Abstracts

INFLUENCE OF THE STRUCTURAL GEOMETRY ON THE STREAM NETWORK IN THE QUATERNARY LERMA VALLEY, CENTRAL ANDES, NW ARGENTINA

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The Lerma Valley is an intramontane structural depression within the Central Andes in northwestern Argentina. The Lerma Valley initiated its formation in relation to Tertiary crustal shortening along the Andes. The studied area is located in the Eastern Cordillera, linked to block-faulted uplifts underlain by moderately to highly indurated metasedimentary and sedimentary rocks (Turner and Mon, 1979). The highest topographic elevations occur in the Lesser and Obispo Ranges along the west with 4200 m a.s.l. The Lerma Valley is limited in the north by Vaqueros Range (1900 m), and to the east by the Mojotoro (1900 m) and Castillejo (1600 m) ranges. The Obispo, Lesser and Mojotoro ranges are dominantly underlain by Precambrian-lower Paleozoic basement rocks. Southward, this substrate dips beneath Mesozoic-Cenozoic sedimentary strata in the Castillejo Range and southern Obispo Range. In the north, the Vaqueros Range interposes a wedge of Cenozoic strata of the Pliocene-Pleistoce Piquete Formation.

During the Quaternary, the Lerma basin had a particular evolution. In the Pleistocene this basin became landlocked to the east by the elevation of the Mojotoro and Castillejo ranges. An endorheic fluvial network delivered sediments to an internal basin characterised by lacustrine deposition. The tectonic deformation in the region has been suggested to play a relevant role in the configuration and evolution of the drainage. It is our purpose to show that drainage basin evolution and geometry, and structural development have affected each other.

The courses of the rivers have been forced to migrate to a position at, or near its present eastward courses, flowing across the future site of the Mojotoro Range. In northern Lerma Valley, four wind gaps cross the Mojotoro Range indicating incision into the emerging topographic barrier; visual analysis supports correlation of river courses west of the Mojotoro Range with the wind gaps. The Mojotoro water gap may have persisted due to the effect of the Mojotoro transverse fault in decreasing the resistance to erosion of the substrate by the time Medeiros terraces developed underlain the Vaqueros anticline influence. In southern Lerma Valley, the Juramento River issues from the Lerma Valley along synclinal and fault-related lows. The ancient Juramento River outlet developed as a subsequent stream.

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USE OF TEM BIOTITE-SCHIST AND AMPHIBOLITE, RESIDUE OF EMERALD MINING IN THE NOVA ERA REGION, MINAS GERAIS STATE AS CORRECTIVE MATERIAL IN AGRICULTURE: VIABILITY AND EFECTS

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The accelerated growth of the world population is promoting a significant increase in the industrialization process, tends as consequence the intensification of use of natural resources and generation of waste number of residues which may cause countless environmental problems, with critical consequences for production of food.

Some of these residues created by mining possesses have peculiar mineralogical and chemical composition, which are demanded by agricultural in the form of correctives and fertilizer.

Some of the residues like carbonates or from dimension stone producing processes are still used in agriculture to reduce governmental import costs and to better the production.

The biotite-schist (biotite/flogopite-anfibolite-schist, amphibolites, feldspar-amphibole containing rocks s. l.), originated from metamorphized and intemperized ultramafic rocks are rich in Mg, Ca, Ti and $\pm$P, and other trace elements which are important for the plant growth or the disponibilization of nutrients from soil.

Initiated greenhouse and field test with different cultures show the positive effect of this corrective material in relation of growth velocity and amount of produced harvests.

The quantity of mining activities in this area, one of five in Brazil, with an annual production of 10.000tons of rejected material permits probably the use on more than 2000ha area/year, substituting a big amount of import of correctives and fertilizers, preserving important amount of funds.

After pilot studies it is necessary to obtain official permit for use, by submitting the material to EMPRAPA approbation.

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EARLY CARBONIFEROUS MID-ALKALINE GRANITE, FAMATINA (NW ARGENTINA): CRUSTAL GROWTH BY ADDITION OF JUVENILE MATERIAL

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During the Carboniferous a minor but widespread type of mid-alkaline, mainly granitic, magmatism occurred along more than 1000 km in the Sierras Pampeanas of NW Argentina. It is represented by scattered plutons with usually sub-circular forms. A newly discovered pluton representative of this magmatism is reported from Cerro La Gloria on the western flank of the Sierra de Famatina. Separated zircons from one sample were dated by U–Pb SHRIMP, 12 analyses yielding a weighted mean $^{238}U/^{206}Pb$ age of 349 ± 3 Ma (MSWD = 1.1). The pluton is circular with a radio of 5 km and an area of ca. 80 km^2. Host rocks are Early Ordovician plutonic rocks. Contacts are sharp and irregular on the local scale. The main plutonic facies is a pink to red, porphyritic to inequigranular, medium to coarse grained biotite syenogranite consisting of microcline (43-49%), quartz (32-41%) and plagioclase (Ab_{88-95}) (11-16%) (n=4), with biotite, ferro-edenite, magnetite, ilmenite, epidote, zircon, allanite and sphene as accessory minerals (< 2%). The Cerro La Gloria samples are felsic (SiO_2 = 75-82 %). On the alkalis vs. silica classification diagram, they plot dominantly at the silica-rich end of the boundary between the alkaline granite and granite fields. They are intermediate between the midalkaline and subalkaline lineages (after Rittmann 1957). The granitic rocks are metaluminous to slightly peraluminous (ASI=0.96-1.05), although they have a relatively high agpaitic index (AI=0.90-0.98). They also are poor in CaO (0.3-0.8 %) and extremely rich in FeO^t relative to MgO (FeO^t/(FeO^t+MgO=0.9-1.0). The granitoids are enriched in TiO_2 relative to MgO (where TiO_2/MgO>1) and they are moderately enriched in total alkalis (8.0-8.7 %), with relatively high K_2O content (K_2O/Na_2O=1.1-1.4). High Field Strength elements are relatively abundant. All the studied plutonic rocks are plot in the A-type granite field in the discrimination diagram of Whalen et al. (1987). REE patterns are flat or slightly enriched in LREE (La_N/Yb_N 2.6-20.3) and have very significant negative Eu-anomalies (Eu_N/Eu^*_N = 0.01-0.33) suggesting plagioclase fractionation in the magma or retention in the source. Three determined εNdt values range between -0.58 and 0.46. In conclusion, the Carboniferous Cerro La Gloria magma was largely derived from juvenile material of mantle character, probably by melting of underplating basaltic material in the lower crust with subsequent fractionation. In comparison with Carboniferous granitoid outcrops to the east (e.g., Dahlquist et al., 2010), the Cerro La Gloria pluton shows a lesser contribution from evolved crustal material, suggesting a probable thinning of the crust in this region.

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INSIGHTS ON SUBDUCTION EROSION PROCESSES THROUGH INVESTIGATION OF 2D ANALOG MODELS WITH SYSTEMATICALLY VARYING PARAMETERS

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Subduction erosion process became accepted since 1970, when lack of sediments and truncation were documented [1]. Nowadays more than half of the convergent margins around the world have been classified as erosive. As the erosive process destroys structures and consumes sediment its investigation proves to be particularly difficult and the internal dynamics of such forearcs is yet uncertain [2]

This work is the first attempt to address the influence of the inherent characteristics of forearcs as a possible first-order patron controlling their mechanics and dynamics. The mass transfer modes are studied by exploring forearc strengths and the influence of the width of a gap at the base of the backwall, through which sediment is leaving the system. The erosive mass-transfer processes quantified are frontal and basal erosions, accretion, and tip retreat. Our 2D-experiments involve the usage of a sandbox of 3 m by 20 cm in size with transparent sidewalls. We quantify the structural evolution and the particle displacement within the wedge by monitoring with Particle Image Velocimetry. A conveyor belt with a high friction surface moves backwards converging a sand wedge-shaped body toward the rigid backwall.The sand wedge represents the crustal wedge, whereas the conveyor belt simulates the subducting plate. The scale factor corresponds to 105, where 125 cm are equivalent to 125 km in a natural forearc.

The tested configurations were: A) variable widths of the gap at the bottom of the backwall; B) wedges made of different mixtures of sand and sugar. The sugar increases the internal friction of the wedge, making it stronger.

The results on the one hand show an invariant tip retreat in both series. On the other hand, an increase of the strength of the wedge results in a decrease of both, frontal erosion and accretion. The frontal and basal erosion values show lower amounts of eroded material as the gap decreases, whereas basal erosion was increased with a higher internal friction. As a consequence, wedges with higher internal friction and large gaps produced erosion ratios (basal erosion/frontal erosion) greater than 1, which agrees with values estimated in natural wedges [3]. Further, total erosion (i.e. frontal- plus basal-erosion) was favored with large gaps as well and stronger wedges showed lower amounts of erosion. From a structural point of view, stronger wedges developed a higher number of backthrusts at the frontal slope before reaching the steady state.

Our results provide information about certain features of the long-term evolution (~107 yr) of erosive forearcs with specific rheological or geometrical configurations and allow a comparison with observed characteristics of erosive margins.

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THE GARZÓN MASSIF, COLOMBIA – A POSSIBLE NEW ULTRAHIGH-TEMPERATURE METAMORPHIC COMPLEX IN NORTHERN SOUTH AMERICA

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The Vergel granulites, part of the Garzón Massif in SW Colombia, are known as part of a granulite province. Previous studies calculate peak temperature conditions of about 780°C (Jiménez-Mejía, 2003; Jiménez-Mejía et al, 2006). The present study considers the remarkable exsolution phenomena in feldspars and pyroxenes. Recalculated ternary feldspar compositions indicate temperatures around 900-1000°C just at or above the “artificial” ultra-high temperature – metamorphism (UHTM) boundary of granulites. The calculated temperature ranges of exsolved ortho- and clinopyroxenes support the existence of a UHTM event. In addition, Ti-in-Qtz thermometry indicates higher temperatures than the previous studies. It is the first known UHTM crustal segment in the northern part of South America. Although mean geothermal gradient of about 40°C km-1 could imply additional heat supply in the lower crust controlling these extreme coordinates of peak metamorphism, an alternative model is suggested. The formation of the Vergel granulites supposed to be formed in a back arc environment with a thinned and weakened crust behind a magmatic arc (Guapotón-Mancagua gneiss) followed by collision. In contrast, the adjacent Las Margaritas migmatites display “normal” granulite facies temperatures and are formed in a colder lower crust outside the arc and back arc influence. Back-arc formation was followed by inversion and thickening of the basin. The three units Vergel granulites, Las Margaritas Migmatites and Guapotón-Mancagua Gneiss, which forms the modern-day Garzón Massif, are juxtaposed during collision and exhumation. The collision leading to the deformation of the studied area is part of the Grenville orogeny leading to the amalgamation of Rodinia.

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TECTONOMAGMATIC EVOLUTION OF COSTA RICA, CENTRAL AMERICA

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A comprehensive field and recompilation of previous (since 1968) and new ages determinations (about 500 $^{40}Ar/^{39}Ar$, K/Ar, U/Th, Rb/Sr, U/Pb, and fission track thermochronology using zircon) of igneous rocks and their stratigraphic relationships, provides a complete picture of the magmatic evolution and igneous stratigraphy of Costa Rica, and some inferences about the age of the major metalogenetic events. The igneous rocks of Jurassic to Eocene age belong principally to the tholeiitic series, both, ophiolites and island arc. Intrusive to hypoabisal granitic to gabboic plutons, stocks, andesitic-doleritic dykes and sills are widely exposed in the Talamanca range (7.8-12.8 Ma), Cerros de Escazú (5.9-6.0 Ma), and less in Fila Costeña (16.8-18.3 and 11.1-14.8Ma), Montes del Aguacate (3.5 Ma) and Tilarán (5.2-6.4 Ma) ranges, emplaced during a gap in the volcanism in each range. Arc volcanism in the last 29 Ma are strongly episodic, with important eruptive peaks at 16-17, 4-6, 1-2, 0.4-0.6, and less 0.1 Ma, and regional lulls in volcanism at 0.1-0.4, 2.1-3 and 6.5-10 Ma. Arc rocks between 10-15 Ma are known only in southern Costa Rica and may be largely buried to the North. There has been a 30°counterclockwise rotation of the arc position between 15 to 8 Ma, with a pole of rotation centered on southern Costa Rica.

At 3.5 Ma, arc volcanism shut off in southern Costa Rica due to the subduction of the Cocos Ridge that started about 8 m.y. ago but adakite volcanism is more extended (0.95-4.2 Ma). Pliocene arc rocks (3.5-8 Ma) extend the length of Costa Rica, paralleled but slightly in front of the modern arc, following by the andesitic-basaltic Monteverde effusive event (1.1-2.1 Ma), which progressively retreated to the NE. The modern volcanoes grew mainly during the last 1 m.y., with episodes of cone/shield building at 0.85-1.4 Ma (Proto-Cordillera), a major event at 0.74-0.25 Ma (Paleo-Cordillera), and relative small but still active at 0-0.25 Ma (Neo-Cordillera) separated by variable 0.1-0.3 Ma intervals of dormancy (erosion), debris avalanche events and/or explosive silica volcanism. Explosive silicic eruptions are an integral part of the evolution of these composite volcanoes, with known ignimbrite-forming eruptions since 24 Ma, but particularly since 4 Ma. Alkaline rocks are subordinate and concentrated on the Caribbean side of Costa Rica, concentrate in five mayor pulses: alkaline dikes (5.82-6.49 Ma), small shield volcanoes and their equivalent subvolcanic intrusive (4.3-5.2 Ma and 3.06-3.60 Ma), small lava cones, lava field and cinder cones (1.21-2.01 Ma and 0-0.3 Ma).

Major primary mineralizations are possible to recognize but their age is still poor constrained: 1. Mezosoic deposits related to oceanic crust (podiform chromite, manganese nodules and Cyprus copper), 2. Orogenic early Cenozoic gold veins, later transformed in Pliocene placer deposits, 3. Epithermal (Au+Ag±Pb±Cu±Zn), porphyry and native copper (Cu±Pb±Zn) deposits related to subaerial volcanism and intermediate to felsic intrusions: ~22.9-22.2 Ma, ~16.4-15.3 Ma and ~5.6-3.5 Ma.

CLIMATE CHANGE AND WATER RESOURCES OF PARAGUAY

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In relation with the Regional Studies on the ERECC Economics of Climate Change, the impact and mitigation measures in the performance of Paraguay's water resources before the climate change have been analyzed.

A new methodology has been developed, following the thinking of IWRM (Integrated Water Resources Management), the defined value of moderate water stress below 1,700 m3/capita/year is taken. The new index of vulnerability relates the availability of the resource per capita with the value defined as water stress. In this index, the vulnerability is high when values exceed 50% and it is not vulnerable to values lower than 20%.

The results for the baseline, and for both scenarios A2 and B2 show that the source is not vulnerable and it only has a moderate vulnerability of 29% in B2, in 2100. The fundamental premise to make the economic resource valuable is the fact that it is scant and it has an assigned value, and since such condition is not met, an amount is not assigned.

The temperature increases gradually; for A2 scenario an increase of 4 º C for and B2 scenario an increase of 3 º C is expected by 2100. The rainfall in the A2 scenario decreases by mid-century to increase in 2100, while the B2 scenario, rainfall decreases over the century. Evapotranspiration is greater than the baseline due to the increase in temperature and precipitation. Surface run-off of water in the two scenarios is below the baseline, in the case of the A2 scenario, it decreases from 400 mm / year to 300 mm / year and for B2 scenario is reduced by half to 200 mm / year.

Among the major impacts, the following may be mentioned: health and production problems, accidents, economic losses and others which are caused by the lack of infrastructure (drinking water coverage and sewerage and effluent treatment, storm drains), education, lack of enforcement of existing regulations, limited management and monitoring capacity, overexploitation of aquifers, building dams without licenses, poorly constructed and abandoned wells, pollution by dumping household and industrial wastes, agrochemicals, among others.

Adaptation measures are known as "no regret" measures, which mainly refer to current identified impacts. Some of them are: improving infrastructure, management, monitoring, education, research, institutional strengthening and implementation of public policies, among others.

Paraguay must develop its own methods of assessment and evaluation, considering its peculiarities.

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DEGRADATION STAGES OF THE VEGETATION IN THE CHILEAN PATAGONIA AND POTENTIAL BIO-INDICATORS

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Notwithstanding the low population density of the Chilean Patagonia, the vegetation of this region experiences high anthropogenic disturbances. The main causes are the extraction of timber and fuel wood, as well as the use of the opened areas for grazing. A mosaic of different plant formations and communities results from the heterogeneous distribution of the disturbances. The reduction of biodiversity and the subsequent introduction of neophytes are the main potential impacts of the human activity in this region.

To understand the effects of grazing on the plant species diversity and composition, we carried out a vegetation survey in the locality El Manzano (47°17'S 72°48'W), on the eastern side of the Baker River. We collected 50 relevés (square plots of 16 m^2, estimation of species abundance in percentage cover) of the characteristic formations in the landscape (preferential sampling sensu Dengler et al. 2008). To determine plant communities, we analysed the vegetation matrix with a UPGMA clustering (Sokal & Michener 1958). For each resulting vegetation unit, we defined diagnostic species (potential indicators) according to their fidelity (phi coefficient; Chytrý et al. 2002).

Seven plant communities were determined by the classification analysis. The four communities represent a sequence in the grazing intensity or duration (use history). Along this sequence, the species richness declines, while the proportion of neophytes (allochthonous species) increases. Nevertheless, in the last stage of this sequence, both parameters remain more or less constant.

In conclusion, a sequence of grazing intensity-duration can be detected through characteristic plant communities. Single diagnostic species seem to be strongly linked to degradation stages, thus allochthonous species are good positive indicators of disturbance, as earlier stated by Ramírez et al. (1991).

The potential use of plant species as biological indicators of disturbance grading in relation to the corresponding changes in the soil conditions are discussed.

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PROVENANCE OF NORTHEAST MEXICAN SEDIMENTARY ROCKS DURING PANGEA FORMATION AND THE "HIDDEN" VOLCANIC SOURCE

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We present element-chemical compositions of Palaeozoic siliciclastic sedimentary rocks in northeast Mexico to reveal the provenance of Carboniferous to Permian strata. During this time, Pangea was formed through amalgamation of Laurentia and Gondwana. In present-day northeast Mexico, the Oaxaquia terrane, which was situated at the Gondwana and Rheic ocean margin in Early Palaeozoic time, represents a connecting link between the Laurentia and Gondwana parts of Pangaea. Sandstones of the shallow-marine, Lower Carboniferous (Mississippian) Vicente Guerrero Formation, the deep-marine, Upper Carboniferous (Pennsylvanian), carbonaceous Del Monte Formation and the turbiditic, Lower Permian Guacamaya Formation cropping out in Cañón de Peregrina ca. 10 km WNW of Ciudad Victoria (ca. 24°N, 99°W) presumably represent pre-collisional (Upper Carboniferous) to post-collisional (Lower Permian) Pangaea sedimentation. Both major oxide and minor element ratios reveal clear stratigraphic trends from the Lower Carboniferous into the Lower Permian. Although the grain size is similar, decreasing SiO_2/Al_2O_3 ratios from 8-20 to 3-5 occur, probably reflecting a change from a quartz-rich to a litharenitic composition. Ratios of provenance-indicative La/Sc and Th/Sc similarly decrease from 2-5 and 0.5-1, respectively, in the Lower Carboniferous to 0.5-1 and 0.1-0.3 in the Lower Permian. The chemical composition of the sandstones from the Cañón de Peregrina presumably reflects successively increased availability of the regional Early Carboniferous Aserradero Rhyolite as source rock. The results presented her support that the magmatic activity, which has been attributed to the closeness to Laurentia, occurred between deposition of the Vicente Guerrero and Del Monte formations. This is supported by the results presented here. The chemical composition of the volcanically influenced sediment units is typical for detrital input from a magmatic arc, although such a tectonic setting is known first from the Lower Permian – after deposition of the studied rock sequence in the Cañón de Peregrina. We also compare the Lower Permian turbiditic Guacamaya Formation with its volcanic input to assumed Lower Permian metasandstone and carbonaceous siltstones Aramberri (ca. 80 km NW of Ciudad Victoria) and on Sierra de Catorce (almost 200 km west of Ciudad Victoria), respectively. Here, SiO_2/Al_2O_3 ratios are 10-100 at Sierra de Catorce and 2-20 at Aramberri, values, which are more similar to the Carboniferous sandstones than to the coeval Guacamaya Formation, despite the lower grain size and metamorphic overprint, respectively. La/Sc of 1-10 and Th/Sc of 0.2-1 also are similar to the Carboniferous units. Apparently, material from the volcanic source, which was present in the vicinity, was not transported into the marine basin in the present-day west. Without the outcrops in the Cañón de Peregrina, the occurrence of Early Carboniferous magmatic activity may not have been identified. Hence, this study emphasizes, that provenance data must be interpreted carefully.

ENVIRONMENTAL GEOCHEMISTRY OF SURFACE WATER AND STREAM SEDIMENTS IN THE FORMOSO RIVER, TROPICAL AREA, MINAS GERAIS, BRAZIL

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The Formoso River is a tributary of the São Francisco River in the northern state of Minas Gerais. Its basin is home to more than 100 families that depend exclusively on its natural and environmental resources. Inserted in the Cerrado biome, its waters drain into huge estates with main tendency agriculture, directly influencing the physical and chemical characteristics of surface water and current sediment. In view of the natural features and anthropogenic features, the study assessed the concentration and distribution of heavy metals: Al, Mn, Fe, Cu, Cd, Cr, Ni, Pb and Zn along the longitudinal profile of the river, correlated their presence to the natural and anthropogenic interference, inferring about the environmental risks of heavy metals and on the restrictions of use.

Was collected 44 water samples (dry and rainy seasons) were analyzed the environmental quality *in-situ* and total metals, and results were compared to the CONAMA Resolution 357/05. The study revealed that in some respects, the concentrations of Fe, Al, Mn, Cd, Cr, are higher than recommended by Resolution 357/05, values of dissolved oxygen, temperature, hidrogenionic potential and turbidity, are also above the limit. We collected 22 sediment samples (dry and rainy seasons), the parameters analyzed were Cu, Cd, Cr, Ni, Pb, Zn, a chemical technique was used to extract partial acid reading was made by ICP-OES, the results were compared to the CONAMA Resolution 344/04. The levels of Cd and Cr are above the values recommended by the resolution. The characterization of mineral was made by X-ray, the geochemical analysis of rock types was performed by ICP-OES. The presence of these elements in the water column shows a natural enrichment along the longitudinal profile, whose main sources are the rock types. There is a strong link between the variables lithopedologic, the types of river channel and hydrodynamic the basin, with the distribution and transport of metals along the longitudinal profile of river.

The concentration of Cd, Cr, Cu, Zn, Ni and Pb in the water compartment are mainly derived from anthropogenic interference and a contribution of geological natural. Sediments, the clay fraction is retaining high concentrations of Cd and Cr. The morphological characteristics of the river channel and the hydrodynamics of the basin acted as an important mechanism for the distribution and transport of metals with sediment. In spite of various parameters analyzed lie within the standards, it is important to monitor these points, since that vary rapidly, in time and space.

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IMPACT AND SEDIMENTARY RECORD OF THE FEBRUARY 27, 2010, CHILE TSUNAMI IN SOUTHERN CHILE

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On 27 February, 2010 an earthquake with a magnitude of Mw = 8.8 occurred off the coast of central Chile. The triggered tsunami devastated a 600 km long coastline between Valparaiso in the north and Tirua, c. 180 km south of Concepcion. On broad coastal plains (e.g. La Trinchera) run-up heights reached about 10 m, along steep cliff coasts (e.g. Tirua) 30-40 m. Maximum inundation distances were in the order of 5 km, e.g. along the Rio Maule.

In a field study 4 weeks after the tsunami, we observed a large number of erosive and sedimentary structures, which are directly related to the run-up and back flow of the tsunami. Large-scale erosional structures were mainly formed by the back flow. At La Trinchera the backflow removed large tracts of tarmac (c. 8x8 m) towards the beach plain. At Isla Mocha, c. 30 km off the coast, erosion of a nearly 1 m thick cover of coastal sediments and soils during backflow exposed the Miocene bedrock. The eroded material was redeposited downstream in seaward prograding sediment fans with a thickness beween 10-15 cm. Parts of the eroded soils were transformed into rip-up clasts.

Besides fine-grained clays, silts and sands, the tsunami deposited boulders during run-up. On Isla Mocha, with run-up distances of 400-600 m and run-up heights of 20 m, boulders with weights of up to 12 t, and on average of about 250 kg, were moved from the tidal zone to new positions about 350 m inland and about 16 m above sea-level. On the mainland coastal plain of Bucalemu boulders from a nearby quarry had been unloaded in a big pile for construction of a breakwater prior to the tsunami. Boulders with a max. volume of 0.3 m^3 and a weight of 720 kg were transported landward by the tsunami by up to 155 m and were deposited in distinct groups. The arrangement in groups appears to have been controled by the local topography and the number of waves of the tsunami wave train.

THE U-PB AND HF ISOTOPE EVIDENCE OF DETRITAL ZIRCONS OF THE ORDOVICIAN OLLANTAYTAMBO FORMATION, SOUTHERN PERU, AND THE ORDOVICIAN PROVENANCE AND PALEOGEOGRAPHY OF SOUTHERN PERU AND NORTHERN BOLIVIA

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The Ordovician Ollantaytambo Formation represents one of only two known occurrences of Early Paleozoic volcanic rocks in southern Peru and northern Bolivia. It consists of mafic lapilli tuffs in the lower and shales and mature sandstones in the upper part. We present LA-ICP-MS U-Pb ages and Hf isotope data of detrital zircons from one of the the upper member sandstones in order to determine the provenance of the mature detritus, and to use the data to further define the paleogeography of the Ordovician basin in the northern Central Andes. The detrital zircon ages of the Ollantaytambo Formation range from 2013 Ma to 445 Ma. They are grouped mainly between 1400 and 1100 Ma (35%), 1100 and 900 Ma (14%), 770 and 650 Ma (14%), and from 500 Ma to 440 Ma (30%). Within these groups the main peaks are at 1249 Ma, 1052 Ma, 741 Ma and 459 Ma. The older groups correspond to major orogenic cycles recorded on the southwestern Amazonia craton, the Rondonia-San Ignacio, Sunsas, and Brazilian orogenies. The younger one reflects the activity of the early Paleozoic Famatinian magmatic arc known mainly from the southern Central Andes, but also recognized on the Arequipa Massif and in northern Peru. The provenance of the grains with ages between 770 Ma and 650 Ma is enigmatic as there are no known sources in southwestern Amazonia or the Central Andes.

The ʃHf(t) values of selected Ollantaytambo Formation zircons are between -22 and +3 and considered to be moderately juvenile to evolved. Truely juvenile zircons with a composition similar to the depleted mantle were not identified. Together with additional literature data from Ordovician formations in southern Peru, the Hf-isotope data indicate production of juvenile crust mainly in the Mesoproterozoic, and increasing recycling of this crust in the Neoproterozoic and Early Paleozoic orogenic events.

EVOLUTION OF ARSENIC AND URANIUM SIGNATURES IN VOLCANIC ROCKS, SEDIMENTS AND GROUNDWATER FROM SAN LUIS POTOSI, MEXICO

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Arsenic (As) and uranium (U) are ubiquitous naturally occurring trace elements known for their ability to cause adverse health effects in exposed populations. Drinking water is the most important human uptake source for both elements. While numerous As problem areas worldwide have been identified (e.g. Bangladesh), U has received significantly less attention in this respect in the past decades.

In deep groundwater of the volcano-sedimentary Villa de Reyes Graben around the city of San Luis Potosí (México), As and U concentrations were partly shown to exceed WHO guideline values and thus to endanger the quality of the by far most important drinking water source in the area. This study was conducted to improve the understanding of elevated trace element concentrations under the given semi-arid climatic and geological conditions.

A total of 131 solid and liquid samples were studied to unravel the distribution and evolution of U and As in groundwater and the potential trace element reservoirs: volcanic rocks and basin filling sediments. These were characterized in terms of geochemistry and mobilization potential. Dissolution of acid volcanic glass is shown to be the dominating process of U and As release into regional groundwater flow systems as indicated by As/U hydrogeochemical signatures, their behaviour during low temperature (50-70°C) rock alteration and evidence from other major (e.g. Na) and trace elements distribution (e.g. Li, F and REE). Trace element (preferentially As) mobilization from a secondary source – the sedimentary basin filling – in the course of decarbonatization of playa lake sediments and desorption from Fe-(hydr)oxide coated clastic material constitutes an additional process modifying the hydrogeochemical fingerprint of congruent As and U dissolution from volcanic glass.

Common incompatible behaviour of As and U during magmatic differentiation and successive drift apart in sedimentary systems were figured out. Comparison with recent studies in similar environments (Nicolli et al. 2010, Rango et al. 2010) yielded accordance in primary trace element source identification but differences in the evolution of groundwater As and U. The study area´s geological and climatic similarity to many volcano-sedimentary basins make the findings transferable to other semiarid regions facing challenges of geogenically impacted drinking water quality.

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Rango, T., Bianchini, G., Beccaluva, L., Tassinari, R. (2010): Geochemistry and water quality assessment of central Main Ethiopian Rift natural waters with emphasis on source and occurrence of fluoride and arsenic. J. Afr. Earth Sci. 57, 479-491.

IDENTIFICATION OF THE SPECTRAL FEATURES OF APATITE USING ASTER THERMAL INFRARED DATA IN ARAXÁ AND TAPIRA REGIONS, BRAZIL

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Rocky phosphates are still the main source of phosphorus for agriculture, forestry and cattle breeding. Phosphorus is vital for plant development as it plays several roles in living organisms such as regulating energy flow through ATP (adenosine triphosphate). In that sense apatite is a phosphate-mineral group closely linked to anionic nutrients and organic matter. Such a group appears adsorbed to the few positive charges on soil colloids.

Two economically important apatite reserves are located in the southeastern region of Brazil, Araxá e Tapira. Araxá is the second largest deposit of rocky phosphate (apatite) in production in Brazil. It contains 35% of total-P as P2O5, 3% of ammonium citrate-soluble P2O5 and does not present water-soluble P. Tapira count is 30 km far from Araxá and the apatite deposit is the largest one in Latin America. The aim of this paper was to determine the potential of the ASTER thermal infrared sensor for identifying the spectral features of apatite in two deposits within Minas Gerais State, Brazil: Araxá and Tapira. The AST_09T image of July 20, 2006 was used.

The product ASTER On-Demand L2 Surface Radiance TIR is atmospherically corrected and provides surface-leaving radiance for the TIR bands at 90 meters spatial resolution. We have used the thermal spectral library (5.0 to 45.0 μm) of the Mars Space Flight Facility at Arizona State University, 501 - apatite spectrum of Yates Mine, near Otter Lake, Quebec, Canada. Two methods were tested: at first, we applied the MNF to reduce the spectral dimension and the noise for the ASTER TIR data. Thereafter we determined the Pixel Purity Index to refine endmembers. At second, we use the Spectral Feature Fitting using the ASU spectrum to identify the intensity of spectral feature. Results have showed pure pixels displayed in some open-casting mines and areas of bare soils apatite spectral feature centered in 9.075 μm scaled for the ASTER TIR bands. The SFF scale image of apatite showed high values in some areas of bare soils and in urban areas. We found an anomalous response for an area in the northeast portion of the scene. The SFF RMS image displayed noises in the East-West axe of all the images and in the North-South axe for urban areas. We minimized the noise using a low pass filter 5x5 and the histogram stretching. We then integrated results with the band 3N to present the apatite abundance with better spatial resolution. We encourage new works to be developed to identifying minerals in tropical environments in the range of the thermal spectrum.

RECYCLED CRUSTAL MATERIALS AS A SOURCE OF MAGMA AND CRUST HOMOGENIZATION DURING THE EARLY PALEOZOIC, SOUTH EASTERN PUNA AND EASTERN CORDILLERA, NW ARGENTINA

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Lower Paleozoic intermediate to felsic magmas, has been emplaced at different structural levels (middle to upper) in the Southern Puna–Eastern Cordillera border. These magmas are represented by batholithic granites (monzogranite, granodiorite, syenogranite) leucogranite and trondhjemites stocks, quartz diorites – granodiorite bodies with magma mixing-mingling evidences and rhyodacitic subvolcanics and volcanics units interbeded into the paleozoic sediments.

The aim of this study is to understand the relationship between the genesis of magmas, migmatites, anatexis and the thermal anomalies in middle crust during the Paleozoic. These thermal anomalies were active over a long period of time, 500-440 Ma, generating a hot type orogen with a HT/LP type metamorphism (Lucassen and Becchio, 2003). The ages of the intrusive and volcanics units, range from ca 500 to 460 Ma in agreement with the age of metamorphism. Mafic to intermediate magmas, in comparison with experimentally derived melts (Patiño Douce, 1999), displays low $Al_2O_3/(FeO+MgO+TiO_2)$ (<5) and high $Al_2O_3+FeO+MgO+TiO$ (20-50), may be derived by dehydration melting of a mafic amphibole and plagioclase bearing lower crustal source (Jung, et al. 2009). Granodiorites probably represent a fractional crystallization from the quartz diorites, or may represent partial melting products from a mafic to intermediate lower crustal source if we consider low degrees of melting in water present conditions. The leucogranites-syenogranites display higher $Al_2O_3/(FeO+MgO+TiO_2)$ ratios (3-25) and narrow range of $Al_2O_3+FeO+MgO+TiO_2$ (15-20) and are generated by dehydration melting of metasedimetary sources.

Geochemical and isotope data suggest homogenization and recycling of pre-existing heterogeneities in the crust by anatexis at different levels. On the other hand, Lower Paleozoic felsic intrusive and volcanic units, upper tertiary ignimbrites and felsic xenoliths from the lower and middle crust show a similar isotopic composition with little involvement of mantle magmas. Therefore it is recognized the ability of the crust itself to produce a wide varieties of magmas (quartz diorite, granodiorite, and leucogranite) without significant contribution to cortical growth.

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Patiño Douce, A.E.,1999. What do experiments tell us about the relative contributions of crust and mantle to the origin of granitic magmas? In: Castro, A., Fernandez, C., Vigneresse, J.L. (Eds.), Understanding Granites: Integrating New and Classical Techniques. Special Publication. Geol. Soc. London, vol. 168: 55–75.

Jung, S., Masberg, P., Mihm, D., Hoernes, S.,2009. Partial melting of diverse crustal sources: Constraints from Sr-Nd-O isotope compositions of quartz diorite–granodiorite–leucogranite associations (Kaoko Belt, Namibia). Lithos, vol.111: 236–251.

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OROGENIC DEVELOPMENT OF THE EASTERN CORDILLERA (NORTHEASTERN ANDES, COLOMBIA) AS REVEALED BY DETRITAL ZIRCONS - PRELIMINARY RESULTS

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The Meso-Cenozoic orogenic history of the Northern Andes is mirrored by a variety of sedimentary deposits, and especially sandstone-bearing formations are of special interest. In the Northeastern Andean range, these deposits include the syn-rift and the subsequent post-rift sequences and the deposits related to the retro-arc foreland basin formation. The detrital composition of the sandstone deposits reveals the source rocks, which were exposed on the Earth's surface at particular geological times. Therefore, the study allows corroborating large-scale tectonic movements, which trigger processes like uplift, exhumation and erosion.

The detailed timing for the initial uplift of the Eastern Cordillera of the Colombian Andes is poorly constrained; estimates range from ca. 60 to 5 Ma. The present research is aimed at evaluating the development of the Eastern Cordillera by the systematic analysis of the detrital composition of the different sandstone deposits (heavy minerals and modal composition), and by U-Pb laser ablation ICP-MS dating of included detrital zircons. The detrital composition analysis reveals the position of the basins within a plate tectonic framework and the U-Pb zircon dating reveals the magmatic and metamorphic crystallization age of the detrital zircons. Concordia diagrams are used to eliminate the odd age points; age range histograms and probability density curves define statistically valid age populations.

The detrital zircon U-Pb ages extracted from the intermontane basin (Sabana de Bogotá) along the axis of the Eastern Cordillera reveal a change of age-spectra at the Paleogene-Neogene transition by the new occurrence of Late Cretaceous to Tertiary magmatic/volcanic zircons (ca. 90 - 30 Ma). The observed change in the age populations in the intermontane basin corresponds to a change in the provenance regime from the Amazon Craton to Andean rock sources, which can be attributed to differential uplift and erosion of parts of the Eastern Cordillera. However, this shift is not noted in the Llanos foothill deposits (retro-arc foreland basin) to the east where the supply from Amazon Craton rocks continued to dominate (as also supposed by paleocurrent data, Parra et al. 2010). This suggests that a natural tectonic barrier isolated the Llanos basin from Andean input. However, minor input may also have been provided from uplifted Amazon basement in the Andean range as observed in the Oriente basin fill of Ecuador (Martin-Gombojav and Winkler 2008). Similarly, the important detrital change in the intermontane basin of the Sabana de Bogotá approx. correlates with major restructuring of the detrital source terranes during Late Eocene - Oligocene in the Andean transect of the Ecuadorian Andes (Martin-Gombojav and Winkler 2008).

K-AR FAULT GOUGE DATING IN THE SIERRA DE COMECHINGONES (ARGENTINA)

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The Sierras Pampeanas in central and north-western Argentina represent an area of N-S trending mountain ranges whose uplift and type of deformation is interpreted to be closely related to the flat-slab subduction of the Nazca plate beneath the South American plate since the Miocene and after the collision of the Juan Fernández Ridge.

In order to contribute to the knowledge of the younger exhumation history of the Sierras Pampeanas as well as to clarify its relationship to the Andean flat-slab subduction we performed K-Ar dating on illite taken from fault gouges along a transect within the Sierra de Comechingones (see Löbens et al. in press).

Eighteen K-Ar ages of three different illite grain-size fractions (<0.2 µm, <2 µm and 2-6 µm) from six fault gouge samples were obtained. The ages range from Early Mississippian to Early/Middle Jurassic (342–174 Ma).

On the basis of the obtained data we conclude: (1) a long lasting brittle deformation history in the Sierra de Comechingones. The minimum age for the onset of brittle deformation is constrained to lay around 340 Ma, (2) a strong indication for a major Permo-Triassic (260-240 Ma) deformation event as indicated from several K-Ar illite fine fraction ages of all analyzed fault gouge samples and (3) that the last illite forming event took place around 174 Ma, indicating cooling below the minimum formation temperature of illite.

Löbens, S., Bense, F.A., Wemmer, K., Dunkl, I., Costa, C.H., Layer, P., Siegesmund S., in press. Is the exhumation of the Sierras Pampeanas just related to the Andean flat-slab subduction? Preliminary implications of K-Ar fault gouge dating and low-T thermochronology in the Sierra de Comechingones (Argentina), International Journal of Earth Sciences, DOI: 10.1007/s00531-010-0608-0

REPEATED GPS OBSERVATIONS TO DETERMINE CRUSTAL DEFORMATIONS AT VILLARRICA VOLCANO

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Villarrica volcano (39°25'S, 71°56'W; 2847 m a.s.l.) is a highly active ice-capped volcano located in the Andean Southern Volcanic Zone, having a small lava lake at the bottom of the crater (90-180 m below surface) with permanent degassing. Its eruptive history is characterised by Strombolian to Hawaiian type of explosions. The most recent eruption took place in 2004 and the latest most violent one in 1971-1972 (Rivera et al., 2008). The summit of the main cone and the depression of the caldera are covered by a glacier body with an area of 30.3 km^2 that flows radially in all directions. The main glacier basin is located in the south-eastern part of the cone (Pichillancahue-Turbio glacier, 17.3 km^2), where its ablation area is partially ash/debris-covered. The glacier experienced an area change of -0.09 ± 0.034 km^2 a^{-1} between 1967 and 2005 (Rivera et al., 2006).

In order to determine crustal deformations induced either by deeper magmatic processes or by glacial-isostatic adjustment, caused by historical and recent glacial changes, a geodetic network was installed on rock between 2003 and 2005, consisting of seven sites. For differential GPS processing a reference station at Península Pucón, located 18.1 km from the summit of the volcano was occupied. This reference station was selected based upon the expectation that it's coordinates would represent regional tectonic deformations but would not experience position changes due to volcanic activities. The other six stations are distributed around the crater: one close to the caldera, one at the old caldera rim close to Pichillancahue glacier, one in a lava flow originated in 1971and one in the lava flow of the 1984 eruption. The remaining two sites complete the network. Field measurements using dual-frequency GPS receivers and antennas were carried out in 2003, 2005, 2009 and 2010, providing observation periods of at least one full UTC day for each site.

The analysis of the GPS observations will be done with the Bernese GPS Software Version 5.1 to estimate coordinates with subcentimetre accuracy in order to interpret possible position changes in the context of volcanic activity and/or glacial-isostatic adjustment. For the interpretation of crustal deformations, the maximum expected vertical uplift rates due to glacial-isostatic adjustment can be calculated for the sites close to the glacier. Movements caused by deeper magmatic changes can be estimated by the classical Mogi model.

Here we present the preliminary analysis and the evaluation of models for interpretation of crustal deformations.

Rivera, A., J. G. Corripio, B. Brock, J. Clavero & J. Wendt (2008): Monitoring ice capped active Volcán Villarrica in Southern Chile by means of terrestrial photography combined with automatic weather stations and GPS. Journal of Glaciology, 54 (188), 920-930.

Rivera, A., F. Bown, R. Mella, J. Wendt, G. Casassa, C. Acuña, E. Rignot, J. Clavero & B. Brock (2006): Ice volumetric changes on active volcanoes in southern Chile. Annals of Glaciology, 43, 111-122.

A PERMANENT ARRAY OF MAGNETOTELLURIC STATIONS LOCATED AT THE SOUTH AMERICAN SUBDUCTION ZONE IN NORTHERN CHILE

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Monitoring the dynamic behaviour of an active deep subduction system is focus of the Integrated Plate Boundary Observatory Chile (IPOC), a permanent array of combined geophysical and geodetic stations in Northern Chile. It is operated since 2006 by the GFZ German Research Centre for Geosciences. Magnetotelluric (MT) data has been gathered at eight of the eleven observation sites.

The MT set-up consists of three component long period fluxgate magnetometers and Ag/AgCl electrodes to measure the two horizontal components of the electric field. The signals of the electromagnetic fields are continuously sampled at a rate of 20 Hz. The average site spacing is approximately 50 km and five of the sites are connected via satellite link to the GFZ in Germany. The objective of the project is to monitor and analyze electromagnetic data to decipher possible changes in the subsurface resistivity distribution, e.g. as a consequence of large scale fluid relocation.

We present magnetic and magnetotelluric transfer functions as time series over a time span of more than three years for the period range from 10 to 10^4 seconds. Variations with a periodicity of roughly one year are observed in the vertical magnetic transfer function time series at all sites of the array. These variations can be explained by source field inhomogeneities caused by geomagnetic activities.

Temporal variations observed in the transfer function time series which are not influenced by external sources could be related to changes in the resistivity structure of the subsurface. We present forward modelling calculations to quantify the effect of temporal variations of the electrical conductivity distribution.

REMOTE SENSING OF CARHUARAZO VOLCANIC COMPLEX: USING ASTER IMAGERY IN SOUTHERN PERU TO DETECT ALTERATION ZONES AND VOLCANIC STRUCTURES – A COMBINED APPROACH OF IMAGE PROCESSING IN ENVI AND ARCGIS/ARCSCENE

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A combined approach to detect hydrothermal alteration zones and their mineral distribution is proposed for a relatively remote area (2,222 km2) around the Carhuarazo volcanic complex in southern Peru encompassing. In this region Tertiary volcanic structures associated with hydrothermal alteration are known to host epithermal ore deposits. We make an attempt to detect and to quantify alteration minerals based on spectral analysis using ASTER reflectance data provided by LP-DAAC. Besides commonly used ratio images, mineral indices (MI) and relative band depth images (RBD) we also extracted endmember spectra using Pixel-Purity-Processing preceded by Minimum Noise Fraction transformation. These spectra represent the spectrally purest pixel of the image and show the typical absorption features of the main constituants. Based on this assumption we used different spectral analysis methods in order to extract the most important alteration minerals for these volcanic regions. The resulting mineral spectra were then used for matched filter processing in areas showing high values in MIs and RBDs.

Using this method we mapped argillic alteration and variations in the distribution of important minerals such as alunite, kaolinite or nacrite. There were no indications for the presence of propilitization at ASTER spatial resolution. Our method can be easily applied to any ASTER scene and provides information about the intensity of alteration and the character of alteration zones. The detected intensitiy is highest in the center of the Carhuarazo volcanic complex where it is mostly argillic with a high content of alunite, dickite and other clay minerals.

Results were incorporated in an ArcMap project and 3-D animations were created in ArcScene in order to better visualize the distribution of alteration minerals. In the GIS project this data was combined with geochemical and geological data to generate a better understanding of the spatial distribution and structural control of alteration features.

Brandmeier, M (2010): Remote sensing of Carhuarazo volcanic complex
Using ASTER imagery in Southern Peru to detect alteration zones and volcanic structures – a combined approach of image processing in ENVI and ArcGIS/ArcScene. Geocarto International 25/8, 629-649.

NEOGENE TO QUATERNARY ASH DEPOSITS IN THE COASTAL CORDILLERA OF NORTHERN CHILE: DEPOSITIONAL CONTEXT, COMPOSITION, AR/AR-AGES AND ORIGIN

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Depositional facies of silicic volcanic ashes in the Chilean Coastal Cordillera (VACC) has been investigated at 14 localities between 23° and 25°S. Depositional textures, modal composition and granulometry of the ashes and tuffs (the latter lithified by halite and gypsum under ultra-arid conditions) allowed for a distinction between primary fallout/aeolian deposits (mean 4 - 5 Φ, sorting 1.5 - 2 Φ) and secondary deposits which formed by down wash from hill slopes during local rain fall. Primary volcanic components of VACC comprise glass shards (fibrous elongate and coarse-walled with rounded to elliptic vesicles), and biotite. Electron microprobe data of VACC glass and biotite has been compared with data from major ignimbrites of the Altiplano-Puna-Volcanic Complex (APVC, de Silva et al., 1989).

Previously published studies on VACC yielded 14 Ar-Ar and K/Ar ages on biotite or sanidine ranging between 6.6 and 0.6 Ma. In our project, three Ar/Ar 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 (3.20 ± 0.12 Ma, 4.09 ± 0.06 Ma, 5.92 ± 0.08 Ma, respectively). Ar/Ar ages on glass from the same samples resulted in systematically older ages (> one Ma). The discrepancy between the biotite and glass ages can be attributed to recoil effects. In summary, the range of the 17 ages coincides with the Late Miocene to Quaternary ages of the major ignimbrite-forming eruptions of the Altiplano Puna Volcanic Complex (APVC, Salisbury et al. 2010). Ages and microprobe data indicate that the VACC outcrops represent at least five different eruptions.

It is assumed that during large APVC eruptions, considerable amount of the co-ignimbritic ash clouds have been blown towards the west. According to atmospheric modeling (Kaspar, FU-Berlin, written comm.), favorable wind directions exist in altitudes of 4000 m during the southern summer in the southern Central Andes.

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ORIGIN OF MAGMATIC COMPONENTS IN THE DIAMANTE TUFF

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The Diamante Ignimbrite, which covers an area of 23.000km^2 in Chile and Argentina, was emplaced 0.45 Ma ago by a catastophic eruption that caused subsidence of the Diamante Caldera. The ignimbrite is underlain by two fallout deposits, one immediately beneath the ignimbrite, the other separated by sediments. All three deposits have rhyolitic compositions but the older fallout contains higher concentrations of incompatible elements at slightly lower silica contents, reflecting a somewhat different crystal fractionation history.

Five juvenile components can be identified in the ignimbrite and its underlying fallout:

(1) The dominant white to pink rhyolitic pumice that contains plagioclase, biotite, quartz and ore phenocrysts; alkalifeldspar crystals occur in the matrix.

(2) Light-gray rhyolitic pumice, also with plagioclase, biotite, quartz and ore phenocrysts, contains significant amounts of broken crystals and lithic fragments, and mostly occurs mixed with the white component in banded pumice clasts.

(3) A highly vesicular, glassy rhyolitic pumice with very few phenocrysts.

(4) Foliated, silky shinning white to grey pumice with strongly elongated vesicles and parallel-aligned phenocrysts.

(5) A minor component of brown pumice distinct in both its dacitic bulk composition and the presence of amphibole phenocrysts next to plagioclase, biotite and ore. Dark-brown regions in these pumice clasts contain higher amounts of amphibole and plagioclase microlites.

There is no systematic vertical compositional zonation through the fallout and ignimbrite but pumice type (5) only occurs in the ignimbrite.

Pumice types (1) to (4) share the same mineral and glass compositions. We interpret type (2) as magma that ascended along the conduit walls where high shear stresses caused crystal fragmentation and entrainment of lithic fragments. The dominant type (1) pumice, in contrast, reflects the main, less sheared magma ascending near conduit center. Foliated type (4) pumice may have been magma from in-between these conduit regions. The higher vesicularity of type (3) relative to type (1) indicates that vesiculation in the magma was spatially heterogeneous.

