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Thesis Abstracts

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Sedimentary evolution and chronology of the Maçambaba Quaternary coastal barrier: the influence of the winds from opposite directions and their possible paleoclimate meaning

August 2015

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Degree: M.Sc.

Supervisor: Paulo César Fonseca Giannini

The Maçambaba Quaternary coastal sand barrier is located between Saquarema and Arraial do Cabo, immediately westward of the abrupt change in the Rio de Janeiro state (Southeastern Brazil) coastline orientation, from SW-NE to W-E, which is one of the main factors determining the coastal upwelling phenomenon in this area. The cooling of the coastal waters by the upwelling explains the relatively low local precipitation indices (less than 1000 mm/year). This coastal barrier was studied with regard to geomorphology, sedimentology (grain size, heavy minerals and limestone petrography) and geochronology (^{14}C AMS and OSL dating). It is represented by two barriers parallel to the coast, tens of kilometers long, deposited during each one of the last events of relative sea level rise (RSL), in the upper Pleistocene (MIS 5e, with maximum RSL around 120 ky ago) and Holocene (MIS 1, with maximum RSL around 5.5 ky ago). The hypersaline Araruama lagoon system is a drowned incised valley up to 8 m deep and 30 km long, that separates the Pleistocene barrier from the pre-Quaternary basement. In the western half, another lagoon system, narrower, shallower and also hypersaline, occurs between the Holocene and Pleistocene barriers. It was generated contemporaneously with the Holocene barrier, thereby having a backbarrier character. Maximum ages obtained at the bottom of the incised valley (6.0 ky BP) and at the backbarrier lagoon deposits (7.0 ky BP) suggest that the two lagoon systems were flooded at the same time during the Holocene transgression. Two aeolian systems with opposite migration direction occur due the alternation between the SW and NE effective wind drift during that time. The system formed by the winds to NE is derived from the beach sands and is characterized by foredunes with increasing height from W to E and by blowouts in the eastern part. This reflects the more dissipative beach eastward and the increase of sediment supply related to the net longshore drift in that direction. The blowouts interrupt the foredunes and play the role of channels in overwash processes. The aeolian system with migration direction to SW occurs as active blowouts and isolated parabolics, which rework the distal part of the eastern washover fans, and as two parabolic paleo dunefields originated in the Araruama lagoon southern shore. These paleo dunefields were formed during the lagoon shore erosional periods. The oldest one, with OSL ages between 7.0 and 6.0 ky, is contemporary to the lagoon maximum flood and is related to the erosion induced by transgression, whilst the new one (OSL age 1.5 ky), immediately westward, is related to lagoon shore erosion linked to circulation changes induced by cuspate spits growth. Besides the evident sediment supply influence, the dune formation is also affected by the climate: the coastal upwelling, and consequently more arid climate in the area are favored by winds to SW. Thus, the age of the new generation of paleo dunefields to SW and the lagoonal calcrete formation age (2.4 cal ky BP) suggest upwelling intensification and aridity increase during the late Holocene.

A PDF of this thesis can be downloaded from: http://www.teses.usp.br/teses/disponiveis/44/44141/tde-22092015-150237/pt-br.php

Xinfu Bao

Lateral intra-stratigraphic sedimentological variations in archaeologically-rich Quaternary karstic complexes: implications on luminescence dating - the case of Galería, Sierra de Atapuerca, Spain

September 2016

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Degree: M.Sc.

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Galería is one of the most significant Pleistocene karst cavities situated in the Sierra de Atapuerca Complex (North-Central Spain), known worldwide for its richness in terms of hominid skeletal fossils, abundant Acheulean lithic artefacts as well as synchronous mammal remains and microvertebrate assemblages since excavations begun in the 1980s. Over the years, the Complex has been dated by multiple methods, including palaeomagnetic measurements and independent numerical chronologies including luminescence (in

the forms of thermo-luminescence TL, optically stimulated luminescence OSL, infrared stimulated luminescence IRSL, and their corresponding sub-techniques), electron spin resonance (ESR) and uranium-thorium (U-Th) dating applied to both clastic sediments and speleothems. Despite the abundance of methodologies, a conspicuous inconsistency between the previously published ages has been observed in an area that barely exceeds 17 m in length and where the different sampled sites are on similar and/or juxtaposed lithological units/levels, only a few centimeters apart.

In this research, lateral sedimentological facies variations within an individual archaeologically-rich layer of the Galera karstic infill were investigated using a novel multi-proxy investigative approach, including a first-time reported horizontal luminescence profiling. The results from the poly-mineral luminescence signal analysis and OSL ages, sedimentological characteristics (e.g. particle size, textural maturity, grain micro-morphology, mineralogical composition), dosimetry and magnetic properties (i.e. magnetic susceptibility, matrix micro-fabric anisotropy) of this layer helped not only to better elucidate the complexities of the evolution of the karstic landscape but also to ascertain the existence of multiple sediment sources and transport paths of the infilling sediments. In our case, the new single grain thermally-transferred TT-OSL ages showed ∼100,000 years difference from one end of the studied layer to the other, confirming different age values due to marked lateral sedimentological facies variations, most likely associated to varying environmental factors and mineral provenance.

This intra-stratigraphic, lateral profiling, multi-proxy analytical approach showed the need to do more detailed geological and stratigraphical work prior to any detailed geochronological endeavour. Moreover, it exposed the complexity of assigning singular and unique numerical ages to individual levels/units/strata in infilled karstic archaeological sites, demonstrating that more care should be taken when selecting sampling locations for age determination in areas of complex stratigraphy and layers of intricate sedimentology and depositional patterns.

