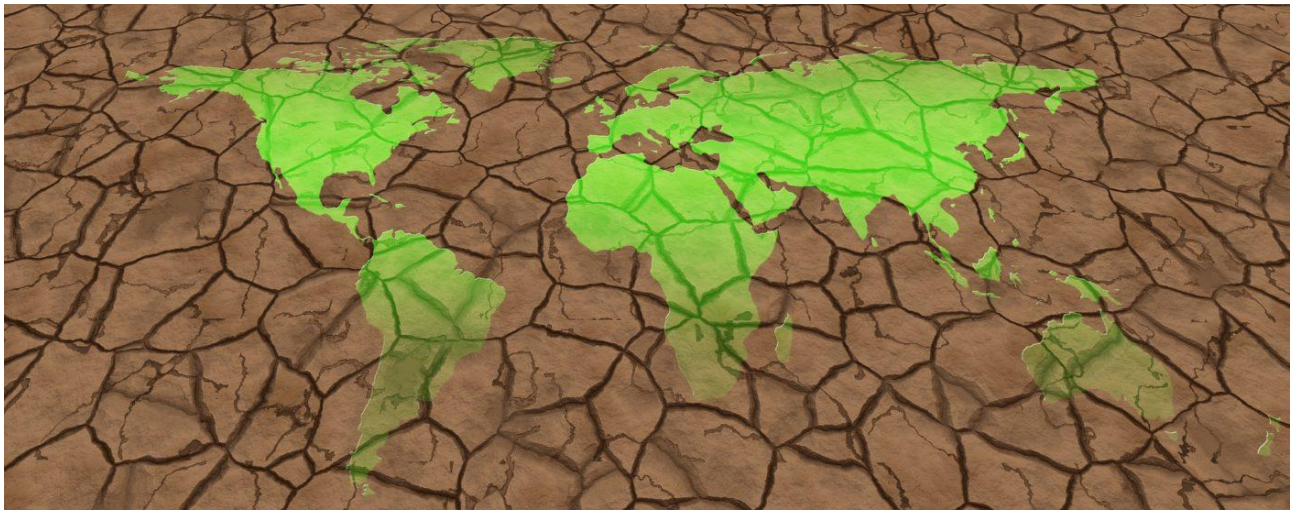
This article was published in ReWriters Magazine, in Italian and English:
https://rewriters.it/siccita-meteorologica-o-antropogenica-un-recente-studio-ce-ne-illustra-i-rischi-ambientali-sociali-ed-economici/

Included among the meteorological phenomena, drought is defined as the lack or scarcity of rain that lasts for an exceptionally long period of time (months to years), during which rainfall is scarce or insufficient to guarantee the balance between the natural availability of water and its consumption by the human being.

In many regions of the Earth, drought is a recurring phenomenon, even with a certain periodicity, and in this sense, it can be faced with appropriate strategies and actions. These include marine desalination works, the collection and storage of rainwater, the planting of crops that need low quantities of water, or recycling with purification of water already used.

Drought can cause a serious risk for the territory and the people who live there, as it involves severe environmental (fires, desertification), economic (reduction of cultivated areas, losses in industrial, agricultural and livestock activities) and social (famine, migration) mass, social tensions, wars) consequences. For this reason, it should not be considered only an effect of the water deficit, but it should be studied, modeled and parameterized including also the anthropic interactions with nature. It is on this point that the authors of a recent article published in the scientific journal Reviews of Geophysics insist: there is also the “anthropogenic drought”, where it is human activities rather than natural factors that cause or intensify drought and its impact.

But how is it possible to incorporate anthropogenic drought into forecasting models, so that its effects can be planned and mitigated for the future?



The intensity of the drought is expressed through indices: the most used internationally is the Standardized Precipitation Index (SPI), whose value quantifies the surplus or deficit of rainfall compared to the average values. However, this indicator explains the availability of water from a meteorological point of view but does not consider the bidirectional interactions between human action and the environment, especially it does not take into account the way in which human activities can change rainfall, increase the risk of water stress or altering the microclimatic conditions. It also does not consider the impact of local water demand or land management practices. For this reason, the authors believe it is more effective to define and treat drought as a multidimensional and multiscale phenomenon.

The evidence of this methodological perspective is immediate, if we consider the combined effects of climate change and human activities. Multivariate climatic conditions could make the negative impacts of drought events more devastating, as the planet's temperatures will continue to rise in the coming years, with unpredictable repercussions on water demand and water use, particularly with increases in demand by the agricultural sector. Furthermore, the frequency and distribution of droughts can affect renewable energy production and current and future economic balances which, in turn, can increase the anthropogenic CO_2 footprint and subsequently affect rainfall conditions and the severity of the anthropogenic drought, in a negative feedback mechanism. In addition, drought can change the length of the plant growing season, local hydrology and the carbon uptake period.

Making forecasts on drought is in general very difficult, but predicting and planning interventions by introducing anthropogenic drought into the analysis models can be a real challenge for science, due to the different rates of development and the different demand for water that characterizes various countries and regions of the world.

However, despite the gloomy picture, we can be cautiously optimistic: the progress in the development of dynamics models of the water / human interaction system and the Integrated Assessment Models (IAM), that are able to dynamically represent the interactions between natural and anthropogenic components at different scales, for example by inserting climatic data in the analyzes to elaborate future scenarios, are proving effective. In fact, through the use of these models it seems possible to identify scenarios in line with future climate projections, which are very useful for making technical choices and political actions, and for evaluating their possible results in advance.

There are, however, some limitations: the models developed so far are more suitable for investigating large-scale events, which occur over a long period of time, but instead present greater uncertainty in predicting short-term and regional-scale effects (such as local droughts).

The real possibility remains that this new way of studying drought, by introducing the anthropogenic factors that influence it, can come to provide increasingly accurate predictive scenarios, able to guide the environmental and development policies of human communities.

Improving the response to future droughts through increasingly effective strategies for managing the demand and water supply of the future, when the climate will be warmer and characterized by numerous extreme climatic events, is not just

an issue of economic sustainability. It is also and above all a great safety issue, which affects everyone, since the drought may be accompanied by growing social and geopolitical tensions. Only responsible and farsighted ruling classes and ever more accurate science and technology will be able to try to defuse the effects of the massive anthropogenic global changes taking place.

Contributions from geoscientists

Acknowledgment

The editor thanks all the members of the GSAf who contributed to the "Contributions from geoscientists" section. A special thank goes to members of the GSAf council who helped to get these articles. The editor thanks Anna- Karren Nguno (Councillor for Southern Africa) for reaching out to our members to get contributions from them. The council hopes to see more contributions from society's followers.

All the following articles reflect the opinion of the authors and may NOT reflect the opinion of the GSAf.

All the following articles were published as they received (i.e., no reviewing process, except minor editing). Therefore these articles may NOT reflect the opinion of the scientific community.

CONDUCTING ON SITE OBSERVATIONS FOLLOWING THE NYIRAGONGO ERUPTION OF MAY 2021, AND ASSOCIATED EARTHQUAKES.

By: Ngaruye, J.C., Ntenge, A.J., Habiyakare, T. and Niyitegeka, T.

Rwanda Mines, Petroleum and Gas Board

INTRODUCTION

Rwanda is tectonically located between two current active branches of the East African Rift System (EARS). The Eastern Branch extends from Red Sea-Afar, Triple Junction (a junction between African, Arabian, and Somalian Plates) through Ethiopia, Kenya, Tanzania, Malawi to Mozambique. The Western Branch passes through Uganda, DRC, Rwanda, Burundi, and Tanzania. It is marked by the aligned lakes from Lake Albert, through Lake Kivu, Lake Tanganyika, and Lake Malawi and divided into Albertine, Tanganyika, Rukwa, and Malawi Rifts. The whole western branch is composed of half grabens characterized by high angle normal faults (Omenda 2017). According to Chorocwicz (2005), the EARS comprises a unique succession of grabens that are joined and cut by intracontinental transform, transfer and accommodation zones. In Chorowiciz (2005), the WEARS was divided into three sections namely; Northern, Central and Southern. WEARS Northern section is composed of successive grabens from White Nile Graben separated from Lake Albert by Rwenzori highs. This continues southern ward through Lake Albert, Edward, and to Lake Kivu. The rift floor in Lake Edward is at 200m, it goes up toward Lake Kivu at 1420m, and then down from Southern Lake Kivu to Northern Part of Lake Tanganyika to 773m Rift floor. WEARS central segment is composed of Lake Tanganyika and Lake Rukwa which is composed of a basin bordered by strike-slip faults compared to Tanganyika and Northern segment that are bound by Normal border faults. The last section is dominated by Lake Malawi and is referred to as the southern section. The western branch is seismically active and is characterized by two active volcanoes (Nyamuragira and Nyiragongo) and various dormant volcanoes which include five volcanoes on the Rwanda side (Kalisimbi, Bisoke, Sabyinyo, Gahinga, and Muhabura) of Virunga volcanic province.

INCIDENT

On 22nd May 2021 and following days, Nyiragongo volcano erupted and was followed by a series of earthquakes that caused damages in Rubavu District. Lava from the eruption reached Rwanda on an area of around 5 hectares and about 10,000 people from DRC moved to Rwanda. 351 Rwandans from Cyanzarwe Sector were displaced to different areas.
Post eruption earthquakes of different magnitude caused considerable damages in 10 days following the eruption. People in Rugerero, Gisenyi and Rubavu Sectors were much exposed to different damages due to close earthquake epicenters and the reactivated cracks passing through the properties. The presence of thick soil, lave layers, bedrock, and location of the buildings near soil bedrock boundary played a role on the level of the damages caused normally attributed to ground conditions.

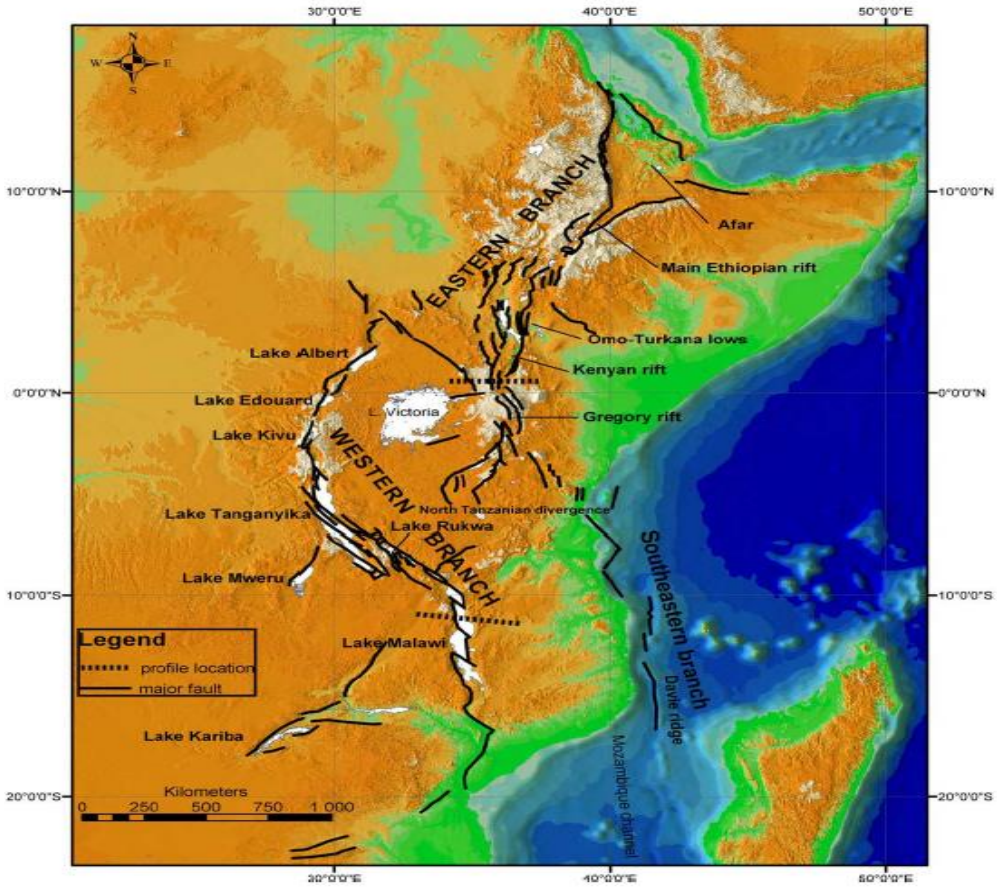


Fig 1: East African rift system. Black lines indicate major rift faults

As a result of volcanic eruption and earthquakes, fissures from Nyiragongo past eruption and tectonic activity were reactivated. During reactivation, more than 500 earthquake events were recorded including the strongest being ML 5.3 on 25/05/2021 at 11:03. Rwanda Mines, Petroleum and Gas Board (RMB) was giving timely updates on the situation of eruption and earthquakes.

VOLCANIC ERUPTION

Though it is understudied, based on the surface regional geology, the volcanic eruption in the area is not new. In Rwanda, there are areas covered by lavas from past volcanic eruptions namely the Northwestern and Southwestern parts of the country. Both these volcanic fields are close to the axis of the East African Rift System. Based on Kampunzu et al (1998) in Chorowicz (2005), Volcanism in EARS western branch started 12 million years ago with fissure eruption, and after a long period (9Ma-3Ma), central volcanoes were formed. Among the formed volcanoes include the Nyiragongo eruption summarized in the next section.

1- NYIRAGONGO ERUPTION HISTORY

Nyiragongo is located in DRC at about 15km from Gisenyi, Rwanda. The recent recorded volcanic activity includes, the 1977, 1982 and 2002 Nyiragongo eruptions. These eruptions were preceded by Nyamuragira Volcanic activity. According to Smets, et al., (2015), Nyamuragira Volcanic eruption can influence the stress field of both volcanoes causing changes in the magmatic system of Nyiragongo including dyke intrusion, Lava lake level changes, and flank eruption. Monitoring Nyamuragira will probably give insights into Nyiragongo Volcano (Smets et al., 2015).

