Rodinia and Gondwana Stratigraphy and Geochronology

Sedimentary provenance of Neogene strata from the SW Portuguese Coast (Sines Cape): detrital zircon U-Pb geochronology

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In this preliminary study of provenance analysis Neogene sandstones and conglomerates of the Alvalade Basin were sampled, from the sea cliffs nearby the Sines Cape (SW Portuguese Coast). Detrital zircons were extracted by conventional methods of particle size separation, magnetic and heavy liquids separation. Detrital zircons were dated by U-Pb method with LA-ICPMS. The U-Pb geochronology results indicate as potential fonts for all samples: i) the Carboniferous greywackes of the Mira Formation (South Portuguese Zone) or the upper Triassic sandstones of the Silves Formation Sandstones (Alentejo Basin) for the zircon ages older than the Permian; and ii) the sienites from the Sines Massif for the upper Cretaceous zircon ages. Note also that one sample includes a significant population of detrital zircon age of Permian age whose potential source is not known in the surrounding of the Alvalade Basin.

Keywords: Plio-Plistocene, Sandstones and conglomerates, Provenance analysis, Alvalade Basin.

Provenance analysis of the Late Ediacaran basins from SW Iberia (Serie Negra Succession and Beiras Group): evidence for a common Neoproterozoic evolution

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This study makes a comparison of the populations of detrital zircon from Late Ediacaran greywackes of the Ossa-Morena Zone (OMZ) and the southern domains of the Central Iberian Zone (S-CIZ). The results obtained reveal that the main difference between the age spectra of both populations of detrital zircon is the Neoproterozoic, in particularly the Cryogenian grains. Our new data suggest that deposition in both CIZ and OMZ Ediacaran basins was coeval and shows a long lived magmatic event typical of the northern Gondwana margin (Avalonian–Cadomian belt and Pan-African belt). Overall, SW Iberia shows the following sequence of Cryogenian and Ediacaran zircon-forming events: i) ca. 850–700 Ma, Pan-African suture (well represented in the Beiras Group and in the Mares Formation of the Serie Negra Succession); ii) ca. 700-635 Ma, Early Cadomian arc (dominant in

the Beiras Group and in the Mares Formation of the Serie Negra Succession); and iii) ca. 635-545 Ma, Late Cadomian arc (the most important in the Mosteiros and Escoural formations of the Serie Negra Succession). The obtained results reinforce that the Late Ediacaran basins of SW Iberia were evolved together in the active margin of North-Gondwana in the same paleogeographic scenario but sufficiently separated to justify the differences mainly identified in their Neoproterozoic detrital zircon contents. This finding shows that there is no apparent reason to believe that the boundary between the OMZ and the S-CIZ marks a Cadomian suture.

Keywords: Detrital zircon, Source-areas, Central-Iberian Zone, Ossa-Morena Zone, North Gondwana.

Decipher a multi-event in a non-complex set of detrital zircon U/Pb ages

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The determination of U-Pb ages from detrital zircons of sedimentary rocks using LA-ICP-MS has been widely used to develop studies of provenance analysis. A problem that frequently arises is to find a population that appears to be non-complex despite of several perceptible age peaks in their spectrum. These peaks are qualitatively defined through diagrams of relative probability – PDF, but difficult to quantify their statistical significance relative to a zircon forming multi-event. As so, can we decipher and characterize a multi-event in a non-complex set of detrital zircon U/Pb ages?

This work is an attempt to answer the above question by means of a statistical analysis. The objectives are: a) to determine the most appropriate minimum number of zircon age populations (peaks), b) to characterize each peak in terms of age and event duration; c) to compare results obtained for two datasets showing similar zircon ages. The process starts by a cluster analysis aiming to group zircon ages into a set of consistent clusters. A Gaussian kernel function is then fitted to each cluster and summed up to obtain a theoretical PDF. At the end of the process, the best modeled PDF must coincide with the original PDF in >=95%, and the deciphered peaks can be characterized.

Keywords: Detrital zircon data, population, peaks, comparions of datasets, Gaussian kernel function.

