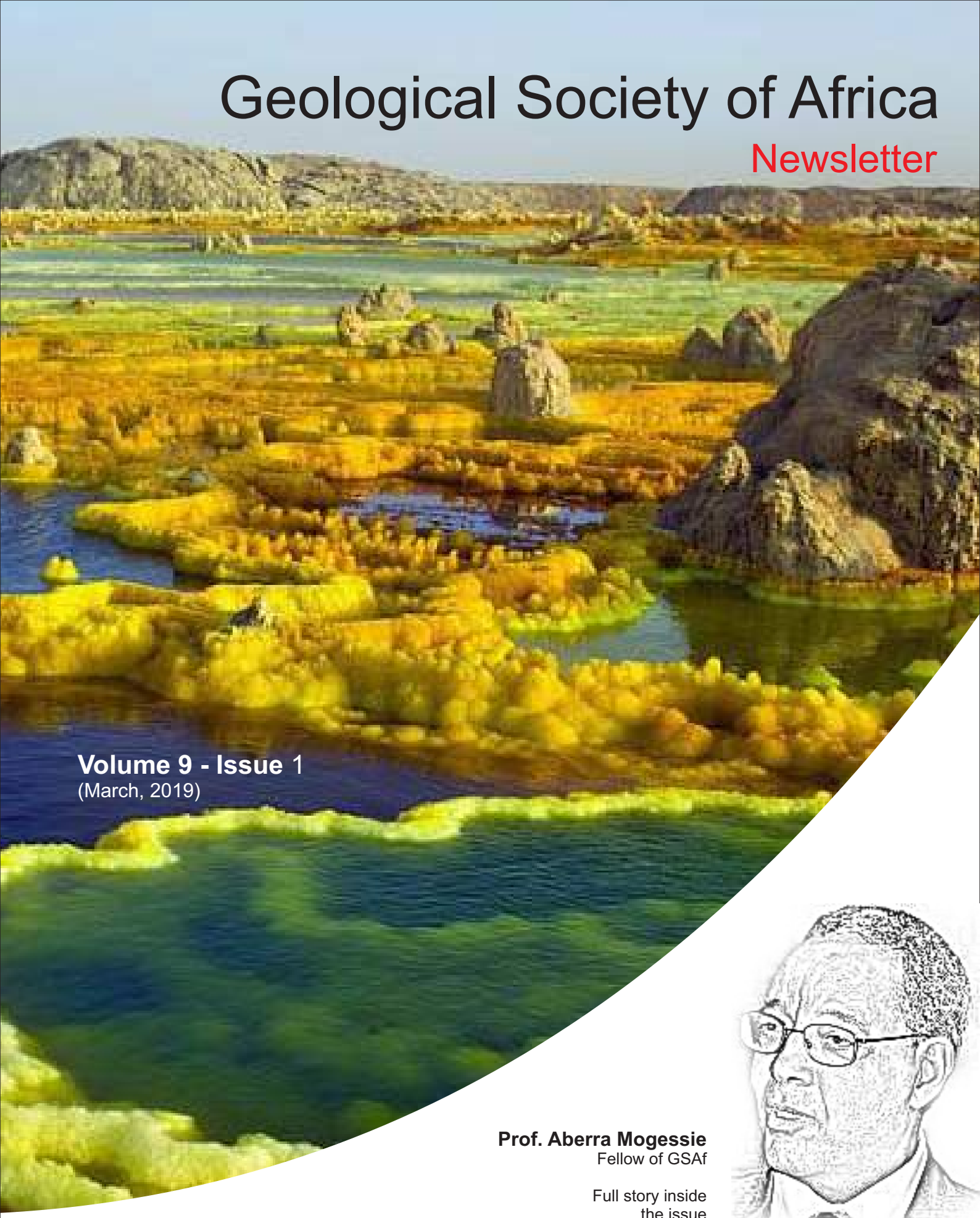
Geological Society of Africa

Newsletter



Volume 9 - Issue 1
(March, 2019)

Prof. Aberra Mogessie
Fellow of GSAf

Full story inside
the issue

Edited by
Tamer Abu-Alam
Editor of the GSAf Newsletter

In The Issue

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http://gsafr.org
http://www.geologicalsocietyofafrica.org/

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GSAF MATTERS

Updating our membership list

The Council of GSAf succeeded to update the membership list of the Society. All the members have now a unique membership ID. An email was sent to the members to inform them of their IDs and asking for confirmation of their personal information. We (as the Council) appreciate the help from the members, please check your email inbox or spam folders to confirm your membership.

If you are a member and did not receive such email or have changed your email address, please send us your name and your new email at tamerabualam@yahoo.com.

If you are not a member and would like to become a member, please read more about the membership here: http://gsafr.org/membership/

Please note: receiving emails from us including information and newsletters does not mean that you are a member of the Society but only that you have registered to receive our free newsletter.

GSAf MATTERS: GSAf renewed the registration with IUGS

The GSAf has been successful, at the beginning of the year, in renewing our registration with IUGS as requested for societies that are 5 years and above in affiliation. IUGS have acknowledged the renewal of our affiliation. We are one of the 1/3 of associations hitherto affiliated that have fulfilled this successfully.

GSAf MATTERS: GSAf at the South Africa Council for Geoscience

Prof. Gbenga Okunlola (President of GSAf) has represented the Society at the South Africa Council for Geoscience annual conference that was held in Pretoria (11-14 th Feb.). The society has presented a topic on "The Geological Society of Africa: The Afro global geoscience bridge between Academia, industry and society".

GSAf MATTERS: Africa: A key player for a better and sustainable world (Final report of CAG27)

Prof. Eduardo Anselmo Ferreira da Silva (University of Aveiro) has reported to the GSAf the final report of the CAG27 which was held in Aveiro 21-28 July 2018 (http://cag27.web.ua.pt/). Once more the Council of the GSAf, would like to thank the Local Organizing Committee on behalf of the members of the Society, for their work that made yet another great meeting for the society.

GSAf MATTERS: Report on the Council for Geoscience Annual Conference 2019

"Marging maps for an emerging future"

11-12 February, 2019 at the CSIR International Convention Centre Pretoria, South Africa

By Wladyslaw Altermann (Vice-President of GSAf)

The annual conference of the Council for Geosciences (CGS) in Pretoria was chaired by Dr Marthinus (Thinus) Cloete of the CGS, and took place in February 2019 at the luxury CSIR International Convention Centre Pretoria, because of renovation work at the CGS headquarters. The two-day conference provided a good insights on the

new “Integrated and multidisciplinary geoscience mapping programme” of the CGS for South Africa, with special emphasis on themes like ‘geoscience for minerals and energy’; ‘geoscience for infrastructure and land use’; ‘geoscience for health’, ‘groundwater and the environment’; ‘geoscience innovation’, and ‘geoscience diplomacy’. The conference also concentrated on the new 1:50000 mapping campaign of the CGS. This long term project is not so much driven by the quality and availability of geological maps, whereby most of South Africa has been mapped only on scale of 1:250,000, but by the necessity to develop certain regions, where economic progress has been slow in the past decades. In this interesting political approach to geological mapping priorities, it is hoped that more detailed geological information on such regions will boost the economic development of such areas – a vision not necessarily shared by all geoscientists. A highlight of the conference was the introduction of a new edition of the Geological Map of South Africa 1:1000000 and its digital version, edited by the CGS with a significant contribution of the South African Committee for Stratigraphy (SACS). It is hoped that this map will be freely accessible via internet to all stakeholders and interested public.

Evening in Pretoria. From right to left: Richard Ernst and his daughter Heather, Chris Hatton and wife, Gbenga Okunlola, Wlady Altermann, Cole Kingsbury.

The 2019 CGS annual conference was very vivid and populated mainly by more than hundred young South African geoscientists and a large number of experienced and established researchers, all exchanging their views, opinions and research results. Around 130 abstracts, including about 30 poster presentations, mainly by South African authors, but often co-authored in international teams, were submitted to this well-organized conference and presented partly in three parallel sessions. Around a dozen of international and national keynote and invited presentations were given during the two-days event by internationally well-known scientists, among them Prof Gbenga Okunlola, Nigeria, the President of the Geological Society of Africa (“GSAf: The Afro-global geoscience bridge between academia, industry and society”); Prof Richard Ernst, Carleton University, Ottawa, Canada and Tomsk State University, Tomsk, Russia (“Multicommodity, multiscale exploration using the large igneous province (LIP) record”); Dr Bob (R.J.) Thomas of CGS (“Reflections on 40 years’ progress in African geoscience”); or Prof Lawrence Robb, Oxford University, UK and University of Witwatersrand, Johannesburg, SA (“Integrating the ‘SmartFarm’ with mining – reawakening the Albert Silver Mine after a century of dormancy”). The conference also offered a workshop on “Global Landmarks in the South African stratigraphic record” and after the conference a half

day discussion round on the main problems of South African stratigraphy was organized by Dr Christopher Hatton at the CGS.

The conference and its social program offered good opportunities to meet and discuss African and South African geology. Prof Gbenga Okunlola and Prof Wlady Altermann of the University of Pretoria and Vice-President (South) of the GSAf, have used this opportunity for discussions with representatives of the CGS and of South African universities, among them Drs Thinus Cloete and Dr Chris Hatton, Prof Nic Beukes of University of Johannesburg and many others. Discussions on new joint projects were held between GSAf representatives and Prof Richard Ernst who invited us to participate in the 7th International Conference on Large Igneous Provinces 'Through Earth History: Mantle Plumes, Supercontinents, Climate Change, Metallogeny and Oil-Gas, Planetary Analogues', in September, 2019, in Tomsk, Russia (http://geoconf.tsu.ru/lip2019/english/). Prof Ernst also gave a one day seminar to Hons students in the Department of Geology and the Exxaro Chair of the University of Pretoria, on invitation by Prof Altermann and has spent a weekend with Wlady and Dr Cole Kingsbury in and around the 1.1 Ga Pilansberg alkaline complex, now a wonderful National Park with the Big Five of African fauna.

Further information on the 2019 Annual CGS Conference can be found at: https://geoscience.org.za/cgs/

GSAf MATTERS: Homage of Prof. Eberhard Klitzsch (1933 – 2018)

By: Sospeter Muhongo and Thomas Schlüter

Eberhard Klitzsch was born on 18 August 1933 as son of a forest warden in Remda, Thuringia, in central Germany. After attending schools at various places in the former German Democratic Republic (GDR) and achieving the obligatory Abitur (Matura) certificate, he enrolled for geology at Jena University in 1951. He had to flee to West Berlin due to having distributed in public of anti-government leaflets against the East German regime. He enrolled again for geology at the newly founded FU-Berlin (founded in 1948), where he completed his diploma in geology/palaeontology in 1957. Only one year later he was conferred with a doctorate for a thesis on the stratigraphy of the Middle Devonian along the Dill basin.

Before finalising his doctorate he was already employed by the US Geological Survey as an engineering geologist, and worked for one year for the survey and subsequently from 1958 to 1967 as a field geologist for the German petroleum exploration company DEA in Libya and neighbouring regions. Subsequently, he returned to West-Berlin, and habilitated at the Technical University of Berlin, and became full professor at the same university in the applied geological disciplines of hydrogeology, petroleum geology and photogeology in 1970.

His biggest merit was surely initiating and developing the special research unit SFB 69 ("Sonderforschungsbereich") *Geoscientific problems in arid and semi-arid regions of Africa"*, established in 1981, whose spokesman and representative he was until 1995. Major research topics of this unit included the analysis of the geological structures in the Sahara and its southern neighbouring regions, under special consideration of their water and mineral resources. In Cairo (Egypt) he came soon into contact and worked successfully together with the eminent Egyptian geologist Rushdi Said (1920-2013), the Harvard-educated Director of the Geological Survey of Egypt, who had published various books on the geology of Egypt and was in charge for fieldwork and mapping of large parts of the Egyptian desert.

Over the years, more than 200 geoscientists were working for the SFB, participating from all universities of Berlin and various universities in Africa. All together more than 120 doctoral dissertations were produced, among them 33 from African research students. Additionally, some habilitation theses were supervised by Eberhard Klitzsch, thus enabling the candidates to qualify for the status of *Privatdozent*, which is a prerequisite to become full professor. The results of his research and his co-workers were summarized in a book entitled: *Nordost-Afrika: Strukturen und Ressourcen* (Northeast Africa: Structures and Resources), published by Eberhard Klitzsch and Ulf Thorweihe in 1999.

Eberhard Klitzsch had originally planned to transfer the human and physical resources of the SFB into an international institute of African geosciences located in Berlin, but after re-unification of the two German states in 1990 all the potentially needed funds for this task had largely to be provided for the reconstruction and maintenance of the Humboldt-University in the eastern part of Berlin, which in the context of integration of its previous infrastructure into the federal education model of Germany, had now completely to be restructured. What had remained of the former SFB was transferred into a research subject now called International Geosystem Analysis (GEOSYS), which was largely based at the Technical University of Berlin. The data and material achieved over the active years of the SFB will still be evaluated by generations of geoscientists in years to come.

Fig. 1: Frontispiece of Eberhard Klitzsch`s autobiographic book *Geologie ist nichts für Feiglinge* ("Geology is nothing for cowards"), published in Berlin in 2012 (he in the centre), Image resolution as from the source.

After becoming Professor Emeritus in 1998 at the Technical University of Berlin, Eberhard Klitzsch was still a highly demanded expert for consultancy in various German and foreign government institutions on geoscientific problems in many parts of the world. He was welcomed in many geoscience institutions all over the world and travelled for instance to Oman, India and Paraguay. His personal interest concentrated still in the exploration of new petroleum fields, but supported also colleagues in other subjects, like in palaeontology.

Eberhard Klitzsch received various awards for his geoscientific achievements, among these several honorary doctorates and in 1988 the highest civilian order of the Federal Republic of Germany, the *Bundesverdienstkreuz*

am Bande. In 2012 he published his autobiography, in which he reported about his scientific merits detailing all his adventures in the deserts of Libya, Egypt, Sudan and other arid or semi-arid countries. Sometimes imprisoned, hijacked or surviving in an airplane crash, he never lost his mood and interest in the respective areas despite of what had happened. Over the final years of his life he became increasingly fragile, but he still participated actively in various scientific meetings. He died in Berlin on 20 September 2018.

GSAf MATTERS: Conference report

A Code for Geoscientific Fieldwork in Nigeria and Africa: Guidelines on Health and Safety Issues in Mapping, Mineral Exploration, Geoecological Research and Geotourism

UNIVERSITY OF NIGERIA, NSUKKA, 06 - 09 NOVEMBER, 2018

By: Prof. Theo Davies* and Dr. Charles Ugbor *

The need to reinforce health and safety management issues in geoscientific and geoecological fieldwork in Africa is considered urgent. This is exemplified from the recurrent reports of unsavory incidents including injuries or even death of fieldworkers; but also engendering unethical field procedures, common law duty of care, litigation and insurance considerations.

The Geoscientific Fieldwork Conference 2018 was organised by the University of Nigeria, Nsukka (UNN), under the auspices of the Ministry of Mines and Steel Development of the Federal Republic of Nigeria. The Conference was held at the Niger Hall of the University, from 6th to 9th November, 2018. The theme of the Conference was: A Code for Geoscientific Fieldwork in Nigeria and Africa: Guidelines on Health and Safety Issues in Mapping, Mineral Exploration, Geoecological Research and Geotourism. This is the first time that a Conference of this theme has been hosted by Africa.

The aim of the Conference was to demonstrate unequivocally that most of the risk encountered during geoscientific and geoecological fieldwork in Africa can be reduced, or, in many instances, obviated altogether, by:

(i) *Knowledge;*
(ii) *Experience;*
(iii) *Adequate preparation, and*
(iv) *Strict adherence to appropriate health and safety precautions*.

The Conference attracted a large group of interdisciplinary participants comprising, geologists, agriculturists, archaeologists, botanists, geographers, geophysicists, legal scholars, miners and zoologists.

The Conference started with an informal gathering where participants took the opportunity to make scientific contacts and meet fellow researchers outside their own specific areas of specialisation, in a bid to develop and strengthen collaborative interdisciplinary studies on fieldwork health and safety.

The Conference was officially opened by Emmanuel Ehlebi, Esq., deputising the Minister of Mines and Steel Development of Nigeria, Hon. Abubakar Bawa Bwari, whose speech was read on his behalf. In this inaugural address, the Minister, speaking through his designee, lauded the organisers of the Conference for their initiative, stating that safety of researchers and officers in the field was a priority of his Ministry. He went on to challenge geology departments in Nigerian universities to include safety and health guidelines for fieldwork in their curriculum, noting that his Ministry had encouraged the inclusion of courses on safety and precautions in the curriculum of the Nigerian Institute of Mining and Geosciences. The Minister called for the review of the national guidelines for safety and health, which he said did not adequately address the peculiarity of fieldwork issues in Nigeria.

Welcome addresses were also delivered by the President of the Nigerian Mining and Geosciences Society, Professor Silas Dada; the Vice Chancellor, UNN, Professor Benjamin Ozumba, deputized by the Deputy Vice Chancellor (Academic) of UNN, Professor James Ogbonna; the Dean, Faculty of Physical Sciences of UNN, Professor Uchechukwu Okoro; and the Chairman of the Conference Local Organising Committee, Professor Theo Davies. A common thread running through these addresses was an emphasis on the Event's timeliness, coming

as it did, in the wake of persistent reports of missing participants, hijackings, encounters with wild fauna and common illnesses in the field such as malaria and diarrhoea.

Highpoint of the opening day was the launching of a book titled "A code for Geoscientific Fieldwork in Africa: Guidelines on Health and Safety Issues in Mapping, Mineral Exploration, Geoecological Research and Geotourism" https://novapublishers.com/shop/a-code-for-geoscientific-fieldwork-in-africa-guidelines-on-health-and-safety-issues-in-mapping-mineral-exploration-geoecological-research-and-geotourism/. The book was authored by the Conference Chair, Professor Theo Davies.

The scientific and technical presentations which included 15 thematic lectures reflected the breadth of the subject and inspired much debate on what is arguably one of the most important aspects of any holistic geoscience fieldwork curriculum. The Conference addressed the following themes through key plenary lectures:

1. Geoscience Fieldwork Preparation (Professor Ayonma Mode)
2. Geology Fieldwork Orientation (Professor Ogbonnaya Igwe)
3. Roles and Responsibilities of Fieldwork Participants (Professor Egodi Uchendu)
4. Roles and Responsibilities of Fieldwork Leaders I [Professor M.A.O. Rahaman (not in attendance) and Professor Silas Dada]
5. Roles and Responsibilities of Fieldwork Leaders II (Professor Krys Edafetano Ashano)
6. Student Comportment and the University's Duty of Care (Dr. Solomon Onwuka)
7. The Risk Management Process [Dr. Andreas Meissner (not in attendance)]
8. Safe Use of Geophysical Field Equipment: Ergonomics of Drilling and Geophysical Surveying (Dr. Ani Donatus Chinedu)
9. Health and Safety in Oil and Gas Exploration and Drilling (Professor Kalu Mosto Onuoha)
10. Fitness and Medical Considerations [Professor Joshua Umeifekwem (not in attendance)]
11. Poisonous Plants (Professor Maria Nwosu)
12. Poisonous Food Plants (Dr. Chinwe Asuzu)
13. Encounters With Wild Fauna (Dr. Gregory Odo)
14. Geoethics in Fieldwork Situations (Dr. Ani Casimir)
15. Legislations, Duty of Care, Indemnity and University Out-of Campus Assignments (Professor Edith Nwosu)

The scientific and technical sessions of the Conference were concluded by attendance of participants at a half-day field excursion to the Nkpologwu Sand Quarry on the outskirts of the town of Nsukka. The precipitous walls of rock and near vertical cliff faces, in part created by reckless quarrying activities, make this locality especially suitable for conducting the hazard assessment and risk management exercises that were designed by excursion leaders, Dr. Charles Ugbor, Professor Anyonma Mode, Professor Krys Ashano and Mr. Chinedu Ibe.

