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Veronika KOUKAL & Michael WAGREICH (Eds.)

Nairobi's Anthropocene 2022 - past, present & future archives

IGCP 732 "LANGUAGE" of the Anthropocene Annual Meeting

14 - 16 November 2022 Nairobi, Kenya and online



The Anthropocene establishes a powerful concept associated with unprecedented global change.

Here we propose to engage new ideas in the development of the Anthropocene concept.

Abstracts

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middle: screenshot by Veronika Koukal of the presentation by Luyuan Zhang;

bottom: screenshot by Veronika Koukal of the presentation by Juliana Ivar do Sul

Page 37: All by Lydia Olaka

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Dear participants and guests!

We cordially welcome you to the annual meeting of IGCP 732 "*LANGUAGE - Lessons in anthropogenic impact: a knowledge network of geological signals to unite and assess global evidence of the Anthropocene*", that took place on November 14-16 in Nairobi, Kenya and online. Here, we present the abstracts proceedings of the IGCP 732 workshop.

The meeting "Nairobi's Anthropocene 2022 – past, present and future archives" was intended to be interactive and to inspire future work in the IGCP 732 project, and focussed on sharing information and filling a framework to address knowledge gaps involving human impact on Earth. Each day was centred on a key theme, which allowed for Nairobi focussed, environmental focussed, and technical focussed discussions in turn.

The program included talks, where Co-PI's, invited speakers, and students present their research. There were also sessions and short courses around lunch time for students to learn the practical skills that they would need to undertake investigations of human disruption to natural processes. The afternoons provided specialist workshop sessions that intend to draw discussion around the key themes and encourage reflection on the core questions and challenges surrounding the record of the Anthropocene.

We would like to express our gratitude to all the people who have contributed to the successful organization of this meeting, on-site as well as online. Special thanks go to Lydia Olaka and her team in Nairobi, Lorna Njanja, Cecilia Chiaji and Emmanuel Ndiema for their hospitality. Further we thank the National Museums of Kenya for hosting the on-site meeting. Capacities for online participation were provided by the University of Vienna. Our appreciation is extended to our funding organizations and institutions, especially UNESCO IGCP for granting financial support.

We finally decided to have a hybrid meeting, knowing about the challenges this might bring up. On the other hand we saved a lot of CO₂ by avoiding international traveling by aircraft. An additional plus is that several presentations will be available on the webpage of IGCP 732 to rewatch.

We hope that this meeting stimulated the interdisciplinary dialogue, and that all participants could connect to each other and took home new ideas and insights.

Sincerely,

Michael Wagreich, Veronika Koukal and the PIs of IGCP 732

NAIROBI-FOCUSSED SESSIONS

10:00 - 10:15 am	Welcome & Introduction to the IGCP 732 project by Michael Wagreich
10:15 - 11:00 am	Opening & Introduction Lydia Olaka (University of Nairobi) Esther Kioko (National Museums of Kenya) Christina Omuombo (Geological Society of Kenya) Lewis Sitoki (Technical University of Kenya)
11:00 - 11:30 am	A Kenyan perspective on the Anthropocene by Lydia Olaka
11:30 - 11:45 am	Coffee Break
11:45 - 12:15 pm	Anthropocene stratigraphy in Southern Africa by Simon Turner
12:15 - 12:45 pm	Geological archives of the Anthropocene by Colin Waters
12:45 - 1:10 pm	PAGES Anthropocene Network ECR activities and opportunities by Christine Omuombo
1:10 - 2:10 pm	Lunch Break
2:10 - 3:10 pm	An Introduction to Google Earth Pro by Stanley Chasia
3:10 - 4:30 pm	Workshop Session I A comparison of herbaceous plant species between abandoned bomas and termite mounds in the dry season at Mpala Research Centre (Laikipia County, Kenya) by Aggrey Minya Impact of nomadic pastoralism on modern landscapes and vegetation cover by Husna Mashaka Nairobi - a virtual tour by Chege Lorna Njanja Discussion
4:30 - 5:00 pm	Coffee Break
5:30 pm	Ice Breaker Party on-site only

* only presenting author is stated

ENVIRONMENTAL-FOCUSSED SESSIONS

10:00 - 10:25 am	Records of radioactive iodine-129 in Chinese sediments by Luyuan Zhang
10:25 - 10:50 am	Multi-time scale variations of black carbon, char, and soot in association with climate change and human activities by Yalan Tang
10:50 - 11:15 am	The Anthropocene Hg pollution record from multi-lake sediment cores in NE China by Kunshan Bao
11:15 - 11:40 am	Warfare impact overtakes climate-controlled fires in the eastern Silk Roads since 2100 BP by Shanjia Zhang
11:40 - 11:55 am	Coffee Break
11:55 - 12:20 pm	Climate change, monsoon variability and anthropogenic controls on floods in Pakistan by Mehwish Bibi
12:20 - 12:45 pm	Climate change and glacial lake outburst flood risk in north Pakistan by Shahid Iqbal
12:45 - 1:10 pm	Geoelectric Imaging of Groundwater Pollution: Groundwater resources in Indonesia's new capital city by Ibnu Taslim
1:10 - 2:10 pm	Lunch Break
2:10 - 3:10 pm	National Museums of Kenya repository tour by Stephen Rucina and Rebecca Muriuki on-site only
3:10 - 4:30 pm	<p>Anthropogenic Activities and how they influence water safety and our health by Faith Mbithe</p> <p>Reconstructing vegetation changes in Kilombe Caldera , Baringo County, Kenya: Using plant microfossils in relation to the modern vegetation composition by Rebecca Muriuki</p> <p>Workshop Session II</p> <p>The Anthropocene landscapes of Nairobi and New Orleans - searching for the signal of change by Catherine Russell & Lydia Olaka</p>
4:30 - 5:00 pm	Coffee Break
5:00 - 5:30 pm	Discussion

TECHNICAL-FOCUSSED SESSIONS

10:00 - 10:25 am	Natural evolution and anthropic changes in Las Tablas de Daimiel National Park (Central Spain) from sedimentary, archaeological and historical records by Alberto Celis
10:25 - 10:50 am	Phases of Environmental Changes in in coastal Boracay, Philippines, deduced from sediment deposits by Mishel Rañada
10:50 - 11:15 am	Direct and indirect anthropogenic indicators in Laguna Lake, Philippines by Chris Toyado
11:15 - 11:40 am	Anthropogenic source of soil contamination: Environmental impacts of Indonesia's new capital city by Jamaluddin
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11:55 - 12:20 pm	From Romans to the Anthropocene, from Carnuntum to Vienna: An Urban Anthropocene Field Lab by Diana Hatzenbühler
12:20 - 12:45 pm	Case study on the approach of technogenic (artificial) ground from the surface structure and physiology of the landscape by Érika Nesta Silva
12:45 - 1:10 pm	Epistemological and ethical reflections on the Anthropocene by Emlyn Koster
1:10 - 2:10 pm	Lunch Break
2:10 - 3:10 pm	Working with Research Data: Principles of FAIR Data Management by Eric Bönecke
3:10 - 4:30 pm	Workshop session III Sampling, processing and dating of natural archives of the Anthropocene (marine, lake and peatland sediments) by Barbara Fialkiewicz-Kozziel, Juliana Ivar do Sul and Luyuan Zhang
4:30 - 5:00 pm	Coffee Break
5:00 - 5:30 pm	Discussion & Closing

Google Earth Pro for spatial exploration and representation

by Stanley Chasia* (Technical University of Kenya)

The presentation “An introduction to Google Earth Pro” at the Nairobi Anthropocene workshop held at the National Museums of Kenya on 14th – 16th November, 2022 was designed to introduce participants on available tools for data exploration, specifically using Google Earth Pro desktop application.

