Extreme environments: understanding and exploiting the potential of proteins from extremophile organisms

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Extremophiles are organisms which survive and thrive in the most extreme chemical and physical conditions on Earth. The proteins from extremophilic organisms play a key role in enabling them to survive and function in specific environmental extremes. These proteins are of great interest as they have the ability to retain their folded structure and to possess the necessary flexibility to be functional under conditions which normally denature proteins. For this reason, they offer attractive, model systems in which to explore the origin of protein structure and dynamics under different, extreme environmental conditions.

Hyperthermophilic organisms can survive high temperatures and make use of specific compatible solutes in their environment. The use of compatible solutes to improve protein stability is a well established practice for many biotechnological and clinical applications. However, the molecular mechanisms that govern this stabilization remain elusive.

In this project you will use single molecule force spectroscopy, using the atomic force microscope, to measure the mechanical stability and flexibility of proteins derived from extremophile organisms. You will examine a protein from a heat-loving hyperthermophilic organism in which the group has significant expertise. A bespoke force-clamp atomic force microscopy (AFM) instrument will be used to examine the conformational dynamics of single extremophilic proteins.

The development of these methods will deliver fundamental insights into the mechanisms of extremophile adaptation, identification of new solutes for protein stabilization and storage, in addition to developing research tools that will be exploited in synthetic biology and bionanotechnology. The project will be embedded within an active research group at Leeds whose focus is Life in Extreme Environments, providing the optimum research environment for this ambitious project.

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