During the closing session, a number of key and critical actions, put together in the form of a communiqué, were recommended to be taken by all stakeholders.

Key Conference Resolutions/Recommendations from the fieldwork conference held at the University of Nigeria, Nsukka from 6th - 9th November, 2018

1. There is the need for annual meetings or conferences on the all-important subject of 'geoethics'.
2. It is observed that, regrettably, no safety units/officers/regulations are in place in some universities in Africa. There is therefore the urgent need for these universities to set up such units, and acquaint staff and students on the type and level of insurance cover that is provided for them.
3. The university should be solely responsible for all aspects of fieldwork, including its financing, provision of adequate insurance cover, and other aspects pertaining to safety, upon employment of staff and admission of students. There is an urgent need for universities to specify and publicize their level of duty of care for students.
4. There is need to revise existing rules guiding operations in the oil and gas industry to reflect the gravity of offences that management and staff routinely commit, especially in instances where punishment for offences are fines defined in the 1950's, like payment of the ridiculously low amount of Naira 100.00 for oil pollution.

5. Special professional bodies such as the Nigerian Mining and Geosciences Society (NMGS) and Nigerian Association of Petroleum Explorationists (NAPE) should liaise with appropriate government agencies like the Department of Petroleum Resources (DPR), as pressure groups, to facilitate the implementation of rules guiding operations in the oil and gas industry in Nigeria.
6. Non-adherence to existing basic safety regulations by the operators in the oil and gas industries has resulted in avoidable fatalities during oil and gas operations; therefore relevant government regulatory agencies should be encouraged to improve the level of safety adherence to minimize or eliminate this trend.
7. Minimum standards of geoethics should be defined, and geoscience field workers made legally bound to adhere to them during fieldwork. For instance, how we treat disabled students or our womenfolk during fieldwork campaigns? What legislations are in place to ensure preservation of geological and archeological heritage sites for future use?

Attendance of participants at a half-day field excursion to the Nkpologwu Sand Quarry on the outskirts of the town of Nsukka

8. Departments involved in vigorous fieldwork should, as a matter of necessity, present to prospective students an overview of what they should expect during field activities, in order to guide them to better career choices; especially where fieldwork involves rigorous physical activities in the fieldwork docket required for graduation. This should be incorporated in the students' admission brochure of relevant departments.
9. Detailed series of duties of a fieldwork leader should be formulated and published as a guide for all fieldwork activities in Africa. A customized duty roster for fieldwork leaders should incorporate risk-free activities during pre-site visits, during the fieldwork proper, as well as during post-field activities, and should include:
    i. Proper safety education of field participants before embarking on the field trip.
    ii. Completion of the Fieldwork Declaration Form, signed by both students and their parents/guardians to show consent.
    iii. Assembly and checking of all field equipment to ensure that they are in good order before the start of fieldwork activities.

iv. Ensuring that adequate medical equipment and supplies, such as first aid kits and anti-snake venom are present before embarking on fieldwork.

10. Appropriate orientation should be given to field participants on various safety issues, for example:
    i. Field participants should be advised to restrain themselves from eating unfamiliar foods or fruits in fieldwork locations.
    ii. Appropriate dress codes should be strictly adhered to; for example, putting on long sleeves, avoiding red dresses, green or brown coloured attire, perfumes and gowns by ladies.
    iii. Adequate safety gears including safety shoes (boot) helmet, and eye goggles should be donned for fieldwork.

Following the closing session, participants were treated to a colourful Gala Night, featuring the ever popular Band of the Music Department of UNN.

The Organising Committee of this Conference is particularly grateful to the Ministry of Mines and Steel Development of the Federal Republic of Nigeria for generously providing financial support for hosting the meeting. We also acknowledge the contribution of the participants, facilitators and their institutions for offering their time and considerable expertise to the successful conduct of the Conference.

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LETTERS TO THE EDITOR

The GSAf newsletter receives letters from members or non-members of the society which highlight important issues or scientific ideas. The letters should be short and to the point. The letters will be registered on the GSAf's website and subjected to a discussion among the society. Approved letters will be posted in the following newsletter.

Use tamerabualam@yahoo.com to send your letters.

The current registered letter is: "One More Geological Clue Still Pending; "The Obsidian of the Land of Punt" by Mahmoud A. Emam.

To follow the discussion around this letter, please follow the following link: http://gsafr.org/letter1/

WELCOME TO FEZ, MOROCCO (CAG28)

Our colleagues from Morocco are working hard in collaboration with the GSAf Council in order to prepare the CAG28 website. Prof. Youssef DRIOUCH (Vice President for Northern Africa) plans to present officially the CAG28 website during the next 3MA colloquium at El Jadida (around 20th April).

Dallol Volcano in Ethiopia

By Strange Sounds

The photos in the article are as appeared in the original article without any colour editing by the editor of the newsletter

Dallol is the hottest inhabited area on Earth, and is also one of the most remote places on Earth.

Located in a depression, at more than 100 meters bellow sea level, this volcano has one of the most unearthly sceneries on the planet. Discover its acidic hot springs, small gas geysers and pools of acid in pictures.

Pretty eerie landscape, no? And this is on Earth!

The Dallol volcano is a fascinating volcanic explosion crater (or maar) situated in the Danakil Depression, northeast of the Erta Ale Range in Ethiopia. 'Dallol' means dissolution or disintegration. This magical place consists of green and yellow acid salt ponds and miniature salt geysers.

Multiple hot springs above the hot magma have washed out the salt layers leaving voids creating these amazing sculptures.

The 1.5 by 3 km large crater of Dallol Volcano has formed by the collapse of salt layers.

The last eruption took place in 1926. These craters are the lowest known subaerial volcanic vents in the world, at over 45 m (150 ft) below sea level.

When the pressure of vapour reaches critical level, the ground (here – salt) above this superheated vapour is blown off in spectacular explosion, leaving a crater – maar.

This story originally appeared on: http://strangesounds.org/2013/06/geological-oddity-discover-the-eerie-and-colorful-landscape-of-dallol-volcano-in-ethiopia.html

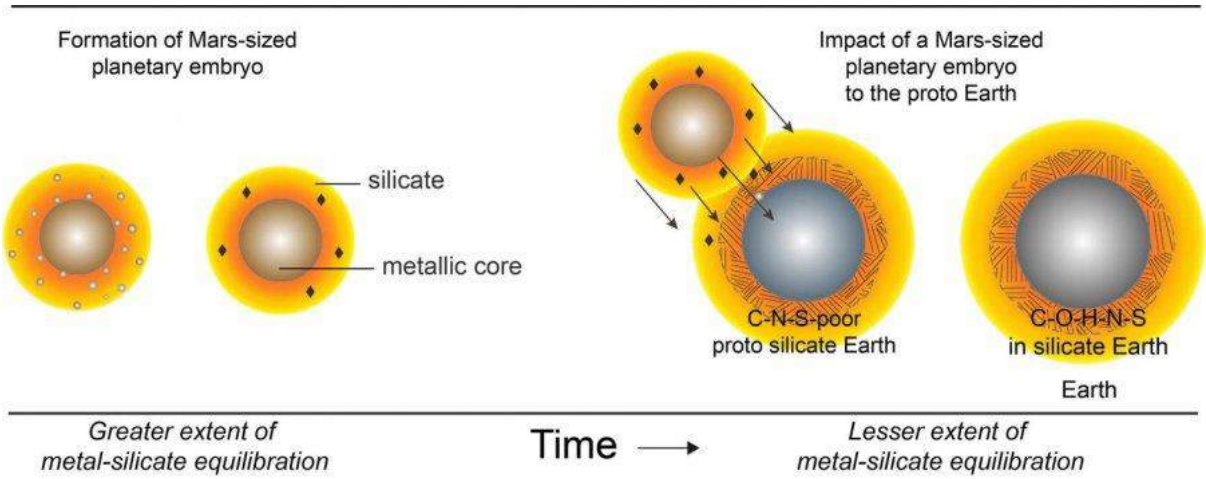
OPINION

Planetary collision that formed the moon made life possible on Earth

Planetary delivery explains enigmatic features of Earth's carbon and nitrogen

Source: Rice University

Most of Earth's life-essential elements probably arrived with the planetary collision that produced the moon. Petrologists now conclude Earth most likely received the bulk of its carbon, nitrogen and other life-essential volatile elements from a collision with a Mars-sized planet more than 4.4 billion years ago.



A schematic depicting the formation of a Mars-sized planet (left) and its differentiation into a body with a metallic core and an overlying silicate reservoir. The sulfur-rich core expels carbon, producing silicate with a high carbon to nitrogen ratio. The moon-forming collision of such a planet with the growing Earth (right) can explain Earth's abundance of both water and major life-essential elements like carbon, nitrogen and sulfur, as well as the geochemical similarity between Earth and the moon. *Credit: Image courtesy of Rajdeep Dasgupta*

Most of Earth's essential elements for life -- including most of the carbon and nitrogen in you -- probably came from another planet.

Earth most likely received the bulk of its carbon, nitrogen and other life-essential volatile elements from the planetary collision that created the moon more than 4.4 billion years ago, according to a new study by Rice University petrologists in the journal *Science Advances*.

"From the study of primitive meteorites, scientists have long known that Earth and other rocky planets in the inner solar system are volatile-depleted," said study co-author Rajdeep Dasgupta. "But the timing and mechanism of volatile delivery has been hotly debated. Ours is the first scenario that can explain the timing and delivery in a way that is consistent with all of the geochemical evidence."

The evidence was compiled from a combination of high-temperature, high-pressure experiments in Dasgupta's lab, which specializes in studying geochemical reactions that take place deep within a planet under intense heat and pressure.

In a series of experiments, study lead author and graduate student Damanveer Grewal gathered evidence to test a long-standing theory that Earth's volatiles arrived from a collision with an embryonic planet that had a sulfur-rich core.

The sulfur content of the donor planet's core matters because of the puzzling array of experimental evidence about the carbon, nitrogen and sulfur that exist in all parts of the Earth other than the core.

"The core doesn't interact with the rest of Earth, but everything above it, the mantle, the crust, the hydrosphere and the atmosphere, are all connected," Grewal said. "Material cycles between them."

One long-standing idea about how Earth received its volatiles was the "late veneer" theory that volatile-rich meteorites, leftover chunks of primordial matter from the outer solar system, arrived after Earth's core formed. And while the isotopic signatures of Earth's volatiles match these primordial objects, known as carbonaceous chondrites, the elemental ratio of carbon to nitrogen is off. Earth's non-core material, which geologists call the bulk silicate Earth, has about 40

parts carbon to each part nitrogen, approximately twice the 20-1 ratio seen in carbonaceous chondrites.

Grewal's experiments, which simulated the high pressures and temperatures during core formation, tested the idea that a sulfur-rich planetary core might exclude carbon or nitrogen, or both, leaving much larger fractions of those elements in the bulk silicate as compared to Earth. In a series of tests at a range of temperatures and pressure, Grewal examined how much carbon and nitrogen made it into the core in three scenarios: no sulfur, 10 percent sulfur and 25 percent sulfur.

"Nitrogen was largely unaffected," he said. "It remained soluble in the alloys relative to silicates, and only began to be excluded from the core under the highest sulfur concentration."

Carbon, by contrast, was considerably less soluble in alloys with intermediate sulfur concentrations, and sulfur-rich alloys took up about 10 times less carbon by weight than sulfur-free alloys.

Using this information, along with the known ratios and concentrations of elements both on Earth and in non-terrestrial bodies, Dasgupta, Grewal and Rice postdoctoral researcher Chenguang Sun designed a computer simulation to find the most likely scenario that produced Earth's volatiles. Finding the answer involved varying the starting conditions, running approximately 1 billion scenarios and comparing them against the known conditions in the solar system today.

"What we found is that all the evidence -- isotopic signatures, the carbon-nitrogen ratio and the overall amounts of carbon, nitrogen and sulfur in the bulk silicate Earth -- are consistent with a moon-forming impact involving a volatile-bearing, Mars-sized planet with a sulfur-rich core," Grewal said.

Dasgupta, the principal investigator on a NASA-funded effort called CLEVER Planets that is exploring how life-essential elements might come together on distant rocky planets, said better understanding the origin of Earth's life-essential elements has implications beyond our solar system.

"This study suggests that a rocky, Earth-like planet gets more chances to acquire life-essential elements if it forms and grows from giant impacts with planets that have sampled different building blocks, perhaps from different parts of a protoplanetary disk," Dasgupta said.

"This removes some boundary conditions," he said. "It shows that life-essential volatiles can arrive at the surface layers of a planet, even if they were produced on planetary bodies that underwent core formation under very different conditions."

Dasgupta said it does not appear that Earth's bulk silicate, on its own, could have attained the life-essential volatile budgets that produced our biosphere, atmosphere and hydrosphere.

"That means we can broaden our search for pathways that lead to volatile elements coming together on a planet to support life as we know it."

Story Source:

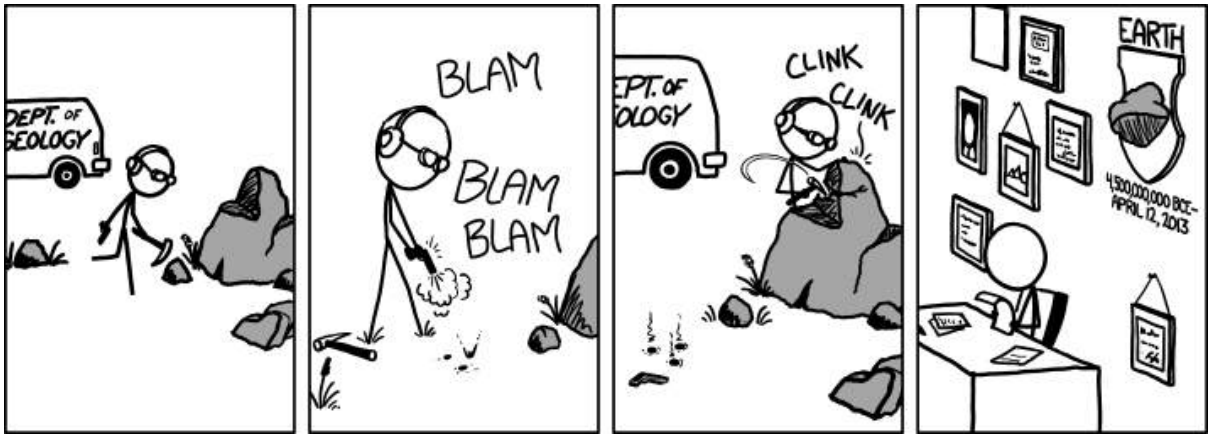
Materials provided by **Rice University**. *Note: Content may be edited for style and length.*

Journal Reference:

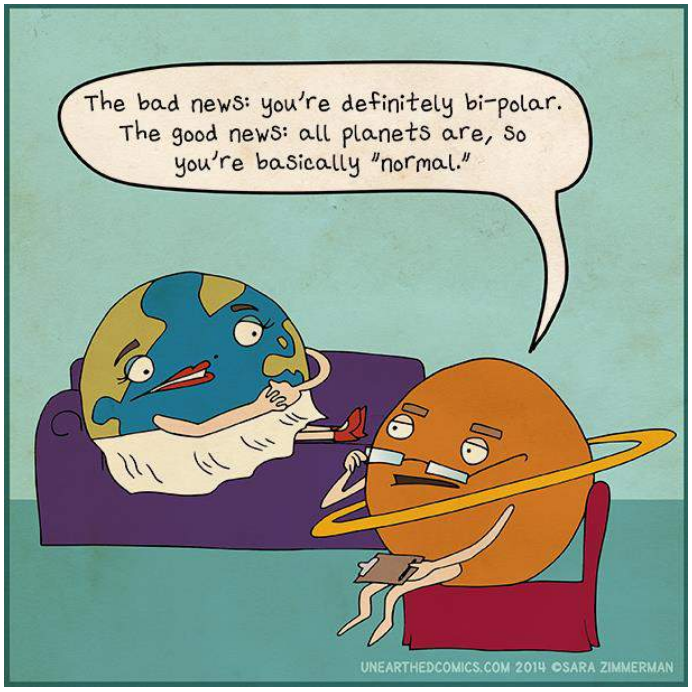
1. Damanveer S. Grewal, Rajdeep Dasgupta, Chenguang Sun, Kyusei Tsuno and Gelu Costin. Delivery of carbon, nitrogen, and sulfur to the silicate Earth by a giant impact**.** *Science Advances*, 23 Jan 2019 DOI: 10.1126/sciadv.aau3669

This story originally appeared on:
https://www.sciencedaily.com/releases/2019/01/190123144519.htm?utm_source=dlvr.it&utm_medium=facebook

GEOLOGY COMIC



This story originally appeared on: https://xkcd.com/1198/



This story originally appeared on: https://unearthedcomics.com/comics/diagnosis/

GEOLOGICAL EXPRESSIONS

Geophysics: is a branch of earth science dealing with the physical processes and phenomena occurring especially in the earth and in its vicinity. Geophysics applies the principles of physics to study of the Earth. It deals with such things as the movement of the Earth's crust and the temperatures of its interior. Another subject is the behavior of the still-mysterious geomagnetic field. Some geophysicists seek out deposits of ores or petroleum; others specialize in earthquakes; still others study the water beneath the Earth's surface, where it collects and how it flows. (Modified from https://www.merriam-webster.com/dictionary).

Geochemistry: is a science that deals with the chemical composition of and chemical changes in the solid matter of the Earth or a celestial body (such as the moon). Also geochemistry is to study the related chemical and geological properties of a substance. (Modified from https://www.merriam-webster.com/dictionary).

AN AFRICAN SCIENTIST

African Scientists can do great if they have the right working environment. In this series, we will put the spotlight on who found the right environment either in Africa or outside Africa.

