

GAEA

heidelbergensis

The 23rd Latin American Colloquium on Earth Sciences

Christina Ifrim,
Francisco José Cueto Berciano
and Wolfgang Stinnesbeck

19

Organizing Team

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Wolfgang Stinnesbeck

Organizing Desk

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Cover picture: Landscape with 4 levels of geology. Photo: Wolfgang Stinnesbeck

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DAAD

Deutscher Akademischer Austausch Dienst



Geo-Network of Latinamerican-German Alumni



Baden-Württemberg

MINISTERIUM FÜR WISSENSCHAFT, FORSCHUNG UND KUNST

Land Baden-Württemberg

UNIVERSITÄT
HEIDELBERG
Zukunft. Seit 1386.

Ruprecht-Karls-Universität Heidelberg

Dipl.-Geol. Francisco José
Cueto Berciano

Welcome and Acknowledgements

Welcome to Heidelberg, Bienvenidos a Heidelberg, Willkommen in Heidelberg!

We cordially welcome you at the 23rd Latin American Colloquium, LAK 2014, held at the Institut für Geowissenschaften, Universität Heidelberg.

We intend to bring together researchers from all fields of Earth Sciences working on the geological evolution of Central- and South America and their continental margins, processes of mountain building in the region, uplift and erosion, as well as interaction between tectonic and climatic parameters. Other contributions are related to palaeontology, natural resources, geo-hazards and economic geology.

Until 2011 the LAK was organized biannually by a working group of the Germany Research Foundation (DFG). Due to a reorganisation in the structure of the DFG, the continuity was interrupted. This is the reason why the present LAK is held after a three year's break, and once more at Heidelberg. The continuity of our meeting is now guaranteed and the next conference already planned to take place in Münster, March 27-31, 2016.

We are grateful to the DFG for providing funds to support the organisation of the meeting as well as travel and subsistence for eleven participants from Latin American countries. Additional travel funds were made available by the Deutscher Akademischer Austausch Dienst (DAAD) for participants in the GOAL initiative (Geo-Network of Latin American-German Alumni).

We are happy to welcome our colleagues from Latin America and Germany once more to the Institute of Earth Sciences at Heidelberg and hope that everybody will enjoy a successful meeting.

Heidelberg, March 24, 2014



Christina Ifrim



Wolfgang Stinnesbeck

IN MEMORIAM STEFAN GÖTZ

*** 27.06.1964**

† 30.07.2012



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Conference Information

Venue

The Campus Im Neuenheimer Feld of the Universität Heidelberg is located north of the river Neckar. The 23rd Colloquium on Latin American Earth Sciences takes place in the lecture halls and foyer of Building 252 behind building 234, the Institute of Geosciences. Please note that building 252 cannot be reached anymore by using the street in front of INF 234 due to construction.

We suggest to use public transport: tram lines 21 and 24 and bus line 31 with direction and stop "Technologiepark". Tickets for public transport cannot be bought inside tram and bus. There are ticket machines e.g. at most major tram stops.

Car parking space is available near Building INF 400 (Kopflinik) for 7 Euros per day. Please note that the parking lot in front of building INF 234, the Institute of Geosciences, does not exist anymore due to construction.

Welcome Reception

Monday, March 24, at 18:00.

The Icebreaker Party will be held in the foyer of building Im Neuenheimer Feld (INF) 252, the Conference Site. The Conference Desk will be open there for your registration

Presentations

There will be oral and poster sessions. The poster sessions start Tuesday and Wednesday afternoon following the last talks. They take place in the foyer of the conference site.

Cash

A cash machine to draw money and the nearest bank to cash cheques is in Building INF 330 (Sparkasse) on the campus.

Opening hours:

Monday, Tuesday, Wednesday: 10.00 – 17.00

Thursday: 10.00 – 14.00

Friday 10.00 – 16.00

The cash machine is also accessible outside the opening hours.

Meals

We provide Campuscards for all LAK participants. You can buy these Campuscards at the Conference Desk for 15 Euros (10 Euros credit balance and 5 Euros refund for the card itself). 10 Euros should be sufficient for a first meal including a drink. Please recharge your card accordingly before selecting another meal and drinks, because there are no possibilities to pay cash in the eating area. Charging stations can be found in the foyer of the University Restaurant Building (INF 304)

The Campuscards can also be used for vending and candy machines at the back of building 252.

The Campuscards can be returned until Thursday 14:00 at the conference desk. Please make sure to use up your charge, we can only refund the 5 € deposit.

University restaurants

The opening hours of the University Restaurant (Mensa, INF 304) are 11:30 to 14:00

Lines A and B offer a great variety of warm food and salads paid on weight basis, and desserts.

Lines D and E offer daily changing menus at economic pricing.

The ground floor of the University Restaurant Building (Mensa, INF 304) hosts a Cafeteria with a limited variety of meals. Campuscard and cash are accepted there. It is opened until 22:00.

In the historic city center of Heidelberg you find another University Restaurant (Marstallhof) which is also opened until 22:00.

Conference Dinner

Wednesday, March 26, at 19:00

The Conference Dinner will take place in the Triplex Mensa at the University Place in the historic city center of Heidelberg. This place is served by bus line 31, direction and stop "Universitätsplatz". Please do not forget your badge for admission!

Conference Desk

The conference desk will open Monday 18:00 and close Thursday 14:00.

Souvenirs from the Heidelberg University Shop like caps, cups and other little things can be bought at the Conference Desk during session breaks.

Copy machines

The Campuscards can also be used for copy machines in the Theoretikum near the University Restaurant (Mensa, INF 304) Please ask at the Conference Desk for details.

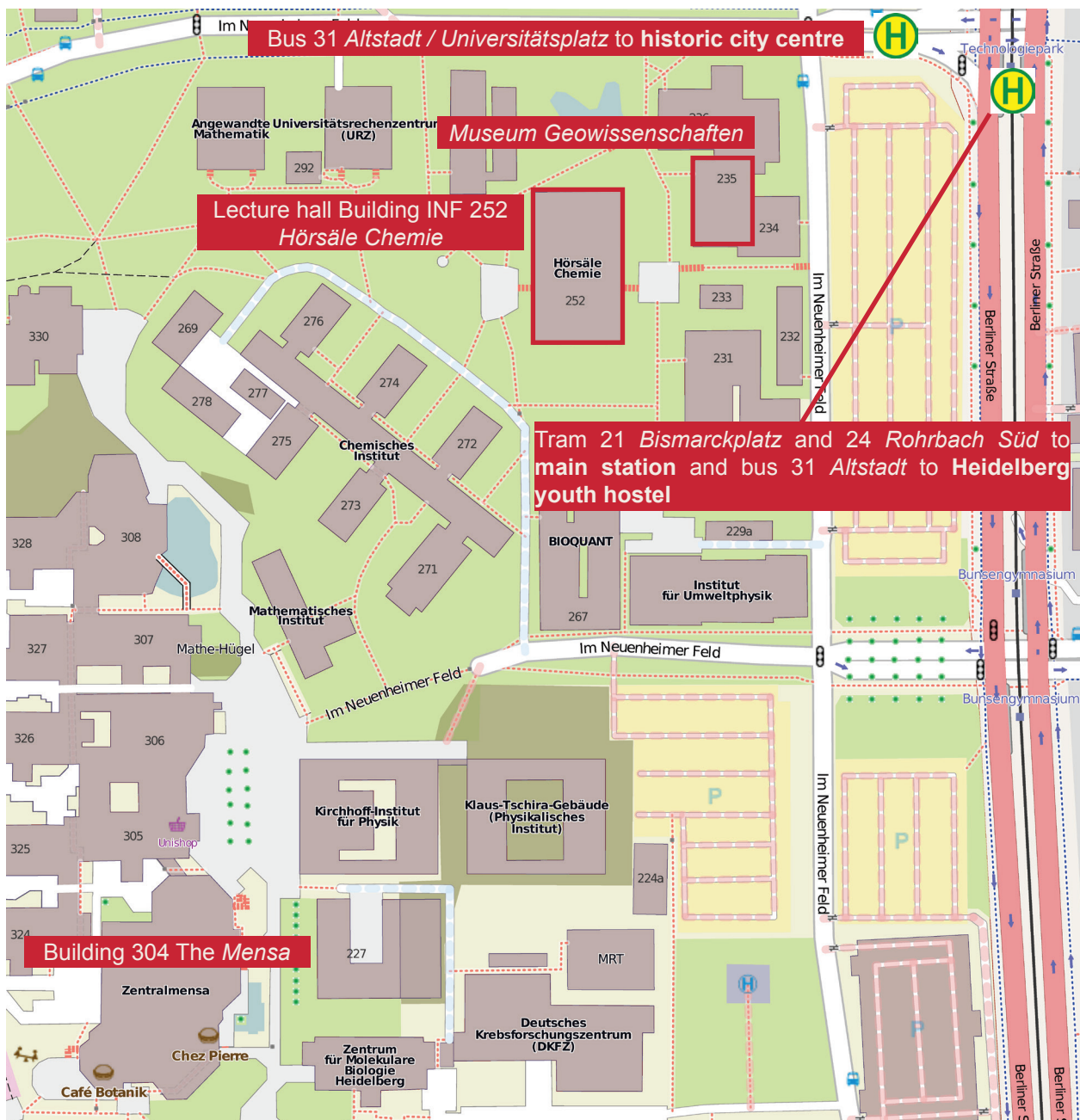
There is also a copy machine at the Conference Site that works with coins.

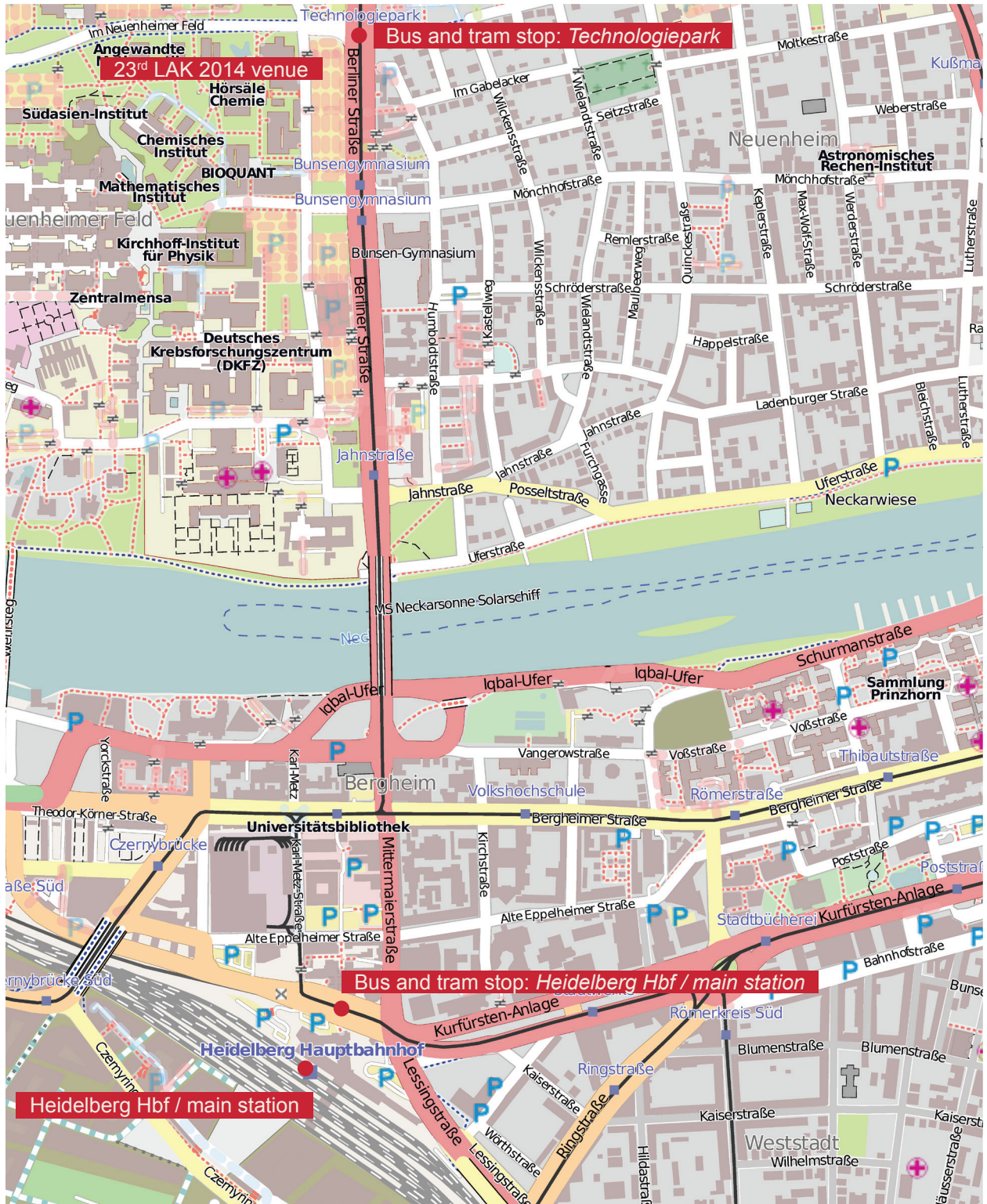
Venue

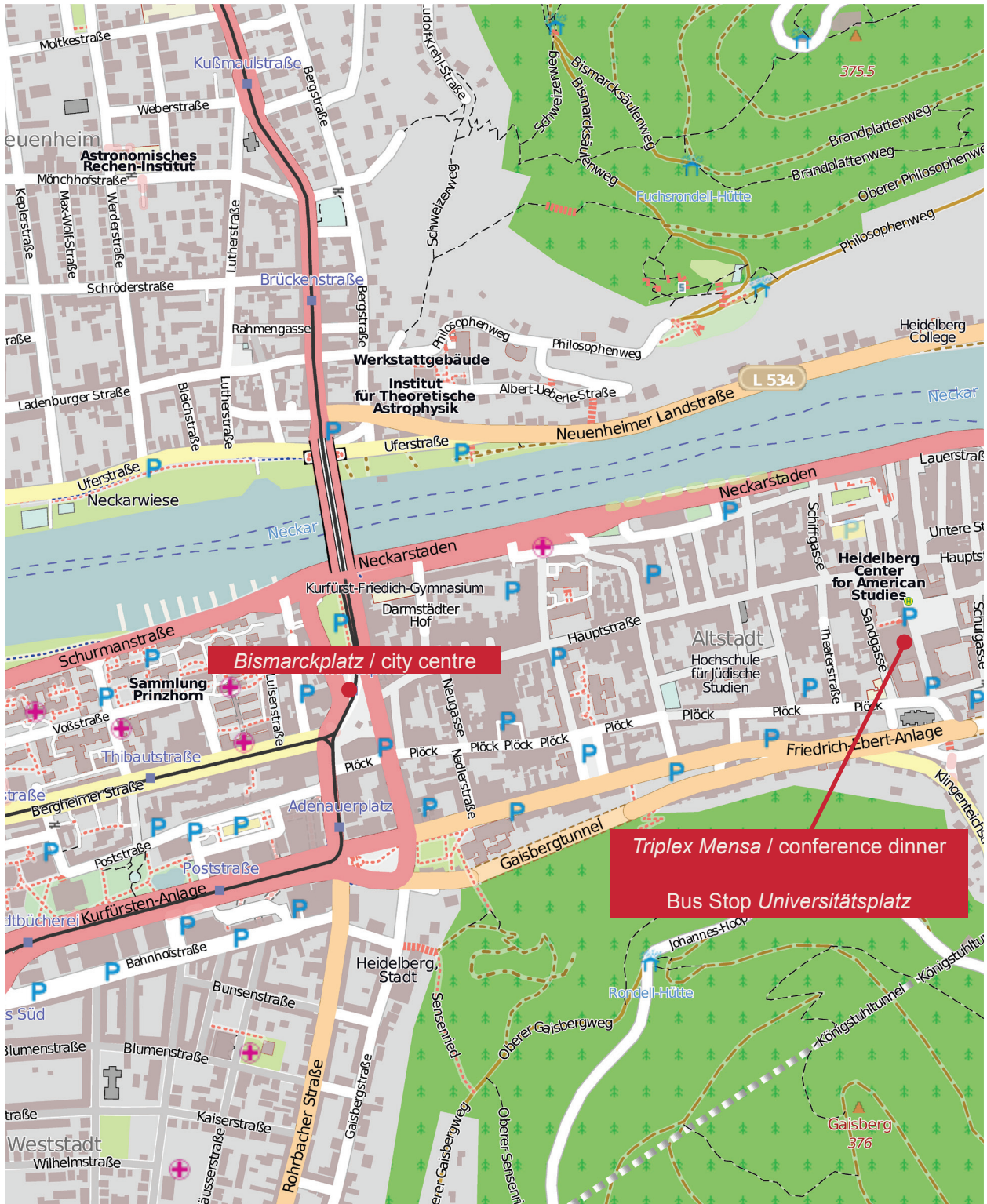
Heidelberg University Natural Sciences Campus *Im Neuenheimer Feld* is located north of the river Neckar. The campus is served by tram lines **21** and **24** from the main station and by bus line **31** from the city centre to stop *Technologiepark*.



The 22nd LAK 2011 meeting will take place in the lecture hall of the Faculty of Chemistry and Earth Sciences (building 252). Ice-Breaker Party takes place in the Museum of Earth Sciences (building 235). For lunch we recommend the university restaurant and cafeteria, the *Mensa* (building 304). Lunch tickets will be available at the conference office.







Internet Access on the LAK2014

For your convenience we have a computer at the Conference Desk, which can be used for short tasks.

If you prefer to connect your own device, please follow the instructions as follows. Please note, that we can not assist you with your own device!

There are two ways to connect to the internet via WLAN:

The **easy way** is to connect to this network (SSID) and open a browser of your choice. You will be redirected to our login site (pop-up and javascript have to be enabled for this site).

- SSID: **UNI-WEBACCESS**
- USER: **ad2**
- PASSWORD: **LAK2014**

The **other way** is to connect to this SSID after installing the Cisco VPN Client Software.*

- SSID: **UNI-HEIDELBERG**
- USER: **ad2**
- PASSWORD: **LAK2014**

* Go to <http://www.urz.uni-heidelberg.de/zugang/vpn/>. Follow the instructions for your operating system. After installing and setting up the client you will be able to log in

- NOTE: If you use your own e-mail software (rather than a website) the following SMTP-Server ("outgoing mail") must be entered: extmail.urz.uni-heidelberg.de
- If you receive an SSL Certificate error message, you can add an exception or update your browser and/or install the root certificate "Deutsche Telekom Root CA 2" (you will find the download link on our login site)

Programme

Monday, March 24

INF 252, Hörsäle Chemie

18:00–
21:00

CONFERENCE DESK OPENING

18:00–
22:00

ICEBREAKER PARTY

Tuesday I, March 25

INF 252, Hörsaal Ost

INF 252, Hörsaal West

09:30

Welcome

Christina Ifrim and Wolfgang Stinnesbeck

DAAD-Fördermöglichkeiten für Geowissenschaftler aus/nach Lateinamerika

Sybilla Tinnap, DAAD, Bonn

Talk 141: Funding Opportunities for Scientific and Technological Cooperation: The Role of the Project Management Agency European and International Cooperation International Bureau of the Bmbf

Inge Lamberz de Bayas, Internationales Büro, Bundesministerium für Bildung und Forschung, Bonn

International Cooperation in DFG-Programmes – Earth Sciences in Latin America

Dietrich Halm, DFG, Bonn

11:00

COFFEE BREAK and POSTER SESSION

Session 1: The southernmost dinosaurs in Latin America and their environment

Chair: Marcelo Leppe

Session 2: Water

Chair: Heinrich Adolf Horn

11:20 **Talk 205: Late Cretaceous Terrestrial Biota from Las Chinas-Cerro Guido Complex, Magallanes Region, Southern Chile: A Key Area for the Antarctic-South American Biogeography**

Marcelo Leppe, Wolfgang Stinnesbeck, Eberhard Frey, Héctor Mansilla, Manfred Vogt, Edwin Gonzalez, Leslie Manriquez, Katherine Cisternas, Maritza Mihoc and Toshiro Jujihara

Talk 132: Nutrient fluxes in the groundwater affecting the northern mangrove coast of the peninsula Yucatán (México)

Lisa Krienen, Thomas Rude, Eduardo Graniel Castro and Antonio Cardona Benavides

11:40 **Talk 131: Depositional Environment of Maastrichtian (Late Cretaceous) Dinosaur-Bearing Deltaic Deposits of the Dorotea Formation, Magallanes Basin, Southern Chile**

Manfred Vogt, Marcelo Leppe, Wolfgang Stinnesbeck, Toshiro Jujihara, Héctor Mansilla, Héctor Ortiz, Leslie Manriquez and Edwin González

Talk 163: Hydro Geochemical Classification of the Upper Rio Doce Basin, Mg – Brazil

Hubert Roeser

12:00 *** Talk 112: The Southernmost Dinosaurs of South America**

Toshiro Jujihara, Sergio Soto-Acuña, Alexander Vargas, Wolfgang Stinnesbeck, Manfred Vogt, David Rubilar-Rogers and Marcelo Leppe

Talk 004: Sediment and Water Quality of the Middle São Francisco River between Três Marias and Pirapora and the Environmental Implications

Heinrich Adolf Horn, Wallace Trindade, Elizêne Velloso and Filho Hernando F. Baggio

12:20

LUNCH BREAK

Session 3: Long-term Landscape Evolution

Chair: Ulrich A. Glasmacher

Session 4: Geohazard Management

Chair: Joachim Karfunkel

14:00 **Talk 207: Rates, Causes, and Dynamic of Long-Term Landscape Evolution of the South Atlantic “Passive Continental Margin”, Brazil and Namibia**

Ulrich A. Glasmacher and Peter C. Hackspacher

Talk 195: Some Hydrogeological Aspects of Landslides in Tropical Zones of Ecuador

Fabian Vasconez

14:20 **Talk 157: Davis Vs. Penck. Did the Debate Start in Argentina?**

Daniel Rubiolo

Talk 023: Yapacarái Lake: Application as Technosols Anti-eutrofizantes and Reduction Cyanobacteria

Celso Velázquez I and Walberto Caballero M

Tuesday II, March 25

INF 252, Hörsaal Ost

- 14:40 **Talk 175: Timing and Rates of Long-Term Landscape Evolution in Southern Argentina**
Sebastian Kollenz, Ulrich A. Glasmacher and E.A. Rossello
- 15:00 *** Talk 088: Uplift Rates Versus Exhumation Rates in the Northern Argentine Broken Foreland**
Julieta Carolina Nobile and Federico Miguel Dávila

INF 252, Hörsaal West

- Talk 111: Gis-Based Analysis of Geo-Resources and Geo-Hazards for a Tropical Metropolitan Area: The Northern Periphery of Belo Horizonte (Minas Gerais, Brazil)**
Monika Hofmann, Andreas Hoppe, Joachim Karfunkel and Allan Büchi
- Talk 005: Use of Emerald Mining Waste as Fertilizer in Agriculture. Evaluation of Nutrient Liberation, Soil- and Plant- Evolution in Laboratory Rehearsal and During Greenhouse- and Open Field Tests**
Amando Aguiar, Heinrich Adolf Horn and Alexandre Sylvio

15:20 COFFEE BREAK and POSTER SESSION

Session 5: Sedimentology

Chair: Christina Ifrim

- 15:40 **Talk 198: Late Jurassic to Early Cretaceous Climatic Variations in the Southern Hemisphere Based on Micro-Glendonite from Central Chile**
Hartmut Jäger, Wolfgang Stinnesbeck and Christian Salazar
- 16:00 **Talk 116: Aptian–Albian (Early Cretaceous) Climate of North-Eastern Brazil: From Evaporites to Open Marine Settings Based on Palynological Evidence**
Marcelo de Araujo Carvalho and Peter Bengtson
- 16:20 **Talk 190: Contourite Erosion-Depositional System in the Northwestern Argentine Basin (South Atlantic)**
Dmitrii Borisov, Ivar Murdmaa, Elena Ivanova and Oleg Levchenko
- 16:40 **Talk 216: Lower Upper Cretaceous $\delta^{13}\text{C}$ Stratigraphy, the Mother of All OAE 2 and Tectono-Sedimentary Evolution in NE Mexico (N.I.)**
Frank Wiese

Session 6: Deposits

Chair: Javier Castro-Larragoitia

- Talk 006: Economic Consequences of Mega Volcanic Eruptions: A Case Study of Diamonds from West Minas Gerais, Brazil**
Joachim Karfunkel, Donald Brunton Hoover, Augusto Fonseca Fernandes, Geraldo Norberto Chaves Sgarbi, Klaus Wilhelm Krambrock, Detlef Walde and Gary Michelfelder
- Talk 193: Heavy Mineral Deposits in Cretaceous Foreland Deltaic Sandstones from the Parras Basin, Northeast, México**
Natalia Amezcua Torres, Enrique Espinosa Arámburu and Juan Antonio Caballero Martínez
- Talk 114: Perspectives for Li- and Ta-Mineralization in the Borborema Pegmatite Province, Ne-Brazil: A Review**
Hartmut Beurlen, Marcelo R. Rodrigues da Silva, Rainer Thomas, Axel Müller, Dieter Rhede and Dwight Rodrigues Soares
- Talk 166: Mercury in Residues of a Historical Metallurgical Site in Mexico: An Unattended Legacy**
Javier Castro-Larragoitia, Israel Razo Soto, Ofelia Morton Bermea, Utz Kramar, Adriana Leura-Vicencio, Ramón Jiménez-Galicia and Friederich Bayer

17:00 POSTER SESSION with DRINKS

INF 252, Grosser Hörsaal

PUBLIC TALK

- 20:00 **Talk 208: Die Zentralen Anden – wie ein Gebirge wächst**
Jonas Kley

Wednesday I, March 26

INF 252, Hörsaal Ost

Session 7: Palaeontology

Chair: Christina Iffrim

- 09:00 * **Talk 126: The Aquatic and Subaquatic Fauna in Miocene Amber of Chiapas: Palaeoenvironmental and Paleocological Implications**
María de Lourdes Serrano-Sánchez and Francisco J. Vega
- 09:20 * **Talk 110: Fauna and Environment of the Marine Pliocene Horcón Formation, Central Chile**
Jorge D. Carrillo Briceño and Sven N. Nielsen
- 09:40 **Talk 146: Crocodylan Teeth from Lake Chapala, Jalisco, SW-Mexico**
Eberhard Frey, Ricardo Aguilar Alonso, H. Dieter Schreiber and Wolfgang Stinnesbeck
- 10:00 * **Talk 121: The Fossil Record of Decapod Crustaceans in Mexico: New Information on Paleobiogeography and Evolution**
Francisco J. Vega

INF 252, Hörsaal West

Session 8: Palaeozoic

Chair: Juan Alonso Ramírez Fernández

- Talk 007: Geochemistry, Provenance and Tectonic Setting of the Granjeno Schist, Evidence from Pangaea**
Torres Sánchez, Sonia Alejandra, Carita Augustsson, Uwe Jenchen, Rafael Barboza-Gudiño, Juan Alonso Ramírez Fernández, Fernando Velasco Tapia and Michael Abratis
- Talk 008: Genetic Relationships of Gondwanan Carboniferous Arc Magmatism in Ne Mexico**
Juan Alonso Ramírez Fernández, Lorena de Leon Barragán and Uwe Jenchen
- Talk 164: Mantle Evolution at the Mexican Margin of Pangea: The Role of Continental Collision and Arc Processes as Inferred from Sm-Nd Isotopes**
Moritz Kirsch, J. Duncan Keppie, J. Brendan Murphy and Maria Helbig
- Talk 107: Claromecó Basin Evolution and Ventana Ranges Deformation (Buenos Aires Province, Argentina): Flexural, Magnetic and Gravimetric Models**
Claudia Prezzi, Haroldo Vizán, Silvia Japas, María Andrea Van Zele and Emiliano Renda

10:20

COFFEE BREAK and POSTER SESSION

Session 9: The Mexican Corridor: Arrival of the Man in Latin America

Chair: Norbert Lenz

- 10:40 **Talk 197: The First Settlers on the Yucatan Peninsula, Mexico, and Reconstruction of Regional Palaeoenvironmental Changes Across the Pleistocene-Holocene Boundary**
Arturo H. González, Alejandro Terrazas, Wolfgang Stinnesbeck, Martha E. Benavente, Jerónimo Avilés, Carmen Rojas, José Manuel Padilla, Eugenio Aceves and Eberhard Frey
- 11:00 * **Talk 192: Human Remains of Late Pleistocene-Early Holocene Age from Submerged Caves of the Eastern Yucatan Peninsula, Mexico: Implications for the Peopling of the Americas**
Alejandro Terrazas Mata, Martha Elena Benavente, Arturo González González and Wolfgang Stinnesbeck
- 11:20 **Talk 142: Reconstruction of Late Pleistocene-Early Holocene Sea-Level and Climate Variations Using Speleothems from Underwater Caves in Quintana Roo, Mexico – An Outlook**
Fabio Hering, Jens Fohlmeister, Wolfgang Stinnesbeck, Norbert Frank, Jerónimo Avilés, Eugenio Aceves Núñez, Alejandro Terrazas Mata, Martha Elena Benavente and Arturo González González
- 11:40 **Talk 174: Strontium Isotopes in Enamel Collected from Pre-Historic Skeletons Found in a Cave System in Quintana Roo/Mexico**
Bernd Kober, Johanna Kontny, Wolfgang Stinnesbeck, Alejandro Terrazas Mata, Martha Elena Benavente, Jerónimo Avilés, Eugenio Aceves Núñez and Arturo González González
- 12:00 **Talk 200: America after the Ice-Man and Megafauna in the New World, an Exhibition Project**
Norbert Lenz and Eberhard Frey

Session 10: Neotectonics

Chair: Hans-Jürgen Götze

- Talk 202: Space Geodetic Velocities at the Northwestern Corner of South America**
Héctor Mora-Páez
- Talk 021: Andersonian and Coulomb Stresses in Central Costa Rica and Its Fault Slip Tendency Potential: New Insights Into their Associated Seismic Hazard.**
Allan López
- Talk 156: Modern Seismotectonic Facies within the Costa Rica Stress Factory: Implications for Reactivation and Structure Signature**
Allan López and Birgit Müller
- Talk 139: Upper-Crustal Kinematics of Continental Plateau Formation in the Southern Central Andes Inferred from Fault-Slip Analysis**
Ulrich Riller and Heidi Daxberger
- Talk 119: The Central Andes Margin Revisited – A New Gravity-Inferred 3D Density Model**
Hans-Jürgen Götze, Theresa Schaller and Monika Sobiesiak

12:20

LUNCH BREAK

Wednesday II, March 26

INF 252, Hörsaal Ost

Session 11: The Mexican Corridor: Jurassic-Cretaceous

Chair: Eberhard Frey

- 14:00 **Talk 118: The Upper Jurassic La Caja and La Casita Formations in Mexico – New Data on Palaeontology and Palaeobiogeography**
Patrick Zell, Seija Beckmann and Wolfgang Stinnesbeck
- 14:20 **Talk 140: Paleoenvironments of the La Caja/La Casita Formations During the Late Jurassic-Earliest Cretaceous, Northeastern Mexico**
Seija Beckmann, Patrick Zell, Wolfgang Stinnesbeck and José Manuel Padilla
- 14:40 **Talk 151: The Timing of the Coastal Progradation in the Western Gulf of Mexico During the Late Cretaceous**
Daniel Pfeiff, Christina Ifrim, Angelica Oviedo and Miguel Franco-Rubio
- 15:00 **Talk 145: The Dinosaur Delta at Las Aguilas, Coahuila, Mexico**
Eberhard Frey, Hector Rivera-Silva, José-Manuel Padilla, Wolfgang Stinnesbeck and Arturo H. González González

INF 252, Hörsaal West

Session 12: Palaeozoic and beyond

Chair: Hans-Joachim Massonne

- * **Talk 009: First Petrological Study of Nelsonites from Grenvillian Novillo Gneiss, Basement of the Sierra Madre Oriental (Ne Mexico): Preliminary Results**
Raymundo Casas García, Juan Alonso Ramírez Fernández, Augusto Antonio Rodríguez Díaz and Bodo Weber
- Talk 153: Paleoproterozoic Metamorphic Evolution of Tonalitic Gneisses and Associated Migmatites from the Cerro El Cristo Area of the Tandilia Belt, Río De La Plata Craton**
Juan Cruz Martínez, Hans-Joachim Massonne, Ailín A. Graff, Jorge A. Dristas and Thomas Theye
- Talk 179: Palaeozoic Drainage Stability Along the Western Gondwana Margin - Detrital Zircon Evidence from the South-Central Andes**
Carita Augustsson, Tobias Rüsing, Hans Niemeyer, Ellen Kooijman, Jasper Berndt, Heinrich Bahlbürg and Udo Zimmermann
- Talk 013: Study of Rocks from the Subduction Channel Below the Late Palaeozoic Accretionary Prisms of Central Chile: Steady Cooling after the Onset of Subduction**
Arne P. Willner and Hans-Joachim Massonne

15:20 COFFEE BREAK and POSTER SESSION

Session 13: The Mexican Corridor: Mesozoic

Chair: Francisco J. Vega Vera

- 15:40 **Talk 148: The Paleontological Collection of Chihuahua, Mexico**
Angelica Oviedo, Miguel Franco-Rubio and Christina Ifrim
- 16:00 **Talk 172: The Complete Skeleton of a Primitive Mosasaurian from the Turonian of Northeastern Mexico**
Krister T. Smith, Marie-Céline Buchy, Christina Ifrim, J. M. Padilla Gutierrez, Eberhard Frey, Wolfgang Stinnesbeck and Arturo González-González
- 16:20 **Talk 144: A Late Maastrichtian Airport at San Francisco, Coahuila, Mexico**
Eberhard Frey, José-Manuel Padilla, Francisco J. Vega Vera, Wolfgang Stinnesbeck and Arturo H. González González

Session 14: Sediments and beyond

Chair: Peter Bengtson

- Talk 224: Integrated Biostratigraphy and Biogeographic Inferences of Uppermost Maastrichtian Ammonites and Planktic Foraminifera of the Pernambuco-Paraíba Basin, North-Eastern Brazil**
Peter Bengtson and Eduardo A.M. Koutsoukos
- Talk 042: Vertical Seismic Profile: A Powerful High Resolution Tool to Identify Sandstone Thickness for Better Reservoir Characterization**
Maria Vargas and Sergio Peralta
- Talk 177: The Camana Basin (Cenozoic, Southern Peruvian Forearc): Zircon U-Pb Geochronology, Petrography, and Geodynamic Implications**
Aldo Alvan, Hilmar von Eynatten, Istvan Dunkl and Axel Gerdes

INF 252 Foyer

16:40 CONFERENCE PHOTO

17:00 POSTER SESSION with DRINKS

Historic City Center, Universitätsplatz, Triplexmensa

19:00 CONFERENCE DINNER

Thursday, March 27

INF 252, Hörsaal Ost

Session 15: The first men and their environment

Chair: Bertil Mächtle

- 09:00 **Talk 158: Can Ceramics Be Used as Possible Archives of Paleoclimate Change? Ceramic Petrology and Geochemistry of Paracas and Late Intermediate Period, Southern Peru**
Daniela B. Oestreich, Bertil Mächtle, Ulrich A. Glasmacher, Markus Reindel, Heike Otten and Debora Faller
- 09:20 **Talk 185: Climate, Natural Resources and Pre-Hispanic Societal Dynamics in the Central Andes**
Bertil Mächtle, Karsten Schitteck and Bernhard Eitel
- 09:40 **Talk 137: Study on the Vulnerability and Impact of Climate Change on the Great American Chaco (Gran Chaco Americano)**
María Alvarez
- 10:00 **Talk 191: High-Altitude Peatlands of the Central Andes as Sentinels of Holocene Environmental Changes**
Karsten Schitteck, Bertil Mächtle, Bernhard Eitel and Frank Schäbitz

INF 252, Hörsaal West

Session 16: Magmatism I

Chair: Gerhard Wörner

- * **Talk 066: Volcanic and Volcano-Sedimentary Sequences of the Casma Group and Its Association to Ammonite Faunas**
Yuly Mamani, Javier Jacay, Jessica Vela, Diana Pajuelo and Rosa Jara
- Talk 127: Fluid Inclusions, Isotopic Fluid Composition and New Age Datings of Rare-Metal Pegmatites, Sierra De San Luis, Argentina**
Graciela Sosa, Alfons van den Kerkhof, Klaus Wemmer, Volker Lüders, Birgit Plessen and Teresita Montenegro
- * **Talk 135: Palaeomagnetism and 40Ar/39Ar Dating from Lower Jurassic Rocks in Gastre, Central Patagonia: Further Data to Explore Tectonomagmatic Events Associated with the Break-Up of Gondwana**
Claudia Beatriz Zaffarana and Rubén Somoza
- Talk 183: Andean Magmatism from Crustal to Crystal Scale**
Gerhard Wörner

10:20 COFFEE BREAK and POSTER SESSION

Session 17: Geology Today

Chair: Helena Fortunato

- 10:40 **Talk 025: "Geotouristic Guide of the Valle Central": A Result of a Teaching Outreach Project from the Social Actions Vicerectorate of the Universidad De Costa Rica for the Diffusion of Geodiversity and the Promotion of Geoconservation Through Geotourism**
Lolita Campos-Bejarano
- 11:00 **Talk 222: Recent Geomorpho-tectonic evolution of the Jamaica Island**
Leomaris Domínguez-González, Klaus P. Stanek, Louis Andreani and Richard Gloaguen
- 11:20 **Talk 165: Gravity and Magnetic Anomalies Associated with Geological Structures in the North of Mexico**
Vsevolod Yutis, José Jorge Aranda Gomez, Roberto Stanley Molina Garza, Gemma Treviño Villareal and Claudia Rigel Peredo Mancilla
- 11:40 **Talk 182: Geomorphologic Differentiation of Beach and Coast on Cozumel Island, Mexico**
Orlando Colín Olivares and Oscar Frausto Martínez
- 12:00 **Talk 169: Coralline Red Algae: A Proxy to Monitor Environmental Changes**
Helena Fortunato

Session 18: Magmatism II

Chair: Christoph Breitkreuz

- Talk 214: Possible Impacts of Strategic Minerals in the Colombian Amazonas and Orinoco area**
Thomas Cramer, Zeze Amaya-Perea, José Franco Victoria, Amed Bonilla-Pérez, Andrés Felipe Alvarado Ávila, Manaes Amaya Perea, José Antonio Castañeda, Luis Hernan Ochoa Gutierrez and Heinrich Adolf Horn
- Talk 123: Temporal Changes in Mantle Wedge Geometry and Magma Generation Processes in the Central Andes**
Rosanne Heistek and Gerhard Wörner
- Talk 210: Temporal and Compositional Patterns and Variations in Ignimbrite Volcanism in the Andes over the past 30 Ma - a geostatistical approach**
Melanie Brandmeier and Gerhard Wörner
- Talk 186: Central Andean Andesites Explained By Three Endmembers?**
Magdalena Banaszak and Gerhard Wörner
- Talk 010: Neogene to Quaternary Ash Deposits in the Coastal Cordillera in Northern Chile: Distal Ashes from Supereruptions in the Central Andes**
Christoph Breitkreuz, Shanaka L. de Silva, Hans G. Wilke, Jörg A. Pfänder and Axel D. Renno

12:20 **CLOSING CEREMONY and POSTER REMOVAL PARTY**

14:00 **CONFERENCE DESK CLOSING**

Posters

INF 252, Foyer

A

- Poster 160: Environmental Quality of the Waters of Maracujá River Sub-Basin, Ouro Preto, Minas Gerais, Brazil**
 Maria Alzira Diniz **Almeida**, Hubert Mathias Peter Roeser, Maria Lúcia Leopoldo and Erik Sartori Jeunon Gontijo
- Poster 162: Geochemistry of Waters of the Stream Ribeirão Do Carmo, Ouro Preto, Minas Gerais, Brazil**
 Maria Alzira Diniz **Almeida**, Hubert Mathias Peter Roeser, Maria Lúcia Leopoldo and Erik Sartori Jeunon Gontijo
- Poster 176: Anatomy of the Camaná Basin (Southern Peruvian Forearc): Stratigraphic Framework and Sedimentary Facies Analysis**
 Aldo Alvan and Hilmar von Eynatten
- Poster 178: The Cenozoic Camaná Basin: Integration of Stratigraphic Logs and Offshore Seismic Information**
 Aldo Alvan, Javier Jacay and Hilmar von Eynatten
- Poster 027: The 1963-1965 Basaltic-Andesitic Phreatomagmatic Eruption at Irazú Volcano (Costa Rica): From High-Fragmented Recycling Tephra to Rain-Triggered Lahars, and its Economical Effects**
 Guillermo E. **Alvarado** and Hans-Ulrich Schmincke
- Poster 019: Piedras Pintadas more than 2200 Years of History from Nicaragua**
 Alvaro Antonio **Amador**

B

- Poster 173: Timing of Plattenkalk Formation in the Turonian (Upper Cretaceous) of the Cañón La Huasteca, Northeastern Mexico**
 Seija **Beckmann**, Christina Ifrim and Theresa Straub
- Poster 017: Social, Environmental and Mining Management, a Challenge for Paraguay and its Novel Mining**
 Juan Carlos **Benitez** Maldonado

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- Poster 024: Boundary Zone Stratigraphy Between the Valle Central and Terraba Sedimentary Basins in Costa Rica**
 Lolita **Campos-Bejarano**
- * **Poster 218: Trace Metals in Moa Cay's Sediments (Cuba): Preliminary Site Contamination Assessment**
 Yosbanis **Cervantes** Guerra, Hans-Juergen Gursky, Yuri Almaguer Carmenates, Allan Pierra Conde and Gerardo Orozco Melgar
- Poster 204: Paleoeology and Evolution of the Carnivorous Mammalian Faunas of South America from the Late Miocene to the Pleistocene: Insights from Stable Isotopic Signatures (¹³C, ¹⁵N, ¹⁸O) in Fossil Bones and Teeth**
 Martin **Cotte**, Francisco J. Prevosti, Leopoldo H. Soibelzon and Hervé Bocherens
- Poster 214: Possible Impacts of Strategic Minerals in the Colombian Amazonas and Orinoco Area**
 Thomas **Cramer**, Zeze Amaya-Perea, José Franco Victoria, Amed Bonilla-Pérez, Andrés Felipe Alvarado Ávila, Manaes Amaya Perea, José Antonio Castañeda, Luis Hernan Ochoa Gutierrez and Heinrich Adolf Horn

D

- Poster 203: Groundwater Management Using Urban Hydrogeology in Monterrey, Mexico**
 René Alberto **Dávila** Pórcel, Héctor de León-Gómez, Jimmy Luis Loaiza Navia, Jaime Max Garfias Soliz and Antonio Cardona Benavides
- Poster 138: Assessing the Morphotectonic Evolution of the Southern Central Andes Using the River Transect**
 Heidi **Daxberger**, Ron Dalumpines, Darren M. Scott and Ulrich Riller
- Poster 221: Water Level Changes of the Enriquillo Lake in Dominican Republic. Climate Change or Active Tectonic**
 Leomaris **Domínguez-González**, Richard Gloaguen, Klaus P. Stanek, Dorothea Deus and Louis Andreani
- Poster 143: Landscape Evolution of the Brazilian Southeastern Highlands, Poços de Caldas Plateau**
 Carolina **Doranti-Tiritan**, Peter Christian Hackspacher and Ulrich A. Glasmacher
- Poster 154: Genesis of Fluorapatite Aggregates in Dolomites, Quartzites, Limestones and Pelites of the Olavarría Area, Tandilia Ranges, Argentina**
 Jorge A. **Dristas**, Juan Cruz Martínez, Hans-Joachim Massonne, Thomas Theye and Ailín A. Graff

* Sponsored by DFG travel grants

E-F

Poster 032: Ichnological Research in Lower Cretaceous Marginal-Marine Facies from Patagonia: Outcrop Studies, Sem Examinations, and Paleontological/Sedimentological Integration

Diana Elizabeth **Fernández**

G

Poster 012: Hydroclimatological Constrains for Water Supply to Bogota (Colombia). The Chingaza Region Case Study

Reinaldo **Garcia**

Poster 211: Environmental Characterization of the Casca River: A Contribution to the Environmental Diagnosis of the Upper Doce River Basin

L. R. **Glória** Wellington, Flaviane C. Silva, Vera L. De M. Guarda and Hubert M. P. Roeser

Poster 159: Characterisation of Aquatic Humic Substances from Caraça Mountain Range and Sorocabinha Stream/ Brazil

Erik Sartori Jeunon **Gontijo**, Cláudia Hitomi Watanabe, Mariana Luiza Fernandes, Maria Alzira Diniz Almeida, Leandro Cardoso de Moraes, Carolina Monteiro Santos, Kurt Friese, Hubert Mathias Peter Roeser and André Henrique Rosa

Poster 161: Geochemical Study of Waters in the Eastern of the Quadrilátero Ferrífero, Brazil

Erik Sartori Jeunon **Gontijo**, Mariana Luiza Fernandes, Cláudia Hitomi Watanabe, Maria Alzira Diniz Almeida, Kurt Friese, Gilmar Antônia da Silva, Hubert Mathias Peter Roeser and André Henrique Rosa

Poster 155: Basement Geology and Geochemistry of the El Cristo and San Verán Hills, Tandilia Belt, Rio de La Plata Craton

Ailín A. **Graff**, Juan Cruz Martínez, Jorge A. Distas and Hans-Joachim Massonne

Poster 149: Map-Based Probabilistic Infinite Slope Analysis of Volcanic Ash Soils. Study Case: Mansiones, San Rafael de Montes de Oca, Costa Rica

Raquel **Granados** Aguilar

H

Poster 212: The Heidelberg Grinding Tomography Lab: The Potential of High Resolution Digital Reconstructions in Low Density Contrast Samples

