Microbial resilience in a ferralsol after an anoxic events simultaneous to rum vinasse amendment

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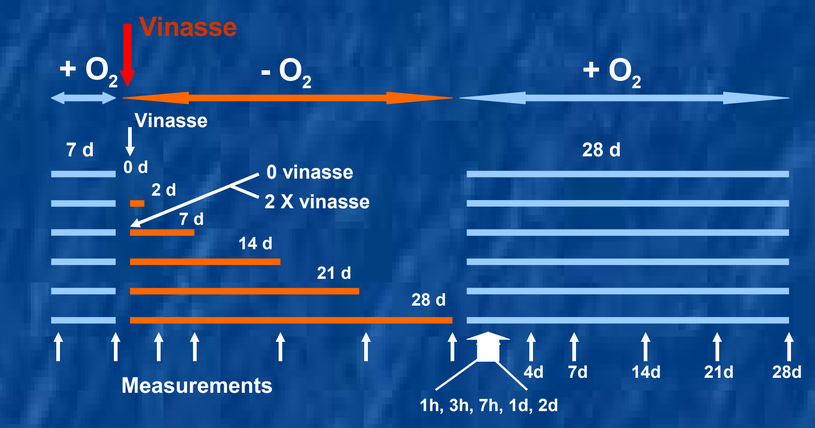
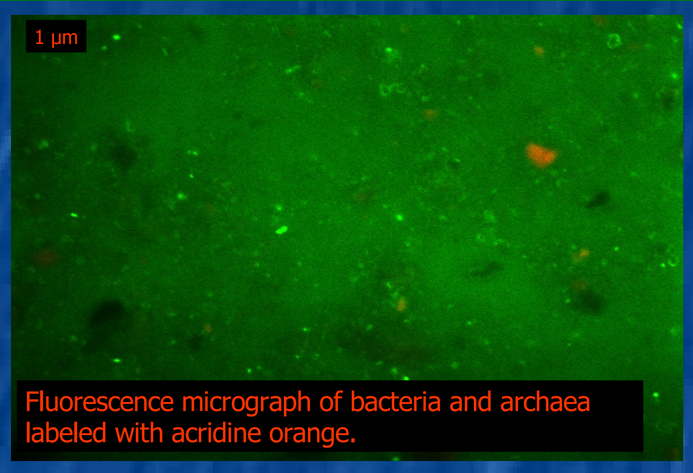
Objective: to assess microbial resilience (quantities of fungi, bacteria and archaea, as well as bacterial molecular diversity) on a soil supplied by a liquid by-product of rum industry that induces anoxia.

Materials and Methods: incubations of a Ferralsol from Reunion island mixed with water and rum vinasse.





Fluorescence micrograph of bacteria and archaea labeled with acridine orange.

Recording of microbial dynamics:

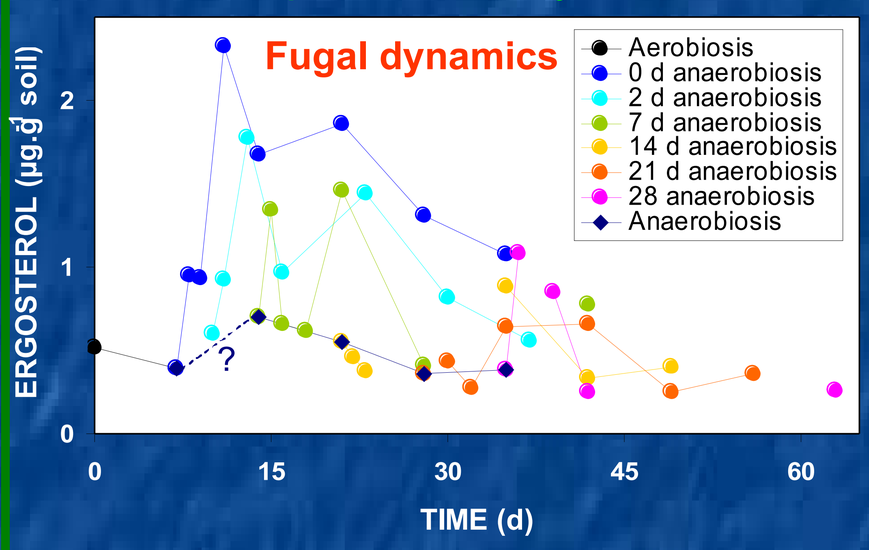
2. Bacteria and Archaea density number (fluorescence microscopy combined with quantitative PCR);
3. Fungal biomass (ergosterol amount);
4. Bacterial molecular biodiversity (PCR-SSCP).