2- NYIRAGONGO MAY, 2021 ERUPTION

Nyiragongo Volcanic eruption occurred on the 22nd May 2021, at around 18h30 pm. It came as a surprise because few days before the eruption, no alerting earthquakes were recorded. However, a month earlier, between 22nd and 24th April, 2021 earthquake swarms were recorded. This attracted attention and OVG attributed the behavior to Nyamuragira which is 13.6 Km, NNE Nyiragongo Volcano.

Before, other earthquakes that may be correlated to this eruption, though it needs further analysis, is the seismicity recorded during December 2020 in Lake Kivu northern section. With multiple data sets, a correlative study of the earthquakes recorded before the eruption and after eruption may guide future monitoring of Nyiragongo Volcano behavior.

3- DAMAGES FROM ERUPTION

Much damage from May 2021 Nyiragongo eruption occurred in DRC, as the lava flow covered a large area in DRC compared to Rwanda. In Rwanda, it covered about 5 hectares in Cyanzarwe sector, in DRC it covered about 984.627Ha (Based on satellite data). Currently, no details from DRC depicting how many people died. However, many people fled from the area as indicated in section 1.2. Post eruption events which include earthquakes, ground deformation, and ash fall from crater roof collapse affected people.

EARTHQUAKES

1- PRE-ERUPTION EARTHQUAKES

Earthquakes that occur before eruption play a key role in detecting possible future eruptions when combined with ground deformation, temperature changes, and degassing. Looking back on seismicity within 6 months before eruption and compare them with earthquake activity, there may be some correlation especially with December 2020, in North Lake Kivu, and the seismic swarms in April 2021. The volcano erupted without a strong earthquake that would be considered as a possible trigger, only other parameters such as temperature changes, degassing, ground deformation would have helped in combination with small earthquakes recorded. However, close monitoring of changes did not indicate alerting precursor. The absence of strong earthquakes before eruption may suggest an open system that allowed lava ascent without breaking crustal rocks which would, in turn, generate earthquakes that can be interpreted as eruption precursors/triggers.

2- POST ERUPTION EARTHQUAKES

About one hour after the eruption, small earthquakes were recorded with an increase in magnitude and frequency of occurrence. From midnight (Kigali Time), 23/05/2021, earthquakes of elevated magnitude above ML 4 continued for 10 days. Due to many earthquakes affecting the same area, and infrastructures, much damage was observed in Rubavu, Gisenyi, and Rugerero and some other sectors in Rubavu District. The earthquake recorded were less than ML 5.4 local magnitude. A single earthquake of this magnitude would normally not cause the observed damage. However, recurring earthquakes in a short time contributed to significant damage which would be caused by a single event of about ML 6-6.5 single event. On the Modified Mercalli Intensity (MMI) Scale, the damage observed may be put in a range from VII to VIII.

3- EARTHQUAKE DAMAGES

Rwanda was not been much affected by the lava flow, rather the earthquakes whose epicenters were in Lake Kivu or inhabited area of Rubavu District, especially Gisenyi, Rugerero, and Rubavu sectors. In addition, to main earthquakes, the damage was controlled by local geology, building types, and building materials as a reaction to seismic shaking. Rubavu District Hospital and other private hospitals along with some schools were temporarily closed and patients and students moved to safer hospitals and schools. Water pipes and roads were cracked. Many people were saved by their arrangement to sleep outside until the seismicity calms down. The country provided timely support to help those who were very much affected. In addition, timely information was being provided on the Radio by the local government. An advertisement put out by MINEMA was in place to help people on what to do during and after the earthquake. As this observation was supplemented by field data, the following section will describe field observation reflecting surface geology, reactivated ground fissures, and the location of mostly affected houses and other damaged infrastructures.

FIELD OBSERVATIONS

On Monday, 24th May 2021, RMB team arrived on-site to record information after the eruption of Nyiragongo Volcano which occurred on the 22nd May 2021. One hour after the eruption, a series of earthquakes occurred and increased in magnitude the next day. Based on field observations and earthquake analysis, the joint team provided technical advice to the emergency command post in Rubavu District in order to contain some post-eruption rumors and take guided decisions. Consecutive minor to moderate earthquakes caused damages to properties. Geological information reflected in damages from volcanism and earthquakes was collected. House cracks, ground fissures, building collapse, and surface geology data were recorded.

1- METHODOLOGY AND COLLECTED DATA

The fissure and cracks were recorded using Compass Clinometer, GPS Garmin 64 and 62s, Measuring Tape, ArcGIS with a built-in GPS in a tablet. Crack and Fissure orientations were measured by compass clinometer. After collecting a lot of information including the location from GPS, dots reflecting cracks and fissures were connected. Regarding the details of the cracks, the opening size was being measured day to day with information about the fissure zone. The geological information was collected as a part of a cracked ground visit. Hence, no detailed geological information can generate detailed geological information about the bedrock and surface geology of the area collected. However, a general picture of the geology of the area was observed. The area I dominated by granite, volcanic rocks, and meta-sediments.

2- DATA POINT ILLUSTRATIONS

a. Earthquake propagations and deviation are probably due to two cross-cutting faults (NNW-SSE and NE-SW). This is also reflected in house cracks, where North to Northeast trending cracks together with NNW trending cracks were observed.

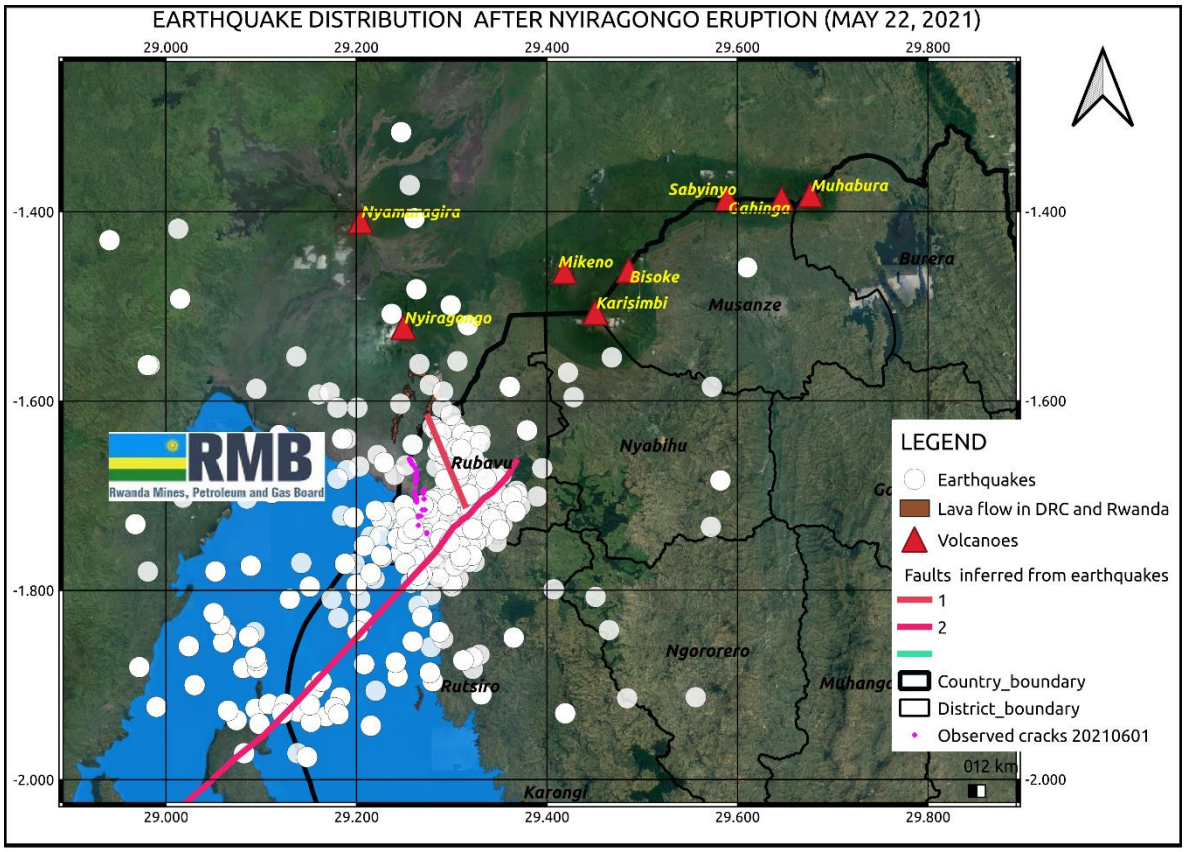
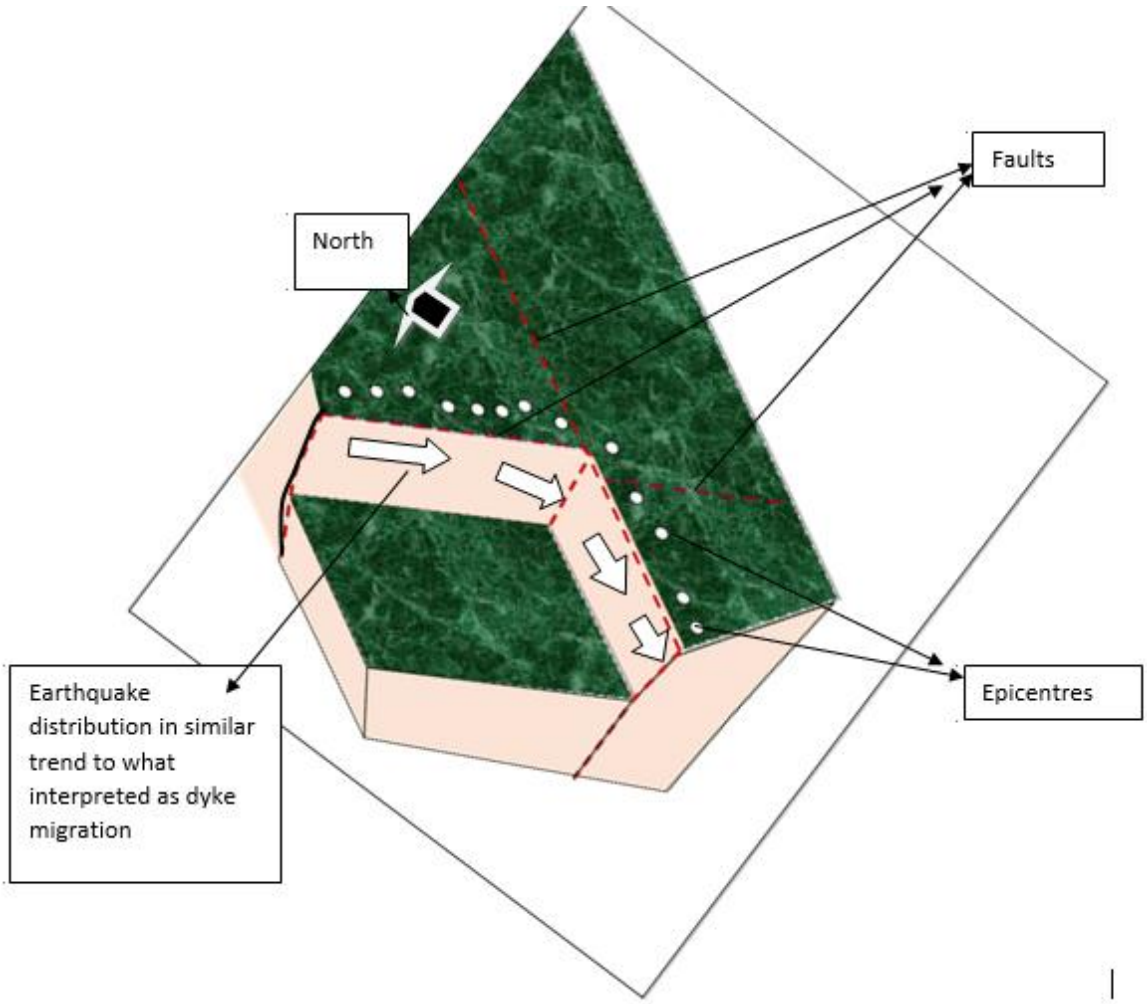


Figure 2: Earthquake distribution after the eruption

3- FINDINGS

- Cracks observed in different places join together to form a continuous fissure running from Nyiragongo Volcanic area, toward Lake Kivu (Mashyuza).
- The crack reactivated and was first observed after the eruption, at Gacuba (ADEPR), and Rubavu District Hospital. Mainly in the city center.
- As earthquakes continued, the crack continued to expand, from a single fissure to about 40-60m wide zone and 8Km long.
- The cracked ground was controlled by the thickness of the soil, bedrock geology near the surface, and the boundary between bedrock and think soil
- Two fissures observed may be named the western branch and Eastern Branch.
- These fissures are separated by granitic bodys between them



- The western fissure passes through a probable thick soil between mont Rubavu and Lake Kivu shore.
- At a certain point, few meters after Rubavu football stadium, the crack change a direction from NS to about N20W following a trend of a change in granitic body
- The width of the observed cracked zone increase from a 2 cm scale to about 60m toward the border.
- The extension of the deformed zone did not happen in a single day, rather during 10 days collecting data, new cracks were being observed as earthquakes occur.
- Eruption occurred on 22nd May, and on 28th Hot spring water stopped coming. I.e 6 days after the eruption. After 5 days, the hot spring water returned. Some of the hot spring sources were still coming with cold water.
- The infrastructures such as buildings, and water pipes crossing the fissures were mostly affected.
- Among the collapsed buildings, most were mud bricks and located near the fissure or soil/bedrock boundary on a slope (case of Rwaza Cell in Rugerero)
- The earthquakes produced migrated from Nyiragongo in the NW SSE direction, though at some point, it changed direction, depicting the same observations as observed from the reactivated fissure trend.
- Nyiragongo Lava Lake drained right after the eruption, and it was suggested that the observed continuous seismic activity was caused by dyke migration.
- Regarding the geology of the area, volcanic rocks, Meta-sediments, and granite were observed.
- In some places, interlayers of soil and volcanic rocks were observed explaining some period of volcanic inactivity.
- In the Gisenyi sector, about 30 cm subsidence in a 2-3m wide fissure were observed

INTERPRETATIONS

May 2021 Nyiragongo eruption occurred without a trigger such as strong earthquakes. As the area is located in an active rift system, with active faults and an open system in the volcanic region, the increase in magma, may have generated enough pressure to push the lava through the existing flanks. Along the way, no strong earthquakes were produced to indicate the fracturing of rocks to create a way for the lavas. When erupted, the lava went in two directions toward, where it covered only ~5ha in Rwanda from DRC /Rwanda border. Though the precise date is not confirmed yet, the Lava Lake was drained after the eruption. This may mean that is in one way

or another connected to an open system beneath the volcanoes that make the lava lake easily drained. After the eruption, the pressure holding the lava in the crater was dropped causing the lava to drain. It may be suggested that lava lake drainage and erupted magma replenishment contributed to the diking event observed 10 days after the eruption. This dyking event is associated with the series of earthquakes observed.

