

YES
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satellite mission
GRACE Follow-On

9–13 September 2019 | Berlin | Germany

5th International Young Earth Scientists
(YES) Congress

Book of Abstracts

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Opening Ceremony / Plenary Lectures

Tuesday, 10/Sep/2019: 10:00am–12:00pm

Session Chair: Thomas Rose

Location: Hall A

Welcome addresses

Opening and Welcome

by YES Chapter, GFZ & Partners

of Prof. Reinhard Hüttl, Meng Wang and Thomas Rose

Plenary Lecture: High-tech metals are key elements for future technologies – How are their global market situations and what are the challenges?

Volker Steinbach

Federal Institute for Geosciences and Natural Resources (BGR), Germany

To increase the sustainable development in many areas of our societies, new technologies, such as industry 4.0, e-mobility, technologies for renewable energy etc. are necessary. These technologies have an increasing demand on so-called high-tech metals – e.g. lithium, cobalt, germanium, gallium, tantalum, graphite, rare earth and indium. Therefore it is a) necessary to analyze the recent situations and trends in their global markets and b) to carry out research on primary mineral deposits and secondary deposits (recycling) containing these high-tech metals and c) to develop concepts for due diligence in their supply chains.

Plenary Lecture: Nunataryuk - Permafrost Thaw and the changing Arctic coast, science for socioeconomic adaptation

Hugues Lantuit

Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Germany

Permafrost coasts in the Arctic make up 34% of the world's coasts and represent a key interface for human-environmental interactions. These coasts provide essential ecosystem services, exhibit high biodiversity and productivity, and support indigenous lifestyles. At the same time, this coastal zone is a dynamic and vulnerable zone of expanding infrastructure investment and growing health concerns. Permafrost thaw, in combination with increasing sea level and changing sea-ice cover, expose the Arctic coastal and near shore areas to rapid changes. The release of previously frozen organic carbon and its transformation into greenhouse gases may push the global climate warming above the 1.5 °C targeted in the COP21 Paris Agreement. The pressing challenge is to quantify and project organic matter, sediment and contaminant fluxes from thawing coastal and subsea permafrost and to accurately assess the implications of permafrost thaw for the indigenous populations, the local communities and the local environment in the Arctic coastal areas. Nunataryuk is an EU Horizon 2020 funded collaborative project, with the main objective of determining the impacts of thawing land, coast and subsea permafrost on the global climate and on humans in the Arctic and of developing targeted and co-designed adaptation and mitigation strategies. In this presentation, we introduce the approach taken by the project to (1) develop a quantitative understanding of the fluxes and fates of organic matter released from thawing coastal and subsea permafrost; (2) assess what risks are posed by thawing coastal permafrost and pollution, to infrastructure, indigenous and local communities and people's health; and (3) use this understanding to estimate the long-term impacts of permafrost thaw on global climate and the economy.

Plenary Lecture

Wednesday, 11/Sep/2019: 1:30pm–2:30pm

Location: Hall A

Plenary Lecture: The voice of Earth scientists in the XXI century

Vitor Correia

Independent evaluator of mineral projects and a member of the Expert Group on Resource Management of UNECE, Belgium

The world around is changing faster than ever before. Population growth, climate change and new technologies are designing a new roadmap, full of crossroads, that will keep society and politics under stress in the years to come.

Because geology is weaved in so many aspects of modern life, many of us believe that geosciences will play an increasingly important role, contributing to tackle a wide range of serious problems, including adaptation to climate change, provision of fresh water, mitigation of natural disasters, control of soils erosion, provision of raw materials and provision of energy.

But the social-politic context is also changing, and the world is now populated with headlines, opinions and fake news that influence politics and shape people's reaction. In this context, it is vital that Earth scientists are recognised as an independent, unbiased, scientifically based voice.

This calls for an urgent repositioning of professional and academic Earth scientists, supported by appropriate standards on ethics, knowledge, experience and continuing professional development.

Plenary Lecture: Global Geochemical Baselines for Resource and Environmental Management

ALECOS DEMETRIADES

IUGS Commission on Global Geochemical Baselines, Greece

It is indeed unbelievable, we have reached the 21st century with humankind making great advances in technology and space research, but we do not yet have sufficient knowledge or geochemical data to be able to assess or predict with any accuracy the implications of human actions on the environment and the primary mineral resources of our home planet Earth. It is interesting to quote a two sentence statement from the 1992 Global Change Report: "The availability of data and how they will be managed are two critical facets of future global change research. Global science is data-limited, and therefore new efforts must be engaged which foster the development and validation of global data sets." Twenty-seven years later we still do not have this very valuable geochemical data set. To fill this gap the mandate of the International Union of Geological Sciences is the establishment of a global network of geochemical reference samples, using a standardised method of sample collection and preparation, and laboratory analysis. In order to begin systematic international geochemical mapping, it is necessary to establish a primary global geochemical reference network, analogous to a geodetic grid. Wide-spaced sampling is required over the entire land surface, including regions already surveyed and regions where there is low probability of any geochemical mapping being carried out in the near future. The samples collected will serve as analytical reference materials, so strict procedures must be followed, and adequate quantities obtained and retained for future use. The primary reference network, covering the terrestrial part of the Earth is based on 7356 grid cells of 160x160 km. A five or eight random sampling design is recommended within each 160x160 km grid cell. Europe carried out the first multi-sampling media continental-scale survey for the establishment of the European geochemical reference network. The project is known as the FOREGS Geochemical Atlas of Europe. It covered 26 European countries and an area of about 4.25 million km². The five random sampling design was used, as this is more cost- and time-effective. Each random point within the 160x160 km grid cell was referred to the nearest second order catchment basin of <100 km² in area, and from which samples of active stream sediment, stream water and residual soil (top and bottom) were collected. From the adjoining large third order catchment basin of 1000 to 6000 km² in area a floodplain sediment sample was collected. In total, 799

stream sediment, 807 stream water, 845 residual topsoil, 788 residual subsoil, and 743 floodplain sediment samples were collected; the average density of each sampling medium is approximately 1 sample/4700 km². All solid samples were prepared at the same laboratory, and analysed for the same suite of determinands at the same laboratory using a strict quality control scheme. The resulting geochemical maps displayed the variable geochemical background variation of each determinand, and the geochemical baseline at the end of the twentieth century was established for Europe. The results apart of their use for environmental purposes, the continental-scale patterns revealed anomalous or elevated element concentrations in the vicinity of most of the known metallogenic provinces. Some anomalous element concentrations warrant follow-up investigation, and this is where the global geochemical baseline project is linked to the IUGS initiative Resourcing Future Generations. Its long-term goal is to ensure the supply of mineral, energy and water resources for the global society for the present and future generations of humankind.

Plenary Lecture

Thursday, 12/Sep/2019: 10:45am–11:15pm

Location: Hall A

Plenary Lecture: The Great Melting: How Small Living Things Affect Global Processes

Liane Benning

German Research Centre for Geosciences - GFZ, Germany

The melting of snow and ice in polar regions and the associated sea level rise are controlled by changes in albedo. On the Greenland Ice Sheet (GrIS) such changes are primarily a consequence of increased delivery of light absorbing particulates that include black carbon (soot), mineral dust and as we have recently shown also pigmented snow and ice algae. I will discuss how close interactions between microbes, soot and minerals in highly dynamic snow-ice transition zones play the crucial role in reducing albedo and enhancing melting. As climate warms, the biologically driven processes will increasingly contribute to the darkening of the GrIS, and further accelerate melting, yet these effects are currently not included in predictive global numerical models, and we are working at rectifying this so as to better predict how climate driven enhanced melting affects global sea level changes.

1.1. How to construct and destruct a mountain range?

Wednesday, 11/Sep/2019: 5:00pm–7:00pm

Poster Session & Social

Location: Foyer

Poster: Deciphering the mantle contribution on surface uplift in the Anti-Atlas and Western Meseta area (Morocco)

Romano Clementucci¹, Paolo Ballato¹, Lionel Siame², Ahmed Yaaqoub³, Essaifi Abderrahim³, Claudio Faccenna¹

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The high topography of the Atlas-Meseta system (Morocco) represents a combination of localized crustal shortening and thickening processes induced by plate convergence and regional dynamic uplift associated with the flow of the asthenospheric mantle. Although the magnitude and timing of large-scale dynamic uplift is poorly constrained, the occurrence of uplifted shallow-water marine deposits in the Middle Atlas Mountains and in the western Meseta indicates that surface uplift must have started after the Late Miocene (Messinian) at rates of 0.1 to 0.2 mm yr⁻¹. This event is still recorded by transient channel profiles and the relief distribution in the catchments of the Atlas-Meseta system.

In order to investigate the regional spatio-temporal distribution and the rates of dynamic surface uplift we have selected key areas in the Anti-Atlas Mountains and the Western Moroccan Meseta where Cenozoic crustal shortening and thickening processes are virtually absent. This approach offers the possibility to isolate and estimate the dynamic component of uplift from present-day topography. In particular, we have combined geomorphic analysis of stream profiles with in situ-produced cosmogenic concentrations (¹⁰Be) in river sediments and bedrock surfaces corresponding to relict landscape upstream of knickpoints. Our catchment-mean erosion rates allow us to quantitatively constrain the landscape evolution and hence to unravel the contribution of regional surface uplift on mountain building processes in Morocco during the Plio-Quaternary.

Poster: Deformation And Structural Evolution Of Subathu Section In Lesser Himalayan Zone

SHIVAM SHIVAM¹, MAHESH THAKUR¹, MOHIT KUMAR PUNIYA², GURWINDER SINGH ABHAYPAL¹

¹Centre of Advanced Study in Geology, Panjab University, Chandigarh, India; ²National Geotechnical Facility, Survey Of India

The Himalayas which are the result of ongoing orogeny between the collision of two continental tectonic plates. This ongoing collision has formed complex structures and fault systems in this 2400 km long mountain range. The study is confined to the deformation history of the Subathu formation in Lesser Himalayan Zone at the Panchkula-Morni transect. The area reveals the deformation pattern of fossiliferous Subathu Formation of Eocene age i.e; known as potential source of hydrocarbon. In our study area, we discovered beds of volcanic ash indicating significant volcanic activity during Eocene time.

In this area, two domains of deformation are identified one is brittle another one is ductile. The ductile deformation can be divided into 3-episodes of complex deformation i.e; pre-Himalayan as D1, syn-himalayan as D2 and D3 syn or post Himalayan emplacement deformation. The ductile –brittle deformation known as D4 intersect all ductile deformation in the area. The ductile–brittle deformation intersect all ductile deformation. All the deformation is characterised by different type of folds in the area. These are the result of transverse faulting in the area near Morni Hills which creates extension between Main Boundary Thrust (**MBT**) at North and **Nahan Thrust** at the South. At shallow depth, the rocks of the area underwent ductile-brittle structure after Himalayan formation.

As these complex geometries of Himalayas need three dimensional modelling for better understanding of the deformation in Himalayan belt.

Poster: Seismicity and Quaternary Deformation in the Lerma Valley, NW Argentina.

Emilio Jose Marcelo Criado-Sutti^{1,2}, Martin Zeckra¹, Frank Krüger¹, Carolina Montero-López², Manfred Strecker¹, German Aranda-Viana^{1,2}, Fernando Hongn¹

¹Universität Potsdam, Germany.; ²IBIGEO-CONICET - Universidad Nacional de Salta, Argentina

The Lerma Valley is the easternmost intermontane basin of the southern Cordillera Oriental in the Central Andes. The Cordillera Oriental is tectonically driven by thick-skinned deformation with thrusts faults rooted at the Neoproterozoic-Cambrian basement and exhuming at the surface in the core of high elevation mountain ranges; besides reactivated normal faults formed during the Cretaceous Rift. It is limited to the West by the Altiplano-Puna plateau and to the East by the Sierras Subandinas and the Santa Bárbara system. The whole mountain range system defines a tectono-structural province who exhibits double vergence.

Ongoing mountain uplift results in seismic activity, like historical (e.g. 1930 M7, La Poma) and recent (2010 MW 6.3) destructive earthquakes. The latter occurred at the central-western part of the Lerma Valley and left one dead.

To unveil hidden active structures a complete and detailed investigation of the crustal seismicity of the valley is carried out using continuous data from a temporary seismological network (LEVARIS), with twelve 3-component seismometers. The overall operation period of this network covered 13 months. The event localization and magnitude estimation is performed using HYPOSAT (2016d). Further, scattering and amplification phenomena (caused by the basin fill) will be studied using 2.5D C-based programs, starting with synthetic seismograms construction. The aim of the work is to correlate microseismic events clustering with the active structures within or near the valley which are leading to recent deformation.

1.2.-1 Carbonates under high Pressure and Temperatures: CarboPaT

Thursday, 12/Sep/2019: 12:45pm–1:45pm

Session Chair: Melanie Jutta Sieber

Location: Hall C

The missing source of hydrocarbon emissions to the atmosphere

Daniil Aleksandrovich Kudriavtcev

Royal institute of technology, Sweden

Nowadays, the exponential growth of hydrocarbon emissions to the atmosphere is a rising problem of society, politics and science. The focus on the role of CO₂ emissions left in shade the problem of hydrocarbons, which have their own strong impact on the Earth. Emissions of hydrocarbons, mainly methane and its closest homologues (ethane, propane and butanes) lead to a complex series of chemical, physical or physicochemical transformations leading to various problems and natural disasters. If with the role of CO₂ emissions and its sources we have a more or less clear understanding, the sources of hydrocarbons still remain questionable due to the attribution mainly to human activity. However, complex studies of Etiope and his group showed that there is a geological source of hydrocarbons in the atmosphere, which, in the case of methane, was recently appraised, while in the case of ethane, propane and butanes are always neglected. In this study, we modelled the synthesis of hydrocarbons from carbonates with the help of high-pressure techniques under the thermobaric conditions of Earth's mantle and proposed the source of various hydrocarbon mixtures which could be generated in the deep Earth's interior and then transported to the surface through the deep faults and cracks.

Elasticity and structure evolution of carbonates at upper mantle conditions

Lea Pennacchioni

GFZ, Germany

In this PhD work the attention will be focused on the carbon reservoirs in the Earth's mantle.

A lot is known about the carbon cycle on the surface of the Earth but little is known about the Carbon in the Earth's deep interior. In particular, the aim of my PhD is the study of the elastic properties of the most abundant carbon-bearing minerals, the carbonates.

The focus of my PhD work is on the systematic characterization of the elastic properties of carbonates as a function of their structure and chemical composition, which is essential in order to be able to identify their presence and distribution in the lithosphere and upper mantle. In particular the study will be performed on the main carbonates such as calcite, aragonite, magnesite, dolomite, siderite and ankerite.

The structure and composition of the samples will be studied by means of Electron Micro Probe Analysis (EMPA) and single crystal diffraction.

Experimental studies by means of Brillouin spectroscopy and ab-initio methods will be used to measure the elastic tensor of the carbonates of interest. The experiments will be performed at both ambient conditions, high pressures up to 18 GPa and high pressure, high temperature conditions (up to 10 GPa and 800 K).

Reaction and elemental redistribution processes between magnesite and mantle phases at transition zone to lower mantle conditions.

Lélia Libon¹, Max Wilke², Karen Appel³

¹Universität Potsdam, Germany; ²Universität Potsdam, Germany; ³European XFEL, Hamburg, Germany

Carbonate inclusions in natural diamonds from lower mantle evidence the existence of carbonates in the mantle (e.g. Brenker et al. 2007). Additionally, these carbonate bearing inclusions show high REE enrichment and thus, raise the question on the role of carbonates as a possible trace-element carrier in the Earth's Mantle. Stability of carbonates in presence of mantle silicates at deep mantle conditions remains unclear. Similarly, the distribution processes of trace-elements between carbonates and silicates mantle minerals at

these depths are not well understood. Experimental studies support that pure magnesite (MgCO_3) in absence of other minerals, is stable at P,T-conditions corresponding to the lowermost mantle conditions ($>110\text{GPa}$). Reaction between magnesite and silica may form bridgmanite+ CO_2 . By increasing P-T, CO_2 breaks down to diamond and oxygen under geotherm condition in diamond anvil cell experiments and could indicate that magnesite is related to diamond formation in lower mantle. To better constrain the magnesite's stability in the deep Earth, reactions have to be studied in a chemical system that is closer to the natural one.

Therefore, in-situ experiments will be performed with laser-heated diamond anvil cell to investigate the reaction between magnesite and silicate mantle composition. Two silicate glasses will be investigated, enstatite-ferrosilite and hablobasalt composition, respectively, at conditions relevant to the upper lower mantle (20–30GPa and 800-2000°C). Later, same reactions will be investigated with Sr/La/Eu-doped materials to show the trace-element distribution between silicate phases and magnesite.

Brenker, et al (2007). Carbonates from the lower part of transition zone or even the lower mantle. *EPSL*, 260(1-2),1-9.

High pressure, high temperature phase stabilities of iron-poor dolomite and a new structure of dolomite V

Jannes Binck¹, Stella Chariton², Michal Stekiel¹, Lkhamsuren Bayarjargal¹, Wolfgang Morgenroth¹, Leonid Dubrovinsky², Björn Winkler¹

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During the subduction of oceanic crust significant amounts of carbon bearing sediments may be transported into the Earth's mantle [1]. Dolomite, $\text{CaMg}(\text{CO}_3)_2$, is thought to constitute up to 50 % of the world's surface carbonate reservoirs [2] and diamond inclusions show evidence for the presence of dolomite in the mantle [3]. Further, experimental studies have provided indication for the existence of high pressure high temperature polymorphs of dolomite [4,5].

Here, we have studied the phase stability of dolomite at high pressures and temperatures, employing a combination of Raman-spectroscopy and synchrotron single-crystal X-ray diffraction using laser-heated diamond anvil cells. We observed the formation of a new dolomite polymorph at 50 GPa and after annealing at 2300 K, which persisted upon pressure release to 12 GPa. A preliminary data analysis indicated that this compound has the structure of a polymorph recently predicted by DFT based calculations [6]. Since this new structure is stable at pressure and temperature conditions found along the Earth's geotherm, we conclude that significant amounts of the phase may be present in the mantle.

Financial support by the DFG (FOR2125/CarboPaT, BA4020 and WI1232) is gratefully acknowledged.

[1] Litasov and Ohtani, *Phys. Earth Planet. Interiors* 177, 46 (2009).

[2] Zenger et al., *SEPM Spec. Publ.* 28, (1980).

[3] Brenker et al., *Earth Planet. Sci. Lett.* 260, 1 (2007).

[4] Mao et al., *Geophys. Res. Lett.* 38 (2011).

[5] Merlini et al., *Am. Min. Lett.* 102, 1763 (2017).

[6] Solomatova and Asimow, *Am. Min.* 102, 210 (2017).

1.2.-2 Carbonates under high Pressure and Temperatures: CarboPaT

Thursday, 12/Sep/2019: 2:15pm–3:15pm

Session Chair: Melanie Jutta Sieber

Location: Hall C

Experimental modeling of the CaCO₃–peridotite–Fe system and its role in the formation of Ca-rich inclusions in diamonds

Naira Martirosyan^{1,2}, Ivan Podborodnikov²

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Carbonates and carbonatite melts are often found as syngeneic inclusions in diamonds [1]. In the same time, mantle redox conditions are too reduced to favor stability of the oxidized forms of carbon. Below ~250 km mantle rocks may contain metallic Fe or Fe-Ni alloy [2]. Under such conditions, carbonates and carbonatite melts will react with Fe to form diamonds [3].

In the present work, we studied CaCO₃-olivine-Fe and CaCO₃-peridotite-Fe systems, which allow to model phase relations in the carbonate-silicate system in the presence of Fe. Experiments were conducted at 6-8 GPa and 1100-1300°C using multi-anvil apparatus. Samples were analyzed by EDS and Raman-spectroscopy. Formation of merwinite (Mw), monticellite (Mtc), ferropericlase (Fp), graphite (Gr), carbide (Fe₇C₃) and silicate-bearing carbonate-oxide melt (CL) was observed. Crystallization of Fe₇C₃ and Gr occurs due to the carbonate–Fe redox reaction.

The present data show that at the upper mantle conditions formation of Mw and Mtc requires specific Ca-rich and Mg- and Si-depleted environments, and can indicate the CaCO₃ metasomatic activity in the ultramafic assemblages. A discovery of merwinite inclusions coexisting with Ca-carbonate and olivine in natural diamonds from Juina, Brazil [1] confirms our experimental evidence.

This work was supported by the Russian Foundation of Basic Research projects no 18-35-00104

[1] Zedgenizov, D.A., et al., 2014. Am. Min., 99: 547-550.

[2] Frost, D.J., McCammon, C.A., 2008. Ann. Rev. of Earth and Planetary Sciences 36, 389-420.

[3] Palyanov, Y.N. et al., 2013. PNAS, 110: 20408-20413.

Probing redox conditions in diamond anvil cell experiments

Serena Dominijanni, Catherine A. McCammon, Leonid Dubrovinsky, Daniel J. Frost, Nobuyoshi Miyajima

Bayerisches Geoinstitut, Germany

Redox conditions (i.e., oxygen fugacity) in Earth's interior affect many petrological processes as well as the stability of mineral phases. Oxygen fugacity is challenging to measure in high-pressure experiments, so development of a metal alloy sensor for large volume apparatus experiments has been a breakthrough. But what if this approach could be transferred to diamond anvil cell (DAC) experiments? Monitoring redox conditions during DAC experiments can, for example, reconcile contradictory results that have been observed in studies of carbonate stability at lower mantle conditions.

We performed DAC experiments using a mixture of synthetic ferropericlase and pure Ir powder, with the main goal to crystallize an Fe-Ir alloy to use as a sensor for oxygen fugacity. Pressure was applied by mechanically tightening DAC screws and temperature was applied using a double-sided laser heating system. At the European Synchrotron Radiation Facility (Grenoble, France) we used X-ray diffraction and Mössbauer spectroscopy to measure the compressibility and iron oxidation state, respectively, at high pressure. After recovering the sample, we used state-of-the-art microanalysis methods to determine the chemical composition. Using these data combined with a thermodynamic model, we made the first calculations of oxygen fugacity in a DAC using a metal alloy sensor. Our results show that redox conditions are quite reducing and close to the iron-wüstite buffer.

Carbon's role in crystal chemistry of the Earth lower mantle minerals

Luliia Koemets

Bayerisches Geoinstitut, University of Bayreuth, Bayreuth, Germany

Global carbon cycle has a great impact on the climate changes, being responsible for example in the past for NeoProterozoic “snowball” Earth and Cretaceous warm period. While quantity of carbon on our planet is still uncertain, there is general consensus that deep Earth is the main reservoir of carbon-bearing compounds. The lower mantle mainly consists of high-pressure phases silicates and oxides, making these compounds important candidates for studies possible reactions with carbon-bearing materials, or hosts for dissolved carbon.

Experimental investigation of possible reactions between carbon-bearing phases and deep mantle silicates and oxides requires accurate knowledge of high-pressure high-temperature behavior of all these phases. A series of recent studies showed that been chemically quite simple, under extreme conditions iron oxides could appear in a wide variety of crystal structures (Bykova et al., 2016, Nat. Com.) and iron carbonate could form previously unknown tetrarbonates (Cerantola et al. 2017, Nat. Com.). We investigate the behavior of geophysically

important materials (with a focus on crystal chemistry of dense silicates) at pressures and temperatures relevant for Earth lower mantle. Our results indicate that interplay between ferrous and ferric iron, oxygen, and carbon define geochemistry of last one.

A portable setup to establish extreme conditions for the study of tetrarbonates

Christian Albers¹, Georg Spiekermann², Robin Sakrowski¹, Christian Sternemann¹, Metin Tolan¹, Max Wilke²

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Iron-bearing carbonates are candidates for carbon storage in the deep Earth, therefore their physical properties and chemistry at high pressure and high temperature are in focus of recent research [1, 2].

We present a setup to establish the conditions in the lower mantle (100 GPa, 3000 K). The required pressure is accomplished by diamond anvil cells [3], in which the sample is heated double-sided by a Nd:YAG-Laser. We use this setup to heat and pressurize FeCO₃ and (Mg,Fe)CO₃ samples at core-mantle boundary conditions. The temperature-quenched samples are characterized at pressure using X-ray diffraction and optical Raman spectroscopy. Via combined X-ray emission and X-ray Raman spectroscopy [4] the electronic structure of the synthesized compounds can be analyzed. We present first results and discuss the capabilities of this setup for in-situ x-ray spectroscopic studies.

[1] V. Cerantola et al., Nature. Communications. 8, 15960 (2017)

[2] M. Merlini et al., American Mineralogist, 100, 2001, (2015)

[3] I. Kantor et al., Review of Scientific Instruments 83, 125102 (2012)

[4] C. Weis et al., Journal of Analytical Atomic Spectroscopy 34, 384 (2019)

1.3.-1 Palaeoclimate reconstruction using aquatic high-resolution archives

Thursday, 12/Sep/2019: 12:45pm–1:45pm

Session Chair: Vanessa Skiba

Session Chair: Christoph Johannes Gey

Location: Hall B

Ostracods from the Upper Cretaceous Lameta Formation, Central India: Palaeoenvironmental implications

Manpinder Kaur¹, Sachin Kania¹, Ashu Khosla¹, Omkar Verma²

¹Panjab University, India; ²Indira Gandhi National Open University, New Delhi

Jabalpur outcrop of the Upper Cretaceous Lameta Formation, (Madhya Pradesh) Central India, is a classic locality as it has yielded numerous biotic remains, belonging to a variety of environments. As a result, this outcrop received a considerable attention from many workers across the globe. Several sections like Chui Hill, Chhota Simla Hill and Bara Simla Hill section in Jabalpur are ostracod bearing localities. The palaeoenvironment of the Lameta Formation of Jabalpur is a topic of hot debate as it is variously interpreted, from marine, fluvial to lacustrine. Therefore, a re-study of the Jabalpur outcrop of the Lameta Formation is warranted in order to know its actual environment of deposition. Lithologically, the outcrop consists of basal green sandstone, overlain by lower limestone, mottled nodular bed, upper limestone and upper sandstone and capped by stupendous lava flows of the Deccan Traps. The systematic rock samplings were carried out in this area and rock samples were collected from various sections in field for their recovery of microfossils particularly ostracods. We used petrol and acetic acid to process the samples collected from the field at laboratory. After wet and dry sorting, ostracods belonging to various genus and species have been recovered from macerated residue. The lithounits such as siltstone, variegated shale and green marl intercalated with lower limestone are the main ostracod-yielding units. The current study of ostracod taxa like *Atlanticypris* sp.; *Mongolianella* sp.; *Cyclocypris* sp. and *Candona* sp. indicates the Lameta rocks of Jabalpur would have been deposited under fluvial-lacustrine environmental conditions.

Hydrological and ecological variations in Lower Himalayas during late MIS 3

Abdur Rahman, Sanjeev Kumar

Physical Research laboratory, India

It is reasonably well known that the Indian summer monsoon (ISM) was relatively intense during late MIS 3 with anomalous extreme events, which were directly or indirectly connected to global changes. During the present study, an attempt was made to understand the ecological and hydrological variations during late MIS 3 by analyzing total organic carbon (TOC) and nitrogen (TN) content along with their isotopic compositions ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) in a sedimentary lake succession (Pipalkoti) from Lower Himalayas. Changes in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of organic matter reflect changes in lake processes, productivity, vegetation type, and runoff condition in the catchment area. The data obtained during the present study suggested the possibility of gradual decline in intensity of ISM and lake level from 45 to 40 kyr as documented by increasing $\delta^{13}\text{C}$ and TN percentage along with decreasing TOC percentage and TOC/TN ratios. Increase in TOC/TN ratios with decrease in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ suggested warm and humid climate (intense ISM) and increase in lake level from 40 to 30 kyr. High TOC/TN ratios and low $\delta^{13}\text{C}$ values suggested relatively high contribution of land-derived organic matter in the lake. From 45 to 32 kyr, there are concurrent abnormal peaks in the data, which have been observed as relatively warm events that may be correlated to globally reported warm events.

Arid Central Asian Holocene paleo-environmental implications of a varved sedimentary record from Lake Chatyr Kol (Kyrgyz Republic)

Julia Kalanke¹, Jens Mingram¹, Anja Schwarz², Birgit Plessen¹, Georg Schettler¹, Stefan Lauterbach³, Achim Brauer¹

¹GFZ German Research Centre for Geosciences, Section 'Climate Dynamics and Landscape Evolution', Potsdam, Germany; ²Technische Universität Braunschweig, Institute of Geosystems and Bioindication, Braunschweig, Germany; ³University of Kiel, Leibniz Laboratory for Radiometric Dating and Stable Isotope Research, Kiel, Germany

High resolution records enable to assess consequences of changing climate factors on a freshwater ecosystem and its catchment through time. The investigations of a varved sediment record retrieved from the high mountainous Lake Chatyr Kol (3530m a.s.l. in the Tian Shan/Kyrgyzstan) enables detailed insights into the Holocene climate development in arid Central Asia. Climate conditions are controlled by the position and strength of the Westerlies, the Siberian High and possibly the Indian Monsoon. The age model was established using γ -spectrometry of ¹³⁷Cs, ²¹⁰Pb and ²⁴¹Am in combination with varve counting and yields a basal age of 11500 ± 478 varve yr BP. Microfacies analysis revealed variations between clastic, mixed clastic-carbonate and clastic-organic varves. Varying varve contents and thicknesses indicate changes in the amount of summer or winter/spring precipitation. Distinct decadal- centennial oscillation in all examined proxies between 7900-4000 cal a BP are likely caused by cyclic erosion from alluvial fans, which occur around the lake basin. C-14 dating of paleo-terraces and changes in the diatom assemblages demonstrate the influence of lake level variations. Paleo-environmental conditions shift at ~10.700, 7900, 4000, 2350, 690 and 160 cal a BP and are likely linked to prominent climate changes like the 8.2ka cold interval, the occurrence of a mid-Holocene central Asian dry phase and the onset of the Little Ice Age. A comparison with other regional archives suggests a dominance of westerly influence for the Holocene.

This is a contribution to the BMBF-funded project CAHOL.

Role of global teleconnections and moisture sources in triggering extreme events in Indian Summer Monsoon realm: comparing a modern and 2K perspective

Ankit Ankit, Anoop Ambili

Indian Institute of Science Education and Research Mohali, India

We aim to develop a comprehensive picture of late Holocene climate variability over the North-Eastern India to address the existing large spatial gaps in paleoclimate data coverage in Indian subcontinent. This region receives precipitation only from the Indian Summer Monsoon (ISM) and lies in the region sensitive to the impact of various teleconnections (e.g., El-Niño, North Atlantic oscillations and Indian Ocean Dipole). A multi-proxy approach involving elemental concentration, isotopic geochemistry ($\delta^{13}\text{C}_{\text{org}}$, $\delta^{15}\text{N}$), pollen as well as biomarker (*n*-alkane) investigations have been performed on short sediment cores (ca. 1.0 m long) retrieved from Shilloi Lake, Nagaland, NE India (25° 35' 44" N, 94° 47' 33" E) to decipher climate vis-à-vis vegetation dynamics in the region.

The chronology of the core sediment is based on the eight ¹⁴C dates derived from bulk organics, charcoal and organic fragments spanning over 2000 cal yr BP. The $\delta^{13}\text{C}_{\text{org}}$ values from the core sediments ranges from -34 ‰ to -23 ‰ with a sharp excursion of 8‰ observed during 1000 cal yr BP. The grain size parameters (D[4,3]- De Brouckere Mean Diameter) also demonstrate enhanced ISM precipitation from 1000 cal yr BP. Furthermore, pollen and *n*-alkanes indices also provide evidences of vegetational shift corresponding to the changes in the rainfall variability. The present work will provide an improved picture of the ISM variability and helps to identify the possible teleconnections responsible for the changes in regional paleoclimate during the late Holocene.

1.3.-2 Palaeoclimate reconstruction using aquatic high-resolution archives

Thursday, 12/Sep/2019: 2:15pm–3:15pm

Session Chair: Vanessa Skiba

Session Chair: Christoph Johannes Gey

Location: Hall B

Elemental ratios in *Acesta excavata*. A potential new tool for paleoenvironmental reconstructions in intermediate water depths.

Nicolai Schleinkofer¹, Jacek Raddatz¹, Silke Voigt¹, Max Wisshak², Axel Gerdes¹, Jens Fiebig¹, Sascha Flögel³, Sebastian Streng¹, Alexander Wachholz¹

¹Goethe University Frankfurt, Institute of Geoscience, Germany; ²Senckenberg am Meer, Marine Research Department, Germany; ³GEOMAR Helmholtz Zentrum für Ozeanforschung Kiel, Germany

Cold-water coral reef communities provide a valuable source of proxy material for intermediate water-depths. Unfortunately, strong vital effects and difficult growth patterns make environmental reconstructions on cold-water corals, like *Lophelia pertusa*, rather difficult. Organisms that inhabit the same habitat, such as the bivalve *Acesta excavata* could provide a proxy-source which is less affected by vital effects and exhibits easier growth patterns.

Here we present LA-ICP-MS elemental ratio measurements on *A. excavata* from two Norwegian cold-water coral reefs (Sula & Nordleksa). Environmental parameters for proxy calibration are provided by three landers that were deployed in close proximity to the observed reefs over the period of 13 month.

Our results reveal a significant correlation between Mg/Ca ratio and temperature in the high-Mg calcite of *A. excavata* with a very high sensitivity that has not been observed so far in any other marine carbonate or inorganic calcite. The calculated temperatures deviate from the in-situ measured temperatures by a maximum of 0.5°C. Mg/Ca ratios in *A. excavata* therefore holds promise to serve a temperature proxy for intermediate water mass reconstructions with relatively low variations. Furthermore Li/Mg and Mg/Sr ratios show promising results as temperature proxies as well, by reducing the temperature deviations between different specimens that are visible when using Mg/Ca ratios. This is presumably caused by similar vital effects on Mg/Ca, Sr/Ca and Li/Ca ratios (e.g., changes in the rate of skeletogenesis, nutrient availability, etc.) which are minimized by using the elemental ratios in combination.

Geochemical signatures of the scleractinian cold-water coral *Enallopsammia rostrata* off the Cape Verde Archipelago: Implications for deep-water variability and biological controls

Reinhard Weidlich¹, Jacek Raddatz¹, Norbert Frank², Axel Gerdes¹, Wolfgang Müller¹, Matthias López Correa^{3,4}, Thor Hansteen⁵

¹Goethe University Frankfurt, Institute of Geosciences, Germany; ²University of Heidelberg, Institute of Environmental Physics, Germany; ³Istituto di Scienze Marine, Consiglio Nazionale delle Ricerche (CNR-ISMAR), Italy; ⁴University of Erlangen-Nürnberg, Geozentrum Nordbayern (GZN), Germany; ⁵GEOMAR Helmholtz-Zentrum für Ozeanforschung, Germany

Scleractinian cold-water corals are a promising archive to reconstruct past oceanic changes with possibly up to subdecadal and annual resolution. The aragonitic skeletons of the framework-building cold-water coral *Enallopsammia rostrata* are underrepresented by geochemical studies so far. Here we present preliminary stable oxygen and carbon isotope analyses as well as LA-ICPMS- based

elemental/Ca ratios of a *E. rostrata* specimen collected during research cruise M80/3 in 1700 m water depth off the Cape Verde Archipelago.

²³⁰Th/U age determinations reveal annual growth rates between 35 to 70 µm/yr and an age range of up to 630 years. Our Li/Mg based deep-water temperature reconstruction exhibit large temperature variations

between 3°C and 10°C. We suggest that this is not only related to occurring vital effect during elemental incorporation of the corals, but also due to oceanographic changes. Reconstructed temperatures and Ba/Ca ratios show an 11-year variability. We suggest that this variability may be linked to the North Atlantic Oscillation. In particular, this phenomenon can be explained by the reduced deep-water production in the Labrador Sea and enhanced precipitation in the Cape Verde region. Finally, our data indicate a transfer of the northern hemisphere cooling event “Little Ice Age” (LIA) into intermediate and deep water zones. The onset of different stages of the LIA come along with large changes in the bottom water temperature. However, our reconstructed deep ocean temperature changes are up to 5 times larger than global surface temperature changes, highlighting the strong influence of coral biomineralization processes.

Reconstructing growth parameters in massive *Siderastrea siderea* corals from different environments across Bahía Almirante, Panama

Oliver Voigt¹, Georg Heiss¹, Ulrich Struck², Vanessa Skiba¹, Aaron O’Dea³, Reinhold Leinfelder¹, Jens Zinke⁴

¹Freie Universität Berlin, Germany; ²Museum für Naturkunde, Leibniz-Institut für Evolutions- und Biodiversitätsforschung; ³Smithsonian Tropical Research Institute; ⁴University of Leicester

Global warming and climate change have taken a devastating influence[1;2] on corals all over the world resulting in bleaching events and reef damage. Some areas are particularly affected, such as the Caribbean Sea since sea surface temperatures have risen more significantly than average global temperatures over the last decades[3]. Besides that also human impacts such as (over)fishing, sedimentation, deforestation and other anthropogenic stressors had a significant negative impact on coral’s health and the nearshore marine environments of Almirante Bay (Bahía Almirante), Panama,[4]. This led to radical marine changes over the last decades due to pollution, nutrification-pesticide discharge and sedimentation[5]. As a consequence, coral reef diversity has declined. Since coral reefs are unique, a better understanding of coral responses to human impacts and climate change is necessary to enable predictions of future developments[6]. It is therefore important to systematically monitor the growth factors of corals so that changes caused by environmental stressors can be observed[7]. In this study measured coral growth rates, skeleton density and calcification rates-based on X-ray analysis-are presented. This work provides important, lacking growth data of *S. siderea* corals from sites across Almirante Bay over the past decades and also enables comparison to measurements from nearby regions. To do so, environmental parameters and their effects on coral growth were tested for seven sites covering several decades of coral growth. Growth rates do not appear to be negatively affected by river runoff/sea surface temperature stress. Coral colonies show no sign of particular stress which can be due to the characteristics of *S. siderea* which is considered a ‘resistant’ coral.

Poster: 2. Late quaternary lake-catchment interactions in remote Arctic glacial lakes: Insights from an XRF-focussed study from Chukotka, northeast Siberia

Stuart Andrew Vyse¹, Boris K. Biskaborn¹, Ulrike Herzschuh^{1,2}

¹Alfred Wegener Institute, Helmholtz centre for Polar and Marine research, Potsdam, Germany; ²University of Potsdam, Potsdam, Germany

XRF analyses provide a rapid and effective method of obtaining palaeoenvironmental data in lacustrine environments at high resolution. Historically, information regarding past limnic oxygen conditions, detrital input and grain-size variations as well as organic productivity have been extracted from data derived from XRF scanning of arctic lake sediment cores. In this study, XRF records from two long sediment cores taken from two organic poor, Pleistocene age glacial lakes during the 2018 AWI expedition to the remote Chukotka region of northeast Siberia are presented. Until now, the Chukotka region of northeast Siberia has been largely devoid of palaeolimnological data- with the notable exception of lake El’gygytyn. The palaeoenvironmental study presented here thus aims to improve the late Quaternary record from the far northeast of Siberia. The Mn/Fe ratio, an indicator of lake oxygen conditions, showed large fluctuations at both lakes suggestive of changing oxygen conditions within the water column during the late Pleistocene and Holocene. The Zr/Rb & Sr/Rb ratios record changes in grain-size that suggest finer grained detrital material was more prevalent during colder phases. Bromine, a proxy for total organic carbon (TOC) variations in lake sediments suggests

that the organic content of both lakes was very low during the late Pleistocene but increased dramatically into the Holocene peaking in the early Holocene. Both Rb/K and K/Ti which have been shown to represent physical vs chemical weathering proxies suggest high physical weathering during the late Pleistocene giving way to a change to a chemical weathering regime during the early Holocene.

Poster: Coral reconstructed Mid-Holocene seasonality in the southwest Caribbean

Vanessa Skiba¹, Jens Zinke^{2,1,3,4,5}, Ulrich Struck⁶, Oliver Voigt⁷, Lars Reuning⁸, Dieter Garbe-Schönberg⁸, Andrea Schröder-Ritzrau⁹, Reinhold Leinfelder¹, Aaron O'Dea¹⁰

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Universität Berlin, Germany; ⁸Section Geosciences, Christian-Albrechts-Universität Kiel, Germany; ⁹Department of Physics and Astronomy, University Heidelberg, Germany; ¹⁰Smithsonian Tropical Research Institute, Republic of Panama

Palaeoclimate reconstructions are crucial to understand the climatic and oceanic system. Coral geochemical proxy archives provide excellent high-resolution reconstructions of several climatic and hydrological parameters. Here, we investigate subfossil (~6200-7100 years old) *Siderastrea* sp. and *Pseudodiploria* sp. corals from a pristine Mid-Holocene reef, located in Panamá, southwestern Caribbean. Model scenarios indicate higher Mid-Holocene insolation seasonality in the Northern Hemisphere and a northward shift of the Intertropical Convergence Zone. The unprecedented fossil coral reef site gives us the rare and crucial opportunity to study seasonal changes in sea surface temperature and hydrological dynamics. To evaluate, if the coral heads can fulfill their high potential for palaeoclimate reconstruction using geochemical proxies, the corals have been screened for diagenetic alteration (2D-XRD, thin section analysis). Stable isotope ($\delta^{18}\text{O}$, $\delta^{13}\text{C}$) and trace element (Sr/Ca) annual cycles will be shown from the Mid-Holocene corals and compared to in situ measurements and modern coral proxy annual cycles.

Poster: Disparity in the abundance of C₃/C₄ plants estimated using the carbon isotopic composition of paleosol components

Vijayananda Sarangi¹, Prasanta Sanyal¹, Shailesh Agrawal²

¹Indian Institute of Science Education and Research Kolkata, India; ²Birbal Sahni Institute of Palaeosciences, Lucknow

The disparity in the estimated abundance of C₃/C₄ plants using carbon isotopic composition of soil carbonates ($\delta^{13}\text{C}_{\text{SC}}$), soil organic matter ($\delta^{13}\text{C}_{\text{SOM}}$), organic matter occluded in soil carbonate nodules ($\delta^{13}\text{C}_{\text{NOM}}$) and biomarkers in paleosol organic matter (saturated fatty acids; $\delta^{13}\text{C}_{\text{FAME}}$) affects the credibility of paleovegetational proxies. Hence, the present study aims to comprehend the factors affecting the $\delta^{13}\text{C}_{\text{SC}}$, $\delta^{13}\text{C}_{\text{SOM}}$, $\delta^{13}\text{C}_{\text{NOM}}$ and $\delta^{13}\text{C}_{\text{FAME}}$ values within a paleosol and its implication for paleovegetational reconstructions. In this context, available $\delta^{13}\text{C}_{\text{SC}}$, $\delta^{13}\text{C}_{\text{SOM}}$, $\delta^{13}\text{C}_{\text{FAME}}$ and newly measured $\delta^{13}\text{C}_{\text{NOM}}$ values from four fluvial cores namely Kalpi, Indian Institute of Technology Kanpur (IITK), Firozpur and Bhognipur from the Quaternary deposit of Ganga plain, India have been used. The abundance of C₄ plants calculated from the $\delta^{13}\text{C}_{\text{SC}}$ and $\delta^{13}\text{C}_{\text{FAME}}$ values is ~2% to 79% higher compared to the estimates from $\delta^{13}\text{C}_{\text{SOM}}$ and $\delta^{13}\text{C}_{\text{NOM}}$ values. The present study suggests that the disparity is due to the variation in the response of proxies to perturbations in the paleovegetational regime, growing season condition, and isotopic fractionation during decomposition and incorporation of organic matter into the soil. In addition, various factors such as grain size, vegetation density, sub-aerial exposure and pedogenesis that is inherent to the depositional environment also affect the carbon isotopic composition of paleosol components. Considering the uncertainties associated with the $\delta^{13}\text{C}$ values of paleosol components, reporting the absolute abundance of C₃/C₄ plants would be biased and dubious. Therefore, the study recommends presenting the relative change in abundance of C₃/C₄ plants during paleovegetational reconstructions.

Poster: Paleotemperature reconstruction using Lakshadweep Island Coral

Harsh Raj, Ravi Bhushan, Sanjeev Kumar

Physical Research Laboratory, India

Corals are an important archive of paleoclimatic proxy records. Oxygen isotopic composition ($\delta^{18}\text{O}$) of coral skeletons have been extensively studied worldwide. Earlier studies have shown that the stable isotope of oxygen in Lakshadweep corals faithfully records changes in sea surface temperature (SST). A coral core with 36 year proxy record spanning between 1977 to 2014 was analysed for its stable isotopic composition. The oxygen isotope values of analysed coral were used to derive paleotemperature equation for sea surface temperature reconstruction. Using this equation, SST was calculated and then compared with observed SST values. The difference between observed and derived SST values was found to be smaller than previously reported values. This suggest that the derived paleotemperature equation is better representative of this region. This study is important from perspective of reconstructing and understanding past climate. This type of proxy record can also used to understand past monsoonal variations and to identify signatures of coupled ocean-atmospheric processes like El Nino Southern Oscillation (ENSO) or Indian Ocean Dipole (IOD).

Poster: Quantifying the influence of natural forcing on water isotopes and climate in polar and alpine regions using HadCM3

Moritz Kirschner¹, Max D. Holloway², Louise C. Sime², Kira Rehfeld¹

¹Ruprecht-Karls-Universität Heidelberg, Germany; ²British Antarctic Survey, Cambridge, United Kingdom

The frequency of extreme weather events depends relatively more on climate variability than on average changes. This makes variability a crucial element to consider in future projections. Stable water isotopes such as $\delta^{18}\text{O}$ extracted from climate archives, including ice-cores, have been used to reconstruct regional climate and evaluate climate simulations. These archives have shown that variability in the Holocene is much lower than that at the Last Glacial Maximum (LGM, 21 kyr ago). However, state-of-the-art climate models still fail to simulate this shift. Comparison is difficult, since paleoclimate equilibrium simulations are typically run for few centuries and do not yet incorporate water isotope tracers.

Volcanic eruptions offer a unique testbed to analyse the link between regional archives and global climate since well reconstructed aerosol data from 800 CE onward allow the investigation of small and large-scale effects in time and space on the climate. Here, millennial simulations from the isotope-enabled version of HadCM3 forced by solar and volcanic reconstructions in pre-industrial, LGM and past-millennium scenarios were evaluated. We then analysed the influence of volcanic eruptions on climate and $\delta^{18}\text{O}$ values in polar and alpine regions. This allowed us to test the dependency of isotope values on regional shifts in climatology as well as global anomalies using composite analysis of volcanic eruptions.

We finally discuss the impact of these results on the climatic representation of polar and alpine ice-cores representing changes in global climate variability.

Poster: Seasonal mid-Holocene sea surface temperature variations inferred from western Indian Ocean coral Sr/Ca records (*withdrawn*)

Maike Leupold¹, Miriam Pfeiffer², Dieter Garbe-Schönberg², Lars Reuning², Nobuko Nakamura^{3,4}, Tim R. McClanahan⁵, Herman Kiriama⁶, Mohamed Mchulla Mohamed⁷, Jens Zinke⁸

¹RWTH Aachen University, Germany; ²Institute of Geosciences, Kiel University, Kiel, Germany; ³Department of Earth and Planetary Science, University of Tokyo, Tokyo, Japan; ⁴Faculty of Science and Technology, Keio University, Yokohama, Japan; ⁵Wildlife Conservation Society, Mombasa, Kenya; ⁶Kisii University, Kisii, Kenya; ⁷Coastal Archeology, National Museum of Kenya, Mombasa, Kenya; ⁸School of Geography, Geology and the Environment, University of Leicester, Leicester, United Kingdom

During the mid-Holocene climate optimum (6k) some climatic parameters, such as ice volume and greenhouse gas concentrations, were similar to today. Understanding the climate system during that time could help us to better understand and predict modern and future climate changes. However, the number of available high-resolution (monthly-seasonal) climate data from the mid-Holocene age is limited, especially in the tropics. Fossil tropical corals can be used to reconstruct past changes of environmental parameters such as

1.3.-2 Palaeoclimate reconstruction using aquatic high-resolution archives

sea surface temperatures (SST) and rainfall by measuring Sr/Ca and stable oxygen isotope ratios and can therefore help to understand changes in past climate variability.

Here, we use three *Porites* coral samples dated to the mid-Holocene (6k) and one modern coral from the western Indian Ocean (East Kenya) to reconstruct past SST. The fossil samples were collected from archeological Swahili ruins build from *Porites* boulders. Their records cover 11 to 20 years, the modern record covers 15 years (1987-2002). The coral samples were sub-sampled at a monthly resolution for trace element analysis. Sr/Ca ratios were measured using ICP-OES with simultaneous data acquisition. The results show reduced seasonality of the fossil SST records (mean 3°C) compared to the modern SST record (mean 4.7°C). This and the shift of the annual SST maximum from November (6k) to February (modern) reflects climate variability due to orbital forcing.

1.4/5-1 Multi-scale geomorphology, active tectonics and sedimentology

Tuesday, 10/Sep/2019: 1:30pm–3:00pm

Session Chair: Jorien Leonorah Ninon van der Wal

Session Chair: David Fernández-Blanco

Location: Hall B

Assessing recent events with recent technology – using UAV-generated image data for soil erosion monitoring. HiRT, RGB and beyond.

