Themes and Sessions - GeoBonn 2018

Topic 1: Early Earth

1a) Cosmochemistry - from dust to planets

Mario-Fischer-Gödde[1], Stefan Peters[2]

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In this session we encourage contributions that address the petrological, mineralogical, chemical and isotopic record of meteorites and planetary materials to better understand the processes and timescales involved during the evolution of matter in the solar system. The session aims gathering contributions from different fields of expertise, including studies on presolar dust, chronology and evolution of the solar system, volatile element depletion processes, material transport in the protoplanetary disk, disk photochemistry, meteorites and their components, planetary accretion and differentiation, and impact processes. The focus of the session will be studies based on analytical and experimental work. These may be complemented by studies using numerical modeling methods.

1b) Tracing life through deep time: New approaches & fresh perspectives

Jan-Peter Duda[1], Jörn Peckmann[2], Joachim Reitner[1]

[1]University of Göttingen Faculty of Geoscience, Germany; [2]Universität Hamburg, Germany

Keynote: *Simon K.-M.R. Rittmann* (Universität Wien, Austria) "Biological methane production under putative Enceladus-like conditions"

Current "geobiological" research on early life commonly focuses on the reconstruction of large-scale environmental conditions on Earth. The fundamental impact of life on its environments, on the other hand, is commonly neglected. This unidirectional perspective clearly limits our understanding of habitability and the evolution of life through geological time. We aim at challenging this dogma by inviting contributions on the reconstruction of life at any time in Earth's history – independent of the approach or viewpoint. We particularly encourage progressive and provocative studies that will help to stimulate discussion and debate across conventional disciplines.

1c) Evolution of the Early Earth's mantle-crust and ocean-atmosphere systems

Armin Zeh[1], Elis Hoffmann[2], Florian Kurzweil[3] and Stefan Weyer[4]

[1]KIT Karlsruhe Institute of Technology, [2]Freie Universität Berlin; [3]Universitaet zu Koeln; [4]University of Hannover, Germany

Keynote: *Vinciane Debaille* (Laboratoire G-Time, Environnement et Société (DGES), Bruxelles, Belgium) "Archean geodynamics and the onset of plate tectonics"

Description: The early Earth featured specific crustal terranes, like high grade gneisses and greenstone belts, that were likely coupled to a change from more plume-like to subduction-driven geodynamic processes. Likewise, the redox state of the oceans and atmosphere significantly changed during the Archean-Proterozoic period from anoxic to oxic. A potential link between both, geodynamics and environmental conditions at the Earth surface, remain debated. In this session, we invite contributions from various Earth science disciplines including field geology, geochemistry, geochronology, petrology and geodynamics, which address the evolution of the Earth's mantle, crust, oceans, atmosphere and life and the link between them.

Topic 2: 50 years of plate tectonics

2a) InterRidge: Multidisciplinary research on oceanic ridges

Philipp A. Brandl[1], Jürgen Koepke[2]
[1]GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel; [2]University of Hannover

Keynote: *Javier Escartín* (Institut de Physique du Globe de Paris, France) "Oceanic core complexes: Evolution, nature of corrugated faults, and interactions between tectonic extension and mass-asting processes"

Oceanic ridges play a key role for global plate tectonics and elemental cycles, connecting litho-, hydro- and biosphere. However, many of the complex interconnections of magmatic, tectonic, hydrothermal and biological processes in oceanic ridges remain poorly understood. Multidisciplinary research approaches are required to gain critical new insights that help better constrain the processes and consequences of ocean crust formation and evolution. These studies are essential, as oceanic ridges have recently come into focus of scientists and policy makers with respect to their potential for polymetallic mineral deposits that may help secure future metal supply. This session invites contributions from all earth and ocean science disciplines (from seismology to geochemistry, petrology, economic geology and geobiology) in order to assess the state-of-the-art perspective on oceanic ridges and to discuss new multidisciplinary approaches of ridge research in both active and fossil systems, including ophiolites.

2b) Microfabrics, deformation mechanisms and physical properties of rocks

Ruth Keppler[1], Michael Stipp[2], Jolien Linckens[3]
[1]University of Bonn, Germany; [2]University of Innsbruck, Austria; [3]University of Frankfurt, Germany

Keynote: *Rüdiger Kilian* (Universität Basel, Schweiz) "Deformation microstructures and textures of quartz - new insights on old paradigms"

The investigation of microfabrics, i.e. microstructures and textures (CPO) of rocks, is ssential for the understanding of deformation in the micro- and macroscale and thus the rheology of the Earth's crust and mantle. Rock microstructure and CPO allow to compare deformation in nature and experiment and to derive deformation mechanisms. Based on the CPO of rocks their physical properties can also be determined. Related rock anisotropies are significant for seismic imaging, but also for geothermal energy research and any prospection including the search for nuclear waste disposal sites in salt, clay(stones) and basement rocks. For this session, we welcome contributions from the entire field of microfabrics investigations and their applications to natural and experimental rock deformation, geomechanical and tectonic modeling, as well as petrophyscial property studies.

2c,e) Fifty Years with Plate Tectonics

Jan H. Behrmann[1], Thorsten, Nagel[2] Ulrich Anton Glasmacher[3], Hans-Peter Bunge[4], Anke Friedrich[4]
[1]GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Germany; [2]Department of Geoscience, Aarhus University, Aarhus, Denmark; [3]University of Heidelberg, Germany; [4]LMU Munich, Germany

A series of journal articles published in 1968 is generally considered as the revolutionary event that convinced the world of Plate Tectonics. Since this paradigm change many concepts have undergone dramatic and continuous changes in many cases relating to the geometry and dynamics of mantle convection. Fundamental issues remain unresolved or controversial, however. Examples are: (1) Mountain building versus backarc-extension at subducting plate boundaries, (2) subduction of continental crust and fluids to great mantle depth and its significance for global mass flux, (3) slab behaviour in the upper and lower mantle and the mechanical nature of horizontal boundary layers, (4) subduction initiation, (5) the mechanical implications of slab windows/tears, (6) the establishment of divergent plate boundaries and the associated dissection of lithosphere, (7) boundary conditions and the onset of Plate Tectonics at planetary scale and alternative global tectonic scenarios and (8) the role of Plate Tectonics for the thermal evolution of a planet. There are also more daring issues such as possible relations between Plate Tectonics and Large Igneous Provinces or between Plate Tectonics and Earth's rotation. The aim is to celebrate this fiftieth anniversary with an interdisciplinary session covering all aspects of Plate Tectonics. Contributions from all disciplines & researchers in tectonics, geophysics, numerical and

analogue modeling, petrology, geochemistry, structural geology, geodesy, and more are welcome. We also encourage regional contributions with plate tectonic implications.

Vertical movements have an impact in various plate tectonic environments, connecting endogenic and exogenic dynamic forces. On one hand, the timing, rates, and causes of vertical movements are important for quantifying the dynamic of topographic evolution of large surface areas on long time scales. On the other hand topographic and related stratigraphic evolution of sedimentary basins are archives that allow studying mantle processes. Whereas timing, rates, and causes of vertical movements in orogenic environments are reasonable understood, similar knowledge within the rift to passive margin environment, and within plate interiors is partly lacking. We seek contributions from field to numerical modelling research in non-orogenic areas, such as recent rifts, passive margin environments, and plate interiors.

2d) Tectonic Systems

Nikolaus Froitzheim[1], Michael Stipp[2], Kamil Ustaszewski[3]
[1]Universität Bonn, Germany; [2]Universität Innsbruck, Austria; [3]Universität Jena, Germany

Keynote: *Thorsten Nagel* (Department of Geoscience, Denmark) "What field geology, P-T modeling, and garnet geochronology can tell about subduction and exhumation"

We invite contributions from the fields of tectonics, structural geology, and crystalline geology. Regional and process-oriented studies from all kinds of active or fossil tectonic settings are welcome – rifting, subduction, collision, transform, and intra-plate deformation. Studies dealing with the development of methods related to the deformation of crust and lithosphere from micro-scale to plate scale are also invited.

