



VELITROP

CNRS International Research Project

FRANCE – BRASIL



WEBINAR

**“VULNERABILITY OF TROPICAL LITTORAL
ECOSYSTEMS TO EUTROPHICATION”**

Gwenaël Abril

Biologie des Organismes et des Ecosystèmes Aquatiques, Muséum Nationale d’Histoire Naturelle,
Paris, France



Bastian A. Knoppers

Prog. de Pós-Graduação em Geoquímica, Universidade Federal Fluminense, Niterói, Rio de Janeiro,
Brasil



Aguinaldo Nepomuceno

Prog. de Pós-Graduação em Biologia Marinha e Ambientes Costeiros, Universidade Federal
Fluminense, Niterói, Rio de Janeiro, Brasil



-- 30 Nov. – 3 Dec. 2020 –



BOREA Museum National d'Histoire Naturelle

CNRS IRD Sorbonne Université



Universidade Federal Fluminense

Programa de pós-graduação em Geoquímica

Programa de pós-graduação em Biologia Marinha



LPG-BIAF Université d'Angers CNRS



Universidade Do Estado do Rio de Janeiro

Faculdade de Oceanografia



LOG Université du Littoral Côte d'Opale – Université de Lille – CNRS



Universidade Federal do Ceará

Instituto de Ciências do Mar – Labomar



CONSULAT GENERAL DE FRANCE
RIO DE JANEIRO



VELITROP Webinar Program

Monday (30/11/2020)

- Time: 10:00-10:20h (Brazil); 14:00-14:20h (France):

“Introduction to VELITROP and objectives of the meeting” – Gwenaël Abril (CNRS)

- Time: 10:20-10:40h (Brazil); 14:20-14:40h (France):

“Diversity of the Brazilian Coastal Zone: Hydro-geomorphology, susceptibility to eutrophication and multiple Anthropogenic Impacts” – Bastian Knoppers (UFF-GEOQ)

Co-authors: Nilva Brandini, Aguinaldo Nepomuceno Luiz C. Cotovicz Jr & Gwenaël Abril

- Time: 10:40-11:00h (Brazil); 14:40-15:00h (France):

“CH₄ production in relation to salinity gradients and organic matter composition in a hypereutrophic coastal lagoon” - Leandro Galliza (UFF-GEOQ)

Co-authors: Marcelo C. Bernardes & Gwenaël Abril

- Time: 11:00-11:20h (Brazil); 15:00-15:20h (France):

“The Sistemas Lagunares do Leste Fluminense Project: Fisheries, community engagement and ecosystem modeling” – Cassiano Monteiro-Neto (UFF-PBMAC)

Co-authors: Rafael de A. Tubino, Tailan M. Mattos, Paulo R. C. Almeida, Maurício D. Abreu, Marcus R. da Costa

- Time: 11:20-11:40h (Brazil); 15:20-15:40h (France):

“pCO₂ distribution in a tropical eutrophic lagoon adjacent to marine waters impacted by upwelling: antagonist effects of biological and thermal processes” – Thaís Erbas (UFF-PBMAC)

Co-authors: Aguinaldo Nepomuceno & Gwenaël Abril

- Time: 11:40-12:00h (Brazil); 15:40-16:00h (France):

“The Brazilian brown mussel *Perna Perna*: a historical and ecological tale from pre-columbian to present times” – Edson Pereira da Silva (UFF-PBMAC)

- Time: 12:00-12:20h (Brazil); 16:00-16:20h (France):

“Coupling geochemical and geoprocessing techniques to evaluate eutrophication history in a tropical lagoon” – Aguinaldo Nepomuceno (UFF-PBMAC)

Co-authors: Fernando Lamego, Mauricio Cerda & Vinicius Vogel

- Time: 12:20-12:40h (Brazil); 16:20-16:40h (France):

“Pigments as a tool for oceanographic and limnological studies” – Silvana V. Rodrigues (UFF-PPGQ)

Co-authors: Marcelo M. Marinho and co-workers

- Time: 12:20-12:40h (Brazil); 16:20-16:40h (France): ***DISCUSSIONS DAY 1***

- Time: 10:00-10:20h (Brazil); 14:00-14:20h (France):

“Experimental Design to Evaluate Ocean Acidification Impacts on Seafood. A Global Approach” –
Fernando Lamego (UFF-PBMAC)

Co-authors: Henrique F. Santos, Aguinaldo Nepomuceno, Micheli Ferreira Ascoli & Sam Dupont

- Time: 10:20-10:40h (Brazil); 14:20-14:40h (France):

“Paleo-oxygenation in dolomitic hypersaline coastal lake based on pore analysis of *Ammonia beccarii* vr. *tepida* (Foraminifera)” - **Daniel François (UFF-GEOQ)**

Co-authors: Camila Areias, Cátia F. Barbosa, Nayara Dornelas, Luiz G.R. Sá-Valle, José C. Seoane & Crisógono Vasconcelos

- Time: 10:40-11:00h (Brazil); 14:40-15:00h (France):

“Proposition of an untargeted metabolomic approach for hypersaline lagoons biofilms” – **Cedric Hubas (BOREA-MNHN)**

Co-authors: Julie Gaubert-Boussarie, Soizic Prado

- Time: 11:00-11:20h (Brazil); 15:00-15:20h (France):

“Changes in the hydrological cycle of two hypersaline lagoon inferred from annually surface water isotopic composition and lipids biomarkers” – **Camila Areias (UFF-GEOQ)**

Co-authors: A. S. Cruz, N. Dornelas, D. S. François, L. Valle, C. Vasconcelos, J. A. McKenzie, T. Eglinton, D. Ariztegui & C. F.