Anna Iglseder, Ronald Pöppl

University of Vienna, Austria

Degradation of arable land by soil erosion is a world-wide phenomenon and can lead to agricultural land falling unproductive. Next to the on-site effects of soil erosion on the fields, off-site effects like input of fertilizers and pollutants into freshwater ecosystems affect the environment.

For a greater understanding of the erosion processes starting from smallest scales, detection and quantification soil erosion is necessary. Therefore, detailed monitoring of changes in topography is a possible approach. Recent technologies of image-matching-based surface reconstruction (Structure from Motion) provide an uncomplicated generation of high resolution DTMs, while the use of cameras mounted on unmanned airborne vehicles (UAVs) allows fast, non-invasive and low-cost data acquisition. Besides the visible electromagnetic spectrum, UAV-based sensors recording near infrared (NIR) or thermal IR can enhance topographic information with additional data.

For the presented study, erosion-prone farmland in a medium-sized agricultural catchment (i.e. Fugnitz, Lower Austria) is chosen as an area of interest. With multi-temporal data recording, the possibilities of detection and quantification of rill as well as sheet erosion on agriculturally used areas are investigated on field scale. Additionally, challenges in accuracy assessment considering the level of detection (LoD), errors in spatial registration of data from different flight campaigns and possibilities of field validation are addressed. Moreover, the added value of multispectral information (NIR, thermal IR) is examined with regard to the identification of erosion-prone spots. The study follows the overall aim to highlight the applicability of UAV-based remote sensing for soil erosion assessment and the related challenges on field scale.

The Evolution of a Dammed Lake on the Eastern Slope of Mount Minya Konka in Sichuan province, southwest China

Yongbo Tie, Xinglei Feng

Chengdu Center of China Geological Survey, China, People's Republic of

A large quantity of moraines are distributed on the eastern slope of Mt. Minya Konka following the glacier retreat since the Quaternary in southwest of Sichuan province, China. These moraines were transported by glacier melt water and formed different deposit landforms in the downstream. The primary objective of this study was to understand the evolution of an old dammed lake and to reconstruct historical geomorphological events in this area. Based on field surveying and the literature, the geographic analysis methods and laser particle-size (LPS) testing of sediment samples are used. The results indicate that the old dammed lake in Moxi basin was blocked by a landslide at the eastern bank of the valley in the early Holocene, approximately 400 aBP ago, a large volume of debris flow entered the old dammed lake, causing its outburst and disappearance. The evolutionary stages of the old dammed lake can be illustrated as the following: the weather became warm at the eastern slope of Mt. Minya Konka in the early Holocene, and frequent rainfall caused the slide of the slope and block the river; this landslide formed the dammed lake with a 70 m thick sediment layer; a large volume of debris flow entered the dammed lake, causing the outburst and its disappearance. This result show us a typical geomorphologic evolution process which associate with the glacier retreating and geo-hazards activity in this area, it is useful for the hazard mitigation.

Reconstructing sea-level from coral reef terrace sequences

Gino De Gelder¹, Anne-Morwenn Pastier², Kevin Pedoja³, Christine Authemayou⁴, Laurent Husson¹

¹ISTerre, Université Grenoble-Alpes, France; ²Laboratoire de Planétologie et Géodynamique, Université Nantes, France; ³Laboratoire de Morphodynamique Continentale et Côtière Caen, Université Caen, France; ⁴Université de Bretagne Occidentale, Brest, France

Quantifying Quaternary sea level fluctuations is of crucial importance to estimate global ice-sheet volumes and its spatio-temporal response to climate change, as well as to estimate local tectonic uplift rates and associated earthquake hazards. The first sea-level curves were constructed by dating uplifted coral reef terraces in fast uplifting areas like the Huon Peninsula (Papua New Guinea) and Barbados, whereas later curves typically relied on oxygen isotope ratios ($\delta^{18}\text{O}$) in marine sediment cores. These later curves provide continuous high-resolution records but $\delta^{18}\text{O}$ values depend on several factors, making them highly variable depending on methodology and core location. We reappraise the classic coral reef sequences of Barbados, with the aim to construct a sea level curve consistent with ages and terrace morpho-stratigraphy. We use topographic data calculated from 0.5 m Pleiades satellite imagery, allowing for elevation measurements and assessment of tectonic deformation wavelengths with unprecedented detail. Using a numerical code for coral reef modeling we attempt to invert the full sequence morphology to reconstruct a full curve. This unique approach of combining high-resolution topography with

landscape evolution modeling may result in the first sea-level curve of this kind, and we discuss its potential implications.

An overview of sedimentology and mineralogy of Pulmoddai mineral sand deposit

Udaya Bhagya Gunawardhana, Ashvin Wickramasooriya

University of Peradeniya, Sri Lanka

Pulmoddai mineral sand deposit which extends about 800,000 m² is located in the northeast coastal zone in Sri Lanka. It is the largest and well known heavy mineral sand deposit in Sri Lanka. High quality Titanium and Zirconium bearing minerals like Rutile, Zircon and Ilmenite are concentrated in this deposit. This study focus to analyze the spatial distribution of the Heavy Minerals and sedimentological characteristics of the deposit. Five miles (8 km) long stretch along the coast connected to the deposit was selected as the study area. Ten traverses (10) representing two traverses within each mile are demarcated across the coastline and are runs from inshore towards backshore. Forty (40) sand samples representing Inshore, Swash zone, Berm and Back shore region were collected. Dry Sieve and Heavy Liquid Separation methods are carried out to achieve the objectives. According to statistical analysis Pulmoddai sediments are mostly fine grained, moderately sorted to moderately well sorted, negatively to nearly symmetrical and mesokurtic in nature. In order to linear discrimination function it has showed that this is a shallow marine agitated deposition concerned by aeolian, fluvial and marine depositional environment under the high impact of turbidity currents. The average heavy mineral concentration at Inshore, Swash zone, Berm region and Backshore (Dune) region are 5.95%, 10.87%, 12.82% and 23.5% respectively. Concentration of the Heavy Mineral increases towards backshore and also increases towards the Southern part of the study area.

Geomorphic framework to record continental rifting

David Fernández-Blanco¹, Gino de Gelder², Robin Lacassin¹, Rolando Armijo¹

¹Institut de Physique du Globe de Paris, Lithosphere Tectonics and Mechanics, Paris, France; ²ISTerre (Institut des Sciences de la Terre), Université de Grenoble Alpes, Grenoble, France

A broad range of geologic archives and geomorphic elements record the evolution of continental landscapes, and yet, such evolution is commonly inferred using monodisciplinary approaches. For example, topography and relief, marine terraces, fluvial geomorphology and morphometrics, and tectonosedimentary records are used individually, but to our knowledge never together, to study the evolution of landscapes in extensional footwalls. We propose a theoretical framework that integrates the aforementioned approaches and reconstructs in detail the evolution of natural landscapes in uplifting rift shoulders and footwalls of rifting continents. The framework allows us to derive the sequence of initiation, growth and subsequent evolution of

colinear faults and their type of linkage, from onset to present, in the natural case of the Corinth Rift, which in turn reveal several new first-order findings for the rift. Application of similar theoretical frameworks in other sites could lead to a better understanding of the mechanics of normal faulting and the thermo-mechanical state of the continental lithosphere elsewhere, and thus, a better understanding of continental tectonics.

Poster Pitch: Study of the Mid-Jurassic Msolwa Sedimentary Successions in Tanzania and the Influence upon the Geological Diversity of the Region

Godfrey Mwendenusu

University of Dar es Salaam, Tanzania

The Msolwa successions are part of the fault-controlled shallow coastal basin of Tanzania located in Morogoro region which resulted from the combination of marine processes and deposition of sediments which were reworked and transported by means of gravity flows and fluvial influence during the early Middle Jurassic from the marine coral reefs rich in carbonates originating from the ancient Indian Ocean.

According to the observation, the sedimentation was influenced by the marine deposition, high energy fluvial deposition and low energy fluvial deposition. The basal conglomeratic beds are a part of Karoo sequence seen in the coastal basin of Tanzania formed after the opening up of Somali basin during the Jurassic times which were followed by series of marine transgressive and regressive sequences. The tectonic events that occurred after the Jurassic such as the fault observed exposed the uplifted block of conglomerates upwards and susceptible to weathering which led to change in lithology and mineralogical composition of the uplifted block. This was then followed by the Fluvial depositions and regressive events which led to the formation of top units and the overall Ruvu sub-basin. Generally the stratigraphy of Msolwa is well exposed for the geologic studies.

1.4/5.-2 Multi-scale geomorphology, active tectonics and sedimentology

Tuesday, 10/Sep/2019: 3:30pm–5:00pm

Session Chair: Gino De Gelder

Session Chair: David Fernández-Blanco

Location: Hall B

Multi-Technique Approach to Determine the Genesis of Neotectonic Structures in the NW Argentine Broken Foreland

Ahmad Arnous^{1,2}, Martin Zeckra¹, Agostina Venerdini³, Patricia Alvarado³, J Ramón Arrowsmith⁴, Angela Landgraf¹, Antonio Gutiérrez², Germán Aranda Viana⁵, Manfred R Strecker¹

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The Santa-Bárbara-System, a morphostructural province in the NW Argentine Andes, forms an environment where Quaternary deposits and landforms recording recent shortening on top of a long-lasting, altering tectonic history. The north-south trending Candelaria basement-cored range and its adjacent basins combine thin-skinned and tick-skinned foreland deformation. In order to unravel the regional evolution, an integrative field survey and geomorphological investigation was performed at probable seismogenic structures.

At first, digital elevation models with a resolution of 5m and 12.5m were combined with satellite-image analysis for geomorphic mapping to characterize surface ruptures. The identification of uplift through tectonic activity was indicated by the incorporation of different tectonically modified generations of alluvial fans and their associated changes in the fluvial network.

In order to better constrain the geometry of these faults, we acquired a total of four 2D electrical resistivity tomographic images and three seismic refraction profiles perpendicular to the strike of identified fault scarps. The resulting electrical resistivity cross-sections show a significant horizontal contrast in resistivities below the inferred fault-scarp location at the surface. The seismic refraction survey reveals a similar anomaly zone with lateral changes in P-wave velocities.

The combined interpretation of the consistent geophysical tomographies with prior geomorphic mapping suggests modifications of superficial Quaternary records by active reverse faults. The apparent structural geometries indicate both the presence of inherited Cretaceous and neotectonic structures to be responsible for the asymmetric appearance of this part of the Broken Foreland.

Continuous and active growth of the Lesser Himalayan Duplex in the Kishtwar Window, NW Himalaya

Saptarshi Dey¹, Rasmus Thiede², Pritha Chakravarti¹, Arindam Biswas³, Vikrant Jain¹

¹Indian Institute of Technology Gandhinagar, India; ²Institute of Geological Sciences, Christian Albrechts University, Kiel, Germany; ³Department of Applied Geology, IIT-ISM Dhanbad, India

The late Quaternary crustal shortening accommodated within the Himalayan orogen have mostly been reported from the Sub-Himalayan fold-and-thrust belt. However, recurring seismicity in the orogen-interiors, new tectono-geomorphic analysis combined with previously-published low-T thermochronological data have emphasized the significance of orogen-interior shortening within the Quaternary or even at shorter timescales.

In this study, we combined tectono-geomorphic field observations and morphometric analysis of the Kishtwar region in the NW Himalaya to assess the spatial distribution of Quaternary fault activity. Morphometric analysis using 30m SRTM and 12.5m ALOS-PALSAR DEM data have provided qualitative information on locations of protracted deformation. The river Chenab shows unadjusted segments in the longitudinal river profile, hypsometric integral and large-scale variations in valley width distribution and Ksn values, indicating

faulting and differential uplift across the Kishtwar window situated ~150 km inside the Himalayan front. Immature hypsometry, high k_{sn} values, and several non-lithological knickpoints in the Chenab river profile, alongwith deformed late Pleistocene-Holocene alluvium suggest neotectonic faulting and growth of the Lesser Himalayan duplex encompassing the Kishtwar Window. Our findings corroborate with the previous studies which suggest Quaternary shortening rate of 3.2-3.6 mm.a⁻¹ has been achieved by faulting and the growth of the duplex. By combining our results with the previously-published studies, we infer rock-uplift and growth of the Lesser Himalayan Duplex forming the Kishtwar window are related to ramp-flat structures within the Main Himalayan Thrust.

We are processing OSL samples to constrain the timing of sedimentation prior to latest deformation.

Earthquake Scenario Map of Sulawesi Island (*withdrawn*)

Catur Cahyaningsih, Afroz Shah, Aminul Islam

Physical and Geological Sciences, Universiti Brunei Darussalam, Brunei Darussalam

The detailed earthquake hazard scenario maps of Sulawesi Island, which is part of the Indonesia in SE Asia, is not available, and therefore this work presented below shows the first such maps for the entire region. These maps are important component of the overall earthquake hazard information of the region, and are developed by using the Google satellite images, seismological, earthquake moment tensor

solution, previous published structural, GPS and geological maps. The first step was to map in detail the tectonic topography of the Island by mapping faulted or deflected ridge axes, topographic breaks, deflected river streams, triangular facets, bedding planes, dip direction of bedding and faults. These tectonic topographic maps were superimposed on the available geological maps, and corrected wherever required. The mapped faults were subsequently used to develop the earthquake scenario maps where the standard fault-scaling relationships were used to measure the magnitude of future earthquakes on the mapped and newly mapped fault systems. We have used published, and newly mapped fault lengths to obtain the width of rupture zone and the fault dip values are derived from the available earthquake centroid moment tensor (CMT) catalogue data. The depth of downdip limit of faulting is used as 15-25 km, which is based on the depth of Moho. Our results show that the shape of the entire Island is controlled by faulting, and most of these faults are active and capable of producing medium to large magnitude earthquakes.

Poster Pitch: Evidence of active strike-slip faulting in eastern Sabah, NW Borneo

Nor Bazliah B. Badar¹, Afroz Shah¹, Nava B.², Nur Syafiqah A.B.A.¹

¹Universiti Brunei Darussalam, Brunei Darussalam; ²University Sains Malaysia

We have mapped a major strike-slip fault using freely available Google satellite images. The first visible trace of the fault is ~40 km long, and has displayed a number of geological units that are clearly cut through by this fault. The strike of the fault is ~NE-SW, and shows characteristic en echelon pattern, which fits strike-slip faulting. The fault lies to the east of actively moving normal fault system (Crocker fault system) that has recently hosted a moderate-sized (Mw 6.0) earthquake on 5th June 2015, which caused significant loss of life. Further west the fault can be traced until the Crocker fault system where it terminates, and it seems the faults roots from it. This pattern of faulting is consistent with the fanning of the major strike-slip fault system that runs through the middle of the Borneo Island that was envisaged by Shah et al. (2018). This makes the faults a major fault that is >250 km long. The examination of available centroid moment tensor (CMT) solutions suggest that Borneo is undergoing normal and strike-slip faulting, and our work clearly shows that the entire region is undergoing transtension, and therefore, we strongly propose that tectonics plays a key role in the deformation of Borneo, and has largely shaped its present structural configuration. The formation of oval shaped basins that are filled with Holocene to Recent deposits further suggest these basins are controlled by faulting, and should ideally put tight constrains on the timing of faulting, which are mostly Holocene to Recent.

Poster Pitch: Earthquake Geology of NW Borneo: tectonic versus gravity driven models of active deformation (*withdrawn*)

Navakanesh M Batmanathan¹, Afroz Ahmad Shah², Fadzli Mohamed Nazri¹

¹*Universiti Sains Malaysia (USM), Malaysia;* ²*University of Brunei Darussalam (UBD), Brunei*

Over the years, NW Borneo have been experiencing low to medium magnitude earthquakes. This includes the 4th June 2015 event that jolted Mw 6.0 and caused the destruction of both life and properties. The clustering of earthquake hypocenters around this region is very prominent, and reflects the occurrence of major structures. Our geomorphic analysis reveals a number of active normal faults, which have influenced the stream patterns and formed a number of knickpoints that are indicators of active movements. And these knickpoints are not related to bedding and consistent with faulting events. Field survey shows normal faults with NW and SE dipping plane, particularly in recent earthquake region. The discovery of large scale landslides and traces of normal faults provides a possibility of some old extensional faults might have reactivated during the 4th June 2015 earthquake. However, we were unable to any surface rupture / break and this concludes the evidence of a blind fault. A large number of geological studies have attributed this to far – field stresses, gravity collapse and mantle processes but the exact cause of extension is uncertain. This research reveals the seismicity is mainly because of reactivation of ancient fault lines in response to sudden sub crustal collapse due to oblique compression. Therefore, this kind of deformation is related to intra – plate deformation process which is controlled at depth by the major strike – slip fault. We can conclude that extension in these region strongly backs a tectonic origin.

1.5. Geomorphic and sedimentary records of active plate tectonics

Wednesday, 11/Sep/2019: 5:00pm–7:00pm

Poster Session & Social

Location: Foyer

Poster: Earthquake Geology of NW Borneo: tectonic versus gravity driven models of active deformation

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Poster: Study of the Mid-Jurassic Msolwa Sedimentary Successions in Tanzania and the Influence upon the Geological Diversity of the Region (*withdrawn*)

Godfrey Mwendenusu

University of Dar es Salaam, Tanzania

The Msolwa successions are part of the fault-controlled shallow coastal basin of Tanzania located in Morogoro region which resulted from the combination of marine processes and deposition of sediments which were reworked and transported by means of gravity flows and fluvial influence during the early Middle Jurassic from the marine coral reefs rich in carbonates originating from the ancient Indian Ocean.

According to the observation, the sedimentation was influenced by the marine deposition, high energy fluvial deposition and low energy fluvial deposition. The basal conglomeratic beds are a part of Karoo sequence seen in the coastal basin of Tanzania formed after the opening up of Somali basin during the Jurassic times which were followed by series of marine transgressive and regressive sequences. The tectonic events that occurred after the Jurassic such as the fault observed exposed the uplifted block of conglomerates upwards and susceptible to weathering which led to change in lithology and mineralogical composition of the uplifted block. This was then followed by the Fluvial depositions and regressive events which led to the formation of top units and the overall Ruvu sub-basin. Generally the stratigraphy of Msolwa is well exposed for the geologic studies.

Poster: STYLOLITES: A MATHEMATICAL APPROACH ON TOTAL CONTRACTIONAL STRAIN (ϵ)

Kaue Seoane, Fabio Henrique Domingos, Flora Menezes

Federal University of Pará, UFPa

Stylolites are well-known indicators of compressive deformation episodes in rock masses. They are commonly evaluated by analyzing its geometrical attributes as length (L), maximum (D_{max}) and average (D_{avg}) amplitudes. These traditional approach was used to investigate a set of stylolites in the mudstones of the Guia Formation, Paranatinga region, Central Brazil. The investigated stylolites occur in a mudstone dragged into the damage zone of a strike-slip fault of the Paraguai Belt. Samples out of the damage zone were used for comparative maths in order to understand the thinning percentage the faulted layer experiences. A total of 49 stylolites were used and 11 of them are more harmonic and simetric but 9 of them are assimetric, reaching amplitude peaks of 0.762 mm. The total contractional strain was calculate using a formula elaborated by Kostrov, and the results are associated to the strain value accomodated by the each layer, which created both thinning and growing of stylolite's population. A total of 20.9 mm of layer thinning is related to the stylolites that are in a lenght range of 2.66 to 28.15 mm and amplitude varying between 0.143 to 1.378 mm. These thinning is observed in the region where the stylolites are more concentrated, which can be correlated to the rising of a total contractional strain acommodated by the layer.

1.6. Quaternary climate: sedimentation and landform evolution

Wednesday, 11/Sep/2019: 3:00pm–5:00pm

Location: Senatssaal

Late Quaternary Indian monsoon records from Andaman Sea

Sajid Ali

BSIP, Lucknow, India, India

The Late Quaternary variability of the Indian monsoon has been linked glacial-interglacial and millennial scale climatic changes but the past rainfall intensity in the river catchments draining into the Andaman Sea remains poorly constrained. Here, we use radiogenic Sr, Nd, and Pb isotope compositions of the detrital clay-size fraction and clay mineral assemblages obtained from sediment core NGHP Site 17 in the Andaman Sea to reconstruct the variability of the Indian monsoon during the past 60 kyr. Over this time interval ϵNd values changed little, generally oscillating between -7.3 and -5.3 and the Pb isotope signatures are essentially invariable, which is in contrast to a record located further northeast in the Andaman Sea. This indicates that the source of the detrital clays did not change significantly during the last glacial and deglaciation suggesting the monsoon was spatially stable. The most likely source region is the Indo-Burman Ranges with material transported by the Irrawaddy river and a possible minor contribution from the Andaman Islands. High smectite/(illite+chlorite) ratios (up to 14), as well as low $^{87}\text{Sr}/^{86}\text{Sr}$ ratios (0.711) for the Holocene period indicate enhanced chemical weathering and a stronger Indian monsoon compared to marine oxygen isotope stages 2 and 3. The most smectite poor intervals also exhibit radiogenic Sr isotope compositions and roughly coincided with Heinrich events in the northern Atlantic suggesting that variations in monsoon intensity in the Irrawaddy catchment were influenced by northern hemisphere climate on millennial timescales.

Evidence of land-sea interaction during mid-late Holocene from the sedimentary records of western India

Upasana S. Banerji¹, Ravi Bhushan², Shilpa Pandey³

¹National Centre for Earth Science Studies, Thiruvananthapuram-695583, Kerala, India; ²Physical Research Laboratory, Ahmedabad-380009, Gujarat, India; ³Birbal Sahnii Institute of Palaeosciences, Lucknow-226007, Uttar Pradesh, India

Unlike Glacial- Interglacial periods, Holocene period is seldom known for any drastic climate and sea level changes and thus has been a prime focus for investigating the interplay land-sea level vacillations. Sea level has fluctuated more or less at the present level during mid-Holocene Period and hence local sea level variability should be considered. In view of this, the present study attempts to investigate both land sea interactions along the western India. The mudflats of Gujarat, Western India, being an ideal platform to study land-sea level fluctuation has been investigated based on various geochemical and palynological proxies supported by radiocarbon dates.

Based on geomorphic and multiproxy evidence, the study demonstrates ~ 2 m high sea levels during 4.7 ka with a gradual regressive trend and the present day coastal configuration attained after 1500 yr BP. Considering the tectonic instability and coastal notch of Gujarat (Saurashtra coast), the effective mid-Holocene sea-level has been estimated to be ~ 1 m higher than the present with a tectonic overprinting of ~ 1 m. Additionally, on comparing the sedimentary records of Saurashtra mudflats and mud deposits of South Kerala (~ 1500 km away from Saurashtra), it can be underscored that high sea level persisted in both location till 2.6 ka. While Saurashtra coastal lagoon converted in to mudflats but the paleolagoon of south Kerala transformed into freshwater lake. The study demonstrates not only a continuous record of land-sea level changes but it also encourages to address the site specific late Holocene post sea level change along the coast.

Where to drill? Applications of compact sub-bottom profilers for drilling of remote Arctic lakes (*withdrawn*)

Stuart Andrew Vyse¹, Boris K. Biskaborn¹, Ulrike Herzschuh^{1,2}

¹Alfred Wegener Institute, Helmholtz centre for Polar and Marine research, Potsdam, Germany; ²University of Potsdam, Potsdam, Germany

The identification of optimal drill sites for sediment core retrieval is of critical importance to palaeoenvironmental studies of lake sediments. Despite this, the high priority of drill site selection is often overlooked with primitive methods still being widely employed. The stratigraphy of lake sediments can be highly variable depending on the proximity of coring sites to lake inflows and outflows in shelf regions and distance from lake shores. Moreover lake sedimentation can be affected by mass movement events such as turbidity currents and debris flows in steep bathymetric regions. Post depositional processes including soft-sediment deformation resulting from seismicity and gas migration as well as thermokarstic processes in permafrost regions can all act to influence the *in-lake* variability of lake sediment. Basic means of core site selection often rely on little to no information concerning the lake sediment stratigraphy or spatial variability. One method of drastically improving site selection is by using seismic-based methods. These are often however not well suited for fast, helicopter based expeditions in remote regions. The usage of compact, echosound based parametric sub-bottom profiler based technology for drill site location is on the rise but has still not come to full fruition. During the 2018 Chukotka expedition to northeast Siberia, an Innomar SES-2000 compact parametric sub-bottom profiler was utilized at two large lakes to derive optimal drilling sites. This methodology allowed the *in-field* visualization of sediment stratigraphy to lake basement as well as allowing generation of high resolution bathymetric maps on site.

Sedimentological response of the wave-dominated coast to the Artificial Channel River Flow Reduction

Thouraya BEN MOUSSA¹, Oula AMROUNI², Laurent Dézileau³, Gil Mahé⁴, Saâdi Abdeljaouad¹

¹University of Tunis El-Manar, Faculty of Science, Laboratory of Eenergetic, Mineral Resources and Environment, Tunisia; ²National Institute of Marine Sciences and Technologies, Laboratory of Marine Environment, Tunisia.;

³University of Caen, Laboratoire Morphodynamique Continentale et Côtière, France; ⁴UMR HydroSciences Montpellier/IRD, France

This study highlights the morphosedimentological response to River sediment supply to the coast area of the Gulf of Tunis. The study case is located on the active Delta: Medjerda River (Tunisia). 92 marine-samples were carried from the watershed to the deltaic coast. Two seasonal campaigns have been achieved during January and June 2014. The methodology was based on the granulometric analysis according to Folk and Ward 1957. Geochemical characterization was applied using the XRF-mobile and the RX. The granulometric results reveal a high silt concentration locality during the winter season than the summer. 28% of sediments are bimodal. The sandy fraction is characterized by medium sand (160 μm with Mz values ranges from 1.01 to 1.57, very well sorted ($0.31 < \sigma < 0.44$), very asymmetric to the finer fraction on the winter season ($0.44 < \text{SKI} < 0.52$). The summer season is marked by heterogeneous sediments, ϕ : [100, 630 μm], a decrease bimodality to 13 %. The Grain-size reveals a medium sand, Mz:[1.02;1.57], very well sorted $0.32 < \sigma < 0.43$ and asymmetry to the coarser distribution as well, Ski: [-0.18 to +0.10]. The geochemical characterization reveals three sources of sediment: terrestrial sediment received from the watershed rich in Fe, K, Rb, Ti, V, Pb, Zn and As; marine sediment (Ca, Sr) and aeolian contribution (Zr). The sub-marine sediment contains 48 % of Quartz, 38% of Calcite. Kaolinite is the most abundant clay mineral in watershed deposits (52%). The morphoscopic analysis confirms the diagnostic. Winter season is characterized by the watershed sediment contribution rich in terrestrial elements. It's related especially with the finer fraction, Silt-clay.

Ancient dammed lakes in East Tibetan Plateau, the special catastrophic sediment in landform evolution

Hailong Li

Chinese Academy of Geological Sciences

The meridional river system (MRS) in the eastern Tibetan Plateau, including the Minjiang, Qingyijiang, Daduhe rivers and others, flow from north to south. The MRS was formed and controlled by both Neotectonics and climate change. Many lacustrine deposits, which formed by paleo- earthquakes events, have been found in the river valleys. The Diexi ancient dammed lake extends along the Minjiang upstream over 30 km long; it formed by ~71kaBP by a big catastrophic event. The broken dam has been found south of Diexi and is composed of three proluvial fans distributed for 10km along the Minjiang river. This dammed lake lasted for ~ 60Ka and was broken ~10Ka ago. What are the main causal factors of these paleolakes? Frequent earthquakes firstly provide a favourable spot for damming event. By summarizing and comparing, we find that three tectonic phases occurring in 85~71kaBP, 43~30KaBP and 20~10KaBP. These tectonic phases were coupled with the climate change recording in the Guliya ice core. So, the Climate changes show cyclical impacts on the processes of erosion-deposition. Tectonic- climate coupling promotes big catastrophic event. This coupling mechanism plays an important role in the evolution of river system and geomorphology.

Microfacies, sedimentary environment and sequence stratigraphy of the Qom Formation in East Siah Kuh surface section (South of Garmsar)

Nasrin Khalaj

azad university, Iran, Islamic Republic of

This paper represents the sequence stratigraphic analysis of the Oligo-Miocene shallow water carbonate succession of the Qom Formation, east of Kuh Siah outcrop (South of Garmmsar). The study is based on the lithostratigraphy, biostratigraphy framework (in the context of European standard bio zonation), microfiches, paleo environmental interpretation and sequence stratigraphic concepts. In this section, only f to c1 members of the Qom Formation can be differentiated. The biostratigraphy results revealed that the benthic foraminiferal composition of the studied section has close affinities with coeval assemblages in Western Tethys and the Middle East. The larger foraminifera associations in the Qom Formation mark the SBZ 23 to 25 zones, referring to a time span from the late Chattian to Burdigalian. Based on the micro paleontological studies, the age of late Chattian (SBZ 23) is ascribed to c1 member which previously considered as Aquitanian, in East of Siah Kuh surface section. Sedimentary environment of the Qom Formation is related to a carbonate ramp platform. Based on sedimentary texture and percentage of skeletal and non-skeletal allochems, 1 lithofacies and 13 microfiches from inner to outer ramp were determined. The sequence stratigraphic studies led to the determination of four 3rd order sequences. The first sequence with the Chattian age includes c1 and c2 members. The second sequence with the Aquitanian age includes c3, c4 and d members. The e and f members belong to third and fourth sequences with the age of Burdigalian.

1.7. Linking Earth Structure, Sub-surface Deformation and Mass Distribution

Thursday, 12/Sep/2019: 8:30am–10:15am

Location: Hall B

Joint inversion of gravity and seismic data with application to Moho structure of Tibetan plateau

Guangdong Zhao^{1,2}, Jianxin Liu²

¹*School of Geosciences and Info-Physics, Central South University, Changsha 410083, China;* ²*GFZ German Research Centre for Geosciences, Telegrafenberg, A20, 14473 Potsdam, Germany*

We present an improved Parker's formula by firstly introducing a reference interface into the exponential term and then employing the Gauss-FFT method to replace the traditional FFT method. The improved Parker's formula is demonstrated to be of high accuracy with maximum absolute error less than 2 mGal compared with the analytical solution by a synthetic forward model. We apply the improved Parker's formula to Moho interface inversion beneath Tibetan plateau using the latest released Earth model EIGEN-6C4 with spatial resolution of 0.1°. Three parameters, including the proper filter parameter, the reference depth and the density contrast, that control the inversion results must be determined before getting reasonable solutions. We combine seismic data as prior information from previous studies to reduce the non-uniqueness and determine the best inversion parameters by searching for the largest correlation coefficient between the inversed result and the Moho depth derived from seismic tomography. The CRUST1.0 model is adopted to design a horizontally varied density contrast to fit the complex heterogeneous lithosphere. Our inversion results show that the Moho structure under Tibetan plateau is complex with depth varying from 45 km in the eastern plateau to 75 km in the western plateau. This huge difference up to 30 km on Moho depth may reveal the strong uplift and thickening of the crust in the Himalayan-Tibetan orogen and explain the rapid eastward flow of the deep crust. Besides, the Moho undulations are in good agreement with the main tectonic sutures.

Tien Shan modern deep structures and geodynamic processes

Kseniia Nepeina, Elena Bataleva, Anatoly Rybin

Research Station of the Russian Academy of Sciences, Kyrgyzstan (Kyrgyz Republic)

The Kyrgyz Republic is located in a seismic region. Where Tien Shan Orogeny has a relatively young age (about 10 M years) and strong seismotectonic activity. Existing studies with density-velocity-temperature models verify surface manifestation of dynamic processes. For extending the study of seismic site effects and risk reduction in earthquake prone-countries we provide geophysical investigations. Magnetotelluric (MT) studies delineate the nature underneath the deep-seated structures to learn the tectonic and surface processes. We also use KNET data. Seismological Network (KNET) belongs to the Research Station of the Russian Academy of Sciences (RS RAS). KNET consists of 10 broadband telemetric stations equipped with systems REF TEK 130 and sensors Streckeisen STS-2.

I am involved in the project of seismo-electric effects studying in Tien Shan. For these purposes, we designed a small geophone array, called the gradient seismic system. The gradiometry theory (Langston, 2007) is applied. The system consists of GS-20DX geophones coupled with three to get a three-component sensor. A physical model of direct upward seismic waves is suitable to explain deep underground source activation. Gradient seismic system is installed at RS RAS. We are interested in ambient seismic noise.

Afterwards, we are able to select only near-vertical direction waves. We observe variations in geophysical fields during experiments of simultaneous registration by MT and seismic methods. In addition, we found a good correlation between both energy characteristics (electrical and seismic) of deep underground source and lunar-solar tides. Its' correlation gets a better understanding of the evolution of the deep earth.

Mass distribution and thermal field across the Alpine orogeny and its forelands

Cameron Spooner

GFZ, Germany

Although crustal and sub-crustal structures in the Alps are some of the best studied of any orogen in the world, different hypotheses still exist regarding plate architecture and the nature of the subduction system. Additionally, rheological configurations of the different crustal units and lithospheric mantle, isostasy in the orogen-foreland system, and variations of flexural rigidity along and across the mountain belt, are at the present-day, poorly constrained with relation to spatial patterns of seismicity and deformation. The primary goal of INTEGRATE, a project in the DFG priority program Mountain Building in 4 Dimensions, as part of the AlpArray initiative, is to provide insights into these questions by integrating different 3D modelling techniques. Here we present a gravity constrained, 3D, density differentiated, structural model of the Alps and their respective forelands derived from integrating numerous existing geological and geophysical datasets. Results indicate the existence of lateral heterogeneities within the crust of the studied area, particularly in regards to the difference in thickness and density of the European and Adriatic crusts. A positive correlation between these crustal density contrasts and present day deformation maps of the region was identified, a trend not noted prior. Additionally we used the 3D density model together with information on seismic velocities to derive lithologies for the different crustal units and calculate the 3D conductive field of the system. As temperature is a key controlling factor for rock strength we also assess the correlation of temperature variations and deformation within the region.

Lithospheric-scale 3D configuration of the Southern Central Andes

Constanza Rodriguez Piceda^{1,2}, Magdalena Sheck-Wenderoth^{1,3}, Judith Bott¹, Claudia Prezzi⁴, Manfred Strecker²

¹Helmholtz-Zentrum Potsdam GFZ - Deutsches GeoForschungsZentrum, Germany; ²Universität Potsdam, Institut für Erdwissenschaften, Germany; ³RWTH Aachen, Germany; ⁴CONICET, Universidad de Buenos Aires. INGEODAV, Dpto. de Cs. Geológicas, FCEyN, Universidad de Buenos Aires, Argentina

Intrinsic physical properties of the overriding plate govern the formation of zones of crustal strength and weakness and control the localization and the style of deformation. This is especially true in the case of the Nazca plate subduction and formation of the Andes. The Andean orogen led to the formation of a ~7000 km long N-S mountain range developed along the South American margin and it is the only known present-day case of subduction-type orogen. The Nazca oceanic plate subducts beneath the South American continental plate. Previous studies aimed to constrain lithospheric-scale density and structural heterogeneities in the Southern Central Andes, in the Puna and the Chaco-Paraná basin (~20 - 27°S). This study focuses on the southernmost segment of Central Andes (~27° - 40°S), characterized by a strong N-S and E-W variation in the crustal deformation style and intensity. The aim of the project is to investigate the link between the compositional, thermal and rheological heterogeneities in the overriding plate, the geometry of the subducting plate and the deformation style. First, we will characterize the present-day state of the lithosphere, regarding the density variation and configuration of the sediments, crust and mantle by building a 3D-lithospheric model consistent with all available geological and seismic data and the observed gravity field. This is the first step on the way to later also assess the thermal and rheological state of the lithosphere. This project is supported by the International Research Training Group StRATEGY.

The nature of the North-South change of the magnitude of tectonic shortening in Central Andes at Altiplano-Puna latitudes: a thermomechanical modeling approach

Michaël PONS^{1,2}, Stephan SOBOLEV^{1,2}, Sibiao LIU^{1,2}, Constanza RODRIGUEZ PICEDA^{1,2}, Anne GLERUM¹

¹Universität Potsdam, Institut für Erdwissenschaften; ²GFZ Helmholtz-Zentrum Potsdam, Germany

While an orogeny typically involves the collision of 2 continental plates, the Andean orogeny formed in a context of subduction, with the oceanic Nazca Plate sinking under the continental South American Plate. Whereas the subduction has been active since ~180 Ma, the shortening of the Andes initiated at ~50 Ma. Moreover, the ~300 km shortening in the Central Andes in Altiplano at about ~19-21°S contrasts with less than 100 km shortening at ~15°S and ~25°S. This raises the question of the cause of change of the shorten-

ing magnitude. We hypothesize that the difference in the strength of the upper plate causes differences in tectonic styles resulting in variable rates of trench roll-back. The parameters that weakened the continental plate and controlled the tectonic style of the foreland deformation (thin-skin, thick-skin) were investigated previously, without regarding the subduction. This project aims to build on previous work by using the Advanced Solver for Problems in Earth's ConvecTion (ASPECT) to numerically simulate 2D and 3D visco-plastic models of the interaction of the subducting Nazca plate and overriding South America plate. First, we will run high-resolution 2D East-West cross sections along the Altiplano and Puna latitudes. Second, we plan to extend the previous cross-sections to a 3D model of the entire region. Finally, we will update the 3D model of the lithospheric structure in the Puna region developed by our partner project. This project is supported by the International Research Training Group StRATEGy.

Experimental study on the progressive structural change of anisotropic sandstones

Flora Menezes

Martin-Luther-University Halle-Wittenberg, Germany

Deformation of rock masses is a continuous process of matrix and pore space rearrangement. This is a well-known example of a natural event characterized by a multi-scale interdependency between rock (e.g., lithological parameters, bedding, joints) and boundary conditions (e.g., lithostatic confinement, pore pressure variation, deformation rate). In order to investigate this issue, the lithological variation of two sandstones and their mechanical response to effective stress conditions are characterized, considering behavioural changes in dependency of anisotropy effects. Three kinds of triaxial compression tests were carried out by using saturated specimens (14 cm length and 7 cm diameter) drilled in two directions of anisotropy (0° and 90°). The sedimentary rocks are the greyish Trendelburg Beds, a silica cemented subarkose Bunter Sandstone of Triassic Age (porosity of ca. 12 %), and the red-brownish Rotliegend Sandstone, a carbonate and silica cemented sandstone of Permian Age, clearly less porous (porosity of ca. 6 %) and less permeable (3.5×10^{-10} m/s) than the Bunter Sandstone. Despite the randomness of the natural boundary conditions, deformation patterns have arisen and could be correlated to lithological parameters. Both materials present a pronounced brittle behaviour and significant anisotropy effects influenced by coring direction. However, Rotliegend and Bunter Sandstone have shown an inversed anisotropic behaviour and distinct deformation paths by pore pressure changes: they accommodate strain differently. To conclude, this experimental approach is illustrated within application-oriented aspects from the Cluster Project, by considering the Trendelburg Beds as an analogue reservoir host rock for geological CO₂ storage.

Petrological Studies of the Cretaceous sedimentary rocks in the Northern Bida Basin: Implications for Provenance and Diagenesis

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The petrography of the exposed Bida and Enagi formations sandstones, northern Bida Basin, northcentral Nigeria were investigated essentially by petrographic microscope, scanning electron microscope and back-scattered electron microscope images with the aim at determining the provenance, diagenesis and reservoir potential. The detrital petrology shows that both Bida and Enagi formations are composed predominantly of monocrystalline quartz with lesser potassic feldspar and lithic clasts from granitic rocks. The ternary plots based on petrographic data indicate quartzarenite and minor sublitharenite petrofacies sourced from dominant felsic igneous rocks and minor metamorphic of craton interior to orogenic within a tectonically stable passive margin settings. The heavy mineral concentrations revealed the amounts of zircon, tourmaline and rutile which indicate a felsic source rock of originally granitic composition probably sourced from southwestern Precambrian Basement Complex rocks. Various diagenetic features have affected the reservoir quality both creating and destroying porosity. Bida Formation sandstones are characterized by silica overgrowths, clay and iron cements which might have occurred due to compaction, whereas Enagi Formation shows presence of feldspar dissolution and kaolinite rims that have resulted to development of dissolution

porosity. Generally, the porosity types include secondary porosity (sp) as a result of feldspar dissolution and microporosity (mp) found within leached feldspars and rock fragments. In conclusion, the northern Bida Basin sandstones are composed of the quartzarenite to sublitharenite petrofacies sourced mainly from felsic igneous rocks that has been subjected to different diagenetic phases including compaction and cementation and evolution of the pore system which is apparently controlled by diagenesis.

Poster: Petrographic study and spatial mapping of PlioQuaternary volcanism, as well as the extraction of the geological lineaments of the hercynian central massif Morocco

Youssef Eloualali

Faculty of sciences Ben Msik, Morocco

The present work focuses on the petrographic study and spatial mapping of PlioQuaternary volcanism, as well as the extraction of the geological lineaments of the hercynian central massif. It consists of determining the relationship between the anterior faults and the lava emission points.

The microscopic study of volcanic rocks allowed us to highlight various facies: nephelinerich phonolites, nepheline basalts, olivine nephelinites, tephrites, basalts and basanites.

The application of the spatial cartography allowed us to elaborate the map of distribution of the volcanic outcrops and the synthetic map of the geological lineaments.

The confrontation of these data allowed us to highlight a relationship between volcanism and tectonic lineaments. It is likely that the establishment of plio-quaternary volcanism of central Morocco is linked to the replay of the old Hercynian faults of major direction North East-South West.

1.8.-1 Earth Surface Processes and Landforms: archives of climate-tectonic interactions in active mountain belts

Wednesday, 11/Sep/2019: 8:30am–10:00am

Session Chair: Seema Singh

Session Chair: Sarabjeet Singh

Location: Hall B

Tectonic Geomorphology of Jammu and Kashmir region, NW Himalaya

Afroz Ahmad Shah, Nurfadylatul K.H. Roslani

Universiti Brunei Darussalam, Brunei Darussalam

Previous studies have mapped the trends of major Himalayan faults, Main central thrust (MCT), Main boundary thrust (MBT), and Himalayan frontal thrust (MFT) as continuous structures. However, Shah and Malik (2017) showed that both MCT and MBT are cut by a number of faults. Here we extend their work, and further show that a large number of unknown structures exist (mapped herein) in southern portion of the Kashmir basin. These faults are mapped by using freely available satellite data coupled with seismological and centroid moment tensor (CMT) data. We use standard methodology to map the traces of active geomorphic features that includes fault ruptures, triangular facets, faulted ridges, displaced rivers, uplifted and faulted Holocene to Recent terraces and alluvial fans. We use the upthrow, and downthrow blocks to understand the slip-on faults, and this information is combined with CMT data to interpret the fault plane solution on the mapped faults. A number of ~NE-SW trending normal faults also cut through the structural trend of the mountains north of the Kashmir basin, and these are active, which clearly suggested that the entire region is experiencing ~NW-SE extension. This is coeval with the regional compression that has created ~NW-SE trending fold and thrust belt, and suggests that frontal portions in NW Himalaya are mainly absorbing the normal component of regional convergence while as the hinterlands portions are mainly absorbing the oblique component, which is reflected via strike-slip and normal faulting presented here.

Shake it until you make it: 25ka of earthquake deposits from the Central Corinth Rift

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¹Université Grenoble-Alpes, ISTerre, France; ²Institut de Physique du Globe de Paris, France; ³Université de Bordeaux, France

Offshore sedimentary cores in tectonically active locations offer the potential for long, continuous and well-preserved records of past seismic events, and may thus provide important constraints for seismic hazard assessment. The cores of IODP expedition 381 drilled in the Corinth Rift provide an exceptional opportunity to obtain such a record, given their high sedimentation rates (~0.5-3 mm/yr), and location in one of the most seismically active areas of Europe. Here we present our detailed analysis of these cores for the past ~25 ka, in which we aim to identify earthquake-induced deposits and understand their occurrence within the framework of the main fault system. We find that the two Central Corinth Rift drillsites contain abundant homogeneite+turbidite (HmTu) layers, which typically form by earthquakes, tsunamis, and landslides. They are easily identified by a combination of grainsize/–shape analysis and XRF measurements, allowing us to distinguish ~125 HmTu layers at both sites. We correlate the events using their stratigraphy, chemical signature, and absolute age constraints obtained by radiocarbon and Pb/Cs dating. If all HmTu layers represent earthquakes, the corresponding average recurrence time of ~200 years is comparable to estimates for Mw >6 earthquakes occurring in the western and eastern Corinth Rift. HmTu layers are more frequent within the pre-Holocene interval, suggesting either a lower threshold to record earthquakes, or an increase in non-seismic landslides during colder periods. We compare our findings to the historical seismic record to discuss rupture scenarios, as well as possible implications for seismic hazard assessment in the Central Corinth Rift.

Monitoring surface deformation in the Suketi basin of Himachal Pradesh: An active tectonic perspective

Angel Caroline Johnsy¹, Sarabjeet Singh^{2,3}, Alessandra Budillon¹, Gilda Schirinzi¹, Tejpal Singh³

¹University of Naples, Parthenope, (ITALY); ²Department of Geology, Panjab University, Chandigarh-160014 (INDIA);

³CSIR-Central Scientific Instruments Organisation, Chandigarh-160030 (INDIA)

The continued convergence of the Indo-Asian plates is manifested by deformation of the Himalayan sequences. The manifestations are commonly observed as occasional seismic activity and surface topographic changes. The surface topographic changes, if captured accurately, are better markers to assess the continuous subtle deformation that may ultimately lead to a seismic event. In our study we capture the essence of surface deformation using space based SAR investigations and validate it through geomorphic and ground investigations. The introduction of new Synthetic Aperture Radar (SAR) sensors for remotely observing the earth has become an effective measure in dynamic monitoring. In particular, SAR tomography which is a multi-baseline and multi-dimensional imaging technique that exploits complex-valued data, provides a full 3D estimation of the distribution of scatterers along the elevation direction and also temporal and thermal deformation contribution (5D). For the Suketi basin, the main objective is to perform 5D reconstruction using both the ascending and descending passes. This would potentially eliminate any insensitivity to the geological faults with parallel displacement to the line of sight (LOS) by utilizing stack of satellite images of the same scene but differing in time. The estimated spatial distribution of displacements throughout the Suketi basin which is of the order of few mm/year would allow the active tectonic characterization of the basin and its geological structures. This would be extremely important to the settlements there and would serve pivotal in any emergency response.

Active Faults of the Sub-Himalayan belt in NW India in context of the 1905 Kangra earthquake.

Tejpal Singh¹, Riccardo Caputo², Seema Singh³, Gurmeet Kaur³

¹CSIR-Central Scientific Instruments Organisation, Chandigarh, India; ²Department of Physics & Earth Sciences - TectoLab, University of Ferrara, Ferrara, Italy; ³Department of Geology, Panjab University, Chandigarh, India

The Sub-Himalayan belt of NW India from Kangra to Dehradun puts forth an exceptional area of most conspicuous lateral variations in terms of the spatial coverage of the sedimentary sequences. The area has been previously analysed for its correspondence of the lateral variation in surface topography, structural geometry and seismicity patterns. Structurally, the predominant features are thrusts oriented normal to the tectonic transport direction. However, there are a large number of fractures, faults and fold trending normal to oblique to the longitudinal thrusts. These together make the tectonic setting intensely complex. In this report we present active faults that display surface manifestations of lateral motion offsetting prominent geomorphic markers and drainage lines. The sense of motion is consistent with the obliquity these structures display in relation to the tectonic transport direction. The fault plane solutions from this seismogenic zone also show thrust faulting with strike slip motion along gently dipping planes. We propose to discuss the role of these lateral offsets in terms of accommodation of tectonic convergence across different segments and their role in the overall seismic hazard scenario. This is extremely important when seen in context of the last major earthquake i.e. 1905 (M_w 7.8) Kangra earthquake that is now more than a century old.

Shallow subsurface fault identification and implication for neotectonic activity in cratonward part of the middle Ganga plain, north India

Aditya Kumar Verma, Pitambar Pati

Indian Institute of Technology Roorkee, India

The middle Ganga plain (MGP) is a part of the larger alluvium filled flexural basin (the Indo-Gangetic basin) whose northern and southern limits are bounded by thrusts and cratonic Vindhyan Highlands, respectively with the Ganga River dissecting the plain into northern and southern halves. The southern part (also known as south Bihar plain) is geomorphologically a monotonous plain with subtle topographic breaks devoid of

surficial structures. The alluvium is underlain by two northward dipping basement ridges striking in NE–SW direction, corresponding to which, the basement faults West Patna Fault (WPF) and East Patna Fault (EPF) have been identified in the northern MGP. However, the present study identifies a southward extension of EPF for ~120 km. An integrated methodology including remote sensing and GIS study, geomorphic indices, field study and ground penetrating radar survey has been adopted to acquire the evidence of shallow sub-surface fault in the south Bihar plain. The neotectonic implication of recent fault reactivation has also been explored through this integrated approach. The study also indicates that the Late Quaternary geomorphic evolution of the southern MGP is largely controlled by the tectonics of the adjacent peripheral bulge whereas the Himalayan activity has most influence on its northern counterpart.