Topics 3: Mountain building from depth to surface

3a) "Investigating mountains with a microscope": How microscale studies contribute to the understanding of mountain building processes

Valby van Schijndel[1], Silvio Ferrero[1]
[1]University of Potsdam, Germany

Keynote: *Matthias Konrad-Schmolke* (Department of Earth Sciences, Göteborg, Sweden) "From orogen to atomprobe – Micro-geochemical investigations of disequilibrium textures to reveal geodynamic processes"

H.C. Sorby was criticized in the 19th century for "examin(ing) mountains with microscopes". One hundred and fifty years later microscale investigation of metamorphic rocks is beyond doubt one of the most fundamental tools to understand the continuous changes of the living Earth. Mountain building proceeds via geodynamic processes which induce changes in texture, mineral assemblage and mineral composition in metamorphic rocks. Their correct interpretation is crucial for unravelling the complex evolution of collisional belts. Moreover, mineral relics, e.g. coesite and diamonds inclusions, are sometimes the only way to reconstruct the deepest history of their host rocks, while petrochronology provides the constraints necessary to quantify the timing at which these processes occur. In this session, we would like to invite contributions in the broad fields of microstructural, microchemical and petrochronological studies of metamorphic rocks equilibrated from low grade to ultrahigh-pressure conditions. In particular we welcome studies involving quantitative microscale mapping, thermodynamic modeling, geochronology, elemental diffusion and geospeedometry, stable isotope investigations and fluid/melt inclusion analyses.

3b) The Eastern Mediterranean: A natural laboratory to study orogenic processes operating at different times and at different structural levels

Gernold Zulauf[1], Paris Xypolias[2], Timur Ustaömer[3]

[1]Goethe Universität, Frankfurt a.M., Germany; [2]Patras University, Patras, Greece; [3]Istanbul University, Istanbul, Turkey

Keynote: *Aral I. Okay* (Istanbul Technical University, Turkey) "The story of Tethys in the Eastern Mediterranean – Black Sea region"

The plate tectonic framework for the modern tectonic setting of the Eastern Mediterranean was established in the 1970th. Since this time, our knowledge about the opening and closure of Paleo- and Neotethys, the formation of ophiolites, the role of transform tectonics and the exhumation of deeply subducted rocks increased significantly. The recent introduction of fast techniques in radiometric age dating further improved the reconstructions of ancient plate configurations, the latter resulting from Cadomian, Variscan, Cimmerian and Alpine orogenic processes. The imprints of these different orogenic cycles, together with the still active orogenic processes in the Eastern Mediterranean, make the latter a key area to study fundamental orogenic processes (subduction, accretion, collision, exhumation) and the interaction of sedimentary, tectonic, metamorphic and igneous processes through time. Papers dealing with these topics are invited.

3c) The Alpine-Mediterranean chain - looking from surface to depth, and back in time

Mark R. Handy[1], Todd Ehlers[2], Wolfgang Friederich[3], Timm John[1], Boris Kaus[4], Heidrun Kopp[5], Klaus Reicherter[6], Leni Scheck-Wenderoth[7], Michael Weber[7]

[1]Freie Universität Berlin; [2]Universität Tübingen; [3]Ruhr-Bochum Universität; [4]RWTH-Aachen; [5]Universität Mainz; [6]GeoMar-Kiel; [7]GFZ-Potsdam, Germany

The Alps and its neighboring mountain belts are excellent for studying the effects of tectonic plate reorganizations and climatic variability on mountain building. Travel-time seismic tomography has allowed us to image velocity anomalies in the upper mantle that may be spatially linked to both modern and ancient zones of lithospheric subduction, extension and denudation preserved at the surface.

This session welcomes contributions from the multinational AlpArray or the German component (4D-MB, Mountain Building in processes in 4D), as well as any other studies investigating the structure and evolution of the Alpine-Mediterranean chain. The session will integrate studies of state-of-the-art seismic imaging of the Alpine subsurface, lithosphere and mantle thermomechanical modeling, studies of exhumed rocks at the surface, and investigation of denudation, deposition and their relationships to climate, seismicity and tectonics. Because 4D-MB is in its early stages, we specifically invite contributions that will further our understanding of the 3D structure beneath the Alps, as well as the evolution of their structure through time.

Topic 4: Dynamics of core and mantle on Earth and Other Planetary Bodies

4a) Magmatic processes and their geochemical signatures on Earth and other planetary bodies

Raul Fonseca[1]; Andreas Stracke[2]; Ambre Luguet[3]

[1]Institut für Geologie und Mineralogie, Universität zu Köln, Germany; [2]University of Münster, Germany; [3]Steinmann-Institut für Geologie, Universität Bonn, Germany

Keynote: *Hugh StClair O'Neill* (The Australian National University, AU) "Shapes of Rare Earth Element patterns in planetary basalts and their significance"

Understanding the geochemical characteristics obtained from terrestrial samples and from other planetary bodies (e.g. Moon, Mars, meteorites, etc.) hinges on a precise knowledge of the processes (melting, crystallization, planetary scale differentiation) within them. In this rather broad session, we invite researchers with diverse backgrounds (petrology, geochemistry, geophysics) who study samples and processes operating in planetary interiors. Relevant topics include but are not limited to: Studies dealing with core formation and silicate differentiation in planetary bodies, geochemical or petrological studies of mantle rocks, or theoretical studies

relevant to core formation, experimental, geochemical and petrological studies dealing with melting and tapping of mantle reservoirs.

4b) Materials, structure and dynamics of Earth's deep interior

Max Wilke[1], Georg Spiekermann[1], Hauke Marquardt[2], Gregor Golabek[2], Marcel Thielmann[2], Clemens Prescher[3], Christine Thomas[4], Stephanie Durand[4]

[1]University Potsdam, [2]University Bayreuth, [3]University Koeln, [4]University of Münster, Germany

Keynote: *Jeroen Ritsema* (University of Michigan, USA) "Seismic constraints on the thermochemical structure of the mantle transition zone"

Understanding the structure and dynamics, including the chemical and mineralogical composition, of mantle and core is fundamental to constrain the evolution and dynamics of the Earth. This interdisciplinary session aims at uniting researchers with Mineralogical-petrological, geochemical and geophysical background who study processes or materials relevant to the Earth's interior using experimental, theoretical or computational methods. Relevant topics include but are not limited to: Experimental and computational studies of phase relations and phase transitions or material properties for mantle or core, geophysical studies on the structure and dynamics of the deep interior, studies on deep cycles of volatiles in the interior, etc.

4c) Dynamics of magmatic and volcanic processes

Roman Botcharnikov[1], Kathrin Faak[2], Kai-Uwe Hess[3], David Neave[4]

[1]Johannes Gutenberg University Mainz; [2]Ruhr Universität Bochum; [3]Ludwig-Maximilians-Universität München, Germany; [4] Leibniz Universität Hannover, Germany

Keynote: *Adrian Fiege* (American Museum of Natural History New York, USA) "Dynamic magma-magma interface processes that moderate volatile and metal mass transfer in arc magma systems"

Plutonic and volcanic rocks record a variety of textural, mineralogical and geochemical information that can be used to decipher the kinetics of magmatic processes. This session is devoted to state of the art studies that seek to identify, quantify and interpret kinetic features in magmatic rocks, such as crystal size distributions, mineral zoning patterns and equilibrium versus disequilibrium mineral associations. Contributions focusing on following topics are welcome:

the texture and chemistry of natural rocks and minerals; time scales of magmatic processes estimated using geospeedometry and mineral zoning (e.g., ascent rate, cooling rate, magma recharge); changes in magma rheology induced by the behavior of minerals and volatiles (e.g., decompression in volcanic conduits); kinetics of processes during magma/lava solidification, mixing and magma ascent (e.g., bubble/mineral nucleation and growth); improvements and applications of thermobarometers for tracing the evolution of magmatic conditions in time and space; experimental studies simulating kinetic processes.

Topic 5: Sedimentary systems

5a) Temperature and fluid dynamics in sedimentary basins

Rüdiger Lutz[1], Ralf Littke[2], Lorenz Schwark[3]

[1]Federal Institute for Geosciences and Natural Resources (BGR); [2]Institute of Geology and Geochemistry of Petroleum and Coal, RWTH Aachen; [3]Institute of Geoscience, Kiel University, Germany

Sedimentary basins contain the vast majority of all energy resources, including coal, petroleum, natural gas and are also the most important storage site for anthropogenic solids and fluids. During basin evolution organic matter-rich sediments and sedimentary rocks are exposed to changing pressure and temperature conditions, which lead to mineralogical and geochemical reactions. Systematic and innovative studies on rock properties, laboratory experiments under well-defined physical and chemical conditions as well as numerical modelling are required to determine rates of transformation, but also fluid flow at different scales.

