Hilmar von Eynatten, Joachim Reitner, Gerhard Wörner (Eds.)

GV Annual Meeting 2009

Earth Control on Planetary Life and Environment
Göttingen, October 5–7, 2009
Abstracts

Universitätsdrucke Göttingen

Hilmar von Eynatten, Joachim Reitner, Gerhard Wörner (Eds.)

GV Annual Meeting 2009

erschienen in der Reihe der Universitätsdrucke
im Universitätsverlag Göttingen 2009

Hilmar von Eynatten, Joachim Reitner,
Gerhard Wörner (Eds.)

GV Annual Meeting 2009

Earth Control on Planetary Life and Environment

Abstracts

Geowissenschaftliches Zentrum (GZG)
der Universität Göttingen,
October 5-7, 2009

Universitätsverlag Göttingen
2009

Bibliographische Information der Deutschen Nationalbibliothek

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliographie; detaillierte bibliographische Daten sind im Internet über <http://dnb.ddb.de> abrufbar.

Editorial contact
Prof. Dr. H.v. Eynatten, Prof. Dr. J. Reitner, Prof. Dr. G. Wörner
Geoscience Centre of the
University of Göttingen
Goldschmidtstr. 1+3
37077 Göttingen
http://www.gzg.uni-goettingen.de

Abstract Collection and Layout: Stefan Möller-McNett, Conny Kaubisch
Cover Design and Cover Image: Conny Kaubisch, Prof. Dr. Hilmar von Eynatten

http://univerlag.uni-goettingen.de
ISBN: 978-3-941875-09-8

Contents

1. Welcome and Acknowledgements

We cordially welcome you to 99th Annual Meeting of the Geologische Vereinigung at the GZG (Geowissenschaftliches Zentrum) of the Georg-August-Universität Göttingen. The central theme of this year's conference is *Earth Control on Planetary Life and Environment*. We intended to bring together researchers from all fields of Earth Sciences and beyond to shape an attractive interdisciplinary program on the geological history of Planet Earth and its control over and interaction with biological evolution, development of habitats, environmental and climate change as well as history and culture of *Homo sapiens*. We hope that our organisational efforts and your scientific input will make the meeting a great success.

Göttingen is an attractive city full of interesting history, young students, medieval buildings, and international flair. Göttingen hosts one of the traditional German universities where - amongst others - famous earth scientists such as Johann Friedrich Blumenbach, J. F. L. Hausmann, Adolf v. Koenen, Hans Stille, Victor Moritz Goldschmidt, and Carl W. Correns worked. We are sure that you will enjoy your visit.

We are thankful to the Deutsche Forschungsgemeinschaft (DFG), Akademie zu Göttingen, Junge Akademie, Ministerium für Wissenschaft und Kultur, Springer Verlag, E. Schweizerbart'sche Verlagsbuchhandlung, and Pearson Education Deutschland GmbH for financial support.

We wish you all a successful meeting and a memorable time in Göttingen.

Göttingen, October 2009

Hilmar v. Eynatten | Joachim Reitner | Gerhard Wörner



2. Conference Information

Welcome Reception: An Ice-breaker party is scheduled for the evening of October 4, starting at 18:00. Here you can meet old and new friends and also register for the meeting. You will be provided with your conference bag, which includes abstract and program volume, name badge, your lunch- and dinner tickets (if you have opted and paid for this), as well as your receipt for conference fees and general information (e.g. map) on Göttingen.

Transportation within Göttingen: Your name badge will serve as a ticket for local city transportation, which will be free of charge for conference participants. Please make sure you are carrying your badge with you when using the bus between your hotel and the conference site.

For *lunch* we recommend the University Cafeteria (called "Mensa"), which is within ten minutes of walking distance from the conference site; please follow the signs or ask any of the organisers.

The *Public Evening Lecture* (H. Seyfried: "Ein Planet organisert sich selbst") will take place downtown at the Aula of the University of Göttingen, Wilhelmsplatz 1 (Monday, Oct 5, 20:00).

In the frame of this year's GV Annual Meeting we have organized the *1st GAUSS Symposium of the Akademie zu Göttingen*, entitled "Impact of Earth processes on history, civilization, and life". Keynote lectures are scheduled for Tuesday morning (Oct 6), a Round Table discussion for Tuesday afternoon.

The *Conference Dinner* will be held at the historic Klausenhof near the old castle of Hanstein. For those who have registered for the Conference Dinner, there will be a bus waiting for you outside the conference building on Tuesday (Oct 6), which will leave at 19:00. Please be there on time, the bus will not wait.

There will be several oral and a central poster session (see program). For oral sessions, please make sure you submit your Powerpoint presentation to the session chair and/or technician no later than 20 minutes before the start of your session (not 5 minutes before your talk!). Normal talks are allocated 15 minutes including discussion, invited keynotes 30 minutes.

The poster session is scheduled for Tuesday (Oct 6) afternoon. There will be free drinks until 18.30. Authors should be attending their posters from 16:00 to 18:30 (17:00 to 18:30 for GV-members).

3. Abstracts (in first author alphabetical order)

1: TS2 Geology of Extreme Earth Environments, oral

Synchronisation of historical and recent glacier fluctuations in the Inner Himalaya

Achenbach H

Geographical Institute, Department of Geography and High Mountain Geomorphology, 37077 Göttingen, Goldschmidtsr. 5, hachenb1@gwdg.de

Investigations were carried out north of Annapurna and Daulaghiri Himal. Here, the semi-aride climate and the relief situation cause glaciers being very suitable for making a historical glacier chronology. The glaciers visited are of continental type with a very small mass turnover. Hence, they are not sensitive to sudden weather changes (Oerlemanns & Reichert 2000). Due to the moderate relief the glaciers are free of debris or just covered with a thin layer of supraglacial till. Therefore it can be expected that the glacier fluctuations are coupled directly to the long time climate conditions. During two expeditions (07,08) the geomorphology of 27 glacier forefields was mapped. Typically the recent glacier tongues end between 5200 and 5700 m asl. They are surrounded by laterofrontalmoraines up to 120 m high, which evidence a glacier stage (st. 1) 1 to 3 km in front of the current ice margin. As can be seen from photos taken by Kuhle (1982) as well as proved by lateralmoraines a last glacier stage (st. 4) took place in the 1970th. Here the glaciers ended some decameters to a few hundred meters outwards the recent ice fronts. In between of stage 1 and stage 4 two more glacier advances/stagnations could have been reconstructed (st. 2 and 3).The relation to neo glacial stages, fresh glacier striations and lichen findings document that stage 1 is the oldest detectable historical glacier stage in the Inner Himal. Derived from different climate proxies the coldest period within the "Little Ice Age" took place at the end of the 17th and at the beginning of the 18th century. Lower average temperatures also occured around 1820 and from 1900 to 19 (Zech et al. 2003). With the exception of the first half of the 19th century no significant precepetation changes could have been reconstructed for the last 400 years (Kayastha et al. 2008, Thompson et al 2000), so it is highly likely that the evidenced glacier stages are caused by the above mentioned cold periods.

References

Kayastha RB, Harrison SP (2008): Changes of the equilibrium-line altitude since theLittle Ice Age in the Nepalese Himalaya. Annals of Glaciology 48, Vol. 289: 1916 – 1919

Kuhle M (1982): Der Dhaulagiri- und Annapurna-Himalaya. Ein Beitrag zur Geomorphologie extremer Hochgebirge. Zeitschrift für Geomorphologie Suppl. Bd. 41: 1-229, 1-183

Oerlemanns J, Reichert BK (2000): Relating glacier mass balance to meteorological data using a Seasonal Sensitivity Characteristic. Journal of Glaciology 46 (152): 1-6

Thompson G, Yao T, Mosley-Thompson E, Davis ME, Henderson KA (2000): A High-Resolution Millennial Record of the South Asian Monsoon from Himalayan Ice Cores. Science 289: 1916-1919

2: IS4 Magmatism and Earth Evolution, poster

High Magmatic Flux During Alpine-Himalayan Collision in central Iran

Ahmadian J, Haschke M, McDonald I, Ghorbani M, Emami M

Payam-e-Nour University, Dept. of Geology, Isfahan, Iran
Free State University, Dept. of Geology, Bloemfontein, South Africa, haschkem.sci@ufs.ac.za
Cardiff University, School of Earth Sciences, UK
Tarbiat Modares University, Dept. of Geology, Tehran, Iran
Geological Survey of Iran, Tehran, Iran

Subduction-related magmatism in Iran ranges from Cretaceous to Recent, but is dominated by 50-35 Ma old intermediate to silicic calc-alkaline and shoshonitic volcanic and intrusive rocks, implying highest arc and backarc productivity prior to the Alpine-Himalayan collision. The petrologic and geodynamic driving forces for high-productivity magmatism during ocean closure are unclear, but comparison of volcanic accumulation rates in Iran and Cenozoic North American arcs indicate that mid-Tertiary arc and backarc activity in Iran accumulated 3 to 4 times more volcanic strata per unit time implying favorable melting conditions and exceptionally fertile source rocks.

The Eocene ore-hosting Kal-e-Kafi backarc intrusive complex in central Iran was emplaced during this period of high magmatic productivity and provides clues to what caused these conditions. Diagnostic geochemical signatures are high K2O and Sr contents and successively depleted middle REE patterns, reflecting a highly metasomatized source and increasing role for amphibole, and garnet (0-%) in the relatively younger granites. Release of concealed K-Sr rich fluids from oceanic fractures and faults during buckling and bulging of a pre-collisional choking oceanic slab, and melting of phlogopite-bearing lithosphere with subsequent interaction of

the melt with lower crustal garnet-amphibolite of a ~40 km thick crust can explain the Kal-e-Kafi geochemical and isotopic signatures. Gravimetric data indicating ~39 km present-day backarc crustal thickness are consistent with geochemical results, but also imply little if any collisional crustal thickening of the central Iranian plateau. High Eocene arc-backarc melt flux prior to collision in this region reflects vigorous thermal convection, which may in fact be diagnostic of collisional magmatism and explains the presence of postcollisional shoshonitic melts in this and other collisional orogenic settings.

3: IS3 Archives of Environmental Evolution and Climate Change, poster

Fractionation of Se and Te in ferromanganese crusts and its potential application as paleo-redox proxy

Alexander BW, Koschinsky A, Hein J, Schirmer T, Bau M

Earth and Space Sciences, Jacobs University Bremen, D28759 Bremen, Germany
United States Geological Survey, Menlo Park, CA 94025, USA
Dept. of Repository Systems, Technische Universität Clausthal,
D-38678 Clausthal-Zellerfeld, Germany

An analytical method for determination of selenium (Se) and tellurium (Te) in hydrogenetic ferromanganese crusts using inductively coupled mass spectrometry (ICPMS) was developed. Though Se concentrations in ferromanganese crusts are frequently close to ICPMS quantification limits, the addition of methanol (~3%) to sample solutions significantly increases ICPMS Se sensitivity. Se and Te concentrations were determined for profiles through up to 15 cm thick in well-characterized hydrogenetic ferromanganese crusts as old as 60 My, in an attempt identify a potential correlation between redox conditions during formation and Te/Se ratios in the precipitate formed under the respective conditions. Previous work demonstrated that Te enrichment in crusts involves surface oxidation of seawater Te(IV) to Te(VI) on the Mn-Fe oxide phase, while for Se, which can also exist as tetra- and hexavalent redox species in oxic marine systems, surface oxidation during sorption on crusts is not evident. Our hypothesis is that the highest Te concentrations or highest Te/Se ratios, respectively, should reflect pronounced oxidizing conditions during growth.

The concentrations in the crusts are low; the highest values (~1 ppm) are in the surface layers of the crusts and rapidly decrease below the uppermost -15 mm. Te concentrations are as high as ~0 ppm in some crust layers, leading to high Te/Se ratios varying over an order of magnitude throughout the crust profiles.

Comparison of our data with Nd, Hf and Pb isotopic ratios in crust profiles, which are published for two of the samples, allow correlation between changing Te/Se ratios and changing environmental conditions as deduced from the interpretation of the isotopic data. For example, Te/Se ratios in layers of one crust correlate negatively with published Nd isotopic ratios, i.e., high Te/Se corresponds to lower, less radiogenic ϵ_{Nd} values.

4: TS1 Early Planets and Life, oral

Deposition of 2.9 Ga Pongola Supergroup Fe-rich shales and Fe sedimentation processes in Archean seawater

Alexander BW, Bau M

Earth and Space Sciences, Jacobs University Bremen, D28759 Bremen, Germany

The geochemical cycling of Fe in the marine system has had global implications for the evolution of the biosphere, and it may be that evolution in the biosphere itself strongly affected the marine Fe cycle, particularly if early life was involved with the production of the extensive banded iron-formations (IF) of the Archean. Essentially composed only of Fe, Si, and O (>98%), pure IF demonstrate that seawater was periodically capable of transporting and precipitating large amounts of Fe (and Si), though IF have provided little information regarding the source(s) of Fe, or the process(es) that removed Fe from seawater. Alternative geochemical insights into the marine Fe cycle are offered by the Fe-rich clastic sediments frequently associated with IF deposition, and Fe-rich shales, as a result of their more varied mineralogy, likely represent the best archives of the particular environmental conditions responsible for extensive Fe deposition in Archean oceans. Iron-rich shales associated with IFs in the 2.9 Ga Pongola Supergroup of South Africa display an almost total loss of Na, K, Rb, Cs, and Ba, likely due to cation exchange with fluids rich in Fe^{2+}. The loss of alkali metals and Ba during periods of high Fe deposition was not possible if the primary Fe precipitate consisted of Fe(III) mineral phases, and it seems that extensive Fe sedimentation primarily occurred through deposition of Fe(II) mineral phases. This suggests that production of Fe(III) phases in seawater via abiotic photochemical oxidation of Fe^{2+} was not an important mechanism for the deposition of relatively shallow water Fe-sediment on the margins of the Kaapvaal craton ~2.9 Ga, implying that either direct or indirect biologically mediated processes were likely responsible for formation of the original Fe-rich sediment.

5: TS2 Geology of Extreme Earth Environments, oral (Invited Keynote)

Geochemical and Geophysical Thresholds at the Biotic/Abiotic Boundary on Earth

Amundson R

University of California, Division of Ecosystem Sciences,
137 Mulford Hall, Berkeley, CA 94720, USA earthy@nature.berkeley.edu

Nearly all commonly studied Earth surface processes bear the direct or indirect impact of biology (Amundson et al., 2007). Only a few places, due to extreme aridity and/or low temperatures, lie outside (or nearly so) of the planet's biotic limits. In northern Chile, by carefully examining a suite of soil and geomorphic processes along a rainfall gradient from ~2 to 0 mm of annual rainfall, we have observed that many landscape properties, and processes, undergo non-monotonic changes (with respect to declining rainfall) at the biotic/abiotic boundary. Soil N (Ewing et al., 2007) and S (Ewing et al., 2008) cycles undergo changes from steady state, largely organic forms, in biotic landscapes to non-steady state, nearly pure inorganic forms on the abiotic side of the climate window. Hillslope denudation rates decline continuously with declining rainfall: from ~ 30 m My to < 1 m My . However, hillslope soil cover changes non-monotonically: biotic hillslopes are covered with soil derived from bedrock, the biotic/abiotic boundary is largely soil-free, and the hyperarid region is covered by relatively thick soils which are a mix of atmospheric solutes and dust, and underlying salt-weathered rock. Our observations suggest that the nearly abiotic regions of Earth offer unique glimpses into to how Earth features would differ had life not evolved, and have much in common with our nearby planetary neighbor Mars (Amundson et al., 2008).

References

Amundson R, Richter DD, Humphreys GS, Jobbagy EG, Gaillardet J (2007): Coupling between biota and earth materials in the Critical Zone. Elements 3: 327-332

Amundson R, Ewing S, Dietrich W, Sutter B, Owen J (2008): On the in situ aqueous alteration of the soils on Mars. Geochemica et Cosmochimica Acta. Geochimica et Cosmochimica Act 72: 3845-3864

Ewing SA, Michalski G, Thiemens M, Quinn RC, Macalady JL (2007): Rainfall limit of the N cycle on Earth. Global Biogeochemical Cycles GB3009: 00-000

Ewing SA, Wang W, DePaolo DJ, Michalski G, Kendall C (2008): Non-biological fractionation of stable C isotopes in soils of the Atacama Desert, Chile. Geochimica et Cosmochimica Act 72: 1096-1110

6: IS2 Tectonics and Sedimentation, oral

Provenance analysis of suspended load by Raman spectroscopy

Andò S, Garzanti E, France-Lanord C, Galy V, Bersani D, Borromeo L

Università di Milano-Bicocca, Dipartimento di Scienze Geologiche e Geotecnologie, Italy, 20126, Piazzale della Scienza 4, Milano, sergio.ando@unimib.it
Centre de Recherches Pétrographiques et Géochimiques, France, 54501, BP 20, Vandoeuvre-lès-Nancy, cfl@crpg.cnrs-nancy.fr
Woods Hole Oceanographic Institution, USA, 02543, 360 Woods Hole Road, Woods Hole, Massachusetts, vgaly@whoi.edu
Università di Parma, Dipartimento di Fisica, Italy, 430, Viale G.P. Usberti 7a, Parma, danilo.bersani@fis.unipr.it

Silt carried in suspension represents most of the sediment flux in big river systems, and the predominant grain size in large deltas and submarine fans. Most provenance studies, however, are traditionally based on compositional analysis of sand, which is much easier to treat in the laboratory and to analyse with classic petrographic and heavy-mineral methods (Garzanti et al. 2007). In order to determine with full confidence silt-sized grains carried in suspension at various water depths in the Ganga-Brahmaputra fluviodeltaic system (Goodbred and Kuehl 19; Galy and France-Lanord 2001), we combined a variety of techniques. The principal novelty of our approach consits in full integration of sediment-concentration, grain size, mineralogical and chemical databases, and in the definition of quantitative relationships between mineralogical and chemical variables for each sample and each size class of each sample. Intersample mineralogical variability is controlled by preferential segregation of faster-settling coarser and denser grains deeper in the water column relative to slower-settling tiny and platy phyllosilicates (Garzanti et al. 2008). Quartz, feldspar and heavy minerals increase with depth; mica, clay and soil aggregates regularly decrease. The Brahmaputra carries no calcite and a rich amphibole-epidote suite. Ganga suspended load contains more quartz, less plagioclase, calcite, dolomite, and a moderately-rich epidote-amphibole-garnet suite; garnet increases progressively with depth relative to less dense amphibole and epidote. Because XRD data become uncertain with increasing number of detrital phases (Schieber and Zimmerle 18), quantitative mineralogical data accurate enough to allow comparison with chemical data and to test settling-equivalence models could only be obtained by the systematic use of Raman spectroscopy, coupled with heavy-mineral analyses and supplemented by XRD data on classes finer than medium silt.

References

Galy A, France-Lanord C (2001): Higher Erosion rates in the Himalaya: geochemical constraints on riverine fluxes. Geology 29: 23-26

Garzanti E, Andò S, Vezzoli G (2008): Size-density sorting of detrital minerals and grain-size dependence of sediment composition. Earth and Planetary Sc. Letter 273: 138-151

Garzanti E, Vezzoli G, Andò S, Lavè J, Attal M (2007): Quantifying Sand Provenance and Erosion (Marsyandi River, Nepal Himalaya). Earth and Planetary Sc. Letter 258: 500-515

Goodbred SL, Kuehl SA (1999): Holocene and modern sediment budgets for the Ganga-Brahmaputra river system: Evidence for highstand dispersal to flood-plain, shelf, and deep-sea depocenters. Geology 27: 559-562

Schieber J, Zimmerle W (1998): Petrography of shales : A survey of techniques. Shales and mudstones 2: 3-12

7: IS3 Archives of Environmental Evolution and Climate Change, oral

Abrupt intermediate water mass reconfiguration in the Florida Straits during MIS 5 recorded with combined foraminiferal Mg/Ca and $\delta^{18}O$ measurements

Bahr A, Nürnberg D, Schönfeld J, Garbe-Schönberg D

IFM-GEOMAR, FB 1, Paleoceanography, Wischhofstr. 1-3, 24148 Kiel, Germany
Christian-Albrecht-Universität zu Kiel, Institut für Geowissenschaften, Ludewig-Meyn-Str. , D-24118 Kiel, Germany

Although interglacials are considered as climatically relatively stable, records from the north Atlantic (e.g. BAUCH&KANDIANO, 2007), Greenland ice cores and W European terrestrial climate archives (e.g. RIOUAL et al., 2001) reveal distinct cooling episodes during the penultimate interglacial, Marine Isotope Stage (MIS) 5. However, it remains unclear whether these events are related to large scale oceanic circulation changes.

Due to its spatial constriction the Florida Straits (FS) represent an ideal location for studies of past Atlantic Meridional Overturning (AMO) strength since variations in the throughflow result in noticeable shifts in the water column structure (e.g. LYNCH-STIEGLITZ et al., 19). To trace gradients between upper and intermediate water masses we combine Mg/Ca-derived temperature estimates with $\delta^{18}O$ analyses to infer past $\delta^{18}O_{seawater}$ changes as an approximation of salinity using the surface-dwelling foraminifera G. ruber (white) and sub-thermocline dwelling G. crassaformis from a core located in the central FS covering MIS 5 in high resolution. Sea surface and intermediate water temperatures vary largely synchronously with north Atlantic climate, indicating a tight link between high and low latitudes. In contrast, ice-volume free $\delta^{18}O_{seawater}$ of the surface waters remains stable throughout MIS 5 while intermediate water masses show an abrupt $\delta^{18}O_{seawater}$ increase around 90 ka, parallel to the first occurrence of significant amounts of IRD in the North Atlantic. The increase of salinities combined with a reduction of density gradients in the intermediate and deep FS inferred from planktic and benthic foraminiferal $\delta^{18}O$ data indicate a reduction of intermediate and deep northward throughflow causing the westward penetration of high-saline Western North Atlantic Central Water into the

FS. These findings demonstrate the sensitivity of the AMO towards even small-scale freshwater perturbations in the North Atlantic.

References

Bauch H, Kandiano E (2007): Evidence for early warming and cooling in the North Atlantic surface waters during the last interglacial. Paleoceanography 22: PA1201

Lynch-Stieglitz J, Curry WB, Slowey N (1999): Weaker Gulf Stream in the Florida Straits during the Last Glacial Maximum. Nature 402: 644-648

Rioual P, Rietti-Shati M, Andrieu-Ponel V, Battarbee RW, Et al. (2001): High-resolution record of climate stability in France during the last interglacial period. Nature 413: 293-296

8: OS Open Session, poster

The Pleistocene Reef Terraces of the Red Sea Coast, Sudan First Results

Basher H, Bussert R, Dominik W

Institute of Applied Geosciences, TU Berlin, Ackerstrasse 76, Germany; alhajhamed@yahoo.com

The major object of the study is to construct a sedimentation model for the emerged Pleistocene reef terraces in the Sudanese coastal plain. Based on the study of carbonate facies and diagenetic history as well as on age dating, their relationship with eustatic sea -level fluctuations will be investigated.

During field work based on existing topographic and geological maps, on remote sensing images and on GPS navigation in March 2008, the general seddimentological setting of the terraces was studied and samples were collected. Fifteen sections along the coast which follow the lateral facies variations were recorded, the southeastern-most section being about 0 kilometers distant from section 15 in the Northwest. The samples were collected according to facies changes and to variations in the diversity of skeleta grains. The detailed thin sections study is targeted to compare the facies distribution as a base to construct the sedimentation model of the coral reef terraces.

The observations show that the reef terraces contain more than fifteen genera of Scleractinian corals. While Porites and Acropora represent about fifty percent of all corals the genus Favites, Galaxea, Diploria, Fungia, Montastrea, Favia and Caulastrea often occur in considerable quantities. Other corals like Cycloseris, Pavona and Solenastrea are also present but generally rare. While corals are the major reef builders, corallinaceonan red algae represent the main reef binders. Major associated fauna are bivalves, gastropods and echinoderms. Thin section studies indicate additionally the presence of green alge, bryozoans, sponges, foraminifera and occasionally hardgrounds.

9: TS1 Early Planets and Life, oral

High Field Strength Elements in the Neoarchean Ocean: Information on their Scavenging Behaviour and Redox-Sensitivity from the Temagami Iron-Formation, Canada

Bau M, Alexander BW

Earth & Space Sciences Program, Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany, m.bau@jacobs-university.de, b.alexander@jacobs-university.de

Banded Iron-Formations (BIFs) have been the subject of geochemical research for more than a century, but while REY distributions and Nd isotopes have significantly increased our knowledge of the early atmosphere-hydrosphere system, other high field strength elements have only been used to screen BIF samples for detrital aluminosilicates that might obliterate the seawater signal. We here report on the distribution of Y, Zr, Hf, Ta, Th, U, and REE in adjacent magnetite and chert bands from the Neoarchean Temagami BIF, Canada, a sequence of chemical sediments associated with turbiditic shales that has been claimed to show negative Ce anomalies, which was used to bolster arguments for an oxic Neoarchean Earth surface system. All magnetite and chert bands show shale-normalized REY patterns with low Nd/Yb ratios and positive Eu, Gd and Y anomalies, demonstrating that they formed as marine sediments. However, in marked contrast to previous claims, none of the samples display any Ce anomaly, indicating the absence of oxidative Ce- REY decoupling. This strongly argues against oxic conditions in the Neoarchean "Temagami seabasin". The distribution of Zr, Hf and Ta suggests that a significant fraction of these elements is non-detrital but sourced from seawater. Zr/Hf and Hf/Ta in the BIF differ from those of local shale and upper continental crust (UCC), and are lower and higher, respectively, than those of modern seawater, pointing towards preferential scavenging of Hf over Zr and Ta, as is typical of the modern ocean. In contrast to local shale and UCC, the Temagami BIF shows low Th/U ratios. Decoupling of U and Th results from U(IV) oxidation and is at odds with the lack of Ce anomalies, suggesting a different redox-sensitivity of the two paleo-redox-proxies. Our results demonstrate that the Temagami BIF warrants further study of other paleo-redox-proxies and suggest that the Temagami BIF might provide information on the Hf isotopic composition of Neoarchean seawater.

10: TS1 Early Planets and Life, oral

The Late Veneer as a Source of Earth's Volatiles: Constraints From Highly Siderophile Elements

Becker H, Fischer-Gödde M

Freie Universität Berlin, Institut für Geologische Wissenschaften, Malteserstrasse 74-0, 12249 Berlin, Germany

The excess abundance of the highly siderophile elements (HSE, the PGE, Re and Au) in the Earth's mantle cannot be explained well by current models of heterogeous accretion and concurrent core formation. Thus, it is commonly argued that the HSE in the silicate Earth were added after core formation and the moon-forming giant impact in a late veneer of chondritic material. Because HSE abundances and $^{187}Os/^{188}Os$ distinguish carbonaceous from other chondrites, these elements might help to assess contributions to Earth's volatile budget from late accretion. In contrast to Earth, the lunar surface has preserved a record of the early bombardment in > 3.8 Ga old lunar impact melt breccias associated with lunar basins and in some ancient highland rocks. Ancient meteorite components in these rocks show a spectrum of HSE compositions, some similar to ordinary or enstatite chondrites (the Serenitatis impactor?), others extending to suprachondritc ratios for some elements that could be associated with the Imbrium event. In ancient lunar rocks, CI chondrite-like Au/Ir are often found in the meteoritic component in granulitic breccias, possibly reflecting pre-Nectarian impact events. $^{187}Os/^{188}Os$ data of fertile peridotites, chromitites and MORB suggest values for the Earth's primitive mantle similar to or higher than enstatite and ordinary chondrites, while ratios such as Ru/Ir and Pd/Ir hint at a slightly supra-chondritic mantle composition, similar to values found in Apollo 14, 16 and 17 impact melt rocks. Endmember compositions derived from recent data on chondrites, lunar samples and terrestrial peridotites suggest that less than 40-50 % of the late veneer arriving on the early Earth may have had a CI chondrite like composition. Assuming on average 19 % water in CI chondrites, these values would limit the maximum permissible water and carbon contents of the bulk silicate Earth to about 450 and 0 ppm, respectively.

11: IS3 Archives of Environmental Evolution and Climate Change, poster

Reconstruction of paleoenvironmental variations during the Cenomanian-Turonian greenhouse – results from the western mid-Atlantic at ODP Sites 1258 and 1260

Beckmann B, Birgel D, Erbacher J, Lückge A, Scheeder G

Bundesanstalt für Geowissenschaften und Rohstoffe,
Stilleweg 2, D-30655 Hannover , Britta.Beckmann@bgr.de,
MARUM Zentrum für Marine Umweltwissenschaften, AG Geobiologie,
Postfach 330440, D-28334 Bremen
Bundesanstalt für Geowissenschaften und Rohstoffe, Stilleweg 2, D-30655 Hannover

During the mid-Cretaceous, high atmospheric CO_2 levels, much higher global temperature and lower latitudinal gradients than today contributed to the widespread and massive deposition of organic carbon in the course of several oceanic anoxic events (OAEs). Investigation of these events representing major perturbations of the ocean system and the global carbon cycle, help to understand environmental evolution and climate change during greenhouse conditions.
Our study aims at deciphering paleoceanographic changes and terrestrial environmental dynamics in the Cenomanian - Turonian tropical Atlantic on sediments from two ODP sites (1258 & 1260). Up to now, few information is available on environmental dynamics and atmosphere/biosphere interactions in terrestrial settings. We investigate organic-rich black shales, with a focus on the OAE2 and the Mid Cenomanian Event, where we anticipate the identification of pCO_2 variations and trace possible humid and arid phases in the hinterland. To address changes in the mid-Atlantic realm, we combine XRF-Core scanning and microscopic investigation. Additionally, we utilize biomarker analysis and subsequently determination of the isotopic composition of selected organic compounds to shed light on changes in the carbon and hydrological cycle oceanographic events across the mid-Cretaceous.
First biomarker data allow the identification of samples showing an almost exclusive marine distribution pattern of molecular markers as well as samples with a considerate input of terrestrial matter into the sediment. The latter are well suited for our anticipated molecular-isotopic approach to investigate carbon and hydrogen isotope signatures of plant wax lipids and fatty acids to address changes in runoff variations and the hydrological cycle. This information allows a comprehensive view of climatic change, providing insight into the direct coupling between ocean, atmosphere, and terrestrial biosphere in the mid-Cretaceous super-greenhouse.

12: OS Open Session, poster

Detection of Gas permeable Strike-Slip Faults by means of Bio-indictors (Hill-building Forest Ants) and Gas Analyses in the Volcanic West- and Hocheifel (Germany)

Berberich G, Schreiber U

University Duisburg-Essen, Faculty of Biology and Geography, Institute of Geography, Dept. of Geology, Germany,45141 Essen,, Universitätsstr. 5, gabriele.berberich@uni-due.de

Nests of hill-building forest ants (*Formica rufa, Formica polyctena, Formica pratensis*) are a suitable tool for the detection of neogen tectonic structures in areas with less geological outcrops, e.g. the Volcanic West- and Hocheifel (Germany). Their linear allocation trace obviously active fracture zones. Correlations between formicines and geological factors were already discussed in the 1930's and 1960's. Schreiber et. al. (2009) showed that formicines nests can provide valuable information for mapping fault pattern [1].

Area-wide studies in the Volcanic West- and Hocheifel covering approx. 1,200 km² have the objective to establish this mapping approach as a geological tool. More than 2,200 ant nests were recorded by GPS and mapped on fault zones in 2008/2009. In-line allocations allow to trace strike-slip faults over km-distances. Cluster of more than 0 ant nests picture the main stress directions.

Three main structure systems (NNE-SSW, NW-SE and WNW-ESE) indicated by recent NW-SE stress field, are the dominant fracture zones in the Western-Eifel. Secondarily N-S fracture zones appear, corresponding to the "Eifel Nord-Süd-Zone". Only a few faults are accompanied by idiomorphic postvariscian quartz and ore mineralization. Slickensides can be measured sporadically.

Additional to mapping area-wide gas analyses (CO_2, He and Rn) of mineral springs and soil gas (1m depth) were performed. CO_2 was detected by a mobile Dräger gas detection system. Concentrations vary from 62 to 84 Vol%. Radon gives not a consistent picture (1 – 145 Bq/l). Helium-samples were analysed by a portable mass spectrometer. Helium concentrations exceed the atmospheric concentration (5,220 $ppb_{(v)}$) up to more than 2,000-fold and vary from 6,000 $ppb_{(v)}$to ,000,000 $ppb_{(v)}$(e.g. mineral spring Strotzbüscher Mühle) above deep reaching fracture zones.

References

Schreiber U, Brennholt N, Simon J (2009): Gas permeable deep reaching fracture zones encourage site selection of ants. ecological indicators 9: 508 to 517

13: OS Open Session, poster

Wind pressures on objects with wind velocities from 5 to more than 250 kilometers per hour

Biermanns L

Univ. Tübingen, Inst.für Geowissenscaften, Sigwartstraße, 72076 Tübingen

Reasons for winds are instabilities in the troposphere, caused by differences in temperature and relative humidity, with formation of high-pressure and low pressure areas as well as of weather fronts.

The general value for the density of the air is 1.2287 kg/m^3, based on a temperature of ca. 17 °C and an atmospheric pressure of 13.25 hPa. Together with the wind velocity, they form the basic data for the calculation of the wind pressure.The wind always has a pressure on objects, in dependence on its speed. The presented formulas for the calculation of the wind pressure, the Bernoulli equation [3; 1], should be modified like this:

p_t [hPa] = ½ · v^2 · ρ · 0.01; or p_t [kg/m^2] = ½ · v^2 · ρ · p_w,where

p_t= wind pressure; v = wind velocity [m/s]; ρ = density of the air [kg/m^3]; p_w = wind-pressure constant [0.1 s^2/m].

The link ½ · v^2 is considered kinetic energy for the movement of the air [4]. Wind velocity and density of the air are enough for the calculation of the wind pressure. When ρ differs by more than ± 5 % from the value of 1.2287 kg/m^3, then it should be changed acordingly.

In the literature, p_t is both given in hPa and kg/m^2 [1; 3; 2]. The constant 0.01 is a comversion factor, necesssary to receive hPa as a unit on the left side of the equation in the fairst formula. In the second one, p_w is used to obtain the value in kg/m^2.

In practical use, 1 hPa is defined as a weight of kg/m^2 [1; 2; 4]. The wind pressure increasesby four times as muchwith doubling the wind velocity. In this way,with a velocity of 25 km/h, thereis awind pressure of ca. 3 kg on an object of 1 m^2 [2; 3;5]; 256 km/h makes ca. 311 kg/m^2. A wind velocity of 5 km/h, however,onlymakes a pressure of 0.138 hPa or 1.38 kg/m^2, just enough for the transport of dust.

References

Henson R (2007): The rough guide to weather. Rough Guides 1: 1 – 422

14: OS Open Session, poster

Calcium and strontium isotopes in low temperature alteration carbonates of the ocean crust

Böhm F, Eisenhauer A, Rausch S, Bach W, Klügel A

IFM-GEOMAR, Kiel, Germany, fboehm@ifm-geomar.de
IFM-GEOMAR, Kiel Germany
University Bremen, Geoscience Department, Bremen, Germany

During low temperature alteration (LTA) $CaCO_3$ precipitates in veins and vesicles of the ocean crust [1]. We analyzed Sr/Ca, Mg/Ca, $\delta^{18}O$, $\delta^{13}C$, $^{87}Sr/^{86}Sr$, and $\delta^{44/40}Ca$ of $CaCO_3$ from basement samples of DSDP and ODP drill cores from the Atlantic and Pacific Oceans. The $^{87}Sr/^{86}Sr$ ratios point to seawater as the major source for Sr in most Cenozoic samples. This interpretation is corroborated by low $\delta^{18}O$ temperatures (0-5°C), close to bottom water values, and by normal marine $\delta^{13}C$ values. In contrast, samples of Cretaceous and Jurassic age show up to 65% of basement derived calcium and $\delta^{18}O$ temperatures between 15 and 50°C.

Calcium isotope values ($\delta^{44/40}Ca$) range from -0.7 ‰ to 1.8 ‰ (SRM 915a). In accord with previous studies [2,3] $\delta^{44/40}Ca$ differs between aragonite (-0.2 to +0.3 ‰) and calcite (0.9 to 1.8 ‰). A negative correlation of $\delta^{44/40}Ca$ and Sr/Ca ratios is explained by precipitation rates varying between $<^{-2}$ to ^{2} $\mu mol/m^2/h$ [4]. The calcites with the highest $\delta^{44/40}Ca$ and lowest Sr/Ca values probably formed close to isotopic equilibrium [5]. The $\delta^{44/40}Ca$ of LTA calcites (1.6 ‰ for Cenozoic sites) is very high compared to biogenic carbonates (0.6 ‰ for modern biogenic carbonates [5]). Thus LTA carbonates represent a sink for heavy Ca isotopes, both with respect to the land-ocean calcium cycle and to the crust-mantle Ca exchange.

References
Alt JC, Teagle DAH (1999): . Geochim. Cosmochim. Acta 63: 1527-1535
Amini M, Et al. (2008): . Geochim. Cosmochim. Acta 72: 4107-4122
Gussone N, Et al. (2005): . Geochim. Cosmochim. Acta 69: 4485-4494
Tang J, Et al. (2008): . Geochim. Cosmochim. Acta 72: 3733-3745
Fantle MS, DePaolo DJ (2007): . Geochim. Cosmochim. Acta 71: 2524-2546

15: OS Open Session, poster

Sedimentology, taphonomic and palaeoecologic aspects of *Ernietta*-bearing Ediacaran deposits (Kanies Member, Nama Group) in Southern Namibia

Bouougri EH, Porada H, Reitner J, Klaus W

Department of Geology, Faculty of Sciences Semlalia, Cadi-Ayyad University, 40020-Marrakech, Morocco
Geowissenschaftliches Zentrum Göttingen, Universität Göttingen, Goldschmidtstrasse 3, D-37077, Göttingen, Germany

The Kanies Member in southern Namibia contains the oldest known Ediacaran biota of the Nama Group represented by *Ernietta* communities. Combined sedimentological study and taphonomic signatures allow constraining the palaeoecological setting of these vendobionts. The Kanies Member records the incipient transgression in the Witputs sub-basin and is divided by a marine flooding surface into a fluvial lower and a marine upper part. It starts with a braided fluvial facies association that is overlain by foreshore to shoreface transgressive deposits which encompass clast concentrations marking a marine flooding surface. The upper part of the Member consists of wave and storm-dominated shoreface deposits that grade laterally westward into muddy inner shelf deposits with thin distal tempestites. Occurrences of *Ernietta* communities are restricted to the shoreface and inner shelf deposits. Aspects of preservation lead to distinguish two main types: i) life position in typical fine-grained sandstone beds encased within shoreface storm deposits; ii) biota reworked by currents during storm events. The latter type comprises three sub-types: a) quasi *in situ* lags interbedded within "*Ernietta* beds"; b) transported fauna that forms part of lag concentrations within shoreface sandstone beds; c) fauna transported to the inner shelf forming allochtonous assemblages. Sedimentary features of *Ernietta*-bearing deposits combined with preservation and taphonomic aspects suggest that various environmental factors controlled the growth of *Ernietta* communities in a non-deltaic storm and wave-dominated shoreface. The palaeoecological model emphasizes a community that colonized a stressed shoreface setting during inter-storm periods and developed as "*Ernietta*-rich beds". These beds with preserved autochthonous *Ernietta* communities characterised by infaunal life habit might constitute the earliest record in siliciclastic settings of "fossil-rich beds" accretion.

16: IS2 Tectonics and Sedimentation, poster

Synsedimentary magmatism in late Pan-African intermontane basins (NE Egypt): Free-rider or driving force for basin dynamics?

Bühler B, Engel J, Steffen M , Breitkreuz C, Eliwa H. A., Gameel K. El

TU Bergakademie Freiberg, Institut für Geologie und Paläontologie,
Germany, 09596 Freiberg, Bernhard-von-Cotta-Strasse 2, buehler@geo.tu-freiberg.de
Minufiya University, Department of Geology, Egypt, Shibin El Kom

Investigations in the Gebel al Kharazah area of the northern Eastern Desert Basement Complex (Egypt) revealed the existence of at least five volcano-sedimentary successions of Neoproterozoic age. Recent SHRIMP U-Pb dating on zircons indicates that, in contrast to previous studies, non-metamorphic volcano-sedimentary successions in the northern part of the Pan-African Orogen are not restricted to the Early Ediacaran, but also formed during Crygenian times. At least three non-metamorphic successions in the study area show intercalations between clastic sediments and volcanic deposits and thus allow new insights into the interplay between magmatism and tectonic events.

Current investigations focus on a c. 475m thick succession continuously exposed over c. 14km^2 south of Gebel al Kharazah. The sequence rests unconformably on basic subvolcanics and Pan-African granitoids and includes three welded porphyritic ignimbrite units, varying in thickness from 60 to 125m. Andesitic lava covers the whole succession. Lenses of Hammamat-type boulder conglomerates and sand-/siltstones are present in the lowermost ignimbrite unit. Two sedimentary units, up to 65m thick, separate the three ignimbrites units. Both sedimentary units show a general coarsening- and shallowing-upwards trend, evolving from a deep lacustrine depositional setting into a delta-influenced to alluvial facies. The top of both sedimentary units is removed by erosion; the unconformities are readily identifiable by incised valleys filled with subsequent ignimbrite deposits.

Apparently accommodation space for the post-ignimbritic lake in this basin system has been created during the eruption phases, since prior to the ignimbrite-forming event the basin fill was under erosion. Possibly, the studied succession resembles a nested system of non-resurgent calderas. With preservation as to further investigations, this model would represent a so far unrecognized type of Neoproterozoic intermontane basins in the Nubian Shield.

17: IS2 Tectonics and Sedimentation, oral

Compositional signatures of Eocene - Oligocene sandstones derived from circum Rhodopian orogen and magmatic belts in Ne Thrace basin: implications for nature and collapsing of Rhodopian orogen and onset of magmatism

Caracciolo L, Critelli S, Manetti P, Tolosana-Delgado R, Von Eynatten H

Università della Calabria, Dipartimento di Scienze della Terra, Italy. 87036, via P.Bucci cubo 15b. luca.caracciolo@unical.it

The Rhodopian Orogen developed since Late Cretaceous-Lower Eocene during accretionary processes following the closure of the Vardar ocean basin , a branch of Neothetys. We concentrate on Paleogene clastic sediments of the Rhodope area, developed synchronous to the post – Cretaceous collisional collapse and the subsequent Tertiary extensional phase. Throughout a multidisciplinary approach, including sedimentary petrology, sandstone geochemistry and compositional data analysis we argue to reconstruct the unroofing history of the Rhodopian orogen and the abrupt onset of the volcanic activity between Late Eocene and Oligocene across the eastern and southern Rhodopian region. Sandstone detrital modes include three distinctive petrofacies, a quartzolithic, quartzofeldspathic and volcaniclastic. The major contributions are from the metamorphic basement units, represented mostly by low-medium grade lithic fragments for the quartzolithic petrofacies and high grade metamorphic rock fragments for the quartzofeldspathic petrofacies. Volcaniclastic sandstones recorded different composition betweeen Eastern (andesite – microlithic lithic fragment textures) and Southern Rhodopes (mainly rhyolitic – acid glass, spherulites, felsitic lithic fragment textures) samples. Compositional signatures testify contributions from two key source areas corresponding with the two main crystalline tectonic units, the Variegated Complex (ultramafic complex), in the initial stage of accretion, and the Gneiss-Migmatite Complex. Petrostratigraphic (detrital modes) evolution and geochemical signatures of the Eocene-to-Oligocene sandstone suites of the western portions of the Thrace basin in Greece and Bulgaria is closely related to various geodynamic stages of the Rhodopian region, from collisional to post-collisional orogenic collapse and the superimposed volcanism related to Tertiary syn- and post-orogenic extension.

18: TS1 Early Planets and Life, oral

$d^{15}N$ chemostratigraphy of Ediacaran-Cambrian sections of South China.