1.8.-2 Earth Surface Processes and Landforms: archives of climate-tectonic interactions in active mountain belts

Wednesday, 11/Sep/2019: 10:30am–12:00pm

Session Chair: Gurmeet Kaur

Session Chair: Seema Singh

Location: Hall B

Climate-Tectonic interactions archived in the terrace deposits of the Beas River valley

Sarabjeet Singh¹, Tejpal Singh², Seema Singh¹

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The active mountain belt of the Himalayas is traversed by many large rivers and their tributaries. In the Western Himalaya of India, Beas River is a major tributary of the Indus river system. It cuts across all the major lithotectonic units of the Himalayas viz. the Higher Himalaya, Lesser Himalaya and the Sub-Himalaya from north to south in that order, producing landforms that are proxy to climate-tectonic interactions. In particular, the upper Beas valley exhibits evidence of glacial landforms such as moraines, cirques etc. that are predominantly formed as a response to climate. On the contrary, in the lower reaches of the Beas River, the landforms show variation in the climatic signal often modulated by the tectonic signal. The landforms show predominant sediment aggradation forming large terraces followed by incision. As the fluctuating ISM's (Indian Summer Monsoon) interaction with regional rock uplift (i.e. climate-tectonic interaction) in north-western Himalaya remains poorly understood, the focus of the present investigation is to identify signatures in landforms that are characteristic of climatic and tectonic forcing.

The study reports spatial distribution of terrace surfaces in the Beas River valley. A total of four levels of terraces have been mapped and characterized based on their lithological details. Their genetic linkages with climate and tectonics have been discussed based on their sediment characterization and morphology.

Estimates of rainfall isotopic composition from the clumped and stable isotope ratios in the paleosol carbonates of Eocene (Daghsai formation) period from Himalaya.

Divya Mishra, Seema Singh, Yogaraj Banerjee, Prosenjit Ghosh

Indian Institute of Science, India

The Eocene succession of Himachal Pradesh, India provided a unique display of records showing distinct episodes of withdrawal of the Tethys Sea during India-Asia convergence and the onset of continental sedimentation as a consequence of tectonic amalgamation of Indian and Eurasia. We analyzed stable and clumped isotopes in the carbonates across the stratigraphic section demarcating marine to terrestrial transition. The unconformable bed overlying the marine Subathu formation host paleosol carbonates as a continental climate record. Several carbonate paleosol from the Daghsai formation were analyzed for clumped isotopes. Temperature deduced from the analysis of clumped isotope suggest values between 25° to 70°C. Modern-day paleosol carbonates investigated previously from the region captured an average of 25-40°C, where T°C(47) recorded in the sample reflect the summertime average (Quade et al., 2013). The T°C(47) recorded in our estimates is similar to the Siwalik paleosol carbonates (Quade et al., 2013). Carbonate precipitated within 1 m depth recorded higher temperatures compared to carbonates precipitated underneath 1.5 m. Paleosols in the upper ~1-1.5 m in the section yielded temperatures of <44°C, slightly higher than the T°C estimates made using modern-day soil carbonate from India. We deduced d18O of precipitation which range from -4.4 to -6‰, which is heavier compared to the average monsoonal precipitation isotope data (-6.5‰) from New Delhi precipitation, but lighter than the average value at the Ahmedabad station (-3.2‰). The implication of our observation will be discussed in the context of moisture transport process during the era of pre-Himalayan uplift.

Topographic markers of drainage divide migration: insights from numerical simulation

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³*Department of Geography, Taiwan University, Taiwan*

Drainage divides are geomorphic features that can migrate dynamically until reaching topographic steady states. The location and mobility of divides are essential parts of the Earth surface processes, and thus a key component to understand landscape evolution. However, continuous historical records of divide migration are difficult to obtain. Fortunately, divide migration and the associated river capture can leave some valuable topographic markers even after the subsequent erosion processes, such as re-entrants in the divide (segments that diverge from the main orientation in map view) and the associated depressions in the divide topographic profile (low-elevation segments). Previous studies have mentioned these two markers, but their formation mechanisms are poorly understood. For this reason, we used a numerical model to generate these two markers using the TopoToolbox Landscape Evolution Model. The model consists of a 50 × 100 km domain in which the four edges were fixed to a constant elevation. An initial steady-state topography with a linear main divide was generated by imposing a uniform uplift rate of 0.5 mm/year for 100 Ma. In order to make the migration rate of the divide varies along the divide, model

erodibility was then set to vary along the divide, which caused divide migration. The numerical model demonstrates that difference of migration rate along the divide triggers the formation of re-entrant in divide and the associated depression in the divide profile.

The experimental research on initiation mechanism of debris flow from glacial till

Yongbo Tie, Jintao Jiang, Shuai Wang

Chengdu Center of China Geological Survey, China, People's Republic of

The debris flow initiate by glacial till always danger the local residents and facilities in alpine region in south-west China. The study of initiation mechanism of debris flow initiate from glacial till can help in understanding the development of alpine mountainous landform. In this study, we designed experiments that simulate the initiating process of glacial till eroded by the gully flow, and focuses on the relationship between the glacial till initiating and the critical value of flow velocity.

After the rush of flow with different velocity, the tested glacial till reaches a failure condition (i.e., the movement of certain particle, the undercutting of soil) which was assigned as the evidence for debris flow initiating. Results show that the time duration of debris flow initiation are negative correlated with the velocity of flow, the sediment content in the flood provided a precondition for the formation of debris flow. According to the statistical results of the experiment, the faster the runoff velocity was, the faster the glacial till erosion rate was; and on the contrary, the slower the glacial till erosion rate was. We show that faster the flow velocity was, relatively shorter time the flood took to form, but relatively longer time the debris flow took to start. Finally, our results demonstrate the runoff scouring first leads to the removal of fine particles in glacial till, then the coarse grained soil was unstable due to the loss of foundation support and it initiated to form debris flows.

1.8.-3 Earth Surface Processes and Landforms: archives of climate-tectonic interactions in active mountain belts

Wednesday, 11/Sep/2019: 3:00pm–5:00pm

Session Chair: Tejpal Singh

Session Chair: Gurmeet Kaur

Location: Hall B

Seismic scenario map of Jammu and Kashmir, NW Himalaya

Afroz Ahmad Shah, Haafiezah B.M.B. Shah, Nurhafiza B.H.A. Manan, Zainul Farhan B.H. A. Jamil

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The work presented here shows the first earthquake scenario map of Jammu and Kashmir region, NW Himalaya. In our calculations we use published, and newly mapped fault length for fault-rupture-length, because it provides a simple way to estimate the overall earthquake potential of the region. The downdip width (W) is derived from estimates of the dips of the faults and the depth of the brittle-ductile transition, which is mainly available from the previous published seismic sections and the data that show Moho depths. The dips of the faults are estimated based on the available centroid moment tensor (CMT) catalogue data and structural data, elsewhere, we use conventional dips of 30° , 60° , and 90° for thrust, normal and strike-slip faults, respectively. The seismogenic thickness of both the continental lithosphere, which is the depth to the brittle-plastic transition boundary, is potentially limited to ~ 15 - 20 km depth. We have analyzed all the major faults in NW Himalaya, and our map shows that most of these faults are capable of producing moment magnitude (M_w) 7.0 and above. These faults are mostly thrust faults and release the inter-seismic strain that develops over the geological past because of the continuous push of Indian Plate, which moves ~ 3 - 5 cm/year, against the Eurasian Plate. Therefore, our earthquake scenario map is the first map that shows the magnitude of future earthquakes on all the major faults in the region, and this can be used for evaluation of seismic risk, and the building of earthquake resistant structures.

Tectonic geomorphology reveals active transtensional features in the west of the Karakorum fault (KF), Kashmir Himalayas.

Dk Nurul Azeerah Pengiran Omar, Afroz Ahmad Shah

University Brunei Darussalam, Brunei Darussalam

The work presented here shows a number of newly mapped active normal faults in Jammu and Kashmir region, NW Himalaya. These faults are mostly \sim NE-SW oriented but a number of \sim NW-SE trending faults are also mapped. The faults are mostly restricted to the west of the Karakorum fault (KF), which is the major dextral strike-slip that accommodate the regional oblique convergence of India against Tibet. The fault zones are wider on the eastern portions of the KF, and narrower in the Kashmir Himalayas, which suggested that these faults have possibly formed before, and also after the formation of KF, and are therefore active. The mapping is achieved by using a variety of freely available satellite images that include Google maps, global earth, and global multi-resolution topography where active geomorphic features are traced. This includes mapping of fault scraps, faulted glacial landforms, topographic breaks, deflected drainages, triangular facets, ridge axes offset, and broken Holocene to Recent sedimentary deposits. The clear evidence of extensive normal faulting west of KF suggests the widespread transtension associated with the strike-slip movement on the major fault system that cuts across the Kashmir Himalaya and roots from the KF. Such a fault system has not been mapped previously, and herein we show that large scale strike-slip faults do occur in Kashmir Himalaya, which are responsible for the observed transtensional tectonic structure.

Locating active fault in Upper Ganga Plain: A Remote Sensing and Digital Elevation Model Based Study

Ankit Gupta, Pitambar Pati, Chinmay Dash

Indian Institute of Technology Roorkee, India

The Ganga plain is one of the largest and tectonically most active alluvial plain in the world. It is limited in the North by Himalayan Frontal Thrust (HFT) and in South by peripheral bulge of peninsular part of Indian plate. Several basement faults and ridges traverse its basement and due to Compressional forces in the north south direction the sediment cover of Ganga plain shows several geomorphic indicator of tectonic activity. This tectonic activity also shows its effect on the Rivers of Ganga Plain. In this remote sensing and Digital Elevation Model based study we have identified and delineate a tectonically active fault parallel to the Himalayan trend in Upper Ganga Plain. This Fault shows its effect on the drainage of the Ganga Plain crossing it like channel Offsetting, change in sinuosity, drainage convergence etc. Earlier Studies have shown that the rivers and streams change their course due to tectonic activity in the area. The Digital Elevation Model (DEM) of the area created by using SOI toposheets (1:50000 scale) also shows morphostructural changes like Cliffs and significant change in slope of the area in the upthrown and downthrown block.

Seismotectonic Insights into Recent Deformation and the Role of Inherited Structures for the Evolution of the Central Andean Foreland

Martin Zeckra¹, Frank Krüger¹, Germán Aranda Viana², Emilio JM Sutti², Ahmad Arnous^{1,3}, Manfred R Strecker¹, Fernando Hongn²

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The orogenic history of the Central Andean Foreland incorporates a superposition of multiple tectonic stages with diverse spatial impact. In particular the Santa-Bárbara-System, a morpho-structural province of the NW Argentine Andes, demonstrates how inherited structures are recycled and overprinted and present a high crustal seismicity of significant magnitude up to M7.

Recently, the need for a better understanding of the neotectonic setting at the Andean mountain front became obvious in 2015, when a Mw 5.7 earthquake hit the town of El Galpón in the Salta Province. For this reason, we installed a local seismological network around the estimated epicenter and noteworthy geological structures. We were able to collect 15 months of continuous data from 13 stations showing numerous earthquakes at different depth levels. Events from crustal seismogenic zones can be clearly distinguished from intermediate (~200km) and very deep (~550km) slab related seismicity.

Besides the separation of spatial seismicity clusters, the identification of active seismotectonic structures and their geometries is crucial for understanding the complex multi-stage evolution of the foreland. The studied region comprises Quaternary structures as well as reactivated inherited structures from a long-lasting, altering tectonic history. Further, the integration of geomorphological and applied geophysical analyses of the shallower part of these structures deepens their understanding. In particular, seismic-refraction and 2D electrical resistivity tomographies were carried out for a number of suspected surface fault locations.

The presented study complements the general comprehension about a part of the Andean foreland, which incorporates geological, lithological, and small- and large-scale tectonic transition zones.

Poster: Analysis of climate variability and anticipated risk of glacial lake outburst in Sikkim Himalaya, India

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The present study reports climatic variability in Sikkim Himalaya using long term (1990-2017) climate data measured at Gangtok meteorological station. The statistical analysis (Mann Kendall and Sens slope) of climate data reveals that the region has experienced an increasing trend of mean maximum ($0.031^{\circ}\text{C yr}^{-1}$) and mean minimum ($0.043^{\circ}\text{C yr}^{-1}$) temperatures applied at 95% confidence interval. Whereas, there was no significant trend in total annual precipitation. Further, seasonal analysis of climate data demonstrates statistically significant increasing trend in mean minimum temperature in pre-monsoon ($0.036^{\circ}\text{C yr}^{-1}$), monsoon ($0.031^{\circ}\text{C yr}^{-1}$), post-monsoon ($0.076^{\circ}\text{C yr}^{-1}$) and winters ($0.058^{\circ}\text{C yr}^{-1}$). However mean maximum temperature has increased ($0.069^{\circ}\text{C yr}^{-1}$) significantly only in winter season. The detailed analysis exhibits that precipitation has decreased (-1.107mm yr^{-1}) significantly in winter season. The present state of climate change (hotter summer and warmer winters along with decreasing trend of precipitation in winters) in Sikkim has serious implications on glacial environment. This trend of climate change may lead to overall mass loss of glaciers, and thus lake expansion and evolution of newer lakes in the region. Previous studies reported presence of 472 glacial and high altitude lakes ($>0.01\text{ Km}^2$) in Sikkim. Therefore, the present scenario underline the need for continued observation, risk assessment, early warning system, and the overall strategic plan using comprehensive multi-model approach to mitigate consequences glacial lake outburst and other glacial hazards.

Poster: Assessment of tectonic and erosional activities in Zanjan region (northwest Iran) using geomorphic and geophysical investigations

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Institute for Advanced Studies in Basic Sciences, Iran

The Zanjan region is the transition between two opposing crustal-scale tectonic movements whose interaction can produce a particular form of active tectonic deformation. In the east side, there is the oceanic-like South Caspian Basin that moves southwest relative to central Iran. This motion is principally accommodated by NW-striking sinistral faults. In the west side, the SW-ward motion of NW Iran relative to central Iran is mainly taken up by NW-striking dextral faults. In Zanjan, signatures of late Quaternary active deformation had been reported by several authors while, there is no evidence of instrumental and/or historical seismicity proportional to this tectonic activity. In the absence of earthquake data, activity of geological structures becomes crucial in evaluating seismic hazard in this particular region. Our knowledge of active faulting in the region is limited to fault traces mapped mainly based on remote sensing observations. In some cases, recognized fault traces cannot be discriminated from the topography of erosional features. This makes active faulting studies a delicate job requiring a combination of geomorphic and geophysical techniques.

We have surveyed a main sector of the Zanjan fault network using magnetic and geo-electric surveys along with direct and remote geomorphic investigations. This multidisciplinary study led us to distinguish erosional features from geomorphic landforms related to Quaternary faulting, and consequently, to revise the active fault map of the region.

These results have major implications for seismic hazard assessment in NW Iran and can improve our image of active faulting geomorphology in regions of relatively low deformation rate.

Poster: Clay gauges in fault zones as evidences of kinematics of active tectonic deformation.

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The Sub-Himalayas is the most tectonically active belt of the Himalayas as it accommodates a major portion (~ 20%) of tectonic convergence between Indian and Eurasian plates. In the present study we focus on an active fault zone of Sub Himalaya in Western India where some of the major fore thrusts and back thrusts cut across this region, making it a complex tectonic setting. The study reports surface rupture, stratigraphic breaks and morphometric anomalies that indicate towards tectonically active deformation zones in this area. Abrupt truncation of geomorphic surfaces along with the deformation of terraces is indicative of active surface deformation. Detailed investigations of clay beds exhibit abrupt disruptions and signatures of deformation. Moreover, disruption in the beds by faulting has exerted enhanced compressive forces that have caused the clay to outflow. The outflowing clays force itself along the fault plane which serves as an excellent proxy to constrain the kinematics and timing of deformation. Microstructural analysis of internal deformation of clay beds also provides important clues to define the direction of movement along the deformation zone. This study ought to establish tectonically formed clay gauges as important active tectonic markers.

Poster: Continental red facies in Himalaya: how reliable to serve an archive for palaeoclimate reconstructions?

Seema Singh¹, Anjali Kumari¹, A. K. Awasthi², B. Parkash²

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The Himalayan foreland basin sediments comprise sedimentary facies which preserve the record of a complex interplay between tectonics, sedimentation, and climate. Paleoclimatic reconstructions from these sediments carried out using multiple-proxy tools. Colour of sedimentary facies is considered as one of diagnostic paleoclimate/climate indicator, wherein researchers have shown association of red colour with the hot, arid climate. Presence of abundant red facies pervasively in these Cenozoic sediments have also been used to as a temporal record of such climate. Detailed field, microscopic, sub-microscopic and geochemical studies of representative Himalayan foreland basin red facies indicate that red colour irrespective of age is not a specific indicator of hot, arid climate and rather depends on various local and regional process-specific conditions at varying spatial scales.

Poster: Effects of spring and autumn prescribed fires on diversity of plant functional groups and establishment of *Agropyron desertorum* in Dehbar rangeland Torghabeh

Saeed Hosseinzadeh Noghondar, Mohammad Farzam, Hamid Ejtehadi

Ferdowsi university Of Mashhad, Iran, Islamic Republic of

Fire is referred as a destructive factor on vegetation, a quick ecosystem modifier, and a cause of landscape heterogeneity. In rangeland Prescribed fires are planned based on climate and vegetation conditions, when the forage species are dormant and noxious plant at full vegetative stage. This research was aimed to investigate effects of spring and autumn prescribed fires on species diversity and plant functional types and establishment of *Agropyron desertorum* Fisch, In Dehbar rangeland of Binalud city, Mashhad. A north facing slope was selected. The spring prescribed fire was performed on 2015, and the autumn prescribed fire was on October 2015. Seeds of *Agropyron desertorum* were sown into the small pits or furrows, in autumn 2015. Seedling emergence and survival were recorded on 28 May 2015 and 21 July 2015 and 15 May 2016 and 16 July 2016. To measure species diversity, canopy cover, richness, density, evenness, and degree of importance of the life forms in control and fire plots, 1m² square plots were established during spring of 2015 and 2016. Establishment of *Agropyron* seedling were up to four times higher in the burnt than control plots. Burning reduced species diversity at both seasons, but PFT diversity increased after the spring burning and reduced after the summer burning treatments. An increase in PFT diversity was due to increase of therophytes and

hemicryptophytes in expense of chamaephytes and geophytes. Prescribed fires may enhance seedling establishment, but at least for the first two years, it can negatively affect vegetation diversity and stability.

Poster: EVIDENCES OF SHEARING IN LOWER SIWALIK SEDIMENTS OF THE SUB-HIMALAYAN BELT AT MORNI HILLS, NW INDIA

Ajay Kumar¹, SEEMA SINGH¹, SOUMYAJIT MUKHERJEE²

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The Morni hills are located in the tectonically active zone of the Sub-Himalaya. The Sub-Himalaya has sedimentary sequences bounded by the Main Boundary Thrust (MBT) in north and the Himalayan Frontal Fault (HFF) in the south and forms part of the Himalayan Foreland Basin (HFB). Like any active foreland sedimentary basin, the HFB sediments are significantly affected by surface and sub-surface processes. Process-specific, unique fabric signatures develop by different stress regimes, characteristic of each process and can provide significant information. Despite this, the effects and intensity of these processes are ignored at local domains and majority of researchers use these foreland basin sediments as the best proxy tools for multiple, regional to global-scale reconstructions: particularly basin analysis and modeling. Therefore, present study is based on identification of process-specific fabrics on the basis of field and microscopic studies of Lower Siwalik sediments exposed at the Morni hills. An effect of shearing on Lower Siwalik sandstones has been observed. Nine pairs of sheared and un-sheared sandstone samples were collected adjacent to each other. The sheared sandstones show sigmoidal structures in mesoscale. This is not the case with the un-sheared samples. Under polarizing microscope, un-sheared sandstone is medium to coarse-grained and angular to sub-rounded in shape with moderate sphericity. Rough disjunctive foliation exists locally. Sheared sandstones are fine to medium grained and angular to sub angular grains with low sphericity.

Poster: Geological factors responsible for anomalously high ground subsidence in parts of Haryana and Punjab in the Indo-Gangetic foreland basin of NW Himalaya, India

Sarabeet Singh¹, Jungrack Kim², Ya-Lun S. Tsai³, Seema Singh¹, Tejpal Singh⁴, Shih-Yuan Lin⁵

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The Indo-Gangetic foreland basin is one of the largest alluvial sedimentary basins. Such basins form world's largest alluvial aquifer systems and are potential sources of ground-water in the plains. Space based InSAR and geodetic measurements employing GRACE data over this basin in Northwest India exhibit rapid subsidence in Punjab and Haryana region. This has been primarily attributed to substantial ground-water depletion. A subsequent study identified another strong local ground deformation anomaly around Ambala-Chandigarh region in northern Haryana. It showed the most significant ground subsidence with maximum cumulative deformation up to 0.2 meters in 3 years (Kim et al., 2018). Further detailed geological investigations reveal that sedimentology and geomorphology of this region are major contributing factors. This region lies in a typical interfan setting, having smaller rivers and dominated by clay sediments. Specific sedimentary facies and architecture resulted in rapid loss of porosity and overall decrease in water storage capacity of basin-fill sediments. At the same time, the smaller rivers present on the surface show insignificant shifting of their courses and undergoing no avulsion thereby resulting in poor connectivity. In addition, there is an absolute lack of any canal network (artificial source/recharge) in the region which is heavily dependent on ground-water for agriculture and other anthropogenic activities. These needs are often fulfilled by the extraction of water through bore wells within the already poor/depleted aquifer system, thereby causing permanent damage to the aquifer system resulting in the observed surface deformation anomaly.

Poster: Role of pre-existing topography in the post-glacial fluvial landforms evolution, Satluj valley, NW Himalaya, India

Shubhra Sharma

IISER Mohali, India

While computing the bedrock incision rate in tectonically active orogen like the Himalaya, it is implicitly assumed that the underlying incised bedrock is genetically related to the overlying alluvium. This assumption may not be applied universally as the majority of the Himalayan rivers are at least of Miocene age and have witnessed multiple cycles of erosion and deposition. Unless we ensure that it not relict topography, the incision rate and hence the crustal deformation inferences may be misleading.

The trans-Himalayan river, Saltuj was investigated river to understand the relationship between the valley-fill sediments and the underlying bedrock topography in the evolution of fluvial landforms. By mapping of the relict channel/fossil valley-fill sequences, geomorphometry, and optical ages, we observed that the bedrock topography is a cumulative expression of multiple cycles of erosion while the post-glacial valley-fill sediments (dated to 14 and 8 ka) represent the most recent aggradation phase. The discreet linear strath terraces and epigenetic gorges represent a combination of climate and tectonically induced mid-Holocene river adjustment particularly in the areas proximal to the local thrusts. Also, the securely dated strath terraces provide the valley wide average incision/uplift rates whereas the epigenetic gorges largely represent climatically controlled focused and local uplift/incision. The study suggests that the morphology of the underlying bedrock must be taken in to account in order to avoid erroneous estimate on incision/uplift rates (crustal deformation) in a tectonically active orogen.

Poster: Role of Late Miocene tectonic event in changing India's climate during tectonic evolution of Himalayan orogen

Seema Singh¹, S Kumar², Asifa Kamboj¹, Manish Kumar¹

¹Panjab University, Chandigarh, India; ²National Institute of Hydrology, Roorkee, India

Tectonic evolution of the Himalayan orogen is believed to have strongly controlled not only evolution but also the inception of the Asian monsoon climate. Since long enormous studies in Miocene Himalayan foreland basin (HFB) sediments restricted researchers to strongly correlate initiation of Indian monsoon climate with Late Miocene Himalayan tectonic upheaval. On the contrary, only few reports show monsoon climate signatures in the Eocene-Oligocene Himalayan sediments, perhaps due only to meagre such studies in pre-Miocene Himalayan sediments. Therefore, early HFB sediments should be first explored for any monsoon signatures and subsequently inception and evolution of monsoon with the Himalayan orogenic events should be investigated for a holistic understanding of relationship between topography/ elevation and rainfall, because this monsoon system has significant socio-economic value. Here we report detailed morphological, micro-morphological and geochemical studies of Oligocene dated Himalayan foreland palaeosols in and around Palampur, located in the Kangra sub-basin of NW Himalaya (India). Amongst various pedofeatures, presences of Fe-Mn oxide and carbonate nodules/ concretions together, as well as together occurrence of illuvial coatings and carbonate in B-horizon are indicative of seasonal climate. Further, alternating wet and dry cycles corroborate well with the calculated MAT and MAP values in these samples. Therefore, it can be concluded that monsoon conditions prevailed during Oligocene- early Miocene time. The submitted work provides additional data for climate change reconstructions during tectonic evolution of the world's youngest and active mountain belt.

Poster: Morphotectonic study of warm climatic terminal fans in the Yamuna-Ganga Interfluvium of the Ganga plain, India

Narendra K. Patel, Pitambar Pati

Indian Institute of Technology Roorkee, India

The terminal fans in the Ganga plain ranging age from early Holocene to present provide important informations regarding climate change and tectonism. Optically stimulated luminescence chronology of the terminal

fan ranging from 2.4 Ka to 9.1 Ka suggests that, these terminal fans were formed in warm climatic conditions. Numerous calcrete layers within fan sequence, limonitised soil horizons and the associated clay mineralogy support their formation in warm climatic regime. These terminal fans preserve a number of paleochannels characterised by salt efflorescence, characteristics of arid climate.

Clay mineral studies by scanning electron microscope from the terminal fans reveals that Illite as the most dominant mineral. Calcrete is ubiquitous and occurs in a variety of forms within the fan sequence and indicate arid environments during fan formation. Three calcrete horizons have been identified between 6.4 to 5.3 Ka attended different stages of development, indicating three warm climatic episodes within the 1100 year duration.

Morphotectonic parameters of the terminal fans suggests channels of fans were tectonically influenced. Therefore, it is believed that not only the tectonics is responsible for formation of the terminal fans, but also influences its channel morphology. Climatic response on channel morphology has been studied through the gradual change in channel-bed facies from proximal to the distal end of the fans. Due to increasing aridity, as evapotranspiration increases the channel strength decreases gradually. Preliminary study of paleochannels and present channels indicate most of the channels are shifting towards NE direction which supports neotectonic activity in the interfluvium.

1.9-1 The Role of Polar Regions in the Earth System

Tuesday, 10/Sep/2019: 1:30pm–3:00pm

Session Chair: Josefina Lenz

Session Chair: Loeka Laura Jongejans

Location: Hall A

Recently ice-free areas of an Antarctic fjord and its colonization: the particular case of the soft-coral *Malacobelemnion daytoni*

Camila Neder^{1,2,3}, Cristian Lagger^{1,2}, Kerstin Jerosch⁴, Ricardo Sahade^{1,2}, Doris Abele⁴

¹Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Instituto de Diversidad y Ecología Animal (IDEA), Córdoba, Argentina; ²Universidad Nacional de Córdoba, Facultad de Cs. Exactas, Físicas y Naturales, Laboratorio de Ecología Marina, Córdoba Argentina; ³Ministerio de Educación de la República Argentina, Argentina; ⁴Alfred Wegener Institut Helmholtz Center for Polar and Marine Research, Department Functional Ecology, Bremerhaven, Germany

At the West Antarctic Peninsula climate change causes rapid frontline retreat of tidewater glaciers, opening new ice-free areas under water and causing meltwater discharges dragging sediments into the water. We aimed to model current habitat suitability of the soft coral *Malacobelemnion daytoni* using Species Distribution Models (SDMs) for two areas differing in ice-free exposure time. We ran with biomod2 R-package, 360 calibrated and evaluated projections (9 algorithms x 20 repetitions for 2 data sets from 2009/10) to build two final models. The first model predicts habitat distribution after glacier retreat based on presence/absence data from Long-term ice-free areas (LTIFA), whereas the other model, which includes data from middle term (MTIFA) and recently ice-free areas (RIFA), predicts the actual current distribution scenario after a complete glacier transition on land. Our results revealed a dissimilar spatial suitability of this soft-coral in areas overlapping in substrate composition and depth and only < 1.3 km apart, but differing in exposure time to open sea conditions due to glacier retreat. Higher abundances and wider depth distribution were found in LTIFA. In contrast, MTIFA and RIFA showed very low abundances or complete absence of the species, respectively. This difference in colonization of the different areas improves the habitat suitability estimation for suspension-feeder assemblages and ecosystem functioning. Using Potter Cove as a natural experiment of community response to glacier retreat and SDM modelling as a tool to understand the system; may help to determine time lag in colonization for Antarctic coastal key species on newly ice-free areas.

Oceanic gateways to Antarctic grounding lines - a study of sub-shelf bathymetry and near-shelf ocean temperatures

Lena Nicola^{1,2}, Ronja Reese¹, Ricarda Winkelmann^{1,2}

¹Potsdam Institute for Climate Impact Research, Germany; ²University of Potsdam, Germany

The floating ice shelves around Antarctica play a key role for the ice flow from the continent into the Southern Ocean, thereby influencing Antarctic sea-level contribution. Being exposed not only to cold atmospheric, but also to relatively warm ocean temperatures, sub-shelf melting is one of the main drivers for the recent mass loss from the Antarctic Ice Sheet. Changes of the ocean water masses within the ice-shelf cavity can enhance melting and thereby accelerate ice flow upstream of the grounding line – where the grounded ice begins to float on top of the ocean. Ocean water masses typically enter the ice-shelf cavities at depth, depending on ocean circulation and wind patterns, sea-ice extent, sub-shelf melting and bathymetry, causing higher melt rates near the grounding lines and less melting or even refreezing towards the ice-shelf front. Troughs and ridges in the continental shelf modulate the access of the deeper, relatively warm water layers to the ice sheet. I here identify potential oceanic gateways and analyse the thermal properties of the ambient water masses, indicating current and potential future vulnerability of the Antarctic Ice Sheet to changes in surrounding ocean temperatures or circulations.

3D radar stratigraphy of the North East Greenland Ice Stream and implications for ice stream variability (*withdrawn*)

Steven Franke, Daniela Jansen

Alfred-Wegener-Institute for Polar and Marine Research, Germany

Fast flowing ice streams are known to contribute in a large proportion to continental ice sheet discharge and contribute therefore to sea level variability, changes in geomorphology and transportation of sediment. In this study we investigate internal layering, stratigraphy and bedrock topography of an active ice stream in North East Greenland. In conjunction with data of physical properties of the EastGRIP Ice Core it enables us to expand insights from a selective data set over a broader area to gain insights into the complex mechanisms governing ice streams.

We acquired airborne radar data at the North East Greenland Ice Stream in the vicinity of EastGRIP Drill Site. The data has been recorded in May 2018 with AWI's Ultra-wideband multichannel radar. A total area of 16000 km² has been mapped with profiles along and perpendicular to ice flow direction. The survey area reaches from 150 km upstream to 150 km downstream of the drilling sites and includes both shear margins and parts of the slow flowing areas adjacent to the ice stream. The data is currently evaluated for bedrock topography and 3D shape of distortion of internal layers.

Our high resolution radargrams provide detailed insights into the bedrock topography. Moreover, we mapped the distortion of internal reflectors within the shear margins of the ice stream in great detail as well as a shift in the north-western shear margin. Outside of the ice

stream large scale fold structures parallel to the main trunk of NEGIS were mapped.

Application of principal component analysis and unsupervised classification (ISODATA) to estimate Arctic sea ice extent using ISRO's SCATSAT-1 data.

Nanaoba Singh Khoisnam¹, Kamaljit Singh Rajkumar², Maisnam Mamata¹, P Jayaprasad³, Maity Saroj³

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Polar-orbiting satellite data are useful in observing and studying long term and seasonal changes of Arctic sea ice extent (SIE). In this study, enhanced resolution SCATSAT-1 data are used to estimate the Arctic SIE. This satellite gives three important parameters- backscattering coefficient (σ_0), incidence angle normalised backscattering coefficient or gamma nought (γ_0) and noise-derived brightness temperature (T_b). The above three parameters are measured in horizontal and vertical polarizations. Therefore, six different datasets per day are available for study at the said resolution. Image analysis technique of principal component analysis (PCA) is applied to highlight different features within an image. A false-colour composite formed using the first three principal components is then subjected to unsupervised classification algorithm (ISODATA) to get a fair distinction between open ocean and sea ice regions. Comparisons between SIE derived from SCATSAT 1) versus SIE from NASA team sea ice concentration thresholded at 30% concentration, and (2) versus EUMETSAT's OSISAF (<http://osisaf.met.no>) SIE for the period (October 2016 to March 2018) are performed. Comparison results show high correlation ($r^2 \sim 0.99$) at 95% confidence level. No statistically significant difference between means of the samples for both the comparisons is found.

Let it Erode: Evaluating the temperature dependence of physical weathering and erosion in "Frozen" landscapes

Donovan P. Dennis¹, Dirk Scherler^{1,2}

¹Helmholtz Centre Potsdam German Research Centre for Geosciences - GFZ; ²Freie Universität Berlin

Ice-dependent weathering mechanisms operating at or below 0°C are important contributors to the breakdown of bedrock material in cold landscapes. These processes (e.g. segregation ice-wedging, freeze-thaw cracking) are sensitive to small changes in temperature, particularly those that bring the bedrock above freezing. Though the nature of this temperature dependence has been well-discussed in the theoretical and

experimental literature, *in-situ* studies linking temperature, physical weathering, and erosion rates remain limited. Unraveling the *in-situ* response of cold landscapes to changing climates is nonetheless important for understanding, on both short and long timescales, how climate contributes to the “deconstruction” of mountains.

We use a unique combination of cosmogenic nuclide geochemistry, numerical modelling, and field observation to evaluate the temperature sensitivity of erosion rates in steep hillslopes, glacier headwalls, and rock walls. To ascertain a paleotemperature for the rock samples, we employ a new application for cosmogenic ^3He , which has recently been shown to diffuse out of mineral grains at rates proportional to temperature. These combined methods therefore provide not only a glacier headwall retreat/erosion rate (^{10}Be), but also a time-integrated temperature for the rock sample (^3He). Both are interpreted using our numerical model, which provides a time-temperature-erosion history for the rock.

Here, we present an evaluation of the sensitivity of cosmogenic nuclide-determined erosion rates and paleotemperatures to variable erosion regimes (constant erosion, stochastic erosion, etc.) using the aforementioned numerical model. Additionally, we present related preliminary findings from several field sites in the western European Alps.

Poster Pitch: Age and geomorphological controls on geo-bio successions in a sub-Arctic glacial forefield (*withdrawn*)

Robin Wojcik^{1,2}, Johanna Donhauser³, Beat Frey³, Anja M. Schleicher⁴, Liane G. Benning^{1,2}

¹GFZ - German Research Centre for Geoscience, Interface Geochemistry, Potsdam, Germany; ²Free University of Berlin, Geochemistry, Berlin, Germany; ³WSL Institute for Snow and Avalanche Research SLF, Forest Soils and Biogeochemistry Rhizosphere Processes, Birmensdorf, Switzerland; ⁴GFZ - German Research Centre for Geosciences, Inorganic and Isotope Geochemistry, Potsdam, Germany

Recently deglaciated areas are unique environments to study the initial development of soils through the alteration of exposed rocks due to weathering and microbial processes. Carbon (C) and nitrogen (N) contents as well as soil pH and soil elemental compositions are thought to be important controls of variations in microbial communities in the early stages of soil ecosystem development. However, the functional linkages between C and N contents, soil composition and microbial community structures remain poorly understood. To address this gap, we studied the correlations between weathering progression, C and N distributions and microbial community structures along a well-dated, 113 years chronosequence in the glacier forefield of the sub-Arctic Fláajökull in south-eastern Iceland. Besides terrain-age since deglaciation, post-deglaciation hydrological and / or slope-related geomorphological disturbances have often been reported to exert a strong influence on patterns of soil development succession in glacial forefields in previous studies. Yet, the relative effect of these two parameters on soil development patterns in glacier forefield has not been quantitatively compared previously. To address this gap, we quantified the relative effects that geomorphological disturbances have on soil development along a shorter transect across a flow channel in the forefield.

Overall, our complementary and interdisciplinary dataset allowed us to develop a generic framework for how co-succession of microbial and geochemical changes lead to soil development in a sub-Arctic glacial forefield. In this contribution, we also discuss to what extent soil development along our chronosequence can be explained as the result of both terrain age since deglaciation and post-deglaciation geomorphological disturbances.

Poster Pitch: The role of permafrost-affected soils in maintaining the integrity of polar regions

Anna Bobrik, Olga Goncharova, Georgy Matyshak, Natalia Petrzhik

Lomonosov Moscow State University, Russian Federation

Polar terrestrial ecosystems and permafrost-affected soils are unique indicators of climate change. The aim of our study was to assess the functional diversity of permafrost-affected soils along the bioclimatic and permafrost transect from the north taiga to the south tundra of West Siberia from such parameters as the soil temperature regime, the composition of soil organic matter and the soil biological activity.

Despite the wide array of changes in both physical (soil temperature and moisture) and biological conditions (vegetation composition, content of labile and microbial soil carbon), our results showed that soil CO₂ flux did not vary significantly throughout transect (north taiga - forest tundra - south tundra). But depth of permafrost table differed significantly. It explains the necessity of adequate assessment of the spatial variability of the active layer thickness as a significant factor influencing regional CO₂ emission.

The lack of easily available carbon for microorganisms is detected in all investigated soils by the Cmic: Corg ratio. The CO₂ flux and the Cmic: Corg ratio are “site-specific” for the research regions and may be used as indicators of environmental changes. Soils represent a unique natural object and ensure the functional diversity and integrity of polar ecosystems. Our results show the important role of permafrost-affected soils in maintaining the structural and functional integrity of terrestrial ecosystems along the polar transect from taiga to tundra in West Siberia.

This research has been financially supported by the project № MK-1181.2018.5 (grant of the President of Russian Federation).

1.9-2 The Role of Polar Regions in the Earth System

Tuesday, 10/Sep/2019: 3:30pm–5:00pm

Session Chair: Josefine Lenz

Session Chair: Loeka Laura Jongejans

Location: Hall A

Organic carbon – how much is stored in ice-rich permafrost?

Loeka Laura Jongejans^{1,2}, Jens Strauss¹, Kai Mangelsdorf², Josefine Lenz^{1,3}, Guido Grosse^{1,2}

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Rapid changes are observed in the Polar Regions. With ongoing climate change, the Arctic will continue to warm approximately twice as fast as the lower latitudes. Vast areas of the Arctic are affected by permafrost where degradation processes such as thermokarst and thermal erosion are expected to increase considerably. Large areas in Alaska and Siberia are covered by ice-rich permafrost, such as yedoma permafrost. These deposits reach a thickness up to 50 m and include large ice-wedges. Thus, warming can trigger deep thaw processes which can mobilize organic carbon well below 1 m soil depth. Consequently, permafrost carbon storage is becoming increasingly vulnerable with ongoing permafrost thaw. Undisturbed yedoma deposits are characterized by relatively high quality organic carbon stored and are presumably highly susceptible for future degradation. We aim to identify the quantity and quality of the organic matter, in order to improve the estimates of the rate and amount of organic carbon that can be released from permafrost thaw with warming.

Mapping permafrost disturbances from Landsat – Sentinel-2 time series: a case study

Alexandra Runge^{1,2}, Guido Grosse^{1,2}

¹Alfred Wegener Institute for Polar and Marine Research, Germany; ²Institute of Geosciences, University of Potsdam, Germany

Landscape changes in the terrestrial Arctic occur on different time scales. We can normally distinguish between gradual and abrupt changes. A high temporal resolution in observations is required to properly monitor both types of changes. LandTrendr is an algorithm originally developed to capture a wide range of forest disturbances and recovery occurrences based on Landsat time series. As optical remote sensing in the Arctic is highly restricted by frequent cloud cover, the number of useable images per summer season is low. However, combining data of multiple optical systems bypasses this limitation. Combining data from Landsat and the newly launched Sentinel-2 mission, enables the use of data from three satellites (L-8, S-2A, S-2B) which shortens the revisit time to less than five days in high latitudes, enhances the likelihood of cloud-free images considerably, and increase the number of images per summer season dramatically. Using both Landsat and Sentinel-2 images will lead to much denser time-series and therefore capturing changes more precisely.

In this case study, we apply the LandTrendr algorithm to Yukechi in North Eastern Siberia. We create a homogenous time series combining both Landsat and Sentinel-2 data to obtain high temporal resolution. We anticipate that the LandTrendr algorithm is transferable to Arctic study areas and that the results will benefit from the temporal resolution when combining Landsat and Sentinel-2. We hypothesize that we can distinguish between different permafrost disturbances, both gradual and abrupt changes, by applying key spectral indices and by adapting the temporal segmentation parameters to permafrost landscape changes.

Modelling past and future peatland carbon dynamics across the pan-Arctic

Nitin Chaudhary

University of Oslo, Norway

The majority of northern peatlands were initiated during the Holocene around 8–12 thousand years ago. Owing to their mass imbalance, they have sequestered huge amounts of carbon in the terrestrial ecosystem.

Distribution of soil organic carbon is widespread and uneven across the pan-Arctic. Recent syntheses have filled some existing gaps, however, the extent and remoteness of many locations pose challenges to develop a reliable regional carbon accumulation estimate. In this work, we employed an individual- and patch- based dynamic global vegetation model (LPJ-GUESS) with dynamic peatland and permafrost functionality to quantify the long-term carbon accumulation rates and to assess the effects of historical and projected climate change on peatland carbon balance. We combined three published peat basal age datasets with independent measurements to form an up-to-date peat basal age surface for the pan-Arctic region which we then used to constrain the model in order to reduce the current and future uncertainties related to the northern peatlands carbon cycle. We divided our analysis into two parts- the carbon accumulation changes detected within the observed peatland boundary and at pan-Arctic scale under two contrasting scenarios (RCP8.5 and RCP 2.6). Our results are largely consistent with published long-term carbon accumulation rates. We found that peatlands will continue to act as carbon sink under both scenarios but their sink capacity is substantially reduced under the RCP8.5 scenario after 2050. The 286 sites within the observed boundary showed similar behaviour as the pan-Arctic scale but their carbon sink capacity would be further strengthened under RCP2.6.

Poster Pitch: Heterogeneity of Yedoma Ice Complex deposits due to regional processes

Torben Windirsch^{1,2}, Guido Grosse^{1,2}, Mathias Ulrich³, Lutz Schirrmeister¹, Alexander Fedorov^{4,5}, Pavel Konstantinov⁴, Matthias Fuchs¹, Strauss Jens¹

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Yedoma Ice Complex is a type of permafrost characterized by high ice content and carbon content of approx. 2 wt%. The high ice content makes it very vulnerable to thawing in terms of global warming. Previously stored organic material becomes available for microbial decomposition, releasing carbon into the atmosphere. But Yedoma deposits might be more heterogenous than previously thought. This is indicated by findings from the Yukechi Alas landscape in Central Yakutia where Yedoma deposits with a lack of carbon for several meters are found. Analysis reveals shifts in regional sedimentary processes as a plausible solution to the found heterogeneity, making it important to further investigate the composition of Yedoma Ice Complex deposits throughout the arctic. Such heterogeneity may change the proposed amount of carbon stored in those deposits but may as well have effects on thaw behaviour and vulnerability to climate warming. Therefore, more information is needed on the scope of such regional influences in order to increase knowledge about the effects of thawing Yedoma on climate change.

Poster Pitch: A new hydrodynamic model for terrestrial run-off in West Antarctic glaciated coves

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Rapid frontline retreat and melting of tidewater glaciers along the Antarctic Peninsula cause surface erosion resulting in a washout of suspended particulate matter (SPM) into coastal surface waters. In Potter Cove, a fjord of ~8.5 km² surface area, meltwater streams transport 23000-39000 tons of eroded sediments per year that disperse into a five meter thick surface layer varying in spatial expansion depending on wind direction and tidal circulation. We addressed the spatial dynamics of the sediment plume in Potter Cove by modelling SPM circulation under different hydrographic scenarios. We applied numerical implementation of the three-dimensional unstructured-mesh model FESOM-C intended for coastal simulations¹. This model is equipped with the high order horizontal advection schemes and rich variety of the vertical turbulence closures based on implemented GOTM turbulence module². The model is based on a finite-volume cell-vertex

discretization and works on hybrid unstructured meshes composed of triangles and quads. Model performance was validated by available observations. Our results reveal that water transportation due to lower velocity values close to the glacier front; retain the SPM inside the cove, so that this inner-cove area is more strongly impacted by sedimentation.

1. Androsov A, Fofonova V, Kuznetsov I, Danilov S, Rakowsky N, Harig S, Wiltshire KH (2018): FESOM-C : coastal dynamics on hybrid unstructured meshes. *Geosci Model Dev Discuss* 2:1–32
2. Burchard H, Bolding K: GETM—a general estuarine transport model. Scientific documentation, Tech. Rep. EUR 20253 EN, European Commission, 2002.

Poster: Age and geomorphological controls on geo-bio successions in a sub-Arctic glacial forefield

Robin Wojcik^{1,2}, Johanna Donhauser³, Beat Frey³, Anja M. Schleicher⁴, Liane G. Benning^{1,2}

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Recently deglaciated areas are unique environments to study the initial development of soils through the alteration of exposed rocks due to weathering and microbial processes. Carbon (C) and nitrogen (N) contents as well as soil pH and soil elemental compositions are thought to be important controls of variations in microbial communities in the early stages of soil ecosystem development. However, the functional linkages between C and N contents, soil composition and microbial community structures remain poorly understood. To address this gap, we studied the correlations between weathering progression, C and N distributions and microbial community structures along a well-dated, 113 years chronosequence in the glacier forefield of the sub-Arctic Fláajökull in south-eastern Iceland. Besides terrain-age since deglaciation, post-deglaciation hydrological and / or slope-related geomorphological disturbances have often been reported to exert a strong influence on patterns of soil development succession in glacial forefields in previous studies. Yet, the relative effect of these two parameters on soil development patterns in glacier forefield has not been quantitatively compared previously. To address this gap, we quantified the relative effects that geomorphological disturbances have on soil development along a shorter transect across a flow channel in the forefield.

Overall, our complementary and interdisciplinary dataset allowed us to develop a generic framework for how co-succession of microbial and geochemical changes lead to soil development in a sub-Arctic glacial forefield. In this contribution, we also discuss to what extent soil development along our chronosequence can be explained as the result of both terrain age since deglaciation and post-deglaciation geomorphological disturbances.

Poster: The role of permafrost-affected soils in maintaining the integrity of polar regions

Anna Bobrik, Olga Goncharova, Georgy Matyshak, Natalia Petrzhik

Lomonosov Moscow State University, Russian Federation

Polar terrestrial ecosystems and permafrost-affected soils are unique indicators of climate change. The aim of our study was to assess the functional diversity of permafrost-affected soils along the bioclimatic and permafrost transect from the north taiga to the south tundra of West Siberia from such parameters as the soil temperature regime, the composition of soil organic matter and the soil biological activity.

Despite the wide array of changes in both physical (soil temperature and moisture) and biological conditions (vegetation composition, content of labile and microbial soil carbon), our results showed that soil CO₂ flux did not vary significantly throughout transect (north taiga - forest tundra - south tundra). But depth of permafrost table differed significantly. It explains the necessity of adequate assessment of the spatial variability of the active layer thickness as a significant factor influencing regional CO₂ emission.

The lack of easily available carbon for microorganisms is detected in all investigated soils by the Cmic: Corg ratio. The CO₂ flux and the Cmic: Corg ratio are “site-specific” for the research regions and may be used as indicators of environmental changes. Soils represent a unique natural object and ensure the functional di-

1.9-2 The Role of Polar Regions in the Earth System

iversity and integrity of polar ecosystems. Our results show the important role of permafrost-affected soils in maintaining the structural and functional integrity of terrestrial ecosystems along the polar transect from taiga to tundra in West Siberia.

This research has been financially supported by the project № MK-1181.2018.5 (grant of the President of Russian Federation).

2.1. Understanding Earth processes through overlapping window of Geophysical, Geochemical and Geochronological testimonies

Thursday, 12/Sep/2019: 8:30am–10:15am

Location: Hall C

Geology and geochemistry of mafic granulites from northern part of Southern Granulite terrain, south India: Implications to petrogenesis and paleotectonic setting.

Jayant Kumar Padhi¹, Chandan Kumar B¹, Kumar Batuk Joshi²

¹Central University of Kerala, India; ²National Centre for Earth Science Studies, India

The granulitic rocks are once part of the deeper crust that has been exhumed to the surface and hence their geochemical characteristics can be used as fingerprints of lower crustal rock units. The current study area is bound between the Kasargod-Mercara-Jaloor Shear zone to the north and Moyar-Bhabani Shear Zone to the south. Geophysical studies indicate the presence of steep gravity gradients in the Mercara Shear Zone which welds the area with Dharwar Craton. Field observations suggest that the granulites show compositional variation and define prominent gneissosity with alternating mafic and felsic bands. The mafic granulites of Karicheri and Perladukkam sections are represented by $\text{Opx}+\text{Cpx}+\text{Hbd}+\text{Bt}+\text{Plag}+\text{Qtz}\pm\text{Gt}\pm\text{Kfs}$ and show calc-alkaline affinity. A basaltic dyke running N-S direction crosscuts the mafic granulites of Karicheri section and represented by porphyritic $\text{Plg}+\text{Cpx}$ and groundmass containing $\text{Plg}+\text{Cpx}$ and a minor amount of quartz. The dyke is tholeiitic. Chondrite-normalized REE patterns of the samples show relative enrichment in LREE with respect to HREE. HREE depletion is more prominent in the Perladukkam granulites. All samples are characterized by negative Eu anomalies except sample V5. The REE chemistry suggests a low degree partial melting of ultramafic protolith with melting depth varying between garnet and spinel stability field. The primordial mantle normalised multi-element diagram displays significant depletion in HFS elements (Nb, Ta, Zr, Hf, Ti and Y) which, in combination with various tectonic discrimination plots attests to a subduction environment.