Cracked ground, missing and returning of hot spring, Lava Lake drainage, is evidence that there is an open (cylindrical?) chamber filled by Magma. After the eruption, when the pressure drops, this chamber is refilled by magma from a deeper reservoir, and by the magma/Lava which was not able to erupt (needs further geoscientific studies, such as geochemical sampling, possible rock fragments from collapsing roof, and geophysics). If this is the case, this may suggest the reason why having cold or no spring water after the eruption, and hot spring after dyke migration explains the connection of Mashyuza groundwater and magma-heated hot rock.

Regarding the ground cracks which are mostly observed on a steep slope near the bedrock-soil boundary, or thick soil in a low-lying area, may be explained by the strength of bedrock vs unconsolidated sediments/soil which is not able to resist tensional stresses. Hence being located in a fault zone, makes it easy to form ground fissures in unconsolidated soil. With further studies and detailed observations, studies can be conducted to confirm the crack propagation in strong rocks such as volcanic rocks.

Having soils and bedrock played a role in the damage of infrastructures because much shaking occurs on unconsolidated soil compared to bedrock as a result of wave amplification. In a dense bedrock such as granite, seismic waves pass there with high velocity and low amplitude. In unconsolidated soil, the same wave passes through with low velocity and higher amplitude (Higher shaking). As observed, the higher damage occurred on poorly constructed houses, mudbrick-made houses, and houses on poorly/unconsolidated sediments. According to Wysessionetal (2003), mudbricks are less resistant to strong shaking. Mudbricks <Redbricks<Concrete<wood<reinforced concrete< Anti-seismic building.

CONCLUSION

Nyiragongo eruption occurred on May 22, 2021, and was followed by a series of earthquakes that caused considerable damage in the Rubavu District. The measure earthquakes recorded include ML 5.3 recorded on 25/05/2021 at 11:03 Kigali time. Before and after, small and moderate earthquakes ranging from (2.5 to 5.1) were recorded. Different damages on water pipes, hospitals, schools, and land were observed. Much of the damages were caused by a reactivated fissure that was opened as a result of eruptions and tectonic activities. There is a possible relationship between ground conditions and the damage observed. Students and patients from some schools and hospitals were relocated due to their location on a fissure that is possibly related to an active fault zone. Houses with adobe bricks located on thick soil or near soil bedrock boundaries suffered more damages.

RECOMMENDATION

Based on observation made, the following suggestions are recommended:

- Carry out detailed geological mapping in Rubavu, Gisenyi, Rugerero, and Nyamyumba sectors in a short term to guide land use and new city master plan. This will involve marking outcropping bedrock and unconsolidated soil. This will answer the site for a new place for Gisenyi hospital relocation.
- In the mid and long term, carry out geological investigations to understand the ground conditions of Rubavu and how best construction can be done to resist earthquake-induced shaking.
- Capacity building to enhance earthquake and volcano monitoring
- Enhance collaborations with similar institutions for access to data and results sharing on time.
- Raise awareness on what to do before, during, and after the earthquake
- Demarcate the fissure/Fault zone in Rubavu District to guide future projects.
- Stay vigilant and mindful of possible strong earthquakes in the region and develop evacuation plans for future eruptions and tectonic activities.

Urban Geology of Windhoek: a case study of the application of geology in a growing city

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INTRODUCTION

Urban geology is generally defined as the geology of the built environment, consisting of its basement rocks, its structure and nature that facilitated settlement (e.g., McGill, 1964). This includes the building stones used to construct structures, its heritage in old stone masonry buildings; its geological natural resources and its capacity to buffer increased settlement. One of the earliest articles written on the implications of urban geology on city growth, was by McGill (1964). As such the science of urban geology has been growing and evolving over time. Urban geology has become more important with issues of rural to urban migration, especially in African cities, where this growth has been exponential, stripping the rate at which services can be provided. This has unfortunately led to the establishment of unplanned settlements across the African continents, commonly known as "shanty compounds", that are located, more often in areas that are unsuitable for the building of structures. In this vein, urban geology needs to rise to the occasion, so that it can provide city authorities with updated geological maps, that encompass structure, lithology, slope geometry, presence or absence of past landslides, and hydrogeology.

Windhoek was first settled in 1849 by Jan Jonker Afrikaner, the chief of the Oorlam people (www.windhoekcc.org.na) in the current suburb of Klein Windhoek, where a strong spring of water was present. Several springs were present in the Windhoek valley, along north-south trending faults that made the area attractive to settle in.

Windhoek is situated in a semi-arid environment, depending mostly on borehole water, recycled water and water transferred from other aquifers across the country, specifically, the Otavi Mountain land, situated some 550 km north of Windhoek (Figure 1). As such Windhoek is constantly under threat from droughts (water scarcity) as happened in 2016 when rationing measures had to be introduced by the City of Windhoek (CoW). Furthermore, Windhoek is situated in a broad valley, that developed during the Cretaceous rifting event. Thus has therefore specific implications on the urban built-up environment, producing seismicity that generally goes up to magnitude 4 on the Richter scale.

Urban geology is such a wide field of study, from engineering geology, hydrogeology, structural geology; geomorphology, aspects of pedology and the impact of industrialization, and the list continues. Urban geology really is "earth science that is designed to solve problems in the urban environment". Local authorities and city councils can use geologic information to formulate long-range plans and policies; planning of how the city will evolve over time in decades; location of underground transport systems such as subways and tunnels; location of future dump sites and cemeteries in relation to groundwater aquifers; location of fuel stations and large chemical hazardous storage facilities. The advantages are numerous. Urban geology is greatly impacted by population growth. In 2005, the population of Windhoek was estimated at 250 000 inhabitants (Mapani, 2005); and now in 2021, the population has risen to almost 300 000 inhabitants and growing. This number does not take into account most of the inhabitants living in unplanned settlements. In this article, attention will be focused on structural geology, hydrogeology and the geological heritage of Windhoek.

CLIMATE AND GEOMORPHOLOGY

Windhoek experiences dry hot summers, from August to October, and hot wet summers from October to April, whereas from May to July, it experiences dry winters. The average rainfall in Windhoek is approximately 370 mm/a (Mapani, 2005), though the value has been decreasing in the last decade (Shikangalah and Mapani, 2019). The highest annual rainfall was recorded in 1936 with a value of 766 mm (Crerar and Church, 1988; Colvin, 1994). That value is yet to be recorded again.

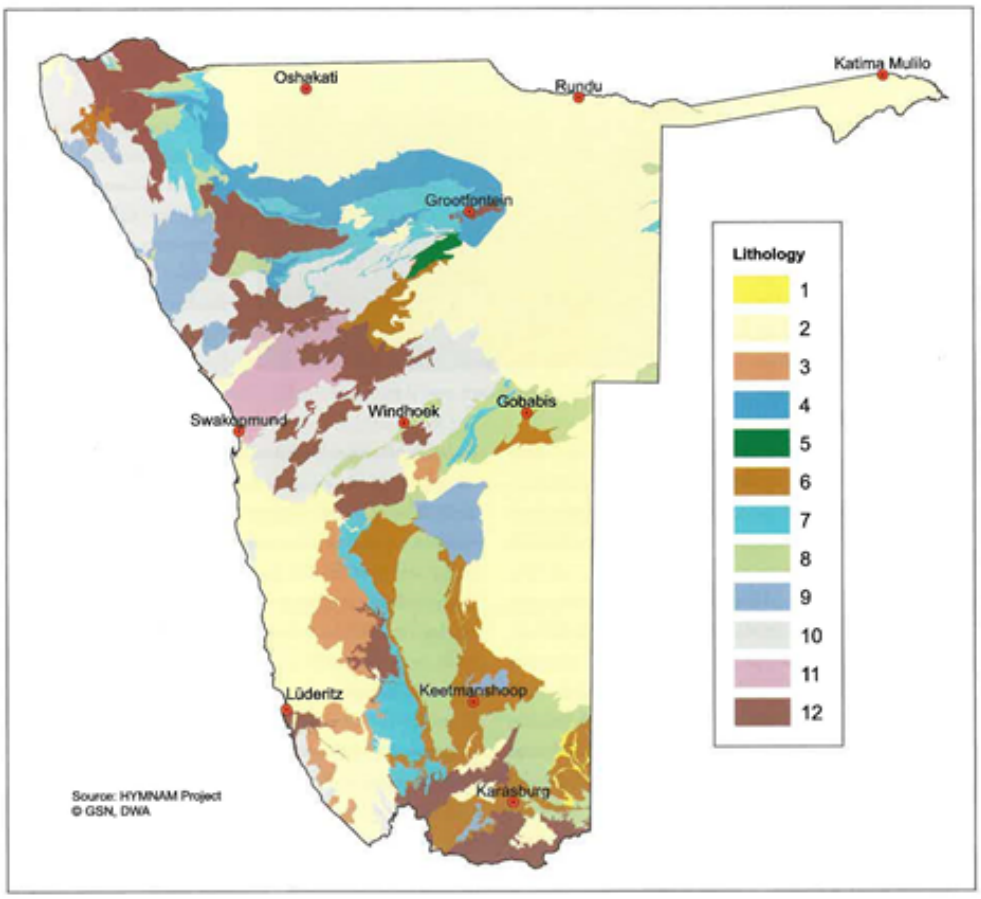

Figure 1. Simplified Geological Map of Namibia. 1-Sand and gravel, alluvium; 2-Unconsolidated to semi consolidated sand and gravel, with minor calcrete; 3-Unconsolidated to semi-consolidated sand and gravel; calcrete and minor bedrock; 4- Calcrete; 5-sandstone; 6-Shale, mudstone and siltstone; 7-Limestone, dolomite and marble; 8- Non-porous sandstone, conglomerate and quartzite; 9. Volcanic rocks of Karroo and younger ages; 10-Metamorphic rocks; 11-metamorphic rocks including quartzite, marble and granitic intrusions; 12-Granite, gneiss and old volcanic rocks. (after Christelis and Struckmeier, 2001)

Windhoek is built in a valley, that stretches from the south of the city to the north, straddling a distance of 25 km; and also from east to west, it straddles a distance of about 12 km (Figures 2 and 3). To the south and east, the city is bounded by Auas Mountains that tower to about 2000 m above sea level; to the west, the Khomas highlands rise to about 1900 m above sea level and the Windhoek valley where the city is built lies at about 1800 m above sea level. Thus Windhoek is the major watershed for central Namibia, with rivers flowing to the north (Goreangab, Avis and Arebusch); to the southwest (Kuiseb River); to the east and southeast (Seeis River). Due to low rainfall amounts, weathering of the rock formations has not progressed very far. The soil horizons around the City of Windhoek were described in Mapani and Schrieber (2008). The Windhoek soils are characterized by a thin 15-20 cm thick horizon, rich in micas, quartz and some k-feldspar (Mapani and Schrieber, 2008). These soils lack a major buffering capacity for contaminants and render the groundwater aquifer vulnerable. From the geomorphic features of the city, it is recognized that high mountains on either side of the valley are the major sources of material in the valley. Several ephemeral streams flow from south to north, which normally gets flooded in the wet season and cause flooding. Two dams have served Windhoek well so far. The Avis Dam in the Avis suburb and the Goreangab Dam in the Goreangab suburb in the NW of the city (Figure 2). In 2009, the Acacia suburb in Dorado Valley (Figure 2) was flooded by the Arebusch River, causing damage to the housing units in the area. Such incidents indicate that there is a need for constant monitoring of the hydrosphere throughout the year. In the dry season, contamination needs to be avoided and constant sampling is the only way.

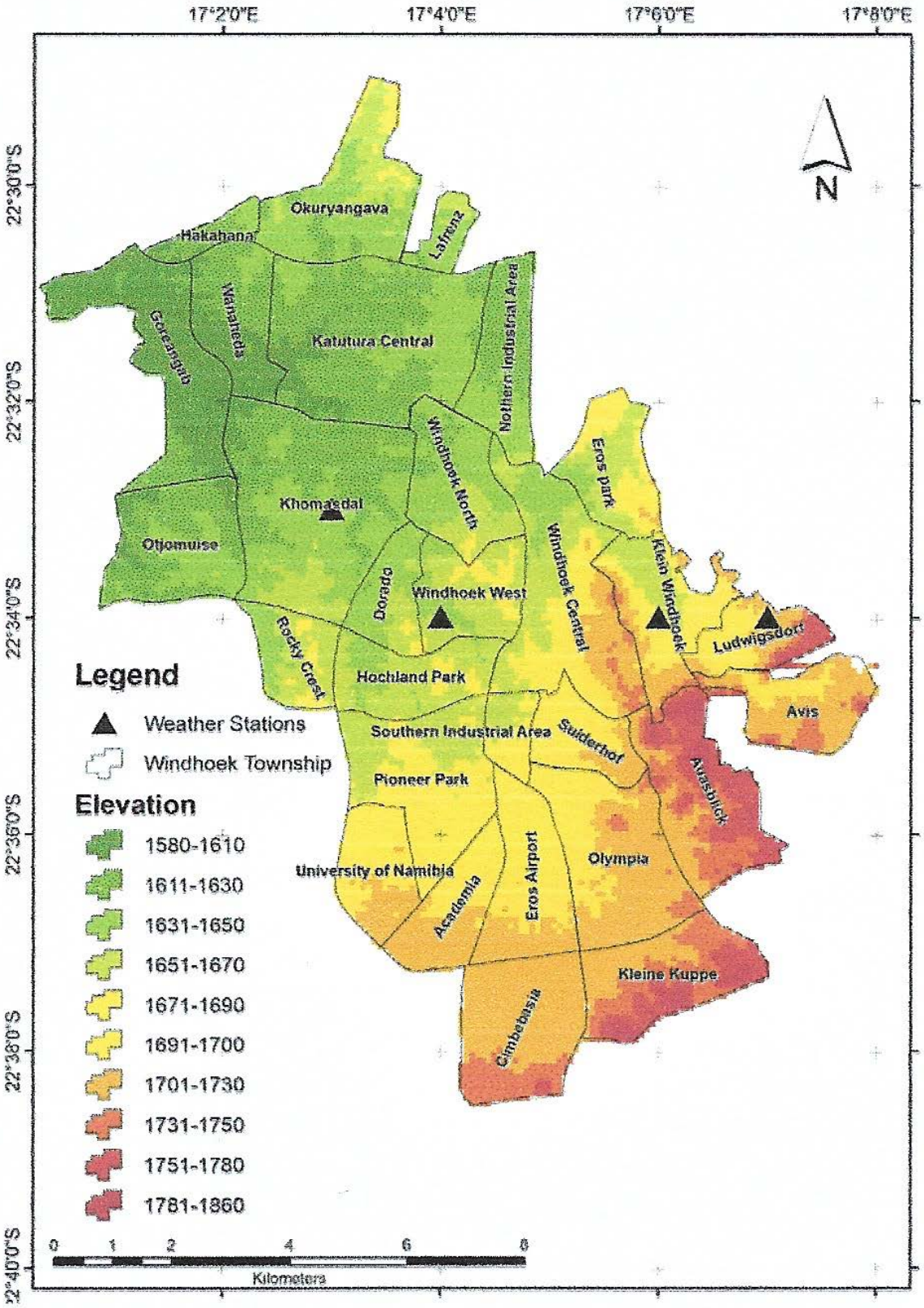

Figure 2. Elevation model of the City of Windhoek. (after Shikangalah and Mapani, 2019).