The ignimbrite also contains abundant plutonic lithic fragments mostly of andesitic to dacitic bulk compositions. While some of these lie on a fractionation trend leading to the rhyolitic pumice compositions, others have distinct chemical compositions. A fraction of the lithics contains amphibole, and these plutonic rocks have the same dacitic composition as the amphibole-bearing pumice (5), which is distinct from the other pumice and lies off the main fractionation trend. We conclude that magma (5) represents a molten crustal component that was added to the rhyolitic magma reservoir.

VOLATILE EMISSIONS OF EVOLVED MAGMAS FROM VOLCANOS AT THE CENTRAL AMERICAN ARC

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Evolved magmas produce highly explosive eruptions, which emit volatiles into the stratosphere where they can affect the climate directly. Previous work estimated volatile budgets based on eruption volumes and volatile contents of melt inclusions. Generally, there is a big discrepance between emitted SO_2-masses determined by satellite measurements and the estimated degassing by the “petrological method” including the measurement of melt inclusions (e.g. Pinatubo eruption 1991).

The glass analyses can only determine the concentration of dissolved sulfur. An exsolved sulfurous fluid already coexisting with the melt in the magma chamber cannot be identified by this method, but may be a major source of total sulfur emission during eruption and is preserved in fluid inclusions. Latter are formed by oversaturation and degassing of volatiles from the melt and formation depend on pressure, temperature changes during the ascent as well as the composition of the magma. Early degassing of CO_2 assist the precocious partioning of H_2S and SO_2 into the fluid phase and extract sulfur in an early stage from the magmatic system.

We conducted microthermometric measurements at fluid inclusions in tephras from of selected volcanic centers along the volcanic arc and derived magmatic temperatures that are used for reconstruction of conditions for crystallisation and depth. Our analysis show, that fluid inclusions in minerals from Guatemalan, El Salvadorian and Nicaraguan tephras have aqueous solutions with small amounts of salt (NaCl and/or KCl) and partly CO_2. Additionally, a predominating shallow level (3-4km) of magma storage has been derived for the higher evolved volcanic systems of the Central American Arc. Those thermo-barometric results from the fluid inclusions are supported by our hornblende measurements, which are used to calculate independent magmatic pressure and temperature values after Ridolfi et al. (2010).

First preliminary data from laser-ablation ICP-MS analysis are used to quantify the volatile contents for fluid inclusions. Final goals are 1) to get an estimation of how much of the volatile masses have been stored in fluids prior the eruption and contributes to the total degassing of the eruptions and, 2) if there is a systematic correlation between depth of crystallization, composition and amount of fluids along the Central American Arc.

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EVALUATION OF THE METAL CONTAMINATION AND ITS POSSIBLE SOURCES IN THE CORREGO SARANDI RIVER SYSTEM, URBAN AREA OF BELO HORIZONTE, BRAZIL

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The complexity of an aquatic system requires consideration of its dynamics: spatial and temporal variations of physical, chemical and biological conditions. These systems are endangered by natural changes and human impact activities. Some of these contaminants have peculiar behavior in the aquatic system and the distribution is often controlled by strong changes in climatic and urban use conditions.

The human activities in the investigated sub-basin of the Sarandi River are responsible for the contamination of Pampulha Lake, one of the most important leisure and touristic area of Belo Horizonte.

This study tries to determine by monitoring of sediment and water of Sarandi River, its actual state and the possible sources of contamination and their importance.

Samples were collected during dry and rainy seasons (2007-2008) to analyze selected metal concentration (Cu, Cd, Cr, Co, Ni, Zn, Pb) and other, physical parameters like pH, conductivity, dissolved solids, temperature and turbidity. This allows the evaluation of state and sensibility of this system by the calculation and use of Hackanson Factor of Contamination (HF).

It was able to indicate very high contamination in sediments by elements like Cr, Cu, and Cd, and a high contamination by Pb, Zn, and Mn and elevated HF values

The Water Quality Indices (IQA) and Toxic Contamination Factor (CT), determined by Instituto Mineiro de Gestão das Águas - IGAM, combined with all analytical data, allowed defining different vulnerability areas along the river.

The use of sediment and water quality indices, element distribution together with data analysis and graphical presentation of the correlation between the used variables permits the correlation between river quality changing and source types.

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GOLD–PLATINUM–PALLADIUM MINERALISATION AT CÓRREGO BOM SUCESSO, MINAS GERAIS, BRAZIL

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Alluvial Pt–Pd–Au mineralisation occurs in historically important diamond placer deposits in the Palaeo–Mesoproterozoic metasiliciclastic domains of the southern Serra do Espinhaço, Minas Gerais, Brazil. One of these deposits, Córrego Bom Sucesso, possibly provided some of the sample material from which the mineral native palladium was first discovered (Hussak, 1906). The Pt–Pd aggregates from Córrego Bom Sucesso reach a few millimetres and are characteristically botryoidal, exhibiting a variety of arborescent forms. The botryoidal Pt–Pd aggregates have high concentrations of iodine, in the range from 10 to ~120 µg/g (Cabral et al., 2011). The presence of iodine suggests biogenic precious-metal fixation in the aqueous alluvial milieu.

Detrital Pt–Pd-bearing gold is also found in the Córrego Bom Sucesso alluvium. This gold has inclusions of tourmaline and titaniferous hematite (up to ~6 wt.% TiO_2), which link the alluvial gold to Ti-hematite–quartz veins and tourmaline-rich quartzite in the vicinities of Córrego Bom Sucesso. A pervasive boron metasomatism affected quartzite of the Sopa-Brumadinho Formation, replacing recrystallised quartz fabric with tourmaline. This tourmaline has $\delta^{11}B$ values in the range between ~1 to -10‰. The B-isotope range and the widespread occurrence of tourmaline in the Sopa-Brumadinho Formation, of lacustrine to fan-deltaic origin, point to non-marine evaporitic brines. Such oxidised brines are capable of transporting otherwise immobile Ti to form the pervasive overprint of titaniferous hematite and also explain the formation of Ag-poor, Pd–Pt-bearing gold. Cross-cutting relationships indicate a late-Brasiliano age, ~0.6 Ga, for the hematite–quartz veins and the tourmaline overprint. The latter can be understood as a highly oxidised facies of the orogenic lode-gold deposit category. Erosion of orogenic Au–Pt–Pd lodes provided detrital minerals that accumulated in alluvia close to the primary source. Detrital Pt–Pd minerals were then dissolved within the alluvia (Hussak, 1906) to form the iodine-bearing botryoidal aggregates of Pt and Pd (Cabral et al., 2011).

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CONTRIBUTION OF THE CERRO DRAGON GEOLOGY TO THE UNDERSTANDING OF THE CENOZOIC EVOLUTION OF MIDDLE COSTA RICA FOREARC BASIN

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Previously it has been thought that the sedimentary series in Cerro Dragón area - located 20 km south from San José, capital city of Costa Rica- constituted the basal refill of Valle Central sedimentary basin, but the new research in the Dragon Hill area and arounds indicate that the outcropping rocks are correlative in facies and age with those of the Descartes and Terraba formations of the forearc Terraba Basin, of respectively Upper Paleocene-Upper Eocene and Oligocene. This will have big consequences for future conclusions about geology evolution and paleogeography of the region.

The surveyed stratigraphic section consists of three main sedimentary successions of different composition: basaltic, volcaniclastic and carbonated. The base is made of alternating green fine breccias, pebbly and coarse sandstones and mudstones of basaltic composition. They are overlain by a turbiditic sucession of black coloured alternance of sandstones and mudstones with interbedded red siliceous shale. To the top they pass gradually to a -more than 1500m thick-volcaniclastic series of alternating pebbly sandstones, sandstones and mudstones with strata and olistostromes of resedimented limestones, originally deposited as ramp limestones. Petrographycally, the limestones are wackestones and packstones. Abundant fragments of larger forams and coralline algae are present in the limestones and in the detrital volcaniclastic facies.

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GEOTOURISTIC ROUTES OF COSTA RICA PROJECT AS A STRATEGY FOR ENVIRONMENTAL EDUCATION FOCUSED ON GEOLOGICAL HERITAGE AND GEOCONSERVATION

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The Geotouristic Guide of Northwestern Costa Rica is the first of several deliveries on the Geology and Geological History of Costa Rica. It has been developed in the framework of the Docent Extension Project (ED-15-05) from the office of Social Action Department of the University of Costa Rica, and addresses the development of six routes to cover the national territory. Apart from the Northwest (1) include: the Central Valley (2), Central Pacific (3), Cordillera de Talamanca (4), South Zone (5) and part of the Southern Caribbean region (6) of Costa Rica

From the geological point of view, the first of these Guides shows the vast amount of geodiversity in the northwestern region of Costa Rica, a segment emerged from the southwestern edge of the Caribbean Plateau. It offers to the reader a stratigraphic tour of nearly 170 million years, showing the location of important and significant geological outcrop sites with information about rock types, age, fossils content and environment origin. The Guide of Central Valley Region is currently in preparation.

Through/ by means of this project, and the publication of geotouristic guides it is expected to promote an alternative economic resource - which contributes to improve the quality of life of communities within the framework of sustainable development-, to spread through a recreative activity general geological concepts as well as the knowledge of the geodiversity of the regions included in the geotouristic routes. As this task is done in collaboration with the Conservation Areas of the SINAC (National Service of Protected Areas) further education in understanding the existence of geological heritage and the importance of their (geo) conservation is expected to be disseminated to visitors of National Parks and other protected areas, and the same time that is taken to communities und SINAC officials.

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MILLENNIAL-SCALE SURFACE WATER CHANGES OFF SOUTHERNMOST CHILE OVER THE PAST 60 KYR

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Glacial millennial-scale paleoceanographic changes in the Southeast Pacific and the adjacent Southern Ocean are only poorly known due to the scarcity of well-dated and high resolution sediment records. Here we present new surface water records from sediment core MD07-3128 recovered at 53°S off the Pacific entrance of the Strait of Magellan.

The alkenone-derived sea surface temperature (SST) record reveals a very strong warming of ca. 8 ˚C over the last Termination and substantial millennial-scale variability in the glacial section largely consistent with our planktonic foraminifera oxygen isotope ($\delta^{18}O$) record of *Neogloboquadrina pachyderma* (sin). The timing and structure of the Termination and some of the millennial-scale fluctuations are very similar to those observed in the well-dated SST record from ODP Site 1233 (41ºS) and the temperature record from EPICA Antarctic ice core. Differences in our new SST record include a long-term warming trend over Marine Isotope Stage (MIS) 3 followed by a cooling towards the Last Glacial Maximum (LGM). We suggest that these differences reflect regional cooling related to the proximal location of the southern Patagonian ice sheet and related melt-water supply at least during the LGM. This proximal ice-sheet location is documented by generally higher contents of ice rafted debris (IRD) and tetra-unsaturated alkenones, and a slight trend towards lighter planktonic $\delta^{18}O$ during late MIS 3 and MIS 2.

On millennial-scales opal contents are generally higher whereas carbonate contents and alkenone concentrations are lower during cold intervals, suggesting SST-related shifts in the siliceous and calcareous plankton communities. These changes may be interpreted in terms of a northward shift of the Southern Ocean fronts and the opal belt during cold periods and/or changes in the nutrient advection consistent with lower planktonic foraminiferal $\delta^{13}C$. Comparatively low opal contents around the LGM are interpreted as reduced productivity due to enhanced melt-water input and resulting surface water stratification.

GEOTECTONIC DOMAINS OF PERU: IMPLICATIONS FOR THE EVOLUTION OF THE ANDES

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The new map of tectonic domains of Peru is the consequence of the integration of maps and data bases that are being made in the Geological Survey of Peru INGEMMET. These are the geological and structural maps of Peru at 1:1 ’000, 000, geochemical data base of major and trace elements, with more than 5000 sampling points; and the recompilation of new data base of the geochronology and thermochronology dating with more than 3000 samples. The interaction of all this information has contributed to build a map of tectonic domains at 1:1 ‘000, 000, which is a fundamental tool for understanding the geodynamic evolution of the Peruvian Andes.

We have put a lot of interest in the boundaries of the domains. Thus, it has been determined, that many of these correspond to edges or allochthonous blocks or para-autochthonous blocks accreted to the Amazonia, in different geological times. One of the most important limits is the NW-SE Cordillera Real fault system, located in the Eastern Cordillera of southern Peru. It is the main suture of the accretion of whole Arequipa Massif, Western Altiplano and Eastern Altiplano. In this suture zone the back-arc magmatism developed, from the Ordovician, highlighting the Triassic-Jurassic rift magmatism. On the other hand, the NW-SE Cincha-Lluta-Incapuquio fault system controlled the evolution of the Mesozoic western basin of southern Peru, and then the uplift and formation of the Western Cordillera, from the Late Cretaceous. Other major faults are the NW-SE Cusco-Lagunillas-Mañazo and Urcos-Sicuani-Ayaviri fault systems. They are related to the origin of the Altiplano. In the Mesozoic, they formed the Cusco-Puno structural high with restrained sedimentation, separating the western basin of the eastern basin. However, in the Cenozoic they controlled more than 10.000 m of synorogenic continental sedimentation. Furthermore, these faults controlled the Neogene potassic to ultrapotassic mafic rocks that proves the existence of two different lithospheric blocks under the Altiplano.

In northern Peru, the Paracas block was accreted to the Amazonia. The suture zone corresponds to the NNW-SSE Marañón River fault system, where Neoproterozoic ophiolite outcrops. In this suture zone the Carboniferous magmatism (Pataz Batholith) and the axis of NNW-SSE Triassic-Jurassic rift developed. Another suture zone is the NE-SW Huancabamba fault system that comes from Colombia and Ecuador. In Peru, it is the suture of the Amotapes-Tahuin para-autochthonous block, accreted in the Early Cretaceous. This suture seems to be more ancient, and it is a branch of the Triassic-Jurassic rift. The intersection of this NE-SW branch with the NNW-SSE branch of the Eastern Cordillera formed a triangular area that is the northern boundary of the former Mesozoic basins of northern Peru.

LATEST DEVELOPMENTS FOR A SELF ORGANIZING MAPS PATTERN RECOGNITION OF SEISMIC NOISE RECORDS AND AN APPLICATION TO THE SEISMIC MICROZONATION OF SALTA CITY, ARGENTINA

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This work improves the proposed (Carniel et al., 2009) use of Self-Organizing Maps (SOM: Kohonen, 1982) for the H/V spectral ratios (HVSR: Nakamura, 1989) when data are noisy and of short duration. Improvements with respect to the original paper concern the FFT algorithm (that has been replaced by Welch´s implementation), map topology, and the possibility of choosing triangle widths to calculate the weighted cross-correlation between patterns. A narrow triangle allows to identify narrow peaks of the H/V function and generally increases the number of clusters on the map, while a wide triangle produces a less “specialized” map and usually fewer and more meaningful larger clusters. With respect to map topology, in a flat map the neurons along the edges do not have the same number of neighbours as the other neurons, and this makes the training more difficult. A solution can be obtained e.g. by adopting a toroidal map connecting the upper and lower edges of the flat map, getting a cylinder and then merging its bases.

After the training, the meaning of H/V spectral ratio clusters has to be investigated. An algorithm of cluster recognition can be applied, using the weighted cross-correlation to calculate the similarity value of the neuron code vectors. At any threshold similarity value a given number of clusters are detected onto the map: the lower the threshold, the larger is the number of (small) clusters that are recognized. Identifying the main cluster, in most cases, means being able to obtain the most stable shape of the H/V function for the investigated site, characterized by a quite low standard deviation (in amplitude) as required by SESAME guidelines (SESAME, 2004). Moreover, SOM analysis allows to preserve the temporal information. For this reason, as data are presented by the neural network temporally ordered, considerations about data clustering results can help to understand if the properties of each cluster are stable in time (as expected for a site effect) or not. An example of application is shown for short and noisy HVSR recordings in Salta City, Argentina.

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PALYNOFACIES ANALYSES OF CREATACEOUS (ALBIAN–SANTONIAN) SUCCESSION FROM THE LARSEN BASIN, JAMES ROSS ISLAND, ANTARCTIC PENINSULA

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The Larsen Basin contains one of the most extensive marine Cretaceous successions among the southern hemisphere. The studied successions crop out in James Ross Island. In order to reconstruct the depositional environment, three formations were analyzed based on palynofacies: Whisky Bay (Albian- Turonian), Hidden Lake (Coniacian) and Santa Marta (Santonian-Campanian) Preview studies suggest a shallowing upward for studied succession.

In this preliminary study, five sample of each formation was analyzed. For the palynofacies analysis the kerogen categories were identified into the three main groups and subgroups: phytoclasts (subgroups opaque lath and equidimensional, non-opaque biostructured and non-biostructured and cuticles), amorphous organic matter (subgroups amorphous organic matter and resin) and palynomorphs (spores, pollen grains, dinocysts and acritarchs).

The phytoclasts group is the most abundant with general average of 62,5%, following by palynomorphs group with 28,4% and amorphous organic matter (AOM) with 9,1%. The phytoclasts group is the most abundant in Santa Marta Formation with an average of 77% and less abundant in Whisky Bay Formation with an average of 50%. The opposite occurs with AOM with 0,8% and 14% respectively. The palynomorphs group shows conspicuously that is more abundant in Whisky Bay Formation with average of 36%.

In the specific case of the dinocysts, herein divided into peridinioids and gonyaulacoids, a larger abundance of the second is observed in the Whisky Bay Formation, suggesting a more distal marine paleoenvironment. Already in Hidden Lake Formation the peridinioids show high abundance. This dinocysts have been shown to yield a productivity signal in coastal and neritic settings.

From base to top is observed conspicuously an increase of the woody elements, especially of non-opaque particles, even with presence of marine elements. This corroborates with the interpretation of a deeper paleoenvironment during the deposition of the Whisky Bay Formation, the beginning of shallowing-upward trends in the Hidden Lake Formation, culminating in a shallow marine of Santa Marta Formation.

USE OF LEAD ISOTOPES AS ENVIRONMENTAL TRACERS IN MEXICO

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The economic development of Mexico during the 20th Century, led to a strong increase in the production and use of base metals, with all the negative consequences for the environment. Due to its widespread use and high toxicity, this study focuses on the distribution of lead (Pb) in various materials, trying to trace its antropgenically modified geochemical cycle, thus helping to dam up its uncontrolled diffusion into the environment and to reduce the health risk which may derive from an unconscious exposure to Pb contaminated materials.

Lead pollution frequently derives from multiple sources which have to be identified and differentiated in order to be able to design efficient prevention and control programmes. Lead isotope ratios (LIR) have proven to be a powerful tool to tackle with this issue (e.g.,Komárek et al., 2008). Because the different Pb isotopes (^{208}Pb, ^{207}Pb, ^{206}Pb and ^{204}Pb) in ores do not undergo noticeable fractionation during the long chain of industrial processes involved in its extraction, metallurgy and industrial or commercial use, Pb-isotope ratios constitute a valuable geochemical fingerprint procedure (Sangster et al., 2000). Variations in the LIRs at a considered site normally results from the mixing of different natural and anthropogenic Pb-sources. Consequently, LIR´s allow to design and verify the validity of different mixing models and evaluate the contribution of each source.

In this study, various primary (Pb-ores, tailings and slags) and secondary Pb sources (old tetraethyl lead facility soil, Pb-glaze, polluted solis, a.o.) were sampled and analysed for the isotopic composition of the Pb contained therein, in order to evaluate the isotopic variability of environmental lead in Mexico, a survey which is an indispensable requirement for they (LIR) efficient use in risk reducing measures. After EDXRF trace element analysis (Panalytical Epsilon5), samples were digested (total digestion) and the abundances of ^{208}Pb, ^{207}Pb, ^{206}Pb and ^{204}Pb were determined with HR-ICP-MS (VG-Axiom). Instrumental drift was corrected using the NBS-981 standard reference material, while mass discrimination effects were corrected on basis of the ^{205}Tl/^{203}Tl ratio of the Tl spiked sample.

Results show a wide range of LIR values even for samples taken from the same areas. In old mining and smelting districts this is probably due to both ore heterogeneity and the additives used for their processing and/or smelting. In smelting facilities where ores from a restricted area were processed, relatively small variations were found. In such cases, the secondary and primary sources can be well distinguished from each other on basis of their LIRs. However, in polluted areas with two or more possible sources, a very detailed geochemical characterisation is necessary in order to be able to explain all the recorded variations and to trace possible transfer paths.

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OPHIOLITES IN THE PERUVIAN ANDES: PRELIMINARY DATA

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A discontinuous, NW-SE trending, belt of scattered ultramafic and mafic (UM / M) occurrences crops out in the Cordillera Oriental for about 250 km (from ~ 9º 30' to ~11º 30' S, Depts. Huánuco and Junín). These rocks had been previously understood as pre-Cambrian intrusive bodies (dikes, sills or diapirs), but recent studies on the Tapo Massif (TM, southernmost occurrence, Tarma province) exclude this hypothesis, showing its allochtonous emplacement and suggesting an alternative interpretation as part of a dismembered ophiolite (Castroviejo et al., 2010). This interpretation is supported by geochronological and petrological data. The TM, the only known chromite source in Peru, is a fragment of Neoproterozoic (~ 718 Ma, Tassinari et al, 2010) oceanic lithosphere, subject to Ordovician (~ 450 Ma, íbid.) high-P metamorphism (Willner et al., 2010), and then thrust upon the siliciclastic sediments of the Lower Carboniferous Ambo Group.

The other known UM / M occurrences, as the Acobamba bodies (A, Tarma) or the Huancapallac, H, and Andas-Raccha, AR, massifs (Huánuco), have also been mapped and share the following features with the TM: UM / M protolith composition, strong metamorphic overprint, intensive pre-Andean ductile deformation, allochtonous emplacement, and overprint by Andean cycle brittle deformation. Some local differences also exist, as: (i) the absence of chromite ores to the north, where talc has been mined instead; (ii) the varying relative proportions of UM & M lithologies (only UM, mainly serpentinites, in H; mainly M, amphibolites, in AR); (iii) the nature of the host-rocks: while the TM is thrust onto upper Palaeozoic non-metamorphic sedimentary rocks (Ambo Group), the A, AR and H massifs are thrust on metamorphic formations of the Marañón Complex. Data strongly support an interpretation as fragments of a dismembered ophiole belt defining a suture within the Cordillera Oriental. Some features as the relative scarcity of M protoliths or the lack of the typical sheeted dyke complex, which do not fit the ideal "Penrose Conference profile", could be explained by tectonic dismembering but they may more likely be primary, suggesting e.g. a Ligurian or Franciscan type of ophiolite (Dilek, 2003). Summarizing, these data are consistent with current ideas about the late evolution of Rodinia, and imply a Neoproterozoic rifting along its western margin (a protracted event starting further south), and an Ordovician collision (possibly with the Paracas terrain, as proposed by Ramos, 2009) affecting the Andean basement.

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ADVANCES IN THE STUDY OF THE EARLY CRETACEOUS GASTROPOD FAUNA FROM THE NEUQUÉN BASIN, WEST-CENTRAL ARGENTINA

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The marine Lower Cretaceous of the Neuquén Basin, west-central Argentina, contains a highly diverse and abundant fossil record. Among the invertebrate benthic fauna, gastropods are moderately abundant in several localities. Nonetheless, this group has been subject of scarce taxonomic study, the work of Weaver (1931) being the most significant contribution so far. Moreover, its paleoecologic and paleobiogeographic implications are unknown.

Here, as part of a long term project on the Early Cretaceous marine gastropod fauna of Argentina, some advances are presented on the basis of newly collected material from several sections in Neuquén and Mendoza Provinces.

Specimens come from more than 30 localities in Neuquén and three localities in Mendoza. In nine of these, detailed stratigraphic sections were measured. The specimens proceed from three units: Mulichinco (Valanginian) and Agrio (Late Valanginian-Late Hauterivian) Formations, belonging to the Mendoza Group, and La Tosca Member of the Huitrín Formation (Barremian), belonging to the Bajada del Agrio Group. The Agrio Formation has yielded most of the material. The stratigraphic interval spanned by these records is Early Valanginian-Barremian.

The taxonomic study carried out revealed the presence of 21 gastropod species in the Agrio Formation, of which at least nine have not been reported from this unit until present. From the Mulichinco Formation, five species have been identified, of which none has yet been reported from that unit. The La Tosca Member of the Huitrín Formation has yielded three species, of which two have not been previously reported.

The gastropod fauna seems to have a significant proportion of endemic taxa at the species level, although genera show affinity with coeval European faunas. Argentinean gastropods also show close relationships with Cretaceous faunas from Chile and northern South America.

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This is the contribution C-09 of the Instituto de Estudios Andinos 'Don Pablo Groeber' (IDEAN).

USE OF CARTOGRAPHIC TOOLS FOR THE IDENTIFICATION AND EVALUATION OF THE INTENSITY OF EROSIVE PROCESSES IN THE BAHÍA MOA, HOLGUÍN, CUBA

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This work is based on a photogeological temporary analysis, in which variation of the erosive dynamics of Cayo Moa Grande are checked since the last century for this study aerial photos were used, corresponding to the K – 10 project of 1972 mission at a 1:36000 estimated scales and images obtained from the Google Earth Program in 2010. For the determinations of geomorphology changes a GIS was implemented as a working tool which permitted vectorized the aerial photos, working on geodynamics maps for the different analyzed years; by means of overlapped maps and calculating the end-point rate the main geomorphologic transformations of the cay in a period of 39 years. The erosion and sedimentation in Cayo Moa Grande occur in a rapid way and are mainly registered in the last 50 years, reaching a maximum advance in the period 1972 to 2010.

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PHANEROZOIC EVOLUTION OF THE SOUTHERN MANTIQUEIRA BELT

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In this work we deal with the Paleozoic history of the Southern Mantiqueira Belt and adjacent areas after the orogen-collapse of the Brasiliano orogenic mountains in southern Brazil and Uruguay, based on thermocronological data (FT and U-Th/He on apatite) and thermal history modelling. During the Palaeozoic intraplate sedimentary basins formed mainly bordering the orogenic systems, and thus, these regions have not been overprinted by younger orogenic processes. In the Mesocenozoic this region was affected by later fragmentation and dispersal due to the separation of South America and Africa. Denudation history of both margins quantified on the basis of thermal history modeling of apatite fission indicates that the margin of southeastern Brazil and Uruguay presented a minimum 3.5 to 4.5 Km denudation of these margins, that included the main exposure area of the Brasiliano orogenic belts and adjacents aaeas..

The Phanerozoic evolution of the West Gondawana is thus recorded first by the orogenetic collapses of the Brasiliano and Pan-African belts, at that time formed a single mountain system in the Cambrian-Ordovician period. Subsequently, formed the intraplate basins as Paraná, in southeastern Brazil, and Congo and some records of the Table Mountains Group and upper section of Karoo units, in Southwestern Africa.

In Permotriassic period, the collision of the Cape Fold Belt and Sierra de la Ventana Belt at the margins of the West Gondwana supercontinent resulted an elastic deformation in the cratonic areas, where the intraplate basin depositional occurred, and also subsidence and uplift of the already established Pan-African-Brasiliano Belts. Younger denudation events, due to continental margin uplift and basin subsidence, occurred during the rifting and dispersal of the South America and Africa plates, which can be very well defined by the integration of the passive-margin sedimentation of the Pelotas and Santos basins and thermochronology on apatite fission track obtained of the adjacent basement units. The main denudation events are 150-130 Ma (rifting), 80-90 Ma, 70-60 Ma, 35-45 Ma and 20-10 Ma (estimated age of the Cone do Rio Grande structure formation).

We conclude that the subsidence, uplift and denudation events that affected the eastern margin of Brazil and Uruguay and western margin of Africa segmented most of Pan-African/ Brasiliano orogenic belts and adjacent areas, difficulting the paleogeographic reconstruction and plate kinematic of the Brasiliano/Pan-African belts.

COMPARATIVE APPLICATION OF PETROGRAPHIC INDEXES IN THE FACIES RECONSTRUCTION OF A PEAT ON RIESCO ISLAND, MAGALLANES COAL BASIN, SOUTHERN CHILE

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The Magellan coalfield has the largest reserves of Chile, with sub-bituminous coal resources over 5 billion tons. On Riesco Island, located on the northern edge of the coal basin, the coals are predominantly vitrinitic, subordinantly liptinitic, and characteristically with a low content of inertinite. These coals show a predominance of bimaceralic (mainly clarite) and monomaceralic (predominantly vitrite) microlithotypes. Trimaceralic microlithotypes are negligible.

In this paper we discuss and compare the usefulness of indexes application specifically proposed for low rank coals, such as the GI/TPI and GWI/VI diagrams (Iordanidis and Georgakopoulos, 2003), the ternary TDF diagram (Silva & Kalkreuth, 2005), the V-MM-I diagram (Singh & Singh, 2000), and the double ternary diagram based on specific microlithotypes (Silva and Kalkreuth, 2005). The samples belong to the same drillhole, characterizing, from the botton up to the top, the so named Principal Seam. Each sample corresponds to a representative composite one meter thick.

The combined application of petrographic indexes and their respective facies diagrams let us to conclude that the peat developed in a limnic swamp (adjacent to a wet forest swamp), under prevailing reotrophic conditions. Based on the results of macerals and microlithotypes analysis, we recognize 3 stages in the development of the peatland, each one of them conciding with respective three sections of the Main Seam: 1) Bottom Section: characterized by greater content of arboreal material, probably associated with clusters of trees in the swamp. Hydrological conditions changes from reotrophic to reo-mesotrophic. 2) Middle Section: marked by rhythmic and fluctuating conditions of both the dominant type of plant material and the position of the water table. 3) Upper Section: the peat conditions remain reotrophic, with minor fluctuations of the water table, while the contribution of herbaceous plant material is predominant, except at the top, where the tree contribution increases.

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ANTUVILU SYSTEM FAULT (ASF), A STRIKE SLIP FAULT IN THE SUBMARINE FOREARC OF CENTRAL CHILE: ITS POTENTIAL LINK WITH GIANT EARTHQUAKES

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An important question in the study of the Chilean convergent margin is on the location, nature and mechanisms controlling strike slip faults along the submarine forearc and their potential seismogenic activity.Several subduction zone studies emphasize the connection between regional faults and rupture areas of big earthquakes (e.g., Cheng and Wang, 2001; Park et al., 2002). These crustal faults could accumulate and release considerable tectonic stress caused by relative plate motion.

Preliminary results from bathymetry, revealed a kilometric scale strike slip fault named as “Antuvilu System Fault” (ASF), displayed along the submarine forearc (around 33°30’-37°S). ASF is nearly parallel to the margin, with a general tendency NNE-SSW. A set of structures with an oblique tendency (NNW-SSE) respect to the main fault is also identified (Contardo et al., in prep.). The kilometric ASF evidences an active and dynamic structure, controlling slope basins and forearc morphology, but it would also play an important role in seismicity; the latter would be evidenced in the 8.8 Mw Maule earthquake, which occurred on February 27th 2010 and ruptured very close to the ASF structure. An actualized model of the fault plane from a constrained distribution of co-seismic slip (Sladen et al., 2010.), displays a narrowest and elongated area which shows a close coincidence with a segment of the ASF structure. From the model, the area of highest slip would be delimited by the second trend of structures NNW-SSE. Around these lattitudes, the structural pattern identified from seismic interpretations is characterized by positive flower structures, which evidence strike slip faults with a predominant transpressive style (Contardo et al., 2008). Thus, several questions can be raised from these observations, e.g., has this fault been active during the earthquake? Should we look for similar regional structures along the entire margin which may represent potential seismogenic faults? How is the nature of the movement along ASF? Could it be represented by segments of seismic and aseismic slip? A close integration between morphological and kinematical features of the submarine forearc structures with newly generated seismic and geodetic information will be crucial to better understand the nature and mechanism controlling strike slip faults along the submarine forearc and their potential link with giant earthquakes.

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GEOLOGICAL APERÇU OF THE POTROK AIKE LAKE AREA, SOUTHERN PATAGONIA, ARGENTINA

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The Potrok Aike lake is at present a relevant geoscientific site due to the discovery of a thick package of lacustrine deposits, able to deliver worthy information about climatic and environmental changes at the southern tip of Patagonia and austral tephrochronology (SALSA, PASADO and PIPA projects). The Laguna Potrok Aike (LPA) area is located in the western flank of the Pali Aike volcanic field in the Magellan Basin, 300 kilometres East of the Andean volcanic front and at the edge of huge morainic arches proceeding from the Andes and the Magellan Strait. The predominant fault systems controlling most of the eruptive activity have a NW direction, later followed by faults of E-W and ENE strike. In LPA the stratigraphic

column is composed by: Santa Cruz Formation (SCF) deposits; deeply eroded Mio-Pliocene table basalts; till deposits; scoria cones, lava flows and maar phreatomagmatic sediments and glacifluvial, fluvial, aeolian and lacustrine deposits.

The Miocene molassic SCF consists of weakly lithified continental tuffaceous sandstones and siltstones, 660m thick at the vertical of LPA. Most of the basaltic outcrops in the area are part of a Mio-Pleistocene back-arc volcanic field. Table mountains, scoria cones, lava flow fields and maars are the main volcanic features. Basaltic table mountains are the oldest volcanic outcrops in Pali Aike. Transitional to alkali basaltic lavas, 10 and more metres thick, lie on the SCF. In the LPA area several scoria cones of Plio-Pleistocene age and alkali basaltic, basanitic and tephritic composition crop out almost devoid of rills, gullies or drainage pattern. The abundance of maars is a characteristic of the Pali Aike volcanic field. Some of these maars are large and shallow, others are smaller and deeper. Mean diameters of the largest maar-craters are: Potrok Aike 4500m, Timote 3100m, and Flamencos (W and E) 1960m and 1470m. Maar-craters developed in a soft-substratum are larger than craters carved in a hard-substratum, and exceptional big craters seem only to occur when country rocks are frozen (permafrost). The Potrok Aike Maar has a broad and flat morphology. The present lake inside the maar's diatreme (113 masl and 100m deep) has an almost circular shape 3 km Ø. The entire depression is ~4.5 km wide. The maar depression+diatreme ensemble has a champagne glass shape, characteristic of maars erupting in soft-rock environments. The diatreme was carved in brittle lithology of the molassic SCF, crowned by unconsolidated till deposits, and patagonian gravels. Cryogenic features -sand wedges and cryoturbations- affecting tills and overlying materials, attest permafrost conditions; but how many times and when these conditions prevailed is still uncertain. Moreover the soft and unconsolidated country rock allowed the development of inner crater walls of low slope angles which caused a very wide crater. Most of the phreato-magmatic deposits of the surrounding rim have been severely deflated.

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NORMAL UPPERPLATE FAULTING DURING THE INTERSEISMIC SUBDUCTION PERIOD IN NORTHERN CHILE: A NUMERICAL MODEL FOR THE MEJILLONES AND SALAR DEL CARMEN FAULTS

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In Northern Chilean forearc Late Pleistocene-Holocene paleoearthquakes along Salar del Carmen (SCF) and Mejillones (MF) faults have been detected and characterized by ongoing paleoseismological investigations. Several authors have suggested that normal faulting is in some way controlled by the cycle of subduction earthquakes (e.g. Delouis et al., 1998; Loveless, 2008). Nevertheless, the timing of normal faulting during the cycle is still a matter of debate. Recently, the Southern Chilean subduction zone has offered us a clear proof of the interplate-upperplate seismic interaction. In March 11th 2010, the Pichilemu Fault produced a Mw 6.9 event in the upper plate with normal focal mechanism following the February 27th Maule Mw 8.8 Earthquake (http://www.globalcmt.org). This is the first time in the Chilean margin that is possible to register the reactivation of normal faults in the upper plate shortly after a subduction earthquake. Notwithstanding this evidence, we present a theoretical model to explain upperplate faulting in the interseismic stage. Our considered interplate zone was modelled by several patches along which an amount of "backslip" equal to the convergence occurs (Savage, 1983). The "backslip" simulates an artificial normal slip in the seismogenic zone and is uniformly distributed in each patch. All the patches are completely locked between 20 and 38-50 km in our model, with exception of those below the Mejillones Peninsula (MP) which remained unlocked. The idea of a non-coupled zone below the MP is consider as plausible from the detection of an aseismic slip pulse after the Antofagasta 1995 Earthquake (Pritchard and Simons, 2006). We then calculate inter-sesimic Coulomb Stress Change (CSC) which indicates that normal faulting is favoured during this stage (positive CSC). To test this idea we are currently performing inversion models from inter-seismic GPS data registered between 2001 and 2005. Preliminary results suggest that there exists a less coupled portion of the seismogenic zone under the MP in comparison with portions located further north. We continue performing models to acquire a comprehensive understanding of how the architecture of the seismogenic zone influences the timing when earthquakes in MF and SCF can occur.

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THE USE OF RESIDUAL MATERIAL OF DIMENSION STONE PRODUCTION AS SOIL CORRECTIVE IN AGRICULTURE: EXAMPLE FROM MG AND ES, BRAZIL

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The State of Espírito Santo is responsible for ~80% of the national production of dimension stones. This industry generate of a big amount of residual stone powder by cutting and polishing produces (~20 and 25%). The presence of these residues in the form of mud generates an enormous environmental impact in water and atmosphere systems, beside the negative visual aspects. The physical-chemical study of these residues is fundamental to orientate an appropriate handling in soil correction, looking forward to sustainability of the area and the reduction of risks of environmental contamination. The investigated residues were collected in the waste deposits of three companies of Cachoeiro de Itapemirim District at southern Espírito Santo State:

-- Marbrasa: separated cutting and polishing residues.

-- Katugram: only polishing waste

-- Limagram: mixed material from polishing and cutting processes.

The present work has as objective to identify the chemical and mineralogical characteristics of the residues, to characterize his handling in the agricultural soils and evaluate the risks of contamination of the system soil-plant. The work was accomplished at greenhouses and laboratories of FAAG in UNIVALE by physical-chemical analyses, dissolution tests, percolation in open field and the physiological development of the used plants.

The materials were dried at normal temperature (30°C), the dispersed particles sieved and the obtained lots dried in an oven (120°C). For the evaluation of the colloidal characteristics, the materials were deposited in test tube with water and soon afterwards collected samples for chemical analyses. The obtained samples were used in open field test with different cultures (bean, mayze, pasture) to obtain information about influence of these supposed soil corrective materials.

The waste material shows a clear elevation of pH of soil after application for a long period. The chemical composition of the investigated waste indicate a lot of nutrient (Mg, P, Ca) inside, and mineral structure of the used waste show the easy availability in soil conditions. The mineralization of ~~the~~ macronutrient is accelerated and permits an easier absorption by the plants. There was a visible better growing in all used plant cultures in comparison to plants in normal soil. This effect, due to control during application (depth; quantity, distribution) permits to better the quality and quantity of production.

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DISSOLVED ORGANIC CARBON (DOC) AND METALLIC ELEMENTS IN WATERS FROM THE EASTERN IRON QUADRANGLE, MINAS GERAIS, BRAZIL

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A total of 40 water samples from lakes, swamps, rivers and streams from the eastern Iron Quadrangle in Minas Gerais, Brazil, were analyzed for metal content and dissolved organic carbon (DOC). The area hosts a number of metal mines (Fe, Al, Mn, and Au) and is considered one of the main mining areas in Brazil. The local lithology, determined by an Archean crystalline basement, the Archean *Rio das Velhas* supergroup and the Proterozoic *Minas* supergroup, within the ore paragenesis of the mines, releases many metallic elements into the hydroenvironment. Especially As, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Zn, were the objects of our investigations.

The field sampling included measurements of the physicochemical parameters: pH, ORP, TDS, Electrical Conductivity, Temperature, and Turbidity.

Some chosen samples were prepared for extraction of the aquatic humid substances (AHS) with post determination of the DOC, and the analyses of major and trace elements (ICP MS). In addition ultrafiltration was applied at 5 samples, which had in each case 20 liters.

In several samples the elements Fe, Mn, and Co, have been determined in concentrations above the allowed limits, established by the National Environmental Council of Brazil (Resolution CONAMA 357/05). Cu and Ni have been classified as elements inside of the standards for the so called “group 1”, allowed for freshwaters. The other elements show different behaviour patterns.

Correlations between major trace elements and DOC are discussed. The pairs of elements Fe / Mn, Ca / Mg, K / Na, Cu / Zn, Pb / Cu, Cr / Ni, and Cr / Co show positive correlations between themselves, indicating a natural origin from local lithology. The results, in particularly those of extracted samples, show in most cases a positive correlation between some major metallic elements, as between trace elements and DOC. Thus, for example, Fe and DOC and Cu and DOC have positive correlations, indicating that DOC interacts forming complexes with these metallic elements. In the samples subjected to ultrafiltration, AHS could be determined by means of Fluorescence Quenching. The AHS are responsible for the dark coloring of the waters. In the *Retentat* 100kDa fraction, positive correlations between DOC and some metals like Ca, Mg, Cu, Zn, Cr, Co, Ni, were detected.

CONAMA – 2005 - Conselho Nacional do Meio Ambiente - Ministério do Meio Ambiente, Resolução No 357, de 17 de março de 2005, Brasília, 23 p.

Supported by CNPq and FAPEMIG

A GEOTECTONIC MODEL FOR THE LATE PALEOZOIC IN THE PROTO-ANDEAN MARGIN OF GONDWANA FROM ND ISOTOPIC DATA, SIERRAS PAMPEANAS (ARGENTINA)

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Late Devonian and Early Carboniferous granitoids in Sierras Pampeanas of Argentina (proto-Andean foreland) are A-type magmas that represent variable mixtures of asthenospheric mantle and continental lithosphere. The magma source was primarily (and dominantly for the Early Carboniferous granites) asthenospheric mantle with subsequent crustal contamination (Rapela et al., 2008; Dahlquist et al., 2010). Our Nd isotopic study reveals varying juvenile magma participation in the parental magma of granitic rocks from Late Devonian to the Early Carboniferous. Late Devonian granites are localized in the east, on the foreland, and the Carboniferous granites towards the west, probably near the paleo-trench. Isotopic data from Late Devonian granitoids of the large Achala batholith (Rapela et al., 2008; Dahlquist et al., 2010) show εNd values of -4.0 to -6.2 (mean = -5.5) for the main granitic facies (379 Ma) and -1.3 to -1.9 (mean = -1.6) for small-scale tonalitic intrusive rocks (369 Ma), representing possible juvenile magma ascended by local conduits. Carboniferous granites represented by the Huaco granitic complex (354 Ma), the San Blas pluton (340 Ma), the Zapata granitic complex (323 Ma), and the Los Árboles pluton (335 Ma) have εNd values of +0.6 to -4.8, (mean = -1.9), -2.6 to -3.9 (mean = -3.3), -0.8 to -2.6 (mean = -1.6), -2.4 to -3.2 (mean = -2.8); respectively. Nd isotope composition thus suggests that the extension in the continental lithosphere (providing suitable conduits for ascending juvenile material and heat influx in the crust) as well as the mantle contribution to the A-type granitic magmas increased with time, starting in the foreland with the Late Devonian and continuing eastward with the Carboniferous magmatism. Sims et al. (1998) argued however that the Achala batholith was emplaced under compressional conditions. Our suggestion, based on structural considerations and the Nd isotope data, is that the Late Devonian parental magmas were generated in a dominantly extensional environment but were emplaced under transient compressional conditions. By the Early Carboniferous pure extensional conditions prevailed on the west, leading to the generation of the Carboniferous parental magmas.

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GROUNDWATER VULNERABILITY ASSESSMENT FOR URBAN HYDROGEOLOGY ANALYSIS; STUDY CASE: LINARES, MEXICO

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Urban hydrogeology studies the relationships between groundwater under the cities and the consequences of the great variety of human activities. Urban hydrogeology is defined as the study of hydrogeological processes and mechanisms that allow to analyze the effects associated with the abstraction, overexploitation, quality, quantity, presence of contaminants and management of groundwater (Custodio, 2004).

In order to protect the water as a resource is important to know the intrinsic vulnerability of the aquifers below the urban and peri-urban areas, DRASTIC method was use to obtain five levels of aquifer vulnerability surrounding Linares city (Aller et al., 1987).

Geographic Information System (GIS) technology and its tools were used to develop the aquifer vulnerability assessment, seven thematic maps were performed in digital format as a result of hydrogeological database (ESRI, 2009). The DRASTIC Vulnerability Index (DVI) was obtained after mathematical processing of thematic maps in raster format. In order to simplify the visualization of results the cell-values were grouped using the Quantile statistical method.

The land-use map of the Linares city and its peri-urban area shows that agricultural activity is the most important, additionally, in the north side of Linares is located the biggest industrial complex, to know the water quality 23 groundwater samples were obtain and analyzed in IAG-Hydrochemistry laboratory (Darmstadt-Germany). High Nitrate concentrations were determined in and around Linares city, denoting a human impact over the natural water chemistry.

The regional groundwater flow is from SW to NE thought the city, industrial zone and its agricultural area. Overlaying maps of vulnerability, land use and nitrate concentrations in the GIS, the possible origin sources were determined. Nitrate values are higher in the downstream area after the urban settlement, showing a clear impact of the human activities. The use of pesticides and fertilizers could be an important source of nitrate and heavy metal, industrial activities like manufacture of plastic parts for cars, food industries, wastewater discharge, cesspools and sewage system are pollution sources, that caused a negatively impact the groundwater sources to human consumption and the water quality of the water reservoir Cerro Prieto.

Integrated analysis with GIS of the aquifer vulnerability, land use, water quality and main pollutants, is a key process in developing countries for environmental management of groundwater as a resource. An environmental management groundwater program is necessary to protect groundwater sources, which supply more than 50% to Linares population and prevent pollution of water from Cerro Prieto reservoir, which is the second surficial source of drinking water state system for the Monterrey metropolitan zone.

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TIMING OF EARLY ANDEAN UPLIFT INFERRED FROM A DETAILED PROVENANCE ANALYSIS OF CENOZOIC SEDIMENTS IN SOUTHERN PERU

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Since Early Jurassic time, the continuous subduction of the Nazca plate underneath the South American continent controlled its western margin. The onset of crustal thickening in Eocene time leads to the present 70 km thick crust and elevations up to ~6500m. Generally, two major pulses of surface uplift are considered: a first episode during Oligocene to Early Miocene (Isacks 1988, J Geophysical Res 93) and a second one during Late Miocene (Schildgen et al. 2007, Geology 35). However, processes that lead to crustal thickening are strongly debated and time constraints on the early uplift phases are relatively weak.

We focus our study on Cenozoic continental siliciclastic formations deposited between the Western Cordillera and the Coastal Cordillera in southern Peru; i.e. the Moquegua Group. Methods comprise geochemistry analysis on single detrital mineral grains (amphibole and Fe-Ti oxide), U-Pb dating on detrital zircon using LA-SF-ICP-MS as well as zircon fission-track thermochronology. The data are used to develop a sediment provenance model and link the latter to the timing of the early episode of Andean uplift.

The combination of field observations, stratigraphic and petrographic descriptions taken from the literature, and our geochemical, geochronological and thermochronological data indicates uplift induced a significant change in provenance at around 35 to 30 Ma. This age coincides with the onset of widespread deformation and a first peak in shortening rates in the Eastern Cordillera (c. 35 Ma) and the Altiplano region (c. 30 Ma) in the Central Andes (Elger et al. 2005, Tectonics 24). A lag time of about 10 Ma is observed between the initial range uplift and the onset of voluminous volcanic activity (~25 to 22 Ma). This suggests that magmatic addition is not a main driver for crustal thickening in this early stage of Andean uplift. The onset of major volcanism is characterized by voluminous plateau-forming ignimbrites in southern Peru and northernmost Chile and is documented in a second profound change in the provenance of detrital minerals.

MAGNETOTELLURIC STUDY OF THE WESTERN CORDILLERA (NORTHERN CHILE), WITH A FOCUS ON LASCAR VOLCANO

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Between September and November 2007 and during a second field campaign in January and February 2010, long period magnetotelluric (LMT) stations were set following an E-W profile around 23.6°S, starting at the Cordillera de Domeyko, crossing the Salar de Atacama and reaching the Puna. A more focussed study, using audio magnetotelluric (AMT) sites, was carried out around Lascar volcano, a subduction related stratovolcano located in the Altiplano-Puna volcanic complex, with an historical activity characterized by fumarolic emissions and occasional vulcanian explosions, the largest one observed during April 1993.

Remote reference and robust techniques were used in the data processing. Induction arrows, phase tensor ellipses and strike direction of the conductivity distribution have been calculated for both data sets as dimensionality indicators, obtaining different results. The AMT sites around the volcano are showing a strong 3D behavior for shallower depths, with induction vectors at the closest sites to the volcano pointing away from it, influenced by the topography and by local conductivity heterogeneities. For the large period data from the profile, the behavior is more 2D with a more stable strike direction which is coherent with the induction vectors and the largest semi axis of the phase tensor ellipses. All these parameters are strongly influenced for the longer periods by a large highly conductive anomaly in the backarc, beneath the Argentinean Puna.