Provenance of the Campanian-Maastrichtian Sandstone, Northern Bida Basin, North-central Nigeria: Constraints from whole-rock Geochemistry, Detrital Zircon Morphology and Typology

Suraju Adesina Adepoju^{1,3,4}, Olusola Johnson Ojo², Samuel Olusegun Akande³, Bulusu Sreenivas⁴

¹Kwara State University, Nigeria; ²Federal University Oye Ekiti; ³University of Ilorin; ⁴LAM-MC-ICPMS National Facility, Council of Scientific and Industrial Research–National Geophysical Research Institute, Hyderabad 500007, India

The Campanian-Maastrichtian sandstones of the Bida and Enagi formations, northern Bida Basin, north-central Nigeria were analyzed to unravel provenance and paleotectonic settings using sedimentology, geochemistry and cathodoluminescence analysis. Mapped and measured paleocurrent sedimentary structures; planar lamination, planar and trough cross-bedding, compound cosets of strata indicate dominant influence of southwestern and minor southeastern paleocurrent transport directions across basin axis. The geochemical proxies; $\text{Al}_2\text{O}_3/\text{TiO}_2$, $\text{SiO}_2/\text{Al}_2\text{O}_3$, $\text{K}_2\text{O}/\text{Al}_2\text{O}_3$, La/Th, La/Co, Th/Co, La/Sc, Cr/Th, Zr/Nb and Zr/Th revealed sediments' derivation mainly from felsic source rocks. Moreover, chondrite-normalized REE patterns, light REE enrichment, heavy REE flat pattern and negative Eu anomalies can also be attributed to a felsic rock source. Discrimination plots of $\log(\text{K}_2\text{O}/\text{Na}_2\text{O})$ versus SiO_2 , TiO_2 versus $(\text{Fe}_2\text{O}_3+\text{MgO})$, $\text{Al}_2\text{O}_3/\text{SiO}_2$ versus $(\text{Fe}_2\text{O}_3+\text{MgO})$ and $\text{SiO}_2/20-(\text{K}_2\text{O}+\text{Na}_2\text{O})-(\text{TiO}_2+\text{Fe}_2\text{O}_3+\text{MgO})$, La/Y versus Sc/Cr, La-Th-Sc, Th-Sc-Zr/10 indicate passive continental margin paleotectonic settings. A higher Zr/Sc and Zr/Hf ratio with Th/Sc and Zr/Sc binary plot reflects considerable zircon enrichment in the source area. Detrital zircon morphological studies reveal characteristics belong to subpopulations with well-developed pyramid {101} and two

prisms {100} - {110} that fall in P1-P5 subtypes which perhaps indicate changes in the primary sources during depositional history. The prismatic and lamellar detrital zircon types with a well-developed oscillatory zoning observed in Bida Formation is typical of magmatic crystallization whereas distinct populations of short and acicular types in Enagi Formation characterizes preservation of crustal rocks. In conclusion, this integrated

study revealed that main sediment input in the northern Bida Basin Nigeria is from Precambrian Basement Complex with possible mixing from two igneous source materials.

Study of Air Quality in and Around Hydropower Projects in the Alaknanda Basin, Garhwal Himalaya

Bhim Chand, Jagdish Chandra Kuniyal, Pawan Kumar Thakur

G.B. Pant National Institute of Himalayan Environment & Sustainable Development, Himachal Regional Center Mohal-Kullu, Himachal Pradesh (Ministry of Environment, Forest & Climate Change Govt. of India), India

Particulate pollutants below 10 micron (PM_{10}) and gaseous pollutants such as Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Ammonia (NH_3) were monitored. In and around the commissioned hydroelectric project Srinagar Garhwal, PM_{10} concentration was found as low as $88.1 \pm 2.0 \mu g m^{-3}$ ranging from 63.6 to $104.2 \mu g m^{-3}$. On the other hand, Tapovan-Vishnugad Hydroelectric Project (HEP) under construction has relatively higher PM_{10} pollution with a mean value of $104.2 \pm 1.1 \mu g m^{-3}$. It was observed that in and around the Tapovan-Vishnugad HEP the particulate pollutants have crossed the permissible limit ($100 \mu g m^{-3}$) Prescribed by National Ambient Air Quality Standards (NAAQS), India. However, gaseous pollutants except particulate pollutants at each site were well within the permissible limit. The analyzed results were further supported by HYSPLIT modal, CALIPSO and CWT analysis which indicated that both Tapovan-Vishnugad and Srinagar sites of the hydropower projects activities are the major source of particulate pollutants in the region.

Mercury soil contents and associated ecological and health risks in kindergartens and functional areas of the city of Vanadzor (Armenia)

Lilit Sahakyan, Gevorg Tepanosyan, Gayane Melkonyan, Nairuhi Maghakyan, Armen Saghatelyan

Center for Ecological-Noosphere Studies of NAS RA

Mercury (Hg) is a widespread environmental pollutant with crucial health concern. The understanding of mercury spatial pattern in different functional urban areas may provide an essential information for urban pollution and health impact assessment. This paper attempts to: study Hg spatial patterns of Vanadzor (Armenia) urban soils, evaluate pollution and assess ecological (PERI) and health risks for different functional areas.

Totally 355 urban and 18 kindergarten soil samples from Vanadzor's different functional areas were taken during the 2016 summer. The total Hg content was determined using XRF (Empirical mode, Innov-X-5000) following US EPA 6200 method.

Vanadzor soils Hg content varies 0.001-0.29mg/kg, (mean-0.043mg/kg), in kindergarten: 0.025-0.049mg/kg (mean-0.037mg/kg). In kindergartens and 21.81km² of the city area, Hg contents did not exceed local background (LB=0.05 mg/kg). In 4.16km² Hg contents were 1.2-2.15 times higher than LB. Intensive LBV excesses are spatially located in industrial area-close to the Chemical plant and in the residential part. The geo-accumulation (I_{geo}) index showed that uncontaminated or moderately contaminated levels were detected in 2 samples located in industrial and 5 samples- in residential areas. The remaining samples were classified as uncontaminated ($I_{geo} \leq 0$) suggesting the possible natural origin of Hg.

PERI revealed low level in all kindergartens and 22.15 km² of city area. Moderate level observed in 3.85 km² of residential and industrial areas and characterized by mosaic distribution. High level observed only in one sampling site located in residential area close to private homes.

For all samples, non-carcinogenic health risk does not observe both for children and adults.

Mineralogical and geochemical constraints on the genesis of Sn-Ta-Nb mineralization in the Abu Dabbab rare metal granite (Central Eastern Desert, Egypt)

Mabrouk Sami¹, Khaled M. Abdelfadil²

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The Abu-Dabbab stock-like intrusion, which located in the Central Eastern Desert of Egypt, represent one of the typical rare metal granites in the Nubian Shield. We report the results of textural, chemical analyses of Sn–Nb–Ta oxide minerals and whole-rock geochemistry to identify the magmatic–hydrothermal processes that operated during the formation of rare-metal mineralization in the Abu-Dabbab pluton. The Abu-Dabbab pluton consisting of muscovite-albite granites (~ 550 Ma) intruded into older quartz-mica schist, metagabbro-diorites and talc-carbonate schist and serpentinites. The rock-forming minerals are quartz, albite (An₀₋₃), K-feldspar (Or₉₅₋₉₉) and muscovite (Li-phengite). The Nb-Ta oxides are represented by zoned columbite-(Fe), columbite-(Mn) and tantalite-(Mn). Cassiterite, fluorite, Hf-rich zircon and topaz are the main accessory phases. The studied granites are peraluminous (A/CNK = 1.01–1.08) and has distinctive geochemical features (e.g., high Rb, Nb, Ta, Sn and many other HFSE and REE contents, and by extremely low Sr and Ba) typical of rare metal-bearing A-type granites. Moreover, the REE patterns show pronounced negative Eu anomalies (Eu/Eu* = 0.06 and 0.08) and M-type tetrad effect (TE_{1,3} = 1.7 and 2.4), implying extensive open system fractionation via fluid–rock interactions that characterize the late magmatic stage differentiation. The textural, mineralogical and geochemical features argue strongly that the Abu-Dabbab granites could be formed due to extensive fractionation with a significant role of magmatic-hydrothermal fluids rich in F- and Li, which explain the formation of Sn-Nb-Ta mineralization in the Abu-Dabbab rare metal granites.

Poster Pitch: LATE ARCHEAN METABASALTS OF THE WESTERN GHATS BELT, WESTERN DHARWAR CRATON, INDIA

Chandan Kumar Boraiaha, Rashmi Chandan

Central University of Kerala, India

Western Ghats belt (WGB) is one among the four major schist belts in Western Dharwar Craton. Consisting of volcano-sedimentary sequences of older Sargur Group (>3.2 Ga) and younger Dharwar Supergroup (2.9-2.5 Ga), it rests unconformably upon the Palaeo-Mesoarchean gneissic complex. An attempt has been made in this study to understand the geochemical characteristics of the metavolcanic rocks of WGB.

Metavolcanics of WGB are classified as high-Mg basalts (HMB) and basalts based on their MgO and transitional element concentration. HMB are low siliceous and high magnesian compared to basalts. Nb, Ta, Zr and Ti are depleted in basalts compared to HMB. HMB have lower concentrations of total REE than basalts. LREE concentrations of HMB are 19-38 times chondrite, with little LREE enrichment and moderate HREE fractionation. Contrarily, LREE concentrations of basalts are 20-88 times chondrite, with moderate LREE enrichment and slight HREE fractionation. HMBs are characterized by moderate to weak negative Eu anomalies (Eu/Eu* = 0.49-0.75), while basalts are characterized by slightly positive to moderately negative Eu anomalies (Eu/Eu* = 0.76-1.22).

HMB and basalts exhibit enriched LREE patterns, significant negative Nb, Ta, Zr, Hf and Ti anomalies, with relative depletion of HFSE and HREE with respect to LILE and LREE, manifested in terms of LILE/HFSE and LREE/HREE ratios. These features suggest arc magmatism in subduction zone setting for HMB and basalts of WGB. This conclusion is also manifested in Nb/La vs. La/Yb, Th/Yb vs. Nb/Yb and Zr/Nb vs. Nb/Th diagrams, in which studied rocks indicate arc affinity.

Poster Pitch: Air quality behaviour and its sources surrounding to hydropower projects: a case study from the Satluj basin, northwestern Himalaya

Bhim Chand, Jagdish Chandra Kuniyal

G.B. Pant National Institute of Himalayan Environment & Sustainable Development, Himachal Regional Center Mohal-Kullu, Himachal Pradesh (Ministry of Environment, Forest & Climate Change Govt. of India), India

Ambient air quality in terms of particulate matter $<10 \mu$ (PM_{10}), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and ammonia (NH_3) was monitored in the upper Satluj basin under construction of Shongtong-Karcham (450 MW) and commissioned Rampur (412 MW) hydropower projects. PM_{10} ranged from 102.8 to 111.9 $\mu g m^{-3}$ with a mean of $106.4 \pm 1.2 \mu g m^{-3}$ in summer season at Shongtong-Karcham, while at Rampur project it was found from 17.8 to 65.5 $\mu g m^{-3}$ with a mean of $50.9 \pm 6.1 \mu g m^{-3}$. Particulate pollution is high in the under construction project as compared to a commissioned project. While gaseous pollutants like SO_2 ($8.2 \pm 1 \mu g m^{-3}$), NO_2 ($10.2 \pm 0.8 \mu g m^{-3}$) and NH_3 ($11.2 \pm 1 \mu g m^{-3}$) were found relatively high at Rampur compared to Shongtong-Karcham where SO_2 ($7.9 \pm 0.6 \mu g m^{-3}$), NO_2 ($4.8 \pm 0.6 \mu g m^{-3}$) and NH_3 ($8.9 \pm 1.1 \mu g m^{-3}$) were found relatively low. The particulate pollutants crossed its permissible limit ($100 \mu g m^{-3}$) as set by National Ambient Air Quality Standards India; while gaseous pollutants were under permissible limit. HYSPLIT and Concentrated Weighted Trajectory analysis indicates that hydropower project activities have been major local sources of particulate ($>80 \mu g m^{-3}$) and gaseous pollutants; although overall air quality index is good (0-50).

Poster Pitch: Depositional environment and reservoir properties' evaluation of Miocene deposits of Pirallahi oil field

Leyla Shikhova¹, Elza Efendiyeva², Aynur Zamanova³

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For investigation of depositional environment of Miocene deposits of the Pirallahi field, a number of chemical element relations (Ti/Mn, Sr/Ba, Na/K, Na/Ca, Fe/Mn) and various geochemical modules were studied; lithological, petrophysical characteristics and mineral compositions' changes of these deposits were analyzed through the section and over the area. On scanning electronic images, by applying the software package STIMAN 3D, a detailed quantitative analysis of the morphological parameters of mineral particles and pore volume was performed, which made it possible to more reliably assess the reservoir properties of the studied rocks.

According to the results of microfaunistic studies of rocks' samples taken from well №1201 of the Pirallahi field, the presence of a characteristic microfauna indicating the Middle Sarmatian age of sediments was established.

Lithologically, the study area is characterized by predominantly clayey deposits with interlayers of fine-grained sandstones, silts and carbonate differences. In the Sarmatian time, the sediments accumulation occurred during a slow subsidence and the bottom of the basin gradually descended. The increase of the basins' depth was slower than tectonic subsidence.

As a result of performed comprehensive investigations it can be claimed that during the Sarmatian time within the study area existed relatively shallow brackish-water basin (sea shelf). Taking into account the presence of sandy-silty and calcareous-clay rocks with sufficient reservoir properties, they can be distinguished as reservoirs in the section of Miocene sediments, especially for gas saturation.

Poster Pitch: Geochemical Mapping in Namibia (Okahandja Map Sheet)

Ulf Kasuto

Ministry of Mines and Energy, Namibia, Namibia

The Geological Survey of Namibia (GSN) has embarked on a countrywide Regional Geochemical Sampling Program (RGSP). The RGSP started in the year 2000, to establish a National Baseline Geochemical Database of elements in the anthropogenically undisturbed geosphere. The project has to date covered eight (8) Map

Sheets (1: 250 000), across the country.

The RGSP for the Okavango Map Sheet was carried out by sampling stream sediments and soil samples with sampling density of one sample/10 km², based on 1: 250 000 scale Map Sheet Index of Namibia. 2700 samples were collected for this survey. Samples were screened for coarse (< 2 mm fraction) and fine fraction (<180 microns). A representative portion of each sample was milled into a powder of < 64 µm using Agate Ball Mills. The fine fraction were analysed for different element concentrations at the GSN laboratories, using the Niton Energy Dispersive X-Ray Fluorescence Spectrometer (ED-XRF) for 150 seconds.

Data from Niton ED-XRF Spectrometer was interpreted into geochemical maps using Oasis Montaj (GeoSoft), to produce element distribution maps. Elements Sr, Mn and Fe were selected and compared to known crustal abundance values. Sr, Mn and Fe all fall below the known theoretical crustal values. The distribution values of these elements are higher in stream sediments compared to soil samples. Such variation in concentration may be attributed to differences in bedrock lithology in various sample locations. The variations may also be related to biological and climatic conditions in various sample localities.

Poster Pitch: Morphometric of Nebkha and its relationship with some vegetation and sediment factors in Sarakhs region

Mohammad Javad Yousefi¹, Alireza Rashki¹, Mohammad Farzam¹, Mohammadtaghi Kashki²

¹Ferdowsi University Of Mashhad, Iran, Islamic Republic of; ²Agricultural Research Center of Khorasan Razavi Province

Nebkhas are one of the forms of present together plant and wind activities in the areas of transport. The development and distribution of Nebkha in the western city of Sarakhs is a sign of the trapped wind deposits by growing vegetation and affect the performance of prevailing winds in the region.

The prevailing wind is from the North West to the South East. These areas are Influenced the winds of 120 days that Usual in the summer and from Turkmenistan into Iran.

120 nebkhas in 3 sites from the north to the south of this area Examined. Morphology and morphometric parameters requirements such as height, length and mass Nebkha and height, large of diameter, mass, and for each Nabka plant was evaluated. Regression between morphology parameters with morphometric parameters Nebkha were evaluated. Also Sediments tested to determine the sediment texture, mineralogy, PH, EC and granulometry.

The results of mineralogical experiment revealed that Sediment samples every 3 sites were almost the same minerals. The results of experiment sediment texture revealed that much of the sediment Formation sand. The highest correlation was established between plants mass parameters with nebkhas mass. Results of granulometry experiment revealed that index particle size is strongly influenced by plant morphology parameters.

Sediments in these areas have been transported from a distance of about 50 kilometers and likely Sediments sources is South regions of Turkmenistan. The most important factor influencing the mass Nebkha is mass plant and indexes particle size is strongly influenced by plant morphology parameters.

Poster: The Plagiogranites of the Chinese and Tajik North Pamir (withdrawn)

Johannes Rembe¹, Edward R. Sobel¹, Jonas Kley², Renjie Zhou³, Jie Chen⁴, Langtao Liu⁵

¹University of Potsdam, Institut für Erd- und Umweltwissenschaften, Potsdam, Germany; ²Georg-August-Universität Göttingen, Abt. Strukturgeologie/Geodynamik, Göttingen, Germany; ³The University of Queensland, School of Earth and Environmental Sciences, Brisbane, Australia; ⁴China Earthquake Administration, Institute of Geology, State Key Laboratory of Earthquake Dynamics, Beijing, China; ⁵Hebei University of Engineering, Hebei, China

The Pamir salient is a striking feature of the Central Asian topography, forming the western termination of the Tibetan plateau. There is much debate about the continuation of large-scale tectonic units from the Tibetan into the Pamir realm. Oceanic suture zones would seem to be easy to follow over long distances, as they originate from large-scale oceanic basins. However, the remote nature of this region and younger tectonic deformation hinders the continuous tracing of such structures. We have found ophiolitic rocks in the North Pamir-Kunlun domain, west of Kashgar, that belong to a Palaeozoic basin described in the literature as the

Oytagh-Kalai Khumb basin (OKB) or Oytagh rift. There is field evidence that part of the OKB was never completely closed. A thick pile of basaltic lava flows containing pillow lavas, intruded by plagiogranites (dated as early- to mid-Carboniferous) forms the base of the sequence. Late- or post-Carboniferous uplift can be inferred from reduced/eroded Permian strata. Post-Permian, mainly continental sediments and volcanics subsequently filled the remaining basin and connect laterally with the Tarim basin. By comparing mineralogical, geochronological and geochemical data from Carboniferous plagiogranites, we can better understand the lateral extent of the OKB. We show that a direct continuation of the OKB into the Kudi suture, as proposed in the literature, is unlikely. Postcollisional plutons along the Kudi suture in the West Kunlun reveal much older ages than the OKB plagiogranites.

Poster: Mineralization related geo-information extraction and integration from multi-source geo-datasets (*withdrawn*)

Wenlei Wang

Institute of Geomechanics, Chinese Academy of Geological Sciences, China, People's Republic of

Paragenetic association of elements is a natural and important geological phenomenon reflecting the geochemical behavior of elements during proceedings of various geo-processes. Because of intrinsic characteristics, different elements of paragenetic association may also be differentiated. As a result, the respective material sources could be shifted from the original places, and the strength of paragenetic association of elements could be declined. Therefore, study on paragenetic association of elements can help with locating the material source, characterizing migration form, and indicating precipitation conditions. Resulted from complicated and cascade geo-processes, the strength of paragenetic relationship between elements presents variations in space. To examine influences of the strength of paragenetic association of elements on polymetallic mineralization, the current research proposed a data processing procedure, including non-linear regression and multi-fractal analysis on the regression coefficient. This procedure is currently tested in the Duolong mineral district, Tibet, China, and encouraging results can be derived. In this research, a geographically weighted regression (GWR) is currently used to examine the relationships between the Au and Cu concentration in the study area. The variation of the strength of Au-Cu paragenetic association across the space can be derived. Furthermore, the porphyry Cu-Au mineralization related elements and fault-activity indicator elements from geochemical data of stream sediments and geophysical data were integrated by principal component analysis, and the results were further analyzed by spectrum-area model. Identified geochemical anomalies spatially coincident with structural framework not only imply the presence of mineralization but also suggest genetic relationship between mineralization and regional fault structures.

2.2. Archaeological structures as archives: understanding human-landscape interaction

Wednesday, 11/Sep/2019: 5:00pm–7:00pm

Poster Session & Social

Location: Foyer

Poster: Influence of historic charcoal production on forest soils SOM stock in the North German Lowland

Alexander Bonhage, Florian Hirsch, Anna Schneider, Thomas Raab, Alexandra Raab

BTU Cottbus-Senftenberg, Germany, Chair of Geopedology and Landscape Development

Recent findings of more than 4000 relict charcoal hearths (RCH) in the forest district Tauer (Brandenburg, Germany) raise the question to what extent soil properties are controlled by a legacy effect of historical charcoal burning. RCH sites are characterized by a substantial admixture of charcoal fragments of varying particle sizes constituting an anthropogenic addition of carbon to the natural forest soil. Ages of about 250 years proven by dendrochronological dating of larger charcoal pieces on RCHs allow for assessing long-term effects of biochar application on forest soils. In this study, we measured the geometry and SOM content of 20 RCH sites in a selected part of the forest district. The results are the basis for a projection of RCH SOM stocks on a 40 ha forest plot with 120 RCH sites. In the range of statistical uncertainties it is shown that RCHs add between 13 % and 32 % of SOM to the SOM stock of the natural forest soil in the studied plot. These substantial amounts of SOM are so far not recognized by any soil survey or forest soil inventories of SOM and SOC stocks. In light of an increasing amount of studies that detect RCH sites in forests of Europe and the USA in the range of tens- and even hundreds of thousands, the question has to be asked how to address this legacy effect in ongoing scientific discussions about soil carbon stocks, carbon sequestration and the long-term effects of biochar application into soils.

Poster: Landscape analysis on distribution of the basin of the Kur river from prehistoric to Islamic era from the perspective of archaeological studies.

Abouzar Tavakol¹, Reza Nafari², Samaneh Roozegar³, Nasrin Khalaj⁴

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³Payam-e Noor university of Marvdasht; ⁴Marvdasht azad University

The Kur River is one of the main rivers of Marvdasht plain. The river originates from the Dena Mountain, northwest of Fars, and drains parts of Ramjerd and Korbali. Due to the small amount of silt in the right part of the Kur river, there are vast lands that cover about forty thousand hectares. Therefore, a variety of landscapes can be seen in the basin of this river, which has resulted in the creation of species-specific habitats from prehistoric to Islamic periods. The approach of this research is based on archaeological studies that seeks to look at the depth of the terrain of the area in question in order to give an appropriate answer to the role of the environment in shaping the settlements of the Kur River basin. As a result, relying on the role of the natural environment in the formation of habitats, which is probably the most important factor in the landscape of the Kur river basin, it can be partly possible to reconstruct and distribute the establishment patterns of the studied area in this Research. This research was carried out with a field method and with an analytical approach. The study area is the Kur river basin which, in the field method, distributes the patterns of the establishment of the ancient sites, and in the analytical approach, the landscape of the area will be dealt with.

Poster: Distribution of *n*-alkane in wetland sediments provides evidence of biomass burning during Harappan civilization

Vijayananda Sarangi¹, Sayak Basu², Prasanta Sanyal¹

¹Indian Institute of Science Education and Research Kolkata, India; ²Indian Institute of Science Education and Research Mohali, India

Biomass burning is an important component of major biomes as it acts as an ecological forcing factor in controlling the vegetation composition as well as biomass production. Thus long-term paleo-fire records are required to understand the extent to which future fire regimes will affect ecosystem health and the global carbon balance. Unfortunately, paleo-fire proxies such as charcoal analysis, dendrochronology, geochemical analysis of sediments and archaeological relics are often fragmented and difficult to interpret owing to their poor preservation in the natural archives. To resolve the uncertainties associated with the existing paleo-fire proxies, biomarker-based investigations provide a new avenue for gaining insight into the paleo-fire events due to their relatively stable chemical property and low susceptibility to degradation. Therefore, the present study aims to evaluate the potential *n*-alkanes (biomarker) as a paleo-fire proxy. In this context, we measured the distribution of *n*-alkanes in the core sediments collected from the arid Banni grassland (with a history of fire events), located at close proximity to the archaeological site of Dholavira (Harappa Civilization), Northwest Gujarat, India. The *n*-alkane distribution in Banni exhibits a dominance of short-chain homologues (maximizing at C₁₈ homologue) with prominent even-over-odd preference (EOP). The indices calculated from the *n*-alkanes recognise paleo-fire events that have been previously overlooked. To the best of our knowledge, this is the first of its kind study where the ability of the *n*-alkane as a paleo-fire proxy at the archaeological sites of Harappan civilization has been evaluated.

Poster: Land use history of Karula National Park (Estonia)

Varvara Bakumenko¹, Ekaterina Ershova¹, Elena Ponamorenko², Pille Tomson³

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Different types of soil analysis give us an opportunity to make paleoecological reconstructions and research the influence of human activities on ecosystems. It is believed that the slash-and-burn cultivation (SABC) was practiced at least since the Bronze Age. Numerous archaeological cultures were associated with the SABC subsistence based on the evidence for plant cultivation in the absence of agricultural implements. Given the short cropping phase and a long rotation cycle of SABC, it is assumed to have been ubiquitous in the past, affecting many forested landscapes. However, its diagnostic features in the soil were formulated only recently, thanks to the work of Tomson et al (2018) who found sites affected by the SABC in 19th century and localized them in the landscape. A multi-proxy analysis of the historically documented swiddens in sandy soils appeared as 5-10 cm thick, dark-colored "humus" layers with a characteristic scalloped lower boundary. The phytolith content of SABC layers varied from tens to hundreds of thousands per gram of soil, with up to 50% of phytoliths being charred. The SABC layers contained dendritic and/or panicoid phytoliths indicative of in situ cultivation of crops. The palynological signature of swiddens is a pollen spectrum of forest ecosystem with a proportion of fire-dependant taxa. Analysis of documented bog pastures showed high concentration of phytoliths and a pollen spectrum of meadow with a proportion of cereals pollen. The spatial and relief-dependent changes of these diagnostic features were also revealed.

2.3. YES Network Latin America: creating bridges to sustainable development

Wednesday, 11/Sep/2019: 3:00pm–5:00pm

Session Chair: Carlos Cónsole-Gonella

Location: Hall C

Microfabric analysis and poral characterization of microbialites: Yacoraite Formation, Maimará, Jujuy, Argentina

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The Yacoraite Formation (Maastrichtian - Danian) is a key unit in the north of Argentina because it is parent rock and reservoir of hydrocarbons. One of most conspicuous facies association along Yacoraite basing are microbialitic levels that acts as reservoir.

Unlike detrital limestones or crystalline dolomites, the petrophysical characteristics of the microbialites are controlled by the microfabric instead of the granulometry or texture. This can have an impact when estimating the amount of hydrocarbons, the efficiency of recovery and reservoir models. However, until now, the microbialites of the Yacoraite Formation do not have a characterization from a geomicrobiological point of view.

Therefore, this work focused on defining the existing relationship between the microfabric and the pores in the microbialites levels of the Yacoraite Formation outcropping at Maimará locality (Jujuy, Argentina). For this, a detailed study of the microfabric was carried out in order to understand the processes that worked in the formation of the internal structure of the microbialites, and its relationship with the porosity, as influencing factor on petrophysical characteristics.

Studied microbialites present a microfabric composed mainly by the intercalation of micritical laminae, where the superficial precipitation of minerals (mineralization) is the main process of formation. The porosity exceeded 35% of the surface of the samples, and its is practically of syn-sedimentary origin (fenestral). The pores in these deposits are closely related to the microfabric, so their study provides a new tool in subsurface mapping and the evaluation of petrophysical flow units.

Cretaceous-early Paleocene drainage shift of Amazonian rivers driven by Equatorial Atlantic Ocean opening and Andean uplift as deduced from the provenance of northern Peruvian sedimentary rocks (Huallaga basin-Perú)

Christian Augusto Hurtado Enriquez

Pontificia Universidad Católica del Perú

In this study, we investigate the provenance of Triassic–Eocene sedimentary rocks deposited in the northern Peruvian Amazonian basin, based on their Sr-Nd isotopic compositions and U-Pb zircon dating. The Triassic–Jurassic samples have $\epsilon\text{Nd}(0)$ values ranging from -7.9 to -10.0 and main U-Pb zircon peaks at 0.9 – 1.3 Ga (31–33%) and 0.5 – 0.7 Ga (21–28%) that suggest a mixed clastic supply from the Western and Eastern Cordillera or craton within a rift to post rift setting. Samples from the Albian–Maastrichtian interval yield much lower $\epsilon\text{Nd}(0)$ values (-16.8 to -18.6) and a dominance of zircon grains derived from terranes in the eastern most Brazilian Shield (Ventuari-Tapajos (2.0 – 1.82 Ga) and Rio Negro-Jurena (1.82 – 1.54 Ga), thus indicating a cratonic source for these sedimentary rocks. This cratonic drainage developed in response to the late Cretaceous uplift of the northeastern part of the South America craton likely driven by geodynamic processes related to post rift opening of the Atlantic Equatorial Ocean. Finally, the early Paleocene–Eocene sedimentary rocks record the first arrival of Andean detritus in the Amazonian retroarc foreland, with $\epsilon\text{Nd}(0)$ values ranging between -5.6 to -12.0 and up to 16% of the zircon grains yielding ages younger than 120 Ma. The formation of a late Maastrichtian–early Paleocene mountain chain in the Peruvian Andes associated with the onset of provenance from the Andean orogenic belt led to a shift of the Amazon drainage pattern.

GROUNDWATER VULNERABILITY DUE TO SALINIZATION OF THE PACIFIC BEACH AREA IN PANAMA: RIO HATO AND SAN CARLOS USING DRASTIC

Bella Mabel Almillategui

YES Network Panama

The DRASTIC method takes into account the physical characteristics of the hydrogeological framework that affects the contamination potential of the water (Martinez, 1998). The index obtained is used for risk assessment, where both terms are closely related. It classifies and ponders intrinsic parameters, a reflection of the natural environmental conditions (Aller et al., 1987). The method selection is based on the recommendations made in previous studies applied in other countries and on the guidelines provided by the International Association of Hydrogeologists. Information was obtained from public entities, thematic maps of Panama. Data from the samples was obtained privately by Prof. Leonidas Rivera during projects carried out around the Pacific beach area. The vulnerability assessment results are represented in a map showing various homogenous areas with different vulnerability levels.

Assuming that all **permeabilities** are **less than 4 (DRASTIC value of 1)** and all **piezometric heads** are between **1.5 and 5 (DRASTIC value of 9)**, the results show that the net recharge, the nature of the aquifer, the nature of the soil, the topography and the impact of the

saturated zone are the same values of those used in the sample points. This technique is applied to the two study zones. Through the formula that defines the method we identified the **VULNERABILITY** as **MODERATE** and **HIGH** in the aquifers found in the study area, according to the values used. In order to determine the precise vulnerability in the study zones, the areas were divided into cells where the known parameters are applied.

INCIDENCE OF THE APPLICATION OF VINASSE IN THE SOILS OF THE PROVINCE OF TUCUMÁN, ARGENTINE

Germán Llomparte Frenzel

Secretaria de Estado de Medio Ambiente de la Provincia de Tucumán, Argentina, Argentine Republic

The Province of Tucumán (Argentina) has fifteen sugar factories. Eleven of them distill alcohol generating an effluent called „Vinasse“, a product with a high organic and potassium content among other components.

The EEAOC (Obispo Colombres Agroindustrial Experimental Station) carried out numerous studies on the application of vinasse in sugarcane soil, obtaining good results in general lines.

However, the results become unfavorable if the vinasse is applied in soils with moderate salt contents or with the phreatic aquifer near the surface. In these cases, the application of the effluent could raise the saline compromising the productive potential of the soils or affecting the free aquifer.

The problem is that industries applied (generally in small areas) large volumes of vinasse without a clear consideration of the type of soil and the depth of the phreatic aquifer. Which generates one of the biggest environmental problems in the province

This work shows the variation of the environmental parameters before and after the application of the vinasse. The same was carried out by sampling soils and phreatic aquifer in the areas where the different sugar factories applied the vinasse, and making a georeferencing cartography in Q-SIG with the data obtained.

The results obtained show that the east of the province of Tucumán is the area most affected by the vinasse. Where high levels of contamination will not only be limited to soil and water table, but also begin to have possible implications for the health of the population.

Geoparks and heritage conservation: possibilities and advances in the Cretaceous - Paleogene Yacoraite Formation outcrops at Maimará locality (Quebrada de Humahuaca, Jujuy province), northwestern Argentina.

Carlos Cónsole-Gonella¹, Patricio Villafaña¹, Silvina de Valais², Ignacio Díaz-Martínez², Paolo Citton²

¹INSUGEO (Instituto Superior de Correlación Geológica) - Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Universidad Nacional de Tucumán, Argentina., Argentine Republic; ²Instituto de Investigación en Paleobiología y Geología - Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Universidad Nacional de Río Negro, Argentina.

The Quebrada de Humahuaca region, site in northwestern Argentina, is a key area of the Central Andes with a rich archaeological history, besides of plenty of unexploited natural resources and beautiful places. All this richness motivated that this region was recognized as Heritage Site by UNESCO since 2002. One of the most important elements to develop at this region are the geological outcrops. The Quebrada de Humahuaca is characterized by the preservation of rocks ranging since Precambrian to current age, with mostly of the periods represented. Although it exists a relevant background of general scientific knowledge from this region, it lacks a proper study related to geotourism, and its diffusion to community. Our contribution here is about the study and preservation of the Cretaceous - Paleogene strata cropping-out at Maimará locality. These strata are represented by epicontinental sea to continental facies. The main geological unit in this time-lapse is the Yacoraite Formation (Maastrichtian - Danian). At this locality, we found a diverse association of avian, dinosaur and other reptilian tracks, in addition to stromatolites recorded in lagoon facies, suggesting a quite diversity of dinosaurs before the K/Pg mass extinction. Since a few years ago, we are working with the local community and government in a project about geological heritage. At this first stage, we are completing both mapping procedures and conservation strategies of the main track-bearing surfaces around Maimara. We hope that these first stages of work will be base of the proposal the creation of a UNESCO geopark in the early future.

The Interpretation centre at Maimará locality, Quebrada de Humahuaca (Jujuy province, Northwestern Argentina): Linking cultural and natural heritages

Silvana Valeria Urquiza¹, Carlos Cónsole-Gonella²

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Natural interpretation centres are specific locations that work in the aim of heritage protection and diffusion. Beyond the traditional sight of museums, usually „static“, these locations seek the interaction between the visitors and the preserved sites, using modern approaches like stimulation of senses, handling of objects and use of technology. The main goal of this project is the construction of the first cultural and natural interpretation centre in the Maimará locality, at the Quebrada de Humahuaca region. There, we are working linking the local community with the paleontological team and governmental institutions. The natural heritage consists of dinosaur tracks that outcrops in a beautiful place. We are now planning the main location of the interpretation centre, in the first stage of planification of the facilities. The main facility consists of a building divided in two sections. The first one is for reception of tourists, and support media to learn about not only about the geology of the area, if not also flora and fauna and emphasis with the archaeological and cultural heritage. The second one allows the

palaeontological reconstruction of tracks and trackmakers using 3d support media and posters. As support of this project, we expose as successful analogous cases the interpretation centres of archaeological sites in Antofagasta de la Sierra (Catamarca) and Coranzulí (Jujuy).

Plant growth promoting bacteria as an alternative for recovery saline soils for grain crops as soybean

Ana Paula Santos, Carolina Belfiore, María Eugenia Farias

Planta Piloto de Procesos Industriales y Microbiológicos, Argentine Republic

Salinity is a problem that threatens the quality and reduces the production of agricultural soils throughout the world. Argentina is classified as the third country worldwide with the largest area of soils affected by halomorphism. Soybean is one of the crops most affected by salinity and it is of great importance to solve this problem for their high value as food, and for their significance to the national economy. Therefore, the general objective of this work is to change saline soils that today are not suitable for cultivation of soybean in productive and sustainable lands with the use of Plant Growth Promoting Bacteria (PGPB).

We have been isolated, identifying and characterize Extremophile PGPB bacteria from Andean wetland with abilities of colonize the plant rhizosphere and confer beneficial effects such as the production of indole-3-acetic-acids (IAA), aminocyclopropane-1-carboxylate (ACC) deaminase, N₂-fixation and antagonism effects. In addition, it was found that these bacteria keep their properties under higher concentrations of salt being able to ameliorate the germination phase of soybean above double of concentration of salt that the crop normally tolerate. Besides, the bacteria show an antifungal activity against *Macrophomina phaseolina*, a fungus which causes the phenomenon called “carbonaceous rot” the roots start changing their aspect, white to grey, and then the infection progress to all the plant.

These results encourage to continue the studies for the use of Extremophile bacteria as bioinoculant for fight with problems of salinity of soils and fungus which limit the growth soybean crops.

Poster: PanamaSPAN: seismic prospectivity and hydrocarbons of Panama

Karen Vanessa Zimmerman Jimenez

Secretaria Nacional de Energía, Panama

The studies of seismic prospecting, of exploratory and stratigraphic wells carried out, have demonstrated the existence of appropriate geological and stratigraphic structures to advance the development of oil and gas fields in the region of the Panamanian isthmus as well as in the offshore Caribbean and Pacific. The existing database consists of 37 exploratory and stratigraphic wells, more than 20,000 kilometers of 2D seismic lines onshore and offshore, reports of geological surface studies and reports generated by companies that have had exploratory activity in Panama since 1914. The recent studies carried out by the oil services company ION Geophysical consisted of the acquisition of 9,948 kilometers of offshore 2D seismic data, where a single seismic vessel and an array of air guns were used as a seismic source, with the purpose of providing to the Panamanian State with new high quality seismic data with innovative and sustainable technologies to know the oil potential of the area, understand the tectonic framework of the southwest Caribbean and allow the exploration and production companies to evaluate and explore the area before a future bidding round. The acquisition setup was designed to capture the deep reflectors such as basement and moho, and simultaneously preserve the frequencies in the shallow section. For the interpretation of the obtained information, the IHS Kingdom software was used, which allows to elaborate time-depth models, determination of geological horizons and geological structures, thus achieving a more accurate geological-structural interpretation of the subsoil conditions.

3.1. Water use in metal mining – Free drinks for all?

Wednesday, 11/Sep/2019: 5:00pm–7:00pm

Poster Session & Social

Location: Foyer

Poster: Biogeochemical barrier methods that reduce the migration of pollutants in the soil.

Gani Narimonovich Mavlyanov

Institute of Hydrogeology and Engineering geology, Uzbekistan

The aim of the study was the development of a biogeochemical barrier that helps prevent and / or reduce contamination of groundwater with residues of mineral fertilizers and toxic chemicals.

The results of the study. The developed biological product (“Ecological shield”) contains coal waste, clay minerals (bentonite) and introduced microorganisms, useful for agroecocenosis.

The test scheme included the following options: control - lysimeter with a rate of application N200P140K100 - background, a lysimeter with a rate of 15 t / ha of „Environmental Shield“ on the background.

The results of the study showed that the highest value of this indicator was noted in the variant where “Ecological stitching” was introduced at a rate of 15 t/ha, which is 0.52 mEq per 100 g of soil more than in the 2nd quarter of the year.

Analysis of the results showed that the introduction of the “Environmental Shield” on the background N200P140K100 is accompanied by an increase in the total nitrogen content in the soil, and does not have a significant effect on the content of total phosphorus and potassium.

Conclusions: The introduction of the “Environmental Shield” contributes to an increase in the content of organic carbon in the soil. An increase in the “Ecological Shield” application rates is accompanied by a corresponding increase in organic carbon in the aeration zone. The highest content of organic carbon in the soil is achieved with the introduction of the “Ecological Shield” at a rate of 15 t/ha.

3.3.-1 Georesources Management

Tuesday, 10/Sep/2019: 1:30pm–3:00pm

Session Chair: Naoufal SAOUD

Location: Hall C

Addressing the Technical Challenges of Climate Change (*withdrawn*)

Julian Chenin

American Association of Petroleum Geologists (AAPG), USA

With the technical challenges of climate change, it is our social due diligence as energy professionals to understand and communicate the holistic aspects of energy and sustainable development. Technology advances and energy policies have made the “circular carbon” concept, such as carbon capture, utilization and storage (CCUS) and produced water recycling, a focus of sustainable development.

Coal is South Africa’s current source of energy with offshore natural gas, a lower carbon fuel, still in the exploration and development phase. SASOL’s gas-to-liquids plant in South Africa is one of the highest emitters of CO₂ in the world. With the ability to utilize and store approximately 60% of produced carbon emissions, CCUS could help balance South Africa’s energy equation and lead to positive environmental impacts. [1]

Another aspect of energy development is produced water recycling to alleviate water shortages and droughts in not only Africa but also globally. In many instances, studies show that it is more economical to treat produced water to agricultural water standards than to dispose it in the subsurface. [2] An E&P company in West Texas is addressing this by using brackish groundwater, recycling their produced water, and eliminating the use of fresh water. [3]

The primary goal of the AAPG SDC is to broadly communicate the positive economic, environmental and social benefits of the petroleum industry and its collective efforts toward sustainable development. The committee believes that ideas, such as CCUS and produced water recycling, have the potential to significantly improve the management of resources.

Effect of Different Weather Conditions on Soils and Plant Growth Characteristics of Oats and Triticale in Gyeongju region (*withdrawn*)

Tomple Byamungu Mayange^{1,2}, Ik Hwan-Jo¹

¹Daegu University, Korea, Republic of (South Korea); ²Centre of Expertise and Geological Surveys-CEEG

The objective of this present research was to investigate the impact of different weather conditions on soils and plant growth characteristics of oats and triticale in Gyeongju region for three years. The mean temperatures of Gyeongju area from October 2015 to June 2016 and from October 2016 to June 2017 were 10.9 and 10.6°C, respectively, which showed the average temperature range of 4.6 ~ 4.9°C higher than the average temperature for 30 years (average 6.0°C, lowest -3.9°C and maximum 19.4°C). The highest temperatures were observed in June (21.9 and 22.2°C) and the lowest temperatures were 1.5 and 1.0°C, respectively. The total rainfall in the experimental period from 2015-2016 and 2016-2017 was 531.8 mm and 382.5 mm, respectively, and the total average rainfall for 30 years was 514 mm.

The soil was sampled on the field and placed in the oven for physicochemical properties experiments. After laboratory parameters, we found out that in 2016, the pH, OM, EC, T-N and available P₂O₅ were higher than the physicochemical properties of 2015 and 2017. On the other hand, the concentrations of calcium, potassium and magnesium ions were 4.90, 0.66 and 1.28 cmol⁺/kg in 2016 respectively, and slightly increased in 2015 and 2017, respectively.

Heading, flowering, and maturing dates of oats sown in 2017, delayed by two days compared to that of spring 2016, and the plant height, stem length and panicle length of oats and triticale in 2016 were significantly longer than that of 2015 and 2016 due to the different weather and environment conditions.

3.3.-2 Georesources Management

Tuesday, 10/Sep/2019: 3:30pm–5:00pm

Session Chair: Naoufal SAOUD

Location: Hall C

Sustainable mining and value addition through geometallurgical collaboration

Victoria Upindi

Skorpion Zinc Mine, Namibia

The current orebody being mined has had a consistent mineralogy for the past 15 years but recently the plant had difficulty extracting the metal with low recoveries and leach grades. The metal that was being sent from mining was not reaching the bottom line and there was difficulty explaining the metal loss.

The first step was in acknowledging that there was a problem, before one could even begin to identify a solution. A team consisting of a mix between novice and experienced geologists and metallurgists was put together to try and identify the source of the low recoveries. This is where the science of geometallurgy came in because we soon understood that by creating a platform for cross-functional collaboration between geology and metallurgy, not only were we providing better inputs to mine planning the results impacted strategic decision making throughout the value-chain.

We began sharing knowledge with geology explaining mineralogical and structural characteristics of the deposit and metallurgists explain what type of mineralogy the plant was designed to handle.

The result has been an improved recovery as well as improved communication between those that mine the ore and those that process it to final metal. All mining projects come with high risk due to uncertainty in commodity prices, but shared knowledge of the mineralogy and the mineral extraction attributes and plant parameters were identified as tools that could significantly increase confidence in the resource and add value to a resource that was already in the process of being mined.

Geological Environment Suitability Evaluation of Underground Space Development and Utilization

Kai Liu¹, Shanshan Wang², Chaobin Guo¹, Ying Sun³

¹Chinese Academy of Geological Sciences, China; ²Beijing Institute of Geology; ³Beijing Institute of Geological Environment Monitoring

The underground space resource is the third largest field which the mankind can exploit besides the astro-space and the ocean resources. It is the strategic land space resource, and is highly prized by the countries all over the world. Geological environment condition is the basis of underground space development and utilization, which determines the safety of underground space and is the core content of underground space exploitation and utilization evaluation. This paper takes Beijing underground space within sixth ring the development of geological suitability evaluation as an example, considering the regional crustal stability, engineering geological conditions, hydrogeological conditions, environmental geological conditions, unfavorable geological conditions, through the improved analytic hierarchy process, cluster analysis and other methods to calculate and evaluate, the plain area within the sixth ring of underground space geological suitability is divided into four zones, the area was 110.99km², 351.46 km², 201.17 km², 1648.65 km², as a whole, the geological conditions are suitable for the development and utilization of underground space, and the evaluation results can provide guidance and reference for the overall planning of underground space development and utilization in Beijing.

The role of engineering geological mapping in sustainable urban development case study – Outapi, Namibia

Giesberta Naipopya Shaanika¹, Matthys Dippenaar²

¹*Geological Survey of Namibia, Namibia;* ²*University of Pretoria*

While the primary objective of engineering geological mapping is to inform planners, developers and communities of the founding conditions and potential hazards associated with developing certain areas, it also subscribes to the principles of environmental awareness aimed at minimizing the negative effects of development on the environment. For a country that is faced with a growing population and increasing urbanisation, this practice is encourage. A case study done in Outapi in northern Namibia highlighted how components that are essential to the livelihood of the urban inhabitants can be sited to coexist with the natural environment. These include residential areas, industrial areas and commercial centres, roads and other transport networks, water and power connections, sanitation infrastructure, waste disposal sites, cemeteries etc. Soil behaviour was deduced from the mapping and testing conducted in the study area and allowable separations or exclusions were recommended for different sites. Areas that could potentially be sources of construction material were mapped out to ensure that they are not sterilized by developments. Surface water resources and areas with shallow water tables were recommended for exclusion given the risk of contamination posed to groundwater. An engineering geological map was produced, with an ultimate aim of ensuring construction of safe and durable structures, environmental protection as well as preservation of natural resources.

Cities as Resource Repositories- Urban Development vis-à-vis Circular Economy

Vivek Jaisree Mohandas^{1,2}, Henning Wilts²

¹*Alexander von Humboldt Foundation;* ²*Wuppertal Institute for Climate, Environment and Energy*

The growth of urban landscapes with regard to growing population and changing lifestyle has led to intensive extraction of resources. In this work, an attempt has been made to articulate the Urban Mining and Construction Ecology aspects which are vital for the Urban development vis-à-vis Circular Economy. The term Urban Mining refers to the extraction and reuse of materials from the anthroposphere. Construction Ecology can be described as the application of concepts from natural systems and industrial ecology for achieving sustainability in the built environment.

Once the infrastructures approach their End-of-Life (EOL) phase, they are often demolished; materials generated are deemed as wastes and send for disposal and management. But as per the principles of resource conservation and circular economy, wastes from any source should not be considered as an environmental liability to be dealt by legislation or waste management strategies, but as a resource which can be effectively integrated into sustainable circular systems. The extraction and management of these Secondary Raw Material (SRM) resources will reduce the burden on virgin raw materials. Introducing the concept of mining in the anthroposphere is also hoped to facilitate new ways of constructing infrastructures, which will ease the deconstruction process. This work further tries to explore the various components that can be possibly recovered from the anthroposphere, as the infrastructures approach their EOL phase. In addition, this work tries to define the Strength, Weakness, Opportunities,Threats (SWOT) involved in the transition of urban landscapes as repositories of resources for achieving sustainable development.