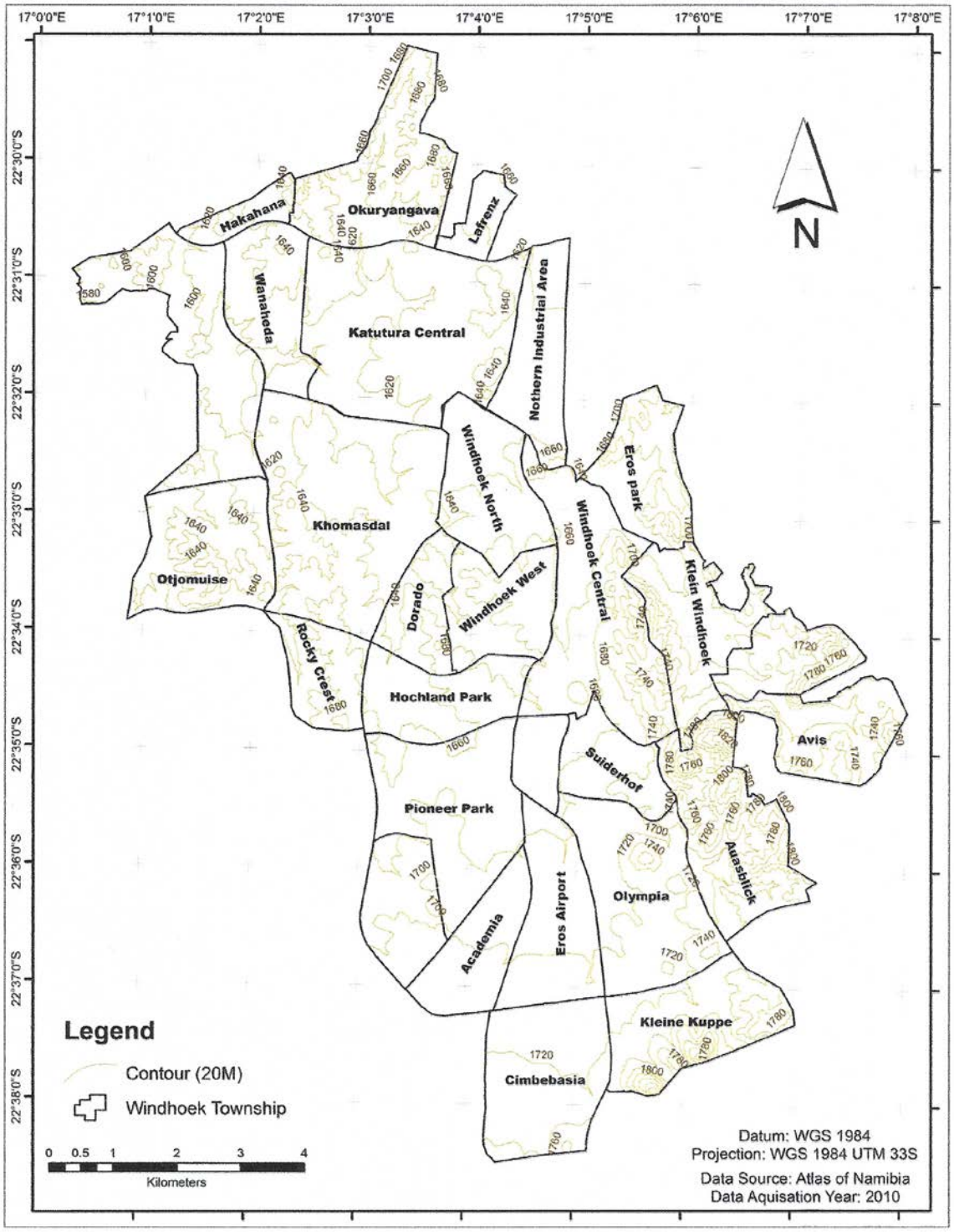

Figure 3. Geomorphology of the City of Windhoek giving heights above sea level in meters (after Shikangalah and Mapani, 2019). The names of the different suburbs are indicated on the map.

GEOLOGY OF THE CITY OF WINDHOEK

The Geology of Windhoek reflects an extent the major geologic evolutionary cycles of Namibia. Windhoek sits in the Khomas highlands, in nearly the center of the country close to the town of Okahandja, which by chance locates where the two cratons, Congo and Kalahari collided about 580 million years ago (Miller, 1983). Before the collision, the Khomas Sea was a major basin, in which sediments of the Damara Supergroup, made up of the Lower Nosib and the Upper Swakop Group were deposited. Deposition began at about 1000-900 million years ago and continued till about 590 million years

ago. The Damaran sediments were deposited on a basement of the Abbabis Complex, a gneissic unit that comprises both ortho- and paragneisses. The oldest rocks of the Nosib Group are the arkosic rift sandstones of the Etusis Formation, which are overlain by the volcaniclastic Khan Formation, essentially made up of basaltic units that have now been metamorphosed to diopside gneisses. Above the Nosib is the Swakop Group, which begins with a deep marine member of the Rossing Formation, essentially carbonate with minor schists. The Rossing formation is succeeded by a highly clastic diamictite, called the Chuos Formation that correlates with the Sturtian glaciation at 750 my ago (Mapani and Schrieber, 2008). It is highly magnetic in places and has been used for regional correlation. Above the Chuos is the Arandis Formation made of carbonates, calc silicates and minor schists; it is followed upward by the Karibib Formation which is dominantly a carbonate, with minor calc-silicate and few schist bands. Above the Karibib Formation is a deep water facies unit, essentially made of main turbidites; the Auas and Kuiseb Formations. In the Windhoek area, the Auas Formation is composed of deepwater fans of the Auas Mountains south of the city. The Kuiseb Formation caps the Swakop Group in the Khomas highlands where Windhoek is situated. The Kuiseb Formation possesses several layers of thin quartzites, circa 30 cm to 2 m thick that alternate with schist that can range in thickness to tens of meters. This geometry is common in turbidite terrains. These fractured quartzites largely make up the Windhoek aquifer that is discussed below. Windhoek is largely underlain by the Kuiseb schists and quartzites. The Kuiseb schist is cross-cut by the Matchless belt, which lies just to the north of the city (Figure 3) and also hosts copper deposits at Onganja, Otjihase, Matchless and Gorob-Hope. The whole Swakop Group was intruded by syntectonic and post tectonic granites (Figure 3) that formed during the peak deformation that occurred at 550-520 Ma (Miller, 2008). The last major tectonic events that have had an impact on urban geology are the intrusion of the post tectonic alkaline plugs, mainly trachytes and phonolites that intrude the schists and the rifting that happened during the Cretaceous, around 132 Ma. This rifting event led to the development of the Windhoek graben and horst structure; which is mainly defined by north-south trending faults (Figure 4). These faults are sites of seismic activity in the city and have an impact on the structures that are built in the valley.

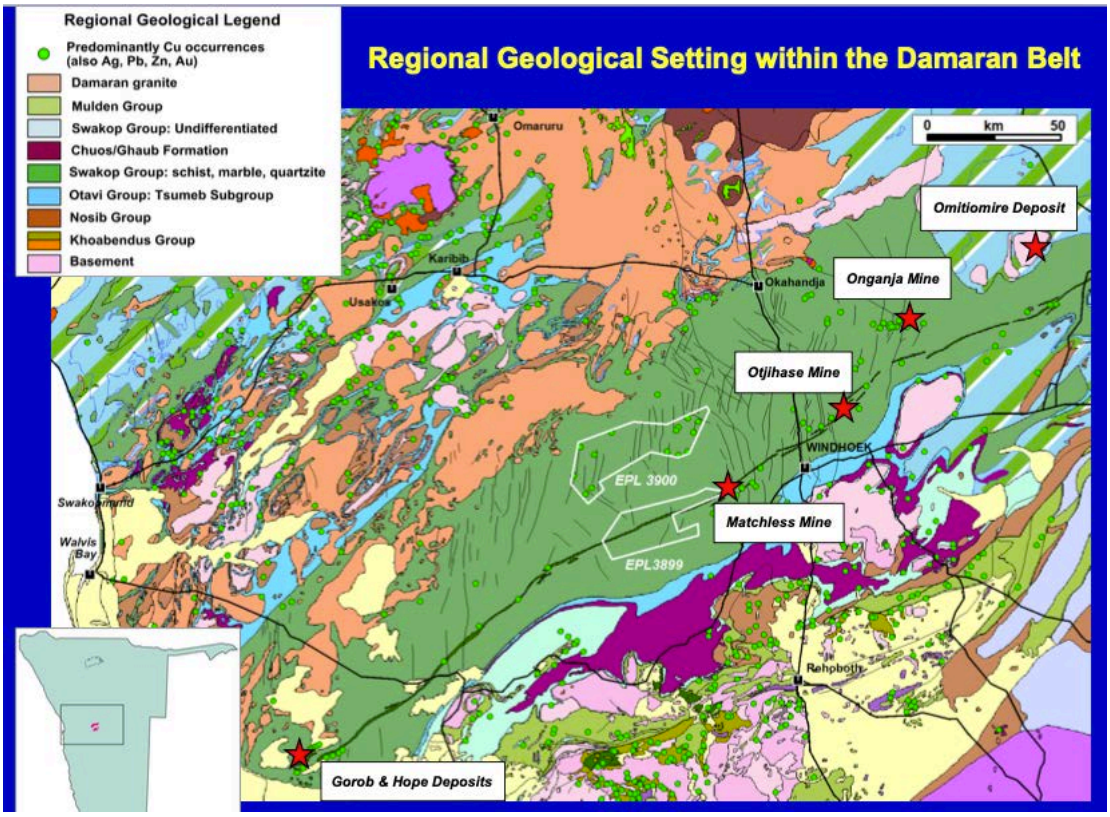

Figure 4. Geological Map of Windhoek, showing the main units of interest and the Swakop Group of rocks (after the Geological Survey of Namibia, 2008).

STRUCTURAL GEOLOGY OF WINDHOEK AND ITS EFFECTS ON STRUCTURES

The main regional structures that dominate the city of Windhoek are faults (Figure 4). These faults are also shown on Figure 3 as N-S trending faults, cutting the Kuiseb schist and Auas Quartzite Formations. The faults create the major graben and horst structure, The suburbs of Ausblick, Olympia and Klein Windhoek and part of Eros, sit on a horst; whereas to the west and east (Avis) of these suburbs, the city strands a valley plain (Figure 4). These faults are the sources of seismicity events of up to magnitude 4 on the Richter scale, which would cause a teaspoon to shake in a cup of tea. Though minor, they do have an impact on structures, especially home dwellings, in that cracks develop slowly and continue to propagate. Thus the residents need to be warned about the need to continuously monitor and repair these cracks.

HYDROGEOLOGY AND WATER SUPPLY

Shikangalah and Mapani (2018); Mapani and Schrieber (2008) and Mapani (2005) have amply summarized the hydrogeology and risks associated with urbanization. In this article, we look at the operational issues around the topic of urban geology.

The Windhoek aquifer was at one time sufficient to supply the needs of the City, i.e., before 1943 (Figure 5). In 1940 there was a recognition that water demand for Windhoek was increasing (dark bars in Figure 5) and therefore plans were put in place to develop surface dams. With the increasing population, the Windhoek aquifer was put under pressure. In 1943, the Avis Dam was built to augment the water from the aquifer (Figure 5). However as the population was increasingly growing, water demand exceeded 2 million m3 of water per annum; in 1961, Goreangab Dam was brought on line to increase surface water resources.

As the population continued to increase, the water demand exceeded 6 million m3 and the recycling of greywater was introduced in 1968 when a state-of-the-art reclamation plant was established in Windhoek. The population kept on increasing and by 1970, a national water transfer scheme was introduced (State Water Transfer Scheme). This was a grand project that transferred water from Berg Aukas to Windhoek via two dams. During this period, abstraction from the aquifer continued to increase; the aquifer as shown by the sinusoidal shape was largely recharged by rainfall. An optimum quantity of water had to be worked out that ensured that aquifer collapse did not happen. That amount was calculated to be 2.34 million m3 per annum, and was deemed not to exceed the mean recharge value; whereas the value of 2.79 million m3 per annum was calculated as the maximum sustainable yield (GTZ-DWA, 1993). This analysis throws light on the importance of geology in the management of urban aquifers for sustainable development. The Windhoek aquifer at this time was being used both as a storage facility and a source of water.