Dominik **Hennhöfer** and Enric Pascual-Cebrian

*** Poster 201: Modeling of Managua's Aquifer with Visual Modflow**

Reyna **Hernández** C and Manuel Martínez M-Advisory

Poster 002: Microprobe Investigations on Dust Particles from Votorantim's Zn Foundry at Três Marias, Minas Gerais, Brazil. - Mineral Particle Distribution and their Chemical Composition

Heinrich Adolf **Horn**, Elizêne Velloso, Wallace Trindade and Hernando Baggio

I-J

Poster 099: Structural Style of the Western Cordillera of Central Peru

Javier **Jacay**, Jimmy Cotrina, Yuli Mamani and Alan Rosales

Poster 109: Paleontological Heritage Management in Northern Brazil: The Tocantins Fossilized Forest Case

André **Jasper**, Jorge Elis, Marjorie Kauffmann, Etienne Fabbrin Pires, Neli Teresinha Galarce Machado. José Rafael Wanderley Benicio, Joseline Manfroi, Mariela Inês Secchi, Cátia Viviane Gonçalves and Dieter Uhl

Poster 108: Permian Wildfires on Gondwana in Space and Time and the Palaeobotanical History of Fire

André **Jasper**, Margot Guerra-Sommer, Neli Teresinha Galarce Machado, Joseline Manfroi, Isa Carla Osterkamp, Alcemar Martello, Átila Augusto Stock da Rosa, Abdalla Abu Hamad and Dieter Uhl

K

Poster 189: A 2,500 Yr High-Resolution Peat Record of Climatic and Environmental Change as Recorded in Stable Isotope Proxies from Oxychloe Peat (Nw Argentine Andes)

Sebastian **Kock**, Karsten Schitteck, Andreas Lücke, Holger Wissel and Frank Schäbitz

* Sponsored by DFG travel grants

L

- Poster 171: Coastal Progradation of the North-Western Gulf of Mexico During the Late Cretaceous** Dominic **Lange**, Christina Ifrim, Angélica Oviedo and Rodolfo Fierro
- Poster 200: America after the Ice–Man And Megafauna in the New World, an Exhibition Project** Norbert **Lenz** and Eberhard Frey
- Poster 217: Water Supply Assessment in Monterrey/Mexico** Héctor de **León**-Gómez, René Alberto Dávila Pórcel, Vsevolod Jutsis and Arquímedes Cruz López
- Poster 170: Cretaceous Aporrhaidae (Gastropoda) from the Sergipe Basin, Northeastern Brazil** Manuela **Lexen** and Peter Bengtson
- Poster 041: Fracture Characterization on Yacoraite Fm, Jujuy Province, Northwest Argentina: Implications for Hydrocarbon Exploration and Production in Folded and Fractured Reservoirs** Jeremias **Likerman**, Daniel L. Yagupsky and Ernesto O. Cristallini

M

- Poster 188: Crustal Evolution and Metallogeny along the Central Andes** Mirian **Mamani** and Gerhard Wörner
- Poster 209: Ammonites of the Late Cretaceous Western Gulf of Mexico Coast** Annika **Meuter**, Christina Ifrim and Angelica Oviedo
- Poster 194: Geological Heritage and Geo-Parks: Current Situation in Peru** César **Muñoz**

N

- Poster 115: The Lateritic-Bauxite Profile in Carajás, Pará, Brazil** Leonardo Boiadeiro Ayres **Negrão**, Marcondes Lima da Costa and Herbert Pöhlmann
- * **Poster 089: K–Ar Fault Gouge Dating in Northern Argentine Broken Foreland** Julieta Carolina **Nobile**, Gilda Collo, Federico Miguel Dávila and Klaus Wemmer

O

- Poster 117: Environmental Quality of the Caparaó National Park (Es / Mg - Brazil): Cr and Pb Concentrations in Bottom River Sediments** J. **Oliveira**, W. Rodrigues and H. Horn
- Poster 136: Cenozoic Growth of the North Patagonian Fold and Thrust Belt Between 40°-43°SL** Darío Leandro **Orts**, Andrés Folguera, Mario Gimenez, Francisco Ruiz, Federico Lince Klinger and Emilio Rojas Vera
- Poster 147: Fossiliferous Richness of Chihuahua, Mexico** Angélica **Oviedo**, Miguel Franco-Rubio and Christina Ifrim

P

- Poster 213: The Use of Neutron Imaging as a Non-Destructive Technique in the Identification of Early Cretaceous Ichthyosaurs from Torres del Paine National Park, Southern Chile** Judith **Pardo** Pérez, Patricio Zambrano, Michael Laaß, Wolfgang Stinnesbeck, Enric Pascal, Francisco J. Cueto Berciano, Eberhard Frey and David Mannes
- Poster 022: Somun Cura Fresh Water Isotopic and Chemistry Features** Claudio A. **Parica**, Cristina Dapeña and Marcela B. Remesal
- Poster 128: Aptian Ammonite and Rudist Association, Cogollo Formation (Guajira, Colombia): Paleobiogeographic Significance to Northern Colombia** Pedro **Patarroyo** and Stefan Götz†
- Poster 129: Stratigraphy of the Lower Calcareous Member (Valaniginian - Hauterivian), Tibasosa Formation, Tibasosa – Boyacá (Colombia, S. A.)** Pedro **Patarroyo**, Alexis Rojas and Andres Felipe Salamanca-Saavedra
- Poster 130: Upper Lower Cretaceous Deposits of Soco River (Dominican Republic)** Pedro **Patarroyo** and Reinhard Schmidt-Effing

* Sponsored by DFG travel grants

Poster 059: The Geological-Geophysical Modeling of the Silence Zone, North Mexico

Claudia R. **Peredo**-Mancilla, Vsevolod Yutsis and José Jorge Aranda-Gómez

Poster 152: Low-Temperature Thermochronology, Exhumation and Long-Term Landscape Evolution in Eastern Argentina

Sabrina **Pfister**, Ulrich A. Glasmacher and Sebastian Kollenz

Poster 020: 1961-2013 Variation of the Glacier Area at Nevado del Huila Volcano (Colombia), and Effects on the Glacier due to the Eruptive Activity Between 2007 And 2010

Bernardo **Pulgarín**, Carlos Laverde, Oscar Manzo, Gerónimo Valencia and John Galarza

Q-R

Poster 133: Cerro Corona 87Sr/86Sr Ratios, High Range of Somún Curá, Extra Andean Patagonia

Marcela **Remesal**, Guadalupe Maro, Claudio Parica and Hubert Miller

Poster 196: Risk Management Initiatives in the Department of Misiones, Paraguay

Carmen **Rojas**

Poster 167: New Interpretation of the Lower Jurassic in Central Peru

Silvia **Rosas**, Kathleen Ritterbush and David Botjjer

S

Poster 187: Coal Facies in Subbituminous Coal Throughout Magallanes Fold and Thrust Belt (Mftb), Magallanes Basin

E. A. **Sanmiguel** and M. E. Cisternas

Poster 161: Geochemical Study Of Waters in the Eastern of the Quadrilátero Ferrífero, Brazil

Erik **Sartori** Jeunon Gontijo, Mariana Luiza Fernandes, Cláudia Hitomi Watanabe, Maria Alzira Diniz Almeida, Kurt Friese, Gilmare Antônia da Silva, Hubert Mathias Peter Roeser and André Henrique Rosa

Poster 124: Information and Communication Technologies (ICT) for Prevention and Mitigation in Case of Natural Catastrophes: A Case Study in the Caribbean Region

Nury **Simfors**-Morales, Raymond Russo and Åke Sivertun

Poster 168: Metamorphic Evolution and Partial Melting of Metapelites in Eastern Cordillera, Central Andes, NW Argentina: New Insights from Equilibrium Phase Diagrams (Pseudosections)

Alfonso M. **Sola**, Pavlina Hasalová and Raúl A. Becchio

Poster 036: Argentinian Puna as Mars Analog Laboratory

Mauro G. **Spagnuolo**

Poster 223: Holocene Climatic Changes and Human-Environment Interactions in the high Andes of NW-Argentina

Sarah **Stinnesbeck**, Karsten Schitteck, Liliana Lupo, Julio Kulemeyer and Frank Schäbitz

T-V

Poster 150: Early Cretaceous Subaqueous Mass Flow Deposition in a Cold Environment- Chester Cone Formation, Livingston Island, Antarctica

N. **Varela**, M. Cisternas, S. Palma-Heldt, H. Mansilla and M. Leppe

Poster 003: Industrial Mineral Dust from Si And Si-Fe Foundries, its Regional Distribution, Mineral and Chemical Composition

Elizéne **Velloso**, Heinrich Adolf Horn, Wallace Trindade and Hans Jürgen Gursky

Poster 103: Paleocological Investigations in the Pampa Seca, Argentina Based on a Multi-Proxy Approach

I. **Vilanova**, K. Schitteck, M. Geilenkirchen and W. Schulz

W-Z

Poster 219: Ichnological Signatures of Prograding and Retrograding Parasequence Sets: An Example from the Paleogene of the Arauco Basin, South-Central Chile

Patricio A. **Zambrano**, Luis A. Buatois, Alfonso Encinas and Sven N. Nielsen

Poster 134: Geochronology and Geochemistry of Jurassic Volcanic Rocks in Northeastern Mexico: Implications for the Origin and Evolution of the Nazas Arc

A. **Zavala**-Monsivais, J.R. Barboza-Gudiño and F. Velasco-Tapia

Poster 113: Upper Jurassic Ammonites of Northeastern Mexico Covered by the Epizoic Oyster Liostrea

Patrick **Zell**, Seija Beckmann and Wolfgang Stinnesbeck

* Sponsored by DFG travel grants

Abstracts

TALK 005: USE OF EMERALD MINING WASTE AS FERTILIZER IN AGRICULTURE. EVALUATION OF NUTRIENT LIBERATION, SOIL- AND PLANT- EVOLUTION IN LABORATORY REHEARSAL AND DURING GREENHOUSE- AND OPEN FIELD TESTS

Amando Aguiar¹, Heinrich Adolf Horn² and Alexandre Sylvio³

1: *Post - Graduation Geology - UFMG*

2: *NGqA - IGC-UFMG, Belo Horizonte-MG, Av. Antônio Carlos, 6627, Brazil, ++553134094446, hahorn@ufmg.br*

3: *UFVJM - Campus Avançado, Teófilo Otoni - MG, Brazil*

The aim of this work is to evaluate the use of material from emerald mining piles as cheap and quality alternative fertilizer in regional agriculture. The tests were done in laboratory, greenhouse and field.

The tailing material, emerald-picotite-phlogopite-amphibole quartz schist with amphibolite- and quartz lenses was mixed in different quantities with a typical soil from the Central Eastern Minas Gerais State (Laterite s.l.).

The chemical properties of the tailing material were determined by ICP-OES, ICP-MS and XRF. Before use it was crashed down to a fraction of <0.500mm (35 mesh) to obtain better and faster mineral reactions in situ.

The soil was characterized by the methods described in the Brazilian Agriculture Research and EMPRAPA manuals.

In laboratory tests the samples were incubated with quantities relative to 0, 1, 2, 4, 8, 12, 16, 20, 40t.ha⁻¹ of rock powder with soil for a period of 60 days and at four repetitions.

In greenhouse four maize grains was planted in 50l pots plain of the mixed material in same proportions at before.

In the field maize were planted in rows for each mixture. Initial treatment was done by addition of small amounts of NPK (after Brazilian Agriculture Research for cultivate maize) and then regular irrigation were done.

Photographs of the different stages of the experiments were taken every month and at the end the plant evolution, the soil quality and chemical composition were determined.

The results of all test show a promising disponibilization of Mg⁺², K⁺, between other smaller compounds, a significant reduction of Al saturation and lowering of pH in the soil.

Plants show increasing of total dry matter and up to 60% more grains/plant in relation to testimonies without addition of rock powder.

The use of the tailing material with low toxic elements concentrations may provide a reduction of environmental impact at the mining sides and the disponibilization of low cost and high-K fertilizers, decreasing in this way production costs and import balance.

POSTER 160: ENVIRONMENTAL QUALITY OF THE WATERS OF MARACUJÁ RIVER SUB-BASIN, OURO PRETO, MINAS GERAIS, BRAZIL

Maria Alzira Diniz Almeida¹, Hubert Mathias Peter Roeser¹, Maria Lúcia Leopoldo² and Erik Sartori Jeunon Gontijo³

1: UFOP, Campus Universitário, Morro do Cruzeiro, S/N, 354000-000 Ouro Preto, Minas Gerais, Brazil. mavddiniz@hotmail.com

2: UFJF, Rua José Lourenço Kelmer, São Pedro, 26036-900 Juiz de Fora, Minas Gerais, Brazil.

3: UNESP/Sorocaba, Av. Três de Março, 511, Alto da Boa Vista, 18087-180 Sorocaba, São Paulo, Brazil.

The Maracujá River and its tributaries are located in the Southern part of the Iron Quadrangle (Quadrilátero Ferrífero - QF) that is an area of about 7,000 km² in the centre of the State of Minas Gerais (Brazil). The origin of its name is due to its rectangular form and the presence of huge reserves of iron ore (Dorr, 1969).

The occurrence of iron ore is reflected mainly as "Banded Iron Formations (BIF)" of Proterozoic age, receiving locally the name of "Itabirites". It is mainly composed of hematite (Fe₂O₃), magnetite (Fe₃O₄) and quartz (SiO₂). In the carbonate facies the quartz is replaced by dolomite (CaMg(CO₃)₂) or calcite (CaCO₃). In rich ores (without quartz or carbonate) the Fe content can reach nearly 70 % (Roeser & Roeser, 2010).

In simple terms, the region's geology presents a crystalline basement of Archean age that consists mainly of granitic rocks. These rocks are extensively weathered and transformed into lateritic soils. During the weathering, they release some elements, mainly Ca, Mg, Na and K. The soils of the region contain elements geochemically less mobile such as Fe, Si, Ti and Al. An important aluminium ore, gibbsite, is one of the three main constituents of bauxite. The rocks from this unit release metallic elements such as Ni, Cr, Co, and Fe to the environment. In addition, sulphide shafts and gold mines may contribute, through acidic drainage, with chalcophile elements such as Cu, Zn, Cd, Pb, and especially, As (Roeser & Roeser, 2010).

For the assessment of the Maracujá River, two field campaigns were conducted (the sampling was based on the hydrological regime of QF). The levels of Hg, As, and Cd determined were excessively high in all samples in the dry season, reaching in the point 1, which is the region of formation of the Maracujá River, concentration of 0.111 mg/L, a value 100% above the maximum value allowed by the legislation of the State of Minas Gerais (Minas Gerais, 2008). As demonstrated by several authors (Parra et al 2007; Roeser & Roeser, 2010), high levels of chalcophile elements such as As, Hg, Cd, in the QF region are generally related to the occurrence of sulfide veins, and in particular the Au mining. Geological processes provide the trace metals in the environment, which are carried to watercourses increasing their concentrations.

Dorr, J.V.D. 1969. Physiographic, Stratigraphic and Structural Development of the Quadrilátero Ferrífero, MG, Ouro Preto, Brazil - U.S. Geol. Surv. Prof. Paper, 1119-A, B, B1-B19.

Minas Gerais, 2008. Deliberação Normativa COPAM/CERH (DN 1/08) N° 1 de 5/05/2008.

Parra, R.R., Roeser, H.M.P., Leite, M.G.P., Nalini Jr., H.A., Guimarães, A.T.A., Pereira, J.C., Friese, K. 2007. Influência Antrópica na Geoquímica de Água e Sedimentos do Rio Conceição Quadrilátero Ferrífero, Minas Gerais, Brasil. *Geochimica Brasiliensis*, 31, 01, 36-49.

Roeser, H.P.M. & Roeser, P.A. 2010. O Quadrilátero Ferrífero - MG, Brasil: Aspectos sobre sua história, seus recursos minerais e problemas ambientais relacionados. *Geonomos*, 18, 1 34 – 37.

Sponsored by FAPEMIG (Brazilian Agency) and UFOP (University).

POSTER 176: ANATOMY OF THE CAMANÁ BASIN (SOUTHERN PERUVIAN FOREARC): STRATIGRAPHIC FRAMEWORK AND SEDIMENTARY FACIES ANALYSIS

Aldo Alvan and Hilmar von Eynatten

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In the forearc of southern Peru, sedimentary facies and stratigraphic architecture of the Cenozoic Camaná Formation are presented in the context of tectono-eustatic controls. The Camaná Formation (Pecho and Morales, 1969) is defined as coarse-grained deltas deposited in a fault-bounded depression that extends from the Coastal Cordillera in the east to the offshore Mollendo Basin in the west. The Camaná Formation was divided into Camaná "A" and Camaná "B" units (Sempere et al., 2004) (CamA and CamB). However, based on facies associations, we propose a refined scheme of Camaná Basin fill, and reinterpret stratigraphic position and timing of the CamA to CamB boundary, subdividing CamA into three sequences (Seq0, Seq1, and Seq2).

Seq0 deposits consist of distributary channels and mouth bars. Seq1 consists of marine delta front deposits arranged in clinothems, reflecting a progradational complex. Seq2 consists of marine delta front to prodelta deposits arranged in retrogradational geometries. A short fluvial deposition in Seq2 reflects pulses of uplift in the hinterland. The overlying CamB unit is characterized by fluvial conglomerates. Based on the available information and stratigraphic correlations we tentatively assigned Seq0 to ?Oligocene, Seq1 and Seq2 to Early Miocene to early Middle Miocene, and CamB to Late Miocene to ?Early Pliocene (Alván and von Eynatten, submitted). For improved chronostratigraphic ages, we refer to Alván et al. (this volume).

CamA deposits differ partly from the global sea-level chart (Haq et al., 1987). Seq0 and Seq1 were deposited during a Regressive Systems Tract, suggesting that significant tectonic uplift along the Coastal Cordillera controls the sedimentary influx. Seq2 was deposited during a Transgressive Systems Tract, which is deposited during a phase of enhanced subsidence that causes a relative sea-level rise in Middle Miocene. The fluvial CamB deposits reflect increased sediment flux due to uplift of the hinterland. Altogether the observed stratigraphic patterns support predominant tectonic control on sedimentation in Camaná Basin and the established stratigraphic framework provides a baseline for correlations of Cenozoic sedimentation in the Central Andean forearc.

Alván, A., von Eynatten, H., Submitted. Sedimentary facies and stratigraphic architecture in coarse-grained deltas: Anatomy of the Cenozoic Camaná Formation, Southern Peru (16°25'S to 17°15'S). *Journal of South American Earth Sciences*.

Haq, B., Hardenbol, J., Vail, P., 1987. Chronology of Fluctuating Sea Levels Since the Triassic (250 million years ago to present). *Science* 235, 1156-1167.

Pecho, V., Morales, G., 1969. Geología de los Cuadrángulos de Camaná y La Yesera. *Boletín de la Carta Geológica Nacional, INGEMMET 21 (A)*, 72 pp.

Sempere, T., Fornari, M., Acosta, J., Flores, A., Jacay, J., Peña, D., Roperch, P., Taipe, E., 2004. Estratigrafía, geocronología y paleotectónica de los depósitos de antearco del sur del Perú. XII Congreso Peruano de Geología, Lima. *Sociedad Geológica del Perú, Resúmenes Extendidos*, 533-536.

Sponsored by DAAD and and Geoscience Center of Georg-August University, Göttingen.

TALK 177: THE CAMANA BASIN (CENOZOIC, SOUTHERN PERUVIAN FOREARC): ZIRCON U-PB GEOCHRONOLOGY, PETROGRAPHY, AND GEODYNAMIC IMPLICATIONS

Aldo Alvan¹, Hilmar von Eynatten¹, Istvan Dunkl¹ and Axel Gerdes²

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2: Institut für Geowissenschaften, Goethe-Universität Frankfurt, Altenhofer Allee 1, D-60431, Deutschland

In the Cenozoic Camaná Formation, U-Pb geochronology on detrital zircons and preliminary petrographic analysis of sandstones has been done to characterize their sediment provenance, geodynamic evolution, and to support the sedimentary and architectural evolution of Camaná Basin proposed previously (Alván and von Eynatten, submitted; see also this volume). The Camaná Formation was divided into two units: CamA and CamB, and CamA is further subdivided into Seq0, Seq1, and Seq2. Furthermore, two main petrofacies are defined in Camaná Formation. This characterization reflects particular source rocks, and mechanisms of exhumation of the Coastal Cordillera and/or the broader hinterland (i.e. Moquegua Basin, Western Cordillera).

The CamA petrofacies reflects erosion of crystalline rocks (Arequipa Massif and San Nicholas Batholith) and minor andesitic sources (most likely Toquepala Group). Detrital zircons in basal Seq1 yield U-Pb youngest ages of 21.78 ± 2.78 Ma, and in topmost Seq2, zircons yield U-Pb youngest ages of 13.57 ± 0.3 Ma. Seq1 and Seq2 of CamA thus span the Lower Miocene to Middle Miocene, while Seq0 series may be older. CamB petrofacies shows a drastic compositional change, where volcanic components are predominant and magmatic and metamorphic components are minor. This is supported by abundant reworked ashes, where zircon U-Pb youngest ages yield 11.62 ± 0.6 Ma at the base, and 7.48 ± 0.28 Ma on topmost CamB. Consequently, CamB is assigned to the Late Miocene. The youngest zircon U-Pb ages of reworked ashes are considered to closely resemble sedimentation ages, and they are coeval with active Cenozoic volcanism in southern Peru (e.g. ~24-10 Ma-old Huaylillas, ~10-3 Ma-old Lower Barroso, Mamani et al., 2012).

Our geodynamic model suggests that the San Nicholas Batholith was exposed since CamA deposition. However, sediments derived from Toquepala Group igneous rocks suggest an connection between Camaná and Moquegua basins (CamA Seq1/Seq2 and MoqC2 according to Decou et al., 2011, respectively), which may be due to uplift in the Western Cordillera. The drastic change of heavy mineral population in CamB is interpreted as a transition of source rocks in the hinterland that are now dominated by Neogene volcanics. CamB is coeval with the depositional age of MoqD in the Moquegua Basin (i.e. Upper Miocene).

Alván, A., von Eynatten, H., submitted. Sedimentary facies and stratigraphic architecture in coarse-grained deltas: Anatomy of the Cenozoic Camaná Formation, Southern Peru ($16^{\circ}25'S$ to $17^{\circ}15'S$). *Journal of South American Earth Sciences*.

Decou, A., Eynatten, H. v., Mamani, M., Sempere, T., Wörner, G., 2011. Cenozoic forearc basin sediments in Southern Peru ($15-18^{\circ}S$): Stratigraphic and heavy mineral constraints for Eocene to Miocene evolution of the Central Andes. *Sedimentary Geology* 237, 55-72.

Mamani, M., Rodríguez, R., Acosta, H., Jaimes, F., Navarro, P., Carlotto, V., 2012. Características Litológicas y Geoquímicas más Resaltantes de los Arcos Magmáticos del Perú desde el Ordovícico. XVI Congreso Peruano de Geología, Lima. Sociedad Geológica del Perú, Resúmenes Extendidos, 5 pp.

Sponsored by DAAD and Geoscience Center of Georg-August University, Göttingen.

POSTER 178: THE CENOZOIC CAMANÁ BASIN: INTEGRATION OF STRATIGRAPHIC LOGS AND OFFSHORE SEISMIC INFORMATION

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An integration of onshore stratigraphic logs and offshore 2D seismic information is applied to Cenozoic sediments of the southern Peruvian forearc, in order to present a tectono-stratigraphic framework for Camaná Basin. Camaná Basin consists of a ~NW-SE depression between the Coastal Cordillera up to the Peru-Chile trench (PERUPETRO, 2003), filled with coarse-grained deltas of the Cenozoic Camaná Formation. The onshore Camaná Formation was divided into two major units (CamA and CamB) in agreement to their respective depositional settings. CamA is further sub-divided into three sequences, i.e. Seq0, Seq1, and Seq2, on the basis of particular stacking patterns and sequence boundaries (Alván and von Eynatten, submitted).

Offshore, "Seq0+Seq1" are grouped as a single unit, consisting of progradational clinoforms that extend up to few tens of kilometres toward SW. Seq0+Seq1 is bounded at the top by a first high-frequency reflector, which represent offlapping and ravinement surfaces and suggest the final stage of a relative sea-level fall. Seq2 consists of aggrading and retrograding deposits, possibly deltaic, with sub-horizontal layering and onlapping geometries. CamB deposits overlay Seq2 unconformably above a second high-frequency reflector. CamB series onshore was defined as fluvial conglomerates; however, in offshore they change to progradational and aggradational deposits, likely deltaic, marking again a geometrical contrast with the underlying Seq2 deposits. CamB is interpreted to be deposited during a relative sea-level fall.

The onshore-offshore correlation of the boundaries between Seq0+Seq1 and Seq2, and between Seq2 and CamB are used as a tool to recognize the three main depositional units in the Camaná Basin (i.e. Seq0+Seq1, Seq2, and CamB). Furthermore, this tracing is used to define thicknesses and depocentres in offshore, where the thickest deposits are located in proximity to the large actual river mouths (i.e. Playa La Chira, Camaná, La Virgen, Quilca, and Punta del Bombón). The development of such depocentres is related to syntectonic sedimentation during Cenozoic, where large ~NE-SW structures probably provide accommodation space and cross the Ica-Ilo-Islay fault system. Offshore, ~NW-SE-aligned grabens and listric faults control CamA deposition. CamB deposits show minor tectonism during sedimentation.

Alván, A., von Eynatten, H., submitted. Sedimentary facies and stratigraphic architecture in coarse-grained deltas: Anatomy of the Cenozoic Camaná Formation, Southern Peru (16°25'S to 17°15'S). *Journal of South American Earth Sciences*.

PERUPETRO, 2003. Peruvian Petroleum, A Renewed exploration opportunity. Lima, Perú, Report of PERUPETRO, 159 pp.

Sponsored by DAAD and PERUPETRO.

POSTER 027: THE 1963-1965 BASALTIC-ANDESITIC PHREATOMAGMATIC ERUPTION AT IRAZÚ VOLCANO (COSTA RICA): FROM HIGH-FRAGMENTED RECYCLING TEPHRAS TO RAIN-TRIGGERED LAHARS, AND ITS ECONOMICAL EFFECTS

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The last eruptive phase at Irazú started on 9 August 1962. An especially vigorous eruptive phase from March 1963 to February 1965 was accompanied by tephra fall and lahars. The moderate size volcanic activity (VEI 3) ranged from dominant phreatomagmatic (~97%) to infrequent strombolian eruptions (ca. $\leq 2.5\%$), rare phreatic events (ca. $< 0.5\%$), and episodic formation of a lava pool. Thin phreatomagmatic pyroclastic density current (PDC) deposits, present on the summit, were emplaced by flows and surges, both of low- to moderate -energy and low- to moderate -temperature. They originated from small, partial column collapse, resulting from laterally moving dense ash clouds, and tephra jets that were controlled by the topography and predominant winds. Several of the flows and surges were captured within the crater. Processes that controlled the explosions and their products include: a) external factors such as erosion and collapse of the conduit walls as well as recycling of tephra and, b) internal processes such as magma/water interaction, c) magma rise and discharge rate, d) and ascent rate of bubbles through the magma. The intense fragmentation reflects not only the magma/water interaction efficiencies but also the recycling process. The eruption resulted in a maar-like crater surrounded by an asymmetric tuff-ring that was superimposed on the pre-existing crater rim topography. Tephra fall volume is crudely estimated as 0.5-0.8 km³ (0.2-0.3 km³ DRE, dense rock equivalent). Juvenile basaltic andesite ejecta (53.72-55.12 % SiO₂) are phenocryst-rich (12-34 vol. %) with an assemblage of plagioclase (An₄₉₋₇₈), two populations of olivine (Fo₉₁₋₈₅ and Fo_{78-74.5}), augite (Wo₃₃₋₄₂En₄₄₋₅₀Fs₈₋₁₈), enstatite (En₇₀₋₇₈) and titanomagnetite. Phenocryst mineralogy, textural features, glass and bulk rock chemistry, including peculiar concentrations of both incompatible elements and Cr and Ni, demonstrate that the seriate-textured tephra resulted from a complete mixing of MgO-rich basalt with a basaltic andesitic magma. Two main trends are present. In the beginning K₂O, P₂O₅, LILE, and Ce, were enriched. A subsequent decrease suggests a new magma injection that might have occurred in early 1964. In addition to ashfall and related problems for human health, agriculture and cattle, about one hundred cohesive to noncohesive lahars (debris flows, hyperconcentrated streamflows) were formed during the rainy season between 1963 and 1965, destroying Taras, a suburb of Cartago, 10-15 km from the vent, and killing 20 people. Today, only five cohesive debris flow deposits (5% of the total events) can be recognized in the depositional area. Economic losses of the 30-months of volcanic activity are discussed, corresponding to the first long-term eruption since the 15th century that seriously affected the economy of a country (49% of the total population was affected by the ashfall) in the Americas. The eruption also triggered the first: a) National Emergency in Costa Rica due a natural hazard, b) international (Japan, USA, and France) collaboration, and c) massive local tourist visits.

TALK 137: STUDY OF THE VULNERABILITY AND IMPACT OF CLIMATE CHANGE ON THE GREAT AMERICAN CHACO (GRAN CHACO AMERICANO)

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The study aimed at a vulnerability and climate change impact analysis of the Gran Chaco region of Argentina, Bolivia and Paraguay, focusing primarily on identifying impacts on agriculture and water resources, and based on the results, defining proposals for adaptation based on ecosystems.

The methodology was based on the definition of the IPCC 2001, which states that vulnerability is a function of the variation to which a system is exposed, its sensitivity, and its adaptive capacity. To determine the vulnerability, the values for exposure and sensitivity are added and the value for adaptive capacity is subtracted.

To estimate the adaptation means available for a given society, the concept of capacity is used as a source of capital, where more capital implies greater adaptability. In turn, capacities are classified as human, social, natural, economic and productive, infrastructure or built, and institutional.

The study identifies for each unit of analysis, the “weaknesses” and the “capabilities”. The weaknesses are the sensitivities of agriculture and water resources to changes in temperature and precipitation. The capabilities can be seen as potential developers and considered as tools for action and investment. In other cases, they are only “potential”, defined as intrinsic strengths for the factors concerned (e.g., natural, social, human) that can be developed through investments of other external factors to become capabilities.

The information in the study consists of quantitative and qualitative data, which were categorized to relate to each other and finally to achieve a rating or index to help identify the level of vulnerability of the region to climate change.

The study provides homogeneous information for people and governments to develop adaptation actions and plans to prioritize their policies according to the needs for the entire region. On the other hand, it provides an integrated vision of the problems of the Gran Chaco from a climate perspective, aimed at making public policy decisions.

This study was funded by the Regional Gateway for Technology Transfer and Climate Change Action in Latin America and the Caribbean (REGATTA), an organization aiming at strengthening capacity and knowledge sharing of climate change technologies and experiences for adaptation and mitigation in Latin America and the Caribbean. Its design and development is aligned with the international climate change negotiations in the context of the United Nations Framework Convention on Climate Change (UNFCCC), after the Cancun Agreements at COP16, which established a Technology Mechanism.

The study was carried out by the Universidad Nacional de Formosa (Argentina), La Fundación de la Cordillera (Bolivia), and the Desarrollo, Participación y Ciudadanía ID (Paraguay).

POSTER 019: THE PIEDRAS PINTADAS ARCHAEOLOGICAL PARK – MORE THAN 2200 YEARS OF HISTORY OF NICARAGUA

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The Chontal was the oldest tribe that settled in Nicaragua. They came from the north (Mexico), from where they were expelled by other tribes inhabiting the Pacific region. When the Europeans arrived, the Chontal were settled in central Nicaragua. One of their sites was Villa Sandino, a small village in the Department of Chontales, where the Piedras Pintadas Archaeological Park (painted stones) is now established. The site was a ceremonial place for the Chontal people. Part of the history of the Chontal is registered in 158 stones and more than 2000 petroglyphs showing zoomorphic and anthropomorphic motives. The petroglyphs depict the Xulo, an extinct dog breed, which lived in Central America and Mexico before the colonization. The poster shows the location, characteristics and history of the Piedras Pintadas Archaeological Park.

Guerrero C., J. N. & Guerrero, L. S. de (1982). Las 9 tribus aborígenes de Nicaragua. 154 pp. Managua.
http://www.museoscentroamericanos.net/museos_nicaragua/variopiedras_pintadas.html
<https://www.facebook.com/pages/Parque-Arqueologico-Piedras-Pintadas-de-Villa-Sandino-Chontales/298799386849769>

TALK 193: HEAVY MINERAL DEPOSITS IN CRETACEOUS FORELAND DELTAIC SANDSTONES FROM THE PARRAS BASIN, NORTHEASTERN, MÉXICO

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Heavy mineral (HM) ore deposits occur at the base and top sandstone intervals of Maastrichtian age, Cañón del Tule Formation in the Parras Basin, México. These ore bodies, which are essentially marine foreshore deposits, contain valuable minerals such as zircon, ilmenite, magnetite, and rutile, together with light rare earth elements.

In the Cañón del Tule Formation, heavy mineral deposits occur as tabular and lenticular in shape; in beds with thicknesses varying from laminae to structureless thick beds of up to 80 cm. These foreshore deposits display planar and high-angle cross-stratification, and are moderately to highly bioturbated. Mineralized bed-sets accumulate total bed thicknesses up to 2.50 m., and are found discontinuously over an area of 35 km along strike of major syncline limbs. Most HM bearing sandstones are medium grained, and range from feldspatic litharenite to sublitharenite, and some are calcite cemented. Less commonly accumulations of HM occur in the matrix of small conglomeratic channels that are composed by well-rounded to sub-rounded clasts (1 to 5 cm diameter) of quartz, limestone, sandstone, volcanic, and metamorphic rocks.

The intervals where the minerals occur, as ores of potential economic interest, are the prograding sandstones found at the lower and upper regressive stages. These intervals are separated by a transgressive stage where accumulations of HM rich sandstones have not been identified in the central part of the Parras Basin.

The valuable minerals in the sandstones of Cañón del Tule, were previously estimated with about 382,230 metric tons, with average grades of: Fe 32%, FeO₂ 71%, Fe₂O₃ 42%, SiO₂ 20%, Al₂O₃ 9%, TiO₂ 11%, CaO 4%, MgO 1%, MnO₂ 0.2%, Zr 2%, and ZrO₂ 4%.

Geometry and heterogeneity of these deposits yet represent challenges for exploration, and eventually for extraction methodologies and metallurgy.

Sponsored by the Mexican Geological Survey

TALK 179: PALAEOZOIC DRAINAGE STABILITY ALONG THE WESTERN GONDWANA MARGIN - DETRITAL ZIRCON EVIDENCE FROM THE SOUTH-CENTRAL ANDES

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The Palaeozoic detrital zircon record of the present-day south-central Andes (N Chile and NW Argentina) has been investigated to reveal time-related variations in the transportation paths. Zircon grains from 17 beds of very fine to fine sandstone of Cambrian to Permian age were analysed. The detritus variably was deposited under shallow-marine, turbiditic, and fluvial conditions. Cathodoluminescence images of the zircon grains reveal a dominance of zircons of magmatic origin, little abrasion and mostly only one growth phase. We detected little variation in the age spectra despite the facies differences of the studied sediment units. Main age clusters for all time periods, except for Cambrian and Silurian times, are at 630 to 440 Ma, representing the Brasiliano, Pampean and Famatinian orogenies. A smaller group is Grenvillian at 1.3-0.9 Ga. The ages can be explained by main local transport from the Ordovician Famatinian magmatic arc. Additional transport was local or from the south - from the area of the Puna and south to the Sierras Pampeanas. There crystalline rocks of Grenvillian, Brasiliano, and Pampean ages are present. The Cambrian and Silurian sedimentary rocks are dominated by Brasiliano (ca. 0.6 Ga) and Transamazonian age zircons (2.2-1.9 Ga). Pampean and Famatinian ages are less common. During these time periods the studied depositional basins were fed from local or southern material (Brasiliano ages) that was included in a longer transport system that emanated on the Río de la Plata craton (Transamazonian ages) in the east. Hence, we infer transport from the adjacent N-S directed Famatinian arc and from the south throughout the Palaeozoic era. The eastern transport during Cambrian and Silurian times can be explained by the position of the studied depositional basins in relation to the Ordovician magmatic arc. The arc acted as an effective erosional barrier long after turning inactive and prevented detritus from the Gondwana interior to reach the marginal basins. Before the emergence of the arc - during Cambrian time - transport could take place from the continent itself. The studied Silurian units crop out on the eastern fringe of the extinct arc. Therefore they could receive input from the interior of Gondwana. Despite southern transport, the zircon suite does not record the accretions of the Cuyania-Precordillera and Chilenia terranes. They collided with west Gondwana west of the Sierras Pampeanas in Ordovician and Devonian time, respectively. Furthermore, Ordovician and Devonian-Carboniferous glaciations in west Gondwana, with probable glacial and glaciofluvial transport from the continent interior to the marginal basins, were not marked in the zircon record. As such the transport system remained stable for ca. 0.3 b. y. with main transport from the nearby arc and from the south. Hence, detrital zircon ages do not necessarily reflect tectonic changes and may represent a much lesser part of the continent than expected.

TALK 186: CENTRAL ANDEAN ANDESITES EXPLAINED BY THREE ENDMEMBERS?

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There are no Neogene basalts in the Quaternary active volcanic front of the Central Andes. The most mafic compositions (52-55 SiO₂ wt%) are characterized by large ranges in major (3.6-9.4 wt% MgO, 4-7 wt% Na₂O+K₂O, 0.8-1.8 wt% TiO₂), trace element concentrations (9-197 ppm Ni, 501-1944 ppm Sr, 95-257 ppm Zr), and trace element ratios (LILE/HFSE: 93>Sr/Y>24; LREE/HREE: 8>La/Yb>63). Such a remarkable variability reflects distinct sources of mantle derived magmas and a strong overprint during ascent through exceptionally thick Andean crust (70 km). With magmatic differentiation and assimilation, more evolved magmas converge in composition to rhyodacites and (more rarely) rhyolites.

Our statistical analysis (Polytopic Vector Analysis, PVA) on a subset of our large database of Andean magmas (>1000 samples) which have complete major- and trace element data and isotope compositions shows that the entire compositional space of Central Andean magmas can be described by the three same endmembers: (1) a low-Mg high-Al calc-alkaline basaltic andesite (BA), (2) a incompatible trace element enriched basalt (EB), and (3) a high-K calc-alkaline rhyodacite (RD). A first mixing stage produces a range of hybrid baseline magmas consisting of the EB and BA. These represent typical recharge magmas into more evolved magma chambers at shallower crustal levels. There, a second mixing stage occurs with mixing between the already mixed, mafic (BA+EB) and the silicic RD component, which typically is crystal rich. Mixing proportions between these endmembers vary widely and magma compositions of endmembers and/or hybrids are overprinted by different degrees of magmatic differentiation and crustal assimilation.

The availability of and interaction with the RD magmas in a subvolcanic system determines the mineralogy of the Fe-Mg phases in the intermediate magmas. Amphibole and Ti-magnetite are present in basaltic andesites through dacites that show evidence for mixing with a large proportion of the silicic RD magma. Other basaltic andesites and andesites of very similar major element composition have ±olivine, pyroxene, Ti-magnetite and ilmenite, while amphibole is absent. During magma mixing, a drop in temperature, an increase in the water content, and changes in the redox conditions of the (BA+EB) component destabilizes olivine, pyroxene and ilmenite and promotes amphibole + Ti-magnetite crystallization in the hybrid magmas. Amphibole-bearing rocks thus form primarily by RD-BA-EB hybridization whereas pyroxene-bearing rocks are differentiation products of dominantly BA-EB hybrids with minor RD admixture.

A particular setting is required for andesite lava fields that occur throughout the Central Andes (Huambo, Andagua, Negrillar). These lava fields are unrelated to stratovolcanoes and probably reflect direct differentiation of the mafic hybrids towards phenocryst poor pyroxeneandesites without interaction with crystal-rich shallow crustal magmas.

The BA, EB, and RD endmembers represent distinct sources: the mantle wedge, enriched lithospheric mantle, and the continental crust, respectively. Therefore, these endmembers are expected to be ubiquitous in the central Andes and have uniform geochemical character.

POSTER 173: TIMING OF PLATTENKALK FORMATION IN THE TURONIAN (UPPER CRETACEOUS) OF THE CAÑÓN LA HUASTECA, NORTHEASTERN MEXICO

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The Vallecillo Plattenkalk Member (Upper Cretaceous) is famous for its excellently preserved Turonian marine fauna, including sharks and marine reptiles like basal mosasauroids (Ifrim, 2006, Ifrim et al. 2008, among others). This Konservat-Lagerstätte formed during the early Turonian on the western shelf of the Gulf of Mexico. Recent research showed that the Plattenkalk Member is exposed in different outcrops in North-Eastern Mexico. Microfacies analysis of the host formation of the Vallecillo Plattenkalk Member, the Agua Nueva Formation, in the Cañón La Huasteca (South-West of Monterrey, North-Eastern Mexico) and the biostratigraphic zonation allow for correlation of Plattenkalk outcrops over 150 km distance. For the first time it is possible to determine the level of the member within the Agua Nueva Formation. In addition, it provides further insight into the still badly determined relation of Plattenkalk formation to the Oceanic Anoxic Event 2 in the Late Cenomanian and the timing of Plattenkalk Formation. Our study sheds new light onto the formation of Plattenkalk on the open shelf, which is an unusual setting

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Ifrim, C., Buchy, M.-C., Smith, K. T., and Giersch, S. 2008. Palaeoenvironment and preliminary description of early Turonian (late Cretaceous) aquatic squamates from Vallecillo, north-eastern Mexico, p. 47-62. In M. J. Everhart (ed.), Proceedings of the Second Mosasaur Meeting. Fort Hays Studies, Special Issue, Volume 3. Fort Hays State University, Hays, Kansas.

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TALK 140: PALEOENVIRONMENTS OF THE LA CAJA/LA CASITA FORMATIONS DURING THE LATE JURASSIC-EARLIEST CRETACEOUS, NORTHEASTERN MEXICO

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The La Caja and coeval La Casita formations (Upper Jurassic – lowermost Cretaceous) are widely distributed in northeast and east-central Mexico and consist of organic rich siliciclastic sediments deposited along the western margins of the Gulf of Mexico Basin during strong transgressional pulses. The units contain abundant well-preserved marine vertebrates and invertebrates which indicate deposition in low-energy and oxygen-depleted environments (Adatte et al. 1996, Ocampo-Díaz et al. 2008, Zell et al. 2013, Zell et al. submitted).

Phosphogenesis is related to the overall transgressional trend during a period of relative sea level rise. Increased water depth combined with a high bioproduction in an open marine shelf may explain the increase in sediment condensation and in abundance of phosphorite towards the south. These phosphorites result from authigenic precipitation at the sediment-water interface, combined with a high bioproduction in nutrient-rich upwelling cells in the open shelf (Michalzik 1988).

Fossils of boreal origin (bivalves, belemnites) occur in repeated but limited intervals of cold-water ingressions into the Gulf of Mexico. They also document a late Jurassic faunal exchange between the Gulf of Mexico and Boreal Pacific and European Boreal realms (Zell et al. 2013). The presence of the rare belemnite *Rhaphibelus* in the early Berriasian indicates that a new connection was established around the Jurassic-Cretaceous boundary between the northeastern Gulf of Mexico and the European Tethys during that time (Adatte et al. 1996, Zell et al. 2013).

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Michalzik, D. 1988. Trias bis tiefste Unter-Kreide der nordöstlichen Sierra Madre Oriental, Mexiko – Fazielle Entwicklung eines passiven Kontinentalrandes, Inaugural-Dissertation des Fachbereichs Geowissenschaften, Technische Hochschule Darmstadt, 1-225.

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Supported by the Deutsche Forschungsgemeinschaft (DFG STI128-17) and the Heidelberg Graduate Academy (LGFG 2012-9).

TALK 224: INTEGRATED BIOSTRATIGRAPHY AND BIOGEOGRAPHIC INFERENCES OF UPPERMOST MAASTRICHTIAN AMMONITES AND PLANKTIC FORAMINIFERA OF THE PERNAMBUCO-PARAÍBA BASIN, NORTH-EASTERN BRAZIL

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The Pernambuco-Paraíba Basin in north-eastern Brazil boasts a widely exposed, upper Maastrichtian marine succession characterized by alternating beds of wackestone and carbonate mudstone deposited predominantly in an upper bathyal environment. The succession (upper Gramame Formation) is accessible in several working quarries along the coast of the states of Pernambuco and Paraíba. The Poty quarry in Pernambuco exposes an extended Maastrichtian to Danian succession, which is currently the best exposed Cretaceous–Paleogene boundary succession known from southern low latitudes. The presence of ammonites and abundant planktic foraminifera (*Globigerinina*) allow an integrated biostratigraphic approach as well as biogeographic inferences based on these fossil groups for the terminal Cretaceous in the northern South Atlantic. The ammonites *Pachydiscus* (*Pachydiscus*) *neubergicus* von Hauer, 1858, *Pachydiscus* (*Pachydiscus*) cf. *noetlingi* Kennedy, 1999, *Sphenodiscus lobatus* Tuomey, 1854, and *Hypophylloceras* (*Neophylloceras*) cf. *surya* Forbes, 1846, together with abundant foraminifera of the *Contusotruncana contusa*–*Racemiguembelina fructicosa* and *Plummerita hantkeninoides* zones characterize the uppermost Maastrichtian in the basin. The highly diverse planktic foraminiferal assemblage is typical of the tropical Tethyan Realm, which extended southwards between 0° and 30° S palaeolatitude. Biogeographic affinities reveal the existence of major circulation patterns of epipelagic ocean currents apparently similar to present-day patterns. The absence of the typical uppermost Maastrichtian foraminiferal genus *Abathomphalus* suggests that this genus was restricted to cooler oceanic waters in intermediate and high latitudes.

