

PROPOSITION DE STAGE 2018/2019

A(FM)<sup>2</sup>BRAC

ATOMIC FORCE MICROSCOPE COMPARISONS OF  
FOSSILIZED AND MODERN BRACHIOPODS

The brachiopods, present since the Early Cambrian (more than 500 MA), are benthic marine invertebrates living attached to various kinds of substrates. These organisms possess a bivalved shell (ventral and dorsal). Within the subphylum, there are 3 series: (1) Rhynchonelliformea: This is the first series of the 3 subphyla, with a shell composed of low-magnesium calcite; (2) Craniiformea: The shells concerned are composed of higher amounts magnesium calcite; and (3) Linguliformea: These species possess a shell composed of apatite (calcium phosphate). Brachiopods still live in modern seas and oceans all over the world. Yet, the species diversity has decreased. Thus, brachiopods remain a true witness of (palaeo)environments.

When working on fossils shells, it is important to analyze living specimens in parallel to understand what is susceptible to modifications during fossilization. The Peak-Force Atomic Force Microscopy (PF-AFM) allows us to reach the nano-level of the hierarchical architecture of the shell complementing Scanning Electron Microscopy observations (SEM) (Gaspard & Nouet, JSB, 2016).

The intern will have the opportunity to work with SPEC-IMAFMP researchers and MNHN researchers on fossils and modern day brachiopods. [SPEC](#) is a joint CEA / CNRS unit ([UMR 3680 CEA-CNRS](#)).

SPEC researchers study condensed matter physics from the most basic physics to industrial applications. Advanced methods on the characterization of materials and their surfaces from the macroscopic scale to the nanoscale aid researchers on their endeavor. Approaches rely on in-house theoretical and experimental platforms. These platforms make it possible to study the long-term damage of the glasses, the corrosion of the archaeological materials, magnetic imaging archaeological materials.... The intern will work on the [IMAFMP](#) platform at SPEC. The internship will equally work with the le Centre de Recherche sur la Paléobiodiversité et les Paléoenvironnements (UMR 7207, CR2P), a co-laboratory between the Muséum national d'Histoire naturelle and the Sorbonne Université. The A(FM)<sup>2</sup>Brac inter will analyze brachiopods of the MNHN Invertebrate Palaeontological collections to understand their nano-mechanical structures.

This research will enable a better understanding of the taphonomy of these species and enabling us to bear witness to their (palaeo)environments. A(FM)<sup>2</sup>Brac seeks a well-rounded student M1 or M2 student interested in implementing modern day technologies to Palaeontological specimens, which will reveal the hierarchical architecture of the inner layers of the brachiopods. A successful candidate should have exposure to equipment such as AFMs, RAMANs, SEMs, STMs....

*Ce stage peut déboucher sur une thèse (financement DIM-Map)*

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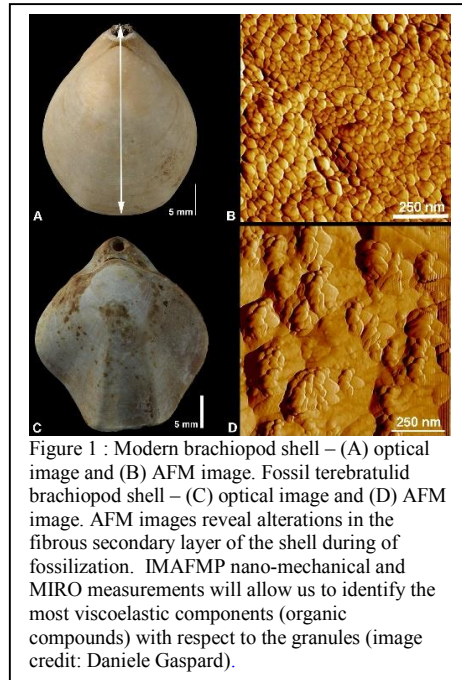


Figure 1 : Modern brachiopod shell – (A) optical image and (B) AFM image. Fossil terebratulid brachiopod shell – (C) optical image and (D) AFM image. AFM images reveal alterations in the fibrous secondary layer of the shell during of fossilization. IMAFMP nano-mechanical and MIRO measurements will allow us to identify the most viscoelastic components (organic compounds) with respect to the granules (image credit: Daniele Gaspard).