4.3.16

Experimental evidence for a direct use of nutriments (Fe, Mg) from basaltic glass, and MWI bottom ash by *Pseudomonas aeruginosa*

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Our goal was to test if an ubiquist bacterium like *Pseudomonas aeruginosa* is able to use as nutriments some constituants of basaltic glass (tholeiite) or bottom ash issued from the incineration of municipal waste (MWI). The growth of these bacteria is very significant in a medium containing (g/l) Casaminoacids (5.00), K_2HPO_4 (1.18), $MgSO_4.7H_2O$ (0.25); $FeCl_3$ (0.016). In such medium, no growth is observable when magnesium is ommited while, without iron addition, *P. aeruginosa* grew poorly but with an important pyoverdine production, conferring to the culture a typical green color.

Increasing amounts of material (basaltic glass or MWI) were added to Mg- or Fe-depleted batch cultures (up to 500mg in 7.5 ml) and growth and pyoverdine production were followed during 48h at 25°C under shaking conditions.

Addition of each material to the iron-depleted medium resulted in a bacterial growth stimulation and a concomitent decrease in pyoverdine production, thus mimicking an iron supplementation. Besides, addition of each material to the Mg-depleted medium restaured a pronounced bacterial growth. These preliminary data clearly indicate that bacteria like *Pseudomonas* are able to utilize for growth iron and magnesium contained in complex silicates like basaltic glasses and bottom ashes.

Does bacterial activity influence the material alteration rate compared to abiotic conditions is a question which remains to be addressed.

4.3.17

New experimental insights on the mechanisms of bacterially mediated K-feldspar dissolution

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Previous research by our group [1] has shown that heterotrophic bacteria can enhance K-feldspar dissolution and that the impact of these bacteria on the amount and rate of dissolution varies with type of organism and growth conditions (media).

The present paper focuses on the mechanisms involved in bacterially mediated K-feldspar dissolution. Experiments were performed to establish the significance of bacterial adhesion to the mineral surfaces, the importance of metal uptake by cells and the impact of bacterial exoproducts on dissolution.

The number of cells attaching to feldspar surfaces appears to vary with organism and growth condition. We found no convincing evidence of enhanced dissolution induced by attached cells.

The accumulation of both Al and Si by cells and by exopolysaccharides (EPS) was demonstrated. Our results suggest that cells accumulated Al predominantly at the cell surface while Si accumulated in much lower amounts might have been taken up internally as well. Al accumulation is a rapid process, most of the metal being bond in the first 15 minutes of the experiment. Exometabolites and EPS substantially enhanced feldspar dissolution over a 48-hr period. Feldspar stimulated EPS production in all the media studied, particularly in conditions of nutrient limitation. Early evidence suggests that stimulation was not due to Al or Si, but may have been a response to the presence of solid surfaces.

Our results demonstrate that bacterial cells (and their metabolic products) play an important role in the dissolution of K-feldspar; the cells, their metabolites and EPS are probably acting as chelating agents for Al and Si thus driving dissolution.

References

[1] Hutchens, E., Valsami-Jones, E., McEldowney, S., Gaze, W., McLean, J. (2003). *Min. Mag.*, **67**(7), 1157-1170.