Characterization of Hydrochemistry and the population perspective in the management of the water in the El Bernal micro-watershed, Mexico

Dulce Oreano, Raúl Pineda, Juan Alfredo Hernández Guerrero

Autonomous University of Querétaro, Mexico

In the alteration chemistry of hydric flow intervene social and nature factors, same that have to be considered to comprehension hydrologic evaluative in a micro-watershed. In this sense the pollution of water, involve anthropic factors as tourist activity and nature processes as characteristics of the soils that affects to vulnerable population in the micro-watershed named El Bernal, located northeast of the city of Querétaro; Mexico. In this context, an analysis of the problematics of the chemistry and water disposition towards pop-

ulation was realized. To address it, physical-chemistry parameters were determine that define the quality water, likewise a sociological study was effected by an application of 30 surveys for rapid valorization and 10 focal interviews, it for knowing the perspective of population for the management of the natural resources and its benefits. The data was processes in a platform of Geographic Information System that permit comprehending the socio-nature spatial distribution. The result defined that in the high of the micro-watershed there is pollution water by mercury (Hg) because of anthropic activities, this involve to population perspective expressed the interested of care of natural resources based on the management of the micro-watershed as an integral tool.

3.3.-3 Georesources Management

Wednesday, 11/Sep/2019: 8:30am–10:00am

Session Chair: Naoufal SAOUD

Location: Hall C 300 Seats

Impacts of Coastal Zone Protection Strategies on Morphological Changes in the Unawatuna Bay Beach Area, Sri Lanka

M. M. G. S. Dilini

University of Peradeniya, Sri Lanka

Unawatuna bay beach area lies along the South-West coastal stretch Sri Lanka. Coastal Zone Management Plan pays an attention on coastline protection due to its vulnerable situation. Even though several strategies has taken to avoid the coastline erosion and beach losses, it seems not success. This study was conducted in order to check whether there is an impact of coastal zone protection strategies on morphodynamics in the study area. The sequential aerial photographs in 1974, 1983 and 1994 and Google Earth images available from 2002 to 2016 were taken to observe critical changes. Field observations, interviews and relevant institutional data were also used for the study. The results showed that, coastal zone protection strategies has become into action after the 1998. Revetment has constructed to avoid erosion during the period. However it had been triggered beach loss at Eastern part while gains had occurred at the Western part of the bay. After the construction of breakwater, about 10,000 m² of beach area had been added to the Western part of the bay from 2013 to 2015 while 10,000 m² of beach area lost at the Eastern part. It could further identified that, sand nourishment also will not make advance. Before the establishment of the sand nourishment in 2015, beach was consist more shingle and pebble materials. However, constructed sandy beach allow less infiltration and friction becomes low causing higher erosion. Therefore it will be better to make implementations after advance investigation in order to avoid the issues in future.

Mechanism of Black Shale Weathering and Its Response to Environment Acidification

Xin Liao, Kangji Wang, Shijie Wang, Xiyong Wu, Bin Li

Southwest Jiaotong University, China, People's Republic of

Water-rock interaction is one of the main driving forces for the evolution of near-surface environment. In order to study the mechanism of black shale weathering and its water-rock interaction characteristics, this paper selects the representative black shale, weathering products and acidic environmental water in the study area. The chemical and mineral composition, microstructure and hydrochemical characteristics under the water-rock interaction are analyzed to study the chemical weathering behaviors of black shale by compositional determination and indoor simulation test. The results show that sulfide minerals contained in the rock, such as pyrite, could produce acid water after oxidation, which may promote the dissolution of the rock-forming minerals, resulting in the changes of mineral composition. It is also prone to produce some secondary harmful minerals to accelerate the structure weakening of the rock mass, such as copiapite and rozenite. The chemical weathering of black shale has caused geotechnical problems due to its weathering products, such as acid environmental water and expansive sulfates. The research results of this paper can also provide a theoretical basis for further research on the chemical weathering law of black shale.

The Effect of Tin Mining Activities On The Soils in Pingel And Environs, Toro, Local Government Area, Northeastern Nigeria

Hauwa Mohammed Aliyu¹, Olawale Oluwafemi², Mahmud Umar Muhammad³, Salamatu Abdullahi⁴

¹Nigerian Space Agency, CGG, Nigeria; ²Nigerian Space Agency, CGG, Nigeria; ³Nigerian Space Agency, CGG, Nigeria;

⁴Nigerian Space Agency, CGG, Nigeria

There is paucity of empirical information on Tin mining effect in Pingel and its Environs. Hence, this study examines the effect of Tin mining activities on the soils of Pingel and Environs, Toro, LGA Local Government Area, Bauchi State Nigeria. Eight (8) rock samples were analyzed under petrographic studies and seven (7)

different soil samples were collected using hand trowel at four different locations namely Mana, Pingel, Doka and Kulfana. The laboratory analysis includes: Thin sectioning, petrographic analysis, geochemical analysis (X-ray Fluorescence Spectrometer (XRF)). The geochemical analysis reveals that 36 trace and rare elements were found in the soil samples. The high concentration values are found in copper, zinc, lead, and zircon ranging between 170 to 300, 79 to 3850, 80 to 1000, 50300 to 650ppm respectively. The lowest value is found in Selenium (Se) with concentration value range between 0.0006 to 0.0001. The impact of heavy metals in the soils have adversely affect the livelihood of the localities, which call for attention in the present research.

Geoinformation Assessment of Malaria Occurrence in Opa Drainage Basin Area, Southwestern Nigeria

Jolaade Oyeremi Oluwafemi¹, Olawale Oluwafemi²

¹Obafemi Awolowo University Teaching Hospital Ile-Ife, Osun State, Nigeria; ²Centre for Geodesy and Geodynamics, Nigerian Space Agency

This study analysed the demographical patterns of malaria in relation to Landuse pattern within Ile-Ife, Nigeria. Data on malaria occurrence (2004-2007) was obtained from hospital records. Field observation, questionnaire and satellite imagery (SPOT 5 XS) were used to ascertain the physical environment of vulnerability to malaria. Remote Sensing and Geographic Information System analytical operations employed with ArcGIS 9.2 software include land-use/land-cover classification, query, overlay and Inverse Distance Weighted (IDW). Data show that there exists spatial variation in the occurrence of malaria with 403 cases. The highest cases recorded at Ilare1 (73), while Yekemi, Akarabata, Okewere1 and Modakeke2 have no reported case. Also, intra-annual variation in the occurrence of malaria shows that highest cases recorded between July and December. The landuse analysis reveals that malaria event varies over space and time with floodplains of Ilode, Esinmirin and Ogbe contributing malaria transmission in Ilode 2, Ilare1 and Iremo 4 respectively.

Environmental Impact of Marble Mining of Igarra Area, Southwestern Nigeria for sustainable development

Mohammed Suleiman Chaanda

Federal University of Petroleum Resources Effurun, Nigeria

The determination of the impacts of marble mining on the environment in Igarra was carried out via the analysis of soil and water samples as geological medium. Seven soil samples, ten water samples and five rock samples were collected. The samples collected were subjected to petrographic and geochemical analysis. The mean concentration of metals in soil from Ekpeshi were Cd (3.254mg/kg), Co (786.554mg/kg), Cu (12.911mg/kg), Ni (18.942mg/kg), Pb (5.5mg/kg), and Zn (28.457mg/kg) while that of the water samples collected from streams, taps and wells were Cd (0.116mg/kg), Co (15.225mg/kg), Cu (0.542mg/kg), Ni (0.276mg/kg), Pb (0.486mg/kg), and Zn (0.742mg/kg). Lead (Pb) showed high concentration of (0.486mg/kg), Ni (0.276mg/kg) and Cd (0.116mg/kg) as against acceptable limits of 0.01mg/l, 0.02mg/l (NIS) and 0.07mg/l (WHO) 0.003mg/l respectively, while in soil it showed high concentration of Cd (3.254mg/kg) compared to the acceptable limit of 0.8 mg/kg set by the Dutch Standard limit for soil. Lead, Nickel and Cadmium are found to be in high concentration in both surface and underground water, and this calls for treating water in the study area before it's used as drinking water via drilling water boreholes by the mining and processing companies operating in the area as a form of corporate social responsibility. Also, the provisions in the mining act should holistically be implemented to safe life and health of the populace of the immediately surroundings.

3.3.-4 Georesources Management

Wednesday, 11/Sep/2019: 10:30am–12:00pm

Session Chair: Naoufal SAOUD

Location: Hall C

THE EFFECTS OF ARTISANAL GOLD MINING ON THE LANDSCAPE OF ITAGUNMODI AND IGUN AREAS, SOUTHWESTERN NIGERIA (*withdrawn*)

Olawale Ayodeji Oluwafemi¹, Oluseyi Johnson Oladepo², Jolaade Oyeremi Oluwafemi³

¹Nigerian Space Agency, Centre for Gesodesy and Geodynamics, Nigeria; ²African Regional Institute for Geospatial Information Science and Technology, OAU,Ife; ³Obafemi Awolowo University Teaching Hospital Ile-Ife, Osun State

Traditionally, the effects of artisanal gold mining have long attracted the interest of geomorphologists both in terms of landforms alteration and biodiversity response to change. In Nigeria, the paucity of GIS-based studies on the effects of artisanal gold mining on the landscape and vegetation within Ilesa Schist Belt have made the assessment of landscape appears intractable. Hence, this study examines the effect gold mining deposit on the landscape of Itagunmodi-Igun Area within Ilesa Schist Belt, Southwestern Nigeria. Data on the miners and methodology used were captured with Focus Group Discussions (FGDs). A GIS-based engineering-geomorphological analysis was conducted using DEM, Geological Information, Soil Characteristics The GIS-based approach predicted the terrain deformation and environmental degradation of the study area. The study showed that over 40% of the entire basin would be impacted by ponds and mounds, 31,536,703 m³ of soil will be displaced and 44 km of stream/river network will be impacted. The result of the NDVI using Landsat 7 ETM+ shows clearly that the values range from 0.19 to -0.31. Mountains and highlands of Itagunmodi-Igun area revealed stressed vegetation cover between 0.11 to -0.31 The study concluded that artisanal mining could cause land and vegetation degradation with consequent loss of biodiversity, ecological modification, and increase in sediment delivery ratio and drainage obstruction within the basin. The study recommended that government should take into cognizance spatial peculiarities, strict practises and monitoring policies on goldfields in Nigeria.

Mapping and Assessment of Gold Mining on the Vegetation of Itagunmodi-Igun Drainage Basin, Southwestern Nigeria (*withdrawn*)

Olawale Ayodeji Oluwafemi¹, Jolaade Oyeremi Oluwafemi²

¹Nigerian Space Agency, Nigeria; ²Obafemi Awolowo University Teaching Hospital Ile-Ife

This study assessed the effect of sediment-hosted disseminated gold mining on the vegetation of Itagunmodi-Igun Drainage Basin, Southwestern Nigeria. This GIS-based approach analyzed vegetation and environmental degradation of the study area. A GIS-based Normalized Differential Vegetation Index was analysed using space-based data between 1972 and 2011 as Input data. The result of the NDVI using Landsat 7 ETM+ 2011 shows clearly that the values range from 0.19 to -0.31. Mountains and highlands of Itagunmodi-Igun area revealed stressed vegetation cover between 0.11 to -0.31. The NDVI was also performed on Landsat imageries of four different epoch: 1972, 1986, 2000 and 2010. Results showed that vegetation index ranged from -0.105 to 0.033, -0.25 to 0.480, -0.313 to 0.19 and -0.29 to 0.5 in 1972, 1986, 2000 and 2010 respectively. The result of the analysis revealed that the study area experienced increase in biomass between 1972 and 1986 but with some areas experiencing outright disappearance of vegetation as indicated by the lower bands of index values in 1972 (-0.105) and 1986 (-0.25). The result showed that the Basin experienced rapid and significant increase in biomass between 2000 and 2010, as indicated by the lower bands of index values in 2000 (-0.291) and 2010 (0.5). The result also revealed that vegetation are impacted along the stream-heads and river channels of the area. The study concluded that artisanal mining could cause land and vegetation degradation with consequent loss of biodiversity, ecological modification, and increase in sediment delivery ratio and drainage obstruction within the basin.

Exploitation of fossil energy resources in eastern DR Congo: environmental issues and prospects for sustainable development.

Josué BAGAYA CHIHYOKA

CREGEM RD Congo and ISPKaziba, Congo, Democratic Republic of the

DR Congo has a great potential of fossil energy whose transformation is an opportunity for the emergence of DR Congo. The strong insufficiency in electrical energy has led to „petro-dependence“. However, this potential is located in a sensitive environment because its exploitation may have severe socio-environmental consequences. It is both a salutary solution and a real threat to Biodiversity. Based on bibliographic data, GIS data (RGC, UNOCHA and MONUSCO database,) processed under QGis and MS Excel, this study focuses on environmental issues, environmental challenges and prospects for sustainable development in the East of the DR Congo. The study shows that the studied area is heavily drained with 133.52m / Km², the waters are highly exposed. Exploitation of hydrocarbons could affect a large part of the biodiversity of which 47.7% of the protected areas, 60% of the national parks, 42.1% of the natural reserves and 46.6% of the hunting grounds, half of the lakes of the country and their exploitable fish stocks estimated at about 40 000T per annum. The gas potential of Lake Kivu remains a threat over 2 million lives despite its current operating model. The exploitation of fossil fuel contributes little to the

national budget. Hydropower would be the best economical and sustainable solution which the potential (100Gw) is largely enough to cover the energy needs of all of Africa. In addition, there are other cleaner energies (solar, wind, geothermal) whose potential in the region is very significant.

THE MIDDLE ATLAS DOMAIN OF MOROCCO: TOWARDS GEOHERITAGE CONSERVATION ALLOWING DEVELOPMENT IN A SUSTAINABLE MANNER

souhail MOUNIR, Naoufal SAOUD, Jaouad CHOUKRAD, Mohamed CHARROUD

Laboratory of Geo-Resources and Environment, FST – USMBA, Morocco

The Middle Atlas offers a wide geodiversity enabling to define specific Geosites. It is elongated on more than 500 km, formed by the pleated Middle Atlas and the tabular Middle Atlas separated by the North Middle Atlas Fault (ANMA).

The tabular Middle atlas is intersected by a N40 directional fracture systems, it is essentially composed by a Jurassic carbonate, provided in the form of layered plateaus and surmounted by quaternary volcanic structures (Cones, Maar, Castings). Limited by the ANMA, the pleated Middle atlas is a culminating chain with more than 3000m and marked by a brittle and supple tectonic, in the form of folds-faults corresponding to anticline ripples that separate for large synclinal depressions.

The Middle Atlas Central offers an important geodiversity that can contribute to strengthening sustainable development, based on identification and geo-conservation of natural sites with geo-morphological, structural, mineralogical, paleontological, archaeological and prehistoric diversity.

The analysis of the socio-economic, cultural and environmental situation highlights opportunities (the great value of the geological heritage), and threats such as structural fragility, insufficient documentation and management from a viewpoint of sustainable development.

That ultimate goal is to provide effective input into policy-making processes of enhancement of the geological riches, by the creation of a management plan in terms of Middle Atlasic georesources. That will in fact, a concret lever for local, regional and national development.

Vermiculture for efficient & responsible waste-management

Marius Andreas Wagner

Technical University Darmstadt, Germany

As population density grows together with Food-, Manure- & other organic products of so-called „waste“, society is in urgent need of efficient, regenerative, economical and simple solution to manage the flow of resources. Meanwhile, Pedosphere has been providing a solution for a rather long time which now comes into human recognition: Eisenia Fetida - This specific wormspecies has adapted throughout the centuries

alongside human agriculture and is able to upcycle our organic waste into black, nutrient-dense soil which is rich and balanced in beneficial microorganisms. Loaden with natural growth hormones this “black gold“ makes plants grow faster, bigger and simultaneously resistant against most pathogenic situations that currently plague modern agriculture. Eventually, groundwater quality, prevention of soil deprivation and erosion and therefore the whole spectrum of biodiversity may profit. Based on the exhaustive research work of Dr. Rhonda L. Sherman, Norman Q. Arancon & Clive A. Edwards possible implementations of Vermiculture Technology into our current infrastructure shall be of our highest concern.

Poster: Biomass Valorization for the Depollution of Medicine’s Rejection

Imane Abourouh, BENCHEIK Imane, abdel dahchour, Souad El Hajjaji

Mohammed V University of Rabat , ENMR, Morocco, Morocco

Water, an essential component of all living organisms, covers about 75 % of earth surface. Unfortunately, actually, much of this water is polluted by household and industrial waste, sewage, and contaminants such as fertilizers, organic chemicals and petroleum. To date, research has been conducted to develop water treatment technologies using renewable resources such as biomass co-products, which are increasingly seen as a credible alternative to the economic and environmental levels. Indeed, these resources offer the advantage of being inexpensive and can be obtained by

operation of co-products from the processing of the plant material. The objective of my work is to study the drug adsorption by treated biomass. This study is divided into two parts:

- Chemical treatment of biomass. An optimization is performed to determine the best chemical treatment. Studied parameters are: concentration, temperature and duration of the treatment.
- The study of the adsorbant capacity of the treated biomass using Dichlofenac drug. An experimental design was carried out to determine the effect of pH, biomass weight and contact time.

Tests conducted under different experimental conditions enabled us to determine ideal chemical treatment conditions for artichoke crushed leaves with NaOH: duration, concentration and temperature.

Various experiments on the adsorbant capacity allowed us to clarify effects of parameters such as pH, biomass amount, contact duration and pollutant concentration (Diclofenac in our case). The most influential parameters are pH, biomass quantity, and interaction of the two. Our tests also allowed us to determine the contact time to obtain a yield of 95 %.

Poster: COMPARATIVE STUDY OF THE MANAGEMENT OF KIVUCIAN LACUSTRINE COAST, CASE OF THE CITY OF GOMA (DRC) AND GISENYI (RWANDA)

KAMBALE KAVYAVU Wisdom Wiseman¹, KAMBALE SIMISI Bienfait²

¹UCNDK/, Congo, Democratic Republic of the; ²Ordre du Géologue Congolais

To achieve the objectives of this writing, the documentary reading related to the subject, accompanied of an analysis of Photographs and resorts to the map library. The field trips accompanied these foreplay as an illustration. Coastal sites are public areas whose management is worthwhile for the well being of the used population. Social development makes lead necessary to consider the development of cultural sites for leisure and other beautiful moments.

Thus, for Lake Kivu, in it’s Northern part, bays justify the existence of beaches in the suitable areas for games. The establishment and development of beaches for common gains; Gisenyi has the public beach and private ones whose management are due to hotels located at lake borders; in Goma, only the hotels dispose of beaches, situation which deprives the natives of these landscapes.

The installation of harbor agencies uses not only the geological conditions but the orientation of the trade winds and other currents too. Now days, for these two cities, only Goma’s is recognized and helped by artisanal sites.

In building of a city, urbanism must categorize spaces in order to classify and assign them to uses according to their geographical location and their bearing.

The management of garbage and wastewater is a parameter limiting the eutrophization of lake and marine

areas.

The edges of Goma are lined with buildings invading the waters opposite Gisenyi. Thus, for these two cities the human activity against the lakesides is seen with more ambler, deteriorating the natural aesthetics of the landscape.

Poster: Environmental impact of the uncontrolled lignite tailings sites in the Neogene basin of Oropos, Northern Attika (*withdrawn*)

Lamprini Arvaniti¹, Evdokia Kampouroglou², Konstantinos Kollias³, Christina Stouraiti⁴

¹National and Kapodistrian University of Athens, Greece; ²National and Kapodistrian University of Athens, Greece;

³National Technical University of Athens (NTUA); ⁴National and Kapodistrian University of Athens, Greece

The objective of this paper is to present the preliminary data of the environmental characterization of the abandoned lignite tailings in the Neogene Oropos basin, northern Attica, Greece. Mining activity in the area of Oropos has lasted for about a century and ceased in the 1960's leaving numerous uncontrolled mining wastes sites. Previous research work in area has shown contamination of Arsenic and other potentially toxic elements in the groundwater. Therefore the aim of this research is to map these disposal sites and study the extent of the contamination in the topsoils in the vicinity of the sites and finally trace the transfer path of the contaminants.

A potential source of contamination is the uncontrolled mine waste sites. Sampling was conducted from piles of old lignite waste, soil and stream sediments. Characterization of samples includes mineralogical analysis by SEM/EDS analysis and XRD and geochemical analysis includes XRF/EDS of the bulk sample and ICP-MS analysis of aqua-regia extracts. Metal leachability from the waste is determined by using the standard test EN 12457-1, -2. Preliminary results indicate high sulfur concentration in the tailings i.e. up to 8 wt.% due to abundant pyrite. Acid Base accounting (ABA) test measurements will be applied in order to investigate the potential of the waste to create acid drainage. Notably the paste pH of the lignite tailings is in the range of 2.7 to 7.9, indicating the locally acid conditions and a large heterogeneity of the waste material.

Poster: The Sustainable Mining Georesources Development in Morocco: Case of the Artisanal Mining Activity in Tafilalt – Figuig Region.

Jaouad CHOUKRAD, Naoufal SAOUD, souhail MOUNIR, Nabil AISSAOUI, Mohammed CHARROUD

FST - USMBA, Fez, Morocco, Morocco

Morocco is located in the North West of the African continent, and characterized by a variety of economic activities such as agriculture, fishing and the mining industry, indeed Morocco is the 3rd producer and 1st world exporter of phosphates.

To equilibrate the resources and the industrial activity in the region of Tafilalt and Figuig, the artisanal mining activity is authorized by the dahir of 1/12/1960, which has created at the same time, the Central Purchasing and Development Center for the Tafilalet and Figuig mining region (**CADETAF**). Under the technical supervision of the Ministry in charge of the mines, the aim of this decision is the collection and the purchase of the artisanal extracted minerals of lead, zinc and barite ores mined from the region, with aids and helps regarding the marketing of these products. In fact, the mining activity occupies the second place in the economy of the region of Tafilalt and Figuig.

The most of exploitation operation are done individually or in the context of cooperatives. Currently, it is recognized that the artisanal mining (**CADETAF**) can no longer develop in the region and that mineralization is becoming deeper, requiring advanced means and methods of development beyond the capacity of artisans. Therefore, it has become necessary to restructure the artisanal mining activity.

Poster: Geological Application in Civil Engineering

Zahra Azareh, Frzad Soltanian

ASTOOREH, Iran, Islamic Republic of

Engineering Geology is a field study between geosciences and civil engineering (geotechnics) that studies the structure and geosynthetics of engineering projects, including the construction of massive structures (large bridges / industrial structures / power plants / Various dams / roads / tunnels and other construction projects), which requires the knowledge and understanding of geological structures in terms of engineering issues. In order to achieve the above goals, the geological engineer of geology / soil mechanics / Hydrology / Rock Mechanics and Geomechanics and utilizing the geotechnical and geophysical experiments, and the results Quantitative and qualitative evaluation of these studies for engineers are offered. It is also possible to use the knowledge of geophysics to identify the suitable sites for damping.

3.4.-1 Challenges and Threats of Heritage Earth “Mitigate by Sustainable Geo-Resource Management

Wednesday, 11/Sep/2019: 10:30am–12:00pm

Session Chair: Bhanwar Vishvendra Raj Singh

Session Chair: RITIKA PRASAD

Location: Hall D

Coastal Management Strategies

Denzel Joseph Van Wyk

University of Namibia, Namibia

With about 40% of the world's human population living close to the coast, there is an increasing concern in conservation of the coastal environment from the rapid increased influence from the human population. Namibia with a 1572km long coast has 6 major towns with a combined population of about 143 000 people living along its coast. This constitutes about 6% of the country's total population which is mainly involved in uranium mining, deep sea diamond mining and fishing. As a result, there have been increasing environmental issues like toxic waste disposal, loss of biodiversity and pollution from these settlements in the coastal environment. Coastal systems are regarded to be more alive and are able to cope with many changes. It is rather the rate of change that poses a more serious threat than the nature of the change. This presentation is thus focused on the reducing of the rapidity of the changes inflicted by the human population on coastal environments through Integrated Coastal Zone Management. Although this strategy has been implemented through a few projects like the Namibian Coast Conservation and Management in the past, its success lies in the continuous re-evaluation and monitoring of its measurable indicators. The presentation will also outline some of the challenges hindering the success of this strategy.

Spatial and temporal analysis of coastal erosion along southern Gujarat, India from 1972-2017: Need for coastal management for a sustainable future.

RITIKA PRASAD

UNIVERSITY OF LUCKNOW, India

Coastal area supports local economics based on fisheries and agriculture, apart from offering diverse opportunities for recreation and tourism. Coastline change detection are critical for coastal resource management, and sustainable coastal development. Rapid climate changes across the globe have contributed to degradation of the coastal environment. Issues of coastal erosion are a global problem. It has been asserted that about 70% of sandy beaches around the world are recessionary. Coastal erosion is probably one of the severe environmental problems facing Indian coast. This phenomenon is particularly more pronounced in western coast along southern state of Gujarat. The current research paper focuses on coastline of Gujarat which over decades has been experiencing minor coastal erosion but the recent situation is becoming fatal and needs further attention. The aim of the study is to monitor and analyse occurrences of coastal erosion in the southern districts of Gujarat from 1972 to 2017. The study area includes districts of Bahruch, Surat, Navsari and Valsad. High resolution satellite imagery are ideal data sources for mapping coastal area for monitoring of erosion along the coast and analysing the changes over a large area. The study suggests that occurrence of erosion over decades has increased and disrupting the fragile ecosystem and its normal functioning. Since the future environmental degradation along these coasts could make it more vulnerable, the paper also seeks to provide various mitigation measures to control coastal erosion for a sustainable future of the overall coastal ecosystem.

Using soil fertility improvement technologies for drought and nutrient resilience on smallholder farms in Zimbabwe

Tariro Gwandu^{1,2}, Florence Mtambanengwe², Katherine Dobson³, Stephen Chivasa⁴, Karen Johnson¹

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⁴Durham University, Biological Sciences Department, Stockton Road, DH1 3LE, Durham, United Kingdom

Severe food insecurity has recently increased in sub-Saharan Africa due partly to climate change and soil degradation. As the global population projection for 2030 is estimated to reach 8.5 billion, with Africa’s population between 1.65-1.71 billion, predictions are that more people will be at high risk of food deficits. Without innovative solutions, the United Nations sustainable development goals, particularly goal number two of eradicating hunger by 2030, will likely not be realised, especially in SSA where about 230 million people are currently facing serious food shortages. Integrated approaches that look at both soil fertility and water management will be fundamental to respond to land degradation as well as to build resilience to climate change. We hypothesise that soil improvement technologies (SITs) involving use of organo-mineral residues such as the water treatment residue (WTR) enhance crop productivity due to improved soil structure (which lead to an increase in water holding capacity) but also due to increased nutrient holding capacity. We will present results based on the evaluation of Aluminium- and Iron based WTRs on soil structure, above and below ground biomass of maize (*Zea mays L.*) and cowpea (*Vigna unguiculata (L.) Walp*) and the interaction of soil structure and root development using X-RCT technique. The research’s impact lies in using local specific “wastes” as SITs to improve nutrient and water use efficiency, and thus enhance drought and nutrient resilience in soils. This work seeks to contribute to the achievement of three sustainable Development Goals (SDGs): SDG1, SDG2 and SDG 11.

Developing a monitoring protocol for the geo-environmental parameters of the Mediterranean Temporary Ponds in Mt. Oiti and Mt. Kalidromo, Greece

Panagiotis Pomonis, Charalambos Vasilatos, Marianthi Anastasatou, John Alexopoulos, Emmanuel Vassilakis, Michael Stamatakis

Faculty of Geology and Geoenvironment, National and Kapodistrian University of Athens, Greece

Mediterranean Temporary Ponds (MTPs) are shallow water bodies with an inundated phase during the autumn-winter period and a dry phase during the spring-summer period. According to the European Union’s Habitats’ Directive, MTPs constitute priority habitats because they host a considerable diversity of flora and fauna species which are often rare and endemic. Field work and sampling of bottom sediments and water was carried out in seven of the MTPs during the dry and wet periods between 2012 and 2014. The study area consisted of two neighboring mounts in Central Greece, Mt. Oiti and Mt. Kalidromo, hosting mountain MTPs. This study aims to propose a monitoring protocol for these (and similar) habitats based on their hydrochemical and geochemical parameters. These types of ecosystems are prone to increased levels of ammonium ions, nitrates and phosphates as a result of decomposition of organic matter. Furthermore, to determine the trophic level of the pond ammonia and phosphorus concentrations in the water need to be specified. Water pH, Eh and conductivity together with total dissolved salts and oxygen saturation in the pond’s water need to be monitored as well. Finally, the fluctuation of the organic matter in the bottom sediments needs to be tested on a regular basis.

This work was supported by the EU frame of LIFE11 NAT/GR/1014 “FOROPENFORESTS”.

Engagement of Farmers in Adaptive Water Governance: Perceptions on the Role of Farmers’ Organization

Mohammad Naser Reyhani^{1,2}, Philipp Grundmann^{1,2}, Saeid Eslamian³

¹Humboldt University of Berlin, Germany; ²Leibniz Institute for Agricultural Engineering and Bioeconomy, Germany;

³Isfahan University of Technology, Iran

Water scarcity and growing social conflicts have led to more request from water users to get effectively engaged in different processes of water governance. This cannot be achieved without proper engagement of farmers as main water consumers whom are expected to compromise relatively more than other water users for reducing water demand in scarce conditions. In this study, we selected the case of Zayandeh-Rud basin (ZRB) in central Iran, where suffers from severe water scarcity, to study: 1) what factors do hinder effective engagement of farmers, particularly, for water demand management, and 2) how different actors perceive the performance and potentials of Farmers’ Organization (FA) as a means to facilitate farmers’ engagement toward water governance in the ZRB. For this order, five participatory workshops have been held to adapt Constellation Analysis method for structuring and integrating various perspectives of multiple stakeholders. As an outcome, a constellation map was jointly-depicted the factors and dynamics of four sub-constellations (water-soil, structural, coordination, and economic). This map clearly explicates the obstacles and hindrances of effective engagement of farmers for a water demand management. Besides, key-actors (N=156) were questioned via a self-administrated questionnaire to comprehend how do they perceive success and potentials of the FA. Appropriately, the results indicated that: 1) all actors have almost homogeneous perceptions on efforts taken by FA, 2) farmers found the taken efforts by FA with a greater impact, and 3) farmers are more optimistic than non-farmers about future contribution of FA towards an adaptive water governance in the ZRB.

The Moroccan Mining Industry: Towards General Sustainable Management System

Naoufal SAOUD, Abdelhafid RACHIDI, Mohamed CHARROUD, Jaouad CHOUKRAD

Sidi Mohammed Ben Abdellah University of Fez - FST- Morocco, Morocco

According to the technological development and that of the New Information and Communication Technologies (NICT), and the evolution of organizational management systems, as well, in front of the new socio-economic factors, and the successive deep international changes, resulting from the globalization, the organization services and structures as well as their process activities (agribusiness industry, automotive industry, infrastructure industry, mining industry...) became more flexible, interactive and virtual. Nowadays, the worldwide mining sector, especially in morocco, marks a radical evolution as productivity and investment regards, which allows it the upgrading of a country characterized by mining vacation to a mining production country. This vision forces a sustainable strategy for improvement in order to position in a market, which is marked by a strong competition. Such a situation encourages the mining companies to cooperate deep changes of their systems of production, as regards energy optimization, quality improvement (products, works...), of safety, of knowledge, of competence, and of industrial performance, while taking account thus the environmental protection. In this paper, we present the actual position of the mining sector in morocco, as regards production, investment, and processing, then we purpose our contribution relation to design a global Management system entitled SDMS (Sustainable Development Management System), ensuring a transition, on which allows the Moroccan companies to get a position into the international mining field.

3.4.-2 Challenges and Threats of Heritage Earth “Mitigate by Sustainable Geo-Resource Management

Wednesday, 11/Sep/2019: 3:00pm–5:00pm

Session Chair: Bhanwar Vishvendra Raj Singh

Session Chair: RITIKA PRASAD

Location: Hall D

Numerical analysis to characterise the fractured zone in the Enhanced Geothermal System Horstberg

Kalliopi Tzoufka, Alireza Hassanzadegan, Torsten Tischner

Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany

Numerical simulations of coupled fluid flow and mass transport processes are used to investigate fluid flow patterns and to characterise the hydraulically induced fracture in the Horstberg geothermal reservoir (North-west German Basin). The Horstberg wellbore penetrates a sequence of low-permeability sandstone layers (i.e. Solling and Detfurth formations) of the Lower Triassic succession, which are hydraulically disconnected due to the presence of an interbedded tight claystone aquitard.

Injection and production target horizons are the Detfurth and Solling formations respectively. In the year 2003, a hydraulic stimulation with fresh water was conducted in a perforated section of the Detfurth formation at a depth of ca. 3700 m. Due to the induced vertical hydraulic fracture that intersects the intermediate claystone, the Detfurth and Solling sandstones became hydraulically connected. Consequently, the hydraulic properties of the fractured claystone are substantial since they enable fluid circulation within the fracture-dominated system. Previous hydraulic field investigations at Horstberg suggested an enhanced fracture permeability within the Detfurth formation in contrast to a respective essentially lower permeability in the overlying claystone. Initially a linear flow field along the Detfurth formation dominates and subsequently fluids ascend through the overlying claystone into the Solling formation.

2D numerical simulations describe the relationship between spatial variability of fracture-permeability and fluid as well as tracer transport processes. The results will provide significant information on transport properties, e.g. fluid residence times and swept area.

Modeling the effects of regional groundwater flow on deep temperatures in the northern Upper Rhine Graben (Germany)

Nora Koltzer^{1,2}, Rafael Schäffer³, Magdalena Scheck-Wenderoth^{1,2}, Judith Bott¹, Mauro Cacace¹, Kristian Bär³, Ingo Sass³

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A successful utilization of deep geothermal resources requires accurate predictions about the reservoir temperature distribution as well as an in depth knowledge of the hydraulic processes. The latter exert a direct influence on the subsurface temperature and therefore on the potential productivity of geothermal reservoirs. The aim of this study is to investigate and quantify the influence that regional thermo-hydraulic processes exert on the geothermal configuration of potential reservoirs in the northern Upper Rhine Graben and adjacent areas. Specifically, we address the questions of (i) how the regional thermal and hydraulic configurations influence local reservoir conditions, and (ii) whether it is possible to improve subsurface predictions iteratively by relying on 3D numerical modeling techniques. Therefore, a highly detailed 3D structural model of the northern part of the Upper Rhine Graben and the adjacent areas was built. The model was then used for coupled 3D thermo-hydraulic simulations of the deep fluid flow and heat transport. By running different simulations, we systematically tested hypotheses for the regional fluid dynamics based on hydro-geochemical analysis results. Springs, mineral and thermal, have been used for the validation process of the flow field

and available temperature measurements for the validation of the thermal field. With this knowledge of the thermo-hydraulic mechanisms of heat transport, the next step will be to downscale this process understanding and implement it in predictions of geothermal potentials on a local scale for the urban area of Frankfurt am Main.

Geo-Spatial Mapping of Sustainable Geo-Resource Management: A Case Study of Ranthambore Tiger Reserve, India

Bhanwar Vishvendra Raj Singh

Mohanlal Sukhadia University, Udaipur, India, India

In the entire world, biodiversity resources are very rapidly diminishing. In the biodiversity, Tiger is an icon of healthy wildlife which is considered as a vital factor for maintaining universal food chain system. This research paper is based on “Geo-Spatial Mapping of Sustainable Geo-Resource Management: A Case Study of Ranthambore Tiger Reserve, India, it’s a micro level study based on primary and secondary data through GIS mapping and consider as a Socio-Economic & Physical factors. Especially, core and periphery LULC have been obtained from the Multispectral images from ETM and ETM+ sensors of Landsat and LISS-III and AWiFS sensors of Resourcesat-satellites. This study examines the spatial and temporal patterns of LULC change along the boundary of Ranthambore in the Rajasthan from 1975 to 2015. Tiger Landscape change within all ecological zones will be evaluated. The Landsat TM and ETM imagery will be used to

produce LULC classification maps for both areas using a hybrid supervised/unsupervised methods. LULC changes are measured using landscape metrics and change maps created by post-classification through change detection. Using all the raster maps and the final change detection of the reserve will be done through spatial analysis using the raster calculator tool in ArcGIS and Erdas and MS Excel 13. The study comes out with LULC and describes human encroachment, Impact on human colonization, interfere with domestic animals, Inter-breeding, and Migration in core and periphery areas, finally, the situation would be alarming for biodiversity of tiger habitat due to high pressure of anthropogenic activities.

Experimental study on mechanism of acid rain-induced slide of gabbro rock slope

Dian Xiao, Xiaoyan Zhao, Kunpeng Li

Southwest Jiaotong University, China, People’s Republic of

In the past decades, acid rain affects over 63% of the Chinese territories, constituted critical social issues as a result of severe impacts not only on the ecosystem but also on slope stability. Mafic igneous rocks are broadly distributed in southern China, where is faced intensive acid rain affecting, but few studies focus on the instability mechanism of mafic igneous rock under the acid rain influences. This paper carries out a study on gabbro slope from the typical acid rain area in southwestern China, and conduct a simulated acid rain experiment to depict the actual acid precipitation in 40 years. The experiment results show that the cohesion and internal friction angle of the samples tumbles more than 33% and 6.8%, respectively, after 40 years’ acid rain attack. In addition, polarizing microscopy, X-ray diffraction, and scanning electron microscopy analyses reveal that the acid weathering of gabbro contains five processes: the dissolution of pyroxene and calcic plagioclase; the chloritization of pyroxene; the illitization of calcic plagioclase; the kaolinization of calcic plagioclase and illite; and the dissolution of illite and chlorite. These processes change the composition and structure of the gabbro and propagate the micro-cracks of the rock mass that cause the reduction on slope stability. Overall, the results are helpful for better understanding the slope failure mechanism affected by acid rain and providing the reference for prevention of geological hazard.

Analyzing engineering geological problems subjected to acid rain action: a case study of No.12 landslide in Panzhihua City, China

Kunpeng Li, Xiaoyan Zhao, Dian Xiao

Southwest Jiaotong University, China, People’s Republic of

Due to the rapid development of heavy and chemical industry in China, acid rain has severely disrupted the normal life of people. Although extensive researches have been done on the hazardous effects of acid rain,

these studies mainly focus on air pollution rather than engineering geology. Neglecting the effects of acid rain on engineering properties of rocks may lead to overestimation of physical and mechanical parameters of rocks and unreasonable designs, even triggering engineering catastrophes. In this paper, a hidden connection between acid rain and the No.12 landslide of high fill slope in Panzhihua City, China is proposed: acid rain may react with dolomite and calcite of silty mudstone located on the sliding surface, causing the dissolution of calcium and magnesium and accelerating the slaking of silty mudstone. Then a new approach, referred to as the fractal theory, is introduced into quantification of slaking process of silty mudstone subjected to different pH acid rain action. The results highlight that the lower the pH value of acid rain is, the higher the fractal dimension of silty mudstone, the more significant the slaking degree, and there is a very significantly positive logarithm correlation between the fractal dimension of silty mudstone and the number of cycles acid rain wetting and drying. Conclusion of this paper may be taken as references for the evaluation of engineering properties of rocks in acid rain area.

Poster Pitch: Ecosystem research focused on water quality in the Cuvelai-Basin, Northern Namibia – a comparison between dry and rainy season

Leona Faulstich¹, Robert Arendt¹, Frank Kavishe², Joachim Lengricht², Achim Schulte¹

¹Freie Universitaet Berlin, Germany; ²University of Namibia, Namibia

The change between rainy and dry seasons poses each year great challenges for the people of the Cuvelai-Basin, Northern Namibia. Extreme dryness and lack of precipitation during the dry season stress the water supply and a storage of water is hardly possible due to the flat landscape and high evaporation. The rainy season brings heavy rainfall, which can lead to floods and life threatening situations. If rainfall doesn't happen, droughts can threaten whole crops and thus the food base for almost half of the Namibian population. The impact of these extreme events on the water quality of surface waters, called lishana, is enormous. During the dry season, the wells filled with water are non-floating waters in which diverse physicochemical and microbiological processes take place. In the rainy season, untreated waste water mixes with lishana and floods from Angola transport numerous sediments and pollutants to the area.

At 24 sites at lishana and the Calueque-Oshakati Canal in the lishana region, more than 35 parameters as well as microbiological activities, suspended solids and sediments were analyzed. Most of the important chemical-physical parameters and ion concentrations of the classical elements could be measured on site. Off site further ion concentrations and the nature of suspended solids were determined, as well as the characteristics of the sediments. Ecotoxicological tests were made to identify toxic characteristics of the waters. This complex methodological approach leads to different results of dry and rainy season and contributes to a better understanding of this unexplored region.

3.5. Mineral and Energy Resources and Sustainability: Exploring the new Possibilities

Thursday, 12/Sep/2019: 8:30am–10:15am

Session Chair: Gurmeet Kaur

Session Chair: PARMINDER KAUR

Session Chair: Tejpal Singh

Location: Hall D

Using Life Cycle Assessment to quantify net atmospheric CO₂ sequestration by soil carbonation and enhanced weathering in Brazil.

David Lefebvre¹, Adrian G. Williams¹, Pietro Goglio^{1,2}, David A.C. Manning³, Antonio Carlos de Azevedo⁴, Magda Bergmann⁵, Jeroen Meersmans¹, Pete Smith⁶

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A greenhouse gas (GHG) removal technology (GGRT) is one that can remove a GHG from the atmosphere. Amongst the plethora of existing GGRT, enhanced silicate rock weathering for long-term CO₂ sequestration has considerable potential. However, extracting, processing, transporting and applying ground rock to land consume energy and thus generate GHG emissions, which must be balanced against the sequestration potential.

We (i) assess the environmental impacts of the practice, using existing basalt rock quarrying in Sao Paulo State by quantifying the emissions associated with current practice plus transport and land application, using Life Cycle Assessment (LCA); (ii) estimate potential sequestration from soil carbonation and enhanced weathering (SCEW) and (iii) determine the potential net GHG balance of SCEW with basalt over all Sao Paulo State (SSP) agricultural land.

The activities to support enhanced weathering and carbonation emit around 75 and 135 kg CO_{2eq} per tonne of CO_{2eq} removed respectively (considering an average quarry to field distance of 65 km.) We underline transportation as the principal process negatively affecting the practice and establish a limiting road distance from quarry to field of 540 ± 65 km for carbonation and 990 ± 120 km for enhanced weathering. Above these, the GHG emissions exceed the potential sequestration, with the particular conditions in SSP.

As various techniques are increasingly promoted as effective solutions to sequester CO₂, this study emphasizes the need to consider practices through the holistic approach of LCA, which identifies multiple process-based impacts and their significance.

Environmental Impacts of Hydro Energy Projects in the Indian Himalaya: Minimizing the Impacts

Bhim Chand, Jagdish Chandra Kuniyal

G.B. Pant National Institute of Himalayan Environment & Sustainable Development, Himachal Regional Center Mohal-Kullu, Himachal Pradesh (Ministry of Environment, Forest & Climate Change Govt. of India), India

The study is focused on the impacts and mitigation measures of ongoing hydropower projects (3 MW-1500 MW) in the upper Satluj basin (895-2845m) of the Indian Himalaya. The impacts were assessed around the selected projects in terms of soil, water and air quality status and socio-economic conditions of natives. Soil quality in terms of available nitrogen (N), phosphorus (P) and potassium (K) was low (211±10-224±14 kg ha⁻¹), medium (13.9±1.7-18±2 kg ha⁻¹) and high (283±30-296±31 kg ha⁻¹) respectively. NPK were higher at Khab (2915 m; a pristine site) as compared to other affected areas. Upslope and downslope regions have been fac-

ing more environmental degradations due to excessive construction activities. Water quality is affected due to debris dumping along the river beds where turbidity (94.8-389.8 NTU) is high. Air quality as particulate pollution (PM₁₀) in a majority of samplings crossed (102.2-107.3 µg m⁻³) the permissible limit (100 µg m⁻³). While the trace gases (i.e. nitrogen dioxide, sulphur dioxide and ammonia) were under limit. Peoples' perception showed that a large number of natives (~66%) are in favour of small projects and are not in favour of adhoc solutions. In view of making hydro energy sustainable in the mountains, feasible mitigation measures are suggested.

Compositional Multi-Point Geostatistics for Tailings Deposits - A Synthetic Case Study

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Currently, tailings deposits have become new resources that are challenging and valuable to exploit. To properly exploit them, we require a 3D spatial characterization of their mineral content. In a natural deposit, this is achieved by sampling at several locations and applying geostatistics to estimate block values. Certain characteristics of tailings deposits make them not amenable to conventional geostatistics. In

particular, it is important to consider both valuable and gangue minerals, thus we need to take the compositional nature of our variables into account. In addition, the interplay of erosional and depositional processes creates structures with certain continuity patterns that cannot be modelled by conventional variogram-based methods such as kriging.

Therefore, we use a Multi-Point Geostatistics method, Direct Sampling (DS). DS is based on selecting the event from a training image, the conceptual spatial arrangement of a variable, with the shortest distance to the data event from the simulation domain. To account for the compositional nature of our variables, the Aitchison distance is calculated. We use numerical stratigraphic modelling to obtain a variety of training images, which we feed into a modified DS to deal with multiple training images at once.

We tested the proposal on a multi-source synthetic tailings deposit produced by numerical stratigraphic processes. Each grid of the model contains information about the content of several sediment species summing to 100%. Hard data are sampled on the model at certain locations and along with several unique training images we recreate the full 3D spatial distribution of the properties.

Sustainable Mining: Urgent Need of an Hour

Ayush Sharma, Arshita Verma

Centre of Advanced Studies, Department of Geology, Panjab University, Chandigarh, India

Ongoing mining practices have posed a great threat to local communities and environment. The immensity of these impacts is expanding and that of ore grades is gradually declining. Since unplanned mining activities have led to environmental degradation, the challenging task that companies are facing is to choose and produce artefacts that will serve society sustainably. Mining activities have important economic, environmental, labor and social repercussion on local and global scales. While this sector provides raw material and energy for large number of industries, its activities are still commonly considered as threat to natural surrounding. Environmental management include a wide variety of practices to be adopted, both mandatory (recuperation of mining sites and paying taxes) and voluntary (environmental management systems). Public interest on environment and ecology has grown manifolds due to rapid climate changes, environment health hazards and energy crises. It has drawn attention to mass media, government to intensify pressure on organisations for transforming their process into eco-friendly process. This brings into picture the importance of sustainable mining since mining is necessary to various industries and to the common man but on the other hand, a check has to be kept so that these practices don't adversely affect our natural environment.

MINING AS PER LAW

Swati Singh, Garima Singh

Panjab University, India

Although mining is the fundamental activity that has supported all the technological development of the world but it comes with its repercussions at every stage. The first step involved in the mining process is preparing the land acquired for the same by loss of forest cover. When the plant is up and running the tailings not only harm the land but also air and water. After the mining is done the area which has lost its natural landscape is left abandoned without any recovery done which only leads to its further degradation. The community residing in and around the area is also affected by the above changes.

If for each of the above mentioned stage there are efficient laws governed by good mineral policy all the problems would be sorted and the damage could be controlled to a very large extent. Taking a worldwide view, the laws related to mining vary from country to country according to various aspects such as local community, topography of the area, the type of mining practice and social corporate responsibility, etc. The mineral policy of various countries can be studied and compared to figure out the best mining practices that are taking place on the ground so that with little or no variation they can be adopted suitably by other countries. Hence the good laws and their way of implementation can serve as an example for all the other countries eventually supporting the Sustainable Development Goals on an international level.

Sustainability of Natural resources: Are we Serious!!

Gurmeet Kaur

Panjab University, India

We have been blessed with magnanimous earth which suffices all our needs without asking for much in return. The greed of humans in the name of development has put an enormous pressure on earth and natural resources. The term 'Sustainability' is in vogue these days for prolonging the survival of natural resources. The earth offers enough resources in the form of water, soil, minerals, energy etc to support life. Why is there a need to practice mineral and energy resource development in a sustainable context? Are we running out of resources? If yes, why is it happening? Are we assessing the loss of natural resources correctly? Are we exaggerating on sustainable development of natural/mineral resources? Are we depriving the new generation of this wonderful gift of Earth? Who is responsible for all this? Where do we find answers to all the above and many more such startling questions? It is time we should introspect and contribute in our little own way to save and try to sustain our natural resources as the disparity in terms of use of these around the globe is alarming!

Poster: Effects of a dolerite sills in the coal petrography and rank of Chipanga coal seam, 2A section, Moatize Coal Basin, Tete Province – Mozambique.

Zelio Salomao Chauque, Lopo Vasconcelos

Eduardo Mondlane University, Mozambique

The Moatize Coal Basin (MCB) is highly affected by igneous intrusions that marked the end of Karoo in Mozambique and other parts of Southern and Central Africa. The presence of these intrusive bodies, particularly the sills, alter very intensely and localized the three parameters that determine the coal quality (rank, type and category), due to the high temperatures transmitted to the affected coal, as well as the injection of hydrothermal fluids, increasing the ash content of the coal, abruptly altering its rank, and leading to formation of natural coke.

This work aims at studying the changes caused by a sill in the Chipanga coal seam, as well as in the definition of the total area of influence of the sill, which will allow the definition of regions less affected and favourable for the start of the exploitation.

The sill studied in this work converted a large amount of coal into natural coke, thus confirming the observations of several authors about the effects of the intrusions in the MCB. The results of the proximate and ultimate analysis show clearly that the physical and chemical properties of these coals changed locally. Near the

contact high values of ash, low moisture and low volatile matter are observed. The decrease of the Crucible Swelling Index (CSN) and calorific values and increase of True Relative Density (TRD) values near the contact, show that near the contact the coals lost their coking potential and their heat generation capacity.