Our African scientists of the current issue is a GSAf fellow

Prof. Aberra Mogessie is an Austrian citizen of Ethiopian origin working at the Institute of Earth Sciences University of Graz, Austria. He is a graduate of the Addis Ababa University (B.Sc.), University of Minnesota (USA), M.Sc., University of Innsbruck (Austria), Dr. rer, nat., and University of Graz (Austria), Dr. Habil. He is the 2011 recipient of the NMGS (Nigerian Mining and Geoscience Society) Award in Gold and a Plaque in honor of Prof. O. Oyawoye of Nigeria as a hard rock African Geologist; and a recipient of the Luis Federico Leloir Prize to International Cooperation in Science, Technology and Innovation from the Argentinian Minister of Science and Technology in November 2012. In 2015 he is elected Fellow of the Geological Society of America as well as the Fellow of the Africa Academy of Sciences and received a Certificate of recognition of 25 years of distinguished service to the society of economic geologists. Moreover, he is Associate Fellow of the Ethiopian Academy of Sciences. Prof. Mogessie has served as elected, President of the Geological Society of Africa (2008-2016). He has served as Vice President of the Austrian Mineralogical Society (2011-2013) and in January 2014 elected as President of the Austrian Mineralogical Society (one of the oldest in Europe). He is a Fellow of the African Science Institute (ASI), elected and served as member of the International Committee of the Geological Society of America for the term 2014 to 2018; He has served as an elected member of the International Union of Geosciences (IUGS) Nominating Committee (2008-2012). He was an elected Board Member of the Earth Sciences Matters Foundation; and is senior advisor to the International Association of Geoethics (IAGETH). As President of the Geological Society of Africa he has intimately worked with UNESCO in organizing regional workshops on Earth Science Education in Africa, and in the African Network of Earth Science Institutions (ANESI). Recently, he has been working with the United Nations Economic Commission for Africa (UNECA), the Africa Union Commission (AUC), the UNDP, to facilitate the implementation of the Africa Mining Vision (AMV). For this purpose he has been invited as member of selected experts to participate at the AUC – AMDC (Africa Minerals Development Center) African Geology and Minerals Information Systems Expert Group and Consultative Meeting, UNECA, Addis Ababa, Ethiopia, July 2014; Country Mining Vision Methodology Workshop, AMDC, Debrezeit (Bishoftu), Ethiopia, September 2014; and the Africa Minerals Geoscience Initiative (AMGI)- African Union Commission & World Bank Africa Geological Mapping Project workshop, Addis Ababa, Ethiopia, October 2014. He has served as member of the advisory panel of the 35th International Geological Congress, held in Cape Town, South Africa end of August 2016. He has worked with the African Minerals Development center in Addis Ababa as its principal geoscience and minerals

information system strategy consultant (2016-2017). Prof. Mogessie is a reviewer of scientific papers for several international journals, reviewer of scientific proposals for funding Agencies, and member of the editorial board of the International Geoscience, African Journal of Earth Sciences, Ethiopian Journal of Science, SINET (established the Journal with other colleagues in 1978 at the Addis Ababa University) etc. He has authored and co-authored over 265 research papers in reviewed journals and conference proceedings in the different fields of Earth Sciences ranging from Petrology, Mineralogy, Geochemistry, Economic Geology, Engineering Geology, Hydrogeology, Computers & Geosciences to his hobby Geotourism in Ethiopia. He is Co-Author of the Country Mining Vision Guidebook: Domesticating the Africa Mining Vision (2014), AMDC-UNECA, Addis Ababa, Ethiopia. P. 200; and Geotourism in Ethiopia (2009, Shama publisher, Addis Ababa). Prof. Mogessie has been awarded a number of research grants by the Austrian Science Foundation for his research projects related to petrology and mineral resources (especially precious metals like Platinum) in Argentina, Austria, Bulgaria, Egypt, Ethiopia, Tanzania and the USA. He has served as an academic advisor to a large number of students ranging from Bachelors degree to PhD and post docs. He has a number of years administrative experience having served in different positions as elected vice chair and then chair of the Institute of Mineralogy and Petrology, University of Graz; as well as, a coordinator for several outgoing and incoming mobility programs in the earth sciences at the University of Graz, Austria.

Prof. Aberra Mogessie is a fellow of GSAf

At present, apart from his academic duties and other engagements he is serving as Vice President of the Advisory Board of the PanAfGeo Mapping Project (EGS-OAGS) and in the UNCE Expert Group on Mineral resources classification to develop an African Mineral Resources Classification (AMREC) and reporting code (PARC).

About Africa

Digital Earth Africa

http://www.ga.gov.au/digitalearthafrica

What is it?

The Digital Earth Africa (DE Africa) program will build the world's largest operational platform for accessing and analysing decades of satellite imagery specific to Africa's land and seas. DE Africa will translate data from the world's free Earth observation satellites into ready-to-use insights about the continent's environmental conditions. Such insights will enable African governments, NGOs, businesses, and individuals to make more informed decisions about soil and coastal erosion, agriculture, deforestation, desertification, water quality and changes in human settlements.

The US-based Leona M. and Harry B. Helmsley Charitable Trust and the Australian Government have funded the establishment of DE Africa. Digital Earth Australia (DE Australia)—a world-class platform funded by the Australian Government that uses satellite imagery to identify changes in Australia's landscape—will provide technical and operational guidance. An African-led ecosystem of governments, private businesses, international investors and non-government organisations will provide the enduring investment for DE Africa.

A Steering Committee for DE Africa was formed in 2018 and has broad representation including; Kenya Office of the Deputy President, Council for Scientific and Industrial Research South Africa, Group on Earth Observations,Ghana Statistical Service, South African National Space Agency, Geoscience Australia, World Economic Forum, Committee on Earth Observations Satellites and the Global Partnership for Sustainable Development Data. With the support of funding from the Australian Centre for International Agricultural Research, the Steering Committee developed a study to determine the viability of a scalable, economically and technically sustainable model in Africa, for Africa.

Why is it important?

The insights gained from DE Africa will provide reliable, routine and near-real-time evidence about changes to Africa's natural and built environment. This kind of evidence underpins informed decision-making about agriculture and food security, deforestation, and strengthens the ongoing monitoring and management of mining, forests and water resources in Africa. Critically, DE Africa will eventually be a sovereign operational and analytic capability to Africa, with in-country expertise in data analysis, use and management.

Who will use it?

Governments, businesses and individuals from across Africa, as well as multinationals, and government and non-government organisations that work in Africa, will use the insights gained from DE Africa.

Where will it be?

The DE Africa Office will be established in Addis Ababa, Ethiopia and will centralise the operations, governance and forward work plan of the program. It will also build technical and policy expertise, and data analytics capability in country. The analysis, products and tools produced by DE Africa will be accessible across the continent to inform decisions about land and water.

How will the DE Africa Office work?

In its first year, the DE Africa Office will establish its operational and governance frameworks and build its

technical expertise. The DE Australia team will help guide this initial development in partnership with data, policy and industry leaders across Africa. Recruitment for the office will include executive positions, technical experts, and communication and media officers. Recruitment is expected to commence in June 2019.

DE Australia will work closely with African government and non-government organisations to augment existing expertise and provide new opportunities to learn and grow from DE Africa's innovative operations. This will likely involve secondments and job sharing in the establishment phase.

The DE Africa Office will expand on the existing DE Africa community, and strengthen the long-term engagement of international donors, philanthropic and multilateral organisations, and nations (inside and outside Africa) that want to invest in high-impact Earth-observation solutions to address environmental and economic challenges across the continent.

Background

Africa is a continent with a rich and diverse environment that faces many development challenges such as ready access to drinking water, rapid urban development, active deforestation and food insecurity. Our understanding of these development challenges in Africa will connect directly to how well we understand its natural resources, and the human and climate impact on them.

Satellites provide images of our land that can help us understand our natural and built environment. Such images are a rich source of information, but they are difficult to acquire, scale up or down, and compute and analyse – their high-quality means having to deal with many petabytes of data. Additionally, a single image can only tell you the story of a single place, and only at a single time.

But what if you could analyse all the images taken over the last 30 years to tell the story of how a place has changed over time? And what if you could tell that story to governments, businesses and individuals so that they can make the most informed decisions about how they use their resources? And what if this story was freely, and openly available to everyone who wanted to hear it?

These questions led to the launch, in May 2018, of the Africa Regional Data Cube (ARDC), an initiative spearheaded by the Global Partnership for Sustainable Development Data, with strong support from the Group of Earth Observation (GEO) and focused on five countries: Sierra Leone, Senegal, Ghana, Kenya and Tanzania. The ARDC was a prototype that clearly showed the need for such a service and its value. It also highlighted the need for an African-owned and led continental-scale approach to the acquisition, storage, interpretation and delivery of satellite data.

A summary report in 2019 comprehensively established the current and growing demand for satellite data and data cube technologies. This demand came from a wide range of African and international governments, NGOs, research and academic institutions, donors and multilateral partners seeking to address specific problems and inform development decisions.

In February 2019, the USA-based Leona M. and Harry B. Helmsley Charitable Trust committed USD10 million to the development of DE Africa, with a further AUD10 million (approximately USD7 million) from the Australian Government. DE Australia committed to providing the technical and operational expertise and will coordinate DE Africa's establishment.

News: About Africa

Researchers unearth an ice age in the African desert

geologypage.com

A field trip to Namibia to study volcanic rocks led to an unexpected discovery by West Virginia University geologists Graham Andrews and Sarah Brown.

While exploring the desert country in southern Africa, they stumbled upon a peculiar land formation—flat desert scattered with hundreds of long, steep hills. They quickly realized the bumpy landscape was shaped by drumlins, a type of hill often found in places once covered in glaciers, an abnormal characteristic for desert landscapes.

"We quickly realized what we were looking at because we both grew up in areas of the world that had been under glaciers, me in Northern Ireland and Sarah in northern Illinois," said Andrews, an assistant professor of geology. "It's not like anything we see in West Virginia where we're used to flat areas and then gorges and steep-sided valleys down into hollows."

After returning home from the trip, Andrews began researching the origins of the Namibian drumlins, only to learn they had never been studied.

The drumlins were formed by fast-moving ice floes instead of slow melting ice. Credit: WVU

"The last rocks we were shown on the trip are from a time period when southern Africa was covered by ice," Andrews said. "People obviously knew that part of the world had been covered in ice at one time, but no one had ever mentioned anything about how the drumlins formed or that they were even there at all."

Andrews teamed up with WVU geology senior Andy McGrady to use morphometrics, or measurements of shapes, to determine if the drumlins showed any patterns that would reflect regular behaviors as the ice carved them.

While normal glaciers have sequential patterns of growing and melting, they do not move much, Andrews explained. However, they determined that the drumlins featured large grooves, which showed that the ice had to be moving at a fast pace to carve the grooves.

These grooves demonstrated the first evidence of an ice stream in southern Africa in the late Paleozoic Age, which occurred about 300 million years ago.

"The ice carved big, long grooves in the rock as it moved," Andrews said. "It wasn't just that there was ice there, but there was an ice stream. It was an area where the ice was really moving fast."

McGrady used freely available information from Google Earth and Google Maps to measure their length, width and height.

"This work is very important because not much has been published on these glacial features in Namibia," said McGrady, a senior geology student from Hamlin. "It's interesting to think that this was pioneer work in a sense, that this is one of the first papers to cover the characteristics of these features and gives some insight into how they were formed."

Their findings also confirm that southern Africa was located over the South Pole during this period.

"These features provide yet another tie between southern Africa and south America to show they were once joined," Andrews said.

The study, "First description of subglacial megalineations from the late Paleozoic ice age in southern Africa" is published in the Public Library of Science's PLOS ONE journal.

"This is a great example of a fundamental discovery and new insights into the climatic history of our world that remain to be discovered," said Tim Carr, chair of the Department of Geology and Geography.

Reference:

Graham D. Andrews et al, First description of subglacial megalineations from the late Paleozoic ice age in southern Africa, PLOS ONE (2019). DOI: 10.1371/journal.pone.0210673

This story originally appeared on: http://www.geologypage.com/2019/02/researchers-unearth-an-ice-age-in-the-african-desert.html#ixzz5hI1bJFVc

News: About Africa

Tracks in rocks tell us where ancient animals roamed in southern Africa

From theconversation.com (Feb. 7, 2019)

At first glance, they look like nothing more interesting than rocks. But to our research team, these two rocks – situated just 420 metres apart on a rugged, remote portion of South Africa's Cape south coast – are fascinating and important pieces of ancient history.

The rocks are described in a paper based on research that's part of a decade-long multi-disciplinary study along a 350km stretch of this particular coastline. It's been rewarding work. We've identified more than 130 sites containing trackways made by vertebrates during the Pleistocene era, dating back to between 36 000 and 140 000 years ago.

We've also found 40 hominin tracks on the ceiling and side walls of a coastal cave. These may represent the first known example of humans jogging.

Roberts Rock, before it slid into the sea, provided evidence of ancient vertebrate life. Charles Helm

Now we can add Roberts Rock and Megafauna Rock to the list. They contain trackways and tracks made by elephant, rhino and antelope, as well as by long-extinct buffalo and horse species, that all roamed the area hundreds of thousands of years ago.

Tracksites like these are scientifically important. They can be thought of as a movie that can tell stories about prehistoric humans as well as animal behaviour, and how many species were in a place at a particular point in time. They also have heritage and aesthetic value. These rocks, and similar finds, are a reminder that it's important to regularly survey and document southern Africa's coastlines. Fossils and trackways can be recorded through cast replicas and detailed photographs. This will allow more people to "read the rocks" and decipher our past.

Ancient megafauna

The rocks that sparked our latest paper lie to the east of a small town in South Africa called Still Bay. The first rock was initially described in 2008; we later named it Roberts Rock in honour of Dr David Roberts, who discovered it.

Its 5 metre x 3.5 metre surface contained spectacular elephant trackways – the first to be reported from southern Africa. Over time we monitored its slow but steady demise. First it split in two, exposing many more tracks. By 2016 it had slumped into the sea, and was destroyed by wave action.

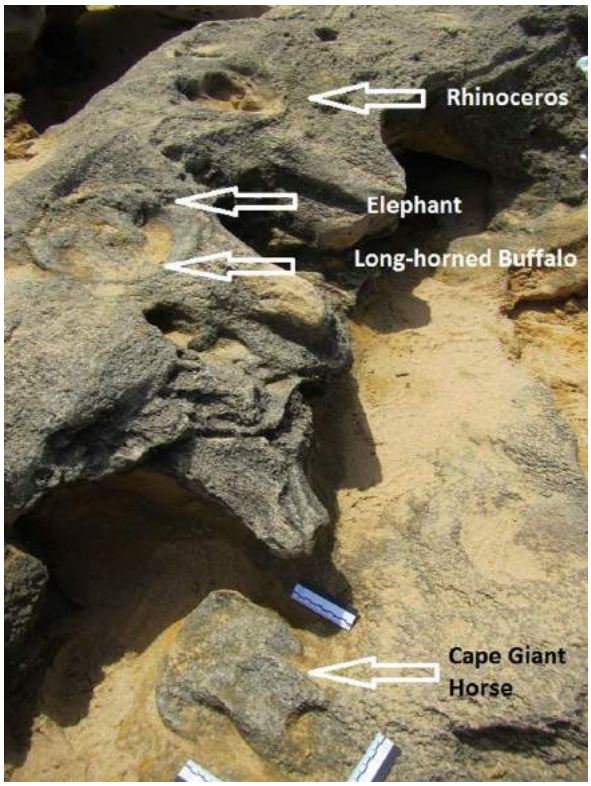
The second rock, measuring 5 metres x 5 metres x 2.5 metres, was arguably even more significant. In addition to numerous elephant tracks it contained probable single tracks of the extinct giant Cape horse (*Equus capensis*) and the extinct long-horned buffalo (*Syncerus antiquus*). We also identified a single track that was probably made by a rhinoceros.

These four animals were all members of the megafauna – large creatures – that lived during the Pleistocene. Finding their tracks on a single rock was a surprise, and we named it Megafauna Rock.

The long-horned buffalo and giant Cape horse both went extinct between 10 000 and 12 000 years ago. At the time of discovery, these were the first probable rhinoceros and giant Cape horse tracks that had been identified. We have subsequently found further such sites. The long-horned buffalo track, meanwhile, confirmed our findings from another site in our study area: the tracks of this species are distinctive, usually being wider than they are long.

Both rocks contained tracks on multiple layers. This suggests repeated use of an area over time, and possibly that the rocks were close to a water source. Using the results from dated samples from sites nearby, we've inferred that most of the tracks in this area are between 116 000 and 128 000 years old.

These rocks are just two highlights in an area that's remarkably rich in trace fossils, and which preserves some of the activities of the Pleistocene fauna in exquisite detail. All this provides a glimpse of Pleistocene dune life and suggests an area teeming with large mammals.



Tracks on Megafauna Rock reveal evidence of four of the species that once roamed there. Charles Helm

Another important element to this research is that the tracks along this coastline were made at the margin of the Palaeo-Agulhas Plain, which was alternately exposed and covered by the ocean during multiple Pleistocene sea level changes. When exposed, this

plain, which at times was up to 100 km wide, could have provided an east-west migration corridor that supported large numbers of mammals. So, our studies can help to shed light on the climate and environmental conditions during the Pleistocene.

A vanishing heritage

One of the realities we've had to come to terms with, working on these coastal bluffs, is that the tracksites we find are ephemeral and unstable. High tides and storm surges batter the bluffs; many fragile sites are destroyed through erosion, while new ones appear.

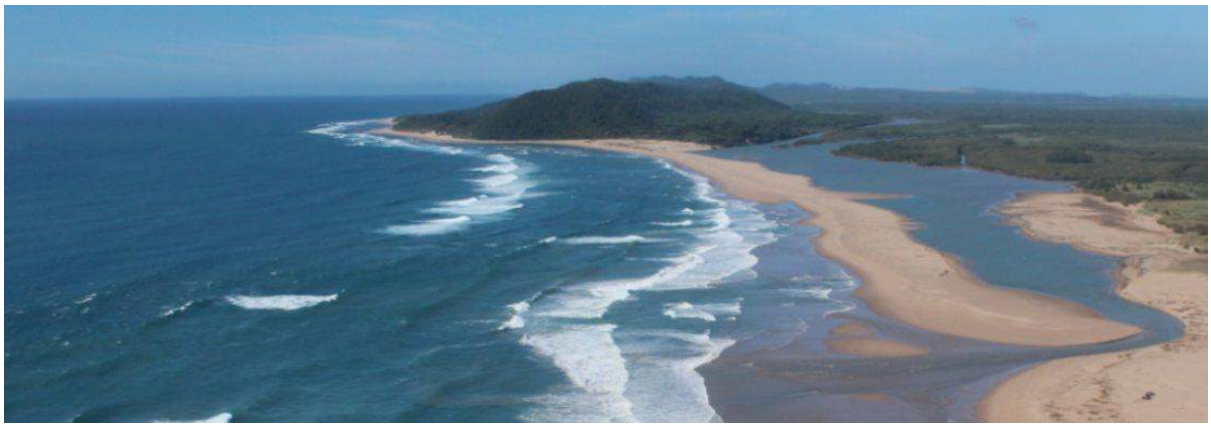
An even larger rock has become exposed close to where Roberts Rock once stood. It contains multiple layers of elephant tracks, bird tracks, golden mole burrow traces and invertebrate traces – but it too is inexorably sliding down the unstable slope into the sea. There is little doubt that many other such sites have been exposed and destroyed without ever being witnessed or identified by humans.

This story originally appeared on: https://theconversation.com/tracks-in-rocks-tell-us-where-ancient-animals-roamed-in-southern-africa-111097?fbclid=IwAR2voHWvb1c13A6HvgulWcugCUpMZGUtLbTRWbR_ricqpUe8zJVr0YMmZNY&utm_campaign=Latest+from+The+Conversation+for+February+7+2019+-+1229911324&utm_content=Latest+from+The+Conversation+for+February+7+2019+-+1229911324+CID_fa3383eb1c2945a8b81f17213e7ed308&utm_medium=email&utm_source=campaign_monitor_africa&utm_term=Tracks+in+rocks+tell+us+where+ancient+animals+roamed+in+southern+Africa

News: About Africa

South African Estuary Information System

http://saeis.saeon.ac.za/



The South African Environmental Observation Network (SAEON) aims to bring about cohesion between existing, but fragmented, environmental research programmes in South Africa and is developing a facility to ensure that long term data is archived and accessible as a national asset for generations to come.

