THE SCIENTIFIC CASE FOR THE CHANDRAYAAN-1 X-RAY SPECTROMETER. K.H. Joy[1,2], I.A. Crawford[1], B.J. Kellett[2], M. Grande[3] and The C1XS Science Team[4]. [1]Birkbeck/UCL Research School of Earth Sciences, Gower Street, London, WC1E 6BT, UK. [2]The Rutherford Appleton Laboratory, Didcot, Oxon, OX11 0QX, UK. [3]Institute of Mathematical and Physical Sciences University of Wales, Aberystwyth, SY23 3BZ, UK.[4] Members of the C1XS Science Team are identified in the Acknowledgments. (Email: K.Joy@ucl.ac.uk).

Introduction: The Chandrayaan-1 X-ray spectrometer (C1XS) will be launched during 2008 on the Chandrayaan-1 spacecraft, India's first mission to the Moon. The UK flew a Demonstration version of a Compact Imaging X-ray Spectrometer (D-CIXS) on the European Space Agency's SMART-1 mission to the Moon between 2003 and 2006 [1]. The new C1XS instrument builds on the technology innovations [2] inherited from this precursor instrument.

C1XS is a scientifically more powerful instrument than D-CIXS, both because Chandrayaan-1's low circular orbit (100 × 100 km) will result in higher spatial resolution of the lunar surface (~25 km FWHM), and because it will operate during a more active period of the solar cycle, resulting in higher X-ray fluxes and greater sensitivity to compositional variations [3].

C1XS Scientific Objectives: C1XS's principal objective is to map the global abundance ratios and abundances of the major rock-forming elements (principally Mg, Al, Si, Ca and Fe) in the lunar crust. It is hoped that C1XS will constrain the composition of regions of the Moon that have not been visited by sample return missions (i.e. the far-side highlands, the giant South Pole-Aitkin impact basin, far-side mare basalts and distinct mare basalt lava flows within individual maria). A more complete understanding of global geochemical variation is an important requirement for constraining the compositional makeup of complex differentiated planetary bodies like the Moon.

Specifically, localised and global elemental maps of the lunar surface will enable us to search for outcrops and/or determine the major element composition of regoliths dominated by lithologies such as High-Mg Suite (HMS) rocks; High-Alkali Suite (HAS); 'unusual' mare basalts (i.e. high-Al basalts); exposures of presumed pre-mare volcanism; cryptomaria and dark mantles surrounding endogenic craters (pyroclastic picritic glasses). C1XS will also be able identify the location of regoliths dominated by rock types that have not been previously identified in the lunar sample collection.

C1XS elemental datasets will help to address many outstanding questions regarding the stratigraphic structure and geological evolution of the Moon:

- Determine the compositional heterogeneity of the anorthositic highlands in different crustal regions (near-side, farside, polar): constraining models of lunar magma ocean petrogenesis [4-6];
- Measure the refractory element (Al, Ca) budget of the lunar crust: helping to constrain the composition of the bulk Moon, and models of lunar magma ocean melting [7,8];
- Determine the regional variations in the Mg# [Mg/(Mg+Fe) ratio]: constraining models of lunar crustal evolution [9];
- Probe the stratigraphy of the lunar crust by studying central peaks and/or ejecta blankets of impact craters [10]: better understanding of lunar differentiation and magma ocean evolution;
- Study mantle evolution through compositional changes in volcanic products (mare basalts etc.) over time: understanding the thermal and magmatic history of the Moon [5];
- Identify the regional settings from which different lunar meteorites are derived [11]: better constraining the petrological history of previously unsampled regions of the Moon throughout lunar history

Instrumental Parameters: Consideration of the principal science aims has led to the following capabilities of the C1XS instrument [3, 12]:

- Spatial resolution. The C1XS collimator stack permits X-rays from a 28 degree-wide aperture to fall on each SCD detector, corresponding to 50 km on the lunar surface (25 km FWHM) from Chandrayaan's circular 100 km orbit.
- Spectral resolution. Pre-launch ground based calibrations indicate a spectral resolution of ≤110 eV (at Fe Kα) [12], ensuring separation of the low-energy lines. In particular, the Mg Kα line is clearly resolvable from the adjacent low energy 'noise peak' and the neighbouring Al Kα line.

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