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# Applications of Laboratory micro-XRF in environmental sciences with a 10 µm spot size.

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X-ray spectromicroscopy coupling micro-XRF and X-ray microscopy, has been developed on synchrotron source more then ten years ago. At the laboratory scale such techniques were more confidential. Due to recent developments in terms of X-ray source and especially in terms of focalization (capillaries, Zones plates…) laboratory micro-XRF equipment have been commercialized in the last 4 or 5 years (Horiba-Jobin Yvon, EDAX, Shimadzu, COX…). Such laboratory machines are not limited to material science and they are known to be very efficient in geoscience and environmental science. Indeed in environmental sciences the studied samples are generally disordered, heterogeneous, and/or fragiles. For such samples the main issue is to assess the transfer of pollutant and/or localize spatially some element of interest at low concentration that are not assessable by SEM-EDX.

In the present work we will present advantages and limitations of a 10 µm micro-XRF/microscope (XGT-5000, Horiba-Jobin-Yvon) on different environmental applications. The X-ray beam is generated with a Rh X-ray tube at an acceleration voltage of 15 to 50 keV with a current adjustable up to 1 mA. The X-ray beam is focused with a X-ray guide tube, whose inner diameter is 10 µm, producing a finely focused and high-intensity X-ray beam. The beam size is controlled with a 5 µm tungsten wire scanned through the beam. X-ray emission from the irradiated sample are detected with an energy-dispersive x-ray (EDX) spectrometer equipped with a liquid-nitrogen-cooled High-purity Si detector. The resolution of the detector is 145 eV at the Mn Kα emission line. A scintillator enables transmission measurements.

Many scientific topics benefit from the laboratory installation. The impact of waste reuse can be assess by determining the transfer mechanism of metal pollutants. Recent results concerning by-products from steel industry indicate that vanadium is release from the initial matrix. Lab-micro XRF help to identify the mineral bearing phases of V.

First results concerning the evolution of the composition of marine sediment are very promising. Indeed the variation of chemical composition can be related to evolution of atmospheric conditions. The analysis of sediment cores from anoxic zones of the Arabian sea presenting annual laminations reveals that the variability at the annual scale can be observed (100 mm scale).

Micro-XRF can also be very helpful to identify the origin of micro-extra terrestrial material by analyzing Fe/Ni and Fe/Si ratio. Indeed such materials are rare, fragile and very small. One need a non destructive technique. Moreover the surface is generally altered and SEM-EDX failed to discriminate samples. Laboratory micro-XRF appears as a very interesting routine tool.