At present there is no single repository of information on estuaries and data or reports that are available, are fragmented across different organizations. This is an untenable situation that may be limiting the way in which these vulnerable ecosystems are currently managed. SAEON and partners aim to redress this issue, by consolidating available data, reports and other information into a single searchable repository called the South African Estuaries Information System.

News: About the World

Indonesian earthquake broke a geologic speed limit

By Paul Voosen (Feb. 4, 2019)

The magnitude-7.5 earthquake that devastated Palu, Indonesia, in September 2018, razing buildings in the nearby village of Perumnas Balaroa, traveled at rare "supershear" speed, potentially heightening its damage. MOHD RASFAN/AFP/Getty Images

The geological rupture responsible for the devastating magnitude-7.5 earthquake that struck Palu, Indonesia, in September 2018 ripped through Earth's crust at rare high speed, two teams of scientists reported this week. This "supershear" behavior likely intensified the shaking in the quake, which triggered a tsunami and killed more than 2000 people. And the setting, on a fault not expected to sustain such a rupture, raises fears that far more regions could be at risk of high-speed quakes than once thought.

The Palu earthquake took place on a strike-slip fault, where two blocks of continental crust slide past each other laterally. From the start it stood out as unusual, says Lingsen Meng, a seismologist at the University of California, Los Angeles, and a co-author of one of the new papers, which appear in *Nature Geoscience*. Its shaking, for its magnitude, seemed especially powerful, causing widespread soil liquefaction and landslides. And, as satellite imagery rolled in, it became clear that the rupture had traveled some 150 kilometers, despite lasting only 35 seconds. "This was a very fast earthquake," says Elizabeth Madden, a geophysicist at the University of Brasília.

Like rips in a piece of paper, earthquake ruptures don't happen all at once. A rupture typically unzips a fault at a uniform rate of about 3 kilometers per second, below the speed of an earthquake's damaging side-to-side waves, called shear waves, which spread out from the rupture tip.

Geology seemed to impose the speed limit: The rupture point chews up energy as it pulverizes rock, and seismologists thought a supershear rupture would consume too much energy to be sustained.

Whereas most earthquakes are content to obey this speed limit, scientists have clocked a handful that broke the supershear barrier, beginning with two 1999 earthquakes in Turkey. Meng says the ground shaking is generally much stronger in these cases. That's because, as the rupture gathers speed, the earthquake shear waves begin to overlap, increasing in strength like overlapping waves in the ocean.

These quakes all seemed to take place on long, linear, and smooth strike-slip faults—geological runways where the sliding allows the rupture to gather speed and leap past the forbidden zone. But the Palu quake broke that rule. Meng and his co-authors tracked the speed of the rupture using variations in the arrival times of seismic waves at a dense array of sensors in Australia. They also analyzed satellite radar observations of the Palu region before and after the earthquake to learn how the rupture displaced the ground—a clue to the fault's geometry. Rather than being a straight runway, the fault had big kinks. Yet the rupture still went supershear, traveling more than a kilometer per second faster than a typical earthquake.

The Palu quake holds other puzzles, Meng adds. Although it traveled at high speeds, it did not go quite as fast as previous supershear earthquakes, which typically run as fast as their leading pressure waves, at 6 kilometers per second. One factor may be the age of the Palu fault; it has likely hosted thousands of earthquakes, leaving shattered rocks that slowed the

rupture's progression. Also, rather than gradually building up speed like earlier supershear quakes, this one hit top speed immediately, like a jet going supersonic at takeoff. "Even in these complicated and rough faults, it can go supershear and it can go supershear right away," Meng says.

A second study, using only satellite imagery of one segment of the rupture, supports the notion that the Palu earthquake went supershear. "We were immediately struck by the sharpness of the rupture at the surface," says Anne Socquet, the study's lead author and a geophysicist at the University of Grenoble in France. The ground seemed to slip almost seamlessly north and south, with little vertical motion, and the quake had no aftershocks—features consistent with past supershear earthquakes. Unpublished 3D computer models of the earthquake, designed to diagnose the tsunami's cause, suggest only a supershear event can explain these observations, Madden adds.

Martin Vallée, a seismologist at the Institute of Earth Physics in Paris, says the evidence is convincing—and disturbing. By showing that even tortuous faults can break the speed limit, the finding means "it is difficult to exclude supershear behavior on most faults," he says. Such quakes are still uncommon. But Meng says hazard assessments for strike-slip faults worldwide now need to reckon with the chance of intense supershear shaking.

As a resident of Los Angeles, perched above the San Andreas, perhaps the world's most famous strike-slip fault, the threat is personal to Meng. "I don't want to say that the San Andreas would go like that," he says, but some believe it may have gone supershear in the past—in the 1906 earthquake that leveled San Francisco, California. "There's definitely a possibility for this to happen."

This story originally appeared on: doi:10.1126/science.aaw9025

News: About the World

Huge Earthquake in Bolivia Has Revealed Vast Mountain Ranges Below Earth's Surface

By Mike Mcrae (Feb. 15, 2019)

We might not actually find dinosaurs down there, but new research is revealing features in the underworld resembling structures on the surface. Far from a bubbling hot mess, there are mountains deep below rivalling anything up here.

Geophysicists from Princeton University in the US and the Chinese Academy of Sciences used the echoes of a massive earthquake that struck Bolivia two decades ago to piece together the topography deep beneath the surface.

On 9 June 1994, an 8.2 magnitude tremor rocked a sparsely populated region of the Amazon in the South American nation. Nothing this powerful had been seen in decades, with shocks being felt as far away as Canada.

"Earthquakes this big don't come along very often," says geoscientist Jessica Irving.

Not only was it big, it was deep, with a focal point estimated at a depth of just under 650 kilometres (about 400 miles). Unlike quakes that grind through the crust, the energy from these monsters can shake the whole mantle like a bowl of jelly.

The tremor happened to be one of the first to be measured on a modern seismic network, providing researchers with unprecedented recordings of waves bouncing through our planet's interior.

Just like the soundwaves from an ultrasound can reveal differences in the density of tissue inside a body, the huge waves pulsing through Earth's molten guts as its crust shudders and grinds against itself can be used to put together an image of what's down there.

Only recently geoscientists used signatures in these waves to determine the rigidity of the planet's core.

In this instance, the researchers took advantage of the 1994 quake's intensity to detect waves scattering as they transitioned between layers, revealing details of the boundaries.

"We know that almost all objects have surface roughness and therefore scatter light. That's why we can see these objects – the scattering waves carry the information about the surface's roughness," says lead author Wenbo Wu, a geoscientist at the California Institute of Technology.

"In this study, we investigated scattered seismic waves travelling inside the Earth to constrain the roughness of the Earth's 660 kilometre boundary."

At this depth there's a division between the more rigid lower parts of the mantle and an upper zone that isn't under quite as much pressure, one that creates a discontinuity marked by the appearance of various minerals.

The deepest hole we've ever dug is a paltry 12 kilometres (7.5 miles) deep, so without a Jules Verne scale tunnel to drop us down there, we've had no idea what this transition zone looks like. Until now.

Based on those all-important waves coursing through the boundary, the researchers have concluded the meeting point between the mantle's upper and lower parts is a zig-zagging mountain range that puts anything on the surface to shame.

"In other words, stronger topography than the Rocky Mountains or the Appalachians is present at the 660 kilometre boundary," says Wu.

This jagged line has significant implications for Earth's formation. Most of our planet's mass consists of mantle, so knowing how it mixes and changes by transferring heat informs us of how it evolves over time.

Different takes on the evidence have produced competing models on how minerals flow and churn within the pressurised rock, some saying it's well-mixed, others suggesting there's interference at the border.

Knowing the details of this subterranean mountain could decide the fate of various models describing the history of our planet's ever-changing geology.

"What's exciting about these results is that they give us new information to understand the fate of ancient tectonic plates which have descended into the mantle, and where ancient mantle material might still reside," says Irving.

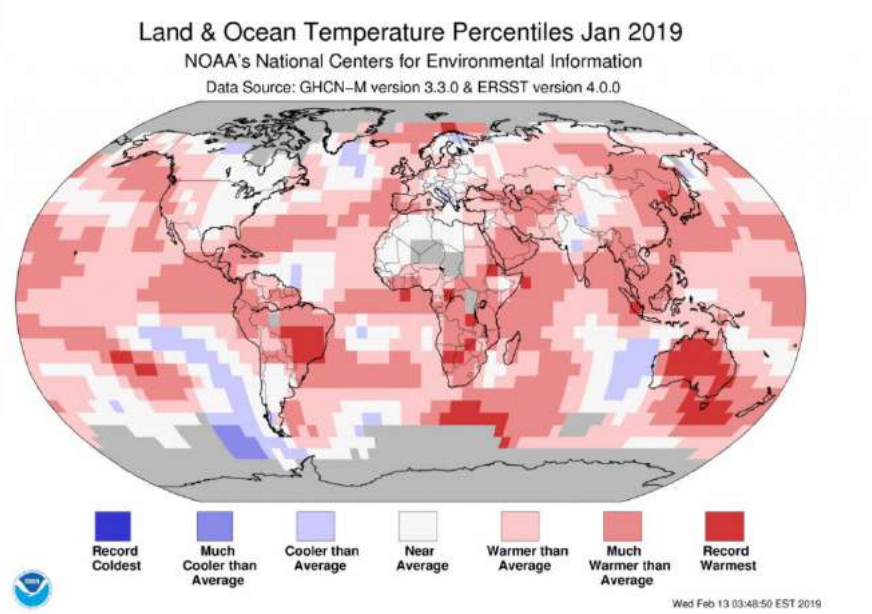
It might not be an easy place to explore. And forget the mastodons and giant insects. But the lost world under our feet still holds clues about our past if we know where to look.

This story originally appeared on: https://www.sciencealert.com/a-huge-earthquake-in-bolivia-revealed-mountains-hundreds-of-kilometres-under-the-surface?fbclid=IwAR2t-2Db6bb3QbGhrnb8GVfblF_L3pYHszbj4Xx7Lu8pFctWGRvX8sTHWxM

News: About the World

January 2019 Was Third Hottest On Record, and No It's Not a"Natural Cycle."

By Dan Satterfield (blogs.agu.org)



NOAA announced that January was *the third hottest on record and the ten warmest have all been since 2002.*

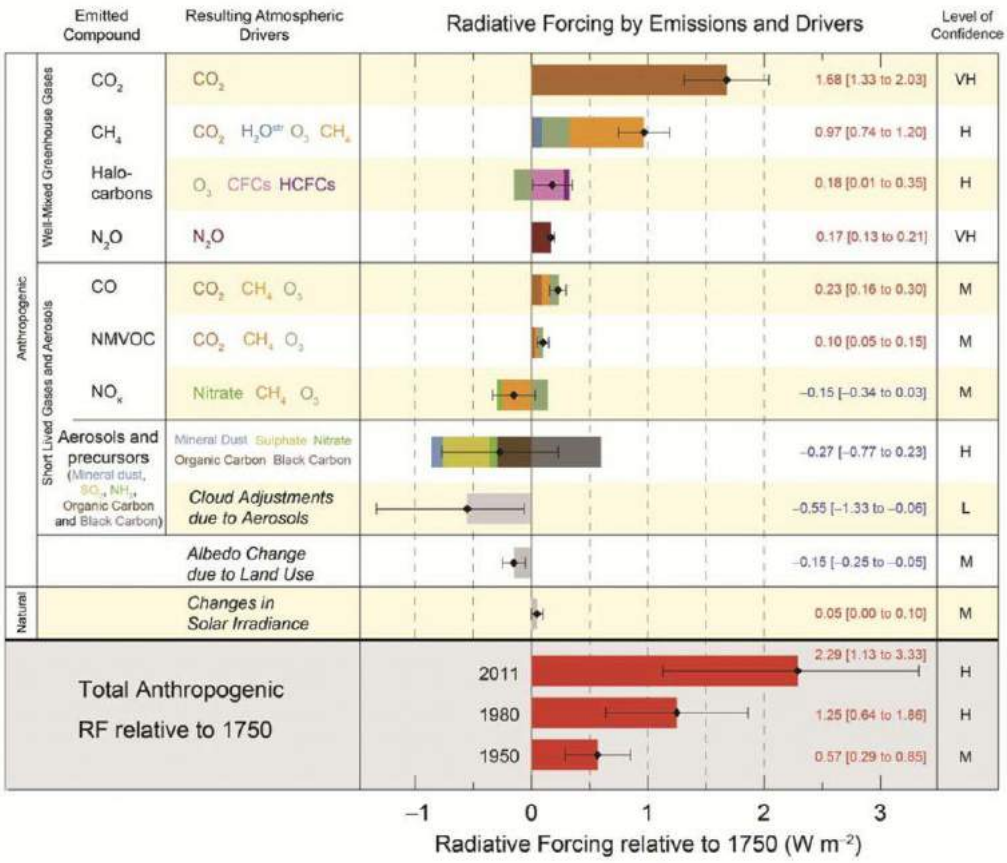
Think about that for a second. If you think that the climate is not changing, then that statistic is impossible

to reconcile. Oh, you may say that this is just a warm period globally, and the thermometer record is not long enough to have any meaning. Well, that record is extended by very good proxies (like tree rings etc), and the January's of this century are likely the warmest in thousands of years.

Still, doubt it?

Ok, then tell me where the heat is coming from because it's all about the physics.

It has to come from somewhere, and we know that carbon dioxide traps heat. We know it because of thousands of experiments that have never been refuted and we understand it as well as we understand why the sky is blue. Look at the graph below and you will see what we know and also why the uncertainties that do exist are not enough to falsify the hard truth that it's the greenhouse gases that are warming the planet.



IPCC Assessment Report 5.

This is the scientific truth, and while it may conflict with your political or world view, it's still true. Go ahead and scream natural cycles all you want when we meteorologists post the data each month, but until you prove that graph wrong, no one is going to take you seriously.

I realized before age ten that if I thought some scientific finding was not true, I'd better learn an awful lot about it and then ask some experts why my idea was wrong. I instinctively knew that I should do this *before* telling every science body on the planet that they were in error! Additionally, I understood that if I failed to do so, I'd end up making a fool of myself.

Certainly, I'm not special and most people came to the same realization by the time they were a young adult, but *my question here is why do some fail to gain the ability to recognize this?*

(The answer, of course, is that it conflicts with their political worldview.)

This story originally appeared on: https://blogs.agu.org/wildwildscience/2019/02/20/january-2019-was-third-hottest-on-record-and-no-its-not-anatural-cycle/

News: About the World

Can Lightning Strikes Produce Shocked Quartz?

www.geologyin.com

Argentine Pampas lightning glass. Photos: Mike Cellinesi

Time and time again, Earth has been pummeled by asteroids, but that ancient record is often faded and dubious. Lightning can beat up rocks like an asteroid strike, casting doubt on past impacts to bolster the notion that rocks were beat up in an extraterrestrial impact, geologists search for a distinctive signature: microscopic bands in the mineral quartz, created when powerful pressure waves ripple through the rock. Now, a new study suggests that a different sort of shock can create the same banding patterns: a lightning bolt.

The result could cast further doubt on claims of asteroid impacts in Argentina and Australia that relied on observations of shocked quartz. The analysis should serve as a warning to geologists not to rely only on that line of evidence, says Matthew Pasek, a geochemist at the University of South Florida in Tampa who was not involved in the study. “This definitely shows that geologists need to consider the geological context of their samples.”

Making shocked quartz is not easy. Previous studies suggest that it requires shock waves of at least 50,000 to 80,000 times the pressure of Earth’s atmosphere—extreme levels that geologists presumed only impacts could provide, says Reto Gierè, a mineralogist at the University of Pennsylvania.

But lightning is powerful, too: It can heat rocks to temperatures above 2000°C within microseconds. Gierè and his colleagues set out to show that the bolts from the blue could also generate the extreme pressures needed to shock quartz.

In the team’s computer simulation, the target of the lightning bolt was a hunk of granite, which bears quartz crystals in large numbers. (It’s also common on mountain ridges and other high spots often struck by lightning.)

When a moderately strong bolt of cyber lightning struck the virtual rock, it created pressure waves that peaked at about 70,000 atmospheres, well into the range needed to produce shocked quartz, the researchers report this month in Geophysical Research Letters.

Fulgurites

The simulated lightning bolt also generated a glassy veneer on the rock up to 9 centimeters or so from where the bolt struck, a so-called fulgurite (fulgur is Latin for lightning) that serves as a sign to geologists that rocks have been zapped. Just beneath this glassy layer lay a thin layer of containing shocked quartz. Gierè says the result could help explain why his team found evidence for shocked quartz in fulgurites they collected from mountainous sites in France and Italy. The results could also provide a more conventional explanation for strange, glassy rocks found at some sites in South Australia and on the Pampas of

Argentina.

The presence of shocked quartz crystals in rocks from both regions have been cited as evidence of impacts, although the new findings suggest that the rocks could have just as easily been made by lightning strikes. Gierè says geologists will have to be more careful when they make their impact diagnosis. But other researchers say that the scale of the effects should make that easy. Shocking from lightning is focused and limited to a thin layer near the surface, whereas impacts create shocked quartz widely throughout a target rock. "This is a curious finding that is understandably going to fascinate a lot of people," says David Kring, a cosmochemist at the Lunar and Planetary Institute in Houston, Texas. "But the scales of lightning strikes are small and not likely to be confused for kilometer-size or larger impact cratering events."

Argentine Pampas lightning glass?

For decades now, impact crater geologists have relied on a seemingly infallible test for the pedigree of a suspected impact structure: If you can find shock-metamorphosed minerals, especially quartz, then the structure was made by a forceful extraterrestrial impact because no other known process could achieve the pressures necessary to alter quartz into one of several high-pressure forms, commonly referred to as"shocked"quartz.

This idea has continued to hold sway in the field in spite of a few cases where such quartz is found, but an impact origin seems unlikely. Now, a group at the University of Pennsylvania has challenged this canon by demonstrating that, under the right circumstances, ordinary storm-generated lightning may produce shock lamellae in quartz.

"Shocked"quartz comes in several varieties, depending upon the peak pressures involved. The lowest pressures that can produce features considered diagnostic of impact create"planar fractures"that form at pressures from 5 to 8 GPa.

This is well above pressures that can be achieved in volcanic"explosions"(volcanic eruptions are really events in which pressure is relieved in the under lying rocks, not generated, in spite of the common description of these events as explosions—they are only explosive in the sense that they can produce atmospheric shock waves).

This story originally appeared on: http://www.geologyin.com/2018/01/lightning-shocked-quartz.html#71Wxbo8a17vM7wAu.99

News: About the World

The Deep-time Digital Earth (DDE) Program approved by IUGS EC as the 1st IUGS "Recognized Big Science Program"

http://iugs.org/

The Deep-time Digital Earth (DDE) Program is a new initiative proposed by several Adhering National Members and International Associations that are Affiliated Members of IUGS. The DDE Program has been approved by IUGS EC as the first IUGS "Recognized Big Science Program".

Deep-time Digital Earth

The DDE aims to establish linked Earth Science big-data hubs that are interoperable with other databases including published data in the public domain and unpublished data in institutions and centres of expertise. Similar to OneGeology, which aims to provide a single map of world geology, DDE will aim to provide harmonized data in a convenient form to science, public and industry. But unlike other existing databases, DDE will provide the geologies and geographies of Deep-time, as well as data on the properties of those geologies, and thus will provide insights into the distribution and value of earth's resources and materials, as well as hazards – while also providing a glimpse of the Earth's geological future.