Cremonese L, Struck U, Shields G, Guo Q, Ling H, Och L

Museum für Naturkunde, Invalidenstrasse 43, 115, Berlin, Germany,l.cremonese@ucl.ac.uk
Graham Shields-Zhou, Department of Earth Sciences, University College London, Gower Street London WC1E 6BT UK
Geologisch-Paläontologisches Institut, Westfälische Wilhelms-Universität Münster, Corrensstrasse 24, 48149 Münster, GermanyState Key Laboratory for Mineral Deposit Research,Department of Earth Sciences, University, Nanjing 2093, China
Department of Earth Sciences, Univ. College London, Gower Street London WC1E 6BT UK

Marine productivity and biogeochemical processes occurring in seawater may be inferred from the isotopic compositions of coeval sedimentary rocks. Isotopic trends of $^{87}Sr/^{86}Sr$ and $d^{13}C$ have been widely utilized in literature for stratigraphic correlation. The use of $d^{15}N$ data for such purposes has been debated for a long time in the literature, resulting in its still ambiguous utility as a geochemical tracer and stratigraphic tool. Here, we compare nitrogen isotope trends for five sections in South China that straddle the Ed-Cm boundary. Nitrogen isotope values for bulk samples range from +8‰ to –3‰ while nitrogen content registers values up to +0.4%, showing highly systematic variability during the period of interest and testifying tochanges in the biogeochemical cycle of the ancient ocean. Negative values might reasonably be ascribed to the action of purple bacteria in the euphotic zone, while slightly positive values (0- +3‰) and up to 8‰ testify, respectively, episodes of strong N-fixation and denitrification in the water column. Many sections show the same general trend, with positive values in upper Ediacaran strata and a strong negative shift in Cambrian strata (more pronounced in black-shales). If these isotopic trends are confirmed, at least two conclusions may be drawn. On the one hand, this evidence is a clear demonstration of nitrogen isotopic signal conservation directly related to biogeochemical processes occurring in seawater, thus excluding diagenetic alteration or isotopic contamination during the time elapsed since marine sedimentation. On the other hand, the use of $d^{15}N$ profiles could then be considered a genuinely useful chemostratigraphic correlation tool, especially where biostratigraphy is of limited usefulness. In the light of what we said, we strongly believe that these new data from South China will provide an interesting new geochemical tool for the understanding of the Ed-Cm boundary, a period regarded to be crucial for the bioradiation in the Earth´s history.

19: IS2 Tectonics and Sedimentation, oral (Invited Keynote)

Interpreting Provenance relations from sandstone detrital modes within the Circum-Mediterranean Region

Critelli S

Dipartimento di Scienze della Terra, Università della Calabria, 87036 Arcavacata di Rende (CS), Italy

The composition and stratigraphic relations of clastic strata in diverse sedimentary basins of the circum-Mediterranean region reflect a complete record of provenance relations since break-up of Pangea, neo-Tethyan thaphrogenesis, and subsequent plate convergence between the two major plates of Europe and Africa, and other related microplates of Iberia, Adria, Mesomediterranean, and toward to the eastern Mediterranean, the Anatolian microplate.

Since plate reorganization after breakup of Pangea, at the end of Paleozoic-earliest Mesozoic, clastic wedges filled sedimentary basins within geodynamic settings evolving from intracontinental rifts, rifted-continental margins, protoceanic basins, arc-trench basin-systems, remnant ocean basins, foreland basin systems and intramontane basins within the all circum-Mediterranean region.

The changing nature of clastic particles in these clastic wedges reflect the provenance relations from differentiate source rocks within the spatial and temporal evolving geo-puzzle terranes, including complex relations between ophiolitiferous, uplifted continental crust (both shallow to deep crust terranes), volcanic and sedimentary (particularly carbonate terranes) source rocks.

Mixed siliciclastic and carbonate shallow- to deep-marine clastic wedges are diffuse in many filled basin systems along the Mediterranean, as such as occurrence of volcaniclastic layers interbedded with clastic wedges.

The variable mosaic of source terranes within the Mediterranean region, offered the possibility to investigate provenance relations with a new plane of precision and sophistication, discriminating grain particles in clastic wedges using spatial (extrabasinal versus intrabasinal) and temporal (coeval versus noncoeval) distinction of clastic detritus. The spatial/temporal approach in deciphering particles in clastic rocks has been widely used to detail the basinal dispersal pathways in different geotectonic settings, wherever mixed silicate and carbonate terranes act as the major source rocks, from rifted-continental margins to collisional orogens.

20: IS1 New Analytical Techniques, oral

Surface roughness-dependent adsorption of colloids – an interferometric study

Darbha GK, Schäfer T, Lüttge A, Fischer C

Georg-August-Universität, Goldschmidtstr. 3, D-37077 Göttingen, Germany
Institut für Nukleare Entsorgung, Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany
Rice University, 60 Main Street, Houston, TX 77005, USA

Adhesion of colloidal particles to mineral and rock surfaces is an important process in the environment that is crucial to manage effects of contaminant transport, drinking-water quality, nuclear waste management, biofouling of transplants, etc. Here we present results about adsorption of colloids on calcite as a function of submicron surface roughness, based on surface data over a large field of view of several mm2. We reacted a freshly cleaved calcite crystal to produce a well-defined surface topography. Etch pits were formed which have heights of a few nanometers. This surface was exposed at the point of zero charge of calcite to a colloidal suspension. As an analog to natural particles we used a bimodal particle size distribution of polystyrene latex (average diameter 4 and 903 nm). Vertical scanning interferometry[1] (VSI) was applied to characterize the surface topography and to quantify the retention of latex colloids.

For both particle types, first experiments showed a positive correlation between the number of adsorbed particles and the amount of surface roughness. Etch pits are the preferred sites for colloidal adsorption than the steps (s) where the particle are trapped into, due to the lower interaction energy barrier between substrate and particle. Moreover, an increasing pit density (D) and depth (d) has a profound influence towards colloidal retention. The data shows that, surface-sections dominated by D~0.0084 μm-2 and d~30 nm directed the maximum colloidal deposition. Interestingly, it was found that the particles are adsorbed preferably at the rhombic edges compared to the deepest part of the pit because of the high surface coverage to the particle in the pit, where the particle experiences an enhanced magnitude of interac - tion energy with interacting substrate. In contrast to the previous theoretical predictions[2], smaller particles were predominantly adsorbed than the bigger particles.

References

Luttge A, Bolton EW, Lasaga AC (1999): 1. An interferometric study of the dissolution kinetics of anorthite: The role of reactive surface area. Am J Sci 299: 652-678

Hoek EMV, Agarwal GK (2006): 2. Extended DLVO interactions between spherical particles and rough surfaces. J Colloid and Interface Sci 298: 50-58

21: IS2 Tectonics and Sedimentation, poster

Geochemical and thermochronological signals in Cenozoic Moquegua sedimentary basin from the Western Central Andes (15-19°S): proxies for sediment provenance and Andean uplift

Decou A, von Eynatten H, Dunkl I, Mamani M, Wörner G

Abt. Sedimentologie, GZG Universität Göttingen,
Goldschmidtstr. 3, 37077 Göttingen, Germany
INGEMMET, Av. Canada 1470 San Borja, Lima 41, Perú
Abt. Geochemie, GZG Universität Göttingen, Goldschmidtstr. 1, 37077 Göttingen, Germany

Uplift and denudation of the Western Central Andes have been controlled through time by the interplay between climatic and tectonic forces. Initial uplift of the western Andes was dated at 30-25 My. Siliciclastic sediments at the Western slope of the Central Andes started at 55 Ma. This Moquegua Group (MG) comprises four formations: Moquegua A (55-45 Ma), Moquegua B (45-30 Ma), Moquegua C (30-15 Ma) and Moquegua D (15-0 Ma). Four subbasins have been studied here, from north to south, the Caraveli-section, the Cuno Cuno- , the Majes- , and the Moquegua-section. Facies and compositional changes of MG sediments range from e.g. fluvial and alluvial fan deposits, with sheet flows, debris flows and, locally, evaporites. A rare marine ingression occurs in the Cuno Cuno section. Sediment ages are constrained by published geochronological work on intercalated tephra.

We present a provenance and thermochronological study to constrain the climatic and tectonic controls on sediment dispersal and accumulation. Sandstones from all Moquegua Fms in the different sections have been sampled. To constrain the potential source rocks we also analysed the Proterozoic-Paleozoic basement, Jurassic-Cretaceous sediments and different Jurassic to Recent volcanic arcs systems. Heavy mineral fractions have been separated for each potential source rock and sediment samples. Single grain amphiboles and oxides were geochemically analysed using the electron microprobe. Trace elements from single grain amphiboles have been obtained using LA-ICPMS. This data allow us to distinguish the different potential source rocks from each other and to define the sediment provenance for each member of the MG, in each of the sections from N to S. Moreover, preliminary thermochronological data (zircon fission track dating) complete the provenance picture in order to better constrain the major uplift event of the Central Andes.

22: IS4 Magmatism and Earth Evolution, poster

Tracing magma differentiation during ascent through thick Andean crust

Banaszak M, Botcharnikov R, Brändlein D, Brass H, Diaz D, Holtz F, Torresi G, Wörner G

Universität Göttingen, Geowissenschaftliches Zentrum Göttingen, Abt. Geochemie, Goldschmidtstr. 1, 37077 Göttingen,
Institut für Mineralogie Universität Hannover, Callinstr. 3, 30167 Hannover
Freie Universität Berlin, Fachrichtung Geophysik, Malteserstr. 74-0, 12249 Berlin

Continental arc magmas derived from the mantle wedge above the subducted oceanic plate must rise through a thick crust that is 70 km thick below volcanoes of the Central Andean Volcanic Zone. Thus Central Andean calc-alkaline magmas are generally evolved (> 52% SiO_2) and strongly affected by assimilation. Stagnation and cooling during ascent control the crystallization pressure and water solubility in the melt, and thereby the residual melt composition. We employ geophysical, experimental and geochemical methods to trace magma ascent and differentiation paths for three end-member type volcanic systems in the Central Andean Volcanic Zone at Parinacota volcano, Taapaca and Lascar. By integration of multidisciplinary methods we intend to construct consistent models for magma differentiation paths below these stratovolcanoes. Volcanoes selected for this study show remarkable variability in morphology, eruption rates, compositional range, and mineral chemistry. Stagnation and differentiation in the deep crust (< 40 km) is indicated by trace element (HREE - depletion) and related isotopic compositions typical for crustal contamination. The contribution of lower crust implies garnet signature in Parinacota and Taapaca magmas in contrast to more shallow assimilation at amphibole and plagioclase as residuum in Lascar magmas. We follow further magmatic differentiation history by estimation of intensive parameters of crystallization (P, T, fO_2, P_{H2O}) using geothermobarometry and crystallization experiments to constrain natural crystallization conditions. We integrate additionally geophysical (magnetotelluric) measurements and modeling aimed at constraining magma storage in the upper crust based on subsurface electrical conductivity. Our preliminary results show that our end-member volcanoes have distinct shallow plumbing systems (small and multiple versus large and steady state) which are linked to distinct magma recharge and mixing rates.

23: TS4 Impact of Deep Earth Processes on History, Civilisation and Life, oral, (Gauss-Invited Keynote)

Sociology and socio-economic consequences of global catastrophe

Dombrowsky W

Steinbeis University Berlin, Disaster Research Unit, Christian-Albrechts-University Kiel

Given the predicted climatic change will occur at worst, regional and temporal economic shortages may turn into vast deficiencies beyond adjustability. This may be called "global catastrophy". Inherent, disaster sociology emphasizes the connection between adjustability and control, or, in reverse, the loss of control and the downturn (kata strephein) into decoupled "spheres of being". The key element of being and beings, or "existence" in general, is mutual orientation, interrelationship, with reference to "conduct" or stronger: control. "Things" seem to be under control if the intended will be achieved – and beings feel desperate if nothing happens the way it should have happen. Exactly that is perceived as "disaster", which is, in sociological terminology, decoupling between "me" and the "other". Less philosophical, disaster can be seen as the final stage of increasing losses of conduct and control ending up in decoupled spheres of nations, groups, institutions. Empirically and historically, such processes of decay always were present with an increase in violence and brutality, with retreats toward "cores", may it be "blood", "family" or "race" – simple binarities of good/evil, in/out etc. – but never were present with an increase in solidarity and cooperation. However, as long as "catastrophy" remains associated with the fatum of unevadability, the strategies of retreat toward the core-lines seem more appropriate than analyzing the pathway into disaster as social decoupling and, consequently, as indicator for improvement and counter-measure, as continuous necessity to cooperate instead of losing control.

24: TS2 Geology of Extreme Earth Environments, oral

Preservation of Miocence/Oligocene landscapes in the Atacama Desert, northern Chile

Dunai TJ, Gonzalez GA

University of Edinburgh, School of Geosciences, Edinburgh EH8 9XP, UK
Departamento de Ciencias Geológicas, Facultad de Ingeniería y Ciencias Geológicas, Universidad Católica del Norte, Antafogasta, Chile

Depositional surfaces of early Miocene sediments surfaces are preserved in the Coastal Cordillera, Atacama Desert, northern Chile. Measurement of cosmogenic ^{21}Ne in clasts from erosion-sensitive sediment surfaces show that these surfaces have been barely affected by erosion since 25 Ma. Predominantly hyperarid condi-

tions since 25 Ma are required to create and preserve these oldest continuously exposed surfaces on Earth. The next oldest continuously exposed surfaces, in the Dry Valleys region, Antarctica, have about half this age. Occurrence of younger exposure ages indicate that brief pluvial episodes occurred since the Early Miocene did occur, which caused limited, localized erosion and material transport, only marginally affecting the large scale landscape.

We present exposure age data from other, similarly old surfaces, from the coastal portion of the Atacama Desert. These data demonstrate that the exceptional landscape stability in this coastal desert is widespread, andextends well into the Oligocene in the driest areas. Only exceptional global climatic disturbances have occasionally permitted humidity transfer across the Andes into the driest regions of this Coastal Desert since the Oligocene.

25: IS3 Archives of Environmental Evolution and Climate Change, poster

Environmental changes in Southwest Africa during the Late Miocene

Dupont LM, Rommerskirchen F, Condon T, Mollenhauer G, Schefuß E

Marum - Center for Marine Environmental Sciences, University of Bremen, Leobenerstr, DE-28359 Bremen, Germany, dupont@uni-bremen.de

The late Miocene epoch is characterised by fundamental changes in the Earth's climate system including changes in the surface- and deep-water circulation, Antarc- tic ice-sheets, sea-level variability, and turnover of marine and terrestrial biota.-
Plants using the C4 metabolism of CO2 fixation expanded globally, which have competitive advantage over other plants under light, hot, dry, and low-CO2 conditions. However, the timing of the expansion of C4 plants is poorly understood, because atmospheric CO2 levels were already low and temperatures declined during Miocene times. Our objectives concern the climatic and environmental change of Miocene Southwest Africa - which we consider a key region - and how these conditions may be linked to the C4 plant expansion. We use a variety of organic geochemical techniques combined with palynology on sediments of ODP Site 85, retrieved at ca. 1700 m water-depth on the continental slope of South Africa in front of the Orange River mouth. Our studies cover the period between 14 and 5 Ma. A major change occurred at ~11 Ma, when the total organic carbon content rose steeply. At the same time the relative input of fluvial material, as indicated by the BIT-index, decreased to very low levels. Sea surface temperature estimates (UK'37 and TEX86) indicate declining SSTs. With the rise in organic carbon the abundance of both marine cysts and terrestrial pollen and spores increased. We connect these observations to a change in the Benguela Current system associated with the global ocean circulation and conditions around Antarctica, and to a change in the predomi-

nant wind direction and growing aridity in South Africa. Lower oxygen of the bottom waters might have preserved more organic material, while a change in wind direction might have enhanced upwelling and marine surface production in combination with increased input of airborne pollen and spores. C4 grasslands in the region became important later, by the end of the Miocene

---

26: IS1 New Analytical Techniques, oral

The application of natural divalent cation isotope (Ca, Sr, Mg) fractionation (DCIF) in earth system research

Eisenhauer A, Boehm F, Fietzke J, Liebetrau V, Dietzel M, Tang J

Leibniz-Institut of Marine Sciences, IFM-GEOMAR,
Wischhofstraße 1-3, D-24148 Kiel/Germany

Geochemical records of elemental and isotopic variations in magnesium (Mg), calcium (Ca) and strontium (Sr) provide key information for the chemical history of our planet, its long term climate evolution and the reconstruction of past water temperatures. In particular, the recent progress in instrumentation (e.g., multi-collector ICP-MS applications) and the improvements of isotope measurement techniques (e.g., TIMS double spike technique) showed that the divalent cation isotope ratios like $^{44}Ca/^{40}Ca$, $^{88}Sr/^{86}Sr$ and $^{26}Mg/^{24}Mg$ are spatially and temporarily not constant on Earth, but rather change as a function of the intensity of continental weathering, mineral polymorphism, pH, the precipitation rates and as a function of ambient temperature during inorganic mineral precipitation and biomineralisation. High temperature controlled, Raleigh type DCIF is observed during hydrothermal processes related to rock and mineral differentiation in magma chambers as well as during the precipitation of anhydrites, calcites and aragonites in the hydrothermal plumbing systems of the mid-ocean ridges. However, very large isotope fractionation (~4‰) values for Ca isotopes can be observed during physiologically controlled fractionation in the human body related to its trace metal homeostasis. Similar to trace element partitioning, temperature dependent DCIF is different for inorganically and biologically precipitated minerals (e.g. carbonates). In addition, there are species dependent DCIF processes which reflect the strong physiological control of uni- and multi-cellular organisms on their trace element homeostasis while sequestering trace elements in different reservoirs. In this regard the DCIF may contribute to a better understanding of the function of ion selective channels and pumps on the trace element partitioning between biominerals and the bulk solution.

27: IS3 Archives of Environmental Evolution and Climate Change, oral

Subtropical coral reveals abrupt early-twentieth-century freshening in the western North Pacific Ocean

Felis T, Suzuki A, Kuhnert H, Dima M, Lohmann G, Kawahata H

MARUM,Center for Marine Environmental Sciences, University of Bremen, 28359 Bremen, Germany, tfelis@uni-bremen.de
Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba 305-8567, Japan
MARUM,Center for Marine Environmental Sciences, University of Bremen, 28359 Bremen, Germany
Alfred Wegener Institute for Polar and Marine Research, 27570 Bremerhaven, Germany
Ocean Research Institute, University of Tokyo, Tokyo 164-8639, Japan

Instrumental climate observations provide robust records of global land and ocean temperatures during the twentieth century. Unlike for temperature, continuous salinity observations in the surface ocean are scarce prior to 1970, and the magnitude of salinity changes during the twentieth century is largely unknown. Surface ocean salinity is a major component in climate dynamics, as it influences ocean circulation and water mass formation. Here we pre sent an annually resolved reconstruction of salinity variations in the surface waters of the western subtropical North Pacific Ocean since 1873, based on bimonthly records of $\delta^{18}O$, Sr/Ca, and U/Ca in a coral from the Ogasawara Islands. The reconstruction indicates that an abrupt regime shift toward fresher surface ocean conditions occurred between 1905 and 19. Observational atmospheric data suggest that the abrupt freshening was associated with a weakening of the winds that drive the Kuroshio Current system and the associated subtropical gyre circulation. We note that the abrupt early-twentieth-century freshening in the western subtropical North Pacific precedes abrupt climate change in the northern North Atlantic by a few years. The potential for abrupt regime shifts in surface ocean salinity should be considered in climate predictions for the coming decades.

28: IS1 New Analytical Techniques, poster

The application of Vertical Scanning Interferometry (VSI) to the study of mineral and rock surface change processes

Fischer C

Georg-August-Universität, Abt. Sedimentologie/Umweltgeologie, D-37077 Göttingen, Germany, Rice University, Dept of Earth Science, 60 Main Street, Houston, TX 77005, USA,

The surface of a mineral or rock is the result of the interaction between the mineral

or rock and the environment. The mechanisms of surface processes such as dissolution or precipitation can be studied by direct observations of the surface changes during experiments. In order to obtain meaningful data about surface topography changes a large field of view is necessary because of differences in reactivity of mineral and rock surfaces. Vertical Scanning Interferometry (VSI) is a method which provides a sufficient field of view (up to several mm2). Lateral resolution is about 200 nm and vertical resolution is about 2 nm or better depending on the measuring mode (white-light scanning mode vs. blue-light phase shift mode). The data obtained by VSI measurements are used to calculate height maps of the investigated surface. Volume changes due to reactions of the observed material can be calculated from the differences in topography before and after the experiment. Surface roughness parameters are used to get statistically-based information about surface topography alterations. Important applications are the investigation of mineral dissolution or growth kinetics during diagenesis or weathering (Lüttge et al. 19), the quantification of reactive portions of rock surfaces during weathering (Fischer and Lüttge 2007), as well as the detection and quantification of reactive sites of minerals and rocks for colloidal adsorption (Darbha et al. 2009).

References

Darbha G, Schäfer T, Luttge A, Fischer C (2009): Retention of latex colloids on calcite as a function of surface roughnes. Geochimica et Cosmochimica Act 73: A261

Fischer C, Lüttge A (2007): Converged surface roughness parameters - A new tool to quantify rock surface morphology and reactivity alteration. American Journal of Science 307: 955-973

Lüttge A, Bolton EW, Lasaga AC (1999): An interferometric study of the dissolution kinetics of anorthite: The role of reactive surface area. American Journal of Science 299: 652-678

29: TS1 Early Planets and Life, oral

Highly siderophile element abundances and $^{187}Os/^{188}Os$ in lunar impact melt rocks: Implications for late accretion processes in the Earth-Moon system

Fischer-Gödde M, Becker H, Wombacher F

Institut für Geologische Wissenschaften, FR Geochemie, Freie Universität Berlin, Malteserstrasse 74-0, D-12249 Berlin, Germany, , Email: mafische@zedat.fu-berlin.de

Ancient lunar impact melt rocks have revealed details about the composition of impacting bodies during the Hadean history of the Earth-Moon system [1]. The application of improved analytical techniques may provide new insights on the origin of the excess abundance of highly siderophile elements (HSE: Re, Os, Ir, Ru, Pt,

Rh, Pd, Au) in the Earth's mantle [2-5], and maybe even its volatile element budget. The current data base for $^{187}Os/^{188}Os$ data and HSE abundances on lunar impact melt rocks is rather limited. The goal of the present work is to increase the data base and to include lithologies and locales for which no comprehensive data set has been available. Lunar impact melt rocks from Apollo 14 (143) and 16 (60315), and the lunar meteorite DaG 400 have been studied and will be compared with previous results. Evaluating mixing between putative impactor compositions and indigenous or earlier meteoritic components in the target rock requires analysis of multiple aliquots of a single rock sample. Slope derived HSE/Ir ratios represent the high HSE endmember composition and yield suprachondritic Ru/Ir, Pt/Ir, Rh/Ir and Pd/Ir ratios for poikilitic impact melt rock 60315, slightly suprachondritic Ru/Ir, Pt/Ir, Rh/Ir and Pd/Ir for basaltic impact melt 143 and slightly suprachondritic Ru/Ir for DaG 400. HSE compositions calculated from linear regressions and $^{187}Os/^{188}Os$ of 143, 60315 and DaG400 are comparable to the compositions of Apollo 17 poikilitic impact melts [2,3] and indicate that HSE ratios of impactors at different sites show similarities. A tentative interpretation could be that these compositions might reflect a family of related impactors, or alternatively widespread contamination from a large impact event (Imbrium?). In any case, these compositions are clearly different from chondrites [4] but similar to ratios inferred for the Earth´s mantle [5].

References

Morgan JW, Ganapathy R, Higuchi H, Krähenbühl U, Anders E (1974): Lunar Basins: tentative characterization of projectiles, from meteoritic elements in Apollo 17 boulders. Proc. Lunar Sci. Conf. 5: 1703-1736

Norman MD, Bennett VC, Ryder G (2002): Targeting the impactors: siderophile element signatures of lunar impact melts from Serenitatis. Earth Planet. Sci. Lett. 202: 217-228

Puchtel IS, Walker RJ, James OB, Kring DA (2008): Osmium isotope and highly siderophile element systematics of lunar impact melt breccias: Implications for the late accretion history of the Moon and Earth. Geochim. Cosmochim. Acta 72: 3022-3042

Horan MF, Walker RJ, Morgan JW, Grossman JN, Rubin AE (2003): Highly siderophile elements in chondrites. Chem. Geol. 196: 5-20

Becker H, Horan MF, Walker RJ, Gao S, Lorand JP (2006): Highly siderophile element composition of the Earth´s primitive upper mantle: constraints from new data on peridotite massifs and xenoliths. Geochim. Cosmochim. Acta 70: 4528-4550

30: TS1 Early Planets and Life, poster

Taphonomy of Early Cambrian Chengjiang fossils and phosphatized organic tissues

Forchielli A, Steiner M, Keupp H, Hu S, Li G

Freie Universität Berlin, Institut für Geologische Wissenschaften FR Paläontologie, 12249, Berlin Germany.
Yunnan Institute of Geological Sciences, 650051, Kunming China
Nanjing Institute of Geology and Palaeontology, AS, 208, Nanjing, China

The Early Cambrian Chengjiang fossil lagerstätte of South China represents one of the key fossil deposits for the reconstruction of metazoan bauplans at the very beginning of metazoan evolution. Although extensive studies of the systematics of taxa of this lagerstätte have been carried out, little has been studied on the taphonomy and bearing of different preservational pathways in the Chengjiang deposit. Currently the Chengjiang fossil lagerstätte is considered as a Burgess Shale-type deposit. However, the detailed study of various fossil groups, such as brachiopods, priapulids, lobopods, arthropods, indicate a more complex preservational history than so far expected. Besides later weathering processes, carbonization, phosphatization, and pyritization played key roles in the preservation of the exceptional soft-bodied organisms.

Ediacaran and Cambrian strata are comparably rich in phosphatic fossil remains, such as (1), the so-called "small shelly fossils" (SSFs)- an informal group of minute primarily or secondarily mineralized fossil remains with various biological affinities, (2), mostly 3-D preserved Orsten-type fossils, that preserve labile tissues (e.g. embryos, polyps) and slightly sklerotized cuticles of arthropods (e.g. Furongian Orsten fossils), (3), Burgess Shale-type fossils with a mixed organic and mineralized tissue preservation (e.g. lobopods, arthropods with phosphatic midgut glands, arrow worm remains), and (4), "typical" organo-phosphatic biomineralizers, such as lingulid brachiopods.

Preliminary results of elemental mappings of soft-bodied organisms from the Early Cambrian Chengjiang conservation lagerstätte indicate that their composition is strongly altered by weathering processes. Our analysis of potential primary phosphate biomineralizers, such as protoconodonts, lobopods and brachiopods, revealed, that in all cases an organo-phosphatic or purely organic fabric prevailed.

31: IS2 Tectonics and Sedimentation, poster

Geothermal potential of Northern Backa

Francuski M, Beric M

NIS-Naftagas,EKO-PONT,Development geology,Serbia,NoviSad,N.Fronta 12, mifran.c@nis-naftagas.rs

Northern Backa is located at the SE part of Pannonian basin, at the North of Vojvodina. Pannonian basin belongs to hyperthermal basins, close to orogenic arches and at divergent zones of the Earth's crust. Predominant influence to geothermal potential has tectonic activity. Intensive tectonic activity, followed by volcanic activity of different intensity, caused forming tectonic depressions during Neogene, characterized by several characteristics during geological and geotectonic development.

In order to define geothermal potential of N. Backa, three structures: Bezdan, Bajmok and Kanjiza were analzsed in detail. Results of available geological and geophysical investigations were used, first of all - data from wells: Be-1, Ba-1, K-1, K-2 and K-3.

Geological structure Bezdan is presented by: basalts, as a result of Miocene volcanic activity, Neogene sedimentary rocks were presented by breccia limestones, marl sendstones and send marls, as well as loess-send-clay Quaternary sediments. Depth of geothermal body is 323,50-301,50 m, and surface temperature: 31º C. Water is used for the spa in Bezdan.

Bajmok structure is presented by the following geological structure: Palepzoic schists, Miocene conglomerates and sendstones, Pannonian marls and Paludinian-Quaternary clay-sendz sediments. From the geothermal viewpoint, Miocene conglomerates and sendstones (540-520m deep and with temperature: 35 º C) are the most important.

The most significant geothermal potential at the area is Kanjiza structure. At the sends of Upper Pontian and Paludinian, high number of thermal aquifers is existent: 679-664 m, 744-724 m, 919-895 m, 965-938 m, 14-08 m, 64-52 m and 85-67 m. Surface temperature of water in the aquifers is 41-68 º C. The water is used for the spa in Kanjiza.

Basic goal of the paper is to highlight geothermal potential of Northern Backa, in order to use geothermal water for different purposes in the future, because geothermal water is environmentallz friendly and energy efficient, getting the major role in the field of energy in Europe.

32: IS4 Magmatism and Earth Evolution, oral

Orogen Meets Rift: Causes of Late Variscan HT Processes

Franke W

Ruhbanksweg 24 35394 Gießen

"Magmatism and HT metamorphism in Variscan Europe between c. 340 and 300 Ma have hitherto been attributed to processes intrinsic to plate tectonics, such as thermal relaxation after stacking, delamination of underplated lithosphere, or slab break-off. New results from the Montagne Noire (S-France) reveal that HT/LP metamorphism was caused by melt intrusion into a dextral pull-apart structure, and was already active before the arrival of the Variscan thrust stack, which took place in time after the Namurian A (i.e., after 317 Ma). The Montagne Noire yields thermal events around 335, 315, 308, 300 Ma and Stephanian/Permian activities, many of which can also be detected in the Pyrenees, in the Massif Central, Black Forest, Vosges, and the Bohemian Massif. The Tournaisian to Viséan „Deckdiabas“ volcanism is an important volcanic manifestation of these processes. It can be traced from Portugal via the British Isles, Rhenish Massif and Harz as far as the Moravo-Silesian belt. Since these events are synchronous over large areas, and – in the external parts of the orogen – pre-date crustal thickening, they must have been caused by a process acting independantly from the Variscan orogeny proper. Metamorphic heat was probably advected by mantle-derived melts along crustal-scale scale shear zones, such as the orogen-parallel shear zones which accomodated the westward drift of Gondwana relative to Laurussia and opened the Tethys ocean., Critical assessment of plate configurations reveal that, in Carboniferous times, Gondwana was still juxtaposed to Variscan Europe and that the tip of the Tethys rift reached the Carnic Alps not before the mid-Permian. It is proposed that magmatic heating along shear zones occurred in a large, complex plume (or plumes) at the rift tip. , Geochemistry does not help to test this model, since an Andean-type Cadomian basement, early Variscan subduction and felsic continental crust have provided a large variety of protoliths. Combined with varying degrees of melting above a heterogeneous plume, the resulting magmatic rocks can be expected to cover an extremely wide range of chemical compositions.

33: IS2 Tectonics and Sedimentation, oral

Mountains or Hills? Stratigraphic clues to Variscan orogenic topography

Franke W

Goethe-Universität Frankfurt, w.franke@em.uni-frankfurt.de

In most orogenic belts, continental collision is followed by areally extensive uplift, erosion, and crustal thinning (by erosion and by thermal weakening of the orogenic root). While isostatic uplift during collision is instantaneous, erosion and thermal relaxation act over times spans in the order of n x Ma.The European Variscides are exceptional, in that marine sediments of mid-/late- Devonian age (≥ 380 Ma) often overstep HP and MP rocks which are little older. Prominent examples are known from the northern Massif Central (France) and the Bohemian Massif. The marine sedimentary record clearly argues against large areas of thickened and uplifted continental crust, such as in the Himalayas. Instead, it can be shown that exhumation of rocks from mantle depths was rapid and restricted to relatively narrow zones. These features are best explained in models which invoke uplift of subducted continental crust within the subduction zone, controlled by hydraulic expulsion, buoyancy and differential stress (e.g, Franke & Stein 2000, Chemenda et al. 15).Large-scale crustal thickening may also have been impeded by mantle activities unrelated to Variscan plate tectonics proper, e.g., mid-/late Devonian basaltic magmatism which weakened the orogenic crust: low-viscosity materials are not stacked, but spread. Mantle-controlled thermal weakening can also be made plausible for later (Carboniferous) times, where the westward-propagating Tethys rift overprinted the Variscan collisional belt.Taken altogether, the sedimentary record does not support „Variscan Himalayas“ , but rather low relief on a hot and weak continental foundation.

References

Frankle (1995): Chemenda et al.. EPSL 132: 225-232

Franke W (2000): Franke & Stein. Geological Society, London, Special Publ. 179: 337-354

34: IS2 Tectonics and Sedimentation, oral

Constraints on provenance, stratigraphic correlation and structural context of the Volta basin, Ghana, from detrital zircon geochronology: an Amazonian connection?

Frei D, Kalsbeek F, Affaton P

Dept. of Geological Mapping, Geological Survey of Denmark and Greenland, Copenhagen K, Denmark, df@geus.dk
Dept. of Geological Mapping, Geological Survey of Denmark and Greenland, Copenhagen K, Denmark
CEREGE, Aix-Marseille Université, Aix-en-Provence , France

We have dated 60 detrital zircon grains from the Neoproterozoic to lower Palaeozoic Volta basin, Ghana, and from sandstones in the adjoining thrust sheets belonging to the Pan-African Dahomeyide belt. All dated zircons in the lower Voltaian Bombouaka Group are older than ~00 Ma, while samples from the middle Voltaian Oti Group and the upper Voltaian Obosum Group contain numerous zircons of 600–00 Ma. The samples we have studied from the Dahomeyide thrust sheets (Buem and Togo structural units) have zircon age spectra similar to those from the Bombouaka Group, confirming a correlation of the investigated sandstones with lower Voltaian strata. The Bombouaka Group was deposited between ~00 and 600 Ma, perhaps shortly after 00 Ma, as suggested by earlier Rb-Sr data on clay minerals. Deposition of the Oti and Obosum Groups took place shortly after 600 Ma, perhaps continuing into the lower Palaeozoic. Most samples contain Palaeoproterozoic zircons with ages of 2000–2200 Ma that probably have been derived from the surrounding crystalline (Birimian) basement. Archaean zircons, present in smaller proportions, may have come from Archaean rocks in the West-African craton. Most zircons of 00–1900 Ma were probably derived from sources outside the West-African craton, the Amazoinian craton being a plausible source region. Zircons with ages around 1200 Ma are believed to have been derived from Grenvillian orogenic belts, perhaps those that fringe the Amazonian craton. If this is so, no major seaways could have been present between these belts and the West-African craton during the early Neoproterozoic. Zircons younger than 00 Ma were probably derived from an eastern continental block that collided with the West-African craton during the Pan-African orogeny ~600 Ma ago.

35: IS4 Magmatism and Earth Evolution, poster

A layered laccolith model for the Götemar Pluton, SE Sweden

Friese N, Vollbrecht A, Tanner DC, Fahlbusch W, Weidemann M

Geoscience Centre, University of Göttingen, Goldschmidtstrasse 1-3, 37077 Göttingen, Germany
Leibniz Institute of Applied Geophysics, Stilleweg 2, 30655 Hannover, Germany

The Götemar Pluton (GP) in SE Sweden is a 1.45Ga old intrusion of mainly alkalifeldspar granites into ca. 1.8Ga old granitoid host rock of the Transscandinavian Igneous Belt. At surface, the GP displays a circular shape with a diameter of about 5 km. Internal zones defined by variations in grain size and partly parallel the circular outlines, are regarded as evidence of multiple intrusions. The contact to the wall rock is sharp without a distinct alteration aureole. Since macroscopic fabrics of ductile deformation are missing, the GP is often classified as "anorogenic". During late block faulting along a N-S striking, steep fracture zone the western part of the GP was uplifted by about 500m over its eastern part, so that different intrusion levels are exposed.

Based on microfabric analysis, field investigations, and earlier published data, a modified multi-stage emplacement model is suggested for the GP:

Magma ascent through a vertical feeder dyke was arrested by a structural discontinuity in the host rocks, which induced lateral emplacement and formation of an initial sill. Subsequent pulsed injections resulted in an episodic (out of sequence) stacking of magmatic layers, which was associated with roof uplift and gradual subsidence of the floor into the source magma chamber. Early-formed layers were overprinted in different ways by later injections depending, e.g., on the melt fraction and composition of the interacting magmas. Distinct grain-size variations between adjacent layers, as observed in borehole cores, indicate that magmas with different crystal fractions were injected, probably supplied from different parts of the magma chamber through several feeders. The stepwise emplacement of small magma volumes with low melt fractions can explain the lack of a distinct contact zone.

Aeromagnetic maps reveal that similar plutons are aligned along a N-S-striking zone, which could be related to the recently defined Danopolian event.

36: IS2 Tectonics and Sedimentation, oral

A tectonic model for the Rhodopes and their relation with the internal Hellenides

Froitzheim N, Nagel TJ, Georgiev N, Jahn-Awe S, Pleuger J

Steinmann-Institut, Uni Bonn, Poppelsdorfer Schloss, D-53115 Bonn, Germany
Steinmann-Institut, Uni Bonn, Poppelsdorfer Schloss, D-53115 Bonn, Germany
Dept. of Geology and Paleontology, University St. Kliment Ohridski, 15 Tzar Osvoboditel Blv., 00, Sofia, Bulgaria
Steinmann-Institut, Uni Bonn, Poppelsdorfer Schloss, D-53115 Bonn, Germany
Geologisches Institut, ETH Zürich, Sonneggstrasse 5, CH-8092 Zürich, Schweiz

Based on structural and geochronological data, we propose a model in which the Rhodopes are composed of four major tectonic units: Unit I (Pangaion-Pirin Complex) represents the former margin of Apulia. It is the metamorphosed equivalent of the External Hellenide platform which is also exposed in the Olympos Window. The overlying Unit II includes mixed continental and oceanic rocks, most notably, metamorphosed Late Jurassic to Early Cretaceous arc magmatites (Turpaud & Reischmann, Int. J. Earth Sci., in press). We suggest that it represents the former continuation of the Vardar Zone, which is exposed further west and includes Late Jurassic arc magmatites as well. Unit II was thrust towards SW over the Pangaion-Pirin Complex during the Early Tertiary. It includes the sutures of both the Vardar and the Pindos-Cyclades Ocean. Unit III is the Ograzhden-Vertiskos complex of mainly continental origin. We interpret it as a part of Europe. Unit IV is the Circum-Rhodope – Mandrica Complex of low-grade metamorphic sediments and ophiolites. The tectonic evolution of the Rhodopes is characterized by a switch in subduction polarity in mid-Cretaceous time. In Jurassic to Early Cretaceous time, Unit IV was emplaced towards NE over Unit III (Europe) in the framework of an arc-continent collision at a SW-dipping subduction zone. After the Cenomanian, the ensemble of Units III and IV was thrust towards SW over Unit II in the framework of a NE-dipping subduction zone which consumed the remaining part of the Vardar Ocean. After closure of the Vardar Ocean, top-SW thrusting went on and eventually affected the Apulian margin (Unit I). Due to this switch in subduction polarity, Unit II includes both Liassic UHP rocks (formed in the SW-dipping subduction zone), and Tertiary HP rocks (formed in the NE-dipping subduction zone).

37: IS2 Tectonics and Sedimentation, poster

Provenance of beach sands from Gran Canaria: constraints from U-Pb detrital zircon geochronology

Gerdes A, Marko L, Dörner E, Brey G

Goethe-Universität Frankfurt, Institut für Geowissenschaften, Abteilung Petrologie und Geochemie, Altenhöferallee 1, 60438 Frankfurt, gerdes@em.uni-frankfurt.de

Recent beach sands from Gran Canaria have been sampled for a zircon provenance study: a light, feldspar-quartz-bearing (GC2; Maspalomas) and a dark, olivine-pyroxen-rich sand (GC1; Playa de Veneguera). As quartz is almost absent in the Miocene to Pliocene volcanic rocks of the island the GC2 sample appear to have a rather exotic origin. This is in line with Saharan dust plumes blown off the west coast of Africa and over the Canary Islands usually during early summer each year. If these plumes, however, can transport particles larger than 50μm, including heavy minerals such as zircon, is so far not well documented.

Zircon (40-150μm in length) is abundant in the heavy mineral fraction of both samples. SEM-CL imaging reveals two distinct populations: idiomorphic grains with weakly developed oscillatory zoning and inclusions of ilmenite and apatite, and well-rounded grains often with sharply defined and fine-scaled oscillatory zoning and a secondary overgrowth domain.

LA-SF-ICP-MS dating reveals a bimodal age distribution with predominantly Miocene (~11-14 Ma) and subordinately Pliocene (~3-4 Ma) U-Pb ages for the idiomorphic grains of both samples. These age peaks are in agreement with the appearance of the main magmatic activity on the island (Miocene Mogan and Fataga formations and Pliocene Roque Nublo), and thus interpreted as dating the crystallisation of the mantle-derived volcanic rocks from Gran Canaria

In addition, 30% of GC2 zircons yielded Precambrian U-Pb ages, consistent with crystallization during Neoproterozoic to Neoarchean time. No older basement is documented on the Canary Island. Therefore, these exotic ages are consistent with Aeolian transport of detrital material from the west coast of Africa. This implies that even heavy minerals such as zircon can be transported under certain circumstances by dust plumes over far distance and highlights the need to be cautious in interpreting detrital zircon populations for provenance studies.

38: IS3 Archives of Environmental Evolution and Climate Change, poster

Temperature and hydrologic variability in mid-late Holocene fossil corals from the Southern Caribbean Sea

Giry C, Felis T, Scheffers S, Scholz D

MARUM, Center for Marine Environmental Sciences, University of Bremen, GERMANY
MARUM, Center for Marine Environmental Sciences, University of Bremen, GERMANY
Coral Reef Research Center, Southern Cross University, Lismore, AUSTRALIA
Heidelberger Akademie der Wissenschaften, Forschungsstelle Radiometrie, Heidelberg, GERMANY

Holocene storm and tsunamis deposits on Bonaire (Netherlands Antilles) provide well-preserved annually-banded fossil corals that we use to reconstruct the climate variability of the Southern Caribbean Sea at monthly-resolution. 19 fossil brain corals (*Diploria strigosa*) ranging in age up to 60 years old (U-series) were cored. X-radiographs reveal that each core contains several decades of coral growth, up to a maximum of about 0 years. Diagenetic investigation reveals an excellent skeletal preservation of most of the corals. Based on growth rate, skeletal preservation and duration of growth, 5 coral cores of different ages have been selected for paleoclimate reconstruction. Sr/Ca (temperature proxy) and oxygen isotopes (a combined hydrology and temperature proxy) were analysed at monthly resolution from samples extracted along the thecal wall.

All coral records reveal clear seasonal cycles in both Sr/Ca and $d^{18}O$. The coral-based proxy records indicate that the Southern Caribbean climate has encountered changes of variable frequencies during the mid to late Holocene. Initial results suggest that interdecadal variability in SST inferred from coral Sr/Ca is a prominent feature of Southern Caribbean climate. Due to the combined effect of temperature and hydrology on coral $d^{18}O$, interdecadal variability of this proxy remains more subtle. Frequency changes of both SST and hydrology recorded by different well-dated fossil corals will be discussed.

We are currently analysing more corals covering different periods when the nearby Cariaco Basin Titanium record indicates highly variable hydrological conditions over northern South America. Combining monthly-resolved records from several well-dated corals will provide robust estimates of changes in SST and seawater isotopic composition of the Southern Caribbean Sea during the mid to late Holocene.

39: IS3 Archives of Environmental Evolution and Climate Change, oral

Mixed carbonates and siliciclastics in the Quaternary of southern Belize: Pleistocene turning points in reef development controlled by sea-level change

Gischler E

Institut für Geowissenschaften, Goethe-Universität, 60438 Frankfurt am Main, Germany

The southern shelf of Belize is a classic location of a modern mixed carbonate-siliciclastic system. Whereas the knowledge of the Holocene deposits in the area is extensive, data on the Pleistocene system are fragmentary. Open questions include the nature of the reef foundations, the ages of the deposits including the initiation of the barrier reef, and the response of the mixed system to sea-level fluctuations. Six, up to 5 m long borings were made in order to better understand the history of this mixed system. Lithostratigraphy, strontium isotopes, and calcareous nannofossil biostratigraphy were used in order to constrain stratigraphic ages. Our results support the contention that the Quaternary development in Belize was quite similar to that of other major barrier reefs such as the Florida Reef Tract, and, further afield, the Great Barrier Reef and the New Caledonian Barrier Reef. Interestingly, all these barrier reefs are mixed carbonate-siliciclastic systems and significant reef growth only began after the onset of high-amplitude, eccentricity-controlled sea-level changes and as late as during the exceptionally long and warm marine isotope stage 11, some 400 ka ago. In Belize, early Pleistocene sections at core bases include mollusc-rich wackestones, rare coral packstones, and marls, which were deposited under low to moderate energy conditions in a ramp setting around 1 Ma, during high sea levels of marine isotope stage 25 and possibly earlier. The Belize shelf was subaerially exposed for most of the mid Pleistocene and dominated by siliciclastic sedimentation, possibly during MIS 24-12 when highstands were comparatively low. Continuous reefs at the shelf margin were developing during highstands. In the late Pleistocene, beginning with the long and high highstand of MIS 11, the southern shelf was entirely flooded and carbonates started to dominate once more. Reefs developed on top of siliciclastic deposits on the shelf. A continuous barrier reef came into existence and largely developed on top of carbonates at the shelf margin. During late Pleistocene lowstands, siliciclastics presumably did not no longer reach the shelf margin anymore because of the topographic high of the barrier reef platform. The Quaternary Belize example may serve as a model for reconstructing ancient mixed systems in icehouse worlds, however, any extrapolations are limited by the fact that fast-growing Scleractinian reef-builders had not yet evolved in the Paleozoic.

