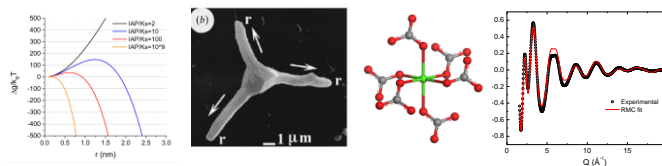


The Amorphous Precursor Strategy: Understanding Biomineral Formation



The Institute des Sciences de la Terre, **ISTerre**, at Grenoble (France), is funded by three different French research agencies (CNRS, IRD and IFSTTAR) and by the University of Grenoble Alpes. Researchers at ISTerre focus on a variety of disciplines within the Earth Sciences, ranging from field-scale seismology and volcanology studies to the study of minerals and geochemical reactions at the nanometer scale.

The Geochemistry group at the ISTerre in Grenoble, France, invites applications for a **Ph.D. fellowship (f/m)** within a project to study carbonate mineral and biomineral nucleation using advanced experimental X-ray and neutron scattering techniques and molecular modeling. If the application is successful, the applicant is expected to start his studies on October 1st 2014.

Description:

In recent years, significant advances have been made towards a deeper understanding of mineralization mechanisms in both synthetic and biological systems. In particular, research in the field of bio-mineralization has unveiled the initial mechanisms of mineral precipitation, which often occur through the formation of an initial hydrous amorphous phase that subsequently crystallizes, allowing the mineral to adopt a given shape.¹⁻³ This ‘*amorphous precursor strategy*’ is becoming a key element in the design and synthesis of new biomimetic materials with improved physicochemical and mechanical functionalities³. However, important questions remain open regarding the structure-function relationships of these amorphous precursors,⁴ their initial composition, and the role of water and organic components in their structures. The goal of this PhD project is to provide answers to these questions using an array of advanced characterization techniques such as neutron and X-ray scattering and spectroscopy, NMR, FTIR, AFM, Raman and molecular modeling. Special emphasis will be put in understanding how crystalline polymorphs of carbonate, iron and aluminum oxy(hydroxides) and phosphates are selected during crystallization from the amorphous precursor.⁵ Experiments will also be designed to ascertain the importance of mineral substrates in the nucleation processes, using mineral substrates with varying hydrophilicity, charge and chemical nature and surface sensitive techniques such as Atomic Force Microscopy and synchrotron X-ray surface sensitive techniques (GISAXS, X-ray Reflectivity).

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- (2) Couradeau, E.; Benzerara, K.; Gérard, E.; Moreira, D.; Bernard, S.; Brown, G. E.; López-García, P. An Early-Branching Microbialite Cyanobacterium Forms Intracellular Carbonates. *Science (80-.)*. **2012**, *336*, 459–62.
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- (5) Fernandez-Martinez, A.; Kalkan, B.; Clark, S. J.; Waychunas, G. A. Pressure-Induced Polyamorphism and Formation of “aragonitic” Amorphous Calcium Carbonate. *Angew. Chemie Int. Ed.* **2013**, *52*, 8354–8357.

Supervision:

Dr. Alejandro Fernandez-Martinez and Dr. German Montes-Hernandez (ISTerre).

Network:

On-going collaborations with the groups of Laurent Michot (thermodynamics of heterogeneous nucleation, PESCA, Paris), Karim Benzerara (intra-cellular bacterial amorphous mineralization, IMPMC, Paris) and Carlos Pina (Atomic Force Microscopy, Univ. Complutense, Madrid, Spain) will provide a strong network for the interdisciplinary formation of the student.

Requirements:

- Master degree (or comparable) in Earth sciences, mineralogy, chemistry, physics, physical chemistry, environmental sciences, or a closely related discipline.
- Fluency in English and good communication skills
- Experience with a programming language (e.g., Python, Fortran, Matlab,...) will be a plus.
- High degree of motivation and independence and ability to work well in a team environment.

The position is limited to 3 years, starting in October 2014. The salary will be paid in accordance with the French Ministry.

For further information please contact **Dr. Alejandro Fernandez-Martinez** (Alex.Fernandez-Martinez@ujf-grenoble.fr, <http://isterre.fr/alex-fernandez-martinez>)

Please forward your applications with the standard documentation (cover letter, letter of motivation, CV and, optionally two references/letters of recommendation) by **May 25th, 2014**, by e-mail to: Alex.Fernandez-Martinez@ujf-grenoble.fr.