Google Earth Pro is a free tool for viewing information and geographically exploring different parts of the earth and outer space (sky, mars, moon), on various themes i.e., climate, temporal change analysis, routing and analysing environmental changes etc.

In this workshop, participants were taken through topical technical skills including: exploring the Google Earth Pro interphase, such as menu items, predefined spatial layers and tools for creating spatial objects, and organizing information on places of interest. In this regard, participants learnt how to create and export points of interest (Place marks) and tagging photos to points; extracting linear features (paths), and polygons such as lake boundary and preparing an elevation profile between two points.

Google Earth also offers an archive of historical satellite images used for visualizing trends in space and time, and explore environmental alterations due to land cover change.

Participants were also taken through the process of importing data from sources i.e., Geographical Information Systems format (shapefiles), GPS data, and importing text data containing coordinates and other information in a table. Finally, participants were taken through the process of creating simple maps containing basic cartographical elements in order to communicate their data.

<https://ustream.univie.ac.at/media/core.html?id=c55d7d9e-8eff-4b19-a540-3e07ce914aee>



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National Museums of Kenya repository tour

by Stephen Rucina* , Veronica Muiruri* & Rebecca Muriuki* (National Museums of Kenya)

On Tuesday, 16 November 2022, on-site participants visited the palynology laboratory of the National Museums of Kenya.



Working with Research Data: Principles of FAIR Data Management

by Eric Bönecke* (Leibniz-Institute of Vegetable and Ornamental Crops)

Eric Bönecke talked about the theories and the principles of FAIR data management, including how to work with research data.

FAIR data is an acronym and represents data which needs to be findable, accessible, interoperable and reusable.

Several examples of data documentation and sharing research data during different stages of a project were provided.



The short course dealt with the questions

- What is research data?
- What is and why do research data management?
- What is metadata and what types are important?
- What is the difference between FAIR and Open data?
- Persistent identifiers
- Databases
- Repositories and repository finders

Interdisciplinary repository finder
<https://www.re3data.org/>

<https://ustream.univie.ac.at/media/core.html?id=46187b04-9570-4688-a7d7-b08b19445d1f>

Text by Veronika Koukal based on the talk by Eric Bönecke

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Nairobi - a virtual tour

by Chege Lorna Njanja* (Nairobi, Kenya)

There have been unprecedented environmental changes in urban centres around the world largely attributed to human activities, including but not limited to infrastructural development, agriculture and resource exploitation.

Nairobi is no different in this regard. One way that has manifested is by the subtle and at times drastic changes in land cover, indicative of a large-scale shift utilization of the 703km² area. Satellite imagery has been instrumental in documenting and quantifying these changes and their spatial distribution. Hopefully, in future, this will inform urban planning, design and land use policy. There has been a marked increase in the surface area covered by artificial structures and a significant portion of vegetation cover and bare land has been lost in the process.

In Nairobi, urbanization is the main cause of these changes. Nairobi started as a small railway settlement back in the late 1890s during the colonial era. "Nyrobi" originally coined by the Masaai meaning "Cool Water" was made the capital of the British East Africa protectorate in 1905, from Masaku, in the now Machakos County. Partly due to its elevated status, movement in and around Nairobi by Black Africans was heavily restricted and ownership of property was prohibited. When Kenya gained independence in 1963, it was made the capital and the colonial government's discriminatory laws governing access and land ownership by local Kenyans finally came to an end.

Nairobi has seen a decadal increase in population according to census data collected every 10 years. Findings from the 2019 census conducted by KNBS (2019) placed the population of Nairobi County at 4,397,073, a 28% increase from the previous census held in 2009, with 84% of its inhabitants under 40 years old.

Rural-Urban migration in search of better opportunities has resulted in a greater demand for accommodation effectively making land one of the most sought-after commodities. The real-estate market in turn has proven to be both competitive and lucrative, making home ownership in Nairobi unaffordable for a majority of its residents. Rent rates have been on an upward trajectory, therefore contributing to the expansion of informal settlements.

One distinguishing feature of these structures is their semi-permanent nature. These settlements are typically situated in areas that are considered public land (adjacent to transport networks and waterways).

In recent times however, there has been a trend embodying informal settlements even in areas that have been set aside for development. Informal settlements deviate from official planning regulations, therefore rendering them poorly serviced by waste management systems. Additionally, the residents cannot afford to pay for these services. As a result, waste from these areas is poorly handled and a significant portion finds its way into our river systems.

by Lydia Olaka & team

Furthermore, the ever-increasing demand for more accessible and affordable construction materials in the greater Nairobi region, has led to the establishment of small-scale mines in various parts of Nairobi. They pose a safety and environmental hazard as once the mines are decommissioned they are used as dumping sites. The sediment collects along the river banks resulting in siltation and flooding during the rainy season.

Despite challenges arising from urbanization, development in certain areas is strictly prohibited. The famous Nairobi National Park is one example. It covers an area of about 117 km² and is located 7 km from the central business district. It is the only one of its kind in the world. Despite this, there is increasing concern that the sprawling structures around the park risks the loss of Wildlife Corridors. There are also green spaces in the form of nature trails, forests and parks for residents to enjoy.

<https://ustream.univie.ac.at/media/core.html?id=c4b706b1-dff6-4f50-8f20-ed50956b3787>

KNBS-Kenya National Bureau of Statistics (2019) 2019 Kenya Population and Housing Census Volume III: Distribution of Population by Age, Sex and Administrative Units. Available at [<https://www.knbs.or.ke/download/2019-kenya-population-and-housing-census-volume-iii-distribution-of-population-by-age-sex-and-administrative-units/>] Accessed on 10th November 2022

Chairs: Lydia Olaka, Veronika Koukal &
Michael Wagreich

Recording available

UNESCO International Geoscience Program IGCP 732 LANGUAGE of the Anthropocene - Introduction

by Michael Wagreich*, Veronika Koukal (University of Vienna) & the IGCP 732 PI-Team

IGCP 732: *LANGUAGE of the Anthropocene (Lessons in anthropogenic impact: a knowledge network of geological signals to unite and assess global evidence of the Anthropocene). Present and future Geology – the global scale evidence of the Anthropocene* was granted as a new UNESCO IUGS IGCP project in spring 2021 and will run for 5 years.

The former International Geological Correlation Project, now International Geoscience Program started in 1972 as a knowledge hub of UNESCO to facilitate international scientific cooperation in the geosciences. IGCP Projects bring together scientists for workshops and field trips and support especially participation from developing countries.

The aims of IGCP 732 are to involve a global community in geoscientific research into the Anthropocene and the anthropogenic predominance of the Earth System. Thus, the Anthropocene establishes a powerful concept associated with unprecedented global change.

Both recognizing and managing this novel situation in a sustainable way requires a planetary network and accompanying knowledge framework. IGCP 732 aims to engage new ideas and networks in the development of the Anthropocene concept by cooperating globally with scientists, especially those in developing and less developed countries.