Valentina Espinel Arias

Morphology, depositional facies and chronology of Quaternary eolianites of the Piauí and Ceará coast, Northeast Brazil

November 2015

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Degree: M.Sc.

Supervisor: Paulo César Fonseca Giannini

The active dune fields and the eolianites between Luís Correa (Piauí State) and Pararucu (Ceará State), Northeastern Brazil, are located in the area of the Intertropical Convergence Zone influence, from which originate the trade winds responsible for their formation. The variation of the direction in which these winds reach the coast is the main criterion for dividing the study area into three sectors: west, center and east. In each sector, the direction of the effective wind, combined with the coastline orientation, determines the deflation plain development, which increases with the angle between wind and coast. The eolianites appear as discontinuous ridges, parallel to the direction of the effective wind. They occur in the deflation plain and exhibit similar morphology to active trailing ridges. Quartz grain dating by luminescence (OSL) and bioclast or calcite cement dating by ^{14}C AMS indicate ages between 650 and 5700 years. The eolianites nearest to the coastline are older than the farthest ones, a pattern expected in trailing ridges, which are successively left behind and stabilized as the dune field migrates. The concentration of Brazilian eolianites in this area is related to the adjacent inner continental shelf constitution, which is rich in branching red algae and rhodoliths. Keywords: carbonate paleodunes, deflation plain, trailing ridges, dating, Holocene paleoclimate

A PDF of this thesis can be downloaded from: http://www.teses.usp.br/teses/disponiveis/44/44141/tde-22122015-144856/pt-br.php

Shubhra Sharma

Palaeo Landslide-Induced Damming and the Resultant Geomorphic Landscape: Case Study of the Middle Satluj Valley near Sunni/Tattapani (Shimla/Mandi Districts), Himachal Pradesh, India

October 2016

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Degree: Ph.D.

Supervisors: Prof. B.S. Marh and Dr. S.K. Bartarya

Fluvial landforms in the Himalaya have been widely investigated to understand relationship between monsoon variability and fluvial dynamics. There are studies on the genesis and climatic significance of fluvial terraces, debris flows, alluvial fans, landslides, epigenetic gorges, and paleo-flood deposits. However, integrating the variegated landforms particularly, the role of landslides in the landform evolution through sediment contribution, and their implications towards extreme events in the Himalayan region are yet to be demonstrated conclusively. The present study is undertaken in the middle Satluj valley, north-western Himalaya in which the geomorphic processes are modulated by the temporal changes in the Indian Summer Monsoon (ISM). Studies so far either focused on fluvial or colluvial landforms largely treating these in isolation. In the present thesis, an attempt is made to investigate yet unexplored middle segment of the river where all the landforms viz., the fluvial terraces, debris flow deposits, alluvial fans, paleo-landslide deposits, flood deposits and epigenetic gorges are studied as complete assemblage to comprehensively understand the response of fluvial system to the Late Quaternary climate variability. Given

the vulnerability of the Satluj River in recent times to the landslides and landslide induced floods, an attempt is made to understand the processes responsible for paleo-landslides and floods. Thus, the specific objectives of the thesis were (i) to understand the genesis of various landforms in the middle Satluj valley in the Late Quaternary with respect to climate variability and steady-state tectonic processes. (ii) Decipher the role played by paleo-landslides towards valley aggradation, river damming and consequent flooding. (iii) Finally, to build a comprehensive understanding of the landform evolution in the study area.

In the thesis detailed geomorphological mapping supported by sedimentology, stratigraphy and geochemistry is employed. The chronology relied upon the optically stimulated dating (OSL) dating technique on the quartz extract. Chronology constitute one of the major components of the thesis, where OSL dating of the Himalayan quartz is a challenge due to low sensitivity, feldspar contamination and heterogeneous bleaching. This was circumvented by subjecting the quartz to magnetic separation to remove the detrital feldspar contamination. While the contribution from feldspar inclusions in the luminescence signal was checked by employing the Infrared Stimulation step before the Blue Light Stimulated Luminescence (BGSL). The above techniques yielded reasonably clean OSL ages which were used to interpret the climatic events, their regional and global correlations and finally reconstruction of chronologically constrained landscape evolution model.

The study suggests that the fluvial landforms have evolved on a much older pre-existing substratum ($>$100 ka), carved over multiple cycles of erosion and deposition. The majority of the floods in the catchment occurred during transitional/moderate climate, when neither the ISM nor the westerlies were strengthened. The flood phases are clustered between 13-11 ka; 8-4 ka; 4-2 ka; and after 2 ka respectively for which the landslide lake outburst (LLOFs) in the Higher and the Trans-Himalayan catchment of the Satluj River is implicated during the interaction between the ISM and mid-latitude westerlies caused due to the negative Arctic Oscillation (-AO) implying a close coupling between the Himalayan floods and northern Atlantic climatic perturbations.

The optical chronology of the oldest preserved fluvial landforms indicate that the aggradation occurred between 18 and 8 ka and is ascribed to the post LGM strengthening of ISM. The study indicates that contribution from the tributary valleys increased significantly during the transitional climate which is dated to $\sim$12 ka and 9 ka. The younger sediments are dated between $\sim$6 ka and $\sim$0.4 ka. To summarize the chronology suggests that i) variability in ISM controls the sediment mobilisation and deposition on pre-existing surface which is at least $>$100 ka. (ii) The floods were caused due to a combination of the ISM, westerlies and AO and compares well with the major flood events across the mid-latitude regions in the world. iii) The valley-fill aggradation occurred during the strengthened monsoon conditions; where hill-slope processes contribute significantly to sediment supply especially in thrust zones through paleo-landslides, alluvial fans and debris flows. The incision occurred during relatively dry phases when the sediment supply in the system exhausted.