- Time: 11:20-11:40h (Brazil); 15:20-15:40h (France):

“The carbonate system of hypersaline lagoons: projected approaches within VELITROP” – **Gwenaël Abril (BOREA-CNRS)**

Co-authors: Luiz C. Cotovicz Jr, Bastiaan Knoppers, Cátia F. Barbosa, Cédric Hubas

- Time: 11:40-12:00h (Brazil); 15:40-16:00h (France):

“Rapid and cheap probes to document 2D porewater chemistry through the sediment water interface: first applications in Brazilian tidal mudflats” – **Edouard Metzger (LPG-BIAF)**

Co-authors: A. Mouret, C. Matos, W. Machado, R. Diaz-Ramos, G. Nascimento, J. Berredo, E. Geslin & G. Abril

- Time: 12:00-13:00h (Brazil); 16:00-17:00h (France):

DISCUSSIONS DAY 2: SEDIMENT WORKS AND SPECIFIC STUDIES IN HYPERSALINE LAGOONS

Wednesday (02/12/2020)

- Time: 10:00-10:20h (Brazil); 14:00-14:20h (France):

“Mixing zones of tropical river-dominated estuaries: a potentially overlooked CO₂ sink” - Luis C. Cotovicz (UFC-Inst. Ciências do Mar)

Co-authors: Bastiaan A. Knoppers, Nilva Brandini, Gwenaël Abril

- Time: 10:20-10:40h (Brazil); 14:20-14:40h (France):

“Development of Ocean Color observation for the study of the biogeochemical dynamics of Brazilian coastal waters” - Vincent Vantrepotte (LOG)

Co-authors: H. Loisel & M. Kampel

- Time: 10:40-11:00h (Brazil); 14:40-15:00h (France):

“Variability of Chromophoric Dissolved Organic Matter properties in an eutrophic tropical coastal embayment (Guanabara Bay, Brazil)” - Daniel Tremmel (UFF-GEOQ)

Co-authors: Daniel Tremmel, Eduardo N. Oliveira, Luiz C. Cotovicz Jr, Nilva Brandini, Dominique Poirier, Bastian A. Knoppers & Gwenaël Abril

- Time: 11:00-11:20h (Brazil); 15:00-15:20h (France):

“On the relationship between the coastal upwelling winds of Cabo Frio and temperature stratification in the Guanabara Bay, Brazil” – Alexandre Fernandes (UERJ-FAOC)

Co-authors: Alexandre Macedo Fernandes, Elisa Nóbrega Passos, Rogério Pinto Espíndola, Eduardo Negri de Oliveira, Gleyci Aparecida de Oliveira Moser

- Time: 11:20-11:40h (Brazil); 15:20-15:40h (France):

“Research perspectives on coastal plumes pollution by nutrients and trace elements in Rio de Janeiro bays” – Wilson Machado (UFF-GEOQ)

Co-authors: Wilson Machado, João Barreira, Gabriela Bravim, M. Santos, Nilva Brandini, Eduardo Negri

- Time: 11:40-12:00h (Brazil); 15:40-16:00h (France):

“The carbonate system : active witness of eutrophication in Tropical coastal ecosystems” – Gwenaël Abril (BOREA-CNRS)

Co-authors: Luiz C. Cotovicz Jr., Thais Erbas, Aguinaldo Nepomuceno, Nilva Brandini, Marcelo Bernardes, Bastian Knoppers

- Time: 12:00-13:00h (Brazil); 16:00-17:00h (France):

DISCUSSIONS DAY 3: CHANGES IN CHEMICAL AND BIOLOGICAL CONDITIONS INDUCED BY EUTROPHICATION: WHAT? WHY? HOW?”

VELITROP Webinar Program

Thursday (03/12/2020)

- Time: 10:00-10:20h (Brazil); 14:00-14:20h (France):

“Investigating temporal changes in the physical, chemical and biological properties of coastal and marine ecosystems” – **Eric Goberville (BOREA Sorbonne Université)**

- Time: 10:20-10:40h (Brazil); 14:20-14:40h (France):

“Primary productivity and size structure of phytoplankton taxa and biomass in Guanabara Bay (Rio de Janeiro, Brazil)” – **Gleicy Moser (UERJ-FAOC)**

Co-authors R.N.T Lopes, Piedras, F. R.; Lima, D. T.; Lannes, D.

- Time: 10:20-10:40h (Brazil); 14:20-14:40h (France):

“Fungi and the role of the Mycoloop in planktonic ecosystems” – **Mélanie Gerphagnon (BOREA Sorbonne Université)**

- Time: 10:40-11:00h (Brazil); 14:40-15:00h (France):

“Assessment of Phytoplankton Distribution in South Brazilian Bight (Southwestern Atlantic Ocean) using Chemotaxonomic (pigments) Techniques” - **Daniel Tremmel (UFF-GEOQ)**

Co-authors: Daniel Tremmel, Daniela Sudatti, Vanessa Monteiro, Marcelo Marinho, Gwenaël Abril, Silvana Rodrigues

- Time: 11:00-11:20h (Brazil); 15:00-15:20h (France):

“Guanabara Bay: Chlorophyll estimation by remote sensing” – **Eduardo Negri (UERJ-FAOC)**

Co-authors: R. Paranhos, L. Cotovitz, Kampel, N. Brandini & B. Knoppers

- Time: 11:20-11:40h (Brazil); 15:20-15:40h (France):

“Beyond Burial: Tidal Export of Blue Carbon in Brazilian Mangroves - BBLUES” – **Luiz Cotovicz Jr. (UFC-ICM)**

Co-authors: Luiz C. Cotovicz Jr., Gwenaël Abril & Isaac Santos

- Time: 11:40-13:00h (Brazil); 15:40-17:00h (France):

DISCUSSIONS DAY 4: FUTURE PLANS FOR BRAZIL-FRANCE COLLABORATIONS ON COASTAL EUTROPHICATION”

Monday (30/11/2020)

Diversity of the Brazilian Coastal Zone: Hydro-Geomorphology, Susceptibility to Eutrophication and Multiple Anthropogenic Impacts.

