DEEP CRUSTAL LUNAR LITHOLOGIES EXPOSED IN THE SOUTH-WESTERN PEAK RING OF THE SCHRÖDINGER BASIN.

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Introduction: Schrödinger basin (Fig. 1), with a 150 km diameter peak ring and 320 km diameter is the best preserved basin of its size [1, 2, 3]. It lies within the main topographic ring of the South Pole-Aitken basin. Schrödinger's peak ring is observed to be mineralogically diverse and calculated to have uplifted material from the crust-mantle interface, i.e., 50 km depth [4]. This makes it a compelling candidate for lunar surface operations and a potential landing site for future human exploration of the Moon [5].

The purpose of this paper is to provide a geological map of the south-western peak ring of Schrödinger basin, interpret exposures of south polar crustal lithologies and structural features, and provide information needed for future mission planning.

Methods: The ACT-REACT Quick Map tool [6] was used to locate high resolution Lunar Reconnaissance Orbiter Camera Narrow Angle Camera (LROC NAC) imagery centered at 75.34ºS, 124.87ºE. A seamless mosaic (Fig. 2) with resolution of 0.72 metres from individual NAC strips was built using ISIS software [7]. The mineral map (Fig. 3) derived from Moon Mineralogy Mapper (M^3) satellite data [4] was co-registered with the mosaic (basemap layer) in ArcGIS 10 software. These two layers were used as references to identify and map all the lithological contacts and structural features in the south-western peak ring.

Results and Discussion:

a) Structural features: The geological map (Fig. 4) shows that two faults (1 and 2) cut across the peak ring and divide it into three parts, which is evidenced by the topography. The occurrence of adjacent norite blocks in the two upper divisions and troctolite hills in the middle and lower divisions suggest the offset of the lithologies by the faults. A graben (H in Fig. 4) separates the respective troctolite and norite boulders of the middle division. It might have been the result of slight uplift of the center of the basin that perhaps occurred shortly after emplacement of the melt sheet [3]. Faults 1 and 2 were produced during the emplacement of the peak ring, while the graben post-dates the peak-ring.

b) Petrology: The LROC NAC mosaic and M^3 mineralogy map show that the south-western peak ring is mineralogically diverse with three dominant rock types: norite, troctolite, and anorthosite. All three lithologies are visible as boulders on the NAC mosaic.

In the case of norite, comparing Fig. 2 and 3 shows

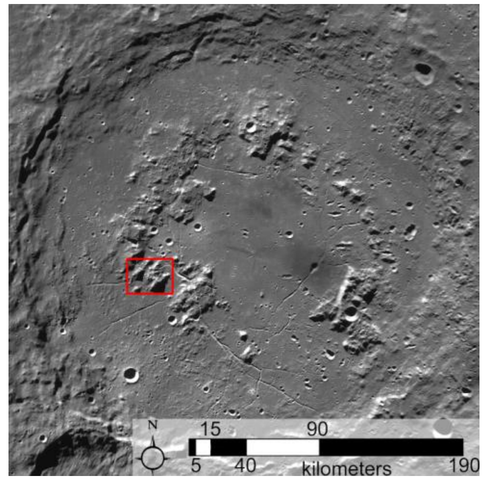

Figure 1. An LROC Wide Angle Camera (WAC) mosaic of the Schrödinger Basin with the region of interest (ROI) shown by the red box.

that norite has a unique albedo and is clearly distinguishable from the surrounding lithologies, except for hill N where low-albedo norite (from M^3 spectra) dominates the composition of the regolith covering making it look darker. Also, norite was observed to be on the edge of the troctolite hill A (Fig. 4). This is because the downslope weathering of norite from block B (Fig. 4) caused the boulders to get scattered to a long distance (evidenced by a trail at location C from figure 4). The norite mounds I and J (Fig. 4) appear to have been separated by the graben and so may have been once a part of a large norite block.

Troctolite is identified in spectra from the northern division, which exhibits spectral features of olivine and plagioclase. It was observed that outcrops farther south become olivine rich (block D in Fig. 4). However, the rock is still inferred to contain plagioclase, although its spectral signature cannot be observed due to the spectral dominance of olivine over plagioclase [4]. An increasing amount of plagioclase can be seen in the spectra of the troctolite hills E and F (Fig. 4). Hills E, F and G exhibit similar spectral features. But hills F and G are disconnected from block E due to the presence of the graben H.

