

Closing the circuit: mapping the fate of electrons in the environment

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At the most fundamental level, life is electric [1]. It is indeed through redox reactions that life is able to make use of the chemical energy available in the environment, i.e., by coupling the oxidation and reduction of available chemical species (electron donors and electron acceptors, respectively). These transfers of electrons are catalysed by a specific group of enzymes, oxidoreductases [2], and the released Gibbs free energy can be further used to support the vital functions of any lifeform we know of, thus being ubiquitous across the tree of life [3]. Exploiting these mechanisms and the compositional nature of metabolism [4], major biogeochemical cycles can be extrapolated by the identification of the available chemical species (i.e., geochemistry) and corresponding oxidoreductases (i.e., biochemistry). Given that subsurface microbial communities constitute a major part of the global biosphere [5], inferring their oxidoreductase composition is critical to ascertain how these important ecosystems function, thus closing the circuit from electron donors to acceptors [6]. Despite the efforts dedicated to study these environments, a comprehensive, detailed view of the biogeochemical processes in the subsurface is still very limited [7, 8]. In this work, we present a bioinformatics pipeline to predict the presence of oxidoreductase genes [9], and validate the results on public datasets of subsurface microbial communities, with the objective of better understanding the fate of electrons and chemical energy in these underexplored environments.

References

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