40: TS3 Geomicrobiology and Biogeochemistry, poster

The Sensitivity of Pore Density in Tests of *Bolivina Spissa* to ambient Oxygen and/or Nitrate concentration in Sediment Bottom Water

Glock N, Eisenhauer A, Milker Y, Liebetrau V, Schoenfeld J

IFM-GEOMAR, Wischhofstr. 1-3, 24148 Kiel, Germany, nglock@ifm-geomar.de

The density and size of pores are important aspects in the morphology of foraminifera. These pores are supposed to control the uptake of oxygen (O_2) and to the release of carbon dioxide (CO_2) as a waste product of respiration (Leutenegger and Hansen, 1979). Hence it seems obvious to test certain characteristics like pore-density and porosity as an indicator for O_2 depletion in the water column and different redox-conditions, respectively. Here we present a first quantification of the relationship between bottom-water-oxygen-concentration ($[O_2]_{BW}$) and the pore-density of tests from *Bolivina Spissa* collected off the Peruvian continental margin. For the experiment the pores of 216 specimens from 7 locations with different redox-conditions were counted. We found an inverse non-linear relation between the pore density (PD), water depth and the oxygen concentration of the adjacent water masses respectively ($R^2 = 0.55$, N = 7; $PD(P/mm^2) = 0.0066 \cdot [O_2]_{BW}^{-0.74}$). At higher oxygen-concentrations the pore-density reach an equilibrium value where the pore density is independent of $[O_2]_{BW}$. Surprisingly, a comparison of the pore-density to the bottom-water-nitrate-concentration ($[NO_3^-]_{BW}$) suggests that the pore-density of *B. Spissa* propably is even more sensitive to $[NO_3^-]_{BW}$ (negative linear correlation, $R^2 = 0.96$, N = 5; $PD(P/mm^2) = -0.0003x + 0.0155$). The observation that certain foraminifera may switch to nitrate respiration during oxygen depletion in the water column was recently documented to occur in different benthic foraminiferal species (Risgaard-Petersen et al., 2006). Future studies will test the application of the pore-density as a possible proxy for $[NO_3^-]_{BW}$ and/or $[O_2]_{BW}$.

References

Leutenegger S, Hansen HJ, Risgaard-Petersen, N, (1979): Ultrastructural and Radiotracer Studies of Pore Function in Foraminifera. Marine Biology 54: 11-16

Risgaard-Petersen, N. et al. (2006): Evidence for complete denitrification in a benthic foraminifer. Nature 443 (7107): 93-96

41: IS3 Archives of Environmental Evolution and Climate Change, poster

End-Permian and end-Triassic mass extinction events: implications from marine plankton associations and land plant communities of the NW Tethys and Peri-Tethys realms

Götz AE, Feist-Burkhardt S, Haas J, Ruckwied K, Pálfy J, Török Á

Darmstadt University of Technology, Institute of Applied Geosciences, Germany, goetz@energycenter.tu-darmstadt.de
The Natural History Museum, Department of Palaeontology, UK, s.feist-burkhardt@nhm.ac.uk
Eötvös Loránd University, Geological, Geophysical and Space Science Research Group of the Hungarian Academy of Sciences, Hungary, haas@ludens.elte.hu
Shell International Exploration and Production B.V., The Netherlands, Katrin.Ruckwied@shell.com
Hungarian Academy of Sciences, Hungarian Natural History Museum, Research Group for Palaeontology, Hungary, palfy@nhmus.hu
Budapest University of Technology and Economics, Department of Construction Materials and Engineering Geology, Hungary, torokakos@mail.bme.hu

Mass extinction events of the early Mesozoic period and the causes of such ecosystem collapses are still controversial and widely debated. A main point in the discussion is the correlation of marine and terrestrial events and the interpretation of carbon cycle perturbations as recorded in carbon isotope excursions. The study of plankton associations in the NW Tethyan realm revealed characteristic stratigraphical and lateral distribution patterns pointing to major perturbations of the marine ecosystems at that times. Blooms of organic walled green algae (prasinophytes) are interpreted to be triggered by elevated carbon dioxide levels in the atmosphere and oceans during mass extinction events. In this context, the diversity history of land plants, the vegetation dynamics associated with the mass extinction and the role of floral change in faunal extinctions are also a matter of debate. Striking changes in the pollen/spore assemblages are documented from palynological analyses of key marine boundary sections, pointing to synchronous changes within the terrestrial and marine realm. Prasinophyte and spore peaks correspond to prominent negative carbon isotope excursions. Thus, marine algal blooms and the temporary dominance of ferns in the terrestrial vegetation may signal the biotic response to the same environmental stress, which also affected the carbon cycle. However, open questions remain about the terrestrial vegetation dynamics, changes in land plant communities and the relations of floral change and mass extinction. This has to be addressed in ongoing integrated palynological and palaeobotanical studies.

42: TS4 Impact of Deep Earth Processes on History, Civilisation and Life, oral, (Gauss-Invited Keynote)

Consequences of explosive supereruptions in Human history

Graf HF

University of Cambridge, Centre for Atmaospheric Science, Downing Place, Cambridge CB2 3EN, UK

Sulphate aerosol fallout in the Greenland GISP2 ice core seemed to confirm crude petrologically-based estimates of a very high sulfur yield for the Younger Toba Tuff and consideration of atmospheric chemical kinetics led to suppose that the climate forcing of the YTT event would have been prolonged because of the very high sulfur loading and slowed oxidation due to limited stratospheric OH. These arguments for major climatic consequences were later seen as part of a bigger picture of environmental catastrophe that was linked causally by some to genetic evidence for a severe bottleneck in the population of anatomically modern humans. Here some critical re-evaluation will be given of more recent findings of the effects of such super eruptions, including new simulation results with Earth System Models that include, besides the radiative effects of volcanic stratospheric aerosols, also vegetation, ocean and global carbon cycle calculations. Very recent findings even question the time sequencing of the Toba eruption and consideration of the eruption style (co-ignimbrite instead of Plinian) may also change injection heights to much lower altitudes with consequences for the life time of stratospheric aerosols.

43: IS2 Tectonics and Sedimentation, oral

Dynamics of a small-scaled depression nearby Amelinghausen (Lower Saxony, Northern Germany)

Grim S, Lehné R, Druivenga G, Seelos K, Sirocko F

Institute for Geosciences, Department of Sedimentology, University of Mainz, Becherweg 21, D-550 Mainz, grimst@uni-mainz.de
Institute for applied Geosciences, Department of Geo Ressources & Geo Risks, Technical University of Darmstadt, Schnittspahnstraße 9, D-64287 Darmstadt
GEOSYM - Geomesssysteme, Forstgrund 16, D-30629 Hannover

Northern Germany is still highly affected by diapirism, subrosion and glacio-isostatic adjustment with consequence for the land surface. In addition the post-glacial lift processes induce genesis and reactivation of faults (Sirocko *et al.* 2008). Today high movement potentials near the land surface appear fortified close to e.g. tectonic faults, salt structures or Elsterian tunnel valleys (Lehné 2005). An investigation area with high movement potentials could be contained in Northeast Lower Saxony

(Germany) (Lehné & Sirocko 2005).

For smaller scaled analysis we observe the centre of highest movement potentials exactly between the salt stocks Wettenborstel and Egestorf-Soderstorf nearby Amelinghausen. In this area a small depression (0.09 km²) is located. The depression shows a high mobility since the last 25 years and subsided in a range of several decimeters.

The objective of the study was to evaluate if the depression is caused by a fault which outcrops at the surface or by subrosion related to the salt structures.

We measured seismic data for the uppermost 0 m to determine the coherency between the surface near structure and the recent topography. Considering the common faults, three parallel seismic profiles were prospected perpendicular to the principal fault direction. The results show a vertical displacement of 5 m at a depth of 85 m at several locations.

The relevant data from "Tectonic Atlas of NW-Germany" (Baldschuhn *et al.* 16) for stratigraphic horizons, the faults and the diapir-localisation were digitised and embedded in a GIS (ArcGIS 9.3). Using the software MATLAB and OpenGeo a 3D-modelling is applied for the investigation area based on the isocontour surfaces to visualise the complex situation of the deep structures.

Actual data of the seismic prospection implies that the movements of the investigation area are caused by a fault which shows clearly the influence of tectonic activity on the modern landscape.

References

Baldschuhn R, Frisch U, Kockel F (1996): Tectonic Atlas of NW-Germany. BGR, Hannover.. :

Lehné R (2005): Rezente Bodenbewegungspotentiale in Schleswig-Holstein (Deutschland) – Lokalisierung und Quantifizierung durch GIS-Analysen, seismische Interpretation, Fernerkundung, statistische Auswertung und Feldarbeit. Dissertation. Mainz.. : 231 p.

Lehné R, Sirocko F (2005): Quantification of recent movement potentials in Schleswig-Holstein (Germany) by GIS-based calculation of correlation coefficients.. Int. J. Earth Sci. 94: 1094-1102

Sirocko F, Reicherter K, Lehné R, Hübscher C, Winsemann J (2008): Glaciation, salt and the present landscape. In: Littke, R., Bayer, U., Gajewski, D. & Nelskamp, S. (Eds.): Dynamics of Complex Intracontinental Basins. The Central European Basin System. Springer, Berlin.. : 233-245

44: IS3 Archives of Environmental Evolution and Climate Change, oral

Fractionation of Ca isotopes in benthic foraminifers

Gussone N, Filipsson HL

Institut für Mineralogie, Universität Münster, Corrensstr. 24, D-48149 Münster, Germany
Forschungszentrum Ozeanränder der Universität Bremen,
Leobener Str, D-28359 Bremen,Germany,
Europrox, Universität Bremen, Leobener Str, D-28359 Bremen, Germany
GeoBiosphere Science Centre, Quaternary Sciences, Lund University,
Sölvegatan 12, S-223 62, Lund, Sweden

Benthic foraminifers serve as important archives for various paleoceanographic proxies, like Mg/Ca, $\delta^{13}C$, $\delta^{18}O$, $\delta^{11}B$, recording bottom water conditions (e.g. temperatures, pH) as well as global oceanic variability (e.g. $\delta^{18}O_{sw}$). In order to evaluate the usability of Ca isotope ratios of benthic foraminifers as archives for fluctuations of the $\delta^{44/40}Ca$ of the seawater or bottom water temperature changes, we investigated environmental parameters and processes that govern Ca isotope fractionation in the foraminifers` tests. To address this question, we analysed Ca isotope ratios of the infaunal foraminiferal species *Cassidulina laevigata, Elphidium sp., Gyroidinoides spp.,* and *Uvigerina peregrina* as well as the epifaunal *Cibicidoides wuellerstorfi* over a depth-temperature gradient of marine core top sediment samples. The calcium isotope ratios of the benthic foraminifers' tests show a distinct anomaly around 4 °C. This anomaly is observed in both epi- and infaunal species, but there are also characteristic differences between both. The $\delta^{44/40}Ca$ characteristics of benthic foraminifers may be explained by the interference of temperature and calcite saturation on Ca isotope fractionation. We suggest that Ca isotope composition of benthic foraminifer tests is dominantly controlled by temperature at temperatures higher than 5 °C, while in the temperature range below 5 °C, calcite saturation (Ω_{Cc}) becomes an increasingly important controlling factor. Due to the non linear shape of the Ω_{Cc}-$\delta^{44/40}Ca$ relation proposed for cellular Ca transport (Gussone et al. 2007), the temperature dependence at low temperature is overprinted by the fractionation effect of Ω_{Cc}. At higher temperatures, the effect of Ω_{Cc} is diminished, and temperature becomes the dominant factor.

References

Gussone N, Langer G, Geisen M, Steel BA, Riebesell U (2007): Calcium isotope fractionation in coccoliths of cultured Calcidiscus leptoporus, Helicosphaera carteri, Syracosphaera pulchra and Umbilicosphaera foliosa.. Earth and Planetary Science Le 260: 505-515

45: TS2 Geology of Extreme Earth Environments, poster

Development of highly elevated peneplains of Tibetan plateau (near Nam Co) in the light of low - T thermochronology

Haider VL, Dunkl I, von Eynatten H and Ding Lin

Sedimentology & Environmental Geology, Geoscience Center, University of Göttingen
Institute of Tibetan Plateau Research, CAS, Beijing, CHINA, vhaider@geo.uni-goettingen.de

Comprehensive understanding of exhumation of Tibetan Plateau is limited in part by poor knowledge of the thermochronological ages. Both, (U–Th)/He and fission track (FT) dating methods on apatite yield cooling age at different temperature therefore also at different times. These methods used together give good opportunity to date the exhumation at a certain level as well as to calculate the exhumation rate.

The investigated area, south of the Banggong Suture and north of the Nyaingentangtha Mountains in the southern fringe of the Tibetan Plateau, involving a broaden range of crystalline rocks are well exposed and main focus of this research. Geomorphologically, this area stands out by well distinguishable and intact peneplains primarily developed in granitic rock body. Distinctive features of these peneplains are their high elevation (> 50m) and a very smooth surface which conclude to very slow formation and erosion, respectively. Partly they are decayed to corestone and build a wollsack structure. The exact mechanism about the development of this special landscape forming feature is not yet properly known. We sampled granitoid, volcanic and sedimentary rocks at different elevation from a □ 6000km2 area around lake Nam Co.

The first (U – Th)/He ages of crystalline rocks cluster around Middle Eocene. We suppose that these thermochronological data reflect a Tertiary thermotectonical event. This event is probably connected to erosion and planation of the granite surface and to the deposition of siliciclastic sediments close to the currently exhumed peneplains.

46: Cloos Modal Lecture, oral

Postglacial slip rate increase on thrust and normal faults caused by glacial-interglacial changes in ice volumes: Numerical modelling and case studies

Hampel A

Institut fuer Geologie, Mineralogie und Geophysik, Ruhr-Universitaet Bochum,
Universitaetstr. 150, 44801 Bochum

Palaeoseismologic data show that many active faults in both extensional and contractional tectonic settings experienced a slip rate increase after the last glacial pe-

riod. Examples include the Teton normal fault in the Basin-and-Range Province (Byrd et al. 14) and the Pärvie reverse fault in northern Scandinavia (Lundquist & Lagerbäck 1976). Numerical models including a fault embedded in a rheologically layered lithosphere show that such slip rate variations can be explained as a response to glacial-interglacial changes in ice volumes. Glacial loading and postglacial unloading cause flexure and subsequent rebound of the lithosphere and hence alter the stress field in the crust, with the consequence that fault slip varies through time. In most cases, both normal and reverse faults experience a slip rate decrease during glacial loading and a strong slip rate increase during postglacial unloading. The magnitude of the slip rate variations is mainly controlled by the spatial dimensions of the load and the rheology of the crust and mantle lithosphere (Hampel & Hetzel 2006; Turpeinen et al. 2008). Application of the normal fault model to the Teton fault shows that the enhanced postglacial slip on this fault was caused by melting of the Yellowstone ice cap and the glaciers in the Teton Range (Hampel et al. 2007). The slip acceleration in the thrust fault models agrees well with the offset and timing of large earthquakes in the Lapland Fault Province, which occurred at ~9 ka, i.e. immediately after melting of the Fennoscandian ice sheet. In general, our findings imply that postglacial slip on faults in glaciated regions may not be uniform through time. Rather, a significant fraction of slip may have accumulated within a few thousand years after the last glaciation. Furthermore, the model results support the idea that the low level of seismicity in currently glaciated regions like Greenland and Antarctica is caused by the presence of the ice sheets.

47: TS2 Geology of Extreme Earth Environments, poster

Exhumation under extreme topographic gradients at propagating orogenic plateau rims: Constraints from apatite fission track and apatite (U-Th)/He ages

Haschke M, Andriessen P, Persano C

Dept. of Geology, Free State University, 9300 Bloemfontein, South Africa

Tectonic plateau propagation, extreme topographic gradients, enhanced exhumation rates, and changes in regional climate patterns along the Andean plateau rim are key parameters in balancing continental and cratonic crustal growth and erosion cycles. We sampled and analyzed 14 Paleozoic granitoid samples from fault-bounded hangingwalls of the Eastern Cordillera in Argentina, the eastern tectonic forefront of the Andean plateau, to reconstruct the time and rate of exhumation of the main episode of Andean plateau formation in the Puna. Combined apatite fission track and (U-Th)/He ages reflect enhanced cooling of shallow and uppermost Andean orogenic crust during the main episodes of shortening (~38 Ma and Ma) and enhanced exhumation rates in the order of 0.1 to 0.4 mm/yr. Correlation with tectonic con-

straints indicates enhanced cooling of thrust faulted crustal blocks in hangingwalls of mainly inherited, reactivated steep-angle normal faults from a pre-plateau stage, Cretaceous continental rift setting. Cretaceous cooling ages (~9-91 Ma) reflect cooling of exposed rift shoulders, Eocene-Oligocene ages (~54-29 Ma) correlate with initial (Incaic) shortening and tectonic preconditioning of the present-day Puna plateau, and Miocene ages (~22- Ma) reflect the main episode of shortening across the Puna plateau. Lack of younger exhumation ages may reflect suspended thrust-induced uplift in this part of the plateau rim, piecemeal plateau propagation and relocation of the present exhumation front. Early exhumation to shallow crustal levels (as early as 9 Ma) and partial reburial can explain some shortened apatite track lengths. Together with existing thermochronometric data (Deeken et al. 2006) of apatite fission track data from elevation transects, the new data provides a higher resolution cooling history and implies stepwise eastward Andean plateau growth.

References

Deeken A, Sobel E, Coutand I, Haschke M, Riller U (2006): Development of the southern Eastern Cordillera. NW Argentina, constrained by apatite fission track thermochronology: From early Cretaceous extension to middle Miocene shortening. Tectonics 25: TC6003

48: TS3 Geomicrobiology and Biogeochemistry, oral

How carbonate precipitation and dissolution is regulated during the formation of Fe-rich banded microbialites: Investigation of geochemical iron and carbon cycling in a cold, iron-rich mineral spring

Hegler F, Hanselmann K, Behrens S, Horath T, Schmidt C, Kappler A

University of Tübingen, Centre for Applied Geoscience - Geomicrobiology, Sigwartstr. , 72076 Tübingen, Germany, florian.hegler@uni-tuebingen.de
University of Zürich, Institute of Plant Biology
Swiss | i-research & training, P.O. Box 1206, CH-8032 Zürich

Some banded structures observable today as lithified, Fe-containing microbialites most likely stem from laminated microbial mats. In order to better understand iron-containing laminations of biological origin preserved in rocks and the role that microorganisms might have played in their formation, we are investigating iron-rich ecosystems with conditions resembling those during anoxic to oxic transitions on early Earth. The field site is a highly mineralized, circum-neutral spring located near Ftan, Switzerland. The spring water is rich in Ca^{2+}, HCO_3^-, H_2CO_3 and dissolved Fe(II). As CO_2 escapes to the atmosphere along the flow path, calcium carbonates precipitate. At the same time oxygen diffuses into the water causing spatially distinct redox gradients with anoxic to oxic conditions. This transition is most likely accom-

panied by phototrophic and nitrate-reducing anaerobes as well as by chemical and microbially mediated aerobic oxidation of Fe(II) at low to intermediate O_2 concentrations leading to precipitation of Fe(III) minerals. The conditions suggest a sequence of reductive and oxidative processes of Fe-cycling as well as inorganic and organic carbon cycling.

We are also studying the selection pressure of the lateral redox gradient on the microbial communities and the changes that microbial metabolism exerts on the mineralogy along the flow path gradient. Changes in the microbial community composition are determined by 16S rRNA phylogeny and fingerprinting employing the DGGE technique. Furthermore, we quantify the abundance of phototrophic as well as aerobically and anaerobically Fe(II)-oxidizing and Fe(III)-reducing, neutrophilic organisms via most probable number counts.

The site offers all essential components to study Fe and C cycling in Fe-rich systems during anoxic-oxic redox transitions similar to the change from an anoxic to a more oxic early Earth.

49: TS3 Geomicrobiology and Biogeochemistry, oral

Biosignatures of a fossil deep biosphere within calcite-fluorite fracture fillings in diorite of the Äspö Hard Rock Laboratory, Sweden

Heim C, Lausmaa J, Sjövall P, Simon K, Kronz A, Thiel V

University of Göttingen , Geoscience Centre, Goldschmidtstr. 3 , 37077 Göttingen

For the characterization of ancient microbially driven ecosystems of the deep biosphere, the use of biosignatures is indispensible, especially the application of organic biomarkers as molecular fingerprints for the organisms involved and inorganic biosignatures as evidence for biomineral formation. Aiming to identify a fossil deep biosphere geochemical investigations were performed on fracture fillings in the 1.8 Ga old Äspö diorite. These fracture fillings frequently consist of a sequence of high-temperature fluorite and low-temperature calcite phases [1,2]. Samples were taken from a 50 mm drill core obtained at 450 m depth in the Tunnel of Äspö (KJ 0052F01, SKB core library). ToF-SIMS molecular mappings were performed on thick sections along the phase boundaries of fluorite and calcite. The measurements reproducibly revealed numerous organic compounds producing ions at e.g. m/z 44.05 (C_2H_6N), 55.06 (C_4H_7), 57.04 (C_3H_5O), 81.07 (C_6H_{11}). In addition, ions of functionalized organic molecules showing masses as high as 339 Da were observed within the fracture fillings. These substances are considered indigenous as they show a very specific distribution confined to the boundary between calcite and fluorite. The functionalized fragments and complementary 13C and 18O isotope data of the calcite fracture minerals imply a young, quaternary age of the fossil biofilm. Further mineralogical and chemical investigations were conducted, using polarization mi-

croscopy, LA-ICP-MS, electron microprobe, in order to unravel the mineral formation mechanisms of the fracture fillings. LA-ICP-MS measurements on the same target areas revealed a concomitant, significant accumulation of the light rare earth elements along mineral phase boundaries, most likely induced by biologically driven element fractionation. Additional investigations are underway to further elucidate these organic and inorganic biosignatures in the ancient deep biosphere ecosystem.

References

Drake H, Tullborg EL (2004): [1] Oskarshamn site investigation - fracture mineralogy and wall rock alteration. SKB P-04-250: 112

Tullborg EL, Drake H, Sandström B (2008): [2] Palaeohydrogeology: A methodology based on fracture mineral studies. Applied Cehmistry 23: 1881-1897

50: TS3 Geomicrobiology and Biogeochemistry, poster

Geo– and biochemical analyses of fluid–venting structures in Italy

Heller C, Blumenberg M, Kokoschka S, Wrede C, Taviani M, Reitner J

University of Goettingen, Geoscience Centre, Department of Geobiology, Germany, 37077 Goettingen, Goldschmidtstr. 3, jreitne@gwdg.de

The mud volcano area of "Salse di Nirano" is located near Bologna (Italy) and was formed by the expulsion of water, mud and gas dominated by methane and higher hydrocarbons. It is suggested that the geological emission of methane from mud volcanoes represent the second most important natural source of these greenhouse gas to the troposhere (Etiope and Ciccioli 2009).

Methane is the substrate for microorganisms that perform the anaerobic oxidation of methane (AOM), a process that is now identified as the major sink of this greenhouse gas in marine systems (Reeburgh 16; Hinrichs und Boetius 2002 and references therin). However, recently the AOM was also found to occur in terrestrial fluid venting systems like mud volcanoes (Alain 2006).

To obtain insights whether the AOM is also occuring at the "Salse di Nirano", we studied the gas composition and the distribution and stable–carbon isotope ratios of lipid biomarkers to get information on the microbial community at this site.

First results showed that sulfate reducers and methanotrophs are present in this environment,′ suggesting that AOM is also taking place in the sulfate–rich mud volcanoes of "Salse di Nirano".

References

Alain K, Holler T, Elvert M, Treude T, Krüger M (2006): Microbial investigation of methane- and hydrocarbon-discharging mud volcanoes in the Carpathian

Mountains, Romania.. Environmental Microbiology 8(4): 574-590
Etiope G, Ciccioli P (2009): Earth`s Degassing: A missing ethane and propane source.. Science 323: 478
Hinrichs KU, Boetius A (2002): The anaerobic oxidation of methane: new insights in microbial ecology and biogeochemistry.. Ocean Margin Systems, Springer -: 457-477
Reeburgh WS (1996): Soft Spots in the global methane budget. In M.E. Lidstrom, adn F.R. Tabita (ed.), Microbial growth on C1 compounds.. Kluwer Academic Publ. -: 334-342

51: IS4 Magmatism and Earth Evolution, oral

Evolution of the Paleo-Tethys and platinum-potential of SW-Yunnan, China

Hennig D, Lehmann B, Frei D, Belyatsky B, Burgess R, Zhao X

Clausthal University of Technology, Mineral Resources, Germany, 38678 Clausthal-Zellerfeld, Adolph-Roemer Straße 2a, Daniel.Hennig@tu-clausthal.de
Geological Survey of Denmark and Greenland, Department of Geological Mapping, Denmark, 1350 Copenhagen, Øster Voldgade , df@geus.dk
Russian Academy of Sciences, Institute of Precambrian Geology and Geochronology, Russia, 1034 St Petersburg, Makarova Emb. 2, bbelyatsky@mail.ru
University of Manchester, School of Earth, Atmospheric and Environmental Sciences, Great Britain, M13 9PL Manchester, Williamson Building, Oxford Road, Ray.Burgess@manchester.ac.uk
University of Hong Kong, Department of Earth Sciences, China, Hong Kong, Pokfulam Road, James Lee Building, xfzhao@hkusua.hku.hk

Southwestern Yunnan is a key region for the understanding of the complex evolution of the Paleo-Tethys at the end of the Paleozoic and the formation of the 260 Ma-old Emeishan large igneous province (ELIP), which hosts several magmatic ore deposits. The geological situation is complicated by Himalayan escape tectonics with the left-lateral NW-SE striking Red-River Ailaoshan shear zone (RRASZ) standing out. We study the possible continuation of the ELIP south of the RRASZ along the Lancang river. The MORB-like basaltic andesite of the Nanlianshan complex near Jinghong has a U–Pb age of 292 ± 1 Ma and indicates sea-floor spreading (Hennig et al., in press). The calcalkaline, mafic to ultramafic Banpo intrusion about 80 km NW of Simao hosts arc-related peridotites and gabbros with an age of 286 ± 2 Ma (Jian et al., in press).Granodiorite intrusions and dacitic lava flows at Jinghong with arc-affinity of 284 ± 1 Ma to 282 ± 1 Ma suggest subduction of the Paleo-Tethys (Hennig et al., in press). The mafic to ultramafic Paleng complex at the border to Laos is similar in composition to the Banpo complex and hosts amphibole-gabbro cumulates with island-arc signature and U–Pb ages of 258 ± 2 to 262 ± 3 Ma and Ar–Ar ages on hornblende of 251 ± 4 to 259 ± 2 Ma. The amphibole gabbro is

associated with arc-type basaltic andesite and within-plate basalt (U–Pb: 262 ± 2 Ma), which resembles in major and trace element characteristics the lavas of the ELIP. Likely, the Permian arc magmatism and the formation of the ELIP are part of the same plate tectonic cycle (Jian et al., in press). Occurrences of basaltic rocks at Jinghong with partly typical intra-plate signature have a stratigraphic position coeval with the ELIP. Chalcophile trace elements and platinum-group elements of the Paleng and Banpo intrusion depict drastic depletion, pointing to a high platinum potential of these rock complexes.

References

Hennig D, Lehmann B, Frei D, Belyatsky B, Zhao X (2009): Early Permian seafloor to continental-arc magmatismin the eastern Paleo-Tethys: U–Pb age and Nd–Sr isotope data from the southern Lancangjiang zone, Yunnan, China. Lithos in press: in press

Jian P, Liu D, Kröner A, Zhang Q, Wang Y (2009): Devonian to Permian plate tectonic cycle of the Paleo-Tethys Orogen in southwest China (II): Insights from zircon ages of ophiolites, arc/back-arc assemblages and within-plate igneous rocks and generation of the Emeishan CFB province. Lithos in press: in press

---

52: IS3 Archives of Environmental Evolution and Climate Change, oral

Relation between abrupt vegetation changes and sea surface temperatures during the last glacial in SW Africa

Hessler I, Dupont L, Groeneveld J

MARUM, Center for Marine Environmental Sciences, University of Bremen, P.O. Box 330440, 28334 Bremen, Germany, GLOMAR, Bremen International Graduate School for Marine Sciences, University of Bremen, P.O. Box 330440, 28334 Bremen, Germany, ihessler@marum.d
MARUM, Center for Marine Environmental Sciences, University of Bremen, P.O. Box 330440, 28334 Bremen, Germany
Marum Excellence Cluster, Alfred Wegener Institute, 27568 Bremerhaven, Germany

During periods associated with North Atlantic Heinrich events (HE) North Atlantic Deep Water formation is interrupted and hence the Atlantic Meridional Overturing Circulation (AMOC) is strongly reduced. According to the hypothesis of interhemispheric climate coupling via the bipolar see-saw a weaker AMOC would lead to decreased drainage of heat from the Southern Ocean heat reservoir and therefore, to warming of South Atlantic surface waters. Abrupt changes in the composition of tropical African vegetation are thought to be related to changes in marine hydrological conditions related to periods associated with Heinrich events.

To address the question of the connection between abrupt changes in African vegetation and changing marine surface conditions during the last glacial high reso-

lution palynological investigations were performed on marine sediments from ODP Site 78 (11°55'S, 13°24'E) off Angola. The distribution of pollen provides information about fluctuations in the dominating vegetation composition on the adjacent continent and corresponding climate during the last glacial. The reconstructed vegetation history of tropical Africa shows that abrupt changes during periods associated with Heinrich events occur. However, the vegetation response is different for different events. Additionally, combined Mg/Ca and $\delta^{18}O$ measurements of planktonic foraminifera *G.ruber* will be performed to reflect the development of sea surface temperatures and salinity changes during the last glacial off the coast of Angola. By combining the records from ODP Site 78 we obtain a direct land-sea correlation and get insight in the interrelation between marine surface conditions and environmental conditions on the adjacent continent.

53: TS1 Early Planets and Life, poster

Low mechanical stability of Ediacaran Yangtze platform margin

Heubeck CE, Scouflaire Q, Zhu M

Institut für Geologische Wissenschaften, Freie Universität Berlin, Malteserstr. 74-0, 12249 Berlin, cheubeck@zedat.fu-berlin.de
Institut für Geologische Wissenschaften, Freie Universität Berlin, Malteserstr. 74-0, 12249 Berlin, quentin.scouflaire@gmail.com
Nanjing Institute of Geology and Paleontology, CAS, 39 East Beijing Road, Nanjing 2008, P.R. China

Even though the Yangtze Platform is thought to contain some of the world's finest record of the Ediacaran-Cambrian transition period and thus potential evidence for the nature of the events leading to the base-Cambrian bioradiation, the measuring of many strtigraphic sections reveal s unconformities (in shallow-water facies) and large-scale disturbed bedding (in "deep-water" facies), respectively, hampering cross-platform correlation for biostratigraphic purposes and rendering chemostratigraphic identification of global climatic perturbations problematic. Our field work along the northern (Hubei, Shaanxi, Sichuan) and southern (Hunan, Guizhou) margin of the Yangtze platform established that many of the thicker sections include submarine slides and olistostromes that can be reconstructed in fair detail. In particular, the southern Yangtze platform margin during the Ediacaran appears to have been of an unusually high sedimentary mobility, causing widespread upslope thinning and downslope section thickening. The well-defined transition between ooid-oncoid-dominated and widely phosphatic shallow-water calcareous facies and the mass-flow-, shale-dominated, anoxic, deep-water siliciclastic slope facies is only a few km wide. In some upper-slope sections, the 90 Ma-record between the end of the Cryogenian (base of cap carbonate) and lower Cambrian strata consists mostly of soft-sediment slumped cap carbonate, documenting early instability during fast post-

Cryogenian sea level rise and complete removal of any overlying sediment that may have accumulated during the Ediacaran.We cannot unambiguously demonstrate that a lack of bioturbation of the outer shelf section contributed to its low mechanical stability through the buildup of gas and fluids in laminated organic-rich sediments but see the need to consider correlation frameworks of lithologically and chemostratigraphically-based profiles of the Ediacaran Yangtze Platform with caution.

54: TS1 Early Planets and Life, oral

An early ecosystem of Archean tidal microbial mats (Moodies Group, South Africa; ca. 3.2 Ga)

Heubeck C

Institut für Geologische Wissenschaften, Freie Universität Berlin, Malteserstr. 74-0,12249 Berlin, cheubeck@zedat.fu-berlin.de

One of the significant questions in Earth history is the nature, extent and habitat of the earliest microbial mats. Likely, the oldest mappable biomats, forming major part of a deposystem, occur in the siliciclastic Moodies Group, Barberton Greenstone Belt, South Africa (ca. 3.22 Ga). There, microbial mats are densely interbedded with coarse-grained and gravelly sandstones in marginal marine, tidal and possibly subaerial coastal environments. Characteristic sedimentary structures include anastomosing bedding, gas or fluid escape structures, sand volcanoes, biomat doming, patchy silicified microstromatolites, and microbial sand-chip conglomerates. The microbial and sedimentary structures collectively indicate rapid growth of mechanically tough and mucilagous microbial mats, possibly aided by early seafloor silicification, in a high-energy, high-sedimentation-rate environment. The common uncompacted but silicified bands of biomats, microbial wraps around "floating" sand grains and fluid-escape structures indicate that the biomat fabric was cohesive enough to retard sediment compaction, dewatering, and possibly also degassing. An early seafloor silicification of microbial mats, initially likely as opaline crusts on mm-scale, would have been highly effective in compartmentalizing interstitial fluids and in retarding dewatering. The suggested very early seafloor silica precipitation, resulting in partial surface sealing and early stiffening of biomats is consistent with a high silica concentration in Archean water. If Archean tidal ranges were generally higher, as suggested from astronomical calculations and supported by geological evidence, and if Precambrian shelves were wider and shallower than today, megatidal environments may have provided extensive regions for biomat habitats. Granular sediment could then have been temporarily fixated in large quantities in near-shore environments by biomats and created sharp near-surface chemoclines.

55: TS1 Early Planets and Life, oral

The Ediacaran-Cambrian ecosphere revolution: Can insights from Chinese microcontinents be generalized ?

Heubeck C and members of FG 736

Institut für Geologische Wissenschaften, Freie Universität Berlin, Malteserstr. 74-0, 12249 Berlin; cheubeck@zedat.fu-berlin.de

Any outside observer considering our planet's history would likely choose the 650-to-500-Ma time interval spanning the Ediacaran and Cambrian periods as one of the most dramatic periods in Earth history. Strata of that age display concurrent profound changes in global tectonics, a large deviation from the steady-state mean temperature, multiple indicators heralding the largest-ever evolutionary radiation, and a significant increase of atmospheric and oceanic oxygen.

Projects of the FG736 focus on profound paleobiological, geochemical and stratigraphic changes near the PC-C transition, calibrated by new geochronologic data. Field work takes place at well-exposed sections on China's Yangtze Platform, with efforts also underway on the Tarim microcontinent. Our work strives to discern whether events near the PC-C boundary are indeed "explosive" else reflect a temporal distortion and/or a preservational bias of an "evolutionary" fossil record, affecting the follow-up question as to the nature of any intrinsic or external drivers capable of modifying evolutionary rates. Undisputed significant changes in environmental conditions and thus taphonomic conditions likely increased metazoan preservational potential. Nevertheless, an "explosive" character of the PC-C boundary is currently favored due to near-contemporaneous events in Neoproterozoic plate tectonics, modified oceanic circulation patterns, changing ocean chemistry, the late Precambrian oxygenation events, an improved nutrient supply to the oceans, and the incipient bioturbation of hitherto laminated shelf sediments. Independently, a biological breakthrough in genomic complexity (HOX genes) may have multiplied the effects of the newly-acquired physiological capability of biomineralization. However, the worldwide geochronological framework is as yet insufficiently developed to allow precise event correlation and to reliably distinguish cause-and-effect chains.

56: IS3 Archives of Environmental Evolution and Climate Change, poster

3-D architecture, depositional patterns and climate triggered sediment fluxes of an alpine alluvial fan (Samedan, Switzerland)

Hinderer M, Hornung J, Pflanz D, Hechler A, Beer A, Maisch M

Technische Universität Darmstadt, Institut für Angewandte Geowissenschaften, Schnittspahnstr. 9, 64287 Darmstadt, Germany, hornung@geo.tu-darmstadt.de
University of Jena, Germany,
Environmental Resources Management (ERM), France,
University of Zürich, Switzerland,

The sedimentary architecture of an alpine alluvial fan with a surface of 300.000m² near Samedan, Switzerland, was three-dimensionally investigated using 9 km of ground penetrating radar sections with a penetration depth of m. Radar facies patterns could be very well calibrated to sedimentology and dated horizons due to a 300 meter long outcrop section at the foot of the fan. Six major reflectors have been identified and represent first order, fan-wide palaeosurfaces. They are made up of up to 20 cm thick fine-grained deposits partly with initial pedogenetic structures and wood remains which yielded ages between 5670 +/- 60 and 7515 +/- 65 a ^{14}C BP. Between these surfaces different depositional lobes and specific architectural elements like channels, levees or snouts of debris flows could be identified. All these data were geo-referenced to establish a complete quantitative 3-D time-stratigraphic framework. This allowed us to calculate deposited sediment volumes and sediment fluxes for different time slices between the dated palaeosurfaces. Sediment fluxes show an overall decline during the Holocene which we interpret as the decling sediment production in the catchment area—a function of the paraglacial cycle. Since the middle Atlantic period, the aggradation of the fan almost ceased and climate perturbations are no longer reflected in the sedimentary record since then. Within the aggradation period, distinct peaks of high sediment fluxes could be correlated with known periods of glacier retreats in the Swiss Alps, which points to a high sensitivity of the system to climate changes. The results of our study give valuable new insights into thresholds of activity and quiescence of an alpine catchment-fan system and its stage in the course of a paraglacial cycle. Although very important for the understanding of such dynamic systems under global warming scenarios and geo-risk assessment, such data sets are rarely available.

57: OS Open Session, poster

Depositional dynamics and preservation potential in a progradational lacustrine to fluvial setting: Implications for high resolution sequence stratigraphy (Upper Triassic, NW-China)

Hinderer M, Hornung J

Technische Universität Darmstadt, Institut für Angewandte Geowissenschaften, Schnittspahnstr. 9, 64287 Darmstadt, Germany, hornung@geo.tu-darmstadt.de

Lacustrine deltaic systems differ in several ways from marine ones and classic sequence stratigraphic concepts need to be modified. We present a quantitative outcrop analogue study with an exceptionally high-resolution record of a lacustrine delta complex (cm to decimetre) of the Upper Triassic at the southern margin of the Junggar Basin (Xinjiang, China). Sedimentological logging of lithofacies and architectural elements were combined with GR measurements and 2D mapping. The data are analysed and interpreted in terms of depositional dynamics, cyclicity, stacking pattern, accommodation vs. sediment supply and preservation potential. The sedimentary inventory comprises various types of gravely channel bodies, sheet like sandy and clayey units, as well as ferrocrete horizons and coal seams organized in four different geosystems: Delta-slope, delta-front, delta-top and distal alluvial plain. A four-fold cycle hierarchy with systematic superposition of cycles show strong external, but linked control of sediment transport, depositional processes and accommodation space was identified. This linked control contrasts to marine settings. According to preservation of cycles and regional geodynamic data, tectonic rates did not change markedly in the Upper Triassic. However, according to climate proxies humidity decreased and seasonality increased which can be observed by an increase in floodplain dynamic, e.g. thicker crevasse splays. Preservation potential and cycle symmetry patterns are strongly related to the A/S ratio, which shows an overall decrease during Norian times with a subsequent increase during the Rhaetian. Gamma ray measurements (GR) are independent of grain sizes but show own cyclicity. The extension of voluminous gravelly channels far beyond the delta front led us to propose a new type of a coarse-grained mixed load delta.

58: TS2 Geology of Extreme Earth Environments, oral

Mature Proglacial sediments as a consequence of extreme chemical weathering in the upper Ordovician (Sanamah Formation, Lower Wajid Group, SW Saudi Arabia)

Hinderer M, Keller M, Al Ajmi H, Filomena C, Rausch R

Technische Universität Darmstadt, Institut für Angewandte Geowissenschaften, Schnittspahnstr. 9, 64287 Darmstadt, Germany, hinderer@geo.tu-darmstadt.de

In Saudi Arabia, the Sanamah Formation of Late Ordovician age has been interpreted either as a glacial or as a fluvial succession. They were mainly deposited in valleys that are cut into the underlying rocks up to 80m and filled by steeply-dipping clinoforms, interpreted as prograding subaqueous, possibly subglacial delta foresets. The basal succession is red conglomerate and coarse-grained sandstone with rounded to well-rounded clasts and a poor sorting. The second unit is composed of massive coarse-grained sandstones and the third facies of medium to coarse sandstones that repeatedly are slumped. A fourth type of sediment is found along the margins of the channels: thin units of conglomerates show trough cross bedding, a bad sorting and subangular to subrounded clasts. Besides few striated clasts several large blocks of friable, well-bedded sandstone are the only direct indicators of a proglacial setting. These blocks can only transported in a frozen state without being destroyed. Our interpretation as a proglacial setting is also supported by the dominance of coarse-grained, massive, weakly sorted beds with large scale channel architecture which together with block transport reflect events with very high flow energy, most presumably by major episodes of extreme meltwater discharge. Strikingly, despite their proglacial setting all the sediments are very mature containing predominantly quartz grains and quartz cobbles. A clay matrix is missing. This can be only explained by a low-relief environment and glacial/proglacial reworking of older, mature clastics. A candidate for this are the widespread distributed quartz arenites of northern Gondwana which were deposited just before the Late Ordovician glaciations and are explained by extreme chemical weathering. The observed close temporal link in our area to glacial/proglacial sedimentation suggest subsequent extreme CO_2 draw down and cooling.

59: TS1 Early Planets and Life, poster

Mineralogical investigations of concretionary nodules at the Precambrian-Cambrian boundary

Hippler D

Technical University Berlin, Department of Mineralogy and Petrology,
Ackerstrasse 76, 13355 Berlin, Germany, dorothee.hippler@falw.vu.nl

China's Yangtze Platform contains a sedimentary succession of terminal Neoproterozoic and Early Cambrian age, reflecting the deposition in different palaeoenvironmental settings including inner shelf, slope and basin deposits. Well-exposed strata of the slope to basinal belt are found close to Lijatuo, in the province of Guizhou, S. China. The Lijatuo section comprises mainly black cherts and laminated shales, with minor occurrences of phosphatic siliceous shales, all representing deeper water deposition. The section includes the Ediacaran-Cambrian Liuchapo and Xiaoyanxi formations. Particularly, the latter formation is of great interest, because the basal layers are composed of nodular phosphate rocks. The nodules and the ambient host sediment have been studied in detail, in order to decipher the major factors responsible for P-mineralization. We applied a combined mineralogical-geochemical approach, including optical microscopy, SEM, microprobe analysis, XRD, and XRF. Preliminary investigations exhibit that P-mineralization occurs as local hazelnut- to walnut-sized concretionary nodules. These phosphatic nodules are non-nucleated impregnations of defined portions of sediment, however sediment structures from the original sediment are not preserved. The nodules are mainly composed of apatite, quartz and barite. A clear zonation of the nodules has been observed resulting from the distinct distribution of the mineral phases and a change in porosity. First chemical analyses, moreover, revealed that the nodules are enriched in Sr, V, As and some rare earth elements. In contrast to localized P-mineralization, considerable barite mineralization already occurs downward in the section. This finding points to an incisive change in porewater chemistry. Summarizing, we intend to clarify P-mineralization, as well as provide new insights in the complex diagenetic history of these deeper water sediments, particularly in relation to major global biogeochemical changes.

