Eco-technology

Access to resources, both in water and in energy, their exploitation in the medium and long term and the impact of their use on the environment (pollutant emissions, waste production, etc.) and on the human population (health effects), are the main concerns of the eco-technology sector.

Strengthening of environmental metrology for all media (air, water, soil, waste...) and the use of applications derived from biotechnology (biomass conversion, biological treatment of effluents and waste, extraction of solvents from renewable resources for green chemistry) are the key issues across the eco-technology sector.

Different industries also have specific issues such as CO_2 sequestration, sources of renewable energy, the treatment of waste water containing antibiotics, air quality in the residential-service sector or processing waste for re-use as raw material.

The advantages of synchrotron radiation at SOLEIL

- Analytical methods that are often direct and useable on raw samples.
- Tunability of the energy to access all the chemical elements in the periodic table.

- Microanalysis for the detection of inorganic, radioactive or organic pollutants present in complex matrices, including trace elements.
- Possibility of setting up a micro-beam to carry out chemical imaging by scanning for the spatial localization of chemical elements or organic molecules.
- Access to the structure of trace metals by the specific technique of X-ray absorption.
- Speciation of chemical elements by the specific XANES technique, over a wide range of spatial resolutions (mm to µm).

Main synchrotron applications for the sector

- Analysis of micro-pollutants in environmental matrices
- Waste characterization and monitoring of eco-processes
- Toxicology, ecotoxicology and environmental health
- Characterization of energy devices while operational: batteries, catalysts, solar cells, etc.
- Characterization and quantification of radioactive products and waste, from trace levels to high concentrations

SOLEIL SYNCHROTRON

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Eco-technology

Radioactive waste in clay

As part of a feasibility study on the storage of radioactive waste in deep geological formations conducted by ANDRA (National Agency for Radioactive Waste Management), research was carried out on the interaction between iron metal, the main constituent of containers, and various clay minerals of the host rock. In this study, KGa-2 kaolinite, an aluminosilicate in the form of 7Å sheets, was placed in contact with grains of iron metal and a weak sodium chloride solution in an anoxic atmosphere at 90 ° C for 1-9 months.

Analyses by micro X-ray absorption spectroscopy at the iron K edge (see figure) were carried out on the LUCIA beamline to determine the location and status of iron in the clay phases and evaluate the heterogeneity of the reaction products.

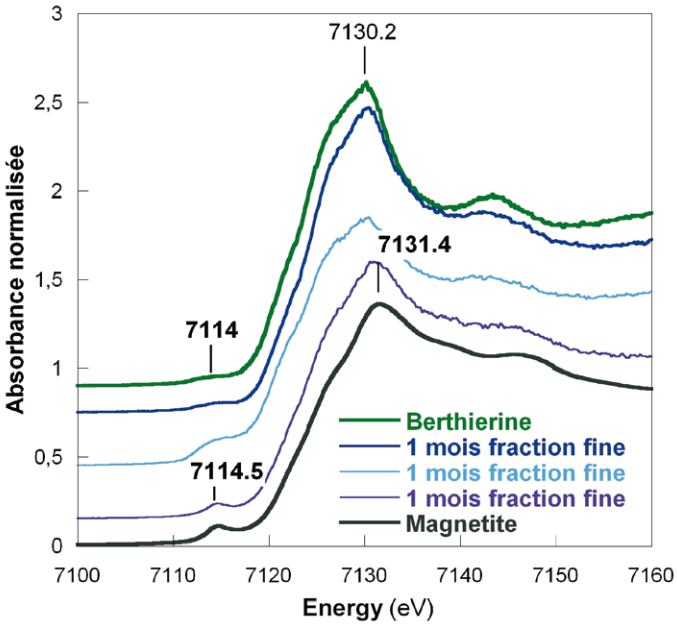
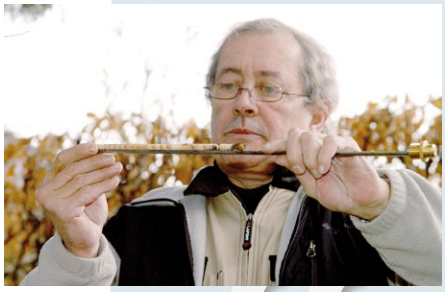


Figure: XANES spectra of the fine fraction after 1 month of reaction, compared with those of berthierine and magnetite.

EXAFS spectroscopy confirmed that the iron-carrying clay phases are essentially berthierine- type phases in which ferrous iron is predominant and that these phases are stable over time.
In the case of a possible storage of radioactive waste, this example of kaolinite-berthierine transformation therefore shows that the interaction between a metal container and an argillaceous rock can lead to the formation of new iron-rich phyllosilicates at the expense of the initial minerals.



Jean-Christophe Balouet, Director of *Environnement International.*

Firm of experts in the field of forensic science of the environment, Environnement International works on a worldwide basis to date pollution in soils, underground and in ground water, using dendrochronological and dendrochemical methods.

In addition to the speed of acquisition of experimental data, the tools and methods offered by SOLEIL, such as line scanning, an analytical process using a translation table or multi-element detection, are a real advantage for analyzing organochlorines, fertilizers, fossil fuels, petroleum products and heavy metals, by providing more detailed and more reliable detection of components under investigation.

Environment International has launched an international program called PIT (Pollution Investigations by Trees) over two and a half years, for which we hope to carry out rapid and regular synchrotron analyses at SOLEIL.