The core aims are to unite and assess global evidence of the Anthropocene and to establish the Anthropocene as a fertile framework for future geosciences. This will be achieved by

- 1) developing a network of expertise and project partners globally;
- 2) designing and running workshops in developing countries; and
- 3) designing and collating an open database of existing information and expertise on the Anthropocene.

In addition, IGCP 732 is also linked to the Anthropocene Working Group (AWG) of the Subcommission on Quaternary Stratigraphy of the International Commission on Stratigraphy, and the ongoing research of potential GSSPs (Global Boundary Stratotype Section and Point, or 'golden spike'), marking the onset of the Anthropocene as a chronostratigraphic unit of the Geological Timescale.

<https://ustream.univie.ac.at/media/core.html?id=c832deeb-8c8f-45a5-a6a8-5d84641bac82>

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Michael Wagreich

Recording available

A Kenyan perspective on the Anthropocene

by Lydia Olaka* (Technical University of Kenya),
Eric Odada & Daniel Olago (University of Nairobi)

It is now widely accepted that humans are a formidable force of nature, the terrestrial and aquatic environments have been modified by human activities. We carried out a review of the studies reporting environmental changes to understand the environmental and ecosystem changes induced by anthropogenic activities associated with the “Anthropocene” the proposed new geological epoch in Earth history in East Africa.

Humans have occupied East Africa for thousands of years but until about 300 Years ago, their impact on the environment was localized and transitory. A number of contemporary natural archives have been considered, including lake and marine sediments, peat sequences and corals. These show that the impacts of human activities intensified during the 19th century due to rapid population growth and extension and intensification of agriculture that was largely driven by colonists: the overprinting of natural environmental changes by human activities is clear and it is marked by increased sedimentation, heavy metals deposition, changes in sediment properties and lake water quality increased pesticides and pharmaceuticals in the environment. This results from land and water degradation and overexploitation of terrestrial and aquatic ecosystem good and services.

The impacts of such changes include changes in ecosystems, and associated biodiversity losses. These changes however are not uniform across the region and there are some temporal and spatial lags depending on the locality. They have been spread out over a 100-year period (1880-present) but with intensification noted in the mid-1900s, thus supporting the AWG (2019) proposed date of 1950 for the start of the Anthropocene.

The most significant are increase in land degradation, deforestation, siltation of water bodies and extinction/disappearance of key terrestrial and aquatic species these are mostly linked to agricultural land expansion and extensive land degradation, over-exploitation of natural resources, and increase in human and livestock populations. The environmental changes during the Anthropocene seen here are not as pronounced as those witnessed in the Northern Hemisphere; however, the trends identified of extinction of species, poaching and environmental degradation need to be curtailed.

Furthermore, a number of studies need to be carried out with different range of anthropogenic markers in different sites for the onset of Anthropocene in East Africa.

<https://ustream.univie.ac.at/media/core.html?id=ad2b2564-2495-466b-85f2-525c486d9844>

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Recording available

Anthropocene stratigraphy in Southern Africa

by Simon Turner*, Neil Rose, Lilly Unger (University College London) &
Chris Curtis (University of Johannesburg)

Southern Africa is rich in geological and archaeological sites where stratigraphic evidence of human evolution and long-term human activity can be found. In contrast the stratigraphic evidence of unprecedented industrialisation, land use and population change proposed to have created a new geological epoch starting in the mid-twentieth century is limited.

Lake sediment stratigraphy work in Lesotho using methods currently being used by the Anthropocene Working Group to build a geological case for the formal ratification of the Anthropocene shows that key anthropogenic markers of the Great Acceleration are present.

A literature review of the range of anthropogenic markers and environmental archives considered to be useful for identification of the stratigraphic Anthropocene in the region highlights several sites where future work would yield comparable data to the sites currently being investigated by the AWG to contain a global stratotype section and point (GSSP) for the Anthropocene. A research plan of investigating unique Southern African freshwaters combining community historical knowledge and lake sediment stratigraphy is proposed.

<https://ustream.univie.ac.at/media/core.html?id=e0c7526f-5e84-464b-aa09-7775fc3e84d1>

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Michael Wagleich

Recording available

Progress in the investigation for a potential GSSP for the Anthropocene Series

by Colin Waters* (University of Leicester) & project leaders of the 12 candidate sites

The Anthropocene Working Group (AWG) of the Subcommission on Quaternary Stratigraphy is the body tasked to investigate the reality of, and provide a definition for, the Anthropocene as a new epoch of geological time. In October 2022, the AWG commenced a formal voting process to identify a single Global boundary Stratotype Section and Point (golden-spike), a requirement for providing the definition of the base of the Anthropocene at around the preferred mid-20th century level within a stratotype section.

12 candidate sites have been put forward as potential candidates by 12 teams, independent of, but supervised by, the AWG. This presentation will discuss the 12 sites, located in marine, estuarine and lake sediments, peat, corals, ice, a speleothem and anthropogenic deposits and which span 5 continents.

It will also introduce the array of physical, chemical, biological and climatic signatures that record a profound shift in the Earth System that have been recorded in these sections. Some signatures will prove to be short spikes in the geological record which are quickly reversed through policy changes (e.g. fallout radionuclides, fly ash particles, certain organic pesticides).

Others will continue as clear markers into the near future (e.g. microplastics) and long-term (e.g. CO₂-forced climate change), irrespective of current actions. Others will represent permanent and growing changes (e.g. species transfers) demonstrating that the realities of the Holocene world no longer persist.

The results of the vote will be announced in spring 2023.

<https://ustream.univie.ac.at/media/core.html?id=af64e8f1-adb3-4797-b916-b8d2138a6fc8>

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Michael Wagreich

Recording available

PAGES Early-Career Network (ECN)

by Christine Omuombo* and the PAGES Steering committee (Technical University of Kenya, ICCA, ECS, UoN, National Museums of Kenya)

The PAGES ECN is a product of PAST Global ChangeS (PAGES), a core project of Future Earth. PAGES is supported by the Swiss Academy of Sciences, the Chinese Academy of Sciences, and the University of Bern.

The PAGES ECN aims to facilitate the exchange of ideas and skill sets, and provide additional tools for early-career researchers to excel in their fields. The goal of the network includes to

- (i) aid in the dissemination of information
- (ii) establish vital scientific networks
- (iii) Increase the visibility of ECRs and their work
- (iv) Improve writing and reviewing skills
- (v) Foster the development of ideas that can lead to future research collaborations and improved job prospects.

There are several ways to get involved in the network as a member of the steering committee, regional representative or working group liaisons. There are other opportunities to contribute to the network as well through participation in the activity clusters such as webinars, writing blogs, joining write club, creating science collaborations and many more. ECRs are encouraged to subscribe to the ECN mailing list and Create or update their PAGES People Database profile to become members.

PAGES ECN can be contacted on email pages.ecn@gmail.com and/or follow on social media platforms on twitter: @PAGE_ECN and Facebook: PAGES Early-Career Network.

<https://ustream.univie.ac.at/media/core.html?id=d8ebd321-122d-4aed-a0e2-62f73537b69a>



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A comparison of herbaceous plant species between abandoned bomas and termite mounds in the dry season at Mpala Research Centre (Laikipia County, Kenya)

by Aggrey Minya* (National Museums of Kenya)

African savannas often include abandoned structures traditionally used to keep livestock overnight, called corrals or bomas. These temporary features are used by pastoralists in savanna areas to protect their animals at night.