60: TS1 Early Planets and Life, oral

Isotope biosignatures and early life: a controversial issue

Hoefs JW

Isotopengeologie, Geowissenschaftliches Zentrum,, Goldschmidtstr.1, D-37077 Göttingen

It has long been recognized that biological processes significantly fractionate the isotopes of C, S and Fe leading to characteristic biosignatures in sedimentary rocks. The idea of using C-isotope compositions of carbonaceous matter for the detection of early life dates back to the classic paper of Craig (1953). A controversy about the meaning of graphite δ13C-values from early Archean rocks has continued till today. In recent years more and more experimental and natural evidence has been presented that Fischer-Tropsch type reactions may produce abiogenic organic matter with δ13C-values similar to biogenic organic matter (i.e. Taran et al. 2007).

Considering a typical difference in δ34S-values of 20 to 60 ‰ between marine sulfate and bacteriogenic sulfide in present-day sedimentary environments, similar fractionations in ancient sedimentary rocks may be interpreted as an evidence for the activity of sulfate-reducing bacteria. Again, there is debate about the first onset of bacterial reduction in the geological record. Recent progress in the analysis of the rare isotopes 33S and 36S can be used as a fingerprint when a particular sulfur metabolism shows up in the geological record.

As is well known, bacteria use Fe during both dissimilatory and assimilatory redox processes. Controversy still exists whether the iron isotope variations observed in very old rocks are controlled by abiological or microbiological fractionations. The combination of C, S and Fe isotope data from Archean and Proterozoic rock sequences may give records of different microbial metabolisms during Earth,s histoty.

61: IS4 Magmatism and Earth Evolution, oral

Strongly depleted mantle sources in early Archean arc-like rocks from Isua, SW-Greenland

Hoffmann JE, Münker C, Polat A, König S, Mezger K, Rosing MT

Universität Bonn, Steinmann Institut, Abt. Endogene Prozesse,
Germany, 53115 Bonn, Poppelsdorfer Schloss, hoffjoel@uni-bonn.de
Universität zu Köln, Germany
University of Windsor, Ontario, Canada
Nordic Center for Earth Evolution, Copenhagen, Denmark

Hafnium isotope studies on Hadean zircons and ^{142}Nd anomalies in early Archean rocks provide evidence that differentiation started as early as 4.3-4.4 Ga on Earth, causing depletion of incompatible lithophile elements in the mantle. These depletion

events can potentially be tracked by Hf and Nd isotope studies. However, due to the metamorphic overprint Archean rocks have experienced in most cases, previous studies centering on Sm-Nd systematics could not clearly discriminate metamorphic disturbance from pristine isotope signals (e.g. Moorbath et al., 18).

Pillow basalts from the ~3.71->3.81 Ga Isua supracrustal belt (ISB) are among the best preserved mafic crustal material in the early Archean record, thus potentially providing evidence for any large scale mantle depletion. Here, we report Hf isotope and high-precision high-field-strength-element (HFSE; Zr, Nb, Ta) from well characterized boninite-like metabasalts from the eastern part of the ISB (Polat et al., 2002). The rocks have been metamorphosed under amphibolite facies conditions but still exhibit relic volcanic textures Initial eHf values of the boninite-like metabasalts range from +3.8 to +11.9. The samples exhibit $^{176}Lu/^{177}Hf$ values as high as 0.065, indicating a previous depletion of their mantle sources in the garnet-stability field. These eHf values are clearly of primary origin, as both initial eHf and gOs (Frei et al., 2004) correlate with major and trace elements, exhibiting a magmatic differentiation trend. All samples follow AFC curves, suggesting assimilation of enriched crustal material, most likely ocean floor sediments.

Our study provides the first firm evidence from the Earth's oldest mafic rock record for a persistence of a highly depleted Hadean mantle reservoirs into the Archean. The volume of this reservoir, however, might be comparatively small as other mafic units of the ISB were not generated from such a depleted reservoir (e.g. Polat et al., 2003).

References

Moorbath S, Whitehouse MJ, Kamber BS (1997): Extreme Nd-isotope heterogeneity in the early Archaean - fact or fiction? Case histories from northern Canada and West Greenland. Chem. Geol. 135: 213-231

Polat A, Hofmann AW, Rosing MT (2002): Boninite-like volcanic rocks in the 3.7–3.8 Ga Isua greenstone belt, West Greenland: geochemical evidence for intra-oceanic subduction zone processes in the early Earth. Chem. Geol. 184: 231-254

Frei R, Polat A, Meibom A (2004): The Hadean upper mantle conundrum: Evidence for source depletion and enrichment from Sm-Nd, Re-Os, and Pb isotopic compositions in 3.71 Gy boninite-like metabasalts from the Isua Supracrustal Belt, Greenland. Geochim. Cosmochim. Acta 68: 1645-1660

Polat A, Hofmann AW, Münker C, Regelous M, Appel PWU (2003): Contrasting geochemical patterns in the 3.7–3.8 Ga pillow basalt cores and rims, Isua greenstone belt, Southwest Greenland: Implications for postmagmatic alteration processes. Geochim. Cosmochim. Acta 67: 441-457

62: IS3 Archives of Environmental Evolution and Climate Change, poster

Geochemical record of the ANDRILL SMS sediment core, Antarctica: Provenance and continental weathering in the Ross Sea embayment as indicator for Miocene Ice sheet variability

Hoffmann S, von Eynatten H, Kuhn G

Dept. of Sedimentology and Environmental Geology, Geoscience Center Göttingen (GZG), Goldschmidtstrasse 3, Göttingen, Germany, s.hoffmann@geo.uni-goettingen.de
Alfred Wegener Institute for Polar and Marine Research, Am Alten Hafen 26, Bremerhaven, Germany

ANDRILL (ANtarctic geological DRILLing) completed in 2007 the AND-2A sediment drillcore from the Southern McMurdo Sound Project (SMS) in the Ross Sea, Antarctica. The main target of the Project was to recover an ice-proximal drillcore which contain the transition from a warming period during the middle Miocene Climate Optimum (15-17Ma) to the today permanent ice sheet. After recovering, the AND-2A drillcore comprises an almost undisturbed ~600m thick section of middle Miocene strata (800-223m).

Geochemical analyses of the AND-2A drillcore were carried out with an Avaatech XRF Core Scanner (XRF-CS) and on discrete samples. The geochemical composition of the sediment was analysed by the XRF-CS with a resolution of cm downcore. Discrete samples for bulk rock analysis were taken from about each meter of the core. High precision geochemical analyses on the discrete samples (XRF, CNS, biogenic opal) provide the identification of paleoclimatic changes downcore.

The results show strong cyclic variations of chemical weathering downcore. In the upper core section (300-0m) some plateaus of significantly enhanced degree of nearly constant values for the chemical index of alteration (CIA) could be observed over several meters. Each of these plateaus is associated with a notable increase of trace elements values (Ce, Cr, La, Nb or Zr). The allocation of the trace elements to source rocks will provide an approach to identify changes in sediment provenance and the degree of chemical weathering as evidence for paleoclimatic variability. Moreover, the CIA values also correlate with the higher values for the biogenic opal as an indicator for bioproductivity. The calculated weathering proxy shows a general increasing trend over the first ~140 m of an interval expanding from 660-420m. Below this, the values for chemical weathering decrease abruptly to a minimal value and then increase again. Further downcore, another plateau with a constant degree of chemical weathering is observed.

63: TS1 Early Planets and Life, poster

Mineralogy and sedimentary facies of the first 'phosphate giant', Yangtze Platform, SW China

Hu N

Technical University Berlin, Department of Mineralogy and Petrology, Ackerstrasse 76, 13355 Berlin, nanjie.hu@hotmail.de

The Yangtze Platform preserves well-exposed sedimentary successions and excellent fossil records across the Ediacaran-Cambrian boundary interval, particularly east of the Dianchi Fault in northeastern Yunnan, SW China. Near Dahai town, the on-site Zongyicun Member is of major economic importance, since it hosts approximately two-third of the total Chinese phosphate deposits. This section, therefore, constitutes key deposits for systematic studies on phosphogenesis, particle generation and concentration processes (phosphorite genesis), as well as for the stratigraphic and paleogeographic context of large-scale phosphorite formation.

Here, we report preliminary results from optical microscopy, including sediment facies analysis, XRD and scanning electron mocroscopy, in order to (i) unravel the genetic processes leading to the formation of this massive phosphate giant, and (ii) examine the overall mineralogy and small-scale anomalies in geochemistry. Francolite (carbonate fluorapatite, CFA) and dolomite, with minor occurrences of SiO_2-rich horizons represent the major mineral phases. We found phosphate mineralization to occur in three major forms: (1) phosphate rocks of granular appearance being the dominant phosphate facies, (2) stratiform phosphate fabrics, and (3) biological and microbial phosphate fabrics. Especially in the basal part of the profile, alternating sequences with dolomite-rich layers and densely packed phosphate horizons (cm-range), with the apparent absence of intergrowth of concretions, indicate intensive mechanical reworking, concentration of phosphate grains by winnowing in a shallow-water platform setting, and subsequent stratigraphic condensation during diagenesis. Therefore, the dolomite-phosphorite rocks of the Dahai/Laolin section have proven the potential to decipher the mechanisms of phosphorus cycling during the Ediacaran-Cambrian boundary, an interval of major geological and biological changes.

64: IS3 Archives of Environmental Evolution and Climate Change, oral

Diatom analysis of the Marine Isotope Stage 3 section of a lake sediment core from the Dehner Dry-Maar (Eifel/Germany)

Illig S, Sirocko F

Johannes Gutenberg-Universität, Institut für Geowissenschaften, FB09, Germany, 550 Mainz, Becherweg 21, illigs@uni-mainz.de

A large number of studies have been undertaken using biological indicators to track environmental changes of earlier interglacials. However, most of these studies focus on climate and vegetation changes on a longer time scale reaching the Eemian interglacial, which corresponds to the marine isotope stage (MIS) 5e or even farther back, due to several existing outcrops. In general fewer studies using biological proxies have been undertaken to understand the rapid climate changes of MIS3 and the rate of temperature change during the stadial-interstadial transitions, which occur in Greenland within years. The diatom analysis of a ^{14}C and tephra chronological dated drilling core from Dehner Maar (Germany), which represents the first continuous Stage 3 record (ka-60ka BP) for Central Europe, is the major objective of this study, and is mainly applied for understanding the ecological effects of the fast stadial-interstadial changes of MIS3 and the peak cold of the LGM. Our main interest is to detect how exact diatom assemblages record climate, or if local changes in lake conditions like eutrophication and pH mainly effect the lakes biology. Our first results show that diatoms response instantaneously to the abrupt stadial-interstadial climate change recorded in the Greenland ice, and thus our main scientific question is on the rate of warming during the stage 3 in Central Europe. We present a diatom stratigraphy for the MIS3 sections corresponding to the Daansgard Oeschger cycles (DO) 8-12 and Heinrich events (H) 4-5 of the Dehner Maar core. Whilst stadials are indicated by a community of small-sized benthic taxa and an overall lower diatom productivity and diversity, the warmer periods corresponding to interstadials are characterised by higher diversity, productivity and abundant planktonic taxa. Our results demonstrate that the diatoms within Dehner Maar core responded to the climate variability of MIS3, and that changing lakes chemistry affected the response.

References

Ampel L, Wohlfarth B, Risberg J, Veres D (2008): Paleolimnological response to millennial and centennial scale climate variability during MIS 3 and 2 as suggested by the diatom record in Les Echets, France.. Quaternary Science Reviews 27(15-16): 1493-1504

Coope GR (2002): Changes in the thermal climate in northwestern Europe during marine oxygen isotope stage 3, estimated from fossil insect assemblages.. Quaternary Research 57(3): 401-408

Jöris O, Street M, Löhr H, Sirocko F (2009): Das Aurignacien – erste anatomisch

moderne Menschen in einer sich rasch wandelnden Umwelt.. Wetter, Klima, Menschheitsentw 1: 71-76

Wohlfarth B, Veres D, Ampel L, Lacourse T, Blaauw M (2008): Rapid ecosystem response to abrupt climate changes during the last glacial period in western Europe, 40-16 ka.. Geology 36: 407-410

65: TS3 Geomicrobiology and Biogeochemistry, poster

Transformation of nitrogen during maturation of sedimentary rocks

Illing C, Ostertag-Henning C, Schwark L

Bundesanstalt für Geowissenschaften und Rohstoffe, Stilleweg 2, 30655 Hannover, Germany
Westfälische Wilhelms-Universität - Institut für Geologie und Paläontologie, Corenstr. 24, 48149 Münster, Germany
Christian-Albrecht-Universität zu Kiel – Institut für Geowissenschaften, Ludewig-Meyn-Str., 24118 Kiel, Germany

One unique feature of several large gas provinces in North America, Russia and Central Europe is a high content of nitrogen (N) gas.

This N could account for more than 90% of the total gases in some reservoirs, for example in the eastern part of the Central European Basin (Lokhorst, 1998).

Different hypotheses have been invoked to explain the large accumulations of N gas: a magmatic origin, generation from coal at very high maturities, and release from shales at high maturities (cf. Krooss et al., 1993). Mingram et al. (2005) highlighted the possible significance of fixed ammonium in clay-rich metasediments for the generation of nitrogen.

In contrast to the well studied transformation of organic carbon during maturation, the detailed understanding of the transformation of – mainly organic – N during early maturation of sedimentary rocks is not adequate. Therefore, this study presents data on the transformation and expulsion of N and the changes in N isotopic composition during burial maturation. Sedimentary rock samples forming a natural maturity series for type II (Hils syncline, cf. Rullkötter et al., 1988) and type III kerogens (Carboniferous coals from the Ruhr area) have been investigated along with those containing immature type I kerogen. To elucidate the possible transformation of organically-bound N into inorganic N (ammonium) during early maturation, a sequential extraction scheme was used to quantify the amount of exchangeable inorganic N, extractable organic N, hydrolyzable N and N fixed in silicate minerals. In addition to its quantity the N isotopic composition of the extractable organic N was determined.

The results point to a significant transformation and expulsion of N during a maturation stage equivalent to the oil window. Hereby, the transformation of organic matter preferentially seem s to release a fraction of N compounds, which are

depleted in 15N. Further studies on a molecular level of the bitumen may corroborate these findings.

References

Gerling, P., Idiz, E., Everlien, G. & Sohns, E. (1997): New aspects on the origin of nitrogen in natural gas in Northern Germany. In: *Geol Jahrb, D*, 103, pp. 65-84, Hannover.

Krooss, B., Leythaeuser, D. & Lillack, H. (1993): Nitrogen-rich natural gases. Qualitative and quantitative aspects of natural gas accumulation in reservoirs. In: *Erdöl und Kohle – Erdgas – Petrochemie*, Vol. 46, 7/8, pp. 271-276.

Lokhorst, A.(ed.) (1998): NW European gas atlas :composition and isotope ratios of natural gases [CD-ROM], Netherlands Inst. voor Toegepaste Geowetenschappen TNO, Haarlem.

Mingram, B., Hoth, P., Lüders, V. & Harlov, D. (2005): The significance of fixed ammonium in Palaeozoic sediments for the generation of nitrogen-rich natural gases in the North German Basin. In: *Intern J Earth Sci*, 94, pp. 1010-1022.

Rullkötter, J. et al. (1988): Organic matter maturation under the influence of a deep intrusive heat source: A natural experiment for quantitation of hydrocarbon generation and expulsion from a petroleum source rock (Toarcian Shale, northern Germany). In: *Org Geochem*, 13, 4-6, pp. 847-856.

66: IS2 Tectonics and Sedimentation, oral

Structural and geochronological evidence for Paleogene thrusting in the Western Rhodopes (SW Bulgaria)

Jahn-Awe S, Froitzheim N, Nagel TJ, Frei D, Georgiev N, Pleuger J

Steinmann-Institut, Universität Bonn, Poppelsdorfer Schloss, D-53115 Bonn, Germany
Steinmann-Institut, Universität Bonn, Poppelsdorfer Schloss, D-53115 Bonn, Germany
Steinmann-Institut, Universität Bonn, Poppelsdorfer Schloss, D-53115 Bonn, Germany
GEUS (Geological Survey of Denmark and Greenland), Øster Voldgade ,
1350 Copenhagen K, Denmark
Department of Geology and Paleontology, University St. Kliment Ohridski,
15 Tzar Osvoboditel Blv., 00, Sofia, Bulgaria
Geologisches Institut, ETH Zürich, Sonneggstrasse 5, CH-8092 Zürich

The Rhodope Metamorphic Province in the area around the Mesta Graben (SW Bulgaria) exposes a structurally lower complex, the Pangaion-Pirin Complex of Variscan continental crust and its cover (mostly orthogneiss and marble), and a higher complex, the Rhodope Terrane of mixed oceanic and continental origin with

metamorphosed Jurassic arc magmatites (Turpaud & Reischmann (in press), Characterisation of igneous terranes by zircon dating: implications for UHP occurrences and suture identification in the Central Rhodope, northern Greece, Int. J. Earth. Sci., doi: -07/s00531-008-0409-x). The boundary between the two is the top-to-the-SW Nestos Shear Zone. Zircons from the post-tectonic Teshovo (South Pirin) Granitoid Pluton in the Pangaion-Pirin Complex yielded crystallization ages of 32 ± 0.2 Ma (LA-SF-ICP-MS U-Pb method). Zircons from two syn-tectonic granite plutons in the Rhodope Terrane (Dolno Dryanovo and Spanchevo) have ca. 143 to 145 Ma old inherited magmatic cores and ca. 55 to 56 Ma old magmatic rims. These ages, especially the presence of the Late Jurassic cores in the plutons from the Rhodope Terrane, and the structural relations indicate that the SW-ward thrusting of the Rhodope Terrane over the Pangaion-Pirin Complex took place in the Paleogene. A model is proposed where the Pangaion-Pirin Complex represents the margin of Apulia and the structure of the Rhodopes is explained by a switch of subduction polarity from SW-dipping in the Jurassic and Early Cretaceous to NE-dipping in the Late Cretaceous and Paleogene.

67: IS3 Archives of Environmental Evolution and Climate Change, oral (Invited Keynote)

Deep time palaeoclimate: Oxygen isotope proxies

Joachimski MM

GeoZentrum Nordbayern, Universität Erlangen-Nürnberg, Schlossgarten 5, 954 Erlangen

Oxygen isotopes have been successfully applied to studies on the Cenozoic climate and ice volume history (Zachos et al. 2001). The use of oxygen isotopes in older time periods is hampered by the potential diagenetic resetting of the oxygen isotope signals. Brachiopod shells have been preferentially used in the Palaeozic due to their low-magnesium calcitic shell mineralogy that is assumed to be relatively resistant to diagenetic recrystallisation. The oxygen isotope record for Palaeozoic brachiopod calcite reveals a significant trend towards lower values with increasing age (Veizer et al. 1999) translating into unrealistically warm oceanic temperatures in the Early Palaeozoic. This decrease has been interpreted to reflect a secular change in the oxygen isotope ratio of the oceanic reservoir and, as a consequence, will not allow any quantitative reconstruction of palaeotemperature changes during the Palaeozoic.

Biogenic apatite represents an alternative mineralogical phase for oxygen isotope analysis since it is very resistant to diagenetic exchange of phosphate-bound oxygen. Conodonts, microfossils composed of carbonate–fluor apatite and abundant in Palaeozoic-Triassic sediments, have been studied for oxygen isotopes. Short-term as well as long-term changes in the oxygen isotope ratios of Ordovician to Carboniferous conodont apatite are interpreted to reflect climatic changes and the waning and

waxing of high-latitude continental ice sheets. In comparison to oxygen isotope values measured on brachiopod calcite, conodont apatite generally shows higher oxygen isotope values. Most important, the oxygen isotope values of biogenic apatite translate into realistic ocean palaeotemperatures and may thus be used for palaeoclimatic reconstructions in the Palaeozoic. Conodont apatite does not show a prominent secular decrease in its oxygen isotope ratios, not supporting the hypothesis that the oxygen isotope composition of Palaeozoic oceans was significantly different from the modern ocean.

68: OS Open Session, poster

Northeastern Gulf of Mexico intermediate water variability over the last 22 ka in relation to Antarctic Intermediate Water expansion

Jung C, Nürnberg D, Bahr A, Garbe-Schönberg D

IFM-GEOMAR, Leibniz-Institute of Marine Sciences, Wischhofstr. 1-3, 24148 Kiel, Germany
Christian-Albrechts-Universität zu Kiel, Institut für Geowissenschaften,
Ludewig-Meyn-Str. , D-24118 Kiel, Germany

Currently, the northward extension of Antarctic Intermediate Water (AAIW) during deglacial cold phases is widely debated. Our high-resolution study on combined benthic foraminiferal Mg/Ca ratios and stable isotopes ($\delta^{18}O$ and $\delta^{13}C$ from Uvigerina peregrina) from the northeastern Gulf of Mexico (GoM, core MD02-2575, 874 m water depth) intends to reconstruct the GoM intermediate water temperature and salinity conditions over the last 22 ka. Analyses were compared with similar data from shallow (G. ruber) and deep (G. crassaformis) dwelling planktonic foraminifera. Bottom water temperatures calculated with the U. peregrina calibration equation of Bryan and Marchitto (2008) are in accord with present day intermediate water temperatures and show no significant change over the last 22 ka. Bottom water $\delta^{18}O_{seawater\ (sw)}$ values, calculated by removing the temperature component from the isotope data, covary with the deglacial sea-level rise. While the overall $\delta^{18}O_{sw}$ amplitude including millennial-scale variations amounts to 1.75‰ the remaining 0.65‰ after subtracting the 1.1‰ isotopic shift due to the eustatic sea-level rise are most likely related to changing watermasses at intermediate water depth. Notably, the temporal variation in $\delta^{18}O_{sw}$ covaries with the εNd record of Pahnke et al. (2008) from Tobago Basin reflecting AAIW variability. However, the northward expansion of the low-saline AAIW during H1 and YD is accompanied by more saline intermediate water conditions in the northwestern GoM. Such increases in salinity at intermediate depths imply the westward intrusion of high-saline western North Atlantic Central Water through Florida Strait at times of a reduced thermohaline circulation, in close interaction with the AAIW variability. These findings demonstrate the sensitivity of the low-latitude intermediate ocean on perturbations of the Atlantic Meridi-

onal Overturning Circulation at high northern latitudes.

References

Bryan SP, Marchitto TM (2008): Mg/Ca - temperature proxy in benthic foraminifera: New calibrations from the Florida Straits and a hypothesis regarding Mg/Li.. Paleoceanography 23: PA2220

Pahnke K, Goldstein SL, Hemming SR (2008): Abrupt changes in Antarctic Intermediate Water circulation over the past 25,000 years. Nature geoscience 1: 870-874

69: IS3 Archives of Environmental Evolution and Climate Change, oral

Element compositions of eolian dust along the West-African Coast: Possible indication, natural variation, and implication for reconstruction of paleoclimate

Kallweit W, Zabel M

Universität Bremen, Fachbereich 5 Geowissenschaften, Abteilung Geochemistry and Hydrogeology, Postfach 330400, 28334 Bremen, Germany, ,
Email: kallweit@uni-bremen.de & *mzabel@uni-bremen.de*

The dominant portion of the mineral dust load of the atmosphere originates from the African continent. Particularly the Sahara desert and its peripheral areas are the predominant source areas nowadays and during early history. Not only the quantity, but also the composition of the eolian particles is controlled by climatic conditions. Beside the geological situation (bedrock types), especially the regional specific hydrology (vegetation, weathering conditions) and the wind field (transport energy) are the most important control parameters. Although these general connections could be proven by numerous, mainly paleoceanographic studies, a lot of open questions exist on the influence of processes that may alter the primary terrigenous signal until its preservation in the marine sediment record. One aim of the study presented here is to improve our knowledge in this field of research.

From 18 to 2008 we have sampled the eolian dust load at sea level off the West-African coast during different seasons on ten cruises e.g. with the German RVs Meteor and Poseidon. Additionally, since 2005 the suspension load of the water column could be sampled sporadically. First results on the dust fraction have revealed that its amount, its composition, and its grain size distribution reflect the different vegetation zones and wind fields along the West-African coast. Some data could be used to identify single source areas (Stuut et al. 2005, and unpubl. data), but on the other side new data on the element composition of dust particles at single locations also show a great short term variability. Regarding the duration of dust outbreaks visualised by satellite observation, this has had to be expected. However, as a consequence

of this finding the common simple interpretation of specific element concentrations in sediments should be reassessed, particularly as our data from the water column give strong indication that the primary input signal significantly alters during particle sinking.

References

Stuut JB, Zabel M, Ratmeyer V, Helmke P, Schefuß E (2005): Provenance of present-day eolian dust collected off NW Africa. J. Geophys. Res. 110: D04202

70: TS3 Geomicrobiology and Biogeochemistry, oral (Invited Keynote)

Formation and transformation of iron minerals by Fe(II)-oxidizing and Fe(III)-reducing bacteria

Kappler A

Geomicrobiology, Center for Applied Geosciences, University of Tuebingen, andreas.kappler@uni-tuebingen.de

Iron is present in almost all terrestrial and aquatic systems with ferrous iron [Fe(II)] and ferric iron [Fe(III)] being the two most important redox states. Microbes are able to harvest energy from anaerobic and aerobic oxidation of dissolved Fe(II) at neutral pH precipitating Fe(III) mineral phases. Aerobic neutrophilic Fe(II)-oxidizers are even able to successfully compete with abiotic O_2-dependent Fe(II) oxidation. Neutrophilic Fe(III)-reducing bacteria are able to grow by oxidation of organic matter or dihydrogen and electron transfer to poorly soluble Fe(III) oxyhy droxides using different bio(geo)chemical mechanisms. Direct contact to the Fe(III) minerals, Fe(III) complexation and thus Fe(III) solubilization or the use of dissolved electron shuttles such as naturally occurring humic substances was shown to be used to reduce and dissolve Fe(III) minerals. Iron redox cycling at neutral pH is closely related to mineral precipitation, dissolution and transformation and is therefore inherently linked to the environmental behaviour of nutrients, trace metals and pollutants. This talk will discuss these different iron biogeochemical processes and give examples for the environmental impacts of iron mineral transformation.

71: TS2 Geology of Extreme Earth Environments, poster

Volcano reconstruction and erosion rate calculation on Miocene to Holocene stratovolcanoes in the arid-hyperarid Central Andes

Karátson D, Telbisz T, Wörner G

Eötvös University, Dept. of Physical Geography, Budapest, Hungary
Georg-August University, Geoscience Center, Göttingen, Germany

Erosion of more than 30 active and extinct stratovolcanoes of the Central Andes in Peru-Chile-Bolivia-Argentina (15-21° S and 68-72° W) has been studied by quantitative DEM analysis. We started from the present surface using the 90-m resolution SRTM data base. By creating derivative maps (e.g. slope, ridge maps) and circularity plots, we investigated how erosion operates with time and what kinds of erosion pattern result with respect to climate, elevation and latitudinal position. Valley development was enhanced by episodic glaciations and has played a key role in the typical evolutionary scheme of stratovolcanoes. Location with respect to deep, major canyons on the western flank of the Andean slope may also have been important.

We distinguished (1) crater-topped active/dormant volcano (e.g. Parinacota), whose "ideal" actual shape can be used for reconstructing the eroded cones; (2) cone-shaped volcano with initial planezes without crater (e.g. Sajama) or with enlarged erosion crater (e.g. Cerro Mamuta), depending mainly on the presence/absence of glaciation; (3) truncated cone with planèzes (e.g. C. Asuasuni/Larancagua), (4) eroded cone with planèze remnants and remnant peaks in the centre (e.g. C. Analajsi); (5) "valley-stage" volcano where headward erosion and coalescence of large valleys result in a degraded, lowered summit (e.g. C. Jatunpuco). Original cones can be reliably reconstructed by using the planèze remnants (that can survive especially under arid climates). Infilling the valleys that propagated on the stratocone flanks and fitting the original ideal cone to the present surface made it possible to calculate original volumes. When calibrated to dated volcanic edifices, the quantification of erosionally removed volumes can be used as a tool for geomorphological dating. Due to the moderate erosion rates, even the Miocene volcanoes have lost only <50 % of their volumes, making it possible to determine long-term erosion rates.

72: TS2 Geology of Extreme Earth Environments, oral

Ordovician Acid Rain and its effects onto sedimentation: an Example from western Laurentia

Keller M, Lehnert O

Universität Erlangen, Geozentrum Nordbayern, Abt. Krustendynamik, 954 Erlangen, Schlossgarten 5, keller@geol.uni-erlangen.de

In western Laurentia, a thick Paleozoic succession is exposed that shows multiple paleokarst horizons. Karstification culminated during the Ordovician (Sandbian) close to the top of the Sauk megasequence. Within this paleokarst succession, there is a systematic increase in depth of erosion and intensity of weathering from the base of the system towards the Sandbian. After deposition of the Ninemile Shale (Floian), the amount of fine-grained detrital material is drastically reduced at the expense of quartz sand. Sand deposition culminated with the formation of the Eureka quartzite (Katian). The Eureka is enigmatic in that, in the southern Great Basin, it is the only prominent (~ 150 m thick) pure quartz sand unit within a thick (several 00 m) Cambrian through Devonian dominantly carbonate platform succession. It is argued that Ordovician volcanism was the ultimate trigger for increasing karstification and increasing quartz sand production. Ordovician volcanism culminated during the Sandbian/Katian with the deposition of the Deicke and Millbrig/Kinnekulle K-bentonites in eastern Laurentia and Laurentia-Baltica, respectively. These were the most giant ash-fall events of the entire Phanerozoic. Concomitant emissions of volcanic gases, especially SO_2, led to acid rain that sped up karstification so that destruction of carbonates per unit of time increased considerably in comparison to other intervals. As a consequence, only relatively short times were needed to develop a mature karst system. In addition, more violent weathering led to the break down of unstable minerals and providing an increasing amount of quartz sand. Finally, the onset of glacial events during times of maximum volcanism apparently is no coincidence. The corresponding sea-level drawdown exposed additional areas to weathering, enhancing the production of quartz sand. During the ensuing sea-level rise, a further cleaning of these sands may have taken place in shallow-marine depositional environments.

73: TS1 Early Planets and Life, oral

Experimental impact cratering, numerical validation, and field work: Strategies to understand the bombardment of the Early Earth

Kenkmann T, Thoma K, Deutsch A, MEMIN-Team

Museum für Naturkunde Berlin (MFN), Ernst Mach Institut Kurzzeitdynamik (EMI)
Institut für Planetologie, WWU Münster
Dresen, G. (GFZ), Grosse, C. (Univ. Stuttgart), Hecht, L., Poelchau, M. H., Reimold, W. U. Schmitt, R.-T., Wünnemann, K. (MFN), Hiermaier, S. Schäfer, F. (EMI), Wenk, H. R. (Berkeley)

The heavily cratered lunar surface testifies to the fundamental role hypervelocity impacts have played in the evolution of the Earth-Moon system. Compared with the approximately constant impact flux of the last three billion years, the collision rate in Hadean and Early Archean times was higher by a factor of 0-00. Thus, impact cratering was by far the most important surface-shaping process of that period, determining relief, composition, and temperature of the planetary surfaces. Large impacts most likely caused re-cycling of the early crust. In addition, impacts of comets and carbonaceous chondrites have delivered substantial amounts of water and probably organic molecules to the early Earth.
To understand the dynamics of impact processes and their environmental consequences, a *M*ultidisciplinary *E*xperimental and *M*odeling *I*mpact Research *N*etwork (*MEMIN*) was recently established as a research unit (DFG-Forschergruppe). Central to MEMIN are newly designed two-stage light gas guns capable to produce craters in the decimeter-range in solid rocks, a size that enables sophisticated in situ, and real-time analyses, as well as detailed post-mortem spatial analyses. Our parameter study focuses on the role of water, porosity, target layering, and impact velocity on cratering mechanics, shock effects, as well as projectile and ejecta distribution during cratering. The work program includes complete mineralogical-petrophysical, and mechanical characterization of the target prior to and after the experiment. Numerical modelling of the impact process is crucial for setting up the experiments, controling and understanding the results, and for extrapolation to natural impact craters that are subject of recent field studies. MEMIN will further our understanding of impact damaging of planetary surfaces and refine the possibilities to scale impact phenomena from the laboratory scale to natural craters.

74: IS4 Magmatism and Earth Evolution, oral

The Sr-Nd-Hf-Pb isotopic evolution of post-collisional high-K basalts and shoshonites

Kirchenbaur M, Münker C, Marchev P

Steinmann Insitut, Universität Bonn, Germany
Mineralogisches Institut, Universität zu Köln, Germany
Geological Insitute of Bulgarian Academy of Sciences, Sofia, Bulgaria

High-K basalts and shoshonites are an important trace element-enriched end-member among subduction zone rocks. They mainly occur in post-collisional settings or in arc systems with a high flux of subducting sediments. Two major models have been proposed to explain the unusual isotope and trace element compositions found in K-rich mafic volcanic rocks: (1) derivation from an old enriched lithospheric mantle source or (2) source enrichment by contemporaneous subduction.

In order to investigate the unusual trace and isotope compositions of K-rich subduction-related rocks, we studied a suite of syn- to post-collisional lavas from the Eo-Oligocene Eastern Rhodope province (SE Bulgaria) with a compositional spectrum ranging from medium-K, high-K lavas to shoshonites and absarokites. The suite was analyzed for Sr-Nd-Hf-Pb isotope compositions and we also obtained some first high-precision HFSE concentration data. Isotope measurements and high precision HFSE analyses were carried out using the multicollector ICP-MS at Bonn.

In $^{87}Sr/^{86}Sr$ - εNd space the samples define a negative trend typical for potassic rocks with radiogenic $^{87}Sr/^{86}Sr$ (0.7070 to 0.7085) and unradiogenic εNd (-5 to -1.5). Within εHf-εNd space, the samples broadly define the expected positive trend but are offset from the mantle array towards more unradiogenic εNd (εHf -0.4 to +3). Pb isotope compositions indicate an important role of subducted sediments.

Combining isotope systematics and HFSE concentration data of the Bulgarian sample suite, we conclude that the source region underwent a fairly recent overprint by sediment-derived subduction components rather than originating from older lithosphere.

75: IS3 Archives of Environmental Evolution and Climate Change, oral

The impact of cold events on the Northern Aegean region from 17 000 to 7000 years BP deduced from terrestrial and marine palynological records

Kotthoff U, Pross J, Schmiedl G, Marino G, Müller UC, Peyron O

Institute of Geosciences, University of Frankfurt, Altenhöferallee 1, D-60438 Frankfurt, Germany

While the impact of cold events on terrestrial ecosystems during the last glacial termination and the early Holocene is relatively well understood, there is still a lack of high-resolution vegetation and climate data for the eastern Mediterranean region. More specifically, the impact of the 8.2-kyr event, the Younger Dryas (YD) and especially of the Heinrich-1 (H1) event on the vegetation development in this area is only poorly examined.

We used a marine core from the northern Aegean Sea, and a terrestrial core from the Drama Basin, NE Greece to carry out dinocyst- and pollen-based vegetation and climate reconstructions. Pollen-based quantitative reconstructions suggest that temperature and precipitation controlled vegetation dynamics until ~15.5 kyr BP. The H1 event is reflected in marine proxies and in the coastal vegetation of the northern Aegean region, but not in the vegetation of the hinterland. Between ~15.5 and ~12.7 kyr BP, temperatures were already comparable to early Holocene conditions, and moisture availability was the major controlling factor for vegetation development. During the Bølling/Allerød interstadial complex, moisture availability was higher than during the preceding interval. The following YD was almost as dry as and probably even colder than the late Pleniglacial.

Until ~11.5 kyr BP, changes in arboreal vegetation show a close temporal correlation with Greenland ice cores, indicating a strong teleconnection between the high and the middle latitudes. During the interval from ~9.5 to ~7 kyr BP, terrestrial climate dynamics were more strongly affected by the monsoonally-influenced climate system of the lower latitudes, with the exception of the North-Atlantic-related 8.2 ka event. This event, in opposite to the H1 event and the YD, is more strongly reflected in the northern Aegean hinterland than in the coastal areas, probably due to mesoclimatic effects in the Drama Basin.

References

Kotthoff U, Pross J, Müller UC, Peyron O, Et al. (2008): Climate dynamics in the borderlands of the Aegean Sea during formation of Sapropel S1 deduced from a marine pollen record. Quaternary Science Reviews 27: 832-845

76: IS1 New Analytical Techniques, oral

The Marine Strontium Budget Derived from Paired ($^{87}Sr/^{86}Sr^*$-$\delta^{88/86}Sr$) Values of Marine Carbonates, Hydrothermal Fluids and River Waters

Krabbenhoeft A, Eisenhauer A, Böhm F, Liebetrau V, Peucker-Ehrenbrink B, Hansen B

IFM-GEOMAR, Leibniz Institute of Marine Science, Wischhofstr. 1-3, 24148 Kiel, Germany

With the normalization to a fixed $^{88}Sr/^{86}Sr$=8.375209 ratio to correct for mass dependent fractionation during TIMS measurement any natural Strontium (Sr) isotopic fractionation in $^{88}Sr/^{86}Sr$ is ignored and important additional information are lost. A first study performed with a MC-ICP-MS (Fietzke and Eisenhauer, 2006) showed significant fractionation between the IAPSO seawater standard and the SRM987 carbonate standard in the $\delta^{88/86}Sr$ value. However, with the application of the Sr double spike TIMS technique (Krabbenhoeft et al., 2009) we are now entering a new dimension in Sr isotope geochemistry by the simultaneous measurement of paired $^{87}Sr/^{86}Sr^*$-$\delta^{88/86}Sr$ values of geological samples. The most important advantage of using paired $^{87}Sr/^{86}Sr^*$-$\delta^{88/86}Sr$ values is that now a complete balance of the oceans Sr budget can be calculated including Sr input and output values. In order to provide a Sr isotope balance for the global ocean we collected paired $^{87}Sr/^{86}Sr^*$-$\delta^{88/86}Sr$ values of a set of river waters samples, hydrothermal fluids, major marine carbonate producers and seawater. In a 3-isotope-plot the IAPSO seawater standard and the the paired $^{87}Sr/^{86}Sr^*$-$\delta^{88/86}Sr$ values of marine carbonates are connected by a fractionation line, whereas the paired $^{87}Sr/^{86}Sr^*$-$\delta^{88/86}Sr$ values of river waters and hydrothermal fluids are connected by a binary mixing line. The intercept of these lines provides the isotopic composition of the marine input ($^{87}Sr/^{86}Sr^*$=0.709314(9) - $\delta^{88/86}Sr$=0.284(24)). The major Sr output corresponds to the Sr incorporated by the major marine calcifiers ($^{87}Sr/^{86}Sr^*$=0.709312(9), - $\delta^{88/86}Sr$=0.240). The offset indicates that modern ocean is apparently not in steady state with respect to Sr. Weathering of young carbonates on the shelfes during sea level low stands can shift the $\delta^{88/86}Sr$ of rivers from its recent value of 0.300(24) to 0.23‰ to equilibrate in- and output.[AE1]

References

Krabbenhoeft A, Fietzke J, Liebetrau V, Böhm F, Vollstaedt H (2009): Determination of radiogenic and stable strontium isotope ratios ($^{87}Sr/^{86}Sr$; $\delta^{88/86}Sr$) by thermal ionization mass spectrometry applying an $^{87}Sr/^{84}Sr$ double spike. JAAS 1: 1

Fietzke J, Eisenhauer A (2006): Determination of temperature-dependent stable strontium isotope (Sr-88/Sr-86) fractionation via bracketing standard MC-ICP-MS. Geochem. Geophys. Geosyst. 7: 1

77: TS3 Geomicrobiology and Biogeochemistry, oral

Dissolution of carbonates caused by the activity of marine aerobic methanotrophic bacteria

Krause S, Aloisi G, Liebetrau V, Treude T

Leibniz Institute of Marine Sciences (IFM-GEOMAR), Wischhofstraße 1-3, 24148 Kiel, Germany, skrause@ifm-geomar.de

Marine sedimentsare a major source of global methane. However, the bulk of methane never reaches the atmosphere, because it is consumed by microorganisms in the sediment and in the water column.Whilst a microbial consortium of methanotrophic archaea and sulfate-reducing bacteria consume methane with sulfate in anoxic parts of sediment, methanotrophic bacteria are responsible for aerobic oxidation at the sediment-water interface and in the water column.In contrast to the anaerobic pathway, which facilitates the precipitation of carbonates , aerobic oxidation of methane leads to ocean acidification posing a threat to the stability of adjacent carbonate structures. Laboratory closed system experiments were carried out to investigate the influence of aerobic methane-oxidizing bacteria (MOB) on carbonate crystals.Our studies demonstrated that the activity of MOB can lead to a substantial decrease of pH inducing calcite dissolution and alteration of the carbonate system. Electron-microscopic analyses of calcite crystals exposed to MOB revealed that dissolution affects relatively large surface areas rather than only restricted spots.Our results support recent studies, which suggest that direct cell surface contact is not required to change crystal surfaces. The experimental results were incorporated into a numerical model linking aerobic microbial methane consumption to induced calcite dissolution and to changes in the carbonate system. The model allowed simulations of changing methane consumption rates, pH and temperature.

78: IS3 Archives of Environmental Evolution and Climate Change, poster

A high-resolution sedimentary archive of Holocene climatic and environmental changes in the Seno Skyring fjord system, Southern Patagonia

Kremer K, Kilian R, Thiel V, Wörner G

Georg August Universität, GZG, Geochemistry, Germany, 37077 Göttingen, Goldschmidtstr.1, kkremer@gwdg.de

A sediment core of 8.2 m was retrieved at Bahia Williams from 35 m water depths at the northern shore of Seno Skyring, Southern Andes (53°S), a marine fjord and ancient proglacial lake (Kilian et al., 2007) to document sedimentation of the last

8000 years. The purpose was to obtain a high-resolution climatic and environmental record. Geochemical parameters of the sediment core were measured with XRF core scanner combined with Micro-XRF and CNS analyses.

Sediments of the lowermost 3 meters of the core are composed of silty to clayey material intercalated with coarse-grained, sandy, layers indicating a lower water level and a coastline near the site. TOC and Br contents as well as Fe/Mn ratios are low while terrigeneous input is high. The low Fe/Mn ratios suggest oxic conditions (Haberzettl et al., 2007). During this period Br content indicates salinities of about 14 ‰ if all Br comes from pore water, while actual salinities in Seno Skyring are around 20 ‰.

After the Mt Burney tephra layer at 4.185 years B.P. a second more fine clastic clayey-silty sedimentation period starts, indicating a significantly higher water level, possibly due to an isostatic depression by increase of Neoglacial glacier load of the Andes. This section shows an upward increase in TOC, S and Br contents and Fe/Mn ratio to the Present. The increase in Fe/Mn suggests increasing anoxic conditions. This agrees with increasing S resulting from sulfate reduction of bacteria and/or from an increased terrestrial organic input due to plant decay caused be the effects of the eruption. Increasing Br contents can be interpreted as an increase of salinity up to 20‰. But even a salinity of 35‰ cannot explain the highest Br concentration of up to 150 ppm. We assume that Br is additionally bound in marine organic material.

Environmental changes at Bahia Williams will be compared with other cores of the area for a more regional interpretation of paleoclimate.

References

Haberzettl T, Corbella H, Fey M, Janssen S, Lücke A (2007): Late glacial and Holocene wet-dry cycles in southern Patagonia: chronology, sedimentology and geochemistry of a lacustrine record from Laguna Potrok Aike, Argentina. The Holocene 17: 297

Kilian R, Schneider C, Fesq-Martin M, Biester H, Casassa G (2007): Palaeoecological constrains on late Glacial and Holocene ice retreat in the Southern Andes (53°S). Global and Planetary Change 59: 49

79: OS Open Session, poster

Significance of Electromagnetic Radiation (EMR) measured along N-S profiles from Southeast Sweden to Central Europe - natural or anthropogenic sources?

Krumbholz M, Vollbrecht A, Burchardt S

Michael Krumbholz, Geoscience Center Göttingen, University of Göttingen, Goldschmidtstr. 1-3, 37077 Göttingen, Germany, mkrumbh@gwdg.de

Based on experimental studies and theoretical approaches, it is assumed that the direction of electromagnetic emissions in rocks correlates with the propagation direction of microcracks (e.g. Koktavy et al., 2004). Thus, in recent years an increasing number of studies have been performed using EMR emissions to determine main horizontal stress directions in the upper crust (e.g. Reuther and Moser, 2009), assuming that microcracks growth occurs in a plane parallel to $\sigma 1$. Another application of EMR method is in the field of earthquake forecast.