Topographic corrections have been applied as well as sensitivity analysis for different cases of synthetic magmatic chambers beneath Lascar volcano, using 3D forward modeling tools. Even when no large highly conductive zone could be detected directly below Lascar volcano, models including a conductive zone to the south of this area fit much better with the measured data.

2D models obtained from the inversion of the LMT profile data are showing good agreement with the largest features of this area, as the Domeyko Cordillera or the Salar de Atacama basin, and also showing the presence of the highly conductive anomaly previously referred by the dimensionality parameters, extending between 20 and at least 80 km depth. The presence of this conductive anomaly beneath the Puna agrees with previous magnetotelluric studies in the Altiplano, obtaining similar conductive anomalies (Brasse and Eydam, 2008), indicating that this feature could be common to the entire plateau.

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RAPID CRUSTAL UPLIFT IN PATAGONIA AS A CONSEQUENCE OF INCREASED ICE LOSS

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GPS observations were carried out between 2003 and 2006 at the northeastern edge of the Southern Patagonian Icefield. The data analysis was performed with the Bernese Software and revealed uplift rates of up to 39 mm a-1. For the region an accelerated glacier wasting has been observed since the termination of the Little Ice Age. This increasing ice loss continues up to present time. Advanced modelling shows that the rapid ice melting in combination with relatively low viscosity of the Earth's mantle caused by the unique regional slab-window tectonics is central for the interpretation of the results. The profile of GPS observations link ice loss to the soft viscoelastic isostatic flow response over the time-scale of the Little Ice Age (LIA), including ice loss in the period of observation.

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GEOMORPHOLOGICAL FEATURES AND DRAINAGE SYSTEM ANALYSIS FROM REMOTE SENSING IN SOUTHERN HISPANIOLA

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The Southern part of Dominican Republic is affected by two major faults. The E- trending Enriquillo Fault Zone which is accomodating the eastward motion of the Caribbean plate with respect to the North American plate and the NE-trending Beata Ridge Fault which separates the eastern and the western Caribbean Plate. Our main objective is to analyse the geomorphologic features and the drainage network of the EnriquilloCabo Rojo, Sierra de Bohoruco and Sierra de Neiba areas in order to evaluate the tectonic activity along the E-trending Enriquillo fault and to compare the evolution of different landforms with the tectonic processes. For this purpose we used a combination of different geomorphic indices extracted from digital elevation models (DEM) of southern Hispaniola.

The Cabo Rojo and Sierra de Bohoruco areas are located south to the Enriquillo Fault Zone. The geometry as well as the asymmetry of the basins located to the south of Cabo Rojo suggest northwestward stream migration. We interpret this lateral migration as the result of block tilting along a normal fault parallel to the Beata Ridge. River profiles, which are perpendicular to the normal fault, also display knickpoints corresponding to the fault scarp, indicating that they are not in an equilibrium state. Geomorphic indices such as Hack index also suggest non-equilibrated river profiles along the Sierra de Bohoruco fold. In addition the hypsometric integrals of several basins indicate a youthful topography in the northern part of the Sierra. These data suggest that the Sierra de Bohoruco is uplifted. The Sierra de Neiba is located north to the Enriquillo Fault Zone . The incision map here reveals that the southern part of the Sierra is more eroded than the northern part. We assume that the Sierra de Neiba is an asymmetric fold which is uplifted along an active thrust.

The geomorphological features and drainage patterns indicate that the Neogene to recent deformation in Hispaniola is not only occuring along the Enriquillo Fault Zone but is also accommodated along thrust faults and folds in restraining bends. Our data also allowed the identification of tilted blocks related to the Beata Ridge Fault System.

TECTONIC GEOMORPHOLOGY OF SOUTHEASTERN CUBA: RELATION OF THE RECENT DEFORMATIONS TO KINEMATICS OF THE CARIBBEAN PLATE

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The Oriente fault is located along the southern Cuban. The on-shore expression of the fault zone is an uplifting of coral reef terraces along the southern coast of Cuba that can be observed from the Sierra Maestra to the easternmost cap of Cuba. Our main objective is to analyse the geomorphologic features and the drainage network of the Imias-Sierra del Purial zone in southern Cuba in order to constrain the evolution of the landforms in response to tectonic uplift. For this purpose we extracted rivers profiles from digital elevation models (DEM) and we also used a combination of different geomorphic indices. The remote sensing analysis was completed by field works in order to better constrain the tectonic of the studied area.

Our geomorphic analysis mainly focused on the Imias-Sierra del Purial region. The basins of this area are highly asymmetric with streams deflected toward the NW. We interpret the north west ward migration of the streams as the result of block-tilting along NE-trending normal faults. In addition topographic profiles made across the area suggest an horst and graben which is consistent with the stream migration pattern . Ground check and structural measurements were done in Eocene to Quaternary rocks. The Early Eocene rocks are characterized by a left-lateral transpressive regime marked by NE-trending shear zones and NW-trending folds and reverse faults. Oligocene and younger rocks show only normal faulting and block rotation and tilting. Our observations suggest that the deformation is partitioned in oblique ENE-trending strike-slip and small extensional basins.

NEW SHRIMP U-PB DATA FROM GRANITOIDS OF THE NORTH-PATAGONIAN BATHOLITH IN THE AYSEN REGION, CHILE

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A regional U-Pb geochronological study has been carried out on granitoids of the North-Patagonian Batholith (NPB) in the Aysen Region, between 44°30' and 45°30' S. In this region the calc-alkaline subduction-related granites of the North-Patagonian Batholith mainly intruded Palaeozoic to Jurassic metamorphic accretionary complexes (Chonos and Eastern Andean metamorphic complexes), Upper Jurassic volcanic rocks (Ibañez Formation), Lower Cretaceous sedimentary (Coyhaique Group) and volcano-sedimentary rocks (Divisadero Formation), and Eocene to Miocene volcano-sedimentary rocks (Traiguen Formation).

New SHRIMP U-Pb zircon dating from 10 samples of migmatites, diorites, tonalities and granites yielded crystallization ages ranging from 110 to 10 Ma, although two main populations can be distinguished, Albian-Cenomanian (110 to 89 Ma) and Langhian- Tortonian (15 to 10 Ma).

Previous geochronological studies in the northern segment (39° to 41°) of the NPB show magmatic pulses during Jurassic, Cretaceous and Miocene (Munizaga *et al.*, 1988). Along the 41° to 44° S segment, Early Cretaceous, Miocene and Pliocene plutonic magmatism are well represented (Pankhurst *et al.*, 1992; Duhart, 2008). Also, rare Upper Cretaceous and Eocene plutons have been reported (Duhart, 2008). In the southern segment between 44° and 47° S, plutonic magmatism evidences a complex geographic age distributions in N-S belts, changing as follows from west to east: Upper Cretaceous, Early Cretaceous, Eocene, Miocene and Early Cretaceous (Pankhurst *et al.*, 1999).

The new SHRIMP U-Pb data are consistent with previous ages reported for the same segment (Pankhurst *et al*., 1999). However, some Miocene plutons exhibit an N-E trend suggesting its emplacement in oblique branches of the Liquiñe-Ofqui Fault System. Furthermore, these data confirm the existence of a large regional plutonic magmatism occurred during Cretaceous and Miocene times with inheritance evidences.

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A SPECIAL AND WONDERFUL CASE OF EROSION: LOS ESTORAQUES, COLOMBIA; FANTASTIC SCULPTURES

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Los Estoraques Unique Natural Area is located in the department of Norte de Santander, close to the city of Ocaña. It is the ideal place for observation of wild fauna and flora. Along its paths, it is possible to admire:

- Fantastic figures sculpted in reddish stone by centuries of erosion.
- Columns and pedestals in various shapes evoke mythical atmospheres while creating a fantastic architecture amid hills,
- Mountain crests and streams.
- Ghost-like geological formations characteristics
- The area measures 640 hectares.
- Its landscape is desert-like and is undergoing an accelerated erosion process.
- The altitude of Los Estoraques ranges from 1,450 to 1,700 above sea level.
- Rainfall is below 1,000 mm a year.
- The long summers extend from January to April and from July to September.
- Vegetation is that of the dry pre-montane forest. The maximum height of the canopy is ten meters.
- It is possible to find quite a variety of birds, reptiles, and mammals.
- Los Estoraques is considered a Unique Natural Area of the National Parks System by virtue of its scenic beauty.
- A series of columns and pedestals created by severe erosion.
- Archaeological remains in the area of Ocaña, Convención, and El Carmel, with funeral urns and mummies in the areas close to the reserve.
- Above the 1,900 meter line is the Pitirama forest, notable for its humidity and exuberant vegetation.
- Hikes through the rock formations to observe the insects, amphibians, reptiles, and birds natural to open, semi-desert areas.

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SEISMOLOGICAL AND VOLCANOLOGICAL INVESTIGATIONS OF THE VILLARRICA-VALDIVIA REGION, SOUTH-CENTRAL CHILE

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The south-central Chilean margin is prone to experience very large earthquakes (e.g., the 1960 Mw 9.5 Valdivia earthquake, and the 2010 Maule earthquake) and intense subduction-related volcanism.

Two temporary seismic networks were installed, as part of the collaborative research centre SFB 574 in cooperation with Chilean and Argentinian partners:

1. The Villarrica Network, between 39° and 40°S, covering the area from the coast to the back-arc. Comprising 55 stations, this network operated from December 2008 until November 2009.

2. A volcanic network around two of South America's most active volcanoes: Llaima and Villarrica. With five stations on each volcanic edifice, data has been retrieved from November 2009 and until March/April 2011.

Our aims are to characterize the larger subduction zone structure and seismicity in this region, known to be a seismic gap due to the low magnitude and number of events registered by both international (IRIS-NEIC) and national networks (SSN). The small volcanic networks are used to recognize and classify the volcano seismic activity and to study the fore-, and aftershocks of the 2010 Maule earthquake, which were observed by the volcano networks.

In this poster, an overview of the results from the seismological project and of the still ongoing work is presented. We analized the local seismicity observed in the Villarrica region, interpreted together with local earthquake tomography and a surface wave dispersion analysis. Ongoing work includes the characterization of the aftershock distribution of the Maule earthquake and the identification of volcano-seismic signals, which will be correlated with the degassing activity measured by DOAS stations in the future.

ECUADOR: GEO-TOURISM AND ITS GEO-ENVIRONMETAL CONTEXT. ROUTES AND ROADS, VOLUME 1: QUITO–PAPALLACTA–BAEZA–TENA–PUYO–BAÑOS

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The main objective of this subject is to promote and enrich the knowledge of Ecuadorian land in its geological context and its relation with the Environment. Even though the country has a small land extension, it has a very special and privileged geographical location, both in relation to its latitude since it is located on the “Equatorial line” as well as a continental location since it is part of the western coastline of South America; therefore it is linked to an active Tectonic plate. These characteristics turn this country into a NATURAL LABORATORY BY EXCELLENCE for earth sciences studies.

If we see geo-tourism in this context, it is a subject that should be introduced at an early age, for example its basic concepts should be taught at elementary school. Geo-tourism allows adults to enrich their knowledge; to the specialists to deepen his/her knowledge and to the tourists to select topics with goals that can be reached. Finally, it allows sectorial governments to use its products as in the case of stone materials for the industry/craftwork and in the same way to increase its development and protection of the areas.

In summary, the mission of the project is: the recreational, tourist and educational use with scientific purposes and the development and protection of its areas.

The project aims to cover the country as much as the access “routes and roads” allow it. At the present we have started and are working at the eastern stretch of Quito: this is Quito-Papallacta-Baeza- Tena-Puyo-Baños.

We have chosen this segment due to the spectacular offer and variations it offers since there are all kinds of rocks (igneous - metamorphic - sedimentary). The access is easy and direct. There are also diverse altitude levels. The scenery offers a varied morphology product of combined and extreme processes; covered and decorated by equal abundant and bio-diverse vegetation. The context includes a “divorsium aquarum” 70 km from the city of Quito. The offer can be compared to a gigantic “Shopping Center” where you have everything and can be reached by hand!

The texts and graphics are used as an introduction for the reader; stating the geographical location. It also has clear references of the types of rocks, photographs of the volcanoes, upwelling, typical vegetation, and the most important plants in each habitat along the route.

Materials are available as well as the use of Laboratories from the Department of the National Polytechnic School of Quito – Ecuador to implement the project. The person responsible of this work will like to express his appreciation to the authorities for their support.

Sponsored by the DAAD GOAL alumni network

ENVIRONMENTAL PROBLEMS ASSOCIATED WITH MINING IN THE IRON QUADRANGLE, MINAS GERAIS, BRAZIL

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The Iron Quadrangle, in Minas Gerais, Brazil, is a geological structure with approx. 7000 km^2 size. Its basement is composed of granitic gneisses of Archean age. Two metasedimentary supergroups overlay this basement. The Archean *Rio das Velhas* supergroup, a greenstone belt, composed by metasedimentary and metavolcanic rocks, which contains enormous goldmines, and the Proterozoic *Minas* supergroup composed of metasedimentary units as schist, phyllites, quartzites and banded iron formations (BIF´s). This region represents one of the main mining districts of Brazil. Beside Fe, Mn, an Al ores, gold, silver and gemstones such as Emerald and Topaz are extracted. Artefacts are made from soapstone. Gneiss and quartzite are used as construction material.

The first mining activities started immediately after the discovery of the alluvial gold occurrences in the late 17th century. Three hundred years of mining activity since then has left its impacts. Large parts of the region are degraded; in particular the basins containing mining wastes of the Fe mines, the old abandoned iron mines and the abandoned Soapstone, Gneiss and Quartzite quarries deform the area. In the lateritic soils that cover the granitic gneisses the erosion is favored by the rapid feldspar decomposition. Topaz extraction from soils that cover weathered dolomites also cause big erosions. The gold mines contribute to acid mine drainage. Specially the decomposition of sulfide minerals such as pyrite, arsenopyrite and chalcopyrite may cause pH values up to 2,5 in drainages. The low pH value can be treated by diverse methods, among others with neutralization by NaOH, or passively with wetlands. Despite that a set of dangerous heavy metals, like Pb, Cd, As arrive into the river courses. A major problem of pollution is the use of mercury by gold prospectors. Although officially prohibited, mercury is still very often used in the amalgamation of gold. Benefiting from the tropical climatic conditions, mercury is transformed by bacterial activities in the very toxic methyl mercury. Within the iron quadrangle, which represents the ecosystem transitional zone from the *Mata Atlantica* to *Cerrados*, large forest areas were cut down in favor of mining activities, and also for the production of charcoal for the metal industry.

Recently, several new federal and state laws were enacted, prescribing p.e. in the case of the iron mines, the restoration of natural landscapes. The use of mercury is prohibited. The quality of waters and the air is controlled. Such measures require intensive monitoring, but in practice there is a lack of effective control. Only a change in public attitudes and mentality of the population can bring significant change to the better. Many promising approaches are observed.

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SANAGASTA: RECORD OF A NEOSAUROPOD NESTING SITE IN A LOWER CRETACEOUS PALEOHYDROTHERMAL LANDSCAPE

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Cretaceous dinosaur nesting sites have been discovered on every continent, except Antarctica. Despite these discoveries, the factors that influenced the choice of selected colonial nesting sites by Cretaceous dinosaur still remained enigmatic. A recent study of the Sanagasta nesting site demonstrated the relation between dinosaurs nesting behaviors and a specific paleoenvironment: the Sanagasta neosauropod dinosaurs nested in an Early Cretaceous geothermal paleosetting (Grellet-Tinner & Fiorelli, 2010). Although the Los Llanos Formation outcrops throughout the La Rioja Province, the new nesting site is geographically restricted to a relatively small area (~300,000 m^2) mostly located within the Sanagasta Geologic Park boundaries, in the central region of the Sierra de Velasco, La Rioja province, NW Argentina. There, the neosauropods ovideposited clutches of 21cm sub-spherical eggs in dug out holes systematically grouped nearby paleohydrothermal conduits, discharge channels, fountain geysers, domal mounds, paleohot spring terraces, ponds, travertine dams and mini-dams (Grellet-Tinner & Fiorelli, 2010). After detailed microscopic characterizations the original ~7.5 mm thick eggshells are hypothesized as an adaptation to this specialized geological paleoenvironment by compensating for the acidity of the hydrothermal solutions during the necessary incubation period. The number and position of the clutches combined with geological dating support colonial and nesting fidelity behaviors, migrations for reproductive purposes, and adaptation to soil moisture and thermoradiance for incubation, which for the latter had not been suspected previously for extinct dinosaurs but still observed in modern saurians. Indeed, several species, i.e. like the megapodes birds (*Megapodius*) and the Galapagos land iguanas (*Conolophos*) (Werner, 1983; Göth & Vogel, 1997) still rely on similar geological conditions to incubate their eggs.Although most of the 80 recorded clutches in the Sanagasta Geologic Park contain an average of 10 eggs, several displays up to 35 eggs with a maximum axis of 220 cm. Thorough field and taphonomic observations and ensuing statistical and geochemical analyses, coupled with microscopic characterizations indicate that the reproductive behaviors of the Sanagasta neosauropods was symbiotic and concomitant with the Early Cretaceous geothermal activities dated by the Gondwanic geothermal cycle. This investigation resolves longstanding geological issues related to the dating of the sedimentary basins in the Sierras Pampeanas Orientales (central-west Argentina) and the Los Llanos Formation by assigning them an Early Cretaceous date (Hauterivian to Aptian, ~134 and ~117 million years; Mutti *et al*., 2005; Grellet-Tinner & Fiorelli, 2010). Furthermore, this research provides the first definitive answer to the question to why neosauropod nesting sites were confined to a few selected geographical localities during the Cretaceous times. As such, the Cretaceous Sanagasta nesting site represents to date one of the most important dinosaur nesting sites in the world, as, for the first time, it shed lights on a particular reproductive behavior of neosauropods.

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RECORD OF THE FIRST CRETACEOUS CONTINENTAL FAUNA FROM LA RIOJA PROVINCE, NORTHWESTERN ARGENTINA: GEO-PALEONTOLOGICAL IMPLICATIONS

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The Cretaceous terrestrial ecosystems in Argentina are relatively well known especially from Patagonia, namely Neuquén, Colorado, San Jorge and, Austral basins. Conversely, the northwestern continental Cretaceous sedimentary basins are virtually unknown besides the rift basin of the Salta Group in the Salta Province. Bodenbender (1911) named the "Estratos de Los Llanos" a suite of sedimentary units scattered throughout the La Rioja Province and dated them to the Upper Cretaceous. However subsequent authors correlated these strata with Cenozoic outcrops from neighboring provinces, a dating that prevailed until (see Ezpeleta et al., 2006) fragmentary dinosaur eggshells were discovered in the Sanagasta Valley (Tauber, 2007). Following this discovery, the age of this locality was reverted to the previous Bodenbender's Cretaceous dating (Grellet-Tinner & Fiorelli, 2010). In 2010, preliminary explorations of the 2007-2010 Sanagasta-Tama Project started with a geo-paleontologic field work in the Los Llanos Formation in La Rioja province, Northwestern Argentina. The main goal of the project was to explore and thoroughly investigate what is now the Sanagasta neosauropod dinosaur nesting site (Grellet-Tinner & Fiorelli, 2010). Subsequent work focused on, correlating this site with other outcrops to better understand the paleontology and paleoenvironments of the Los Llanos Formation. Recent field work led to the identification of numerous fossil-bearing localities, with specimens ranging from fragmentary bones to semi-articulated vertebrates. The main objective of this communication is to report the discovery of a new Cretaceous fossiliferous deposit at Tama –the type locality for Los Llanos Formation–, La Rioja. The locality offers a diverse Cretaceous terrestrial fauna composed of several major vertebrate clades, namely turtles, crocodyliforms, and several sauropod and theropod fossils. Crocodyliform is represented by very diagnostic notosuchian cranial remains. The rostral and teeth share characters with *Notosuchus terrestris* and *Sphagesaurus huenei* that are typical Cretaceous taxa from the Gondwana (Fiorelli & Calvo, 2008). Likewise, dinosaurs are represented by indeterminate neosauropod and several theropod taxa possibly affiliated with Titanosauria, Abelisauria, Carcharodontosauridae and Coelurosauria, respectively. The paleofaunal assemblage is very similar to those from the Cretaceous Neuquén and Baurú basins as well as African Cretaceous basins.The Los Llanos Formation exposures in Tama are characterized by a succession of well developed paleosols, composed by quartz sandstone cemented by sparry calcite. Paleosols display pedogenetic structures (e.g. calcareous nodules, laminar gypsum, and abundant rhizocretions) suggesting a typical aridisol calcitic horizon intersperced by ephemeral rivers, represented by the presence of isolated and fossil-bearing sandy river channels. Bioturbations, burrows, and pupal chambers (in ephemeral lake facies), and indeterminate trace fossils are also ubiquitous. Overall, the results of the field work at Tama coupled with the research at Sanagasta resolve the longstanding geological debate about the relative age of the sedimentary basins from the Sierras Pampeanas Orientales (central-west area of Argentina) by offering definitive geological (Gondwanic Cycle) and paleontological evidence of a Cretaceous age for the Los Llanos Formation.

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ONSHORE FRACTURE ZONES AND THEIR EXTENSION OFFSHORE IN THE SOUTH ATLANTIC: INSIGHTS FROM GEOPHYSICAL ANOMALIES AND LOW-TEMPERATURE THERMOCHRONOLOGY

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The south and southeast passive continental margin of Brazil and Namibia is a key-area to understand post-break-up processes of the South-Atlantic driven by endogen and exogen forces. Fault movement, rock and surface uplift, and subsidence and inversion of offshore basins are the surface expressions of lithospheric and mantle processes. Important for the understanding of the causes of the dynamic topography evolution along the passive continental margins of the South Atlantic are the evolution of NW-SE fault zones. These onshore fault zones are often reactivated shear and fault zones of Neoproterozoic age. They can be traced to fracture zones offshore. Therefore, their dynamic evolution is important for the understanding of the sedimentary basins offshore.

The integration of low-temperature thermochronology data, with topography, gravitational and aeromagnetic maps, and seismic reflection profiles allow to discuss the long-term exhumation history since Late Cretaceous – Paleocene time.

HIDROGEOGRAFÍA DEL ORIENTE DE LA PENÍNSULA DE YUCATÁN

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La península de Yucatán se ha descrito como un sistema generalizado de corrientes subsuperficiales y ausente de ríos, esta apreciación se debe a la carencia de estudios detallados y a la diferenciación del paisaje vinculado a los cuerpos de agua y a su caracterización morfográfica. El presente estudio contribuye a la caracterización de las unidades territoriales vinculadas con los cuerpos de agua, diferenciando su génesis, dinámica y propiedades morfométricas y morfológicas. Los pasos metodológicos para la caracterización territorial fueron los siguientes:

- Identificación de los cuerpos de agua y sistemas hídricos de las 71 cartas topográficas 1:50000 que integran el territorio del sector Este de la península de Yucatán
- Diferenciación altimétrica, inclinación del terreno y mapa de depresiones
- Diferenciación de cuerpos de agua de acuerdo a sus sistema de inundación: permanente, ordinario y extraordinario
- Diferenciación de la génesis de los cuerpos de agua: tectónico – cárstico-fluvial-lacustre o costero
- Caracterización morfológica y morfométrica de los cuerpos de agua de acuerdo a las diferenciaciones antes descritas
- Sistematización de los procesos hidrogeográficos del sector este de la península de Yucatán con una resolución a escala 1:50000.

Los resultados principales son los siguientes:

Construcción de un sistema de información hidrográfico del sector este de la península de Yucatán con una escala de resolución 1:50000, integrado por las siguientes variables: relieve (altimetría, pendientes, modelos digítales del terreno y depresiones); cuerpos de agua (ríos, lagos, lagunas) y sistema de inundación (permanentes, ordinarios y extraordinarios); morfogénesis (tectónico-estructural-cárstico) y formas y procesos unitarios (fluvial, lacustres y costero).

En el sector este de la península de Yucatán se reconocen sistemas hidrográficos claramente diferenciados, en el norte, predominan el cárstico – fluvial incipiente y de lagunas costeras; en el centro el cárstico, tectónico- lacustre y tectónico – costero; en el sur, el tectónico – fluvial, tectónico – lacustre, fluvial, lacustre y costero.

La diferenciación hidrográfica es un paso inicial para la comprensión de los estadios de desarrollo del relieve del sector este de la península de Yucatán, asimismo, mediante el apoyo del sistema de información hidrogeográfico, se logra sistematizar y potenciar la caracterización de los cuerpos de agua, su dinámica y su génesis con vista a plantear nuevas aproximaciones multidisciplinares en el estudio de esta región.

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MESOZOIC REPTILES OF NORTHEAST MEXICO, A COMPILATION OF TEN YEARS' RESEARCH

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Since the last ten year, the research on Mesozoic reptiles and their traces has boosted in Mexico. Numerous historically known localities have been reactivated but many new ones were discovered since then and the process has not stopped until today. Our first research activities concerned the Late Jurassic La Casita/La Caja Formation in Nuevo León and Coahuila, which not only yielded marine super predators such as the pliosaur now known as the "Monster of Aramberri" but also an unexpected variety of other marine reptiles in an extraordinary preservation. One of the most proliferous concentration lagerstätten from Late Jurassic age is an outcrop near Gomez Farías in Coahuila, yielding pliosaurs, ichthyosaurs, marine crocodilans and remnants of elasmosaurid plesiosaurs.

A second area of research are the laminated limestone deposits in Nuevo León (Vallecillo) and Coahulia (Múzquiz) forming one the most complete Late Cretaceous sequences in the world, spanning from the Turonian into the Santonian. Both areas have yielded remnants of marine reptiles. Early mosasauroids with supreme soft tissue preservation and gastric content were unearthed at Vallecillo and allow an exceptional insight into the external morphology, lifestyle and ecological role of these animals. The discovery of large mosasaur remains in the slightly younger sediments north of Múzquiz yield the potential for an enquiry on the evolution and paleobiogeograpy of the American mosasauroids. Remnants of sea turtles, pterosaurs and plesiosaurs are exceedingly rare in the Late Cretaceous laminated limestone.

One of the most enigmatic fossiliferous localities is the Parras basin. Near the hamlet Porvenir de Jalpa (Coahuila) outcrop sediments of Campanian age (Late Cretaceous) that were deposited in an oscillating delta system. Here, dinosaur bones and skeletons as well as fossil trackways document a diverse dinosaur population: coelurosaurid, dromaeosaurid and ornithomimitid theropods, hadrosaurine and lambeosaurine hadrosaurs, titanosaurid sauropods and ceratopsians. The dinosaur remnants are mixed with dyrosaurid crocodilians, trionychid turtles and mosasaurs. Further to the north, further coeval dinosaur localities were discovered yielding remnants of the gigantic alligatoroid crocodilian *Deinosuchus* possible in its southernmost distribution.

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NEW PORPHYRY COPPER-GOLD-SILVER ORE DEPOSITS BELT IN LA TERNERA LOWER TERTIARY RANGES, COPIAPÓ, NORTHERN CHILE

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A new porphyry copper-gold-silver ore deposit belt, associated to a Lower Tertiary magmatic-volcanic belt in the La Ternera Andean Ranges at Copiapó, Northern Chile, has been recently discovered, and is undergoing initial exploration.

The new occurrences - Paipotito (UTM coordinates: 446.000-450.000E/ 7.010.000-7.014.000N), Marilyn (UTM coordinates: 458.000-461.000E/ 7.002.000-7.005.000N), La Ternera (UTM coordinates: 423.000-426.000E/ 6.985.000-6.990.000N), Las Norias (427.000-431.000E/ 6.976.000-6.971.000N) - from a geologic and metallogenic point of view, have in common:

a) a similar host rock regional geology environment, consisting of Upper Jurassic to Lower Cretaceous marine to transitional sedimentary series with volcanic andesitic type intercalations.

b) the porphyry type magmatic-subvolcanic systems, which produced the alteration-mineralization, are of a quartz-dioritic to granodioritic composition. They are poorly exposed, and most of the typical mineralization and alteration porphyry assemblages affecting the host rock environment are on the top of the porphyry ore deposit systems.

c) a common occurrence of altered-mineralized hydrothermal breccias and structurally controlled stockwork type bodies.

d) the better gold-silver mineralization grades appear associated to clusters of epithermal-mesothermal type swarms of quartz (mostly dark) veinlets bodies emplaced, as telescoped processes, on top of the systems;

e) each one of the porphyry systems shows a size of the altered-mineralized surface area of about 12 to 16 Km^2, which includes the propilitic halo (epidote-chlorite), all of them having a preliminary estimation of a possible economic ore tonnage of about 200 up to 400 million tonnes of sulphides (Fe, Cu, Ag) and gold bearing mineralization.

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SOUTH AMERICAN JURASSIC MAMMALS: THEIR RELATIONSHIPS AND PALEOBIOGEOGRAPHICAL IMPLICATIONS

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South American Jurassic mammaliaform corporeal remains have only been reported from Queso Rallado locality, in Chubut Province, Argentina. The bearing strata probably represent the basal levels of the Cañadón Asfalto Fm, which are thought to be of Toarcian age (Cuneo & Bowring, 2010). The mammaliaform fauna found in this locality is composed at present by three described forms: *Argentoconodon fariasorum*, *Asfaltomylos patagonicus*, and *Henosferus molus*.

Argentoconodon is closely related to *Ichthyoconodon jaworowskorum* and *Volaticotherium antiquus*, forming a clade nested among alticonodontine eutriconodonts. Given this scheme of relationships, *Argentoconodon* might be the earliest representative of Triconodontidae. Moreover, *Ichthyoconodon* and *Volaticotherium* lineages must have been present at least from the Early Jurassic. This also applies to the other members of Alticonodontinae, only reported from North American Cretaceous localities (see Kielan-Jaworowska *et al*., 2004).

Asfaltomylos patagonicus and *Henosferus molus* have been regarded as basal members of Australosphenida (Rougier et al 2007), extending the temporal range of this group to the Toarcian. Australosphenidans molariforms highly resemble tribosphenic ones; in contrast, Jurassic forms from Northern landmasses lack tribosphenic-like teeth (see Kielan-Jaworowska *et al*., 2004) except for the enigmatic *Shuotherium dongi* from the Late Jurassic of China (Chow & Rich, 1982).

Jurassic South American mammaliaforms point to the origin of australosphenidans and alticonodontines prior to the complete separation of Southern and Northern landmasses in a Pangeic paleogeographic setting.

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SOIL COLUMN TOMOGRAPHY – COMBINED GEOELECTRICAL AND HYDRO-CHEMICAL INVESTIGATIONS AT A LABORATORY SCALE TO CHARACTERIZE TROPICAL SOILS IN THEIR POTENTIAL FOR ARTIFICIAL GROUNDWATER RECHARGE

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The controlled percolation of pre-treated municipal wastewater is a simple and economic treatment technique. One target of this method besides natural wastewatertreatment is groundwater recharge by percolating water though the unsaturated zoneto the groundwater table.

Hydraulic conductivity, grain size distribution and composition are importantparameters and have major impact on the infiltration process and the retardation potential of the soil.

Geoelectrical measurements can be applied as a non destructive survey method forsubsurface characterisation, e.g. investigation of depth to water table and monitoringof subsurface contamination. Other applications, especially for hydrological studies, are investigation of groundwater mineralisation and soil moisture.This project aims on the development of a quick and easy tool to approximate thepercolation process in a party saturated soil in focus of treatment of wastewater andartificial groundwater recharge.

This work deals in detail with a combined method of geoelectrical measurements andhydrochemical balancing in laboratory scale. Therefore a device for tomographicgeoelectrical measurements on soil columns has been constructed. The measurement device is cylinder-shaped (diameter: 10 cm; height: 20 cm) and fitted with 48 electrodes which are installed in six layers with equidistant electrode spacing. Each electrode ring contains eight electrodes also in equidistant spacing. The electrodes are controlled by three decoder units which are connected to a RESECS® earth resistivity meter. To gain high resolution results a measurements sequence with246 single measurements is applied. The monitoring measurements are first donealong each electrode ring individually with a dipole-dipole electrode configuration. This method, also well known from geoelectrical tree trunk tomography, produces 2D, horizontal and equidistant information about the electrical resistivity distribution inthe soil column. As a second step of the geoelectrical monitoring a vertical series ofmeasurements using all six electrode rings is conducted. All geoelectrical data areprocessed and analysed using an inversion software to get a detailed 3-D image ofthe electrical resistivity distribution in the soil column.

Following the measurements on the unsaturated soil column (background measurements) an artificial wastewater with defined mineralisation is percolatedthrough the soil column while the tomographic measurements described above arecontinuously running.

The main objective of this investigation is to evaluate relationships between infiltration of wastewater with known composition and changes of electrical resistivityin the soil column going along with the infiltration, by observing it with geoelectricaland hydrochemical measurements. The eight different soils used in this investigationrepresent typical tropical soils from *Distrito Federal*, Brazil.

These investigations will be combined with multiple field, climate and hydrologicaldata to estimate the potential for artificial groundwater recharge for the different soils.

RAINFALL ANOMALIES IN THE NORTHWESTERN ANDES ASSOCIATED WITH THE ‘’EL NIÑO’’ PHENOMENON

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Using a test of symmetry a rainfall interpretation is made based on the comparison between the mean monthly multi-annual data with the annual total. Rainfall in pre-El Niño phases is analized in three areas of northwestern Andes (SW Colombia) with similar rainfall regimes but different topographic and humidity conditions: subhumid mid-lowlands of an interandean valley (986 meters above sea level-asl), humid edge of a plateau (1750 meters asl), and a low-dry valley (350 meters asl). The characterizations are those of 1982-1983 and 1992-1993 El Niño events, taking into account the preliminary stages, i.e. October 1981-June 1982 and December 1990-July 1991.

According to the results no relation was found in the pre-events between the humidity and the rainfall distribution, although the relationship was high between the two referenced periods and among them and the mean annual rainfall.

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QUATERNARY TECTONICS OF THE LERMA VALLEY, EASTERN CORDILLERA, NORTHWESTERN ARGENTINA

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The Lerma valley is an intermontane basin elongated in N-S sense and located between 24°30' - 25°35' SL at Eastern Cordillera geological province. The basin is limited by basement blocks uplifted during Miocene to Plio-Pleistocene times (Monaldi et al., 1996). The neotectonic basement of the region is composed by diverse rocks from Precambrian metasediments and marbles to Mio-Pliocene continental red beds. The Quaternary infill begin with reddish conglomerates and siltstones of the upper part of Jujuy Subgroup (Piquete Formation), followed by middle Pleistocene clast supported conglomerates grouped into the Calvimonte Formation. In the central part of the valley, light brown and red siltstones and mudstones conform the upper Pleistocene Tajamar Formation and are unconformable covered by reddish conglomerates of La Viña Formation (upper Pleistocene-Holocene) (Gallardo & Georgieff, 1999).

The Tajamar Formation is tilted towards the NW in the Guachipas hills and folded at the Calvimonte hills. In the Guachipas area the contact between the Tajamar Formation and the upper part of the Piquete Formation (Calvimonte Formation?) occurs by means of progressive unconformities. The La Viña Formation, the upper Pleistocene to Holocene agradational surface, is cuted by a piedmont scarp in the alluvial bajada of the Altos del Tapado, at the SE corner of the valley. Quaternary terraces correlated with La Viña Formation are tilted and faulted at the NW-SE trending mountain front of the Sierra de Quijano. These structures and growth strata geometries between Piquete and Calvimonte Formations are the most impresive evidences of neotectonic activity in the region. The epicentre of the Salta earthquake (February 27, 2010, Mw=6.2) was located close to this region with a focal mechanism indicating a NW-trending SW-dipping seismic source (García et al., 2011). More detailed mapping and dating are needed to determine recurrence interval, kinematics and displacements of these structures associated with the Calama-Olacapato-Toro lineament.

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ANDEAN EVOLUTION OF THE ALUMINÉ FOLD AND THRUST BELT, NORTHERN PATAGONIAN ANDES (38º30'– 40º30' S)

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The Aluminé fold and thrust belt constitutes the southern expression of the Agrio fold and thrust belt, which has been extensively studied during the last decades (Cobbold and Rossello, 2003; Zamora Valcarce *et al*., 2006; among others). It involves the eastern slope of the Patagonian Cordillera across the inner retro-arc, as well as the Southern Neuquén Precordillera to the east, an independent mountain system more important in topographic terms that the Patagonian Cordillera located more than 400 Km east from the trench. Its extensive development, high altitudes, and its position within the retro-arc, raise a question about its genesis in the context of this Andean segment. The study of the retroarc area between 38º30' and 40º30'S allowed us to define and characterize the different stages that led to its present configuration. The analysis of the Tertiary synorogenic deposits, and its relationship with the main structural features, together with the ages obtained for the cretaceous - paleogene volcanic sequences, and the determination of a structural control in their emplacement, allowed us to define the main contractional phases that affected this segment. The most significant event took place between the Late Cretaceous – Early Paleocene, related to an eastward expansion of Late Cretaceous to Eocene arc-related sequences. The inversion of normal faults of the Mesozoic rift phase along the external portion of the fold and thrust belt, resulted in the early uplift of the Southern Neuquén Precordillera. On the basis of tectonostratigraphic controls we define the last Andean contractional phase between the Late Miocene and Early Pliocene (~11 – 4.3 Ma). This event induced the reactivation of both sectors of the fold and thrust belt, leading to the uplift of the Patagonian Andes and reshaping the Southern Neuquén Precordillera (García Morabito *et al*., 2010). Both intervals of compression and shortening are separated by a period of extensional activity that resulted in the development of the Collón Cura basin within this Andean segment. Here, large thicknesses of volcanosedimentary sequences accumulated between the Early Oligocene and the Early to Middle Miocene. Data and observations were integrated in a tectonic model consisting in five principal stages developed between mesozoic and cenozoic times, which lead to the present configuration of this Andean segment trough a complex history of deformation characterized by the alternation of tectonic regimes.

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METASOMATIC REACTION ZONES AT PERIDOTITE-SCHIST INTERFACE IN THE FRONTAL CORDILLERA MAFIC-ULTRAMAFIC BELT, CENTRAL ANDES, ARGENTINA

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Metasomatic reaction zones related to chemical interactions at peridotite- schist contacts are documented in ultramafic (UM) bodies cropping out in Río de Las Tunas Mafic-Ultramafic Belt, Central Andes, Mendoza Province, Argentina. These UM bodies belong to an alpine type belt which has been interpreted as a dismembered and metamorphosed ophiolitic section. The mafic unit dated by Sm-Nd gave a neoproterozoic age of 655±76 Ma (López de Azarevich et al., 2009). The reaction zones are developed at the interface between metaperidotite bodies and the country metamorphic rocks belonging to the Guarguaráz Complex. These reaction zones are characterized by concentrates of talc close to the UM body, followed by a fibrous amphibole zone and a black-wall of chlorite near the country-rock. The interface between each mineral zone is transitional and the size of the entire reaction zone varies from 10 cm to 1 m wide. This size is proportional to that of the UM bodies. Several monomineralic pods in the area, such as chlorite, actinolite or talc clots may also represent smaller size metasomatized ultramafics. Magnesite pods also occur when carbonate-bearing levels are present in the surrounding metamorphic basement. Mayor element contents in bulk rock and mineral phases crystallized in the reaction zones demonstrate the chemical exchanges occurred at these interfaces (Gargiulo 2010), showing MgO and CaO transfer from the UM body to the country-rock and the transfer of FeO*, SiO2 and Al2O3 from the schist to the UM body. Geobarometric calculations based on amphibole Al content gave P estimations between 3.1 y 1.8Kbar to the formation of these reaction zones.

According to Sanford (1982) we interpret the development of the reaction zones as a consequence of metasomatism produced in regional metamorphic terranes where the sharp chemical potential (or activity) gradient between pod-like UM bodies and the pelitic or quartzo-feldspathic country rocks has produced elements diffusion or infiltration between these rock-types, in order to reach the chemical equilibrium. The P values obtained allow us to assign the formation of the reaction zones to the latest stage of the pre-Carboniferous regional metamorphism occurred in the area.

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DISTRIBUTION OF PLATINUM GROUP MINERALS (PGM) IN DIFFERENT CHROMITITES FROM BRAZIL

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In this contribution we report on the presence of platinum group minerals (PGM) in stratiform (Monte Alegre do Sul, Luanga, Niquelandia, Campo Formoso, Serro-Alvorada de Minas, Pedra Branca) and podiform (Crominia and Morro Feio) Brazilian chromitites. According to the literature data, the stratiform chromitites occur in the mafic-ultramafic portion of Lower Proterozoic layered Complexes, whereas the podiform chromitites are considered to be part of Precambriam ophiolites (Upper Proterozoic). All the investigated chromitites contain PGM, however with some differences as it regards their variety, and the following PGM have been recognized: Monte Alegre do Sul = laurite, erlichmanite, irarsite, platarsite, hollingworthite, cuprorhodsite, malanite, Rh-pentlandite, Ir-Ni-S, Pd-Ir-Te; Luanga = sperrylite, laurite, irarsite, hollingworthite, platarsite, Pt-Fe alloys, platinum, tulameenite, rustenburgite, cooperite, Pt-Fe oxide, Pt-Mn-Pb-Fe, Pd-Sb, Pt-Sb-Bi-As, Pd-Pb; Niquelandia = laurite, erlichmanite, irarsite, tetraferroplatinum, isoferroplatinum, Os-Ir alloys, geversite, moncheite, merenskyite, sobolevskyite, stumpflite, Ru-oxide; Campo Formoso = laurite, erlichmanite, irarsite, ruarsite, hollingworthite, osmium, Pd-Sb, Pt-Te; Serro-Alvorada de Minas = irarsite, ruthenium, sperrylite and Pd-Te-Bi; Pedra Branca = laurite, irarsite, hollingworthite, sperrylite, cooperite and Pd-Te; Crominia = laurite, Ru-oxide, irarsite, and Morro Feio = laurite, sperrylite, irarsite, hollingworthite.

These results, although preliminary, indicate that the stratiform type chromitites are enriched in PGM containing also abundant phases of the more valuable Pt and Pd. Furthermore, the samples of Luanga, characterized by the presence of abundant Ni-Cu-Co sulfides, proved to be the PGM richest chromitites. On the contrary, in the ophiolitic chromitites the PGM are less abundant and, with the exception of some samples of Morro Feio, that contain rare Pt and Rh bearing PGM, they mainly consist of Ru, Ir and Os minerals, as typical of most of the ophiolitic chromitites worldwide distributed. Texture and paragenesis of the PGM, being associated with stratiform or podiform chromitites, indicate that most of them were reworked or re-deposited under hydrothermal conditions, possibly by alteration and dissolution of preexisting PGM formed at magmatic stage.

RELATION BETWEEN JURASSIC RIFTING AND ACTIVE WRENCH TECTONICS IN THE SOUTHERNMOST ANDES OF TIERRA DEL FUEGO

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There is a current general agreement that deformation history of the Fuegian Andes involved late Paleozoic to early Mesozoic compression, Jurassic extension, and a Cretaceous – Paleogene overall compressive regime followed by a Neogene to Recent phase of strike-slip deformation (i.e. Diraison et al. 2000; Menichetti et al. 2008). However, there are several intriguing events such as a late Paleocene-early Eocene phase of extensional deformation related to the opening of Drake Passage (Ghiglione et al. 2008) as well as a Neogene rifting system showing extension parallel to the orogen (see Diraison et al. 2000 and references therein).

Using seismic lines and field data from the Fuegian fold-thrust belt we reconstruct the interaction between mid-late Jurassic faulting, Andean compression and Neogene strike-slip deformation. The presented structural mapping and serial cross-sections define lateral variations in the structural style and a transversal segmentation of the fold-thrust felt. There is a passage from detachment folds in some segments to fault-propagation folds in others, with similar shortening rates, that may be denoting lateral changes in the rheological properties of the detachment level, as well as changes in depth to basement of each segment, reflecting differential extensional faulting during the mesozoic rifting.

The structural mapping allows to separate the fold-thrust belt north of the Magallano-Fagnano fault system in discrete fault-bounded blocks that were reactivated by strike-slip tectonics. Regarding the presence of widespread quaternary scarps that may be reflecting the presence of active faulting, our mapping allows to distinguish which lineaments are truly the expression of active strike-slip deformation. This differentiation is partly confirmed by previous paleomagnetic studies (Maffione et al. 2009) and by the distribution of low magnitude (between 2-4 Mb) and mainly superficial (<10 km) earthquakes (Buffoni et al., 2009) that are clustered in close proximity to this lineaments. We propose that due to an orientation match between compressional faults arrays an riedel shears a continuum synergetic transition took place from Middle-Late Eocene compression to Oligocene-Neogene transcurrence.

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LATE CRETACEOUS FISH ASSEMBLAGES IN NORTHEASTERN MEXICO AND THEIR PALAEOBIOGEOGRAPHICAL SIGNIFICANCE

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The recent discovery of about ten *Plattenkalk* localities within the states of Coahuila and Nuevo León in northeastern Mexico produced a high number of exceptional preserved actinopterygian fish fossils during the last six years. The abundance of the fishes varies widely within the *Plattenkalk* deposits depending on both locality and stratum. Ongoing research on the stratigraphy of the deposits shows, that the age of the fossil assemblages range from Middle Cenomanian to the Santonian (Stinnesbeck et al. 2005).

Fishes occupy almost all marine environments, making them a good tool to assess paleogeographic models. Additionally, the fossil record of fishes is proportionally good compared to other vertebrates. Taxonomical analyses of the Mexican material clarifies for the first time the systematic and phylogenetic relationships of the fish assemblages, which inhabitated the shelf region of the Western Tethys and allows for a comparison with contemporaneous fossil assemblages. The current dataset already provides new insights into the paleobiogeography of the Upper Cretaceous Gulf of Mexico.

There is a strikingly high number of sister-taxa and congruent taxa in northeastern Mexico and northern Africa within the Cenomanian and early Turonian deposits. This distribution pattern indicates a strong vicariant event during this time, similar to that observed between South America and Africa during the early Cretaceous (Cavin 2008). The observed pattern coincides in time with the opening of the Atlantic Ocean starting in the South.

From the late Turonian to the Santonian, there is an increase of taxa which are also known from the nearby Western Interior Seaway (WIS). Some of the Mexican specimens predate the first stratigraphical occurence elsewhere. This pattern indicates an occurence first in the Western Tethys and a subsequent dispersal into the Western Interior after the connection of the WIS with the Gulf of Mexico. (Giersch et. al 2010).

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HIGH-GRADE METAMORPHIC ALTERATION OF ZIRCON: A COMBINED LA-ICPMS ISOTOPIC AND TRACE ELEMENT STUDY OF A COMPOSITE MAFIC-ULTRAMAFIC LAYERED COMPLEX IN CENTRAL BRAZIL

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Zircon recrystallization is a common process during high-grade metamorphism and promotes partial or complete resetting of the original isotopic and chemical characteristics of the mineral, which may lead to the misunderstanding of U-Pb isotopic/geochronological data. In Central Brazil, this may be illustrated by three composite mafic-ultramafic intrusions metamorphosed under amphibolite-to-granulite conditions. Their emplacement and metamorphism ages have been a matter of controversy for the last thirty years. The Serra da Malacacheta and Barro Alto complexes compose the southernmost of these layered bodies and four samples from distinct rock types were investigated in order to verify the consequences of metamorphic alteration of zircon for U-Pb dating.

Cathodoluminescence imaging reveals internal features which are typical of concomitant dissolution-reprecipitation processes, such as convolute zoning and inward-moving recrystallization fronts, even in samples in which partially preserved igneous textures are observed. Due to this extensive alteration, LA-ICPMS U-Pb dating rendered inconclusive data. However, in situ Hf isotopic and trace-element analyses help clarifying the real meaning of the geochronological data. Low Lu/Hf (<0.004) and homogeneous $^{176}Hf/^{177}Hf_t$ values imply that the zircon populations within individual samples have crystallized in a single episode, despite the observed variations in age values. Trace element signature of zircon grains from garnet-bearing samples reveals that they were unreactive to the development of the peak metamorphism mineral assemblage and, thus, the main chemical feature in such grains is attributed to a coupled dissolution-reprecipitation process. Additionally, Ti-in-zircon thermometer renders constant values at ca. 700°C which cannot be interpreted as representative of igneous or metamorphic conditions.

Combined isotopic and geochemical investigation on zircon grains allowed the distinction of two magmatic events. The first corresponds to the crystallization of the Serra da Malacacheta Complex and characterizes a juvenile magmatism at ~1.3 Ga. The younger episode, recognized in the Barro Alto Complex, is dated at ca. 800 Ma and is represented by mafic and ultramafic rocks showing intense contamination with continental crust, implying that the emplacement took place, most likely, in a continental back-arc setting. Altered domains of zircon grains as well as titanite grains date the metamorphic event at ca. 760-750 Ma.