Bomas create sections with improved soil textures and abundant nutrients that result in the increased growth of highly palatable and unpalatable herbaceous plants. This is in turn a source of preferred nutrition by herbivores.

Termite mounds on the other hand, are structures engineered by termites which act as their home and as well as the home for other living organisms (vertebrates like lizards) and provide food hotspots (grasses) for livestock and wild herbivores. Understanding the role of bomas and termite mounds as drivers of ecosystem change is a major area of interest for ecologists as it provides insights into how they influence changes.

This research project, therefore, set out to study and compare the differences in the composition and abundance of herbaceous plants between bomas and termite mounds during the dry season.

I collected and analyzed vegetation data from 13 bomas, termite mounds and control fields. Results indicated that bomas had very few (n=7) species abundance as compared to termite mounds (n=23).

In terms of vegetation frequency, termite mounds had more species (n=142) than bomas (n=61) and the control fields had (n=160) species frequency.

The study therefore concluded that this may have resulted from overdependence by livestock and wild herbivores on the bomas more than termite mounds and control fields. This could indicate bomas as a human invention are playing a bigger role in reshaping the ecosystem during the dry season. The study recommends more studies to be done during the wet season to understand the differences in these dynamics.

<https://ustream.univie.ac.at/media/core.html?id=b4bdb623-621d-4fbc-b127-4726bef018a4>

Impact of nomadic pastoralism on modern landscapes and vegetation cover

by Husna Mashaka^{1*}, E. W. Wahome¹, B. N. Nyanchoga¹, R. N. Kinyanjui² & E. N. Ndiema³

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Phytoliths; plants' silica, formed as a result of the deposition of Silica in plant cells. They can either be deposited around cells or within cells, forming cell replicas or casts through the transpiration process. These silica cells are deposited in the soils when the plant dies and decays, and they can be preserved in the sediments for long periods of time, becoming important plant micro-fossils that can be studied in the reconstruction of vegetation history even after the actual vegetation is long gone.

Globally, it has been recorded that Holocene climates were highly variable. In East Turkana, climates scenarios included shifting from wetter climates during the Early Holocene (9ka-6ka) to drier climates during the Middle Holocene (6ka-4ka), with lake level dropping from 80m to 55m above the current (1976) lake level and drier climate during late Holocene (2ka) to present.

One of the main research objectives of the Koobi Fora Field School (KFFS) is to determine the impact of these climatic variabilities on vegetation cover and Human subsistence in and around the East Turkana region.

Here we present the results of modern phytolith data analyzed to visualize the accuracy of phytoliths in predicting the aboveground vegetation cover. Soil samples were collected from recently abandoned bomas and from different unoccupied habitats (riverine, grasslands, bushlands, scrublands) where modern vegetation was identified and quantified.

The vegetation was classified as woody, grasslands, or mixed, while sites were classified as either Boma or unoccupied. Modern soil samples were collected from these habitats/sites, and phytoliths were extracted, identified, and classified. Despite the limitation of research time and limited sample size, the results indicate that fossil phytoliths can accurately predict past vegetation cover, especially in classifying different habitats such as grasslands, wooded grasslands, and wooded vegetation.

<https://ustream.univie.ac.at/media/core.html?id=24ed3685-65c8-4ce5-b529-812386c24897>

Records of radioactive iodine-129 in Chinese sediments

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Deposition history of atmospheric ¹²⁹I covering natural and anthropogenic sources is far not understood in the surface earth environment due to lack of long deposition records.

Laminated sediment in lakes is an ideal archive for studying historical emission records of radioactive atmospheric pollutants from human nuclear activities, and also for the Anthropocene study.

Here, aiming to reconstruct the deposition history of long-lived radioactive ¹²⁹I, we analyzed the sediment cores from four Chinese lakes for ¹²⁹I records (Sihailongwan, Huguangyan, Gonghai, Mayinghai), and summarized another lake sediment (Chenghai), one peat core (Barkol) and two coastal sediments (Jiaozhou Bay and East China Sea) in China that were previously reported in our research group (Fan et al., 2016; Zhao et al., 2021, 2019).

The sediment was sampled, dated by radiometric method, and analyzed for the concentrations of stable ¹²⁷I and radioactive ¹²⁹I, and used to calculate the history of cosmogenic and anthropogenic ¹²⁹I deposition fluxes in the atmosphere over 170 years, and estimate the total deposition fluxes of anthropogenic ¹²⁹I in China.

The results show significant increases in ¹²⁹I concentrations and ¹²⁹I/¹²⁷I atomic ratios by three orders of magnitudes since the middle of 20th century, attributing to the artificial releases of nuclear activities. Compared to the sedimental ¹²⁹I records in low and mid-latitude regions, the ¹²⁹I/¹²⁷I atomic ratios in mid-high latitude lakes were significantly high at the same periods, even up to 2 orders of magnitude, indicating high deposition fluxes not only in pre-nuclear age but also during the whole period of human nuclear activity.

<https://ustream.univie.ac.at/media/core.html?id=c9db4840-d9e8-4ff9-9014-8bbf34a05ea7>

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Chair: Maria Luisa Tejada

Multi-time scale variations of black carbon, char, and soot in association with climate change and human activities

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The Anthropocene as a new potential geological epoch is still an informal term due to the absence of a stratigraphic definition presenting a signature distinct from Holocene epoch, thus, there is a need for stratigraphic marker that indicates human signals to formalize the term of Anthropocene.

Here we report the historical variations of black carbon (BC) to discuss the probability of using these as a marker for the stratigraphic definition of Anthropocene. BC produced by incomplete combustion of biomass and fossil fuels is archived in various sediments more than millions of years and thus can be used to reflect the environment change and industrialization.

Its subtypes including char (combustion residues) and soot (combustion condensates) have different pathways caused by different particle size. The smaller soot fraction is atmospherically widely distributed, while the larger char fraction tends to be deposited close to the emission source.

Consequently, soot has more liable indicting significance at a regional scale than char. In geological period with less anthropogenic impact, more char occurred in local smoldering fire associated with wet climate, yet high soot emits in regional flaming fires associated with dry climate.

Since industrialization, transition from biomass burning to fossil fuel combustion leads to more emission of soot, which has been showed in sediments through both global increase of soot concentration and radiocarbon isotope of that.

Therefore, high resolution soot sequence showing the transition from nature to human driven may provide an ideal stratotype profile.

Chair: Maria Luisa Tejada

The Anthropocene Hg pollution record from multi-lake sediment cores in NE China

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The recent substantial expansion of human activities in northeast (NE) China has resulted in increased emission of environmental pollutants. Longer-term records of such environmental pollutants provide a benchmark against which it is possible to evaluate the nature, extent and timing of anthropogenic environmental changes.

Based on measurements of mercury (Hg) concentrations and accumulation rates in 11 lake sediment cores from the Songnen Plain in NE China, we here present a reconstruction of the historical deposition of Hg as an indicator of the changing scale of human impact.

The results demonstrate an increasing trend of Hg concentration, concurrent with elevated anthropogenic emissions, beginning from the early 1900s, accelerating through the mid-1950s and slightly decreasing from the late 1990s onwards.

The increase in anthropogenic Hg coincides with the reform and opening up of China, which precipitated social and economic transformation, and rapid industrial and economic growth.

