Microbial life findings inferred from paleoenvironmental archives

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Introduction

- Subsurface sediments microorganisms regulate processes in one of the largest parts of Earth but are suggested to have very low mineralization and duplication rates because of energy limitation (Jørgensen and D'Hondt, 2006).
- Organic matter is considered to be very refractory resulting in slow degradation rates (Lomstein et al., 2012).
- Efficiency of degradation is not constant and organic matter decomposition rates depend on its quantity and quality, and on external conditions such as temperature and nutrient availability (Dauwe et al., 1999).
- Organic matter availability depends on organic burial rate that is directly affected by sedimentation and consumption in water column and surface sediments.
- Microbial activity can vary depending on location, age of sediment and organic matter availability (Jeffries et al., 2011).

Scope of study

The aim of the present study is to estimate microbial activity in subsurface sediments in environments with different depositional ages and its relationship with the dissolved organic matter diversity.

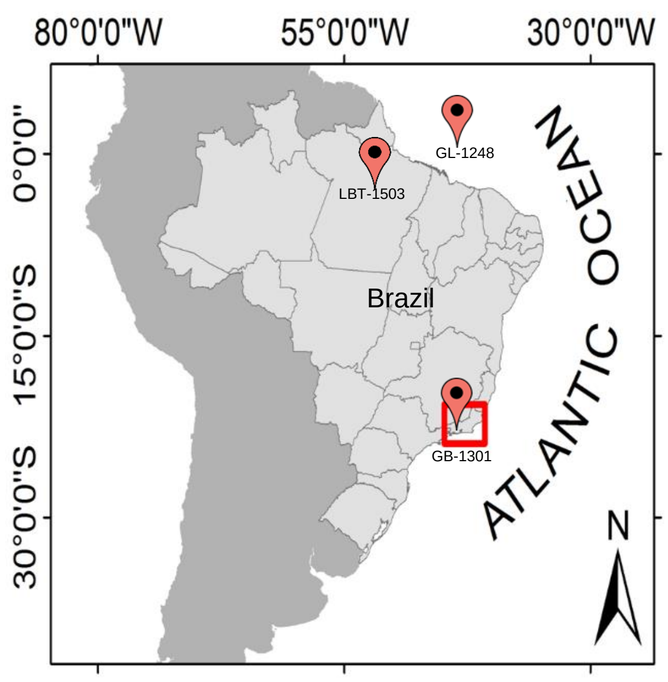
Methods

- Core Sampling (vibracore system or piston core drilling)

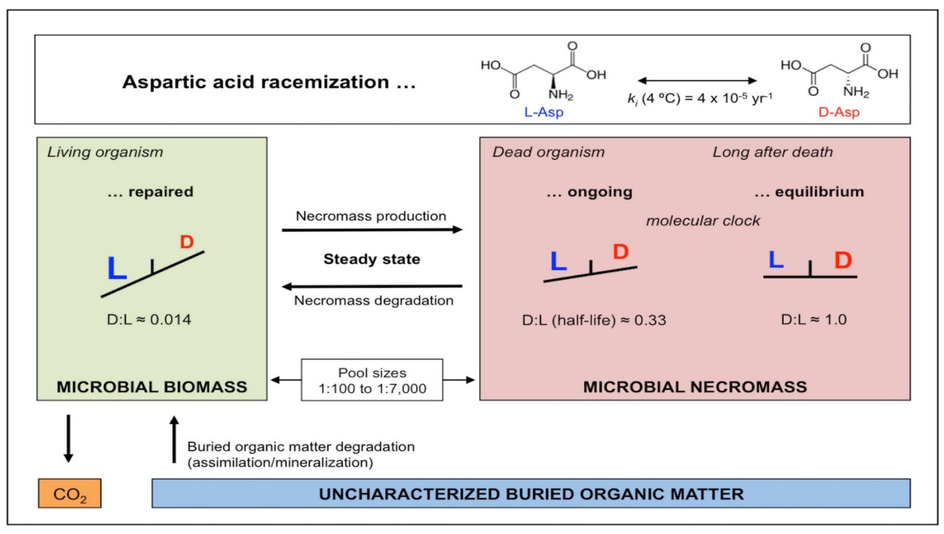
GB-13.01: Guanabara Bay - Rio de Janeiro