Sponsored by the Alexander von Humboldt Foundation

POSTER 017: SOCIAL, ENVIRONMENTAL AND MINING MANAGEMENT, A CHALLENGE FOR PARAGUAY AND ITS NOVEL MINING

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Latin American Minerals Inc. Paso Yobai, Paraguay.

Paraguay is facing challenges in the mining sector. Its economy, since always based on the agricultural sector, with significant exports of meat and agricultural products; is experiencing the possibility of receiving contributions from the mining sector, as the discovery of mineral resources extend under the policies carried out by the Paraguayan Government in relations to attracting foreign investments, counting this segment that has huge potential to develop.

Paso Yobai, which is the country's first mining area since the XIX century, shows two very opposite facets. On the one hand, a gold mining company, operates with the support of a Law Of Concessions, and following modern techno-environmental parameters of quality, and all these in contrasts with the grim handling of informal mining in the surrounding areas, where more than half a thousand small informal miners, nucleated in several associations, exploit the metal or have a large number of mills along small water courses, where the gold is recovered through the amalgamation with mercury, contaminating the water streams of the area's basin. They usually operate illegally, they have neither environmental nor mining licenses, the exploitation of men, women and children by Paraguayan or foreign capitalists is a common practice, and the profits do not reach the government neither are reported, therefore the absent of the state is more than noticed in this area. This current reality, with the lack of effective control, sees a resurgence of the disorders previously described, that in the long run are going to be affecting all local communities.

On the one hand, a proper government management must be conducive, so that international standards of exploitation, environment, health and occupational safety care are not unique tools of corporations, but that the use of such tools by the participants of the small-scale mining may work as a beneficiary solution of the dignity of the people (informal miners) besides constituting a way of living. On the other hand, the Government must be consistent with its policy of attracting investment, by ensuring such investment, so that companies could reach their goals, including side programs of social welfare that will allow its insertion into the community without any traumas.

These government efforts will favor all current activities being performed in the mining sector, and will result in it being environment friendly, peaceful and inclusive of the surrounding communities, although they are a part of the economic chain, they do so in detriment of its environmental quality of life and their own personal safety.

The presence of the Government in Paso Yobai and in the country's emerging mining industry is imperative. Its policies should be clear and effective, redirecting the raw potential of the sector and organizing them harmoniously in a corporate form, raising awareness within all participants of the negative environmental, social and economic implications that may lead to messy resource exploitations. The state must;

- Provide security, legal framework and facilitate the sustainable development of the sector.
- Ensure harmonious coexistence among all the participants of the sector.
- Develop collective capacity of informal miners providing special training programs, access to technical criteria and funding.
- Raise awareness among companies to help the most vulnerable communities and mining sectors, providing real assistance.
- Make proper changes in order to recognize how much the mining sector can contribute to the whole country's economy chain.

TALK 114: PERSPECTIVES FOR LI- AND TA-MINERALIZATION IN THE BORBOREMA PEGMATITE PROVINCE, NE-BRAZIL: A REVIEW

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The increasing strategic importance of Li- and Ta-ores during the last decades due to the strong consumption growth for rechargeable batteries and high temperature and corrosion resistant capacitors reactivated the interest of studies in pegmatite fields around the world, because these rocks supply respectively 25% and 100% of the world consumption in these elements. Research on petrogenetic issues and test of major and accessory mineral chemistry variations in rare element (REL)-pegmatites of the Borborema Pegmatite Province in Northeast Brazil as tools for the diagnosis of the metallogenetic potential of rare metals in individual pegmatites and in the province as a whole were intensified along the last dozen of years. The results allowed to establish the nearly isobaric (3.8 kbar) crystallization conditions of the REL-pegmatites between and 580°C (liquidus) and 400 °C (solidus) from a peraluminous melt saturated in a aquo-carbonic medium to low salinity volatile phase and immiscible peralkaline flux-enriched (H₂O, CO₂, F, B, Li etc.) melt fraction, based on melt and fluid inclusions. Mineral-chemistry data from 30 selected REL-pegmatites in the province allowed classify three of them as being of the complex-spodumene or -lepidolite subtype in the Černý classification. Both subtypes are supposed to be potentially fertile, (highly fractionated, and with good chances to bear Li- and Ta-ore concentrations). It was also possible to identify several pegmatitic granite intrusions with identical textural and lithogeochemical characteristics found for supposed REL-pegmatite source granites in other provinces throughout the world. Preliminary chemical Pb/U/Th geochronological determinations in uraninite and xenotime crystals of these granites indicate an age of 520±10 Ma, matching recently published Ar/Ar in mica and U/Pb ages in columbite-group minerals (CGM) of the REL-pegmatites between 509 and 525 Ma. Mineral-chemistry data from grains of the outer zones of the pegmatites do not allow to distinguish potentially fertile from barren pegmatites. This discrimination is only possible if samples of the inner intermediate zone, replacement pockets or quartz core are used. From the tested minerals trace-element determinations (mainly Li, Al, Ti, Ge, B among 14 tested elements) by LA-ICP-MS technique in quartz seem to be more efficient than the classical approach (of Rb, K, Cs, Ga, Sr Ta,) in K-feldspar or micas, due to the susceptibility of late hydrothermal or supergene alteration of the latter. The test of mineral-chemistry variations in CGM, tourmalines, garnet and gahnite turned out to be good discriminators but have all the disadvantage of an eventual and, if present, random distribution, typical for accessory minerals in pegmatites, not allowing a regular sampling in most cases. Additional tests of mineral-chemistry to confirm the preliminary results about the efficiency as exploration tools on a larger number of pegmatites and geochronological determinations to confirm the existence of an older syntectonic REL-pegmatite generation is recommended.

TALK 190: CONTOURITE EROSION-DEPOSITIONAL SYSTEM IN THE NORTHWESTERN ARGENTINE BASIN (SOUTH ATLANTIC)

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Contourites are sediments deposited or significantly affected by bottom currents (Stow, Faugeres, 2008). Prevalence of contourites at the continental margin in the western Argentine Basin (South Atlantic) is related to high sediment input by the de la Plata River and a dynamic oceanographic regime. Adjacent contourite features (moats, terraces and drifts) produced by the same bottom current represent contourite erosion-depositional systems (CEDS).

The CEDS adjacent to the Southern Sao Paulo Plateau escarpment (northwestern Argentine Basin) is studied during four cruises of the RV “Akademik Ioffe” (2010-2013). At the escarpment foot (3700–3900 m) very high resolution seismic profiles crossed a large drift, 120 m high and 19.5 km long, that is separated from the escarpment by a 4.5 km wide moat. A contourite terrace, up to 10 km wide, with a small drift at its outer edge, is discovered on the escarpment at the depth range of 3350–3450 m. Core AI-2563 retrieved from the summit of the drift at the escarpment foot recovered homogenous hemipelagic clay intercalated by a thick layer of color banded clay (muddy contourite) with several hardgrounds (Borisov et al., 2013). Core AI-3152 obtained from the drift on the terrace recovered silty clay contourites.

Geometry of the drifts and moat, as well as the depth of their location implies that the CEDS was formed by the bottom current of Antarctic waters. Hemipelagites in the core AI-2563 are considered to be deposited during the last deglaciation as inferred from planktic foraminiferal data. The greater amount of silt-size material and absence of hemipelagites in the core AI-3152 indicate higher flow velocities on the escarpment terrace.

A comprehensive analysis of multi-channel seismic profiles obtained during cruise of the RV “Fred H. Moore” and multibeam data collected in the cruise M29/2 of the RV “Meteor” allowed us to trace the revealed CEDS along the escarpment. The moat at the escarpment foot is located at the extension of the Cananea canyon running through the Sao Paulo Plateau from the shelf break. The absence of any evidence of gravity flow deposits in the cores which recovered last ~130 ka indicates that gravity-driven processes have been non-active in the study area during this time.

Formation of the CEDS in the study area during the late Quaternary was generally affected by the bottom current of Antarctic water. During the last deglaciation, decreased flow velocities resulted in domination of hemipelagic settling.

Borisov, D.G., Murdmaa, I.O., Ivanova, E.V., Levchenko, O.V., Yucis, V.V., Frantseva, T.N. 2013. Contourite systems in the region of the southern Sao Paulo Plateau escarpment, South Atlantic. *Oceanology* 53, 4, 460-471.

Stow, D.A.V. and Faugeres, J.-C. 2008. Contourite facies and the facies model. *Developments in Sedimentology* 60, 223-256.

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TALK 210: TEMPORAL AND COMPOSITIONAL PATTERNS AND VARIATIONS IN IGNIMBRITE VOLCANISM IN THE ANDES OVER THE PAST 30 MA - A GEOSTATISTICAL APPROACH

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Temporal and compositional patterns of Neogene ignimbrite magmatism in the Central Andes were analyzed using GIS and geostatistical modeling. We compiled and comprehensive ignimbrite data base using available literature, satellite imagery and geochemical data for ignimbrites of the Central Andes. We digitized 203 individual ignimbrite sheets, for which geochemical, isotopic (partly), and geochronological data are available from literature sources and own data to estimate composition, volumes and sources of erupted ignimbrite magmas through space and time for five segments of the Central Andes.

We estimate a total erupted ignimbrite magma volume of 31,000 km³ for the past 30 Ma, with 2,400 km³ for Southern Peru, 2,700 km³ for Southernmost Peru, 8,400 km³ for the Altiplano, 14,200 km³ for the Northern Puna and 3,100 km³ for the Southern Puna segments. Following the approach of de Silva and Gosnold (2007), we calculate a minimum plutonic equivalent of 7,200 km³, 8,100 km³, 25,200 km³, 42,600 km³ and 9,300 km³ for the respective segments. There is a clear N-S “younging” of eruption ages and ignimbrite pulses. Major pulses occurred at 19-24 Ma (e.g. Oxaya, Nazca Group), 13-14 Ma (e.g. Huaylillas ignimbrites), 6-10 Ma (Altiplano and Puna ignimbrites, e.g. Vilama ignimbrite) and 3-6 Ma (e.g. Atana, Los Frailes, Toconao) and very young ignimbrites from 0-3 Ma (e.g. Lauca-Perez, Purico). We propose that large-volume ignimbrite eruptions occurred in the wake of subduction of the Juan-Fernandez ridge on the Nazca Plate that passed below the Central Andes from N to S during the past 25 Ma. This event resulted in compression, uplift, low angle subduction (flat slab) and fluid release in a first stage, followed by massive inflow and melting of asthenospheric mantle above the steepening slab after the passing of the ridge. This in turn caused massive melting within the crust aided by advective heat transport shortly after slab steepening. Differences in chemical and isotopic composition of the large-volume ignimbrites are related to changes in crustal thickness, and its “preconditioning” during the Andean orogeny over time. Isotope data and whole rock compositional data suggest a higher degree of crustal assimilation for the younger Altiplano ignimbrites in the S compared to the older (22-19 Ma) ignimbrites in the North.

Total volumes for the northern segments and the Northern Puna are similar. However, calderas and intra-caldera volumes for ignimbrites in the northern segments are poorly constrained due to the lower level of study, higher ages and precipitation rates in that region and thus much higher degrees of incision and erosion. In any case, there is no “single” ignimbrite flare up in the Central Andes with one regionally and temporally restricted event of high-magma flux and batholith construction (de Silva and Gosnold, 2007). Instead, we suggest a more dynamic scenario, with “flare ups” moving from N to S across the Central Andes during the past 25 Ma and our database should help to better constrain numerical models of Andean geodynamic processes.

The database and a globally available Web Mapping Application will be shown during the poster sessions.

de Silva, S., Gosnold, W.D. (2007) Episodic construction of batholiths: Insights from the spatiotemporal development of an ignimbrite flare-up. *J. Volcanol. Geotherm. Res.* 167: 320–335

TALK 010: NEOGENE TO QUATERNARY ASH DEPOSITS IN THE COASTAL CORDILLERA IN NORTHERN CHILE: DISTAL ASHES FROM SUPERERUPTIONS IN THE CENTRAL ANDES

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Silicic volcanic ash deposits investigated at 14 localities between 22° and 25°S in the Chilean Coastal Cordillera are found to be the distal ash fall from supereruptions in the Central Andean cordillera several hundreds of kilometers to the east. Depositional textures, modal composition and granulometry of the ashes and tuffs (the latter lithified by halite and gypsum under ultra-arid conditions) allow for a distinction between primary fallout/aeolian deposits (mean 4 - 5 F, sorting 1.5 - 2 F) and secondary deposits that formed by down wash from hill slopes during local rain fall. Primary volcanic components comprise two types of glass shards (with small stretched vesicles and coarse-walled with rounded to elliptic vesicles), and biotite.

Previously published studies on ash deposits in the north Chilean Coastal Cordillera reported 14 ⁴⁰Ar/³⁹Ar and K/Ar ages on biotite or sanidine ranging between 6.66 ± 0.13 and 0.6 ± 0.4 Ma. In this project, three ⁴⁰Ar/³⁹Ar ages on biotite have been determined for samples from the Cuenca del Tiburón, the northern margin of Salar de Navidad and from the Quebrada de la Chimba (3.9 ± 0.1 Ma, 4.1 ± 0.1 Ma, 6.0 ± 0.1 Ma, respectively). The range of the 17 ages coincides with the Late Miocene to Quaternary ages of the major ignimbrite-forming eruptions of the high Andes to the east such as the Altiplano Puna Volcanic Complex (APVC).

Electron microprobe data of glass and biotite of the Coastal Cordillera ashes have been compared with data from major ignimbrites of the APVC, of other major Central Andean volcanic fields, and of marine ashes (ODP Leg 201). Biotite composition of the investigated Coastal Cordillera ashes is similar to those of ignimbrites from the APVC. In particular, based in Fe, Mg, Mn and Ti, distal equivalents of the 3.96 ± 0.08 Ma Atana and/or 4.09 ± 0.02 Ma Puripicar and of the 5.6 ± 0.2 Ma Pujsa and/or the 5.56 ± 0.01 Ma Guacha eruptions can be identified. In addition, based only on age relations, distal ash units of the Pastos Grandes, Tatio and Purico eruptions may be present in the Coastal Cordillera. Composition of glass is comparable to APVC ignimbrite matrix glass and to marine glass, however, significant alkali depletion and SiO₂ enrichment is attributed to in situ alteration.

The identification of these ashes demonstrates for the first time that the supereruptions in the southern Central Andes gave rise to voluminous ash clouds, most likely co-ignimbrite. The present outcrops represent ash dispersed by easterly winds, consistent with atmospheric models that show favorable westward-directed winds existing in the upper troposphere/stratosphere during the southern summer in the southern Central Andes. This requires that current volume estimates for the major eruptions to be considered minima with a significant augmentation likely.

POSTER 024: BOUNDARY ZONE STRATIGRAPHY BETWEEN THE VALLE CENTRAL AND TERRABA SEDIMENTARY BASINS IN COSTA RICA

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Recent stratigraphic studies in the southwestern sector of the Valle Central reveal the presence of rocks from the Paleogene of the forearc Terraba basin. Thus suggesting that the (intraarc) basin of the Valle Central is related with a neogene shallow marine fill that was installed above a previous deep marine fill that corresponds with turbidite deposits of the Descartes Formation ranging in age from Paleocene to Eocene. The Paleocene is composed of green and redish muddy and very fine sandstone interbeddings locally synsedimentarily deformed, while the Eocene is composed of interbeddings of four main facies: alternations of granule to pebble sized breccias, pebbly sandstones, coarse to fine sandstones y fine sandstone and mudstones interbeddings with variable volcanoclastic composition. The presence of the Oligocene is subject of debate, because there has only been one datation in scientific literature, which was based upon the reported presence of *Globigerina ciperiensis* inside a lithological unit that presents litostratigraphical definition problems because of unclear structural relationships with the adjacent rocky formations, thus pending a revision. The Neogene of the Valle Central sedimentary basin would be represented by a general sequence of shallowing characterized by external muddy shelf facies (from the Mid-Miocene) to upper bathyal and inner shelf facies. This fill was covered close to the Mio-Pliocene limit by inner volcanic arc volcanics from this age, by quaternary arc transition volcanic (fissure lavas and ignimbrites) and finally by Holocene inner arc products such as lahars, lava flows and ashes.

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Obando, L., 2011: Estratigrafía y tectónica de la parte Noreste de la Hoja Dota (1:50.000), Costa Rica. Rev. Geol Amer. Central., Vol. 44, San José, C.R. Editorial Universidad de Costa Rica. 71-82 pag.

TALK 025: “GEOTOURISTIC GUIDE OF THE VALLE CENTRAL”: A RESULT OF A TEACHING OUTREACH PROJECT FROM THE SOCIAL ACTIONS VICERECTORATE OF THE UNIVERSIDAD DE COSTA RICA FOR THE DIFFUSION OF GEODIVERSITY AND THE PROMOTION OF GEOCONSERVATION THROUGH GEOTOURISM

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The “Geotouristic Routes of Costa Rica” is a teaching outreach of the Social Actions Vicerectorate from the University of Costa Rica. It was first proposed and executed in 2005 with the goal of bringing together various components: identification and conservation of the natural geological patrimony and the promotion of cultural and economical development of rural communities.

The introduction of geotourism as an additional ecological touristic activity has an established niche, due to the changes in soil policies in the last 20-30 years which have cost their jobs to a great sector of the population traditionally dedicated to agriculture, fishing or cattle-raising. In the face of this scenario some communities have organized themselves to offer services such as hosting, transportation and guiding. Many of these activities are centered in the vicinity of the conservation areas or national parks. The National System of Conservation Areas (SINAC, in spanish) manages these protected areas, nonetheless its vision of nature is solely focused on Biodiversity. Even if they protect some geodiverse elements which may even amount to a patrimonial value, they are not considered attraction because the country lacks a *geological culture* for most of its population. Thus, knowledge of geodiversity is not offered to the national or foreign tourist. In this sense, one of the goals of this project of teaching outreach is to promote “geolphabetization” through the explanation of geological concepts, phenomena and processes in “geosites” located along routes both outside and inside established protection areas. This objective is completed through workshops where community members, local guides and SINAC workers take part. As a complement to these activities, work is progressing on the development of geotouristic guides that cover geologically important routes of the country: North Pacific, Central Pacific, Southern Pacific, Valle Central, Talamanca Mountain Range and Southern Caribbean. With work currently in progress on the Talamanca Mountain Range Guide.

Regarding the “Valle Central Geotouristic Guide”, it is composed by a total of thirty “geosites” that show the evolution of the sedimentary fill of this basin starting in the Paleocene, when it was still connected to the forearc Terraba basin and sedimentation had a deep-water character, until Middle Miocene when a shallowing trend is documented in the inner shelf sedimentation, and culminate with continental sediments and later cover by volcanics from the Upper Miocene-Pliocene, inner volcanic arc, Pliocene-Pleistocene transition volcanics and finally the inner volcanic arc Holocene volcanic of the Central Volcanic range.

Campos, L. 2001: Geology and basins history of middle Costa Rica: an intraoceanic Island arc in the convergence between the Caribbean and the Central Pacific Plates. Tuebinger Geowissenschaftliche Arbeiten, Reihe A, Bd.62, 138pp.

TALK 110: FAUNA AND ENVIRONMENT OF THE MARINE PLIOCENE HORCÓN FORMATION, CENTRAL CHILE

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The Horcón Formation crops out along the coast some 50 km north of Valparaíso, central Chile. Its Pliocene age is verified based on the mollusks *Chlamys* cf. *hupeanus*, *Panopea coquimbensis*, *Chorus blainvillei*, *Chorus doliaris* and *Hermineospina mirabilis* and can therefore be correlated with the classic Coquimbo Formation. With a total of more than 60 taxa, it contains also the most diverse southeastern Pacific Neogene vertebrate fauna to date. The fauna encompasses corals, mollusks, crabs, sharks and rays, marine birds, and marine mammals (Carrillo-Briceño et al., 2013; Chávez Hoffmeister et al., accepted). It also includes the southernmost occurrences of several taxa and a new species of penguin. The depositional environment of the Horcón Formation is discussed as well as climatic and oceanographic implications of its fauna.

Carrillo-Briceño, J.D., González-Barba, G., Landaeta, M.F. and Nielsen S.N. 2013. Condrictios del Plioceno tardío de la Formación Horcón, Región de Valparaíso, Chile central. *Revista Chilena de Historia Natural* 86(2), 191–206. doi:10.4067/S0716-078X2013000200008.

Chávez-Hoffmeister, M., Carrillo-Briceño, J. and Nielsen S.N. The evolution of seabirds in the Humboldt Current: New clues from the Pliocene of central Chile. *PLoS One*, accepted.

Sponsored by DFG travel grants

TALK 116: APTIAN–ALBIAN (EARLY CRETACEOUS) CLIMATE OF NORTH-EASTERN BRAZIL: FROM EVAPORITES TO OPEN MARINE SETTINGS BASED ON PALYNOLOGICAL EVIDENCE

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Conifer pollen of the genus *Classopollis* are recorded in Aptian–Albian rocks in most of the continental margin basins of Brazil. *Classopollis* is confined mainly to lagoonal and marine nearshore environments and often associated with evaporites (Vakhrameev, 1981, Doyle et al., 1982). Schrank & Mahmoud (1998) suggested that *Classopollis*, *Equisetosporites*, *Steevesipollenites* and *Gnetaceopollenites* were elements of a xerophytic flora present in most South American and African basins.

Fern spores are also common elements in Aptian–Albian successions. They depend on water to reproduce, as they have a delicate free-living gametophyte that needs to be covered by water to bring a sperm to the egg and to complete its life cycle. Thus, ferns are usually associated with moist conditions and, consequently, rarely reported from arid environments (Aldasoro et al., 2004; Ozenda, 2004). A total of 152 palynological samples of Petrobras well GTP-24-SE from the Sergipe Basin in north-eastern Brazil were analysed and found to contain a high abundance of a xerophytic flora, in particular *Classopollis*. Although the abundance decreases markedly upwards, fern spores increase. This reflects the progressive increase in humidity, evidenced also by the relatively high proportion of mountain floral elements (e.g., *Araucariacites*). Chaboureau et al. (2012) show a humid belt in the northern South Atlantic region and explain the presence of evaporites in this area as a result of geodynamic conditions, i.e., not a result of arid climate. This would explain the presence of fern spores. However, in the interval where evaporites occur, the ratio of fern spores vs. xerophytes (Fs/X) and the diversity of fern spores show very low values. According to Anthelme et al. (2011), ferns occur more frequently in arid environments than previously assumed as a result of efficient dispersal. Thus, arid conditions during the Aptian–Albian in the northern South Atlantic region are conceivable. Three humid phases can be recognised, of which the first one is recorded in the dominantly non-marine Muribeca Formation. In the beds overlying the evaporites, a conspicuous increase in mountain flora, the Fs/X ratio and diversity of fern spores is observed. These data support the conclusion of Chaboureau et al (2012) that a high rift relief induced precipitation, which created conditions favourable for fern growth and inhibited evaporite deposition. Two humid phases in the overlying Riachuelo Formation seem to be related to rises of sea level, evidenced by the progressive increase in marine deposition as a result of the separation of the South American and African continents.

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Anthelme, F., Abdoukader, A. & Viane, R. 2011: Are ferns in arid environments underestimated? Contribution from the Saharan Mountains. *Journal of Arid Environments* 75, 516–523.

Chaboureau, A.-C., Donnadieu, Y, Sepulchre P., Robin, C., Guillocheau, F. & Rohais, S. 2012: The Aptian evaporites of the South Atlantic: a climatic paradox? *Climate of the Past* 8, 1047–1058.

Doyle, J.A., Jardiné, J. & Doerenkamp, A., 1982: *Afropollis*, a new genus of early angiosperm pollen, with notes on the Cretaceous palynostratigraphy and paleoenvironments of northern Gondwana. *Bulletin des Centres de Recherches Exploration-Production Elf-Aquitaine* 6, 39–117.

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Vakhrameev, V.A. 1981: Development of floras in the middle part of the Cretaceous Period, and older angiosperms. *Paleontologicheskij zhurnal* 2, 3–14. (In Russian.)

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TALK 009: FIRST PETROLOGICAL STUDY OF NELSONITES FROM GRENVILLIAN NOVILLO GNEISS, BASEMENT OF THE SIERRA MADRE ORIENTAL (NE MEXICO): PRELIMINARY RESULTS

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3: *Departamento de Geología, Centro de Investigación Científica y de Educación Superior de Ensenada, Ensenada, B.C., México.*

This investigation represents the first integrated study of the precambrian nelsonites from the grenvillian Novillo Gneiss. It is the oldest unit (~990 Ma; Cameron et al., 2004) of the Sierra Madre Oriental basement, with metamorphic conditions of granulite facies (730-775 °C and 8.9-9.7 kbar; Orozco-Esquivel, 1990). The latter unit is exposed in the Huizachal-Peregrina Anticlinorium located 10 km west of Cd. Victoria, Tamaulipas, and represents the northernmost part of the precambrian Oaxaquia microcontinent in Mexico.

Nelsonites are rocks composed of Fe-Ti oxides and apatite associated with anorthosite complexes, in this case the Anorthosite-Mangerite-Charnockite-Granite (AMCG) suite of the Novillo Gneiss. There is a wide variety of hypothesis for the formation of these Fe-Ti oxide deposits, but there is still no consensus on this issue (Dymek & Owens, 2001). Previous works from this area are scarce and the only one known is that of Ortega-Gutiérrez (1978), which focused on the precambrian and paleozoic metamorphic rocks of the basement, providing little petrological information on the nelsonites.

The preliminary results indicate that the nelsonites may have originated from a gabbro-anorthositic magma by a liquid immiscibility process, which derived a silica-rich melt (anorthosites; AMCG suite) and another with high contents of Fe, Ti and P (nelsonites). Petrographic evidence shows apatite globules within Fe-Ti oxides (ilmenites), a good indicator of immiscibility. On the other hand, geochemical graphics display clear gaps between the nelsonites and AMCG rocks. The REE and Spider diagrams show a strong enrichment of La, Ce, Pr, and Nd in the nelsonites, mainly concentrated in apatites. TiO₂ and Eu anomalies and trace element content are the most important differences between nelsonites and AMCG suite, in terms of composition. A U-Pb geochronological study in apatites is being carried out, but a grenvillian age is assumed on the basis of spatial and temporal association between Fe-Ti oxide-apatite deposits and anorthosites.

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TALK 166: MERCURY IN RESIDUES OF A HISTORICAL METALLURGICAL SITE IN MEXICO: AN UNATTENDED LEGACY

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The silver and gold mining and metallurgical activities increased significantly its profitability with the introduction of the Patio Method by Bartolomé de Medina in 1557 during the colonial époque in Mexico. By this method, the silver and gold ores were crushed and distributed over a stone covered flat floor, afterwards the ores were mixed with sodium chloride, ferric- or copper sulfate, and finally approximately 500 grams of mercury each 50 kg ore were added. After a few weeks of repeatedly mixing, the Ag/Au-Hg amalgam was recovered and the residues were dumped on the surroundings of the metallurgical site.

Cedral is a small town located in north-central Mexico in the state of San Luis Potosí. By the end of the 18th Century at least nine of the so called Haciendas de Beneficio were using the Patio Method for the amalgamation of the silver ores of the nearby mining district of Real de Catorce. After the closure of the mines of Catorce, Cedral recovered its agricultural vocation, but during the 20th Century, the residues of the Patio method were reprocessed in order to recover the mercury and silver residual contents.

This work describes the procedure used to assess and understand the environmental impact caused by the historical metallurgical activities in the town of Cedral, particularly the destiny of the residues left in the town and its surroundings.

After a detailed soil geochemical mapping, sampling focused on the two main tailing heaps located on the SW side of the town, identified as the main pollution sources. Samples were taken from old "original" and reprocessed tailings. After a chemical characterization, mobility tests were applied. In order to identify the main chemical mercury phases in the tailings, a speciation study was carried out with X-Ray spectroscopy. Furthermore blood samples were taken from 6 to 12 years old children living or going to school nearby the tailings.

Results show soil concentrations with maximal 70 mg/kg Hg; by contrast original tailings show concentrations up to 550 mg/kg Hg and reprocessed tailings up to 60 mg/kg Hg. Extraction tests with simulated rain water present always mobility rates below 1%. The speciation study indicates that over 90% of the mercury is present in form of cinnaber ($\text{HgS}_{\text{trigonal}}$) or metacinnaber ($\text{HgS}_{\text{cubic}}$), supporting the results of the mobility tests. Children blood analysis show results ranging from 4 to 76.7 $\mu\text{g/L}$; and 85% of these samples are above the reference limit of 5.8 $\mu\text{g/L}$ of the USEPA.

These results point to the Aeolian transport as probably the main pathway of mercury in Cedral, remarking thus the necessity to attend this old legacy as a present priority.

POSTER 218: TRACE METALS IN MOA CAY'S SEDIMENTS (CUBA): PRELIMINARY SITE CONTAMINATION ASSESSMENT

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This work presents an evaluation of four trace elements (arsenic, As; copper, Cu; lead, Pb; and zinc, Zn) contained in the superficial sediments of Cayo Moa Bay. This area has been impacted by human activity since the middle of the last century with the exploitation of one of the most important mines of Cuba. Three basic methods were used to evaluate the range of concentration: comparison with other marine ecosystems, determination of metal concentration by calculating the contamination factor, and interpretation of the data obtained based on quality criteria. The range of concentrations varied from 7-153 $\mu\text{g g}^{-1}$ for As, 18-175 $\mu\text{g g}^{-1}$ for Cu 5-62 $\mu\text{g g}^{-1}$ for Pb and 46-527 $\mu\text{g g}^{-1}$ for Zn. The spatial distribution of concentrations shows high values throughout the bay and surrounding areas, with variation according to the elements analyzed. The higher values of As were found at the mouth of Moa and Cayo Guam rivers. High amounts of Cu, Pb, and Zn were found in the inner bay specifically in P5; however; these contaminants were also in large quantities in spots localized at the south of Cayo Moa Grande. The results obtained show enrichment of the studied elements in the bay's sediments and that according to the level of contamination some of the areas studied can be classified as highly polluted or as a potential biological risk.

Sponsored by DFG travel grants

TALK 182: GEOMORPHOLOGIC DIFFERENTIATION OF BEACH AND COAST ON COZUMEL ISLAND, MEXICO

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The use of GIS and remote sensing tools permit to display, to acquire and to manage all spatial reference information's, in order to model spatial and temporal phenomena. These new computer techniques became more typical the studies of the impact on the environment. The geomorphologic survey on Cozumel Island is the product of a methodological approach based on geomatics. The objective of this work is to explain of the morphographical variations of the Cozumel beaches and coasts in regard to its geomorphologic and environmental characteristics. It is mainly founded on the combination of a surface numerical analysis and a traditional synthetic approach.

The traditional approach to the management of beaches in most of the developed countries is focused on its use for two main functions: protection and recreational, however, management approach used in the present work, poses as a basis, environmental territorial zoning model contained in the Environmental Agenda of the Secretariat of Environment and Natural Resources (In spanish: Secretaría de Medio Ambiente y Recursos Naturales, SEMARNAT), which defines the Territorial Zoning Model as: representation, in a geographic information system of environmental management units and their respective ecological guidelines. According to its characterization and diagnosis of the environmental unit, the protection, conservation, use and restoration policies will be applied.

The geomorphological study of the spatial analysis was made on the basis of LiDAR data, especially to create morphological maps such: the slope, ground digital model as well as the beaches system maps of the aforesaid zone. The use of the spatial remote detection and visual interpretation in the analysis of the Orthophoto, allowed us to detect physiographical and geological evidences of the littoral dynamic. Subsequently conducted fieldwork to the delimitation and collect information such as: type of beach, dynamics and erosional processes - cumulative, human activity, tourism, biodiversity, extent, sediments, among others. The use of GIS on the basis of the LiDAR model and orthographic images allowed us to get a digitized model by the littoral system of the studied zone for purpose to make a spatial distribution of the physiographical data of various environmental components on Cozumel beaches.

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POSTER 204: PALEOECOLOGY AND EVOLUTION OF THE CARNIVOROUS MAMMALIAN FAUNAS OF SOUTH AMERICA FROM THE LATE MIOCENE TO THE PLEISTOCENE: INSIGHTS FROM STABLE ISOTOPIC SIGNATURES (¹³C, ¹⁵N, ¹⁸O) IN FOSSIL BONES AND TEETH

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South America was isolated during most of the Tertiary and developed a very particular mammalian fauna. In contrast to other continents, the carnivore adaptive zone was filled by crocodiles, large snakes and birds, and metatherian mammals (Sparassodonta). Sparassodonta were diverse during the Tertiary with a broad range of sizes (\approx 2-50 kg). This diversity decreased towards the late Miocene and the group became extinct at the middle Pliocene (\approx 3 Ma). The cause of this decline and extinction may have been immigration of placental Carnivores to South America (\approx 6-7 Ma ago), which putatively competed with the sparassodonts (Ecological Competitive Displacement Hypothesis, ECD). This hypothesis was recently criticized and the Ecological Replacement (ER) hypothesis was proposed, which postulates that newcomers (placental carnivores) filled ecological niches left empty after the extinction of previous occupants (marsupial carnivores) due to other causes, such as environmental changes. This subject is currently being studied using morphometrics, which, however, may be biased by a phylogenetic signal. Here we propose using stable isotopes (¹³C, ¹⁵N, ¹⁸O) to complement the study of the evolution of the carnivore guild during the late Cenozoic in Argentina. This purely phenotypic approach will yield direct information on actual ecological changes. Under the ER scenario, environmental changes should lead to changes in the isotopic relationships among fossil taxa, while in the ECD scenario, similar isotopic relationships should be observable between extinct marsupial predators and the placental predators that replace them.

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POSTER 214: POSSIBLE IMPACTS OF STRATEGIC MINERALS IN THE COLOMBIAN AMAZONAS AND ORINOCO AREA

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Speculative notices about “Coltan”-deposits in the eastern Colombia region since 2009 revealed the necessity of fundamental research in these large but poorly studied areas in vicinity to Brazil and Venezuela.

At the beginning, field trips to Guainía and Vichada departments followed by sieving, magnetic separation, density- and grain-analysis, ore microscopy, SEM, XRD and XRF revealed that many Ta-Nb-occurrences in alluvial “black sands” are accompanied by Fe- and Ti-oxides. Their chemistry varies (<50% Ta, <20% Nb with mainly Fe, Ti and few Mn). In ilmenites from Guainía-Department, Nb-rich rutils and pyrochlore inclusions occur. Also Ta-rich cassiterites exist. Later also illegally mined wolframite deposits were analyzed.

Although pegmatites and acid magmatism are the main primary sources of the Ta-, Nb-, Sn-, W and REE minerals, abundant Ti-minerals indicate a more complex geology.

Normally, these minerals are mined in secondary alluvial or eluvial deposits; very low knowledge about the true economically exploitable content of coltan and other mineralizations often lead to speculative devastation of only Fe- and Ti-oxides bearing rain-forest areas by informal mining, sometimes linked to criminal activities.

In order to get more clarity about these complex situation, since the end of 2011 our group prepared a research project which finally started in December 2013 in four Eastern Colombian departments: Vaupes, Vichada, Guainía and Guaviare. In the project called “Initial evaluation of strategic and industrial minerals (Ta, Nb, Sn, W, Ti, Fe, Mn, Al, Zr, Hf, U, Au, REE), gems, construction materials, their use and possible environmental and social impacts of their mining for a sustainable development of the Llanos-Region” during 9 fieldtrips in 1 year 18 study-areas will be visited by some twenty geologists, biologists and sociologist for getting geological-mineralogical data and samples, as well as plant specimens and sociological information. A very important aspect is the communication with both the Indigenous communities and local actors like informal miners, in the latter case with the objective of teaching more sustainable exploitation-practices in areas where mining is legally and environmentally suitable and agreed. In a middle term a fundamental objective of the project is establishing permanent links between the Geosciences Department in Bogota and local multipliers and future researchers from the region. In this way something which started some years ago with the question of identifying so called coltan minerals is transforming in a serious intent of understanding each time better these very complex geoenvironmental tropical systems in a nearly 1,6 Ga old geological terrain as large as Germany.

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TALK 153: PALEOPROTEROZOIC METAMORPHIC EVOLUTION OF TONALITIC GNEISSES AND ASSOCIATED MIGMATITES FROM THE CERRO EL CRISTO AREA OF THE TANDILIA BELT, RÍO DE LA PLATA CRATON

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The Tandilia belt in central-eastern Argentina represents the southernmost portion of the Paleoproterozoic Río de la Plata craton. As P-T paths were rarely estimated for metamorphic rocks of this craton, we selected the area of Cerro El Cristo for studying its P-T evolution. In this area, which is located ~65 km southeast of the town of Tandil, three main lithologies can be recognized: (1) amphibole(Am)-biotite(Bt) gneisses, (2) garnet(Grt)-Bt-bearing migmatites and (3) metamorphosed pegmatites and granites. In order to determine the P-T evolution of such rocks we applied the PERPLE_X software package for calculating P-T pseudosections for a gneiss and a migmatite in the 11-component system Si-Ti-Al-Fe-Mn-Mg-Ca-Na-K-O-H. Information on the experienced P-T conditions was obtained by electron microprobe analysis of the minerals and the contouring of the pseudosections by isopleths of chemical parameters of these minerals.

The selected mesosome of a stromatic metatexite (0224) contains about 30 vol.% quartz (Qtz), 20 vol.% each of K-feldspar and plagioclase (Pl), 15 vol.% Bt and almost 10 vol.% Grt, which formed porphyroblasts by a peritectic melt reaction. Grt core compositions of $\text{pyr}_{4.5}(\text{gro}+\text{andr})_{10}\text{spes}_6\text{alm}_{79.5}$ crystallized at about 5.4 kbar, 670 °C, and a melt proportion of < 40%. The outermost Grt rim of $\text{pyr}_{3.5}(\text{gro}+\text{andr})_{17}\text{spes}_6\text{alm}_{73.5}$ points to about 6.8 kbar and 645 °C, where the proportion of melt was < 30%. As we assume that only Grt rims were in equilibrium with the analyzed bulk-rock, we subtracted the Grt cores from the bulk rock, but obtained similar P-T conditions for the final garnet crystallization (6.9 kbar and 642 °C). The modal composition (vol.%) of the modeled gneiss (0324) is: Qtz(28)+Pl(32)+Bt(24)+Grt(5)+Am(7)+Accessories(4). Zoned Grt porphyroblast also allowed us to derive two metamorphic stages. Core compositions of $\text{pyr}_{6.5}(\text{gro}+\text{andr})_{26}\text{spes}_{12}\text{alm}_{55.5}$ yielded P-T conditions of 8.9 kbar and 640 °C at solidus state. Grt rim compositions of $\text{pyr}_{4.5}(\text{gro}+\text{andr})_{33}\text{spes}_{12}\text{alm}_{50.5}$ resulted in 9.6 kbar and 580 °C.

The derived P-T path is characterized by P increase from 5.5 to 9.5 kbar at cooling by nearly 100 °C. We interpret this unusual anti-clockwise P-T path by tectonic transport from mid-crustal to deeper levels along a major suture zone, eventually the contact zone between the Río de la Plata craton and a colliding crustal plate in the south. The cooling of the studied rocks, being part of the Río de la Plata craton, was caused by relatively cold, fastly buried material of the downgoing plate.

POSTER 203: GROUNDWATER MANAGEMENT USING URBAN HYDROGEOLOGY IN MONTERREY, MEXICO

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The aim of this study is to determine the environmental impact on groundwater (GW) and the aquifers in the study area applying Urban Hydrogeology (UH). These impacts are generated by urban activities of Monterrey Metropolitan Area (MMA) with ~4.2 million of inhabitants (INEGI 2010). MMA has mostly industrial activities characterized by fast growth population with extreme climatologic conditions, presence of long droughts and important floods into the basin. During the last 30 years, anthropogenic activities results in over-exploitation of GW and aquifer pollution, which affects the storage and availability of this resource. On the other hand, the water required to supply the increasing population. At the present day Monterrey has a total deficit of ~6m³/s of drinking water.

The planned methodology to develop this project must integrate data from water supply measurements, traditional hydrogeological evaluation and intrinsic vulnerability assessment of aquifers using the DRASTIC method (Aller et al. 1987). All these information are part of the UH research which took into account the analysis and relations of complex processes involving: physical-demographic growth, GW exploitation, GW use and distribution, sewer coverage, water table behavior, hydrogeochemical quality and distribution of nitrates into the aquifers, as well as potential pollution sources (Foster, Lawrence, and Morris 1998). The expected scenario could be complex. For this reason, a serious analysis will be developed using Geographic Information Systems, database and a multivariate analysis to study the possible aquifer scenarios.

GW resource management and environmental impact on the aquifer into the city are priority and relevant issues for the future of MMA in order to guaranty the public health of inhabitants and the future of the economic growth of the most important metropolitan area in the northeast of Mexico. In conclusion, groundwater sustainable management guidelines in the first stage and the initial diagnostic phase are exposed in this document.

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POSTER 138: ASSESSING THE MORPHOTECTONIC EVOLUTION OF THE SOUTHERN CENTRAL ANDES USING THE RIVER TRANSECT TOOL

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To better understand deformation processes in active orogens and assess potential seismic hazards, the detection of tectonically active regions is key to such analysis. Besides studies on seismicity, analysis of landform development provides insight into young deformation processes. Specifically, the combination of tectonomorphic indices, such as the mountain front sinuosity (Smf index), the valley width to valley height ratio (Vf – ratio) and the Transverse Topographic Symmetry Factor (T-factor) delineating drainage basin symmetry, can be used as a relative measure of tectonic activity along fault-bound mountain fronts. The fast evolution of high resolution satellite elevation data and imagery provides an ideal base for remotely-sensed tectonomorphic studies of large areas using Geographical Information Systems (GIS). However, a manual extraction of the above mentioned morphologic parameters is tedious and time consuming. Moreover, basic GIS software suites do not provide the necessary built-in functions. Therefore, we present a newly developed, ESRI ArcGIS compatible tool and stand-alone script, the River Transect Tool. This tool facilitates an automated extraction of the Vf-ratio and the T-factor for large regions. Using a digital elevation raster and watershed polygon files as input, the tool provides output in the form of several ArcGIS data tables and shapefiles, ideal for further data manipulation and computation. Furthermore, our ArcGIS-compatible River Transect Tool is coded in Python using arcc scripting for geoprocessing. This coding enables an easy application among the ArcGIS user community and code conversion to earlier ArcGIS versions. The River Transect Tool is easy to use due to a simple graphical user interface. The tool is tested for the southern Central Andes using a total of 3366 watersheds.

POSTER 162: GEOCHEMISTRY OF WATERS OF THE STREAM RIBEIRÃO DO CARMO, OURO PRETO, MINAS GERAIS, BRAZIL

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The study area of this work is located in the basin of the Stream Ribeirão do Carmo in the Baçõ Complex, which is a structure inside Quadrilátero Ferrífero (QF, Brazil). The QF is one of the most important regions of gold and iron ore exploration (Dorr, 1983). Aluminium, manganese and precious gems are also found. The geochemistry of water and sediment from the Stream Ribeirão do Carmo is related to both the geology of the area and human activities. Mining is a major contributor to environmental and physico-chemical characteristics of elements in the studied area. It contributes to increase the content of various metallic ions as iron, manganese, gold, aluminium, arsenic and cadmium. These events become important as they affect the quality of water and the use and occupation of the region.

According to PIRHDOCE (2009), the waters of the Stream Ribeirão do Carmo basin are highly contaminated by toxic agents and have a bad water quality index (WQI, related to classification of waters), which is derived from the geological conditions of the region and anthropogenic activities developed around the basin (Almeida, 2008). These activities have their origin mainly in the discharge of sewage, mining and rural activities and industrial waste. The mining and industrial activities are responsible for the most pollutants found in water (Fellenberg, 1980). The removal of riparian vegetation and the constant act of disturb the surface layer of soil modify the geomorphology and the natural hydrological and thermal flow influencing the availability of physical habitat and nutrient cycling in fluvial ecosystems (Sponseller et al., 2001).

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POSTER 221: WATER LEVEL CHANGES OF THE ENRIQUILLO LAKE IN DOMINICAN REPUBLIC. CLIMATE CHANGE OR ACTIVE TECTONIC

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Lake Enriquillo is located in the south western region of the Dominican Republic and covers an area of 265 sq.km. Historically, the Enriquillo lake level has been controlled by the seasonal variations of climatic and hydrological parameters (e.g. rainfall, temperature). Since 2008, the lake level increased drastically, affecting thus the surrounding communities. The aim of this work is to examine the factors that are affecting the dynamics of Enriquillo lake system and thus the lake surface growth.

Using satellite images, we computed the Normalized Difference Water Index (NDWI) in order to separate water bodies from other land-cover features based on the spectral characteristics. NDWI calculation was done on TM and ETM+ Landsat images (30 m pixel resolution) covering the Enriquillo catchment area. In order to produce a time series analysis we selected images from 1985 till nowadays. Scenes were taken in the same season in order to avoid climatic bias. The lake surface variations between 1985 and 2012 were then compared to in situ and remote-sensed monthly climatic data (e.g. precipitation, evaporation, temperature).

The meteorological parameters recorded over the last 33 years indicate a generally constant climate marked by minor inter-annual variations. Prior to 2008, lake level and surface area show small variations correlated with climatic variables such as temperature and rainfall. According to the trend observed during the past 24 years, the water surface of Lake Enriquillo should have decreased from 2007 to 2013. However, after 2008, the lake area increased dramatically with an anomalous trend starting from 2009. The size of the lake water surface was expanded by 108 sq.km in spite of a significant decrease in rainfalls.