Measurements of the Hg enrichment factor in all the cores enables identification of the anthropogenic contribution to Hg accumulation. The geoaccumulation index indicates that the lakes are in general moderately polluted by Hg. The historical trend of Hg accumulation rate parallels the temporal progression of biomass burning and fossil fuel consumption in the region.

The findings elucidate the extent of anthropogenic pollution in the Anthropocene and underline the importance of identifying Hg sources to reduce emissions and guide the implementation of effective mitigation strategies.

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Chair: Maria Luisa Tejada

Warfare impact overtakes climate-controlled fires in the eastern Silk Roads since 2100 BP

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Fire has crucial effects on the earth system. Modern warfare activities played an important role in fire regimes, however, it remains unclear whether it has had an impact on fire history over long time scales.

Based on a high-resolution record of black carbon in alpine-lake (35.25°N, 106.30°E) sediment, we use variations in the fire history to explore the relationships between fire, fuel, climate, and human activity during the past 6000 years in the eastern Silk Roads.

The results show that fire activities were low in the middle Holocene but gradually increased in the late Holocene, which was closely related to the reduced moisture and expansion of herbaceous vegetation in the northwest China on the millennial time scale.

The intensity and amplitude of paleo-fire increased significantly in the past 2100 years, which was no longer synchronized with climate and vegetation changes, but had a significant positive correlation with the number of wars in different dynasties. Warfare between different political powers might have begun to overwhelm natural climatic variability as the main controlling factor for fires on the centennial time scale in the eastern Silk Roads.

Our study firstly reveals the impact of warfare activities related to dynastic change on fire regimes in Chinese history, providing a new perspective for understanding the impact of human activities on environment and Anthropocene.

Climate change, monsoon variability and anthropogenic controls on floods in Pakistan

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Summer is the major rainfall season in Pakistan that has remained the major cause of floods in the country's historical records. May and June are the hottest months of the year, and the monsoon rainfall occurs mostly in July and August in the country in which the northern and central parts receive more rainfall than the southern parts. During the 21st century, the frequency of extreme temperature events and floods has increased in the country in response to climate change.

The recent floods of August 2022 are the latest events of climate change in the country. The floods affected thirty-four (34) million people, destroyed 1.7 million homes, cost 1400 lives, and submerged 10% of the land area of the country. These floods are by no means a one-off occurrence but represent climate disasters that at one extreme occur in the form of heatwaves which in 2015 saw more than 65 000 people hospitalized with heat stroke, while flooding in 2010 claimed more than two thousand lives, affected approximately 20% land area of the country (160,000 km²). Precipitation records for this year (2022) indicate an extended drought period before the floods (February to May) where the country received extremely low rainfall and observed high average temperatures. The rainfall pattern indicates pre-monsoon rainfall during June with +68% above normal rainfall, mostly concentrated in the northern parts and the southern province of Sindh received -15% below normal rainfall during June.

The country received heavy rainfall during July and August (+180% and 243% above normal rainfall respectively) inducing heavy floods. During this period, the southern parts of the country received exceptionally high rainfall up to +580% in Baluchistan and 725% in Sindh in August. The floodwater coming as fluvial discharge from the northern parts of the country further worsened the situation in the already submerged southern parts.

The heavy monsoon rainfall was the triggering factor of the floods. However, the anthropogenically induced blockage of the natural drainage system substantially contributed to the destruction of property, livelihood and infrastructure, and human lives. In many parts of the country, people have constructed residential settlements, hotels, and agricultural farms in the main channels of the local rivers thereby causing blockage of the natural drainage network. Similarly, the recently constructed motorways and highways are repeatedly proving to be dam walls thereby flooding the nearby regions. Thus, climate change and anthropogenic interference with the Earth's System have posed new challenges that have put the survival of people living in the country at risk.

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Chair: Maria Luisa Tejada

Climate change and glacial lake outburst flood risk in north Pakistan

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Pakistan is home to more than seven-thousand glaciers, more than any other country in the world outside the polar regions. Glacial lake formation in high-altitude regions of the Himalayas, Karakorum, and Hindu Kush ranges of north Pakistan is a common process due to snow melting during summer. However, recent global warming and climate change have accelerated glacier melting thereby creating glacial lakes in the country.

More than thirty of these lakes have been identified as at risk of bursting and releasing millions of cubic meters of water and debris in just a few hours. This year, at least sixteen such Glacial Lake Outburst Floods (GLOF) linked to heat waves have occurred, compared with an average of five or six per year previously. Thus, GLOF poses threats to human lives, infrastructure, and agricultural lands in downstream areas and there is a need for a comprehensive GLOF risk assessment for proper planning, mitigation, and adaptation strategies.

The present study focused on the Shishper glacier ice-dammed lake in Hunza, north Pakistan using a methodological approach for risk assessment by GLOF simulation and downstream impact assessment.

Hydraulic softwares (HEC-RAS and ARCGIS) were used and the hydrological DEM was generated from ASTER DEM, while the land use data was acquired from National Agriculture Research Council (NARC). The inundation flood threat was modelled using low, medium, and high flood scenarios to create a flood by first digitizing the river centerline, banks, flow paths, cross-sections, and obstructions.

The study revealed that the Hassanabad bridge, power plants, and nearby agricultural land and houses were at the highest risk during any GLOF unpleasant event. All the high-risk points identified in the study were flooded and destroyed during the May 2022 GLOF disaster, however, the timely warning avoided the loss of human lives.

This modelling may help in the preliminary identification of potential high-risk areas, thereby allowing the local authorities to spread awareness among all the stakeholders on how to avoid any GLOF-related future disasters. Furthermore, it may also allow the local climate change and meteorology departments to issue timely warnings during such emergencies.

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Chair: Maria Luisa Tejada

Geoelectric Imaging of Groundwater Pollution: Groundwater resources in Indonesia's new capital city

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Indonesia plans to relocate its capital from Jakarta in Java to a new city named Nusantara in East Kalimantan on Borneo. Researchers estimate that six million people will move to the city to find work and take advantage of opportunities.

Population growth will strain resources like water and land. The public doesn't have access to all that water or abundant rainwater. Therefore, it is necessary to produce quite a lot of water of high quality so that it can be suitable for use by the surrounding community.

Most of the people of Manggar have drilled wells to meet their needs. However, the condition of the water in the drilled well is cloudy, smells, and does not comply with the standards for clean water quality in the regulation of the Minister of Health of the Republic of Indonesia, Number 492/MENKES/PER/IV/2010. This is a problem faced by the surrounding community.

The research location is Manggar Village, a densely populated area with a dominant red-yellow podzolic soil type as the topsoil layer. This research on groundwater potential is expected to be able to identify the presence of aquifer layers and estimate groundwater potential in the Manggar alluvial area using the geoelectric method of the Schlumberger configuration.

Based on the results of the cross-sectional study of layer one (1) at the measurement point of the first track, there are three types of layers, namely: soil in the form of loose material from alluvial deposits with a resistivity value of 108 Ωm . The second layer is assumed to be a sandy clay layer with a resistivity value of 7.23–26.6 Ωm as a compressed aquifer layer and has the potential to contain groundwater at a depth of 14.7–25.6 meters from the ground surface, although it is still in the low category. The third layer is assumed to be a layer of sand with a resistivity value of 121 Ωm which is a shallow aquifer layer found on Track 1.

