Introduction

Results for grain size/morphology by SEM and bulk mineralogy by XRD are presented for 3 lunar regolith simulants: EAC-1 and NU-LHT-2M (Zybek and USGS). These simulants are contained as voucher specimens within the ESA Exploration Sample Analogue Collection (ESA²C).

The analyses were carried out at the Natural History Museum’s (NHM) Imaging and Analysis Centre (IAC) in London as part of activities for the ESA Sample Analogue Curation Facility [1].

Lunar Simulants

Sub-sample Preparation: Riffle split sub-samples of each simulant were prepared as polished blocks (7 for EAC-1 and 1 each for Zybek and USGS).

The sub-samples were set in Specifix resin (RI ~1.54) with hardener Endecotts 1/2” Products Inc. as a Lunar highland regolith simulant [3]. Includes glass, agglutinates and synthetic products produced by Zybek [4]. The majority of the material was sourced from Stillwater Mine in Nye (Montana, USA).

XRD Analysis

Sub-sample Preparation: Riffle split sub-samples of each simulant were milled to a fine powder (<0.1µm) using a Retsch XRD Mill McCrone.

Approximately 3g of each powder was then mixed with ~10% of a corundum standard (Al₂O₃) to 1 from Baikowski).

Methodology: The samples were analysed at the NHM using a PANalytical X'Pert Pro diffractometer with a Cobalt X-ray source.

Data Processing: The bulk mineralogy was characterised using Panalytical HighScore for phase identification and BGMN for phase quantification (Rietveld Method).

Bulk Mineralogy Results

The estimated relative errors are approximately 5% for phases >10 wt. %, and approximately 10% for phases <10wt.%.

Conclusions & Further Work

- The greater packing of grains in the USGS sub-sample may explain a higher 'cohesivity' observed on a large scale (i.e. more stable bionodes). However, more USGS and Zybek sub-samples need to be analysed to determine whether there is a bias in how the grains are spread in the polished block.
- During the milling of the USGS sub-sample for XRD analysis, the 'cohesivity' in the sub-sample remained suggesting a potential mineralogical/chemical control on this bulk property (also suggested in [6]).
- Future research work should examine the relationship between mineralogy and grain size and incorporate other analytical data types (i.e. Particle Size Distribution (PSD) by sieving and laser particle analysis; mineralogical chemistry by SEM point analysis). The relationship between cohesion and grain size/shape/mineralogy is another important line of enquiry.