FIRST SYSTEMATIC APATITE AND ZIRCON FISSION-TRACK, AND APATITE, ZIRCON AND MAGNETITE (U-TH-SM)/HE DATA FROM THE CERRO DE MERCADO (DURANGO, MEXICO) IRON ORE DEPOSIT

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The paper presents the first systematic data set of radiometric age determinations of zircon (U-Pb, fission-track, (U-Th-Sm)/He), apatite (fission-track and (U-Th-Sm)/He) and magnetite (U-Th-Sm)/He minerals from several outcrops and lithologies within the Cerro de Mercado iron ore deposits. The Cerro de Mercado iron deposit is located outside of Durango City within the Chupaderos Caldera complex and is one of the most important iron ore deposits in Mexico. Detailed geologic studies in the area have been performed by several authors. Fluorapatite crystals obtained from the open pit mine of the iron ore deposit Cerro de Mercado, Durango, Mexico; generally referred to as “Durango apatite” is with an assumed age of 31.4±0.4 Ma the most commonly used fission-track and (U-Th-Sm)/He age standard.

Surprisingly, despite its common use as geochronometric standard no detailed studies on the precise ages of its various and heterogeneous occurrences within the open pit mine have previously been performed. Therefore, a potential for uncertain calibrations due to unresolved age variations exists. They confirm earlier age estimates and render the issue of the above mentioned uncertain calibrations unwarranted. At the same time the data demonstrates that the entire Chupaderos Caldera complex was deposited within in a surprisingly brief period of volcanic activity. The formation of the complex must have occurred very rapidly so that the different phases cannot be resolved within the analytical errors of the applied dating techniques. Hence the Durango locality promises to offer the potential for the establishment of additional minerals such as zircon and magnetite as age standards.

THE SAN PEDRO–LINZOR VOLCANIC CHAIN AT 22° TO 22°30' S: LOW-PRESSURE EVOLUTION OF CENTRAL ANDEAN MAGMAS ON THICK CRUST

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The Central Andean magmatic province (26 Ma – Recent) has been built over a thick continental crust (up to ~70 km) that mostly evolved by crustal shortening of the Andes. The thickening of the crust has been demonstrated to be reflected in geochemical variations observed in magmas erupted through time. Magmas erupted in the early stages of Central Andes evolution that traversed thin crust show low Sm/Yb ratios whereas this ratio increases in younger magmatic products (Mamani et al., 2010). This change has been related to the role of garnet as an important stable residual phase during magmatic differentiation and/or assimilation processes under high pressure within the deep crust. However, Mamani et al. (2010) have already pointed out that at any given time and place after crustal thickening, there are also abundant volcanic rocks that do *not* show this "garnet signature", even after maximum crustal thickening. Sm/Yb ratios of a particular volcanic rock therefore is no measure for crustal thickness at the time it formed.

In this work, we present new trace element data from San Pedro-Linzor volcanic chain (22°-22°30'S, northern Chile) from the Central Andes active magmatic arc that show consistently low Sm/Yb ratios [1,48 - 4,5]. High Sm/Yb ratios, typical for Andean magmatism on thick crust, are conspicuously absent. This indicates that mantle-derived magmas did not evolve under high pressure with stable garnet at the base of the crust in this area. In addition, amphibole is only an accessory phase in a few of the erupted lavas in this region. Accordingly, constant Dy/Yb ratios with differentiation rule out amphibole as an important residual phase even for the most evolved volcanic products. We propose that the main compositional control on the erupted lavas in this chain is related only to olivine+pyroxene±plagioclase fractionation and that these magmas ascended without contamination at the base of the crust. Magma storage and evolution by differentiation and assimliation took place at relatively shallow levels (20-40 km). At such depth, the region is characterized by a large, partially molten crustal region (Schilling et al., 2006). Also, abundance of large-volume ignimbrite eruptions during the last 10 Ma have been observed in this zone (Salisbury et al, 2010). The absence of both, garnet and amphibole signatures may be linked to this particular setting in the Central Andes.

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NUMERICAL MODELING OF GROUNDWATER FLOW OF THE PIPIRIPAU BASIN, BRASILIA, DF, BRAZIL

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In order to understand the dynamics of the groundwater and to improve the management of water resources in the Federal District region, this research proposes a 3D groundwater model to represent the groundwater level and flow system and the in the Pipiripau basin. The development of such a model it was necessary to gather a large amount of available geological, hydrogeological, geomorphological, climatological and pedological data. Firstly, geological and hydrogeological data were organized to construct a three-dimensional groundwater flow model. The 3D structure of the model was implemented in the framework of the scientific software OpenGeoSys (OGS) based on the finite element method, which splits the study region into grids of tetrahedral and prismatic elements. Then, with the 3D mesh appropriate boundary conditions, annual-averaged infiltration data and hydrogeological parameters were incorporated. Afterwards, the model was calibrated to steady-state conditions using the available data from wells. Then, the steady-state condition was used as initial condition for the transient simulation from 2004 to 2007. For the transient simulation the abstraction rates of the production wells and discharge of the springs of area were considered. Finally, the calculated and measured groundwater levels were compared. The results show the distribution of the steady state hydraulic head in the model domain, where the highest values occur in the east and west recharge areas and the lowest values are in the north of the basin. The analysis of measured water level indicates a small decrease but continues for the period. The declination is likely to be caused as a reaction of the significant increase in pumping groundwater in the last decade. The results of this study can be a useful tool for analyzing the hydrological processes and provide a scientific base for water resource management.

A COMBINED QUASIGEOID MODEL FOR TIERRA DEL FUEGO APPLYING EQUIVALENT SOURCE TECHNIQUE

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Since 2006 until 2010, it has been being developed a new quasigeoid model for the argentine portion of Tierra del Fuego Island. Many factors like terrain corrections, differences between geoid and quasigeoid, as the whole gravimetric reduction scheme, has been studied.

The first attempts in order to get a geoid or quasigeoid had a precision of centimeters or decimeters. In this stage, we have developed a quasigeoid with a precision of 5 cm in the north and centre part of Tierra del Fuego, and 7-9 cm in the south. It is important to remark that those areas where the quasigeoid was determined with lower precision coincide with mountainous regions with lack of data.

We have compared those results with the global model EGM2008, and we have made an external test in a place where vertical deviation was available. The experiments show results which are very satisfactory.

HUMAN EVIDENCE OF TERMINAL PLEISTOCENE–EARLY HOLOCENE IN MEXICO, THEIR CONTEXT, AND IMPLICATIONS FOR DATING THE AMERICAN SETTLEMENT

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The end of the Pleistocene period is critical for understanding the phenomena observed in the Holocene. The beginning of global warming made big changes in ecosystems , the extinction of most of the mega fauna and the arrival of the man to the American continent are among the events that are part of the Pleistocene/Holocene transition. This paper summarizes and describes those sites in which human evidence , dating from before the 10,000 years BP is present, placing human presence in other regions of Mexico. Items associated with this evidence, new dating and general contexts allow us to bring paleoecological data that provides information on the complex and controversial phenomenon of American settlement and its implications.

THE MARINE ICHTHYOFAUNA FROM THE UPPER JURASSIC (TITHONIAN) OF VACA MUERTA FORMATION, NEUQUÉN BASIN, ARGENTINA: A PRELIMINARY REPORT

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The Jurassic was a significant moment in the history of bony and cartilaginous fishes. Certainly in this period begin to delineate the major taxa that dominate the seas and rivers today. For example, batoids (rays and related forms) and many of the basal teleosts groups appear in the fossil record.

Most of the marine Jurassic fish assemblages comes from Europe, the fossil record from southern of South America is characterized by descriptions based in fragmentary specimens, except for some studies based on exceptionally preserved fishes from the Quebrada del Profeta in the Jurassic (Oxfordian) of northern Chile (e.g. Arratia et al., 1975) and from the Vaca Muerta Formation in the Jurassic (Tithonian) of Argentina (Cione et al., 1987).

In Argentina, Jurassic marine fishes have been found in the Vaca Muerta Formation at Neuquén and Mendoza provinces, where they are the most abundant and diverse vertebrates (e.g. Arratia & Cione, 1996). These fishes were primarily studied by Dolgopol de Saez (e.g. 1939), who identified many new species based on fragmentary material. These identifications were subsequently questioned by Cione et al. (1987) and Cione & Pereira (1990).

In this poster communication we briefly present the current state of knowledge of the Jurassic ichthyofauna of Vaca Muerta Formation; several taxa previously identified as Batoidea, Semionotiforms, Aspidorhynchiforms, Pachycormiforms,

Teleostei sensu stricto and a possible Coelacanthiform. All this taxa are also present in the classical and contemporary limestones of Solnhofen (Germany) and Cerin (France), representatives of the Tethyan faunas. However there are some taxa described for the European limestones (e.g. sharks, chondrosteans, pycnodontids and macrosemids) that have not been found yet in any area of the Neuquén Basin.

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PETROLOGY OF THE LUINGO CALDERA: A KEY TO UNDERSTANDING THE MIDDLE MIOCENE ARC-BACK-ARC CONFIGURATION IN THE SOUTHERN PUNA PLATEAU

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In the present contribution we present geochemical and mineral chemistry data of rocks from the middle Miocene Luingo caldera and of a spatially close group of upper Miocene lavas. Luingo caldera (Guzmán and Petrinovic, 2010) is located in the south-eastern portion of the Central Volcanic Zone (CVZ) of the Andes, and is the oldest caldera (ca. 13-12 Ma: Guzmán and Petrinovic, 2010) of the Southern CVZ (SCVZ: 25-27ºS). We modelled the petrogenesis of the Luingo caldera rocks as a mixture of ca. 20% crustal magmas and 80% of mantle magmas by AFC with recharge processes.

We compare the Luingo caldera with the nearby and younger Cerro Galán caldera (upper Miocene to Pliocene: e.g. Sparks et al. 1985) and with other westward volcanic centres of the Southern CVZ. Luingo caldera's location makes this a key area for assessing geochemical variations over time and also to constrain differences across the main volcanic axis of the Andes.

A comparison of Luingo geochemical data with the composition of Miocene-Pliocene volcanic rocks from the region, points to major thickening events during the middle Miocene for the western portion and during the upper Miocene for the eastern portion of the Southern CVZ.

The main objective of this research is to assess the conditions of the SCVZ during middle Miocene on the basis of geochemical data but also of the areal distribution of the volcanic products. The combination of these two tools allows to visualize a broad arc, which was structurally controlled at the proto-Puna/Puna margins and whose geochemical differences are related to variations in crustal thicknesses and heterogeneous mantle sources from west to east.

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CRUSTAL THINNING OF THE SOUTH AMERICAN PLATFORM DURING THE EOCENE–MIOCENE: LOW-TEMPERATURE THERMOCHRONOLOGY IN SOUTHEASTERN BRAZIL

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The morpho- tectonic evolution of the South American Platform at the Atlantic margin and its post-break-up evolution need to be understood. The southeast Brazilian margin registers high elevations discrepancies, until 2000 m, in a small distance from the coast inside the country. A complex and heterogeneous morphotectonic evolution is described by the literature with: i) Early Cretaceous tectonism, magmatism and exhumation processes related to the Gondwana break-up, around 130 Ma; ii) Late Cretaceous basement uplift and surface formation as a response of thermal anomaly induced by plumes; iii) Paleocene extensional tectonic causing uplift and erosion; and iv) Eocen to Miocene reactivation in NE-SW and NW-SE directions followed by exhumation and denudation. Related sedimentary basins are described in off- and onshore regions.

New Zircon Fission Track (ZrFT) and Apatite Fission Track (AFT) analyses, between Rio de Janeiro and Sao Paulo- Brazil shows ZrFT ages around 130 Ma and AFT ages around 60 Ma for Eocen sediments and surrounding basement rocks. Eocen to Miocen extensional tectonic with exhumation and uplift can be interpreted with this data, probably related to a crustal thinning at that time. Block tectonic and different erosion rates put together blocks at same level with different termochronological histories. This heterogeneous evolution may influence the sedimentation in on- and offshore basins with economic impact.

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HISTORY OF CRUSTAL GROWTH AND RECYCLING OF WESTERN MARGIN OF GONDWANA: U-PB AND HF ISOTOPE DATA ON TURBIDITES AND IGNEOUS ROCKS OF THE PALEOZOIC BASEMENT OF NW ARGENTINA

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The tectonic significance of the Neoproterozoic-early Paleozoic low grade metaturbidite sequence, is considered to be instrumental to unravel the tectonic history of the western margin of Gondwana. Three key areas, believed to be representative of the temporal and spatial evolution of the NW Argentina Neoproterozoic-Paleozoic metasedimentary basement were selected: (i) the Tastil area, (ii) the El Niño Muerto Hill, and (iii) the Río Blanco Valley. A combined LA-HR-ICPMS U-Pb and Lu-Hf isotopic study of zircon grains from metasediments and associated igneous rocks from these three localities has been carried out. The obtained results allowed us to distinguish three turbidite sequences, previously mapped as Puncoviscana Fm. *s.l* (Turner, 1960): **i)** turbidites exposed in the Tastil area, with a maximum depositional age (MxDA) of 562 and a minimum depositional age (MnDA) of 534 Ma (age of the Tastil granodiorite intrusion) deposited in a syn-orogenic setting and not in a long-lived passive margin as previously suggested by several authors, ii) turbidites of the El Niño Muerto Hill with a MxDA of 496 and a MnDA of 483 Ma (El Niño Muerto dacites), were deposited during Late Cambrian to Tremadocian times in a N-S elongated narrow basin located between the Pampean belt and the Arequipa-Antofalla terrain, and **iii)** the turbidites of the Río Blanco Valley have a MxDA of ca. 463 Ma. Their association with contemporaneous E-MORB/OIB type basalts and the dominantly Famatinian provenance of zircon population, suggest that these sediments are post-Caradoc, deposited in an extensional basin to the east of the Famatinian arc. The Hf isotopes indicate that i) three major periods of magmatic activity may be recognized in the sources of the detrital zircon grains: i) A Paleoproterozoic (2.0 Ga) event characterized by reworking of Archean crust; ii) a juvenile Mesoproterozoic/Neoproterozoic boundary (0.95 to 1.2 Ga) event, and iii) a Late Neoproterozoic to Early Paleozoic (0.75 to 0.46 Ga) magmatism, indicating reworking of Mesoproterozoic to Paleoproterozoic crust. Our data suggest that the western margin of Gondwana underwent a dynamic tectonic evolution from Neoproterozoic to Early Paleozoic times, controlled by subduction processes and accretion of two continental terrains. On the basis of geochronological and geological constraints we suggest that the accretion of a minor block occurred between 550 and 535 Ma, whereas the Arequipa-Antofalla terrain collision occurred after ca. 480 Ma. These tectonic processes controlled the rapid deposition of syn-orogenic turbiditic sequences, their rapid denudation and synchronous magmatism.

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QUANTITATIVE PALEOBIOLOGY OF A *BIRADIOLITES MOORETOWNENSIS* BOUQUET (LOWER MAASTRICHTIAN OF CENTRAL JAMAICA)

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During the Cretaceous rudist bivalves were the most important carbonate producers on tropical to sub-tropical carbonate platforms. Yet questions concerning the biology of rudist bouquets remain unanswered to a great extent. In this study a densely packed bouquet of the small radiolitid rudist *Biradiolites mooretownensis* has been examined in respect to biological variables. The sample originates from Guinea Corn Formation (Upper Campanian to Maastrichtian) in Central Jamaica, which developed as a shallow marine platform along the margin of the Caribbean plate. It has been influenced by island arc volcanism and crops out as platform carbonates interbedded with volcaniclastic sediments.

Three-dimensional, high-resolution, quantitative analysis using grinding tomography techniques provides detailed evaluation of growth, reproduction and population dynamics of an *in-situ* rudist association from the fossil record. Along with this study a total of 1.237 consecutive tomograms with a vertical spacing of 0.1 mm have been produced and digitally measured for total area, number of specimens, packing density, spat density, recruitment, survival time, mortality, and accommodation space. These true-colour tomograms were produced in the Heidelberg Grinding Tomography Lab using a G&M MPS 2R 300S precision grinding machine in combination a high-resolution flat bed scanner.

As results, the data shows constant coverage of about 60 %, a stable packing density of 3.2 individuals per cm^2 and a constant reproduction throughout the bouquet. This can be interpreted as optimum use of area within a healthy rudist association. Time series analysis (spectral analysis) using PAST shows cyclic spat density of 14 mm in wave length. Combined with the results of the $\delta^{18}O$ isotope analysis (showing a temperature cyclicity of 13-14 mm) and average annual growth rates, a reproduction that is following annual cycles can be assumed. Furthermore, evaluation of population dynamics for the species *Biradiolites mooretownensis* shows a mortality of at least 46.4 % for all settlers during the first 3 mm of vertical growth. More than 93 % of the initial spat does not exceed an adult age of 15 mm shell height or 1 year, respectively. Two mortality peaks in the juvenile's life at 4 mm and 10-15 mm shell height either represent important obstacles in the ontogenic development of the species or reflect external influences. Furthermore, the survival time of a single settler is directly linked to the space that is available at the time of settlement. Spat that finally reached adult ages benefited of increased space of 9.3 % in average in comparison to settling spat that dies at a juvenile age.

GEOCHRONOLOGY AND ITS RELATION TO TECTONIC PROCESSES IN THE CHILPANCINGO–TIERRA COLORADA REGION, GUERRERO STATE, SOUTHERN MEXICO

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The Chilpancingo – Tierra Colorada region in Guerrero is a key area for understanding the regional magmatic and structural events related to plate tectonic processes in the Circum-Pacific region of southern México. According to tectonic interpretations proposed for the southwestern margin of Mexico this region was affected by episodes of continental truncation, subduction erosion, and changes in the geometry of the subducted slab. In order to document the chronology of magmatic, structural, and stratigraphic events in the study area we obtained U-Pb and K-Ar ages from various rock units.

Early Cretaceous ages. 126 Ma metavolcanic sequences of the Chapolapa Formation are the oldest known magmatic sequences in the region. These rocks can be correlated to 130 Ma deformed metagranitoids that intrude the Xolapa Complex which is considered to form the basement unit of southern Cordilleran Mexico. Both units display similar foliation, mineral lineation, green-schist metamorphic facies, and (D2) mylonitic deformation.

Late Cretaceous – Paleocene ages. Volcanic rocks of the Balsas Group (Agua de Obispo and Papagayo Formations) and deformed Amatlán and Las Piñas plutons of the Xolapa Complex show contemporary ages between 65 and 50 Ma. These ages are important because they constitute the key to distinguish the major tectonic processes in the region (D1, D2, D3), which occurred between 70 and 40 Ma. Andesites of the Agua de Obispo Formation were dated at 64.8 ± 1.3 Ma (U-Pb) and 56.3 ± 1.4 Ma (K-Ar). From ignimbrites and rhyolitic domes of the Papagayo Formation we obtained U-Pb zircon ages of 51.36 ± 0.97 Ma, 50.7 ± 1.2 Ma, and 49.89 ± 0.78 Ma. The Amatlán granite was dated at 66.45 ± 0.74 Ma (U-Pb) and is characterized by both mylonitic (D2) and non deformed fabrics. The mylonitic part is foliated and lineated, similar to the Chapolapa Formation. The Amatlan pluton intrudes amphibolites, migmatites and metagranites of the Xolapa Terrane.

Eocene-Oligocene age. The youngest magmatism is represented by granitic and granodioritic bodies as well as pyroclastic volcanics which formed a caldera. This magmatism is emplaced in structures of a compressive event (D3), represented by folds, thrusts, and strike-slips. We obtained a K-Ar biotite cooling age of the Azinyehualco pluton of 33.7 ± 0.9 Ma, which is in concordance with an earlier reported U-Pb zircon age of the close-by Tierra Colorada granite. The volcanic rocks are concentrated in the structure of the Alquitrán caldera collapse, characterized by more than 1000 m thick ignimbrites associated with various pyroclastic events. For these rocks we obtained a 36.0 ± 0.2 Ma U-Pb zircon age and a 30.3 ± 0.8 Ma biotite with the K-Ar method.

Deformation Events. The Laramide deformation phase (D1) affected northern, central, and southern Mexico from mid Cretaceous to early Cretaceous, represented by mainly N-S oriented folds. Ductile deformation (D2) is associated with a regional shear event and corresponds to a NW dipping normal fault which is the result of the exhumation of the Xolapa Terrane (63 - 59 Ma). Finally, a post-Laramide (47 to 40 Ma) Sierra Madre del Sur deformation event is affecting both D1 and D2 phases.

THE MIOCENE TRANSITION OF ARC VOLCANISM IN CENTRAL AND SW MEXICO: GEOCHEMICAL AND ISOTOPIC EVIDENCES AND PLATE-TECTONIC SIGNIFICANCE

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During the Miocene, magmatism in Mexico changed from silicic to intermediate and mafic and shifted from the Sierra Madre Occidental (SMO) in the northwest to the modern Trans-Mexican Volcanic Belt (TMVB) in central Mexico. This transition was initiated when the North American Plate started to override the East Pacific Rise and subduction ceased in the northwest. In the Sierra del Sur (SMS) in southwestern Mexico both magmatic provinces overlap and show marked temporal and spatial gaps during the Miocene transition which are only partly studied so far.

A survey of own new geochemical and isotopic data from the SMS, together with compiled data from the literature shows distinct differences between SMO and TMVB during the Miocene transition. In general, SMO and Eocene to early Oligocene plutonic and volcanic rocks of the SMS generally show higher crustal assimilation and stronger subduction components, reflected by higher radiogenic isotopic ratios such as $^{87/86}$Sr (~0.7035 - 0.7070), $^{206/204}$Pb (~18.65 - 19.00), $^{207/204}$Pb (~15.55 - 15.65), and $^{208/204}$Pb (~38.25 - 38.82). Also fluid-sensitive elements such as Ba are generally more enriched with respect to Nb or Th. Volcanic rocks of the TMVB show isotopic ratios of $^{87/86}$Sr (~0.7029 - 0.7046), $^{206/204}$Pb (~18.56 - 18.70), $^{207/204}$Pb (~15.55 - 15.60), and $^{208/204}$Pb (~38.21 - 38.42). On average, Ba is less enriched.

In the early Miocene, volcanism of the Sierra Madre del Sur is restricted to southeastern Oaxaca (20.6 - 15.0 Ma) and Central Mexico (Tepoztlan Formation 22.8 - 18.8 Ma; Lenhardt et al. 2010). Although the timing and position of the latter might be interpreted as a final, southeasternmost expression of the SMO province, its trace element concentrations and isotopic data are closer to the modern TMVB and may represent its initiation and begin of eastward spreading until the upper Miocene. In contrast, the isolated volcanic province in Oaxaca conserves geochemical and isotopic characteristics of the Paleocene-Oligocene volcanism of the SMO/SMS province, before it concluded in this region, where the heterogeneous nature of the basement under the SMS plays an important role defining the geochemical and isotopic composition of this volcanism. An explanation of this termination in the SE and initiation of a new arc in the north is the possible strike-slip removal of the Chortis Block to the southeast. Discontinuity and varying dip angles of the slab(s) from new oceanic microplates (Rivera and Cocos plate) may be responsible for geochemical and isotopic signatures close to the upper mantle, e.g. due to asthenospheric upwelling above the subducting slab or through their gaps.

Lenhardt, N., Böhnel, H., Wemmer, K., Torres Alvarado, T.S., Hornung, J. & Hinderer, M. (2010): Petrology, magnetostratigraphy and geochronology of the Miocene volcaniclastic Tepoztlan Formation: implications for the initiation of the Transmexican Volcanic Belt (Central Mexico). J. of Volcanology. DOI 10.1007/s00445-010-0361-z

A GEOSITE PROJECT IN THE MAGELLAN REGION, SOUTHERN CHILE

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This is a geosite project in the Magellan region trying to transmit geology in an easy way for everybody. It was realized in the years 2008/2009 together with Chilean National Oil Company (ENAP), the Chilean Antarctic Institute (INACH) and the Chilean National Service for Tourism (SERNATUR) in Punta Arenas, Chile.

The idea behind the project was to present valuable geological sites in Chilean Patagonia to its inhabitants and to the increasing number of tourists reaching the tip of the South American continent. Besides the dissemination of knowledge another aim was to gain a better understanding of geology, natural processes and appreciation of beautiful landscapes for every visitor to get everybody to protect these sites for future generations and to increase the general understanding for our enclosing nature.

All together eleven sites in the surroundings of Punta Arenas and the Torres del Paine National Park were picked. Most of the sites were already known to the public and sometimes also guided tours led to these points of interest but the geological background was not explained, if not by chance a tourist guide knew something about its origin. All eleven sites were fitted with boards displaying information in Spanish and English. Every sign elucidates the geological development of the respective place including a geological time scale to show the time range in which the processes took place.

The following sites where chosen: 1) *The Magellan Basin,* explicating the development of a foreland basin and also the formation of fossils in general. 2) *The Las Minas River - where geology lives,* distributing information about the coal and gold deposits in the Las Minas River canyon. 3) *Drumlins: hills mounted in line and their geological history,* according to the title - how Drumlins probably form and the different theories existing. 4) *The geology around the Estancia Río Verde,* telling about glacial caused formations like sounds and erratic blocks. 5) *The geological origin of the Magellan Strait,* presenting the development of the Magellan Strait - in particular the Magellan-Fagnano fault system. 6) *The volcanic field of Pali Aike,* giving an overview of the different cycles of volcanic activity known in this area. 7) *Morro Chico – a neck of an extinct volcano*, telling about volcanoes in general and the onset of volcanic necks in particular. 8) *The Milodon cave – more than a cave of milodons,* explaining turbiditic sequences and the formation of this specific cave. 9) *Amarga Lagoon – the history of the beginning of life on Earth,* referring to Stromatolites and their way of growing.10) *The Sarmiento Lake and the history of its white shoreline,* explicating the origin of Thrombolites and sedimentary rock formation. 11) *The blue massif - Torres del Paine Nationalpark*, explaining the development of the granite massif in the middle of sedimentary rocks.

Further information to all sites can be found on: www.geositiosmagallanes.cl

CRYSTALLIZATION TIMESCALES AT VOLCAN PARINACOTA, CHILE: THE REJUVENATION OF AN OLD MAGMATIC SYSTEM

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Volcan Parinacota is a stratovolcano on the Aliplano of the Andean Central Volcanic Zone (CVZ). It consists of the remains of an old edifice that underwent sector collapse at 15-20ka and younger lavas that have since formed a symmetrical new cone. Because of its location on thick crust, its varied eruptive rates correlated to changing lava composition, and amenability to multiple dating methods, this volcano has been the subject of many field, geochemical, and geochronological studies(e.g.1-3). Consequently, it is one of the best-understood volcanic systems in the region.

Analyses of ^{238}U-^{230}Th disequilibrium on minerals from the earliest phase of Parinacota growth (Dome Plateau, eruption ages 47-40 ka by $^{40}Ar/^{39}Ar$ on sanidine) contain crystals that are up to 122 k.y. older than eruption. The mineral data do not form a linear array on an equiline diagram, but rather define a pair of wedges delineated by reference isochrons that have ages of 47.7 and 168 ka. Because these are bulk crystal ages, we interpret scatter within the wedge regions as either being indicative of (1) a protracted crystallization interval, during which crystals were nucleating continuously, or (2) crystal cores that are older than 168 ka were subsequently overgrown with younger rims of variable thickness, resulting in average ages that in some cases approach that of eruption.

In contrast, some of the most recently erupted lavas at Parinacota (Upper Ajata flow and several young cone lavas) have large bulk-rock Th-excesses, with eruption age-corrected ($^{230}Th/^{238}U$) activity ratios as high as 1.33. These values are near the limit of Th enrichment possible given realistic estimates of garnet in the melting source region and degree of partial melting[3]. This implies that short source-to-surface transit times of < 20 k.y. occurred not only in flank lavas that bypassed the main reservoir, but in those erupted from the summit vent as well.

In the broader context of the eruptive history of this volcano[1,2], the U-series data show that crystallization and crustal transit timescales are correlated with eruption rate and magma composition over time. At Parinacota, there was a change from a slow to fast eruptive output regime. This was likely initiated by mafic recharge and remobilization of a long-lived crystal-rich reservoir. As pace of recharge increased, this stagnant system was subsequently replaced by a regime where individual magma batches transited the crust very quickly.

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[2]*Hora, Singer, and Wörner (2007): Volcano evolution and eruptive flux on the thick crust of the Andean Central Volcanic Zone: $^{40}Ar/^{39}Ar$ constraints from Volcan Parinacota, Chile GSA Bulletin. 119:3/4:343-362.*

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METAL CONCENTRATION IN RECENT SEDIMENTS OF THE CÓRREGO DAS PEDRAS SUBBASIN IN THE BURITIZEIROS REGION, MINAS GERAIS, BRAZIL AND ITS ORIGINS

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Introduction: Sediments have the ability to accumulate and remobilize contaminants due to the changing and unstable factors in environmental conditions.

In this context, this study determined the levels of eight metals in sediment samples collected in the watershed of the soil and basin sediments from the Sub-basin of Córrego das Pedras river northeast of Buritizeiro in the Pirapora region (MG).

There exist a lot of possible contamination sources like Si-Fe and Si foundries, textile industries and extensive agriculture use. All this activities produce air contamination by dust or smoke which acts over the nearby production of vegetables and fruits.

Field: Sampling occurred in the soil and sediments of the planting areas and the principle wind direction of the contamination plume from Pirapora industrial quarter. Were sampled the first 15cm of the surface and taken nearby 1kg and transported cooled in plastic bags to laboratory. There were carried out also field related fisico-chemical parameters.

Laboratory: Granulometric distribution was determined, like organic material and pH. The finer fraction (<074µ) were used for chemical determination.

After drying, followed by acid digestion (HNO3) in microwave furnace, the selected elements were determined by inductively coupled plasma - optical emission spectrometry - ICP-OES. A DRX was executed to find the principal minerals.

Results: The elements in higher concentrations were Al, Mn, Ca and Mg, probably because they are found in greater amounts in natural environments.

The areas close to industries showed higher values of Cd and Zn, which shows probable influence.

These results may support further research to affirm the human influence on the concentration of heavy metals in sediments of the study area.

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Sponsored by the DAAD GOAL alumni network

INVESTIGATION OF VEREDAS IN THE FORMOSO RIVER BASIN, NEAR PIRAPORA, MINAS GERAIS, BRAZIL

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The Formoso River Basin, a major tributary of the Rio São Francisco, is located southwest of the city of Buritizeiro, draining an area of approximately 826 km^2.

Inserted in the Cerrado, this basin is built up by numerous veredas, a peculiar type of wet ecosystem, formed under defined climatic and morphologic conditions in Cerrado regions. At the cutting line between morphology and subsurface water level are localized generally the springs which formed the river. The form and constitution of these veredas is controlled by morphologic, geologic and climatic factors.

These wetlands together with the whole Cerrado suffer strong anthropogenic interference due to planting of coffee, pine and eucalyptus, as well as by smaller agricultural activities and other manmade impacts that may influence the chemical equilibrium of the soils in this environment. Close to these study objects exist areas with agro-silvo-pastoral activities, represented by big plantation, forests and cattle farms and charcoal activities.

This paper presents data of geochemical distribution of selected elements like Cr, Cd, Cu, Co, Ni, Pb, Zn and Ba in soils of three veredas located in the basin of the Formoso River, using a network of sampling surface and vertical profiles to evaluate their current status. These elements were selected because they represent pesticides and fertilizers which are the major sources of contamination.

The chemical technique was preparation by partial acid extraction in Microwave oven, followed by reading on ICP-OES and ICP-MS.

The founded data were compared with CONAMA and CETESB guiding values for soils, using international and internal reference materials. The mathematical treatment was accomplished using Geoaccumulation Index (GI) and Contamination Factor (CF).

The metals levels found in soil samples from the veredas require attention in order that many of them beyond the limits of prevention set by CONAMA, and the results of calculations of GI and CF revealed partially a high contamination by some metals (particularly Ni, Zn and Ba) indicating sources and mechanism of introduction.

Thus, it is necessary to implement mechanisms that promote the protection of these environments as important to the region.

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BASIN FRAGMENTATION BY TECTONIC INVERSION AND BASEMENT UPLIFT: FROM RIFTING TO FORELAND SETTINGS IN SIERRAS PAMPEANAS AND SANTA BÁRBARA SYSTEM, NORTHWEST ARGENTINA

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The study region is located in the Central Andes, north of the Pampean Flat Slab subduction. This sector comprises the northernmost Sierras Pampeanas and the southern part of the Santa Bárbara System. This segment of the Andean chain is characterized by basement cored ranges with uneven elevations. Sedimentary basins located between this sierras recorded the evolution through their layers architecture. Growth strata associated with the raising history of the nearby ranges and blind thrusts were identified in many sectors of the basin. These features played a key role in identifying the evolution of the basin, the uplifting age and mechanisms.

Several seismic sections in Tucumán, Choromoro, Metán, Campo Arenal and Santa Maria basins have been studied. Basement, syn-rift, post-rift and three foreland stages were interpreted according to the arrangement of the horizons. Onlapping layers help to identified the timing when structures started to form. The ranges in the area were uplifted mainly by high angle faults. The rising of Sierras de Aconquija, Quilmes, Metán, La Candelaria, Guasayán, Medina and Cumbres Calchaquíes determined 3 differentiated foreland basin stages. Foreland Basin 1 stage was formed when local ranges haven´t been raised yet, and the basin was almost continuous covering the entire area. Foreland Basin 2 stage was set during uplift of the mayor ranges, with the basin´s depocenters and drainage net already differentiated. Foreland basin 3 stage is composed by coarser sediments product of the denudation of the local ranges properly uplifted.

The infill of this type of foreland basin does not follow the classical model of two stages, deep sea fans followed by continental conglomerates. The deformation style does not propagates in a piggyback sequence progressively incorporating the active margin of the basin is into the fold and thrust belt frontal wedge. This thick skinned system involves a coarsening up continental sequence and the deformation sequence intercalates break-back episodes. The basement discontinuities inherited from previous tectonic cycles, conditioned the orientation and style of the structures in this region.

The present region of the Andes shows different types of faulting: Cretaceous extensional faults and Andean faults (thrust faults of low and high angle, inverted faults and strike slip faults). Tectonic inversion of previous half graben can be recognized in the western and northern margins of the Tucumán basin, in the Metán basin and in the ranges of the Santa Barbara System. Basement related faults, raising the Sierras Pampeanas, weren´t active during the Salta rift, and started to uplift diachronically since Foreland basin 1 stage. Buttressing was responsible for shallow detached faults in Choromoro and Metán basins.

RESEARCH INTO THE TURONIAN (LATE CRETACEOUS) FOSSILS FROM THE PLATY LIMESTONE AT VALLECILLO, NUEVO LEÓN, MEXICO – STATE OF THE ART

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The Vallecillo platy limestone is interpreted as an outer shelf deposit suggesting water depths of more than 100 m, and a distance of at least 500 km from the nearest shore. The water column was layered, with dysoxic to anoxic hostile bottom conditions. The surface waters, however, yielded supreme conditions for abundant marine life. The dys- to anoxic bottom conditions are related to the Late Cenomanian Oceanic Anoxic Event 2, which in the Vallecillo sea apparently persisted into the Early Turonian and caused the environmental conditions for excellent fossil preservation.

Vallecillo is famous for its abundant, well-preserved vertebrates, among them abundant fishes, but also early mosasauroids, turtles and a pliosaur tooth. The continuous fossil record allows for biostratigraphic subdivision by ammonites, inoceramid bivalves and planktonic foraminifers, with the one of the most complete early Turonian records worldwide.

Fishes are abundant and diverse in the Vallecillo fossil assemblage. To date, at least 14 taxa of selaceans, chondrosteans and teleosteans were identified. The abundance of fossils allows the interpretation of the three most abundant Vallecillo fishes: *Rhynchodercetis*, *Tselfatia* and *Nursallia* differ in preferred water depth, feeding strategy and locomotion. They constitute the majority of the fossil vertebrate assemblage at Vallecillo, but they existed in the Vallecillo sea without interfering each other. More results regarding the ontogeny, paleobiology and paleoecology of the fossil vertebrates and invertebrates from Vallecillo are under work, and we are at the point where we start to reconstruct the early Turonian foodweb.

Today, the Vallecillo Platy Limestone and its fossil assemblage represent one of the best understood fossil *Lagerstätten* in Mexico, even though paleontological research has just started.

MIGRATION PATHWAYS OF THE LATE CAMPANIAN AND MAASTRICHTIAN SHALLOW FACIES AMMONITE *SPHENODISCUS* IN NORTH AMERICA

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Records of the ammonites *Sphenodiscus lobatus* and *Sphenodiscus pleurisepta* from the latest Cretaceous Gulf of Mexico region, the Western Interior Seaway and the Atlantic coast have repeatedly been used as a stratigraphic index for a Maastrichtian age. In recent years, however, high-resolution biostratigraphy on north-eastern Mexican occurrences and its combination with other correlation tools, such as sequence stratigraphy, as well as a refined definition of the Campanian–Maastrichtian boundary, led to a different interpretation regarding the age of the earliest *Sphenodiscus*: The FA of *Sphenodiscus* in north-eastern Mexico is thus latest Campanian in age. However, before this formal definition of the boundary, the level of its FA in Mexico was in the Maastrichtian.

The Mexican occurrences of both species of *Sphenodiscus* are the key to understanding the migration pathways of *S. lobatus* and *S. pleurisepta* in North America. These can be reconstucted from many precisely dated occurrences throughout this continent. During the latest Campanian and early Maastrichtian, the two species immigrated to North America from the South; they did not evolve on this continent. Both species used changes of the sea level to migrate or disperse over the continent. The dispersal route of *Sphenodiscus* during the Maastrichtian does not reflect a general dispersal pattern for ammonoids in North America, as is indicated by an opposing north to south-directed migration trend of *B. ovatus* (Ifrim and Stinnesbeck, 2010).

Both *S. lobatus* and *S. pleurisepta* are long-ranging species, not suited as high-resolution biostratigraphic markers for correlation over large distances. Instead, they are excellently suitable as facies indicators for proximal near-shore environments. Their short local ranges in different regions of the North American continent results from this characteristic and the fact that *Sphenodiscus* followed shallow water areas and shorelines during times of changing sea levels.

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NEW BIOSTRATIGRAPHIC DATA FROM THE MAASTRICHTIAN (LATE CRETACEOUS) PARRAS BASIN AT LA PARRA, COAHUILA, MEXICO, AND THEIR IMPLICATIONS FOR THE CORRELATION OF THE LOWER DIFUNTA GROUP

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The Difunta Group in northeastern Mexico represents a thick succession of deltaic sediments. However, few biostratigraphic data exist within this succession, mainly due to the absence of index fossils. A rich cephalopod fauna with 19 ammonoid species from 15 genera and 1 nautilid from La Parra, southeastern Coahuila, Mexico, and associated planktonic foraminifers allow for precise biostratigraphic assignation to the early Maastrichtian planktonic foraminiferal zone CF 5 (Ifrim et al., 2010). The new biostratigraphic data presented here allow precise dating of the Cañon del Tule Formation of the Difunta Group, and thus provide an important marker level for correlation of the lower Difunta Group. The combination with existing sequence- and magnetostratigraphic data improve the correlation of the Cretaceous part of the Difunta Group with time-equivalent lithostratigraphic units such as the Cárdenas Formation in Mexico.

Ifrim, C., Stinnesbeck, W., Rodríguez Garza, R. & Ventura, J.F. (2010): Hemipelagic cephalopods from the Maastrichtian (Late Cretaceous) Parras Basin at La Parra, Coahuila, Mexico, and their implications for the correlation of the lower Difunta Group. Journal of South American Earth Sciences 29, 597–618.

EPIZOIC STRAMENTID CIRRIPEDES ON AMMONITES FROM LATE CRETACEOUS PLATY LIMESTONES IN MEXICO

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The thoracic crustacean *Stramentum* spp. is widespread in sediments of Cenomanian-Coniacian age. The discovery of platy limestone deposits in northeastern Mexico has led to the collection of well-preserved stramentids of early Turonian age from Vallecillo, state of Nuevo León, and of early Coniacian age from El Carranza, state of Coahuila. The Vallecillo Platy Limestone has been noted for well-preserved fossils, particularly fishes, ammonites and marine reptiles during the last decades, and the palaeoenvironment is well known from previous studies. El Carranza is less understood, but precise biostratigraphic data exist (Ifrim et al., in press).

The detailed taphonomic analysis of both hosts and epibionts showed that the ammonite shells were colonized during their lifetime in all cases. The Stramentids may have survived the death of the ammonite, but the shell did not float for a long time. The well-preserved Stramentids seem to have been embedded alive.

Stramentids colonized the shells of various ammonite species, but their target shells were restricted to few morphotypes. In addition, the cirripedians were mapped on the ammonite shells. The interpretation of these quantitative data allows for new insights into the palaeobiology of the epibionts and the host ammonites.

Ifrim, C., Vega-Vera, F.J., and Stinnesbeck, W. (in press): Epizoic stramentid cirripedes on ammonites from Mexican late Cretaceous platy limestones: Journal of Paleontology.

LA CAROLINA PULL-APART IN WESTERN TERTIARY VOLCANIC BELT, PAMPEAN FLAT-SLAB (33º S), ARGENTINA

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Located at the transitional southern end of the Pampean flat-slab in central-western Argentina (Ramos et al., 2002), the Tertiary Volcanic Belt (TVB) records the eastward migration of the Andean volcanic arc due to the flattening of the Nazca Plate in Mio-Pliocene times. Volcanics and associated ore-deposits crop out following a ~ 80 km long, NW-WNW trending belt that from west to east includes La Carolina, Cañada Honda - Cerros Largos, Cerros del Rosario and El Morro districts.

At the 10 km2 La Carolina district, volcanic activity took place between 8.2 to 6.3 Ma and it comprises andesitic, lacitic and trachytic lavas, domes and dykes, closely associated with phreatic breccias and base surge deposits (Sruoga et al., 1996 and references therein). Related to a maar-diatreme system (Sruoga et al., 1996) there are several small mineralizations of AuAg low-sulphidation, epithermal type (Urbina et al., 1997, Urbina & Sruoga 2009).

Structural analysis shows that previous structures have strongly controlled the emplacement of volcanic rocks and related mineral deposits at La Carolina (Japas et al., 2011). Two parallel-to-the-foliation sets of faults (N-S and NNE) bound this rhomboid-shaped volcanic district. Slip on the main N-S faults indicates dominant right-lateral motions whereas NNE faults show components of vertical slip. The presence of this gentle deflection in the foliation trend (~30º) resulted in a NNE releasing bend allowing magma emplacement. In this pull-apart structure, volcanic domes are aligned following a NNE trend. These and previous results at Cañada Honda (Japas et al., 2010) confirm strike-slip structures controlling Tertiary volcanic emplacement at the western TVB.

Japas, M.S., Urbina, N.E. & Sruoga, P. (2010): Control estructural en el emplazamiento del volcanismo y mineralizaciones neógenas, distrito Cañada Honda, San Luis, Argentina. Rev.Asoc.Geol.Argentina (in press).

Japas, M.S., Urbina, N.E., Sruoga, P. & Gallard, C. (2011): Pull-apart La Carolina, Faja Volcánica Terciaria, San Luis. 18º Cong. Geol. Argentino (in press).

Ramos, V.A., Cristallini, E.O & Pérez, D.J. (2002): The Pampean flat-slab of the Central Andes. Journal of South American Earth Sciences 15, 59-78.

Sruoga, P., Urbina, N.E. & Malvicini, L. (1996): El volcanismo terciario y los depósitos hidrotermales (Au, Cu) asociados en La Carolina y Diente Verde, San Luis, Argentina. 13° Cong. Geol. Argentino Actas 3, 89-100.

Urbina, N.E. & Sruoga, P. (2009): La Faja Metalogenética de San Luis (FMSL), Sierras Pampeanas, Argentina:mineralización y geocronología en el contexto metalogenético regional. Rev. Asoc. Geol. Argentina. 64/4, 635-645.

Urbina, N.E. Sruoga, P. & Malvicini, L. (1997): Late Tertiary gold-bearing volcanic belt in the Sierras Pampeanas of San Luis, Argentina. International Geology Review 39/4, 287-306.

MACROSCOPIC CHARCOAL AND INERTINITES IN PERMIAN GONDWANA COAL DEPOSITS: ARE PALEOWILDFIRES RESPONSIBLE FOR BOTH?

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Macroscopic charcoal is widely accepted by the scientific community as direct indicator of the occurrence of paleowildfires. For the Late Paleozoic of the Northern Hemisphere records of macroscopic charcoal are relatively common and more or less homogeneously distributed. Meanwhile, until recently, the Southern Hemisphere could be considered an “undiscovered” area for this type of registers. Nevertheless, it was recently testified by different studies that, at least the western Gondwana Realm (Brazilian Paraná Basin), macroscopic charcoal are common element in the Late Paleozoic deposits, mainly related to coal bearing strata.

On the other hand, also inertinite is accepted as indicator for paleowildfires by some authors in North Hemisphere as formed by pyrolysis of vegetal biomass. However, the origin of the high inertinite content of the Gondwana Permian coals had largely been discussed and, until recently, some authors inferred that it was connected to events other than paleowildfires. This hypothesis was reinforced until now by the rare registers of macroscopic fossil charcoal as direct evidence of palaeowildfires for the Gondwana during this period.

Detailed analyses in different coalfields along the Lower Permian (Sakmarian) coal-bearing strata of the Paraná Basin (Brazil) allowed identify the presence of inertinite in coal seams and also macroscopic fossil charcoal in associated strata. Accepting that the lowland floras developed in the peat generating sites were submitted to paleowildfires (as evidenced by the presence of macroscopic charcoal in clastic strata directly associated to coal seams) a connection between the high inertinite contents of the Paraná Basin coals and the occurrences paleowildfires in the hypautochthonous peat generating floras must also be considered. Thus, the joint occurrence of inertinite in coals and macroscopic fossil charcoal in directly associated strata in different coalfields in southern Paraná Basin leads to the hypothesis that pyrolysis during the peat generation process must be considered as a potential origin for the high inertinite contents in the Gondwana coals.

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GEOLOGICAL HERITAGE MANAGEMENT IN LATIN AMERICA: THE CASE OF PALEONTOLOGICAL HERITAGE IN BRAZIL

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Geological heritage, geodiversity and geoconservation are concepts that increasingly gain popularity alongside similar ideas of the “green” agenda. However, in most countries world-wide, and in Latin-America in particular, the geological component of the landscape has not yet been given sufficient visibility as an essential asset.

The World Heritage List and the World Network of Biosphere Reservas include sites like the City of Potosí / Bolivia and the Cordillera Volcánica Central Biosphere Reserve / Costa Rica, respectively, which may intensively deal with geologic features. In addition, UNESCO’s Global Geoparks Network (GGN) provides a platform for cooperation and exchange between experts and practitioners in geological heritage.

In Brazil, approximately 64% of the national territory is covered by sedimentary basins, which have a high fossiliferous potential. The best known fossiliferous areas, both by scientists and by the population in general, are located in the Paraná and Parnaíba Basins (Paleozoic-Mesozoic) and in the Araripe Basin (Mesozoic).

Brazilian legislation protects all the fossils of its territory as a National Heritage. The first legal reference on Brazilian fossil protection was made in 1935 in the Federal Ordinance number 25, which declared fossils as “Natural Notable Patrimony”. In 1942, with the Federal Ordinance number 4.146, fossils were declared “Propriety of the Nation”. Following UNESCO orientations, the Federal Ordinance number 72.312 confirmed in 1973 that the sale of fossils, principally to foreign countries, violates the Brazilian legislation. Subsequently, complementary legislation e.g. on the punishment to be applied for the illegal sale of Brazilian fossils has been enacted.

Despite these legal restrictions, Brazilian fossils are easily found in international markets and internet sites. Triassic wood from the Paraná Basin (Rio Grande do Sul State), Permo-Triassic wood from the Parnaíba Basin (Tocantins State) as well as Cretaceous fishes from the Araripe Basin (Alagoas, Paraíba, Pernambuco and Sergipe States) are the most commonly observed fossils in these sites. Reasons for this scenario include insufficient control by the government 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 on the international market they reach considerable prices.

As of March 2011, Brazil is the only Latin-American country that has a site in the GGN, namely the Araripe Geopark. Geoparks combine conservation, sustainable development and community involvement. The geopark concept involves e.g. sustainable tourism initiatives, which may lead to job creation in local rural communities. In summary, the application of geopark methodologies in the management of renowned fossiliferous sites may constitute a valuable tool towards their conservation.

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EROSION RATES AND EROSION PATTERNS OF NEOGENE TO QUATERNARY STRATOVOLCANOES CONTROLLED BY AGE AND CLIMATE IN THE ALTIPLANO PLATEAU (CENTRAL ANDES): AN SRTM DEM BASED QUANTITATIVE ANALYSIS

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Erosion patterns and rates of 33 symmetrical stratovolcanoes in the arid to hyperarid Central Andean Volcanic Zone (14° S to 27° S) have been quantified by morphometric modeling and published geochronological data. In order to ensure that results can be compared, we restricted thus study to highly symmetrical cones of stratovolcanoes on a relatively flat subsurface. This allow to define the base of the volcanic edifices and a direct comparison to the presumed original cone shape. Volcan Parinacota has been chosen and morphologically characterized as the „standard“ Andean stratovolcano based on a method developed by Karatson et al., (2010). Eroded volumes of older volcanoes are then quantified via a statistical comparison wth this standard cone.

