GEOLOGY OF THE NORTHERN PORTION OF THE SPA BASIN ON THE MOON: EVIDENCE FOR COMPOSITIONAL STRATIFICATION OF THE ANCIENT LUNAR CRUST. M. A. Ivanov[1,2], H. Hiesinger[2], C. Orgel[3], J. H. Pasckert[2], C. H. van der Bogert[2], J. W. Head[4]. [1]Vernadsky Inst., RAS, Russia, [2]Westfälische Wilhelms-Universität Münster, Germany, [3]Freie Universität, Berlin, Germany, [4]Brown University, Providence, USA.

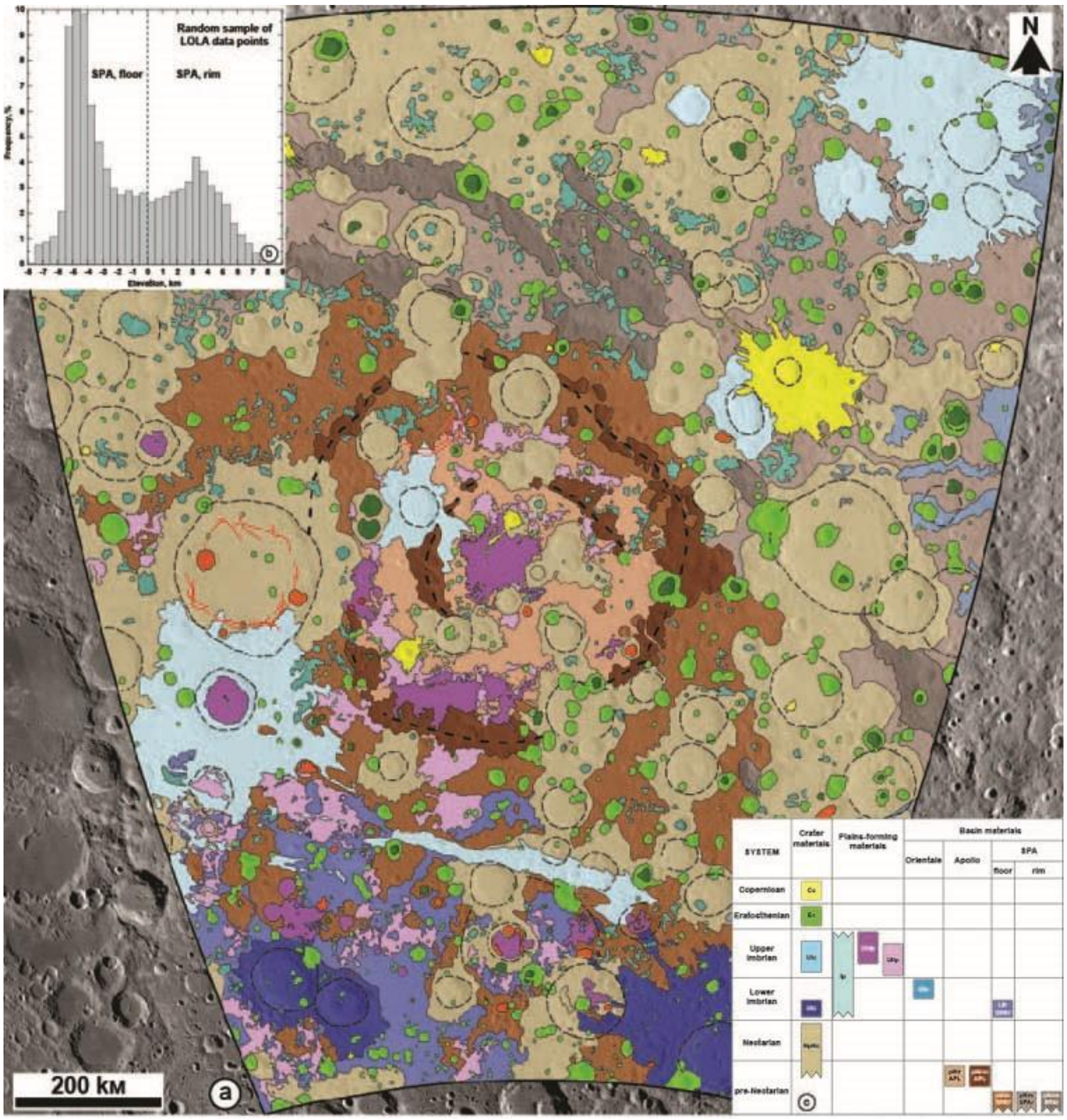

Fig. 1. Geological map, hypsogram, and stratigraphic correlation chart for the northern SPA basin.

Introduction: We studied a region between 10-60° S and 125-175° W that encompasses the northern portion of the South Pole-Aitken basin (SPA, *Fig. 1a*), which is the largest known [1-5] and likely the oldest, ~4.2 Ga, impact structure on the Moon [6,7]. The SPA basin is a huge topographic feature [1,8,9], formed within a solid crust. The detailed photogeological investigation of the basin is motivated by the need for additional constraints on the structure and composition of the ancient lunar crust.