Bastiaan A. Knoppers, Nilva Brandini

Programa Pós-Graduação em Geoquímica, Universidade Federal Fluminense, Niterói, Brasil

Aguinaldo Marques Jr

Programa de Biologia Marinha e Ambientes Costeiros, Universidade Federal Fluminense, Niterói, Brasil

Luis C Cotovicz Jr.

Instituto de Ciências do Mar, Universidade Federal do Ceará, Fortaleza, Ceará, Brazil

Gwenaël Abril

Biologie des organismes et des écosystèmes aquatiques CNRS, Muséum National d'Histoire Naturelle, Paris, France

The coastal zone of Brazil harbors a high diversity of ecosystem types, varying from mesotrophic to eutrophic lagoons, typical mesotrophic estuaries, eutrophic estuarine embayments, smaller river deltas and large deltas. It is governed by three scenarios, the NE with a semi-arid climate, restricted input of materials from land and the direct impingement of the oligotrophic South Equatorial Current (SEC), which efficiently washes out the coast and dilutes land materials, leading together to low primary productivity. The second scenario corresponds to the eastern coast with a climatic NE-S gradient from semi-arid to humid harboring small to medium sized rivers with moderate material inputs. The Brazil Current (BC) being the southward meandering branch of SEC also flows over the narrow continental shelf and dilutes materials from land leading to a regional diversity in poor primary productivity, depending on the seasonal flow of the rivers. Within its pathway on the shelf one finds the Abrolhos Bank with coral reefs and other calcifying algae and also the eutrophic embayment of Salvador City, set at the narrowest extension (~ 8 km) of the shelf. The third scenario corresponds to the Quaternary stretches in the SE from the more intensive urbanized area of Rio de Janeiro with eutrophic Guanabara Bay and a conglomeration of coastal lagoons varying from mesotrophic to eutrophic (i.e. the main focus of VELITROP), and henceforth proliferating southwards along the coastal lagoon rich state of Santa Catarina to Rio Grande do Sul. The shelf expands and the BC flows further offshore and shelf edge upwelling is the marine nutrient source. Due to the impact of low wave energy, coastal lagoons with varying degrees of enclosure and material inputs dominate, being mesotrophic to eutrophic, but the link between material inputs, water residence times and other multiple human impacts still has to be established for some regions.

CH₄ production in relation to salinity gradient and organic matter composition

Leandro Louis Magalhães Galliza¹, Marcelo Corrêa Bernardes¹ and Gwenaël Abril^{1,2}

¹Programa Pós-Graduação em Geoquímica, Universidade Federal Fluminense, Niterói, Brasil

²Biologie des organismes et des écosystèmes aquatiques CNRS, Muséum National d'Histoire Naturelle, Paris, France

Water and sediment collection took place in three coastal lagoons and anaerobic incubation of these sediments was performed in three salinities for 81 days in order to assess the contribution of salinity, OM quantity and quality for CH₄ production. Local CH₄ concentration varied between 1197 ± 88 and 4 ± 2 and was higher in Jacarepaguá lagoon. Lipid analyses showed that all lagoons are contaminated with sewage and suggest that

Jacarepaguá's and Tijuca's OM are more labile than Marapendi's. CH₄ concentration in the incubations revealed more correlation with TOC than with salinity. SO₄²⁻ contribution for TA production was higher in the highest salinities. Organic matter quality associated with anthropogenic eutrophication plays an important role in the CH₄ production, this is, eutrophication stimulates local primary production which gets deposited in the sediment, generating labile substrate, which enhances further CH₄ production.

The Sistemas Lagunares do Leste Fluminense Project: Fisheries, community engagement and ecosystem modeling.

Cassiano Monteiro-Neto^{1,2}, Rafael de Almeida Tubino^{2,3}, Tailan Moretti Mattos², Paulo Roberto Camponez de Almeida², Maurício Düppré de Abreu⁴, Marcus Rodrigues da Costa^{1,2}

¹ Departamento de Biologia Marinha, Instituto de Biologia, Universidade Federal Fluminense.

² Pós-Graduação em Biologia Marinha e Ambientes Costeiros, Universidade Federal Fluminense.

³ Departamento de Biologia Animal, Instituto de Ciências Biológicas e da Saúde, Universidade Federal Rural do Rio de Janeiro.

⁴ Cardume Socioambiental & Comunicação.