Based on reconstructed volumes and ages, typical long-term erosion rates of ~10 m/Ma over the last 14 Ma have been calculated. Lowest erosion rates are typical for the hyperarid Puna region around >24° S (7-9 m/Ma) while somewhat higher values (13-22 m/Ma) are recorded for volcanoes in less arid southern Peru (>18° S). This suggests climatic control on erosion rates due to the gradient in precipitation along the western margin of the Altiplano-Puna Plateau from northern Chile to southern Peru.

Short-term relatively high erosion rates of 112 to 66 m/Ma, decreasing with age, are only found at Late Quaternary volcanoes, i.e. at the initial stages of erosion. Young and growing volcanoes thus erode more easily due to their unconsolidated cover, and surface denudation slows down significantly to approximately one tenth after a few Ma.

A significant negative correlation is observed between the denudation ratio (defined as removed volume/original volume) and post-erosional edifice height. This relationship is independent of climate and original edifice elevation.

Dated volcanoes allow to calibrate denudation ratio to age and thus provide a morphometric tool to constrain the eruptive age of remote Andean volcanoes with an uncertainty of ~1 Ma.

Karátson D, Favalli M, Tarquini S, Fornaciai A, Wörner G (2010) The regular shape of stratovolcanoes: a DEM-based morphometrical approach. J Volcanol Geotherm Res 193: 171-181

NEW APATITE FISSION-TRACK DATA REFLECTING THE LANDSCAPE EVOLUTION USING THE EXAMPLE OF THE SOUTHEASTERN PASSIVE CONTINENTAL MARGIN IN CENTRAL BRAZIL

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Low-temperature thermochronolgy like AFT yield a well established tool to understand and reconstruct the rift to post-rift evolution of the passive continental margin in Brazil.

The aim of the study is to quantify the temperature, exhumation, uplift, and long-term dynamic evolution of the topography of the southeastern passive continental margin in the states of Paraná and Santa Catarina (Central Brazil) along different transects.

The working area shows the active evolution since the Early Cretaceous with altitudes up to 1400 m a.s.l and partly deep incised valleys. The first transect crosses the Ponta Grossa Arch with Devonian to Jurassic sediments in an NE-SW direction from the escarpment (Escarpa Devoniana) of the Serra Mantiquera in the NE to the escarpment in the SE built up of the overlying Early Cretaceous flood basalts of the Serra Urtigueira. The second transect drops down perpendicular to the coast where the eastern escarpment of the Serra Geral (up to 1400 m a.s.l) reaches nearly the coast. The highlands consist of Cretaceous flood basalts whereas the coastal lowlands consist of Precambrian metamorphic and intrusive rocks.

Previous apatite fission-track data of the states of Parana and Santa Catarina provide ages between 144 (5) Ma (Gallagher et al., 1994) and 25 (1.8) Ma (Franco-Magalhaes, A.O.B., 2010) and show different post-rift reactivation from the Cretaceous to the Paleogene. But none of the studies indicate a clear relationship between age distribution and topography or age distribution and stratigraphic age.

This study is based on samples taken along the transects within the working area. The results will provide new insigths into the evolution of the southeastern passive continental margin in Central Brazil concerning the thermal, exhumation, and uplift history of the Brazilian passive continental margin.

Gallagher K. et al. (1994): The denudation history of the onshore continental margin of SE Brazil inferred from apatite fission track data, JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 99, NO. B9, PP. 18, 117-18, 145, 1994 doi 10.1029/94JB00661

Franco-Magalhaes A.O. et al. (2010): Rift to Post-rift evolution of a "passive" continental margin: The Ponta Grossa Arch, SE Brazil, Int. J. Earth Sci. (Geol. Rundsch.) (2010) 99:1615–1617, doi 10.1007/s00531-010-0574-6.

THERMAL HISTORY, EXHUMATION, UPLIFT, AND LONG-TERM LANDSCAPE EVOLUTION OF THE SOUTH ATLANTIC PASSIVE CONTINENTAL MARGIN IN EASTERN ARGENTINA

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The project deals with the longterm landscape evolution of the South Atlantic passive continental margin in eastern Argentina. The eastern Argentina South Atlantic passive continental margin (SAPCM-A) is linked to a very flat topography without any escarpment. The aim is to quantify processes, like uplift-, exhumational and erosional events by using fission-track (FT) data, because the evolutional processes of the basin and the topography are only partly known.

The interpretation of the FT-ages and the thermo-kinematic modeling will lead to new conclusions on this topic and helps to understand the causes and timing of the evolution of the eastern Argentina South Atlantic passive continental margin. The SAPCM-A trends NE-SW and is linked to the SE-NW trending Salado-basin and the also SE-NW-trending Colorado-basin. These two basins are separated by the Tandill and Ventana Hills, which both also trend NE-SW. FT-data, generated from samples from the Tandill and Ventana Hills by using apatite and zircon from the different lithologies will be combined with HeFTymodels, to get new information about the kinematic processes like cooling, exhumation/inversion, uplift rates and erosional events, which have taken place and formed the topography of this region. This area is also a key area to study the influence of Fracture Zones (transform faults, transfer zones) on the evolution of the SAPCM.

Additionally we will work on data generated out of drill sites from the Colorado-and the Salado-basin, to get further information about the evolution and the geological processes of these two basins had to deal with in the past.

INNOVATIVE RESEARCHES IN THE CONTEXT OF MARINE AND SPACE GEODESY LABORATORY AT THE FEDERAL UNIVERSITY OF PARANÁ, BRAZIL

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The Marine and Space Geodesy Laboratory (LAGEM) coming through knowledge derived from geodetic sciences to generate subsidies for coastal environmental diagnostics. The main goal is to improve the quality of life using environmental management and supporting politics actions. Geodetic surveys based on satellite positioning and marine geodesy can quantify and qualify changes at a specific study area. The importance of monitoring a dynamic phenomena and looking for environmental models are highlighted in this group.

This laboratory has been conducting, over the years, many studies that could generate contributions for the environment. By a geodetic monitoring it is possible to study a complex spatial-temporal interaction among the various elements that compose a marine system.

The development of an expert system for determinate levels of fragility has been studying. This research discusses the criteria for the expert basic of knowledge system and also introduces a new mathematical model for determining the fragility index. All elements related to natural and human interventions that can be part off the equilibrium or disequilibrium in an environment complex. This research that climbs through the data from the Geodetic Sciences together with other sciences can be generated subsidies for the planning and management of the territory.

Other research aims to demonstrate a comparison and assessment between three different models of shoreline prediction: robust parameter estimation, artificial neural network and linear regression. From this propose temporal data, related to the years 1954, 1963, 1980, 1991 and 1997, were used for shoreline extraction in a 6 km section of Matinhos beach in the state of Paraná, Brazil.

Some hypotheses changing the weigh matrix for the case of linear regression and robust estimation were done. Different tests with artificial neural network were organized setting the parameters like: architecture of the network, number of neuron in hidden layers and the training algorithms. The best statistics result shows the MAPE (Mean Absolute Percentage Error) when compared with the residuals between the prediction and the shoreline of control. With these criteria an ideal model for the study area has been evaluated.

The tendency modeling with neural networks has been looking as an attractive model for prediction. The characteristics of seeking relationships using many sources of information that can be incorporated in the input data are an attractive for coastal areas and also for shoreline models.

It would be interesting in the future, if possible, to add more input data with different variables to verify the behavior of the artificial neural network. For example, data related with temporal climatic variations such as atmospheric temperature, winds, tides, atmospheric pressure, wave energy and variation in the mean sea level could be achieved seeking a new model for coastal trends.

TECHNOLOGY INNOVATION IN THE SPACE GEODESY LABORATORY IN MARINE AND SATELLITE POSITIONING

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The Space Geodesy Laboratory in Marine and Satellite Positioning (LAGE) has invested in research and technology, since 2006. Among some technologies innovation, detach the establishment of the first Calibration Station for GNSS Antennas in Brazil and Latin America (BCAL/ UFPR: Baseline Calibration Station for GNSS Antennas at UFPR), that was built, especially, due to an International Cooperation between CAPES (Brazil) and DAAD (Germany).

Complementarity, the LAGE's researches has developed a material called Attenuator of Multipath Effect (AEM-LAGE) that might be coupled to an antenna in order to decrease the multipath effects and mitigate the indirect signals that reach the positioning receiver located at the Baseline Calibration Station for GNSS. The results achieved with the use of the first prototype AEM was acceptable, as regards to the imported frequency attenuator.

Actually, the marine researches have focused in create a prototype in which its main function is monitoring the barrages water levels and currents. That instrument was built with national technology, thus cheaper than the similar imported devices. The prototype was tested in Vossoroca reservoir, located in Tijucas do Sul, Paraná, Brazil. The method of Kinematic Relative Positioning was applied with the use of different GPS receiver, and a sampling rate of 1 second. The prototype developed for this study was designed to suit the characteristics of estuarine areas, to measure the reservoir circulation (speed and direction) and to provide information about the fragility of environmental ecosystems in coastal areas.

THE EARTH SCIENCE APPROACH TO ARCHAEOLOGY: RECENT EXAMPLES FROM CENTRAL AND SOUTH AMERICA

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The investigation of the complex interrelationship between nature and culture has always been a core element of the study of ancient societies. While the focus has long been on the natural environment shaping culture, and being shaped by it, investigations of intangible aspects of environmental structures, such as culturally determined landscape perception, have gained prominence in recent years.

Approaches and methods developed by and for the Earth Sciences have proven to be powerful and versatile tools in these studies, first in Old World archaeology, and more recently also in New World archaeology. This paper cites some recent studies from Central and South America by the author and other researchers, using a variety of approaches.

The archaeological site of Cerén in El Salvador has become known as the Pompeii of the Americas (Sheets ed. 2002). Buried under thick layers of volcanic ash at around AD 590, this agricultural village at the southeastern margin of the Maya realm has been investigated in close cooperation between archaeologists and geo and bio scientists, resulting in unprecedented insights into the economy, agriculture, and rural village live during the Classic Maya period. At the same time, archaeological data provided evidence for the dating of the Loma Caldera eruption.

Another example from Central America refers to applications of remote sensing, a technology mostly driven by its use in the Earth Sciences, to archaeology (Wiseman, El-Baz eds. 2007). Since the 1990, aerial and satellite images as well as radar and lidar data have been successfully used to detect and map archaeological sites and features under the seemingly unpenetrable forest canopy. This has been a major step forward for archaeological research at the regional scale that investigates settlement and land use patterns in relation to environmental parameters.

A third example from Peru demonstrates how geoinformation systems (GIS) can shed light on culturally determined landscape perception and structuring. A recent GIS study of the famed Nasca lines and geoglyphs in south Peru, the largest example of prehistoric landscape art, revealed spatial order in the apparent maze of geoglyphs in the desert based on visibility patterns (Lambers & Sauerbier 2009). This indicates a use of the geoglyphs as stages for ritual gatherings. This GIS application thus helped to explain the function of these unique archaeological features.

Lambers, K. & Sauerbier, M. (2009): Context matters: GIS-based spatial analysis of the Nasca geoglyphs of Palpa. In New technologies for archaeology, Reindel

M. & Wagner, G. (eds.), 322-338. Heidelberg: Springer. Sheets, P. D. (ed.) (2002): Before the eruption: the ancient Cerén village in Central America. Austin: University of Texas Press. Wiseman, J. & El-Baz, F (eds.) (2007): Remote sensing in archaeology. New York: Springer.

GEOLOGY AND WHOLE-ROCK GEOCHEMISTRY OF THE LAS CHACRITAS PLUTON, SIERRA DE HUMAYA, CATAMARCA, ARGENTINA

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The Sierra de Humaya (Sierras Pampeanas, NW Argentina) is an igneous-metamorphic basement block uplifted during the Andean tectonic event. The basement is dominated by widespread metasedimentary rock sequences metamorphosed under different metamorphic grades, such as migmatites, gneisses, and schists, and small intrusive igneous bodies, all grouped under the name of El Portezuelo Metamorphic–Igneous Complex. The high T/P metamorphism took place during the Famatinian orogen, between 477 to 470 Ma (ID-TIMS U-Pb in monazite; Larrovere et al., in press). In the northern region of the Sierra de Humaya, the Las Chacritas pluton (LCP), an elongated sub-ellipsoidal body (about 4 x 2 km) is intruded into the mentioned metamorphic rocks. This body is concordant with the main regional foliation (NNW-SSE /N-S strike and ENE/E dip). Internal foliation of the body is nearly parallel to the country-rock foliation. The contacts between the LCP and the wall rock (mostly schists) are sharp and straight. In the border zone, mainly concordant dykes (up to 5 m thick) and thin quartz-rich veins (1-5 cm) are observed into the country rock. In some dykes wall rock fragments (xenoliths) with angular shapes are presents. The main plutonic facies is a light gray equigranular medium-grained two-mica granodiorite to tonalite. It consists of plagioclase (31-44%), quartz (30-46%), microcline (0-14%), muscovite (6-12%), biotite (5-11%) and less than 2% (modal) of accessory minerals (apatite, zircon and epidote) (n=4). On the eastern margin of the pluton, leucocratic equigranular muscovite-bearing dikes are associated to the main plutonic facies. They are white, medium- to coarse-grained, and consist of microcline (13-37%) plagioclase (18-33%), quartz (26-43%), muscovite (13-25%) (n=4) and biotite (less than 1%), with tourmaline, garnet, oxides and apatite as accessories. The main facies of the LCP is felsic or evolved in composition (SiO_2 ≈ 73 wt.%) and slightly peraluminous (ASI=1.12-1.16). The leucocratic dykes are also felsic (SiO_2 ≈ 73 wt.%) but slightly to moderately peraluminous (ASI=1.18-1.23). On the Na_2+K_2O vs. Si_2O classification diagram, all samples (main facies and dykes) fall in the field of granite and on the subalkaline trend, whereas on the A-B diagram after Villaseca et al. (1998) they are discriminated as moderately peraluminous and felsic peraluminous respectively. Chondrite-normalized REE patterns show that the main granitic facies has relatively high LREE and low HREE values ($[La/Yb]_N$=7.7-8.3), with moderately negative Eu-anomalies (Eu/Eu*=0.57-0.65). Leucocratic dyke samples are depleted in REE, with a flat pattern ([La/Yb]N=1.7-1.9) and show strong to moderate negative Eu-anomalies (Eu/Eu*=0.26-0.70) suggesting previous plagioclase fractionation in the magma or retention of this phase in the source. On the Y-Nb tectonic discrimination diagram all studied rocks plot in the field of volcanic arc-granites + syn-collisional granites. In conclusion, we report a new magmatism in the Sierra de Humaya, Las Chacritas pluton, composed by peraluminous granitoids and Ms-Tur-Grt bearing dykes associated. The field and whole-rock geochemical data suggest that this magmatism was originated by anatexis of metasedimentary rocks probably during the Famatinian orogen.

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IMPACT ANALYSIS OF TROPICAL STORM "ALEX" IN PABLILLO RIVER BASIN, LINARES, N.L., MEXICO

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The northeast of Mexico is characterized by the incidence of hydrometeorological phenomena (hurricanes, cyclones, tropical storms and tropical depressions) originated in the Mexican Caribbean with paths through the Gulf of Mexico, affecting the Tamaulipas and Veracruz coast, ridges of the Sierra Madre Oriental and the cities of Linares and Monterrey.

"Alex" hurricane with category 2 (Simpson's Scale) fading to penetrate the Mexican Gulf coasts, transforming in "tropical storm" causing torrential rains higher than hurricane "Gilbert" in 1988. The accumulated rainfall in Monterrey was higher than 616 mm during 60 hours (La Estanzuela, climatologically station), while in 1988 "Gilbert" generate 280 mm in the same period of time. Cerro Prieto climatologically station placed near to the water reservoir close to Linares the rainfall exceeds 264 mm in 60 hours, these unusually heavy rainfall caused historic extraordinary runoff over the strategic rivers Pablillo (Linares) and Santa Catarina river (Monterrey) which carried over 2,500 m^3/s, resulting in extensive damage to the urban infrastructure (CONAGUA, 2010).

In Linares, a city with 70,063 inhabitants (INEGI, 2005) and Pablillo river basin were documented severe damage and destruction to the infrastructure, agricultural land and urban development, as well as erosion of the rivers (Pablillo, Camacho, Camachito and Hualahuises) that generated a huge volumes of transported materials, including human settlements located on the rivers banks, these sediments were deposited inside the Cerro Prieto drinking water reservoir, reducing its useful life in a very short period of time. There was also, domestic, municipal, and industrial pollutant removal in the Linares area. Numerous mass movements from the Sierra Madre Oriental/Cañón Santa Rosa have damaged and disrupted major roads like Linares-San Roberto. Moreover, was allowed the recharge of aquifer, drinking water reservoirs, rivers, lakes and water bodies.

CONAGUA/Comisión Nacional del Agua (2010): Alex provocó lluvias torrenciales superiores a las de Gilberto, en 1988. Boletín Semarnat, Gobierno Federal. Publ. 156/10, 1-3.

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AN ANTARCTIC ORIGIN OF THE SOUTH AMERICAN TEMPERATE FORESTS? NEW INSIGHTS IN AN OLD QUESTION

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At least 4 different paleogeographic models has explained the evolution of the relationship between southern South America and the Antarctic Peninsula in the Cretaceous, only in the last 30 years. As well as a new continental configuration appeared, new visions about the abundance and distribution of organisms took place. But in the last 10 years, enormous volumes of information coming from multidisciplinary approachs from disciplines as paleomagnetism, sedimentary provenance, paleobiogeography, molecular phylogeny and paleoecology, between others, are offering alternative or complimentary explanations to the complex relation between landscape and evolution. In the present report we analyze new data on the paleofloral associations of Cretaceous age in 8 localities of the South Shetland Islands, Antarctica, and Patagonia. These localities were studied within Fondecyt project 11080223 (2009-2011), applying paleobiogeographic tools such as Parsimony Analysis of Endemicity (PAE); the diversity of each outcrop is compared with localities in the Antarctic Peninsula and Patagonia. The tree generated clearly distinguishes at least two major events in the Cretaceous megafloral assemblages, with increasing endemism areas towards the end of the Lower Cretaceous. This condition gradually changes since Coniacian-Santonian lapse, as evidenced in Hannah Point, in Livingston Island, Antarctica. It is postulated that this floral pattern is strongly linked with the Gondwana breakup and the timing of the opening and closure of the “Rocas Verdes Basin”, a hypothetic vicariant event that starts at the end of the Jurassic and ends in some moment during the Upper Cretaceous, with a terrestrial reconnection among South America and Antarctica. According with the new evidence, this moment would be the Turonian, a complicate stage with several taxa using the novel land bridge between southern South America and the Antarctic Peninsula as a dispersal way to the rest of the subcontinents still linked with Gondwana.

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MID-CRETACEOUS MARINE GASTROPODS OF THE SERGIPE BASIN, NORTH-EASTERN BRAZIL

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The Museum of Earth Sciences of Heidelberg University houses the probably largest collection of marine Cretaceous macrofossils from Brazil outside this country. The material comprises approximately 14,000 specimens of ammonites, bivalves, gastropods, echinoids as well as fish remains and other minor groups, mainly from the Sergipe Basin in north-eastern Brazil. To date, the ammonites, bivalves and echinoids have been the subject of taxonomic and/or biostratigraphic studies. The present project concerns the Aptian–Coniacian gastropods from the Sergipe Basin, including exquisitely preserved specimens with colour patterns from the Aptian "quasi-lagerstätte" Limeira.

The Sergipe Basin is one of a series of continental margin basins along the Brazilian coast, which were formed in the late Mesozoic by rifting and separation of the South American and African continents. The marine sedimentary fill of the basin is of Aptian to Miocene age. The Cretaceous succession is extensively exposed and composed of predominantly shallow-water carbonates and mudstones representing one of the most complete Cretaceous successions of the South Atlantic region.

Preliminary studies of the Cenomanian–Coniacian gastropods (Burrer 2003; Dietzel 2003; Lexen, in preparation) have revealed a diverse fauna with at least 30 genera, notably *Pseudamaura, Aporrhais, Anchura, Drepanocheilus* and *Piestochilus*. There are close affinities with coeval faunas of the Tethyan realm, such as those of northern Africa, the Near East and North America.

Besides taxonomic treatment of the gastropods, the palaeoecology and palaeobiogeography of the fauna is being studied. Particular attention is paid to the biostratigraphic potential of individual species, in defiance of the general assumption that gastropods are poor guide fossils. The project is part of a long-term project comprising the entire macro- and microfauna of the marine Cretaceous of north-eastern Brazil, with the overall objective of establishing an integrated biostratigraphy for the South Atlantic region.

Burrer, N. 2002. Gastropoden aus dem Cenoman–Coniac des Sergipe-Beckens, Brasilien. Teil 1: Die Gattungen *Aporrhais*, *Avellana*, *Drepanocheilus*, *Epitonium*, *Fasciolaria*, *Fusus*, *Globiconcha*, *Lunatia*, *Piestochilus*, *Pterocera*, *Ringinella*, *Turbo*, *Turritella*, T*ylostoma*, *Voluta*, *Volutilithes*, *Volutomorpha*. - 101 pp. Unpublished Diploma thesis, Heidelberg University.

Dietzel, S. 2002. Gastropoden aus dem Cenomanium–Coniacium (Ober-Kreide) des Sergipe-Beckens, Brasilien. Teil 2: Die Gattungen *Akera*, *Ampullina*, *Cerithium*, *Cimolithium*, *Dicroloma*, *Drepanocheilus*, *Drilluta*, *Euomphalus*, *Fasciolaria*, *Mesalia*, *Piestochilus*, *Pterodonta*, *Scalaturris*, *Solarium*, *Turbo*, *Turritella*, *Tylostoma*, *Uchauxia*, *Voluta*. - 215 pp. Unpublished Diploma thesis, Heidelberg University.

THE OPHIOLITIC CHROMITITES FROM HABANA-MATANZAS (WESTERN CUBA): CHROMITE COMPOSITION AND MINERALOGY OF THE PLATINUM GROUP ELEMENTS

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The ophiolites of Habana-Matanzas (Western Cuba) host several chromite deposits vary from refractory (Al-rich) to metallurgical (Cr-rich) type. The chromitites occur in the upper part of a mantle tectonite close to mantle-crust transition zone. Generally, chromitites are massive and form small lenticular bodies associated with strongly serpentinized dunite. Cr-rich chromitites were collected in Loma de Jacan, Arco de Canasi and Tetas de Camarioca and they have this composition: #Cr=0.65-0.74, #Mg=0.61-0.68, TiO_2=0.15-0.44 wt%. Al-rich chromitites (#Cr>60) are from Mina Ricreo and they have this composition: #Cr=44-46, #Mg=0.73-0.74 and TiO_2=0.33-0.41 wt%.

Based on the chromite mineral chemistry, the calculated melts in equilibrium with Cr-rich and Al-rich chromitites are island-arc tholeiite (IAT) with boninitic affinity and back arc basin basalt (BABB), respectively. This variety in their parental magma, suggests that paleotectonic environment in which the investigated chromitites formed, corresponds to a suprasubduction zone (SSZ) varying from the axial zone of a volcanic arc to the BABB.

Platinum group minerals (PGM) were found only in the Cr-rich chromitites. They are very small, less than 10 µm, and they occur as euhedral or subeuhedral crystals, included in chromite. They form polyphasic grains composed of different PGM and silicates, mainly clinopyroxenes as and amphiboles. The most abundand PGM is laurite, accompanied by minor osmium, cuproiridsite, iridium and an unnamed phase composed of Ir-Ni-Fe-S. According to the mineralogical observation, all the discovered PGM are magmatic in origin, i.e. formed before or concomitantly with the host chromite.

Our main conclusions are that the investigated chromitites are very similar to those associated with SSZ ophiolites and, in particular, to the chromitites of Sagua del Tanamo hosted in the ophiolite belt of Mayari-Baracoa (Eastern Cuba). The presented results, although preliminary, indicate that only the Cr-rich chromitites are enriched in PGM and, as a consequence, probably in platinum group elements (PGE).

NEW ASPECTS ON THE UPLIFT AND EXHUMATION HISTORY BY LOW-T THERMOCHRONOLOGY IN THE SIERRA DE COMECHINGONES (ARGENTINA)

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The younger uplift and exhumation history of the Sierras Pampeanas is interpreted to be closely related to the flat-slab subduction of the Nazca plate beneath the South American plate since the Miocene (e.g. Jordan and Allmendinger 1986; and references therein). Low temperature thermochronologic dating methods can contribute to reveal new aspects on the geodynamic evolution. We performed these dating methods and thermal modelling along one elevation profile within the Sierra de Comechingones.

(U-Th)/He ages of zircon and apatite as well as apatite fission track ages show a positive correlation with elevation varying between the Early Triassic (oldest (U-Th)/He age of zircon) and the Early Cenozoic (youngest (U-Th)/He age of apatite). The obtained apatite (U-Th)/He ages of the samples in the middle profile section are around 80-70 Ma indicating cessation of the thermochronologic record within the investigated profile and implying that our samples left the partial retention zone (PRZ) at that time. This is also confirmed by results of thermal modelling which was performed following the approach of Ketcham (2005) using HeFTy.

Assuming a geothermal gradient of approximately 26° C/km as suggested by Sobel and Strecker (2003) the upper thermal boundary of the PRZ is located in 2300 m depth. Thus, the final exhumation, including the younger Andean deformation, is constrained to approximately 2300 m since the passage of analysed samples through the PRZ at around 80-70 Ma. Due to the difference in elevation of approximately 1850 m between the lowermost and uppermost sample the amount of eroded thickness from the top of the profile can be constrained to be around 450 m since 80 Ma. Therefore, a very rough approximation of the erosion rate, affecting the top area of the profile, results in less than 6.4 m/Ma (0.006 mm/a), indicating very stable conditions concerning erosional processes since around 80 Ma. Anyway, this does not contradict with the structural evolution model usually accepted for the Sierras Pampeanas (e.g. Jordan and Allmendinger 1986; and references therein) but places constraints on the possible uplift during the Andean orogeny. If the Comechingones fault had evolved from a Mesozoic extensional fault later inverted by Neogene shortening, then the overall displacement related to the Andean orogeny might be larger than the current topographic relief at the conducted cross-sections.

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THE NICOYA BIG ONE EXPECTED EARTHQUAKE IN COSTA RICA AND ITS REGIONAL FAULT REACTIVATION SCENARIOS BASED ON COULOMB FAILURE STRESS & SLIP TENDENCY ANALYSIS

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Based on the recent short term recurrence of highly destructive earthquakes in NW Costa Rica (1900,1950,1990) several researchers have proposed a “big one“ Mw 7,6 event within the Nicoya peninsula in NW Costa Rica where the smooth sea bottom of the east pacific rise originated Cocos plate subducts the Caribbean plate at a rate of 11cm/year towards N30°E along the 5/m.y. old Middle America trench. Ongoing controversy (forecast wrt prediction) is based mainly on the lack of reliable instrumental data needed to constrain the seismic cycle and generate a plausible model from representative databases although no doubt exist about its highly destructive potential. Recent studies also assigns high seismic hazard to some other regions within the Caribbean plate-Panamá microplate, for example at southern Costa Rica-northern Panamá where the triple junction of the Nazca-Cocos-Caribbean imposes a complex and quite active seismotectonic setting.

To help descipher this context a fault reactivation scenario is herewith presented built from a joint application of the Coulomb Failure Stress (CFS) and Slip Tendency (ST) methods. The former yields a 3D vision of the affected crustal volumes with increased seismic hazard induced by the expected earthquake at the megatrust Nicoya interface and the latter the geomechanical likelyhood of induced displacements on known or suspected and outcropping or blind regional faults. The results indicate that the area to be affected is about 9.000 km^2, with colateral damage to central Costa Rica with its dense concentration of social and economic infrastructure and the southern edge of Nicaragua. Vertical modeled displacements could be in the range of 0.22 m to 0.35 m.

The thrust, strike-slip and normal regional structures to be reactivated by the transfer of static Coulomb stresses are categorized and zoned while the ST confirms the same scenario. Incidence in the behavior of active volcanoes can not be ignored as demonstrated in the Pinatubo and Vesuvious volcanotectonic sequences. These results are a new insight, an original approach and a contribution to the evaluation of seismic hazards in Costa Rica and a suggested method to be applied elsewhere.

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STRUCTURAL AND TEMPORAL RELATIONSHIP BETWEEN RIO BLANCO PLUTON AND METAMORPHIC BASEMENT, SIERRA DEL ACONQUIJA, NW ARGENTINA

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In this work, financed by the CIUNT Project 26/G427, we present preliminary data on the geology of La Ovejería area. The research area is located to the east of Sierra del Aconquija, at the latitude of the department of Tafí del Valle, Province of Tucumán, NW Argentina. This area is separated from Cumbres Calchaquíes by the NNW-SSE trending Amaicha depression. In the studied area, the metamorphic basement consists of deformed biotite-muscovite schists, that have been intruded by the Río Blanco pluton.

The internal structure of the banded schists consists of two foliations identified as superimposed episodes of ductile deformation. The first foliation (S1) is pervasive and, occasionally, is obliterated by a crenulation cleavage (S2) associated with microfolds. Additionally, the internal structure is affected by fractures that indicate a younger brittle deformation episode that affected the schists during the latest stages of their geological evolution.

The Río Blanco pluton is an N-S trending elongated gray to pink-gray, tonalitegranodiorite with an extension of 8 km2. This pluton is characterized by a medium grain size inequigranular phaneritic texture (0,5 to 2 cm). The essential minerals are plagioclase, quartz, and scarce K-feldspar, with biotite as the most important accessory. The pluton contains centimetric to metric-scale xenolits of biotite-muscovite banded schists, with different degrees of assimilation. Based on petrographic and field relationships, the Río Blanco pluton can be genetically, spatially, and temporarily related to nearby outcropping granitic bodies. These bodies, characterized by metaluminous to peraluminous geochemical signatures, have been interpreted as derived from fractional crystallization of calc-alkaline magmas

Although the age Río Blanco pluton is unkown, geochronological data from the other granites in this region suggest a post-tectonic magmatic event between 404 and 507 Ma. The emplacement of these granites has been related to the Lineamiento de Tafí, a mega-structure interpreted as a lower Paleozoic fault, which is at present active.

GEOLOGICAL MAPPING OF AN AREA OF CUMBRES CALCHAQUÍES AND SIERRA DEL ACONQUIJA, NW ARGENTINA, USING DIGITAL PROCESSING OF SATELLITE IMAGES LANDSAT 7 AND CBERS-2B

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Digital processing of satellite images is an excellent tool for mapping extensive areas of geological interest, because satellite imagery enhances lithological, structural, and topographic features. In this study, digital processing of satellite images was applied for the identification of several granitic bodies intruding the metamorphic basement of Cumbres Calchaquíes and Sierra del Aconquija, in Northwest Argentina. The studied area belongs to the Sierrras Pampeanas environment, between 26º 45´ and 27º 00´ S, latitude and 65º 33´and 65º 50´ W, longitude. Landsat 7 and CBERS-2B freeware computer programs were applied in this study. The programs can be accessed through the internet at their official webpages: www.landcover.org/data/landsat and www.dgi.inpe.br/CDSR.

The methodology followed for the mapping of the studied area, financed by the CIUNT Project 26/G427, consisted of the determination of the geographical coordinates of the area by using Google Earth. Once the coordinates were fixed, the images were downloaded directly from the official web pages. Processing of the images was performed through Envi, a specific software. The next step was the trimming of the area of interest and then the combination of RBG equal resolution bands, in order to obtain an image that enhanced the most notable geological features, e.g. topographical, lithological, and structural.

In this case, recognition and identification of several plutonic bodies that intrude the metamorphic basement was made. As a result of the application of this technique the combination of 753 Bands (RGB Landsat 7) allowed the perfect identification and delimitation of plutonic bodies of Cumbres Calchaquíes, particularly Cerro Pabellón and Los Cuartos granites, besides Loma Pelada and Ñuñorco Grande granites in the center and to the south of the valley. In the other hand, with the combination of 531 Bands (RGB Landsat7) was possible to constrain the plutonic bodies that crop out to the east side of Sierra del Aconquija, such as El Infiernillo and Río Blanco granites.

As a conclusion, we support the use of this methodology in order to improve the planning of geological field trips and for the optimization of time and efforts.

LOS MICROPRODÚCTIDOS DEL ESTE DEL LAGO TITICACA, NOROESTE DE GONDWANA OCCIDENTAL Y SUS POSIBLES INTERPRETACIONES PALEOCLIMÁTICAS

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La fauna fosilífera colectada de los afloramientos de la Formación Copacabana en la zona de Ancoraimes, (Norte de La Paz), consta de una asociación de pequeños ejemplares (desde 0.5 hasta 1 cm), similares en variedad y cantidad a los prodúctidos de gran tamaño que son frecuentes en los afloramientos de la Fm Copacabana de otras localidades. Se distinguen en este grupo dos géneros de brachiópodos: Aseptella y Spiriferellina, (López-Velásquez, 2010), cuya presencia permite asignar a la Formación Copacabana una probable edad carbonífera superior, definida en base a su correlación con *Aseptella. Aff patriciae* de la Formación El Paso de Argentina. Los niveles portadores de la microfauna son parte de la sección estratigráfica del abra de Patapatani, estudiada por Grader et al. (2003). La secuencia alcanza hasta 130 m de espesor y presenta una alternancia de facies limolíticas y lutíticas calcáreas, con facies arenosas de tipo lacustre cerca de la base. Los fósiles ocurren aproximadamente a partir de los 30 m desde la base, hasta los 60 m. Los bancos fosilíferos se encuentran en litofacies predominantemente limolíticas y masivas, con cemento calcáreo, poco compactas, con algunos niveles de hasta 20 cm de packstone compuesto por abundantes fragmentos de valvas. Esta asociación consiste principalmente de pequeños prodúctidos, acompañados en menor proporción por ostrácodos, briozoarios, corales, trilobites, gastrópodos y fusulinas del género Pseudowagerina? y otros.

Los primeros registros de Aseptella corresponden a niveles del Carbonífero Superior de la Cordillera Cantábrica, España. En Argentina, se encontraron en niveles de la misma edad, *A. aff patriciae* y *A. patriciae,* junto a prodúctidos de pequeño tamaño (Zona de Lanipustula) en la Fm El Paso (Martínez & Winkler, 1998). Así mismo en esta región, Spiriferellina fue asignada al Viseano y Pérmico (Martínez & Legrand, 1993). La paleoecología interpretada para los niveles de Aseptella en la Cordillera Cantábrica es de un habitat de aguas oscuras probablemente anóxico. Este brachiopodo, al migrar, se adaptó con facilidad a las nuevas condiciones paleoambientales, aparentemente más frías, donde alcanzaron mayor robustez (Martínez, & Legrand, 1993).

En la zona de estudio, el reducido tamaño de estos organismos sugiere condiciones paleoambientales marinas de aguas tranquilas que, debido a una posible circulación restringida, eran poco oxigenadas, afectando su crecimiento. Otra posibilidad es la presencia de aguas turbias que pudo limitar su desarrollo, o que las glaciaciones registradas para la región (Spilleti et al., 2010), con un interglacial corto sincrónico a esta fauna, haya influido en ella. Se descarta que la posición paleolatitudinal influyera decisivamente en el desarrollo de estos ejemplares.

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ENCRUSTING PATTERNS IN CRETACEOUS MOLLUSKS: COMPARISONS BETWEEN BENTHIC AND NEKTOBENTHIC HOSTS

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The encrusting fauna of nektobenthic nautilids (genus Cymatoceras Hyatt), semiinfaunal trigonioids (genus Steinmanella Crickmay) and cementing epifaunal pectinids (genus Prohinnites Gillet) were surveyed, and compared to each other. The hosts have been collected from Hauterivian beds of the Agrio Formation in the Neuquén Basin, Argentina. The unit is composed of grey shales, calcareous shales, limestones, and coquinas (Leanza et al., 2006), and has been interpreted as shoreface and offshore shelf deposits (Lazo et al., 2005).

Differences in composition of the encrusting fauna and relative abundance of encrusters where found between hosts. The encrusting fauna is dominated by oysters (53% to 86%), followed by uncoiled serpulids (18% to 13%). Minor components of the encrusting fauna vary, but are represented by bryozoans (most diverse and abundant in pectinids), coiled serpulids (absent in trigonioids), foraminifers (found only in trigonioids, and possibly nautilids) and other serpulids (with one or three keels, found only in pectinids).

It is significant that the two dominant encrusting groups, oysters and uncoiled serpulids, are commonly clustered together or overgrown. Oysters rarely exceed 3cm in length, while serpulid size varies. Both groups frequently present a gregarious behavior; the attachment of pioneer individuals triggered the attachment of other specimens and this is a factor to be considered when evaluating their great abundance as encrusters. Differences in the abundance and presence of the other groups probably respond to the interplay of the requirements of each kind of encruster, and the environmental conditions provided by each host. Taphonomy also plays an important role, since the original patterns of encrustation are obscured by taphonomic modification, which follows different pathways in each host; for example, cementing pectinids may lose the upper valves, but preserve the cemented ones, which may provide shelter for attaching organisms; nautilids, on the other hand, may go through a nekroplanctonic phase, undergoing extensive modification before reaching the sea bottom, where further modification takes place. Unveiling these pathways is essential to attempt an adequate paleobiological interpretation; and thus, this is the current line of investigation.

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This is the C-08 contribution of the Instituto de Estudios Andinos "Don Pablo Groeber".

3D LITHOSPHERIC DENSITY STRUCTURE OF THE CENTRAL AMERICAN SUBDUCTION ZONE FROM SATELLITE DERIVED GRAVITY DATA

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The combined geopotential models based on satellite and surface gravity data provide a homogenous gravity database with near global coverage. In this work, such data is interpreted to model the three dimensional lithospheric density structure along the Middle American trench as well as the segmentation of the oceanic Cocos and Nazca plates and the overriding Caribbean plate. The EGM2008 combined geopotential model was used for the forward modelling of the density structure on the regional scale while assessing the viability of satellite derived gravity data as input for the modelling of the solid Earth. The density model is constrained by available seismic velocity models, magnetotelluric cross-sections and receiver function data as well as the integration of seismic hypocenter data from local seismological networks.

The geometry and density distribution was modelled and focuses on the subducting Cocos Plate and the overriding Caribbean Plate. The thickening of the oceanic crust by the influence of the Galapagos hot-spot was taken into account and the structure was carried through to the slab outlining the effects of ridge subduction both on the plate margin and the overriding plate. The density structure of the Caribbean plate is found to be heavily influenced by the tectonic evolution of the Caribbean region and the crust presents a patchwork of tectonic blocks with crustal basements of contrasting densities such as the granitic Chortis Block, the mainly ultramafic Mesquito Composite Oceanic Terrain and a basaltic unit part of the Caribbean Large Igneous Province.

STUDY OF GOLD MINERALIZATION IN THE NOVO HORIZONTE, NEZINHO, CÍCERO AND TUCANO MINES, NORTHEASTERN GOIÁS, BRAZIL

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The Novo Horizonte, Nezinho, Cicero and Tucano gold mines are located in the northeastern region of Goiás state, nearby the town of Monte Alegre de Goiás. The gold mineralization occurs in quartz veins in shear zones nearby intrusive contact between Suite Aurumina granites and graphite-bearing schists of the Ticunzal Formation. In the Novo Horizonte mine, gold occurs associated with pyrite and arsenopyrite whereas in the Tucano mine, gold occurs associated only with pyrite. These mineralisations were characterized by EPMA mineral chemistry and fluid inclusion analysis. The arsenopyrite from Novo Horizonte has atomic concentration of As between 32.09% and 33.64%, suggesting a temperature of crystallization of about 350 ° C. The microtermometric results obtained for the Tucano mine indicate average melting temperature of ice (Tmi) of 0.17 ° C and average total homogenization temperature (Tht), of 212.4 ° C. For the Novo Horizonte mine the average Tmi and Tht was -0.51 ° C and 280.14 ° C. The EPMA and fluid inclusions data show comparable temperatures, ranging from 200 to 350ºC, for the fluids responsible for gold mineralization in the studied mines.

HOLOCENE ENVIRONMENTAL CHANGES IN SOUTHERN PERU AND THEIR IMPACT ON PRE-COLUMBIAN CIVILISATIONS

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At the eastern margin of the south Peruvian coastal desert (Palpa region, 14.5 °S) and the adjacent Andes, geomorphological investigations have shown that oscillations of moisture transport from the Amazonian lowlands to this (semi-)arid environment coincided with pre-Columbian cultural boom and decline.

During the latest Pleistocene and the early- to mid-Holocene, the present-day coastal desert received more precipitation, which allowed the expansion of Andean grasslands down to the foreland. Loess formation occurred, being representative for ~ 200 mm mean annual precipitation, 10 times more than today (Eitel et al. 2005). During the mid-Holocene, the study area received the Holocene maximum of precipitation and soil formation occurred, as palaeo-soil sequences document. In contrast, the Titicaca region further south-east (16° S) experienced extreme drought during that time (Rowe & Dunbar 2004), which was previously assumed to be representative for the entire central Andes. Increasing drought from about 4 ka led to a re-expansion of the coastal desert, the grassland diminished and loess formation ended, whereas the Titicaca lake level rose again. This regional antagonism between humid and dry conditions was a result of meridional shifts in moisture transport across the Andes and occurred also during pre-Columbian times, indicated by changes in geomophological activity and stability along the river oases. During increased moisture transport to the north, the Paracas and Nasca cultures experienced a time of florescence along the river oases between 800 BC–650 AD. From 650 to 1150 AD, drought affected oases and societies there, but more southerly moisture transport to the Titicaca region led to more favourable conditions there and the Tiwanaku culture boomed. From 1150 to 1450 AD, the oases received more moisture again. More detailed evidence is offered from cushion peatlands by new palynological analyses of Schittek et al. (this session).

Considering the coincidence between environmental and cultural changes, we state that success and decline of civilizations were dominated by hydrological oscillations, triggering fertility as well as a critical loss of natural resources. In response to spatial changing resources cultural foci were shifted. Therefore, the success of pre-Columbian civilizations was closely coupled to areas of geo-ecological favourability (Mächtle & Eitel 2011, submitted).

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PRELIMINARY GEOCHEMICAL DATA OF MISSISSIPPIAN VOLCANIC ROCKS FROM THE SOUTHERN PUNA (NW ARGENTINA): EVIDENCE OF EXTENSION AFTER CHILENIA TERRANE COLLISION?

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Recent works have recognized in NW Argentina a major magmatic event of Mississippian age (Martina and Astini 2009; Martina et al., 2011), previously only known through indirect evidences (Willner et al. 2008). It consist of ~2000 m thick non metamorphosed bimodal volcanic and volcaniclastic rocks resting on a heterogeneous metamorphic basement and covered by thick (>1000 m) Late Paleozoic siliciclastic successions. Petrographic and geochemical data from the southern Puna (27º01'54"S- 67º04'16"W) suggest the presence of rhyolites, trachytes, trachyandesites and picritic basalts with silica contents ranging from 44.3% to 78.8%. In the K_2O versus SiO_2 diagram the felsic volcanics plot in the K-rich field and the basalt in the medium-K. The alumina saturation index is >1 in the rhyolites and <1 in the trachytes, while the agpaitic index is <1 in all samples. The basalt has high Fe_2O_3 and TiO_2 contents and low Mg number, typical of evolved magmas. The low concentration of Ni and Cr may indicate fractionation of olivine and clinopyroxene, respectively. Lithophile elements (LILE) content is high in all samples excepting Ba which is low. Rare-earth elements (REE) patterns display light REE enrichment (La/Yb_N = 2.74-10.34) and relatively flat medium to heavy REE profiles (Dy/Yb_N = 0.95-1.40), with strongly negative Eu anomalies (Eu/Eu* = 0.79-0.08) in the most felsic samples. The basalt profile is similar to those of the trachytes but with a slightly lower total REE concentration. Another difference with the felsic rocks is its positive Eu anomaly (Eu/Eu* = 1.38) which characterize the early crystallizing assemblages. Although the results are limited and not conclusive in order to define the source of the volcanism, the different SiO_2 content between the basalt (44%) and the rhyolites and trachytes (60-79%) suggests they are not cogenetic. Basalts show high LILE, LREE, Nb and TiO_2 and low Ba contents, typical of OIB- type magmas. In contrast, the felsic rocks evidence crustal melting processes due to its high incompatible elements content and prominent negative Eu anomaly suggesting feldspar in the source. Moreover, the low Zr/Nb (6.20-14.74) and Nb/Th (0.97-2.61) ratios are common of continental crust. This is consistent with the reported high initial $^{87}Sr/^{86}Sr$ ratios (Martina et al. 2011). The pronounced negative Ba anomaly is typical of rift settings. This interpretation is in agreement with the tectonic discrimination diagrams where samples plot in the intraplate granites field. An extensional environment could also explain the juvenile εNd(t) values of the rhyolites (Martina et al. 2011) and it suggests mixing of crustal and mantle melts. A similar explanation was proposed for coetaneous A-type granites in the Andean foreland region (Dahlquist et al. 2010). Widespread crustal melting can be explained through underplating processes. In this sense, the OIB-like basalt may represent the primitive component. This magmatism occurred immediately to the east of the suggested Chilenia terrane collision (~390 Ma) and thus it could represent post-collisional extension.

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UNCONFORMITY-RELATED HYDROTHERMAL ALTERATION ASSEMBLAGES INCLUDING CLAY MINERALS AT TANDILIA, ARGENTINA

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An alteration zone, up to 30 m thick and rich in clay minerals, occurs at the unconformity between the Paleoproterozoic igneous-metamorphic basement and the Late Precambrian overlying sedimentary succession in the San Manuel hills (~37° 47' S; ~58° 50' W). Around 40 km to the NW, in the Barker area, two transitional alteration patterns rich in secondary clay minerals at such an unconformity have been established depending on pervasiveness and type of alteration (e.g. Martínez et al., 2010). There, the most pervasive alteration is characterized by the common appearance of Na-rich dioctahedral white micas, Na and K-bearing pyrophyllite, and florencite-type aluminum phosphate sulfate (APS) minerals. A comparison between the Barker and San Manuel areas should reveal if there was a regionally widespread fluid flow alteration event where the most pervasively altered basement can be recognized at San Manuel.

The basement protolith from San Manuel was a banded migmatite (Dristas and Frisicale, 1984) possibly similar to that outcropping at Barker. Bulk-rock analyses of the altered basement at San Manuel show an enrichment of LREE, a ∑REE of up to ~1800 ppm and either positive (Ce/Ce* ~2.5) or negative (Ce/Ce* ~0.5) cerium anomalies. Light REE hosted in secondary APS minerals derived from monazite present in unaltered basement according to studies of the most altered basement at Barker (e.g. Martínez et al., 2010). Pyrophyllite in the altered basement at San Manuel shows 0.02-0.18 K pfu and 0.07-0.12 Na pfu. Such values are notably lower than the Na (up to 1.0 pfu) and K (up to 0.6 pfu) contents detected in pyrophyllite from Barker (Martínez et al., 2010). Secondary dioctahedral white mica of the altered basement at San Manuel has a paragonite content of up to 58 mol% remarkably higher than the content (45 mol%) determined at Barker (Martínez et al., 2010). The Na contents in dioctahedral white micas and Na-K contents in pyrophyllite could be linked either to solid solution or to separate phyllosilicate phases so finely intergrown that this could not be resolved with the electron microprobe (Shau et al, 1991).

According to common radiometric ages, the fluid flow causing the studied alteration acted during the Brasiliano orogeny (~ 600 M.a.). The corresponding fluids were either generated by basement uplift or hidden Neoproterozoic igneous bodies in the Río de la Plata Craton.

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MAGNETIC FABRICS AND ROCK MAGNETISM OF PERMIAN DONOSA PLUTON–LA ESPERANZA PLUTONIC COMPLEX, NORTHERN PATAGONIA, ARGENTINA

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Magnetic fabrics are investigated by anisotropy of magnetic susceptibility studies on the Permian isotropic La Esperanza Plutonic Complex (Llambías and Rapela 1984) exposed in a northernmost area of Patagonia, south of Argentina. This intrusive complex is formed by at least three facies –Prieto Granodiorite, Giménez Granite and Donosa Granite- whose emplacement mechanisms are not clear yet. The younger pluton of the complex, the Donosa Granite, is a biotite rich K-feldspar megacrystic granite which crops out as an elongated N-S trending body formed by small discrete outcrops around Estancia La Esperanza (40°24.363´S/ 68°28.585´W). The age of Donosa can be bracketed by the age of its host, the Prieto Granodiorite, which has been accurately dated as 273±2Ma and the age of the cover, the Dos Lomas volcanics 264±2Ma, both obtained using U-Pb SHRIMP (Pankhurst et al., 2006).

