



# Equipex MARSS

## *[Video] MARSS, MAss Spectrometry Centre for Reactivity and Speciation Sciences*



The president and the management team of the University of Pau and the Adour region (UPPA) are pleased that the **MARSS project** has been a winner in the second round of the Equipex (Equipment of Excellence) call for projects, a component of the government's *Grand Emprunt* (Big Loan) scheme. The **MARSS project**, MAss Spectrometry Centre for Reactivity and Speciation Sciences, is being carried out by **IPREM**, a research laboratory directed by **Olivier Donard**.

### **MARSS, MAss Spectrometry Centre for Reactivity and Speciation Sciences**

Metals and metalloids play an important role in various areas such as living resources, the environment and in industrial processes. For many years it has been recognized that simple information on the total content in a sample no longer suffices to assess metals' reactivity, their transport in the environment or their essential role or toxicity. It is now vital to tackle these issues by characterising the chemical species or forms (speciation analysis).

The aim of the MARSS Equipex project is to establish a mass spectrometry centre for metal speciation study, bringing together the latest instrumentation technologies in the field of mass spectrometry which, supported by the existing potential of IPREM (Institute of analytical science and physical chemistry for the environment and materials) will place it in the international arena. This project will be dedicated to advances in the fields of science linked to reactivity and speciation, based on a **high-level instrumental platform** made up of four premium mass spectrometers for cutting-edge speciation analysis. The scientific aim is to **push the boundaries of speciation analysis** towards:

- Understanding the role of elements, in particular metals and metalloids, in relation to their chemical identity or isotopic signature,
- Understanding their primary reactivity linked to their chemical identity and kinetic transformations,
- Identifying chemical species of interest in their matrix environment, on surfaces or interfaces, to pinpoint their location by imaging and mapping in two or three dimensions.

New areas of application are, for example, characterisation at nano scale, surface reactivity, battery optimisation, improvement in environmental management and remedial measures.



The originality of this unique platform lies in the ability to **integrate speciation concepts at isotopic level up to 3D imaging** for studies dealing with the environment, living resources, industrial applications and materials. The different mass spectrometers of this platform are complementary in terms of state-of-the-art speciation analysis:

- An HR MC ICP/MS: a high-resolution multi-collector inductively coupled mass spectrometer allowing a very high precision, extremely sensitive elementary analysis of isotope ratios,
- A 15 Tesla FT-ICR MS: 15 Tesla Fourier-Transform mass spectrometer; molecular identification and structural characterisation,
- A NanoSIMS: secondary ion mass spectrometry, analysis process of surface (2D) and volume (3D) down to a few microns, elementary and isotopic imaging at nanometric scale,
- A TOF-SIMS: time-of-flight secondary ions mass spectrometer; an extremely sensitive method of elementary and molecular analysis to analyse the very outermost surfaces.

This platform, which is a **world first**, will facilitate breakthroughs and:

- New research avenues in speciation,
- New developments in instrumentation,
- Extensive possibilities for collaboration at academic level with other research establishments,
- The provision of an international academic and professional course
- Extensive opportunities for industrial partnership.

This project will also, in the field of instrumentation, help redevelop skills connected to key sectors of innovation in living resources and the environment, and will open up new doors in industrial sectors. The MARSS project also relies on **a close collaboration with major companies (mainly European) in the world of mass spectrometry** (NU-INSTRUMENTS and CAMECA). BRUKER and ION-TOF are also partner companies on this platform. This project benefits from **the participation of national bodies** such as:

- The Atomic Energy Commission (CEA: innovation and nuclear support division),
- The National Agency for Radioactive Waste Management (ANDRA: R&D division),
- The National Metrology Laboratory (LNE: scientific and industrial division),
- *Lyonnaise des Eaux* Water Board (LyRe: Bordeaux research centre for *Lyonnaise des Eaux*).

It also enjoys **very strong support from the Aquitaine region** and is therefore able to be involved in the interconnection of substantial new environment-related infrastructures in Aquitaine (accessibility to and support for developments of Bordeaux University 1's UMR 5805 EPOC – Oceanic and continental environment and paleoenvironment). Finally, it is involved in restructuring analytical sciences at national level. The MARSS project also has its sights set on achieving financial independence after four years, by generating income through research contracts with universities, government institutions and industry, providing cutting-edge analytical services and training courses at international level.