The SPA iron anomaly: The SPA region displays a distinct iron anomaly [10-11], although it is significantly weaker than those in typical maria. The floor of the basin shows a limited extent of obvious volcanic plains. So, what could have caused the SPA iron-rich region? Is the anomaly linked to the presence of extensive cryptomare deposits on the floor [12] or does it reflect vertical compositional stratification of the ancient crust?

Goals of the study: We approached this question via detailed photogeological/stratigraphic analysis of the study area. We compiled a geological map (*Fig. 1a*) based on LROC WAC mosaics and LOLA topography, and analyzed the FeO abundancies in units with different ages using the Clementine FeO abundance map [13].

General topography of the study area: The hypsogram of the study area is bimodal (*Fig. 1b*) indicating that this region consists of two topographic domains (SPA-floor and SPA-rim). The mean difference between the domains is ~8.5 km.

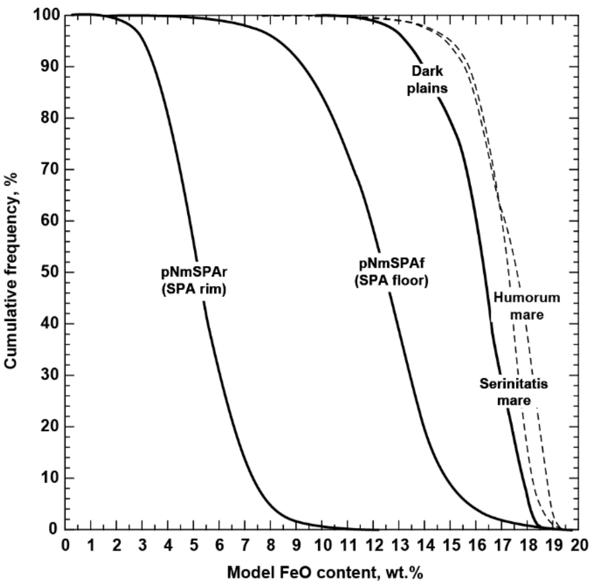

Fig. 2. Cumulative distribution of FeO in materials in the SPA basin and Humorum and Serenitatis maria.

Morphology and stratigraphy of map units: Two major classes of landforms occur in the study area: (1) impact craters and related features, and (2) plains-forming terrains of volcanic and impact origin.

The crater-related landforms include the following stratigraphic units (Fig. 1a,c): Copernican craters with prominent rays and ejecta (Cc), Eratosthenian sharp-crested craters without rays (Ec), and large craters with ejecta and surrounding fields of secondary craters. Determination of the absolute model ages of these craters shows that they vary in age from the Lower to Upper Imbrian (LIc, UIc) epochs. Additional crater-related units include: Ejecta from the Orientale basin of the Lower Imbrian age (LIo), craters with complete rims but without ejecta. These craters formed during the Nectarian and pre-Nectarian epochs (NpNc). Also present are massifs of the Apollo (pNrnAPL) and SPA (pNrnSPA) basin rims of the pre-Nectarian age. Finally, strongly degraded crater materials of the pre-Nectarian age occur within both SPA topographic domains, predate unit NpNc, and show no lower stratigraphic limit. We interpret these units as those displaced to form the SPA rim (pNmSPAr) and exposed on the floor (pNmSPAf) of the basin due to the SPA event.

Plains-forming units include dark and light plains of the Upper Imbrian age [14] (UIdp, UIlp) and low-relief rugged terrain. This unit occurs in two areas where it has different ages. Near the SW corner of the map area, this unit is of the Lower Imbrian age (LIlr), associate with the other plains-forming units and likely represent older volcanic plains. Within the Apollo basin, this unit (pNlrAPL) has the same age as the basin itself and probably represents its impact melts.

Discussion: In order to assess possible sources of Fe inside SPA, we collected data on the FeO content for the Upper Imbrian dark plains and the pre-Nectarian materials on the SPA rim and floor, and compare the concentration of Fe in these units with those in materials of the Serenitatis and Humorum mare. The dark plains have the highest FeO abundance comparable with that of typical mare materials (*Fig. 2*), which is in agreement with the volcanic nature of the dark plains. The oldest units in the map area (pNmSPAf and pNmSPAr) represent rugged terrains whose morphology is inconsistent with their interpretation as possible ancient volcanic plains. In addition, the Fe content in these materials is significantly lower than in typical mare units (*Fig. 2*).

The oldest materials on the basin floor have typical Fe content of ~11-13.5 wt % (*Fig. 2*), which accounts for the absolute majority of the SPA iron anomaly; materials on the basin rim are significantly Fe-poorer (*Fig. 2*). The large difference in the Fe abundance between the SPA floor and rim primordial materials suggests that by the time of the SPA event the lunar crust was stratified in respect to the iron content. The oblique SPA impact [5,15,16] likely stripped away the upper (Fe-poorer) portion of the crust, the materials of which were re-deposited in the SPA rim, and exposed the lower (Fe-richer) portion of the crust on the basin floor. The characteristic difference between the SPA topographic domains (~8.5 km) provide the upper estimate of the thickness of the upper, Fe-poorer portion of the crust.

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