A.7: Indus-2- focus XRF beamline helps analyzing Chandrayaan-1 data.

It is a well known fact that moon does not have essential conditions (air and water) that can sustain human life on its surface. However, in a recent investigation performed by the on-board Moon Mineralogy Mapper (MMM) using Chandrayaan-1 spacecraft has confirmed the existence of surface ice-water in the form of hydroxyl ions. The determined concentration of lunar surface ice-water molecules has been found to be as high as ~1000ppm. In addition, moon surface also comprises of abundance of several other elements e.g. Na, Mg, Al, Si, P, K, Ca, Ti, Mn and Fe. It is important to know actual concentrations and topographic distribution of these elements on the lunar surface in order to trace their origin.

A group of scientists from Indian Space Research Organization (ISRO), Bangalore are exploring the use of synchrotron x-rays emitted from Indus-2 synchrotron light source to investigate the actual mineral composition of Lunar Simulant Samples. They used microfocus x-ray fluorescence beamline (BL-16) for their investigations. The basic objective behind these investigations was to establish the detector calibration and to validate the methodology developed for finding out the lunar surface elemental abundance before the launch of the Chandrayaan-2 satellite.

Fig. A.7.1 shows a schematic layout where solar x-rays excite the trace elements present on the lunar surface. The calibrated detector on-board the Chandrayaan-1 x-ray spectrometer (CXS) is used for the detection of fluorescent x-rays originated from the lunar surface excited by solar x-rays.

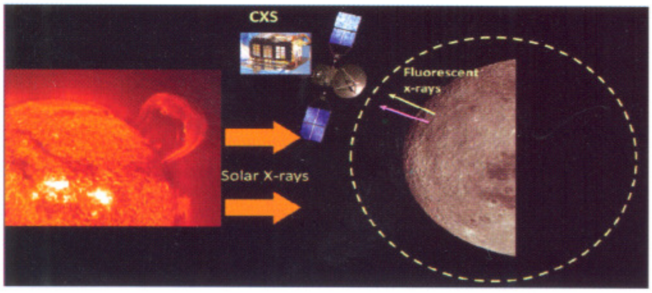

Fig. A.7.1: A schematic layout showing the working principle of Chandrayaan X-ray Spectrometer (CXS).

BL-16 beamline comprises of a double crystal monochromator (DCM) with Si (111) symmetric and asymmetric crystals (mounted side-by-side), a Kirkpatrick-Baez (KB) focusing optics and a combination of slits in order to reduce the scattered background reaching the experimental station. It is possible to get either unfocused (i.e. collimated) or micro-focused x-ray beams at the experimental station for fluorescence excitation of a specimen.

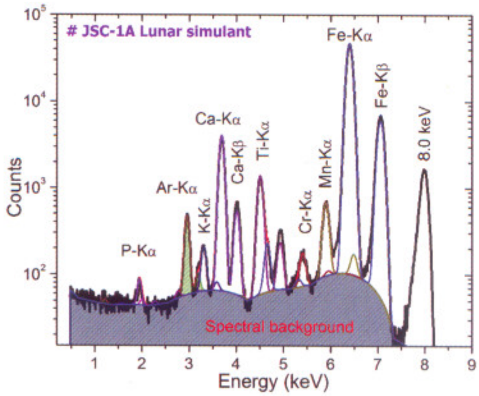

Fig. A.7.2: Measured XRF spectrum from a JSC-1A lunar stimulant sample. The elemental composition of this sample corresponds to the low level points at the lunar surface

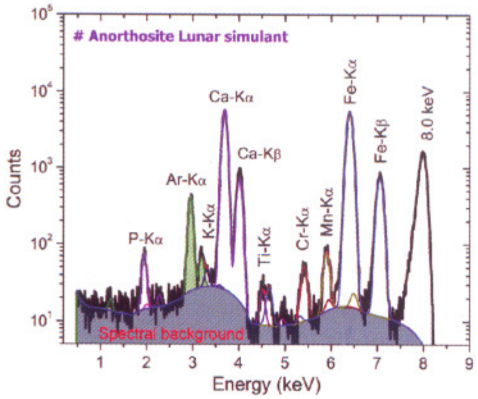

Fig. A.7.3: Measured XRF spectrum from an Anorthosite lunar stimulant sample. The elemental composition corresponds to the highlands points at the lunar surface.

Figs A.7.2 and A.7.3 depict measured x-ray fluorescence spectra obtained using JSC-1A and Anorthosite lunar stimulant samples. Collimated monochromatized synchrotron x-rays of 8.0 keV energy, has been used for fluorescence excitation of these samples. The fluorescence spectra were recorded for an acquisition time of 100s.

These investigations led us to develop a vacuum assisted fluorescence measurement system in order to determine concentration of low Z elements (e.g. Na, Mg, Al, Si) which are present as majority in the lunar stimulant samples. The development of vacuum compatible XRF spectrometer on the microfocus x-ray fluorescence beamline is under way. This spectrometer will cater to the need of all users requiring the XRF analysis, especially the low Z elements.

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