The lagoon systems on the East coast of Rio de Janeiro State, provide various environmental services to local human populations. Among them, fishing stands out providing biomass and work to a considerable number of artisanal fishers and their families. However, these coastal systems are strongly affected by anthropic actions that hinder local productivity and, consequently, fisheries. The multidisciplinary project Sistema Lagunares do Leste Fluminense (SLLF), supported by Fundo Brasileiro para a Biodiversidade (FUNBIO) has the central objective of identifying the main mechanisms that control lagoon biological productivity, with an emphasis on fisheries, habitat use by ecologically important species, and how environmental drivers and human uses within lagoons impact local communities. Since January 2019, different sampling programs are in progress in four large lagoon systems of the eastern Rio de Janeiro State coastal plain (Piratininga-Itaipu, Maricá-Guarapina, Saquarema and Araruama). Baseline data on primary productivity, fisheries harvest, species life history, and plankton dynamic, will feed Ecopath with Ecosim trophic models, characterizing the structure and functioning of the trophic webs. Models provide the opportunity to evaluate ecosystems attributes (e.g., trophic state, biomass flow, respiration), and elaborate future possible scenarios of lagoon system development. The Rural Rapid Appraisal methodology used by the project, has a strong community engagement for fishery voluntary self-monitoring. Interviews with fishers from different generations, and the use of self-monitoring electronic forms to record individual catches are helping to draw a historical fishery timeline and record production of lagoon systems. This strategy became very important in estimating impacts of SARS-COV-2 pandemic on fishers' livelihoods. Preliminary results on the eastern Rio de Janeiro lagoons indicate that: 1) they show high biological diversity; 2) environmental gradients among systems are mostly derived from the balance between the freshwater input and the connection with the sea; 3) species exploited by the fisheries are mostly from intermediate trophic levels including finfish (e.g., black drum, mullets, croaker, tilapia, snook) and shellfish (blue-crab and shrimps); 4) fishing gears and methods, predominant species and quantities captured vary considerably from one system to another. Using this information on mass balance models may help us to test hypotheses about fisheries management and the effects of natural or human induced ecosystem changes over time.

pCO₂ distribution in a tropical coastal lagoon adjacent to marine waters impacted by upwelling: antagonist effects of biological and thermal processes

Erbas T.¹, Marques Jr A. N. ¹, Abril G.^{1,2}

1 Universidade Federal Fluminense (UFF), Instituto de Biologia, Programa de pós graduação em Biologia Marinha e Ambientes Costeiros, Niterói, RJ, 24020-971, Brazil

2 Biologie des Organismes et Ecosystèmes Aquatiques (BOREA), UMR 7208, Muséum National d'Histoire Naturelle, CNRS, SU, UCN, UA, IRD, 61 rue Buffon, 75231, Paris cedex 05, France

We study the contribution of thermal effects, biological activity and gas exchange in the spatiotemporal variability of surface water pCO₂ in the Saquarema lagoon, a shallow lagoon, receiving moderate amounts of freshwaters and influenced by the Cabo Frio's upwelling. Fieldwork consisted in continuous in situ monitoring and discrete sampling spatial and temporal. Our results show that upwelling cold waters supersaturated in CO₂ enter the lagoon and mix with the less saline waters and warm-up, which should increase pCO₂. However, biological activity inside the lagoon was able to absorb the excess CO₂ brought by the resurgence water and the produced by the heating of marine water masses; and absorb even more CO₂, generating regions of atmospheric CO₂ uptake in the less saline part. We discuss quantitatively the significance of the thermodynamical and biological processes in the context of marine eutrophication of the region.

The Brazilian brown mussel *Perna Perna*: a historical and ecological tale from pre-columbian to present times

Edson Pereira da Silva

Laboratório de Genética Marinha e Evolução, Universidade Federal Fluminense, Niterói, RJ
Brazil

Perna perna (Linnaeus, 1758) is one common species on the Brazilian south-eastern rock shores but not found on north and north-east coast. This restricted distribution is probably limited by salinity and temperature conditions of the sea. As an ubiquitous resource in their distributional area it was always thought as a native species. However, the history of the species became to be rethought as studies with sambaquis (Brazilian shellmiddens, some of them dating as far as 8.000 AP) showed that this mussel is not found in the pre-Columbian archaeological registers from Brazil. Summing up to this some genetic evidences has also been showing that the brown mussel populations from Brazil present some characteristics of a species recently established. In this talk this history will be briefly summarized with some spices from ecological genetics.

Coupling geochemical and geoprocessing techniques to evaluate eutrophication history of tropical coastal lagoons (RJ)

Vinicius Vogel, Mauricio Cerda, Fernando Lamego, & Aguinaldo Nepomuceno

Universidade Federal Fluminense (UFF), Instituto de Biologia, Programa de pós graduação em Biologia Marinha e Ambientes Costeiros, Niterói, RJ, 24020-971, Brazil

The present study aims evaluate the historical process cultural eutrophication in two lagoon-systems in the eastern region of Rio de Janeiro State: Itaipu Lagoon (Niteroi City) and De Fora Lagoon (Saquarema City). The relations between urbanization in the drainage basins and its effects in the two lagoons was established from (i) reconstructing the urbanization process in drainage basins, using historical series of demographic data

and orbital scenes and (ii) reconstructing the eutrophication history in the lagoons through geochemical proxies in sediment cores. The demographic data of the past 40 years showed that the number of inhabitants in the Itaipu Lagoon and De Fora Lagoon increased, respectively, 9 and 3 times during this period. In the same way, the orbital scenes showed more dense occupation in the Itaipu, once the urban area and surroundings cover almost the entire basin. The two cores pointed to siltation of both lagoons, showing the importance of drainage basin as a source of sediments to the lagoons. The phosphorus concentration in the sediments of Itaipu Lagoon ($1,8 \text{ mg g}^{-1} \pm 0,8$) was 6 times higher than in De Fora Lagoon ($0,3 \text{ mg g}^{-1} \pm 0,07$). The ^{210}Pb sedimentation rates obtained from cores with CIC model were, respectively, $\text{SCIC} = 2 \text{ cm ano}^{-1}$; and $\text{SCIC} = 0,4 \text{ cm ano}^{-1}$; for Itaipu and De Fora lagoons. Even though sewage treatment plants have been built in both areas, the evolution of phosphorus concentrations clearly shows that they have not prevented much of sewage load from domestic diffuse sources to still enter the drainage basins.