Then, the results of the second track measurement point show that the first layer is soil in the form of loose material from alluvial deposits with a resistivity value of 228 Ωm . The second layer is assumed to be a sandy clay layer with a resistivity value of 5.87 - 13.1 Ωm . The third layer is assumed to be a layer of sand with a resistivity value of 129 Ωm which is a shallow aquifer layer found on track two. This is because the rock units in the study area are still in the form of unconsolidated material, still in the form of loose clay-sized material, so they can affect the quality of the well water in the area.

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by Catherine Russell & Lydia Olaka

Anthropogenic activities and how they influence water safety and our health

by Faith Mbithe Wambua* (University of Nairobi)

This is an ethnographic study on anthropogenic activities influencing water safety around the points of collection, transportation, and storage in Mwingi North Sub-County.

The study examined the effects of anthropogenic activities on water safety and the community-level mitigation strategies that address the effects of the activities on water safety. Integrated Behavior Model was used to assess the people's intentions on water safety and whether they have sufficient knowledge and skills that will help them act towards attaining water safety in their community.

Data were obtained, through in-depth interviews, unstructured observations, key informant interviews, and focus group discussions. Transcribed data were coded and analyzed thematically guided by the study objectives. The findings established that open defecation, collecting water from open water sources, poor livestock fecal disposal, stepping in, and dipping of jerricans into the water sources affect water safety at the point of collection. These practices affect water by changing its taste, odor, and color thus making it unfit for consumption. To mitigate against water contamination, the community reported boiling and use of water guard to treat the water, praying for the water, use of a stone called & "ivia ya ukuna kiw'u" to desilt the dirty water and buying of bottled water for visitors.

Polluted water affects community economic productivity as well as their health. The community members suffer from amoeba, diarrhea, typhoid and stomach aches especially immediately after the rainy season.

The study, therefore, recommends re-socialization of the community to embrace safe water access, transportation and storage. The community together with the government should reinforce ways that ensures change of behavior to most of the community members. Since water pollution doesn't occur in isolation, informal and formal levels of water governance need to integrate elements that minimize water pollution as part of addressing water insecurity in the community, this would mean holding water hygiene clinics as part of community engagement in safe and sustainable water consumption. Moreover, knowledge sharing and awareness creation at water resource user association level would inform more on water pollutants and how to efficiently mitigate the same at household level. A feasibility study on an affordable mobile technology system that tests water quality is highly recommended.

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by Catherine Russell & Lydia Olaka

Reconstructing palaeovegetation in Kilombe Caldera, Baringo County Kenya; Using plants microfossils in relation to the current vegetation composition and distribution

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This research explores ecosystem changes caused by environmental disturbances as a result of human activities and climate change variabilities.

The study is driven by a research gap linking an ongoing archaeological research covering Pleistocene period with environmental & land cover changes in late Holocene to present in Kilombe Caldera, Baringo County Kenya.

The main objectives of this study is, to reconstruct the past vegetation changes using plants microfossils (pollen, phytoliths & charcoal), to document all the modern vegetation and come up with plants species inventory within the caldera to investigate which species were there in the past and what is existing currently.

This will help to understand the role of human and climate change factors on the environment, land cover and the landscape hence recommend on measures for conservation and management purposes.

<https://ustream.univie.ac.at/media/core.html?id=e661a0fc-a290-4285-8da8-c52ed894a571>

by Catherine Russell & Lydia Olaka

The Lower Mississippi River and Delta Nature or Nurture

by Catherine Russell* (University of New Orleans, University of Leicester, Louisiana State University, Fulbright Association)

Through both engineering and climate change, humans have transformed the global water system. Rivers are now under stress through sediment starvation, water shortages, and human modifications, which in turn affect delta behaviour. Additionally, abundant plastic pollution and other anthropogenic litter affects ecosystems, which is transported to the ocean.

The Mississippi River would move laterally as it meanders across the floodplain, and avulse as and when a more efficient route to the ocean became possible. Humans have intervened in a way that distinctly impacts the cause and effect mechanisms of river processes, hence socio-hydrology becomes a necessary component of the discussion.

The Mississippi River attempted to avulse in 1950, which led to the installation of the Old River Control Structure, such that the delta would stay in its present position.

More recently, Neptune Pass has opened into Quarantine Bay, which is causing significant sedimentation in the main channel, therefore significant expenses in dredging to keep passage safe. As such, the new channel is planned to have its flow reduced to its pre-flood conditions in the coming year.

An Anthropocene River such as the Mississippi River and Delta system combines understandings from physical landscapes to safety, trade, and politics. Hence, there is a requirement for socio-hydrology and consequential discussion for where we divide human interaction on a landscape and nature.

<https://ustream.univie.ac.at/media/core.html?id=51728b71-e69a-462d-9492-1eec598cfb8a>

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Chairs: Caroline Jaraula & Ann E. Enova

Natural evolution and anthropic changes in Las Tablas de Daimiel National Park (Central Spain) from sedimentary, archaeological and historical records

by Alberto Celis* (University of Seville)

The study of the accumulated sediments in the wetland that is part of the Las Tablas de Daimiel National Park (Central Spain) was the starting point of my thesis defended in December of 2021. In 2013, I began to collaborate with the research team of the project "Palaeoclimatic and paleohydrological reconstruction of Alto Guadiana (Tablas de Daimiel)", directed by Dr. Rosa Mediavilla López, of the Geological and Mining Institute of Spain (IGME, CSIC). Amongst others, the main task was to work with archaeological and historiographic sources to correlate this information with that provided by the sedimentary record, and thus to try to reconstruct the evolution of the wetland in relation to the climate and its interactions with humans.

In order to understand these changes, it has been essential to study the evolution of agriculture throughout history since climate was the main determining factor until the 18th-century transition towards an agricultural activity controlled by human action, which led to the transformations in the wetland. These changes did not all have the same impact, and three phases can be established: Phase I or natural phase (Bronze Age-1750), Phase II or anthropization phase (1750-1950) and Phase III or artificialization phase (1950-present).

In the natural phase, no major changes have been recorded in the characteristics of the system, neither due to climatic changes, nor to human activity. It was in this phase when the first hydraulic infrastructures were built.

The anthropization phase was the consequence of the transition from a climate-driven to human-driven agriculture that led to the drainage and desiccation of the Las Tablas de Daimiel

wetland during the 1750s, altering the geochemical parameters of the system forever.

However, it was in the artificialization phase that the wetland became permanently dependent on human activity. The agricultural technical improvements that took place from the second half of the 20th century made possible an intensive irrigated agriculture that increased the anthropic impact on the system, drastically altering its ecological characteristics.

The artificialization phase could be equivalent to the stage that Steffen et al. (2007) describe as Great Acceleration or Stage 2 of the Anthropocene, and that the Anthropocene Working Group (AWG) has proposed as the beginning of the Anthropocene (Waters et al., 2018). In order to know how the transit from a natural stage to another one intervened by man occurred (from the Holocene to the Anthropocene), I have studied in depth the first desiccation of Las Tablas de Daimiel from 1750 which produced permanent changes of anthropic origin in the ecology of the wetland. It was the beginning of a pre-Anthropocene that would correspond to the stage that Steffen et al. (2007) called Stage 1 of the Anthropocene.

