Geophysical Research Abstracts, Vol. 8, 04032, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04032

Methods for interpreting D-CIXS X-ray fluorescence data

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D-CIXS is a compact imaging X-ray spectrometer that is currently in orbit about the Moon onboard ESA's SMART-1 mission. This instrument measures the X-ray emissions of the lunar surface, and during times of heightened solar activity the induced X-ray fluorescence (XRF) can be utilized to infer the abundance of certain elements. To date, spectral peaks corresponding to Fe, Mg, Al, Si, and Ca have been unambiguously identified.

The initial data products that will be useful for scientific interpretation will include (1) the combination of reduced XRF and X-ray solar monitor (XSM) spectra, and (2) elemental abundance ratios. Not until after significant data processing will absolute elemental abundances be obtained. The purpose of this sudy is to demonstrate methods that will be useful for the scientific analysis of data obtained from the D-CIXS instrument.

The first data analysis method will be to compute theoretical XRF spectra of the lunar surface for a given composition and inducing X-ray solar spectrum. By comparing a suite of theoretical spectra obtained from a variety of compositions to the observations, the major element geochemistry of the surface will be constrained. In contrast, by making use of elemental abundance ratios, the inferred composition can be compared to the elemental ratios of analyzed lunar samples. In order to distinguish among samples of the Mg- and Ferroan-suites, we will make use of bi-element-ratio plots.

In addition to demonstrating techniques that will be useful for inferring the composition of the lunar surface, we will quantify how the instrument's field of view convolves

the X-ray measurements from adjacent terrains, such as mare and highlands. Additionally, by utilizing the orbital measurements over the Apollo and Luna landing sites, the fidelity of the measurements and calibration techniques will be assessed.