Windhoek has mainly three sources of water, (i) the Windhoek aquifer; which is mainly recharged by rainfall through the Auas quartzites south of the city; (ii) water transferred from the National Transfer Scheme from Berg Aukas in the Otavi Mountain land to the Omatakao Dam by the canal; then transferred to Von Bach Dam in Okahandja and finally to pumped to Windhoek (Figure 3).

To date, the amount of water available for the City of Windhoek is no longer sufficient and more water is required. In 2008, CoW decided to plan for deep recharge boreholes to augment the 50 production boreholes. This project looked at extending the current aquifer levels from an average of 60-100 m depth to 250 m. Frequent droughts in arid climates are common; any such drought introduces water deficits in the Windhoek aquifer. As such the deepwater project was a case study for urban geology, to solve a problem that plagued the city. In 2016, there was a water shortage in Windhoek, such that rationing strategies were introduced by the CoW. Such strategies are not very good for businesses, as they decrease productivity and the City and national economy contracts.

Windhoek, together with Okahandja and Karibib, share the water coming from Omatako Dam to Von Bach dam in Okahandja. The demand for water from Von Back dam rose from 29 million m3 per annum in 2003 to 40.2 million m3 per annum in 2021. This scenario shows how population growth puts pressure on water resources and the requisite infrastructure.

The other issue with Windhoek water supply is leakages in the supply system. It is estimated that at least 900 000 m3 of water is lost through leakages. Here then is an opportunity for urban geology specialists to help the CoW solve these intractable issues. Through a well-designed GIS system, and metering system, geophysicists through the use of either resistivity or ground-penetrating radar methods could help cut on the leakages experienced by the city. Sewer bursts on the other hand act as sources of contamination for the groundwater aquifer. Again, engineers working with geophysicists can help isolate such areas in record times.

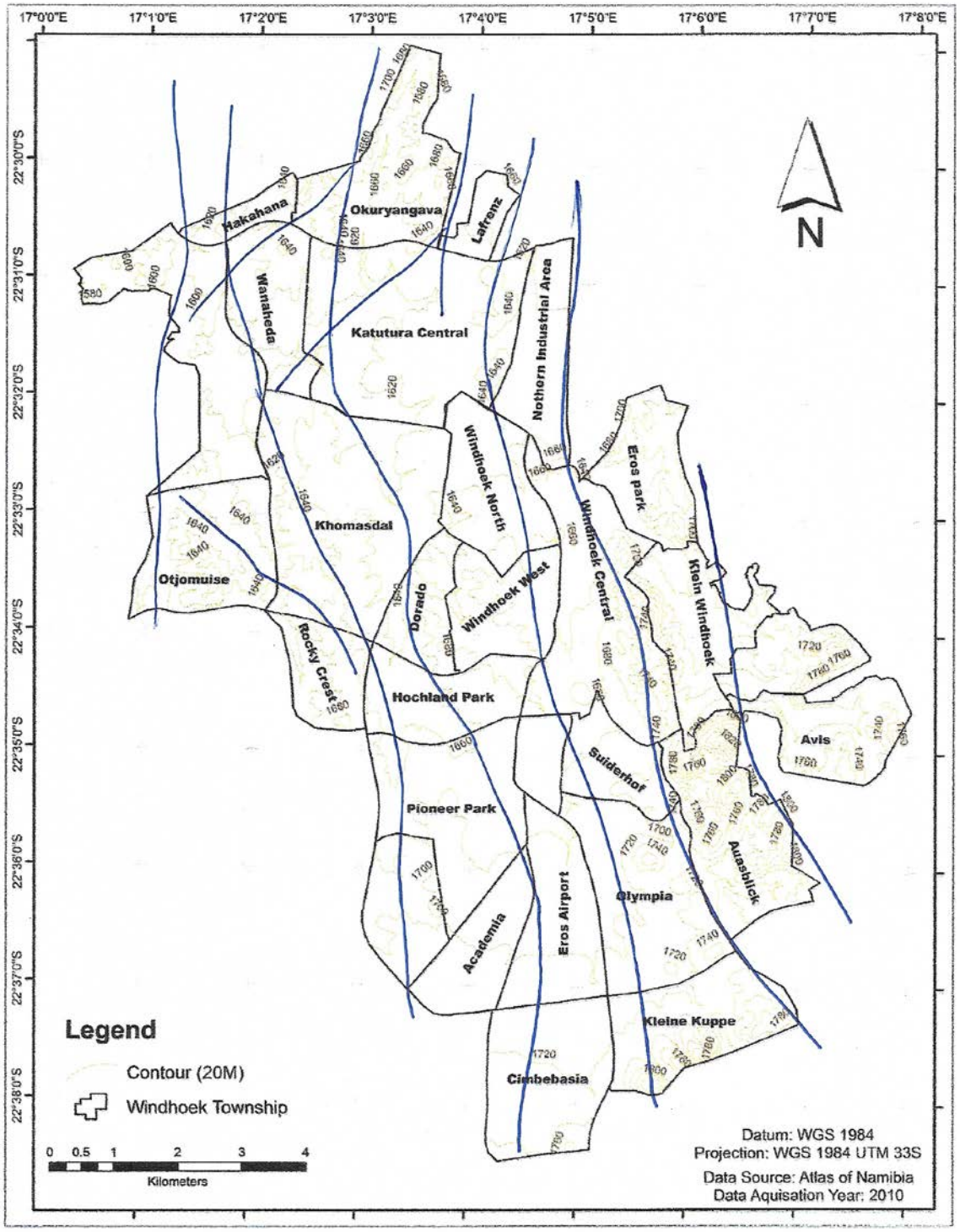

Figure 5. Structural elements of faults that dominate the City of Windhoek. (after Shikangalah and Mapani, 2019).

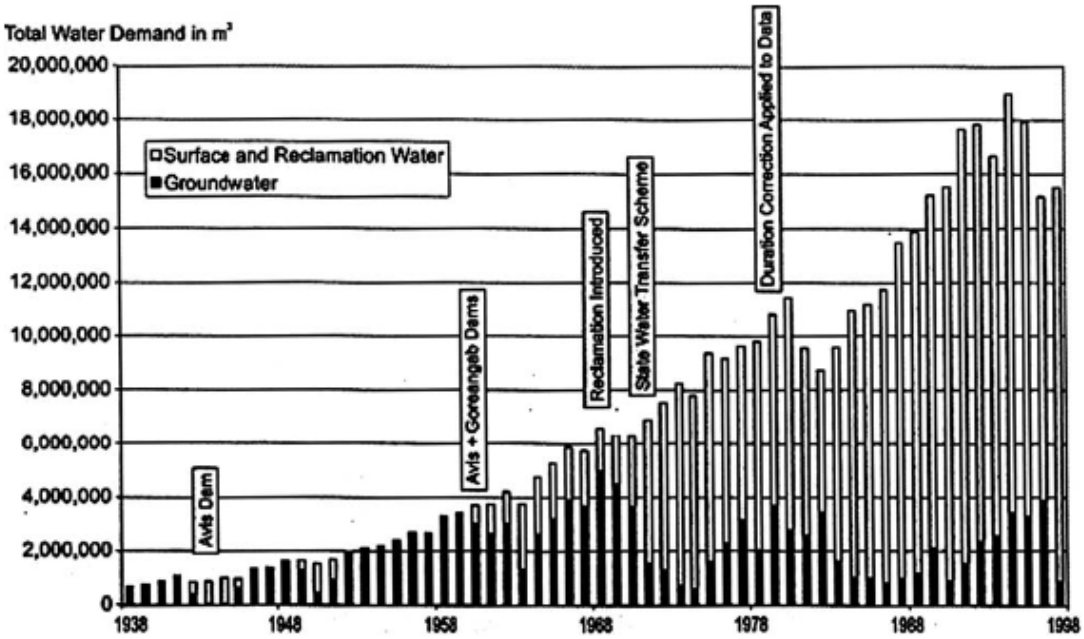

Figure 6. Windhoek water demand from 1938-1999. After Kirchner, 2001.

CONCLUSIONS

The incorporation of GIS, Geophysics and Remote Sensing techniques in urban geology allow Municipal authorities to quickly monitor what is happening in the city, from leaking water pipes, pollution monitoring up to the detection of the erection of illegal settlements rapidly. This methodology needs to be adopted by all Town councils experiencing rapid growth. City authorities need to incorporate in their projection plans updated geological maps and topographic maps at relevant scales such as 1:25 000 and 1:12 500. The use of geological maps that have been combined with hydrogeological and soil maps is a first "pass" for the identification of chemical contaminant hazards.

Planners and engineers require special assistance to deal with the problem of urban migration and the need to provide appropriate infrastructure for the residents. Geologists have yet to appreciate that to solve this challenge they need to become part of the solution. This is mainly so because by the time engineers and planners are on-site, the geologists must have completed their work far much more in advance. Geologists have an obligation as scientists to fully engage in urban geology both from areas of hydrogeology, engineering geology and planning for major infrastructure.

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Impact of COVID-19 on Raw Material sectors in Africa

Preface by

Mary Barton, Beate Orberger, Edmund Nickless, Ismahene Chaouche, Gabi Schneider,

In November 2020, the Geological Survey of Namibia was chosen to host the 7th SGA-IUGS-SEG-UNESCO Short Course on African Metallogeny under the theme: 'Energy metals for a Sustainable Society'. Due to travel restrictions imposed as a result of the COVID 19 pandemic the short course was cancelled and will be rescheduled soon.

For the students who registered for this short course and those who participated in previous short courses (Ivory Coast and Gabon), SGA with the Geological Survey of Namibia and IUGS proposed to run a series of seminars to allow attendees to obtain a SGA certificate in Metallogeny.

The first seminar was held in October 2020. 16 students from 8 countries gave presentations on the topic of 'Green' metals.

The second seminar under the theme "The Impact of COVID 19 on the raw material and geoscience education sectors in Africa" was held in June and July 2021. In total 10 MSc, PhD students and two young associate professors participated. The following countries were represented: Namibia, Cameroon, Ghana, Benin, Ivory Coast, Senegal, Algeria, Gabon, and person from Iran.

For the presenters, it was an excellent opportunity to prepare and present high level topics in English and to work together in small groups. A challenge was to collect, evaluate and synthesize complex data. An outcome of the seminars was that participants could increase their network and even make new friends.

The Geological Society of Africa's Newsletter is publishing a few articles written by the presenters on the topic: "The Impact of COVID 19 on the raw material and geoscience education sectors in Africa".

The Impact of COVID-19 on the Manganese Sector in Africa: Lessons learned and Solutions for Future Pandemic

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Abstract

Manganese (Mn) is mainly used in the steel and alloy industries but has growing markets in lithium-ion batteries. Major producers of Mn ore are located in African countries. South Africa is the world's largest producer (about 5 800 Mt/a), followed by Gabon (2 510 Mt/a), Ghana (1 550 Mt/a) and Ivory Coast (482 Mt/a). The supply chain in Africa covers mine production, to a lesser degree ore transformation (extraction metallurgy), transportation, and mine-related services and equipment. The pandemic has reduced production by 10.3 %. This was caused by stopping mine operations during the lockdown. Transport harbors in South Africa and Gabon were also closed, and this caused Mn companies such as South32 and ERAMET-COMILOG in these countries, to stop exports of Mn ore. This further affected the supply chain, steel, alloy and battery production. Increasing automatization and digitalization in the Mn mining and processing sector can minimize severe economic and sanitary impacts in pandemic times.

***Keyword**: Manganese, COVID-19, Digitalization, Automatization, Africa, Pandemics, mining, metallurgy, supply chain*

Introduction

Mn is imperative for the metallurgical (e.g. Steel, alloys) and non-metallurgical sectors (e.g. Li-ion batteries, glass, chemicals) worldwide (USGS, 2021). Africa is the mainstay for Mn production, producing about 63 % of the global Mn – representing 9, 860 metric tons in 2020 (**Figure 1**, USGS,2021). The African supply chain mainly covers mine production, ore transport (trucks, ships), and mine-related services and equipment, and to a lesser degree ore transformation (extraction metallurgy). All these sectors are impacted by COVID-19 which has resulted in a 4.7% decrease in Mn production in Africa from 2019 to 2020, **Figure 2**.

Applications of Mn

Mn is mainly associated with a variety of metallurgical and non-metallurgical applications. Metallurgy applications mainly consists of ferrous metallurgy (i.e. steel) and non-ferrous metallurgy (i.e. aluminum alloys) (**Figure 3**). Ninety percent of Mn produced is consumed by the steel sector, to improve the rolling and forging qualities, strength, toughness, stiffness, hardness, wear resistance, and hardenability of steel (Metalpedia, 2021). Moreover, the Aluminum alloy sector is the second largest metallurgical application for Mn. About 8% of Mn is added to increase resistance against galvanic corrosion. Mn is also used in other metal alloys, such as alpha-beta titanium based alloys (8% Mn-, Zn- and Mg- alloys containing 0.1% to 0.2% Mn (**Figure 4**). Mn also plays a major role in non-

metallurgical applications such as producing Lithium (Li ion) batteries and in lithiated Mn dioxide battery. These batteries contain about 61% Mn (Palisade, 2017).

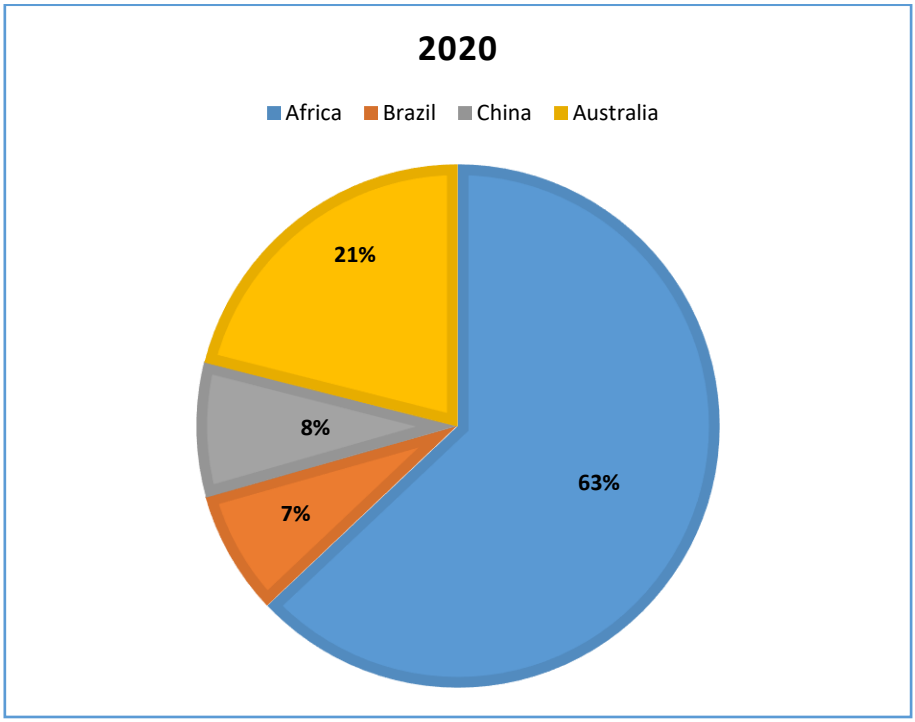

Figure 1: Percentage of Mn production around the world (source: USGS, 2021).