These results have been compared with others carried out so in the Iberian Peninsula as in other locations. Changes similar to this did not occur at the same time. However, trying to establish an initial moment, the Early Modern Age (16th-18th centuries) could be considered as the moment from which anthropic activity gradually overcame the climatic conditions that were imposed on agricultural production. This process led to the beginning of the transformation of the natural environment that accelerated from the middle of the 20th century.

Chairs: Caroline Jaraula & Ann E. Enova

Phases of Environmental Changes in coastal Boracay, Philippines, deduced from Sediment Deposits

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The tourism-dependent island of Boracay nearly breached ecological thresholds in 2012 (Limates et al., 2012) and reached over 2 million tourist arrivals in 2017. Beyond the carrying capacity of the island, anthropogenic activities infringe not just the coastal beaches but also the wetlands and lagoons.

This study aims to understand the biogeochemical processes that influence the coastal deposits deduced from a sediment core collected in September 2018 close to the outflow of the Dead Forest lagoon.

Major and trace metals from X-Ray Fluorescence analyses and bulk stable carbon and nitrogen isotope trends from Elemental Analyzer-Isotope Ratio Monitoring System indicate three distinct phases. The bottom core deposits (22 to 33 cm) have significant influences of terrestrial and mangrove signals with C/N ranging from 15.97 to 19.24, and relatively higher %Fe, %Mg, and Ti ppm. The transition to core top deposit yielded the highest magnetic susceptibility coinciding with the highest Ti and Al abundances. In contrast to the bottom section, a more intense terrigenous influence is more prominent during the transition phase compared to the terrigenous influence that may have been enhanced with higher trapping efficiency of mangrove roots that may have been more available during the earlier phase.

Core top deposits (0 to 6 cm) has chemical and isotopic signals close to sewage/bacterial range (11.95 to 14.36 C/N, low %Corg) reported in literature and relatively high Cu, Zn and Pb concentrations.

These preserved chemical and isotopic signals are consistent with the known changes and observed stressors in the vicinity. This study suggests ongoing anthropogenic influences in the coastal lagoon, particularly associated with anthropogenically-derived effluents. As observed last December 2019, the plausible sources of waste are from the residences, wastewater from the drainage pipes directly discharging into the sea, emissions from the transportation and wastes from the construction of establishments, roads, and pathways at or close to the mangrove park. With the environmental changes directly related to population, land-use, and residential and urban effluents, this serves as an example of the advanced/late Anthropocene record of land occupation.

Chairs: Caroline Jaraula & Ann E. Enova

Direct and indirect anthropogenic indicators in Laguna Lake, Philippines

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Laguna Lake is a shallow coastal lake east of Philippines' capital region, Metro Manila. The capital and its neighboring industrial provinces heavily rely on the lake for water supply and aquaculture. Because of this setting, Laguna Lake would be an excellent recorder of anthropogenic processes.

A sediment core was collected at the lake's western lobe, closest to the capital.

Bulk elemental concentration records for the last century were measured via X-ray Fluorescence. These records were then subjected to cluster analysis, which grouped into redox- and salinity-sensitive, productivity-associated, and anthropogenically-influenced elements. Ti, Al, and Fe are linked to terrigenous sources and since the mid-1960s increased beyond average baseline values at rates much more than the variability of semi decadal rainfall trends.

This could be due to increased terrestrial sedimentation due to increases in Metro Manila's residential, commercial, and industrial land use in the 1970-80s, and continuing expansion of the Metro Manila urban core in the mid-1980 to mid-1990s.

By late 1970s, the abundances reached maximum values. The enrichment pattern of Zn and Pb, relative to average terrigenous input, increased from consistently below-average until mid-1960s to twice for Zn in the 1980s and fourfold for Pb in the late 1990s, which attests to anthropogenic influence.

The organic matter record shows a slight increasing trend from the mid-1910s, reaches a maximum in around 1950, and then declines by more than half of the 1910-50s values towards the 1980s.

These simultaneous enrichments or depletions in terrigenous elements, organic carbon, and anthropogenically-influenced trace metals could constrain the beginning of anthropogenic impact on the lake.

Chairs: Caroline Jaraula & Ann E. Enova

Anthropogenic source of soil contamination: Environmental impacts of Indonesia's new capital city

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Indonesia recently announced that the nation's capital will be relocated from the coastal areas of the island of Java to the inner part of the island of Borneo. The new capital is envisioned to be a smart, green and sustainable city, providing a high quality of life for its projected 1.5 million inhabitants with ample greenspace, unlike overcrowded and sinking Jakarta.

However, the relocation of the national capital to East Borneo also requires a review of the soil conditions in the area, due to the large amount of coal mining deposits that could cause soil contamination.

In the present study an attempt has been made to measure the level of contamination of heavy metals in the regional soil of coal-mining affected areas along with the spatial distribution of contamination levels. The study also tried to assess the basin level potential ecological risk created by metal pollution using handheld XRF elemental analyses. Based on XRF data, the concentrations of heavy metals (ppm) in soil samples were found in the following ranges: Cd (434 to 721); Cr (65 to 216); Zn (12 to 123); Cu (16 to 60); Ni (0 to 41); Pb (0 to 18).

Based on the mean values, the metal concentrations decreased in the following order: Cd > Cr > Zn > Cu > Ni > Pb.

Cd had the highest degree of enrichment, belonging to moderate enrichment and significant enrichment. Cd-containing dust released into the atmosphere by human activities like coal combustion, waste incineration, and transportation may have been further enriched by natural sedimentation processes and rain. The results of the geo-accumulation index (Igeo) indicated that soils in the coal mine area were significantly polluted by Cd, which presented class 6 (extremely contaminated). Cr, Zn, Cu, Ni, and Pb were associated with Igeo classes 1 and 0 (practically uncontaminated).

Consequently, Cd is interpreted as the most serious heavy metal soil pollutant in Indonesia's new capital city, having a significant impact on crop quality and yield and the potential to contaminate livestock and inhabitants.

Chairs: Caroline Jaraula & Ann E. Enova

From Romans to the Anthropocene, from Carnuntum to Vienna: An Urban Anthropocene Field Lab

by Diana Hatzenbühler* Michael Weißl & Michael Wagreich (University of Vienna)

The Anthropocene, a debated potential new unit of the Geological Time Scale, describes the intensified anthropogenic influence on the environment and geological processes, and its traces in geological archives (see Head et al., 2021, Waters et al., 2014, Zalasiewicz et al., 2019 and references therein). Regional studies characterizing the growth of human impact, the Anthropocene transformation, are scarce, especially for urban environments.

In this project, we investigate the transformation of two Roman cities, Carnuntum and Vindobona, towards medieval settlements, and farther the urban development of the Vienna region by applying historical, sedimentological, geochemical methods, and remote sensing data.

Historical research targets the divergent evolution of the two former legionary camps, Carnuntum and Vindobona, and their urban environment over time, by applying (geo-)archaeological data and GIS-based models, based on the classification, distribution and growth of anthropogenic layers.

Despite their comparable location along the Danube River, the camps' proximity of less than 45km and similar military importance, solely Vindobona has been able to develop into a major city, by now known as Vienna, while other settlements in this region have ceased to exist. The Carnuntum-Vienna Anthropocene field lab offers the opportunity to integrate environmental systems modelling with an Anthropocene equation approach for the temporal and spatial growth of the anthropogenic layers.