Poster: EARTH'S ENERGY

Swati Singh, Garima Singh

Panjab University, India

The fight for search of alternative energy resources started with the realization, provided by the scientific evidence, that how the use of conventional energy resources was not only having a negative impact on our environment but they are limited in amount and will take millions of years to replenish. This realization gave us the concept of 'sustainability'. Renewable resources are and will be the foundation of this idea. Due to rise in population, the ever increasing demand of energy has put many resources under stress, hence we need to tap as many renewable resources as we can. It becomes more imperative with the understanding that even renewable energy resources come with their own limitations.

Geothermal energy is largely untapped source of renewable energy that can prove to be a significant addition to the family of non-conventional energy resources. Firstly since this energy is derived from heat radiated by earth we don't have to worry about it running out of power source. Secondly, it is eco-friendly as there is no emission of greenhouse gases. It is highly efficient. There are many more advantages of this type of energy. And in certain regions it is capable of outperforming even some conventional sources in many aspects. The world can learn from the example of Iceland which is successfully harnessing its geothermal energy to a very large extent. Countries are required to make a serious effort to explore regions where geothermal energy can be harnessed, it is certainly worth giving a shot!

Poster: REVIEW ON IGNEOUS PHOSPHATE RESOURCES OF EAST AND SOUTH EAST AFRICA (withdrawn)

Wondafrash Mamo Ghebre

Ministry of Mines & Petroleum, Ethiopia

The most abundant phosphate deposits in East and Southeast Africa region are related to igneous rocks. These deposits can be broadly divided into four categories. Carbonatite-related deposits are the most important category but apatite may also be found in association with basic intrusions, syenitic intrusions, and pegmatite bodies.

Local Phosphate Resources for Sustainable Development is a crucial issue which aims to support the context for poverty reduction and elimination. In order to enable poverty alleviation, it should be focused on the promotion of local use rather than the export of phosphate.

Africa imports several million tones of fertilizers annually. Delineation and definition of the phosphate rock will facilitate the need of potential investors towards mining and development of fertilizer raw materials. The findings will ultimately benefit the investors, the stakeholders, the government and the population at large.

Soil degradation and infertility are major constraints to the sustainability of agricultural systems in many developing countries, particularly those located in the tropical humid lowlands of Sub-Saharan Africa (SSA) where phosphorus (P) and nitrogen (N) deficiencies are recognized as major constraints to sustainable agricultural productivity.

Therefore, the study will contribute as a raw material for phosphate fertilizer, by increasing agricultural yields, will definitely plays major role in poverty alleviation applying sustainable utilization of indigenous resources.

Keywords: Phosphate, Poverty alleviation, Sustainable Development, Soil degradation, Sustainable

Poster: Sustainable Mining: Some issues

JASPREET SAINI

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Mining sector contributes towards the economic growth of every country. The mining activity can have profound effect on the lives of the surrounding communities as well as the environment. Umpteen laws such as water pollution Act(1974), Air Pollution Act (1981), Environment Assessment (EIA) programme (1994) have been elaborated in Indian mining sector. However, these laws are of little help due to their weak execution at different levels. The present day requirement is to examine various mining issues and take initiatives on sustainable development. The best way to make mining sustainable is to follow a circular economy approach where recycling and reuse is promoted. What has been in practice to date is the linear economy where products manufactured from raw material are sold, used and ultimately thrown away. Further, sustainable mining can be promoted by reduced waste generation, preventing air, water, soil and noise pollution, use of low grade ores, improved techniques to extract by-products, providing employment to local population, check on illegal mining, implementation of reclamation policy, inventing substitute materials with no adverse effect on the environment and earth.

Poster: Makrana marble mines of Rajasthan: Case study for sustainability of Historic white marble from India

Parminder Kaur

Department of Geology, Panjab University, Chandigarh, India

In today's world mining refers to the method of extraction of minerals from crust and has been a practice in the past for centuries without any formal name. The significant advancement in the mining sector with modern techniques over the period of time has implications in terms of sustainability of the natural mineral resources for the future generations. The primary concern of sustainability of non-renewable resources is paramount and has led to advent of many strategies in terms of mining techniques and legal procedures on a wide global platform. The increasing population and the disproportionate demands for metals and minerals have led to the expansion of mining areas. The marble mines in Rajasthan, particularly from the Makrana area, represent the longest open-cast marble mining activity of the India (Garg et al., 2019). The Makrana marble is globally famous for its pure white variety which was used to build the famous Taj Mahal, one of the Seven Wonders of the World, in 1632. The marble is still extracted from the same excavations by manual, semi-mechanized and unscientific methods and has resulted in over exploitation of the resource creating bad topography of the region and caving in of the quarrying areas. Furthermore, this poses a great threat to health and life of the workers and has resulted in environment degradation and destruction of the landscape. Proper laws should be enforced in mining sector to maintain the balance between social, ecological and economic domains which will together contribute to sustainable development.

Poster: Lithofacial analysis and petrophysical evaluation of Productive Series' deposits of the Azeri-Chirag-Guneshli field

Leyla Shikhova¹, Gunel Gasimova²

¹Oil and Gas Institute of Azerbaijan National Academy of Sciences, Azerbaijan; ²Geography Institute of Azerbaijan National Academy of Sciences, Azerbaijan

The study area – Azeri-Chirag-Gunashli (ACG) field complex is located in the north-eastern part of Azerbaijan sector of South Caspian Basin.

The principal aim of the performed research is to identify the main lithological types of facies from electric and gamma-ray logging data in various suites and horizons of Productive Series (PS) and to evaluate the main petrophysical parameters of the ACG field.

The analysis of lithological composition was carried out according to the results of interpretation of GR, SP, Density and Neutron log and core data investigations. The definition of facies and paleohydrodynamic conditions by using well-logging data was performed according to the studies of V.S.Muromtsev, A.V.Yezhova and

M.H.Rider. Fluvial-deltaic facies, which deposited under the conditions of high paleohydrodynamic levels of sedimentation, occurred mainly in VIII, X horizons of Balakhany suite (BS), horizons of Pereriva suite and Postkirmaky (PKS) suite. Based on lithological composition's studies on well-logging data interpretation and core materials, 5 transgressive stages of sedimentation can be distinguished up to the top of Balakhany suite. The main regularities in petrophysical parameters variation in wells sections of individual horizons and suites of PS were established. BS VIII horizon, horizons B and D of Pereriva suite and PKS suite are characterized by the most favorable reservoir properties.

The use of research results will lead to a correct understanding of the facial structure of objects and revealing of perspective reservoirs within the study area.

Poster: Mineralogy, sulphur isotope and wall rock geochemistry of the Deblin Copper Mine in southern Otavi Mountain Land, northern Namibia: Implications for a Mississippi Valley Type-associated copper deposit.

Josia Shilunga¹, Judith Kinnaird², Susan Webb²

¹University of Namibia; ²University of the Witwatersrand

The Deblin Copper Mine lies on the southern margin of the Otavi Mountain Land metallogenic province in northern Namibia. Previous studies on this deposit have resulted in a large set of data, but also controversial interpretations. Many early geologists pointed out similarities with volcanic-hosted massive sulphide deposits, whereas others proposed a shear-hosted hydrothermal style and interpreted the mineral assemblage as equivalent to the Iron Oxide Copper Gold-type. This study used geological mapping, petrography, ore mineralogy, sulphur isotope and whole rock geochemical data to establish the mode of occurrence of Cu mineralization. The Deblin Copper Mine ore is characterized by chalcopyrite as the main ore mineral with minor amounts of sphalerite and rare bornite. The sulphides are hosted in the Neoproterozoic platform carbonates, primarily the silicified dolomite and dolomite breccia both in the groundmass and in the quartz-calcite veins. Microscopic observations reveal that both sulphide mineralization types contain pyrite, chalcopyrite, sphalerite, bornite and pyrite as hypogene minerals and covellite, malachite, and goethite as secondary minerals. Vein type mineralization is characterized by a relatively narrow range of sulphur isotopes ($\delta^{34}\text{S} = -4.9\text{‰}$ to $+6.0\text{‰}$) compared to that of disseminated sulphides ($\delta^{34}\text{S} = -9.99\text{‰}$ to $+3.63\text{‰}$). The two sulphur isotope ranges suggest that both magmatic and sedimentary sulphur sources were involved in the genesis of the deposit. Geochemical and petrological data suggest that the metavolcanic rocks in the area formed as alkali basalts in an oceanic island geotectonic setting. The deposit shows ore forming processes associated with both VMS and MVT-type mineralization.

Poster: Mining and Sustainability: Problem and Solution.

Amritpaul Singh

Panjab University Chandigarh, India

Mining is an activity, occupation and industry which is related to extraction of minerals from earth's crust. Mining can be dated back to paleolithic period when humans used flint (sedimentary cryptocrystalline quartz) as tools for hunting. Mining has played significant role in establishment, evolution and continuity of civilizations but on other hand, it has always resulted in environmental degradation and social impacts globally. Minerals being non-renewable natural resources cannot go indefinitely. Thus, mining can never be sustainable. So what is the solution? A nation must reduce mining and mineral demand or new technologies must be developed to reduce its negative impacts or simply improve use of the minerals and technologies to access it? A logical answer is to improve mineral use and develop technologies which are able to reduce environmental downfall and social impacts. But rate of mining is solely controlled by demand in market irrespective of its impact on environment and society. Furthermore, unorganized mining has resulted in short term benefits and long-term loss. Even government agencies such as IBM (Indian Bureau of Mining) and SP-CBs (State Pollution Control Board) failed to perform their regulatory work to the levels needed. So, there is an urgent need to administrate mining with specific technologies, proper management and enforcement to reduce wastage of this nature's gifts, optimizing mineral utilization, upgrading its value and changing it into a

long-lasting commodity for present generation as well as for future generation.

Poster: Problematic of the artisanal mining exploitation and their impacts on the environment in walikale (north kivu. DR Congo)

ALAIN BINDU

CEEG, Congo, Democratic Republic of the

The artisanal mining exploitation in democratic Republic of Congo is adjusted by the article 26 of the mining Code that arranges: „without prejudice of arrangements of the article 27, only the major physical people of Congolese nationality can acquire and can detain the cards of artisanal operator and trader’s cards „. otherwise, the article 109 of the IV title of the mining code institutes the artisanal exploitation zone in these terms: „When the technical and economic factors that characterize some lodgings of gold, diamond or all other mineral substance don’t permit to assure an industrial or semi-industrial exploitation of it, but permit an artisanal exploitation, such lodgings are erected, in the limits of a determined geographical area, in artisanal exploitation zone.

The institution of an artisanal exploitation zone is made by way of decree of the minister after opinion of the direction of the Mines and the governor of the province concerned, but an activity without control However, it includes enormous inconveniences notably on the human health but also the one of the environment and the natural resources. She also has some consequences on a social level. It is necessary to note indeed that the artisanal mining exploitation contributes to the deforestation, to the deterioration of soils, to the pollution of air by the dust and the monoxide of carbonic, of soil and water by the used oils of the motors and the chemicals.

3.6.-1 Geoparks and geotourism for achieving the Sustainable Development Goals (SDGs)

Thursday, 12/Sep/2019: 12:45pm–1:45pm

Session Chair: JEAN-ROBERT NSHOKANO MWEZE

Session Chair: KAMBALE KAVYAVU Wisdom Wiseman

Location: Hall D

Urbanism of African Cities and the Destruction of Geosites and Geomorphosites, Case of the City of Goma / DRC

KAMBALE KAVYAVU Wisdom Wiseman¹, MALAIKA GAKURU Ange²

¹UCNDK/ DRC, Geology department; ²Université de Goma, Geology department

No societal development of a civilization will not have its peak without resorting of geological services. Apart plant products, most building materials are inorganic. Urbanization is a universal phenomenon and has experienced a particular acceleration in African Sahara. This strong growth occurred in a particular economic context marked, the case of Goma, being border and provincial town, its surroundings in the last ten years are vulnerable security targets whose consequence is the rural exodus. Demographical evolution is a threat to space in urban entities. Some ones come to town looking for work while others come there just to consume their fortunes. The use of the areas in the urban center is detrimental to heritage, cultural, tourist and even customary. In the case of Goma, selected examples; Mount Goma-Kanyaruchina-Lac Vert -Kamuchanga concretely illustrate the protection, management and development of Geosites and Geomorphosites. The inventory and strategies to protect the geosites and geomorphosites by their allocation to the protected areas besides a mutual aid between university and ministerial posts and local political volunteers is worth for the safeguarding and to emphasize the geotourist and geomorphic heritage. Goma is losing its touristic sites due to the demographical threats.

Geotourism: Kairouan's Current Prospects for Sustainable Rural Development and Poverty Alleviation

Intissar Farid

Association of protection of Nature and Environment of Kairouan

Geotourism is a relatively new type of tourism with significant growth potential. Initially defined in Europe, USA and Australia, it is an international developing academic, economic and sustainable rural development investigation field. The term geotourism has been in use since the early 1990s, although its precursor activities can be traced back to the 17th century. Benefiting from its significant social, historical and industrial archaeological underpinnings, the concept is still undergoing redefinition and refinement. This paper explores current literature on geotourism in relation to sustainable development in Kairouan (central Tunisia). Furthermore, it explores current literature on the direct and indirect sustainable development impacts from geotourism and geoparks, and their implications on social, environmental and economic development on rural communities. The literature has shown that these concepts, relatively new in Kairouan, present essential credentials for poverty alleviation and sustainable rural development on the continent.

The exceptional Geoheritage, Geopark and Geotourism potential of the Cenozoic Successions of Western Kutch, India

SHUBHENDU SHEKHAR, PRAMOD KUMAR

UNIVERSITY OF DELHI, India

Geoheritage and Geopark is a concept concerned with the preservation of features with importance to earth science, such as landforms and sites where geological features can be examined for the further study and conservation. Geoheritage, geopark, and geotourism studies are gaining interest worldwide because of their scientific, academic, historical, societal, cultural and aesthetic values. The Cenozoic (last 65Ma.) sedimen-

3.6.-1 Geoparks and geotourism for achieving the Sustainable Development Goals (SDGs)

tation (~900m) is considered as a strato-type section for the shallow-marine sedimentary records in India. Some Cenozoic sections of Kutch are the only remained section in the world. This sedimentary succession acts as a geological museum for paleontology, stratigraphy, biostratigraphy and sequence stratigraphy. Such records of past climates and sea-level fluctuations are characterizing the global sea level history. It also provides an outcrop analog for reservoir rocks of Bombay High. Taking this into account we propose seven selected sites in the Cenozoic succession to be preserved as Geoheritage sites and development of geotourism viz. Matanomadh cliff section, Naredi cliff section, Fulra limestone section, Miocene succession, Paleosol of Sandhan Formation, Kharai River paraconformity section and Bermoti River section. These Geoparks will help to enhance the local economy by infrastructure development, health and educational pursuits to the village level society and employment. The geological records are the consequences of millions of years of processes and are precious that require special care. If these records once destroyed will be lost forever and cannot be restored artificially. It is our prime responsibility to transfer the knowledge and Geoheritage to the future generations.

3.6.-2 Geoparks and geotourism for achieving the Sustainable Development Goals (SDGs)

Thursday, 12/Sep/2019: 2:15pm–3:15pm

Session Chair: JEAN-ROBERT NSHOKANO MWEZE

Session Chair: KAMBALE KAVYAVU Wisdom Wiseman

Location: Hall D

Assessment of capabilities and geomorphic tourist priorities of Lorestan Province

Reza Nafari, Elham hydari, Fariba Kazempour

Azad university, Iran, Islamic Republic of

Geotourism as a sub-branch of nature tourism alongside the other tourism branches such as rural tourism and cultural tourism possesses a plenty of potentials for the development of land and sustainability of natural resources. Iran with a wide variety of geomorphologic and geologic structures has great capacities in the area of geotourism attractions and therefore, the new arena will be opened in the field of tourism. Lorestan province, located in the west of Iran, is one the areas which has great potentials for the development of geotourism activities. The aim of this study was to evaluate the capacity of geomorphologic attractions in order to develop geotourism in the area of study. This study was experimental and the data required collected in two ways: through library and field studies. The analysis of geotourist capacities based on Prolong model shows that TeleZang waterfall has the most capability in geotourist due to its high scientific value and beautiful appearance whereas Lake Gohar has the least capability among Landforms. The results of this study show that geomorphologic attractions of Lorestan province possess high capabilities for analyzing tourism capacity.

Reflection on the challenges of development and diversity of natural resources of DR Congo: How to reduce Paradoxes between evaluated potentialities and real poverty.

JEAN-ROBERT NSHOKANO MWEZE¹, MIIREILLE MUHIGWA²

¹Université Paris 8, France; ²StrongWomen DRC

Located in the central part of Africa, the DR Congo is one of the richest countries in the world in term of its diversified and incredible natural resources. It has 53% of the surface of Congo Rainforest, 42, 5% of global cobalt minerals reserves, huge deposit of copper, gold, uranium, diamond, tin and coltan and many others. This country has 23% of pure water in Africa. It is also one of the largest countries in terms of its population number in Africa. With a national demographic growth average of 2, 45%, this country has more than 80 million inhabitants (UN, 2015).

However, this country is one of the most vulnerable and poorest in the world: with an HDI = 0.435/1, an infant mortality rate = 69, 8 per 1000. It is facing the water scarcity, access to education, access to land, insecurity and political instabilities.

This work intends to understand throw analysis the contradiction or paradox between evaluated potentialities and real poverty in Africa, particularly in DRC. It consists of exploring the socio economic level of country by questioning the “top-down” approach of problem solving and “bottom-up” approach of problem solving to reduce the poverty. The second is to find a way in which geoscientists can engage to create or instance geotouristic opportunity in regard of the combination of the measurement of these 3 asset patterns: “potentialities asset”, “Capability Asset”, “Responsibility asset” in order to overcome the challenges of development process.

Mineralogical Heritage of M'goun Geoparc Valorization and Exploitation

Salma ABOUTOFAIL¹, Mohammed BOUTAKIOUT², Abdelmalek OUADJOU³

¹Faculty of Science Université Mohammed V de RABAT , Morocco; ²Professor at the Faculty of Science of RABAT;

³Engineer at the operations department, Groupe MANAGEM, MARRAKECH

Being located in the Beni-Mellal, Khenifra region, the M'goun Geopark is a space formed of a succession of reliefs with often high altitude.

The objective of this study is foremost to help mediate the mineral wealth of this region especially to participate in its sustainable development.

For this basis, several methodologies based primarily on bibliographic research have been carried out, including all sectors of the region ranging from geographical location to wealth, as well as the land phase that was carried out for the exploration of the mining areas and the sampling of their ores.

This study has resulted in a revelation within the mineralogical richness of this region, of which its majority remains unknown, and allowed us to give the idea of the creation of a géotourism circuit and a programme representing a chain of the different visited mining sites as well as the navigated geosites and the realization of a mineral showroom.

Mines and the regional mining exploitation can contribute to this geotourism valorisation by a simple know how explaining the geological and mineralogical origins of these mines in the sustainable development

Keywords: M'goun Geopark, mineralogical richness, sustainable development, mining areas, the sampling, circuit, mineral showroom.

Potential Geoparks and Geotourism as a Tool for Regional Sustainable Development of Egypt.

Enas Abd Elhady Ahmed^{1,2}

¹Matrouh University, Egypt; ²UGGPC member

Egypt is a remarkable country with its intangible and tangible heritages that can be traced from the remote prehistoric past through the various stages of world civilization. Those heritages link us to the earth and human cultures, makes us aware of our geological, paleontological and natural fortunes. It is our duty to use it sustainably to be able to present it to our future generations. Raising from that the need to design a management plan to foster socio-economic development which will aim to enhance the value of such sites to promote it as a geopark, while at the same time creating employment and promoting regional economic development, encouraging the local people and visitors to get involved rather than remain as tourism spectators. The choice of involving women is a choice for sustainability and will empower the choices that will lead to the conservation of natural resources besides increasing the benefits which are close linked with conservation responsibilities and climate change mitigation. Designation of Egyptian geopark will contribute in changing future of Egypt and its economy.

4.1. Emerging contaminants in groundwater

Thursday, 12/Sep/2019: 8:30am–10:15am

Session Chair: Maurizio Barbieri

Location: Senatssaal

Geochemistry of high concentrations of fluoride in groundwater at Oued Rmel aquifer (North-eastern Tunisia), and risks to human health from exposure through drinking water

Meriem Ameer, Fadoua HAMZAOUI-AZAZA, Moncef Gueddari

Faculty of sciences of Tunis, Tunisia

Located between the Mediterranean Sea and the Sahara, Tunisia has a semi-arid climate. The rainfall is irregular in space and in time. The Tunisian population has always had to cope with scarce water resources, often of poor quality, to satisfy its needs particularly in agriculture and human consumption.

The Oued Rmel aquifer, in Zaghouan city in north-eastern Tunisia, extends geographically between 36°18' and 36°26' North, and between 10°06' and 10°24' East. The groundwater of the Oued Rmel aquifer is exploited for drinking and irrigation purposes. To monitor the chemical water quality, and especially to identify the occurrence and behaviour of fluoride, 23 water samples were collected in January 2013, and analysed for chemicals parameters like Na^+ , Ca^{2+} , Mg^{2+} , K^+ , Cl^- , SO_4^{2-} , HCO_3^- and F^- .

This study applied conventional techniques such as hydrochemical compositions, multivariate statistical methods, Geochemical Modeling and Geographical Information Systems (GIS).

Concentrations of fluoride in samples from the Oued Rmel aquifer ranged from 4–22 mg/L. The highest values were observed in the surroundings of hydrothermal sources, especially from Hammam Zriba and Hammam Djedidi. Compared with international and national guidelines, all analysed samples exceeded the maximum permissible concentration, in drinking water, of WHO and Tunisian Standards (NT.09.14), which are 1.5 and 1.2 mg/L, respectively. An excessive fluoride concentration in water causes many problems such as dental and skeletal fluorosis, as well as other risks to human health. Thus, the treatment of fluoridated water through methods such as precipitation, ion exchange, electro dialysis, and reverse osmosis is essential.

SAFEGAURDING FRESH WATER RESERVOIRS FROM CONTAMINATION

NITISH GANDHARVE

PANJAB UNIVERSITY, India

Fresh water is of vital importance to sustain any kind of terrestrial life form on this planet. Health of our Fresh water reservoirs has been declining in the recent past as human advancement has encroached most of the space available on Earth, interfering with the natural phenomenon that indigenously help support life systems. Any magnitude of alteration to these reservoirs, physical or chemical, can potentially have hazardous implications on natural flora and fauna including humans. The situation has become more threatening due to rapid contamination of these reservoirs. Fresh water contamination intensifies our worries as it is evidently an irreversible process. Minute amount of impurities can infiltrate into a large water body and make it unfit for an entire ecosystem. Unregulated human developments in and around these reservoirs have destroyed their potential to nurture numerous species. Unsupervised industrial growth has resulted in transportation of certain heavy metals and carcinogenic chemicals into the fresh water resources, from where they enter into the food chain which directs the stream of these unwelcomed substances into our own body. We ought to work diligently towards exploring uncontaminated fresh water reservoirs around the globe and trace the quantity, source and effluence of water contained in them. These reservoirs can include High altitude lakes, aquifers,

Wetlands, watershed areas and even some part of rivers or channels near their origin. We can further contribute in safeguarding such priceless natural resources, by giving them status of international importance and by giving them complete protection against contamination.

HEAVY METAL CONTAMINATION IN AGRICULTURE LAND

NITISH GANDHARVE, Debabrata DAS

PANJAB UNIVERSITY, India

As dedicated research is going on throughout the world to protect our nature from the unwanted circumstances. One such situation is depletion of fertile soil owing to extensive use of chemical fertilizers and pesticides. One of the most potential contaminants include heavy metals like Cadmium, Nickel, Arsenic, etc. Me and project mates under guidance of Proff. Devbrata Das, collected soil samples in agricultural land near Barnala, Punjab. We already know the permitted parameters by WHO for various contaminants. By testing those samples we concluded that concentration of certain heavy metals is quiet high when compared with WHO parameters. We studied the chemical composition of the pesticides and other agricultural products and tried to find out the source of the contamination.

My lecture will be on our findings based on chemical testing and our field observations.

Poster: Production Boreholes Water Quality Evaluation Using GIS Based Geostatistical Algorithms in Windhoek

Silas David

Namibia University of Science and Technology, Namibia

The contemporary threats of climate change have however prompted the dependency on production boreholes as a sustainable supply for domestic water in Windhoek. Therefore, maintaining the production boreholes water quality has however remained a vital intervention for a city like Windhoek. The aim of this research is to provide an overview for evaluation of water quality for production boreholes in Windhoek, through applying geographic Information system and geostatistical algorithms. Furthermore, the production boreholes water quality parameters, chloride, Iron, temperature, pH and electrical conductivity were all sampled and analyzed from existing production boreholes owed by the City of Windhoek; maps of each parameter were created using geostatistical (kriging) approach. Experimental semivariogram values were tested for different ordinary kriging models to identify the excellent fitted for the five water quality parameters and the exceptional models were selected on the basis of mean square error, average standard error, root mean square error and root mean square. The results showed that this method is an appropriate tool for environmental spatial distributed parameters. However, pro-active measures must be taken into consideration before the water of the production boreholes are used domestically, as the water is not save at certain areas of Windhoek due to high temperature causing bacteriological contamination to occur in the production boreholes.

Poster: Trace and Major Elements in Iranian Bottled Waters; Effect of Geology and Accordance with National and International Standards

Mahsa Tashakor¹, Soroush Modabberi²

¹Freelance researcher, Iran, Islamic Republic of; ²School of Geology, College of Sciences, University of Tehran, Tehran, Iran

Being considered as a safe source of drinking water, bottled water has gained a universal popularity. Mineral waters are the most common type of bottled waters. They contain essential ions and elements mainly derived from lithological sources. Above certain levels, these elements can be detrimental to human health. Due to the fact that mineral waters are mainly originated from the groundwater resources, the influence of regional geology on chemical composition of waters is anticipated. In this study, 29 Iranian brands of mineral bottled water were analyzed for elements (by ICP-OES & ICP-MS) and ions (by ion chromatograph) at BGR Laboratory, Germany. The results showed that bicarbonate is dominant in 86% of the samples (med 172 mg/l). Calcium and sodium show the median concentration of 48.50 and 9 mg/l, respectively. High levels of nitrate (>2.62 mg/l) were measured in 86% of the samples. All of the trace elements were below the threshold values, except for As (57.92 µg/l) and B (521.89 µg/l) in a sample originated from the Central Iran structural Zone. Deriving from Cretaceous and Oligo-Miocene carbonate rocks of Zagros; the bottles from west-southwest of Iran are all calcium and bicarbonate (Ca-HCO₃) hydrofacies. According to the piper diagram, the bottled

4.1. Emerging contaminants in groundwater

waters originated from central Iran are classified as the sulfate type (Ca-SO₄). The content of elements in the samples from north of Iran vary due to the influence of several structural subdivisions of Alborz Zone. Sedimentary and igneous rocks control various cationic-anionic compounds of the springs in this region.

4.2. Influence of Natural and Human activities on Coastal Environment Risk

Wednesday, 11/Sep/2019: 5:00pm–7:00pm

Poster Session & Social

Location: Foyer

Poster: Tsunami Simulation and Inundation Modeling for Coastal Zone of Alexandria City, Northern Egypt

Mohamed Mohamed Elsayed¹, Yushiro Fujii², Bunichiro SHIBAZAKI³

¹National Research Institute of Astronomy and Geophysics (NRIAG), Seismology department, Egyptian National Seismic Network (ENSN), Helwan, Egypt.; ²International Institute of Seismology and Earthquake Engineering (IISEE), Building Research Institute (BRI), Japan.; ³International Institute of Seismology and Earthquake Engineering (IISEE), Building Research Institute (BRI), Japan.

The Alexandria's coastal zone suffered from disastrous tsunamigenic earthquakes; the 142, 365, 1303, and 1222 earthquakes that were mainly produced from the Hellenic and Cyprian arcs. We focused on the Alexandria middle coastal zone to investigate tsunami propagation and inundation by adopting the assumed fault models for the earthquakes. Using TUNAMI (Tohoku University's Numerical Analysis Model for Investigation) code, we performed numerical simulations and constructed inundation maps. We downloaded bathymetry data of GEBCO 30 arc-sec and topographic data of SRTM 1 arc-sec. We divided the computation domain into four grids, such as the finest grid represented inundated area merging GEBCO and SRTM data. We set six coastal output points along the Egyptian shoreline including the real Alexandria gauge to study tsunami height and arrival time. Moreover, we picked out five important points to evaluate tsunami run-up height and inundated depth. Our computation results showed that the first wave arrived at the coast-line of the Alexandria after 62 min of the 142 earthquake with the maximum tsunami run-up height of 6.48 m and inundated depth of 7.63 m. While, the 1222 source closest to Alexandria had the maximum tsunami run-up height of 0.55 m and inundated depth of 1.2 m. Computed inundation maps showed that the 142 event covered the largest inundation area than other events. For all sources, the western inundated areas were much wider than the eastern inundated areas.

4.4. Vadose zone Hydrogeophysical studies in Urban Environment

Wednesday, 11/Sep/2019: 5:00pm–7:00pm

Poster Session & Social

Location: Foyer

Poster: Carbon based nanoparticle: A nascent Nano tracer for groundwater studies

TAUFIQUE WARSI¹, R RANGARAJAN¹, RAMA RANJAN BHATTACHARJEE²

¹CSIR-National geophysical research Institute, India; ²Amity university, India

Tracers are meant to be a potential tool in providing information on groundwater flow characteristics such as flow velocity and flow direction. Conventional tracers were normally used as injected tracers in hydrological applications. However, use of chemical, Radio and Dye tracers have limited scope. There have been lot of progress made in the area of biological tracers/markers based on nanomaterials in India, but no effort has been put for geo-tracers. An attempt is being made to use fluorescence emitting carbon nanoparticle tracer as an alternate tracer in fluid movement for characterizing the hydro-dynamic conditions of polluted areas in various geo-environments. In this paper we report the experimental work using laboratory columns to study performance of three different tracers such as chloride, tritium and carbon particle tracers (CQD) which is fluorescent under simulated condition. The study was initiated for identifying alternate tracer which has less diffusion coefficient for studying water movement in unsaturated or saturated zones. The porous media used in the present column experiment is medium to fine sand and red soils. The column studies indicated that nano-tracers arrived together with the conventional tracers with almost same velocity. The experimental study indicated that nano particle tracer could be a substitute for existing chemical and radiotracer for groundwater and environmental studies. The column study provides scope to analyze the performance of different tracers and to select the suitable and better tracer for water movement through different type of formation to estimate reliable hydraulic parameters.

Poster: VADOSE ZONE HYDROGEOPHYSICAL STUDIES IN URBAN ENVIRONMENT

SEPISO SHAWIN MUSHE

University of Namibia

Namibia is the driest country south of the Sahara. Rainfall is low with annual rainfall figures varying from 550mm to 600mm in the far North and between 250mm to 300mm in the south as well as to less than 50mm at the coast. This is coupled with high evaporation rates, resulting in a deficit in surface water resources over most of the country. Hence, Namibia depends largely on groundwater which forms a substantial part of water resources in the country. With an urbanization rate of over 50% and a rapid population growth rate of approximately 2.09% in cities and towns of Namibia, studies of Vadose zone hydrology are of utmost importance. A Vadose Zone refers to the part of the earth that is between the land surface and the phreatic zone. With this zone being the main factor that controls water movement from the land surface to the aquifer, it plays a major role in maintaining the life of the Namibian Population. This presentation emphasizes on the importance of applications and challenges faced when using geophysical methods such as electrical resistivity tomography, induced polarization and electromagnetic induction to maintain the Vadose zone.

Poster: Adsorption Characteristics of Riverbed Sediment on Iron and Manganese Contaminant during bank filtration: a case study in northeastern China

Wenzhen Yuan^{1,2}, Xiaosi Su², Siqi Wang¹, Kemo Jin¹, Yifei Xing¹, Feng Liang¹

¹Chinese Academy of Geological Sciences, Beijing 100037, China; ²College of Construction Engineering, Jilin University, Changchun 130026, China

During bank filtration, there are two main different flow paths from the river to the center of the depression cone, in northeastern of China. One is the shallow lateral infiltration, with lower permeability, which inhibits the speed of infiltration and shortens the physical path, and the other is the deep vertical infiltration, with greater permeability. The solute carried in the river water infiltrates into the groundwater, and its migration

process is not only affected by the convection and dispersion of groundwater, but also by the action of water and rock. Adsorption is an important process of interaction between solute and medium solid phase, directly or indirectly affecting the geochemical process of iron and manganese in the underground environment, and thus affecting the mobility and retention of iron and manganese in the aquifer. In this paper, the adsorption kinetics and adsorption thermodynamics of iron and manganese in aquifer media on shallow and deep water flow paths were analyzed by static experiments with maximum adsorption capacity, adsorption rate and adsorption kinetic constant. The results show that the adsorption of $\text{Fe}^{2+}/\text{Mn}^{2+}$ in solution is consistent with nonlinear adsorption, and the adsorption thermodynamics process and Freundlich model have the best fitting results. The adsorption amount and adsorption rate of $\text{Fe}^{2+}/\text{Mn}^{2+}$ in solution by aqueous medium are determined by particle size, effective form mineral content and microbial community structure.

Poster: Coupled Groundwater flow modeling in unsaturated and saturated conditions in hard rock aquifer

Payal Rani, Tanvi Arora

CSIR-National Geophysical Research Institute, Hyderabad-500007, India

Groundwater is one of the important, valuable and renewable resources. Because of rapid growth of residential colonies and many-fold increase in the withdrawal of groundwater, the water table has reached at a critical level in many parts of India especially in hard rock terrain. The knowledge of groundwater recharge is an important information for the sustainable management of limited water resources. Water flow in vadose zone or commonly known as unsaturated zone plays an important role and affects the transfer rates between the surface and groundwater table. The main objective of the present work is to simulate potential groundwater recharging capacity of the Vadose zone through coupling between unsaturated and saturated zone parameters.

For the present study, CSIR-NGRI campus in Hyderabad situated in urban environment has been selected. The area is conceptualized by using information coming from geophysical methods and boreholes present in the surroundings. In order to estimate the recharge parameters a preliminary groundwater flow model for saturated zone has been developed by using visual MODFLOW classic interface. For modeling groundwater flow in unsaturated zone, an open source program, such as HYDRUS-1D is being applied. Finally, the coupling between these programs is anticipated to represent the both zones as a unique system.

4.5. Volcano Hazards and Benefits

Wednesday, 11/Sep/2019: 5:00pm–7:00pm

Poster Session & Social

Location: Foyer

Poster: REDUCTION RISK AND SEISMIC ACTIVITY AT NYIRAGONGO AND NYAMULAGIRA VOLCANOES IN THE WESTERN BRANCH OF THE EAST AFRICAN RIFT/DRC

KIRO ROCKY KUBUYA¹, BISIMWA INNOCENT RUTEGA²

¹DONG A UNIVERSITY, Korea, Republic of (South Korea); ²AFRICA GEOMINES AND TECHNOLOGY SERVICES, DR. CONGO

These are an active stratovolcanics with an elevation very high in the virunga mountains associated with the albertine rift, It is located inside virunga national park in the Democratic Republic of the Congo, about 20 km north of the town of Goma and Lake Kivu and just west of the border with Rwanda. The main crater is about two kilometres wide and usually contains a Lave lake.

Measuring gases for air quality monitoring and eruption volcanic control is a challenging task that claims a lot of time of observation and large number of equipment. The aim is to develop a partially autonomous drone equipped with sensors, in order to monitor and collect air quality at real time and reduce disease for population around for atmospheric problems, also to make advantage for the volcanic sources to develop a small power energy plant to serve the population neighbor also as volcanics provide a fertilized soil for agriculture, this can be a good opportunity to be evaluated. The proposed project contains several sensors to measure temperature, Humidity, Dust, CO, CO₂, and SO₂. The data will be transmitted to a server by wireless internet connection and be stored. The data will help us to see all advantages and disadvantages that volcanoes provide to the nearest local population in the environment, hydrogeological and Geotourism tasks.

4.6. Do we understand natural hazard risk? (Roundtable Discussion)

Wednesday, 11/Sep/2019: 8:30am–10:00am

Session Chair: Paul Hudson

Location: Senatssaal

Intensification of riparian occupation of Bukavu city: analysis of population vulnerability in the face of landslide.

JEAN-ROBERT NSHOKANO MWEZE

Université Paris 8, France

In developing countries in general, and particularly in the Democratic Republic of Congo (DRC), the urbanization rate and population growth, associated with poor adequate policies, is one of the causalities that explain the increasing population vulnerability. According to UNEP (2011), in DRC, the population is mainly rural. However, the country has shown a demographic growth rate of 4, 6% per year (from 2005 to 2015), which is superior to the demographic growth in rural area and to the national average, respectively from 1, 8% and 2, 8%. Bukavu is located in the eastern part of DRC close to the Lake Kivu and Ruzizi River where many natural hazards such as earthquake, landslides, occur and have effects on people activities. The population density and the socioeconomic level are among the factors that influence the landuse. Hence, the combination of permanent and active landslides with social vulnerability is crucial to the risks that people can undergo in the city.

For this, two main zones are investigated. The first one is located in the Lake Kivu riparian zone where some researches (Dewitte, 2017) have shown that the landslide is shallow: it means the susceptibility to landslide is low; while the landslide in Ruzizi River riparian zone is deep: it means the susceptibility to landslide is high. In addition to field observations, a diagnostic survey has been done to understand the perceptions of different actors in regard of the space organization, natural hazard knowledge, risk representation and risk management.

Collapse or compatibility: Forecast of Iran's future based on the destructive effects of global warming

Babak Shaikh Baikloo Islam¹, Tahmineh Sokhansefat²

¹*Department of History and Archaeology, Science and Research Branch, Islamic Azad University, Tehran, Iran.;*

²*Department of New Sciences and Technologies, University of Tehran, Tehran, Iran.*

The climatic conditions of the earth have been fluctuating for various reasons, and the frequent occurrence of abrupt climate change has led to tensions and severe pressures on the nature and lifestyle of human societies. Although the general trend of temperature in the Late Holocene has tended to cool, but due to the intense human activities and the progressive increase in population over the past two hundred years, Earth's temperature has risen steadily. This climate change can disrupt the species life and can also threaten human health. Iran, due to its semi-arid to arid climate and desert nature, has been a vulnerable country in the face of drought, and population growth without adequate infrastructures and facilities, by breaking the balance between supply and demand, could exacerbate the unfavorable outcomes of this situation. Therefore, optimal management of resources (especially water) and the use of renewable energies can not only be fruitful in terms of adaptation and tolerance of drought periods, but also considerably necessary. Paleoclimate studies indicate that, on average, the duration of natural climate change during the Holocene has been around 300 years, but the current trend of global warming, which occurs artificially, has no time limit, so it can go to the boundary of life destruction on the planet. Therefore, given the occurrence of a long period of climate anomalies and severe droughts, if climate change adaptation programs in Iran are not quickly implemented, soon broad sections of the country will become uninhabitable.

CONSTRUCTION WITH SAFE AND MINIMAL DESTRUCTION

ATUL BRICE

PANJAB UNIVERSITY, India

Being a developing country huge amount of construction takes places everywhere in the nation for a population over 1.3 billion people which requires a lot of money. To transport the goods and people, highways are constructed everywhere. Highways are prone transportation infrastructures that are at risk of landslides in many areas. The cause of landslide is triggered by a number of geological, geomorphological and anthropogenic factors like lithology, slope, elevation, weathering, proximity to road etc. While constructing a highway in mountain regions slopes are destabilized and often lead to the expansion of settlements into hazard zones. A proper study of the area is required to carry out the construction in such landslide susceptible zones. The Shimla-Kalka highway in northern India is still in the construction phase and already has been affected by numerous landslides due to poor study of the area. Which costed a lot of time and money along with the obstruction to moving traffic. The theoretical analysis or computer software to solve the slope instability plus using aerial photographs, topographical maps and field verification could minimize such impact. The study cites analysis of highway landslides (focusing on different highways in northern India) causes, effects and prevention based on theoretical study.

Poster: Environmental effects of radioactive materials (nuclear energy)

Farzad Soltanian

azad university, Iran, Islamic Republic of

This article discusses the environmental effects of radioactive substances descriptively and analytically. In this paper, issues such as the early radioactive history, radioactive units, the introduction of radioactive substances (radioactive), the types of radiation and the amount of radioactive radiation absorbed, uranium emissions, atomic reactors and nuclear waste, methods for the destruction of nuclear waste, the effects of radioactive substances On humans, the effects of radioactive substances on the natural ecosystem, the Chernobyl accident, the definition and effects of nuclear weapons, the Hiroshima and Nagasaki atomic bombardment, and the disarmament are briefly outlined. The goal is to understand the dangerous effects of atomic materials on the planet and warn governments and scientists about nuclear pollution. Heat contamination, hazardous radiation, waste and nuclear waste all put the environment at serious risk. The human race faces painful deaths and acute and chronic illnesses. All living creatures: plants, animals, and all environmental environments, including atmosphere, land, water, air, and in fact threaten the entire planet. The results of this study indicate that the most serious nuclear power problem is the proper use and disposal of radioactive waste. The probability of a major and major incident, such as fusion of nuclei in power plants, is very important. The devastation of power plants and the possibility of stealing plutonium for acts of terrorism tell us that the present generation and future generations are at risk.

4.7.-1 Impacts of climate change and human interventions on the water cycle

Tuesday, 10/Sep/2019: 1:30pm–3:00pm

Location: Hall D

Determining the driving factors of shallow groundwater levels in a diverted section of the Danube

Balázs Trásy^{1,2}, József Kovács¹, István Gábor Hatvani³, Tamás Garamhegyi^{1,2}

¹Eötvös Loránd University, Hungary; ²Eötvös Loránd University Institutional Excellence Program, Hungary; ³Institute for Geological and Geochemical Research, Research Centre for Astronomy and Earth Sciences, MTA, Hungary

Climate change and anthropogenic activity adversely affect shallow groundwater levels (SGWL), thus the fragile riparian ecosystems. The Diversion of the Danube due to the construction of a water barrage system changed the SGW balance in NW Hungary. The aim of the study was to explore this change and its driving factors using hourly measurements of 94 SGW wells and the time series of other meteorological parameters from 2013 using wavelet spectrum analysis.

The presence of diurnal periodicity of the water level was present in 41% of the wells, while water temperature did not behave periodically. With wavelet coherence analysis it was shown that the water level time series' followed the change in evapotranspiration with 5 to 12 hour lag.

The periodic daily fluctuation of SGWL does not primarily depend on the SGW depth, but on the physical properties of the lithological unit characteristic of a given depth. The time series of the wells whose water level lies in the fine-grained sediment zone show diurnal periodicity, while in gravel it is uncommon. The determining factor of periodic SGWL fluctuation is capillary elevation, which creates a connection between the groundwater table and the upper strata, which does not function even if the water level is just a couple of cms below the upper strata. This occasionally minor difference can have a major effect on the characteristics of the vadoze zone. This can be driven by climatic factors (e.g. an increase in extremities), or by local anthropogenic effects (water management, river regulation).

Crops Planning Constrained to Groundwater Sustainable Consumption Using a Hydro-Agronomic Model

Mojtaba Shourian, Iman Sabzzadeh

Shahid Beheshti University, Iran, Islamic Republic of

Groundwater is a strategic resource for supplying water particularly in arid regions. Management of groundwater resources is essential to preserve sustainability while conserving economic interests. In this paper, crops area in a plain and pumping rates from wells are optimized by coupling SWAT and MODFLOW (as the surface-agronomic and groundwater simulation models) and the Particle Swarm Optimization algorithm. Maximization of the net benefit gained from agricultural production is defined as the objective function while the water withdrawal for irrigation is limited to a pre-defined level as the groundwater sustainability constraint. The decision variables are cultivation areas for four major irrigated crops which are searched by PSO and the model is applied for the Asemanabad plain in west of Iran. Results indicated that the agricultural net benefit is increased significantly comparing the present situation while the aquifer's depletion is remained in the sustainable range. Through sensitivity analyses, it was found that the crop's unit price has a major effect on the optimum crop pattern and water consumption while improvement of the irrigation efficiency showed a negligible impact on the system's optimum net benefit.

Sustainability Problem of The Euphrates & Tigris Basin Water Resources Under a Changing Climate

Mahsa Zeynalzadeh, Yusuf Alizade Govarchin Ghale, Omer Lutfi Sen

Istanbul Technical University, Turkey

The Euphrates–Tigris River Basin is a large transboundary basin that covers an area of about 800,000 km² distributed between Iraq, Turkey, Iran, Syria, Saudi Arabia and Jordan. The Basin is known by the two snow-fed rivers, the Euphrates and Tigris, which are an essential part of the Southeastern Anatolian Project in Turkey. This project aims at generating energy and irrigating the vast semi-arid plains in southeastern Turkey via constructing 19 hydropower plants and 22 dams. Irrigated agriculture development and construction of several dams and canals by the riparian countries will lead to increasing evapotranspiration and decreasing runoff in the basin. Consequently, these actions will cause mismatches between water supply (average discharge) and water demand in the basin. In this study, Global Circulation Model (CMIP5) projections were used to investigate the hydro-climatic effects for three future periods (2016-2035, 2041-2060, 2081-2100) compared to 1986-2005 reference period. The results indicated that precipitation and evapotranspiration will decrease in the basin, especially in the headwaters region. Consequently, runoff is projected to decrease in the entire basin. The decrease is larger in Turkey (10-50 %) and Syria (15-30%). The runoff decrease in Iraq and Iran is between 5% and 20%. These estimations suggest that the water sharing problem in the basin will be exacerbated in the future by the changing climate that decreases water resources. Therefore, the riparian countries are urgently required to find a sustainable solution to the water sharing problem, which should also take into account the impacts of the changing climate.

Climate Variability and its Impact on Water Potentiality and Management: A Case Study of Upper Alaknanda Basin Western Himalaya

Bindhy Wasini Pandey

Department of Geography, Delhi School of Economics, University of Delhi, India

Present research aims to investigate the issues concerning ecohydrology and potentiality of water in high mountain areas of Western Himalaya. Upper Alaknanda Basin of Western Himalaya region are the source of perennial streams of South and East flowing rivers of Ganga Plain which feed almost half of the Indian population. For the climate, people, economy and ecology, Upper Alaknanda Basin of Western Himalaya region are known as “Water Tower” as drinking water for humans and animals; water for irrigation of food other agronomic practices; and, a very mountain-specific use: hydropower depend on water of the Upper Alaknanda Basin of Western Himalaya. Increasing population and economic transformations have exerted considerable pressure on land and water resources in Western Himalaya. Such changes have brought modifications in water flows, nutrients, sediments and pollutants as well as loss of biodiversity. Hence, the ecohydrological processes in headwater regions of Western Himalaya have been degraded. The role of natural processes, impact of human interference and climate variability on the availability of water, highland-lowland interactive linkages, and sustainable use of water require attention for planning and conservation. There is, therefore, an urgent need for a better understanding of the vulnerability of the land-water system to human activities and climate variability impacts in high mountain region of Western Himalaya. Present research will suggest sustainable pathways resilience to mountain communities which will help in coping strategic plans against Climate Variability and Water Potentiality in High Altitude Basins of Western Himalaya.

Keywords: Climate change, Mountain sustainability, Natural resource management.

Poster Pitch: Estimation and modelling of spatiotemporal variability of precipitation in the Upper Teesta Valley- Sikkim, using Geostatistical Methods

PAWAN KUMAR

UNIVERSITY OF DELHI, DELHI, INDIA, India

Study region: Upper Teesta River Basin, Sikkim, India.

Estimation of rainfall distribution is imperative in order to know the variability and rainfall patterns. Yet in

mountainous regions it is problematic to calculate the rainfall distribution because of the rugged, hilly terrain as well as poor obtainability of rainfall points. Rainfall estimation is vital for land use patterns and zoning and resource analysis. In this context geostatistical techniques have been developed for mapping rainfall in the Upper Teesta river Basin with the help of data extraction using DEM and long-term mean monthly rainfall (MMR) data of 19 rain gauge stations. Techniques of Krigging and Co-Krigging were applied to standardized rainfall depths associated with elevation, as the primary varietal, and the surface elevation values as the secondary variant. Semi-variogram model was used for its modelling. All these results were established with the help of ArcGIS. The study has been successful in bringing out the rainfall pattern in Teesta region which is helpful for the locales because Teesta is considered as “The Lifeline of Sikkim”. Assessing the variability in rainfall will consent the people to choose the precise technique for management of the river water also serving them with ideas to regulate flash floods. This paper will provide an insight to the people of Sikkim who are reliant on the river water to step a foot towards development.