We invite contributions to this session dealing with sedimentary systems and their constituent elements. We welcome basin modeling studies from crustal to reservoir scale, studies on various aspects of the petroleum system, e.g. source rock deposition, maturation, petroleum generation, expulsion and biodegradation, studies on temperature and heat flow evolution in sedimentary systems based on petrological, mineralogical, and geochemical data as well as studies on porosity and permeability evolution, transport and storage of fluids.

5b) Advanced techniques and case studies in sedimentary provenance analysis

Tom McCann[1], Matthias Hinderer[2], Hilmmar von Eynatten[3]
[1]Uni Bonn, Germany; [2]TU Darmstadt, Germany; [3]Uni Göttingen, Germany

Keynote: *Nils Keno Lünsdorf* (Georg-August-Universität Göttingen, Germany) "High resolution heavy mineral analysis by automated Raman spectroscopy – Methodology and Application"

This session welcomes contributions from studies using advanced and/or novel techniques to investigate sedimentary provenance analysis. In recent years, there have been many advances in this area, particularly involving the areas of geochemistry and isotopic analysis examining both bulk compositions and increasingly single minerals. Such analytical techniques, or combined/integrated approaches where individual case studies are presented, will be showcased in this session. We invite contributions from a range of scientists working in the area - from sedimentologists through to geochemists - to present new and provocative work in this session.

5c) Tectonics & Sedimentation - From Fractures to Basins

Tom McCann[1], Linda Prinz[1], Klaus Reicherter[2]
[1]Steinmann Institute, Uni Bonn, Germany, [2]RWTH-Aachen, Germany

Sedimentary basins, and the depositional successions within them, provide the most tangible and accessible records of the lithospheric, geographic, oceanographic and ecological developments which occur in a specific area over a specific period of time. Tectonic activity, on a range of scales, is a major control on sedimentary activity. This session welcomes contributions examing the interaction of sedimentation and tectonic activity on a range of scales, from post-depositional injection processes through to the large-scale control of facies architecture in basin systems.

5d,g,i) Marine Systems

Florian Pohl[1]; Mike Tilston[1]; Yvonne Spychala[1]; Thomas Mann[2]; Maria Mutti[3]; Stefan Huck[4]
[1]Utrecht University, The Netherlands; [2]Leibniz Centre for Tropical Marine Research, Germany; [3]Universität Potsdam, [4]Leibniz Universität Hannover, Germany

Keynote: *Matthieu J. Cartigny* (Durham University, UK) "How new deep-sea observations change turbidity current models"

The deep marine is the biggest repository for terrestrially weathered siliciclastic sediment and organic carbon that are transported beyond the near-shore environment. By sequestering large volumes of organic carbon, the oceans have a significant impact on the climate system of the earth. Furthermore, marine deposits have become a focus of attention in exploration of hydrocarbons or mineral ores due to the progressive depletion of conventional onshore reservoirs. Consequently, there are strong environmental and economic rationales why these systems merit intensive scientific research efforts. Yet despite their significance, the surface of the moon is better known than the floor of the oceans due to the latter being poorly accessible, hostile and dark environment, which hampers rigorous investigation. As such, the deep marine is not understood in a sufficient way, and the processes controlling these systems is largely speculative.

We welcome contributions on all aspects of marine sedimentary system going from the continental shelf to the deep-marine abyssal plane which improves our understanding of the architecture and the processes of all sedimentary system in the oceans. This session will explore a range fields including, but not limited to: studies on ancient marine systems (field and seismic studies), morphodynamics of the ocean floor, direct monitoring of present day natural systems as well as physical experiments and numerical modelling of flow processes.

Marine carbonate cementation is a phenomenon responsible for the accumulation and consolidation of sedimentary bioclasts in tropical and up to the polar oceans. Differences in composition, geometry and spatial extent of carbonate sediment bodies determine categories of different carbonate rock types and systems such as beach rocks, mud mounds or platforms. Thereby carbonate sediment cementation depends on the environmental conditions – on the carbon chemistry of the seawater and the resulting seawater carbonate saturation state. However, besides the chemical seawater parameters that drive calcium carbonate cementation in a quasi-abiotic way it is also well recognized that organic extra-polymeric substances, such as polysaccharides, proteins and enzymes, facilitate the formation of calcium carbonate cement growth – and in certain environments may even play the dominant role for cementation. Marine cementation thus may often not be solely the result of chemically driven direct precipitation of calcium carbonate out of the seawater – the accumulation and nucleation due to organics, and re-precipitation and recrystallization of carbonates under biological activity are likewise and simultaneously possible. This session invites contributions covering all aspects of marine carbonate cementation. We seek to combine studies dealing with the fundamental processes of carbonate cementation deciphering the abiotic and biotic controls, as well as with its implications for the reconstruction of environmental settings, ranging from macro- to microfacies studies and from recent to deep time.

Modern and ancient marine and lacustrine carbonate systems provide an outstanding record of sea (lake) level, water chemistry and climate history, represented by facies trends and changes geochemical signatures. Biosedimentation patterns in carbonate depositional systems are governed by variable ecological tolerance limits of the carbonate producing organisms with respect to changes in temperature, water chemistry, oxygen and nutrient level or siliciclastic influence. Important prerequisites for the extraction of environmental information from carbonate archives are a precise temporal assignment and only limited diagenetic alteration of the geochemical inventory, both of which need to be considered with great care. This session aims at bringing together carbonate sedimentologists, geochemists and (bio-/chemo-/sequence) stratigraphers, who are developing integrated approaches in order to evaluate paleoenvironmental and paleoceanographic controls on the facies patterns, spatial geometries, geochemical signatures and stratigraphic distribution of modern and fossil carbonate systems. Contributions are most welcome that are applying innovative tools to deepen our understanding of forcing mechanisms on carbonate system evolution.

5e,h) Quaternary Geochronology and Earth Surface Processes

Silke Mechernich[1], Dominik Brill[2], Manfred Frechen[3], Jan Henrik Blöthe[4], Kristen Cook[5], Lothar Schrott[4]

[1]Institute of Geology and Mineralogy, University of Cologne, Germany; [2]Institute of Geography, University of Cologne, Germany, [3]Leibniz-Institut für Angewandte Geophysik, University Hannover, Germany, [4]University of Bonn, Germany; [5]GFZ Potsdam, Germany

Precise and accurate chronologies form the basis to interpret Quaternary processes and link them to climate, tectonic, isostatic and/or volcanic processes. In recent years, significant advances were achieved for various Quaternary dating approaches leading to an improved reliability and the development of new methods and applications.

In this session, we particularly welcome both methodic and applied contributions that focus on all kinds of Quaternary dating methods (e.g. radiocarbon, cosmogenic nuclides, luminescence, ESR, fission track, U-series, and Ar-dating). This might concern (1) the reduction of dating uncertainties, (2) the establishment of new dating methods, and/or (3) the quantification of process rates. We highly welcome resulting interpretations of the resulting ages (e.g. chronologies of climatic and environmental change, long-term landscape evolution).

In contrast to the flow of water, sediment flux in natural systems is highly intermittent. Along the sediment cascade, sediments get frequently trapped in valley fills, on slopes, in fans, and on floodplains along their way to the ultimate sink, thus complicating the calculation of sediment travel times and sediment output from the system.

Especially in mountain environments, erosional (i.e. the production of loose debris) processes cover a wide range of temporal and spatial scales, from glacial erosion, rock fall, debris flows, landslides, river aggradation and incision to bank collapse. These processes also have a range of triggers and drivers, including seismicity, strong precipitation events, steep topography, etc. Measuring the dynamical interplay of erosion and sedimentation as well as quantifying the rates and fluxes is highly challenging. Furthermore, these processes potentially pose threats to human infrastructure and livelihoods and thus need to be better understood and quantified to provide a valuable process understanding to better prepare for consequences of related natural hazards.