In this study, first results of EMR measurements on three 500 – 1000 km long profiles that run from Central Germany to Southeast Sweden are presented. The profiles consist of more than 70 measuring points with a spacing of 20 to 50 km. In addition, measurements at 6 other sites were performed (e.g. Lanzarote, Canary Islands, Spain; Venlo, Netherlands).

In parts, the main EMR directions correlate well with main horizontal stress directions determined with well-established methods (e.g. hydrofracturing, see World Stress Map). However, a plot of all main EMR directions on a map displays a concentric pattern with a common centre, with only a few exceptions. This center is situated near Papenburg, Lower Saxony and coincides with the position of DHO38, a NATO VLF transmitter. Likewise, some previously published EMR data, which were related to in situ-horizontal stress configurations fit into this concentric pattern, and hence may have to be re-interpreted (including studies on earth quake predictions).

80: OS Open Session, poster

Snowline Variations and Different Morphodynamic Processes as a Consequence of Petrographical and Tectonical Structure Variations Observations on Geomorphology in the Phu-Khola (Nepal-Himalaya)

Künkel H

University of Göttingen, Geographical Institute, Dept. Of High Mountain Geomorphology and Geography,
Germany, Goldschmidtstr. 5, 37077 Göttingen, hkuenke@gwdg.de

In 2007 a four-week expedition to the almost unknown area of Damodar Himalaya was carried out with the aim to work out the altitudinal zonation of geomorphological processes depending on topography and climate. Two facts turned out to be determinating for the detectability of altitudinal limits of geomorphological processes apart from climate: First the geological structure, especially the orographical variation within the catchment area; with mesozoic Tethys-sediments of the Inner Himalaya in the western part and the tectonically uplifted palaeozoic Manaslu-crystalline as a part of the Himalaya Main Ridge in the eastern part and second the large scale sedimentation of late quarternary moraine deposits. The petrographical change causes significantly higher erosion rates in the crystalline area due to the higher elevation and steeper flanks. As a result the quaternary debrismaterial is almost completely excavated and plain rock surfaces build out the flanks. Material deposits in which geomorphological processes (i.e. freeze-thaw processes) could create evident geomorphological key forms for altitudinal limits (i.e rock glaciers as indicators of permafrost) are missing and therefore a differentiated altitudinal zonation of geo-morphological processes is not possible there. In contrast to that in the western Tethys-area an almost complete zonation of periglacial process limits has been proven by geomorphological evidence in the Mesozoic sediment zone. A second unambiguous difference caused by the petrographical and tectonical variation are the extent of glaciation and differences in the microclimate. Due to higher altitude, the catchment area of the glaciers in the crystalline area is bigger, with the consequence that the glacier-termini reach more than 500 m further down than in the less high sediment zone in the western part of the catchment area. This indicates a local climate variation caused by the topography because all other influence-factors are excluded

81: IS3 Archives of Environmental Evolution and Climate Change, oral

Antarctic geological drilling ANDRILL: results of the first two projects

Kuhn G, MIS and SMS Science Team

Alfred-Wegener-Institut für Polar- und Meeresforschung,
Germany, 27568 Bremerhaven, Am Alten Hafen 26, Gerhard.Kuhn@awi.de

The Antarctic geological DRILLing Program (ANDRILL) is an international collaboration between Germany, Italy, New Zealand, the United Kingdom and the United States. By drilling and pre-investigating a series of targeted sites ANDRILL recovers stratigraphic records from the Antarctic margin that are vital to address scientific questions regarding the past and future behavior of Antarctic ice sheets, the evolution of tectonic basins and related sedimentation, and in general the geological history of this continent. Two projects were undertaken during the International Polar Year. The McMurdo Ice Shelf (MIS) project was drilled 2006/07 and the Southern McMurdo Sound (SMS) project end of 2007.

With 1285 meters below the sea floor and a rock recovery of more than 98% the MIS drilling was record-breaking in Antarctica. The analyses of the core are exciting as well. Diatomites and diamictites indicate substancial glacial/interglacial climatic variation over the past ~14 million years, revealing the history and stability of the Ross Ice Shelf and the hereto related West Antarctic Ice Sheet. Volcanic components together with other parameters provide a relyable age control of the sequence. Geochemical characterization of the core allows the reconstruction of sediment provenances, the paleoclimatic settings and discovered an early diagenetic dolomite precipitation in these glaciomarine environments.

The SMS project drilled 1138 meters of rock core with identical good recovery. The Mid-Miocene Climate Optimum (15 to 18 million years ago) a period much warmer than today is recorded with high sedimentation rates of 20 cm/k.y. between 200 and 800 mbsf. Sedimentary and geochemical cycles reveal changes in sedimentation processes related to past climate and sea level history.

82: TS3 Geomicrobiology and Biogeochemistry, oral

A miniaturized approach to study chemoherm carbonates from Hydrate Ridge

Leefmann T, Kronz A, Liebetrau V, Schmidt BC, Reitner J, Thiel V

Geoscience Centre, University of Göttingen, Germany, tleefma@gwdg.de
IfM-GEOMAR, Kiel, Germany

Chemoherm carbonates from Hydrate Ridge consist of complex assemblages of microbially mediated mineral precipitates. However, the linkage between the different mineral phases and specific organisms involved in their precipitation is as yet unclear. We used a miniaturized sampling technique for lipid biomarkers and carbonate isotopes combined with spatially highly resolved Raman spectroscopy and electron microprobe (EMP) analysis to study these linkages and trace specific biosignatures within the chemoherm carbonates.

Raman spectroscopy and phase-specific biomarker analyses revealed that high amounts of organic carbon and specifically lipids related to the anaerobic oxidation of methane (AOM) are concentrated within a minor mineral phase, whitish aragonite. In a further, macroscopically lucent aragonite phase, only trace amounts of lipid biomarkers were detected. A third phase, gray micrite, showed minor amounts of AOM-biomarkers but a strong signal of water-column derived compounds. Element mappings of the areas sampled for biomarkers showed specific inorganic traits for the distinct phases whereas $\delta^{13}C_{carbonate}$ values of all phases are well in the range of methane-derived seep carbonates.

The phase-specific biomarker results suggest that the whitish aragonite represents fossilised biofilms of consortia of mainly ANME-2 archaea and sulphate reducing bacteria, whereas the lucent aragonite most likely lacked the immediate proximity of microorganisms during formation. By contrast, the gray micrite formed by incorporation of allochthonous organic and inorganic matter during carbonate precipitation induced by AOM.

83: IS4 Magmatism and Earth Evolution, oral

Thick lithosphere in India 65 million years ago, as opposed to thin lithosphere today

Lehmann B, Burgess R, Frei D, Belyatsky B, Mainkar D, Chalapathi Rao NV

Mineral Resources, Technical University of Clausthal, 38678 Clausthal-Zellerfeld, Germany
Earth Sciences, University of Manchester, Manchester M13 9PL, UK
Geological Survey of Denmark and Greenland (GEUS), 1359 Copenhagen, Denmark
Precambrian Geology and Geochronology, Russian Academy of Sciences,
1034 St Petersburg, Russia
Directorate of Mines and Energy, 492007 Raipur, Chhattisgarh, India
Geology, Banaras Hindu University, 2205 Varanasi, Uttar Pradesh, India

India is known for its historic diamonds from alluvial gravels. The source rocks for these diamonds are thought to be among the so far nearly 0 identified kimberlite/lamproite pipes and dikes which occur mostly in the Dharwar craton (Andhra Pradesh) and the Bundelkhand craton (Madhya Pradesh), and which all have Mesoproterozoic ages with a peak at 1.1 Ga (Kumar et al. 13). However, diamondiferous kimberlite pipes in the recently discovered Mainpur kimberlite field in central India have surprisingly young $^{40}Ar/^{39}Ar$ whole-rock ages of 66.5 ±2.0 and 62.4 ±2.9 million years (2σ), confirmed by more precise laser ablation ICP-MS $^{206}Pb/^{238}U$ perovskite data of 65.1 ±0.8 and 62.3 ±0.8 Ma (2σ). These ages overlap with the main phase of the Deccan flood basalt magmatism at 65 million years, and suggest a common tectonomagmatic control for both flood basalts (including carbonatite-alkaline rock variants) and kimberlites. The kimberlites were studied in drill core (Mainkar and Lehmann 2007) and have textural, bulk and mineral chemical composition typical of orangeite (African kimberlite Group 2), confirmed by Sr and Nd isotope data. The presence of macrodiamonds in the pipes implies that Central India had a cool and thick lithospheric mantle root at the Cretaceous/Tertiary boundary of at least 140 km thickness (graphite/diamond equilibrium), significantly different from the modern Indian lithosphere of about 80-0 km thickness only (Kumar et al. 2007). The loss of Indias cratonic roots must have taken place in the Tertiary, i.e. after much of the superfast northward motion of the Indian plate from Gondwana break-up at about 130 million years until the collision with Eurasia at about 50 million years ago. Indias unique plate-tectonic behavior in the Cretaceous cannot be related to a plume-eroded lithosphere. About one third of the Indian lithosphere was lost during or after the Deccan flood basalt event.

References
Kumar A, Padma Kumari VM, Dayal AM, Murthy DSN, Gopalan K (1993): Rb-Sr ages of Proterozoic kimberlites of India: evidence for contemporaneous emplacement. Precamb Res 62: 227-237
Kumar P, Yuan X, Kumar MR, Kind R, Li X (2007): The rapid drift of the Indian tectonic plate. Nature 449: 894-897
Mainkar D, Lehmann B (2007): The diamondiferous Behradih kimberlite pipe, Mainpur Kimberlite Field, Chhattisgarh, India: reconnaissance petrography and geochemistry. J Geol Soc India 69: 547-552

84: IS3 Archives of Environmental Evolution and Climate Change, oral

Short-term fluctuations in lacustrine sedimentation during the Middle Eocene greenhouse climate: a 600 kyr record from the Messel oil shale (Germany)

Lenz OK, Wilde V, Riegel W, Harms FJ

Technische Universität Darmstadt, Institut für Angewandte Geowissenschaften, Angewandte Sedimentgeologie, Germany, D-64287 Darmstadt, Schnittspahnstrasse 9;
lenz@geo.tu-darmstadt.de
Seckenberg Forschungsinstitut und Naturmuseum, Sektion Palaeobotanik,
Germany, D-60325 Frankfurt am Main, Senckenberganlage 25;
volker.wilde@senckenberg.de, harms.messel@t-online.de
University of Goettingen, Geowissenschaftliches Zentrum, Abteilung Geobiologie,
Germany, D-37077 Göttingen, Goldschmidtstrasse 3;
wriegel@gwdg.de

The oil-shale of the Middle Eocene maar lake of Messel is one of the world's best known "*Fossillagerstätten*". A continuous core drilled in 2001 in the center of the basin provided a complete reference section of the lake deposits representing a unique climate archive for the Middle Eocene in Central Europe. The classical "Messel oil-shale" is characterized by a continuous succession of finely laminated bituminous claystones, representing long-term stable meromictic conditions. They show a very fine light/dark lamination, which is the product of annual algal blooms of the coccal green alga *Tetraedron minimum*. Therefore, individual laminae consist of a light spring/summer algal layer and a dark winter layer composed of terrigenous background sediment. Since varved maar lake deposits have served as accurate archives of climatic changes during the Quaternary, we used the core Messel 2001 to test whether subtle changes during the stable greenhouse phase of the Eocene are recorded in the Messel oil-shale. For that purpose four suitable slices of the section,

each about 4 - 7 cm in length, were selected from the core in order to count varves. The data of total varve thickness and the thickness of light and dark laminae were treated with spectral analyses. Fluctuations are significant in the quasi-biennial (2.3 - 2.4 yr) and low-frequency band (2.8 - 3.5 yr, 4.9 - 5.6 yr) thus showing that algal growth as well as the background sedimentation were controlled by El Niño/ENSO effects at least over a time interval of 600 kyr. This confirms the existence of a stable "Eocene El Niño". Significant signals of quasi-decadal (- 12 yr), interdecadal (17 - 22 yr) and multidecadal fluctuations (~52 yr, ~82 yr) show the enduring influence of cyclic instabilities which are comparable to the modern Pacific Decadal Oscillation.

85: OS Open Session, poster

Seismic interpretation of an active doline area; the 'Bergbad Northeim', southern Lower Saxony, Germany

Liebermann C, Tanner DC, Polom U, Leiss B, Krawczyk CM

Geoscience Center, Georg August University of Göttingen,
Goldschmidtstraße 3, D-37077 Göttingen, chris.liebermann@googlemail.com, bleiss1@gwdg.de
Leibniz Institute for Applied Geophysics,
Stilleweg 2, D-30655 Hannover, DavidColin.Tanner@liag-hannover.de, Ulrich.Polom@liag-hannover.de, lotte@liag-hannover.de

During the winter of 2008/2009, a sinkhole (doline) developed within the grounds of the Northeim swimming pool 'Bergbad'. This is the latest in a series of dolines which have been observed in the area north of Northeim for as long as human occupation has taken place.

The dolines are situated on the eastern shoulder of the N-S trending Leinetal graben-structure. Stratigraphically, the surface of the sinkhole is situated at the boundary of the upper Muschelkalk/lower Keuper. The middle Muschelkalk is assumed to be the horizon that is karsted and collapsing. The reasons for a seismic survey of the dolines within the grounds of the swimming pool are two-fold: (1) Do such data allow an evaluation of the geohazard? (2) are the 'collapse structures' fault-bounded, i. e. tectonically controlled?

We carried out two ca. 150m S-wave and one P-wave seismic profiles that strike north-south and east-west. We used a mobile P and S wave source, with sweeps of 60-240 and 20-160 Hz, respectively. The S-wave seismic suggests that there is a system of steeply-dipping faults which can be traced to less than m under the surface. It is probable that the faults strike north-south. The north-south S-wave section also recorded a large-scale downwards flexure which must be related to the stratigraphy.

From the first data processing, we cannot directly detect a collapse structure

beneath the doline, but we can deduce a probable karst area down to a depth of at least 70 m, with a horizontal extension of about 0 m, which indicates potential for further sinkhole development. The strike and geometry of the faults suggest that the dolines are located within a relay structure instead of an initially-supposed transverse fault zone."

86: IS3 Archives of Environmental Evolution and Climate Change, oral

The new stable Sr approach on a shallow-marine archive throughout the last 27 Ma: Comparing $\delta^{88/86}$Sr-^{87}Sr/^{86}Sr*, $\delta^{44/40}$Ca, δ^{18}O and Sr/Ca signatures of aragonitic molluscs

Liebetrau V, Eisenhauer A, Krabbenhoeft A, Fietzke J, Boehm F, Ruggeberg A

Leibniz Institute of Marine Sciences, IFM-GEOMAR, RD2 - Marine Geosystems, Wischhofstr. 1-3, 24148 Kiel, Germany, vliebetrau@ifm-geomar.de

Applying a recently developed ^{87}Sr-^{84}Sr double spike the Sr-isotope fractionation for both ^{88}Sr/^{86}Sr and ^{87}Sr/^{86}Sr ratios in water and carbonates can precisely be determined using the TIMS [1]. Measurements of seawater standard (IAPSO, $\delta^{88/86}$Sr=0.382(11) ‰) and JCp1-coral standard (0.193(9) ‰), are in close accordance to earlier findings [1-3], implying marine carbonates systematically lighter than seawater (JCp-1 about 70ppm even in ^{87}Sr/^{86}Sr*). Note, samples from different marine environments (shallow brackish Baltic Sea, N- and E-Atlantic, Mediterranean Sea) reflect homogeneous signatures close to IAPSO. 13 bulk carbonate samples of aragonitic composition, representing marine shallow water molluscs (0 to 0m water depth) with close correlation of bio-stratigraphic ages and Sr isotope stratigraphy (SIS), are covering an age range from the Late Oligocene to Pleistocene (about 27 Ma).

The $\delta^{88/86}$Sr record reflects an overall variation of about 0.2 ‰ with a minimum value of 0.08 ‰ around 21 Ma followed by a dominant increase of about 0.15 until 17 Ma. This pattern closely correlates with the timing of the highest rate of change in the marine radiogenic Sr record throughout the last 0 Ma at approx. 18 Ma.

The $\delta^{44/40}$Ca values represent a very similar pattern compared to the $\delta^{88/86}$Sr record, just reflecting a higher amplitude with an overall variation of about 0.45 ‰ and minimum value of 0.3 ‰, implying comparable fractionation systematics and/or source changes; Sr/Ca ratios reflect a negative correlation and δ^{18}O values plot rather indepentently from $\delta^{88/86}$Sr. The determined ^{87}Sr/^{86}Sr* seawater record shows higher values than classical normalized ^{87}Sr/^{86}Sr data, with increasing offset at higher $\delta^{88/86}$Sr. Preliminary interpretation take seawater temperature variations and

varying Sr supply from isotopically distinctively different sources into account.

References
Fietzke J, Eisenhauer A (2006): Determination of temperature-dependent stable strontium isotope (88Sr/86Sr) fractionation via bracketing standard MC-ICP-MS.. Geochemistry, Geophysics, Geos 7 (8): Q08009
Halicz L, Segal I, Fruchter N, Stein M, Lazar B (2008): Strontium stable isotopes fractionate in the soil environments?. Earth Planet. Sci. Lett. 272: 406-411
Krabbenhöft A, Et al. (2009): Ocean Sr-budget from paired δ88/86Sr and 87Sr/86Sr*-ratios. Geochim Cosmochim Acta 73: A 694

87: TS3 Geomicrobiology and Biogeochemistry, oral

Time scales of microbial mediated precipitation processes of cold seep carbonates: Comparison of different geological settings and analytical perspectives

Liebetrau V, Eisenhauer A, Fietzke J, Reitner J, Seifert R, Linke P

Leibniz Institute of Marine Sciences (IFM-GEOMAR),
Wischhofstr. 1-3, 24148 Kiel, Germany, vliebetrau@ifm-geomar.de
Geowissenschaftliches Zentrum Göttingen, Univ. Göttingen,
Goldschmidtstr. 1-3, 37077 Göttingen, Germany
Institute of Biogeochemistry and Marine Chemistry, Univ. Hamburg,
Bundesstr. 55, 20146 Hamburg, Germany

Cold seep ecosystems are often characterized by microbial mediated carbonate precipitation processes, due to interaction between methane-rich fluid and biological activity. The understanding and quantification of potential feedback mechanisms between marine methane sources and changes in ocean chemistry and climate requires detailed data about the dynamics of methane emanation processes at the seafloor throughout time.

Carbonates from these ecosystems provide unique archives of focused marine methane emanation by their geobiological, geochemical, mineralogical and structural inventory. Precise and high resolution geochronology of these geomicrobiological archives allow new insigths into the speed and duration of precipitation processes and microbial activity.

In this study large carbonate samples from very different geological settings of focused cold seep activity are compared in order to investigate their specific time scales and precipitation environment.

Beside new insights into growth structures, emplacement processes and initial

approaches on high resolution geochemistry and biomarker analyses [1], special emphasis was given to the geochronological identification of paleo-vent activity phases. The actual data set is spanning a wide range from almost recent methane related carbonate precipitates from the Black Sea throughout circum Pacific settings (South China Sea, Costa Rica & Nicaragua, New Zealand) back to more than 200 thousand years old archives from Hydrate Ridge (Cascadia Margin, off Oregon). Promising analytical advancement is provided by Laser Ablation U-Th geochronology and the investigation of new environmental proxies like the stable Sr isotope ratio ($\delta^{88/86}$Sr [2]). In a first approach, white biomarker-rich aragonite layers reflected a significant relative increase of 0.094 ± 0.025 ‰, compared to adjacent transparent aragonite, indicating elevated temperature during the precipitation process.

References

Leefmann T, Bauermeister J, Kronz A, Liebetrau V, Reitner J (2008): Miniaturized biosignature analysis reveals implications for the formation of cold seep carbonates at Hydrate Ridge (off Oregon, USA). Biogeosciences 5: 731-738

Fietzke J, Eisenhauer A (2006): Determination of temperature-dependent stable strontium isotope (88Sr/86Sr) fractionation via bracketing standard MC-ICP-MS. G3 7: Q08009

88: TS2 Geology of Extreme Earth Environments, poster

Interaction beetween tectonics and erosion in Taiwan: insights from analogue models

Limoncelli M, Malavieille J, Molli G

Dipartimento di Scienze Geologiche e Geotecnologie, Università di Milano Bicocca, Piazza della Scienza 4, 20126 Milano, Italy
Géosciences Montpellier, University Montpellier 2, 34095 Montpellier, France
Dipartimento di Scienze della Terra, Università di Pisa and CNR Istituto di Geoscienze e Georisorse, Pisa Via S.Maria 53, I, 56126 Pisa, Italy

This study examines the role of erosion on tectonic exhumation and deformation history of accretionary orogens. Our focus is on Taiwan, where interaction between active tectonics, earthquakes and cyclonic storms, are responsible for the highest erosion and deformation rates in the world. Two experiments are used to investigate the effects of erosion in the active bivergent orogenic wedge of Taiwan. The first model of thrust wedge without erosion is used as reference model. The second has been submitted to erosion under flux steady state conditions (1), to simulate an erosion pattern close to what is expected in Taiwan. First model shows the structure,

morphology and evolution of classical high friction thrust wedges. Analytical measurements of the second model with high basal friction submitted to erosion, outline that the presence of weak layers (made with glass microbeads) that mimic décollements in the entering sequence, favors strain partitioning. Basal accretion of thrust units develops an antiformal nappe stack, whose growth and location is enhanced by erosion. A rapid uplift of underplated material occurs in the rear part of the wedge whereas frontal accretion characterizes the front of the growing prism. A zone of high exhumation develops in the retrowedge and migrates toward the backstop with continued shortening. This model is compared to the recent morphostructural evolution of Taiwan. In Taiwan, underplating characterizes the core of the orogenic wedge, where continental units from the subducting eurasian margin develops a regional scale antiformal nappe stack (in the Central Range), (2). Here, metamorphic rocks have been rapidly exhumed (in less than 4 Ma.) from depth of about 15 km due to combined effects of basal accretion and erosion. Our results emphasize the role of crustal décollements the internal dynamics of thrust wedge and how the coupling between tectonics and surface processes controls this dynamics, particularly the exhumation

References

Willett SD, Brandon MT (2002): On steady states in mountain belt.. Geological Society of America v. 30 n.2: 175-178

Lu CJ, Malavieille J (1994): Oblique convergence, indentation and rotation tectonic in Taiwan Mountain belt: Insights from experimental modeling. Earth Planet. Sci. Lett. v.121: 477- 494

89: IS4 Magmatism and Earth Evolution, oral

Geology and exploration geochemistry of the El Volcán Gold Project in the Maricunga Belt, northern Chile

Lohmeier S, Taaks P, Lehmann B, Du A, Burgess R

Mineral Resources, Technical University of Clausthal, Clausthal-Zellerfeld, Germany
Institute for Geoanalysis, Chinese Academy of Sciences, Beijing, China
Department of Earth Sciences, University of Manchester, UK

The El Volcán gold project (Andina Minerals) is in the Maricunga Gold Belt in northern Chile, around 130km to the east of the city of Copiapó at the foot of volcano Copiapó. The 50km² area (4400-5300 m altitude) is explored since 2003 by

surface mapping, sampling and drill programs. The current results define a low-grade gold resource of around 200t of gold (242Mt @ 0.85g/t Au). The Maricunga Belt is situated in the southern part of the Central Volcanic Zone, where normal subduction passes to flat slab subduction. The basement consists of Devonian sedimentary rocks and is intruded by Late Carboniferous to Permian granitoids. Continental andesitic lavas and siliciclastic rocks form the Mesozoic unit. The Cenozoic volcanic rocks are mostly of andesitic to dacitic composition, partly covered by rhyolitic/dacitic ignimbrite blankets which evolved until 5Ma ago. The ore deposits are of a transitional porphyry to epithermal style with high-sulfidation gold-(silver) mineralization.The major ore stages in the Volcán deposit are early porphyry-style quartz veinlets (magnetite-hematite-pyrite-molybdenite-chalcopyrite) and advanced argillic overprint in quartz-alunite-anhydrite veinlets (pyrite-enargite-fahlore-covellite-gold). A remarkable feature of the system is the abundance of anhydrite which occurs together with abundant alunite. The hydrothermal system is dated by Mo-rich bulk ore samples which define a Re-Os isochron age of 11.0 ± 0.2 Ma. Ar-Ar age data on deep potassic alteration and on alunite-altered rock combined define an identical age of 11.20 ± 0.25 Ma. The hydrothermal system is characterized by a spectrum of elements enriched over bulk continental crust: Re (320x), Au (190x), Te (160x), S (90x), As (45x), Mo (35x), Se (28x), Sb (26x), Bi (11x), Cu (x), Hg (8x), Pb (5x) W (5x). Cd, Ag, Sn and Zn are slightly enriched (2-3x). Element correlations define three metal associations: Au-Cu, As-S-Te-Se-Sb-Bi, Mo-Re-W-Sn.

90: OS Open Session, poster

Modern ostracode species assemblages of aquatic habitats in the lowlands and highlands of southern Guatemala for the reconstruction of climate and environmental changes

Lorenschat J, Scharf B, Pérez L, Bugja R, Schwalb A

Technische Universität Braunschweig, Institut für Umweltgeologie,
Germany, Braunschweig, 386, Pockelsstrasse 3, j.lorenschat@tu-bs.de

As indicators of past environments and climate, fossil ostracode assemblages from lake sediments are frequently used. Because their ecology is often poorly understood, a total of 63 lakes and streams were sampled in Yucatán to better understand fossil assemblages. From three lakes in the Guatemalan highlands above 1400 m (Lago de Atitlán, Lago de Amatitlán, Laguna de Ayarza) and two lakes as well as one river in the lowlands below 600 m (Laguna de Atescatempa, Lago de Güija, Río Dulce) located between 14.1° to 15.4° N, and 88.6° to 91.2° W surface and littoral

sediment samples and water samples were collected. Furthermore environmental parameters were surveyed. Based on these parameters, it is possible to describe fossil assemblages and Quaternary climate and environmental changes from long sediment cores, retrieved by the Lake Petén Itzá (Guatemala) Scientific Drilling Project (PISDP).

By using valve and soft part characteristics a total of 14 species were identified. Four species are restricted to the highlands, five to the lowlands, and five occur in both areas. Highland species include *Ilyocypris* cf. *gibba*, *Eucypris* sp., *Limnocythere* sp. and *Chlamydotheca colombiensis*. Lowland sites are characterized by *Thalassocypria* sp. 1 and sp. 2, *Cypretta* sp., *Elpidium bromeliarum* and *Cytheridella ilosvayi*. In both highland and lowland lakes *Darwinula stevensoni*, *Fabaeformiscandona* sp., *Physocypria globula*, *Stenocypris malcolmsoni* and *Cypridopsis vidua* are present. *Fabaeformiscandona* sp. and *P. globula* offer a broad hydrochemical tolerance and wide distribution. The narrowest tolerances show *Thalassocypria* sp. 2, *Cypretta* sp. and *E. bromeliarum*. They were present only in Río Dulce. These results could help to interpret the long sediment core, because the recent highland species could be prominent in the lowland Lake Petén Itzá during the Quaternary cold periods.

91: TS4 Impact of Deep Earth Processes on History, Civilisation and Life, oral, (Gauss-Invited Keynote)

Pulsed Climate Variability Hypothesis: a new theory of Early Human Evolution in Africa

Maslin M

Department of Geography, University College London, Pearson Building, Gower Street, London, WC1E 6BT

The study of past climate has shown that rapid climate changes coincide key stages in the physical and social evolution of humanity. The challenge that we face is understanding whether this relationship is a causal one and if so what is the true influence of climate change. A long-term research collaboration between Potsdam University and University College London has recently published redical new views of the causes of early human evolution.

The new theory, the Pulsed Climate Variability Hypothesis, links speciation of early hominin to periods of extreme climate variability shown by the appearance and disappearance of huge deep fresh water lakes. The appearence of these lakes is only possible due to the development of the East African Rift system. These so called 'amplifier lakes' respond rapidly to moderate, precessional-forced climate shifts, and as they do so apply dramatic environmental pressure to the biosphere. Amplifier lakes may provide the missing link between long-term, high-amplitude tectonic processes and short-term environmental fluctuations and evolution.

92: OS Open Session, poster

Rotational behaviour of complex shaped porphyroblasts during general flow: microstructural investigation of staurolite-mica schist of the Bossòst structural-metamorphic dome, central Pyrenees

Mezger JE

Martin-Luther-Universitaet Halle-Wittenberg, Institut fuer Geowissenschaften, von Seckendorff-Platz 3, 06120 Halle, jochen.mezger@geo.uni-halle.de

Non-equidimensional objects tend to attain stable positions during general flow, their long axes become aligned to the shear plane. The amount of finite rotation therefore depends on the initial orientation of long axes prior to deformation, and can be inferred from inclusion trails preserved in metamorphic porphyroblasts. Staurolite is indicative of middle pressure amphibolite facies forming euhedral poikiloblastic porphyroblasts. In contrast to spherically growing garnets, staurolites have elongated prismatic shapes often occurring as interpenetrating growth twins with a variety of forms, such as crosses. Flow behaviour of staurolite porphyroblasts from the Bossòst structural andmetamorphic dome was investigated by statistical analyses. Angular relations of porphyroblast long axes and inclusion trails (S_i) with the schistosity were measured insections parallel to mineral lineation and perpendicular to schistosity (xz), orthogonal tomineral lineation and schistosity (xy) and parallel to the schistosity plane (xy). Aspect ratios and long axes orientation were obtained from best-fit ellipses calculated with the free-ware ImageJ. Initial pre-deformational growth of staurolite is random. In xz-sections S_i lies at higher angles to S_e as in yz-sections, as to be expected from rotation of staurolite grains in direction indicated by the stretching lineation. Staurolites with a rather spherical shape display continues angles (0–180°) between length axes and S_e, while long axes of staurolites with an elongated shape (aspect ratios >2) cluster at low angles with Se, implying attainment of stable positions of long axes parallel to flow plane. An important parameter is the ratio between long axis length and inclusion trail length. High ratios imply orthogonal long axes-inclusion trails angles and high crystal aspect ratios. Positive correlation with high S_i-S_e angle shows that these porphyroblasts experienced maximum rotation of 1°.

93: IS2 Tectonics and Sedimentation, poster

Jurassic granitoid magmatism in the Dinaride Neotethys: geochronological constraints from detrital minerals

Mikes T, Baresel B, Kronz A, Frei D, Dunkl I, Tolosana-Delgado R, von Eynatten H

Geoscience Centre University Göttingen, GZG, Sedimentologie/Umweltgeologie, Goldschmidtstr. 3, 37077 Göttingen (TM, BB, ID, RTD, HvE), GZG Geochemie, Goldschmidtstr. 1, 37077 Göttingen (BB, AK), GEUS, Copenhagen DK-1350 (DF), mikes@geowi.uni-hannover.de

Three independent single-grain geochronometers applied to detrital minerals from Central Dinaride sediments constrain the timing of felsic magmatism that associated the Jurassic evolution of the Neotethys. The Lower Cretaceous clastic wedge of the Bosnian Flysch, sourced from the Dinaride ophiolitic thrust complex, yields magmatic monazite and zircon grains with dominant age components of 164 ± 3 Ma and 152 ± Ma, respectively. A unique tephra horizon within the Adriatic Carbonate Platform was dated at 148 ± 11 Ma by apatite fission track analysis.

These consistent results suggest that leucocractic melt generation in the Central Dinaride segment of the Neotethys culminated in Middle to Late Jurassic times, coeval with and slightly postdating sub-ophiolitic sole metamorphism. Growth of magmatic monazite and explosive volcanism call for supra-subduction zone processes at the convergent Neotethyan margin.

A new compilation of geochronological data demonstrates that such Jurassic felsic rocks are widespread in the entire Dinaride-Hellenide orogen.

94: IS1 New Analytical Techniques, oral

Double dating of detrital zircon by fission-track and LA–ICPMS U/Pb analysis: new perspectives in decomposing mixed provenance signatures

Mikes T, Jeffries TE, Dunkl I, Tolosana-Delgado R, von Eynatten H

Geoscience Centre University Göttingen, GZG, Sedimentologie/Umweltgeologie, Goldschmidtstr. 3, 37077 Göttingen (TM, ID, RTD, HvE), Mineralogy Department, The Natural History Museum, Cromwell Road, South Kensington, London SW7 5BD, mikes@geowi.uni-hannover.de

A novel approach combining fission track (FT) and in-situ LA–ICPMS U/Pb isotope analyses in single detrital zircon grains is used to trace the exhumed sources of Tertiary synorogenic sediments in the Dinarides. Grains were dated by the FT method and their interiors were imaged by SEM-CL to avoid ablation of inherited or other unsuitable domains. U/Pb isotopic compositions were determined by an instrument

setup of a 213 nm Nd:YAG laser source coupled to a quadrupole-based ICP-MS, and an analytical protocol providing a cost-effective sample throughput (70-0 grains per day) while maintaining high analytical precision and accuracy. CL-control and a good spatial resolution helped suppressing age bias, as justified by a notably high proportion (>90%) of concordant (±5%) grain ages. Finally, the FT and U/Pb ages were integrated for each grain using a bivariate statistical algorithm that takes the different precisions permitted by the two dating techniques into account.

The zircon double dating approach yields valuable insights into the thermal history of source terrains of synorogenic sediments both in the Outer Dinaride foreland basin and in the Dinarides-Tisza collisional zone. We can isolate several clusters of characteristic pairs of crystallization/cooling ages, which pin-point Alpine tectonostratigraphic units with a confidence that could not be achieved by using the two dating techniques separately.

The Adriatic basement of the Dinarides affected by themajor Jurassic–Early Cretaceous cooling event was not the exclusive source for the siliciclastic fill of these Tertiary basins. The distributary systems involved much detritus from Ordovician and Late Permian magmatic unitsaffected by aLate Cretaceous thermal event; such units are nottypical in the Dinarides. A major sediment input from the Austroalpine, Tisza and Pelagonian Units in the Tertiary is the most likely scenario for the evolution of the Dinaride basins.

95: IS2 Tectonics and Sedimentation, poster

Structural-tectonic model of Mokrin-jug field

Milovan Beric , Miroslav Francuski M

NIS-NAFTAGAS, Geophysical Institute Belgrade, Batajnicki Drum 18, Serbia, milovan.beric@nis-naftagas.rs
NIS-NAFTAGAS, Novi SAD, Narodnog Fronta 12, mifran.c@nis-naftagas.rs

Mokrin-Jug structure is located at the SE part of Pannonian basin, southern part of Banat depression. During evolution at the Pannonian basin, present tectonic form of the Mokrin-jug structure formed as a result of geodynamical processes. Tectonic movements were in several stages and consequence of regional movements with expressed horizontal and different vertical movements. The oil-gas field Mokrin-jug is characterized by very complex geological structure and structural-tectonic relationships. The mentioned structure is rise at the bottom of Neogene sediments, made of metamorphic rocks.The oldest rocks found at the Mokrin-jug structure are presented by crystalline schists from the group amphibole, epidote-amphibole, biotite-albite schists, muscovite-biotite schists and gneiss, as well as chlorite-sericite schists. Rocks of the basement were destroyed and fractured because of tectonic processes, containing plenty of macro- and micro-fractures, improving their collector features.Badenian and Sarmatian sediments are separated at the coastal shallow-

water- reef medium, presented by sendstones, breccias and conglomerates. Over Sarmatian sediments, Pannonian formations are present. Lower Pannonian is presented by marls and marly limestones, showing that sedimentation has been developed within the calm water. There is no correct boundary between Pannonian and Lower Pontian, because of similar lithological and mineralogical content. During Upper Pontian and Paludine, steep shallowing of the water basin is existent.Intensive radial tectonics had a main role during forming Mokrin-jug structure. On the basis of geological-tectonic interpretation, N-S, rarely E-W faults were defined. By the faults, Mokrin-jug field was divided into five parts. By complex synthesis of structural-tectonic model and mineralogical and petrological analyses, it was concluded that the field is characterized by significant hydrocarbon potential.

96: IS3 Archives of Environmental Evolution and Climate Change, poster

Dolomite at glacial to interglacial transitions, a hypothesis of precipitation due to mixing zones in Ross Sea deposits, Antarctica

Monien D, Kuhn G, Von Eynatten H, Vogel SW, Hoffmann S, Aghib FS

Alfred Wegener Institute for Polar and Marine Research, 27568 Bremerhaven, Germany
Dept. of Sedimentology and Environmental Geology, Geoscience Center Göttingen (GZG), Goldschmidtstrasse 3, Göttingen, Germany
Department of Earth and Planetry Sciences, University of California, Santa Cruz, USA
CNR-IDPA,Via Mangiagalli 34, Milano, Italy

The retreat phases of Antarctic ice mass fluctuations during the Plio-Pleistocene were characterized by large-scale environmental changes at the continental margin. According to these changes a huge variety of chemical reactions due to specific paleoenvironmental changes can occur. We detected discrete horizons with high TIC and Ca content (up to and 19wt%, respectively) in the AND-1B core from the ANDRILL McMurdo Sound Project. We measured the split cores in the field during the austral summer 2006/2007 with a non-destructive AVAATECH XRF-Core Scanner. Chemical analyses were carried out on discrete samples and the mineral composition was examined using X-ray diffraction measurements and SEM/ EDX.

At specific depths dolomite, siderite and ankerite values were found within the glacial to interglacial transition zones. Our hypothesis is that in this environment, dolomite was precipitated in the pore water system, where sub-ice freshwater was mixed with seawater during glacial to interglacial transitions. We assume reducing conditions for building up carbonate phases like ankerite, siderite and dolomite. The degradation of the organic material in the overlain diatomites may have caused these reducing conditions in the diamictites. The carbonate concretions can potentially be linked to different stages in carbonate precipitation.

(i) The precipitation of dolomite indicates that the 'microenvironment' was likely

sulfate reducing with a higher salinity. (ii) In the layers where siderite formed oxic or anerobic non-sulfidic conditions had occurred. (iii) Primary ankerite in association with dolomite possible stands for transgressions from low sulfate reduction and available Fe to non-sulfidic conditions. These different 'microenvironments could represent different types/stages of glacial to interglacial transition zones.

97: IS3 Archives of Environmental Evolution and Climate Change, oral

Global versus regional enhancement of oceanic anoxia during the OAE-2 and the T-OAE: constraints from Mo and U isotopes

Montoya Pino C, Weyer S, Van de Schootbrugge B, Arz HW, Oschmann W, Pross J

Goethe University Frankfurt, Institute of Geosciences, Germany 60438, Altenhöferallee 1 (montoya@em.uni-frankfurt.de)

During the Mesozoic, oceans experienced several anoxic events (OAEs) characterized by extensive black shale formation, reaching regional or even global distribution. Combining Mo and U isotopes with redox sensitive trace metals concentrations in black shales, we present an approach to determining the increase of ocean anoxia during the OAEs compared to modern conditions. We focused on two well known OAEs, T-OAE and OAE-2, both with possibly a global extension [1-2]. A shift towards lighter Mo and U isotopic compositions is observed for both OAEs, compared to their modern equivalents (Black Sea). U isotope compositions of OAE-2 black shales display the same shift relative to above/below OAE-2 black shales; however, Mo isotopes were likely affected by isotope fractionation during non-euxinic conditions [3] before and after the onset of the OAE-2, thus displaying even lighter Mo isotope signatures in the above/below OAE-2 black shales compared to those within the OAE-2. Combining the U isotope offset (≈0.2-0.3‰ between modern and OAE black shales) with previous results from [4] and applying mass balance constraints, we modeled the increase of U removal to anoxic-euxinic sinks to about 60% during both OAEs, compared to % at present day. This increase represents ≈1-3% anoxic settings during both OAEs. Moreover, a positive trend is observed between U isotopes and U/Al for T-OAE samples, contrary to a negative one for the Black Sea and OAE-2. This may reflect long term removal of U from the water column during the T-OAE, e.g. in an isolated basin, while during OAE-2, U concentrations and isotope compositions in the oceans kept constant at a lower level. According to [5], based on Mo/TOC ratios, high water mass restriction was found for the Toarcian basins. Hence, we interpret the increase of anoxic settings during the OAE-2 as a global event, while that during the T-OAE more likely as a regional event, restricted to the European epicontinental seaways.

References

Erbacher J, Friedrich O, Wilson PA, Birch H, Mutterlose J (2005): Stable organic carbon isotope stratigraphy across Oceanic Anoxic Event 2 of Demerara Rise, western tropical Atlantic. Geochem. Geophys. Geosyst. 6: 1-9

Pearce R, Cohen A, Coe A, Burton KW (2008): Molybdenum isotope evidence for global ocean anoxia couple with perturbations to the carbon cycle during the Early Jurassic. Geology 36: 231-234

Hetzel A, Böttcher ME, Wortmann UG, Brumsack HJ (2009): Paleo-redox conditions during OAE 2 reflected in Demerara Rise sediment geochemistry (ODP Leg 207). Palaeo 273: 302-328

Weyer S, Anbar AD, Gerdes A, Gordon GW, Algeo TJ (2008): Natural fractionation of 238U/235U. Geochim. Cosmochim. Acta 72: 345-359

McArthur JM, Algeo TJ, Van de Schootbrugge B, Li Q, Howarth J (2008): Basinal restrictions, black shales, Re-Os dating and the Early Toarcian (Jurassic) Oceanic Anoxic Event. Paleoceanography 23: 1-44

98: IS4 Magmatism and Earth Evolution, oral

Linking geochemistry and geodynamics: new insights from trace element and isotope systematics of western Pacific arc rocks

Münker C, Schuth S, König S, Nebel O

Institut für Geologie und Mineralogie, Köln, Germany,
Steinmann Institut, Universität Bonn, Germany
RSES, Australian National University, Canberra, Australia

The western Pacific region comprises a prominent convergent margin, marking the western boundary of the Pacific plate. It has been argued that this plate boundary also marks a major convective boundary between the Pacific and Indian-Australian mantle domains. Both mantle domains appear to be distinct in their isotope compositions, i.e., rocks from the Indian-Australian plate are more radiogenic in ^{208}Pb, ^{207}Pb and ^{87}Sr, and less radiogenic in ^{143}Nd for a given Hf isotope signature. Hence, radiogenic isotope studies on western Pacific arc rocks have the potential to unravel the mantle domains present beneath the arcs and the subduction components being involved. Our results for arc rocks from the Solomon Islands, Papua New Guinea, Kamchatka, New Zealand and Tonga indicate that for most cases Hf-Nd isotope systematics are a viable tool to distinguish both mantle domains. Lead isotope compositions in the arc lavas mirror the slab compositions. In general, Hf-Nd isotope compositions of arc rocks from the Solomon Islands, Kamchatka, and Tonga-Kermadec overlap with compositions of Indian-type MORB, suggesting a widespread distribution of this mantle domain beneath the Australian-Asian plates. There are regional Hf-Nd isotope variations between different arc systems, possibly caused by mixing with Pacific mantle material. In most cases, the mantle domain boundary follows the western Pacific plate boundary. A notable exception includes

the Solomon Island arc where a reversal of the subduction polarity ca. 6 Ma ago triggered the isolation of a fossil block of Indian mantle domain NE of the present arc. In the Australia-New Zealand region, the mantle domain boundary (AAD) is presently located ca. 2000 km W of the active continental margin. Isotope compositions of Late Paleozoic and Mesozoic rocks can show that (1) the mantle domain boundary already existed in Permian time and (2) followed the plate boundaries until Cretaceous time when New Zealand separated from Australia.