The Cryogenian and Ediacaran records from Amazon Palaeocontinent

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The Amazon Craton was enrolled in the buildup of the Rodinia and the Gondwana Supercontinents during the Neoproterozoic. Along this Era, the Earth surface was marked by important transformations as global glaciations, atmospheric and ocean oxygenation pulses and the turnover of life forms. Most of these events were record on the margins of Amazon Palaeocontinent exactly during the time between the Rodinia Breakup and the Gondwana Assembly, today located in its southeastern border as part of the Paraguai Thrust and Fold Belt. This abstract shows the age constraints obtained for the respective sedimentary successions based on several tools as geochronology using U-Pb, Pb-Pb and Ar-Ar methods, isotope chemostratigraphy of C and Sr and paleobiology. According the results, the sedimentary successions record the Earth surface conditions from the Early Cryogenian to the Early Cambrian.

Keywords: Cryogenian, Ediacaran, Paraguai Belt, Brazil.

The Cadomian Orogen: Neoproterozoic to Early Cambrian crustal growth and orogenic zoning along the northwestern periphery of the West African Craton

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The Cadomian Orogen in the NE Bohemian and the northern Armorican Massifs shows a distinct orogenic zoning from recent NW to SE consisting of (i) an outboard sitting continental crustal unit comprising Neoproterozoic rocks associated with c. 2.0 Ga old Icartian Basement, (ii) a magmatic arc and a back-arc basin, (iii) a foreland or retro-arc basin, respectively, and (iv) the passive margin of the Back-arc basin. New U-Pb zircon ages of detrital zircon of Neoproterozoic to Fortunian siliciclastics from the Schwarzburg Antiform in the Saxo-Thuringian Zone (NE Bohemian Massif) identify the West African Craton as the hinterland for the Cadomian Orogen. U-Pb ages and Hf isotope data constrain timing of orogenic events and episodes of crustal growth of both the Cadomian orogen and the cratonic hinterland.

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Keywords: Cadomian Orogen, Bohemian Massif, Saxo-Thuringain Zone, zircon, U-Pb isotopes, Hf isotopes.

CHRONIBERIA: ongoing development of a geochronological GIS database of Iberia

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Geochronological comparisons of large datasets are facilitated by the use of structured databases. This work represents the ongoing development of the CHRONIBERIA, a geochronological GIS database of Iberia that will provide access to zircon U-Pb age data sets from Iberia and will integrate other relevant distinct dataset from other world correlative regions in order to build up a framework based on stratigraphy, sedimentology and paleogeographic data.

Keywords: Geochronology, Zircon U-Th-Pb, database, GIS, Iberia.

Biostratigraphic correlation of the Cambrian succession between Shandong Province, North China and the Taebaeksan Basin, Korea

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The Paleozoic North China Platform is an epeiric platform developed on the Sino-Korean Craton. The Cambrian succession is superbly exposed in Shandong Province which is located in the central part of the North China Platform. The Taebaeksan Basin, Korea displays a somewhat similar Cambrian succession to that of North China, and is known to have been situated at the eastern margin of the North China Platform, ca. 900 km away from Shandong Province. Although both regions have similar Cambrian trilobite faunal assemblages, the independently developed biozonal scheme has hampered a detailed correlation of the Cambrian strata of the two regions. Recent paleontological and sedimentological studies on Shandong Province and the Taebaeksan Basin, enable a detailed correlation of the two regions. The biostratigraphic and lithostratigraphic correlation of the two regions reveals that carbonate production was more active in Shandong Province than in the Taebaeksan Basin, and the Cambrian Series 3 microbial carbonate-dominant facies appeared earlier in Shandong Province. The abrupt cessation of the microbial carbonate accumulation, followed by deposition of siliciclastic mud also occurred earlier in Shandong Province than in the Taebaeksan Basin.

Keywords: North China Platform, Cambrian, biostratigraphy, lithogstratigraphy, correlation.