In our session, we welcome contributions investigating:

- sediment mobilization and deposition
- quantification of erosion fluxes in space and time
- concepts of dynamics and connectivity of sediment
- sediment travel times and transport processes
- interaction of stabilizing and destabilizing processes on slopes

We invite presentations that focus on conceptual, empirical, methodological, or modelling approaches or a combination of those in mountain environments and particularly encourage early career scientists to apply for this session.

5f) Integrated chemostratigraphy and applications

André Bornemann[1], Jochen Erbacher[1], Michael Joachimski[2]
[1]*Bundesanstalt für Geowisenschaften und Rohstoffe, Germany;* [2]*GeoZentrum Erlangen, Germany*

Sedimentary rocks are not only of enormous economic interest as resources or as places for surface and subsurface storage, but also represent important geological archives of paleoenvironmental and biotic changes. Studies of the physicochemical properties of sedimentary rocks for applied purposes as well as detailed paleoenvironmental studies of different intervals in Earth history rely both heavily on the quality of age control and the integrated application of proxy data. Over the last two decades high-resolution chemostratigraphy based on stable isotopes or XRF core scanning in combination with astronomical tuning and integrated biostratigraphy allowed for the establishment of a robust high resolution stratigraphy of the Cenozoic era, but also for Mesozoic and Paleozoic strata the stratigraphic accuracy is slowly improving. For this session we invite interdisciplinary contributions that provide new clues about chemostratigraphy and the integration of other stratigraphic disciplines such as biostratigraphy, cyclostratigraphy or sequence stratigraphy in order to advance our knowledge about stratigraphic accuracy and correlation.

Topic 6: Neotectonics, earthquakes, impacts and natural hazards

6a,c) Natural Hazards: earthquakes, tsunamis, landslides | Sea-level fluctuations over time – Sea-level index points and dating approaches

Klaus Reicherter[1], Gösta Hoffmann[2], Lothar Schrott[3], Silke Mechernich[4], Christoph Grützner[5], Martin Seeliger[6], Anna Pint[6], Yvonne Milker[7]
[1]*RWTH Aachen University, Germany;* [2]*Univ. Bonn, Germany;* [3]*Univ. Bonn, Germany;* [4]*Univ. zu Köln, Germany;* [5]*Univ. Jena, Germany;* [6]*University of Cologne, Germany,* [7]*University of Hamburg, Germany*

Keynote: *Jens Erik Wendler* (Friedrich-Schiller University Jena, Germany) "Orbital forcing of the hydrological cycle and sea-level during greenhouse climate: The importance of aquifer-eustasy"

Natural hazards are not necessarily catastrophes, however, if they concern man, society and the environment they become a risk. Natural hazards have always occurred in the system Earth and need to be evaluated cautiously in space (local, regional, global), time (duration, date), intensity and recurrence interval.

We ask for contributions of natural hazards studies that recognize, evaluate and eventually manage past and future hazards affecting Earth and society, especially in times of generally accepted climate change.

Earthquakes, tsunamis, mass movements (landslides) and subsidence as well as climate extremes (e.g. wave events, storm surges) are major topics concerning our session along with long-term studies e.g. on neotectonics, paleoseismology, archeoseismology and related topics.

Sea-level variations spread over a very broad spectrum. The largest global-scale sea level changes (50–200 m in amplitude) occurred on geological timescales. And even throughout the relatively short period of mankind immense sea-level fluctuations took place infecting human settlements.

Defining sea-level index points and their dating is challenging. This session calls for contributions dealing with sedimentological, geological, biological and anthropogenic sea-level proxies to reconstruct sea level over time and from global to the regional scale. We also explicit invite papers presenting recent dating approaches on this topic.

6b) Impact cratering throughout the solar system

Michael Poelchau[1]; Ulrich Riller[2]
[1]*University of Freiburg, Germany;* [2]*Hamburg University, Germany*

Impact cratering processes play a fundamental role in planetary sciences and geosciences, from the formation of planetary bodies to the effects of life on earth. The study of these highly complex structures often requires a multidisciplinary approach, taking from a diverse range of research areas and fields of expertise. We therefore invite submissions dealing either with the highly dynamic cratering process itself, or the effects of this process on geological, planetary, biological or other systems. Contributions ranging from shock metamorphism, geochemical and geochronological studies of impactites and impactors, field studies, geophysical imaging, remote sensing, experimental techniques, and numerical modeling are all welcome.

Topic 7: Mineralogy, material science of the Earth

7a) Advances and new applications in chemical, isotope and structural analysis

Markus Lagos[1]; Killian Pollock[2]; Frank Wombacher[3]
[1]*Universität Bonn;* [2]*University Jena;* [3]*Universität zu Köln, Germany*

Keynote: *Dieter Garbe-Schönberg* (CAU Kiel University, Germany) "Reference materials for microbeam sampling - where do we stand?"

We welcome contributions concerning the chemical, isotope and structural analysis of minerals, rocks and other materials that lead to an improved characterization and understanding of Earth system processes or applied materials. The session is open to all kinds of analytical approaches like mass spectrometry, synchrotron-based material characterization, electron microscopy or spectroscopic methods.

7b,c) Minerals and Materials: Properties and Structures

Reinhard X. Fischer[1]; Jürgen Schreuer[2] Nasser Hbib[3], Davood Yosefnejad[3], Georg Nover[3]
[1]*Universität Bremen, Germany;* [2]*Ruhr-Universität Bochum, Germany;* [3]*Rheinische Friedrich-Wilhelms-Universität Bonn, Germany*

This session covers the synthesis and physicochemical characterization of minerals and inorganic materials. All contributions are invited which are related to crystallization processes, physical and chemical properties of crystals, and the description of the crystal structures of minerals and their materials analogues. Minerals like, e.g., zeolites, are important compounds with various utilizations. They also serve as model systems to better understand the properties of technical compounds. Thus, their characterization by various powerful methods is of major importance in materials chemistry and mineralogy.

This session welcomes contributions from all fields of applied (technical) mineralogy. A special focus is on technical processes like mining, combustion, underground storage, ceramics, cement, etc. Issues from all fields of analytical techniques that contribute directly to the optimization of technical processes are welcome. This includes basic research as well as investigations on new ideas that relate scientific and analytical tools to technical processes with the aim to increase resource efficiency. The developments of models that enhance process efficiency by using chemical and mineralogical data of the residues of the thermal processes are particularly invited. Thermo analytical laboratory studies hopefully can cover the gap between small scaled laboratory experiments and large scale technical processes. One topic of this session deals with problems related to slagging and fouling in power plants due to inorganic impurities and the use of biomass and waste in power plants.

Topic 8: Climate change, climate dynamics and paleoclimate

8a) Groundwater and climate change

Traugott J. Scheytt[1], Joannes Barth[2]
[1]*FH-DGGV Technische Universität Berlin, Germany;* [2]*Friedrich-Alexander-Universität Erlangen, Germany*

Keynote: *Richard G. Taylor* (UCL Department of Geography, Gower Street, London, UK) "Groundwater in a warming world: the impact of changing climate extremes"

Climate change has the potential to impact all parts of the hydrological cycle. Increase of average temperature, a shift of precipitation both spatially as well as temporally, lower snow coverage, more extreme precipitation events and an increased duration of vegetation will result in changes of groundwater recharge. This will impact drinking water management especially for critical areas and will have long-term effects on general water management. We are seeking contributions from various scientific fields on questions including but not limited to 1) Does the climate change already have an effect on groundwater? 2) Will groundwater levels change in the future and if so in which way? 3) What kind of groundwater and water resources management as to be adopted? 4) What consequences may be inferred on groundwater - surface water interactions?