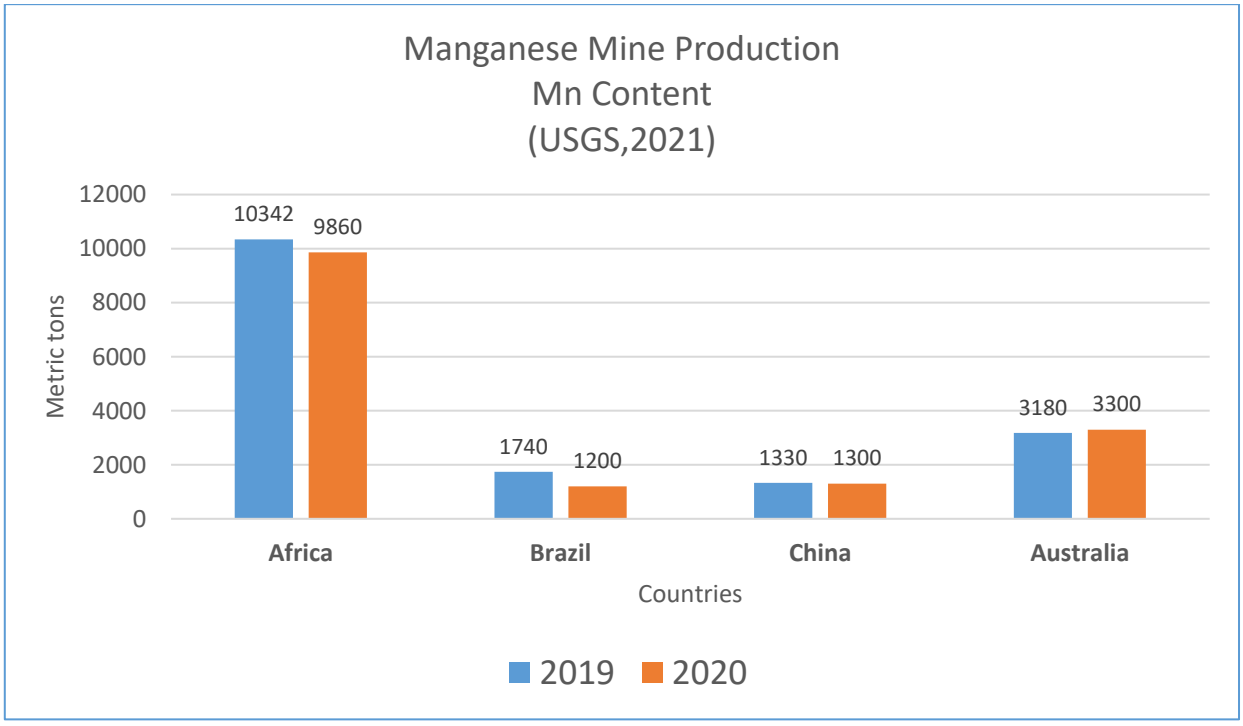

Figure 2: Mn content in metric tons around the world in comparison to Africa (source: USGS, 2021).

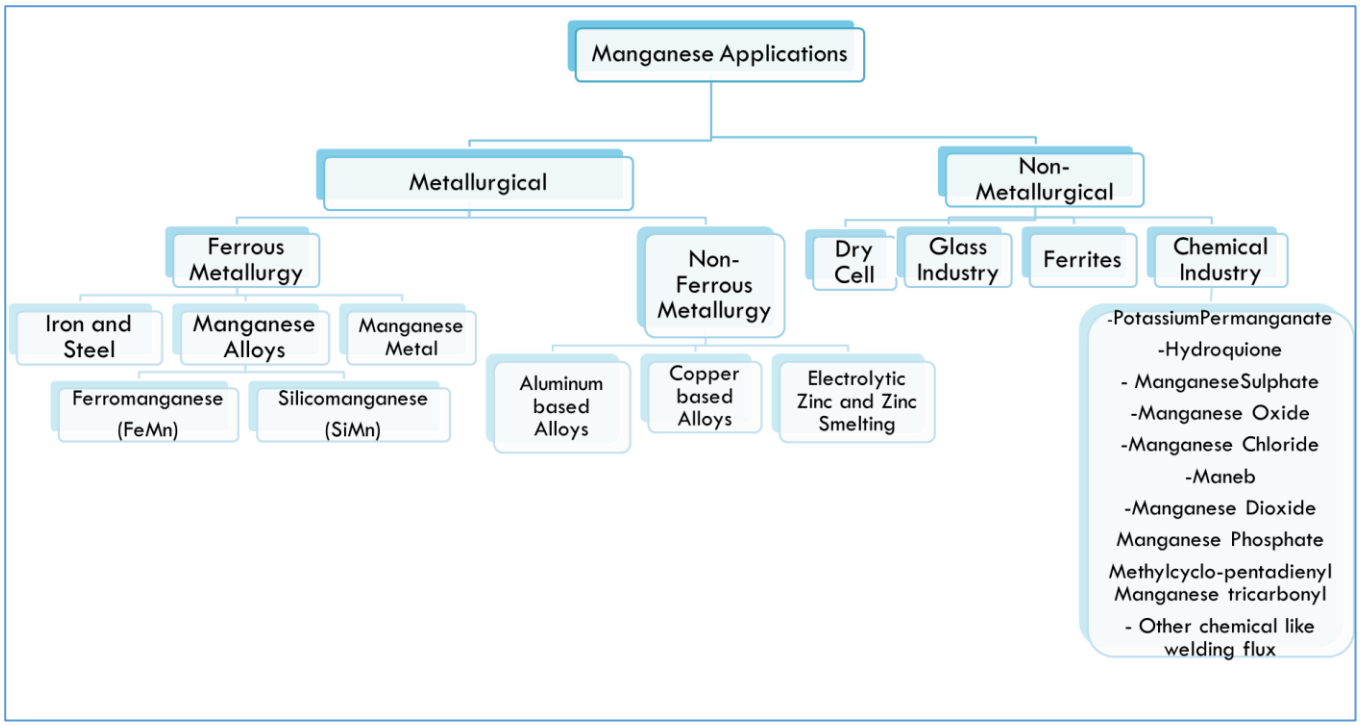

Figure 3: Metallurgical and non-metallurgical applications associated with Mn (source: Metalpedia,2021).

Mn production worldwide

Approximately 18.5 million tons of Mn ore are produced around the world annually. The Kalahari region in South Africa hosts more than 70% of the world's Mn reserves. South Africa, Australia, and China are the major producers of Mn in the world, these countries represent more than 65.4% of the world Mn production. South Africa accounts for about 29% of the global Mn production and has an annual Mn production of about 6.2 million tons, which is the largest not only in Africa but in the whole world (Kiprop, n.d.). Consequently, the COVID-19 lockdown in South Africa, which included the suspension of all mining operations, has significantly impacted Mn production. However, it is notable that Mn production in countries such as Gabon and Australia was not impacted by the pandemic, as their Mn production increased from 2019 to 2020 by 11.5 and 3.7%, respectively. **Figure 5** shows the impact of COVID-19 on global Mn production.

The Mn supply chain and the impact of COVID-19 in Africa

The Mn supply chain starts with ore miners who sell the ore to alloy producers or smelters. Although a few smelters are vertically integrated with the ore miners, independent alloy producers dominate Mn consumption. Steel producers are currently the predominant end-use consumers of Mn but lithium battery producers are starting to take a significant share of the end-use market. Overall, the demand for Mn is closely aligned with the steel demand.

In March 2020, South Africa declared a national state of disaster due to the covid-19 pandemic. This declaration was accompanied by a national lockdown and strict protocols. These protocols included travel bans and visa cancellations; closure of land and seaports; strict social distancing; and limits in the number of people at gatherings. These measures had a significant impact on the Mn sector. During 2019, the price of Mn had been on a downward trend. At the onset of the Covid-19 pandemic, the price saw a sharp upward trend because lockdown in South Africa resulted in decreased production. Although increased prices were favorable for African producers, this was a short-term gain as prices returned to normal when operations re-started. Logistics issues however prevailed both

on the producer and the consumer ends of the supply chain – closure of ports, no flights and overall reduced traveling. The pandemic has not only affected the prices and production of Mn but has also affected other major steel producers like China. With the closure of ports in South Africa, steel producers had delayed access to Mn.

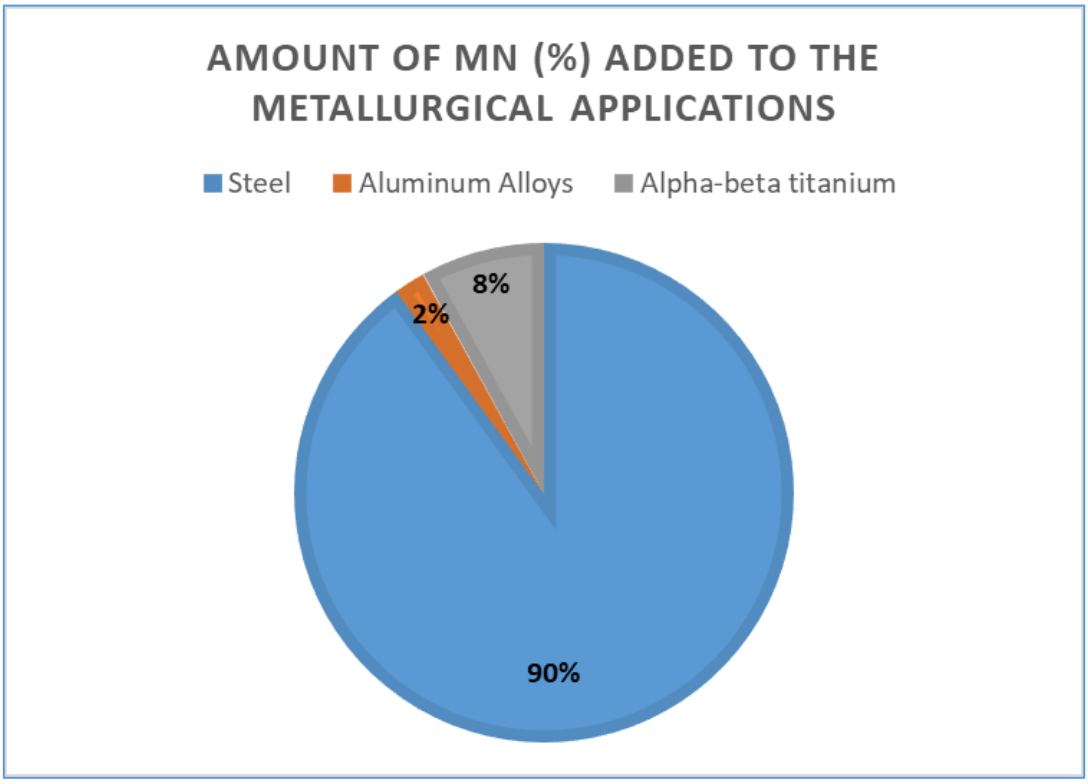

Figure 4 Percentage of Mn added to metallurgical applications (Sources: Metalpedia, 2021)

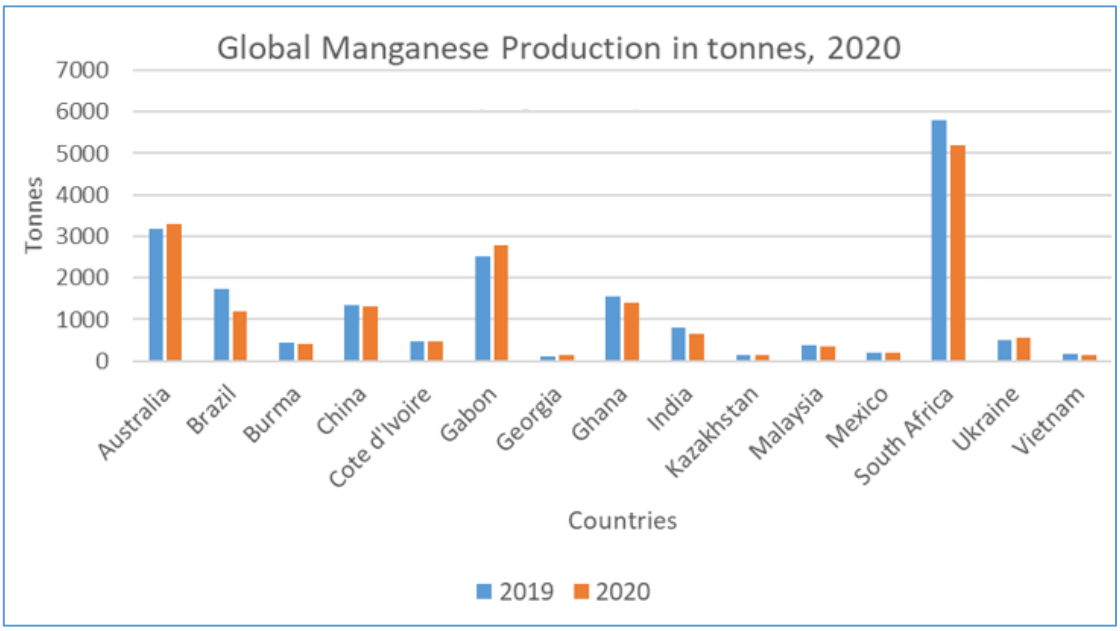

Figure 5: Global Mn production in tons (Source: USGS, 2021).

