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Exploring the metabolic pathway of Fe uptake though the role of iron-oxidizing bacteria on the alteration of Fe(II)-bearing basalts

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In recent years, investigations of microbial mats in marine environments have shown a wide variety of microorganisms, among which microaerophilic Zetaproteobacteria stand out prominently [1,2]. These bacteria use iron as a source of energy and catalyze the Fe^{2+} into Fe^{3+} that precipitated into iron oxides within the microbial mats, which could be taxonomically and/or environmentally driven [2]. The effect of iron-oxidizing bacteria on oceanic basalt alteration and the mechanisms of Fe mobilization, from its uptake until the oxide precipitation remains however unclear.

This study is part of the IRONWOMAN ANR project, and is dedicated to clarify the crucial role of marine Fe-oxidizing Zetaproteobacteria (FeOB) in the development of Fe-rich mats. The objective is to investigate how those bacteria influence the biogeochemical cycle of iron, particularly within the current context of environmental changes, such as temperature fluctuations and shifts in oxygen levels in deep-seawater.

In vitro bioalteration experiments have been conducted to characterize the microbially mediated processes. In artificial seawater under microaerophilic conditions, Fe(II)-enriched natural basaltic glasses have been altered in the presence of chemolithoautotrophic Fe-oxidizing Zetaproteobacteria (*Mariprofundus ferrooxydans* PV1 and *Ghiorsea bivora* strains) for two weeks. Altered glasses were then observed using SEM and epifluorescence microscope. Several experimental modalities have been tested, notably the use, or not, of dialysis membranes enveloping the glasses, to target the direct/indirect glass-bacteria interactions involved in the Fe uptake mechanisms. The different pools of the cultures (basaltic glass, seawater, bacteria, iron oxides) are currently submitted to iron isotopic measurements to study the specific biotic and abiotic processes based on Fe isotopes. The Fe oxidation state and coordination will then be investigated on in *situ* collected samples and on *in vitro* prepared samples through Fe-XANES experiments. Combining those characterization techniques will allow identifying of the direct/indirect pathways of Fe uptake and a better understanding of the iron oxide morphology drivers.

References:

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