AN INTEGRATED VIEW OF THE HISTORY AND EVOLUTION OF VOLATILES IN THE MOON. M. Anand[1,2], [1]Planetary and Space Sciences, The Open University, Milton Keynes, MK7 6AA, UK; [2]Department of Earth Sciences, The Natural History Museum, London, SW7 5BD, UK Affiliation (Mahesh.Anand@open.ac.uk).

Introduction: The last decade has witnessed an unprecedented growth in lunar volatiles research, which has revealed a complex history of volatiles in the lunar interior. A range of volatile elements and their isotopes (e.g. H, C, N, O, Cl, K, Zn) have been measured in lunar samples exploiting latest advancements afforded by modern analytical instrumentation, confirming not only a significant presence of volatiles in the lunar interior but also highlighting an array of complex physico-chemical processes that might have influenced the volatile inventory of the Moon. Such processes range from interaction of solar wind with lunar melts to degassing of magma during and upon eruption to shock-induced volatile redistribution in volatile-bearing minerals/phases. Furthermore, the variety of data that has been acquired on lunar interior volatiles can now be brought to bear on various hypothesis testing a genetic connection between the Earth and the Moon as well as the evolution of the Lunar Magma Ocean (LMO) that formed in the aftermath of lunar accretion.

Recent dataset: Recent measurements have targeted bulk-samples, individual mineral phases such as apatite and plagioclase feldspar, and melt-inclusions in lunar samples returned by the Apollo missions and lunar meteorites [e.g., 1-4]. As a result of these recent efforts, there now exists a considerable dataset for volatile elements in lunar samples but to a large extent, integration of different dataset has been lacking. This is critical for fully understanding the history and evolution of lunar volatiles since the accretion of the Moon until the present day. Such an approach is also essential for reconciling various lunar formation theories (several new models for the origin of the Moon have been proposed recently) and in developing a coherent view of the timing of delivery, sources and distribution of volatiles in the lunar interior [e.g., 5-7]. Furthermore, a comprehensive understanding of the inventory of various volatiles in lunar material would facilitate in developing appropriate *in-situ* resource utilisation (ISRU) applications on the Moon – an increasing possibility in light of the emergence of new space faring nations and private entities intrested in space exploration.

Future prospects: Recent efforts have already resulted in several new discoveries about the Moon, one of which has been an unambiguous detection and quantification of water in lunar samples. Nevertheless, our understanding of complex physico-chemical processes influencing the volatile inventory of lunar samples is relatively poor. Future analytical work using a multi-proxy approach and targeting a range of lunar samples, minerals and other analogue materials will lead to new discoveries and better understanding of the abundance, distribution and sources of volatiles in the Moon. As the next phase of planetary sample return missions is unfolding, an integrated view of lunar volatiles would be instrumental in guiding/informing not only future lunar sample return missions but also missions to other target bodies such as Mars, asteroids, and beyond.

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