Mn miners were not only impacted in terms of their mine output but also in their ability to access material needed to carry out mining activities as well as technical services.

The pandemic has also had an adverse impact on employment within the Mn sector. Many mining companies were forced to operate with only 50% of their workforce. Consequently, mining companies had to resort to the retrenchment of their workers to reduce operational costs and sustain the life of their operations.

Lessons learned and solutions

The COVID-19 pandemic has impacted the production of Mn particularly in Africa, the major Mn producer in the world. The pandemic has, however, opened eyes in the sector, as it has taught the African Mn-producing countries (South Africa, Gabon, Ghana and Cote d'Ivoire) lessons. African countries were not prepared for the pandemic and acted late when the pandemic broke out in China, 2019. Therefore, the lesson is that African countries should have acted earlier as possible when the pandemic broke out. The pandemic has shown that the continent has an insufficient supply of basic medical equipment (i.e. masks, sanitizers) and that there is a long way to go to the digitalization of the mining industry.

The solution to address future pandemics from doing huge damage in the mining industry is for mining companies to start investing more into mine digitalization. Implementing autonomous robotics; anti-collision solutions; Big Data in real-time; and artificial intelligence, will reduce the impacts of any future pandemics on production. The aforementioned solutions will aid in ensuring continuous mine operations during pandemics. Mining companies should upsurge their corporate social responsibility (CSR) and Environmental, social and governance (ESG) initiation for the benefit of the community in which they are operating. Because health and mining are mostly connected to one another, meaning for a mining operation to produce effectively, the health sector should be of a good standard in that country.

Acknowledgment: This article was based on the presentation title; *The impact of COVID-19 on the manganese sector in Africa.* This presentation was part of the SGA-organized online seminar on the Impact of COVID 19 on the Raw Material and Hydrocarbon sectors. I would like to give special thanks to Dr. Beate Orberger and Mrs. Mary Barton for the time they have invested in guidance and to make this article a reality.

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COVID – 19 and the Mining Sector: A focus on Africa

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Abstract

The demand and supply of products of the mining and metals sector are considered inelastic and very well accustomed to market volatilities and business cycles. However, the strong culture of safety, health awareness and disaster preparedness of this sector were tested in an unprecedented way, by the outbreak of the novel coronavirus (COVID-19). The global demand for industrial metals has been seriously weakened by restrictions on movement, resulting in negative impacts on the already fragile economies of African countries. In this contribution, we present data on the mineral production and potential of Africa, the impact of covid-19 on metal supply and value chains, and we argue that complete automation and digitalization of the mining process, together with intra-industry cooperation, may hold the key, to mitigating future shocks on the sector.

Introduction

The African continent is host to over 30% of global mineral reserves and currently produces over 60 metals and diamonds (Global mining review mag, 2021). The economies of many African countries such as South Africa, Burkina Faso, the Democratic Republic of the Congo and Mali, depend heavily on these mineral resources for foreign exchange earnings: - for example, gold alone accounts for about one-third of South Africa's exports (www.brandsouthafrica.com) and 66% of exports of Burkina Faso (Zabsonre *et al*. 2016). The continent plays a leading role in the supply of highly critical materials such as Mn, Co, PGMs, Ta, Nb, Ti, bauxite, uranium and diamonds, and an important role in the supply of many other mineral commodities globally.

Recapping Africa's Mineral production and potential – the talking numbers

In addition to high-quality diamonds, Africa currently produces about 60 metals, among which are critical materials such as Cobalt, Platinum groups metals, Tantalum and Niobium, REEs, Manganese, Uranium and bauxite.

Bauxite

Being the third-largest producer of bauxite in the world (67 million metric tons/year), Guinea (Conakry) hosts the world's largest reserves of this critical material (7.4 bn tons). The country is also currently mobilizing resources to increase its alumina production capacity which currently stands at 460 thousand tons per year (USGS, 2019). Other important reserves are equally being developed in Cameroon (Conyon Resources Ltd), which could see the continent overtake giant producers like China and Australia within the shortest possible time.

Cobalt

The Democratic Republic of the Congo is the world's leading producer of Cobalt, commanding more than 70% of the market share. Other important producers on the continent are Zambia, South Africa and Rwanda. According to the US Geological Survey (2021), Africa holds about 52% of global Cobalt reserves. Chambishi Metals Ltd in Zambia is the only facility in the world producing both LME registered Co and Cu metals (6.8ktpa Co metal and 55ktpa Cu cathode).

Coltan (Tantalum and niobium)

Although most of it is mined illegally by armed militia operating in the Eastern DRC, the continent prides itself as the biggest producer of this highly demanded critical material. Combined Africa produces 60% global Coltan output.

Platinum Group Metals (PGMs)

The Republic of South Africa alone currently accounts for 80% of all the PGMs mine globally. Even more importantly, the country holds a monstrous 93% of proven reserves of PGMs in the orthomagmatic Bushveld complex. Anglo-American Ltd operates two PGM smelters in the country, producing a Pt matte and wide range of the PGMs (Pt, Pd, Ir, Os, Ru, and Rh) with Ni and Cu as byproducts.

Heavy Mineral Sands (Titanium and Zirconium ores)

Africa is the highest producer of titanium feedstock (33%), representing about 2.5 million tons/year from five countries – South Africa, Senegal, Mozambique, Madagascar and Sierra Leone (USGS, 2019). In South Africa, Tronox operates smelting plants that separate smelts the heavy minerals sands into intermediate products like synthetic rutile, tiatania slag, zircon and high-quality pig iron for sale to pigment and steel industries.

Diamonds

In 2019, Africa accounted for about 38.6% (21.5 million carats), with DRC being the highest producer on the continent (11 million carats). According to the Namibian Chamber of mines (2021), diamond production accounts for approximately 10% of Namibian GDP, 40% of export revenue, and 7% of annual government revenue.

Besides being the leading producer of Co, Bauxite, mineral sands, PGMs, Coltan and diamonds, Africa equally plays an important role in the supply of other mineral commodities globally, some of which are listed in the table below.

Table 1. Other mineral commodities in Africa. (Data in thousand metric tons except otherwise stated).

Mineral Commodity	Country	Mine production 2019	Reserves
Copper	Zambia	797	21000
	Congo DR	1290	19000
Gold	Ghana	142 t	1000 t
	Mali	61t	800
	South Africa	105 t	2700 t
	Sudan	90 t	NA
REEs	South Africa	0	790000
	Madagascar	4000	NA
	Burundi	25000	NA
	Tanzania	0	890000
Uranium	Niger	2983 t	411
	Namibia	5476 t	463
	South Africa	346 t	790
Iron Ore	South Africa	72400	1000

Source: US Geological Survey, 2019.

Although mining activities contribute a great deal to African GDP, it is worth noting that these economies are increasingly becoming over-dependent on mining (Ericsson and Lof, 2019). The International Council on Mining and Metals (ICMM) uses the mining contribution index (MCI) to evaluate the dependence level of a country on mining. The most recent edition (ICMM-2018), places five African countries at the top of its list – DR Congo (MCI=96.4), Guinea (MCI=94.3), Burkina Faso (MCI=93.4), Mali (MCI=93.2) and Sierra Leone (MCI=92.6). This phenomenon makes these countries more vulnerable to economic crises in the event of a supply chain disruption such as Covid-19.

The impact of Covid-19 on the mining sector in Africa

Most of the effects of the pandemic on the metals sector are related to the supply chain disruptions during the periods of mandatory lockdowns in the various countries. In Africa, lockdown peaked between February and June 2020. During this period, most mining activities were shut down in many countries across the continent. Liberia was the most affected, in terms of lockdown days (59) while Burkina Faso mines remained operational throughout the periods of lockdown.

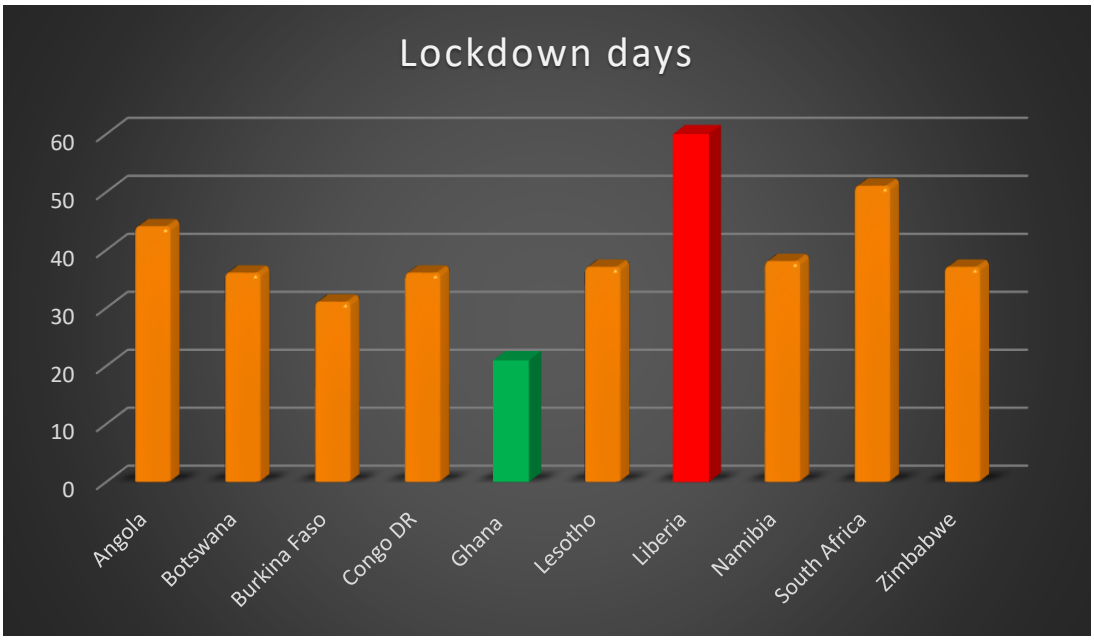

Figure 1. Lockdown days by the country for the period January to June 2020 (South African Minerals Council, 2021).

The table below illustrates the effect of lockdown on mine production of various metal commodities in South Africa. But for diamonds, all other commodities witnessed a drop in production during the lockdown.

Table 2. Effects of lockdown on mine production in South Africa (data in thousand metric tons, unless staed)

Mineral commodity	Mine Prod. 2019	Mine Prod. 2020	Drop/Rise	%Change
Zirconium (metric tons)	370	320	-50	-14
Titanium feedstock	1,100	1,000	-100	-9
Platinum (Kilograms)	133,000	120,000	-13000	-10
Manganese	5,800	5,200	-600	-10
Iron ore	72,400	71,000	-1400	-2
Gold (metric tons)	105	90	-15	-14
Diamonds (million carats)	1	3	2	200
Cobalt (metric tons)	2,100	1,800	-300	-14

Souce: US Geological Survey, 2021

Due to movement restrictions imposed by countries around the world, port calls for bulk carriers, container vessels and vehicle carriers in South African ports fell consistently, thereby affecting the mid-stream of the supply chains for mineral commodities in the country. Also, the global demand for metals plummeted, prompting a fall in the production of mines in the continent.

According to the South African Minerals council, (2021), the country had lost 387 mine workers to the pandemic, while a further 33,277 had been tested positive by April 2021. The council further estimated that at least 34000 direct mining jobs were lost in 2020, due to the pandemic. The Scorpion Zinc mine in Namibia was placed under care and maintenance, causing the loss of 1500 direct jobs. Diamond prices also plummeted in 2020, negatively affecting government revenue.

The upsides of the Pandemic and Lessons learned

The covid-19 pandemic most certainly dealt a huge blow to the metal and diamond sectors in Africa. The loss of lives and jobs, supply chain disruptions, a fall in the GDPs of many countries and the corresponding impact on the respective economies cannot be overemphasized. However, the pandemic is not without its upsides and inadvertent opportunities which could be harnessed to the advantage of the metals sector in Africa.

- Firstly, the global restrictions on movements mean that more local Geologists and mine workers are being hired in the place of expatriates.
- Most recently, there have been renewed discussions on how to strengthen the local supply of mining inputs and less reliance on international suppliers.
- Government stimulus plans and Covid-19 packages to citizens around the world have caused significant global inflation. Consequently, many investors have shifted to gold to preserve the value of their wealth, causing the price of gold to increase, peaking at the $2000/Oz mark (the highest since 1975). The favorable gold prices have permitted some African governments to earn foreign exchange to cover for the slump in demand on the other mineral commodities, thereby narrowly escaping huge negative economic setbacks.

Going forward, on the supply side, automation and digitalization of the mining process would be the path to follow, to limit person-to-person contact in mines, in the event of another pandemic. Besides Covid-19, mining is a dangerous profession with hazards such as fires, flooding, mine collapse, and health risks such as respiratory diseases, hearing loss, musculoskeletal disorders and heat stress. Introducing autonomous equipment such as robotic loaders, laser sensors and driverless trucks can help ensure workers' safety while minimizing daily person-to-person contact. The remarkable increase in the use of virtual conferencing corridors such as Zoom and Microsoft Teams certainly marks a paradigm shift in the way work will be viewed and done in the future of the mining industry. The Resolute Mining's Syama gold mine in Mali, for example, remained operational throughout the pandemic due to its highly automated design. It is for this reason that the autonomous mining equipment market is expected to grow from $2.28 in 2020 to $2.81 billion in 2021 at a compound annual growth rate (CAGR) of 23.2%, and is projected to reach $3.44 billion in 2025 (Autonomous Mining Equipment Global Market Report 2021).

On the demand side, the metals industry needs to work towards strengthening the supply chains by building resilience and flexibility into business models and the value chain. This can be achieved through collaboration and data sharing among industry stakeholders; de-globalization and diversification of supply chains based on proximity and constant availability rather than on cost only; engaging proactively with key suppliers; mapping supply chains and conducting "what if" scenarios and creating tact teams for supply chain assessment and management and crises response.

