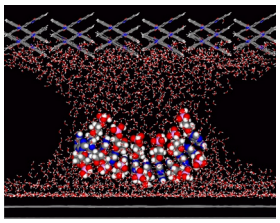
Research group Dr. Frank Trixler,
LMU, Department of Earth and Environmental Sciences & Center for NanoScience (CeNS)

Bachelor- /Master Theses

Topic: **Abiotic formation of polypeptides via nanofluid effects in nanogeochemical environments**



Background
Although all life is dependent on water, aqueous environments prevent the synthesis of biopolymers such as nucleic acids and polypeptides for thermodynamic reasons. This long-standing puzzle in the research field of prebiotic chemistry and the question of the origin of life, known as the "water paradox", has so far been attempted to be solved in synthesis approaches by various groups. However, these approaches are not compatible with a basic principle of evolution: new innovations always build on existing solutions (conservative nature of evolution).

Our group has discovered a synthesis pathway for the abiotic generation of complex biopolymers that mimics nanogeochemical environments and generates nanofluidic effects in water. In this pathway new properties of water emerge that allow biopolymerisations in water. It utilizes phenomena that occur both in nanogeochemical environments and in the intracellular environment of living cells. Therefore, this approach to chemical evolution is highly compatible with the conservative nature of evolution and thus is prebiotically plausible. It creates a bridge between geochemistry and biochemistry.

Projects
As a proof of concept study it has to be examined whether not only nucleotides can combine to form RNA under the conditions described above (having been demonstrated by our group) but also amino acids can polymerize into polypeptides. First positive indications from our experiments motivate to perform such studies. The basis for the sample preparation are geomaterials that can be assumed to be plausibly present during the archean world in the form of particle suspensions. These include material from meteorites (collaboration with the Mineralogical State Collection and a working group from Barcelona), fougerite, a mineral from alkaline vents in the deep sea (collaboration with a working group from Marseille), polycyclic aromatic hydrocarbons as plausible aerosols from the early Earth, and other materials such as primitive lipids around mineral particles. The knowledge gained can also be transferred to technical innovations in the field of sustainable, environmentally friendly syntheses (green chemistry).

The exact project definition and design is agreed with the applicants in order to be able to respond to their personal interests, aptitudes and plans.

Techniques used (training by PhD student)
- Qubit Fluorometry (main technique! Lab: Theresienstr. 41, LMU)
- Capillary Gelelectrophoresis (Biocenter, LMU)

Requirements
- Interest in questions of geobiology and the origin of life on the early Earth
- Ideally: basic knowledge and initial laboratory experience in molecular biology
- you like interdisciplinary research at the border between geoscience and bioscience

Applications
Just send an email to Frank Trixler: **f.trixler@lmu.de** (nano.geo.uni-muenchen.de)