GEOLOGICAL AND GEOCHEMICAL STUDY OF THE SOUTH POLE-AITKEN BASIN AND FUTURE SAMPLE RETURN MISSIONS

A. M. Borst[1,2], F. Bexkens[1,2] , B. H. Foing [1], [1] SRE-S. Research and Scientific Support Department, ESA ESTEC, Postbus 299, 2200 AG Noordwijk, NL, [2] Department of Petrology, Vrije Universiteit, Amsterdam, NL, (**aborst@rssd.esa.int** / Tel; +31611213813 , Bernard.Foing@esa.int/ +31 71 5655647)

Introduction

The South Pole - Aitken (SPA) Basin, situated on the southern farside of the Moon, is currently one on of the highest priority targets for sample future return missions. This PreNectarian basin (>3.9 Ga) measures 2500 km in diameter with a depth of up to 13 km and is commonly alleged to have excavated deep into the lunar crust. Consequently the SPA Basin floor may provide a unique opportunity to sample and study deep seated lunar materials.

Furthermore, the basin is assumed to have formed due to a large oblique impact during the Late Heavy Bombardment [1]. Returning samples of the impact melt breccia produced during this event allows exact age determination of the impact, which permits verification of the LHB concept. As yet, most evidence on the LHB relies on ages provided by the Apollo and Luna samples, which is severely biased towards the near-side equatorial regions. Exploration of the South Pole- Aitken Basin would therefore not only provide information on the Lunar interior and evolution, but will also greatly improve insights in the dynamics and origin of the Late Heavy Bombardment and its influence in the evolution of the early Solar System [4].

However, rocks initially exposed by the impact event have been heavily altered or hidden from view, due to subsequent weathering and impact processes over the last 4 billion years. Consequently the identification of the most suitable landing sites to ensure sampling of pristine SPA Basin floor material and impact melt breccia has become rather complicated and extensive ground-based remote sensing studies are necessary .

SPA Geology and geochemistry. Here we combine structural and geochemical analyses of the SPA Basin, in order to improve descriptions of geological units and mafic rock types exposed within the South Pole - Aitken Basin. Multispectral data from Clementine ultraviolet/visible and near-infrared cameras are used and processed in ENVI following a similar approach as described by Tompkins and Pieters [2,3]. The method relies on diagnostic shapes of band absorptions for key mafic minerals as olivine and high Ca-pyroxene, in order to discriminate between geologic units of noritic, gabbroic and troctolitic compositions.

The global geological structure of the SPA Basin has been studied using Clementine altimetry and gravity data, obtained by LIDAR instruments. SMART-1 high resolution AMIE images will provide improved geological context for areas identified as candidate landing sites.

In particular we have studied the Bhabha-Bose region located in central SPA Basin, which is a previously proposed possible landing site (central SPA, Fig 1). The Bhabha crater is interesting as it shows a noritic central peak (blue unit), which might represent either deep pristine crustal material or the uplifted impact melt sheet from the SPA Basin impact event. Other areas identified for sampling are the fresh crater rims of Bhabha, Bose or Stoney (yellow unit) or Olivine hill (dashed area below Bhabha) [2,3].

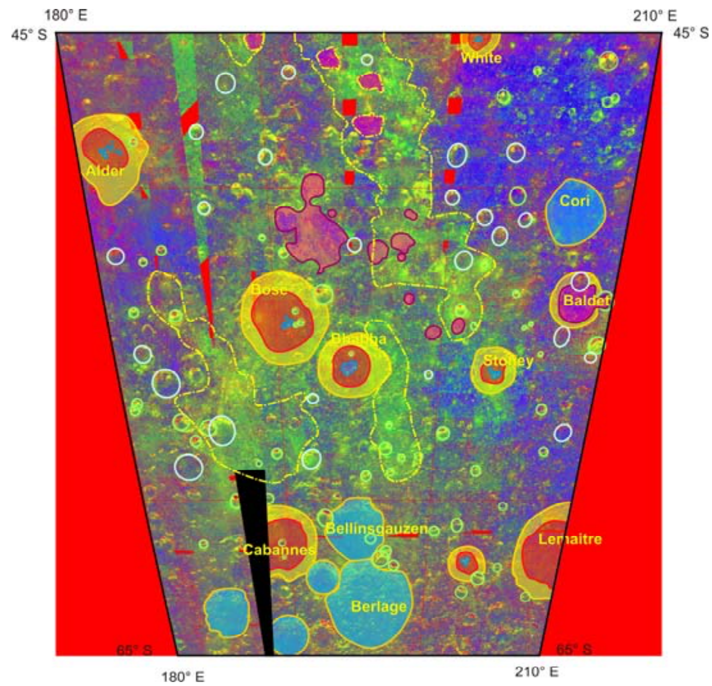

Fig. 1 Geological units overlayed on a false color image produced in ENVI using the method described by Pieters [2,3]. Flooded basins are indicated in purple, crater morphology is subdevised in yellow (crater walls), red [1](floor), dark blue (central peak) and light blue (altered crater). Dashed areas represent geochemically different regions, possibly impact meltsheet or cryptomaria.

With the prospect of future sample return missions, careful studies of the exposed materials and considerations on science/technology trade-off are required. This study aims to contribute in identifying locations which ensure optimal scientific gain in the next phase of Lunar exploration.

References:[1] Schultz, P. H., (2008) LPSC XXXIX, 2451. [2] Pieters, C.M., et al. (2001) JGR, 106, 28,001- 8,022. [3] Tompkins, S., and Pieters, C.M. (1999). Meteor. Planet. Sci., 34(1), 25-41. [4] Duke, M.B. (2003) Adv. Space. Res., 31, 2347-2352