8b,d) Oceanic oxygen, ice ocean interactions and climate change

Michael E Weber[1], Janne Repschläger[2]; Jacek Raddatz[3], Wolfgang Rübsam[4]
[1]*Steinmann Institut, Universität Bonn;* [2]*Max-Planck Institut für Chemie, Mainz, Germany;* [3]*Institute of Geosciences, Goethe University Frankfurt, Germany;* [4]*Institute of Geosciences, University of Kiel, Germany*

Keynote: *Thomas Ronge* (Alfred Wegener Institute, Bremerhaven, Germany) "A Southern Ocean perspective on climate, CO_2 and ice sheets"

Due to rising temperatures and CO2 levels ice sheets covering Greenland and Antarctica have the potential to provide a significant contribution to global sea-level rise over the coming decades to centuries. It is therefore imperative to improve our understanding of the processes governing the dynamics of ice sheets and sea ice in polar regions. In recent years it has emerged that the interaction with surrounding oceans might be key to changes in both the Arctic and Antarctic ice dynamics. Therefore, studies on past changes in ocean temperature, circulation, and sea-ice coverage are critical. Also, better knowledge on ice-sheet behavior from near- and far-field data and modeling is needed to improve projections of future behavior. This highly interdisciplinary session invites contributions from both polar regions and various fields including paleoceanography, marine geology, glaciology, ocean and ice sheet modeling, as well as climate and atmospheric sciences, to unravel bipolar linkages and describe interactions between different parts of the climate system for critical periods of earth's history.

Oxygen is necessary to support (most of) life in the oceans. Half of the oxygen we breathe is produced by phytoplankton in the oceans, thus highlighting the importance of oceanic oxygen especially under recent climate change, where oceanic oxygen is progressively decreasing. Even though oxygen is so important for the oceans interior and marine ecosystems its variability throughout Earth History is still a matter of debate. Nevertheless, the importance of ocean oxygenation is also highlighted by the fact that major Phanerozoic mass extinction events were accompanied by widespread shelf sea/ocean anoxia.

We aim to improve our understanding of ocean oxygenation and deoxygenation, as well as of underlying Earth System processes, and therefore invite contributions dealing with (geochemical) proxy development as well as paleoceanographic reconstructions of oceanic oxygen covering the entire Earth History.

8c) Loess systems and the reconstruction of Pleistocene climate dynamics

Ulrich Hambach[1], Peter Fischer[2], Christian Zeeden[3], Igor Obreht[4], Daniel Veres[5]
[1]*BayCEER & Chair of Geomorphology, University of Bayreuth, Germany;* [2]*Institute for Geography, University of Mainz, Germany;* [3]*IMCCE, Observatoire de Paris, France;* [4]*MARUM-Center for Marine Environmental Sciences and Department of Geosciences, University of Bremen, Germany;* [5]*Institute of Speleology, Romanian Academy, Romania*

Keynote: *Qingzhen Hao* (Chinese Academy of Sciences, Beijing, China) "Extra-long interglacial in Northern Hemisphere during MISs 15-13 and its influence on the second major dispersal of African hominins"

Loess-paleosol sequences are the most extensive terrestrial paleoclimate records in Europe and Asia documenting atmospheric circulation patterns, vegetation, and sedimentary dynamics in response to glacial-interglacial and potentially sub-orbital climatic cyclicity. Assessment of common patterns and differences in these terrestrial paleoclimatic records is crucial for the understanding of Eurasian climate evolution. This represents a major challenge for understanding the interaction and evolution of Northern Hemisphere climate systems over the continental areas, and also their relation to marine and other proxy records and reference datasets, including orbital and greenhouse gas forcing. During the last decades, beside grain size environmental magnetic parameters (e.g. magnetic susceptibility, MS) have been recognized as fundamental paleoclimate proxies for Eurasian loess-paleosol sequences (LPS). MS has been employed as stratigraphic tool, facilitating correlations between terrestrial deposits and the marine isotopic record, ice core, and lacustrine records, suggesting a close interconnection between dust deposition, global ice volume, and global climate. In recent years, detailed and high resolution studies on faunal and floral remains, biomarkers, and stable isotopes provided new and powerful proxies for the reconstruction of regional and local temporal environmental dynamics from LPS in Eurasia.

This session aims to highlight integrative paleoclimate research on LPS closely integrating sedimentological research with paleoclimate and environmental sciences, by focusing on the development of new environmental proxies, contextualization of sedimentary environments and integration of numerical dating results (luminescence, radiocarbon, tephrochronology). We especially encourage submitting papers on the integration of different disciplines and on modelling of past and present climates using data from loess-paleosol records.

8e) New Insights into the Quaternary Vegetation and Climate History

Nadine Pickarski[1], Andrea Miebach[1], Thomas Litt[1], Sophie Stolzenberger[2]
[1]Steinmann Institute, University of Bonn, Germany, [2]Institute of Geodesy and Geoinformation, University of Bonn, Germany

Quaternary archives provide valuable insights into long-term and rapid changes of the ecosystem. An improved knowledge of climate and vegetation dynamics in the past allows to understand environmental interactions and helps to assess the impact of recent and future climate changes.

We invite contributions dealing with various aspects of Quaternary environments. We particularly welcome investigations based on long, continuous, and high-resolution records from terrestrial, lacustrine, and marine sequences. We appreciate innovative studies to describe, reconstruct, and model paleoenvironments.

Topic 9: Earth materials, resources, and waste management

9a) Geoscientific aspects of the safe management of mineral, hazardous and nuclear wastes

Daniel Höllen[1], Guido Deissmann[2], Thorsten Schäfer[3], Thorsten Geisler-Wierwille[4]
[1]Montanuniversität Leoben, Austria; [2]Forschungszentrum Jülich GmbH, Germany; [3]Institut für Geo-wissenschaften, Universität Jena, Germany; [4]Steinmann-Institut, Universität Bonn, Germany

Keynote: *Reto Gieré* (University of Pennsylvania, USA) "Mineralogy and geochemistry of biomass-combustion waste"

Mineral wastes like excavated and contaminated soil (incl. soil-like fine fractions in landfills), construction and demolition waste (incl. artificial mineral fibres and asbestos) and ashes from waste, biomass and fossil fuel incineration, industrial residues like (metallurgical) slags, dusts and sludges as well as mining wastes represent the largest material flows in waste management. Nuclear and hazardous wastes represent smaller waste streams, but their deep geological disposal poses major scientific and societal challenges to substantiate the long-term safety of the repository system over time scales of up to one million years.

Material sciences and geosciences provide important contributions to the scientific bases of the safe management of both mineral and nuclear wastes containing heavy metals and/or radionuclides, in particular with respect to their release into the environment and the geosphere. Moreover, for mineral waste the potential recovery of metals by physical, chemical or biological methods is highly relevant in a circular economy. Both,

recovery and release of toxic metals or radionuclides from mineral and nuclear wastes is significantly influenced by the mineral phases in which these elements are incorporated. A fundamental understanding of the relationship between mineralogy and mobility of chemical elements allows for tailor-made solutions for the disposal of nuclear waste as well as the recycling and treatment of mineral waste.

Thus, this session intends to bring together contributions from all fields in geoscience providing insight into important processes relevant to the treatment, disposal, re-use or recycling of mineral and nuclear wastes. The scope of this session includes topics ranging from mineralogical aspects of eco-design, re-use and recycling of mineral wastes and phytoremediation of contaminated sites via waste form performance, migration of contaminants from mineral and nuclear waste (incl. reactive transport modelling and risk assessment/performance assessment) to repository concepts for nuclear waste disposal and site characterization.

9b,c) Geology of unconventional resources of critical raw materials

Torsten Graupner[1], Dennis Krämer[2], Mathias Burisch[3], Marta Sosnicka[4]
[1]BGR Hannover, Germany; [2]Jacobs University Bremen, Germany; [3]TU Bergakademie Freiberg, Germany; [4]GFZ Potsdam, Germany

Keynote: *Peter Onuk* (Montan Universität Leoben, Austria) "HIGH-TECH METAL POTENTIAL OF SPHALERITE FROM EASTERN ALPINE LEAD-ZINC DEPOSITS"

Keynote: *Max Frenzel* (TU Bergakademie Freiberg, Germany) "Criticality - What makes a raw material critical?"

The transition of our society towards the increased usage of climate-friendly technologies forms one of the major challenges of the next decades. Major points are the consolidation of an energy system relying to increased parts on renewable resources and the development of e-mobility. Consequently, the increasing demand for technology-critical strategic metals (e.g. Co, Li, Ge, Ga, Sb, Sn, Cu, Nb, Ta, as well as REE and PGE) has led to a misbalance between supply and demand, and the dependence on single suppliers has added significant supply risk. Since to date the supply of strategic metals cannot be secured by recycling, supply from new ore deposits is needed in the near future. This requires continuous exploration for ore deposits and related research and technology development for exploration, efficient and eco-friendly mining and ore processing, particularly of unconventional resources. We invite contributions that address this field of ore deposit research and particularly en-courage contributions from projects funded within the BMBF r4 framework.