A three-day Forum will be held in Beijing, China on February 26-28, including a one-day plenary session

and two-day technical and working group discussions on implementation of DDE. The forum will be organized jointly with the IUGS 73rd EC Meeting (February 27 - March 2). The first Circular of the Forum is available at: http://iugs.org/uploads/DDE_Forum_FirstCircular_final.pdf

News: About Space/Astronomy

Earth's oldest rock found on the Moon

From: newsroom.usra.edu

Houston, TX and Columbia, MD—January 24, 2019. Scientists discover what may be Earth's oldest rock in a lunar sample returned by the Apollo 14 astronauts. The research about this possible relic from the Hadean Earth is published today in the journal *Earth and Planetary Science Letters*.

An international team of scientists associated with the Center for Lunar Science and Exploration (CLSE), part of NASA's Solar System Exploration Research Virtual Institute, found evidence that the rock was launched from Earth by a large impacting asteroid or comet. This impact jettisoned material through Earth's primitive atmosphere, into space, where it collided with the surface of the Moon (which was three times closer to Earth than it is now) about 4 billion years ago. The rock was subsequently mixed with other lunar surface materials into one sample.

The team developed techniques for locating impactor fragments in the lunar regolith, which prompted CLSE Principal Investigator Dr. David A. Kring, a Universities Space Research Association (USRA) scientist at the Lunar and Planetary Institute (LPI), to challenge them to locate a piece of Earth on the Moon.

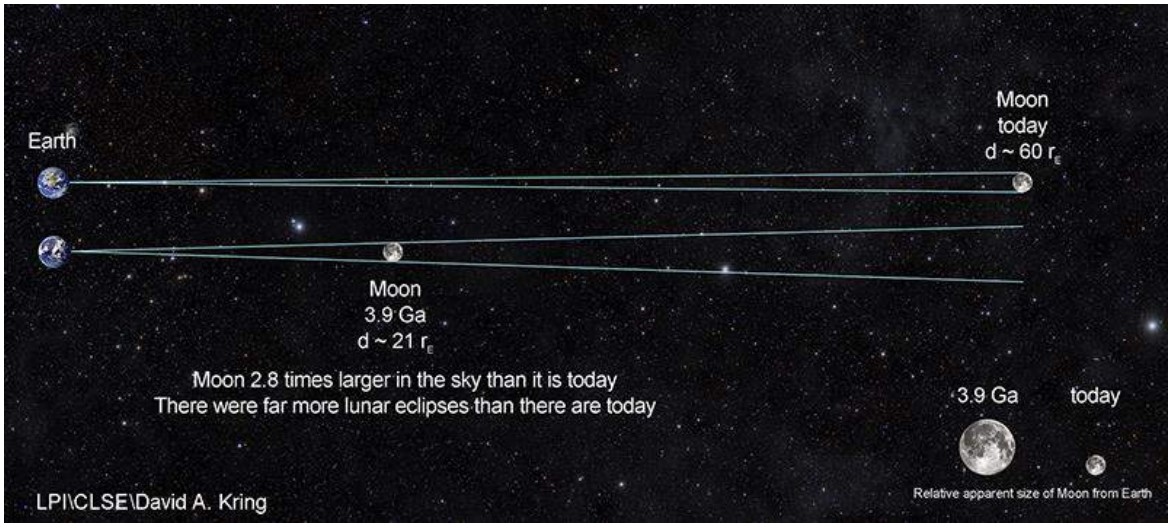


Illustration 1. The Moon was much closer to the Earth than it is today when the rock fragment was produced and ejected from the Earth to the Moon in a large impact event. Illustration credit: LPI/David A. Kring.

Led by Research Scientist Jeremy Bellucci and Professor Alexander Nemchin, team members working at the Swedish Museum of Natural History and Curtin University in Australia rose to the challenge. The result of their investigation is a 2 gram fragment of rock composed of quartz, feldspar, and zircon, all commonly found on Earth and highly unusual on the Moon. Chemical analysis of the rock fragment shows it crystallized in a terrestrial-like oxidized system, at terrestrial temperatures, rather than in the reducing and higher temperature conditions characteristic of the Moon.

"It is an extraordinary find that helps paint a better picture of early Earth and the bombardment that modified our planet during the dawn of life," says Dr. Kring.

It is possible that the sample is not of terrestrial origin, but instead crystallized on the Moon, however, that would require conditions never before inferred from lunar samples. It would require the sample to have

formed at tremendous depths, in the lunar mantle, where very different rock compositions are anticipated. Therefore, the simplest interpretation is that the sample came from Earth.

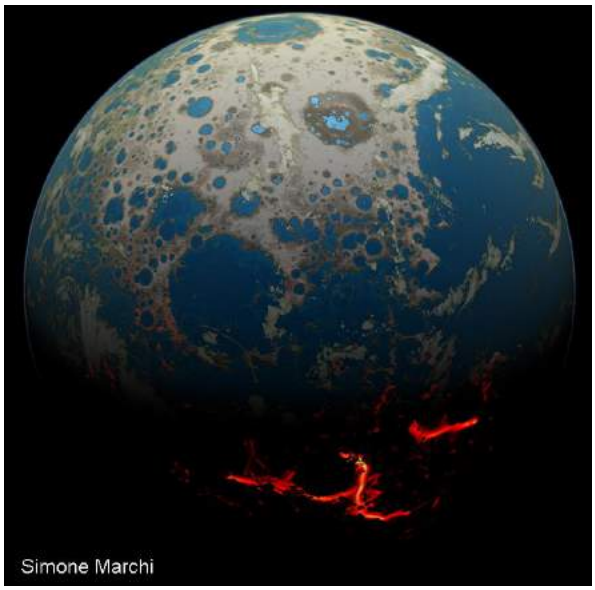


Illustration 2. An artistic rendering of the Hadean Earth when the rock fragment was formed. Impact craters, some flooded by shallow seas, cover large swaths of the Earth's surface. The excavation of those craters ejected rocky debris, some of which hit the Moon. Illustration credit: Simone Marchi.

The team's analyses are providing additional details about the sample's history. The rock crystallized about 20 kilometers beneath Earth's surface 4.0-4.1 billion years ago. It was then excavated by one or more large impact events and launched into cis-lunar space. Previous work by the team showed that impacting asteroids at that time were producing craters thousands of kilometers in diameter on Earth, sufficiently large to bring material from those depths to the surface. Once the sample reached the lunar surface, it was affected by several other impact events, one of which partially melted it 3.9 billion years ago, and which probably buried it beneath the surface. The sample is therefore a relic of an intense period of bombardment that shaped the Solar System during the first billion years. After that period, the Moon was affected by smaller and less frequent impact events. The final impact event to affect this sample occurred about 26 million years ago, when an impacting asteroid hit the Moon, producing the small 340 meter-diameter Cone Crater, and excavating the sample back onto the lunar surface where astronauts collected it almost exactly 48 years ago (January 31–February 6, 1971).

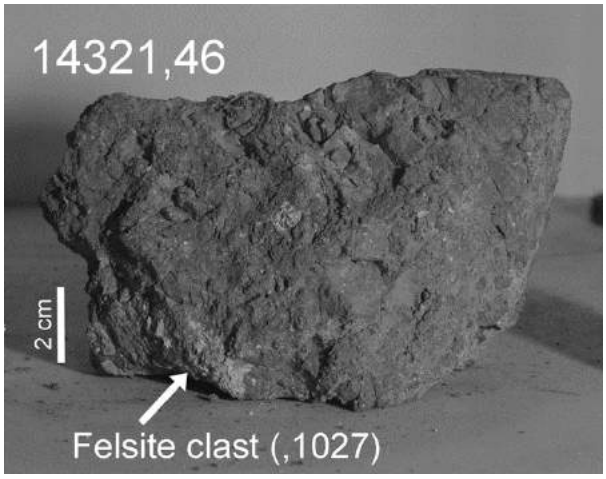


Illustration 3. Rock fragment.

Kring suspects the conclusion of a terrestrial origin for the rock fragment will be controversial. While the Hadean Earth is a reasonable source for the sample, a first find of this kind may be a challenge for the geologic community to digest. He notes that samples of Hadean Earth certainly peppered the lunar surface; other samples will likely be found with additional study.

Dr. Katharine Robinson, a postdoctoral researcher at the LPI, was also involved in the study, as were Dr. Marion Grange (Curtin University), Dr. Gareth Collins (Imperial College London), Dr. Martin Whitehouse (Swedish Museum of Natural History), Dr. Josh Snape (Vrije Universiteit Amsterdam), and Prof. Marc Norman (Australian National University).

The research is supported by NASA's Solar System Exploration Research Virtual Institute (SSERVI) through a cooperative agreement with the CLSE, a joint venture between the LPI and NASA's Johnson Space Center.

Videos illustrating the Hadean Earth can be found on the Lunar and Planetary Institute website: https://www.lpi.usra.edu/exploration/HadeanEarth/.

About USRA

Founded in 1969, under the auspices of the National Academy of Sciences at the request of the U.S. Government, the Universities Space Research Association (USRA) is a nonprofit corporation chartered to advance space-related science, technology and engineering. USRA operates scientific institutes and facilities, and conducts other major research and educational programs, under Federal funding. USRA engages the university community and employs in-house scientific leadership, innovative research and development, and project management

expertise. More information about USRA is available at www.usra.edu.

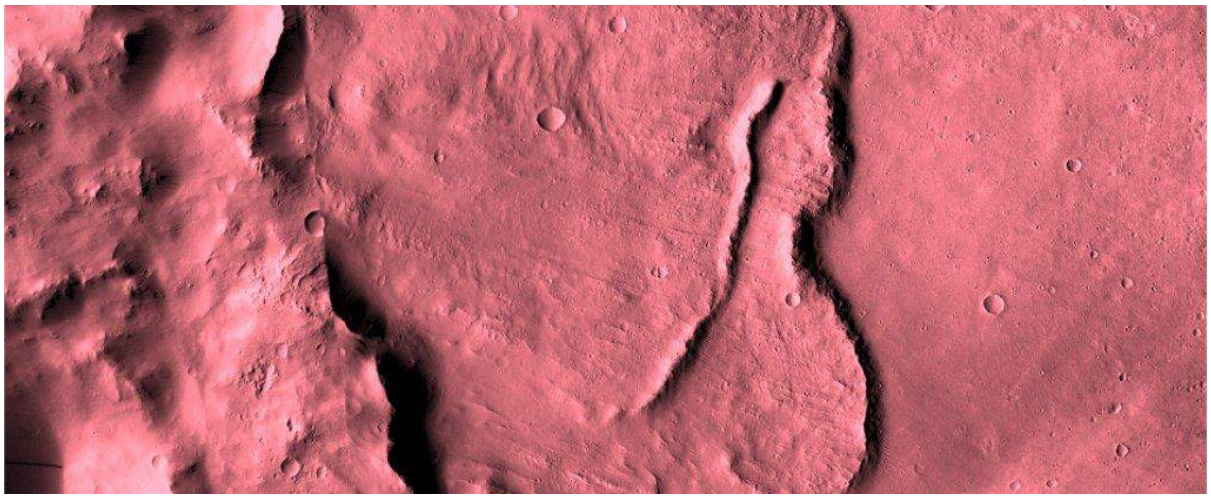
About LPI

The Lunar and Planetary Institute (LPI), operated by Universities Space Research Association, was established during the Apollo program to foster international collaboration and to serve as a repository for information gathered during the early years of the space program. Today, the LPI is an intellectual leader in lunar and planetary science. The Institute serves as a scientific forum attracting world-class visiting scientists, postdoctoral fellows, students, and resident experts; supports and serves the research community through newsletters, meetings, and other activities; collects and disseminates planetary data while facilitating the community's access to NASA science; and engages and excites, and educates the public about space science and invests in the development of future generations of explorers. The research carried out at the LPI supports NASA's efforts to explore the solar system. More information about LPI is available at www.lpi.usra.edu.

This story originally appeared on: https://newsroom.usra.edu/earths-oldest-rock-found-on-the-moon/?fbclid=IwAR2u7HMMQzGvoF6gpN_Qf44LiXaNq3w3R_Nd-xgE8CTWNnDYoH8j-7sooyw

News: About Space/Astronomy

We Just Got the First Evidence of a Planet-Wide Groundwater System on Mars From:
By Kristin Houser (Feb 28, 2019)



Mars may look like a dry, dusty planet today. But scientific models indicate that it was likely once home to massive amounts of water, both above and below its surface - and now, researchers have evidence to back those models up.

"Early Mars was a watery world, but as the planet's climate changed this water retreated below the surface to form pools and 'groundwater'," European Space Agency (ESA) researcher Francesco Salese said in a press release.

"We traced this water in our study, as its scale and role is a matter of debate," he continued, "and we found the first geological evidence of a planet-wide groundwater system on Mars."

Using data from a trio of instruments - the High Resolution Stereo Camera (HRSC) aboard the ESA's Mars Express spacecraft, NASA's High Resolution Imaging Science Experiment (HiRISE), and the Context Camera aboard NASA's Mars Reconnaissance Orbiter - the ESA researchers explored two dozen enclosed craters in Mars' northern hemisphere.

On the floors of these craters, the team found features that suggest the craters once contained "pools and flows of water that changed and receded over time".

They were even able to estimate past water levels and found they matched up with the expected shorelines of an ocean that many believe existed on Mars between three and four billion years ago - and which may have been connected to a system of subterranean lakes.

Water is a key indicator of life, so any evidence of water on Mars lends credence to the idea that the planet might have once been home to living organisms.

But evidence of a groundwater system isn't the only ESA discovery with life-on-Mars implications - within five of the craters they examined, the team also found signs of minerals that past research has connected to the emergence of life on Earth.

As Mars Express project scientist Dmitri Titov noted, the discovery could help researchers pinpoint the spots on Mars most likely to contains evidence of past life on the Red Planet - potentially putting us one step closer to finding extraterrestrial life.

This story originally appeared on: https://www.sciencealert.com/researchers-first-geological-evidence-of-mars-planet-wide-groundwater-system?fbclid=IwAR1B6uUvrFanws-fmwfKUmSJzy9uFgYmgdiD70YvCGLLnwb9GSKIzF6TwVo

GEOETHICS

Teaching GeoEthics Across the Geoscience Curriculum

By David Mogk, Department of Earth Sciences, Montana State University and Monica Bruckner, SERC, Carleton College

Ethics Education is an increasingly important component of the pre-professional training of (geo) scientists. Funding agencies (NSF, NIH) require training of graduate students in the responsible conduct of research, employers are increasingly expecting their workers to have basic training in ethics, and the public demands the highest standards of ethical conduct by scientists. Yet, few faculty have the requisite training to effectively teach about ethics in their classes, or even informally in mentoring students working in their labs.

This module has been developed to meet the need of introducing ethics education into the geoscience curriculum:

- **For faculty,** resources, case studies, and teaching activities are provided to facilitate instruction in ethics within established geo "core" courses or in a dedicated course on "GeoEthics";
- **For students**, resources are provided to help expand their understanding of ethical situations that may arise in their careers, and to give them the tools they need to appropriately address these issues.

What do we mean by "GeoEthics"?

GeoEthics encompasses the values and professional standards required of geoscientists to responsibly work in the profession and in service to society. The training of scientists in ethics has traditionally been focused on the Responsible Conduct of Research. However, GeoEthics encompasses many more dimensions, including personal and professional behaviors as well as responsibilities to society and to stewardship of Earth.

Why Teach GeoEthics?

The scientific community, as well as our civic communities, must have trust that the conduct of scientists and the integrity of their scientific product, is above reproach. Charles Darwin famously wrote:

> *False facts are highly injurious to the progress of science, for they often long endure; but false views, if supported by some evidence, do little harm, as every one takes a salutary pleasure in proving their falseness; and when this is done, one path towards error is closed and the road to truth is often at the same time opened (Descent of Man, 1871, Volume 2, Chapter XXI, p. 385).*

A formal course of instruction is needed to prepare students to enter the community of practice in the geosciences. Students should have the opportunity in our classes to **recognize ethical dilemmas** in the first instance, to **develop the strategies and skills** needed to responsibly participate in the profession, and **gain experience in ethical decision-making**. Instructors, at all levels, should be aware of the need for ethical training in their coursework and mentoring of students, and look for opportunities to introduce those "teachable moments" to explicitly identify and address ethical issues.

How to Teach GeoEthics?

"Most graduate students and post-doctoral fellows currently learn research practices primarily through *ad hoc*, informal exposures in their individual laboratories, rather than through formal training" (NRC, 2009). Training in ethical practices in our science is too important to leave to random experiences that require ethical decision-making, and training in ethics at the

graduate or post-graduate level is too late in the pre-professional training of students. We propose that a systematic curriculum that helps students identify and address ethical issues in the geosciences is needed. The tenets of "best practices" in STEM education extend to instruction in GeoEthics, primarily through use of a variety of active learning methods. There is a related need to develop appropriate assessment instruments to determine the mastery of ethical principles and ethical maturity of our students.

Opportunities to Teach GeoEthics in Existing Geoscience Courses for Majors and Non-Majors

There are many opportunities to build GeoEthics training into existing courses, from the introductory level to the "core" geoscience courses for majors. Short readings, discussions, and examinations of case studies, for example, can be introduced into formal course work to explore ethical dimensions of the conduct of geoscientists at work or regarding events or phenomena that impact the welfare of society. In addition to presentation of geologic concepts, content, and activities that enhance skill development, instructors are encouraged to go a step beyond, and explicitly provide opportunities for students to engage the ethical implications and applications of topics covered in a course. Some departments are even formulating a dedicated GeoEthics course, commonly as a capstone course for geoscience majors.

Assessment of Student Learning Outcomes in Ethical Training

Evidence of students' mastery of ethical principles, and their ability to apply these principles to ethical challenges they may encounter in their careers, may be demonstrated using a variety of assessment techniques. It is often the case that there is not a singular right or wrong answer; rather, the students' demonstrations of the process of ethical decision-making may be more important. The 2014 Teaching GeoEthics workshop participants provided some practical advice and methods on Assessment of Student Learning Outcomes in Ethical Training.

Multiple Facets of GeoEthics

Ethical conduct in the geoscience professions has many dimensions, including responsibilities toward the Profession, to Society, and to the Earth System. Learn more about each of these facets, including teaching resources that speak to each:

- GeoEthics and Self: How can we best prepare students to develop self-monitoring and self-regulating behaviors such that they will be able to recognize ethical issues when they arise, and have the tools to engage ethical decision-making practices?
- GeoEthics, Geoscientists and the Geoscience Professions: Part of students' pre-professional training must be targeted to engage the accepted practices and values of the discipline. This is reflected in:
  - Professional Societies and Their Mission Statements and Codes of Ethics as well as
  - Responsible Conduct of Research, which includes Data and Data Management, Mistakes and Negligence, Research Misconduct, Laboratory Safety, Authorship, Plagiarism, Falsification or Fabrication of Data and much more.
  - Geoethics and Professionalism: the Responsible Conduct of Scientists--principles of professionalism, (un)professional behaviors (sexual harassment/assault, bullying), interpersonal behaviors that impact department "climate", professional relations built on trust...
- GeoEthics and Society: The work of geoscientists commonly has a great impact on society, particularly in the areas of geohazards, resource development, and environmental issues (both anthropogenic and natural).
- GeoEthics and the Earth System: Geoscientists are in a unique position to interpret the dynamic, heterogeneous and complex Earth System. What is the responsibility of geoscientists to address questions of sustainability? What principles guide choices we make related to environmental ethics? How can we reconcile issues when societal needs/values come in conflict with environmental ethics and values?