99: TS2 Geology of Extreme Earth Environments, oral

Late Miocene patterns of precipitation, uplift, and erosion in the Andean foreland

Mulch A, Uba CE, Strecker MR, Schoenberg R, Chamberlain CP

Leibniz Universität Hannover, Institut für Geologie, Callinstr. 30, 30167 Hannover
Universität Potsdam, Institut für Geowissenschaften, Karl-Liebknecht-Str. 24, 14476 Golm
Univ. Bergen, Centre of Geobiology, 5020 Bergen, Norway
Stanford University, Earth Environmental Systems Science, Stanord, California 94305, USA

The Andean orogen including its arid and hyperarid plateau and desert regions represents one of the most extreme terrestrial environments. Especially the late Miocene evolution of the Andean chain is of global importance as this time interval has been recognized as one of dramatic changes in sediment deposition, erosion, and potentially surface uplift rates in the many major mountain ranges. Due to its high elevation the modern Andes are also the most important topographic element controlling southern hemispheric atmospheric flow. The topography of the Andes induces two major climatic effects: a) S-ward deflection of Atlantic-derived moisture that results in monsoonal climate along the E and hyperaridity on the W side of the central Andes and b) north-to-south asymmetry in SST and position of the ITCZ in the equatorial Pacific. Terrestrial stable isotope records reflect the distribution and amount of precipitation and eventually changes in mean annual temperature and hence provide important archives for the reconstruction of long-term climate change. We present multi-isotope ($\delta^{18}O$, $\delta^{13}C$, $^{87}Sr/^{86}Sr$) data from late Miocene pedogenic carbonate in the Eastern Andean foreland (Bolivia) that record the onset of such seasonality and distribution of precipitation. $\delta^{18}O$ and $\delta^{13}C$ data from pedogenic carbonate suggest a rapid change in precipitation consistent with a deflection of the low-level Andean jet to more southerly latitudes at ca. 8.5 Ma. A contemporaneous increase in $^{87}Sr/^{86}Sr$ of pedogenic carbonate indicates a transition to higher silicate weathering rates and/or accelerating headward erosion and higher river discharge. Such a rapid (<0 ka) transition to more cyclic climate either due to enhanced seasonality or as a response to the onset of ENSO, strongly affects isotopes in precipitation and provides previously unavailable boundary conditions for Andean climate and topography reconstructions.

100: TS1 Early Planets and Life, poster

Carbon isotope signatures of Ediacaran slope facies carbonates from the Yangtze Platform (South China)

Neldner K, Baero W, Wiechert U, Becker H

Freie Universität Berlin, Institut für Geologische Wissenschaften,FR Geochemie, Malteserstr. 74-0, 12247 Berlin, Germany, neldner.k@arcor.de

The late Proterozoic comprises dramatic environmental changes in the chemistry of the atmosphere and oceans, reflected in major secular δ13C variability of more than ‰ (Jacobsen & Kaufman, 19). Origin, global significance, and duration of the δ13C variations are a subject of controversy. Here we report new δ13Ccarb data for carbonates of the Doushantuo Formation (lower Ediacaran) from slope facies lithologies collected at two sections near Songtao (Guizhou). Both sections are comprised of cap carbonates at the base of the Ediacaran followed by shales, layered dolomite-limestone sequences, limestones that become increasingly siliceous towards the top, black shales and black cherts in the uppermost Ediacaran, followed by an unconformity and lower Cambrian black shales and cherts. Cap carbonates show δ13Ccarb (precision: ± 0.2‰) between -1.8‰ and -6.2‰, and no systematic variation with stratigraphic position. Subsequent lithologies display a drop in δ13C. Micritic dark carbonates, pyrite bearing gray limestones, and carbonate concretions from black shales, display relatively constant values between -8.0‰ and -.0‰, similar to values reported by Guo et al. (2007). The cause for these negative values, destabilization of gas hydrates, oxidization of large DOC reservoirs in the deep ocean or incorporation of biomass into the sedimentary organic matter pool, is still under debate. The sample highest in the sequence shows a sharp increase to -1.2‰, marking the transition from lower to upper Ediacaran. Remarkable is the absence of positive δ13C values in carbonates overlying the cap carbonates, a common feature of shallow platform sequences of the Doushantuo (Zhu et al., 2007). Either this reflects unconformities hidden in the lower part of the Songtao sections or, much reduced sedimentation rates and absence of carbonate precipitation

References

Guo Q, Strauss H, Liu C, Goldberg T, Zhu M (2007): Carbon isotopic evolution of the terminal Neoproterozoic and early Cambrian: Evidence from the Yangtze Platform, South China. Palaeogeography, Palaeoclimato 254: 140-157

Jacobsen SB, Kaufman AJ (1999): The Sr, C and O isotopic evolution of Neoproterozoic seawater. Chemical Geology 161: 37-57

Zhu M, Zhang J, Yang A (2007): Integrated Ediacaran (Sinian) chronostratigraphy of South China. Palaeogeography, Palaeoclimato 254: 7-61

101: IS4 Magmatism and Earth Evolution, poster

Towards a new geodynamic model for granite genesis at the Svecofennian continental margin (Baltic Shield, SE-Sweden)

Nolte N, Kleinhanns IC, Hansen BT

Georg-August Universität Göttingen, Geowissenschaftliches Zentrum, Abt. Isotopengeologie, Goldschmidtstraße 3, 37077 Göttingen
Department of Earth Sciences, University of Bergen, Allégaten 41, 5007 Bergen, Norway
Georg-August Universität Göttingen, Geowissenschaftliches Zentrum, Abt. Isotopengeologie, Goldschmidtstraße 3, 37077 Göttingen

The Palaeoproterozoic (~1.8Ga) Västervik area (SE-Sweden) represents a transitional zone between the Svecofennian domain to the north and the Transscandinavian igneous belt (TIB) to the south. The Svecofennian domain is characterized by granites of the Loftahammar type and the TIB is characterized by Smålandgranites. Both granitoid groups intruded the metavolcanosedimentary Västervik formation -the oldest stratigraphic unit- and occur intermingled throughout the Västervik area. Extensive mapping work has shown five granitoid generations that ranges from quartzdiorite to syenogranite composition. Intrusion ages in the Västervik area range from ~1840Ma in the north to ~1800Ma in the south. The quartzdiorite, quartzmonzodiorite and augengneissic syenogranite groups (I) are characterized by the presence of amphibole and highly variable alkalifeldspar contents. N-MORB normalized multi-element diagrams show weak Eu- and Sr- anomalies. Further, a Dy-Ho trough and relative depletion in Nb and Ta is observed. These groups classify as calc-alkaline I-Type granites with a transition to S-Type granites and represent "normal" granitoids with typical continental crustal signatures and are presumably produced by AFC-controlled petrogenesis. In contrast to that the monzogranites and anatectic syenogranites (II) show strong negative Eu- and Sr anomalies, as well as a wide variability in the alkalifeldspar content and blueish quartz crystals. These groups classify as calc-alkaline S-Type granites. On the basis of field relationships of the different groups, we postulate that the granitoids of group (I) represent the Svecofennian domain and are cogenentic with the Loftahammar granites slightly further north. The other groups (II) are in our opinion typical TIB granitoids. The monzogranites were presumably produced by typical AFC-controlled petrogenesis. The syenogranites were produced in situ by crustal anatexis of the Västervik formation with only very short transport distances.

102: IS3 Archives of Environmental Evolution and Climate Change, poster

Variations of the $^{238}U/^{235}U$ isotope composition in rivers and hydrothermal waters

Noordmann J, Weyer S, Sharma M, Georg RB

Institute of Geosciences, University of Frankfurt, Germany, j.noordmann@em.uni-frankfurt.de
Department of Earth Sciences, Dartmouth Collage, New Hampshire, USA
Department of Earth Sciences, University of Oxford, UK

Recent studies observed $^{238}U/^{235}U$ isotope fractionation between oxic and anoxic oceanic environments, which may be used to constrain the oceanic U mass balance. However, U isotope fractionation during continental weathering and transport to the oceans, as well as during hydrothermal alteration (the second most important sink for U) is yet unknown [1]. Previous considerations were based on the assumption that there is no U isotope fractionation between the continental crust and rivers (the major U source to the ocean) and that hydrothermal alteration does not result in any isotope fractionation for U. In this study, we have been analyzing water samples from rivers of different climatic conditions, e.g. Venezuela, India, Pakistan, Germany and three different rivers from Switzerland (supported by SNSF, grant 2000 20/1 780) to constrain the range of U isotope compositions of rivers. Additionally, we analyzed five different hydrothermal fluids from the Juan de Fuca Ridge, i.e. low-temperature and high-temperature fluids. Preliminary results from the river samples display a range of U isotope compositions between $\delta^{238}U$= -0.03 and -0.34 ‰. In particular, rivers with high U display U isotope composition very similar to that of the crustal value ($\delta^{238}U$~ -0.3 ‰ [1]), indicating that in average only minor U isotope fractionation occurs during weathering and transport. This limited fractionation may be explained by an essentially quantitative transfer of the well soluble Uranyl complex during oxidative weathering from the eroded continental crust to the rivers. The hydrothermal waters display a tight range of $\delta^{238}U$ (-0.32 and -0.54 ‰) around the seawater value of $\delta^{238}U$= -0.4 ‰ [1], however, at much lower U concentration levels (0.08 to 0.24 ppb) compared to that of seawater (3.3 ppb [1]). These preliminary results indicate that little U isotope fractionation occurs during hydrothermal removal of U from seawater.

References

Weyer S, Anbar AD, Gerdes A, Gordon GW, Algeo TJ (2008): Natural fractionation of 238U/235U. GCA 72: 345-359

103: IS4 Magmatism and Earth Evolution, poster

Zircons from kimberlite pipes – drilled cores through the continental crust? A case study from the Ekati mine (Canada)

Nuber N, Gerdes A, Brey G, Crawford B, Grutter H

Goethe-Universität Frankfurt, Institut für Geowissenschaften,
Abteilung Petrologie und Geochemie, Altenhöferallee 1, 60438 Frankfurt,
nuber@em.uni-frankfurt.de

The grain size distribution of micro diamonds is an important tool in the evaluation of the economic value of diamond deposits. For this large volumes of kimberlite material are subjected to the so-called caustic fusion process leaving mainly diamond, zircon and rutile behind. We have analyzed such zircons from the Ekati-mine district, Slave Province Canada. We consider kimberlite diatremes as drill cores through the continental crust providing us with information from the deeper crust. The age distribution together with the Hf isotopic composition of the zircons should give us constraints on the timing of formation and recycling of continental crust.

Three main age groups can be distinguished: The youngest ages are 55-60 Ma which correspond to the kimberlite emplacement ages at Ekati in several episodes between ~48-60 Ma. Their Hf isotopic ratios are fairly primitive.

A second age group of 95-8 Ma is so far unknown in this area. Their Hf isotopic composition is highly variable and ranges from juvenile (εHf +11) up to Palaeoproterozoic crustal residence times (εHf -18) of the protoliths.

The third most abundant group is defined by Archean zircon with ages of 2.54 to 2.87 Ga. The majority of them have early Archean depleted mantle model ages of 3.2 to 3.6 Ga, with maxima at 3.3 and 3.5 Ga. Others are more juvenile, pointing to Mesoarchean crust formation of around 2.9 Ga.

A minor age group around 1.8-2.0 Ga suggests Palaeproterozoic recycling of this Mesoarchean crust. Furthermore, some zircons, with concordant Jurassic to Palaeproterozoic (1.9 Ga) ages and positive εHf, point to minor addition of juvenile crust between Cretaceous to Archean times.

In summary, the crust of the Ekati-mine district in the Slave province was predominantly formed during Archean times in two phases: Mesoarchean (3.2 - 2.8 Ga) and Neoarchean (2.8 – 2.5 Ga). In addition, minor amounts of juvenile crust formed through smaller intrusions sporadically until Eocene.

104: TS4 Impact of Deep Earth Processes on History, Civilisation and Life, oral, (Gauss-Invited Keynote)

Earthquakes and Archaeology

Nur, A

Dept of Geophysics, Stanford University, Stanford, CA 94305 USA

'Earthquakes and Archaeology' is an emerging field with impact on both earthquake science and archaeological studies. It has been controversial as archaeologists and historians have traditionally rejected earthquakes as an important agent. But now with the advent of plate tectonics and modern instrumentation, this controversy is subsiding as we begin to offer answers to some key questions in both disciplines: Some Significant Geophysics Questions: 1. Time/space pre-instrumental patterns of large earthquakes. 2. Maximum earthquake magnitude, maximum rupture length, etc. 3. One big event or several smaller ones? Some Significant Archaeological Questions: 1. Why so many ruins? 2. Why so many layers/levels of destruction? [Knossos-, Jericho-22, Armageddon-30, Troy-45]. 3. Who buried the Dead Sea Scrolls? 4. The nature of regional destructions and system collapse. One example for massive collapse is the catastrophic end of the late bronze age (LBA) @1200BC. The reasons for this wide spread political as well as physical collapse in the Aegean and Eastern Mediterranean areas remain a major enigma. It has been attributed by historian to attacks by the so-called 'Sea people". Unfortunately there is no real evidence for this. However the geographic the coincidence of 20th century earthquakes and the destroyed 1200 BC LBA sites suggests that a major "earthquake storm" may have occurred in the Late Bronze Age Aegean and Eastern Mediterranean during the years 1225–1175 . This "storm" may have destructively interacted with societal, political and economic forces at work in these areas c. 1200. Similarly unexplained civilization collapses may also be linked to catastrophic earthquakes e.g., the Indus Valley and the Cassas Grandes civilization in Mexico.

References

Nur A, Burgess D (2008): Apocalypse: Earthquakes, Archaeology, and the Wrath of God. Book 1: 309

105: TS1 Early Planets and Life, oral

The Neoproterozoic Oxidation Event: Trace elements chemostratigraphy at the Precambrian/Cambrian transition in South China

Och LM

Dept. of Earth Science, University College of London, Gower Street, London, WC1E 6BT, UK

The transition to a fully oxygenated Earth surface environment during the late Neoproterozoic involved major global events such as climatic swings, tectonic reorganisation and biological innovations and had profound effects on the biogeochemical cycling. An increasingly oxygenated Earth's surface would possibly have led to the ventilation of the deep marine environment and to a build-up in the ocean of the redox-sensitive trace metals that are generally more soluble as oxidised complexes, e.g. Mo and V. Because reductive sequestration of these metals results in authigenic enrichment in oxygen-depleted sedimentary facies, ocean anoxic events can affect the budgets of these biogeochemically significant elements [1]. Hence, investigating the trace metal distribution in Neoproterozoic/Cambrian black shales, when a redox stratified ocean [2] and an oxygenated atmosphere coexisted, can shed light on the development and timing of the Neoproterozoic Oxygenation Event (NOE) and enhance our understanding of the Cambrian Explosion. In this study, we present high resolution trace metal data, with a focus on Mo and V, coupled with other paleoredox proxies like iron speciation data (FeHR/FeT) and Ce anomaly as part of a multielement chemostratigraphic approach across 5 Neoproterozoic-Cambrian sections from the Yangtse Platform, South China. Furthermore, we generate Mo/TOC ratios in order to constrain changes in the ocean Mo budget during the interval [3]. This preliminary dataset shows that the black shales on the Yangtse Platform were deposited under anoxic conditions without evidence for euxinia. Nevertheless, variations in trace-metal enrichment might indicate fluctuating redox conditions from the Upper Ediacaran to the Lower Cambrian and/or an increase in the Mo reservoir triggered by increasing oxidative weathering on land.However, our preliminary data does not allow to draw any firm conclusions so far and will be expanded in the near future.

References

Tribovillard N, Algeo TJ, Lyons T, Riboulleau A (2006): Trace metals as paleoredox and paleoproductivity proxies: An update. Chemical Geology 232: 12-32

106: TS3 Geomicrobiology and Biogeochemistry, oral

Volcanic CO_2 vents as natural laboratories for risk assessment of CO_2 geosequestration

Oppermann BI, Krüger M, Blumenberg M, Michaelis W

Institute of Biogeochemistry and Marine Chemistry, University of Hamburg, Bundesstr. 55, 20146 Hamburg, Germany
Department of Geobiology, Geoscience Centre, University of Göttingen, Goldschmidtstr. 3, 37077 Göttingen, Germany
Institute of Biogeochemistry and Marine Chemistry, University of Hamburg, 20146 Hamburg, Germany

Geologic storage of CO_2 offers a new set of options for reducing greenhouse gas emissions. Our study aims to assess the environmental impact of possible CO_2 leakage from these deep reservoirs into near-surface terrestrial environments by investigating natural CO_2 vents.

Here we report strong changes in soil microbial community composition due to high CO_2 concentrations in soils.

A detailed lipid biomarker analysis was conducted to investigate differences in microbial community composition between the CO_2-rich sites (>90 % of soil gas) and the control site with background CO_2 concentrations.

At the studied sites, the CO_2 of volcanic origin was enriched in ^{13}C relative to atmospheric CO_2. Therefore, it was possible to follow the uptake of volcanic CO_2 with the help of ^{13}C enriched lipid biomarkers and identify responsible microbial groups. As another track of evidence, microbial cell counts and growth rates were determined. The combined results revealed significant differences between CO_2 influenced and pristine soils. Overall a shift towards anaerobic processes and the utilization of CO_2 as a carbon source were observed.

For example, in the CO_2 vent, archaeal tetraethers dominate compared to bacterial derived tetraethers contrary to the reference site. Tetraethers and their isotopic values also showed that the archaeal population changes from mostly crenarchaeota at the background site, to CO_2-reducing methanogenic Archaea at the CO_2 vent. Thus high CO_2 concentrations foster CO_2 based methanogenesis. Accordingly direct measurements demonstrated enhanced production of methane, a much stronger greenhouse gas than CO_2 at the CO_2 vent. In summary, at terrestrial CO_2 vents, significant effects of high CO_2 concentrations on lipid biomarker inventory, microbial activities, and cell numbers were ob served and will be presented. Our work shows that biomarkers, including iso topic studies, are an excellent tool to track CO_2 leakages from deep reservoirs into surface environments.

107: IS2 Tectonics and Sedimentation, oral

Geometry of growth strata in transpressive systems in field and analogue model: Gosau Group at Muttekopf, Northern Calcareous Alps, Austria

Ortner H, Kositz A, Willingshofer E, Soukoutis D

Institute of Geology and Paleontology, University of Innsbruck, Innrain 52, 6020 Innsbruck, Austria

Growth strata have been studies extensively in cylindrical settings, where the geometry of clastic wedges on folds or normal faults is well known. We studied growth strata deposited in a setting of oblique convergence, that could be characterized as thrust-dominated transpression, which have not been studied before. The most important difference to orthogonal shortening or extension is the presence of tear faults creating a segmented depositional area. The main focus of this presentation is the deviation of sediment geometry due to activity of tear faults. A detailed study of the main unconformity in cross section which displays apparent combined rotational offlap-onlap-overlap revealed that the offlap-onlap pattern is mainly produced by changes in strike instead of changes in dip as seen in classic examples. The geological map shows that cross sections displaying only rotational offlap or rotational overlap are located between high-angle tear faults, whereas the principal unconformity is located above a tear fault crossing the basin. The presence of the tear fault seems to control sediment geometry. We imagine deposition in a basin in which dextral shearing and folding in the bedrock were active contemporaneously. Fold limbs would be tilted and offset across the high-angle faults. Given some surface topography of the depositional system related to progressive tilting of fold limbs, dextral offset across high-angle faults would create a slope sub-parallel to the fault, which then would be onlapped by younger strata. Due to progressive shearing this geometry would then be further enhanced by development of a trishear zone within the soft sediments. Therefore offlap-onlap-overlap patterns created by changes of strike document the synsedimentary activity of high-angle faults rather than folding. This hypothesis was confirmed by analogue modelling. Syn-tectonic sediments deposited above a tear fault developed a pronounced tri-shear zone between segments of the basin.

108: TS3 Geomicrobiology and Biogeochemistry, oral

Light hydrocarbons in gas-hydrate-bearing shallow deposits of a high-flux seepage site in the Eastern Black Sea

Pape T, Bahr A, Kessler JD, Abegg F, Klapp SA, Bohrmann G

MARUM - Center for Marine Environmental Sciences and Department of Geosciences, University of Bremen, Klagenfurter Strasse, D 28334 Bremen, Germany
IFM-GEOMAR Leibniz-Institute of Marine Sciences, Wischhofstrasse 1-3, D-24148 Kiel, Germany
Department of Oceanography, Texas A&M University, College Station, Texas 77843-3146, USA

In order to elucidate quantity and fate of shallow submarine hydrocarbons (HC) within the gas hydrate stability zone, we investigated a high-flux seepage site in the anoxic Eastern Black Sea. Pressure and non-pressure sediment cores, vent-gas, and methane-derived carbonates were collected at the Batumi seep area in about 845 m water depth. Recovered sediments represented late glacial to Holocene Black Sea sediments. Gas hydrates were absent in top sediments but abundant below ca. 0.9 m bsf. Pressure core degassing yielded volumetric gas/bulk sediment ratios of up to 20.3 which confirm substantial hydrate presence. In situ methane concentrations suggest hydrates to fill ~27% of the pore volume in the deeper core sections. Based on depth-integrated hydrate abundances, this results in an estimated 14.2 kt of hydrate-bound methane accumulated in sediments down to 265 cm bsf over the entire study area covering about 0.5 km^2.

Molecular hydrocarbon ratios along with stable C and H isotopic compositions of methane indicate a predominant microbial formation of light HC. Of all gas types analyzed, vent gas appears to be least affected by molecular fractionation during sediment migration and hydrate precipitation. Thus, its properties might resemble that of gas in deep reservoirs. HCs in top sediments are characterized by relative methane depletions most probably due to the anaerobic oxidation of methane, although enrichments of ^{14}C-CH4 substantiate concurrent methanogenesis on modern organic matter.

Stable O isotope data and petrology of carbonates suggest that hydrate dissociation accompanied by high gas/fluid discharge in overlying sediments occurs episodically interrupted by phases of hydrate build-up and reduced fluid flux. We conclude that such vigorous dissociations and/or upfloating of shallow-buried hydrates are responsible for the observed rough seafloor micro-topography and constitute an important factor for altering the carbon budget of the Black Sea.

109: TS3 Geomicrobiology and Biogeochemistry, oral (Invited Keynote)

Cryptoendolithic life in marine pillow basalts

Peckmann J, Bach W, Eickmann B, Behrens K, Böttcher ME, Reitner J

MARUM - Center for Marine Environmental Sciences, University of Bremen, Leobener Straße, 28359 Bremen, Germany
Leibniz Institute for Baltic Sea Research, Seestraße 15, 18119 Warnemünde, Germany
Geoscience Center, University of Göttingen, Goldschmidtstraße 3, 37077 Göttingen, Germany

Signatures of life in volcanic glass of pillow basalts have now been recognized for more than two decades. They are represented by different types of microborings that can be regarded as trace fossils, for which ichnotaxons have recently been erected (McLoughlin et al., 2009). These trace fossils were even found in Archean pillow lavas, suggesting that basalt-dwelling microorganisms may represent a form of early life (Furnes et al., 2004). According to the terminology describing ecological niches within rocks, the microorganisms dwelling in basaltic glass represent euendoliths that actively penetrate the mineral matrix. We recently found evidence of another mode of endolithic life in marine basalt. Devonian pillow basalts from Variscan orogens in Germany contain abundant putative biogenic filaments. The mineralized filaments are found in calcite-filled amygdules (former vesicles), where they started to form on internal surfaces after seawater ingress. The filaments post-date an early fibrous carbonate cement but predate later equant calcite spar, revealing syngenetic formation. A biogenic origin of the filaments is indicated by their size and morphology resembling modern microorganisms, their independence of crystal faces and cleavage plans, complex branching patterns, and internal segmentation. These microorganisms represent cryptoendoliths that lived in structural cavities of the basalt. They became preserved upon microbial clay authigenesis similar to the encrustation of modern prokaryotes in iron-rich environments. Based on the discovery of fossilized filamentous microorganisms in Devonian pillow basalt of three Variscan orogens (Rheinisches Schiefergebirge, Thüringer Wald, Frankenwald) and the recognition of similar mineralized microorganisms in amygdules of modern pillow basalt of the Kolbeinsey Ridge, it is apparent that cryptoendolithic life was and still is present in the oceanic crust.

References

Furnes H, Banerjee NR, Staudigel H, De Witt M (2004): Early life recorded in Archean pillow lavas. Science 304: 578-581

McLoughlin N, Furnes H, Banerjee NR, Muehlenbachs K, Staudigel H (2009): Ichnotaxonomy of microbial trace fossils in volcanic glass. Jour. Geol. Soc., London 166: 159-169

Peckmann J, Bach W, Behrens K, Reitner J (2008): Putative cryptoendolithic life in Devonian pillow basalt, Rheinisches Schiefergebirge, Germany. Geobiology 6: 125-135

110: OS Open Session, poster

Ostracode species assemblages from lacustrine sediments as proxies of climatic and environmental change in the lowland neotropics

Perez L, Lorenschat J, Scharf B, Schwalb A

Technische Universität Braunschweig, Institut für Umweltgeologie, Germany, 38106 Braunschwei, Pockelsstrasse 3, l.perez@tu-bs.de

Lago Petén Itzá is located in northern Guatemala, and is the deepest lake (ca. 165 m) in the lowland Neotropics providing an environmental record for the past ~200 kyrs. The lake was the target of the ICDP-Petén Itzá Scientific Drilling Project (PISDP), and here we present results from ostracode species assemblages that were analyzed from core PI-6, 70 m long, retrieved from a water depth of 71 m, with a maximum age of 85 kyrs. For a better understanding of ostracode species assemblages in long cores, modern ostracode ecology and their spatial distribution in Lago Petén Itzá was studied. In addition, surface sediments, and hydrochemical characteristics from aquatic environments across the Yucatán Península were analyzed. Eight species were identified in core PI-6: *Cypridopsis okeechobei*, *Cytheridella ilosvayi*, *Darwinula stevensoni*, *Fabaeformiscandona* sp., *Heterocypris punctata*, *Limnocythere opesta*, *Physocypria globula*, and *Strandesia intrepida*. Results of species assemblages reveal that the lake level during the Deglacial (11-18 kyrs) was lower (~68-56 m lower than modern lake level) than during the Last Glacial Maximum (LGM)(18-23 kyrs). The presence of *P. globula* (a species that tolerates low concentrations of dissolved oxygen and prefers organic rich environments) suggest a humid climate during the LGM. Ostracode species that today live in littoral zones and shallow waters (<20 m), *H. punctata*, and *S. intrepida*, were present in sediments of the Deglacial, indicating lake level lowering, and warmer conditions. This is supported by the presence of gypsum layers in these sediments. The abundance of ostracode species has changed from the LGM to the present, and none of the species has become extinct during the last 23 kyrs. This indicates that the environmental and climatic conditions in the lowlands of the Neotropics have changed, and ostracodes were able to tolerate or adapt to such conditions.

111: IS2 Tectonics and Sedimentation, poster

Exhumation of high-temperature metamorphic rocks of the Starcevo unit (Rhodopes, Bulgaria)

Pleuger J, Nagel TJ, Georgiev N, Jahn-Awe S, Froitzheim N

Geologisches Institut, ETH Zürich, Sonneggstraße 5, CH-8092 Zürich,jan.pleuger@erdw.ethz.ch
Steinmann-Institut, Universität Bonn, Poppelsdorfer Schloß, D-53115 Bonn
Department of Geology and Palaeontology, University St. Kliment Ohridski,
15 Tzar Osvoboditel Boulevard, BG-00 Sofia
Steinmann-Institut, Universität Bonn, Poppelsdorfer Schloß, D-53115 Bonn
Steinmann-Institut, Universität Bonn, Poppelsdorfer Schloß, D-53115 Bonn

Eclogites have been found in several basement units of the Rhodopes [e.g. 1]. Equilibrium phase diagrams for eclogites from the East Rhodopean Starcevo unit show that the high-pressure (HP) assemblage Omp+Ky+Grt was stable at c. 20-25 kbar/600-700 °C. During a high-temperature (HT) overprint, the decomposition of Ky led to the formation of Pl+Spl+Spr+Crn coronas at T>750 °C. P was relatively low since for the estimated overall composition of these coronas the stability field of the assemblage Pl+Spl+Spr+Crn is delimited toward higher P by a boundary trending through c. 6kbar/800 °C and c. 9 kbar/900°C.

While the age of the HP stage is unknown, the migmatisation in the Starcevo and underlying Arda units was dated at c. 37-38 Ma [2]. We assume that the HT stage of the eclogites has the same age.

The exhumation of the Arda and Starcevo units after the HT stage to a near-surface position occurred rapidly as constrained by still Priabonian syntectonic sediments resting discordantly on the Arda and Starcevo units along the top-N Kyuse-Hasanlartepesi fault. However, this fault was only active under greenschist-facies to brittle conditions. The exhumation initiated with the amphibolite-facies top-NW Kardžali and Borovica shear zones [3] which parallel the main foliation of the basement.

References

Liati A (2005): [1]. Contrib. Mineral. Petrol. 150: 608 – 630

Ovtcharova M, Cherneva Z, Quadt AV, Peytcheva I (2002): [2]. Geochim. Cosmochim. Acta 66: 573 - 573

Sarov S, Kolcheva K, Voinova E, Gerdjikov J (2004): . Rev. Bulg. Geol. Soc. 65: 101 - 106

112: IS2 Tectonics and Sedimentation, oral

Feather Textures - A Possible Shock Feature in Quartz Diagnostic of Low Shock Pressures

Poelchau MH, Kenkmann T

Museum für Naturkunde, Leibniz Institute at Humboldt University Berlin, Invalidenstr. 43, 115 Berlin, Germany
Museum für Naturkunde, Leibniz Institute at Humboldt University Berlin, Invalidenstr. 43, 115 Berlin, Germany

During the formation of impact craters, a shock wave is generated that passes through the target rock and deforms minerals. While microscopic planar deformation features (PDFs; sets of 2-3 µm wide, amorphous lamellae) are commonly found in quartz that was shocked above GPa, to date, no shock features have been identified below GPa that are uniquely attributed to shock deformation.The term "feather textures" describes an unusual type of planar microstructure, which has been found in shocked quartz grains in several confirmed impact craters. These features were first described in detail by [1]. Feather textures consist of a planar fracture ("P1" in [1]) from which a group of thinly spaced lamellae ("P2" in [1]) branch off, typically only from one side.We have also observed these structures in gneissic clasts in the suevite of the Nördlinger Ries impact crater, where they occur in highly shocked grains alongside multiple sets of PDFs, and therefore raise the question if they are actually "incipient PDFs" as proposed by [1].To reproduce feather textures, plane-wave shock recovery experiments were carried out at the EMI-Freiburg in 2000 on cylindrical samples of single crystal quartz. Feather textures occur in experiments with pressures <16 GPa at sites where shear deformation is concentrated. Our preliminary data are in accordance with the hypothesis in [1] that feather textures may form between 5 and Gpa.Our preliminary analyses of both experimental and natural samples has led us to the conclusion that these structures are formed as conjugate shear fractures. The dominant P1 feature often shows an offset due to shearing, while P2 features occur on one side, occasionally show "dragging" at the base of the P1 feature which is related to the sense of shear, and have angles of 40-75° to P1 typically seen in conjugate fracture systems TEM analysis is planned to confirm if the P2 features.

References

French BM, Cordua WS, Plescia JB (2004): The Rock Elm meteorite impact structure, Wisconsin: Geology and shock-metamorphic effects in quartz. GSA Bulletin 116: 200-218

113: TS2 Geology of Extreme Earth Environments, oral

Controls on sediment deposition in arid environments: Examples from the Quaternary of Arabia

Preusser F

Institut für Geologie, Universität Bern, Baltzerstrasse 1+3, 3012 Bern, Switzerland

Sediments depositing in arid environments are mainly formed by aeolian, fluvial and lacustrine-like processes. They are of eminent importance for applied research (e.g., petroleum exploration) and sedimentological aspects have been studied in much detail in the past. However, still relatively little is known about the external controls on sediment formation processes such as climate change and about the time dimensions recorded in such deposits. This paper summarises the results gained through studying Quaternary deposits from the Arabian Peninsula. The advantage of investigating such young deposits is that time frameworks are provided by luminescence dating. By doing so, periods of sediment deposition can be correlated to palaeoclimate records such as marine deposits or speleothems reflecting the environmental conditions at times.

Our results indicate that sediment accumulation in Arabia has been highly episodic. Aeolian deposition took place during relatively cold periods at mid-latitudes but the Last Glacial Maximum (ca. 20 ka ago) is not very prominent. It appears that aeolian deposition was mainly controlled by sediment supply triggered by the lowering of global sea-level (Preusser et al. 2002, Radies et al. 2005, Preusser 2009). Furthermore, spatial differences in aeolian deposition have been observed and are explained the lack of preservation potential (Preusser et al. 2005). The aggradation of alluvial fans was controlled by both sediment production and later transport of sediments triggered by increased precipitation (Blechschmidt et al. 2009).

References

Blechschmidt I, Matter A, Preusser F, Rieke-Zapp D (2009): Monsoon triggered formation of Quaternary alluvial megafans in the interior of Oman.. Geomorphology 341: (in press)

Preusser F (2009): Chronology of the impact of Quaternary climate change on continental environments in the Arabian Peninsula.. Comptes Rendus Geoscience 341: (in press)

Preusser F, Radies D, Matter A (2002): A 160,000-Year record of dune development and atmospheric circulation in Southern Arabia.. Science 296: 2018-2020

Preusser F, Radies D, Driehorst F, Matter A (2005): Latest Quaternary history of the coastal Wahiba Sands, Sultanate of Oman.. Journal of Quaternary Science 20: 395-405

Radies D, Preusser F, Matter A, Mange M (2004): Eustatic and climatic controls on the development of the Wahiba Sand Sea, Sultanate of Oman.. Sedimentology 51: 1359-1385

114: TS3 Geomicrobiology and Biogeochemistry, oral

Biogeochemistry and Biodiversity of Chemolithotrophic Microorganisms in the Tunnel of Äspö (Sweden)

Quéric NV, Heim C, Thiel 1, Simon K, Hansen BT, Reitner J

Department of Geobiology, University of Göttingen, Göttingen, Germany
Department of Geochemistry, University of Göttingen, Göttingen, Germany
Department of Isotope Geology, University of Göttingen, Göttingen, Germany

Rock fractures, deep groundwater seepage sites and associated open pond systems accessible at the Äspö Hard Rock Laboratory (Äspö HRL, Sweden) are being investigated as a model system for the biodiversity and structure of the deep continental biosphere.

The development of microbial mats at the rock-water interface is simulated by the use of non-pressurized flow reactor systems in order to reproduce open pond systems under contamination-free and controlled conditions. Phylogenetic and functional gene (*dsrB, apr*A, *pmo*A) analyses of the different microbial mat communities using denaturing gradient gel electrophoresis (DGGE) point to the dominance of iron- (*Gallionella*-community) and methane-oxidizing (*Methylomonas sp.*) consortia, as well as to sulfur oxidizing (*Thiocapsa sp.*) and sulfate reducing bacteria (*Desulfolobus propionicus*). Rare earth element (REE) analyses indicate an unexpected 1.000- to .000-fold enrichment in the iron/manganese consortia, as well as a significant accumulation of trace elements like beryllium, yttrium, zirconium and hafnium. Antimony, copper, zinc, cadmium and molybdenum preferably accumulated in the sulfur oxidizer and sulfate reducer mats. ToF-SIMS spectra of iron/manganese microbial mats revealed glycero-phosphoglycerol as major lipid according to exact mass determination, comparison with reference standards, and characteristic molecular fragments.

Microbial communities supplied by these waters proved to differ significantly from the intermediate aquifer and deep $CaCl_2$ brine water consortia, presented as preliminary results of an ongoing multidisciplinary project (DFG-Research Unit FOR 571).

115: TS1 Early Planets and Life, poster

A critical review of the octocorallian fossil record (Cnidaria: Anthozoa)

Reich M

Geoscience Centre of the Georg-August University Göttingen, Museum, Collections & *Geopark, Goldschmidtstr. 1-5, D-37077 Göttingen, Germany*

Octocorals have a rather disjunct record throughout the geological column. The earliest possible occurrence date back to Cambrian faunas and are widely represented and diversified today as soft and horny corals (Alcyonacea and gorgonians), sea pens (Pennatulacea), as well as blue corals and stoloniferans (Helioporacea and Stolonifera) and some other small groups. They are generally characterised by a lightly chitinised exoskeleton (e.g. gorgonians) or endoskeleton with microscopic calcareous sclerites or axial rods (e.g. soft corals, sea pens) and poor preservation potential, which is clearly the principal reason for their rarity and occasional absence in the fossil record.

Despite this, over the decades a number of Palaeozoic octocorallian fossils have been described. In many of these, precise attributions to understanding higher-level taxa have not been determined, largely as a result of indifferent preservation of the microstructure. After the recent detection of skeletal carbonate hydroxylapatite in recent gorgonaceous octocorals, several Early Cambrian phosphatic 'problematica' now appear in another light, with close relationships to this group.

Similarly, fossils of the Ediacaran leaf-like presumed pennatulids have been described from Cambrian rocks, e.g. *Priscapennamarina* (Early Cambrian, Yunnan, China), and *Thaumaptilon* (Burgess Shale, Middle Cambrian, BC, Canada), but interpretations of these fossils as octocorals cannot accept with regard to the further Phanerozoic fossil record.

Another Burgess Shale fossil *Echmatocrinus*, originally described as a crinoid, was later interpreted as a probable octocoral, and show relationships to the gorgonians.

The early fossil record, evolution and phylogeny of Octocorallia and Anthozoa, including recent molecular analyses, is still in a state of confusion and more palaeontologic work must definitively be done accepting or rejecting one hypothesis or the other.

116: OS Open Session, poster

Comparison between different gas bearing structures; indicators, methods and first results

Reuther J, Janßen P, Luick H, Schreiber U

Univ. Duisburg Essen, Department of Geology, Germany, 45117 Essen

Gas bearing structures as indicators for tectonic and volcanic elements are well known. Migration of subterrestrial gases has been studied in different fields of geosciences (Etiope and Martinelli, 2002). Characteristic ascending gases are mainly CO_2, He, Rn, CH_4, and N_2 (Sugisaki et al., 1980; Ioannides et al., 2003). Our research group is focused on the detection of recent open fracture zones and post volcanic elements (mofettes and mineral springs) in different locations in Germany and also in the Czech Republic. Because of the different types of gas bearing structures, dry and wet different methods were used.

In addition to the detection on the basis of taking gas samples, the infrared thermography was tested to identify gas bearing zones due to difference in temperature of the gas flow contrary to the background. After detection our aim was to characterise the gas flow type. Therefore the concentrations of helium, Rn and CO_2 and the isotope ratio of He were determined. Additionally to this we investigated the origin of periodic changes of the helium concentrations in gas bearing mineral springs and fracture zones based on monitoring of the gas phase.

Secondary, the phenomena that gas permeable fracture zones encourage site selection for ants (Schreiber et al. 2009) have been born in mind during the investigation of gas bearing fracture zones. In the area of the East Eifel Volcanic Field strong variations of the observed parameter He occur in soil gases and in the free gas phase of mineral waters even over a short time scale. A multi-parameter monitoring station including the parameters He and Rn recorded diurnal small scale variations and stronger fluctuations that show significant correlation to seismic activity in the area.

Periodic changes of the helium concentrations were observed at the North Sea island Amrum. These changes are caused by the ocean load tides which evoke a rise of the helium concentration near by high tide.

References

Etiope G, Martinelli G (2002) Migration of carrier and trace gases in the geosphere: an overview. Phys. Earth Planet. In. 129: 185-204

Sugisaki R, Anno H, Aedachi M, Ui H (1980) Geochemical features of gases and rocks along active faults. Geochem. J. 14: 101-112

Ioannides K, Papachristodoulou C, Stamoulis K, Karamanis D, Pavlides, S Chatzipetros, A. and Karakala, E (2003) Soil gas radon: a tool for exploring active fault zones. Appl. Radiat. Isot. 59: 205-213

Schreiber U, Brennholt N, Simon J (2009) Gas permeable deep reaching fracture zones encourage site selection of ants. Ecol. Ind. 9: 508-517

117: IS3 Archives of Environmental Evolution and Climate Change, poster

Paleotemperatures from Mediterranean cold-water coral Lophelia pertusa

Riethdorf JR, Rüggeberg A, López Correa M, Fietzke J, McCulloch M, Dullo WC

IFM-GEOMAR, Leibniz-Institute of Marine Sciences, Wischhofstr. 1-3, D-24148 Kiel, Germany, E-Mail: jriethdorf@ifm-geomar.de
GZN-IPAL, Geo-Center Northern Bavaria, University of Erlangen-Nuremberg, Loewenichstr. 28, D-954 Erlangen, Germany
ANU-RSES, Research School of Earth Sciences, The Australian National University, Canberra 0200, Australia

Cold-water corals are one of the most promising climate archives that contain high-resolution records of long-term climate change. However, mechanisms of element incorporation are not fully understood and deciphering paleoceanographic information from these animals has only begun. Here, we apply different elemental and isotopic proxies of paleotemperatures on recent and fossil specimens of the cold-water coral Lophelia pertusa from the central Mediterranean Sea and reconstruct temperatures of intermediate water masses for the late glacial period and the Younger Dryas.

Electron-probe microanalysis (EPMA) was used to generate high-resolution profiles of Sr/Ca-ratios across the thecal wall of the coralline aragonite which have afterwards been converted into temperatures using the equation of Cohen et al. (2006). On same sections LA-MC-ICP-MS-determination of stable strontium isotopes ($\delta^{88/86}Sr$) was performed and used to apply the temperature relationship published by Rüggenberg et al. (2008). Additionally, measurements of stable carbon ($\delta^{13}C$) and stable oxygen ($\delta^{18}O$) isotopes conducted on the same specimens were used to apply the "lines technique"-method (Smith et al., 2000). Fossil coral samples were U/Th-dated after having been checked for alteration.

Applying the Sr/Ca-T-relationship of Cohen et al. (2006) to the recent specimens shows that regional Sr/Ca-calibrations are needed for L. pertusa whereas the calculated T-variability along the thecal profiles is plausible for intermediate water masses. The "lines technique"-method results in paleotemperatures of 2.8°C at 17.6 ka and of 5.1°C at 12.4 ka compared to the present 14°C. However, these estimates are compromised by a large error of 1.1°C because of the unknown isotopic composition of the seawater. Verification of lower temperatures than at present comes from the $\delta^{88/86}Sr$-method which emphasizes the great potential of cold-water corals as evaluable climate archives.

References

Cohen AL, Gaetani GA, Lundälv T, Corliss BH, George RY (2006): Compositional variability in a cold-water scleractinian, Lophelia pertusa: New insights into vital effects. G3 7: Q12004

Rüggeberg A, Fietzke J, Liebetrau V, Eisenhauer A, Dullo WC (2008): Stable strontium isotopes (d88/86Sr) in cold-water corals - A new proxy for reconstruction of intermediate ocean water temperatures. EPSL 269: 570-575

Smith JE, Schwarcz HP, Risk MJ, McConnaughey TA, Keller N (2000): Paleotemperatures from deep-sea corals: Overcoming vital effects.. Palaios 15: 25-32

118: TS2 Geology of Extreme Earth Environments, poster

Methane bubble emissions at the seafloor at the Makran Continental Margin, offshore Pakistan - Flare detection and video-based quantification

Römer M, Sahling H, Bohrmann G

MARUM-Center for Marine Environmental Sciences and Faculty of Geosciences, University of Bremen, Klagenfurter Strasse, 28359 Bremen, Germany

Makran is an extensive accretionary wedge formed by the subduction of the oceanic Arabian Plate beneath the continental Eurasian Plate. The occurrence of mud volcanism and fluid seepage has been documented in the literature but detailed surveys and sampling of these seeps have not been conducted so far.

A systematic search for fluid seeps along an continental margin segment from the shelf break to the abyssal plain was carried out during R/V Meteor cruise M74/2 and 3. The survey covered an area of about 6850 km^2. Seeps were found using a combination of exploration techniques including multibeam mapping, sidescan sonar imagery, high-resolution seismics, Parasound sediment echosounder, TV-sled and remotely operated vehicle (ROV) Quest seafloor observation and sampling.

Ten gas bubble emission sites were recorded within the study area in water depths between 575 and 2870 m using the 18 kHz signal of the Parasound system. Gas bubbles in the water column cause acoustic anomalies in the echosounder that look like flares. The highest flare observed showed gas bubbles rising up to 1870 m into the water column before being dissolved in the ocean water.

Video observations with ROV Quest were carried out at four bubble emission sites, which were connected to different structural settings and varying associated biological communities. The bubble flux was estimated by video-based analyses of the bubble volume and number. Flux rates are in the range of $0.25\pm0.13\times^6$ mol CH_4 min^{-1} to $8.4\pm6.2\times^6$ mol CH_4 min^{-1} for individual seep sites. The results further show that high bubble fluxes cause strong acoustic anomalies in the Parasound signal while low fluxes effect weak anomalies. This allows to roughly estimate the total flux of bubbles in the study area. Assuming a steady discharge the amount of emitted methane from the seafloor is about $18.62\pm13.47\times^6$ mol CH_4 yr^{-1}, which is comparable to the average annual gas demand of 280 family households.