Based on our analyses of long term variations of lake water surface and climate, we suggest that seasonal change is not the main cause for the lake surface growth. The lake expansion may be related to other factors, such as an increase in sediments input (possibly due to deforestation) or tectonic deformation (Enriquillo Lake is located between two tectonically active front ranges).

TALK 222: RECENT GEOMORPHO-TECTONIC EVOLUTION OF THE JAMAICA ISLAND

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In this work we examine the morphology along the deformation zones in Jamaica island, in order to provide new insights into the evolution of the Jamaican restraining bend from late Miocene to present, and the relations between active structures and landscapes. The island of Jamaica, commonly interpreted as a restraining bend between the Walton Fault and the Plantain-Garden Fault, lies at the boundary between the Caribbean plate and the Gonave microplate. To determine the features related to each stage of the evolution of the landscapes, we analyzed and classified the landscapes between different erosional/evolutionary stages. We also analyzed the river profiles to detect structures, delineate spatial patterns in uplift rates and estimate the uplift or incision.

We identified in Jamaica three main morpho-tectonic regions. Each region has a specific morphological signature which marks a different stage in the Late Miocene to present evolution of the Jamaican restraining bend. The evolution of the bend is mainly associated to the western propagation of the E-trending strike-slip faults and NW-trending thrusts. The western and central parts of Jamaica correspond to the area, where the present-day motion between the Caribbean plate and the Gonave microplate is distributed, while in the easternmost part of the island it seems to be almost completely accommodated along the Blue Mountain range and the Plantain-Garden Fault.

POSTER 143: LANDSCAPE EVOLUTION OF THE BRAZILIAN SOUTHEASTERN HIGHLANDS, POÇOS DE CALDAS PLATEAU

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The post rift evolution of the western South Atlantic passive continental margin starts with Late Cretaceous alkaline volcanics, subvolcanics and intrusions along two NW-SE trending belts. The largest intrusion is the Poços de Caldas Alkaline Massif (PCAM) located on the west side of the Mantiqueira Mountain Range within Proterozoic greenschist to amphibolites facies metamorphic rocks

Characterized by alkaline rocks, topography reaches over 1700m (a.s.l) high. The topography of the crystalline basement, called North Crystalline Zone (NCZ), is a dissected plateau with irregular topographic ridges reaching 1200m in elevation. The PCAM and NCZ areas together form the Poços de Caldas Plateau characterized as a remnant of the South American Planation Surface resulted from erosional events from Late Cretaceous–Paleogene transition.

The Apatite Fission-Track ages range from 333.3 ± 27.6 to 94.0 ± 13.7 Ma for the metamorphic basement area (NCZ), and 76.8 ± 10.9 to 48.7 ± 10.7 Ma for the PCAM area. The older ages are concentrated on the lower topography region (lower than 1200m until ~700m a.s.l), close to the Pardo River Valley on the north. The ages on this area are from Carboniferous to Triassic.

The youngest ages can be interpreted as caused by exhumation processes in Paleocene and Eocene time. The age-elevation relationship shows that the ages decrease systematically with increasing elevation with a break-in-slope near the 150Ma and another in 80Ma, which means two periods of exhumation that are related to the opening of the South Atlantic and timing of alkaline intrusion, respectively.

In comparison to published thermochronological data from other southeast Brazilian highlands as Mantiqueira and Serra do Mar mountain ranges, data indicates that the landscape evolution is associated with several distinct exhumation events at the South American passive continental margin, which include the Gondwana break-up, the Late Cretaceous alkaline magmatism, and the Cenozoic evolution of a N-S trending continental graben system

Sponsored by CAPES and CAPES/PROBRAL/DAAD

POSTER 154: GENESIS OF FLUORAPATITE AGGREGATES IN DOLOMITES, QUARTZITES, LIMESTONES AND PELITES OF THE OLAVARRÍA AREA, TANDILIA RANGES, ARGENTINA

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At the acid hydrothermal alteration front (pyrophyllite-kaolinite paragenesis) of the most intensely altered migmatitic basement from the Barker, La Juanita and San Manuel areas, Tandilia ranges, neither primary apatite nor monazite were recognized, though they are normally present in the same but unaltered rocks. However, epigenetic apatite veinlets and fluorapatite-rich aggregates have been identified in different levels at the unconformably overlying sedimentary sequence of the Barker area. This Neoproterozoic-Early Paleozoic sedimentary succession is better exposed in several quarries of dolomite (upper Villa Mónica Fm.) and limestone (Loma Negra Fm.) at the Sierras Bayas-Olavarría area. At the basal contacts of both carbonatic lithologies, fluorapatite-rich aggregates and secondary quartz-rich aggregates are commonly present.

Previous works on the Olavarría area (Martínez et al., 2009; Gómez Peral et al., 2011) mention that hydrothermal activity affected the basement and the overlying stratigraphic sequence. The orthoquartzites of the Villa Mónica Fm. at the upper contact with the dolomite bed show clear textural evidences of dissolution and replacement of syntaxial quartz overgrowths and clasts by fluorapatite-rich aggregates (+ chlorite + sericite + secondary quartz + goethite). Secondary quartz-rich aggregates (+ chlorite + sericite + goethite) also fill dissolution cavities of the orthoquartzite. Finally, calcite veinlets cross-cut both types of aggregates and replace the syntaxial quartz overgrowth and clasts of the orthoquartzite. Ondulose extinction in quartz clasts and their syntaxial quartz cement points to slightly deformed rocks. Trails of secondary bi-phasic fluid inclusions (L+V) cross-cutting quartz clasts and their cement, can also be recognized. Under the microscope, the micritic dolomite of the stromatolitic dolomite bed is replaced by large idiomorphic dolomite crystals (50-80 µm), filled interstitially by secondary quartz + goethite + fluorapatite. The original stromatolitic structure of the dolomite is also destroyed by the presence of centimetric "micro-breccias", which include clasts of corroded orthoquartzite, fluorapatite-rich aggregates and secondary quartz-rich aggregates. Late calcite cemented and partially replaced clasts and aggregates of the "micro-breccias". The calcite cement contains small irregular patches of sericite and also exhibits low-temperature fluid inclusions.

We suggest that the acid front of hydrothermal fluids is loaded with phosphate from the destruction of original apatite and monazite in the igneous-metamorphic basement rocks, as well as with fluoride from fluorite. The fluids migrated upwards through breccias and contacts to different stratigraphic levels and precipitated fluorapatite-rich aggregates (+ chlorite + sericite + secondary quartz), when the acid solutions were neutralized by carbonatic lithologies.

Gómez Peral, L.E., Raigemborn, M.S., Ganem, F., Poiré D.G. and Canalicchio J.M. (2011) Argilofacies con pirofilita en el Grupo Sierras Bayas, area de Olavarría, Argentina: implicancias genéticas. XVIII Congreso Geológico Argentino, Neuquén, Argentina. CD, S16.

Martínez, J.C., Dristas, J.A., Massonne, H-J. and Theye, T. (2009). Hydrothermal alteration patterns in Tandilia Ranges, Olavarría area, Argentina. International Lateinamerika-Kolloquium. Abstract, 175-177. Göttingen, Germany.

POSTER 032: ICHNOLOGICAL RESEARCH IN LOWER CRETACEOUS MARGINAL-MARINE FACIES FROM PATAGONIA: OUTCROP STUDIES, SEM EXAMINATIONS, AND PALEONTOLOGICAL/SEDIMENTOLOGICAL INTEGRATION

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During the past few years, the first in-depth ichnological analysis of Lower Cretaceous, marginal-marine facies from the Neuquén basin (Northern Patagonia, Argentina) has been carried out. The Agua de la Mula Member (Agridio Formation) is a mixed carbonate–siliciclastic marine (Spalletti et al. 2001) and marginal-marine (e.g. Pazos et al. 2012) succession. Along with the sedimentological work on this unit, the focus has been made on the study of trace fossils.

Several ichnogenera have been identified (e.g. Fernández et al. 2010; Pazos and Fernández 2010; Fernández and Pazos 2012). The ichnological interpretations enhance the paleodiversity; some inhabitants had not been documented through body fossils. Xiphosurid trackways (Kouphichnium) and dinosaur tracks (Therangospodus) indicate exposure in areas considered basinal facies in paleocoastline reconstruction maps. The scale of the analyses goes from outcrop studies up to SEM examinations. Microbially induced sedimentary structures (MISS) are present in some trace fossil-bearing levels. The presence of microbial mats was confirmed through SEM analyses (Fernández and Pazos 2013). This is an example of the importance of sedimentological-ichnological data integration. The ichnological and sedimentological characteristics found show that:

- The ichnodiversity is greater than shown by previous works. This has consequences on the paleodiversity and ethological information for the unit.
- Microbial mats are a necessary condition for the exceptional preservation of certain traces.
- The inferred paleoenvironment for the top of the unit is shallower than traditionally thought. Trace fossil studies are key for reviewed paleocoastline reconstructions and can be applied in the oil industry as paleobathymetric controls.

Fernández, D.E. and Pazos, P.J. 2012. Ichnology of marginal marine facies of the Agridio Formation (Lower Cretaceous, Neuquén Basin, Argentina) in its type locality. *Ameghiniana*. *Ameghiniana* 49(4), 505-524.

Fernández, D.E. and Pazos, P.J. 2013. Xiphosurid trackways in a Lower Cretaceous tidal flat in Patagonia: Palaeoecological implications and the involvement of microbial mats in trace-fossil preservation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 375, 16-29.

Fernández, D. E., Pazos, P. J. and Aguirre-Urreta, M. B. 2010. *Protovirgularia dichotoma* – *Protovirgularia rugosa*: an example of a compound trace fossil from the Cretaceous (Agridio Formation) of the Neuquén Basin, Argentina. *Ichnos* 17(1), 40-47.

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Pazos, P.J. and Fernández, D.E. 2010. Three-dimensionally integrated trace-fossils from shallow marine deposits in the Lower Cretaceous of the Neuquén Basin: *Hillichnus agrioensis* sp. nov. *Acta Geologica Polonica*, 60 (1), 105-118.

Spalletti, L.A., Poiré, D., Pirrie, D., Matheos, S. and Doyle, P. 2001. Respuesta sedimentológica a cambios en el nivel de base en una secuencia mixta clástica-carbonática del Cretácico de la cuenca Neuquina, Argentina. *Revista de la Sociedad Geológica de España* 14, 57–74.

Sponsored by the Bunge and Born Foundation, and CONICET (Contribution C-65 IDEAN).

TALK 169: CORALLINE RED ALGAE: A PROXY TO MONITOR ENVIRONMENTAL CHANGES

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The eastern Pacific coast of Panama presents two quite different environmental regimes. In the low lands surrounding the Panama Bight, the interaction of the trade winds crossing the Isthmus in south-westerly direction and a strong low-pressure cell over southern Panama leads to a strong seasonal upwelling in the Panama Bight. On the other hand the Talamanca range prevents the trade winds from crossing the isthmus, resulting in reduced upwelling in the Chiriqui Bight and allowing a substantial reef growth. Despite similar seasonal variations in salinity, temperature ranges show distinct differences between these two regions: nearly constant temperatures year round in the Chiriqui Bight and seasonal temperature variations in the Panama Bight.

Coralline red algae are especially abundant in the Gulf of Chiriqui, occurring with different species and growth forms. Variations in the Mg/Ca ratio in coralline red algae have been widely reported to depict changes in temperature of the ambient seawater environment. Growth banding in corallines has been used to calculate and compare growth rates in various environmental settings. Such data is then used as proxy in paleoenvironmental studies.

Corallines with open-branching thalli (*Lithothamnium* sp.) display a distinct banding with light and dense layers. Light bands consist of cells with thin walls and open lumina, whereas dense bands display thicker cell walls and narrow cell lumina. Mg/Ca mapping and EDX analysis along thallus profiles reveal significant differences between open and dense layers.

Lithothamnium sp. from the Gulf of Chiriqui dwells under nearly constant temperatures (annual SST range 27°-29°C; 26°-27°C in 40 m water depth) and strong salinity fluctuations (SST 25-35psu). Differences in Mg/Ca ratio between light bands and dark bands in the Panama species, therefore, suggest a much stronger salinity control of the Mg/Ca thermometer signal than expected.

Geochemical and isotope analysis of coralline algae, in combination with growth studies should provide a more precise determination of the seasonal variations during growth and helping to unravel the evolution of the environmental conditions in the studied areas.

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TALK 146: CROCODILAN TEETH FROM LAKE CHAPALA, JALISCO, SW-MEXICO

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The collection of the Museo de Paleontología de Guadalajara (MPG) contains numerous remnants of crocodylians comprising an osteoderm, and several isolated teeth of crocodylians from a Late Pleistocene fossil site on the shoreline of Lake Chapala about 50 km south of Guadalajara, Jalisco. Most of the teeth if not all are referable to the genus *Crocodylus* because of the strongly serrated carinae. The remains come from different ontogenetic stages and tooth positions. Most of the teeth are shed and thus come from living animals. Those, who bear roots, derive from carcasses. The largest tooth suggests an animal with a total length of 6 to 7 m, which would be consistent with an adult *Crocodylus acutus*. Evidently the crocodylians inhabited Lake Chapala during the Late Pleistocene. According to the distribution of extant crocodylians the annual temperature average in the Lake Chapala area must have been 21° C, with minimum temperatures above 0° C. Today the annual average temperature is 19.9° C (GHCN, 1.594 months between 1934 and 1984).

The remains of crocodylians show the same preservation pattern as most other remains of the late Pleistocene faunal assemblage found around Lake Chapala. The material is fragmented and intensively mineralised, with a dark brown to black stain on bone and enamel. From the erosion states of the crocodylian teeth three taphonomic scenarios are likely:

- 1. not or slightly eroded: fast deposition at or in the lake (autochthonous).
- 2. partially eroded: short distance transportation from a fluvial system (allochthonous deposition), or erosion by oscillating water movement at the shoreline (autochthonous deposition).
- 3. strongly eroded: long transportation or multiple reworked and deposited sediments along the shoreline by changes of the water level (allochthonous).

The geological settlement of the Lake Chapala region is a result of the tectonic developments since the Cretaceous (see Ferrari et al. 2000). In this boundary area between the Sierra Madre Occidental (SMO) to the north, the western Mexican Volcanic Belt (MVB) and the Jalisco Block (JB) to the south, a graben system developed and was filled with Plio-Pleistocene fluvial and lacustrine deposits. Lake Chapala is one of several lakes in the region that represent a widespread intermontane basin system temporarily occupied by lakes in various extents.

Ferrari, L. Pasquarè, G., Venegas-Salgado, S. & Romero-Rios, F. (2000): Geology of the western Mexican Volcanic Belt and adjacent Sierra Madre Occidental and Jalisco Block. – Geological Society of America. Special Paper, 334: 65-83, 8 fig., 2 tab., Boulder.

Global Historical Climatology Network (GHCN), <http://www.worldclimate.com/>.

TALK 144: A LATE MAASTRICHTIAN AIRPORT AT SAN FRANCISCO, COAHUILA, MEXICO

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During the Late Maastrichtian the desert around the hamlet of San Francisco between Monclova and Saltillo was covered by a system of slow flowing shallow rivers and oxbows leading to the deposition of siliclastic sediments. A single silt layer was discovered with ripple marks and patchy remnants of bacterial mats. Likely, this sediment was accumulated in warm and shallow waters full of microbial life which gave the potential for preservation of tracks of all kinds of tetrapods. In this case – with one exception – the visitors to this place were aerial. They used the water rich plains as a kind of an airport. This is suggested by the remnants of these visitors, which mostly comprise footprints and trackways of an exquisite preservation state. Some of the trackways even accumulate to trampling horizons.

Most trackways were produced by small birds. The standard tracks have a diameter of about 65 mm with stout toes and webbing at the base of the toes. A second more rare type of avian trackways is a little more than half the size of the standard one and does not show any webbing. Less abundant are the manus and pes prints of pterosaurs with a maximum estimated wingspan of about three metres. While the manus prints are un-diagnostic, the pes prints show a metatarsal area which is about three times the length of the digital area. Such a pes metatarsus ratio is well documented for Brazilian azhdarchoid pterosaurs. One single footprint with a length of about 200 mm was produced by a theropod, likely a coelurosaur.

Tracksites that combine avian and pterosaurian tracks are exceedingly rare, but have previously been reported from the Wuerhe asphaltite, Early Cretaceous, Xinjiang, and the Lower Cretaceous of Emei County, Sichuan China. From the Maastrichtian no such site is known to date.

Xing, L.D., Lockley, M.G., Klein, H., Zhang J.P., He, Q., Divay J.D., Qi, L.Q. & Jia, C.K. 2013. Dinosaur, bird and pterosaur footprints from the Lower Cretaceous of Wuerhe asphaltite area, Xinjiang, China, with notes on overlapping track relationships. *Palaeworld*, 22 (1/2): 42–51.

TALK 145: THE DINOSAUR DELTA AT LAS AGUILAS, COAHUILA, MEXICO

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The vicinity of the hamlet Porvenir de Jalpa, Coahuila, NE Mexico, particularly the La Aguilas valley some 5 km to the northeast of this village, are exceedingly fossiliferous, not only with respect to invertebrates and plants but also vertebrates such as turtles, crocodiles, and namely dinosaurs, which are documented by trackways and bones. The sediments are siliclastic and belong to the Upper Campanian Cerro del Pueblo Formation. Deposition formed part of a gigantic delta system known as Difunta Group that drained to the east into the ancient Gulf of Mexico and was influenced by repeated marine ingressions. The dinosaur bones and traces are found in intercalating sediments of a deltaic system that drained into the ancient Gulf of Mexico and occur in at least three different layers. The dinosaur bones mostly occur in clusters suggesting that they derive from complete or partial carcasses. Until now it remains unclear if the animals drowned near the embedding place, or were washed in by flood events that carried masses of silty material. The number of dinosaurian bone clusters is impressive. In one section, which is only about 200 metres long and 30 metres wide, at least 15 clusters were located with bones partially weathered out of the sediment.

The vast majority of dinosaur bones is assigned to hadrosauromorphs with a size range from 1 to 12 meters. Theropoda are represented by Tyrannosauridae, Ornithomimosauridae and Dromaeosauridae but are predominantly documented by trackways. To date only a few bones of a weathered out partial skeleton and a hand full of isolated long bone sections are referable to theropods. However, some hadrosaur bones show theropodian bite marks. The lack of callus tissue suggests that the theropods fed on carcasses.

The palaeobiodiversity yet discovered in the Dinosaur Delta at Las Aguilas will allow us to reconstruct an unknown Late Mesozoic ecosystem of the southernmost margin of the Northamerican continent. The site is also unusual in the absence of an alpha predator that inhabited the coastlines and rivers only some 500 km further north: the giant alligatorid *Deinosuchus riograndensis*.

Rivera Sylva, H.E., Rodriguez de la Rosa, R. & Ortiz Mentieda, J.A., 2006. A review of the dinosaurian record from Mexico. In: Vega, F.J., Nyborg, T.G., Carmen Perilliat, M., Montellano Ballesteros, M., Cevallos Ferriz, S.R.S. & Quiros Barroso, S.A. (eds.): 233-249, Springer.

POSTER 012: HYDROCLIMATOLOGICAL CONSTRAINTS FOR WATER SUPPLY TO BOGOTA (COLOMBIA). THE CHINGAZA REGION CASE STUDY

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This poster discusses the interannual climatic variability associated with El Niño-La Niña phenomena in the North-western Andean region, based primarily on La Rotta & Pabón, and Garcia. The study area is located in the high Andean mountain grasslands (páramo) of Colombia, between 2.300 and 3.900 meters above sea level, east of Bogotá.

Weather conditions may considerably vary and, as a result, the availability of runoff. Variations in the quantity of water, in turn, have effect on the environment and hence on the socio-economic activities. A better understanding of the mechanism of such a phenomena will provide a wider basis to manage the water resources, increasingly scarce.

Methodologically, the climatic variability is studied based on air temperature, rain, and discharge.

The main results show that there is a thermal anomaly both in an interseasonal and interannual temporal scale. During El Niño the air temperature raises up to 1.5 centigrades, while during La Niña it drops up to 2.0 centigrades below the average. Accordingly, the discharges are reduced in about twice from the average, particularly at the end of the first year of El Niño, and raise to twice during La Niña.

La Rotta, E., Pabón, D. 2007. Climatic variability and climatic change phenomena and its influence on water resources. LAK-20 poster.

Garcia, R. Pre-El Niño phases in North-western Andes. LAK-20 poster.

TALK 206: DID UPPER CRETACEOUS INTRUSIONS REACTIVATE PRE-CRETACEOUS STRUCTURES AT THE SOUTH ATLANTIC PASSIVE CONTINENTAL MARGIN OF BRAZIL?

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“Passive” continental margins especially of the South Atlantic Ocean are perfect locations to quantify exhumation, rock uplift, and surface uplift rates, model the long-term landscape evolution and provide information on the influence of mantle processes on a longer time scale. Furthermore, these passive margin allow to study the influence of large intrusions on the reactivation of Pre-Intrusion structures.

In Southern Brazil, the Poços de Caldas intrusion (83 Ma) took place in Neoproterozoic para-metamorphic rocks of amphibolite facies, which are deformed and metamorphosed during the Central Brazilian Orogeny (630 Ma – 510 Ma). The compressional deformation caused major N-S trending transform faults, and related perpendicular structures. In the Serra da Mantiqueira and Serra do Mar to the East, these N-S trending transform structures are reactivated at about 120 Ma.

Together with the surrounding Precambrian metamorphic rocks the Poços de Caldas Intrusion forms the Poços de Caldas Plateau reaching elevations between 900 m.a.s.l. and 1300 m.a.s.l. The intrusion covers an area of 800 km². The presentation will provide data and discuss the influence of the large intrusion on Pre-Intrusion structures within the surrounding metamorphic basement.

POSTER 211: ENVIRONMENTAL CHARACTERIZATION OF THE CASCA RIVER: A CONTRIBUTION TO THE ENVIRONMENTAL DIAGNOSIS OF THE UPPER DOCE RIVER BASIN

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The assessment of water quality is a very important factor for the implementation of an efficient management of available water resources. In the present case, the results of investigations in Rio Casca basin, a source river of the upper Rio Doce are presented. The study area is situated in the Eastern part of the Brazilian state of Minas Gerais. Between March and December 2013, water samples were taken at 30 points: two in the rainy season (summer), and one in the dry season (winter). The physical-chemical parameters: pH, dissolved oxygen - OD , oxidation and reduction potential - ORP , total dissolved solids - TDS , conductivity, resistivity , temperature and turbidity were measured in situ. The values of alkalinity, sulfate and chloride were determined by classical chemical methods (titration). The chemical elements were determined by ICP- OES. The coliform bacteria (total and *Escherichia coli*) were analyzed via enzyme -linked immunosorbent assay - Colilert method 24 hours (IDEXX , USA).

The parameters turbidity, conductivity, OD, STD, ORP and sulfate showed higher values during the rainy season. For most chemical elements, higher concentrations resulted in the dry season, which can be explained by the dilution factor of the water. Al, Fe , Mn, Ca, K , Mg , Na, P , S, Si , Sr, and Ba, reflect the lithological conditions (Orthogneiss - Charnockite - Enderbite - Tonalite) in the region. Cu and Ti showed significant variations in some points. It is not yet clear whether this can be attributed to local mineralization or anthropogenic influences.

The levels of fecal coliform bacteria are high, which is explained by the non-treated wastewaters. This is observed especially in the vicinity of villages where the values rise sharply. In these cases, no bigger seasonal variations are observed.

The values for the parameters pH, temperature, OD, conductivity, resistivity, STD, ORP, turbidity, alkalinity, sulfate, chloride are within the legal regulations (limits prescribed by the CONAMA Resolution 357/ 05). This also applies to concentration of the levels of dissolved chemical elements.

The waters of the Rio Casca can be classified in Class 2 - (CONAMA Resolution 357/ 05). To restore a better quality of water and then to obtain it, the control measures should be strengthened.

CONAMA - National Council for the Environment. CONAMA Resolution N°. 357 of 2005. Available at: <<http://www.mma.gov.br>>.

Mapa geológico de Minas Gerais (2003): <http://www.codemig.com.br/uploads/mapag.pdf>

Supported by: UFOP / FAPEMIG / CNPq

POSTER 159: CHARACTERISATION OF AQUATIC HUMIC SUBSTANCES FROM CARAÇA MOUNTAIN RANGE AND SOROCABINHA STREAM/ BRAZIL

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Humic substances (HS) are coloured organic acids derived from the degradation of debris of plants and animals. They are ubiquitous in the environment and can interact with metal ions changing their bioavailability (McDonald et al, 2004). In this way, the study of these substances is needed to understand the influence of these interactions and their role in the environment. About 150 L of water were sampled in 2 points in the region of Caraça Mountain Range (Minas Gerais, Brazil) and in the Sorocabinha Stream (São Paulo, Brazil) in order to characterise the aquatic humic substances (AHS) and understand their behaviour in the studied areas.

The AHS were extracted from the water using DAX-8 resin. The extracts were lyophilised and the material was characterised using infrared (IR) spectroscopy, elemental analysis and thermal analysis (just for Sorocabinha Stream). The IR spectra was recorded using samples in KBr pellets. These pellets were made after weighting about 1 mg of HS and about 99 mg of KBr. Absorption bands characteristic of HS (Stevenson, 1994) were observed in the IR spectrum in the regions of 3435 cm⁻¹ (O-H stretching of carboxyl, phenol, alcohol and water), 2926 cm⁻¹ (aliphatic C-H stretching), 1590 cm⁻¹ (C-O stretching of COO⁻ and aromatic C), 1411 cm⁻¹ (aliphatic C-H bending and COO⁻ asymmetric stretching). The peaks more intense around 1033 cm⁻¹ (related to Si-O) and 3435 cm⁻¹ (O-H stretching in kaolinite) were observed in the samples of Caraça indicating higher content of inorganic material.

The elemental composition of the HS of Sorocabinha Stream was 44.5% of C, 4.5% of H, 50.9% of O and 0.05% of S. The thermal analysis showed that the HS of Sorocabinha have about 42% of inorganic material. The H/C ratio of Sorocabinha was 1.22 and had the highest value considering nearest rivers researched by Goveia et al. (2011). This fact indicated low aromaticity. The O/C ratio was 0.86 that is similar to other rivers in the region. An evaluation of O/C ratio is important because its higher content indicates more content of COOH. Furthermore, oxygenated functional groups are related to the complexation of AHS with metallic ions in environment (Rocha e Rosa, 2003).

Goveia, D.; Rocha, J. C.; Oliveira, L. C. D.; Moraes, L. C. D.; Campos, V. D.; Fraceto, L. F.; Rosa, A. H. 2011. Caracterização estrutural das substâncias húmicas aquáticas extraídas dos rios Itapanhaú e Ribeira de Iguape. *Química Nova*, v. 34, 753-758.

McDonald, S.; Bishop, A. G.; Prenzler, P. D.; Robards, K. 2004. Analytical chemistry of freshwater humic substances. *Analytica Chimica Acta*, v. 527, n. 2, 105-124.

Rocha, J. C.; Rosa, A. H. 2003. Substâncias húmicas aquáticas: interação com espécies metálicas. São Paulo: Editora Unesp, 120p.

Stevenson, F. J. 1994. *Humus Chemistry: Genesis, Composition and Reactions*. New York: John Wiley & Sons, 512p.

Sponsored by FAPESP, FAPEMIG and CNPq (Brazilian Agencies).

POSTER 161: GEOCHEMICAL STUDY OF WATERS IN THE EASTERN OF THE QUADRILÁTERO FERRÍFERO, BRAZIL

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Located in southeast of Brazil, the Quadrilátero Ferrífero (QF) is a geological structure whose shape is similar to a square. It is an important mining area where is found gold, manganese and iron ore deposits (Borba et al. 2003; Roeser & Roeser, 2010). The aim of this work was to characterise geochemically some rivers and small lakes in eastern QF using multivariate analysis. In this way, about 2 L of water were sampled in 10 points in different water bodies in the study area. The parameters dissolved organic carbon (DOC), pH, temperature, conductivity, oxidation reduction potential (ORP), turbidity, resistivity, total dissolved solids, alkalinity, chloride, sulphate and the metals As, Ca, Fe, Mg, and Mn were measured in situ and in laboratory. The results were analysed using multivariate methods.

The results indicate high concentration of As ($57.3 \mu\text{g L}^{-1}$) in a body of water near the city of Mariana. This value is almost 6 times above the limit of $10 \mu\text{g L}^{-1}$ recommended by World Health Organization (WHO) for As in drinking water (WHO, 2011). The highest level of sulphate was found in the Tripuí Stream in the city of Ouro Preto and Rio do Carmo River in the city of Mariana, which also had the highest value for chloride. It indicates anthropogenic contamination. A principal component analysis (PCA) was performed to analyse the data. It was necessary 6 components to explain 99.41% of the data variability and the first and second components explained 66.3% of the variance. The multivariate technique Kohonen neural network was also performed in order to get a better visualisation and an easier interpretation of the results. Furthermore, this technique explains all variability of the data in a two-dimensional space. Both techniques showed similar distribution of the groups formed. From the Kohonen maps, it was observed that the point in Caraça Mountain Range had the lowest pH and one of the highest levels of dissolved organic carbon (DOC). This pH could indicate high levels of fulvic and humic acids. The results also indicate that Ca and Mg have lithological origin because they are related in the Kohonen variable maps. This research revealed characteristics of some water bodies in the QF using two multivariate techniques. It was pointed out some places with higher As concentration and places possibly contaminated by man.

Borba, R. P.; Figueiredo, B. R.; Matschullat, J. 2003. Geochemical distribution of arsenic in waters, sediments and weathered gold mineralized rocks from Iron Quadrangle, Brazil. *Environmental Geology*, v. 44, n. 1, p. 39-52.

Roeser, H. M. P.; Roeser, P. A. 2010. O Quadrilátero Ferrífero - MG, Brasil: Aspectos sobre sua história, seus recursos minerais e problemas ambientais relacionados. *Geonomos*, v. 18, n. 1, p. 34-37.

WHO. 2011. Guidelines for Drinking-water Quality - 4th edition. Available in < http://whqlibdoc.who.int/publications/2011/9789241548151_eng.pdf>. Accessed in January 2014.

Sponsored by FAPESP, FAPEMIG and CNPq (Brazilian Agencies).

TALK 197: THE FIRST SETTLERS ON THE YUCATAN PENÍNSULA, MEXICO, AND RECONSTRUCTION OF REGIONAL PALAEOENVIRONMENTAL CHANGES ACROSS THE PLEISTOCENE-HOLOCENE BOUNDARY

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Information gathered since more than a decade allows us to document eight well preserved human skeletons from submerged caves in Quintana Roo, south Mexico. These human activities are dated between 13 and 9 BP and provide evidence of funeral rituals that took place in special chambers located more than 500 meters from the next entrance to the cave system. The finds are associated with fire sites and a diverse megafaunal assemblage of latest Pleistocene age, most of which is yet unreported.

Here we will highlight the enormous preservational potential of the cenote assemblage with special reference to human settlers and associated fauna, taphonomy and discussion of palaeobiogeographical links with coeval evidence from North and South America.

Within our ongoing research we will assign prehistoric evidence chronostratigraphically, using ¹⁴C and U/Th dating on bones, teeth and charcoal, and we will analyze stalagmites, cave sediments, paleobotanical evidence (pollen, charcoal) for palaeoecological signals. Isotopes and DNA will be analyzed from fossil teeth and bones. With these multidisciplinary sets of data at hand we will be able to model the origin, mobility and environmental context of the first settlers on the Yucatan peninsula.

TALK 119: THE CENTRAL ANDES MARGIN REVISITED – A NEW GRAVITY-INFERRED 3D DENSITY MODEL

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The western margin of the South American subcontinent is caused by subduction related processes and interactions of the oceanic and continental plate. The subduction process leads to high stresses in the lithosphere, which are accommodated by recurrent large earthquakes (e.g. Sobiesiak et al., 2007). A large seismic gap exists in the northernmost area of Chile and southern Peru which is supposed to be one of the last ones at the western margin with high-capacity to provoke an M8 or even larger earthquake. Structural heterogeneities in the forearc lithosphere play a key role in generating large rupture processes and display those areas where high energy release can be expected. Gravity-inferred density models can help to resolve the structure and nature of these heterogeneities within both the overriding and downgoing plate.

Constrained 3D density modelling has been conducted since the last 20 years by members of the MIGRA group. MIGRA stands for “Mediciones de gravedad en los Andes”. Most recently we developed a density model of the southern Central Andes between 74° and 64° W and 19°-24° S using the 3D forward modelling software IGMAS+ (Schaller 2013). The model comprises crust and upper mantle of the downgoing Nazca plate, as well as continental crust and mantle down to a depth of 220 km; the modelling results from fitting the Bouguer anomaly of this region. To a first degree the oceanic and continental Moho interfaces are constraint by Vening-Meinesz isostasy. Crustal bodies and the downgoing slab are constraint by modern earthquake hypocenters which were collected in a local network in the area of Iquique (northern Chile). As part of the interpretation process we compared our results to seismological tomography and found that the structure of the Coastal Cordillera batholiths agrees extremely well with known asperities and seismic gaps.

Another focus was set to the region of the Salar de Atacama basin, which forms a topographic depression. Here, Bouguer anomalies display a substantial gravity high, which is also part of the larger regional Central Andean gravity high (Götze and Krause, 1992). Tomographic studies identified a stronger rheological block in the subjacent lithosphere of the basin. As part of the gravity modelling process three density model alternatives were tested which fit the Bouguer anomaly at the South American continental margin.

Götze, H.-J. and Krause, S. 2002. The Central Andean gravity high, a relic of an old subduction complex? *J. S. Am. Earth Sci.* 14(8), 799-811.

Schaller, T. 2013. Gravity-Inferred 3D density model of the Southern Central Andes. Diploma thesis, Inst. f. Geowissenschaften, Christian Albrechts Universität Kiel, pages 93

Sobiesiak, M., Meyer, U., Schmidt, S., H.-J. Götze, and C.M. Krawczyk (2007), Asperity generating upper crustal sources revealed by b-value and isostatic residual anomaly grids in the area of Antofagasta, Chile, *J. of Geophys. Res.*, Vol. 112, B12308, doi:10.1029/2006JB004796.

POSTER 155: BASEMENT GEOLOGY AND GEOCHEMISTRY OF THE EL CRISTO AND SAN VERÁN HILLS, TANDILIA BELT, RIO DE LA PLATA CRATON

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The southernmost exposures of the Rio de la Plata craton occur over more than 350 km in the NW-SE trending Tandilia belt of central-eastern Argentina. The basement of this belt is Paleoproterozoic in age and composed of igneous and mainly high-grade metamorphic rocks with different degrees of deformation. The area of the El Cristo and San Verán hills, ca. 35 km west of Balcarce, well exposes 24 km² of such rocks being representatives of the three major lithologies of the Tandilia belt.

We present new field-survey results as well as petrographic and geochemical data of amphibole-biotite gneisses, garnet-biotite-bearing migmatites and metamorphosed granites and associated pegmatites. The gneisses exclusively crop out in the northern portion of the study area. Towards the south they change to migmatites. Pegmatite dykes are widespread in the entire area, whereas the main pegmatitic granite forms the structural antiform of the San Verán hill. The NE-SW trending main foliation ($S_1 + S_{\text{mylonite}}$), being subvertical (75-90°) was re-oriented to ENE-WSW by the granite. This granite shows K-feldspar porphyroclasts with core and mantle structure, a fine-grained recrystallized matrix (< 40 vol.%), and quartz crystals with 'chessboard' texture. A recrystallized matrix usually amounts to less than 20 vol.% in the migmatites and < 10 vol.% in the gneisses.

The gneisses are metaluminous to slightly peraluminous with variable contents (wt.%) of SiO₂ (57-67), Fe₂O₃ (7.4-10.3), CaO (2.7-7.6), TiO₂ (0.7-1.0), Na₂O (1.7-2.9) and K₂O (1.3-4.0), whereas mesosomes of migmatites are slightly peraluminous and richer in SiO₂ (71-77), K₂O (0.7-6) and Na₂O (2.0-3.6), but poorer in Fe₂O₃ (1.5-6.0), CaO (0.9-2.9), TiO₂ (0.1-0.4), MgO (0.1-0.60) and P₂O₅ (0.03-0.21). The gneisses are tonalitic to granodioritic. Mesosomes in migmatites are tonalitic, granodioritic, quartz-monzonitic and granitic. The granite also shows granodioritic variations and shares geochemical similarities with the mesosomes of the migmatites. The field survey reveals the occurrence of garnet and sillimanite in some varieties of the granite, indicative of an S-type granitoid.

The REE distribution patterns of gneisses and migmatites prove analogous enrichment in LREE and negative Eu anomalies (Eu/Eu* = 0.4-0.64 and 0.24-0.59, respectively). In addition, the HREE patterns of the migmatites are more variable with depressed values of Yb and Lu. The granites show clearly negative Eu anomalies (Eu/Eu* = 0.22-0.38) and either positive or negative HREE slopes caused by fractionation of plagioclase and garnet, respectively.

With the new geochemical characteristics and field relationships in mind, it is suggested that a progressive partial melting of the gneisses has led to the formation of small slightly peraluminous granitic bodies of pre- to syntectonic nature. The observed microstructures in all rocks indicate ductile deformation, overprinting the migmatization stage, having turned to brittle-deformation at the final stage when the rocks were exhumed.

POSTER 149: MAP-BASED PROBABILISTIC INFINITE SLOPE ANALYSIS OF VOLCANIC ASH SOILS. STUDY CASE: MANSIONES, SAN RAFAEL DE MONTES DE OCA, COSTA RICA

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Stability of natural slopes mainly composed of volcanic ash soils in a region east of San José, Costa Rica, was determined using the software PISA (Haneberg, 2005). The method is based on probabilistic analysis and the infinite slope equation and requires geomorphological and geotechnical data to model the results. The study was supported by geological and mineralogical data and performed as a social benefit project. The results were used by the local government to assess hazard management programs.

The lithologies Lahar Roosevelt (middle Pleistocene), Cenizas Mansiones (Holocene) and Depósitos Cuaternarios (Holocene) were identified. The soil samples were found to contain the minerals albite, allophane (?), anorthite, anorthoclase, augite, cristobalite, quartz, diopside, halloysite, hypersthene, illite, magnetite, iron oxide, plagioclase (labradorite), metahalloysite (?), ferrous calcium magnesium silicates, calcium and aluminum silicates, and volcanic glass. Geotechnically, the volcanic ash soils were classified as (MH), (MI), (MV) and (ME).

Five geomorphological units were defined, according to their origin and using the Van Zuidam (1986) classification: Mansiones landslide, volcanic soils flow, inactive landslides, fluvial valleys, and Recent ash fields. Slope stability was evaluated using PISA, both static and pseudo static and in fully dry and fully saturated soil conditions, in order to represent the best and worst case scenarios, as done by Cole (2013).

Static factor of safety mean (static mean) required a DEM of the area and geotechnical data as entries for PISA, and was run in fully saturated soil conditions for the worst case possible. Seismic probability of sliding was calculated for both fully dry and fully saturated soil, using acceleration values of 0,05 g, 0,1 g, 0,15 g and 0,21 g. Classification of probability ranges was based on the scale of Wang et al. (2008).

Results show that in both static and pseudostatic conditions, landslide probability increases as acceleration value and saturation of the soil is increased. Also, the areas classified as moderate to steep slopes, most of them found in fluvial valleys, inactive and active landslides were defined as unstable by PISA. Fully dry and fully saturated soil conditions are not possible in nature, so real scenarios are expected to lie somewhere between these end members.

Cole, R. A., 2013: Map-based Probabilistic Infinite Slope Analysis of the Stephens Creek Watershed, Portland, Oregon. 76 pp. Portland State Univ. [M.Sc. thesis.]

Haneberg, W.C, 2005: PISA: Probabilistic infinite slope analysis, version 1.0 user manual. 15 pp. Haneberg Geoscience.

van Zuidam, R., 1986: Aerial photo-interpretation in terrain analysis and geomorphologic mapping. 443 pp. Smits Publishers, The Hague.

Wang, H., Wang, G., Wang, S., Sassa, K. & Chen, Y., 2008: Probabilistic modeling of seismically triggered landslides using Monte Carlo simulations. *Landslides*, 5: 387–395. DOI 10.1007/s10346-008-0131-6.

TALK 123: TEMPORAL CHANGES IN MANTLE WEDGE GEOMETRY AND MAGMA GENERATION PROCESSES IN THE CENTRAL ANDES

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Miocene volcanoes in the Central Andes typically overly regionally extensive plateau-forming ignimbrites. These “early” andesites typically form low angle, large-volume (~2.24 km³) volcanic shields with long single lava flows up to 20 km and are succeeded by younger (“late”) and more evolved steep-sided strato-cones that characterize much of the CVZ active volcanic front. Young Pliocene-Quaternary stratovolcanoes (~0.72 km³) are often characterized by amphibole phenocrysts. The transition between these magmatic regimes could be due to (1) a change in the mantle melting regime from decompression (hot and dry?) to flux melting (wet and lower T?), (2) different rates in magma production and effusion, and (3) different P-T-regimes of magma evolution within the crust.

This sequence of distinct magmatic regimes (plateau-ignimbrites, shield andesites and evolved stratovolcanoes) is diachronous during the past 26 Ma of Andean evolution: with age's getting younger from N to S. This suggests control by “deeper” processes guided by the geometry of the slab and the thermal evolution of the upper plate during Andean orogeny. As patterns, timing of events, subduction parameters and magma production rates in the mantle wedge change regionally and temporally during ongoing thickening of the Central Andean crust, the upper plate reacts at any given location individually to these changes according to its thermal state, crustal composition, magmatic history and tectonic stress conditions.

We studied Miocene to modern Central Andean volcanic rocks that represent different ages, petrography, composition, and volcanic style in order to test differences in processes of magma generation. Based on a survey of >4000 chemical analyses (<http://andes.gzg.geo.uni-goettingen.de/>) we selected three representative sample types: (1) most mafic samples (50-55 % SiO₂), (2) intermediate andesites representing 63 % of the data (55-60 % SiO₂), and (3) felsic samples (60-65 % SiO₂), all of which were identified before as important endmember magma type in the Central Andes. Using a range of geothermometers, hygrometers and MELTS modelling we show that the P-T parameters at the time of eruption, for a give composition, remained surprisingly constant through time and throughout the Central Andes (e.g. 974 °C to 984 °C for 2-px thermometry). Moreover, the depth of crystallization of Miocene to Present magmas took place between 9 and 3.5 km throughout Andean history. These observations argue for a general control on magma evolution, such as density and viscosity, that is independent of crustal conditions and subduction geometry. The thickened upper crust not only serves as a chemical filter for mantle wedge magmas but also controls (and synchronizes) P-T conditions of crystallization as recorded in erupted products. Accordingly, any distinct regimes of magma formation in the mantle wege are almost entirely dampened out during the passage through the crust. Only the rate of effusion, and by implication, magma production and upper crustal stress regime remain as primary factors that may have influenced differences between Miocene and Recent magmatic products.

Changes in effusion rate may thus be the only parameter that relates to changing angles and/or convergence rates of the slab. Since only convergence rates changed during the last 26 Ma (Sérbier and Solar, 1991), this parameter likely controls magmatic activity. In southern Peru, Miocene voluminous magmatic activity correlates with high convergence rates, both decreasing in the last 10 Ma (Sérbier and Soler, 1991).

Sérbier, M., Solar, P. 1991. Tectonics and magmatism in the Peruvian Andes from late Oligocene time to the Present. *Geological Society of America* 265, 259–278.

POSTER 212: THE HEIDELBERG GRINDING TOMOGRAPHY LAB: THE POTENTIAL OF HIGH RESOLUTION DIGITAL RECONSTRUCTIONS IN LOW DENSITY CONTRAST SAMPLES

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The digital reconstructions of rock samples presented here are based on the production of sequential high-resolution images (tomograms). This image stack forms the base for a later three-dimensional reconstruction. X-ray Computed Tomography proved to be the most successful method in reconstructing fossil material, but has its limitations in low density difference samples (e.g. calcitic shells in a limestone matrix). Here, we describe a technique that can provide true colour and high-resolution data sets in limestone samples.

The working process starts with orienting the samples in a standard mould and embedding in epoxide resin. Once hardened, the mould can be removed and the block is ready to be polished on a precision surface-grinding machine. After each polishing step, the newly exposed surface is scanned on a customised high-resolution scanner. The method provides a maximum resolution of 2540 dpi (horizontally) and 10 µm (vertically). Sample sizes can vary between 1 mm³ and 15 x 15 x 30 cm³, however, productivity is strongly linked to resolution and sample size, and varies between 5 and 38 tomograms per hour. The main advantages of the method are: fast production of true colour and high resolution tomograms, capability of processing samples of various sizes, as well as simultaneous processing of multiple samples in one block. Other than the three dimensional reconstructions of surface and internal structures in fossils (Pascual-Cebrian et al. 2013), sedimentary structures, fractures and porosity; the outstanding image quality allows further applications such as the quantitative evaluation of palaeobiological entities in dense reefal communities (Hennhöfer et al. 2012), or precise volume based calcite/aronite ratio measurements.

Hennhöfer, D.K., Götz, S. and Mitchell, S.F. 2012: Palaeobiology of a *Biradiolites mooretownensis* rudist lithosome – Seasonality, reproductive cyclicality and population dynamics. *Lethaia* 45, 450-461.

Pascual-Cebrian, E., Hennhöfer, D.K. and Götz, S. 2013. High resolution and true colour grinding tomography of rudist bivalves, exemplified with the taxonomic revision of *Mathesia darderi* (Astre). *Caribbean Journal of Earth Sciences* 45, 35–46.