Resources to Support Teaching GeoEthics

- Resources To Support Teaching GeoEthics: You don't have to start with a clean slate. Take a look at these websites, reports, articles and other resources to get you started.
- Browse the GeoEthics Case Study Collection, contributed by participants of the 2014 Teaching GeoEthics workshop.
- The On the Cutting Edge and InTeGrate projects have developed a substantial body of peer-reviewed teaching activities that address a wide range of ethical issues. Browse this compilation of activities and modules that can

be used as an entree to further explorations of ethical issues in the geosciences.

2014 Teaching GeoEthics Workshop

The National Science Foundation (Ethics Education in Science and Engineering) supported the 2014 Teaching GeoEthics Across the Geoscience Curriculum Workshop. This was a catalytic event that brought together geoscience educators and colleagues involved with ethics education from sister disciplines (philosophy, engineering, biology) to identify areas where ethics is currently being taught, and to chart new directions to enhance instruction in ethics, across the geoscience curriculum. See the Program to access presentations and discussion group summaries. And see the Participant List, which includes contributions made by each participant

LITERATURE

About Africa

Journal of African Earth Sciences (volume 150)

Engineering, hydrogeological and vadose zone hydrological aspects of Proterozoic dolomites (South Africa)
Matthys A. Dippenaar, J. Louis van Rooy, Roger E. Diamond
Pages 511-521

The Neoproterozoic Katanga Supergroup (D. R. Congo): State-of-the-art and revisions of the lithostratigraphy, sedimentary basin and geodynamic evolution
Jacques L.H. Cailteux, Thierry De Putter
Pages 522-531

A review of the geochronology of the Margate Terrane reveals a history of diachronous terrane docking and arc accretion across the Mesoproterozoic Natal belt, southeastern Africa
P. Mendonidis, R.J. Thomas
Pages 532-545

A review of the latest Cenomanian to Maastrichtian geological evolution of Nigeria and its stratigraphic and paleogeographic implications
A.J. Edegbai, L. Schwark, F.E. Oboh-Ikuenobe
Pages 823-837

Hydrogeophysical and hydrochemical characteristics of Pliocene groundwater aquifer at the area northwest El Sadat city, West Nile Delta, Egypt
Amal Othman, Ismael M. Ibraheem, Hosni Ghazala, Hani Mesbah, Torleif Dahlin
Pages 1-11

The late Pleistocene – Holocene paleoclimate reconstruction in the Adamawa plateau (Central Cameroon) inferred from the geochemistry and mineralogy of the Lake Fonjak sediments
N'nanga Alexandrine, Ngos Simon, Ngueutchoua Gabriel
Pages 23-36

CO2-rich fluid inclusions in mantle xenoliths from Barombi-Mbo and Nyos maars (Cameroon volcanic line, central Africa): Upper mantle equilibria and history of magma ascension
Joëlle Flore Tene Djoukam, Charles Nkoumbou, Jean Pierre Tchouankoué, Robert Moritz
Pages 68-85

Soft sediment deformation structures in the Neoproterozoic Kansuki formation (Katanga Supergroup, Democratic Republic of the Congo): Evidence for deposition in a tectonically active carbonate platform
Matanda Pascal Mambwe, Sébastien Lavoie, Damien Delvaux, Jacques M. Batumike
Pages 86-95

Cenomanian–Turonian depositional history of a post–Gondwana rift succession in the West Beni Suef Basin, Egypt
Amer A. Shehata, Farouk M. El Fawal, Makoto Ito, Mohammed H. Abdel Aal, Mohammad A. Sarhan
Pages 783-798

SHRIMP U–Pb zircon geochronology of the granitoids of the Imiter Inlier: Constraints on the Pan-African events in the Saghro massif, Anti-Atlas (Morocco)
Bouchra Baidada, Moha Ikenne, Pierre Barbey, Abderrahmane Soulaimani, ... Abdelkhalek Alansari
Pages 799-810

Gravity contribution to the geological study of grabens in the northwest region of Tunisia including the Kef Basin region
Nesrine Frifita, Kevin Mickus, Fouad Zargouni
Pages 811-822

Major ions, δ18O, δ13C and 87Sr/86Sr compositions of water and precipitates from springs along the Cameroon volcanic line (Cameroon, west Africa): Implications for provenance and volcanic hazards
Wilson Yetoh Fantong, Brice Tchakam Kamtchueng, Yasuo Ishizaki, Ernest Chi Fru, ... Takeshi Ohba
Pages 12-22

Enrichment of ferrous iron in the bottom water of Lake Nyos
Minoru Kusakabe, Rosine E. Tiodjio, Bruce Christenson, Kazuto Saiki, ... Muga Yaguchi
Pages 37-46

30 years of the Lakes Nyos and Monoun gas disasters: A scientific, technological, institutional and social adventure
Gregory Tanyileke, Romaric Ntchantcho, Wilson Yetoh Fantong, Festus Tongwa Aka, Joseph Victor Hell
Pages 415-424

Lago Albano, the “anti-Nyos-type” lake: The past as a key for the future
Dmitri Rouwet, Giovanni Chiodini, Cecilia Ciuccarelli, Alberto Comastri, Antonio Costa
Pages 425-440

Special section on Geology, tectonics and mineralizations of the East African Orogen; Edited by Zakaria Hamimi, Harald Fritz, Salvador Mondlane, Amara Masrouhi, Nelson Boniface and Lenka Baratoux

Geochronological systematics for the Chimoio-Macossa frontal nappe in central Mozambique: Implications for the tectonic evolution of the southern part of the Mozambique belt
F.R. Chaúque, U.G. Cordani, D.L. Jamal
Pages 47-67

An overview of the Ediacaran-Cambrian orogenic events at the southern margins of the Tanzania Craton: Implication for the final assembly of Gondwana
Nelson Boniface
Pages 123-130

Strain analysis and deformation history of Zalm area, Arabian shield, Saudi Arabia
Ali Y. Kahal, Essam Abd El-Motaal, Osama M.K. Kassem, Abed H.R. Al Ghoreiby
Pages 441-450

Structural style and kinematic evolution of Al Ji'lani area, Ad Dawadimi terrane, Saudi Arabia
El-Sawy K. El-Sawy, Amara Masrouhi
Pages 451-465

Journal of African Earth Sciences (volume 151)

Sequence stratigraphic approaches for reservoir modeling, Arshad area, Sirt Basin, Libya
M. Burki, A. Abu-Khadra
Pages 1-8

Exploration and evaluation of potential groundwater aquifers and subsurface structures at Beni Suef area in southern Egypt
Taha Rabeh, Kamal Ali, Sayed Bedair, Mervat A. Sadik, Ahmed Ismail

Interpretation of gravity data using 3D inversion and 2D continuous wavelet transform in Hedil deformed structures, northern Tunisia
Mohamed Atawa, Hassina Boukerbout, Taher Zouaghi, Houcem Mzali, ... Abdeslam Abtout
Pages 371-390

Mineralization and pollution sources in the coastal aquifer of Lebna, Cap Bon, Tunisia
Amira Ziadi, Najla Tlatli Hariga, Jamila Tarhouni
Pages 391-402

Determination of earthquake source parameters using the inversion of waveform data: A case of small earthquakes around High Dam Lake, Aswan region, Egypt
Hamada Saadalla, Abd el-aziz Khairy Abd El –aal, Abdelnasser Mohamed, K. El-Faragawy
Pages 403-416

Combining geology, geomorphology and geotechnical data for a safer urban extension: Application to the Antananarivo capital city (Madagascar)
Solofo Nirina Andriamamonjisoa, Aurélia Hubert-Ferrari
Pages 417-437

Ammonoid and foraminiferal biostratigraphy from uppermost Valanginian to lowermost Barremian of the Jebel Boulahouajeb section (northern Tunisia)
Sarra Melliti, Stéphane Reboulet, Nebiha Ben Haj Ali, Mohammed Sabri Arfaoui, ... Lucia Memmi
Pages 438-460

A Preliminary study of relationships between thermal conductivity and petrophysical parameters in Hamra Quartzites reservoir, Hassi Messaoud field (Algeria)
Ahmed Ali Zerrouki, Yves Geraud, Marc Diraison, Kamel Baddari
Pages 461-471

The geochemical composition of the Palu Formation from the Palu-Uluova basin, Elaziğ, Eastern Anatolia (Turkey): Implication of source area, weathering, and tectonic setting
Dicle Bal Akkoca, Osman Karataş
Pages 472-489

Structural modeling of the hidden parts of a Paleozoic belt: Insights from gravity and aeromagnetic data (Tadla Basin and Phosphates Plateau, Morocco)
Abdellah Nait Bba, Mustapha Boujamaoui, Adnen Amiri, Younes Hejja, ... Haddou Jabour
Pages 506-522

Palaeoenvironmental assessment and lithostratigraphic revision of the Carboniferous-Early Permian succession in the Sanandaj-Sirjan Block (Iran)
Fariba Shirezadeh Esfahani, Aram Bayet-Goll, Abdolhosein Kangazian, Mardavij Sadri, Amir Akbari Mohammadi
Pages 523-547

The late Aptian requieniid rudist Pseudotoucasia catalaunica Astre from the Mediterranean region with emphasis on Moroccan occurences of the species
Jean-Pierre Masse, Fatiha Hadach, Mukerrem Fenerci-Masse, Ahmed Algouti, Abdellah Algouti
Pages 548-554

High-grade metamorphism during Neoproterozoic to Early Palaeozoic Gondwana assembly, exemplified from the East African Orogen of northeastern Mozambique
Ane K. Engvik, Einar Tveten, Arne Solli
Pages 490-505

Earth-Science Reviews

A geodynamic model for the Paleoproterozoic (ca. 2.27–1.96 Ga) Birimian Orogen of the southern West African Craton – Insights into an evolving accretionary-collisional orogenic system
Earth-Science Reviews, In press, accepted manuscript, Available online 15 February 2019
Mikael Grenholm, Mark Jessell, Nicolas Thébaud

Evolution of an Archaean intracratonic basin: A review of the Transvaal Supergroup lithostratigraphy in Botswana
Earth-Science Reviews, In press, accepted manuscript, Available online 27 February 2019
Fulvio Franchi, Read Brown Mthanganyika Mapeo

Aspects of the Archean-Proterozoic transition: How the great Huronian Glacial Event was initiated by rift-related uplift and terminated at the rift-drift transition during break-up of Lauroscandia
Earth-Science Reviews, Volume 190, March 2019, Pages 171-189
Grant M. Young

Archean-Paleoproterozoic transition: The Indian perspective
Earth-Science Reviews, Volume 188, January 2019, Pages 427-440
Rajat Mazumder, Shuvabrata De, P. V. Sunder Raju

Detrital zircon provenance of Permo-Carboniferous glacial diamictites across Gondwana
Earth-Science Reviews, In press, accepted manuscript, Available online 14 February 2019
John P. Craddock, Richard W. Ojakangas, David H. Malone, Alexandros Konstantinou, George Gehrels

The generation and reworking of continental crust during early Paleozoic in Gondwanan affinity terranes from the Tibet Plateau
Earth-Science Reviews, Volume 190, March 2019, Pages 486-497
Yiming Liu, Sanzhong Li, M. Santosh, Huahua Cao, Zaizheng Zhou

Archean fluvial deposits: A review
Earth-Science Reviews, Volume 188, January 2019, Pages 148-175
Darrel G. F. Long

Insights into geological processes with CO2 remote sensing – A review of technology and applications
Earth-Science Reviews, Volume 188, January 2019, Pages 389-426
Manuel Queißer, Mike Burton, Ryunosuke Kazahaya

Environmental impact of mineralised black shales
Earth-Science Reviews, In press, accepted manuscript, Available online 25 January 2019
Annika Parviainen, Kirsti Loukola-Ruskeeniemi

New starting point for the Indian Ocean: Second phase of breakup for Gondwana
Earth-Science Reviews, Volume 191, April 2019, Pages 26-56
J. O. Thompson, M. Moulin, D. Aslanian, P. de Clarens, F. Guillocheau

Tetrapod ichnotaxonomy in eolian paleoenvironments (Coconino and De Chelly formations, Arizona) and late Cisuralian (Permian) sauropsid radiation
Earth-Science Reviews, Volume 190, March 2019, Pages 148-170
Lorenzo Marchetti, Sebastian Voigt, Spencer G. Lucas, Heitor Francischini, Amanda Millhouse

Holocene climate, dynamic landscapes and environmentally driven changes in human living conditions in Beijing
Earth-Science Reviews, Volume 191, April 2019, Pages 57-65
Gan Xie, Yi-Feng Yao, Jin-Feng Li, Jian Yang, Yu-Fei Wang

Cycling of biogenic elements drives biogeochemical gold cycling
Earth-Science Reviews, Volume 190, March 2019, Pages 131-147
Santonu Kumar Sanyal, Jeremiah Shuster, Frank Reith

The importance of a weak mid-lithospheric layer on the evolution of the cratonic lithosphere
Earth-Science Reviews, Volume 190, March 2019, Pages 557-569
Zhensheng Wang, Timothy M. Kusky

An evaluation of Australia as a major source of dust
Earth-Science Reviews, In press, accepted manuscript, Available online 21 January 2019
Patrick De Deckker

Quaternary time scales for the Pontocaspian domain: Interbasinal connectivity and faunal evolution
Earth-Science Reviews, Volume 188, January 2019, Pages 1-40
W. Krijgsman, A. Tesakov, T. Yanina, S. Lazarev, F. P. Wesselingh

The end-Ordovician mass extinction: A single-pulse event?
Earth-Science Reviews, In press, accepted manuscript, Available online 21 February 2019
Guangxu Wang, Renbin Zhan, Ian G. Percival

Davis Strait Paleocene picrites: Products of a plume or plates?
Earth-Science Reviews, In press, corrected proof, Available online 22 January 2019
D. Barrie Clarke, Erin K. Beutel

Sequence stratigraphic expression of greenhouse, transitional and icehouse conditions in siliciclastic successions: Paleozoic examples from the central appalachian basin, USA
Earth-Science Reviews, Volume 188, January 2019, Pages 176-189
Kenneth A. Eriksson, Wilson S. McClung, Edward L. Simpson

Sedimentary basin analysis of the Neo-Tethys and its hydrocarbon systems in the Southern Zagros fold-thrust belt and foreland basin
Earth-Science Reviews, Volume 191, April 2019, Pages 1-11
Masoumeh Kordi

The evolution of latitudinal temperature gradients from the latest Cretaceous through the Present
Earth-Science Reviews, In press, corrected proof, Available online 30 January 2019
Laiming Zhang, William W. Hay, Chengshan Wang, Xue Gu

Oxygen isotopes in bioarchaeology: Principles and applications, challenges and opportunities
Earth-Science Reviews, Volume 188, January 2019, Pages 77-107
Sarah Pederzani, Kate Britton

Dynamics of Vulcano Island (Tyrrhenian Sea, Italy) investigated by long-term (40 years) geophysical data
Earth-Science Reviews, Volume 190, March 2019, Pages 521-535
Salvatore Alparone, Alessandro Bonforte, Salvatore Gambino, Francesco Guglielmino, Rosanna Velardita

Nitrous oxide from streams and rivers: A review of primary biogeochemical pathways and environmental variables
Earth-Science Reviews, In press, accepted manuscript, Available online 21 February 2019
Annika M. Quick, W. Jeffery Reeder, Tiffany B. Farrell, Daniele Tonina, Shawn G. Benner

Long and short-term magma differentiation at Mt. Etna as revealed by Sr-Nd isotopes and geochemical data
Earth-Science Reviews, Volume 190, March 2019, Pages 112-130
V. Di Renzo, R. A. Corsaro, L. Miraglia, M. Pompilio, L. Civetta

A geodynamic model for the Paleoproterozoic (ca. 2.27–1.96 Ga) Birimian Orogen of the southern West African Craton – Insights into an evolving accretionary-collisional orogenic system
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Mikael Grenholm, Mark Jessell, Nicolas Thébaud

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Yiming Liu, Sanzhong Li, M. Santosh, Huahua Cao, Zaizheng Zhou

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Lorenzo Marchetti, Sebastian Voigt, Spencer G. Lucas, Heitor Francischini, Amanda Millhouse

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Kenneth A. Eriksson, Wilson S. McClung, Edward L. Simpson

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Masoumeh Kordi

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Sarah Pederzani, Kate Britton

Dynamics of Vulcano Island (Tyrrhenian Sea, Italy) investigated by long-term (40 years) geophysical data
Earth-Science Reviews, Volume 190, March 2019, Pages 521-535
Salvatore Alparone, Alessandro Bonforte, Salvatore Gambino, Francesco Guglielmino, Rosanna Velardita

Nitrous oxide from streams and rivers: A review of primary biogeochemical pathways and environmental variables
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Annika M. Quick, W. Jeffery Reeder, Tiffany B. Farrell, Daniele Tonina, Shawn G. Benner

Long and short-term magma differentiation at Mt. Etna as revealed by Sr-Nd isotopes and geochemical data
Earth-Science Reviews, Volume 190, March 2019, Pages 112-130
V. Di Renzo, R. A. Corsaro, L. Miraglia, M. Pompilio, L. Civetta

Decoding the mechanism of formation in marine ooids: A review
Earth-Science Reviews, Volume 190, March 2019, Pages 536-556
Mara R. Diaz, Gregor P. Eberli

A new approach to understanding diamond surface features based on a review of experimental and natural diamond studies
Earth-Science Reviews, In press, accepted manuscript, Available online 13 February 2019
Yana Fedortchouk

New lithostratigraphy for the Cantabrian Mountains: A common tectono-stratigraphic evolution for the onset of the Alpine cycle in the W Pyrenean realm, N Spain
Earth-Science Reviews, Volume 188, January 2019, Pages 249-271
José López-Gómez, Fidel Martín-González, Nemesio Heredia, Raúl de la Horra, Georges Gand

Carbon and hydrogen isotopes of methane, ethane, and propane: A review of genetic identification of natural gas
Earth-Science Reviews, Volume 190, March 2019, Pages 247-272
Quanyou Liu, Xiaoqi Wu, Xiaofeng Wang, Zhijun Jin, Qi Fu

Holocene climate records from lake sediments in India: Assessment of coherence across climate zones
Earth-Science Reviews, Volume 190, March 2019, Pages 370-397
Pavani Misra, S. K. Tandon, Rajiv Sinha

Empirical constraints on magnitude-distance relationships for seismically-induced submarine tsunamigenic landslides
Earth-Science Reviews, Volume 191, April 2019, Pages 66-92
Amos Salamon, Pio Di Manna

Iron cycling and isotope fractionation in terrestrial ecosystems
Earth-Science Reviews, Volume 190, March 2019, Pages 323-352
Bei Wu, Wulf Amelung, Ying Xing, Roland Bol, Anne E. Berns

Predation in the marine fossil record: Studies, data, recognition, environmental factors, and behavior
Earth-Science Reviews, In press, accepted manuscript, Available online 22 February 2019
Adiël A. Klompmaker, Patricia H. Kelley, Devapriya Chattopadhyay, Jeff C. Clements, Michal Kowalewski

Establishing tephrostratigraphic frameworks to aid the study of abrupt climatic and glacial transitions: a case study of the Last Glacial-Interglacial Transition in the British Isles (c. 16-8 ka BP)
Earth-Science Reviews, In press, accepted manuscript, Available online 9 January 2019
Rhys G. O. Timms, Ian P. Matthews, J. John. Lowe, Adrian P. Palmer, Simon P. E. Blockley