The significance of changes in the source-areas during the Carboniferous turbiditic deposition (SW Iberia)

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U-Pb dating of detrital zircons from the Carboniferous turbidites of SW Iberia (Cabrela, Mértola, Mira and Brejeira formations) showed that synorogenic sedimentation during the Carboniferous was marked by significant variations in the source-areas, involving the denudation of different crustal blocks and a break in synorogenic volcanism. The Visean is characterized by the accumulation of immature turbidites (Cabrela and Mértola

formations and the base of the Mira Formation). These turbidites were probably formed in relation to Mid-Late Devonian sources (magmatic arcs) poorly influenced by sedimentary recycling, as indicated by the almost total absence of pre-Devonian zircons, ages that are typical of the Gondwana basement. The presence of Carboniferous grains in Visean turbidites indicates that volcanism was active at this time. Later, Serpukhovian to Moscovian turbiditic sedimentation (Mira and Brejeira formations) included sedimentary detritus derived from felsic mature source rocks situated far from active magmatism. The abundance of Proterozoic and Paleozoic zircons reveals strong recycling of the pre-Carboniferous basement. A peri-Gondwanan provenance is indicated by zircon populations with Neoproterozoic (Cadomian-Avalonian and Pan-African zircon-forming events), Paleoproterozoic and Archean (West African Craton zircon-forming events) ages. The presence of Upper Ordovician and Silurian detrital zircons in the Brejeira turbidites, which have no correspondence in the Gondwana basement of SW Iberia, indicates an external source (Laurussia?).

Keywords: U-Pb zircon geochronology, South-Portuguese Zone, Ossa-Morena Zone, Variscan orogeny, Pangaea.

Provenance analysis of Lower Paleozoic siliciclastic rocks of SW Iberia (Ossa-Morena Zone): distal shelf deposition in the North Gondwana passive margin

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U-Pb dating of detrital zircons from the Lower Paleozoic siliciclastic rocks of SW Iberia (Ossa-Morena Zone: Fatuquedo, Ossa, Colorada and Terena formations) showed that sedimentation during the Mid-Upper Cambrian-Lower Devonian was marked by slight variations in the source-areas, involving: i) the denudation of crustal blocks with similar zircon-forming events typical of North Gondwana and ii) the absence of volcanism younger than ca. 470 Ma. The potential source-areas of the Mid-Upper Cambrian-Lower Devonian basins of the OMZ could be: i) the Neoproterozoic basement of the OMZ (Serie Negra) intruded by plutonic rocks of Cambrian and Lower Ordovician age and ii) the Lower Paleozoic sedimentary sequences of the OMZ with Cambrian and Lower Ordovician volcanism. In the oldest siliciclastic rocks the most relevant populations of detrital zircons have Cryogenian and Ediacaran age (Ossa and Fatuquedo formations). In addition, in the youngest siliciclastic rocks, beyond Cryogenian and Ediacaran grains, relevant age clusters of Cambrian and Tonian ages (Colorada Formation) and of Cambrian and Ordovician ages (Terena Formation) also exist. No evidence was found from sources outside North Gondwana. The lack of zircon-forming events younger than ca. 470 Ma seems to indicate that the Mid-Upper Cambrian-Lower Devonian siliciclastic rocks of SW Iberia were deposited in a distal shelf of the North Gondwana passive margin related with the Rheic Ocean opening and in the absence of magmatic activity.

Keywords: U-Pb detrital zircon geochronology, Mid-Upper Cambrian, Ordovician, Lower Devonian, Rheic Ocean.

Provenance of Cambro-Ordovician siliciclastic rocks of the SW Iberia: insights to the evolution of North Gondwana margin

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This study makes a comparison between the populations of detrital zircon of the Cambrian sandstones from the Ossa-Morena Zone (OMZ) and the Ordovician quartzites from the southern domains of the Central Iberian Zone (S-CIZ) in order to identify the sources during development of North Gondwana basins (SW Iberia). The U-Pb results obtained for the Lower Cambrian sandstones of the OMZ show a remarkable similarity with the detrital zircon ages of greywackes from the underlying OMZ Ediacaran basement (Série Negra Succession). However, there is a greater proportion of the Cryogenian grains in the Cambrian rocks which main sources are: i) the Late Cadomian magmatic arcs (Ediacaran, ca. 635-545 Ma) which also contributed to infill the Late Ediacaran basins of the OMZ; and ii) the Early Cadomian arcs (Cryogenian, ca. 700-635 Ma). In the Lower Ordovician quartzites of the S-CIZ (Armorican and Sarnelha formations) the age distribution of detrital zircons overlaps the population of detrital zircons of the underlying S-CIZ Ediacaran basement (Beiras Group). Nevertheless, there are some differences in the Sarnelhas quartzites which have a population of detrital zircons similar to those of the Ediacaran greywackes and Cambrian sandstones of the OMZ. The Cambrian grains found in the Lower Ordovician quartzites fit the ages of magmatism representing the onset of rifting in North Gondwana that occurs in the OMZ and is absent in the S-CIZ. The Lower Ordovician grains are probably related to the magmatic event that preceded the passive margin stage of the Rheic Ocean, and exist in the CIZ and OMZ.

