Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.15130

# Alteration of stained glass windows: influence of the Mn-oxidising bacteria *Pseudomonas putida* on the dissolution of 5 model glasses

**CHLOÉ BOUTILLEZ**[1], ANNE PEREZ[1], AURÉLIE VERNEY-CARRON[2] AND STÉPHANIE ROSSANO[1]

[1]Université Gustave Eiffel - Laboratoire Géomatériaux et Environnement

[2]Paris-Est Créteil, Paris Diderot, CNRS

Presenting Author: chloe.boutillez@univ-eiffel.fr

For several centuries, medieval stained glass windows are continuously exposed to water, which causes the alteration of their external and internal surfaces. In particular, high humidity favours the development of microorganisms. Moreover, medieval glasses can be attractive substrates for the development of biofilms, as they represent a source of nutrients for microorganisms and are sensitive to alteration. However, these interactions are not well understood.

To test the influence of glass substrates on their colonisation by microorganisms and the induced alteration processes, a panel of five model medieval glasses was subjected to short term (closed system, 7 days) and medium term (opened system in bioreactor, 1 month) alteration experiments in a minimalist liquid medium at 25°C. The five glasses have identical potash-lime-silica base and variable Mn and Fe contents (between 0 and 2 wt% of oxide), in order to target the role of these elements in the development of bacteria/biofilm, and investigate the potential role of bacteria in the browning pathology impairing some stained glass windows containing Mn. Two bacteria strains were chosen: *Pseudomonas putida* for its affinity for Fe and its Mn oxidation properties and *Arthrobacter Crystallopoietes,* a strain that has been collected on stained glass windows and known for its altering capacity. The filtered cultures were periodically analysed by ICP-OES in order to determine the dissolution kinetics and glass samples were characterised by SEM.

The results show that the presence of *P. putida* has no real effect on the short-term hydrolysis rate of glasses, but significantly modifies the dissolution and the speciation of some elements (Mn, Fe, P) from the glass. The bacterial growth is also strongly linked to the composition of the glass: in the presence of Mn-bearing glass, consistent biofilms are observed, whereas in the presence of Fe-bearing glass, bacteria mostly develop in a planktonic form. Moreover, the absence of Fe in the glass triggers the production of siderophores. In all experiments with Mn and without Fe, the production of siderophores is followed by the formation of Mn oxides in solution and in the biofilms formed on the glass surface.