Anorthosite occurs as pure anorthosite traces in cumulates of pyroxene-bearing anorthosite in all three divisions. However, three different transitions of lithologies were observed on the map (Fig. 4): pyroxene bearing anorthosite to norite (location K) in the northernmost division, gradation from 2 to 5%

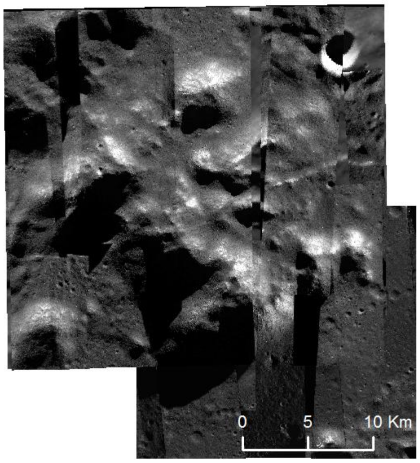

Figure 2. An LROC NAC mosaic of the south-western peak ring of the Schrödinger basin created in ISIS.

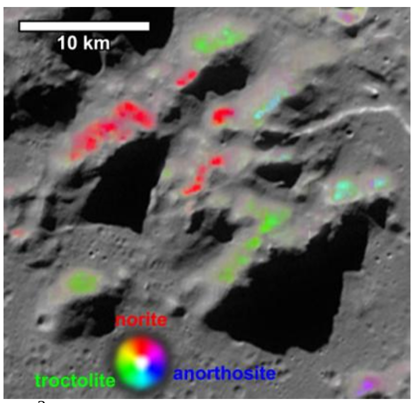

Figure 3. M^3 mineralogy map of the ROI from [4].

pyroxene bearing anorthosite to pure anorthosite to olivine-rich troctolite (location L) in the middle division, and troctolite to pure anorthosite to troctolite again (location M) in the east of southernmost division. Some pyroxene-bearing anorthosite also occurs in a crater east of the peak ring (upper right of Fig. 4).

The peak ring has a rough surface where the slope decreases due to an increased accumulation of regolith. Most of the craters on this surface have been worn away by slumping of material. However, smooth patches, seen in flat areas, preserve a cluster of fresh craters due to the absence of slumping.

Some mineralogies marked as "unknown" in Fig. 4 could not be identified due to being in shadow in the M^3 data.

The light grey area delineated in the map is the peak ring regolith, distinguishable from the surrounding regolith on the basis of change in slope and a rougher texture.

Conclusion: The south-western peak ring of Schrödinger basin is composed of 3 major lithologies: norite, troctolite, and anorthosite, which occur as isolated massive cumulates. The occurrence of large amounts of troctolite formations observed at various places in the peak ring either represent a primary igneous lithology or a comingling of cumulate olivine and plagioclase during peak ring formation. The lithologies can be used as proxies in providing information about the lunar interior, i.e., the crust-mantle interface, as Schrödinger basin's peak ring has been found to contain uplifted material from that depth (50 km).

The map shows that some structural boundaries, like faults 1 and 2, which divide this section of the peak ring into three massifs, offset deep crustal lithologies. Likewise, the graben (H in Fig. 4) cuts through and offsets outcrops of troctolite and norite in the middle massif.

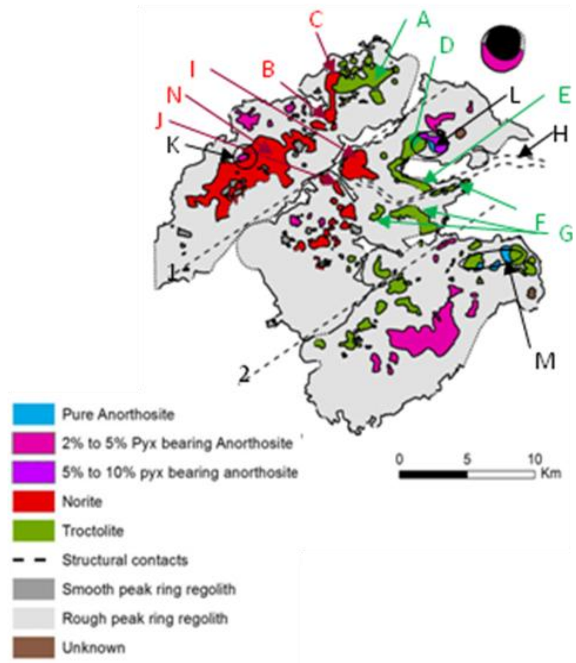

Figure 4. Generated map of the south-western peak ring of the Schrödinger basin in ArcGIS 10.

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