119: TS2 Geology of Extreme Earth Environments, poster

The effect of microstructure on grain growth rate, in particular in ice

Rößiger J, Bons PD, Griera A, Jessell M, Evans L, Faria SH

Institute for Geosciences, Eberhard Karls University of Tübingen, Wilhelmstraße 56, 72074 Tübingen, Germany
Université de Toulouse, UPS (SVT-OMP), LMTG, 14. av. Edouard Belin, F-31400 Toulouse, France
School of Earth Sciences, University of Melbourne, VIC 30, Australia
University of Goettingen, GZG, Sect. of Crystallography, Goldschmidtstr. 1, D-37077 Göttingen, Germany

Static grain growth, driven solely by grain boundary surface energy, is considered an important process in polar ice. Grain growth is not only important in the upper hundreds of metres of ice where the grain size steadily increases, but also at deeper levels where grain size appears balanced by grain growth and dynamic recrystallisation that reduces grain size.

The increase in grain size (G) with time (t) from a starting grain size of G0 is usually described by the following rate law:

$G^n - G0^n = k \cdot t$,

where n is the growth exponent and k is a rate constant. The growth constant k is important for any process where grain growth plays a role. It is normally assumed that k is a material property that only depends on temperature. Here we show, using numerical simulations with the program Elle, that the factor k also incorporates the effect of the microstructure on grain growth. For example, a change in grain size distribution from normal to lognormal in thin section is found to correspond to an increase of k by a factor >3. Not considering the change in k when the microstructure changes, can lead to erroneous estimates of the growth exponent n.

120: TS2 Geology of Extreme Earth Environments, oral

Denudation rates from terrestrial cosmogenic nuclideBein the western branch of the East African Rift System

Roller S, Wittmann H, Hinderer M, Hornung J

Technical University Darmstadt, Institute of Applied Geosciences,
Schnittspahnstrasse 9, D-64287 Darmstadt, roller@geo.tu-darmstadt.de

Long-term denudation rates from in-situ produced cosmogenic nuclide concentration of Be from riverborne quartz were determined for 13 catchments draining the Rwenzori Mountains (western Uganda). The 75 km long and 30 km broad mountain range was exhumed during syn-rift tectonics during the last 12 My as a structural accommodation zone fault block. It is positioned in a central graben position between two rift segments of the Western Rift and exposes an impressingly steep topography with average slopes between 22 - 24 degrees and glaciated peaks at 50 masl.

Effects from this steep morphology on the production rate of cosmogenic Be were accounted for by correcting for topographic shielding; snow and ice shielding correction was carried out by using historical glaciation maps. Calculated values for recent denudation rates lie between 29 and 149 mm/ky for catchment sizes between 1 and 265 km^2; thus, the derived rates integrate over a time scale of 4 – 21 ky. The two highest values (115 and 149 mm/ky) stem from the catchments with the highest slope gradient, both draining the fault determined steep southeastern flank of the Rwenzoris. In contrast, smallest values (29 –72 mm/ky, modal value 50 mm/ky) are obtained for the catchments on west and east sides of the narrow northern part of the Rwenzori range.

On the one hand, the denudation rates show a significant positive relationship to average basin slope (converging towards a threshold value of 24 degrees for this young topography) and on the other hand are largely independent from catchment size and basin relief. Compared with analogue tropical and montainous settings, the Rwenzori denudation rates are relatively low, probably reflecting low erodibility of gneissic basement rocks and dense vegetation cover.

121: IS3 Archives of Environmental Evolution and Climate Change, oral

^{14}C reservoir ages show deglacial changes in ocean meridional overturning circulation

Sarnthein M, Grootes PM, Kuehn H, Nadeau MJ

Institut für Geowissenschaften, Universität Kiel, D-24098 Kiel, Germany
Leibniz Labor, Universität Kiel, D-24098 Kiel, Germany

Near the end of the Last Glacial Maximum (LGM), deep and intermediate waters in the Timor Sea and subarctic North Pacific had apparent ventilation ages of 3300-3600 yr, in contrast to 450-650 yr found in the glacial Icelandic Sea. ^{14}C reservoir ages of ocean surface waters varied from 1200 to 2500 yr, if accepting the results of the ^{14}C plateau tuning method (Sarnthein et al., 2007). With the onset of H1 near 17,500 cal. yr BP (GISP2 and Hulu Cave record; Meese & Sowers, 17; Wang et al., 2001) surface water ages in the subarctic northwest Pacific dropped to 300 yr. This low value reveals a short interval of deep-water convection in the northwest Pacific, being also reflected by an abrupt 1200-to-1500-yr drop in the age of upper and lower deep waters in the subarctic north Pacific. At the same time find an abrupt increase in the age of Icelandic Sea intermediate waters up to 2000 yr, recording a short-term reversal of the Denmark Strait Overflow. The deep penetration of young waters in the North Pacific Ocean implies a significant overturning of intermediate and deep waters over H1 times, an event with great implications for the 'Conveyor Belt' concept and a better understanding of the coeval 190-‰ shift in atmospheric ^{14}C. The abrupt onset of North Pacific deep-water formation near 17.5 ka may be linked to a major salinity increase in surface waters of the subarctic northwest Pacific, reaching 36 psu, which in turn may result from a reduced freshwater supply by the Kuroshio Current, a current that collects all major rivers from the Southeast Asian monsoon region like a rain gully. The monsoonal freshwater supply was strongly reduced ~17.5 ka with the abrupt start of severe Southeast Asian aridity during H1, as documented in the Hulu Cave.

References

Sarnthein M, Grootes PM, Kennett JP, Nadeau MJ (2007): 14C reservoir ages show deglacial changes in ocean currents and carbon cycle. AGU Monograph 173: 175-198

Meese DA, Et al. (1997): The Greenland Ice Sheet Project 2 depth-age scale: Methods and results. J. Geophys. Res. 102: 26,411-26424

Wang YJ, Et al. (2001): A high-resolution absolute-dated Late Pleistocene monsoon record from Hulu Cave, China. Science 294: 2345-2348

122: IS4 Magmatism and Earth Evolution, oral

Zircon trace element evidence for Hadean infracrustal differentiation

Schersten A, Frei D

Department of Geology, GeoBiosphere Science Centre, Sölvegatan 12, Lund University, SE-223 62 Lund, Sweden. Anders.Schersten@geol.lu.se
Department of Mapping, Geological Survey of Denmark and Greenland, Øster Voldgade , DK-1350 København K, Denmark

We have analysed the U-Pb ages and trace element signatures of detrital zircons from Itsaku, West Greenland, where a major hiatus separates an Upper Albian to Lower Cenomanian deltaic sandstone succession from an Upper Campanian to Paleocene marine turbidite succession. Zircons from the lower deltaic succession are derived from the tonalite-trondhjemite-granodiorite (TTG) gneisses that dominate the Archaean rocks exposed in southern West Greenland, whereas zircons from the turbiditic succession are derived exclusively from the the nearby A-type granite of the Prøven Igneous Complex (PIC).

Trace element ratios and patterns are overlapping to a large extent, but there are some distinctive features between the TTG and Prøven zircon groups that might be petrogenetically significant. Zircons from both groups have high U/Yb compared to oceanic crust zircon, which apparently reflects a common feature of zircon originating from continental crust. However, the TTG zircons generally have higher Sr/Nd and Eu/Eu* compared to the PIC zircons, reflecting the differing signatures of their assumed source rocks. Furthermore, each group plot along different Eu/Eu* versus Ce/Ce* trends that point to their source rock compositions, reflecting magmatic differentiation.

The origin of Hadean zircons is controversial, but of great importance for understanding crust formation processes during early Earth. We compare our data with available literature data for Hadean zircons to assess if further constraints on the origin of Hadean zircons can be made. Similar to zircons from Greenland, Hadean zircons typically have high U/Yb. Furthermore, Hadean zircons have relatively pronounced Eu/Eu* for a given Ce/Ce*, which is a feature that resembles the signature of zircons from the PIC. These observations point to an origin of Hadean zircons from settings where infracrustal melting is important, and rule out TTG-like rocks as a prominent source for Hadean zircons.

123: TS3 Geomicrobiology and Biogeochemistry, poster

Iron cycling in modern and ancient environments

Schmidt C, Kappler A

Geomicrobiology, Centre for Applied Geosciences, University of Tuebingen,, Tuebingen, Germany

Iron is one of the major redox-active elements in the earth crust and respiratory pathways based on iron redox transformations are prevalent among microorganisms. The conversion of iron by chemo – or phototrophic microorganisms under various physicochemical conditions (i.e. pH, pO_2, light intensity) has been described to be of great importance in both ancient and modern environments. In the early earth ocean where at least deep waters were free of oxygen, ferrous iron was expected to be abundant and thought to be oxidized either via anoxygenic photosynthetic Fe(II) oxidation or chemically/microbially via cyanobacterially produced O_2, both leading to the deposition of iron oxides (e.g. in Precambrian banded iron formations, BIFs). In contrast, modern aqueous environments are exposed to high levels of oxygen, which cause a rapid removal of ferrous iron from the water column by abiotic or biotic (aerobic) Fe(II) oxidation. The occurrence of iron oxidation and reduction, as well as the competition between biotic and abiotic processes is strictly controlled by local physico-chemical conditions. One of the remaining questions is how these processes are linked to each other throughout a redox-, light- or substrate gradient and how the geochemical iron cycle functions and varies in ecosystems that are exposed to different environmental conditions. Accounting for local physicochemical conditions, a conceptual study is proposed to evaluate the appearance and dominance of either oxidative or reductive processes driven by light or chemical energy in modern and ancient environments. Under consideration of thermodynamic and kinetic aspects the availability of substrates and the possible development of different iron-depending microbes will be evaluated. In order to determine the linkage of the different iron transforming processes, the obtained results will be interpreted as a function of sources and sinks of substrate, that consequently close the geochemical cycle of iron.

124: TS3 Geomicrobiology and Biogeochemistry, poster

Uranium retention mechanisms in soil-aquifer-systems

Schöner A, Noubactep C

Martin-Luther-Universität, Institut für Geowissenschaften, Ingenieurgeologie, Germany, D-06120 Halle, Von-Seckendorff-Platz 3, angelika.schoener@geo.uni-halle.de, Geowissenschaftliches Zentrum der Universität Göttingen, Abt. Angewandte Geologie, Germany, D-37977 Göttingen, Goldschmidtstraße 3

Natural enrichment of uranium in soils and sediments is feasible to study the migration and immobilisation processes of radioactive elements in the geological environment. This study covers geochemical, hydrogeological and radiometric aspects of uranium retention in soil. The identification of the available uranium phases and its association with soil phases is one of the main interests.

Main controls in soil-aquifer systems include flow rate and water quality, mineralogical composition and physico-mechanical soil properties, vegetation and microbiological activity. A hydrologic regime with slow flow rates and vertical flow paths facilitates essential contact time between water and solid surfaces. Sufficient contact time (water/solid) allows for chemical retention mechanisms in the aquifer material; in soils plant related and microbiological processes contribute via bioreduction, -sorption or -accumulation. The latter are capable of retaining high uranium concentrations on the dry mass basis as frequently shown by laboratory investigations. Secondary enrichment of uranium as frequently observed in organic-rich soils and sediments may suggest that biological processes are fundamental in preconcentration by means of uranium entrapment. Thereby pore-water depletion of uranium occurs, resulting in retention through plant detritus or microorganisms. When biomass degrades, biosorbed or bioaccumulated uranium will be integrated in the soils. Hence, as remobilisation or resuspension are a matter of concern, laboratory studies suggest that uranium reduction and (bio-)mineralisation of U(IV) species are crucial for conservation. However on field scale, the presence of a hexavalent immobile uranium phase U(VI) contradicts uranium reduction (spectroscopic, wetchemical and mineralogical investigations). In applying advanced imaging methods (TEM) and microbiological complementary studies (DNA isolation) more detailed conclusions on uranium retention mechanisms can be drawn.

125: IS2 Tectonics and Sedimentation, oral

From basement high to basin: The Triassic to Early Jurassic Panthalassan margin of Gondwana in North Victoria Land (Antarctica)

Schöner R, Elsner M

Friedrich-Schiller-Universität Jena, Institut für Geowissenschaften, Burgweg 11, 07749 Jena

The tectonic evolution of the East Antarctic craton was governed by subduction-accretion along the Panthalassan margin of southern Gondwana throughout most of the Paleozoic and Mesozoic. The basin evolution along this margin is documented by the Beacon Supergroup of the Transantarctic Basin (Devonian to Early Jurassic), which consists of dominantly continental clastic deposits. They are overlain by up to 00 m thick lava flows, which erupted at about 184Ma (Ferrar large igneous province). Although the influence of a magmatic arc source has been inferred from sedimentological and compositional data of certain Beacon Supergroup units, the interaction of tectonic and igneous processes at the plate boundary, and sedimentation in adjacent basins is not well constrained. The southeastern part of North Victoria Land was part of a stable basement high (Ross high) that separated different sub-basins until the (?) Early Triassic, and became apparently inactive thereafter. The entire Triassic to Early Jurassic continental clastic sequence on top of the Ross high is less than 300 m thick, much less than in adjacent sedimentary basins. Compositional data of sandstones reflects provenance from both magmatic arc sources and basement lithologies of the craton margin. Thickness, sediment architecture and lithofacies patterns do not show evidence for significant synsedimentary tectonic activity, but suggest the gradual overstepping of sedimentation onto the Ross high during the Triassic. Basin formation was probably related to loading of the crust by the magmatic arc at the active margin of Gondwana. The deposits in North Victoria Land do not support the model of a Early Jurassic tectono-magmatic rift as previously suggested (Elliot, 12).

References

Elliot DH (1992): Jurassic magmatism and tectonism associated with Gondwanaland break-up: an Antarctic perspective. Geol. Soc. London, Spec. Publ. 68: 165-184

126: OS Open Session, poster

Origin of Life - tectonically controlled by Strike-Slip Faults of the Early Crust?

Schreiber U, Buck V, Epple M, Flemming HC, Mayer C, Locker-Gruetjen O

University Duisburg-Essen, Faculty of Biology and Geography 1, Faculty of Physics 2, Department of Chemistry 3, Science Support Centre 4, Germany, 45141 Essen, Universitätsstr. 5,

Inferred from today's condition strike-slip faults might have already exist during formation of the early crust. Deep reaching faults are permeable to fluids and gas. We presume ideal conditions for the formation of first pre-biotic molecules within these faults. From this follows, that these faults might actually be the real place of origin for biological life.

Through physical and chemical selection mechanisms, a great number of pre-biotic molecules could have been developed into ones that were more complex.

These interconnected reactivity environments had dimensions from nano to centimeter cavaties. The entire volume of all environments was more than km^3. At different levels of the earth crust, various pre-biotic molecules could emerge under various pressure and temperature conditions. The molecule's structure depended on the facies (pT-conditions, chemical and mineralogical conditions and cavaties). Through fluid migration, caused by temperature-related circulation and rising gas bubbles, a molecule exchange from facies to facies could have taken place. At a third stage, the molecular precursors could have been transformed into chemical compounds that were more complex. Our approach presumes that:

- conditions of the Fischer-Tropsch-synthesis were given to rise alkanes, alkenes and alcohols,
- all starting substances (CO, H_2, catalysts, add. CO_2, NH_3, H_2S, SO_2, HF, phos. compounds) existed. The pT-conditions were met at a level of a few hundred metres,
- vein mineralization provide accessible metallic surfaces,
- directionally crystallized quartz allowed piezoelectric flow under tectonic stress.

These circumstances allowed the formation of a significant number of pre-biotic and biotic molecules that serve as the basis for all known further developments. The concentration of molecules in the nanopores should have been high enough to form additional compounds. First experiments under early crust's developing conditions were carried out, results are presented.

127: IS3 Archives of Environmental Evolution and Climate Change, poster

Sedimentation rates based on downhole logging data from AND-2A borehole, ANDRILL Southern McMurdo Sound Project, Antarctica

Schroeder H, Wonik T

Leibniz Institute for Applied Geophysics,
Stilleweg 2, D-30655 Hannover, Germany, henning.schroeder@liag-hannover.de

During the 2007-2008 austral summer, the Antarctic geological DRILLing program (ANDRILL) recovered a core of sedimentary rock from an 1138-mbsf-deep borehole in the Southern McMurdo Sound. In this borehole downhole logging was conducted including density, neutron porosity, sonic velocity, magnetic susceptibility, geochemistry and natural gamma radiation measurements.

This study focuses on several intervals between 400 mbsf and 00 mbsf.

First results from different chronostratigraphic studies indicate that the complete interval contains sediments from an overall time span of about 3.5 million years (Ma): Early Miocene; 17 – 20.5 Ma. This leads to an average accumulation rate of 18 cm/ka, which is approximately constant over the whole interval. It is assumed that no hiatuses in sedimentation appear.

The relevant physical parameters are magnetic susceptibility and natural gamma radiation . Spectral analysis shows the relation between these physical properties and the conditions of sedimentation and reveals present astronomical cycles. The rates derived from the logging data differ slightly from the one given above. The gamma ray log gives a higher average rate of 20 cm/ka whereas the susceptibility log is ambiguous. It leads to a rate between 18 and 22 cm/ka. A disturbing factor is the deposition of material from volcanic origins which is not linked strictly to the investigated cycles.

128: IS4 Magmatism and Earth Evolution, poster

An experimental and theoretical investigation of Mg isotope fractionation in the Earth's mantle

Schuessler JA, Pinilla CC, Elliott TR, Kohn SC

Department of Earth Sciences, University of Bristol, U.K.
GeoForschungsZentrum Potsdam, Germany, jan.schuessler@gfz-potsdam.de
School of Chemistry, University of Bristol, U.K.

Mg isotope analyses of mantle rocks and minerals revealed large variations. Systematic differences in δ^{26}Mg found between minerals from mantle xenoliths offer the potential for this isotopic system as an isotope geothermometer. However, re-

sults from other studies reveal a more complicated picture, where isotopic variability was found in similar samples (San Carlos olivines). To date, the cause for the observed variability remains uncertain. We explore the role of inter-mineral Mg isotope fractionation at upper mantle conditions. Experiments were done at 2 GPa and 00°C for 167 to 185 hours to investigate isotope partitioning between forsterite (Fo) and enstatite (En). Mg isotopes of coexisting En and Fo were analysed by MC-ICP-MS. The experiments were complemented by analyses of olivine and orthopyroxene from a SC xenolith and by theoretical estimations of equilibrium inter-mineral Mg isotope fractionation, based on vibrational frequency calculations and minimization of the total free energy of the solids. First experimental results revealed no Mg isotope fractionation between En and Fo beyond analytical precision at 00°C, 2 GPa ($\Delta^{26}Mg_{En\text{-}Fo}$ = -0.02‰±0.12 (2SD); -0.03‰±0.). This result is consistent with our measurement on the SC xenolith ($\Delta^{26}Mg_{opx\text{-}ol}$ = -0.08‰±0.11) and is close to the theoretical estimate (0.21‰). The absence of equilibrium inter-mineral Mg isotope fractionation suggests that the variability observed in various mantle-derived rocks is caused by other processes, such as diffusion-induced kinetic isotope fractionation as previously observed for Li isotopes. This is supported by a co-variation between Li and Mg isotopes found by others in a global peridotite dataset, implying both Li and Mg isotopes are affected by the same process. Hence, a combined Mg and Li isotope approach has the potential to better understand processes leading to the observed isotopic variability.

129: TS1 Early Planets and Life, oral

Post-Cryogenian recovery of the shallow marine ecosystem as a base for Ediacaran metazoan evolution, central China

Scouflaire Q, Heubeck C, Zhu M

Freie Universität Berlin, Institut für Geologische Wissenschaften,
Malteserstr. 74-0, 12249 Berlin, Germany. quentin.scouflaire@fu-berlin.de

The Doushantuo Formation (Ediacaran, 635-551 Ma) of the south China Yangtze Platform contains some of the earliest known well-preserved metazoa. However the sedimentary environment and any possible interaction between biogenic processes and sedimentation during this 85-My-long interval is poorly known.

Composition of economic minable phosphatic and manganiferous strata of the lower Doushantuo formation (635-580 Ma) at the northern margin of the Yangtze Platform constrain oceanic chemistry and paleoceanography in the aftermath of the Cryogenian. In Sichuan and Chongqing provinces, spectacular oolithic-oncoidic manganese carbonates (rhodochrosite) are found within dysoxic-sulfidic black shale (Fan et al., 19). Their average stable carbon isotopic composition ($\delta^{13}C \approx$ -15‰ VPDB) points to a high rate of burial of organic matter and intense microbial sulfate

reduction during very early seafloor diagenesis. In adjacent northern Hubei province, extensive oncoidic phosphorites show evidence of primary phosphatization in shallow-water, high-energy, subtidal to shoreface environments and of reworking of phosphatic clasts in lower shoreface microbial dolomites. Surprisingly, the manganiferous and phosphatic sedimentation related to biomats persists in southern Shaanxi province despite siliciclastic input from a nearby western source (Zhou et al., 2002).

The manganese and phosphate deposits result from biotic-abiotic interactions, most of them rare in the Phanerozoic: a post-Cryogenian persistence of oceanic stratification (Ling et al., 2007), resulting in steep physico-chemical gradients (greenhouse climate, beginning oceanic overturn and oxygenation), a high productivity of the well-fed microbially-dominated biosphere, and the wide extent of ecological niches for microbial communities in low-sedimentation-rate shelfal basins.

References

Fan D, Ye J, Yin L, Zhang R (1999): Microbial processes in the formation of the Sinian Gaoyan manganese carbonate ore, Sichuan Province, China. Ore Geology Reviews 15: 79-93

Zhou C, Yuan X, Xiao S (2002): Phosphatized biotas from the Neoproterozoic Doushantuo Formation on the Yangtze Platform. Chinese Science Bulletin 47: 1918-1924

Ling H, Feng H, Pan J, Jiang S, Chen Y (2007): Carbon isotope variation through the Neoproterozoic Doushantuo and Dengying Formations, South China: Implications for chemostratigraphy and paleoenvironmental change. Palaeogeography, Palaeoclimato 254: 158-174

130: TS1 Early Planets and Life, oral

Latest Ediacaran transgressive-regressive cycle (Gaojiashan Member) at the northern margin of the Yangtze Platform (China): evolutionary push and taphonomic window for evolving metazoan communities

Scouflaire Q, Weber B, Cai Y

Freie Universität Berlin, Institut für Geologische Wissenschaften,
Malteserstr. 74-0, 12249 Berlin, Germany. quentin.scouflaire@fu-berlin.de

On the northern Yangtze Platform, the Gaojiashan Member represents a singular, thin (-80m) yet regionally-extensive siliciclastic interval within the otherwise thick (ca. 00m) carbonate-dominated Dengying Formation of Late Ediacaran age (551-542 My); it thus offers a distinctive glimpse at low-latitude paleoenvironments prior to the Cambrian bioradiation (Meert & Lieberman, 2008).

In its type locality in Shaanxi province, this 60-meter-thick unit of alternating

nearshore shales, sandstones and limestones exhibits a wide range of compositions and sedimentary structures - most notably intraformational breccias, glauconitic sandstones, and tempestites.

Three Late Ediacaran macrofossil assemblages have been recognized within the Gaojiashan Member in differing sedimentary settings: (1) A mass accumulation of Shaanxilithes (a probable body fossil) occurs in glauconitic siltstones that likely relate to a transgressive pulse. (2) The classical Gaojiashan Biota contains various articulated, tube-shaped metazoa preserved by primary pyritization in tempestites (Cai & Hua, 2007) and some of the oldest known complex trace fossils (Weber & Scouflaire, this volume). (3) A typical Cloudina fauna (Hua et al., 2007) in biolaminated calcarenites marks the resumption of carbonate sedimentation, presumably following transgression.

The lithologies of the Gaojiashan Member record a complex interplay of sedimentary processes in a mixed carbonate-siliciclastic nearshore depositional system. Field observations in adjacent Sichuan and Hubei provinces and a growing body of global bio- and chemostratigraphic data suggest that the Gaojiashan Member and its correlatives represent a short-duration latest Neoproterozoic regressive-transgressive cycle taking place at a time of high biological innovation. Such a cycle may have provided new ecological niches and taphonomic windows in shallow-water environments, thereby favouring the spreading and preservation of new metazoan communities.

References

Cai Y, Hua H (2007): Pyritization in the Gaojiashan Biota. Chinese Science Bulletin 52: 645-650

Hua H, Chen Z, Yuan X (2007): The advent of mineralized skeletons in Neoproterozoic Metazoa - new fossil evidence from the Gaojiashan Fauna. Geological Journal 42: 263-279

Meert JG, Lieberman BS (2008): The Neoproterozoic assembly of Gondwana and its relationship to the Ediacaran-Cambrian radiation. Gondwana Research 14: 5-21

131: TS4 Impact of Deep Earth Processes on History, Civilisation and Life, oral, Gauss and GV Public Evening Lecture

Self-organization: a planetary perspective

Seyfried H

Institut für Planetologie, Universität Stuttgart

Earth is the product of a chain of cosmic processes that ultimately resulted in the formation of a planet with a chemically highly differentiated and physically very mobile crust. This crust contained a delicate balance among chemical elements needed for organic systems to develop and sustain higher life forms. Over much of the Earth's history the Earth's core, mantle, and crust developed a high degree of self-organization eventually expressed by plate tectonics. Plate movements exert strong controls on all inorganic subsystems (e.g., oceans, mountain chains, continental plateaus) and are essential in providing a suitable habitat for thriving life and its organic subsystems. In contrast to the inorganic compartments, the organic Earth is not only self-organizing but self-optimizing, thus greatly expanding its adaptative efficiency on a planet experiencing increasing heat supply from the sun through geological time. As a result, CO_2 released from the Earth's interior (and originally also from icy meteors) is increasingly stored within the crust, mostly in reduced state (tar sand, oil shale, oil, gas, gas hydrate, coal, graphite schist, graphite-bearing gneiss) but also in oxidized form (limestone). The amount of carbon from the atmosphere that is temporarily or permanently locked in crustal rocks surpasses the living biomass by a factor of more than 20. Convergent plate margins and collision zones are sites of constant carbon recycling releasing CO_2 back into the atmosphere. However, in the long run, the amount of CO_2 recycled from crust to atmosphere will diminish with the decreasing heat supply from the Earth's interior. It is probable that the cosmic window of complex multi-cellular life on Earth is directly related to plate tectonics. Thus, a mobile differentiated crust combined with the invention of photosynthesis, and the global interplay between both, are the basic ingredients for fundamental biologically induced changes in planetary evolution: a) long-term stabilization of surface temperature at levels above 0°C and below 30°C through burial of organic matter and carbonates, and, b) enrichment of oxygen providing a globally available source of chemical energy. On time-scales of billions of years the concentrations of atmospheric CO_2 and O_2 are reciprocal. Leaves or C4 plants, for instance, are biological innovations in response to long-term decreasing CO_2 concentrations. On time-scales of tens of millions of years concentrations of CO_2 and O_2 may vary considerably or even rise simultaneously. At present, ancient CO_2 concentrations are much better known than O_2 concentrations, which possess large error bars. However, trends are recognizable and it appears that all major steps in multi-cellular evolution are related to episodes in Earth history when concentrations of atmospheric CO_2 and O_2 were rising simultaneously. Gigantism, especially among animals, developed only when oxygen demands were oversupplied while at the same

time high CO_2 concentrations provided the excess food necessary for strong specialization. Crucial events of the Earth's history will be discussed in the context of the complex relations between these parameters and their interplay with corresponding climate states. The action of humans is finally evaluated in a planetary perspective.

132: IS3 Archives of Environmental Evolution and Climate Change, poster

Holocene environmental reconstructions from two coastal lakes in south-central Chile (Lago Lanalhue and Lago Lleu, 38°S)

Stefer S, Arz HW, Lamy F, Echtler HP, Haug GH

MARUM Center for Marine Environmental Sciences, Leobener Strasse, 28359 Bremen, Germany, sstefer@marum.de
Deutsches GeoForschungsZentrum GFZ, Potsdam, Germany
Alfred-Wegener-Institute AWI, Bremerhaven, Germany
Eidgenössische Technische Hochschule ETH, Zürich, Switzerland

The active continental margin of south-central Chile is characterized by both subduction-related coastal deformation and pronounced variations in regional climate. Accordingly, the depositional records of the coastal lakes Lanalhue and Lleu (38°S) give indications of past tectonic and climatic processes. Both lakes developed within former river valleys, which once discharged towards the Pacific; at ~ 8000 cal yr BP, the rivers became disconnected from the ocean due to localized uplift along a margin-parallel fault (Stefer et al., 2009). Since then, lacustrine sediments accumulated in the formed lake basins, preserving continuous records of Middle to Late Holocene environmental changes.

Here, we present paleoclimatic inferences from multi-proxy analyses of sediment cores from Lago Lanalhue and Lago Lleu Lleu (see also Stefer, 2009). The sediment sequences of both lakes indicate a long-term (multi-millennial) climate trend with decreasing aridity from the Middle (8000-4200 cal yr BP) to the Late (4200 cal yr BP-present) Holocene. Precipitation in the study area is most notably driven by the latitudinal position/strength of the Southern Westerly Winds (e.g. Lamy et al., 2001); hence, the detected climate trend is interpreted to reflect a northward shift/ strengthening of the prominent wind belt.

In both lakes, the transition out of the Middle Holocene is characterized by an increase in the terrigenous sediment input. Late Holocene sediments of Lago Lleu Lleu are above all marked by frequent occurring detrital layers, which may be related to an increase in the El Niño activity. Enhanced climate variability is recorded in the sediments of Lanalhue and Lleu Lleu during the last 2000 yrs, suggesting important hydrological changes on the short-term (centennial) scale as well. More arid phases broadly correspond to the Roman, Medieval and Modern Warm Periods, whereas generally wetter conditions correlate with the Dark Ages and Little Ice Age Periods.

References
Stefer S, Moernaut J, Melnick D, Echtler HP, Et al. (2009): Forearc uplift rates deduced from sediment cores of two coastal lakes in southcentral Chile. Tectonophysics doi:10.1016/j.t: ecto2009.05.006
Lamy F, Hebbeln D, Röhl U, Wefer G (2001): Holocene rainfall variability in southern Chile: a marine record of latitudinal shifts of the Southern Westerlies. EPSL 185 (3-4): 369-382
Stefer S (2009): Late Pleistocene-Holocene Sedimentary Processes at the Active Margin of South-Central Chile: Marine and Lacustrine Sediment Records as Archives of Tectonics and Climate Variability. PhD Thesis Potsdam University, Germany

---

133: IS3 Archives of Environmental Evolution and Climate Change, oral

Pacific climate forcing detected in a coral record from the NW Indian Ocean

Storz D, Gischler E

Goethe-Universität, Institut für Geowissenschaften, Facheinheit Paläontologie, Altenhöferallee 1, D-60438 Frankfurt am Main, david.storz@em.uni-frankfurt.de

We present the first coral proxy record ($\delta^{18}O$, linear extension-rates, ER) from the Maldives. The monthly record (1917-2006) originates from a *Porites lutea* colony sampled at Rasdhoo Atoll (4°N/ 73°W). Field correlations between $\delta^{18}O$ record and sea surface temperature (SST) datasets in the NW Indian Ocean yield information about the extension of the area of monsoon-induced SST cooling. The effect of sea surface salinity (SSS), covarying with instrumental SST (2°x2°) on interannual range, diminishes the potential to reconstruct SST by using $\delta^{18}O$ ($r = -0.41$, $p < 0.001$). $\delta^{18}O$ is significantly linked with interannual (3-6 yrs) and decadal (12-14 yrs) variability in the instrumental Nino3.4 record (measure for ENSO). Since SST does not exhibit an ENSO-like decadal variability, it is more likely that this signal is forced by variation in seawater $\delta^{18}O$. Statistical coherence between $\delta^{18}O$ and gridded (0.5°x0.5°) SSS in the decadal range supports this conclusion. This relationship is an evidence that $\delta^{18}O$ records ENSO-forced decadal variations of the strength of the Indian monsoon current system. Annual ER increase throughout the 20th century and follow the warming trend in the Maldives ($r = 0.48$, $p < 0.001$). ER reveal typical periods of interannnual ENSO modes and hence demonstrate the strong impact of interannually ENSO-driven SST variability on coral growth. The detection of the Pacific Decadal Oscillation (PDO), a multi-decadal climate phenomenon, provides further evidence of SST-sensitive coral growth, and for the notion that a substantial portion of Indian Ocean climate variability is driven by the Pacific.

134: IS4 Magmatism and Earth Evolution, oral (Invited Keynote)

A chondritic bulk Earth composition?

Stracke A, Bourdon B, Kleine T, Birbaum K, Günther D

ETH Zürich, Institut für Isotopengeologie und Mineralische Rohstoffe, Clausiusstrasse 25, NW C81.3, 8092 Zürich

Meteorites are remainders of the building blocks of the planets in our solar system and as such, provide crucial information about Earth's bulk composition that is not available from terrestrial rocks. While it has long been known that Earth is depleted in volatile elements (e.g., Rb, K, Pb) relative to chondritic meteorites [1], the relative proportion of refractory element ratios (e.g. REE, Al, Th, Nb) is generally assumed to be invariant among chondrites and between chondrites and the bulk Earth [2]. High-precision trace element data in bulk chondrites reported here, however, show significant refractory element fractionation between the different chondrite groups. Refractory element fractionation is observed among the REE and between the REE and other refractory elements (e.g. the HFSE Zr, Hf, Nb, Ta), whereas some refractory elements ratios are indeed invariable (e.g. Zr/Hf, Nb/Ta). The preservation of refractory element fractionation at the bulk chondrite scale suggests that the various components that aggregate to form chondritic meteorites originated in different environments and were efficiently transported, but not entirely mixed in the solar nebula. Consequently, bulk planetary bodies, including Earth may have refractory element proportions that differ from those observed in chondrites. Whether Earth's bulk composition is chondritic or not has important implications for understanding its differentiation and compositional evolution. For investigating differentiation of the Earth into continental crust and mantle, and mantle evolution in particular, the bulk Earth composition represents the initial reference point. By shifting this reference point, any inferences on the relative depletion or enrichment of these reservoirs will change. This has important consequences for the timing of crust-mantle differentiation processes, especially for early Earth differentiation.

References

Anders E (1964): Origin, age, and composition of meteorites.. Space Science Reviews 3: 583-714

Palme H (2000): Are there chemical gradients in the inner solar system?. Space Science Reviews 192: 237-262

135: OS Open Session, poster

The internal architecture of a strike-slip fault zone near Hardegesen, Lower Saxony

Tanner DC, Bloch NW, Paul J, Geothermal Group Göttingen

Leibniz Institute for Applied Geophysics, Stilleweg 2, D-30655 Hannover, Tanner@liag-hannover.de
University of Göttingen, Geoscience Centre Göttingen,Goldschmidtstr. 1-3, 37077 Göttingen

On the western border of the NNE-SSW striking Leinetal Graben, Lower Saxony, near the town of Hardegsen, a quarry exposes an E-W striking, strike-slip fault zone in Lower Muschelkalk. According to Vollbrecht (1985), the faults have displaced the Base Muschelkalk dextrally by 326 m. The core of the fault consists openly-folded Upper Buntsandstein (Röt) clays and marls in which bedding is still apparent. We mapped the structure using a differential GPS and a tachymeter, and constructed the shape of the fault enclave in three dimensions in GoCAD.

The model shows that the form of the fault enclave is continuously consistent in thickness along strike (at the top level of the quarry), but has a large positive (to the north) asperity in one place (30 m lower). From its 3D shape of the enclave we suggest that the faults removed a block out of the Röt sediments, which was subsequently moved upwards during dextral strike-slip movement. Due to compression during lateral motion, some of the material formed an active diapir. Fault enclave capture is rarely observed in the field, but mapping this fault structure in three dimensions has allowed the mechanisms to be analysed in more detail.

References

Vollbrecht R (1985): Der Westrand des Leinetalgrabens zwischen Lutterhausen und Hardegsen. Unveröffentlichte Diplomarbeit Uni Göttingen: 220

136: TS3 Geomicrobiology and Biogeochemistry, poster

Uptake of alkaline earth metals in Alcyonarian spicules (Octocorallia): response to changes in atmospheric pCO_2

Taubner I, Böhm F, Eisenhauer A, Garbe-Schönberg D, Erez J

Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany, itaubner@ifm-geomar.de
Institute of Geosciences, Christian-Albrechts-Universität, Kiel, Germany (dgs@gpi.uni-kiel.de)
Institute of Earth Sciences, The Hebrew University of Jerusalem, Israel (erez@vms.huji.ac.il)

Alcyonarian corals live in shallow tropical seas and produce spicules that contribute to the formation of reef sediments. These high-Mg calcite spicules (~13mole% $MgCO_3$) are more soluble than aragonite and calcite and should therefore be very

sensitive to ocean acidification. The effect of warming temperatures on these organisms is not known. Alcyonarians spicules may be an important archive for paleoceanography and almost nothing is known about their chemical and isotopical response to temperature and pH.

We measured the response to these parameters on a new model organism *Parerythropodium fulvum*. It was grown under controlled laboratory conditions in natural seawater at (i) a temperature range from 19 to 32°C at constant pH; and (ii) a pH range from 7.6 to 8.5 at constant temperature and dissolved inorganic carbon concentration. Results indicate that trace element ratios and Ca isotope fractionation are controlled by more than one environmental parameter.

The temperature response of Mg/Ca in *P. fulvum* is significant (1.0 mmol/mol/K), but less sensitive than inorganically precipitated Mg-calcites[1]. While the weak temperature dependency of Sr/Ca in *P. fulvum* (-0.012 mmol/mol/K) agrees well with experimental data of inorganic calcites, precipitated at rates typically known for corals ($\log(R)=4\mu mol/m^2/h$), the strontium distribution coefficient is slightly higher ($D_{Sr,\ P.fulvum} \sim 0.3$ compared to $D_{Sr,\ inorg.} < 0.2$ [2]). The pH exerts an even stronger control on metal partitioning, with 6.1 and 0.22 mmol/mol/pH-unit for Mg/Ca and Sr/Ca, respectively. So far no other studies have been conducted in this field.

Although being a high Mg-calcite, the $\delta^{44/40}Ca$ of *P. fulvum* (0.79‰ relative to NIST SRM915a) is identical within error with mean value measured for *Acropora* sp. (0.81‰)[3], an aragonitic scleractinian coral, but shows no significant temperature dependency. On the other hand $\delta^{44/40}Ca$ demonstrates a weak dependence on pH (-0.18‰/pH unit).

References

Mucci A (1987): Geochim. Cosmochim. Acta 51: 1977-1984
Tang J (2008): Geochim. Cosmochim. Acta 72: 3718-3732
Böhm F (2006): Geochim. Cosmochim. Acta 70: 4452-4462

137: TS2 Geology of Extreme Earth Environments, oral

Supercontinents, Orogens, Rifts: Geodynamic Contributions from Antarctica

Tessensohn F, Kleinschmidt G

Lindenring 6, 29352 Adelheidsdorf, Germany
Institut für Geowissenschaften, Altenhöferallee 1, 60438 Frankfurt/M.

Antarctica was a centrepiece of the supercontinents Rodinia and Gondwana and therefore provides important information on the periodic clustering of continental fragments on the earth's surface. Research at present concentrates on the formation of Gondwana. As collisional processes form an important construction mechanism,

the respective orogens in Antarctica and its neighbouring continents are prime research targets.

Several collisional orogens document the welding of continental fragments to the Antarctic core with a climax during Pan-African time (~550 Ma). The latest of these orogens in the Shackleton Range (~500 Ma) overlaps in time with the beginning of accretionary events at the Palaeo-Pacific margin of Gondwana. In the Antarctic segment, the Ross orogen (500 Ma) is followed by the younger accretionary Gondwanide (Permo-Triassic) and Andean (Cretaceous-Tertiary) orogens. These accretionary complexes indicate a persisting active plate boundary between Palaeo-Pacific and Gondwana. There is no indication for the closure of the ocean or for a Wilson cycle over the last 500 Ma.

The break-off of Africa, India, Australia and South America occurred in a clockwise sense around Antarctica forming tangential break-off margins. However, one major extensional geodynamic feature, the West Antarctic Rift System, does not fit into this regular scheme, because it splits Antarctica in a radial N-S direction, inwards from the Ross Sea. This active continental rift is characterized by deep sedimentary basins, high heat flow, alkali-basaltic magmatism and a pronounced rift shoulder. The magmatic record starts in the Eocene with gas-rich alkali-intrusions, followed by a major alkali-volcanic phase from about 25 Ma to the present. The rift provides a sedimentary record through the entire ice age. Drill cores of the Antarctic climate drilling programme (Cape Roberts, ANDRILL) have yielded a unique history of ice advances and retreats over the last 30 Million years.

138: IS3 Archives of Environmental Evolution and Climate Change, poster

Bedding rhythms in the Neogene Basin of northern Greece: astrochronology and rockmagnetics

Tougiannidis N, Kleineder M, Weber ME, Rolf, C. C, Apostolikas T, Ricken W

Institute of Geology and Mineralogy, University of Cologne, Zülpicher Str. 49a, 50674 Köln, Leibniz Institute for Applied Geophysics, Stilleweg 2, 30655 Hannover, Germany
General Mining and Mettalurgical S.A. LARCO, Kastoria Mines, 52050 Mesopotamia, Grecce

The Miocene-Pliocene sediment of the NNW – SSE striking Ptolemais-Basin comprises the largest Lignite deposit in the Balkan area. The basin extends from Monastir in the north to the Elassona region (GR) in the south. Besides their economical value the rhythmically bedded lignites potentially contain a detailed palaeoclimatic record of the north eastern Mediterranean realm. The aim of the present project is to analyse the rhythmically bedded Neogene lignite-sequences (Miocene-Pliocene) from the Ptolemais-Basin and to proof the existence of suspected periodical and quasi periodical climatic cycles. Section Lava is exposed in a

private open-pit mine, situated 8 km southeast of Servia. The sediments of the Lava-Section show distinct cyclicity. Moreover, there is a good stratigraphic control consisting of radiometric and biostratigraphic (de Bruijn et al., 19) ages.

Palaeomagnetic results from most of the samples reveal characteristic remanent magnetization directions with either steeply reverse or flat to steeply normal inclinations. Generally the Late Neogene samples (except for the Lava-section) have relatively low magnetic intensities. This suggests a low concentration of magnetic components. Rock magnetic investigations indicate an inhomogenous magnetomineralogy, composed of iron oxides (magnetite, hematite, goethite) and iron sulfides (greigite). The magnetic polarity change at 29 m above the base belongs to the lower boundary of chron C3An.2n and is 6.73 Ma old according to Steenbrink (2001).

The variation pattern of the cycles - the astronomical series expansion and sub-Milankovitch spectra which yield periods of 93.6 to 19.9 and 12.3 to 1 ka (Tougiannidis, 2009) - has been verified by time series of various, high-resolution spectrophotometrical (C*) and geophysical scalars. Accordingly, the visually distinguishable light-/dark-layers detected in this rather small intramontane basin, allow the evaluation of climate trends on a supra-regional scale.

References

De Bruijn, H. 1, Saraç, G. , Van den Hoek Ostende, L. , Roussiakis, S. (1999): The Status of the genus name Parapodemus Schaub, 1938 ; new data bearing on old controversy.. Deinsea 7:: 95 - 112

Steenbrink, J. 1 (2001): Orbital signatures in lacustrine sediments.. Geol. Ultraiectina, Ph.D. No. 205: 167 pp.

Tougiannidis, N. 1 (2009): Karbonat- und Lignitzyklen im Ptolemais-Becken: Orbitale Steuerung und suborbitale Variabilität (Spätneogen, NW-Griechenland). Sedimentologische Fallstudie unter Berücksichtigung gesteinsmagnetischer Eigenschaften.. Ph.D. Thesis -: 131 pp.