Pigments as a tool for oceanographic and limnological studies

Silvana V. Rodrigues, Marcelo M. Marinho and co-workers
Universidade Federal Fluminense (UFF), Instituto de Química Niterói, RJ, 24020-971, Brazil

Pigments as a tool in studies which involve the phytoplankton community in different ecosystems will be addressed. A case study at the Continental Shelf of the Campos Basin ($20\text{--}25^\circ\text{S}$) will be presented, showing temporal and spatial variations of the phytoplankton community structure and their correlations with abiotic factors. A spatial/temporal study at the Guanabara Bay estuary shows different degrees of eutrophication and different phytoplankton community structures at the central channel, linked to the coastal marine system, and at sites strongly influenced by continental and anthropogenic inputs.

Tuesday (01/12/2020)

Experimental Design to Evaluate Ocean Acidification Impacts on Seafood. A Global Approach.

Fernando Lamego, Henrique Fragoso dos Santos, Aguinaldo Nepomuceno, Micheli da Silva Ferreira Ascoli, Sam Dupont

The ocean absorbs around 30% of the anthropogenic carbon dioxide emitted from fossil fuels to the atmosphere. As a result of the increase in CO_2 partial pressure the ocean pH is lowered as compared to pre-industrial times and a further decline is expected. Ocean acidification (OA) has been argued to pose a major threat for marine organisms, particularly shell-forming and carbonate-based organisms. The present study will investigate the impacts of different OA scenarios on mussel culture from the Itaipu Marine Extractive Reserve (Rio de Janeiro, Brazil). The mussels will be evaluated for growth, survival and their quality as seafood as well. This proposal focuses on an experimental approach to evaluate the OA impacts on seafood as well as possible mitigation using associated microbial communities. Isolated microorganisms will be investigated on their potential ability to protect seafood, providing beneficial capability against OA impacts. These Beneficial Microorganisms for Marine Organisms (BMMOs) make a new research field in which the nuclear techniques fit as closing tools to evaluate their efficiency as mitigators of OA impacts. Seafood incubations with radioisotopes to study physiological mechanisms like calcification changes will provide a unique method to study kinetics and calcium ion transport pathways. The seafood vulnerability to contamination of metals and polonium present in seawater will be also investigated through experimental assays with mussels in different

sets of acidification and metal concentrations. Cost-effective methods to protect the health of seafood and consumer population are envisaged.

Paleo-oxygenation in dolomitic hypersaline coastal lake based on pore analysis of *Ammonia beccarii* var. *tepida* (Foraminifera).

Daniel François N. Silva¹, Camila Areias¹, Cátia F. Barbosa¹, Nayara Dornelas¹, Luiz G.R. Sá-Valle², José Carlos Sícoli Seoane³, Crisógono Vasconcelos⁴

¹ Departamento de Geoquímica, Universidade Federal Fluminense, Outeiro São João Batista, s/n, Centro, Niterói, Rio de Janeiro CEP 24.020-141, Brazil.

² Departamento de Geologia e Geofísica, Universidade Federal Fluminense Niterói, Rio de Janeiro, CEP 24.210-346, Brazil.

³ Departamento de Geologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, CEP 21.941-916, Brazil

⁴ Department of Earth Sciences, ETH Zurich, Zurich, Switzerland

The Brejo do Espinho lake is one of the few places in the world where dolomite minerals precipitate in recent environments due to local bacterial sulfate reduction activity. Despite being a hypersaline environment, the lake supports a considerable number of organisms such as foraminifera and ostracodes, which present low diversity and high dominance, characteristics of extreme conditions. Recent studies have associated the variation of oxygenation to different pore dimensions in foraminifera tests that represents a biological response to distinct oxygen conditions. The objective of the present study is to assess the use of pore patterns to better understand paleo-O₂ dynamics during dolomite deposition. We measured the parameters of porosity, area, density and number of pores in 33 *Ammonia beccarii* var. *tepida* individuals and compared the obtained data to available $\delta^{13}\text{C}$ carbonate, TOC, and XRD geochemical records of the lake, during the last 1.700 yrs BP. The pores increased as the microbial activity and dolomite precipitation occurs more intensively, which indicates lower oxygen availability in the sediments, as seen in present conditions. In this first attempt, our data provides strong support for the application of pores as a paleo O₂ proxy in paleo-redox carbonate precipitation in coastal lakes.

Proposition of an untargeted metabolomic approach for hypersaline lagoons biofilms

Cédric Hubas, Julie Gaubert-Boussarie, Soizic Prado

Biologie des organismes et des écosystèmes aquatiques CNRS, Muséum National d'Histoire Naturelle, Station Marine de Concarneau

The term metabolome refers to all the small molecules present in a sample. These molecules can be endogenous or exogenous. Endogenous metabolites can be separated into two distinct categories: specialized (quorum sensing molecules, defense molecules, ...) and non-specialized metabolites (fatty acids, amino acids, ...). Metabolomics is an emerging discipline in chemical ecology that generates a large amount of data. This is the reason why most studies have focused, to date, on model organisms, microorganism cultures and also why metabolomic approaches are relatively rare at the scale of communities. We have recently developed a non-targeted metabolomics method on marine biofilms [1]. Through several examples, we will show the potential of this novel approach for the study of hypersaline lagoons biofilms of the Brazilian coasts.

Changes in the hydrological cycle of two hypersaline lagoon inferred from annually surface water isotopic composition and lipids biomarkers

Areias, C.1; Cruz, A.S.²; Dornelas, N.¹; François, D.S.¹; Valle, L.¹; Vasconcelos, C.³; McKenzie, J.A.³; Eglinton, T.³; Ariztegui, D.⁴; Barbosa, C.F.¹

1Universidade Federal Fluminense; 2 California State University, Bakersfield; 3ETH Zurich; 4University of Geneva.