The session will address the recovering of heat and minerals from geothermal brines. Studies can include research on different scales, from laboratory to real field scale. Necessities for large infrastructures are emphasized for geothermal heat production as the most significant resource in the energy market (heating and cooling accounts for 50% of the EU´s energy consumption). Furthermore, geothermal mining of the mineral-rich fluids presents a potential driver for more economical geothermal projects. Contributions addressing the geologic origin or pathways of mineral resources being favourable for future extractions are welcomed as well as economic and data analyses of geothermal projects.

9d) Magmatic Ore Deposits

Lennart Alexander Fischer[1], Malte Junge[1], Felix Kaufmann[2]
[1]Albert-Ludwigs-Universität Freiburg; [2]Museum für Naturkunde Berlin, Germany

Keynote: *Thomas Aiglsperger* (University of Technology, Sweden) "Mobilization of platinum group elements and the neoformation of platinum group minerals under supergene conditions"

The constant development in technology and the worldwide increasing standard of living, leads to continuous demand for metals. The understanding of existing as well as exploration for new ore deposits is therefore an important contribution to our society. Magmatic ore deposits cover a wide range of magmatic settings from dynamic MOR, back-arc systems, granite-related deposits to layered intrusions. These include rock types such as pegmatites, carbonatites and ultramafic-rocks, implying a vast number of ore formation processes. To understand the petrogenesis of magmatic ore deposits it is important to identify and explain ore formation processes including magma mixing, liquid immiscibility, crystal fractionation, partial melting, alteration and interaction with hydrous fluids. The diversity of different magmatic ore deposits provides the opportunity to study field relations, magmatic processes and mineralogy by using analytical tools, such as EPMA, LA-ICP-MS and

isotope studies. We invite contributions from studies of natural rocks, experiments and numerical modelling in the field of magmatic ore deposits.

Topic 10: Fossil ecosystems

10a) The early `Explosion of Life´ - from the Cambrian innovations to the great Ordovician radiations

Oliver Lehnert[1], Thomas Servais[2]
[1]FAU Erlangen-Nürnberg, Germany; [2]USTL, CNRS, UMR 8198 - Evo-Eco-Paleo, France

Keynote: *David Harper* (Durham University, UK) "The Early Palaeozoic marine diversifications: some causes and consequences"

The session is a regional contribution to the current IGCP project 653 `The onset of the Great Ordovician Biodiversification Event´. The `GOBE´ started at distinct times on different palaeocontinents and displays diachronic pulses of radiations in different faunal groups. Its roots date back into the Cambrian with pulses in the late Cambrian and Early Ordovician, and major bursts in biodiversity during Middle and Late Ordovician times. Interdisciplinary studies and contributions from different geoscientific fields related to the evolution of different groups and changes in ecosystems as well as to the triggers for the GOBE are very welcome.

10b) Biodiversity dynamics in deep time - signatures of radiation and extinction in the geological record

Richard Hofmann[1]; Wolfgang Kießling[2]
[1]Museum für Naturkunde Berlin, Germany, [2]GeoZentrum NordBayern, University of Erlangen, Germany

Keynote: *Erin E. Saupe* (University of Oxford, UK) "Macroecology in deep time"

Analysing ancient biodiversity patterns is key to the understanding of principal drivers of diversification and extinction in the geological past. Episodes of diversification offer fundamental insight into macro-evolutionary processes that are not readily accessible by the study of extant ecosystems alone. Likewise, ancient mass extinctions serve as the only available analogues of the modern biodiversity crisis and thereby help to make well-founded predictions of the effects of the current global change on biodiversity and ecosystem functioning. This session is intended to bring together a multidisciplinary set of researchers to better understand these lessons from the geological past. We invite contributions at all scales: from outcrop studies to global data compilations, from analyses of single clades to whole communities. Presentations that integrate geochemical data of any sort with biodiversity patterns are also highly encouraged.

10c,e) Bone histology and tetrapod locomotion - Part 1: Bone histology; - Part 2: Tetrapod locomotion

Dorota Konietzko-Meier[1], Dawid Surmik[2], Jens Nikolaus Lallensack[1], Michael Buchwitz[3]
[1]Steinmann-Institut für Geologie, Mineralogie und Paläontologie, Germany, [2] University of Silesia, Faculty of Earth Science, Sosnowiec, Poland, [3]Museum für Naturkunde Magdeburg, Germany

Keynote: *Koen Stein* (Earth System Sciences - AMGC, Vrije Universiteit Brussel, Belgium) "Black beauties: histology and geochemistry of Iguanodon bernissartensis from the Early Cretaceous of Bernissart, Belgium"

Keynote: *Holger Preuschoft* (Ruhr-Universität Bochum, Germany) "Locomotion on limbs"

In paleontology, bone histology is one of the major sources to obtain direct information about paleobiology such as life history traits or physiology. Various approaches are developed in paleohistological studies, including skeletochronology, growth dynamics, microanatomy, quantification of the structural, functional and phylogenetic signals in bone organization, bone biomechanics and bone paleoecological signals. This session invites contributions dealing in general with vertebrate bone histological topics.

The locomotion of extinct animals is of fundamental importance for understainding their paleobiology and -ecology, and thus fossil ecosystems. Tetrapods evolved a wide variety of locomotor styles, including terrestrial and aquatic locomotion, and flight. Their locomotion, sometimes without any living analog, may be inferred

indirectly from the skeleton using biomechanical analyses, or directly from observations on living animals or fossil trackways. In this session, we welcome contributions from these and other fields of research that provide new insights on the locomotion of fossil tetrapods.

10d) Marine reptiles: a successful story in Mesozoic ecosystems

Jun Liu[1,2], Tanja Wintrich[2], Dayong Jiang[3]
[1]Hefei University of Technology, Hefei, China; [2]University of Bonn, Germany; [3]Peking University, China

Keynote: *Michael James Benton* (University of Bristol, UK) "Marine vertebrates and recovery of life from the Permian-Triassic mass extinction"

Different lineages of reptiles invaded the marine realms from time to time in the Mesozoic. They include these iconic animals such as ichthyosaurs, plesiosaurs and mosasaurs among others. Mesozoic marine reptiles were top predators of their time. They occupied a new and distinct ecological niche that was not open until after the Permo-Triassic mass extinction, the most severe catastrophe in the history of life. The invasion of these predators into the marine realm also constituted an integral part of the Mesozoic Marine Revolution, which caused the formation of modern marine ecological system. Study of Mesozoic marine reptiles thus helps to elucidate the pattern and process of the recovery from the mass extinction and the origin of the modern marine ecosystems. Investigation of these extinct predators is especially useful in providing historical perspective to mitigate the deterioration of large predators in the modern oceans. This session welcomes any contribution related with Mesozoic marine reptiles from paleontological, geological and geochemical disciplines.

10f) Isotope analyses on calcareous and phosphatic fossils: Potentials and weaknesses

Thomas Wotte[1], Thomas Tütken[2], Eric Otto Walliser[2]
[1]Institute of Geology, Technische Universität Bergakademie Freiberg, Germany; [2]Institute of Geology, Johannes Gutenberg Universität Mainz, Germany

Keynote: *Christophe Lécuyer* (University of Lyon, France) "Combined use of 18O/16O and 34S/32S in apatite to decipher the ecology of vertebrates"

Isotope analyses on calcareaous and phosphatic fossils provide valuable proxies for reconstructing metabolic processes of marine and terrestrial organisms, as well as their palaeo-environmental conditions. Whereas applications on Cenozoic and Mesozoic skeletal remains are common, they become more critical for older stratigraphic units due to diagenetic alteration processes that may bias original life time signatures. However, the application of nontraditional isotope systems, refined analytical techniques and new approaches provide more precise data characterizing palaeoenvironments and palaeoclimate back in Earth history.

This session welcomes contributions reflecting the broad variety of isotope systems and analytical methods applied to non-marine as well as marine calcareous and phosphatic fossil remains.