Geochemical change monitoring:

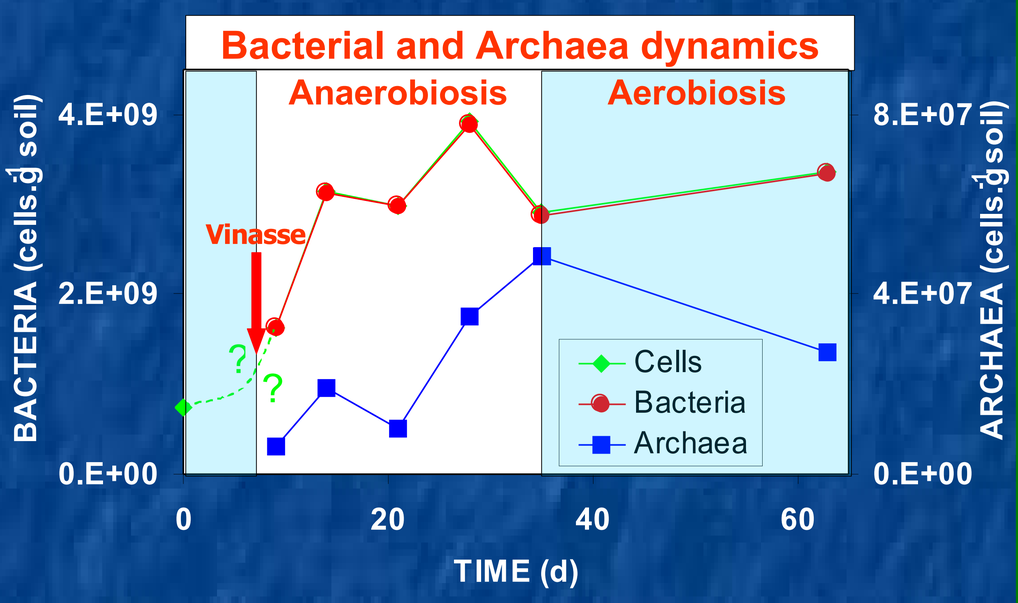
4. Gases;
5. Metal mobilizations;
6. Organic compounds.

Results:

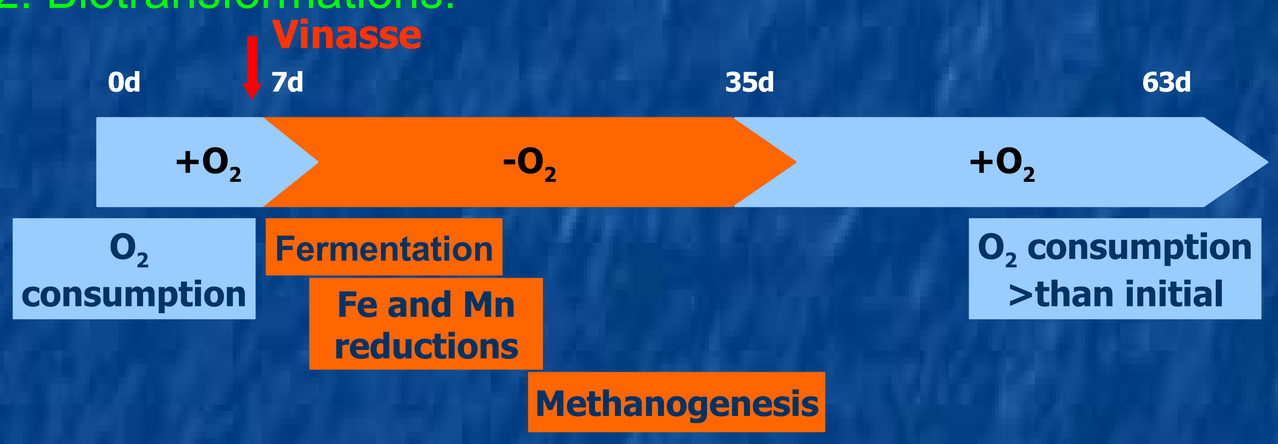
1. Microbial quantitative dynamics:



- Fungal biomass remained roughly constant during anaerobiosis; it transiently increased after returning to aerobic condition. At the end of incubations, it was negatively correlated to the duration of the anaerobic period.
- Bacterial density increased during anaerobiosis as a consequence of vinasse supply.
- Archaea density increased during the second half of anaerobiosis and decreased thereafter in aerobic conditions.