The coastal region of the Rio de Janeiro state (Brazil) is characterized by a semi-arid microclimate associated with the upwelling coastal system of nearby Cabo Frio, which affects the hydrological and biogeochemical cycles in the region. The hypersaline lagoons, Lagoa Vermelha (LV) and Brejo do Espinho (LBE), represent one of the few places in the world where modern precipitation of dolomite occurs. In this study we measured seasonal variation in stable isotopic composition of surface water and suspended particulate organic matter to better constrain the hydrological cycle and environmental features involved in the biomineralization of dolomite in the hypersaline lagoons. The surface water stable isotopes (δD and $\delta^{18}O$) indicate a highly evaporative environment along the year. The n-alkanes and n-alkanoic acid concentrations of the suspended particulate organic matter (SPOM) vary seasonally. The terrestrial/aquatic ratio (TAR index) suggest that terrigenous inputs are the main organic matter source to LBE during the wet season, differing from LV where the pattern is not clear. The variation of the n-C29 hydrogen isotopic composition is coupled with precipitation and temperature changes which shows the large influence of the hydrological cycle on the organic matter deposition on both lagoons. LBE is shallower than LV and tends to dry out being thus, more impacted by the environmental changes. Using an approach combining organic and inorganic geochemical proxies in surface water has led to the recognition of the important regional climatic influence on the carbonate sedimentation in these hypersaline coastal lagoons.

The carbonate system of hypersaline lagoons: projected approaches within VELITROP

Gwenaél Abril^{1,2}, Luiz C. Cotovicz Jr³, Bastiaan A. Knoppers², Cátia F. Barbosa², Cédric Hubas¹

¹Biologie des organismes et des écosystèmes aquatiques CNRS, Muséum National d'Histoire Naturelle, Paris, France

²Programa Pós-Graduação em Geoquímica, Universidade Federal Fluminense, Niterói, Brasil

³Instituto de Ciências do Mar, Universidade Federal do Ceará, Fortaleza, Ceará, Brazil

Hypersaline lagoons have specific properties with respect to the aquatic carbonate system and air-water CO₂ exchange. Recent field works in the Araruama lagoon revealed this system acts simultaneously as a CO₂ sink and a site of carbonate precipitation. Because carbonate precipitation, heating and evaporation, increase water pCO₂, our observations indicates that planktonic primary production induced by eutrophication is able to outcompete all these processes in the Araruama Lagoon, resulting in this uncommon biogeochemical situation. Extremely low pCO₂ were also observed in the still relatively preserved Lagoa Vermelha lagoon, which is known as a site of intense CaCO₃ precipitation including dolomite and stromatolite formation. In order to understand the respective role of the specific properties both physico-chemical (low CO₂ solubility, high carbonate buffering capacity) and biological (active cyanobacteria and sulfate reducing biofilms), high resolution monitoring of the complete carbonate system as well as the stable isotopic composition of DIC, DOC and carbonates during diurnal cycles could provide some answers on the biogeochemical factors controlling carbonate precipitation in the Lagoa Vermelha lagoon

Rapid and cheap probes to document 2D porewater chemistry through the sediment water interface: first applications in Brazilian tidal mudflats

Metzger E., Mouret, A., Matos, C., Machado, W., Diaz-Ramos, R., Nascimento, G., Berredo, J., Geslin, E., Abril, G.

On the last decade, the LPG-BIAF in collaboration with IPGP and EPOC, developed a series of methods for chemical imagery of porewaters at submillimetric resolution (Fe, PO₄³⁻, NO₂⁻, NO₃⁻, NH₄⁺, Mn, Siderophores). These techniques allowed to show the importance of non diffusive transport processes such as bioirrigation on benthic fluxes for nutrients and redox sensitive species. We will focus the presentation on some preliminary results obtained with these techniques in different mangrove tidal mudflats in Rio de Janeiro and Para states. Dissolved iron and phosphate were analyzed in Marapanim, Sepetiba and Paraty mangroves. While Marapanim and Sepetiba showed a strong coupling between Fe and P, Paraty showed no detectable P despite a very intense iron recycling suggesting a strong Fe and P decoupling.

Wednesday (02/12/2020)

Mixing zones of tropical river-dominated estuaries: a potentially and overlooked CO₂ sink

Luiz C. Cotovicz Jr.^{1*}; Bastiaan A. Knoppers²; Nilva Brandini²; Gwenaël Abril^{2,3}

1 Instituto de Ciências do Mar, Universidade Federal do Ceará, Fortaleza, Ceará, Brazil

2 Programa de Geoquímica, Universidade Federal Fluminense, Niterói, RJ, Brazil

3 Laboratoire de Biologie des Organismes et Ecosystèmes Aquatiques (BOREA), Muséum National d'Histoire Naturelle, FRE 2030, CNRS, MNHN, IRD, SU, UCN, UA, Paris, France

The carbonate chemistry predicts that mixture of warm and poorly buffered freshwater with well-buffered seawater will create rapid consumption of the freshwater carbon dioxide (CO₂) by the carbonate buffering capacity of the seawater. To test this hypothesis, we used two tropical river-dominated estuaries in Brazil as laboratories to investigate how thermodynamics compare with biological processes, gas exchange, and tidal advection from mangrove. In both estuaries, the partial pressure of CO₂ (*p*CO₂) followed a bell-shaped curve predicted by carbonate chemistry for conservative mixing. At salinities above ~3, under-saturated *p*CO₂ values and invasion of atmospheric CO₂ occurred because of predominating thermodynamics. Slight deviation from conservative mixing were calculated and attributed to water heating, gas exchange, ecosystem metabolism and mangrove tidal pumping. The low buffering capacity in tropical estuarine deltas can be the predominant driver of *p*CO₂, generating CO₂ under-saturation along the mixing zone, a process overlooked in estuarine systems.