Keywords: SW Iberia, Cambro-Ordovician, rifting, zircon, provenance.

Provenance of the Upper Triassic basins during the first stages of rifting in Pangaea (SW Iberia)

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The Upper Triassic basins of the SW Portugal were filled with continental detrital deposits dominated by sandstones and some interbedded conglomerates and mudstones. Detrital zircons were separated from the upper Triassic sandstones of the Arenitos de Silves Formation, collected in the Alentejo and Algarve basins. Conventional methods of separation of heavy minerals by sizing, magnetism and gravity were used, and the zircon grains were dated through U-Pb geochronology using LA-ICPMS. The analysis of detrital zircon populations through the statistical method of Kolmogorov-Smirnov has highlighted the similarities and differences between the samples of the same basin and between the two basins. Samples of both basins have significant similarities regarding the populations of detrital zircon with ages older than c. 515Ma reflecting the

North-Gondwana basement. If we compare the populations of detrital zircon ages younger than c. 515Ma the two basins shows that: i) the Alentejo Basin contain Paleozoic grains that reflect the influence of sources related to the Upper Paleozoic formations of the South Portuguese Zone or the Ossa Morena Zone basement with Variscan (Upper Paleozoic) zircon-forming events; ii) in the Algarve Basin grains of Paleozoic age are insignificant and suggests the Upper Devonian formations of the South Portuguese Zone or the Ossa Morena Zone basement without Variscan zircon-forming events as the potential sources.

Keywords: Detrital zircon, U-Pb geochronology, Provenance analysis, Arenitos de Silves Formation.

Stratigraphy of the lower Paleozoic Bowers Supergroup, Northern Victoria Land, Antarctica: preliminary results from the Korea Antarctic geological expedition 2012-13

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Since Korea built the first Antarctic research station in the King George Island, South Shetland Islands, Korea Polar Research Institute (KOPRI) carried out geological projects on the island, i.e., stratigraphy, petrology, geochronology, and pedology. The second Korean Antarctic research station is being built, with its opening scheduled in the March of 2014, on the Northern Victoria Land, East Antarctica. KOPRI started moving its focus of the geologic research to the Transantarctic Mountains including Northern Victoria Land. Among many research targets, the lower Paleozoic stratigraphy of the Northern Victoria Land will be the first issue to tackle. The tectonics and related basin evolution of the NVL, which is deviated from those of the main part of the TAM has been the core geological issue of the region. To better understand the basin evolution history, KOPRI is planning a multi-year research program spanning such geological methods as sedimentology, paleontology, structural geology, and petrology. As a reconnaissance study, a group of sedimentologists and paleontologists had a field work in the Eureka Spurs, ca. 220 km northwest of the new station in the austral summer season of 2012-13. Here, the results and the strategy for further research are presented.

Keywords: Antarctica, Transantarctic Mountains, Northern Victoria Land, lithostratigraphy, Ross Orogeny, provenance.

Permo-Carboniferous successions of the Tengchong Block, Western Yunnan, China: status and problems

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The Permo-Carboniferous of the Tengchong Block is composed of a clastic succession (Menghong Group) and an overlying carbonate succession (Dadongchang Formation). Content of Diamictite, pebbly mudstone and Gondwana-affinity faunas suggests that the Tengchong Block was a Gondwana-derived block. Similar successions have also been reported in many places in Southeast Asia and the Tibet plateau. Although the framework of Permo-Carboniferous successions of the Tengchong Block has yet been figured out, biostratigraphic studies need to be improved in many aspects.

Keywords: Tengchong, stratigraphy, Carboniferous, Permian.