IMPACTS OF HYDROPOWER CONSTRUCTION PROJECTS ON THE ENVIRONMENT- A CASE STUDY OF BEAS RIVER BASIN

Saravanan RAVINDRAN¹, Prakasam C²

¹Chitkara University; ²Chitkara University

Hydropower is one of the critical energy sources. This renewable wellspring of energy has some genuine negative impacts on its surrounding condition particularly during development period. These negative impacts have mainly been reflected in both biotic and abiotic situations. The state has rich water resources and a high inclination profile, which makes it appropriate to generate hydro-influence. The state is accounted for to have the generating capability of more than 20,463 MW of hydroelectric energy. To tap this potential, the Himachal Government has just built a few tasks and substantial undertakings amounting to a limit of 3263 MW are under development in the Beas river basin. The 16 MW Patikari HE Project, executed by Patikari Power Private Limited, is a kept running of the river type hydro control venture based on the Bakhli Khad, a left bank tributary of the Beas River joining into the reservoir behind the Pandoh dam. It is one of the 18 hydropower ventures which is in under development. Patikari Project is located in Mandi area of Himachal Pradesh, India. Two generating Units driven by level shaft Pelton Turbines, each having a rated yield of 8.0 MW + 15% continuous most extreme rating are installed in the Power Station. The present spotlights on knowing the impacts of hydropower development exercises on the ecosystem and indirectly its impact on water cycle. Landuse LandCover Change and Vegetation monitoring causes us in arriving at a conceivable decision about the impact of the development upon nature.

4.7.-2 Impacts of climate change and human interventions on the water cycle

Tuesday, 10/Sep/2019: 3:30pm–5:00pm

Location: Hall D

Use of Wastewater to Irrigate Vegetables in the Kurdistan Region of Iraq: Assessing Toxic Hazard against Nutritional Benefits

Karzan Abdullah Mohammed¹, Baset Burhan Karim², George Shaw³, Liz Bailey⁴

¹Sulaimani polytechnic university/ College of applied science/ Natural resource and environment; ²Sulaimani polytechnic university/ College of applied science/ Natural resource and environment; ³University of Nottingham/ School of bioscience/Division of agriculture and environment; ⁴University of Nottingham

Vegetable fields in and around urban areas in Kurdistan region of Iraq may accumulate potentially toxic elements (PTEs) from various contamination sources including municipal waste disposal and waste water used for irrigation. The purpose of this study was to assess PTE concentrations in the edible parts of different field-grown vegetables and to assess risks to the local population consuming the produce. In this study 316 vegetables and 96 corresponding soils were sampled from 17 areas around Sulaymaniah, Halabja and Kalar cities. The soils are calcareous (pH 7.5 - 8.18) and classified as silty loam, sandy or silty clay with total carbon (TOC) contents between 1.4 and 5.47%.

Chromium, Ni and Cu concentrations in soil exceeded EU or UK soil guideline values at one or more locations. However, total concentrations are not representative of the 'bioavailable' fraction that may be readily taken up by plants and DTPA extractions and measurements of isotopically exchangeable metal may better represent this fraction. DTPA extractable and isotopically exchangeable metals (E-value) were typically low but can be up to ~20% for Zn, Cd and Pb. Sequential extraction suggested that most PTEs were in the residual fraction.

Children are potentially at risk from exposure to PTEs, particularly Cd and As from consumption of vegetables grown in industrialised areas in Kurdistan. There is now a pressing need to assess the 'benefits' side of cultivation of peri-urban areas and use of wastewater in irrigation - ie the contribution to key dietary micro-nutrients (iodine, selenium, zinc, magnesium).

Investigation of Environmental Migration in Iran: Negin-e Kavir and Tasooj Case Study

Fa'ezeh KhajehZadeh, Mohammad Jalal Abbasi-Shavazi, Rasoul Sadeghi

University of Tehran, Iran, Islamic Republic of

Using mixed methods this paper tried to understand the relation between environmental changes (specifically drought) and internal migration. Accordingly, in the quantitative part, by investigating the drought of 110 cities of the country using SPI index and creating correlation between immigration conditions of selected cities in 30 years, the relation between these two variables has been examined. The results show that drought in dry regions has a positive relation with immigration in these regions, however there is not any correlation in other areas of country with different climate. Therefore, in order to better understand the issue, Negin Kavir, a district in Kerman province, and Tasooj, a district in Fars province, which are regions with very dry and dry climate respectively have been investigated. Sample of residents of each region have been interviewed about the effects of drought on their lives. The results indicate that drought affects the residents of these regions in two ways: 1. Risking their livelihood, and 2. Risking people's health. In occurrence of consistent droughts, migration is considered as a last solution to the problem. Previously, the residents of such regions tried to confront this problem by adjusting their lives with this new condition. However, in comparison with residents of more developed regions, residents of less-developed regions have a less opportunity to adapt with new condition. Adaptation strategies in these regions have failed and people were compelled to migrate. Therefore, forced migration is a result of drought in dryer areas of country.

Poster Pitch: Effects of Danube diversion in Szigetköz - a clogging case study

Balázs Trásy^{1,2}, Tamás Garamhegyi^{1,2}, Péter Laczko-Dobos¹, József Kovács¹, István Gábor Hatvani³

¹Eötvös Loránd University, Hungary; ²Eötvös Loránd University Institutional Excellence Program, Hungary; ³Institute for Geological and Geochemical Research, Research Centre for Astronomy and Earth Sciences, MTA, Hungary

The efficient operation of shallow groundwater monitoring networks is crucial to water supply, inland water protection, agriculture and nature conservation. In this study, the spatial representativity of such a monitoring network is assessed in different discharge scenarios, taking the directional characteristics of this representativity into account, i.e. exploring whether geostatistical anisotropy is present, and investigate how this changes with flooding. The Szigetköz monitoring network adjacent to the Danube is located in an area that has been thoroughly impacted by anthropogenic activity (river diversion/ damming). The time series of 85 shallow groundwater monitoring wells tracking flood events (2006, 2009, 2013) were assessed. Variography was conducted on the residuals, and the degree of anisotropy was assessed to explore the spatial autocorrelation structure of the network. Since the spatial density of the raw data proved to be insufficient, an interpolated grid was derived, and the final results were scaled to be representative of the original data. It was found that during floods the main direction of the spatial variance of the shallow groundwater monitoring wells alters, from perpendicular to the river to parallel with it for over a period of about two week. However, with the passing of the flood, this returns to its original orientation in ~2 months. It is likely that this process is related first to the fast removal of clogged riverbed strata by the flood, then to their slower replacement. In addition, the work highlights the importance of assessing the direction of the spatial autocorrelation structure of monitoring networks.

Poster Pitch: Detection and Attribution of Climate Change in Extreme Precipitation using the Optimal Fingerprinting (Case Study: Southwestern Iran)

Tofigh Saadi¹, Bohloul Alijani², Alireza Massah Bavani³, Mehry Akbary⁴, Mojtaba Noury⁵, Soad Saeidi⁶

¹Alborz Regional Water Authority, Iran, Islamic Republic of; ²Kharazmi University, Tehran, Iran; ³University of Tehran (Abourihan Campus), Tehran, Iran; ⁴Kharazmi University, Tehran, Iran; ⁵Iran Water Resources Management Company; ⁶B.Sc. in Soil Engineering from Shahid Chamran University, Ahwaz, Iran

Determining regional vulnerability of a basin is one of the issues which has attracted scientists and researchers' attentions in recent years. In the present study, the climate change detection and attribution approach was employed to determine the contribution of the effects of climate change to extreme precipitation in southwestern Iran in the recent decades, using the optimal fingerprint method, and ordinary least squares was hired to compare the observed changes in the annual maximum daily precipitation and the annual maximum five-day precipitation with the NorESM1-1 model simulations under the effects of anthropogenic plus natural external forcing (ALL), anthropogenic forcing alone (ALL), and the effects of greenhouse gases forcing alone (GHG). Pre-processing steps including remapping, calculation of the probability index (PI), and five-year average of time series. The results indicated that both extreme precipitation indices in the recent years had a significant change in the trend, and these changes were attributable to anthropogenic plus natural external forcing (ALL), anthropogenic forcing alone (ANT), and greenhouse gases forcing alone (GHG), but natural forcing (NAT) was not detected. In addition to the obtained results, the extent of the contribution of climate change effects on extreme precipitation was identified. Accordingly, extreme precipitations in the study area were influenced by ANT from the magnitude of the mean values of time series, and the effects of GHG begin from more extreme precipitation values. The results of study are consistent with the global pattern for the increase in extreme precipitation induced by atmospheric humidity resulting from global warming.

Poster: Estimation and modelling of spatiotemporal variability of precipitation in the Upper Teesta Valley- Sikkim, using Geostatistical Methods

PAWAN KUMAR

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Poster: IMPACTS OF HYDROPOWER CONSTRUCTION PROJECTS ON THE ENVIRONMENT- A CASE STUDY OF BEAS RIVER BASIN

Saravanan RAVINDRAN¹, Prakasam c²

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4.8. The challenge of Seismic Hazard and Risk Evaluation

Wednesday, 11/Sep/2019: 10:30am–12:00pm

Location: Senatssaal

The Young Deformation Mechanism in Tehran Plain: a combination of field observation and analog modeling

Farzad Soltanian¹, Zahra Azareh²

¹Azad university, Iran, Islamic Republic of; ²Azad university

The capital city of Tehran is located to the south of central Alborz. The North Tehran fault, as the main structure of this region, perched on the northern part of the city and separate alluvial fans from volcanic rocks of the Alborz. There are several other faults within the city which seem to be structurally related to the North Tehran fault. Geomorphic study of fans and river deposits suggest that most of these faults are active and taking up both left-lateral and shortening in a wider zone to the south of North Tehran fault. Field observation along road cuts which cross these structures suggest that young folding in Tehran plain are active and escalate due to the activities of the underlying faults. There is little evidence of rupture in front of these structures and thus most of them are considered as blind faulting. The trend of these structures is oblique to the North Tehran fault which is probably due to distribution of left lateral deformation in wider zone within the Tehran plain. The distance between active folds and the North Tehran fault increase from west to east. Analog modeling's were carried out to study the effect of thickness and slop of deposits on position and trend of structures within the Tehran plain. Results from these experiences show that geometry, orientation and distance between structures is probably controlled by oblique shortening of the zone, as well as increase in thickness and slope of the sedimentary deposit.

Relations between pore pressure and acoustic emissions in critically stressed wet sandstone

Alexander Catalinac¹, David Dempsey¹, Michael Pender¹, Lei Wang², Grzegorz Kwiatek², Georg Dresen²

¹The University of Auckland, New Zealand; ²GFZ German Research Centre for Geosciences, Germany

Injection-induced seismicity poses a risk to public safety, infrastructure and perception. Cases of wastewater disposal deep underground present the greatest seismic hazard. Currently, relations used in risk assessment are based on injection volume and rate. However, the physical mechanism of fault initiation is known to be a reduction in the effective normal stress. Information of its components, the stress state and fluid pressure, are generally unavailable in the field. Experimentation on cores of 0.05 m diameter and 0.1 m length is undertaken to establish relations between pore pressure and acoustic emissions, a proxy of seismicity. Wet sandstone is held at high differential stress and confining pressure to replicate crustal conditions and subsequently injected into while acoustic emissions are monitored. The stress state is determined from mechanical behaviour and acoustic emissions during compression. Injection pressure is stepped to allow pressure equilibration and acoustic emissions to cease before it is increased until macroscopic failure occurs below the minimum principal stress. Previous experiments have been in initially dry conditions, and this has limited their applications. The relations and one-dimensional flow of fluid in a bounded homogenous porous medium will form an induced seismicity model to be calibrated to the catalogue of events. Model applications are in the inversion of rock properties and critical pressure, a measure of the proximity of optimally orientated faults to failure.

Site Effects and Microzonation of Srinagar Region, Kashmir Basin from Microtremor Measurements

S Vishal Gupta^{1,2}, Imtiyaz Ahmed Parvez¹, Ankit Kumar¹

¹CSIR-Fourth Paradigm Institute, Bangalore, India; ²Indian Institute of Technology (Indian School of Mines)-Dhanbad, India

High-resolution single station microtremor ambient noise data acquisitions were carried out at 430 sites in Srinagar region of Kashmir Basin to characterise local site response and assessment of seismic hazard and risk. Srinagar is the summer capital city under Kashmir province of Jammu and Kashmir state of India which is exposed to more than 2 million inhabitants and significant earthquake risk. The acquired dataset has been processed with the Horizontal to Vertical Spectral Ratio (HVSr) technique, following the SESAME guidelines to map the resonant frequencies, the thickness of sedimentary cover and to identify the areas prone to seismic amplification. HVSr inversion was also performed to calculate localised average shear wave velocity (V_s) for shallow and deeper sedimentary deposits. Using the estimated average V_s for shallow and deeper sedimentary deposits as 238 m/s and 1084 m/s, two distinct boundaries as shallow and deeper seismic impedance contrast have been delineated at many places. The predominant first peak resonance frequency shows variation from 0.24 Hz to 17.76 Hz and corresponding estimated sediment depth varies from 3 m to 1205 m. A non-linear regression relation between predominant frequency and corresponding sediment depth for Srinagar was established as ($h = 165.9 \pm 21 f_1^{-1.492 \pm 0.031}$). The spatial classification of all obtained HVSr curves was done to describe distinguished subsurface features. The present study is aimed to emphasize the distinguished seismic responses and associated seismic hazard and risk in Srinagar region of Kashmir valley.

Towards Improved Uncertainty Quantification and Visualization for Aftershock Forecasts in the Pacific Northwest

Max Schneider^{1,2}, Peter Guttorp^{1,3}, Nadine Fleischhut², Michelle McDowell²

¹University of Washington, Seattle, United States of America; ²Max Planck Institute for Human Development, Berlin, Germany; ³Norwegian Computing Center, Oslo, Norway

Probabilistic aftershock forecasts based on seismicity models are crucial for earthquake risk reduction. However, forecasts come with uncertainty, which must be rigorously quantified to properly assess seismic risk. We build several models for the Pacific Northwest (PNW) of North America, based on the Epidemic Type Aftershock Sequence (ETAS) method. ETAS is a parametric space-time point process model that describes background seismicity and aftershock clustering. The PNW catalog from 1970-2011 is merged with data on measurement error for reported earthquake magnitudes and locations. We discuss the effects of estimating parameters differently across two- and three-dimensional space, to account for regional differences in aftershock clustering. Unlike other seismicity models, we propagate the known measurement errors through the model to obtain more realistic uncertainties on estimates of earthquake rate and its parameters. We use a simulation-based approach that isolates the effect of measurement error and model stochasticity on these model outputs. We present results showing spatial dynamics in estimated PNW earthquake rates. The effect of measurement error on model outcomes is more nuanced and also influenced by space and time. Implications for aftershock forecasting are discussed. The visualization of these forecasts is a non-trivial matter: how can we effectively communicate a forecast together with its uncertainty, to facilitate seismic decision-making under uncertainty? In an experiment, we evaluate the effectiveness of three competing uncertainty visualizations for aftershock forecasts. Subjects perform realistic judgment tasks and responses and response times are compared across visualizations. We discuss the design of such an experiment and provide first results.

Cordierite metapelites: tracers of the late orogenic PanAfrican evolution of the Laouni terrane. LATEA, Tuareg shield, Algeria.

BRAHIM AYAD^{1,2}, EL-HOCINE FETTOUS¹, AZIOUZ OUABADI¹

¹Laboratory of Geodynamics, Engineering Geology and Planetology, FSTGAT / USTHB, Algeria; ²Young Earth Scientists Network, Algerian Chapter

In orogens, interactions between heat transfer and tectonics lead to rheological instabilities that initiate and localize the deep seated rock exhumation. The presence of Precambrian metamorphic and magmatic rocks within the LATEA-Iskel collision zone, South of Laouni, offers a good opportunity to understand these interactions.

The Laouni terrane, in the LATEA superterrane, is constituted of Proterozoic formations affected by two metamorphisms, one of high temperature with a discussed age -Paleoproterozoic or PanAfrican?- and the other of high pressure with a PanAfrican age. The magmatism, at the Neoproterozoic, is calc-alkalin highly potassic syn-orogenic and alcalin post-orogenic. The structure of Laouni is described to be constituted by a PanAfrican thrust sheet set followed by a transcurrent tectonics. Recent and ongoing works highlight a North-South extension exhumating the lower continental crust and the high pressure rocks and which is compatible with an East-West shortening.

We propose to study, in the Tin Began region's most meridional structural trend containing exhumed PanAfrican eclogite lenses, the different parageneses developed in the migmatitic metapelites, their temperature and pressure conditions and their relation with the fabrics of deformation. The stability conditions of the two principal foliation parageneses and of the associated structures translate an isothermal decompression with a relatively high temperature estimated at different pressures.

The presence of numerous plutons of a mixed origin and coeval mantelic mafic and ultramafic rock complexes, suggest a heat advection from a deep origin leading to a partial melting of the lower continental crust and which contributed to its exhumation.

Poster: UNMANNED AERIAL SYSTEMS FOR MONITORING TRACE OF NYIRAGONGO VOLCANO GASES, DRC Eastern Branch

KIRO ROCKY KUBUYA

DONG A UNIVERSITY, Korea, Republic of (South Korea)

The Emission of volcanic gases has many composition and affect the atmosphere during it Anthropocene. The sources and magnitude of Volcano emission is an important undertaking for discriminating the contributions of different processes to pollutant and radioactive forcing, currently there is no mobile that is able to quantify trace gases at altitudes <100m above ground level that can achieve good spatio resolution, UAV can be deployed on site in minutes and around the town near volcano and can support the charge of sensors to quantify the trace gases. therefore, the use of UAV effort to the civilian market and cheap designed analytical system for monitoring gas will help us to evaluate the trace gas detectors which is an infrared laser absorption technic to provide the best cost and convenience sensors deployment. Goma town is the one who is very affected by volcanic gas emission, and data are very ignored and collection time is very huge. this will provide a good data base for updated data and the introduction of new collection model.

In conclusion, UAS offer new and exciting opportunities to study atmospheric composition emitted by volcanic emission and its effects on weather patterns and climate change.

Poster: Seismic zoning of the dynasty and its adjacent areas

Reza Nafari, Nasrin Khalaj, Fariba Kazempour

Azad university, Iran, Islamic Republic of

To zoning seismic hazard of the dynastic region, several parameters of the historical and instrumental earthquake, region slope, geology, geomorphology and distance from faults and fractures have been used. Using Landsat 7 and 8 images and applying Sobel filters in ENVI and Lineament Extraction software in Geomatics software and visual auxiliary techniques, the fault layer of the region is extracted and combined with other

4.8. The challenge of Seismic Hazard and Risk Evaluation

layers of space in the GIS space and assigning weight to them using An Analytical Hierarchy Process (AHP), the ultimate zoning map for seismic hazard was created. 5 areas in the zoned area: a very high risk area with Km²275, a high risk area in Km², an average risk area of Km² 801, a low risk area in Km² 284 and a very low danger zone in Km² 48. By studying the mapping of hazardous areas with regard to the severity of hazards with the results of the study of the regions, it can be concluded that the evaluation and analysis of various parameters of hazard identification using Hierarchical Analytic Method (AHP) can be applied and can be applied. Use this method with Thauran for more areas and more parameters. In the analysis of this region, the most risky area of the eastern Chalanholan and south of Borujerd is due to the presence of faults and the focus of the seismic center. Secured areas are located in the west and southwest of Zagh, west of Cearamen, west-southwest and north of al-Shater and west of Firoozabad.

5.1.-1 Data-driven remote sensing of Earth surface processes

Thursday, 12/Sep/2019: 12:45pm–1:45pm

Session Chair: Taylor Smith

Location: Hall A

Glacier dynamics study of selected Ny- Alesund glaciers and analyzing their response to the changing climate

Suvrat Kaushik, Praveen Kumar Thakur, Arpit Chouksey, Shiv Prasad Aggarwal

Indian Institute of Remote Sensing, Indian Space Research Organization, India

Monitoring of the vast ice sheets of Antarctica by field measurements is a challenging endeavour. Large volumes of remote sensing datasets, both near real time and past archives is available freely worldwide. Glacier velocities, Ice-thickness and Equilibrium Line Altitude (ELA) are the parameters frequently used to characterize the state of a glacier. Their interannual variations or deviations from a long term mean value may be interpreted as consequences of climatic variations. This impact is especially pronounced in the Arctic glaciers. The aims of the study are, but not restricted to 1: The response of Equilibrium Line Altitude to the changing climate, and its associated mass balance and 2: Assessment of surface velocities of a few selected glaciers over a temporal time scale of 30 years and subsequent estimation of ice thickness. ELA is a dynamic parameter sensitive to variations in winter precipitation, summer temperature and wind transport of dry snow. ELA of the selected glaciers was estimated using the Accumulation Area Ratio (AAR) and Area-Altitude Balance Ratio (AABR) methods. Landsat images from 1990 till 2018 were assessed for estimating the changing trend of ELA with the changing climate. Climate variables were downloaded from ERA Interim ECMWF daily forecast data. Glacier velocities were calculated using the feature tracking algorithm for identifying similar features in two optical images and then tracking their displacement to estimate velocity. Ice thickness was estimated from surface velocities using the equation of Laminar flow given by Cuffey and Paterson, 2010.

Assessment of the low magnitude tremors of September 6 - 7th, 2018 in Abuja Nigeria, using integrated Satellite Thermal Infrared (TIR) and Aeromagnetic data

Abayomi Gaius Osotuyi¹, Ayomiposi Henry Falade¹, Abraham Adekunle Adepelumi¹, Samson Deji Onibiyo²

¹Seismological research laboratory, Obafemi Awolowo University, Ile-Ife, Nigeria; ²Department of Geosciences, Georgia State University, Atlanta , Georgia, USA.

The Mpape–Abuja, Nigeria earth tremor occurred between September 6–7th, 2018, though with sparse information recorded, did not cause death or property loss but sent great panic and confusion among residents of the Federal Capital Territory (FCT). To explore other sources of information, Satellite thermal infrared (TIR), which has recorded anomalies in association with fault systems prior to major earthquakes was used to verify if Thermal Infrared (TIR) anomalies can be found in association with low magnitude events which took place in the basement complex terrain with medium to high density local fault system; and aeromagnetic data analysis was used to decipher the fault system and provide information about the lineament juxtaposition of the terrain. Aeromagnetic tectono-structural mapping revealed distribution of 7 faults trending in an approximately NE-SW and E-W directions with 3 faults identified as deep seated faults whose depths were estimated at a range -1000 to 2500 m. 2 other lineaments were identified as regional faults that pass through FCT, Abuja and possibly extend beyond to other regions. A N-E distribution of the TIR around the major faults were observed before the mainshock, and showed that the spatial temperature rose by 10–13°C and suddenly attenuated on the day after the aftershock. It was inferred reactivation of faults in the weak/sheared zones of the FCT, triggered by strain energy released and propagated through the seismically active NE-SW Romanche fault from the Gulf of Guinea, could be the most plausible causative factor of the tremor.

Geospatial Techniques to Determine the Effect of Land Surface Temperature on Forests in Sri Lanka: A Case Study in and around Wilpattu National Park

M. M. G. S. Dilini¹, A. K. Wickramasooriya²

¹Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka; ²Department of Geography, University of Peradeniya, Sri Lanka

Forests play an important role in regulating background climatic conditions. As identified in many studies, effects of forests on temperature have a gradient distribution from cooling to warming from the equator towards the polar region. Alleged deforestation of the Wilpattu National Park has been focused in recent past in Sri Lanka. Therefore, this study was conducted in identifying this critical area using Landsat 8 OLI and TIRS bands for the years 2013 and 2018. NDVI images were used to clarify the situation of deforestation in the study area. Land Surface Temperature (LST) maps were used to compare the effects of forests on LST through the comparison between forests and nearby open lands. The results showed that, remarkable LST in the Eastern part of the Wilpattu National Park in the year 2018. Especially the areas adjoining to Anuradhapura district such as Dematamalgama, Nelumvila, Kulkattuwa, Hunuwilgama. Though the same areas were remarkable in year 2013, extent of higher LST distribution was less. Mullikkulam, Karadikkuli, Marichchukaddi and Palalikuli areas which are adjoining to Mannar district are indicating higher LST from 2013 to 2018. LST value goes up to 31 for the above areas. However, the forest boundary adjoining the Puttalam district indicates lower LST (14 even in 2018). When the situation is compared to the nearby open land, all lands outside the forest area show distinctly higher LST (36). As it is clear that deforestation has led to an increase in LST, forest protection strategies should be implemented to maintain a favorable environment for human and fauna species in the area.

Monitoring the water quality changes of Urmia Lake using remote sensing techniques and field survey data

Yusuf Alizade Govarchin Ghale¹, Mahsa Zeynalzadeh¹, Seyed Ershad Barhagh²

¹Climate and Marine Sciences Department, Eurasia Institute of Earth Sciences, Istanbul Technical University, Istanbul, Turkey; ²Faculty of Civil Engineering, University of Tabriz, Tabriz, Iran.

Urmia Lake, the second largest hypersaline lake in the world, located in the northwestern Iran, has faced extreme drought during recent years. Agricultural development in the basin and climate change are known as the main reasons behind the drying up of Urmia Lake. The salinization and desertification progress due to the drying up of Urmia Lake has led to ecosystem changes in the region. Moreover, the water salinity in the remaining part of the lake has increased dramatically and the life of existing microorganisms such as *Artemia* and organisms such as birds has faced many problems. The hydrometric and climatic data, Landsat satellite images and image processing techniques in conjunction with field survey data were used in this study to determine the monthly and seasonal water salinity changes of the lake in 2016. Understanding the interaction between inputs to the lake and outputs from the lake can play a key role in the water quality controlling to provide the living conditions for some organisms and microorganisms in the lake. According to our results, the minimum and maximum salinity in the sampled points were about 235 g/l and 415 g/l, respectively. Image processing results indicated the linear relationship and a good match between observed (field survey) and modeled (using remote sensing) water salinity changes with a RMSE value equal to 23 g/l. According to the results of this study, there was an inverse relationship between inputs to the lake (precipitation and runoff) and water salinity changes of the lake.

5.1.-2 Data-driven remote sensing of Earth surface processes

Thursday, 12/Sep/2019: 2:15pm–3:15pm

Session Chair: Taylor Smith

Location: Hall A 350

Trend analysis of Changing Temperature over the Time Period of 1979 to 2014 in Uttarakhand, Western Himalaya, India

Sarita Palni, Charu Pundir, Arvind Pandey, Jivan Singh Rawat

Kumaun University, Nainital, India

Himalayan mountain region lying in the northern piece of Indian sub-landmass is among those zones which bears the most biologically delicate situations and are additionally a vault of biodiversity, new water stockpiling (Fresh Water Ecosystem) and environment administrations. In the course of the most recent three decades, arrive change identified with exploitative land utilizes is among the primary drivers of changing snow cover, vegetation cover and profitability in western Himalayas region. In a region where field-based research is tiring because of heterogenous alleviation and high elevation, measuring the adjustments in temperature design utilizing remote detecting procedures can give fundamental data in regards to varying patterns in various components identifying with temperature. This paper studies the trend analysis of changing temperature patterns using SWAT data (1979–2014) over Uttarakhand Himalayas and its association with altitudinal gradient. This paper investigates the trends in maximum (T_{max}), minimum (T_{min}) & mean (T_{mean}) temperatures in the annual, seasonal and monthly time-scales for 117 stations in the 5 regions of Uttarakhand's Western Himalayan region which are categorized on the basis of elevation, from year 1979-2014. Statistical approaches are used to examine the effect of change in pattern of temperature upon the phenology of vegetation in the region under study, fresh water ecosystems, agricultural productivity, decreasing snow line & increasing tree line, change in duration of the seasons etc.

A COMPARATIVE STUDY OF LANDSLIDE SUSCEPTIBILITY MAPPING USING CERTAINTY FACTOR MODEL AND ARTIFICIAL NEURAL NETWORK OF RISHIKESH-BADRINATH MANA ROUTE, INDIA.

ANITHA REVI, SHIKHA SRIVASTAVA, SUMIT SHARMA, SUNIL DHAR

DEFENCE TERRAIN RESEARCH LABORATORY, India

The present study aims to compare the performance of landslide susceptibility map (LSM) of Rishikesh–Badrinath Mana route of India generated using certainty factor model (CF) and artificial neural network (ANN). Total of 700 landslides including active and old slides were mapped using satellite image and field investigation. The landslide inventory was then randomly split into training dataset (70%) and testing dataset (30%). Geographic information system was used to correlate relation between landslides and various conditioning factors through spatial data analysis. The present study identified 13 conditioning factors including distance to anthropogenic activity, slope-aspect, distance to fault, geomorphology, Land Use, distance to Lineament, Lithology, distance to River, distance to Road, distance to Settlement, slope, slope morphology and Weathering . Using these factors and ground truth data, LSM were generated based on the obtained weights and ranking of each factor's by CF model and common three layer architecture Back-propagation neural network (BPNN). Developed Model performance was checked on an independent validation set of landslide events and the accuracy was determined using the receiver operating characteristics (ROC) including the area under the curve (AUC). The calculated AUC values were 80% for the CF model and 85% for BPNN. Hence, it is concluded that the landslide susceptibility map obtained by the BPNN gives satisfactory results for the prediction of future landslide zones in the study area. The result obtained was further verified by field visit.

Global near real-time flood mapping using a fully automated Sentinel-1-based processing chain

Christian Böhnke, Sandro Martinis, Michael Nolde, Stefan Schlaffer, Torsten Riedlinger

German Aerospace Center (DLR)

An automated Sentinel-1-based processing chain for global near real-time flood detection and monitoring is presented. In contrast to optical satellites Sentinel-1, as a C-band radar satellite mission, operates independently from weather and illumination conditions. Within the scope of crisis management the processing chain provides time-critical information about the flood extent about one hour after data availability.

The processing chain consists of pre-processing the radar data, preparing global auxiliary data, unsupervised classification as well as post-processing with a fuzzy logic-based approach. The final results are disseminated via a web-service to the users. Deployed in Python 3 the overall run time including data retrieval, processing and dissemination is less than 40 minutes. Future development foresees the integration of Cython in order to reduce calculation time.

The thematic accuracy has been assessed for a flood event in Kerala State, India, in August 2018 where unusually heavy monsoon rainfall caused severe damages. This event led to the activation of the International Charter “Space and Major Disasters”, for which the German Aerospace Center (DLR) provided TerraSAR-X data. In contrast to Sentinel-1, TerraSAR-X operates in X-band mode. Hence, it generally provides a better contrast between water and non-water covered areas and is more suitable for flood detection. Therefore, flood data sets derived from TerraSAR-X serve as a suitable reference for validating the Sentinel-1-based flood products in this study.

Poster Pitch: Glacial Lake Inventory of Uttarakhand Himalaya, India

Bidyutjyoti Baruah, Himangshu Sharma, Arvind Pandey

Kumaun University, India

The worldwide temperature increase over the most recent couple of decades prompted breakdown of major chilly lakes and inevitably shaped various frosty lakes crosswise over different mountain runs in the World, yet equivalently little consideration has been given to these themes in the Indian Himalayas, particularly in the Uttarakhand Himalaya. Advancement of the Glacier Lake and their lifetime are constrained by the mind-boggling transaction of atmosphere and land limit conditions, geomorphological procedure movement and ice sheet elements. In the present study, we have produced an icy mass lake stock of Uttarakhand Himalaya utilizing Landsat satellite pictures. A total of 348 icy mass lakes (measure $> 900 \text{ m}^2$) of Uttarakhand Himalaya have been mapped utilizing remote detecting method. Elevation shrewd appropriation of icy mass lakes in Uttarakhand Himalaya go from 3069 m a.s.l. to 5795 m a.s.l. Least height lake is found at a rise of 3069 m a.s.l. what's more, most extreme rise lake is found at a rise of 5795m a.s.l. The biggest lake in the Uttarakhand Himalaya has been covering and zone of $\sim 0.21 \text{ km}^2$ is sited at frontal of anonymous icy mass close to the Milam Glacier. The present study will give a reference database to measure effect of environmental change on icy masses and frosty lakes in the Uttarakhand Himalaya and will permit distinguishing proof of conceivably risky lakes in the state related to definite ground examinations.

Poster Pitch: Land Use Land Cover Changes and Their Impact on Land Surface Temperature in Shimla City, Himachal Pradesh, India

PAWAN KUMAR THAKUR, Renu Lata, Jagdish Chandra Kuniyal

G. B Pant National Institute of Himalayan Environment & Sustainable Development, Himachal Regional Centre, Mohal- Kullu, Himachal Pradesh, India

The important impacts of urbanization in Indian cities is the transformation of vegetation belts and agriculture land into the built-up area in the fringe. The Land Surface Temperature (LST) plays an essential role in studies related to urban thermal environment, climate change and Land Use and Land Cover (LULC) changes. The satellite data of Landsat 7 (ETM+), Landsat 5-TM and Landsat 8 (OLI) have been used for mapping of LULC and extracting LST for the three years of 2001, 2011 and 2016. Linear regression analysis was carried out to

generate relationships between LST with Normalized Difference Vegetation index (NDVI) and Normalized Difference Built-up Index (NDBI). The LST for Landsat-7 (ETM+) of 18th October 2001 ranged from minimum 12.10°C to maximum 36.05°C, Landsat-5 (TM) of 22nd October 2011 ranged from minimum 10.09°C to maximum 28.91°C. While, for Landsat-8 (OLI) of 19th October 2016, LST ranged from minimum 13.37°C to maximum 30.81°C. The results showed that the built-up areas, barren land have the highest surface temperature; however, water bodies, forests and vegetation land was observed in the lower side. The linear regression relationship detected a positive correlation between NDBI and LST with correlation coefficient of $R^2 = 0.92$, $R^2 = 0.97$ and $R^2 = 0.97$ for 2001, 2011 and 2016 respectively. The negative correlation between NDVI and LST occurs with correlation coefficient of $R^2 = 0.94$, $R^2 = 0.93$ and $R^2 = 0.92$ for 2001, 2011 and 2016. These interactions of the urban environmental implications can provide some insights for proper planning of land use.

Poster Pitch: Remote Sensing and Spatial Analysis for Strengthening Disaster Risk Management in Disaster-Prone Country

Dian Nuraini Melati

Center for Disaster Risk Reduction Technology - Agency for the Assessment and Application of Technology (BPPT), Indonesia

A large number of the area over the world faces a number of natural disasters recently. Undeniably, the impact of disasters has increased which could be attributed to climate change and the high population at risk. In Indonesia, almost 99% of disasters in 2017 were due to hydro-meteorological hazards such as flood, landslide, forest and land fire. These phenomena caused a large number of victims. For instance, landslides caused 163 people died, 185 injured, more than 59.641 suffered, and thousands of houses damaged. In order to reduce damage and loss due to catastrophes, disaster risk management is necessary to be effectively done including hazard, vulnerability, and risk assessment. In this regards, spatial data are required for further analysis, such as hazard records, driving factors, environmental data, and elements at risk. Satellite imagery with its large coverage and time series acquisition as well as high spatial resolution availability has a promising potential for the disaster-risk reduction effort. Principally, satellite data contributes on the monitoring a number of hazards, affected areas, and providing element at risk inventories. As a result, a risk analysis can be delivered as baseline information for the decision maker in disaster risk reduction. Example of a particular study case will be performed in this study.

Poster Pitch: Contribution of remote sensing and geochemistry to identify hydrogeological interconnections between Sminja - Oued Rmel Aquifer System (SORAS) (North-eastern Tunisia)

Meriem Aneur, Fadoua HAMZAOUI-AZAZA, Sonia Gannouni, Moncef GUEDDARI

Faculty of Sciences, University of Tunis el Manar, 2092, Tunisia;

The Sminja -Oued Rmel aquifer System, located in the Zaghouan region, are exploited for irrigation and meeting the drinking water demands of agglomerations. In order to identify the lateral communications between the Sminja and Oued Rmel aquifer System, two important approaches were applied: Geochemistry and Remote Sensing. The chemical analyses of waters of the two aquifers show the predominance of sodium and calcium for the cations and of chloride and bicarbonate for the anions with an enrichment of sodium and chloride from upstream to downstream of each aquifer. If the chloride-sodium facies is the same in the downstream parts, it is not the same in the upstream parts: Na-Ca-Cl-SO₄ for the Sminja aquifer and Na-Ca-Cl-HCO₃ for the Oued Rmel aquifer were found. This difference would be in favor of a mixture of waters on both sides of the boundary between the two aquifers. The application of Landsat ETM+ satellite image processing techniques (Color Composition, Principal Component Analysis and Filtering) contributed to the development of a map of lineaments showing a total of 13 fractures that provide hydraulic communication between Sminja and Oued Rmel aquifers. The statistical analysis of these lineaments using directional rosettes and the linea density map showed a predominance of ESE-WNW faults. The superposition of the various boreholes capturing Oued Rmel and Sminja aquifer with the plot of the lineaments determined by remote sensing made it possible to deduce that the communication between the two layers is essentially

ensured by the faults.

Poster Pitch: Building Deformation Monitoring in a landslide prone area using Multi-temporal PSInSAR techniques – Shimla, Himachal Pradesh, India

Aaravinth R¹, C Prakasam², Alok Kumar Agrawal³

¹Department of Civil Engineering, Chitkara Univeristy, Himachal Pradesh, India; ²Department of Civil Engineering, Chitkara Univeristy, Himachal Pradesh, India; ³Department of Computer Science Engineering, Chitkara Univeristy, Himachal Pradesh, India

Buildings are sensitive to movements caused by ground deformation. SAR datasets play a pivotal role in monitoring land deformation. The study area chosen for the deformation modelling is Shimla Municipal Corporation. According to Seismic Vulnerable zone classification by India, Shimla is present in Zone IV with high vulnerability. The region is also highly prone to disasters such as Earthquake, Landslides, Flash floods, improper building construction due to natural and anthropogenic causes. The deformation rate has been calculated between for the year 2019 using multi-temporal Sentinel – 1 C band imageries. The datasets were acquired from Sentinel Data Hub organized by ESA. C- Band Sentinel -1A SLC TOPSAR data at descending orbit with dual polarization has been used for deformation analysis. Precise orbit files will be applied to the data and then each successive data was co-registered as Master and Slave Image. Interferograms were formed and used for the analysis. These images were then subject to further pre-processing such as topographic phase removal and phase filtering to smoothen the interferograms. The unwrapped image was acquired by analysing the image through SNAP in Linux environment. The output received was converted into displacement data through band math into mm units. The results derived will be helpful in monitoring the movement of built-up areas. The result obtained from this study from measuring active monitoring of ground deformation and rate will help stakeholders and government authorities to take necessary steps in constructing built-up lands and other environmental related projects.

Poster Pitch: A CNN based approach for flood mapping using Sentinel-1 GRD SAR data

Angel Caroline Johnsy, Sergio Vitale, Gilda Schirinzi

University of Naples, Parthenope, Italy

Flood maps obtained from the remotely sensed data are the first-hand response of the disaster scene due to its wide area coverage from space and frequent revisit time. Synthetic Aperture Radar (SAR) imaging system that works all day-night and all-weather conditions is more suitable for identifying the inundated areas from the back scattered profile than optical sensors which are typically affected by cloud coverage and rain during the unstable weather conditions. In the last years, convolutional neural networks (CNN) based methods have reached state-of-the-art performances in many applications such as classification, segmentation and detection of natural images. In this work we propose a CNN based method for flood mapping from remote sensed images, in particular using SAR images. We depict this problem as a pixel-based classification: the network will be able to classify each pixel as flooded or not-flooded producing a final binary map. The aim is to use the ability of the CNNs in extracting a big number of not hand-engineered features and in introducing high level abstractions, in order to catch useful information for classification from the informative content of SAR images. Sentinel-1, ground range detected (GRD) images from European Space Agency (ESA) will be exploited to perform the detection. The performance of the method will be evaluated and the experiments on the real dataset followed by visual analysis will be carried out.

Poster Pitch: Assessment of Grid reanalysis products of the European Centre for Medium Range Weather Forecasts (ECMWF datasets) in Different Elevation and Climatic Regions of Iran

Azam Arabiyazdi¹, Seyed Hosein Sanaei Nezhad¹, Naser Niknia²

¹Ferdowsi University of Mashhad, Iran, Islamic Republic of; ²South Khorasan Regional Water Authority, Power Ministry of Iran

The inadequacy of climate observational data in different regions can lead to lack of awareness in different climates and low management power in the fields of meteorology, hydrology and agriculture. Today, the development of centers for forecasting and modeling of climatic data has provided access to almost real-time data. Reanalysis data is used in conjunction with static data, or in non-data locations, for instances. This study evaluates the accuracy of the ECMWF (ERA-Interim) reanalysis data on rainfall estimation and temperature variables in the five regions with diverse topographic and climates located in North, North-East, East, South and west East exponents of Iran. Daily reanalysis data from precipitation, average temperature, maximum and minimum temperature and dew point temperature from the ERA-Interim database with synoptic stations data at corresponding geographic locations for the statistical years 2015 to 2017 and with The spatial resolution of 0.5 * 0.5 degrees were used. In order to compare, the correlation coefficients (R^2), RMSE and NRMSE, MBE, Nash–Sutcliffe

model efficiency coefficient and residual coefficient were used. In general, the model has been able to simulate the process of time variation of different variables at selected stations, and the accuracy of the model is acceptable. According to the results of this research, the data of this model can be used along with the station data. This study highlights the importance of conducting spatial analysis of observations and potential measurement errors in order to obtain an understanding of the potential deviations of network data before being used in hydro-climatic applications.

Poster Pitch: Evaluation and prediction of vegetation index dynamics and restoration prospects in khajeh woodlands

Ahmad Emamian, Mohammad Farzam, Alireza Rashki

Ferdowsi university of Mashhad, Iran, Islamic Republic of

The average of vegetation index, vegetation changes in the past and the future, and the potential of vegetation were studied separately in restoration sites, geological formations, and topographic units. The average of 30-year vegetation index in the growing season (GSN) was 0.236. Maximum GSN was estimated to be 0.431, in 2002 and minimum GSN was estimated at 0.142, in 2000. The study of vegetation changes during the growing season showed significant changes in 1.6% (90.5 ha) of the study area at 95% significance level, exhibiting a decreasing trend. The average of Hurst's index in the region was 0.59. In 0.94% of the region, the changes showed negative pairwise correlation. In 2.14% in the region, future changes will be completely random, but in more than 96.9% of the region, the Hurst index was greater than 0.5. By overlapping maps of trends in vegetation change, maps of significant changes and the Hurst index, trends and future development of vegetation in the Khajeh pistachio woodland were mapped. The study of the development and trends in vegetation cover on restoration sites showed that 99.5% of these sites did not undergo statistically significant changes at 95% significance level, but in 57.7% of restoration sites, degradation was slowing. None of the restoration sites had significant increasing trends. The ratio of development in decreasing classes on loess sediments is relatively more pronounced. The Hurst index has a very high potential for prediction of vegetation changes. In this region, vegetation density is highest in Kalat Formation and north-facing slopes.

Poster Pitch: Temporal monitoring of land cover change and its impact on water resources in south part of Iran

Mojtaba Naghdizadegan Jahromi¹, Maryam Naghdizadegan Jahromi², Sajad Jamshidi¹

¹Shiraz University, Iran, Islamic Republic of; ²Tehran University, Iran, Islamic Republic of

Excessive water use and prolonged drought have strained the limited water resources in southern regions of Iran. Agricultural productions (primarily citrus) are the main driver of the economy in these regions. Local observations have witnessed the increasing agricultural land cover at the cost of exploiting water table. In this study, land cover change with special regards to expansion of agricultural regions has been investigated using Landsat imagery. In addition, precipitation trend from TRMM data and groundwater table from observation wells were analyzed. The coupling effect of land cover transformation, precipitation variation and groundwater level was studied using geographic information system to address the changes taken place in the region through the last decade. Our primary result indicated that while rainfall amount decreased from 2005 to 2015, significant increase in supplanting bare soil to agricultural sites (i.e., cultivated areas and citrus garden) was observed. The limited water availability from rainfall, has caused excessive use of groundwater for sustaining the cultivated areas. As a result, the average water table of the region was declined over through the study period. The result of this study suggests agencies and decision makers to provide correct managements for the region to: retain citrus garden through correct agricultural practices such as deficit irrigation, decrease cultivated areas and regulate groundwater pumping, and increase irrigation efficiency by proving accurate crop water demand and training through extension parties.

Poster Pitch: High resolution geological and structural mapping by using low cost unmanned drones

Mohd Zulfadzli Noraminidin Awg Zulmajdi, Afroz A. Shah

University Brunei Darussalam, Brunei Darussalam

Throughout the world the routine of taking geology students to field sites for geological mapping related courses has unfortunately diminished over the years, and has completely stopped at some places. And one of the major reasons for this practice is the lack of funding. Although geological field site visits remain an essential part of the fundamental geological courses however the funding constrains could strictly restrict or stop such visits, and therefore an alternative should be explored to overcome such a problem. Another related problem is the temporarily or permanent loss of geological outcrop information to loads of overburden, which can be due to landslides, earthquakes, flooding, and urbanization. Therefore, the present study explores these problems in Brunei Darussalam, SE Asia. This study uses aerial drone technology to map geological and structural details of exposed lithological outcrops wherever available. The motivation of the work is to map, and preserve all of these outcrops and archive them for the future uses. A total of 105 outcrops have been studied, and captured. The results show that the exposed rocks are inter-bedded sandstone and shale lithologies that have not been deformed, except the presence of occasional faulted sequences. The entire country is a folded geological rock sequence where Berakas syncline is the major geological structure, which is truncated by a thrust fault that seems to have resulted in the formation of Jerudong anticline. The study of historical satellite data show that a number of geological outcrops are lost due to urbanization, and this study aims to preserve whatever is left behind before it gets blanketed in overburden.

Poster Pitch: Uranium prospectivity from radiometric and ASTER data in the Abankor-Timgaouine area (Western Hoggar), Algeria

Siham Zerrouk¹, Federico Solano², Abderrahmane Bendaoud¹, Mohamed Hamoudi¹, Hamid Haddoum¹

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The Abankor-Timgaouine area is one of the most prospective uranium-bearing regions in the Western Hoggar Shield (Southern Algeria), mainly associated with hyper-alkaline granites. We use airborne radiometric data, Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data, and field data to identify lithologic units, structural features, and hydrothermal alteration zones. ASTER L1B imagery was

calibrated to reflectance and mapping of hydrothermal alteration zones was performed using Interactive Data Language logical operators. ASTER hydrothermal alteration units include argillic, phyllic, hydrothermal silica-rich, and propylitic, which consists of two subunits (carbonate and epidote-chlorite). ASTER SWIR and TIR bands are used to delineate hydrothermal silica, epidote-chlorite, and carbonate rocks whereas the SWIR bands are used for the identification of sericite, muscovite and kaolinite, and alunite-bearing alteration zones. The radiometric maps clearly highlight shear zones and structural features such as faults that also contain ASTER-mapped hydrothermally altered rocks, which are interpreted as conduits for hydrothermal fluids. Additionally, the radiometric maps allow the distinction of different generations of granites in the area. The youngest granites show very high uranium and potassium radiometric signatures. The high calc-alkaline granitoids are moderately rich in radioelements and the oldest granites show the lowest radiometric signature. The ASTER-derived alteration maps are consistent with the airborne radiometric data maps and with identified uranium sites (Abankor, Timgaouine and Tinef), suggesting that the combination of these tools could be suitable for use in unexplored, remote areas, particularly to encourage the development of uranium exploration in this area and other parts of the Hoggar Shield.

Poster: Monitoring of forest and rangelands of Iran using remote sensing techniques

Ali Gholami, Sahar Rezapour, Amir Ebrahimi

Ferdowsi University of Mashhad, Iran, Islamic Republic of

Collecting information about land use and land cover is a commonly utilized practice across the world, and in this regard, remote sensing plays a very important and major role. Iran's forests and pastures are threatened and in danger, and remote sensing can help access and monitoring their current status and also enable us to predict their future condition. For this purpose, MODIS satellite imagery was used to investigate changes in Iran's forests and rangelands. The results indicate that even if afforestation takes place in different parts of the country, special measures are still needed.

Poster: Land Surface Temperature Estimation Using Split-Window and Mono Window Algorithm: A Case Study of Delhi City, India

PAWAN KUMAR THAKUR, Renu Lata, Bhim Chand, Jagdish Chandra Kuniyal

G. B Pant National Institute of Himalayan Environment & Sustainable Development, Himachal Regional Centre, Mohal- Kullu, Himachal Pradesh, India, India

Rapid urbanization is one of the major causes of climate changes, melting of snow/glaciers and ice sheets are affected by the changes in Land Surface Temperature (LST) in global environment. The Thermal Remote sensing of Landsat 7 and Landsat 8 is a key tool to collect thermal infrared (TIR) data. The estimation of Land Surface Temperature using Landsat 7 Enhanced Thematic Mapper (ETM+) and Landsat-8 Operational Land Imager (OLI), through Mono Window (MW) and Split-Window (SW) algorithm. The supervised classification technique using Support Vector Machine (SVM) was used in this present study for detection of Land Use/Land Cover (LULC) categories. NDVI threshold was used for estimating land surface emissivity for both algorithm. The spatial distribution of LST of Landsat 7 (ETM+) of 10th May 2003 ranged from 17.04°C minimum to 38.58°C maximum with a mean of 28.55°C and standard deviation of 2.00 and Landsat-8 (OLI), dated 16th May 2014 ranged from 24.83°C minimum to 44.00°C maximum with a mean of 33.19°C and standard deviation of 1.79. The study of LST for LULC categories reveals that the higher vegetative cover brings down the surface temperature. The validation of standard daily LST product of MODIS has been used for both algorithms. These results indicate that the proposed method can be used to estimate LST from SW (TIR) data with a sensible accuracy. The result shows that the industrial and fellow land have significantly higher surface temperature in spite of its water bodies and denser/sparse vegetation cover of the city in lower side.