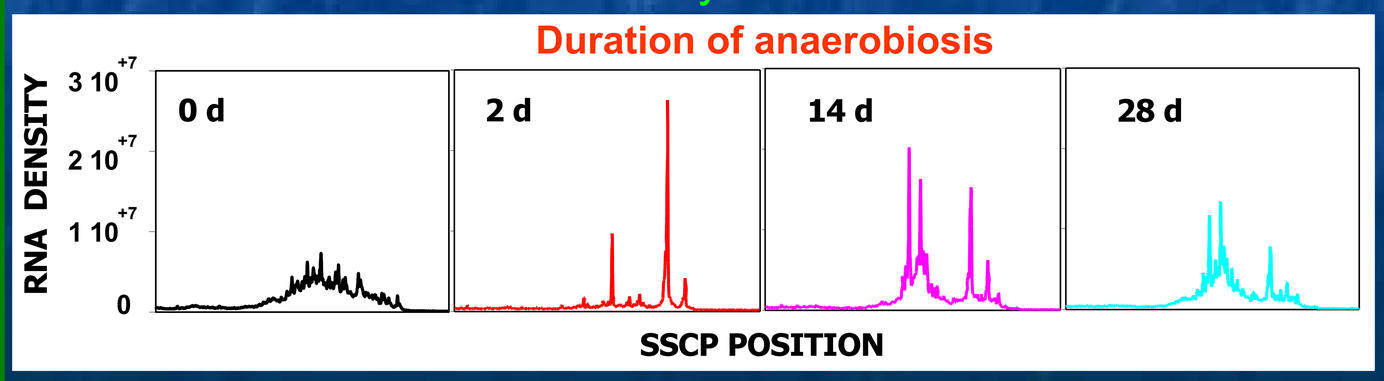


2. Biotransformations:

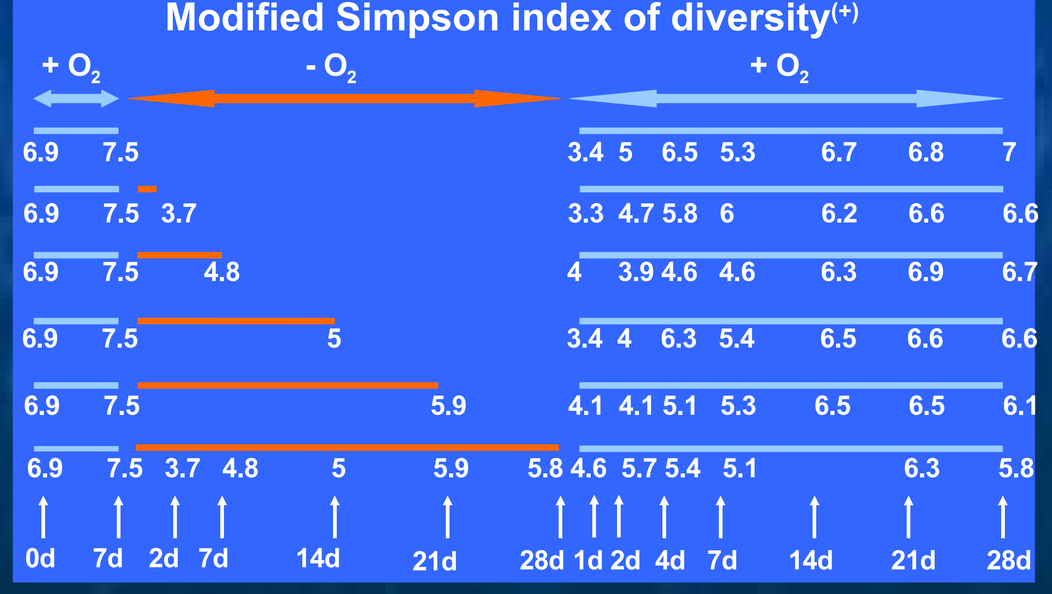


Major anaerobic biotransformations included fermentations, true acetogenesis, Fe(III) and Mn(IV) reductions and methanogenesis. In the second aerobic period, O_2 consumption was higher than at the beginning of incubations.

3. Bacterial molecular biodiversity:



Bacterial molecular diversity decreased at the beginning of the anaerobic period with the emergence of some populations; it increased thereafter but differed from the initial one. Similar results were observed after the return to aerobic conditions.



* Zemb O., Haegeman B., Delgenes J. P., Lebaron P. and Godon J. J., 2007. Safum : statistical analysis of SSCP fingerprints using PCA projections, dendrograms and diversity estimators. Molecular Ecology Notes 7, 767-770.

Conclusion:

Fungi survived during anaerobiosis, the return to aerobiosis leading to transient increases in their biomass. Archaea and bacteria densities increased during anaerobiosis as a consequence of vinasse supply. The sudden changes in aeration (coupled the first time with vinasse supply) affected bacteria diversity. However, this diversity and aerobic functions (O_2 consumption, C mineralization and nitrification) seemed to be restored after anaerobic events. Soil resilience would be observed over periods that increase with the duration of the anaerobic period.