The geomicrobiology of ancient glass alteration with implications for nuclear waste disposal

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Samples obtained from excavation of an ancient Swedish hillfort provide a unique opportunity to study how microbial communities work together to control local chemistry, and how they adapt to colonize anthropogenically-engineered materials over a period of thousands of years. Here, we examine bacterial and fungal species present on: (i) pre-Viking era glass formed from silicate melting intended to fortify stones on the hillfort margins; (ii) surrounding heat-damaged rock from the vitrification process; (iii) lithologies representing the local geology; and (iv) soil in contact with each of these materials.

Microscopy, tomography and diffraction provide detailed characterization of the interface between the microbial community and the vitrified material, compared to the native rock, to determine the effect of the microbes on local structure, chemistry and mineralogy (Fig. 1) [1]. Results presented are dually beneficial, providing: (i) a greater understanding of the extent to which microbes exert positive or negative influences over both anthropogenically-engineered and natural materials to control their environment and obtain nutrients; and (ii) data on long-term glass corrosion to inform contaminant release models from nuclear waste repositories. Analyses indicate that microorganisms may play a primary role in determining the long-term stability of the pre-Viking era Swedish glass. This provides an opportunity to study long-term bioweathering of natural and anthropogenic materials, in various states of alteration, as a funtion of their physical location in the 'grass-to-glass' profile.

[1] Weaver at al. (2018) *IJAGS*, in press

Figure 1. Sectioning and analysis of Broborg sample