Development of Ocean Color observation for the study of the biogeochemical dynamics of Brazilian coastal waters

V. Vantrepotte (LOG), H. Loisel (LOG), M. Kampel (INPE)

Satellite ocean color radiometry now offers the possibility to depict the spatio-temporal dynamics of a variety of key marine biogeochemical variables in continuous over more than two decades. Numerous methodological developments have been performed at LOG during the last 10 years for specifically developing the description of coastal waters biogeochemical properties from space. This presentation will provide a synthetic overview of these developments as well as of the related recent and ongoing studies based on the exploitation of ocean color archives in coastal waters focusing on the works currently related to Brazilian waters.

Variability of Chromophoric Dissolved Organic Matter properties in an eutrophic tropical coastal embayment (Guanabara Bay, Brazil)

Daniel Tremmel, Eduardo N. Oliveira, Luiz C. Cotovicz Jr, Nilva Brandini, Dominique Poirier, Bastiaan A. Knoppers, and Gwenaël Abril

Coloured dissolved organic matter (CDOM) is the dissolved organic matter's optically active fraction and correlated successfully with dissolved organic carbon (DOC) in numerous coastal aquatic environments. Along with phytoplankton and suspended solids, CDOM substantially contributes to the penetration of sunlight in the water and therefore is an important modulator of its colour. Its strong absorption in the ultraviolet-blue region of the electromagnetic spectrum can compromise the estimation of chlorophyll by satellite blue-green algorithms. Thus, the proper assessment of CDOM variability in coastal environments is essential for the calibration of satellite measurements. This study shows the variability of CDOM in relation to water quality and DOC concentration in eight campaigns during 2013-2014 in Guanabara Bay (Rio de Janeiro, Brazil). Results have shown that samples with high chlorophyll and phaeopigments presented the highest average values of CDOM. Despite the heterogeneity of processes and sources within the DOM pool, CDOM derived equations can assess DOC with an accuracy between 14.8-103.8 μM of C.

On the relationship between the coastal upwelling winds of Cabo Frio and temperature stratification in the Guanabara Bay, Brazil.

Alexandre Macedo Fernandes, Elisa Nóbrega Passos, Rogério Pinto Espíndola, Eduardo Negri de Oliveira, Gleyci Aparecida de Oliveira Moser.

FAOC UERJ

Abstract: The Guanabara Bay (GB), Brazil, has been historically described as a tidally dominated estuary due to its low fluvial discharge and relatively weak influence of local winds. In this study, results from a 15 month long temperature time series analyses indicated that subinertial processes, associated with remote wind forcing, were more effective than tides on controlling temperature variability in the Guanabara Bay. Correlation analyses applied to winds measured at Arraial do Cabo, located 100 km eastward of GB, and temperatures collected near bottom in Guanabara Bay resulted in values from 0.62 to 0.84 and show that remote winds are responsible for the cold water penetration events observed on Guanabara Bay. This cold water penetration produces remarkable top to bottom temperature differences and may be very important to local chemical and biological processes.

Research perspectives on coastal plumes pollution by nutrients and trace elements in Rio de Janeiro bays

Wilson Machado, João Barreira, Gabriela Bravim, Mauricio Santos, Nilva Brandini, Eduardo Negri

Research perspectives for better understanding of nutrients and trace elements dynamics and consequences in tropical bays affected by multiple impacts will be addressed. Coastal pollution gradients will be evaluated, focusing on biogeochemistry of coastal plumes and consequent spatial-temporal changes in water quality, with support from remote sensing of plumes and stable isotopes of C, N and Zn in suspended particulate matter to improve the evaluation of sources and interpretation of processes.

The carbonate system: active witness of eutrophication in tropical coastal ecosystems

Gwenaël Abril, Luiz C. Cotovicz Jr., Thais Erbas, Aguinaldo Nepomuceno, Nilva Brandini, Marcelo Bernardes, Bastian Knoppers

During the last 6 years, we have observed strong CO₂ depletions in eutrophic waters of the Guanabara Bay, the Araruama Lagoon and the Saquarema lagoon. All these eutrophic systems behave as CO₂ sinks, particularly in their most inner and confined regions, where residence time of waters are longer, where stratification can occasionally occur and where phytoplankton blooms are denser. The drawdown of pCO₂ below values of 100 ppmv (occasionally less than 20 ppmv) suggests that, despite the large buffering capacity of these saline waters, CO₂ could become a limiting nutrient within phytoplanktonic bloom, favoring the growth of cyanobacteria versus other microalgae. In addition to this strong negative correlation between pCO₂ and Chl *a* concentrations, we also observed a negative correlation between pCO₂ and the dissolved organic carbon (DOC), a pattern opposite to what has been reported in coastal systems elsewhere. This suggests that at very low pCO₂ concentrations, phytoplankton exudates DOC in large quantities constituting an important carbon loop specific to hypertrophic coastal ecosystems.

Thursday (03/12/2020)

Investigating temporal changes in the physical, chemical and biological properties of coastal and marine ecosystems

Eric Goberville

Laboratoire de Biologie des Organismes et Ecosystèmes Aquatiques (BOREA), Muséum National d'Histoire Naturelle, FRE 2030, CNRS, MNHN, IRD, SU, UCN, UA, Paris, France

Abrupt and persistent changes in ecological processes - and methods for detecting changes - have been widely investigated in coastal and marine ecosystems over the last decades. Short and long-term changes in both the structure and functioning of ecosystems are often related to substantial changes in environmental and climate conditions. Why, when and how these changes are initiated, propagate within ecological compartments and impact an ecosystem as a whole is still poorly understood, however, and the characterisation of changes at local/regional scales will reinforce our comprehension of the consequences of large-scale influences. The

response of ecosystems to climate change (*e.g.* changes in biodiversity and species dominance, occurrence and magnitude of abrupt episodes such as eutrophication) often occur in a nonlinear way and cross-scale interactions, by changing the pattern–process relationships across scales, could have important influences on ecosystems processes. Here, using data from several monitoring surveys, we examined year-to-year changes in the physical, chemical and biological properties of several coastal ecosystems, at different temporal scales and quantified the potential influence of large-scale and local-scale processes. Our studies reveal that variability in coastal and marine waters are mainly connected to changes in large-scale atmospheric and oceanic circulation patterns, that modulate local climate conditions, which in turn alter coastal and marine environment.