Within petrographic facies, sedimentological and geochemical markers are applied to characterize the anthropogenic strata in the urban and peri-urban area of Vienna. The archive of fine-grained natural Danube deposits, i.e. erosional profiles and sediment cores, is analysed for trace metals, artificial radiogenic isotopes, and microplastics with the aim to identify and evaluate the proposed Anthropocene geological boundary around 1950 CE and a potential auxiliary Golden Spike in the area of Vienna.

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Chairs: Caroline Jaraula & Ann E. Enova

Case study on the approach of technogenic (artificial) ground from the surface structure and physiology of the landscape

by Érika Cristina Nesta Silva^{1*} & Caio Augusto Marques dos Santos²

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In recent decades, the number of works that mention human/social participation in surface natural processes, such as erosion and sedimentation, with consequent changes in relief, surface materials, etc., has increased, a context in which the approach to technogenic grounds arises.

The present work discusses the production of technogenic grounds, associated with the production of space and the socioeconomic vulnerability of the residents in the vicinity of the Córrego da Piscina (stream) in Rondonópolis-MT, in continuity with the studies previously carried out in its source area, and which is being developed at the postdoctoral level. Images from different periods of Google Earth Pro are used, in addition to the use of other tools, such as Street View, demonstrating that this software is very usable, especially for monitoring changes in aspects of the landscape. Fieldwork was also carried out to identify the most up-to-date aspects of the landscape.

From a theoretical point of view, the analyses were supported by the methodological levels of geomorphological studies: surface structure and physiology of the landscape (AB'SABER, 1969)

In addition, data from the 2010 IBGE (Brazilian Institute of Geography and Statistics) census was used to identify the different levels of socioeconomic vulnerability in the urban perimeter of the city.

The results showed, in general, that, over time, through direct interference in the course of the stream, for urbanization purposes, such as the frequent groundings in technogenic features (accelerated erosion), in an area of former alluvial plain, the surface structure of the land was altered, which led to changes in the physiology of the landscape that, in turn, have had an impact on the characteristics of the surface structure in a process of constant feedback. It is worth noting that these continuous observed interferences have been carried out in an area where a significant part of the population are socioeconomically vulnerable. It concludes with the statement that technogenic ground should be studied from the perspective of totality, that is, considering the natural physical aspects of landscapes and their modifications resulting from the process of production of space that has occurred in the last hundreds of years within the logic of the capitalist system.

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Chairs: Caroline Jaraula & Ann E. Enova

Epistemological and ethical reflections on the Anthropocene

by Emlyn Koster* (North Carolina, USA)

Since my geologic-and-public-minded participation in the first annual meeting for this 'Language of the Anthropocene' project and the forums of the Anthropocene Working Group (AWG) last May in Berlin and last September in Florence, I have reflected on the course of Anthropocene deliberations. Contexts have included this project's keyword choice of 'language' given UNESCO's global imprimatur of education, science and culture as well as dictionary definitions such as "a systematic means of communicating ideas" and "vocabulary and phraseology belonging to a department of knowledge". Also, this meeting's theme of 'Language—lessons in anthropogenic impact: a knowledge network of geological signals to unite and assess global evidence of the Anthropocene' implies that the a priori purpose of the Anthropocene remains unclear.

It has been two decades since Paul Crutzen proposed adding the Anthropocene to the Geologic Timescale, thirteen years since the AWG was established, nine years since seven issue-framed questions about a potential Anthropocene were raised by Stanley Finney in a *Special Publication of the Geological Society of London*, three years since the AWG opted for an exclusive focus on a mid-20th century epoch-defining GSSP based above all on atomic bomb test fallout, and almost a year since the alternative criterion of a cumulative event tied to human evolution was proposed by Philip Gibbard et al. in *Episodes* and the *Journal of Quaternary Science*. Indeed, the recent emergence of contrasting isochronous epoch and diachronous event rationales while the AWG vigorously presses ahead with prioritization of candidate GSSP sites with its epoch rationale as the sole basis for sequential decisions by the AWG, ISQS, ICS and IUGS risks dividing the geoscience

profession and confusing other invested disciplines and the news media. As I recently remarked in *Episodes*, the AWG's one-track approach thwarts consideration of a more profound role of the Anthropocene as the apt title for the Earth's needed renaissance toward more harmonious relations between nature and culture. Also pertinent is that this project's second meeting is in the global south which did not submit any candidate GSSP sites. With the National Museum of Kenya hosting this meeting, additional germane considerations are that Kenya joined Sweden in hosting the UN's Human Environment conferences in 1972 and 2022 and that Kenya became the first developing country to host the headquarters of a UN agency with the UN Environment Program in Nairobi as a 1972 legacy initiative. Surely a truly global view is an imperative.

These reflections oblige consideration of what are arguably unresolved core aspects of the Anthropocene definition. First, considerations of its epistemology include the seven issue-framed questions raised in 2014. Second, considerations of its ethos include its potential value as the premise of a transdisciplinary renaissance for this troubled world with the geological profession in a leading role. Third, what if the ISQS and other bodies to whom the AWG reports were to re-issue their mandates? Would they frame them differently? Would a singular focus on a mid-20th century GSSP be revisited? Would the concerns and suggestions of non-geological professions be differently considered? Might a case be made that the traditional GSSP-approach to the Geologic Time Scale diminished as the Earth System ceased to function in an entirely natural state? And should geology even be leading the charge for the Anthropocene or is it more appropriately considered as part of the Archeologic Timescale?

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Sampling, processing and dating of natural archives of the Anthropocene

by Barbara Fiałkiewicz-Kozieł*, Juliana Ivar do Sul* and Luyuan Zhang*

3 Pls of IGCP 732, Luyuan Zhang, Barbara Fiałkiewicz-Kozieł and Juliana Ivar do Sul, explained in this short course how to sample, process and date deposits which can be used as natural archives of the Anthropocene. A special focus was on marine, lake and peatland sediments.

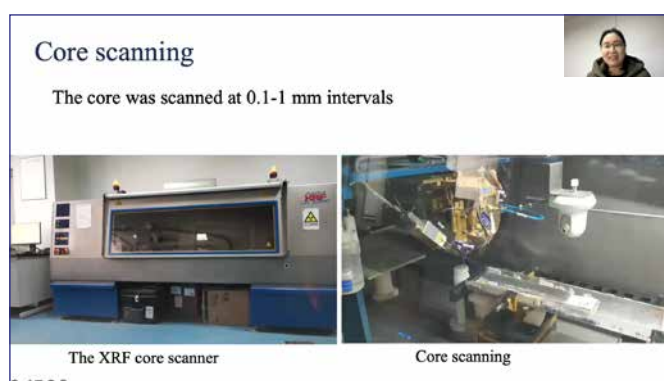
Based on their own cores and sections, examples of how to collect and process samples in the field and the lab were given. Also potential sites for a GSSP (Global Boundary Stratotype Section and Point) of the Anthropocene were included. Pictures and videos demonstrating a step-by-step approach were provided, before participants had the opportunity to ask questions and discuss further details.

Luyuan focussed on varve counting of lake sediments and explained sample preparation for radiometric dating.

Barbara talked about the importance of following a sampling protocol for peat cores to enable correct analysis and further correlation to peatlands across the world.

Juliana provided an example of sampling marine sediments and preparing them for microplastic analysis.

<https://ustream.univie.ac.at/media/core.html?id=e898de87-df5a-498a-8d56-97940a3e95c3>



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