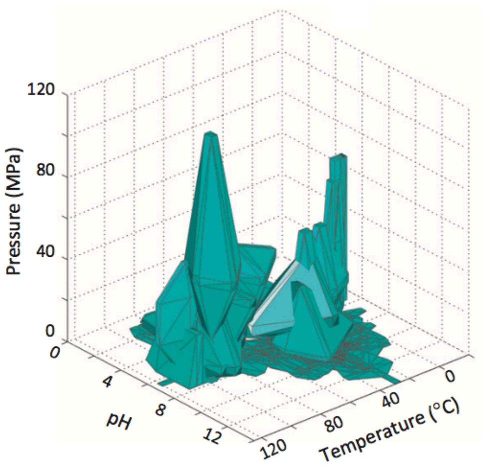
Life at multiple extremes: is hydrostatic pressure conflicting or compensatory?

Microbial life at multiple extremes is still largely unclear. Temperature, pH, salinity and hydrostatic pressure (HP) are known stressors impacting microbial pathways and microbial representatives. However, the application of multiple extremes exerting compensatory effects is expected to support life at conditions which would normally be inhibiting. For instance, high temperature enhances cell membrane fluidity, as opposed to high hydrostatic pressure. Intracellular accumulation of organic compounds to maintain cell homeostasis involves temperature, salinity, pH and HP shifts to different extents and with different functions. Among these factors, HP is by far the most overlooked parameter. Provided that the large majority of the microbes on our planet live at elevated HPs, this lack of information deprives us of basic knowledge about numerous essential processes in our environment. HP renders any reaction leading to a positive volume change (*e.g.*, gas production) unfavorable, since it would be energetically challenging. As a result of reduced membrane fluidity, phospholipid fatty acids increase their level of unsaturation as a compensatory effect. Transmembrane and multimeric protein complexes are largely inactivated as their three-dimensional configuration is impacted by HP. However, several of these effects could offset an opposite stress as imposed by extreme temperatures, salinities or pH values. What is the comprehensive role of HP on cell metabolism? Which conditions are likely to be counterbalanced by HP? Can microbial life be stimulated by applying HP under multiple stressing conditions?



The **Center for Geomicrobiology** has been awarded a **3-year project funded by Mærsk Oil** entitled *Self-Healing Cement*, which targets constructions located in the deep sub-seafloor. This renowned biotechnology uses microbes to fix cracks in concrete structures which are affected by long-term exposure to water. Under certain conditions, the CO_2 released by microbial respiration of organic carbon reacts with Ca^{+} to precipitate as $CaCO_3$ crystals. The latter would heal the crack thereby preventing corrosion and weakening of the material due to water penetration. However, boreholes and oil/gas reservoirs in the deep sub-seafloor are characterized by high HPs, temperatures and pH values, imposing critical limits for microbial catalysis.

The present thesis project is integrated in the *Self-Healing Cement* project funded by Mærsk Oil and aims at describing the impact of HP on **cell metabolism in pure cultures**. The experimental activity falls in the frame of the physiology of polyextremophiles and their capacity to assist **applied biotechnologies** here related to sustainable constructions. The candidate will join the team working on the *Self-Healing Cement* project, working with cultivation dependent (microbiology) and independent (molecular) techniques, and be required to work independently in the lab, produce and process the data, and summarize results for internal project meetings, for a period of 6 to 10 months. She/He is also expected to develop creative thinking and decision making, and build up an original, scientifically-sound perspective on microbial physiology. **For further information, contact:**

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