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Geological Hydrogels. Emergence of Proto-Cytosolic Media

This project is a comparative study of a range of chemical and physical processes, each with putative prebiotic relevance, in both aqueous and hydrogellular media.

In origin-of-life studies it is usually considered that proto-cellular environments were aqueous salt-containing environments in close proximity to a mineral surface with the potential to act as a catalyst or partitioning material. However, the environment within a contemporary biological cell is better described as a hydrogel rather than an aqueous suspension (Figure 1). To date, there have been no systematic investigations of how proto-cells could have assembled within geological hydrogel environments[1-4] such as those based on hydrogels with a porous silica matrix silica matrix (Figure 2), an early stage of silicification, or rock formation. This project builds up our preliminary work to address this problem.

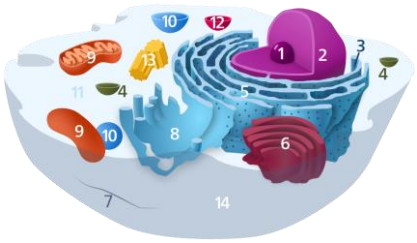

Figure 1. Biological cell

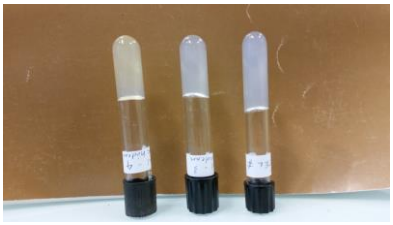

Figure 2. Silica hydrogels

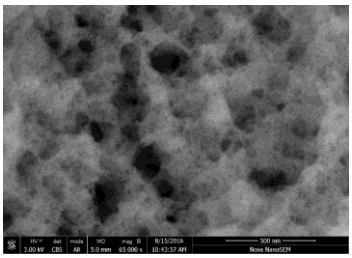

Figure 3. Silica hydrogel matrix (SEM)

It is possible to take this project in several different directions, some of which are outlined below. In each case however there is a fundamental emphasis on using a broad range of analytical tools to probe behaviours in aqueous and hydrogellular environments with an emphasis on processes of prebiotic importance. Techniques include SEM, EDX, BET surface area measurements, fluorimetry, dynamic light scattering, SAXS, NMR, rheology, mass spectrometry, circular dichroism.

Direction 1. Vesicular self-assembly in geological hydrogel media. An examination of the comparative self-assembly behaviour of various amphiphilic materials between aqueous and hydrogellular phases.

Direction 2. An exploration of how chemical transformations such as peptide formation, nucleotide oligomerisation and peptide folding are influenced when performed in hydorgellular media.

Direction 3. Investigations into how gel phase transitions could have been employed as primitive mechanisms for the earliest forms of life on Earth to have displayed function. For example, such primitive functions include molecular partitioning, gradient maintenance and response to physical chemical changes in the local environment.

Please contact Dr Terry Kee (t.p.kee@leeds.ac.uk) for further details about this opportunity.

References

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3. J. T. Trevors & G. H. Pollack, *Prog. Biophys. & Mol. Biol.* (2005), 89, 1-8
4. J. T. Trevors & G. H. Pollack, *Biochemie* (2011), 94, 258-262.