TALK 142: RECONSTRUCTION OF LATE PLEISTOCENE-EARLY HOLOCENE SEA-LEVEL AND CLIMATE VARIATIONS USING SPELEOTHEMS FROM UNDERWATER CAVES IN QUINTANA ROO, MEXICO – AN OUTLOOK

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The subsurface of the Mexican state of Quintana Roo, located on the northeastern Yucatan peninsula, is known to house one of the largest underwater cave systems in the world. Sinkholes, regionally known as cenotes, and several levels of interconnected caves reach to >150 m depth and formed within thick-bedded shallow water carbonate bedrock of Mio-, Plio-, and Pleistocene age. Most underwater caves investigated here are located at only a few kilometers distance from the Caribbean coastline and are linked with the ocean via an extended system of subterranean conduits. Water level within the caves thus corresponds to sea-level. Since the end of the Wisconsin glaciation, about 18 ka ago, sea-level rose from about 150 m below present, gradually flooding the caves. Modern water levels were reached at about 6 ka BP. In order to reconstruct the environmental history of the Yucatán peninsula, speleothems may represent an independent and highly promising archive for the evaluation of sea-level and climate variations in the region. Stalagmites only grew when the cave floor was dry; they are sensitive to climatic changes and easy to date with the U/Th-excess method. Here we present initial data on 14 speleothems, 5 of which grew during the late Pleistocene. Their ages are plotted against established sea-level curves to identify those stalagmites that stopped growing due to a rising sea-level. Additional samples were collected during a field campaign in December 2013 and are presently being analyzed.

Numerous prehistoric human and animal bones, both articulated and disarticulated, were discovered inside the caves. The oldest human remains have been ¹⁴C-dated to 14,500 CALYBP, challenging the “clovis-first”-theory for the settling of the Americas. In general, however, preservation of collagen in the bone material is bad and the ¹⁴C-isotopic record of the findings doubtful. Recently, however, we retrieved a stalagmite that grew directly onto a human pelvis. By dating the base of this stalagmite with the U/Th-excess method we will determine a minimum age of this human in which organic material is not preserved.

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POSTER 201: MODELING OF MANAGUA´S AQUIFER WITH VISUAL MODFLOW

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The quasitridimensional modular finite difference program for troubleshooting groundwater flow, MODFLOW developed by the USGS (U.S. Geological Service), compiled in the commercial adaptation of Waterloo Hydrogeologic, Inc. It simulates groundwater flow in the aquifer Managua, located in the southern basin of Lake Managua, in order to display and evaluate the proposed conceptual hydrogeologic model. This is a mathematical interactive model of flow, which means that the results were adjusted to fluid lines that approximately coincide with the calculated levels.

The aquifer according to studies performed is divided into three sub basins, the Eastern, Central and Western, the saturated thickness ranges from 100 to 400 m. The classic type multi-layer or is composed of multiple water-bearing formations. The transmissivities were measured as higher than 8500 m² / d with an average of 830 m² / d for the entire East Sub-basin. It is the variable with the highest degree of knowledge in the aquifer. For the most part the aquifer is considered free or groundwater, although located overflowing artesian observed in some deep formations. The recharge was calculated based on the isohyets of 1999, the percentages of infiltration according to the slope and type of material of the aquifer formations in the study area which had been calculated for the Eastern basin for modeling conducted in FLOWPATH, ranging recharge of 500 mm / year to 140 mm / year.

The method was calculated at steady state, using the same static levels of 1999 as the initial condition, and considering the conceptual hydrogeologic model. They analyzed data from 2000, 2003 and 2011. This model is an approximation to the behavior of the system and can be used to predict with sufficient accuracy and long-term impact on groundwater levels of actions planned in resource use. The application of visual modflow is valid.

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P-O. Johansson, C. Scharp, T. Alveteg, A. Choza. Framework for Ground Water Protection.- The Managua System as an example. Reprinted from Ground water, Vol 37. No 2, March-April 1999.

Waterloo Hydrogeologic, Visual Modflow User´s Manual.

Sponsored by DFG travel grants

TALK 111: GIS-BASED ANALYSIS OF GEO-RESOURCES AND GEO-HAZARDS FOR A TROPICAL METROPOLITAN AREA: THE NORTHERN PERIPHERY OF BELO HORIZONTE (MINAS GERAIS, BRAZIL)

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Belo Horizonte is a fast growing city in the state of Minas Gerais in Brazil. Designed at the end of the 19th century as the state capital, it rapidly outgrew the planned urban limits. Today, the metropolitan area is the third largest in Brazil, comprising over 5 Million inhabitants. Especially in the north, the population increases rapidly with an annual rate of 5% due to the new highway that connects the international airport to the city. In this highly dynamic situation, risks and resources controlled by the geological underground have a strong impact on the sustainability of urban development: karstified terrain hosts a potent aquifer that is highly vulnerable to pollution, its protection competes with the exploitation of karst outcrops in profitable limestone quarries and with agriculture on fertile soils near doline bottoms. Increased sealing quickly changes the catchment hydrology and leads to a higher risk of inundation and linear erosion. Especially deeply weathered hills composed of pelitic sediments or granite are often cut by deep gullies. Also pollution of surface water is a large issue and exploitation of sand resources in alluvial plains interferes with land use planning for urban development.

In this context, maps of geo-resources and geo-hazards have been created for an area of 400 km² in the northern periphery of Belo Horizonte using a Geo-Information-System (GIS). After a consistency check between the topographic map (1:25.000) and the geological map (1:50.000), the updated geological information was combined with relief parameters to regionalize pedologic data that are relevant for catchment hydrology and for groundwater protection. As regionalization method, an expert-knowledge based semantic import model was chosen. This method transfers knowledge gained from field and literature studies into a rule based reasoning algorithm that automatically generates maps of the desired output parameters. During this process, the output maps were recursively checked regarding their plausibility and also using images provided by Google Earth.

Among the regionalized parameters are estimates of the depth of highly permeably red topsoil layer, weathering depth, effective field capacity, base saturation, hydromorphic soils, soil erodibility and risk of near surface epikarst. Afterwards, several maps of easily understandable geo-resources and geo-hazards were created. These maps include estimates of the intrinsic vulnerability of the aquifer, the availability of limestone and sand resources, agricultural value, risk of gully erosion and risk of pollution of surface water.

While these maps are designed to be understandable for all stakeholders, their creation process is transparently documented in GIS tools and thus accessible and modifiable for experts. For actual land use planning issues, the GIS can be used to compare the geo-scientific information with maps of infrastructure, social factors, current land use and biotic habitats to detect areas of potential conflicts and help to solve them in an objective way.

Sponsored by the DAAD

TALK 125: CONSTRAINTS ON PRESSURE – TEMPERATURE – TIME PATHS OF CENTRAL ANDEAN MAGMAS

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Silicic magmas erupted as domes that form parts of composite volcanoes Parinacota and Taapaca appear to have similar storage conditions, despite differences in overall volcanic history. At Parinacota, the dome-forming phase lasted only ca. 10 ky and preceded transition to a mafic recharge-dominated regime with two cycles of cone growth separated by sector collapse - the entire history constrained to 52 ka. Taapaca is a much longer-lived, slow-throughput system that has been erupting compositionally uniform dacitic magmas for the last 1.5 Ma.

At Parinacota, we compare results of several pressure-dependent geothermometers: Ti-in-quartz (Huang and Audetat, 2012), Ti-in-zircon (Ferry and Watson 2007), Zr-in-titanite (Hayden et al. 2008), as well as more established two-phase thermometers involving amphibole-plagioclase, two feldspars (Putirka 2008) and Fe-Ti oxides (Ghiorso and Evans, 2008). By assuming coeval near-eutectic crystallization of all phases, and using more thermometry equations than free variables, we simultaneously constrain P, T, and activities of chemical components. The result is a set of curves in P-T space that intersect at the conditions of crystallization. Whereas most geothermometers intersect at 750°C and 3 kbar (in agreement with from the Al-in-hornblende barometer of Schmidt 1992), the Ti-in-quartz and Fe-Ti oxide thermometers are displaced toward lower apparent T (730° and 710°, respectively) at corresponding pressures. This may be due to faster diffusion in these minerals, with consequent partial resetting of their thermal record – and those lower obtained temperatures may reflect eruption rather than crystallization at depth. Calculated P-T conditions for shallow storage are similar at both volcanoes. Magnesio-hastingsite amphibole cores and calcic plagioclases in glomerocrysts point to a deeper and hotter component entering the mixed magmas in both magma systems, however mixing at Parinacota was more pronounced. These results may be indicative of more general density/viscosity control on crystallization depths of dacites in the crust.

U-Th disequilibrium ages determined in the same growth zones as Ti-in-zircon temperatures constrain timing of the thermal history, and indicate protracted near-solidus crystallization and storage at Parinacota. The system was either thermally buffered by crystallization and/or recharge, or solidified crystal mush was rejuvenated several times prior to eruption.

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TALK 004: SEDIMENT AND WATER QUALITY OF THE MIDDLE SÃO FRANCISCO RIVER BETWEEN TRÊS MARIAS AND PIRAPORA AND THE ENVIRONMENTAL IMPLICATIONS

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Introduction: The investigated area is localized in the north-eastern part of Minas Gerais State, between the cities of Três Marias and Pirapora.

The area of the medium to upper São Francisco River was always used intensively by population. The construction of hydroelectric power plants led to an increase of the implantation of heavy industry, agriculture and tourism (IEF, 2005).

Examples are the heavy industry and smelters along the Paraobeba, Rio das Velhas and São Francisco rivers and also the occurrence of charcoal ovens, textile industry and bricks production. With this intensive human influence and the lack of state and federal supervision, the situation escalated to an immense degradation of this region (CPRM, 2003). The overall contamination levels are actually beyond the permitted limits.

The increasing of farming caused a second impact wave over the Cerrado, different in way from the first, but with almost the same results. Big areas were transformed in corn-, soybean-, eucalyptus- and coffee plantations allowing the exposure of large soil surfaces to the atmosphere together with intense fertilizer and agro toxic use.

Activities: Sampling of water and sediments was done beginning from the 1990, near Três Marias Lake, continued at the Zn-foundry and finished (2006 to 2010) by detailed sampling between the Três Marias Lake and the das Velhas River confluence. At all sampling points common physical-chemical parameters were taken. The samples were transported in plastic bags and bottles in cooling boxes to the laboratories in Belo Horizonte.

The water samples were filtered and stabilized by acid to pH 1-2. The sediment samples were dried, sieved and the fine fraction (<0.64 µm) was separated in two portions; one of them was leached with water and the other one with diluted HNO₃ (10%) in a microwave oven. Analytical work was done with by ICP-OES spectroquant Arcos equipment using internal and international standards.

Results: Anomalous element concentrations in sediment and water are clearly connected to human activities, high tenors of Zn, Cd, Pb near the industrial plants Cu, Pb, Hg, \pm Zn in agriculture-influenced samples.

The ion concentration in water samples near industry affected places is higher than from agriculture regions whereas absorbed element concentrations are higher in agricultural regions.

The changes in the concentrations and spectra of the PDE's indicate clearly a change in the primary sources. Together with climatic changes, such as stronger rains, winds and higher temperature changes, the later one increases continuously in intensity and reach.

CPRM, 2003. Projeto São Francisco. 455p.

IEF, 2005. Mapeamento da Cobertura Vegetal e Uso do Solo do Estado de Minas Gerais.

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POSTER 002: MICROPROBE INVESTIGATIONS ON DUST PARTICLES FROM VOTORANTIM'S ZN FOUNDRY AT TRÊS MARIAS, MINAS GERAIS, BRAZIL. - MINERAL PARTICLE DISTRIBUTION AND THEIR CHEMICAL COMPOSITION

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Key words: Metallurgic industry, minerals, heavy metals, air dust, pollution

Introduction: At the surroundings of the city of Três Marias was established a Zn - metallurgic plant during the 20th Century (figure 1). The localization was determined for two reasons, easy and cheap electrical energy by the CEMIG storage lake nearby, and the transport facilities of the Zn ore from the mines of Vazante (Silicate-Zn-Ore) and Morro Agudo (Sulfite-Zn-Ore) together with the transport of the final products.

Both mines are localized in rocks of the Precambrian Bambuí Group, built up by meta-argillites, metamorphosed Ca- and Ca-Mg-carbonates, quartzites and sub-ordinates conglomerates.

The ores are regular transported by trucks from the mines to the metallurgic plant.

The peculiarity of this plant is that there are used silicate and sulfite ore together at a hydrometallurgical process. This point called our interest to investigate the composition of the liberated dust particles and its distribution in the surrounding.

Two field measures campaigns were executed, one in 2006 and one in 2010, using adhesive surfaces sampler for particles >50 -10 μ , and laser sampler for PM 10, 5 and 2.5 (figure 3).

Morphologic evaluation of the particles and the quantification was done by optical microscopy. Electronic microprobe (wdXRF and edXRF) was used for mineralogical determination and heavy element concentrations and distribution in the grains.

Results: Optical microscope investigation shows particles which were from the ores, from the industrial processes together with minerals from the local sediments. A small part is produced by traffic at the road beside and home burning.

The Microprobe results executed on the particles show distinct groups of Zn-minerals like ZnS, Zn-Si-O, Zn-sulfate, ZnO, ZnCO₃ among other together with other sulfates and carbonates.

The "natural" particles are argillites, quartz, salt (NaCl; MgCl₂), subordinately Mg-Ca-carbonates.

From 2008 to 2011 the relation between industrial produced and natural particles changes from (~1:1 to ~1:1).

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POSTER 099: STRUCTURAL STYLE OF THE WESTERN CORDILLERA OF CENTRAL PERU

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The boundary between the Central Peruvian highlands and the Pacific Pedemont region is represented by the SE-NW oriented Western Cordillera. There, sedimentary successions can be divided spatially into two areas, i) a western flank, consisting of marginal Mesozoic Basin, which is affected by a major subsidence, and ii) an eastern flank, that was deposited in a stable platform in during minor subsidence.

In the western flank, stratigraphic units are between Late Jurassic and Quaternary. Older sediments, from base to top, correspond to Oyon Formation, deltaic facies of Goyllarisquizga Group, tidal facies of Pariahuanca Formation, and carbonate deposits of Chulec, Pariatambo, and Jumasha formations. In the other hand, the eastern flank consists of thick Paleozoic successions (Excelsior and Mitu Group), Jurassic series (Pucara Group), and Cretaceous (Goyllarisquizga, Pariahuanca, Chulec, Pariatambo, Jumasha, and Celendín).

Tectonic inversion affected that stratigraphic system and triggered the formation of a foreland basin, containing the Casapalca Group (south area) and Chota Formation (north area). This system as well support the emplacement of large and consecutive volcanic emissions i.e. Sacsacero, Millotingo, Grupo Rímac, Grupo Calipuy, and other deposits, where the name was proposed according to the locality.

Structurally, this stratigraphic system presents folding which is related to a thrust tectonic with well-defined eastward vergence (Romaní 1982; Ángeles 1987). This folding has affected Mesozoic series with strong shearing and tightness (Mégard 1978, Scherrenberg 2008). Another thrust system is developed with westward vergence, affecting Cenozoic volcanic successions. Several along strike faulting that are related to this structural framework correspond in fact to transcurrent faulting. These statements suggest a large transpressive structure along the departments of Ancash, Lima, Junín, Huancavelica and Ayacucho, where it is possible to observe inversion-expulsion of hemigrabens (Huayhuash, Puajanca, and la Viuda). Along western Lima (Lima mountains), structures correspond to fold systems with westward vergence, while toward the eastern side, a classic foreland system with eastward thrusting is interpreted.

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Mégard F., 1978. Estudio Geológico de los Andes del Perú Central. Inst. Geol. Min. y Met. Bol. N° 8. Serie D. Estudios Especiales, 227 pp.

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Scherrenberg, A.F., 2008. Structural framework of mineralization, Marañón Fold-Thrust Belt, Perú. Ph.D. thesis, The University of Queensland, 232 pp.

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Winner of the poster price of the LAK 2014

TALK 198: LATE JURASSIC TO EARLY CRETACEOUS CLIMATIC VARIATIONS IN THE SOUTHERN HEMISPHERE BASED ON MICRO-GLENDONITE FROM CENTRAL CHILE

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The traditional view of a uniformly warm Mesozoic world is strongly challenged during recent times. Based on geochemical proxies, brief cold (icy?) intervals were recently proposed for the late Jurassic to early Cretaceous within a generally warm global palaeoclimate. For the early Cretaceous this interpretation is supported by first occurrences of glendonite, indicating maximum sediment/water temperatures of about 4°C. Glendonite was reported from the Valanginian to lower Hauterivian in several high-latitude localities of the northern hemisphere (Siberia, Spitsbergen, Arctic Canada) and provides strong evidence for at least brief local glaciations during the early Cretaceous. From the southern hemisphere no such record exists. The oldest record of glendonite from the southern hemisphere is from the late Aptian in Australia.

Recent palaeontological studies in central Chile and Mexico provide detailed correlations across the Jurassic - Cretaceous boundary and give evidence for oceanographic and climatic variations during the Tithonian to Valanginian far beyond the polar region of the northern hemisphere. The preliminary results from palynofacies analysis of selected samples from two sections in the Lo Valdés and Cajon del Maipo area in central Chile indicates shallow marine, relatively near-shore shelf environments with a high input of terrestrial-derived organic matter. In sample residues used for palynofacies analysis mineral residues are also preserved, which partially contain microscopic glendonite crystals varying in frequency and size (10's to 100's µm), according to different stratigraphic levels. Glendonites are recorded from the same stratigraphic levels in both sections, clearly supporting the stratigraphical control of glendonite occurrence. In shallow marine shelf environments, as indicated by palynofacies analysis, the occurrence of glendonite indicates very low surface temperatures, unaffected by palaeoceanographical effects of mixing with cold water streams, as frequently seen in deep marine settings. Thus the repeated occurrence of glendonite in the two Chilean sections indicates short periods of cold ocean water temperatures alternating with periods of warmer oceans. Therefore our data indicate that periods of climatic cooling also existed in the latest Jurassic to early Cretaceous of the southern hemisphere.

Ongoing research will focus on the high-resolution analysis of the stratigraphical and regional distribution of micro-glendonite combined with isotope and palynofacies analysis for palaeoenvironmental reconstructions, from central Chile towards Antarctica. This will shed more light into the timing, distribution and intensity of climatic cooling in the late Jurassic to early Cretaceous of the southern hemisphere and improve the understanding of the controlling factors for these climatic variations.

POSTER 109: PALEONTOLOGICAL HERITAGE MANAGEMENT IN NORTHERN BRAZIL: THE TOCANTINS FOSSILIZED FOREST CASE

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Paleontological heritage and paleoconservation are innovative concepts that increasingly gain popularity alongside similar ideas of the “green” agenda. In most countries world-wide, and in Latin-America in particular, the geological and paleontological components of the landscape are not given sufficient visibility as a fundamental asset of natural history (Prosser et al., 2011; Wimbledon, 1996). The World Heritage List and the World Network of Biosphere Reserves include sites like the City of Potosí/Bolivia and the Cordillera Volcánica Central Biosphere Reserve/Costa Rica, respectively, which intensively deal with geologic features. Global Geoparks Network (GGN), supported by UNESCO, provides a platform for cooperation and exchange between experts and practitioners in geological heritage. In Brazil, approximately 64% of the territory is covered by sedimentary basins, which have a high fossiliferous record. The best known fossiliferous areas are located in the Paraná and Parnaíba Basins (Paleozoic-Mesozoic) and in the Araripe Basin (Mesozoic). Brazilian legislation protects all fossils on its territory as a National Heritage. The first legal reference on Brazilian fossil protection was made in 1935 in a Federal Ordinance (FO) which declared fossils as “Natural Notable Heritage”. In 1942, another FO declared fossils “Propriety of the Nation”. Following UNESCO orientations, a FO from 1973 confirmed that the sale of fossils, principally to foreign countries, violates the Brazilian legislation. Subsequently, complementary legislation has been enacted (Jasper, 2010). Despite these legal restrictions, Brazilian fossils are easily found in international markets and Internet sites (Permo-Triassic plant remains from the Parnaíba Basin are amongst the most common). Reasons for this include insufficient control by governmental institutions and the poor conditions of the people living in the surroundings of the fossiliferous areas. Remarkably, in the national market, the fossils are relatively inexpensive, while in the global market they reach considerable prices. So far, Brazil and Uruguay are the only Latin-American countries that have sites in the GGN (Araripe Geopark and Grutas del Palacio Geopark, respectively). Geoparks combine conservation, sustainable development and community involvement. The geopark concept involves e.g. geo-tourism initiatives, which may lead to job creation in local communities. In this context, the application of geopark methodologies in the management of renowned fossiliferous sites from the Tocantins State and other Brazilian areas may constitute a valuable tool towards geological heritage conservation and local sustainable development.

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Wimbledon W.A.P. 1996. Geosites: a new conservation initiative. *Episodes* 19, 87–88.

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POSTER 108: PERMIAN WILDFIRES ON GONDWANA IN SPACE AND TIME AND THE PALAEOBOTANICAL HISTORY OF FIRE

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Fossil charcoal is widely accepted as a direct indicator for the occurrence of palaeo-wildfires (Scott, 2000; 2010) and, in Upper Paleozoic sediments of Euramerica and Cathaysia, reports on such remains are relatively common and (regionally and stratigraphically) more or less homogeneously distributed (Jasper et al., 2013). On the other hand, just a few records have been published for the Late Paleozoic of Gondwana and only recently it has been demonstrated that macroscopic charcoals (and thus fires) were also common on this southern continent (Jasper et al., 2011; 2013). The most important Gondwanan records are predominantly charred gymnospermous wood predominantly connected to coal bearing strata. Charcoal occurrences are spread out in different sequences and also in distinct stratigraphic intervals in the Permian [e.g. Paraná Basin (Sakmarian/Artinskian of Brazil), Karoo Basin (Artinskian of South Africa), Damodar Basin (Lopingian of India) and Wadi Himara (Lopingian of Jordan)]. They range from peri-glacial/post-glacial to warm temperate climatic conditions throughout the Permian. The data obtained from fossil macro- and micro-charcoal are compared to known occurrences of inertinites to support the pyrogenic origin for these coal macerals and to provide an up to date overview on the occurrences of Permian wildfires on Gondwana in space and time.

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Scott, A.C., 2010. Charcoal recognition, taphonomy and uses in palaeoenvironmental analysis. *Palaeogeography, Palaeoclimatology, Palaeoecology* 291, 11–39.

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TALK 112: THE SOUTHERNMOST DINOSAURS OF SOUTH AMERICA

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4: Área de Paleontología, Museo Nacional de Historia Natural, Casilla 787, Santiago, Chile.

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The record of osteological remains of non-avian dinosaurs in Chile is restricted to titanosaurid sauropods from the Late Cretaceous of northern Chile (Rubilar-Rogers et al., 2012), The record of theropods is limited to fragmentary material of Tithonian (Late Jurassic) age from Aysen (Salgado et al., 2008) and of the Late Cretaceous from Pichasca (Rubilar-Rogers et al., 2012). Osteological remains of dinosaurs from the far south of South America are exclusively represented to date by material from the Argentinian Patagonia, including the southernmost record for the group from the Santa Cruz Province (Novas et al., 2004), which is north to the new locality presented in this talk.

During a field-campaign in February 2013 in in the Valle de Las Chinas, northeast from the Torres del Paine National Park, in the northern sector of the Magallanes Region, Ultima Esperanza Province, semi-articulated skeletons of dinosaurs of the Upper Cretaceous period were discovered. Among these remains, the presence of hadrosaurs is now identified based on distinctive features of a dentary fragment and vertebral centra.

Our finding of a locality with abundant dinosaur bones is important as:

- it is presently the southernmost site of non-avian dinosaurs known to exist on the South American continent.
- it includes the first finding of an hadrosaur in Chile.
- it includes the most complete remains of ornithopod dinosaurs in Chile.

The new location allows us to perform paleobiogeographic studies and to understand the distribution of Late Cretaceous dinosaurs, evaluate possible migratory routes across the continent, and discuss possible connections between South America and Antarctica. It will also allow help evaluate the faunal composition of the southernmost dinosaurs during the latest cretaceous of South America. Geological evidence suggests that this site may belong to the latest Maastrichtian, otherwise poorly documented in South America. The site and its fossils have not been studied previously. Our planned research will create new possibilities of developing tourism of special interests in the Magallanes and Chilean Antarctic Region.

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TALK 006: ECONOMIC CONSEQUENCES OF MEGA VOLCANIC ERUPTIONS: A CASE STUDY OF DIAMONDS FROM WEST MINAS GERAIS, BRAZIL

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Diamond occurrences in the Coromandel area, as well as the local geology have been investigated focusing on the surface source which provided the gems. For over 250 years Western Minas Gerais supplied a major amount of Brazil's diamonds and almost all stones over 100 ct came from river gravels of this region, surpassing South African production of stones over 100 ct. Over the past half a century almost all major diamond companies came to this region and discovered hundreds of sterile or non-economic kimberlites and related rocks, but no economic ones. Their withdrawal from the area, leaves the enigma of the original source rock without answers.

The authors selected two case studies (1) Gravels from an abandoned placer on the headwaters of the Santo Antônio do Bonito River, and (2) An Upper Cretaceous, epiclastic deposit of the Mata da Corda Group, 5 km to the NW on a slope of the Santo Inácio River, worked in the past for diamonds. The gravels of both rivers combined provided half of all large Brazilian stones over 100 ct. In the former case the headwater area has been mapped in detail. Only epiclastic sediments of the Mata da Corda Group occur. They should represent the diamond surface source for the river gravels. In the latter case the small mine working the epiclastic material produced three diamonds (total 2 ct). Two of them have been analyzed in detail.

The authors exclude the kimberlites in the region as the principal original source for the diamonds, as already postulated by Barbosa et al. (1970, p.102). They propose that the Mata da Corda Group is the surface source of the diamonds. The huge carbonatite complexes Serra Negra and Salitre lying 50 km to the SE of the study area are considered the primary source for the pyroclastic units of the Mata da Corda Group. They were later mixed with other material to form the epiclastic units. On the Volcanic Explosivity Index scale, these carbonatite complexes belong to category 8 and represent one of the largest supervolcanic explosion-events in Meso/Cenozoic time. The authors calculated the volume of the epiclastics being around 600 km³ or more, about 30 times or more the size of the Krakatoa explosion in 1883. The huge volume of this epiclastic material could be a future target for large scale mining. Since diamonds are "diluted" in such a huge volume, a study of the geology of the epiclastics, mainly the processes and nature that have been responsible for their formation, with emphasis on concentration processes and content of diamonds should be done prior to high investments.

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TALK 164: MANTLE EVOLUTION AT THE MEXICAN MARGIN OF PANGEA: THE ROLE OF CONTINENTAL COLLISION AND ARC PROCESSES AS INFERRED FROM SM-ND ISOTOPES

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The Late Paleozoic to Early Mesozoic tectono-magmatic history of southern Mexico is dominated by arc-related processes related to subduction of paleo-Pacific oceanic lithosphere beneath the western margin of North America. The geodynamic evolution of the Acatlán and Ayú complexes (southern Mexico) involves: (1) intrusion of continental tholeiites during Mississippian back-arc extension; (2) Pennsylvanian–Middle Permian intra-arc transtension leading to mafic–felsic plutonism and pull-apart basin formation; (3) a change from steep to flat subduction during the Middle to Late Triassic coinciding with a hiatus in arc magmatism, and causing local uplift and active shearing; and (4) continued (andesitic) arc-magmatism in the Early Jurassic.

Sm-Nd isotopic data from mantle-derived mafic igneous rocks in the Acatlán and Ayú complexes show a gradual shift of average depleted mantle model ages from ca. 1.2 Ga in the Ordovician to values of ca. 0.7 Ga in the Jurassic. These data indicate the replacement of an old subcontinental lithospheric mantle by a more juvenile, asthenospheric mantle, reflecting mantle delamination as a result of continental collision associated with the formation of Pangea. A superimposed, second-order variation of initial ϵNd values between 350–170 Ma is strongly correlated with the apparent magmatic flux and the style of deformation in the regional continental arc. Similar observations in other Cordilleran arc systems have been attributed to the episodic development and delamination of a dense arc root.

TALK 208: DIE ZENTRALEN ANDEN – WIE EIN GEBIRGE WÄCHST

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In menschlichen Zeitmaßstäben erscheinen Gebirge fast unveränderlich. Geowissenschaftler fragen sich trotzdem schon lange, wie Gebirge wachsen, doch trotz vieler methodischer Fortschritte bleibt die Antwort schwierig. In Gebirgen wird die leichte kontinentale Kruste eingeeengt und verdickt; dadurch „schwimmt“ sie auf dem dichteren Mantel höher auf als Kruste normaler Dicke. Die aufsteigende Kruste wird verstärkt von Erosion angegriffen, welche die typischen schroffen Gebirgsformen schafft. Eine genaue Bilanz des Krustenmaterials und seiner Verlagerungen ist deshalb ein Weg, sich der Geschichte eines Gebirges zu nähern.

Die Zentralen Anden sind ein ungewöhnliches Hochgebirge, das durch Subduktion der ozeanischen Nazca-Platte unter den Westrand Südamerikas entstanden ist. Mit Ausnahme der Schmelzen des magmatischen Bogens, die teilweise aus dem Mantel stammen, bestehen sie ausschließlich aus der kontinentalen Kruste der Oberplatte. Es sollte daher einfacher sein, die Entwicklung des Gebirgskörpers zu verfolgen als in Kollisionsgebirgen, wo eine kontinentale Lithosphäre die andere überfährt. Tatsächlich ist eine Materialbilanz der Kruste auch in den Anden schwierig zu erstellen. Die Vorderkante Südamerikas hat durch sogenannte Subduktionserosion viel Krustenmaterial verloren, dessen endgültiges Schicksal – Anbau an die tiefe Kruste, Abfuhr in den Mantel? - unklar ist. Vor allem von der Ostflanke wird Material abgetragen, das nur teilweise im Vorlandbecken östlich der Anden gefangen wird, teilweise aber über große Flüsse in die Ozeane gelangt. Fehlbeträge in der Materialbilanz zeigen sich vor allem an zwei Stellen: (1) Die tektonische Verkürzung, die zur Krustenverdickung führt, reicht bestenfalls knapp aus, um das gesamte vorhandene Krustenvolumen zu erklären. (2) Bei vorsichtiger Abschätzung aus ergänzten Schichtfolgen entspricht die vom Gebirge abgetragene Materialmenge etwa dem Volumen der Sedimente im Vorlandbecken, nicht aber dem des exportierten Sediments. Direkte Daten zur Erosionstiefe legen ebenfalls nahe, dass viel Material abgetragen wurde. Für den Fehlbetrag (1) gibt es noch keine gute Lösung. Für (2) bietet sich an, mächtige alttertiäre Sedimente in den Anden als Reste eines großen Sedimentbeckens zu deuten, das große Teile der späteren Anden vor deren Aufstieg bedeckte. Die Liefergebiete für seine Füllung müssten im Osten liegen, vermutlich auf dem gehobenen Atlantikrand Brasiliens.

Eine zuverlässige Beschreibung des Zusammenspiels von Verformung, Krustenverdickung, Hebung, Abtragung und Sedimentation wird dadurch erschwert, dass sich die Höhe des wachsenden Gebirges in der geologischen Vergangenheit nur indirekt und mit großen Fehlern fassen lässt. Deshalb liegen die Vorstellungen über den zeitlichen Ablauf der Gebirgshebung weit auseinander und reichen von einem regelmäßigen Wachsen der Anden nach Osten seit 40 Millionen Jahren bis zu einem Emporschießen des zentralandinen Hochplateaus zwischen 10 und 7 Millionen Jahren. Beide Extreme scheinen unzutreffend. Die heutigen Plateauränder zeichnen sich schon seit etwa 35 Millionen Jahren als Hebunggebiete ab. Das Plateau selbst folgt etwas verzögert. Seit etwa 10 Millionen Jahren beginnen die Anden, mit zunehmender Geschwindigkeit den Brasilianischen Schild nach Osten zu überfahren. Dabei wird an die Ostflanke rasch Material angebaut, während sich das Innere des Gebirges kaum mehr deformiert. Die Mechanik dieses kompliziert erscheinenden Ablaufs ist nicht vollständig verstanden.

TALK 174: STRONTIUM ISOTOPES IN ENAMEL COLLECTED FROM PRE-HISTORIC SKELETONS FOUND IN A CAVE SYSTEM IN QUINTANA ROO/MEXICO

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Strontium (Sr) isotope analyses have been established in archaeology as a tool for the investigation of the provenance, migration and mobility of prehistoric humans and animals. We have analysed Sr isotope compositions of enamel of a tooth from a giant megathere sloth and of teeth collected from several human skeletons found in submerged caves of the extensive karstic system between Tulum and Playa del Carmen in the Mexican state of Quintana Roo, Northern Yucatan peninsula (Gonzalez et al., 2013). The data were prepared in order to discuss the relations of Late Pleistocene-Early Holocene animals and of coeval prehistoric humans to the places of discovery of their skeletons. Did they live at the locations where their skeletal remains were found, or did they migrate from distant areas to the cave system of Quintana Roo?

High-precision Sr isotope ratios were determined using cleanroom chemical procedures and a multi-collector thermal ion mass spectrometer (MC-TIMS; e.g. Turck et al., 2014). The present data set shows a narrow variation of the isotope ratios between the different samples. However, the differences are hardly significant on the 95 percent confidence level. The Sr isotope ratios cluster in a range which is rather conform to data reported by Price et al., 2010 for Northern Yucatan. We conclude that the investigated pre-historic humans and the giant megathere sloth lived in the vicinity of the large cave system of Northeastern Yucatan. The tiny variations of the enamel Sr isotope ratios of the human teeth and minor differences to the data of Price et al., 2010 may be due to a seafood component in the diet of the prehistoric individuals.

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POSTER 189: A 2,500 YR HIGH-RESOLUTION PEAT RECORD OF CLIMATIC AND ENVIRONMENTAL CHANGE AS RECORDED IN STABLE ISOTOPE PROXIES FROM *OXYCHLOE* PEAT (NW ARGENTINE ANDES)

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We present first results of a multi-proxy approach for the reconstruction of the Holocene climatic and environmental history based on high-altitude peat records. The study area is located in the high Andes of NW Argentina (Jujuy province). The study site (24° 09' 00.2"S, 66°24' 01.8"W) represents an extended cushion-plant peatland, located at an altitude of 4,350 meters, close to the Tuzgle volcano. High-altitude cushion-plant peatlands are well-suited for paleoecological multi-proxy studies. The advantages of these geoarchives are their comparability with climatic gradients, their high accumulation rates and the high quality of their peat deposits, which ensures precisely radiocarbon-datings.

An 8 m-peat core was extracted by percussion drilling in December 2012. The age depth model is based on 20 AMS dates and reveals the climatic and environmental history of the past 8000 cal years. The dominant peat-accumulating species of the peatland is the Juncaceae *Oxychloe andina*.

We have extracted cellulose from *Oxychloe andina* plant parts separated by sieving at 200 µm from the bulk peat sample. The cellulose extraction is based on an improved method starting with sample bleaching with sodium chlorite and followed by cellulose dissolution with cuprammonium ([Cu(NH₃)₄](OH)₂) solution (CUAM) and re-precipitation by using sulphuric acid (Wissel et al., 2008). This extraction has the advantage compared to conventional methods (e.g. Ménot and Burns, 2001), that contamination of *Oxychloe* cellulose with small amounts of minerogenic matter like silt and clay could be completely excluded. The separated cellulose is highly homogenous and free of inorganic contaminants ensuring isotopic homogeneity when using small sample amounts for isotope measurements (Moschen et al., 2009).

Here we present the results from the first 2.5 m of the 8 m master core, showing oscillations in high-resolution stable ¹⁸O isotopes over the past ~2500 yr.

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TALK 175: TIMING AND RATES OF LONG-TERM LANDSCAPE EVOLUTION IN SOUTHERN ARGENTINA

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The eastern Argentina South Atlantic passive continental margin is distinguished by a very flat topography. Out of the so called Pampean flat two mountain ranges are arising. These mountain ranges, the Sierras Australes and the Sierras Septentrionales, are located in the State of Buenos Aires south of the capital Buenos Aires. North of the Sierras Septentrionales the Salado basin is located. The Sierras Septentrionales and the Sierras Australes are also divided by a smaller intracratonic basin. Further in the South the Colorado basin is located. The Sierras Australes is a variscian fold belt originated by strong phases of metamorphosis, but till now it is unclear by how many tectonic phases the area was influenced (Tomezzoli & Vilas, 1999). It consists of Proterozoic to Paleozoic rocks. The Sierras Septentrionales consists mainly of Precambrian crystalline rocks. The Precambrian sequences are overlain by younger Sediments (Cingolani, 2010). The aim is to understand the long-term landscape evolution of the area by quantifying erosion- and exhumation-rates and by dating ancient rock-uplift-events. Another goal is to find out how the opening of the south atlantic took effect on this region. To fulfill this goal, thermochronological techniques, such as fission-track dating and (U-Th-Sm)/He dating has been applied to samples from the region. Because there was no low- temperature thermochronology done in this area, both techniques were applied on apatites and zircons. Furthermore, numerical modeling of the cooling history has provided the data base for the quantification of the exhumation rates. The data-set shows clusters of different ages which can be linked to tectonic activities during late Paleozoic times. Also the thermokinematic modeling is leading to new insights of the evolution of both mountain ranges and shows patterns of ongoing tectonic processes in this region. Calculated exhumation rates show also varying cooling histories and the influence of tectonics throughout the research area.

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TALK 215: FUNDING OPPORTUNITIES FOR SCIENTIFIC AND TECHNOLOGICAL COOPERATION: THE ROLE OF THE PROJECT MANAGEMENT AGENCY EUROPEAN AND INTERNATIONAL COOPERATION INTERNATIONAL BUREAU OF THE BMBF

Inge Lamberz de Bayas

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The Federal Ministry of Education and Research (BMBF) has commissioned the International Bureau (PT-IB) with providing support to German universities, research institutes and small and medium-sized enterprises exploit the opportunities posed by international networking.

The key responsibility of the International Bureau is to support stable international cooperation in the areas of education and research. In this context, the International Bureau advises German institutions on the subject of international research cooperation and provides financial support for the development of new contacts and collaborations. The International Bureau is also strongly involved in the conception, coordination and planning of BMBF activities aimed at advertising Germany as a key research location.

On behalf of the BMBF, the PT-IB observes and analyses international research and education policy developments. This is a prerequisite for creating and developing cooperation strategies for the international implementation of the Federal Government's High-Tech Strategy and the Internationalization Strategy and for supporting an international benchmarking of German research policy.

TALK 132: NUTRIENT FLUXES IN THE GROUNDWATER AFFECTING THE NORTHERN MANGROVE COAST OF THE PENINSULA YUCATÁN (MÉXICO)

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In the last years a decrease of water quality has been observed in the northern part of Yucatán peninsula, specifically in the region of Merida city. The reason for changes in groundwater quality is the disposal of barely treated or untreated domestic and industrial wastewater into the karstic aquifer (INEGI 2005). This kind of aquifer shows a high vulnerability towards contaminants. The lack of a covering soil layer facilitates the infiltration of contaminants into the groundwater. High groundwater flow velocities transport microbiological and partly toxic substances towards the coast and into the coastal mangroves, for instance, algae growth has been strengthened. These circumstances are worth to be considered, because the drinking water supply of the population of Yucatán is completely based on groundwater (BGS 1995; Graniel et al. 1999).

The urban area of Merida acts as recharge zone, which can be explained by the fact that the city gets its water supply from the surrounding region. In that way, a high amount of used water drains directly, without being channeled and treated, into the aquifer below Merida. The subsoil beneath the city consists mainly of tertiary limestones, strongly affected by karstification (Bonet & Butterlin 1962; López 1979). Through pumping tests in the karstic aquifer, flow velocities of maximum 3800 m d⁻¹ were calculated referring to preferred flow paths. The existence of preferred flow paths is also proofed by tracer tests and borehole camera inspections performed in a test field. Due to such karstified zones with high flow velocities, untreated wastewater of the urban area can reach the coast in a distance of 30 km in around 20 days. Therefore artesian groundwater springs in coastal mangrove zones were sampled: the analyzed groundwater shows, for instance, high concentration of phosphorous (~0.58 mg L⁻¹). The coastal spring discharge accounts 1.2*10⁶ m³ km⁻¹ a⁻¹ and leads to a high phosphorous load of maximal 787 kg km⁻¹ a⁻¹ into the mangrove zone.

A further problem represents the progressive saltwater intrusion. Groundwaters in northwestern areas of Merida have a trend towards Ca-Cl-type and a reductive zone at the freshwater saltwater interface point to an upconing of saltwater from deeper parts of the aquifer into the freshwater level. However, the salinity of groundwaters beneath the main urban area of Merida has decreased compared to the early 1990ies.

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POSTER 171: COASTAL PROGRADATION OF THE NORTH-WESTERN GULF OF MEXICO DURING THE LATE CRETACEOUS

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The Ojinaga Formation crops out along the border between Texas and Chihuahua. It represents the last open marine stage before progradation of the Gulf Coast during the Late Cretaceous. We studied a section South of Sierra Vieja, close to the town of Manuel Ojinaga, Chihuahua, Mexico. The formation consists of clay, siltstone, and marl. Abundant fossils are well-preserved in concretions. The outcrop is especially rich in ammonites, but various bivalves are also present. Upsection, the coarse clastic content increases considerably, representing the progradation of the Late Cretaceous Gulf Coast which can be precisely dated by the ammonites found in the section. At the top, the formation transists into the sandstone of the San Carlos Formation, which represents the near-shore facies. The study provides further insight into the timing and dynamics of the progradation of the Gulf Coast during the Late Cretaceous.

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POSTER 200: AMERICA AFTER THE ICE-MAN AND MEGAFUNA IN THE NEW WORLD, AN EXHIBITION PROJECT

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The settlement of the Americas, the questions of when, from where, how and why humans first entered the Americas is one of the big unsolved questions of natural history, despite the fact that numerous archaeologists, anthropologists, biologists and palaeontologists have been working on this array of questions for decades. However, for many years significant progress in this field of research had been obstructed by the 'Clovis First' hypothesis, or paradigm, ingrained in North American archaeology.

According to this hypothesis, the people associated with the Clovis culture had been the first inhabitants of the Americas. The Clovis people were supposed to have crossed the Beringia land bridge over the Bering Strait from Siberia to Alaska during a period of lowered sea levels after the Last Glacial Maximum, and then made their way southward through an ice-free corridor as the glaciers retreated. Clovis sites have been found in large parts of the contiguous United States, in Mexico, Central America and even in Northern South America. Clovis sites were identified by a characteristic toolkit, the best-known component of which is the Clovis point, a distinctively-shaped, fluted stone spear point, named after the town of Clovis, New Mexico, where the first examples have been recovered in the 1930s. The primary support for the 'Clovis First' hypothesis was that no solid evidence of pre-Clovis human inhabitation had been found in the Americas, although a pre-Clovis inhabitation had been claimed for a number of sites from various parts of the Americas, such as Meadowcroft Rockshelter (Pennsylvania, USA), Buttermilk Creek (Texas, USA), the Valsequillo Basin (Puebla, Mexico), Pedra Furada (Piauí, Brazil), and Monte Verde (Llanquihue, Chile). Despite all the difficulties associated with dating methodologies and their data there is meanwhile unequivocal evidence of a pre-Clovis settlement of the Americas, while the Clovis culture likely originated somewhere in the contiguous United States. During the international Paleoamerican Odyssey conference in Santa Fe, New Mexico, in October 2013, with an attendance of 1,130 experts, the 'Clovis First' hypothesis has finally been declared 'dead'.

Many data indicate that the presence of people in the Americas correlates with a decline in megafaunal populations. As in other parts of the world, a number species of large mammals and birds got extinct in the Americas during the transition from the Pleistocene to the Holocene. According to some palaeontologists this was due to climatic change, while others claim overkill by humans was the cause of this extinction event, or a combination of both, or even an impact event. The immense amount of research that has been done on this question as well as on the settlement of the Americas is largely unknown to the general public in Europe. Therefore, the State Museum of Natural History Karlsruhe (SMNK) is organising a major exhibition on what happened in 'America after the ice', what we know on the settlement of the Americas by humans and what we don't, as well as what we know on the relationship of 'man and megafauna in the New World'. The SMNK is most interested in establishing a contact network for this project and welcomes all forms of participation.

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POSTER 217: WATER SUPPLY ASSESSMENT IN MONTERREY/MEXICO

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In many cities around the world, groundwater is the main source of potable water. In turn, anthropogenic activities discharge large volumes of waste water and industrial effluents. The use of a variety of chemicals and hydrocarbons causes pollution of groundwater supplies and soils (CUSTODIO, 2004).

The drinking water supply for the City of Monterrey urban area consisting of ~4.2 million inhabitants (INEGI, 2010) and with a water demand nearing 18 m³/s is the foremost dominant water supply problem of northeastern Mexico. The current water supply of 12 m³/s is satisfied in equal parts by using surface water and groundwater sources such as aquifers on fractured and karstified limestones and on alluvial deposits. The surficial reservoirs are El Cuchillo Dam, Cerro Prieto Dam and La Boca Dam while the main groundwater resources are: infiltration galleries, wells, and water tunnels (CAPDM, 1990). These sources have to be investigated to satisfy current and future domestic, municipal and industrial water demands of the city and its metropolitan area.

This work is based on an environmental assessment of Monterrey and the drinking water supply challenge using Urban Hydrology and Hydrogeology. This city is characterized by predominantly industrial activities, rapid population growth, extreme weather condition and long droughts. Furthermore, pollution of rivers, pore and fractured aquifers and over-exploitation in the urban area is a result of domestic, municipal and industrial activities, which affects the quality of the surface water and groundwater storage. Currently, there is a supply shortage of more than 6 m³/s. This research project will be based on hydrology, geology, hydrogeology, engineering geology and environmental geology methods. The main goal is to obtain more insight in the current situation and to generate a scope of solutions for the drinking water supply problems of Monterrey.