Nearly 150 oriented specimens were studied from 14 equidistributed sites on the Donosa Granite to determine its magnetic fabric pattern. Magnetic susceptibility (κ) measurements indicate that average magnetic susceptibilities for Donosa Granite are close to 3 E^{-03} SI, yielding a ferromagnetic character, whereas its host, Prieto Granite exhibits κ reaching up to $1.5x10^{-2}$ SI. Microscopic observations, blocking temperature analysis, thermomagnetic curves (from about -195°C to 700°C) and bulk susceptibility measurements at room temperature for the Donosa Granite point out that in every case low Ti- and/or pure multidomain magnetite seems to be not only the most important carrier of the susceptibility but also a primary phase. Donosa Granite data analysis indicates that anisotropy degree is generally low for a ferromagnetic body. The analysis of the shape parameters of the susceptibility ellipsoids (i.e. Pj vs T, Jelinek statistics), indicates prolate to isotropic to oblate magnetic fabrics depending on the location of the site. Magnetic directional data reveal a consistent SE-NW trending foliation arrangement with variable dips mostly towards N along the southern and central parts of the pluton and a SW-NE trending foliation with subhorizontal dips towards SE in the northern part. However, steady NW-SE lineation data is consistent in every site with subhorizontal dippings (<30°). These in progress-studies about the magnetic fabrics of the La Esperanza Plutonic Complex and its mechanic significance, indicate that the magnetic features are representative of the strain conditions in the rock body during the late stages of its emplacement.

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GLACIAL AND PERIGLACIAL GEOMORPHOLOGY AND CHRONOLOGY IN THE NEVADO DE CHAÑI (CORDILLERA ORIENTAL OF JUJUY): IMPLICATIONS FOR PAST CLIMATE IN NW ARGENTINA

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The Nevado de Chañi (24º 3' 45'' S; 65º 44' 43'' W) is one of the highest picks in northwestern Argentina (5882 m.a.s.l.). It is the summit of a N-S trending mountain range located just north of the Arid Diagonal, which separates the southern Pacific westerlies from the South American Summer Monsoon domains. This range consists of Paleozoic sedimentary and metamorphic rocks intruded by Ordovician granites. It has been broadly eroded by glaciers during the Late Pleistocene but today no glaciers exist in the area and the periglacial activity takes a main role in the development of the landscape above 4600m. The orographically-driven climate conditions, with seasonal summer wet-air masses moving from the Atlantic determine that the west side is clearly dryer and probably warmer than the east faced side. These conditions determined a greater extent of the ice-masses and a lower paleo-equilibrium line altitude on the east side during the past glaciations.

Three main groups of moraines were recognized on both sides of Chañi. 62 moraine boulders were sampled from the different glacial events, ten of which were selected for a preliminary ^{10}Be surface exposure dating. Four peat bogs were cored to obtain radiocarbon minimum ages of the deglaciation. Preliminary results of ^{10}Be dates revels two main glaciations: one is pre-LGM (Last Glacial Maximum) and the other occurred during the late-glacial stage, before the Younger Dryes.

The periglacial geomorphology is mainly represented by scree activity, giving way to solifluxion and protalus lobes formation. Special attention was presented to rock glacier formation. Active, inactive, and fossil rock glaciers were distinguished taking in account geomorphological characteristics like the frontal slope and ridge and furrows preservation. The lower limit for active and inactive/fossil rock glaciers is located above ~4700m and ~4500m, respectively. Cross-cutting relation with dated moraines provides the maximum age of these geomorphic features.

Finally, our geomorphological and geochronological results allow us to propose a preliminary correlation with other glaciated areas in the arid Andes and the northern Cordillera Oriental and with lake transgression phases recorded on the southern Bolivian Altiplano during late Pleistocene.

HIGH-PRESSURE METAPELITES IN THE CORDILLERA REAL OF NORTHERN ECUADOR

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High-pressure rocks (HP, ~14 kbar at 525°C, maximum T = 560°C at P < 14 kbar) were recognized to be abundant in the basement of the Cordillera Real in central Ecuador (Massonne & Toulkeridis, 2010). The HP nature of these rocks has been related to a collisional event that occurred in Cretaceous times (Buchwaldt & Toulkeridis, 2010). Massonne & Toulkeridis (2010) proposed that an extended previously unknown microplate collided with the South American plate and was thrust under it after oceanic crust between these plates was subducted. Recent fieldwork was achieved in order to trace the boundary zone between the colliding edges of these plates by searching for additional occurrences of HP rocks in Ecuador. In the northern end of the Cordillera Real, about 50 km SW of the border to Columbia, HP metapelites, typically being rich in potassic white-mica and containing significant amounts of garnet, were found. In contrast to similar rocks located in the central Cordillera Real, we found also chloritoid enclosed in garnet inside rocks from the newly detected HP locality and, thus, another important mineral enabling us to decipher the P-T evolution of the sampled HP metapelites. For this purpose we applied the PERPLE_X software with which we constructed a P-T pseudosection for one representative sample in the system Si-Ti-Al-Fe-Mn-Mg-Ca-Na-K-O-H, contoured by isopleths for various chemical parameters of relevant metamorphic minerals. The hereby reconstructed P-T path starts at 21 kbar and 440°C compatible with the maximum Si content in phengite of 3.42 pfu in relict cores of this mineral and with x_{Mg} of chloritoid cores of 0.14 observed in the corresponding sample. Garnet growth (core: alm62.5py3.5gr22sp12) appears to have started at P-T conditions of about 18.5 kbar and 490°C. At this stage, contents of Si in phengite were 3.34 pfu. Maximum x_{Mg} of 0.17 of chloritoid points to final enclosure of this mineral in garnet at temperature of 520°C. Further rising temperatures and falling pressures are compatible with garnet compositions around alm76py8gr12.5sp3.5 intermediate between core and rim. Peak temperatures between 580 and 605°C at pressures of 7-10 kbar were determined on the basis of the garnet outermost rim composition (alm83.5py11gr4.5sp1) and the late formation of biotite and plagioclase. The Si contents of 3.09-3.15 pfu observed for rims of potassic white-mica are compatible with these P-T conditions. The P-T path outlined here is similar to that derived for metapelites of central Ecuador in terms of HP, low-temperature metamorphism and subsequent significant P decrease and T increase. Nonetheless, the here determined maximum pressures and temperatures are clearly higher.

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YOUNGER DRYAS COOLING IN THE SOUTHERN HIGH LATITUDES? INSIGHTS FROM OXYGEN ISOTOPES OF LAGUNA POTROK AIKE (PATAGONIA, ARGENTINA)

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An increased interest for palaeoclimate information from the southern hemisphere arose when improved dating of ice core and marine records suggested a re-organization of the ocean-atmosphere system during the last glacial-interglacial transition. There is evidence that ice core records from Antarctica and Greenland do neither show synchronous climate patterns during the last deglaciation nor during the last glacial cycle. Given the observed hemispheric differences of Polar Regions the question arises to which latitudes deglaciation modes can be assigned to the Antarctic or Northern Hemisphere types. Climate records from southern South America can play a key role for this paleoclimatic discussion, as Patagonia reaches further south than any other ice-free landmass. It has strong regional latitudinal and longitudinal climatic gradients and therefore allows pinpointing shifts in climatic regimes. However, previous studies disagree with regard to the question whether the Late Glacial in the southern high latitudes followed a Northern Hemispheric or an Antarctic climate mode. The deep drilling site Laguna Potrok Aike (ICDP project PASADO) in southernmost South America (52°S) offers a unique possibility to reconstruct past hydrological and west wind variability during the last 51,000 years in the Patagonian steppe. Oxygen isotopes of endogenically precipitated carbonates commonly serve as a proxy for water temperatures and lake water isotopic composition. The carbon ($\delta^{13}C_{carb}$) and oxygen ($\delta^{18}O_{carb}$) isotope records developed for core PTA-03/12+13 (obtained in the second SALSA expedition in 2003) show concurrent variations during the Holocene and the Late Glacial, a typical pattern for closed basins. Recently, more detailed isotope studies of Late Glacial samples have been carried out. These high-resolution studies clearly document a $\delta^{18}O_{carb}$ increase within the Late Glacial which occurs during the Younger Dryas chronozone (YD). Combination of these results with $\delta^{18}O$ values of lake water, inferred from $\delta^{18}O$ values of aquatic moss cellulose from the same time interval, allows an estimation of Late Glacial water temperature changes. Based on this data set water temperatures of Laguna Potrok Aike were several degrees colder during the YD than before and thereafter. Accordingly, these results imply a cooling phase equivalent and contemporaneous to the northern hemispheric YD in southernmost South America.

EVALUATION OF INFLUENCES OF THE ANTHROPIC ACTIONS ON THE PROCESS OF RUNOFF AND SEDIMENTATION IN THE WATERSHED OF LAGO PARANOÁ, BRASÍLIA, DF

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Changes in patterns of land use occupation in a watershed can cause a series of consequences on the hydrological cycle of the watershed. Within the hydrological cycle, one of the phases that is most affected by these changes is the runoff.

The runoff increasing, in turn, implies a higher occurrence of erosion, sediment transport, nutrients and pollutants into streams, rivers and reservoirs. As a result of these phenomena, silting of reservoirs may occur. Under this scenario, the *Lago Paranoá* watershed presents itself as a field that is particularly interesting because of its geographical position and urbanization, which brings weakness, in terms of quality and quantity of water, due to the intense occupation of the margins and their watershed contribution.

The main purpose of this study is to evaluate the influence of anthropic action in the processes of runoff and sedimentation in the watershed of *Lago Paranoá*, and also identify possible areas of greater contribution to the sedimentation of the lake.

For this reason, we held a multi-temporal analysis of urban land use and occupation, between 1954 and 2009, using maps generated by satellite images and aerial photos. It was also analyzed the evolution of the runoff to a simulated rainfall event (50 mm), through the curve number method. Finally, the variation in the area of water surface of *Paranoá Lake* was calculated using orthorectified aerial photos and satellite images of high spatial resolution, also orthorectified.

All results point to the hydrographic unit of the *Riacho Fundo* as the watershed that is on threat concerning the urban density and extensive population area, with high values of runoff. As a result, the silting evaluation revealed that sedimentation in the *Paranoá Lake*, supplied by this hydrographic unit, increased the loss of the Lake area.

DIMENSIONAL STONES OF URUGUAY

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Dimensional stones in Uruguay are used in architecture as facade coating, countertops, flagstone-patio, sculptures and tombstone. They are mainly represented by granitoids, marbles and slates (Comunità Economica Europea-Uruguay, no date). The granitoids have a wide range of color: absolute black, dark gray, blue gray, violet gray, red, pink, blue gray and pink, green. The fabrics also vary significantly from one granitoid to another:

- very fine grained without any structures as it is the case of the Absolute Black Dolerites (Morales Demarco et al, 2010),
- middle-grained with mafic enclaves as it happens with some gray granites,
- very coarsed-grained with parallel oriented phenocrysts as is the case of Santa Teresa Gray Granite, to mention some examples.

Uruguayan Geology is mainly divided in the crystalline basement on the south and northeast and the sedimentary basins located in the northwest of the country. Most of the dimensional stones that are commercially mined, come from the south regions of the basement. Examples are:

- the dolerites, which come from the Piedra Alta Terrane (PAT),
- the gray granites and the syenites, which come either from Nico Pérez Terrane (NPT) or from Punta del Este Terrane (PET) (Oyhantçabal et al, 2007).

Some red granites, however, are mainly found in the northeast region of NPT, for example Guazunambí and Luján Granites (Bossi & Navarro, 2001). The marbles and the slates are found exclusively in the supracrustal units of Dom Feliciano Belt. Other dimensional stones that are emerged in the local sector are yellow to orange middle-grained sandstones, which deposits are located in the sedimentary basins of northern PAT. Potentially interesting are a conglomerate unit of Dom Feliciano Belt and a fuchsite quarzite of NPT.

The granitoids have been commercially mined since the beginning of the 20th century mainly for the local and regional market. In the last decades some granitoids have been exported, as it is the case of the black granites (dolerites) and some gray granites. The marbles have been used mostly in the local market but in the last decades the sectors are experiencing difficulties to compete with the cheaper imported marbles. The slate sector suffer from similar difficulties: After it began to develop rapidly in the middle of the 20th century it is nowadays still active but with very modest annual production.

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THE OSA-GOLFO DULCE SEISMICITY, COSTA RICA: MARCH 11−14, 2009 EARTHQUAKES

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The Osa-Golfo Dulce Region, Southern Costa Rica covers a region which is prone to earthquakes due to the presence of the subduction of the Cocos Plate beneath the Panamá Microplate along the end of the Middle America Trench, and the Panama Fracture Zone (PFZ) which separates the Coco and Nazca plates. The studied area is located in a seismic zone beneath the sea floor of Golfo Dulce, at a depth between10 to 30 km. The earthquakes that we are mention in this work occurred between March 11 - 14, 2009. The first earthquake, with a magnitude of 5.8 M_W, occurred at 11:24 (local time), while the second one with a magnitude of 5.7 M_w occurred at 15:03 (local time), Between 11 and 14 March about 150 aftershocks occurred of magnitudes greater than 3.0 Richter scale, five of them had a magnitude higher than 4.0 M_L. The focal mechanisms of the mainshocks correspond to reverse faulting with a strike-slip component. The total rupture after the subduction earthquakes is about 40 km^2, sliding about 40 cm to the NNE, but the total potential rupture in the area is about 3000 km^2. There is a medium-term probability of a strong earthquake M_w 7.3 in Osa-Golfo Dulce area. The recurrence of events $M_w \geq 7.0$ is of 45 years ± 6, however, due to the geological setting of Costa Rica other important events may occur anywhere in the country before it happens. The objetive of this paper is to contribute to the study of the spatial and temporal seismicity and earthquake rupture processes in Southern Costa Rica. Understanding these processes is important for hazard prevention and risk mitigation in the studied area.

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DEVELOPMENT AND VALIDATION OF AN ANALYTICAL METHOD FOR THE DETERMINATION OF LEAD ISOPOPIC COMPOSITION USING ICP-QMS

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In the last years the development of sensitive and highly precise analytical techniques has allowed the determination of isotopic relations of Pb in diverse types of environmental and geologic materials with. The utility of ICP-QMS in Pb isotopic studies has been explored in environmental area. The main advantages of this technique make ICPQ-MS more practical to use. However, this technique has been found to be limited in both, precision and accuracy. Recently, some factors that affect the accurate and precise isotope compositions analysis such as instrumental mass bias phenomenon, have been carefully evaluated and discussed. A suitable mass bias correction procedure aims to improve measurements of accuracy and precision. The detector dead time is the time required for the detection and electronic handling of an ion pulse. The choice of the optimum dead time value was based on measuring the isotope ratio at different Pb concentrations. An internal standardization is employed to avoid instrumental drift. The objective of this study was to provide a rapid and precise analytical method to determine lead Pb isotopic composition using ICP-QMS in a routinely way. The method was validated via the analysis of reference materials.

The precision of the isotopic ratio measurement was calculated in terms of standard deviation and for all reported values, it was better than 1.3 % RSD. The estimation of the accuracy was assessed in terms of % deviation between reported and experimental results. This data are between 0.007 and 0.8216%. It is not possible to identify a trend that could indicate that certain isotopic ratio presents better accuracy values. There is also no trend in the quality of the results depending on the analyzed matrix (geologic or environmental). The better accuracy values for $^{207}Pb/^{204}Pb$ ratio were 0.056 %, and for $^{208}Pb/^{206}Pb$ ratio -0.0074 %.

The data obtained for isotopic ratio determination in this study, indicate that the optimization of instrumental and analytical parameters allowed to assess the quality assurance of the analytical methodology in terms of precision and accuracy using three standard reference materials. The obtained data show measured isotope compositions comparable with the published values Pb in these environmental and geologic materials using ICP-QMS.

EVIDENCE OF LATE JURASSIC–EARLY CRETACEOUS EXTENSIONAL TECTONICS IN CENTRAL MEXICO: FACIES ANALYSIS AND PROVENANCE OF THE MARINE SUCCESSIONS OF PEÑA DE BERNAL, QUERETARO, MEXICO

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A clastic marine succession, exposed at Peña de Bernal area, recorded an event of basement uplift and erosion during the Early Cretaceous time. The area is located at the edge of the Oaxaquia block formed by a Proterozoic grenvilleanbasement, which is the backbone of eastern Mexico. The basement of the area is made up of a Triassic-Jurassic? subduction complex, covered unconformably by volcaniclastic rocks of the San Juan de la Rosa Formation, which is intruded by coeval intermediate igneous bodies that show peperitic textures at the contacts with limestone and volcanic sandstone. Transitionally upward change to the La Peña Azul Fm. In this work we propose to separate these formations in sedimentary facies.

The San Juan de la Rosa Fm. is made up of thin-bedded limestone with sparse shale and volcanic sandstone (SJR1 facies), and volcanic sandstone and tuff interbedded with minor calcareous shale (SJR2 facies). These volcaniclastics show a detrital zircon U-Pb Lower Cretaceous age (139 M.y.) in neighboring areas. This submarine felsic volcanic event marks the initiation of the Mesozoic marine succession in the area, and is interpreted as part of the Jurassic volcanic arc in central Mexico that migrated in time and space towards the south. The San Juan de la Rosa Fm. changes transitionally upward to the La Peña Azul Fm. of Lower Cretaceous age, which is formed by calcareous debris-flows and turbidites (facies association AF1) and fine-grained sandstone (F2 facies); followed by conglomeratic sandstone, fine-grained sandstone, sandy limestone with fossil ostrea, and tuff (facies association AF4). They all recorded shallowing-upward marine sedimentation. The PeñaAzul Fm. changes transitionally upward to cherty limestone of the Tamaulipas Fm. (TS1 facies).

According to the modal analysis of sandstones, the PeñaAzul Fm. recorded uplift and erosion of the basement. They show inverted clast stratigraphy, with limestone and chert clasts (derived from litified limestone units) and volcanic clasts (derived from San Juan de la Rosa Fm.) in basal strata. Upper strata contain metamorphosed sandstone and sandstone clasts, derived from the basement.

Thus, we propose that the sedimentary basin was originated by extensional processes in submarine conditions, where local basement highs were the source of the clasts. The area was initially part of the southern Jurassic volcanic arc of central Mexico, under submarine conditions (San Juan de la Rosa Fm.) from Upper Jurassic to Lower Cretaceous time, followed by gradually cease of volcanism and continous extensional processes until Albian time (La Peña Azul Fm.). This period of horst and graben tectonics was followed by higher and more regional subsidence recorded in the TS1 facies of the Tamaulipas Formation of Albian-Cenomanian age.

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MINERAL EXPLORATION IN PERU: CHALLENGES AND THREATS FOR THE COMING YEARS

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In the last 20 years mineral exploration in Peru has been strengthened due to several factors (metal prices, political, legal and social stability, openness to capital markets, low exploration costs, increment of geological information, property access). Peru was the third largest destination of mineral exploration investment during 2009. This corresponds to 5% (512 million US$) of the total world investment and 22 % of the Latin American investment (Minerals Economics Group, 2009). Due to these facts the Peruvian country faces with big challenges as well as threats for the next future, taking in account a number of factors that will determine the viability of the exploration projects. Exploration investment has increased in recent years, but the increment in exploration activity is not as large as expected, because exploration expenses have increased tremendously too (services like geophysics and drilling, goods costs, salaries).

If Peru wants to keep a high level of investment in order to maintain leadership in exploration and consequently in mine production will be essential succeed in some challenges in the medium and long term. It is necessary to maintain and improve the legal stability, the social policy and an active state participation. Exploration strategies must be innovative on the basis of better geological models. Modern concepts have to be used and paradigms need to be discarded. Exploration methods should use modern tools and advanced technologies. This is closely related to strengthening generation of geoscientific information (a large base of information with the compulsory contribution of public and private companies) and investment in training human resources (research institutes, universities).

There are some threats and restrictions that Peru has to face and has to try to eliminate or at least to minimize. There is a rapid decline in reserves and resources, particularly in gold, where there is no evidence to expect recover or overcome of the reserves of the last 5 years. Is there an insufficient investment? There is a decrease of the number and size of discoveries, partly due to maturity of specific areas in terms of exploration. This requires search for not outcropping or blind targets (eg. Tía María and Coroccohuayco projects). The social, political, environmental, and security factors determine the investors preferences, this makes Peru less attractive than some other Latin American countries (like Chile and Mexico). Some legal restrictions (reserved areas, limited availability of land, inadequate water use legislation, etc) and insufficient availability of geological information (geophysic, geochemistry, geochronology, etc.) is a major barrier to efficient exploration programs.

The reserves and resources of tomorrow depend on the today's exploration efforts. Peru accounts with a privileged geological situation that makes it interesting for investors in terms of "geological attractiveness" (Fraser Institute, 2009), but is the geological knowledge that permits discoveries.

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THE PLUTONIC ROCKS OF THE ORDOVICIAN CORDÓN DE LILA MAGMATIC ARC IN NORTHERN CHILE

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The ordovician geology of the Cordon de Lila may be described according to two north-south trending blocks, namely the western block and the eastern block and they are divided by the Tucúcaro Fault.

In the western block it is exposed the Early Ordovician Cordón de Lila Complex formed by strongly east-west folded tholeiitic basalts, calc-alcaline dacytic to rhyolitic lavas, and turbidites. It was interpreted as an island volcanic arc. It is intruded by fine-grained pre-tectonic and post-tectonic amphibole gabro-dioritic sills and stocks. Afterwards, medium-grained tonalitic to grano-dioritic El Engaño and Pingo-Pingo Plutons were emplaced.

In the eastern block it is exposed a huge batholithic plutonic mass composed by coarse-grained monzogranites to minor syenogranites that form the Tucúcaro, Tilopozo and Tambillo Plutons. These rocks intrude a metamorphic proterozoic? basement. A roof-pendant in the Tam-billo Pluton is formed by thin remains of non-turbiditic ordovician? north-south folded sedimentary rocks intruded by sills of coarse to medium-grained amphibole gabros. Finally, the granodioritic medium-grained Choschas Pluton intruded on both blocks.

The plutonic rocks of the western block plot in the superposed fields of IAG and CAG on a petro- geochemical tectonic classification, inasmuch as the plutonic rocks of the eastern block plot in the POG and CCG superposed fields. The rocks of the Choschas Pluton plot exclusively in the IAG.

Our U-Pb dating by LA-ICP- MS in single zircons from these plutonic rocks revealed a 30 m.y. spanning of the plutonic magmatic activity within the limits of their analytical error, from 490 to 460 Ma. Although all the ages superpose within their analytical error, three peaks of plutonic magmatic activity may be suggested at: 483 Ma for the eastern block, 476 Ma for the western block and 466 Ma for the Choschas Pluton.

We suggest that both blocks of the Cordón de Lila could be two different parts of the same magmatic arc that developed upon very different kinds of crustal substrate. A peninsular paleo-geographic feature similar to the present Aulentian arc for the ordovician arc of Cordón de Lila has been already suggested by other authors. An important strike-slip displacement along the Tucú-caro Fault was probably responsible for their lateral assemblage during the Ocloyic Orogeny.

STUDY ON ATMOSPHERIC POLLUTION: MINERAL AND CHEMICAL COMPOSITION OF PARTICULATES SURROUNDING INDUSTRIES IN PIRAPORA, MINAS GERAIS, BRAZIL

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The industrial and urban development has caused an increase in the emission of atmospheric pollutant agents. The increase in the concentration of these substances in the atmosphere, its deposition in the soil, water, and vegetation is responsible for the negative impacts at local, regional, and global levels.

In the geoscience field, works indicate changes to geoenvironments correlated to particulated pollutant emissions, soil contamination by metal originated from atmospheric particulates and geochemical changes caused by mineral atmospheric pollution.

The current work aims at assessing the chemical and mineral composition of precipitated particulates in the soil and vegetation in the surroundings of iron-silicon and metallic-silicon processing industries in the region of Pirapora - MG.

The area of work is inserted in the Cerrado biome and its physiognomic gradings. The municipality has a dynamic industrial park where the main activities are Si, Iron-Si processing and textile production. The first one deserves emphasis in this study not only due to particulate pollutant emissions, but also for the extraction of basic raw materials to produce Si and Iron-Si, coal and quartz, both related to the environmental issues in the region.

The analyses were carried out by X ray diffractometry and fluorescence spectrometry which found iron oxides, calcite and quartz and determined concentrations of Fe, Ti, Al, Ca, Si.

In the area of study, the frequent atmospheric particulate emissions are associated with the soil, vegetation, and river bed contamination, as well as to the development of respiratory problems, once preliminary dust analyses pointed to problems related to a high concentration of inhaling particles and the presence of a fraction of crystaline silicon.

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GROUNDWATER GEOCHEMICAL CLASSIFICATION OF THE "CENOTES RING" COMPLEX, YUCATÁN, MÉXICO

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The Yucatan Peninsula aquifer, located at the southeast of Mexico, is mainly composed by caves, caverns, and sinkholes (cenotes) which are aligned in a circular shape called "Cenotes Ring". This geological structure acts like an "underground river" and is connected to the sea. The karstic, coastal and high permeability characteristics of this system, besides the importance of its hydrological contribution to the region, are the basis of numerous investigations at the zone.

These projects are mainly focused in the evaluation of the supply ability, as well as the classification and determination of quality and chemical composition of groundwater.

Representative samples from the 14 cenotes considered for this project were analyzed. This investigation reports: physical-chemical parameters (pH, T, EC) and the chemical composition of cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Sr^{2+}) and anions (HCO_3^{-}, SO_4^{2-}, Cl^{-}).

The results from this investigation were evaluated with different hydrogeochemical tools for classification (Piper and Stiff Diagrams, ionic relations). Data interpretation indicates that the analyzed groundwater samples are classified in three water types: Mg-Cl type, Ca-Cl type, and Mg-HCO3 type. The lack of homogeneity at the groundwater classifications may be related to the geographic features of the sampled caves (cenotes).

The location of the caves (cenotes) in relation to the coast determines the possibility of seawater intrusion. In addition, the water-rock interaction will be determined by the mineralogical composition of the hosting rock.

THE TRIASSIC–JURASSIC RIFT SYSTEM OF THE MITU GROUP IN PERU: PRELIMINARY RESULTS ON THE VOLCANOSEDIMENTARY FACIES EVOLUTION IN THE URUBAMBA VALLEY NORTHEAST OF CUZCO

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The Triassic-Jurassic Mitu Group in the Peruvian Andes represents a continental rift system at the margin of Gondwana. In the Urubamba Valley northeast of Cuzco, a Mitu succession is well exposed comprising terrestrial red beds, alkalibasaltic lava and rhyolitic to peralkaline ignimbrites. We carried out detailed field work in the area of Pallpa-Oqoruro, and measured additional sections in the Pisac and Calca areas.

In the Pallpa-Oqoruro section (POS), the unconformity between the Mitu succession and the underlying Permian marine Copacabana Beds is well exposed. The top of POS is cut off by Andean over thrusting. The sedimentary record of the POS, which measures a thickness of about 2800 m, features sheet flood deposits, fluvial sandstones, conglomerates, and fine-grained flood plain deposits. A possible eolian member in the middle POS needs reconfirmation.

In the lower 2000 m of the POS, volcanic intercalations consist mainly of alkaline basalt lava (piles up to 300 m thick). The upper 800 m of POS are dominated by thick welded phenocryst-poor ignimbrites of rhyodacitic to peralkaline composition intercalated into alluvial fan systems which are dominated by sheet flood deposits. One of these parataxitic ignimbrites reaches a thickness of over 300 m, and it can be traced at least over 35 km from the POS into the area northeast of Calca. Apparently it is the product of a major caldera-forming eruption during the late evolution of the Mitu rift in the Cuzco region. The localization of the caldera as well as of the vents that produced the alkali basaltic lava requires further fieldwork.

Classification of volcanic rocks was carried out on the base of whole rock analyses of 13 POS samples. The data indicates a general trend from the base to the top of POS, from subalkaline to alkaline compositions.

The investigated part of the Mitu rift displays coarsening upward sedimentation from fluvial to alluvial fan facies. This progradational trend might be related to uplift of intra-basinal blocks or to a local transpressive tectonic regime. At the same time, magmatism evolved towards a more alkaline and SiO_2-rich composition and volcanic mode switched from effusive to explosive activity.

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A NEW SPECIES OF *PLATYPTERYGIUS* OR A MORPHOLOGIC VARIATION?

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The Early Cretaceous ichthyosaurs graveyard at the Tyndall Glacier in the Parque Nacional Torres del Paine, South Chile, is an outstanding locality both nation and worldwide. During two field campaigns in the years 2009 and 2010 46 articulated and semi-articulated ichthyosaur skeletons were discovered, comprising adults, juveniles, babies and embryos. The majority of the ichthyosaur specimens preserve diagnostic features permitting their identification to species level. Until now three different ichthyosaur species were identified in the field: *Platypterygius hauthali* (v. Huene, 1927) (Pardo et al. 2010 in review), *?Caypullisaurus bonapartei* Fernández, 1997 and a specimen of *Platypterygius* which have been preserved the forefin complete but disjointed from the rest of his body. This specimen shows features that are not observed in *Platypterygius* species. Nevertheless, some factors such as the few amount of each species of *Platypterygius*, the poor state of conservation of most of them and the morphologic variability among individuals of a population, which is in part determinated by environmental parameters; make difficult a certain and complete taxonomic identification.

The highly amount and well preservation of the Tyndall ichthyosaur graveyard is tremendously important for the understanding of the diversity of paleocommunities of ichthyosaurs during the Early Cretaceous and will throw new lights on the evolutionary history of Cretaceous ichthyosaurs prior to their final extinction at the beginning of the Late Cretaceous. The abundance of near complete articulated ichthyosaur skeletons in the Tyndall area suggests mass mortalities caused by high-energy mudflows travelling down along submarine canyons. The ichthyosaurs were either caught directly by these mudflows or were dragged down into the abyss by the suction wave behind them. Their bodies ended up in an abyssal anoxic environment and were rapidly covered by fine sediment, which explains the excellent preservation.

ISOTOPIC FEATURES OF THE GEOTHERMAL AQUIFER OF DECEPTION ISLAND, SOUTH SHETLAND ISLANDS, ANTARCTICA

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Deception Island is an active volcano in the Bransfield Strait sited in a marginal basin between the Antarctic Peninsula and the South Shetland Islands. Several ages had been proposed for its origin, based just on the stratigraphy 5 Ma, on palaeomagnetic studies by Valencio et al. (1979) the age is related to the Bruhnes cycle, which means 780.000 years. Keller et al. (1991) on K/Ar ages presented an age of 153.000 ± 46 years. Evolutive studies based on isotopes were developed by Parica et al. (1990), Ortíz Ramis, et al. (1987).

For a better interpretation of the geothermal aquifer, several streams, fumaroles, sea water, snow and ice, and glassy rocks were sampled for different isotopic analyses, $\delta^{18}O$, $\delta^{2}H$ and $^{87}Sr/^{86}Sr$.

The interaction in the volcanic system is clear, access of sea water to the geothermal aquifer, also fresh water in lesser proportions. Everything has the isotopic signature to understand the interaction. The glassy rocks, also are representative of the presence of sea water in the geothermal aquifer, when the glass is dry has $^{87}Sr/^{86}Sr$ typical for these rocks and origin (0.7031 and 0.7032), but in hydrated glasses the $^{87}Sr/^{86}Sr$ ratios the sea water signature were recognized (0.7093). Some others chemistry (Cl^-) and isotopic analysis by Dapeña et al. (2005) were also useful to understand the dynamic of this volcano.

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THE PALAEOENVIRONMENT OF BYERS PENINSULA, SOUTH SHETLAND ISLANDS, ANTARCTICA

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Byers Peninsula exposes marine outcrops of Jurassic times with deep marine deposits (Anchorage Formation). After a transitional period, a non marine regime took place in cretaceous times, established near 130 Ma and dated on volcanic rocks emplaced in a continental environment (Parica et al., 2007).

The outcrops of several basaltic and basandesitic lava flows with columnar junction are representative of water presence. Former papers from other authors considered these structures as subvolcanic bodies (Cerro Negro, Clark Nunatak and others).

This non marine basin is ferns rich and a strong volcanism marked the features since the Cretaceous to Tertiary. Based on the study of sedimentary rocks and their structures a seasonal regime, with rainfalls, and high energy environment could be defined, inferred. Sedimentary rocks and their structures are typical of a seasonal regime, with rainfalls, and high energy environment The carbonate deposits in lagoons were the tool to apply stable isotopes studies ($\delta^{18}O$ for palaeotemperatures, and $\delta^{13}C$ for environment). Anyway, some peperitic breccias in the Ratón Hill suggest the simultaneity in shorts distances of sea water and fresh water in the non marine environment.

Data from the analyzed samples have values for $\delta^{13}C$ since -10.6 to -15.9‰ and $\delta^{18}O$ de 0.5 a -2.8‰. These sensitive data confirm the non marine regime for the deposited carbonates, and the equilibrium rank of temperatures was established in between 15 to 20°C. The upper Mesozoic and Tertiary environmental setting is determined by the palaeoflora, sedimentary features and the stable isotopes analytical data (Parica, 2008). Some of the family ferns determined still continue alive in the Patagonian Andean forests (Cesari et al., 1998).

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HIGH RESOLUTION, TRUE COLOR TOMOGRAPHY OF LOW DENSITY CONTRAST SAMPLES BASED ON SEMI-AUTOMATIC SERIAL GRINDING

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The tomography of fossils is based on the production of numerous sequential high resolution pictures (tomograms) that form the base for a later three dimensional evaluation. X-ray CT proved to be the most successful method in tomography but has limitations in low density contrast samples (e.g. carbonate shells in limestone). Here, we describe a technique that can produce high resolution, true color images in limestone samples.

The method is based on automatic serial grinding and serial scanning. The working process starts with embedding the samples in a mold with epoxide resin. The hardened block is then polished by a precision surface grinding machine. After each polishing step, the surface is scanned in a water quench by a custom built high resolution scanner. This method provides a maximum resolution of 2400 dpi (horizontally) and 10 µm (vertically). Sample sizes can vary between 1 mm^3 and 15 x 15 x 30 cm. The productivity of this method is 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 color and high resolution tomograms, capability of processing samples of various sizes, as well as multiple samples in one block. Apart from 3D shape reconstruction of fossils, sedimentary structures, fractures and porosity; the outstanding image quality makes even new applications possible such as the quantitative evaluation of paleobiological entities in reefs (e.g. spat density), or volume based calcite / aragonite ratio measurements, among others.

KARAKASCHICERAS IN VALANGINIAN DEPOSITS OF CHÍQUIZA NEAR VILLA DE LEYVA (BOYACÁ, COLOMBIA)

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Near Villa de Leyva (Boyacá Province) to the NNW of Bogotá are present the Arcabuco (upper Jurassic – ? lower Cretaceous), Cumbre (Berriassian), Rosablanca (Valanginian - ? lower Hauterivian), Ritoque (Hauterivian), Paja (upper Hauterivian – Aptian), Lower and Upper San Gil (Albian) formations.

Different publications and geological maps recognize only the Arcabuco, Ritoque, Paja, Lower and Upper San Gil formations related to the Arcabuco Anticline because an eastward deposit thinning that can indicate the absence of the Cumbre and Rosablanca deposits. The thinning of the deposit was controlled toward the ancestral Boyacá paleofault.

East of Villa de Leyva, in Chíquiza, along the eastern flank of the Arcabuco Anticline, equinoids, bivalves and ammonites were found into calcareous beds. Some authors assigned these deposits to the Hauterivian Ritoque Formation because its thin calcareous intercalations, however, the fossil age according to *Karakaschiceras* indicates deposits of the Rosablanca Formation.

The primary finding and identification of *Karakaschiceras* into limestone beds in Chíquiza near Villa de Leyva confirms the existence of Valanginian deposits to this area as it was before proposed.

Valanginian ammonites were recovered into limestone deposits of the Rosablanca Formation but to the W and NW of Villa de Leyva, where this lithostratigraphic unit shows thick and very good outcrops.

Karakaschiceras was reported already in Colombia but this is the first illustration of a Colombian exemplar. This genus is also present in Argentina, Bulgaria, Caucasus, Crimea, England, France, Germany, Himalayas, Madagascar, Mexico, Morocco, Poland, Romania, Spain, Switzerland and USA (Texas).

ON SOME ALBIAN AMMONITES OF THE HILÓ FORMATION, PACHO (CUNDINAMARCA, COLOMBIA)

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The Hauterivian – Coniacian Villeta Group to the west of Bogotá includes the Trincheras (Hauterivian – Aptian), Socotá (Aptian), Capotes (Albian), Hiló (Albian), Pacho (Cenomanian), La Frontera (?Cenomanian – Turonian) and "Conejo" (Turonian – Coniacian) formations.

The Hiló Formation is an Albian lithostratigraphic unit that overlies Albian deposits of the Capotes Formation and underlies the Cenomanian Pacho Formation. The transgressive deposits of the Hiló Formation are constituted by black shales, silicified mudstones and calcareous beds. Also, on the lower Hiló Formation is common the occurrence of biomicrites and biosparites with chaotic framework. This level in some places as in Pacho (Cundinamarca province) has iron enrichment. Bivalves with thick ornaments, thick shell and ammonites (e.g. *Tegoceras*) are present. Moreover, on the middle and upper part of the Hilo Formation appear black shales and silicified mudstones. Principally are present crushed, short and thin bivalves, and crushed ammonites with attached cirripeds (*Stramentum* not *Loricula*).

Mojsisovicziids are the most abundant fossils (e.g. *Oxytropidoceras Venezoliceras*), and heteromorphs (e.g. *Protanisoceras* (*Torquistylus*).

The most recent geological cartography of INGEOMINAS (Colombian Geological Survey) near Pacho (Cundinamarca province) includes some deposits of the Hiló Formation as the Pacho Formation ("Limolitas de Pacho") that represents a Cenomanian age.

This situation reflects that the lithostratigraphy and biostratigraphy were not carefully considered because the presence of Albian fossils and deposits was already reported to this area in different publications and geological maps.

AMMONITE AND INOCERAMID EVIDENCE FOR AN EARLY TURONIAN (CRETACEOUS) AGE OF THE BASE OF THE LOMA GORDA FORMATION IN THE UPPER MAGDALENA VALLEY BASIN, SOUTH-WESTERN COLOMBIA

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The section studied is located along Bambucá Creek, north-west of the town of Aipe, Department of Huila, south-western Colombia. The rocks form part of the Aptian–Maastrichtian (Cretaceous) succession exposed on the western flank of the Media Luna Syncline in the Upper Magdalena Valley Basin. In this area the syncline is affected by local faulting and intersected toward the south by the Chusma Fault System.

The Turonian–Coniacian Loma Gorda Formation is well exposed in the basin. The formation rests on the Cenomanian Hondita Formation and underlies the Santonian cherts of the Oliní Group. Along Bambucá Creek, the Loma Gorda Formation reaches a thickness of 245 m and is informally divided into three members. The boundary between the Hondita shales and the Loma Gorda biomicrites is sharp, reflecting a transgressive event with an increasing abundance of micro- and macrofossils.

The lower member of the Loma Gorda Formation consists of a 99-m-thick succession of alternating micrites, biomicrites and black calcareous mudstones of varying thicknesses. The mudstones contain fossiliferous carbonate concretions. Near the base of the lower member there occur scattered phosphatic fragments, shark teeth and wood fragments. Approximately 6 m above the base, the ammonites *Fagesia* cf. *thevestensis* (Peron, 1896) and *Neoptychites* cf. *andinus* (Leanza, 1967), the inoceramid bivalves *Mytiloides kossmati* (Heinz, 1933) and *M*. *goppelnensis* (Badillet & Sornay, 1980) and the bivalve *Anomia* sp. were collected. The ammonites and inoceramids indicate an early Turonian age for the base of the Loma Gorda Formation.

The recommended stratigraphic nomenclature for the Aptian–Maastrichtian succession of the Upper Magdalena Valley Basin comprises the Yaví, Caballos, Tetuán, Hondita and Loma Gorda formations, the Oliní Group, and the Buscavidas and La Tabla formations. However, in internal reports of petroleum companies and in some publications and geological maps an alternative nomenclature usage can be found (Villeta Group or Formation, Bambucá shale, La Luna Formation, Monserrate Formation, etc.), which may lead to stratigraphical problems and confusions. The Loma Gorda Formation studied here is approximately equivalent to the La Luna Formation of Venezuela.

ALBIAN AMMONITES AND DECAPODS OF THE SIMITÍ FORMATION NEAR VÉLEZ (SANTANDER, COLOMBIA)

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The Simití Formation is a lithostratigraphic unit of the Middle Magdalena Valley in Colombia, which overlies the Tablazo Formation into the Cundinamarca Basin (Tablazo – Magdalena subbasin). Its equivalent in the Villa de Leyva area near Vélez is the Upper San Gil Formation that overlies the Lower San Gil Formation.

Biosparites, biomicrites and principally black shales are characteristic of the Simití Formation of Albian age near Vélez (Santander Province), NNW of Bogotá.

Some beds show mechanical accumulation and fossil fragmentation, other beds contain flattened fossils of ammonites, bivalves, gastropods, decapods and foraminifers.

Ammonites as *Platiknemiceras*, *Engonoceras*, *Parengonoceras*, *Douvilleiceras*, *Carloscaceresiceras* and *Eubrancoceras* or *Hysteroceras* were found near the decapod *Meyeria*. This association indicates a lower or middle Albian age.

Meyeria was already reported in Colombia together with Aptian cephalopods (Heminautilus, *Kutatisites* and *Cheloniceras*) to the southwest of Bogota in the Upper Magdalena Valley subbasin associated to initial offshore deposits because the progressive marine advance to the south of the basin.

BENTHIC FORAMINIFERAL BIOSTRATIGRAPHY OF NORTHERN SOUTH AMERICA: PROBLEMS AND PERSPECTIVES

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Benthic foraminifera in the Lower Cretaceous sediments had showed their importance as biostratigraphic tools because their worldwide distribution (e.g. Bettenstadt and Wicher 1955), similar stratigraphic positions (e.g. Bartenstein 1979) and their correlation with other stratigraphic tools (e.g. ammonites).

The study of the sediments of Lower Cretaceous age in northern South America had allowed the description of important benthic foraminifera assemblages specifically in Trinidad (e.g. Bartenstein et al. 1957) and eastern Venezuela (Guillaume et al. 1972). However, the thick sedimentary sequences of western Venezuela and Colombia had been systematically discarded to foraminiferal studies, including regional works such as Bolli et al (1994) with few exceptions (e.g. Petters 1954; Rod and Maync 1954).

This work illustrates new reports of the benthic foraminifera *Epistomina caracolla* joined of the ammonite genus *Pseudohaploceras*, *Pedioceras*, *Nicklesia*, *Pulchellia* and *Karsteniceras* in several localities in Colombia with an age designation of early Barremian. This new data allow us the discussion of the biostratigraphy based on benthic foraminifera and achieve us to illustrate a “state of art” of these schemes. Some interesting contradictions in the stratigraphic ranges of the foraminifera and the future “work to do” in the area are discussed too.

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LONG-TERM THERMAL AND EXHUMATION EVOLUTION OF THE CHARAGUA RANGE, REVEALED BY FISSION-TRACK DATASETS, SOUTHERN SUBANDEAN REGION, BOLIVIA

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During the last years, the study of fold and thrust belts by the petroleum industry has been driven by the application of new and more precise analytical techniques. One of the most important goals is to know the exhumation histroy of the different mountain ranges during the evolution of the fold and thrust belt. The Charagua Range is part of the southern bolivian subandean area. It has been structured during the formation of the Central Andes. This range constitute of asymmetrical and symmetrical anticlines, with N-S trending direction.

We present the first thermochronological data revealed by apatite fission-track technique on samples from a stratigraphical sequence of Middle Paleozoic, Mesozoic, Paleogene to Neogene age. Ten apatite fission-track analysis (AFT) have been made in these sequences. AFT data results, and AFT t-T modeling, combined with Charagua Range architecture and lithostratigraphy, helped to identify at least two burial–exhumation events thattook place simultaneously with tectonic deformation in the Southern Subandean region of Bolivia.

According to the samples studied, a thermal subsidence interval linked to the development of a passive margin related basins took place in Carboniferous to Devonian time. During the early break-up of the Atlantic Ocean, an oblique extensional tectonic setting developed inland, causing the opening of grabens and the differential exhumation of certain blocks giving place to the development of basins shoulders. Carboniferous and Devonian sequences analysed in Charagua would have been partially exhumed from about 280 Ma until Jurassic deposition, causing the erosion of the upper part of the sequence. This Paleogeographic evolution is verified in the stratigraphic column of Charagua Range, by a Permian to Triassic hiatus. During the Triassic, the Grupo Cuevo basin is filled, closed, and aborted. During the Jurassic, a widespread desert environment is developed. It is represented by fluvioeolian deposits of Grupo Tacuru.

The following cycle corresponds to the filling and burial of sediments linked to the foreland basins system, during the Paleogene, since the Eocen. According to AFT data, a first exhumation stage occur in the Late Paleogene. At the same time the Andean peripheral bulge deformation started and continued with the migration of the orogenic front to the east.

Thus, according to the thermocronological results and the AFT T-t modeling, two exhumation events occur in the Charagua Anticline. These events are important for the understanding of the life of the hydrocarbon system in the associated to fold and thrust belts in Central Andes.

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DETERMINING THE BEHAVIOR OF LANTHANIDE IN LEACHING EXPERIMENTS OF MINE WASTE IN MEXICO: EVALUATION OF ITS USE FOR IDENTIFYING POLLUTION SOURCES

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During the last decade, the study of lanthanides in acid mine drainage has been used to identify processes that control rock-water interaction. These resulted in the use of lanthanides as tracers of anthropogenic impact on mining areas.

This work presents the comparison of distribution patterns of lanthanides in mining wastes and their corresponding solutions generated in batch experiments. For this work, 18 different samples of mining wastes were collected in 4 different mining districts of Mexico located in Taxco (Guerrero), Real del Angel (Zacatecas), Charcas (San Luis Potosi) and Zimapan (Hidalgo). The batch experiments were conducted at different time, pH conditions and chloride concentrations. Concentrations of lanthanides were determined by ICP-MS. In order to relate the behavior of lanthanides in solution with the main mineral phase present in the mine waste, we identified minerals using X-Ray Diffraction.

The results suggest that the behavior of the lanthanides in leachates depends on the mineralogical composition of mining waste and their degree of oxidation. Based on the mineralogy, lanthanide patterns are classified into two different groups. The Group I is constituted by the oxidized residues with gypsum as the dominant mineral phase. The lanthanide patterns of this group are similar to their corresponding residues. The Group II consists of residues that lack oxidation and calcite is the main mineral. The lanthanide patterns of leachates from this group are different from their corresponding original waste and show enrichment of heavy REE. This indicates that calcite acts as an inhibitor in the release of lanthanides.

We observe that the pH of leachates is controlled by the mineralogy of the mine waste and is independent of pH initially adjusted in the process of batch experiment. The Group I of leachates with gypsum as dominant mineral has a pH around 3, whereas the Group II shows pH between 6 and 7. We also note that lanthanide behavior is not affected by the changing conditions of the leaching processes.

RECONNAISSANCE GEOLOGY OF ISLA MARIA MADRE, MEXICO: CARTOGRAPHY, STRATIGRAPHY, AND GEOCHEMISTRY

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Islas Marias Archipelago is located 110 Km NW of San Blas, Nayarit, between latitudes 21°51'N/21°48'N and longitudes 106°80'W/106°40'W in the mouth of the Gulf of California. The archipelago is formed by San Juanito, Maria Madre, Maria Magdalena and Maria Cleofas islands. These islands are of special importance because their location represents a key point for paleogeographic reconstructions of northwestern Mexico and the tectonic evolution of Baja California Peninsula. Maria Madre is the largest island and covers an area of 145 Km^2. We carried out geological mapping and identified the major lithologies of the island. Field observations suggest that the oldest basement rocks are exposed in the western part as a plutonic-metamorphic assemblage which we called "Papelillo Complex". This complex includes folded and banded orthogneiss and metasedimentary units as well as garnet-bearing calc-silicates in close association to intermediate-silicic plutonic rocks (61.72-73.51 wt. % SiO_2). We performed U-Pb zircon geochronology (MC-LA-ICPMS) from another granitic body at the SW coast yielding a crystallization age of 84.2 ± 1.8 Ma (1σ) with some inherited components of 104.0 +6.7/-3.7 Ma (1σ). No older components were found. The crystalline basement is partly covered by diverse volcanic units, which are widely distributed in the central and northern part of the island and are represented by old strained, fractured and often hydrothermally altered lava flows, pyroclastic deposits, and massive unaltered lava flows. The composition of the volcanic units ranges from andesite to rhyolite (52.61-72.04% SiO_2). The top of the stratigraphic column of Maria Madre Island consists of Miocene to Pleistocene sedimentary rocks such as slightly folded and faulted non-marine and shallow marine sequences that are overlain by an undeformed marine sedimentary sequence. Single zircon U-Pb ages from the shallow marine sequence yielded peaks at 84.0 +1.2/-2.2 Ma and 103.4 +2.6/-2.0 Ma, which are identical to the obtained granite ages. Geological, geochemical, and geochronogical data of Maria Madre Island suggest a common magmatic activity with rocks of southern Baja California (Los Cabos Block) and the Mexican continental margin between Sinaloa and Jalisco. María Madre Archipelago forms part of the southward continuation of the Cordilleran range that extends from North America to the Isthmus of Tehuantepec.

