The VIOLA Project: Functional responses of groundwater microbial community across the salinity gradient in a coastal karst aquifer

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The vulnerability to salinization is a major issue for coastal aquifers. The resulting rapid modifications of hydro-geochemical characteristics, driven by the different origin of water inputs, can modify the properties of the resident biological communities. The study of structural and functional properties of groundwater microbial community, posed at the base of the heterotrophic food web, assumes an increasing importance to describe the effect of water quality on C-cycling and the resilience of groundwater systems to changes.

Within the framework of the VIOLA project, this study was entailed to explore the groundwater quality and the functional responses of the microbial community across the gradient of salinity in a coastal karst aquifer located in Apulia Region (Southern Italy). The investigated area (1227 km²) is located in a semi-arid climate region with predominantly agricultural vocation. In this area, an excess of withdrawals for irrigation and other uses, often results in a significant decline of the water table, facilitating saline intrusion.

The main physical-chemical parameters of 47 groundwater sampling sites (T, pH, oxidation-reduction potential, electrical conductivity, major anions/cations, trace elements, dissolved oxygen, ammonia, nitrites, cyanides and dissolved organic carbon) were measured, along with microbial community analyses including the total cell abundance, the High Nucleic Acid and Low Nucleic Acid content cell ratio (Flow Cytometry), the total coliform and Escherichia Coli contamination (Colilert-18 assay), the microbial metabolic potential (Biolog EcoPlates), and the microbial respiration (Biolog MT2 MicroPlates). The preliminary results allowed identifying two major groups of waters with different salinity levels and concentrations of Cl, Na, Mg and SO₄. Prokaryotic cell abundance (mean $3.5 \times 10^4 \pm 4.6 \times 10^4$ cells/ml) showed higher values in saline waters, so as HNA cell percentages and total coliforms. Saline waters were also characterised by relatively higher metabolic potential and respiration values. In conclusion, the observed groundwater quality changes induced the stimulation of the functional microbial properties and the functional diversity. These changes in the metabolic potential of the resident communities could alter the ability to exploit the available resources and modify the related groundwater biogeochemical cycling.