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TALK 205: LATE CRETACEOUS TERRESTRIAL BIOTA FROM LAS CHINAS-CERRO GUIDO COMPLEX, MAGALLANES REGION, SOUTHERN CHILE: A KEY AREA FOR THE ANTARCTIC-SOUTH AMERICAN BIOGEOGRAPHY

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The Las Chinas-Cerro Guido Complex is located north of the Magallanes Region, southern Chile, and has been visited by scientific expeditions since 1898. Summarizing the results of this previous works, a Late Cretaceous environment (Campanian-Maastrichtian) was reported with a transition of marine to deltaic deposition. The paleoflora was dominated by *Sterculia*, without *Nothofagus*, and the fauna restricted to curculionid insects. As a result of a recent multidisciplinary work, including detailed stratigraphy, satellite analysis, palynology, invertebrate and vertebrate paleozoology, palaeobotany and petrology, the existence of a river delta was established, controlled by tides and three stages of plant assemblages. The upper level contained *Nothofagus* leaf imprints, underlying partially-articulated hadrosaur and other undetermined vertebrate remains. The presence of *Nothofagus*, key genus of the sub Antarctic forests of Chile and Argentina, can be interpreted as strong evidence of Antarctic-Patagonian land bridges during the latest Cretaceous, presence that could be correlated to an overall decline in sea level and a brief cooling event following the Cretaceous greenhouse period. Indeed, this *Nothofagus* record is the oldest in America, and the dinosaurs findings are the southernmost worldwide excluding Antarctica.

We are grateful to the crew of “Estancia Cerro Guido” and the Chilean Antarctic Institute for their logistic support for our field campaigns to this area. Financial support by FONDECYT 11080223 (2009-2011) and the German BMBF (CHL 10A/09) are gratefully acknowledged.

POSTER 170: CRETACEOUS APORRHAIIDAE (GASTROPODA) FROM THE SERGIPE BASIN, NORTHEASTERN BRAZIL

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The Cenomanian–Coniacian Cotinguiba Formation of the Sergipe Basin in northeastern Brazil contains a rich fauna of gastropods and other molluscs. The basin is one of the numerous continental margin basins formed in the late Mesozoic by rifting and separation of the South American and African continents. The marine sedimentary fill of the basin ranges from the Aptian to the Miocene. The extensively exposed Cretaceous part of the succession is composed of highly fossiliferous, predominantly shallow-water carbonates and mudstones, which represent one of the most complete Cretaceous successions of the South Atlantic region.

The gastropod fauna of the Cotinguiba Formation is dominated by the family Aporrhaidae, represented by the genera *Aporrhais* (45 % of the specimens), *Anchura* (22 %), *Piestochilus* (18 %) and *Drepanocheilus* (15 %). Because of the generally poor preservation as internal moulds lacking diagnostic characters, the majority of the taxa are left in open nomenclature. Seven species have been identified: *Aporrhais? dutruegi?* (Coquand, 1862), *Aporrhais? sp.*, *Drepanocheilus? sp. A*, *Drepanocheilus? sp. B*, *Piestochilus? (Cryptorhytis?) bleicheri* (Thomas and Peron in Peron, 1889), *Piestochilus? (Cryptorhytis?) sp.* and *Anchura? sp.* This fauna is similar to coeval Tethyan faunas of the Middle East, North Africa and northern South America (Lexen 2013). The study is based on the collections of P. and S.I. Bengtson from 1971–1972 (Bengtson 1983) and additional material collected by P. Bengtson from 1977 onwards.

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POSTER 041: FRACTURE CHARACTERIZATION ON YACORAITE FM, JUJUY PROVINCE, NORTHWEST ARGENTINA: IMPLICATIONS FOR HYDROCARBON EXPLORATION AND PRODUCTION IN FOLDED AND FRACTURED RESERVOIRS

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The Tres Cruces structure, located in northwest Argentina, is an approximately 20-km-long and 12-km-wide NNE-SSW trending anticline cut by faults that involve Paleozoic basement and Mesozoic-Cenozoic sedimentary cover. Regional-scale seismic lines (Kley et al, 2005), show that Tres Cruces is an Andean pop-up structure formed by foreland-directed faults dipping westward, and newly formed hinterland-directed reverse faults dipping eastward. This structure is located on the western edge of the Eastern Cordillera and the eastern border of the Puna, between two areas with different stratigraphy and Andean structural styles: the Puna, Eastern Cordillera and the Subandean Ranges belong to the fold and thrust belt of the Andean orogen and represent the area of transportation, transition and front, respectively (Seggiario et al., 2008).

The aim of this study is to analyze and interpret the joint system associated with the geometry of the Tres Cruces plunging folds. The Tres Cruces basin sedimentation occurred from the Neocomian to the Paleogene, and further developed into a thrust-bounded syntectonic depression that was filled by up to 5 km of locally derived clastic sediments (Marquillas et al, 2005). The main reservoir in the Tres Cruces structure is a carbonate unit (Yacoraite Formation) that has proven to be gas bearing on test. In addition, other stratigraphic units (Mealla, Maiz Gordo, and Lumbrera formations) have been identified as possible hydrocarbon-bearing zones (secondary reservoirs). A good knowledge of the geometry and kinematics of the anticline is essential to perform volumetric estimations of the reservoir. Understanding the below seismic resolution fracture network, in turn, has a direct impact on the development planning of the hydrocarbon field, given that production strongly depends on the fractures induced permeability anisotropy.

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Sponsored by CONICET.

TALK 021: ANDERSONIAN AND COULOMB STRESSES IN CENTRAL COSTA RICA AND ITS FAULT SLIP TENDENCY POTENTIAL: NEW INSIGHTS INTO THEIR ASSOCIATED SEISMIC HAZARD

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Plate boundary forces acting within the Cocos Plate that is being subducted at a rate of 8.5 to 9.0 cm/year towards N32°E below the Caribbean Plate and the Panama microplate are found responsible for contemporaneous superimposed compressive, wrench and extensive fault patterns in Central Costa Rica. The stress inversion of fault-slip planes and focal mechanisms reveals a prevailing, convergence imposed, N20°-45°E almost horizontal compression, with ellipsoid R values ($R = \sigma_1 - \sigma_2 / \sigma_2 - \sigma_3$) in the range of 0.3 to 0.05 and 0.8 to 0.93 which are responsible for the permutation of σ_2 to σ_3 , and σ_2 to σ_1 , respectively, and that show typical Andersonian configurations with one stress axis vertical or close to it. Coulomb Failure Stress analysis reveals that up to 5 bars (0.5 MPa) of tectonic loading are being imposed on E-W thrusts and on critically oriented conjugate NW and NE trending strike slip faults. Also non optimally oriented structures are potential targets for reactivation even with 2 bars (0.2 MPa) of load. Triggering and interaction with volcanic activity is highly suspected in one documented recent case. When the regional fault population was tested for its slip tendency (t/σ_n) a good correlation with CFS results was found.

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TALK 156: MODERN SEISMOTECTONIC FACIES WITHIN THE COSTA RICA STRESS FACTORY: IMPLICATIONS FOR REACTIVATION AND STRUCTURE SIGNATURE

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We have compiled and analyzed a database of 1735 earthquake focal mechanisms and 26 breakouts from eight oil drillings and used it as input for determination and modelling of the modern stress field of Costa Rica, southern Nicaragua and northern Panamá. Three stress orders of magnitude are identified, the main one trending sub-parallel to the N 22° E convergence trend of the Cocos plate on the Caribbean plate. The second is recognized where the previous approaches the Cordilleras backbones and mayor tectonic accidents where it is reflected towards North while the third one is locally represented by northwest oriented abrupt and sharp contortions. These properties along with local and regional permutations of the stress ellipsoid explain unexpected fault regimes and important neotectonic complications. The breakout interpretation was very useful to constrain the seismic limitations and sampled the upper lithosphere up to 6 km depth and the focal solutions down to 190 km. A fine 3D scenario was generated depicting realistic and more objective seismotectonic limits than the classical proposals by using the World Stress Map regime categories along with the R' tectonic relation (Delvaux, 1995) and the slip sense of every selected nodal plane. In general, the mainland is overlying transtensive-transpressive deformation with isolated small volumes of pure extension and the outer arc, along the strike of the Middle America Trench, depicts pure compression and transpression with outer rise distension. The Back-arc displays a similar stress-strain style.

Only top quality stress tensors, assumed or inferred friction, cohesion and pore pressure were used as input for slip-dilation tendency and fracture stability analysis. The theoretical fault reactivation potential of several well studied active structures responsible for recent destructive earthquakes is herewith presented.

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TALK 185: CLIMATE, NATURAL RESOURCES AND PRE-HISPANIC SOCIETAL DYNAMICS IN THE CENTRAL ANDES

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In pre-hispanic southern Peru, several societies as the Paracas, Nasca, Huari or Tiwanaku represent periods of prosperity under the environmental settings of the warm coastal desert river oases as well as the cold Andean highlands, respectively.

Notably, boom times in the highlands and the coastal desert were systematically out-of-phase. We found that favorable environmental conditions coincided with cultural prosperity, why we tested a concept of climatically determined cultural dynamics, studying the El Niño-Southern Oscillation (ENSO)-system on a regional scale. To explain the obvious spatial contrast we hypothesize a mechanism of moisture supply to the ecosystems which was controlled by the ENSO mode, the associated characteristics of Pacific sea surface temperatures, the mean position of the ITCZ and the South American summer monsoon (SASM). We conclude that pre-hispanic societal dynamics were closely related to and therefore in part triggered by climatic shifts, which are also known from faraway regions of the world.

Mächtle, B. and Eitel, B. 2013: Fragile landscapes, fragile civilizations – how climate determined societies in the pre-Columbian south Peruvian Andes.– *Catena* 103, 62–73, doi:10.1016/j.catena.2012.01.012.

POSTER 188: CRUSTAL EVOLUTION AND METALLOGENY ALONG THE CENTRAL ANDES

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It is important to address both the crustal and metallogenetic evolution in the Central Andes where are located the Giant Porphyry deposits (<10 million metric tons [Mt]-10 billion metric tons [Gt]) as well as Cu, Au (<1Mt->1 Gt). In Peru, Chile, Argentina and Bolivia these topics are studied separately and there are usually specialists related to metallogeny and others to crustal evolution but not both. We will like to show the geologist working in take strategic planning for regional and local exploration in the western margin of South America to consider parallel the crustal evolution and metallogeny as a framework for understanding ore-forming systems.

The results of the work are based on research done over 25 years along the Central Andes, in detailed compilation geochemical and geophysical dates related to the crustal evolution of the Central Andes, compilation of detailed studies of the spatial and temporal distribution of mineral deposits.

Since the Miocene, the Central Andes are composed by different Pb-present isotope crustal domains and each is characterized by different geophysical properties: The Arequipa domain have $^{206}\text{Pb}/^{204}\text{Pb}$ between 16,083 and 18,453, this reflects a Proterozoic mafic eclogite cortical domain. North and south of Arequipa domain are located the Paracas-Antofalla crustal domains with $^{206}\text{Pb}/^{204}\text{Pb} > 18,551$ related to Paleozoic felsic amphibolite cortical domain. To understand the crustal and metallogenetic evolution is important to know the spatial and temporal evolution of ore deposits and their metal occurrences. During the Paleocene (66 Ma to 55 Ma) the Arequipa domain had amphibolite composition and 38 km crust thickness ideal to form magmas with amphibole signature (rich in hydrothermal fluid). Later in the Eocene, the Arequipa crustal domain thickened (45 km) and the basement metamorphosed to eclogite composition, due to the garnet signature during this time the magmatic fluid were barren. In the other hand, north (northern Chile) and south (Las Bambas-Andahuaylas Yauri Batholith) of Arequipa domain during the Eocene have been formed other Giant porphyry Copper cluster deposits because in these zones started the crustal maturation and the basement rocks had amphibolite composition. Other examples, during the Lower Cretaceous (145-105 Ma) the IOCG deposits (Fe-Cu-Au) formed outside of the Arequipa domain, while in the Arequipa domain were located the porphyry deposits (like Tia Maria Cu-Mo) and others. During the Upper Cretaceous (85-66 Ma) have been formed important porphyry deposits into the Arequipa domain, and less outside to the Arequipa Domain.

In summary, since 55 Ma the Arequipa domain thickened and had eclogite rocks as basement and the magmas emplaced and contaminated with such basement had less hydrothermal fluid to form ore-system, but the concentration of metallic element could be increase if the amount of crustal contamination increase in the upper crust (like Chucapaca Au-Ag). Important is that since 55 Ma north and south of the Arequipa domain the basement matured to amphibole composition and the magmas are fertile to form ore deposits.

TALK 066: VOLCANIC AND VOLCANO-SEDIMENTARY SEQUENCES OF THE CASMA GROUP AND ITS ASSOCIATION TO AMMONITES FAUNAS

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Lower Cretaceous rocks of coastal Central Peru (Lima- Ancash) known as Casma Group, displays volcanic and volcano-sedimentary sequences containing an abundant ammonites fauna, that allows assigning to this sequence the Albian-Cenomanian age.

Huacho North recognizable facies of the Casma Group can be observed in Huaura, Atahuanca Punta, Punta Caleta Vidal Gramadal, they contain essentially a lower volcanic sequence and an upper volcanoclastic sequence.

The lower sequence of breccia intervals, pillow lavas and hyaloclastites, which follow stratigraphic descriptions and volcanic facies of Myers(1980) correspond to Punta Gramadal and La Zorra Formations. Between pillow lavas generally there are thin levels of detrital sediments which in some cases are autobrecciation and/or autoclastic materials from rupture and peeling of the outer crust of the pillow lavas, can be observed also syn-sedimentary slumps of different sizes affecting the sedimentary levels interbedded between pillow lavas.

This sequences can distinguish three types of facies: Pillow lavas facies: basaltic lava levels that are arranged as thickening upward sequences of roughly cylindrical layer lava; exhibiting semicircular cross sections that have a concentric or radial inner structure, between pillow lavas there are druses of calcite, prehnite and quartz. Breccia and pillow lava facies: transitional sequences between breccias and pillow lavas; correspond to autobrecciation of lavas, hyaloclastites and/or isolated pillow. Breccia lavas facies: are basaltic breccias sequences that result from the destruction of volcanic levels, usually during volcanic inactivity periods. Intercalated between these thick levels there are thin shale beds displaying synsedimentary deformation formed during distentional stages.

The cephalopod fauna is relatively abundant throughout this volcano-sedimentary sequence, which has allowed a stratigraphic range Albian - Cenomanian. Among these we can mention the following cephalopods *Oxytropidoceras peruvianum* (VON BUCH) *Oxytropidoceras carbonarium* (GABB) *Venezoliceras* sp, *Hamitidae*, *Laymeriella*, *Broncoceras* sp. on the cliffs of Punta Gramadal (Myers 1980 and Guevara 1980), also *Lyelliceras* sp., *Venezoliceras* sp. and *Mortoniceras* sp. in Chancay and Pasamayo.

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POSTER 209: AMMONITES OF THE LATE CRETACEOUS WESTERN GULF OF MEXICO COAST

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Late Cretaceous sediments crop out over wide areas in northern Mexico. The ammonite faunas they yield are widely unexplored, with few exceptions published decades ago (Kummel and Decker 1954; Powell 1963a, 1963b; Wolleben 1967). We describe an assemblage from a new outcrop in central Chihuahua. There, the transition from distal marine to more proximal facies is exposed and can be precisely dated by the associated ammonites. These are assigned to seven genera, with three subgenera, and thus one Upper Cretaceous ammonite biozone. This precise zonation by biostratigraphy provides new insight into the timing and dynamics of the progradation of the Gulf Coast during the Late Cretaceous. In addition, surprising details regarding the faunal composition and its relation to distant biogeographic provinces can be shown.

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TALK 202: SPACE GEODETIC VELOCITIES AT THE NORTHWESTERN CORNER OF SOUTH AMERICA

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The Colombian Geological Survey, formerly INGEOMINAS, initiated in 2007 a research and development project based on space geodesy technology. GEORED, the acronym for “Geodesia: Red de Estudios de Deformación” was adopted for the project “Implementation of the National GPS/GNSS Network for geodynamics”, which takes a multifaceted approach to cataloging and defining the geodynamics of Northwestern South America in order to reduce the associated hazards within a wide plate margin deformation zone. The space geodetic network has two main components: an active network, composed by continuously operating permanent stations; and the passive network, which corresponds to episodic occupation stations conducted in field campaigns. In order to establish the most appropriate locations for the installation of the stations, several discussions within the GEORED group led to a master plan for the distribution of the base permanent GPS/GNSS stations array and specific areas of interest for campaign site construction. The use of previously identified active faults as preferred structures along which stresses are transferred through the deformational area led to the idea of segmentation of the North Andes within Colombia into 20 tectonic sub-blocks. Each of the 20 sub-blocks is expected to have, at least, 3 – 4 permanent GPS/GNSS stations within the block along with construction of campaign sites along the boundaries. 54 permanent installations and more than 260 campaign style constructions have been funded until now. Full implementation of 70 permanent installations and 280 campaign site constructions should be completed by 2014.

All data have been processed with the software GYPSY-OASIS II, developed by the Jet Propulsion Laboratory, JPL, California Institute of Technology. Initial positions of the processing solutions were transformed to the ITRF-2008 Reference Frame. The velocity vectors obtained confirm the oblique subduction of the Nazca Plate and Carnegie aseismic ridge collision processes at the Colombia-Ecuador trench which are assumed to be the mechanism for the transpressional deformation and the “escape” of the North Andes Block (NAB). The North Andes block (NAB) is a hypothesized tectonic block that migrates (escapes) north-northeast relative to a stable South American reference frame. The northernmost vectors in Colombia are indicative of the ongoing collision of the Panama Arc with northwestern Colombia.

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Sponsored by the DAAD

POSTER 194: GEOLOGICAL HERITAGE AND GEO-PARKS: CURRENT SITUATION IN PERU

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The geological heritage of Peru is geo-diverse (in the sense of Carcavilla, et al., 2008), abundant and interesting. However, studies and research related to its enhancement, conservation and protection are incipient. There are many references to geological sites in geological and related sciences literature, and/or related to other activities and interests, such as tourism, ecology and others. Knowledge of the geological heritage of Peru requires initiatives and decisions to identify, take stock (catalog), classify, study and enhance it. The first step is to have adequate laws that as part of a State policy guarantee a legal framework, necessary resources, society's commitment –regions, communities, municipalities, civil society, etc.–and sustainability over time. The geological heritage of Peru is not included in existing laws. Only Natural Protected Areas (ANP), under the responsibility of the National Service for Natural Protected Areas (SERNANP, an agency of the Ministry of Environmental Affairs) indirectly takes into account the protection of our natural heritage, including geological formations, volcanic areas, rock forests, and geological landscapes. Zavala (2011) proposes classifying Peru's geological heritage according to its geomorphological, volcanic, geodynamic, landscape, paleontological and touristic characteristics into natural monuments, natural parks, paleontological monuments and national sanctuaries.

Initial initiatives to enhance the geological heritage of Peru date back to the last decade (Rivas, et al., 2000; Alleman and Benavente, 2002; Rivera, et al., 2002; Zavala and Fidel, 2002), including a round table (Geoparks; enhancement of natural and cultural heritage) during the XV Peruvian Congress of Geology (2010), that proclaimed the Declaration of Cuzco proposing guidelines and policies to conserve Peru's geological heritage. In 2006, the Geology, Mining and Metallurgy Institute of Peru (INGEMMET) launched its Heritage and Geotourism program to study some areas regarded as protected geological and natural areas (APN), and published a series of geo-tourist guides (Marcahuasi, Paracas, Andahua, Huayllay). Since 2011, INGEMMET has included in its research programs the study of geological sites with a view at proposing the Global Geoparks Network the establishment of national geoparks. This will encourage geotourism and the sustainable development of local communities. So far, efforts to study, enhance, conserve and protect Peru's geological heritage are limited to the INGEMMET initiative and isolated efforts from some universities and/or private companies. These isolated efforts lack support of appropriate regulations to ensure their sustainability over time.

A comprehensive assessment of Peru's geological heritage and the possibility to create geoparks must be based on a conceptual analysis (both technical and scientific), stock taking, and a methodological proposal for its enhancement (selection, information, identification, valuation, mapping and management). Our geological heritage and, consequently, geoparks should be included in land use planning, should be prepared as comprehensive projects, and receive cross-disciplinary support from a range of relevant government agencies. Many areas of geological importance will be degraded if they are not comprised in development policies. Existing programs, mainly from INGEMMET, intermittent private efforts (Huamán, 2013) and by the Geological Society of Peru (XVII Congreso Peruano de Geología, 2014), for the enhancement, dissemination and conservation of Peru's geological heritage must be actively supported through immediate laws to ensure their sanctity and sustainability over time. It is also necessary to recruit international organizations (UNESCO, RGG, EGN, ProGEO, etc.), scientific institutions and civil society (regions, municipalities and communities).

Sponsored by the DAAD GOAL alumni network

POSTER 115: THE LATERITIC-BAUXITE PROFILE IN CARAJÁS, PARÁ, BRAZIL

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Bauxites are the main raw materials of aluminum and refractory industry. Brazil is currently the third largest producer of bauxite, also being the country that has the third largest reserves of this ore, of which 97 % are concentrated in the Amazon region. In the Carajás Mineral Province, bauxitic bodies occur associated with the famous lateritic iron reserves of the region. In order to identify the bauxite's bedrock and their relation with iron formations, as well as the genesis of these bauxites, a detailed sampling of the borehole F3-39 - performed aiming the iron ore's evaluation – was realized. 46 samples were collected and described. Selected samples were studied by optical microscopy, XRD, subjected to chemical analysis, and partly by SEM / EDS. The FN3-39, inclined hole (75°) and with 163 m depth, allowed from the base, the recognition of the following horizons: fresh rock substrate (likely bedrock), saprolite, clay horizon, bauxite horizon and ferruginous crust. The substrate is represented by a greenish gray rock, aphanitic, consisting of labradorite, andesine, hornblende, orthoclase, chlorite and quartz, suggesting basalt with superimposed hydrothermal alteration. In the saprolite horizon the relicts of the rock are surrounded by clay matrix consisting of smectite, vermiculite, chlorite and phillipsite. Above the clay horizon is dominated by kaolinite and gibbsite, beside hematite and goethite in smaller proportions. This bauxite horizon reaches up to 15 m thick, consisting of meso- to microcrystalline gibbsite (up to 50 % of Al_2O_3), hematite and goethite. The ferruginous crust on top is reddish, earthy and cavernous dominated by goethite, hematite and gibbsite to a lesser extent, where the contents of Fe_2O_3 are approaching 65 %. The distribution Al and Fe concentrations increase, whereas Si decreases and the complete leaching of Ca, Mg, K and Na reinforce the lateritic evolution and maturation equivalent to formation of bauxites in Amazon.

TALK 088: UPLIFT RATES VERSUS EXHUMATION RATES IN THE NORTHERN ARGENTINE BROKEN FORELAND

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The Argentine broken foreland topography shows evidence of differential surface uplift from S to N with a remarkably topographic step located at 28°SL (Dávila et al., 2012). How fast is the relief growing? The use of longitudinal river profiles to determine uplift rates has demonstrated to be a good quantitative technique (e.g., Roberts and White, 2010). We calculated the uplift velocities of Sierra de Ambato and Sierra de Aconquija (northernmost Argentine broken foreland) using the inverse algorithm derived from the equation $\partial z/\partial x = U(t) - vx^m(\partial z/\partial x)^n + \kappa(\partial^2 y/\partial x^2)$ (Roberts and White, 2010), where v is the advective coefficient of erosion, m and n are positive constants that control the concavity of a river profile, κ is erosional diffusivity. Independent geological studies (low-temperature thermochronology, stratigraphy and structure, Dávila et al., 2012) proposed that the main uplift episode would have occurred at <5 Ma. We determined the best uplift rate solutions from a set of results on the base of the geological constraints. For the Sierra de Ambato the uplift rates are between 0.13-0.4 mm yr⁻¹, whereas for the Sierra de Aconquija the uplift rates vary between 0.6 mm yr⁻¹ -0.2 mm yr⁻¹. Sobel and Strecker (2003), nevertheless, estimated values of exhumation rate between 0.7-1.3 mm yr⁻¹ based on low temperature thermochronology. Exhumation rates are, consequently, almost the double respect to the uplift rates. In a semiarid region, like the Andean foreland system, it would be expected an incomplete exhumation of the mountain range. Then, why erosion (exhumation) is faster than uplift? A plausible explanation might be a slower isostatic recovery of the foreland surface topography that could be related to a less elastic rheological behavior of the crust (viscoelastic or even plastic). We also considered the possibility of sublithospheric and non-isostatic forces affecting such equilibrium (e.g., dynamic topography, Davila and Lithgow-Bertelloni, 2013) pulling the topography down and preventing the generation of relief (as indicated by the uplift from the river profiles).

Dávila, F. M., Gimenez, M., Nobile, J. C. and Martinez, P. M. 2012. The evolution of the high-elevated depocenters of the northern Sierras Pampeanas (ca. 28° SL), Argentine broken foreland, South-Central Andes: the Pipanaco Basin. *Basin Research* 24, 1–22.

Roberts, G. G. and White, N. 2010. Estimating uplift rate histories from river profiles using African examples. *Journal of Geophysical Research*, 115, B02406.

Sobel, E. R. and Strecker, M. R. 2003. Uplift, exhumation and precipitation: tectonic and climatic control of Late Cenozoic landscape evolution in the northern Sierras Pampeanas, Argentina. *Basin Research*, 15, 431–451.

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POSTER 089: K–AR FAULT GOUGE DATING IN NORTHERN ARGENTINE BROKEN FORELAND

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The Argentine northern broken foreland has been the subject of continuous research to determine the uplift and exhumation history of the region. High-elevation mountains have been uplifted by N-S reverse faults resulting from the Andean tectonic compression scenery that disrupted a W-E Miocene foreland basin. We performed K–Ar dating on fault gouge related clay minerals samples (illite) collected along a transect within the Sierra de Ambato. K–Ar ages (3 samples) range from Late Devonian to Late Triassic (~ 360 to 220 Ma) and become older with increasing grain-size (~ 360-311 Ma for 2-1 μm grain size fraction, ~326-286 Ma for 1-0.2 μm and ~291-219 Ma of <0.2 μm). The reverse faults of Sierra de Ambato offset Neogene sedimentary rocks (Aconquija Fm., ~ 9 Ma, Nobile, 2013). Faults affect the basement comprising Paleozoic metamorphic and igneous rocks that have been dated at ~477-470 Ma (migmatization age, Larroverre et al., 2011) to the north of Sierra de Ambato and ~340 Ma (crystallization age, Dalquist et al., 2006) to the south. If we consider all illite grains as associated to fault gouge formation, a long lasting brittle deformation history with a minimum age of ~360 Ma and a last illite forming event at 220 Ma can be interpreted. According to our data, the Neogene reactivation would not have affected the K–Ar system.

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Sponsored by DFG travel grants

TALK 158: CAN CERAMICS BE USED AS POSSIBLE ARCHIVES OF PALEOCLIMATE CHANGE? CERAMIC PETROLOGY AND GEOCHEMISTRY OF PARACAS AND LATE INTERMEDIATE PERIOD, SOUTHERN PERU

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The rise of Pre-Columbian cultures in southern Peru has a first peak with the Paracas culture (800 - 200 B.C.). After this period, aridification increased (rainfall was less than 150 mm/a), and as a consequence settlements shifted eastward into the Andean river valley. The following centuries after the collapse of the Nasca culture (200 - 600 A.D.) were too arid to support larger communities. During the Late Intermediate Period (1000 - 1400 A.D.) monsoonal raining intensity increased again, with rainfall around 150 - 200 mm/a. In this period the settlement bloomed again in the Andean footzone (Mächtle, 2007; Eitel et al., 2005).

The development of Pre-Columbian cultures in southern Peru was closely coupled with the hydrological fluctuations and, thereby, varying water supply in the river oases (Mächtle, 2007). The adaptation of population to regional impacts of global environmental changes was reflected by a shift in settlement patterns. The spatially limited settlement options in the river oases led to population concentrations, and cultural developments. This shift also led to cultural changes, which may be reflected through changes in production techniques and raw material sources of the local manufactured ceramics.

To unravel this linkage, the presented study compares ceramics of the Paracas- and Ica culture (Late Intermediate Period). Various petrological and geochemical analyses like ICP-MS, ICP-ES, XRD and thin sections will be applied (Oestreich, 2012; Faller, 2013). This allows identifying changes in raw material sources and production techniques of ceramics as a possible reaction to climate change.

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POSTER 117: ENVIRONMENTAL QUALITY OF THE CAPARAÓ NATIONAL PARK (ES / MG - BRAZIL): CR AND PB CONCENTRATIONS IN BOTTOM RIVER SEDIMENTS

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The creation of protected areas is currently becoming a major form of government intervention to reduce the damage to biodiversity in the face of environmental degradation caused by society. From this point of view, the Caparaó National Park as a timely territorial unit for a study of the current situation of natural conditions and human activities developed as it may compromise the environmental quality of the park.

Due to the use and occupation of land, the natural environment is submitted to changes that may impair the composition of water courses, sediments and soils. For thus a monitoring quality becomes an important mechanism to evaluate the actual conditions and to plan future actions to ensure the objectives established for the Park to face the intensive use inside the limits and in the surroundings.

Thus the study of sediment and water composition by analytical methods allows for analysis of change result and defines a geochemical signature of local and specific uses in time and space. So it may be possible to identify the importance of anthropogenic influence, climate changes and other natural phenomena due to a cumulative effect occurring in river sediments. Sediments also play an important role in water quality by its ability to retain and release pollutants.

The main objective of this research is to analyze the concentration of potentially toxic elements in bottom sediments samples from rivers of Caparaó National Park (MG - ES), in order to understand and evaluate the correlation with the geoenvironmental characteristics and anthropogenic factors.

Field studies were conducted in the Caparaó Range with a sample collection subjected to particle size analysis, determination of concentrations of selected elements (Mg, Cr, Co, Cu, Cd, Ti, Mn, Ni, Zn, Ba, Pb) and solubilization tests under various conditions (neutral, weak and strong acid, total digestion).

In order to evaluate these results a comparison was established using data of CONAMA Resolution 344/04.

The results show high levels of Cr and Pb for all samples. Cr content is above level II (90mg/kg) in four cases and ranging from 86mg/kg to 119.2mg/kg. Pb-values are distributed between 21mg/kg and 48.97mg/kg, exceeding level I of CONAMA classification.

The distribution of Cr and Pb varies for the Southern and Northern portions of the Eastern edge of the Park. The high Cr and Pb levels in the Southern portion may be related to a higher density of human occupation, intensive agriculture and tourism activities with the largest number of villages in this region.

The obtained results indicate that the quality of sediments and water are compromised, which points to the need for more intensive monitoring and also possible controlling actions of anthropogenic sources to create a proper background values for this area.

POSTER 136: CENOZOIC GROWTH OF THE NORTH PATAGONIAN FOLD AND THRUST BELT BETWEEN 40°-43°SL

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The Oligocene to Present evolution of the North Patagonian Andes is analyzed linking geological and geophysical data in order to decipher the deformational processes that acted through time and relate them to basin formation. Seismic reflection profiles reveal the shallow structure of the retroarc area where contractional structures, associated with Oligocene to early Miocene inverted extensional depocenters (Mancini and Serna, 1989; Giacosa et al., 2005), are partially overlapped by early to late Miocene synorogenic deposits. From the construction of five structural cross sections along the retroarc area between 40° and 43°30'S, constrained by surface, gravity and seismic data, a shortening gradient is observed along Andean strike.

The highest shortening of 18.7 km (15.34%) is determined near to 41°30'S where basement blocks were uplifted in the orogenic front area, and the deepest and broadest synorogenic depocenters were formed towards the foreland. Additionally, eastward shifting of Miocene calc-alkaline rocks occurred at these latitudes, which is interpreted as indicative of a significant change in the subduction parameters at this time. Deep crustal retroarc structure is evaluated through inversion of gravity models that made it possible to infer Moho attenuated zones. These coincide with the occurrence of younger than 5 Ma within-plate volcanics as well as with crustal thermal anomalies suggested by shallowing of the Curie isotherm calculated from magnetic data.

Finally, the analysis of the lithospheric structure, derived from previous density models (Tašárová, 2007), thermal models scaled from S-wave tomographies (Shephard et al., 2012), and 1D S-wave-velocity profiles together with elastic thickness calculations performed in this work, suggest the existence of relatively deeper cold lithospheric roots beneath the North Patagonian massif in the foreland area. Changes in plate convergence since late Oligocene times could have played a significant role favoring the development of a shallow subduction regime in Miocene times next to this lithospheric block, similarly to other settings proposed for other Andean segments.

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Tašárová, Z.A., 2007. Towards understanding the lithospheric structure of the southern Chilean subduction zone (36°S-42°S) and its role in the gravity field. *Geophysical Journal International* 170, 995–1014.

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POSTER 147: FOSSILIFEROUS RICHNESS OF CHIHUAHUA, MEXICO

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With 247,087 km², Chihuahua is the largest state of the Mexican Republic. On its territory 41% of igneous volcanic and intrusive rocks and 52% of alluvial valleys are exposed. The remaining outcrops are of sedimentary rocks, mostly of the Cretaceous System. For many years, this entity has been considered as an important fossil generator in the country. Unfortunately, most collected specimens are illegally exported, others are deposited in private collections, and few are exhibited in museums within and outside the state. Recently, important foreland and hinterland tectonic elements were identified in Chihuahua (Franco-Rubio et al. 2013). They structure the northern Chihuahua, Intermedia, Sabinas and Mexican Sea sedimentary basins and allow us to relate the most important fossil localities to central and eastern foreland elements. The Upper Jurassic La Casita Formation of central foreland contains a pool with almost intact ammonites, some of them reaching 70 cm diameter, only one example for the quality of the fossil preservation from those locations. Biohermal major structures characterize the bottom of the Albian-age Glen Rose, Edwards and Georgetown formations. The epitomized Aurora Reef, located in the stratigraphic type locality of the same name, emphasizes the close relationship between reef facies as a host rock and the mineral deposits of economic value (Naica, Santa Eulalia, San Antonio, Los Lamentos, La Aurora, etc.). These issues differentiate the mining state per excellence of Mexico. Several outcrops with dinosaur bone remains from the El Picacho Formation (Montellano-Ballesteros, 2003) characterize Late Cretaceous terrestrial assemblages. Pleistocene fossil localities contain distinctive large land mammals (mastodonts, horses, cats, etc.), lacustrine diatoms and pollen (Messing, 1986, etc.).

The paleontological wealth in the state of Chihuahua is part of the geological heritage that must be preserved and studied to make it a clear evidence of its history.

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Sponsored by Project no. 167638 Conacyt: Arco magmático pérmico relacionado con la zona de Sutura Ouachita en Chihuahua, México.

TALK 148: THE PALEONTOLOGICAL COLLECTION OF CHIHUAHUA, MEXICO

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Chihuahua is the largest political state of Mexico in its northern border. Its climate is dry, so it is the center for the the most important North American desert environment, the Chihuahuan Desert, which extends for about 520,000 km². Chihuahua owns one of the most complete stratigraphic successions (Proterozoic - Holocene), with twenty five marine units and 7,150 m thickness, fourteen of them with varying clay content and 5,500 m thick. In desert environment and steep topography, marine clays montmorillonite-illite possessing importantly expansion-contraction coefficient, promote the release of abundant fossilized organic remains. Chihuahua exhibits exceptional paleontological natural resources of flora and fauna, easy to recover but little studied, with only very few publications such as Ramirez and Acevedo, 1957; Böse, 1910; Boucot & Johnson, 1964; Brown et al. 2004; Buitrón, 1974; Montellano-Ballesteros, 2003; Oviedo et al. 2012, among others.

The new Paleontological Collection of Chihuahua in the Faculty of Engineering of the Autonomous University of Chihuahua is the first scientific collection in this huge state. It will establish a shelter and safeguard for the existing richness of fossils, but also for their increasing number to be studied by national and foreign specialists, and like that form another center of the study of the Earth History within Mexico.

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Sponsored by Project no. 167638 Conacyt: Arco magmático pérmico relacionado con la zona de Sutura Ouachita en Chihuahua, México. With kind support by the DFG.

POSTER 213: THE USE OF NEUTRON IMAGING AS A NON-DESTRUCTIVE TECHNIQUE IN THE IDENTIFICATION OF EARLY CRETACEOUS ICHTHYOSAURS FROM TORRES DEL PAINE NATIONAL PARK, SOUTHERN CHILE

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46 specimens of fully and partially articulated ichthyosaurs have been discovered during the field campaigns of 2009 and 2010 in Early Cretaceous sediments located adjacent to the Tyndall glacier, in the northwest sector of Torres del Paine National Park in southern Chile. Four of these specimens were excavated and transported to Germany for preparation and documentation. However, the sediment turned out to be harder than the fossil bones and mechanical preparation was hardly possible. Application of hydrochloric and acetic acid methods was also hampered by the exceedingly low carbonate content of the bedrock. Therefore, we opted for the use of neutron imaging techniques as a third option to identify diagnostic morphological elements covered by sediment without destruction. The experiment was performed at the facility Neutra of the Paul Scherrer Institute in Villigen, Switzerland. The sections analyzed show cranial and postcranial features shared with other Tyndall specimens identified as *Platypterygius* von Huene. Here we report on the progress of our taxonomical analysis of the Tyndall ichthyosaurs.

POSTER 022: SOMUN CURA FRESH WATER ISOTOPIC AND CHEMISTRY FEATURES

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Somun Cura Plateau was developed in the centre north of the Argentinean Patagonia. It is a large plateau of 25.000 km² of tertiary basaltic lava flows in a first stage and several post plateau events represented by post plateau events of alkaline composition (Ardolino et al 1999). Located in the provinces of Río Negro and Chubut, has a desert environment with high speed winds from the west, with extreme temperatures day and night and Summer Winter too. Rain regime is extremely limited to Spring and Autumn (100/170 mm).

The hydrology in the plateau is controlled by the morphology and the structures with lagoons sited in depressions developed by wind erosive processes and under washing (piping). Small streams and creeks are also developed, mainly with a structural pattern. Some natural springs are located on the flanks of the plateau with particular features, one the most important features is the temperature, with highest up to 45°C, all of them on the northern area (Parica et al, 2012), meanwhile on the South (Chubut Province), the maximum temperature determined was 22°C. The difference between both areas are interpreted because the residence time inside the basaltic plateau, which would be the source of the temperature, long in the northern, short in the south. As a common feature for the water flow in the plateau, the water provenance is located in the highest areas where snow is deposited.

Water isotopic analyses, $\delta^{18}\text{O}$ and $\delta^2\text{H}$ (made by laser spectroscopy following Lis et al 2008) made on local rainfalls and snowfalls show poor or non evaporation processes, which means fast entrance of water into the fractures system in the plateau, mainly radial with flux between different lava flows.

Piper, Schöller Berkaloff diagrams and RAS index were the tools used for chemistry classification. According Piper Diagram and Schöller-Berkaloff water samples are Na-Ca bicarbonated to chlorinated, with pH between 5 to 8 with 7 as dominant. The RAS index shows samples grouped in c2-s1 and c3-s1. Most of samples are representative of drinkable water; just a few are non drinkable water coming from closed lagoons.

Ardolino A., M. Franchi, M. Remesal y F. Salani, 1999. El volcanismo en la Patagonia extrandina. En *Geología Argentina, Anales* 29. R. Caminos editor. SEGEMAR, Buenos Aires. Pp: 576-612.

Lis, G, Wassenaar, L.I. and Hendry, M.J., 2008. High-Precision Laser Spectroscopy D/H and $^{18}\text{O}/^{16}\text{O}$ measurements of Microliter Natural Water Samples. *Anal. Chem.* 80:287-293.

Parica, C. A., Dapeña, C. Remesal, M.B. y Salani, F.M. 2012. Caracterización química e isotópica del agua en el sector norte de la Meseta de Somun Cura. Río Negro. ICES 8. Resúmenes, Mar del Plata. CD. 2pp.

POSTER 128: APTIAN AMMONITE AND RUDIST ASSOCIATION, COGOLLO FORMATION (GUAJIRA, COLOMBIA): PALEOBIOGEOGRAPHIC SIGNIFICANCE TO NORTHERN COLOMBIA

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Ammonites and rudists of Aptian age were collected from the calcareous Cogollo Formation exposed at the Punta Espada settlement, Alta Guajira, in northern Colombia, near the Venezuelan border.

The ammonite *Dufrenoyia* was collected from a biomicritic and marly interval. Above this level, the rudist *Amphitriscoelus* was found in a biomicritic and biosparitic interval with bivalves in life position, transported or fragmented. Further up in sequence, deformed and flattened ammonites of the genera *Cheloniceras* and *Pseudohaploceras* occur in marlstones.

Dufrenoyia had already been reported from this succession, but the find of *Amphitriscoelus* is the first record from the Cogollo Formation and from Colombia, although Renz had reported rudists in Aptian deposits of this area.

Because of the hardness of the biomicrites and biosparites, grinding techniques were used to obtain 3D reconstructions of the internal structures and external morphology of *Amphitriscoelus*

Amphitriscoelus has been recorded from the Aptian of Mexico, Texas, Cuba, Trinidad, Venezuela, possibly Jamaica and now from northern Colombia, which indicates paleobiogeographic and paleoecological relationships with the Lower Cretaceous Caribbean province. *Amphitriscoelus* may also be present in the Philippines.

Dufrenoyia and *Cheloniceras* indicate an Aptian age for the stratigraphic interval containing *Amphitriscoelus*.

The faunal association shows that the depositional environment during the Cretaceous in northern Colombia was clearly different from that of central Colombia. As a result of the Caribbean and South American plate interaction, the northern part of Colombia is presently being shifted to the east along the Oca and Cuisa strike-slip faults.

POSTER 129: STRATIGRAPHY OF THE LOWER CALCAREOUS MEMBER (VALANGINIAN - HAUTERIVIAN), TIBASOSA FORMATION, TIBASOSA – BOYACÁ (COLOMBIA, S. A.)

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The Tibasosa Formation crops out in central Colombia over the Eastern Cordillera to the NE of Bogotá. The Tibasosa Formation of Renzoni was separated into four intervals: the basal member with conglomerates and sandstones, the lower calcareous members with marlstones and limestones, the intermediate sandstone member and the upper calcareous member with biomicrites, biosparites and black shales. Detailed outcrop studies of the lower calcareous member of the Tibasosa Formation near the little town of Tibasosa (Boyacá – Province), where the type section (Manecuche creek) and locality are found, allowed us to collect the fossil fauna. There, the succession is represented by marlstones, biomicrites, biosparites and poor sandstones with a thickness of 74 m. The fossil occurrence along the Manecuche creek shows the stratigraphic ammonite position of *Neocomites* sp., *Subsaynella boyacaensis*, *Leptoceras* sp., *Pseudofavrella* sp., *P. colombiana* and *Olcostephanus* sp. In addition, the diverse macrofauna of the Tibasosa Formation includes echinoids, gastropods, brachiopods, trigonids, ostreids and other bivalves. Although relatively few brachiopods were recovered (n=15), the shells are typically conjoined and well-preserved. These specimens are here provisionally referred to *Sellithyris* Middlemiss, 1959. Brachiopod species belonging to this taxon in Colombia have previously been recorded exclusively in Valanginian - Hauterivian sediments of the Rosablanca Formation from both Santander and Boyacá Provinces. However, this brachiopod genus ranges from Berriasian to Turonian in age. The ammonite association also supports an upper Valanginian to Hauterivian age for the lower calcareous member of the Tibasosa Formation. In particular, specimens of *Raimondiceras* collected ex-situ in a number of sections of the Tibasosa Formation confirm the existence of Valanginian deposits at the bottom of the lower calcareous member. A previous publication indicates that the Tibasosa Formation represents Hauterivian to Albian age. Others publications related with this lithostratigraphic unit assigned a Valanginian to Albian or Hauterivian ? to Aptian age. Our new biostratigraphic data suggests that the lower calcareous member of Tibasosa Formation range is from the upper Valanginian to the Hauterivian in age. In addition, the occurrence of both Barremian and Aptian ammonites in the upper calcareous member extend its age to the Aptian. The lower stratigraphic position of the basal member and the recent biostratigraphic data of the lower calcareous member could not rejected a Berriasian age for the lowest Tibasosa Formation.

POSTER 130: UPPER LOWER CRETACEOUS DEPOSITS OF SOCO RIVER, DOMINICAN REPUBLIC

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A large, flattened, deformed ammonite has been found in radiolarites of the Arroyo La Yabana Member, Las Guayabas Formation, exposed along the Soco River, northeast of El Seibo in the Eastern Cordillera (Sierra del Seibo), Dominican Republic.

The umbilical width is relative narrow; the principal and secondary ribs are sinusoidal and curved forward between the upper flank and the ventral area. Principal ribs start at the umbilical rim and secondaries at middle flank. Ribbing is fine and dense. Bifurcation of ribs is not recognizable.

The specimen is clearly referable to the Albian subfamily Mojsisovicziinae of the family Brancoceratidae, containing the closely related genera *Oxytropidoceras*, *Benavidesites* and *Venezoliceras*, which are distinguished on account of their tuberculation. However, because of the poor preservation, the presence or absence of tubercles in the Soco River specimen cannot be established.

Upper Cretaceous (Cenomanian–Coniacian) volcano-sedimentary rocks are recognized along the Soco River. Weyl (1966) indicated the existence of Lower Cretaceous in the area, a dating supported by the present find of a mojsisovicziine ammonite. This new biostratigraphical data leads to the following interpretations:

- (1) Lower Cretaceous deposits occur in the area.
- (2) The Arroyo La Yabana radiolarites are not Coniacian–Santonian as previously assumed, or there are different radiolarite levels.