SOTARÁ VOLCANIC COMPLEX (SVC), COLOMBIA: ASSOCIATED STRUCTURES

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The SVC is located in the Central Cordillera of Colombia (2°06´ N, 76°35´ W), on the border between Cauca and Huila States, some 37 km SW of Popayán city (Cauca) and 400 km SW of Bogotá city. There are several indigenous and peasant populations located around it, as they are Río Blanco (9 km W), Guachicono (11 km SW), Chapa (11 km NW), Paispamba (15 km N) and Paletará (15 km NE), all of them with about 5,000 inhabitants in total. The major drainages around the volcano are the Quilcacé river and Flautas gorge at NW, Blanco, Negro and Guachicono rivers at W-SW and Majuas river at SE, which would be capable of carrying large debris flows through their channels to populated areas located in lower lands.

Sotará Volcanic Complex (CVS) includes the remnants of an ancient stratovolcano (Pre-Sotará) on which other three eruptive centers and the Sotará volcano, were built. The ancient stratovolcano (Pre-Sotará) evolved to a Calderic state leaving an opening of about 6 km in diameter. On the N flank of the Pre-Sotará building the eruptive centers Cerro Negro (3,760 m.a.s.l.) and Cerro Azafatudo (3,420 m.a.s.l.) were developed, while the Cerro Gordo (3,925 m.a.s.l.) and Sotará (4,420 m.a.s.l.) volcanoes represent a resurgent post caldera collapse volcanism, where the first one was built on the S edge and the second one, inside the caldera. Pre-Sotará volcano has associated interbeded ignimbrite and lava flow deposits, ash falls and at least one welded block and ash flow deposit, as well as huge debris flows and debris avalanche deposits. The generation of some large volume ignimbrites caused destruction of the volcano and formation of the caldera, but only a few remnants of it are currently found. Cerro Negro and Azafatudo volcanoes have generated lava flows, some pyroclastic density current deposits and lava domes, being obsidians those of Azafatudo volcano. Cerro Gordo produced lava flows and lava domes and the youngest of them, the Sotará active volcano, was developed in three stages in a concentric way, characterized by lava dome construction and destruction that led to the production of pyroclastic density currents, as well as the generation of some block lava flows. The last stage (III) of Sotará volcano is represented by a dome complex that has the highest altitude and was developed inside 1 km in diameter crater of a collapsed cone of the Stage II. There are not records of historic eruptions for Sotará volcano and its current activity is manifested by a low seismic activity and the presence, in the upper part, of fumarolic fields in the S sector, on the heads of Majuas river and hot springs in the W zone, on the heads of the Blanco river. Additionally, the deposits associated to the Stage III are very preserved in morphology.

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GEOLOGY OF THE COASTAL RANGE, BIOBÍO REGION, CHILE

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The area of research is located in the wets part of Chilean Coastal range, Concepción Province, Biobío Region, between 36º30'-37º15' S and 72°45'-73°13' W. the oldest rocks are metamorphic, that the protolite correspond to continental sediment from the Silurian, corresponding to turbiditic sequence from the "Serie Oriental" Metamorphic Basement, that constitutes an accretionary prism formed by metapsammites and metapelites (phyllite, slate, schist and andalusite). The accretion, basal type, is characterized by a complex internal dynamics of the prism coincides with the formation of a large magmatic arc, whose expression is the batholith of the Coast (Carboniferous-Permian). This intrusion caused contact metamorphism regional Buchan type, with a zoning of WE: Biotite (furthest from the intrusive), Andalusite and Sillimanite. In some sectors there migmatites in contact with the intrusive.

Some authors suggest that the Permian there is a change in the dynamic prism tectonics leads to erosion of large amounts of material, probably correspond to the pelitic rocks are characterized by very low grade metamorphism, distributed in several areas, primarily south of the Bio Bio River in Patagual area on the "Serie Oriental". In the Middle-Upper Triassic boundary reactivation of inherited structures give rise to Paleozoic Basin Biobío whose associated rocks are part of the Santa Juana Formation, assigned to the Late Triassic, characterized by the presence of rivers, lakes, foothills deposits with some marine transgressions. The paleoflora present at the Santa Juana is associated with the Paso Flores Formation of S in Argentina. During the Upper Triassic is possible to recognize different magma pulses along the coast of Chile including the Stock Hualpén and Constitution Granite (225-220 My). The Quiriquina Formation (Maastrichtian) is a fossiliferous marine sequence that includes a basal conglomerate and glauconitic sandstone with calcareous sandstone levels, deposited in unconformity over the metamorphic and granitic basement. Overlying these sediments is the Curanilahue Formation (Paleocene) which is continental sequence with marine intercalations, characterized by the presence of some levels of carbonaceous siltstone and coal. In disconformity is overlying polimitic conglomerates of Andalién Formation (Pliocene). Covering all of the previously formations are the modern deposits of Pleistocene-Holocene, which form the Punta de Parra siliceous terraces and Huachipato Formation, also of Modern unconsolidated deposits, which consist of beach sands, filled plains due to river action, arranged sub-horizontal covering the previous sequences.

RARE EARTH ELEMENT GEOCHEMISTRY OF LATE QUATERNARY LACUSTRINE SEDIMENTS FROM THE CHIHUAHUA DESERT, NORTHWEST MEXICO

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A 976 cm long sediment core was collected from the central-eastern part of paleo-lake Babicora (western Chihuahua Desert) using a Eijelkamp soil corer in order to register the orbital and millennial scale paleo-climatic events using high resolution geochemical data. Radiocarbon dates assign ages of 28,960±230 and 34,520±440 years at depths of 273 cm and 375 cm, respectively. The base of the sequence was assigned an age of 72 cal kyr BP by assuming a constant sedimentation rate for rest of the sequence. We present rare earth element (REE) geochemistry of sediments from the paleolake and rocks exposed in the surroundings to understand the provenance of the lacustrine deposits. REE concentrations were measured in 25 sediments along the core and 5 rock samples. Sediments were divided into two different regimes of deposition: drier conditions with aeolian activities and humid conditions with higher inflow. Sediments from drier regimes are characterized by lower TiO_2, chemical index of alteration (CIA) and higher Zr/Al_2O_3 and Sr. Similarly, sediments from humid regimes are characterized by higher TiO_2, CIA and lower Zr/Al_2O_3 and Sr. Sediments of both regimes show similar REE systematic (Drier regime: TREE = 145 – 259 ppm, LREE = 125 – 232 ppm, HREE = 17 – 24 ppm, $(La/Sm)_N$ = 2.4 – 4.3, $(Gd/Yb)_N$ = 1.6 – 2.2 and Eu/Eu* = 0.6 – 0.8; Humid regime: TREE = 136 – 241 ppm, LREE = 117 – 216 ppm, HREE = 16 – 23 ppm, $(La/Sm)_N$ = 2.3 – 4.2, $(Gd/Yb)_N$ = 1.6 – 2.1, Eu/Eu* = 0.6 – 0.8). This suggests that the basin received sediments from erosion of similar rocks by pluvial and aeolian processes during both arid and humid regimes. However, chondrite normalized fractionations of light REE, heavy REE and Eu anomalies distribute the lacustrine sediments into three different groups and indicate inflow mainly from south-eastern and western catchments into the basin. The first group of sediments shows REE characteristics similar to Paleogene andesite and rhyolite, exposed in the south-eastern part of the basin. The second group has similarities with andesite and trachy-andesite, present in the western part. The third group suggests influence of rocks exposed both at south-eastern and western part. This varying provenance and hence inflow might be as a result of changing wind patterns and rainfall regimes throughout the Late Pleistocene ± Holocene.

GEOLOGICAL RECORD OF GONDWANA RELATED ORIGIN OF PALEOZOIC UNITS IN NE MEXICO: GRANJENO SCHIST

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The basement under the nearly 3,000 m thick sedimentary sequence of the Sierra Madre Oriental (SMO) is exposed in the Huizachal-Peregrina Anticlinorium (HPA), Miquihuana and Bustamante (Tamaulipas) and in the Aramberri Uplift (AU, Nuevo Leon). The Neoproterozoic to Permian basement comprises among other units the Granjeno Schist (GS). The aim of this work is to present data and interpretations of the most important areas where GS is present: Caballeros Canyon (HPA) and Aramberri Uplift (AU).

In Caballeros Canyon (CC) GS outcrops massive, black to gray, with interstratifications of pelitic to psammitic lithologies. The mineralogical assemblage is dominated by quartz, muscovite, albite, graphite, chlorite, tourmaline, and minor biotite. The pelitic levels are strongly deformed, while the psammitic beds are more competent and display brittle deformation. Quartz segregations are more abundant in the pelitic levels, where they are parallel to the main schistosity and commonly folded, recording the deformation phases. At least four events are preserved: three schistosities with 150/55, 320/60, 99/58° and a mesoscopic folding trending 240/54°. AU shows massive schists that vary from gray to greenish, greenish to black, and red to greenish tonalities. The lithology is dominated by phyllite, quartzphyllite, talc schist, soapstone, metashale, metagraywacke, metavolcanic and metadiabase rocks. Metapillows are also present. They develop more quartz segregations, is less deformed, more competent and more fractured than GS in CC. On the other hand the metamorphic grade is lower in AU. The main schistosity trends 330/20° NE-SW.

AU represents a more complex unit than CC, where the lithology is much more constant. In CC GS protoliths were deposited in a deep basin along a distal acretional prism. On the other hand AU involves mafic-ultramafic, siliciclastic and volcanic lithologies. In both cases these protoliths were originated in a forearc basin. Zr ages indicate Grenvillean (1250-920 Ma) and Panafrican (730-530 Ma) source areas (Barboza et al., 2011). Zr samples related to the Northamerican craton were not detected. The metamorphism during Late Paleozoic (≈ 330±30 Ma) could be related to the subduction along the western margin of Gondwana (Granjeno-Acatlán Belt), following the Laurentia-Gondwana collision. After the Pangea breakup this exotic terrane remained as part of the basement, covered later by the Mesozoic sedimentary sequence of the SMO. This sequence was deformed during the Tertiary by the Laramide Orogeny.

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EVOLUTION OF THE ANDEAN OROGENIC FRONT SOUTH OF BARILOCHE AREA, ÑIRIHUAU BASIN AND EL MAITÉN BELT (~42º S)

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A field study of the Ñirihuau basin, nearby the El Maitén range, between the 42º00´S and the 42º20´S, has revealed new stratigraphic relationships. The structural analysis of this Andean segment, allowed a new interpretation of the tectonic setting of these Patagonian foothills.

The stratigraphic sequence consists of four units: The base is represented by the Oligocene Ventana Formation, formed mainly by andesitic volcanic and pyroclastic rocks. The sandstones of the Ñirihuau Formation of ~22-17 Ma rest in general conformably on the previously described volcanic piles (González Bonorino, 1973). Paredes et al. (2009) differentiated a series of lithofacies associations in stratigraphical order in the northern part of this basin. We identified a series of sections, circumscribed to the southern part of the basin that can be compared to the ones described to the north. These sequences are exhumed at the eastern slope of the El Maitén range corresponding to the Cushamen fold and thrust belt. In the western sector an east-verging thick-skinned structure is dismembered by a series of synthetic-to the main thrust front structures, affected by a series of west-verging backthrusts developed in the back limb.

In the eastern sector, four sets of progressive unconformities from the base to the top of the Ñirihuau Formation and the base of the Collón Curá Formation were recognized. These findings imply that this basement structure was created at the time of both Ñirihuau and Collón Curá sedimentation at the foothills and therefore that these constitute remnants of a proximal foreland basin. These progressive unconformities are typically found at the fold and thrust belt top wedge, implying that the early to late Miocene orogenic front was located in the El Maitén range. Based on these findings, four pulses of contractional deformation are proposed for the fold and thrust belt at these latitudes coetaneous to the sedimentation of the Ñirihuau and the base of the Collón Cura Formations (>22 to ~15 Ma), implying a mechanism of subsidence associated with orogenic loading of the El Maiten range.

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INTRUSION-RELATED GOLD MINERALIZATION IN THE GALAN VOLCANIC COMPLEX (SOUTHWEST BOLIVIA) AND EXPLORATION MODEL FOR THE CENTRAL ANDES

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The Galan Volcanic Complex (GVC) in SW Bolivia is of middle Miocene age (14.6 ± 0.5 Ma; Lema and Ramos Collorana, 1997) and is part of the Central Andean tin belt. The GVC has features which suggest an intrusion related gold system (IRGS) (Ramos Collorana, 2006). The main criteria are presented and compared to the IRGS model of Lang and Baker (2001).

The basement of the GVC consists of Ordovician and Cenozoic sedimentary rocks. The stratovolcanic edifice consists of ignimbrites, lavas, subvolcanic stocks and volcanic domes of dacitic to andesitic composition. It is cut by EW- and NS-trending dykes of granodioritic composition. Chemical analysis show that the rocks are near the metaluminous to peraluminous boundary, and belong to the calc-alkaline high-potassium series. The Fe_2O_3/FeO ratio varies (0.09 – 2.51).

The associated ore deposits are mainly of vein-type (E-W strike, N or S dip, up to 1500 m), with the polymetallic association of W, Bi, Pb, Zn, Ag, Au and minor Sn. The main economic ore minerals are wolframite (hubnerite), bismuth, bismuthinite, galena, sphalerite, fahlore. Tenors of Au in veins up to 1450 ppb Au (10 background). The main gangue minerals are pyrite, quartz and hematite. The mineralization presents a lateral and vertical zonation. The fluid inclusions are L-V-S and L-V types, the homogenization temperatures in quartz are up to 450°C, and in sphalerite up to 170-265°C. The salinities range from <25 wt% up to 50 wt% in NaCl equivalent. The regional alteration consists of propylitization, with tourmalinization and silicification in the central part. Kaolinite and sericite alteration is restricted to halos around veins.

The GCV is proposed to represent the shallow part of the IRGS exploration model. This model includes the Tasna and Kori Kollo deposits (Lang & Baker, 2001). The exploration criteria and their application to the Central Andes relate to the Sn-W belt as expressed in the tectonic environment, magmatism of intermediate character, W, Bi, Sn, Au ± As metal association, and a lateral and vertical zonation linked to mineralization and alteration style.

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VOLCANIC CENTRES IN THE ALTA SIERRA OF SOMÚN CURÁ AND SURROUNDINGS, PATAGONIA, ARGENTINA

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The Oligocene Somún Curá basaltic plateau covers a large area in the north of the Extra-Andean Argentine Patagonia. The mostly Miocene post-plateau volcanic associations are distributed over the plateau either as bimodal volcanic complexes (Salani et al., 2008) or as monogenetic basaltic centres. Alta Sierra of Somún Curá (ASVC) is the youngest bimodal volcanic complex; it shows a typical alkaline basalt-trachyte association of intraplate geochemistry. Although major and trace elements display fairly linear trends, the conspicuous disequilibrium textures as well as some chemical features may suggest that other petrogenetic processes beside fractional crystallization controlled the evolution of the series. The ASVC is surrounded by minor monogenetic centres emplaced over the Oligocene Somún Curá plateau; these mostly basaltic centres show several petrologic types (Remesal et al, 2007). Morphological studies makes evident that there are effusions with different rheological features (spatter cones, short lava flows, long lava flows, etc.).The evaluation of the structural control based on satellite images (false colour and RGB bands combined), along with aerial photographs and field data, allowed us to compile and classify around 200 vents within an area of 3000 Km^2. The distribution of these vents defines two main directions: one of NE-SW strike and the other SE-NW oriented. Both directions result parallel to two major lineaments recognized to the south of ASVC: Abdala and Telsen alignments which cut across the Jurassic to Cenozoic volcano-sedimentary record (Franchi *et al*.,1977; Lapido & Page, 1979; Cortés, 1987 Ardolino & Franchi, 1996). Most of the large bimodal post-plateau complexes located south of ASVC are also arranged along a SE-NW oriented belt (Remesal et al., 2011)

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ANOMALOUS ELASTIC CRUSTAL PROPERTIES IN TIERRA DEL FUEGO? INDICATIONS FROM EARTH TIDE OBSERVATIONS

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The solid earth tides manifest themselves in gravity variations, deformations of the earth crust, and variations in the tilt of the earth surface with respect to an equipotential surface, among other effects. The ocean tidal loading, i.e. the elastic response to the displacement of water masses due to the ocean tides, generates an additional contribution to these effects. These load tides depend on the ocean tide signal and the elastic-rheological properties of the earth crust.

The first systematic investigation of tidal effects in Tierra del Fuego was based on lake-level observations in Lago Fagnano. The comparison of the observed lake tide signal with a model comprising solid earth tides and load tides revealed a significant deviation of the observations from the theoretical prediction. It suggests that this difference is due to an anomalous amplification of the load tides in the order of 20%.

Since 2009, tidal gravity metre observations have been carried out at four sites in the Argentine part of Tierra del Fuego main island. Our gravimetric records, the first ones obtained in the region under investigation, confirm the amplification of the load tide effects with respect to the model. However, the anomaly of the tidal loading gravity signal seems to be a regional phenomenon confined to the southern part of the island.

Pressure tide gauge observations were carried out at three locations off the Atlantic coast of Tierra del Fuego main island. These are used for a regional validation of the global ocean tide model applied as load model in the modelling of the ocean tidal loading effects. A very good agreement between ocean tide model and observations is found.

This leads to the conclusion that the detected anomaly in the load tide effects should be attributed to a regional deviation of the effective elastic properties of the earth crust from the global earth model (Gutenberg-Bullen A) used in the load tide modelling. The presence of the Magallanes-Fagnano fault system, representing the transform boundary between the South-American and Scotia tectonic plates and traversing the southern part of the island, provides a further motivation for an assumption of anomalous crustal properties in the region.

CENTRAL ANDEAN DEFORMATION PATTERNS ARE CAUSED BY A CRUSTAL STRENGTH GRADIENT

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Hot orogens are characterized by high crustal heat flow, pervasive felsic magmatism, large widths and distributed deformation. The Central Andes are a type example of an actively forming hot orogen. A prominent feature of this continental plateau is the presence of anastomosing transpressive deformation zones. In the southern Central Andes, these zones form morphological ranges, which envelop elliptical to rhomb-shaped sedimentary basins. The cause of upper-crustal segmentation into rhomb-shaped, shear zone-bound domains associated with contractional sedimentary basins is not well understood. Here we use scaled multilayered analogue experiments to investigate the role of an orogen-parallel crustal-strength gradient on the formation of such structures. We show that the ellipticity and size of domains, the sinuous character and abundance of transpressional shear zones vary with the integrated mechanical strength of crust. Upper-crustal deformation patterns and the degree of strain localization in the experiments are controlled by the ratio between the brittle and ductile strength in the model crust as well as gradients in tectonic and buoyancy forces. The experimental results match the first-order kinematic and structural characteristics of the southern Central Andes and provide insight on the dynamics of underlying deformation patterns in hot, wide orogens.

HYDROLOGICAL ANALYSES AS BASE DATA FOR TERRITORIAL PLANNING IN THE TOWN OF ÑEMBY (PARAGUAY)

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The Development Project ORDAZUR (German Technical Cooperation) executed by the German Federal Institute of Geosciences and Natural Resources in cooperation with the Paraguayan Environmental Board (Ministry) is working since 2007 in the district of Ñemby (170.000 habitants) as one of 5 pilot working areas. Ñemby is situated in the Capital´s Metropolitan Area in Central Paraguay where the main activities have commercial and industrial character.Ñemby, as the whole Paraguayan Central Department, provides its water from the groundwater reservoir Patiño Aquifer, which has a stretch-out of approximately 1173 km² and delivers water for around 2 million of people of the social economically most important area of Paraguay. The contamination of the ground- and superficial waters is a main problem.

In Ñemby, the activities of ORDAZUR aim to an urban zonification plan, which focuses on the protection of the groundwater resource by marking out areas of special interest.

Analysis of water samples (urban wells and superficial waters), hydrogeological survey (Isotopes) and urban studies lead to the knowledge, that most of the urban drinking water has contamination problems, especially with coliform bacteria. In a medium term scenery, there will be a water supply conflict, not only caused by the descending water quality but also by the growing demand caused by the expected population growth. To deal with this conflict, there is a necessity to define recharge areas for the groundwater body, and at the same time implementation of a waster- water- system with treatment installation.

ORDAZUR tends to include those groundwater recharge areas, which will be defined within further investigations in 2011, in an urban planning regulation. First results have already been reached, such as a pre- project of waste-water-system (SES), a regulation for the implementation of a waster-water- household installation for the city centre and a regulation proposal which establishes well protection zones.

SES (2009): Resultados de Análisis de Isotopos para el Municipio de Ñemby.
ORDAZUR (2010): Manual para la aplicación de areas de protección de pozos.
ORDAZUR (2009): Proyecto "Ordenamiento Ambiental en Zonas Urbanas".
VAN DER LINDEN, W. (2001): Desarollo del banco de datos hidrogeológicos de Senasa- Informe Técnico 1.1.
WEHRLE MARTÌNEZ, A. (2007): Estudio de politicas y manejo ambiental de aguas subterraneas en el Área Metropolitana de Asunción (Acuifero Patiño)
IDM (2000): Desarollo Urbano- Manual para la Zonificación Estratégica

THE INFLUENCE OF REGIONAL LITHOLOGY ON THE COMPOSITION OF WATERS AND SEDIMENTS IN THE UPPER RIO DOCE BASIN, MG, BRAZIL

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A resume of results of some 40 works, such as M.Sc. and Ph.D. thesis, final reports of projects, all products of a scientific cooperation between the UFOP and UFZ, Magdeburg, are presented. The hydrographic basin of the Doce River is located between the parallels 18 ° 45 ‘and 21 ° 15 ‘ S latitude and 39 ° 55 ‘and 43 ° 45 ‘ W longitude. The catchment area encompasses around 83,400 km² in the states of Minas Gerais (MG) (86%) and Espírito Santo (ES) (14%), southeastern Brazil, with 228 municipalities - 202 in MG and 26 in ES. The Doce river has a length of 853 km, being source of water for 3 million inhabitants, 69% of which live in urban areas.

The main rivers that form the upper basin of the Rio Doce are: Rio Piranga, Rio do Carmo, Rio Gualaxo do Norte and Rio Gualaxo do Sul, Rio Piracicaba. Samples were collected at 600 stations for water and sediment. Physicochemical parameters (pH, Eh, TDS, Electrical Conductivity, Temperature, and Turbidity) were measured in situ. At all stations two sampling campaigns (winter – summer) were carried out, to investigate seasonal differences. Therefore all work resulted in over 2,000 samples of water and sediments, which were analyzed for alkalinity, sulfate, chloride, heavy metals and major elements (by ICP MS and ICP OES, leading to an estimated 50,000 geochemical data). Sediments were minerlogically characterized by X-ray diffraction spectrometry.

Quite succinctly it can be verified that: all investigated water courses are highly influenced by the local rocks. This is shown, especially for some litophile major elements on the basis of positive correlations, such as Mg - Ca, Na - K, Ca - Na, Fe - Mn. For rivers under influence of Au mining activities, such correlations are observed for chalcophile elements as Pb - Cd, As - Cd, Cu - Zn.

In areas without mining activities, e.g., in the upper basin of Rio Piranga, high levels of Zn, not correlated to Cu may indicate anthropogenic contribution. In many rivers high concentrations of mercury were determined, originated from the activities of prospectors. The waters of the Caraça Mountain, the State Park Itacolomi and the Ecological Station Tripuí are the “cleanest” ones. These are places where any human interference is absent. The physical and chemical parameters as the chemical compositions of these waters can serve as “standards” for the ongoing works and future research. The diagram of Total Dissolved Solids vs. $Na^+ / (Na^+ + Ca^{2+})$, (Berner and Berner, 1987), allows a classification of rivers in the main supporting mechanisms that interfere with the natural chemistry of surface waters: (1) precipitation, both in composition and in quantity, (2) weathering of rocks, (3) evaporation and (4) fractional crystallization.

Most of the rivers and investigated barrages are mainly controlled by their environmental geology. Some very particular lithologies, e. g. of Serra do Caraça, with its composition almost exclusively by ortho-quartzites, and the headwaters of the Conceição River, with its iron mines, are contributing for the allocation of these rivers outside the diagram range.

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CHARACTERIZATION AND SOURCE SUSPENDED SEDIMENTS OF THE PARAÍBA DO SUL BASIN

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Considering the growing need to maintain and recover water resources, hydrosedimentological studies have been important to constrain environmental conditions of watersheds.

This work presents an integrated study involving the grain size, mineralogical and Sm-Nd isotopic characteristics of the suspended sediment drained out of the São Paulo portion of the Paraíba do Sul river watershed. The results of X-ray Difratometry and Sm-Nd isotopic geochemistry analyses, aiming at assessing the main source areas of the suspended sediments, are also presented. For this purpose the São Paulo portion of the Paraíba do Sul river watershed was divided into 11 sub basins based on water discharge, draining area and geology.

The suspended sediment drained out of the study area is characterized by a grain size of silt (in 68,83%) and clay (in 20,95%),and is basically composed of kaolinite with some important traces of quartz, illite and gibbsite. The concentrations of Sm are between 5,2 and 10,3 ppm while Nd varies from 30,7 to 64,6 ppm. The model ages (TDM) vary from 1718 to 2131My and all samples are characterized by low •Nd(0) values (between –16,86 and –21,93). The results has shown that Sm-Nd isotopic analyses represent a powerful tool in studies of sediment provenance. The X-ray Difratometry analyses allowed the characterization of the suspended sediment but, due to the high homogeneity of the weathering processes in the study area, they provided little information on the sediment provenance. Of all the studied sub basins those drained by the Piquete, Guaratinguetá, Bocaina, Una, Buquirinha and Parateí rivers showed the greatest contribution to the suspended sediment flow in the Paraíba do Sul river. Of those, the Piquete's and Guaratinguetá's rivers represented the most important contributor considering the suspended sediment reaching the Funil reservoir (end point of the study area). The geological units of the Piracaia Complex are the most influential for the Sm-Nd isotopic composition of the suspended sediment that reaches the Funil reservoir.

KNOWING WATER INITIATIVES IN BENJAMÍN ACEVAL, CHACO, PARAGUAY

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Paraguay is divided into two geographical regions divided by the Paraguay River. The Eastern region has 40% of the territory and 98% of the total population. The western region or Chaco has 60% of the land and 2% of the population. This difference in the population's distribution is due to the characteristics of natural resources. Chaco is characterized by the highest average temperatures throughout Paraguay and a high percentage of salt water, both surface and groundwater. Rainfall is considerable but the evaporation is higher. The collection of rainfall water is made only by a small group of people, especially in the center zone of Chaco. The study area for this analysis corresponds to a portion of Benjamin Aceval District. The area is known for being the only area that has a local freshwater aquifer (approximately 90Km2), surrounded by salt water. Salt water is most common in the area. About 16,000 people, with different ways of managing water supply, bring water from the local aquifer.Each water supply system is unique and has its positive and negative features for efficient supply of the final users. In each management model the existing gender relations are striking, those associated with executive committees as well as users. Three types of models of water management have been identified:

a) Boards of sanitation, community and voluntary organizations.

b) Private water seller companies: established as a business, with specific rules by the Paraguayan State.

c) Toba Qom aborigine community: This community presents a form of water management that is different than the previous two mentioned.

The Main Objective was : To analyze different models of water management in the community of Benjamin Aceval, Chaco, Paraguay, on the axis of the analysis of transparency, participation and gender relations. Conclusions: Among the three water management models analyzed, two were classified as communal, and they are the Health Board and the Aborigine Community, the other observed pattern is classified as a business. In relation to the participation of people in decision making on water, In Qom Toba aborigine community, there is a traditional culture, where, the decisions taken by the leader or chief is respected, and that for certain situations, they resort to the opinion of the advisers or the elderly, formed only by men. In the Health Board, the ultimate authority is the Council, meeting as required by its articles of association. For decision-making on technical issues is the executive committee the one leading the decisions. For major issues, the Council is asked for an opinion. Concerning Emprendimientos Chaco water private seller, since it is a company there is then no direct mechanism for participation of users in the decisions of such. In terms of gender relations in relation to water the following has been learned: In the aborigine community "San Francisco de Asis" Toba Qom, people who primarily make decisions regarding water are leaders or Chiefs, who are men. And the water commission is composed entirely of men and that with regard to water use, it is women who have more contact with it, and they are responsible with children from carrying water to their home. The faucets are on community courts and a faucet supplies from two to eight families. The women are organized and they make decisions, specifically in the commission of craftsmanship, where they developed the product and they are in charge of selling them. In relation to the knowledge of those laws that govern in relation to water and related issues could be seen: The Health Board shows ignorance in regard to existing laws related to water, but it shows a strong interest in learning more and wishes to participate in training courses on it.The owner of Emprendimientos Chaco water private seller demonstrated knowledge of current legislation related to water.

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GEOSCIENTIFIC VIEW AT THE NASCA LINES

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The project “Geoscientific investigations of the geoglyphs of Nasca” includes geophysical, geochemical and petrographic investigations in the stone desert of Nasca and Palpa (Peru). The project aims at a better understanding of the geological structures and processes in the vicinity of the geoglyph sites. A first study-phase performed between 2005 and 2009 left some open questions (Hartsch et al. 2009), like the origin of unexpected resistivity anomalies under the geoglyphs down to a depth of about 2 m and the physical context of recognized vertical density differences which are the subject of a recently started second study-phase. The field campaign 2010 included geoelectrical resistivity and georadar measurements. Sampling was performed from the surface until a depth of 90 cm. Our poster presents preliminary results of these studies.

The typical desert soil in the investigation area is the so-called hamada, developed through the aeolic removal of fine-grained material. Wind erosion left blocks and stones that show a dark-coloured crust from oxidation and precipitation processes.

The geoelectrical survey revealed a clear differentiation between conductive zones caused by depressions filled with loess material and resistive anomalies related to larger blocks of rock. Also the results of the GPR measurements can be classified into these two categories. Due to the high attenuation of the radar waves in a conductive zone the regions of a loess filled depression shows very small reflection energy, whereas the regions with pebbly material shows a stronger reflection signal. Furthermore larger blocks of stone can be localized in the results of the GPR measurements. Petrographically the coarse fraction of these clastic sediments consist of mono- or polycrystalline quartz, plagioclase, K-feldspar or amphibole grains, as well as lithic fragments of volcanic glass, andesite, rhyodacite, granite, granodiorite, syenite, monzonite, sandstone, hydrothermal altered rocks and, subordinately, metamorphic rocks. A conspicuous enrichment in sulphates (gypsum, anhydrite) as well as halite of early diagenetic origin is recognized. Following the results of the first study-phase including a detected As-anomaly in most of the samples, preliminary geochemically analysis using Laser-ablation coupled with ICP-MS indicate that this anomalous As is included in the hydrothermal altered rocks and volcanic glass fragments.

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THE ATLANTIC MARGIN BETWEEN 33º AND 41º S (URUGUAY AND ARGENTINA): A TECTONOSEDIMENTARY REVISION

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The Atlantic margin is characterized by a diachronous, extensional phase dominated by half-grabens preserved along the wide continental platform of the southern South American plate. In the margin segment in front of the Uruguayan and Buenos Aires province coast the structural asymmetry of the Pelotas, Punta del Este, Salado and Colorado basins is mainly due to differential geometries of the previous multicompositional basement and the tectonically-induced subsidence. Four main stages have been identified in the evolution of these basins: a) pre-rift, b) rift, c) sag, and, d) passive margin. The basins show significant similarities in their latest phases of evolution (sag and passive margin stages) but they display drastically different characteristics during the pre-rift and rift phases.

Classic seismic signatures in the Mesozoic asymmetric half grabens include fanning (strongly divergent internal configuration) on fault borders, thinning (convergent internal configuration) and onlap on flexural margins, and compaction synclines over basement footwall cut off points. This half-graben fill phase was followed by a Tertiary sag phase dominated by thermal subsidence which expanded beyond the rift shoulders. The geometries and distribution of facies, particularly in the lower section of the sag fill, have been influenced by highs inherited from the underlying asymmetric half-grabens. New 2D seismic acquired for ANCAP (Uruguayan oil state company) in offshore Uruguay allows to draw significant differences between the offshore Pelotas and Punta del Este basins and their counterpart further south in Argentina (Salado and Colorado basins). The Punta del Este and Salado basins as well as the Colorado basin exhibit half-graben geometries at the rift stage followed by a laterally extensive sag Tertiary fill powered by sediment discharge of the ancient La Plata and Colorado rivers. In contrast, the Pelotas basin does not exhibit fully developed half grabens. The rifts present in the Punta del Este basin have a Jurassic-Cretaceous fill and show dominant westward vergence, opposite to the present deepening of the continental margin.

The presence of fossiliferous Ordovician (Curamalal Gr. and Balcarce Fm), Devonian (Lolén Fm.) and Permian (Mangrullo Fm. and Pillahuincó Gr.) units confirms the heterogeneous nature of the pre-rift basement, principally made up of: a) Lower and Upper Paleozoic sedimentary rocks, equivalent to those exposed in the Paraná (Brazil, Uruguay), the Sierras Australes (Ventana) and Septentrionales of Buenos Aires (Argentina) and Karoo (South Africa) outcrops, b) crystalline rocks of the Precambrian La Plata craton as inferred by highs in the gravity maps, and c) Precambrian calcareous and silicoclastic sequences (La Tinta Gr.) prograding toward SW as correlated in the Claromecó basin.

GEOCHEMICAL AND MAGNETIC SIGNATURES OF SEDIMENTS FROM PALEO-LAKE BABICORA: A HIGH RESOLUTION LATE QUATERNARY PALEOCLIMATIC REGISTER FROM WESTERN CHIHUAHUA DESERT, MEXICO

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In the dry lands of northern and north-western Mexico, poor preservation of biological proxies caused a major obstruction in generation of continuous Late Quaternary paleoclimatic archives. In the present work, we present preliminary high resolution data on multi-elemental concentrations (1 cm interval) and magnetic susceptibility (0.5 cm interval) of a 270 cm long sediment core collected from the paleo-lake Babicora, located in the western margin of the Chihuahua Desert. Additionally, we present concentrations of C_{org}, $CaCO_3$ and Nitrogen and abundance of detrital and authigenic minerals. Magnetic susceptibility is comparable to the abundance of Ti, Fe and K and minerals such as feldspars, amphiboles, mica and kaolinite. Their higher values represent periods of higher inflow into the basin. Similarly, Ca and Sr are associated with calcite and suggest saline conditions.

The 3 ^{14}C AMS dates constrain the sediment column between 26 cal kyr BP and present, with presence of a sediment hiatus during ca.4-8 cal kyr BP. Distribution of samples in the ternary diagrams of chemical weathering and provenance suggests that sediments deposited at the paleo-lake are mainly sourced from the erosion of sub-alkaline trachy-andesite and andesite, exposed in the western drainage basin. Based on the precipitation of authegenic calcite, dry conditions are identified at ca.3, 8-9, 11, 13, 15-16 and 24-26 cal kyr BP. During these periods, sediments deposited in the basin are characterized by lower or absence in chemical alteration. Similarly, humid events during 0-2, 14 and 19-23.5 cal kyr BP are characterized by higher influx of clastic minerals and higher chemical alteration of the sediments. During the LGM (ca.21 cal kyr BP) and Younger Dryas (11.5-13 cal kyr BP), the basin received higher inflow, although it was relatively higher during the LGM. Relation between C/N suggests that vegetation cover in the drainage basin was reduced during LGM. It was higher during 22-26 and 0-2 cal kyr BP, respectively. Spectral analysis of the high resolution data reveals periodicities of 106, 128, 183 and 256 years for the varying hydrological conditions. This register will be compared with NGRIP (Greenland ice core) and marine registers from Gulf of California to understand the dynamics of rainfall regimes in the region.

AN OVERVIEW ON THE DINOSAURS AND FOSSIL BIRDS OF CHILE

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Dinosaurs are main components of the Mesozoic terrestrial fauna of Chile. Their presence in Jurassic and Cretaceous sediments is often restricted to footprints (Rubilar-Rogers, 2003), whereas skeletal remains are rare and consist of a single occurrence of a tetanuran theropod from the Jurassic and several bones of titanosaur sauropods in the late Cretaceous, including partial skeletons (e.g. Atacamatitan chilensis Kellner et al.). From this last period an ornithopod vertebra, a pair of theropod teeth and one tarsometatarsus of a Gaviiformes bird (Neogaeornis wetzeli Lambrecht) were also reported. The Cenozoic fossil record comes principally from Eocene and Miocene marine deposits; they include abundant and well preserved marine birds, especially Sphenisciformes and Procellariiformes. There is an excellent record of other birds such as Odontopterygiformes, including the most complete skeleton of a pelagornithid, Pelagornis chilensis Mayr & Rubilar-Rogers. Curiously some orders of birds, such as Charadriiformes, are characteristically absent in the Chilean fossil record. Fossil birds are also known from Pliocene and early Holocene strata. A remarkable collection of birds was discovered recently in lacustrine sediments of Holocene age and are there associated to human activity. The perspectives in the study of dinosaurs in Chile are promising because plenty of material archived in instituional collections is not described yet. The record of Chilean dinosaurs is important, for example, to understand the dynamics and evolution of this group of terrestrial animals in the western edge of Gondwana, while Cenozoic birds from the region may contribute to the understanding of the emergence and establishment of the Humboldt Current.

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CENOZOIC VOLCANISM AND MINERALIZATION IN THE CENTRAL ANDES: A REGIONAL APPROACH

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The Volcanic Zone of the Central Andes (CVZ) extends from southern Peru, along the Bolivian Altiplano, northern Chile to northwestern Argentina. This zone includes important ore deposits related to Cenozoic magmatism. Migration and broadening of the volcanic arc took place across different morphotectonic units, which are from west to east the Central Depression, Domeyko Cordillera, Western Cordillera, Altiplano, Eastern Cordillera, Precordillera, Famatina and Sierras Pampeanas. Four major metallogenic provinces are distributed from west to east, namely Copper province along Domeyko Cordillera, Altiplano–Western Cordillera polymetallic province, Eastern Cordillera tin province, and Eastern polymetallic province. These provinces overlap different morphostructural units, and are characterized by one or more deposit types, which are distributed into metallogenic belts of diverse ages.

The regional distribution of epithermal gold and copper porphyry deposits display time-space relationships, which are related to the interplay of magmatic evolution, character of volcanic arc basement, distribution of transfer zones, and geomorphologic processes combining rapid uplift and erosion with concomitant volcanism. The evolution of Cenozoic volcanism can be divided into six stages: 1) Paleocene to Early Eocene; 2) Late Eocene to Early Oligocene; 3) Late Oligocene to Early Miocene with the development of the Maricunga belt; 4) In the Middle Miocene, the arc extended across the Altiplano; 5) in the Late Miocene the volcanic arc migrated and broadened to the east, reaching the Cordillera Oriental and Sierras Pampeanas, with a zenith ca. 7 Ma; 6) From Pliocene to Quaternary the volcanic arc contracted to the west to the current position on the Western Cordillera.

Regional volcanogenic units seem to be located along “corridors” or transfer zones, following different patterns during its migration and broadening. From Oligocene to Middle Miocene the volcanic arc expanded in a SW-NE direction. In contrast, from Late Miocene to Recent the regional distribution of volcanic units appear to follow NW-SE directed corridors.

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FACIES AND STRATIGRAPHY OF THE LATE JURASSIC TO EARLY CRETACEOUS SEDIMENT SEQUENCE OF THE ANDEAN BASIN IN CENTRAL CHILE

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The Jurassic-Cretaceous boundary in Chile is well recorded in the High Cordillera of central Chile by the Baños del Flaco and Lo Valdés Formations. The Baños del Flaco Formation consists of conglomerate, limestone, calci-mudstone, sandy limestone and calcareous sandstone characterising a lower member, it is assigned to the Early Tithonian based on the occurrence of ammonites. The Upper Member is placed to the Late Tithonian? and is characterized by siltstone, calcareous sandstone, calcareous siltstone, and sandy limestone. The Lo Valdés Formation is divided into four members (from base to top): a) An Andesite Member composed by andesite and also containing restricted levels of calcareous sandstone and calcareous siltstone; b) A Sandstone Member consisting of calcareous sandstone; c) A Siltstone Member composed of calcareous siltstone and silty limestone; d) A Limestone member consisting of limestone, silty limestone and calcareous siltstone. Age-diagnostic ammonites occur throughout the section and allow for biostratigraphic assignation of the Andesite Member to the lower-middle Tithonian, the Sandstone Member to the Late Tihonian (lower to middle part?), the Siltstone Member to the uppermost Tithonian? to Berriasian, and the Limestone Member to the Valanginian and Hauterivian.

Lithologies of the Lo Valdés and Baños del Flaco Formations represent shoreface, offshore transition and offshore depositional environment. The sections analyzed represent a retrogradational and progradational pattern of depositional facies, which may have been the result of a sea level rise during the lower Tithonian. Depositional energy decreases during the middle Tithonian and increases again in the upper Tithonian?. During the Berriasian and Valanginian energy decreases gradually within offshore transition and offshore facies. Offshore conditions are developed during the Valanginian while the Hauterivian is represented by offshore transition facies.

TITHONIAN AMMONOIDS FROM ALTO MAIPO, CENTRAL CHILE

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Marine sediments of the Lo Valdés Formation are locally present in the High Cordillera of Central Chile. The Cruz de Piedra and Paso Los Bayos sections in the Alto Maipo area (Metropolitan Region) contain abundant well preserved ammonites of Tithonian to possibly Berriasian age. We identified fifteen species referred to ten genera: *Windhauseniceras internispinosum*, *Substeueroceras koeneni* and *Neocomites* (*Neocomites*) *regularis* were described before from these sections, whereas *Torquatisphinctes proximus*, *Spiticeras*? *acutum*, *Aspidoceras andinum Microcanthoceras lamberti*, *Microcanthoceras*? *spinulosum*, *Microcanthoceras*? *vetustus*, *Corongoceras mendozanum*, *Berriasella* (*Berriasella*) *fraudans*, *Substeueroceras koeneni kayseri*, *Substeueroceras intercostatum*, *Substeueroceras calistoides* and *Pterolytoceras magnum* are first records for these sections, and *S. acutum*, *A. andinum, M. vetustus*, *C. mendozanum*, *B. fraudans*, *S. koeneni kayseri*, and *S. calistoides* are first records for Chile. The assemblage resembles ammonite associations of the Argentinian side of the Andean Basin, but differ from other South American assemblages (e.g. Perú and Colombia); *S. koeneni* is the only species in common with Mexico. Based on the calpionellid record in Mexican sections, *S. koeneni* crosses the Jurassic/Cretaceous (J/K) boundary into the Berriasian. In the absence of calpionellids in the Chilean sections, however, the precise biostratigraphic range of the Chilean specimens of this taxon and position of the J/K boundary are difficult to assess and correlation with the European localities remains arbitrarious.

LATE CRETACEOUS (MAASTRICHTIAN) SEQUENCE STRATIGRAPHY, BIOSTRATIGRAPHY AND PALEOBIOGEOGRAPHY OF THE QUIRIQUINA FORMATION IN CENTRAL CHILE

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The Late Cretaceous Quiriquina Formation crops out around Concepción Bay in central Chile and presents a retrogradational pattern in shoreface environments, which may have been a result of sea level rise (transgression) at the end of Early Maastrichtian. Upsection, low energy offshore facies are developed during the Late Maastrichtian. Thirty ammonite species referred to seventeen genera (Salazar *et al.* 2010) have been detected and represent one of the most diverse assemblages for the topmost Cretaceous. The presence of *Hypophylloceras* (*Neophylloceras*) *surya*, *Zelandites varuna*, *Pachydiscus* (*P.*) *jacquoti*, *Diplomoceras cylindraceum*, *Baculites anceps, Eubaculites carinatus, Hoploscaphites constrictus* and *Menuites fresvillensis* indicates a an early late to late Maastrichtian age for the unit.

The following three biozones are distinguished (from base to top): Zone of *Baculites anceps*, Zone of *Eubaculites carinatus* (subdivided into the *Menuites fresvillensis* and *Kitchinites darwini* sub-biozones) and Zone without baculitids (subdivided into the *Hoploscaphites constrictus* biozone and a zone without ammonites). Species richness and abundance of ammonoids are high throughout the Quiriquina Formation but gradually decline in the uppermost 10 meters of the section within the unit of green sandstone-siltstone. No ammonoids appear to be present in the last 5 meters of the unit, indicating that the extinction of ammonites in the region was completed prior to the end of the Maastrichtian. The assemblage shows an Indopacific character, but endemic and cosmopolitan as well as European-Tethyan faunal elements are also present.

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DETECTING POSSIBLE FLUID SIGNALS FROM CRUSTAL MICROSEISMICITY, RELATED TO SLAB-FOREARC SYSTEM IN THE NORTH OF THE CHILEAN SUBDUCTION ZONE

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We have studied the seismicity of the crust in the slab-forearc system in the north of Chilean subduction zone, with a focus on clustering phenomena, in order to determine its sources and possible connection with fluid migration.

Beside structural and tectonic features we observe that some characteristics of the main two clusters found in the study zone differ from each other. The central cluster (relative position to the station network) at a depth of 9 km has characteristics of an earthquake swarm with two distinct phases which can clearly be identified, whereas the SW cluster at a depth of 35-40 km has a clear main shock associated and can be separated into two subclusters (A and A' respectively).

In contrast, the similarities found permit us to infer that they could have a common origin. The b-values for both are characteristic of tectonic plate boundaries. The spatial spreading - which is approximately confined to a single plane - reveals a progressive growing of the main fracture of the swarm and the subcluster A activity. We also found that the earthquakes themselves trigger aftershocks near the border of their rupture areas.

In addition, the spatio-temporal migration of hypocenters, as well as, spatial correlation - with areas that had previously interpreted as fluid migration zones (Yoon et al., 2009) - indicate that there is a close relation between fluids and the sources of the swarm and subcluster A.

Our observations point to a stick-slip behavior of the rupture propagation, which can be explained by stress transfer and induced fluid flow due to earthquakes in a fluid-permeated critically loaded fault zone.

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KINEMATICS AND MECHANISMS OF UPPER-CRUSTAL DEFORMATION IN THE EASTERN CORDILLERA, SOUTHERN CENTRAL ANDES, NW ARGENTINA

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The Eastern Cordillera constitutes the eastern margin to the Puna Plateau, the second highest continental plateau on Earth, and is thus of particular importance for understanding plateau growth. Deformation in the Eastern Cordillera is characterized by basement-involved folding and reverse faulting during the Tertiary and Quaternary. However themechanism and kinematics of deformation of first-order structures in the Eastern Cordillera is not well known. To remedy this situation, we conducted comprehensive structural analyses in selected areas, i.e., La Poma, Luracatao and Cachi. The analyses encompassed (1) field mapping and remote sensing of first-order fold structures and faults, (2) 3D modelling of these structures and (3) a detailed analysis of small-scale brittle shear faults (828 faults at 79 stations).

Examination of first-order structures revealed that the Eastern Cordillera was affected by two deformation regimes: Non-cylindrical deformation, i.e., doming of upper crust, followed by cylindrical deformation, notably formation of km-scale folds with straight hinge zones in the hanging walls of orogen-parallel thrust and reverse faults. 3D modelling of these faults at La Poma and Luracatao revealed that west-dipping faults are consistently shallower than east-dipping ones. Displacement on shallow (< 15°) west-dipping thrust faults amounts to 2.4 km and exceeds displacement magnitudes on east-dipping reverse faults.

Analysis of small-scale brittle shear faults shows that doming occurred during EW shortening followed by NE-SW shortening on west dipping thrust and reverse faults and later by NW-SE shortening on east-dipping reverse faults. The latter ones are also characterized by a component of left-lateral displacement. NW-SE shortening is particularly evident at reverse faults that were active in Quaternary to recent times. This shortening direction is at variance with the post 3.2 Ma convergence direction between the Nazca and South American Plates (N75°E). Thus, brittle shear faults cannot be used as reliable indicators of far-field paleostress. In addition, fault rock in some areas is characterized by cataclasite and growth of hydrous minerals at low temperature. This points to an enhanced influence of meteoric water on the deformation and can be attributed to the morphotectonic setting of the Eastern Cordillera that is conducive of inducing humid conditions. Collectively, the structural analysis of the fault-slip data and mapping of the faults suggests that deformation was controlled by the local structural complexity of upper crust, including higher-order, pre-Andean mechanical anisotropies (such as aplitic dikes, foliation surfaces and cretaceous normal faults).

REE-COMPOSITION ON PEGMATITIC FELDSPARS AND MUSCOVITES FROM MAZÁN RANGE, NORTHWESTERN ARGENTINA

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Four K-feldspars (KF), two Na-feldspars (NF) and two muscovites (Ms) of pegmatites from Mazán range, Argentina, were analyzed for REE using ICP-MS methodology. The Mazán peraluminous Granite of Ordovician age with S-type affinity is the host-rock of the pegmatites. These have a simple zoning with aplite on the border, following towards the center of the bodies an intermediate zone composed of feldspars and finally a quartz-core. They have andalusite as accessory mineral, but rare-elements minerals (like Be and Li) had not been found so far..