139: IS3 Archives of Environmental Evolution and Climate Change, oral

Vegetation response to late Quaternary climate change in southern Indonesia

Van der Kaars S

University of Göttingen, Albrecht-von-Haller-Institute for Plant Sciences, Department of Palynology and Climate Dynamics,
Germany, 37073 Göttingen, Untere Karspüle 2, Sander-van-der.Kaars@biologie.uni-goettingen.de

Palynological analysis of marine cores from the Indian Ocean, taken in close vicinity to Central Sumatra, East Java and Sumba, provides the basis for reconstruction of past changes in vegetation along a strong climatic gradient that extends from

everwet to seasonal. At present, the Central Sumatran lowlands are characterised by rainfall in excess of 2000 mm/year and experience no 'dry' season. Early results from analysis of core SO184 029-3 indicate that closed canopied evergreen rainforest cover has persisted throughout the last 19 ka, indicating that, during the last glacial period, bioclimatic conditions in this part of the Indonesian Archipelago were comparable to those of today. In the lowlands of East Java, rainfall of 1500 mm/year and a short 'dry' season of 1-4 months, gives rise to moist deciduous and semi-evergreen forests. First results from core SO184 053-7 show that forest cover was greatly reduced during the last glacial period, the landscape instead dominated by open grasslands and pockets of rainforest. This indicates some reduction in rainfall and a marked increase in the duration of the 'dry' season. By contrast, the lowlands of Sumba receive an annual rainfall total of ~00 mm and a 'dry' season of between 4 and 8 months. Reflecting this drier climate, dry deciduous and thorn forests dominate the island's flora. Analysis of core SO184 069-3 indicates that, during the last glacial period, the landscape here was more sparsely vegetated, and fires were more frequent, reflecting a climate with lower annual rainfall and a longer 'dry' season than at present. While helping to fill gaps in the knowledge of the past history of the vegetation in these parts of the archipelago, these new data also improve ourunderstanding of the parameters driving climatic change and variability on orbital and millennial scales in the region.

140: IS3 Archives of Environmental Evolution and Climate Change, oral

The Phanerozoic $\delta^{88/86}Sr$ record of marine carbonates - A new dimension for the Sr isotope system

Vollstaedt H, Eisenhauer A, Krabbenhöft A, Farkas J, Veizer J

IFM-GEOMAR, Leibniz Institute of Marine Sciences,
Wischhofstraße 1-3, D-24148 Kiel, Germany, hvollstaedt@ifm-geomar.de
Harvard University, Dept Earth & Planetary Sci, Cambridge, MA 02318 USA
Carleton University and Ottawa-Carleton Geoscience Centre, Ottawa, ON, Canada K1S 5B6

For the first time we extend and complete the application of the radiogenic Sr isotope system ($^{87}Sr/^{86}Sr$) [1] with a simultaneous measurement of radiogenic and stable strontium (Sr) isotopes [2] ($\delta^{88/86}Sr[‰]=(^{88}Sr/^{86}Sr_{sample}/^{88}Sr/^{86}Sr_{NBS987}-1)*00$). Applying a $^{87}Sr/^{84}Sr$-double spike we measured paired $\delta^{88/86}Sr$-$^{87}Sr/^{86}Sr$* ratios of 34 Phanerozoic marine carbonates samples which were screened for diagenesis prior to the measurement. The $^{87}Sr/^{86}Sr$* ratios are renormalized to $\delta^{88/86}Sr=0‰$ ($^{88}Sr/^{86}Sr=8.375209$) in order to be compatible to the radiogenic Sr isotope system values. Data reduction and denormalization follows an iterative algorithm by Krabbenhöft et al. [3]. External $\delta^{88/86}Sr$ reproducibility based on an internal coral carbonate standard (JCp-1) corresponds to 0.008‰ (2SEM).Our data reveal that the

$\delta^{88/86}Sr$ values of Phanerozoic brachiopods and belemnites samples are in the range of modern marine carbonates (JCp-1 coral standard value: 0.192±0.008‰) but isotopically lighter than modern seawater ($\delta^{88/86}Sr_{IAPSO}$= 0.385±0.007‰) being in the range between ~0.080‰ and ~0.370‰ (mean of 0.168). We observe a decrease in $\delta^{88/86}Sr$ from Ordovician (0.200‰) to Silurian period (0.080‰) with a consequent increase in $\delta^{88/86}Sr$ towards the upper Permian period. Highest values (~0.370‰) of $\delta^{88/86}Sr$ are reached close to the Permian/Triassic boundary.This study examines the main factors that control $\delta^{88/86}Sr$ on Phanerozoic timescale. It was found that temperature is not the main factor that drives $\delta^{88/86}Sr$ of marine carbonates. Rather we suggest that the $\delta^{88/86}Sr$ of Phanerozoic seawater is controlled by changes in the Sr flux in and out of the ocean. Modeling of our data allow a quantification of the Phanerozoic imbalance between the Sr input and output fluxes of the ocean.

References

Veizer J, Et al. (1999): 87Sr/86Sr, δ13C and δ18O evolution of Phanerozoic seawater. Chemical Geology 161: 59-88

Fietzke J, Eisenhauer A (2006): Determination of temperature-dependent stable strontium isotope (88Sr/86Sr) fractionation via bracketing standard MC-ICP-MS. Geochem. Geophys. Geosyst. 7: Q08009

Krabbenhöft A, Et al. (2009): Determination of radiogenic and stable strontium isotope ratios (87Sr/86Sr; δ88/86Sr) by thermal ionization mass spectrometry applying an 87Sr/84Sr double spike. J. of Analytical Atomic Spectr DOI: b906292k

---

141: TS1 Early Planets and Life, oral

The history of open ocean seawater stable Fe isotopes from the carbonate record

Von Blanckenburg F, Kamber BS, Bau M, Webb GE

GeoForschungsZentrum GFZ Potsdam, Germany (fvb@gfz-potsdam.de)

We have recently suggested that microbial carbonates, including stromatolites, could potentially serve as an Fe isotope proxy for seawater. Amongst the evidence provided was the observation that modern microbial carbonates contain virtually unfractionated Fe. New data published for dissolved Fe in Atlantic seawater also appear to indicate unfractionated modern seawater Fe. Microbial carbonate offers considerable advantages over more widely used archives to date, which record bottom water (BIF, shales) or diagenesis (sulphides). Microbial carbonates are possibly the only widely available archives of truly open ocean water and their major and trace element chemistry as well as Sr-isotope record can be used to screen against diagenetic overprint and to verify precipitation in unrestricted open ocean water.

Our initial survey of microbial carbonates throughout Earth history shows an Fe

isotope evolution that mimics that of many other proxies: namely, Neoarchean stromatolitic carbonates from the Hamersley Group, Western Australia, and of the Campbellrand Formation, Kapvaal craton, contain uniquely light Fe ($d^{56}Fe$ as low as -2.5‰), while older Archean stromatolites and Paleozoic as well as Mesozoic microbial limestones mostly range between 0 and -1‰ $d^{56}Fe$.

The sum of these new records and the chemical sediments published to date provides evidence for the presence of a prominent reservoir of light seawater iron in the ferrous form at the termination of the Archean. The light Fe is likely a residue from large-scale oxidation of ferrous iron, precipitated into BIF or pelagic clay. A diagenetic origin of the light Fe is unlikely in light of preserved seawater and hydrothermal REE patterns. In the post 2.4 Ga era, microbial carbonates could be overwhelmed by interstitial ferric Fe from (hydr)oxides. Quantitative oxidation under excess O_2 conditions led to unfractionated conditions.

References

Von Blanckenburg F, Mamberti M, Schoenberg R, Kamber BS, Webb GE (2008): The iron isotope composition of stromatolitic carbonate. Chemical Geology 249: 113-128

142: IS3 Archives of Environmental Evolution and Climate Change, poster

Geomorphogenetic and pedogenetic analyses of glacial deposits as paleoclimatic indicators in the Himalaya

Wagner M

University of Goettingen, Institute of Geography,
Goldschmidtstrasse 5, 37077 Goettingen, Germany, mwagner4@gwdg.de

For the Himalaya one can still find a controverse discussion on the extent and chronology of pleistocene glaciation. Besides differing geomorphological results, pedological relative datings delivered further inconsistent findings. For selected reas along the Kali Gandaki a detailed field review of different glaciogeomorphological reconstructions has been carried out, supplemented by new equilibrium line altitude (ELA) calculations. These observations have been used as benchmark to explore the options and limits of pedological relative dating of glacigene deposits in the Higher Himalaya.

An elaborate discussion of the geomorphological investigations clearly appoved the more extended glaciation and the relative chronology found in Kuhle (1982) in contrast to the more restricted glaciation advanded by Fort (2000).

To reconstruct former ELA depressions within the very steep and highly dynamic landforms of the Himalaya, "Toe-To-Summit-Altitude-Methods" (TSAM) are most adequate. The method Kuhle is proved to provide the most suitable results, because its "factor of snowline deviation" allows for simulating the strong influence of the valley topography and the degree of debris cover. Maximum ELA depressions

of 1300 to 1500m can be observed for the south-face of the Higher Himalaya as well as for the arid north-face and the Inner Himalaya (cf. Wagner 2007).

In the central part of the Higher Himalaya most of the pedochemical weathering indices mirror the relative chronology of deglaciation correctly due to comparable soil development conditions (cf. Wagner 2005, 2007). On the other hand north of the Himalaya main range, the options of pedochemical relative dating are partly restricted due to drier climatic conditions. South of the Higher Himalaya variations of the parent material and the high degree of relief energy, precipitation, and anthropogenic use preclude a for this method obligatory primary form conservation of the accumulations.

References

Fort M (2000): Glaciers and mass wasting processes: their influence on the shaping of the Kali Gandaki valley (higher Himalaya of Nepal). Quaternary International 65/66: 101-119

Kuhle M (1982): Der Dhaulagiri- und Annapurna-Himalaya. Ein Beitrag zur Geomorphologie extremer Hochgebirge. Zeitschrift für Geomorphologie 41: 1-229, 1-183

Wagner M (2005): Geomorphological and pedological investigations on the glacial history of the Kali Gandaki (Nepal Himalaya). GeoJournal 63: 91-113

Wagner M (2007): Zur pedologischen Relativdatierung glazialgeomorphologischer Befunde aus dem Dhaulagiri- und Annapurna-Himalaja im Einzugsgebiet des Kali Gandaki (Zentral-Nepal). Pedological relative dating of glaciogeomorphological features from the Dhaulagiri and Annap. Geography International 1: 1-410

143: TS4 Impact of Deep Earth Processes on History, Civilisation and Life, oral, (Gauss-Invited Keynote)

Can the near and far future be predicted?

Ward P

Dept of Biology, The University of Washington, Seattle, 98195, USA

For both human civilization and future human evolution based on predictions for future climate, future tectonic plate movement, and future stellar evolution. Since there is no a priori reason that Homo sapiens will necessarily go extinct by any internal/inherent genetic or evolutionary mechanism, there is the real possibility that our species could indeed last not only millions, but billions of years, and thus bear witness to the transformations the dwindling atmospheric carbon dioxide and internal planetary heat coupled to increasing solar radiation on the Earth will bring. I will also address a newly recognized phenomenon of life summarized in the recently proposed "Medea Hypothesis" that may apply to all life, irrespective of its galactic habitation

144: TS1 Early Planets and Life, poster

Microbial mats, Ediacaran benthos and preservation of trace- and body fossils - examples from the Ediacaran of the northern Yangtze Platform

Weber B, Scouflaire Q

Freie Universität Berlin, , Institut für Geologische Wissenschaften, FR Geologie, (FOR-736)

Microbial mats probably played an ecological key role from late Archean up to late Neoproterozoic (Ediacaran) times in shallow marine habitats worldwide (Simonson & Carney, 19; Seilacher, 19). Most early benthic metazoans were highly adapted to the specific abiotic and trophic conditions on and beneath the microbially sealed seafloor (e.g. *Seilacher,*19). Moreover, microbial mats may have been an important factor during embedding processes, diagenesis and preservation of Ediacaran trace- and body fossils. On the late Proterozoic Yangtze Platform, the Gaojiashan Member (Middle Dengying Formation, Upper Ediacaran: 551-542 My.) represents a regional siliciclastic interval within a dolostone-dominated sequence (see *Scouflaire & Weber*, this volume). During field work in 2009, the type section near Gaojiashan (Shaanxi Province) provided new insights into the paleoecology and taphonomy of this unusual Ediacaran fossil lagerstaette. We here present new examples of mat-related trace fossil horizons as well as examples of unusual preservation of body fossils from this section.

The hitherto poorly understood Gaojiashan biota (*Conotubus*, *Gaojiashania*) consists of large, tube-shaped and three-dimensionally preserved (primarily pyritized) exoskeletons (Cai and Hua, 2007). The fossils occur in large number mainly in distinct event layers (probably storm layers). Some preservations display taphonomic features of biomat-mediated embedding processes forming "Ediacaran death masks" (sensu Gehling, 19).

The trace fossils occurring in the Gaojiashan Member are exclusively preserved in distinct layers within a dolostone bed above the body-fossil-containing siliciclastic sequence. They are always closely related to microbial mat horizons indicating a biomat-related lifestyle of the unknown trace originators. The fossil biomats display various mat-induced sedimentary structures as wrinkle- and roll-up structures (Simonson & Carney, 19).

References

Cai Y, Hua H (2007) Pyritization in the Gaojiashan Biota. Chin Sci. Bull. 52: 645-650
Gehling J (1999) Microbial mats in terminal Proterozoic siliciclastics; Ediacaran

death masks. PALAIOS 14: 40-57
Simonson BM, Carney KE (1999) Roll-up structures; evidence of in situ microbial mats in late Archean deep shelf environments. PALAIOS 14: 13-24
Seilacher A (1999) Biomat-related lifestyles in the Precambrian. PALAIOS 14: 86-93

145: IS4 Magmatism and Earth Evolution, poster

Geochemical and isotopic variations in western Panama magmas: Evolution of arc magmatism since Late Cretaceous

Wegner W, Wörner G, Harmon RS, Jicha B

Universität Göttingen, GZG, Abt. Geochemie, Goldschmidtstr. 1, 37077 Göttingen
USARL Army Research Office
Dep. of Marine, Earth, and Atmospheric Sciences, N. Carolina State University
Dep. of Geology & Geophysics, University of Wisconsin, Madison

Major and trace elements, Sr-, Nd-, Pb-, and O-isotopes and $^{40}Ar/^{39}Ar$ dating of igneous rocks from the Cordillera de Panama and the Soná and Azuero Peninsulas define the magmatic evolution over the last 100 Ma in western Panama. An initial phase of intraplate magmatism derived from a Galapagos-type plume source and forms the Caribbean Large Igneous Plateau basement at 95-69 Ma. Younger accreted terranes with enriched trace element patterns were amalgamated 70 to 20 Ma. A distinct magmatic suite in the Azuero and Soná Peninsulas shows trace element patterns suggesting the initiation of subduction at 71-69 Ma. 'Early' arc magmatism continues in the cordillera from 68-60 Ma (Chagres and Bayano) and a second pulse of the 'early' arc is observed along the entire length of the Cordillera 50 to 40 Ma. A third phase of the 'young' arc started after a significant magmatic gap of about 20 Ma from 19-5 Ma. The youngest phase consists of isolated volcanic centers of adakitic composition in the Cordillera de Panama that developed over the last 2 million years.

Trace element modelling shows different mantle components (variably highly depleted mantle and enriched OIB-mantle) enriched by 0.2 to 1.5 % slab fluids and melting degrees from ~ 8% to ~ 18%.

Initiation of arc magmatism at 71 Ma coincides with the cessation of Galapagos plateau, suggesting a causal link. The transition from intraplate to arc magmatism occurred relatively fast (3 Ma) and introduced a new enriched mantle source. The transition between 'early' and 'younger' arc (40 to 20 Ma) involves a change to more homogeneous intermediate mantle wedge compositions through mixing and homogenisation of sub-arc magma sources through time and/or the replacement of the mantle wedge by a homogeneous, relatively undepleted asthenospheric mantle. The break-up of the Farallon plate at this time (~ 25 Ma) may have triggered these changes. Adakite volcanism started after a magmatic gap, enabled by the formation of a slab window.

146: TS1 Early Planets and Life, poster

Biogeochemistry and petrography of Early Cambrian phosphorites from the Meishucun section, Yangtze Platform, South China

Wegwerth A, Dellwig O, Struck, U, Hippler D, Gehlken P-L, Trappe J, Franz G, Böttcher ME, Heubeck C

Freie Universität Berlin, Geowissenschaften, Geologie, Malteserstr.74-100, D-12249 Berlin
Leibniz Inst. f. Ostseeforschung Warnemünde, Marine Geologie, Seestr.15, D-18119 Rostock
Museum für Naturkunde, Humboldt Universität Berlin, Invalidenstr.43, 115 Berlin, Germany
Technische Universität Berlin, Mineralogie, Ackerstr.76, 13355 Berlin, Germany
Prüfung mineralogischer Roh- und Reststoffe, Mühlengasse 1, 37136 Ebergötzen
Universität Bonn, Institut für Geologische Wissenschaften, Nußalle 8, D-53115 Bonn, deceased

The Precambrian-Cambrian transition is one of the most dramatic time intervals in Earth´s history, as global changes in tectonics, climate and chemistry of the Earth's atmosphere and oceans fostered the worldwide Cambrian Radiation and a concomitant ecosphere revolution. This time also correlates with the first occurrence of the widespread giant phosphorite deposits. The well-known Meishucun section, a former candidate section for the Pc-C boundary, documents phosphorite formation amid a rapid biodiversification, immediately following the end of the Precambrian in a low-latitude, shallow-water carbonate shelf.

This contribution aims to elucidate the relation between contemporaneous significant phosphorite deposition and global environmental change at the Pc-C boundary. 14 samples, mostly of phosphorite-oo- and -bio-grainstones and –packstones from the app. 20 m thick Cambrian part of the Meishucun section (Zhujiaqing and Shiyantou Formations) were analysed for mineralogical (XRD, FTIR), geochemical (ICP-OES, XRF), and isotopic (C-irmMS) composition. The lower and upper phosphorites reach max. apatite contents of 90% and overlying dolostones show max.78% dolomite. These, in turn, are overlain by siliceous phosphorite and dolomitic shale of the Shiyantou Formation. Pyrite and trace metal enrichments (As, Cd, Mo, Zn) at the top of the lower phosphorite and in the Shiyantou Formation suggest transient anoxic conditions. Bulk $\delta^{13}C$ values correlate with dolomite abundance throughout. A slight negative $\delta^{13}C$ excursion at the top of the lower phosphorite coincides with the first appearance of SSF's. However, $\delta^{13}C$ values do not only reflect dolomite due to interference of carbonate groups from apatites amounting to about 10%. Bulk $\delta^{18}O$ values generally show a stratigraphic-upward trend towards lighter values throughout the phosphorite sequence. They may either indicate a warming trend during deposition, reflect an isotopic shift in sea water composition, or increased apatite content.

147: TS4 Impact of Deep Earth Processes on History, Civilisation and Life, poster

Environment and Politics shaping economic strategies in the Northeast African Eastern Desert

Weschenfelder P

Humboldt-University Berlin, Institute of Archaeology, Department of Northeast African Archaeology, Berlin, Unter den Linden 6, p_weschenfelder@yahoo.de

Desert environments condition the lives of its nomadic inhabitants by restricting their choices for economic strategies. Yet nomadic populations not only balance severe climate conditions but cope with globalization efforts induced politically from outside. As my paper demonstrates the challenge to develop economic strategies that answer such efforts but at the same time provide means to cope with extreme climate changes. Such situations are faced by the Bedja-speaking peoples inhabiting the Northeast African Eastern Desert between the Nile Valley and the Red Sea. Different areas of this desert provide for seasonal agro-pastoral tactis which is a major economic strategy of the Bedja peoples. Due to the unpredictability of seasonal rainfalls and the outcome of crops and animal husbandry Bedja peoples develop a variaty of alternative strategies to balance a possible failure. Such strategies involve interaction with sedentary peoples.The aspect of balancing these interactions and the climate conditions in the desert will be analysed from an ethnohistorical perspective. In the 19th century additional strategies involved caravan trade through the desert connecting the Nile Valley and the Red Sea. Yet, by the end of that century the British Colonial Gouvernment in the Sudan intensivied its involvement in international trade by constructing highways leading directly through the desert; thereby making caravan trade obsolete. The Bedja peoples developed new income generating tactics. Their environmental and geopolitical settings marked their choice for diverging tactics that in some cases led to fundamental cultural changes. Long-term trends were established whose effects in terms of adaptation towards the environmental constraints of the desert became visible during the severe drought of the early 1980ies. My paper gives details on geopolitically and environmentally based reasons for choosing strategies, their adabtability during the drought and thereby initiated trends.

References

Gleichen A (1905): North-Eastern Sudan (Chapter III), Central Eastern Sudan (Chapter IV). The Anglo-Egyptian Sudan 1: 83-116

Manger L, Abd el Ati H, Harir S, Krzywinski K, Vetaas O (1996): General Introduction. Survival on Meagre Resources. 1: 18-36

Murray G (1923): The Ababda. Royal Anthopological Inst. 53: 417-423

Owen T (1937): The Hadendowa. Sudan Notes and Records 20: 183-208

Sanders G (1933): The Bisharin. Sudan Notes and Records 16: 119-149

148: IS3 Archives of Environmental Evolution and Climate Change, oral

Leaving the early Eocene Greenhouse – Ice on the Poles already ~50 Ma ago?

Westerhold T, Röhl U

Center for Marine Environmental Sciences (MARUM), Bremen University, Leobener Strasse, 28359 Bremen, Germany, twesterhold@marum.de

Earth's climate during the early to middle Eocene has been characterized as a greenhouse with high CO2. Global temperatures reached a long-term maximum with its climax within the Early Eocene Climatic Optimum (EECO; ~53 to 51 Ma), the interval with the highest global temperature recorded in the past 70 Ma. The termination of the EECO is globally expressed by the onset of increasingly cooler deep-water temperatures and marks the onset of the long-term cooling trend towards the icehouse world.

Here we present a unique high-resolution cyclostratigraphy based on X-ray fluorescence (XRF) core-scanning data from tropical western Atlantic sediments (Demerara Rise, ODP Leg 207, Site 1258). Eocene sediments of Site 1258 consist of nannofossil chalk with foraminifers, which exhibit extremely well developed cycles covering the interval from magnetochron C20 to C24 (45 to 54 Ma). These data have been used to construct an orbitally calibrated chronostratigraphy in order to revise and evaluate the early to middle Eocene Geomagnetic Polarity Time Scale (GPTS).

Our new record shows, that right at the onset of the long-term Cenozoic cooling trend the dominant eccentricity-modulated precession cycles of ODP Site 1258 are interrupted by strong obliquity cycles for a period lasting ~800 kyr. These distinct obliquity cycles at this low latitude site point to a high-latitude driving mechanism on global climate variability ~50 Ma ago, and seem to coincide with a significant drop in atmospheric CO2 concentration below a critical threshold between 3- and 2-times the pre-industrial level. We hypothesize that a specific orbital configuration with low eccentricity and high obliquity components - similar to what was identified at the intensification of the Northern Hemisphere glaciation 3.0 to 2.3 Ma ago - following the crossing of a critical pCO2 threshold might have led to the formation of the first ephemeral ice sheet or at least extended sea-ice areas 50.1 to 49.4 Ma ago.

149: IS4 Magmatism and Earth Evolution, poster

Laacher See Carbonatites: Genetic and Temporal Link to a Stratified Phonolitic Magma Chamber

Wetzel F, Schmitt AK, Cooper KM, Zou HB, Wörner G

Inst. Isotopengeologie Mineral. Rohstoffe, ETH Zürich, 8092 Zürich, Switzerland
Dept. of Earth and Space Sciences, Univ. of California – Los Angeles, CA 90095-1567, USA
Department of Geology, University of California Davis, One Shields Avenue, Davis, CA 95616-8605, USA
Department of Geology and Geography, Auburn University, Auburn AL 36849, USA
Geoscience Centre, Geochemie, Goldschmidtstrasse 1, 37077 Göttingen, Germany

Carbonatite-bearing syenite xenoliths from the Laacher See volcano (Germany, ~13,000 years ago) document subvolcanic processes, the link between phonolite and carbonatitic magmatism and the time scales of magma storage and residence in the crust. Petrographic evidence suggests that Laacher See carbonatites form by phonolite - carbonate melt immiscibility. The timing and storage conditions of these melts are unknown and should provide insights into the pre-eruptive differentiation environment. Oxygen isotopes of zircon are typical of mantle-derived magmas. The bulk rock REE budget of the carbonatite is controlled by calcite modal abundances and by carbonate-silicate melt partitioning. Low-calcite syenite rocks share REE patterns with highly evolved phonolite. Syenitic sanidines and carbonates show evidence for simultaneous crystallisation. K-feldspars? lack magmatic compositional zoning patterns, and show exsolution textures that result from extended low-T subsolidus residence. This suggests that the syenite-carbonatite association formed in an extensive subvolcanic intrusive complex at the magma chamber margins, but was largely decoupled from the main compositionally zoned phonolite magma body. Individual xenoliths have tightly constrained zircon crystallization ages (to within <2,000 years) , and pyrochlore crystallized over an even briefer interval because it defines a high-resolution mineral isochron age of 25.5 +/- 2.1 (2s). Zircon crystallization and bulk rock model differentiation ages coincide within 2-3 ky and show peak values at ~6 ky and possibly ~20 ky prior to eruption. U-series crystallisation ages thus coincide with previous age constraints and reveal that carbonatite genesis may be episodic and that the evolved Laacher See magma system existed and/or accumulated over at least 20 ky prior to the eruption of the residual phonolite magmas at c. 13.000 ky. The subvolcanic syenite-carbonatite complex may have been older and cooler at its margin with the compositionally zoned phonolite accumulating in and erupted from its core after c. 20 ky of magma evolution.

150: IS1 New Analytical Techniques, oral (Invited Keynote)

The impact of MC-ICP-MS in the stable isotope field: > 50 potential tools

Weyer S

Institut für Geowissenschaften , Goethe-Universität Frankfurt, Germany

Isotope variations produced by chemical reactions, so called stable isotope fractionation, have been investigated by more than 60 years and related findings have contributed to important questions in geosciences, such as the evolution of the solar system and life on Earth. With previous techniques, stable isotope investigations have been limited to a small number of elements, e.g. H, Li, B, C, N, O, S. The plasma source offers high ionization efficiency and stable conditions, which are very suitable for stable isotope analyses of most elements. As a result, isotope variations for essentially all investigated elements cross the periodic table (from Li to U) have been detected. Some of these "non-traditional" isotope systems have been studied extensively (e.g. Si, Fe, Cu, Zn, Mo). As each element has unique (bio-) geochemical properties, its isotope signature can be used to constrain and quantify a variety of processes, including evaporation, adsorption, redox processes, nutrient uptake, anthropogenic pollution, hydrothermal and even magmatic processes. As isotope variations of such "heavy metals" are usually small (typically 0.1-5‰) very high precision isotope analyses are essential. Major improvements are based e.g. on the overcome of mass interference problems (e.g. with high mass resolution) and improved instrumental mass bias control. The use of elemental (e.g. Cu for Fe, Ni or Zn for Cu) or double spike techniques pushed precision limits routinely to < 0.1‰. Due to the improved sensitivity of 2nd and 3rd generation MC-ICP-MS only a few ng of an element are usually required for high precision isotope analyses, which allows e.g. trace metal isotope investigations of natural waters or small amounts of meteoritic- or biomaterials. Improvements in Laser-ablation-techniques additionally open the possibility of in situ stable isotope analyses by LA-MC-ICP-MS.

151: IS2 Tectonics and Sedimentation, oral

Long-term Stability of Global Erosion Rates and Weathering Fluxes during late Cenozoic Cooling

Willenbring JK, Von Blanckenburg F

GFZ Section 3.4 : Earth Surface Geochemistry, Helmholtz Center Potsdam, GFZ German Research Center For Geosciences,
Telegrafenberg, D-14473 Potsdam, Germany, Phone: +49 (0)331 288 28 600,
Email: jane@gfz-potsdam.de, Email: fvb@gfz-potsdam.de

Over geologic timescales, removal of atmospheric CO_2 by weathering of silicate rocks balances CO_2 input from the Earth's interior. The coincidence of global cooling and the rise of mountain belts during the late Cenozoic has led geologists to suggest feedbacks between these two events. A centerpiece of this hypothesis was partially founded on observations of a young (0-5 My) 4-fold increase in global sedimentation rates, which seemed like a clear proxy for increased denudation and uplift of uplands. Over the same time interval, the radiogenic seawater Sr isotope record seemed to confirm enhanced global chemical weathering. However, paleo-ocean pH records provide no evidence for reduced atmospheric CO_2 concentrations over this period. Here, we provide evidence that this increase in global erosion rate and weathering flux has never occurred. First, the sedimentary record is biased towards measuring decreasing rates of erosion and sedimentation with increasing age due to observational biases and the stochastic nature of erosion and sediment transport. Second, new estimates of the global erosion rate extrapolated from hundreds of field measurements of loads and cosmogenic nuclides in bedload of modern rivers match those expected from the Phanerozoic stratigraphic record after correction for time scale bias. Third, we provide evidence that Quaternary glaciers of Arctic areas were much less erosive than commonly assumed. Fourth, we recast the ocean dissolved $Be/^9Be$ isotopic system as a weathering proxy that spans the last ~12 Ma. This proxy indicates stable weathering flux magnitudes during the late Cenozoic. These independent observations show neither clear evidence for increased erosion nor for a pulse in weathering fluxes to the ocean. We conclude that processes different from an increase in global denudation has caused Cenozoic global cooling, and that global cooling had no profound effect on global, spatially and temporarily averaged weathering rates.

152: TS2 Geology of Extreme Earth Environments, oral

Middle Pleistocene megafloods in the Münsterland Embayment: depositional setting and flood dynamics

Winsemann J, Meinsen J, Landmeier N, Weitkamp A

Leibniz Universität Hannover, Institut für Geologie,
Germany, 30167 Hannover, Callinstr. 30, winsemann@geowi.uni-hannover.de

The largest known terrestrial floods are associated with glaciations and the outburst of large sub- or proglacial lakes. Much of the evidence for the past occurrences of such megafloods is erosional, developed from studies such as those in the Channeled Scabland (NW USA), the Altai Mountains (Sibiria) and the Strait of Dover. More recent work has tied the influence of megafloods to sedimentation in nearby marine basins.

Although large and deep proglacial lakes formed in central Europe at the margin of the Middle Pleistocene ice sheets, little is known about the drainage history of these lakes and the subsequent routing of meltwater.

During the Early Saalian glaciation ice-damming of the Upper Weser Valley led to the formation of glacial Lake Weser. During the maximum lake-level highstand the lake covered an area of at least 1700 km^2 with more than0 km^3 water stored in the lake basin. The lake drained catastrophically southwestward into the Münsterland Embayment as the western ice dam failed, probably releasing up to 70 km^3 of water within a few days with a peak discharge of at least 150.000 m^3/s.

The drainage routes are characterized by the occurrence of deep plunge pools, streamlined hills and trench-like channels, cut into bed rock and/or Quaternary deposits.

Plunge pools are developed in front of the main overspill channels and are incised into Mesozoic basement rocks. They are up to 780 m long, 400 m wide and 35 m deep, corresponding in size with plunge pools formed at the Niagara Falls and the Victoria Falls.

Downflow fan-shaped arrays of hills occur, covering an area of approximately 200 or 300 km^2, respectively. These streamlined hills are 2-13 m high, 550-4000 m long and 150-3000 m wide and consist of meltwater sand, overlain by relics of diamicton. The hills partly resemble features produced by currents around obstacles. The "obstacle" is a plug of more resistant diamicton and the tail is composed of sand, representing sand bars formed in the lee of streamlined hills during flood. The hills are separated by 50-400 m wide and 5-9 m deep channels, which merge downflow into 1-2 km wide, 5-7 km long and -20 m deep trench-like channels, now occupied by small underfed streams.

153: IS2 Tectonics and Sedimentation, oral

A cosmogenic nuclide-based sediment budget of the Amazon basin

Wittmann H, Von Blanckenburg F, Guyot JL, Maurice L, Kubik PW

GFZ Potsdam, Telegrafenberg, Potsdam, Germany
IRD Brazil, Lago Sul, Brasilia, Brazil
IRD/LMTG Toulouse, Avenue Edouard Belin, Toulouse, France
Laboratory of Ion Beam Physics, ETH Zurich, Zurich, Switzerland

We used cosmogenic nuclides in stream sediment to construct a sediment budget of the Amazon basin. The procedure is based on basin-wide denudation rates derived from cosmogenic Be in quartz. The measured denudation rates integrate over ^{3} years. When multiplied with the basin´s area, the sediment load can be calculated. Within the large Amazon basin, the areas providing sediment to the central Amazon are the Andes, and the Brazilian and Guyana Shield, respectively; these areas have been systematically analyzed for their cosmogenic nuclide signals. An integrated Andean denudation rate of 0.36±0.06 mm/yr has been determined. The headwaters of the Brazilian and Guyana shields denude at very low rates (~0.015 mm/yr), as is expected for tectonically stable cratons. These headwater denudation rates can now be compared with those derived from the central Amazon. Here, we found that nuclide concentrations are strongly grain size dependant; the fine grain size fraction (125-250 μm) contains a nuclide signal that is similar to that of Andean source areas. Therefore, we used this fraction to calculate an integrated denudation rate of 0.22±0.02 mm/yr for the entire Amazon basin. Coarse grain sizes (>500 μm) record the very low denudation signal of the shields, and correspondingly, they contribute only small amounts of sediment into central Amazon streams. The Andean erosion signal is best represented by the fine sand fraction.The integrated cosmogenic-based denudation rate of the entire Amazon basin converts to a total sediment load of 540 Mt/yr, a signal that records sediment production in the Andes and that is not affected by storage processes within the central Amazon floodplain. From present-day gauging, suspended loads are higher by a factor of 2-3 than our loads. This is a surprising finding, because modern loads integrate over much shorter time scales, where high magnitude low frequency events usually do not occur.

154: IS3 Archives of Environmental Evolution and Climate Change, oral

Magnesium stable isotope systematics in marine biogenic $CaCO_3$

Wombacher F, Eisenhauer A, Böhm F, Gussone N, Rüggeberg A, Regenberg M

FU Berlin, Inst. Geologische Wissenschaften, Malteserstr. 74-0, D-12249 Berlin, Germany, IFM-GEOMAR Leibniz-Institut für Meereswissenschaften, Wischhofstr. 1-3, D-24148 Kiel

Magnesium stable isotope compositions in marine biogenic aragonite and calcite were determined in order to investigate the mechanisms for Mg incorporation and Mg isotope fractionation during CaCO3 precipitation and the possible use of Mg isotopes as proxies in paleoceanography. Analysis were carried out by MC-ICP-MS with a repeatability of ±0.22‰ (2 sd) for δ26Mg, as estimated from coral reference sample JCp-1 (n = 37) [1]. Five species of aragonitic cold and warm water corals and sponges display a uniform offset of Δ26Mg = 0.9±0.2 (in ‰) relative to seawater, similar to warm water coral data [2]. Only Vaceletia spp., displays larger fractionations possibly due to secondary calcite. High-Mg calcites from sponges, coralline red algae and an isidid coral also show uniform isotope fractionations relative to seawater with Δ26Mg = 2.5±0.2, in line with data for another calcitic coral and speleothems [3,4]. Milliloid high-Mg foraminifera display somewhat more scatter, possibly due to alteration or vital effects. An echinoid sample (Diadema setosum), displays less fractionated Mg isotope compositions, apparently because of the initial formation of amorphous CaCO3.The aragonite and high-Mg calcite samples span a range in seawater temperatures of 19 and 29 K, respectively. Within analytical uncertainty, however, the Mg isotope fractionation is independent from temperature (and related parameters such as carbonate ion concentration) as previously observed for speleothems and planktonic foraminifera [3,4]. Thus Mg isotopes seem to be of no use for paleotemperature reconstructions. The mineralogically controlled, uniform Mg isotope fractionations observed for various biogenic high-Mg calcites and aragonites reflect the Mg isotope fractionation expected for inorganic CaCO3 precipitation. In contrast, low-Mg calcites (foraminifera, coccolith oozes and a brachiopod) display significant biological effects.

References

Wombacher F, Eisenhauer A, Heuser A, Weyer S (2009): Separation of Mg, Ca and Fe from geological reference materials for stable isotope ratio analyses by MC-ICP-MS and double-spike TIMS. JAAS 24: 627-636

Chang VTC, Williams RJP, Makishima A, Belshaw N, O´Nions RK (2004): Mg and Ca isotope fractionation during CaCO3 biomineralization. BBRC 323: 79-85

Galy A, Bar-Matthews M, Halicz L, O´Nions RK (2002): Mg isotopic composition of carbonate: insight from spelothem formation. EPSL 201: 105-115
Pogge von Strandmann PAE (2008): Precise magnesium isotope measurements in core top planktic and benthic foraminifera. G3 9: doi:10.1029/200

155: TS2 Geology of Extreme Earth Environments, poster

Detrital zircon U-Pb and heavy mineral constraints on pre-Neogene geology and evolution of the Western Andean Cordillera, Northern Chile

Wotzlaw JF, Decou A, Von Eynatten H, Wörner G, Frei D

Abt. Sedimentologie/Umweltgeologie, GZG, Univ Göttingen,Goldschmidtstr. 3, D-37077 Göttingen
Abt. Geochemie, GZG, Universität Göttingen, Goldschmidtstr. 1, D-37077 Göttingen
Geological Survey of Denmark and Greenland (GEUS), Øster Voldgade , DK-1350 København
Dépt. de Minéralogie, Université de Genève, Rue des Maraîchers 13, CH-1205 Genève

The Western Cordillera of the Central Andes is widely covered by Neogene arc-related volcanic and volcaniclastic deposits. Pre-Neogene rocks are exposed only in deep valleys and few basement uplifts (Precordillera and Bolivian Altiplano). Clastic sediments deposited prior to extensive Neogene volcanism potentially provide additional insights into pre-Neogene geology and structure of the Western Cordillera.

We sampled Jurassic-Cretaceous sediments from the Precordillera and Oligocene clastics from the Central Depression of Northern Chile (Azapa Fm.) and the western Bolivian Altiplano (Azurita Fm.) to assess the composition of their source terrain using detrital zircon U-Pb geochronology and heavy mineral chemistry. We further sampled metamorphic rocks from exposed basement complexes to characterize potential basement sources.

Zircon age spectra of Mesozoic clastics in conjunction with their high compositional maturity suggest that they were derived from Paleozoic sediments that were intruded by Carboniferous-Permian granitoids presently exposed in the Eastern Cordillera. The majority of zircons from the Azapa Fm. is derived from Late-Cretaceous-Paleogene granitoids. Exposure of local metamorphic basement is indicated by abundant 0.4-0.5 Ga zircons and almandine-rich garnet. The sample from the Azurita Fm. is essentially derived from high-grade metamorphic rocks of Grenvillian age as indicated by pyrope-rich garnet and 1.0-1.2 Ga zircon ages. Strikingly different basement sources and much larger volumes of Oligocene to Miocene sediments to the East of the Western Cordillera (Altiplano) compared to W (Western Andean Slope) suggest (1) significant relief already existed in the pre-Neogene

that probably was related to a bivergent thrust system and (2) strongly W-E assymetric denudation rates indicating strong gradient in precipitation that must have already existed in Oligocene times.

156: TS3 Geomicrobiology and Biogeochemistry, poster

Microbial investigations of methane seeps by using correlative light/electron microscopy

Wrede C, Kokoschka S, Heller C, Taviani M, Reitner J, Hoppert M

Institute of Microbiology and Genetics, University of Goettingen, Germany [mhopper@gwdg.de], Geoscience Centre, University of Goettingen, Dept. of Geobiology, Germany, [jreitne@gwdg.de]
Instituto di Scienze Marine (ISMAR), Consiglio Nationale delle Richerche (CNR), Bologna, Italy, [marco.taviani@bo.ismar.cnr.it] ,
TU Bergakademie Freiberg, Institut für Geologie und Paläontologie, Germany, 09596 Freiberg, Bernhard-von-Cotta-Strasse 2, buehler@geo.tu-freiberg.de
Minufiya University, Department of Geology, Egypt, Shibin El Kom

In several fields of cell biology, correlative microscopy is applied to compare the structure of objects at high resolution under the electron microscope with low resolution light microscopy images of the same sample. It is, however, difficult to use samples and specific markers for both microscopic techniques at the same time. In our studies we used mats from cold seep "microbial reefs", located in the black sea shelf (Michaelis et al., 2002). The mats consist of bacterial and archaeal microorganisms, coupling „reverse“ methanogenesis with the reduction of sulfate. The reverse methanogenic pathway also generates carbonates that precipitate inside the mat and may be the main reason for the formation of a microbial „reef“. The mat shows highly differentiated aggregates of the various organisms, tightly interconnected by exopolysaccharides (EPS). Our study aimed at the localization of either proteins or extracellular polysaccharides inside the calcifying biofilm (Heller et al., 2008, Krüger et al., 2003, Wrede et al., 2008).

Furthermore we want to compare this habitat with microbial data of the terrestrial mud volcanoes of “Salse di Nirano”, which is located near Bologna (Italy) (Alain et al., 2006).

References

Alain K, Holler T, Musat F, Elvert M, Treude T (2006): Microbial investigation of methane- and hydrocarbon-discharging mud volcanoes in the Carpathian Mountains,. Environmental Microbiology 8: 574-590

Heller C, Hoppert M, Reitner J (2008): Immunological localization of Coenzyme M Reductase in anaerobic methane-oxidizing archaea of ANME1 and ANME2 type.- Geomicrobiology. Geomicrobiology Journal 25: 1-8

Krüger M, Meyerdierks A, Glöckner FO, Amann R, Widdel F (2003): A conspicuous nickel protein in microbial mats that oxidize methane anaerobically. Nature 426: 878-881

Michaelis W, Seifert R, Nauhaus K, Treude T, Thiel V (2002): Microbial reefs in the Black Sea fueled by anaerobic oxidation of methane. Science 297: 1013-1015

Wrede C, Heller C, Reitner J, Hoppert M (2008): Correlative light/electron microscopy for the investigation of microbial mats from Black Sea cold seeps. Journal of Microbiological Met 73: 85-91

157: IS1 New Analytical Techniques, oral

Selenium and Tellurium abundances in mafic and ultramafic rock reference samples using ID-ICP-MS

Ziegler A, Wombacher F, Becker H

Freie Universität Berlin, Institut für Geologische Wissenschaften, Malteserstr. 74-0, D-12249 Berlin, Germany, fwo@zedat.fu-berlin.de

Relative to the CI chondrite reference, Se and Te are among the most depleted non-atmophile elements in the bulk silicate Earth [1]. The low abundances are apparently due to the combined effect of efficient siderophile/chalcophile element stripping to the core and volatile element depletion in late accreted materials. However, only few Se and Te data exist for (ultra-)mafic rocks. Therefore, the igneous geochemistry and silicate Earth abundances of Se and Te are poorly constrained. Here, we present a method that allows for their accurate and precise determination at low abundances in mafic and ultramafic materials.

To this end, isotope dilution, hydride generation and thiol cellulose powder (TCP) separation were combined. The use of isotope dilution allows for some analyte loss during sample preparation without loss in accuracy. For the chemical separation, the sample solution was loaded onto thiol cellulose powder in HCl and Se and Te were eluted using ammonium hydroxide and HNO_3. Hydride generation boosted the ion signal intensities by about 15-fold (normalized to uptake rate). A Scott-type double-pass glass spray chamber was used as gas liquid separator and the reductant ($NaBH_4$) and sample solution were fed through the drain into the spray chamber via T and Y connectors. Se and Te isotope ratios were determined using sector-field ICP-MS in low resolution mode. The instrumental background was determined right before each sample analysis and subtracted. Analyses of two basalts (BHVO-2 and BE-N) and two ultramafic samples (UB-N and DTS-2b) yielded

between 6 and 170 ng/g Se. The Se data from two repeated digestions and separations reproduced within about 5% (2 sd). Te concentrations were between 0.8 and 9.3 ng/g (DTS-2b was not analyzed). One repeated digestion and separation from BHVO-2 yielded indistinguishable Te concentrations. Our results agree well with some, but not all published data.

The 99th Annual Meeting of the Geologische Vereinigung (GV) and International Conference on Earth Control on Planetary Life and Environment, held in October 2009 at the Geosciences Centre of the Georg-August-Universität Göttingen, brings together researchers from all fields of Earth Sciences and beyond to shape an attractive interdisciplinary program on the geological history of Planet Earth and its control over and interaction with biological evolution, development of habitats, environmental and climate change as well as history and culture of Homo sapiens. This volume contains the abstracts of invited keynote lectures as well as all oral and poster presentations.

GEORG-AUGUST-UNIVERSITÄT
GÖTTINGEN

ISBN 978-3-941875-09-8

Universitätsdrucke Göttingen