Currently, foreign exchange economic policies, in many African countries, are disproportionately skewed towards mining and non-renewable resources (Ericson and Lof, 2019). Agriculture quickly comes to mind as a more reliable economic indicator that can effectively balance the weight of mining on these systems. Diversification through investments in large-scale agro-industrial projects, with large irrigation schemes and local transformation facilities, can, in a long term, render the economies more resilient and better prepared, in the event of another global shock.

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MAURITANIDES 2021

6TH MAURITANIAN MINING, OIL & GAS CONFERENCE AND EXHIBITION

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Supported by Ministry of Petroleum, Mines and Energy, Mauritania

Press Release

FOR IMMEDIATE RELEASE 13 July 2021

6th edition of Mauritanides returns to Nouakchott, Mauritania from 7 - 9 December 2021

Mauritanides, the largest and only biennial mining and energy conference and exhibition held in Mauritania since 2010, returns to Nouakchott, Mauritania from 7 - 9 December 2021. The event was last held in 2018 but was postponed in 2020 due to the COVID-19 pandemic.

More than 1600 attendees converged in Nouakchott in 2018 for this flagship showcase, which is a major fixture in the global mining and energy trade event calendar. Mauritanides 2021 will continue to shine the spotlight on Mauritania's vast minerals and energy wealth, with a strong core representation from Mauritanian companies and SMEs.

This event is supported at the highest level by the Mauritania government and key government leaders including the President, Prime Minister and Minister for Petroleum, Mines and Energy have graced the 2018 edition.

Statistics for 2018

Under the helm of Spire Events (Singapore), a dynamic global Expos and Conference organiser specialising in energy and mining trade events, Mauritanides was successfully revamped in 2018. With a brand new event logo and new website www.mauritanidesmr.com, Mauritanides was also the first event to be held at the brand new Al Mourabitoune International Convention Centre, the latest conference venue built in Nouakchott.

The refreshed Mauritanides event was extremely well received by all sponsors and attendees in 2018 and the event statistics are a testimony to the success:

- Compared to the 2016 edition,
  - More than 60% increase in number of sponsors
  - More than 30% increase in number of exhibitors
  - Around 20% increase in attendee numbers
- 50% of the sponsors were first time participants, with more financial institutions onboard reflecting the strong investment and financial event theme
- First time sponsors included major MNCs such as BP, TOTAL, Shell and ExxonMobil

- More than 28 countries represented at the event, with 80% core of Mauritanian attendees
- Spike in print, broadcast and social media coverage of the 3 day event, with more than 50 articles written in Arabic, French and English across Mauritania and beyond

Top 3 reasons to be a part of Mauritanides 2021

1. **Strong top-level government support**

Mauritanides has always had the strongest support from the Ministry of Petroleum, Mines and Energy, Mauritania as the platform to bring global industry players to the country and showcase the mineral and energy resources abundant here in Mauritania. Besides key Mauritanian government leaders in attendance, government ministers from regional countries such as Morocco have also attended.

2. **The only platform in Mauritania to connect with key industry and government decision makers**

Since its inception in 2010, Mauritanides has been the event to connect key industry and government decision makers in Mauritania and it will continue to be the preferred platform for years to come. With a strong Mauritanian core, this has always been the event for mining and oil and gas industry players looking to enter the Mauritanian market.

3. **Experienced global events organiser with profound understanding of mining and energy sector, especially within Africa**

Spire Events successfully brought its extensive global expertise to deliver a fresh, revamped Mauritanides experience for all attendees in 2018. Given the positive reception, Spire Events has once again been entrusted by the Ministry of Petroleum, Mines and Energy to helm Mauritanides and showcase the country as a land of opportunities.

How to participate

With limited physical space at the Convention Centre, companies are encouraged to sign up early to secure the best locations onsite for their sponsorship and exhibition booths. Enquiries for sponsorship and exhibition packages as well as delegate passes for Mauritanides 2021 can be sent to Mahesh.babu@spire-events.com.

Background on Spire Events

Spire Events is a Singapore based events company that has conceptualised and organised the global Mining Investment Conference Series since 2015. From the inaugural Mining Investment Asia Conference in Singapore, the series expanded to across Asia, Europe, Middle East, North and Latin America and Africa. Spire Events also launched the MiningTech Conference Series in 2018 in Chile to focus on the role of technology in mining. In 2021, Spire Events launched a new Mining & Energy Investment Australia-Europe Conference and Exhibition in Perth, Australia to focus on critical minerals and energy across Australia and Europe. The full calendar of all Spire Events conferences can be found at www.spire-events.com

ISSUED BY: SPIRE EVENTS SINGAPORE

SPIRE EVENTS

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Pictures (to be credited to 'Spire Events (Singapore)')

Mauritanides 2021 logo

Past Mauritanides 2018 event picture

MAURITANIDES 2021

6ÈME CONFÉRENCE ET EXPOSITION SUR L' EXPLOITATION MINIÉRE, PÉTROLIÉRE ET GAZIÉRE EN MAURITANIE

7 - 9 DÉCEMBRE 2021 | NOUAKCHOTT, MAURITANIE

Pris en charge par : Ministère du Pétrole, des Mines et de l'Energie, Mauritanie

Communiqué de presse

POUR DIFFUSION IMMÉDIATE 13 juillet 2021

La 6e édition de Mauritanides revient à Nouakchott, Mauritanie du 7 au 9 décembre 2021

Mauritanides, la plus grande et la seule conférence et exposition biennale sur les mines et l'énergie qui se tient en Mauritanie depuis 2010, revient à Nouakchott, en Mauritanie, du 7 au 9 décembre 2021. L'événement a eu lieu pour la dernière fois en 2018, mais a été reporté en 2020 en raison de la pandémie de COVID-19.

Plus de 1600 participants ont convergé à Nouakchott en 2018 pour cette vitrine phare, qui est un élément majeur du calendrier mondial des événements miniers et énergétiques. Mauritanides 2021 continuera de braquer les projecteurs sur les vastes richesses minérales et énergétiques de la Mauritanie, avec une forte représentation de base des entreprises et des PME mauritaniennes.

Cet événement est soutenu au plus haut niveau par le gouvernement mauritanien et des dirigeants gouvernementaux clés, dont le président, le Premier ministre et le ministre du Pétrole, des Mines et de l'Énergie, ont honoré l'édition 2018.

Statistiques pour 2018

Sous la direction de Spire Events (Singapour), un organisateur mondial dynamique d'expos et de conférences spécialisé dans les événements commerciaux de l'énergie et des mines, Mauritanides a été réorganisé avec succès en 2018. Avec un tout nouveau logo d'événement et un nouveau site Web www.mauritanidesmr.com, Mauritanides a également été le premier événement à se tenir au tout nouveau Centre international des congrès Al Mourabitoune, le dernier lieu de conférence construit à Nouakchott.

L'événement mauritanides rafraîchi a été extrêmement bien accueilli par tous les commanditaires et participants en 2018 et les statistiques de l'événement témoignent du succès:

- Par rapport à l'édition 2016,
  - Augmentation de plus de 60 % du nombre de sponsors
  - Augmentation de plus de 30% du nombre d'exposants
  - Augmentation d'environ 20 % du nombre de participants

- 50 % des commanditaires étaient des participants pour la première fois, et un plus grand nombre d'institutions financières à bord reflètent le solide thème de l'investissement et de l'événement financier
- Les premiers sponsors comprenaient de grandes multinationales telles que BP, TOTAL, Shell et ExxonMobil
- Plus de 28 pays représentés à l'événement, avec 80% du noyau de participants mauritaniens
- Pic de couverture imprimée, radiodiffusée et sur les réseaux sociaux de l'événement de 3 jours, avec plus de 50 articles écrits en arabe, Français et en anglais à travers la Mauritanie et au-delà

Top 3 des raisons de faire partie de Mauritanides 2021

1. **Solide soutien gouvernemental de haut niveau**

Mauritanides a toujours reçu le soutien le plus fort du ministère du Pétrole, des Mines et de l'Énergie, Mauritanie comme plate-forme pour amener les acteurs de l'industrie mondiale dans le pays et mettre en valeur les ressources minérales et énergétiques abondantes ici en Mauritanie. Outre les principaux dirigeants du gouvernement mauritanien présents, des ministres de pays de la région tels que le Maroc ont également participé

2. **La seule plate-forme en Mauritanie pour se connecter avec les décideurs clés de l'industrie et du gouvernement**

Depuis sa création en 2010, Mauritanides a été l'événement pour connecter les décideurs clés de l'industrie et du gouvernement en Mauritanie et il continuera d'être la plate-forme préférée pour les années à venir. Avec un noyau mauritanien fort, cela a toujours été l'événement pour les acteurs de l'industrie minière, pétrolière et gazière qui cherchent à pénétrer le marché mauritanien.

3. **Organisateur d'événements mondiaux expérimentés avec une compréhension approfondie du secteur minier et énergétique, en particulier en Afrique**

Spire Events a apporté avec succès sa vaste expertise mondiale pour offrir une expérience Mauritanides fraîche et remaniée à tous les participants en 2018. Compte tenu de l'accueil positif, Spire Events a une fois de plus été chargé par le ministère du Pétrole, des Mines et de l'Énergie de diriger mauritanides et de présenter le pays comme une terre d'opportunités.

Comment participer

Avec un espace physique limité au Centre des congrès, les entreprises sont encouragées à s'inscrire tôt pour obtenir les meilleurs emplacements sur place pour leurs kiosques de commandite et d'exposition. Les demandes de renseignements pour les forfaits de commandites et d'exposition ainsi que les laissez-passer de délégués pour Mauritanides 2021 peuvent être envoyées à Mahesh.babu@spire-events.com.

Contexte des événements Spire Events

Spire Events est une société d'événements basée à Singapour qui a conceptualisé et organisé la série mondiale de conférences sur l'investissement minier depuis 2015. Depuis la conférence inaugurale Mining Investment Asia à Singapour, la série s'est étendue à l'Asie, à l'Europe, au Moyen-Orient, à l'Amérique du Nord et à l'Amérique latine et à l'Afrique. Spire Events a également lancé la série de

conférences MiningTech en 2018 au Chili pour se concentrer sur le rôle de la technologie dans l'exploitation minière. En 2021, Spire Events a lancé une nouvelle conférence et exposition Mining &Energy Investment Australia-Europe à Perth, en Australie, pour se concentrer sur les minéraux et l'énergie critiques en Australie et en Europe. Le calendrier complet de toutes les conférences Spire Events se trouve à www.spire-events.com.

PUBLIÉ PAR: SPIRE EVENTS SINGAPORE

SPIRE EVENTS

our les demandes de renseignements des médias, veuillez communiquer avec :

M. Ng Chin Chye
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Email : chinchye.ng@spire-events.com

Photos (à créditer à 'Spire Events (Singapour)')

Logo de Mauritanides 2021

Photo de l'événement Passé Mauritanides 2018

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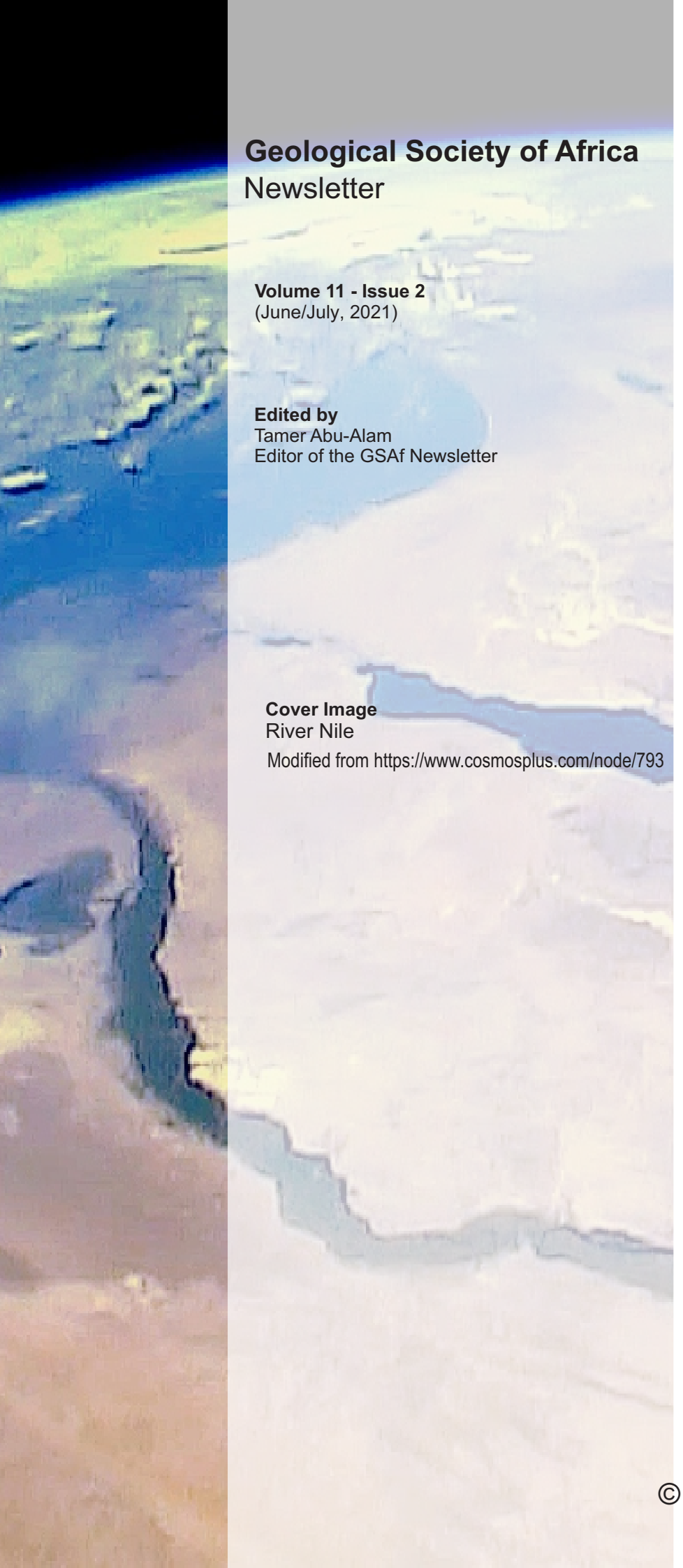

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