Weyl, R. (1966): Geologie der Antillen, Band 4, Beiträge zur Regionalen Geologie der Erde. Berlin, Gebrüder Bornträger, 410 pp.

POSTER 059: THE GEOLOGICAL-GEOPHYSICAL MODELING OF THE SILENCE ZONE, NORTH MEXICO

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On the boundary between the states of Chihuahua, Durango and Coahuila there is an area that is known as “Silence Zone” whose tectonical environmet, as the rest of North Mexico, is dominated by divergent-margin development related to the opening of the Gulf of Mexico and overprinted by non-igneous Laramide orogenic effects (Pindell et al., 1985). This area combines elements of two tectono-stratigraphic provinces that are highly contrasting between them, the Province of Gulf of Mexico and the Province of Pacific Mexico.

The period of extension occurred during Late Cenozoic (initiated on the Late Eocene-Early Oligocene) caused normal faulting with NNW, NS and NE trending. Some of the faults are listric which have led to the tilting of the stratigraphical secuencias that are subsecuent and contemporaneous to the faulting. As a result of the faulting a process of erosion of the foot walls took place; this was accompanied with the deposition of clastic secuencias. The effect of the fault combined with the deposition of sediments frequently caused the formation of roll-over folds and alluvial fan that represent the progress and time of the event of extension. This process of deformation by extension is believed to continue active in some regions and although it has been inferred that some of the normal faults have more than one period of activity it is unknown if deformation acted continuously or if the faulting developed in discrete pulses.

Exposure patterns in volcanic and sedimentary rocks related with polideformation are located in the study area. Previous geological cartography works suggest this could be caused by a possible structure of the basement that could have been reactivated during the period of extension on the Mid-Late Tertiary.

This paper presents the integral analysis of the gravity and aeromagnetic data recovered from the Silence Zone which combined with the study of the geological features can be used to define the surface structures and blocks of basement in this area. In order to get a deeper understanding of the geological evolution of the study area one of the specific objectives of this work is to establish the possibility of a connection between possible faulting of the basement with the existence of over and simple folding that is affecting the volcanical and sedimental secuencias overlaying it.

Pindell, J. L., 1985, Alleghenion reconstruction and subsequent evolution of the Gulf of Mexico, Bahamas and Proto-Caribbean, *Tectonics*, Vol. 4, No.1, pp. 1-39.

Sponsored by CONACYT Project 129550 “Evolución terciaria de cuencas continentales del norte de México: controles tectónicos heredados, pulsos de deformación, magmatismo y registro bioestratigráfico (continuación proyecto 47071)”.

TALK 151: THE TIMING OF THE COASTAL PROGRADATION IN THE WESTERN GULF OF MEXICO DURING THE LATE CRETACEOUS

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The Ojinaga Formation and the San Carlos Formation are Late Cretaceous Formations deposited in the Chihuahua trough of north-central Mexico.

The Ojinaga Formation comprises marine clastic deposits, mainly mudstone, siltstone and sandstone derived from terrigenous input into the Chihuahua trough. A progradation of terrigenous clastic sediments produced the transition from non-marine to coastal deposits, containing mainly sandstone, which form the overlying San Carlos Formation. The formations represent the transition from offshore sedimentation to a more proximal environment, and thus show the progradation of the coast North-Eastwards during the late Cretaceous. Previous authors determined this transition to have happened during the Campanian.

Two different successions have been analysed in our study, situated in central Chihuahua and at the border to Texas. Both successions contain the transition from the upper Ojinaga Formation into the lowermost San Carlos Formation. The sedimentological analysis of thin sections from both successions and X-ray diffractometry of mudstones and bentonites also from both successions is also presented. Both sections contain the gradual change from marine shale with few siltstones with abundant ammonite fossils to cross stratified sandstones from a more proximal setting. The results of our study show that this transition is diachronous in a surprisingly strong way, supported by biostratigraphic evidence. This sheds new light onto the timing and dynamics of coastal progradation in the western Gulf of Mexico during the Late Cretaceous.

POSTER 152: LOW-TEMPERATURE THERMOCHRONOLOGY, EXHUMATION AND LONG-TERM LANDSCAPE EVOLUTION IN EASTERN ARGENTINA

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To understand the evolution of the passive continental margin in Argentina low temperature thermochronology is an appropriate method, which will lead to new conclusions in this area.

The Tandilia System, also called Sierras Septentrionales, is located south of the Río de la Plata Craton in eastern Argentina in the state of Buenos Aires. North of the hills Salado basin is located whereas the Claromecó basin is situated south of the mountain range. In contrary to most basins along the southamerican passive continental margin the Tandilia-System and the neighbouring basins trend perpendicular to the coast line. The topography is fairly flat with altitudes of. The igneous-metamorphic basement is pre-proterozoic in age and build up of mainly granitic-tonalitic gneisses, migmatites, amphibolites, some ultramafic rocks and granitoid plutons it is overlain by a series of Neoproterozoic to early Paleozoic sediments (Cingolani, 2010), like siliciclastics, dolostones, shales and limestones (Demoulin et al., 2005).

The aim of the study is to quantify the long-term landscape evolution of the passive continental margin in eastern Argentina in terms of thermal history, exhumation and tectonic activities.

For that purpose, samples were taken from the Sierra Septentrionales and analyzed with the apatite fission-track method. Further 2-D thermokinematic modeling was conducted with the computer code HeFTy (Ketcham, 2005; Ketcham 2007; Ketcham et al., 2009).

The results indicate apatite fission track ages between 101.6 (9.4) to 228.9 (22.3) Ma, what means all measured ages are younger as their formation age. That shows all samples have been reset. Six samples accomplished enough confined tracks and were used to test geological t-T models against the AFT data set. These models give a more detailed insight on the cooling history and tectonic activities in the research area.

Cingolani C. A. (2010): The Tandilia System of Argentina as a southern extension of the Río de la Plata craton: an overview. *Int. J. Earth Sci. (Geol. Rundsch.)* (2011) 100:221-242, doi 10.1007/s00531-010-0611-5.

Demoulin, A., Zarate, M., Rabassa, J.; (2005) Longterm landscape development: a perspective from the southern Buenos Aires ranges of east central Argentina; *Journal of South American Earth Sciences*, Vol. 19, pp. 193–204.

Ketcham, R. A. (2005): Forward and inverse modeling of low-temperature thermochronometry data, in *Low-Temperature Thermochronology: Techniques, Interpretations, and Applications*, edited by P. W. Reiners and T. A. Ehlers, pp. 275-314, Mineralogical Society of America/Geochemical Society, Chantilly, Virginia.

Ketcham, R. A., et al. (2007): Improved modeling of fission-track annealing in apatite, *American Mineralogist*, 92, 789-798.

Ketcham, R. A., Donelick, R. A., Balestrieri, M. L., Zattin, M. (2009): Reproducibility of apatite fission-track length data and thermal history reconstruction, *Earth and Planetary Science Letters* 284 (2009), 504–515.

TALK 107: CLAROMECÓ BASIN EVOLUTION AND VENTANA RANGES DEFORMATION (BUENOS AIRES PROVINCE, ARGENTINA): FLEXURAL, MAGNETIC AND GRAVIMETRIC MODELS

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The evolution of Claromecó Basin and the deformation that generated Ventana Ranges have been studied and analyzed by different authors. While the infill of Claromecó Basin is of Cambrian-Early Permian age, the deformation that elevated Ventana Ranges took place only during the Devonian or the Early-Middle Permian. Such deformation and the evolution of Claromecó Basin have been closely related to the origin of Patagonia. Recent studies would indicate that the Northern Patagonian Massif was a part of South America since the Early Paleozoic. In this context, it is extremely important to know the evolution of the Claromecó Basin and to evaluate possible mechanisms of subsidence, which could allow creating the necessary accommodation space for the sediments that fill in the basin.

In this work, an analysis was carried out through the development of: a) 2D isostatic flexural models applying the software tAo and b) 3D magnetic and gravity models. The obtained results indicate that the initial evolution of Claromecó Basin would have been associated to the existence of a rift stage during 531-524 Ma, however, basin subsidence would have been fundamentally dominated by a process of dynamic topography till at least the Devonian or the Early Permian. Only from the Devonian or the Early-Middle Permian onwards, the evolution of Claromecó Basin would have entered in a foreland stage, related to the deformation and elevation and the corresponding surface load of Ventana Ranges. During this last period of time, only approximately 1500 m of sediments would have been deposited, corresponding to Tunas Fm.

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POSTER 020: 1961-2013 VARIATION OF THE GLACIER AREA AT NEVADO DEL HUILA VOLCANO (COLOMBIA), AND EFFECTS ON THE GLACIER DUE TO THE ERUPTIVE ACTIVITY BETWEEN 2007 AND 2010

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Colombian Geological Survey, Volcanological and Seismological Observatory of Popayán.

Using remote sensing images, as aerial photographs from 1961 to 1995 (Pulgarín et al 1996) and satellite images from 1976 to 2013, the glacier mass areas of Nevado del Huila volcano (Colombia, 2.9 N, 76.1 W, 5364 masl) were delineated in order to analyze their areal glacier receding due to both global climate change and local effects of the volcanic activity occurred between 2007 and 2010, including two phreatic eruptions in 2007, a phreatomagmatic eruption in 2008 (all of them generated lahars, that were increasing their volumes: < 5 million m³, 75 million m³ and 400 million m³) (Pulgarín et al 2009), ash emissions and an extrusion process (located on the southwestern flank of Central Peak) occurred between 2008 and 2010, which was characterized by the development of two lava domes, one next to the other, with a volume close to 150 million m³ (Manzo et al., 2011) (with an approximate mass of 375 million tons). The growth process of the domes was not thermally efficient in order to melt ice-snow, since the stream flows that head in the glacier of this volcano were not greatly affected by this phenomenon. Analysis of glacier areas in different years shows a general loss: 18.8 km² in 1961, 18.1 km² in 1970, 14.6 km² in 1989, 13.3 km² in 1995, 10.5 km² in 2007 (before the first eruption), 9.8 km² in 2009 and near to 9.0 km² in 2013. Morphological changes on glacier mass were very noticeable, mainly during the period when the eruptions, felt seismicity and ash emissions occurred, generating large scale fractures on the glacier with abundance of gas fountains, ice-snow melting channels, systems of cracking, stepping and tilting on ice surfaces, small snow avalanches and intercalated layers of snow and volcanic ash.

Pulgarín, B., Jordan, E. & Linder, W, 1996. Nevado del Huila (Colombia): Cambio glaciar entre 1961 y 1995. In: Memorias VII Congreso Colombiano de Geología. Tomo I, Ingeominas, Santafé de Bogotá, pp 440–451.

Pulgarín, B., Cardona, C., Agudelo, A., Santacoloma, C., Monsalve, M., Calvache, M., Murcia, H., Ibáñez, D., García, J., Murcia, C., Cuellar, M., Ordóñez, M., Medina, E., Balanta, R., Calderón, Y. & Leiva, O., 2009. Erupciones históricas recientes del volcán Nevado del Huila, cambios morfológicos y lahares asociados. INGEOMINAS. In: Resúmenes XIII Congreso Colombiano de Geología y XIV Congreso Latinoamericano de Geología. Medellín.

Manzo, O., Santacoloma, C. & Laverde, C., 2011. Análisis de cambios superficiales asociados a la actividad eruptiva en el volcán Nevado del Huila entre 2007 y 2010. INGEOMINAS. In: Resúmenes XIII Congreso Colombiano de Geología y XIV Congreso Latinoamericano de Geología. Medellín.

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TALK 008: GENETIC RELATIONSHIPS OF GONDWANAN CARBONIFEROUS ARC MAGMATISM IN NE MEXICO

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The geology of Northeastern Mexico is dominated by thick Mesozoic and Cenozoic deformed sedimentary sequences. However, magmatic events of very different ages are present in the lithological record: the protoliths of the Grenvillian Novillo Gneiss, late Precambrian basic dykes, lavas and pyroclastica from Carboniferous Granjeno Schist, Carboniferous acid magmas, Permian pyroclastica in Guacamaya Fm., Jurassic Arc volcanics from La Boca Fm., altered distal pyroclastica in Upper Cretaceous San Felipe Fm., and finally the Tertiary Alkaline Province.

Unmetamorphosed Mississippian to Pennsylvanian plutonics and volcanics crop out in the basement of the Sierra Madre Oriental, near Ciudad Victoria. The former are described as “Tonalita Peregrina” (De León Barragán, 2012), and were dated by Dowe (2005) with 351 ± 54 Ma (U-Pb in zircons) and 313 ± 7 Ma (Ar^{40}/Ar^{39} in muscovites). The latter are defined as “Riolita Aserradero” by Gursky & Ramírez (1986) and dated by Stewart et al. (1999) with 334 ± 39 Ma (U-Pb in zircons). Both units have an arc affinity and are interpreted as direct product of the subduction of the Paleopacific Plate along the Northwestern Gondwana border, as known from other Late Paleozoic and Lower Mesozoic complexes in Southern Mexico, Middle, and South America.

The first hypothesis pointed out to a common origin of both units: plutonic roots and their volcanic equivalents of nearly the same age. However, the geochemical comparison of both arc related units shows that they are not genetically related, and are interpreted as originated from partial fusion of different crustal units.

The tectonic processes along the Pacific border of Mexico during different times played and still play a major role in the regional geological development.

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POSTER 133: CERRO CORONA ⁸⁷SR/⁸⁶SR RATIOS, HIGH RANGE OF SOMÚN CURÁ, EXTRA ANDEAN PATAGONIA

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Cerro Corona fits a shield volcano in the “Alta Sierra de Somún Curá” (High Range of Somún Curá), the bimodal complex of youngest relative age in the Magmatic Province of Somún Curá. Its activity, mainly effusive, is represented by alkaline, basaltic, trachyandesitic-basaltic and trachytic lava flows, with a discontinuity of 2% in SiO₂ between both groups. According the geochemistry analyses, the most compositional extremes are cogenetic. The geochemical modelling reveals that the trachytic magmas would be the consequence of fractional crystallization of trachyandesitic-basaltic liquids through a high degree of fractionation (~70%) of clinopyroxene, Fe and Ti oxides, plagioclase and apatite. The alkaline feldspar should be fractionated into a late stage of the evolution of the system together with the biotite, engaging the important role in the differentiation of most evolved trachytes. Furthermore, the presence of quite a lot of disequilibria textures, mainly in the phenocrysts of the trachytic rocks, is evidence of changes in the physical conditions in the magmatic reservoir, which suggests the influence of the emplacement of hottest magmas in the base of it with or without recharge (Maro and Remesal, 2012). The trachyandesitic-basaltic lavas building the main structure of the Cerro Corona are aphyric of intersertal texture composed by plagioclase, olivine, clinopyroxene and opaque minerals. They are characterized by high SiO₂ (>50%) and low MgO (≈4%). The most differentiated rocks are porphyric with high content of anorthoclase, clinopyroxene, olivine, plagioclase, biotite and apatite. They have: SiO₂ >57% and Mg <2%. An aphyric basalt, younger, according the stratigraphy on the northern side of the hill, has lesser SiO₂ (≈49%) and higher MgO (≈6%). The samples belonging to a trachybasalt at the main body of the volcano and two trachytes (from the top and lavas on the northern side) have isotopic ratios for Sr of 0.70447, 0.70470 and 0.70460 respectively. On other hand the ⁸⁷Sr/⁸⁶Sr initial ratio from a younger basalt is an unusual high value (0.7151). Otherwise the analytical results are preliminar, the low contents of Sr (<400 ppm) could support the hypothesis of a contamination process with crust materials with high radiogenic Sr.

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TALK 139: UPPER-CRUSTAL KINEMATICS OF CONTINENTAL PLATEAU FORMATION IN THE SOUTHERN CENTRAL ANDES INFERRED FROM FAULT-SLIP ANALYSIS

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Elucidating the tectono-morphologic evolution of the Central Andes is important for understanding the mechanical behavior of non-collisional orogens at convergent plate boundaries. Fault-kinematic data from the southern Central Andes are generally interpreted in terms of changes in plate (boundary) kinematics or vertical-axis rotation associated with the formation of the Andean orocline. However, none of these hypotheses accounts adequately for Neogene to Recent horizontal extension and vertical shortening of upper crust documented from the Puna Plateau and the adjacent Eastern Cordillera. Based on new and compiled fault-kinematic data, in total 4746 brittle faults at 317 stations, we propose that strain axis configurations in the southern Central Andes are controlled by (1) local deformation kinematics, (2) overall WNW-ESE horizontal shortening imposed by plate convergence and (3) differences in crustal thickness and respective surface elevation, i.e., gravitational potential energy. Specifically, the Puna Plateau and Eastern Cordillera have been undergoing horizontal shortening and gravitational spreading of upper crust, whereas the topographically lower Pampean Ranges continue to undergo horizontal shortening only. Although less apparent in the fault-kinematic data than E-W and NW-SE extension, orogen-parallel extension is inherent to the Puna Plateau and Eastern Cordillera and compensates likely for overall WNW-ESE shortening of thickened crust. The importance of orogen-parallel extension in the kinematics of topographically elevated parts of the southern Central Andes is underscored by the strike-slip components on prominent reverse or thrust faults. The data supports geodynamic interpretations in which topography and crustal thickness influence significantly upper-crustal kinematics of the southern Central Andes.

TALK 163: HYDRO GEOCHEMICAL CLASSIFICATION OF THE UPPER RIO DOCE BASIN, MG - BRAZIL

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The Doce River Basin is located in the Brazilian states of Minas Gerais and Espírito Santo. It covers a catchment area of approximately 83,400 km². About 3.2 million people are living in it. The main rivers that form the headwaters of the Doce River are the rivers Piranga, Carmo and Piracicaba.

In about 800 sample points in the upper basin of the Rio Doce, the physico-chemical parameters (pH, ORP, TDS, Cond. T, Turb. OD) were *in situ* determined. To examine seasonal differences in water chemistry, two samplings were carried out at every point, one in the winter (dry season) and another in the summer (rainy season). Alkalinity, chloride and sulphate were determined in the laboratory. Major and trace elements were analyzed by ICP - OES / MS and TXRF.

The most studied waters are strongly influenced by the local lithology. In the headwaters, which rise in the mining areas of the Iron Quadrangle, occur frequently chalcopyrite elements. Thus, Cd, As, Cu, Zn, are associated with the Sulfide mineralization in the gold mines. The siderophile elements Cr, Ni, Co, V show positive correlations. They are of natural origin and come from the volcano - clastic series of the Archean Rio das Velhas greenstone belt. The main elements Ca, Mg and Fe have their origin mainly in schist's and gneissic rocks from the Archean Basement. Berner and Berner made in 1996 a proposal for a classification of rivers which support the "boomerang diagram" with the parameter TDS versus Na / (Na + Ca).

They showed here that the main mechanisms that affect the natural chemistry of surface waters are as follows:

- Atmospheric precipitation, both in composition and quantity;
- Weathering of rocks;
- Evaporation and fractional crystallization.

The investigated rivers and water bodies are positioned in the diagram in the lower half. The Peti Lake (dam) and the rivers Oratorios, Piranga and Casca fall in the "Rock dominated" area. The Piracicaba falls in the transition area for "Precipitation dominance". The Conceição River extends over a wide range and falls partly like the Caraça River completely out of the diagram. This can be explained by special lithological characteristics. Because the Serra do Caraça is almost exclusively composed of ortho-quartzites. In the case of the Conceição River the Fe mines at its source affect the water chemistry.

An environmental problem is the pollution by Hg, which is still used by the gold washing people. BERNER, EK & BERNER, R. A (1996) Global Environment: Water, Air, and Geochemical Cycles. Prentice Hall, 376 p.

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POSTER 196: RISK MANAGEMENT INITIATIVES IN THE DEPARTMENT OF MISIONES, PARAGUAY

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Paraguay is a country with a territory of 406 752 km² and a population of about 6,700,000 inhabitants. It is divided into two natural regions and 19 departments.

The environmental risks to which it is subjected Paraguay are:

Floods, droughts, storms and fires.

The institution in charge of public policy management and risk reduction is the National Emergency Secretariat (SEN) which was created by the law No. 2615. In addition, in the year 2013, was created the Decree No. 11.632 , which regulates the law.

The SEN's, purpose is to prevent and counteract the effects of emergencies and disasters caused by natural agents or any other source, and to promote, coordinate and direct the activities of public institutions, departmental, municipal and private designed prevention, mitigation, response, rehabilitation and reconstruction of communities affected by emergencies or disaster

Misiones is one of the 19 Departments of Paraguay. It is located in the eastern region, with an area of 9556 km². It has ten districts. The reality of the risks are the same as nationally stand.

The governance of this department, created the secretariat of management and risk reduction in August 2013, in order to work for public policies related to that topic. It has been prepared a strategic plan in order to have a North in the actions to be taken.

In late October 2013, the first forum management and risk reduction of Missions Department was organized, which resulted in the formation of the Departmental Council Risk Management .

The ten existing districts of Misiones department have already been able to realize the diagnosis of risks and subsequent preparation of a contingency disaster plan for the District of Ayolas.

Three other diagnoses and their respective contingency plans, are planned to be realized in 2014 in three districts of the Misiones Department Paraguay.

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POSTER 167: NEW INTERPRETATION OF THE LOWER JURASSIC IN CENTRAL PERU

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The carbonate rocks of the Pucara Group (Upper Triassic – Lower Jurassic) at Domo de Yauli in Central Peru, harbor polymetallic replacement ores described by various authors (Kobe 1995, Loughman and Hallam 1982, Mégard 1979, Szekely and Grose 1972), being studied and interpreted in detail during the last decades (Beuchat et al. 2004, 2005).

New field and microfacies examinations show that the Lower Jurassic age Aramachay Formation was constructed with a significant abundance of siliceous sponges on a shallow carbonate ramp, which explains the formation's pervasive diagenetic chert nodules and layers. The results are paleoecologically and lithologically consistent with contemporaneous siliceous sponge-dominated rocks from Nevada, USA (Ritterbush and Bottjer 2011).

Development of these sponge colonies is consistent with enrichment of marine silica concentrations, here interpreted as a product of weathering of basalts produced during eruption of CAMP during the Triassic/Jurassic transition, which in turn is related to the mass extinction of biocalcifying organisms that characterizes this interval. The siliceous sponges represent the first major development of benthic ecosystems after the T/J mass extinction, and biocalcifying organisms did not develop pre-extinction diversities until the Upper Jurassic.

The Central Peruvian record would be worldwide, after Nevada, the second locality where this important event of siliceous sedimentation on epicontinental platforms of Panthalassa is recognized in high stratigraphic resolution for the early Jurassic.

The biostratigraphic record in Nevada includes the Hettangian stage; in Peru the collected ammonites (Arnioceras) represent the Sinemurian stage (Rosas et al. 2007 and this work). To establish accurately the age of the Aramachay Formation siliceous sponge occurrences and its coincidence with those of Nevada, radiometric ages of intercalated volcanic tuffs are ongoing.

At the “Domo de Yauli” the Aramachay sequence is frequently described as a “silicified limestone” that would have acted as a trap or partial seal for ascending hydrothermal fluids through the underlying Upper Triassic more reactive carbonate rocks (Chambará Formation), which permitted the development of replacement ore bodies. It is then a case where the facial sedimentary features of the host rock have a connection with the development of ore bodies.

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TALK 157: DAVIS VS. PENCK. DID THE DEBATE START IN ARGENTINA?

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Davis and Penck's debate can also be perceived by those different regions, where both scientists did their first work activity in Argentina. How much could the South American landscape influence both young geoscientists to shape their minds on what would crystallize in their different geomorphologic models in the subsequent years?

William Morris Davis (1850-1934) spent two and a half years in Argentina between 1870 and 1873. He was working as an assistant of Benjamin A. Gould at the Argentine National Observatory in Cordoba. Davis paid particular attention to entomology, rather than astronomy, geography or meteorology. Back in the United States, he held the chair for physical geography at Harvard University, and he emphasized education in high school and college throughout his career. Davis was a prolific writer and public speaker. His ideas took a leadership position extending over the entire first half of the 20th century. His most influential concept was the "*Geographical Cycle*" (1889) in which he presents a deductive, theoretical, and genetic model of landscape evolution. Davis, technically a geographer, formulated a general theory of landscape evolution in order to create an improved system for describing landforms. His model was simplified to an initial uplift of landmass, which was then modified by denudation processes during a still-stand. Uplift and denudation were successive and climatic erosion an important process. The Appalachian system, located on a passive continental margin of Eastern North America, played Davis's prototype for his model. Could the Cordoba's hills in Argentina have given Davis his earliest inspirations to his theory? Geology and structure of Appalachian and Pampean Ranges systems are totally different. Nevertheless, from a global tectonic point of view, both systems belong to intraplate setting.

Walther Penck (1888-1923) spent two years in Argentina, working at the National Geological Survey between 1912 and 1914. He was mapping a remote area of the Andes in Catamarca province. After returning to Europe, he was briefly teaching at the universities of Berlin, Leipzig and Istanbul. Penck never had the strong authority of a chair at a university behind him, and had no students during his short but productive life. He wrote and revised his most important paper, "*Die morphologische Analyse*", shortly before his death at 35 years of age. Penck, technically a geologist, proposed a different theory on land denudation in order to interpret the history of dynamic crustal movements. He challenged Davis's model, and he saw landforms as an expression of the continuous interaction of the tectonic and erosional processes. His landscape models depended on the comparative rates of uplift as against the rate of denudation: slopes reflect the ratio of endogenetic/ exogenetic processes. Evaluation of Penck's model was hindered by its hurried writing, posthumous publication (1924) and confused translation into English. Penck's theory was inspired mostly in the Andes, Alps and Anatolia, which are located at the border of geotectonic plates, and involve subduction-related volcanism and/or dramatic Cenozoic tectonic activity.

Davis vs. Penck debate could also be observed as the interrelationship between global tectonics and macro scale landscape development, i.e. "intraplate" vs. "interplate" settings.

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TALK 007: GEOCHEMISTRY, PROVENANCE AND TECTONIC SETTING OF THE GRANJENO SCHIST, EVIDENCE FROM PANGAEA

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Late Paleozoic metamorphic rocks from the basement of the Sierra Madre Oriental are related to the Laurentia-Gondwana collision in Carboniferous time, during Pangaea amalgamation. Field work and petrographic analysis reveal that the Granjeno Schist comprises metamorphic rocks with both sedimentary (psammite, pelite, turbidite, conglomerate, black shale) and igneous (tuff, lava flows, pillow lava and ultramafic bodies) protoliths. The chlorite geothermometer as well as ⁴⁰Ar/³⁹Ar ages on metavolcanic rocks indicate that the Granjeno Schist was metamorphosed under sub-greenschist to greenschist facies (250-345°C) during Carboniferous time (330±30 Ma).

The metavolcanic rocks have sub-alkaline to alkaline chemical composition characterized by low SiO₂ (42-47wt%) contents, high Al₂O₃ (16wt%) and #MgO of 48-66. ΣREE abundances in the metavolcanic rocks vary in ranges from 51-167 ppm and chondrite-normalized REE patterns are moderately fractionated, with LaN/YbN values of 0.73-8.83. Europium anomalies are variable (Eu/Eu*0.80-1.09) with a slightly negative mean anomaly. Most metavolcanic rocks have compositions that are associated with ocean-island basalt (OIB) or mid-ocean ridge basalts (MORB) due to Zr/Nb and Y/Nb in the ranges 4.91-8.06 and 0.74-1.0 for the OIB and >9.2 and >1.25 for the MORB, respectively.

The geochemical composition of the metasedimentary rocks is in accordance with iron shale, wacke and quartz arenite protoliths. Some of the variations can be explained by the grain sizes (e. g., 69-74% and 78-96% SiO₂ and 10-15% and 3-9% Al₂O₃ in metapelite and metapsammite, respectively). ΣREE abundances are highly variable in the metasediments (13 to 152 ppm) and chondrite-normalized REE patterns are more fractionated than in the metavolcanic rocks (e.g., LaN/YbN 2.66–16.46) with negative europium anomalies of Eu/Eu*0.67. The metasedimentary units represent a wide variety of clastic sediments derived from mixed felsic and basic source compositions (e. g., Ti/Nb 200-400).

The trace element characteristics point to a continental island arc or active continental margin setting due to e. g., Th/Sc and Zr/Sc ratios of 5-8 and 0.3-0.5, respectively. Values ranges from 60-74 for the Chemical Index of Alteration and Plagioclase Index of Alteration (>75) in the metasediments indicate intermediate chemical weathering in their source area or during transportation and that recycling processes might have been significant. The chemical composition of detritic tourmaline, rutile, allanite, sillimanite, tremolite, crossite, zoisite and detrital zircon ages for metapsammites reveal that the major sources are Grenvillian (1250-920 Ma) rocks that can be found in the ca. 1 Ga Oaxaquia Complex in NE Mexico (Novillo Gneiss). Hence, short transport can be assumed. Maximum depositional ages are Neoproterozoic, Silurian and Devonian. They indicate that the volcanosedimentary deposition probably took place during Devonian time.

Based on our results we suggest a modified plate-tectonic frame for Oaxaquia. Most models suggest that Oaxaquia was situated between Laurentia and Gondwana during collision in Carboniferous time. The zircon data indicate that the Granjeno Schist was deposited before this collision. The presence of ocean basalt floor and serpentinite lenses intercalated with tuff and active continental margin sedimentary rocks necessitates a near-continental environment, such as a back-arc basin. Hence, we present the first evidence of a subduction zone predating the collision of Laurentia and Gondwana.

POSTER 187: COAL FACIES IN SUBBITUMINOUS COAL THROUGHOUT MAGALLANES FOLD AND THRUST BELT (MFTB), MAGALLANES BASIN

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The Eocene Loreto Formation in the Magallanes basin, located at the southern tip of South America, has reserves of subbituminous coal, which have been exploited since the late 19th century. In recent years production has increased reaching an estimated 7 million tons per year in 2016 from three operating mines: Pecket and Isla Riesco in Chile, and Rio Turbio in Argentina. The objective of this poster is to study, based on petrographic and geochemical analysis, the environment of deposition of the Loreto Formation coals. The commercial coal seams constitute the lower part of the formation; they include beds of up to 11 meters of thickness and more than 40 kms of lateral continuity. A second generation of carbon appears in the middle of the formation with coal seams up to 6 meters and lateral continuities under 6 Km. The ash content is over 15% for all seams; sulfur is low (< 1%) for the coal seams of more than a meter, except only one occurrence in the south (2.19%) for one 4 meters thick coal bed.

The coal seams occur in an overall paralic succession, developed in a marine deltaic to lagunar depositional setting (Mella, 2001). The study area has been divided into three sectors through the MFTB. Random vitrinite reflectance measurements range from 0.28% to 0.58%, the lowest measurements are found south of the study area and the highest in North. Vitrinite is the dominant maceral group (48 to 97.8%); less abundant is liptinite (1.5-52%) with the highest values in the northern part; all the coals seams are characterized by a low content of inertinite (< 1.7%). The indexes proposed by Calder et al (1991) and Diessel (1982, 1986) were used for the interpretation of coal facies. (1) The Gelification Index (GI) in all beds is larger than 15; (2) Tissue Preservation Index (TPI) in the north and south is mostly less than 1, while in the central area the values are between 1 and 6. (3) The Groundwater Index (GWI) is mostly greater than 1 in the north and southern parts, whereas in the center is between 0.3 and 1.1; (4) the Vegetation Index (VI) is mostly less than 1 and in the north and south, while in the center is between 1.5 and 5.

Depositional conditions on the MFTB suggest an environment of peats originating from limnic to limno-telmatic conditions, with marginal aquatic/herbaceous vegetation and a rheotrophic hydrogeological environment, with very low oxidation levels.

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TALK 191: HIGH-ALTITUDE PEATLANDS OF THE CENTRAL ANDES AS SENTINELS OF HOLOCENE ENVIRONMENTAL CHANGES

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High-Andean cushion peatlands are valuable natural archives for palaeoenvironmental research. They have the quality to be very sensitive towards environmental changes and are well-suited for the application of a variety of methods that can be used for the reconstruction of palaeoclimates. The strengths of these geoarchives are their comparability over climatic gradients, their high accumulation rates and the high quality of their peat deposits to be precisely ¹⁴C-dated.

For the first time, we present an overview on several recent paleoecological projects based on peatland archives at various sites in the Peruvian and Argentine Andes. For the reconstruction of Holocene environmental changes, multi-proxy methods (fossil micro-/macroremains, XRF, CN) were applied, based on extracted peat cores from cushion peatlands at 4000-4500 m a.s.l. throughout the Cordilleras. The results contribute to the controversial discussion whether the middle Holocene in the Central Andes was arid or humid. They further offer high-resolution records of palaeoclimatic variabilities, which are indispensable for comparison with continent- or global-scale palaeoclimate records.

Prominent Late Holocene climate anomalies are reflected by the palaeoecologic data and provide evidence that Northern Hemisphere temperature oscillations were extensive and affected the South American summer monsoon belt. A mid-Holocene cold event at about 5.0 ka, as evidenced by Quellcaya ice cap (Buffen et al. 2008), is also evident at peatland sites crossing the Andes.

In the past, the peatlands recovered from climatic perturbations. Nowadays, many Andean peatlands are heavily degraded by human impact and peat deposits increasingly become susceptible to erosion and incision (Schitteck et al. 2012). If these processes continue in the future, these high-mountainous ecosystems will lose their unique water storing and regulating capacity.

Buffen, AM, Thompson LG, Mosley-Thompson E & Huh KI (2008): Recently exposed vegetation reveals Holocene changes in the extent of the Quellcaya Ice Cap, Peru. - *Quaternary Research* 72:157-163.

Schitteck K, Forbriger M, Schäbitz F & Eitel B (2012): Cushion peatlands - fragile water resources in the high Andes of southern Peru. In: Weingartner H, Blumenstein O & Vavelidis M (eds.) *Water - Contributions to sustainable supply and use. Landscape and sustainable development, Volume 4*, p. 63-84.

TALK 126: THE AQUATIC AND SUBAQUATIC FAUNA IN MIOCENE AMBER OF CHIAPAS: PALEOENVIRONMENTAL AND PALEOCOLOGICAL IMPLICATIONS

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The amber of Chiapas is famous worldwide for its inclusions of plants, insects and occasional small amphibians and reptiles. The age of the amber has been considered to be Oligocene to Miocene, but recent research indicates that was deposited during the early to middle Miocene (Solórzano-Kraemer, 2007; Perrilliat et al., 2010). Since the 1950ies, mostly insects have been described, but a diverse assemblage of subaquatic and aquatic crustaceans is currently under study. This assemblage includes several species of ostracods, amphipods and a crab. Additionally, four species of terrestrial isopods are present and for first time, aquatic coleopterans are described. The ostracods belong to at least four species, with strong affinities to modern species living in the Caribbean region in caves with influence of brackish water. The specimens show evidence of being trapped alive by the resin, since the morphology is complete and tracks of escape behavior are seen associated to some specimens. Amphipods also show evidence of escape, as legs are detached from the specimens. At least two families are recognized, with male and female features to offer a complete diagnosis. The isopods are represented by four species, and for first time for the amber of Chiapas, formal reports of these Peracarida will be presented, including an exceptional case of parental care, represented by a female surrounded by 16 mancae stages. The small crab belongs to the Sesamidae, being the first crab in amber to be described in detail. The specimen shows evidence of recent molting, since a leg of the exuvia was preserved behind and cuticle appears to be soft when the animal got trapped by the resin. A large larva of an aquatic coleopteran was recently found, along with a piece that includes at least five adult aquatic coleopterans. The robust assemblage of aquatic arthropods, along with features included in amber such as abundant sediment that includes gypsum, suggest that some of the amber from Chiapas was deposited in aquatic environments, large enough to support development of complex biota such as large coleopteran larvae and a relatively high diversity of ostracods. Numerous authors support the idea that aquatic animals in amber were associated to bromeliid tanks, which may be the scenario for certain kind of amber specimens, but the ones that usually include the aquatic arthropods are flat, sometimes large (more than 1 m) and stratified pieces that contain important amounts of sediment and organic matter. The “bottom” of these pieces is irregular in shape, sometimes with leaf impressions. In conclusion, it is suggested that the amber of Chiapas was deposited in an ecosystem at close distance to the ancient Gulf Coast, with amber falling on sub-aerial to aquatic environments (mainly freshwater). Crustacean biodiversity in this amber is presently the most noticeable among amber deposits in the world.

Solórzano Kraemer, M. M. 2007. Systematic, palaeoecology, and palaeobiogeography of the insect fauna from the Mexican amber. *Palaeontographica Abteilung A*. 282.

Perrilliat, M.C., Vega, F.J., Coutiño, M. 2010. Miocene mollusks from the Simojovel area, Central Chiapas, southwestern Mexico. *Journal of South American Earth Sciences*. 30:111-119.

Sponsored by DFG travel grants

POSTER 124: INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) FOR PREVENTION AND MITIGATION IN CASE OF NATURAL CATASTROPHES: A CASE STUDY IN THE CARIBBEAN REGION

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The Caribbean region has long been recognized as an area susceptible to natural hazards, including seismic and volcanic hazards, and hazards posed by tropical storms. Endemic risk in the Caribbean region is exacerbated by an increasing population and high population density, poverty, and infrastructure that varies in quality from good to inadequate. In order to mitigate the consequences of future natural hazards, and in particular to assess the potential for cascading disasters in which one event triggers others (e.g., landslides, flooding, fires, and tsunamis) that may cause more damage than the triggering event, an integrated study of Caribbean natural hazards and emergency disaster and crisis management using Geographical Information Systems (GIS) and Remote Sensing are outlined in this project. We will design and demonstrate a functional GIS of the full suite of hazards that afflict the Caribbean region. The Caribbean region is developing steadily, and current and potential partner institutions there are well positioned to take full advantage of the results of our study. The methods and models proposed herein can be adapted to other regions vulnerable to natural hazards and associated catastrophic events. In a short term, this study can reduce cost and increase coordination efficiency in the immediate aftermath of natural events. In long-term, it can allow to identify the construction in risk areas to be avoided and can indicate areas in need of mitigation measures. The possibility to use GIS and RS to gather information about a developing catastrophic situation and to exchange information critical for informed decision making is crucial in prioritizing time-critical mitigation actions.

TALK 172: THE COMPLETE SKELETON OF A PRIMITIVE MOSASAURIAN FROM THE TURONIAN OF NORTHEASTERN MEXICO

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Mososauria, also known as Pythonomorpha, is a clade of marine lizards that arose during the Cenomanian (early Late Cretaceous), underwent an adaptive radiation that produced predators of gargantuan proportions, and went extinct around the Cretaceous-Paleogene boundary. The traditional history of the clade observes that long-necked dolichosaurs and primitive mosasauroids (“aigialosaurs”) were present in the Cenomanian, and surmises that Mosasauridae, including its major subclades, began to diversify and increase in body size during the Turonian (lucidly articulated by Bardet et al. 2008). Recent phylogenetic studies of Mosasauroidea have suggested a re-interpretation of these data: that mosasaurid subclades may have originated from different aigialosaur lineages in the Cenomanian (that is, Mosasauridae as traditionally circumscribed is not monophyletic). Furthermore, limbs and girdles adapted for high-performance swimming (hydropedal and hydropelvic conditions, respectively), and large body size may have arisen more than once. Finally, the phylogenetic position of Mososauria within Squamata is in doubt, with some analyses placing the clade near the base of Squamata instead of within anguimorph lizards (which include the predatory Monitor Lizards and the Gila Monster).

A complete new skeleton from the lower Turonian plattenkalks near Vallecillo, Nuevo León, Mexico (Ifrim et al., 2007), sheds light on these problems. The skeleton differs from the holotype of *Vallecillosaurus donrobertoi* Smith & Buchy, 2008 in minor, although telling, characters of the tail. Apart from mosasauroid features in the tail, the axial skeleton is quite plesiomorphic. The specimen contains the best-preserved skull of any primitive mosasauroid, particularly in the lower jaw (such as the presence of a long, delicate posteromedial process of the coronoid). The new specimen contributes in significant ways to a resolution of early mosasauroid ecology and evolution.

Bardet, N., Houssaye, A., Rage, J.-C. and Pereda Suberbiola, X. 2008. The Cenomanian-Turonian (late Cretaceous) radiation of marine squamates (Reptilia): the role of the Mediterranean Tethys. *Bulletin de la Société Géologique de France* 179, 605-622.

Ifrim, C., Stinnesbeck, W. and Frey, E. 2007. Upper Cretaceous (Cenomanian-Turonian and Turonian-Coniacian) open marine plattenkalk deposits in NE Mexico. *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen* 245, 71-81.

Smith, K. T. and Buchy, M.-C. 2008. A new aigialosaur (Squamata: Anguimorpha) with soft tissue remains from the Upper Cretaceous of Nuevo León, Mexico. *Journal of Vertebrate Paleontology* 28, 85-94.

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POSTER 168: METAMORPHIC EVOLUTION AND PARTIAL MELTING OF METAPELITES IN EASTERN CORDILLERA, CENTRAL ANDES, NW ARGENTINA: NEW INSIGHTS FROM EQUILIBRIUM PHASE DIAGRAMS (PSEUDOSECTIONS)

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We apply thermodynamic modeling on pelitic rock compositions to study in detail and quantify the metamorphic evolution and the partial melting process in the Sierra de Molinos (Salta Province) during Famatinian orogen. We interpret the metamorphic evolution of Sierra de Molinos with reference to pseudosections in NCKFMASH system that are based on an average subaluminous pelites considered to be representative of the presumed protolith (samples mo40 and mo10408; see Sola et al. 2013). Metamorphism in the Sierra de Molinos is the subject of ongoing research and some preliminary results were briefly summarized by (Sola et al. 2013). The sedimentary protolith of the metamorphic rocks consists of a turbiditic sequence assigned to the Puncoviscana Formation (Neoproterozoic to Early Cambrian) composed by metapelites, metapsammites and minor calc-silicates. The metasediments show a continuous transition from low and medium metamorphic grade to anatexitic migmatites (metatexites and diatexites). On the base of mineral assemblages recognized in metapelites the study area is divided into four metamorphic zones that according to the increase in the grade are: (1) chlorite – white mica (2) muscovite-biotite (3) sillimanite-K-feldspar and (4) cordierite-K-feldspar. The metamorphic grade increases from W to E, from sub-greenschist facies in the west to upper amphibolite facies migmatites on the east. The mineral assemblages appear to be the result of a progressive increase in temperature without a significant change in pressure (Sola and Becchio 2012; Sola et al. 2013). Due to the lack of assemblages suitable for conventional geobarometry, the integration of the results obtained in pseudosections, the Ti in biotite thermometry (Henry et al. 2005) along with the observation of mineral assemblages, provide key information to recreate the tectonothermal history of this region. The high content of Mg in pelites stabilized cordierite with small increment of temperature. The sillimanite becomes stable within the subsolidus field (≈ 3 to 4 kbar/500-650°C). This reaction is observed in zone (2) where fibrolite aggregates replace cordierite porphyroblasts. The predicted amount of melt produced by crossing the wet solidus is small (< 5 vol %) and the first major melting reaction encountered is related to the breakdown of muscovite which produce 15-16 vol % of melt over a small temperature interval, equilibrating melt, K-feldspar along with sillimanite in metatexite migmatites of zone (3). The highest temperatures obtained for this stability field (bt+melt+qtz+pl+kfs+sill) yielded 650-660°C. The microstructures and equilibrium modeling reveal that cordierite replace biotite and sillimanite increasing temperature through reaction: $bt + sil + pl + qtz \leftrightarrow crd + kfs + melt$. At the peak conditions (≈ 700 -710°C) the sillimanite disappears and the mineral assemblage in migmatites is dominated by peritectic cordierite and K-feldspar (bt+melt+qtz+crd+pl+kfs). The stability field for this assemblage is limited to pressures below 4 - 4.5 kbar. There is no record in migmatites of Sierra de Molinos of assemblages involving garnet and cordierite which marks the transition to the granulite facies above 730-740°C. The abundance of late muscovite in some migmatites require the retrograde P–T path of the Sierra de Molinos to have passed at pressures above 3.5 kbar.

Henry, D.J., Guidotti, C.V. and Thomson, J.A. 2005. The Ti-saturation surface for low-to-medium pressure metapelitic biotites: Implications for geothermometry and Ti-substitution mechanisms. *American Mineralogist* 90: 316-328.

Sola, A.M. and Becchio, R.A. 2012. Distribución de Elementos Traza y Grado de Fusión Parcial en Migmatitas de la Sierra de Molinos, Salta, NW de Argentina. *Revista de la Asociación Geológica Argentina* 69 (2): 240 - 251.

Sola, A.M., Becchio, R.A. and Pimentel M.M. 2013. Petrogenesis of migmatites and leucogranites from Sierra de Molinos, Salta, Northwest Argentina: A petrologic and geochemical study. *Lithos*, 177:470-491. <http://dx.doi.org/10.1016/j.lithos.2013.07.025>.

TALK 127: FLUID INCLUSIONS, ISOTOPIC FLUID COMPOSITION AND NEW AGE DATINGS OF RARE-METAL PEGMATITES, SIERRA DE SAN LUIS, ARGENTINA

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Rare-metal (Be, Li, Nb, Ta, Sn) granitic pegmatites from the Sierra de San Luis (Argentina) are related to syn-Famatinian, meta- to peraluminous S-type granites (Sosa et al. 2007). Nb-Ta-pegmatites are concordantly emplaced in fine-grained quartz-mica schist of the Conlara Metamorphic Complex in the east, while Sn-bearing pegmatites are emplaced in the westerly schist of the Pringles Metamorphic Complex (Sosa, 2002; Sims et al, 1998). The pegmatite minerals must have crystallized at 400-500°C /2-3 kbar from a H₂O-NaCl-CO₂-CH₄-N₂ dominated fluid, preserved as primary inclusions in beryl and plagioclase. Columbite-tantalite preserves only aqueous inclusions and crystallized at 300-400°C, the same crystallization temperature of cassiterite; apatite crystallized at 200-300°C. Carbonic fluid inclusions show always higher CH₄-concentrations in the Sn-pegmatites compared to the Nb-Ta-pegmatites (Van den Kerkhof et al., 2005).