Primary productivity and size structure of phytoplankton taxa and biomass in Guanabara Bay (Rio de Janeiro, Brazil)

Moser, G.A.O.; Lopes, R. N.T.; Piedras, F. R.; Lima, D. T.; Lannes, D.
FAOC UERJ

Phytoplankton community in Guanabara Bay (BG) is dominated by nanoplanktonic organisms, notably flagellates, however, the contribution of these organisms to primary productivity of BG was unknown. Tides and intrusions of the South Atlantic Central Water directly influences the composition of phytoplanktonic community in this coastal system, enhancing the microphytoplankton representativeness, notably diatoms. In this context, our aim was to understand the contribution of different phytoplanktonic size fractions for biomass and primary productivity in the central channel of Guanabara Bay (GB), considering both the influence of the tides and the presence of different water masses. Here we present the results of 3 campaigns (Autumn / 2015; Winter / 2015 and Autumn / 2016- 200 observations), along the GB central channel and in a transect transverse to the GB mouth, over complete tidal cycles. Samples were collected close to the surface and bottom, for qualitative analysis of phytoplankton taxa, biomass and primary productivity analyzes carried out immediately on a fluorimeter (Phyto-PAM-Walz). Complementary data included dissolved nutrients, oxygen, temperature, salinity, euphotic zone depth and PAR. Our data confirm the major contribution of nanoplankton size fraction for phytoplankton biomass and primary productivity, represented mainly by chlorodendrophytes (*Tetraselmis* spp). PAR was positively correlated with flood tides and SACW intrusions, this availability of light in the water column as well as the transport of autotrophic cells from the adjacent continental shelf are important factors for restructuring phytoplankton community in the central channel.

Assessment of Phytoplankton Distribution in South Brazilian Bight (Southwestern Atlantic Ocean) using Chemotaxonomic (pigments) Techniques

Daniel Tremmel, Daniela Sudatti, Vanessa Monteiro, Marcelo Marinho, Gwenaël Abril, Silvana Rodrigues

Phytoplankton are tiny photosynthetic organisms that live floating in oceanic and inland aquatic environments. Despite their importance as the basis of the marine trophic web, they are involved in several global biogeochemical cycles, including carbon, nitrogen, and oxygen. Cultural eutrophication may stand for an enormous source of nutrients for these organisms, working as a fertilizer of coastal margins (Walsh, 1988), affecting human health, and possibly causing loss of biodiversity in the longterm. This work's main objective is to assess phytoplankton abundance and diversity by analyzing the photosynthetic and photoprotectant pigments through chromatographic and chemotaxonomic techniques (Mackey et al., 1996; Rodrigues et al., 2017). Further on, the community structure will be correlated with environmental variables in order to understand the biological response to oceanographic features. Sampling is performed during winter 2019 and

summer 2021 and is distributed in 60 stations over the continental shelf and beyond the shelf-break of the South Brazilian Bight (Southwestern Atlantic Ocean).

Guanabara Bay: Chlorophyll estimation by remote sensing.

Negri (FAOC UERJ), Paranhos, Cotovitz, Kampel, Brandini, Knoppers

Guanabara Bay is dominated by primary productivity. In Situ radiometric measurements have been used to tune algorithms for chlorophyll estimation. The algorithm can be used in high spatial resolution images to diagnose details of phytoplankton blooms in the region.

Beyond Burial: idAL Export of BLUe Carbon in Tropical MangrovES - BBLUES

Luiz C. Cotovicz Jr.^{1*}; Gwenaël Abril^{2,3}; Isaac Santos⁴

1 Instituto de Ciências do Mar, Universidade Federal do Ceará, Fortaleza, Ceará, Brazil

2 Programa de Geoquímica, Universidade Federal Fluminense, Niterói, RJ, Brazil

3 Laboratoire de Biologie des Organismes et Ecosystèmes Aquatiques (BOREA), Muséum National d'Histoire Naturelle, FRE 2030, CNRS, MNHN, IRD, SU, UCN, UA, Paris, France

4 Department of Marine Sciences, University of Gothenburg, Gothenburg, Sweden

Tropical mangrove wetlands are hotspots in the marine carbon cycle. However, these ecosystems remain overlooked in marine carbon budgets. The carbon sequestration capacity of mangroves has been underestimated because we have focused on soils rather than the oceans as the ultimate, long-term carbon sink. This project will close research gaps by resolving carbon budgets from source to sink across a mangrove-estuary-continental shelf continuum in the largest mangrove system on Earth in the Amazon. This project will use a combination of state-of-the-art approaches, including the dual carbon isotopic approach, natural radioactive tracers of porewater flow through soils, high resolution greenhouse gas analysis, and molecular biomarkers. If tropical carbon outwelling is indeed significant, the carbon sequestration capacity of mangroves (based on soil burial only) has been underestimated. Overall, this project will focus on a poorly understood but important tropical ecosystem and may create new arguments for preserving or rehabilitating threatened mangroves to maximize carbon sequestration.