5.2. Big Data in GeoSciences

Wednesday, 11/Sep/2019: 5:00pm–7:00pm

Poster Session & Social

Location: Foyer

Poster: Multivariate Analysis of Global Sea Ice Index Data With Respect To CO₂ Emission

Ifeanyi Innocent Okaro

Universität Potsdam, Germany

The effects of CO₂ emission on our environment is perhaps the most controversial discussions of our time. While many scientist believe it is a major anthropogenic contributor to Global warming and Climate change, others have argued that many other natural and geologic factors could be responsible for these changes in climate and that these factors are beyond human control and thus reducing CO₂ emissions will have little or no effect on our planet. A research to investigate this phenomena was conducted through multivariate analysis of variations in Sea Ice Extent (a major indicator of climate change) in both Northern and Southern Hemispheres across a period 35 years to find the relationship between these variations and Global CO₂ emission at this time. Pearson and

Spearman's Correlation Coefficient as well as Classic Linear Regression and other statistical analysis methods were employed to explore and analyse the Sea Ice Extent and CO₂ emission data. The results show a relative correlation between the CO₂ emission and the Sea Ice Extent in the Northern hemisphere but no relationship with that of the Southern hemisphere. This could be attributed to the fact that the Northern hemisphere bears more than 67% of Earths land, thus most of the countries from which these CO₂ gasses emerge are located in this region.

Poster: Neural networks and their application in the study of the Petrikov potash salt deposit (Belarus)

Aliaksei Kirykovich

Belarusian State University, Belarus

The Petrikov potash salt deposit is on the final stage of preparing to the development by JSC Belaruskali. The deposit was discovered in the 1960s. After mineral exploration, a large amount of field data was collected from a hundred boreholes. The lithological core description of salt rocks from preferred mining strata of the potash horizon IV-p and relevant chemical test results were used for the construction of neural networks that can predict a content of potassium chloride. In the potash horizon IV-p main rock is a sylvinite characterized by high content of carnallite that contains harmful for potash ore magnesium chloride. Lithological core description of sylvinite includes color, grain size, structure, character of carnallite impurities, and presence of interlayers. These parameters and geological features (depth, thickness, confinement to a specific layer of horizon and to a structural element of geological structure) are categorical and continuous inputs. Neural networks with different combination of the inputs were built. According to sensitivity analysis, the most powerful inputs are confinement to a specific layer, structure and color of sylvinite. Average mistake of output prediction (a content of potassium chloride) fluctuates from 9 to 14% of the target content. According to the regulations, maximum mistake should not exceed 5% in forecast researches. Resulting mistakes can be explained by absence of pattern of salt rock description during the exploration. In spite of the mistakes neural networks are useful in the study of dependence between lithological description and chemical content of salt rocks.

Poster: Solar Wind Driven Model of Important Waves in the Earth's Magnetosphere

Dedong Wang¹, Yuri Shprits^{1,2,3}

¹GFZ German Research Center for Geosciences, Germany; ²University of Potsdam, Germany; ³UCLA, USA

In the Earth's inner magnetosphere, there are large number of particles flying close to the speed of light. These particles are harmful for the operating satellites in Low Earth Orbit and GEO orbit, and can be dan-

gerous for astronauts working in the space. Waves in the inner magnetosphere play an important role in the dynamics of these high energy particles. Through wave-particle interaction, they can cause acceleration or loss of particles. By using 15 years of satellite data, we developed an analytical model for important waves in the Earth's magnetosphere. This model depends on parameters from the solar wind. The model will be helpful for the forecasting of Earth's environment.

Poster: Application of Concentration-Volume Fractal Model to Identify and Classification of Gold Veins: A Case Study From Qolqoleh Gold Deposit, NW of Iran

HOOMAN DADASHZADEH AHARI^{1,2}, Peyman Afzal³

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The separation, identification, and assessment of high-grade veins from low-grade veins are first aims and extremely important operation in vein deposits, especially in the gold deposit. Because low-value variation is very signification in their mineral exploration. In this paper based on surface and subsurface lithochemical Au Data Concentration-volume (C-V), Fractal Model was utilized for separation and classification of gold veins in the Qolqoleh deposit which is located in the Kurdistan province, NW of the Sanandaj-Sirjan metamorphic structural zone. Based on the obtained result from the model different population consisting of wall rock, low grade, moderately grade, high grade, and enriched zones were Separated in the deposit. Rock types of the deposit were correlated with resulted mineralized zones by log ratio matrix. The most parts of the deposit have Au values lower than 3.98 ppm including low and moderately grade veins. However, mineralized veins hosted in chlorite-schists and this can be one of the exploration keys for gold prospecting in other parts of the Sanandaj-Sirjan zone.

Poster: Arctic Environmental Data Analytics

Gregor Pfalz^{1,2,3}, Johann-Christoph Freytag^{3,4}, Bernhard Diekmann^{1,2}, Boris K. Biskaborn¹

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This interdisciplinary research project focusses on a spatial-temporal analysis of lake sediment cores from the Russian Arctic by using data scientific approaches.

While the North American Arctic lake system has been widely studied, the Russian counterpart - as one of the key research areas of the Alfred Wegener Institute - is still underrepresented in many reports due to a lack of aggregated data. Creating a coherent system for the Arctic - supported by machine learning algorithms - could provide new insights into the understanding of a changing climate as well as facilitate the development of new innovative concepts in order to accelerate the process of analyzing a large amount of paleoclimatological data.

The foundation of this project is the newly designed database (ARCLAKES), consisting of complex data from polar paleolimnological records of 400+ lake sediment cores from previous and current AWI expeditions plus additional data from Russian partners. The necessary analytic system, which allows spatial-temporal analysis of multiple cores at the same time, is currently under development under the leadership of the Alfred Wegener Institute supported by the Einstein Center Digital Future / Humboldt University of Berlin.

Poster: Knowledge-driven predictive mapping of copper prospectivity in the portion of the Khorasan Razavi Province, NE of Iran: Application of Index Overlay Method.

HOOMAN DADASHZADEH AHARI^{1,2}, OMID ARDABIL³

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Integrate various evidential maps that obtained from spatial data set of great scientific significance and has considerable value for mineral prospectivity mapping (MPM). Mineral prospectivity mapping by considering

the various aspect of data set layers and information can be used to make mineral exploration less expensive, more efficient, and more accurate, it is important to move beyond traditional concepts and establish a rapid, efficient, and intelligent method of predicting the existence and location of minerals. Over the past years, two contrasting analytical approaches have been used to produced mineral prospectivity mapping. one is a conceptual knowledge-driven approach, and the other is an empirical data-driven approach. The knowledge-driven approach in exploration is carried out by extracting the spatial factors from exploration dataset on the basis of the exploration model, quantification of spatial factors and finally integration of these factors through map combination processes. In this study the integration process includes the weighting and scoring of different layers affecting the copper mineralization at studied area (Khorasan Razavi province SE of central Iran structural-metamorphic zone.) carried out by Index Overlay method as one of the knowledge- driven approaches within GIS environment. According to obtained results, we could achieve an initial guideline for effectively prospecting copper mineralization in the studied area.

Poster: Feature engineering from spatial data for adding process information to points

Fabio Brill, Heidi Kreibich

GFZ Potsdam, Germany

A specific machine learning task is presented to predict structural damages to buildings under El Niño flood conditions in Peru. Classification of spatial data is a common problem in the domain of remote sensing and is typically done either pixel by pixel or on object level. Usually, stable targets are to be classified using information about their spectral or textural properties taken from several sources, but always from the same location (e.g. to identify building types or plant communities). Opposed to this, observed damage grades at certain points are influenced mainly by exterior factors, i.e. process information derived from locations far away from the points themselves (e.g. slope of the nearest channel rather than local slope, vegetation cover of the catchment rather than vegetation cover of the building's roof or garden). Here the question arises how to hand this information over to an algorithm in the most meaningful way. A strategy for spatial aggregation or allocation is required. Different approaches to tackle this problem are sketched within the frame of the presented classification task. While in some cases simple distance measures, averages or frequency counts for neighbourhoods are sufficient, we propose to weight information along active pathways (in the flood context: the flow accumulation raster). The hereby engineered features shall act as proxies which describe the potential hazard intensity at a location and enable probabilistic predictions.

Poster: Big date analysis of hydrocarbon migration in tight reservoir based on Artificial Immune Ant Colony Algorithm

Tao Wang

Chinese Academy of Geological Sciences, People's Republic of China

Hydrocarbon migration in tight sandstones is a complex process. However, the big data of such factors of hydrocarbon migration in tight sandstones have not been well studied. Therefore, specific mathematical models are needed to simulate the secondary hydrocarbon migrations. This study presents a numerical simulation method based on Artificial Immune Ant Colony Algorithm (AIACA) to simulate the secondary hydrocarbon migrations in tight reservoirs. This method is applied in the numerical simulation of the hydrocarbon migration in Chang 8 member in the Ordos Basin. Simulated results show that the big date analysis results and the actual conditions are basically coincident. It is concluded that the hydrocarbon at the late phase will inherit the former pathways and reservoir shapes and keep developing vertically downwards. During the hydrocarbon migration, there are dynamic adjustments of the hydrocarbons which result in the change in shapes of the reservoirs. The current reservoir distribution pattern is then formed after multiple times of impulsed-type of injections

Poster: Identification and classification methods for rock thin section based on deep learning

Wei Ren, Minghua Zhang, Sheng Zhang, Jihua Qiao

China Geological Survey Development and Research Center

In geology work, mineral samples are often used for identification, and the most common sample is the rock thin section. Because the light-colored main minerals in the rock thin section under the microscope are colorless and transparent, and the refractive index is similar, so the classification and identification of the traditional rock thin section is difficult. In recent years, related theories and applications based on deep learning are developing rapidly. Convolutional neural network is an important technology for deep learning, and has achieved outstanding results in the fields of image recognition, voice recognition, and natural language processing. This paper applies the convolutional neural network of deep learning to the field of geological experimental testing, try to train and classify rock thin sections.

We selected eight typical types of thin section datasets, including sandstone, granite, limestone, basalt, peridotite, sulphate, gneiss, and tuff. The convolutional neural network used in this experiment was VGG16, it consists of five stacked ConvNet layers, three fully connected layers and one Softmax layer of the convolutional neural network, which is a „network-in-network“ architecture. The methods of random position slicing, random flipping and rotating slicing are used to expand the number of training sets and enhance the robustness of the models. In the training phase, we used standardized and transfer learning techniques on the input pictures to accelerate the convergence of accuracy. The training model obtained by the final optimization has an accuracy rate of 95.16% for identification of the test set, this method achieves good results.

5.3. Early Earth Formation and evolution: Hadean-Archaean

Wednesday, 11/Sep/2019: 5:00pm–7:00pm

Poster Session & Social

Location: Foyer

Poster: Geochemistry and Petrogenesis of Archaean Closepet Granites from Bundelkhand Craton, India: Constraints from Whole Rock Geochemistry and Zircon Geochronology

Joyeeta Bhattacharjee¹, Talat Ahmad²

¹Department of Geology, University of Delhi, Delhi, India; ²Vice-Chancellor's Office, University of Kashmir, J & K, India

The Archaean geological record corresponds to 1/3rd of our planetary history from 4.0 Ga to 2.5 Ga. This was also the time for the geodynamic evolution of the 29,000 sq. km. terrain of Bundelkhand Craton. Bundelkhand TTG's evolved (3.3 to 2.5 Ga) in Paleo-Archaean paving the way for the genesis of compositionally variable, undeformed K-rich granites (2.57-2.52 Ga) in the Neo-Archaean, one among which are the Closepet Granites.

Geochemically these granites are characterized by moderate to high SiO₂, MgO, K₂O, HFSE, Ni, Ba+Sr and low Yb content. The Chondrite normalized REE plot are highly fractionated with a sharp negative Eu anomaly whereas the multi-elemental plot shows sharp positive U, Th and Pb anomalies acting a proxy for continental crustal involvement.

U-Pb SIMS zircon ages gives younger crystallization age of 2560 ± 7 Ma. Older inherited ages of are displayed by two zircon grains. Closepet granites with a lower Mg content probably was formed by the mixing of anatectic melt with mantle-derived melts, which holds true for the closepet granites of Bundelkhand Craton. As the Bundelkhand TTG's have higher SiO₂, the magma produced by melting them would produce melt with higher silica indicating that the Closepet's are not the products of melting of an older TTG magma. Therefore, they are probably formed by mixing of high Mg Sanukititic magma with the older fragments of continental crust, generating magma which is lower in Mg content. This inference is in correspondence with their older inheritance age of 2842 ± 3 Ga.

5.5.-1 Emerging techniques for deep earth exploration

Wednesday, 11/Sep/2019: 8:30am–10:00am

Session Chair: Junlun Li

Session Chair: Yunyue Elita Li

Location: Hall A

SALT IDENTIFICATION: SEGMENT SALT DEPOSITS BENEATH THE EARTH'S SURFACE

Prakash Kumar

Panjab University, India

Several areas of Earth with large accumulations of oil and gas also have huge deposits of salt below the surface. One of the challenges of seismic imaging is to identify the part of subsurface which is salt. Salt has characteristics that make it both simple and hard to identify. Professional seismic imaging still requires expert human interpretation of salt bodies. This leads to very subjective, highly variable renderings. More alarmingly, it leads to potentially dangerous situations for oil and gas company drillers. To create the most accurate seismic images and 3D renderings, deep learning models with image segmentation algorithm can be deployed that can automatically and accurately identifies if a subsurface target is salt or not.

Deep Earth Exploration Project

Kemo Jin, Feng Liang

Chinese Academy of Geological Sciences, China, People's Republic of

Deep Earth Exploration Project is a continuation of the SinoProbe project, China's deep earth transparency project to 2030. The goals of the project are to "see through the earth, explore resources, expand space and green development". Through the implementation of the deep earth exploration plan, the second exploration space and underground development space will be effectively expanded, and the status quo of modern urban development space utilization will be greatly improved.

Full waveform inversion for salt delineation and subsalt imaging

Jizhong Yang, Yunyue Elita Li

National University of Singapore, Singapore

Salt model building have been the bottleneck for subsurface imaging, especially when the target is subsalt. Although full waveform inversion (FWI) has demonstrated its ability in resolving the salt structure in a couple of field studies, it requires significant amount of low frequency and extremely long offsets. Otherwise, FWI will suffer from the severe nonconvexity and likely be stuck in local minima. In this presentation, we introduce a robust gradient sampling algorithm (GSA) to mitigate the nonconvexity of FWI. The original implementation of GSA requires explicit calculation of multiple sampled gradient within each iteration, which is prohibitively expensive for seismic applications. Therefore, we approximate the sampled gradients from the current gradient with random space shifts. The resulting algorithm has the same computational complexity as conventional FWI, yet it yields much better convergence especially when low frequency (< 2 Hz) data are missing from the seismic acquisition. We demonstrate the effectiveness of the proposed algorithm on the 2004 BP model for salt delineation and subsalt imaging.

Seismic Wave Propagation and Response Characteristics of Ultra-basic Rock Mass in Luobusa Chromite Area

Xiaoqiong Lei¹, Rongyi Qian²

¹Institute of Crustal Dynamics, China Earthquake Administration, China, People's Republic of; ²China University of Geosciences, Beijing, China

The largest chromite deposit in China is Luobusha chromite deposit, which is located in the ultra-basic rock mass of the eastern part of the ophiolite belt on the south bank of the Yarlung Zangbo River, Tibet. The problems of complex structure, rough topography, poor stratification and steep dip angle caused by tectonic

movement in ultra-basic rock mass and small size of chromite block in Luobusha chromite area, make the reflection wave of deep reflection seismic data have poor continuity and low signal-to-noise ratio, which make it difficult to process and interpret deep reflection seismic data.

Combined with the characteristics of forward modeling wave field, real seismic single shot records and attribute analysis methods, we study the characteristics of the seismic reflection wave in the ultrabasic rock area, get the following conclusion: they have mixture for the reflection wave and first-arrival wave at the near rock mass outcrop; The reflection wave of upper interface is clear, and the reflection wave of lower interface is weak due to the function of shielding; It have reverse phase of reflected wave from upper and lower interfaces of the rock mass; The existence of chromite decreases the local frequency and energy of reflection events from the bottom interface of rock mass; There are discontinuous and weakly-like events in the ultra-basic rock mass. The propagation law and response characteristics of seismic wave in ultrabasic rock mass are obtained, which provides theoretical basis and reference for deep reflection seismic exploration in ultrabasic rock area in the future.

3D near-surface structure: Application of ambient noise tomography with a dense seismic array

Feng Liang, Kemo Jin, Siqi Wang, Hongqiang Li, Hailong Li, Yifei Xing, Wenzhen Yuan, ChaoBin Guo, Kai Liu, Tao Wang

Chinese Academy of Geological Sciences, China, People's Republic of

Urban geophysics ups the ante in the world of applied geophysics, which requires innovative thinking and seemingly off-the-wall approaches, if for no other reason than the settings. Ambient-noise-tomography (ANT) can play a pivotal role in yielding subsurface information in urban areas, which is capable of dealing with challenges related to these scenarios (*e.g.*, human activities and low signal-to-noise ratio). In this study, the ANT was conducted to investigate the near-surface shear-velocity structure in the surrounding area of the Baotu Spring Park in downtown Jinan, Shandong Province, China. Quiet clear Rayleigh waves have been obtained by the cross-correlation, which indicates that strong human activities, such as moving vehicles and municipal engineering constructions, can produce approximately isotropic distribution of noise sources for high-frequency signals. The direct surface-wave tomographic method with period-dependent ray-tracing was used to invert all surface-wave dispersion data in the period band 0.2-1.5 s simultaneously for 3D variations of shear-velocity (V_s) structure. Our results show a good correspondence to the geological features with thinner Quaternary sediments, the geological structural characteristic of the limestone surrounded by the igneous which has the highest velocity than that of the limestone in the study area, and several concealed faults of which specific location has been detected at depth. The results demonstrate that it is possible to successfully use ANT with high-frequency signal in an urban environment provided a detailed planning and execution is implemented.

5.5.-2 Emerging techniques for deep earth exploration

Wednesday, 11/Sep/2019: 10:30am–12:00pm

Session Chair: Feng Liang

Session Chair: Junlun Li

Location: Hall A

Seismic Investigation of the Tanlu Fault in China through dense passive seismic array

Junlun Li, Ning Gu, Jian Xu, Wen Yang

University of Science and Technology of China, China, People's Republic of

The Tanlu Fault is one of the largest faults in China, spanning over 2000 km in the eastern part of China with varying degrees of seismic activity. It caused tremendous damages in history, e.g., a M8.5 earthquake occurred in 1668 on this fault and at least another two M7+ earthquakes in the 20th century. Today, this major fault is mostly quiet, but close monitoring is still ongoing.

In this study, we deployed 45 3-C 5 Hz seismic nodes over a length of 22 km across the Tanlu fault near the Chao lake in the Anhui Province, China. The nodes were deployed along a 2D line over a period of 33 days mainly to collect ambient noise and teleseismic events to image the Tanlu fault. In addition to the traditional approaches, we are also developing a novel approach to image the fault by migrating the ambient noise surface wave Green's functions. The initial analysis indicates there exists very strong velocity change across the Tanlu fault, and the derived seismic velocity model corresponds well with the resistivity structure from a regional MT survey.

Identification and determination of the boundary between the Cathaysian and Yangtze block: a preliminary understanding of integrated geophysical exploration

Jiayong Yan, Feng liang, Yongqian Zhang, Ronghui Xue

Chinese Academy of Geological Sciences, China, People's Republic of China

South China continent has undergone multi-stage tectonic evolution since its formation. Many important basic problems such as the boundary between the Cathaysian and Yangtze block are still debated because of the superposition and reconstruction of many tectonic-magmatic events in the later period. In order to define the boundary, scope and structure of the boundary of the Cathaysia-Yangtze junction zone, we focus on the regional large-scale satellite gravity and magnetic data, combined with the regional electrical and seismic data comprehensive processing and analysis to identify and determine boundary between the Cathaysian and Yangtze block. Two tracking faults were found by comprehensive analysis of gravity, magnetic, magnetotelluric and passive seismic tomography: the F1 tracking fault along Ningbo-Jinhua-Shangrao-nan-Ganzhou North-Chenzhou-Linwu-Wuzhou-Yulin East-Beihai East is the north boundary of boundary of Cathaysia and Yangtze block, the F2 tracking fault along Nanjing-Xuanzhou-Huangshan-Jiujiang-Xianning-Yiyang-Huaihua-Liuzhou-Nanning is the south boundary of Cathaysia and Yangtze block, the middle zone of these two faults is the Jiangnan orogenic belt. There are also local differences in the geophysical fields in the Jiangnan orogenic belt, revealing that the tectonic belt has undergone multiple stage magmatism and formed different combinations of metal deposits in different sections.

Study on the interpretation of seismic reflection profile in chromite bedrock area of Luobusha, Tibet

Jiaying Li, Rongyi Qian, Xiaoqiong Lei

China University of Geosciences, Beijing, China, People's Republic of

Luobusha Chromium Iron Minerals occur in the ultra-basic rock body. Its formation, migration, enrichment, storage are closely related to the geological tectonic evolution of the ultra-basic rock body. In this study, the structure of bedrock in this area is studied by means of reflection seismic method, and the study aimed at predicting the enrichment area of chromite in rock body. The complex structure of this area leads to the se-

rious multiple wave interference, and the shielding effect of the ultra-basic rock body makes the reflection wave of the interface under ultra-basic rock body in the reflection profile weak. These problems make the data interpretation work difficult. In this study, the geological interpretation of two two-dimensional seismic migration profiles in the study area is carried out, and the dynamic information of seismic waves is used to reveal the abnormal characteristics by means of attribute analysis, channel integral inversion and time-frequency analysis techniques, in addition to the effective waves identified by forward simulation. Finally, it is found that the ultra-basic rock body is tilted southward and inserted into the Upper Triassic Unified Cretaceous strata in the form of nappe tectonics, and the main ore-controlling structures in this area are judged to be two thrust faults., and the main ore-bearing areas in the rock bed are predicted to be in the Fanghui peridotite of the ultra-basic rock body, and near the contact surface between the Fanghui peridotite and the pure Olive rock.

The Study of Integral Equation Forward modeling used in Three-dimensional Controlled Source Audio-frequency Magnetotelluric (CSAMT)

Ronghui Xue¹, Qingyun Di², Guixiang Meng¹, Jiayong Yan¹, Feng Liang¹

¹China Deep Exploration Center-SinoProbe Center, Chinese Academy of Geological Sciences, Beijing, China; ²Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China

In this paper, we have computed the Controlled Source Audio-frequency Magnetotelluric (CSAMT) forward modeling data by using the integral equation, which shows great advantages on solving the Green Functions. Comparing to the method of finite difference (FD) and finite element (FE), integral equation forward modeling could solve the problem in comparative low time-consuming and high precise, while the “anomalous induction number” does not get too large. By the model we computed, integral equation could correctly shows the anomalous body (bodies) buried underneath.

Effect of Solar wind and Magnetosphere Interaction on Liquid Outer Core Flow

Gurtej Singh, Anjali Anjali

Panjab University, India

The high energy coronal mass ejections from the Sun after traveling through the vacuum of space for 7-8 minutes when pass by the earth then they interact with the magnetosphere of the earth, through this interaction the magnetosphere of the earth got distorted and this distortion leads to having an effect on the generator of the magnetosphere, the outer core. This proxy effect of the solar wind or the solar flares on the outer core has a profound effect on the flow of liquid core by changing the velocity and direction of moving ions in the liquid core when viewed on the scale of millions of years of repeated strikes by the Solar wind. This effect on the flow of the liquid core had been quantitatively dealt with. Its possible relationship with deep earth processes as plume/hotspot activity and it's correlation with Solar wind frequency through space and time along geochemistry of the hotspot magmatism are important shreds of evidence for the effect of solar wind on the Outer core flow and can prove as an important aid in understanding plume origination at the Crust-Mantle boundary.

Poster Pitch: Land Surface Temperature Estimation Using Split-Window and Mono Window Algorithm: A Case Study of Delhi City, India

PAWAN KUMAR THAKUR, Renu Lata, Bhim Chand, Jagdish Chandra Kuniyal

G. B Pant National Institute of Himalayan Environment & Sustainable Development, Himachal Regional Centre, Mohal- Kullu, Himachal Pradesh, India, India

Rapid urbanization is one of the major causes of climate changes, melting of snow/glaciers and ice sheets are affected by the changes in Land Surface Temperature (LST) in global environment. The Thermal Remote sensing of Landsat 7 and Landsat 8 is a key tool to collect thermal infrared (TIR) data. The estimation of Land Surface Temperature using Landsat 7 Enhanced Thematic Mapper (ETM+) and Landsat-8 Operational Land Imager (OLI), through Mono Window (MW) and Split-Window (SW) algorithm. The supervised classification technique using Support Vector Machine (SVM) was used in this present study for detection of Land Use/

Land Cover (LULC) categories. NDVI threshold was used for estimating land surface emissivity for both algorithm. The spatial distribution of LST of Landsat 7 (ETM+) of 10th May 2003 ranged from 17.04°C minimum to 38.58°C maximum with a mean of 28.55°C and standard deviation of 2.00 and Landsat-8 (OLI), dated 16th May 2014 ranged from 24.83°C minimum to 44.00°C maximum with a mean of 33.19°C and standard deviation of 1.79. The study of LST for LULC categories reveals that the higher vegetative cover brings down the surface temperature. The validation of standard daily LST product of MODIS has been used for both algorithms. These results indicate that the proposed method can be used to estimate LST from SW (TIR) data with a sensible accuracy. The result shows that the industrial and fellow land have significantly higher surface temperature in spite of its water bodies and denser/sparse vegetation cover of the city in lower side.

Poster: Deep Reflection Seismic Data Processing in Hard Rock Areas: A Case Study of Deep Reflection Seismic Data in Luobusha, Tibet

Xiaoqiong Lei¹, Rongyi Qian²

¹*Institute of Crustal Dynamics, China Earthquake Administration, China, People's Republic of;* ²*China University of Geosciences, China*

Usually in the Hard rock areas, the terrain fluctuates sharply, the underground structure is complex, the thickness of overburden layer changes rapidly, and some sections of bedrock are exposed, resulting in low signal-to-noise ratio of raw data, prominent static correction problems, the development of multiple refractions, which pose a difficult problem for the processing of reflection seismic data. In this study, taking the Luobusha data in Tibet as an example, aiming at the first break characteristics of hard rock area, we comprehensively analyze the various static correction methods and experiment, The „dual“ static correction method for hard rock area is obtained as follows: first, the tomographic static correction is carried out, and then the secondary „residual“ refraction static correction is carried out on the basis of the tomographic static correction, which solves the static correction problem well in the hard rock area of Luobusha. The steep dip angle of hard rock in Luobusha area, the serious development of multiple wave, which cause the reflection wave of steep dip stratum submerged by the multiple wave. The multi-domain and multi-method denoising method is determined through experimental research to remove multiple refraction wave and retain effective wave. Multi-domain and multi-method denoising is to remove noise in shot domain and in receiver domain separately, and separate the data on both sides of the shot gathers and the receiver gathers, remove the noise separately with different parameters, and then merge the denoised data. The two methods provide high quality data for subsequent processing and interpretation.

Poster: Application of Geophysical Methods in the Exploration of Medium and Low Temperature Mixed Geothermal Resources-Taking Baokang Depression as an Example

Longsheng Li

The forth hydrogeology engineering geology institute of Inner Mongolia, China, People's Republic of

Baokang depression is located in the southwest uplift area of Songliao basin, it is generally believed that the medium and low temperature conduction geothermal resources are the main. There are some problems in this area, such as low deposit thickness, shallow basement and low geothermal gradient, which make it difficult to break through in geothermal exploration. In this study, controlled source audio-frequency magnetotelluric sounding was used to carry out field tests, five exploration lines perpendicular to the western boundary of the depression were arranged, and exploration points in the geophysical anomaly area were encrypted. The profile reveals the geological information of the depth of 3km underground, which provides a basis for geothermal exploration. After drilling, the geothermal water has a depth of 71m, the water output is 2,148 cubic meters/day, and the water temperature is 45°C. It has achieved great success and established a medium-low temperature mixed geothermal resource model.

Poster: Hydrochemistry Characteristics of Geothermal Water in Gudui, Tibet

Siqi Wang

Chinese Academy of Geological Sciences, China, People's Republic of

Geothermal resource has been recognized as one of the most green and clean resources in the world. Due to climate change and environmental pollution, geothermal resource has been widely used recently in heating, hot water supply, medical treatment, tourism and entertainment. In China, most geothermal resources are low temperature ones and they are extensively distributed across the country, whereas high temperature geothermal resources are mainly scattered in south Tibet, Sichuan, and Yunnan. In this study, Gudui area is thoroughly investigated in hydro chemical aspects. 22 water samples were analyzed via surface investigation, including 11 springs, 6 rivers and 5 samples from <Tibet hot springs>. These samples were analyzed chemically and isotopically for the development and utilization of this area. The hydrogen and oxygen isotopes data show that the meteoric waters could be the main source of the recharge, but the results might be slightly compromised due to the deficiency and uncertainty of the samples. The reservoir temperatures were estimated, and results from different geothermometers vary. Silicon enthalpy method was also used to estimate the reservoir temperature and the proportion of mixed cold water. There are only five samples suitable for this method. The mineral saturation indexes were calculated where only a few are saturated.

Poster: Research on Exploration Technology of Deep Carbonate Geothermal Reservoir

Yifei Xing¹, Dailei Zhang², Wenzhen Yuan³, Siqi Wang⁴

¹Chinese Academy of Geological Sciences, China, People's Republic of; ²Chinese Academy of Geological Sciences, China, People's Republic of; ³Chinese Academy of Geological Sciences, China, People's Republic of; ⁴Chinese Academy of Geological Sciences, China, People's Republic of

The geothermal resources in North China are superior, mainly divided into shallow sandstone reservoir and deep carbonate reservoir. With the development of geothermal resources exploitation, the advantages of carbonate geothermal reservoir over sandstone geothermal reservoir gradually appear, such as high temperature, large amount of water, easy to be fractured and strong recharge capacity, etc. The potential of future development and utilization is huge, so the research on deep carbonate geothermal reservoir detection technology is particularly important. This study is aimed at a key area in North China, using ground surveys, geophysical and geochemical methods, such as magnetotelluric, two-dimensional seismic and hydrochemical analysis. The reservoir and thermal control fracture zone in the field were divided effectively, which was verified by geothermal geological deep well. The reservoir parameters were obtained. And finally an effective set of exploration technology on deep carbonate reservoir were established, which provided guidance and reference for geothermal exploration on similar fields.

6.1.-1 Earth Science Through Art – Communicating through creative expression

Thursday, 12/Sep/2019: 12:45pm–1:45pm

Session Chair: Courtney Jermyn

Session Chair: Eduardo de Mulder

Location: Senatssaal

The power of precise and appropriate words by taking a delicious cup of Colombian coffee “From geology to coffee”

Karina Andrea Portilla Mendoza, Gloria Prieto Rincón

Colombian Geological Survey, SGC, Colombia.

Colombia is an important coffee producer worldwide, not only because of its quality, its flavor and the millions of sensations you feel by drinking a delicious cup of Colombian coffee, but also because of the commitment and dedication of our coffee growers and their organizations, hardworking and proud people who produce it along the mountains of the Andes from the south to the north, and its soils derived from volcanic ash that make this Latin American country rich in coffee cultivation.

“From geology to coffee” is a book made by the Colombian Geological Service which describes the millions of years that Earth has taken on molding its geography, represented by natural processes in geological time that have originated the universe of the soils generating the optimal geological, environmental and geographic conditions in which grows the plant that today produces coffee beans.

The approach of this book was accompanied by several questions and with them, expectations; how to write this book in a precise and appropriate language accessible to the lover of Colombian coffee that is not necessarily part of the geoscientific community? How to create illustrations that really show the scientific concept that is required? It is important that geosciences can express themselves with words that are understood for the general public and also positively create an understanding of geology seeking ways to do writs showing the history and earth processes through illustrations and the art, by innovating teaching methods in which the community of geosciences can communicate with society.

The International Year of Planet Earth (2007-2009), its origin, development and legacy

Eduardo de Mulder

Earth Science Matters, Netherlands, The

This paper describes the IUGS initiative to develop the International Year of Planet Earth (IYPE) together with UNESCO, its UN Proclamation for 2008, its launch and global support, and its legacy. Although several major scientific initiatives were taken in connection with the IYPE, its main legacy had been on outreach. National committees have been active in 80 nations in all continents. The Young Earth Scientists Network developed from the IYPE Global Launch Event held in UNESCO headquarters in Paris, France, in February 2008 and may be considered as one of IYPE’s legacy items. A summary of other main IYPE legacy items is given in the end of this paper.

How to communicate earthquake science to people

Afroz Ahmad Shah, Nava B., Qibah Reduan, Zirah Jawi, Sheeba Khwaja, Chatur C., Aminul Islam

Universiti Brunei Darussalam, Brunei Darussalam

It took more than 250 years for scientists to develop the science of earthquakes, which has reached to a level where we are confident about scientific wisdom on mapping and understanding of faults and earthquakes but sadly, and unfortunately, we are largely far behind in communicating this vital wisdom to people, who are the real victims of earthquake hazards. And this is the major problem that needs to be addressed. Therefore, this contribution aims to demonstrate the earthquake science communication gap in South and Southeast Asia, and how to deal with it. The earthquake outreach fieldwork experience in India, Malaysia, Indonesia,

and Brunei is highlighted to engage audience in understanding that communication of science is equally important as is the work on scientific wisdom. Our work clearly shows people are largely unaware about the science of earthquake hazards, and to deal with it. Poverty, corruption, political stability, and funding problems have categorically exaggerated the unawareness about the science and scientific practices applied to real life problems. Therefore, it is suggested to make separate budget for such earthquake outreach activities, and to engage in building a peaceful, conscious and responsible society throughout the globe. We also show through our small documentary project on earthquake hazards in NW Borneo that communication of science can be achieved through the use of documentary movies, which could become one of the best ways to communicate science to people, and in particular the youngsters.

Science outreach from the Colombian Geological Survey: The Geology of Colombia book as a prime case

Ana Oliva PINILLA PACHON, Jorge GÓMEZ TAPIAS, Lisbeth FOG CORRADINE, Alejandra CARDONA MAYORGA, Daniela MATEUS ZABALA

Servicio Geológico Colombiano, Colombia

The Colombian Geological Survey (CGS) has been developing an ambitious pilot enterprise by aiming to extend science to the public and policy makers. The strategy consists primarily in present to wide audience the chapters of the book written in an understandable language.

The Geology of Colombia book project has a multidisciplinary team conforms by a science journalist, a professional photographer, a designer and CGS geologists that support the entire process starting from chapters selection to publication of newspapers articles.

We start by selecting the most media subjects according to intended audience to focus on. The author of selected chapter and editorial team organize a field trip to the area of study where science journalist and professional photographer mainly work in audio, video and photographs, for documentary and animation. The scientists explain us how drive their research and communicate their findings.

Based on the interview, the science journalist does an article, using comprehensible language and stripping out all terminology. That final piece is sent to authors and chief editor for feedback, and goes to the printer or on the book's website.

To date, seven articles have been published in the main media of Colombia such as *El Tiempo*, *Semana* and *El Espectador*. Our objective is disseminating science to people who think don't be part of this.

6.1.-2 Earth Science Through Art - Communicating through creative expression

Thursday, 12/Sep/2019: 2:15pm–3:15pm

Session Chair: Courtney Jermyn

Session Chair: Eduardo de Mulder

Location: Senatssaal

Geo graphics – reflecting potential and challenges for the use of graphic design in geosciences

Dorothee Post

University of Vienna, Austria

Communication of concepts and results in research is constantly gaining attention in the scientific community. As visual material is a great tool to communicate the outcome of scientific work to different target groups, techniques of graphic design are applied on a regular basis for talks, posters or publications. These techniques are described as the use of typography, forms, colors and images for communication purposes. Although their use is permanently integrated in scientific work, the lack of financial resources, time or professional experience can potentially lower the comprehensibility and outreach of research projects. This circumstance is not only concerning the communication to public or decision makers, but also the intercommunication within the scientific community. Due to these issues, the current position of high-quality graphic design in geoscientific research is analyzed to reveal strengths, weaknesses, opportunities or threats. The aim of this SWOT-Analysis is to enhance the awareness for the appearance of geosciences and open the discussion about it.

An interactive website for geochemical and mineralogical data for soils from the conterminous United States

Federico Solano, David Smith, Laurel Woodruff, William Cannon

U.S. Geological Survey, United States of America

The U.S. Geological Survey (USGS) completed a low-density continental-scale geochemical and mineralogical survey of soils across the conterminous United States. Samples from 4,857 sites distributed in a balanced spatial array were gathered. Soils were collected at 3 depths: 1) the top 0- to 5-cm, regardless of the soil horizon; 2) a composite of surface mineral soil (A horizon); and 3) a composite of deeper subsoil (B or C horizon). The <2 mm fraction of each sample was analyzed for 45 major and trace elements using a near-total digestion method. Abundances of the major minerals in the soil A- and C-horizons were measured using X-ray diffraction. The results of the geochemical analyses and mineralogical determinations were published in 2013 and interpolated distribution maps were released in 2014. The published data have been used in numerous scientific or technical applications, including studies related to public health, environmental regulations, food safety, homeland security, mineral exploration, and forensic analysis, among others. A new interactive website, the first of its kind by the USGS, now offers access to the maps along with text describing factors influencing the distribution of elements and minerals, including relations to geologic parent materials, physiographic regions, geomorphologic features, climate, and/or anthropogenic influences. Additional features of the website allow users to download .kml and spreadsheet data files, and access other related USGS databases.

Communicating Earth science through cartoons and stories

Neelu Singh¹, Frédéric Bouchard², Frozen-Ground Cartoons' Team³

¹Mangalore University, India; ²Géosciences Paris Sud (GEOPS), Université Paris Saclay, Orsay, France; ³www.frozengroundcartoon.com

The need for scientific and non-scientific public cooperation becomes very important when mankind is facing a different kind of cross-border and global challenges. To tackle these global challenges, it is crucial that geoscientists and the general public work together to solve cross-border problems. Considering the global problems that we are facing like climate change, global warming, anthropogenic pollution, and many more. it becomes important to communicate with the common public so that they can also take an active part to help solving these issues. The content provided by the geoscientists is often full of jargon and critical for the common public, which makes it difficult to create an understanding for the non-scientific public. Hence, there is a need to develop new innovative methods in order to give full scientific information without any jargons or difficult language.

With this communication, we share our ideas on how to communicate Earth science to the non-scientific people in an easy way with the help of cartoons and stories. We give specific examples from the science of permafrost (frozen ground) in the Arctic and long-range transportation of pollutants in polar regions by the distillation process. Such cross-disciplinary creative efforts will surely communicate geoscience with the general public and create awareness about global issues.

Using Art to Retell Earth's Stories

ZHAO Yating

PNSO, Beijing, China

PNSO's "scientific art" is using art and story telling to educate the public about science and get children to be interested in science. Dinosaurs are a prominent part of PNSO's work. We will explain how we restored dinosaurs and what kind of stories we tell. In How to create Wilson the T. rex, we explained the scientific basis for making the T. rex model and the decisions PNSO made, regarding its diet and the presence of feathers. Apart from dinosaurs, PNSO has done scientific art for pterosaurs, aquatic reptiles, constellations, and more. We welcome geoscientists to work with us on their projects.

6.3. Geoscience outreach at national and international levels; and the IYPE legacy

Wednesday, 11/Sep/2019: 3:00pm–5:00pm

Session Chair: Courtney Jermyn

Session Chair: Eduardo de Mulder

Location: Hall A

Community Outreach: Raising Awareness on the Importance of Geoscience

Josephine Naambo UUshona

Ministry of Mines and Energy, Namibia

Earth Science helps us understand the history, structures, physical and chemical processes of the earth, this enables us to unlock new mineral prospects, advance in new geological research for the development of the country. Promoting the importance of earth science within the community creates a platform where we educate the community on the daily use of products produced as a result of earth science activities.

The Geological Survey of Namibia has taken up an initiative to educate, inform and share the vital importance of earth science, within Namibia, this is done through various outreach programs such as annual science week, heritage week, science fair and school outreach activities, particularly where scientists go out to rural communities and schools to raise awareness on geoscience programs and activities.

The essential contribution of the presentations is to spread the necessity of minerals and how these different minerals enhance our daily lifestyles, for example rock display that contains minerals such as mica, fluoride, quartz and etc. In addition to the presentations scientist include one on one sessions to educate learners on different fields of earth science and how they complement each other in problem solving and to encourage learners to think on how to contribute to the science that is already within existence.

Sports, Sciences and Rock's role

Francesca Romana Luger¹, Piero Farabollini², Emy Fuffa¹

¹Institute for Environmental Protection and Research, Italy; ²University of Camerino, Italy

The focus of this proposal is the role of Landscape in communicating Earth Sciences, using landscape as a trigger element for motivate curiosity of knowledge relates to Earth Science, as a possibility for open channels of communication and information, especially referring to the binomial risk/resource inherent most of the land settings in Italy as well as in most of the Countries. The core of our project is in accomplishing new ways in communicating Sciences, aiming at reaching the widest public.

The project's vision, is a wide-ranging idea about new and unconventional ways in communicating Earth Sciences to the wide public, especially focusing on the intergenerational communication. We choose the outdoor sports as vectors of scientific information. The natural scenery where the sport events are located, give us the chance to divulge the geological history of the places. An interesting experience has been realized at the Giro d'Italia cycling race, reaching encouraging results.

The project follows the IYPE) principles: the diffusion of scientific heritage, using topics well known and appreciated, may represent one of the new goals for the Territorial Sciences. Now more than ever, it is clear the need to provide the general public with correct and clear information on the complex scenario characterizing our Planet.

We try to transmit the responsibility of everyone in landscape protection and enhancement, (Landscape convention) and the participation in territorial management (participative democracy), by sharing knowledge: this is an ethic objective.

The European Geosciences Union outreach initiatives and strategy

Olivia Trani

European Geosciences Union, Germany

The European Geosciences Union (EGU), is Europe's premier geosciences union, dedicated to the pursuit of excellence in the Earth, planetary, and space sciences for the benefit of humanity, worldwide. It is a non-profit international union of scientists with about 17,500 members from all over the world. In addition to publishing scientific journals, organising meetings, and recognising eminent scientists with awards and medals, the EGU is engaged in many outreach activities with the purpose of satisfying the following aims:

1. to identify and highlight societal challenges, which can be addressed by the scientific work of the EGU membership and to harness the expertise of the EGU membership to address societal needs,
2. to increase public awareness of the scientific work of the EGU membership and to facilitate the broad dissemination of information beyond the geosciences community,
3. to facilitate interactions and transfer of information within the geoscience community by means other than scientific meetings and publications, such as newsletters, websites, data portals, bulletins, blogs, and social media,
4. to establish and strengthen links between the EGU membership and policy- and decision-makers for the mutual benefit of both parties,
5. and to encourage interaction with other parties interested in the Union and its activities.

Many of EGU's outreach initiatives are undertaken by the Union's early career scientist (ECS) community, including EGU's appointed ECS Representatives. This presentation will outline some of our outreach projects, with a focus on ECS involvement, and the challenges that remain.

Shared vision as solution of sustainable management water footprint in east-arid region of Iran (case study: Neyshabur and Birjand basins)

Naser Niknia^{1,3}, Azam Arabiyazdi², Hosein Emami¹

¹South Khorasan Regional Water Authority, Iran, Islamic Republic of; ²Ferdowsi University of Mashhad, Iran, Islamic Republic of; ³Lorestan university, Iran

The sustainable management of natural resources, and particularly groundwater, presents a major challenge in arid regions and need collaboration of all stakeholders of the basin. Water has value from a social, economic and environmental perspective and is required to be managed within a sound, integrated socio-economic and environmental framework. Neyshabur and Birjand are two big cities in east of Iran. The groundwater in both basins have been overexploited to meet the increasing trend of water demand during the past 20 years. Consequently, the regions have faced with water scarcity and water quality problems which originates from inefficient use and poor management. To tackle the water issue on a durable basis, within the economic, ecological, and political constraints (i.e. the integrated water resources management, IWRM concept), a Non-Governmental Organization (NGO), have been established that encompasses contribution of basins stakeholders. These NGOs consider the UN-Water IWRM spiral conceptual model by implicating participatory water management (water users' involvement) methods in basins. In addition to revealing the hidden link between products or consumption patterns of populations and their needs in terms of water resources, the water footprint (WF) indicator generates new debates and solutions on water management at basin scale. Furthermore, These NGOs visions for own basins are achieving to sustainable equilibrium of water resources and consumptions in the basin based on water footprint index by the prospect to 2040 year. At the moment, the key achievement of them were "the strategic guideline for reduction of water footprint consumptions" in the basins.

Role of young geologists in a conflict zone and their contribution in the process of artisanal mining scaling and formalization :formalization: case of North Kivu.

JEAN-ROBERT NSHOKANO MWEZE¹, GUY SHUNGU LAMA², MIREILLE MUHIGWA³

¹Université Paris 8, France; ²Université de Goma; ³StrongWomen DRC

Since 1990, with inflation and increase of the informal economy in DR Congo, artisanal mining activities started attracting more people, because of its quick rate of revenue and the precariousness of agricultural activities. From 1996 to 2010, this sector became a target of rebels and different antagonists involved in conflict by selling minerals like coltan, gold and using children in artisanal mine sites. Taking into account the last two decades, it is important to note the very decisive commitment of the American government's « Dodd Frank law » and its consequences on the population income of North Kivu. This decision seems to have played an important role in getting the armed rebel groups out of the artisanal mining sites and reducing the illegal sale of minerals. It has enabled artisanal miners from local communities to somehow improve their revenue through the initiative of the transparency and traceability measures developed by the congolese government and international NGOs. Today, young geoscientists from North Kivu are facing challenges to exercise their profession in industrial companies. Because these companies are few, their need of geologists is limited, the training of geologists at university is producing many young geologists regardless of jobs opportunities and national policy for their professional insertion. In which way can the young geoscientists involvement in artisanal mining sector make it sustainable and profitable for the community development? The objective is to understand the young geoscientists impact on artisanal mining sector and their geological profession adaptability in an unfavorable social economic and political context.

Involvement of Early-Career Scientists in the IPCC review process through international associations

Gwenaëlle Gremion¹, Nicolas Champollion¹, Mathieu Casado¹, Kelsey Aho¹, Helena Bergstedt², Jilda Caccavo¹, Emily Choy¹, Sarah Connors^{3,7}, Adrian Dahood¹, Rahul Dey¹, Alfonso Fernandez¹, Juan Höfer¹, Shridhar Jawak¹, Alexander Koch⁴, Martine Lizotte¹, Sarah Maes¹, Kyle Mayers¹, Katja Mintenbeck⁵, Jhon Mojica¹, Prashant Pandit¹, Elvira Poloczanska⁵, Ankit Pramanik¹, Valentina Rabanal⁶, Paul Rosenbaum¹, Rupa Rupa¹, Elisa Seyboth¹, Sarah Shakil¹, Maud Van Soest¹, Florian Vidal¹, Gerlis Fugmann¹

¹Association of Polar Early Career Scientists (APECS), <https://www.apecs.is/>; ²Permafrost Young Research Network (PYRN), <https://pyrn.arcticportal.org/>; ³Université Paris Saclay, Paris, France; ⁴PASt Global ChangES Early-Career Network (PAGES-ECN), <http://www.pages-igbp.org/about/structure/26-initiatives/working-group/1888-ecn-intro>; ⁵Alfred Wegener Institute, Integrative Ecophysiology, Bremerhaven, Germany; ⁶Young Earth System Scientists (YESS), <https://www.yess-community.org/>; ⁷TSU WGI & II, IPCC, <https://www.ipcc.ch/>

Early-Career Scientists (ECS) represent a large part of the workforce in the natural sciences. While ECS typically have substantial academic training, they often have limited exposure to how the scientific community self-evaluates and communicates; ECS are rarely invited to engage in the peer-review process usually devoted to senior scientists. We argue that such engagement would benefit ECS and the scientific community as a whole. Our research presents a group review of the first and second order drafts of IPCC “Special Report on Ocean and Cryosphere and in a Changing Climate” (SROCC) supported by 154 ECS from all around the world on behalf of the Association of Polar Early Career Scientists (APECS) during 2018. We present our methodology, results, and lessons learned. Altogether, data from participant surveys and a comments catalog illustrate ECS as competent reviewers, comparable to more experienced researchers. We note the particularly diverse expertise and geographic perspectives, and the fruitful training of ECS to review from senior scientists. IPCC has agreed to collaborate with APECS and other international association of ECS such as PAsT Global ChangES Early-Career Network (PAGES-ECN), Permafrost Young Research Network (PYRN), Young Earth System Scientists (YESS) in the review of the main assessment report AR6 starting in 2019. We aim to enhance our conclusions with additional data from AR6 and future group review processes. We also aim to promote the transfer of knowledge between senior scientists and ECS through this new round of review by increasing the numbers and the diversity of involved ECS. Session

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