



Abstract EANA2023-7



Perchlorate salts lower the vitrification point of *Bacillus Subtilis* to temperatures lower than those expected beneath the Martian south pole

Stewart Gault (1), Charles S Cockell (1), Fernanda Fonseca (2), Stéphanie Passot (2)

(1) University of Edinburgh, United Kingdom, (2) Université Paris-Saclay, France

The discovery of lakes beneath the Martian south pole has led to questions of their habitability. These lakes should be characterised by incredibly low temperatures, around -70°C , and high concentrations of eutectic compounds, such as perchlorate salts, in order to facilitate their liquid nature at such low temperatures (1,2). Previous research has shown that the low temperature limit for life is physically set by the onset of intracellular vitrification, which typically occurs around -23°C (3). This suggests that any potential life found within these lakes would be vitrified and preserved as opposed to being biologically active. However, as perchlorate salts can greatly depress the freezing point of water, the question arose as to whether they could likewise reduce the point at which cells vitrify. Using differential scanning calorimetry and fluorescence microscopy and spectroscopy, we found that $\text{Mg}(\text{ClO}_4)_2$ lowered the vitrification point of *Bacillus Subtilis* cells in a concentration dependent fashion from 0.6M onwards. Additionally, we found that 2.5M $\text{Mg}(\text{ClO}_4)_2$ lowered the vitrification point of *Bacillus Subtilis* to -83°C , therefore suggesting that cells could remain in an active, liquid-like state beneath the Martian south pole if they could tolerate such high perchlorate concentrations alongside extremely low temperatures. These results also represent a new theoretical low temperature limit for life.

Acknowledgments

S.G. and C.S.C would like to thank EPSRC for their funding and support. S.G. would like to further thank the Company of Biologists whose Travelling Fellowship facilitated this work.

References

1. Orosei, R. et al (2018) *Science* 80, 361
2. Lauro, S. E. et al. (2021) *Nature Astronomy* 5, 63–70
3. Clarke, A. et al. (2013) *PLoS One* 8, e66207