Deep learning and its application in geochemical mapping
Earth-Science Reviews, In press, accepted manuscript, Available online 4 March 2019
Renguang Zuo, Yihui Xiong, Jian Wang, Emmanuel John M. Carranza

Precambrian Research

Episodic collisional orogenesis and lower crust exhumation during the Palaeoproterozoic Eburnean Orogeny: Evidence from the Sefwi Greenstone Belt, West African Craton
Precambrian Research, Volume 325, June 2019, Pages 88-110
H. B. McFarlane, L. Ailleres, P. Betts, J. Ganne, S. Block

Geochemistry and petrogenesis of Archean mafic rocks from the Amsaga area, West African craton, Mauritania
Precambrian Research, Volume 324, May 2019, Pages 208-219
Ashlea N. Wainwright, Fatima El Atrassi, Vinciane Debaille, Nadine Mattielli

Transition from subduction to collision recorded in the Pan-African arc complexes (Mali to Ghana)
Precambrian Research, Volume 320, January 2019, Pages 261-280
Stéphane Guillot, Yao Agbossoumondé, Jérôme Bascou, Julien Berger, Stéphane Schwartz

Crustal fracturing, unconformities, and barite deposition, 3.26-3.23 Ga, Barberton Greenstone Belt, South Africa
Precambrian Research, In press, accepted manuscript, Available online 28 February 2019
Donald R. Lowe, Nadja Drabon, Gary R. Byerly

Northwest Africa's Ediacaran to early Cambrian fossil record, its oldest metazoans and age constraints for the basal Taroudant Group (Morocco)
Precambrian Research, Volume 320, January 2019, Pages 438-453
Dominik Letsch, Simon J. E. Large, Stefano M. Bernasconi, Christian Klug, Albrecht von Quadt

Metamorphic P-T path and geochronology of garnet-bearing amphibolite of the Inyoni Shear Zone, southwestern Barberton Greenstone Belt, South Africa
Precambrian Research, Volume 321, February 2019, Pages 261-276
Tao Peng, Guo-Dong Wang, Hao Y. C. Wang, Jia-Hui Liu, Chun-Ming Wu

Neoarchean (2.7 Ga) lacustrine stromatolite deposits in the Hartbeesfontein Basin, Ventersdorp Supergroup, South Africa: Implications for oxygen oases
Precambrian Research, Volume 320, January 2019, Pages 291-302
D. T. Wilmeth, F. A. Corsetti, N. J. Beukes, S. M. Awramik, A. J. Celestian

Provenance and tectonic implications of the 3.28–3.23 Ga Fig Tree Group, central Barberton greenstone belt, South Africa
Precambrian Research, Volume 325, June 2019, Pages 1-19
Nadja Drabon, Aleksandra Galić, Paul R. D. Mason, Donald R. Lowe

Reviewing the puzzling intracontinental termination of the Araçuaí-West Congo orogenic belt and its implications for orogenic development
Precambrian Research, Volume 322, March 2019, Pages 85-98
Carolina Cavalcante, Haakon Fossen, Renato Paes de Almeida, Maria Helena B. M. Hollanda, Marcos Egydio-Silva

Geochronological characterization of a transition zone between the Mozambique Belt and Unango-Marrupa Complex in SE Tanzania
Precambrian Research, Volume 321, February 2019, Pages 134-153
Epiphania G. Mtabazi, Nelson Boniface, Arild Andresen

The Neoproterozoic Upper Ruvubu alkaline plutonic complex (Burundi) revisited: Large-scale syntectonic emplacement, magmatic differentiation and late-stage circulations of fluids

Precambrian Research, Volume 325, June 2019, Pages 150-171
Sophie Decrée, Daniel Demaiffe, Luc Tack, Gérard Nimpagaritse, Vinciane Debaille

Geochemistry of banded iron formations and their host rocks from the Central Eastern Desert of Egypt: A working genetic model and tectonic implications
Precambrian Research, Volume 325, June 2019, Pages 192-216
A. K. El-Shazly, K. I. Khalil, H. A. Helba

Norite from the Mahalapye granitoid complex, northern edge of Kaapvaal Craton: Implications for the extent of the Paleoproterozoic Bushveld LIP
Precambrian Research, Volume 324, May 2019, Pages 146-154
H. M. Rajesh

The evolution of the Arabian-Nubian Shield and survival of its zircon U-Pb-Hf-O isotopic signature: A tale from the Um Had Conglomerate, central Eastern Desert, Egypt
Precambrian Research, Volume 320, January 2019, Pages 46-62
Yasser Abd El-Rahman, Mohamed Abu Anbar, Xian-Hua Li, Jiao Li, Ahmed E. Masoud

The Neoproterozoic southern passive margin of the São Francisco craton: Insights on the pre-amalgamation of West Gondwana from U-Pb and Hf-Nd isotopes
Precambrian Research, Volume 320, January 2019, Pages 454-471
Alice Westin, Mario C. Campos Neto, Peter A. Cawood, Chris J. Hawkesworth, Hélène Delavault

Evolution of the North West Arm and the Central Sector of Mashava Igneous Complex in south central Zimbabwe from an investigation of its silicate minerals compositions
Precambrian Research, Volume 324, May 2019, Pages 109-125
Jeff B. Chaumba

Zn isotopic evolution in early Ediacaran ocean: A global signature
Precambrian Research, Volume 320, January 2019, Pages 472-483
Bin Yan, Xiangkun Zhu, Xuexian He, Suohan Tang

The evolution of the Neoproterozoic Elat Metamorphic Complex, northernmost Arabian-Nubian Shield: Island arc to syncollisional stage and post-collisional magmatism
Precambrian Research, Volume 320, January 2019, Pages 137-170
Yehuda Eyal, Moshe Eyal, Boris Litvinovsky, Bor–ming Jahn, Tzahi Golan

Ore Geology Reviews

Global Miocene tectonics and regional sandstone-style uranium mineralization
Ore Geology Reviews, Volume 106, March 2019, Pages 238-250
Yinhang Cheng, Shaoyi Wang, Ruoshi Jin, Jianguo Li, Xueming Teng

Multi-stage and multi-sourced fluid and gold in the formation of orogenic gold deposits in the world-class Mana district of Burkina Faso – Revealed by LA-ICP-MS analysis of pyrites and arsenopyrites
Ore Geology Reviews, Volume 104, January 2019, Pages 495-521
Jérôme Augustin, Damien Gaboury

Antimony in rutile as a pathfinder for orogenic gold deposits
Ore Geology Reviews, Volume 106, March 2019, Pages 1-11
Andrea Agangi, Steven M. Reddy, Diana Plavsa, Denis Fougerouse, Tim E. Johnson

The mineralogy and mineral associations of platinum-group elements and precious metals in the Aurora Cu-Ni-Au-PGE deposit, Northern Limb, Bushveld Complex
Ore Geology Reviews, Volume 106, March 2019, Pages 403-422
Katie McFall, Iain McDonald, Dominique Tanner, R. E. (Jock) Harmer

Titanium, zirconium resources and production: A state of the art literature review
Ore Geology Reviews, In press, accepted manuscript, Available online 20 February 2019
Cameron Perks, Gavin Mudd

Geology of the Ngualla carbonatite complex, Tanzania, and origin of the Weathered Bastnaesite Zone REE ore
Ore Geology Reviews, Volume 105, February 2019, Pages 28-54
W. K. Witt, D. P. Hammond, M. Hughes

Secondary gold mineralization in the Amani Placer Gold Deposit, Tanzania
Ore Geology Reviews, Volume 107, April 2019, Pages 87-107
Stephan C. Dunn, Bjorn P. von der Heyden, Abraham Rozendaal, Rikard Taljaard

From Mantle to Motzfeldt: A Genetic Model for Syenite-hosted Ta,Nb-mineralisation
Ore Geology Reviews, In press, accepted manuscript, Available online 27 February 2019
Adrian A. Finch, Jamie A McCreath, Callum D. J. Reekie, William Hutchison, Siri L. Simonsen

P–T–X conditions on the genesis of orogenic Au (As, Bi, Ag) deposit in metasedimentary rocks of the Buracão Area, Araí Group, Brasília Fold Belt, Brazil
Ore Geology Reviews, Volume 105, February 2019, Pages 163-182
G. L. C. Pires, C. Renac, E. M. Bongiolo, R. Neumann, A. Barats

Imaging Regional Geology and Au – Sulphide mineralization over Dhanjori greenstone belt: Implications from 3-D Inversion of Audio Magnetotelluric data and Petrophysical Characterization
Ore Geology Reviews, Volume 106, March 2019, Pages 369-386
Roshan K. Singh, Ved P. Maurya, Shalivahan, Sahendra Singh

Earth and Planetary Science Letters

The roles of climate and human land-use in the late Holocene rainforest crisis of Central Africa
Earth and Planetary Science Letters, Volume 505, 1 January 2019, Pages 30-41
Germain Bayon, Enno Schefuß, Lydie Dupont, Alberto V. Borges, Luc André

Rift evolution in regions of low magma input in East Africa
Earth and Planetary Science Letters, Volume 506, 15 January 2019, Pages 332-346
James D. Muirhead, Lachlan J. M. Wright, Christopher A. Scholz

Emergence and evolution of the South Atlantic Anomaly revealed by the new paleomagnetic reconstruction SHAWQ2k
Earth and Planetary Science Letters, Volume 512, 15 April 2019, Pages 17-26
S. A. Campuzano, M. Gómez-Paccard, F. J. Pavón-Carrasco, M. L. Osete

Source characteristics of the 2017 Mw6.4 Moijabana, Botswana earthquake, a rare lower-crustal event within an ancient zone of weakness
Earth and Planetary Science Letters, Volume 506, 15 January 2019, Pages 348-359
Kathryn Materna, Shengji Wei, Xin Wang, Luo Heng, Roland Bürgmann

Progressive metasomatism of the mantle by kimberlite melts: Sr–Nd–Hf–Pb isotope compositions of MARID and PIC minerals
Earth and Planetary Science Letters, Volume 509, 1 March 2019, Pages 15-26
Angus Fitzpayne, Andrea Giuliani, Roland Maas, Janet Hergt, David Phillips

Complexity of Saharan paleoclimate reconstruction and implications for modern human migration
Earth and Planetary Science Letters, Volume 508, 15 February 2019, Pages 74-84
Abotalib Z. Abotalib, Mohamed Sultan, Gloria Jimenez, Laura Crossey, Victor Polyak

Geophysical evidence for crustal and mantle weak zones controlling intra-plate seismicity – the 2017 Botswana earthquake sequence
Earth and Planetary Science Letters, Volume 506, 15 January 2019, Pages 175-183
Max Moorkamp, Stewart Fishwick, Richard J. Walker, Alan G. Jones

Isopycnicity of cratonic mantle restricted to kimberlite provinces
Earth and Planetary Science Letters, Volume 505, 1 January 2019, Pages 13-19
I. M. Artemieva, H. Thybo, Y. Cherepanova

Chlorine isotopes as tracers of solute origin and age of groundwaters from the Eastern Desert of Egypt
Earth and Planetary Science Letters, Volume 510, 15 March 2019, Pages 37-44
Mahmoud I. Sherif, Mohamed Sultan, Neil C. Sturchio

Combined remote sensing analyses and landform evolution modeling reveal the terrestrial Bosumtwi impact structure as a Mars-like rampart crater
Earth and Planetary Science Letters, Volume 506, 15 January 2019, Pages 209-220
G. Wulf, S. Hergarten, T. Kenkmann

Secular change in TTG compositions: Implications for the evolution of Archaean geodynamics
Earth and Planetary Science Letters, Volume 505, 1 January 2019, Pages 65-75
T. E. Johnson, C. L. Kirkland, N. J. Gardiner, M. Brown, M. Santosh

Quaternary International

Aridification of the Egyptian Sahara 5000–4000 cal BP revealed from x-ray fluorescence analysis of Nile Delta sediments at Kom al-Ahmer/Kom Wasit
Quaternary International, In press, corrected proof, Available online 11 January 2019
Benjamin T. Pennington, Mohamed A. Hamdan, Ben R. Pears, Hamed I. Sameh

Combined US-ESR dating of fossil teeth from El Harhoura 2 cave (Morocco): New data about the end of the MSA in Temara region
Quaternary International, In press, corrected proof, Available online 23 February 2019
Eslem Ben Arous, Christophe Falguères, Olivier Tombret, Mohamed Abdeljalil El Hajraoui, Roland Nespoulet

Is the past key to the present? Observations of cultural continuity and resilience reconstructed from geoarchaeological records
Quaternary International, In press, accepted manuscript, Available online 15 February 2019
Kathleen Nicoll, Andrea Zerboni

EVENTS

List of international conferences, symposia, congresses on Earth Sciences between 2019-2024

A contribution From Natalya Nikitina, IAGETH

2019

4 – 7 February 2019
GeoEurasia-2019 - The International G&G Conference and Exhibition: Advanced Exploration and Development Technologies.
Moscow, Russia
Website: https://www.gece.moscow/kopiya-glavnaya

20 - 21 February 2019
International Conference "Arctic: Offshore Projects and Sustainable Development of Regions 2019»
Moscow, Russia
Website: http://arctic.s-kon.ru/

24 - 27 February 2019
2019 SME - Society for Mining, Metallurgy & Exploration Annual Conference
Denver, Colorado, USA
Website: http://www.smeannualconference.com/

14 - 16 March 2019
EUROGEO 2019 Annual Meeting and Conference "Teaching Geography in challenging times"

Paris, France
Website: http://www.eurogeography.eu/conference-2019/

14 - 17 March 2019
International Conference on Geoscience for Society
Dhaka, Bangladesh
1st announcement http://iugs.org/uploads/Second%20Announcement_GeoSoc.pdf
2nd announcement http://iugs.org/uploads/Second%20Announcement_GeoSoc.pdf

18 - 21 March 2019
Geoscience & Society Summit,
Stockholm, Sweden
Website: https://connect.agu.org/gss/home

24 - 27 March 2019
Geo-Congress 2019, Philadelphia
"Eighth International Conference on Case Histories in Geotechnical Engineering"
Pennsylvia, USA
Website: https://www.geocongress.org/

27 – 29 March
2nd Mining & Exploration Forum and Expo – MINEX Uzbekistan 2019
Tashkent, Republic of Uzbekistan
https://www.minexuzbekistan.com/
admin@minexforum.com

28 - 30 March 2019
AGIC2019 - 2nd Atlas Georesources International Congress "Applied Geosciences for Groundwater"
Hammamet, Tunisia
Website: https://lgr-certe.com.tn/

1 - 5 April 2019
VIII Earth Science Convention "Geosciences at service of Society and Development"
Havana, Cuba
Website: http://www.cubacienciasdelatierra.com/es/default/principal

7 - 12 April 2019
EGU General Assembly 2019
Vienna, Austria
Deadline: Abstracts 10 January 2019
Website: https://egu2019.eu/

12 - 13 April 2019
International symposium on climate change and the role of education
Lincoln, Lincolnshire, United Kingdom
Website: https://www.bishopg.ac.uk/climatechange/

16 - 19 April 2019
IMCET 2019 - 26th International Mining Congress and Exhibition
Antalya, Turkey
Website: http://www.imcet.org.tr/

24 - 26 April 2019
International Symposium on Structural Geology and Global Tectonics
Trabzon, Turkey
Website: http://www.generalgeology.com/

12 - 15 May 2019
GAC-MAC-IAH Conference "Where geosciences converge"
Québec, Canada

The preliminary program includes sessions on
- Geosystem and hydrogeosystems
- Resources, energy and environment
- Data science for geosciences
- Geosciences and society
Website: http://gacmac-quebec2019.ca/

12 - 24 May 2019
Geological Society of Nevada 2020 Symposium
Sparks, Nevada, USA
Website: http://www.gsnv.org/2020-symposium/

13 - 17 May 2019
GP2019 - Global Platform for Disaster Risk Reduction
Geneva, Switzerland
Website: https://www.unisdr.org/we/coordinate/global-platform

19–22 May 2019
GEM 2019 Xi'an - International Workshop on Gravity, Electrical & Magnetic Methods and Their Applications
Xi'an, China
Deadline: Abstracts 30 November 2018
Website: https://seg.org/events/GEM19

22–23 May 2019
7th International Conference on Earth Science, Climate Change & Space Technology
Rome, Italy
Deadline: Abstracts 11 April 2019
Website: http://earthscience.alliedacademies.com/

22 - 24 May 2019
15th International Congress of the Geological Society of Greece
Athens, Greece
Website: https://www.gsg2019.gr/

3 - 6 June 2019
81st EAGE Annual Conference and Exhibition
London, United Kingdom
Website: https://events.eage.org/en/2019/eage-annual-2019

4 - 7 June 2019
I Congreso Internacional de las Ciencias Exactas y Naturales
San José, Costa Rica
Website: http://www.eventos.academicos.una.ac.cr/index.php/cicen/ICICEN/

10 - 13 June 2019
7th International Conference on Debris-Flow Hazards Mitigation
Golden, Colorado, USA
Website: https://dfhm7.csmspace.com/

11 - 14 June 2019
EGC 2019 - European Geothermal Congress
The Hague, Netherlands
Website: http://europeangeothermalcongress.eu/

17 - 20 June 2019
7ICEGE - International Conference on Earthquake Geotechnical Engineering
Rome, Italy
Website: http://www.7icege.com/

18 - 19 June 2019

International Meeting on Paleoclimate: Change and Adaptation
Coimbra, Portugal
Website: https://paleoclimate2019.wixsite.com/paleoclimate2019

23 - 26 June 2019
ICONHIC 2019 - 2nd International Conference on Natural Hazards & Infrastructure
Chania, Greece
Website: https://iconhic.com/2019/

23–27 June 2019
11th North American Paleontological Convention
Riverside, USA
Website: https://napc2019.ucr.edu/

2 - 5 July 2019
STRATI 2019 - 3rd International Congress on Stratigraphy
Milano, Italy
Website: http://www.strati2019.it/

3–5 July 2019
7th International Conference on Coupled THMC Processes: GeoProc2019 - Earthquake and Faulting Mechanics
Utrecht, The Netherlands
Deadline: Abstracts 1 December 2018
Website: http://geoproc2019.sites.uu.nl/

8–11 July 2019
Space Climate 7 Symposium
Canton Orford, Québec, Canada
Website: http://craq-astro.ca/spaceclimate7/

21 - 27 July 2019
8th International Symposium on Gully Erosion
Townsville, Australia
Express interest https://www.research.net/r/FWCM3G2

25 - 31 July 2019
INQUA 2019
Dublin, Ireland
Website: http://www.inqua2019.org/

28 July – 2 August 2019
AOGS 16th Annual Meeting
Singapore, Singapore
Website: http://www.asiaoceania.org/aogs2019/public.asp?page=home.htm

12 - 13 August 2019
Earth & Geo Science 2019 - 2nd International Conference on Earth Science & Geo Science
"Insight into Innovations in Earth System Sciences and Climate Change Challenges"
Prague, Czech Republic
Website: https://www.scientificfederation.com/earth-science-2019/

12 – 15 August 2019
MEDGEO 2019: the 8th International Conference on Medical Geology
Guiyang, China
Website: www.medgeo2019.com

18 - 23 August 2019
Goldschmidt2019 - International Conference on Geochemistry and Related Subjects
Barcellona, Spain
Website: https://goldschmidt.info/2019/