Preliminary stable isotope ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) studies were carried out on gas-rich inclusions from both types of pegmatites using a crusher, which is connected to an elemental analyzer and isotopic mass spectrometer. CO₂ in quartz from Nb-Ta-pegmatite (Conlara Complex) shows $\delta^{13}\text{C}$ values between -18 and 0‰ VPDB. Magmatic signatures of ca. -4‰ for CO₂ are mainly found for pegmatites in the central easternmost part of the Sierra de San Luis. The $\delta^{13}\text{C}$ values of abundant CH₄ in cassiterite and quartz are very low (-42/-48‰ VPDB) suggesting a thermogenic origin from kerogen break down. The $\delta^{15}\text{N}$ values of N₂ is ca. +3 to +6 ‰ for quartz and slightly lower, i.e. ca. 0 to +3 ‰ for cassiterite. These values confirm the contamination of the mineralizing fluid with organogenic material.

New K-Ar datings on muscovite from the Nb-Ta-pegmatites reveal 393-435 Ma, and 366-374 Ma for muscovite from the Sn-pegmatites, suggesting that the latter are at least ca. 20 Ma younger. This confirms earlier findings of Sosa et al. (2002), except that the presently found ages are somewhat younger. U/Pb datings of columbite-tantalite fall in the range 481-437 Ma, i.e. always ca. 20-40 Ma older than the muscovite ages (Melcher, pers. comm.).

The Nb-Ta-pegmatites are restricted to the Conlara Complex. The uptake of organic material in the mineralizing fluids must have been much larger in the Pringles Complex and was probably responsible for a higher Sn mobility and the forming of cassiterite-bearing pegmatite in this area.

Sims J., Ireland T., Camacho A., Lyons P., Pieters P., Skirrow R., Stuart Smith P. and Miró R. 1998. In: Pankhurst R., Rapela C. (Eds.) Geological Society of London, Special Publications 142, 259-281.

Sosa G.M., Augsburger M.S. and Pedregosa J. 2002. *Eur. J. Mineral.* 14, 627-636.

Sosa G.M., Van den Kerkhof A.M., Lopez de Luchi M. and Ortiz Suarez A. 2007. ECROFI-XIX Bern, 204.

Van den Kerkhof A.M., Sosa G.M. and Montenegro T. 2005. ECROFI XVIII-Siena Abstract e-book.

POSTER 036: ARGENTINIAN PUNA AS MARS ANALOG LABORATORY

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Argentinian Puna is a high plateau desert environment which may serve as a Mars analog for several geomorphological processes. The lack of water together with low pressure atmosphere generates a perfect environment for several processes and landscape that resemble Mars.

For example: 1) Coarse gravel bedforms in the Puna of Argentina represent some of the most extreme aeolian deposits on Earth in terms of particle properties and inferred formation conditions (Milana, 2009; de Silva et al., 2010, 2013). The bimodal clast population of pumice and lithics in coarse gravel Puna megaripples is critical to the development of gravel bedforms. The impact of saltating (low-density) pumice is the main driving force for creep of the denser lithic clasts together with low density atmosphere may be a useful analog for the development of Terra Meridiani ripples through basalt impact on hematite. 2) Several landslides and they regional setting resembles terrestrial avalanches in dry environments on Earth like in Puna. An example of these processes is found in the Argentinian Southern Puna, which is a high plateau of 4 km elevation. This area is characterized by volcanic features, salt deposits and extensional features associated with bimodal volcanism (e.g., Kraemer et al., 1999). A similar association of neotectonic/dry environment landslide have been found on Mars and compared to the Terrestrial environment (Spagnuolo et al. 2011). 3) Finally pit craters are conical collapse structures widely spread along Mars surface. Main morphology differences with impact craters are the lack of the crater rim and impact ejecta. Terrestrial counterparts for these structures are rather scarce. Recent studies associate these structures with dilatational fractures related to normal faults under tensional regimes and they would be related to the presence mechanical strong layers where a void is generated and unconsolidated material from above collapses. Some of these structures are found in Puna Argentina and may resemble Martian structures. The Puna therefore serves as a natural laboratory for Mars.

de Silva S.L., Burr, D.M., Ortiz, A., Spagnuolo, M., Zimbelman, J.R., and Bridges, N.T., 2012, Dark aeolian megaripples from the Puna of Argentina: Sedimentology and implications for dark dunes on Mars, in Proceedings, Lunar and Planetary Science Conference XLIII: Houston Texas, Lunar and Planetary Institute, abstract 2038.

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Kraemer, B., Adelman, D., Alten, M., Schnurr, W., Erpenstein, K., Kiefer, E., van den Bogaard, P., Görler, K., 1999. Incorporation of the Paleogene foreland into the Neogene Puna Plateau, the Salar de Antofalla area, NW Argentina. *J. South Amer. Earth Sci.* 12, 157–182.

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POSTER 223: HOLOCENE CLIMATIC CHANGES AND HUMAN-ENVIRONMENT INTERACTIONS IN THE HIGH ANDES OF NW-ARGENTINA

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We present first results of our ongoing research on the Quaternary environmental history of the semiarid Puna region in northwest Argentina. Here, we will focus on a geoarchaeological approach to reconstruct changes in vegetation and human settlement.

During a field campaign in September 2013, we documented and sampled an exposed 9 m sequence (COR) of alternating peat and fluvial sand deposits, located close to Coranzuli village, at an altitude of 4,000 m a.s.l. (22° 58' 539 S, 66° 21' 202 W), at approx. 285 km north of San Salvador de Jujuy. More than 50 samples of the COR-section were analyzed for lithostratigraphy and palynology in order to reconstruct the palaeoenvironmental history of the region. The COR-section initiates near the Pleistocene-Holocene boundary and covers the early and middle Holocene. We also took 20 samples from a core of a recent cushion peatland (V20) at about 2 km distance from the COR-section. The V20 core covers the last 2,500 years. The palynological analysis reveals a pollen spectrum dominated by Poaceae (e.g. *Festuca*), Cyperaceae (e.g. *Eleocharis*) and Asteraceae (e.g. *Senecio*). Non-pollen-palynomorphs (NPP) (fungi and algae) are also frequent. Poaceae dominate the high-Andean altitudinal belt. In contrast, Asteraceae spread in the Puna belt at about 3,400 – 4,000 m a.s.l., with less need for water. The alternating abundance of Poaceae, Cyperaceae and Asteraceae, indicates changes in humidity and climatic variability in the region. Some samples are characterized by a high amount of charcoal, probably representing human activity in the area.

Non-pollen-palynomorphs (NPP) (e.g. *Sporormiella*) have also been detected in the COR samples. The evaluation of NPP may indicate the introduction of cattle, but may also allow us to date the initial domestication of camelids in NW-Argentina.

The Coranzuli deposits feature a record of broad climatic variabilities throughout the Holocene, but the area may further be a key for the analysis of human interaction with the environment.

Markus Dzakovic 2013. Fungal spores as indicators for climate and environmental conditions in High Andean Cushion Peatlands of southern Peru. Unveröff. Staatsexamensarbeit. Universität zu Köln.

TALK 207: RATES, CAUSES, AND DYNAMIC OF LONG-TERM LANDSCAPE EVOLUTION OF THE SOUTH ATLANTIC “PASSIVE CONTINENTAL MARGIN”, BRAZIL AND NAMIBIA, AS REVEALED BY THERMO-KINEMATIC NUMERICAL MODELING

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The aim of the research is to quantify the long-term landscape evolution of the South Atlantic passive continental margin (SAPCM) in SE-Brazil and NW-Namibia. Excellent onshore outcrop conditions and complete rift to post-rift archives between Sao Paulo and Porto Alegre and in the transition from Namibia to Angola (onshore Walvis ridge) allow a high precision quantification of exhumation, and uplift rates, influencing physical parameters, long-term acting forces, and process-response systems. Research will integrate the published and partly published thermochronological data from Brazil and Namibia, and test lately published new concepts on causes of long-term landscape evolution at rifted margins.

The climate-continental margin-mantle coupled process-response system is caused by the interaction between endogenous and exogenous forces, which are related to the mantle-process driven rift – drift – passive continental margin evolution of the South Atlantic, and the climate change since the Early/Late Cretaceous climate maximum. Special emphasis will be given to the influence of long-living transform faults such as the Florianopolis Fracture Zone (FFZ) on the long-term topography evolution of the SAPCM's. A long-term landscape evolution model with process rates will be achieved by thermo-kinematic 3-D modeling (software code PECUBE and FastCape). Testing model solutions obtained for a multidimensional parameter space against the real thermochronological and geomorphological data set, the most likely combinations of parameter rates, and values can be constrained. The data and models will allow separating the exogenous and endogenous forces and their process rates.

TALK 192: HUMAN REMAINS OF LATE PLEISTOCENE-EARLY HOLOCENE AGE FROM SUBMERGED CAVES OF THE EASTERN YUCATAN PENINSULA, MEXICO: IMPLICATIONS FOR THE PEOPLING OF THE AMERICAS

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Early settlers of the American continent have variously been assigned to a typical cranial morphology, called *Paleoamerican*, which is characterized by a robust, long and narrow cranium and a long, narrow and high skull. This morphology differs substantially from *Amerindian* groups of middle and late Holocene age, characterized by gracile and rounded crania, wide and low faces with a marked flattening of the middle region.

Here we present new anthropological evidence from submerged caves located along the eastern coast of the Yucatan Peninsula. Our data set is based on well preserved skeletal remains of eight individuals dated to >9,000 BP, which allows us, for the first time, to evaluate the morphological characteristics of an old population from the tropical region of North America. Contrary to all expectations for a population of that age, the Yucatan individuals present cranial characters that substantially differ from coeval reference collections of South America and central Mexico, with crania that are little prolonged and facial regions low and relatively wide. The Yucatan individuals thus also differ from Amerindians, eg. late Holocene groups of the Yucatan peninsula.

The new human skeletons from Yucatan thus reveal a morphological diversity different to that observed in other coeval late Pleistocene-early Holocene groups in the Americas. We therefore conclude that the process of peopling of the continent must have been far more complex than estimated today and included periods of local microevolution at different geographical and chronological scales.

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POSTER 150: EARLY CRETACEOUS SUBAQUAEUS MASS FLOW DEPOSITION IN A COLD ENVIROMENT- CHESTER CONE FORMATION, LIVINGSTON ISLAND, ANTARCTICA

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The section reviewed is part of the Sealer Hill Member, located in the upper section of the Chester Cone Formation (Crame et al. 1993, redefined by Hathway & Lomas 1998) part of the Byers Group, exposed in the peninsula of the same name in Livingston Island, South Shetland Islands, Antarctica. The studied outcrop is located at the "Zig Zag Gully" as mentioned by Hathway (1997).

Consists of mainly volcanoclastic and epiclastic facies of tuffaceous sandstones and agglomerates interbedded with mudstones, deposited rhythmically in a subaqueous environment. Contains marine fossils such as ammonites, bivalves and fish remains, observed between the first 4 to 5 m from the baseline, along with plant remains, becoming more common towards the top of the sequence. At a palynofacies level, the high content of opaque phytoclasts (inertinite) evidences the wildfires associated with intermittent volcanic activity, which would have restricted the development of a gymnosperms forest, being pteridophyte spores dominant. The limited presence of dinoflagellate cysts despite the marine environment, is consistent with the high terrigenous input provided by volcanism, generating stressful conditions and low oxygenation, which is coincident with an epiclastic granular subaqueous mass flow in the sense of Cas & Wright (1987), deposited in a marine platform environment. In this setting of predominant volcanic activity at high latitudes, the presence of glendonite (pseudomorphs of the low-temperature carbonate mineral ikaite) representing a climate with temperatures to a maximum of 5 to 8° C (De Lurio, 1995), may be due to transient 'cold snaps' or seasonal extremes that resulted from high latitude winter darkness (Littler et al. 2011) during a period of dominantly greenhouse conditions, or be part of a scheme in which global climate conditions were not uniform during the Early Cretaceous.

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TALK 042: VERTICAL SEISMIC PROFILE: A POWERFUL HIGH RESOLUTION TOOL TO IDENTIFY SANDSTONE THICKNESS FOR BETTER RESERVOIR CHARACTERIZATION

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Consisting of interbedded sandstones and shales with a minimum thickness of 300 meters increasing up to 2000 meters at the depocenter of the Tampico-Misantla Basin, the Chicontepec Formation still represents a challenging area for reservoir characterization, taking into account that the remaining reserves and prospective resources of the basin are mainly located in this formation.

The possible limitations for the study are lack of well log information in the area, 3D surface seismic acquisition data currently being processed, current 2D seismic lines as the only available resource in terms of seismic. Unfortunately for this case of study, the closer available 2D line is around 800 meters away. Hence the Mexican Oil Company decided to acquire a vertical seismic profile to obtain a robust time-depth curve to determine interval velocities along all well trajectories and to increase vertical resolution to identify the smallest sandstone thickness that current 2D surface seismic is unable to resolve for better reservoir characterization. Vertical seismic profile array configuration for this well, placing an energy source on the surface wellbore and borehole multicomponent receivers, allows preserving higher frequencies compared to surface seismic where receivers are located at the surface recording more attenuation energy than borehole seismic at target depth. The recovery of high frequencies helps defining sandstone thickness below the limit of seismic bed resolution.

The VSP acquisition showed excellent downgoing compressional signal quality allowing time-picking of first arrivals to obtain a time-depth curve to calculate interval velocities. Further processing allowed obtaining a corridor stack, seismic trace, which represents the subsurface seismic response along the borehole and below the drill bit position. The results also showed the expected increase in vertical resolution preserving up to 90 Hz at target depth. Surface seismic and corridor stack correlation was done using available 2D seismic line located 800 meters away from the well head.

The key factor for the Mexican Oil Company to successfully continue reservoir characterization in the area is by integrating all the available information, precisely what it has been done with 3D surface seismic acquisition and current processing, 3D older data reprocessing, and currently with the acquisition of well log information. This integration will also help to improve some aspects in surface seismic processing due to vertical seismic profile can provide Q factor information, accurate velocity, P and Ps signal for multi-component processing.

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TALK 195: SOME HYDROGEOLOGICAL ASPECTS OF LANDSLIDES IN TROPICAL ZONES OF ECUADOR

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Prior to proceed analyzing the influence of climatic factors on landslides, it is necessary to estimate the real amount of water that infiltrates into the ground after rainfall events. For this purpose, calculations need to take into account factors such as the amount of rain and the evapotranspiration, where; a water balance between rainfall and evapotranspiration is needed in order to determine the total amount of surface-runoff and groundwater-runoff and consequently, to estimate the water flow of streams within a landslide area.

Indeed, water temperature measurements will effectively identify the various groundwater-bodies. This information was collected from water springing from pipe-drains, natural springs, groundwater within exploratory boreholes and from water flowing naturally on the ground.

Physical evidences of groundwater bodies were registered by logging discontinuities of drill cores. Features such rust stains, concretions and Redox (reduction-oxidation) reactions were recorded. Low rock mass quality indexes (highly jointed or weathered areas) were taken as further indicators of the presence of possible groundwater levels. Special attention was given to those drill-cores in which landslide surface's depth had been previously established by inclinometer monitoring, similarly, to those drill-cores in which depth, an unusual hydrogeological behavior had been recorded during the drilling works.

Further, the results obtained from tests with markers (tracers) together with the analysis of iso-resistivity maps, were used to determine the preferential groundwater flows.

Water amount drained by pipe-drains were recorded especially after intense rainfalls with the purpose to analyze hydrogeological behavior over time as direct consequence of rainfall events. Rainfall data, such as intensity, duration, and amount of water were also considered for the analysis.

On the other hand, while some hydrogeological features were similar in whole area, other features were only relevant within isolated landslide bodies.

To conclude, hydrogeological aspects were correlated with landslide activity. Hydrogeological characteristics of different landslide bodies were set up. Critical groundwater levels, necessary for landslide reactivation, were also determined. Finally, response delay time of groundwater levels after pluviosity variations; as well as of landslide activity after groundwater levels variations were established.

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TALK 121: THE FOSSIL RECORD OF DECAPOD CRUSTACEANS IN MEXICO: NEW INFORMATION ON PALEOBIOGEOGRAPHY AND EVOLUTION

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The fossil record of decapod crustaceans of Mexico was scarce until a decade or two, but more than 50 species are known today, ranging from Early Cretaceous (Aptian) to Pliocene. Although most taxa be biogeographically restricted, several other species are widely distributed in age-equivalent lithostratigraphic units from North and South America, as well as Europe and the Middle East. These are frequently associated to anoxic events that may have influenced the distribution strategies of these crustaceans, e.g. for the glyphaeid lobster *Meyeria magna* and the raninoid crab *Cenomanocarcinus vanstraeleni*. *M. magna* is now known to exist in Aptian/Albian deposits of Europe, North and South America and China (González-León et al., in press), while *C. vanstraeleni* was located in Albian/Turonian sediments of North and South America, Africa and the Middle East (Garassino et al., 2013). Specimens are extremely abundant in all localities, represented mostly by corpses in what seem to be mass mortality events, associated to anoxic events as revealed by sedimentology and organic matter contents. *C. vanstraeleni* has a very thin carapace with two pairs of swimming legs and spinose chelae, features that suggest a species capable to swim and/or be associated to floating algal mats. The thin carapace of *M. magna* and strong abdomen also suggest crustacean with some ability to swim. A wide geographic distribution is seen in decapod crustaceans during Aptian/Turonian times. The portunoid *Ophthalmoplax brasiliensis* occurs in North America during the early Maastrichtian but is also present in Brazil to North Carolina during the late Maastrichtian (Vega et al., 2013). The genus *Branchiocarcinus* existed during the latest Cretaceous, with species found in Europe and the West and East Coasts of North America (Phillips et al., 2013; Téodori et al., 2013). During the Cenozoic, the distribution of crustaceans become gradually more restricted and lasted longer than restricted species of the same genera, with an average stratigraphical duration of 10 My.

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TALK 023: YAPACARAI LAKE: APPLICATION AS TECHNOSOLS ANTI-EUTROFIZANTES AND REDUCTION CYANOBACTERIA

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The results of tests with Technosols to reduce the concentration of nutrients are presented. N (nitrogen) and P (phosphorus) cause eutrophication in the water body of Lake Ypacarai in the central region of Paraguay, located in the National Park Ypacarai Lake. Malpractice in the management of natural resources, inappropriate agricultural practices, discharges of untreated domestic and industrial effluents are loaded with nutrients causing blooms of cyanobacteria and blue green algae. Species detected are *Cylindrospermopsis raciborskii*, *Anabaena spiroides*, *Aphanocapsa* sp., *Microcystis aeruginosa*, *Chroococcus turgidus*, *Aphanocapsa* sp., *Anabaena affinis*, *Aphanocapsa delicatissima*, *Merismopedia tenuissima* and *Microcystis flosaquae*. Technosols are inert soils prepared with components similar to those of natural soil. They have higher specific adsorption capacity of organic phosphates and organic solubles and were selected according to the level N and P. A limnocorral of two meters in diameter was installed in the lake for the experiment. Eight kg bags with Technosols were installed at 0.5, 1.0, 1.5, 2.0 and 2.5 meters depth. Our results show that adsorption and ion exchange interact with the adsorbent surfaces, and that they adhere nutrients. Technosols thus permit the reduction of phosphorus in water. A consequence of the adsorption of N and P by Technosols is a strong reduction or even disappearance of some species of cyanobacteria, shown by the laboratory results .

POSTER 003: INDUSTRIAL MINERAL DUST FROM SI AND SI-FE FOUNDRIES, ITS REGIONAL DISTRIBUTION, MINERAL AND CHEMICAL COMPOSITION

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Key words: Metallurgic industry, minerals, heavy metals, air dust, pollution

Introduction: At the middle course of São Francisco river basin Si- and Si-Fe foundries are located in the Pirapora County. This foundries cause notable environmental impact, visible and healthy, due to the emission of smoke very rich in particles whose deposition on the surface can cause adverse effects on water, soil, plants and the population health.

The electro-thermal production process with the input, the output and the principal contamination points were investigated and samples of the smoke from the processes analyzed by XRD and microprobe.

This work has as main goal to present a characterization of compounds released into the atmosphere by the metallurgical industry in Pirapora by microprobe analysis.

Sampling was executed directly before and after the filter system of the chimneys and at some distance from the source in principal wind direction. Sampling were performed by adhesive surfaces sampler for particles >50 - 10 μ , and laser sampler for PM 10, 5 and 2.5. The sampling was executed for 18 month.

Results:The data analysis has revealed that two distinct observed types of smoke, white and black have distinct mineral composition. The first is composed principally of amorphous SiO₂ (<80%) and crystalline SiO₂ (<15%), and the second by amorphous SiO₂ (<55%) and crystalline Fe₃O₄ (~40%) together with less amounts of carbon, organometallic compounds, argillite, barite and Cr-compounds.

With a greater distance from the source can be observed an alteration between foundries produced particles and natural particles like argillites, hematite and quartz.

Microprobe and TOF-SIMS analyses show distribution of different amounts heavy elements on the crystals, due to the type of prime material used.

The mineral and chemical composition and its influence over the environment are discussed.

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POSTER 103: PALEOECOLOGICAL INVESTIGATIONS IN THE PAMPA SECA, ARGENTINA BASED ON A MULTI-PROXY APPROACH

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The Pampa Seca is a preferential area for the reconstruction of the younger quaternary environmental evolution. It contains more than 200 water-filled deflation pans, which provide (1) geomorphological archives containing information about the past wind systems concerning the quality (direction) and quantity (the volume of transported material); and (2) lake sedimentary archives, covering information about the ecology of the environment (palynomorphs and charcoal). Laguna Nassau, one of those water-filled deflation pans, is located at the northeastern edge of the Pampa Seca. Radiocarbon dating suggests that the deposition of lacustrine sediments in this pan started not before 1630 +/- 35 BP. We conducted a multi-proxy approach with the aim to provide a high-resolution study of the past 1600 years in order to reconstruct environmental and vegetation changes related to geomorphological evolution and climatic conditions. The pollen spectra consists primarily of three groups of taxa, (1) the surrounding grassland and sand dune vegetation, (2) the xerophytic woodland, the so-called Caldenal, and (3) the local vegetation, represented by semi aquatic and aquatic taxa (*Typha*, *Ruppia* and *Potamogeton* types). The curves of other palynomorphs like *Botryococcus* and *Pediastrum* along with those from fungus reflect variations in the stability in water level/depth and environmental conditions such as moisture and salinity over time. The geochemical and geophysical analyses and macroscopic charcoal show that fire played a significant role during warm periods which coincide with a lowering water level suggested by palynological spectra; also these analyses indicate that the implementation of agriculture yielded the occurrence of erosional processes that have induced a strong change over the environment.

TALK 131: DEPOSITIONAL ENVIRONMENT OF MAASTRICHTIAN (LATE CRETACEOUS) DINOSAUR-BEARING DELTAIC DEPOSITS OF THE DOROTEA FORMATION, MAGALLANES BASIN, SOUTHERN CHILE

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The Cretaceous stratigraphy of the Ultima Esperanza District, southern Chile, is exposed parallel to the adjacent fold-thrust belt of the Patagonian Andes and reflects the evolution of the Magallanes retroarc foreland basin. The final filling of the basin is known as the Dorotea Formation which represents a delta system of Maastrichtian–Danian age. The unit consists of shallow-water shelfal and deltaic strata and forms the topset of large-scale southward-progradating shelf-and-slope clinofolds. The Dorotea Formation contains marine invertebrates, plants, and rare marine reptilians (e.g. mosasaurs). In addition, abundant dinosaur remains, among them several partially articulated hadrosaurs, were recently recorded from the Dorotea Formation by INACH expeditions carried out in 2012 and 2013 to the El Puesto locality in the Río de las Chinas valley, at approximately 4.2 km southeast of the border to Argentina. The new findings represent the southernmost known documented dinosaurs in South America and are associated with well preserved plant remains, including the oldest South American *Nothofagus* leaf imprint.

Here we reconstruct the depositional environment and sedimentary facies of the dinosaur- and *Nothofagus*-bearing strata. Based on three stratigraphic columns with total thicknesses of 485 m, 211,5 m and 211 m, depositional sequences at El Puesto are divided into four cyclic units of 65–303,5 m thickness. Each unit is separated by morphologically resistant sandstone and conglomeratic ridges up to 14,5 m thick which crop out on top of fine grained sediments several to up to 129 m thick. These units reveal upward-coarsening lithologies characteristic of a southward progradation of the deltaic succession. Lithofacies include mudstone, shale, fine- to medium-grained structureless sandstone, irregular and cross-bedded as well as trough cross-stratified medium- to coarse-grained sandstone, and horizontally bedded conglomerate. These lithologies represent fine-grained prodelta or delta-plain environments and underlie wave-dominated delta-front mouth bar sandstone or delta lobe sandstone, subaqueous delta-plain distributary-channels and interdistributary deposits. Conglomerate layers are interpreted as fluvial deposits of a braided river, or stream-channel alluvial fans. Storm deposits in a shoreface or foreshore position were inferred from coquinite layers and calcareous concretions containing abundant shell fragments. *Panopea* (*Panopea*) *inferior* WILCKENS 1905, *Panopea* sp. and *Pterotrigonia* (*Rinetrigonia*) *windhauseniana* (WILCKENS 1921) indicate shallow-water marine conditions and a late Cretaceous age, while *Modiolus* sp. indicates brackish environments for the uppermost part of the measured sections, for which a Paleogene age is indicated by *Venericardia* sp.

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TALK 216: LOWER UPPER CRETACEOUS $\delta^{13}\text{C}$ STRATIGRAPHY, THE MOTHER OF ALL OAE 2 AND TECTONO-SEDIMENTARY EVOLUTION IN NE MEXICO (N.L.)

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Albian to Lower Coniacian strata are exposed in the form of (in ascending order) the Cuesta del Cura Formation (CCF: slumped pelagic micrites), the Agua Nueva Formation (ANF: C_{org} -rich black marls and limestones) and the San Felipe Formation (SFF: siliciclastic marls, limestones, volcanic ashes) in the Sierra Madre Oriental fold belt (NE Mexico). Biostratigraphy is crude and previous dating especially of the Cuesta de Cura and Agua Nueva formations (Ice & McNulty 1980) cannot be confirmed. This contrasts excellent biostratigraphic data from the Sierra Madre Oriental foreland near Saltillo (Ifrim & Stinnesbeck 2008). To date lithofacies turnovers, the position of OAE 2 and tectono-sedimentary events, a $\delta^{13}\text{C}$ framework based on five localities was established between Linares and Monterey (distance ca. 150 km). The resulting curves were calibrated against $\delta^{13}\text{C}$ events from biostratigraphically well-dated European reference sections. 21 isotope events were recognized. The facies turnover from the CCF to the ANF corresponds to an isochronous major facies change and sequence boundary in Europe (here: *geslinianum* Sequence boundary). It likewise marks the base of the OAE 2 carbon isotope excursion, which has a thickness of ca. 100 m in the working area. This is the most expanded onshore OAE 2 occurrence in C_{org} -rich facies world-wide. Furthermore, the Hollywell Event (Lower Turonian), the Pewsey (Middle Turonian), Hitch Wood (Upper Turonian) and Navigation (Lower Coniacian) events are documented. Composite sections from the Huasteca Canyon suggest a thickness of ca. 300 m for the ANF. The SFF starts in the basal Upper Turonian around the LO of *Helvetoglobotruncana helvetica* and, crossing the Navigation Event (approximate Turonian/Coniacian boundary interval), ranges at least into the Lower Coniacian. The record of Lower Coniacian inoceramids (Seibertz 1985) from the upper SFF is in accordance with this data. Increasing accumulation rates from ca. 27 mm/ky (CCF) to ca. 200 mm (ANF) in the working area are not observed in the Sierra Madre Oriental foreland, where only 4 m thickness occurs from the base Turonian to the base of the *nodosoides* Zone (working area: ca. 80 m). Slumping in the CCF and the onset of strong regional differential subsidence with high accumulation rates detached from global sea-level are interpreted to result from pull-apart movements due to strike-slip tectonics along the San Marcos and Walper (Mojave-Sonora) megashears. Interestingly, contemporaneous tectono-sedimentary events occur in the European shelf areas, and the occurrence of a short-termed tectonic pulse on both sides of the Atlantic might be expression of a global signal (accelerated break-up of Pangaea, increased spreading rates?).

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TALK 013: STUDY OF ROCKS FROM THE SUBDUCTION CHANNEL BELOW THE LATE PALAEOZOIC ACCRETIONARY PRISMS OF CENTRAL CHILE: STEADY COOLING AFTER THE ONSET OF SUBDUCTION

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During late Palaeozoic times an accretionary system consisting mainly of greenschist facies metapsammopelitic rocks with minor mafic intercalations developed in central Chile between latitudes 30°S and 42°S. A temporal change from an early frontal (Eastern Series) to a later basal accretion mode (Western Series) is the typical characteristic of these accretionary prisms^{1,2}. This is interpreted as due to steady cooling of the convergent margin³. During the basal accretion stage the former frontal accretionary system is incorporated into a magmatic arc forming part of a paired metamorphic belt with the high-pressure basal accretionary prism in the west^{4,5}. At four different localities in central Chile lenses with exotic rocks of about 100 m size were intercalated within basally accreted units^{1,4,5,6}. Whereas frontally accreted units show variable peak metamorphic conditions of 280-320°C, 4-6 kbar¹ and basally accreted units of 350-430°C, 6-9 kbar^{4,6,7}, conditions in the exotic blocks range between 350 and 750°C, 10 and 16 kbar^{1,4,6}. At Los Pabilos (lat. 41°S) an anticlockwise PT-path was proved with formation of a garnet-hornblende assemblage at 340 ± 2 Ma (Lu-Hf) and isobaric cooling to an overprinting glaucophane-phengite assemblage formed at 305 ± 2 Ma (Rb-Sr)⁶ contrasting the ages of metamorphism of the surrounding basally accreted rocks around 250 Ma (Rb-Sr)⁸. At 35°S lat. phengite in an exotic block formed at 319 ± 2 Ma (Ar-Ar)⁵ and at 32°S lat. at 303 ± 2 Ma (Ar-Ar)¹ contrasting peak metamorphic ages of the surrounding basally accreted rocks around 300 Ma⁵ and 279 Ma¹, respectively. The exotic blocks, which show strong non-coaxial internal deformation, were formed in a subduction channel at a convergent margin. First onset of subduction under a still hot mantle wedge in central Chile occurred around 340 Ma and rocks in the subduction channel cooled isobarically at depth for about 40 Ma by underplating of later subducted cooler material⁶. Afterwards these rocks were exhumed by forced flow and incorporated into the basally accreted rocks that were mainly deformed by pressure solution. At 292-298 Ma blueschist formed at the transition between the subduction channel and the accretionary prism indicating that the subduction channel cooled to 350-380°C at 11 kbar at that time^{4,5}. Due to steady accretion and subduction of cold sediments after the formation of the convergent margin at 340 Ma the entire margin cooled at a rate of about 10°C/Myr.

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TALK 183: ANDEAN MAGMATISM FROM CRUSTAL TO CRYSTAL SCALE

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Our field and laboratory work since 1986 in the Central Andes involved supportive colleagues and collaborators, many students, and good friends. It has resulted in a body of work that attempts to characterize aspects of Andean magmatism through time and space over more than 1500 km and from 35 Ma to present. Magmatism in the „modern“ Andes, i.e. since uplift and crustal thickening started 35 Ma ago, is initiated by voluminous plateau-forming ignimbrites. These reflect episodes of mantle and crustal melting which migrate from N to S from 25 - 10 Ma. Compositional and isotopic variation of Andean andesites, that follow the ignimbrites, reflect distinct crustal domains and different lithologies that were assimilated at conditions of increasing pressure while the crust was thickened to 70 km during Andean orogeny.

Isotope compositions of magmas and Proterozoic basement allow to estimate the proportion of juvenile to recycled crustal input (20 to 50% at 30 to 90 km³/km²*Ma) and thus to constrain the role of magmatic addition to crustal thickening during the past 35 Ma to less than 10%.

The extreme climate of the Atacama desert is an ideal playground to link processes of uplift, erosion, valley incision, and sedimentation and the way these are linked to, and constrained by, the composition and age of volcanic rocks. Geological and geochronological evidence date both, fossil ignimbrite surfaces on the Western Andean slope and the onset of formation of deep canyons to around 10 Ma, which is consistent with tectonic models and sedimentary records.

On the other end of scale, the evolution of individual magma batches, their sequence and evolution in individual Andean magma systems were reconstructed from micro meter zonation features in magmatic phenocrysts, high-resolution geochronology and U-series isotope analyses.

This talk presents a summary of our results over the past 25 years.

TALK 165: GRAVITY AND MAGNETIC ANOMALIES ASSOCIATED WITH GEOLOGICAL STRUCTURES IN THE NORTH OF MEXICO

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There are several conspicuous magnetic anomalies in the north-central part of Mexico. The most remarkable and continuous anomaly extends for more than 600 km in a WNW direction across several states and it apparently dies or is masked by high frequencies related to the extensive Sierra Madre Occidental volcanic field. This anomaly roughly corresponds to the San Marcos fault, a major structure that separates the Coahuila Platform from the Coahuila folded belt. Some of the folds occur around intrusive complexes as in the San José del Bosque area, where a volcanic complex and a sub-volcanic intrusive are exposed. In some areas, the deformed conglomerates appear to be re-folded. Along the area where we began our investigation there are numerous NS- and EW-trending folds exposed along a NS belt on the eastern limit of the closed playa-lake basin. Some of the exposed folds drape around sub-volcanic intrusives or near Cretaceous sedimentary rocks. This fact suggests that both early Tertiary intrusive and Mesozoic rocks acted as resistant elements during the deformation of the Ahuichila conglomerates. Our hypothesis is that a basement block controlled sedimentation during the Jurassic and Cretaceous, and later, in the Early Tertiary, is influenced the deformation style both in the Coahuila Folded Belt and within the Coahuila Block. We believe that the complex structural features in and around our study area were formed mainly during the Paleocene-Early Eocene Laramide Orogeny and forceful injection of sub-volcanic intrusives in the Late Eocene-Early Oligocene.

Comparing of magnetic anomalies with paleographic maps shows that they may be related to the basement of Coahuila Peninsula during Jurassic and especially to the Coahuila Island in the Early Cretaceous. The most remarkable feature in the gravity is that the region can be divided in two domains and the boundary corresponds with the belt of deformed Ahuichila. The gravimetric lows in the NW and SE parts of the area correspond with closed basins where large playa lakes exist or existed in the past. Our tentative interpretation of the gravity is related with Basin and Range extension which was overprinted on the Laramide structural grain both in the Coahuila Fold Belt and to a lesser extent on the Coahuila Platform. Northwest of our study area is the Camargo Volcanic field and the Bolsón de Mapimí. Plio-Pleistocene normal faulting is obvious in the Camargo Volcanic Field. The Bolsón de Mapimí is a large Basin and Range feature. Both sets of structures probably were reactivated by activity along the San Marcos fault. Farther south in our study area, the geomorphic features related to Basin and Range faults are less obvious probably because these structures have remained inactive for a long time.

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TALK 135: PALAEOMAGNETISM AND $^{40}\text{Ar}/^{39}\text{Ar}$ DATING FROM LOWER JURASSIC ROCKS IN GASTRE, CENTRAL PATAGONIA: FURTHER DATA TO EXPLORE TECTONOMAGMATIC EVENTS ASSOCIATED WITH THE BREAK-UP OF GONDWANA

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New $^{40}\text{Ar}/^{39}\text{Ar}$ data indicate ages of c. 185 Ma for the Lonco Trapial volcanic field in Gastre (Page and Page, 1993), north–central Patagonia, implying that this andesitic unit is roughly coeval with the Marifil silicic province (Pankhurst and Rapela 1995) that crops out in the eastern part of northern Patagonia. These volcanic fields are therefore roughly coeval with the Karoo–Ferrar large igneous province, further contributing to the huge, 185–180 Ma magmatic outpouring in southern Gondwana. The comparison of palaeomagnetic results from the unit with Early Jurassic reference palaeopoles suggests that Gastre records a small, anticlockwise finite rotation with respect to stable South America. This contrasts sharply with the large clockwise rotation recorded by roughly coeval dolerites from the Falkland/Malvinas Islands (Taylor and Shaw 1989) and argues against a direct relationship between the rotation of the islands and the tectonic activity in Gastre that was previously suggested in the literature (Rapela et al. 1992, Rapela and Pankhurst 1992). The results support previous suggestions that the Gastre Fault System is not the locus of major strike-slip displacement activity in the Jurassic (von Gosen and Loske 2004, Zaffarana et al. 2010, 2012). Taken as a whole, palaeomagnetic data from Patagonia suggest a more complex than previously thought pattern of distributed and variable deformation during the early stages of Gondwana breakup. The crustal block boundaries in the region remain cryptic.

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POSTER 219: ICHNOLOGICAL SIGNATURES OF PROGRADING AND RETROGRADING PARASEQUENCE SETS: AN EXAMPLE FROM THE PALEOGENE OF THE ARAUCO BASIN, SOUTH-CENTRAL CHILE

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The Paleogene marine succession of the Arauco Peninsula, south-central Chile, is commonly divided, from base to top, into the Curanilahue, Bocalebu, Trihueco, and Millongue formations. The gradual transition between the Bocalebu and Trihueco formations, associated with a regressive event, shows a vertical change from distal and proximal prodelta to distal and proximal delta front deposits, forming a progradational parasequence set and having a diagnostic trace-fossil distribution. The ichnofauna is dominated by feeding (e.g., *Asterosoma*, *Rosselia*, *Dactyloidites*, *Macaronichnus*) and dwelling (*Ophiomorpha*) traces. High sedimentation rates are reflected in equilibrium structures (as seen in *Conichnus*), and poorly preserved escape trace fossils. This succession is covered by tide dominated delta plain facies and coal layers. This upper part of the succession is either unbioturbated or contains a few ichnotaxa (*Ophiomorpha* and *Skolithos*). A regional transgressive surface coincident with the base of the Millongue Formation, indicates the beginning of the transgressive systems tract, characterized by a retrograding parasequence set. This major event resulted in the abandonment of the Trihueco delta system. This interval shows typical signatures of storm-wave influence (hummocky-cross stratification, erosional truncations, horizontal or parallel lamination), as well as soft-sediment deformation structures. Deposits of strongly storm-dominated settings show low ichnodiversity (*Ophiomorpha nodosa*, *Cylindrichnus*, *Thalassinoides* and *Teichichnus*). Under lower degrees of intensity and frequency of storms, a fair-weather suite is developed, illustrating the archetypal *Cruziana* Ichnofacies (*Asterosoma*, *Rosselia*, *Planolites*, *Chondrites*, *Palaeophycus*, *Thalassinoides*, *Teichichnus*, *Rhizocorallium*). This ichnofacies varies along strike, probably in relation with shoreline paleogeography. This succession is capped by shelf and turbiditic deposits, exhibiting a low to moderate ichnodiversity (*Zoophycos*, *Chondrites*, *Phycosiphon*) and illustrating the *Zoophycos* Ichnofacies. A *Glossifungites* Ichnofacies is locally developed at the base of the Paleogene Lebu Group (K-T boundary; *Gastrochaenolites*) and in the various associated transgressive surfaces (*Thalassinoides*).

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POSTER 134: GEOCHRONOLOGY AND GEOCHEMISTRY OF JURASSIC VOLCANIC ROCKS IN NORTHEASTERN MEXICO: IMPLICATIONS FOR THE ORIGIN AND EVOLUTION OF THE NAZAS ARC

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Volcanic successions outcropping in the states of Coahuila, Durango, Zacatecas, San Luis Potosí, Nuevo Leon and Tamaulipas, in northeastern Mexico, underlie Upper Jurassic and cretaceous marine clastic and carbonate rocks. At the different localities the same volcanic rocks rest on continental or marine Triassic sedimentary rocks as well as Precambrian or Paleozoic metamorphic rocks. The volcanic rocks are mainly rhyolite, rhyodacite, dacite andesite and basalt-andesite and occurred as lava flows, dikes, domes and pyroclastic rocks like breccias, ash flow tuffs, and also epiclastic deposits. In some locations of Tamaulipas, these volcanic rocks are interbedded with Lower to Middle Jurassic fluvial redbeds. Mean while a similar relation with shallow marine marginal beds occurs in lower Jurassic rocks of Sierra de Catorce, towards the Mesa Central province. The formal name for this volcanic succession, including some conglomeratic and red sandstone to siltstone layers is Nazas Formation and its type locality is the vicinity of Villa Juarez, Durango.

Although several studies by diverse authors were performed in the past about these rocks, still remains uncertainty about the age of volcanism in different locations, which so far have just been related stratigraphically by some limited isotopic data obtained by the different authors that used mainly the K-Ar method in whole rock, some $^{40}\text{Ar}/^{39}\text{Ar}$ and a few U-Pb ages in zircons. It is important to note that many of these data (mainly the K-Ar and $^{40}\text{Ar}/^{39}\text{Ar}$) are just overheating ages.

For our research we performed new petrographic and geochemical studies, as well as several U-PB ages obtained by the LA-MC-ICPMS technique applied to zircons. The results reflect alkaline character of the volcanic rocks and confirm ages between 170 and 195 Ma. The stratigraphic position, geochemical analysis, and the obtained ages support the genetic relation of the entire studied rocks with a continental volcanic arc that was active along the ancient western margin of Pangea during the Lower to Middle Jurassic.

TALK 118: THE UPPER JURASSIC LA CAJA AND LA CASITA FORMATIONS IN MEXICO – NEW DATA ON PALAEOONTOLOGY AND PALAEOBIOGEOGRAPHY

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In northeastern Mexico, the Upper Jurassic to lowermost Cretaceous La Caja and La Casita formations are well known for their abundant and well-preserved faunal content of marine vertebrates and invertebrates. The latter include conspicuous ammonites, aptychi and bivalves from the concentration Lagerstätte at Gomez Farías. Identified ammonite taxa allow for a stratigraphic assignment to the Lower Tithonian “*Hybonoticerias Zone*” of Imlay (1980) and to the Lower Tithonian “*Virgatosphinctes mexicanus-Aulacomyaella neogaeae Assemblage*” of Cantú-Chapa (1971). Most invertebrates are endemic to the Upper Jurassic Gulf of Mexico region (e.g., *Aulacosphinctoides potosinus*, *Pronicerias jimulcense*) (Verma and Westermann, 1973; Myczyński, 1989), whereas cosmopolitan taxa (e.g., *Hybonoticerias hybonotum*) only form a minor constituent of the assemblage. The ammonites *Phylloceras knoxvillense* and aptychi (*Lamellaptychus* of *Haploceras* aff. *transatlanticum*, *Laevaptychus longus*, *Laevilamellaptychus* sp.) have not been formally described previously from Mexico.

The bivalve *Liostrea roemeri* was discovered in the Kimmeridgian “*Idoceras Beds*” and the Tithonian “*Virgatosphinctes Beds*” in Nuevo León, always attached to ammonites (Zell et al., submitted).

Belemnite-rich intervals were identified in several sections throughout the northern part of the Sierra Madre Oriental (Zell et al., 2013), including the boreal *Cylindroteuthis* and a new species of *Rhaphibelus*, which was previously thought to be restricted to Europe. *Cylindroteuthis* is restricted to specific units of the La Caja/La Casita formations and indicates intermittent faunal exchange between the Boreal Pacific and the Gulf of Mexico. *Rhaphibelus* only occurs in a short interval in the earliest Berriasian rich in *Calpionella alpina*. The co-occurrence of these Tethyan elements provides evidence for the hypothesis that a new connection, the Hispanic Corridor, opened near the Jurassic-Cretaceous boundary between the Gulf of Mexico and European Tethys.

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POSTER 113: UPPER JURASSIC AMMONITES OF NORTHEASTERN MEXICO COVERED BY THE EPIZOIC OYSTER *LIOSTREA ROEMERI*

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The Upper Jurassic to lowermost Cretaceous (Kimmeridgian-Berriasian) hemipelagic La Casita Formation in northeastern Mexico is widely known for its diverse and abundant assemblage of well-preserved ammonites. During recent years, numerous well-preserved specimens of *Liostrea roemeri* (Quenstedt, 1843) were collected from the La Casita Formation in Nuevo León. All specimens identified were attached to the shells of following ammonites: Kimmeridgian *Idoceras* sp. and Tithonian “*Virgatosphinctes*” aff. *communis* Spath.

Attachment to both sides of the ammonite shells, taphonomic and epizoan-to-ammonite orientation analyses as well as shell-size measurements indicate that the oysters were attached to living hosts; the presence of distinct bivalve growth cohorts is here interpreted to reflect two generations of epizoic settlement (Zell et al., submitted). An initial cohort of oysters settled on the inner whorls of ammonites and was followed by a second set of smaller individuals on the outer whorls.

A pseudoplanktonic mode of life of *L. roemeri* attached to ammonites may reflect a strategic response to oxygen-depleted conditions near the seafloor of the Upper Jurassic La Casita Sea (Schumann, 1988). The species was previously described from Europe, also attached to ammonites (e.g., Quenstedt, 1843, 1858; Sauvage and Rigaux, 1872; Scholz et al., 2008).

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Zell, P., Beckmann, S. and Stinnesbeck, W. submitted. *Liostrea roemeri* (Ostreida, Bivalvia) attached to Upper Jurassic ammonites of northeastern Mexico. Palaeobiodiversity and Palaeoenvironments.

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