GL-1248: South Atlantic Deep Ocean - Amazon Shelf

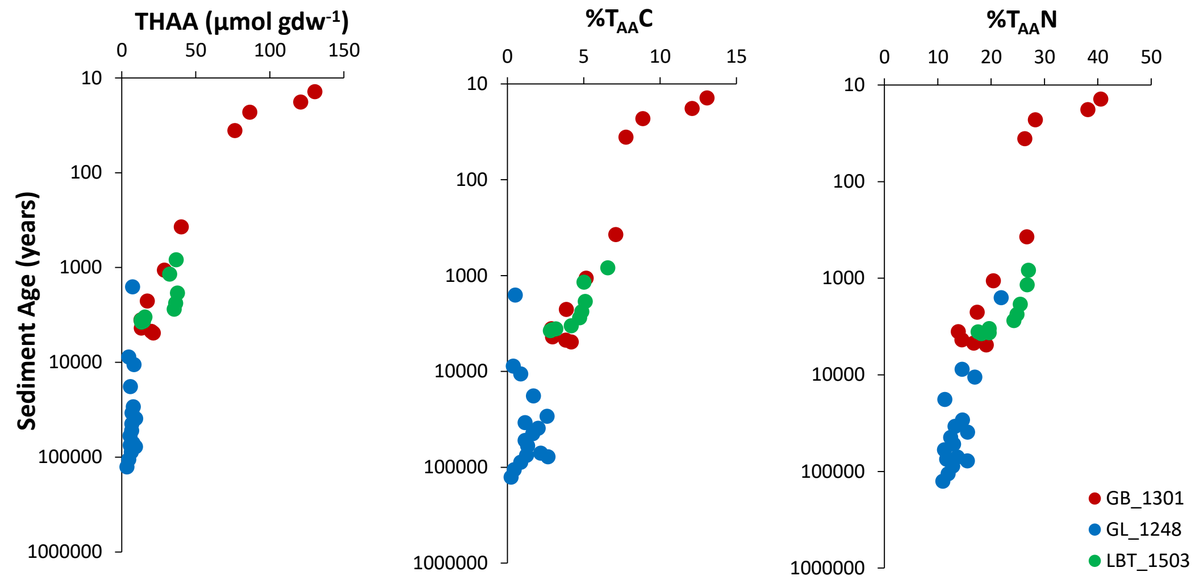
LBT-1503: Boto Lake - Amazon

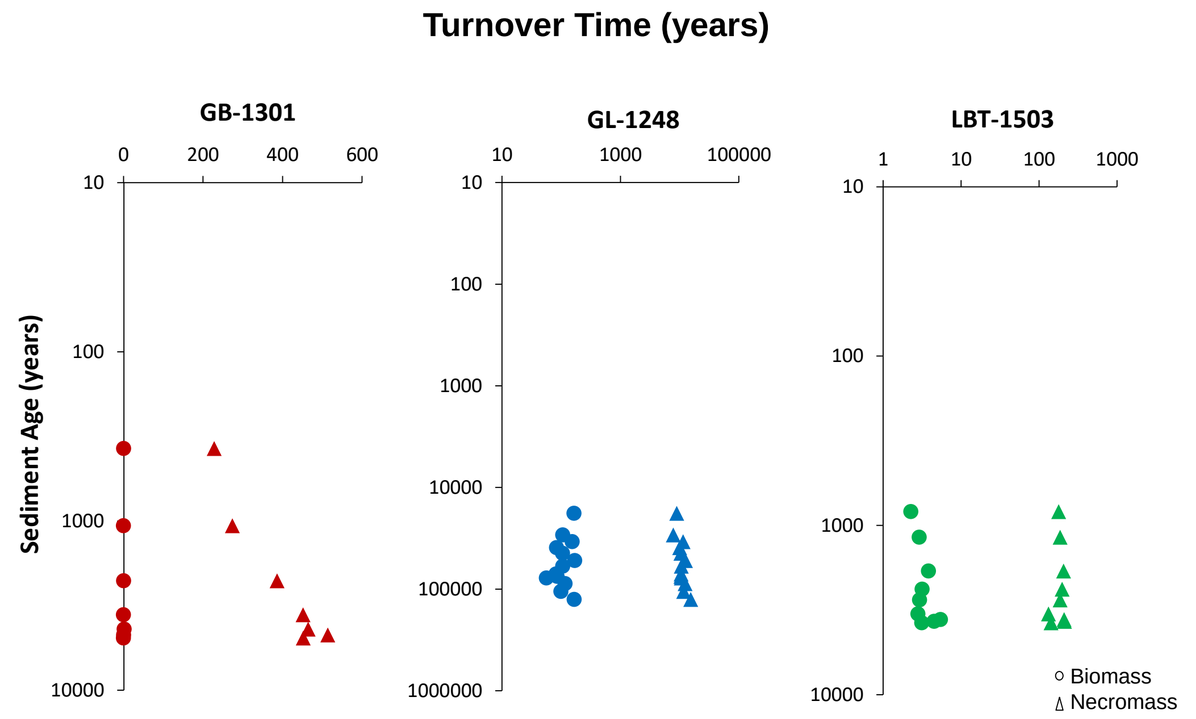


- Total organic carbon and total nitrogen
- Radiocarbon dating (C14)
- Total cell counts
- 3M hydrolysis - dipicolinic acid
  6M hydrolysis - amino acids
- HPLC analysis
  - Total hydrolysable amino acids (THAA);
  - Amino sugars
  - Dipicolinic acid
  - D- and L-isomers of aspartic acid
- Degradation index
- D:L-amino acid racemization modelling of microbial activity
- Extraction of pore water dissolved organic matter (DOM)
- Fourier transform ion cyclotron resonance mass spectrometry (FTICR-MS) analyses



Results





Conclusions

- Diagenetic processes had a strong influence on the quality of sedimentary organic matter and the origin of presented molecules and, as expected, organic matter was progressively degraded.
- THAA are degraded faster and preferably before TOC, which became progressively more refractory and unavailable.
- Overall microbial activity was low, decreasing its activity.
- Microbial biomass production is sustained by organic carbon deposited from sediment surface in a short period of time at GB-1301 and LBT-1503 and up to hundreds of years at GL-1248.
- Microbial necromass is recycled over timescales up to thousands of years.
- Observed differences in turnover rates may be due to sediment age.
- Buried organic carbon was sufficient to fuel microbial activities over timescales up to thousands of years, due to slow mineralization rates.

Ongoing study

We are still analyzing the obtained assignments by FTICR-MS. By prior observation of the data, we are aiming to answer if there is any pattern of DOM changes on a molecular level regarding aromaticity, oxidation level, C:N and C:O ratios and complexity according to depth and age of sediments.

Acknowledgments