# Société Française de Minéralogie et de Cristallographie

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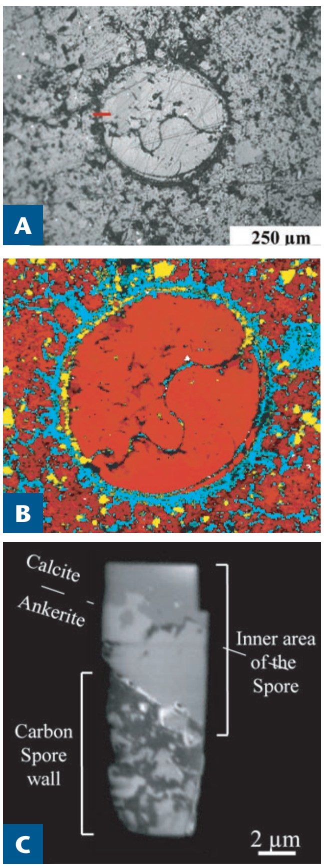
## PRIX HAÜY-LACROIX 2009 TO SYLVAIN BERNARD

Sylvain Bernard

The Prix Haüy-Lacroix recognizes a young scientist for the quality of his or her PhD research in the fields of mineralogy, petrology, geochemistry, or materials science. This year it is awarded to Sylvain Bernard, who obtained his PhD from Denis Diderot-Paris VII University (IMPMC and ENS laboratories) with a thesis entitled "Organic Fossils Preservation during Diagenesis and Metamorphism – From Natural Cases to Experiments." Bruno Goffé, Olivier Beyssac, and Karim Benzerara were his advisors. He is now a postdoctoral researcher at the Organic Geochemistry Group of GeoForschungs Zentrum (Potsdam, Germany). A summary of his work follows.

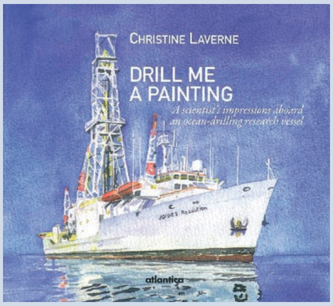
Identifying traces of life in ancient rocks can be challenging. Metamorphic processes often lead to the loss of the original biochemical structure of fossilized biogenic organic molecules (OM), preventing the reconstruction of their geochemical heritage and constituting a major limitation in the search for early life. However, exceptions do exist. The structure and chemistry of natural biogenic organic fossils associated with various minerals (phyllosilicates, carbonates, pyrite, etc.) in sedimentary and metasedimentary rocks were characterized at multiple length scales. Sylvain Bernard studied fossilized lycophyte spores found in Triassic (230 Ma) metamorphic rocks from the western Alps (Vanoise, France). Exceptionally, their morphology has been preserved through metamorphism at blueschist facies (~360°C, ~14 kbars). The nature, spatial distribution, and relationships of both mineral and organic phases forming the spores were determined at the micrometer scale by Raman spectromicroscopy and at the 25 nm scale by synchrotron-based scanning transmission X-ray microscopy (STXM), providing in situ imaging with a chemical-based contrast. The chemical nature of the carbon functional groups of the OM of spore walls was investigated using synchrotron-based high spatial (~25 nm) and energy (~0.1 eV) resolution X-ray absorption near-edge fine structure (XANES) spectroscopy. From this multiscale characterization, the textural, chemical, and mineralogical heterogeneities were interpreted as inherited from original biogeochemical heterogeneities. For instance, the chemical signature (i.e. original functional groups) of the biopolymers of the spore outer walls was preserved despite metamorphism, while the biopolymers from the inner walls were selectively replaced by a Fe,Mg-bearing calcium carbonate. Sylvain Bernard demonstrated that, contrary to what is usually supposed, high-grade metamorphism does not always erase all structural and chemical biofeatures.




**(A)** Photomicrograph in reflected light of a polished section of an exceptionally well-preserved lycophyte spore within Triassic metamorphic rocks from the western Alps (Vanoise, France). The spore wall is still made of organic matter (in black). The red line indicates the location of the ultrathin section shown in C. **(B)** Raman mapping of the spore section shown in A. Organic matter appears in cyan, ankerite crystals are in yellow, and calcite crystals are in red. This mosaic, compiled from ~40,000 Raman spectra, illustrates the complex structure of the metamorphic fossil. **(C)** STXM image of an ultrathin section of a spore wall. Areas absorbing at the energy of carbon appear dark.

Laboratory experiments were aimed at constraining the processes that might have occurred in natural samples and led to preservation. They were set up to define the evolution of the structure and chemistry of ideal carbonaceous biocompounds (e.g. sporopollenin, lignin, and cellulose) associated with various minerals under pyrolysis and high-pressure conditions. Using the same multiscale spectromicroscopy approach, it was established that various organic biopolymers had different evolutions during carbonification and graphitization, in agreement with the observed chemical heterogeneities in natural samples. More generally, this study sheds new light on the fate of biosignatures during geological processes.

## DRILL ME A PAINTING – A SCIENTIST'S IMPRESSION ABOARD AN OCEAN-DRILLING RESEARCH VESSEL




* Atlantica Editions, Biarritz, France.
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*Drill Me a Painting**, which contains 118 original watercolors, is Christine Laverne's personal memoir of her days at sea as a petrologist member of DSDP, ODP, and IODP expeditions.

In the book's preface, Peter Molnar writes, "In *Drill Me a Painting*, Christine Laverne describes in words and paintings life at sea in this modern oceanographic world, and specifically one of the prevailing themes of ocean drilling – the unraveling of the composition and evolution of ocean crust, which was inaccessible until ocean drilling began to probe its depths. Trained originally as a field geologist with a hammer and compass, she later turned to the sea and witnessed the evolution of ocean drilling, as well as her own maturation as a scientist. *Drill Me a Painting* presents that evolution in graphic detail."

Watercolor of a thin section with epidote and laumontite, by C. Laverne

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