The ∑REE is variable on the analyzed minerals, being between 0.71 y 3.34 ppm on KF, 4.91 and 6.40 ppm on NF, and 7.05 and 14.7 ppm on Ms. The gradient of the chrondrite-normalized pattern on these minerals is markedly positive, with La_n/Yb_n values of 6.35 to 22.07 on KF, 14.88 and 41.79 on NF, and 6.74 and 7.36 on Ms. Both ∑REE and La_n/Yb_n values are agreement with the same minerals from pegmatites from other places.

However, the Eu-anomaly on NK and Ms is negative being the Eu/Eu* values lesser than 1 (0.12 and 0.14, and 0.41 and 0.53, respectively). On KF, it is very variable due to on two samples of them, the result is negative (Eu/Eu* 0.31 and 0.68), but the other two samples is positive (Eu/Eu* 2.51 and 11.43). The mineral samples are from different pegmatites of Mazán range or different sectors of the intermediate zone of the same pegmatite. For this reason, the different Eu/Eu* values is attributed to the variability on the chemical conditions (especially the fO_2) in the pegmatite generating-melting.

GEOCHEMICAL TRACERS OF SUBDUCTED MATERIALS IN A COMPLEX CONTINENTAL MAGMATIC ARC: THE CASE OF THE TRANS-MEXICAN VOLCANIC BELT

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The Trans-Mexican Volcanic Belt (TMVB) consists of more than 8000 volcanic structures, including more than 20 stratocones, and extends in W-E direction from the Pacific to the Gulf of Mexico. Magmatism is related to the subduction of the Pacific Cocos and Rivera plates. Due to oblique subduction, the emplacement of the magmatic arc is not trench-parallel but, instead, also oblique. Down going dip and velocity of the subducted oceanic plates are changing considerably from NW to SE. The slab trajectory is heterogeneous from steep to nearly sub-horizontal and achieves a depth of ca. 100 km beneath the central TMVB, corresponding to pressures of ca. 35 kbar, which is typical of most volcanic fronts in subduction zones. Estimates for the crustal thickness in central Mexico based on seismic and gravimetric data range between 42 and 50 km. The central part of the TMVB is related to a roughly N-S oriented extensional stress field with prominent E-W normal faults and shallow crustal seismicity.

Calc-alkaline rocks are predominant but minor OIB-type and alkaline volcanism also occurs. Direct evidence for the composition of the subducted oceanic crust in front of Pacific Mexico is not very abundant. N-MORB and high-Ti MORB derived material with different Sr, Nd, and Pb isotopic ratios are involved together with heterogeneous deep sea turbidites and sedimentary ooze. A chemical contribution from these sediments in andesitic and basaltic TMVB samples can be deduced from elevated Ba/Nb (40-250) or Ba/La ratios because Ba is usually concentrated in oceanic sediments containing hydrothermal minerals and clays. One of the most sensitive elements to detect contributions from subducted sediments is Pb. TMVB volcanics show Pb concentrations between 4 and 30 ppm which is always displayed in large positive Pb spikes in primitive mantle normalized spidergrams. Sediments from Pacific DSDP sites have Pb concentrations around 100 ppm whereas for the MORB source mantle Pb contents of only 0.05 ppm are reported. The often cited negative Nb anomaly is not always a convincing parameter to detect the influence of the subducted plate in arc rocks. Amphibole, the most important Nb-bearing mineral can break down with increasing depth of the slab, releasing Nb. But this must not always be the case. Sub-horizontal slab trajectories like those observed underneath the TMVB can gradually decelerate amphibole breakdown and arc rocks from this scenarios can display only weak or even absent Nb anomalies.

The presence of minor alkaline and OIB-type rocks in the overall TMVB can be explained by significant upper mantle heterogeneities. It has been shown that these heterogeneities can occur within a 10 km scale. Another model favors removal of mantle lithosphere and lower crustal material beneath high-K TMVB magmatic sites combined with the release of fluids and mantle upwelling around the sinking mass.

MASSIVE GARNETITE FROM MARGARITA ISLAND, VENEZUELA: A METAMORPHOSED PLACER DEPOSIT?

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The geology of Macanao, the western peninsula of Margarita Island, is dominated by rocks of the Juan Griego Metamorphic Suite, a heterogeneous sequence of old Paleozoic continental basement and overlying Mesozoic sedimentary sediments, metamorphosed together at HP-LT conditions in the Late Cretaceous. In southern Macanao, metapelite (in part very graphitic), ortho- and paragneiss, metaquartzite, and, locally, serpentinite lenses and pegmatoid intrusions are exposed. During a recent field campaign, massive rose-coloured garnetites were discovered which form concordant m-sized layers/boudins within mica schist. Garnets are subhedral, < 2 mm in diameter (100 - 200µm on average) and are set in a quartz matrix. Minor constituents are rutile, ilmenite, apatite, allanite and white K-mica. Allanite forms euhedral grains, in some cases also filling garnet interstices. Dark-green, mm-sized spots in the garnetite are chlorite, probably pseudomorphs.

Some garnetites contain numerous isometric apatite grains leading to 8.5 wt.% P_2O_5 in some bulk-rock composition. These P-rich garnetites are also higher in CaO, Sr, Ce, La, Nd and lower in Al_2O_3, Si, Zr, Nb, compared to their P-poorer (P_2O_5 = 0.07-1.96 wt.%) equivalents.

In general, garnets are quite rich in spessartine component. Zonation is not very pronounced. Cores are lower in grossular component (typically $Alm_{60.8}Gross_{4.5}Prp_{11.3}Spess_{19.2}And_{2.8}$) compared to the rims ($Alm_{59.3}Gross_{9.0}Prp_{9.0}Spess_{19.3}And_{1.4}$), whereas pyrope, almandine and andradite are higher. The Si-content of white K-micas varies between 3.08 and 3.25 pfu. Ilmenites are characterized by appreciable amounts of pyrophanite component ($(Fe_{0.72\text{-}0.87}Mn_{0.28\text{-}0.11})_{\Sigma=1}TiO_3$); the geikielite component is negligible. Garnets from the adjacent metapelitic country rock are generally much lower in spessartine component.

Two main alternatives to explain the formation of such garnetites present themselves. The association of isometric grains of apatite with garnet suggests a former placer environment, in agreement with the enclosing metapelitic sediments. Alternatively, the protolith of the garnetite could represent a former layer of Fe- and Mn-rich mud formed in a black-smoker-like volcanic environment in a submarine basin. Such an origin has been proposed for spessartine-rich garnetites (“coticules”) in Belgium (e.g. Kramm, 1976; Krosse & Schreyer, 1993). Willner et al. (2001) describe “coticules” from Central Chile, and interpret these to have formed from Fe- and Mn-rich hydrothermal precipitates mixed with aluminous alteration-derived material, deposited on oceanic crust. These rocks are similarly deficient in alkalis, but much higher in Si than the Macanao garnetites. However, the garnetites from Belgium and Chile are decidedly higher in Spess (> 40mol%) than the garnets analyzed here. Thus a placer origin appears most likely for the Macanao occurrence.

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TRACKING LATE-HOLOCENE ENVIRONMENTAL CHANGE IN THE WESTERN ANDES OF SOUTHERN PERU (14°) USING HIGH-ALTITUDE PEATLAND ARCHIVES

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From a palaeoenvironmental point of view, high-altitude peatlands of the Andes still remain relatively unexploited, although they offer an excellent opportunity for high-resolution chronologies. Especially in the central Andes, additional high-quality proxy records are still needed due to the lack of continuous and well-dated records, which show a significant variability on sub-centennial to decadal precision scales.

In the central Andes, cushion peatlands form on slopes below spring outlets, below groundwater seepages in the lower part of fluvio-glacial debris fans and in shallow valley bottoms, threaded with streams fed from springs along the valley margin, at altitudes ranging from 4000-4900 m a.s.l. Within the multidisciplinary project “Andes Transect – Climate Sensitivity of pre-Columbian Man-Environment-Systems” several sediment cores were retrieved from the Llamoca peatland in the western cordillera of southern Peru (Lucanas province) at approximately 4.300 m a.s.l. The most suitable sampling sites were identified by means of electrical resistivity tomographies (ERT). A chronology based on 99 AMS ^{14}C-datings provides a high temporal resolution.

An 11.5 m continuous core of peat with intercalated sediment layers was examined for all kinds of microfossils and macroscopical plant remains, including fossil charred particles. The pollen record reveals the expansion of grasslands during humid phases. The results are substantiated by geochemical and geophysical analyses (humification degree, CNS measurements, XRF-scanning).

We stress a humid/relatively stable interval between 1.8 and 1.3 ka, which coincides with the florescence of the Nasca culture in the Andean foreland. An abrupt turnover occurs at 1.3 ka, which coincides with the collapse of the Nasca society. Markedly more variable and overall drier conditions prevail until 0.8 ka, providing evidence for the presence of a warm Medieval Climate Anomaly. Moister, but hydrologically highly variable conditions took place again after 0.8 ka BP, which allowed the re-expansion of tussock grasses in the highlands, increased discharge into the Andean foreland and the re-occupation of the settlements during this so-called Late Intermediate Period.

On a supraregional scale, our findings can ideally be linked to and proofed by the archaeological chronology of the Nasca-Palpa region as well as deep-sea cores from the southern Pacific Ocean.

HYDROGEOLOGICAL AND HYDROCHEMICAL EXPLORATION OF A LITHIUM-BRINE DEPOSIT: THE SALAR DE UYUNI, BOLIVIA

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Salar de Uyuni, located at an altitude of 3,653 m asl in the Bolivian Altiplano, is the world's largest salt pan with a size of 10,500 km². It consists of interbedding halite and clayey layers. Pores in the salt are filled with a highly mineralized interstitial brine rich in lithium, magnesium, bromine, and potassium (Risacher & Fritz 1991).

Against the background of a possible future extraction of lithium by an innovative method developed in cooperation between the TU Freiberg and the University of Potosí (UATF) in Bolivia the hydrochemical and hydraulic properties of the salt crust were investigated. Two field campaigns took place in 2009 and 2010 under the participation of Bolivian and German scientists and graduate students.

Basic information was gathered by drillings with depths of 2 to 12 m at 11 different locations on the salar. The stratigraphy of the sediments was documented and core samples were transported to Germany for further mineralogical and geochemical analyses. Bore holes were completed as pumping and monitoring wells and served for the depth-dependent sampling of brines, which were subject to several chemical analyses including the determination of main ions, trace elements and isotopes. Characterized by a high salinity of ~ 300 g/L, the brines show rising concentrations of lithium towards the delta of the main tributary Rio Grande in the south and decreasing contents of calcium and sodium due to gypsum and halite precipitation, while a depth dependency was not observed. Pumping tests performed at different sites on the salar revealed high, but varying hydraulic conductivities in the order of 10^{-3} - 10^{-4} m/s and thus a high permeability. Computer tomography (CT) was used for the determination of the salt's effective porosity showing values up to 30% and thus supporting the results of the pumping tests.

The data obtained from chemical and hydraulic analyses are utilized for the compilation of a hydrogeological model to simulate groundwater flow in the Salar de Uyuni taking into account density and temperature gradients as well as differences in porosity and stratigraphy. The model is further used to estimate consequences of the extraction of lithium and other valuable elements from the brine on the hydrogeologic system.

Future research includes the analysis of the isotopic composition (e.g. $^{6}Li/^{7}Li$, $^{14}C/^{12}C$) of the brine to gather information about the chemical evolution of the brine and the salt pan as well as possible sources and mechanisms for the enrichment of lithium in salars.

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GEOMORPHOLOGICAL AND PALEOECOLOGICAL INVESTIGATIONS AT THE LAGUNA NASSAU, PAMPA SECA, ARGENTINA

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The Pampa Seca, situated in Central Argentina, ranges about 530 km in meridional direction from 34° to 39° S, and approximately 200 km in zonal direction from 64° to 67° W.

It is a preferential area for the reconstruction of the younger quaternary environmental evolution because it provides (1) geomorphological archives, containing information about the quality, particular the direction, and quantity, particular the volume of transported Material, of the forming wind systems; (2) lake sedimentary archives, covering information about the ecology of the environment as well as dating possibilities; (3) it spans largely the overlapping area of the southern hemisphere westwind-drift with the south-american tropic circulation, which implies the potential to detect its spatial fluctuations in time.

We present palynological and geochemical analyses of lacustrine sediments, which deposition starts not before 1630 +/-35 BP, of one deflation pan in the northern part of the Pampa Seca, called the Laguna Nassau, at 33°S, 65,5°W, and complement this with the interpretation of the geomorphology of the eolian features in its surroundings.

The data allow the reconstruction of wind direction and humidity. By means of geomorphological mapping we can clearly define three distinct dune forming wind systems, and from the palynological analysis we get, beside the evolution of the local and regional growing plant communities, data of the water-table fluctuation.

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THE POÇOS DE CALDAS ALKALINE MASSIF, A KEY TO UNDERSTANDING THE THERMAL, EXHUMATION, ROCK AND SURFACE UPLIFT HISTORY AT THE "PASSIVE" CONTINENTAL MARGIN OF BRAZIL

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The present data constrain the pattern and history of exhumation of the Poços de Caldas alkaline massif (PCAM) and surrounding area since the Carboniferous. The PCAM (~83 Ma intrusion age) is a semi-circular feature with a nearly flat plateau (average elevations of ~1300 m.a.s.l.) in the interior. Nearly all borders of the plateau are surrounded by topographic ring features that reach more than 1600 m.a.s.l. In the West, the Neoproterozoic basement occurs at elevation of about 750 m. Five AFT samples of the alkaline massif range in age from 69.0 (4.4) Ma to 42.7 (3.4) Ma and one AFT sample of a Neoproterozoic foliated granite provide an age of 101.3 (5.4) Ma. Color selected zircon concentrates of the foliated granite and the Lower Cretaceous Botucatu sandstone revealed ZFT-ages between 254.9 (19.4) Ma and 424.2 (39.6) Ma. Colorless to white and yellow zircon of the Botucatu sandstone are much younger than the red colored zircon grains. AHe-ages are in the range of 47.1 (5.8) Ma to 84.1 (4.4) Ma. ZHe-ages cover the age range between 534.0 (42.7) Ma and 83.5 (3.8) Ma. Application of system filters lead to a reliable AHe age of 47.1 (5.8) and ZHe-ages of 293.6 (1.3) Ma for the Neoproterozoic foliated granite. The Botucatu sandstone provided a reliable ZHe-age of 78.7 (0.4) Ma. Two samples of the alkaline massif revealed each two reliable zircon grains with an age range from 89.1 (7.1) Ma to 83.6 (6.7) Ma. The thermochronological cooling history of rocks exposed in the PCAM reveals that the faster cooling and main exhumation process occurred shortly after the intrusion of the alkaline magma (83 Ma) and lasted for about 11 Myr until about 72 Ma. This very fast cooling is partly contributed by the heat dissipation of the hot magmatic rocks to the surrounding colder Neoproterozoic foliated granite (~ 100 °C at ~80 Ma) and an erosion of about 2,000 m of volcanic and subvolcanic rocks. The erosion leads to a topography with elevation differences of about 200 m in the PCAM. During the Late Cretaceous (~ 70 Ma) and Early Paleogene (~45 Ma) the exhumation nearly vanished. The exhumation rate decreased to 0.005 mm/a with an average of about 100 m erosion. The presented thermochronological data set do not support the formation of the "South American Planation Surface" during the Late Cretaceous to Early Paleogene. At the proposed time range the thermochronological data set indicates a rock column of more than 2,000 m thickness above the recent sample locations. Thermochronological modeling clearly indicates that near recent surface temperature conditions were reached at about 40 Ma in the north of the PCAM and at about 35 Ma in the southwest of the massif. Therefore, the nearly flat plateau of the PCAM has been formed in the time range between 45 and 35 Ma and was stable thereafter. The climate evolution from a dry episode of tropical climate in the Paleocene (65 - 55 Ma), followed by a humid climate with associated chemical weathering in the Eocene (55-36 Ma), and drier conditions during the Neogene (23-2 Ma) could explain the change in exhumation rates. Nevertheless, the structural reorganization of the passive continental margin in Eocene to Oligocene time could also account for the change in exhumation rates.

BIOGEOGRAPHIC IMPLICATIONS OF THE FIRST PALEOGENE VERTEBRATE LOCALITY IN TROPICAL NORTH AMERICA

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The hypothesis of transatlantic dispersal of the ancestors of South American rodents and primates (Lavocat, 1980; Wyss et al., 1993) is founded on the sister-taxon relations of the living groups and the absence of close relatives in mid-latitude North America. Yet some morphological intermediates from middle latitudes have been suggested (Ferrusquía-Villafranca, 1989; Wahlert, 1973; Wood, 1973), and ancestors of these groups could have lived in Central America, where fossils are unknown, leaving the origin of the South American groups unsettled (Flynn et al., 2007). We report on the first Paleogene vertebrate locality from tropical North America, thus filling a major geographic and temporal gap in the fossil record. The fauna exclusively contains rodent species with North American relations, undermining the last argument against transatlantic dispersal. A later Eocene age, as indicated by radiometric data, is broadly consistent with the large mammal component of the fauna, but some incongruent faunal elements may be present. The rodents, particularly the Geomorpha, are more typical of post-Eocene assemblages from middle latitudes and confirm an ancient history of that group in the Neotropics.

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MAPPING DEPTH UNCERTAINTY BY COMPARISON BETWEEN MULTIBEAM REGULAR AND CROSSCHECK LINES

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After data cleaning process, it is common trying to evaluate the quality of the hydrographic survey so, maps generated from the comparison between multibeam regular and crosscheck lines might help hydrographers to identify the depth uncertainty. Complementary, as a result of the sub-analysis, one will be able to identify some mistakes that were not corrected before performing the hydrographic survey. All the process will be done from the analysis of two distinct ASCII files; one from regular and other from crosscheck lines, in which contains the geographic information about the processed and reduced depths and their beam number.

As final products, some maps where ones can identify the depths uncertainty according to the SP-44 Standards Specification; histograms from where it will possible to show the statistical distribution of the depths differences regarding to their mean; and others graphics that will tell us an amount of information about the roll, pitch and yaw biases that were not removed, and thus still remains in the raw data.

That method was applied in two surveys performed in Baía de Guanabara - Rio de Janeiro, by the years 2009-10, and its results showed itself satisfactory because it was capable to give us a general idea how were distributed the errors geographically and what kind of errors were present in the survey.

DATING THE DEFORMATION AND VERY LOW GRADE METAMORPHISM OF THE CHAPADA DIAMANTINA, BAHIA, NE BRAZIL

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The area of study is located in the central part of Bahia and encompasses a small part of the Chapada Diamantina (Seabra, Morro do chapéu). In the Chapada Diamantina area the mesoproterozoic sediment succession “Espinhaço Supergroup” is unconformably overlying the São Francisco Craton and from base to top divided into the three subgroups Rio dos Remédios, Paraguaçú and Chapada Diamantina Group.

The present study aims to elucidate the deformation history of the Chapada Diamantina and it´s relation to an orogenic cycle, Pan-African/Brasiliano or Grenvillian. Clay-rich rocks with a pronounced cleavage, in which new growth of minerals are expected, were analysed to date the age of illite formation. The challenging question was to evaluate the influence of detrital contamination on the K-Ar ages. Illite polytype quantification of detrital $2M_1$ illite and diagenetic $1M_d$ and $1M$ illite by XRD and TEM combined with K-Ar dating will be applied for the extrapolation of apparent detrital and diagenetic illite ages. In order to estimate the degree of burial metamorphism the transformation of Kaolinite to Dickite is used as a reliable paleogeothermometer[3]. Kaolinite and Dickite will be distinguished by the combined use of infrared spectroscopy (IRS) and XRD.

Previous studies indicate a change in provenance from the West (Paraguaçú subgroup) to the East (Chapada Diamantina Group) deduced from paleocurrents in fluvial facies. Dating detrital micas will be carried out as an additional tool to locate the source area of the sediments.

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MANTLE XENOLITHS AND THEIR HOST MAGMAS IN THE EASTERN ALKALINE PROVINCE, NORTHEAST MEXICO

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Alkaline magmas along the periphery of Sierra de San Carlos-Cruillas and Sierra de Tamaulipas (Eastern Alkaline Province, northeast Mexico) contain ultramafic nodules. Most of the host rocks are mafic (e.g., basalts, basanites, trachybasalts, phonotephrites), and have geochemical characteristics of nearly primary magmas generated in subcontinental zones (SiO_2 = 42.6–48.4%, MgO = 6.3–11.2%, Mg# = 59.2–69.7). MORB-normalized patterns are similar to those displayed by extension related mafic magmas. This hypothesis is supported by an enrichment in light REE ($[La/Yb]_N$ =10.8–27.1; chondrite-normalized ratios) and the behavior of relatively immobile trace elements.

Using a partial melting model for REE, the source for the mafic magmas apparently was in the garnet P-T stability field. On the other hand, peralkaline phonolites and tephriphonolites (SiO_2 = 52.9–54.1%, MgO = 1.5–1.8%, Mg# = 33.1–39.8) also contain mantle xenoliths. These evolved magmas show MORB-normalized multi-element diagrams characterized by enrichment in highly incompatible elements (e.g., Rb, Sr, Ba) and positive anomalies for HFSE. Ultramafic xenoliths are predominantly protogranular spinel-lherzolites as well as harzburgites and rare dunites, websterites, and wherlites. A few samples display transitional and porphyroclastic textures, indicating that the xenoliths were carried to the surface from stable mantle zones with little or no deformation. The mineralogy (olivine + orthopyroxene + clinopyroxene ± spinel) of xenoliths contained in mafic magmas is typical of unaltered mantle nodules. However, small garnet crystals exhibiting disequilibrium textures occur in one sample. The core and rim compositions in olivine range from Fo_{90} to Fo_{94}, whereas orthopyroxenes are characterized by En88-93 and clinopyroxenes by $En_{44-51}Fs_{3-10}Wo_{43-50}$. Chromiferous spinels have $Mg/(Mg + Fe^{+2})$ = 0.76–0.83 and Cr/(Cr + Al) = 0.10–0.25. In comparison to the nodules included in mafic magmas, mantle xenoliths included in phonolitic liquids show some differences: (1) smaller size (diameter < 1 cm); (2) clinopyroxene is less common (< 5% volume) and spinel is absent; and (3) partial alteration to micaceous minerals.

Equilibrium temperatures for mantle xenoliths contained in mafic magmas range from 850 to 1170°C, as calculated applying different geothermometers, whereas mantle nodules sampled by peralkaline liquids show only lower equilibrium temperatures (<900°C). A first approximation to equilibrium pressure, based on mineralogical constrains, indicates values from 10 to 25 kbar. Summing up, we consider that the mafic magmas were generated within the spinel-garnet domain of the lithospheric mantle, having little or no interaction with their wall rocks. The ultramafic xenoliths were probably sampled during magma ascent above its source. In contrast, the geochemistry of phonolitic rocks and their altered mantle xenoliths reveal that such magmas cannot be explained by direct mantle melting. The petrogenesis of these peralkaline magmas can be described by a two-step model: (1) partial melting of metasomatized mantle which produced an alkaline magma enriched in LILE and HFSE; and (2) subsequent fractional crystallization of this magma at upper mantle pressures, producing phonolites. While ascending, the peralkaline magmas sampled altered nodules in a shallow level of the subcontinental mantle. The rise and eruption of the mantle-bearing mafic and evolved magmas were facilitated by the post-Laramide extensional regime established during Tertiary time in northeast Mexico.

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FIRE IN THE MIRE – EVIDENCE OF PALAEOWILDFIRES IN EARLY PERMIAN COAL SWAMPS OF THE PARANÁ BASIN, BRAZIL

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Macroscopic charcoal is widely accepted by the scientific community as a direct indicator of the occurrence of palaeowildfires. For the Late Palaeozoic of the Northern Hemisphere records of macroscopic charcoal are relatively common and more or less homogeneously distributed. However, the Southern Hemisphere can largely be considered an “undiscovered” area for this type of fossils and only few records have so far been reported. For the Brazilian Paraná Basin, the first palaeobotanical evidence as represented by macroscopic charcoal has so far been described in detail just from a single site [Quitéria Outcrop (Kungurian of the Rio Grande do Sul State)]. During recent fieldwork a number of new occurrences have been discovered and at the moment macroscopic charcoal remains can be considered a common element at the Southern and Southeastern borders of the Paraná Basin, throughout the Rio Bonito Formation coal forming interval. Up to now samples from the Recreio, Seival, Faxinal and Morro Papaléo mines (Sakmarian, Rio Grande do Sul State), Bonito I mine (Artinskian, Santa Catarina State) and the Figueira coalfield (Artinskian?, Paraná State) yielded macroscopic charcoal. All the charcoal fragments are relatively large (between 1.1 x 0.6 x 0.2 and 10.2 x 3.7 x 0.9 cm) with non-abraded edges indicating that transport has been short or absent prior to sedimentation. However, in most cases the woody tissues have been shattered into more or less small pieces by compression during diagenesis. The anatomical characteristics where sufficiently preserved to establish a connection of the charred woods to gymnosperms and arborescent lycopsids. The occurrence of macroscopic charcoal remains in different mire systems of the Paraná Basin’s Late Palaeozoic, adds evidence to previous studies which demonstrated the abundant presence of inertinite as a pretrographic component of coal in different coalfields, suggests that palaeowildfires have been common during the Early Permian in the Western Gondwana Realm and affected the vegetation responsible for the formation of the original coal biomass.

FOSSIL HILL, A KEY LOCALITY TO THE UNDERSTANDING OF THE EVOLUTION OF THE EOCENE OF SOUTH AMERICA AND ANTARCTICA

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King George Island is one of the two of the key areas for the understanding of the complicated scenario of the Eocene; in this stage, it begins the definitive disconnection between South America and Antarctica, with the presence of shallow waters in wide areas of the istmo formed between both subcontinents.

The well known continental outcrops in Antarctica are from Mount Wawel, in Admiralty Bay and Fossil Hill,Fildes Bay, both in the King George Island, and the Meseta Formation in Seymour Island. These Islands are exhibiting a wide spectrum of organism and fossils with an common origin, reporting a strong terrestrial link between Patagonia and the Antarctic Peninsula previous to the stage of complete spreading.

Especially important for the record is Fossil Hill Formation (Middle Eocene), which is known since at least four decades. The fossil data was registered in a volcanoclastic sequence of approximately 15m thick, with fine to medium grained agglomerates, intercalated with fine layers (0,5-5 cm thick) of purple mudstone, which containes most of the well preserved flora and invertebrate and vertebrate tracks, with an avian origin with at least three different avian ichnotaxa, such as Gruipeda fuenzalidae, and even a possible track of a mammal, in a lacustrine enviroment seasonally dried and episodically refilled.

Up to 72% of the plant taxa has been described for other localities of the South American Eocene, evidencing the past connection between the two continents. Nearly 80% of the palynomorphs pertain to cryptogamic flora (fungi, bryophytes and ferns) and 5% to the gymnosperms (Araucariaceae and Podocarpaceae). Angiosperm pollen grains are few in number; these are dominated by the morphogenus Nothofagidites but contain the species N. senectus, a primitive form of Nothofagus, which underscores the Cretaceous age of the sequence. Among the megafossils found, the most important impressions are of Sphenopteris, Podocarpaceae and dicotyledons, such as Nothofagus.

PREDICTION OF THE TOP OF A RESERVOIR LOCATED BELOW THE CURRENT DRILL BIT POSITION USING THE RESULTS FROM A ZERO-OFFSET VERTICAL SEISMIC PROFILE

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One of the advantages that can be obtained from Zero-Offset Vertical Seismic Profile or ZVSP data is to determine with accuracy the depth at which the top of a reservoir is located below the current drill bit position in order to reach this objective, have a better control of the well and avoid drilling problems or loss risks when such objective is reached in case of a gas or oil reservoir where pressure conditions might vary (overpressured zones).

The techniques used, which allow to determine the objective with accuracy using the results from the processing of ZVSP data are the following: a) Seismic Inversion Technique, b) Linear Equation and c) Graphic Method. The Seismic Inversion technique permits to obtain the Acoustic Impedance values from the seismic trace obtained from the processed ZVSP data. By applying a Linear Equation of second or third grade to the Time-Depth values, a linear approximation of this curve is obtained and then it is extrapolated in order to predict the objective below the current drill bit position. The Graphic Method consists of the extrapolation of the trend of the Time-Depth curve displayed in a plot over the reflected signal to determine its interception with the reflectors and estimate the depth. The method is similar to the linear trend adjustment method mentioned above, but it is based on the graphic only.

The application of the methods mentioned in the abstract are discussed in relation to a case study of the use of predictive VSP. The example involves the processing sequence and the results of a ZVSP, from which, a Seismic Inversion technique, a Linear Equation and a Graphic Method are applied in order to predict the top of a reservoir below the current drill bit position.

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PRELIMINARY EVALUATION OF DEPOSITIONAL FEATURES OF THE SURETKA FORMATION IN THE DAM SITE OF THE REVENTAZÓN HYDROELECTRIC POWER PROJECT (COSTA RICA) AND THE PROBABLE RELATION WITH GROUTING

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This work present a preliminary identification of the lithological units and the sedimentary structures in the conglomerade of the Suretka formation located in the dam site of the Reventazón hydroelectric project located in the NE region of Costa Rica. Also are presented data of permeability obtained from water pressure test (WPT) make in boreholes, grout take and the probable relation between the permeability and grout take. The geological units are observed in galleries excavated for the construction of the grout curtain of the dam foundation and the abutments and outcroups in the abutments. The lithological structure can be separate in three components: the sandy-loam cemented matrix (20-40 %); gravel and boulders (60-80%), sometimes disposed in lenses, and sandy cemented lenses. The lithological units can be described like: course conglomerade, medium conglomerade, gravel lenses and sandy lenses. The gravel lenses represent the projection of fluvial ancient channels. Although the ancient fluvial dynamic in these depositational environment could be complex, it will be possible to identified a depositational direction and the dip from the orientation of axis of imbricated subrounded igneous gravels, blocks and boulders, affected lately by tectonic forces. The dip average is in the range of 15-20° and the main dip direction is NW. The ranges values of permeability obtained from Lugeon water pressure test (WPT) is related to the occurrence of the different lithological identified units and discontinuities. The sandy matrix have low permeability and is no injected with normal water/cement rations, but the course conglomerate, gravel lenses and open fractures show higher permeability values (>10 U.L.) and can be injected with water/cement ratios between 1 and 0,5. The results of WPT shows that the major frequency of permeability data are between 0-5 U.L. (60 % of test), 6-10 U.L. (20%), 11-20 U.L. (13%) and high than 20 U.L. (7%). The most frequently effect identified is the wash out. The effect of wash out and turbulent flow is associated with course conglomerate and the impervious effect is associated with sandy lenses and the matrix. The cement take average value obtained in the primary boreholes make in a test grout curtain is 0,8 bags of cement per lineal meter. A direct relation between permeability values and grout take can be identified. The water/cement ratios more used were 1,0 (4/4, 100 kg water/100 kg Portland cement) but the sealed of void spaces and fractures must be confirmed with the execution of secondary line of boreholes and the respective WPT.

KINEMATIC MODELS OF LANDSLIDES IN A METAMORPHIC BELT, ECUADOR

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Main point of the present work is the investigation of a landslide area located in the Andes, which hillside movements risk the operation of one of the most important Ecuador's hydroelectric power plants.

Azimuths of linear features, identified on aerial imageries, as well as of geological structures and discontinuities were statistically analyzed and correlated. The role played by each of these groups of discontinuities in the occurrence of landslides was established based on the observation of morpho-genetic processes.

The steep dip toward WSW of the main cleavage "S_1" from metamorphic rocks (greenschist facies) commonly constitute the lateral flanks of some landslide units. Orientation of a secondary regional cleavage "S_2", mainly observed in chlorite-, muscovite greenschists, have played an important role in the occurrence of mass movements. In fact, strikes and dips of this "S_2" cleavage and main landslide surfaces are similar.

An important geological structure is a dextral fault registered at the left side of the "Paute" river. Azimuth of this structure (NE – SW) is coincident with the direction of the river. Consequently, a structural control of the river flow by this fault is possible.

The orientations of the geological structures as well as the engineering properties of the metamorphic rocks determine the kinematic of the hillside movements. The basement of the central part of the landslide area is composed by albite-quartz-muscovite-chlorite schists with low shear strength. This material is strong susceptible to slide. In fact, the morphology of this area is characterized by thick landslide masses with abrupt slope changes. These changes can be correlated with linear features observed on aerial photographs and with normal faults registered at the sides.

Massive metamorphic rocks with good engineering properties constitute the left flank of the landslide area. Nevertheless, this apparently stable sector has step morphology and is crossed by a set of normal faults. Field evidences let suspect that a mountain collapse of this sector is feasible.

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TECTONO-MAGMATIC AND PALEOGEOGRAPHIC EVOLUTION IN THE NORTHWESTERN PART OF THE SOUTH AMERICAN PLATE: GEOCHEMISTRY, GEOCHRONOLOGY AND PALEOMAGNETISM

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Recent mapping carried out in north Colombia has provided a significant step forward in the geological knowledge of this region. In order to supply a quantitative characterization to the new data and to consolidate a model for the Mesozoic tectonic evolution of the Northern Andes, geochemical and geochronologic analysis for Jurassic and Cretaceous rocks will be integrated. Latest paleomagnetic (Bayona et al., 2005; Bayona et al., 2010) and geochemical studies (Vásquez et al., 2006; Vásquez et al., 2010) on different Jurassic and Cretaceous rocks indicate that these terrains reflected a long-term magmatic history (ca. 90 Ma). These terrains were displaced along a subduction margin during the Jurassic and subsequently involved in rifting processes during the Cretaceous. However, Jurassic magmatism has also been related to extensional settings during the break up of Pangea and opening of the proto-Caribbean ocean. There are regional geological evidences that the tectonomagmatic situation in the Pre-Andes varies at different paleolatitudes. However, up to now there is no systematic geochemical evaluation to reconstruct the origin and differences between the Jurassic and Cretaceous magmatism in time. The data in this study involves Jurassic and Cretaceous rocks from five geological regions in the Colombian Andes. Ar/Ar radiometric dating in plagioclase and mica and U/Pb in zircons extracted from volcanic rocks will permit us to establish a time-space evolution of the northern Pre-Andes lithosphere.

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FIRST RECORDS OF SUBLETHAL AND LETHAL INJURIES IN LATE JURASSIC (TITHONIAN) AMMONOIDS FROM ARGENTINA

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Late Jurassic-Early Cretaceous ammonite shells are the most common invertebrate remains in the marine sedimentites of the Vaca Muerta Formation, Neuquén Basin, west-central Argentina. Despite of their high abundance and well preservation, sublethal and lethal injuries in Argentinian ammonoids have been overlooked by previous workers, hence this is the first approach to their study.

From a total of 2,000 Tithonian ammonites recovered from different localities along the basin only 1.2% of them have evidences of shell regeneration and only one specimen shows a ventral bite mark on its living chamber comparable to the cases studied by Klompmaker *et al*. (2009) and Andrew *et al*. (2010), and consequently interpreted as a successful predatory attack. 86% of the damaged specimens exhibit lateral, latero-ventral and ventral injuries which are correlated in most cases with sculpture disruptions in the form of backwards rib bending (*Rippenscheitelung*) with or without a median furrow associated (*Rippenknickung*). This morphology -*forma verticata*- Hölder (1956) is the result of a punctual injury on the mantle edge, the one in charge of sculptured shell secretion. Shell breakage areas on other specimens are inferred from abrupt direction changes in the ornamentation elements or little shell portions unornamented or with a lowest relief sculpture -*forma substructa* of Hölder (1973)-. When only the internal mould is preserved, these kind of injuries are preceded by a slight depression as a consequence of extra shell material accumulation to heal the traumatism.

Regenerated shell areas in ammonites have been frequently associated with frustrated predation attempts, although injuries around the peristome during mating or feeding on prey, have been also considered. Many potential predators are found on the same stratigraphic levels than the injured ammonoids. These include marine reptiles (crocodiles, sea turtles, ichthyosaurs and pliosaurs), fishes (Pachycormids, Ichthyodectiforms and Caturidae-like) and other groups of cephalopods (nautilids and belemnites). Taking into consideration the feeding habits of those taxa and the small to medium size of the injured ammonites shells (diameter < 90 mm), only the smaller durophagous active predators, or their hatchlings, with strong beaks or jaws may have been the ones who attacked but not succeed in killing the ammonites.

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This is the contribution C-11 of the Instituto de Estudios Andinos Don Pablo Groeber.

NEOPROTEROZOIC GLACIATIONS: IRON FORMATION, PHOSPHORITE AND EVOLUTIONARY LEAP

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In the last years, much work has been done on the climatic history of theNeoproterozoic. There is now new data available on the many glacial events of that time, in particular from China, South America and South Africa. Besides providing newknowledge describing the characteristics of glaciogenic sediments, they highlight theimportance of biological activity, related to improved climates following glaciations, which has been linked to the precipitation of iron and phosphate.

In Brazil, Gonzaga & Walde (2007) presented a review and a proposal from theirmany previous works on the occurrence of glaciogenic sediments of Ediacarian agerelated to mountain glaciations which developed in the many orogenic belts in the Brasiliano event (~630 -540 My) around the São Francisco craton in Brazil. The deposits are not continuous, do not occur in a single stratigraphic level, were oftenexposed to intense gravitational reworking (turbidites) in a glacio-marine environmentand can show considerable associated deposits of phosphorite an/or iron formation. This scenario is very compatible with examples from West Africa and elsewhere, andcan even be extended into the beginning of the Cambrian.

The Ediacarian glaciogenic sediments in Brazil have been and are still oftenmistaken for continental glaciogenic deposits associated with the São Francisco Glaciation (or Jequitaí) which occur on the São Francisco craton and are dated asSturtian (~750 My).

The origin and location of iron formations and phosphorite are of great economical interest. Therefore it is important not to mistake Ediacarian iron formation and phosphorite stratigraphic sequences of economical potential with Sturtian sequences.

Swanson-Hyssell et al (2010) suggest that the Sturtian glacial event removed theregolith that had accumulated since the end of the Makganyene glaciation (~2.1 Gy), accelerating weathering and allowing for a considerable transport of iron into the oceans. Planavisky et al (2010) reported a similar idea in relation to phosphorous, whichcontributed to the evolution and radiation of metazoans.

The action of the Sturtian glaciation had important consequences for the evolution of life on Earth, as well as for the formation of important economical depositsof iron formation and phosphorite during the Ediacarian and the beginning of the Cambrian.

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GLACIAL LAKE OUTBURST FLOODS IN PATAGONIA: THE CASE STUDY OF LAKE CACHET II

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With glaciers in Patagonia receding and thinning, glacial lakes dammed either by a moraine or by glaciers become more abundant and pose an increasing risk of outburst floods. We present the history of flood events at the Northern and Southern Patagonian Icefields during the last 100 years and contrast it with the warming temperature trend in the region of 0.5íC during the last 40 years.

A prominent example is Lake Cachet II at the eastern margin of the Southern Patagonian Icefield (47°12'S, 73°15'W, 422 m a.s.l.), dammed by Colonia Glacier. The lake, with an area of 4 km^2, has a record of at least 8 outburst floods in the last 3 years without any known event before this date.

In each of the events, the lake emptied through a subglacial channel and produced a flood wave down Colonia River that reached the confluence with Baker River some 35 km downstream within 48 hours with a peak flow of approximately 2,000 m^3/s.

Airborne laser scanning data acquired a few days after the flood event in October 2008 allow us to map the lake bathymetry and estimate the water volume of the filled lake to be 0.2 km^3.

In November 2009, two time-lapse cameras were installed at Lake Cachet II and at the front of Colonia Glacier which operated for more than one year. The cameras, which take 3 photos per day, allow monitoring the lake and analyzing the outburst events and associated morphological changes in more detail.

The flood events have been modelled based on the subglacial flood model of Clarke (2003) assuming a subglacial tunnel of semi-circular cross section. The model shows that a maximum tunnel diameter of 15 m can evacuate Lake Cachet II in approximately 48 hours, with peak flows around 4000 m^3/s at the glacier terminus.

A combination of in-situ data, airborne measurements, satellite imagery and hydrological data collected by automatic sensors from DirecciŚn General de Aguas (Chilean Water Cadastre) is used to describe the flood events in an attempt to predict them.

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HIGH- AND MEDIUM-PRESSURE METAMORPHISM DURING EARLY PALEOZOIC TIMES IN THE EASTERN CORDILLERA OF PERÚ (TARMA PROVINCE): EVIDENCE FOR MICROPLATE COLLISION

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Ramos (2009) proposed an Early Ordovician collision of a suspect Paracas Terrane with Gondwana at a suture zone along the entire length of the Peruvian Eastern Cordillera. Here we provide PT-data of two metamorphic complexes along the suture zone for refinement of this scenario. The suture zone is marked by the Tapo-Acobamba Complex, a discontinuous belt of elongated ultramafic rock bodies. One of the main occurrences is the Tapo Massif, a lense-shaped serpentinite body, which also contains small podiform chromitite deposits and lenses of garnet-amphibolite, both strongly sheared and thrust upon the upper Palaeozoic sediments (Ambo Group). The metabasite geochemistry suggests a mid-ocean ridge or an ocean island protolith. The whole sequence can be interpreted as a disrupted ophiolitic complex (Castroviejo et al., 2010). Smaller ultramafic bodies of the Tapo-Acobamba Complex occur as tectonic lenses within the Marañon Complex. This term refers to widely distributed low to high grade metapsammopelites and intercalated metabasic rocks within the Peruvian Eastern Cordillera which are also intruded by Ordovician as well as Late Paleozoic-Triassic plutons (Chew et al. 2007).

Applying pseudosection techniques to garnet amphibolite in the Tapo-Acobamba Complex we can restrict its peak metamorphic conditions to 12.5±1 kbar and 535±20°C corresponding to 41-48 km burial depth (calculating with a mean crustal density of 2.8 g/ccm) and a low metamorphic geotherm of 10-13°C/km. A K-Ar cooling age of hornblende of 448±26 Ma approximates the age of this metamorphic event (Tassinariet al. 2010). Within an adjacent block of the Marañon Complex east of Tarma conditions of 4.9±0.8 kbar, 385±30°C were detected in a similar way for partly garnet-bearing amphibolite and mica-schist.

Such high and medium pressure conditions occur in subduction settings and collisional belts. Similar conditions were derived e.g. by Willner et al (2011) in a Devonian collision zone between an exotic microplate (“Chilenia”) and South America. A comparable situation might also be conceivable for the situation in the Eastern Cordillera of Peru.

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AN INTERACTIVE MAP-BASED CENTRAL ANDEAN GEOCHEMICAL DATA COMPILATION FOR USE IN BASIC RESEARCH AND PROSPECTION

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We have compiled >3500 geochemical analyses on mostly volcanic and intrusive rocks from the Central Andes in order to document the chemical composition of Andean magmatism in space and time. The data set includes radiogenic (Sr-, Nd-, Pb-) isotope analyses and more than 2000 radiometric ages. Furthermore it includes >1000 geochemical data from our own analytical work over the years (Mamani et al.,2008; 2010) and literature sources.

Geochemical analyses are presented using AJAX technology based on google-Maps API 2.0. MySQL data base management is done in PHP-, html- and Java-script and uses an optimized server-client architecture. http://www.uni-geochem.gwdg.de/index.php?option=com_content&task=view&id=136&Itemid=155

This system provides the compositional and age data as well as relevant meta-data for each sampled locality at high spatial resolution by zooming-in either onto a topographic base or satellite imagery.

The data set can be filtered for several important geological and geochemical parameters such as geological age, individual volcanoes, SiO_2 content, rock type, author, and country. Individual samples (according to sample number) can also be selected. Filtered or unfiltered data can be downloaded in an Excel sheet.

We provide this data base and envision a variety of potential uses: (a) geochemical studies on the petrogenesis of Mezozoic to Recent magmas in the Central Andes, (b) geochemsitry of potential targets for mineral exploration activities, (c) characterization of basement rocks using isotope data, (d) prospection for geothermal energy, (e) hazard assessment, and (f) last but not least geological mapping and understanding the regional geology of an area.

We present an example of a study on the variation of trace element patterns in Central Andean magmas before and after crustal thickening and with respect to distinct crustal domains. We can demonstrate how these variations are linked to changes in the style and conditions of magma evolution through time and space.

The ease of use of the Andean Data Base will be demonstrated and can be explored by potential users “online” at the session.

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BOTTOM MORPHOLOGY AND RECENT SEDIMENTATION OF CERRO PRIETO WATER RESERVOIR, NE MEXICO: GEOPHYSICAL STUDY

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Role of bathymetric control and recent sedimentation in water reservoir management is very important, especially in the case of developing and semi-arid countries. Concerns exist about the future of many Mexican reservoirs due to soil erosion and subsequent siltation producing losses in storage capacity. Besides, the number of studies of these problems is very poor. Lake Cerro Prieto shares this problem with most impoundments in Nuevo Leon State (NE Mexico).

Geophysical investigation including gravity, magnetic, electrical and shallow (onshore) seismic study of the Cerro Prieto water reservoir and adjacent areas was carried out as the first step of our integrated research (Yutsis et al, 2009). It was suggested that shallow structure of the Pablillo basin area is affected by the deep tectonics, and that the basement blocks are still in motion and hence being a real threat for the Cerro Prieto dam.

The objective of the very high resolution seismic research in the Cerro Prieto dam was in conducting a detailed bathymetric and sedimentologic survey of the reservoir for the purpose of (1) obtaining an accurate map of Lake Bathymetry (depth) and water volume, and (2) determining of distribution, thickness and volume of recent sediments in the Lake basin.

The SES-2000 parametric (non-linear) dual frequency echo sounder was used. It is possible to recognize two different areas into the Lake basin. The western shallow-water area is largely occupied by a flat to rolled bottom at a depth of between 0.5-10 m. Eastern deep water area is characterized by irregular topography. The bottom depth is generally more than 15-20 m and attains a maximum depth of approximately 28-30 m.

A high rate of recent sedimentation due to damming is discovered. Data interpretation shows that the thickness of sediments due to siltation of the reservoir reaches 2.5-4.0 m. This factor has never been taken into account in the calculations of volume of water for this reservoir. Meanwhile, the account of the two above-mentioned factors (topography and the recent sedimentation) in the calculation of water volume in Cerro Prieto dam results in difference reaching from 8-10 up to 30 million cubic meters which is about 2-8% of total storage capacity.

PRIMARY AND SECONDARY PLATINUM GROUP MINERALS (PGM): THE EXAMPLE CASE OF THE LOMA PEGUERA OPHIOLITIC CHROMITITES (DOMINICAN REPUBLIC)

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On the basis of their mode of occurrence, morphology, textural position and mineral chemistry, the PGM associated with ophiolitic chromitites can be classified as 1) primary, i.e. crystallized at magmatic temperatures, and 2) secondary, i.e. formed during hydrothermal or weathering processes, at low temperature.

We report on the presence of primary and secondary PGM in chromitites of Loma Peguera (Loma Caribe ultramafic massif, Cordillera Central, Dominican Republic). The chromitites form massive, podiform ore bodies of metric size included in partly serpentinized and lateritized peridotite. Primary chromite composition is Cr-rich ($0.74 < Cr\# < 0.78$) with high Ti and Fe^{3+} contents (0.84 wt% TiO_2; 7.82 wt% Fe_2O_3). Bulk rock concentrations of platinum group element (PGE) vary from 1.8 up to 3 ppm, showing relatively high (Os-Ir-Ru)/(Rh-Pd-Pt) ratios although with a positive anomaly in Pt (249–269 ppb).

The primary PGM consist of small polygonal grains, less than 10 microns in size, included in fresh chromite. The mineral assemblage includes: laurite, irarsite, iridium, cuproiridiste, malanite, Rh-and Ru-pentlandite, and a suite of unnamed compounds of Ru-As, Ir-Rh-S, Ir-Rh-Pd-Fe-S, Pt-Fe, Pt-Fe-Ni and Fe-Ir-Rh-Cu. They form single-phase or poly-phase grains in association with pyrrhotite, clinopyroxene, amphibole and rutile. The secondary PGM are bigger (up to 100 microns) and are characterized by irregular shape and chemical zoning. They occur in contact with secondary minerals, mainly chlorite, serpentine, Ni-Fe alloys and ferritchromite. They consist of hexaferrum, garutiite, ruthenium, unnamed $Pt(Ni,Fe)_3$, (Ru,Pt)(Fe,Ni), $(Fe,Ru,Ni,Os,Ir,Co)_2S$ and compounds of Rh,Ni,As and Ru-Os-Ir-Fe-O.

The chromite composition and primary PGM assemblage indicate relatively high Ti concentration and S fugacity in the chromite forming system at Loma Peguera. These features are unusual for ophiolitic chromitites crystallized from boninitic melts in a supra-subduction geodynamic setting. The secondary PGM do not appear to have precipitated from low temperature solutions, but probably formed in situ after pre-existing magmatic phases become unstable under alteration conditions. Their compositions reflect remobilization of PGE at a small scale during alteration, thus leaving primary whole-rock concentration of the PGE unaffected.