SALTGIANT ETN – Early Stage Researcher in Microbiology of Extreme Halophiles – ESR 9

Title	**Long-term survival of microbes in halite brine inclusions**
Duration	36 months
Expected start date	October 2018
Host Institution	University of Essex, School of Biological Sciences, Wivenhoe Park, Colchester. UK; www.essex.ac.uk/bs
Primary Supervisor(s)	Terry J. McGenity
Objectives	The overall aim is to understand the survival of halophilic microbial communities inside the brine inclusions of halite, providing a model system for investigating the conditions that could have preserved traces of life in evaporites both on Earth (e.g. Messinian halite) and Mars. The specific objectives are to: 1) Determine the influence of environmental conditions on the growth and survival of halophilic microbial communities and pure cultures inside halite crystals, by experimentally trapping cells inside brine inclusions, and periodically quantifying viable cells by a combination of labile molecular markers (such as mRNA), recultivation and microscopy. These experiments will be carried out both in Earth surface conditions and under Mars-simulation conditions (using the specialist facilities of partner DLR (German Aerospace Centre). 2) Develop a numerical model simulating fundamental energy flows in microbial cells in order to investigate survival in conditions of severe energy limitation when cells devote nearly all of their energy flow to somatic maintenance, rather than growth and reproduction. 3) Compare the halophilic microbiota living inside different types of halite crystals in Messinian evaporites and present-day analogues (e.g. sampled during a SALTGIANT field course based near the Dead Sea) by surface-sterilising halite followed by analysis of phylogenetic marker genes and cultivation in diverse media, in collaboration with the Icelandic biotechnology partner, MATIS.
Expected results	Objective 1 will yield fundamental insight into the survival and growth of halophiles (especially haloarchaea) in halite brine inclusions. At the same time, it will provide important data (e.g. survival / growth rates *versus* nutrient levels) that will feed into models in Objective 2. Objective 2 will provide a physiological explanation that reconciles low-energy environments, slow growth, and survival in confined spaces on the geological time scale. Objective 3 is the most ambitious part of the project, and should identify halophilic microbes that have survived in halite for ~5.6 to 5.9 million years, and their potential role as indicators of a particular depositional setting. All these results will contribute to better define the possibility that traces of life could have been preserved in evaporites from Mars.
Planned secondments Provided by	**S1**: (months 10-12): MATIS (Reykjavik, Iceland) (V. Marteinsson for the culturing of extremophilic halophiles and sequencing for diversity and metagenomic analyses on natural halite samples); **S2**: (months 18-20): German Space Agency (DLR) (P. Rettberg and S. Leuko for testing the survival of halophilic microbes in Martian

SALTGIANT partners to ESRs; duration 1-3 month each	atmospheres); **S3** (months 27-29): Institut de Physique du Globe de Paris (Paris, France) (G. Aloisi for the modelling of microbial physiology in energy-poor environments).
Specific requirements	This is an exciting opportunity for a highly motivated student with a background in Microbiology, Biogeochemistry, Geomicrobiology, Biological Sciences, Earth Sciences or other relevant disciplines. Training will be provided in the techniques used, so motivation, drive and a numerate good-quality degree are key criteria. The applicant should have completed an undergraduate degree with equivalent to a minimum of upper second class (based on UK system), and ideally a Masters degree.
Keywords	Microbiology, geomicrobiology, biogeochemistry, astrobiology, extremophiles, halophiles, halite
Application	Send application via : www.ipgp.fr/saltgiant
For further information	Contact the primary supervisor for an informal discussion: tjmcgen@essex.ac.uk Web page; Google Scholar; ResearchGate