10g) Reconstructing the ecological roles of extinct organisms: functional morphology, phylogeny and ontogeny

Joachim Haug[1]; Kenneth De Baets[2]
[1]Department of Biology II and GeoBio-Center, Ludwig-Maximilians-Universität, München, Germany; [2]Geozentrum Nordbayern, Erlangen, Germany

Keynote: *Tyler Ranse Lyson* (Denver Museum of Nature & Science, USA) "Fossoriality and the origin of the turtle body plan"

Keynote: *Imran Alexander Rahman* (Oxford University Museum of Natural History, UK) "Computational fluid dynamics and its applications in palaeontology"

There is an increased interest in roles or functions that species played in past communities or ecosystems. Despite lack of direct observations, comparative studies in form and function of invertebrates, vertebrates and plants can be used to infer ecologies of lineages that no longer exist. Additional clues to the relationship between form and function can be obtained through taphonomic studies, ontogenetic comparisons or modelling. They

allow tracking the first appearance or major changes in ecologies in the geological record. Furthermore, they even allow to infer ecologies and reproductive strategies which are no longer represented in extant relatives. These methods allow to restrict how ancient organisms functioned and the environments in which they lived.

10h) Vertebrate jaws and teeth — form and function

Julia A. Schultz[1]; Thomas Martin[2]
[1]*University of Chicago, Chicago, USA;* [2]*Steinmann-Institut für Geologie, Universität Bonn, Germany*

There is a remarkable diversity in vertebrate jaws and teeth. These structures are closely related to diet and reflect adaptations to various feeding strategies. They provide important information on ecomorphology and the role of vertebrates in fossil and extant ecosystems.

10i) Greening of the living Earth: Advances in Palaeobotany and Palynology

Carole T. Gee[1]; Hans Kerp[2]
[1]*Steinmann Institute, University of Bonn;* [2]*University of Münster, Germany*

Keynote: *Carole T. Gee* (Universität Bonn, Germany) "Water lily leaves at the base of the Nuphar and Nymphaeaceae clades from the middle Eocene lake of Messel, Germany"

Keynote: *Michael Krings* (Bayerische Staatssammlung für Paläontologie und Geologie, Germany) "Primary producers in the Lower Devonian Rhynie and Windyfield cherts: Cyanobacteria and eukaryotic microalgae"

Ever since terrestrialization in the Early Palaeozoic, plants have had a major impact on geological processes such as weathering, erosion and soil formation. They are also the primary producers in virtually all ecosystems on earth, have created most habitats, and constitute the green lungs of our planet. Plant fossils, including pollen and spores, provide valuable information on the biostratigraphy, palaeoecology, and reconstruction of ancient terrestrial ecosystems. Moreover, they serve as reliable proxies for palaeoclimate studies. In this symposium, we welcome palaeobotanical and palynological contributions on plant evolution, radiations, diversity, vegetation patterns, and interactions with animals through time and space, as well as on the morphology, anatomy, and systematics of ancient plants.

Topics 11: Fossilization and the quality of the fossil record

11a) The fossil record of evolution and evolutionary processes

Ralph Thomas Becker[1], Thomas Martin[2]
[1]*Westfälische Wilhelms-Universität Münster, Germany;* [2]*Steinmann Institute, University Bonn, Germany*

Keynote: *Christian Klug* (Universität Zürich, Switzerland) "Ammonoid beginnings"

It is a wide-spread misconception, for example among many evolutionary biologists, that the fossil record is too incomplete and episodic to record details of phylogeny and evolutionary processes. However, since the famous study of the Steinheim gastropods by Hilgendorf (1866, 1867) it is clear that there are many rich occurrences of fossil in time and space that preserve clearly the paths of morphological change, speciation, or the multifold aspects of macroevolution. This applies to all groups of organims, including invertebrates, vertebrates, and plants. Ca. 150 years after the first published phylogenetic tree based entirely on fossils, the session shall provide a platform to present new or revised case-studies, which exemplify evolutionary patterns, from the timing of speciation and reconstructed adaptive radiations to iterative evolution and rates of evolutionary change, in deep time.

11b) Taphonomy: Inferences about ecosystems and paleobiology

Jelle Heijne[1], Kayleigh Wiersma[1], Michael Wuttke[2]

[1]Steinmann-Institut für Geologie, Mineralogie und Paläontologie, Rheinische Friedrich-Wilhelms-Universität Bonn; [2]Palaeoclimate- and Palaeoenvironment Research, Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt, Germany

Although the taphonomy of fossils is a widely studied and well understood branch of palaeontology, the information provided by the study of taphonomy for understanding both terrestrial and marine ecosystems is often overlooked. Recent studies showed the wide array of conclusions that could be drawn from assessing the disarticulation and completeness of specimens. Environmental factors that can be inferred from taphonomical analysis include, but are not limited to, water depth, stressed environments (e.g., hypersalinity/anoxia), carcass transport, scavenging, and current activity. Furthermore, decay patterns might provide insights in the anatomy and thus the paleobiology of studied organisms. Examples include the recurrent preferential preservation of certain body regions shown in one specific taxon. Invited to this session are vertebrate and invertebrate palaeontologists as well as paleobotanists with talks on taphonomy. Contributions regarding the sedimentology of fossil bearing layers will also be taken into consideration.

11c) Soft part preservation: The limits of the fossil record

Paul Martin Sander[1], Jes Rust[1], Koen Stein[2]

[1]Steinmann-Institut für Geologie, Mineralogie und Paläontologie, Rheinische Friedrich-Wilhelms-Universität Bonn,Germany [2]Vrije Universiteit Brussel, Brussels, Belgium

Traditionally, animal fossils have been equated with mineralized remains such as shells and bones. However, it has been increasingly recognized that the preservation of non-mineralized tissue and the organic component of mineralized tissues is commonplace. Such soft part preservation may come in the guise of altered organic remains, templating and replacement by minerals, and pure impressions in fine-grained sediments. Soft part preservation has classically been associated with conservation deposits but the organic components in mineralized tissues result from different, as yet poorly understood, conditions of preservation. The purpose of the session is to review the state of the art and bring together researchers interested in a synthetic view of soft part preservations and its implications for our understanding of the limits of the fossil record. Contributions are invited by the members of the DFG FOR 2685 and any other interested researcher.

Topics 12: Applied and industrial micropalaeontology

12a) Reconstructing lost worlds - applications of microfossils

Anna Pint[1], Peter Frenzel[2]

[1]University of Cologne, Germany; [2]University of Jena, Germany

Keynote: Gerhard Schmiedl *(University of Hamburg, Germany)* "Applicability of benthic foraminifera in marine paleoclimate research"

The small size of microfossils and their high diversity enable studying large associations, often with well preserved and complete individuals even from small samples as typical from sediment cores. Microfossils are valuable tools in Geology, Physical Geography, Palaeooceanography, Palaeoclimatology and Geoarchaeology. Their assemblage composition, environmental induced morphological reactions and shell chemistry signatures enable reconstructing a wide range of environmental factors in aquatic or terrestrial ecosystems. Biostratigraphical ranges of microfossil taxa are another important application for bringing strata into a chronological order. The great importance of microfossils for geoscience is their application but as past organisms they are excellent palaeontological study objects in their own as well.

Topics 13: Applied Geophysics

13a) Rock rheology, deformation transients, and the earthquake cycle

Georg H. Dresen[1], Livia Nardini[1], Bernhard Schuck[1], Erik Rybacki[1], Steven Miller[2]
[1]GFZ Potsdam, Germany, [2]Centre d'hydrogéologie et de géothermie, Universite de Neuchâtel

Keynote: *Michel Campillo* (Université Joseph Fourier, Grenoble, France) "Deformations and the combined analysis of seismic and GPS weak signals"

Rock deformation at depth in the Earth's crust and Upper Mantle is typically governed by thermally activated viscous creep. Extensive laboratory studies and quantitative field observations allowed formulating robust constitutive equations for major crustal and upper mantle rocks. However, key questions such as whether the ductile roots of faults are concentrated in weak narrow shear zones or broad regions of bulk ductile flow, how the rheology of shear zones affects the temporal evolution of stress and surface strain during the earthquake cycle and the nature of coupling between elastic and ductile lithosphere have not yet been fully addressed. This also holds for the seismic and geodetic signatures of slip transients along plate-bounding faults that have been reported over the last decade suggesting that deformation at depth may be governed by a complex interplay of non-steady state processes. For this session, we invite contributions that address field observations, numerical modelling and laboratory studies of rock deformation.