27 - 30 August 2019
15th Biennial Meeting of the Society for Geology Applied to Mineral Deposits
Glasgow, Scotland
Website: https://www.sga2019glasgow.com/

2 - 12 September 2019
INHIGEO Annual Conference
44th Symposium of the International Commission on the History of Geological Sciences
Varese and Como, Italy
Website: https://inhigeo2019.jimdofree.com/

4–5 September 2019
ICSD 2019: 7th International Conference on Sustainable Development
Rome, Italy
Deadline: Abstracts 10 June 2019
Website: http://www.rsc.org/events/detail/33849/icsd-2019-7th-international-conference-on-sustainable-development
9 - 13 September 2019
5th International YES Congress
Berlin, Germany
Website: https://yesdeutschland.weebly.com/
https://eurogeologists.eu/call-for-sessions-for-5th-international-yes-congress/

13 - 18 September 2019
ISRM 14th - International Congress of Rock Mechanics
Iguassu Falls, Brazil
Website: http://www.isrm2019.com/

22 - 25 September 2019
Geological Society of America Annual Meeting
Phoenix, Arizona, USA
https://www.clocate.com/conference/Geological-Society-of-America-Annual-Meeting-and-Exposition-GSA-2019/74866/

24–26 September 2019
8th International Symposium on Andean Geodynamics
Quito, Ecuador
Deadline: Abstracts 1 March 2019
https://www.igepn.edu.ec/8isag

26-30 September 2019
XVII Congress of the International Society for Mine Surveying - ISMS 2019
Irkutsk National Research Technical University (INRTU), City of Irkutsk, Russia
https://ism2019.com/news/the-follow-up-meeting-about-organizing-the-congress-has-taken-place-in-irkutsk-national-research-technical-university-1/
Coordinator of the forum - Alina Kshanovskaya
Tel: +7 (964) 215-60-96
Email: president@ism-minesurveying.org
Work Email: kshanovskayaav@gmail.com

8-10 October 2018
15th Russian Mining and Exploration Forum
MINEX Russia Mining and Exploration Forum is regarded as one of the most successful business-driven mining events in Russia. The Forum is held annually and consistently attracts top executives and managers from leading Russian and international companies. The Forum addresses the ongoing developments and prospects for exploration, mining and processing of minerals and metals in Russia and across the countries of the Eurasian Economic Community. The Forum actively promotes investment and stimulates exchange of best practices and technologies in mining and mineral exploration
Moscow, Russia
https://www.showsbee.com/fairs/MINEX-Russia.html
E-mail: russia@minexforum.com

21 - 25 October 2019
International Congress: "Geoethics & Groundwater Management: Theory and Practice for a Sustainable Development"
Porto (Portugal)
Website: https://geoeth-gwm2019.wixsite.com/porto

4–8 November 2019
4th COSPAR Symposium: Small Satellites for Sustainable Science and Development
Herzliya, Israel
Deadline: Abstracts 15 April 2019
Website: http://www.cospar2019.org/

11-12 November 2019
6th International Conference on Geology, Geophysics and Environmental Science
Theme: Global View of Geological features and Environment for futuristic advancements
Helsinki, Finland
https://geology.conferenceseries.com/

14–15 November 2019
Dorothy Hill Women in Earth Sciences Symposium
Brisbane, Australia
https://sees.uq.edu.au/event/8493/dorothy-hill-women-earth-sciences-symposium

9 - 13 December 2019
AGU Fall Meeting
San Francisco, California, USA

2020

2 – 8 March 2020
36th International Geological Congress
Delhi, India
Website: http://www.36igc.org
e-mail: igc.delhi2020@nic.org

27 April - 1 May 2020
World Geothermal Congress 2020
Reykjavik, Iceland
Website: https://www.wgc2020.com/

3 - 8 May 2020
European Geosciences Union (EGU) General Assembly 2020
Vienna, Austria
Website: https://www.egu2020.eu/

12 - 24 May 2020
Geological Society of Nevada 2020 Symposium
Sparks, Nevada
Website: http://www.gsnv.org/2020-symposium/

16 - 18 June 2020
16th ICAAR - International Conference on Alkali Aggregate Reaction in Concrete
Lisbon, Portugal
Website: http://icaar2020.lnec.pt/

4–10 July 2020
ESOF: EuroScience Open Forum 2020
"Freedom for Science, Science for Freedom"
Trieste, Italy

Website: https://www.esof.eu/en/trieste-2020.html
15–23 August 2020
43rd COSPAR Scientific Assembly
Sydney, Australia
Deadline: Abstracts 15 February 2020
Website: https://www.cospar-assembly.org/

2021

25–30 April 2021
EGU General Assembly 2021
Vienna, Austria
Website: https://www.egu.eu/meetings/calendar/

2022

3–8 April 2022
EGU General Assembly 2022
Vienna, Austria
Website: https://www.egu.eu/meetings/calendar/

2023

23–28 April 2023
EGU General Assembly 2023
Vienna, Austria
Website: https://www.egu.eu/meetings/calendar/

2024

14–19 April 2024
EGU General Assembly 2024
Vienna, Austria
Website: https://www.egu.eu/meetings/calendar/

OPPORTUNITIES

The Following opportunities collected for you from several sources, so duplications of the same position may be occurred.

Post-doctoral position in Stable Isotope Geochemistry	Erlangen-Nürnberg, Germany	07/03/19
Summer Internship in Japan	Misasa, Japan	01/04/19
11 Early Stage Researchers (PhDs) at various partners institutions in the European Training Network P-TRAP	Utrecht, Netherlands	01/04/19
Temporary Project Coordinator - Copernicus Marine Biogeochemistry	Galway, Ireland	08/03/19

PhD Position in Zircon Petrology	Amsterdam, The Netherlands	10/03/19
Research Position - Polar Science/Remote Hydrology	San Diego, CA, USA	22/03/19
PhD position - bioturbation impact of a chemosymbiotic bivalve on mangrove geochemistry	Plouzane, France	22/05/19
Research engineer position in hydro-biogeochemistry modelling	Toulouse, France	31/03/19
Science Officer	Strasbourg, France	15/03/19
Senior Scientist (tenure track) - (Akademischer Rat/ Akademische Rätin)	Bayreuth, Germany	01/05/19
Senior Scientist (fixed term) - (Akademischer Rat/ Akademische Rätin auf Zeit)	Bayreuth, Germany	01/05/19
Postdoctoral Fellow in Mineral chemistry of hydrothermal sulfides	Tromsø, Norway	15/03/19
PhD position in Mass-extinction Research (4 years)	Utrecht, Netherlands	30/03/19
Roger E. Deane Postdoctoral Fellowship in Earth Science	Toronto, ON, Canada	08/03/19
2019 Postdoctoral Fellowship Program	Moss Landing, CA, USA	20/03/19
Research Fellow in Sea Ice Altimetry	Leeds, UK	31/03/19
Research positions in Geosciences	Dublin, Ireland	01/04/19
Senior Civil Engineer - Microdrainage	London, UK	21/03/19
Contract Management Officer	Reading, UK	02/04/19
User Engagement Manager - Copernicus Services	Reading, UK	26/03/19
Transmission Electron Micro-Spectroscopy Researcher/ Laboratory Manager (m/f/x)	Potsdam, Germany	10/03/19
PhD/PostDoc candidate in the BRU21 program	Trondheim, Norway	13/03/19
PhD position: Fracture growth in anisotropic rocks	Zurich, Switzerland	13/03/19

Postdoctoral Research Positions of experimental soil mechanics and rock mechanics / 2019 CALL	Chengdu, Sichuan, China	31/03/19
Researcher in Geotechnical Engineering	Brest, France	15/03/19
MSc Climate Change and Development MSc Sustainable Development	London, UK	Apply Now
Summer Internship in Japan	Misasa, Japan	01/04/19
Laboratory Geochemist	Edinburgh, UK	19/03/19
PhD position - Active tectonics - What is tectonic fault damage ?	Valbonne, France	31/05/19
Research positions in Geosciences	Dublin, Ireland	01/04/19
11 Early Stage Researchers (PhDs) at various partners institutions in the European Training Network P-TRAP	Utrecht, Netherlands	01/04/19
Experienced Geophysicist	Nottingham, UK	31/03/19
Technician in Geosciences W/M	Verneuil-en-Halatte, France	28/03/19
2 yr Researcher Position: 3D Geodynamic modelling of continental rifting and interaction with surface processes	Bergen, Norway	01/04/19
Research Fellow (3D Modelling)	Crawley, Australia	17/03/19
PhD Position in Zircon Petrology	Amsterdam, The Netherlands	10/03/19
PhD in Petroleum Geochemistry and Lipidomics	Halifax, Canada	30/04/19
PhD position - bioturbation impact of a chemosymbiotic bivalve on mangrove geochemistry	Plouzane, France	22/05/19
Post-Doc/Research Associate in the field of Interplay between surface processes and deformation at rifted margins	Bremen, Germany	22/04/19
Senior Scientist (tenure track) - (Akademischer Rat/ Akademische Rätin)	Bayreuth, Germany	01/05/19
Senior Scientist (fixed term) - (Akademischer Rat/ Akademische Rätin auf Zeit)	Bayreuth, Germany	01/05/19

Laboratory Instructor L2 - Geoscience	Calgary, Canada	22/03/19
PhD Positions in Experimental Petrology/Geochemistry	Zurich, Switzerland	20/04/19
PhD position: Fracture growth in anisotropic rocks	Zurich, Switzerland	13/03/19
Research Assistant: Hydrogeology	Berlin, Germany	12/03/19
Postdoctoral Research Associate in Earthquake Processes	Bochum, Germany	08/03/19
Senior Reservoir Modeller/Geophysical Interpreter	Edinburgh, UK	22/03/19
Science Officer	Strasbourg, France	15/03/19
Transmission Electron Micro-Spectroscopy Researcher/ Laboratory Manager (m/f/x)	Potsdam, Germany	10/03/19
PhD/PostDoc candidate in the BRU21 program	Trondheim, Norway	13/03/19
Researcher in Geology-Sedimentology Short period	Brest, France	21/03/19
Research Assistant/Associate - Remote Sensing	Singapore	12/03/19
Postdoctoral Research Positions of experimental soil mechanics and rock mechanics / 2019 CALL	Chengdu, Sichuan, China	31/03/19
Researcher in Geotechnical Engineering	Brest, France	15/03/19
Postdoctoral Associate Position in the Application of a Portable Laser Ablation Sampling Device and ICP-MS to the Analysis of Cultural Heritage Objects	New Haven, CT, USA	03/03/19
PhD position in Mass-extinction Research (4 years)	Utrecht, Netherlands	30/03/19
Postdoctoral Research Positions of Geohazards / Sedimentology/Geomorphology/Geotechnical Engineering - 2019 CALL	Chengdu, Sichuan, China	15/04/19
Post-Doc/Research Associate - General Geology/Marine Geology	Bremen, Germany	15/03/19
Petroleum Geoscience (MSc) - Open Day 6 February 2019 Pollution and Environmental Control [MSc]	Manchester, UK	Apply Now

PhD position in the Helmholtz Young Investigators Group - CLEAR	Potsdam, Germany	15/03/19
Energy Policy MSc	Brighton, UK	Apply Now
Roger E. Deane Postdoctoral Fellowship in Earth Science	Toronto, ON, Canada	08/03/19
2019 Postdoctoral Fellowship Program	Moss Landing, CA, USA	20/03/19
Summer Internship in Japan	Misasa, Japan	01/04/19
PhD position - Active tectonics - What is tectonic fault damage ?	Valbonne, France	31/05/19
Associate Professor at the University of Orléans, France - Tectonics and experimental rock deformation	Orleans, France	26/03/19
Lectureship in Earth Sciences - 3 posts	London, UK	28/03/19
2 yr Researcher Position: 3D Geodynamic modelling of continental rifting and interaction with surface processes	Bergen, Norway	01/04/19
Senior Scientist (tenure track) - (Akademischer Rat/ Akademische Rätin)	Bayreuth, Germany	01/05/19
Senior Scientist (fixed term) - (Akademischer Rat/ Akademische Rätin auf Zeit)	Bayreuth, Germany	01/05/19
Assistant Professor, Earth and Environmental Sciences	Calgary, Canada	22/03/19
PhD Positions in Experimental Petrology/Geochemistry	Zurich, Switzerland	20/04/19
Geo-Information Analyst (PhD) - Part of the Shell Graduate Programme	Rijswijk, The Hague, Netherlands	18/03/19
Postdoctoral Research Associate in Earthquake Processes	Bochum, Germany	08/03/19
Science Officer	Strasbourg, France	15/03/19
Assistant Professor with doctoral degree (in polish Adiunkt) in the Department of Seismology	Warsaw, Poland	10/03/19
Researcher in Geology-Sedimentology Short period	Brest, France	21/03/19

Research Assistant/Associate - Remote Sensing	Singapore	12/03/19
Postdoctoral Research Positions of Geohazards / Sedimentology/Geomorphology/Geotechnical Engineering - 2019 CALL	Chengdu, Sichuan, China	15/04/19
Post-doctoral position in Stable Isotope Geochemistry	Erlangen-Nürnberg, Germany	07/03/19
Postdoctoral Fellowship in Pesticide Biogeochemistry at Water/Sediment Interface	Strasbourg, France	31/03/19
11 Early Stage Researchers (PhDs) at various partners institutions in the European Training Network P-TRAP	Utrecht, Netherlands	01/04/19
Professor (tenure track) and UQAC institutional Research Chair in Archean metallogeny	Chicoutimi, Canada	04/03/19
Associate Professor in Hydrogeology	Cape Town, South Africa	17/03/19
Tenure-Track or Tenured Position in Human Dimensions of Water Security as Assistant Professor	Saskatoon, SK, Canada	15/03/19
Senior statistician / infectious disease modeller	Wallingford, UK	31/03/19
Research Position - Polar Science/Remote Hydrology	San Diego, CA, USA	22/03/19
Laboratory Instructor L2 - Geoscience	Calgary, Canada	22/03/19
Assistant Professor, Earth and Environmental Sciences	Calgary, Canada	22/03/19
Senior Civil Engineer - Microdrainage	London, UK	21/03/19
Research engineer position in hydro-biogeochemistry modelling	Toulouse, France	31/03/19
Research Assistant: Hydrogeology	Berlin, Germany	12/03/19
Researcher in Geology-Sedimentology Short period	Brest, France	21/03/19
Researcher in Geotechnical Engineering	Brest, France	15/03/19
Permanent Assistant Professor or Associate Professor position in surface water hydrology	Beijing, China	30/04/19

Master of Hydrogeology	Perth, WA, Australia	Apply Now
Faculty Position Mining Engineering: Mineral processing and environment	Quebec, Canada	15/04/19
Junior Academic Position in Mineralogy/Geology	Concepcion, Chile	29/03/19
Experienced Geophysicist	Nottingham, UK	31/03/19
Senior Scientist (tenure track) - (Akademischer Rat/ Akademische Rätin)	Bayreuth, Germany	01/05/19
Senior Scientist (fixed term) - (Akademischer Rat/ Akademische Rätin auf Zeit)	Bayreuth, Germany	01/05/19
Laboratory Instructor L2 - Geoscience	Calgary, Canada	22/03/19
MSc Global Management of Natural Resources	London, UK	Apply Now
Research Scientist - Ore Deposit Geologist	Perth, Australia	11/03/19
MSc Global Management of Natural Resources	London, UK	Apply Now
MSc Climate Change and Development MSc Sustainable Development	London, UK	Apply Now
Petroleum Geoscience (MSc) - Open Day 6 February 2019 Pollution and Environmental Control [MSc]	Manchester, UK	Apply Now
Energy Policy MSc	Brighton, UK	Apply Now
Research Fellow in Sea Ice Altimetry	Leeds, UK	31/03/19
Experienced Geophysicist	Nottingham, UK	31/03/19
Principal Earth Observation Scientist	Wallingford, UK	31/03/19
Spatial Information Service - Developer	Livingston, UK	15/03/19
Research Fellow (3D Modelling)	Crawley, Australia	17/03/19
Research Position - Polar Science/Remote Hydrology	San Diego, CA, USA	22/03/19

Assistant Professor, Earth and Environmental Sciences	Calgary, Canada	22/03/19
Contract Management Officer	Reading, UK	02/04/19
User Engagement Manager - Copernicus Services	Reading, UK	26/03/19
Research engineer position in hydro-biogeochemistry modelling	Toulouse, France	31/03/19
Geo-Information Analyst (PhD) - Part of the Shell Graduate Programme	Rijswijk, The Hague, Netherlands	18/03/19
Science Officer	Strasbourg, France	15/03/19
Specialis - Physical Oceanography	Suva, Fiji	13/03/19
Research Assistant/Associate - Remote Sensing	Singapore	12/03/19
Research Assistant/Associate - Software Development and Operations	Singapore	12/03/19
Software Developer - Climate Data Store Toolbox Applications	Reading, UK	13/03/19
Permanent Assistant Professor or Associate Professor position in surface water hydrology	Beijing, China	30/04/19
Postdoctoral Research Positions of Geohazards / Sedimentology/Geomorphology/Geotechnical Engineering - 2019 CALL	Chengdu, Sichuan, China	15/04/19
Research Scientist - Ore Deposit Geologist	Perth, Australia	11/03/19
2019 Postdoctoral Fellowship Program	Moss Landing, CA, USA	20/03/19
Geoscientist	London, UK	15/03/19
Geoscience Softare Developer	Llandudno, UK	25/03/19
PhD in Petroleum Geochemistry and Lipidomics	Halifax, Canada	30/04/19
Geo-Information Analyst (PhD) - Part of the Shell Graduate Programme	Rijswijk, The Hague, Netherlands	18/03/19

Senior Reservoir Modeller/Geophysical Interpreter	Edinburgh, UK	22/03/19
PhD/PostDoc candidate in the BRU21 program	Trondheim, Norway	13/03/19
Petroleum Geoscience (MSc) - Open Day 6 February 2019 Pollution and Environmental Control [MSc]	Manchester, UK	Apply Now

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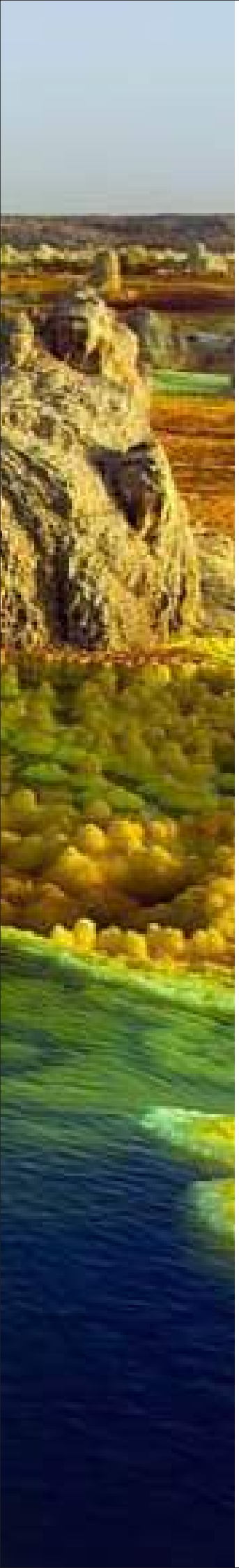

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Edited by
Tamer Abu-Alam
Editor of the GSAf Newsletter

Cover Image
Dallol Volcano in Ethiopia
http://strangesounds.org/2013/06/geological-oddity-discover-the-eerie-and-colorful-landscape-of-dallol-volcano-in-ethiopia.html