Return to the Moon: Insights into lunar volatile resources through analysis of new samples

Supervision team: Mahesh Anand and Ian Franchi

External collaborator: Dr Chip Shearer, University of New Mexico, USA

Lead contact: Mahesh.Anand@open.ac.uk

When first returned, the lunar samples appeared to be from a barren, dry, environment, but recent advances in analytical capability and understanding of the lunar surface has forced us to revise this assessment, and we now realise that the lunar surface contains a wealth of useful volatiles that have the potential to be a critical resource for future exploration [1].

One of the major challenges with the study of lunar samples is that they were returned to Earth 50 years ago and exposed to various environments in the curation facility since. However, new pristine samples have recently become available through meticulously planned opening of two new core samples from the Apollo 17 mission that have been stored unopened since their return in 1972. The Open University staff are members of a recently NASA funded project (led by Dr Chip Shearer, University of New Mexico) to systematically examine the Apollo 17 Core Sample Vacuum Container (CSVC) sample 73001 and its double drive tube companion 73002.

Consequently, the availability of pristine lunar samples provides an ideal opportunity to:

- Define volatile reservoirs and volatile cycles on the Moon and assess their potential for utilization;
- Conduct an overarching evaluation of the collection and preservation of volatile-rich samples to inform future missions to the lunar surface;

The proposed studentship will focus on measurements of volatiles (e.g. H, C, N etc) in lunar samples, building upon recent work carried out at the Open University [2-4]. The student will also have an opportunity to be involved in the preliminary examination of 73001 and 73002, contribute to a sample catalogue and identify new lithologies. Short visits to Lunar and Planetary Institute and University of New Mexico are anticipated.

The project goals will be accomplished through (a) determination of bulk volatile element contents (indigenous, meteoritic, solar wind components) in regolith using a variety of elemental, stable isotopic and organic measurements by mass spectrometry; (b) In-situ investigations of volatile-rich target phases using microbeam techniques (e.g. NanoSIMS) (c) placing these data within the context of lunar geological processes in order to evaluate the origin and inventory of volatiles on the Moon and its potential usefulness as a resource.

We seek a highly motivated candidate with an interest in cosmochemistry and willingness to participate in developing and applying new analytical protocols for analysis of planetary materials. The successful applicant must be able to work in a dynamic research team consisting of several PhD students, post-doctoral researchers and international collaborators.
References:

2. Barnes et al. (2019) Multiple volatile reservoirs in the lunar interior revealed by the isotopic composition of chlorine in lunar basalts. *Geochim Cosmochim Ac*

**Qualifications required:** A first class or upper second class Msci degree in Earth Sciences or related discipline. Any previous experience in using micro-analytical instruments such as EPMA or SEM would be an advantage.