13b) Geophysics and the new "Standortauswahlgesetz"

Christian Buecker[1], Andreas Schuck[2]
[1]DEA Deutsche Erdoel AG, Germany; [2]GGL Geophysik und Geotechnik Leipzig GmbH, Germany

Keynote: *Michael Kühn* (GFZ German Research Centre for Geosciences, Germany) "Utilisation of the georesource subsurface for the disposal of radioactive waste"

The search for radioactive waste deposits has been given a restart with the amendment to an act called "Standortauswahlgesetz" by the Bundesrat. Goal of this new act is a science-based, transparent, self-questioning and -learning selection procedure to find a new location for radioactive waste for final storage at highest safety. Host rocks can be Salt, Clay, and Granite in depth from 300 m to 1500 m. In the sense of an unprejudiced approach in finding suited locations, Germany will be seen as a "white landscape".

Geophysics in particular will play an essential role in this context. In this session talks on geophysical standards and procedures as well as proposals for new exploration and monitoring methods are welcomed. The content of the session will be guided by the following questions:

- What is the contribution of Geophysics, in particular Applied Geophysics for the above ground and subsurface exploration?
- What is the current status of geophysical exploration and monitoring of already existing radioactive waste disposals?
- Which geophysical procedures are best suited for the exploration of locations, what is the need for R&D?
- What is the role and relevance of Geophysics in the framework of a comprehensive geoscientific exploration?

Topics 14: 3D applications in the geosciences

14a) Computational geosciences

Mathias Knaak[1], Gösta Hoffmann[2], Mario Valdivia-Manchego[2]
[1]Geologischer Dienst NRW, Krefeld, Germany; [2]Uni Bonn, Germany

Keynote: *Tobias Kurz* (Uni CIPR Bergen, Norway "State of the art 2D-3D geospatial methods for surface modelling and characterisation in the geosciences"

This session aims to bring together researchers who are engaged with 3D spatial data. This could be surface related modelling as 3D-point clouds generated by both airborn or terrestrial laserscanner, photogrammetric range imaging techniques (structure from motion), optical multi- and hyperspectral as well as thermal sensor imaging techniques, differential GNSS or others. In the same way classical subsurface modelling, integrating tectonic and sedimentological 3D-approaches, as well as long term dynamic processes models and scaling analysis will be of central interest. Contributions covering methodical aspects such as data acquisition, analysis, visualisation, and integration in 3D geological models are welcome. We would like to discuss current workflows, practices and other practical issues. Furthermore, case studies on Earth surface processes and landforms using 3D data are invited.

We particularly encourage early stage researchers to present their studies.

Topic 15: Outreach, education, and the societal relevance of Geosciences

15a) Geoscientific collections in the area of responsibility between science and public relations

Birgit Kreher-Hartmann[1], Dorothée Kleinschrot[2]
[1]*Univerity of Jena, Germany,* [2]*University of Wuerzburg, Germany*

There is no geoscience education without the fundamental subjects like e.g. mineralogy or geology. The curators of geoscientific collections retain and maintain the original material for teaching in showcases, in special educational collections and stored in magazines. Because curators are in close dialogue with other scientists, one of their fundamental tasks is to mediate between science and the public by using their collections as translator and thus conveying current research to a wider audience. In German schools, for example, the geoscientific education became increasingly reduced, but especially pupils should acquire the basic knowledge of Earth Sciences at an early stage and they should understand the relevance of this science to our daily lives. This session should bring together curators and other scientists who deal in any way with public relations and the mediation of geoscientific issues.

Topic 16: Fluid-Rock Interactions

16a) Fluid-rock interaction: from mechanisms to rates – from atoms to plates

Oliver Plümper[1], Raul Fonseca[2], Esther Schwarzenbach[3]
[1]*Utrecht University, The Netherlands,* [2]*University of Cologne,* [3]*Free University Berlin, Germany*

Keynote: *Sarah Incel* (University of Oslo, Norway) "Reaction-induced faulting in granulites causes earthquakes in the lower continental crust"

Reactions between fluids and rocks have a fundamental impact on the geodynamics and geochemistry of Earth at all scales. Fluid-rock interactions strongly affect the petrophysical properties and chemical and isotopic composition of the rocks. Therefore, they play an important role in processes such as plate tectonics, the formation of economic deposits, and global geochemical cycles. The fact that fluid has migrated through rocks is evident from field observations such as veins, metasomatic alteration zones, (de)-hydration reaction fronts occurring on outcrop to regional scales, and porosity observed on the micron down to nanometre scale. Metasomatic alteration zones, but also ore deposits point to the chemical effect of fluid flow that facilitated element mobilisation. Mechanical effects of fluid flow are expressed in phenomena such as zones of localised deformation and hydration.

The underlying mechanisms as well as the rates of the processes are still poorly understood, despite the current field, experimental, and theoretical arguments for the importance of fluid-rock interaction for geodynamic and geochemical processes. This is mainly because rocks provide only a snapshot in time, while processes like deformation, reaction, and fluid flow are complex coupled processes, which provide a challenge for numerical modelling as well as for interpreting and controlling experiments. Numerical modelling, experiments, and comprehensive field and laboratory studies that focus on the mechanisms, the rates, the interplay between fluid flow, reaction, deformation and mass transport processes, or the connection between small to large scales, will help to improve our understanding of fluid-rock interactions.

We invite contributions that shed light on the coupled processes of fluid flow, reaction, deformation and fluid-mediated mass transport at all scales, both from a fundamental and applied point of view. We also welcome geochronology and geospeedometry studies related to fluid flow processes, studies on the use of isotope tracers of fluid-mediated processes, as well as regional and outcrop scale field studies of fluid-rock interaction. Petrology and geochemistry research using state-of-the art analytical equipment with high spatial resolution (e.g. down to the nanometer scale) that focus on the mechanisms documented in rocks that interacted with fluids contributes to the many facets of fluid-rock interaction. Numerical modelling studies that are designed to handle the complexity and coupled nature of fluid-rock interaction are also encouraged. Finally, studies based on laboratory experiments in which mechanisms and rates of fluid-rock interaction can be further constrained will complete the diversity of this session.

16b) Solid-fluid reactions in technical and Earth systems

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A detailed mesoscopic understanding of the various reactions that may occur at the solid-fluid interface is essential for a number of scientific and engineering disciplines focusing on both natural as well as anthropogenic, i.e., technical systems. Solid-fluid reactions control many processes of environmental significance, including weathering of rocks, secondary mineral formation, contaminant behavior in mine tailings, nutrient and element cycling, the security of nuclear waste encapsulated in minerals and glasses, as well as mineral scaling in industrial applications. This session invites contributions that report investigations on mineral-fluid interactions in computational, experimental, and natural systems at various length scales. We welcome studies on mineral dissolution, precipitation, stable isotope fractionation, ion exchange, as well as on coupled processes at solid-fluid interfaces.

16c) Subduction zone input, processes and output

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At convergent plate margins crustal components are recycled through a filter of subduction-related magmatism back into the deep mantle. This session focuses on the quantification of the subduction zone input, the progressive metamorphic processing of slab materials, the characteristics of fluids and melts that are released from materials in the slab, their interaction with the mantle at the slab-mantle interface and in the mantle wedge, and recycling of components into the deep mantle. This type of research provides direct constraints on key aspects of arc magmatism and deep mantle refertilization, in both modern and ancient environments, with relevance extending to the generation of intra-plate magmas. This platform shall foster an integrated discussion on geochemical, geophysical and petrologic aspects of material transport and metamorphic and magmatic processes in subduction zones and their relevance on Earth's mantle dynamics. We solicit contributions from field-based, experimental and numerical geochemistry and petrology, geophysics, and research potentially related to subduction zone input and output.

Topic 17: Open Session

17a) Young Scientist Session

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If you are a young scientist, this session is the possibility to present your project among peers. We consider everybody without PhD or recently finished PhD project a young scientist and especially welcome all those who will present at a conference for the first time. Project work, your thesis or PhD project – it doesn't matter! We welcome all kind of submissions from all fields in the Geosciences. The primary focus of the session is not the scientific outcome but to provide a platform to practice conference presentations and discussions with a diverse audience.